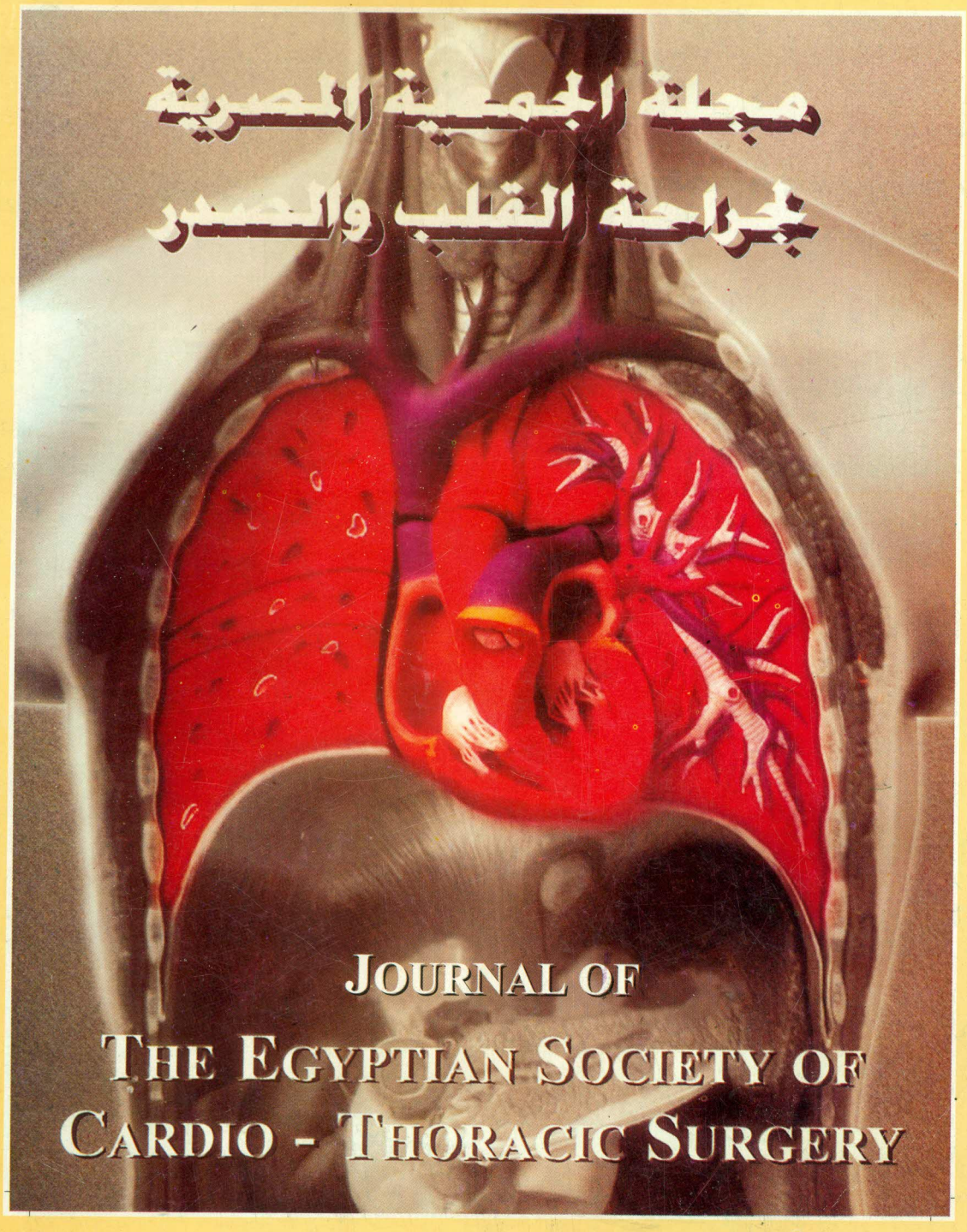
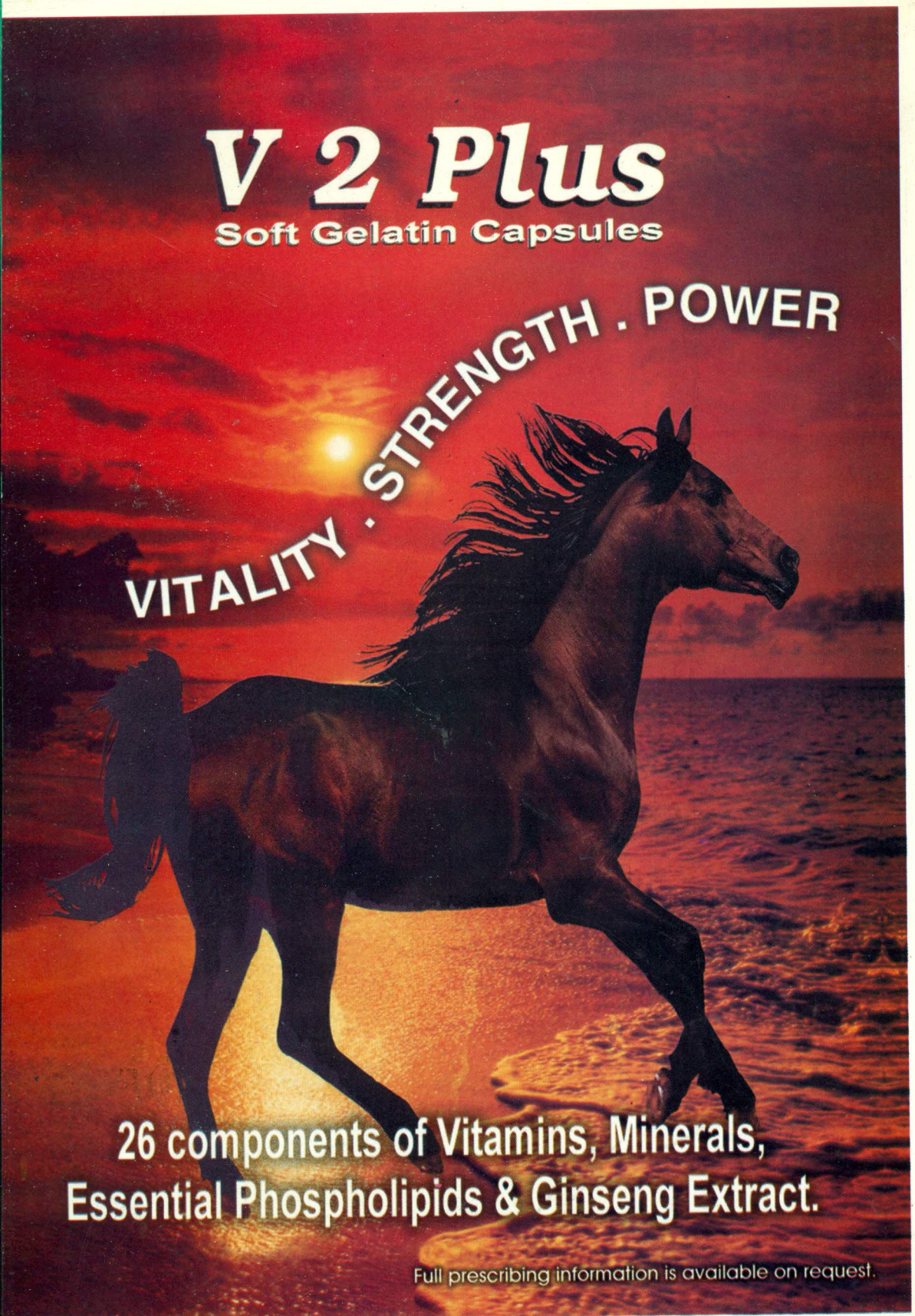
Vol. V, No 3. July 1997
ISSN 1110-578X

المجلد الخامس عدد رقم ٣ يوليو ١٩٩٧



Editor
MOHAMED EL FIKY


V 2 Plus
Soft Gelatin Capsules
VITALITY . STRENGTH . POWER
26 components of Vitamins, Minerals,
Essential Phospholipids & Ginseng Extract.
Full prescribing information is available on request.

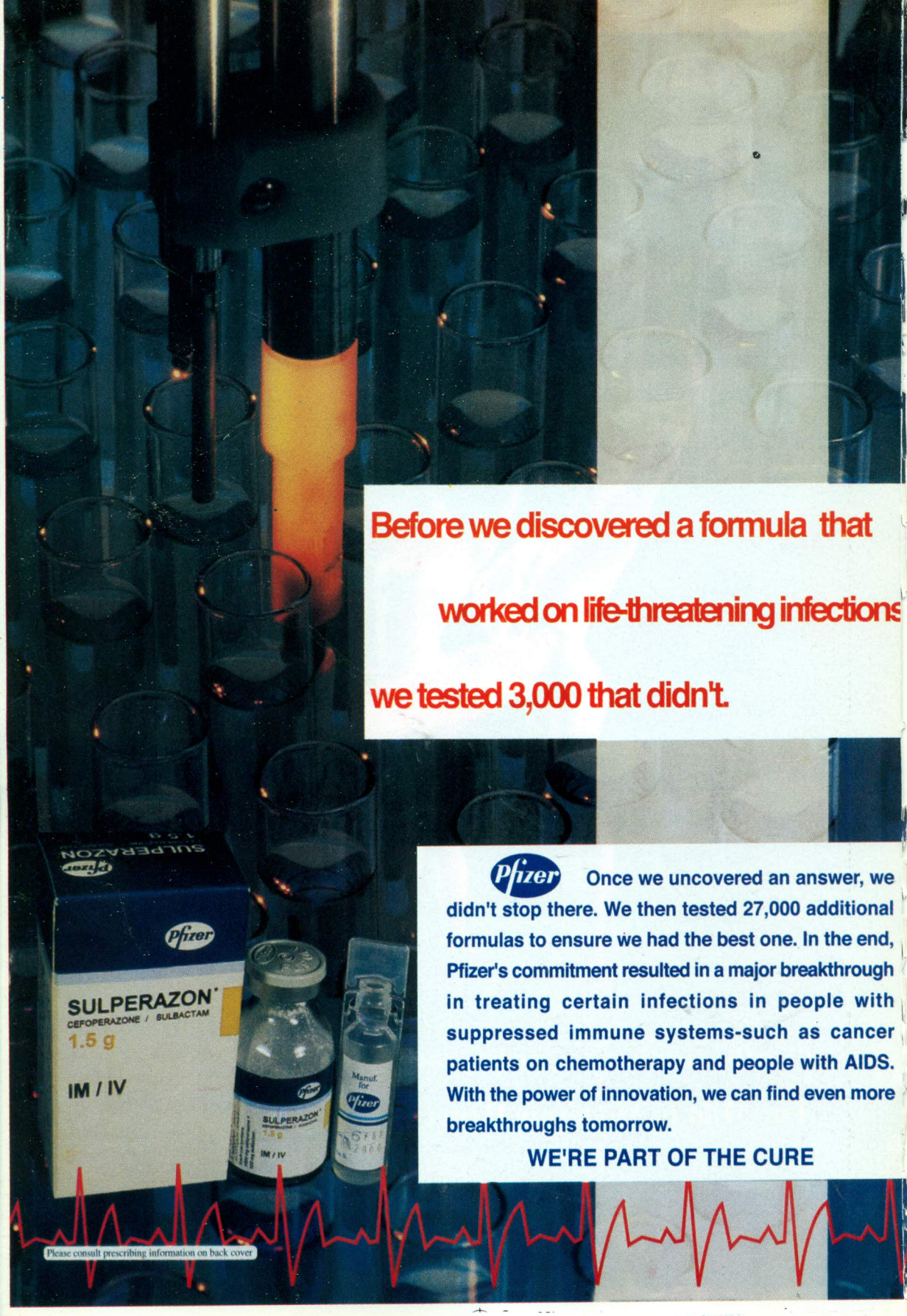
ATELOL

Atenolol 100 mg - Scored tablets

Cardioselective & Cardioprotective Beta-Blocker

For Mild to Moderate Hypertension and Angina

Full prescribing information is available on request.



Before we discovered a formula that worked on life-threatening infections we tested 3,000 that didn't.

Pfizer Once we uncovered an answer, we didn't stop there. We then tested 27,000 additional formulas to ensure we had the best one. In the end, Pfizer's commitment resulted in a major breakthrough in treating certain infections in people with suppressed immune systems-such as cancer patients on chemotherapy and people with AIDS. With the power of innovation, we can find even more breakthroughs tomorrow.

WE'RE PART OF THE CURE

Please consult prescribing information on back cover

The First "Deep-Spectrum" Antibiotic

Sulperazon IM/IV

cefoperazone/sulbactam

DESCRIPTION

Sulbactam sodium is a derivative of the basic penicillin nucleus. Chemically it is sodium penicillinate sulfone and is an off-white crystalline powder highly soluble in water. The molecular weight is 255.22.

Cefoperazone sodium is a semisynthetic broad-spectrum cephalosporin antibiotic for parenteral use only. It is the sodium salt of 7-D (-) - (4 - ethyl - 2,3 - dioxo - 1 - piperazinecarboxamido) - (4 - hydroxyphenyl) acetamido - 3 - (1 - methyl - 1H - tetrazol - 5 - yl) thiomethyl - 3 - cephem - 4 - carboxylic acid. It contains 34 mg sodium (1.5 mEq) per gram. Cefoperazone is a white crystalline powder which is freely soluble in water. The molecular weight is 667.65.

SULPERAZON brand of sulbactam sodium/ cefoperazone sodium combination is available as a dry powder for reconstitution in a 1 :2 ratio in terms of free sulbactam and cefoperazone. Vial contains 500 mg + 1000 mg of sulbactam and cefoperazone, respectively.

ACTIONS

Human Pharmacokinetics

Approximately 84% of the sulbactam dose and 25% of the cefoperazone dose administered with SULPERAZON is excreted by the kidney. Most of the remaining dose of cefoperazone is excreted in the bile. After SULPERAZON administration the mean half-life for sulbactam is about one hour while that for cefoperazone is 1.7 hours. Serum concentrations have been shown to be proportional to the dose administered. These values are consistent with previously published values for the agents when given alone. Mean peak sulbactam and cefoperazone concentrations after the administration of 3 grams of SULPERAZON (1g sulbactam: 2 g of cefoperazone) intravenously over 5 - 15 minutes have ranged between 76.8 and 128.7 mcg/ml for sulbactam and 245.7 and 254.4 mcg/ml for cefoperazone. This reflects the larger volume of distribution for sulbactam (Vd = 18.0 - 27.6L) compared to cefoperazone (Vd = 10.2-11.3L).

After intramuscular administration of 1.5 g SULPERAZON (0.5 g sulbactam, 1 g cefoperazone) peak serum concentrations of sulbactam and cefoperazone are seen from 15 minutes to two hours after administration. Mean peak serum concentrations were 19.0 and 64.2 mcg/ml for sulbactam and cefoperazone, respectively.

After multiple dosing no significant changes in the pharmacokinetics of either component of SULPERAZON have been reported and no accumulation has been observed when administered every eight to 12 hours.

The pharmacokinetics of SULPERAZON have been studied in elderly individuals with renal insufficiency and compromised hepatic function. Both sulbactam and cefoperazone exhibited longer half-life, lower clearance, and larger volumes of distribution when compared to data from normal volunteers. The pharmacokinetics of sulbactam correlated well with the degree of renal dysfunction while for cefoperazone there was a good correlation with the degree of hepatic dysfunction.

In patients with different degrees of renal function administered SULPERAZON, the total body clearance of sulbactam was highly correlated with estimated creatinine clearance. Patients who are functionally anephric show a significantly longer half-life of sulbactam (mean 6.9 and 9.7 hours in separate studies). Hemodialysis significantly altered the total body clearance, and volume of distribution of sulbactam. No significant differences have been observed in the pharmacokinetics of cefoperazone in renal failure patients.

Studies conducted in pediatrics have shown no significant changes in the pharmacokinetics of the components of SULPERAZON compared to adult values. The mean half-life in children has ranged from 0.91 to 1.42 hours for sulbactam and from 1.44 to 1.88 hours for cefoperazone.

Both sulbactam and cefoperazone distribute well into a variety of tissues and fluids including bile, gallbladder, skin, appendix, fallopian tubes, ovary, uterus, and others.

There is no evidence of any pharmacokinetic drug interaction between sulbactam and cefoperazone when administered together in the form of SULPERAZON.

Microbiology (In vitro Susceptibility Data)

The anti-bacterial component of SULPERAZON is cefoperazone, a third generation cephalosporin, which acts against sensitive organisms during the stage of active multiplication by inhibiting biosynthesis of cell wall mucopeptide. Sulbactam does not possess any useful antibacterial activity, except against **Neisseriaceae** and **Acinetobacter.** However, biochemical studies with cell-free bacterial systems have shown it to be an irreversible inhibitor of most important beta-lactamases produced by beta-lactam antibiotic-resistant organisms.

The potential for sulbactam's preventing the destruction of penicillins and cephalosporins by resistant organisms is confirmed in whole organism studies using resistant strains in which sulbactam exhibits marked synergistic effects when given together with penicillins and cephalosporins. As sulbactam also binds with some penicillin binding proteins, sensitive strains are also often rendered more susceptible to SULPERAZON than to cefoperazone alone.

The combination of sulbactam and cefoperazone is active against all organisms sensitive to cefoperazone but in addition demonstrates synergistic activity (up to fourfold reduction in minimum inhibitory concentration values with the combination versus those for each component) in a variety of organisms, most markedly the following:

- Haemophilus influenzae	- Bacteroides species	- Staphylococcus species
- Acinetobacter calcoaceticus	- Enterobacter aerogenes	- Escherichia coli
- Proteus mirabilis	- Klebsiella pneumoniae	- Morganella morganii
- Citrobacter freundii	- Enterobacter cloacae	- Citrobacter diversus

SULPERAZON is active in vitro against a wide variety of clinically significant organisms.

Gram-Positive Organisms:

Staphylococcus aureus, penicillinase and non-penicillinase-producing strains

Staphylococcus epidermidis

Streptococcus pneumoniae (formerly **Diplococcus pneumoniae**).

Streptococcus pyogenes (Group A beta-hemolytic streptococci)

Streptococcus agalactiae (Group B beta-hemolytic streptococci)

Most other strains of beta-hemolytic streptococci.

Many strains of **Streptococcus faecalis** (enterococcus)

Gram-Negative Organisms:

- **Escherichia coli**
- **Klebsiella** species
- **Enterobacter species**
- **Citrobacter species**
- **Haemophilus influenzae**
- **Proteus mirabilis**
- **Proteus vulgaris**
- **Morganella morganii (formerly Proteus morganii)**
- **Providencia rettgeri (formerly Proteus rettgeri)**
- **Providencia species.**
- **Serratia species (including S. marcescens).**
- **Salmonella and shigella species**
- **Pseudomonas aeruginosa and some other pseudomonas species**
- **Acinetobacter calcoaceticus**
- **Neisseria gonorrhoeae**
- **Neisseria meningitidis**
- **Bordetella pertussis**
- **Yersinia enterocolitica**

Anaerobic Organisms:

Gram - negative bacilli (including Bacteroides fragilis, other Bacteroides species, and Fusobacterium species)

Gram-positive and gram-negative cocci (including Peptococcus, Peptostreptococcus and Veillonella species)

Gram -positive bacilli (including Clostridium, Eubacterium and Lactobacillus species)

The following susceptibility ranges (according to guidelines of the U.S. National committee for Clinical Laboratory Standards) have been established for SULPERAZON.

	Minimal inhibitory concentration (MIC), mcg / ml (expressed as cefoperazone concentration)
Susceptible	16
Resistant	64

	Susceptibility Disc Zone Size, mm (Kirby - Bauer)
Susceptible	21
Intermediate	16 - 20
Resistant	15

For MIC determinations, serial dilutions of SULPERAZON may be used with a broth or agar dilution method. Use of a susceptibility test disc containing 30 mcg of sulbactam and 75 mcg of cefoperazone is recommended. A report from the laboratory of "susceptible" indicates that the infecting organism is likely to respond to SULPERAZON therapy, and a report of "Resistant" indicates that the organism is not likely to respond. A report of "Intermediate" suggests that the organism would be susceptible to SULPERAZON if a higher dosage is used or if the infection is confined to tissues or fluids where high antibiotic levels are attained.

The following quality control limits are recommended for 30 mcg/75 mcg Sulbactam/ cefoperazone susceptibility discs.

CONTROL STRAIN	ZONE SIZE MM
Acinetobacter Spp, ATCC 43498	26 - 32
Pseudomonas aeruginosa ATCC 27853	22 - 28
Escherichia Coli, ATCC 25922	27 - 33
Staphylococcus aureus, ATCC 25923	23 - 30

INDICATIONS

SULPERAZON is indicated for the treatment of the following infections when caused by susceptible organisms:

Respiratory Tract Infections (Upper and Lower)
- **Urinary Tract Infections (Upper and Lower)**
- **Peritonitis, Cholecystitis, Cholangitis, and Other Intra-Abdominal Infections**
- **Septicemia**
- **Meningitis**
- **Skin and Soft Tissue Infections**
- **Bone and Joint Infections**
- **Pelvic Inflammatory Disease, Endometritis, Gonorrhea, and Other Infections of the Genital Tract.**

Combination Therapy

Because of the broad spectrum of activity of SULPERAZON, most infections can be treated adequately with this antibiotic alone. However, SULPERAZON may be used concomitantly with other antibiotics if such combinations are indicated. If an aminoglycoside is used, renal function should be monitored during the course of therapy. (See DOSAGE AND ADMINISTRATION SECTION)

CONTRAINDICATIONS

SULPERAZON is contraindicated in patients with known allergy to penicillins or any of the cephalosporins.

WARNINGS

Serious and occasionally fatal hypersensitivity (anaphylactic) reactions have been reported in patients receiving beta-Lactam therapy. These reactions are more apt to occur in individuals with a history of hypersensitivity reactions to multiple allergens. If an allergic reaction occurs, the drug should be discontinued and the appropriate therapy instituted.

Serious anaphylactic reactions require immediate emergency treatment with epinephrine. Oxygen, intravenous steroids, and airway management, including intubation, should be administered as indicated.

PRECAUTIONS

General

Those precautions that pertain to sulbactam and cefoperazone will also pertain to the combination as discussed below.

Cefoperazone is extensively excreted in bile. The serum half-life of cefoperazone is usually prolonged and urinary excretion of the drug increased in patients with hepatic diseases and/or biliary obstruction. Even with severe hepatic dysfunction, therapeutic concentrations of cefoperazone are obtained in bile and only a 2 to 4 fold increase in half-life is seen.

Dose modification may be necessary in cases of severe biliary obstruction, severe hepatic disease or in cases of renal dysfunction coexistent with either of those conditions.

In patients with hepatic dysfunction and concomitant renal impairment, cefoperazone serum concentrations should be monitored and dosage adjusted as necessary. In these cases dosage should not exceed 2g/day of cefoperazone without close monitoring of serum concentrations.

The serum half-life of cefoperazone is reduced slightly during hemodialysis. Thus, dosing should be scheduled to follow a dialysis period.

As with other antibiotics, Vitamin K deficiency has occurred in a few patients treated with cefoperazone. The mechanism is most probably related to the suppression of gut flora which normally synthesize this vitamin. Those at risk include patients with poor diet, malabsorption states (e.g. cystic fibrosis) and patients on prolonged intravenous alimentation regimens. Prothrombin time should be monitored in these patients and exogenous vitamin K administered as indicated.

A reaction characterized by flushing, sweating, headache, and tachycardia has been reported when alcohol was ingested during and as late as the fifth day after cefoperazone administration. A similar reaction has been reported with certain other cephalosporins and patients should be cautioned concerning ingestion of alcoholic beverages in conjunction with administration of SULPERAZON. For patients requiring artificial feeding orally or parenterally, solutions containing ethanol should be avoided.

As with other antibiotics, overgrowth of nonsusceptible organisms may occur during prolonged use of SULPERAZON. Patients should be observed carefully during treatment. As with any potent systemic agent, it is advisable to check periodically for organ system dysfunction during extended therapy; this includes renal, hepatic, and hematopoietic systems. This is particularly important in neonates, especially when premature, and other infants.

Drug Laboratory Test Interactions

A false-positive reaction for glucose in the urine may occur with Benedict's or Fehling's solution.

Usage During Pregnancy

Reproduction studies have been performed in rats at doses up to 10 times the human dose and have revealed no evidence of impaired fertility and no teratological findings. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed.

Usage in Nursing Mothers

Only small quantities of sulbactam and cefoperazone are excreted in human milk. Although both drugs pass poorly into breast milk of nursing mothers, caution should be exercised when SULPERAZON is administered to a nursing mother.

Usage In Infancy

SULPERAZON has been effectively used in infants. It has not been extensively studied in premature infants and neonates. Therefore, in treating premature infants and neonates potential benefits and possible risks involved should be considered before instituting therapy.

Cefoperazone does not displace bilirubin from plasma protein binding sites.

Adverse reactions

SULPERAZON is generally well tolerated. The majority of adverse events are of mild or moderate severity and are tolerated with continued treatment.

Gastrointestinal - As with other antibiotics, the most frequent side effects observed with SULPERAZON have been gastrointestinal.

Diarrhea/loose stools have been reported most frequently followed by nausea and vomiting. The frequency of these reported reactions has ranged from 3.6 to 10.8%.

Dermatologic Reactions - As with all penicillins and cephalosporins, hypersensitivity manifested by Maculopapular rash, urticaria, eosinophilia and drug fever has been reported. These reactions which have been reported in 0.8 to 1.3% of the cases, are more likely to occur in patients with a history of allergies, particularly to penicillin.

Hematology: Slight decreases in neutrophils have been reported. As with other beta-lactam antibiotics, reversible neutropenia may occur with prolonged administration. Some individuals have developed a positive direct Coombs test during treatment with cephalosporin antibiotics. Decreased hemoglobin or hematocrit have been reported, which is consistent with published literature on cephalosporins. Transient eosinophilia and thrombocytopenia have occurred, and hypo-prothrombinemia has been reported.

Miscellaneous adverse events (headache, fever, injection pain, chills) occurred in less than 1% of patients.

Laboratory Abnormalities: Transient elevations of SGOT, SGPT, alkaline phosphatase and bilirubin levels have been noted in 6.3 to 10.0% of the reported cases.

Local Reactions: SULPERAZON is well tolerated following intramuscular administration. Occasionally, transient pain may follow administration by this route. As with other cephalosporins and penicillins, when SULPERAZON is administered by an intravenous catheter some patients may develop phlebitis at the infusion site.

DOSAGE AND ADMINISTRATION

SULPERAZON is available in 1.5 g strength vial.

Total Dosage (g)	Equivalent Dosage of sulb. + cefoperazone (g)	Total Volume of Reconstituted Solution (ml)	Maximum Final Conc. (mg/ml)
1.5	0.5 + 1.0	4.0	125 + 250

The usual adult dose of SULPERAZON is 1.5 to 3 g per day (i.e., 1 to 2 g cefoperazone activity) given intravenously or intramuscularly in equally divided doses every 12 hours.

In severe or refractory infections the daily dosage may be increased up to 12 g of SULPERAZON (8 g cefoperazone activity) given intravenously in equally divided doses every 12 hours. The recommended maximum daily dosage of sulbactam is 4 g (8 g SULPERAZON).

Dosage regimens of SULPERAZON should be adjusted in patients with marked decrease in renal function (creatinine clearance of less than 30 ml/min) to compensate for the reduced clearance of sulbactam. Patients with creatinine clearances between 15 and 30 ml/min should receive a maximum of 1 g of sulbactam administered every 12 hours (maximum daily dosage of 2 g sulbactam), while patients with creatinine clearances of less than 14 ml/min should receive a maximum of 500 mg of sulbactam every 12 hours (maximum daily dosage of 1 g sulbactam). In severe infections it may be necessary to administer additional cefoperazone.

The usual dosage of SULPERAZON in children is 30 to 60 mg/kg/day (i.e., 20 - 40 mg/kg/day cefoperazone activity) in 2 to 4 equally divided doses. In serious or refractory infections, these dosages may be increased up to 240 mg/kg/day SULPERAZON (i.e.,160 mg/kg/day cefoperazone activity) in 2 to 4 equally divided doses. For neonates in the first week of life, the drug should be given every 12 hours. The maximum daily dosage of sulbactam in pediatrics should not exceed 80 mg/kg/day.

Intravenous Administration

For intermittent infusion, each vial of SULPERAZON should be reconstituted with the appropriate amount (shown in table) of 5% dextrose in water, 0.9% Sodium Chloride Injection or Sterile for water Injection and then diluted to 20 ml with the same solution followed by administration over 15 to 60 minutes.

For intravenous injection, each vial should be reconstituted as above and administered over a minimum of three minutes.

Intramuscular Administration

Sterile water for Injection should be used for reconstitution. For a concentration of cefoperazone of 250 mg/ml or larger, a two step dilution is required using Sterile water followed by 2% lidocaine to approximate a 0.5% lidocaine solution (see below).

Incompatibilities

SULPERAZON has been shown to be compatible with water for injection, 5% dextrose, normal saline, 5% dextrose in 0.225% saline, and 5% dextrose in normal saline at concentrations of 10 mg cefoperazone and 5 mg sulbactam per ml and up to 250 mg cefoperazone and 125 mg sulbactam per ml. Initial reconstitution with Lactated Ringer's Solution or with 2% lidocaine HCl solution should be avoided since these mixtures have been shown to be incompatible. However, a two step dilution process involving initial reconstitution in water for injection will result in a compatible mixture when further diluted with Lactated Ringer's Solution at a sulbactam concentration of 5 mg/ml. Similarly, after appropriate initial reconstitution with water for injection SULPERAZON could be further diluted with 2% lidocaine hydrochloride to yield solutions containing up to 250 mg cefoperazone and 125 mg sulbactam per ml in 0.5% lidocaine HCl solution. Solutions of SULPERAZON and aminoglycosides should not be directly mixed since there is a physical incompatibility between them. If combination therapy with SULPERAZON and an aminoglycoside is contemplated (SEE INDICATIONS section) this can be accomplished by sequential intermittent intravenous infusion provided that separate secondary intravenous tubing is used, and that the primary intravenous tubing is adequately irrigated with an approved diluent between doses. It is also suggested that doses of SULPERAZON be administered throughout the day at times as far removed from administration of the aminoglycoside as possible.

How Supplied

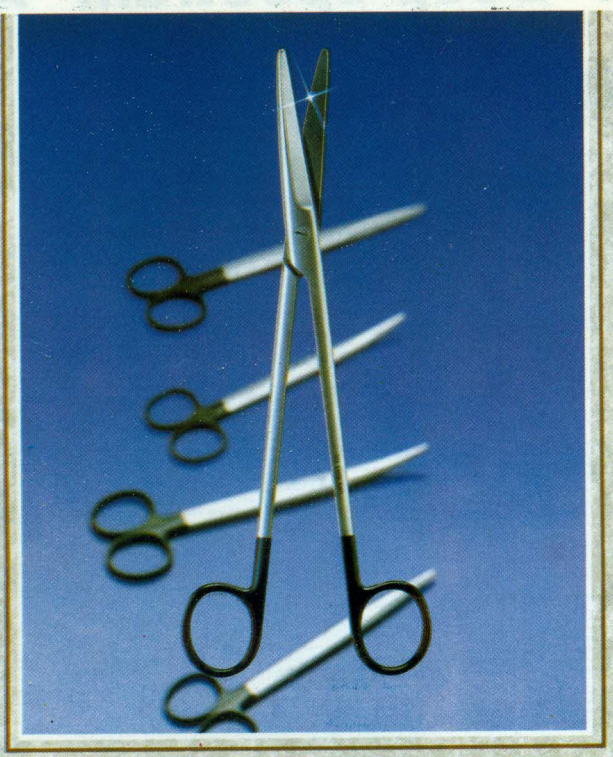
One vial containing 1.5 gm Sulperazon (500 mg sulbactam + 1000 mg cefoperazone) + distilled water ampoule for injection.

Manufactured by PFIZER EGYPT, S.A.E. CAIRO, A.R.E.
Under authority of PFIZER INC., U.S.A.

LPD No 179.B
Date January 29,1988

Pfizer

Further information is available on request PFIZER-Egypt SAE 47 Ramses Street, Cairo, EGYPT.



Super-cut

SCISSORS

- Sharp upper blade and serrated anvil blade grips and cuts tissue precisely.
- Superb cutting control right to blade tips.
- Hand crafted edges and blade setting for long life.
- Specialist resharpening facility at GU.

GU MANUFACTURING

BRITISH SURGICAL INSTRUMENT MAKERS SINCE 1920

REPRESENTED BY:-

GESCA

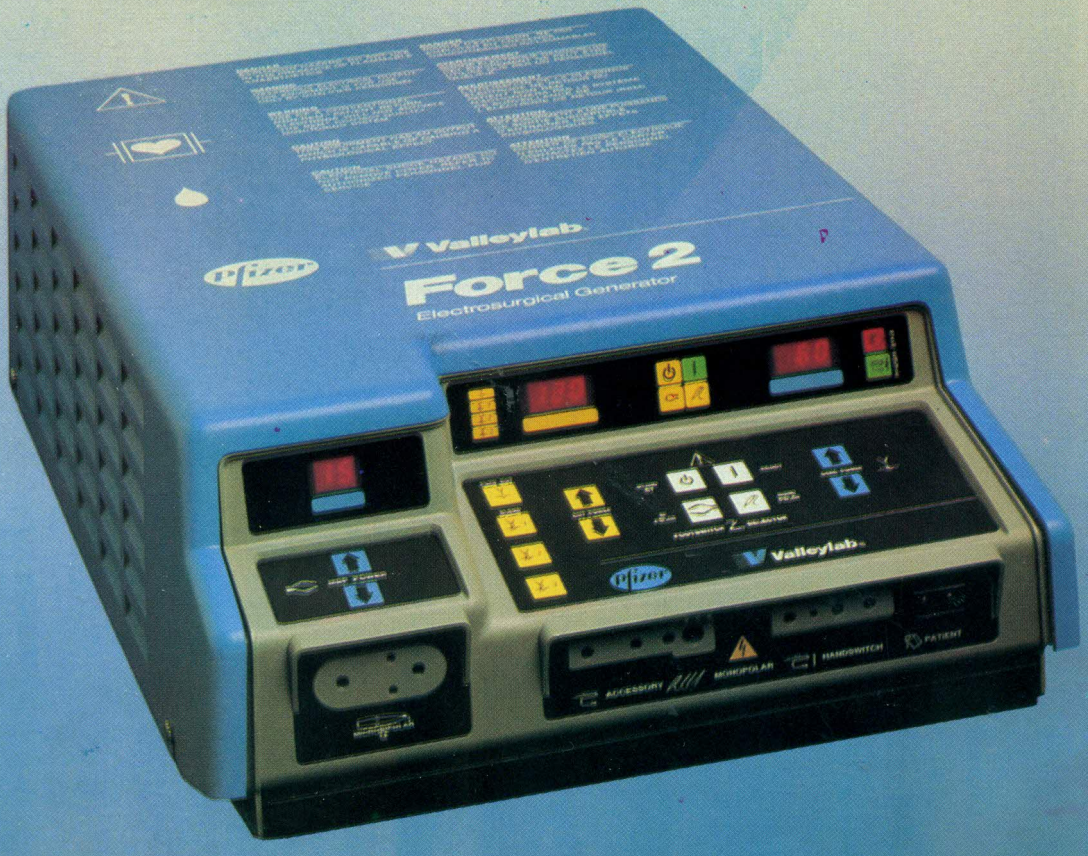
45-ABD EL-KHALEK SARWAT STREET -CAIRO
TEL :- 3919696-3909848 FAX :- 3901136

REPRESENTED BY:-

GESCA

45-ABD EL-KHALEK SARWAT STREET -CAIRO
TEL :- 3919696-3909848 FAX :- 3901136

The *FORCE* in electrosurgery



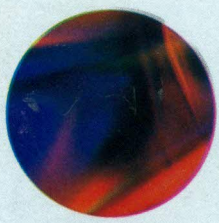
Pfizer

Valleylab

MOT-5601SR
MOT-5601SRB

Features:

1. The tabletop is rotatable by 180°, so that the column base at your feet does not get in the way during surgical operations.
2. The sliding mechanism incorporated in the tabletop facilitates X-ray fluoroscopy.
3. These models, equipped with various functions, are cost-effective operating tables.



REPRESENTED BY:-

GESCA

45-ABD EL-KHALEK SARWAT STREET -CAIRO
TEL :- 3919696-3909848 FAX :- 3901136

The new Universal Clinical Workstation will forever change the way you think about clinical information management.

Our Universal Clinical Workstation (UCW)™ with Dynamic Network Access (DNA) provides a new level of access to clinical information that makes it easier and more cost-effective to adapt to changing information management needs. DNA gives you the ability to view and control remote applications via X-windows and VT220 functionality, while a powerful new architecture — the Patient Care Information System (PCIS)™ — allows you to import and export data to and from other hospital information systems such as the laboratory or pharmacy.

The UCW also provides optimum functionality and flexibility — it can operate as a bedside patient monitor, a central or a clinical terminal. And, if your hospital already uses the SpaceLabs Medical Patient Care Management System (PCMS)™, you'll have the benefit of full system compatibility — the UCW utilizes all existing PCMS modules and components and operates with the same menus and touchscreen controls as all PCMS monitors.

Building on our PCMS, the PCIS gives you the flexibility to select the exact system configuration you need now and then add components in the future. This new architecture also lets you choose the clinical information system solution that best fits your hospital's requirements — SpaceLabs Medical's PC Chartmaster™, your own hospital-defined system or a system provided by another manufacturer.

See how the UCW can change the way you think about clinical information management. Please call SpaceLabs Medical today for a demonstration.

SpaceLabs Medical

The Clinical Information Company

15220 N.E. 40th Street, P.O. Box 97013 • Redmond, WA 98073-9713 • U.S.A.
Telephone: 206-882-3700 • Fax: 206-885-4877 • Telex: 4740085 SPL UI

REPRESENTED BY:-

GESCA

45-ABD EL-KHALEK SARWAT STREET -CAIRO
TEL :- 3919696-3909848 FAX :- 3901136

Journal of the

Egypation Society of Cardio Thoracic Surgery ISSN 1110-578 X

Vol.V, No 4 July 1997

Correspondence to be sent to:
Prof. Dr. Mohamed El Fiky, 79, Ramsis Str., Cairo, Egypt, Post Code 11111

Journal of the

Egypation Society of Cardio Thoracic Surgery ISSN 110-578X

Vol. V No 3
July 1997

Contents July 1997

Editorial

Journal of the

Egyptian Society of Cardio Thoracic Surgery ISSN 1110-578 X

EDITOR

MOHAMED EL FIKY.

79, Ramsis Str.
Cairo - Egypt.
Post Code 11111.
Fax (202) 772535

Information for authors

The Journal of the Egyptian Society of Cardiothoracic Surgery [ISSN 1110-578 X] is the official publication of the Egyptian Society of Cardio Thoracic Surgery, a professional society dedicated to promoting scientific knowledge and research in Cardio Thoracic Surgery.

The Journal of the Egyptian Society of Cardiothoracic Surgery, publishes original articles, review articles, leading articles, case report, abstracts from the literature, letters to the editor, special communications and abstracts of papers presented at the Annual Scientific Meeting of the Egyptian Society of Cardio Thoracic surgery. The Journal is published every 3 Months (January, April, June, September). All correspondence should be sent to the Editor-in-Chief at the above address.

The journal is sent free of charge to all members of the Egyptian Society of Cardio-Thoracic Surgery. For other Subscribers, Libraries, Organization, the annual subscription rate is 20 Egyptian Pounds including mailing expenses. For subscribers abroad, the annual subscription rate is $ 30 including mailing expenses. The price of a single number is $8. Back numbers can be obtained, if available at a price which depends on the availability of spare copies.

Three copies of the Manuscripts should be sent to the Editor-in-Chief (at the address given above), type-written on good quarto sized paper, with double spacing and liberal margin (2.5 cms).

The title should be separate and should include: title of paper, Author (s) full names, institution in which the work was carried out complete address, telephone and fax number for mailing purposes. The article should comprise:

1- An Abstract of 150-200 words not exceeding one double spaced page. The abstract should summarize the Material, Methods Results and Conclusions.

2- Introduction, Material, Methods, Results, Discussion and references.

3- Tables and figures should be provided separately; the position of the tables and figures in the text should be marked on the manuscript. Drawings should be with china ink.

References should be given in the Vancouver style. References should be mumbered serially in the text and listed, on a separate sheet, double spaced, at the end of the paper in that order: Author(s) Names & initials, title of article, Journal name, year, volume, number & inclusive pages in that order. List all authors of six or less; when seven or more,

list only three and add et al.

Reprints

Fifty reprints will be furnished to authors at the publication fees (150 Egyptian pounds). Larger quantities could be orderd in advance. The Editor in-Chief can consider excempting special papers & contributions from the fees. Coloured photographs could be published at a rate of L.E. 100 for each page.

Statements and opinions expressed in the articles and communications herein are those of the author(s) and not necessarily those of the Editor and the Editor disclaims any responsibility or liability for such material. The Editor does not, guarantee, warrant, or endorse any product or service advertised in this publication.

An original and two copies of all material, including illustrations, should be submitted. Place author's name and page number in the upper right corner of each page. Use double spacing throughout. Include a covering letter stating that the material has not been previously published or submitted elsewhere for publication. Identify at the letter the name, address, business and home telephone numbers of the author to whom correspondence should be sent.

Illustrations (three Sets of glossy prints) should be numbered in the order of their mention in the text, and marked lightly on the back with the author's name and an arrow to indicate top edge. Original drawings or graphs should be prepared in black India ink or typographic lettering. All lettering must be done professionally and should be in proportion to the drawing, graph, or photograph. Do not send original art work, x-ray films, or ECG strips. Glossy print photographs, 3 by 4 inches (minimum) to 5 by 7 inches (maximum), with good black-and-white contrast or colour balance are preferred. Consistency in size within the article is strongly preferred. Any special instructions regarding sizing should be clearly noted. Suitable legends should be typewritten, double-spaced, and listed on a separate sheet of paper and included at the end of the manuscript.

Tables should be self-explanatory and should supplement, not duplicate, the text. Type on pages separate from the text. Provide a brief title for each. Abbreviations used in Tables should be defined at the bottom of the table.

The Editor-in Chief has the right to make any amendments or abridgment in the articles which he considers necessary to render them suitable for publication in this Journal.

Electronic storage: Permission of the publisher is required to store electronically any material contained in this journal, including any article or part of an article. Contact the publisher at the address indicated.

All published articles are written under Author(s), responsibility. All manuscripts are under the copyright of the publisher and they can not be published anywhere else without written permission of the Editor.

Editorials will be requested to Author (5) by invitation of the Scientific Committee, and should be a maximum of 20 typewritten sheets plus illustrations, graphes and tables.

The Pulmonary Autograft Donald Ross (London)

The pulmonary autograft operation that we are discussing represents the transfer of the patient's own pulmonary valve to the aortic position together with reconstruction of the right ventricular outflow tract. It was first Performed in 1967 and after a long delay it is now an accepted and established surgical modality.

The history of the operation of course is closely related to the homograft which was first used by us in 1962. At that time we believed we had an ideal valve replacement since its use was based on the sound principle that the natural heart valves are the product of millions of years of evolution and inspite of our advanced technology we have not been able to improve on them.

Donald Ross
J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

However it became clear within 5 years that the first homograft explants were uniformly acellular and instead of being repopulated with the patient's own cells as we had anticipated. The cusps showed progressive tissue degeneration and even calcification.

We realised then that an ideal and permanent replacement could only be achieved by using fresh homovital homograft valves plus immunosuppression or by the use of living autologous tissue with structural characteristics identical with the aortic valve; only the patient's pulmonary valve fulfils these criteria. The use of long term immunosuppressives clearly negates one of the main advantages of the trouble-free homograft and in spite of cyropreservation and other forms of preservation and storage all homograft valves become acellular and end as non-viable collagen skeletons.

We consequently embarked on an autograft clinical programme doing our first pulmonary transfer in 1967 using the patient's own pulmonary valve.

In spite of encouraging experimental evidence on the strength of the pulmonary valve from Shumway's group our first clinical case was a source of great anxiety. This related to the thin filmy structure of the pulmonary cusps and their unknown potential to withstand acutely-induced systemic diastolic pressure.

Fortunately there has never been an acute valve failure as far as I am aware in well over 2000 cases world wide. This finding is less surprising when it is recalled that during foetal development the aortic and pulmonary valves have a common origin from the truncus arteriosus and function there under the same pressure conditions.

However, it was not until 1982 or 15 years later that there was objective supporting evidence from Polish workers to back our clinical findings.

Although our first autograft patient is still alive with a functioning valve almost 30 years post-operatively our initial plan

was to confine the technique to young patients with the prospect of a 30-40 year lifespan ahead of them.

In spite of this recommendation reports of one day old infants and 71 year old patients continue to appear in the literature.

During the first 10 years of our early and traumatic learning curve our surgical mortality was in the region of 7-8% but it is now in the region of 1-2%. This seems to be a uniform finding and is comparable with other forms of aortic valve surgery inspite of a longer than average bypass time of 100-120 minutes and with a remarkably smooth post-operative course.

Major problems involving the early cases related to the proximity of the first septal artery to the root of the pulmonary artery. Damage to this vessel gave rise to septal Infarcts and sometimes fatal arrhythmias. The operation was consequently in difficulties till the surgical anatomy of the first septal artery was studied and published by one of my assistants a Belgian doctor Dr. Marcel Geens. This work represented a turning point in the operation and encourage everyone to read it in the 1971 Journal of Thoracic and Cardiovascular Surgery.

A further problem at that time common to both our homografts and autografts was the difficulty of achieving a competent valve in the subcoronary position. This took about 10 years to achieve.

Nowadays a freestanding aortic root replacement is in favour and has a number of advantages in that it is simpler to insert and virtually guarantees a competent valve. Our first 271 cases had a subcoronary insertion and show no evidence of progressive dilitation or regurgitation. Our subsequent cases have been root replacements and although we are perfectly satisfied with the results at present we retain an open mind since we read reports of dilitation of the homograft root in other series.

There clearly needs to be a retrospective or prospective review comparing subcoronary and root replacement. My own belief is that most root problems arise from being inserted in an unsupported supra-annular position. Additionally one should avoid removing the fat and fascia from the autograft this being a source of strength and nourishment through the vasa vasorum. To guide us I have formulated a set of rules.

Reconstruction of the right ventricular outflow tract still presents some problems although there is now overwhelming evidence in favour of a pulmonary homograft which we have used in this position since 1987.

So far we have had to remove no pulmonary homografts and we have a 80% freedom from removal of all right ventricular homografts over a 20 year follow-up period.

My cardiological colleague Dr. Somerville recently reported on all the patients operated upon at the national heart hospital from the time they were introduced in 1967 to 1984. This time frame gave an average follow-up of 21 years (range 9-26 years) and ensured that the entire follow-up was well beyond the vulnerable 7 year period when biological valves tend to undergo degeneration.

There were 131 sequential pattents in this cohort and the follow-up was 95% complete. The cases of course include the whole period of the traumatic high mortality learning curve. The resutls were reviewed by Kirklin and Blackstone. 72 patients were alive at the end of the follow-up period with an actuarial survival at 10-20 years of 85% and 61% respectively, also there was a 75% freedom from autograft replacement at 20 years and no evidence of progressive regurgitation. Even on these early results Kirklin and Blackstone conceded somewhat reluctantly that the autograft performed better than the more recently reported cryopreserved homografts.

Our more recent follow-up includes a total of 426 cases but is less complete because it includes a number of overseas patients. Actuarial patient survival in this group is 80% at 20 years with an overall mortality of 6.7% but less than 2% over the past 10 years,

There has been no evidence of tissue failure or calcification and explanted valves all show retention of cellular viability and structure and includes a valve studied at 25 years post insertion. This suggests that the autograft represents a permanent valve subject only to the normal aging process.

An additional finding since the introduction of the operation, has been evidence that the valve grows with the patient. We and others had observed apparent growth but Elkins of Oaklahoma has convincing clinical evidence of growth and not simple dilitation. This of course enlarges its application to children and more recently to infants making it applicate to virtually all age groups.

A number of technical variations have grown up around the surgery including the use of rings to overcome a size mismatch between pulmonary artery and aorta. The autograft is elastic and very adaptable so that this problem does not usually constitute a problem. We routinely surround the lower suture line with a strip of autogenous pericardium which not only reduces the chances of a blood leak but may also act as a flexible restraining ring.

In our view the autograft technique should not be used in Marfan's syndrome or other connective tissues disorders and it is not recommended in young patients with recent rheumatic history.

One of the most rewarding features of the operation reported recently has been the outstandingly good results in infective and prosthetic endocarditis pioneered by Oswalt in the USA and Joyce and Pettersen of Copenhagen.

Their enthusiasm has led them to suggest that "the operation may emerge as the procedure of choice for most patients under 63-65 years of age with aortic valve disease and for most pateints of any age with advanced prosthetic aortic valve endocarditis" I agree with their sentiments.

Finally the operation is almost unique in cardiac surgery in that Oury of Montana, USA has introduced an international register of patients which means that we will be able to gather and assess results and information as they arrive rather than scanning the literature over a number of years.

To date there are over 2000 cases in the register and preliminary clinical results are impressive. The latest to hand is as follows:

In summary the pulmonary autograft is we believe as near to a perfect valve replacement as we have been able to. Achieve.

The Effect of Repair of Coarctation of the Aorta in Adults on Systemic Hypertension

ABSTRACT

The benefit of repair of coarctation of the aorta in adults regarding it's effect on systemic hypertension has been questioned and that surgery may have no impact on the natural history of the disease.

A retrospective study with 23 adult patients with a mean age of 25.9 years ± 5.56, who underwent repair of coarctation of the aorta between January 1990 and July 1996, is presented. Nine of them were females and 14 were males. All patients were hypertensive on presentation. Systolic blood pressure ranged from 155-215 mmHg, with a mean of 185.3 mmHg ± 17.38. All of them were under antihypertensive medication. All patients underwent catheterization [the mean peak systolic gradient across the coarctation was 82 mmHg ± 26.17, with a range of 50-135 mmHg].

Operative technique included resection and primary anastomosis [1 pt.], patch angioplasty [16 pts.], interposition graft [5 pts.], and bypass tube graft [1 pt.].

The mean follow-up period was 30.5 months ± 22, [range of 4 months to 6 years] at last visit. All patients had a significant improvement of systemic blood pressure. Most of them [16 pts.] were normotensives with no medication, 7 had improved but needed one antihypertensive medication [4 pts.], and 2 medications [3 pts.]. Most of the patients who required medications were old [above 25 years]. The peak systolic gradient across coarctation significantly improved [82 mmHg and 9.13 mmHg, pre- and postoperatively respectively].

The surgical repair of coarctation in adults was effective, had low risk, improved systemic hypertension and decreased the need for antihypertensive medications, ameliorating cardiovascular complications of coarctation.

Hassan El-Sawy, M.D.,* M. Moataz Abdel-Khalek, M.D.,* M.F. El-Guindy.,** and M.M. El-Abbady. M.D.**

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

Coarctation of the aorta is a common congenital malformation. It represents 5% of all patients with congenital disease (1).

Neglected cases of aortic coarctation usually result both in high morbidity and mortality from hypertension and its complications including heart failure, myocardial infarction, infective endocarditis, aortic dissection, rupture, and cerebral hemorrhage, most untreated patients die before the age of 50 years (2) .

The optimal timing of surgical treatment is usually in the early childhood unless poor tissue perfusion and/or heart

* *From the Cardiothoracic Surgery Dept., National Heart Institute, Cairo, Egypt.*

** *From the Cardiology Dept., National Heart Institute, Cairo, Egypt.*

failure necessitating urgent neonatal interference (3-6).

There is much debate as to the effect of surgery, in adult, on systolic hypertension. Many surgeons report poor response of systolic hypertension to surgical treatment(7-9) .

In our study, it was our aim to clarify the effect of repair of coarctation on systolic blood pressure in adults.

Patients and Methods

In the period between January 1990 and July 1996; 23 adult patients underwent repair of coarctation of the aorta in the National Heart Institute by more than one surgeon.

Their age ranged from 17 years to 38 years [mean 25.91 ± 5.56]. Fourteen patients out of 23 were males [60.87%] and 9 [39.13%] were females. Eight patients had failed balloon dilatation [34.78%], one patient underwent a re-do operation, and one had a late postoperative complication of a ductal division and suture 20 years before the repair of coarctation was done.

All patients had systolic blood pressure >150 mmHg at operation. The common symptoms on referral to surgery were headache, intermittent claudication and easy fatigability.

Blood pressure measurement:

Blood pressure values both before and after surgery were obtained by simultaneous cuff pressure measurement of both right arm and lower extremities. The aortic pressure both proximal and distal to the obstruction was measured both during catheterization and intraoperatively, before and after correction.

According to the Joint National Committee on Detection, Evaluation and Treatment of High Blood Pressure (10), systolic hypertension is defined as follows [Figure I]:

Mild	140-159 mmHg
Moderate	160-179 mmHg
Severe	180-210 mmHg
Very severe	> 210 mmHg

All patients were under hypotensive medications including angiotensin converting enzyme inhibitors [ACE inhibitors], diuretics, β-blockers, and calcium channel blockers [Figure 2].

Operative technique:

1. All procedures were done through a left thoracotomy.

2. In one patient [4.35%], simple clamping and sew technique for coarctation repair was done.

3. In 5 patients [21.74%], with full heparinization of the patients, a tube graft between the proximal and distal aorta was used.

4. In a re-do patient with full heparinization, a left atrium to femoral artery bypass using a BIOMEDICUS Centrifugal Pump was used.

5. In 16 patients [69.57%], patch angioplasty with a synthetic material [Gore-Tex, in 7 patients; and a double Velour Dacron, in 9 patients].

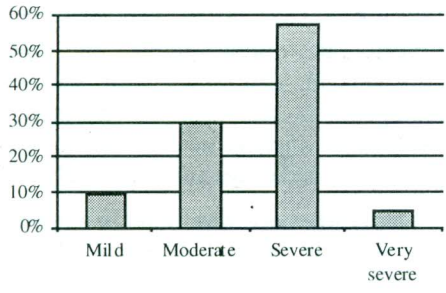


Fig. (1): Preoperative classification of hypertensive patients.

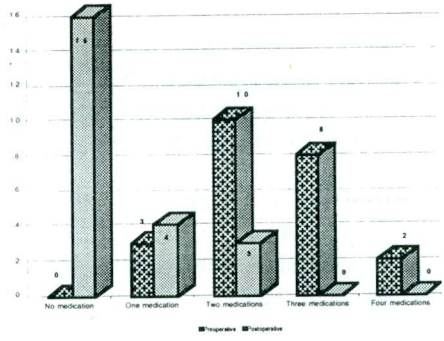


Fig.(2): Pre-and postoperative antihypertensive drug therapy in the study group.

6. A bypass Dacron tube graft between the proximal [just distal to the aortic arch] and the descending thoracic aorta in the re-do patient was used.

Follow up and statistical data:

All patients were followed up in the outpatient clinic from 4 months to 6 years. Data are presented as the means ± standard deviations. Systolic blood pressure gradients across the coarctation before and after repair was evaluated using the paired Student's t-test. A confidence level of 0.05 was chosen, so p-values less than 0.05 were considered significant.

Results:

Preoperative:

All patients were hypertensive at the time of referral to surgery. Systolic blood pressure ranged from 155 mmHg to 215 mmHg with a mean of 185.3 mmHg ± 17.38 [table 1].

Diastolic blood pressure ranged from 90 mmHg to 120 mmHg with a mean value of 115 mmHg ± 00. The peak systolic gradient across the coarctation ranged from 55 mmHg to 135 mmHg with a mean maximal gradient of 82.4 mmHg ± 62.17.

Postoperative:

All patients were followed up for 4 months to 6 years. There was no mortality either early or late. Four patients [17.39%] developed transient hoarseness of voice for 4-9 months postoperatively. Three pts. [13.04%] were reopened for bleeding. Nine patients [34.78%] developed superficial wound infection. One patient underwent a reoperation in the second day postoperatively because of high systolic gradient [55 mmHg].

Blood pressure:

Sixteen patients out of 23 [69.57%] were normotensive in the last visit. Seven patients [30.43%] improved significantly in comparison to the preoperative results i.e. preoperative mean systolic pressure was 185.26 mmHg ± 17.38, and postoperatively it was 128.83 mmHg ± 14.52 [p- value 0.003]. However, these patients needed an antihypertensive regimen [Figure 2].

Mean diastolic blood pressure significantly improved [p-value <0.005]. The systolic gradient between upper and lower halves of the body was trivial in 19 patients [82.61%] and was mild [<20 mmHg] in 4 patients [17.39%]. Those patients whom were in need of antihypertensive medications were above the age of 25 years.

Discussion:

Persistence of a preoperative hypertension represents a major problem after successful repair of coarctation of the aorta. Several factors have been implicated including a complex interaction, increased aldosterone level, a renal effect moderated by renin and angiotensin leading to increased intravascular volume (11-13), and poor compliance of the arterial tree proximal to the coarctation (14) .

Clarkson et al in 1983 showed that up to 20% of adult patients after coarctectomy were still hypertensive 5 years after surgery, and thereafter, the incidence of hypertension increases significantly (15).

Olley in 1979(8) suggested that operations may not be indicated for patients more than 25 years of age. However, Wells et al in 1995 reported that 12% of their series remained hypertensive after surgery, among whom many failed drug therapy and remained hypertensive even with medications (16).

In this series, a 70% complete resolution of hypertension is reported and patients needed no medication at all postoperatively. The rest of patients [30%] although improved significantly, still needed one [4 patients] or 2 [3 patients] antihypertensive drugs. This may in part reflect the improvement in medical management, new drugs with their better manipulation and also in another way reflect the improvement in new anesthetic techniques and drugs perioperatively.

No difference was found in outcome on the basis of surgical technique. The fourth technique of repair provided an excellent relief of the gradient across the coarctation.

Conclusion

Repair of adults with coarctation is highly recommended on the basis of the above results. Patients up to the age of 40 years have been improved surgically although some of them were still hypertensive in spite of combining 2 or even 3 drugs preoperatively, and some of them became normotensive after surgery.

Although 30% of our patients were still in need of one or 2 drugs postoperatively, none of them exceeded a resting systolic blood pressure of 150 mmHg. Because the risk of operation is extremely low, it is recommended to operate on adult patients at any age even with mild hypertension as long as the gradient across the coarctation is significant at least to guard against cardiovascular complications.

References

1. van der Horst ML and Gostman MS: Racial incidence of coarctation of aorta. Br Heart J 1972;34:289-294.
2. Campbell M: Natural history of coarctation of aorta. Br Heart J 1970;32:633-640.
3. Cohen M, Fuster V, Steele PM, et al: Coarctation of aorta. Long-term follow-

up and prediction of outcome after surgical correction. Circulation 1989;80:840-5.

4. Coarctation repair: The first forty years [Editorial]. Lancet 1991;338:546 7.

5. Koller M, Rothlin M and Senning A: Coarctation of aorta: review of 362 operated patients. Long-term follow-up and assessment of prognostic variables. Eur Heart J 1987;8:670-9.

6. Brouwer RMHJ, Erasmus ME, Ebels T, et al: Influence of age on survival, later hypertension, and recoarctation in elective coarctation repair, including long-term results after elective coarctation repair with a follow-up from 25-44 years. J Thorac Cardiovasc Surg 1994;108:525-31.

7. Maron BJ, O'Neil-Humphries J, Rowe RD, et al: Prognosis of surgically corrected coarctation of the aorta: a 20-year postoperative appraisal. Circulation 1973;47:119-26.

8. Olley PM: The late results of coarctectomy performed after one year of age. In: Tucker B (ed.): First Clinical Conference on Congenital Heart Disease. New York, Grune & Stratton. 1979; pp 159-66.

9. Nauton MA and Olley PM: Residual hypertension after coarctectomy in children. Am J Cardiol 1976;37:769-72.

10. Gifford RW: The fifth report of the Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure. Arch Intern Med 1993;153:154-83.

11. Benedict CR, Grahame-Smith DG and Fisher A: Changes in plasma catecholamines and dopamine β-hydroxylase after corrective surgery for coarctation of the aorta. Circulation 1978;57:598.

12. Fox S, Pierce WAS and Waldhausen JA: Pathogenesis of paradoxical hypertension after coarctation repair. Ann Thorac Surg 1980;29:135.

13. Parker FB Jr, Streeten DHP and Farrell B: Preoperative and postoperative renin levels in coarctation of the aorta. Circulation 1982;66:513.

14. Kirklin JW and Barratt-Boyes BC: Cardiac Surgery. New York. Churchill Livingstone. 1992; pp 1263-325.

15. Clarkson PM, Nicholson MR, Barratt-Boyes BC, et al: Results after repair of coarctation of the aorta beyond infancy: a 10-year follow-up with particular reference to systemic hypertension. Am J Cardiol 1983; 51: 1481-8.

16. Wells WJ, Thomas WP, Farhouch B, et al: Repair of coarctation in adults. Fate of systolic hypertension. Ann Thorac Surg 1996;61:1168-71.

Univentricular Heart Univentricular Versus Biventricular Repair: Anatomical Consideration. Experience of the National Heart Institute

ABSTRACT

Twenty patients with double-inlet ventricle, 17 patients with double-inlet left ventricle [DILV] and 2 patients double-inlet right ventricle [DIRV] and one patient with double-inlet ventricle of undetermined morphology were studied between January 1994 and February 1997. Their ages ranged from 2 years to 12 years. Eighteen patients underwent univentricular repair, 4 patients of this group underwent Fontan's operation, 9 patients underwent a bidirectional Glenn operation, and 5 patients had hemiFontan operation. Two patients out of 4 who underwent Fontan's operation had had a bidirectional Glenn operation beforehand. In the second group [2 patients], septation has been adopted because of a higher PVR where Fontan's operation was not feasible and because of a suitable anatomy.

The total mortality was 5 patients, 2 after Fontan's operation, one after bidirectional Glenn and 2 patients after septation.

M. Moataz Abdel-Khalek M.D.*; and Hamdy Soliman M.D @ .

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

The term "Univentricular Heart" has been used first for cases of single ventricle with undetermined morphology in which the two atria are draining, but they found that it is not logic to have a main title like that for a very rare anomaly in which there is a single ventricle of ambiguous morphology in which the two atria are draining (1,2,4).

So, they shifted to a wider definition which is "Univentricular Atrioventricular Heart", but they found that this definition is very wide because cases of tricuspid atresia and cases of mitral atresia will be included under this name. Because physiologically they are a single ventricle and they have a univentricular atrioventricular connection (5,7). Because it was always preferred for cases of tricuspid atresia to be included within hypoplastic right heart syndrome and cases of mitral atresia with hypoplastic left heart syndrome. So, they came to the definition of "Double-inlet Ventricle" which actually is not a true single ventricle because there is usually a small rudimentary ventricle on the left or right side.

DIV can be a DILV with rudimentary RV on the left or right side or, DIRV with a rudimentary LV on the left or right side, double-inlet, double outlet LV with a rudimentary RV on the left or right side, double-inlet, double outlet RV with a rudimentary LV on the left or right side. Finally, DIV of undetermined morphology,

* *Cardiothoracic Surgery Dept.-National Heart Institute*
@ Cardiology Dept.-National Heart Institute

the true single ventricle. All these anatomical variants can be with atrial situs solitus or situs inversus and can be with ventriculoarterial concordance or discordance.

The management of single ventricle as any complex congenital malformation, the surgeon has to choose between the two main lines of treatment, the univentricular or biventricular repair.

By univentricular repair we mean that, to have one ventricle as the systemic ventricle and you have the whole venous blood shifted directly to the pulmonary circulation with some sort of Fontan's operation. On the other hand, by biventricular repair we mean that to try to septate this ventricle into two nearly equal ventricles, something very similar to the normal anatomy.

With univentricular repair it is not essential for the surgeon to be aware of the minute anatomy of this single ventricle, all what he has to fulfill are the important criteria for a successful Fontan's procedure like the PA pressure, the PVR and the pulmonary artery index. However, if he decided to do septation then accurate information of the detailed anatomy of this single ventricle is very crucial.

As regard univentricular repair (10,13,18):

Univentricular repair has become the main and essential line of treatment for the univentricular heart because of the associated high hospital mortality with the biventricular repair, a very high incidence of heart block and a terrible incidence of late sudden death.

In the univentricular repair we prefer now the lateral tunnel technique [total cavopulmonary connection; TCPC] rather than direct right atrium-to-pulmonary artery connection. We prefer now to do staged repair i.e. bidirectional Glenn's or hemi Fontan's operation than fenestrated Fontan a year later then transcatheter closure of this fenestration when the hemodynamics allow.

We found also that hemitontan's operation facilitates the second stage more than the bidirectional Glenn because in the second stage with the hemiFontan, you don't have to dissect the area of the right pulmonary artery and SVC to do the anastomosis between the cardiac end of the SVC and the lower border of the right pulmonary artery but it is enough to open the right atrium and remove the patch closing the SVC orifice and make the lateral tunnel between the IVC and SVC orifices.

As regard biventricular repair (3,12,13,14,15,16,17) :

As we have mentioned before, this technique has been nearly abandoned and is only reserved for cases which are not candidate for Fontan's operation because of a pulmonary vascular resistance more than 4 Todd units provided that the anatomy is very suitable for septation.

If the surgeon decides to do septation, he has to be aware of the detailed anatomy of this single ventricle.

Scheme for preoperative prediction of the important anatomical landmarks prior to septation:

By septation we mean that a Dacron patch be inserted between the two A-V valves posteriorly and the two semilunar valves anteriorly. The rudimentary ventricle is usually connected by a restrictive VSD called "the outlet foramen to the main ventricle" and this rudimentary ventricle may support the aorta or pulmonary artery, so enlarging and extending the VSD to avoid subaortic obstruction is essential.

With septation, there are three main problems:

First: The inadvertent induction of heart block during enlarging the VSD.

Second: The development of LVOT obstruction because the VSD is usually restrictive and if we could not enlarge because of an unsuitable position of the bundle and the VSD.

Third: The inadvertent induction of A-V valves incompetence in case if there is straddling of one or both A-V valves across the outlet foramen into the rudimentary ventricle.

We have postulated a scheme for preoperative identification of the important anatomical landmarks to avoid those three problems and to identify the ideal anatomy for septation.

This scheme helps us to identify and predict the anatomy and position of the bundle, of the VSD and to predict preoperatively which of the two A-V valves will be responsible for straddling, if any.

First: Avoidance of heart block (8,9):

Because there are so many anatomical variants of the univentricular heart and because conductive tissue disposition usually varies from one anatomical variant to the other, we have to follow the rule for conductive tissue disposition in congenital heart disease.

N.B. Intraoperative electrophysiological mapping is not feasible in most centers.

This rule is made up of many points but the most important point is that conductive tissue disposition depends on the proper alignment between the atrial septum and the inlet part of the ventricular septum. This alignment depends on 3 main factors:

1.A-V connection concordant or discordant.

2.Ventricular topology D- or L-loop.

3.The presence or absence of the inlet part of the ventricular septum as in double-inlet LV where the inlet septum is almost always absent.

With concordant A-V connection, with D-loop and when the inlet septum is present, this alignment is preserved and the bundle will be normally situated, while, with discordant A-V connection, with L-loop and when the inlet septum is absent, this alignment is distorted and the bundle will be abnormally situated.

By normally situated conduction tissue we mean that the bundle will arise from a regular posteromedial A-V node at the base of the triangle of Kokh and will pierce the central fibrous body at the apex of this triangle where it passes posteroinferiorly to the membranous septum, and if there is a VSD involving the membranous septum i.e. a perimembranous VSD, the bundle will be situated posteroinferiorly in relation to the VSD.

However, when this alignment is distorted, the bundle will be abnormally

situated i.e. it will arise from an anterolateral A-V node at the base of the right atrial appendage and will pass anterosuperior to the membranous septum or to any perimembranous VSD.

So, in our scheme, in any anatomical variant of the univentricular heart, we look to the type of A-V connection, the ventricular topology and the inlet septum whether present or absent then we can predict whether the bundle will be posteroinferior or anterosuperior to the VSD.

Second: Avoidance of LVOT obstruction by enlarging or extending the VSD (6, 11):

The VSD can be anterosuperior in which case the anterosuperior border will be rudimentary and the posteroinferior border will be well-developed. The reverse is true if the VSD is posteroinferior in which case the anterosuperior border will be well-developed. If the VSD is anterosuperior and the A-V bundle is anterosuperior, then, enlarging the VSD posteroinferiorly and, accordingly, avoidance of heart block and LVOT obstruction is feasible. However, if the bundle is posteroinferior, enlargement of the VSD will not be possible or else, we will have to sacrifice the bundle. Also, if the VSD is posteroinferior and the bundle is posterior then enlarging the VSD anterosuperior without injuring the bundle is possible.

A proper preoperative echocardiography can tell us whether the VSD is anterosuperior or posteroinferior but because of the spatial arrangement of the two chambers, this is not always accurate.

However, if we go slightly back to the embryological development of the ventricular septum, we can predict the position of the VSD [Figs. 1-1, 1-2&1-3]. The ventricular septum is formed of three main parts, the ventricular septum proper [the sinus and trabecular parts], the conus septum and the fused A-V cushions. The conus septum is anterosuperior and is at first on the right aspect of the ventricular septum proper, then it rotates with the truncal rotation to come in line with the ventricular septum proper. So, the conus septum is considered a right-sided structure in relation to the ventricular septum proper and it closes it anterosuperiorly.

The ventricular septum proper fuses with the right aspect of the fused A-V cushion to close it posteroinferiorly so, the fused A-V cushions are considered a left-sided structure in relation to the ventricular septum proper because it fuses with their right aspect and they close the ventricular septum posteriorly.

If the rudimentary ventricle is on the left side, this means that the ventricular septum is shifted to the left towards the left-sided rudimentary ventricle to make it rudimentary. So, it is logic that the ventricular septum will fuse with the left-sided A-V cushions and will be closed posteriorly but will not fuse with the right-sided conus septum so, it will be left open anterosuperiorly so, the VSD will be anterosuperiorly situated.

The reverse is true, that is, if the rudimentary ventricle is on the right side, the VSD will be posteroinferior because the septum will fuse with the right-sided conus septum and will be closed anterosuperiorly

but will not fuse with the left-sided fused A-V cushions.

Third: Avoidance of A-V valve incompetence in case if there is straddling of one of the A-V valves across the outlet foramen into the rudimentary ventricle:

Preoperative echocardiography can tell us if there whether or not straddling of one or both A-V valves is present, but cannot give a definitive clue as regard the valve responsible for this straddling especially if this straddling affects only the tensor apparatus without definite overriding.

But, anyway, we can identify the valve responsible for straddling if any by following the rule for straddling and overriding of the A-V valves. The rule states that:

a) If the ventricular septum is not attached to the crux, a right A-V valve will be responsible for straddling with atrial situs solitus and D-looping; while the left A-V valve will be responsible for straddling with atrial situs solitus and L-looping.

The ventricular septum does not attach to the crux cordis when there is a posterior [inlet] VSD which is juxtacrux or when the inlet part of the VSD is absent as in DILV.

b) If the ventricular septum attaches to the crux cordis, the left A-V valve will straddle an anteriorly-situated VSD away from the crux, if the ventricular topology is D-loop and a right A-V valve will straddle anterior VSD if the ventricular topology is L-loop.

Identification of the valve responsible for straddling is very important because if the left A-V valve was the valve responsible for straddling and the rudimentary ventricle is on the left side, thus will cause no problem because both the left A-V valve and the left half of the main ventricle together with the left-sided rudimentary ventricle will belong to the same ventricle which is the newly fashioned LV, so, it will not cross the estimated plane of the septal patch.

From this discussion, we come to a final conclusion that DILV with rudimentary left-sided RV, concordant A-V connection and discordant V-A connection is the ideal anatomical variant for ventricular septation, because:

First: We have mentioned that the problems with septation are inadvertent induction of heart block, of LVOT obstruction or of A-V valve incompetence if there is straddling of one or both A-V valves.

- As regard heart block: The bundle will arise from an anterolateral A-V node because the inlet part of the ventricular septum in DILV is absent and the bundle will be on the anterosuperior border of the VSD and on the pulmonary annulus because the ventricular topology is L-loop.

- As regard LVOT obstruction: Because the aorta is on the left side arising from the rudimentary RV, enlarging the VSD to avoid subaortic obstruction is essential. Because the rudimentary right ventricle is on the left side, this means that the ventricular septum is shifted to the left so, will fuse with the left-sided fused A-V cushions and will be closed posteriorly and the VSD will be at the site of the conus septum i.e. anterosuperior and the anterosuperior border will be rudimentary and we can enlarge the VSD posteroinferiorly towards the

apicotrabecular septum and because the bundle is anterosuperior, this will not cause heart block. So, avoidance of heart block and LVOT obstruction is feasible with this anatomical type [Fig. 1-4].

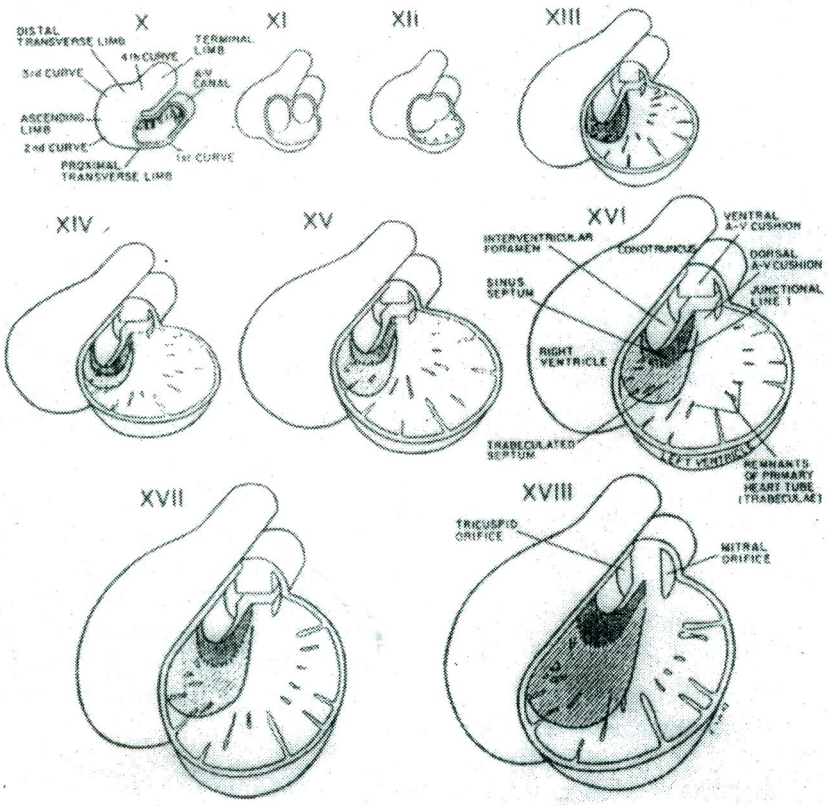


Fig. (1-1):Embryology of the heart

- As regard A-V valve incompetence in case if there is straddling of the A-V valves: According to the rule of straddling, the left A-V valve will be responsible for straddling because the ventricular septum is not attached to the crux due to the absence of the inlet septum and because the ventricular topology is L-loop. So, even if there is straddling, it will affect the left A-V valve and this will not preclude septation because both the left A-V valve and the left half of the main ventricle together with the left-sided RV will belong, after septation, to one ventricle, the newly fashioned LV.

First: There is A-V concordance, so that after septation, the RA will joint the RV and the LA will open into the LV and no need for atrial switch operation.

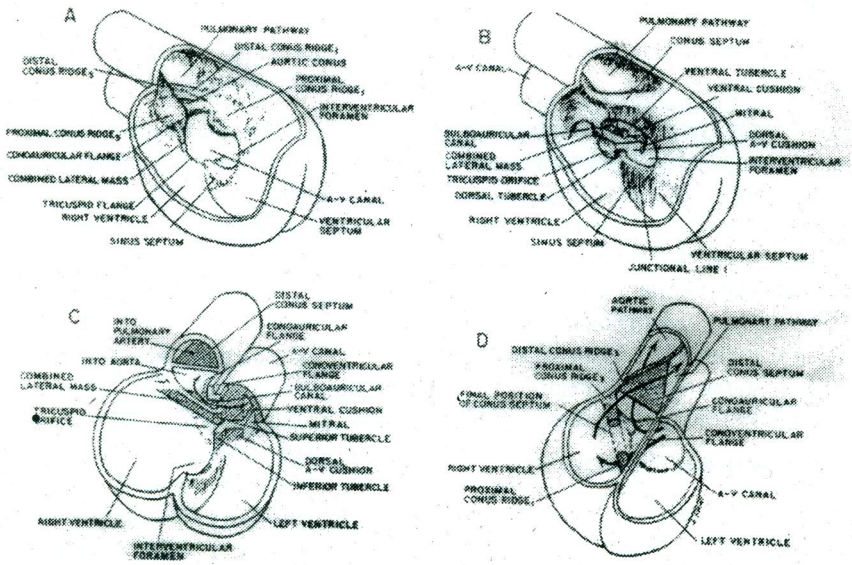


Fig. (1-2): Embryology of the heart

Second: There is V-A discordance i.e. the aorta will arise from the left-sided RV. Because the aorta is one the left side, we can use a simple straight patch during septation. However, if the aorta was on the right side arising from the LV [V-A concordance], we have to make a spiral shaped patch or to deliver the two great vessels into the LV and make a conduit from the RV to the distal pulmonary confluence and the use of a conduit in septation is invariably fatal.

So, DILV with concordant A-V and discordant V-A connection and left-sided rudimentary RV is the ideal anatomical variant for septation.

Patients

Twenty patients with double-inlet ventricle, 17 patients with DILV, 2 patients with DIRV and one patient with DIV of undetermined morphology were studied from January 1994 through February 1997 in the NHI.

Their ages ranged from 2 years to 12 years. Eighteen patients underwent univentricular repair, 9 patients underwent bidirectional Glenn's operation, 5 patients underwent hemitFontan's operation and 4 patients underwent Fontan's operation. In the two remaining patients, septation was adopted because of a higher PVR where Fontan's operation was unfeasible. The two patients had double-inlet left ventricle with a rudimentary left-sided right ventricle with concordant atrioventricular connection and discordant ventricular arterial connection.

Methods

A. Univentricular repair:

It means to have one ventricle as the main ventricle, pumping all the blood to the systemic circulation and to have all the systemic venous blood shifted directly to

the pulmonary circulation with some sort of Fontan's operation.

Fontan's operation can be made directly if the anatomy and hemodynamics allow as in many cases of tricuspid atresia. However, cases of DIV usually require staged repair, first hemiFontan's operation as a bidirectional Glenn [which is of the same physiologic significance as the hemiFontan's operation], then fenestrated Fontan, then transcatheter closure of this fenestration when the hemodynamics allow.

First: Bidirectional Glenn [n=9]:

Through a median sternotomy, the pulmonary artery and its two main branches were dissected properly. The SVC was dissected and the azygos vein was ligated.

CPB was started with a single venous cannula and an arterial perfusion cannula. Cooling down was started. The SVC was divided and the cardiac end was sutured during cooling. When corporeal temperature reached 15°c, the aorta was cross-clamped and circulation stopped.

The right pulmonary artery was widely opened and the arteriotomy extended behind the aorta over the pulmonary artery bifurcation. The SVC was anastomosed to the right pulmonary artery starting with the posterior wall first, then a patch of Gore-Tex 0.4 mm was used for the anterior part of the anastomosis. The main pulmonary artery was ligated.

The technique of circulatory arrest was preferred in our series, because it helped to make a wide arteriotomy in the right pulmonary artery extending behind the aorta to the origin of the left pulmonary artery and the orifices of the right and left branches and excising any obstructing ridges or diaphragms.

The cardiopulmonary bypass was then reinstituted, warming up started, then aortic cross-clamp removed after proper deairing of the aortic root.

Second: The hemiFontan's operation [n=5]:

It has the same idea and function as the bidirectional Glenn's operation. After anastomosing the SVC to the right pulmonary artery, the cardiac end of the SVC was not sutured closed, but we anastomosed it to the inferior surface of the right pulmonary artery then we opened the right atrium and we closed the cardiac orifice of the SVC with a Dacron patch.

The main advantage of this technique was that during the second operation [the complete Fontan's operation], we avoided extensive connection of the right pulmonary artery and the SVC. We just opened the right atrium and we removed the Dacron patch closing the SVC orifice and we fashioned the lateral tunnel.

Third: The Fontan's operation:

Four patients underwent the Fontan's operation, 2 of them underwent Fontan's operation by connecting the main pulmonary artery to the roof of the right atrium and closing the ASD and the right A-V valve with a Dacron patch. Both of them had a left-sided right ventricle with the aorta arising from it i.e. L TGA.

The other two patients had undergone a previous bidirectional Glenn's operation and they underwent a total cavopulmonary connection by using a lateral patch between

the IVC orifice and the SVC orifice then, the cardiac end of the SVC was anastomosed to the inferior surface of the right pulmonary artery.

As regard the Fontan's operation:

Median sternotomy, bicaval cannulation, standard CPB was instituted, the aorta was cross-clamped and cold crystalloid potassium cardioplegia was then infused. A right atriotomy was done on the roof of the right atrium. Partial excision of the atrial roof was used to provide a wider opening.

The pulmonary artery trunk was transected close to the pulmonary valve to keep the greatest possible length of the trunk to facilitate the atriopulmonary anastomosis. The two pulmonary artery branches ought to be dissected to permit anastomosis without tension.

The right A-V valve was closed with a patch fashioned from Dacron attached onto the leaflets to avoid the conduction tissue. We preferred to fix the midpoint of the free edge of each leaflet to the center of the patch to prevent formation of thrombi between the patch and the valve. The ASD was closed with a Dacron patch.

The atriopulmonary anastomosis was then performed; first, the posterior wall with 4/0 polypropylene sutures, then a pericardial patch was used on the anterior part of the anastomosis.

Total cavopulmonary connection using a lateral patch:

Two patients with a previous bidirectional Glenn's operation underwent total cavopulmonary connection with a lateral patch:

Median sternotomy with the oscillating saw. Dissection of the SVC and right and left pulmonary artery branches. Direct caval cannulation was made. CPB, aortic cross-clamping and cold crystalloid potassium cardioplegia. The right atrium was then opened. An appropriately-sized and shaped patch made of a Dacron tube was prepared [Gore-Tex if fenestration is to be done]. A corporeal temperature of 15°c was achieved before total circulatory arrest.

The IVC cannula was then removed to avoid distortion of the IVC orifice. The patch was sutured around the IVC orifice and then alongside the lateral wall of the right atrium till the cardiac end of the SVC. The cardiac end of the SVC was opened and anastomosed to the inferior surface of the right pulmonary artery. We made the posterior half of the anastomosis then the anterior half was closed with a patch of Gore-Tex 0.4 mm. When the procedure was done with, the IVC cannula was then reinserted, CPB restarted and warming up begun.

B. Biventricular repair:

The septation procedure.- Two patients with a high PVR [> 4 units] underwent a septation procedure because they were not candidates for a Fontan's procedure.

The anatomy of the heart in the two patients was carefully studied preoperatively by echocardiography and cardiac catheterization. The two patients had DILV with rudimentary left-sided right ventricle with concordant A-V connection and discordant ventriculoarterial connection i.e. the aorta was on the left side arising from the left-sided right ventricle which was subaortic.

The VSD was anterosuperior with a rudimentary anterosuperior border and a well-developed posteroinferior border.

The A-V bundle was anterosuperior arising from an anterolateral A-V node, the bundle of Hiss penetrated the junction of the right A-V valve and pulmonary valve to pass over the subpulmonary area along the anterior left ventricular free wall. As it passed along the interventricular septum, it coursed anterior to the VSD.

Technique:

Median sternotomy, standard CPB was instituted with an aortic cannula and 2 caval cannulae introduced directly in the SVC and IVC to provide a wider exposure through the right atrium [Fig. 1-51.

The approximate size of the septation patch was determined before CPB by noting the external dimension of the ventricular mass and estimating the wall thickness. An appropriate-sized piece of knitted Dacron was backed with pericardium to create an impervious patch. The patch ought be a bit smaller because if it was too large, it would bulge into the right ventricle and impair cardiac function, however, if it was made too small, dehiscence would be the end.

Cooling down to 15°c was usually needed so that period of circulatory arrest might be used when needed for improvement of exposure. The interior structure of the LV main chamber was examined through the right-sided A-V valve. The repair was made through the intact right A-V valve supplemented with an inferior fish-mouthed ventriculotomy incision, taking care that the ventriculotomy incision would not interfere with the origin of the papillary muscles and that after septation, it would remain rightward within the pulmonary ventricle.

A few marking stitches were placed to outline the proposed septation suture line. The goals are:

1) To partition the two ventricles about equally.

2) To provide unobstructed pathways from the right atrium through the right-sided A-V valve to the pulmonary artery and from the left atrium through the left-sided A-V valve to the VSD, outlet chamber [right ventricle] and aorta.

3) To avoid damage to the coronary arteries by placing all the sutures from within the ventricles.

The position of the sutures line was predetermined by the anatomy of the tensor apparatus of the A-V valves posteriorly and inferiorly and by the location of the semilunar valves and VSD superiorly. So, only anteriorly can the surgeon select the suture siting in an attempt to partition the ventricle equally.

Teflon-pledgetted, 2/0 Dacron mattress sutures were placed and held individually by small hemostats. The most difficult area was the heavily trabeculated diaphragmatic surface.

The suturing was begun there and then carried out posteriorly and superiorly between the tension apparatus of the right A-V valve and that of the left A-V valve. Starting again at the diaphragmatic surface, the suture placement was carried out to the left and anteriorly and then superiorly along the anterior LV wall in the previously determined line, the suture line passed over the VSD and then swang posteriorly and the right beneath the subpulmonary area.

Fig. (1-3):

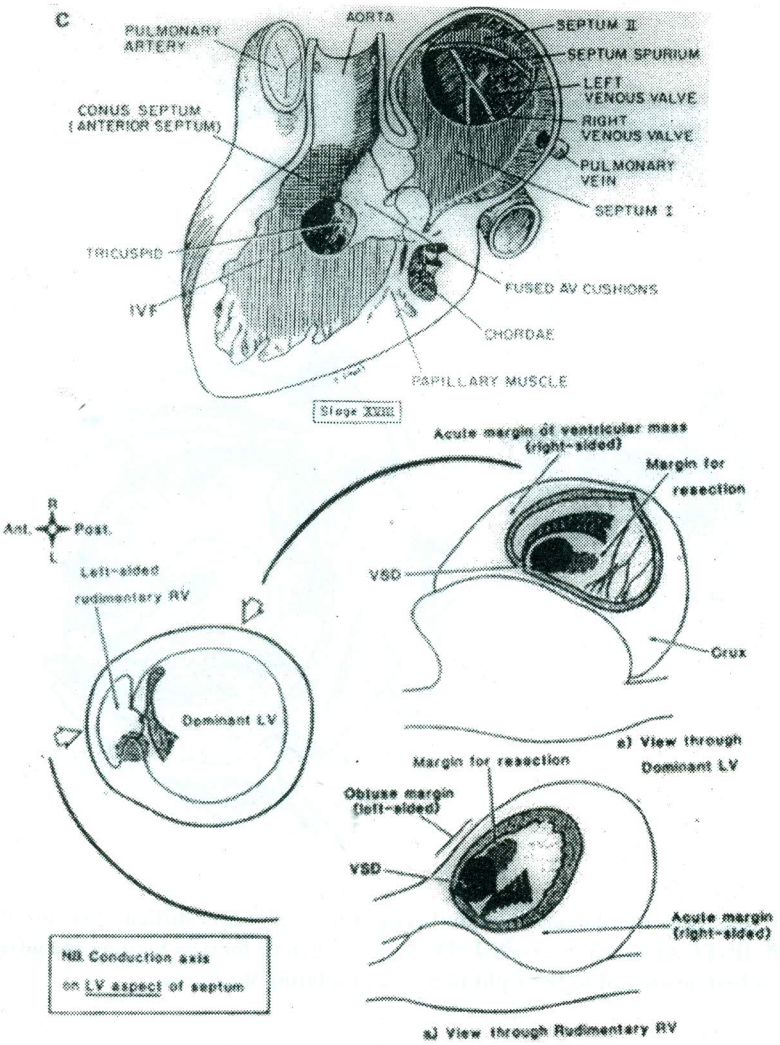


Fig. (1-4): Diagram illustrating how the disposition of the conduction tissues in double-inlet left ventricle with left-sided rudimentary right ventricle can apparently vary according to the approach of the surgeon. The left panel shows the basic arrangement of the conduction axis as seen in short axis of the ventricular mass viewed from above. The "safe area " for excision of the apical trabecular septum is marked. The upper right panel shows how the surgeon would view the axis if approaching through the dominant left ventricle [or through the right atrioventricular valve]. The lower right panel shows the view through the left-sided rudimentary right ventricle.

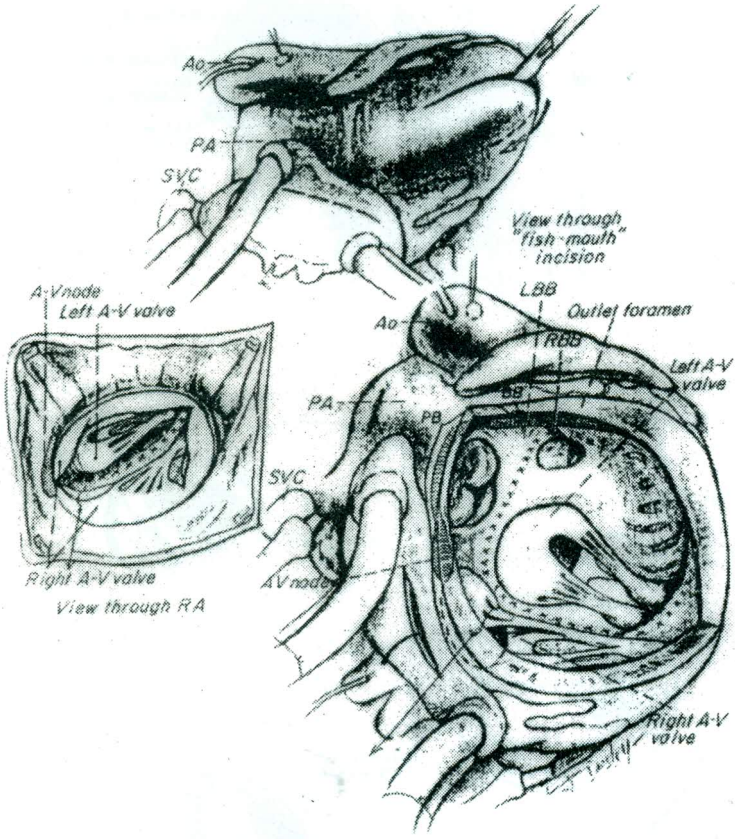


Fig. (1-5): Insertion of the aortic cannula might be, somewhat, difficult because the aorta was on the left [L-TGA] as in corrected TGA. So, an artery forceps holding the adventitia of the aorta was pulled down and to the right to help cannulating the aorta.

The sutures ought to be placed close together, 20-30 sutures were usually required. As they were individually clamped and set aside, care was taken to maintain their proper order. The sutures were passed through the patch, the patch was slid into position and the sutures were tied.

Results

Out of 20 patients with DIV, 17 patients with DILV, 2 with DIRV and one patient with double-inlet ventricle of undetermined morphology. Five patients died, 2 patients after the Fontan's operation in the first week postoperatively because of elevated central venous pressure and decreased left atrial pressure due to decreased forward flow from the right atrium to the pulmonary artery. The two patients had not had a hemiFontan's procedure beforehand and direct connection of the RA to the PA was adopted.

One patient died after bidirectional Glenn's operation due to markedly elevated SVC pressure most probably due to small anastomotic stoma. The patient died a few hours after he came out of the OR.

Two patients died after the septation procedure. The first patient could not be weaned from the CPB because of severe low cardiac output, while the second patient suffered from complete heart block and died suddenly on the 4th postoperative day.

The two patients who underwent the total cavopulmonary connection using a lateral patch passed a smooth postoperative course. The two patients had undergone a previous bidirectional Glenn's operation a year before the procedure.

Except for one patient, all the patients who underwent a bidirectional Glenn's or a hemiFontan's operation survived.

Discussion

Univentricular repair has become the main line of treatment for cases of DIV because septation in all centers is associated with a high hospital mortality, a high incidence of surgically-induced complete heart block, high incidence of late reoperation for residual VSD and A-V valve incompetence and disappointingly high incidence of sudden death.

But, there remains a small number of patients for whom septation is the only reasonable definitive surgical option primarily because of higher than normal PVR.

Univentricular repair in DIV is usually made as a staged repair because patients with DIV are considered risky patients for complete Fontan's operation because of the high volume overload affecting the single ventricle function and because of the condition of the two A-V valves.

So, the univentricular repair is usually preceded by a hemiFontan's operation or a bidirectional Glenn. In our institute, we sometimes prefer the hemiFontan's operation as it facilitates the second operation as we do not have to dissect extensively in the area of the right pulmonary artery and SVC.

This palliative operation unloads the main ventricle and dramatically improves the result of complete Fontan's operation.

In the second stage, Fontan's operation is completed by diverting the IVC blood to the SVC through a lateral tunnel of Gore-Tex and a fenestration is made in this

tunnel by an aortic punch, that is to say, fenestrated Fontan.

Lastly, when the time is appropriate i.e. no marked elevation of the central venous pressure and no marked depression of the LA pressure, the patient is taken to the catheter laboratory and the communication is closed with a percutaneously-inserted device.

Two cases only in our institute have been submitted to septation because of the higher than normal PVR and because of the suitable anatomy for this procedure. But, the patients died in the postoperative period because of low cardiac output in the first case and sudden death on the 4th day in the second case who was suffering from complete heart block.

DILV with concordant A-V and discordant V-A connection is the only anatomical variant suitable for septation precautions as regard the avoidance of heart block, of LVOT obstruction and of A-V valve incompetence are essential, also avoidance of A-V valve replacement or an extracardiac conduit is a must.

Preoperative understanding and full orientation of the detailed anatomy of the inside of this single ventricle is essential if we decide to do septation.

Because echocardiography and cardiac catheterization may not be able to provide us with all the data we need because of the complexity of these anatomical variants and because intraoperative electrophysiological mapping is not available in many centers, we have postulated a scheme which helps any surgeon to identify the important anatomical landmarks. This scheme depends on applying three rules which help us to predict the position of the A-V bundle, the position of the outlet foramen whether anterosuperior or posteroinferior and finally, the condition of the A-V valves and whether there is straddling or not and more important which valve is responsible for this straddling. Those are the rules for conductive tissue disposition in congenital heart disease, the rule for LV septum development and the rule of straddling of the A-V valves respectively and we have described the three rules in the introduction.

References

1. Anderson RH, Lenox CC, Zuberbuhler JR, Ho SY, Smith A, Wilkinson JL: Double-inlet left ventricle with rudimentary right ventricle and ventriculoarterial concordance. Am J Cardiol 1983;52:573.

2. Anderson RA: Weasel words in pediatric cardiology: Single ventricle. Intern J Cardiol 1983;2:425.

3. Arai T, Sakakibara S, Ando M, Takao A: Intracardiae repair for single or common ventricle, creation of a straight artificial septum. Singapore Med J 1973;14:187.

4. Anderson RH, Tynan MJ, Freedom RM, Quero-Jimenez M, Macartney FJ, Shinebourne EA, Wilkinson JL, Becker AE: Ventricular morphology in the univentricular heart. Herz 1979;4:184.

5. Anderson RH, Wilkinson JL, Gerlis LM, Smith A, Becker AE: Atresia of the right atrioventricular orifice. Br Heart J 1977;39:414.

6. Anderson RH, Penkoske PA & Zuberbuhler JR: Variable morphology of ventricular septal defect in double-inlet left ventricle. Am J Cardiol 1985;55:1560.

7. Anderson RH, Becker AE, Macartney FJ, Shinebourne EA, Wilkinson EA, Tynan MJ: Is tricuspid atresia a univentricular heart? Pediatr Cardiol 1979; 1:5 1.

8. Becker AE, Wilkinson JL & Anderson RH: Atrioventricular conduction tissues in univentricular hearts of left ventricular type. Herz 1979;4:166.

9. Bharati S & Lev M: The course of the conduction system in single ventricle with inverted [L-] loop and inverted [L-] transposition. Circulation 1975;51:723.

10. Bridges ND, Ionas RA, Mayer JE, Flanagan MF, Keane JF, Castaneda AR: Bidirectional cavopulmonary anastomosis as interim palliation for high-risk Fontan candidates. Early results. Circulation 1990;82 (suppl IV):IV-70.

11. Cheung HC, Lincolin C, Anderson RH, Ho SY, Shinebourne EA, Pallides S, Rigby ML: Options for surgical repair in hearts with univentricular atrioventricular connection and subaortic stenosis. J Thorac Cardiovasc Surg 1990;100:672.

12. Doty DB, Schieken RM & Laver RM: Septation of the univentricular heart: Transatrial approach. J Thorac Cardiovasc Surg 1979;78:423.

13. Edie RN, Ellis K, Gersony WM, Krongrad E, Bowman FD, Malm JR: Surgical repair of single ventricle. J Thorac Cardiovase Surg 1973;66:350.

14. Feldt RH, Mair DD, Danielson GK, Wallace RB, McGoon DC: Current status of the septation procedure for univentricular heart. J Thorac Cardiovasc Surg 1981;82:93.

15. Kreutzer G, Schlichter A, Laura JP, Suarez JC, Vargas JF: Univentricular heart with low pulmonary vascular resistances: septation Vs. atriopulmonary anastomosis. Arq Bras Cardiol 1981;37:301.

16. Kurosawa H, Imai Y, Fukuchi S, Sawatari K, Koh Y, Nakazawa M, Takao A: Septation and Fontan repair of univentricular atrioventricular connection. J Thorac Cardiovasc Surg 1990;99:314.

17. McGoon DC, Danielson GK Ritter DG, Wallace RB, Maloney JD, Marcelletti C: Correction of the univentricular heart having two atrioventricular valves. J Thorac Cardiovase Surg 1977;74:218.

18. Yacoub MH & Radley-Smith R: Use of a valved conduit from right atrium to pulmonary artery for correction of single ventricle. Circulation 1976;54 (suppl III):III-63.

Surgical Management of Complete A-V Canal Defect: Experience of the National Heart Institute. Criteria For Successful Repair

ABSTRACT

Eighteen patients with complete A-V canal defect have been operated on from January 1995 through December 1997 in the National Heart institute.

Their ages ranged between 6 months and 14 years. Ten patients had type A complete A-V canal defect, 6 patients had type C complete A-V canal defect and 2 patients had type B complete A-V canal defect.

Two patients died, one from patients with type C complete A-V canal and one from patients with type B complete A-V canal. Criteria for successful repair are proper repair of the A-V valves, the avoidance of heart block, the avoidance of residual septal defect and weaning from CPB with left atrial pressure less than 14 mmHg.

M. Moataz Abdel-Khalek M.D.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

A-V canal defect is a complex congenital malformation made of a triad of atrioventricular septal defect, deficiency of the base of the diaphragmatic wall of the heart which is a deficiency similar to the septal one and atrioventricular valvular malformation. This triad is common for partial, intermediate or complete A-V canal.

But in complete form, A-V cushions do not extend along the ventricular septum, in intermediate form, anterior A-V cushion extends along conus septum and posterior A-V cushion extends along sinus septum, resulting in chordal insertion of anterior and posterior leaflets into conus and sinus septa, spaces between these leaflets and ventricular septum allow interventricular shunting. In the partial form, the extension of the cushions along the septa → the leaflets are inserted directly in the ventricular septum which prevent interventricular communication.

As regard complete correction of complete form of A-V canal, successful repair depends on good repair of the mitral and tricuspid valve, the avoidance of induction of heart block, the avoidance of a residual atrial or ventricular septal defect and weaning from CPB with left atrial pressure not more than 14 mmHg.

First. Regarding the avoidance of A-V valves incompetence or stenosis: the important criteria for successful repair of the mitral and tricuspid valve are(1):

1. Preoperative echocardiography should provide us with complete data as regard the type of the A-V canal, the condition of the A-V valves whether competent or not, whether there is straddling or not of the mitral valve.

Cardiothoracic Surgery Dept.-National Heart Institute

2. Careful and deliberate identification of the anatomic characteristics.

3. After the anatomy of the anterior and posterior common leaflets has been carefully determined and the extent of the underlying interventricular communication has been defined, approximation of the mitral components of the anterior and posterior common leaflets so as to constitute the anterior leaflet of the mitral valve.

4. Reconstruction of the mitral valve should be in the alignment that it would assume during systole in the preoperative state, this alignment can often be determined by floating the leaflets into their closed position by infusion of saline under pressure into the left ventricular cavity.

Second. As regard the avoidance of heart block (2):

Thiene in 1981 studied the conduction tissue in A-V canal defect and they concluded the following [Figs. 1-1, 1-2 & 1-3]:

1. The conduction tissue disposition was basically the same whatever the type of the defect.

2. The defect effectively breaks up the thickened trigonal areas of the fibrous annulus into anterior and posterior components, the anterior component incorporates the aortic root and supports the attachment of the anterior bridging leaflet, the tendon of Todaro inserts into this anterior fibrous area. The posterior component where the posterior margin of the atrial septum comes into contact with the ascending posterior crest of the inlet ventricular septum supports the posterior leaflet.

3. This division into anterior and posterior fibrous bodies distorts the anatomy of the triangle of Koch. In the normal heart, this triangle is produced between the tendon of Todaro and the attachment of the septal leaflet of the tricuspid valve. A second triangle not present in the normal heart is produced in the A-V canal defects between the tendon of Todaro and the leading edge of the atrial septum which, itself, contains a firm collagenous bridging tendon. This triangle is called the nodal triangle and its important boundaries are the posterior insertion of the bridging tendon to the posterior bridging leaflet. The upper border is the ostium of the coronary sinus.

4. The effect of the A-V defect is to displace the entire specialized junctional area in a posterior direction to the area of junction of the atrial sinus septum and the inlet part of the muscular ventricular septum.

5. The precise location of the node within the nodal triangle depends on the degree of development of the sinus septum, the more deficient the sinus septum, the more posteriorly deviated is the atrioventricular node [Fig 1-3]. When the sinus septum is well-formed, the A-V node is away from the coronary sinus and when the sinus septum is poorly-formed, the coronary sinus is adjacent to the apex of the nodal triangle and the node is adjacent to the ostium of the coronary sinus [Fig. 1-3].

6. The A-V node becomes the penetrating A-V bundle precisely at the

apex of the nodal triangle, so the apex of this triangle is the major risk point.

7. The branching segment itself was located beneath the posterior bridging leaflet, being superficial when the leaflet was loosely attached but deeper when the leaflet was adherent to the septum.

8. The left bundle branch then found out into the left ventricle, its posterior radiation being adjacent to the diaphragmatic wall i.e. displaced posteriorly so, it has no relationship to the left ventricle outflow tract.

So, our recommendations to avoid heart block are:

a) The triangle of Koch in A-V canal defect is not a guide to the A-V node but the posterior nodal triangle.

b) Although the apex of the nodal triangle is the major risk point, the conduction axis can also be interrupted by sutures placed in either the inlet ventricular or the sinus atrial areas.

c) As regard the sutures placed in the ventricular septum, it would seem advisable always to place these stitches down the right ventricular septal surface away from the septal crest.

d) It is advisable to place the patch so that the coronary sinus remains in the right atrium but if the sinus septum is deficient then, the coronary sinus ostium will be adjacent to the apex of the nodal triangle and the A-V node, so in this situation, it is advised to place the patch so as to incorporate the coronary sinus within the newly constructed left atrium.

Third. As regard the avoidance of a residual septal defect:

1. The septal patch must be placed between the tricuspid and mitral components of the common leaflet which must be attached both to the crest of the ventricular septum and to the rim of the atrial septal defect.

2. Often the interventricular communication does not reach the true annulus of the A-V valve since there is a variable length of fibrous fusion of the base of the posterior common leaflet to the crest of the ventricular septum.

3. The latter is a favorable situation, in that it provides a buffer area of intact fibrous septum that protects the conduction tissue from the suture line. When this fibrous fusion or membrane present, the incision in the posterior common leaflet will have been extended posteriorly only to the limit of the interventricular communication.

4. When both the ventricular septal defect and the atrial septal defect are small, the use of a single patch is advised. But, when the defect is big, the use of two separate patches, one for the VSD and another for the ASD is advised.

5. In type B complete A-V canal, the chordae tendineae extending from the mitral portion across the ventricular septum to the anomalous right ventricular papillary muscle should be severed close to their leaflet attachments, this to avoid any residual VSD. Later on suturing the incised edges of the common anterior leaflet to the patch can prevent significant mitral regurgitation (3).

Fourth. As regard the avoidance of a high left atrial pressure (4):

1. A-V canal is a defect which usually has a small left atrium because the jet of mitral regurgitation is usually from the LV to the RA which is attributed to the low down atrial septal defect caused by scooping or deficiency of the base of the ventricular septum.

2. So, after repair of a complete A-V canal defect, we have to ensure that after repair, we shall get a big left atrium, so, if the atrial septal defect was small, it should be enlarged to use a big patch.

3. Also, it is advisable to have the patch more to the right to add to the left atrial side. In this way we go with the patch to the right of the coronary sinus ostium and if the atrial sinus septum is well-developed, we can cross again with the suture line between the mouth of the coronary sinus and the apex of the nodal triangle. However, if the sinus septum is hypoplastic then we have to incorporate the coronary sinus in the LA.

4. In unbalanced form of A-V canal where the left side may be small, leaving a residual atrial septal defect is advised. The residual defect should be controlled by continuous 4/0 prolene sutures as a purse-string suture around the defect and brought outside the heart, to adjust the size of the defect so as to have a satisfactory left atrial pressure at completion of bypass.

Patients

Eighteen patients with complete A-V canal defect have been operated on in the period from January 1995 through December 1997 in the National Heart Institute.

Their ages ranged between 6 months and 14 years. Ten patients had type A complete A-V canal defect, 6 patients had type C complete A-V canal defect and 2 patients had type B complete A-V canal defect.

Two patients died in this series, one had type C complete A-V canal and one had type B complete A-V canal. The patient with type C died on the second postoperative day because of persistent pulmonary hypertension which lead to hypoxia and low cardiac output. The patient with type B died because of severe mitral regurgitation caused by excision of the chordae tendineae straddling the ventricular septum and attached to a papillary muscle in the right ventricle.

Methods

Median sternotomy. The anatomy of the anterior and posterior common leaflets has been carefully determined. The two components of the anterior mitral leaflet were approximated. The entire length of the crest of the ventricular septum was exposed and the anterior and posterior common leaflets were incised along a line estimated to demarcate the tricuspid from the mitral components of the leaflets.

In type A deformity, the natural division in the anterior common leaflet has already shown this demarcation, between the mitral and the tricuspid parts. A septal patch between the tricuspid and mitral components of the common leaflet was inserted.

When the ventricular and atrial septal defects were small, we usually preferred a single patch but when the septal defects

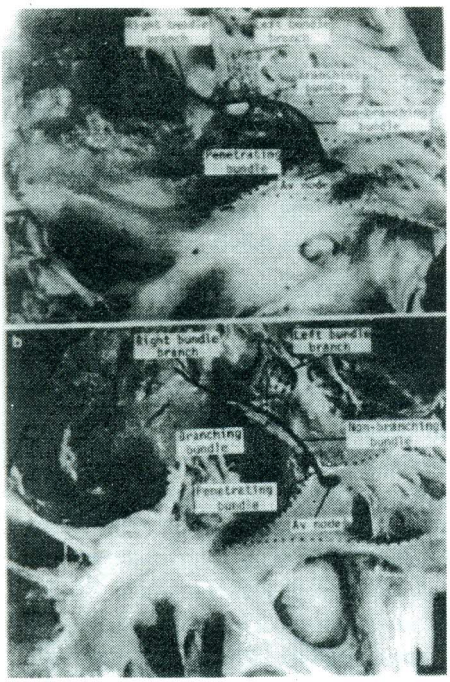


Fig. (1-1):

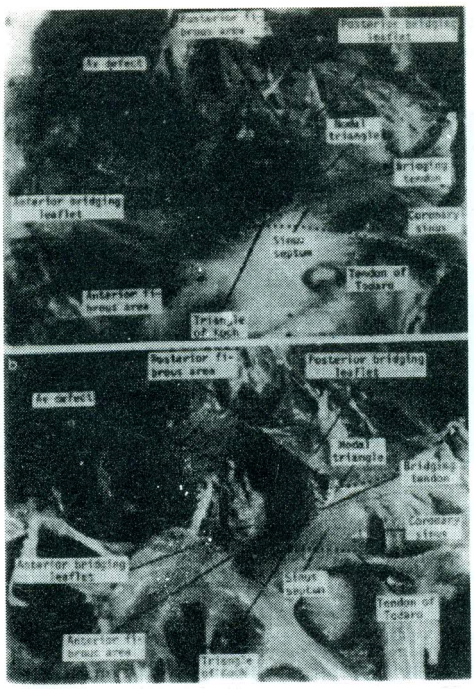


Fig. (1-2):

were large, a double patch technique was preferred.

In type C variant, it was necessary to incise the anterior common leaflet along a line estimated to demarcate the tricuspid from the mitral components of the anterior common leaflet. A similar incision in the posterior common leaflet was nearly always required which extended from the free margin of that leaflet to the posterior limit of the underlying ventricular communication.

Precautions for successful repair have been mentioned in the introduction to this work, and they included:

1. Avoidance of A-V valve incompetence or stenosis.

2. Avoidance of heart block.

3. Avoidance of a residual septal defect.

4. Avoidance of a high left atrial pressure.

Results

Eighteen patients with complete A-V canal defect have been operated on in the period from January 1995 through December 1997 in the National Heart Institute. Their ages ranged from 6 months to 14 years. Ten patients had type A complete A-V canal, 6 patients had type C complete A-V canal and 2 patients had type B complete A-V canal.

One patient with type C complete A-V canal and another one with type B died after the corrective procedure.

The patient with type C was a female baby 15 months old with severe pulmonary

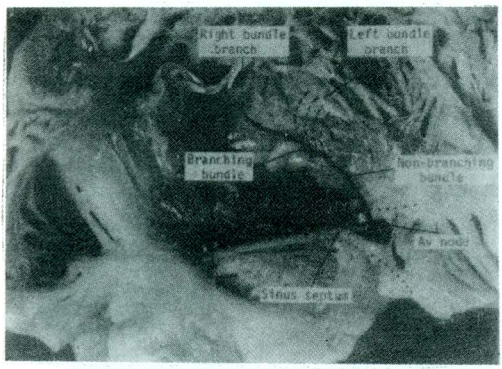


Fig. (1-3):

hypertension [PAP 75 mmHg]. Weaning from CPB was difficult because of a high PAP which necessitated intrapulmonary infusion of PGE_1 [protein VR 500 mg]. The patient improved with intensive postoperative management and prolonged hyperventilation and on the 3d postoperative day, she could be weaned from the ventilator and seemed to be doing well. Weaning from the inotropic support could also be made [epinephrine 0.2 µ/kg/min]. On the 4th postoperative day, the baby became hypoxic with high CVP [25 mmHg] and low blood pressure and a low systemic oxygen pressure, a condition which has been diagnosed as pulmonary hypertensive crisis. The patient was reintubated and ventilated with heavy sedation and reinfusion of PGE_1, but with no improvement and she died on the 4th postoperative day.

The other patient with type B complete A-V canal defect was a female patient 14 years old with severe straddling of the chordae tendineae of the left superior leaflet of the mitral valve which was inserted into a papillary muscle in the apex of the right ventricle. PAP was 85 mmHg. We were obliged to sacrifice this leach of chordae tendineae at the leaflet tissue and then suturing the incised edged of the leaflet to the septal patch.

Intraoperative testing of the mitral valve revealed moderate degree of mitral regurgitation near the anterolateral commissure which was judged acceptable.

In the postoperative period, the increased PVR which was complicated with moderate mitral regurgitation lead to disturbed hemodynamics of the patient. The patient has been reoperated upon for mitral valve replacement where St. Jude Medical valve size 27 mm has bee used but the patient couldn't be weaned from CPB.

As regard the morbidity, 3 patients suffered morbid events, one with type A, two with type C suffered from complete heart block but only one patient with type C required permanent pacemaker.

Discussion

With the progressive development of pediatric cardiac surgery in Egypt which lead to operating on babies with low body weight [4-5 kgs], cases of complete A-V canal attracted a lot of attention of the pediatric cardiac surgeon who started to encounter this anomaly with increased frequency.

In the National Heart Institute and before 1995, only 2 cases of complete A-V canal have been described in more than 20 years of open heart surgery. Starting from 1995 through December 1997, 18 cases of complete A-V canal have been described in this work, meaning that more attention is

being given to this anomaly as a guide for successful repair.

Insistence to get competent A-V valve, avoidance of complete heart block, avoidance of a residual defect and weaning from CPB with a left atrial pressure less than 14 mmHg are the essential criteria for successful repair as was described in the introduction to this work.

We can add to these criteria some important points which apply to any baby submitted for open heart surgery. These points are;

First: Preoperatively:

The preoperative echocardiography should provide us with accurate data as regard the detailed anatomy, the type of the complete A-V canal, the size of the atrial and ventricular septal defect, the presence of straddling of the chordae tendineae of the mitral leaflets, the presence of double-orifice mitral valve and more important, is the exclusion of associated diseases as Fallot's tetralogy which is not uncommonly associated with complete A-V canal in which cases , the ECG axis becomes a right axis instead of the superior axis of complete A-V canal. Other associated diseases are TGA, parachute mitral valve, interrupted aortic arch, SAM and Ebstein's anomaly of the tricuspid valve.

Preoperative evaluation of the different systems of the baby is essential and most important in baby with complete A-V canal or any baby with left-to-right shunt is the condition of the chest, any chest infection should be corrected preoperatively with the proper antibiotic and follow-up with repeated x-ray of the chest and leucocytic count is very helpful. Any diarrhea present should be corrected as it may affect the fluid balance of this baby and may low down the resistance.

Second: Intraoperatively (5,6,7,8,9,10)

* Heart surgery for neonates 4 or 5 kgs in weight necessitates the cooperation of the surgeon, the anesthetist and the perfusionist.

* The anesthetist should be acquainted with anesthesia in the neonates, most important is the ability to insert all the venous and arterial catheters without complications, for example, inability to have a good arterial line from the radial artery may affect the outcome of the whole surgery.

* Also, a good central venous line in the internal jugular vein for infusion of the inotropes and monitoring of the CVP is very crucial, this central venous line should be with a double or triple-lumen catheter to provide a multiple access to the central veins. The availability of a left atrial catheter is very helpful for monitoring the left atrial pressure in patients with complete A-V canal. But this catheter should be introduced by the surgeon through the left atrial appendage and tied by a pursestring suture, because the introduction of a Swan-Ganz catheter by the anesthetist is not possible in the neonates or small children.

* Also, all the infusions given by the anesthetist should be given with an electric syringe pump, which can work with a flow rate down to 0.1 mL/hr. This is for accurate control of all the fluid intake.

* Care of the ventilation of the baby during the operation, the ventilator should be a pressure-cycled one to avoid a high airway pressure which can lead to a barotrauma.

* Also, care of the left lung in particular because the tube may slip into the right main bronchus leading to left lung collapse. The use of nasal intubation is better for a child expected to be ventilated for a long time and follow the curve which determines the proper length of the endotracheal tube for nasal or oral intubation according to the weight of the baby, this is to ensure that the tube will not proceed more into the right main bronchus.

* Also, the use of Jackson's T-piece for manual ventilation especially during transportation of the baby after surgery is better than the use of the classical hand ventilator [The Ambu bag].

* Transportation of the baby with the presence of a transportation monitor which can demonstrate the ECG, the invasive blood pressure and the O_2 saturation of the baby is very crucial.

* The perfusionist should be aware of the different precautions needed for neonates and small infants. The use of a membrane oxygenator is very helpful as the time of CPB may be very long and this membrane oxygenator may help protect the lung surfactant and decrease the possibility of hemolysis.

* The use of one unit of fresh blood together with 30 mL/kg of Hartman's solution as a priming fluid is accepted, but if the baby has a hematocrit less than 35%, the use of whole blood in the priming is better.

* Careful measuring of the fluid balance of the baby and the acid-base balance, weaning from CPB with a hematocrit more than 30% is preferred.

Third: Postoperatively (8):

Postoperative care of a baby with complete A-V canal defect is the same as any baby with complex cardiac lesion submitted to an open heart surgery. Baby less than 8 kg should be managed and manipulated in a special ICU resuscitator which has a warmer to warm up the baby. This warmer should have a servo controller which means that there is a probe for measuring the surface temperature of the baby and we adjust the servo device at the required temperature and if the temperature of the baby decreases less than the set up level, the warmer works automatically to keep the temperature of the baby fixed.

* Care of the fluid balance, sodium and potassium levels, nutrition and care of the cardiovascular subsystem hemodynamics by manipulating the preload, the afterload and the cardiac dysrhythmias.

* In patients with complete A-V canal defects, the presence of a left atrial line is very helpful and the LAP should be maintained between 5 and 14 mmHg. In the presence of LAP greater than 15 mmHg, it may be necessary to administer frusemide 1 mg/kg intravenously together with further inotropes. In this instance, the use of 2D echocardiography for the assessment of the mitral valve and LV function is mandatory.

* Cardiac dysrhythmias represent a major problem in the postoperative care of a baby with complete A-V canal. So, the patient must return from the OR with four pacing wires, two of them are attached to the right ventricle and emerge on the left side of the midline, and the other two wires are attached to the right atrium and emerge

on the right side of the midline. If the baby is in sinus rhythm less than 100 BPM, atrial pacing at 120 BPM may be indicated.

* Digitalization may be needed with sinus tachycardia but very carefully in patients with complete A-V canal repair whom may have transient junctional rhythm and may pass into complete heart block. The presence of A-V sequential pacing is very helpful because it allows for a very fast pacing [up to 600 BPM] to the atrium followed by rapid decrease to manage cases with atrial flutter [overdrive pacing].

N.B. Never connect a rapid pacer to the ventricular wires.

* Junctional tachycardia is a common form of dysrhythmia after repair of a complete A-V canal and needs overdriving with atrial pacemakers set at 10-15% above current rate and if this is ineffective, faster pacing rates can be employed up to 600 BPM. Also cooling to 34°c is helpful.

* Avoidance of pulmonary hypertensive crisis in babies or children after repair of complete A-V canal is important. The unavailability of phenoxybenzamine and nitric oxide therapy in Egypt adds much to this problem. Precipitating factors are:

1. Hypoxia.

2. Hypercarbia.

3. Acidosis.

4. Pain.

5. Increased core/peripheral temperature gradient.

- The management of this crisis includes (11).

1.Hand bagging with 100% oxygen.

2.Prostaglandin or prostacyclin infusion.

3.Complete sedation and paralysis.

4.Decrease core temperature.

5.Aminophylline infusion.

- Care of the renal system:

The greatest risk of postoperative renal failure is hypotension which may be potentiated by hypoxia, acidosis, hypoglycemia, volume overload, hypothermia, arrhythmia and the administration of α-adrenergic agonists.

- Management:

* Optimize cardiac output.

* Frusemide 1 mg/kg IV, this dose may be repeated up to 5 mg/kg.

* Dopamine 2-5 μ/kg/min.

* Mannitol 20% 0.5 gm/kg over 15 minutes.

* A water load test 10 mL/kg may be considered if intravascular water depletion is suspected.

* If all these measures failed, peritoneal dialysis must be considered.

- Indications for dialysis.

* BUN greater than 100 mg/dL.

* Uncontrollable hyperkalemia.

* Intractable severe metabolic acidosis.

* Severe hypo- or hypernatremia and fluid overload.

Infants and neonates with acute renal failure cannot afford the conventional peritoneal dialysis, but we use the cross flow technique in which two peritoneal catheters are used one for infusion and the

other for drainage and the dialysis solution is not allowed to stay inside the peritoneal cavity. The fluid is given at a rate of 30 mL/kg/hr of 1.36% dialysis solution.

References

1. Abbruzzese PA, Livermore J, Sunderland CO, Issenberg H, Konsari S, Garcia GE, Starr A: Mitral repair in complete A-V canal. J Thorac Cardiovasc Surg 85:388-395; 1983.
2. Thiene G, Wenink ACG, Frescura C, Wilkinson JL, Galluci V, Yenho S, Mazzucco A, Anderson RH: Surgical anatomy and pathology of conduction tissues in atrioventricular defects. J Thorac Cardiovasc Surg 82:928-937;1981.
3. Pacifico AD and Kirklin JW: Surgical repair of A-V canal with anterior common leaflet attached to an anomalous right ventricular papillary muscle. J Thorac Cardiovasc Surg 65:727-730;1973.
4. Mavroudis C, Weinstein G, Turley K, Ebert PA: Surgical management of complete A-V canal. J Thorac Cardiovasc Surg 83:670-679;1982.
5. Bender HW, Hamman JW, Hubbard SG, Muirhead J, Graham TP: Repair of A-V canal malformations in the first year of life. J Thorac Cardiovasc Surg 84:515-522;1982.
6. Berger TJ, Kirklin JW and Blackstone EH: Primary repair of complete A-V canal in patients less than 2 years old. Am J Cardiol 41:906;1978.
7. Chin AJ, Keane JF, Norwood WI, Castaneda AR: Repair of complete common A-V canal in infancy. J Thorac Cardiovasc Surg 84:437-445;1982.
8. Clupepper W, Kolff J and Chunge Yuan L: Complete A-V canal in infancy-surgical repair and postoperative hemodynamics. Circulation 58:550; 1978.
9. Kirklin JW and Blackstone FH: Management of the infant with complete A-V canal. J Thorac Cardiovasc Surg 78;32-34;1979.
10. Main DD and Mcgoon DC: Surgical correction of A-V canal during the first year of life. Am J Cardiol 78:32;1979.
11. Newfeld EA, Sher M and Paul MH: Pulmonary vascular disease in complete A-V canal defect. Am J Cardiol 39:721;1977.

Rastelli's Operation for Anatomical Repair of TGA with VSD and LVOT Obstruction: Experience of the National Heart Institute & Criteria of Successful Repair

ABSTRACT

Fourteen patients with TGA & VSD together with LVOT obstruction underwent anatomical repair of their defects using the Rastelli technique in the NHI from March 1993 through February 1997.

Their ages ranged from 5 years to 9 years. The patients were classified into 3 groups according to the type of the conduit used for restoring the continuity between the RV and PA.

Group I: comprised 7 patients in whom we used composite Dacron conduits containing a xenograft valve.

Group II: comprised 4 patients in whom we used a simple Dacron conduit without a valve.

Group III: comprised 3 cases in whom we used the Polystan Bioprosthesis which is a valved pulmonary conduit made of a "Jersey type woven polyester" tubular vascular prosthesis supplied with a tricuspid valve in the middle position of the tube. The tube is lined with pericardium which is attached with horizontal rows of stitches 1 cm apart.

A segment of gel seal Dacron conduit is tailored to the proper configuration and used as a ventricular septal defect patch, diverting LV blood through the VSD into the aorta.

Conduit complication in the form of obstruction from neointimal peel formation, valvular degeneration or calcification were prominent in group I patients [2 patients] 2 patients one in group I and another in group II developed LVOT obstruction which could have been caused by a VSD that was too small or by the geometry of the tunnel. Group III patients showed no complication or mortality.

We could not use aortic or pulmonary arterial homograft because they were not available in the NHI.

Immediate hospital mortality: one patient died in group I from bleeding, while 2 patients, one in group I and another in group II from LVOT obstruction. Late mortality: two patients in group I died from conduit complication.

M. Moataz Abdel-Khalek M.D.; & Hassan Abdullah Al-Sawy M.D.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

Cardiothoracic Surgery Dept.-National Heart Institute

INTRODUCTION

Rastelli's operation has usually been reserved for older and bigger children [more than 5 years of age] with TGA, VSD and LVOT obstruction (1,2,3,4,5,6,7,8).

Poor results in younger children were reported in the early Mayo Clinic experience. These were attributed to the difficulty of creating an unobstructed tunnel from the LV to the aorta in the smaller infant's RV and the likelihood of early conduit obstruction as a result of subsequent growth of the younger patient and the associated rapid conduit and valve calcification.

The anatomic criteria that are useful in choosing the best type of repair and that are essential for successful outcome are:

1. Normal LV and RV size and function.

2. LV systolic pressure higher than 80% of the RV systolic pressure.

3. No major abnormalities of the A-V valves that would interfere with repair e.g. septal chordae of the T_3 valve attached to the edge of the VSD.

4. The VSD should be in a subaortic position otherwise resection of the infundibular septum may be required to achieve an unobstructed LV-aortic connection.

The technical criteria that are essential for successful outcome are:

A. Criteria for the septal patch:

The patch used in Rastelli's operation is a spiral patch used for intraventricular tunnel repair not just to close the VSD as the normal straight patch but it is used to establish a new LVOT. It should have certain criteria all directed towards prevention of LVOT obstruction.

* The patch is usually longer than the straight patch but it should be as short as possible because the longer the LVOT the easier to get obstructed.

* The patch is usually more oblique than the ordinary VSD patch but it should be as straight as possible to avoid LVOT obstruction.

This can be achieved if the VSD is directly subaortic but if not, then, we have to resect the conus septum to have an unobstructed tunnel from the LV to the aorta (9).

* The patch should be as wide as possible because the narrower the LVOT the easier to get obstructed. This can be achieved by enlarging the VSD anteriorly to make it at least the same size as the aortic valve.

* The patch made of a segment of a Dacron conduit to ensure an unobstructed pathway but we should be careful that this segment should not represent more than one-third of the LV-aortic pathway i.e. at least two-thirds of this pathway should be made of the patient's own tissue. This is to ensure normal growth of the newly fashioned LVOT (10).

B. Criteria of the conduit (11,12,13):

* The distal anastomosis between the conduit and the distal pulmonary confluence should be as wide as possible. This can be achieved by augmenting the

distal pulmonary confluence with a pericardial patch or by spatulating the distal end of the conduit.

* It should not cross the midline and should be placed on the left side of the aorta allowing it to lie in the anterior left hemithorax in order not to be compressed by the sternum.

* If the PVR is low, a valve-free conduit can be used but when using a valved conduit, the valve should be away from the ventriculotomy on the left side of the aorta.

Patients

Fourteen patients with TGA & VSD together with LVOT obstruction underwent anatomical repair of their defects using the Rastelli technique in the NHI from March 1993 through February 1997.

Their ages ranged from 5 years to 9 years. The patients were classified into 3 groups according to the type of the conduit used for restoring the continuity between the RV and PA.

Group I: comprised 7 patients in whom we used composite Dacron conduits containing a xenograft valve.

Group II: comprised 4 patients in whom we used a simple Dacron conduit without a valve.

Group III: comprised 3 cases in whom we used the Polystan Bioprosthesis which is a valved pulmonary conduit made of a "Jersey type woven polyester" tubular vascular prosthesis supplied with a tricuspid valve in the middle position of the tube. The tube is lined with pericardium which is attached with horizontal rows of stitches 1 cm apart.

Methods

The heart and great vessels are exposed through a median sternotomy incision. Pericardium was harvested and preserved in glutaraldehyde for eventual use in the repair if needed.

All previously created palliative systemic-pulmonary shunts were mobilized for ligation or division. CPB with distal aortic perfusion cannula and two right-angled venous cannulae to have a good and wide exposure through the RA. Crystalloid cold potassium cardioplegia in the aortic root was used.

Total body hypothermia to 18° to 20° was preferred to have a short period of circulatory arrest to facilitate excellent exposure within the pulmonary arteries and ventricles even in the presence of significant bronchial circulation. Decompression of the left ventricle using a plastic sump catheter placed through the LSPV.

The VSD was exposed and managed through the RA and then completed through an anterior right ventriculotomy in a longitudinal axis pointing towards the distal anastomosis and avoiding major coronary arteries. Obstructive muscle bundles around the ventriculotomy incision were excised.

The conal septum was excised superior and anterior to the VSD to create the longest possible communication between the left and right ventricles.

The LVOT was obliterated by extracardiac ligation or division and suturing of the main pulmonary artery.

A segment of "double-velour Dacron conduit" was then tailored to the proper configuration and used as a VSD patch

diverting LV blood through the VSD into the aorta.

The patch was secured with a series of 4/0 polypropylene sutures with Teflon pledgets extending from the T_3 valve posteriorly and to the cephalad aspect of the ventriculotomy.

Generally, the pulmonary trunk was not divided since the conduit lied in an ideal position when end-to-side rather than end-to-end anastomosis was made to the pulmonary artery.

The pulmonary trunk was opened with a longitudinal incision along its left side carrying this, if necessary, on to the proximal portion of the left pulmonary artery.

The conduit was prepared, in group I patients, we used a Dacron conduit with a xenograft valve [Hancock valve] inserted in its middle part. In group II, we used a simple Dacron tube without a valve [PVR <3 units]. In group III, we used Polystan bioprosthesis which was a valved conduit made of Jersey type woven polyester tubular vascular prosthesis supplied with a tricuspid valve in the middle position of the tube. The tube was lined with pericardium attached with horizontal rows of stitches, approximately 1 cm apart. The pericardium lining had a thickness between 0.1 and 0.15 mm.

The mesothelial side of the pericardium was on the luminal side of the tube. The three cusps were also made from pericardium having a thickness of between 0.1 and 0.15 mm. The cusps with the mesothelial side upwards were sutured on to the open, flat-out pericardial-lined polyester, which was then made into a tube by stitching longitudinally.

The prosthesis is totally covered on the inner surface by pericardium. The conduits are available in sizes 12 mm, 14 mm, 16 mm, 20 mm, 22 mm & 24 mm internal diameter. In our patients, we used size 18 mm in one patient and size 20 mm in two patients [Figs. 1-1, 1-2 & 1-31.

The conduit should lie smooth in an arc shape with the convexity to the left pointing into the left pleura.

End-to-side anastomosis was made of the graft to the pulmonary trunk. If the main pulmonary artery was small, which was not usually the case, we excised it and made the anastomosis to the distal pulmonary confluence which could be enlarged by augmenting this common opening between the two pulmonary arteries with two pericardial patches on the left and right sides or we could spatulate the distal end of the conduit to augment the distal anastomosis instead of the pericardium but this could lead to kinking of the conduit in our experience.

A period of deep hypothermia and low perfusion or circulatory arrest was sometimes needed to complete this distal anastomosis if there was excessive bronchial circulation.

The proximal anastomosis to the right ventriculotomy was made with interrupted 4/0 Ticron or Ethibond, Teflon-pledgetted mattress sutures placed from within around the heel of the graft, the remainder of the suture line was made by placing similar sutures from without so as to evert this part of the anastomosis.

Valved Pulmonary Conduit (VPC)

	A	B	C	D	E
Order Code	Dimensions in mm				
930012	8	14	51	51	12
930014	10	16	50	50	14
930016	11	18	50	50	16
930018	13	20	49	49	18
930020	15	22	48	48	20
930022	16	24	47	47	22
930024	17	26	46	46	24

When the anastomosis was completed, the conduit lied in a smooth curve well away from the sternum and off to the patient's left side.

With the Polystan bioprosthesis [group III patients], we preferred to suture the posterior part of the tricuspid pericardial valve to the cephalad part of the ventriculotomy incision, then we completed the closure of the ventriculotomy incision with glutaraldehyde-fixed pericardium sutured to the anterior part of the valve annulus and the rest of the pericardium for the hood over the ventriculotomy. This decreased the possibility of being compressed by the sternum.

Rewarming started and weaning from CPB was done as usual leaving the sternum opened and covered only by Gore-Tex patch [0.4 mm], has been adopted in 3 patients in group 1 and one patient in group II, only for 24-48 hours, then reclosure has been made.

Results

Immediate hospital mortality was 3 patients, one patient in group I from bleeding. This patient was reopened but he died from bleeding due to coagulation defects as a complication of excessive surgical blood loss and most probably DIC.

Two patients, one in group I and another in group II died from LVOT obstruction which was most probably from the geometry of the tunnel or a VSD which was too small and not directly subaortic and couldn't be enlarged enough.

Late mortality from conduit complication occurred in 2 patients in group I. Conduit complication in the form of obstruction from neointimal peel formation, valvular degeneration or calcification were prominent in group I patients. One of them underwent reoperation but died during reopening from massive bleeding from the conduit.

Discussion

Rastelli's operation is a procedure used for the management of TGA with VSD and LVOT obstruction. It is a member of the intraventricular rerouting operations as Koashima & MeGoon operations which are operations used to re-establish the route between the LV and its major vessel, the aorta.

It is used in TGA with VSD and LVOT obstruction but characteristically the VSD is not closed and the outflow obstruction is not resected.

We mean that the VSD is used to fashion a new LVOT using a spiral shaped patch to fashion this tunnel. The patch should have certain criteria all directed

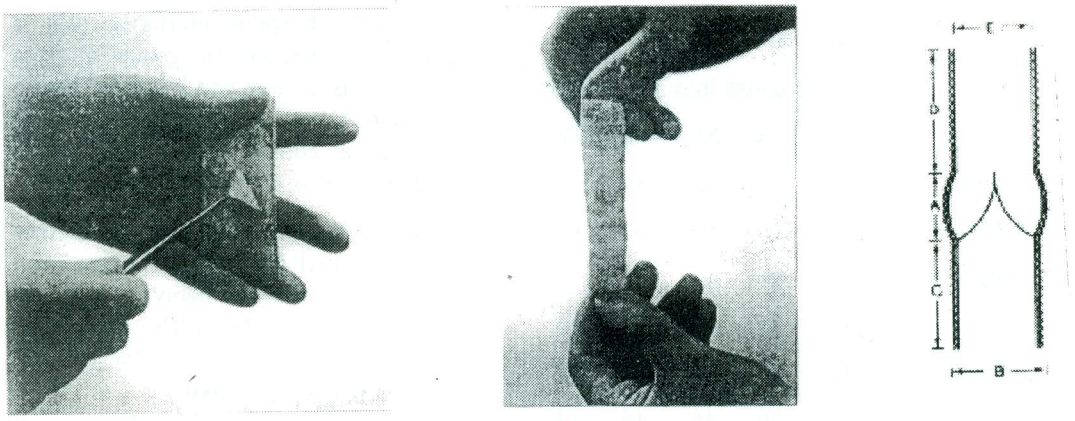


Figure (1-1) (1-2 & 1-3): Valved pulmonary conduit

towards preventing LVOT obstruction as has been mentioned in the introduction.

Also, the outflow obstruction should not be attacked directly but it should be bypassed with a conduit. Because if the LVOT obstruction can be relieved directly, it is better to do arterial switch operation which is the best operation for TGA as it avoids the complication of the conduit and of the tunnel patch.

The conduit should have certain criteria to prevent or decrease the incidence of conduit complications in the form of obstruction or valvular degeneration as have been mentioned in the introduction.

The unavailability of aortic or pulmonary homograft in Egypt and in the NHI raises the problem of conduit complications.

The use of a valve-free right ventricle to pulmonary arterial communication may reduce the complication associated with valve degeneration in selected patients, but the effect of valve-free pulmonary artery on RV function must be considered in terms of quality of life and exercise tolerance.

We can see that group I patients with composite Dacron conduit containing a xenograft valve have the highest incidence of mortality and morbidity due to conduit complication and valvular degeneration.

Group II patients with a valve-free conduit has less mortality but the effect on RV functions and exercise tolerance is not predicted. Also, it can be done only in very selected patients with PVR less than 3 units.

Group III patients, we used the Polystan bioprosthesis as described before. Its main advantage is that it is more or less analogous to the homograft with the advantage of being available with reasonable coast and in different sizes together with easy handling and suturing.

But, being only for low pressure chambers as recommended by the manufacturer, its long-term result as regard durability and resistance to calcification

and degeneration may be doubtful in comparison to the homograft which can be used in low and high pressure chambers.

However, until now and according to our limited experience with this new bioprosthesis, it seems to provide an excellent substitute and alternative to the aortic and pulmonary arterial homografts.

References

1. Rastelli GC, Wallace RB & Ongley PA: Complete repair of transposition of the great arteries with pulmonary stenosis. A review and report of a case corrected by using a new surgical technique. Circulation 39:83;1969.
2. Rastelli GC, McGoon DC & Wallace RB: Anatomic correction of transposition of the great arteries with ventricular septal defect and subpulmonary stenosis. J Thorac Cardiovasc Surg 58:545;1969.
3. McGoon DC, Wallace RB & Danielson GK: The Rastelli operation: Its indications and results. J Thorac Cardiovasc Surg 65:65;1973.
4. McGoon DC, Wallace RB & Danielson GK: Transposition with ventricular septal defect and pulmonary stenosis: The Rastelli operation. Israel J Med Sci II:82;1975.
5. Marcelletti C, Mair DD, McGoon DC, et al: The Rastelli operation for transposition of the great arteries. Early and late results. J Thorac Cardiovasc Surg 72:427;1976.
6. Marcelletti C, Mair DD, McGoon DC, et al: Complete repair of transposition of the great arteries with pulmonary atresia. J Thorac Cardiovasc Surg 72:215; 1976.
7. Naito Y, Fujita T, Tomino T, et al: Rastelli operation as one stage anatomical correction for infants with complete transposition of the great arteries and ventricular septal defect. Jpn J Surg 15:36;1985.
8. Sakata R, Lecompte Y, Batisse A, et al: Anatomic repair of anomalies of ventriculo-arterial connection associated with ventricular septal defect. 1. Criteria of surgical decisions. J Thorac Cardiovasc Surg 95:90;1988.
9. Kurosawa H & Van Mierop LH: Surgical anatomy of the infundibular septum in transposition of the great arteries with ventricular septal defect. J Thorac Cardiovasc Surg 91:123;1986.
10. Pacifico AD, Kirklin JK, Colvin EV, Bargeron LM Jr: Intraventricular tunnel repair for Taussig-Bing heart and related cardiac anomalies. Circulation 74:153; 1986.
11. Ciaravella JM, McGoon DC, Danielson GK, et al: Experience with the extracardiac conduit. J Thorac Cardiovasc Surg 78:920;1979
12. Mc Goon DC, Danielson GK, Puga FJ, et al: Late results after extracardiac conduit repair for congenital cardiac defects. Am J Cardiol 49:1741;1982.
13. Schaff M, Di Donato RM, Danielson GK, et al: Reoperation for obstructed pulmonary ventricle-pulmonary artery conduits. J Thorac Cardiovasc Surg 88:334;1984.

T Shaped Ministernotomy for Valve Surgery

ABSTRACT

The Surgeon's interest in minimal invasive procedures has been increasing. The potential of less surgical trauma, greater patient comfort, shorter hospital stay, lower chance of postoperative complications and better cosmetic appearance, are used to justify this current tendency. For surgical repair or replacement of cardiac valves, adequate exposure is crucial. Various surgical incisions have been advocated to adress cosmetic aspects, i.e. Lateral thoracotomy, submammary skin incision, J - shaped upper sternotomy and inverted C-Shaped sternotmy. To combine adequate access with a smaller scar, less pain and reduced respiratory discomfort as well as shorter hospital stay, T-shaped Lower Ministernotomy has been proposed.

From April 1997 till October 1977, 25 patients had been operated upon for valve surgery using the T-shaped Ministernotomy. Aortic valve replacement was done for 18 patients, mitral valve replacement for 5 patients and mitral valve repair for 2 patients.

There were no intraoperative complications. All patients survived and could be discharged home within one week. Cardiopulmonary bypass time, aortic cross clamp time, and total operating time mean 93±19, 54±19 and 162±40 minutes, respectively. Five patients could be extubated in the operating theater, the others in the intensive care unit at a mean of 7±4 hours postoperatively. Chest drainage was 260 ± 210 ml. in mean. This approach showed a better cosmetic scar, less surgical trauma, minimal respiratory discomfort and a potentially lower risk of infection. Patient satisfaction was high.

Samieh Amer, MD, Yahia Balbaa, MD, Tarek Helmi, MD, Ihab El-Shihy, MD and Wagih El-Boraey, MD.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

THE T-shaped ministernotomy for routine cardiac operations was described by Moreno - Cabral on, 1997. (1) He reported that this approach has the advantages of providing better exposure than parasternal and transverse "Mini" incisions. It also preserves the internal thoracic arteries, which are sacrificed with transverse incisions. In addition, direct connulation is simple. It provides versatility for combined procedures . The incision can be simply converted to a full sternotomy. A distinct advantage of the T- Shaped Ministernotomy is less postoperative discomfort, Because the clavicle and the first and second ribs are undisturbed when the manubrium is left intact (1) unlike the approaches of Benetti, F.J. and colleagues, 1997 (2) and Cosgrove DM III and his colleague, 1996 (3) this approach does not need femoral connulation with its sequelae.

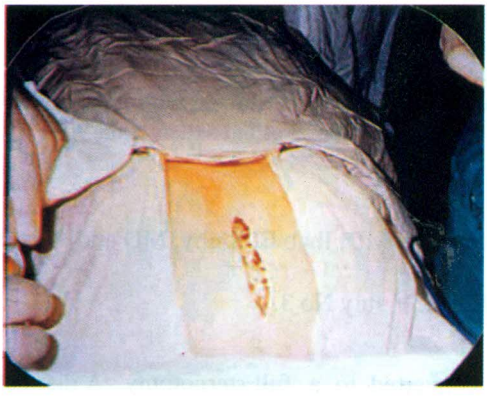
Cordiothoracic Surgery Department, Cairo University

Patients and Methods

From April 1997 Until October 1997, a series of 25 consecutive patients with severe aortic and mitral valve diseases

Table (1):

Variable	Mean ± SD	Range
Cardiopulmorary bypass time (min)	93±19	73 – 122
Aortic cross clamp time (min)	54 ± 19	32 - 90
Total Operation time (min)	162 ± 40	130 - 223



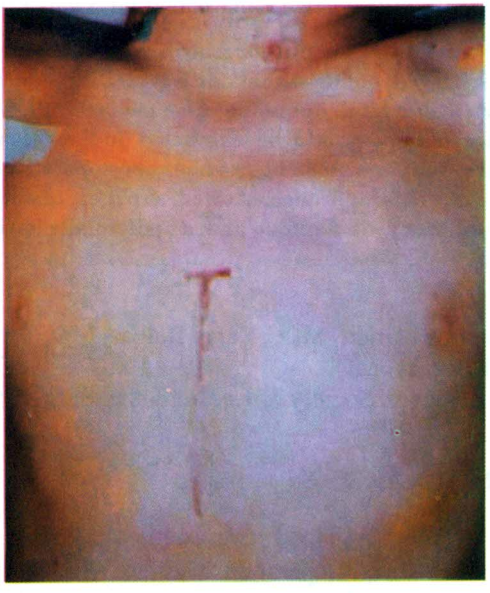


Fig. (I): Showing a drawing and an incision for the T-shaped ministernotomy

underwent valve surgery via a T - shaped ministernotomy. Aortic valve replacement with prosthetic valves was done in 18 patients, mitral valve replacement with prosthetic valves was done in 5 patients and mitral valve repair was done in 2 patients. The patients were 9 males and 16 females. Their age ranged between 10 and 34 years with a mean of 29± 4.1 years.

Patients were given total endovenous anesthesia and were ventilated via an endotracheal tube. An 8 cm vertical skin incision was made extending from the xiphoid to the 3rd intercostal space. The

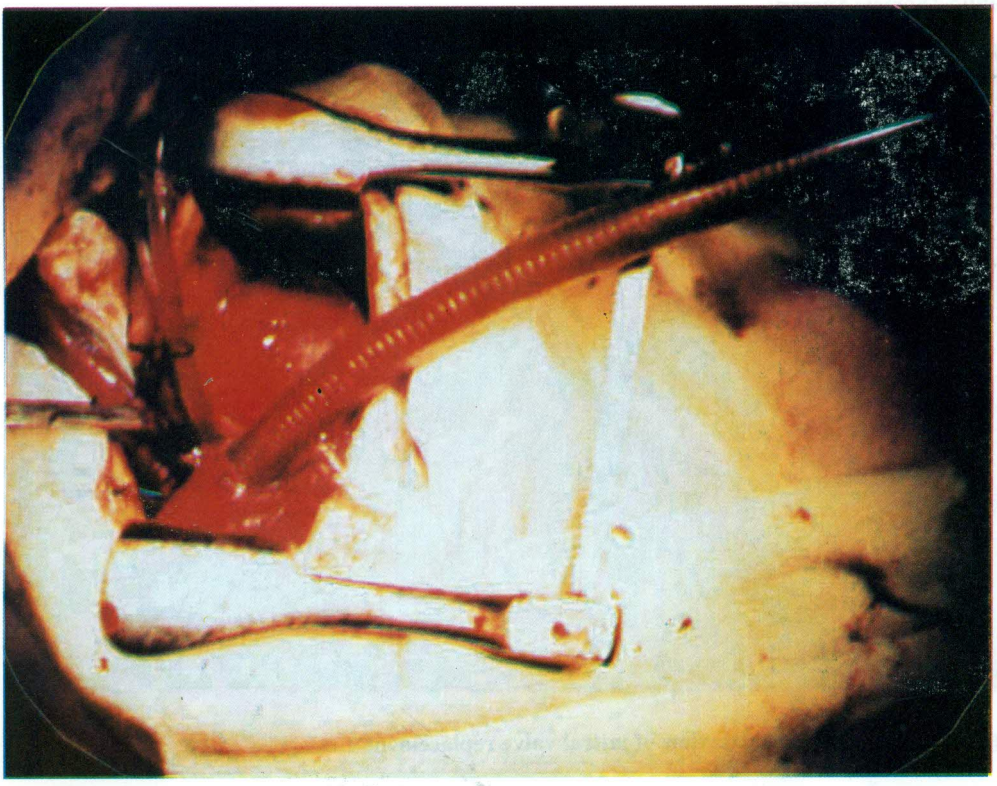


Fig. (II): An intraoperative view for the surgical field

midline sternotomy started just at the xiphoid and extended to the level of the 3rd intercostal space, where it is "Td" to the left and right. Care taken to avoid injury to the intercostal pedicles (Fig.II).

A standard sternal retractor was inserted and exposure of the ascending aorta was enhanced by lifting the manubrium with a fork retractor. A hemostat was applied to the adventitia of the root of the aorta and was pulled down by the assistant surgeon, so as to expose an additional length of the ascending aorta. Direct cannulation of the aorta and right atrium was done. The vent was inserted into the pulmonary artery. Conventional Cardiopulmonary bypass was conducted under moderate general hypothermia. The aorta was cross clamped Just below the aortic cannula. In case of aortic valve replacement, the aorta was opened transversely above the sinotubular junction, and the potassium rich cardioplegia solution was adminstered directly into both coronary ostia with a rigid coronary perfusion connula. In case of mitral valve repair or replacement, the cardioplegia solution was adminstered into the aortic root. The left atrium was opened as in conventional surgery, Fig (III).

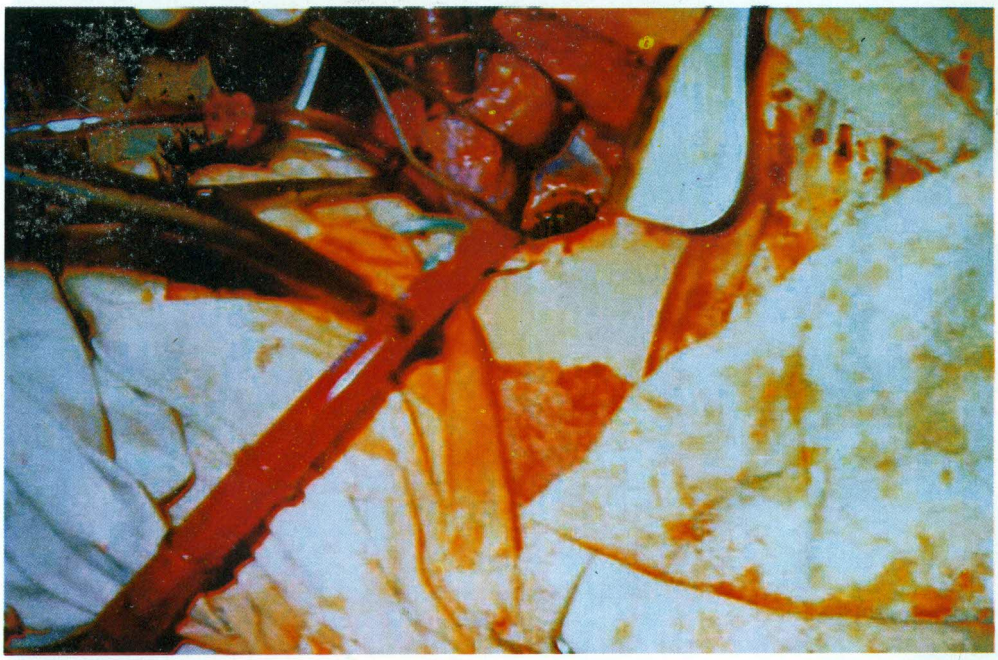


Fig. (III): An intraoperative view of mitral valve replacement

At the end of surgery, sternal closure was done with standard peristernal wires and an additional set of vertical wires from sternum to manubrium,

Results

There were no intraoperative complications requiring conversion into conventional sternotomy. Table (1) shows the cardiopulmonary by pass time, aortic cross - Clamp time and total operation time.

Eight patients needed slight intropic support with epinephrine during the first hours after the operation. Five patients could be weaned off the respirator and extubated directly in the operating theater. All others were extubated in intensive care unit at a mean of 7± 4 (standard deviation) hours (Range 2 to 13 hours) postoperatively and mobilized on the next day. The chest drainage lost during the first 24 hours mean 260 ± 210 (standard deviation) ml (range 80 to 830 ml). The need for blood transfusion was 235 ± 400 (standard deviation) ml (range, 0 to 1500 ml); 15 patients (60%) had no blood transfusion at all.

All patients survived. All could be discharged home within 1 week. Non of the patients showed signs of wound infection or mediastinitis.

Comment

Minimally invasive valve surgery is suitable for the majority of patients with isolated aortic or mitral defects (4).

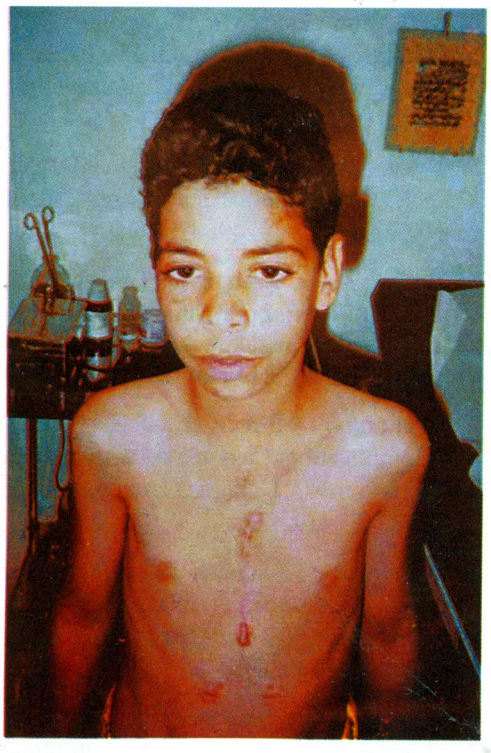


Fig. (IV): Postoperative view of the wound

Although median sternotomy remains the most reliable approach to the heart, for cosmetic reasons a Y-incision in the neck was introduced. (5) Alternatively in girls and young women a bilateral submammary skin incision is made (6). However, the extensive subcutaneous detachment to expose the sternum and the potential risks of both infection and sensory changes in the breast have led to its abandonment. The complications of sternotomy are well known (7). Antero lateral thorocotomy through the 4th intercostal space is an adequate approach for procedures performed through a right atriotomy. This approach however, presents some potential disadvantages such as opening of the pleural space, which could provoke greater incidence of atelectasis and other pulmonary complications, as well as greater postoperative pain due to trauma to intercostal nerves. (8)

To avoid the potential drawbacks associated with sternotomy, interest in minimally invasive cardiac surgery started as evidenced in myocardial revascularization with or without the use of extracorporeal circulation (9), and for aortic and mitral valve replacement (10).

The T-shaped ministernotomy has the advantages of eliminating the postoperative pains, sternal instability and overstitching of the sternum with resulting brachial plexus damage (2). This enabled us to extubate 20% of our patients inside to operating theater, while the remaining patients were extubated early in the intensive care unit (average 7±4 hours), postoperatively and mobilized next day. Cosmentic, and psychological considerations are also met, especially in women. Most patients were satisfied cosmetically, and were discharged from the hospital within 7 days.

The limited exposure did not affect the course of surgery, and exposure of the ascending aorta was improved by applying traction on the aortic root adventitia by a haemostat. Non of the patients needed conversion to conventional stenotomy. Cardiopulmonary bypass, cross clamp and total operation times showed no prolongation than normal. The amounts of blood loss and transfusion were acceptable.

One of the advantages of T-shaped ministernotmy over the other exposures including the limited upper sternotomy, is

the good exposure of the entire heart, allowing sufficient debubbling of the heart at the end of surgery and better access into all the chambers and vessels.

Conclusion

Our initial experience with the T-shaped ministernotomy confirms that, it is a promising technique that can be considered as an alternative to conventional sternotomy. The access is adequate for isolated mitral or aortic valve surgery. The advantages include a better cosmetic scar, less surgical trauma, minimal respiratory discomfort and lower risk of infection. Despite the Limited approach, the surgical field was satisfactory with good exposure of the entire heart. With some technical manipulation, better exposure of the ascending aorta could be achieved.

References

1. Moreno-Cabral R J. "Mini-T Sternotomy for cardiac operations." J Thorac Cardiovasc Surg. 1997, 113:810.
2. Benetti FJ, Mariani MA, Rizzardi JL, Benett I. " Minimally invasive aortic valve replacement."J Thorac Cardiovasc Surg 1997; 113. 806-807.
3. Cosgrove DM III, Sabik J.F. "Minimally invasive approach for aortic valve operation" Ann Thorac Surg. 1996;62: 596-7.
4. Carmine Minale, MD, Hans J. Reifschneider, MD, Edgar Schmits, MD, and Frank P. Uckmann, MD. "Single Access for Minimally Invasive Aortic valve Replacement". Ann Thorac Surg 1997, 64: 120 -3.
5. Nandi P, Mock CK, Ong GB ."Y incision for median sternotomy". Aust N Z J Surg. 1979, 49: 489-491.
6. Brutel de la Riviere A, Brom GHM. Brom A "Horizontal Submammary Skin incision for median sternotomy". Ann Thorac Surg 1981, 32: 101-104.
7. Sanfelippo PM, Danielson GK. "Complications associated with median Sternotomy". J Thorac Cardiovasc Surg 1972, 63: 419-423.
8. Rosengart TK, Stark JF. "Repair of atrial septal defect through a right thoracotomy". Ann Thorac Surg 1993, 55: 1138-1140.
9. Benetti FJ, Battester C ."Use of thoracoscopy and a minimal thoracotony, in mammary-coronary bypass to left anterior descending artery, without extracorporeal circulation. Experience in 2 cases. J. Cardiovasc Surg 1995, 36: 159-161.
10. Lin PJ, Chang CH, Chu JJ, Liu HP, Tsai FC, Lin FC, Chiang CW, yang MW, Tan PP."video assisted mitral valve operations." Ann Thorac Surg 1996, 61: 1781-1787.

Pericardioperitoneal Window Versus Video Assisted Thoracoscopic Drainage in the Management of Aseptic Pericardial Effusions

ABSTRACT

In this study, 39 patients with massive aseptic pericardial effusions were referred to surgery for diagnosis and therapy of their effusions. They were divided into two groups. Group I; included 24 patients for whom subxiphoid pericardial window (SPW) was performed. Group II; included 15 patients subjected to video assisted thoracoscopic surgical (VATS) drainage of their effusions.

In group I, the age ranged from 6 months-72 years (mean 37.27 years, 4 patients below 10 years). No mortality was reported. The morbidity was minor and included; arrhythmias in 25% of patients, minor wound infection in 16.67% and leakage from drainage site in 16,67%. Recurrence of the effusion occurred in one patient (4.17%) for whom pericardiectomy was performed.

In group II, the age ranged from 18- 60 years (mean 38.13 years, no patients below 10 years). No mortality was reported. The morbidity was also minor, including; arrhythmias in 20%, minor wound infection in 13.3%, leakage from drainage site in 6.67% and pneumonia in 13.3%. Recurrence of the effusion occurred in one patient (6,67%) for whom SPW was done.

The two groups differed significantly only in: a- Performance status, being better for group II, b- Type of anaesthesia. local in 66.67% and general in 33.3% in group I, and only general in 100% of group II, c- Operating time. shorter for group I and d- Cost, more expensive for group II. The choice of the procedure also differed in the two groups.

The indications, contraindications, advantages, disadvantages and complications of both techniques were compared with review of the literature.

To conclude; SPW and VATS drainage are both equally safe as regards mortality and morbidity, and effective as regards immediate decompression and incidence of recurrences. However, SPW could be done without general anaesthesia, more rapid, so more suitable for emergency situations and in critically ill patients. It is simpler and cheaper utilizing the ordinary surgical tools and setup. Subxiphoid pericardioscopy combines the advantages of both techniques and increases the visualized area.

K. Karara, MD and A.M. Ramadan, MD.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

Different causes may result in pericardial effusions that may accumulate, becoming massive, leading to cardiac tamponade (1). From the surgical point of view, these causes may be divided into septic or purulent and aseptic effusions

Cardiothoracic Surgery Department, Alexandria Faculty of Medicine.

because the plan of management differs. Purulent effusions should be drained externally whereas aseptic effusions could be drained externally, to the pleura or to the peritoneum (2-4), The commonest causes of aseptic effusions include, viral and tuberculous infections, malignancy, uraemia, chylopericardium, post-myocardial infarction, congestive heart failure and rheumatic effusions (2). Iatrogenic causes encountered include; drug induced as the use of anticoagulants and some chemotherapeutic agents, irradiation, post-cardiac catheterization, post-pericardiotomy syndrome and post cardiac, oesophageal mediastinal or pulmonary surgical interventions (5,6).

The surgeon may be consulted to clinch the diagnosis of the effusion or for therapy of massive effusions. The aim of surgery in such situations is to drain the effusion for relieving cardiac compression and to send it for analysis, to take pericardial tissue biopsy, to break loculi and to establish a more definitive method for avoiding reaccumulations and cardiac compression by creating a window or resecting the pericardium (5,6).

The aim of this study is to compare two currently used techniques of surgical therapy of massive aseptic effusions; the SPW and the VATS drainage demonstrating the advantages and disadvantages of each technique.

Material and Methods

The material of this study was divided into two groups:

Group 1: 24 patients with massive aseptic pericardial effusion managed by SPW.

Group II: 15 patients with massive aseptic pericardial effusion managed by VATS drainage of the effusion.

For each patient, thorough history taking, clinical examination and electrocardiographs were done. The necessary laboratory investigations to reach a specific diagnosis of the effusion were performed as indicated. Radiological examinations included plain X-ray chest showing the classical flask shaped heart in most cases of chronic pericardial effusions, detecting pericardial calcification especially in tuberculous cases and showing accompanying pleural effusions or pulmonary lesions. CT-scan chest was of value in detecting malignant tumours invading the pericardium. In one patient with chylopericardium, bilateral upper limb venography demonstrated superior vena caval obstruction extending to the termination of the thoracic duct obstructing it. Echocardiography was done for each patient before and after the interference and for follow up, Examination of the drained effusion and the pericardial biopsy was thoroughly performed (Table 1).

The SPW was done under local or general anaesthesia following the standard technique (7-10). The patient was preferably placed in 20-30 degrees Trendelenberg position, A midline, 5-7 cm, epigastric incision was done. The linea alba was incised and the peritoneum was reflected done. The xiphoid process was retracted up by the assistant or incised especially in patients with narrow subcostal angle. Needle aspiration was done first to test the site that would be chosen for creating the pericardial window. The central tendon was incised to drain the

pericardium, inspect it, introduce a finger to feel and explore the pericardium and break the filmy adhesions present and to take finally the necessary pericardial biopsies, A suitable piece of pericardium, as much as 5x5cm- was excised. In some cases, the video assisted thoracoscope was introduced through the window to visualize a wider area of pericardial surfaces; subxiphiod pericardioscopy. This was facilitated by elevating the bridge of the table, as for cholecystectomy, and by the assistant introducing a curved retractor into the window and elevating the sternum upwards. In most of the cases the peritoneum was intentionally incised and fixed by few stitches to the edge of the pericardium to create a pericardioperitoneal window. A pericardial drainage tube was left and brought out through a separate stab. The linea alba and skin incisions were then closed. The tube was removed when the drainage was less than 25 Ml /day.

VATS drainage was done under general anaesthesia and single lung ventilation following the standard technique (2,5,6,11). The thoracoscope (a 10 mm, 0 degree rigid telescope and camera attached to a video monitor) was introduced through a 10 mm trocar in the eighth intercostal space in the posterior axillary line. In patients with associated pleural effusions, exploratory video thoracoscopy was first performed sampling any suspicious pleural nodules. Through separate stabs the scissors, generally in the six space posterior axillary line, and graspers, generally in the six space anterior axillary line, were introduced. The pericardium was longitudinally cut mostly anterior and occasionally posterior to the phrenic nerve. A window was created between the pleura and the pericardium by excising a suitable piece of pericardium as much as 5x7 cm. An intercostal tube was left through the inferior incision till the drainage was less than 100 ml / day.

Echocardiography was done within a week postoperatively and at least monthly during follow up that varied from 3-6 months.

Statistical Studies

Variables were compared between the two clinical groups using t-test, Z-test and Pearson chi-square test. A p-value of 0,05 or less was considered to be statistically significant. The statistical tests were performed using the SPSS® (statistical package for social sciences) computer program.

Results

Age and Sex:

In group I, the male to female ratio was 1:1 and the mean age was 37.27 years, ± SD 21.04 (range 6 months-72 years). In this group, 4 patients were below ten years, when excluded, the mean age of the group will be 43.56 years (range15-72 years). In group II, 8 patients were females and 7 were males and the mean age was 38,13 years, ± SD 14,28 (range 18-60years). No patient in this group was below 10 years, for whom the subxiphoid approach was preferred.

The two groups were compared as regards age using the t-test giving t-value of -0,14, p=0.890 which was insignificant. The sex incidence was compared using the chi-square test giving, a value of 0.041, p=0,839 which was also insignificant.

Presentation:

All the patients presented by varying degrees of increasing excertional dyspnoea.

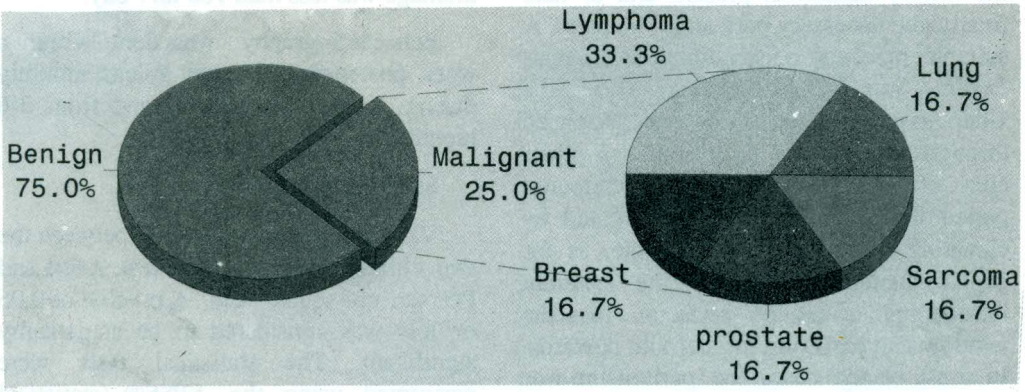


Fig. (1): Final diagnosis of cases undergoing subxiphoid pericardial window technique.

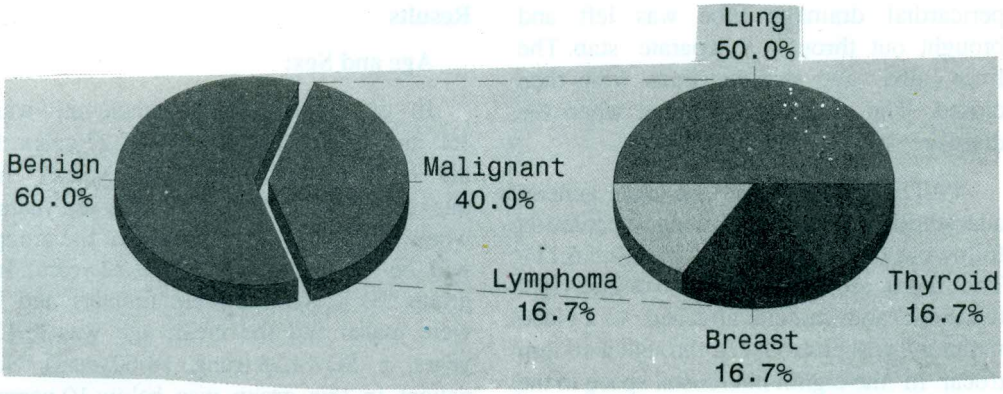


Fig. (2): Final diagnosis of cases undergoing video assisted thoracoscopic surgical drainage technique.

Manifestations of low cardiac output as disturbed consciousness and low urine output were evident in patients with higher degrees of cardiac compression. Performance status (0 to 3) of patients of group I was: 2 patients (8.3%) in state 1, 9 patients (37.5%) in state 2 and 13 patients (54,17%) in state 3, In group II: 4 patients (26.7%) were of status 1, 9 patients (60%) were of status 2 and 2 patients (13.3%) of status 3, This shows the tendency of group II patients to have a better performance status and the differences were statistically significant (chi-square value 7.031, p=0,0297), 9 patients (37,5%) of group I had associated pleural effusion, bilateral in

Table (1): Examination of pericardial effusion.

♥ **Physical**	* Colour, Aspect, Viscosity
♥**Chemical**	⇒ Proteins, Sugar, LDH
	⇒ Immunological tests e.g. for TB and tumour
	⇒ Specific tests e.g. for chylothorax.
♥**Pathological**	□ Cytological •Cell count
	•Malignant cells
	□ Pericardial tissue biopsy.
♥**Bacteriological**	⇔ Culture and sensitivity.
	⇔ ZN stain for AFB.

Table (2): Final diagnosis in both groups.

Diagnosis	Group I	Group II	Total
Malignant:	6(25%)	6(40%)	12(30.77%)
■ Lung	1(4.17%)	3(20%)	4(10.26%)
■ Lymphoma	2(8.33%)	1(6.67%)	3(7.69%)
■ Breast	1(4.17%)	1(6.67%)	2(5.13%)
■ Prostate	1(4.17%)	0	1(2.56%)
■ Thyroid	0	1(6.67%)	1(2.56%)
■ Sarcoma	1(4.17%)	0	1(2.56%)
Uraemic:	6(25%)	3(20%)	9(23.08%)
Tuberculous:	5(20.8%)	2(13.33%)	7(17.95%)
Viral:	3(12.5%)	0	3(7.69%)
Postcardiac Oper.:	2(8.33%)	1(6.67%)	3(7.69%)
CHF & Cirrhosis:	0	1(6.67%)	1(2.56%)
Rheumatic:	0	1(6.67%)	1(2.56%)
Chylopericardium:	1(4.17%)	0	1(2.56%)
Idiopathic:	1(4.17%)	1(6.67%)	2(5.13%)
Total:	24(100%)	15(100%)	39(100%)

5 of them, that were managed separately by thoracocentesis or tube drainage followed by tetracycline pleurodesis, On the other hand, 5 patients (33.3%) of group II had pleural effusion, mild bilateral in one of them. The side of the effusion influenced the side of the procedure to take associated pleural biopsies and to leave tube drainage for pleurodesis. The incidence of pleural effusion in the two groups were compared and was statistically insignificant (chi-square value 0,0696, p=0.792),

Final Diagnosis:

As shown in (table 2), 25% of patients of group I, 40% of patients of group II and

Table (3): Comparison of the results of SPW and VATS drainage.

Characteristics	SPW	VATS	Significance (*p*)
-No. of patients:	24	15	
-Age:	37.27y.(6m-72y), 4 patients<10y	38.13y.(18-60y), no patients<10y	0.890
-Male: Female:	1:1	7:8	0.8394
-Performance Status:	I: 8.3% II: 37.5% III: 54.17%	I: 26.7% II: 60.0% III: 13.3%	0.0297*
-Pleural Effusion:	37.5%	33.3%	0.79186
-Anaesthesia: Local G.A.	16 (66.7%) 8 (33.3%)	0% 100%	0.0004*
- Procedure Choice	See Text	See Text	
-Operative Time:	20-45(32.3 min)	60-150(95 min)	0.0000*
-Mortality:	0	0	
-Morbidity (Minor):	Arrhythmias: 25% Wound inf.:16.67% Leakage:16.67% Pneumonia:0%	20% 13.3% 6.67% 13.3%	$p>0.05$
-Final Diagnosis:	Malignant: 25% Benign: 75%	40% 60%	0.3234
-Hospital Stay:	4.17 days	6.67 days	0.245
-Cost:	Less Expensive	More Expensive	
-Recurrences:	4.17%	6.67%	$p>0.05$

*** Significant if p ∠ 0.05**

30.77% of both groups had malignant effusions and the rest had effusions of benign aetiologies. The commonest three origins of malignancy were the lung, malignant lymphoma and the breast (Fig. 1,2). The commonest benign aetiologies were uraemic, tuberculous, viral and postcardiac operations. The differences in the final diagnosis between the two groups were statistically insignificant (chi-square value 0.975, p=0.323). The pericardial biopsy was diagnostic in only 9 patients (23.08%), diagnosing malignant nodules in 4 patients (10.26%) and tuberculosis in 5 patients (12.82%). The biopsy report of the remaining cases was evidences of acute to chronic pericarditis. The diagnosis in most of the cases depended on thorough analysis of the history, laboratory investigations, radiological examinations, echocardiography and analysis of the pericardial effusion.

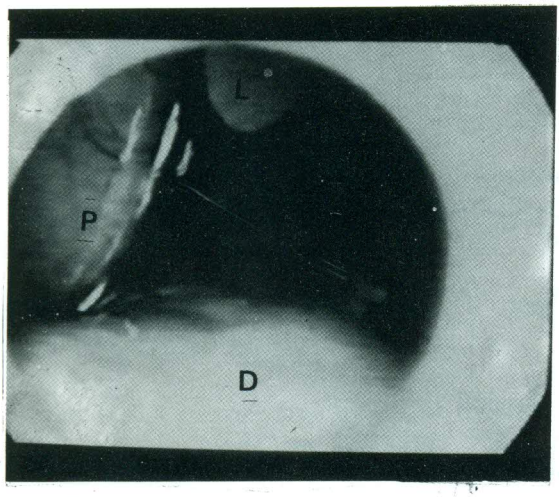


Fig. (3): Video-assisted thoracoscopic view form a case of associated pericardial and pleural effusions. L: lung, collapsed from single lung ventilation. P: Ballooned pericardium by pericardial effusion. D: Diaphragm. E: pleural effusion.

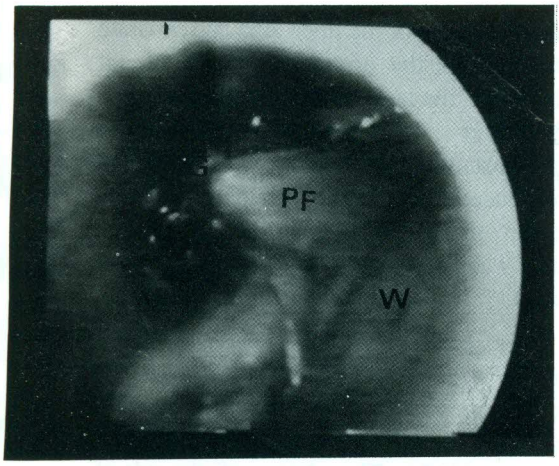


Fig. (4): Video-assisted thoracoscopic view after opening the pericardium and raising a triangular pericardial flap (PF), grasped at its apex by the grasper (G) which is seen coming out of the chest wall. The heart is seen through the created pericardial window (W).

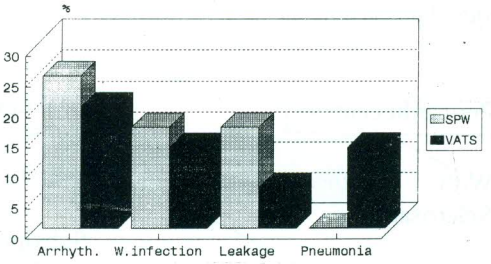


Fig. (5): Prevalence of minor morbidity in both studied groups.

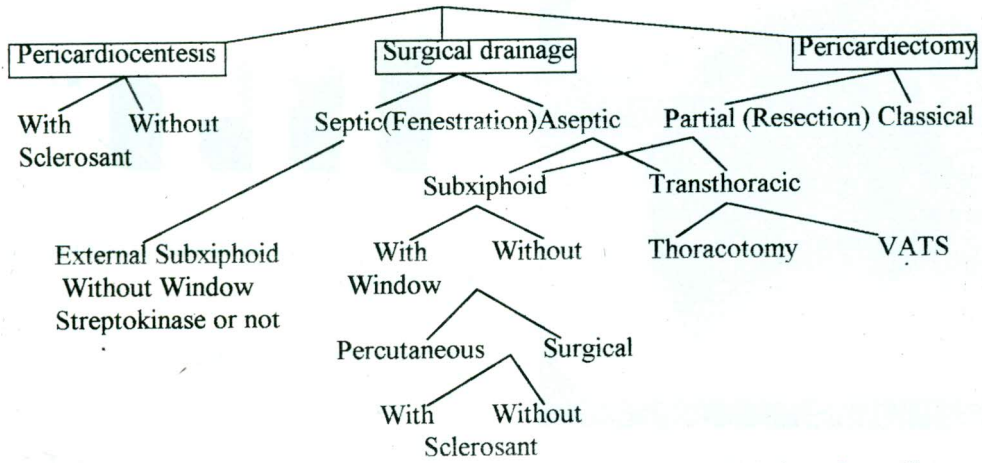
Choice of the procedure:

In group I, patients were chosen for SPW for one of several reasons; 1) in the era before the availability of VATS facilities, 2) the patient considered by the anaesthetist to be unfit for general single lung anaesthesia, 3) in emergency situations, 4) in one patient, there had a history of bilateral intercostal tube drainage and bilateral pleurodesis, 5) in a patient with bilateral chylothoraces and chylopericardium, the pericardium had to be drained to the peritoneum rather than the pleurae, 6) patients in extremes of age; below 10 years and above 65 years.

In group II, the patients were chosen for VATS drainage in the following conditions, 1) when the anaesthetists permit general one lung anaesthesia, 2) in two patients with tense ascites and one patient with previous open cardiac surgery, the subxiphoid approach was considered hazardous, 3) in five patients with associated pleural effusions to take pleural biopsies.

Procedure:

General endotracheal anaesthesia was given to 8 patients (33,33%) of group I and



N.B. Denver pleuroperitoneal shunt is a new surgical drainage technique for malignant pericardial effusions (3).

Fig. (6): Plan of management of massive pericardial effusions.

local anaesthesia to the rest. General anaesthesia was preferred in this group for the young uncooperative patients, patients with acceptable general condition and when another interference was planned. An example of the latter is the patient with chylopericardium and chylothorax, where a Denver plcuroperitoneal shunt was inserted at the same time. The difference in the type of anaesthesia between the two groups was statistically significant (chi-square value 16.957, p=0.0004). The midline incision was 5-7cm long. The peritoneum was intentionally opened to create a definitive pericardioperitoneal window in 14 patients (58,33%). A good piece of pericardium was excised varying from 2x2 to 5x5 cm. In the initial 6 patients of this study, the drainage tube was passed from the lower end of the skin incision. It was then realized that bringing it from a separate stab allows better closure of the linea alba and separate dressings of the original wound to keep it clean. In the last 9 patients, to increase the visualized pericardial surface, the thoracoscope with the camera attached was introduced through the subxiphoid window to perform a pericardioscopy. The drainage tube was left for 3 to 5 days (mean 3.92 days).

For group II patients, general one lung anaesthesia was used for all patients. The procedure was done from the left side in 9 patients (60%) and the right side in 6 patients (40%). The choice of the side of the procedure was affected by; a- the presence of associated pleural pathology from which thoracoscopic biopsies were required (Fig. 3), b- previous intercostal tube drainage and pleurodesis on one side. In the initial 3 patients of this study, just

pericardial fenestration and drainage of the effusion were attempted. For the remaining 12 patients, a window varying from 2x2 cm to 5x7cm was created and pericardial tissue was sent for pathological examination (Fig.4). The drainage intercostal tube was left for 3 to 7 days (mean 4.45 days).

The operative time for group I patients varied from 20 to 45 min with a mean of 32.3 min and for group II varied from 60 to 150 min with a mean of 95 min. The difference was significant statistically (t-value 12.71, p=0.000).

Hospital Stay:

The mean hospital stay for group I patients was 4.29 days (range 3-7 days), and for group II was 4,87 days (range 3-8 days). The difference was not statistically significant (t-value = -1.18, p=0.245).

Complications:

No mortality was reported in both groups. No major complications or intraoperative injuries were reported. In group I, 6 patients (25%) developed cardiac arrhythmias, 4 patients (16.67%) had minor wound infection at the site of the drainage catheter, and 4 patients (16.67%) had prolonged drainage from the site of the drainage catheter after its removal for about 5 days. There was no single report of herniation of abdominal contents through the window into the pericardial sac.

In group II, the postoperative complications included 3 cases (20%) of arrhythmias, 2 cases (13.3%) of minor wound infection at the site of the drainage catheter, one case (6.67%) of prolonged drainage from the site of the drainage catheter after its removal and 2 cases (13.3%) of pneumonia (Fig. 5),

Z-test for comparing morbidity between both studied groups as regards arrhythmia, wound infection, leakage and pneumonia showed a Z-value to be 0.36, 0.28, 0.91 and 1.83 respectively and all were statistically insignificant.

Follow Up:

During the period of follow up of 3 to 6 months, only one patient (4.17%) of group I required classical pericardiectomy 3 months after subxiphoid drainage and no other patient developed recurrence of the effusion. The preoperative diagnosis of that patient was effusive-constrictive pericarditis and the original subxiphoid approach was done for both diagnosis and drainage of the effusion. The condition was diagnosed as being tuberculous. The patient then presented by increasing constriction and recurrence of mild effusion and pericardiectomy was decided.

One patient (6.67%) of group II, done early in this series, for which just fenestration was performed, developed recurrence of the effusion and subxiphoid drainage was done. The difference in the rate of recurrence between the two groups was statistically insignificant (Z-value 0.34, p>0.05).

Summery of significant differences:

The two groups differed significantly in: a- Performance status, better for group II, b- Type of anaesthesia, local in 66.67% and general in 33.3% in group I, and general in 100% of group II. c- Operating time, shorter for group I and d- Cost, more expensive for group II. The choice of the procedure differed in the two groups. They did not differ significantly in the other items summarized in table 3.

Discussion

Mild or moderate pericardial effusions could be managed conservatively and pericardiocentesis could be performed for these cases mainly for diagnostic purposes. However, a more aggressive plan of management should be adopted for massive effusions failing to respond to medical treatment and pericardiocentesis to avoid haemodynamic instability from cardiac compression (Fig. 6).

To make a window or perform partial pericardiectomy for effusive pericardial disease had its standard approaches subxiphoidally or through anterior thoracotomy and more recently by the use of video assisted thoracoscopy popularized since 1990 (5-9). Pericardiopleural window or partial pericardiectomy through an anterior thoracotomy allowed direct visualization of the pericardium, performing a wide pericardial resection, breaking down of loculi, creating a good sized window and dealing with simultaneous left pleural effusion. On the other hand, it requires general anaesthesia, it is more invasive, and attended with higher incidence of operative mortality, postoperative pulmonary complications and definite post-thoracotomy pains, in addition to a longer hospital stay (3,8,12).

The subxiphoid approach to the pericardium was originally described by Larrey in 1829 (13). Fontanelle and colleagues in 1970 were the first to apply the term window to the subxiphoid approach (14). It is one frequently performed operation because of its several advantages. It can be done under either local or general anaesthesia. It is more simple, rapidly performed and minimally invasive so ideal in emergency situations and for patients in poor performance status (6-9,12). This approach utilizes ordinary surgical tools and setup and is not expensive. In malignant effusions, it allows pericardial sclerosis to be done by the instillation of acid tetracycline or bleomycin before removal of the drainage catheter (8,15). It is suitable for patients with bilateral pleurodesis for pleural effusion when VATS drainage will be contraindicated. By introducing a finger through the window, feeling of pericardial surface nodularities and tumour infiltrations and breaking down of loculi are possible. It also allows good visualization of diaphragmatic pericardial surfaces, the visualized scope could be increased by introducing the video assisted thoracoscope from the subxiphoid window to perform a wider pericardioscopy (suhxiphoid pericardioscopy).

However, SPW is not suitable for patients with ascites and when the subxiphoid region was utilized before as for insertion of epicardial electrodes, repairing hernias, placing retrosternal digestive conduits and for recurrent effusions after previous SPW (6). Compared with VATS, the approach do not visualize the pleural surface or deal with its effusions, a matter which could be dealt with separately (6).

The mechanism by which pericardial windows works does not seem to be by the creation of a persistent communication through which fluid might drain to the subxiphoid fascial plans or to the peritoneum or pleura (5). It is rather by fusion of the epicardium to the pericardium with obliteration of the potential space(7,8).

In an autopsy on 4 patients who died of their underlying malignancy after subxiphoid drainage of their malignant pericardial effusions, confirmed this fusion which started as an inflammatory process(7). Accordingly, to achieve the best results, insure initial complete drainage by good sized window and maintain tube decompression until fluid output is minimal, less than 25 ml/day, to allow apposition and fusion of the two surfaces(7,12). Based also on this concept, there should not be any fear of herniation of abdominal contents through a created pericardioperitoneal window since the pericardial sac will become obliterated. The drainage tube placed through the window is not removed until the drainage is minimal. An additional protection is offered by the left lobe of the liver. This is supported by not reporting any single case of such herniations in this study or others (7-9). Creating such direct pericardioperitoneal window performed in this study is cheaper, simpler and more durable than placing a Denver shunt or valveless tube between the two cavities (3,16). In addition, such placed shunts and tubes had to be removed later after control of the effusion exposing the patient to another interference, a matter which is avoided in the described technique.

The experiences of the study and that of others with this approach were very satisfactory. Despite dealing with critically ill patients, the operative mortality was zero in this study and others (7,9) and 4,5-10% in studies dealing only with malignant effusions (3,8,12). The morbidity was minimal. The recurrence rate in this study was 4.17%, compared to an incidence varying from 0-12% in the literature (3,7-9,12). The rate of recurrence was reported to correlate with the size of the window; windows of 5x5 cm had 0% recurrence (12). In addition, excision of such large pieces of pericardium will increase the diagnostic value of its pathological examination (12).

VATS drainage had the advantages of being minimally invasive with ready surgical access to pericardium. It allows visualization and biopsy of both pleura and pericardium (5,6). It is also suitable for patients with ascites and previous interferences in the subxiphoid region. A pericardial resection equivalent to open thoracotomy and more than the subxiphoid approach can now be performed especially with the potential of performing bilateral VATS pericardiectomies in the same sitting (2,5,6). It also produces less postoperative pains when compared to thoracotomy (2,5). Yet, it has the disadvantage of using general anaesthesia and single lung ventilation which is not always possible in critically ill patients (2,5). It is not suitable for emergency situations, to the extend that even during VATS procedure, the patient should be prepared for emergency subxiphoid drainage if haemodynamic instability is encountered during the maneuvers (6). Pericardial visualization is limited to the surface facing the thoracoscope and feeling by a finger is not possible.VATS utilizes delicate instruments and special setup that requires maintenance and is accordingly more expensive. It is more demanding as regards surgical experience and familiarity with this approach. It is also not suitable with bilateral pleurodesis, with thick pericardium and minimal effusion and in the presence of pericardial adhesions (2,17). Dissemination of malignant tumours after VATS procedures is a reported

complication (18). As with other VATS procedures, there should be no hesitation to convert the procedure to an open technique in presence of adhesions, suspicion of intraoperative bleeding or haemodynamic instability (19),

VATS drainage is a safe technique when used in its proper indications (6). No intraoperative complications or mortality was reported in this study and those of others (2,5,6). The postoperative complications were minor and easily manageable and comparable to the subxiphoid approach (2). In this study, the incidence of recurrences of pericardial effusion was 6.67%. As mentioned with subxiphoid drainage, the rate of recurrence depends largely on the area of pericardium resected. In a study using only thoracoscopic pericardial fenestration the incidence of recurrence of effusion was 60% without pericardial sclerosis and 12,5% after bleomycin pericardiodesis (17). In studies performing wider pericardiectomies, the incidence of recurrence was 0 % after a follow up of 6-9 months (2,5). The only case of recurrence reported in this study was after VATS pericardial fenestration.

A final point to be mentioned is that although both techniques are safe and effective therapeutically, yet, diagnostically they are of little advantage over analysis of the effusion and reviewing the patients' history and investigations (9). In this study, positive data from pathological examination of the pericardial tissue removed were obtained in only 23.03% of patients and the diagnosis was not reached after all investigations, i.e. remained idiopathic, in 4.17% of group I and in 6.67% of group II. In a recent study, the pericardial biopsy provided additional information in fewer than 20% of cases and failed to make the diagnosis in more than 50% (15).

To conclude.; SPW and VATS drainage are both equally safe as regards mortality and morbidity, and elective as regards immediate decompression and incidence of recurrences. VATS drainage of pericardial effusions is a new minimally invasive technique with less post-thoracotomy pains and pulmonary complications than the classical anterior thoracotomy. However, the SPW could done without general anaesthesia and more rapid, so more suitable for emergency situations and critically ill patients. It is simpler and cheaper utilizing the ordinary surgical tools and setup. Subxiphoid pericardioscopy combines the advantages of both techniques and increases the visualized area.

References

1. Shabetai R. Diseases of the pericardium. In: The Heart. Vol II. Hurst JW (editor). Sixth edition. Mc Graw Hill company. 1986.

2. Mack MJ, Landreneau RJ, Hazelrigg SR and Acuff TE. Video thoracoscopic management of benign and malignant pericardial effusions. Chest 1993; 103: 390S-93 S,

3. Wang N, Feikes R, Mogensen T et al. Pericardioperitoneal shunt: An alternative treatment for malignant pericardial effusions. Ann Thorac Surg 1994; 57: 289-92.

4. Mann-Segal DDM, Shanahan A, Jones B and Ramasamy D.Purulent

pericarditis: Rediscovery of an old remedy. J Thorac Cardiovasc Surg 1996; 111: 487-8.

5. Hazelrigg SR, Mack MJ, Landreneau RJ et al. Thoracoscopic pericardiectomy for effusive pericardial disease. Ann Thorac Surg 1993; 56; 792-5.

6. Liu HP, Chang CH, Lin PJ et al. Thoracoscopic management of effusive pericardial disease: Indications and technique. An Thorac Surg 1994; 58: 1695-7.

7. Sugimoto JT, Little AG, Ferguson MK et al. Pericardial window: Mechanisms of efficacy. Ann Thorac Surg 1990; 50: 442-5.

8. Chan A, Rischin D, Clarke CP et al. Subxiphoid partial pericardiectomy with or without sclerosant instillation in the treatment of symptomatic pericardial effusions in patients with malignancy. Cancer 1991; 68: 1021-5,

9. Campbell PT, Trigt PV, Wall TC et al. Subxiphoid pericardiotomy in the diagnosis and management of large pericardial effusions associated with malignancy. Chest 1992. 101: 938-43.

10. Glower DD. Pericardial window. In. Atlas of Cardiothoracic Surgery. Vol.I. David C. Sabiston, Jr.(editor). W.B. Saunders Company. 1995.

11. Hanke I and Douglas JM. Pericardial window. In: Atlas of Cardiothoracic Surgery, Vol.II. David C. Sabiston, Jr. (editor).W.B. Saunders Company. 1995.

12. Park JS, Rentschler R and Wilbur D. Surgical management of pericardial effusion in patients with malignancies. Comparison of subxiphoid window versus pericardiectomy. Cancer 1991; 67 (l): 76-80.

13. Larrey DJ. New surgical procedure to open the pericardium in case of fluid in its cavity, Clin Chir 1829; 2: 303-37,

14. Fontanelle LJ, Cuello L, Dooley BN. Subxiphoid pericardial window. Am. J Surg; 1970; 120- 679-80,

15. Maher EA, Shepherd FA and Todd TJR Pericardial sclerosis as the primary management of malignant pericardial effusion and cardiac tamponade, J Thorac Cardiovasc Surg 1996,112: 637-43.

16. Molnar TF and Jeyasingham K. Pericardioperitoneal shunt for persistent pericardial effusions: A new drainage procedure. Ann Thorac Surg 1992; 54: 569-70.

17. Canto A, Guijarro R, Arnau A et al. Thoracoscopic pericardial fenestration: diagnostic and therapeutic aspects. Thorax 1993; 48,. 1178-80.

18. Downey RJ, McCormack P, LoCicero J et al. Dissemination of malignant tumours after video-assisted thoracic surgery: A report of twenty-one cases. J Thorac Cardiovasc Surg 1996; 111: 954-60.

19. Krasna MJ, Deshmukh S and McLaughlin JS. Complications of thoracoscopy. Ann Thorac Surg 1996, 61: 1066-9.

Role of Nd (YAG) Laser in Corrosive Esophageal Stricture: A Comparative Study.

ABSTRACT

Objective: Accidental ingestion of potash by children is a serious problem leading to corrosive esophageal stricture. Various methods for esophageal dilatation were tried using either antegrade or retrograde dilators, but the results were unsatisfactory. We started to use laser (Nd: YAG) as a new technique for esophageal dilatation, This work evaluates the efficacy and morbidity of the different techniques for esophageal dilatation.

Methods: During the last six years, 220 patients with corrosive esophageals tricture were treated as follows: Group I: 109 patients for whom esophageal dilatation was done using Gum Elastic dilators, Group II: 24 patients, retrograde Tucker's dilators through a gastrostomy tube, Group III: 45 patients, wire guided Savary's dilators, Group IV: 22 patients, Balloon dilators, Group V: 20 patients, Nd (YAG) laser. For laser dilatation we used a rigid esophagoscope under general anaesthesia. The laser beam was applied to two opposite points to open the scarred roof using either the contact or the non-contact technique.

Results: The approximate mean number of dilatation for each patient of group I was 7, group II was 9, group III was 6, group IV was 3 and group V was 3. Satisfactory results were obtained in 77.9% (Group I), 79.2% (Group II), 88.8% (Group III), 90.9% (group IV) and in 95% (Group V). Esophageal perforation occurred in 7.3% (Group I), 2.2% (Group III) and in 5% (Group V).

Conclusion: Savary, balloon and laser dilatation are safe and effective procedures for corrosive esophageal stricture with minimal morbidity and mortality. Yet, Savary's dilators have the advantage of being cheap and can be used by junior staff after training.

Key words: Corrosive esophageal stricture (CES), Esophageal dilatation (ED) and Esophageal perforation (EP).

K. Karara, MD, A. Ramadan MD, and S. Keshk, MD.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

A CES results from the ingestion of solid or liquid caustic substance, leading to deep caustic burn healing by scarrig and stricture formation. Potash, a mixture containing mainly potassium hydroxide, is still used in our country as a household bleaching agent by people of low social classes and is the main cause of CES encountered (1). The most frequent victims are children between two and five years old. Preventive strategies are strongly recommended based on public education programs and safe manufacturing practices

Cardiothoracic Surgery Unit, Faculty of medicine, Alexandria University.

by putting caustic household products in chlidproof containers (2).

Dilatation of these strictures is carried out by various methods using different routes. Antegrade dilatation is performed either blindly using the gum elastic dilator, or through a marked steel guide wire using the Savary's and balloon dilators (3,4). In retrograde dilatation, the Tucker's dilators are passed over a silk thread through the gastrostomy stoma (5,6). Although these techniques are effective, yet there is a variable incidence of morbidity among them. Recently, we started to use Nd: YAG laser for short CES as a new technique for ED.

The aim of this study was to evaluate the efficacy and morbidity of the different techniques of dilatation of CES,

Material and Methods

The material of this study included 220 patients suffering from CES presenting with dysphagia dealt with in Alexandria Main University Hospital in the period from January 1991 till December 1996, Their age varied from 2 to 31 years with male to female ratio of 1.4:1. All patients were thoroughly examined, esophagogram and esopagoscopy were done to estimate the site,, the type and extent of the stricture (Fig. 1,2,3).

The patients were divided into five groups according to the method of dilatation as follows: Group I: included 109 patients for whom Gum Elastic dilators were used, Group II: 24 patients, Retrograde Tucker's dilators threaded through a gastrostomy stoma, Group III: 45 patients, marked wire guided Savary's dilators, Group IV: 22 patients, Balloon dilator, Group V:20 patients, Nd: YAG laser.

All dilatations were carried out after control of the acute stage which took about one month. The dilatations were done under general endotracheal anaesthesia using a rigid esophagoscope. The laser apparatus was Medilas 2 Nd: YAG laser (power 20-40 watt, wave length 1060 nm, pulse duration 0.3 sec and energy up to 1500 Joules). The laser beam was applied to two opposite points to open the scarred ring using either the contact or non-contact technique (Fig.4). A plain chest radiogram after dilatation was done to excluded EP in suspected cases especially those presenting by post-dilatation fever.

The success of dilatation was assessed by clinical improvement, esophagogram and increased interval between dilatations. Satisfactory results demonstrate that the patients could swallow ordinary food without dysphagia, while in fair results the patients encountered occasional difficulty in swallowing solid food. Unsatisfactory results indicate liquid swallowing only.

Statistical Studies:

Variables were compared between the two clinical groups using F-test. Scheffe test and Pearson chi-square test. A p-value of 0.05 or less was considered to be statistically significant. The statistical tests were performed using the SPSS® (statistical package for social sciences) computer program.

Results

In Group I, 760 Gum Elastic dilatations were carried out for 109 patients with a

Table 1. Results of esophageal dilatation.

Group	I	II	III	IV	V
No. of patients	109	24	45	22	20
Approx. Mean of dilatation.	7	9	6	3	3
Satisfactory Results.	77.9%	79.2%	88.8%	90.9%	95%
Fair Results.	13.8%	8.3%	4.4%	4.5%	5%
Unsatisfactory Results.	8.3%	12.5%	6.7%	4.5%	0

Table 2. Morbidity of esophageal dilatation.

Group	I	II	III	IV	V
Esophageal perforation	7.3%	0	2.2%	0	5%
Esophageal bleeding	37.6%	20.8%	22.2%	18.2%	5%

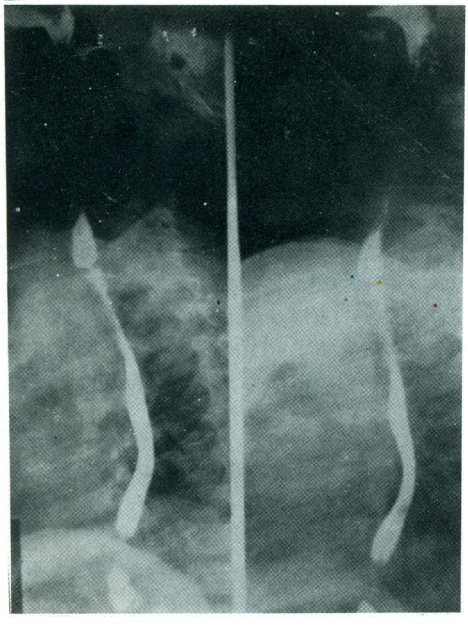


Fig. (1): Barium swallow of the esophagus showing annular corrosive stricture; most ideal for laser therapy.

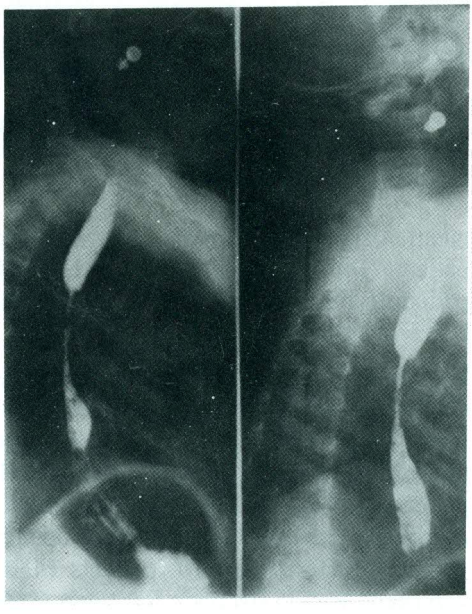


Fig. (2): Barium swallow of the esophagus showing short tubular corrosive stricture (Dumbell-shaped), most ideal for balloon dilatation.

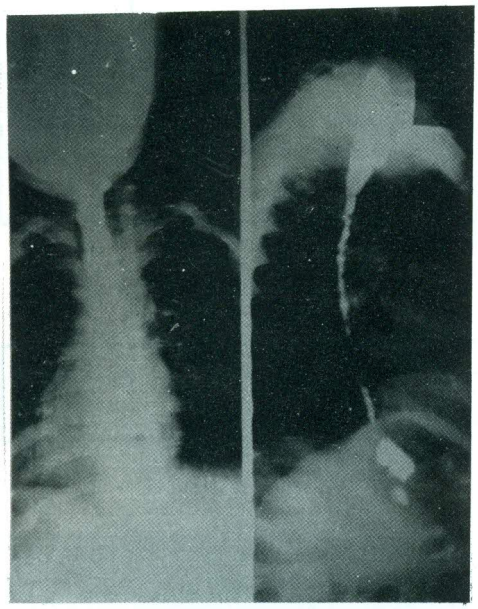


Fig. (3): Barium swallow of the esophagus showing long tubular stricture, most ideal for Savary or Tucker Dilators.

mean of 6.97±SD 1.8281 dilatations per patient. The results were satisfactory in 85 patients (77.98%). EP occurred in 8 patients (7.3% of patients. 1.05% of dilatations).

In Group II, 215 Tucker's retrograde dilatations were done for 24 patients with a mean of 8.96±SD 1.8528 dilatations per patient. The results were satisfactory 19 patients (79.2%). In this group, excoriation of the skin around the gastrostomy opening was encountered in 10 patients (42%), persistent gastric fistula in 6 patients (25%) and erosion of the external ala nasi in 3 patients (12.5%). However, no EP was reported in this group.

In Group III, 270 Savary's dilatations were done for 45 patients with a mean of

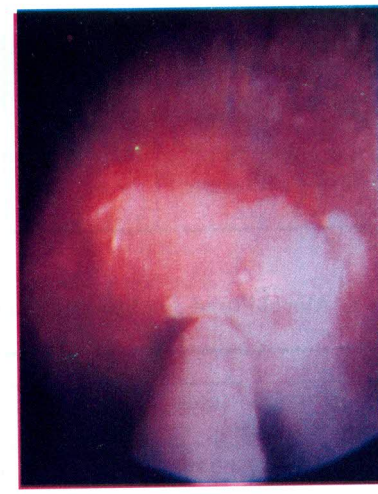


Fig. (4): The tip of the gastrofiber in contact with the stricture.

6±SD 1.4924 dilatations per patient. The results were satisfactory in 40 patients (88.8%). EP occurred in one patient (2,2% of patients, 0.37% of dilatations).

In Group IV, 64 Balloon dilatations were done for 22 patients with a mean of 2.9±SD 1.1509 dilatations per patient. The results were satisfactory in 20 patients (90.9%). No EP was reported in this group.

In Group V, 59 Laser dilatations were performed for 20 patients with a mean of 2.95±SD 1,3169 dilatations per patient. The results were satisfactory in 19 patients (95%). EP occurred in one patient (5% of patients, 1.69% of dilatations).

Patients with EP were treated conservatively by massive antibiotics, intravenous hyperalimentation till gastrostomy feeding was started and intercostal drainage of associated pyopneumo-

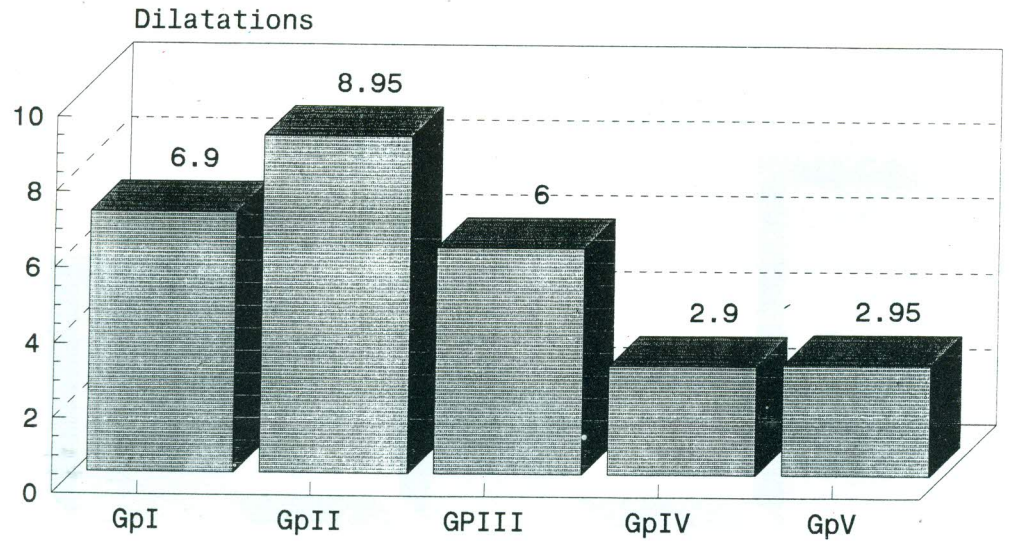


Fig. (5): Mean number of esophageal dilatation done for the studied groups.

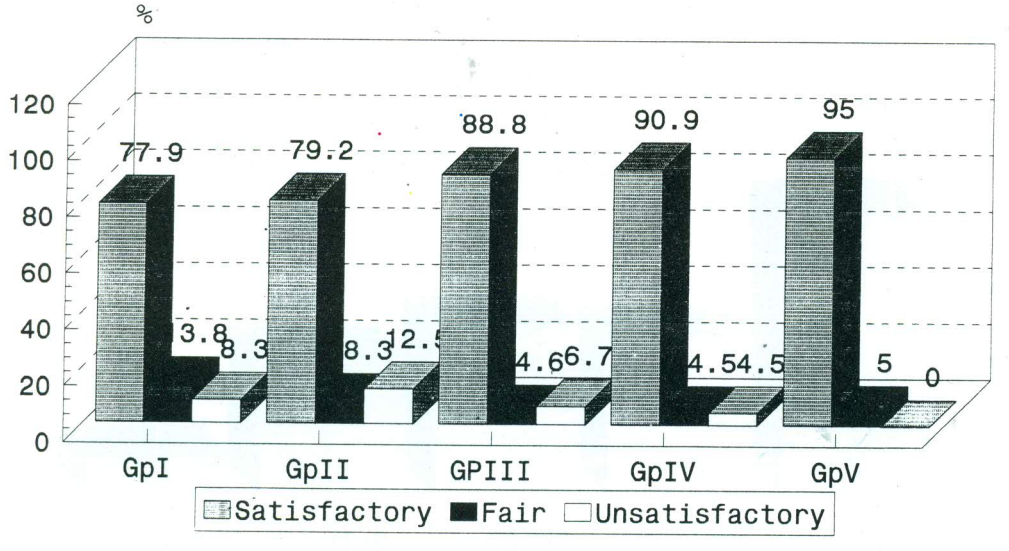


Fig. (6): Distribution of studied groups according to the dilatation results.

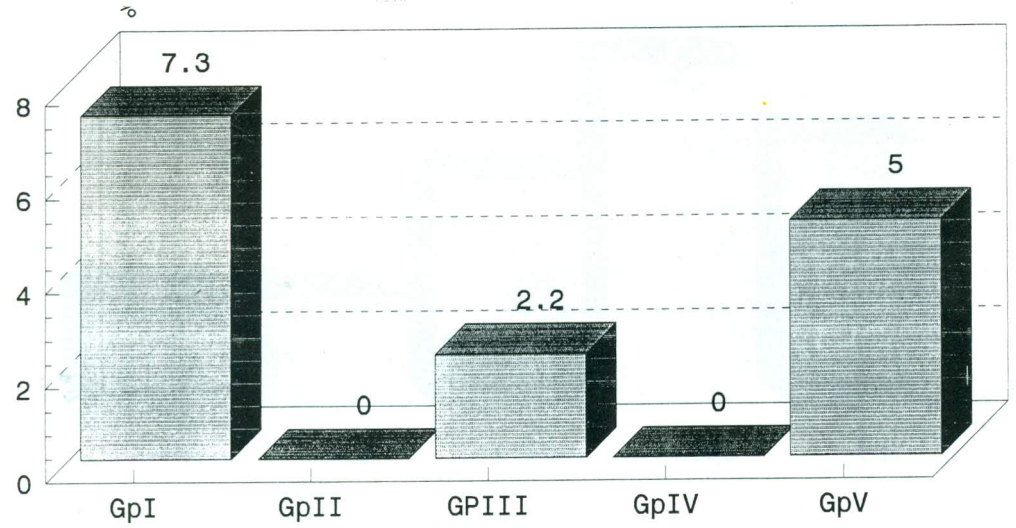


Fig. (7): Prevalence of esophageal perforation in the studied groups.

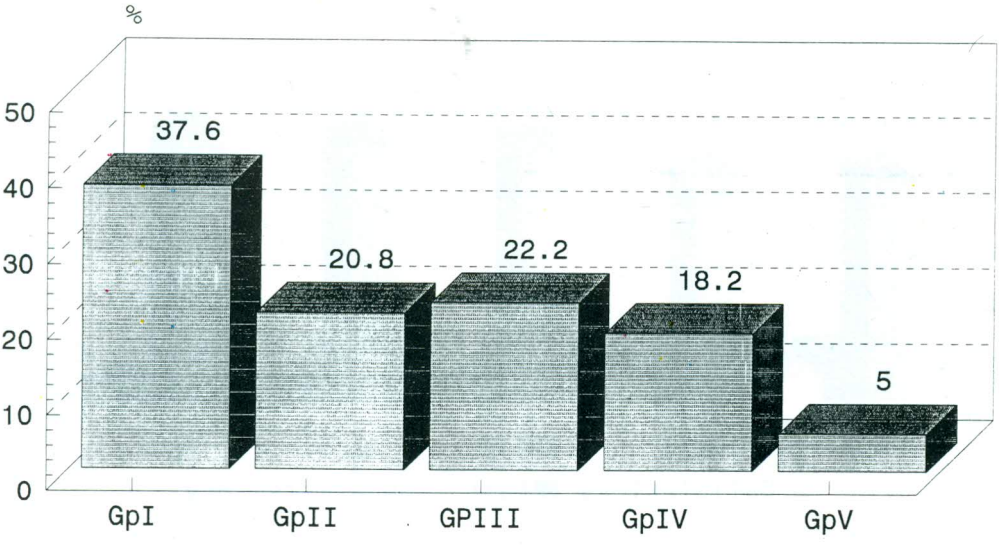


Fig. (8): Prevalence of esophageal bleeding in the studied groups.

thoraces. The perforation healed, as evidenced by gastrographin study of the esophagus, within 3-8 weeks during which gastrostomy feeding was continued. These patients with history of perforation and those patients with unsatisfactory results had retrosternal colon interposition. However, we had recent experience in two cases who were successfully dilated after a previous history of EP.

Figure (5) demonstrates the mean number of ED done for the studied groups. Table (1) and Figure (6) summarize the results of ED, while table (2), Figures (7) and (8) depicts the morbidity of ED. As shown in these tables and figures, Gum Elastic dilatations carried the least favorable results and were accompanied by the highest incidence. of EP,

Results of statistical analysis:

Using the F-test, statistically significant difference was found between the five groups as regards the mean number of dilatations per patient. Scheffe test indicated that this difference lied between group IV and groups I, II and III, between group V and groups I, II and III, between group III and groups I and II and between group I and group II while the other comparisons were not statistically significant,

Using the Chi-square test, the differences between the groups in the results of the dilatation were not statistically significant (value 8.12236, Significance 0,42161).

The differences between the five groups as regards the incidence of esophageal perforation were not statistically significant (Pearson Chi-Square value 4.7209, Significance 0.31715) while the differences in the incidence of esophageal bleeding were statistically significant (Pearson Chi-Square value 12,72275. Significance 0.01271). A larger number of patients, probably from a multicenter study, is required to get significant results for the insignificant comparisons.

Discussion

Fabricius (1537-1619) is cited as the first to use wax taper with which he pushed a foreign body onwards into the stomach. The word bougie was derived from the Arabic Algerian town Boujiyah, center for wax candle trade (7). With the discovery of esophagoscopy by the late nineteenth century, the first effective dilatations were made possible. Since then great progress had been made to render the techniques of dilatation safer and more effective. These techniques fall under one of the following groups: 1. Antegrade dilatation using blind bougies, guided bougies or balloon dilators, 2. Retrograde dilatation using Tucker's dilators, 3. Cutting, diathermy and laser, and 4. Indwelling tubes introduced through an esophagostomy (8).

Blind bougienage was the original method used (1,7). Examples included the Chevalier-Jackson, Maloney, Hurst, Bunt, Velpeau and Teflon dilators. These dilators are easily available and less expensive, yet associated with the highest incidence of oesophageal perforation and unsatisfactory results. For these reasons, their use in our department for ED was gradually abandoned and was replaced by the other guided techniques, the same was done in other centers (9).

Bougies can be guided using a long thread swallowed by the patient (Plummer's technique) or using a steel guidewire as the

Eder-Puestow, Celestin and Savary-Gilliard bougies (3,9). Through the rigid esophagoscope. the stricture is seen and the guidewire is passed through it to the stomach to be visualized and palpated there. With the patient anaesthetized and relaxed, it is quite easy to see and feel the guide wire in the stomach, and we found it unnecessary to verify the position of the wire fluoroscopically. However, other authors perform the technique in children also under general anaesthesia, but use flexible endoscope with fluoroscopic control (9). For adults, the dilatation can be done under local anaesthesia with sedation (3). Then the bougies are passed along the guidewire in a gradually increasing fashion. This technique is accompanied with a lower incidence of perforation and better satisfactory results.

As regards Tucker's retrograde dilatation, it was associated in this study with the highest number of dilatations per patient, and high unsatisfactory results. This is actually due to the severe nature of the strictures this technique is chosen to deal with; all these strictures were so tight to compel the surgeon to insert a feeding gastrostomy. On the other hand, it had a zero incidence of perforation. However, the complications associated with the gastrostomy and the more prolonged periods of hospitalization required to care for it made the child's parents refuse the adoption of the technique on routine bases when other techniques are applicable.

Balloon dilatation of oesophageal strictures is a recently introduced technique (4). The balloon is introduced into the stricture and inflated applying stationary radial dilating forces on the stricture without additional shearing longitudinal forces of ordinary bougienage. McLean and Leveen measured the radial and shear forces generated by dilatation with Maloney, Savary and balloon dilators (11). The mean radial forces generated were 6.42, 4.46 and 4.04 N respectively. However, the mean shear forces measured were 16.92, 6.92 and 1.44 N respectively. Therefore, trauma to the esophageal wall is much reduced and the risk of perforation is also lowered as evidenced by reporting no EP in this group in this study. However, it is more expensive, less durable, requires more technical experience and was only used for short segment strictures.

The use of Nd (Neodymium): YAG (Yttrium-Aluminium-Garnet) laser (Light Amplification by Stimulated Emission of Radiation) endoscopically for dilatation of benign esophageal strictures had added another new technology in this field (12,13), The Nd: YAG laser emits light in near infrared range. At this wavelength, absorption in tissue is very low. Slow heating of tissue occurs followed by deeper coagulation. This is followed by vaporization at the tissue surface with marked shrinking. The shrinkage of the tissue combined with uniform coagulation, results in sealing of blood and lymph vessels (14). It allowed immediate vaporization of attached points, sloughing of the lasered tissue and healing of the lasered area by more elastic tissue with low incidence of perforation. However, this technique is expensive, requires a lot of training and is not applicable to long segment strictures.

In the present study. five different methods of ED were used for CES. The

highest satisfactory results were obtained by Savary, balloon and laser techniques, with balloon dilatation having a further advantage of no EP. However, balloon and laser techniques were used for rather short segment strictures while Savary's dilatation was done for all types of strictures including the tight long strictures and the more risky ones as multiple long segment strictures, cul de sac and even after a previous history of EP.

Loffler et al reported satisfactory results with laser in 55% and fair results in 27% compared to 95% and 5% respectively in this study (13). The better results obtained can be attributed to the selection of patients with short strictures and to the use of Savary's bougienage after the second laser session.

On the other hand, our results with balloon dilatation are comparable to other studies (15-17). They reported success rate varying from 67-87% and an incidence of perforation varying form 0-0.4%. Using Savary's dilators, our results were comparable to those of Dumon et al. (3), and superior to those of Gallardo et al,(9); all stating that these dilators offer a reliable and safe method for the treatment of esophageal strictures. By abandoning the use of blind bougienage, we rarely see now cases of EP, and we noticed a definite decrease in the number of patients requiring eventual colon interposition due to failure of dilatation.

From this study, it was concluded that Savary balloon and laser techniques are effective and safe procedures for CES with minimal morbidity and mortality. Yet, Savary's dilators have the advantage of being cheap. applicable to various types of strictures including more risky ones, and can be used by junior staff after training,

References

1. Ragheb MI, Ramadan AA and Khalil MA: Management of corrosive esophagitis. 1976; 79(5): 494-8,

2. Bautista CA, Estevez ME, Varela CR et al.: A retrospective analysis of ingestion of caustic substances by children. Ten-year statistics in Galicia. Eur J Pediatr 1997; 156(5): 410-4.

3. Dumon JR, Meric B, Dupin B, Jahjah F and Rebound E: Une nouvelle methode de dilatation esophagienne sous controle de la vue: Les sondes de Savary. JMM 1983; 2: 23-34.

4. Dawson SL, Mueller PR, Ferrucci JT et al,: Severe esophageal strictures: Indications for balloon catheter dilatation. Radiology 1984; 153: 631-5.

5. Tucker JA, Turtz ML, Silberman HD et al.: Tucker retrograde esophageal dilatation, 1924-1974: A historical review. Ann Otol Rhinol Laryngol 1974; 83, 1.

6. Tucker JA and Yarington CT. The treatment of caustic ingestion. Otolaryngol Clin North Am 1979;12: 343-50.

7 Earlam R and Cunha-Melo JR: Benign esophageal strictures. Historical and technical aspects of dilatation. Br J Surg 1981; 68: 829-36,

8. Mils LJ, Estrera AS and Platt MR. Avoidance of oesophageal stricture following severe caustic burns by the use of an intraluminal stent. Ann Thorac Surg 1979; 28: 60-5.

9 Gallardo LM, Fragoso AT, Sagaro GE et al.: Treatment of esophageal stenosis

with Savary-Gilliard bougies in children. GEN 1995; 49(l): 15-22

10. Bogliolo G, Pietropaolo V, Petruzziello L et al.: Endoscopic treatment of benign esophageal stenosis. G Chir 1997; 18(10): 481-4

11. Mc Lean GK and Leveen RF: Shear stress in the performance of esophageal dilatation. Comparison of balloon dilatation and bougienage. Radiol 1989; 172: 983-86.

12. Sander R and Poes H: Treatment of non-neoplastic stenoses with Nd (YAG) laser. Indications and limitations. Endoscopy 1986;18: 53-6,

13. Loffler A, Dienst C and Velasco SB: International survey of laser therapy in benign gastrointestinal tumours and stenoses. Endoscopy 1986; 18: 62-5.

14. Frank F: Technical prerequisites and safety considerations for the use of the Nd: YAG Laser in gastroenterology Endoscopy 1986; 18: 6,

15. Patterson DJ, Graham DY, Lacy Smith J et al.: -Natural history of benign esophageal strictures treated by dilatation. (Gastroenterol 1983. 85: 346-50,

16. Maynar M, Guerra C, Reyes R et al.: Esophageal strictures: Balloon dilatation. Radiology 1988; 167: 703-6.

17. Chia SJ, Chua CL, Cheong WY and Low CH: Evaluation of non-surgical treatment of benign esophageal stricture. Ann Acad Med Singapore 1994; 23 (5): 781-4.

Substernal Colon Interposition for the Management of Corrosive Stricture of the Esophagus: Early and Late Complications

ABSTRACT

During a 12-year period between January 1986 and January 1998, 104 patients underwent substernal colon interposition for the treatment of caustic esophageal stricture after failure of esophageal dilatation to provide an acceptable pathway for swallowing. At the time of the procedure, their ages ranged from 21 months to 36 years. Seventy three patients were male and 31 patients were females. There were 5 deaths (4.8%).Two patients died of septic shock due to necrosis of the colonic conduit, two patients died of respiratory failure due to bronchopneumonia in the immediate postoperative period and one patient died due to massive upper gastrointestinal bleeding. Postoperative complications were experienced in 85 patients (82.7%). Cervical anastomotic leakage was the most commonly encountered early complication (53.8%), while colo-esophageal stricture was the most common late complication (24%).

Most of the complications are preventable, transient and non serious. The corner stone of such operation lies in reducing its mortality and morbidity which can be achieved by a through understanding of the complications of this procedure which will enable us to avoid many of them or to deal with them more efficiently.

Dr.Abdel Maguid Ramadan, MD and Dr.Moustafa Elhamami,MD.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

Caustic esophageal stricture is one of the most common indications of esophageal replacement.(1) Although the indications have not been clearly defined, some of the strictures resulting from chemical injuries necessitate esophageal replacement for treatment. (2-6)

Successful outcome following interposition by colon has been reported.(7) Substernal colon interposition without esophagectomy is the method popularly adopted in our department for many years. (8) However, it has been observed that, this procedure is attended with a considerable rate of postoperative complications.

Aim of the study

The aim of this work is to study and analyze these complications in an attempt to achieve a better perspective as far as their prophylaxis and management is concerned with the objective of lowering the incidence of morbidity and mortality of such frequently performed operation.

Patients and Methods

During a 12-year period between January 1986 and January 1998, 104 patients

Cardio-thoracic Surgery Department, Faculty of Medicine, Alexandria University

underwent colonic interposition for the treatment of caustic esophageal stricture after failure of esophageal dilatation to provide an acceptable pathway for swallowing.

Routine hematological investigations, plain X-Ray chest radiographs and barium swallow were done to all patients. Rigid esophagoscopy to determine the level of esophageal obstruction was done. Seventy two patients had gastrostomy for feeding purposes as a primary stage before definitive surgical procedure was undertaken.

The decision to carry out colonic interposition as a succeeding mode of treatment include patients in whom esophageal bouginage failed to restore the normal ability to swallow within a month period following the last dilatation after completion of 1-year dilatation program. Patients who had exposed to esophageal perforation - during the procedure of esophageal dilatation - had colon interposition if bleeding and difficulties developed during further dilatations.

Substernal tunneling for the colon transplant was carried out. Interposition with the colonic segment on a pedicle of the middle colic vessel (86 patients) or left colonic vessels (18 patients) were used to bypass esophageal obstruction.

The postoperative complications were analyzed with regard of their:

1. Incidence.
2. Probable causes and pathogenesis.
3. Clinical presentations.
4. Management and its results.

The tools employed for detecting complications included:

1. Plain radiography of the chest and abdomen.
2. Barium study of the upper esophageal segment, interposed colon and stomach.
3. Endoscopy of the upper esophageal stump using the rigid Negus esophagoscope or the fiberoptic one to study the upper esophagus, interposed colon and stomach.

Results

The age of the patients varied from 21 months to 36 years. Seventy three patients (70.2%) were male and 31 (29.8%) were females. The stricture was caused by potash ingestion in 100 patients and by sulfuric acid in only 4 patients. The postoperative complications were experienced in 85 patients (82.7%), some patients developed more than one complication. These complications were divided into early and late complications (Table 1 & 2 respectively).

The mortality rate in this study was 4.8% (5 patients), two patients died of septic shock due to necrosis of the colonic conduit while two patients died of respiratory failure due to bronchopneumonia in the immediate postoperative period and one patient died due to massive upper gastrointestinal bleeding.

Cervical anastomotic leakage was the most frequently encountered complication in 56 patients (53.8%), it occurred a variable period after the operation ranging from 6-12 days, in 14 patients, it followed infection in the neck. This complication

Table I. Early postoperative complications.

Complications	No of patients	%
• Leakage at cervical anastomosis (salivary fistula)	56	53.8%
• Chest complications		
1. Bronchopneumonia	4	3.9%
2. Pneumothorax	7	6.7%
• Recurrent laryngeal nerve balsy	2	1.9%
• Necrosis of colon	2	1.9%
• Postoperative intestinal obstruction	3	2.9%
• Wound sepsis		
Cervical	14	13.5%
Abdominal with burst abdomen	5	4.8%
• Postoperative peritonitis	1	0.9%

Table II. Late postoperative complications.

Complications	No of Patients	%
Colo-esophageal stricture	25	24%
Colo-gastric stricture	10	9.6%
Redundant colonic loop	9	8.6%
Upper gastrointestinal bleeding	5	4.8%
Persistent gastric fistula	7	6.7%

*** Some of 85 patients had more than one complication.**

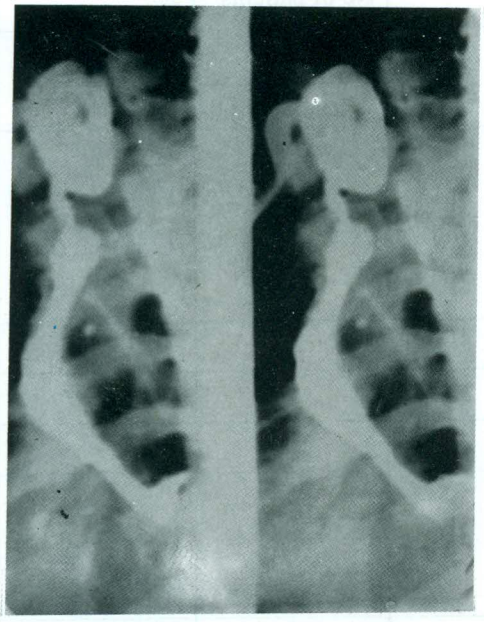


Fig. (1): Barium swallow in a patient with colon interposition showing stricture at the esophagocolic junction.

was transient and self limited where salivary fistula closed spontaneously. Some patients developed stricture at the esophago-colic anastomosis at a later date (20 patients).

Chest complications were encountered in 11 patients (10.6%). Seven patients (6.7%) suffered from postoperative pneumothorax (4 left sided and 3 right sided) which was discovered on routine chest radiography in the operative night and occurred when the substernal tunnel was created by the surgeon's hands. It was managed successfully by intercostal tube drainage to underwater seal system. The other 4 patients (3.9%) were suffering from

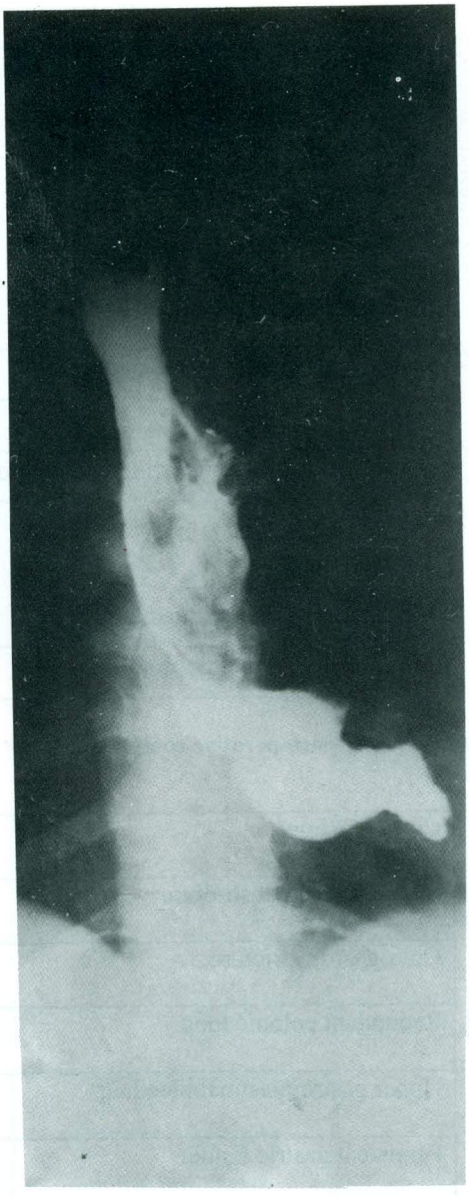


Fig. (2): Barium swallow showing cologastric stricture.

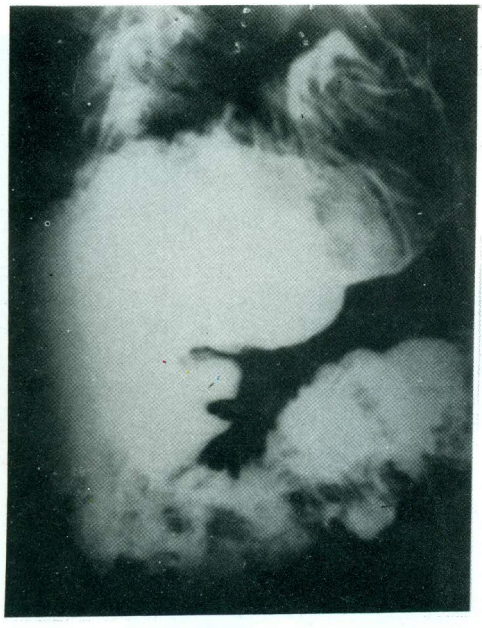


Fig. (3): Barium study of the interposed colon showing redundant colonic segment.

bronchopneumonia and treated by systemic antibiotics, endobronchial suction, humidified oxygen therapy and physiotherapy. In two patients, however, this complication had a fatal outcome.

Colonic necrosis was the most serious complication encountered in this study. It led to two immediate postoperative deaths. Complete gangrene of the colonic conduit occurred with the presence of a foulodoured dark-colored discharge.

Wound sepsis complicated the operation in 19 patients. In 14 patients, infection occurred in the cervical incision where it was heralded in six patients by a cervical abscess that necessitated external drainage. Salivary fistula developed secondary to sepsis in all these patients. In five patients, on the other hand, sepsis developed in the abdominal incision where in three of them, it was followed by complete dehiscence of the abdominal wound that needed secondary surgical repair with tension sutures. All cases with wound sepsis were treated classically by systemic antibiotics and frequent local dressings.

Postoperative intestinal obstruction occurred in 3 (2.8%) patients in the immediate postoperative period. Internal herniation and strangulation of the small intestine through the inadvertently closed transverse mesocolon was the cause of the obstruction in two patients in whom resection anastomosis of the affected segment was mandatory. In the 3 rd patient the cause of obstruction was intussusception of small bowel, the cause of which was not clear, manual reduction was all that was needed.

Postoperative peritonitis occurred in only one patient after repairing burst abdomen, on exploration no obvious sources of leakage were encountered peritoneal toilet was carried out and the abdomen closed.

Recurrent laryngeal nerve injury occurred in only two patients. it was unilateral and non of the patients needed tracheostomy.

Cervical esophagocolic stricture, the most frequent late complication, occurred in 25 patients (24%) in the present series. All patients presented with dysphagia at a variable period ranging from immediate postoperative period to 8 years after the operation. Barium swallow examination showed either stenosis or complete arrest of the contrast material at the esophago-colic anastomosis (Fig 1). All patients were

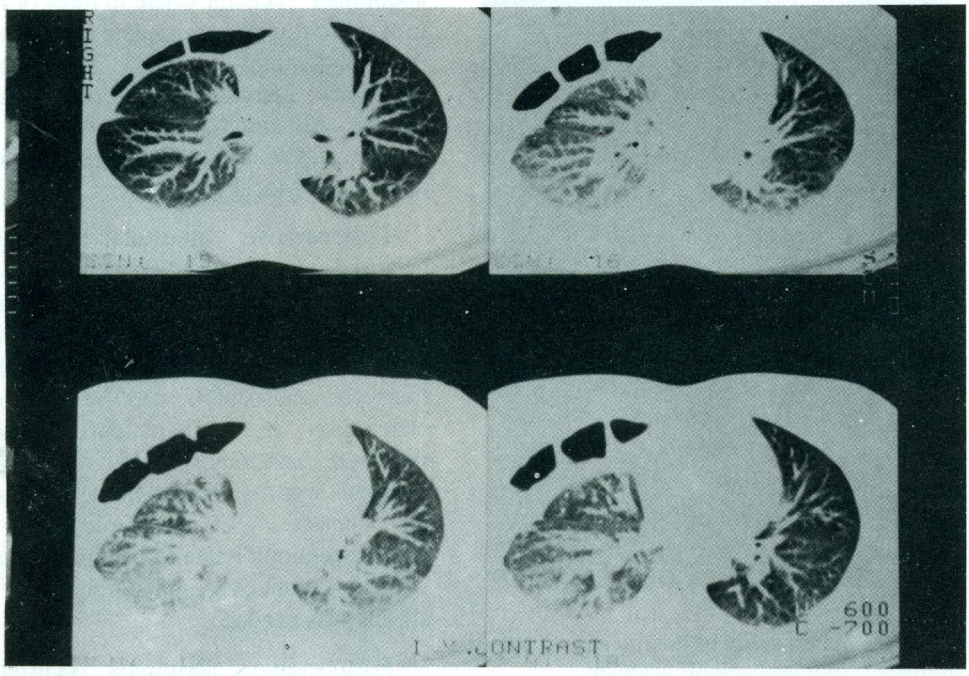


Fig. (4): C.T of the same patient shows the substernal redundant colonic segment.

submitted to rigid eosophagoscopy, in 5 patients, esophageal dilatation succeeded to achieve a good swallowing with a permanent dilatation of the stricture. In the remaining 20 patients, surgical reconstruction was necessary to achieve good functional results.

Colo-gastric strictures were encountered in 10 patients who had the same clinical presentation namely regurgitation of food shortly after meals especially on lying down or after bulky meals. The complaint started 2 months to three years after operation, most of the patients presented with weight loss. Barium study of the transported colon readily showed the obstruction at the colo-gastric anastomosis. (Fig. 2)

Surgical revision of the anastomosis was performed in all patients with prompt relief of their symptoms.

Redundant colonic loop was the cause of repeated vomiting with evident intermittent nocturnal regurgitation in 9 patients one month to four years after operation. Barium study and C.T scanning showed an excessive length of the transposed colonic segment (Fig. 3 & 4). Surgical correction in the form of a second anastomosis between redundant colon and anterior gastric wall succeeded in alleviating the symptoms.

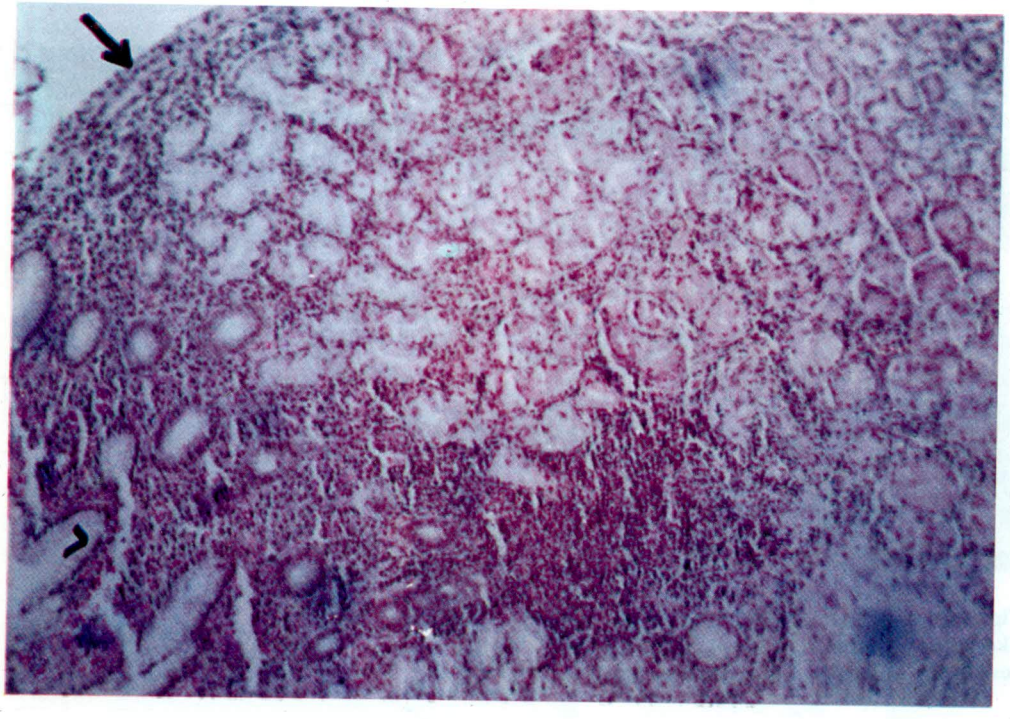


Fig. (5): H&E staining: showing rudimentary glands of Lieberkuhn (wide interval between the glands with absence of goblet cells) with stratification of the lining epithelium (arrow simulating that of the upper esophagus. Mic MagX 100)

Upper gastrointestinal bleeding was encountered in 5 patients. Barium swallow showed complete patency of the colonic segment. Fiberopetic endoscopy under general anathesia was done to all patients and demonstrated congestion and ulceration of the interposed colon, biopsies were taken from upper and lower parts of the interposed colon (Fig. 5 & 6) respectively Four patients received medical treatment and cured while one patient died from massive bleeding.

Persistent gastric fistula occurred in 7 patients and it was nearly due to failure of spontaneous closure of the gastrostomy stoma with no evidence of pyloric obstruction in barium study. It was managed by surgical closure of the fistula in layers.

Discussion

Caustic esophageal obstruction is a problem of considerable magnitude in Egypt.(9) It is not infrequently that esophageal dilatation fails to establish a permanently patent and normally functioning esophagus and the employment of an alternative definitive surgical procedure is often mandatory.(10) Colon interposition has been the procedure of choice to bypass the obstructed esophagus in our department. It has been found that,

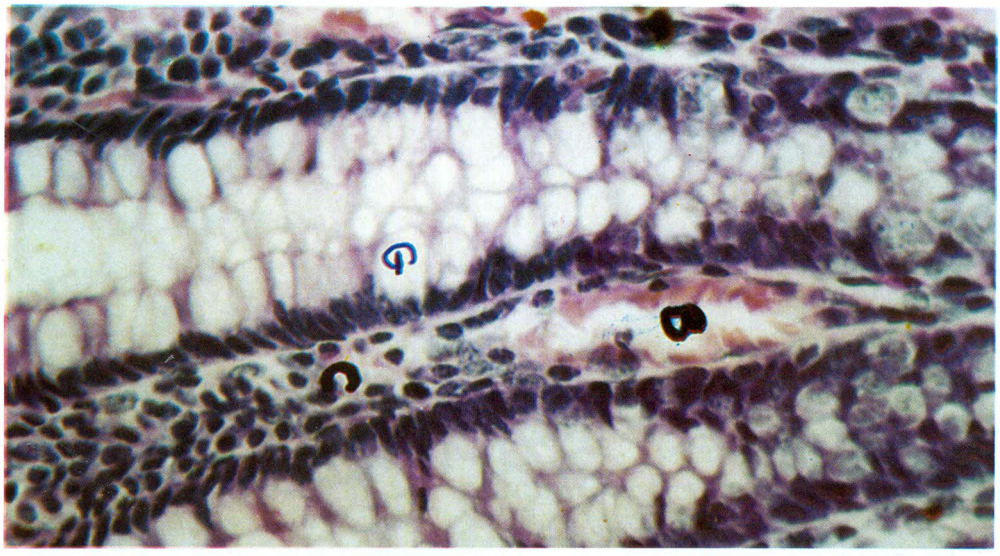


Fig. (6): H&E staining showing parts of the glands Lieberkuhn with increased goblet cells (G) like mucous glands of the lower esophagus the corium between the gland shows congested blood vessels (B) and extensive cellular infiltration (C) (Mic Mag X 400)

this procedure was not uncommonly attended with complications, the incidence of these complications has been minimized through increased experience, improved techniques and careful preservation of the vascular competence of the transplant.

The overall complication rate of colon interposition in the present study was 82.7%. Comparably high figures were reported in the literatures by some workers (11,12) , where as considerably lower rates were reported by others (13,14,15)

In general, the complications of colon interposition are mostly ascribed to one or more of three factors namely: (1) Inadequacy of blood supply of the interposed colon, (2) Faulty surgical techniques and (3) Infection.

Adequacy of the blood supply to the colonic segment used for interposition is by far the most important factor determining success of such operations (16,17). Ischemia of the colonic conduit is held responsible entirely or in part of the occurrence of early postoperative complication like, colonic necrosis and leakage with late strictures . (14,15,16) Some centers advocate preoperative selective mesenteric angiography to ensure the adequacy of the blood supply to the esophageal substitute.(18) However, we believe that such a method should in no way entirely replace or deny the personal ability and skills of an experienced surgeon to judge the vascularity of the colonic conduit especially in centers lacking such facility or dealing with a large number of

cases. Moreover, we are inclined to believe that, in experienced hands, colonic ischemia is not due to the non meticulous choice or uncareful preparation of the segment of the colon to be used for bypass, but it may be due to other risk factors and maneuvers that may induce ischemia even to an adequately vascularized colonic segment during and after operation. These include the placement of clamps on the colonic conduit, the occurrence of kinks, torsion or extrinsic compression (narrow thoracic inlet, subxiphoid space or aortic arch) or undue tension on the conduit and occurrence of shock or prolonged hypotension and dehydration in the immediate postoperative period.

Refinements of the surgical techniques of colon interposition can also largely contribute to improvement of the outcome of that operation. The use of an adequate length of the colon where by redundancy or otherwise tension on the suture line leading to cervical anastomotic leaks is emphasized. (19) In our department, like others (20) the construction of the length of the colonic graft equal to the gap between the esophagus above the stricture and the stomach as well as fixation of the graft to the neck muscle reduced the incidence of late colonic redundancy and decrease tension over suture line at colo-esophageal anastomosis respectively. Estimation of the length of the colonic segment to be used taking into account the length of its vascular pedicle where by in relation to the latter an unnecessary long proximal segment and short distal segment are avoided. Furthermore, technical overenthusiam in terms of placement of too much sutures at the anastomotic lines should be avoided to prevent local ischemia leading to anastomotic leak, breakdowns or strictures. Some workers advised the use of a sleaving anastomosis to prevent anastomotic breakdown and strictures (21), others used end to side esophago-colic anastomosis to decrease the incidence of postoperative leak and late stenosis(20). In our department, the increased incidence of anastomotic leak and late stricture (56% and 25% respectively) led us to use the end to side esophago-colic anastomosis instead of the routinely done end-to-end anastomosis in the early trials.

Some workers claimed that, the location of colo-gastric anastomosis may have some bearing on the occurrence of gastro-colic reflux with the result of colo-gastric stricture as well as peptic ulceration of the interposed colon (22), they advised that anastomosis should be performed as high as possible in anterior wall of the stomach to prevent reflux. In our series, we performed anterior colo-gastric anastomosis to all patients.

Infection has also been incriminated as an important factor responsible for some of postoperative complications of colon interposition. Some workers reported the frequent occurrence of infection after colon surgery in general, they attributed it into a number of factors namely; remote foci of infection, prolonged operations and prolonged preoperative hospitalization (23). As far as colon interposition is concerned, in our belief, there are certain precautionary measures which when followed can significantly reduce the incidence of infective complications, these include proper preoperative preparation of the colon. the routine use of side drapes to avoid contamination of the wound with colonic and esophageal contents, the routine use of postoperative broad spectrum

antibiotics and the prompt control of chest infection before operation.

Finally, although the morbidity rate in this study was high, yet, most of the complications encountered were either transient, non serious or easy to manage. The incidence of serious complications such as colon necrosis which was encountered in early operations were rather low as compared to other reported series (17,24). Moreover, some of the complications reported in the literatures were not, met with in the present series, these include esophageal cyst formation (25), retardation of growth (21) dumping symptoms (1) and gastric mucocele with chronic anemia (14).

In conclusion, one can assume that, colon interposition is still one of the most gratifying operations where by a durable and adequately functioning esophageal substitute is provided. The corner stone of success of that operation lies in reducing its morbidity and mortality which can be achieved by a thorough understanding of the complications of this procedure which will enable us to avoid many of them or to deal with them more efficiently in future.

References

1. Hulya Z, Gundogdu F, Nabil Buyukpan KU. Colonic replacement for the treatment of caustic esophageal stricture in children. J Pediat Surg 1992;27 (6):771-4.
2. Anderson KD. Esophageal substitution. In Holder TM, Ashcraft KW. Pediatric Surgery. Philadelphia PA, Saunders, 1980;284-291.
3. Azar H, Cripsin R, Waterstone DS. Esophageal replacement with transverse colon in infants and children. J Pediatric Surg 1971;6:3-6.
4. Berkowita WP, Raper CL, Spector GJ. Surgical management of severe lye burns of the esophagus by colon interposition. Ann Oto Rhinol Laryngol 1975;84:576-82.
5. Blanchard H, Roy CC, Perrealut G. Retrosternal esophageal replacement in 18 children. Can J Surg 1972;15:137-145.
6. Hendern WM, Hendern WG. Colon interposition for esophagus in children. J Pediatr Surg 1985;20:134-8.
7. Anderson KD, Randalph JG. Gastric interposition: A satisfactory alternative to colon for esophageal replacement in children. Ann Thorac Surg 1970; 75: 521-5.
8. Dwidar ML, Ramadan AA. Acute corrosive esophagitis. Bull Alexandria Fac Med 1967;3:251-3.
9. Ragheb MI, Ramadan AA, Khalil M.A.Management of corrosive esophagitis. Surgery 1967,79:494-6.
10. De Meester T, Johnson KE, Franze I, Eypasch E, Zaninotto G. Indications, surgical techniques and long term functional results of colon interposition. Ann Surg 1988,08:460-73.
11. Berkowitz WP, Roper CL, Spector EJ. Surgical management of severe lye burns of the esophagus by colon interposition. Ann Otol 1975;84:578-78.
12. Gaisert AA, Mathisen DJ, Grillo HC. Short segment intestinal interposition of

distal esophagus. J Thorac Cardiovasc Surg 1993; 106 (5):860-6.

13. Chien TK, Wang PY, Lak S. Esophagoplasty for corrosive stricture of the esophagus : An analysis of 60 cases. Ann Surg 1974;179:510-13.

14. Wu MH, Lar WW. Esophageal reconstruction for esophageal strictures or resection after corresive injury. Ann Thorac Surg 1992;53 (5):798-802

15. Ming-Howa, Wu Weilai, Mu Yenlin. Prevention and management of strictures after hypopharyngocolostomy or esophago-colostomy. Ann Thorac Surg 1994;58:108-11

16. Nick SR. Colonic replacement of the esophagus: Some observations on infarction and wound leakage. Brit J Surg 1987;54:124-8

17. Wilkins EW. Long segment colon substitution for the esophagus. Ann Surg 1980;162 (8):722-25

18. Ventemiglia R, Khalil KG, Frazier OH. The role of preoperative mesenteric arteriography in colon interposition. J Thorac Cardiovase Surg 1977;74:98-108.

19. Hendrson RD, Hendrson RF. Surgical management of 100 consecutive esophageal strictures. J Thorac Cardiovasc Surg 1990;99:1-7

20. Bassiouny IE, Bahnassy AF. Transhiatal esopagectomy and colic interposition for caustic esophageal stricture. J Pediat Surg 1992;27 (8): 1091-5

21. Schillaci A, Cavallaro A, Stipa S. Comparative results of three different techniques for colonic anastomosis in dogs. Surg Gyn Obstet 1979;149:238-41

22. Othersen HB, Clatwarthy HW. Functional evaluation of esophageal replacement in children. J Thorac Cardiovase Surg 1967;53:55-57

23. Altemeier WA, Hummel RP, Hill EO. Prevention of infection in colon surgery. Arch Surg 1976;93:326-9

24. Huguier M, Gorolin F, Maillard JN. Results of 117 esophageal replacements. Surg Gyn Obstet 1970;130:1954-58

25. Hong PW, Seel DJ. The use of colon in the surgical treatment of benign strictures of the esophagus. Ann Surg 1984; 190:202-6.

A Comparison Between Left Atrial and Superior Septal Approach for Mitral Valve Surgery.

ABSTRACT

This study included 84 patients who underwent mitral valve surgery. Patients were divided into two groups. Group I included 45 patients in whom the conventional left atrial approach was used and group II included 39 patients who underwent mitral valve surgery through a superior septal approach. our study was designed to compare the conventional left atrial approach versus the superior septal approach on mitral valve operations.

We found that the maintenance of sinus rhythm; the incidence of postoperative rhythm disturbance and development of atrioventricular block were not significanty different between both groups. No significant blood loss was found between the two groups. Also no residual atrial septal defect was detected in patients with superior septal approach. Longer cardio pulmonary bypass and cross clamp times were reported in group II (In group II mean 101.5 min & 74.9 min respectively while in group I mean 65.5 & 46.6 respectively).

From our study we concluded that the safety of the superior septal approach as a routine incision should be more evaluated by a larger number of patients. But, this approach provides optimal exposure of the mitral valve and the subvalvular apparatus in every anatomic situation.

Mohammad Abdel Alim, M.D., Ihab ElShihy, M.D., Wagih El-Boraey, M.D., Ashraf Helal, M.D. and Said Abdel - Aziz M.D.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

The approach of the mitral valve is through one of several different cardiac incisions. The choice of incision is varied because of differences in atrial anatomy and body habitus of the patient. The standard approach which is through a longitudinal left atrial incision may not provide optimal visualization , especially in patients with a deep chest or small left atrium (Smith, 1992)(1).

On the other hand the superior septal approach by an incision in the roof of the left atrium between the aorta and superior vena cava gives excellent exposure of the mitral valve and its subvalvular apparatus in every anatomic situation ; however, the risk of transecting the sinus node artery and the internodal pathways and the need to reconstruct the wall of the atria and the interatrial septum were considered important limitations to its routine use.

In our present study we compared the use and outcomes of the superior septal approach with those of the traditional left atiral incision in patients undergoing mitral valve surgery.

Cardio - Thoracic Surgery Department, Kasr El Aini, Faculty of Medicine, Cairo University.

Material and Methods

The study was conducted on 84 patients who underwent mitral valve surgery in 2 years duration. Surgery was done using either the conventional left atrial approach or the superior septal incision. Particular attention was paid to all surgical problems and complications that arose related to the atrial incision. The cardio-pulmonary bypass and cross - clamp times, postoperative blood loss, and alteration in cardiac rhythm were compared in both groups.

The patients were divided into two groups. Group I included 45 patients with standard incision while group II included 39 patients with superior septal incision.

Preoperatively, all patients in both groups underwent a thorough clinical examination ; twelve - leads ECG ; chest X-Ray P-A and lateral views; echocardiography and cardiac catheter for patients above 50 years old .

Both groups were compared in terms of age, sex distribution functional status, dimension of the left atrium mean ejection fraction, presence of tricuspid insufficiency and pulmonary artery systolic pressure.

In the conventional left atrial incision used in group I the incision was made parallel to the interatrial sulcus. It started from the superior vena cava and extended inferiorly to the mitral annulus. Closure of the incision was achieved using 2/0 polypropylene running sutures started from the two ends of the atriotomy and tied in the midpoint. If a concomitant procedure on the tricuspid valve was planned in any patient in this group, we used the traditional oblique right atriotomy, taking care to avoid the sinus node region.

In group II with the superior septal approach, the right atrium was opened along the anterior aspect of the atrioventricular groove. A 2 to 3 cm. incision was made in the interatrial septum starting from the inferior end of the fossa ovale; the right atriotomy was then extended superiorly between the right appendage and the atrioventricular groove to join the interatrial incision. At the point where the two incisions meet, the roof of the left atrium was opened for 4 to 5 cm. Closure was performed using 4-0 poly propylene running sutures; first we closed the roof of the left atrium and then the septal incision. The two sutures were tied where they meet, and the right atrial incision was closed.

In the postoperative period , the type of cardiac rhythm, amount of blood loss and the presence of any complications were reported.

Postoperatively all patients in both groups underwent the following:

1- Twelve - leads ECG during the first 3 postoperative days and just before discharge from the hospital.

2- Two-dimensional echocardiography before discharge. The integrity of the interatrial septeum was carefully investigated in patients of group II

3- Twenty - Four hours holter monitoring.

Follow up was done by clinical examintion, ECG and echocardiography .

In our statistical analysis , we used the student's "t" test for independent samples. Categoric data were examined with contingency tables and X^2 or Fisher's test as appropriate.

Results

The preoperative data for both groups are shown in table 1 The operative data are shown in table (2) and (3) . From table (2) we found that the mean cardio-pulmonary bypass and cross - clamp times in group II (101.5 min and 74.9 min respectively) were significantly longer than in group I (65.5 min and 46.6 min respectively).

In the early postoperative period no statistically significant difference in the cardiac rhythm was found between the two groups among the patients who were in sinus rhythm preoperatively. In group I (13 out of 23) and (9 out of 16) in group II maintained their rhythm at hospital discharge table (5).

The presence of sinus rhythm preoperatively was the only predictive factor of the presence of sinus rhythm at hospital discharge. The type of atrial approach was not found to be associated with the persistence of sinus rhythm at discharge.

The major postoperative complications are shown in table (4). Surgical revision for the control of bleeding was necessary in one case of group I and two cases in group II. The atrial suture line was not responsible for the bleeding in any of the reexplored patients postoperatively .

No statistically significant difference in the blood loss during the first 24 hours postoperatively was found between the two groups .

The mean chest tube drainaje in group I was 415 ml (range, 180 to 1650). The mean chest tube drainaje in group III was 428 nil (range, 175 to 1850) .

We had 3 postoperative deaths. Two cases in group I (4.44 %) and one case in group II (2.56 %

The cause of death was not related to the type of atrial approach. Renal failure and endocarditis were the cause of death in the 2 patients of group I ; while low cardiac output was the cause of death in one patient in group II.

Discussion

Adequate exposure of the mitral valve and the subvalvular apparatus is the corner stone in the success of mitral valve surgery. Exposure of the mitral valve for replacement is critical if it is calcified or if a previous prosthesis has to be removed. Visualization of the mitral valve and its subvalvular apparatus can be difficult in patients with deep chest, small left atrium, and / or adhesions. In such circumstances the conventional left atriotomy may not provide adequate exposure. Several alternative surgical approaches had been described to overcome these problems (Kon et al, 1993)(2). Ien 1991 Guiraudon and his associates proposed an "extended vertical transatrial septal incision". This approach provides optimal exposure of both the mitral valve and its apparatus. The need to transect both the sinus node artery and part of the internodal pathway, may lead to postoperative rhythm disturbances. They assumed that the need to reconstruct both the wall of both atria and the septum may lead to excessive postoperative bleeding and laceration of the atrial wall (Guiraudon et al, 1991)(3).

Table (1): Preoperative data:

RESULTS

Table (1): PREOPERATIVE DATA:

	DATA	Group I	Group II	Pvalue
Sex :				
	• MALE	25	24	NS
	• FEMALE	20	15	NS
AGE :				
	(Years)			
	• RANGE	15-47	17-42	NS
	• MEAN	28 ± 4	25 ± 3	NS
SYMPTOMS	:			
	• SHORTNESS OF BREATH			
	• NYHA II	10	9	NS
	• NYHA III	28	21	NS
	• NYHA IV	7	9	NS
	• HAEMOPTYSIS :	8	7	NS
RHYTHM :				
	• Sinus Rhythm	23	16	NS
	• Atrial Fibrillation	21	22	NS
	• Junctional rhythm	1	1	NS
ECHOCARDIOGRAPHY				
	LEFT ATRIUM			
	• Range	42-120	42-95	NS
	• Mean	56.4±11	50.4±10	NS
	TRICUSPID REGURGE	23	18	NS
	EJECTION FRACTION			
	• Range	0.35-0.83	0.25-0.80	NS
	• Mean	0.56±12	0.55±10	NS
	SYSTOLIC PULMONARY ARTERY PRESSURE			
	• Range (mmHg)	28-110	30 - 95	NS
	• Mean	53±16	50±15	NS

NS = Not significant

Table (2): Operative data

OPERATIVE DATA	GROUP I	GROUP II	T value	P value
Cardio-Pulmonary bypass time (min.)			0.845	> 0.05
Range	31-133	53 - 170		
Mean	65.5	101.5		
Aortic cross-clamp time (min.)			0.337	> 0.05
Range	30- 87	31 - 134		
Mean	46.6	74.9		

Table (3): Surgical procedures

SURGICAL PROCEDURE	GROUP I	GROUP II
Mitral valve replacement	26	29
Mitral valve replacement + tricuspid repair	9	5
Mitral valve repair	10	5

Table (4): Postoperative complications

COMPLICATIONS	GROUP I	GROUP II	X^2
low cardiac output	3	2	NS
Renal failure	1	-	NS
Cerebral stroke	1	-	NS
Prolonged ventilation (>24h.)	2	1	NS
Sepsis	2	1	NS
Complete A-V block	2	1	NS

Table (5): Rhythm disturbance

GROUP	TYPE OF RHYTHM							
	SR		AF		JR		AVB	
	No.	%	No.	%	No.	%	No.	%
• Group I								
Preoperative	23	51.11	21	46.67	1	2.22	-	-
On discharge	13	28.88	28	62.22	3	6.66	1	2.22
• Group II								
Preoperative	16	41.02	22	56.41	1	2.56	-	-
On discharge	9	23.07	28	71.79	1	2.56	1	2.56

SR = Sinus Rhythm. **AF = Atrial Fibrillation**
JR = Junctional Rhythm. **AVB = Atrio-Ventricular Block.**

The exact role of sinus node ischaemia and the lesion in the interatrial pathways in influencing cardiac rhythm is not definitely understood, though experimental data indicate a possible influence of sinus node artery lesions on cardiac rhythm. The clinical observations in patients who underwent Mustard or Fontan procedure seem to confirm this (Tamiya et. al., 1992)(4). On the other hand , the results of transplantations, the surgical treatment of Wolff - Parkinson - White syndrome and other experimental trials contradicts this hypothesis (Kon et. al. , 1993).

Also, Smith (1993) reported that transection of the sinus node artery and part of the internodal pathways leads to minor rhythm disturbance. These minor alterations do not seem to have major clinical implications, (Smith 1993) (5).

In our experience the use of the superior septal approach was not associated with a significantly higher incidence of postoperatrive arrhythmias as compared with the incidence associated with the traditional left atrial approach (40% versus 43.48% respectively). The percentage of patients who were in sinus rhythm preoperatively and who maintained their rhythm at discharge was similar in both groups.

Berreklouw et. al. (1991)(6) reported a series of 22 patients who underwent mitral and tricuspid valve procedures using the superior septal approach. No major postoperative complications were reported, and all patients in sinus rhythm preoperatively maintained their rhythm postoperatively. Another larger series of 111 patients was reported by Alfieri and associates (1991)(7). They found no major rhythm disturbances or postoperative complications, so they suggested the possibility of routine use of this approach . Similar results were obtained and conclusions drawn by Kon and associates in (1993) .

On the other hand, Smith in 1993 reported a considerable incidence of postoperative arrhythmias in patients in whom the superior septal approach was used and he expressed caution concerning its routine use. The same results were achieved by Kovacs and Szabados in 1994, they reported high incidence of postoperative arrhythmias with the superior septal approach, leading them to suggest the use of this approach in very selected cases (Kovacs and Szabados, 1994)(8). In 1995 the same conclusions were reported by Kumar et. al (9).

In our study we did not have major complications during the postoperative period such as blood loss from the atrial suture and / or residual atrial septal defect in group II. The only significant difference between both groups was the longer cardiopulmonary bypass and cross-clamp times in the superior septal approach group. This may be improved by more experience with that approach.

In our series, because of the quite small number of patients in whom we used the superior septal approach and lack of long term follow up of the patients, we had no definite conclusions to be drawn concerning the effectiveness and safety of the superior septal approach. However, regarding exposure of the mitral valve and its subvalvular apparatus it is defenitly better than the conventional left atrial approach in all situations evaluate its safety in mitral valve surgery. The superior septal approach has some advantages over the conventional

left atrial approach. It gives better exposure in every anatomic situation especially in patients with small left atrium and in patients undergoing redo surgery. Minor rhythm disturbance and longer operative time were the only disadvantages of the superior septal approach. Provisionally these minor limitations of this approach are largely outweighed by the optimal exposure of the mitral valve and its subvalvular apparatus, neverthless, its routine use should be more investigated to be sure of its safety regarding arrhythmias.

References

1. Smith, C.R.: Septal-superior exposure of the mitral valve. J. Thorac. Cardiovasc. Surg.; 103:623-8, 1992.
2. Kon, N.D.; Tucker, W.Y; Mills, S.A.; Lavender S.W. and Cordell, A. R. : Mitral valve operation via an extended transseptal approach. Ann. Thorac. Surge.; 55: 1413-7, 1993.
3. Guiraudon, G.M.; Ofiesh, J.G. and Kaushik, R.: Extended vertical transatrial septal approach to the mitral valve. Ann. Thorac. Surg.; 52:1058-62,1991.
4. Tamiya, T.; Yamashiro, T.; Hata, A.; Kuge, K; Asano, S. and Sato, T. Electrophysiological study of dysrhythmias after atrial operations in dogs. Ann. Thorac. Surg.; 54:717-24, 1992.
5. Smith, C.R.: Efficacy and safety of the superior-septal approach to the mitral valve. Ann. Thorac. Surg. ; 55:1357-8, 1993.
6. Berreklouw, E.; Ercan, H. and Schonberger, P.: Combined superior transseptal approach to the left atrium. Ann. Thorac. Surg.; 51 : 193-5, 1991.
7. Alifieri, O.; Sann\drelli, L.; Pardini, A. and David, T. E. Optimal exposure of the mitral valve through an extended vertical transseptal approach. Eur. J. Cardiothorac. Surg.; 5 : 294-9, 1991.
8. Kovacs, G-S. and Szabados, S.: Superior septal approach to the mitral valve. Ann. Thorac. Surg. ; 57: 516-24, 1994.
9. Kumar, N.; Saad, E.; Parbhakar, GT.; De vol, E. and Duran, C.M.G.: Extended transseptal versus conventional left atriotomy: early postoperative study. Ann. Thorac Surg.; 60: 426-30, 1995.

De Vega Repair Versus Segmental Annuloplasty for Tricuspid Regurgitation

ABSTRACT

Sixty patients with functional tricuspid regurgitation due to rheumatic left sided valve lesion were included in this prospective study. Operative correction of the left sided valve lesion was performed for all patients. Regarding the tricuspid regurgitation (TR), the patients were divided into 3 groups, each consists of 20 patients .

The patients of group I were having mild to moderate TR grade I and II which was managed conservatively. Group II patients were having severe TR grade III and IV for which De Vega repair was done. Group III patients were having severe TR grade III and IV for which segmental annuloplasty was done.

All patients were subjected to preoperative, early postoperative (after one week) and late postoperative (after six months) evaluation including clinical examination, liver functions, ECG, chest X-ray and echocardiography.

The late postoperative evaluation revealed 60% of group I patients had no TR while 25% had TR grade I and 15% had TR grade II. Group II patients had 75% with no TR, 20% with TR grade I and 5% with TR grade II. Group III patients had 85% with no TR, and 15% with TR grade I.

We conclude that conservative management should be restricted to patients with mild (grade I) TR only and for moderate and severe TR (grade II, III, and IV) repair is mandatory. Both De Vega repair and segmental repair of the tricuspid valve are easy, safe, and of good early postoperative results, but segmental repair has better late results than De Vega repair.

Khalaf SA, MD, Mowafey AA, MD, Gayyed NL, MD, and El Gamal MF, MD.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

Despite efforts to identify patients who require tricuspid repair (TR) with correction of mitral valve disease, there remains disagreement as to what constitutes the optimal treatment of TR. (1) Tricuspid valve replacement was used to correct TR but this was limited because of high thrombotic complications in the implanted prosthesis. (2) Annular ring insertion was used to correct for TR. (3) DeVega repair (semicircular annuloplasty) is one of the simplest and easiest methods for tricuspid repair. (4) Also , segmental annuloplasty is another safe and simple method for tricuspid repair. (5)

The treatment of functional TR in patients who have mitral valve disease remains controversial because of spontaneous regression of mild TR (grade I and II) in many cases after correction of the mitral valve disease but spontaneous regression of significant TR (grade III and IV) in these cases is impossible and tricuspid repair is inevitable. (6)

Department of Cardiothoracic Surgery, Mansoura University.

The aim of our study is to assess the conservative management of functional TR in patients with grade I and II tricuspid regurge after correction of mitral valve lesions and to compare between two methods of tricuspid repair; i.e. DeVega and segmental annuloplasty in patients with grade III and IV tricuspid regurge after correction of mitral valve lesion.

Patients and Methods

Our prospective study included sixty patients with tricuspid valve disease associated with mitral valve disease with or without aortic valve disease.

These patients were admitted and operated upon in the Cardiothoracic Surgical Department Faculty of Medicine, Mansoura University between January 1996 to January 1998 . According to the severity of TR and mode of treatment , the patients were divided into 3 group:

Group I included 20 patients with grade I-II tricuspid regurge in whom the tricuspid valve was managed conservatively after correction of the left sided valve lesion.

Group II included 20 patients with grade III-IV tricuspid regurge. These patients were managed by DeVega repair with surgical correction of the left sided valve lesion.

Group III included 20 patients with grade III-IV tricuspid regurge. These patients were managed by segmental repair with surgical correction of the left sided valve lesion.

The sex and mean age distribution of the patients is shown in table 1.

Different types of left sided valve surgery were done for all patients including open mitral valvotomy in 8 patients, mitral valve replacement in 42 patients, mitral valve repair in 6 patients, and mitral and aortic valve replacement in 4 patients.

Preoperative evaluation :

For all patients, preoperative evaluation was done including clinical examination routine hematologic study, liver functions, renal functions, ECG, chest X-rays, and echocardiography including M-mode, 2D, pulsed Doppler, colored Doppler, and TEE. If the regurgitant jet reaches to 1/4 of RAD (right atrial diameter), it is grade I, If it reaches 1/2 of RAD it is grade II, if it reaches to 3/4 of RAD it is grade III, if it reaches to the free RA wall or if there was systolic gap, it is grade IV TR.

Intraoperatively and before insertion of the superior vena caval cannula, the degree of TR was evaluated by finger palpation through the right atrial appendage where the diameter of the tricuspid ring is evaluated and the regurgitant jet is estimated. Dilatation of the right atrium with thinning of its wall, as well as high ossicilation of blood in the superior vena caval cannula indicated severe TR.

Surgical procedure:

After completion of the left sided valve surgery, deairing of the left ventricle and removal of the aortic clamp, the following was done:

1- In the conservation group (group I with grade I-II TR) the tricuspid valve was not repaired, but the degree of TR was reassessed on a beating heart to check its response to the correction of the left sided valve lesion. This was done by a finger inserted in the small right atrial appendage incision after removal of the superior vena caval cannula.

Table 1: Sex and mean age distribution of the patients.

Group	Group I	Group II	Group III
Sex			
Male	6 (30%)	8 (40%)	7 (35%)
Female	14 (70%)	12 (60%)	13(65%)
Mean age (years)	25.26 ± 4.32	26.30 ± 4.25	25.64 ± 4.29

2- In the De Vega repair group (group II with grade III-IV TR) The right atrium was opened on a beating heart using a longitudinal incision I cm. parallel to the atrioventricular groove. A suture of 2/0 polypropylene was passed through a pledget of Teflon, and the suture line was begun near the commissure between the anterior and septal leaflets. Deep bites were taken just into or near the annulus as the suture line proceeded laterally around the anterior and posterior leaflets. Near the commissure between the posterior and septal leaflets the suture was passed through another Teflon pledget and was carried back to its origin taking bites just outside the first suture line. A valve sizer appropriate to the patients size was placed in the annulus for calibration. The suture was then tied over the medial pledget as the suture was gathered and the annulus was brought against the sizer.

3- In segmental repair group (group III with grade III-IV TR), the right atrium was opened same way like that used in group II and the tricuspid ring was carefully identified by gentle traction of the anterior leaflet using a valve hook, then the area of annulus corresponding to the anterior and posterior leaflets was repaired after placement of a valve sizer appropriate to the patients size in it. Usually 5 to 6 interrupted polypropylene 2/0 transverse mattress sutures on Teflon pledgets were used, the first one at the commissure between the posterior and septal leaflets then the rest of the suture is proceeded in an anticlock wise manner till the last one at the commissure between the anterior and septal leaflets. This was done to avoid injury of the coronary sinus and AV node. The sutures were then tied in consequence with the sizer in place to prevent over or under correction.

After completion of the repair of the tricuspid valve in group II and III, the competence of the valve was tested by injecting saline into the right ventricle with a large bulb syringe. After closure of the right atrial incision and discontinuation of cardiopulmonary bypass, the valve was reassessed on a beating heart by a finger inserted in the small right atrial appendage incision after removal of the superior vena caval cannula.

The postoperative evaluation of the tricuspid valve repair was done one week after surgery (early postoperative) and then mon thly in the outpatient clinic (late postoperative). The follow up included clinical, laboratory, radiological, and echocardiographic evaluation.

Results

The follow up data were statistically studied using standard deviation test (SD) and student test (ST) for quantitative

Table II: preoperative, early postoperative, and late postoperative clinical evaluation.

Clinical data	Conservation group I				DeVega repair group II				Segmental repair group III			
Evaluation	Preop.	early postop.		late postop.		Preop.	early postop.		late postop.		Preop.	early postop.		Late postop.	
Jaundice	1	0	NS	O	NS	3	2	NS	0	S	2	0	S	0	S
-Neck vein congection	5	4	NS	1	S	19	16	NS	11	S	20	17	NS	12	S
Mean liver size (in fingers)	2.76±0.74	2.46 ± 0-28	NS	1.37± 0.08	HS	3.55± 0-68	2.50 ± 0-88	HS	1.48± 1-43	HS	3.74 ± 0.58	2.42 ± 0-68 HS	HS	1.38±.0-72	HS
Ascitis	O	O		O		3	O	S	0	S	2	0	S	0	S
Oedmae LL.	3	2	NS	1	NS	8	4	S	2	S	6	2	S	1	S
Tricuspid sytsolic murmur	8	6	NS	3	NS	16	4	HS	3	HS	17	4	HS	2	HS
Dyspnea															
Grade o	0	11	HS	15	HS	0	7	HS	14	HS	0	6	HS	14	HS
Grade I	5	6	S	4	S	2	9	HS	3	HS	3	11	HS	5	HS
Grade II	9	2	HS	1	HS	7	2	HS	2	HS	6	2	HS	1	HS
grade III	4	1	S	0	S	7	2	HS	1	HS	8	1	HS	0	HS
grade IV	2	0	S	0	S	4	0	HS	0	HS	3	0	HS	0	HS
Pulm. Hypertension	6	4	NS	3	NS	14	14	NS	9	S	14	13	NS	9	S
RT. Ventricular enlagement	7	6	NS	3	NS	17	17	NS	11	S	18	18	NS	9	HS

Table III: preoperative, early postoperative, and late postoperative liver function studies.

	Conservation group I			Late postop.		DeVega repair group II			late postop.		Segmental repair group III			late postop.	
	Preop.	Early postop.				Preop.	Early postop.				preop.	Early postop.			
S.albumin gm%	3.50 ±0.28	3.45 ±0.50	NS	3.62 ±0.23	NS	3.24 ±0.32	±3.48 ±0.26	HS	3.66 ±0.40	S	3.26 ±0.24	3.52 ±0.15	HS	3.78 ±24	HS
S bilirubin mg%	0.91 ±0.12	0.93 ±0.24	NS	0.90 ±0.33	NS	1.24 ±0.34	0.98 ±0.24	S	0.91 ±0.38	NS	1.22 ±0.54	0.92 ±0.02	S	0.91 ±0.12	NS
SGPT U/L	28.20 ±4.25	30.28 ±4.25	NS	27.52 ±3.25	NS	34.73 ±7.21	36.84 ±6.22	NS	30.24 ±0.73	NS	33.88 ±6.92	31.75 ±5.85	NS	32.68 ±6.08	NS
SGOT U/L	30.32 ±5.22	30.88 ±6.22	NS	29.39 ±4.53	NS	36.34 ±5.22	35.82 ±2.08	NS	31.29 ±0.88	NS	35.54 ±5.38	32.62 ±6.22	NS	33.58 ± 5.95	NS

Table IV: Preoperative, early postoperative, and late postoperative chest X-ray findings.

	Conservation group I				DeVega repair group II				Segmental repair group III			
	Preop.	early postop.		late postop.	Preop.	early postop.		late postop.	Preop.	early postop.		late postop.
Mean CTR%	68.94+ 784	68.88+ 6.96	NS	62.98+ 7.84	70.88 +6.36	70.25+ 5.88	NS	64.94+ 7.40	71.24+ 5.95	70.98+ 5.84	NS	63.56+ 6.22
Chamber enlargement												
LA	16	16	NS	8	19	18	NS	12	20	19	NS	11
RA	12	12	NS	5	17	16	NS	10	18	18	NS	9
RV	13	13	Ns	6	19	19	Ns	11	19	19	NS	10
Pulmonary hypertension	10	9	NS	6	18	18	NS	14	19	19	NS	15
Pleural effurion	0	0	NS	0	4	3	NS	1	3	0	S	0

	HS	HS	HS	HS	HS	S	S

Table V: Preoperative, early postoperative, and late postoperative echocardiographic findings.

	Conservation group I				DeVega repair group II				Segmental repair group III			
	Preop.	early postop.		late postop.		Preop.	early postop.		late postop.		Preop.	early postop.		late postop.	
Mlean LAD (in cm)	6.88 ± 1.33	5.44±1.2	S	5.15± 1.35	S	7.05± 0.88	6.40± 0.75	S	5.62± 0.88		7.10± 0.92	6.34± 0.88	HS	5.78 ± 0.74	HS
RVD	2.18 ± 0.38	2.05±0.28	NS	2.01± 10.22	NS	2.86± 0.48	2.75± 0.42	NS	2.60±0.54	L.S	2.91± 0.50	2.80± 0.28	NS	2.58± 0.34	S
LVES	3.4 ± 0.52	3.38±0.48	NS	3.12± 0.24	NS	3.89± 0.65	3.85± 0.58	NS	3.62± 0.42	NS	3.90± 0.93	3.89± 0.38	NS	3.64± 0.28	S
LVEDD	5.45 ± 2.81	5.37± 0.56	NS	5.15± 0.37	NS	5.57± 0.40	5.50± 0.26	NS	5.45± 0.55	NS	5.60± 0.34	5.58± 0.42	NS	5.50± 0.54	NS
F.S.%	30.87 ± 2.81	28.22±2.25	S	32.92± 2.11	S	32.42± 3.50	30.78±1.86	S	34.18± 2.04	HS	32.56±3.67	30.48±2.02	S	34.22± 1.98	HS
Grade of TR. (No.of patients) 0	-	9		12		-	14		15		-	16		17	-
I	12	6		5	S	-	4		4		-	4		3	
II	8	5	S	3		-	2	S	1	S	-	-	S	-	S
III	-	-		-		13	-		-		12	-		-	
IV	-	-		-		7	-		-		8	-		-	
PH (No . of patients) mild	15	16		19	S	-	14	S	15	S	-	15	S	16	S
moderate	5	4	NS	1		14	6		5		13	5		4	
severe	-	-		-		6	-		-		7	-		-	

values, and sign test (+ve or -ve), chi-square test (X^2),and fischer exact test for qualitative purpose comparison. The threshold of significance was fixed at the 5% level where $P>0.05$ the difference was not significant (NS), $P<0.05$ the difference was significant (S), and $P<0.01$ the difference was highly significant (HS).

The following tables (II, III, IV and V) show the early and late postoperative evaluation data of the three groups (conservation group I, De Vega repair group II, and segmental repair group III) compared to the preoperative data with its statistical significance.

Discussion

The tricuspid valve is the largest valve in the heart with a surface area of about 10.5 cm^2. Tricuspid regurgitation (TR) may be organic due to trauma, endocarditis, and as a part of Ebstein malformation.(7, 8, 9) In patients with rheumatic heart disease it may be organic, but mostly it is functional. The degree of functional tricuspid regurgitation is related to the severity and duration of mitral valve lesion, the severity of pulmonary hypertension, and the degree of right ventricular dilatation.(10)

The importance of tricuspid repair emerged after follow up of many cases of mitral valve replacement or repair where the patient did not improve, or even deteriorated, and the course was neglicance of tricuspid repair. (11) The goal of treatment of TR is reconstruction rather than replacement due to many complications associated with the prosthesis. The valve can be repaired in almost all cases with excellent results. (2) Patients with mitral valve disease, severe TR, and severe pulmonary hypertension with alteration of liver functions should be operated upon as rapidly as possible after optimal preparation to avoid the load on the liver. (3)

Pulsed wave Doppler is a sensitive way for diagnosis and assessment of the severity of TR, by identification of the turbulence produced by the TR and measurement of its extent into the right atrium. (12)

In all surgical procedures done for rheumatic left sided valve lesions, digital palpation for the tricuspid valve through the right atrial appendage before insertion of the superior caval cannula gives the final assessment of the valve condition and whether it is in need for repair or not.(13)

In our study, the annulus just admitted 2 fingers in group I and admitted more than 2 figures in group II and III. The degree of TR can also be assessed by the jet of regurge through the right atrium. (14) Digital palpation of the tricuspid valve after discontinuation of cardiopulmonany bypass allows assessment of the valve response to the correction of left sided valve lesions as well as to the tricuspid valve repair. (15)

In our study a minimal jet was found in 20% of patients in group I, while in group II a mild jet was found in 15% of patients and in 20% of patients in group III after repair. The mild jet was neglected for fear of overcorrection.

Moderate and severe TR secondary to rheumatic valve disease is considered to be a serious condition for which an appropriate surgical management is recommended at the time of mitral valve surgery. (3,16)

The optimal method for managinge functionl TR remains controversial, whether to conserve or to operate, and whether to repair or to replace. The multiple procedures for tricuspid repair denote that none of them is completely perfect. (17) The aim of the different methods used for tricuspid repair is to narrow the dilated annulus, maintain the leaflet length and function and preserve the course of the conductive tissue from the atrium to the ventricle .(3)

Grath and his colleagues found that non operative management of functional TR have similar results to those achieved by various tricuspid repair techniques, and estimated 40% late mortality after tricuspid repair. (18) However, the majority of recent publications do not match with those statements .(2, 5, 12)

Conservative management for mild TR was assessed by different authors. Broker and colleagues at 1976 used it for 21 patients with satisfactory results. (13) Duran and colleagues in 1986 and in 1993 used it for mild to moderate valve legion . (19, 20)

We used conservative management for TR in 20 patients with Grade I to II TR with correction of the left sided lesion (group I). Our results showed 60% of patients to have no TR after surgery while 25% had grade I TR and 15% had grade II TR. The early follow up showed highly significant improvement of dyspnea and non significant improvement of other parameters. Six month follow up showed highly significant improvement in liver size and significant improvement in dyspnea, LVESD, LVEDD, and FS, reflecting improvement of LV function, with nonsignificant improvement in RVD and PH. These results suggest to do repair of tricuspid valve for grade II TR, and to use conservative management for only grade I TR.

De Vega annuloplasty for TR was reported to be a simple and safe method with good early postoperative results, but with unsatisfactory long-term results. (17,21) It was first used by De Vega in 1975 in 155 patients with good results expect one patient who had partial detachment of the sutures. (4) This was since then, followed by many other authors who used this technique or its modifications for the repair of functional TR. (22, 23, 24, 25, 26) Rivera and colleagues reported that there is 1/3 to 12 of patients having De Vega repair will have recurrent significant TR on the longterm follow up, (23) while others reported only 5% incidence of severe TR requiring surgical reintervention. (24, 26)

In our 20 patients for whom De Vega repair was done for TR, there was no recurrence of TR as we used deeper bites in the annulus in an alternative sequence.

Mc Grath et al 1990 reported that De Vega repair was associated with a higher risk of hospital death than simple plication.(1) De Vega et al 1975 reported 9% mortality and Duran et al 1986 reported 8.4% mortality. (4, 19)

In our study there was no mortality related to the repair itself. In many publications the mortality is excluded because the cause of death is usually not related to the tricuspid valve but related to other factors such as right ventricular failure and low cardiac output.

In our study, the 20 patients of TR grade III and IV (group II) repaired by De Vega

technique showed in the early follow up a highly significant improvement in the tricuspid systolic murmur, mean liver size, serum albumin, and functional class of dyspnea, significant improvement in ascites, leg edema, serum bilirubin, LAD, FS, and PH and nonsignificant improvement in neck vein congestion, jaundice, ECG, X-ray picture, RVD, LVESD, and LVEDD. In the late follow up there was highly significant improvement in tricuspid systolic murmur, mean liver size, ECG, and radiology, significant improvement in jaundice, neck vein congestion, ascites, leg edema, functional class of dyspnea, PH, and LVESD, and non significant improvement in serum bilirubin, RVD, and LVEDD. There was no residual TR in 75% of patients, mild TR in 20% of them and moderate TR in only 5%.

In 1989 Revuelta and Garcia Rinaldi suggested the technique of segmental tricuspid annuloplasty to achieve annular reduction and compensate for suture tearing which was the main disadvantage for the De Vega Repair. (27, 28) If one suture fails, the others will be there to prevent severe TR. (27) However, still the openions differ about the best way to render the tricuspid valve competent without causing stenosis.(29)

Segmental tricuspid annuloplasty carries the advantage of the more expeditions one suture, one knot, while still securing the periannular tissue.(5)

We used segmantal tricuspid arnuloplasty for 20 patients with grade III and IV TR (group III), and in the early follow up they showed highly significant improvement in systolic tricuspid murmur, mean liver size, functional class of dyspnea, serum albumin, and LAD, and significant improvement in ascites, leg edema, jaundice, serum bilirubin, FS, and PH, and nonsignificant improvement in neck vein congestion, radiography, ECG, RVD, LVESD, and LVEDD. In the late follow up there was highly significant improvement in the tricuspid systolic murmur, mean liver size, functional class of dyspnea, ECG, radiography, serum albumin, PH, RVD and LAD, significant improvement in ascites, leg edema, jaundice, neck vein congestion, and LVESD, and nonsignificant improvement in serum bilirubin and LVEDD. There was significant improvement in both the early and late postoperative follow up with no residual TR in 85% of patients and mild TR in 15% of patients.

Conclusion

From our study we conclude the following:

1- Repair of the tricuspid valve is recommended for cases of functional TR associated with left sided valve lesions.

2- This is highly indicated in cases of moderate and severe TR after correction of the left sided valve lesion, and it can be ignored for cases of only grade I (mild)TR, for which conservative management is restricted.

3- De Vega repair is a simple and safe method for tricuspid repair with good early results, but the late follow up is unsatisfactory for possible suture tearing.

4- Segmental tricuspid aunuloplasty is a safe, simple, and rapid method for tricuspid repair with good early and late

follow up as it avoids the possibility of suture tearing and the risk of atrioventricular block.

References

1- Mc Garth LN, Gonzalez - Laving, Bailey BM, Grynkemeir GL, Fernandez J, Laub GW. "Tricuspid valve operations in 530 patients; Twenty- Five years assessment of early and late phase events". J Thorac Cardiovas Surge. 1990, 99:124.

2- Wei J, Chang CH, Lee F, Lai WK. "De Vegas's semicircular annuloplasty for tricuspid valve regurgitation". Ann Thorac Surg. 1993, 59:482.

3- Kaiser GC and Fiore AC. " Acquired disease of the tricuspid valve" In Glenn's Thoracic and Cardiovascular Surgery; Editor Arthur E. Byaue; Appleton and Lange; Norwalk, Connecticut/ San Mateo, California, 5th edition, chap 115, 1990.

4- De Vega NG, Rabago G, Castillon L, Moreno T, Azpitarte JA." New tricuspid repair. Short-term clinical results in 23 cases." J Cardiovasc Surg. 1975,6:384.

5- Antunes M J." Segmental tricuspid annuloplasty: A new technique." J Thorac Cardiovasc Surg. 1990,100: 321.

6- King RM, Schaff HV, and Danielson GK."Surgery for tricuspid regurgitation late after mitral valve replacement." Circulation. 1984, 70: 193.

7- Sons H, Dausoh W, Kuh JH. "Tricuspid valve repair in right sided endocarditis". J heart valve Dis. 1997, 4: 606.

8- Hetzer R, Nagdymou N, Ewert P, Weng Y G, Alexi MV, Perger F, Basic M, Lauge PE. "A modified repair technique for tricuspid incompetence in Ebstein's anomaly". J Thorac Cardiovasc Surg. 1998, 115: 857.

9- Vargas FO, Mengo G, Grauja MA, Gentile J A, Ranzini ME, Vazguez K. "Tricuspid annuloplasty and ventricular plication in Ebstein's malformation". Ann Thorac Surg. 1998 , 65: 1755.

10- Carpentier A, Deloche A, Hanania G, Forman J, Sellier PH, Diwnica A, Dubost Ch" Surgical management of acquired tricuspid valve disease". J Thorac Cardiovasc Surg. 1974, 67:53.

11- Starr A. "Acquired disease of the tricuspid valve" . Saunder Company. Philadelphia London, Toronto, page 1176,1976.

12- El Said A, Badr M, Ekram S, Shaaban N. "Value of two dimensional echocardiography and colored Doppler flow imaging in the decision of tricuspid valve repair ". Egypt H J. 1993,6:49.

13- Breyer RH, Mc Clenathan JH, Michaelis LL, Mcintoch CHL, Morrow AG. "Tricuspid regurgitation. A comparison of non- operative mangement, tricuspid annuloplasty and tricuspid valve replacement." J Thorac Cardiovas surg. 1976, 72:867.

14- Rackley CE, Wallace RB, Edwards JE, Katz NM. "Tricuspid valve disease: The heart, arteries and veins". Chap 43; th edition, Mc Graw-Hill Information Services Company; NewYork, 1990.

15- Guyton RA and Hatcher CR. "Techniques of valvular surgery: The heart, arteries and veins". Chap 138; 7th edition, Mc Grow-Hill Information Services Company, New York, 1990.

16-Cohen SR, Sell JE, Mcintosh CL, Clark RE. "Tricuspid regurgitation in patients with acquired, chronic and pure mitral regurgitation: Prevalence, diagnosis, and comparison of preoperative clinical and hemodynamic features in patients with and without tricuspid regurgitation." J. Thorac Cardiovasc Surg. 1987, 94:481.

17-Abdel Salam Kh M, and Gheit S. "Conservative management of functional TR in patients with MV surgery". Egypt H J. 1996, 2:87.

18-Mc Garth LN, Gonzalez - Laving, Bailey BM, Grynkemeir GL, Fernandez J, Laub GW. "Tricuspid valve operations in 530 patients; Twenty- Five years assessment of early and late phase events". J Thorac Cardiovasc Surg. 1990, 99:124.

19-Duran CMG, Pomar PL, Collman J, Figuera A, Revuelta JM, Ubago JL. "Is tricuspid valve repair necessary?." J Thorac Cardiovasc Surg. 1980,80: 849.

20-Duran CMG, Kumar N, Prabhakar G. "Vanishing De Vega annuloplasty for functionan tricuspid regurgitation." J Thorac Cardiovasc Surg. 1993, 106:609.

21-Hashimoto K, Arai T, Kurosawa H. "Technical considerations and intermediate-term results with modified De Vega tricuspid annuloplasty. J Thorac Cardiovasc Surg. 1993,5:573.

22-Grondin P, Daude M, Raymond L, Ramiro R. "Carpentier's annulus and De Vega annuloplasty. The end of tricuspid challenge." J Thorac Cardiovasc Surg. 1975,70:852.

23-Rivera R, Duran E, Ajuria M. "Carpentier's flexible ring versus De Vega annuloplasty." J Thorac Cardiovasc Surg. 1985. 89:196.

24-Chidambaram M, Abdulali SA, Baliga BA."Long-term results of De Vega annuloplasty." Ann Thorac Surg. 1987, 43: 185.

25-Arai T, Hashimoto K, Korikoshi S, Matsui M, Suzuki S. "Modification of De Vega tricuspid annuloplasty." J Thorac Cardiovasc Surg. 1991, 102:320.

26-Kamar R. "Segmental annuloplasty versus De Vega annuloplasty in tricuspid regurgitation." The Bulletin of the Egyptian Society of Cardiothoracic Surg. 1995,2:73.

27-Revuelta JM and Garcia-Rinaldi R "Segmental tricuspid annuloplasty: A new technique." J Thorac Cardiovasc Surg. 1989, 97: 799.

28-Frank G. "Segmental tricuspid annuloplasty, revisited." J Thorac Cardiovasc Surg. 1992, 103:1025.

29-Minaldi C, Lambertz H, Nikol S, Gerish N, Messmer BJ. "Selective annuloplasty of the tricuspid valve." J Thorac Cardiovasc Surg. 1990, 99: 846.

Value of Preservation of the Chordae Tendineae During Mitral Valve Replacement

ABSTRACT

The beneficial effects of preservation of the chordae tendineae during mitral valve replacement for patients with mitral regurgitation was studied prospectively by analyzing the results of 44 patients with conventional MVR (group 1), 23 patients with preservation of the posterior chordae only (group 2), and 9 patients with preservation of both the anterior and posterior chordae (group 3). The three groups of patients were similar regarding the demographic, clinical, and echocardiographic parameters. During operation the three groups took nearly the same aortic clamp time (58.86 ± 8.67, 61.06 ± 6.94, and 64.44 ± 5.87 min. respectively) and the same mitral valve size (30 ± 2.45, 29.6-8 ,±2.65, and 29;-1.41 respectively), but the conventional MVR group needed more pump time. In the early post operative period group I needed more ventilation(18.5 ± 2.6, 6.15 ± 1.09, and 5.56 ± 1.23 hours respectively), inotropes (44.1%, 34.8%, and 33.3% respectively), and ICU stay (3.01 ± 0.55, 1.9 ± 0.6, and 1.81 ± 0.37 days respectively), and showed more complications and was the only group having mortality. During the early and six months follow up period, there was a steady improvement in the clinical NYHA class and echocardiographic parameters in the two preservation groups than the conventional MVR group, the later showed early deterioration of echocardiographic parameters and a high percent of clinical regression to a higher NYHA class. These results support the choice of preservation of the chordae tendineae during mitral valve replacement for mitral regurgitation and the best results were those of complete preservation of all the mitral valve apparatus.

Mowafey AA,d MD, Gayyed NL, MD, Khalaf SA, MD Elsaeid MM, MD, and Elsaftey I E* MD.

J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V July No 3.

INTRODUCTION

Mitral valve replacement (MVR) for chronic mitral valve disease with predominant mitral regurgitation still carries a higher risk of morbidity and mortality than other operative cardiac procedures. This higher risk continued inspite of the improvements of myocardial preservation, surgical techniques, prosthetic valves, and perioperative care. (1, 2)

Department of Cardiothoracic Surgery, and Cardiology Unit Faculty of Medicine, Mansoura University.*

The most common cause of morbidity and mortality after conventional mitral valve replacement is pump failure and low cardiac output syndrome. (1,2,3)

Preservation of both mitral valve leaflets and their attached subvalvular system was used on a global scale only after Tirone David and his group in 1984 who demonstrated its beneficial value on the post-operative LV performance after MVR. (2,4)

The aim of this study is to present our initial experience with the technique of

preservation of the posterior and the whole mitral valve apparatus, and to discuss its effect on the left ventricular function in comparison to the conventional technique. Also to find out if this technique needs extra time or skill during the operative procedure or results in any additional side effects.

Patients and Methods

Patient selection

This prospective study included seventy six patients who had chronic severe mitral regurgitation treated by MVR in the Department of Cardio thoracic Surgery, Mansoura University Hospital between November 1994 and February 1998 . Forty four patients had MVR by the conventional method (group I), 23 patients had MVR with preservation of the posterior chordae only (group II), and 9 patients had MVR with preservation of both anterior and posterior chordae tendineae (group III).

The clinical and the echocardiographic parameters of all patients showed severe (grade III and IV) mitral incompetence with its ill effects on the left ventricular haemodynamics, this is shown in table 1 and table 2.

LVEDD: Left ventricular end diastolic diameter, LVESD: Left ventricular end systolic diameter, FS: Fractional shortening, and EF: Ejection fraction. .

Excluded from this study are (1) patients who had previous open or closed cardiac operation, (2) patients who had other cardiac lesion to be corrected during mitral valve replacement except for tricuspid valve repair by segmental annular plication or De Vega annular suture in patients in whom tricuspid valve regurgitation was assessed by echo - Doppler to be more than moderate in severity. Tricuspid repair was done for 7,4, and 2 patients in the three successive groups respectively, (3) patients requiring re-replacement due to prosthetic valve malfunction, (4) patients whose lesion is predominately mitral stenosis as this lesion protects the left ventricle from excessive dilatation, (5) patients with excess pulmonary hypertension above 70 mmHg, as the elevated pulmonary vascular resistance will preclude the beneficial results of chordal preservation on the ventricular functions on the short term analysis of the study.

Operative details

Both St. Jude Medical and Carbomedics bileaflet prosthetic mitral valves were used in the patients in this study on a random basis. St. Jude valve was used for 36 patients and Carbomedics valve was used for 40 patients. Cold crystalloid cardioplegia (St. Thomas,) was used for all patients in this study, cardioplegia was infused in the aortic root every 35 minutes or on appearance of electrical activity which is earlier. Moderate systemic hypothermia (25 to 28°C) was used with continuous cross clamping in all patients.

In the conventional MVR group (group I) both mitral valve leaflets were excised together with the attached chordae tendineae till the head of the corresponding papillary muscle. Ticron transverse mattres sutures with or without Teflon pledgets were inserted circumferencially across the mitral valve annulus from the atrial to the ventricular sides , then through the sewing ring from inside out.

In the posterior chordae preservation group (group II) the same suture technique as in (group I) was used, but the posterior mitral valve leaflet with its attached chordae tendineae were left intact, the Ti-cron transverse mattress sutures were passed through the mitral valve annulus from the atrial side to the ventricular side, then through the corresponding segment of the free margin of the posterior cusp of the mitral valve. The technique proceeded typically as in group I. On setting the valve prosthesis, the sutures by this configuration had collected the posterior cusp backward in-between the prosthesis and the valve annulus.

In the both chordae preservation group (group III) in addition to what was done in group II , we had preserved a wedge of the edge of the anterior cusp that carries the attachment of the main chorda to the anterior papillary muscle and attaching this wedge to the annulus of the mitral ring at the anterior commissure. The same was done with a wedge of the cusp at the posterior papillary muscle attachment. This is a modification of the method used by David. (4, 5, 6)

Patient studies

All patients in this study had preoperative, early (3 to 6 weeks), and 6 months (range from 5 to 9 months), postoperative clinical history, physical examination electrocardiography, chest X ray and echocardiography.

Low cardiac output syndrome was defined as the requirement of infusion of inotropic drugs for more than 30 minutes to maintain a systolic blood pressure greater than 90 mmHg or a cardiac index above 2 L/min/m2, (7) and postoperative mortality was considered if that occurred within 30 days of the operation or during the hospitalization for operation. (8)

Statistical analysis: Statistical significance between preoperative and postoperative means were determined by paired t test analysis and between groups by non-paired t test analysis.

Results

(A) Preoperative parameters

There were no statistically significant preoperative differences in the age, sex, functional NYHA class, or the haeamodynamic parameters (as measured by echo - Doppler) between the three groups of patients except the male/ female ratio in the third group (table 1) and (table 2) .

(B) Operative parameters

There were no significant differences between the three groups regarding the aortic cross clamp time. The cardiopulmonary bypass (CPB) time was nearly the same in the second and third groups, but was significantly higher in the first group due to more cases that needed prolonged time to wean from the circulatory support of the cardiopulmonary bypass. In fact three patients of this group needed the return to cardiopulmonary bypass after weaning from it, and one of those patients had refractory and worsening low cardiac output syndrome in spite of all possible support and finally died on table after 245 minutes of pump recording the only intraoperative mortality in the first group. This problem was not met in the two chordal preservation groups. The average size of the valve inserted was the same in the three groups (Table 3).

Table (1): Preoperative demographic and clinical parameters.

Parameter	Group I	Group II	Group III
No. of patients	44	23	9
Age	25.72±4.24	24.19 ± 4.90	28.85 ± 5.10
Sex Male	18 (40.9%)	10 (43.4%)	3 (33.3%)
Female	26 (59.1 %)	13 (56.5%)	6* (66.6%)
Pre-operative NYHA (Class) I	0	0	0
II	4 (9.1%)	2 (8.7%)	0
III	21 (47.7%)	11 (47.8 %)	5 (55.6%)
IV	19 (43.2%)	10 (43.5%)	4 (44.4%)
Mean	3.35 ± 0.64	3.34 ± 0.51	3.45 ±0.48

Table (2): Preoperative echocardiographic parameters.

Parameter	Group I	Group II	Group III
LVEDD (mms)	5.4 ± 0.7	5.48 ± 0.5	5.52 ± 0.8
LVESD (mms)	3.6 ± 0.4	3.64 ± 0.6	3.7 8± 0.6
FS (%)	33.3 ± 6.4	33.5 ± 5.8	31.5 ± 6.1
EF	60.5 ±11.2	61.2 ± 10.5	57.8 ± 12.2

(C) Intensive care unit parameters

There was a significant difference between the mean period of ICU stay of patients of group I and the other two groups (3.01 days versus 1.90 and 1.81 respectively) which amounts to 160% increase in ICU stay (p value 0.035 and 0.031 respectively). The same statistical difference was found in the use of inotrope

Table (3): Operative parameters.

Parameter	Group I	Group II	Group III
Number of patients	44	23	9
Aortic clamp time (minutes)	58.86± 8.67	61.06 ± 6.94	64.44± 5.87
CPB time (minutes)	117.66± 18.92	96.68± 8.65	93.06±13.6
Valve sizes 27 29 31 33	 2 (4.6%) 19 (43.2%) 22 (50.0%) 1 (2.2%)	 4 (17.4%) 15 (64.7%) 3 (13.4%) 1 (4.3%)	 2 (22.2%) 5 (55.5%) 2 (22.2%) 0
Mean valve size	30.00 ± 2.45	29.08 ± 2.65	29.00 ± 1.41

Table (4): ICU parameters.

Parameter	Group I	Group II	Group III
No. of patients	43	23	9
Inotrope	19(44.1%)	8 (34.8%)	3 (33.3%)
Ventilation (hours)	18.5 ± 2.6	6.15± 1.09	5.56± 1.23
ICU stay (days)	3.01±0.55	1.90 ± 0.6	1.81± 0.37
LCOP	11(25.6%)	4 (17.3%)	0 (. %)

Table (5): Postoperative parameters.

Parameter	Group I	Group II	Group III
No. of patients	43	23	9
Post.op. hospital stay	20.84 ± 5.33	14.75 ± 2.71	12.32 ± 2.43
Mortality	7%	4.3%	O%
Renal Failure	4.64%	0%	O%.

Table (6): Postoperative echo-Doppler findings.

Parameter	Group I	Group II		Group III	
Group (No. of patients)	6 Month (39)	Postop (23)	6 Month (22)	Postop (9)	6 Month (9)
LVEDD (mm)	5.02± .39	5.18± .64	4.94± .62	4.83±.39	46.4± .32
% of pre- operative	93%	94.6%	90.1%	87.5%	84.1%
p value (Vs G I)	p< o.o1	p<o.01	p< o.001	p<o.o1	p<o.oo1
P value II vs III	--	--	--	***p < o.o1***	***P < o.o5***
LVESD (mm)	3.31± .41	3.28±.56	3.05± .52	3.04± .45	2.83± .28
% of pre-operative	92.1%	91.1%	83.7%	80.4%	76..8%
P value (Vs G I)	p<o.o5	p<o.o5	p< o.o1	P< o.oo5	p< o.oo1
P value II vs III	--	--	--	***P < o.oo5***	***p < o.o1***
Peak Grad. LVOT	4.23 + 0.12	5.05+ ..34	4.87 + 0.31	5.56+0.69	5.43 + .76
FS (%)	28.9 ± 3.11	36.6 ± .56	3.82±4.81	37.1±5.2	39 ± .44
% of pre-operative	100.6%	109.2%	114%	117.4%	123.8%
p value (Vs G I)	NS	p< o.o1	p<o.oo1	p<o.oo1	p<o.oo1
P value II vs III	--	--	--	***P < o.o5***	***P < o.o1***
E F	60.9 ± 8.45	64.8± 4.69	66.45±5.66	65.7± 6.55	68.4±5.88
% of pre-operative	100.6%	105.8%	108.5%	113.6%	118.3%
p value	NS	p<o.o5	P< o.o1	p< o.o1	p< o.oo5
P value II vs III	---	--	--	***p < o.o5***	***p < o.o1***

Table (7): Post operative NYHA Class.

Class	Group I		Group II		Group III	
	Post op (40)	6 month (39)	Post op (23)	6Momth (22)	Post op (9)	6 Month (9)
I	22 (55%)	18 (46.1%)	15 (65.2%)	16(72.7%)	5 (55.5%)	7 (77.7%)
II	13 (32.5%)	13 (33.3%)	7 (30.4%)	6(27.2%)	4 (44.4%)	2 (22.2%)
III	5 (12.5%)	7 (17.9%)	1 (4.3%)	0	0	0
IV	0.	1 (2.5%)		0	0	0
Mean	1.57±.21	1.78±.3	1.40±.21	1.21±.22	1.39±.11	1.22±.13*

between the first and both other groups respectively (44.1% Vs 34.8% and 33.3%) with a significant p value (0.047 and 0.031 respectively). There were statistically significant differences in the incidence of the LCOP between the first and both the second and the third groups (p value was 0.041 and 0.012 respectively) and there was a statistically significant difference between the second and the third groups (p value 0.32). The patient's need for ventilation (hours) was significantly higher in group I (18.5 hrs) compared to the second (6.15 hours) and third group (5.56 hours) which was 301 % and 330% more, the p value was 0.011 and 0.008 respectively (table 4).

ICU: Intensive care unit, LCOP : Low cardiac out put.* one patient in group I had intraoperative mortality.

(D) Early post-operative parameters

There was a clear statistical difference in hospital mortality between the three groups of patients (7%, 4.3%, and 0%), also in the incidence of morbidity as renal failure and stroke (table 5) .

Comparison of the echocardiographic data of the patients of the three groups (Tables 2 and 6) showed that in the early post operative period there was deterioration of the LVEDD FS and EF of the patients of the first group.

LVEDD: left ventricular end diastolic diameter, LVESD: left ventricular end systolic diameter, FS: fractional shortening, EF : ejection fraction., Vs G I : student t test values compared to corresponding value in group one. P value II Vs III : student t test values of group three results compared to corresponding results of group two.

This was attributed to the sudden increase of the LV afterload after conventional mitral valve replacement due to sudden interruption of the fraction of the blood previously ejected into the low resistant left atrium. This improved to a small degree on the period of 6 months of follow up, though the improvement was not significant as in the other two groups. The obvious improvement of these parameters in patients of the other two groups is attributed to the beneficial effect of preserving the annulo-papillary continuity, which preserves the geometry and hence the ejecting force of the left ventricle. This effect is more pronounced and clear in the group III due to preservation of the whole mitral valve system.

(E) After six months of follow up

By comparison of the functional NYHA class between the three groups of patients (table 1 and 7) we found that more than 90% of the patients of the three groups were in class III and IV before surgery.

The average NYHA class was 3.35, 3.34, and 3.45 respectively in the three groups reflecting the critical functional state of the patients of the three groups before the operation. We found no statistically significant differences in this parameter. In the early follow up period, there was a great improvement of the functional NYHA class with 87.5%, 95.6%, and 100% of the patients of the three groups respectively in class I and II, with an average NYHA class 1.57, 1.40, and 1.39 respectively. The statistical difference between the first and the other two groups approached significance (p value .0056, and .052 respectively.) .

The difference in improvement of the functional NYHA class between the three

groups began to appear with time during the period of follow up, while there was significant deterioration of the NYHA calss in the group I, with only 79.4 % in class I and II, there was corresponding improvement in the functional status in the second and third groups with 100% in NYHA class I and II, the average NYHA became 1.78, 1.21 and 1.22 in the three groups respectively, with a statistically significant differences (p value .023, and .024 respectively).

The results of the echocardiography of the patients of the three groups six months after the operation (tables 2 and 6) showed minimal improvement of the parameters of the patients of the first group, a small but statistically significant improvement in the LVESD and LVEDD, but no improvement in the EF at the end of the period of follow up in this group I in contrary to the conventional group. there was a steady improvement in all the parameters, with statistically highly significant differences between the early postoperative results, and the corresponding values of the first group.

Discussion

The pump function of intact left ventricle depends on the interaction of the left ventricular muscle contraction, and the supporting effect of the papillary muscles with its own attached chordae tendinae especially in the isometric contraction phase of the cardiac cycle. Severing of the chordal attachment of one or both the mitral valve leaflets, as that occurs in conventional MVR, results in marked impairment of the left ventricular systolic function.(9) Moreover, sudden interruption of the regurgitant flow into the low resistance left atrium after mitral valve replacement for chronic mitral regurgitation increases left ventricular afterload, which may further depress an already compromised left ventricle .(4,9,10)

The relative contribution of each component of this complex was studied experimentally by Hansen and his colleagues, the left ventricular muscle alone was responsible for 58% of the systolic function, the chordae attached to the anterior mitral valve leaflet contributed to 26% of the systolic pump function, and the chordae attached to the posterior leaflet contributed to 16% of the systolic function.(10)

This experimental data was largely supported by the clinical results of mitral valve replacement in which the left ventricular function showed little improvement or even deterioration in some cases in the group treated by conventional mitral valve replacement, compared to the patients who had their posterior or both chordal attachment preserved .(1,5)

The explanation of the preservation of the chordal attachment for the perfect performance of the LV function is that on the isometric contraction phase of the LV the chordae keep the geometry of the ventricle unchanged, while severing the chordal attachment produces distinct dyskinesia of the LV geometry with prominent bulging of the regions of the anterolateral and posteromedial papillary muscle insertions .(9,10)

Intact chordae reduces the regional LV afterload, i.e. make the regional forces acting upon the LV chamber homogeneous and well balanced. With severing of the

suffer dyspnea and reverted to ciass III and VI during the 6 month period of follow up. This result was not found in both preservation groups. This statistically significant difference in the functional state of the patients in the three groups after 6 months of operation reflects the excellent haemodynamic improvement in LV functions gained by preservation of the chordal system.

Comparison of the echocardiographic data of the patients of the three groups (Tables 2 and 6) showed that in the early postoperative period there was deterioration of the LVEDD, FS and EF in the patients of the first group. This was attributed to the sudden increase of the LV afterload after conventional mitral valve replacement due to sudden interruption of the fraction of the blood previously ejected into the low resistance left atrium. This improved to a small degree on the period of 6 months of follow up, though the improvement was not significant as in the other two groups. The obvious improvement of these parameters in patients of the other two groups is attributed to the beneficial effect of preserving the annulo-papillary continuity, which preserve the geometry and hence the ejecting force of the left ventricle. This effect is more pronounced and clear in group III due to preservation of the whole mitral valve system. The same results were got by other investigators (1,11,12)

The technique we used for chordal preservation of the anterior leaflet is claimed by some to deform the normal left ventricular geometry, because of the insertion site of the strut chordae of the anterior mitral leaflet have been displaced laterally, however, the 6 month follow up of these cases showed excellent improvement of the LV functions as determined by serial echocardiographic studies. Our results are supported by the results of other groups. (13)

Straub et al, 1997, found improved segmental myocaredial performance in all segments if both leaflets were preserved or the anterior mitral leaflet was attached to the anterior mitral annulus. (14) Goldfine et al,1998, found that LV afterload will fall when chordal preservation techiques are used with MVR.(15) Hassouna and Elmahalawy, 1998, found that total chordal preservation is associated with lower hospital mortality and morbidity and better preservation of the postoperative LV systolic function when compared with posterior chordal preservation. (15)

Our technique of bileaflet preservation faced some concerns from many surgeons about interference with prosthetic valve motion by preserved chordae tendinae. It was feared that the remaining subvalvular structures may hamper the function of a low profile valve . This dysfunction was not found in the patients of our group during our reasonable period of follow up, neither clinically nor by echocardiography. The explanation is that the height of the leaflet just exceeds that of the support frame at the outflow of this prosthesis. Our results are also supported by the work of other groups . (1,12,13)

An operative technique was used by Choh in 1997 to allow preservation of anteriar and posterior mitral leaflets and insertion of tilting-disc valve. (16)

Another concern is that anterior chordal preservation may obstruct the LV outflow

tract.(16) which has been reported frequently with MV repair using a Carpentier ring .(18,19) We have found no patient that has a gradient across the left ventricular outflow tract more than 6 mmHg. These results coincide with the results reached by Okita. (12) This may be due to that we displace the preserved anterior leaflet segments laterally with resection of the middle clear zone of the leaflet, this gives enough room to insert a valve of suitable size without encroachment on the LV outflow tract.

Conclusion

Based on our study, and the work of other many groups, we found that maintenance of the continuity between the mitral valve annulus and the papillary muscles has a beneficial effect on the post operative left ventricular performance, especially in patients with chronic severe mitral regurgitation and depressed pre operative left ventricular functions. These benefits are gained without any more complications or difficulty of surgical technique.

References

1) Hennin H , Swain J , McIntosh , Bonow, Stone C, Clark R. "Comparative assessment of the chord preservation versus chordal resection during mitral valve replacement". J Thorac Cardiovasc Surg. 1990, 99 : 829.

2) Natsuaki M, Itoh T, Tomita S, Furukawa K, Yoshikai M, Suda H , and Ohteka H. "Importance of preservation of the mitral subvalvular apparatus in mitral valve replacement. Ann Thorac Surg .1996, 61:585.

3) Ferrazzi P,Mc Giffen DC, Kirklin JW, Blackstone EH , Bourge RC . " Have the results of mitral valve replacement improved ?". J Thorac Cardiovasc Surg . 1986, 92:186.

4) David TE. "Mitral valve replacement with preservation of chordae tendinea: rationale and technical considerations". Ann Thorac Surg.1986, 41: 680.

5) David TE , Burns RJ, Bacchs CM, Druck MN. " Mitral valve replacement for mitral regurgitation with or without preservation of the chordae tendinea". J Thorac Cardiovasc Surg . 1984, 88 :71.

6) Hetzer R, Drews T, Siniawski H, Komoda T, Hofmeister J, Weng Y."Preservation of papillary muscles and chordae during mitral valve replacement: possibilities and limitations". J Heart Valve Disease . 1995, 4 supp : Sl15.

7) Rao V, Komeda M, Weisel R, lvanov J, lkonomedis J, Shirai T, David T "Results of represervation of the chordae tendinea during redo mitral valve replacement" Ann Thorc Surg. 996 62 :179.

8) Edmunds LH, Clark RE, Chon LH, Grunkemeir GL, Miller C, Weisel RD, "Guidelines for reopening morbidity mortality after cardiac valvular operations". nn Thorac Surg. 1996, 62:932.

9) Spence P, Peniston CM, David TE, Mihic N, Jabr K, Salerno. "Towards a better understanding of the etiology of left ventricular dysfunction after mitral valve replacement: an expremental study with possible clinical implications." Ann Thorac Surg. 1986, 41: 363

10)Hansen DE, Cahill PD, Derby GC, Miller C. "Relative contribution of the

anterior and posterior mitral chordae tendineae to canine global left ventricular systolic function" J Thorac Cardiovasc Surg . 1987 , 93:45.

11)Okita Y, Miki S, Ueda T, Sakai T, "Left ventricular function after mitral valve replacement with or without chordal preservation" J Heart Valve Disease. 1995 4 suppl 2: S 181.

12)Okita Y, Miki S, Kusuhara K, Udea Y, Tahata T, Yamanaka K Higa T. "Analysis of left ventricular motion after mitral valve replacement with a technique of preservation of all chordae tendineae". J Thorac Cardiovas Surg.1992,104: 786.

13)Saber W."Initial experience of mitral valve replacement with total preservation of both valve leaflets". J Egypt Soc of Cardiothorac Surg. 1996, 4 : 19 .

14)Straub UJ, Huwer H, Kalweit G, Volkmert I, Games E. "Improved regional left ventricular performance in mitral valve replacement with orthotopic refixarion of the anterior mitral leaflet." J Heart valve Dis. 1997, 6: 395.

15)Hassouna A, and El Mahalawy N."Valve replacement in rheumatic mitral incompetence: Total versus posterior chordal preservation". Cardiovase Surg. 1998, 6:133.

16)Choh JH. " Preservation of anterior and posterior leaflets in mitral valve replacement with a tilting. disc valve" Ann Thorac Surg. 1997, 64: 271.

17)Gold fine H, Aurigemma cop, Zile MR, Gasch WH".Left ventricular force shortening relations before and after surgical correction of chronic mitral regurgitaion". J Am coll Cardiol. 1998, 31:180.

18)Come PC, Riely MF, Weintraub RM. "Dynamic left ventricular outflow tract obstruction when the anterior leaflet is retained in at prosthetic mitral valve replacement". Ann Thorac Surg.1987, 43:561.

19) Mihaileanu S, Marino JP, Chauvaud S : " Left ventricular outflow obstruction after mitral valve repair". Circulation. 1988, 78 : 178.

20)Schiavone WA, Cosgrove DM, Lever HM, Stewart WJ, Salcedo EE. "Long term follow up of patients with left ventricular outflow tract obstruction after Carpentier ring mitral valvuloplasty". Circulation. 1988, 78: 160.

TRITACE® comp LS

Ramipril 2.5mg + Hydrochlorothiazide 12.5mg

TRITACE® comp

Ramipril 5mg + Hydrochlorothiazide 25mg

Expands The Value of TRITACE To More Hypertensive Patients

Full information available on request

Hoechst Marion Roussel S.A.E

Scientific Office

3 El Massaneh St., Zeitoun

P.O. Box: 1486 Cairo Egypt

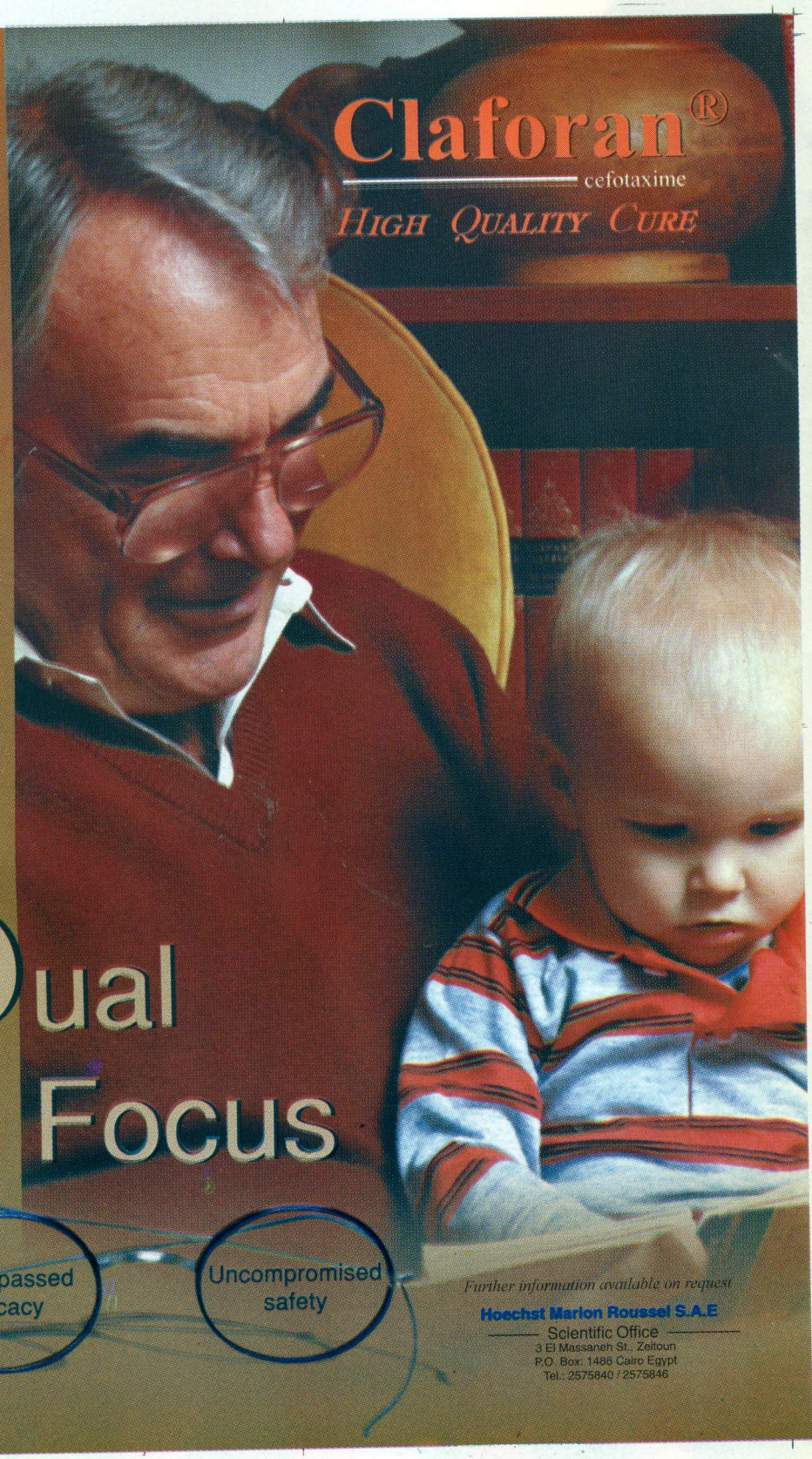
Tel: 2575840 / 2575846

Hoechst

Hoechst Marion Roussel

The Pharmaceutical Company of Hoechst


IN RESPIRATORY TRACT INFECTIONS
once daily
TAVANIC 500 mg
(levofloxacin)
tablets
Worldwide proven
clinical efficacy and safety
in more than
100 million patients
Full information available on request
Hoechst Marion Roussel S.A.E
Scientific Office
3 El Massaneh St., Zeitoun
P.O. Box: 1486 Cairo Egypt
Tel.: 2575840 / 2575846



Claforan®

cefotaxime

High Quality Cure

3rd GC that offers

Dual Focus

Unsurpassed efficacy

Uncompromised safety

Further information available on request

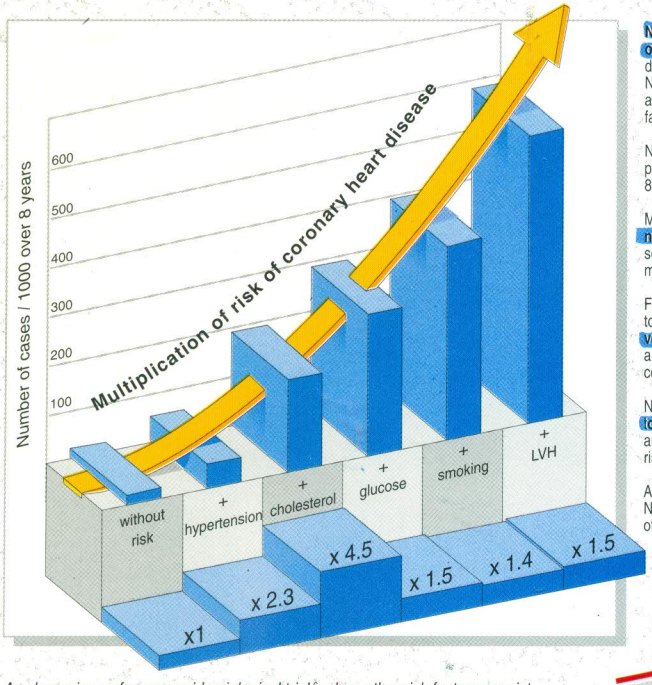
Hoechst Marion Roussel S.A.E
Scientific Office
3 El Massaneh St., Zeitoun
P.O. Box: 1486 Cairo Egypt
Tel.: 2575840 / 2575846

NATRILIX®

INDAPAMIDE 2.5 mg

1 tablet daily

THE REFERENCE DIURETIC FOR OPTIMAL CARDIOPROTECTION



As shown in a reference epidemiological trial,[6] when other risk factors coexist with hypertension, the risk of coronary heart disease increases dramatically.

Natrilix is the reference diuretic for optimal cardioprotection: specifically designed for treating hypertension, Natrilix is the only diuretic that addresses all the cardiovascular risk factors of the hypertensive patient.

Natrilix is **highly effective** on blood pressure readings,[1] normalizing up to 80% of hypertensive patients.

Moreover, Natrilix is **metabolically neutral:** Natrilix does not compromise serum cholesterol[2] or glucose metabolism[3].

Furthermore, Natrilix has been proven to **consistently reduce left ventricular hypertrophy,**[4] a recognized critical and independent coronary risk factor.

Natrilix has also been demonstrated **to reduce microalbuminuria,**[5] another independent cardiovascular risk factor in the diabetic hypertensive.

All these major advantages make Natrilix the reference diuretic in terms of cardioprotection.

HYPERTENSION

Treats hypertension without replacing one risk factor by another

1. Abbou CB et al. *Curr Med Res Opin.* 1985; 9 (7): 494-499.
2. Leonetti G et al. *Am J Cardiol.* 1990; 65 (17): 67-71.
3. Raggi U et al. *Hypertension.* 1985; 7 (6) (Part II): 157-160.
4. Raftery EB et al. *J Cardiovasc Pharmacol,* 1993; 22 (suppl 6): 106-110.
5. Flack JR et al. *J Cardiovasc Pharmacol.* 1993; 22 (suppl 6): 75-77
6. Kannel WB. *Am J Hypertens.* 1991; 4: 283-287

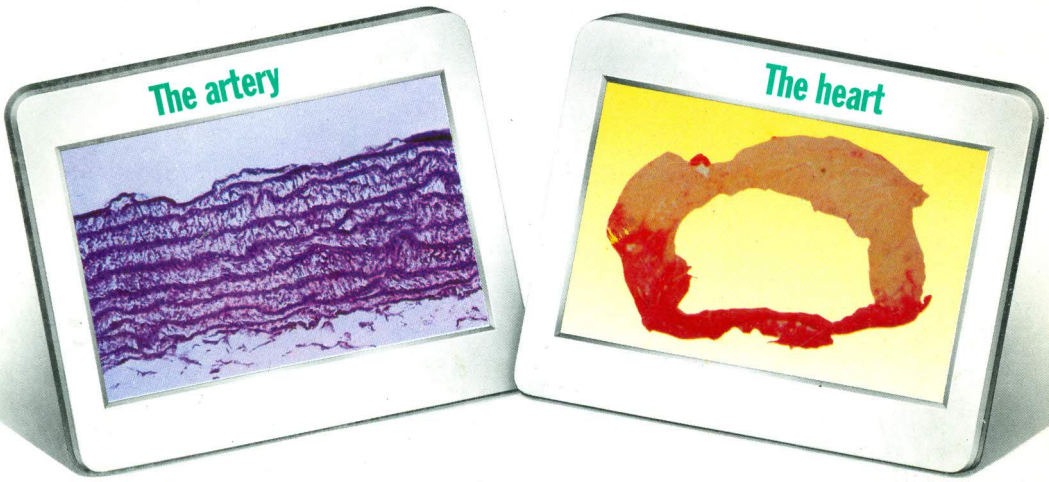
Composition: Each coated tablet contains 2.5 mg of 1-(4-chloro-3-sulfamyl-benzamidol)-2-methylindoline (or indapamide hemihydrate). **Indication:** Essential hypertension. **Contraindications:** Severe hepatic insufficiency, recent cerebrovascular accidents. Drug combinations to be avoided: tienilic acid, lithium, fenoxedil, lidoflazine, prenylamine, vincamine. **Combination treatments:** Natrilix may be combined with all nonthiazide antihypertensive agents, with beta-blockers, calcium channel blockers, and ACE inhibitors. **Precautions:** Pregnancy. Lactation. Monitoring of potassium and uric acid serum levels is recommended, especially in subjects with a predisposition or a sensitivity to hypokalemia and in patients with gout. Although no allergic manifestations have been reported during clinical trials, patients with a history of allergy to sulfonamide derivatives should be closely monitored. **Adverse effects:** Hypokalemia, fatigue, orthostatic hypotension, allergic manifestations. **Dosage and administration:** One tablet daily. **Overdosage:** Symptoms of overdosage would be those associated with a diuretic effect; electrolyte disturbances, hypotension, and muscular weakness. Treatment should be symptomatic, directed at correcting the electrolyte abnormalities. Refer to data sheet for complete prescribing information.

Les Laboratoires Servier - 45520 Gidy - France. Correspondent: **Servier International** - 6, place des Pléiades, 92415 Courbevoie Cedex - France

SERVIER

ARTEM - 96 NX 275 IA

Scoring an ACE in cardiovascular remodeling



1 tablet daily

COVERSYL® 4 mg

PERINDOPRIL

in hypertension and heart failure...

...cardiovascular remodeling is a key pathogenic feature. Coversyl 4 mg actively combats cardiovascular remodeling by correcting the structural and functional alterations of the heart and artery.[1-4]

Coversyl 4 mg is a true once daily ACE inhibitor with guaranteed antihypertensive efficacy right up to 24 hours post dose.[5]

In heart failure, Coversyl 4 mg (half-a-tablet) offers a safer start to treatment thanks to an absence of significant hypotensive first-dose response.[6]

With its original properties, Coversyl 4 mg is a high-performance ACE inhibitor in both its indications.

1. SIHM I et al. *Eur Heart J.* 1993; 14(suppl) : 63 - 2. LEVY BI et al. *Circ Res.* 1988; 63 : 227-239 - 3. ASMAR RG et al. *J Hypertens.* 1988; (suppl 3) : S33-S39 - 4. MICHEL JB et al. *Circ Res.* 1988; 62 : 641-650
5. MORGAN TO et al. *Am J Hypertens.* 1993; 6 : 116 A - 6. MAC FADYEN RJ et al. *Br Heart J.* 1991; 66 : 206-211.

Coversyl is a long-acting ACE inhibitor. **International nonproprietary name** : Perindopril. **Indications :** Essential hypertension. Congestive heart failure (adjunctive therapy). **Dosage and administration :** *Hypertension :* 4 mg once a day in the morning. If necessary, the dose may be increased to 8 mg after one month of treatment. Coversyl should be taken before food. *Congestive heart failure* : Coversyl should be started under close medical supervision at a starting dose of 2 mg in the morning. This may be increased to 4 mg once blood pressure acceptability has been demonstrated. *Elderly patients* : start treatment at 2 mg daily. **Contraindications :** Children. Pregnancy. Lactation. Patients with a history of hypersensitivity to Coversyl. **Precautions :** Assess renal function before and during treatment where appropriate. Renovascular hypertension. Surgery/Anesthesia. Renal insufficiency : the dose should be cautiously adjusted in accordance with the creatinine clearance *(refer to complete data sheet)*. Symptomatic hypotension is rarely seen, but is more likely in volume-depleted patients, those receiving diuretics, or with the first two doses. In diuretic-treated patients, stop the diuretic 3 days before starting Coversyl. A diuretic may later be given in combination if necessary; potassium-sparing diuretics are not recommended. Combination with neuroleptics or imipramine-type drugs may increase the hypotensive effect. Serum lithium concentrations may rise during lithium therapy. **Side effects :** Rare and mild, usually at the start of treatment. Cough, fatigue, asthenia, headache, disturbances of mood and/or sleep have been reported. Less often, taste impairment, epigastric discomfort, nausea, abdominal pain, and rash. Reversible increases in blood urea and creatinine may be observed. Proteinuria has occurred in some patients. Rarely, angioneurotic edema and decreases in hemoglobin, red cells, and platelets have been reported. **Composition :** Each tablet contains 4 mg of the tert-butylamine salt of perindopril. **Presentation :** Packs of 30 tablets of Coversyl 4 mg (scored). *Refer to data sheet for complete prescribing information.*

Les Laboratoires Servier, 45520 Gidy - France. Correspondent : **Servier International,** 6, place des Pléiades, 92415 Courbevoie Cedex - France.

SERVIER

bgr 94 CO 388 IA