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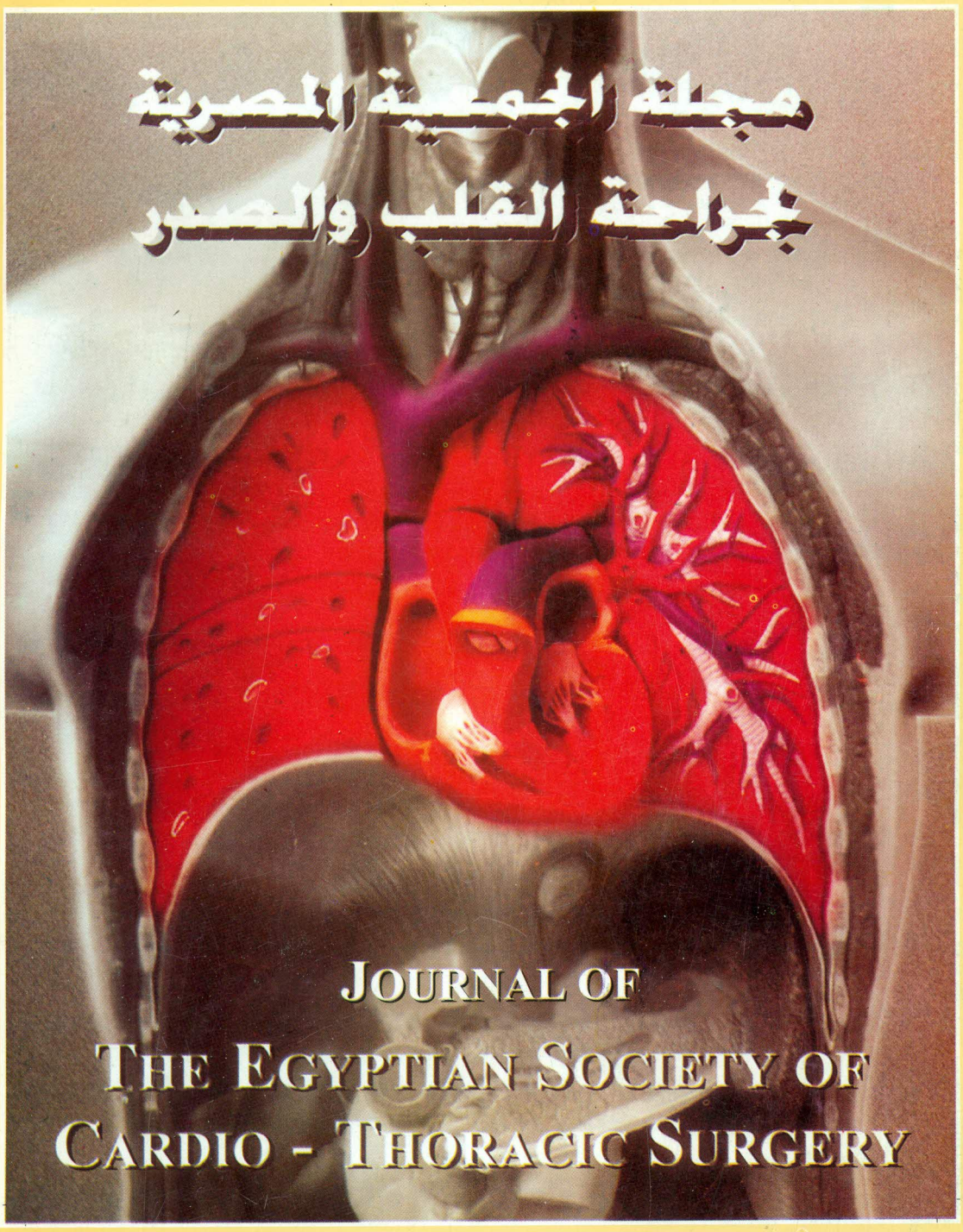
المجلد الخامس عدد رقم ٢ ابريل ١٩٩٧



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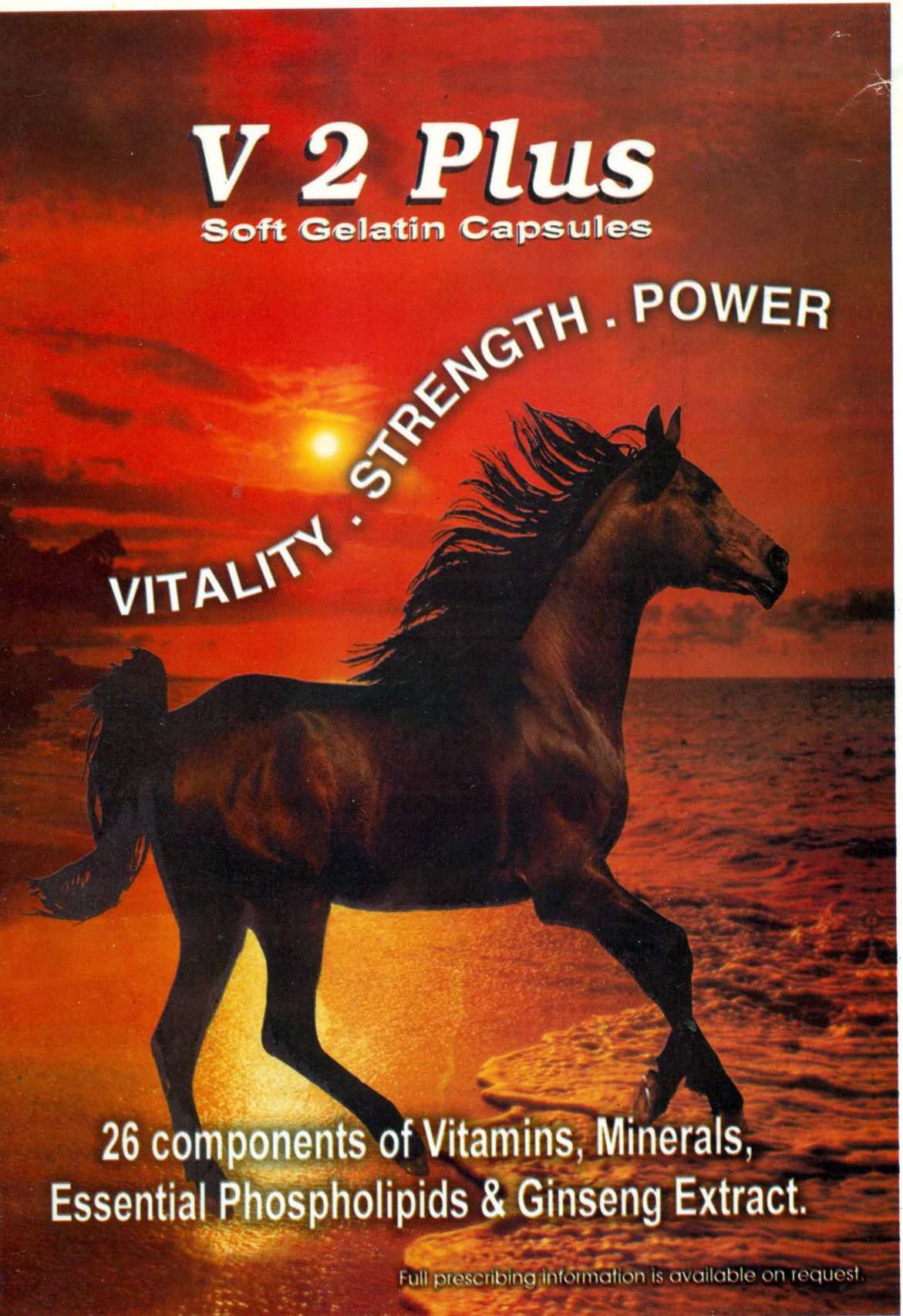
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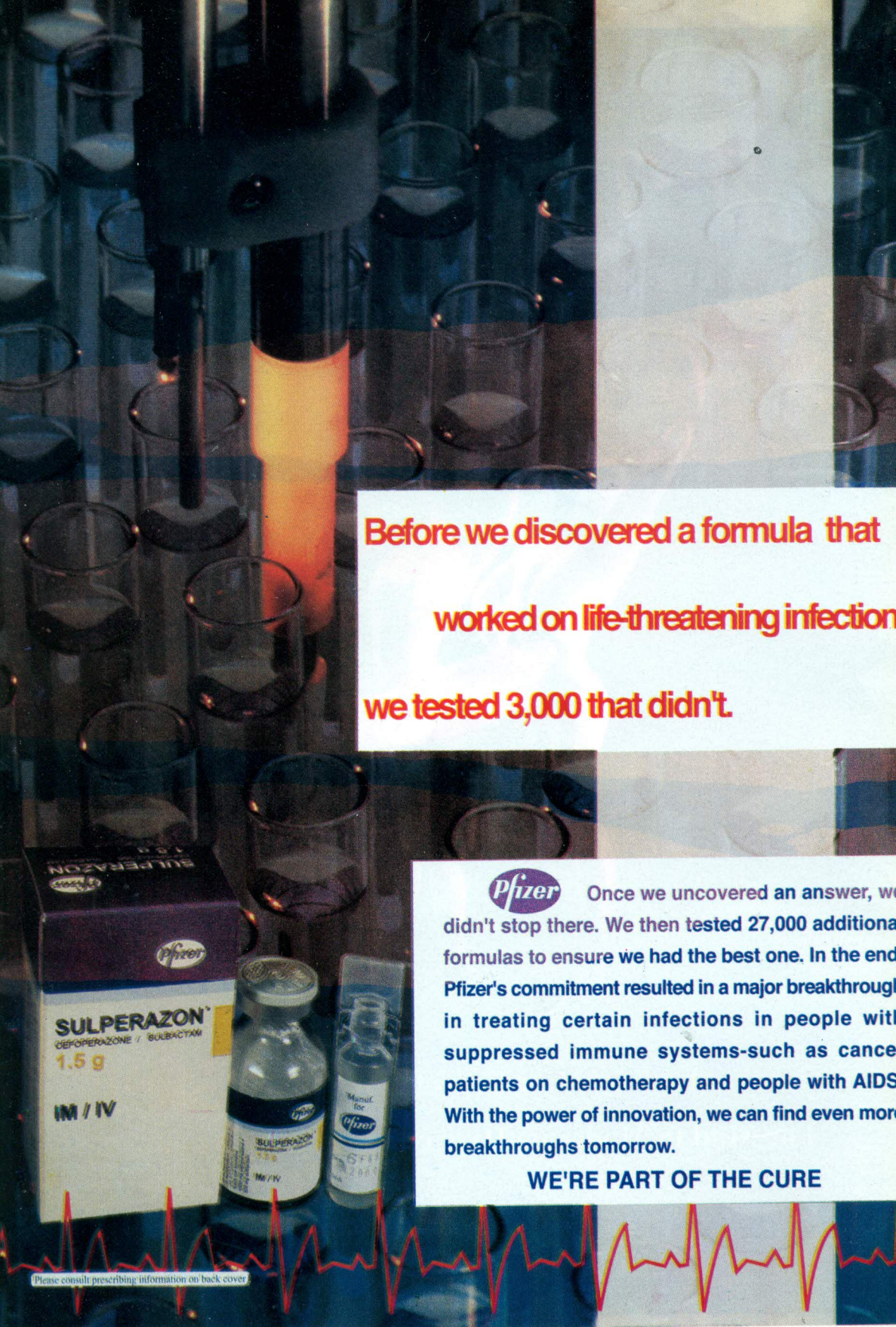
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DESCRIPTION

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 [7- (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 76.6 and 128.7 mcg/ml for sulbactam and 245.7 and 264.4 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, gall bladder, 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 then 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 diarrhea 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. This 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 recommended dosages 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.

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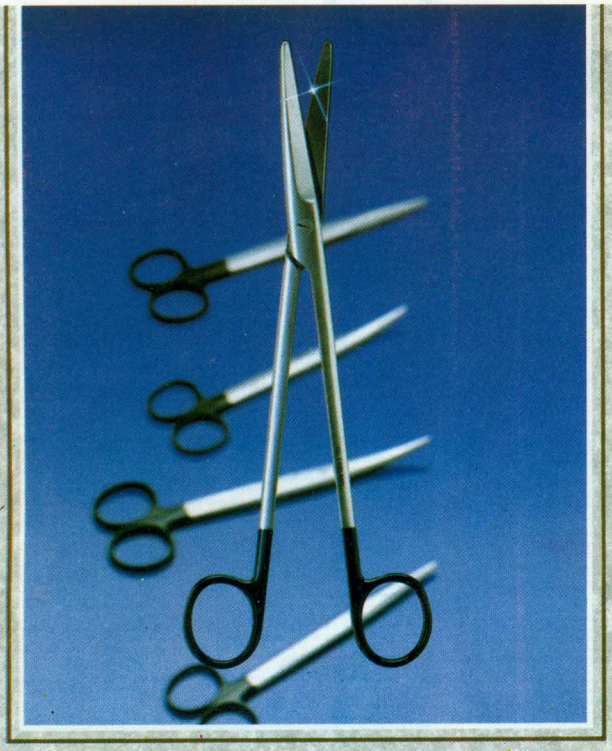

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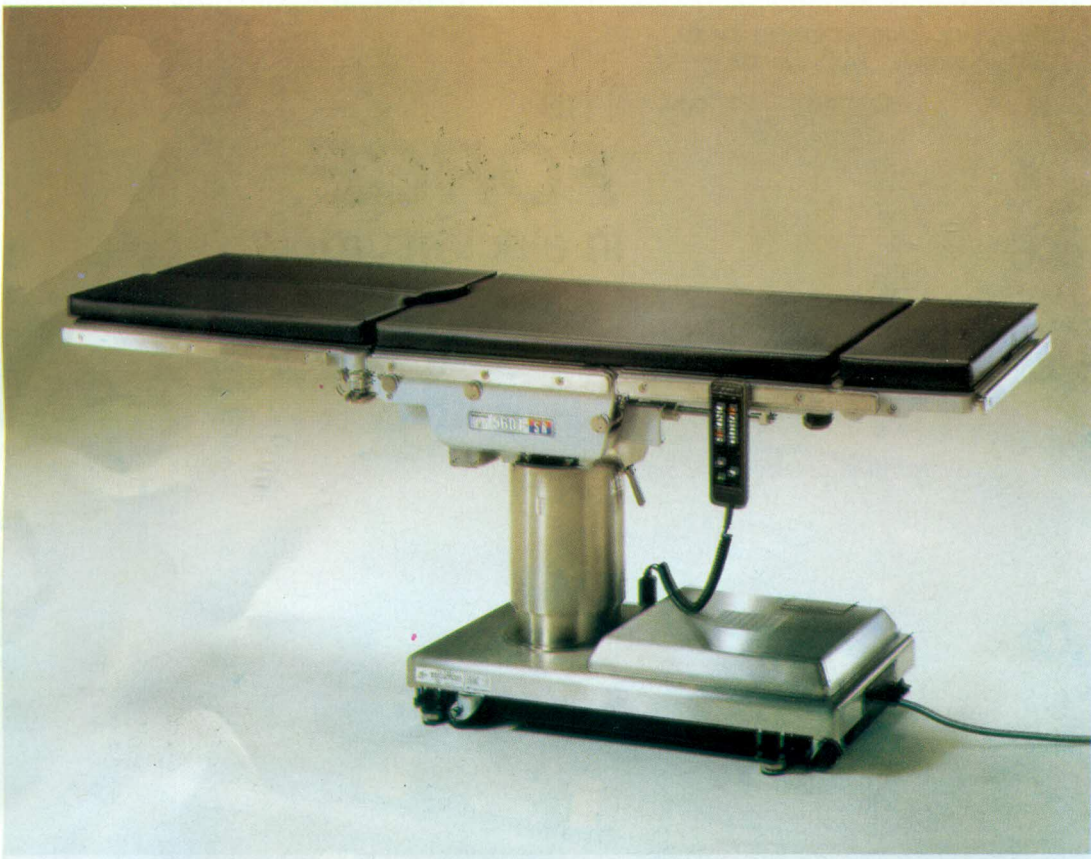

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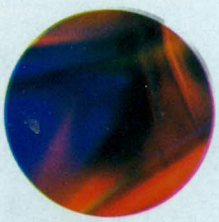

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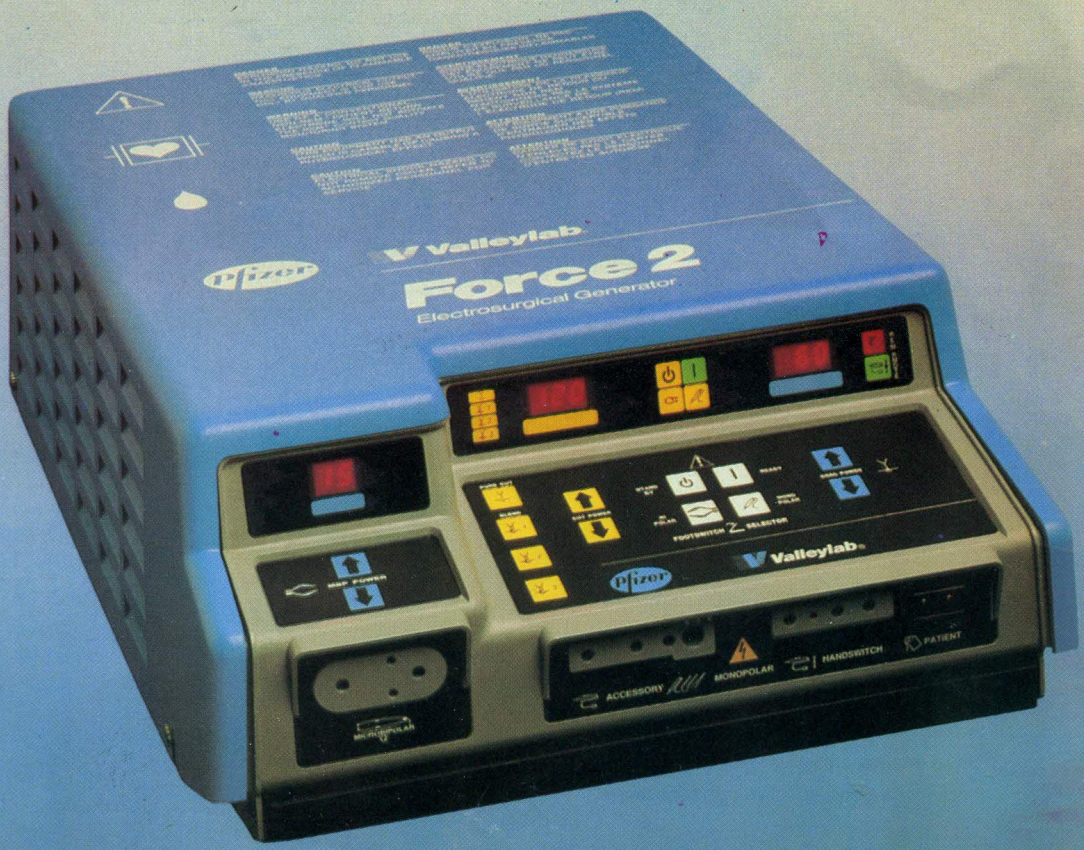

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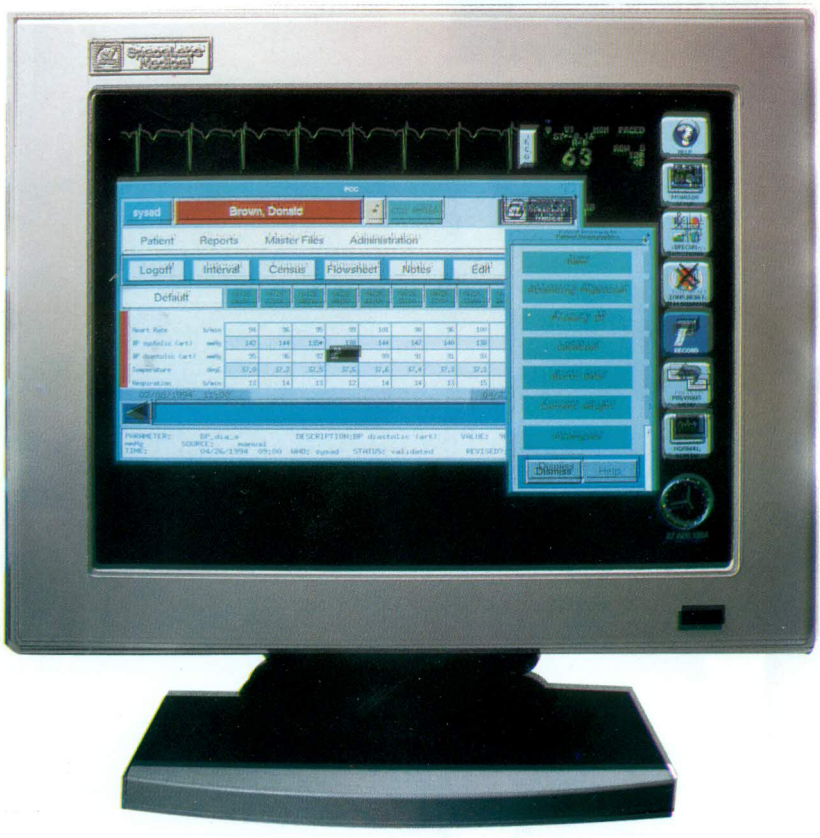

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Information for authors

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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.

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Sequential Saphenous Vein Grafting (SSVG), A New Experience With An Old Technique

ABSTRACT

Sequential Saphenous Vein Grafting (SSVG) is an old technique for myocardial revascularisation though never used in our unit.

Objectives: 1) to assess its reproducibility by analysing techniqual difficulties. 2) to analyse the predictors for early mortality and 3) to evaluate the early functional outcome.

Patients and Methods : 92 consecutive patients operated upon between May 1995 and November 1996 were prospectively studied. All demographic and perioperative date were analysed.

Results : There were 6 females and 86 males. Thirteen patients had double vessel disease and 79 had triple vessel disease. Left ventricular function was normal in 68 patients, moderately impaired in 16 and severely impaired in 8. Operation was elective in 59 patients, urgent in 22 and emergency in 11. Ninety two saphenous vein grafts were anastomosed sequentially to 269 distal anastomosis out of a total 375 anastomoses, (4.1 ± 0.1 per patient). There was only one technical problem. There were 5 early deaths (5.5%). Poor left ventricular function, urgent of operation, obesity and female gender were all significant independent risk factors for early death. Functional status has significantly improved in all survivors early after surgery.

We Conclude : that the technique is reproducible with acceptable risk. Poor LV function, urgent operation, female gender and obesity are significant risk factors for early death. The technique offers excellent myocardial revascularisation.

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INTRODUCTION

The internal mamary artery (IMA) anastomosed to the LAD has proven to have excellent long term patency (1), significant reduction in reoperation rate (2) and better survival over 15 years (3) However, the use of saphenous vein conduits to revascularise the rest of ischaemic myocardium remains widely utilised in most cases. These are usually used as separate grafts but can also be anastomosed sequentially to multiple targets, a technique which has been previously described in the early 1970's (4,5). several authors emphasised the advantages of the technique including a shorter operative time (6), more complete revascularisation (7) and better patency rate (8,9) probably due to favourable flow characteristics (10,11). Nevertheless, it has been claimed that the flow through a sequential grafts can be jeopardised by technical fault (12) or by proximal occlusion with serious consequences (13).

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Background

Venous conduits are usually used as separate grafts, a technique which entails using a considerable length of a valuable

conduit. Some centers adopted the sequential technique using one piece of vein anastmosed to multiple targets. Attention to technical details is a crucial clue to obtain operative success and to maintain the long term patency. This technique has been adopted by us.

Objectives

This study aims at [1] assessing the reproducibility of SSVG technique by analysing technical difficulties at operation, [2] analysis of the predictors of early death in our patient population and [3] analysis of the early functional outcome of the survivors as an indicator of efficiency of revascularisation.

Patients and Methods

Since we have adopted this technique, all patients were planned to have a LIMA to the LAD and SSVG to other targets (except the RCA), 92 consecutive patients operated upon between May 1995 and November 1996 were prospectively studied. Clinical profile, operative details, immediate and early postoperative complications were analysed. Preoperative and operative variables were statistically analysed using multivariate regression analysis to identify the independent risk factors for early death. Functional status of the survivors was evaluated 6-12 months postoperatively and compared to preoperative status using Chi square test.

Results

a) Clinical Profile :

There were 86 male and 6 females, age ranged between 35 and 74 years (mean 52.2 ± 8.4). The distribution of risk factors for having ischaemic heart disease is shown in table (1). Sixty eight patients (74%) complained of chronic stable angina while 24 were in an unstable condition. Ten patients had associated dyspnea of variable grades. Angiographic analysis showed that 13 patients (14%) had double vessel disease while 79 patients (86%) had triple vessel disease. Left main stenosis > 50% was seen in 7 patients (8%). Left ventricular function was normal (EF > 50%) in 68 patients (74%), moderately impaired (EF 30-50%) in 16 (17%) and severely impaired (EF < 30%) in 8 patients (9%).

b) Operative technique :

A suitable length of the long saphenous vein is prepared starting from the ankle usually to below or just above the knee, while the IMA is dissected down. Standard bypass technique is conducted using bubble oxygenator in all patients with moderate systemic hypothermia (30 degrees C.). After starting the extracorporeal circulation, the target vessels are identified. Cardiac arrest is achieved by antegrade crystalloid cold cardioplegia through aortic root with topical ice sluch. Cardioplegia is reinfused every 30 minutes or if any electromechanical activity is resumed. Then the most distal vessel is anastomosed to the vein graft end to side using 7/0 monofilamentous prolene continuous suture. The vein is then injected with heparinesed saline to ensure free distal run off and absence of suture line leak. The next target vessel is then opened, the vein is gently distended and stretched for optimal orientation and venotomy is done on the proper site. The length of each side to side anastomosis is about 2-4 mm according to vessel size. The rest of the distal anastomoses are done in sequence either in a diamond, oblique or parallel fashion to

Table (1): Risk factors for having ischaemic Heart disease

Risk Factor	No	%
Hypertension	65	71
Diabetes mellitus	50	54
Smoking	41	45
Dyslipidaemia	36	39
+ve family history	21	23
Obesity	20	22
> 2 Risk factors	72	78%

Table (2) : Causes of early death and associated risk factors

No	Age	Sex	Time of death	Cause of Death	Risk Factors	Risk Score*
1	35	M	Intraoperative	LCOP**	Dyslipidaemia – Emergency operation – renal dysfunction	10
2	73	F	3 days	LCOP	Poor L.V – Emergency operation – old age	11
3	58	F	5th day	Pulmonary Embolism	Obesity – Urgent operation – anaemia	8
4	54	M	10th day	Congestive HF	D.M. Urgent operation – poor L.V.	11
5	44	M	15th day	Mediastinitis & Toxaemia	D.M. Obesity HTN, CVPD	3

*** Risk scoring according to Higgins et al. (1992)(16)**
**** LCOP = Low Cardiac Output**

obtain the best graft allignement. Utmost attention is given to avoid kinking, twisting, redundancy or overstretch of the graft. The free run off is tested following each anastomosis while injecting heparinised saline with gentle occlusion of graft distal to that anastomosis. It is our policy to use a separate graft to RCA and LAD if LIMA can not be used for any reason. After finishing all distal anastomoses, the aortic clamp is released and the heart is allowed to beat. The SSVG is oriented anteriorly having a nice smooth loop. The proximal anastomosis is done to the ascending aorta. This is done during the arrest period if the ascending aorta is atheromatous so as not to apply a side biting clamp to avoid increased risk of plaque detachment. Haemostasis is then secured (Fig. 1).

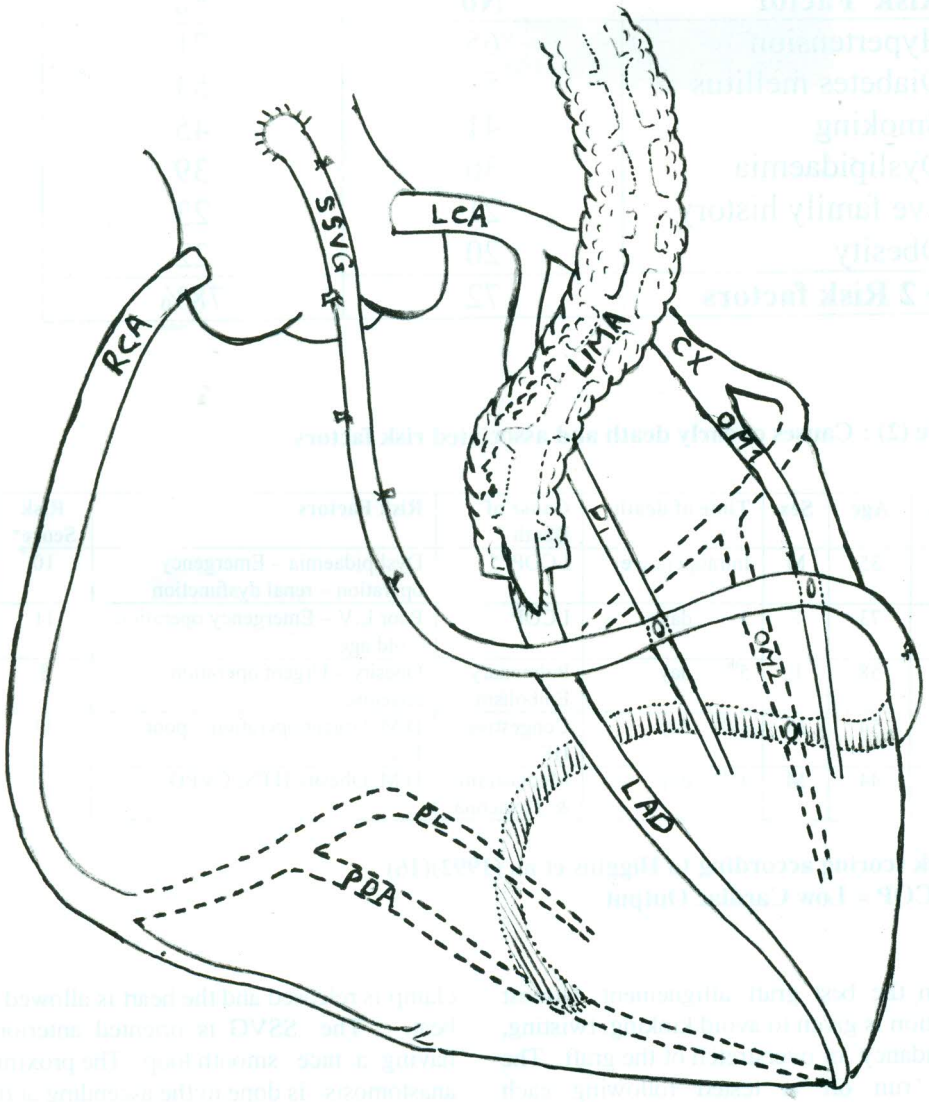

Fig.1: A diagram showing LIMA to LAD and sequential saphenous vein graft to PDA →OM2 → OM1 → Diagonal of LAD → Aorta

Table (3) : Multivariate regression analysis of the twelve preoperative and operative predictors of early death.

Variables	P – Value	F	Coefficient
1- Age	0.664	0.188	0.0073
2- Sex*	0.029	4.0932	0.0182
3- Smoking	0.811	0.057	0.0125
4- Diabetes mellitus	0.895	0.017	0.0069
5- Hypertension	0.793	0.069	0.0158
6- Dyslipidaemia	0.536	0.386	0.0322
7- Previous M. I.	0.226	1.483	0.0632
8- Obesity*	0.050	3.926	0.118
9- Left main disease	0.254	1.314	0.115
10- Poor ejection fraction**	0.0001	16.730	0.0085
11- Emergency Operation**	0.0011	11.4318	0.2483
12- No of grafted vessels	0.4749	0.515	0.0425

* significant ** Highly significant

c) Operative data

Surgery was performed electively in 59 patients (64%) and either as urgent or emergency in 33 (36%). Twenty one patients had three anastomoses, 48 had 4, 19 had 5 and 3 had 6 and only one patient received seven distal anastomoses. The total number of distal anastomoses was 375 in 92 patients (mean 4.1 ± anastomoses per patient). The LAD was grafted with IMA in 82 patients (89%) and with a separate vein graft in the rest of cases (11 %). The RCA was also grafted separately in 14 patients. The remaining 269 distal anastomoses were performed using 92 segments of reversed saphenous vein in a sequential fashion, each supplying between 2-6 coronary arteries (mean 2.9 ± 0.8/patient), there was one technical fault early in the experience with enclosure of the opposite side of the anastomosis in the suture line while performing a small diagonal branch distal anastomosis. This was promptly repeated with no ill effects. Aortic cross clamp ranged between 27-100 min (mean48.9±14.1 min). After aortic unclamping, the heart resumed spontaneous sinus rhythm in 58 cases, one D/C shock was needed in 27 patients and more than one in 7 patients. Transient atrial fibrillation occurred in 13 patients and reverted to sinus rhythm either electrically or pharmacologically.

d) Mortality and Morbidity

Causes of early deaths (5 patients) are shown in table (2) with the associated risk factors in each one.

Multivariate regression analysis was used to identify the independent risk factors

for early mortality. Twelve preoperative and operative variables were tested including age, sex, smoking, diabetes mellitus, obesity, hypertension, dyslipidaemia, previous myocardial infarction, left main stenosis, ejection fraction, status of operation and number of grafted vessels. This analysis showed 4 variables to be independent risk factors for early deaths including female gender ($p = 0.029$, $F = 4.09$, coefficient = 0.0 18), severe LV dysfunction ($p = 0.001$, $F = 16.7$, coefficient = 0.0085), obesity ($p = 0.05$, $F = 3.92$, coefficient = 0.0013) and emergency operation ($p = 0.001$, $F = 11.43$, coefficient=0.248). Other variables were insignificant predictors (table 3).

Post operative complications included perioperative myocardial infraction in 4 patients (4.4%), low cardiac output in 3 (3.3%), and sternal dehiscence in 1 (1.1 %).

e) Functional outcome

Improvement in symptoms was assessed by comparing angina class pre and post operatively using Chi square test showing improvement of a statistically significant difference at six months ($p = 0.0001$) with all survivors in class 0 or I.

Fifty two patients had exercise or dobutamine stress test 6-12 months postoperatively either to assess chest pain in 5 patients or to assess effectiveness of revascularisation in asymptomatic 47 patients. Only one patient had a positive stress test at 7 months and repeat coronary angio showed his LIMA → LAD to have anastomotic narrowing while is sequential SVG to three distal anastomoses was patent. This patient is planned to have PTCA for his discrete anastomotic narrowing.

DISCUSSION

The superiority of IMA over venous conduits in term of long terms patency, impact on long term survival and need for reoperation is well documented in the literature (1,2,3). Such a fact dictated our routine use of LIMA for the LAD unless it was judged unsatisfactory. In this series, it has been used in 89% of patients. The next conduit that remains to date the most widely used for other targets is the reversed saphenous vein graft, used as separate or sequential conduit. SSVG has many advantages including short operative time (6,14) conserving a valuable conduit material for anticipated redo surgery, anastomosis to smaller coronary arteries (8,13,14) and better patency rate (6,8,9). This technique has however been criticised for (a) being technically more demanding (b) measurements between recipient arteries are crucial for proper functioning of the conduit (c) torsion is possible (d) proximal occlusion can jeopardise more than one myocardial territory (e) and late graft atherosclerotic disease can endager a large myocardial mass (15). Emphasis on the techniqual points has been pointed out by many authors. Hutchin and Bulkley (12) concluded that jump grafts were susceptible to torsion due to somewhat redundant vein and they stated that lumen reduction by encroachement on the vessel lumen lead to its occlusion. Grondin et al.(8) reported one technical fault that lead to occlusion of 4 out of 5 distal anastomoses in one patient with overall early patency rate of 95.7% in their series. We had only one technical fault out of 269 sequential anastomoses which was corrected easily at operation with no consequences. We believe that attention to the minute technical details together with a solid training experience should keep the

incidence of technical problems to a minimum. The flow through each distal anastomosis should be chequed independently before advancing to the next target. Strict attention is given to avoid redundancy, overstrech, kinking or twisting of the graft and no compromise is to be accepted.

The hospital mortality in this series (5.5%) should be analysed considering the high surgical risk score according to Higgins et al. (16) of many patients (36% were urgent surgery) and 26% had moderate to severe LV dysfunction.

Multivariate regression analysis identified 4 variables to be significantly associated with high hospital mortality including female gender, obesity, severe LV dysfunction and urgency as being associated with risk of death. There is almost a general agreement that severe LV dysfunction and emergency operation increase the incidence of early mortality 16). Some other authors identified obesity and female gender as being associated with high risk of death (17,18) In the present series, other risk factors including smoking, D.M., previous MI, left main occlusion or number of grafted vessels could not reach a statistically significant difference as an incremental risk for hospital mortality. Similar findings were shared by others (19).

Relief from angina and improved exercise tolerance were very impressive in the early post operative period in the present series.

Probably this reflects the total revascularisation that is one of the main advantages of this technique.

This study is limited by its time frame, so long term follow up is not available. However, Meeter et al (14) reported that patients with sequential venous grafts had the same 10 years results as those with separate grafts. Moreover, Similar good long tenn results have been recently reported by Christenson and Schmuziger (20) with 85% potency rate of SSVG over 10y which look far superior to the previously reported incidence of 50% partial or complete occlusion of single venous conduit over similar period (21). Furthermore, they have also reported in an outstanding paper (22) a very small incidence of proximal occlusion (0.7%) of SSVG treated either medically or surgically. We strongly feel that combination of LIMA to LAD and SSVG to other stenosed coronary arteries will offer excellent myocardial revascularisation.

We Conclude that:

I- SSVG is a reproducible technique with acceptable risk.

2- Poor LV function, urgent operation, female gender and obesity were all significant risk factors for early death .

3- This technique offers excellent myocardial revascularisation

References

1- Loop FD, Lytle BW, Cosgrove DM et al : Influence of the internal mammary artery graft on 10 year survival and other cardiac events. N. Eng. J. Med. 1986, 314: 1-6.

2- Lytle BW, Loop FD, Cosgrove DM et al : Fifteen Hundred Coronary Reoperations : Results and Determinants of Early and Late Survival J. Thorac. Cardiovasc. Surgery 1987, 93 : 874-859.

3- Cameron A, Davis KB, Green G and Schauf HV: Coronary By pass surgey with internal thoracic grafts. Effects

on survival over 15 years period. N. Engl. J. Med. 1996, 334: 216-219.

4- Flema RJ, Johnson WD and Lepley J : Triple aorto-coronary veins bypass as treatment for coronary insufficiency. Arch. Surg 1971,103:82-3

5- Bartely TD, Bigelow JC and Page US : Aortocoronary by pass grafting with multiple sequential anastomosis to single vein. Arch. Surg. 1972, 105 : 915-7.

6- Cheanvechai C, Groves LK and Surakiatchanukul S : Bridge saphenous vein graft. J. Thoracic Cardiovasc. Surgery 1975, 70 : 63-68.

7- Bigelow JC, Barley TD, Page US and Krause AH: Long-term follow up of sequential aortocoronary venous graft. Ann. Thoracic Surgery 1976, 22 : 507-14.

8- Grondin CM, Vouhe P, Bourassa MG et al : Optimal patency rates obtained in coronary artery grafting with circular vein grafts. J. Thoracic and Cardiovasc. Surgery 1978, 75 : 161-167.

9- Grondin CM and Limer R : Sequential anastomosis in coronary artery grafting. Technical aspects and early and late angiographic results. Ann. Thoracic. Surgery 1977, 23 : 1-8.

10- O'Neill MJ, Wolf PD, O'Neill TK et al: A rationale for the case of sequential coronary artery bypass grafts,. J. Thorac. Cardiovasc. Surgery 1981, 81 : 686-690.

11- Prislean WH, Voegele LD and Hairston P: Flow in sequential vein grafts with diamond anastomosis. J. cardiovasc. Surg. 1986, 27:477-9.

12- Hutchin GM and Bulkley BH : Mechanism of occlusion of saphenous vein coronary artery jump grafts. J. Thorac. cardiovasc. Surg. 1977, 73 : 660-667.

13 - Kieser TM, FitzGibbar GM and Keon WJ : Sequential coronary bypass grafts. Long term follow up. J. Thorac. cardiovasc. Surg. 1986, 91: 767-772.

14- Meeter K, Veldkamp R, Tijssen JGP et al : Clinical outcome of single versus sequential grafts in coronary bypass operation at ten years following up. J. Thoracic Cardiovasc. Surgery. 1991, 10:1076-81.

15- Loop F. Choice of conduit in.coronary artery. Chapter 102, Thoracic and cardiovascular surgery text book, 4 th ed. (1983) Application-Century Grafts.

16- Higgins TL, Estfanous FG, Loop FD et al : Stratification of morbidity and mortality outcome by preoperative risk factor in coronary artery bypass patient, A clinical severity score. JAMA 1992, 267 : 2344-8.

17- Paiement B, Pelletier C, Dyrda I et al : A simple classification of the risk in cardiac surgery. Can. J. Anaesth. 1983; 30 : 61-80.

18- Hannan EL, Bernard HR, Kilburn HC et al : Gender differences in mortality rates for coronary artery bypass surgery. Am. Heart J. 1992, 123 : 866-872.

19- Cosgrove DM, Loop FD, Lytle BW et al : Primary myocardial revascularisation : Trends in surgical mortality. J. Thoracic cardiovascular surgery 1984, 88 : 673-684.

20- Christenson JT and Schmuziger M : Sequential venous bypass grafts : Results 10 years later. Ann Thoracic Surgery. 1997; 63 : 371-6.

21- Angelini GD and Newky AC : The future of saphenous vein as coronary artery bypass conduit. Eur. Heart. J. 1989, 10 : 273-280.

22- Christenson JT and Schmuziger M : How serious is proximal occlusion of a posterolateral sequential bypass. Texas Heart institute Journal 1996; 23 (3) : 201-206

Reconstruction of Aneurysmal Left Atrium Combined with Mitral Valve-Surgery, Is It Needed ?

ABSTRACT

The impact of aneurysmal left atrium (ALA) on results of mitral valve surgery is controversial. The purpose of this study was to assess the effect of atrial reconstructive procedures on the immediate postoperative results

Methods: Twenty eight patients with rheumatic mitral valve disease and aneurysmal left atrium (left atrium > 7 cm) were included. Thirteen patients had one or more reconstructive procedures (group I) while the remaining 15 patients did not (group II). Operative and postoperative details were compared,

Results: Early mortality was 7.7% (1/13)in group I and 13.3% (2/15) in group II. The need for prolonged artificial ventilation and inotropic support for > 24 hours was significantly higher in group II. There were 2 embolic episodes in group II and none in group I. Right C/T ratio and left atrial size were significantly reduced early after operation in group I but unchanged in group II. The reconstructive procedures added a mean of 22.4 ± 8.1 minutes to the ischemic time without increasing the operative risk.

In Conclusion : Surgical reconstruction of the aneurysmal left atrium at the time of mitral valve operation is a safe and justified procedure to improve the early surgical results.

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INTRODUCTION

Left atrial dilatation associated with rheumatic mitral valve disease is considered advantageous technically in allowing excellent surgical view of the mitral valve for repair or replacement. However, the impact of giant or aneurysmal left atrium (ALA) on surgical results of mitral valve has been controversial. Some authors have identified ALA as a risk factor for mortality after mitral valve replacement and advocated atrial plication procedures to improve surgical results (1,2,3,4). Some others have found no correlation between left atrial size and surgical outcome (5,6,7)

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It has been reported that enlarged left atrium is among the atrial risk factors increasing the incidence of postoperative thromboem- bolization even after bioprosthetic valve replacement and long term oral anticoagulation was recommended (8-9).

The aim of this study was to investigate the effect of atrial reconstruction procedures on surgical results of patients with ALA undergoing mitral valve surgery.

Anatomical consideration

Normally the left atrium is the most superior and most posterior of the cardiac chambers lying just under the tracheo-bronchial bifurcation in front of the spine

with the descending aorta and esophagus in between. It is partially bounded anteriorly by the great vessels arising from the base of the heart, the left ventricle lies to the left, anteriorly and inferiorly. The four pulmonary veins enter the left atrium at the corners of its posterior wall which is quadrangular in outline. The right and left pulmonary arteries run along its upper border (l0). The left atrium can enlarge in the pathway of least resistance, laterally to the right or left, superiorly displacing the adjacent bronchi with widening of the carinal angle, posteriorly displacing the esophagus (11). It has been also shown by echocardiography that giant left atrium can enlarge anteriorly and slide behind the base of the left ventricle bending its posterobasal wall (12). Recently, Minagoe et al (13) showed elegantly that aneurysmal left atrium can obstruct the venous return at the IVC arifice by marked displacement of the atrial septum.

Definition of Giant or Aneurysmal Left Atrium (ALA) :

There is no established criteria for ALA (14). Left atrial dilatation has been. previously estimated roughly based on radiological and angiographic examination (11-15-16). Echocardiography has then become the ideal diagnostic tool to measure left atrial dimension (17). Kawazoe et al (3) defined giant left atrium by its compression effect. They identified 2 types, left ventricular compression type diagnosed by echocardiography and broncho pulmonary compression type diagnosed radiologically when the right C/T ratio exceeds 0.6 or carinal angle exceeds 120°. Picolli (3) et al defined Giant left atrium when C/T ratio is > 0.7 and confirmed by echocardiography. Left atrial dimension of 6.5 cm has been considered empirically as a definition of ALA (13). We elected to define ALA when it exceeds 7 cm by echocardiographic examination.

Patients and Methods

Twenty eight consecutive patients with ALA were operated upon essentially for rheumatic mitral valve disease between September 1995 and January 1997 by the same surgeon. All of them fulfilled the basic criterion of having left atrial size exceeding 7 cm by echocardiography and they represent 6.6% of patients having mitral valve surgery during the same period. Left atrial dimension was obtained in the supine position by standard left parasternal long axis view with two dimensional and M-Mode echocardiography at the time of aortic valve closure and was averaged over 3 consecutive beats.

There were 19 females and 9 males with age ranging between 15 and 50 years (mean 30.8 $\pm$ 9.4). Thirteen consecutive patients had one more atrial reconstructive procedures, (Group I) while the comparable group included 15 consecutive patients operated upon before adopting this technique (group II).

Clinical, radiological and echocardiographic data were compared preoperatively and postoperatively within each group and between both groups. Postoperative comparison included immediate assessment and at 3 months period after operation. Statistical analysis of all data was done using the appropriate significance test (18). Histological examination of a piece of excised left atrial

Table (1): Relations of preoperative data among the studied groups.

Data	Group I n=13 No %	Group II n=15 No %	Statistical significance	
Sex : F	8 6.1	11 73.3	$\chi^2 = 0.44$	P = N. S
M	5 38.5	4 26.7		
Age: (Mean ± SD)	33.9 ± 11.1	29.1 ± 6.7	t = 1.69	N.S.
Range	15 – 50	15 – 40		
F.C. I	1 (7.7)	2 (13.3)		
III	4 (30.8)	4 (26.7)		
IV	8 (61.5)	9 (60)		
Mean ± SD	3.54 ± 0.6	3.47 ± 0.74	t= 0.27	N.S.
Thromboembolism	3 (23.1)	2 (13.3)	χ^2=0.45	N.S.
Previous operation	5 (38.5)	2 (13.3)	χ^2=2.35	N.S.
Rhythm : Sinus	1 (7.7)	1 (6.7)		
AF	12 (92.3)	14 (93.3)	χ^2=0.01	N.S.
Predom. Lesion. M.S.	9 (69.2)	7 (46.7)		
MR.	3 (23.1)	8 (53.3)		
Normal	1 (7.7)	0 (0)	$\chi^2 = 2.22$	N.S.
Associated TR	5 (38.5)	4 (26.7)	$\chi^2 = 0.44$	N.S.
Rt C/T (mean ± SD)	79.1 ± 13.5	79.9 ± 8.3	t = 0.19	N.S.
L.A. size (mean ± SD)	8.5 ± 1.6	8.1 ± 1	t = 0.89	N.S.
Range	7.2 – 13	7.1 – 10		
PAP (mean ± SD)	55.6 ± 20.8	53.7 ± 9.5	t = 0.33	N.S.
Range	34 – 95	35 – 70		

wall was performed to describe the pathological changes in such aneurysmal atria. The data reported here followed the guidelines recently published by Edmunds et al (19).

Results

A- Preoperative data :

Preoprative clinical, radiological and echocardiographic data of both groups are shown in table (1). It was noticed that none of our patients had pressure symptoms of ALA inspite of the marked increase in cardiac size. Seven of our patients had previous mitral valve operations, 5 in group I and 2 in group II. Five patients had preoperative thromboembolic episodes, 3 in group I and 2 in group II, four of them had predominant stenotic lesion and one had ALA with well functioning mitral prosthesis. Thirty six patients (93%) were in atrial fibrillation. Sixteen patient 57% had predominant stenotic lesion while 11 had predominant incompetence and one had normally functioning prosthetic valve. This last one had a reversible ischemic neurological deficit and was operated upon because of a big left atrial thrombus. Only 3 patients had severe pulmonary hypertension > 80 mmHg while the mean PAP was 55.6± 20.8 and 53.6 ± 9.5 in group I & II respectively.

Both groups were comparable as regards the age, sex distribution, preoperative

Table (2): Different valvular operations in both groups.

Procedures		Group I n = 13		Group II n = 15	
		No	%	No	%
Mitral valve :	Repair	1	7.7	7	46.7
	Replacement	10	79.9	8	53.3
	None	2	15.4		
Aortic Valve	Replacement	4	30.8	0	0
Tricuspid valve	Repair	5	38.5	4	26.7
Ischemic time (min)		82.5 ± 18.2		56.1 ± 5.6	

Table (3): Immediate and early postoperative assessment data of the studied groups.

Parameters		Group I n = 13	Group II n = 15	Statistical Significance	
Need for inotropic*	Yes	3 (23.1%)	9 (60%)	χ^2= 3.88	P < 0.05
	No	10 (76.9%)	6 (40%)		
Need for artificial ventlation*	Yes	2(15.4%)	10(66.7%)	χ^2= 7.48	P < 0.01
	No	11(84.6%)	5(33.7%)		
Hospital mortality	Yes	1(7.7%)	2(13.3%)		
	No	12(92.3%)	13(86.7%)	χ^2= 0.23	NS
Functional class	(Mean ± SD)	0.9 ± 0.5	2 ± 0.8	t =3.93	P < 0.005
Right C/T ratio	(Mean ± SD)	45.2 ± 5.9	76.3 ± 4	t=12.95	P < 0.0001
Left atrial size	(Mean ± SD)	5.9 ± 0.4	7.8 ± 0.8	t=7.37	P < 0.0001

*** > 24 hours**

functional class, thromboembolization. predominant lesion, previous operation, atrial fibrillation, associated tricuspid incompetence, right C/T ratio, left atrial size and pulmonary artery pressure.

B- Operative data :

All patients underwent the operation using the standard cardiopulmonary bypass with myocardial protection using cold crystalloid cardioplegia and moderate systemic hypothermia. Different valvular operations are shown in table (2).

Technique of left atrial reconstruction

We observed that the left atrium, when gets aneurysmal, can enlarge in any of the three spatial axes, anteroposterior, left to right and cranio-caudal compressing adjacent structures. Reconstruction procedures of the left atrial chamber are fashioned individually according to the findings on table :

a- Para~annular reconstruction, to treat left ventricular compression type by plicating the recess of atrial wall sliding behind the postro basal wall of the left

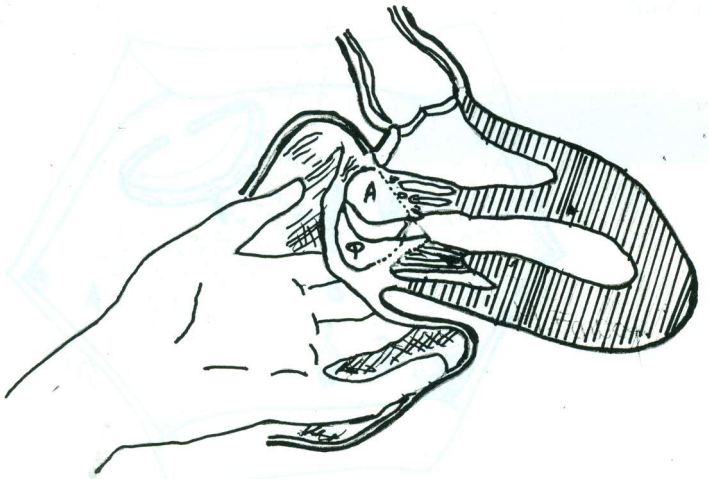


Fig.1: Diagram showing surgeon's finger in the atrial recess .

ventricle which can easily accommodate the fingers of surgeon's left hand (Fig. 1). This recess is plicated in a semilunar fashion starting from the upper end of the atrial appendage down to the posteromedial area of the mitral annulus. The edge close to the mitral annulus is at least 1 cm away to avoid injury or kinking of the circumflex coronary artery while the other edge is at least 1 cm from the lower left pulmonary vein. Plication is performed using Prolene 3/0 sutures over and over taking not too deep bites and tucking the posterior wall between the two edges (Fig. 2a).

b- Inter pulmonary reconstruction, to treat the enormous expansion of the atrial wall between the openings of the right and left pulmonary veins which causes splaying and compression of the bronchi. This area can be obliterated by plication sutures as before reducing this distance to about 5-6 cm (Fig. 2b).

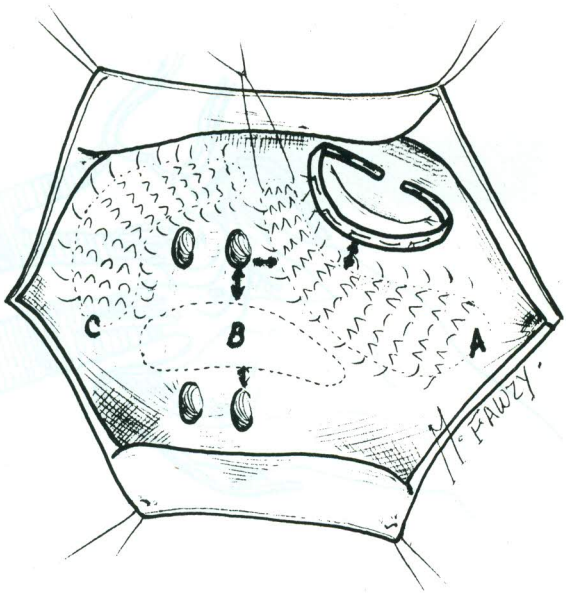
c- Superior wall reconstruction, the superior wall of the left atrium can be markedly enlarged causing widening of the carina and adding to the bronchial compression. This can be plicated in the same semilunar fashion (Fig. 2c).

d- Right side reconstruction, a variable width of the free left atrial wall on the right side can be excised in a fusiform manner leaving at least 1 cm of in front of the right pulmonary veins.

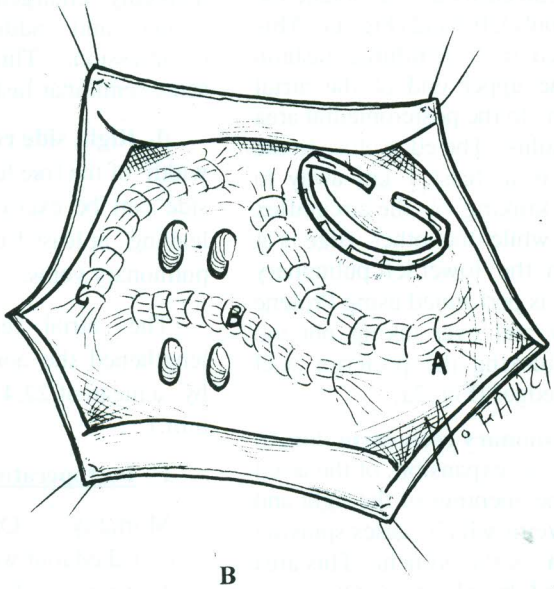
The atrial reconstruction procedures lengthened the aortic cross clamping time by a mean of 22.4 $\pm$ 8.1 min. (Range 10-35 min.)

C- <u>Postoperative data</u>

Mortality : One patient in group I (7.7%) died four weeks postoperative due to mediastinitis and septicemia. 2 patients in group II (30.3%) died within the postoperative week due to low cardiac output. The difference between both was statistically insignificant.



A



B

Fig.2: Diagram A&B showing reconstructive procedures .

a- Para-annular b- Inter - pulmonary c- Superior wall

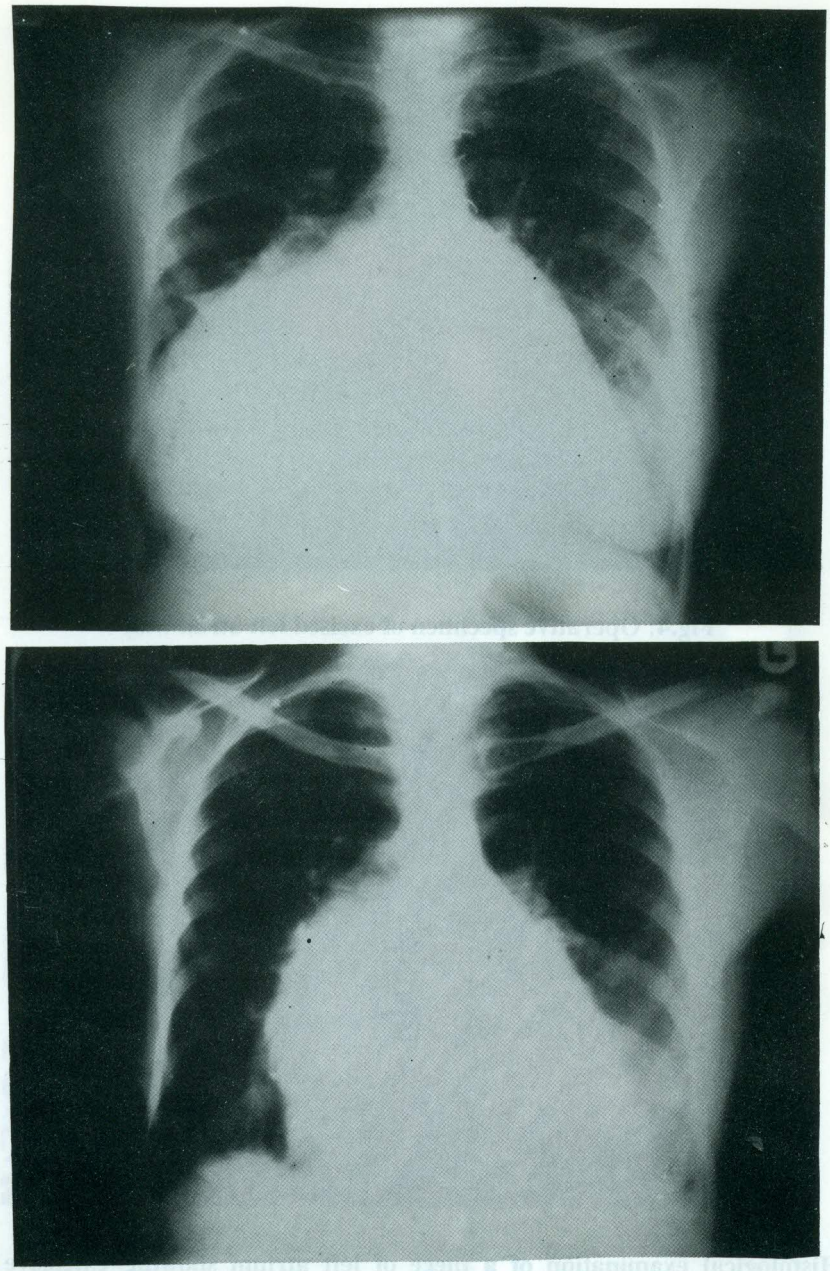


Fig.3: Pre (a) and postoperative (b) posteroanterior chest X-ray in a patient in group 1 .

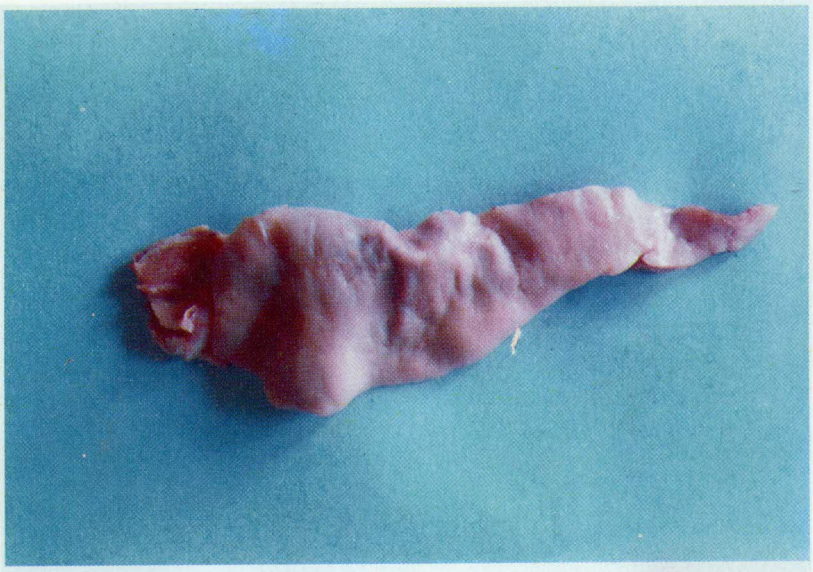


Fig.4: Operative specimen of excised left atrial wall

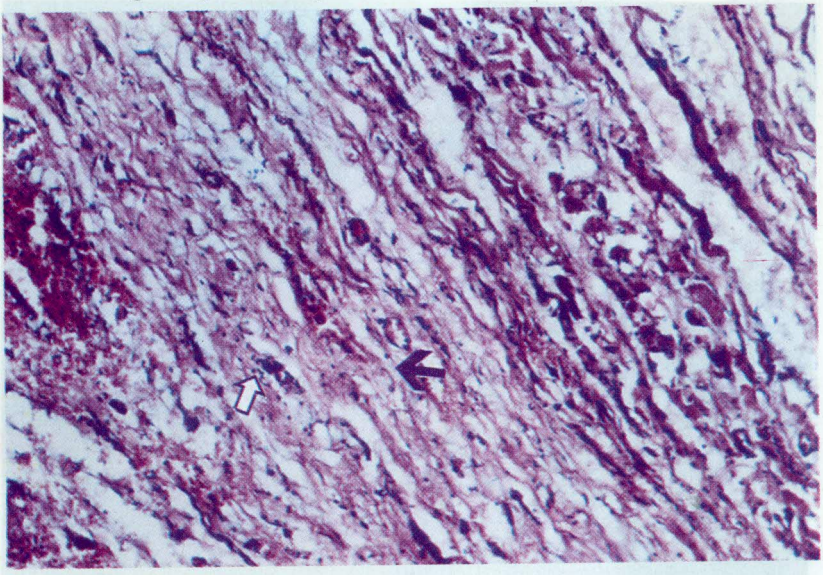


Fig.5: Histological examination of a piece of left atrium showing extensive fibrosis (black arrow) and inflammatory lymphocytic cellular infiltration (white arrow).

Three patient in group I (23%) and Nine in group II (60%) needed moderate to high dose of catecholamine support for more than 24 hours. The difference between both was statistically significant ($p < 0.05$).

Two patient in group I (15.4%) and ten patient in group II (66.7%) required artificial ventilatory support more than 24 hours. The difference between both was also statistically significant ($p > 0.01$).

During assessment at 3 months postoperatively group I showed better improvement in their functional class (mean 0.9 ± 0.5) which was significantly better than the preoperative condition (mean 3.5 ± 0.67) with $p < 0.001$. Patients in group II also showed significant improvement in their function class from 3.4 ± 0.6 preoperatively to 2 ± 0.8 postoperatively ($p < 0.001$). However, postoperative function class of the patients in group I was significantly better than the patient in group II ($p < 0.001$).

Postoperative radiological reduction of the right C/T ratio and echocardiographic decrease of left atrial size were highly significant in group I with p value < 0.05 for both parameters (Fig. 3) while the postoperative change in group II was insignificant with p value > 0.05. When both groups were compared postoperatively for the same parameters group I was significantly better ($P = < 0.001$). The data of immediate and early postoperative assessment are shown in table 3

Two patients in group II had embolic episodes (1 had transient ischeamic attack and 1 had reversible ischaemic neurological deficit) during the early postoperative period. None of the events happened in group I.

Histological examination of the excised piece of the left atrial showed marked attenuation of the muscle fibers which was replaced by extensive fibrous tissue with evidence of lymphocytic cellular inflitration (Fig. 4 & 5). This indicates the extensive involvement of the left atrial wall with inflammatory rheumatic process.

Discussion

Different criteria have been adopted to define ALA (1,3,11,15) (however none has been agreed upon (14) . Echocardiography has been an established tool to measure left atrial dimension (17) and describe the morphological and hemodynamic significance of giant left atrium (9). We still have a big patient population with advanced rheumatic mitral disease. We elected to consider left atrial dimension > 70 mm as an indicator of ALA. This was taken emperically as others did(8). Confirming the diagnosis was made by postero-anterior and lateral radiological examination showing right C/T rate > 0.6 and posterior atrial enlargement.

We noticed that ALA can occur similarly with either predominant mitral stenotic or regurgitant lesions. Four of our patients had thrombembolic events, all of them had predominant mitral stenotic lesion with mild or moderate mitral incompetence. A similar observation has been recently reported by Karatasakin et al (20) explaining that severe mitral incompetence has a washing out effect. Aneurysmal left atrium in presence of normally functioning mitral valve prosthesis predisposed to a big thrombus formation with subsequent embolic event in one of our patients in group I indicating reoperation for thrombus excision and atrial reconstruction. Two patients in group II had early postoperative

embolic events inspite of well functioning mitral prosthesis and proper oral anticoagulation. Correlation between embolization and atrial fibrillation has been well established (21,22,23) but left atrial dimension failed to predict independently the likelihood of developing systemic embolization (24,25)

However, both studies described smaller atria (50-60mm). Our patient population had much bigger atrial cavity (mean > 80 mm) and can represent a different group of patients. This could be supplemented by a recent study concluding that left atrial enlargement remained a significant predictor of stroke in men and death in both sexes (26) . Further study is needed to elucidate the relationship in rheumatic heart disease.

The effect of ALA on left ventricular performance was elegantly described by Kawazoe and his team (2-12) . They showed abnormal position and motion of posterobasl left ventricular wall which could contribute to low cardiac output state. They advocated plication procedure to ameliorate this effect. We believe that this phenomenon was the reason of significantly higher incidence of LCOP state among patients without reconstruction procedure in our study. This is supported by others (3,4,5) believing that giant left atrium when untreated affects MV surgical results. postoperative respiratory failure requiring prolonged artificial ventilation for > 24hs. was evident in group II of our patients. This pathological effect was also described by others (2,4,27) emphasizing that atrial wall reconstruction would significantly improve pulmonary function of such patients.

Left atrial reconstruction has increased the ischemic time during valve operation by a mean of 22.4 $\pm$ 8.1 min (range 10-35 min). However this extra time did not increase the surgical risk and was clearly nullified by the evident improvement of left ventricular and pulmonary functions.

Despite that the two deaths in group II were due to LCOP, no statistically significant conclusion could be reached to show the impact of atrial reconstruction on hospital mortality. However, the effect on post operative course was clearly evident. This was also augmented by the highly significant reduction in C/T ratio and left atrial size following surgery.

ALA occurs in 0.3%-12% of patients with advanced mitral valve disease. This has occurred in 6.6% of our patients operated upon. To understand why some atria enlarge massively while others with similarly advanced mitral valve disease don't , is of theoretical interest. This has been explained by the markedly increased compliance of the left atrial wall allowing massive left atrial enlargement with normal or slightly elevated left atrial and pulmonary artery pressures (28). We proved like other (29) , by histological examination that the atrial wall of such patients was extensively involved by inflammatory process causing marked attenuation of the muscle component and replacement by extensive fibrous tissue with evident lymphoytic inflammatory cellular infiltration. This healing process caused the atrial wall to yield under any increase in

left atrial pressure ending by aneurysmal left atrium.

We conclude that surgical reconstruction of aneurysmal left atrium at time of mitral valve operation is safe and justified to improve the early surgical results.

We thank deeply Dr. M Fawzy for his contribution in drawing the diagrams .

References

1. Barhorst DA, Oxman HA, Connolly DC et al.: Long Term follow up of isolated replacement of the aortic or mitral valve with Starr-Edwards prosthesis. Am. J. Cardial 1975; 35 : 228-233.

2. Kawazoe K, Beppu B, Takahara Y et al. : Surgical treatment of gaint left atrium combined with mitral valvular disease. J. Thorac. Cardiovase. Surg. 1983; 85 : 885-892.

3. Piccoli G, Massini C, Eusanio GD et al. : Gaint left atrium and mitral valve disease : Early and late results of surgical treatment in 40 cases. J. cardiovascular surgery. 1988; 25(4) : 328-336.

4. Johnson J, Danielson GK, Mac Vaugh H et al. : Plication of the gaint left atrium at operation for severe mitral regurgitation. Surgery. 1967; 61 : 118-121.

5. Appelbaum A, Kouchoutos NT, Blackstone EH et al. : Early risk of open heart surgery for mitral disease. Am. J. Cardicol. 1976; 3 7: 201-8.

6. Grunkemeier GL, Mac Manus G, Thomas DR, et al. : Regression analysis of late survival following mitral valve replacement. J. Thorac. Cardiovasc. Surg. 1978; 75 : 131-7.

7. Salomon NW, Stinson EB, Griepp RB et al. : Patient related risk factors as predictors of results following isolated mitral valve replacement. Ann. Thorac. Surg. 1977; 24 : 519-30.

8. Hetzer R, Hill JD, Kerth WJ, et al. : Thromboembolic complications after mitral valve replacement with Hancock xenoygraft. J. Thorac and cardiovasc. Surgery. 1978; 75(5) : 651-8.

9. Matloff J. Discussion of Hetzer R (ref 8).

10. Gunnigham's manual of practical anatomy: London Oxford University Press 5 Extreme left atrial th ed. 1964; page 102.

11. De Sanctis RW, Dean DC and Bland EF: enlargement. Some characteristic features. Circulation 1964; XXIX 14-23.

12. Beppu S, Kawazoe K, Nimura Y et al. : Study of abnormal position and motion of the posterobasal wall of the left ventricle in cases of gaint left atrium. Am. J. Cardiology 1982; 49: 467-72.

13. Minagoe S, Yoshikawa J, Yoshida K, et al. : Obstruction of inferior vena caval orifice by giant left atrium in patients with mitral stenosis. Circulation 1992; 96 (1) : 214-225.

14. Oh JK: Echocardiographic evaluation of morphological and hemodynamic significance of giant left atrium. Circulation 1992; 86(1) : 328-330.

15. Plaschkes J, Borman JB, Merin G et al.: Giant left atrium in rheumatic heart disease. A report of 18 cases treated by mitral valve replacement. Ann. Surg. 1971; 174 (2): 194-201.

16. Lukas DS, Mahrer PR and Steinberg I: Angiographic and physiologic correlations in mitral stenosis. Circulation 1958; XVII : 567-575.

17. Hirata T, Wolfe SD, Popp R et al. : Estimation of left atrial size using ultrasound 1969; 78 : 43-52.

18. Shwartz D : Statistical methods for use in medicine and biology. Flammarian medicine, sciences Press. Paris 1988; 5 th ed. Page 1592.

19. Edmunds LH, Clark RE, Gohn LH et al.: Guidelines for reporting morbidity and mortality after cardiac valvular operations J. Thorac. Cardiovasc. Surg. 1996; 112 : 708-711.

20. Karakasakis GT, Gotsis AC and Cokkinos DV: Influence of mitral regurgitation on left atrial thrombus and echocardiographic contrast in patients with rheumatic mitral valve disease. Am. J. Cardiol. 1995; 76 : 279-81.

21. Lie JT : Atrial fibrillation and left atrial thrombosis : an insufferable couple. Am. Heart J. 1988; 1374-1377. 22.

22. Coulshed N, Epstein EJ, McKendrik CS et al. Systemic embolism in mitral valve disease. British Heart J. 1970; 32 : 26-34.

23. Dewar HA and Weightman D: A study of embolism in mitral valve disease and atrial fibrilation. British Heart J. 1983; 49 : 133-140.

24. Burchfiel CM, Hammer meister KE et al. : Left atrial dimension and risk of systemic. Embolism in patients with prosthetic heart valve. J. Am. Coll Card, 1990; 1S (l): 32-41

25. Sherid MV, Clark RD and Cohn K: Echocardiographic analysis of left atrial size before and after operation in mitral valve disease. Am. J. of Cardiology 1979; 43 (2) : 171-178.

26. Benjamin EJ, Agostino RB, Belanger AJ : Giant left atrial size and risk of stroke and death. Circulation 1995; 92 : 835-841.

27. Le Roux BT and Gostman MS : Left atrium. Thorax. 1970; 25: 190-198.

28. Braunwald E and Awe WC A syndrome of severe mitral regurgitation with normal left atrial pressure. Circulation 1963; 27 :27-29.

29. Parsonnet AE, Bernstein A and Martland HS : Massive left auricle with special reference to its etiology and mechanisms. Am. Heart J. 1946; 31 : 438-450.

Surgical Closure of Patent Ductus Arteriosus in 40 Premature Newborns.
Indications, Technique and Complications

ABSTRACT

Surgical closure of patent ductus arteriosus has been used in 40 premature newborns from October 1994 till February 1997 in Dubai Hospital, U.A.E. Mean gestational age at birth was 29 ± 3.1 weeks and the mean age at the time of operation was 25.8 ± 19.7 days. Medical management in the form of anti-failure measures and mechanical venilation was offered to all patients preoperatively and Indomethacin therapy was tried in patients above one kgm birth weight earlier in the study. All cases were done under general endotracheal anaesthesia, in the operating theatre. The approach was left lateral minithoracotomy, with no or minimal dissection of the ductus. The ductus was closed using medium size hemo clips. All patients tolerated the operative procedure with no mortality. Only one case was complicated intraoperatively with bleeding and later developed persistent left lung atelectasis, which could be managed through bronchoscopic aspiration of the left main bronchus.

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J. of Egypt. Society of Cardio thorac. Surg. 1997, Vol. V April No 2

INTRODUCTION

Patent ductus arteriosus (PDA) is the persistence in postnatal life of the normal fetal vascular conduit that connect the central pulmonary and systemic arterial systems (1).

PDA is common in premature infants and is associated with increased incidence of the respiratory distress syndrome (2). If pulmonary vascular resistance is less than systemic vascular resistance, a PDA will result in excessive lung perfusion at the expense of systemic blood flow. This may result in metabolic acidosis, pulmonary oedema, ventricular failure and reduction in splanchic and cerebral blood flow. Those phenomena are added to the disorders of gas exchange associated with the primary lung disease (3).

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The diagnosis of PDA in premature newborns is based on clinical examination and echocardiography which can reliably confirm the presence of the shunt (4).

Surgical closure of PDA is a major procedure, but the improvement in pulmonary function and peripheral perfusion justifies the risk (6).

With increasing advances in neonatal intensive care, survival rates for extremely prematures, very low birth weight infants have been improving. The management of patent ductus arterosius (PDA) in these high risk infants remains an area of controversy. Standard therapy for PDA includes fluid restriction, diuretics and prostaglandin-inhibitor Indomethacin with surgical closure reserved for medical failure (5).

In this report we describe our early experience with surgical closure of PDA in the newborn with special reference to indication, techniques and complication and this report is a step towards retrospective study comparing Indomethacin therapy (which was abandoned because of multiple complications) with surgical closure in our centre.

Patients and Methods :

From October 1994 till February 1997, we had 800 premature newborns among a total of 17,295 live births at Al Wasl Hospital, for maternity and children in Dubai, United Arab Emirates. One hundred premature newborns were diagnosed to have persistent ductus arterosius of significant left to right shunt.

All patients were diagnosed in the routine postnatal clinical assessment. Findings included wide pulse pressure, systolic murmur best heard on the second left intercostal space, evidence of pulmonary plethora and evidence of heart failure. Radiologically there was cardiomegaly and excess pulmonary blood flow (Fig 1). Echocardiography was a reliable method of confirming the diagnosis and estimated the left to right shunt through PDA in all cases.

All patients were subjected to medical treatment in the form of anti - failure measures of fluid restrictions, diuretics, mechanical ventilation for respiratory failure and only patients above 1 kgm body weight had a trial of Indomethacin therapy.

The indication for surgical intervention was premature newborn with PDA who remained ventilator dependent or remained in congestive heart failure in spite of intensive medical therapy.

All operations were performed in the operating theatre, the newborn was transferred from Special Baby Care Unit (SBCU) in a special transport incubator (Fig 2) and then transferred carefully to the standard operating table. The ambient operating room temperature was 28°C. In addition overhead heater and warming mattress were used routinely.

Monitoring consisted of E.C.G., non invasive blood pressure, rectal temperature and pulse oxymetry in the lower limb (left big toe).

Anaesthesia was conducted using Fentanyl, Pancronium and air oxygen mixture.

The patient is positioned on his right side. The ductus is approached through Left lateral mini thoracotomy of one inch incision, dividing the latissmus dorsi muscle and sparing the serratous anterior muscle to enter the chest through the 4th intercostal space using neonatal size self retaining chest retractor. The lung is retracted anteriorly and downwards very gently by the assistant using two tiny swabs on artery forceps.

The mediastinal pleura over the descending thoracic aorta is incised, the superior intercostal vein is divided between two small hemoclips or after its cauterization, minimal dissection on both upper and lower margins of the ductus is done (Fig 3) and two medium size hemoclips were applied (Fig 4). Then the

lung is allowed to inflate, pleura is left open and intercostal tube size 10 or 12 is inserted and connected to an underwater seal. Then the ribs were approximated by a single suture of 2/0 vicryl. The soft tissue were closed in 2 layers with running suture of absorbal material. Transport back to the SBCU is carried out in the same way. After chest radiography on the same day or next morning and with full lung expansion, the chest tube is removed.

Results :

From October 1994 till February 1997, 40 premature newborns out of a hundred (40%), who were diagnosed as having PDA, underwent surgical closure and 60 cases showed spontaneous closure or could be cured with Indomethacin therapy (60%).

The mean gestational age at birth for those who required surgical closure was 29 ± 3.1 weeks (range 24 to 38 weeks), the mean age at the time of operation was 25.8 ± 19.7 days (range 7 to 97 days) and the mean birth weight was 1028.7 ± 379.7 gms (range 640 to 2580 gms).

The operating time was in the range of 35 - 45 minutes. All patients had their pleural catheters removed before 24 hours.

There were no operative mortality in our series but we have one case complicated by intraoperative bleeding and had incidental closure of a main bronchus on the left side during stitching of the bleeder. This patient developed postoperative left lung atelectasis and prolonged ventilation and underwent bronchoscopic aspiration of the bronchus which was partially clipped and partially occluded by blood clots on the 5th postoperative day. All 29 patients who had preoperative congestive heart failure improved and it was possible to stop the anti-failure medications within one week after operation (Fig 5).

The 4 patients who had preoperative impending renal failure, their serum creatinine and urea levels were back to normal by the end of the first postoperative week.

The weaning from mechanical ventilation could be achieved successfully for all patients within a mean time of 7.2 ± 6.5 days (range 1 to 23 days).

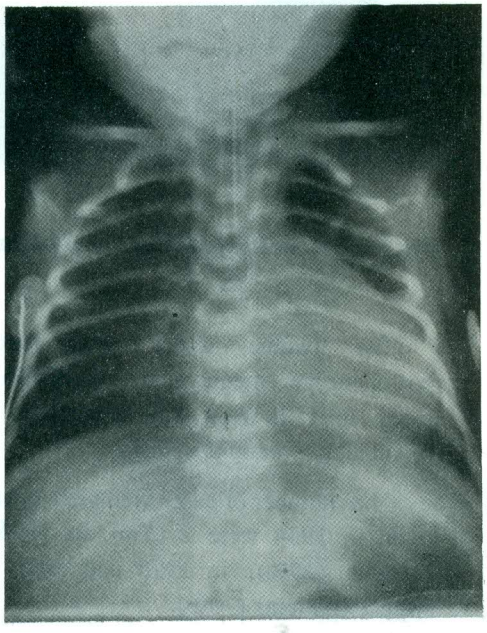

Fig.1: Preoperative chest x-ray shows cardiomegaly and pulmonary congestion (patient is intubated).

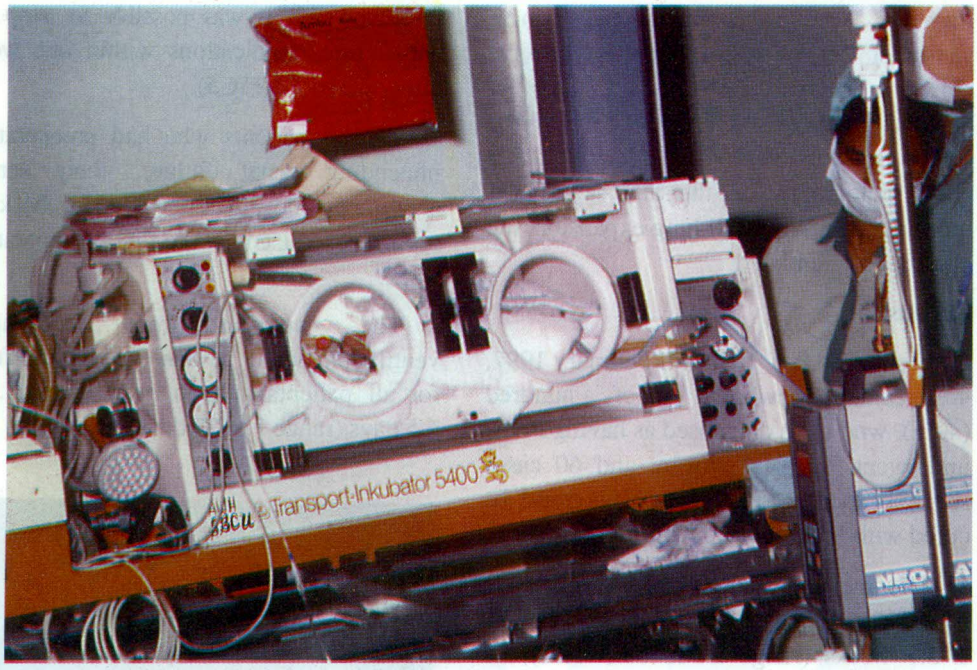

Fig.2: Baby in the transport incubator .

The twelve cases who required postoperative mechanical ventilation for more than a week were associated with bronchopulmonary dysplesia.

The number of cases who were operated upon in 1994 were 2 (5%), in 1995 - 10 patients (25%), in 1996 and early 1997 were 29 patients (70%).

Discussion :

Incidence of PDA in premature infants in our series is 12.5% which correlate with all reports which document increased incidence of prematures and low birth weights (7, 9, 11).

Premature infants who are candidate for PDA closure generally fall into three categories. One category is those patients with minimal lung disease and congestive heart failure. These infants usually do well after ligation and have marked improvement in their clinical course and constitute 29 patients in our series (72.5%). In the second category are those patients with moderate lung disease and congestive heart failure. It is often difficult to

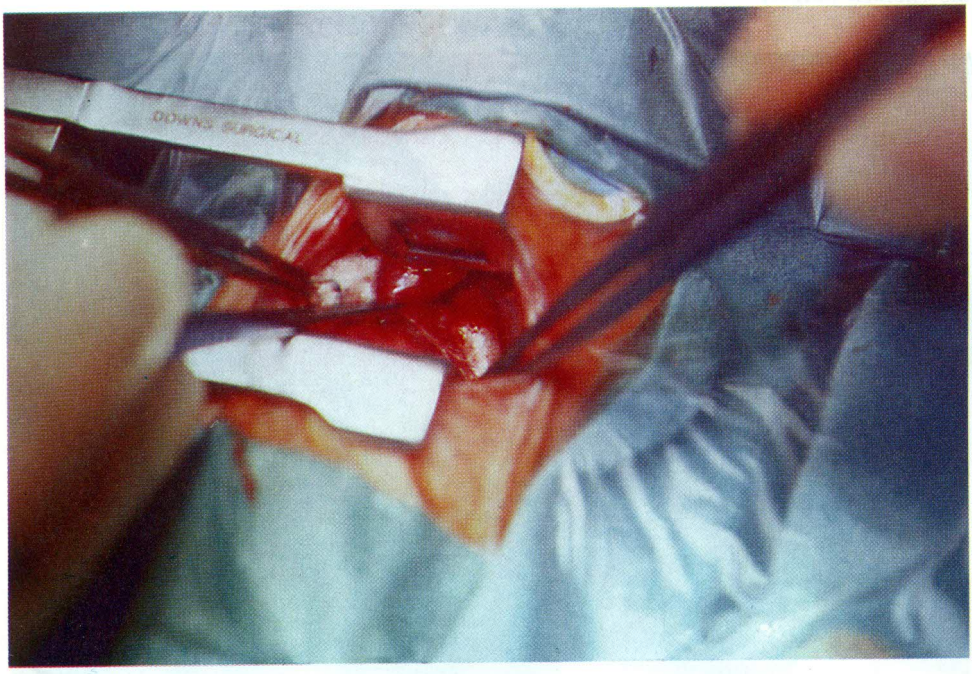

Fig.3: Operative field with (big) ductus wall displayed .

distinguish which is contributing most to the patient problem. This category constitute 9 patients (22.5%) in our series. The third group of patients are those who seriously have severe lung disease and PDA only represents a small part of the problem. The result in this group have been the poorest (8) and we had only 2 patients (5%) in this category.

Early closure of PDA has the potential benefit of reducing baro trauma due to positive pressure ventilation (8). The fact that PDA in premature with congestive heart failure and low cardiac output can promote renal failure and cerebral complications was evident in our series.

The current management of PDA in prematures includes anti-failure measures in the form of fluid restriction, diuretics, digitalization, use of prostaglandin inhibitor Indomethacin. Surgical closure is a final effort when conservative medical management fails (3).

Pharmacological management using Indomethacin shows a 42% failure rate in the literature received (9,10,11).

It seems that in high risk patients, under 1500 gm, with severe respiratory distress syndrome, treatment with Indomethacin and delayed operation apparently affect the prognosis (12).

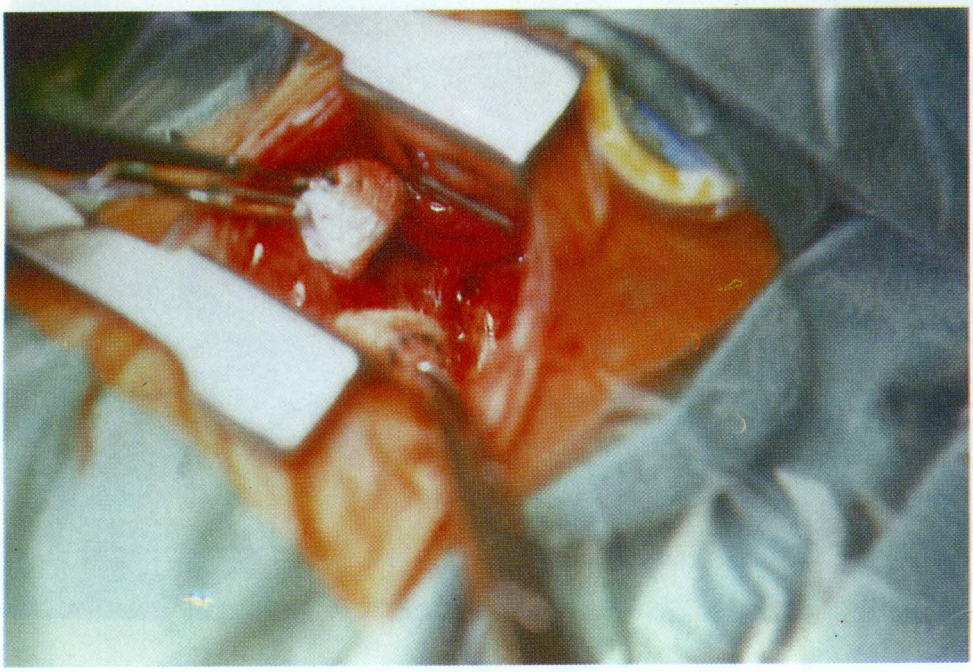

Fig.4: Ductus after application of 2 haemodip .

Complication after Indomethacin therapy includes reduction in renal perfusion with varying degree of renal dysfunction, gastrointestinal bleeding, bleeding dyscrasias and hyperbilirubinaemia (8).

In our series we had 5 cases with raised blood urea level and 3 patients who developed gastrointestinal bleeding. The failure rate of Indomethacin in prematures less than 1000 gm birth weight made our neonatologist not to try it in those group of patients and with increasing complications over the last year. Indomethacin was abandoned even in patients above 1000 gm birth weight in our center.

The increase in the referral for surgery in 1996 since Neonatologists discontinued use of Indomethacin as a line of therapy during this period because in our center 5 patients showed rise of blood urea and 3 patients had gastrointestinal bleeding during Indomethacin therapy.

On the other side surgical closure of PDA has shown to be relatively safe with low morbidity rate and even no mortality in premature newborns (8).

Surgical closure of PDA in premature low birth weight newborn is a major procedure and transport of these patients to operating room is risky. For this reason

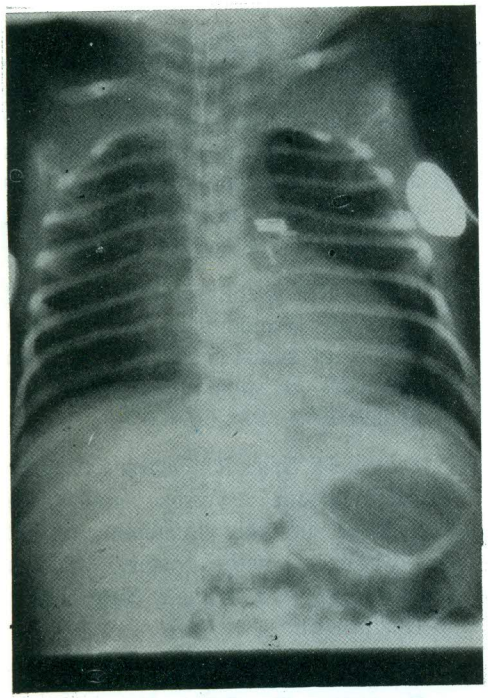

Fig.5: Postoperative chest X-ray showing clip at the site of the ductus, intercostal tube removed and patient is still on ventilator, but pulmonary vascularity is markedly improved compared with preoperative figure (1).

some centers perform the procedure in neonatal intensive care in an open incubator (8). The transport incubator that we used to carry our patients to the operating room was convenient and we had no complications related to transport.

Since Robert Gross first successful ligation of PDA in 1938 (13), many techniques have been described for ductal interruption (14) we used hemoclip closures of PDA with minimal dissection of the ductus which is usually thin walled and friable in premature newborns. The whole procedure takes less than 45 minutes and this technique is simple, rapid and reliable. In our experience we had no operative related mortality and we had only one case (2.5%) complicated by intraoperative bleeding which was well controlled in the theatre but the patient developed postoperative persistent left lung atelectasis in spite of repeated suction and physiotherapy. Bronchoscopy on the fifth postoperative day revealed compression of a main bronchus on the left side by incidental stitching of a main bronchus during the operation. This obstruction could be relieved by bronchoscopic dilatation and suction of blood clots which resulted immediate inflation of the left lung.

In this series the mean age at intervention was 25.8 ± 19.7 days, which indicate either delay in diagnosis or delay in referral for consideration of surgical closure. This observation is important as it is now agreed in most centers that early surgical closure within the first week has the best results.

This report is an introductory step for undergoing research comparing patients treated with Indomethacin earlier in the study versus early surgical closure in our center.

References

1. Gitten Berger - de - Groot, A.C.: Persistent ductus arteriosus : most probably a primary congenital malformation. Br. Heart J. 1977 ; 40 : 610.

2. Kitterman JA, Edminds LH, Gregory GA, et al : Patent ductus arteriosus in premature infants. Incidence, relation to pulmonary disease and management. N. Engl. J Med. 1972 ; 287 : 473 - 477.

3. Christopher Hubbard, Ralph W. Rucker, Fidel Realy-Vasquez, et al: Ligation of the patent ductus arteriosus in newborn respiratory failure. Journal of paediatric surgery. 1986;21, No 1 : 3-5.

4. Castaneda AR, Joans, Mayer and Hanely : Patent ductus arteriosus. In cardiac surgery of neonate and infant. WB Saunders Co., 1994 : 203 - 213.

5. Gersony WM, Peckham GJ, Ellison RC, et al Effects of Indomethacin in premature infants with patent ductus arteriosus. Results of a national collaborasive study. J Pediatric. 1983; 102:895-906.

6. Horsley BL, Lerbert DB, Allen AC et al : Respiratory distress from patent ductus arteriosus in the premature newborn. Ann Surg. 1973;177:806-810.

7. Heymann MA : Patent ductus arteriosus. In Adams FA, Emmanonilides GC, Reimenschneider TA (Eds). Moss Heart Disease in infants, children and adolescents. 4th Edition - Baltimore Williams and Wilkins 1989.

8. Canarelli JP, Poulian H, Clamadi C, et al : Ligation of PDA in premature infants - indications and procedures. Eur J Pediatr Surg. 1993 ; 3:5.

9. Cassady G, Grouse DT, Kirkin JM, Strange MJ, Joiner CH, et al:A randomized controlled trial of very early prophylactic ligation of ductus arteriosus in babies who weighed 1000 gms or less at birth. The New Eng. J. of Medicine. 1989 ; 320 : 1511-1516.

10. Cotton RB, Stahlman MT, Bender H W et al : Randomized trial of early closure of symptomatic patent ductus arteriosus in small preterm infants. J Pediatr 1978 ; 93 : 647 - 651.

11. Zerella JT, Spies RJ, Deaver DC, et al: Indomethacin versus immediate ligation in the treatment of 82 newborns with patent ductus arterosius. J Pediatr Surg 1983; 18:835-840.

12. Murat I, Lagnemie G, Esteve C, Couturier C, Saint Maurice JP: Ligature Chirurgicale du canal arterial cher le premature de tres petit poids de naissance. Ann Fr Anesth Reanim 1983; 2 : 301 - 307.

13. Gross RE, Hubbard JP : Surgical ligation of patent ductus arteriosus. JAMA. 1939; 112:729-73 1.

14. Wright J, Newman DC : Ligation of patent ductus : Technical consideration at different ages J Thorac Cardiovasc Surg. 1973 ; 65:635-638.

Clinical and Hemodynamic Performance of the St. Jude Medical Hemodynamic Plus Versus Standard Valves in the Small Aortic Root

ABSTRACT

To verify in vivo the experimental advantages of the St. Jude Hemodynamic Plus (HP) valve in terms of hemodynamics and clinical performance in the small aortic root, thirty five patients with predominantly aortic stenosis had replacement of their valves using the 2l mm BP SJM in 12 patients, the 21 mm standard SJ in 10 patients and the 23 mm standard SJ in 13 patients. There was no significant difference in the preoperative characteristics of the patients between the three groups. Postoperative hemodynamic evaluation was done using the Doppler Echo cardiography for all patients.

The peak and mean pressure gradients were significantly lower in the 21 mm HP group (15.2 ± 1.3 and 7.6 ± 2 mm Hg) than in the 21 mm standard group (20.3+2 and 12.2±1.5 mm Hg) P=0.04 and 0.03 respectively confirming the better hemodynamic performance already described in invitro studies

Pressure gradients did not differ significantly between the 21 mm HP and the 23 mm standard groups. The 21 mm HP valve demonstrated the highest performance index 0.66±0.08 compared with 0.49±0.1 for the 21 mm standard valve (P<0.001) and 0.59±0.07 for the 23 mm standard valve (P<0.001).

According to these results the St.Jude Medical heart valve Hemodynamic Plus showed superior hemodynamic performance when compared to the standard valve. Therefore the HP valve appears to be a very attractive device for aortic valve replacement in patients with narrow aortic root.

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J. of Egypt. Society of Cardio thorac. Surg. 1997, Vol. V April No 2

INTRODUCTION

The challenge with valve operation in the small aortic root is to obtain the most favorable hemodynamic performance with the shortest cross clamping time (Carrel et al., 1996). The usual alternative to small valve implantation is to reduce valve prosthesis- patient mismatch by implanting a larger valve after enlargement of the aortic ring. The drawback of this approach is that it increases the duration and the risk of the operation (Konno et al., 1975 and Manouguian et al., 1979). Another alternative might be the use of valvular homografts which have excellent hemodynamics, but are not readily available to most centers (Chambers et al., 1994).

The Hemodynamic Plus (HP) series of St.Jude medical heart valves represents an interesting innovation in valve technology. The sewing cuff of the valve and its attachment to the valve were redesigned to achieve an effectively larger valve orifice area with an equivalent tissue annulus diameter.

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The present study analyses the performance of the 21 mm HP St.Jude Medical prosthesis and compares the hemodynamic characteristics of this valve with those of 21 mm and 23 mm standard St.Jude Medical valves in patients with small aortic root.

Patients and Methods

Out of 58 patients who were operated on between May, 1996 and April, 1997 in the cardiothoracic department, Cairo University Hospitals, by replacing their aortic valves, thirty five patients underwent replacement of the aortic valve on account of predominantly aortic valvular stenosis using the St. Jude Medical heart valve prosthesis; the 21 mm HP SJM prosthesis was used in 12 patients, the 21 mm standard SJ in 10 patients, and the 23mm standard SJ in 13 patients.

Twenty three other patients who were operated on during the same period were excluded from the study due to associated moderate or severe aortic regurgitation (14 patients), replacement with Sorin valve (6 patients), Toronto stentless porcine valve (2 patients) and pulmonary autograft (Ross operation) in one patient.

All operations were performed using the standard cardiopulmonary by pass technique with a bubble oxygenator. Myocardial preservation consists of moderate systemic hypothermia (28°c), topical cooling with ice slush and intermittent multidose potassium cardioplegia which was infused into the aortic root or coronary ostia at 4°c. Valve suture technique was performed with interrupted mattress sutures stitched in an aorto ventricular fashion. Non of the root enlarging techniques was used in our study.

Postoperative evaluation included clinical examination and echocardiographic studies. Postoperative echocardiography was performed before hospital discharge and later during the follow up period which ranged between 6-18 months with a mean of 10 months.

(Doppler effect measurements) :

With the guidance of color flow images systolic velocities in the outflow tract near the valve were measured in pulsed Doppler mode from the apical four chamber view. Velocities through the prosthetic valve were measured in the continuous Doppler mode from the right parastermal long axis view.

Peak and mean systolic transvalvular pressure gradients were calculated from peak and mean flow velocities by the modified Bernoulli equation.

Pressure gradient = 4 (V valve^2 - V Lvot^2), Where V valve is the peak velocity through the prosthesis and V Lvot the peak velocity in the left ventricular out flow tract just below the prosthesis (Hatle and Angelsen, 1985).

Effective orifice area was calculated with the continuity equation by the simplified peak velocity as CSA = (PK V Lvot / PK V jet) where CSA is the subvalvular cross sectional area and PK V Lvot and PKV jet are the maximal velocity in the left ventricular out flow tract and across the valve respectively (De Paulis et al., 1994).

Effective orifice area is an index of how well a valve design utilizes its geometric orifice area.

Table (1) : Preoperative clinical and echo cardiographic data .

Parameter	Standard 21mm	21 mm HP	Standard 23mm
Number of patients	10	12	13
Age (years)	24±5	23±4	25±2
Sex (male/female)	6/4	7/5	8/5
NYHA (I/II/III/IV)	0/2/6/2	0/3/8/1	0/4/9/0
Native valve opening area (Cm^2)	0.53±.13	0.52±0.15	0.61± 0.16
Ejection fraction	0.62±0.1	0.59±0.5	0.63±0.4
Fraction shortening	0.33±0.2	0.32±0.1	0.34±0.5
Peak valve gradient (mmHg)	93±10	91±8	88±4
Mean valve gradient (mmHg)	68±8	64±7	62±2

The effective area index is a measure of how well the effective orifice area (or flow area) of the valve matches the body surface area and is calculated as effective orifice area divided by the body surface area. This index is used to detect mismatch between valve size and body surface area. Index greater than one indicates a good match between valve size and body surface area. The performance index is a measure of how well a valve utilizes the valve annulus area It is defined as the effective orifice area divided by the sewing area.

Statistical analysis of postoperative data consisted of a comparison of the means of each valve size group and a wilcoxon paired rank test for the comparison of each matched paired group of patients.

Results :

Table (I) reveals the preoperative characteristics of the 3 groups of patients defmed by the size of the aortic prosthesis implanted. The main demographic parameters did not reveal any significant difference between the three groups of patients.

In all patients sizing of the valves was achieved with the standard and HP sizers. A close correspondence between 21 mm HP standard and 21 mm HP sizers was observed in all cases . There was no significant difference in the ischaemic time (mean value for all groups 50 ± 10 minutes) and total by pass times (75 ± 8 minutes) between the three groups of patients.

Table (II) : Postoperative hemodynamic parameters .

Parameter	21 standard	p value	21 HP	P value	23 standard
Body surface area (m^2)	1.58±0.19	N.S	1.64±0.11	N.S	1.67±0.4
Peak gradient (mm Hg)	20.3±2	0.04	15.2±1.3	N.S	14.5±2.5
Mean gradient (mmHg)	12.2±1.5	0.03	7.6±2	N.S	6.8±1.2
Effective orifice area (Cm^2)	1.76±0.5	0.009	2.15±0.3	N.S	2.11±0.6
Effective area index	1.11±0.4	0.05	1.31±0.3	N.S	1.26±0.1
Performance index	0.49±0.1	0.001	0.66±.08	0.001	0.59±0.07

There was no perioperative mortality in the three groups of patients. Short term clinical follow up was marked by complete absence of valve thrombosis, thromboembolic events and anticoagulant related hemorrhage postoperatively. All patients were in New York Heart Association functional class I except one patient in the 21 mm HP group and 2 patients in the 21 mm standard group who were in functional class II.

Table (II) reveals the main postoperative hemodynamic parameters. There was a significant difference in the Doppler echocardiography derived pressure gradients and performance index between the three examined valve sizes.

As expected, patients with a 21 mm standard valve had higher mean and peak pressure gradients than did those with a 21 mm HP and those with a 23 mm standard valve. There was no significant difference in hemodynamic performance between the 21 mm HP and the 23 mm standard valve.

Discussion :

The surgical management of patients with small aortic rings is controversial because of the suboptimal hemodynamics of small sizes of even the most advanced types of prostheses (Gonzalez-Juanatey et al., 1996). The prognosis is worse for patients with small implanted valves than for those with larger prostheses (Bojar et al., 1989).

The problem of valve prosthesis-patient mismatch can be considered to be present when the effective prosthetic valve area after insertion into the patient is less than that of a normal human valve (Rahimtoola, 1978).

This mismatch results mainly from the fact that all valve prostheses have an in vitro effective orifice area that is smaller than that of the normal human valve. In addition, after valve insertion there is tissue in growth and endothelialization which further reduces the in vivo effective prosthetic valve area to less than the in vitro valve area (Bristow and Kremkau, 1975), and therefore all valve replacement devices can be considered stenotic even if they are normal . In some patients the problem is compounded because the size of the prosthesis that can be inserted is limited by the size of the annulus which is small compared to the size of the patient.

The well known correlation between prosthetic valve orifice area and transvalvular gradients has raised concerns about the presence of significant residual gradients when the size of the prosthesis that can be implanted is limited by the presence of a small aortic annulus (Fisher, 1994).

High residual gradients may effectively produce left ventricular out flow tract obstruction and could account for the unexplained occasional late deterioration of the cardiac function or even sudden death in this group.of patients (Arom et al., 1994). High gradients were said to occur more frequently with a small prosthesis inserted in a patient with a large body surface area (Rahimtoola, 1978) and the effective orifice area of a specific prosthetic valve corrected for body surface area (effective orifice area index) provides more useful index of its performance in an individual patient. An effective orifice area index more than 0.9 cm $2/m^2$ has been predicted as a requirement to minimize the postoperative transvalvular gradient (Dumesnil et al, 1990). For patients having a small aortic ring the usual alternative to small valve implantation is one of the root enlarging techniques. Each method has its own advantages and disadvantages.Therefore, surgical treatment varies with the patient's symptoms, hemodynamic characteristics, age, lifestyle and body surface area as well as the types of prosthesis available and the familiarity of the surgeon with root enlarging techniques (Carrel, 1996). Obviously the main goal is to obtain the best hemodynamic results with the shortest aortic cross clamping time.

Nowadays, the Hemodynamic Plus series of St.Jude heart valves allow for larger orifice area in annuli that may have traditionally called for root enlargement. The main valve design objective is to maximize the effective orifice to tissue annulus to minimize pressure gradients. Therefore, the ratio of flow orifice to valve mounting is one of the most important determinants of a heart valve's hemodynamic potential besides occluder opening angle (Kratz et al, 1994).

.Orifice to annulus ratio (based on purely theoretical calculations) is much more favorable in the 21 mm HP SJM valve than in other bileaflet valves. Considering the value of an ideal orifice to annulus ratio is 1.0, this value is 0.74 in the SJM 21 mm HP valve, 0.58 in the standard 21 mm SJM valve, 0.55 in the 21 mm carbomedics standard valve and 0.61 in the 21 mm carbomedics reduced series (Carrel et al, 1996).

The hemodynamic performance of the SJM HP valve (19 and 21 mm) has already been studied in vitro in a pulsatile model by Fisher, who demonstrated that this valve had significantly lower forward flow pressure drops and lower total energy loss

than the Carbomedics, Duromedics and Bjork-Shiley valves (Fisher, 1994).

The hemodynamic characteristics and performance index of the SJM HP valve prosthesis in our study are comparable with other reported studies evaluating the standard SJM or carbomedics valves (Gray et al, 1984 and De Paulis et al, 1994).

In conclusion, the HP valve achieves a reduction in external valve diameter without any reduction of the internal orifice diameter. This valve design improves the hemodynamic performance of the 21 mm HP valve getting similar characteristics to those of the 23 mm standard valve. Our results demonstrate that the hemodynamic performance of the 21 mm HP valve corresponds closely to those of the standard 23 mm valve and are substantially better than those of the 21 mm standard valve.

The HP SJM valve can be recommended in patients with narrow aortic root and will help minimize the need for aortic annulus enlargement.

References

1- Carrel, T., Rolfjenul, U.Z, Aeschbacher, B., and Turina, M.I.: Early in vivo experience with the hemodynamic plus St-Jude Medical heart valves in patients with narrowed aortic annulus. Ann. Thorac Surg., 1996; 61:1418- 22.

2- Konno, S., Imai, Y., Nakajima, M., Tatsuno, K. : A new method for prosthetic valve replacement in congenital aortic stenosis associated with hypoplasia of the aortic valve ring. J. Thorac. Cardiovasc Surg., 1975; 70:909-917.

3- Manouguian, S., Seybold, W. : Patch enlargement of the aortic valve ring by extending the aortic incision into the anterior mitral leaflet : new operative technique. J.Thorac Cardiovasc Surg., 1979; 78:402-412.

4- Chambers, J., Fraser, A., Lawford, P., Nihoyannopoulos, P., and Simpson, I.: Echocardiographic assessment of artificial heart valves. British Society of Echocardiography position paper. Br. Heart, J., (Suppl) 1994; 71:6-14.

5- Hatle, L., and Angelsen, B. : Pressure velocity relationships in : Doppler ultrasound in cardiology physical principles and clinical applications. 2nd ed. Philadelphia: Lea & Febiger, 1985:22-26.

6- De Paulis, R., Sommariva, L, Russo, F., et al: Doppler echocardiography evaluation of the carbomedics valve in patients with small aortic annulus and valveprosthesis-body surface area mismatch. J. Thorac Cardiovasc Surg., 1994; 108:57-62.

7- Gonzalez-Juanatey, JR., Garcia Acuna, J.M., Fernandez, M. V., Amaro, A., et al.: Influence of the size of aortic valve prosthesis on hemodynamics and changes in left ventricular mass : implications for the surgical management of aortic stenosis. J. Thorac Cardiovasc. Surg., 1996; 112:273-280.

8- Bojar, R. M., Dieh1, J. T., Motten, M., et al : Clinical and hemodynamic performance of the Ionescu-Shiley valve in the small aortic root: results in 117 patients with 17 and 19 mm

valves. J Thorac Cardiovasc Surg. 1989; 98:1087-95.

9- Rahimtoola, SH. : The problem of valve prosthesis-patient mismatch. Circulation, 1978;58:20-24.

10- Bristow, J.D., and Kremkau, E.L : Hemodynamic changes after valve replacement with Starr-Edwards prostheses. Am. J. Cardiol, 1975;35:716.

11- Fisher, J. : Comparative study of the hydrodynamic function of the St-Jude Medical Hemodynamic Plus bileaflet heart valve for small aortic root. J. Heart Valve dis., 1994;3:75-80.

12- Arom, K. V., Goldenberg LI. F, Emery, R. W.: Long-term clinical outcome with small size standard St-Jude Medical valves implanted in the aortic position. J. Heart Valve Dis, 1994; 3:531 -536.

13- Dumesnil, T. G., Honos, G.M., Lemieux, M., Beauchemin, J.: Validation and application of indexed aortic prosthetic valve areas calculated by Doppler echocardiography. J. Am. Coll Cardiol., 1990; 16:637-643.

14- Kratz, J.M., Sad, R.M., Crawford, FA., Crumbley, A.J., Stroud, M.R.: The risk of small St-Jude aortic valve prostheses. Ann. Thorac Surg., 1994;57:114 - 119.

15- Gray, R.S., Chaux, A., Matloff, J.M., et al Bileaflet tilting-disc and porcine aortic valve substitutes : in vivo hemodynamic characteristics. J. Am. Coll. Cardiol., 1984; 3:321-327.

Surgery of Non-small Cell Lung Carcinoma with Chest Wall Invasion

ABSTRACT

The aim of this work was to study the surgical management of patients with non-small cell lung carcinomas (NSCLC) with chest wall invasion of stage IIB (T3N0M0) or IIIA (T3N1M0). The patients were divided into two groups. Group I; included 15 patients treated by lung and chest wall resection. Wedge resection was done for one patient (6.67%), lobectomy for 12 patients (80%), bilobectomy for one patient (6.67%) and pneumonectomy for one patient (6.67%). The number of ribs resected varied from 2-4(mean 2.93). Only two patients required skeletal reconstruction using prolene mesh. One patient (6.67%) died three weeks postoperatively of respiratory failure. The major postoperative complications included residual pocket in two cases (13.3%) requiring localized thoracoplasty and prolonged air leak for more than 10 days in two patients (13.3%) requiring prolonged tube drainage.

To demonstrate the benefits of surgery for this group of patients (Group I), a comparison was made with another group of 20 patients (Group II) with stage IIB (T3N0M0) or IIIA (T3N1M0) NSCLC with chest wall invasion for whom a nonsurgical protocol of multimodality therapy utilizing radiotherapy and chemotherapy was adopted. There were two complete responses (CR) and 13 partial responses (PR) in the radiation field, for a response rate of 75%. The relapse pattern was predominately locoregional (65%). Major acute toxicity (≥ grade 3) included 13 patients (65%) with leukopenia, seven patients (35%) with thrombocytpenia and one patient (5%) with oesophagitis. One possible treatment-related death due to diffuse pneumonitis was observed (5%).

Group I had an actuarial one-year survival of 78%, 2-year survival of 44% and 3-year survival of 30% compared to 60%, 35% and 0% respectively for group II. The differences were statistically significant. The survivors of Group I patients experienced less pains and had a better quality of life than group II patients.

It was concluded that lung and chest wall resection for this group of patients with stage IIB or IIIA NSCLC can be done with acceptable mortality and morbidity. It is also attended with improved survival and quality of life.

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INTRODUCTION

The incidence of chest wall invasion in patients with bronchogenic carcinoma varies between 2-8% (1-4). The early reports about long-term survival of this group of patients were pessimistic (5). Coleman, in 1947, reported two long-term survivors among 5 patients for whom en bloc resection of the lung and chest wall was done (6). Since then, several reports appeared finding reasonable survival for

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these patients provided that complete full-thickness resection of the chest wall was done especially if the lymph nodes were not metastatically involved (1,7-12).

This view was confirmed in the International Staging System for Lung Cancer of 1986 which divided stage III into a group who may be offered surgical intervention (IIIA) and a group where surgical treatment should be considered only under special circumstances (IIIB) (13). Patients with bronchogenic carcinoma and chest wall invasion (T3) were included in stage IIIA(I3). On finding that the survival of patients with T3N0M0 was similar to stage II patients, they were included in stage IIB of the recent Revisions in the International System for Staging Lung Cancer (14). T3N1-2M0 patients were left included in stage IIIA (14).

In this report, patients with NSCLC and chest wall invasion were studied regarding preoperative preparation and staging, operative technique and postoperative results and were compared with a similar group of patients for whom no surgery was done.

Material and Methods

This study included two groups of patients with NSCLC invading the chest wall. They were managed in the Alexandria Main University Hospitals by the cardiothoracic surgeons and/or the oncologists in the period from January 1991 till December 1996.

Group I: included 15 patients for whom lung and chest wall resections were done.

Group II: included 20 patients managed by combined modality therapy utilizing radiotherapy and chemotherapy without resection. The latter patients were randomly selected from the era before adopting a resection protocol for patients with bronchogenic carcinoma invading the chest wall that was recently adopted in our Cardiothoracic Surgery Unit. They had the same medical and oncologic criteria as group I patients.

For each patient, thorough history taking and clinical examination were done. The routine preoperative evaluation for every patient included; complete and differential blood cell count, routine blood chemistry measurements, chest radiography, CT-scan chest, whole brain CT, abdominal ultrasound, bronchoscopy, pulmonary functions and percutaneous needle biopsy. Mediastinoscopy was not routinely performed.

A preoperative staging was done for all patients. Patients with chest wall invasion (T3 tumours), N0-1 and M0 were included while those with N2 disease were excluded from the study.

Surgical resection included lung resection varying from wedge resection to pneumonectomy, as indicated according to the extent of the tumour, and rib resection with a safety margin of one rib above and below the tumour and 5cm anteroposteriorly. No mediastinal lymph node dissection was done because patients with N2 nodes were excluded from the study. The resected specimen was removed en bloc as much as possible. Chest wall reconstruction was not routinely done and if required a prolene mesh was used.

Multimodality therapy:

Radiotherapy was given with telecobalt therapy with two opposed anteroposterior and posteroanterior (AP/PA) beams to all patients of group II and postoperatively to only 10 patients in group I. Preoperative irradiation was given also to cases with superior sulcus lesions (400 cGy/5 fractions) to the primary lesion and mediastinum, and complemented with postoperative irradiation to a total dose of 45 Gray (Gy).

The initial field target volume included the primary tumour with a 2-2.5 cm margin, ipsilateral hilar lymph nodes with 2.0 cm margin and contralateral hilar lymph nodes with 1.0 cm margin. Bilateral supraclavicular lymph nodes were treated if the primary tumour involved the upper lung lobes or main stem bronchus, and the inferior mediastinal nodes were treated when the primary tumour involved the lower lobes. The boost field included the pretreatment tumour volume with 2.0-2.5 cm margin around the original mass.

The target volume of the initial field received 45 Gy in 1.8 Gy fraction five days per week in continuous fashion. The boost field, given after the initial 45 Gy was delivered, received 20 Gy in 2 Gy fraction, for a total dose of 65 Gy in 35 fractions. Spinal cord doses were calculated and kept at or below 40 Gy by utilizing wedges and /or custom compensators when appropriate.

Combination chemotherapy was given as follows for group II patients: Cyclophosphamide 400 mg/m2 IV, adriamycin 40 mg/m2 and cisplatin 40 mg/m2 IV infusion after adequate hydration (CAP) every 21 days four weeks after the end of radiation therapy (Range 3-6 cycles).

Response and toxicity were recorded according to the WHO criteria (15), whereas staging was done according to Mountain (14).

Radiographs used to document initial measurable disease were done within two weeks of the start of therapy. Radiographic studies for evaluation of response were repeated after the initial 7-week treatment and every three months following completion of therapy.

Statistical Studies:

Variables were compared between the two clinical groups using chi square test. Survival curves were plotted and calculated by the actuarial method of Kaplan-Meier. Comparison of survival curves between groups was performed using log rank test. Cox regression model was used for multivariate analysis to predict the independent different prognostic variables (age, sex, performance status, histopathological types, nodal involvement) affecting survival as the dependent variable in both groups. 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:

For group I, there were 13 men (86.67%) and two women (13.33 %). The age ranged from 36 to 64 years with a mean of 52 years. 15 patients of group II were males (75%) and five were females (25%) with a mean age of 57.5 years (range 42-72 years) (Table 1).

Table I: Patient characteristics.

	Group I		Group II		
Characteristics	No.	%	No.	%	
Age (years)					
Mean	52		57.65		
Range	36 - 64		42 - 72		F= 0.351
± SD	9.5		10.1		*P*= 0.557
Gender					
Male	13	86.67	15	75	x^2= 0.71
Female	2	13.33	5	25	*p*=0.39
Histology					
Squamous cell carcinoma	9	60	11	55	
Adenocarcinoma	4	26.67	6	30	x^2=1.86
Large cell carcinoma	1	6.67	3	15	*p=0.6*
Anaplastic carcinoma	1	6.67	0	0	
Performance status					
0	10	66.7	6	30	
1	3	20.0	10	50	x^2= 6.2
2	2	13.3	2	10	*p*=0.103
3	0	0.0	2	10	
TNM staging					
T3N0M0	12	80	14	70	x^2= 0.45
T3N1M0	3	20	6	30	*p*=0.50
Laterality					
Right side	9	60	12	60	
Left side	6	40	8	40	

Table II: Patient symptoms

Symptom	Group I		Group II	
	No	%	No	%
Cough	10	67	17	85
Chest pain	13	87	13	65
dyspnoea	5	33	11	55
Hemoptysis	2	13	9	45

Symptoms:

In group I, chest pain was the commonest initial symptom occurring in 13 patients (86.67%) and coughing in 10 (66.67%). A palpable mass was felt in three patients (20%) at the time of presentation. In group II, cough was the presenting symptom in 85% of patients and chest pain in 65% (Table II).

Table III: Operative procedures done (Group I).

	No.	%
Lobectomy	12	80.00
- Upper		
Right side	6	40.00
Left side	4	26.67
- Lower		
Left side	2	13.33
Bilobectomy	1	6.67
Pneumonectomy	1	6.67
Wedge resection	1	6.67
Anterior transcervical approach	3	20.00

Table IV: Morbidities.

Surgical morbidities (Group I)	**No.**	**%**				
Failure to complete lung expansion	2	13.3				
Prolonged air leak	2	13.3				
Nonhaematological toxicities (Group II)	**0**	**1**	**2**	**3**	**4**	**% ≥ Grade 3**
	No.	**No.**	**No.**	**No.**	**No.**	
Emesis	17	2	1	0	0	0
Liver	16	3	0	1	0	5
Kidney	18	2	0	0	0	0
Skin	16	4	0	0	0	0
Esophagus	6	5	8	1	0	5
Pulmonary	16	2	1	0	1	5
Hematological toxicities (Group II)	**No.**	**No.**	**No.**	**No.**	**No.**	
Leukopenia	0	4	3	12	1	65
Thrombocytopenia	7	4	2	3	4	35
Anemia	4	6	6	3	1	20

Table V: Clinical response to the therapy (Group II).

	CR	PR	NC	PD	% CR + PR
As radiotherapy (within radiation field)	2	13	3	2	75
As chemoradiotherapy	2	12	2	4	70

Table VI: Median survival time (MST) of patients in both groups.

Variable		MST (months)	95% Confidence interval (CI)
N0	Group I	24	1 , 32
	Group II	10	6, 14
N1	Group I	15	3, 27
	Group II	7	6, 8
Performance Status score 0*	Group I	24	15, 33
	Group II	18	16, 20
Performance Status score 1*	Group I	14	12 , 16
	Group II	9	8 , 10
Performance Status score 2*	Group I	1	
	Group II	4	

***Significant in multivariate survival analysis using Cox regression model: Wald test = 21.3, 4.5 and 8.8, p = 0.0000, 0.0350 and 0.0030 respectively.**

Preoperative evaluation:

The findings in the chest X-rays and CT scan included (Fig. 1,2): Tumour largest diameter ranged from 2.3 to 9 cm (average 5.38 cm). In group I; superior sulcus tumour was present in three patients (20%). The tumour was on the right in 9 patients of group I (60%) and on the left in 6 (40%) compared to 12 patients (60%) and 8

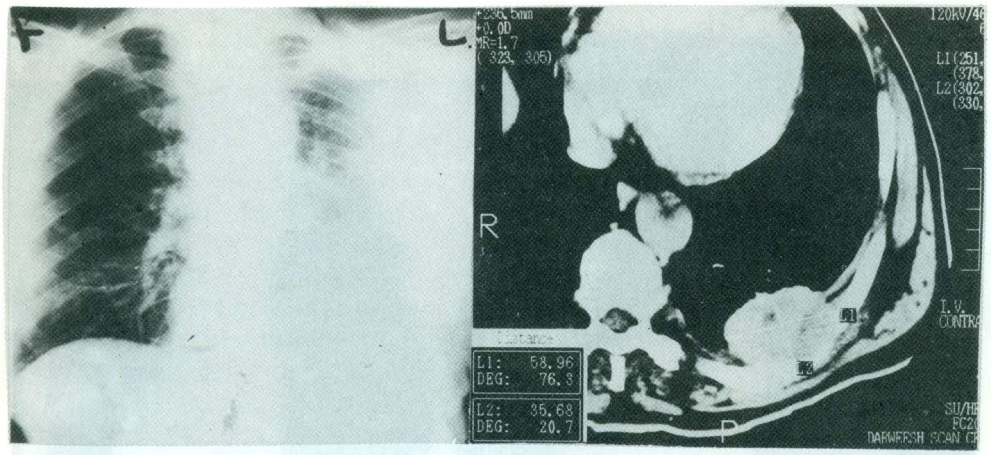


Fig. 1. Left lower moderately differentiated squamous cell carcinoma of the lung with chest wall invasion (right). Left lower lobectomy and chest wall resection was done (left).

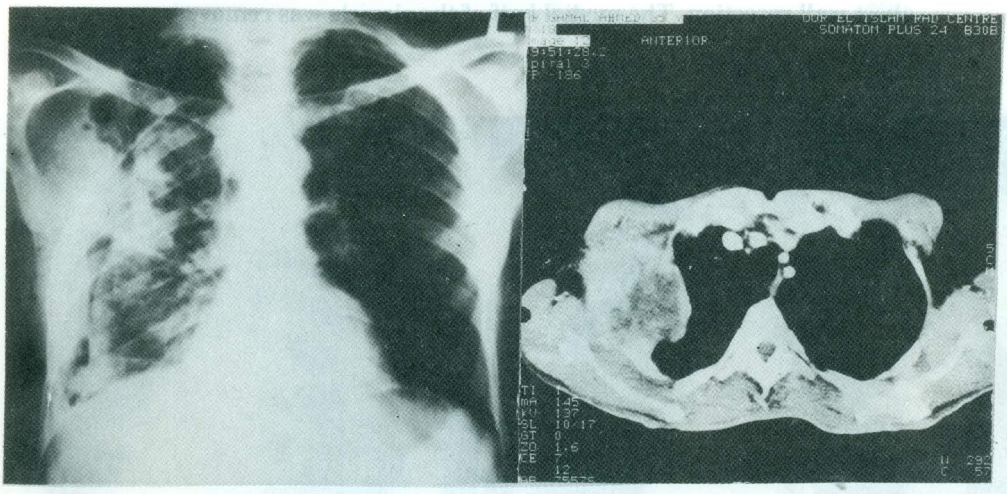


Fig. 2. Right upper large cell anaplastic carcinoma of the lung infiltrating the chest wall before (right) and after (left) right upper lobectomy and chest wall resection. The patient had prolonged air leak postoperatively before complete lung expansion.

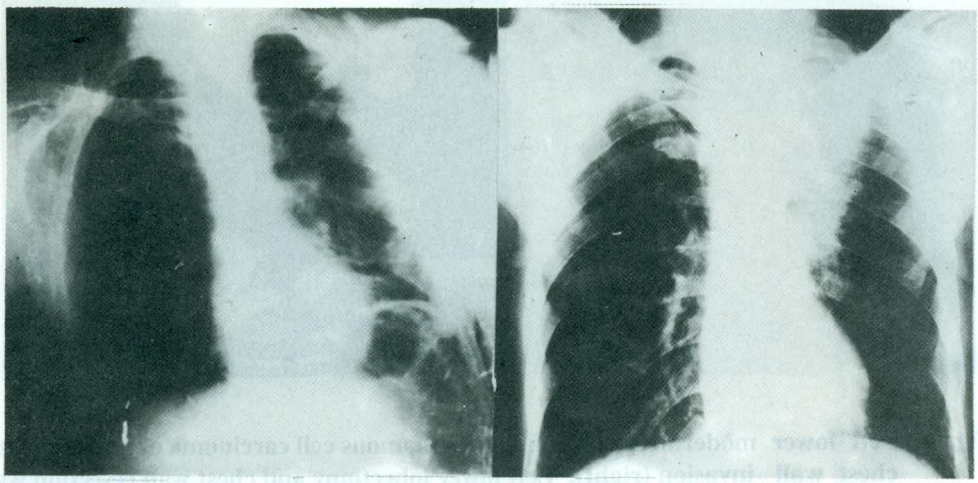


Fig. 3. Superior sulcus tumour before (right) and after (left) left upper lobectomy and chest wall resection. The medial half of the clavicle was removed.

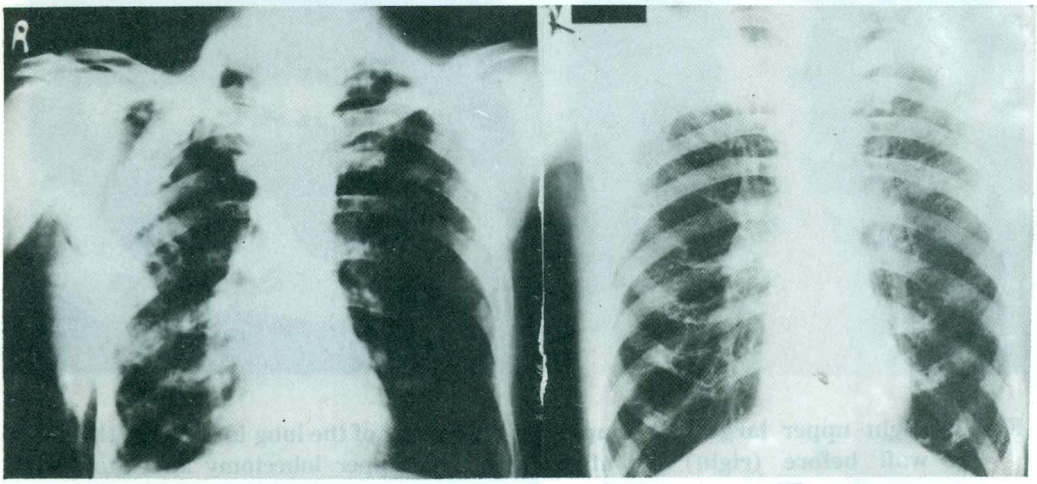
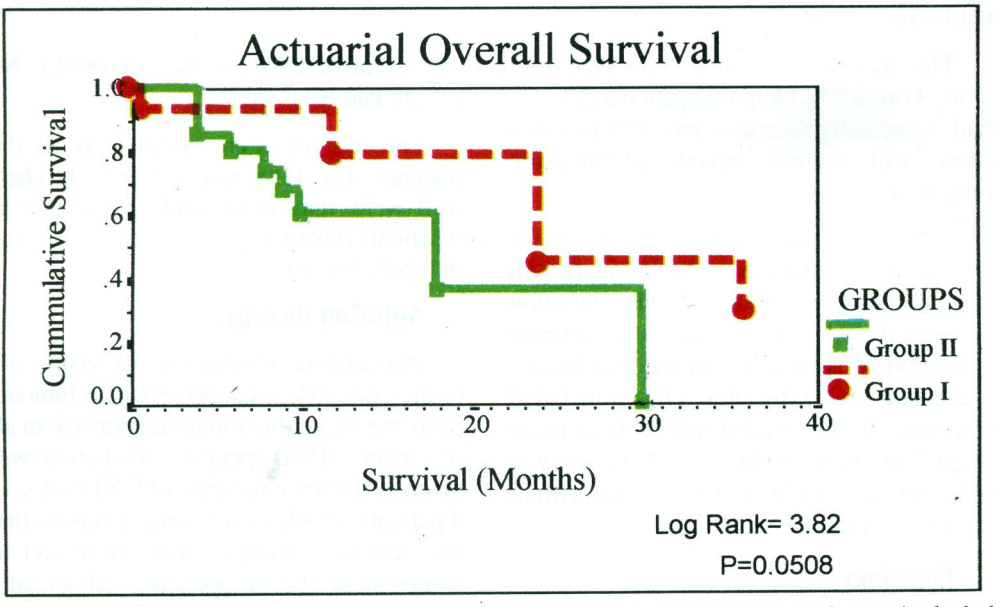


Fig.4. Right superior sulcus tumour before (right) and after (left) right upper lobectomy and chest wall resection without removal of the medial half of the clavicle.



patients (40%) in group II. All the patients had no evidence of enlarged mediastinal lymph nodes since any patient with such an evidence (i.e.N2 disease) was excluded from the study. All the tumours were of peripheral locations; with definite radiological evidence of rib erosion or soft tissue mass in 10 patients (66.67%) (Table I).

Bronchoscopy could visualize a mass in two patients of group I (13.3%), with positive lavage for malignant cell in another 4 patients (26.67%).

Staging:

Preoperative staging was tried in every patient. Patients with evidence of metastasis (stage IV) and those with N2 disease were excluded from the study. Not all tumours with parietal pleural invasion were identified preoperatively. Two patients in this study had neither radiological or CT features of rib erosion nor localized chest pain and were found during operation to have chest wall invasion and were included in this study. In addition, out of the three patients with N1 nodes studied, two were diagnosed on preoperative CT scan and an additional one was diagnosed after pathological examination of the resected specimen to have N1 nodes. The final TNM classification of the patients of group I was accordingly: 12 patients (80%) with T3N0M0 (Stage IIB), and 3 patients (20%) with T3N1M0 (Stage IIIA).

Staging of group II patients depended on clinical and radiological findings of their CT scans. 14 patients (70%) were of T3N0M0 (Stage IIB) and 6 patients (30%) were T3N1M0 (Stage IIIA) (Table I).

Operative data:

Right upper lobectomy was done for 6 patients (40%), left upper lobectomy for 4 patients (26.67%), left lower lobectomy for two patients (13.33%), bilobectomy for one patient (6.67%), pneumonectomy for one patient (6.67%) and wedge resection for one patient (6.67%) (Table III).

The number of ribs resected varied from 2 to 4 (av.2.93). Only two patients (13.3%) had large anterolateral defects and required chest wall skeletal reconstruction using prolene mesh.

Three patients with superior sulcus tumours were included in the study, two on the right and one on the left. The operation performed to them was the anterior transcervical approach recently described by Dartevelle and associates (16). It included resection of the medial half of the clavicle in two of them, right upper lobectomy in two and left in one, with removal of two to three ribs in each case (Fig.3,4).

Pathology:

Squamous cell carcinoma was present in group I in 9 patients (60%), adenocarcinoma in 4 patients (26.67%), large cell carcinoma in one patient (6.67%) and anaplastic carcinoma in one patient (6.67%). On the other hand, 11 patients of group II presented with squamous cell carcinoma (55%), six with adenocarcinoma (30%) and three patients with large cell carcinoma (15%) (Table I).

In one patient with superior sulcus tumour, bronchoscopic lavage was positive for malignant cells and the transthoracic needle biopsy showed the presence of grade 2 squamous cell carcinoma. This patient received preoperative irradiation with progressive reduction in tumour size. The pathologic report of the removed specimen showed nothing but fibrosed tissue and no malignant cells indicating the effectiveness of preoperative irradiation.

Positive N1 lymph nodes in the resected specimen were present in 3 patients (20%) and negative (N0) in the rest (80%). No patient had N2 nodes.

The margins were negative in all the patients. The lung resected and the chest wall were removed in continuity en bloc in 9 patients (60%) and in more than one piece in 6 patients (40%).

Adjuvant therapy:

Preoperative irradiation was given only to the three cases of superior sulcus tumours resulting in a reduction in tumour size in all of them. Post operative irradiation was given to the three patients with N1 nodes, to 4 patients for whom the surgeon reports that the resection margin was close and to complement the preoperative radiotherapy in the three patients mentioned (total of 10 patients, 60%).

Mortality and Morbidity:

In group I, one patient (6.67%) died three weeks postoperatively of progressively increasing respiratory failure.

Failure of complete lung expansion occurred after two cases (13.3%) of upper lobectomies, one on the right and one on the left. The residual space was the site of localized empyema and chest wall sinus. Localized thoracoplasty was required for deroofing of the pockets.

Prolonged air leak for more than 10 days occurred in another two patients (13.3%) resolved by low continuous suction without surgical intervention (Table IV).

There were no symptomatic chest wall instability and no local tumour recurrence appeared on follow up.

The two cases operated for superior sulcus tumours for which the medial half of

the clavicle was resected complained in the follow up of marked dropping of the shoulder on the operated side with inability of using their arms to return back to work. In addition, the operation did not improve much their shoulder and arm pains.

The median hospital stay was 13 days (range 7-30 days). Two cases required rehospitalization for localized thoracoplasty.

In group II, one possible treatment-related death due to diffuse pneumonitis was observed (5%). One patient (5%) experienced grade 3 oesophagitis after completion of irradiation and required temporary intravenous hyperalimentation and recovered within four weeks without permanent oesophageal stricture. Grade 3 or worse leukopenia was observed in 65% of the patients and 35% of patients experienced grade 3 or more thrombocytopenia. Non of the patients suffered from severe complications due to hematological toxicity, such as sepsis or hemorrhage. All of the patients recovered well from the acute toxicity of the treatment (Table IV).

Response/Survival:

Table V shows the clinical responses of the radiation therapy in group II patients. Two patients achieved a CR and 13 patients achieved PR within radiation field. The overall response rate (CR+PR) to radiotherapy was 75%. Two patients developed systemic progressive disease (PD). One patient achieved PR within the radiation field, and the other achieved local no change (NC), but they nevertheless progressed outside the radiation field. Thus, the response rate to chemoradiotherapy was 70%. The initial relapse pattern was predominately locoregional (13 patients,65%); the tumour relapsed within the radiation field in 10 patients, at the field margin in 3 patients and at distant sites in 5 patients (pleural effusion in 2, bone metastases in 1, intrapulmonary metastases in 1 and adrenal gland metastases in 1 patient).

Figure I, shows the actuarial overall survival curve for both groups. The median survival time (MST) was 24 months (95% CI 8.59, 37.41), with one-year survival rate of 78% and the two-year survival rate of 44% for group I, compared to 18 months (95% CI 8.20, 25.80), 60% and 35% respectively in group II. The difference between both therapeutic groups was significant where the log rank test = 3.82 and p = 0.05. However, the 3-year survival rate of group I was 30% and its actuarial survival curve tends to run towards a plateau while there were no survivors in group II after 2.5 years.

When utilizing the method of Kaplan-Meier for the analysis of MST to patients of both groups as regard the performance status and nodal involvement, it was found that patients with performance status of score 0 had a MST of 24 (95% CI: 15,33) compared to 18 (95% CI: 16,20) in both group respectively. Regarding the nodal involvement, N0 had a MST of 24 (95%CI: 1,32) compared to 10 (95% CI: 6-14) and N1 had 15 (95% CI: 3,27) versus 7 (95% CI: 6,8) in groups I, II respectively (Table VI).

Using the multivariate survival analysis employing Cox regression model, the only variable that achieved statistical significance was performance status (Wald test = 21.3, 4.5 and 8.8, p = 0.00, 0.0350,

0.0030 for Scores 0,1 and 2 respectively), despite the method of treatment (Table VI).

Discussion

The survival of patients with NSCLC with chest wall invasion following complete resection is encouraging. The overall 2-year actuarial survival rate was found to be 44% in group I patients of the present study and to be 40% in another study (11). The 5-year actuarial survival varied from 21-40%, generally about 30% (4,7-9,11,17,18). On the other hand, if no resections were performed for such patients as in group II of the present study, no survivor would be reported after 2.5 years despite the use of multimodality therapy of radiotherapy and chemotherapy.

Several factors affect the survival of this group of patients. The presence of lymph node metastases strongly decreases survival. Patients with T3 N0 M0 (IIB) neoplasms were found to have 42% 5-year survival while those with T3 N1-2 M0 (IIIA)had only 19% 5-year survival (18). The same improved survival for patients with N0 neoplasms was reported by several other authors (4,7,9,11,14).

As regards the cell type, small cell carcinoma had an adverse effect on survival, while the remaining non-small cell carcinomas had not (7,9,11). In the present study, the cell type of our NSCLC patients did not affect survival.

In addition, the 5-year survival of patients with 60 years of age and younger was also found to be much better than patients older than 60 years (7,9,19). Yet, one report did not find such survival advantage for the younger patient (4).

Completeness of the resection with a safety margin is mandatory for better survival and for decreasing local tumour recurrences (4, 10). The median survival of patients having incomplete resection was 9 months and there was no 3-year survivor (4). The chest wall invasion should be managed by full thickness resection of the chest wall with a safety margin of one rib above and below the tumour and at least 5cm in both directions, to be removed en bloc with the lung resected (4,7,9). The extra thoracic muscles and the skin are not generally included in the full thickness resection if they are not apparently involved. However, a point of controversy exists when the tumour invades only the parietal pleura. Some believe that extrapleural resection is adequate in this situation (4), while most other authors believe that this is inadequate and a full thickness resection should always be done not only to improve the survival but also to decrease the incidence of local recurrence (9,11,20,21). In this concern, one should differentiate at the time of operation whether the chest wall adhesions are inflammatory or malignant. Inflammatory adhesions are filmy, delicate and easily detachable, and the tumour is movable. In contrast, malignant adhesions are firm and broad and the tumour mass is fixed (9). Accordingly, if any resistance is encountered during the extrapleural dissection, it should be stopped and chest wall resection is undertaken (12).

Most authors found that the depth of chest wall invasion did not affect survival provided a complete resection is performed with normal margins (4,7,9). On the other hand, others believed that depth of chest

wall invasion had prognostic importance (3). The 5-year survival of those with parietal pleural involvement only was 48% while that of patients with deeper invasion was 16% (12).

The value of radiation therapy, which may be given pre or postoperatively combined or not with chemotherapy, is controversial. Most authors including ourselves had demonstrated the benefit of preoperative radiotherapy in patients with superior sulcus tumours (22,23) while others disagreed (24). In non-apical chest wall, the role of adjuvant radiotherapy is unclear (11,12). Many authors believe that pre and postoperative radiotherapy is of no value especially in N0 tumours (2,4,21). Postoperative radiotherapy may be given if the margins were close or if there were positive nodes (11). Mishina and colleagues (3) suggest that adjuvant radiotherapy does improve survival, but the number of patients in their series was small, and in some patients adjuvant chemotherapy was also used. Patterson and colleagues (8) found a 5-year survival of 30% in the non irradiated group and 56% in the irradiated one. However, the difference was not statistically significant probably because of the small number of observations involved. The latter authors claimed also that radiotherapy diminished the incidence of local recurrence (8).

Randomized trials had demonstrated in selected patients with locally advanced disease that chemotherapy improves survival when added to either radiation therapy or surgical resection(I8,25,26). The median survival of patients having incomplete resection was 9 months and there was no 3-year survivor despite perioperative interstitial and external radiation (4). In the present study, group II patients having no resection but combined radiotherapy and chemotherapy had a better median survival of 18 months and still no 3-year survivor. It was also noticed that those receiving adjuvant chemotherapy have fewer recurrences and improved disease-free survival (25).

Some other factors were found not affecting the survival as sex, tumour diameter and extend of pulmonary resection (4,7).

A pre-thoracotomy staging should be done for all patients to determine the need and the extent of the surgical resection and to offer prognostic information (11). Most thoracic surgeons, including ourselves, rely upon the mediastinal findings of the computerized tomography, being non-invasive. Others perform mediastinoscopy routinely pre-thoracotomy for proper staging of resectable tumours to assess the need of performing mediastinal lymph node dissection for patients with N2 tumours. Still others, who perform a routine mediastinoscopy, rule out patients with N2 disease because of their low long-term survival and the high operative mortality attended with mediastinal lymph node dissection (11,21). In a recent report, the 5-year survival with mediastinoscopy negative nodes was found to be 32.2%, and with positive nodes to be only 15% (26). There is no controversy that for unresectable tumours mediastinoscopy could be done to obtain tissue diagnosis for proper radiotherapy and/or chemotherapy. In this condition, mediastinoscopy is done for diagnosis rather than for staging (9).

Chest wall skeletal reconstruction following resection is not usually required

(8,11). Defects 5cm or less and the posterior defects covered by the scapula even if 5-7cm in diameter are not repaired (12). However, larger and anterior defects especially in patients with marginal respiratory functions and for cosmetic reasons chest wall reconstruction is performed (27). Among the various materials used to accomplish this, we found that a simple prolene mesh is quite satisfactory as the cases encountered in this study and as stated in one of our previous reports (28). Serous collections were minimal with prolene mesh being permeable. Infection is also minimal because the fibrous ingrowth of tissue effectively seals off the prosthesis from the surrounding tissue. Compared with earlier prosthesis, prolene does not cause erosion and is not opaque to obscure the lung fields on chest radiographs (27). Soft tissue reconstruction using a myocutaneous flap to cover large defects is rarely required. This is because extra thoracic muscles and soft tissues are generally not invaded by the tumour and are not resected.

The overall operative mortality in modern series ranges from 4% to 12% (4,7,9,11,20,21,26). Izbicki et al (29) did not find a statistically significant difference in operative mortality between extended and non-extended resections that were 7.4% and 6.3% respectively. In this study, operative mortality was 6.67% and was due to the development of respiratory failure which was also the leading cause of death in other series (4,7-9,11).

In this study, three cases with superior sulcus tumours were successfully operated using the anterior transcervical approach recently introduced in our unit (16). During the follow up, there was marked dropping of the shoulder and difficulty in using the ipsilateral arm in manual work in the two cases for which the medial half of the clavicle was resected. In addition, the postoperative relief of their pains was not evident. We started to have cases who refuse to be operated in this manner. However, because of the small number of operated cases it is difficult to draw conclusions on this approach. Another study is required to compare the different approaches for resection of superior sulcus tumours and to compare the resection protocol with using radiotherapy without resection.

In group II patients, the hematological toxicity was predictable and manageable. Pulmonary toxicity was much more severe than expected. This is perhaps because of the inclusion of the contralateral hilar field plus a margin resulting in a sufficiently large volume of irradiated lung. Though the overall response rate was high (75%) in this study, median survival was similar to that in most combined chemo/radiotherapy trials of about 15 months (15,25,26). This indicates that chemo and radiotherapy are not effective alone in complete eradication of intrathoracic disease. Better results will be achieved when they are combined with complete surgical resection giving results superior to surgery alone (25).

References

1. Grillo HD, Greenberg JJ and Wilkins EW: Resection of bronchogenic carcinoma involving the thoracic wall. J. Thorac Cardiovasc Surg 1966; 51: 417.
2. Geha AS, Bernatz PE and Woolner LB: Bronchogenic carcinoma involving the

thoracic wall: Surgical treatment and prognostic significance. J Thorac Cardiovasc Surg 1967; 54: 394.

3. Mishina H, Suemash K, Yoneyama T, et al: Surgical pathology and prognosis of the combined resection of the chest wall and lung in lung cancer. Jap J Clin Oncol 1978; 8: 161.
4. McCaughan BC, Martini N, Bains MS et al: Chest wall invasion in carcinoma of the lung. Therapeutic and prognostic implications. J Thorac Cardiovasc Surg 1985; 89: 836-841.
5. Gebauer PW: The differentiation of bronchogenic carcinoma. J Thorac Surg 1941; 10: 373.
6. Coleman FP: Primary carcinoma of the lung with invasion of the ribs. Pneumonectomy and simultaneous block resection of the chest wall. Ann Surg 1947;126:156.
7. Piehler JM, Pairolero PC, Weiland LH et al: Bronchogenic carcinoma with chest wall invasion. Factors affecting survival following en bloc resection. Ann Thorac Surg 1982; 34 (6): 684-91.
8. Patterson GA, Ilves R, Ginsberg RJ et al: The value of adjuvant radiotherapy in pulmonary and chest wall resection for bronchogenic carcinoma. Ann Thorac Surg 1982; 34 (6): 692-7.
9. Pairolero PC, Trastek VF and Payne WS.: Treatment of bronchogenic carcinoma with chest wall invasion. Surg Clin North Am 1987; 67 (5): 959-64.
10. Ratto GB, Piacenza G, Frola C et al. Chest wall involvement by lung cancer. Computed tomographic detection and results of operation. Ann Thorac Surg 1991; 51: 182-8.
11. Allen MS, Mathisen DJ, Grillo HC et al: Bronchogenic carcinoma with chest wall invasion. Ann Thorac Surg 1991; 51: 948-51.
12. Burt M, Martini N and Ginsberg RJ. Surgical treatment of lung carcinoma. In Glenn's Thoracic and Cardiovascular Surgery. 6th edition. Baue AE (ed.). Prentice-Hall International Inc. 1996.
13. Mountain CF.: A new international staging system for lung cancer. Chest 1986; 89:225s-35s.
14. Mountain CF. Revisions in the International System for Staging Lung Cancer. Chest 1997;111(6): 1710-23.
15 Millar AB, Hoogstraten B, Staquet M, Winkler A.: Reporting results of cancer treatment. Cancer 1981; 47: 207-214.
16. Dartevelle PG, Chapelier AR, Macchiarini P, et al: Anterior transcervical thoracic approach for radical resection of lung tumours invading the thoracic inlet. J Thorac Cardiovasc Surg 1993; 105: 1025-34.
17. Casillas M, Paris F, Tarrazona V et al. Surgical treatment of lung carcinoma involving the chest wall. Eur J Cardiothorac Surg 1989; 3: 425-9.
18. Detterbck FC and Socinski MA. IIB or not IIB: The current question in staging non-small cell lung cancer. Chest 1997; 112 (l): 229-34.
19. Nugent WC, Edney MT, Hammerness PG, et al.: Non-small cell lung cancer at the extremes of age: Impact on diagnosis and treatment. Ann Thorac Surg 1997; 63: 193-7.

20. Trastek VF, Pairolero PC, Piehler JM, et al. En bloc (non chest wall) resection for bronchogenic carcinoma with parietal fixation. J Thorac Cardiovasc Surg 1984; 87:352-8.

21. Albertucci M, DeMeester TR, Rothberg M et al.: Surgery and management of peripheral lung tumours adherent to the parietal pleura. J Thorac Cardiovasc Surg 1992; 103(l): 8-13.

22. Paulson DL. Carcinomas in the superior pulmonary sulcus. J Thorac Cardiovasc Surg 1975; 70: 1095.

23. Hilaris BS, Martini N, Wong GY and Nori D. Treatment of superior sulcus tumour (Pancoast Tumour). Surg Clin North Am 1987; 67 (5): 965-77.

24. Kirsh MM, Dickerman R, Fayos J, et al. The value of chest wall resection in the treatment of superior sulcus tumours of the lung. Ann Thorac Surg 1973; 15: 339.

25. Holmes EC and Colquhoun SD. Multimodality therapy of carcinoma of the lung. In Glenn's Thoracic and Cardiovascular Surgery. 6th edition. Baue AE (ed.). Prentice-Hall International Inc. 1996.

26. Vansteenkiste JF, De Leyn PR, Deneffe GJ, et al.: Survival and prognostic factors in resected N2 non-small cell lung cancer: A study of 140 cases. Ann Thorac Surg 1997. 63: 1441-50.

27. McCormack PM, Bains MS, Martini N et al.: Methods of skeletal reconstruction following resection of lung carcinoma invading the chest wall. Surg Clin North Am 1987; 67 (5): 979-86.

28. Karara K.: Resection of primary sternal tumours. J Egypt Soc Cardiothorac Surg 1996; 4(l): 101-6.

29. Izbicki JR, Knoefel WT, Passlick B et al. Risk analysis and long term survival in patients undergoing extended resection of locally advanced lung cancer. J Thorac Cardiovasc Surg 1995;110 (2):386-95.

Sensitivity of Combined Pleural Fluid Cytology and Pleural Needle Biopsy in Malignant Pleural Effusion

ABSTRACT

Objectives: The purpose of this study is to determine the sensitivity of combined pleural fluid cytology and pleural needle biopy in malignant pleural effusions.

Background: Patients with malignant pleural effusion are usually in a bad general condition. The optimal diagnostic tool for these patients is the least invasive with the highest sensitivity. Combined pleural fluid cytology and percutaneous pleural needle biopsy are evaluated for this purpose.

Methods: During a time range of 24 months, a prospective study was performed at the Cardiothoracic Surgery Departments, Cairo University and Menoufia University Hospital in which 40 consecutive patients with malignant pleural effusion were subjected to combined pleural fluid cytology and percutaneous pleural needle biopsy. To be included in the study, transthoracoscopic pleural biopsy done afterwards should prove a malignant etiology.

There were 28 (70%) men and 12 (30%) women; the mean age was 50.1 ± 8.3 years (38- 65 years) and 30 (80%) of the patients were ≥ 50 years old.

Results: Pleural malignant disease was diagnosed with needle pleural biopsy in 18 out of the 40 patients (45%). With peural fluid cytology malignant disease was diagnosed in 23 out of the 40 patients (57.5%). Pleural malignant disease was diagnosed in 25 out of the 40 patients (62.5%) when the results of both techniques are combined. There were minor complications related to the technique in 6 patients (15%).

Conclusions: The specificity of the percutaneous needle biopsy of the parietal pleura (45%) is less efficacious in the diagnosis of the malignant pleural disease than is cytologic evaluation of the fluid sediment (57.5%), whereas the combined results (62.5%) are superior to both techniques seperately. Thus more than half of the patients are spared more invasive diagnostic procedures. There are still 37.5% of the patients which were not diagnosed. Thus, a negative combined pleural fluid cytology and percutaneous pleural needle biopsy should not give the clinician a false sense of security, and further diagnostic tools must be used.

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INTRODUCTION

From 28 to 61% of effusions in different literature reviews are malignant and up to half of patients with breast cancer will develop effusion during the course of their illness (Hausheer & Yarbo, 1985) (1).

Approximately half of all patients with metastatic cancer develop malignant pleural effusions. Because these patients are already terminally ill, these effusions can present

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significant diagnostic and therapeutic challenges (Fenton & Richardson, 1995) (2). The most common malignancies causing effusion are lung, breast, gastrointestinal, and genito-urinary carcinomas (Mc Alpine et al, 1990) (3).

Malignant pleural effusion is a signficant cause of morbidity in patients with advanced cancer. Although the quality of patient lives is more often determined by the progress of their systemic cancer, the quality of their lives can be improved significantly by successful mangement of their effusion (Rukdeschel, 1988) (4).

Ultimately 10 to 20% of pleural effusions remain undiagnosed inspite of chemical and Cytological examination of pleural fluid, as well as percutaneous pleural biopsy (Rusch & Harper, 1989) (5).

Pleural aspiration and needle biopsy of the parietal pleura, simple procedures with attendant low morbidity, are recognized as valuable adjuvants in the evaluation of pleural effusions of unknown etiology (Scerbo et at 1971) (6).

Pleural aspiration and pleural biopsy can often establish a diagnosis, saving patients further work-up (Von Hoff & LiVolsi, 1975) (7).

The present work aims at analysis of the technique of combined pleural needle biopsy and fluid cytology in 40 patients with proven malignant pleural effusion. Preoperative data, sensitivity, and complications due to this minimally invasive procedure are evaluated to assess the the values and limitations of the technique, to define and evaluate the most appropriate diagnostic tool for the individual patient with malignant pleural effusion, who is generally in a bad general condition.

Patients and Methods

A prospective study was performed at the Cardiothoracic Surgey Departments, Cairo University and Menoufia University Hospitals in which 40 consecutive patients with malignant pleural effusion were subjected to combined pleural fluid cytology and percutaneous pleural needle biopsy. To be included in the study, each case should prove to have carcinoma documented subsequently by thoracoscopy, biopsy from primary site, or clinical course. there were no exclusion criteria. and all patients with proven malignant effusion were included in the study, regardless of their malignant etiology.

Preoperative characteristics of the patients were recorded for analysis as age, the complaint of the patients, physical examination laboratory data, as well as chest X-ray posteroanterior and lateral views.

A computerized Tomography (CT) scan of the chest was done in all cases to chose a site for the pleural biopsy most probably invaded and affected by the malignant process.

Thoracentesis and pleural needle biopsy using the Abrams, needle were done at the same setting for all patients. Having established the position of the intrapleural collection of fluid by aspiration of a small amount, and having infiltrated the track of the needle with local anesthetic, a 5 mm skin incision was made at the site of the original intradermal wheal and the Abrams,

needle introduced into the chest wall. A three-way tap and syringe were then connected, the needle advanced further, and the pleural cavity entered. The inner trocar of the needle was then rotated anticlockwise fully into a locked position and when free withdrawal of the fluid was possible, a sufficient amount for histopathological examination was removed, and the whole needle was slightly angulated and slowly pulled back until the side window was felt to catch on the parietal pleura. The inner trocar of the assembly was then rotated sharply clockwise and as it advanced, it cut off a small specimen. The whole needle was then withdrawn and the specimen for histology was retrieved from within the needle tip. This procedure was repeated in 4 different directions through the same skin incision.

Specimens were sent for histopathological evaluation of the pleural biopsy and for cytological assessment of the fluid sediment.

For patients with massive pleural effusions, a chest tube with underwater seal was inserted in the same setting.

The patients were observed for complications after the procedure needle was slightly angulated and slowly pulled back until the side window was felt to catch on the parietal pleural. The inner trocar of the assembly was then rotated sharply clockwise and as it advanced, it cut off a small specimen. The whole needle was then withdrawn and the specimen for histology was retrieved from within the needle tip. This procedure was repeated in 4 different directions through the same skin incision.

Specimens were sent for histopathological evaluation of the pleural biopsy and for cytological assessment of the fluid sediment.

For patients with massive pleural effusions, a chest tube with underwater seal was inserted in the same setting.

The patients were observed for complications after the procedure.

The 40 patients consisted of 28 males and 12 females - with a mean age of 50.1 ± 7.6 years, ranging from 38 - 65 years (Table 1).

Table 2 describes the preoperatives symptoms of those patients with malignant pleural effusion Radiological findings ecountered in the CT - chest of thesen patients are outlined in table 3. The effusion was right sided in 22 patients (55%), and left sided in 18 cases (45%).

The sensitivity of a diagnositc procedures is defined as the measure of its ability to distinguish as positive those patients who have the condition under investigation (pleural malignancy). We measure it as the number tested as positive divided by the total with the condition.

Differences between variables were tested for statistical significant using the students t-test.

The standard error of percentage was used to get the confidence limits. All values are presented as means ± standard deviation (SD), and the probability (P) values were used.

Results

The amount of pleural fluid aspirated from patients with malignant pleural effusions is shown in table 4. The types of malignancy encountered with histopathological examination, which were responsible for the malignant effusions are listed in table 5. The most commonly

Table 1: Reported number and percentage of patients with malignant pleural effusion in relation to both age and sex.

Age groups (years)	Number (%)	Male Number (%)	Female Number (%)
< 40	2 (5%)	0 (0%)	2 (5%)
40 - 50	6 (15%)	2 (5%)	4 (10%)
51 - 60	24 (60%)	18 (45%)	6 (15%)
>60	8 (20%)	8 (20%)	0 (0%)
Total	40 (100%)	**28** (70%)	**12** (30%)

Table 2: Preoperative symptoms in 40 patients with malignant pleural effusion.

Preoperative symptoms	*Number of patients*	*Percentage of patients (%)*
asymptomatic	*5*	*12.5*
dyspnea	*35*	*87.5*
cough	*9*	*22.5*
hemoptysis	*8*	*20.0*
chest pain	*4*	*10.0*
loss of weight	*4*	*10.0*

Table 3: CT findings in 40 patients with malignant pleural effusion.

CT finding	*Number of patients*	*Percentage of patients (%)*
Pleural effusion	*40*	*100.0*
Multiple variable sized nodules	*24*	*60.0*
Diffuse pleural thickening	*14*	*35.0*
Large mass	*1*	*2.5*
Heterogenous opacification	*1*	*2.5*

encountered cause for malignant effusion are lung cancer (40%), breast cancer (30%), and mesothelioma (20%).

Pleural biopsy failed to provide adequate tissue in 3 patients (7.5%).

Table 4: Amount of pleural fluid aspirated from patients with malignant pleural effusions.

Amount of pleural fluid aspirated	*Number of patients*	*Percentage of patients (%)*
less than 500 ml	*4*	*10*
500 - 1500 ml	*32*	*80*
more than 1500 ml	*4*	*10*

Table 5: The reported incidence of the different causes for malignant pleural effusion.

Etiology of Malignant pleural effusion	Number of Patients	Percent of Patients (%)
Bronchogenic carcinoma	16	40 %
Breast carcinoma	12	30 %
Mesothelioma	8	20 %
Ovarian tumor	2	5 %
Gastric tumor	2	5 %
Total	40	100 %

Table 6: Sensitivity of the different diagnostic tools in malignant pleural effusions.

	Total Patient Number	*Pleural Biopsy* Number of patients diagnosed (Sensitivity)	*Pleural Cytology* Number of patients diagnosed (Sensitivity)	*Combined* Number of patients diagnosed (Sensitivity)
Mesothelioma	*8*	*5 (62.5%)*	*3 (37.5%)*	*5 (62.5%)*
Squamous cell carcinoma	*12*	*7 (58.3%)*	*7 (58.3%)*	*7 (58.3%)*
Adenocarcinoma	*18*	*5 (27.7%)*	*11 (61.1%)*	*11 (61.1%)*
Undifferentiated carcinoma	*2*	*1 (50.0%)*	*2 (100.0%)*	*2 (100.0%)*
Total Malignancy	*40*	*18 (45.0%)*	*23 (57.5%)*	*25 (62.5%)*

The sensitivity of the needle pleural biopsies, cytoloical examination of pleural aspirate, and the combined needle biopsy and pleural fluid cytological are shown in table 6. The combined needle biopsy and pleural fluid cytologic analysis (sensitivity = 62.5%) showed a higher sensitivity ($p < 0.005$) than the cytological analysis of pleural fluid (sensitivty = 57.5%), whilst the cytologic analysis of pleural fluid showed a higher sensitivty ($p < 0.001$) than pleural needle biopsy (sensitivty = 45%) for diagnosing malignant pleural effusions.

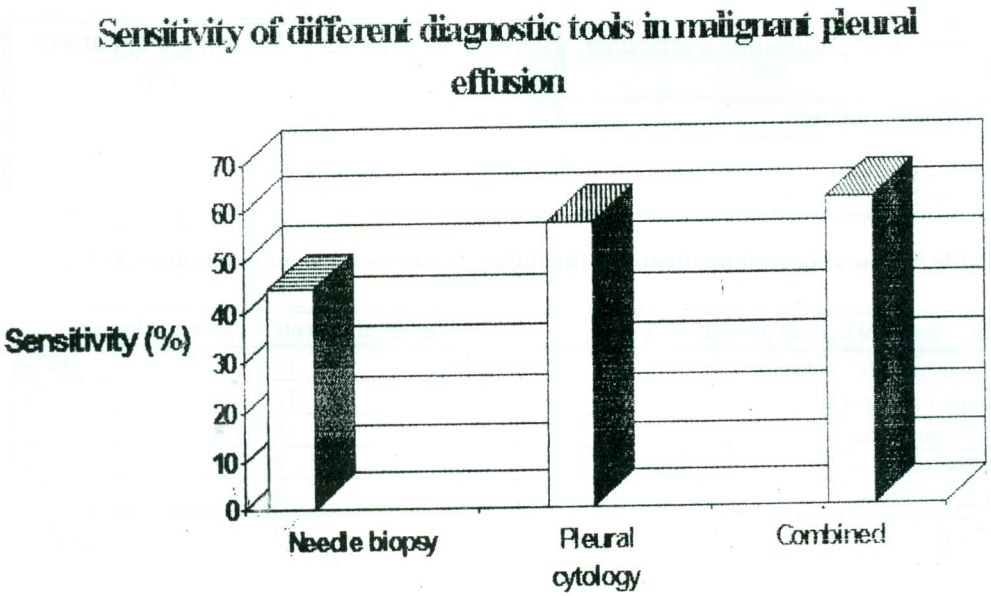

Fig: 1

In 7 patients (17.5%) there were some complications related to the technique: Pneumothorax occured in one patient, surgical emphysema in 2 cases, wound infection in 2 cases, and late seeding of the biopsy tract in one patient.

Discussion

One of the most common diagnostic problems encountered by chest physicians and surgeons is the presence of undiagnosed pleural effusion, the percentage of the so called "idiopathic" effusions amounting approximately up to 20% in published series (Boutin et al., 1993) (8).

Sixteen cases out of 44 patients (36.36%) with cofirmatory evidence of cancer invloving the pleural surfaces were diagnosed by closed pleural biopsy (Frist et al., 1979). (9).

Prakash & Reiman in 1985 (10), reported that pleural malignant disease was established by pleural needle biopsy in 43% of 281 patients with malignant pleural disease. Sahn in 1987 (11) reported that pleural biopsy was diagnostic for malignancy in 46% of pleural carcinomatosis. In another large series, pleural biopsy fared somewhat better, being diagnostic of malignant pleuritis in 57% of cases (Tomlinson & Sahn, 1987) (12). The sensitivity of pleural biopsy was 65% in a study with patients with malignant pleural effusion (Poe et al., 1984) (13).

The big variation in the sensitivity of pleural needle biopsy can be attributed to the fact that the biopsy is taken from a minute portion of the vast area of the pleural surface, and since tumor implants tend to be focally distributed, the chance of

missing tissue is great (Von Hoff & LiVolsi, 1975) (7). Another factor responsible for variable results in pleural biopsy is the adequacy of the specimen. Prakash & Reiman in 1985 (10) reported that pleural biopsy failed to provide adequate tissue in 13.3% of patients. Another report states that in 5.1% of the biopsies, pleura was not identified in these specimen (Von Hoff & LiVolsi, 1975) (7).

In this study the sensitivity of closed pleural needle biopsy for diagnosing pleural malignancy is 45%.

The diagnosis of malignancy can be made by cytologic examination of pleural fluid. False positive results are rare. Pleural fluid cytologic examination is positive for cancer cells in about 50% of malignant pleural effusions (Salyer et al., 1975) (14). Prakash & Reiman in 1985 (10) reported that pleural malignant disease was established by cytologic study in 57.6% of 281 patients with malignant pleural disease. Fenton and Richardson in 1995 (2) reported that cytology is positive for cancer cells in the initial pleural fluid specimens from 60% of patients who are ultimately shown to have malignant effusions. Sahn in 1987 (11) reported that cytologic examination of malignant pleural effusions was diagnostic in 66% of cases. In another study 43 out of 44 patients (97.7%) with cofirmatory evidence of cancer involving the pleural surfaces had positive cytologic findings (Frist et al., 1979) (9).

Several different techniques may enhance the cytologic evaluation of pleural fluid. Monoclonal antibodies are useful in distinguishing among adenocarcinoma, mesothelioma and benign mesothelial cells (Salyer el al., 1975) (14).

In this study the sensitivity of thoracentesis for diagnosing pleural malignancy is 57.5%.

For the diagnosis of a suspected malignant effusion, the information obtained from a pleural biopsy complements that from pleural fluid cytology examination, and both tests should be performed. Although pleural biopsies are positive in only 40 to 65% of malignant pleural effusions, biopsies may show evidence of malignant disease even when pleural fluid cytology is normal or equivocal Salyer et al., 1975 (14); Prakash & Reiman, 1985 (10). A correct diagnosis of malignancy was made by a combination of Abrams, needle biopsy and pleural fluid cytology in 75% of patients with malignant pleural effusion (Edmondstone, (1990) (15). The combination of a pleural biopsy and cytologic examination of three separate samples of pleural fluid will yield a positive diagnosis in 85 to 90% of malignant effusions. (Salyer et al., 1975) (14).

In this study the sensitivity of combined thoracentesis and closed needle pleural biopsy for diagnosing pleural malignancy is 62.5%.

The most common complications of pleural biopsy and thoracentesis is pneumothorax, which occurs 3 to 20% of the time (Tomlinson & Sahn, 1987) (12). Other complications observed include surgical emphysema, vasovagal reaction, biopsy site pain (nerve lacertion), hemothorax secondary to intercostal artery laceration, tumor seeding of biopsy tract, and hematoma around the biopsy site (Levine and Cugell, 1971) (16). Pulmonary edema following thoracentesis has also been reported (Ragozzino & Greene, 1991) (17).

12)Tomlinson JR and Sahn SA (1987): Invasive procedures in the diagnosis of pleural disease. Semin Respir Med; 9:30.

13)Poe RH, Israel RH, Utell MJ, Hall WJ, Greenblatt DW, Kallay MC (1984): Sensitivity, Specificity, and predictive values of closed pleural biopsy. Arch Intern Med; 144, 2:325-328.

14)Salyer WR, Eggleston JC, Frozan YS (1975): Efficacy of pleural needle biopsy and pleural fluid cytopathology in the diagnosis of malignant neoplasm involving the pleural. Chest; 67:536.

15)Edmondstone WM (1990): Investigation of pleural effusion: comparison between fiberoptic thoracoscopy, needle biopsy and cytology. Respir Med; 84:1,23-26.

16)Levine H and Cugell DW (1971): Blunt end biopsy of pleura and rib. Arch Intern Med; 109:516.

17)Ragozzino MW and Greene R (1991): Bilateral reexpansion pulmonary edema following unilateral pleurocentesis. Chest; 99:506.

Surgical Management of a Posterior Mediastinal Infantile Fibrosarcoma in a Newborn

Case Report

We report a case of a huge posterior mediastinal mass in a near term newborn of thirty-seven weeks who was born by normal vaginal delivery. During antenatal followup there was only decreased fetal movements at 35 weeks. The mother was admitted to the hospital. The baby had birth asphyxia and convulsions. Then the baby's apgar score improved from 1'to 10'.

Blood gases taken at birth showed PO_2 94.3 mmHg and PCO_2 120.8 mmHg and base excess-13 and pH 6.9. The baby was intubated and ventilated.

Chest x-ray at that time showed right sided homogenous opacity occupying the right hemithorax and shifting the mediastinum to the left side (Fig 1).

Ultrasound scan of the chest and abdomen showed a mass of mixed echogenicity confined to the right hemithorax and extending through the diaphragm downwards. C.T. Scan of the chest and abdomen revealed a large soft tissue mass occupying the right hemithorax posteriorly and extending across the midline and downwards, behind the liver. The mass was partly cystic and partly solid (Fig 2, 3, 4).

A true cut biopsy under ultrasound control was taken and showed features consistent with small cell tumour most probabaly fibrosarcoma.

A skeletal survey revealed no involvement.

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J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V April No 2

INTRODUCTION

The patient underwent exploratory right posterolateral thoracotomy when she was eighteen days old, during which a large tumour 12 x 17 em occupying the posterior mediastinum, pushing the right hemidiaphragm down and extending to the left side of the chest and spreading into the abdomen through the aortic opening in the diaphragm . The tumor was not invading neither the bone nor the diaphragm. The tumour was encasing the aorta and difficult to be separated from it. The tumour was encapsulated and partly solid and partly cystic. Most of the tumour could be removed. The tumour tissue was friable and necrotic, greyish to white in colour. The right lung expanded well after removing the tumour and the patient tolerated the procedure well.

The general condition of the baby improved dramatically. The baby recovered well after the surgery and was extubated on

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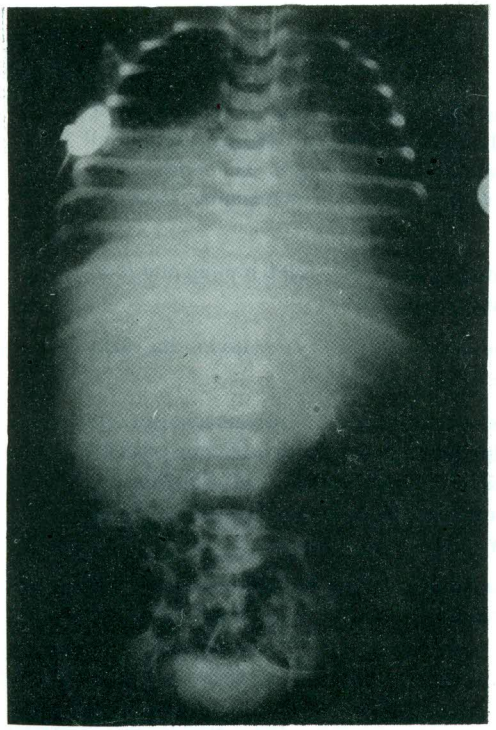

Figure (1): Preoperative chest x-ray shows the tumor occupying the most of the right hemithorax and extending to the left. Patient is intubated.

the fifth postoperative day, intercostal drain was removed on the sixth postoperative day (Fig 5). By the tenth postoperative day, the baby was on full oral feeding.

Histopatholgic examination revealed:

1. A cellular tumor composed of spindle cells arranged in interlacing fascicles. The nuclei had a coarse chromatin pattern with nucleoli (Fig 6).

2. Mitotic figures were frequent (Fig 7).

3. Reticulin stain showed reticulin fibres in parallel arrangements around individual cells but there was little or no collagen (Fig 8).

4. Immunocytochemistry showed positive staining for vimentin (marker for mesonchymal cells) S-100, NSE (markers for neuronal differentiation). Actin and desmin (markers for muscle cells) were negative (Fig 9).

The patient was discharged from the hospital after two weeks and she was under medical follow-up. Three months later arranged second stage operation for resection of the residual tumor and replacement of the thoraco abdominal aorta. The operation was done through left thoraco abdominal incision through the bed of the seventh rib and continued retroperitoneally. There was no easy resection margin and the tumor was attached to the aorta, vertebral bodies and ribs. There was extension to right pleural cavity and through the hiatus around the aorta. The aorta from thoracic vertebra No 9 to lumbar vertebra No 1 showed narrowing and pinhole stenosis and was relatively normal at the level of coeliac, superior mesentric and renal arteries. There was a big bilobed infra renal aneurysm. Thoracic aorta was transected at the eighth thoracic vertebra and end to end anastomosis with 6 mm PTFE tube using 6/0 Prolene, a big central patch of coeliac trunk, superior mesentric artery and renal arteries plus some intercostals was attached to the tube graft. Then end to end anastomoses between the grafts and the terminal aorta at common ilac bifurcation was completed by 6/0 Prolene.

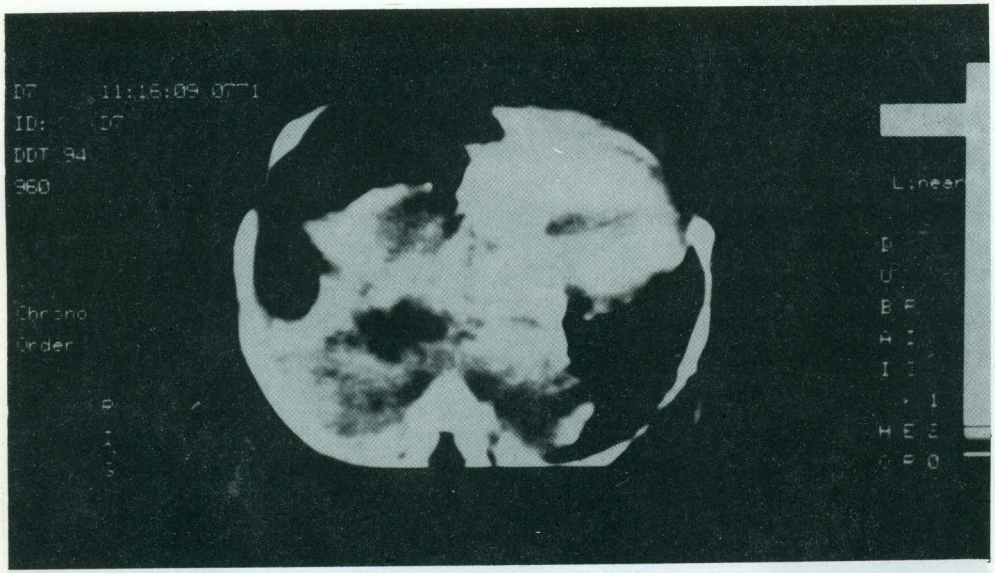

Figure (2): C.T. Scan of the chest shows the tumor pushing the heart to the left and occupying the posterior mediastinal.

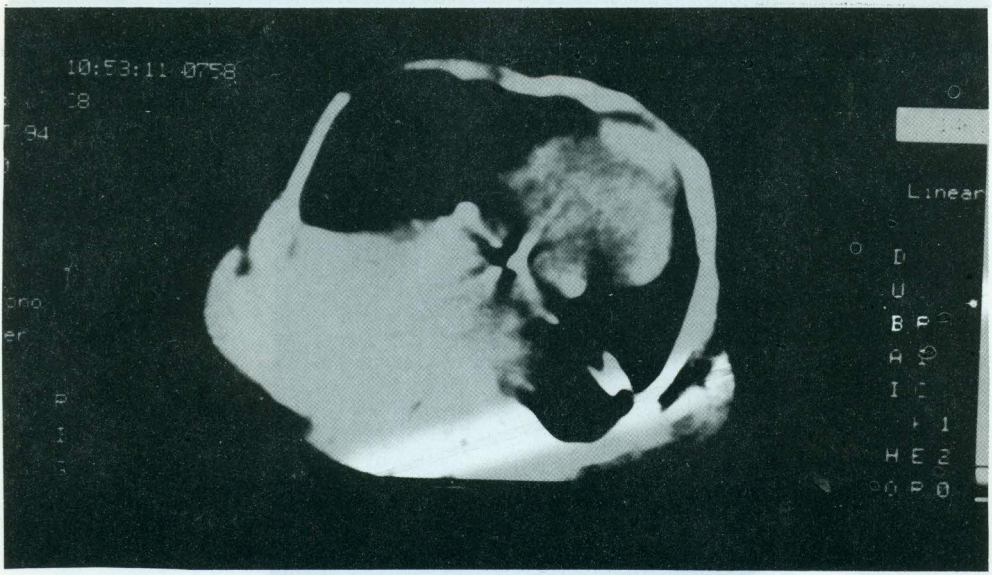

Figure (3): C.T. Scan of the chest shows tumor in the posterior mediastinal at the level of the carina.

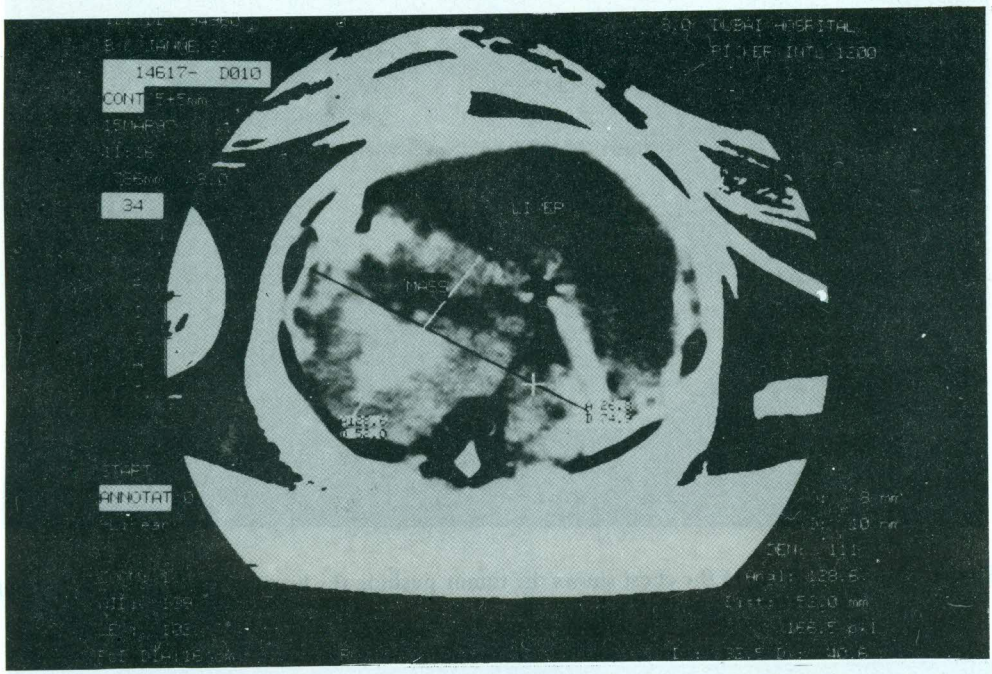

Figure (4): C.T. Scan of the abdomen shows the tumor extending down through the diaphragm and pushing the liver.

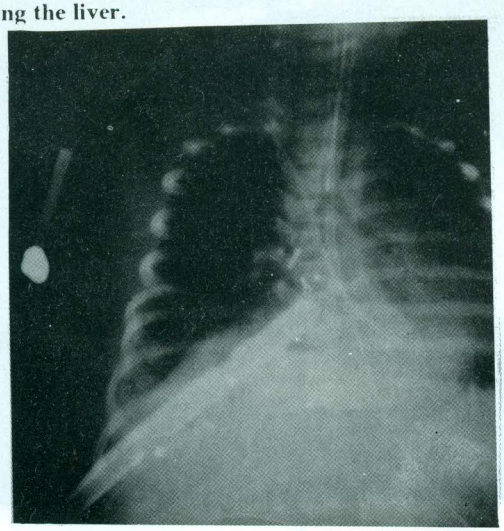

Figure (5): Postoperative chest x-ray shows clearance of the right hemithorax from the tumor. Intercostal chest tube is there. Patient is extubated.

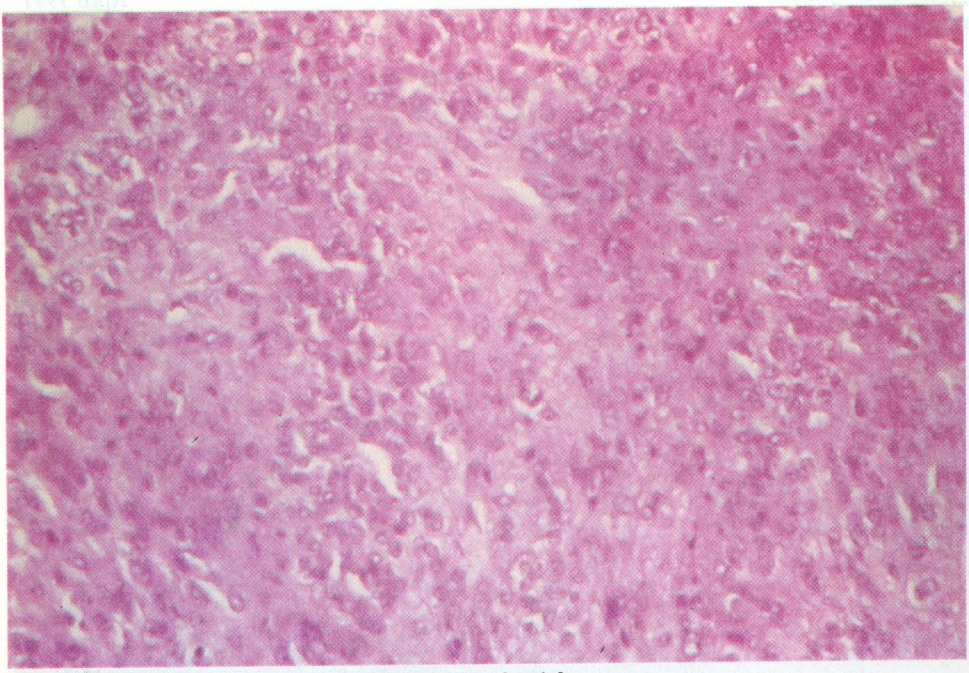

Figure (6): Spindle cells arranged in interlacing fascicles.

The tumor was dissected from the chest wall with considerable bleeding, dissection continued to free the descending thoracic aorta and through the aortic hiatus and crura. Dissection then continued downwards to expose entire aorta and its main branch. Little residual tumor below the diaphragm which was removed (resection is 95% complete). After aortic reconstruction the wound was closed in layers. The patient tolerated the procedure and had reasonable recovery but later she had repeated vomiting, dyspepsia and difficult to thrive. Barium meal study showed big hiatus hernia. Three months later the patient had exploration of the abdominal part of the thoraco abdominal incision for repair of the diaphragmatic hernia. There was no evidence of the tumor on exploration and there was 2 cm ovoid defect in the left diaphragm anteromedially in front of the aortic hiatus. The abdominal content of the peritoneal sac included stomach, small bowel, transverse colon were reduced and the sac excised, margins cleared and the defect repaired with 3/0 Prolene without tension. The patient improved after the operation with increasing tolerability for feeding, no vomiting with normal bowel sounds. Baby's growth was remarkable with no evidence of recurrence of the tumor both clinically and radiologically 9 months after radical surgical excision.

Discussion

Mediastinal mesenchymal tumors originate from connective tissue, striated and smooth muscle, fat, lymphatic tissue and blood vessels present within the

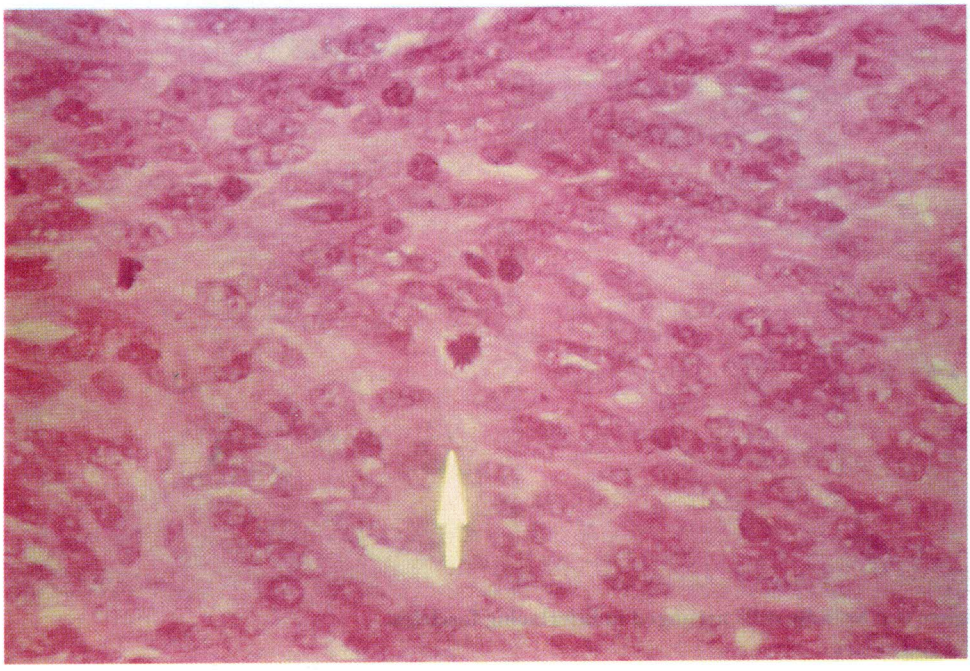

Figure (7): Mitotic figures.

mediastinum and give rise to diverse group of neoplasms. These tumors occur less commonly within the mediastinum relative to other sites in the body. They constitute 7% of the primary masses in the collected series (1) .

Fibromas and fibrosarcomas are mesenchymal tumors and usually are well encapsulated. They may grow to an enormous size, resulting in symptoms secondary to compression of adjacent structures (2) .

Infantile fibrosarcoma occurs in infancy and childhood (3). In 37% of patients, the tumour is present at birth. In such cases, the condition is called congenital fibrosarcoma (4). No sex predominance has been reported. The most common sites at presentation are the trunk, the extremities and the head and neck region.

Fibrosarcoma is much more common in adults than it is in children. In adults, the tumour tends to be centred in its distribution. Children are affected in a more peripheral location (18) .

Infantile fibrosarcoma is locally aggressive and microscopically resembles adult fibrosarcoma (4). Late metastasis have been reported (4). However, no distant metastasis was reported in 13 patients after follow-up of 2 to 15 years after the original diagnosis (5) . Because of its more

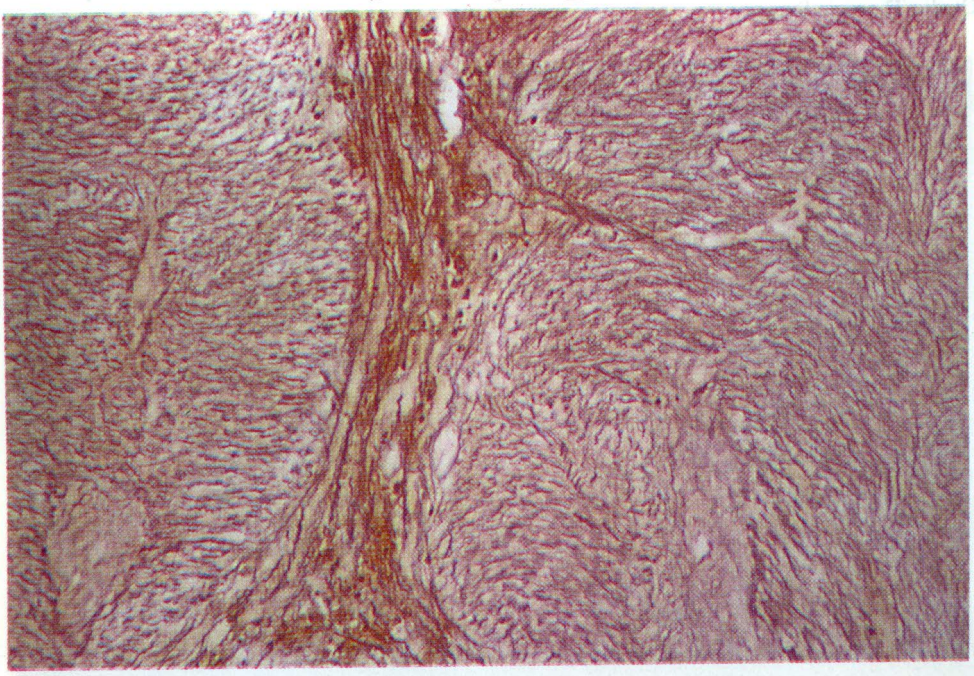

Figure (8): Reticular stain

favourable outcome Infantile fibrosarcoma has been considered an entity separate from adult fibrosarcoma. This has been confirmed by cytogenetic studies showing numerical abnormalities involving 11,17 and 20 in Infantile Fibrosarcoma (7) and structural abnormalities in adult fibrosarcoma (6) .

Also, in vitro studies have shown that the tumour cells in Infantile fibrosarcoma do not have the biologic properties of malignant cells (8). The most common posterior mediastinal tumours in infancy are neurogenic tumours and the histopatholic features of the tumour we resected from this patient had some similarities to malignant peripheral nerve sheath tumour which could be excluded by Fluorosence In-situ Hyperidization. Treatment of Infantile fibrosarcoma has varied from local excision to amputation. But most of the publications agreed about local excision either complete or incomplete according to the location of the tumour. In our case we excised most of the tumour about 95% resection on two stages due to the general condition of the patient.

Follow-up of the patient did not show any evidence of recurrence after nine months, both clinically, radiologically and on exploration. Efficiency of chemotherapy as an adjuvant form of treatment to surgery has not been established (9). Some authors prefer preoperative chemotherapy to reduce the size of tumour in inoperable Infantile

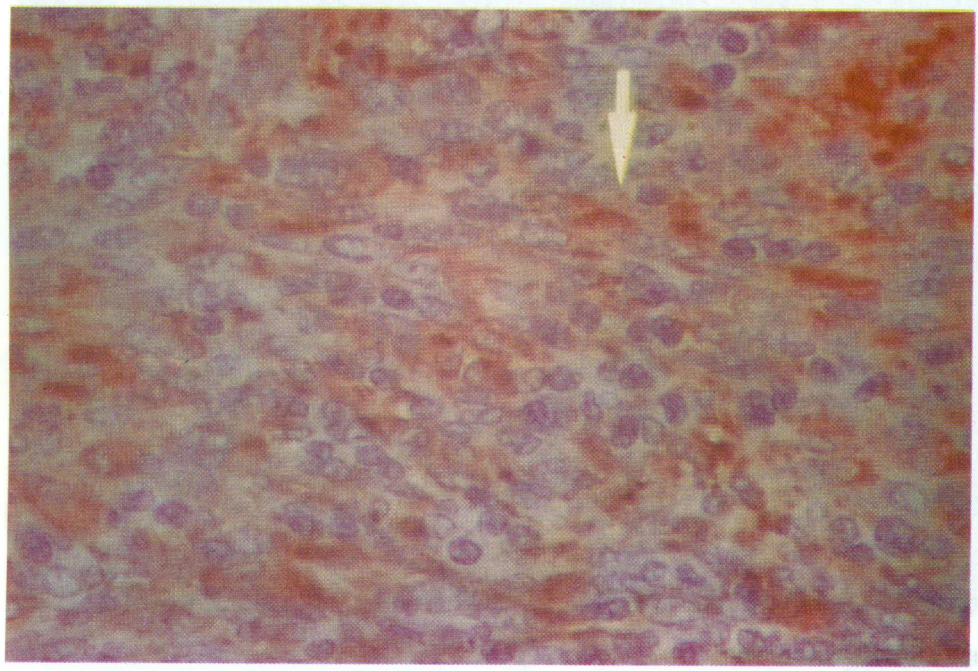

Figure (9): Immunocytochemistry stains

fibrosarcoma, avoiding mutilating surgery (10). Postoperative chemotherapy also has been used in some cases of incomplete resection (11). Moreover, serious late side effects, including second malignant neoplasm should be taken into account when adjuvant chemotherapy is considered.

Most literature agree that Infantile Fibrosarcoma are rarely associated with metastasis and may not progress or recurr even after partial resection (3,14,15,16,17).

The ideal management is local surgical excision if it is possible, otherwise chemotherapy can be given to reduce the size of the tumour to avoid mutilating surgery, chemotherapy can be used to treat local recurrences and metastasis (13).

Review of 78 cases of fibrosarcoma reported in the literature in children under one year of age showed sixty patients only (77%) were under one month of age. The limb was the commonest site (32 lower limbs, 17 upper limbs), 16 tumours were on the trunk and 13 on the head and neck (13). None was in the posterior mediastinum as in our case.

There is no report in literature as far as we know about this unusual location for Infantile Fibrosarcoma (posterior mediastinum) which usually are located in the extremities (12).

The largest series of patients with infantile fibrosarcoma is that of Soule and

Pitchard. In 1977, they found the prognosis to be directly related to age at diagnosis. Patients who were more than ten years old when diagnosed had a rate of metastasis of 50% at five years. This rate closely approximate that in adults. However, in patients who were less than five years old at the time of diagnosis, the rate of metastasis was 7.3%. In this series the treatment was primarily operative (16) .

In very large retrospective study done by Kransdorf for 38,484 patients with soft tissue tumours, fibrosarcoma was diagnosed below 5 years of age in 74 patients and there was no case of posterior mediastinal location and only 4 cases were reported to be located retroperitoneally (19).

Infantile Fibrosarcoma in the posterior mediastinum is the first case to be reported in literature and is well documented with clinical, radiological, histopathological and cystological evidences.Two-stage operative resection for the tumor was satisfactory and follow-up clinically and radiologically for nine months shows no evidence of recurrence or metastasis.

Referenccs

1. David C Sabiston, Jr., M.D. and Frank O Spencer, Surgery of the Chest, Fifth Edition, W.B. Sander Company 1990, Volume I, 527.
2. Mahajan V, Strimilan V, Van Ordstran HS, Loops FD : Benign superior vena cava syndrome. Chest 68: 32, 1975.
3. Chung EB, Enzinger FM. Infantile fibrosarcoma cancer. 1976;38:729.
4. Lauren DH, Enzinger FM. Cranial fascities of childhood cancer. 1980;45:401-406.
5. Coffine CH, Dehner LP. Soft tissue tumors in the first year of life. Paediatr Pathol. 1990;10:509-526.
6. Becker R, Wake N, Gibas Z, Ochi H, Sandberg AA. Chromosome changes in soft tissue sarcomas. J Natl Cancer Inst. 1984;72:823-831.
7. Dal Cin P, Brock P, Van Daele MC, De Weber I, Van Damme B, Van den Berghe H. Cytogenetic characterization of congenital or infantile fibrosarcoma. Eur J Pediatr. 1991;150:579-581.
8. Wilson MB, Stanley W, Sens D, Garvin J. Infantile fibrosarcoma : a misnomer? Pediatr Pathol. 1990; 10:901-907.
9. Alfredo Pinto, Oliver R Dold, Dagmar Muller, Enid Gilbert Barness AJDC. 1993; 147:691-692.
10. Ninane J, Gosseye S, Panteon E, Claus D, Rombouts J.J, Cornu G. Congenital fibrosarcoma : preoperative chemotherapy and conservative surgery cancer. 1986;58:1400-1406.
11. Brock P, Renard M, Simet M, De Weber I, Van Daele MC. Infantile fibrosarcoma. Med Pediatr Oncol. 1991; 19:210.
12. S. Variend, N.M.A. Bax and J. Van GORP. Are infantile myofibromatosis, congenital fibrosarcoma and congenital haemangilo pericytoma histogenetically related ? histopathology. 1995;26:57-62.
13. N.P. Madden, R.D. Spicer, E.B. Allbone and I.J. Lewis. Br. J. Cancer. 1992;66, Suppl XVII:372-S75.
14. Hays DM, Mirabal VQ, Karlam MS, et al. Fibrosarcomas in infants and children. J Pediatr Surg 1970;5:176-83.

15. Imasaki H, Enjoji M. Infantile and adult fibrosarcomas of the soft tissues Acta Pathol JPN. 1979;29:377.

16. Soule E H., Pritchand DJ. Fibrosarcoma in infants and children cancer 1977; 40:1711-21.

17. Stoat AP. Fibrosarcoma in infants and children cancer. 1962; 15:1028-40.

18. Whitney Robinson and Alvin H. Crawford. Infantile fibrosarcoma. Report of a case with long term follow-up. The Journal of bone and joint surgery. 1990;72A, No 2:291-294.

19. Mak J. Kransdorf. Malignant soft-tissue tumors in a large referred population Distribution of Diagnosis by age, sex and location. AJR - 1995; 164:129-134.

Prognostic Significance of Intraoperative Pleural Lavage Cytology in Patients with Bronchogenic Carcinoma

ABSTRACT

Pleural lavage cytology immediately after thoracotomy was performed in 124 patients with lung cancer. Eighteen patients (14.5%) had positive results. The positivity of pleural lavage cytology was significantly related to the cell type (adenocarcinoma> other cell types of lung cancer), and pathological stage (Stage IV > Stage III > Stage II > Stage I).

The positive lavage group had a significantly higher recurrence rate than the negative lavage group in patients with stage I disease (50% versus 25.8% respectively).

The 2 year survival of patients having negative results was more favorable than that of positive results (63.2% versus 27.8% respectively).

Pleural lavage cytology is an important prognostic factor that indicates microscopic exfoliation of cancer cells into the pleural cavity.

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J. of Egypt. Society of Cardiothorac. Surg. 1997, Vol. V April No 2

INTRODUCTION

In 1958 Spjut (1)and associates reported the cytological findings of pleural cavity washings in lung cancer patients and referred to the possibility of implantation of malignant cells by incisional biopsy. Eagan and colleagues (1984) (2) Studied the cytological findings from pleural lavage after curative lung resection for lung cancer. In both studies intraoperative pleural lavage was performed only after pulmonary resection for lung cancer and neither study considered its prognostic value, Buhr and associates, (1990) (3) reported the results of pleural lavage cytology before and after pulmonary resection and the poor prognosis of patients with positive cytological findings and insisted that positive cytological findings of pleural lavage should be added to the criteria for the staging system.

We conducted this study to determine whether exfoliated or disseminated cancer cells can be present in the pleural cavity in the absence of pleural effusion and to determine its prognostic significance.

Patients and Methods

This study was conducted on 124 patients (108 men and 16 women, average age 51.8 years) who underwent resection for primary lung cancer at the Cardiothoracic Surgery Department. Cairo University Hospitals between January 1995 and December 1996. Preoperative evaluation included a detailed history and physical examination, biochemical profile. chest Xray examination, bronchoscopy, computed tomography of the chest and upper portion of the abdomen and abdominal ultrasonography.

Cardiothoracic Surgery and Pathology Departments. Cairo University Hospitals.

The majority of patients in the study group had an exact diagnosis preoperatively either by bronchoscopy (73 patients) or by transthoracic needle biopsy (32 patients).

None of the patients had an obvious pleural effusion or pleural dissemination at thoracotomy. Furthermore, those who had diffuse adhesions in the pleural cavity or previously received chemotherapy or radiotherapy and those who had secondary malignant tumour were excluded from the study.

Pleural lavage cytology was performed immediately after thoracotomy and before any further manipulation of the pulmonary parenchyma. The technique for sample collection consisted of instillation of 500 ml of physiological saline into the pleural cavity.

The pleural space was carefully washed by hand for one minute. The saline was then aspirated into a bottle and sent directly for pathological examination.

The fluid was examined by centrifugation technique. After centrifugation the buttom of sedimented material was smeared into a stripe with a cotton tip applicator.

The specimens were immediately fixed in alcohol, stained by the Papanicolaou method and examined by the cytopathologist. Findings of microscopic examination were reported according to Papanicolaou's classification. The results of the cytologic examination were divided into two categories: negative lavage and positive lavage.

Papanicolaou classes I to III were declared as negative lavage, and Papanicolaou classes IV and V as positive lavage.

The primary tumour and lymph node status were classified according to the international staging system reported by Mountain (1986). Careful intraoperative staging at the time of surgical resection was done by dissecting intrapulmonary and hilar nodes and sampling mediastinal lymph node stations. The histologic type of the tumour was determined by applying the World Health Organization Classification. The results of the histopathologic examination regarding the status of lymph node metastasis and pleural involvement by the tumour were documented. In dealing with the lung tumour, the surgical procedure ranged between lobectomy, bilobectomy, pneumonectomy and exploratory thoracotomy.

The X^2 test was used to evaluate the significance of the relationship between the cytologic results of the intraoperative pleural lavage and the histopathologic findings. Survival curves were calculated according to the method of Kaplan and Meier (1958) (5) and log-rank test was used to compare the survival curves.

Results

The characteristics of the patients, operations, histopathologic type and final tumour stage of the patients undergoing intraoperative pleural lavage are shown in table (I):

Of the 124 patients with lung cancer in whom pleural lavage was performed, 18 patients (14.5%) had positive results.

*** Cell type:**

Positive cytologic findings on lavage were most common in patients with

Table (I):

		No.	%
* Sex :	Male	108	87%
	Female	16	13%
* Operations:	Lobectomies	72	58.06%
	Bilobectomies	8	6.45%
	Pneumonectomies	38	30.65%
	Exploratory thoracotomies	6	4.84%
* Postoperative tumour stage			
	Stage I	66	53.3%
	Stage II	29	23.4%
	Stage III A	19 ┐ 23	15.3%
	Stage III B	4 ┘	3.2%
	Stage IV	6	4.8%
* Histologic type: Squamous cell carcinoma		57	45.97%
	Adenocarcinoma	38 ┐ 49	30.65%
	Adenosquamous carcinoma	11 ┘	8.87%
	Large cell carcinoma	13	10.48%
	Small cell carcinoma	5	4.03%

adenocarcinoma. Forty nine lavages were done in patients with either adenocarcinoma or mixed adenosquamous cell carcinoma and results were positive in 11 (22.45%) ($P<0.05$). On the contrary 57 lavages were done in patients with squamous cell carcinoma and only 6 had positive lavage (10.53%). None of 5 patients with small cell carcinoma and only one of the 13 patients with large cell

Table (II): Cytologic results of intra operative pleural lavage according to the type of lung cancer. (P<0.05).

Cell type	Total	Negative	Positive	
			No.	%
Adenocarcinoma	38	29	9	22.45%
Adenosquamous carcinoma	11 (49)	9 (38)	2 (11)	
Squamous cell carcinoma	57	51	6	10.53%
Large cell carcinoma	13	12	1	7.7%
Small cell carcinoma	5	5	0	0

Table (III): Pathological stage and pleural lavage cytology.

Cytology	Stage I	Stage II	Stage III	Stage IV	Total
Negative	62	26	16	2	106
Positive	4 (6.06%)	3 (10.34%)	7 (30.43%)	4 (66.7%)	18 (14.5%)
Total	66	29	23	6	124

Table (IV): Recurrence rate and pleural lavage cytology.

Cytology	Stage I	Stage II	Stage III	Stage IV	Total
Negative	16/62 (25.8%)	7/26 (26.9%)	15/16 (93.7%)	2/2 (100%)	40/106(37.7%)
Positive	2/4 (50 %)	1/3 (33.3%)	6/7 (85.7%)	4/4 (100%)	13/18 (72.2%)
P value	< 0.03	< 0.12	N. S	N. S	< 0.01

N. S: not significant

carcinoma had positive cytologic results. (Table II).

*** Pathological stage:**

Malignant cells were detected in 4 of 66 patients with stage I disease (6.06%), 3 of 29 patients with stage II disease (10.34%), 7 of 23 patients with stage III disease (30.43%), and 4 of 6 patients with stage IV disease (66.7%). Positive findings in intra operative pleural lavage fluid were more frequent in advanced tumour stages. (i.e stage IV > III > II > I) (P = 0.008) table III.

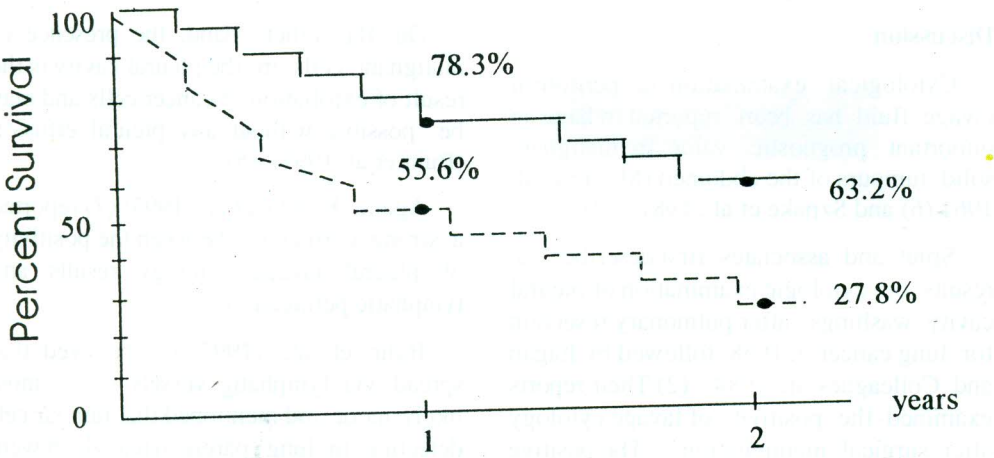

Fig. (I): Survival curves for the positive lavage group and the negative lavage group.
— Negative lavage group (n = 106)
--- Positive lavage group (n = 18)

* Preoperative transthoracic needle aspiration biopsy:

Preoperative transthoracic needle aspiration biopsy was performed in 32 patients. Positive cytological findings were obtained in 5 patients with it (15.6%) and in 12 patients without it (13.04%). Presence or absence of preoperative transthoracic needle aspiration biopsy had no significant relationship with the frequency of positive cytological findings.

*** Recurrence rate:**

Forty patients in the negative lavage group (37.7%) have had recurrence. On the other hand 13 patients in the positive lavage group (72.2%) have had recurrence ($P<0.01$).

The recurrence rate for the positive lavage group is significantly higher than that for the negative lavage group, but the fact that the proportion of higher stages is greater in the positive lavage group than in the negative lavage group should not be neglected. Therefore, difference in recurrence rate between the two groups must be discussed in each stage. In stage I and stage II the recurrence rate was higher in the positive lavage group. In stage III and stage IV there was no significant difference between the results of lavage cytology and the recurrence rate (Table IV).

*** Prognosis:**

The survival rates for 1 year and 2 years were 78.3% and 63.2% in the negative lavage group, and 55.6% and 27.8% in the positive lavage group respectively.

The survival rate for the negative lavage group was significantly better than that for the positive lavage group ($P < 0.04$). Fig. (I).

Discussion

Cytological examination of peritoneal lavage fluid has been reported to have an important prognostic value in malignant solid tumours of the abdomen (Moore et al, 1961 (6) and Szpake et al., 1981). (7)

Spjut and associates first described the results of cytologic examination of pleural cavity washings after pulmonary resection for lung cancer in 1958, followed by Eagan and Colleagues in 1984. (2) Their reports examined the positivity of lavage cytology after surgical manipulation. The positive findings may refelect the exfoliation and contamination of cancer cells into the pleural cavity during surgical procedures. We must discriminate between pleural lavage performed just after the chest is opened and that performed after pulmonary resection.

Buhr et al, (1990) (3) and Okumura et al, (1991) (4) reported the prognostic significance pleural lavage cytology. However, they evaluated the prognostic value of pleural lavage cytology without making a distinction between that performed before resection and that performed after resection.

The detection of tumour cells in pleural lavage fluid before resection proves that tumour cells have spread into the pleural cavity even in the early stages of lung cancer (Buhr et al, 1997). (5)

How the tumour cells enter the pleural cavity is still unknown. The presence of microscopic pleural stomas that connect subpleural lymphatics to the pleural space may account for tumour cell dissemination 2+ (Wang, 1975). (6)

On the other hand, the presence of malignant cells in the pleural cavity is the result of exfoliation of cancer cells and may be possible without any pleural effusion (Buhr et al, 1997). (5)

Again, Kondo et al, (1993) (7) reported a strong correlation between the positivity of pleural lavage cytology results and lymphatic permeation.

Buhr et al, (1997) (5) believed that spread via lymphatic vessels is the most likely mode and mentioned that tumour cell detection in lung parenchyma which were initially tumour free at the beginning of lung tissue cultures could be explained by the tumour cell detection in the intraoperaive pleural lavage fluid.

In our study eighteen of 124 patients (14.5%) had positive cytological findings. The incidence of positive cytologic results had a significant correlation with the cell type. Positive pleural lavage findings were observed more frequently in patients with adenocarcinoma and mixed adenosquamous cell carcinoma (11/49 i.e 22.45%) than in patients with other cell types (table II).

Also, positive cytological findings were significantly more frequent in patients with stage IV or stage III (66.7% and 30.43% respectively) than those with stage I or stage II (6.06% and 10.34% respectively) (P=0.008). (Table III). These results are comparable with those reported by Kondo et at, (1993). (7)

There is some fear that preoperative needle aspiration biopsy may cause mechanical exfoliation of malignant cells into the pleural cavity (Berger et al., 1972).(8) However, our results in

agreement with those reported by Okumura et al (1991) (9), revealed the negligible effect of the preoperative needle biopsy on the pleural lavage cytology result.

The positive findings of pleural lavage are significant prognostic factor for patients with lung cancer. In our series the survival rate of positive lavage group was significantly less than that of the negative lavage group (55.6% and 27.8% versus 78.3% and 63.2% at one and two years respectively). Buhr et at, (1989) reported also a significantly poorer 2 year survival for patients with positive findings in pleural lavage (35.2% versus 72.8% P<0.007).

Furthermore, the positive lavage group had significantly greater recurrence rate than the negative lavage group especially in stage I disease (50% versus 25.8%) and stage II (33.3% versus 26.9%), though no significant difference between the two groups was detected in the recurrence rate in stage III or stage IV. These results are in agreement with those reported by Okumura et al, (1991) 2+9 (a) who also stated that results of pleural lavage cytology may have greater importance as a prognostic factor in patients with stage I or stage II disease than in those with stage III a, stage IIIb or stage IV disease.

In conclusion. pleural lavage cytology immediately after thoracotomy is a good indicator of subclinical exfoliation or dissemination of cancer cells into the pleural cavity. It should be considered an important prognostic factor in lung cancer operations.

References

1. Spjut JH, Hendrix VJ, Ramirez GA and Roper CL. Carcinoma cells in pleural cavity washings. Cancer 1958; 11: 1222- 1225.
2. Eagan RT, Bernatz PE, Payne WS et al: Pleural lavage after pulmonary resection for bronchogenic carcinoma. J. Thorac Cardiovasc Surg. 1984; 88:1000-3.
3. Buhr J, Berghäuser KH, Morr H, Dobroschke J. Ebner HJ: Tumour cells in intraoperative pleural lavage : an indicator for the poor prognosis in bronchogenic carcinoma. Cancer 1990; 85:1801-1804.
4. Mountain CF: A new international staging for lung cancer. Chest 1986; 89 (suppl.): 225-33.
5. Buhr J. Berghäuser KH, Gonner S, Kelm C, Burkhardt EA, Padberg WM. : The prognostic significance of tumour cell detection in intraoperative pleural lavage and lung tissue cultures for patients with lung cancer. J. Thorac Cardiovasc Surg. 1997; 113:683-90.
6. Wang NS: The preformed stomas connecting the pleural cavity and the lymphatics in the parietal pleura. Am Rev Respir Dis. 1975; 111 : 12 - 20.
7. Szpak CA, Creasman WT, Vollmer RT, Johnston WW. Prognostic value of cytologic examination of peritoneal washings in patients with endometrial carcinoma. Acta Cytol 1981; 25 : 640 -6
8. Kondo H, Asamura H, Suemasu K, Goya T, Tsuchiya R, Naruke T,
9. Yamagishi K, Uei Y. Prognostic significance of pleural lavage cytology immediately after thoracotomy in patients with lung cancer. J Thorac Cardiovasc Surg. 1993; 106:1092-7.
10. Okumura M, Ohshima S, Kotake Y, Morino H, Kikui M, Yasumitsu T.:

Intraoperative pleural lavage cytology in lung cancer patients. Ann Thorac Surg. 1991; 51:599-604.

11. Buhr J., Berghäuser KH, Morr H, Dobroschke J. Determination of the prognosis of bronchogenic carcinoma by intraoperative pleural lavage. Deutsch Med Wochenschr 1989; 114: 1597-1601.

12. Moore GE, Sako K, Kondo T, Badillo J, Burke E. : Assessment of the exfoliation of tumour cells into the body cavities. Surg Gynaecol. Obstet. 1961; 112:469-74.

13. Berger RL., Dargan EL, Huang BL.: Dissemination of cancer cells by needle biopsy of the lung. J Thorac Cardiovasc. Surg. 1972; 63:430-2.

14. Kaplan EL, Meier P. Non parametric estimation from incomplete observations. J Am Stat Assoc 1958; 53: 457-81.

Outcome after Delayed Sternal Closure in Pediatric Heart Operations : A 5 - Year Experience

ABSTRACT

Early closure of median sternotomy after repair of complex congenital heart malformation may lead to life threatening respiratory and hemodynamic embarrassment. To avoid such a fatal outcome in these situation, we postponed sternal closure in thirty light patients from six hundred and sixty patients (5.76%) who underwent open heart surgery during the period of this study (1990 - 1995).

This maneuver in a setting of optimal inotropic and ventillatory support allowed twenty seven of these critically ill thirty eight patients to survive (27/38) (71%). The mean age at operation was 7.4±30.4 months (range 2 day to 10 years). 5 patients required extracorporeal membrane oxygenation.

Delayed sternal closure (DSC) was carried out in 31 patients at a mean of 3.74±3.52 days (range 1 to 17 days) postoperatively. Eleven patients died of low cardiac output, multiorgan failure and respiratory distress syndrome (4 of them after delayed chest closure and 7 died before chest closure). Overall mortality was 29% (11/38). It was 23% (7/03) when the sternum was left open primarily at the end of operation and it was 50% (4/8) when the chest opend as an emergency procedure in the ICU due to hemodynamic instability. The incidence of sternal wound infection was relatively low 3/38 (7.89%) in the form of superficial wound infection with no single case of deep seated mediastinal infection reported. Morbidity and mortality related to this technique have proved acceptable in this high - risk group.

Our results indicate that DSC is an important and life saving procedure in infants and children with compromised cardiac output after repair of congenital cardiac defects and it should become a viable part of the pediatric surgeon's management of critically ill infants and children.

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INTRODUCTION

Profound hemodynamic deterioration may complicate attempts to close the median sternotomy incision after completion of many complex congenital cardiac surgical procedures.

Attempts to reapproximate the sternal edges in this situation may result in hemodynamic changes resembling cardiac tamponade with a rise in right and left heart filling pressures and a fall in cardiac output.

When myocardial or pulmonary injury does not respond promptly to therapeutic measures, It may be necessary to leave the skin edges apart to maintain satisfactory hemodynamic function. This wound closure without sternal reapproximation may alleviate cardiac compression and allow ready access to the mediastinum when there is ongoing medistinal hemorrhage.

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Several techniques for decompressing the mediastinal structures have been described in the literature ranging from stenting open the bone edges and closing the skill to leaving even the skin edges apart. We present here our experience with these various techniques over a five year period at Royal hospital for sick children in Glasgow (U.K).

Patients and Methods

During the period from 1990 - 1995, six hundered and sixty (660) paediatric open heart operations were performed at the royal hospital for sick children. (Glasgow). Of these thirty eight (38) underwent delayed sternal closure (DSC) (5.76%). The age distribution of the patients is illustrated in Table (1)

A) Two lengths of semiriged chest tube are cut to enough length to push the sternal edges apart .

B) Each end of each segment is notched to provide purchase or the sternal edge .

C) Using a heavy monofilment suture, the chest tube segments are sutured in place against the sternal edges .

D) These stents allow the heart to beat without impingement by the sternal edges .

The indication for delayed sternal closure were (Table 2):

1) hoemodynamic instablility and marked cardiac oedema in 20 patients

2) Intractable bleeding and coagulopathy in 10 patients

3) Conduit compression by the sternum in 6 patients

4) Marked postbypass lung hyperinflation in 2 patients where the sternal approximation led to hypoxemia and respiratory acidosis. This downhill respiratory spiral could not be reversed until the sternum was reopened.

The 30 patients undergoing DSC because of haemodynamic instability and medistinal hemorrhage comprised two subgroups: those in whom the sternum was not closed at the time of the initial operation (group 1) (22 patients) and those in whom the sternum was initially closed but was later left open after reexploration for ongoing hemorrliage and tamponade or due to hemodynamic instability (8 patients) (group 2).

Once the decision to delay sternal closure is made, both pleural cavities are drained independently with chest drain tube. Also the mediastinum is drained with single or two tubes through a separate stab incision below the sternotomy incision

The techniques employed for DSC are outlined in table (3):

- In 10 patients the sternum was actively splinted open, by using struts of chest drain segments in 8 patients (Figure 1) and by leaving the sternal retractor insitu to prevent cardiac compression in 2 patients.
- 10 patients had swabs loosely inserted between the sternal edges and this was covered with a sterile Betadine impregnated occlusive dressing (steri drape)
- 18 patients had their skin closed, either directly using prolene sutures (4 patients) or by suturing an oval piece of

Table (1): Age distribution of the patients

Age	No. of patients
< 7 days	12
8-30 days	7
1-12 months	9
1-5 years	6
>5 years	4
Total No.	38

Table (2) : Indications for delayed sternal closure

Main indication	No. of patients
Haemodynamic instability and marked cardiac oedema	20
Intractable bleeding and coagulopathy	10
Conduit compression by the sternum	6
Marked post bypass lung hyperinflation	2

Gore - tex membrane to the skin edges (14 patients) (Figure 2). The dressings were left intact until it was felt that closure could be safely performed and only changed if fluid accumulated in the medistinum causing the membrane to bulge externally.

Once the indication for DSC had subsided, all dressings and struts were removed and after the bacteriological swabs were taken, the medistinum was debrided and the sternum approximated with stainless steel wires. The soft tissues and skin were than closed with absorbable sutures. A mediastinal and pericardial drains were left in situ and removed at 24 hours unless drainge persisted. Antibiotics were given for 24 hours as prophylaxis unless specific bacteriological results mandated another regimen.

Table (3) : Surgical Techniques

	No. of patients
Splintage of sternum using a section of chest drain ± sterile swabs + steri - drape	8
Sterile swabs + steri - drape	10
Skin closure only	4
Sternal retractor + steri drape	2
Gore-tex membrane sutured to skin edge	14

Table (4) : Diagnosis and operative procedures

Diagnosis	Operation	No. of patients
TGA	Arterial switch	9
	Senning	4
TGA, VSD, PS	Rastelli repair (CE12)	1
Corrected TGA, VSD, PS	VSD patch; RV/PA(17 mm homograft	2
HLHS	Norwood operation	3
TAPVD	Correction	2
F4; pulmonary atresia	Correction (19 mm homograft)	4
CAVSD & severe MI	Repair + MVR	2
Taussig bing anomaly	Arterial switch; Intraventricular baffle	2
DOLV	Repair (CE 14 mm)	1
Truncus arteriosus	Repair (CE 12 mm)	2
IAA type 2; AP window	Repair IAA; closure of AP window	2
DORV + subpulmonary VSD	Total correction + RV - PA conduit	4

Results

Thirty eight patients were managed with DSC following various open heart procedure to repair different forms of complex congenital cardiac defects. The diagnosis and operative details of the patients are showen in Table (4).

Overall survival to discarge occured in 27patients (71%).Of those who died,7 still had their chest stented open and 4 occured at a later stage after chest closure had accomplished.

Hospital mortality was higher among the patients who had their chest opened as an emergency procedure in the intensive care unit due to hemodynamic instabilty or cardiac tamponade with hospital mortality in this group (group 2) was (4/8) (50%). On the other hand the hospital mortality was (23%) among the patients in whom the chest was not closed at the time of operation due to hemodynamic instability or massive bleeding (group 1).

Although the hospital mortality was high in this group of patients who had their

Table (5) : Effect of sternal splintage on the hemodynamics in Emergency group (group 2) .

Pat. No	B.P.		CVP		Urine output		Skin T.		Po^2		Acid Base	
	pre	after	pre	after	pre	after	pre	after	pre	after	pre	after
1	65	89	19	14	15	38	31	34	65	95	-3	+1
2	70	95	21	16	20	45	32	32.5	81	95	-4	-1
3	80	90	18.5	15	35	50	29	31	70	79	0	+3
4	85	100	17	12	25	90	30	32	69	95	-2	+3
5	77	95	19	12.5	7.5	27	32	34.7	81	116	-4	-2
6	55	70	20	16	5	8	28	29	65	78	-8	-5
7	75	95	18	12	20	65	31	33.5	79	105	-5	-2
8	60	85	22	15	16	35	28.5	30.2	83	105	-9	-5
mean± SD	70.87 +10.30	89.87 ± 9.26	16.81 + 6.55	14.06 ± 1.70	17.93 ± 9.54	44.75 ± 24.76	30.18 ±1.557	32.11 ± 1.961	74.12 ± 7.62	96.000 ± 12.97	-4.37 ±2.9	-1.0 ± 3.1
P value	P<0.0001		P=0.32		P=0.006		P<0.0001		P<0.0001		P<0.0001	

Pre = parameters recorded immediately before sternal splintage.

Table (6) : Age distribution of the patients Vs mortality

	< 7 days	8-30 days	1-12 months	1-5 years	> 5 years
Total No. of patients	12	7	9	6	4
No. of deaths	7	3	1	0	0
%	58	43	11	0	0

Table (7) : Timing of delayed sternal closure

Interval	No. of patients
24 th	5
24 h- 48 h	9
48 h - 72 h	8
7 days	6
17 days	3

chest opened as an emergency procedure in I.C.U. but the majority of them showed marked initial improvement in their hemodynamics following sternal splintage with a fall in the central venous pressure and a significant increase in blood pressure ($P<0.0001$), urine output ($P=0.006$) and skin temperature ($P<0.0001$) and P02 ($P<0.0001$) with significant decrease in acidosin ($P<0.0001$) (Table 5).

When divided into age groups,.The highest mortality(58%) was noted for patients between 2 and 7 days of age followed by 43% hospital mortality for patients with age between 8 to 30 days. There was no hospital mortality in patients over one year of age (Table 6).The causes of hospital mortality were refractory low cardiac output in 7 patients, multiorgan failure in 3 patients and respiratory distress syndrome in one patient.

Associated morbidity occured in six cases in the form of temporary phrenic nerve paralysis (3 patients), cerebral injury in one patient and chylothorax in a further patient.

Of the group who had their chest eventually closed (31 patients) the delay in sternal closure ranged from 1 to 17 days postoperatively (average 3.74 ± 3.52 day) ('l'able 7). Recognized complications of delayed sternal closure were seen in 3 patients in the form of superficial sternal wound infection. All 3 were successfully treated with local care and systemic antibiotics. There was no incidence of deep seated mediastinal infection or infected sinuses following closure of the sternum .

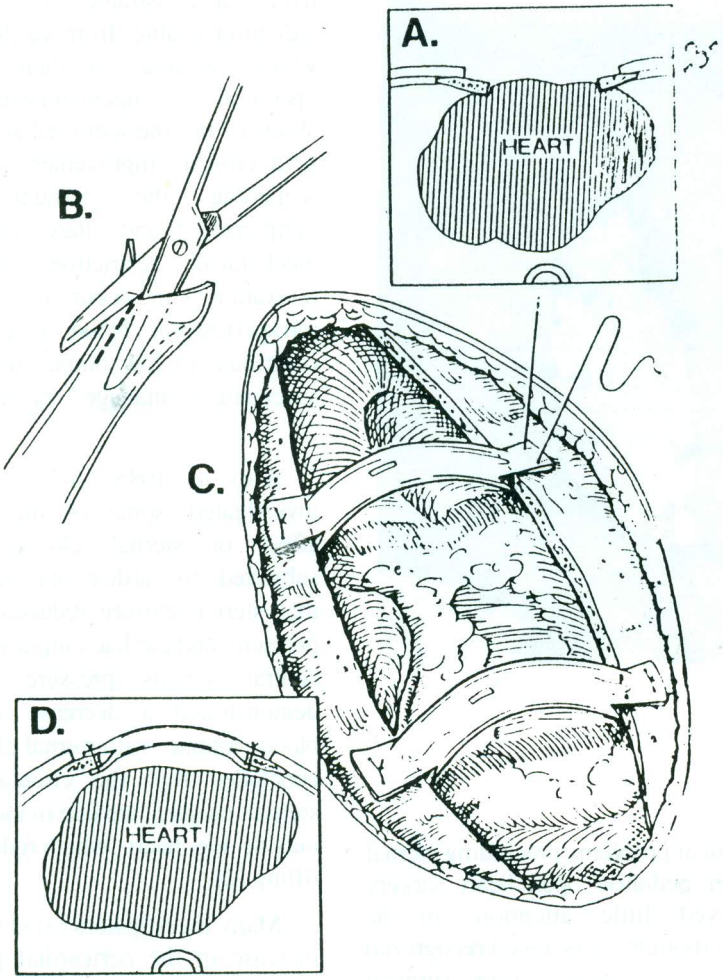

Fig.1: Technique of splintage for DSC

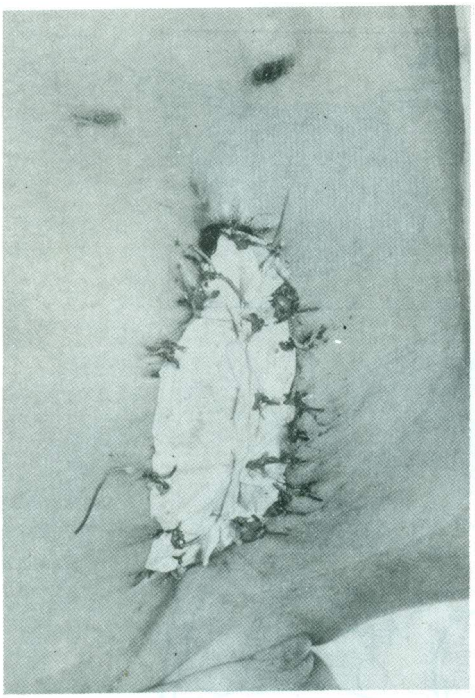

Fig. (2):

Discussion

The clinical problems precluding sternal closure after pediatric open heart surgery have received little attention in the literature, althought it is a well recognized technique in the adult cardiac surgical population.

On occasion after complicated intracardiac repairs and prolonged extracorporeal support. the resultant puilmonary, myocardial and chest wall edema produces a constrictive effect on cardiopulmonary function after chest closure.

In 1982 Shore and his colleagues (1) have demonstrated a state clinically indistinguishable from cardiac tamponade which occured in their patients after operation for congenital heart disease in the absence of intrapericardial blood or clot with clinical improvement has occured on reopening the sternum to exclude tomponade and they concluded that mechanical restriction of ventricular relaxation can occur in the absence of intrapericardial blood clot and this may contribute to low output status and can be successfully managed by sternal splinage (1).

Also in 1985, Jogi and Warner (2) investigated some of the hemodynamic effect of sternal closure in children subjected to cardiac operation and found that sternal closure reduced mean arterial pressure and cardiac output while rising the central venous pressure. They also demonstrated a decrease in intracardiac blood volume with sternal closure and they concluded that the circulating effect of sternal closure are due to increase pressure outside the heart which reduce ventricular filling (2)

Many investigators (3) (1) attributed this increase in the pericardial pressure which occured in the postoperative period in the absence of blood or clot date to swelling of the retrosternal fibrofatty tissue, pericardium and thymic tissue. This in addition to right ventricular dilatation which occurs commonly especially after right ventriculotomy, may significantly increase the volume of tissue which has to be accomodated in the retrosternal and

pericardial space. Also further difficulty arises when this space has to accomodate external conduit or homograft (1) (4). In our experience, we have encounted 6 patients with right ventricle - pulmonary artery conduit who developed a persistent hypotension on sternal approximation despite a generous incision of the pericardium on the left side to allow the heart to herniate toward the left hemithorax. This phenomenon was also observed by other investigators (1) (4) (5).

This phenomenon of low cardiac output with increase in the central, venous pressure after sternal approximation could be misinterprted as a failure of cardiac systolic function but the echocardiographic data from Matsumoto et al (6) demonstrated that upon sternal closure there is a significant fall in cardiac output and ventricular diastolic dimension with a preserved velocity of circumferential fiber shortening and this implies impaired diastolic rather than systolic function as the cause of the depressed cardiac output.

In the present series and in the other series (5) (7), the indications for DSC after pediatric open heart surgery included the hemodynamic instability, intractable bleeding and coagulopathy, conduit compression by the sternum and marked postpypass lung hyperinflation .

The largest group of patients in the present series undergoing DSC were the patients who demonstrated hemodynamic or respiratory deterioration, or both during an intraoperative trial of sternal closure (79%) while 21% of patients in this series did have to undergo delayed sternal reopening for refractory postoperative low cardiac output.

In shunt dependent circulations(as in complex palliation of univentricular heart), the increase in pulmonary vascular resistance caused by chest closure with decrease in residual functional capacity, may lead to significant oxygen desaturation resulting secondarily ill cardiac and circulatory failure. This may arise even if cardiac failure have not been additional problem before. This mechanism was the reason to perform DSC in the 3 patients with an univentricular heart in our patients.

Delayed sternal closure was performed in 31 patients after hemodynamic stabilization at a mean of 3.74 ± 3.52 days (range 1 to 17 days) postoperativ. In 71% of our patients (22/31), we managed to close the sternum within 72 hours postoperatively where by that time, the myocardial edema and cardiac dilatation subsided and the inotropic drug support had decreased significantly and the sternum could be approximated without difficulty. In the other series reported about DSC after pediatric open heart surgery the mean time for DSC ranged between 3.8 days (8)(9) to 5.6 days (10). This is in coincidence with our series where the mean time for DSC was 3.74 ± 3.52 days.

The decision of when to close the sternum must be individualized in each patient and persistence in trying to close the sternum prematurely in the postoperative period may lead to gradual recrudescence of poor hemodynamics and pulmonary function (5). Early in our series we had to reopen the chest 4 to 6 hours on the second postoperative day because of cardiopulmonary compromise due to early chest closure

One of the determinants of the reluctance of surgeons to leave the chest open is the life threatening deep mediastinal infection as the natural barrier between the medistinum and the envimorment is altered.

Approximation of the skin is the most logical approach but it is not always possible, other approaches to cover the skin have been advocated. Although we have had used early in this series, the standered adhesive surgical draps seem not to be the ideal method because they do not completely seal the wound. Also with continuous oozing the need to change the dressing several times a day may compromise the expected sterile condition required to manage an open post surgical mediastinum (11).

Gangahar et al (9) was the first to report the use of woven Dacron patch for temporary closure of the median sternotomy in a baby with critical pulmonary stenosis. The indication was secondary hemodynamic deterioration in the ICU. In 1984, Murphy et al (12) reported also the use of rubber patch technique for airtight closure of the median sternotomy incision which may prevent contamination of the mediastinum from the external source. Other surgeons reported the use of other material like bovin pericardium and Gore-tex membrane (5). All these material are sutured to the skin edges allowing a good decompression of the heart with no much difference regarding the incidence of sternal reported infection.

Early in our experience, we have used the standered adhesive surgical draps but now we shifted completely toward the use of Gore-tex membrane which we believe that It is a good barrier to protect the mediastinum. In fact we found no evidence of infection in these patients in contrast to our patients who had a standered adhesive surgical draps where 3 of them developed superficial wound infection.

Although hospital mortality in this series was a bit high (29%) but it is less than other investigators like Elami and his Colleagues (10) who reported 36%, Ziemer et al (5) (40%) and Alexi-Meskishvili et al (7) who reported 36.5% of hospital mortality. We believe that this high hospital mortality is accepted in those critically ill patients and this mortality could be higher without the use of DSC technique which saved many patients without any additional risk.

Accepting the notions that the patients reported belong to the illest group to be delt with, we should not look at the 29% mortality found in our patients with DSC but more favourably at the survival of 71 %.

Our results and others (5), (7), (13) indicate that this technique of delayed sternal closure is an important approach in pediatric cardiac surgery. It is a life saving technique and can assist in management of infant and children with compromised cardiac output after repair of congenital cardiac defects. We believe that this technique should become a viable part of the surgeon's management of critically ill infant and children after open heart surgery.

References

1. Shore., D.F, Capuami.A, Lincoln.C: A, Lincoln. Atypical tamponade after cardiac operation in infants and children. J thorac cardiovasc Surg 1982, 83 :449 - 452 .

2. Jogi P, Waoer Hemodynamic effect of sternal closure after open heart surgery in infant and children. Scand J thoroc cardiovasc, surg. 1985, 19 : 217-20

3. Fanning. WJ; Vasko J.S and Kilman J.W Delayed sternal closure after cardiac surgery. The Annals of thoracic surgery. 1987: Vol 44 No 2 Aug.

4. Odim J.N.K; Tchervenko C.I; Dobell. A.R.C. Delayed sternal closure: A life saving maneuver after early operation for complex congenital heart disease in the neonate J. Thorac cardiovasc Surg. 1989, .98:413-6

5. Ziemer G, Karck M, Muller H and Luhmer. I Staged chest closure in pediatric cardiac surgery preventing typical and atypical cardiac tamponade Eur J cardio-thorac surg. 1992, 6 :91 - 95 .

6. Matsumoto M, Oka Y, Strom J, et al Application of transesophageal echocardiography to continuous intraoperative monitoring of left ventricular performance Am. J. cardiol. 1980, 46.95.

7. Alexi-Meskishvili.V, Weng. Y, Uhleman. F, Lange PE, Hetzer. R Prolonged open sternotomy after pediatric open sternotomy after pediatric open heart operation : experience with 113 patients. Ann. thorac. Surg. 1995, Feb (2). 379-83

8. Iyer.R.S, Jacobs. JP, de-Leval. MR, Stark. J; Elliott. MJ outcomes after delayed sternal closure in pediatric heart operations: alo year Experience. Ann. thorac. Surg. 1997, Feb; 63 (2) : 389 - 91

9. Gangahar. D M, Mc Gough E.C and Synhorst, D. Secondary sternal closure A method of preventing cardiac compression. The Annals of thoracic surgery 1980, Vol 31 No 3 Mar 1981.

10. Elami. A, Permut. LC, Laks. H, Drimkwater. DC, Sebastion JL. Cardiac decompression after operation for congential heart disease in infancy. Amm. thorac. surg. 1994, Nov; 58 (5) 1392-6 .

11. Hakimi, M, Walters. H.L, Pinsky. W.W, Gallagher. MJ, Lyoms. JM.: Delayed sternal closure after neonatal cardiac operations. J. thorac. cardiovasc - surg. 1994, Mar; 107 (3) : 925-33 .

12. Murphy A.D. Delayed closure of the median sternotomy Incision Ann. thorac. Surg. 1985, 40:76-77.

13. Mestres C.A, Pomar JL, Acosta M, Ninot S, Barriuso C, Abad C and Mulet J Delayed sternal closure for life-threatening complications in cardiac operations : An update Ann thorac surg. 1991, 51 : 773-6 .

Upper Mini-Sternotomy for Aortic and/or Mitral Valve Operations

All open heart operations have been traditionally performed via median sternotomy allowing excellent surgical exposure. However, this incision has the potential for many complications. Upper Mini-Sternotomy (UMS) has recently evolved for aortic and/or mitral valve operations. To evaluate the benefits and potential hazards of this new approach, twenty two patients underwent aortic and/or mitral valve operations through (UMS) (group I) were prospectively studied. Operative and postoperative details were collected, analyzed and compared to 22 patients having exactly the same operations via Standard Median sternotomy (SMS) (group II). There was no significant difference in the total operative time or period of artificial ventilation between both groups. Group I had significantly less blood loss, less hospital stay and more patient convenience. One patient in group I had delayed pericardial tamponade and one had superficial wound infection. Two patients in group II required sternal rewiring one due to non union and another for severe infection and 4 had superficial infection. We conclude that limited approach through UMS allows satisfactory exposure to aortic and mitral valves without increased risk. It has definite benefits as less blood loss, less hospital stay, less wound complication and more patient convenience.

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INTRODUCTION

Median sternotomy has been the standard approach in all open heart operations to achieve excellent access to all cardiac structures. However. this incision has many potential complications including pain, abnormal sensation, nonunion, infection and brachial plexus injury (1,2,3). Sternal wound infection may be deep with serious consequences (4) .

The concept of less invasiveness has been evolving and is gaining wider acceptance among the medical profession and is reflected on many surgical subspecialities. In cardiac surgery minimally invasive myocardial revascularization either directly or with video-assisted instrumentation is gaining more acceptance (5,6,7) .

More recently there has been some alternative approaches to perform either aortic or mitral value operations via small incisions to lessen surgical trauma, reduce wound complication and achieve more patient's convenience (8,9,10,11, 12) .

The aim of this work was to evaluate the benefits of the upper ministernotomy (UMS) for aortic and/or mitral valve operations and its potential hazards.

Patients and Methods

Twenty two patients underwent aortic, mitral or combined operations via UMS representing group (1) were prospectively compared with another group of 22 patients

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having similar procedures, via standard median sternotomy (SMS) incision (group II). Pre-operative, operative and post-operative parameters were collected and compared.

Statistical Analysis

Results were expressed as a range with the mean ± the standard error of the mean. The means of both groups were compared using student t test for paired events and frequencies with p value of < 0.05 considered significant (13) .

Surgical technique

The patient is positioned on his back and anaesthetized as usual. A midline skin incision of about 8 cm starting 1 cm below sternal notch. The muscle layer is cut by electrocautery. Sternum is opened in the midline till the 3rd intercostal space where the electric saw is curved to the right sternal edge. A small sternal retractor is placed and gently spreaded avoiding injury of the right internal thoracic artery. Thymic gland is dissected and pericardium is opened and retracted to the wound edges.

In case of aortic valve or subaortic membrane operation, the ascending aorta is cannulated and the venous blood is drained via a single common two stage venous cannula inserted into right atrial appendage. Cardiopulmonary bypass is instituted. Myocardial protection is achieved by systemic cooling to 28°C and cold crystalloid cardioplegia directly infused into both coronary ostia after clamping the ascending aorta. After completion of the procedure, rewarming is started during closure of aortotomy. Deairing is achieved through aortic root connected to suction before declamping. Small defibrillator paddles can be used if needed to regain cardiac beating.

In case of mitral valve repair or replacement the same steps are followed with some differences. The SVC is cannulated directly and snared. The IVC is cannulated through right atrial wall and snared after going on bypass and emptying the heart. Cardioplegia is infused through aortic root after aortic clamping. The mitral valve is approached via right atrial trans-septal incision which can be extended to the dome of the left atrium between the aorta and SVC. Both edges of interatrial septum are retracted by pledgetted matters sutures then pulled and fixed to wound edges. Repair or replacement of the mitral valve is performed. Then the interatrial septum is closed and the left side is deaired before tying the suture. Deairing is completed through the aortic root connected to suction. After declamping, the right atrium is closed on a beating heart. After heparin reversal with appropriate dose of protamine sulphate and decanulation haemostasis is secured. Strenotomy is closed with 3 stainless sutures after inserting two intercostal tubes into the mediastinum and closure as completed.

Results

Upper Mini-Sternotomy (UMS) patients (group I) included 10 males (45%) and 12 females (55%) with a mean age of 26.9 ± 7.6 years (range 17 to 45). Standard median sternotomy (SMS) patients (group II) included 12 males (55%) and 10 females (45%) with a mean age of 24.2 ± 6.7 years (range 13 to 40). Both groups were comparable as regards the type of operations performed, operative time and time of artificial ventilation time table (1).

Table (1) : Some parameters in studied groups

Parameter	Group I (n=22)		Group II (n=22)		Significance
Operation : Aortic	11	50%	11	50%	
Mitral	8	36.6%	7	31.8%	
Double	3	13.6%	4	18.2%	
Chi square test					**N.S**
Operation time: Minimum	155 min		150 min		
Maximum	270 min		290 min		
Mean ± SD	186 ± 31 min		193 ± 36 min		
t test					**N.S**
Artificial ventilation time :					
Range	4-10 hrs		3-14 hrs		
Mean ± SD	6 ± 1.9 hrs		6 ± 3.6 hrs		
t test					**N.S**

N.S. = Statistically insignificant ($P > 0.05$)

Post-operative blood loss was significantly less in group I than in group II (250cc ± 85 versus 605cc ± 160) respectively with $p < 0.001$. One patient in group I had delayed cardiac tamponade and one had superficial wound infection. Two patients in group II required sternal rewiring one for mediastinitis and one for sternal nonunion. Also 4 patients had superficial wound infection. The whole incidence of wound complications was significantly less in group I ($P < 0.05$). We did not apply a measurable scoring system to evaluate postoperative wound pain or patient's convenience, however, all patients in group I were happy with their wound shape (Fig. 1). In group II, 10 patients were rather satisfied while 12 patients were unhappy or complaining of their wounds. Hospital stay was also significantly less in group I than in group II (5 ± 1.8 versus 8.9 ± 1.5 days) with $P < 0.001$.

Discussion

More than a century ago, Milton in Kasr El Aini hospital made this prophetic remark. "If it be established that median thoracic incision is a fairly safe procedure, 1 have no doubt that it will constitute the most generally useful route to the thoracic organs. And if once safe route is established, a great field for surgical interference lies open". He also added " heart surgery is still in its infancy, but it requires no great stretch of fancy to imagine the possibility of plastic operations in some, at all events, of its valvular lesions. (14) It took cardiac surgeons more

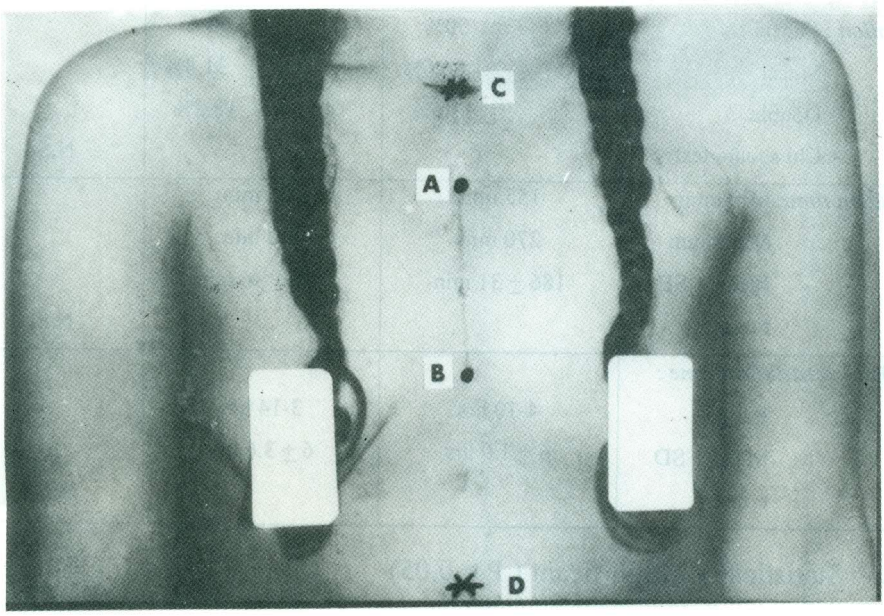

Figure (1) : Post operative photograph shows the extent of upper mini-sternotomy (a & b) compared to the standard median sternotomy (c & d)

than 5 decades to make this prophecy true. Since the early 1950s, median sternotomy and cardiopulmonary bypass and then myocardial protection were the milestones in modern cardiac surgery (15). Recently the concept of less invasiveness is rapidly increasing. Laparoscopic, thoracoscopic and port access video assisted operations became possible.

Heart valve surgery has been traditionally performed through full median sternotomy. However one must remember that the aortic valve lies behind left third intercostal space and the mitral valve is just behind it. Also a good part of the right atrium, ascending aorta and superior vena cava all lie behind the upper half of the sternum. (16) It is quite clear that all these structures can be easily exposed via limited upper ministernotomy, hence cardiopulmonary bypass can be safety instituted, cardioplegia can be infused, surgical procedures of aortic or the mitral valves can be performed and deairing can be accomplished. In our limited experience, we didn't face any problem in any step of the operation. However, we admit that

passing the tape around the IVC is very difficult and can be done a lot easier and safer after going on bypass and emptying the heart. We noticed that the mitral valve can be visualized satisfactorily and replaced easily. The surgical field is really smaller than usual but enough for the job to be done.

Right parasternal incision with (10) or without (9) resection of the 3rd and 4 th costal cartilage's has been reported recently. However this approach may lead to paradoxical chest wall movement in this area. Tam et al., (11) reported recently upper ministernotomy without horizontal transaction of the sternum for primary aortic valve replacement but we think that this can lead to irregular fracture not only on right side but in both sides of the sternum. So far, we didn't have any injury to the right internal thoracic artery and we don't deny that this may happen but it is not serious. Proper deairing of the left side should be done patiently through aortic root. Operative transesophageal echocardiography is an important tool to ensure absence of air in the left side. This facility was available in some operations and we think it is helpful but not mandatory in this approach. likewise, the CO_2 beam poured into the surgical field is useful in reducing air embolism but not essential. Small defibrillating paddles are used to restore cardiac beating and can replace the defibrillator patches if not available.

We did not find statistically significant difference in the total operation time or period of artificial ventilation between both groups. No trial was made in this study to fast track patients but we believe that, with limited sternotomy, on table or early extubation can be accomplished and further study is needed to prove this point.

Postoperative blood loss was significantly less in group I. this can be explained by the lesser extent of sternotomy and mediastinal dissection with consequent less blood loss from sternal bone marrow and mediastinal tissues. Hospital stay was also significantly less in group I. This can be attributed to the significantly less incidence of wound complications and faster wound healing.

In general, UMS lets the surgeon work with some unease but definitely with enough exposure. So, why to open more while the operation can be performed through a much lesser cut? Meanwhile patients were much more satisfied with less suffering than patients with SMS. Inspite of having no measurable assessment scoring system we think that our clinical judgement is justified to show one of the benefits of this technique.

From this limited study we conclude that:

1. This approach is safe for straightforward aortic and mitral operations with enough surgical field without increased operative risk.

2. The benefits include, less blood less, less hospital stay and more patient's convenience.

References

1- Cordell AR and Ellison RG. Complications of intrathoracic surgery. Little, Brown and Company Boston. 1st ed. Chapter 35 p. 341-345; 1979.

2- Loop FD, Lytle BW, Gosgrove DM et al. Sternal wound complications after isolated coronary artery bypass grafting: Early and late mortality and cost of care. Ann Thorac. Surgery 1990; 49 179-187.

3- Cooley DA. Cardiac surgery. WB Saunders Company 1984; chapter 1 p. 12-20.

4- Hellman AA, lammermerier DE and Cooley DA. Management of the complicated sternotomy incisions. Texas Heart Institute Journal, 1989; 16: 11-14.

5- Bennetti FJ, Ballester C, Sani G et al Video-assisted coronary bypass surgery. J. Card Surg. 1995; 10 : 620-5 .

6- Subramanian VA, Sani G, Bennetti FJ et al. Minimally invasive coronary bypass surgery : a multicenter report of preliminary clinical experience. Circulation 1995; 92 (suppl) : 1645.

7- El-Fiky MM, Abdelfallal S Khalil K et al. Minimally invasive direct coronary artery bypass (MIDCAB). J. of Egypt Society of Cardiothoracic Surg. 1996; Vol IV No 3; 7-14.

8- Minale C, Reifschneider HJ, Schmitz E et al. Single access for minimally invasive aortic valve replacement. Ann. Thorac. Surg. 1997; 64 : 120-3.

9- Cosgrove DM and Sabilc JF. Minimally invasive approach for aortic valve operations. Ann. Thorac. Surg. 1996; 62 : 596-7.

10- Navia J Land Cosgrove DM. Minimally invasive mitral valve operations. Ann. Thrac Surg. 1996; 62 : 1542-4.

11- Tam RK, Garlick RB, Almeida AA et al. Minimally invasive redo aortic valve replacement. J. of Thorac cardiovasc. Surg. 1997; 114 : 682-683

12- Chitwood WR, Elbeery JR, Champan WH et al. Video-assisted minimally invasive mitral valve surgery : The "Micro Mitral" operation. J. of Thorac. and Cadriovasc Surg. 1997; 114 : 413-414.

13- Kirkwood BR. Essentials of medical statistics. Blackwell scientific puplications Oxford 1988, chapter 3 & 7.

14- Milton H. Mediastinal surgery. Lancet 1897; 1 : 872-5.

15- Lytle BW. Minimally invasive cardiac surgery. J. of thorac. cardiovasc. Surg. 1996; 111 : 554-5

16- Smith JW, Murphy TR, Blair et al. Textbook Regional Anatomy Illustrated. 1983. Churchill Livingstone. 1 st ed. P. 170.

Hemodynamic Performance of Aortic Homograft Versus Bileaflet Aortic Prosthesis Size 23mm or More, Compared to Normal at Rest and with Exercise

ABSTRACT

Superior hemodynamic performance (HP) of aortic homografts (AH) over any prosthesis in small sizes is well known. However, this advantage in larger sizes is undefined yet. This study was designed to evaluate (HP) of (AH) versus Bileaflet Aortic Prosthesis (BAP) in patients with annular size 23mm or more. All patients were asymptomatic at evaluation time 12-15 months after operation. Doppler-echocardiography was performed for evaluation in the 2 groups at rest and with exercise. Normal control group was also evaluated similarly as a reference group. Group I (AH) had significantly less rest trans-aortic mean (5.6 ± 1.5mmHg) and peak (9.7 ± 1.9mmHg) gradients than is group II (10.2 ± 4.1) & (20.2 ± 6.7mmHg) respectively with p < 0.001. Effective orifice area (EOA) and EOA index were significantly bigger in group I (2.98 ± 0.19 cm2 & 1.62 ± 0.1 cm 2/m2) versus (2.63 ± 0.22cm2 & 1.41 ± 0.09cm 2/m2) respectively in group II with p < 0.001. Immediately after exercise, group II showed significantly higher mean (19.2 ± 7.8mmHg) and peak (40.5 ± 13.8mmHg) gradients than group I (9.8 ± 2.6 and 16.6 ± 3.1mmHg) respectively with p < 0.0001. However exercise has caused significant increase in both parameters in both groups. Normal control group showed better HP with all indices with significant difference. We conclude that :

(1) Aortic homografts have superior HP over BAP at rest and in response to exercise even in sizes > 23mm. (2) even the homografts in such sizes could not match exactly with the performance of normal native aortic valves.

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INTRODUCTION AND AIM OF WORK:

Aortic homograft (AH) is the best valve substitute in small aortic annulus due to evident superior hemodynamic performance (HP) (1). Despite the fact that all prosthetic valves are stenotic to some extent due to the sewing ring, some stated that with a large annulus, hemodynamic factors are not critical in choosing the type of a valve . (2) In vitro testing of a valve substitute in a pulse duplicator doesn't always reflect its in vivo performance (3). Echocardiography has proved valid in evaluating the HP of different valve prostheses in vivo at rest and with exercise (4,5,6) Bileaflet prostheses (7) are known to have the best hemodynamics among artificial valves (4) .

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The purpose of this study was to define wether AH have a hemodynamic advantage over bileaflet valves in annular size 23mm or more or not?

Patients and Methods:

A total of 18 patients divided into two properly matched groups were studied to evaluate the HP of two types of aortic valve substitutes 12-15 months following AVR. All patients were operated upon between Jan. 1994 & Jan. 1996 by the same surgeon in Kasr El-Aini Hospital and fulfilled the following entry criteria: (1) the primary indication for AVR was isolated severe aortic incompetence (2) all patients received valves 23mm or more (3) all patients were asymptomatic at time of evaluation (4) all patient in sinus rhythm. (5) BSA within $0.2m^2$ around $2m^2$ (6) all patients showed normally functioning valves with echocardiographic regression of LV dimensions to normal or near normal range and normal L.V function. Evaluation was done by means of echocardiography 12-15 months following surgery under resting supine condition and immediately after maximum physiological exercise. Exclusion criteria included (1) any patient with associated valvular or coronary artery disease, (2) any patient with residual symptoms or (3) residual L.V enlargement or dysfunction and (4) age below 18 or over 40 or (5) beyond the allowed range of BSA.

Group I included 9 patients (6 males and 3 females) with AH and group II included 9 patients (5 males and 4 females) with bileaflet aortic prosthesis (BAP). The same evaluation protocol was applied to a group of 11 healthy volunteers matched for age, sex and BSA (group III). The last group served as a control group to have a reference to which both groups 1 & II can be compared in addition to inter group comparison. The number of patients in each group as well as the normal control was enough to perform statistical analysis.

Echo-Doppler Study :

Each individual underwent a complete two-dimensional, pulsed wave (PW), continuous wave (CW) and colour flow mapping (CFI) echo Doppler examination at rest as well as CW Doppler examination immediately after exercise. Echocardiographic imaging was performed using the standard parasternal, apical, subcostal and suprasternal views.

Hemodynamic evaluation of the aortic valve substitute analyzed 3 parameters.

(A) transvalvular gradient using CW transducer, multiple acoustic windows were used to record the spectral wave form across the aortic valve to identify the maximum jet. The modified Bernoulli equation (8) was used to calculate the peak pressure gradient. The mean gradient was calculated by averaging the instantaneous pressure gradient measured at 10 msec intervals. Three cardiac cycles were analysed in case of sinus rhythm. Peak and mean pressure gradients were measured at rest and after exercise.

(B) Aortic valve EOA was calculated using the continuity equation (9) EOA index was calculated by dividing the EOA by BSA.(C) Degree of aortic incompetence.

Exercise Protocol :

Patients and Normal controls were subjected to treadmill exercise testing according to Bruce protocol using

commercially available machine. They were exercised to maximal heart rate achieving at least 85% of the maximum predicted HR. Before the exercise, the site of optimal window for Doppler interrogation was marked on the chest wall. Each one was allowed to exercise to fatigue or submaximal heart rate and immediately shifted to the examination table for measuring the gradients.

Statistical Analysis :

Data were collected as means with standard error of the means. The F test was used to compare the means of different groups. The 3 groups were compared quantitatively through an analysis of variance (ANOVA). A " p" value of 0.05 was considered the limit below which the difference of the value would be statistically significant (10). To study the change of a parameter in relation to another, a simple linear regression test was utilized. Thus calculating the regression equation and the coefficient of correlation (r) in the corresponding degree of significance (p) (11). The student "t" test was used to compare the change of a parameter within the same group.

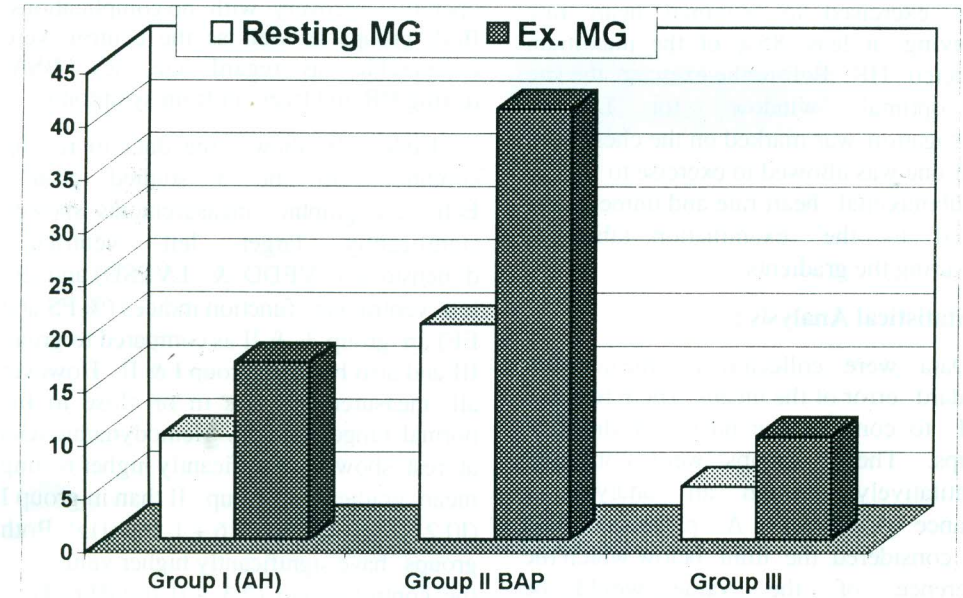
Results

Eighteen patients fulfilled the entry criteria for this study were operated upon by the same surgeon between 1994 and 1996 in Kasr El-Aini Hospital were divided into 2 groups according to the implanted aortic valve substitute. Nine patients of group I had aortic homografts, 5 as root replacement with coronary reimplantation and 4 as free hand homografts with 2 suture line technique. Group II (9 patients) received BAP (4 St. Jude and 5 carbomedics) by the conventional insertion method. Sizes of valves inserted are shown in table 1. All patients had smooth post operative recovery with no complications. Both groups as well as the control were comparable as regard age, sex, BSA, resting HR and freedom from symptoms.

Table (2) shows the data in resting condition in the 3 studied groups. Echocardiographic measurements showed significantly larger left ventricular dimensions (LVEDD & LVESD) and less left ventricular function indices (% FS and EF) in group I & II as compared to group III and also between group I & II. However all measurements lie in or close to the normal range (table 2). Hemodynamic data at rest showed significantly higher resting mean gradient in group II than in group I (I0.2 $\pm$ 4.1 versus 5.6 $\pm$ 1.5mmHg). Both groups have significantly higher value than the control group (2.3 $\pm$ 0.7mmHg). Peak systolic gradient was significantly less in group I than in group II (9.7 $\pm$ 1.9 versus 20.2 $\pm$ 7mmHg). Both were significantly higher than the control group (5 $\pm$ 1.3mmHg) with P <0.0001 in both parameters. There was a significant difference in EOA in group II than is group I (2.98 $\pm$ 0.19 cm^2 versus 2.63 $\pm$ 0.22cm^2) and both were significantly less than EOA of group III (3.23 $\pm$ 0.21 cm^2), with P<0.0001. Also, the EOA index was significantly bigger in group I than in group II (1.62 $\pm$ 0.1cm^2/m^2) versus 1.41 $\pm$ 0.09cm^2/m^2), and group III had significantly bigger values (1.71 $\pm$ 0.11 cm^2/M^2) than both with P <0.0001.

Effect of Exercise:

Exercise data are shown in table (3). There was no significant difference in either the exercise time or maximum heart rate among the 3 groups (p >0.05). Exercise mean gradient across aortic valve was



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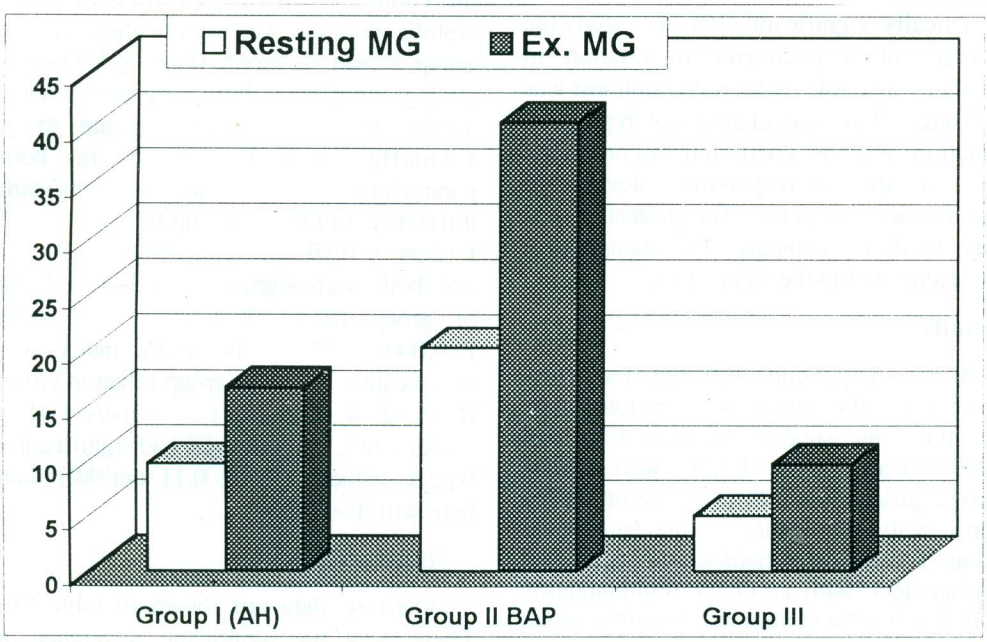

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Fig: 1-A : Shows the changes of mean gradient in response to exercise
Fig: 1-B : Shows the changes of peak gradient in response to exercise.
The changes were highly significant in all groups for both parameters.

Table (1) : Sizes of valves inserted in group I and II:

Group I (AH) = 9		Group II (BAP) = 9	
Size	*No.*	*Size*	*No.*
23/24	4	23	2
24/25	3	25	4
25/26	2	27	3

Table (2) : Shows the data at rest in the 3 studied groups

Parameter (mean ± SD)	Group I (AH) no = 9	Group II BAP no = 9	Control group III no = 11	ANOVA F	ANOVA p
Age	23.4 ± 4.77	23.89 ± 4.68	22.18 + 3.82	0.37	N.S.
BSA	1.85 ± 0.07	1.91 + 0.16	1.89 + 0.06	0.73	N.S.
Resting HR	68.22 ± 2.39	70.11 + 8.02	71.55 + 7.23	0.66	N.S.
Resting MG	5.56 ± 1.51•□	10.19 + 4.09•□	2.28 + 0.68••	25.76	<0.0001
Resting PG	9.72 ± 1.91•□	20.2 + 6.97•□	5.02 + 1.34••	34.91	<0.0001
LVEDD	5.48 ± 0.48•	5.7 + 0.21•	5.04 + 0.36••	8.61	<0.001
LVESD	3.63 ± 0.4•□	3.97 + 0.16•□	3.2 + 0.26••	17.48	<0.0001
FS %	33.11 ± 3.66•	30.33+ 2.35•	37.09 + 4.97 ••	7.34	<0.01
EF %	63.22 ± 4.06□	64.89 + 5.23•	71.0 + 2.93 ••	5.51	<0.01
EOA	2.98 ± 0.19•□	2.63 + 0.22•□	3.23 + 0.21••	19.98	<0.001
EOA index	1.62 ± 0.1•□	1.41 + 0.09•□	1.71 + 0.11••	23.39	<0.001

BSA = Body surface area **HR = Heart rat** **MG = mean gradient**
PG = Peak gradient **EOA = Effective orifice area**

Significant difference elicited between group I & II.
• Significant difference elicited between group I & III.
*** Significant difference elicited between group II & III.**

significantly less in group I than in group II (9.8 ± 2.6 mmHg versus 19.2 ± 7.8mmHg) while in group III, It was significantly less than both groups (4.2 ± 1.5 mmHg). Peak systolic gradient was also significantly less in group I than in group II (16.6 ± 3.1 versus 40 ± 13.8 mmHg) while in group III showed less value (9.7 ± 3 mmHg) with p <0.0001 for both parameters.

The changes of mean & peak gradients in response to exercise within each group has been shown with its significance in Figure (1). Group II showed the highest elevation in response exercise. Both groups (I & III) also showed significant change with much less values.

There was a significant correlation between BSA an EOA only in group II

Table (3) : Shows the data or exercise test in the 3 groups

Parameter (mean ± SD)	Group I (AH) no = 9	Group II BAP no = 9	Control group III no = 11	ANOVA	
				F	P
Ex. Time	11.17 ± 1.12	10.78 ± 1.15	12.0 + 1.12	3.1	N.S.
Ex. HR	161.44 ± 4.88	164.0 + 5.12	166.0+ 5.25	1.98	N.S.
Ex. MG	9.83 ± 2.59•□	19.24 + 7.84*□	4.18 + 1.45•*	26.09	<0.001
Ex. PG	16.56 ± 3.05•□	40.5 + 13.84*□	9.65 + 2.99•*	38.51	<0.001

Significant difference elicited between group I & II
• Significant difference, elicited between group III &
*** Significant difference elicited between group II & III.**

patients with r = 0.75 and p < 0.05 (Fig. 2). All other correlation data between BSA & EOA of other groups, EOA index, resting mean and peak gradients could not reach statistical significance. Correlation between exercise HR and both exercise mean and peak gradients were insignificant. There was also insignificant correlation between EOA and EOA index and both exercise mean and peak gradients.

Trivial aortic incompetence was found in 5 patients in group I and in 6 patients in group II (insignificant difference) [6].

Discussion

Hemodynamic performance (HP) is one of the important factors in choosing a valve substitute for AVR. Bileaflet AP are known to have the best HP among all artificial prostheses. (2,12,13) Aortic homografts are superior to all other valve substitutes in small sizes (1). It has been thought that with bigger sizes, hemodynamic factors are not critical in deciding which valve to use assuming that all would offer satisfactory hemodynamics (2). Assessment of HP of a valve substitute was always done in vitro using pulse duplicator or clinically by cardiac catheterization or non invasively by Doppler-echocardiography in resting conditions (14,15,16) and exercise. We agree with others (3) that an effective orifice area of a valve can be acceptable for a patient but unacceptable for another due to different BSA and physical activity.

In this study, we tried to avoid any variable that may invalidate the results or weaken the conclusions due to lumping of different valve types or sizes or because of different original anatomical status of the replaced valve (stenosed or incompetent). So we compared the HP of AH versus BAP only in patients with pure severe aortic incompetence. These patients had no systolic outflow gradient preoperatively and they have rather large annuli allowing insertion of valves sized 23mm or more. Furthermore both groups were adequately matched as regards age, BSA, functional status and resting HR.

Doppler echocardiography has proved valid in assessing the HP of artificial valves. In this study, only one senior

cardiologist expert in echocardiographic imaging was responsible for the assessment to avoid interobserver variability. To minimize the effect of BSA as an important factor in correlation with EOA, entry criteria allowed a narrow margin of difference in BSA within 0.2 m^2 only. More importantly EOA index was calculated in cm^2/m^2, as a better evaluation of this parameter.

The significant difference found in left ventricular dimensions between group I & II as compared to group III should not be over estimated because the values are still either within or near normal range. Actually these values manifest a significant regression from preoperative values. The ventricular function indices were all within normal range.

Significantly higher resting mean and peak gradients in patients with BAP than AH and normals is explained by presence of the fixed obstruction imposed by the sewing ring at the aortic annulus. This inherited characteristic in the prosthetic valve design also explains the significantly less EOA & EOA index in this group compared to others. So, with constant cross sectional area the gradient will be primarily a function of stroke volume.

Although considerable data exist regarding the function of aortic valve substitutes at rest, few data exist regarding the response to exercise. In all instances, emphasis has been put on small sizes (14,15,16). To the knowledge of the authors, no data have been published to evaluate the HP of bigger valve sizes in response to physiological stress. To elucidate this aspect, we choosed the treadmill exercise test because it is more physiologcial than other techniques. Data after exercise showed that both patient groups achieved similar maximum HR and exercise time which were comparable to values achieved by the normal controls indicating again the adequacy of matching of the 3 groups. Similar results have been reported by Jaffe et al (14) but they found no significant difference in valve area.

In response to exercise, there was significantly higher mean and peak gradients in BAP group than AH and control groups. The changes of gradients from resting to exercise conditions were also significant within each group. However, the rise of gradients in group I and III in spite of being statistically significant, it was clinically comparable and was within the physiological range (17). On the other hand. higher values encountered in BAP group shifted this group into another category with some degree of left ventricular outflow tract obstruction.

The behavior of BAP at rest and in response to exercise, emphacise in our opinion and others (3), the critical extent of cross sectional area reduction inherent in prosthetic valves and the absence of functional reserve in these devices to accommodate additional flow even in big sizes.

The AH group shares the normal control group in maintaining the normal physiological function in the aortic root. Basically, there are two mechanisms in this respect. The first has been nicely shown (18), that during left ventricular systole, the extralength of the cusp tissue allows ballooning of its free edge towards the aortic wall and parallel to it allowing central unobstructed flow. More interestingly as previously demonstrated

that there is a significant increase of the diameter of aortic root by 16% during systole compared to diastole (19). That would accommodate the extra flow in response to exercise with much less increase in the gradients. However, there is still a significant higher gradients in AH group as compared with the normal control group. This can be explained by the fact that the 2mm rim of tissues at the donor homograft root offers some anatomical obstruction, nevertheless without fixing the annulus.

It should be born in mind that the homografts degenerate with time and they gradually loose their advantage of flexibility by thickening and calcification. Every effort should be made to delay this process as much as possible.

Conclusions : We conclude that aortic homografts have superior hemodynamic performance over BAP at rest and in response to exercise even in size 23mm or more. Even the homograft in such sizes could not match exactly with the performance of normal native aortic valves.

References

1.Bojar RM. Adult cardiac surgery 1992. Blakewell Scientific Publication p. 159.

2.Morgan RJ, Davis T and Fraker TD. The surgical clinics of North America 1985. Current status of valve prostheses. P. 699-720

3.Rahimtoola SH. The problem of valve prosthesis patient mismatch. Circulation 1979, 58 : 20-24.

4.Chambers J, Fraser A, Lawford P et al. Echocardiographic assessment of artificial heart valves. Br. Heart J. 1994, suppl. 71:6-14.

5.Chambers J, Deverall PB. Limitations and pitfalls in the assessment of prosthetic valves with Doppler ultrasonography. J. Thoracic Cardiovasc. Surg. 1992, 104: 495-501.

6.Van-den Brink RB, Verheul HA, Visser CA et al. Value of exercise Doppler echocardiography in patients with prosthetic or bioprosthetic cardiac valve. Am. J. Cardiol. 1992, 69 (4): 367-72.

7.Yoganatban AP, Chaux A, Gray RJ et al. Flow characteristics of the St. Jude prosthetic valves : An in vitro and in vivo study. Artif Organs 1982, 6 : 228.

8.Currie PJ, Seward JB, Reeder GS et al. Continuous-wave Doppler echocardiographic assessment of severity of calcific aortic stenosis. Circulation 1995, 71 :1162-9.

9.Otto GM, Pearlman AS, Comess KA et al. Determination of the stenotic valve area in adults using Doppler echocardiography. J. Am Coll Cardiol. 1986, 7 :509-17.

10.Daniel WW. Biostatistics, a foundation for analysis in health science 1987. Wiley series in probability and mathematical statistics, USA.

11.Knapp RG and Miller MC. Clinical epidemiology and biostastics 1992. Horwall publish Co. Pensylvania.

12.Wang JH. The design simplicity and clinical elegance of the St-jude medical heart valve. Ann thoracic Surg. 1989, 48 (3 suppl) : 53-54.

13.Chafizadeh ER and Zoghbi WA. Doppler-echocardiographic assessment of St. Jude Medical prosthetic valve using the continuity equation. Circulation 1991, 83 : 213-223.

14.Jaffe WM, Coverdale AMB, Rocke AH. Rest and exercise hemodynamics of 20 to 23 mm allograft, Medtronic Intact (porcine) and St-Jude Medical valves in the aortic position. J. Thorac. Cardiovasc. Surg. 1990, 100 : 167-174

15.Izzat MB, Birdi I, Wide P et al. Comparison of hemodynamic performances of St-Jude and carbomedics 21 mm aortic prosthesis by means of Dobutamine stress echocardiography. J. Thorac. Cardiovasc Surg. 1996, 111 : 408-15.

16.Arom KU, Goldenberg IF, Emery RW. Clinical outcome with small size standard St-Jude Medical valves implanted in aortic portion. J. Heart Valve Dis. 1994, 3 : 531-6.

17.Hall RJ and Julian DG. Textbook "diseases of the cardiac valves" 1989. Churchill Livingstone. P. 14-16

18. Edwards JE. Varieties of valvular heart disease. Pract. Cardiol. 1982, 8 : 117-135. Quoted from text "The aortic valve" by Emery R and Arom K (1991). Hanley & Belfus Inc. Philadelphia p.3.

19.Brewer RJ, Deck DJ, Capati B et al. The dynamic aortic root. J. Thorac. Cardiovasc. Surg. 1976, 72 (3): 413-417.

Standard Versus Low Pressure Fixed Carpentier-Edwards Mitral Bioprosthesis Valve: Long Term Performance

ABSTRACT

A retrospective analysis of the clinical and explant pathology data of 153 patients undergoing mitral valve replacement between 1980 and 1982 with either Carpentier-Edwards low pressure fixed valve (L) [99 patients] or with the Standard Carpentier-Edwards valve (S) [54 patients] was carried out.

Mean age was 60 ± 11 years for L and 60 ± 9 years for S and both groups were similar in preoperative characteristics. Moderate or severe left ventricular dysfunction was present in 28% of both groups. Coronary artery disease was present in 49% of L and 44% of S with combined coronary artery grafting done in 37% of L and 39% of S. Hospital mortality for the entire group was 6.5% (5% in L, 9% in S [NS]).

Follow-up was 99.3 % complete at a mean of 8.5 ± 4 years for L and 9.1 ± 4.4 years for S. Thirty-seven patients had their bioprosthetic valve explanted, 4 of whom are excluded from analysis because of an extrinsic cause of valve degeneration. The remaining valves are 11 (S) and 22 (L). Incidence of commissural dehiscence, tissue fibrosis, foreign body reaction, and collagen degeneration were of no significant difference. Both stenotic lesions(p=0.054) and cuspal tears (p=0.001) were less prevalent in L.

At 8 years, freedom from valve related events was 84.5% ± 4.2% in L and 84.5% ± 5.9% in S (NS); late survival was 67.4% ± 5% and 63% ± 6.9% (NS) respectively. Freedom from mitral valve reoperation was 90% for L and 87.8% for S. (NS). Valve type was not an independent predictor of survival, valve related events, or mitral reoperation.

We conclude that despite similar clinical results and durability of the low pressure and standard Carpentier-Edwards mitral bioprosthesis, low pressure fixed valves have a significantly lower incidence of cuspal tears.

Short-Abstract: A retrospective analysis of the clinical and explant pathology data of 153 patients undergoing mitral valve replacement between 1980 and 1982 with either Carpentier-Edwards low pressure fixed valves (L) [99 patients] or with the Standard Carpentier-Edwards (S) [54 patients] was carried out.

Follow-up was 99.3 % complete at a mean of 8.5 ± 4 years for L and 9.1 ± 4.4 for S. 33 explanted valves are studied , 11 (S) and 22 (L). Incidence of commissural dehiscence, tissue fibrosis, foreign body reaction and collagen degeneration were of no significant difference. Stenotic lesions(p=0.054) and cuspal tears (p=0.001) were less prevalent In L.

At 8 years, freedom from valve related events, late survival or mitral valve reoperation were all of no significant difference. Low pressure fixed valves have a significantly lower incidence of cuspal tears.

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INTRODUCTION

The popularization of the Hancock porcine bioprosthesis and Ionescu-Shiley pericardial bioprosthesis in the early 1970s heralded a new promise of an anticoagulation-free valve substitute with good hemodynamics and neglegible hemolysis. Though these features were a definite advantage over mechanical valve prosthesis, this category of valve had one common problem: limited durability (1). To address this critical issue, research focused on two main areas in valve development. First was improvement in structural design and, second biomaterial preservation. All commercially available bioprosthesis have used glutaraldehyde fixation for tissue preservation. Initially it was at high fixation pressure to evolve later on to low pressure, and ultimately to zero pressure fixation (2).

The concept of low pressure fixation for bioprosthetic valves was first introduced in the mid-1970s by Broom and has the advantage of preserving normal morphology of the collagen wave form (3). In porcine bioprosthesis, this is responsible for preserving leaflet elasticity by maintaining fibrosal ridges on the outflow side of the valve and optimizing the bending stresses and tissue flexibility Though these biomechanical properties are well documented in laboratory settings (3,4), little clinical evidence is available regarding the advantage of this method of tissue fixation (5,6). Standard and low pressure fixed Carpentier-Edwards bioprosthesis were evaluated for the implications of low pressure fixation on long-term clinical performance, including our data on explant bioprosthesis pathology to evaluate the effect of gluteraldehyde fixation pressure on mode of primary structural bioprosthesis failure.

Material and Methods

From January 1980 through December 1982, 153 patients underwent primary mitral valve replacement with Carpentier-Edwards bioprosthesis. Exclusion criteria included concomitant valve replacement at the same operation and those in whom a bioprosthesis replaced a previously inserted artificial mitral valve.

Table 1 lists the preoperative demographic and clinical data.

Fifty-four patients received a standard valve (S) and 99 patients a low pressure fixed valve (L). Mean age was 60 ± 11 years for L and 60 ± 9 years for S. Fifty-five percent of L group and 52% of S were males.

Preoperative predisposing risk factors included atrial fibrillation, hypertension, smoking, coronary artery disease, age > 65, peripheral vascular disease and left ventricular dysfunction. The etiology of mitral valve dysfunction was primarily rheumatic in both groups. Other pathologies included myxomatous degeneration, endocarditis and papillary muscle ischemia (Table 2).

Operative protocol was bicaval cannulation and ascending aortic cannulation with systemic hypothermia to 32°C and cold crystalloid antegrade cardioplegia in ail cases. In cases with combined coronary artery bypass grafts, distal anastomosis were performed before opening the left atrium.

Distribution of valve sizes in both groups did not demonstrate any statistically significant differences. Isolated mitral valve replacement was done in 50% of L and 49% of S (p=NS).The most frequent associated procedure was coronary artery bypass grafting (37 % of L and 39% of S).

Criteria for postoperative anticoagulant therapy included atrial fibrillation, whether chronic or recent, and refractory to cardioversion, enlarged left atrium and presence of a left atrial thrombus. Warfarin sodium was administered to 46% of L and 45% S at hospital discharge.

Thirty-seven patients had explantation of their mitral bioprosthetic valve. Three of these patients had active subacute bacterial endocarditis and a fourth had early degeneration of the bioprosthesis secondary to Whipples' disease. The remaining 33 cases were analysed .

A detailed pathological examination is available for 8 valves in the standard group (73%) and 16 valves in the low pressure group (72.7%) (N.S.).This includes gross examination of the valve and microscopic study for the presence of foreign body reaction, extent of calcification, and fibrosis. Photomicrography to evaluate extent of calcification was also done. In the remaining cases, preoperative echocardiographic and angiographic data and operative reports identified the lesion as mitral stenosis or mitral regurge, the presence and degree of calcification, and the location of cusp tears.

Follow-up

Follow-up was completed by either patient or physician contact and using a detailed questionnaire for present symptomatology, functional status, cardiac medications, need for hospitalisation, cardiac catheterisation, or reoperations.

Follow-up was 99.3% complete with a mean of 9.1 ± 4.4 years for L and 8.5 ± 4.0 years for S. (N.S.). Of the 143 hospital survivors, a total cumulative experience of 806 pt.years for L and 434 pt.years for S were available for analysis.

All patients that had their mitral bioprosthesis explanted secondary to structural valvular dysfunction were identified. Pathological data about these explants were available from pathology report, intraoperative description or echocardiographic finding.

Data analysis

Values are expressed as the mean ± the standard error of the mean unless otherwise noted. We used Pearson chi square analysis statistics for discrete categorical variables, student t-test for continuous variables, Kaplan-Meier actuarial survival curves and the Log- Rank statistics for survival analysis. Actual survival curves were performed as described by Starr & Grunkemeier (7). Factors predictive of freedom from valve-related events and for late survival were analysed using Kaplan-Meier method.

Significant factors were then entered into a multivariate stepwise Cox proportional hazards model to identify independent and additive variables including risk factors for reoperation for mitral valve explantation, freedom from valve related morbidity and mortality and for late survival. A two-tailed p value < 0.05 was considered to be statistically significant.

Results

Patient- characteristics

Both groups were homogenous when compared for differences in age , sex and preoperative functional class distribution. Group S had a higher incidence of smoking history compared to group L (54% versus 29%) [p= 0.003]. Differences in etiology of native mitral valve disease, relative incidence of regurgitant and stenotic lesions, left ventricular ejection fraction, atrial fibrillation, peripheral vascular disease, hypertension and diabetus mellitus did not reach statistical significance. (Table 1)

Early morbidity mortality and cause of death,

Hospital mortality was 5% of L and 9% of S [p=0.33]. The incidence of hospital morbidity including reexploration for bleeding, cardiac arrest, atrial fibrillation, cerebrovascular accidents, renal failure, and myocardial infarction is shown in Table 2 and did not show statistically significant differences between groups.

Valve related complications

Freedom from valve related events, specifically thromboembolic events, anticoagulant-related complications and prosthetic valve endocarditis were not statistically significant at 10 years [p = 0.12]. (Fig. 1).

Multivariate analysis could not identify valve type as an independent predictor of late valve related events. (Table 3).

Reoperations

Forty patients underwent reoperation. One patient had an aortic valve replacement one coronary artery bypass surgery and a third patient had a combined aortic valve replacement and coronary artery bypass surgery. Thirty-seven patients underwent mitral bioprosthetic valve explantation. In this group, structural dysfunction of the mitral bioprosthesis was identified in 22 of 24 from L group and 11 of 13 from S group. The remaining patients with explanted valves had nonstructural valve dysfunction.

Gross pathological study of the specimens revealed tears in one or more of the cusps in 6 of 22 patients (27.2%) in group L and 9 of 11 (82%) of group S [p=0.001]. Similarly patients in the low pressure group had a higher incidence of stenotic lesions compared to the standard group. (45.5% versus 9%) [p=0.054]. Incidence of calcific degeneration and leaflet dehisence was not statistically significant between the two groups. Microscopic examination failed to demonstrate a significant difference between the two groups in terms of fibrosis, collagen degeneration, or foreign body reaction. (Table 4).

Actuarial incidence of reoperation for structural bioprosthesis deterioration at 10 years (late freedom from explant) was not significantly different between the two groups [p = 0.46]. (Fig. 2). Multivariate analysis could not identify valve type as an independent predictor of reoperation for mitral valve rereplacement. (Table 3).

Actual freedom from bioprosthesis explant using parametric (Weibull) predictors to 15 years did not demonstrate any statistically significant difference between the two groups. (Fig. 3).

Table (1): Preoperative demographic and clinical data.

	Low pressure.		Standard		P value
	N	%	N	%	
Female sex	45	45	26	48	0.75
Age>65	38	38	18	33	0.54
Smoking	29	29	29	54	0.003
D.M.	9	9	6	11	0.65
Hypertension	20	20	8	15	0.41
A. Fibrillation	38	38	18	33	0.54
P.V.D.	15	15	10	19	0.59
L.V.F.					0.85
normal	31	35	21	41	
mild	33	38	16	31	
moderate	19	22	12	24	
severe	5	6	2	4	
C.A.D.	49	49	24	44	0.55
Native mitral V.path.					0.46
Rheumatic	42	43	31	57	
Degen.	37	38	14	26	
Ischaemic	9	9	6	11	
S.B.E.	5	5	0	0	
Others	4	4	3	6	
Native mitral V. functional status:-					
Regurge	88	89	45	83	0.33
Stenosis	37	37	26	48	0.2

Table (2): Hospital morbidity and mortality:

Hospital morbidity and mortality.

	Low pressure.		Standard		P value
	N	%	N	%	
Hospital mortality.	5	5	5	9	0.33
Morbidity:					
Reexploration.	5	5	0	0	0.16
C.V.A.	7	7	4	8	N.S.
Acute M.I.	0	0	1	2	N.S.
Renal failure.	4	4	2	4	N.S.
Cardiac Arrest.	3	3	3	6	N.S.
Wound.	2	2	2	4	N.S.
A.F. on discharge.	43	45	23	48	N.S.

Table (3): Cox regression models:

Cox regression models.

	Late Survival.		Freedom from explant.		Freedom from morbidity & mortality.	
	RR	P value	RR	P value	RR	P value
C.A.D.	2.1	0.004			1.9	0.003
Age > 65.	1.9	0.005	0.33	0.039	1.5	0.038
D.M.	2.7	0.003			2.4	0.008
Use of Low Pressure Valve						
*adjusted	1.0	0.89	1.1	0.46	1.1	0.44
*unadjusted	1.0	0.81	1.2	0.29	1.0	0.81

Table (4): Explant Bioprosthesis Pathology.

	Standard N=11	%	Low pressure N=22	%	P Value
GROSS PATHOLOGY:					
Calcification.	5	45%	14	61.0%	NS
Stenotic lesions.	1	9%	10	45.5%	0.054
Cuspal Tears.	9	82%	6	27.7%	0.001
Leaflet dehiscence.	2	18%	5	22.7%	NS
MICROSCOPIC PATHOLOGY:					
Tissue fibrosis.	6	55%	15	68.0%	NS
F.B. reaction.	5	45%	8	36.0%	NS
Collagen Deg.	7	64%	13	59.0%	NS

Table (5): Late follow-up data:

	Low pr. N	%	Standard N	%	P value
Events.					
NYHA fc III/IV.	2	2.1%	1	2%	NS
Arrhythmias	5	5.3%	5	10.2%	NS
Endocarditis.	2	2.1%	1	2%	NS
Cardiac cath.	23	24.5%	10	20.5%	NS
All reoperation.	26	27.7%	14	28.5%	NS
Causes of late deaths.					
Cardiac deaths.	34	68%	22	76%	NS
Sudden death	11		5		
? Cardiac death	6		3		
Arrhythmias	5		2		
CHF, cardiomyopathy	5		7		
Acute MI.	2		4		
Prosthesis failure	1		0		
Reop hospt mortality	4		1		
Non Cardiac.	10	20%	6	21%	NS
Malignancy	3		0		
Cerebral hge	1		2		
CVA	3		2		
Others	3		2		
Unknown.	6	12%	1	3%	NS

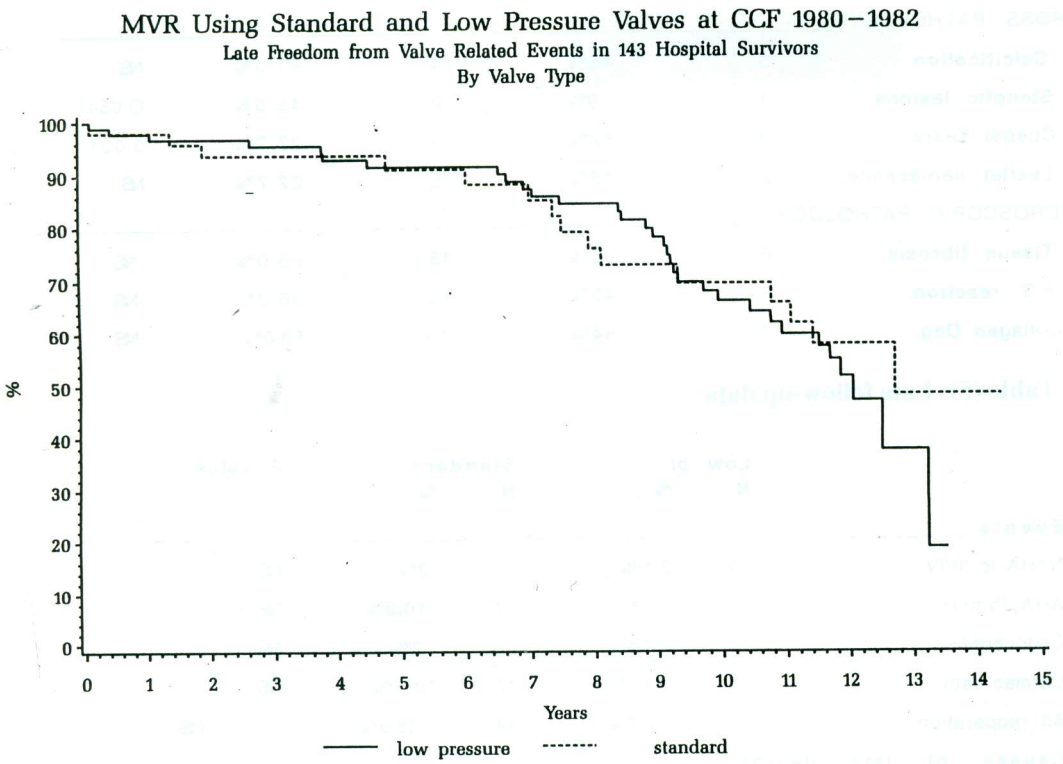

Fig. (1): Late actuarial freedom from valve related events.

Late events, survival and cause of death,

Late events and causes of late death analysis failed to detect any statistically significant differences between the two groups (Table 5). Multivariate analysis could not identify any independent predictor of late survival including the type of valve inserted (Table 3). Actuarial late survival at 8 years was 67.4% ± 5% for L and 63% ± 7% for S [p= 0.89]. (Fig. 4).

Comment

This study compared the long-term performance of two bioprosthetic valves that differed only in the gluteraldehyde fixation pressure used in processing. Degeneration of porcine bioprosthesis reflects mechanical failure of the cusp tissue to cope with the stresses of its new position. Previous studies of the Carpentier-Edwards valve have shown a higher incidence of structural dysfunction in the

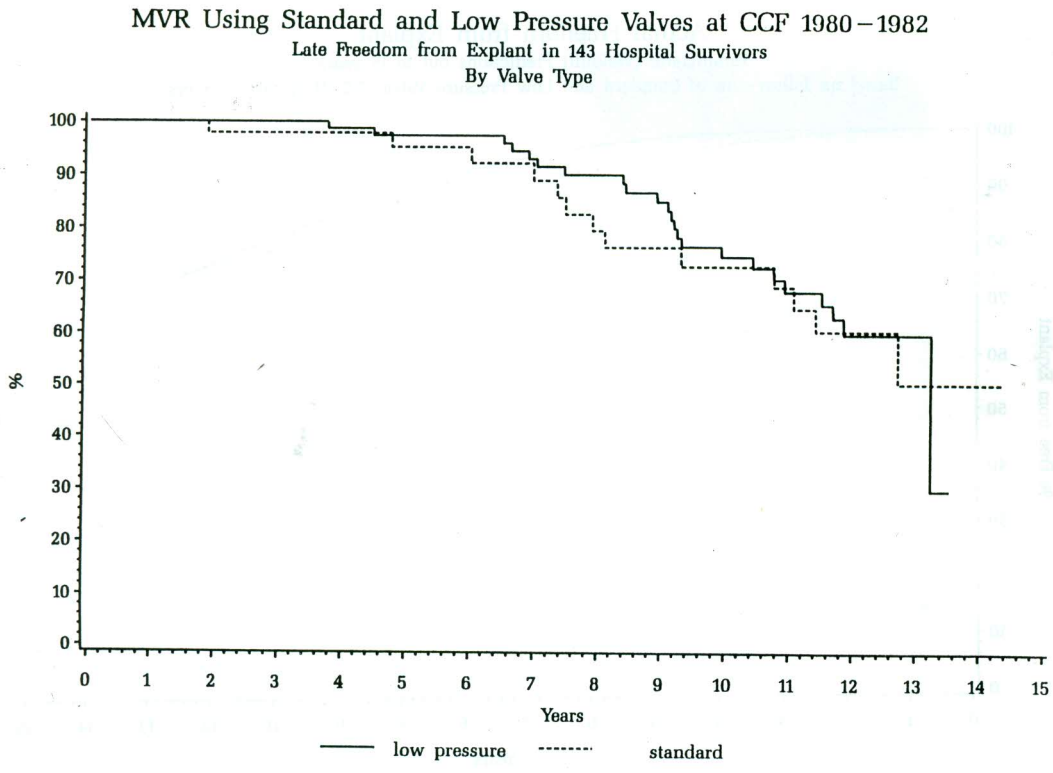

Fig. (2): Late actuarial freedom from bioprosthesis explant.

mitral position compared to the aortic position (8) . Exposure of the bioprosthetic valve in the mitral position to higher diastolic pressure generated at a right angle to the valve axis translates into a larger mechanical stress that sets the stage for degenerative changes. Because of the observed higher incidence of bioprosthetic valve degeneration in the mitral position, this study focused only on valves in this location to test the probability of structural failure.

Cases with associated valve replacement were excluded from this study not to confuse the haemodynamic settings of the implanted valve. While associated coronary artery disease negatively affects long-term survival of post-valve replacement cases (9), it does not directly relate to the structural integrity of the implanted valve and thus did not constitute an exclusion criteria .

Akins et al. demonstrated freedom from structural valve deterioration and from

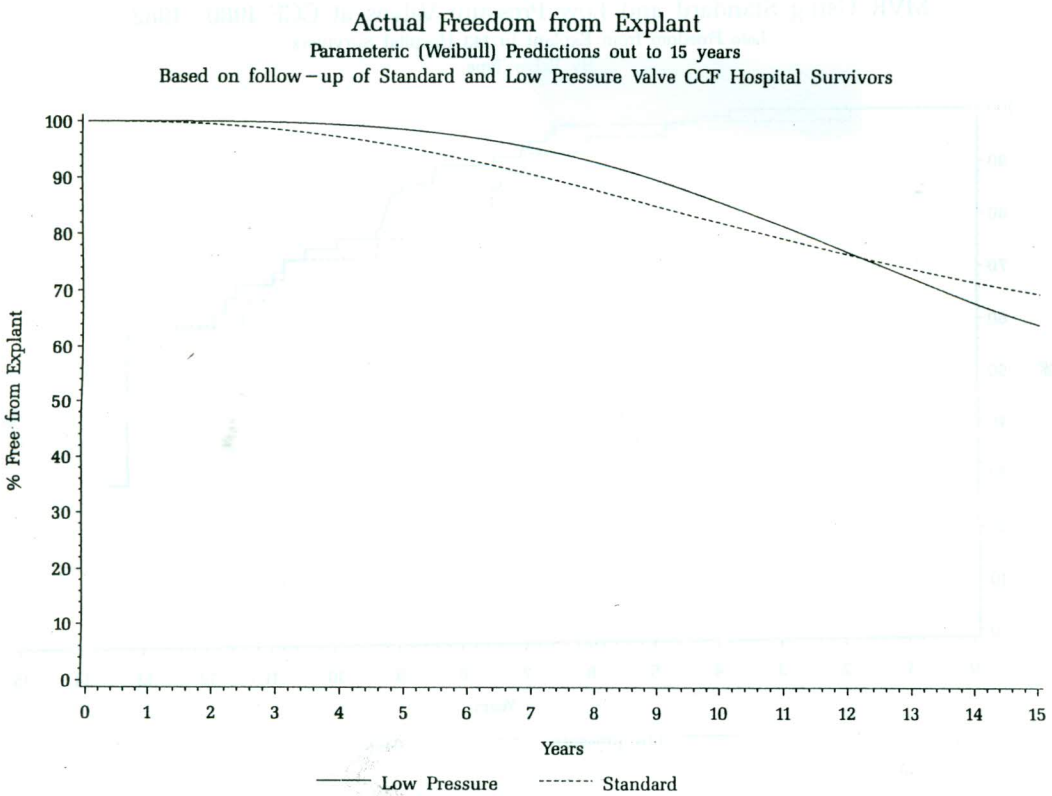

Fig. (3): Actual freedom from bioprosthesis explant.

reoperation for valve related dysfunction at 10 years of 75.1 ± 4.0% and 74.4 ± 3.7% respectively in the mitral position using S valves (10). Jameison et al. showed freedom from structural valve deterioration of 72.1 ± 4.9% in the mitral position using S valves (11). Other series have similar results (12,13,14,15). The results of these studies are concurrent with our results for the standard group.

The series from Deborah Heart and Lung center looked at a similar comparative study and noted no difference in either actuarial freedom from late valve related events or in actuarial survival between the groups. Actuarial freedom from structural valve failure at similar intervals was 97%, 68%, 39% at 5, 10 and 15 years respectively in S group vs 100% freedom in L group [p=0.131. Actuarial freedom from valve related death was

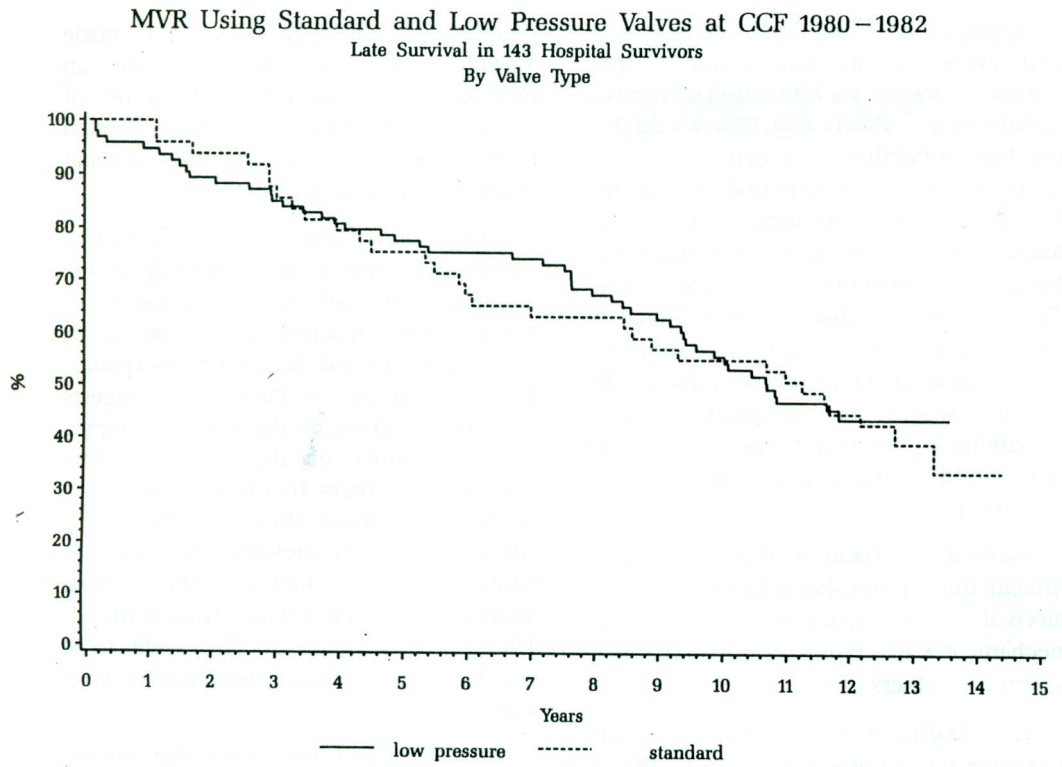

Fig. (4): Late actuarial survival.

96.9% and 93.7% at 5 and 10 years in the standard group vs 100% freedom in the low pressure group [p=0.23]. Reoperation for valve failure was not identified in L group (5). Since the ratio of patients in this study is 51/234 and the ratio of mean follow-up in months is 55/106 months with the larger numbers being of S group, the lower proportion of population at risk in term of patient-years in L group and their shorter period of follow-up may be responsible for the lower incidence of reoperation for valve failure and freedom from valve related deaths in their series.

Jameison et al., reported a large series of patients with either a supra annular or a standard CE bioprosthesis implanted in the mitral or aortic position. There was improved long-term performance of the supra annular valve in the mitral position in term of freedom from structural valve deterioration at 10 years though the difference did not reach statistical significance (74.5% ± 4.6% for supra annular vs 68.7% ± 2.8% for the standard valve) (6).

Application of actuarial studies to non-fatal events is an extrapolation of their original function for estimation of survival probabilities. Practically, they would thus test the probability of a certain event to occur over an unlimited period of time until this event happens . Actuarial curves censor death and generate an estimation error of the actual probability of an event to occur (7). This error is directly proportional to patients' age. For an event like structural degeneration of bioprosthetic valves, older patients would be assigned a higher probability of structural valve failure than they would normally live long enough to experience.

Method of fixation did not have a clinical impact on valve-related events, late survival or incidence of reoperation for mechanical valve failure. Similar data were reported by others (5,6).

Late leaflet tears have been reported in degenerating bioprosthesis (16,17,18). A higher incidence of cusp tears was highly significant in the standard fixation group. Macroscopic studies of cusp tears and perforation are well illustrated by Ishihara et al. who suggested classifying them in four categories (16). Most of the cusp tears in this series were related to the cuspal edge (type I) or next to areas of calcification (type IV). None was found parallel to the annulus perimetry (type II). The pathogenesis of cuspal tears has been the subject of multiple speculations. Grabenwoger et al. describes phagocytosis of collagen fibrils and elastic material by macrophages and foreign body giant cells around perforations and tears which indicates a possible role of an active foreign body reaction (17). Absence of lymphocytes in such a reaction made Valente and associate question an immunologic basis for degeneration of porcine bioprosthesis (19). The observed foreign body reaction may reflect a result rather than a cause of cusp tears.

Our data failed to substantiate a statistically significant difference in the incidence of collagen degeneration or foreign body reaction among the valves with cusp tears and the remaining explants. The distribution of cusp tears suggests mechanical stress as the possible culprit. The uniformity of the collagen fibers orientation confers to the cusp tissue its resistance to those stresses. One of the advantages of low pressure gluteraldehyde fixation is to maintain the normal morphology of the collagen wave form (3). The clinical correlate to this seems to be manifested as a lower incidence of cusp tears in L.

It was interesting to notice that stenotic lesions were more frequent with low pressure valve, though with only border line statistical significance. The cause for such an observation is not clear from our data. Whether the gradual deterioration in function in a stenotic bioprosthesis should be considered less detrimental to the patient compared to acute regurgitant lesions induced by cuspal tears is largely of hypothetical interest.

Study limitations:

The main limitation of this study is the small number of patient-years available for analysis. We elected not to increase our patient population from more recent years to minimize disparity in the duration of exposure to the risk of structural deterioration between the two groups.

Almost all CE mitral valves implanted in our center after 1982 were low pressure. It is possible that with a longer follow-up in a larger patient population, other clinical differences would become evident. This limited patient population prevents an analysis of results for different age strata. Previous series have documented different long-term results in the young with earlier calcification and in the elderly who seem to develop the least structural valve degradation (21,22).

Conclusion

We conclude that despite similar clinical results and durability of the low pressure and standard Carpentier-Edwards bioprosthesis in the mitral position in a comparable patient population, low pressure valves have a significantly lower incidence of cuspal tears. Whether this reflects a better preservation of the native tissues flexibility and pliability is speculative at the present stage. Further refinement in bioprosthesis preparation with zero pressure fixation and addition of calcification retardant are expected to improve long-term durability.

References

1. Schoen FJ. The first step to understanding valve failure:an overview of pathology. Eur J Cardiothorac Surg 1992; 6 (Suppl l): S 50-3.
2. Vesely I. Analysis of the Medtronic Intact bioprosthetic valve. J Thorac Cardiovasc Surg 1991; 101:90-9.
3. Broom ND and Thomson FJ. Influence of fixation conditions on the performance of gluteraldehyde-treated porcine aortic valves: towards a more scientific basis. Thorax 1979; 34 :166-76.
4. Broom ND. The stress/strain and fatigue behaviour of gluteraldehyde preserved heart valve tissue. J of Biomechanics 1977; 10:707-24.
5. Fernandez J, Chen C, Gu J et al. Comparison of low-pressure versus standard-pressure fixation Carpentier-Edwards bioprosthesis.Ann Thorac Surg 1995; 60: S 205-10.
6. Jameison WR, Burr LH, Tyers GI, Munro AI. Carpentier-Edwards standard and supraannular porcine bioprosthesis: 10 Year comparison of structural valve deterioration. J Heart Valve Dis 1994; 3:59-64.
7. Starr A and Grunkemeier GL. The expected lifetime of porcine valves. Ann Thorac Surg 1989; 48 : 317-8.
8. Schoen FJ, Levy R. Bioprosthetic heart valve failure: Pathology and pathogenesis. Cardiology Clinics 1985; 2:717-39.
9. Lytle BW. Impact of coronary artery disease on valvular heart surgery. Cardiology Clinics 1991;9: 301-14.
10. Akins CW, Caroll DL, Buckley MJ, Daggett WM, Hilgenberg AD, Austen WG. Late results with Carpentier-Edwards Porcine bioprosthesis. Circulation 1990; 82 (Suppl IV): 65-74.
11. Jameison WR, Rosado LJ Munro AI et al.Carpentier-Edwards Standard porcine Bioprosthesis: Primary tissue failure (Structural valve deterioration) by age groups. Ann Thorac Surg 1988; 46 : 155-62
12. Jones EL, Weintraub WS, Craver JM et al.Ten-year experience with the porcine bioprosthetic valve: Interrelationship of valve survival and patient survival in

1,050 valve replacements. Ann Thorac Surg 1990; 49:370-83.

13. Magilligan DJ jr., Lewis JW jr., Stein P, Alam M. The porcine bioprosthetic heart valve : Experience at 15 years. Ann Thorac Surg 1989; 48: 324-9.

14. Burdon TA, Miller C, Oyer P et al. Durability of porcine valves at fifteen years in a representative North American patient population. J Thorac Cardiovasc Surg 1992;103: 238-51.

15. Bolooki H, Kaiser GA, Mallon SM, Palatianos GM. Comparison of long term results of Carpentier-Edwards and Hancock bioprosthetic valves. Ann Thorac Surg 1986;42:494-9.

16. Ishihara T, Ferrans VJ, Boyce SW, Jones M, Roberts WC. Structure and classification of cuspal tears and perforations in porcine bioprosthetic cardiac valves implanted in patients. Am J Cardiol 1981;48:665-678.

17. Grabenwoger M, Grimm M, Eybl E, et al. New aspects of the degeneration of bioprosthetic heart valves after long-term implantation. J Thorac Cardiovasc Surg 1992; 104:14 - 21.

18. Pomar JL, Bosch X, Chaitman BR, Pelletier C, Grondin CM. Late tears in leaflets of porcine bioprosthesis in adults. Ann Thorac Surg 1984; 37: 78-83.

19. Valente M, Bortolotti U, Thiene G. Ultrastructural substrates of dystrophic calcification in Porcine valve failure. Am Pathol 1985; 119 (1): 12-21.

20. Rocchini A, Weesner KM, Heidelberger K, Keren D, Beherendt D, Rosenthal A. Porcine xenograft valve failure in children: An immunologic response. Circulation 1981; 64 (Suppl II): 162-71.

21. Curcio CA, Commerford PJ, Rose AG, Stevens JE, Barnard MS. Calcification of glutaraldehyde-preserved porcine xenografts in young patients. J Thorac Cardiovasc Surg 1981; 81: 621-5.

22. Jamieson WR, Burr LH, Munro AI, Miyagishima RT, Gerein AN. Cardiac valve replacement in the elderly: Clinical performance of biological prostheses. Ann Thorac Surg 1989; 48: 173-84.

Successful Conservative Management of Boerhaave's Syndrome

ABSTRACT

We report a successful conservative management of a case of Boerhaave's syndrome. This case was diagnosed on the third day after rupture of the oesophagus, and the management included double jejunostomy tubes technique with control of post-rupture right pleural empyema.

Herman Boerhaave's first described spontaneous rupture of the oesophagus in 1724 (1). Since then Boerhaave's syndrome has been associated with high mortality if prompt surgical intervention was not achieved. However, conservative management has been reported but the results were unsatisfactory (2).

Abdallah M; and Leverment J;

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CASE REPORT:

A 74 year old man was abroad when he experienced forceful vomiting and shortness of breath after drinking at a night party.

The following morning vomiting became frequent with respiratory distress and referred right shoulder pain. He was admitted to the local hospital, where he was resuscitated by oxygen, fluids and Dopamine. Subsequently, chest X-ray showed right pleural effusion, managed by thoracostomy which drained 1500 mls of turbid fluid. At this stage he had Cefuroxime as a prophylactic antibiotic.

The third day, thoracostomy tube recorded marked progressive increase in volume raising a great suspicion of spontaneous rupture of the oesophagus. Contrast esophagogram confirmed rupture of the middle third of the oesophagus into the right pleural cavity (Fig 1). The patient refused to have any further treatment away

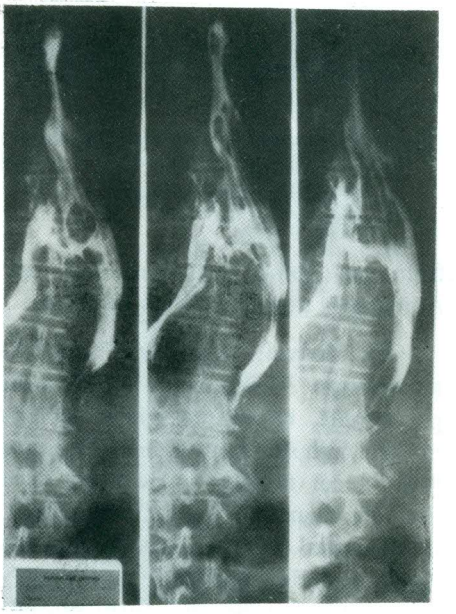

Figure 1: Contrast esophagogram (Third day-post rupture). Showing rupture middle third esophagus.

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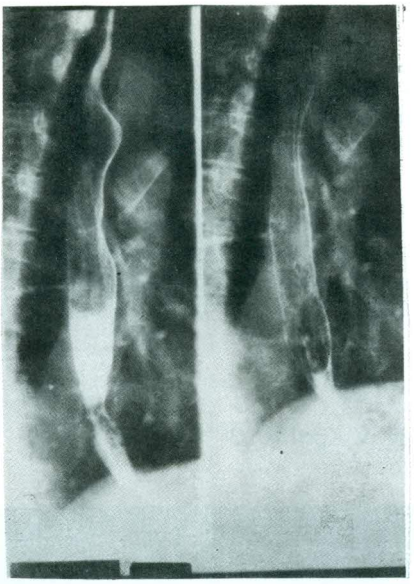

Figure 2: Niopam swallow (29th day - post rupture). Showing complete healing and no peak.

from his home, and requested an Air Ambulance transfer back to England.

On arrival, he was dehydrated, temperature 38.5°c, sinus tachycardia 115 per minute, blood pressure unstable 85/60 mmhg, with shortness of breath (respiratory rate 28 per minute). He had no air entry into the mammary and inframammary area of the right lung on auscultation, normal heart sounds and soft abdomen. The thoracostomy tube previously placed was partially blocked with unsatisfactory drainage. ECG, sinus rhythm with rate of 115 per minute. Blood gas was pco_2 38, p02 75, subsequent chest X-ray showed considerable pleural collection with retained contrast material and pneumonic patches in the lower and middle lobes of the right lung.

He was stabilized with oxygen, fluids, antibiotics (Erythromycin, Metronidazole, Cefuroxime intravenous), Nystatin and Ranitidine syrup orally, total parenteral nutrition and an additional chest drain sited posterolaterally. He became generally stable after 24hrs and accepted surgery. Double jejunostomy technique was done, the first jejunostomy to drain the duodenum, the stomach and the oesophagus, the second for enteral feeding when the bowel activity has been confirmed.

Five days after continuous total parenteral nutrition physiotherapy, changing of the antibiotics according to culture and sensitivity (pseudomonas aerogenosa, gentamycin) and two chest drains. Thick pus was still coming through the chest drains with temperature around 38°c. Serial chest X-rays denoted loculated empyema. Under general anaesthesia rib resection thoracostomy was done for drainage of the loculated empyema.

Three days later, total parenteral nutrition was replaced by enteral feeding after his remarkable progress.

Six days post-thoracostomy, niopam swallow showed residual oesophageal leak less than the previous serial niopam swallows. Therefore the same management continued.

On 29th post-oesophageal rupture, niopam swallow showed no leak (Fig 2). The patient improved psychologically particularly when he started drinking water sips 15 mls hourly increasing gradually

every day up to 120mls per hour followed by free fluids by mouth.

Five days later, enteral feeding was stopped completely when he became satisfactorily dependent on soft meals.

After another eight days, niopam swallow was without oesophageal leak. On the same day jejunostomy tubes were removed and he remained under observation with good care to the chest drain which was still draining 50-100mls a day.

Two days later, he has been discharged to be followed up regularly in outpatient clinic with chest drain collecting into a closed bag.

Three months after discharge, he recorded more improvement and again his niopam swallow without leak, and right lung fully inflated. Chest drain was kept in place as it was still draining about 50mls a day.

Two months later we were able to remove the chest drain and the patient carried on normal daily life.

Discussion

Spontaneous oesophageal rupture is a life threatening condition that requires early diagnosis and subsequent effective treatment. The presenting clinical picture of spontaneous oesophageal rupture can be confused with any acute chest, heart or abdominal problems (3). Even vomiting, chest pain with or without cervical emphysema which are mostly accompanied oesophageal rupture, need confirmative chest X-ray and contrast esophagogram which is still the most reliable diagnostic test (4). We prefer niopam to other radio-opaque materials in view of the less toxic effects on the mediastinal structures.

Therefore, early diagnosis within 24 hours is the optimal time for primary surgical repair. This surgical repair includes debridement of the site of perforation, followed by direct closure with enforcement using viable tissues. It has been found that primary repair has less mortality and morbidity than a conservative management which usually is done for late diagnosis (5). The high morbidity and mortality in conservative management is related to firstly inability to repair the oesophagus due to oedema, necrosis and subsequent contamination of the mediastinum and the pleural cavity. Secondly instability of the general condition of most of the patients (6,7,8).

Cameron et al reported two cases of spontaneous rupture oesophagus, both managed successfully without primary surgery (9). They suggested that non surgical management may be considered if the following criteria are met, disruption is contained in the mediastinum, the cavity drains back into the oesophagus, symptoms are minimal and there are only minimal signs of sepsis.

Troum et al reported another case surviving after management by conservative treatment (10). In such case, our patient met none of the camerons criteria. However, Pate et al (2) reported his experience with four patients over 30 year period treated without primary repair and all died.

In our patient we used our experience in managing similar cases with anastomotic leak by double jejunostomy technique, as well as a routine procedure of short and

long colonic or jejunal segment interposition in elective esophageal resection. The reason for using this technique, is to spare the stomach in case of the need for esophagogastrostomy. Under general anaesthesia midline subxiphoid labarotomy incision is usually used. The first jejunostomy to drain the oesophagus aimed to be about 8 inches away from the duodenojejunal junction. The tube (salum sump 18 FG) should be passed retrogradely up to the oesophagus through the stomach. The second jejunostomy aimed to be about 8 inches distal to the first one. The tube (salum sump 12 FG) should be pushed distally down the jejunum for feeding purpose. Both tubes come out from the jejunal stomas through a tunnel made by folding the antimesentric wall of the jejunum over the tubal wall and fixed by serosal interrupted stitches. Both tubes are kept in place until contrast esophagogram confirms complete healing of the oesophageal leak. In the period of tubal stay, the draining jejunostomy tube is left to drain by gravity. The feeding jejunostomy tube is being flushed regularly during total parenteral nutrition.

Inspite of the high mortality and morbidity which were recorded with conservative management of rupture oesophagus, some factors might have contributed to our patient survival. Firstly, proper management of the empyema. Secondly, the nutritional regime which was used for keeping the optimal daily caloric requirement without loss of weight, our patient has lost only two kilograms over the period of illness. Thirdly, the double jejunostomy technique which was used gives good results in our experience. Finally regular physiotherapy and psychotherapeutic support over the period of management are mandating.

Conclusion

Boerhaave's syndrome is a surgical problem related to wide spectrum of presentations, associated complications and the results of treatment which are difficult to predict. Each case should be managed on an individual basis.

Double jejunostomy technique, we have continued to use it in similar subsequent cases with excellent results. At present there are expensive commercially available gastrotomy/jejunostomy tubes which are introduced through the anterior stomach wall. This technique may interfere with the use of the stomach as a conduit if needed at a later date.

References

1. Henderson JAM, Peloquin AJM. Boerhaave revisited: spontaneous esophageal perforation as a diagnostic masquerader. Am J Med 1989; 86:559-67.

2. Pate JW, Walker WA, Cole FH Jr, Owen EW, Johnson WH. Spontaneous rupture of the esophagus: a 30-year experience. Ann Thorac Surg 1989: 47:689-92.

3. Sawyers JL, Lane CE, Foster JH, Daniel RA. Esophageal perforation: an increasing challenge. Ann Thorac Surg 1975; 19:233-38.

4. Pillay SP, Ward M, Caven A, Pollard E. Oesophageal ruptures and perforations: a review. Med J Aust 1989; 150:246-52.

5. Smyth AR, Wastell C. Spontaneous rupture of the oesophagus (Boerhaave's syndrome): delayed diagnosis and successful conservative management. J Roy Soc Med 1989; 82:498.

6. Patton AS, Lawson DW, Shannon JM, Risley TS, Bixby FE. Reevaluation of the Boerhaave syndrome: a review of 14 cases. Am J Surg 1979; 137:560-65.

7. Sealy WC. Rupture of the esophagus. Am J Surg 1963; 105:505-10.

8. Larrieu AJ, Kieffer R. Boerhaave syndrome: report of a case treated non-operatively. Ann Surg 1975; 181:452-54.

9. Cameron JL, Kieffer RF, Hendrix TR, Mehigan DG, Baker RR. Selective nonoperative management of contained intrathoracic esophageal disruptions. Ann Thorac Surg 1979; 27:404-08.

10. Troum S, Lane CE, Dalton ML. Surviving Boerhaave's Syndrome Without Thoracotomy. Chest 1994; 106:297-299.

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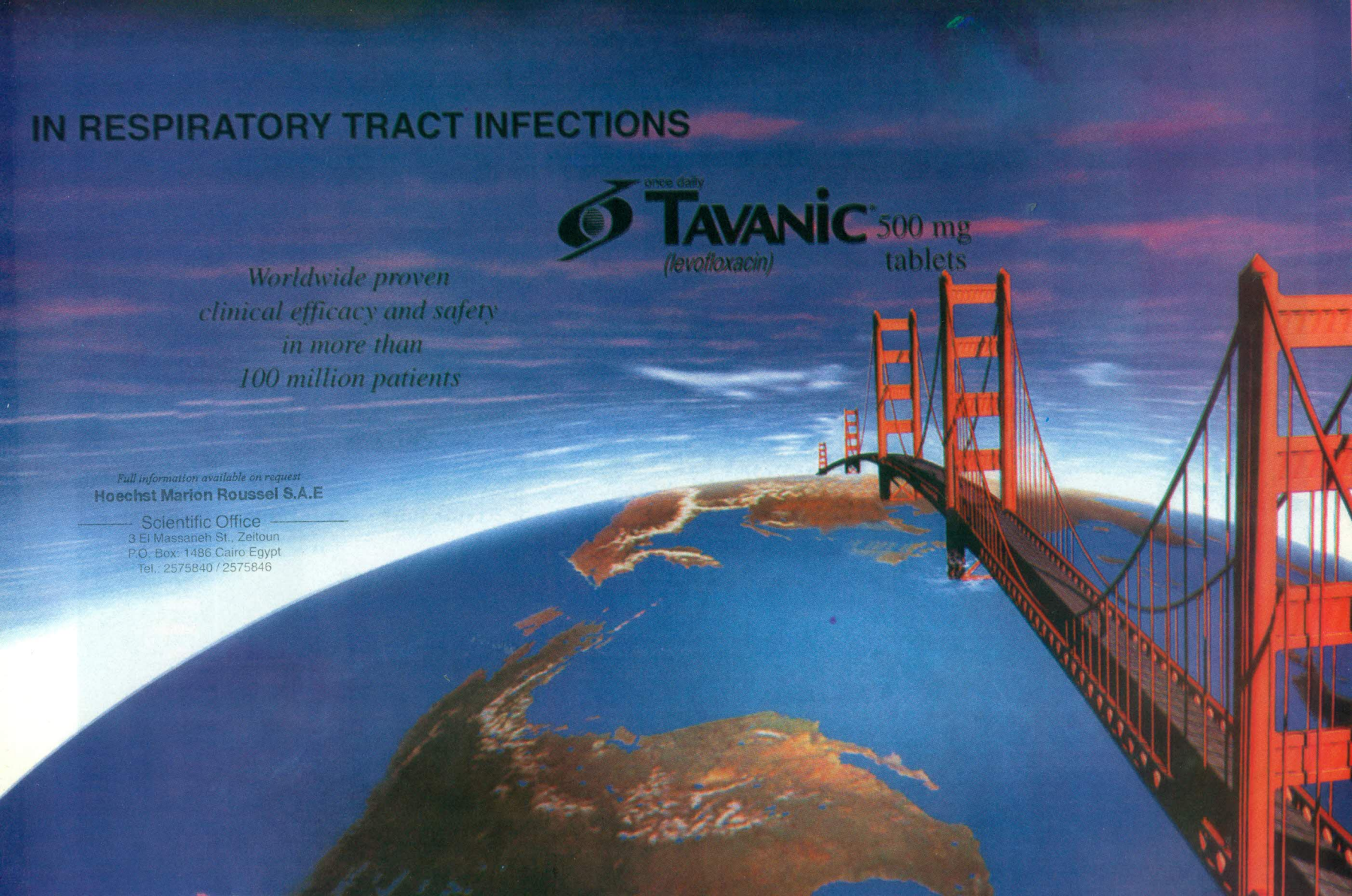
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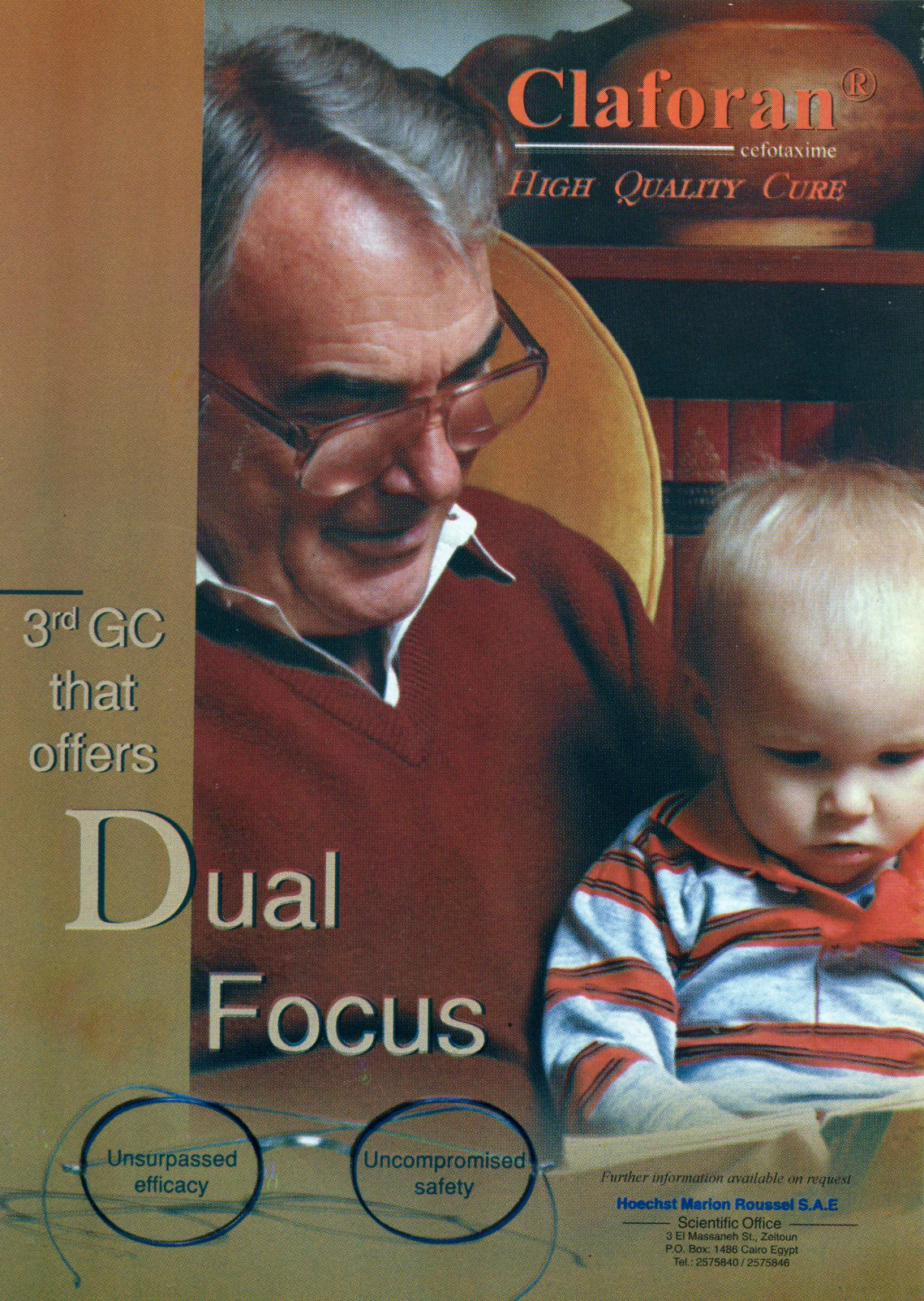

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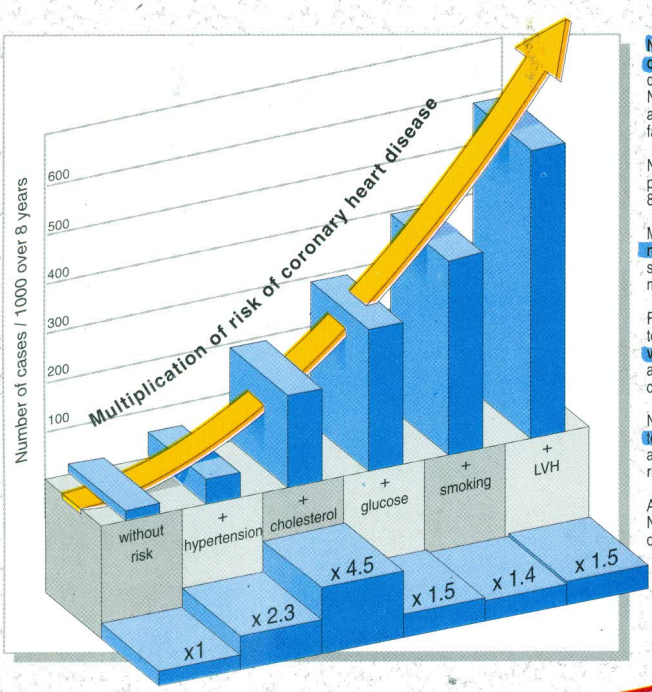

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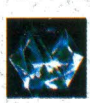
2. Leonetti G et al. *Am J Cardiol.* 1990; 65 (17): 67-71.
3. Raggi U et al. *Hypertension.* 1985; 7 (6) (Part II): 157-160.
4. Raftery EB et al. *J Cardiovasc Pharmacol,* 1993; 22 (suppl 6): 106-110.
5. Flack JR et al. *J Cardiovasc Pharmacol.* 1993; 22 (suppl 6): 75-77
6. Kannel WB. *Am J Hypertens.* 1991; 4: 283-287



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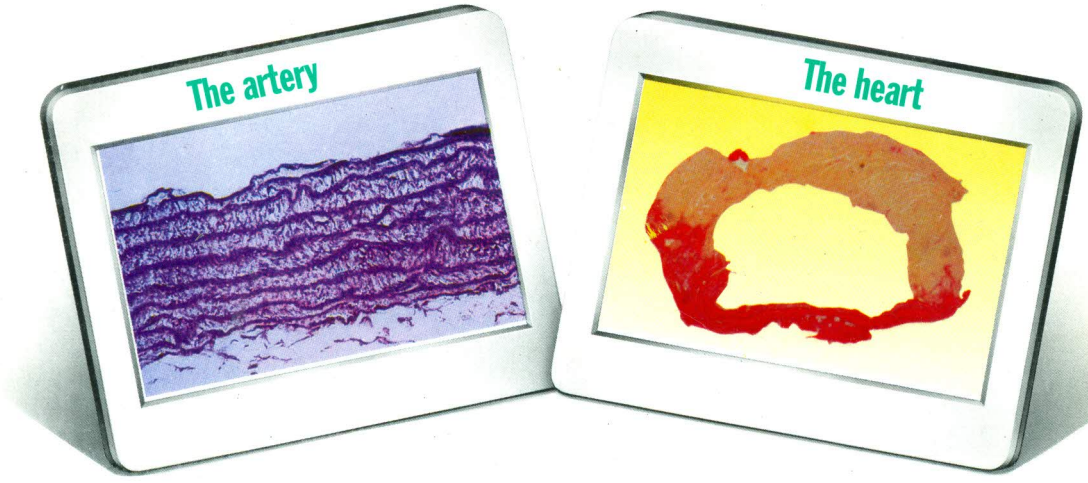

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5. MORGAN TO et al. *Am J Hypertens.* 1993; 6 : 116 A - 6. MAC FADYEN RJ et al. *Br Heart J.* 1991; 66 : 206-211.

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