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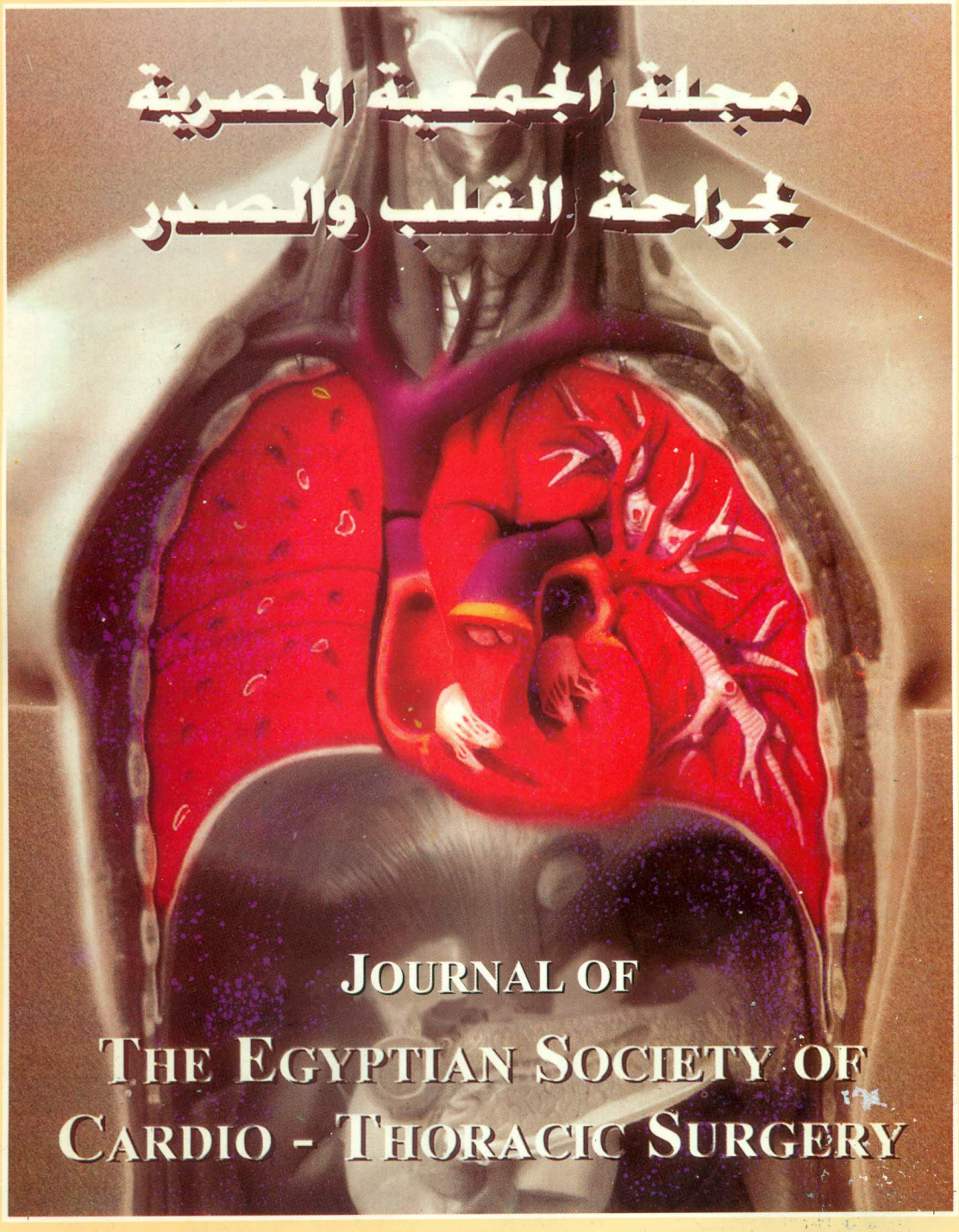

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MOHAMED EL FIKY

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

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EDITOR

MOHAMED EL FIKY.

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

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Minimally Invasive Direct Coronary Artery Bypass (MIDCAB): First Experience in Egypt

ABSTRACT

In Novemebr 1994, the results of the first clinical experience of Minimally Invasive Direct Coronary Artery Bypass (MIDCAB) was reported in literature (Benetti and Sani, 1994). Since then, a huge interest has emerged through the world to adopt, develop and apply this technique. We report in this paper the results of the first five cases performed in Egypt using this technique. Material: All five patients were males with a mean age of 52+9 years with grade III-IV angina. Three had totally occluded left anterior descending (LAD) coronary artery, one with 95% occluded LAD and one with totally occluded LAD and right coronary artery. Unsuccessful percutaneous intervention was performed at least once for all patients pre-operatively. Method: After careful pre-operative preparation special anaesthetic techniques, the left internal mammary artery (LIMA) was dissected through a small (8 cm) incision over the left fourth intercostal space anteriorly. After stabilization of the LAD, the LIMA was carefully anastomosed to it under direct vision. Patients were extubated one hour following surgery and the LIMA was selectdively catheterized in the first or second post-operative day. Results: All patients were discharged from hospital well and symptom free. One patient had an occluded LAD and was re-operated upon in the same hospital stay. The mean hospital stay was 4 days and all patients are still symptom free at a mean follow-up of 4 months following surgery. Discussion: The importance of learning this new technique by training cardiac surgeons is emphasized. This technique developed extensively in the last 2 years, it started to be considered in special situations as a technique intermediate between formal CABG and percutaneous intervention. It potentially offers the good long term results of formal CABG with very low risk. However, it has a definite learning curve and its long term results are not yet available.

M.M. El Fiky, Samia Abdel Fattah, Kawsar Khalil and Sayed El-Guizy

J. of Egypt. Society of Cardiothorac. Surg. 1996, Vol. IV July No 3

INTRODUCTION

The idea of anastomosing the left internal mammary artery (LIMA) to the left anterior descending coronary artery (LAD) on a beating heart is not a new one. The Russian surgeon kolessov in 1967 performed this anastomosis through a left thoracotomy without the use of cardiopulmonary hypass (CPB). He palpated the lesions in the LAD or the circumflex coronary arteries and performed the anastomosis with interrupted silk sutures achieving clinical. (1)

Between the years 1968 and 1975, intrest in performing CABG on a beating heart through median sternotomy and without CPB was shown by different enthusiastic groups (2-4) This interest was

** Cardiac Surgery Depatment-Ain-Shams University*
*** Anaesthesia Department - National Heart Institute*
$ Cardiology Department-National Heart Institute

then lost due to developments of more safe techniques of CPB and more effecient myocardial preservation.

In 1985, reports from two groups in Argentina (5) and Brazil, (6) revived intrest in performing coronary artery bypass grafting without the use of CPB. Their results suggested similar mortality and lower morbidity to patients performed with the help of the heart-lung machine.

In October 1994, at the International Symposium on myocardial protection held in Chicago, it was Benetti who suggested that CABG could be performed through a small left throracotomy without the help of CPB, (7). In November of the same year, at the International workshop on arterial conduits for myocardial revascularization held in Rome, Benetti and Sani demonstrated the clinical use of MIDCAB (8). During the same meeting, Subramanian (from New York) also presented his first clinical experience (9). Since then, many reports have been published by different groups about their experience, the largest series was published by the Italian surgeon Calafiore with the biggest world series (10).

Indications:

The primary indication for MIDCAB is single-vessel coronary artery disease involving the LAD and causing either significant proximal lesion or total obstruction with distal viable myocardium. The distal vessel should be well visualized in the angiogram. These patients usually complain from chest pain and they either had a failed percutaneous intervention or they are unsuitable for this kind of intervention (11)

This procedure can also be performed for patients with double-vessel or triple vessel disease if the LAD is the only decent target and the other vessels are peripherally diseased and unsuitable for grafting. These patients could be also offered hybrid therapy in the form of percutaneous intervention either before or after the MIDCAB (12).

Patients with obstructed vein grafts and need LIMA to the LAD could be offered a MIDCAB. The field in these cases is even more stable and the adhesions work for the advantage of the procedure (13).

MIDCAB could be also performed on the right side to target the right internal mammary to the right coronary artery or subxyphoid to target the right gastro-epiploic artery to the posterior descending coronary artery, (14).

Five male patients fitted the indications for MIDCAB. All patients were males with ages ranging from 35 to 60 years and mean age of 52+9 years. All patients were suffering from grade III-IV angina. Three patients had a totally occluded LAD; one patient had a 95% proximal lesion; and one patients had a totally occluded LAD and RCA with diseased and beaded PDA. All patients had at least one trial of percutaneous intervention with unsuccessful result.

Three of our patients were diabetic, one was suffering from famelial hypercholesterolemia. All patients were consented for MIDCAB, post-operative catheterization and possible formal CABG during the same hospital stay. Table 1 describe the pre-operative data for these patients.

Anaesthetic techniques:

All patients were heavly beta-blocked by atenolol orally pre-operatively and till the morning of surgery. A basal heart rate of 50-60 mmHg was achieved in all patients. Premedication was in the form of morphine 0.2 mg/kg 2 hours before surgery. All anti-anginal therapy was continued till the morning of surgery.

Induction of anaesthesia was achieved by midazolam 0.2 mg/kgm; fentanyl 10-15 ugm/kgm; propofol 1.5-2 mg/kg; and pancuronium 0.1 mg/kg. All patients were intubated with a single lumen endotracheal tube. The left lung was partially collapsed by the surgeon using a large abdominal lap to give him a satisfactory view. Maintenance of anaesthesia was by propofol continous infusion in addition to oxygen isoflurane mixture.

Monitoring of these patients was through a 5-lead ECG with ST analysis, finger-tip oxygen saturation, radial artery cannula with continious blood pressure monitoring. All patients had a tripple lumen central venous line and a urinary catheter. Control of heart rate was needed in two patients where verapamil and inderal intravenously were used to achieve this goal.

All patients were transferred awake but intubated to the ICU where they were extubated within one hour following surgery. Post-operative pain releif by non-steroidal anti-inflammatory together with small doses of pethidine were mandatory.

Table 1: Describes the pre-operative data for the 5 patients included in the study.

	E.A	N.M	H.H.	MA	S.A
Age (Yearss)	60	35	60	52	55
Sex	Male	Male	Male	Male	Male
Smoking	Ex-smoker	Ex-smoker	Ex-smoker	Ex-smoker	Ex-smoker
Diabetes	+ve	+ve	+ve	-ve	+ve
Hypercholesteroleamia	-ve	-ve	-ve	-ve	-ve
Precutaneous Interventions	4 times	4 times	Once	Once	Once
Angina grade	IV	IV	III	III	IV
LAD lesion	95%	95%	100%	100%	100%
Other vessels effected	Normal	100% RCA	Normal	Normal	Normal

Surgical techniques:

Patients were postioned and drapped as for formal CABG except for more exposure and slight elevation of the left hemithorax. The fourth rib was identified and an 8 cm incision was created over it starting 2 cms from the lateral border of the sterum. The pectoralis was split and part of the fourth rib was removed and the pleura entered. The pericardial fat was dissected carefully and moved towards the lateral side. The pericardium was opened vertically and the LAD was identified before any further dissection (11).

Dissection of the LIMA was then performed to reach the second intercostal space and clipping of its large intercostal branch there. Dissection was carried out one space below the incision. Heparin was then administrated systemically in a dose of 1.5 mg/kg. The LIMA was then divided, cannulated and verapamil injected intra-luminally. The flow was excellent in all cases (9).

The pericardium was then retracted using stay sutures to stabilize the heart. Two 3/0 problene sutures were then passed proximal and distal to the target point on the LAD. Tightening of the proximal snare for 3 minutes was then performed with careful monitoring of any haemodynamic changes or ST changes. Non of the patients experienced severe changes and the distal snare was then also tightened.

The LAD was then opened for 5 mms and a locally made stabilizer (figure 1) was held by the second assistant hand with its two limbs parallel to the LAD. The distal end of the LIMA was then fashioned appropriately and two 7/0 prolene sutures were used to complete the anastomosis. Three bites were taken at the heel and three at the apex of the anastomosis then the LIMA was parachuted down. The middle portions of the anastomsis were then completed under direct vision and the sutures tied. The snares were then relieved, the bulldog on the LIMA removed and the anastomosis was inspected. the pedicle of the LIMA was then secured in the epicardium (11).

Heparin was not neutralized except in one case. The epicardial fat was then brought forwards to cover the anastomosis. two redivac drains were then placed in the pericardial and pleural cavities and the wound closed in layers.

Patients were then transferred to the ICU intubated but all of them were extubated within one hour from arrival. They were not on intravenous medications except for clear fluid maintenance. They were allowed to sit on a chair the night of surgery and the redivac drains were removed the following morning. All patients were catheterized either the first post-operative or the second post-operative day except for one patient who refused.

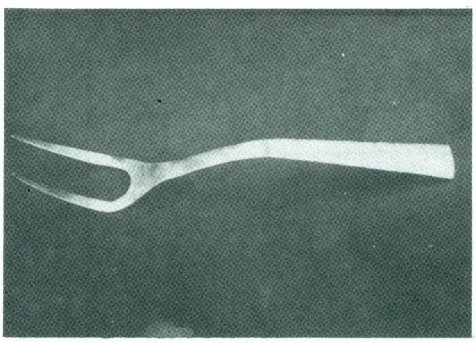

Fig. 1

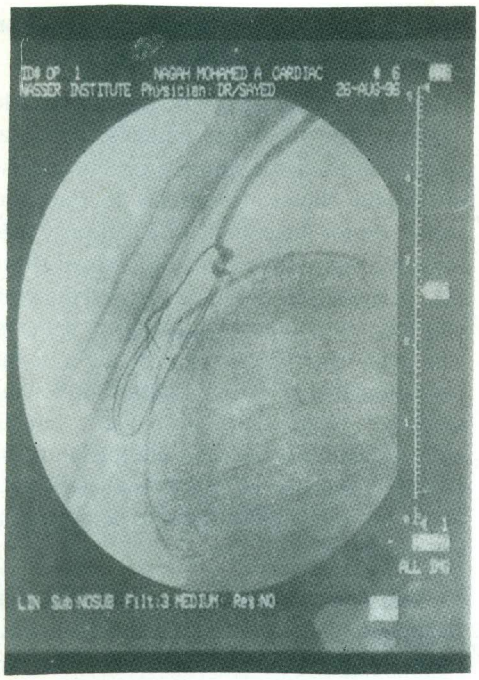

Fig. 2 a

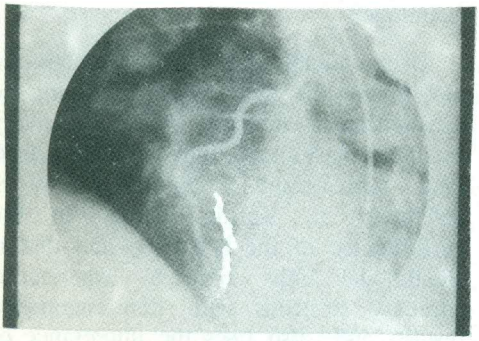

Fig. 2 b

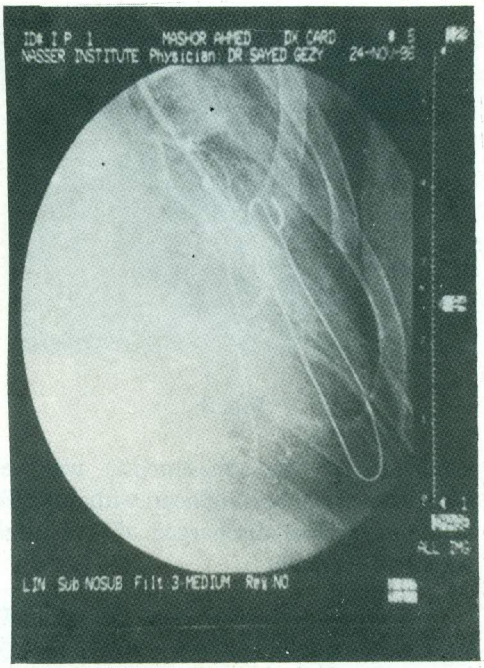

Fig. 2 c

Results

There were no hospital mortality. All patients were discharged from hospital symptoms-free within four days from surgery except one. The patient who refused catheterization was discharged 2 days post-operatively symptom-free. From the four patients who had their LIMA catheterized (Figure 2), one had a totally occluded LIMA and three had satisfactory results. The patient with occluded LIMA was re-operated upon on the second post-operative day and it was found that the LIMA was constricted by a tight pericardium with a thrombus in its lower inch. This was

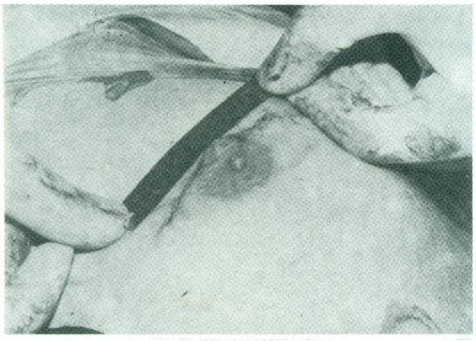

Fig. 3

trimmed and the anastomosis was re-fashioned on a beating heart without CPB. The patient was discharged after 1 week with no chest pain.

The mean operating time was 3 hours with a maximum of 4 and a minimum of 2 hours. None of the patients received blood transfusion. There was no wound infection. All of them were discharged from hospital only on beta-blockers and aspirin.

Discussion

At the international course on minimally invasive cardiac surgery held in Montreal, Calafiore presented the world's largest series of MIDCAB of almost 300 patients. This presentation set the standards for the results of MIDCAB in the present era. He had 3.3% incidence of conversion to formal CABG during the same sitting because of intramuscular or small LAD. He also had 3.3% incidence of graft occlusion and the need for redo surgery during the same hospital stay. He had 1% incidence of late graft failure necessitating surgery. At mean follow-up of about 9 months, he had 93% of the patients alive, asymptomatic and not on medical therapy (Calafiore, 1996). (12)

As for our results, we did not need to convert any of these patients to formal surgery in the same sitting probably because of careful choice of patients to start this series. As for the patient who had early redo surgery, this might be due to a small slit in the pericardium which constricted the graft and this was avoided in subsequent patients. The four patients catheterized are well and asymptomatic at mean 4 months following surgery. The patient who refused catheterization is missed from the follow-up probably because of fear of catheterization since he had a failed trials of percutaneous interventions.

The great enthusiasm about this new technique arises from the excellent long term results offered to patients who had their LIMA anasttomosed to the LAD using the coventional technique. The important question that we should address is whether we should wait until long term results of MIDCAB is documented or should we join in the making of the history of this technique?

Using suitable stabilization methods, the mobility in the field while performing the anastomosis is minimal which allows very accurate anastomosis thus predicting good long term results. However, there is defenitely a learing curve in the performance of the MIDCAB and that it should be only tried by experienced coronary surgeons with well established results and also rises the importance of catheterizing all the patients postoperatively to improve the technical aspects and treat early any complications.

Another important debate is the need for thoracoscopic assistance during the procedure. The only benefit from the thoracoscope is the ability to dissect the full length of the LIMA during the procedure to ligate all its branches and avoid the contraversal steel phenomena. There were sporadic cases reported in the literature of coronary steel, however, the importance of these reports are doubtful. First, the coronary flow is mainly diastolic while the flow through the side branches are mainly systolic. Second, the presence of a good distal coronary bed with no anasstomotic or distal obstruction ensures the avoidance of coronary steel. Third, Calafiore group only dissect the LIMA for a short distance and never hadd a patient suffering from a steel syndrome (Calafiore et al, 1996) (10) Our policy is to dissect the LIMA directly without the help of the thoracoscope but to make sure to clip the second intercostal branch because it is the biggest branch of the LIMA and because its release gives us adequate length.

Cost containument is not discussed extensively in the western literature, however, there is no doubt that the cost of a MIDCAB is only 20% of the total cost of the formal CABG procedure and negligable when compared to the cost of percutaneous interventions especially when a stent is used. This issue is of importance in our country as we would be able to offer the service to a larger portion of our population.

The appeal of a small incision to the patient should not be ignored (figure 3). At the present state, patient opt to be treated with percutaneous intervention modalities at a higher cost and with less reliable and predictable results than formal CABG just to avoid the large incision and cardiopulmonary bypass. The development of the MIDCAB techniques offers an intermediate phase for the patients to consider a cheaper less invasive way with more predictable results.

The development of an integrated approach to the coronary artery disease problem is the way to go in the future. When indicated, percutaneous intervention, MIDCAB or formal CABG should be integrated to offer the patient the safest, most reliable techniques with the best long term outcome.

Finally, the future generation of cardiac surgeons will have to become familiar with the minimally invasive procedure and not to wait for another 10-15 years until the long term results of these procedures are published.

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"Homograft" for Aortic Valve Replacement: Early Results

ABSTRACT

Since November 1994, 47 homograft aortic valves were harvested under semi-sterile conditions, kept in antibiotic solution for 24 hours and preserved at 4°C in tissue culture media for maximum of two months. Only 15 antibiotic-sterilized homograft aortic valves were used for aortic valve replacement in patients aged sixteen to thirty three years with maximum follow-up of 1 year period. Ten (67%) of the patients were female. The underlying pathology was rheumatic in 80% of patients. Seven patients (47%) had New York Heart Association class III functional status before operation and one patient (7%) underwent emergency operation. Freehand (subcoronary) technique was used in fourteen patients (93%) and free-standing root replacement with implantation of the coronaries in one patient (7%). Associated mitral reparative procedures were performed in seven patients (47%) including three patients (20%) with tricuspid valve repair as well. Hospital mortality was two patients (13%), one after emergency operation for bacterial endocarditis on a prosthetic valve and one associated with mitral and tricuspid valve repair. There were no late mortalities. Postoperative thromboembolic complications were not recorded inspite of no anticoagulation given routinely, except if associated with mitral valve repair and for a short period, or in the presence of atrial fibrillation. We conclude that, inspite of problems of procurement and availability, the homograft valves provide good alternative for aortic valve replacement, which in association with the reparative valvular procedures could minimise the need for anticoagulation with its well known sequelae in our patient population.

Nasser R. H. Rasmi., MD.

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Introduction

Since the original description of the "free-hand" (subcoronary) technique for homograft aortic valve replacement by Ross (1) and Barratt-Boyes (2) followed by the introduction of the technique of "free-standing" homograft aortic root replacement with re-implantation of the coronaries by Yacoub (3) and also Ross (4), these valves were increasingly used as a very attractive alternative to xenograft and prosthetic valves in aortic valve replacement. Homograft aortic valves offer many theoretic and proven advantages, which include restoration of normal flow in the aortic root, sinuses and coronary orifices; lack of thromboembolism and resistance to infection, (4-6). However, these valves have limited availability and durability which may restrict its widespread applications. Two of the most important determinants of durability are the methods of sterilization and preservation of the homograft. Chemical preservation using B propriolactone, irradiation (7,8) and freeze

Cardiothoracic Surgery Department. Kasr El Ainy Faculty of Medicine. Cairo University.

drying (9) were used in the past and discontinued because of their deleterious effects on the durability of the valves. The homograft commonly used nowadays are the antibiotic-sterilized (10-12) and the cryopreserved (13-15), both have improved the long-term performance of homograft valves. These valves are taken under semi-sterile conditions from cadavers and sterilized in antibiotic mixture solution and preserved in tissue culture media at 4°C in the former, while in the later cryopreserved in the vapour phase of liquid nitrogen (-196°C) until implantation, (16). The third type used is the "viable" homograft or homovital homograft with no sterilization as it is taken under sterile conditions from cardiac transplants recipients or brain-dead multiorgan donors and only kept in tissue culture media at 4°C, (17). The purpose of this article is to review our experience with a group of aortic homografts -harvested under semi-sterile conditions from routine post-mortem examinations, sterilized in an antibiotic mixture solution, then kept in tissue culture medium- used for aortic valve replacement over a period of one year to determine their short-term performance and to identify the homografts procurement difficulties, the surgical complexity of the procedure and associated mortality and morbidity.

Patients and Methods

Patients. (Table.I)

During a period of one year, from November 1994, 15 patients underwent aortic valve replacement with antibiotic-sterilized aortic homografts. At the time of operation the ages varied from 16 to 33 years (average 21 ± 5 years). Nine patients (60%) were aged 19 years or younger.

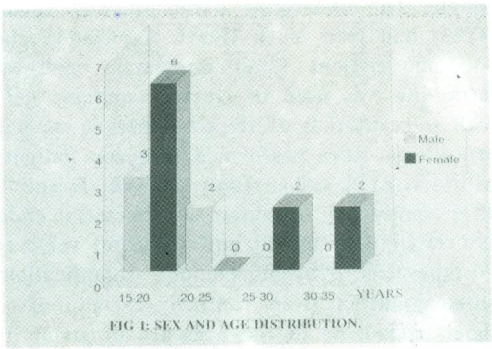

FIG I: SEX AND AGE DISTRIBUTION.

There were 10 females (67%) and 5 males (33%) patients, (Fig. 1). Rheumatic pathology was the aetiology identified in twelve patients (80%) and degenerative in two (13%) while bacterial endocarditis on a previously inserted prosthetic valve with aortic root abscess in one patient (7%). The indication for operation was aortic regurgitation in 13 patients (87%), and combined with stenosis in two patients (13%). Eight patients (53%) had isolated aortic valve disease, 4 (27%) had associated mitral valve disease and 3 (20%) had associated mitral and tricuspid valve diseases as well. Six patients (40%) had New York Heart Association (NYHA) functional class II status, 7 (47%) had class III status and 2 (13%) had class IV status, (18). The operation was performed electively in 14 patients (93%) and as emergency in one patient (7%). Cardiac rhythm was sinus in 13 patients (87%), while two (13%) had atrial fibrillation with an apical heart rate ranging from 75 to 100 beats/min. (average 86±5 beats/min). Cardiothoracic ratio index in chest X-ray

Table. I. Preoperative Patient Characteristics. *n=15*

Characteristics	*Measurements*	*%*
Age at operation (years)		
Average	21	
SD	5	
Range	16-33	
Sex (No.)		
Female	10	67
Male	5	33
Pathology (No.)		
Rheumatic	12	80
Degenerative	2	13
Endocarditis	1	7
Aortic Regurgitation (No.)		
Pure	13	87
Combined with stenosis	2	13
NYHA		
Class II	6	40
Class III	7	47
Class IV	2	13
Cardiothoracic ratio (%)		
Average	65	
SD	4	
Range	55-73	
Echocardiography:		
***LVEDD (mm)**		
Average	67	
SD	12	
Range	44-90	
***LVESD (mm)**		
Average	46	
SD	11	
Range	30-63	
***Fractional shortening (%)**		
Average	32	
SD	7	
Range	21-45	

Table. II. Homografts data. *n=47*

Characteristics	*Measurements*	*%*
Age at time of death (years)		
Average	46	
SD	14	
Range	15-65	
Sex (No.)		
Male	31	66
Female	16	34
Cause of death (No.)		
Cerebrovascular stroke	13	28
Haematemesis	9	19
Chronic renal failure	8	17
COPD	7	15
Ischaemic heart disease	6	13
Liver cirrhosis	4	8
Rejected and accepted homografts (No.)		
Hepatitis B or C positive	20	42
Bact.& Fung. cultures positive	6	13
Abnormal valves	4	9
Long storage	2	4
Healthy and Implanted	15	32
Death and implantation interval (days)		
Average	32	
SD	17	
Range	9-56	
Aortic annulus size (mm)		
Average	24	
SD	3	
Range	18-29	

ranged from 55% to 75% (average 65% ± 4%). Echocardiographic examination revealed a left ventricular end-diastolic diameter (LVEDD) ranging between 44-90 mm. (average 67 ± 12 mm.), a left ventricular end-systolic diameter (LVESD)

ranging between 30-63 mm. (average 46±11) and a fractional shortening index (FR%) ranging between 21-45% (average 32±7%).

Homografts data. (Table II)

Forty seven homograft valves were harvested under semi-sterile conditions from routine post-mortem examinations as soon as possible within 48 hours (average 25 ± 13 hours). The donors varied in age from 15 to 65 years (average 46 ± 14 years). There were 16 female (34%) and 31 male donors (66%). The commonest causes of donors death were cerebro-vascular stroke in 13 (28%), haematemesis in 9 (19%) and chronic renal failure in 8 donors (17%). Almost all causes of death were accepted other than systemic infection and malignancy. The valves were prepared for sterilization by trimming excess tissues leaving the intact valve ring, 1-2 cm of ventricular muscle, the anterior leaflet of the mitral valve, 0.5 cm of the coronary arteries, approximately 2.5-4 cm. of aorta above the coronaries or more and a small parts of the discarded aorta is kept for bacteriological check after sterilization. Prepared valves were washed repeatedly in sterile Ringer's solution and then placed in antibiotic mixture solution "Harefield solution" (19-21)- containing Carbenicillin 1gr., Cefotaxime 1gr., Gentamicin 80mg. and Amphotericin B 25 mg (without Polymyxin B 500.000 IU) -for 24 hours and then transferred and preserved in tissue culture media "199"-"Giblo BRL" Abbotsinch Industrial Scotland- at 4°C until implantation with an interval between death and implantation varied from 9 to 56 days (average 32 ± 17 days).

All harvested valves were seronegative for human immunodeficiency virus antigen, (100%). Valves were discarded because of seropositivity for hepatitis virus B of C antigens in 20 valves (42%), positive bacterial and fungal cultures in 6 valves (13%) and significant abnormalities such as naked eye calcification, cusp fenestrations or a congenital abnormality in four valves (9%). Two valves (4%) were also rejected due to long storage time for more than nine weeks. All implanted valves (32%) were seronegative for human immunodeficiency virus and hepatitis antigens and bacteriological and fungal culture free with an approximate internal aortic annulus diameter estimated visually and not with obturator for fear of damaging valve cusps ranging from 18 to 29 mm (average 24 ± 3 mm).

Operative procedures.

All patients were operated upon through median sternotomy. Extracorporeal circulation was established and myocardial preservation was achieved using moderate hypothermia at 28°C, topical hypothermia with cold saline at 4°C and injection of a cold hyperkalemic crystalloid solution in the coronary arteries ostia every 30 minutes. Freehand (subcoronary) technique was used in fourteen patients (93%) by means of a two-suture line technique with a lower interrupted and upper continuous suture line. A transverse aortotomy is made and extended onto the non-coronary sinus of Valsalva. The aortic valve is excised and the diameter of the outflow tract at the annulus of the aortic valve is measured using prosthetic valve calibration devices.

The size of homograft was chosen to match with the patient's aortic valve annulus with a diameter equal to or (ideally) 1 to 2 mm smaller than that of the patient's aortic valve annulus, (16,17). The septal myocardium and anterior leaflet are removed leaving 3 to 4 mm below the lowest point of aortic valve cusp attachment. The right and left aortic sinuses of the homograft are removed leaving 3 to 4 mm of homograft aorta as a convenient margin for suture attachment. The non-coronary sinus is left intact and the valve is placed into the aorta in anatomic position.

The free-standing root replacement technique with implantation of the coronary arteries was used in one patient (7%), (17,23,24), for root abscess due to bacterial endocarditis on a prosthetic valve, this patient underwent aortic and mitral valve prosthetic replacements one year before. The aortic homograft root was used intact and in anatomic orientation to completely replace the recipient's aortic root due to gross deformity, using simple unbuttresed interrupted sutures. The coronary arteries are mobilised along with a button of the surrounding aortic sinus to be anastomosed to the homograft using continuous suture. The repair is completed by end-to-end anastomosis of the distal end of the homograft to the recipient's aorta using continuous suture as well.

Associated procedures.

Associated mitral reparative procedures were performed in seven patients (47%) including three patients (20%) with tricuspid valve repair using DeVega suture annuloplasty technique as well. Assessment of the mitral repair was achieved using the bulb syringe technique with cold saline injections during the flaccid period and the intraoperative transoesophageal echocardiography (TEE) by 2D-echocardiography and Doppler colour flow with Ultramark 9-A system following cardiopulmonary bypass, (21).

Follow-up.

All patients were followed-up at our hospital with clinical, radiographic, electrocardiographic and echocardiographic examinations. Anticoagulation was maintained indefinitely in patients who had atrial fibrillation regardless the mitral valve annuloplasty technique, while, patients with sinus rhythm were anticoagulated for 3 months only if prosthetic ring annuloplasty was applied.

Results

Operative and Associated Procedures. (Table. III)

The average aortic occlusion time was 162±21 minutes (ranges 140 to 195 minutes), and the average total bypass time was 218±53 minutes (ranged 175 to 360 minutes). Associated mitral reparative procedures were performed in seven patients (47%) including three patients (20%) with tricuspid valve repair using DeVega annuloplasty technique as well. There was restricted leaflet motion of the mitral valve in 3 cases which were corrected by valve mobilisation using commissurotomy and resection of secondary chordae as well as separation of the papillary muscles. Leaflet prolapse was present in 2 cases for which shortening of chordae were done in addition to

Table. III. Operative Characteristics. ***n=15***

Characteristics	*Measurements*	*%*
Implantation technique (No.)		
Subcoronary homograft	14	93
Homograft root	1	7
Associated procedures (No.)		
Mitral valve repair	7	47
commissurotomy	3	
2nd chordal resection	3	
papillary ms. separation	3	
chordal shortening	2	
ring annuloplasty	2	
suture annuloplasty	2	
Mitral & Tricuspid valves repair	3	20
Emergency operation (No.)	1	7
Cardiopulmonary bypass time (minutes)		
Average	218	
SD	53	
Range	175-360	
Cross-clamp time (minutes)		
Average	162	
SD	21	
Range	140-195	

Carpentier-Edwards ring annuloplasty. Annular dilatation with normal leaflet motion was present in 2 cases which were corrected by Wooler suture annuloplasty, (31). The average reparative procedure was 2 per patient.

Mortality and Morbidity. (Table. IV)

The follow-up period extended from 1 to 13 months (average 7.6±4.8 months), and median of 9 months. There were two hospital mortalities (13%), both were females. One was a 33 years old who underwent mitral and aortic valve prosthetic replacement one year before and received homograft aortic root implantation and died intraoperative due to left ventricular failure. She was in a critically ill emergency status with aortic root abscess due to bacterial endocarditis, with massive inotropic support

Table. IV. Mortality and Morbidity. *n=15*

Characteristics	*Measurements*	*%*
Mortality (No.)		
Early	2	13
Late	0	0
Morbidity		
Prolonged Inotropics	2	13
Delayed mental recovery	1	7
Superficial wound infection	1	7

Table. V. Follow-up data of Survivals. *n=13*

Characteristics	*Measurements*	*%*
NYHA		
Class I	11	85
Class II	2	15
Diastolic murmur		
Grade I	2	15
Grade II	1	8
Echocardiography		
***LVEDD (mm)**		
Average	58	
SD	9	
Range	37-64	
***LVESD (mm)**		
Average	41	
SD	8	
Range	24-46	
***Fractional shortening (%)**		
Average	31	
SD	7	
Range	20-50	

pre-operatively. The second patient was an 18 years old who underwent homograft (subcoronary) aortic valve implantation associated with mitral and tricuspid valve repair, she died on the 6th postoperative day due to low cardiac output (LCOP). Both were in New York Heart Association (NYHA) functional class IV status. Aortic regurgitation was not present in both cases after implantation as recorded by TEE examination. There were no late mortalities.

Low cardiac output requiring prolonged inotropic support for more than one day was observed in 2 patients (13%) post-operatively. In one patient (7%) a superficial wound infection developed, which was treated with drainage and intravenous antibiotics. Delayed mental recovery was observed in one patient (7%) with no sequelae. Postoperative bleeding requiring reoperation were not recorded, and no thromboembolic complications or endocarditis occurred among survivals during the follow-up period, (0%).

Follow-up data of survivals. (Table. V)

Functional status was normal in 11 patients, (85%). Only 2 patients (15%) were in New York Heart Association Class II functional status and none were considered to be in class III or IV at time of follow-up. The 2 patients who died were not considered in the functional analysis.

Initially, valve competence at operation was assumed on the basis of good closing tap of the aortic valve, the absence of diastolic thrill, and good hemodynamics, especially normal aortic diastolic blood pressure. Intraoperative TEE was performed in 5 cases associated with mitral valve repair. No patient returned to cardiopulmonary bypass for repair of incompetent aortic homograft. Valve Competence was also evaluated by echocardiography before discharge from the hospital, and no patient was returned for operation.

At follow-up time, there were 2 patients (15%) having grade 1, and 1 patient (8%) grade 2 aortic diastolic murmur. Systolic murmurs were observed in 3 patients (23%) and aortic gradient did not exceed 10 mm Hg in any patient. Echocardiographic examination revealed a left ventricular end-diastolic diameter (LVEDD) ranging between 37-64 mm. (average 58± 9), a left ventricular end-systolic diameter (LVESD) ranging between 24-46 mm. (average 41 ± 8) and a fractional shortening index (FR%) ranging between 20-50% (average 31 ± 7%).

Discussion

The first aortic homograft was implanted in the subcoronary position in humans in 1962 by Ross (1) and in 1964 by Barrat-Boyes (2), who were working independently. The superiority of the homograft valves was extensively studied since then, in terms of both early and late results, and many surgeons considered it the valve of choice, (5-7,12-16,19-20,23-26). Inspite of that, there was a reluctancy in many developing countries to introduce this valve substitute, this was largely due to religious and social reasons. Rheumatic multivalvular heart disease constitutes the majority of the patient population in these countries, with the consequent decrease in

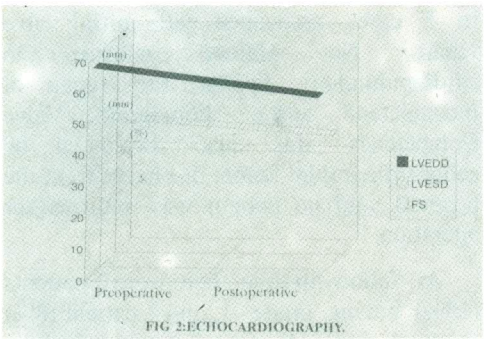

FIG 2:ECHOCARDIOGRAPHY.

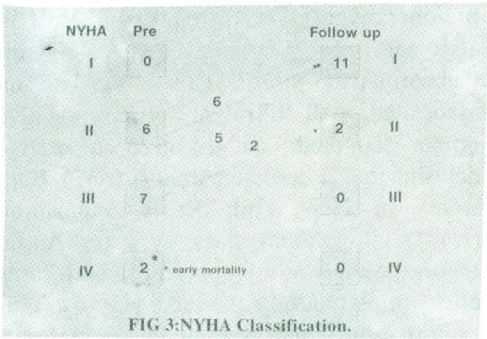

FIG 3:NYHA Classification.

the left ventricular functions, increasing the risk of surgery. These patients, when subjected to prosthetic valve replacement, will replace their rheumatic heart disease by "the prosthetic valve disease". Quoting Selzer's words from 1987 (27): "The prognosis and natural history in patients with prosthetic aortic valves become those of the prosthesis rather than those of the underlying disease in term of morbidity and mortality", and also quoting Lund's words from 1993 (28): "The prosthetic valve disease is an unquestionable consequence of aortic valve replacement".

In the present study, the rheumatic pathology was 80% with multivalvular disease in 47% and emergency status in 7%. The early mortality was 13%, which is higher than many studies (12,16,25,26,29) but was comparable to Ross's study (14%) in his early days (30). This high early deaths may be due to : 50% was an emergency reoperation due to bacterial endocarditis (1 patient) and 50% in a multivalvular surgery (1 patient). This is comparable to Barrat-Boyes's experience with 50% of his early deaths due to emergency operations, (12). In contrast, the result was better in elective isolated aortic implantation, a group of seven patients (47%), where there was no early mortality. In Pacifico's (25) and Penta's (11) experiences, early mortality in isolated aortic implantation was 4.8% and 2.9% respectively. Also, incidence of morbidity was comparable to all these studies.

Inspite of the advanced functional status of our patients pre-operatively, being 60% of patients in NYHA class III-IV, yet they showed marked improvement post-operatively where 85% of survivals were normal at time of follow-up, and there was a decrease in left ventricular dimensions post-operatively (Tables. I&V), (Fig 2&3). Similarly, Doty and his collegues (17) had 87% of their patients in NYHA Class I at follow-up.

The thromboembolic and haemorrhagic complications are inherited complications of all prosthetic heart valves available, which in our patient population, where the majority are female, young age with multivalvular disease requiring multivalvular surgery are dominant risk factors of patients survival, (28). In this

study, as in other studies (11,17), there were no thromboembolic events reported among our patients, inspite of no indefinite post-operative anticoagulation, presenting an advantage which is unique to the homograft valves.

On the other hand, the surgical complexity of the techniques of implantation of aortic homograft, may be reflected by our long aortic occlusion time (average 162 ± 21 minutes). This could be compared favorably with other studies, (12,17,19,24), if we put into consideration the complex mitral reparative procedures associated.

Also, the known inherited problem of availability of the homograft valves, was slightly magnified in the present study, having 68% of donors valves discarded (42% positive hepatitis antigen). This was very high as they were all taken from patients who died in hospital with high incidence of repeated blood transfusion. This was not the case in almost all other studies because their main sources for donors valves are the road-traffic accidents and brain-dead multiorgans donors, which allow a very small chance of harvesting unhealthy valves. That is why our expected increase in healthy donors valves could be true if we depend on the road-traffic accidents as main source of donors, hopefully soon.

Comment

The "IDEAL" valve for replacement of a diseased heart valve is still non-existing. In this article, an attempt has been made to present our experience with the use of antibiotic-sterilized homografts for aortic valve replacement, although in a small group of patients done over a period of one year, which has shown that this type of valve substitute gives satisfactory early results among our patients population. The aortic homograft valves are slightly demanding in their technique of implantation and with limited availability, but their main advantages are the good hemodynamic performance and freedom from thromboembolic complications. This later advantage is crucial among our majority of young patients with rheumatic multivalvular heart disease, mainly females in the childbearing period, which means that these valves in association with the mitral and tricuspid valves reparative procedures may offer a better quality of life to these patients without anticoagulation and its well known problems.

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Determinants of Exercise Performance After Total Repair of Tetralogy of Fallot

ABSTRACT

Objective - To determine different variables that reduce exercise performance after repair of tetrealogy of Fallot.

Design - Retrospective study.

Setting - A regional cardiothoracic centre "Harefield Hospital".

Patients - Twenty seven patients "19 males" with tetralogy of Fallot were studied. All of them underwent diagnostic cardiac catheterization and angiography and subsequently had surgical repair. Patients had complete physical examination, chest radiogram, 12-leads electrocardiography, Doppler echocardiography and treadmill exercise test.

Results - 19 patients (70%) had cardiothoracic ratio more than 50%. Doppler study showed eight patients (30%) had mild, 13 patients (48%) had moderate and six patients (22%) had severe pulmonary regurge. The mean exercise time was 11.14 minutes (standard deviation SD=2.5), the mean maximum heart rate was 182.6 beats/minute with "SD = 16.7" while the mean maximum systolic blood pressure was 144.2 mmHg "SD = 23.0". Exercise time was significantly correlated with pulmonary regurge "P=0.039" and cardiothoracic ratio "P = 0.013" but not correlated with previous shunt and interval since operation. maximum heart rate was correlated with age at operation (p=0.0198) and cardiothoracic ratio "p=0.002". multivariate analysis showed that maximum systolic blood pressure was correlated with cardiothoracic ratio and interval since operation. By spirometry, the mean forced vital capacity was 73.35 "SD = 12.31". Forced vital capacity was correlated with exercise time (P=0.046), age at operation (P = 0.03) and maximum heart rate (P = 0.007).

Conclusion - Significant pulmonary regurge, low forced vital capacity, increased cardiothoracic ratio and older age at operation were risk factors for impaired exercise performance. Early correction and measures to reduce the severity of pulmonary regurge improve exercise performance after correction of tetralogy of Fallot.

Reda Ahmed Maaty, MSc, Magdi H Yacoub.

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INTRODUCTION

Follow up studies after surgical repair of tetralogy of Fallot have shown that most patients have no subjective limitations in their exercise capacity (1-3). However, some have impaired exercise capacity after TOF repair (4-8). Impairment of exercise capacity has been attributed to a multiplicity of factors including: old age at the time of surgery, residual lesions e.g. pulmonary stenosis and ventricular septal defect,

* *Correspondence to professor Sir Magdi Yacoub, Professor of Cardiothoracic Surgery, Harefield Hospital, Harefield, Middx UB9 6JH. Fax 0895 82890*

pulmonary regurge "PR", right ventricular dysfunction and increased cardiothoracic ratio "CTR". Other factors that affect exercise performance include genetic factors, body build, physical training and motivation (6). Also Impaired lung function after TOF repair reduces exercise capacity and causes functional impairment. (9,10).

We present this paper to determine the different variables that reduce exercise performance and lung function after TOF repair.

Patients And Methods

Between 1970 and 1985, 27 patients "19 males" with TOF were studied. They underwent diagnostic cardiac catheterization and angiography at Harefield Hospital and subsequently had surgical repair performed.

The medical records were reviewed to confirm diagnosis. The angiographic and echocardiographic criteria for TOF were large perimembranous outlet VSD with infundibular stenosis and antero-cephalad deviation of the insertion of the outlet septum relative to the rest of ventricular septum. (11)

The age at operation ranged from one to 41 years. The interval from surgery ranged from 2.5 to 24 years, while the age at follow up ranged from 9 to 47 years. Nine out of 27 patients (33%) had previous shunt before total correction. Total repair was done in all patients through transeventricular route. Patients were studied in the outpatient clinic as follows: history and complete physical examination, chest X-ray, 12 leads ECG, Doppler echocardiography, lung function test and treadmill exercise test "TET".

We used colour Doppler flow imaging which superimposed colour coded flow pattern on real time two dimensional images to map abnormal flow patterns through tricuspid and pulmonary valves. The severity of the regurgitation was measured by the use of jet length and jet area methods. Doppler windows for tricuspid valve are: apical 4 chamber view and short parasternal view while Doppler windows for pulmonary valve are long axis view of RVOT and high left parasternal short axis view (12).

If the jet length is 1.5 cm beyond the valve, it is considered mild regurge, from 1.6 cm to 3 cm, it is considered mederate and more than 3cm, it is severe. Mild regurge is non significant "NS" while moderate and severe regurge are siginificant "S".

Treadmill Exercise Test:

A symptom limited treadmill exercise test was performed by treadmill machine case 12 (Marquette) using Bruce protocol for all patients above the age of eight years i.e. in 24 patients, as three patients refused to do the test. The patients were not allowed to touch the guard rail for more than a few seconds to get their balance during changes in speed. Instructions were given by an experienced technician and the study subjects would be allowed to try the treadmill equipment before the test. The treadmill exercise test would always be performed by the same personnel. Before the test, ten electrodes were placed on the patient to allow recording of three simultaneous electrocardiographic leads. Before exercise the standard 12 leads ECG were recorded with the patient sitting and

Treadmill exercise test; summary results (24 patients)

	Mean of raw data	Standard deviation	Mean of percent of predicted value	Standard deviation
Exercise time (min)	11.14	2.50	97.9	20.4
Maximum heart rate (beats/min)	182.6	16.7	91.5	7.7
Max. systolic B.P. mm Hg	144.2	23.0	80.7	11.4

Table 1

The predicted normal exercise time according to age and sex [11].
The predicted maximum heart rate (beats/min) according to the equation:
210 - (0.67 x age in years)[12].
The predicted normal values of maximum systolic blood pressure (BP), mm Hg, according to Bruce[13] which are 194 ± 28 for males and 166 ± 22 for females.

	Mild pulmonary regurge			Moderate pulmonary regurge			Severe pulmonary regurge		
Variable	Mean	SD	n	Mean	SD	n	Mean	SD	n
Max heart rate	189.67	18.47	6	179.17	13.54	12	182.33	21.10	6
Max syst. B.P.	143.33	21.60	6	141.42	24.04	12	150.80	25.00	6
FVC	76.00	12.56	8	67.55	11.24	11	84.00	5.42	4

Table 2

There is no significant evidence of a difference in the three mean values for heart rate ($p = 0.47$) and blood pressure ($p = 0.73$), but there is significant evidence of a difference for forced vital capacity ($p = 0.047$).
FVC = forced vital capacity.

these recordings were included as a part of the test because they could have disclosed a mild anxiety state as the patient anticipated the impending exercise.

During the test, leads II, AVF and V5 were monitored continually and and ECG was printed every three minutes i.e. at the end of each stage and any arrhythmia was printed as well. Blood pressure was measured every two minutes and the heart rate was recorded continually. The end point of the test occurred when, despite considerable verbal encouragement, a patient refused to exercise further due to

fatigue. We did not find it necessary to stop the exercise test in any patient. Exercise time was recorded. Recovery period was measured from the end of the exercise until the pulse and blood pressure reached the basal limits before the test. The test was considered positive if it induced >2 premature ventricular contractions PVCs. The exercise induced PVCs were detected during the exercise only, the immediate recovery period only and during exercise and recovery.

Lung Function Tests:

Spirometry, using micro medical printer spirometer, was performed prior to exercise in 27 patients. Forced vital capacity "FVC" and forced expiratory volume in the first second "FEV1" were assessed as percent predicted mean values by gender, age and height. FEV1/FVC was measured for patients with low FVC to exclude the obstructive low FVC. FEV1/FVC <0.8, this means obstructive low FVC and these patients were excluded from the study, FEV1/FVC >0.8, this means restrictive low FVC. FVC was considered low if it is less than 80% of the predicted values.

Statistical Analysis:

Statistical significance was tested as follows: for comparing two populations, a two-sample t-test was used where the normality assumption was satisfied and a Mann-Whitney test was used otherwise. For comparing more than two populations, one-way analysis of variance was used for continuous data and a chi-square test for categorical data. Zero correlation was tested using a t-test, Pearson's product moment correlation was used where the normality assumption was satisfied and Spearman's rank correlation was used otherwise. Multiple regression was used to model the relationship between exercise time, maximum heart rate, maximum systolic blood presure and the possible explanatory variables e.g. age at operation, interval since operation, PR etc.

Results

Twenty patients were in New York Heart Association "NYHA" class I and seven were in class II. All patients had normal blood pressure, and respiratory rate. None had cyanosis, clubbing or signs of heart failure. All patients had signs of pulmonary and tricuspid regurgitations with various degrees of severity. Lungs were clear in all patients. Nineteen out of 27 patients (70%)had cardiothoracic ratio "CTR" more than 50%.

All patients were in sinus rhythm. Twenty one out of 27 patients (78%) had right bundle branch block.

Doppler Echocardiography:

Eight out of 27 patients (30%) had mild pulmonary regurge, 13 (48%) had moderate pulmonary regurge and six (22%). had severe pulmonary regurge "PR" Seventeen patients (63%) had mild tricuspid regurge TR, ten (37%) had moderate regurge, none had severe TR. Two patients had residual outflow obstruction with gradients 20 mmHg and 35 mmHg. None had residual ventricular septal defect.

Treadmill Exercise Test "TET":

Exercise time, 14 out of 24 patients (58%) had exercise time less than the predicted normal exercise time according to age and sex (13), see figure 1.

Percentages less and greater than predicted exercise time

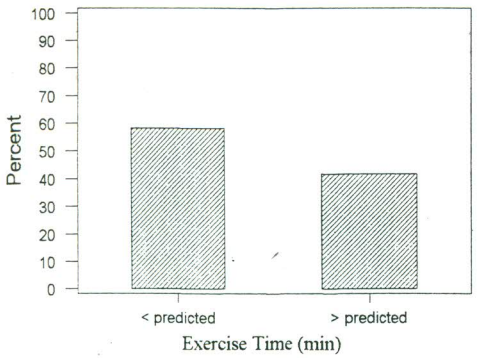


Fig. 1

Percentages less and greater than predicted max heart rate

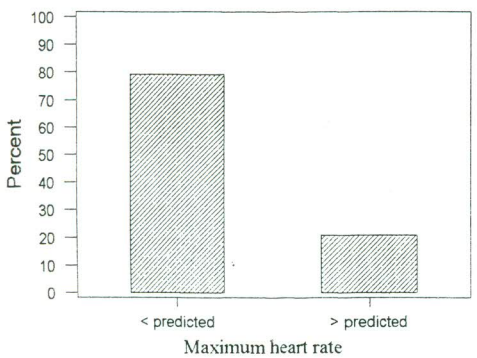


Fig. 2

Mean Exercise Time (min) v Pulmonary Regurge

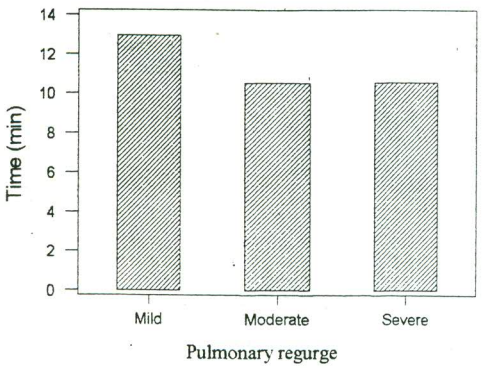


Fig. 3

Exercise Time (min) v Cardiothoracic ratio

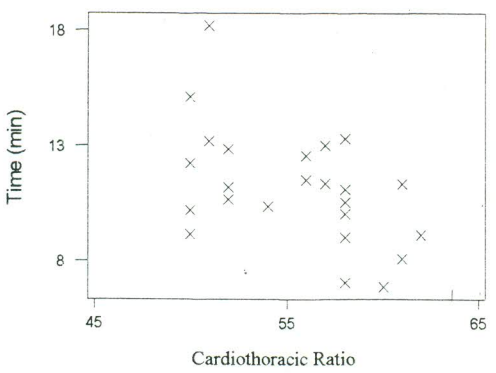


Fig. 4

The increase from resting heart rate to maximum heart rate during exercise represents the chronotropic reserve of the heart. We found 19 out of 24 patients i.e. 79% had maximum heart rate less than the predicted normal maximum heart rate according to the equation 210 - (0.67 x age in years) (14), see figure 2. The increase from resting systolic blood pressure "BP" to maximum systolic BP represents the inotropic reserve of the heart. We found 22 out of 24 patients (92%) had maximum systolic blood pressure less than the predicted normal values which are 194+28 for males and 166+22 for females (15). Table 1 represents the mean of percent of predicted values of exercise time, maximum

Maximum Heart Rate v Age at Operation

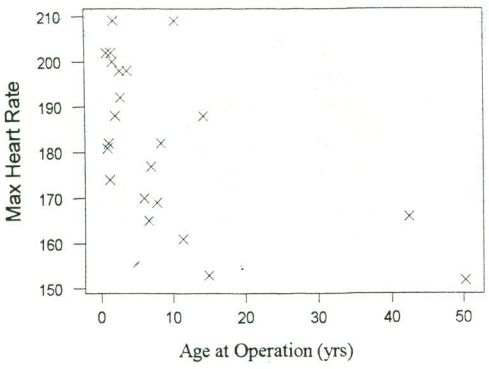


Fig. 5

Maximum Heart Rate v Cardiothoracic Ratio

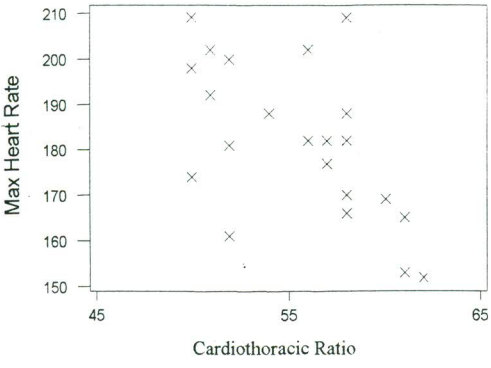
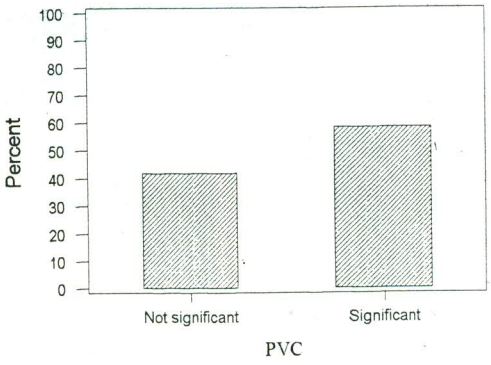


Fig. 6

heart rate and maximum systolic blood pressure. Exercise time was significantly correlated with the severity of pulmonary regurge "p=0.039", see figure 3, ie there was significant evidence of a decrease in the mean exercise time with increased severity of pulmonary regurge. We found strong evidence "P = 0.007" of increased CTR with increased severity of pulmonary

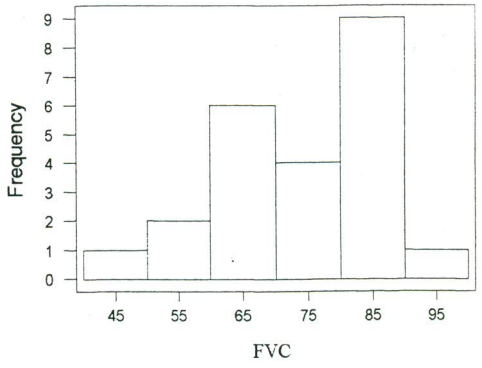
Percentages with non-significant and significant PVC on treadmill exercise test



PVC = premature ventricular contractions

Fig. 7

Histogram of FVC



FVC = forced vital capacity

13 out 22 patients (i.e. 59%) had FVC less than 80%

Fig. 8

regurge. Also exercise time was significantly correlated with cardiothoracic ratio "CTR" (P = 0.013), see figure 4. On the other hand exercise time was not statistically correlated with age at operation, interval since operation and previous shunt.

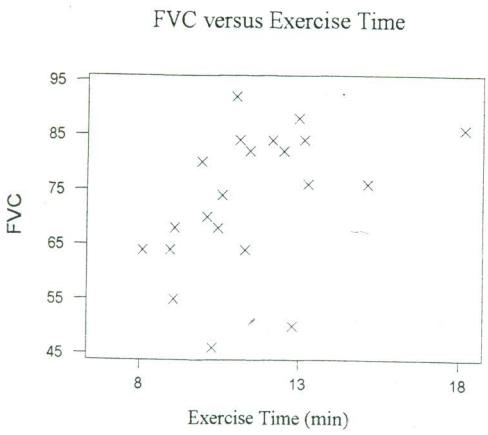


Fig. 9

Fig. 10

There was significant correlation between maximum heart rate and age at operation i.e. lower maximal heart rate was associated with inceased age at operation (P=0.0198), see figure 5. The maximum heart rate was correlated with increased CTR "P=0.002", see figure 6, but maximum heart rate was not correlated with other risk factors e.g. interval since operation, severity

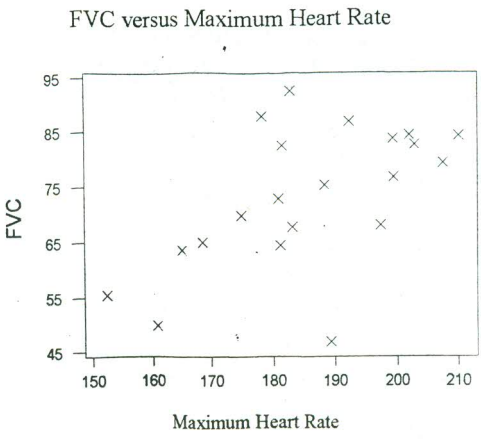


Fig. 11

of PR and previous shunt. By the use of multivariate analysis, maximum systolic blood pressure "BP" was correlated with the CTR and interval since operation and the fitted model is: maximum BP =252-2.46 CTR +2.13 interval since operation (i.e. the estimated reduction in maximum BP for every increase in CTR of one was 2.26 and the estimated increase in maximum BP for every increase in interval since operation of one is 2 (13), but age at operation, severity of PR and previous shunt were not correlated with maximum systolic blood pressure during TET. Exercise induced ventricular arrhythmia "VA" was found in ten out of 24 patients (42%), see figure 7. But VA on TET was not correlated with different risk factors e.g. old age at operation, interval since operation and severity of pulmonary regurge.

Lung Function test:

This test was done in 27 patients, five of them were excluded as they had obstructive

low vital capacity because FEV1/FVC in these patients was less than 0.8, and FVC was studied in the remaining 22 patients. Thirteen out of 22 patients (59%) had FVC less than 80%, the mean FVC was 73.35 with "SD = 12.31", see figure 8.

FVC was not correlated statistically with the severity of PR but there is trend towards decreased FVC with increased severity of PR (P=0.047), see table "2". FVC was correlated with exercise time ie decreased FVC was associated with decreased exercise time (P=0.046). This was an important result because it means that reduced exercise capacity is associated with impaired lung function, see figure 9.

Another interesting correlation was the correlation between FVC and age at operation, decreased FVC is associated with increased age at operation "P = 0.03", see figure 10, this correlation may favour early correction as we will mention in the discussion. Reduced FVC was associated with decreased maximum heart rate (P = 0.007), see figure 11, i.e. impairment of lung function was associated with reduction of the chronotropic reserve of the heart.

On the other hand, interval since operation, CTR and previous shunt were not correlated statistically with FVC.

Discussion

The primary purpose of this study is to determine the different variables that reduce the exercise performance after TOF repair. According to Bruce (15), when an ambulatory cardiac patient is exercised to the limits of fatigue, if the exercise performance is reduced, this reduction is due to low cardiac output "COP", this low COP is usually due to diminished effective stroke volume and/or reduced maximum heart rate. So, we studied exercise time, maximal heart rate and maximum systolic blood pressure against different variables to determine the risk factors that cause impairment of exercise performance after TOF repair.

Fourteen out of 24 patients (58%) had exercise time less than the predicted normal values 11. We and others 9,10, found significant correlation between impaired exercise peformance and severity of pulmonary regurge. Right ventricular dysfunction and diminished stroke volume due to pulmonary regurge may explain the association between impaired exercise performance and significant PR6. On the other hand our results were different from the results of others (16-18) who found no significant correlation between exercise performance and significant PR.

We found strong evidence of increased cardiothoracic ratio "CTR" with increased severity of PR (P = 0.007). On the other hand we and others 6 found that there was significant evidence of decreased exercise time with increased CTR. We think that this may reflect the degree of PR present and suggested a link between residual PR and intolerance to exercise in these patients. Another result in our series was the correlation between exercise time and forced vital capacity FVC ie decreased FVC was associated with decreased exercise time suggesting insufficient ventilation with exercise.

Although James et al (8) postulated that earlier repair allowed normal activity and

exercise patterns to develop in early childhood, we and others (6,10,19,20) found no direct correlation between age at the time of repair and exercise time. There was no significant correlation between exercise time and interval since operation or previous shunt in our series which confirmed the results of Rowe et al 10.

Nineteen out of 24 patients in our series ie "79%" had maximum heart rate less than the predicted normal heart, this confirmed the results of others 4,7 and was different from the results of Norgard et al 9 and Mocellin et al. (21).

It has been suggested that operation in early childhood might favour a normal heart response during exercise 8. Our results confirmed this as we found that lower maximal heart rate is associated with increased age at operation. This means that correction at young age preserves the chronotropic reserve of the heart and this favours early correction of TOF. The reduced maximum heart rate among these patients has been attributed to impaired autonomic nervous system for both adrenergic and vagal components (22,23).

We found also significant correlation between maximum heart rate and increased CTR ($P = 0.002$) ie the cardiac enlargement affected the chronotropic reserve of the heart. But the maximum heart rate was not correlated with severity of PR and this differs from the results of others (10,24). Also we found no correlation between maximum heart rate and interval since operation or previous shunt.

Twenty two out of 24 patients, in our series, ie 92%, had maximum systolic blood pressure less than the predicted normal values (15) which was different from the results of Norgard et al (9). The maximum systolic blood pressure was significantly correlated with CTR i.e. the cardiac enlargement impaired the inotropic reserve of the heart due to diminished stroke volume. The interval since operation was another risk factor which affects the inotopic reserve of the heart and this was explained by Kobayashi et al (25) who said that degeneration of the cardiac muscle advanced even after surgical repair because of residual ventricular stress such as pulmonary stenosis, ventricular septal defect and PR.

The incidence of ventricular arrhythmia "VA" among our patients on TET was 42% while the incidence of VA on routine 12 leads ECG was 0%, this strongly confirmed the results of Garson et al (26) who suggested that exercise testing is a more sensitive method for detecting ventricular arrhythmia than in routine 12 leads ECG. The aggravation or induction of significant VA by exercise indicated that the graded exercise test was useful in unmasking potential rhythm disturbances which are not apparent at rest (8).

So we and others (8) recommend exercise testing to all patients who had repair of TOF especially who had palpitation or syncopal attack and had no VA on routine 12 leads ECG. But VA on TET, in our series was not correlated with old age at operation and interval since operation like the results of Rowe et al (10), also VA was not corrlated with severity of PR which was different from the results of others (10).

Thirteen out of (19) of our patients (59%) had FVC less than 80% of predicted which is higher than the results of others 9. A low resting vital capacity after total repair of TOF was correlated to significant PR, an increased right ventricular stroke volume in patients with moderate and severe PR might increase lung blood volume and interstitial water and decrease lung compliance (9,10). Also reduced lung capacity in TOF might be due to hypoplasia of lung arteries and palliative shunting (20,27). Opposite to the results of others (20), we found no correlation between low FVC and previous shunt. Although the correlation between FVC and severity of PR was not statistically significant but there was a trend towards low FVC with increased severity of PR ($P = 0.047$), see table 2. others (9,10) found statistically significant correlation between low vital capacity and severity of PR.

Another result in our study was the correlation between low FVC and age at operation i.e. decreased FVC is associated with increased age at operation. This confirm the results of others (20) who found normal ventilatory response in children undergoing repair at age <5 years, we think this correlation adds more support to the trend towards early correction of TOF.

Norgard et al (9) found no correlation between low vital capacity and maximal heart rate while we and others 10 found that low vital capacity was associated with decreased maximum heart during exercise. This strengthens the relation between low VC and reduced exercise performance.

From our results, although we did not find direct correlation between reduced exercise time and older age at repair but there was an indirect link as older age at repair reduced the chronotropic reserve of the heart and FVC which strongly impaired exercise performance. So we and others (8,21,28) suggest early correction of TOF to improve the exercise performance after intracardiac repair.

Conclusion

Significant pulmonary regurge, low FVC, increased CTR and older age at the time of repair were risk factors that impaired exercise performance after TOF repair, the interval since operation and previous shunt were not correlated with exercise performance. Early correction and measures to reduce the severity of PR improve the exercise performance after TOF repair.

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We gratefully acknowledge the assistance of Terry Dillon, ECG technician, Dr D Robinson, the statistician, Richard Osborn, the Librarian, and Joan Green, the secretary, for their great help.

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Surgical Management of Left Atrial Myxoma: Efficacy and Safety of the Biatrial Approach

ABSTRACT

From January 1987 to January 1996, eleven patients with left atrial myxoma were operated upon. Seven of the patients were females and four were males. The age ranged between 16 to 57 years. The biatrial approach was utilized in all patients. In order to assess the validity of the biatrial approach we compared our data with those of other authors adopting the same technique and other techniques. The advantages of the biatrial approach are: (1) Provides thorough search of all chambers for myxoma. (2) Complete excision of the area of attachment in the atrial septum (when the myxoma arises from this location) and either primary or patch closure of the atrial septal defect. (3) Excision of myxoma and underlying endocardium for myxomas arising on the free wall of the atrium (4) Safe with minimal incidence of complications.

Ahmed Saleh, Abd El Meguid Ramadan, Moustafa K El Hamami, Suzan M.F Helal* and Mohamed A. Khalil

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Introduction

The majority of cardiac myxomas occur as sporadic lesions and are usually found in middle aged women as an isolated, benign, tumor of the left atrium without accompanying pathologic conditions. (1) It was not until the early ninteenth century that Thomas Hodgkin made the clear distinction between intramural tumor and thrombus. (2) Yater in 1931, reviewed 75 myxomas that had been individually reported up to that date. (3) In 1951, intracardiac myxoma was recognized by angiography (4) and in 1954, the first atrial myxoma was excised using cardiopulmonary bypass. (5) Since that time, there has been a vast increase in the number of clinical reports on the diagnosis and treatment of left atrial myxomas. (6,7)

Over the past years, however, an additional major step has been made in the clinical recognition of atrial myxoma with the advent of non-invasive procedures such as echocardiography which provides even greater ease and sensitivity in clinical detection of these tumors. (8,9)

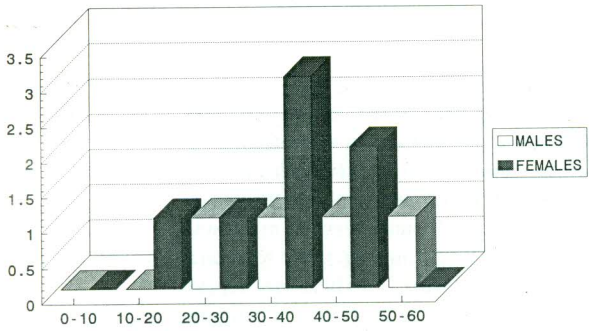
The aim of this work is to evaluate the validity of the biatrial approach in the surgical management of left atrial myxoma, by comparing the results of this approach with the other reported approaches in terms of post-operative morbidity and mortality.

Patients and Methods

From January 1987 to January 1996, Eleven patients (seven females and four males) underwent resection of left atrial myxomas. The mean age was 34 years (range 16 to 57 years); Figure (1) shows age and sex distribution in this study.

Clinical symptoms and signs are summarized in Table I & Figure 2.

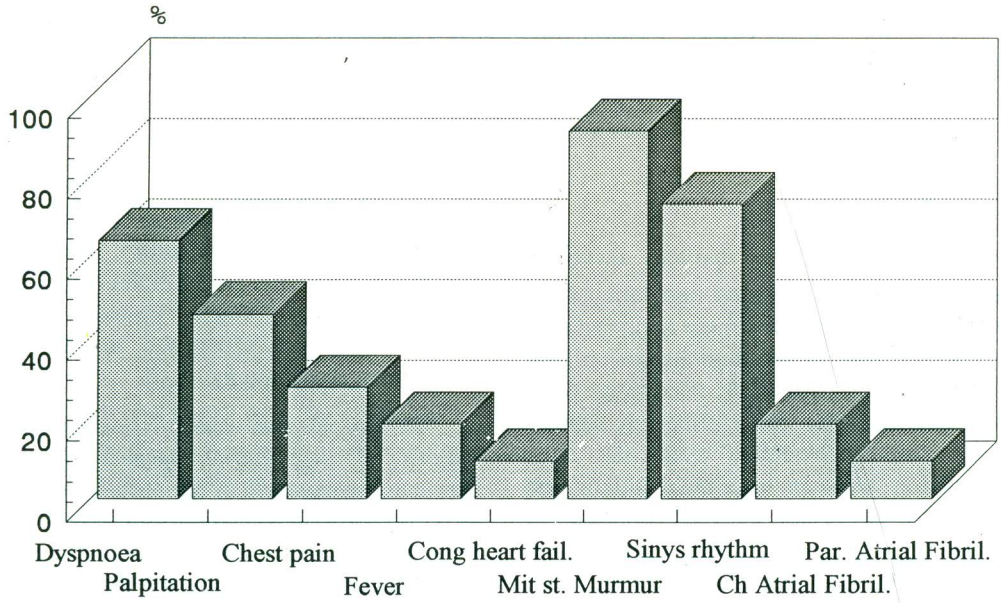
The Cardiothoracic Surgery and Pathology Departments, Faculty of Medicine, University of Alexandria*



Fig(1) Distibution of studied patients by age and sex.

Table I: Clinical findings.

Finding	No.	%
Dyspnoea	7	63.63
Palpitation	5	45.45
Chest pain	3	27.27
Fever	2	18.18
Congestive heart failure	1	9.09
Mitral stenosis murmur	10	90.9
Electro-cardiogram		
Normal sinus rhythm	8	72.7
Chronic atrial fibrillation	2	18.18
Paroxysmal atrial fibrillation	1	9.09



Fig(2) Clinical findings of studied patients.

Echocardiography was the primary method of diagnosis in all patients, and cardiac catheterization was done in three patients; to confirm the diagnosis and exclude associated diseases such as coronary artery disease in two patients and mitral valve lesion in one patient.

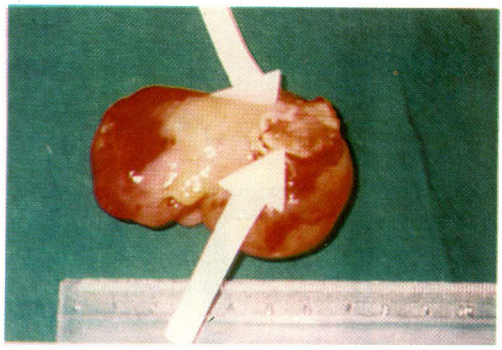


Fig.3 : Shows a left atrial myxoma which was removed en toto with a full-thickness segment of the interial septum (Arrows).

Table II: Correlation by the Z-test, as regards arrhythmia and mortality

	Arrhythmia		Mortality	
	Z-test	P	Z-test	P
Present study in correlation with:				
1. Jones[12]	0.0322	>0.05	0.82	> 0.05
2. Kabbani[16]	0.039	> 0.05	1.43	> 0.05
3. Sellke[26]	**2.279**	**< 0.05**	0.32	> 0.05
4. Bortolotti[6]	0.042	> 0.05	0.042	> 0.05
5. Larsson[15]	1.045	> 0.05	1.22	> 0.05

During surgery, cardiopulmonary bypass was instituted with moderate hypothermia (25-28°C), surface cooling and antegrade cold cardioplegia.

An incision was made in the left atrial wall posterior to the interatrial groove, after the diagnosis of myxoma was confirmed an attempt was made to idenitify its point of attachment without mobilizing the tumor.

A second incision was made in the right atrial wall; after the right chambers were explored for the possibility of extension of the left atrial lesion or a second myxoma, a full-thickness segment of the interatrial septum at the site of attachment of myxoma was excised. The tumor was then delivered with minimal manipulation, usually through the left atrial incision. When the tumor was attached to the atrial wall and not to the usual site in the septum, the approach through the right atrium facilitates excising its attachment with wide margins of endocardium or full-thickness section of the atrial wall. (10)

After complete excision, the left cardiac chambers were inspected for possible remaining fragments of tumor or another myxoma, the mitral valve evaluated for any abnormalities (usually insufficiency due to a dilated annulus) that may require valve repair or replacement, and the left chambers were irrigated adequately. The iatrogenic atrial septal defect was repaired simply or with a patch, the left and right atrial incisions were closed.

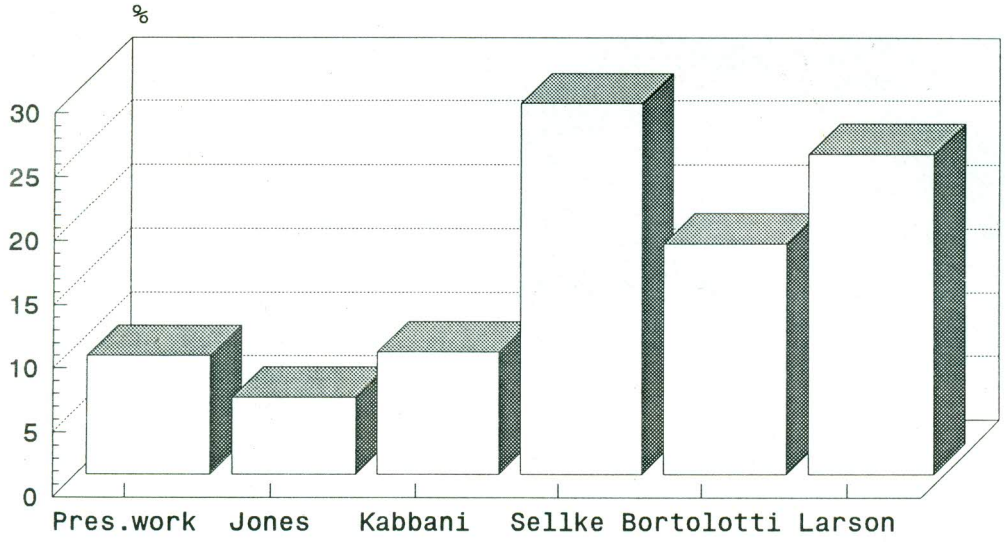
Patients proved to have atrial thrombus (three patients) or other cardiac tumours (one patient) were excluded from this study.

Follow-up study ranging between six months to nine years was done by thorough clinical examination, electrocardiography and echocardiograhy to exclude recently developed arrhythmias or tumour recurrence.

The data were statistically analyzed by the Z-test.

Results

The eleven patients of this study were operated upon through the biatrial approach. Nine tumours were found



Fig(4) Arrhythmia among studied patients in the present work in comparison with other similar works.

attached by a pedicle to the fossa ovalis, they were removed en toto with a full-thickness segment of the interatrial septum (Figure 3). The iatrogenic atrial septal defect was closed directly in seven patients and with a patch in the remaining two patients. The tumour was attached to the atrial wall in two patients, and both tumours were removed with a full-thickness part of the atrial wall.

Apart from post operative recently developed arrhythmia in one patient, and one operative death, due to cardiac arrest from left ventricular failure, no recurrence or mortality occurred during the period of follow-up. Figure (4) compares our post-operative complications with those reported by others utilizing the same technique and other techniques. While table II shows the correlation by the Z-test.

The gross anatomic types were one solid ovoid myxoma and ten soft papillary type. With light microscopy, the tumours had a lose myxoid stroma with a fine, fibrillar appearance and with stellate or spindle-shaped cells with visible abundant cytoplasm. Special stains demonstrated the presence of reticulin and elastic fibers, foci of calcification, and prominent metachromasia with Alcian blue. Thin-walled blood vessels as well as areas hemorhhage were present, the intact endocardium in the figure denotes complete surgical removal (Figure 5). Electron microscopic studies of the myxomas revealed a large range of differentiation in

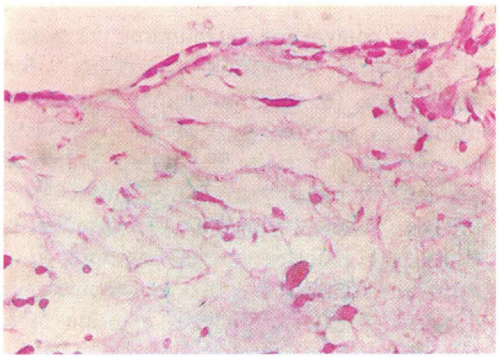


Fig. 5: Alcian blue stain demonstrating areas of blue colour (myxomatous areas) with scattered spindle and oval cells, covered by an intact endocardium (x 200).

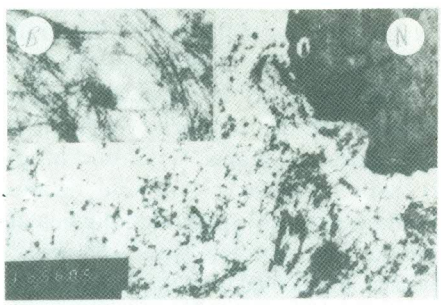


Fig. 6: A) Electron micrograph showing a single myxoma cells with nucleus (N), and a large number of cytoplasmic filaments. B) Higher power view of cytoplasmic filaments.

the neoplastic cells; some had the features of maturing smooth muscle cells, while others displayed the features of endothelial cells, fibroblasts, and macrophages. These findings are in agreement with the previous studies of Ferrans and Roberts (11) which suggest that myxomas arise from multipotential mesenchymal cells that are capable of differentiating into various types of cells. Figure 6-A shows a single myxoma cell while, figure 6-B presents the cytoplasmic filaments.

Discussion

For years surgical approaches to left atrial myxoma has been a topic of concern, in an effort to achieve a safe, efficacious operation. The surgical approach to atrial myxomas should: (10,12)

1. Allow minimal manipulation of the tumor.

2. Provide adequate exposure for complete resection of the tumor.

3. Allow inspection of all four heart chambers.

4. Minimize recurrence.

5. Be safe and efficacious.

These approaches include an isolated left or right atriotomy, right atriotomy with trans-septal incision and a biatrial approach. (13-16)

In 1973, the biatrial approach was described by Cooley (16), and reported later by others. (10,12). The initial left atriotomy should be only large enough to confirm the diagnosis of myxoma, to identify the tumor pedicle in the case of left atrial myxomas, and to assess the friability and size of the tumor. We do not attempt to mobilize the tumor through this incision, only to localize it under direct visualization. The right atrial incision allows inspection of the right atrium and ventricle for coexistent myxomas. The biatrial incisions then

faciliate resection of the myxoma with optimal margins of excision. Finally, the left cardiac chambers can be inspected adequately for mitral valve abnormalities, other tumors and tumor fragments.

Myxomas are classified into two main pathologic types; solid ovoid myxoma and soft papillary one which has a very friable consistency which enhances its tendency for embolization mainly to the brain. (9)

Cardiac myxomas are presumed to arise from "pretumor" cells present in the endocardium of the cardiac chambers. (17) Because most myxomas arise from the atrial septum, it has been reasoned that excision of the atrial septum would decrease the risk of recurrence. Myxomas can recur at the site of the original tumour, at multiple intracardiac sites, and at sites outside the heart. Recurrences can occur more than once after surgical excision. It is uncertain whether they are due to a multicentric origin of the initial lesion, inadequate resection of the initial lesion, intracardiac implantation, peripheral embolization, or a combination of these factors. (18) There is a distinct group of patients with cardiac myxoma who have a tendency to have multicentric myxomas. In these patients, multiple myxomas may present at the same time (synchronous) or may occur after excision (metachronous). (17) Therefore, some authors have recommended complete removal of the tumor and septum, with patch closure if necessary (19,20). However, Hanson et al. (21) provided long-term follow-up (mean 6.5 years) of 33 patients, none of whom had recurrence despite the use of conservative resection in most of the patients.

This controversy surrounding the extent of surgical resection necessary for appropriate treatment of cardiac myxoma is related to the existence of the previously unappreciated group of patients with the marked tendency to have multicentric tumors. After reviewing the cumulative experience reported in the literature, it is estimated that the risk of a second myxoma developing after complete excision of a sporadic cardiac myxoma is 1 to 3%. (22)

Several practical clinical points emanate from these pathological findings. First, adequate treatment of a sporadic myxoma consists of excision of the tumor with the underlying endocardium. Second, patients at high risk for multiple or meta chronous myxomas may be identified preoperatively by the presence of distinct associated elements of the complex which includes seven rare conditions: (1) cardiac myxoma (2) skin myxomas (3) myxoid mammary fibroadenomas (4) spotty skin pigmentation (lentigo and several types of nevi) (5) primary pigmented nodular adrenocortical disease, a cause of Cushing's syndrome (6). pituitary adenoma and (7) unusual testicular tumours, especially large cell calcifying Sertoli cell tumours. Third, in these patients, a thorough search for synchronous tumors should be made at operation and more extensive resection of the tumor-bearing endocardium may be indicated. Fourth, close postoperative follow-up of these patients is imprative. Fifth, family members should be screened for cardiac myxoma other elements of the complex. (22)

So, during surgery these two pathological characteristics (recurrence and

embolization) have to be taken into consideration.

Advocates of the left atrotomy approach consider the exposure to be adequate and have demonstrated low recurrence rates and safety of this technique. (13) Interestingly, 34% to 85% of patients had a subendocardial, not full-thickness, resection of the interatrially based tumor. This approach prevents inspection of all four cardiac chambers. In addition, a left atriotomy alone requires excessive manipulation of tumor and depending on the size of the tumor, may prevent adequate excisional margins to be obtained. It is for these reasons that an isolated left atriotomy fails to meet required surgical principles of atrial myxoma resection. (12)

The trans-septal approach or the extended vertical one to artrial myxomas is a technique in which the interatrial septum is incised vertically through a right atriotomy. (23,24) The line of incision in the septum and resection of the tumor may be guided by intraoperative transeophageal echocardiography. (25) Proposed advantages of this technique include only one atrial incision, adequate exposure to evaluate the mitral valve, low recurrence rates, and long-term efficaciousness. (25,26) Kabbani and colleagues have criticized this approach as being inadequate to identify the site of tumor attachment and for thorough inspection of all cardiac chambers. (17) Alternatively, Chitwood used transesophageal echocardiography successfully to identify tumor attachment and to inspect cardiac chambers. Removal of large myxomas with this approach may be difficult and may necessitate bisection of the tumor to remove it safely. (27) This degree of tumor manipulation seems unnecessary and potentially dangerous. In addition, Sellke and associates reported a 12% incidence of microscopically positive tumor margins using the trans-septal approach. (26) Finally, 15 to 40% of the left atrial tumors are not attached to the interatrial septum and a trans-septal approach, even with modification, may provide difficult exposure to these tumors. (28)

The biatrial approach has been criticized for being responsible for a high incidence of arrhythmias and conduction disturbances after resection of left atrial myxomas. (29) We had only one significant dysrhythmia postoperatively. This is contrasted with a 12% incidence of complete heart block and a 46% incidence of new onset atrial fibrillation or flutter in the immediate postoperative period as reported by Sellke and associates using the trans-septal technique. (26) We have found the biatrial approach affords excellent exposure and allows avoidance of the conduction system.

A second criticism of the biatrial approach has been the extra incision, which potentially may be associated with increased bleeding postoperatively. We had no bleeding from either atrial incision suture line.

In a tumor with such pathologic features of recurrence or embolization the biatrial approach is preferred as it offers;

1. Thorough searsh of all chambers for myxoma.

2. Complete excision of the area of attachment in the atrial septum (when the myxoma arises from this location) and either primary or patch closure of the atrial septal defect.

3. Excision of myxoma(s) and underlying endocardium for myxomas arising on the free wall of the atrium or ventricles.

4. Safe with minimal incidence of complications.

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Present Status of Emergency Closed Mitral Commissurotomy

ABSTRACT

This study included 18 patients with isolated rheumatic mitral stenosis requiring emergency closed mitral commissurotomy [CMC]. They were divided into three groups; Group I: included 10 patients who required emergency CMC because of failure of mitral balloon valvuloplasty [MBV] due to cardiac perforation [8 patients] or sudden serious arrhythmia [2 patients]. Of the 8 patients with cardiac perforation, the tear was in the left atrium in 5 patients and in the right atrium in 3. CMC was successful in all the patients, increasing mitral valve area [MVA] from a mean of 0.97±SD 0.186 cm2 to 2.38±SD 0.494 cm2.

Group II: included five pregnant females requiring emergency CMC because of severe pulmonary congestion that failed to be controlled medically. The operation was done in the second trimester for all patients. No maternal or foetal death occurred. The CMC increased MVA from a mean of 0.68 ± SD 0.144 cm2 to 2.23±SD 0.268 cm2.

Group III: included 3 patients with pulmonary oedema for which emergency CMC was done. The patients were saved and the MVA increased from 0.65±SD 0.132 cm2 to 2.14±0.19 cm2.0.19 cm2.

It was concluded that in the present era of open mitral commissurotomy [OMC] and BMV, CMC is still considered a safe and successful technique in some emergency situations.

Dr. K. Karara* and Dr. M. Sobhy**

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INTRODUCTION

Isolated mitral stenosis could be managed by CMC, MBV, OMC or mitral valve replacement [MVR]. (1) CMC was the original technique used that was first performed digitally then using the transventricular Tubbs dilator. (2,3) Recently, CMC can be done under transoesophageal echocardiographic {TEE} control. (4)

CMC is strongly competed now by OMC where the commissurotomy can be performed under direct vision and by MBV which avoids thoracotomy. (5,6) However, CMC still has its indications in some emergency situations where it may be even superior and safer than the former two techniques. (4,5).

In the present study, the indications and results of using CMC in some emergency situations are discussed

Material and Methods

From August 1993 till August 1996, 18 patients having isolated rheumatic mitral stenosis were subjected to emergency CMC in Alexandria Main University Hospital. According to the indication for operation,

From Cardiothoracic Surgery Unit and Cardiology Unit**, Alexandria Faculty of Medicine.*

the patients were divided into 3 groups [Table 1].

Table (1): Indications for emergency CMC

Group	No	Indication	Criteria
I	10	Failed BMV	Cardiac perforation Severe arrhythmias
II	5	Pregnant females	MVA < 1 cm^2 Failed medical treatment Second trimester Foetal distress No previous safe pregnancy
III	3	Intractable decompensation	MVA < 1 cm^2 Failure of medical treatment

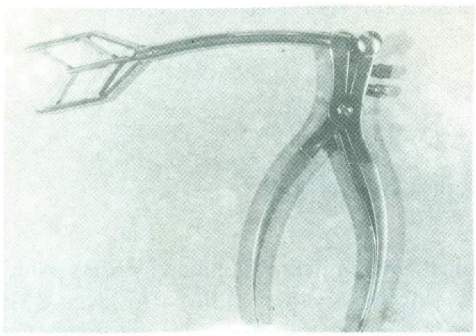

Fig. 1: Tubbs transventricular mitral valve dilator with two screws for gradual dilatation of the mitral valve.

Group I: 10 patients having failure of MBV. After full clinical evaluation, routine laboratory investigations, X ray chest and heart, ECG and coloured Echo Doppler study, these patients had been chosen for elective MBV. All had symptomatic mitral stenosis [NYHA class II-III], no atrial fibrillation, no thrombi, no previous history of thromboembolic phenomena, and echo score of the mitral valve less than 8/16. For this group, elective MBV using the double balloon technique [balloon No 18 or 20 mm, Mansfield] was tried first. (6) Yet, 8 patients developed cardiac perforation and two patients developed serious arrhythmias and the procedure was immediately stopped before doing valvuloplasty. For the 8 patients with cardiac perforation, six were haemodynamically unstable with manifestaions of cardiac tamponade. Two were stable; myocardial perforation was diagnosed by the presence of the dye in the pericardial sac during septostomy. without evident cardiac tamponade. All the 8 patients were carried immediately to the operating room for emergency CMC.

The remaining patients with serious arrhythmias; one had complete heart block and developed Stokes-Adams attack during the procedure and the other developed serious ventricular tachycardia. For these patients, the procedure of MBV was stopped, the patients arrhythmias were first controlled and CMC was done within 24-48 hours later.

During operation, emergency left anterolateral thoracotomy was done. The pericardial sac was longitudinally opened generally anterior to the phrenic nerve. The pericardial sac was evacuated of blood. A thorough search was done for the bleeding site which was sutured.

Classical CMC was then started using a transventricular Tubbs technique. (7,8) The Tubbs mitral dilator used had two screws to allow gradual commissurotomy to be done. [Fig. 1]. Following commissurotomy, the index finger in the left atrium was used to assess the success of commissurotomy and the presence of any residual mitral regurge. The atrial and ventricular purses were closed. A pericardial window was created

posterior to the phrenic nerve inferiorly. The pericardium was closed by interrupted sutures, so as to allow any blood collecting in the pericardium to escepe freely to the pleura. The pleura was drained and the thoracotomy was closed. The patients were transferred to the ICU for 1-2 days.

Group II: 5 patients requiring emergency CMC during pregnancy. For these patients thorough history taking, clinical examination, ECG and coloured Echo Doppler were done. Radiological examination was avoided.

The criteria used to select candidates for emergency CMC during pregnancy were:

1- Patients with MVA < 1 cm2.

2- Patients who had passed the first trimester.

3- Failure of medical treatment to control patients' symptoms, with special attention to progressively increasing distressing coughing episodes indicative of pulmonary congestion and impending pulmonary oedema.

4- Patients who did not pass a previous normal pregnancy or have a history of miscarriages need special consideration.

5- Manifestations of starting foetal distress.

Preoperative intensive medical treatment was started to operate in patient's best condition. Consultation of an obstetrician for follow up before and after operation was needed. Also, the foetal sounds were monitored before and after operation to detect any signs of foetal distress.

Hypoxia was avoided by the anaesthetist during operation and postoperatively. Light anaesthesia was required. Some inotropic drugs as dopamine, nor epinephrine and dobutamine may jeopardize the foetus by decreasing intrauterine blood flow and stimulating uterine contractions. (9)

Beta-adrenergic blockers lowers umbilical blood flow and have the potential of initiating premature labour. Nitroprusside can result in foetal accumulation of thiocyanate and cyanide. Alpha adrenergic agents and ketamine decrease uterine blood flow and should be avoided. (9) Other cardiac drugs can be used with relative safety during pregnancy as diuretics, digitalis, lidocaine, calcium channel blockers and nitrate preparations. (9)

The operative technique did not differ from classical CMC. (7,8) Special attention to perform the dilatation gradually was done to avoid inducing mitral regurge that might precipitate pulmonary oedema for these vulnerable patients.

Postoperatively, the patients were nursed in a semisitting position. Antifailure measures were given till stabilization of patients' condition. Radiological examination of the chest was avoided postoperatively. Clinical examination was done to assess lung expansion before removal of the chest tubes. Postoperative echocardiography was done to all patients.

Group III: 3 patients developing pulmonary oedema and intractable heart failure. These patients were first seen by the cardiac surgeon in the ICU, having

pulmonary oedema and heart failure not responding to intensive medical treatment. Preoperative clinical, radiological, electrocardiographical and echocardiographical evaluations were done. All patients had isolated rheumatic mitral stenosis with MVA < 1 cm2 and Echo score < 10/16.

These hemodynamically unstable patients required emergency CMC using the classical technique. (7,8) All were returned back to the ICU to continue intensive medical treatment till haemodynamic stability.

Results

The age of the 18 patients included in this study ranged from 12-36 years with a mean of 24.02 years. Of them, 3 were males and 15 were females with a ratio of 1:5. Excluding the group of 5 pregnant females the male to female ratio was 1:3.33.

Preoperative clinical evaluation

The patients of the three groups had in common an advanced NYHA class [III-IV] when subjected to emergency CMC.

In group II, four cases were primigravida, and one patient had previous normal pregnancy and labour two years before. Three patients had known history of rheumatic fever and rheumatic mitral stenosis, and two patients had their cardiac problem diagnosed for the first time during pregnancy. All the cases of this group presented by progressively increasing dyspnoea and deterioration of their functional NYHA class from II to III-IV depite intensifying the medical treatment. All started during the course of their pregnancy to present by distressing coughing episodes of increasing severity, interfering finally with patients' sleep at night. Clinically, there was increasing weight gain, progressive lower limb oedema and pulmonary crepitations. All patients were supported medically during their first trimester. Once it was realized that conservative lines failed and the patients would not be able to reach full term, neither mother nor foetus, emergency CMC was done during the second trimester.

In group III patients, the precipitating causese of the rapid patient's decompensation were pregnancy and abortion in one case and severe chest infection in two cases. The first case had passed well her pregnancy till end of the second trimester to present by sudden decompensation, intrauterine foetal death and abortion before considering emergency CMC to save the foetus. The mother, being still decompensated after abortion, emergency CMC was done to her.

Operative results

For all patients an emergency left anterolateral thoracotomy was required. In only one patient of group I, having a bleeding right atrial tear, the incision was carried anteriorly to divide transversely the sternum and reach the right side.

In group I patients with cardiac perforation, after opening the pericardium and aspirating blood inside, a thorough search was done for the bleeding site. The operative findings are summarized in table (2). The perforation was left atrial in 5 patients and right atrial in 3 patients. In

Table (2): Operative findings in patients with cardiac perforations.

Case No	Number	Status	Site	Interference
1	3	Bleeding puncture	Around left atrial appendage	Suture + CMC
2	-	Inconspicious	Rt atrium*	CMC
3	1	Sealed by clot, bruise	Lt atrial appendage	CMC
4	1	Bleeding puncture	Lt atrial roof	Suture + CMC
5	-	Inconspicious	Rt atrium*	CMC
6	1	Bleeding puncture	Lt wall of left atrium	Suture + CMC
7	2	Bleeding puncture	Lt atrial appendage	Suture + CMC
8	1	Bleeding tear	Rt atrium	Suture + CMC (Extended left thoracotomy)

* Rt atrial perforation was diagnosed by preoperative angiocardiography performed in the course of MBV.

Table (3): Mitral valve area before and after CMC.

		Group I	Group II	Group III
Before CMC	Mean	0.97	0.68	0.65
	SD	+ 0.186	+0.144	+ 0.132
After CMC	Mean	2.38	2.23	2.14
	SD	+0.494	+0.268	+0.19
Significance	t test	S	S	S

S: Significant (P < 0.000)

Table (4): A-V gradient before and after CMC.

		Group I	Group II	Group III
Before CMC	Mean	14.09	13.94	18.67
	SD	+ 5.04	+ 5.08	+ 7.52
After CMC	Mean	7.79	7.32	8.77
	SD	+ 3.208	+ 5.03	+ 5.44
Significance	t test	S	S	S

S: Significant (P < 0.000)

three patients, no fresh bleeding was detected from the puncture sites and nothing was done to it. In 5 patients, sutures were needed to arrest bleeding. The

pathological finding varied from bleeding puncture, puncture sealed by a blood clot, bleeding tear or simple bruis. In two cases, the bleeding site was inconspicuous but suspected from the preoperative angiocardiogram to be in the right atrium.

The Tubbs opening varied from 3-4 cm depending on the condition of the valve and patient's age.

Postoperative results

No hospital mortality was reported in the present study. All patients were transferred postoperatively to ICU till haemodynamic stability. The functional class of the patients improved gradually from III or IV to I or II. All the pregnant females were able to reach full term with no foetal deaths or abortions, with an impressive improvement of the distressing coughing episodes.

The mitral valve area showed statistically significant increase in all groups as shown in table (3).

The A-V gradient showed also a significant decrease in all groups as shown in table (4).

Discussion

From its introduction in the late forties, till 1970-1972, CMC was considered as the safest technique for mitral commissurotomy because of the early problems associated with the cardiopulmonary bypass. (5) Since then OMC was the preferred technique in most developed countries with an operative risk less than 1%. OMC allowed commissurotomy to be done under direct vision, so doing it more extensively, separating any fused chordae and correcting any induced mitral insufficiency. It allowed also, removal of any left atrial thrombi decreasing the risk of cerebral embolization to about 0%. (1,5)

By that time, larger series of CMC appeared and the disadvantages of CMC was realized. These included; 1-bleeding from left atrial tears; 2- cerebral embolization from undiagnosed left atrial thrombi; 3- induction of acute mitral regurge and 4- incomplete commissurotomy and restenosis. (1,5)

After realising such problems, several attempts were made to overcome them. The introduction of the Tubbs transventricular dilator by 1959, allowed more extensive commissurotomy to be done. (3) Also, adding two screws to its handle allowed the gradual dilatation needed to decrease the incidence of regurge. To decrease the incidence of cerebral embolization, the CMC was avoided in any patient with previous embolization, or suspected left atrial thrombi by echocardiography. In this respect, TEE allowed better visualization of such thrombi (1). Furthermore, flushing the left atrium before proceeding with CMC may expel undetected thrombi of 1-2 cm especially in patients with atrial fibrillation. (8)

In earlier experience, the incidence of restenosis after CMC was 50% after 5 years. (5). It decreased more recently to less than 20% at 5 years. (10). To decrease further such incidence every effort should be done to perform as complete commissurotomy as

possible. This depends largely on the learning curve of the surgeon. (11) It can be also improved by doing the procedure under TEE guidance. (4) In addition, CMC as with MBV, is better reserved for patients with echo score of 8/16 or less. (12) Patients with score between 8 and 11 are borderline candidates and are more suitable for OMC than MBV or CMC. CMC is better avoided for patients with echo score above 11, with calcified immobile valves and marked involvement of the subvalvular apparatus when MVR is the procedure of choice. (10)

MBV, developed from the late 80's allowed commissurotomy to be performed without surgery with less pain and less hospitalization. (6,12) It could be performed for patients with operative risks from associated medical problems. (6,12) On the other hand, it has all the critics of CMC being also a blind procedure. (5) Its major complications include severe mitral insufficiency, systemic embolism, atrial septal defect that may be severe enough to cause right sided heart failure and cardiac perforation. (13)

CMC is, however, still practiced on a wide scale in the developing countries. (4,11) It is much less expensive than OMC and MBV and could be used in centers where these facilities are not available. Hospital mortality after CMC is less than 1%. (14) both procedures are safe. (15) Analysis of cardiac performance, thromboembolism, functional status, survival and reoperation have also shown no advantage of open over closed commissurotomy. (14) Significant restenosis after OMC is also recorded at 5 years, which reachs 50% after 8 years. (16) Even the supporters of OMC over CMC could not deny that CMC is superior in some emergency situations as during pregnancy and in severe cardiac failure. (5,15) The introduction of MBV added another emergency indication of CMC for patients with failed technique. (13)

The incidence of cardiac tamponade during MBV varies generally between 1 and 10%. (13) Such incidence depends largely on the operator's experience. In the Cardiology Unit of our Institute, the incidence was 25% in the first 12 cases and decreased much with time. (17)

Cardiac perforation may occur during septostomy procedure as all the cases reported in this study. The perforations then occur in the right or left atrial wall, and are less serious. Guide wires, septal dilators or balloon catheters can produce more serious lacerations of the cardiac walls, atrial or left ventricular, with faster hemodynamic deterioration. (13)

Generally, the rate of bleeding into the pericardial sac depends on the site, size and number of tears, coagulability of blood and the abrupt pressure changes during inflation procedure. A small puncture at atrial level may start to re-bleed during balloon inflation because of the marked elevation of left and right atrial pressures at the moment of mitral valve occlusion. (13)

Clinically the patients may be haemodynamically stable and the perforation is diagnosed by the mere presence of dye in the pericardial sac during the procedure or by echocardiography later. On the other hand, the patient may present with manifestations of cardiac tamponade of

various degrees of severity amounting to rapid death in the catheterization laboratory. (13)

The treatment depends largely on the patient's presenting condition and whether or not the MBV was accomplished. If the patient's condition was stable, and the MBV was already done and the patient presents by mild to moderate pericardial effusion after the procedure, the patients may be successfully managed without surgery. (13) Percutaneous insertion of pericardial drainage and administration of protamine are sufficient. However, utmost care sould be taken since the patient may rebleed. the patient should be carefully monitored and serial echocardiograms are done. (13)

On the other hand, if cardiac perforation was diagnosed and the MBV was not yet done, it is our policy to stop the procedure and perform emergency surgery. With this plan of management, the mortality was zero% in this series. Once the patient is diagnosed to have perforation, protamine is given and pericardial drainage is instituted. Resuscitative measures are started and continued while the patient is transferred rapidly to the operating theatre. During surgery, the pericardium is opened and aspirated, the bleeding site is repaired and emergency CMC is done. A valuable measure during resuscitation while preparing surgery is autohemoperfusion, where the aspirated blood from the pericardial drainage catheter is returned to the patient by a wide bore cannula inserted into a large vein.

Preferring CMC rather than OMC in such cases of failed MBV is because of several advantages. OMC requires longer set up period before starting the operation than CMC. This includes preparation of larger amount of blood, insertion of more monitoring lines, insertion of aortic and caval cannulae, preparation of the machine and calling up of senior anaesthetist and perfusionist. OMC entails also heparinization and heparinizing a patient in a bleeding episode is risky. In addition, to start with, the chosen candidates of MBV have generally lower mitral echo scores while those chosen for OMC have a relatively higher echoscores. (10,12) So, CMC, the counterpart of MBV for such low score candidates, is sufficient in this situation. Furthermore, the higher expenses of the OMC than CMC should be considered in such patients who already paid for the MBV. Most cardiac surgeons in Egypt are more familiar with the CMC technique and find it safer for such haemodynamically unstable patients.

During pregnancy, there are several physiological processes adding further burden to the heart. There is sodium and water retention increasing the plasma volume. The later increases from the sixth week of gestation, reaching its maximum by the second trimester and approximates 1 1/2 times normal by the time of delivery. (9) The cardiac output increases in the first trimester to reach 30-50% normal values during the second trimester. (9) There is also a fall in sestemic vascular resistance with slight fall in mean arterial pressure. (9) Tachycardia progressively occurs during

pregnancy and O2 consumption increases by 20% above normal by full term. (9)

For the foregoing reasons, patients with mitral stenosis may start to present by symptoms of pulmonary congestion starting from the 12th week to be aggravated further at time of labour. Maternal death may occur from pulmonary oedema failing to respond to medical treatment. (9)

Another risk is added to patients with mitral stenosis towards the end of pregnancy. The enlarged uterus by pressing on inferior vena cava in supine position will decrease the venous return, left atrial filling and left ventricular filling with consequent dramatic fall in cardiac output. This may explain sudden death of women with mitral stenosis with no previous congestive heart failure. (9)

It is our policy to intensify first the medical treatment for pregnant females with mitral stenosis who start to present with congestive symptoms and to resort to CMC when this fails. To decrease foetal and maternal morbidity and mortality, the decision of surgery sould not be delayed in the females with MVA < 1 cm2 especially those who did not pass a previous normal pregnancy or had a history of miscarriages.

In such emergency situation, most cardiac surgeons prefer CMC than OMC. (1,4,5,8) MBV has the potential risk of prolonged foetal irradiation. In addition, such orthopnoeic females may not tolerate the supine position for a long time during the procedure with the added risk of uterine compression on the inferior vena cava. On the other hand, OMC adds the potential hazards of heparinization and the reduction of uterine blood flow during bypass. Cardiopulmonary bypass and perfusion add the maternal risk of overinfusion, overloading the already congested lungs with pulmonary oedema. Becker, 1983, showed a general preference to CMC than OMC by the cardiac surgeons. (18) For 124 pregnant females with mitral stenosis, 101 CMC were done despite the fact that in western countries OMC is preferred more than CMC. Maternal survival was 100% in both groups. Foetal death was 2.97% with CMC and 4.35% with OMC. Premature labour was zero% with CMC and 8.7% with OMC. (18) In this study, no maternal or foetal deaths were reported with CMC. If the open heart surgery proceeded to MVR, the risk will increase for both the mother and foetus. (19)

For the last group of mitral stenosis with intractable congestive failure, CMC had several advantages over OMC. It is more rapidly and safely performed with a shorter operative time. It doeas not have the potential risk of over infusions during CPB aggravating the present pulmonary oedema. It is less expensive and our surgeons are trained to do it with much ease and success.

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Transesophageal and Transthoracic Echocardiography Versus Surgery in Assessment of left Atrial Thrombus

ABSTRACT

This is a prospective comparative study for fifty patients, thirty five (35) males (70%) and fifteen (15) females (30%), their ages ranged between 16 years and 47 years with mean age of 31±15.5 years.

Those patients had been investigated using transthoracic (T.T.E) and transesophageal (T.E.E.) to detect accuracy for presence or absence of left atrial thombus versus surgical findings. Showed absence of left atrial thrombus (L.A.T) in (38) patients (76%) and presence of (L.A.T) in (12) patients (24%) using T.E.E and confirmed by surgical findings. This proved a positive correlation between T.E.E and surgical findings.

We conclude that positive correlation between surgical findings and T.E.E findings is a good indicator for T.E.E to be done before mitral valve surgery.

Abbreviations

T.T.E. = Transthoracic echocardiography.
T.E.E. = Transesophageal echocardiography.
L.A.T. = Left atrial thrombus.
L.A.A.T. - Left atrial appendage thrombus. M.V. = Mitral valve. L.A.A. = Left atrial appendage. P.A. = Posteroanterior.

Farag Ibrahim Abdel Wahab M.D.* Esam Al-Garhy, M.D, Ahmed El-Sayed Mahmoud, M.D., Mohamed Salah El-Din, Abdel-Salam M.D., and Omar Osman El-Ghamry M.D.**

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Introduction

Thrombi in the left atrium are found in 16% to 64% of patients with rheumatic heart disease in surgical studies (1,2). The presence of left atrial thrombi was initially suggested by surgical studies. Two-dimensional transthoracic echocardiography has been used, although this modality has advantage of being non-invasive, there we well recognized limitations in detecting left atrial thrombi (L.A.T), especially those in the left atrial appendage (L.A.A). Transesophageal echocardiography (T.E.E) is found to be highly sensitive for detecting L.A thrombi (L.A.T) including left atrial appendage compared with direct visualization at time of surgery (1,2).

Patients and Methods

Fifty patients with rheumatic mitral valve disease referred from the Department of Cardiology to Cardiothoracic Surgical Unit, Al-Hussein University Hospital From March 1994 to July 1996 were enrolled in this study.

Fifteen (15) of patient were females and thirty five (35) were males, their ages ranged between 16 years and 47 years with mean age of 31±15.5 years.

Each patient in this study underwent the following:

* *Unit of Cardiothoracic Surgery, Faculty of Medicine, Al-Azhar University*

** *Cardiology Department, Faculty of Medicine, Al-Azhar University*

1. Complete clinical examination, including conventional 12 lead electrocardiogram and chest X-ray (P.A) and lateral views.

2. M-Mode, Two-dimensional and colour Doppler transthoracic Echocardiographic examination.

3. Transesophogeal echocardiographic examination.

4. The fifty patients of the studied group underwent surgical intervention.

Patients Classification:

In this study the patients were classified into three groups:

- The first group involved the patients who had predominant mitral stenosis.

- The second group involved the patients who had predominant mitral regurgitation.

- The third one involved the patients who had combined mitral valve disease.

The left atrium and left atrial appendage were studied by T.T.E and

T.E.E in all the patients to detect the presence or absence of L.A.T.

The presence of LA thrombus was established by demonstrating a well-circumscribed echogenic mass with echo-texture from that of the atrial wall, despite of alteration in gain settings.

Surgical study:

All patients who were involved in our study underwent open surgical intervention, the intra-operative surgical data (as regard sites and sizes of the thrombi) were studies for each patient, concerning with left atrial thrombus and mitral valve morphology with left atrial appendage thrombi. Operation was done for every patient including removal of L.A.T or L.A.A thrombi, excision of mitral valve (M.V) leaflets was done except in (8) cases (16%) were preserved posterior mitral leaflet Mitral replacement was done using prosthetic bileaflet valves of different sizes and plication of L.A.A in 12 cases (24%) with posterior and para-annular plication was done in markedly enlarged left atial size. In one case, removal of huge left atrial thrombus (L.A.T) associated with left atrial decortication was performed.

Results

Fifty patients with documented mitral valve diseases were studied by transthoracic echocardiography (T.T.E) and transesophageal Echo cardiography (T.E.E) before surgical intervention. The echocardiographic results were compared with surgical data especially for the presence of left atrial thrombus (L.A.T) and left atrial appendage (L.A.A.T).

T.T.E and T.E.E versus surgery in detection of L.A.T:

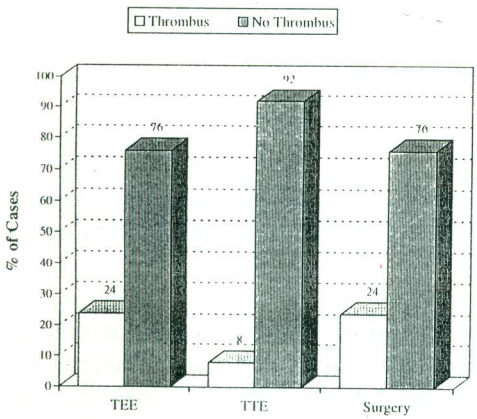
In this study 12 patients 24% had left atrial thrombus which was detected by TEE and its presence was proved by surgery (table, 1 fig.1), 76% of patients (38) had no thrombus, TTE had no ability to detect the left atrial thrombus in all patients, it could detect left atrial thrombus in only four patients 8% and another 92% of patients (46) had no thrombus by T.T.E (table 2, fig. 2).

Table (1): TEE and TTE versus Surgery in detection of LAT:

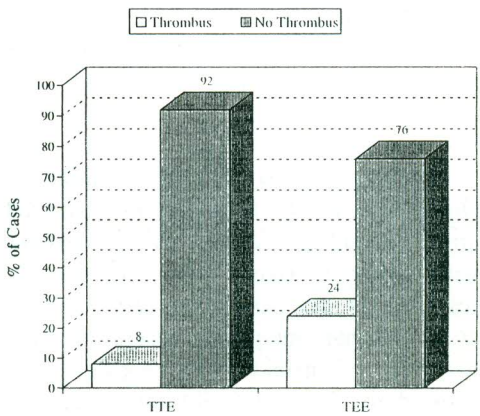
No. of cases	TEE	%	TTE	%	Surgery	%
Thrombus	12	24	4	8	12	24
No thrombus	38	76	46	92	38	76

Table (2): TEE versus TTE in detection of LAT:

No. of cases	TTE	%	TEE	%
Thrombus	4	8	12	24
No thrombus	46	92	38	76



(Fig. 1) Comparison of TEE, TTE versus surgery in detection of LAT



(Fig. 2) TTE versus TEE in detection of left atrial thrombus

Transthoracic echocardiography detected only a big left atrial thrombi in these patients, in (four cases) despite the presence of left atrial appendage thrombi in (two cases) which were detected by TEE (table 3).

Table (3): TTE versus TEE in detection of LAT site:

	L.A apendage	L.A (apical)	L.A (Post. Lat)
TEE	9	4	1
TTE	-	4	-

Table (4): Comparison between TEE and TTE results:

TEE	TTE				Total	
	Thrombus		No thrombus			
	No	%	No	%	No	%
Thrombus	4	8	8	16	12	24
No thrombus	0	0	38	76	38	76
Total	4	8	46	92	50	100

Total Chi-square=1.1 P>0.01 Insignificant

Transesophageal echocardiography characterized by its ability to detect left atrial appendage thrombi in nine patients with different sizes, very big size was recorded in one patient and very small size as in another one patient besides its ability to detect left atrial thrombi in general, who showed big left atrial thrombi and patient who showed posterolateral big left atrial thromus (table 3).

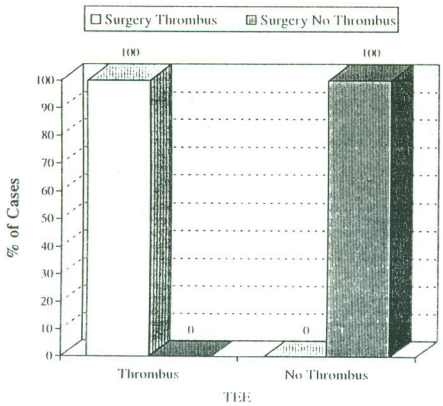
So, there is a weak correlation between TTE and TEE in detection of left atrial thrombus especially left atrial appendage, thrombus, correlation value = 1.1 with insignficant statistical value P>>0.01 (table 4).

The surgical results were in agreement with TEE results, the same patients who detected LAT by T.E.E (12 patients) had left atrial thrombus by surgery. So, there is a very strong correlation value between T.E.E and surgery in detection of left atrial thrombus, correlation value = 50 with highly statistical significance P<<0.001 (table 5, fig. 3).

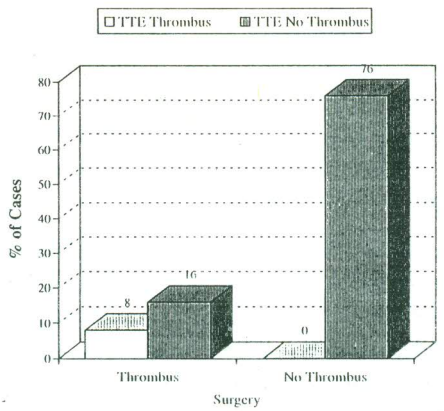
Table (5): Comparison between TEE and Surgical results:

TEE / Surgery	Thrombus		No thrombus		Total	
	No	%	No	%	No	%
Thrombus	12	100	0	0	12	24
No thrombus	0	0	38	100	38	76
Total	12	100	38	100	50	100

Total Chi-square=50 $P \leq 0.001$ Significant



(Fig. 3) Comparison between TEE and surgical results



(Fig. 4) Comparison between TTE and surgical results

According to this agreement between surgical transesophageal results we found that there is weak correlation between surgery and TTE in detection of L.A.T, with insignificant statistical value P>>0.01 (table 6 and fig. 4).

Discussion

Left atrial thrombus is a common pathological finding in rheumatic mitral valve disease (3). Transthoracic echocardiography (TTE) is a useful and traditional technique for the evaluation of left atrial thrombus (LAT).

However, there are several limitations to this approach, particularly for patients who are obese, have emphysema, chest deformities, or thrombi in left atrial appendage (4,5). The left atrial appendage was best visualized in patients with markedly enlarged left atria (5).

Table (6): Comparison between Surgical and TTE results:

TTE / Surgery	Thrombus		No thrombus		Total	
	No	%	No	%	No	%
Thrombus	4	8	8	16	12	24
No thrombus	0	0	38	76	38	76
Total	4	8	46	92	50	100

Total Chi-square=1.1 P>0.01 Insignificant

Transesophageal echocardiography (TEE) has provided a new acoustic window to the heart, which allows high quality imaging of the left atrium, so that diagnosis of left atrial thrombus can be unequivocally made. (6)

There has been an increasing interest in comparing (TEE) and surgery for detection of left atrial thrombi in mitral valve disease. (Andress et al., 1991)(7) showed in their study which included 100 patients who had mitral valve disease that (38) patients had left atrial thrombus detected by (TEE). and 20 patients underwent surgical intervention, all of them showed left atrial thrombus, with accuracy of 100% (7).

Many previous studies concerned with comparison between (TTE) and surgery for detection of LAT in mitral valve disease. (Andress et al., 1991) (7) found in their study which included (100) patients had mitral valve disease that (18) patients had left atrial throumbus detected by (TEE) (20) patients underwent surgical intervention, all of them showed left atrial thrombus which indicated the weak correlation TTE and surgery for detection of (LAT) (7)

The same results were proved by (Shoa-Lin et al., 1992) (8) studies, (TEE) identified (21) (19.1%) of (110) patients had mitral valve disease with left atrial thrombus. Among the (21) patients who underwent surgical intervention, (13) were found to have left atrial thrombi. (TEE) visualized the left atrial thrombi in these (13) patients, with a sensitivity of 100%) specificity of 100%) and accuracy of 100%. (8)

Thomas et al., 1992 (9) also found in their study that left atrial thrombus was detected in 6/35 patients had rheumatic mitral valve disease by (TEE), thrombus was confirmed at mitral valve replacement in five patients. (9)

Thomas et al., 1992 (9) found in their study that left atrial thrombus was detected by (TTE) in (1/35) patients had mitral valve disease, the thrombus was confirmed at

Table (7) Correlation of Surgical findings versus TTE and T.E.E

Authors	No. of patients	Thrombus by		Correlation of surgical findings with	
		TTE	TEE	TTE	T.E.E
Andress et al., 1991	100	18/100	20/100	20/100 Weak correlation	20/100 positive (+ve) strong correlation
Shoa Lin et al., 1992	110	-	21/100	-	13/12 + ve
Thomas et al., 1992	35	1/35	6/35	5/35 Negative (-ve) correlation	5/35 +ve
This study	50	-	12/50	12/50 - ve	12/50 + ve

mitral valve replacement in five patients (9) This data were in agreement with our present study which showed no correlation between (TTE) and surgery for detection of left atrial thrombus (LAT).

These results were in agreement with our study which showed a complete correlation between surgery and transesophageal echocardiogram. Left atrial thrombus was detected in (12) patients by (TEE) and all of them showed left atrial thrombus bu surgery P<<0.001 (table 7) (fig. 5,6 &7).

All patients in this study did not have thrombus in left atrium by TTE, but in the same time, left atrial thrombus was present by T.E.E in (12) patients and confirmed at mitral valve surgical intervention (table 7), so, the assessment of mitral valve morphology is very important prior to mitral valve surgical intervention.

Summary

Transesophageal echocardiography (T.E.E) has become established as a very important investigation in the cardiac laboratory due to its superiority in detection of many structures than transthoracic echocardiography.

The results of this work to give highlight the importance of transesophageal echocardiocardiography (T.E.E) in detection of left atrial thrombi which was confirmed by surgical data in contrast to transthoracic echocardiography which had very limited value.

Conclusion

Surgical confirmation to the role of T.E.E is an efficient approach in detection of L.A.T and L.A.A.T., and it is indicated for patients with mitral valve disease who had suspicion of left atrial thrombus before surgical intervention.

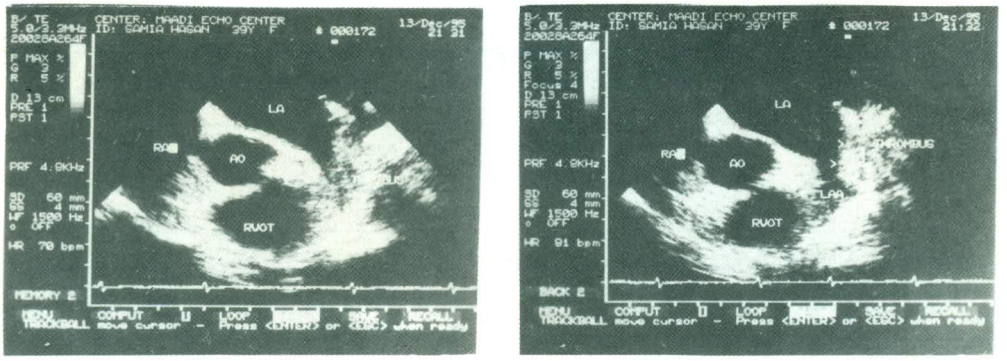


Fig. 5: Transesophageal echocardiography basal short axis view demonstrating thrombus left atrial appendage.

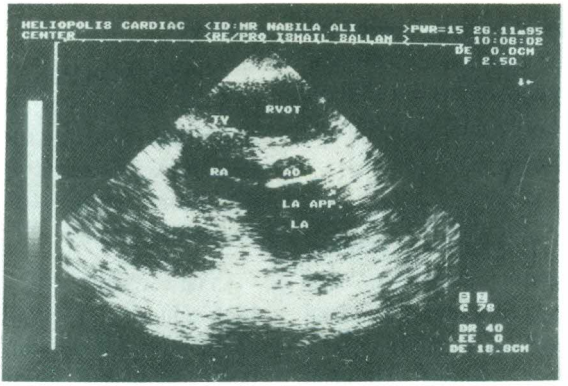


Fig. 6: Transesophageal echocardiography basal short axis view demonstrating lateral wall left atrial thrombus extending to the apex including left atrial appendage.

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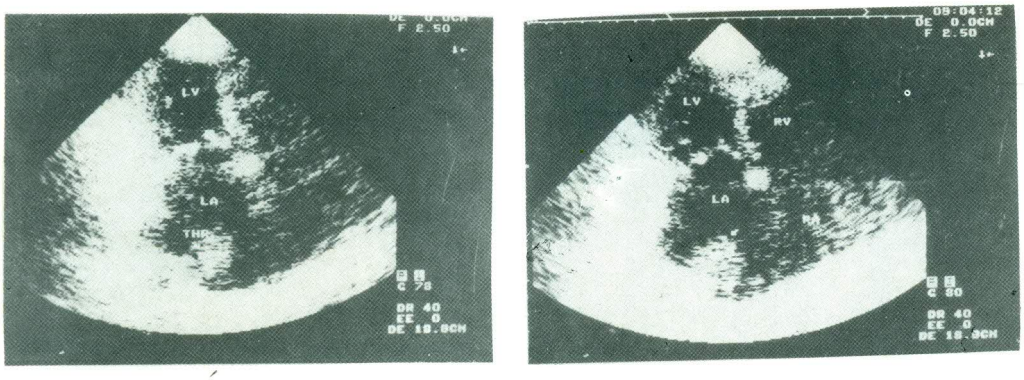

Fig. 7: Transesophageal echocardiography four chamber short axis view demonstrating big apical left atrial thrombus. Dilated left atrium with big left atrial thrombus (LAT) attached to its posterior and superior wall.

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Trans-Septal Surgery for Mitral Valve is It a Necessity ?

ABSTRACT

We looked at an important sector of our population (Mitral valve disease) undergoing mitral valve surgery to evaluate transseptal approach.

We have studied 20 patients who underwent mitral valve surgery at cardiothoracic surgery departement Tanta University Hospital either alone or in combination with other valvular surgery , via trans septal route.

We found that transseptal approach provides adequate surgical exposure in most of cases, average operative time, secure suture lines and we report one complication of, one case complicated by complete heart block necessitating permenant pace-maker implantation.

We concluded hat transseptal approach is an alternative approach to mitral valve especially in patients with small or inaccesable left atrium, associated tricusped valve lesion and in patients with dense adhesions.

Ehab A. Wahby - Abd El-Hady M. Taha - Hamed M. Al-Akshar

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Introduction

Mitral valve surgery is becoming a routine procedure in all centres of cardiac surgery.

* Good exposure is mandatory for mitral valve operations, but the mitral valve visualization may not be adequate via traditional left atriotomy so, many authers advocated various surgical techniques to approach the mitral valve (1). There are some situations under which the exposure of the mitral valve may be difficult via left atriotomy such as :-

* Cases with small left atrium

* Presence of dense adhesions from previous operations or recurrent attacks of rheumatic activity .

* Presence of large organized left atrial thrombus .

* Atrial calcifications .

* Congenital anomalies of the heart or thorax .

* Patients with deep chest (2).

When the right atrium is to be opened for correction of associated tricusped valve lesion, the mitral valve may be approached via septal incision (3).

Early in development of cardiac surgery Julian and his colleagues described the transseptal approach via the long axis of the fossa ovalis to expose the mitral valve (4). Other authors used various technical modifications of the transseptal approach. Dubost et al (1966) extensively used a transverse biatrial incision (5).

Browley (1980) combined a transverse right atriotomy with an incision in the

Cardiothoracic Surgery Unit, Tanta University

Table 1: Mitral operative procedures during 1995

Total Number	Type of procedure
15	- Double valve: aortic and mitral replacement
44	- Mitral valve replacement
4	- Open mitral commissurotomy
2	- Ring annuloplasty of the mitral valve.
4	- Aortic valve replacement and open mitral commissurotomy
1	- Aortic valve replacement and mitral ring annuloplasty
1	- Aortic valve replacement, open mitral commissurotomy and tricusped repair.
6	- Open mitral commissurotomy and tricusped repair.
1	- Mitral valve replacement and aortic valvotomy.

interatrial septum prependicular to the original longtudinal left atriotomy (6). McGrath et al (1988) again used a right atriotomy then septal incision in the fossa ovalis for mitral valve exposure (7). Alfier et al (1991) extended the septal incision into the roof (dome) of the left atrium (1).

Some authors claimed that trans-septal approach is associated with rhythm disturbance and interatrialshunts (8).

Aim of the work

The aim of this work is to evaluate the mitral valve surgery via trans-septal approach

Patients and methods

During the last year (1995) we have performed 78 cases of mitral valve surgery 40 females and 38 males their ages ranged from 16-48 years, with a mean of 21±0.7 The mitral valve surgery was done alone or in combination with other surgery such as aortic valve replacement, tricusped repair and left atrial thrombectomy. The mitral valve surgery was in the form of either replacement, ring annuloplasty or open mitral commissurotomy (Table 1).

Out of those 78 patients 20 patients underwent the mitral valve surgery using the transseptal approach.

Those patients were operated upon via transseptal approach due to either presence of small left atrium, presence of adhesions due to past history of previous closed mitral commissurotomy or presence of associated tricusped valve lesions necessitating right atriotomy or combination of these factors (Table 2).

Table 2: Operative procedures via trans-septal approach

Total Number	Type of procedure
6	- Open mitral commisurotomy and tricusped repair.
1	- Mitral valve replacement and aortic valvotomy.
1	- Aortic valve replacement, open mitral commissurotomy and tricusped repair.
2	- Aortic valve replacement and open mitral commissurotomy.
6	- Mitral valve replacement.
2	- Double valve replacement.
2	- Open Mitral commissurotomy.
20	**Total**

All patients are subjected to routine studies, complete Echo study and complete ECG study.

Surgical technique of the trans septal approach :-

Preparation of the patients as usual, cardiopulmonary bypass was established utilizing the ascending Aorta for the site of arterial inflow and indirect bicaval cannulation for venous inflow.

Aortic cross clamping, cardioplegia was infused via Aortic route cannula, the venous cannulae were snared and right atriotomy were performed anteriorly and parallel to the interatrial groove by distance of about 2-2.5 cm. between the venous cannulae, it may extend to the Rt. atrial appendage. The septal incision was done in the posterior portion of fossa ovalis and extended superiorly and inferiorly, but great care was made to avoid injury of the coronary sinus ostium and the area of Koch's triangle. Using simple right angled retractors to retract the right atrial and septal edges. The mitral valve is readily exposed and the mitral valve surgery was done either replacement or open mitral commissurotomy. After completion of mitral valve surgery, the septal incision was closed by continous monofilament polyprolene 4/0 suture, then the tricusped valve repair was performed either before or after removal of aortic cross clamp. Then closure of right atriotomy was made by continous, monofilament, polyprolene 3/0 suture in 2 layers. Because of the thin right atrial wall good haemostasis must be performed. Weaning of the patient from cardiopulmonary bypass, closure of median sternotomy.

Transseptal approach was evaluated operatively and post-operatively.

Table 3: Indication of transseptal opproach.

Total Number	Indication
7	Associated tricusped valve repair.
10	Small left atrium.
3	Previous operation (CMC) with adhesions.

Table 4: Age and sex of the studied group.

Total Number	Indication
Total Number	20
Age	29.0.7+9.37
Sex	M 12 F 8
	M 60% F 40

Table 5: Rhythm of the patients

No. of cases	Preoperative	Postoperative
10	Sinus	Sinus
9	AF	AF
1	Sinus	heart block

I. Operatively by:-

* Field of exposure
* Technical problems and complications
* Suture lines

Operative time including; ischaemic time and total bypass time

II. Post-operative course of the patients was evaluated with special stress on study of the rhythm and its changes. Complete Echo doppler study to evaluate integrity of the atrial septum.

Results

*** Feild of exposure :**

The transseptal approach found to be adequate in 17 patients (85%), difficult exposure was met in 3 patients (15%) who needed forceful retraction of the septal edges to expose the mitral valve and to maintain this exposure. There was no need to complete the surgery via left atriotomy.in these patients.

*** Operative time :**

The operative time of the cases operated upon by the transseptal approach was average. The ischaemic time was 35.9 ± 6.3 for mitral valve replacement and 29 ± 1.4 for open mitral commissurotomy and total bypass time was 53 ± 6.3 for mitral valve replacement and 35.6 ± 5.6 for open mitral commissurotomy.

*** Technical problems & complications**

* One patient was complicated by complete heart block, that patient needed temporary implantation of pace-maker then permenant pace-maker was implanted postoperatively.

No technical problems were met by using the transseptal approach.

*** Suture lines :**

The sutures lines was closed securely but additional sutures were needed to reinforce the right atrial wall incision.

No bleeding related to the suture lines was noted.

*** Post-operative drainage :**

No incidence of postoperative bleeding necessitating postoperative exploration .

Total drainage was (389 ± 0.5) average .

*** Rhythm disturbance :**

By continuous monitoring of the patient and complete ECG study the rhythm of the patients was studied and compared with preoperative ECG. We met one case of complete heart block that required pace maker implantation which (Table 5) represents (5%) . Apart from this patient no changes of the rhythm occured .

Complete echo doppler study :

Postoperatively it showed no residual atrial septal defects following the septal incision .

* We met no mortality in this studied group.

Discussion

Mitral valve surgery can be performed more readily when optimal exposure is obtained. In most cases this is obtained via traditional left atriotomy (10).

* Other surgical approaches to the mitral valve was described including the transseptal approach and its technical modifications [2,4,5,6,7]

* In our studied group we used the transseptal approach for 20 patients and these patients underwent mitral valve replacement or open mitral commisurotomy, alone or with other valvular surgery. The indications were :

1) Small atrium.

2) The presence of associated tricusped valve lesion .

3) The possibility of presence of adhesions from previous closed mitral commissurotomy or recurrent rheumatic attacks .

4) Combination of those factors .

We have found that this approach provides adequate surgical feild exposure in most of cases and it provides visualization of the mitral valve components however, forcefull retraction may be needed for exposure, this results is in agreement with most authors used this approach such as McGrath et al (1988) who adopted this approach for routine use for mitral valve surgery specially if associated with tricusped valve operation.

We also found that this approach was associated with secure suture lines and no residual interatrial shunts occured following closure of the septal incision, our results is in agreement with McGrath et al (1988 (7), Berreklow et al 1991 (13), but Alfier et al 1991 (1), in their study on 108 patients found that, cardio pulmonary bypass was reinstituted for one patient because of incomplete closure of the septum.

Rhythm disturbance accurs postoperatively after transseptal approach due to either:-

1) Excessive atrial retraction

2) Atriotomy and interruption of the conduction pathway between S.A. node and A.V. node.

3) Division of the sinus node artery however the effects of division of sinus node artery on S.A. node function is not established as Michelle and Yacoub in 1985 found that the recipient sinus node function remain intact in patients who previously underwent cardiac transplantation (11).

Also, the spread of impulses between S.A node and A.V. node is more rapid through the thicker anterior limbus in contrast to slower conduction through the fossa ovalis. (12)

In our studied group we had one case in whom complete heart block occured (5%). Apart from that patient no rhythmic changes occured. Alfeir et al 1958 (14), found that little injury of the conduction pathway when entery to the left atrium was obtained by an incision in the fossa ovalis. Bowman and Malm at 1956 (15), found that temporary artio ventricular dissociation was encountered as a common complication of transseptal approach. But, it is important that Bowman and Malm's incision was through the anterior limbus in which more rapid spread of atrial conduction occurs through it in contrast of the usual transseptal approach confined to the fossa ovalis. McGrath et al 1988 (7), found that no episodes of transient or permenant atriovetricular dissociation in his group of study (12 patients). Calderon and Verdin 1993 found no atrial dysrhythmia was associated with transseptal approach to the mitral valve. (16)

Conclusion

The transseptal approach is an alternative approach to assess the mitral valve specially in patients with small left atrium, associated tricusped valve lesion needing correction via right atriotomy, patients with dense adhesions and in patients with deep chest.

The long term effects of this approach on the conductivity or cardiac rhythum needs more study on large group of patients and for long term follow up.

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CT and Surgical Evaluation of Pulmonary Hydatid Disease

ABSTRACT

Fourteen patients with pulmonary hydatid disease were prospectively evaluated with respect to computed tomography and surgical intervention. On the basis of localization and multiplicity, the cysts were divided into single unilateral in 7 cases (50%), single bilateral in 2 cases (14.3%), multiple unilateral in 2 cases (14.3%), and multiple bilateral in 3 cases (21.4%). On the basis of density and clinical picture, the cysts were divided into simple cysts in 5 cases (35.7%), infected cyst in 1 case (7.1%) and ruptured cysts with cystobronchial communication in 8 cases (57.2%). All cases were proved by serological tests. Five cases (35.7%) were not candidates for surgery and were treated medically by mebendazole. Nine cases (64.3%) were surgically treated and the diagnosis was confirmed by pathological examination of the cysts. Limited pulmonary procedures were done in 11 out of 13 (84.6%) major surgical procedures in the form of enucleation of the cyst, segmental resection or middle lobectomy. Right upper and left lower lobectomies were done in 2 out of 13 (15.4%) major surgical procedures. In one of them (7.7%) median sternotomy was done for right upper lobectomy for ruptured cyst and for enucleation of a left lower lobe simple cyst. Prolonged air leakage followed one operation (7.7%) and was controlled in a few weeks. There was no mortality in our study.

S.A. Khalaf M.D., M. Abd El-Shahead M.D., T.A. Amer M.D., and M.E. El-Desouky M.D.

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Introduction

Echinococcosis is a widespread disease in many temperate and subtropical regions of the earth, particularly in meat producing countaries where it has endemic character. The occurance of the disease in man appears to be limited geographically to areas where close and continuous contact exists between domesticised carnivores such as dogs and ungulates such as cattle and sheep (Abul Ela et al., 1991).

Pulmonary hydatid disease presents a wide range of radiological findings. Some of the x-ray appearances are characteristic of hydatid disease. However, others may present a diagnostic problem (Balikian and Mudarris, 1974 and Beggs 1985).

CT of the chest may help in the diagnosis by revealing the fluid density of a cystic lesion (intact cyst), the air fluid density of a cystic lesion (ruptured cyst), and the solid density of a complicated cyst (Saksouk et al., 1986). Surgery is the treatment of choice for the disease whenever possible. The choice of the surgical technique depends on the number, site, size, and condition of the cysts as predicted radiologically and this is confirmed during thoracotomy (abul Ela et al., 1991).

The aim of this work is to discuss CT appearances of pulmonary hydatid disease and to evaluate these cysts surgically.

From the Dep. of Cardiothoracic Surgery, Diagnostic Radiotherapy, and Chest Medicine Diseases. Mansoura University

Table I: Clinical presentation

Clinical presentation	*No. of cases*	*%*
Cough	4	28.6
Discovered accidently	3	21.4
Dull aching chest pain	2	14.3
Expectoration of salty sputum	2	14.3
Abdominal pain with splenic and or liver affection	2	14.3
Haemoptysis	1	7.1
Total	14	100

Table 2: Localization of 37 pulmonary hydatid cysts.

Site	No. of cysts	%
Right lower lung zone	12	32.4
Left lower lung zone	12	32.4
Right upper lung zone	4	10.8
Right middle lung zone	4	10.8
Left middle lung zone	3	8.2
Left upper lung zone	2	5.4
Total	37	100

Patients and Methods

All patients suspected to have pulmonary hydatid disease by plain X-ray chest and those who had intraabdominal cysts suggested to be hydatid cysts by ultrasonography were referred to do CT scan of the chest in CT unit in the Radiology Department. All patients were referred from Chest Medicine Diseaes and Cardiothoracic Surgery Departments. From those patients, 14 were proved by CT scan to have pulmonary hydatid cysts and the diagnosis was confirmed by serological test in all patients (100%) and by pathological examination of resected specimens in 9 patients (64.3%) treated surgically. The study included14 patients, 10 males (71.4%) and 4 females (28.6%), and their ages ranged from 12 to 59 years (m.32.3). Chest X-rays, posteroanterior and lateral views were done for all patients. CT scans (Chest and abdomen) were done for all patients by Philips Tomoscan Scanner (matrix: 320x320) using 230-350 mA; 125 KVP and 4.5 second scan time. Slice thickness was 9mm, and interslice gap was 10mm. All scans were made after injection of I.V. contrast medium. Full haematological picture was done before surgery. Nine patients were selected for surgical treatment, and 5 patients were treated medically.

Table III: Classification of pulmonary hydatid cysts according to multiplicity and localization.

Type	No. of cases	%
Unilateral single cysts	7	50
Bilateral single cysts	2	14.3
Unilateral multiple cysts	2	14.3
Bilateral multiple cysts	3	21.4
Total	14	100

Table IV : Classification of pulmonary hydatid cysts on the basis of density and complications.

Type	*No. of cases*	*%*
Ruptured cyst	8	57.2
Simple cyst	5	35.7
Infected cyst	1	7.1
Total	14	100

Table V : Methods of treatment of pulmonary hydatid disease.

Methods	*No. of cases*	*%*
Surgical treatment	9	64.3
Medical treatment	5	35.7
Total	14	100
Surgical treatment	***No. of operations***	***%***
Enucleation of the cyst	6	46.1
Right middle lobectomy	3	23.1
Right anterior basal segmentectomy	1	7.7
Left lower lobectomy	1	7.7
Right upper lobectomy , and	1	7.7
enucleation of left lower lobe cyst both	1	7.7
through median sternotomy		
Total	13	100

Table VI: Distribution of enucleated pulmonary hydatid cysts.

Site	*No. of cysts*	*%*
Right upper lobe	5	41.7
Left upper lobe	2	16.7
Left lower lobe	2	16.7
Right lower lobe	1	8.3
Middle lobe	1	8.3
Right inferior pulmonary ligament	1	8.3
Total	12	100

Results

Our results are summerized in tables 1-6. Our 14 patients had 37 pulmonary hydatid cysts. The most common symptom was cough (28.6%). There was equal distribution of the cysts in both right and left lower lung zones (32.4% for each). Unilateral single cysts were found in the majority of cases (50%). Simple non complicated cysts were found in 35.7% of cases. Fig. 1-4 represent the plain chest x-ray, abdominal ultrasound, chest CT, and postoperative chest x-ray respectively of one patient.

These cysts were found as well defined hypodense nonenhancing masses of regular outline. Their internal contents were of fluid denisty (range from 3 to 29 H.U.). Enucleation of the cysts were done for these simple cysts.

Ruptured and infected cysts were found in 57.2% and 7.1% of cases respectively, and segmental resection and lobectomy were indicated in these two groups. Surgical treatment was indicated in 64.3% of cases while medical treatment was indicated in 35.7% of cases.

In only one case the wall of a simple cyst was calcified (Fig.5). Only one cyst was infected (Fig.6) with high density number than that of the simple cysts. Fig. (7) represents plain x-ray chest of a huge left hydatid cyst. Fig. (8) is the left lateral view of the same patient. Fig (9) is the chest CT of the same patient with crescent (moon sign-meniscus sign) which is considered as a sign of impending rupture.

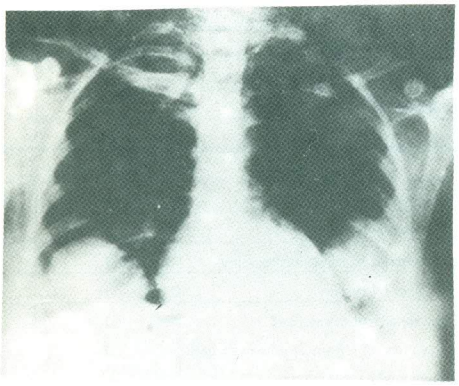

Fig. 1: Plain x-ray chest with bilateral basal hydatid cysts.

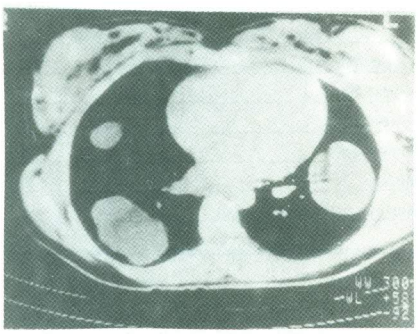

Fig. 2: Chest CT scan of the same patient with bilateral multiple pulmmonary hydatid cysts.

Ruptured cysts with intracystic gas contents were seen in 8 cases. Of these cysts, one was completely empty except for the retained endocystic membrane (Fig. 10), two cysts showed membrane floating on a fluid level which is known as "water lily" sign (Fig. 11), one cyst showed "double arch sign of Cumbo" with gas and fluid content (Fig. 12) and the remaining four cysts were completely full of air due to cystobronchial

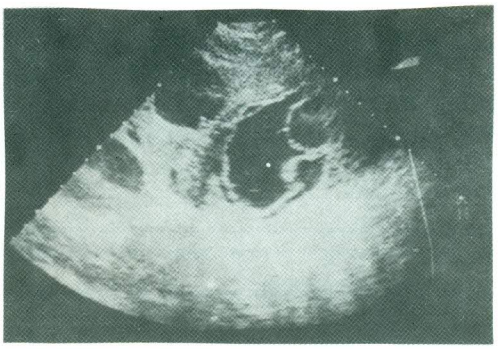

Fig. 3: Abdominal ultrasound of the same patient with mltiple hepatic hydatid cysts with cyst within cyst appearance in the largest one of them.

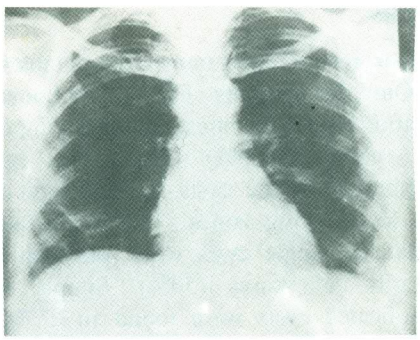

Fig. 4: Plain chest x-ray of the same patient after the second operation with complete disappearance of the cysts.

communication (Fig. 13). Associated intraabdominal hydatid cysts were detected in 6 cases (42.8%) (Fig. 10). Fig. 14 represents simple hydatid cyst in the left lower lobe and ruptured hydatid cyst in the right upper lobe. This patient was managed by median sternotomy with enucleation of the simple cyst and right upper lobectomy. Fig. 15 represents the postoperative chest x-ray for the same patient.

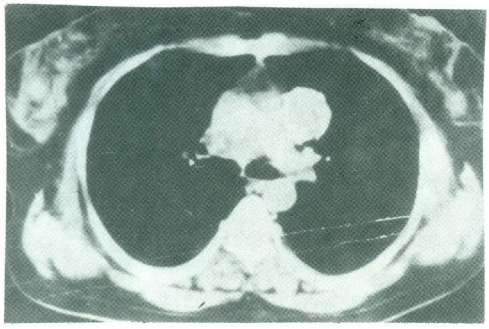

Fig. 5: Left single cyst with well defined curvilinear calcification of its wall.

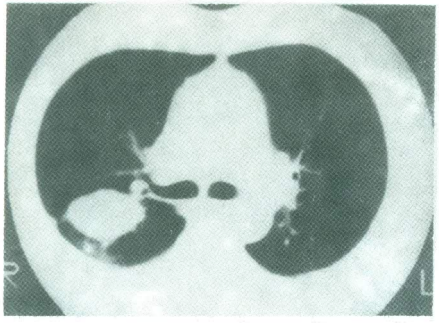

Fig. 6: Right infected cyst in CT with increased denisty proved at operation.

Two cysts ruptured during surgery due to high intracystic pressure and the fluid was adequately irrigated. One patient showed prolonged air leakage for a few weeks after enucleation of the cyst, but improved later with full lung expansion using thoracostomy tube drainage. There was no mortality in our study.

Discussion

The most common location of hydatid cysts in human is the liver (75%), followed by the lungs (15%), followed by other parts of the body (10%) (Beggs, 1985). Among

Fig. 7: Plain x-ray chest showing a huge left pulmonary hydatid cyst.

Fig. 8: Left lateral view of the same patient showing well defined borders than in the P.A. view.

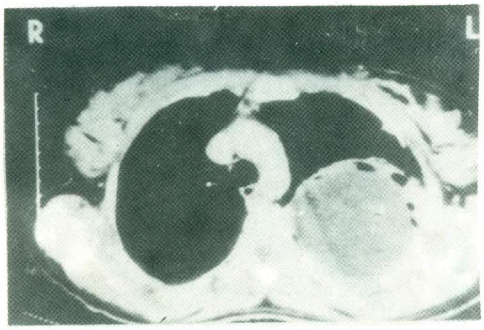

Fig. 9: Chest CT of the same patient showing a large cyst with a small amount of perivesical air ("moon sign"- "crescent sign"- "meniscus sign") denoting impending rupture.

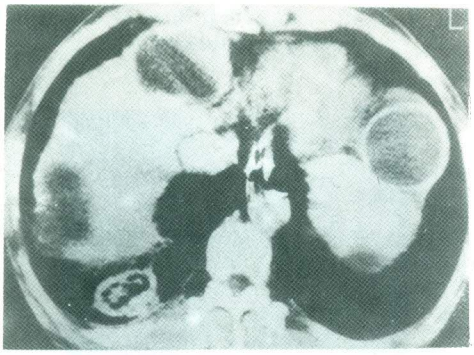

Fig. 10: Right ruptured cyst with a crumpled membrane seen inside it associated with some air content. Hepatic and splenic cysts are also noticed.

the series of Gouliamos et al., 60% of pulmonary hydatid cysts were solitary and 40% were multiple (Gouliamos et al., 1991). We have nearly similar results with solitary hydatid cysts in 64.3% and multiple cysts in 35.7% of cases. Le Roux in his retrospective series of 100 cases found solitary pulmonary hydatid cysts is 73% of

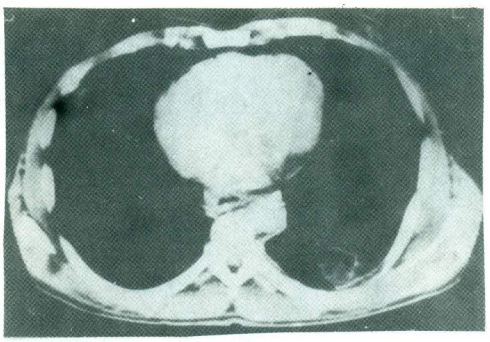

Fig. 11: Left cyst with a membrane floating on the fluid "water lily sign".

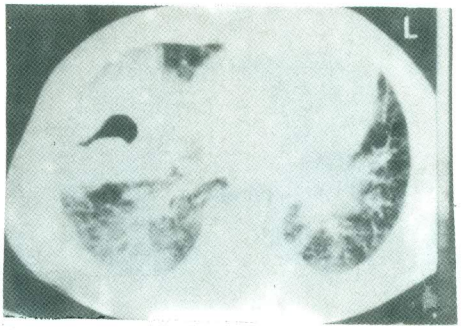

Fig. 12: Right ruptured cyst with "double arch sign of Cumbo".

cases and multiple cysts in 27% of cases (Le Roux, 1981). Most of the cysts in our series were simple and showed well defined thin walls with fluid content. One cyst was proved to be infected with increased density. Ruptured cysts were seen in 8 patients (57.2%). Most of the cysts were seen in both lung bases (32.4% for each lung base). In four cases (28.6%) there was suggested dissemination of the disease from the subdiaphragmatic hydatid cysts (Fig. 10). In these cases, CT scanning provides a road map and has an advantage over plain

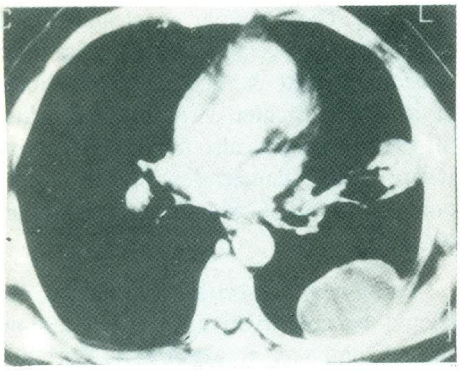

Fig. 13: left two lung cysts one of them is simple. The other is ruptured with much internal air due to cystobronchial communication.

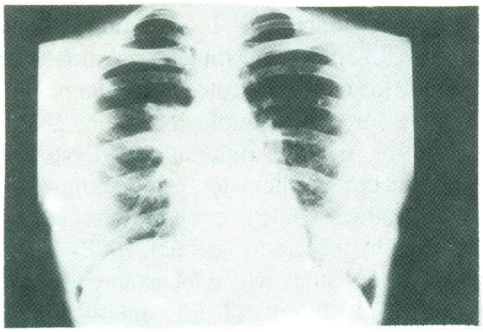

Fig. 14: Simple cyst in the left lower lobe and ruptured cyst in the right upper lobe.

radiography and can modify the surgical approach (thoraco-abdominal approach instead of separate abdominal and thoracic approaches). Chest CT scanning provides also the accurate location, number and size of the cyst, whether it is ruptured or not, if there is other complications, as well as the different radiologic signs diagnostic of hydatid disease. Computed tomography can

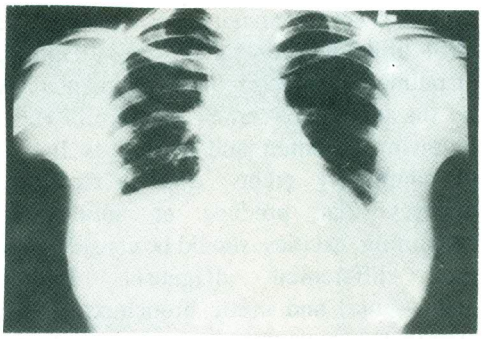

Fig. 15: Postoperative chest x-ray for the same patient in Fig. (14) Exploration was done through median sternotomy with enucleation of the simple cyst in the left lower lobe and right upper lobectomy.

be of value in detection of small lesions particularly those in areas partially hidden in chest x-ray films. Also, CT is superior to plain radiography in the cystic characterization of the parenchymal abnormality. Furthermore, determination of the wall thickness is more accurate with CT, as compared with other diagnostic modalities.

Multiple hydatid cysts present a diagnostic problem since they should be differentiated from metastatic disease and granulomatosis. Gouliamos et al., (1991) reported that 50% of benign pulmonary lesions will have low CT numbers. Howevere, the presence of other findings, such as detached endocystic membrane floating within the fluid content of a pulmonary cyst, increase the specificity of CT scanning. Complicated hydatid cysts, either ruptured or infected, are also difficult to differentiate from other cavitary lesions,

such as active cavitary tuberculosis. The most difficult problem in the CT diagnosis of pulmonary hydatid disease is the increase in the attenuation numbers (above 25 H.U.) following infection and/or fibrosis. In case of completely empty cysts, a variety of diseases that produce or mimic air-containing cavities should be considered in the differential diagnosis. Bullous emphysema and cystic bronchiectasis are among the most common of these lesions (Shamji et al., 1988).

Considering the classic roentgenographic findings, we observed the crescent sign (Fig. 9) in one case (7.1%) in contrast to Gouliamos et al., 1991 who did not observe it. The "double arch" sign or "Cumbo's" sign was noted in one case (7.1%) of a ruptured cyst (fig. 12). "Water lily" sign was detected in two cases (14.3%) (fig. 11). "Ring within -a-ring" sign was described by Aggarwal et al., in 1989 (Aggarwal et al., 1989). It was seen in one case (7.1%) in our series. None of these radiologic signs was seen in Abul-Ela et al series (Abul-Ela et al., 1991). In one case (7.1%), the cyst showed well defined wall calcification (Fig. 5). The "membrane" sign was described by Maden et al in 1992 (Maden et al., 1992). This sign was not observed in our series.

The optimal treatment of pulmonary hydatid cyst is surgical removal. Peschiera in 1964 advocated conservative pulmonary operations whenever possible (Peschiera, 1964). This is also true in our study where conservative pulmonary operations were done in eleven out of thirteen major operations (84.6%). The majority of surgeons favor simple enucleation of the intact cyst, specially if it is not under tension (Barrett & Thomas, 1952, Wolcott et al., 1971, Lichter, 1972 and Xanthakis et al 1972). This was also favored in our study where simple enucleation of the cyst was done in 12 out of 18 cysts surgically treated (66.6%).

Pulmonary resection for hydatid cysts should be conservative as the disease may recur (xanthakis et al., 1972). Barrette in 1978 advocated segmental or wedge resection for cysts up to one inch in diameter (Barrett, 1978). In our study, limited pulmonary resection was done in the form of right middle lobectomy in 3 operations (23%), and right anterior basal segmentectomy in 1 operation (7.6%). Three of these four limited resections were done for noncomplicated cysts and one was done for right middle lobe lung abscess resulting from a ruptured cyst. Cysts from 1-5 inches in diameter can be removed by enucleation, while very large cysts are best treated by lobectomy (Barrett, 1978). This is true in our study where lobectomy was done in only 2 out of 13 major surgical procedures (15.4%) for large pulmonary hydatid cysts. So, conservative pulmonary operations were done in 84.6% of our operations. Conservative pulmonary operations were also used by Peschiera, 1964, and Barrett, 1978.

Concomitant control of pulmonary and hepatic cysts could be done in the same setting through an incision in the ipsilateral hemidiaphragm. It was done in 2 patients in Abul Ela series (Abul-Ela et al., 1991). This approach was not done in our series.

In our study one patient with multiple pulmonary hydatid disease was managed surgically using median sternotomy incision. Enuleation of the cyst was done for a left basal non complicated cyst, while right upper lobectomy was done for a complicated ruptured cyst. This incision avoided a second operation, lowered the postoperative pain and minimized the hospital stay. It took more time with some difficulty in exposure during surgry. This exposure is not used for resection of left lower lobe due to difficulty in ligation of the left lower lobe vein. The advances in video-assisted thoracoscopic surgery allowed thoracoscopic removal of complicated hydatid cyst (Hugh and David, 1996).

During surgery, 1 out of 18 cysts (5.5%) ruptured due to high intracystic pressure. Postoperative morbidity included continuous air leakage for a few weeks in 1 out of 9 patients (11.1%) and was controlled by prolonged thoracostomy drainage. There was no mortality in our series.

The medical treatment using mebendazole was used in 5 out of 14 patients (35.7%). Two patients had multiple pulmonary and hepatic hydatid disease. The hepatic lesions started first and were surgically managed but were followed by the development of pulmonary lesions and the patients were not good surgical candidates. Two patients had hepatic, splenic and bilateral pulmonary hydatid disease. The last patient had multiple hepatic, splenic, and very small left pulmonary upper zonal hydatid diseae. The response to medical treatment was effective where it led to complete resolution in 3 out of 5 patients (60%). So medical treatment is indicated mainly in multiple systemic disease, those who are not suitable for surgical treatment, or following rupture of the cyst as a prophylactic measure.

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Congenital Diaphragmatic Hernia Past the Neonatal Period

ABSTRACT

This series included 16 patients (10 males and 6 females) treated for cogenital diaphragmatic hernia (11 Bochdalek hernias, 2 central hernias, and 3 Morgagni hernias) that presented beyond the neonatal period. Their ages ranged from 3 months to 11 years (mean 3.7 ± 3.1 years). The mean age if patients presented with gastrointestinal symptoms (9 patients, 56%) was 5.1 ± 3.0 years compared to 1.3 ± 1.0 years, mean age of those presented with respiratory symptoms (6 patients, 38%). Diagnostic confusion occured in three patients (19%), two as pneumonia and one as hydropneumothorax. Transabdominal approach was used in the three cases had Morgagni hernias and combined abdominal and thoracic approach was used in the case presented with acute large bowel obstruction. Our approach regarding Bochdalek and central hernias was to do a barium meal and follow through examination to exclude the presence of a malrotation. In patients without a malrotation (10 patients), transthoracic approach was used. In patients with a malrotation (2 patients), abdominal approach was used and simultaneous Ladd's procedure was done for both patiens. Primary diaphragmatic repair was done in 15 patients where as one patient required a prosthetic diaphragm patch. There was no intraoperative or postoperative mortality but postoperatively, one patient developed sever gastric atony and a pyloroplasty was done for this patient.

A diaphragmatic hernia should be suspected in every patient in whom the diaphragm is not clearly visible on radiography and keeping the possibility of the diagnosis in mind should avoid undue delay, misdiagnosis, and inappropriate treatment. Transthoracic approach, after exclusion of the presence of a malrotation is a good approach because of its main advantage of dissecting adhesions with abdominal viscera and hernia sac under direct vision.

Ahmed M. Deebes, M.D., El-Rady Kamal, M.D., Khaled H. Abdel-Bary, M.D. and Essam, S. Abdel-Wahed, M.D..

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INTRODUCTION

Congenital diaphragmatic hernia (CDH) is typically diagnosed in the first hours of life due to the almost immediate respiratory insufficiency it imposes. This failure of adequate gas exchange is in small part due to the lung's loss of domain in the chest to the abdominal viscera, but more importantly, to underlying pulmonary hypoplasia compounded often by persistent pulmonary hypertension of the newborn (1). Between 5% and 30% of congenital diaphragmatic herniae (CDH) present after the neonatal period (1- 4), but despite this high incidence, diagnostic delay usually occur and this may be fatal (5-9). The presenting features are usually related to gastrointestinal tract or respiration and pulmonary symptoms, if present, are rarely life-threatening (1,3,4,10,11).

Cardiothoracic Surgery Department, Faculty of Medicine, Zagazig University

We reviewed our experience with congenital diaphragmatic hernia in patients beyond the newborn period, summarizing the diagnostic and therapeutic considerations in these patients and comparing them with other published cases. The purpose of this paper is to draw attention to these defects and the circumstances leading to diagnostic delay and inappropriate treatment.

Patients and Methods

From January 1991 to December 1995, 16 patients aged 3 months to 11 years (median 2.5 years) were surgically treated for congenital diaphragmatic hernia that presented beyond the neonatal period at Cardiothoracic Surgery Department, Zagazig University Hospitals. The records of each patient were reviewed for presenting symptoms and signs, methods of diagnosis, operative techniques, operative findings postoperative mortality and morbidity and follow-up period. Patients with eventeration of the diaphragm, paraesophageal and hiatal hernia, and traumatic diaphragmatic hernia were not included in this series.

Operative techniques:

Substernal (Morgagni) defects:

Abdominal approach for surgical repair of this hernia was chosen. A right subcostal incision was used. The rectus muscle was transected and the peritoneum was opened. The contents of the hernia were reduced into the peritoneal cavity and the margins of the hernial sac were identified and excised. The repair was made with two rows of interrupted non absorbable (2/0 or 3/0 silk) mattress sutures. The first row was placed through the anterior edge of the defect with stitches about 1 cm apart,. then a second row was placed 2 cm away from the margin of the defect. This last row of sutures was passed through the chest wall except for skin and subcutaneous tissue. Then the anterior sutures were pased through the chest wall in a similar fashion but through the next lower interspace. All of these sutures were tied and the abdominal wall incision was closed. Single chest tube was introduced and left in place for 24 to 48 hours.

This approach was used for the three cases of Morgagni hernia.

Posterolaterol (Bochdalek) and central hernias:

Our approach to these late diagnosed Bochdalek and central hernias was to do a bariun meal and follow through examination to exclude the presence of a malrotation. In patients without malrotation a trasthoracic approach was used to repair the defect and in patients with malrotation, abdominal approach was used to facilitate a simultaneous Ladd's procedure.

Thoracic approach:

Postrolateral thoracotomy on the side of the hernia was used. The pleural space was entered through the seventh intercostal space. The adhesions with the hernia sac or the abdominal viscera, in absence of a sac, are then dissected using blunt and sharp dissection. The edges of the defect were identified. The contents of the hernia then reduced into the peritoneal cavity and if this was difficult, widening of the defect was done to facilitate reduction. The hernia sac,

if present, was excised. The hernia orifice was closed in two layers by approximating the margins of the defect with interrupted non absorbable sutures (2/0 or 3/0 silk). The first row consisted of horizontal mattress sutures inserted 5 mm from edge of the defect and the second row approximated the everted rim. If the defect was wide and primary diaphragm closure can not be done, the defect was closed with a prosthetic patch (a piece of Marlex mesh). Two intercostal, apical and basal, drains were used routinely. The tubes were removed after full expansion of the lung.

This approach was used for ten patients.

Abdominal approach:

Abdominal approach was used for two patients who had left sided Bochdalek hernias with associated mid gut malrotation. Left subcostal muscle cutting incision was used. The peritoneum was opened and trials of gentle extraction of abdominal viscera, after passage of a catheter into the thorax allowing air to enter, was done. Widening of the defect was needed in both cases to allow reduction. The defect was repaired by direct sutures using interrupted non absorbable (3/0 silk) sutures in two layers. Intestinal malrotation was corrected by dividing abnormal bands and splaying the root of the mesentery. The duodenal loop was straightened and the small intestine placed in the right side of the abdomen with caecum in the left upper quadrant. The abdominal wall is then closed. A single chest tube was introduced. The tube was removed after full expansion of the lung.

Combined laparotomy and thoracotomy:

This approach was used in one patient who had left Bochdalek hernia that presented with acute large bowel obstruction. In this case the diagnosis was made at laparotomy. The colon from hepatic flexure to the middescending colon was incarcerated through 2 cm left posterolateral diaphragmatic defect. The defect was widened to allow reduction but this failed. Left thoracotomy in the seventh intercostal space was done. There was no hernia sac and there were dense adhesions with the incarcerated colon. Combined sharp and blunt dissection was made and the reduction was completed. The defect was closed primarily using interrupted 2/0 silk sutures, from the thoracic side. Thoracotomy and laparotomy were closed as usual leaving two intercostal, apical and basal, drains.

Statistics:

Means are followed when appropriate either by standard deviation, median or both. Statistical comparison between means of ages of the group of patients presented with gastrointestinal symptoms and those presented with respiratory symptoms was made by student "t" after logarithmic transformation.

Results

This series included 16 patients treated for congenital diaphragmatic hernia that presented beyond the neonatal period. Overall there were 10 males (62.5%) and 6 females (37.5%). Eleven patients had posterolateral (Bochdalek) hernias, 2

Table (1): Types of hernias

	Sac present	Left	Right	Total
Bochdalek hernia	5	8	3	11
Central hernia	1	1	1	2
Morgagni hernia	3	0	3	3

Table (2): Presenting symptoms

	No. of patients (%)	mean age ± SD*
Gastrointestinal symptoms	9 (56%)	5.1±3.0 years** Range (18m to 11 y)
Respiratory symptoms	6 (38%)	1.3±1.0 years** Range (3 m to 3 y)
No symptoms	1 (6%)	2 years

* SD= Standard deviation

** $P < 0.005$

patients had central hernia and 3 patients had substernal (Morgagni) defects. Nine patients (56%) had left sided hernias and 7 patients (44%) had right sided hernias. The three Morgagni hernias were right sided and eight (73%) of the eleven Bochdalek hernias were left sided (Table 1). No bilateral hernias in our series.

Age at operation ranged from 3 months to 11 years (mean 3.7±3.1 years and median 2.5 years).

Presenting features are listed in table 2. Nine patients (age range 18 months to 11 years, mean 5.1±3.0 years) presented with gastrointestinel symptoms with repeated episodes of vomiting, often associated with abdominal pain. Abdominal pain consisted of cramping, usually following a meal, which generally preceded episodes of projectile vomiting. One of these patients, aged 11 years presented with acute large bowel obstruction and a left Bochdalek hernia discovered at laboratory. Weight loss or poor weight gain were also seen in two patients in this group.

Six patients (age range 3 months to 3 years, mean 1.3±1.0 years) presented with symptoms related to respiration. Recurrent pneumonitis, wheezing or tachypnea, and

apparent dyspnea on exertion were typical presenting symptoms.

There is a statistically highly significant difference in age between patients who presented with gastrointestinal symptoms and those who presented with respiratory symptoms ($t=3.33$ & $P<0.005$).

The clinical impression of dextrocardia was the indication for chest radiograph in the asymptomatic patient.

The physical signs included the absence of breath sounds on the side of the hernia in eleven cases, auscultation of bowel sounds in chest in five cases, mediastinal shift in four cases, tachypnea and wheezing in four cases, and scaphoid abdomen in two cases.

The diagnosis of CDH was primarily made by plain chest roentogenography in twelve patients and mainly showing "connecting" bowel segments passing through the diaphragmatic defects. In all of these patients the diagnosis was confirmed by a barium meal and follow through examination.

In two cases, confusion with pneumonia was made. In one of these cases careful reading of another plain chest x-ray, two weeks later, showed a "connecting" bowel segments passing to the left side of the chest. Barium meal through a nasogastric tube and follow through examination confirmed the diagnosis. In the second case, a bronchoscopic examination was done, 6 weeks later, to diagnose the cause of the unresolved pneumonia, and revealed no abnormalities. A computerized tomography (C.T) then was done, showing loops of the intestine inside the left side of chest. A barium meal and follow through examination, then was done to exclude the presence of a malrotation.

In one patient, wrong diagnosis of left hydropneumothorax was made and intercostal tube insertion, for drainage, was done. The intercosatal drain was functioning, but with no drainage. By careful reading of the previous chest radiographs and a new one, the diagnosis of a diaphragmatic hernia was suspected and then confirmed by a nasogastric tube and injection of barium.

In another patient, the diagnosis of a left Bochdalek hernia was made at laparotomy for acute large bowel obstruction.

A mid gut malrotation was diagnosed in two of our 16 patients.

A hernia sac was present in 9 (56%) patients (table 1). The hernia contents included small bowel, colon, stomach and spleen in various combinations. The defects in diaphragm ranged from 2 to 6 cm in diameter. Primary defect closure using interrupted non-absorbable sutures in two layers was done in 15 patients and prosthetic Marlex mesh was needed in one patients with left Bochdalek hernia.

There was no intraperative nor postoperative mortality. Superfircial wound infection occurred in three (19%) cases and delayed gastric emptying in one (6%) case who required prolonged gastric drainage for 20 days and then a Heineke-Mikulicz pyloroplasty.

Post-operative chest roentgenograms in all cases showed excellent re-expansion of

the lung. During the follow-up period that ranged from 4 months to 59 months with a median of 24 months, no patient developed long-term respiratory or gastrointestinal symptoms.

Discussion

Wiseman and McPherson 1977(11) classify patients of all ages with congenital diaphragmatic hernia into four groups based on presence and severity of pulmonary hypoplasia. Group 1 includes those with the highest mortality, presenting early in neonatal life with bilateral pulmonary hypoplasia. In this group, herniation probably occurs early in fetal life preventing adequate pulmonary development. Group 2, with unilateral pulmonary hypoplasia, and group 3, with insignificant or no pulmonary hypoplasia, might present at birth with mild respiratory distress. Group 4 includes those patients presenting past the newborn period. The group 4 patients may have a small amount of abdominal viscera herniated into the thoracic cavity at birth, which escapes detection because of the absence of symptoms, or may have a defect with no herniation until an episode of increased intra-abdominal pressure causes herniation. This later group has been termed "acquired" congenital diaphragmatic hernia (11) or "delayed presentation" congenital diaphragmatic hernia (2-4, 7, 8). Congenital diaphragmatic hernia (CDH) presenting past the neonatal period (greater than 8 weeks of age) usually presents with chronic respiratory and gastrointestinal symptoms (3, 4, 7, 10, 11-15). But in the study of Malone et al., 1989 (2), failure to thrive was the commonest presentation and less than half of their patients had respiratory and gastrointestinal symptoms. To our knowledge, their report is the only one that emphasized that poor weight gain is a common presenting feature of congenital diaphragmatic hernia diagnosed after the neonatal period. In our study, poor weight gain was seen in only two patients. Nine (56%) patients presented with gastrointestinal symptoms, and six (38%) presented with chronic respiratory symptoms. Weber et al. (13) suggested that group 4 patients in the classification of Wiseman and McPherson can also be divided into two other subgroups: (1) those presenting early after the neonatal period and in early childhood with respiratory symptoms and (2) those presenting later in childhood with gastrointestinal symptoms. Our study agreed with this suggestion as the mean age of our patients presenting with respiratory symptoms was 1.3±1.0 years compared to 5.1±3.0 years, in patients presenting with gastrointestinal symptoms with a statistically significant difference between both groups ($t = 3.33$ & $P < 0.005$). Sometimes, patients may be asymptomatic as in one of our patients (6%) and in 23% (5 of 22) in the study of Malone et al., 1989 (2).

Misdiagnosis of late presenting diaphragmatic hernia was recorded in many series and many case reports. In the study of Fotter et al., 1992 (7), 4 of their 8 patients (50%) were misdiagnosed primarily, two as pneumothorax, one as inflammatory lung disease and in one patient a Morgagni hernia was primarily missed. Schimpl et al. (1993) (10) reported confusion with pneumonia or pneumothorax in 43% of

their cases of late presenting Bochdaleck hernias. Misdiagnosing right sided congenital diaphragmatic hernias as persistent pleural effusion were recorded by Chilton et al., 1978 (9) Graviss et al., 1980 (16) and Malone et al., 1989 (2). Snyder et al., 1990 (17) reported a case, 29 month old child with left sided Bochdalek hernia which was misdiagnosed as tension pneumothorax and tube thoracostomy resulted in clinical improvement by perforating and decompressing the stomach. So, they recommended placement of nasogastric tube, with any doubt to reach correct diagnosis. Misdiagnosis was occurred in three of our 16 patients (19%), two were misdiagnosed as pneumonia and one wrongly diagnosed as left hydropneumothorax with insertion of thoracostomy tube but fortunately did not result in perforation of the stomach.

In children with respiratory or feeding difficulties one should be aware of late presenting CDH, and diaphragmatic defect should be suspected in every patient in whom the diaphragm is not clearly visible on radiography. A careful analysis of chest films and searching for "connecting" bowel segments passing through the diaphragmatic defects may help to avoid incorrect diagnosis and undesirable delay in treatment. Confusion with pneumonia or pneumothorax can be diminished by placing a nasogastric tube and instillation of contrast material.

One of our patients presented with acute large bowel obstruction. Also, this complication was recorded by Malone et al., 1989 (2), and Karanikas et al., 1994 (14). Other reported complications of CDH past the neonatal period include small bowel necrosis (8), strangulation of the funds of the stomach (14), Torsion of the spleen (18) empyema (19), and sudden death (6). As there is a risk of complications in the herniated viscera rapid diagnosis and operative management would seem advisable.

Three patients (18%) in our study had Morgagni hernias, this is a higher incidence than the usually reported 1-2% of all congenital diaphragmatic hernias (20). Malone et al., 1989 (2) reported a similarly high incidence (23%) of Morgagni hernias in older children. The defects are usually right sided, as in our three cases, and lie anteriorly between the xiphisternum and costal muscle fibers of the diaphragm. The Our three patients had gastrointestinal symptoms and their hernias contained colon. Right subcostal approach was used for their repair .

Some authors prefer the abdominal approach for Bochdalek and central hernias to facilitate a simultaneous Ladd's procedure in cases with associated malrotation (7, 10, 12, 13). Malone et al., 1989 (2) in common with us performed the following approach; a barium meal and follow through examination is carried out to exclude the presence of a malortation. In patients without a malrotation, a transthoracic approach is recommended. Any adhhesions with the herniated viscera can be dissected easily with this approach. Only two of our cases (12.5%) had midgut malrotation. None of the cases in the studies of Booker et al., 1981 (5), Fotter et al., 1992

(7), Schimple et al., 1993 (10) had a midgut malrotation, but in the studies of Malone et al., 1989 (2) and Weber et al., 1991 (13), 33% (8 of 24) and 31% (4 of 13) of their patients had mid gut malortation respectively.

The only major postoperative complication in our series was delayed gastric emptying due to gastric atony in one patient 6 years old, that required a Heincke-Mikulicz pyloroplasty. The cause of this gastric atony may be due to the presence of the stomach and proximal small bowel in thorax constantly or intermittently for along period of time that may have some pathophysiologic significance, possibly due to the effects of a negative intrathoracic pressure on the organ involved or chronic compression of the vagus nerve (13). Most published series on late presenting CDH had not commented on postoperative gastric atony and delayed gastric emptying (2,3,5,11,12,14,21,23) but Weber et al., 1991 (13) reported a very high incidence (58%). Four of their 7 patients who developed this complication required pyloroplasty.

In conclusion, we want to draw attention to congenital diaphragmatic hernia past the neonatal period and that it should be suspected in every patient in whom the diaphragm is not clearly visible on radiography. Also, the transthoracic approach for repair of Bochdalek and central hernias, after exclusion of the presence of midgut malortation with barium meal and follow through examination, is a good approach because of its main advantage of dissecting adhesions with the abdominal viscera under vision.

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Transhiatal Esophagectomy Without Thoracotomy for the Management of Carcinoma of the Thoracic Esophagus and Cardia

ABSTRACT

Transhiatal esophagectomy without thoracotomy has been performed in 27 patients with carcinomas at various levels of the thoracic esophagus (eight at the upper third, three at the middle third, ten at the distal third and 6 at the cardia).

Esophageal resection and reconstruction was performed in a single stage, and the stomach was positioned in the posterior mediastnum in the original esophageal bed. The operative mortality was 14.8%, the causes of death being pulmonary embolism in two patients, septic shock in one and myocardial infarction in the fourth patient. Complications included pneumothorax, hemothorax, vocal cord paresis, mediastinitis and anastomotic leakage. Average intra-operative blood loss for the entire group has been 1.400 mL.

In order to highlight the validity of this approach we compared this group of patients with another group of 31 patients operated upon by the transthoracic standard esophagogastrectomy. Transhiatal esophagectomy complications are less as regards the post-operative anastomotic leakage (Z = 0.785), empyema (Z = 2.97), mediastinitis (Z = 2.97), respiratory failure (Z = 2.07) and mortality (Z = 1.29). Also we compared these data with other reported series.

Transhiatal esophagectomy without thoracotomy is safe, offered excellent palliation and resulted in little morbidity. It is far better tolerated physiologically than the combined transthoracic and abdominal operations. It is to be noted that patients who had previous splenectomy for bilharzial hepato-splenomegaly, transhiatal esophagectomy is not easy and is better to be avoided.

Dr. Ahmed Saleh Abou El-Kassem

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INTRODUCTION

Despite improvements in pre-operative evaluation, anaesthesia, operative techniques, and post-operative care, esophageal resection and reconstruction remains a formidable operation in patients whose nutritional and pulmonary status have been compromised by impaired swallowing. (1)

One promising approach is the use of extrathoracic blunt esophagectomy and cervical esophagogastrostomy for the management of carcinoma of the thoracic esophagus and cardia. (2)

The aim of this work is to highlight the validity of posterior mediastinal replacement of the stomach after transhiatal esophagectomy for the management of resectable carcinoma of the thoracic esophagus and cardia by comparing the

Assistant Professor of Cardiothoracic Surgery Faculty of Medicine, Alexandria University

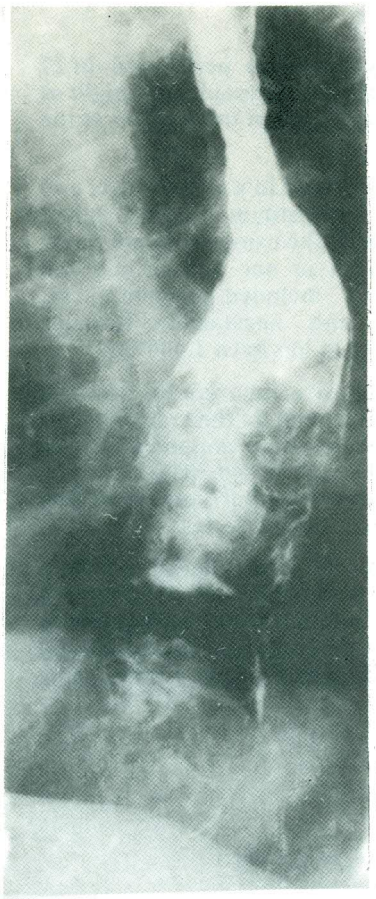

Fig. 1: Squamous cell carcinoma of the middle third of the esophagus. This tumor was readily mobilized through the abdominal incision.

results of this technique with those of the standard transthoracic approach and with other reported series.

Patients and Methods

During the period from May 1990 to May 1996, transhiatal esophagectomy without thoracotomy as described in the literature (3-5), has been performed in 27 patients with carcinoma of the thoracic esophagus and cardia. Upper third tumors of the thoracic esophagus were defined as those extending from the thoracic inlet to the level of the carina or from approximately 19 cm to 25 cm from the upper incisors at endoscopy. Middle third tumors involved the esophagus from the level of the carina to a point approximately 5 cm above the esophagogastric junction roughly 25 to 35 cm from the incisors (Figure 1). Distal third tumours involved the esophagus from 35 to 40 cm from the incisors. (6)

Among these patients, 22 were males and 5 were females ranging in age from 28 to 69 years with an average of 53 years (Figure 2). Dysphagia was the predominant presenting complaint in all patients and the average duration of symptoms before diagnosis was two months.

The preoperative assessment included barium swallow and Computed Axial Tomography was done in those patients with middle third carcinoma to assess invasion of the mediastinal structures and lymph node enlargement. Esophagoscopy with biopsy was done for all patients. Bronchoscopy was done for those patients with upper or middle third tumours to assess possible tracheobronchial invasion and/or fistulation.

Operative Technique:

The technique was basically that which has been described in detail by others (3-5) and will be summarized briefly here. The incisions consist of an upper midline laparotomy and an oblique left cervical

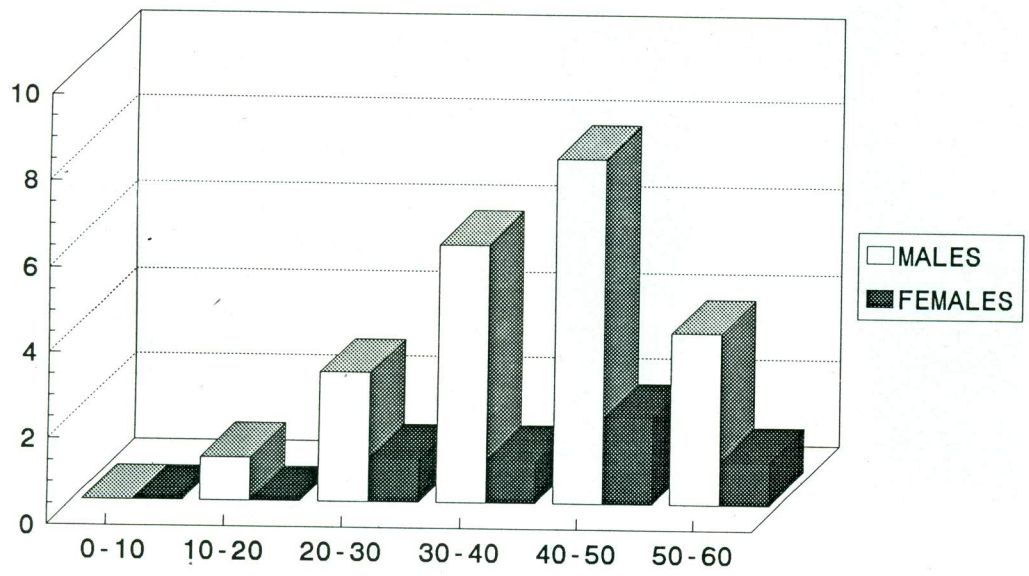

Fig. 2: Distribution of studied patients by age and sex.

incision along the anterior border of the sternocleidomastoid muscle. The laparotomy is performed first to assess resectability of the tumour and exclude liver metastasis. The stomach is mobilized, leaving the right gastric and right gastroepiploic vessels and the gastro-epiploic arcade intact and Kocherization of the duodenum was done. A pyloroplasty or a pyloromyotomy is cardied out. The esophageal hiatus in the diaphragm is stretched manually.

The resectability of neoplasms of the distal esophagus is assessed under direct vision using narrow retractors inserted up through the hiatus. Tumours located higher in the esophagus are evaluated by manual palpation through the hiatus. If the neoplasm is found to be firmly fixed to the aorta, pericardium, or tracheobronchial tree and cannot be freed from these structures by gentle, cautious dissection, the transhiatal approach is abandoned and either a transthoracic esophagectomy or a substernal bypass is done. Conversely, if the neoplasm is adherent only to the prevertebral fascia, it can be 'fractured away" from this layer.

If the tumour appears resectable, the mobilization of the esophagus is continued by blunt dissection. The left cervical incision is then made and the upper esophagus is mobilized, again under direct vision, down nearly to the carina.

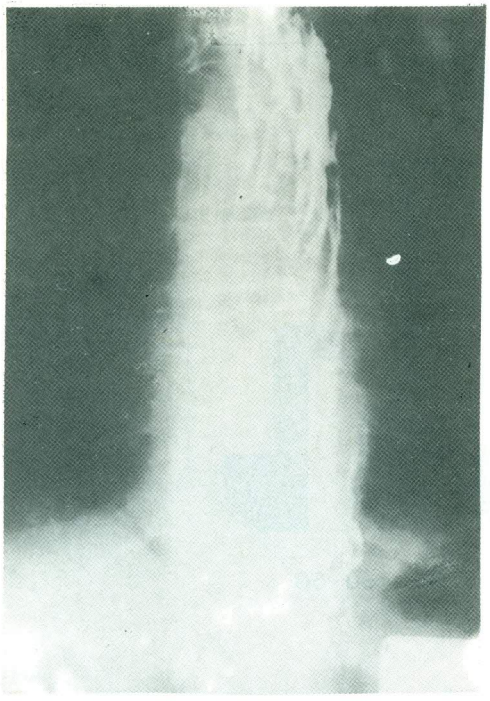

Fig. 3: Postoperative upper gastrointestinal series outlining the gastric contour in the esophageal bed. There is no evidence of an anastomotic leak.

With the esophagus now free; the cervical esophagus is divided. The stomach is passed through the posterior mediastinum to the neck. The fundus is sutured to the prevertebral fascia, and then the cervical esophagus is anastomosed to a newly created opening on the anterior gastric wall using two layers of interrupted nonabsorbable sutures. The cervical and abdominal incisions are closed in a routine fashion, with a small Penrose drain left in the former. Immediate postoperative plain chest radiogram is done to detect pneumothorax or hemothorax.

Follow-up barium swallow was done before discharge from the hospital to exclude complications (Figure 3).

Another group of 31 patients were operated upon by the standard transthoracic approach. they were 25 males and six females ranging in age from 34 to 61 years with an average of 49 years. The site of carcinoma was in the upper third in five patients, middle third in eleven patients, lower third in eight patients and cardia in seven patients. After doing the laparotomy incision, the stomach was mobilized and left thoracotomy was done 14 patients, while right thoracotomy was done in 17 patients and the esophagogastrostomy was done in the chest.

The data were statistically analysed by the Z-test, T-test and Anova test.

Results

There were no intraoperative deaths in both groups. Average blood loss intraoperatively was 1.400 mL in the first group and 1.700 in the second one. Histological diagnosis of the transhiatal group was squamous cell carcinoma in the eight patients of upper third of the transhiatal group, the three patients of the middle third tumours, while ten of the lower third tumours were also squamous cell carcinoma, the six patients with tumours of the cardia were adenocarcinoma (Table I). Complications resulting from transmediatsinal esophagectomy with cervical esophagogastric anastomosis were relatively minor. Pneumothorax occurred in five patients and was managed by the insertion of thoracostomy tube. It occurred on the left side in three patients and on the

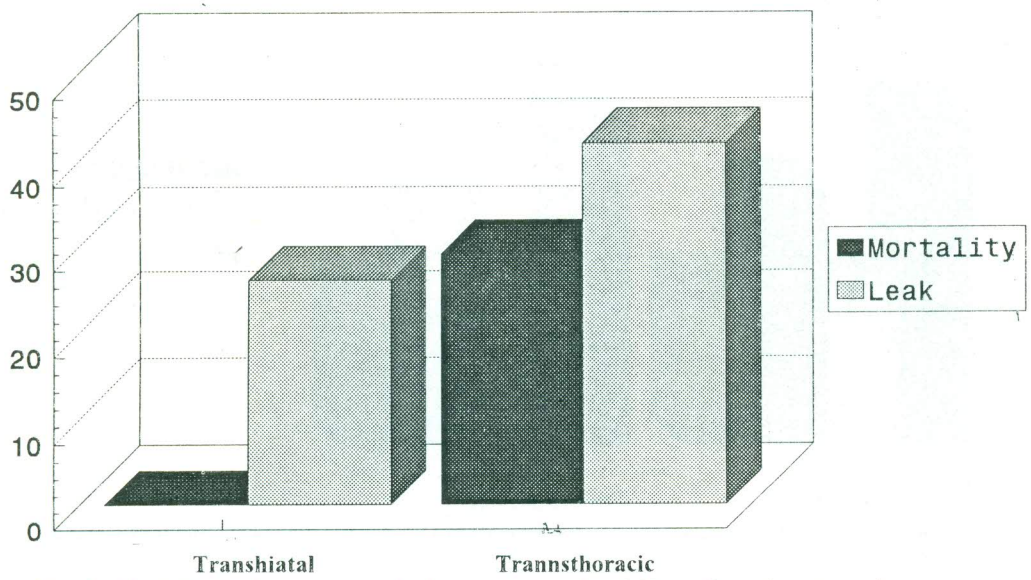

Fig. 4: Mortality and anastomotic leak in transhiatal and Transthoracic approaches.

Table I: The histological diagnosis according to the location of the tumour in the 27 patients of the transhiatal group and the 31 patients of the transthoracic group.

	Transhiatal		Transthoracic	
	Sq. cell carcinoma	Adeno-carcinoma	Sq. cell carcinoma	Adeno-carcinoma
Upper third	8	-	5	-
Middle third	3	-	11	-
Lower third	10	-	-	-
Cardia	-	6	8	7
Total	21	6	24	7

right side in two patients. Hemothorax occurred in four patients and was managed by tube thoracostomy without the need of thoracotomy to control excessive bleeding. The thoracostomy tubes were removed after full lung expansion from 5 to 9 days postoperatively except in one patient who developed empyema and mediastinitis from infected hemothorax.

Left recurrent laryngeal nerve paresis occurred in three patients and resolved spontaneously within 3 months of operation in all patients.

Cervical esophageal leakage occurred in seven patients (25.92%) and resolved completely within 4 to 12 days in all patients except two, in whom exploration of the cervical wound and reanastomoting the site of leakage was done. This cervical leakage did not lead to any mortality.

There were four deaths (14.8%) within three weeks of operation. Two patients died from pulmonary embolism, the third patient died from acute myocardial infarction and

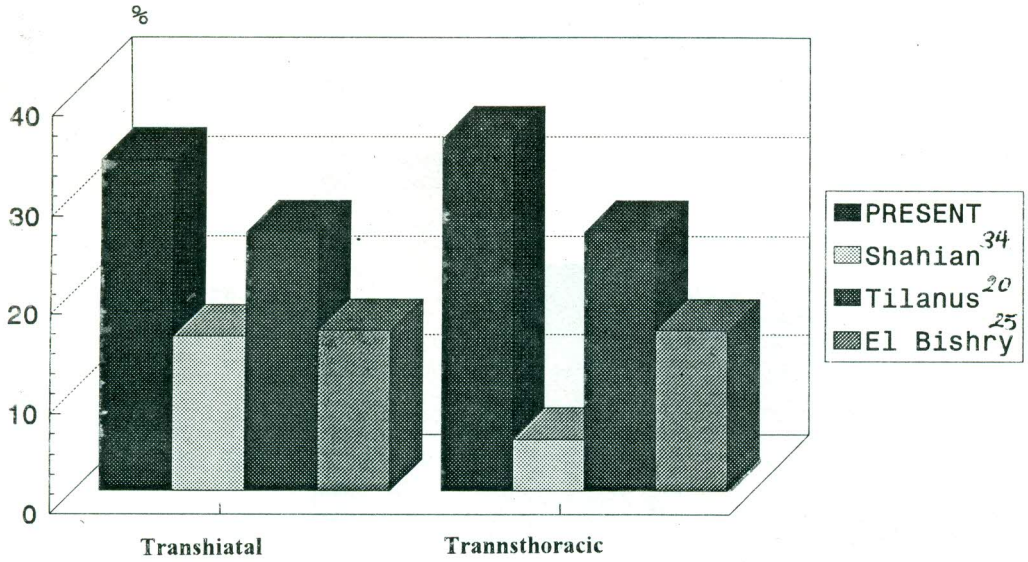

Fig. 5: Anastomotic leak in transhiatal and Transthoracic approaches in the present work as compared with other works.

TableII: Morbidity and mortality in the transhiatal and transthoracic approaches.

	Transhiatal		Transthoracic		Z-test p<0.05
	No.	%	No.	%	
Pneumothorax	5	18.51	-	-	-
Left	3				
Right	2				
Hemothorax	4	14.81	-	-	-
Left	3				
Right	1				
Empyema	1	3.71	11	35.48	2.97*
Anastomotic leakage	7	25.92	13	41.93	3.04*
Mediastinitis	1	3.71	11	35.48	2.97*
Respiratory failure	1	3.71	7	22.58	2.07*
Myocardial infarction	1	3.71	1	3.22	0.10
Pulmonary embolism	2	7.42	1	3.22	0.72
Vocal cord paresis	3	11.11	0	0	1.905
Mortality within 3 weeks	4	14.81	9	29.03	1.29*

* Highly significant.

Table III: Days of hospitalization following transhiatal esophagectomy.

	No. of patients	Hospitalization after operation			
		7 - 14 days	15 - 21 days	Average (days)	$\bar{x} \pm SD$
		No.	No.		
Upper third	8	7	1	13	10.10 ± 4.71
Middle third	3	1	2	16	15.5 ± 4.3
Lower third	10	8	2	11	17 ± 3.16
Cardia	6	5	1	12	11.75 ± 3.06
Total	27	21	6	13	

Table IV: Days of hospitalization following transthoracic approach

	No. of patients	7 - 14 days	15 - 21 days	$\bar{x} \pm SD$
Upper third	5	4	1	123 ± 3.15
Middle third	11	3	8	15.95 ± 3.5
Lower third	8	2	6	14.12 ± 3.4
Cardia	7	3	4	13.9 ± 4.2

the fourth patient died from septic shock following mediastinitis (Table II).

Table I, shows the location of the tumour and the histopathological diagnosis in the 31 patients of the second group.

In the second group (transthoracic) anastomotic leakage occurred in 13 patients (14.93%), mediastinitis in 11 patients (35.68%), empyema in 11 patients (35.68%), respiratory failure in seven patients (22.58%) and death in nine patients (29.03%). Table II shows the incidence of complications and its comparison with the first group (Z-test).

Figure (4) compares the incidence of leakage and mortality as a result of it (leakage in the first group occurred in the neck). Figure (5) compares the incidence of complications in this study and that of other reported series performing the same technique and the transthoracic esophagogastrectomy.

The duration of hospitalization following transhiatal esophagectomy is shown in table III. The longest hospitalization followed the middle third tumor resections (mean 15.5±4.3) due to longer stay of the chest tubes in these patients because of pneumothorax. Table IV shows the duration of hospitalization in the transthoracic approach. Hospital stay is longer at all levels in the second group.

All patients were able to eat a regular diet at the time of their discharge from the

hospital. Delayed gastric emptying occurred in 2 patients of the transhiatal group and responded to medical treatment only.

Discussion

Pull-through esophagectomy for esophageal carcinoma was described in 1933 by Turner (7), but because of fear of hemorrhage from the esophageal bed, the technique was not often used. (8) In 1960, Ong and Lee described resection of a normal intrathoracic esophagus using blunt dissection associated with cervical esophageal carcinoma. This approach was applied widely for pharyngeal carcinoma and for benign disease. (9) In 1974 Kirk attempted resection of esophageal carcinoma with the pullthrough technique, with good results for palliation in inoperable patients. (10)

Regardless of the visceral esophageal substitute used, the posterior mediastinal route in the original esophageal bed is the preferred location because: (6)

1. It is the shortest distance between the neck and abdomen.

2. Subsequent esophageal dilatations, if required, are made difficult by the anterior displacement of the anastomosis that occurs when the stomach or colon are positioned substernally in the anterior mediastinum.

3. The incidence of anastomotic leak is increased when a cervical esophagogastric anastomosis is positioned in the anterior neck as opposed to the more posterior location in the esophageal bed. (11)

Early experience with the stomach as a visceral esophageal substitute documented that gastric length and mobility permitted a cervical esophagogastric anastomosis in most patients. (12) More recently, the relative ease with which the gastric fundus can be mobilized into the neck has been capitalized upon for retrosternal gastric bypass of incurable esophageal carcinoma. (13) Further, patients whose entire stomach is intrathoracic, in contrast to those in whom a portion of the stomach lies above and part below the diaphragm, seldom experience the degree of gastroesophageal reflux which follows intrathoracic esophagogastric anastomoses (14). Finally, the incidence of suture line recurrence of tumor is minimized by increasing the margins of resection with total esophagectomy. (1)

Caution is urged when applying the technique of blunt esophagectomy to esophagogastric junction adenocarcinomas. Before mobilizing the thoracic esophagus and dividing the cervical end, one must be certain that an adequate gastric margin distal to the tumor can be obtained without the need to sacrifice the greater curvature aspect of the gastric fundus. If, in error, the entire thoracic esophagus is mobilized first and the cervical esophagus is divided, and if the tumor is large, one may find that a proximal hemigastrectomy is required to resect it, and that the remaining stomach may not reach to the neck. (6)

Transhiatal esophagectomy for carcinoma has been criticized for denying an adequate esophageal resection and formal lymph node dissection to patients with potentially curable tumors. (15,16) However, a few American and European surgeons subscribe to the concept of radical esophagectomy with a formal en bloc dissection of contiguous lymph node

bearing tissues, pleura, and abdominal lymphatics. (17,18) In the vast majority of patients with esophageal carcinoma the goal of esophagectomy is palliation, not cure, and if the latter should somehow be achieved, it is more a function of individual tumor biology and host resistance rather than the extent of the resection performed. Skinner (18) has reported his results of "radical esophagectomy and en bloc dissection" in the treatment of 80 patients with carcinoma of the esophagus and cardia. His 29 patients with midesophageal tumors had a 3-year actuarial survival of 14%, while the 37 patients with lower third tumors had a 3-year survival of 33%. 918) These data do not differ appreciably from the 3-year actuarial survival in patients undergoing transhiatal esophagectomy without attention to a formal lymph node dissection - 17% for middle third tumors and 31% for distal tumors. (6)

Total thoracic esophagectomy with a cervical esophagastric anastomosis when possible is the treatment of choice for esophageal carcinomas at all levels, including distal third adenocarcinomas. (19) Avoiding an intrathoracic anastomosis eliminates the disastrous consequences of disruption of the suture line in the chest. (20)

Certain unique features of esophageal anatomy have an influence on the complication of anastomotic disruption associated with esophageal resection. The esophageal submucosa has an unusual fat content which permits relatively good mobility of the overlying squamous mucosa, when performing an esophageal anastomosis, therefore, unless great care is taken to deliberately identify and transfix the mucosal edge with each stitch, carelessly placed suture may fail to achieve mucosal apposition, and an anastomotic leak may result. (21) Also anatomic studies of the esophageal blood supply have demonstrated that the aortic arterial branches become a fine capillary network before they enter the wall of the esophagus. (22) This explains why, even after these arterial branches have been divided, the esophagus will still remain viable. Therefore, poor technique rather than poor blood supply most often explains the complication of esophageal anastomotic disruption. (23,24)

One of the advantages attending transhiatal esophagectomy is a generally low operative mortality. Our operative mortality of 14.8% (4 deaths in 27 patients) is similar to that of other authors (6,25), who perform the same technique of avoiding thoracotomy and doing a transhiatal approach with cervical esophagogastric anastomosis.

With the notable exception of a few reported series in which the hospital mortality has been less than 5% (26,26), esophageal resection and reconstruction for carcinoma through transthoracic approach carries a mortality that is generally between 15-40%. (28,29) Giuli and Gignoux, presenting the results in 2400 patients with esophageal carcinoma operated upon in multiple European hospitals, report a mortality for esophagectomy of 30%. (30) Similarly, Earlam and Cunha-Melo, in an extensive literature review, report a hospital

mortality of 33.3% in 83, 783 esophagectomies. (31)

The objection that life-threatening hemorrhage may occur because of the blind dissection is not confirmed in our series. The intraoperative blood loss in several reported series averaged around 1,000 to 1500 mL, less than is generally encountered during a transthoracic esophagectomy. (2,31)

The technique of transhiatal esophagectomy is better to be avoided in patients with portal hypertension due to bilharziasis especially those with a previous splenectomy which leads to difficulty in dissecting the gastric fundus and profuse bleeding from the portasystemic shunts at the lower third of the esophagus.

Transabdominal and transcervical blunt esophagectomy without thoracotomy is a safe, effective means of removing the diseased esophagus, preparing the visceral esophageal substitute, and providing a route of access between the cervical esophagus and abdominal cavity. The procedure is far better tolerated physiologically, particularly by elderly and debilitated patients, than is a combined transthoracic and abdominal operation. (32)

Five of our patients had such severe chronic obstructive pulmonary disease that their marginal pulmonary function contraindicated thoracotomy for esophageal resection; they tolerated the operation without difficulty. The complications of blunt esophagectomy are few and easily managed. In no way, however, a sound kowledge of thoracic surgery is not of utmost importance in performing esophagectomy and esophageal reconstruction. (34) The surgeon must be prepared to enter the thorax if uncontrolled bleeding occurs or blunt esophagectomy cannot be achieved. Management of pneumothorax, which occurred in nearly one third of our patients, is essential. This is achieved by the insertion of intercostal tubes after immediate postoperative plain chest radiogram.

Thus, we conclude that transhiatal esophagectomy is a reasonable alternative to transthoracic resection for neoplasms at all levels of the esophagus, provided the patients are carefully selected for the procedure by the methods we have outlined; that is, preoperative esophagoscopy and sometimes bronchoscopy coupled with careful transhiatal palpation of the esophageal tumor during laparotomy. these methods have proved more reliable in selecting patients than has preoperative computed tomographic scanning (35), although it was done in all patients with middle third carcinoma and some of the other levels. Particular caution must be exercised when the transhiatal technique is used for large carcinomas of the gastric cardia; otherwise it may not be possible to obtain tumor-free margins and still bring the stomach to the neck.

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INTERNET

REVIEW ABSTRACTS

MIDCAB

Minamally Invasive Direct

Coronary Artery Bypass

"1990-1996"

Regional Cardiac Wall Immobilization for Open chest and Closed Chest Coronary Artery Bypass Grafting on the Beating Heart: The "Octopus" Method

Cornelius Borst, Erik W.L. Jansen, Paul F. Grundeman, Jeroen W.F. van Dongen, Hendricus J. Mansvel Beck, Hans Wesenhagen, Pieter J. Slootweg, Jaap J. Bredee. Utrecht University Hospital, The Natherlands

To facilitate (minimally invasive) coronary artery bypass grafting on the beating heart, a novel cardiac wall immobilization method was devised and tested on the beating heart. By means of a suction device ('Octopus'), the epicardium adjacent to a coronary artery was taken hold of by 8 - 19 suction domes and immobilized through an arm contraption fixed to the operating table. During 43 suction periods (-400 mmHg) in 4 anastomosis areas, immobilization was achieved for 15-169 minutes (more than 30 hours in total) in 13 open and 9 closed chest procedures in consecutive pigs (52-108 kg) without hemodynamic deterioration. The 2-D motion of an epicardial beacon was monitored by video camera. In the open chest procedure, the maximum beacon excursion was reduced from 15.6±4.7 mm to 1.8±0.5 mm ($p < 0.001$).

In the closed chest procedure, it was reduced to 0.7±0.3 mm. The surgeon's working area was reduced from 73.0±43.0 mm2 to 1.3±0.5mm2 ($p < 0.001$) in the open chest procedure and to 0.2±0.2 mm2 in the closed chest procedure. No animal died spontaneously. At sacrifice at 0 (n = 7) and 2 days (n=2), light microscopic analysis (83 marked suction samples) showed hemorrhagic suction lesions 5 mm in

diameter and <2.5 mm deep. Coronary vesseles which traversed suction lesions showed intact endothelium. After 6 weeks (n = 6), neither myocardial suction lesions nor coronary intimal hyperplasia were found. Conclusion: Both in open and in closed chest procedures, the 'Octopus' method reduced regional cardiac wall motion in the pig to about 1 x 1 mm without compromising cardiac function and without causing injury to coronary vessels.

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Minimally Invasive Coronary Artery Bypass Grafting

Tea E. Acuff, MD, Rodnet J. Landreneau, MD, Bartley P. Griffith, MD, and Michael J. Mack, MD

Division of cardiothoracic surgery, Medical City Dallas Hospital, Dallas, Texas, Division of Cardiothoracic surgery, University of Pittsburgh, Pittsburgh, Pennsylvania

Background. Standard options for the invasive mamagement of proximal disease of the left anterior descending coronary artery include coronary artery bypass grafting with a left internal mammary artery and percutaneous transluminal coronary angioplasty.

Methods. We describe a surgical technique for bypass of the left anterior descending coronary artery with a left internal mammary artery without median sternotomy and without cardiopulmonary bypass. Thoracoscopy is used to harvest the internal mamary artery, whereas the mammary - coronary artery anastomosis is performed under direct vision though a limited anterior thoracotomy.

Result. We have performed this procedure successfully in 3 patients with minimal morbidity and shortened hospital stay. Average operative time was 3 hours and postoperative hospital stay averaged less than 48 hours.

Comclusions. Although experience is limited and follow-up is very short, with further experience , this less invasive surgical technique may become a viable option for the management of proximal left anterior descending disease.

(Ann Thorac Surg1996;61:135-7)

Minimally Invasive Coronary Artery Bypass Grafting : A New Method Using an Anterior Mediastinotomy

M. Clive Robinson, M.D., David R. Gross, D.V.M., Ph.D., William Zeman, M.D., and Eric Stedje - Larsen, M.D.

Division of Cardiovascular and Thoracic Surgery, Department of Surgery, College of Medicine, University of Kentucky, Lexington, Kentucky

ABSTRACT The benefit of internal mamary artery (IMA) grafting as a long-lasting intervention for coronary artery disease is well recognzied. However, largely because they are less invasive, catheter based alternatives are frequently chosen, particularly to treat single or double vessel disease. To retain the advantages of the IMA graft, and to offset the invasiveness of conventional coronary artery bypass grafting, we developed a new minimally invasive method using an anterior mediastinotomy for treating left anterior descending (LAD) or right coronary artery disease, or both, Feasibility studies using 16 pigs and a human cadaver led to approval by the Institutionl Review Board for use of this procedure to treat six patients (four men, two women; mean age, 63.8±13.6 (SD) yrs) who granted informed consent. Pedicle dissection of the IMA, using video assisted thoracoscopy if necessary, was made through a 2 - to 3 - inch horizontal anterior mediastinotomy. The underlying LAD artery was grafted during femoral vessel cardiopulmonary bypass, with cooling to 30 C, induced ventricular fibrillation, and left ventricular venting if required. Transesophageal echocardiography performed after bypass showed that two patients maintained normal wall motion and four had improvement from the original impairment. One patient suffered a recurrence of angina 4 weeks after the procedure; recatheterization showed an acutely angled IMA, subsequently corrected by balloon angioplasty. The results of follow-up dobutamine echocardiographic stress test were negative in all patients. With this minimally invasive approach, the procedure should provide the benefits of IMA grafting with shorter hospital stay, more rapid recovery, and less overall cost. (J Card surg 1995; 10 : 529- 536)

Coronary Artery Byass Graft off Bypass Through Sternotomy

Enio Buffalo, M.D

Coronary artery bypass grafting (CABG) without cardiopulmonary bypass is now an accepted technique of myocardial revascularization. Recently, with the possibility to perform mammary artery left anterior descending (LAD) anastomosis in a beating heart through a left anterior minor thoracotomy the interest increased.

Kolessov in the former Soviet Union did for the time a mammary artery grafting to LAD with mechanical suture through a left thoracotomy approach.

Trapp & Bisarya in Canada and Ankeney in USA reported the first series of patients operated on but abandoned later due to technical problems.

Our experienc with CABG began in 1981 as new drugs used to slow heart rate and decrease oxygen consumption of the heart became available to us. Initial clinical results from our institution were reported documenting the advantages of the technique over the conventional one for a subset of patients.

Almost at the same time Benetti in Argentina demonstrated the advanages of the "non pump" technique with an applicability higher than our group.

During these 15 years experience we studied some basic topics that we considered important to support the benefits of this technique in our postgraduate course such as: 1) patency of mammary artery LAD - anastomoses in patients operated on with and without CPB (Rotta, 1993);

2) Interruption of coronary blood flow: relationship between type of coronary blood flow: relationship between type of occlusion and vascular lesion (SOARES, 1987); 3) Transesophageal echo during myocardial revascularization without CPB (MOIS'ES, 1993);4) Surgical myocardial revascularization without CPB in patients with acute myocardial infarction treated with streptokinase (VEGA, 1990); 5) Results of myocardial revascularization in patients 70 years of age or more (SUMMO, 1994); 6) Neurological outcome in patients submitted to coronary bypass surgery with and without CPB (MATHEUS, 1995); 7) Reactance, resistance and phase angles total body bioelectrical impedance in cardiac surgical patients (MATTAR, 1995) ; 8) study of citoquines (TNF-a) Release during myocardial revascularization with and without CPB (BRASIL, 1996).

These studies were performed in our post-gradutate course as thesis and presented in Brazilian or international journals or in meetings of our Brazilian Society of Cardiovascular Surgery.

At this moment two other studies are being prepared: 9) Multivariate analysis of operative risk in patients operated with and without CPB (GRANDINI) and 10) intraoperative and post-operative CKMB release during myocardial revascularization without CPB (AGUIAR).

Our clinical experience started in september, 81 and till March, 96 we have operated on 1549 patients in a total 9070 patients revascularized in this period with an applicability of 17%.

Recently this applicability increased to around 25 % despite the widespread use of angioplasty techniques.

In 1515 patients the revascularization was achieved through sternotomy and in 34 through minimum left thoracotomy started by us in October, 1995.

The ages varied from 26 to 86 years (medium - 57) being 1126 males (72. 7%) and 423 females 27. 3%). The number of grafts varied from 1 to 5 with 1,7 grafts / patient.

The most common grafted artery was LAD (1618) and right (856). Diagonal (130) posterior descending (26) marginal circumflex (24) marginal right (24) and obtuse marginal (11) were the others traeted arteries. Left internal mammary artery was the most commonly used conduit for the LAD (1126) and saphenous vein grafts to the other arteries. In the last year we are replacing the saphenous conduits to arterial grafts especially the radial artery.

Preoperative clinical conditions were as follows: chronic cornary insufficiency (1104), unsuccessful angioplasties (140), reoperations (103), after thrombolysis (72), unstable angina (70) and acute evoling myocardial infarction (60).

In a small number of cases, 24 / 1549 (1,5%), it was passible to perform associated procedures such as : endarterctomy (7), plicature of LV aneurysm (4), pace- maker implant (2), transmyocardial laser (2), bypass to brachio-caphalic trunk (2), coronary aneurysm (1), thymus ressection (1), Vineberg implant (1), resection of a stellate ganglion tumor (1), pulmonary resection (1), periicardial hernia (1 and coronary fistula (1).

Major potoperative complications such as : arrhythmias, neurologic and pulmonary were considerably lower comparing with a prospective group operated by us in same period and institutions with the conventional technique.

The total mortality rate was 2.4 % (38 / 1549) being the major cause low cardiac observed in patients with acute myocardial infarction and acute ischemia coming from the cath lab (10 cases).

Direct cost savings include blood transfusion (only in a few cases), one day less of intensive care unit, oxygenator and four days less of hospitalization comparing with the "pump group".

In summary, in this 15 years with CABG without CPB the indications for operation with this method have been identified ;the mehod can be used in approximately 25% of patients undergoing xoronary revascularizathion, the arterial conduits can safely be used and the patency rate is similar to that of conventional techniques. The mortality rate is low and major postoperative complications lower than that observed with CPB.

There is strong evidence that extacorporeal circulation "per se" is an important risk factor, perhaps the most important one , for morbidity and mortality during myocardial revascularization especially in high risk patients and bad operative clinical conditions.

The procedure is cost effective and the continuing use of this technique of coronary artery surgery is therefore justified.

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Left Anterior Descending Coronary Artery Grafting Via Left Anterior Small Thoracotomy Without Cardiopulmonary Bypass

Antonion Maria Calafiore, M.D.

Background: We explored the possibility of anastomosing the left internal mammary artery (LIMA) to the left anterior descending (LAD) in a beating heart via a left anterior small thoracotomy (LAST). Safety of surgical technique can affect surgical indications, that depend on many factors :

Surgeon's adaptability to the new approach cardiologist's acceptanc of a new strategy for treatment of coronary artery disease, patient,s patient's willing of shorter in-hospital stay and postoperative recovery.

Indications: Candidates to the procedure are patients with LAD lesions not suitable for a PTCA or selected patients with two or three vessel disease with right or circumflex territories with vessels occluded and recanalized, with a previous myocardial infarction or not, with a distal disease and / or poor vessel quality. A combination of these possibilities can be present.

Methods: This procedure was performed in 289 / 299 scheduled patients: in 10 (3.3%) the LAD was not suitable or was too small. The chest was opened in the 4 th intercostal space (mean wound length 10.5 cm) and the LIMA was harvested for about 4 cm. The LAD was occluded by means of two 4/0 prolene sutures, the proximal suture was snared. The anastomosis was performed with 2 8/0 prolene sutures, while the heart was beating. Early postoperatively all pts underwent reangiography or a doppler flow assessment of the LIMA or both.

Results: In 248 pts the LIMA was connected directly to the LAD, AND IN 38 pts with interposition of an inferior epigastric artery (IEA). In 3 pts the diagonal branch was also grafted using an IEA from the LIMA. One patient (0.3%) died 38 days after the operation due to multiorgan failure. Thirteen pts (4.5%) had redo surgery failure; 10 (3.3%) early and 3 (1.0%) late; one more patient had a late PTCA for anastomotic stenosis. At mean 8.9 month of follow - up 269 pts (93.1 %) were alive, asymptomatic with or without medical treatmen, and without cardiac events.

Comment. LIMA - to - LAD anastomosis performed in a beating heart via a LAST Is a safe procedure. In selected pts the operation has good early and midterm results.

Minimally Invasive Coronary Artery Bypass Grafting with Left Ventricular Support

Michael J. Mack, M.D.

Minimally invasive coronary artery bypass grafting encompasses a spectrum of procedures from "port Access" coronary artery bypass greafting through various mini sternotomy and parasternal approaches through the MIDCAB procedure. In the port access model, cardiopulmonary bypass is initiated by a femoral - femoral approach and the heart undergoes cardioplegic arrest. The anastomosis on the non beating heart is then prefromed through ports only. The advantage of this approach is minimal lesions; however, the disadvantage is the usse of cardiopulmonary bypass. As has been mentioned in previous talks, the disadvantages of cardiopulmonary bypass include inciting total body inflammatory response by means of complement activation, neurophychologic disorders due to cerebral micro embolization and coagulopathy and potential for blood transfusion due to hypothermia and hemodilution.

At the other end of the spectrum is the MIDCAB procedure in which the conduit - coronary anastomosis is performed without extracorporeal support and through minimal incisions. The advantage of this approach is the avoidance of both cardiopulmonary bypass and the median sternotomy. Among the disadvantages in the limitation of myocardial revascularization to coronary arteries located on the front side of the heart.

In an attempt to extend the MIDCAB procedure, yet avoid the negative aspects of cardiopulmonary bypass, alternative measures of circulatory support have been sought.

These include the intra - aortic balloon which potentially offers some support of the circulatory system during transient periods of low cardiac output due to the manipulation of the heart.

A further extension of this concept is percutaneous placement axial flow devices. The most experience gained with axial flow devices is with the Hemopump device which is an axial in line flow pump that can be placed percutaeously into left ventricle astride the aortic valve.

The impeller rotor is capable of puming 2.5 L/M of flow with the percutaneous device and 4.5 L/M of flow in the larger devices placed directly into the aorta. There has been significant clinical experience using the Hemopump device as an alternative to cardiopulmonary bypass via median sternotomy. A randomized study Casimer - Ahn and colleagues has demonstrated that when compared to cardiopulmonary bypass the Hemopump offers sufficient circulatory support to adequately perform coronary bypass to all vessels.

Experimental work has been performed in the animal laboratory performing endoscopic coronary artery bypass grafting using percutaneous Hemopump device as a sole means of circulatory support. It is

hoped that upon successful completion of animal studied to extend this method of circulatory support to the clinical setting.

An alternative means of temporary circulatory support is the "short circuit" left ventricular assist device. In this model, a 40 or 80 cc pediatric centrifugal pump is constructed in a short circuit configuration with minimal tubing. Through a sternotomy, this pump is placed to deliver support to the left ventricle by a cannula placed in the right superior pulmonary vein and another one in the aorta. At the times when reteraction of the heart is necessary to access the back side, i.e. revascularization of the circumflex system, support of the left ventricle via the short circuit for the 10 - 15 minutes required to perform the anastomosis may prove to be a less invasive to full cardiopulmonary bypass with oxygenator.

If the present MIDCAB procedure is to be extended beyond its current limitations, some method of support of the left ventricle appears to be necessary. The progress towards alternatives to full cardiopulmonary bypass will hopefull allow extension of this procedure.

One interesting alternative to left ventricular support to extend the minimally invasive techniques is the field of motion rebotics. In this model, surgical instruments would sit in a "cardiostationary orbit" adjacent to the heart and the motion of the instruments "gated" to the heart beat. Virtual immobilization of the myocardium would be obtained by video imaging of the gated motion of the surgical instrumentation.

If this sophisticated motion robtic system can ultimately be perfected, the necessity for left ventricular support may be obviated all together.

Redo Cabg Without CPB

Piet W. Boonstra, M.D.

Patients and Methods: From January 1955 up till May 1996, we performed 5 reoperative and 75 first CABG operations in which we anastomosed the left internal mammary artery (LIMA) to the left anterior descending coronary artery (LAD) through a small anterolateral thoracotomy and without CPB (MIDCABG).

Indications for the reoperative CABG operations were recurrence of angina pectoris and positive exercise test, due to progressive atherosclerosis in the old vien. These patients also had an expected high complication rate of a PTCA with or without stent implantation.

The method that we used in reoperative MIDCABG operations was the same one used in first MIDCAB operations.

Results: One woman and 4 men with a mean age of 67.5 years were operated. Mean operation time was 90 (range 55 to 120) minutes and and mean hospital stay

was 5 (range 5 to 8) days. One patient had a prolonged hospital stay (8 days) compared to the other patients because of an atonic bladder requiring a prolonged stay of the urine catherter.

All patients with anterolateral thoracotomy experienced less pain than they did after the first operation with midsternotomy wound. Moreover patients generally felt that they recovered much faster from the MIDCAB procedure than from their operation. Follow - up was 6 to 12 months and all patients are now in NYHA class 1-11.

Comment: This small group of 5 patients was part of a greater group of 80 patients that were operated by means of this technique in our Institute. No mortality and almost no morbidity were recorded, along with a less painful approach, a rapid recovery and a short hospital stay. From the technical point of view we found that the mammary - to - coronary anastomosis was facilitated by the reduced motion of the epicardial surface, that in these cases is firmly adherent to the pericardium.

The results obtained in this group led us to conclude that the technique seems safe and promising in preoperative CABG.

Subxyphoid Gastroepiploic Coronary Grafting "The Gastro Midcab"

James D. Fonger, M.D.

MIDCAB grafting on the undersuface of the heart presents new and different challenges for the surgeon with respect to exposure, stabilization, and the harvesting of the gastroe epiploic pedicled conduit. Previous experience with the subxyphoid approach to the heart has been to evacuate the pericardium when it was not adherent to the heart. This operation also did not require specific visualization of the distal right coronary circulation. Exposure was extremely limited because the object of the operation was to open only the pericardium and insert a drain. Coronary grafting on the undersurface of the heart requires the harvesting of a pedicled abdominal conduit which in turn necessitates an upper midline laparotomy. The extension of the pericardial incision inferiorly into the epigastrium affords the critical extra degree of freedom which makes exposure, stabilization, and grafting of the distal right coronary system possible.

This operation was first performed at sinai Hospital of Baltimore in May of 1995. The patient had undergone coronary bypass grafting years ago complicated by a sternal infection with placement of a muscle flap into the sternal defect. The patient now had developed recurrent angina which required both IV medications and an intra-aortic balloon pump to control. Cardiac catheterization confimed a patent left internal mammary graft below the muscle flap with an occluded vein graft to the right

coronary circulation. The proximal posterior descending branch of the right coronary artery was successfully grafted using a MIDC - 3 approach which has subsequently been employed in over 30 additional primary and reoperative cases.

The indications for this operation include single vessel disease to either the distal right or distal left anterior descending coronary circulations. Primary operations are generally done when the proximal and mid right coronary regions are too diseased for right internal mammary artery grafting through an anterior MIDCAB approach. Pulmonary disease which obviates single lung ventilation does not restrict the surgeon doing subxyphoid grafting. Reopertative patients typically have a patent substernal internal mammary graft and require right coronary grafting. Occasionally patients have had the left internal mammary artery previously placed to the side of the heart and now require left anterior descending grafting with a pedicled reterograde gastoepiploic conduit. This summary will focus on the MIDCAB approach for the distal right coronary artery only.

The contra-indications include general issues such as the connective tissue diseases with vasospastic disorders. A specific history of previous gastric or duodenal surgery makes the existence of an adequate gastroepiploic conduit unreliable. Otherwise previous abdominal surgery complicates but does rule out the harvesting of the gastroepiploic artery. Inability to visualiza a graftable coronary artery from any of the dye injections makes this approach inadvisable. The postero-lateral branch of the right coronary artery connot be adequately visualized from below and grafting of this branch should not be attempted through a subxyphoid incision.

The technique involves a 5 inch vertical midline epigastric incision from the sternum half way down to the umbilicus. The xyphisternum is removed and the sternum is retracted vertically.

Anterior adhesions are not released since they aid in vertical retraction. The leteral diaphragmatic attachments are released and the diaphragm can then be retracted downward unfolding the space between the heart and the diaphragm like a book. A graftable coronary target is confirmed and then attention is focused to the abdomen. The right gastroepiploic artery pedicle is harvested from the greater curvature of the stomach in a standard fashion and injected with an intra-luminal mixture of papaverine and verapamil. After 10,000 units of heparin is administered, a five minute test occlusion of the coronary at the grafting site is done to confirm hemodynamic stability. The gastroepiploic pedicle is then brought up anterior to the stomach and left lobe of the liver.

The pedicle is brought throught a surgically created hole in the diaphragm for posterior descending grafting and anastomosed in an antegrade fashion. Distal right coronary grafting is done in either a retrograde or antegrade fashion bringing the conduit over the top of the diaphragm.

The conduit is tacked to the epicardium in the final configuration and a transit time doppler flow measurement made of the in - situ flow prior to closuer. Systemic pressure, graft flow, and the actual waverom are recorded and a drain is placed across the

abdomen into the pericardium and pleura if violated. The diaphragm does not need to be re-attached to the costal margin prior to closure.

Nasogastric suction is discontinued the folowing morning and the graft flow is checked with a non-invasive transmitted doppler velocity measurement. Patients are generally discharged the evening after surgery on ASA, Motrin for 10 days, Tylox prn, and one month of Nifedipine. There are no specific restrictioons on activity and follow-up visits are arranged at two weeks, three month, and one year. Symptoms and doppler flow velocities are checked at visit aith a postoperative stress thallium test done three months after surgery as well.

Results have been very encouraging and specific problems will be discussed. The subxyphoid approach to the "GASTRO MIDAB" is currently an under-Utilized strategy for grafting the inferior surface of the heart which was devised out of necessity and is now being used with increasing frequency. Further specific technical details of the operation are beyond the scope of this summary. However, surgeons comfortable with MIDCAB surgery and using the gastroepiploic artery in the open setting can easily master the additional challenges required to employ this new approach safely and effectively.

Direct Myocardial Revascularization without Extracorporeal Circulation Experience in 700 Patients

Federico J. Benetti. M.D.; Gandolfo. Naselli M.D.; Michael Wood. M.D.; and Luis Geffner. M.D.

Between May 1975 and March 1990. 700 patients were operated on with direct coronary surgery without extracorporeal cirulation (ECC): 529 (76 PERCENT)were male and 171 (24 percent) were female.

The average age was 64 years (range. 35 to 56 years) . 454 (65 percent had unstable angina. 163 (23 percent) had stable angina. 51 (7 percent) had postmyocardial infarction angina. And 32 (5 percent) had acute myocardial infarction at the moment of the operation. In this series of patients all branches of the coronary arteries were bypassed: the mammary artery was used in 40 percent of the cases, the average bypass per patient was 2.2 (range, 1 to 5). And 26 percent had associated disease of high risk to undergo ECC. The morbidity was 4 percent and the mortality for this series of patients was I percent: the probablity of survival at seven years was 90 percent. This experience shows us that this surgery is an alternative in the treatment of coronary disease, especially for aged patients with associated disease. In some cases of acute transmural infarction. And also for patients who need coronary angioplasty, Also. It can improve the relation cost benefit in coronary surgery. (Chest 1991: 100 312-16)

CABG = coronary artery bypass graft : ECC = extracorporeal circulation: I.M.A. = internal mammary artery: SVG = saphenous vein graft

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Direct Coronary Surgery with Saphenous Vein Bypass Without Either Cardiopulmonary Bypass or Cardiac Arrest

Federico J. Benetti

From the Hospital Espanol de Rosario, Samiento 3150, (2000, Rosco and Instituto de Cardiologia de Rosario "Dr. Luis Gonzalez Sabathie 2000, Rosario, Argentina

SUMMARY. - From October, 1980 to April, 1983, 30 patients underwent direct coronary surgery without either cardiopulmonary bypass or cardiac arrest. Patientswere selected according to the site of the lesion or the condition of the vessel, i.e. generally arteries with a good calibre (more than 1.5 mm), without big plaques in the anastomotic area and resions limited to the left anterior descending, the diagonal or the right coronary arteries, independently from the clinical condition or state of left ventricular function. Eighteen had stable angina, 10 unstable angina, 2 post-myocardial infarction, angina, and 4 had a severe concomitant disease. The operations performed were: 17 simple aorto - coronary bypasses, 11 double bypasses and 2 triple bypasses. When it was necessary to revascularize the diagonal or the left anterior descending artery, the operating table was rotated to the right, a gauze pack was applied posteriorly and the arteries were sutured with 6-0 or 7-0 prolene sutures. There were no deaths and no perioperative infarctions.

It should be noted that to date this technique could be used only on 7% of our patients, but we consider this percentage could be increased in the future.

Port-Access Coronary Artery Bypass Grafting: A Proposed Surgical Method

John. H. Stevens, MD, Thomas A Burdon, MD, William S. Peters. MB. ChB Lawrence C. Siegel. MD, Mario F. Pompili. MD, Mark A. Vierra. MD Frederick G. St. Goar. MD, Greg H. Ribakove. MD, R. Scott Mitchell. MD and Bruce A. Reitz. MD

Minimally invasive surgical methods have been developed to provide patients the benefits of open operations with decreased pain and suffering. We have developed a system that allows the performance of cardiopulmonary bypass and myocardial protection with cardioplegic arrest without sternotomy or thoracotomy. In a canine model: we successfully used this system to anastomose the internal thoracic artery to the left arterior descending coronary artery in nine of 10 animals. The left internal thoracic artery was dissected from the chest wall and the pericardium was opened with the use of thoracoscopic techniques and single lung ventilation. The heart was

arrested with a cold blood cardioplegic solution delivered through the central lumen of a balloon occlusion catheter (Endoaortic Clamp: Heartport. Inc., Redwood City. Calif.) in the ascending aorta. And cardiopulmonary bypass was maintained with femorofemoral bypass.

An operating microscope modified to allow introduction of the 3.5x magnification objective into the chest was positioned through a 10 mm port over the site of the anastomosis. The anastomosis was performed with modified surgical instruments introduced through additional 5 mm ports. In the cadaver model (n=7) the internal thoracic artery was harvested and the pericardium opened by means of similar techniques. A precise arteriotomy was made with microvascular thoracoscopic instruments under the modified microscope on four cadavers. In three other cadavers we assessed the exposure provided by a small anterior incision (4 to 6 cm) over the fourth intercostal space. This anterior port can assist in dissection of the distal internal thoracic artery and provides direct access to the left anterior descending, circumflex, and posterior descending arteries. We have demonstrated the potential feasibility of grafting the internal thoracic artery to coronary arteries with the heart arrested and protected, without a major thoracotomy or sternotomy.

(J THORAC CARDIOVASC SURG 1996; 111: 567 - 73)

Minimally Invasive Coronary Artery Bypass Grafting

Tea E. Acuff, MD, Rodney J. Landreneau, MD, Bartley P. Griffith, M,D, and Michael J. Mack, MD

Division of Cardiothoracic Surgery, Medical City Dallas Hospital, Dallas, Texas, and Division of Cardiothoracic Surgery, University of Pittsburgh, Pittsburgh, Pennsylvania Background. Standard options for the invasive management of proximal disease of the left anterior descending coronary artery include coronary artery bypass grafting with a left internal mammary artery and percutaneous transluminal coronary angioplasty.

Methods. We describe a surgical technique for bypass of the left anterior descending coronary artery with a internal mammary artery without median stenotomy and without cardiopulmonary bypass. Thoracoscopy is used to harvest the internal mammary artery, whereas the mammary - coronary artery anastomsis is performed under direct vision through a limited anterior thoracotomy.

Results. We have performed this procedure successfully in 3 patients with minimal morbidity and shortend hospital stay. Average operative time was 3 hours and postoperative hospital stay averaged less than 48 hours.

Conclusions. Although experience is limited and follow-up is very short, with further experience, this less invasive surgical technique may become a viable option for the management of proximal left anterior descending disease.

(Ann Thorac Surg 1996; 61: 135 - 7)

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Technical Considerations for Coronary Artery Bypass Without Cardioplegia

LAWRENCE I. BONCHEK, M.D.

Department of Cardiothoracic Surgery, Lancaster General Hospital Lancaster, Pennsylvania

ABSTRACT Coronary artery bypass without cardioplegia remains the preferred technique at many centers around the world. This report describes in detail a technique that emphasizes intermittent cross-clamping of the aorta at mild hypothermia (30°c). Since coronary bypass procedures require interruptions of coronary blood flow only for the distal anstomoses, the duration of myocardial ischemia with this technique is not prolonged by unexpected changes in the operative plan. Many bypass grafts can also be carried out without cross - clamping of the aorta by using local control of the coronary arteries. The increasing number of elderly patients with atherosclerotic aortas that cannot be safely clamped makes it helpful for all cardiac surgeons to be familiar with noncardioplegic techniques.

Reoperative Coronary Artery Bypass Grafting Without Cardiopulmonary Bypass

William J. Fanning, MD, Gerard S. Kakos, MD, and Thomas E. Williams, Jr, M,D PhD

Divisions of Thoracic and Cardiovascular Surgery, Crant and Mount Camel Medical Centers and The Ohio State University, Columbus, Ohio

Between June 1979 and January 1992, 46 men and 13 women aged 35 to 81 years (mean, 58 years) underwent reoperative coronary artery bypass grafting without cardiopulmonary bypass. Isolated reoperative circumflex bypass was performed through a left thoracotomy, and reoperative bypass to the right coronary artery and left anterior descending coronary systems was through a median sternotomy. Complete revascularization was the goal in all patients. Saphenous vein grafts were placed to the right coronary artery (n = 21), circumflex artery (n=11), and left anterior descending artery (n = 24), and 14 internal thoracic artery to left anterior desceding artery bypass grafts were performed. The overall mortality rate was 3.4% (2 deaths). Postoperative morbidity included myocardial infarction in 1 patient and pleuropulmonary complications in 6. No patient was reexplored for hemorrhage, and 19 patients required no blood products.

Twenty patients underwent repeat coronary angiography, and 18 of 20 grafts

placed without cardiopulmonary bypass were patent. At a mean follow - up interval of 42.2 months 35 of 50 evaluable patients were in functional class 1 or 11 In selected patients, reoperative coronary artery bypass grafting can be performed without cardiopulmonary bypass with a low perioperative morbidity and mortality rate, satisfactory graft patency retes, and good long - term symptomatic improvement.

(Ann Thorac surg 1993,55 : 486 - 9)

Direct Myocardial Revascularization without cardiopulmonary Bypass

E. Buffolo, J.C.S. Andrade. J Succi, L.E.V. Leao, and C. Gallucei

Division of Cardiothoracic Surgery, Escola Paulsta de Medicina. Sao Paulo, Brazil

The authors present their experience with 160 patients who underwent coronary artery saphenous vein bypass revasculrization without cardiopulmonary bypass. The distal sutures were performed with interruption of the coronary flow without any devices for perfusion of the coronary artery: the proximal sutures were made with tangential clamping of the aorta.

Vessels most frequently revascularized were the anterior descending and the distal right coronary artery. Out of 597 patients who underwent bypass surgery in this period, this technique could be employed in 160 cases (25.8%). Hospital mortality was 3.1% (5% 169) and perioperative myocardial infarction as determined by daily EKGs and CKMB occurred in 4 patients (2.5%). Control hemodynamic studies were performed in 41 of the 160 patients (25.6%) with a patency rate of 83.9% in the 62 grafts restudied.

We conclude that direct myocardial revascularization can be performed safely without major difficulties and with efficient anastomoses. The main advantages of the technique are that it does not require the of extracorporeal circulation and consequently, the use of any blood, as well as its low cost due to shorter hospitatization periods.

Coronary Artery Bypass Without Cardiopulmonary Bypass

Albert J. Pfister, MD, M. Salah Zaki, MD, Jorge M. Garcia, MD, Luis A. Mispireta, MD. Paul J Corso, MD, Anjum G. Qazi, MD, Steven W. Boyce, MD, Thomas R. Coughlin, Jr, MD, and Patricia Gurny, MD

Washington Hospital Center, Washington, DC, and the Washington Adventist Hospital, Takoma Park, Maryland

The purpose of this article is twofold: to describe our technique for performing coronary artery bypass grafting without cardiopulmonary bypass (off pump) and to

demonstrate that this operation is safe, in terms of mortality and certain indices of morbidity. Very little has been published in regard to off-bypass operations. From 1985 through 1990, 220 patients underwent operation off bypass, 220 on-pump controls were retrospectively matched for number of grafts, left ventriclar function, and date of operation. Groups were compared in terms of mortality and ten indicators of morbidity. The same analysis was performed for ten subgroups. We found no statistically signifcant difference between groups in mortality off pump, 1.4% (3/220); on pump, 2.4% (5/2204), which held across all subgroups. Patients undergoing operation off pump required blood far less often (not transfused; off pump, 72.7% (160/ 220), on pump, 54.6% (116/ 220), p = 0.005 by Fisher's exact test), and the low output state occurred statistically less frequently off pump (off pump, 5.5% (12/220), on-pump, 12.7% (28/220), p = 0.01 by Fisher's exact test). Further research should be directed to which subgroups can be operated on to advantage off pump and which, if any, groups of patients should be confined to on - bypass operations

Coronary artery bypass without cardiopulmonary bypass [see comments]

Pifster AJ Zaki MS Garcia JM, Mispireta LA, Corso PJ Qazi AG Boyce SW Coughlin TR Jr Gurny P Washington Hospital Center, DC 20009

The purpose of this article is twofold: to describe our technique for performing coronary artery bypass grafting without cardiopulmonary b (off pump) and to demonstrate that this operation is safe, in terms of mortality and certain indices of morbidity. Very little has been published in regard to offpypass operations. Form 1985 through 1990, 220 patients underwent operation off bypass; 220 onpump controls were retrospectively matched for number of grafts, left ventricular function, and date of operation. Groups were compared in terms of mortality and ten indicators of morbidity. The same analysis was performed for ten subgroups. We found no statistically significant difference between groups in mortality (off pump, 1.4% [3/220]; on pump, 2.4% [5/220]), which held across all subgroups. Patients undergoing operation off pump required blood far less often (not transfused: off pump, 72.7% [160/220]; on pump, 54.6% [116/220]; p = 0.005 by Fisher's exact test), and the low output state occurred statistically less frequently off pump (off pump, 5.5% [12/220]; on-pump, 12.7% [28/220]; p = 0.01 by Fisher's exact test). Further research should be directed to which subgroups can be operated on to advantage off pump and which, if any, groups of patients should be confined to on-bypass operations.

Ann Thorac Surg 1992 Dec Vol. 54 no. 6 pp. 1085-91; discussion 1091-2.

(Ann Thorac Surg 1992; 54, 1085 - 92)

Bilateral vs single internal thoracic artery grafting for left main coronary artery occlusion. Otaki M Lust RM Sun YS Norton TO Spence PA Zeri RS Hopson SB Chitwood Department of Cardiothoracic Surgery, East Carolina University School of Medicine, Greenville, NC. 19. Chest 1994 Oct. Vol. 106 no. 4 pp. 1260-3.

This study was conducted to compare the coronary flow distributed by single and bilateral internal thoracic artery (ITA) grafts in the setting of the left main coronary occlusion. Ten dogs underwent coronary artery pypass grafting through a left thoracotomy, off pump, using a brief local occlusion to perform the anastomosis. Dogs were randomly assigned to receive either a single left ITA (LITA) graft to the circumflex coronary artery (CFX), or bilateral ITA grafts, with additional placement of the right ITA (RITA) to the left anterior descending artery (LAD). After the grafts were placed, the left main coronary artery was ligated. Electromagnetic flows were obtained in the LAD and the CT proximally and distally to ITA grafts in both groups before grafting and after grafting. ITA flow in situ was also measured before rotation from the chest wall. Total left ventricular flow requirements were satisfied equally well by either a single LITA graft (116.7 + /- 11.6 mL/min) or bilateral ITA grafts (total, 116.8 + /-9.6 mL/min divided as LITA, 55.9 + /-7.4 mL/min; RITA, 60.9 +12.0 mL/min). When two grafts were replaced, competitive flow in the proximal regions of both native vessels was noted, although basal flow requirements were maintained. When an individual graft was occluded in the bilaterally grafted system, the remaining graft immediately recruited the additional flow, demonstrating that either right or left ITA can support flow demands five to six times higher than in situ chest wall flow (RITA, 21.9 +/-3.1 mL/Min; LITA, 22.3+/-4.9 mL/min). These data suggest that in this canine model, a single ITA graft can support the entire flow requirements of the left ventricle. Assuming no intervening stenosis is present in native coronary systems, bilateral ITA grafting may provide a margin of safety, but under resting conditions, provides no perfusion advantages over single ITA graft.

Limitations of using arterial conduit for myocardial revasclarization in patients with combined coronary and other arterial lesions.

Mishra Y Kertsman VP Alekyan BG Burokowski VI Bakulev Institute of Cardiovascular Surgery, Moscow, Russia.

To explore the limitations of using arterial conduit for myocardial revascularization in patients with combined coronary and other arterial lesions, we evaluated 195 patients with combined lesions undergoing CABG, either alone or in combination with peripheral vascular reconstruction between October 1987 to October 1990. Doppler flow and spectral analysis revealed that 14 patients (7.1%)

had atherosclerotic lesions of the subclavian artery, in whom ipsilateral internal mammary artery pedicle graft was contraindicated for myocardial revascularization. Out of 195 patients, 165 patients were subjected for aortography, 18 of whom (10.9%), revealed atherosclerotic involvement of the celiac trunk, thereby contraindicating the use of gastroepiploic artery for myocardial revascularization. Thus in our experience use of arterial conduit for myocardial revascularization in patients with combined coronary and other arterial lesions in limited.

Indian Heart I. 1993 Mar-Apr. Vol. 45 no. 2 pp. 117-20.

Myocardial revascularization using branches of the left internal mammry artery.

Tappainaer E Fabbri A Pessotto R Luciani GB Mazzuco A Divisione e Cattedra di Cardiochirurgia, Universit* di Verona, Italy. J.

To increase the number of arterial grafts in patients with multivessel coronary disease, we have used branches of the left internal mammary artery (LIMA) as bypass grafts. From March 1990 to June 1993, 15 patients (13 males and 2 females) aged 38 to 65 years (mean 57 +/-8), received a total of 30 LIMA branch anastomoses. The two terminal branches were used to perform a "Y" graft to the left anterior descending coronary artery territory in 13 patients. A pericardiophrenic branch was used in four cases. Five patients (33.3%) had complete myocardial revascularization using IMA only. There were neither early nor late deaths and all patients are free from angina at a mean follow-up of 20 months (6 to 45 months). However, early postoperative cardiac catheterization, performed in 12 patients (80%), revealed a 20% occlusion rate for each terminal branch and a 50% occlusion rate for the pericardiophrenic branch. Techically challenging due to the small diameter of the grafts, the terminal LIMA branches should be limited to selected patients when more conventional arterial or vein conduits are not available. More proximal branches have a higher occlusion rate and their use is not recommended.

Card Surg 1995. Sep. Vol. 10 no. 5pp. 559-63.

Minimally invasive coronary artery bypass grafting.

Acuff TE Landreneau RJ Griffith BP Mack MJ Division of Cardiothoracic Surgery, Medical City Dallas Hospital, Texas, USA.

Background. Standard options for the invasive management of proximal disease of the left anterior descending coronary artery include coronary artery bypass grafting with a left internal mammary artery and percutaneous transluminal coronary angioplasty. **Methods.** We describe a surgical technique for bypass of the left anterior descending coronary artery with a left internal mammary artery without

median sternotomy and without cardiopulmonary bypass. Thoracoscopy is used to harvest the internal mammary artery, whereas the mammary-coronary artery anastomosis is performed under direct vision through a limited anterior thoracotomy. Results. We have performed this procedure successfully in 3 patients with minimal morbidity and shortened hospital stay. Average operative time was 3 hours and postoperative hospital stay averaged less than 48 hours.

Conclusion

Although experience is limited and follow-up is very short, with further experience, this less invasive surgical technique may become a viable option for the management of proximal left anterior descending disease.

Ann Thorac Surg 1996. Jan. Vol. 61 no. 1pp. 135-7.

Minimally invasive coronary by pass artery grafting: a new method using anterior mediastinotomy

Robinson MC Gross DR Zeman W Stedje-Larsen E

Department of Surgery, College of Medicine, University of Kentucky, Lexington. 1995. Sep.

The benefit of internal mammary artery (IMA) grafting as a long-lasting intervention for coronary artery disease is well recognized. However, largely because they are less invasive, catheter based alternatives are frequently chosen, particularly to treat single or double vessel disease. To retain the advantages of the IMA graft, and to offset the invasiveness of conventional coronay artery bypass grafting, we developed a new minimally invasive method using an anterior mediastinotomy for treating left anterior descending (LAD) or right coronary artery disease, or both. Feasibility studies using 16 pigs and a human cadaver led to approval by the Institutional Review Board for use of this procedure to treat six patients (four men, two women; mean age, 63.8±13.6 [SD] yrs) who granted informed consent. Pedicle dissection of the IMA, using video assisted thoracoscopy if necessary, was made through a 2-to 3-inch horizontal anterior mediastinotomy. The underlying LAD artery was grafted during femoral vessel cardiopulmonary bypass, with cooling to 30 degrees C, induced ventricular fibrillation, and left ventricular venting if required. Transesophageal echocardiography performed after bypass showed that two patients maintained normal wall motion and four had improvement from the original impairment. One patient suffered a recurrence of angina 4 weeks after the procedure; recatheterization showed an acutely angled IMA, subsequently corrected by balloon angioplasty. The results of follow-up dobutamine echocardiographic stress tests were negative in all patients. With this minimally invasive approach, the procedure should provide the benefits of IMA grafting with shorter hospital stay, more rapid recovery, and less overall cost.

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Video-assisted thoracoscopic surgery-indications, results, complications, and contraindications.

Karier D Ennker IC Hartz C Department of Thoracic Surgery, Lung-Hospital Heckeshorn, Berlin, Germany.

In recent times minimally invasive surgery has secured a firm place among the therapeutic options in thoracic surgery. The experience and results gained from video-assisted surgery on 109 patients between January 1,1992 and July 31, 1993 are critically discussed. The procedure could be completed thoracoscopically on 94 of them. A change of method was necessary nine times for technical reasons and six times for oncological reasons (two times due to metastasis, four times due to bronchial carcinoma). A total of 154 individual operations were conducted. Sixty-three patients with recurrent spontaneous pneumothorax were successfully treated. The relapse rate was 1.5%. With the exception of three rethoracotomies (one due to postoperative hemorrhage and two to persistent fistula) no significant complications occurred. Further indications included capsulated pleural empyema (n = 1), persistent hematothorax (n = 2), pleurectomy for malignant pleural effusion (n = 2), pleural tumors (n = 3), pulmonary parenchyma (n = 2), interstitial lung diseases (n = 3), bullous emphysema (n = 2), peripheral lung nodules (n = 18), mediastinal tumors (n = 8), and sympathectomy (n = 2). The advantages of video-assisted thoracoscopic surgery for patients include cosmetic considerations, low pain, earlier postoperative mobilization, and for some indications, a shorter operation period. The significant disadvantages for the surgeon are the loss of binocular vision as well as the impossibility of intraoperative palpation.

Thorac Cardiovasc Surg 1993 Dec. Vol. 41 no. 6 pp.330-4.

Minimally invasive coronary artery bypass grafting: a new method using anterior mediastinotomy.

Robinson MC Gross DR Zeman W Stedje-Larsen E Department of Surgery, College of Medicine, University of Kentucky, Lexington.

The benefit of internal mammary artery (IMA) grafting as a long-lasting intervention for coronary artery disease is well recognized. However, largely because are less invasive, catheter based alternatives are frequently chosen, particularly to treat single or double vessel disease. To retain the advantages of the IMA graft, and to offset the invasiveness of conventional coronay artery bypass grafting, we

developed a new minimally invasive met d using an anterior mediastinotomy for treating left anterior descending (LAD) or right coronary artery disease, or both. Feasibility studies using 16 pigs and a human cadaver led to approval by the Institutional Review Board for use of this procedure to treat six patients (four men, two women; mean age, 63.8 +/-13.6 [SD] yrs) who granted informed consent. Pedicle dissection of the IMA, using video assisted thoracoscopy if necessary, was made through a 2-to 3-inch horizontal anterior mediastinotomy. The underlying LAD artery was grafted femoral vessel cardiopulmonary bypass, with cooling to 30 degrees C, induced ventricular fibrillation, and left ventricular venting if required.

Transesophageal echocardiography performed after bypass showed that two patients maintained normal wall motion and four had improvement from the original impairment. One patient suffered a recurrence of angina 4 weeks after the procedure; recatheterization showed an acutely angled IMA, subsequently corrected by ballon angioplasty. Thesults of follow-up dobutamine echocardiographic stress tests were negative in all patients. With this minimally invasive approach, the procedure should provide the benefits of IMA grafting with shorter hospital stay, more rapid recovery, and less overall cost.

J. Card 1995 960822 ol. 0.5 52936.

Minimally invasive cardiopulmonary bypass with cardioplegic arrest: a closed technique with equivalent myocardial protection [see comments].

Schwartz DS Ribakove GH Grossi EA Stevens JH Siegel LC St. Goar FG Peters WS McLoughlin Bauman F.G. Colings B, Galoway AC D Department of Surgery, Division of Cardiothoracic Surgery, New York University Medical Center, NY 10016, USA,
Comment(s):

Thoracoscopic cardiac surgery is presently under intense investigation. This study examined the feasibility and efficacy of closed cardiopulmonary bypass and cardioplegic arrest in comparison with standard open chest methods in a dog model. The minimally invasive closed chest group (n = 6) underwent percutaneous ry b and cardiac venting, as well as antegrade cardioplegic arrest through use of a specially designed perctaneous endovascular aortic occluder and cardioplegic solution delivery system. The control group (n = 6) underwent standard sternotomy and conventional open chest cardiopulmonary bypass, aortic crossclamping, and antegrade cardioplegia. Ischemic arrest time was 1 gour in each group. Ventricular pressures and sonomicrometer segment lengths were recorded before bypass and at 30 and 60 minutes after bypass. Left ventricular function did not differ significantly between the two groups, as demonstrated by measurements of elastance and end-

diastolic stroke work. Also, the preload recruitable work area was 69% and 60% of baseline at 30 and 60 minutes after bypass in the mainimally invasive group versus 65% and 62% in the conventional control group (p = not significant); the stroke work end-diastolic length relationship was 78% and 71% of baseline in the minimally invasive group at these intervals versus 77% and 74% in the conventional control group (p = not significant). Myocardial temperatures were similar throughout bypass in the two groups, and ultrastructural examaination of prebypass and postbypass biopsy specimens showed no differences between groups.

These results demonstrate that minimally invasive cardiopulmonary bypass with cardioplegic arrest is as feasible, safe, and effective as conventional open chest cardiopulmonary bypass. Thus current technology may allow wider clinical application of closed chest cardiac surgery.

Comment in: J Thorac Cariovasc Surg 1996 Mar; 111(3):554-5. J. Thorac Cardiovasc. Surg. 1996 Mar.Voll no.3pp. 55-66.

Coronary surgery without cardiopulmonary bypass [editorial] Yamanaka J Takeuchi Y Gomi A Torii S Koyanagi T Yashima M Department of Cardiovascular Surgery, Kanto-Teishin Hospital, Tokyo, Japan.Nippon Kyobu Gakkai Zasshi 1995. Vol. 43 no. 7 pp. 1069-72. Br Heart I. 1995 Mar Vol. 73 no. 3 pp. 203-5 Type: Editorial England.

[Coronary artery bypass grafting without cardiopulmonary bypass in patients with LV dysfunction (EF < or = 30%) --a report of 3 cases]

The purpose of this article is to describe our technique for performing coronary artery bypass grafting without cardiopulmonary byass and to demonstrate that this operation is safe and useful to the case of LV dysfunction. Between April 1988 and March 1994, 2 men and 1 woman aged 61 to 69 years (mean 65 years) with LV dysfunction (EF < or = 30%) underwent coronary artery bypass grafting without cardioplmonary bypass. Saphenous vein grafts were placed to the right corory artery (n = 2), left anterior descending artery (n = 2), and internal thoracic artery grafts were placed to the right coronary artery (n = 1), left anterior descending artery (n = 1). The post operative course were uneventful in all patients and discharged with no complications. All patients underwent coronary angiography, and 5 of 6 (83.3) grafts placed without cardiopulmonary bypass were patent. In selected patients, coronary artery bypass grafting to the case of LV dysfunction without cardiopulmonary bypass can be performed safe and satisfactory graft patency rates.

Reoperative coronary revascularization cardiopulmonary bypass Kigawa I Suma H Marat Fujita S Tanaka J Nishimi M Horii T Fukuda S Wanibuchi Y Department of Cardiovascular Surgery, Mitsui Memorial Hospital, Tokyo, Japan.

We report a case of successful reoperation of coronary revascularization without cardiopulmonary bypass. The patient was a 62-year-old man, who had undergone coronary artery bypass grafting (CABG) to the LAD and CX with two saphenous vein grafts (SVG) for the left main lesion 12 years before. He required reoperation for unstable angina due to progressive ischemic heart disease and the diseased SVG. Preoperative coronary angiogramrevealed total occlusion of major 3 branches and the diseased SVG to the LAD. The reoperation was performed wthout cardiopulmonary bypass through the repeated median sterntomy for revascularization of the LAD and RCA. The left internal thoracic artery and the gastroepiploic artery were anastomosed to the LAD and RCA under the beating heart without any hemodynamic or electrocardiographic deteriorations. The operation was uneventfully finished in 3 hr 40 min. Without the use of blood products. Postoperative angiogram showed both new grafts were widely patent, and he was discharged 14 days after the operation without angina. We also performed 4 other cases of reoperative CABG without cardiopulmonary bypass, and conclude that this technique is a safe and effective alternative alternative in a carefully selected group of patients for reoperative CABG to reduce several technical problems related to coronary reoperation.

Kyobu Geka 1994 Nov. Vol. 47 no. 12pp. 979-82.

Coronary artery bypass grafting without cardiopulmonary bypass. Buffolo E de Andrade CS Branco JN Teles CA Aguiar LF Gomes WJ Ann Thorac Surg Escola Paulista de Medicina, Hospital Sao Paulo,

Background. Coronary artery bypass grafting without cardiopulmonary bypass is now an accepted technique of myocardial revascularization. We herein report our total experience with this procedure. **Methods.** In a consecutive series of 8,751 patients operated on in our institution for coronary artery disease from 1981 to 1994, 1,274 patients received coronary artery bypass grafting without cardiopulmonary bypass. Results. **Results** indicate that the operation can be performed with an acceptable mortality (2.5%), and that all types of arterial conduits can be used. Most commonly the left anterior descending and right coronary arteries were bypassed. The incidence of arrhythmias and of pulmonary and neurologic complications were significantly lower in this group of patients compared with patients receiving coronary

artery bypass grafting with cardiopulmonary bypass. Most importantly, there was decreased cost when the procedure was used because no extracorpeal circulation, cardioplegia sets, or other cannulas were used. **Conclusions.** We conclude that the continuing use of coronary artery bypass grafting without cardiopulmonary bypass is justified and that, with proper selection of patients, the procedure is safe and cost-effective.

Disciplina de Cirurgia Cardiovascular, Sao Paulo, Brazil. 1996 Jan. Vol. 61 no. 1 pp. 63-6.

The second coronary reoperation via the left thoracotomy without cardiopulmonary bypass

Kigawa I Suma H Nishimi M Horii t Fukuda S Wanibuchi Y Department of Cardiovascular Surgery, Mitsui Memorial Hospital, Tokyo.

A 75-year-old female who had underwent coronary artery bypass grafting (CABG) reoperation 2 years before was readmitted because of unstable angina. Two arterial grafts and one saphenous vein graft (SVG) were all occluded one and half year after the primary operation. The second operation was approached via the repeated sternotomy. LAD and RCA were revascularized with a Yshaped SVG which had only one inflow. Coronary angiogram revealed stenosis of LMA and RCA and occlusion of the inflow of the Y-shaped SVG. We performed the 3rd CABG via the left thoracotomy without cardiopulmonary bypass for revascularization of the LAD area. A new SVG was anastomosed from descending aorta to the old SVG just proximal to the anastomotic site with LAD. Local coronary occlusion time was 7 min without any hemodynamic or electrocardiographic deteriorations. The operation was successfully performed in 3 hr 55 min. The patient recovered well uneventfully. Postoperative angiogram showed that the new SVG was adequately patent and she was discharged without angina. We conclude that CABG without cardiopulmonary bypass via the left thoracotomy is an useful alternative to decrease mortality and morbidity for reoperative myocardial reveascularization.

Nippon Kyobu Geka Gakkai Zasshi 1994 Apr. Vol.42 no. 4pp. 603-6 Type:.

Minimally invasive coronary artery bypass grafting: a new method using an anterior mediastinotomy.*

Robinson MC, Gross DR, Zeman W, Stedje-Larsen E Department of Surgery, College of Medicine, University of Kentucky, Lexington. 1995 960822.*

The benefit of internal mammary artery (IMA) grafting as a long-lasting intervention for coronary artery disease is well recognized. However, largely because they are less invasive, catheter based alternatives are frequently chosen, particularly to treat single or double vessel disease. To retain the advantages of the IMA graft, and to offset the invasiveness of conventional coronary artery bypass grafting, we developed a new minimally invasive method using an anterior mediastinotomy for treating left anterior descending (LAD) or right coronary artery disease, or both. Feasibility studies using 16 pigs and a human cadaver led to approval by the Institutional Review Board for use of this procedure to treat six patients (four men, two women; mean age, 63.8+/-13.6 [SD] yrs) who granted informed consent. Pedicle dissection of the Ima, using video assisted thoracoscopy if necessary, was made through a 2-to 3-inch horizontal anterior mediastinotomy. The underlying LAD artery was grafted during femoral vessel cardiopulmonary bypass, with cooling to 30 degrees C, induced ventricular fibrillation, and left ventricular venting if required. Transesophageal echocardiography performed after bypass showed that two patients maintained normal wall motion and four had improvement from the original impairment. One patient suffered a recurrence of angina 4 weeks after the procedure; recatheterization showed an acutely angled IMA, subsequently corrected by ballon angioplasty. The results of follow-up dobutamine echocardiographic stress tests were negative in all patients. With this minimally invasive approach, the procedure should provide the benefits of IMA grafting with shorter hospital stay, more rapid recovery, and less overall cost.

J Card Surg 1995 Sep. Vol. 10 no. 5 pp. 529-36

Minimally invasive coronary artery bypass grafting.

Acuff TE; Landreneau RJ; Griffith BP; Mack MJ Division of Cardiothoracic Surgery, Medical City Dallas Hospital, Texas USA. 1996 960822.

Background. Standard options for the invasive management of the left anterior descending coronary artery include coronary artery bypass grafting with a left internal mammary artery and percutaneous transluminal coronary angioplasty. Methods. We describe a surgical technique for bypass of the left anterior descending coronary artery with a left internal mammary artery without median

sternotomy and without cardiopulmonary bypass. Thoracoscopy is used to harvest the internal mammary artery, whereas the mammary-coronary artery anastomosis is performed under direct vision through a limited anterior thoracotomy. Results. We have performed this procedure successfully in 3 patients with minimal morbidity and shortened hospital stay. Average operative time was 3 hours and postoperative hospital stay averaged less than 48 hours. Conclusion. Although experience is limited and follow-up is very short, with further experience, this less invasive surgical technique may become a viable option for the management of proximal left anterior descending disease.

Ann Thorac Surg. 1996 Jan. Vol. 61 no. 1 pp. 135-7.

Port-access coronary artery bypass grafting : a proposed surgical method [see comments]

Stevens JH; Burdon TA; Peters WS; Siegel LC; Pompili MF; Vierra MA; St. Goar FG; Ribakove GH; Mitchell RS; Reitz BA

Minimally invasive surgical methods have been developed to provide patients the benefits of open operations with decreased pain and suffering. We have developed a system that allows the performance of cardiopulmonary bypass and myocardial protection with cardioplegic arrest without sternotomy or thoracotomy. In a canine model, we successfully used this system to anastomose the internal thoracic artery to the left anterior descending coronary artery in nine of 10 animals. The left internal thoracic artery was dissected from the chest wall, and the pericardium was opened with the use of thoracoscopic techniques and single lung ventilation. The heart was arrested with a cold blood cardioplegic solution delivered through the central lumen of a balloon occlusion catheter (Endoaortic Clamp; Heartport, Inc., Redwood City, Calif.) in the ascending aorta, and cardiopulmonary bypass was maintained with femorofemoral bypass. An operating microscope modified to allow introduction of the 3.5x magnification objective into the chest was positioned through a 10mm port over the site of the anastomosis. The anastomosis was performed with modified surgical instruments introduced through additional 5 mm ports. In the cadaver model (n = 7) the internal thoracic artery was harvested and the pericardium opened by means of similar techniques. A precise arteriotomy was made with microvascular thoracoscopic instruments under the modified microscope on four cadavers. In three other cadavers we assessed the exposure provided by a small anterior incision (4 to 6 cm) over the fourth intercostal space. This anterior port can assist in dissection of the distal internal thoracic artery and provides direct access to the left anterior descending, circumflex, and posterior descending arteries. We have

demonstrated the potential feasibility of grafting the internal thoracic artery to coronary arteries with the heart arrested and protected, without a major thoracotomy or sternotomy.

Department of Cardiothoracic Surgery, Stanford University School of Medicine, CA 94305-5117, USA. 1996 960822.

J. Thora Cardiovasc Surg 1996 My. Vol. 111 no. 3pp. 567-73.

Coronary artery bypass grafting without cardiopulmonary bypass in patients with LV dysfunction (EF < or = 30%)-- a report of 3 cases

Yamanaka J; Takeuchi Y; Gomi A; Torii S; Koyanagi T; Yashima M

Department of Cardiovascular Surgery, Kanto-Teishin Hospital, Tokyo, Japan. 1995 960823.

The purpose of this article is to describe our technique for performing coronary artery bypass grafting without cardiopulmonary bypass and to demonstrate that this operation is safe and useful to the case of LV dysfunction. Between April 1988 and March 1994, 2 men and 1 woman aged 61 to 69 years (mean 65 years) with LV dysfunction (EF < or = 30%) underwent coronary artery bypass grafting without cardiopulmonary bypass. Saphenous vein grafts were placed to the right coronary artery (n = 2), left anterior descending artery (n = 2), and internal thoracic artery grafts were placed to the right coronary artery (n = 1), left anterior descending artery (n = 1). The post operative course were uneventful in all patients and discharged with no complications. All patients underwent coronary angiography, and 5 of 6 (83.3%) grafts placed without cardiopulmonary bypass were patent. In selected patients, coronary artery bypass grafting to the case of LV dysfunction without cardiopulmonary bypass can be performed safe and satisfactory graft patency rates.

Nippon Kyobu Geka Gakkai Zasshi Vol. 43 no. 7 pp. 1069-72.

Minimally invasive coronary artery bypass grafting*

Acuff TE; Landreneau RJ; Griffith BP; Mack MJ

Division of Cardiothoracic Surgery, Medical City Dalass Hospital, Texas, USA. 1996 960822.

Background.. Standard options for the invasive management of proximal disease of the left anterior descending coronary artery include coronary angioplasty. Methods. We describe surgical technique for bypass of the left anterior descending coronary artery with a left internal mammary artery without median sternotomy and without cardiopulmonary bypass. Thoracoscopy is used to harvest the internal mammary

artery, whereas the mammary-coronary artery anastomosis is performed under direct vision through a limited anterior thoracotomy. Results. We have performed this procedure successfully in 3 patients with minimal morbidity and shortened hospital stay. Average operative time was 3 hours and postoperative hospital stay averaged less than 48 hours. Conclusion. Although experience is limited and follow-up is very short, with further experience, this less invasive surgical technique may become a viable option for the management of proximal left anterior descending disease.

* Ann Thorac Surg 1996 Jan Vol. 61 no. 1 pp. 135-7.

Coronary artery bypass grafting surgery without cardiopulmonary bypass Department of Thoracic and Cardiovascular Surgery, St. Mary's Hospital, Kurune, Japan. 1993 960823.

Improved technique in coronary artery surgery has allowed coronary artery bpass graftings (CABG) to be placed on beating heart. The effects of extracorporeal circulation and cardiac arrest are eliminated. From Jan. 1991 to June, 1992, we performed CABG surgery without cardiopulmonary bypass and cardiac arrest in 15 patients; the age ranged from 47 to 82 years with the mean of 65. Patients who had LAD and/or RCA stenosis were candidate of this procedure in early series. However in recent series, we etended the candidate to three-vessel or LMT stenosis cases who were considered ineligible for standard CABG because of renal failure or poor left ventricular function. Distal anastomoses were performed with interruption of cflow. From one to two distal anastomosis to the LAD and/or RCA (mean 1.4/pantient) were performed. The ITA was used in all 15 patients. Combined cardiac or vascular operation was performed in 5 patients (AAA repair, TAA repair, carotid endarterectomy or cornary endarterectomy). There were no deaths and no perioperative myocardial infarction. Postoperative angiography were performed in 12 patients with a patency rate of 89%. Tashiro T Todo K Haruta Y Yasunaga H Nagata M Nakamura M.

Nippon Kyobu Geka Gakkai Zasshi. 1993 Apr. Vol. 41 no. 4 pp. 598-602 Type.

Mini-sternotomy for coronary artery bypass grafting.

Arom KV Emery RW Nicoloff DM Minneapolis Heart Institute, Minnesota 55407, USA. Vol. 61 no. 4 pp. 1271-2

This communication details the approach to the left anterior descending artery, right coronary artery, or both via a single limited incision of the chest. The mini-sternotomy incision is 10 to 12 cm long. The distal anastomosis can be

accomplishes, with a beating heart, through this small incision, with or without cardiopulmonary bypass.

Ann Thorac Surg 1996 960822 Apr.

Mini-coronary artery bypass grafting.

Maihot-C

ISSN: 0744-6314.

Perioperative nursing has been impacted by a multitude of changes as medical technology continues its rapid advance. What may prove to be a major innovation in coronary artery bypass surgery is currently being performed in the United States, Europe and South America. Mini-coronary bypass grafting (CABG) is a minimally invasive procedure in which the surgery is performed through small incisions made in the chest wall, eliminating the need to "crack" the chest. This method reduces the pain and trauma to the patient and shortens the time required for hospitalization and recovery.

Nirs-Manage. 1996 Jun; 27(6): 56,58.

Less invasive coronary surgery: consensus from the Oxford meeting.

Westaby-S; Benetti-FJ.

Department of Cardiac Surgery, Oxford Heart Center, Oxford Radcliffe Hospital, John Radcliffe, Headington, England.

Ann-Thorac-Surg. 1996 Sep; 62(3): 924-31.

ISSN: 0003-4975.

Revascularization using angioplasty and minimally invasive techniques documented by thermal imaging.

Emery-RW; Emery-AM; Flavin-TF; Nissen-MD; Mooney-MR; Arom-KV.

Cardiac Surgical Associates, Minneapolis, Minnesota 55407, USA.

Minimally invasive direct coronary artery bypass grafting offers mortality and morbidity advantages to selected patients. To broaden indications for such, an appropriate and combind disciplinary approach using angioplasty and minimally invasive direct coronary artery bypass grafting is described in a patient requiring reoperative grafting. Documentation of patency of new left internal mammary

artery-to-left anterior descending artery anastomoses performed without the use of cardiopulmonary pypass was obtained intraoperatively using a Thermal Imaging Camera.

Ann-Thorac-Surg. 1996 Aug; 62 (2): 591-3.

ISSN: 0003-4975.

Video-assisted thoracic surgery for delayed pericardial effusion post-CABG.

Hurley-JP; Subarreddy-K; McCarthy-J; Wood-AE.

Department of Cardiothoracic Surgery, Mater Hospital, Dublin, Ireland.

Delayed-onset pericardial effusion following coronary artery bypass grafts can give rise to significant morbidity in its presentation and in its management by traditional surgical techniques. A video-assisted thoracoscopic technique to create a pericardial window, with the advantage of minimally invasive appratch combined with excellent visualization in such patient is described.

Chest. 1994 Nov; 106(5): 161709.

ISSN: 0012-3692.

Mini-sternotomy for coronary artery bypass grafting.

Arom-KV; Emery-RW; Nicoloff-DM.

Minneapolis Heart Institute, Minnesota 55407, USA.

This communication details the approach to the left anterior descending artery, right coronary artery, or both via a single limited incision of the chest. The mini-sternotomy incision is 10 to 12 cm long. The distal anastomosis can be accomplished, with a beating heart, though this small incision, with or without cardiopulmonary bypass.

From 1978 to 1995, 1420 patients underwent direct coronary surgery without cardiopulmonary bypass (CPB). Among them 32 consecutive patients (2.2%) were operated on from 1984 to 1995 for acute transmural myocardial infarction. there were 27 males and 5 females (mean age 59.2 +/- 6.7 years; range 35-72). Mean extent of coronary artery disease was 2.1 cessels/-patient. Four patients were admitted to surgery in cardiogenic shock, 5 with life-threatening ventricular arrhythmias. A mean time of 311 +/- 109 min (range 100-685 min) was recorded between the onset of symptoms and surgical reperfusion. Patients were operated on using saphenous vein or left internal mammary graft. Intraoperative transmural myocardial biopsies were taken

in the area of myocardial infarction, 15 minutes before and 45 minutes after revasclarization: biopsy specimens showed a marked reduction in signs of mitochondrial and myofibril damage. No in-hospital death occurred. Postoperative low cardiac output was never recorded. One patient had a mediastinitis. All patients, except one died 8 years postoperatively, are alive at present: 1 is Nyha class II, 1 in Nyha IV and 27 are asymptomatic, with yearly treatmill test negative for recurrent myocardial ischemia. One patient underwent redo surgery 7 years after surgery for recurrent angina. First 5 consecutive patients were studied angiographically 1 to 30 days after surgery: all grafts were detected patient. In conclusion coronary surgery without CPB may be considered an alternative to conventional surgical revascularization of myocardial infarction.

Ann-Thorac-Surg. 1996 Apr;61(4): 1271-2.

ISSN: 0003-4975.

Video assisted coronary bypass surgery.

Benetti-FJ; Ballester-C; Sani-G; Doonstra-P; Grandiean-J Benetti Foundation, Buenos Aires, Argentina.

An alternative way to revascularize coronary vessels is described, using arterial conduits without extracorporeal circulation. The heart is exposed via a small thoracotomy over the fifth left intercostal space. A thoracoscope is introduced into the thorax, to assist in the harvesting of the left internal mammary artery (LIMA). In selected patients with two or three vessel disease, the same procedure can be achieved on the right side, harvesting the right internal mammary artery to revascularize the right coronary artery. The gastroepiploic artery can be easily reached and used to revascularize the posterior descending artery, through a mini-subxiphoid median laparotomy. This technique was used to revascularize 30 patients from April 1994 to June 1995. All received a LIMA graft to the left anterior descending artery, and two had a free Radial artery graft from LIMA sequentially by passing the diagonal and obtuse maiginal branches. There was neither perioperative mortality nor morbidity myocardial infarction. Fifteen patients were restudied angiographically before discharge. Average hospital stay was 43+/- 11 hours.

J-Card-Surg. 1995 Nov; 10(6): 620-5.

ISSN: 0886-0440

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Coronary artery bypass grafting without cardiopulmonary bypass.

Buffolo-E; de-Andrade-CS; Branco-JN; Teles-CA; Aguiar-LF; Gomes-WJ.

Escola Paulista de Medicina, Hospital Sao Paulo, Disciplina de Cirurgia Cardiovascular, Sao Paulo, Brazil.

Background. Coronary artery bypass grafting without cardiopulmonary bypass is now an accepted technique of myocardial revascularization. We herein report our total experience with this procedure.

Methods. In a consecutive series of 8,751 patients operated on in our institution for coronary artery disease from 1981 to 1994, 1,274 patients received coronary artery bypass grafting without cardiopulmonary bypass. Reults. Indicate that the operation can be performed with an acceptable mortality (2.5%), and that all types of arterial conduits can be used. Most commonly the left anterior descending and right coronary arteries were bypassed. The incidence of arrhythmias and of pulmonary and neurologic complications were singnificantly lower in this group of patients compared with patients receiving coronary artery bypass grafting with cardiopulmonary bypass. Most importantly, there was decreased cost when the procedure was used because no etracorporeal circulation, cardioplegia sets, or other cannulas were used. **Conclusion.** We conclude that the continuing use of coronary artery bypass grafting without cardiopulmonary bypass is justified and that, with proper selection of patients, the procedure is safe and cost-effective.

Ann-Thorac-Surg. 1996 Jan; 61(1):63-6.

ISSN: 0003-4975.

Coronary grafting using a temporary intraluminal shunt instead of heart-lung bypass.

Levinson-MM; Fooks-GS.

Division of Cardiothoracic Surgery, Providence Hospital and Medical Center, Seattle, Washington, USA.

The application of a temporary intraluminal shunt is presented as a technique to prevent ischemia when coronary grafting is performed without cardiopulmonary bypass. This simple maneuver expands the indications for coronary grafting without cardiopulmonary bypass.

Ann-Thorac-Surg. 1995 Dec; 60(6): 1800-1.

ISSN:0003-4975

Use of thoracoscopy and minimal thoracotomy, in mammary-coronary bypass to left anterior descending artery, with extracorporeal circulation. Experience in 2 cases.

Benetti-FJ; Ballester-C

Fundacion Benetti Buenos Aires, Argentina.

A new surgical approach to mammary-coronary bypasses, to the left anterior descending artery, without the use of extracorporeal circulation, is described here. A minimal left anterior thoracotomy and the use of thoracoscopy are combined in this procedure performed in two patients (54-year-old male and 56-year-old male). Results were excellent: both patients were soon discharged from hospital (3 days patient 1 and 36 hours patient 2). Neither blood nor inotropic drugs were required. New angiographies previous to discharge were done, showing 100% patency of the mammary grafts. Both Patients are angina-free. Due to its simplicity, and with more experience, this technique could be a good alternative for patients with severe lesions of the left anterior descending artery.

J-Cardiovasc-Surg-Torino. 1995 Apr; 36(2): 159-61.

ISSN: 0021-9509.

Port-access coronary artery bypass with cardioplegic arrest: acute and chronic canine studies.

Sevens-JH, Rurdon TA, Siegel-IC, Peters-WS; Pompili-MF; St-Goar-FG; Rerry-GJ; Ribakove-GH; Vierra-MA; Mitchell-RS; Toomasian-JMa Reitz-RA.

Background. Our goal is to perform minimally invasive coronary artery bypass grafting without sacrificing the benefits of myocardial protection with cardioplegia. **METHODS**. Twenty-three dogs underwent acute studies and 4 dogs underwent survival studies. The left internal mammary artery was taken down using a thoracoscope. Cardiopulmonary bypass was conducted via femoral cannulas and using an endovascular ballon catheter for ascending aortic occlusion, cannulas and using an endovasclar balloon catheter for ascending aortic occlusion, root venting, and delivery of antegrade blood cardioplegia. Pulmonary venting was achieved with a jugular vein catheter. An internal mammary artery-to-coronary artery anastomosis was performed using a microscope through a 10 mm port. **RESULTS**. All animals were weaned from cardiopulmonary bypass in sinus rhythm without inotropes. Cardiopulmonary bypass duration was 104 +/- 28 minutes and aortic clamp duration was 61 +/- 22 minutes Cardiac output and pulmonary artery occlusion pressure were unchanged. The internal mammary artery was anastomosed to the left anterior descending artery (25) or

the first diagonal (2) with patency shown in 25 of 27. One dog in the survival study had a very short internal mammary artery pedicle under tension and was euthanized for excessive postoperative hemorrhage. Three weeks postoperatively the remaining dogs had angiographically patent anastomoses, normal transthoracic echocardiograms, and histologically normal healing and patent grafts.

Concl usions. Endovascular cardiopulmonary bypass using a ballon catheter is effective in arresting and protecting the heart to allow thoracopic internal mammary artery-to-coronary artery anastomsis.

* Ann-Thorac-Surg. 1996 Aug; 62(2): 435-40; discussion 441.

Minimally invasive coronery artery bypass grafting: a new methods using an anterior mediastintomy.

Robinson-MC: Gross-DR; 7 eman-w; Stedje- Larsen-F.

AR: The benefit of internal mammary artery (IMA) grafting as a long - lasting intervention for coronary artery disease is well recognized. However, largely because they are less invasive, catheter based alternatives are frequently chosen, particularly to treat single or double vessel disease. To retain the advantages of the IMA graft, and to offset the invasiveness of conventional coronary artery bypass grafting, we developed a new minimally invasive method using an anterior mediastinotomy for treating left anterior descending (LAD) or right coronary artery disease, or both. Feasibility studies using 16 pigs and a human cadaver led to approval by the Institutional Review for use of this procedure to treat six patients (four men, two women; and mean age; 63.8 +/- 13.6 [SD] yrs) who granted informed consent. Pedicle dissection of the IMA, using video assisted thoracoscopy if necessary, was made through a 2-to 3- Inch horizontal anterior mediastinotomy. The underlying LAD artery was grafted during femoral vessel cardiopulmonary bypass, with cooling to 30 degrees, C, induced ventricular fibrillation, and left ventricular venting if required. Transesophageal echocardiography performed after bypass showed that two patients maintained normal wall motion and four had improvement from the original impairment. One patient suffered a angina 4 weeks after the procedure; recatheterization showed an acutely angled IMA, subsequently corrected by balloon angioplasty. The results of follow-up dobutamine echocardiographic stress tests were negative in all patients. With this minimally invasive approach, the procedure should provide the benefits of IMA grafting with shorter hospital stay, more rapid recovery, and less overall cost.

J-Card -Surg. 1955 Sep; 10 (5): 529-36.

Total arterial myocardial revascularization without cardiopulmonary bypass

G. Sani, M.A. Mariani, F. Benetti*. G. Lisi, P. Totaro, P.P. Giomarelli and M. Toscano.

Institute for Thoracic and Cardiovascular Surgery, University of Siena, Italy and * Benetti Foundation, Buenos Aires, Argentina.

The risks associated with cardiopulmonary bypass have led to an interest in coronary surgery without the use of such a bypass. Six patients of mean (S.D.) age 62.0 (8.0) (range 52-71) years were selected for elective coronary surgery without cardiopulmonary bypass. In five cases a midline sternotomy and in one case a small anterolateral thoracotomy were performed; in the latter case the use of this procedure to treat six patients (four men, two women; mean age, 63.8 +/- 13.6 [SD[yrs) who granted informed consent. Pedicle dissection of the TMA, using video assisted thoracoscopy if necessary, was made through 2 to 3 inch horizontal anterior mediastinotomy. The underlying 1 AD artery was grafted during femoral vessel cardiopulmonary bypass, with cooling to 30 degrees C, induced ventricular fibrillation, and left ventricular venting if required. Transesophageal echocardiography

performed after bypass showed that two patients maintained normal wall motion four had improvement from the original impairment. One patient suffered a recurrence of angina 4 weeks after the procedure; recatheterization showed an a acutely angled IMA, subsequently corrected by balloon angioplasty. The results of follow-up dobutamine echocardiographic stress tests were negative in all patients. With this minimally invasive approach, the procedure should provide the benefits of IMA grafting with shorter hospital stay, more rapid recovery, and less overall cost.

Cardiovascuolar Surgery December 1996 Vol 4 no. 6

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Vol. IV, No 3 July 1996

The Egyptian Society of Cardiothoracic Sugery (Registered No 346 in 1996) announces

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2- Azhar University on 24.7.1996
(Dr. Ezz El Din Abdel Raouf)

3- Kasr El Aini on 30.9.1996
(Prof. Dr. Moustafa Radwan)

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5- Shebeen ELKom on 28.12.1996
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6- Tanta University (March 1997)
(Prof. Hamed El Akshar)

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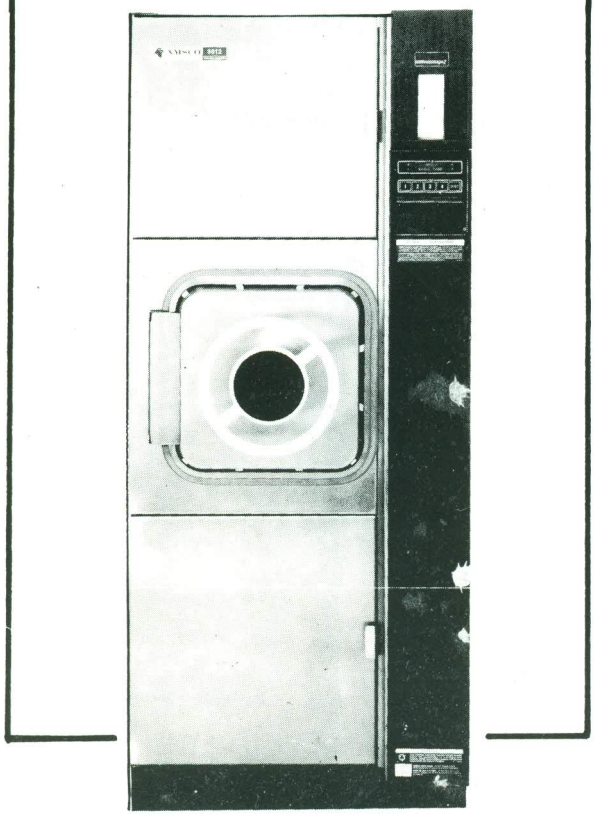

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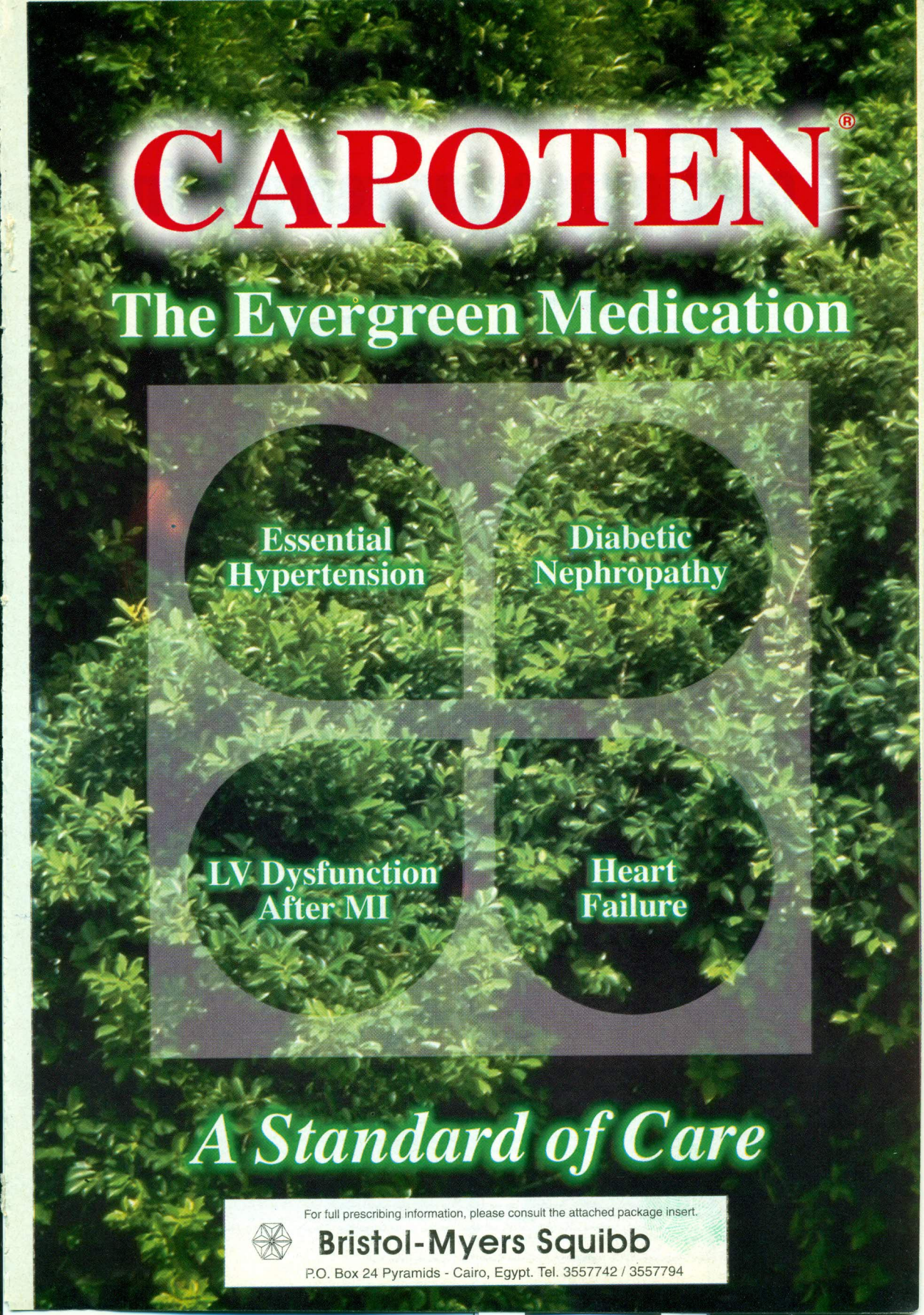
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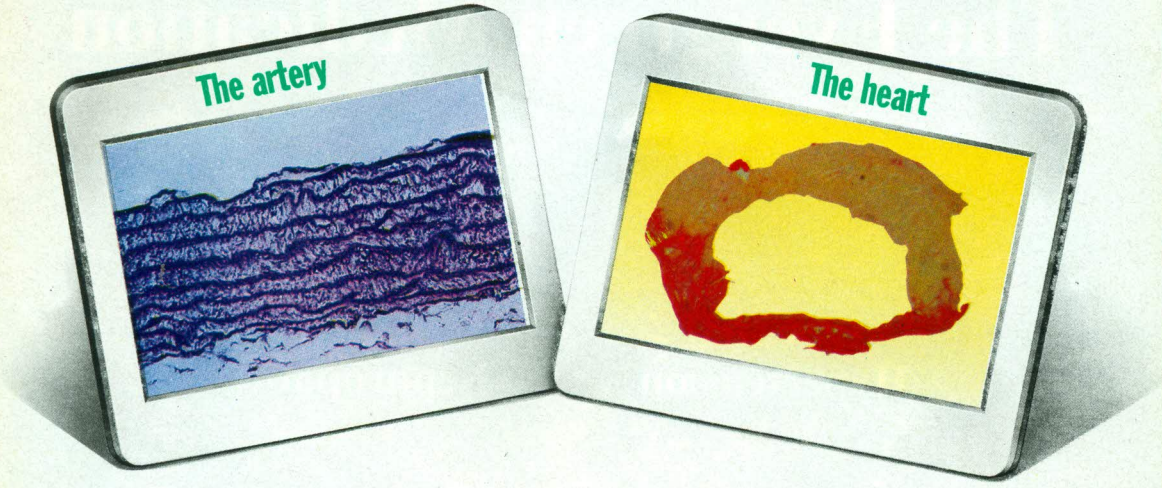

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1. SIHM I et al. *Eur Heart J.* 1993; 14(suppl) : 63 - 2. LEVY BI et al. *Circ Res.* 1988; 63 : 227-239 - 3. ASMAR RG et al. *J Hypertens.* 1988; (suppl 3) : S33-S39 - 4. MICHEL JB et al. *Circ Res.* 1988; 62 : 641-650
5. MORGAN TO et al. *Am J Hypertens.* 1993; 6 : 116 A - 6. MAC FADYEN RJ et al. *Br Heart J.* 1991; 66 : 206-211.

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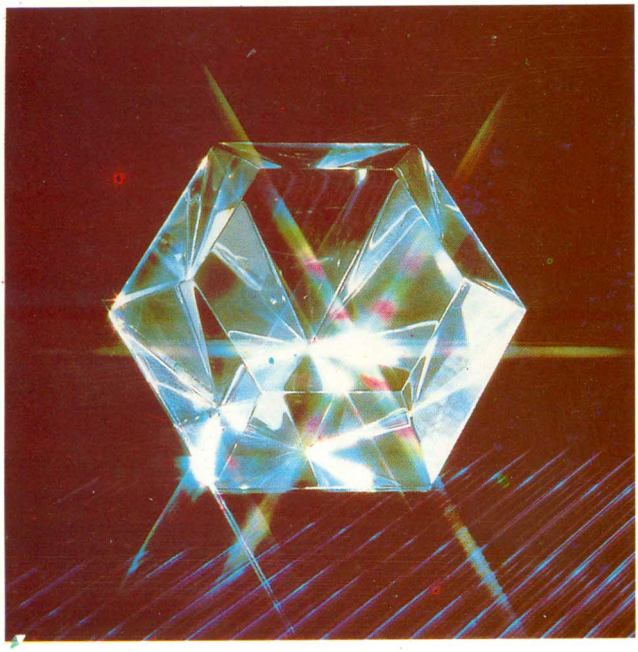

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(1) Wheeley M. St G. et al. (1982) Pharmatherapeutica, 3 (2): 143-152. (2) Watters K., Campbell D.B. (1986), Concilia Medica, 1 (3): 33-41. (3) Vukovich R.A. et al. (1983), CMRO, 8 (suppl. 3): 109-122.

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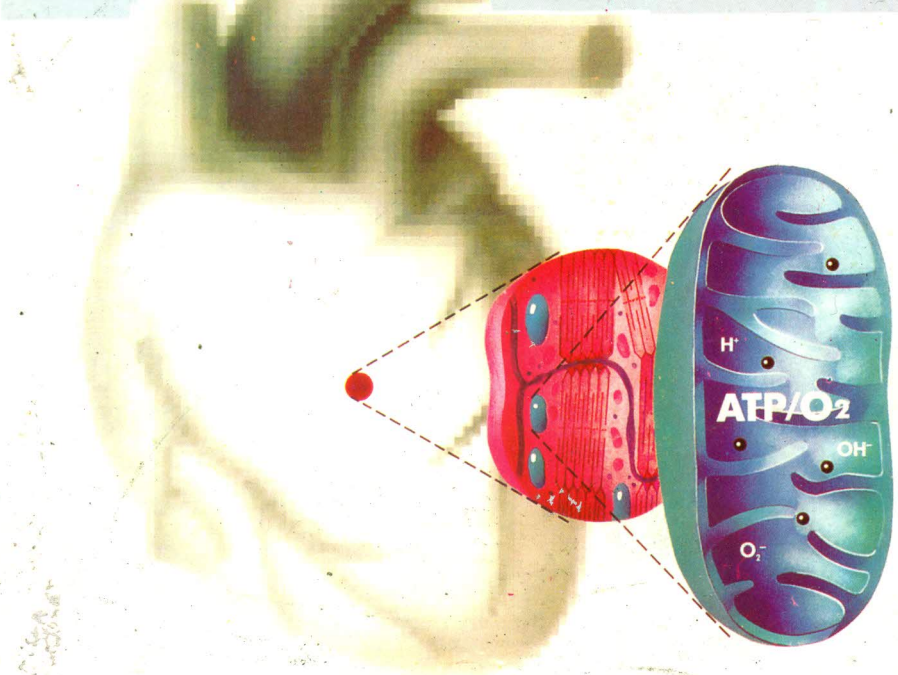

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1. Guarnieri C et al. *Biochem Pharmacol.* 1988; 21: 128-135.
2. Aussedat J et al. *J Cardiovasc Pharmacol.* 1993; 21: 128-135.
3. Fantini E, Grynberg A. *J Mol Cell Cardiol.* 1994; 26: 949-958.
4. Detry JM et al. *Br J Clin Pharmacol.* 1994; 37: 279-288.
5. Dalla Volta S et al. *Cardiovasc Drugs Ther.* 1990; vol 4 (suppl 4): 814-825.
6. Monpère C et al. *Cardiovasc Drugs Ther.* 1990; 4 (suppl 4): 824-826.

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