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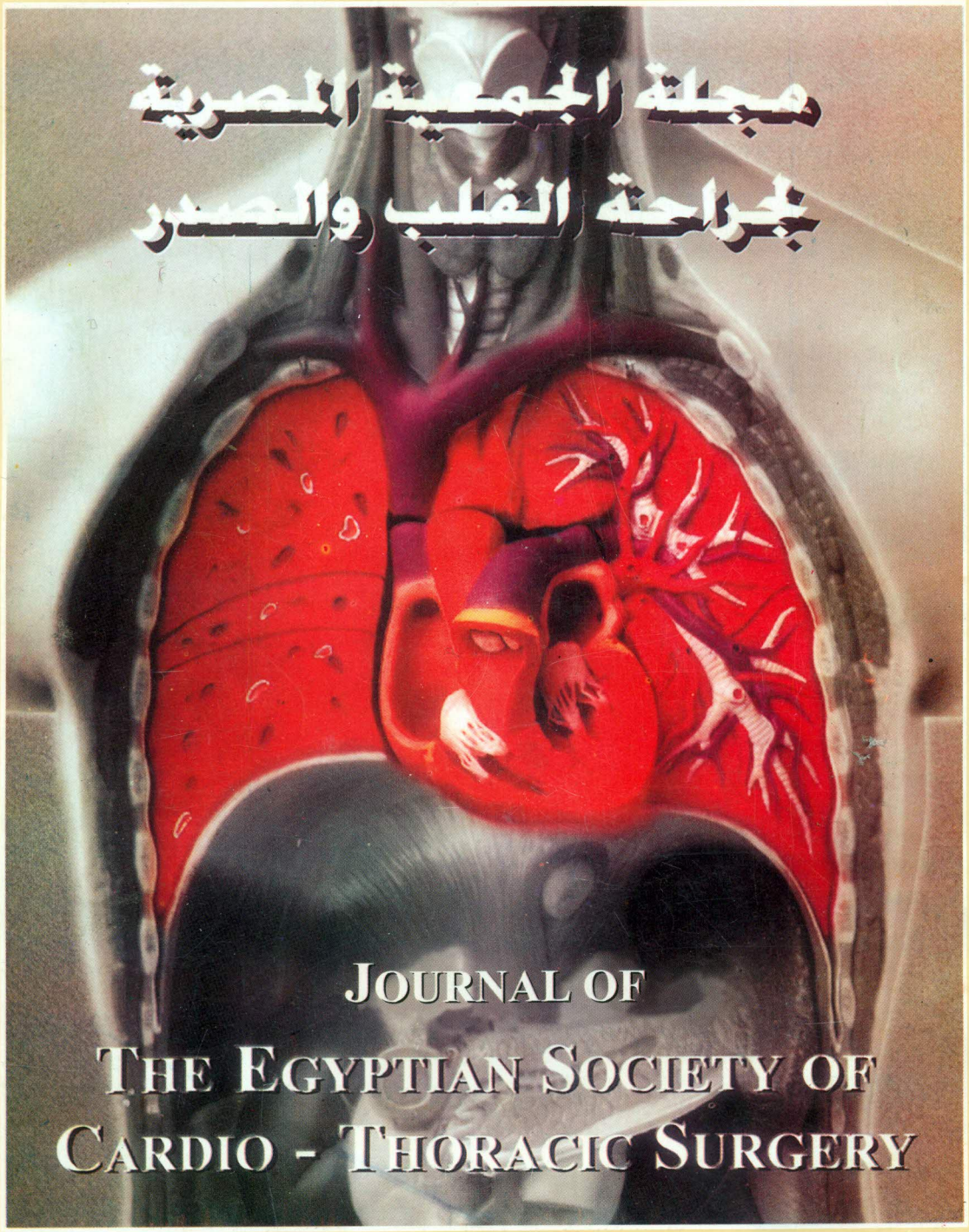

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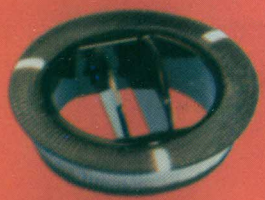

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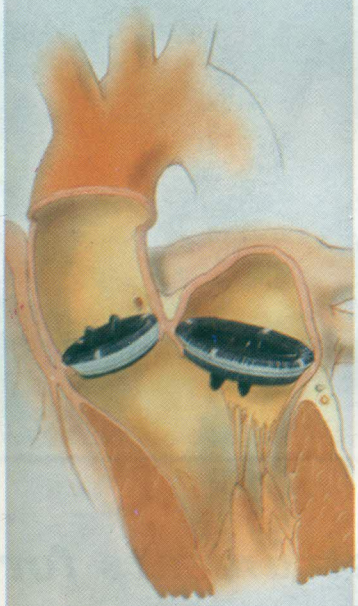

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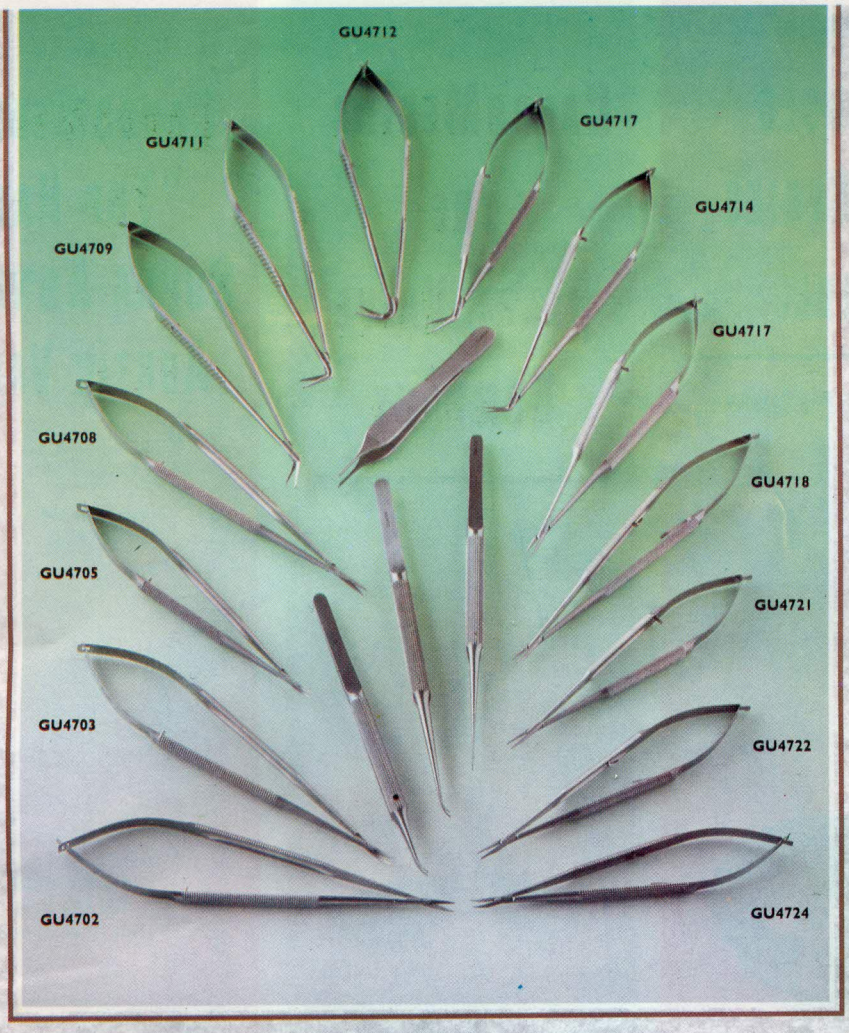

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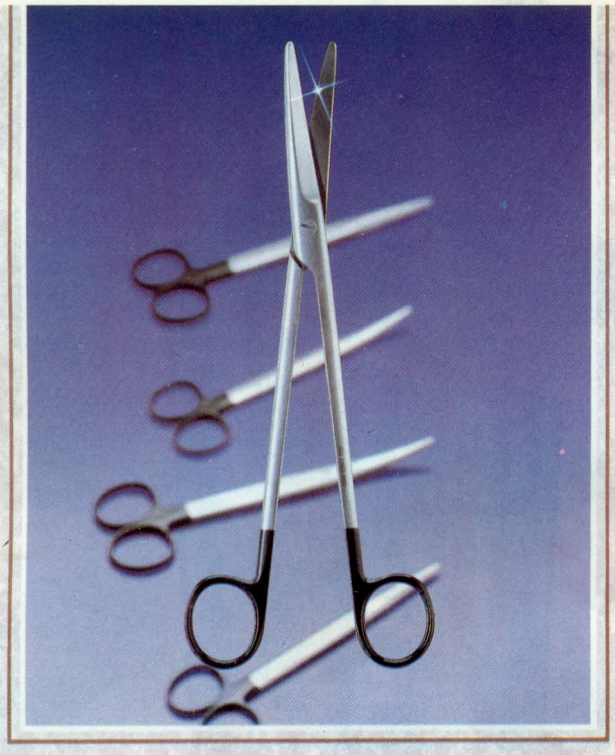

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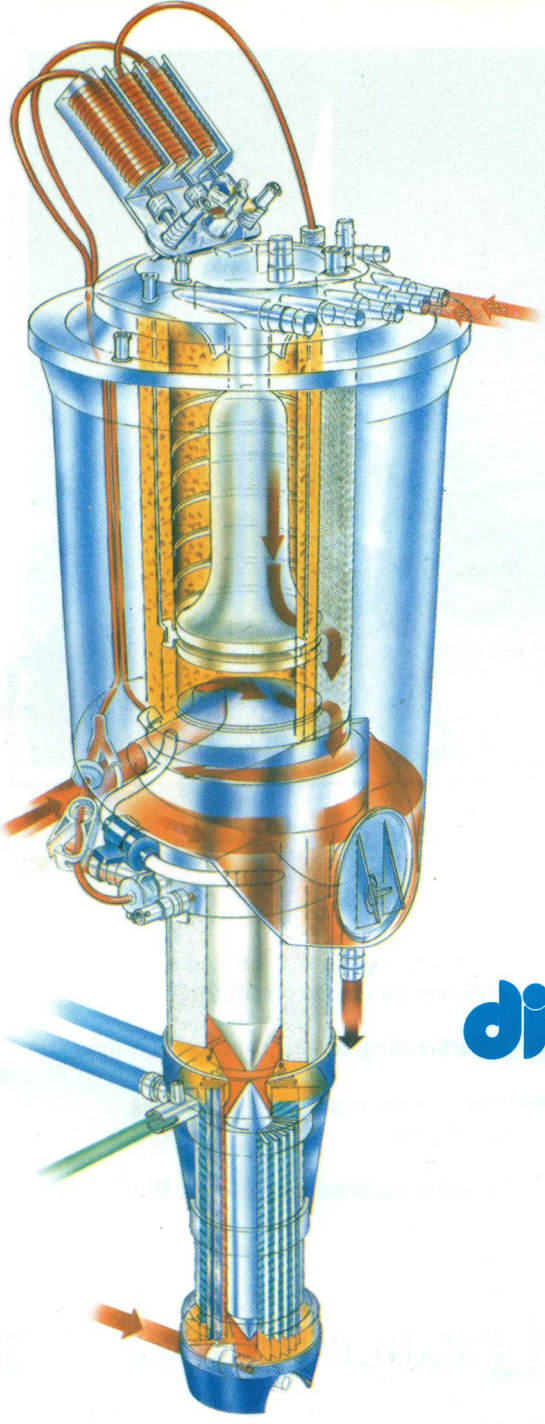

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EDITORIAL

Transposition of the Great Arteries: Indications for Surgery

V. Vanini, B. Murzi, M. Carminati, R. Moschetti, V.S. Luisi, M. Bernabei

J. of Egypt. Soc. of. Cardiothorac. Surg., 1996, Vol. IV, January, No 1

Historical Notes:

Albert (1) in 1954 was the first to publish an experimental study prospecting an intra-atrial deviation of all pulmonary and systemic veins. During the same year Mustard (2) described a technique using monkey lungs in seven patients with transfer of the left coronary artery alone. Idriss (3) et al in 1961 transferred both the ascending aorta and the coronary arteries into the pulmonary artery. Baffles and coworkers (4) in 1961 and Anagnostopoulos (5) in 1973 continued the experimental work on transposition. Jatene (6) in 1975 reported the first successful case operated on following the technique of the "arterial switch". Yacoub (7) in 1977 wrote a paper describing the possibility of a two-stage repair by firstly doing a banding of the pulmonary artery+/- a shunt. Lecompte (8) introduced the idea of transferring the pulmonary artery anteriorly to the aorta, avoiding the use of a conduit during arterial switch repair. Castaneda (9) in 1983 reported the first series of transpositions corrected by an "arterial switch" in neonates.

Surgical Considerations

We can distinguish various kinds of TGA, which require differentiated treatment from the surgical point of view.

1) Simplex TGA
2) Complex TGA:
   a) TGA, VSD
   b) DORV
   c) TGA, VSD and LVOTO
3) Corrected TGA
4) Univentricular heart with TGA
5) TGA physiologically corrected by Senning or Mustard technique to be converted into an "arterial switch"

1) Simplex TGA

As soon as discovered, a Rashkind procedure should be performed as a first step before surgical correction. The anatomic correction is nowadays the preferred solution independently from the coronary anatomy. Even if the coronary anatomy is very complex, especially in presence of intramural types, shifting to the alternative surgical option, at the operating table, invariably leads to the following problems.

. The physiological correction in our hands has still a very high mortality (at least 20%) when undertaken during an arterial switch procedure

. Leaving the abnormal coronary anatomy

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:in situ," increases the possibility of future sudden death, either at rest or during exercise as well demonstrated by some authors. The arterial switch is also preferred for anatomical reasons: the left ventricle is a pressure pump and the right ventricle is a low pressure volume pump, moreover, the disposition of the papillary muscles is peculiar and is predisposed for a specific cardiac function. Another important reason in favor of the arterial switch is the low incidence of disrhythmias, very frequent sooner or later after physiological corrections.

During the neonatal period the procedure is performed in one stage, while the so-called rapid two-stage repair is performed immediately after the optimal time for correction, i.e. beyond the 20 days of age. After this period, it is necessary to reach a quick induction of adaptation of the left ventricle to an acute pressure load: this is the target of the first stage, consisting of a banding procedure. The two-stage repair is adopted also at a later age, when multiple muscular defects or other associated pathological conditions are present.

2) Complex TGA

In this case a Rashkind procedure is not strictly needed, because there is enough mixture of blood at different levels of the heart.

a) TGA and VSD. The timing of the operation should be decided shortly after diagnosis, and the operation should be done in the one-stage procedure. In case of multiple VSDs, as already said, the two-stage procedure with a banding as a first step is particularly recommended because of the complexity of the disease.

b) TGA, VSD and coarcitation, so called Taussig-Bing malformation. In this situation, we can either perform the coarcitation repair as a first step or undertake the complete correction immediately, although a higher mortality rate is to be expected in this latter case. The subpulmonary position of the VSD or the different arrangement of the great arteries do not preclude the anatomic correction. However, the Lecompte maneuver in this condition can sometimes compromise the coronary flow.

c) TGA, VSD and PS. The subpulmonary obstruction can be dynamic or steady: in the former case, an arterial switch is performed during the neonatal period. In the latter, different paths are open, depending on anatomic characteristics in presence of a membrane, a resection is possible, if a posterior deviation of the infundibular septum is found , a miotomy and/or a miectomy through the pulmonary valve is performed, if a long hypoplastic LVOT is found, it is better to postpone the complete correction and to proceed with a palliative operation such as a shunt, followed by a Rastelli or a REV procedure one or more years later. In our Center we prefer to adopt the REV technique instead of the Rastelli's because it does not require the introduction of a conduit. The REV operation is usually done at a younger age, sometimes at the end of the first year or even before. On the contrary, the Rastelli

operation is done later because of the necessity to replace the conduit in the future.

3) Corrected TGA and VSD

In this case an arterial switch is suggested, because:

- A late right ventricular failure is a frequent, inevitable event.

- A tricuspid insufficiency will appear soon after right ventricular failure or it might be present even before.

- Dangerous and multifocal arrhythmias or A-V block will appear and they should be treated as soon as possible switching the right ventricular systemic load into a low pressure load.

We know that both physiological and anatomical corrections are indicated, but the anatomic- the so- called "double switch" without interposition of a conduit- is preferable. The risk of injuring the conduction tissue is the same for both surgical solutions, even if the approach through the right ventricle for the closure of the VSD should elude this complication during the anatomical correction. If a pulmonary stenosis is associated, the anatomic correction is accomplished by means of a conduit placed between the right ventricle and the pulmonary artery.

The age of operation is around two years or before if a pulmonary hypertension is expected, but in this case a previous banding is usually anticipated in order to decrease the risk of total correction. Potential drawbacks for anatomical correction in C-TGA+VSD are:

- The well-known complications intrinsic to the Mustard or Senning operation

- A subaortic stenosis due to the construction of the interventricular patch

- Injuries of the conduction tissue even if the VSD is not enlarged

- Technical difficulties due to prolonged surgery and extracorporeal circulation.

In case of more serious manifestations of the disease, a Fontan procedure is the suggested surgical choice. If other anomalies, such as an Ebstein disease, are combined, the option of a heart transplantation should be considered in the future.

4) Univentricular Heart and TGA

The increased pulmonary blood flow obliges to perform a PA banding first. Later a Glenn procedure is the most common, if a subaortic stenosis or a restrictive VSD develops, there is the theoretical possibility of doing an arterial switch. Another option in this latter case is to enlarge the VSD or to perform a Damus-Kay procedure. If a subaortic stenosis or a restrictive VSD is present from the begining, an arterial switch can be the primary choice, also in the neonatal age. If, in addition, the aortic anulus and the ascending aorta are underdeveloped, a kind of Norwood operation is a valid alternative to heart transplantation

5) TGA Corrected with Mustard or Senning

Patients who underwent TGA correction with Mustard or Senning procedure may show symptoms of heart failure later in life,

and can be treated converting the previous operation into an arterial switch. The presence of supraventricular arrhythmias also caused by the decompensated right ventricle lends further support to this surgical strategy. Sometimes in this situation the left ventricle is not prepared to sustain the systemic pressure, being the left systolic pressure lower than 60% of the former. For this reason a "banding" procedure is advisable in order to "prepare" the left ventricle to the new hemodynamic state. The banding should remain for the period (three to six months) needed to reintegrate the mass, volume and pressure required for doing an arterial switch.

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Risk Factors Scoring System for Pediatric Cardiac Surgery Unit of Ain Shams University

Abstract

A total of 19 risk factors either universal or local were applied to design a risk factor scoring system for our patients classifying them into no risk, low risk, moderate risk or high risk patients and providing a standard method to assess our results in the new pediatric cardiac surgery unit at Ain Shams University. This system was applied for our patients who were assigned to open heart surgery in the period between January 1993 to December 1994. The total number of patients was 271 with a total hospital mortality of (17.3%). Among the 44 patients with no risk, the mortality was (2.3%), in the low risk group it was 10 out of 114 (8.8%), in the moderate risk group it was 18 out of 73(24.6%) and in the high risk group the mortality was 16 patients out of 40 (40%). In conclusion, the risk factor scoring system is needed for assessment and anticipation of the individual patient risk, it facilitates reporting the results of operations, helps in intergroup comparison in the same hospital, lastly interhospitals comparison will be made easy.

Mohsen Abd El-Karim (MD), Walaa Saber (MD), Ayman Shoeb (MD), Ezz El-Din Moustafa (MD), and Ismail Sallam

J. of Egypt. Soc. of. Cardiothorac. Surg., 1996, Vol. IV, January, No 1

Introduction & Aim of the work

The need for scoring system

Because of the variability between different groups of patients regarding their clinical status, operative risks and postoperative results from the morbidity and mortality points of view, we tried to formulate our scoring system for evaluation of the patients and the risk of operations depending on our own experience and results and also going with the universal risk factors.

Risk factors evaluated

A total of 19 risk factors either universal or local were evaluated. Each factor was given a numerical score between one to four. The sum of all risk factors' scores gives the final risk score.

A) Universal risk factors

1- NYHA class (without medical treatment)

NYHA class III	*
NYHA class IV	**

2- Ventricular function (VF)

LVEF less than 50%	*
LVEF less than 30%	**

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Moderate RV dysfunction	*
Severe RV dysfunction	**
Hugely dilated ventricle	*
3- Cardiothoracic ratio (CTR)	
More than 50%	*
More than 70%	**
4- Emergency procedures	
Required operation on the day of admission	**
Urgent operation	*
Operation on an infected patient	**
B) Local risk factors	
1- Age	
Neonate	****
Less than 6 months	***
Less than one year	**
Less than 2 years	*
2- Body weight	
Less than 3 kg	***
Less than 6 kg	**
Less than 12 kg	*
3- Cardiac cachexia	
Less than 80% of expected body weight	*
Less than 60% of expected body weight	**
Less than 50% of expected body weight	***
4- Cyanosis (in neglected cases)	
Severe cyanosis (Hb> 20gm%)	*
Frequent spells	*
5- Previous operation	
Thoracotomy	*
Sternotomy	**
6- Associated disease	
Repeated chest infection	*
Renal dysfunction	*
Diabetes mellitus	*
Anaemia (less than 10 gm%)	*
CNS damage	*
Mental retardation	*
7- ECG abnormalities	
Grade 2-3 heart block (HB)	*
Recurrent tachyarrhythmia	*
8- Atrioventricular valve malfunction	
Moderate (grade III) left AVV regurge	*
Severe (grade IV) left AVV regurge	**
Severe right AVV regurge	**
9- Pulmonary hypertension (PH)	
Moderate PH (1/3 to 2/3) of systemic BP	*
Severe PH (more than 2/3) of systemic BP	**
10- Pulmonary vascular resistance (PVR)	
PVR 4-6 IU	*
PVR 7-9 IU	**
PVR 10-12 IU	***
PVR> 12 IU	****

11- Pulmonary arterial (PA) problems	
PA annular hypoplasia	*
Main PA hypoplasia	*
Ostial stenosis of one PA	*
Ostial stenosis of both PAs	**
Peripheral PA stenosis	*
Incomplete arborization	*
McGoon's ratio less than 2	*
McGoon's ratio less than 1.75	**
McGoon's ratio less than 1.5	***
12- Number of lesions	
Three associated lesions	*
Four associated lesions	**
More than four lesions	***
13- Risks related to conduction pathways	
VSD in corrected TGA	*
Single ventricle (septation)	*
Single atrium	*
Ambiguous connection (multiple VSDs)	*
14- Valve replacement	
One valve replacement	*
Two valve replacement	**
Three valve replacement	***
15- New procedures	
First time to be done in the hospital	**
First time to be done by the surgeon	**
Rare operations e.g. : Senning, Mustard, Fontan, Arterial switch, Kono, Rastelli...etc	**

Cardiac risks after scoring

A) Zero score: no risk factors:

e.g. "10- year old child, 25 kg, with isolated secondum ASD, no pulmonary hypertension and no associated disease"

e.g. "8- year old child, 20 kg, with isolated subaortic membrane, gradient 60 mm Hg with normal left ventricular function".

So, in these two cases, isolated mortality and morbidity should be zero% or near zero%

B) Less than "5" score: low risk group:

e.g. , 6-year old child, 20 kg, F4 with severe cyanosis, frequent spells and good pulmonary anatomy: score (3-4)

C) Between "6-10" score: moderate risk group:

e.g., 2-year old child, 8 kg, VSD with PAP equals 90 mm Hg, CTR=0.75 with severe TR: score (8).

D) More than "10" score: high risk group:

e.g., 1-year old child, 6 kg, ostium primum, VSD, severe MR, PAP of systemic level, cardiac cachexia, PVR 10 units, severe anaemia: score (12).

Application of the scoring system on the results of the pediatric cardiac surgery unit (Fig. I)

In the period between January 1993 to December 1994, 271 open heart surgery operations were done in the new pediatric cardiac surgery unit of Ain Shams University. The overall mortality was 45 cases (17.3%). When the scoring system was applied on the

results, the following groups showed the following results:

1) Group 1 (no risk): included 44 patients with only one mortality (2.3%).

2) Group II (low risk): included 115 patients with 10 mortalities (8.8%).

3) Group III (moderate risk): included 73 patients with 18 mortalities (24.6%).

4) Group IV (high risk): included 40 patients with 16 mortalities (40%).

Discussion

No doubt that the preoperative functional status of the patients affects the postoperative outcome. This has been reported in atrio-ventricular canal defects, truncus arteriosus, congenital aortic stenosis, and other types of congenital heart diseases as the postoperative mortality increases by advanced preoperative NYHA functional class. [1,2]

The preoperative status of the left ventricle

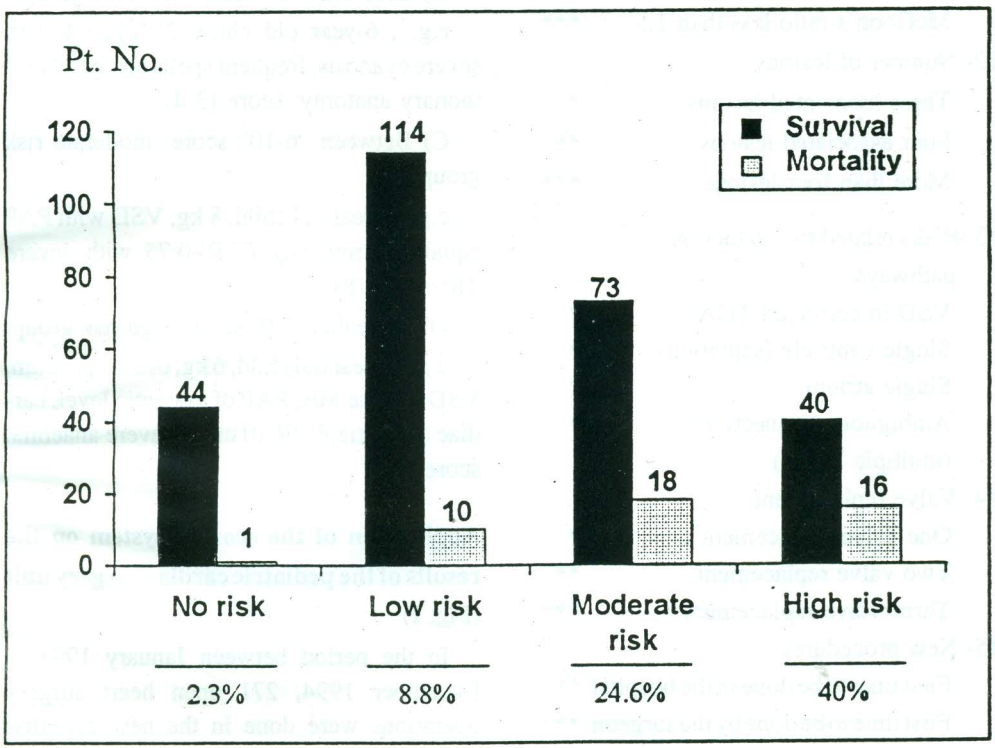

Fig. I: *Mortalities among different risk group in two years (1993 & 1994)*

is also an important risk factor for death during or early after the repair of congenital heart diseases as in the case of congenital anomalies of the coronary arteries(2). The cardiothoracic ratio (CTR) is an important risk factor in predicting the operative outcome such as in AVR for aortic valve disease when it has been reported that patients with a preoperative CTR > 64% had a postoperative death rate of 30% in contrast to 7% in patients with less cardiac enlargement. (3)

Emergency operations carry by themselves the risk of high mortality and morbidity as when surgery is done the same day of admission when the patient is incompletely prepared and the preoperative problems are not promptly treated.

Surgery on an infected patient increases the mortality and morbidity postoperatively as AVR for native valve endocarditis increases the risk of postoperative prosthetic valve endocarditis.(4)

Young age at operation is an important risk factor affecting the results of operations as it has been reported that infancy increases the risk for hospital mortality in total anomalous pulmonary venous connections.(5) This is the same for surgical outcome in cases of atrioventricular canal in the first year of life.(6)

As in the case of almost all operations for congenital heart diseases, very small birth weight was found to be a risk factor for death postoperatively as after the atrial switch operations for transposition of great arteries.(2)

The effect of cardiac cachexia as a risk factor in predicting the operative outcome has been proved when it was found to prolong the period of ventilatory support increasing the postoperative morbidity and mortality.(7)

The degree of cyanosis reflecting the high hematocrit as in cases of tetralogy of Fallot is a strong risk factor for hospital death.(8)

Redo surgery especially after previous sternotomy carries the risk of intra and postoperative bleeding which is much less nowadays than before because of the great improvement in surgical techniques and the use of aprotinin which reduces the postoperative bleeding by 50%.(9)

Associated disease can affect the postoperative outcome such as mental retardation in the form of Down's syndrome as it has been proved to increase the mortality when complete atrioventricular canal is associated with tetralogy of Fallot.[10]

Severe preoperative atrioventricular valve incompetence has been reported to increase the risk of mortality in partial AV canal defect than in complete AV canal defects.[11]

The relation of pulmonary hypertension and pulmonary vascular disease was proved to affect results of operations for congenital heart diseases such as ventricular septal defects, as it was found to affect the late results after its closure.[2,12]

The pulmonary arterial problems have been found to be strong risk factors predicting the operative outcome as diffuse severe hypoplasia, severe and multiple localized

areas of hypoplasia (stenosis) or iatrogenic stenosis of the left and right pulmonary arteries increase the probability of hospital death after repair of TOF with pulmonary stenosis or atresia.[13,14]

Fontan and Colleagues in 1989[15] reported that when McGoon's ratio is less than 1.5 it increases the risk of early death postoperatively such as after Fontan operation for tricuspid atresia.

No doubt that when the number of lesions increases, the risk of operation increases as in coexisting severe left sided cardiac effects (components of hypoplastic left heart syndrome such as aortic hypoplasia, severe endocardial fibroelastosis, left ventricular hypoplasia, extreme left ventricular hypertrophy and congenital mitral valve disease) are associated with high mortality after operation.[16]

The preoperative status of the conduction pathways is a strong risk factor for the postoperative outcome as in corrected transposition of the great arteries where the abnormalities of the conduction system increases the operative mortality.[17]

The relation of the number of valves to be replaced to a high postoperative mortality is clear when it was reported that double valve replacement is an incremental risk factor for death compared with isolated replacement of the mitral or aortic valves.[2] McKay and associates in 1982[18] reported that complete heart block has developed after most septation operations in cases of univentricular heart. Also the prevalence of complete heart block is higher after closure of multiple VSDs than after closure of single VSD.[19]

Lastly, when the procedure is to be done for the first time by the surgeon or in the hospital increases the operative risk as well as rare operations which are not performed routinely necessitating more care and anticipating higher rate of complications such as after Senning, and arterial switch operations...etc.

It is clear now that most of the risk factors chosen for our scoring system are accepted by many authors. When it was applied to the results of 1993 and 1994, the high risk group as we anticipated had the highest mortality while that of the no risk group was very low, moreover this facilitated reporting the results of different groups of patients with different natures of diseases. The use of this scoring system will help in evaluation of our progress regarding the complexity of the cases we are dealing with, and for self assessment to open the door for further progress and improvement of the results. Intergroup comparison will be more logic this system helping to encourage different surgical teams in the same hospital to improve their results. Lastly if this scoring system is used widely by many hospitals and centers, interhospital comparison will be made easy.

Conclusion

Risk factor scoring system for paediatric cardiac surgery patients is essentially needed for assessment of the individual patient risk

either high, moderate, low, or no risk. This method facilitates reporting the results of operations, and intergroup comparison in the same hospital. Lastly, interhospital comparison will be made easy.

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Initial Experience of Mitral Valve Replacement with Total Preservation of Both Valve Leaflets

Abstract

Routine preservation of the posterior mitral leaflet by many surgeons had already demonstrated the potential benefit of posterior leaflet preservation and had reduced the incidence of posterior wall rupture after mitral valve replacement (MVR). Superior results of mitral valve repair (which generally preserves the subvalvular apparatus) versus replacement, led to further speculation that MVR with preservation of the chordae tendineae would produce better results than conventional MVR. We compared a series of 10 consecutive patients who under went MVR by the author with preservation of both leaflets, to a control group of 82 patients who under went standard MVR at our hospital during the same period. Use of inotropic drugs and duration of postoperative intensive care were compared and shown to be markedly reduced in the study group, however, statistical analysis was not applied due to the small number of patients. Comparison of the available pre-and post operative echocardiographic values showed a more decrease in left ventricular end-diastolic and end systolic diameters in patients with preserved leaflets. MVR with preservation of only the posterior leaflet was not considered in this study.

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Introduction

Although first suggested by Lillehei in 1964, (1) preservation of the anterior mitral leaflet during mitral valve replacement (MVR) gained popularity only after David and colleagues (2) demonstrated the beneficial effects of preserving the whole mitral valve apparatus in terms of ventricular performance and operative mortality.

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Patients and methods

- Study Group, from I April 1994 through 31 January 1995, 10 patients with mitral valve disease were selected for MVR with preservation of the anterior and posterior mitral leaflets, their ages ranged from 12 to 46 years with a mean of 32±13.3 years. The origin of mitral disease was rheumatic in all patients. Other clinical data, including New York Heart Association (NYHA) functional class, are presented in Table 1.

Preoperative echo cardiograms revealed a

Table I: Preoperative Data of the 10 patients who underwent MVR with preservation of Both Leaflets:

Patient Number	Age/Sex	NYHA Class	Rhythm	Lesion	Valve Size/ type
1	22/M	III	SR	MS-MR	27/Mech
2	43/F	IV	AF	MR-TR	29/Mech
3	12/M	III	SR	MS-MR	27-/Mech
4	36/M	III	AF	MR	27/Mech
5	46/F	IV	AF	MS-MR-TR	27/Mech
6	27/M	III	SR	MR	27/Mech
7	39/F	IV	AF	MR-TR	29/Mech
8	45/F	IV	AF	MS-MR	27/Mech
9	12/F	IV	AF	MS-MR-TR	27/Mech
10	40/F	IV	AF	MR-TR	29/Mech

Mech = mechanical Valve - SR = Sinus rhythm
AF = Atrial fibrillation - MS = Mitral Stenosis
MR = mitral regurgitation
TR = tricuspid regurgitation

mean pulmonary pressure of 47.0± 4.0 mm Hg (range,42 to 61 mm Hg). Table II presents other echocardiographic data.

- Control group, During the same period, 82 patients underwent a standard MVR at our hospitals (control group) Their ages ranged from 14 to 58 years with a mean of 32± 6.2 years. Among these 82 patients, there were 50 with mitral regurgitation (mainly) and 32 with mitral stenosis (mainly). Thirty five patients were in NYHA functional class III and 47 were in class IV.

- Exclusions, patients with mean pulmonary pressures above 65 mm Hg were excluded from the study, because it was thought that severe pulmonary hypertension would outweigh the hemodynamic benefits of leaflet preservation. Patients with long stays in the intensive care unit and those who died were also excluded from consideration in this study because these events were not attributable to the variations in MVR techniques.

Surgery:

- Study group, Surgery was performed with the patient under cardio pulmonary bypass and with the use of double venous cannulae, moderate hypothermia (28°C) crystalloid antegrade cardioplegia, and pericardial ice slush. In all patients double pledgetted

Table II :

Pre-and postoperative comparison of LVEDD, LVESD, Inotropic support, and length of stay in ICU in MVR patients with and without leaflet preservation.

Type of valve lesion	Type of MVR	LVEDD (mm)		LVESD (mm)		IV Inotropic Drugs *	ICU Stay (hrs) *
		Preop.	Postop. 3 months	Preop.	Postop. 3 months		
Mainly MR	Preserv.(8)	66	52	40	30	0	24
	Standard (30)**	64	56	41	36	25 (83%)	46
Mainly MS	Preserv. (2)	57	49	34	27	0	24
	Standerd (10)**	58	52	33	30	8 (80%)	36

* *These data were available for all study and control patients.*

** *Postoperative echocardiographic values were avialable in only 40 patients (out of 82) who underwent standard MVR.*

ICU = Intensive care unit ; IV = intra venous ; LVEDD = left ventricular end-diastolic diameter ; LVESD = left ventricular end-systolic diameter ; MR = Mitral regurgitation ; MS = mitral stenosis ; MVR = mitral valve replacement ; Postop. = postoperative ; Preop. = preoperative
Preserv. = with preservation of both leaflets.

sutures were inserted from the atrial aspect of the valve and were then passed through the annulus, the valve and the prosthesis. Both leaflets remained plicated between the prosthesis and the annulus (Fig.I). In all patients, the anterior leaflet was divided at its midpoint from the valve orifice to the annulus and then each portion of the leaflet was sutured to the corresponding commissure, while in the last patient, the anterior leaflet was detached from the annulus, divided into two leaflets with their own chordae, and sutured to the respective commissural annular area using the procedure described by Miki and colleagues, (3) (Fig.2) Tricuspid Devega annuloplasty was performed in 5 patients.

- Control group: Eighty- Two patients underwent standard MVR with mechanical valves the surgical procedure was the same as that in the study group with the exception of valve preservation which was not performed in the control group. Twenty- four patients underwent associated tricuspid

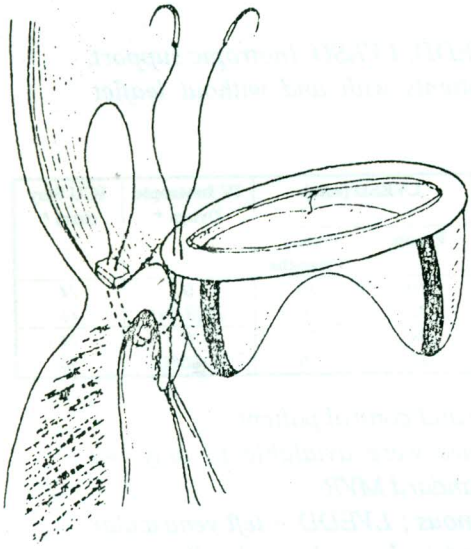

Fig. 1: Plication of the posterior leaflet and insertion of plodgetted sutures.

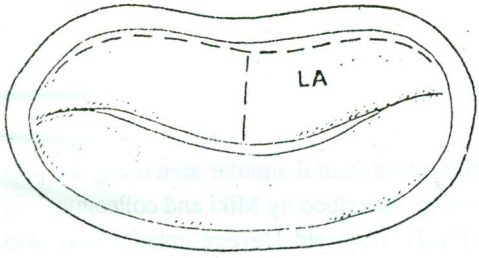

Fig. 2: Dotted lines indicate the incision and division of the anterior leaflot (LA)

annuloplasty procedure.

Results

- Study group. No patient required intravenous (IV) inotropic support postoperatively. The average intensive care unit stay was 24 hours.

- Control group. Postoperative inotropic support was administered in 82% of the patients. The average intensive care unit stay was 40 hours.

- Follow up: Late follow up in both groups ranged from 3 to 9 months. Comparison of the postoperative echo-cardiograms showed that the left ventricular end-systolic and-diastolic diameters were reduced in both groups (Table II), but to a greater degree in patients with dual leaflet preservation than in those with standard MVR. The study patients were in NYHA functional class I(9 patients) and II (one patient), the 40 control patients (with available postoperative echo cardiograms) were in class II (35 patients) and class III (5 patients).

Discussion

Mitral valve repair is most likely more successful than MVR because it maintains the continuuity of the valve, chordae tendineae, papillary muscles, fibrous skeleton at the base of the ventricles, and the lateral walls of the left ventricle. However, when repair is not possiple because of unfavorable valve anatomy or when results of a repair are unsatisfactory, MVR with preservation of the mitral leaflets and subvalvular apparatus appears to reduce the impact of a rigid ring in the mitral annulus and to enhance late ventricular function although first reported only in patients with mitral regurgitation,

chordal preservation can be adopted whenever distortion of the leaflets and subvalvular apparatus is not extensive. Rheumatic lesions should not necessarily be a deterrent to valve tissue preservation, if the subvalvular apparatus is not excessively hypertrophied, any mitral annulus with both native leaflets in situ can accept a valve prosthesis of the same size or one size smaller than would be used in standard MVR. In rheumatic valves with extensive fibrotic and thick mitral valves, removal of the anterior leaflet is often necessary to allow insertion of a valve of adequate size. Other researches (4,5,6,7,8,9) added to the body of evidence indicating that the mitral valve apparatus plays an important role in ventricular function, although some (10) out lined possible risks of left ventricular outflow obstruction.

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Pulmonary Vascular Changes in Patients with Hypertensive Left to Right Shunts

Abstract

Thirty five (35) patients with congenital hypertensive left to right shunt diseases were studied in Ain Shams University Hospitals, Department of Cardiothoracic Surgery over four years period of time. Patients were classified as VSD patients (19 patients), ASD patients (9 patients) and PDA (7 patients). Open lung biopsies were taken in every patient to study the pathology of pulmonary vasculature. Preoperative, intra and postoperative studies were carried out for each patient to detect the correlation between the preoperative hemodynamics, pathological findings and the surgical outcome. Significant correlation was found between the pathological grade of the disease and the drop in postoperative pulmonary artery pressure.

Patients with Heath & Edwards pathological grade ≤II showed significant decrease in the mean pulmonary arterial pressure. Patients with higher grades showed no significant changes in their pulmonary artery pressures. Surgical mortalities were three in number (8.57%) and they were all in the VSD group of patients. Significant correlation between mortality rate and young age of patients was found. We conclude that age, pathological findings and pulmonary vascular resistance determine the surgical outcome.

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Introduction

Pulmonary vascular disease is a serious complication of large left to right shunts, and when advanced is associated with a high operative mortality. However, recent advances in the surgical treatment of these cases demand a more precise understanding of the development of pulmonary disease in this condition(1).

Now most congenital heart diseases can be corrected surgically during infancy or early childhood However since the impediment to a successful outcome, is the presence of pulmonary vascular disease with severe elevation in the pulmonary vascular resistance, it is difficult to choose the proper time

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for operative intervention (2). Choosing the best time for surgery is difficult because clinical, electrocardiographic, echocardiographic, and haemodynamic findings do not always distinguish reversible from irreversible disease. Also, it is not easy to predict in which patient, pulmonary vascular disease will progress despite successful correction, nor it is possible to identify patients who would benefit and survive from the surgical repair(3). Moreover, Haworth in 1984 pointed out that, from patients with left to right shunts and moderately elevated pulmonary resistance, clinical improvement could not be reliable. Therefore, recently, examination of the pulmonary vasculature in lung tissue obtained at open biopsy, has been used to help to identify patients who would benefit from corrective surgery i.e. those with lesions which might regress (i.e. medial hypertrophy and non-occlusive cellular intimal hyperplasia(1,4).

Material and Methods:

The material consisted of two groups. The first group (G I) included lung biopsies obtained from patients with congenital left to right shunts with pulmonary hypertension. The second group (G II) included various specimens of normal lung tissue and served as age matched control.

Group I:

This group included 35 cases of congenital left to right shunts with pulmonary hypertension, obtained from the Department of Cardiothoracic surgery, Ain Shams University Hospital. These cases were referred to the department over a four-year period of time, starting from March, 1990 to February, 1994.

This series included cases with pressure overload on the pulmonary vascular bed where some of the high systemic pressure was transmitted to the pulmonary arterial circulation through shunts at the ventricular level (19 patients with ventricular septal defect) or arterial level (7 patients with patent ductus arteriosus). Also included in this series were cases with increased pulmonary blood flow under low pressure (i.e. volume overload) (9 patients with atrial septal defect).

Group II [Control group]

Ten specimens of grossly free lungs were included in this group which were confirmed later by histopathologic examination. The specimens were obtained from autopsy cases performed at the Department of Pathology, Ain Shams University. The cause of death was not directly related to a cardiovascular disease. Lung specimens in this group weretaken either from the anterior segment of the right upper lobe or from the apical segment of right lower lobe.

All patients of group I were subjected to preoperative and postoperative studies as well as histopathologic studies of their lung biopsy specimens. These studies included clinical examination, radiograms, E.C.G.,echocardiography, laboratory investigations, and cardiac

Table 1: Age distribution of patients and control groups.

Age range	Group I (35 cases)			Group II (10 Cases)
	VSD	PDA	ASD	
6 mons-3 yrs	3	1	-	3
3-6 yrs	7	2	1	2
6-9 yrs	3	2	3*	-
9-12 yrs	2	2	-	1
12-15 yrs	2	-	2	2
15-18 yrs	1	-	2	1
18-21 yrs	1	-	-	-
21-24 yrs	-	-	1	1
Total	19	7	9	10

* One case of ASD also had transposition of great vessels
VSD = Ventricular septal defect.
PDA = Patent ductus arteriosus.
ASD = Atrial septal defect.

catheterization.

All cases (35 cases) were operated upon by the open heart technique to correct the congenital anomalies under cardiopulmonary bypass. A lung biopsy specimen with the average size of 1 - 2 cm obtained from every case intraoperatively and soon after closure of the cardiac shunt. The biopsies were taken either from the anterior segment of the right upper or from the apical segment of the right lower lobe. These locations generally show less pulmonary oedema and congestion than the more dependent parts of the lung. The anterior aspect of the right lung was chosen since it was most easily accessible to the surgeon. Specimens were fixed in 10% buffered formalin, blood gases were reported.

Results

Pulmonary vascular structure was studied in lung biopsy specimens taken from 35 patients with 3 different types of congenital left to right cardiac shunts (Group I) and 10 normal age matched control subjects (Group II) (Table I).

Group I included cases with pressure overload on the pulmonary vascular bed and cases with increased pulmonary blood flow (i.e. volume overload).

Cardiac lesions were detected in other members of the family in 2 cases and consanguinity was reported in 5 other cases.

A. Pressure overload: This group consisted of:

- 19 patients with ventricular septal defect (VSD). Two of these cases were associated with aortic regurge and a third case had an associated small atrial septal defect. One pa-

Tab.2: Incidence of symptoms in different types of cardiac shunts.

Symptom	Number of cases		
	VSD 19	PDA 7	ASD 9
1. Exertional dyspnea	4/19	1/7	2/9
2. Low cardiac output symptoms	3/19	2/7	2/9
3. Chest pain	2/19	0/7	0/9
4. Palpitation	1/19	0/7	2/9
5. Recurrent chest infections	7/19	2/7	4/9
6. Cyanosis on exertion	2/19	1/7	0/9
7. Hemoptysis	0/19	1/7	1/9
8. Asymptomatic (accidentally discovered mumur)	4/19	2/7	3/9

Tab. 3: Incidence of precordial signs in different types of cardiac shunts.

Signs	Number of cases		
	VSD 19	PDA 7	ASD 9
1. Congested pulsating neck veins	1/19	0/7	5/9
2. Apex with rt. vent. characters.	13/19	2/7	3/9
3. Left parasternal heave.	8/19	2/7	6/9
4. Pulsations in Lt. 2nd space	10/19	3/7	5/9
5. Systolic thrill in Lt. 2nd space.	17/19	4/7	6/9
6. Splitting of 2nd heart sound	0/19	0/7	9/9
7. Harsh pansystolic murmur	19/19	0/7	0/9
8. Continuous machinary murmur	0/19	7/7	0/9

tient died on table during surgical correction of the cardiac defect (case no-3) and two others died 6 hours postoperatively. (Case no. 1 and 8)

- 7 patients with wide patent ductus arteriosus (PDA).

B. Volume overload: This group consisted of 9 patients with atrial septal defects (ASD). Six of these patients were of the ostium secundum type, one of them was associated with transposition of the great vessels. The other 3 patients were of the ostium primum type. Three patients had other congenital abnormalities including cleft mitral valve (1 case), small high VSD (1 case), and small

Tab. 4: Incidence of radiological findings in different types of cardiac shunts.

Radiological Findings	Number of cases		
	VSD 19	PDA 7	ASD 9
1. Increased cardiothoracic ratio	12/19	2/7	4/9
2. Right atrial dilatation	13/19	1/7	4/9
3. Rt. ventricular enlargement	16/19	1/7	2/9
4. Dilated main pulmonary arteries			
Mild	12/19	5/7	6/9
Moderate	6/19	2/7	3/9
Severe	1/19	0/7	0/9
5. Peripheral lung fields			
Plethoric	19/19	6/7	8/9
Normal	0/19	1/7	1/9
6. Left atrial dilatation	13/19	3/7	3/9
7. Hilar dance on fluoroscopy	0/19	4/7	5/9

Table 5: Pulmonary haemodynamics in 19 cases of VSD.

No.	Age	PAP (mean) mmHg		PVR Units	PBF L/min	Comments
		Preop.	Postop.	Preop.	Preop.	
1	6M	60	-	12.5	3.5	Died 6 hrs. postop.
2	3Y	65	63	9	5.4	
3	3Y	70	-	11.4	4.2	Died 6 hrs. postop. due to pul. hyperten. Crisis
4	4Y	74	74	13.5	3.2	
5	5Y	60	50	9	3.4	
6	5Y	80	70	10.1	6.1	
7	5Y	28	24	2.5	4	
8	6Y	70	-	14.2	3.8	Died on table due to Pul. hypertensive crisis
9	6Y	35	25	5.4	3.6	
10	6Y	42	40	11	6.4	
11	7Y	30	28	1.5	7.3	
12	8Y	60	62	8.9	3.3	
13	9Y	65	55	9.2	5.6	
14	11Y	60	40	13.6	10	
15	12Y	32	30	2.5	5.3	
16	13Y	90	85	11	6.2	
17	15Y	25	22	3.8	3.4	
18	16Y	80	75	10.9	6.3	
19	20Y	25	22	2.7	5.2	

PAP = Pulmonary arterial pressure
PVR = Pulmonary vascular resistance
PBF = Pulmonary blood flow

Table 6: Pulmonary haemodynamics in 7 cases of PDA.

No.	Age	PAP (mean) mmHg		PVR Units	PBF L/min	Comments
		Preop.	Postop.	Preop.	Preop.	
1	18M	40	40	9	2.7	
2	5Y	29	20	2.1	2.6	
3	6Y	25	20	3.6	3.6	
4	9Y	25	16	2.3	7.2	
5	9Y	35	32	2.8	7.1	
6	10Y	27.5	23	2.4	6.1	
7	10Y	25	20	2.5	5.5	

Table 7: Pulmonary haemodynamics in 9 cases of ASD.

No.	Age	PAP (mean) mmHg		PVR Units	PBF L/min	Comments
		Preop.	Postop.	Preop.	Preoper.	
1	5Y	35	25	2.2	6.1	
2	7Y	40	28	3.5	7.3	
3	8Y	30	28	8.1	1.8	
4	9Y	30	26	3.4	4.4	Also had transposition of great vessels
5	14Y	25	22.5	3	7.5	
6	15Y	39	30	3.4	7.4	
7	16Y	22.5	16	1.5	3.2	
8	16Y	35	35	3.6	5.5	
9	24Y	17	15	2.8	4.3	

VSD with mitral incompetence (1 case).

Age and Sex:

The male: Female sex ratio in group I was 17:18 and age ranged from 6 months to 24 years. In Group II, the male: female ratio was 1:1 and age ranged from 8 months to 22 years.

The results included the following items:

A. Preoperative data.

B. Pulmonary haemodynamics.

C. Histopathologic examination.

D. Correlation between pulmonary haemodynamics and histopathologic findings.

A. Preoperative data: See Tables 2,3&4.

B. Pulmonary haemodynamics

Mean pulmonary arterial pressure (PAP) was measured through cardiac catheterization

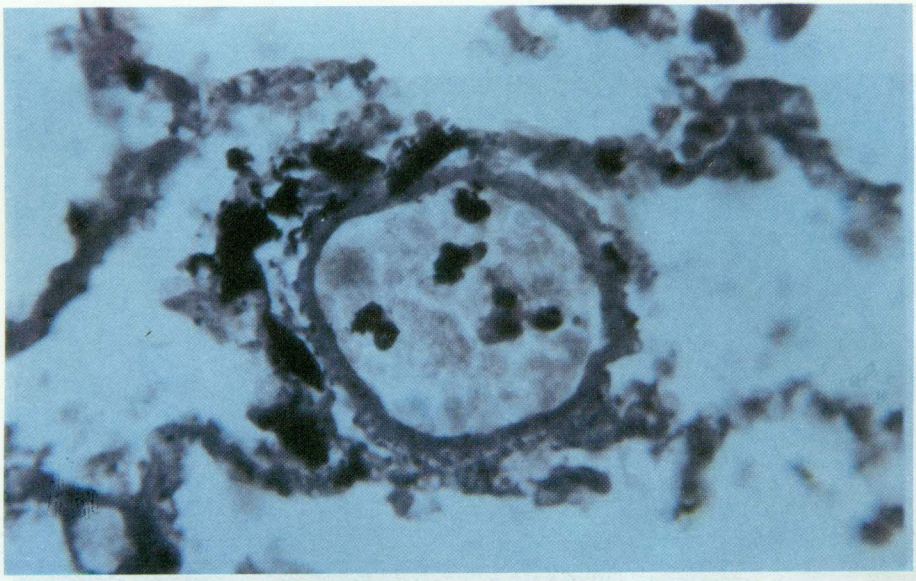

Fig. 1: Showing a normal small intrapulmonary muscular artery accompanying an alveolar duct of an infant 6 months of age. The media is thin and the lumen wide (Hx & E X 250).

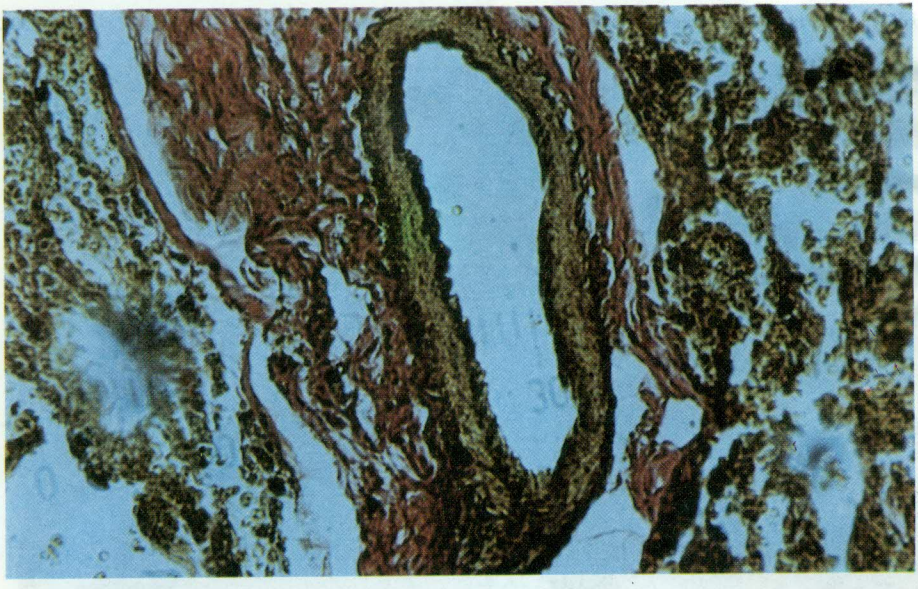

Fig. 2: Large musclar pulmonary artery showing internal and external elastic laminae; taken from an infant 6 months of age. Though at this stage of development the medial is still relatively thick, the lumen is wide, (Verhoeff-Van Gieson stain x 250).

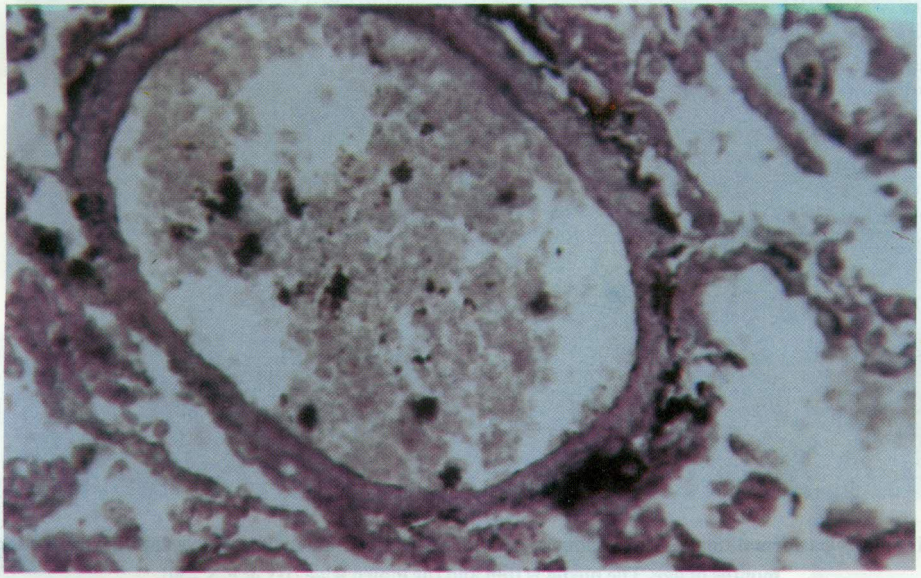

Fig. 3: Showing a more peripheral intrapulmonary vessel of an infant aged 18 months (H x & E x 250).

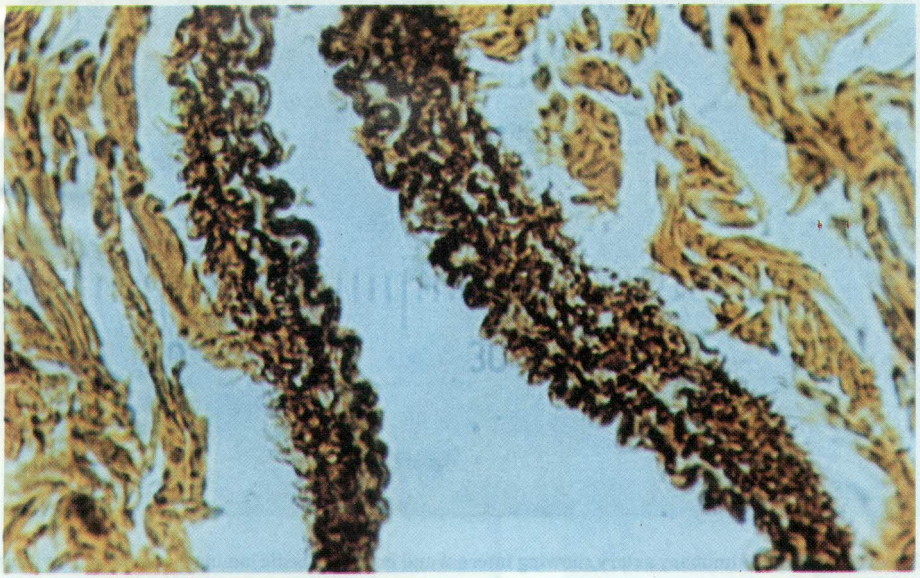

Fig.4: Large elastic bronchiolar pulmonary artery showing internal elastic lamina with well-marked medial elastic tissue but-ill-defined external elastic lamina taken from a 2 years old child (Silver stain x 250).

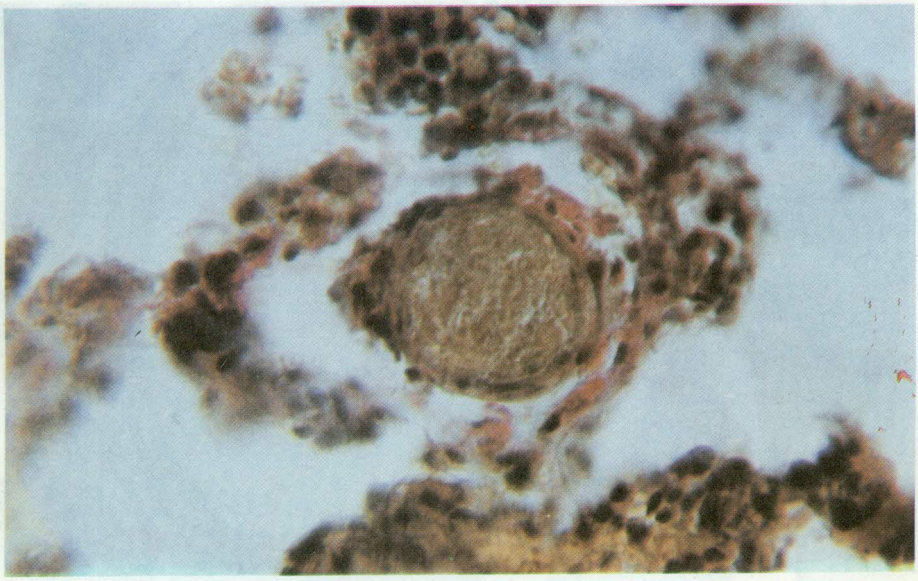

Fig. 5: A small muscular pulmonary artery in the lung of a child 7 years old showing a very thin layer of media. (Verhoeff-Van Gieson x 100).

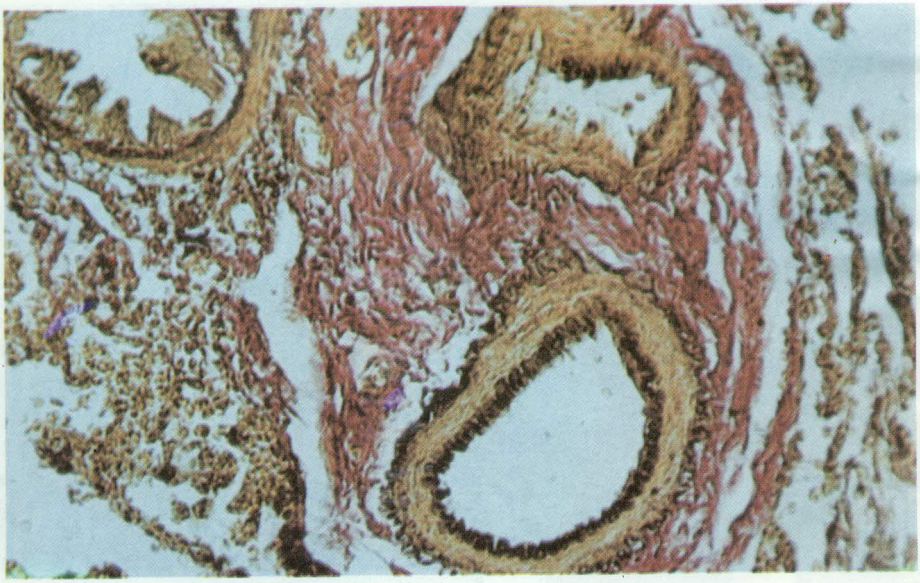

Fig.6: Showing a respiratory bronchiolus artery, with increased wall thickness (elastic Van Gieson stain x 100). (from a patient with ventricular septal defect).

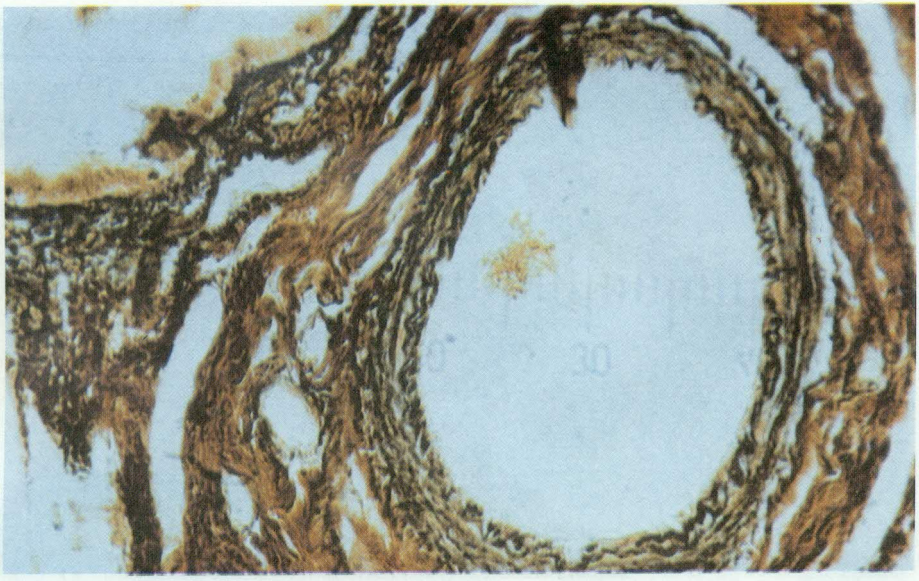

Fig. 7: Showing a respiratory bronchiolus artery in a patient with an atrial septal defect and pulmonary artery hypertension. The wall thickness in markdely increase (Silver stain, x 250).

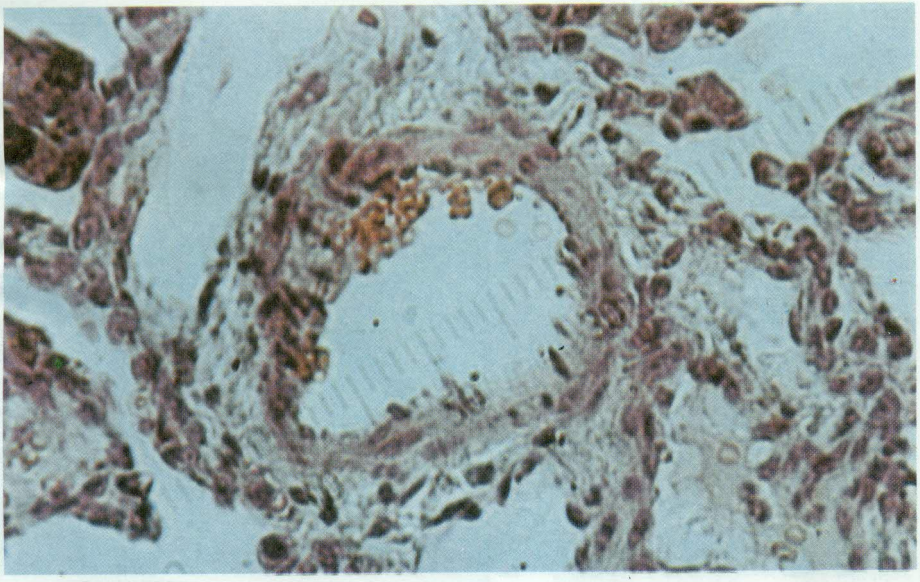

Fig.8: Showing alveolar duct artery. There is a complete and thick wall of muscle surrounding the artery (H x & E x 250).

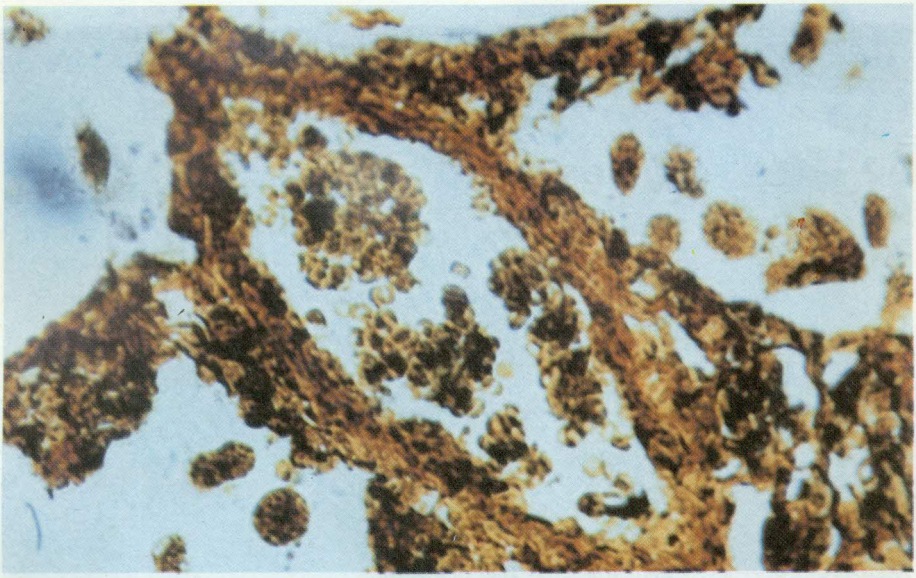

Fig. 9: Showing alveolar duct artery (Silver stain, x 250).

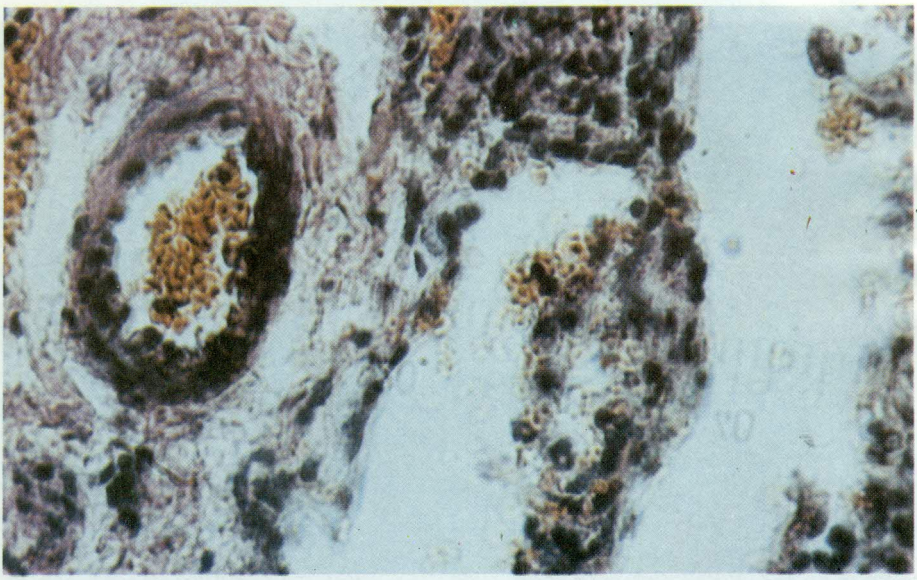

Fig.10: Alveolar wall artery in a patient with a defect of the atrioventricular canal with pulmonary artery hypertension. There is medial hypertrophy (H x & E; x 250).

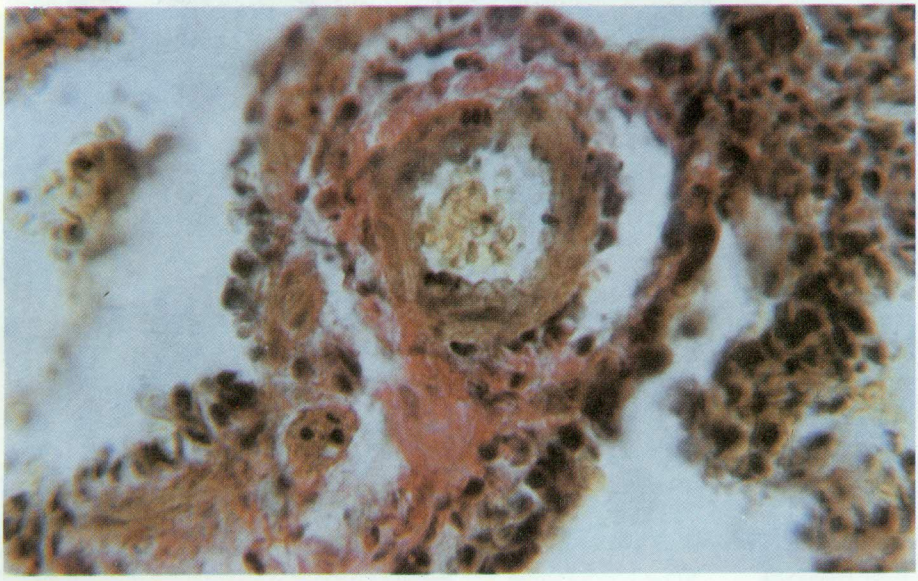

Fig. 11: Showing alveolar wall artery (Verhoeff-Van Fieson x 400).

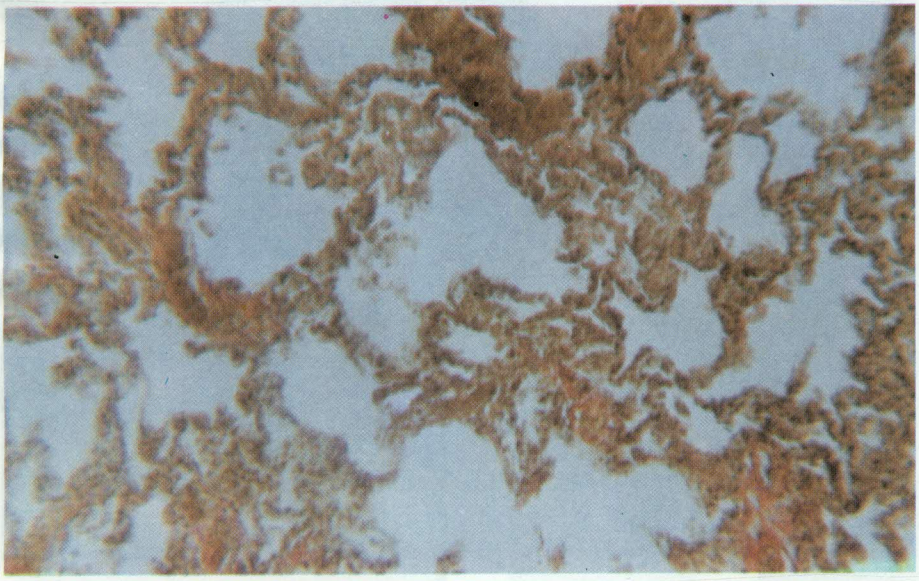

Fig.12: A low power field from a patient with normal pulmonary artery pressure and resistancem with abundant small arteries (Van Cieson stain, x 100).

Table 8: Incidence of initimal proliferation (IP) in patients with different types of cardiac shunts.

Value range	VSD		PDA		ASD	
	Mild IP	Severe IP	Mild IP	Severe IP	Mild IP	Severe IP
6 Mon-3 Yrs	3/3	0/3	0/1	1/1	-	-
3.1-6 Yrs	2/7	3/7	0/2	0/2	1/1	0/1
6.1-9 Yrs	2/3	1/3	1/2	1/2	0/3	3/3
9.1-12 Yrs	2/2	0/2	0/2	2/2	-	-
12.1-15 Yrs	1/2	0/2	-	-	0/2	2/2
115.1-18 Yrs	0/1	1/1	-	-	0/2	2/2
18.1-21 Yrs	0/1	1/1	-	-	-	-
21.1-24 Yrs	-	-	-	-	0/1	1/1

Table 9: Incidence of initimal fibrosis in patients with different types of cardiac shunts.

Age Range	VSD	PDA	ASD
6 Mon-3 Yrs	3/3	1/1	-
3.1-6 Yrs	2/7	1/2	0/1
6.1-9 Yrs	2/3	0/2	2/3
9.1-12 Yrs	2/2	0/2	-
12.1-15 Yrs	1/2	-	0/2
115.1-18 Yrs	0/1	-	1/2
18.1-21 Yrs	0/1	-	-
21.1-24 Yrs	-	-	1/1

Table 10: Incidence of medial abnormalities in patients with different types of shunts.

Value range	VSD		PDA		ASD	
	El Dep.	Ir Thc.	El. Dep.	Ir. Thc.	El. Dep.	Ir. Thc.
6 Mon-3 Yrs	1/3	2/3	1/1	1/1	-	-
3.1-6 Yrs	5/7	4/7	2/2	1/2	1/1	1/1
6.1-9 Yrs	1/3	2/3	2/2	0/2	1/3	2/3
9.1-12 Yrs	2/2	0/2	1/2	1/2	-	-
12.1-15 Yrs	1/2	2/2	-	-	1/2	2/2
115.1-18 Yrs	1/1	0/1	-	-	2/2	2/2
18.1-21 Yrs	1/1	1/1	-	-	-	-
21.1-24 Yrs	-	-	-	-	1/1	1/1

El. Dep. = Excessive deposition of elastin.
Ir. Thc. = Irregularity of the thickness.

preoperatively and by echo Doppler postoperatively. Pulmonary vascular resistance (PVR), and pulmonary blood flow (PBF) were calculated preoperatively by means of cardiac catheterization. PVR was calculated by the Fick's principle as follow:

$$PVR = \frac{\text{Mean PAP-Mean left atrial pressure}}{\text{P.B.F.}}$$

Normal mean PAP was taken as 18 mm Hg or less and normal PVR as less than 3.5 u/m2 as previously published (6) Table 5,6, and 7 show pulmonary haemodynamic data for each case in group I in relation to its disease entity and age.

C. Histopathologic examination:

Histopathologic examination of the specimens of the 2 groups, group I and group II (Fig. 1-5) revealed that each lung biopsy contained arteries cut at different points along the arterial branching pathway and each artery was slightly different in size, appearance and anatomic location (i.e. type of airway accompanied) from the arteries proximal and distal to it. These peripheral lung biopsies included mostly intra-acinar arteries and the following vessels were identified.

1. Bronchiolar arteries (Fig. 6-7): These were relatively large arteries with the external diameter >101 μ. They were located in the vicinity of the branchioli and were the least numerous arteries encountered in the biopsy.

Table 11: Incidence of plexiform lesions in patients with different types of cardiac shunts

Age Range	VSD	PDA	ASD
6 Mon-3 Yrs	1/3	0/1	-
3.1-6 Yrs	0/7	1/2	0/1
6.1-9 Yrs	1/3	0/2	0/3
9.1-12 Yrs	0/2	0/2	-
12.1-15 Yrs	0/2	-	0/2
115.1-18 Yrs	0/1	-	0/2
18.1-21 Yrs	0/1	-	-
21.1-24 Yrs	-	-	1/1

In 2 cases, the lung biopsy specimen did not include any bronchiolar arteries.

2. Alveolar duct arteries (Fig. 8-9), these were smaller arteries with the external diameter range 51-100 μ, they were identified by their location close to the alveolar ducts and were more numerous in the biopsies.

3. Alveolar wall arteries (Fig. 10,11,12). These were the smallest arteries encountered with the external diameter <50 μ. They were located at the alveolar walls and were the most numerous vessels seen.

Comment was only given on arteries showing pathologic features in the different disease entities. In each biopsy specimen, a mean of 35 arteries were studied (range 18-60). The various pathological abnormalities present were reported as intimal damage, intimal fibrosis, medial abnormalities and plexiform lesions as reported by Heath and Edwards in 1958 (5).

A. Intimal damage:

Two forms of intimal damage were seen, intimal proliferation and intimal fibrosis.

1. Intimal proliferation: The extent of any existing proliferation (IP) was estimated. Mild IP was indicated by a focal process whereas severe IP was identified when the process was circumferential. The presence of

Table 12: Grading of 19 cases of VSD

Case no.	Age	Mean % AMT/ normal	Size	Alv/art.	Int. Prolif.	Int. fibr.	Plex. les.	Grade
1	6M	< 1.5	Inc.	N	mild	+	+	IV,A
2	3Y	1.5-2	Dec.	N	mild	-	-	II,B
3	3Y	< 1.5	N.	N	mild	+	-	III,A
4	4Y	1.5-2	Dec.	Inc.	severe	+	-	III,B
5	5Y	1.5-2	Dec.	Inc.	severe	-	-	II,B
6	5Y	< 1.5	Dec.	Inc.	severe	+	-	III,A
7	5Y	< 1.5	Dec.	Inc.	-	-	-	I,A
8	6Y	< 1.5	Dec.	Inc.	mild	-	-	II,A
9	6Y	> 2	Dec.	Inc.	mild	-	-	II,C
10	6Y	2	Dec.	Inc.	-	-	-	I,C
11	7Y	< 1.5	Dec.	Inc.	severe	-	-	II,A
12	8Y	2	Dec.	Inc.	mild	+	-	III,C
13	9Y	< 1.5	Dec.	Inc.	mild	-	-	II,A
14	11Y	< 1.5	Dec.	Inc.	mild	-	-	II,A
15	12Y	< 1.5	Dec.	Inc.	mild	-	-	II,A
16	13Y	< 1.5	Dec.	Inc.	mild	-	-	II,A
17	15Y	< 1.5	Dec.	Inc.	-	-	-	I,A
18	16Y	1.5-2	Dec.	Inc.	severe	-	-	II,B
19	20Y	1.5-2	Dec.	Inc.	mild	-	-	II,B

N = Normal
Dec. = Decreased
Inc. = Increased
Gradw A : 11/19
Grade B (mild): 0/19
Grade I : 3/19
Grade II: 11/9
Grade III: 4/19
Grade IV: 1/19
Grade C (Severe) : 3/19

IP was the characteristic feature of Grade II, Heath and Edwards classification. IP was more pronounced in bronchiolar than alveolar duct of alveolar wall arteries. It was seen more frequently in children 3-12 years and with ASD more than with VSD or PDA.

2. Intimal fibrosis represented a severe form of intimal damage (Grade III, Heath and Edwards classification) and was accompanied by extreme narrowing or even complete obliteration of the lumen. Although intimal fibrosis was seen in 10 children studied, it was more pronounced in patients above 12 years of age.

B. Medial abnormalities

Pathological features of the media included the following two findings:

1. Excessive deposition of elastin.

2. Irregularity of the medial thickness.

These changes were seen more frequently in long standing conditions as in patients above 2 years of age.

C. Plexiform lesions

Table 13: Grading of 7 cases of PDA.

Case no.	Age	Mean % AMT/ normal	Size	Alv/art.	Int. Prolif.	Int. fibr.	Plex. les.	Grade
20	18M	< 1.5	N	Inc.	severe	-	-	III,A
21	5Y	< 1.5	N	Inc.	-	-	-	I,A
22	6Y	< 1.5	Dec.	Inc.	severe	+	+	IV,A
23	9Y	1.5-2	Dec.	Inc.	severe	-		II,B
24	9Y	< 1.5	Dec.	Inc.	mild	-	-	II.A
25	10Y	< 1.5	Dec.	Inc.	severe	-	-	II,A
26	10Y	< 1.5	Dec.	Inc.	severe	-	-	II,A

N - Normal
Dec. - Decreased
Inc. - Increased
Grade A : 6/7
Grade B (mild): 1/7

Grade I: 1/17
Grade II: 4/7
Grade III: 1/7
Grade IV: 1/7

Table 14: Grading of 9 cases of ASD

Case no.	Age	Mean % AMT/ normal	Size	Alv/art.	Int. Prolif.	Int. fibr.	Plex. les.	Grade
27	5Y	< 1.5	N	N	mild	-	-	II,A
28	7Y	< 1.5	Dec.	Inc.	severe	-	-	II,A
29	8Y	< 1.5	Dec.	Inc.	severe	+	-	III,A
30	9Y	1.5-2	Dec.	Inc.	severe	+	-	III,B
31	14Y	< 1.5	Dec.	Inc.	severe	-	-	II.A
32	15Y	1.5-2	Dec.	Inc.	severe	-	-	II,B
33	16Y	< 1.5	Dec.	Inc.	severe	-	-	II,A
34	16Y	< 1.5	Dec.	Inc.	severe	+	-	III,A
35	24Y	< 1.5	Dec.	Inc.	severe	+	-	III,A

N - Normal
Dec. - Decreased
Inc. - Increased
* This case also had transposition of great vessels
Grade A : 7/9
Grade B (mild): 2/9

Grade II: 11/9
Grade III: 4/19

The presence of plexiform lesions indicated advanced pathologic process (Grade IV, Heath and Edwards classification). Cases that showed plexiform lesion formation (2 cases) were also tested for the presence of hemosiderin granules (Grade V, Heath and Edwards classification) by means of iron staining. None of these cases included hemosiderin granules to qualify for Grade V, and therefore, Grade IV was the highest grade

Table 15: Structural abnormalities and hemodynamic findings in cases of VSD.

Case No.	Age	Grade	mean PAP mmHg		RVR	Intimal abnormal.	Medial abnorm.	Other structural abnormal.
			Preop.	Postop.				
	Cases with significant drop in postoperative PAP							
5	5 Y	II,B (mild)	60	50	9	IP	-	↑MS. ↓ S,↓ N
9	6Y	II,C	35	25	5.4	IP	EL	↑MS. ↓ S,↓ N
13	9 Y	II,A	65	55	9.2	IP	IR	↑MS. ↓ S,↓ N
14	11 Y	II,A	60	40	13.6	IP	EL	↑MS. ↓ S,↓ N
16	13 Y	II,A	90	85	11	IP	EI, IR	↑MS. ↓ S,↓ N
18	16 Y	II,B (mild)	80	75	10.9	IP	EL	↑MS. ↓ S,↓ N
	Cases with significant drop in postoperative PAP							
1	6 M	IV.A	60	-	12.5	IP.IF	EL.IR	↑MS. S, Plex.L.
2	3 Y	II,B (mild)	65	63	9	IP	-	↑MS. S,
3	3 Y	III,A	70	-	11.4	IP.IF	IR	↑MS.
4	4 Y	III,B	74	74	13.5	IP.IF	EI.IR	↑MS. ↓S,↓N
6	5 Y	(mild)	80	80	10.1	IP.IF	EL.IR	↑MS. ↓S,↓N
7	5 Y	III,A	28	24	2.5	-	-	↑MS. ↓S,↓N
8	6 Y	I,A	70	-	14.2	IP	EL.IR	↑MS. ↓S,↓N
10	6 Y	II,A	42	40	11	-	EL.IR	↑MS. ↓S,↓N
11	7 Y	I,C (mild)	30	28	1.5	-	IR	↑MS. ↓S,↓N
12	8 Y	I, A	60	62	8.9	IP.IF	EL	↑MS. ↓S,↓N
15	12 Y	III, C	32	30	2.5	IP	EL	↑MS. ↓S,↓N
17	15 Y	(mild)	25	22	3.8	-	IR	↑MS. ↓S,↓N
19	20 Y	II, A I, A II,B (mild)	25	22	2.7	IP	EL	↑MS. ↓S,↓N

IP = Intimal Proloiferation
IF = Intimal Fibrosis
EL = Increased Elastin
IR = Irregular thickness

S = Size of pulmonary arteries
N = Number of pulmonary arteries
Plex. L = Plexiform lesions
MS = Muscularity.

seen in this study. Tables 8,9,10 and 11 summarize the incidence of these descriptive findings.

Grading of study cases

Grading of all cases was performed using both the Heath and Edwards classification as well as the morphometric grading system adopted by Rabinovitch et al., (1984). The ratio of mean % AMT/ normal mean % AMT was determined in each case in order to distinguish between Grades A, B (mild), and C (severe) in the morphometric grading system as follows (Tab.12,13,14):

Table 16: Structural abnormalities and hemodynamic findings in cases of PDA.

Case No.	Age	Grade	mean PAP mmHg		PVR U	Intimal abnormal	Medial abnorm	Other structural abnormal
			Preop.	Postop				
	Cases with significant drop in postoperative PAP							
21	5 Y	I, A	29	20	2.1		EI	↑MS. ↓N
22	6Y	IV, A	25	20	3.6	IP, IF	EI, IR	↑MS. ↓ S,↓N PlexL:
23	9 Y	II, B	27.5	23	2.4	IP		↑MS. ↓ S,↓N
25	10 Y	II, A	27.5	23	2.4	IP	EL.IR	↑MS. ↓ S,↓N
26	10 Y	II, A	25	20	2.5	IP		↑MS. ↓ S,↓N
	Cases with significant drop in postoperative PAP							
20	18 M	III,A	64	40	9	IP.IF	EL.IR	↑MS.
24	9 Y	I, A	35	32	2.8	IP	EI	↑MS. ↓ S,↓N

IP = Intimal Proliferation
IF = Intimal Fibrosis
EL = Increased Elastin
IR = Irregular thickness
S = Size of pulmonary arteries
N = Number of pulmonary arteries
Plex. L = Plexiform lesions
MS = Muscularity.

- Grade A when specimen mean % AMT/normal mean % AMT <1.5.

- Grade B (mild) when specimen mean % AMT/normal mean=1.5-2.

- Grade C (severe) when specimen mean % AMT/normal mean % AMT=2 or more.

D. Correlation between pulmonary hemodynamies and histopathologic findings:

Correlation was made between pulmonary hemodynamcis and various histopalthologic findings as shown in tables (15,16,17).

Cases that showed significant drop in their pulmonary blood pressure after surgical correction (> 4 mmHg). were grouped together. Other patients whose pulmonary blood pressure remained the same or increased postoperatively together with those who died were all grouped together.

Interpretation of the pathological specimens showed that intimal damage was more evident in patients with ASD when compared with those with VSD. This is in contrary to the increased muscularity that occurred more in the VSD group of patients.

Patients who showed significant drop in

Table 17: Structural abnormalities and hemodynamic findings in cases of ASD.

Case no.	Age	Grade	mean PAP mmHg		PVR U	Intimal abnormal	Medial abnorm	Other structural abnormal
			Preop.	Postop				
	Cases with significant drop in postoperative PAP							
27	5 Y	II, A	35	25	2.2	IP	EL, IR	↑MS. ↓N
32	15 Y	II, B	39	30	3.4	IP	EL, IR	↑MS. ↓S,↓N
33	16 Y	II, A	22.5	16	1.5	IP	EI, IR	↑MS. ↓S,↓N
	Cases with significant drop in postoperative PAP							
28	7 Y	II,A	40	28	3.5	IP	IR	↑MS. ↓S,↓N
29	8 Y	III, A	30	28	8.1	IP.IF	-	↑MS. ↓S,↓N
30	9 Y*	II,B	30	26	3.4	IP,IF	EI,IR	↑MS. ↓S,↓N
31	14 Y	II,A	25	22.5	8	IP	IR	↑MS. ↓S,↓N
34	16 Y	III,A	35	35	3.6	IP.IF	EI, IR	↑MS. ↓S,↓N
35	24 Y	III,A	17	15	2.8	IP.IF	EI, IR	↑MS. ↓S,↓N

IP = Intimal Proliferation
IF = Intimal Fibrosis
EL = Increased Elastin
IR = Irregular thickness

S = Size of pulmonary arteries
N = Number of pulmonary arteries
Plex. L = Plexiform lesions
MS = Muscularity.

*** This case also had transposition of graft vessels.**

postoperative PAP all had moderate cellular intimal proliferation but not intimal fibrosis (cases 5, 9, 13, 14, 16 and 18) as shown in table 15. Similar findings were observed in patients with PDA (cases 21, 23, 25 and 26) and those with ASD (cases 27, 32 and 33) as shown in tables 16 and 17 respectively.

Discussion

Most congenital heart defects can now be corrected surgically during infancy or early childhood. Choosing the best time for surgery is difficult because clinical, electrocardiographic, echocardiographic and hemodynamic findings do not always distinguish reversible from irreversible disease.

Heath and Edwards in 1958 (5), graded the pulmonary vascular disease according to structural changes in the pulmonary arteries into 6 grading:

Grade I: Changes as being characterized by medial hypertrophy without intimal proliferation.

Grade II: Medial hypertrophy with cellular intimal reaction.

Grade III: Intimal fibrosis as well as medial hypertrophy and possibly with early generalized vascular dilation.

Grade IV: Generalized vascular dilatation an area of vascular occlusion by intimal fibrosis, and plexiform lesions.

Grade V: Other dilatation lesions such as cavernous and angiomatoid lesions, and

Grade VI: In addition, necrotizing arteritis.

The development of pulmonary vascular disease varies in different types of congenital heart disease as shown by Haworth in 1984 who stated that the biopsies were taken either from the anterior segment of the right upper or from the apical segment of right lower lobe. These locations generally show less pulmonary oedema and congestion than the more dependent parts of the lung. The anterior aspect of the right lung was chosen since it was most easily accessible to the surgeon.

It was observed in this series that intimal damage that occurred in patients with atrial septal defect was more pronounced than that seen in those with ventricular septal defect. Increased muscularity of the media with the accompanying decrease in arterial size, however, were more marked in the latter group. Similar observations were reported in other series studies by Haworth in 1984 (1).

This study shows that the lungs of patients in whom the pulmonary critical pressure returns to normal after a cardiac repair show pulmonary arterial medial hypertrophy with moderate cellular intimal proliferation at the time of repair Other studies show a similar observation (4,6,7).

However, not all patients showing these structural abnormalities had a normal pressure after repair.

In addition, fatal documented pulmonary hypertensive crisis, similar to those happened to three of our patients, have occurred in patients with excessive pulmonary arterial musclarity in earlier series (8). Thus, medial hypertrophy carries a favorable prognosis in that it is potentially reversible but it is not necessarily a safe lesion. The pathological criteria for operability are yet to be distinguished from those of potential reversibility of structural abnormalities in patients who survive the operation.

The status of the pulmonary vasculature is of extreme importance in the consideration of patients as candidates for surgery. Observation on the relation between hemodynamic findings and surgical mortality have shown that there is a greater dependence on the pulmonary vascular resistance than on pulmonary hypertension. The 3 cases of ventricular septal defect who died during or soon after surgery in this study (cases 1,3,8) had very high pulmonary vascular resistance (11.4, 12.5 and 14.2 units). However, 2 other cases had high vascular resistance (13.5 and 13.6 units) but survived the operation (cases 4,14). In patients with pulmonary hypertension and a markedly increased pulmonary

blood flow, with a normal or only moderately elevated pulmonary vascular resistance, the risk of surgical closure of the shunt are relatively low (9).

The reason for the high surgical and postoperative mortality of patients with severe pulmonary vascular obstruction is unknown. Presumably, acute right ventricular failure follows closure of the defect. A high pulmonary vascular resistance imposes a marked obstruction to right ventricular outflow, and pulmonary blood flow may be reduced. In the absence of right to left shunt, systemic blood flow will be impaired, with a fall in systemic pressure. The reduced systemic arterial pressure may result in decreased coronary blood flow, which further interferes with right ventricular function and a vicious circle is established culminating in acute failure of the right side of the heart (10).

The partial collapse of the lungs as an effect of anaesthesia on systemic vascular resistance and possible hypoxemia during surgery, all accentuate the increased pulmonary and decreased systemic vascular resistance. Added to this is the decreased right ventricular function secondary to ventriculotomy which frequently contributes to the fatal outcome with surgery (11).

In this study, we conclude that in assessing a lung biopsy specimen, no pathological finding should be considered in isolation. The techniques of measurement and descriptive pathology are complementary and both were essential in the present study. Such a combination was used in other recent works (12,13).

We also stress that while both mean pulmonary pressure and pulmonary vascular resistence showed a good correlation to the histological changes, no relation was found between pulmonary blood flow and pulmonary vasculopathy.

Conclusion

From this study we conclude that:

1- The status of the pulmonary vasculature is of extreme importance in the consideration of patients as candidates for surgery.

2- In congenital heart lesions with left to right shunts, the pulmonary vascular changes and the resulting haemodynamic effects, remarkably affect the outcome of surgical management of these cases.

3- Early surgical correction of congenital heart disease is recommended for the following reasons:

a. To allow the pulmonary vessels to develop in a normal manner. Surgical correction, in these cases, is ideally performed early in life which is the period of active postnatal lung growth.

b. To avoid the persistence of progression of structural changes in the pulmonary vascular bed.

4- In assessing a lung biopsy specimen no pathological finding should be considered in isolation. The techniques of measurement and descriptive pathology are complementary and both were essential in this study.

5- The behaviour of the pulmonary vessels in atrial septal defect is quite different from that in ventricular septal defect or patent ductus arteriosus. In most patients with a ventricular septal defect, pulmonary arterial medial hypertrophy is the principle abnormality during early childhood, intimal proliferation develops gradually, and intimal damage that occurred in patients with atrial defect was more pronounced than that seen in those with ventricular septal defect.

6- Medial hypertrophy carries a favourable prognosis in that it is potentially reversible but it is not necessarily a " safe" lesion.

7- The lungs of patients in whom the pulmonary arterial pressure returns to normal after an intracardiac repair show pulmonary arterial medial hypertrophy with moderate cellular intimal proliferation at the time of repair.

8- Patients with interventricular or interarterial communications develop earlier and more severe pulmonary haemodynamic and vascular changes than patients with interatrial communication.

9- Both the mean pulmonary pressure and pulmonary vascular resistance showed a good correlation to the histopathological changes, no relation was found between the pulmonary blood flow and pulmonary vasculopathy.

10- Future directions in research should be aimed both at determining how to induce regression of structural changes (extension of muscle, medial hypertrophy and mild intimal hyperplasia), and how to stimulate growth of new vessels.

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Clinical Experience with the new "Sorin bicarbon" Bileaflet Heart Valve Prosthesis

Abstract

Between 1991-1993 the new "Sorin Bicarbon" valve prosthesis was implanted in a series of 64 patients, aging 60 years in average (34-73 years) in the Department of Cardiothoracic and Vascular Surgery, University Witten- Herdecke in Wuppertal, Federal Republic of Germany. Preoperatively 2 patients were in New York Heart Association (NYHA) class IV, 36 patients in class III, 26 patients in class II or I . The operations performed were 31 aortic, 24 mitral and 9 double valve replacements. The reported early mortality was two deaths (3.2%), one case after10 weeks due to valve thrombosis and brain embolisation, another patient 2 weeks after surgery due to acute left ventricular failure.

Mean follow up was 7.5 months (1-17 months). One patient died 6 months postoperatively due to cancer. Perivalvular leakage was reported in one case (1.6%), requiring surgical re-intervention. Of all survivors, 59 patients were in class I-II, 3 patients were found in NYHA class III. The functional improvement averaged 1.2 NYHA class. Postoperatively, the mean gradient across the mitral valve prostheses (sizes 25-30 mm) averaged 3.4 mm Hg (1-8 mm Hg). For aortic valve prostheses (sizes 23-31) the mean gradient across the aortic valve prostheses was 10.7 mm Hg (1-27 mm Hg). The Sorin Bicarbon valve prosthesis shows good hemodynamics, and a low complication rate. The present results compare well with other accredited bileaflet valve prostheses.

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Introduction

During the last 15 years, due to excellent hemodynamic characteristics and low thrombogenicity, bileaflet heart valve prostheses became the most popular mechanical valve substitutes. This type of device shows generally average lower energy loss in vitro than the conventional tilting disc or ball valve prostheses. Recent studies indicate the " Sorin Bicarbon" bileaflet prosthesis is the best one with respect to the hemodynamic values in vitro (1). To our knowledge, this is the first report analysing the results of a clinical series of patients in whom the Sorin Bicarbon valve prosthesis was implanted.

Material and Methods

The Sorin Bicarbon bileaflet valve has two curved leaflets which are manufactured from pyrolytic carbon deposited onto a graphite

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core. The leaflets are cylindrical with a principal radius of curvature approximately 2.1 fold the radius of the valve orifice and an opening angle of 80 degrees. The leaflets are held in a titanium/aluminium/vanadium housing which is coated with Carbofilm (Sorin's low temperaturs pyrolytic carbon coating process), a thin film of pyrolytic carbon. The sewing ring is made from two different fabrics: where contact is made with the heart tissues a Dacron double velour fabric is employed, Elsewhere, where the principal tissue in contact with the sewing ring is blood, knitted Teflon fabric coated with Carbofilm is used (2) Between September 1991 and June 1993, 70 Sorin Bicarbon valve prostheses were implanted in 64 patients, 41 males and 23 females. Patient age averaged 60+/- 8.2 years, ranging from 34-73 years. The majority of the patients were in New York Heart Association (NYHA) functional class III or IV preoperatively with 36 patients (56.3%) in class III and 2 patients (3.1%) in class IV, 25 patients (39%) in class II and one patient (1.6%) in class I. The operative procedures and patient characteristics are listed in tables (1) and (2). The surgical techniques remained fairly constant throughout the study period. All patients underwent operation with standard cardiopulmonary bypass techniques and normothermia. Hollow fibre oxygnators were employed. In all cases myocardial protection was afforded by cold blood cardioplegic cardiac arrest according to Buckberg's protocol (3). In addition, topical cooling of the heart with ice slush was used. During the operative procedure myocardial septal temperature was monitored and held at average 14°C. Details of the surgical technique has been reported elsewhere (4). Valve size distributions are listed in table (3). Among the 33 mitral valve replacement procedures performed, the posterior leaflet and valve apparatus were totally or partially preserved in 15 patients (45.5%) provided no heavy calcification was present. Mitral valve re-replacement was performed in 3 patients (4.6%).

In opposition to the usual interrupted stitch technique, in one case of aortic and mitral valve replacement, the aortic valve was secured using continuous 2-0 prolene sutures to decrease the ischemic time.

Heparin administration was started at the same day and a coumarine derivative (phenoprocoumon = coumarine) therapy was usually started 2-3 days postoperatively and administered permanently thereafter. Morbid and fatal valve related events were categorized according to the frame work devised by The American Association for Thoracic Surgery (AATS) and the Society of Thoracic Surgeons (STS) (5).

Statistics:

Continuous variables are presented with ± 1 standard deviation of the mean. Event-rates are presented as lineralized (% per patient-year) occurrence rates.

Follow-up:

Follow-up information has been obtained mainly by interviewing the patients personally. For patients who could not be contacted, information was obtained from their house

Table 1: Operative Procedures

Operative Procedure	No. of patients
MVR	18
MVR + CABG	4
MVR + TVR	1
MVR + TVR + CABG	1
AVR	22
AVR + CABG	7
AVR + graft for abd aorta	1
AVR + MVR	4
AVR + TVR + Mitral paravalv leak suture	1
MVR + AVR + TV Rep	2
MVR + AVR + CABG	3

MVR= mitral valve replacement; AVR= aortic valve replacement; TVR= tricuspid valve replacement; TV REP= tricuspid valve repair; CABG= coronary artery bypass graft

Table 2: Patient characteristics

	AVR	MVR	MVR & AVR	ALL
Patient number	30	24	10	64
Mean age	59.4	61.4	60.9	60
Male: female	5:1	1:1.4	1.5:1	1.7:1
Mean NYHA preop	2.7	2.9	2.5	2.8
Reoperation	0	3	1	4
Additional surgery	8	6	6	20

AVR= aortic valve replacement; MVR= mitral valve replacement

physicians. Dead line for the follow-up was June 1993.

Postoperative hemodynamic assessment:

Two dimensional echocardiography was performed before the patients were discharged from hospital. From the apical transducer position, both atrioventricular valves and the aortic valve could be visualized.

The colour-coded flow mapping technique was the method applied for assessing the degree of valve incompetence or leakage. Pulsed Doppler study demonstrated the flow velocity through the valve. Mean instantaneous gradients were calculated by means of the modified Bernoulli equation.

Table 3: Valve size distribution

Size mm	Aortic valve prosthesis n	Mitral-valve prosthesis n
23	9	0
25	19	1
27	7	0
29	1	12
31	1	16
33	0	4
all	37	33
total	70	

Results

Early results:

The operative mortality rate was 3.1%, with 2 deaths occuring in the first 30 days or in the hospital regardless of time post-operatively. One patient died on the 16th postoperative day due to cardiac failure after replacement of an infected mitral valve prosthesis, the other patient died in hospital 65 days after MVR because of prosthetic thrombosis despite of satisfactory anticoagulation with coumarine derivatives.

Postoperative morbidity includes 1 case of thromboembolism (1.6%)

Late results:

All survivors were followed up for 1-17 months postoperatively with an average of 7.5 ± 4.0 months. The follow-up rate was 100%.

No valve related late mortality occured among our patients.

One patient died 6 months postoperatively due to bronchogenic carcinoma.

Late morbidity includes: 1 case of paravalvular leak (1.6% = 2.5% linearized rate) and 2 cases with minor bleeding (3.1% = 5% linearized rate).

Functional Results of the Patients post-operatively:

Of all survivors, 59 patients were found in class I-II (95%), 33 being in class I (53%) and 26 in NYHA class II (42%), 3 patients (5%) were found in NYHA class III. The functional improvement averaged 1.2 NYHA class.

In 57 patients (90.4%) there was an improvement in the NYHA class. Six patients (9.6%) had the same NYHA class as preoperatively. Postoperatively 49 patients were investigated by Doppler Echocardiography to assess the transvalvular gradients and regurgitation.

For the mitral valve prostheses sizes between 25-33 mm, the mean diastolic gradient averaged 3.5 ± 1.9 mmHg (ranging from 1-8 mmHg).

For the aortic valve prostheses sizes 23-31 mm, the mean systolic gradient averaged 10.1 ± 3.9 mmHg (ranging from 1-27 mmHg).

Discussion

During the past 15 years, the bileaflet valve prosthesis has been the mechanical cardiac valve prosthesis of choice in many institutions, and has represented a valuable challenge to biological valves. Beside the advantage of long term durability, bileaflet mechanical valves have similar good hemodynamic properties as biological valves. In vitro studies showing the superiority of bileaflet Sorin Bicarbon valve prostheses over other bileaflet valves (1) prompted us to implant this new device in a series of patients and to analyse the results. By comparing this latter with those reported in the literature with other valve models, we had to take into consideration the inhomogenicity of different patient cohorts. To minimize this problem, we used the guidelines of AATS and STS suggested by Edmunds and Co workers in 1988 (5) for reporting morbidity and mortality rates after cardiac valvular operations. As stated before, our technique for mitral valve replacement includes the preservation of the posterior papillary muscle and its chordae tendinae in all but the heavily calcified valves.

This method has proved to be very effective in preserving left ventricular function (6,7).

One of the advantages of the Sorin Bicarbon valve prosthesis consists of preserving the papillary muscles and chordae tendinae inspite of the large valve size used. In case the leaflet motion is obstructed by the papillary muscles, the Prosthesis can be rotated to a position in which the leaflets are free. The same advantage is recognized in cases of double mitral and aortic valve replacement. Also in this setting, problems arising within the trigonal areas when the two prostheses are very close to each other can be eliminated by rotating one of prostheses.

Hemodynamics:

Our patients were examined by Doppler Ultrasonography for the measurements of transvalvular gradients. We resorted to this noninvasive method as it has been demonstrated that the catheter mean systolic gradients are consistently smaller than the ultrasonic gradient (4.3 ± 4.8 mmHg), but with a significant correlation between the two methods (8).

Our measured gradients at rest were 3.5 ± 1.94 mmHg mean transvalvular gradient for 25-33 mm mitral valve prostheses and 10.1 ± 3.96 mmHg for 23-31 mm aortic valve prostheses.

Johnston and coworkers in 1992 (9), reported a mean systolic gradient of 12.6±5.5 mmHg and a mean diastolic pressure drop of 4.6 ± 1.4 mmHg for the St Jude Medical

aortic valves size 23 and mitral valves size 29, respectivaly. Thus the sorin Bicarbon valve prosthesis compares well both in aortic and mitral position with the most popular bileaflet valve prostheses as the St. Jude Medical valve prosthesis.

Mortality:

In our study we had an early mortality averaging 3.1% which compares favourably with those reported in the literature. Hospital mortality after valve replacement still averages between 2 and 7% (10). Thromboembolic complications are the most common causes of death. This was also the case in one of our early deaths. With respect to prosthetic related late mortality, none occured in our study after an average follow-up of 7.5 months. One patient died 6 months postoperatively due to cancer. Data of literature show however a linear increase of late mortality in relation to the length of follow-up after implantation of bileaflet valve prostheses. This ranges between 1.5% and 16.9% after 1.5 and 10 years, respectively (11,12). With respect to non lethal complications, perivalvular leak occured in mitral position despite single stitch technique with teflon felt buttressed sutures. This occured in one case of native mitral valve endocarditis which had to be reoperated. Perivalvular leakage occurs generally at a lineraized rate of 2.2% after replacement with mechanical devices (13). From the functional point of view, our patients improved by 1.2 NYHA class from a preoperative mean NYHA of 2.8 to a postoperative mean NYHA class of 1.6 after a mean period of 7.5 months. According to Arom and coworkers in 1989, 96% of patients were in NYHA class I and II postoperatively after valve replacement with St Jude Medical valve prosthesis. Moritz and coworkers in 1990 (12) reported functional improvement from class 3.0 ± 0.7 preoperatively to class 1.6±0.7 one year after valve replacement using Duramedics Edwards bileaflet valve prosthesis. This improvement was sustained throughout the following 3 years of follow up (class 1.6 ± 0.7 after 2 and 3 years and class 1.5 ± 0.7 after 4 years).

Conclusions

Early and intermediate results of the Sorin Bicarbon bileaflet valve prosthesis compare well with the most accreditated available bileaflet prostheses today. One could hypothesize that fewer complications as leaflet entrapments or escapes, as well as deterioration would not occur due to the intrinsic structual and design features of this model. This however remains to be demonstrated in a larger series of patients and over a longer follow-up period. Due to the shortness of the observation time, no definitive conclusion can be drawn for the moment.

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Transatrial Versus Transventricular Correction of Tetralogy of Fallot

Abstract

Between 1970 and 1994, 57 patients (36 males) underwent total repair of tetralogy of Fallot at Harefield Hospital. Seventeen patients were corrected transatrially and 40 transventricularly. All patients returned for a thorough evaluation consisting of history and complete physical examination, chest radiography, 12 leads electrocardiography "ECG", Doppler echocardiography and 24-hour Holter monitoring. The mean age at operation was 4.86 years (standard deviation SD = 8.37, the mean age at follow up was 11.85 years (SD =10.45) and the mean interval from surgery was 6.98 (SD =6.99). Twenty two patients were found in New York Heart Association class I and 11 were in class II, 14 patients had palpitation and three had history of syncopal attacks. The mean cardiothoracic ratio was 55.81% with SD =2.26. 47% of patients with transatrial correction had right bundle branch block "RBBB" while 83% with transventricular correction had RBBB.

There was significant evidence (p=0.0064) of higher percentage of RBBB for transventricular route. Significant tricuspid regurge "TR" was present in 71% of patients after transatrial correction and in 30% of patients after transventricular correction. There was significant evidence "p=0.0471" that pulmonary regurge was more severe for transventricular route. Significant ventricular arrhythmia "VA" was found in three patients "18%" after transatrial correction and in 55% of patients after transventrricular correction. Transatrial correction of tetralogy of Fallot was less risky than the conventional transventricular correction and associated with lower incidence of ventricular arrhythmia, pulmomary regurge and RBBB.

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Introduction

Transventricular approach to total correction of tetralogy of Fallot "TOF" was first described by Lillehei and associates in 1955(1).

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This conventional method of correction of TOF is associated with increased risk of ventricular arrhythmia "VA", pulmonary regurge PR, RBBB and right ventricular dysfunction (2). Hudspeth, Cordell and Johnston in 1963 suggested a new method of correction of TOF using transatrial transpulmonary route without ventriculotomy or external enlargement of the pulmonary

outflow tract to avoid the complications of transventricular route (3). The conventional right ventriculotomy is associated with significant ventricular arrhythmia "VA"(4). According to an electrophysiologic study of ventricular tachycardia in patients after TOF repair, focus was located in the right ventricle especially around the scar of right ventriculotomy (5). Also the automaticity of the ventricular muscle was reported to increase around the scar of experimentally induced myocardial infarction in cats (6). Pulmonary regurge "PR" is a common complication after total correction of TOF due to insertion of transannular patch or an outflow patch after right ventriculotomy (7) on the other hand, transatrial approach for TOF repair is more likely to result in postoperative tricuspid regurge "TR" than TOF repair through a right ventriculotomy because the tricuspid valve is violated during the procedure (8). RBBB is common after correction of TOF. The production of RBBB has been attributed to right ventriculotomy and VSD closure and the incidence is higher after transventricular correction (9). The documentation of ventricular arrhythmia "VA", pulmonary regurge and RBBB after transventricular repair of TOF led us to present this paper which compares the results of the transatrial approach with those of the conventional transventricular approach.

Patients and methods

From 1970 to 1994, 57 randomly selected patients "36 males" with TOF underwent diagnostic cardiac catheterization at Harefield Hospital and subsequently had surgical repair performed. The medical records were reviewed to confirm diagnosis and all patients had the following before operation: history and complete physical examination, laboratory investigations eg haemoglobin %, chest radiogram, 12 leads electrocardiography ECG, echocardiography and cardiac catheterization. Family history of congenital heart disease was present in three patients, one his father had VSD and two sisters had TOF with Down's syndrome. The age at operation ranged from 50 days to 51 years old and the mean age at operation was 4.86 years "SD=8.37", the mean age at follow up was 11.85 years "SD=10.45" and the mean interval from surgery was 6.98 with "SD=6.99". The angiographic and echocardiographic diagnostic criteria for TOF were large perimembranous outlet ventricular septal defect "VSD" with infundibular pulmonary stenosis which was severe enough to make gradient more than 40 mm Hg in the majority of patients. Fifteen patients were acyanotic at the time of correction, five had Down's syndrome, five had atrial septal defect "ASD", three had patent ductus arteriorsus "PDA". The preoperative haemoglobin was more than 15 gm% in 26 patients. All patients were in sinus rhythm and had evidence of right ventricular hyper-

trophy where tall R wave in V1 was seen in all patients after 12 leads ECG. Thirty six patients had cardiothoracic ratio more than 50% and 29 patients showed evidence of lung oligaemia on routine chest X-ray.

Cardiac surgery

(a) Palliative shunts: 16 patients had previous shunt before total correction, two left Blalock-Taussig shunt "B-T", five right Blalock-Taussig shunt, five modified right B-T shunt and one bilateral B-T shunt, two modified bilateral B-T shunt and one central aortopulmonary shunt.

(b) Total repair was done in all patients where low flow hypothermic cardiopulmonary bypass was used in all patients above the age of one year "37 patients" and 20 patients had deep hypothermia with total circulatory arrest. Transventricular correction was done in 40 patients using conventional long right ventriculotomy while transatrial correction was done in 17 patients. During transatrial approach, VSD was closed through the right atrium and tricuspid valve in all patients with dacron patch and using interrupted stitches with pericardial pledgetts. pulmonary arteriotomy was done in 17 patients i.e. in all patients where myomectomy was done through the pulmonary valve in 11 patients, pulmonary valvotomy was done in six patients. Pulmonary arteriotomy was closed by direct sutures in 13 patients and widened with pericardial patch in four patients. During transventricular correction, VSD was closed by dacron patch and interrupted stitches with pericardial pledgetts, transanannular patch was used in 20 patients where homograft monocusp was used in 19 patients and dura patch in one patient. Right ventricular outflow tract "RVOT" reconstruction was done in 31 patients as follows: pulmonary homograft with dacron patch inferiorly in four patients, pulmonary homograft monocusp in 12 patients, homograft homovital monocusp in three patients, gortex patch in five patients, dacron patch in five patients, and dura patch in two patients. Infundibulectomy was done in 21 patients. Patients were studied in the outpatient clinic as follows: history and complete physical examination, chest X-ray, 12 leads ECG, Doppler echocardiography and 24-hour Holter monitoring.

Doppler echocardiography:

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 right ventricular outflow tract and high left parasternal short axis view. 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 moderate and more than 3 cm , it is severe. Mild regurge is non significant "NS" while moderate and severe

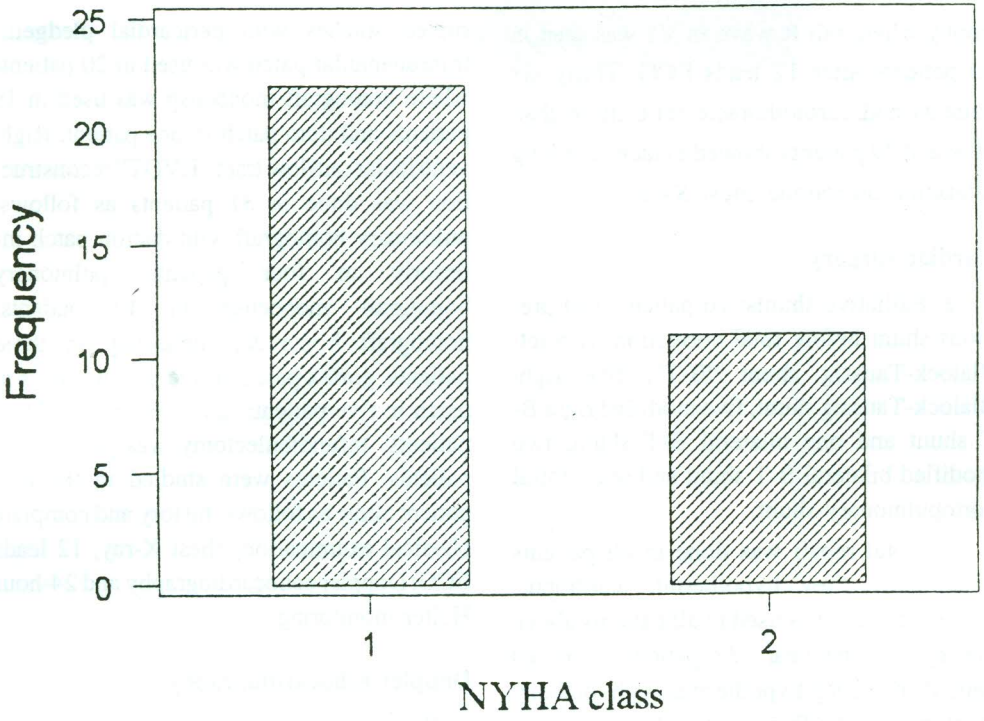

Fig. I: Numbers of patients in NYHA classes

regurge are significant "S".

24-Hour Holter monitoring:

Two channel 24-hour Holter monitoring was performed in all patients with Holter tracker and analysis was performed using Holter analyser pathfinder 3 for detection of arrhythmias. Severity of ventricular arrhythmia :(VA) was classified according to Lown's criteria (10). grade O=no PVCs. grade I= uniform PVCs with a peak hourly count<30, grade II= >30 uniform PVCs in any hour, grade III=couplets or multiform PVCs with a peak hourly count <30, grade IV= couplets or multiform PVCs>30 in any hour and grade V=ventricular tachycardia defined as >3 consecutive PVCs with a mean rate >110/minute. Ventricular arrhythmia was considered significant when>grade II.

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

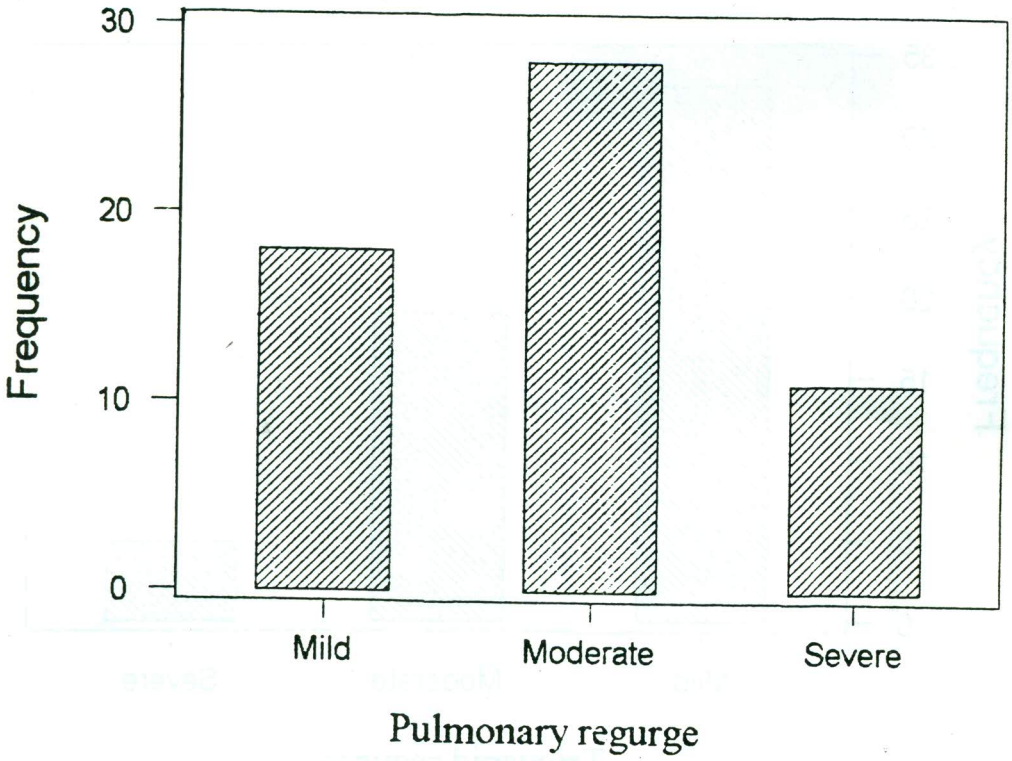

Fig. II: Number of patients with different degrees of pulmonary regurge

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.

Results

Twenty two patients were found in New York Heart Association "NYHA" class I and 11 were in class II (see figure I). Fourteen patients had palpitations and three had history of syncopal attacks. All patients had normal blood pressure, respiratory rate. None had cyanosis, clubbing or signs of heart failure. The majority had signs of pulmonary and tricuspid regurgitations with various degrees of severity. Lungs were clear in all patients. Forty nine patients "86%" had cardiothoracic ratio "CTR" more than 50% and the mean CTR was 55.81% with "SD= 2.26". All patients were in sinus rhythm. Eight patients, 47% with transatrial correction had RBBB on 12 leads ECG while 33 patients (83%)

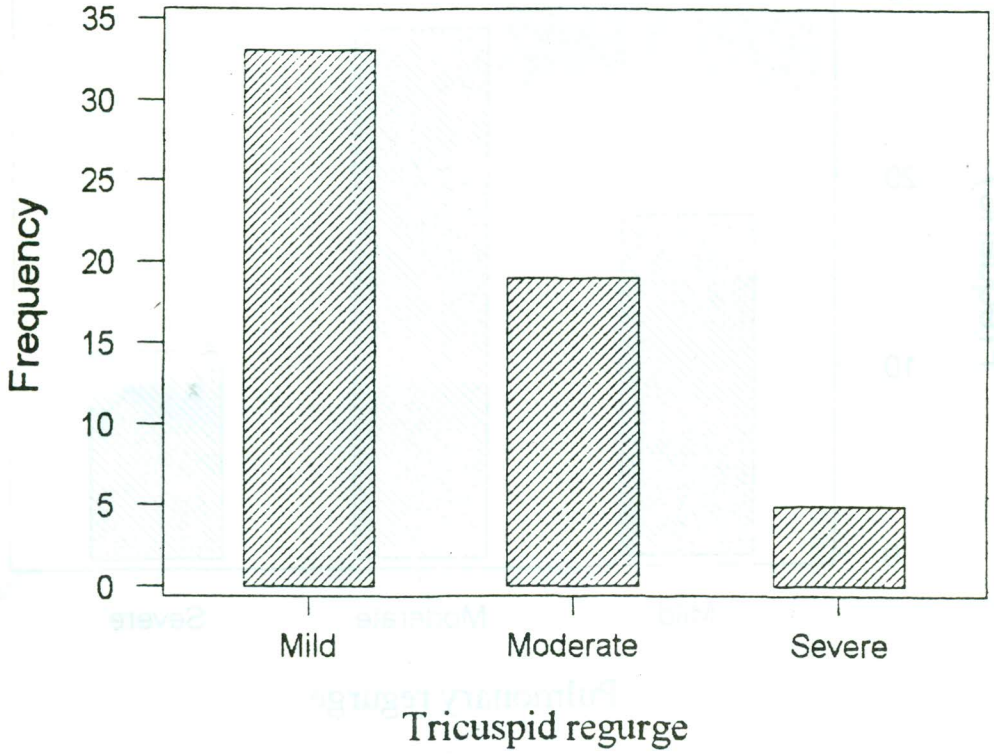

Fig. III: Number of patients with different degrees of tricuspid regurge

had RBBB after transventricular correction. There was significant evidence "p=0.0064" of higher percentage of RBBB for transventricular route (see table IV). Tricuspid regurge "TR" after transatrial correction was mild in five patients (29%), moderate in 11 (65%) and severe in one (6%). While with transventricular correction, TR was mild in 28 patients (70%), moderate in eight (20%) and severe in four (10%). There was significant evidence (p=0.0174) that TR was more severe for transatrial route of correction (see table I).

Pulmonary regurge "PR" after transatrial correction was mild in eight patients (47%), moderate in eight (47%) and severe in one (6%). While with transventricular correction PR was mild in ten patients (25%) moderate in 20 (50%) & severe in 10 (25%). there was signfilcant evidence (p=0.0471) that PR was more severe for transventricular route of correction (see table II). Non significant ventricular arrhythmia "VA" was found in 14 patients (82%), while significant VA was found in three (18%) after transatrial correc-

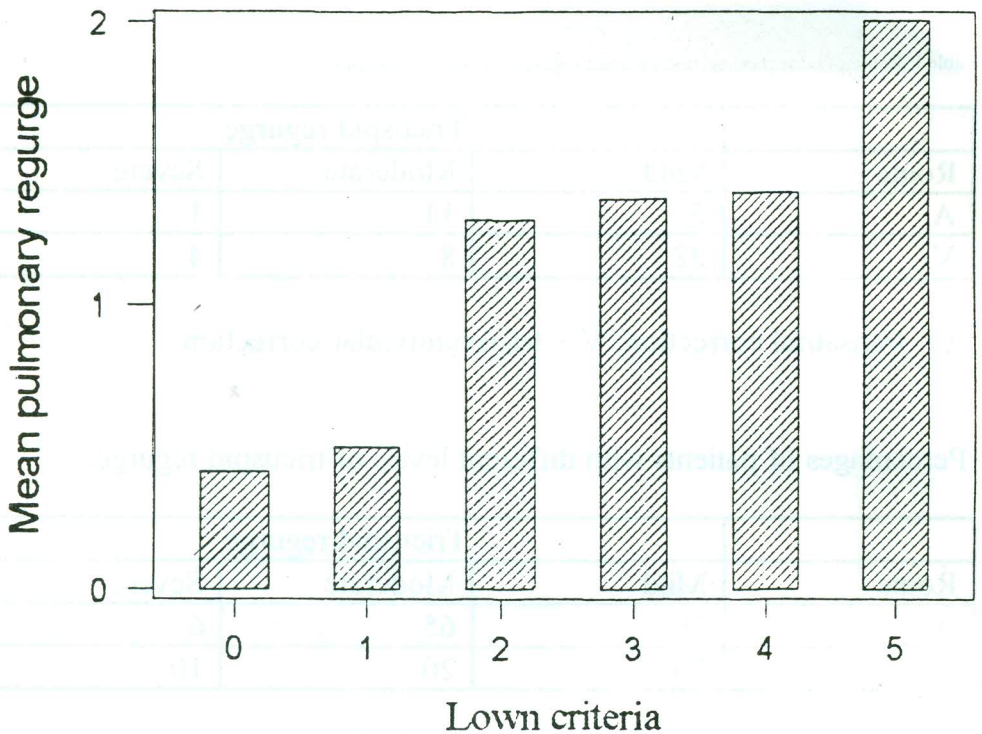

Fig. IV: Mean Pulmonary Regurge v Lown Criteria

tion. While after transventricular correction, non significant VA was found in 18 patients (45%) and significant VA in 22 (55%). There was significant evidence (p=0.0159) that VA was higher with transventricular correction (see table III).

Discussion

Although transventricular approach gives better exposure and its extensive applications have proved its efficacy (11), but it is associated with various complications e.g. pulmonary regurge, RBBB and higher incidence of ventricular arrhythmia (2,12). On the other hand, although transatrial approach is time consuming, technically difficult and not possible when there is severe long infundibular stenosis (9,13) but it allows correction of TOF without the conventional right ventriculotomy and its complications (3). Pulmonary regurge is a common complication after TOF repair due to insertion of an outflow patch or transannular patch (2). Nearly all

Table I: Route of correction against tricuspid regurge: numbers of patients

	Tricuspid regurge		
Route	Mild	Moderate	Severe
A	5	11	1
V	28	8	4

A = transatrial correction; V = transventricular correction

Percentages of patients with different levels of tricuspid regurge.

	Tricuspid regurge		
Route	Mild	Moderate	Severe
A	29	65	6
V	70	20	10

A = transatrial correction; V = transventricular correction

There is significant evidence (p=0.0174) that tricuspid regurge is more severe for route A (using a Mann-Whitney U test)

patients in our study, with transventricular route, had transannular patch, outflow patch or transannular outflow patch, so, we have high incidence of pulmonary regurge "75%" after transventricular correction like others (2) and also we have significant evidence that pulmonary regurge was more severe for transventricular technique. None of our patients, with transatrial correction, needed transannular patch during correction but pulmonary valvotomy was done in six patients through pulmonary arteriotomy, so, pulmonary regurge which occurred after transatrial correction in eight of our patients was due to pulmonary valvotomy. we believe and others (8) that transatrial correction of TOF is better than the classical transventricular route for more preservation of pulmonary valve annulus. Transatrial approach for VSD closure is more likely to result in postoperative tricuspid regurge "TR" than VSD closure through right ventriculotomy because the tricuspid valve is violated during the procedure (8). In our study 12 patients (71%) after transatrial correction had significant TR while 12 patients

Table II: Route of correction pulmonary regurge: numbers of patients

	Pulmonary regurge		
Route	Mild	Moderate	Severe
A	8	8	1
V	10	20	10

Percentages of patients with different levels of pulmonary regurge.

	Pulmonary regurge		
Route	Mild	Moderate	Severe
A	47	47	6
V	25	50	25

A = transatrial correction; V = transventricular correction

There is significant evidence (p=0.0471) that pulmonary regurge is more severe for route V (using a Mann-Whitney U test)

only "30%" after transventricular correction had significant TR. Kobayashi et al (8) reported significant TR in 19% of his patients which is relatively low in relation to our result "71%", this is because all of our patients had VSD closure through tricuspid valve but Kobayashi divided his patients into two groups, in one group VSD was closed through tricuspid valve and in another group VSD was closed via main pulmonary artery and minimal right ventriculotomy and it is obvious that tricuspid valve is not violated during the use of transpulmonary route with minimal right ventriculotomy. RBBB is a common complication after repair of TOF and reports in the literature on the cause of postoperative RBBB are conflicting (12). Some authors believe that ventriculotomy alone is responsible due to interruption of right ventricular subendocardial Purkinjie network (15). Others believe that RBBB is due to injury to the proximal main right bundle branch which is intimately related to the postero-inferior portion of the VSD (16). Horowitz et al (16) assume that infundibular resection transects the peripheral conduction

Table III: Route of Holter and Lown's criterion: numbers of patients

	Holter and Lown's criteria					
Route	0	1	2	3	4	5
A	6	8	0	3	0	0
V	6	12	10	5	5	2

Percentages of patients with different levels of Holter and Lown's criterion.

	Holter and Lown's criterion					
Route	0	1	2	3	4	5
A	35	47	0	18	0	0
V	15	30	25	12	12	5

A = transatrial correction, V = transventricular correction

There is significant evidence (p=0.0159) that Holter and Lown's criterion is higher for route V (using a Mann- Whitney U test)

system in a location similar to that of a right ventriculotomy. The incidence of RBBB after transventricular route in our study is 83% and higher than the incidence reported by okoroma et al (17) which is 60%. This may be attributed to the type of ventriculotomy, method of VSD closure and infundibular resection, as the majority of our patients had vertical right ventriculotomy, none of them had direct VSD closure and 32 of our patients 80% had infundibular resection while patients of Okoroma had transverse right ventriculotomy, five of his patients had direct VSD closure without patch and the number of patients who had infundibular resection is lower than the number of our study. It was reported that vertical right ventriculotomy (15), patch VSD closure (17), and infundibular resection (16) had increased the incidence of RBBB. However, our incidence of RBBB was lower than the incidence of Gelband et al (14) who found that the incidence of RBBB after transventricular route was 100%. RBBB after transatrial correction in our study is 47% which is similar to the result of others (17) and it is mostly due to

Table IV: Route of correction Holter and Lown's criterion: numbers of patients

	RBBB	
Route	No	Yes
A	9	8
V	7	33

Percentages of patients without and with RBBB.

	RBBB	
Route	No	Yes
A	53	47
V	17	83

A = transatrial correction; V = transventricular correction

There is significant evidence (p=0.0064) of higher percentage for route V (using a Mann- Whitney U test)

injury of right ventricular Purkinjie network during infundibular resection and/or injury to thr proximal right bundle branch during VSD closure. On the other hand our results differ from the results of Kawashima et al (9) as they found the frequency with which RBBB developed did not differ significantly with the use of transatrial route of correction, but in our study, there is significant evidence of higher percentage of RBBB for transventricular route. Postoperative ventricular arrhythmia "VA" occured during ambulatory Holter monitoring in 20 to 40% of patients after transventricular correction of TOF and was considered responsible for the problem of sudden death occuring late after TOF repair (18). According to an electrophysiologic study, the site of origin of ventricular arrhythmias was in the subendocardium of the right ventricular outflow tract & the ventricular scar was believed to provide a barrier around which the tachycardia could circulate (18). In another study, ventriculotomy may be the site of macroreentry circuits (5). In our study we found 22 patients "54%" had significant VA after

transventricular correction, this incidence is slightly higher than the incidence in the literature which is 20-40% (10). We think that this higher incidence may be attributed to higher incidence of significant pulmonary regurge among our patients after transventricular correction. We and others (2) found significant evidence that VA is higher with increased severity of pulmonary regurge (see figure IV). Significant pulmonary regurge may lead to longstanding elevated right ventricular systolic pressure which causes myocardial degeneration and fibrosis with subsequent VA. Our study also showed that there is significant evidence that VA is higher for transventricular route and this confirms the results of others (9).

Conclusion

1. Transatrial correction of TOF is less risky than conventional transventricular correction and associated with lower incidence of ventricular arrhythmia, pulmonary regurge and RBBB.

2. We recommend the use of transatrial correction of TOF as a successful method of correction as long as there is no contraindication for its use.

3. We suspect marked reduction of the problem of late sudden death after TOF repair, in the future, due to increased application of transatrial correction in the meantime.

4. Further studies will be needed to determine the incidence of late sudden death among patients corrected transatrially.

Acknowledgement:

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Late Results of Mitral Valve Repair

Abstract

Between 1990 and 1993, 150 patients underwent mitral valve repair in El Hussein University and National Heart Institute. Fifty patients out of those 150 were carefully followed up for a period of 2-4 years postoperative. Age was 7-22 years, 34 were females and 16 were males.

The valve lesions were 38 pure mitral regurge and 12 regurge + stenosis. Late result were classified into:

a) Good results (non to mild M.R.) about 70% in patients with pure M.R. and about 60% in patients with mixed lesions.

b) Satisfactory (Moderate M.R.) 30% in patients with pure M.R. and 40% in patients with mixed lesion. Causes of recurrence were found to be:

1. Residual M.R.

2. Recurrent M.R.

3. Recurrent M.S.

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Introduction

Since the clinical introduction of cardiac valve prothesis in 1960, valve replacement has succeded in saving the lives of hunderds of thousands of patients affected by rheumatic and non-rheumatic lesions. However, when the consequence of prosthetic mitral valve replacement were soon dealt with, it became evident that valve replacement is simply exchanging one disease with another. Consequently, the concept of preservation of mitral valve, whenever possible, has gained popularity.

The late results of mitral valve reconstruction depend upon several factors:

(1) The pathology of the valve: Mitral valvuloplasty is known to be least effective in rheumatic valves, not only does rheumatic carditis affect all components of the mitral valve apparatus, but it also involves other valves especially the tricusped and the aortic as well as the myocardium. Patients often require surgery during the active phase of

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the disease or in the resolution period when the healing process of the valve is not stablished sufficiently to guarantee a durable repair (7).

(2) The severity of valve lesion: it is well known that isolated mitral regurgitation has best results of repair than in combined regurgitation and stenosis or calcification.

(3) State of left ventricle particularly in mitral regurgitation because severe myocardial dysfunction often persists or even worsens after surgery (1,6,8).

(4) Other patients related factors which affect the results of mitral valve repair are NYHA functional class, the size of left atrium and atrial fibrillation. Early correction after the onset of atrial fibrillation is more likely to be followed by successful results (8).

(5) The perfection of the technique.

Patients and methods

Fifty patients with rheumatic valve disease were operated upon for mitral reconstruction in the period between Jan. 1990 and Dec. 1993.

Age was ranging between 7-22 years with mean age 15 years with 34 females and 16 males. The lesion was pure mitral regurge in 38(76%) and mitral regurgitation and stenosis in 12 patients (24%). Twelve patient (24%) presented an associated functional tricuspid insufficiency.

Preoperative findings:

No patients was in NYHA functional class I. Twenty- two patients (44%) were in functional class II-III and 28 (56%) were in functional class III to IV.

Twenty eight patients (56%) were in sinus rhythm whereas 22 (44%) were in atrial fibrillation. The mean cardio-thoracic ratio was 0.70±0.07.

Intraoperative findings:

(1) Annular dilatation: was found in all cases (100%) of pure mitral regurgitation but was the only lesion in 13.4% only. While it was found in only 66.6% of patients with mixed lesions.

(2) Chordal elongation: was found in 86.6% of patients with pure M.R. and in 33% of patients with Mixed lesion. Rupture chordae was found in only 0.5% of patients with pure M.R.

(3) Fused chordae: Was found in 75% of patients with mixed lesion.

(4) Cusps: Was thickened in 25% of patients with mixed lesions. Fused commissures was found in all patients with mixed lesion but only in 5.2% in patients with pure M.R.

Technique

Carpantier ring was inplanted in all patients with pure M.R. and in 60% of patients with mixed lesions.

Chordal shortening was performed in 86.6% of patients either in one of the two

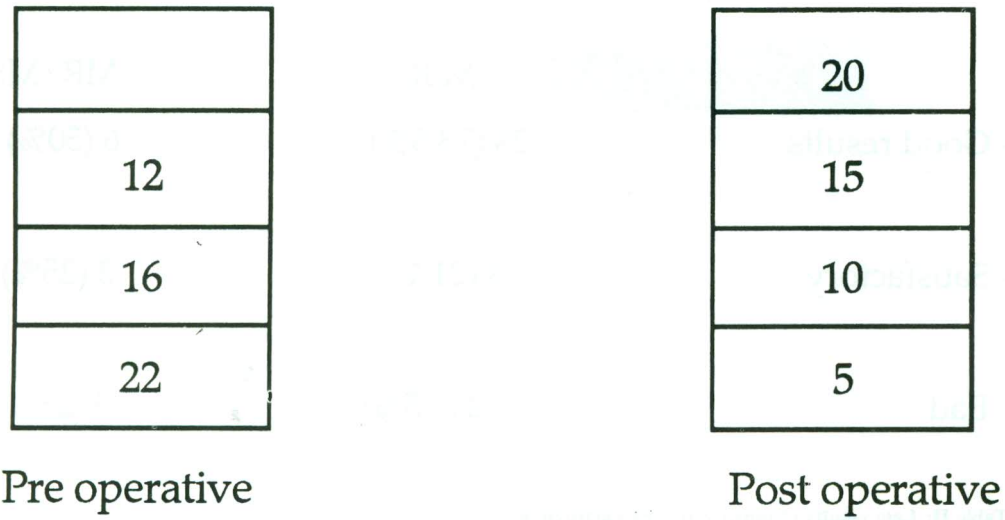

Fig. 1: Pre and post operative status of trhe patients (NUHA classification)

-	Isolatated M.R.	MR/MS
- Annular dilation	38 (100%) (The only lesion) (13.4%)	(8 (66.6%)
- Chordal elongation	33 (86.6%)	4 (33.3%)
- Fused chordae	-	9 (75%)
- Thickened Cusps	-	9 (75%)
- Fused Commissures	2 (5.2%)	12 (100%)

Table I: Intra operative findings

groups of chordae. Chordal transplatation was done in 0.5% of patients with M.R.

Commissurotomy was performed in all patients with mixed lesions (100%) fenestration of chordae and resection of secondary and basal chordae was performed in 75% of patients with mixed lesion.

Tricusped repair with Devega annulaplasty technique was done in 24% of patients.

All patients received oral anticoagulation after surgery. Anticoagulation was discontinued after 2 months if sinus rhythm was present. The use was indefinite in patients with atrial fibrillation.

	M.R.	MR/MS
– Good results	28 (73.5%)	6 (50%)
– Satisfactory	8 (21%)	3 (25%)
– Bad	2 (5.5%)	3 (25%)

Table II: Late results of mitral valve reconstruction

- Residual mitral incompetence	3
- Slipped suture	1
- Detachement of prosthetic ring	1

Table III: Causes of reoperation

Results

Those 50 patients were subjected to strict follow up by clinical examination monthly for the first 6 months. Then every 6 months and for echocardiographic examination every 6 months or earlier if there is any haemodynamic problems for at least 2 years.

The results were classified as:

(1) Good results:

With non to mild M.R. in 73.5% of the group of patients with pure M.R. and 50% in patients with mixed lesion and 70% in all of our patients.

(2) Satisfactory:

With mild to moderate M.R. 21% in patient with pure M.R. and 25% in patient with mixed lesion.

(3) Bad:

With severe M.R. or severe restenosis affecting the haemodynamics of the patients. It was 5.5% in patient with pure M.R. and tricusped valve lesion and patients with mixed lesion 25%.

Valve failure was related to the complexity

of the procedure. It was found to be about 30% in patients with fenestration of the chordae, commissurotomy and shortening to the chordae whereas it is 20% in patients with shortening to the chordae and ring application and 18% for the patients with ring application only.

Clinical state:

Of 22 patients in NYHA classification II, III., 11 were retunred to class I and 9 of 28 in class III to IV did so. Class II to III included 15 patients and class III 10 patient and class IV had 5 patients who were in need to re-operations for severe M.R. and T.R.

Discussion

Controversy remains as to the predictability of the techniques and the stability of the results in valve reconstruction. Mitral valve reconstruction has a striking superiority in children and young females to avoid use of oral anticoagulants (3,5,9).

The break through in reconstructive mitral valve surgery was the recognition that mitral insufficiency is a result of multiple lesions which affect the various components of the mitral apparatus. Therefore reconstructive operations should utilize several techniques directed towards the various lesions, otherwise residual mitral insufficiency will results (2).

In our series, follow up for about 2-3 years showed that 5 of our cases 10% of our cases needed to be reoperated. In three of them reoperation was needed to correct severe mitral incompetence and in one of them for additional tricuspid regurgitation, although the valves were apparently satisfactory when tested during the first operation. All of these patients, were in group of mixed lesion with severe restricted leaflet motion and dilatation of the annulus. In the other two patients the cause was avoidable technical faults in the first operation and was recognised in the second operation. One of them was due to ring dehisence due to weak sutures in the posterior annulus, the other was due to slipped suture of the chordal shortening resulting in re-elongation of the antero lateral group of chordae and severe mitral regurgitation due to restricted leaflet motion. After many trials to reconstruct the valve residual mitral regurgitation was accepted during the first operation. Later on the regurgitation was increased and affected the patient's haemodynamics. So, those three patients needed to be reoperated for mitral valve replacement. This will prove that, if the result is not satisfactory during the valve reconstruction, one should not hesitate to remove the valve. By eliminating improper evaluation of the lesions, technical errors, and unsatisfactory repairs failure rate should drop to 1% per year (3).

The other two cases needed to be reoperated. In one of them mitral insufficiency was due to ring dehesince and in the second operation the ring was refixed and we obtained a very good result. In the second case re-shortening of re-elongated chordae gave a good result.

So, The outcome of operations of mitral valve reconstruction depends upon:

- The experience of the surgeon who should be prepared psychologically and technically to perform valve repair, but he is ready at the same time to replace the valve if the result of repair is not satisfactory during the operation.

- Patient Selection: Primary indication, this group of patients comprises the lesions which can be treated easily safely by reconstructive techniques, mainly annular dilatation, for ring implantation and leaflet resection suture. A residual murmur of no haemodynamic significance may be present following annulus remodelling in mitral incompetence associated with a very large ventricle caused by excessive tension on the chordae. This murmur usually disappears after the heart has returned to normal size.

- Relative indication: This group comprises complicated lesions requiring complex techniques or multiple lesions requiring a combination of techniques.

- Contraindications: With exception of extensively calcific valves and markedly fibrotic valve, all mitral valve lesions were initially treated by conservative technique but with poorer late results than the simpler valve lesions (3).

The incidence of reoperation should be reduced further in the future by better selection of the patients. The additional effort by the surgeons to aquire the necessary experience will be rewarded by a superior quality of life for the patient.

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Pregnancy Outcome in Patients with Cardiac Valve Prostheses

Abstract

Fifteen women with prosthetic cardiac valves were studied during 16 pregnancies, Warfarin was the oral anticoagulant used during pregnancy that was replaced by heparin or its derivatives after the first missed period till the end of the first trimester, and from the 36-38 th week gestation till delivery. The obstetrical outcome was one abortion, two were still born, one had congenital cataract and one baby was premature.

One patient had antepartum hemorrhage that was managed by section, while two patients had post-partum hemorrhage that was managed conservatively.

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Introduction

Management of anticoagulants during pregnancy remains controversial. The first successful pregnancy in a patient with a prosthetic heart valve was reported by Confield et al, in 1958 [1]. Oral anticoagulants considerably increase the risk to the fetus, but its omission increases the danger of systemic embolization to the mother [2]. Oral anticoagulants result in an increased incidence in fetal death and birth defects whereas heparin results in an increased incidence of maternal hemorrhage [3].

In the present study, the maternal and fetal sequelae of anticoagulants during pregnancy in 15 patients with artificial heart valves during a total of 16 pregnancies were discussed.

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Patients and Methods

Out of 93 female patients who were operated upon by replacing one or more of their cardiac valves with a mechanical prosthesis at Kasr El-Aini Hospital during the period from January 1993 to December 1994, fifteen women with 16 prosthetic cardiac valves had a total of 16 pregnancies were observed in the surgical out patient clinic and their obstetrical performance was followed in the department of Obstetrics and Gynaecology.

Among the study group: Tweleve had mitral valve replacement, two had aortic valve replacement and one had mitral and aortic replacement. Eleven valves were Sorin and five were Carbomedics.

Their ages ranged between 20-35 years. At the time of study 9 were nulligravida while 6 were having children. Our anticoagulation protocol was as follows: After the first missed

menstrual period and when pregnancy became certain, warfarin was stopped and replaced by calciparine subcutaneously 2-3 times daily according to the clotting time till the end of the first trimester, after that oral warfarin was started till the 36-38 weeks gestation when they were admitted to the hospital and heparin 5000 IU/IV every 6 hours was given and continued till the onset of labour. Oral warfarin was resumed from the second day after labour. Most patients received digoxin and diuretics together with salt restriction during the whole period of pregnancy. All patients had spontaneous onset of labour. Morphia was given during the first stage of labour. Outlet forceps and midline episiotomy were done in most patients to shorten the second stage. Oxygen by mask was given to avoid hypoxia. Prophylactic antibiotics (ampicillin & garamycin) were given to all patients for 5 days.

* Maternal out come: There were no maternal deaths nor thromboembolic complications in association with prgnancy. One patient had antepartum hemorrhage at 36 weeks gestation and was managed by Caesarian section. Two patients had post partum hemorrhage that was managed conservatively.

* Fetal outcome: One patient had spontaneous abortion during the 8th week, but she had another pregnancy 6 months later. Two fetuses were still born (12.5%). Warfarin embryopathy was manifested in a baby who was born with congenital cataract (6.25%). One baby was prematurely deliverd at 36 weeks by section.

Discussion

The management of the pregnant female with valve prosthesis is controversial [4]. Oral anticoagulants, unlike heparin cross the placenta and may damage the fetus. During the first trimester, oral anticoagulaunts may cause Warfarin embryopathy [5]. Oral anticoagulants especially Warfarin were responsible for 35% spontaneous abortions in excess than normal population and also 10% perinatal mortaility in excess. Significant hemorrhage was present in only one third of these cases of perinatal mortality while the remaining deaths were unexplained [6].

In this study Warfarin was the oral anticoagulant used during pregnancy. The total fetal loss out of 16 pregnancies was one spontaneous abortion, and two were stillborn (18.75%). Further more one baby was born prematurely by Caesarian Section indicated by the occurrence of antepartum hemorrhage due to retro-placental hemorrhage at 36th week gestation, while another baby had congenital cataract.

Similar results were mentioned by Abdallah et al. [7] who reported a total fetal loss of 18.2% in his series of 12 pregnancies using phenindione as an oral anticoagulant that was replaced by I.V. heparin after 36-38 weeks gestation.

However, our results are still better than that mentioned by Hilary et al. [8] who reported 12 patients with prosthetic heart valves who were treated during 18 pregnancies with

Warfarin. One baby had Warfarin embryopathy. Six pregnancies ended in spontaneous abortions and there were two intra uterine-deaths accounting for a total fetal loss of 47%.

Sareli et al. [9] in his study that involved 50 pregnancies in 49 women who were all given warfarin during the first and second trimesters reported a frank coumarin embryopathy in 4% and fetal wastage of 36%.

Heparin is considered the safest anticoagulant during pregnancy as it does not cross the placental barrier [10]. However heparin is commonly inconvenient, as intravenous injections for long time is untolerable to many patients. Furthermore the problem of continuous monitoring and adjustment of the dose is unanswered yet [7]. Again, Howell et al. [11] recorded serious bone demineralization if more than 15000 IU of heparin are given daily for more than 6 months. Because of this many investigators (10,12) suggested to limit its administration to the first trimester to avoid the teratogenic potentiality of oral anticoagulants and after the 36 weeks to avoid the possibility of neonatal bleeding considering that the effects of oral anticoagulants on the fetus may last for up to 14 days after the drug is discontinued. However, the relatively high incidence of fetal loss reported in our study inspite of using heparin or its derivatives after the first missed period and later at the 36-38th week gestation may be due to the fact that shifting from oral warfarin to heparin after the first missed period is probably too late especially among non educated women of low socioeconomic status who usually present late to seek medical advice. By that time the congenital anomaly has already been established.

Pregnancy was well tolerated by our patients. All of them were hemodynamically stable during pregnancy. The main maternal problem was uterine bleeding. Antepartum hemorrhage in one patient was managed by Caesarian Section, and postpartum hemorrhage in two patients was successfully managed by conservative measures.

It is concluded that safe pregnancy in women with artifical heart valves is not an impossible dream. With strict medical supervision and careful instruction of these patients the maternal and fetal hazards of anticoagulants during pregnancy can be reduced to a minimum.

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Closure of Patent Ductus Arteriosus in Premature Infants, Early Experience

Abstract

Patent ductus arteriosus (PDA) in the premature infant has special features and requires different management than in the full term infant. During a 6 month period ending May 1995, 10 premature infants underwent surgical closure of PDA. The mean gestational age at birth was 28.6±2.6 weeks and the mean age at the time of operation was 26.3±13.6 days. The mean weight at the time of surgery was 1093±452 gms. Indomethacin therapy was not tried in infants below 1 Kg (6 cases), failed in 3 cases and was contraindicated in one case. All the cases were done through a limited left lateral thoracotomy and the ductus was closed using medium sized hemoclips. All the cases tolerated the procedure well and there was no mortality and no surgically related morbidity.

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J. of Egypt Soc. of. Cardiothorac. Surg. 1996 Vol. IV, January, No 1

Introduction

PDA is the persistence in post-natal life of the normal fetal vascular conduit that connects the central pulmonary and systemic arterial systems. In the mature infant it accounts for 7% of all congenital heart defects(1). PDA in the premature infant deserves special comment. With advancing fetal maturity, the vasoconstricting effect of oxygen on the ductus becomes more prominent, and the dilating effect of prostaglandins becomes less effective in preparing for duct closure after birth. This explains why PDA is much more common in premature infants(2). It has been estimated that the ductus is patent in as many as 45% of infants with birth weights less than 1750 gms and 80% with birth weights less than 1200 gms(3).

In addition to exacerbating underlying parenchymal disease of the lungs, the hemodynamic consequences of a PDA may also promote renal failure, induce intestinal ischemia, promote intracerebral problems and affect the function of respiratory muscles(4). Chronic lung disease (bronchopulmonary dysplasia) commonly develops in premature patients treated with aggressive ventilator support for a combination of primary lung disease and PDA.

The diagnosis of PDA in premature baby

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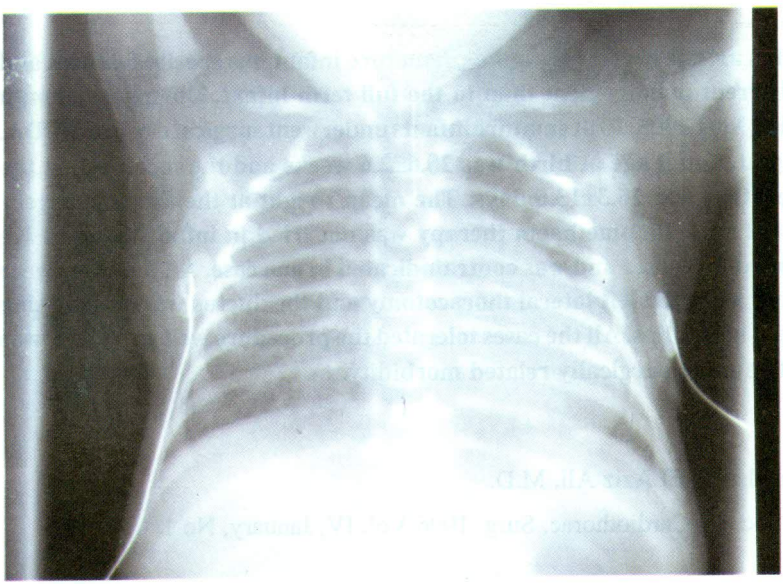


Fig. 1. Preoperative chest X-ray showing cardiomegally and severe pulmonary congestion (patient is intubated).

is often suggested by physical examination revealing a wide pulse pressure and a systolic murmur that may extend into diastole. Echocardiography can reliably document the patency of ductus(3).

In premature infants, early closure of PDA has been shown to be beneficial, therefore aggressive intervention (initially pharmacologic with indomethacin, if no contraindications are present) is indicated as soon as the diagnosis is made.

Material and methods

Over a 6 month period ending May 1995 among a total of 3420 live births at Al Wasl Hospital for maternity and children in Dubai, United Arab Emirates, there were 161 premature infants. Among those preterm infants 26 were having PDA (16%), out of them 16 showed spontaneous closure or were cured with indomethacin therapy. The remaining 10 were closed surgically. The diagnosis of PDA was established on the typical murmur, wide pulse pressure, cardiomegally and evidence of excess pulmonary blood flow by radiographic examinations. (Figures 1,2) Echocardiographic confirmation was obtained in all cases .

The mean gestational age at birth was 28.6±2.6 weeks (range 26 to 32 weeks) and the mean age at the time of operation was 26.3±13.7 days (range 15 to 62 days). The

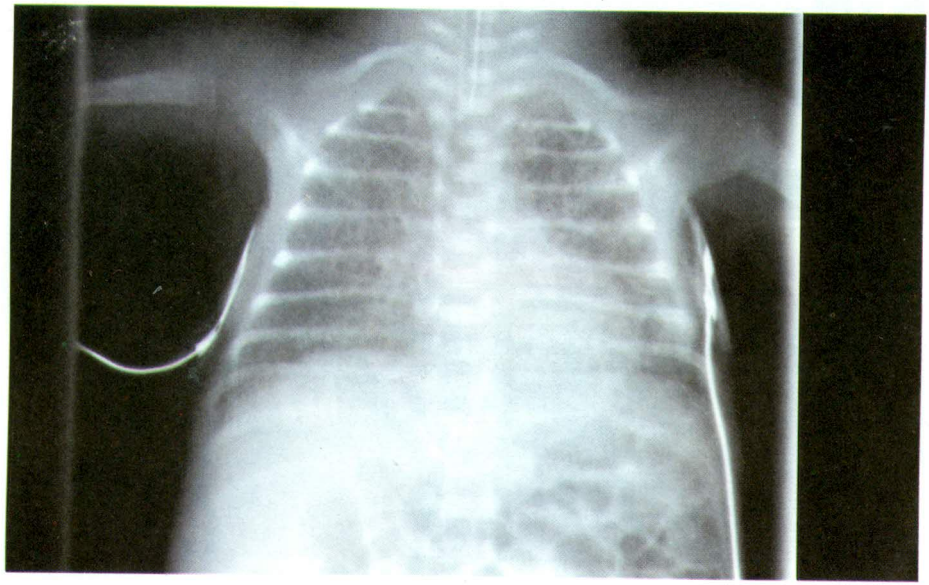


Fig 2: Preoperative chest X-ray showing marked cardiomegally (patient is intubated).

mean weight at the time of birth was 978±274 gms (range 670 to 1420 gms). The mean weight at the time of operation was 1093±453 (range 665 to 2110 gms). The indication for surgical closure consisted of a PDA in a premature infant who either remained ventilator dependent, or remained in congestive heart failure despite medical management and showed a left to right shunt on echocardiograms.

Indomethacin was not tried in 6 patients whose weight was below 1000 gms. In one case its use was contraindicated due to progressive rise in the level of urea and creatinine. In 3 cases the course was discontinued because of rising urea level in one case and gasterointestinal bleeding in two cases.

All operations were performed in the operation room. Infants were taken to the operation room in a special transport incubator (Figure 3) and then transferred carefully to the standard operating table. The ambient operating room temperature was preset at 28°C. In addition overhead heater and a warming mattress were used routinely. Monitoring consisted of ECG, non invasive blood pressure, rectal temperature and pulse oxymetry in the lower limb. Anaesthesia was conducted using phentanyl, pavulon and air oxygen mixture.

The infant is positioned on the right side and a short (about one inch) left lateral thorac-

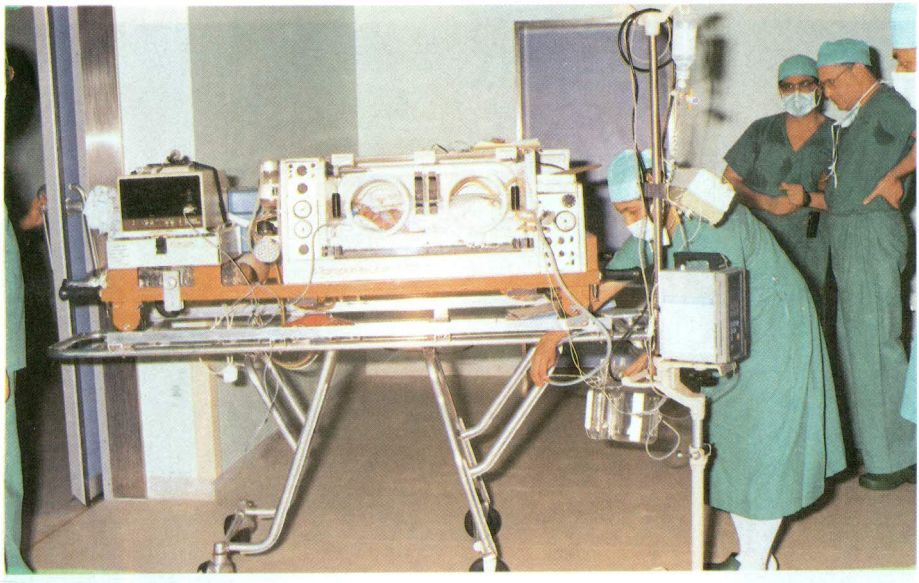


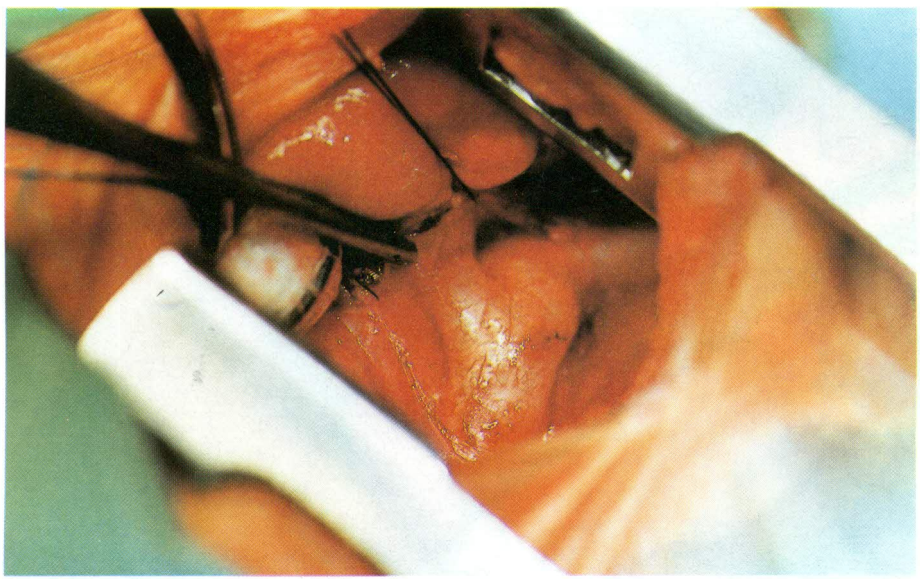
Fig. 3: Infant in the transport incubator.

tomy was done dividing the latissimus dorsi muscle and retracting the serratus anterior muscle anteriorly to enter the chest through the fourth intercostal space. The lung is retracted anteriorly and downwards, very gently by the assistant using a tiny swab on an artery forceps.

The mediastinal pleura over the descending thoracic aorta is incised and a small area on both the upper and lower margins of the ductus is dissected (Figure 4) and two medium hemoclips were applied (Figure 5). Then the lung is allowed to inflate, pleura is left open and an intercostal tube size 10 or 12 is inserted and connected to an under water seal. Then ribs were approximated with a single suture. The soft tissues were closed in 2 layers with running sutures. Transport back to the Special Baby Care Unit is carried out in the same way. After a chest radiograph in the same day or next morning and with full lung expansion the chest tube was removed.

Ressults

The duration of the operation from the time of incision to the completion of skin closure was in the range of 35 to 45 minutes. Blood loss was minimal and there were no intraoperative complications. All cases had their pleural catheters removed before 24 hours. There were no morbidity or mortality



Fiig. 4: Operative field with huge ductus well displayed.

related directly to the operative procedure.

Four infants who had congestive heart failure before the operation improved and it was possible to stop the antifailure medications in a period ranging from 3 to 9 days. The infant who had had impending renal failure before the operation had his urea and creatinine back to normal. It was possible to wean all the cases from mechanical ventilation within a mean time of 7.2±6.5 days (range, 1 to 23 day). The 5 cases who required postoperative ventilation for more than a week were associated with bronchopulmonary dysplasia. Figures 6&7 show the postoperative chest X-rays of two cases whose preoperative chest X-rays were shown in figures 1&2 respectively. These show the reduction in cardiac size as well as the improvement in pulmonary congestion.

Although in 5 of our cases preoperative brain ultrasonography showed intraventricular hemorrhage, the pre-discharge scan showed that it was stationary and there was no clinical neurological deficit in any of our patients.

Discussion

With increasing advances in neonatal intensive care, survival rates for extremely premature, very low birth weight infants have been improved. In our series 4.7% of the total live births were prematures. Instead of a 7% incidence of PDA among those who are born

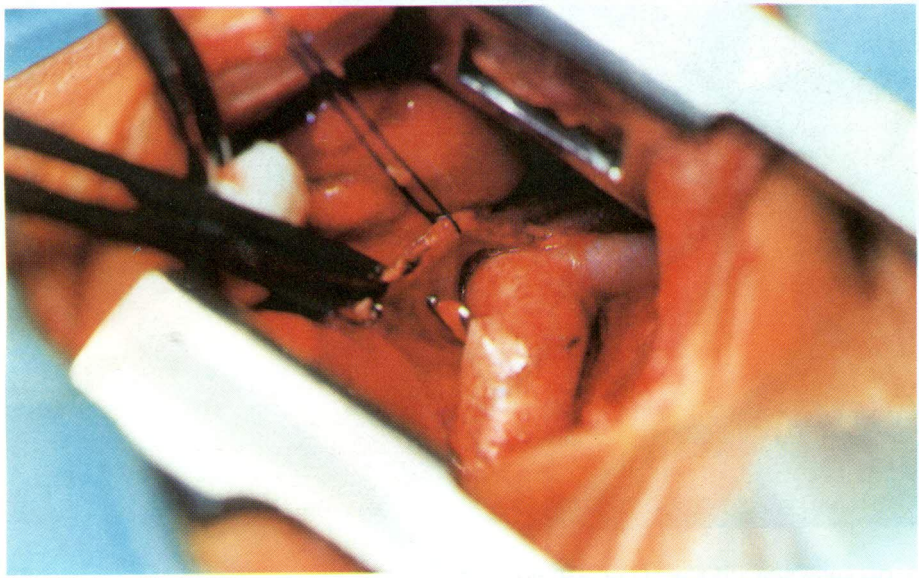


Fig 5: Ductus after application of 2 hemoclips.

with congenital heart defect(1), the incidence in the premature is much higher(3). In this series it was 16% of the premature population.

PDA in neonates weighing less than 1200 gms present a bronchopulmonary failure resistant to mechanical ventilation(5). The degree of left to right shunting varies as does its clinical impact, consequently this shunt could have a serious clinical impact with tachycardia, tachypnea needing prolonged ventilatory assistance. Early ligation has the potential benefit of reducing barotrauma due to positive pressure ventilation(6). The fact that PDA in the premature can promote renal failure and intracerebral problems(4) was evident in our series.

Standard therapy for PDA includes fluid restriction, diuretics and the prostaglandin-inhibitor indomethacin, with surgical ligation reserved for medical failures(7). Failure of ductal closure with indomethacin is reported between 30% to 40%, with higher failure rates in infants weighing less than 1000 gm(7). It is because of this fact that our neonatologists do not even try it in the 6 cases who were under 1000 gms and referred these cases directly to surgery . This is also supported by others who believe that even below 1500 gms indomethacin will delay the operation and affect the prognosis(6). Of the various complications described with indomethacin therapy we got one case of renal impairment and two of gastero-intestinal

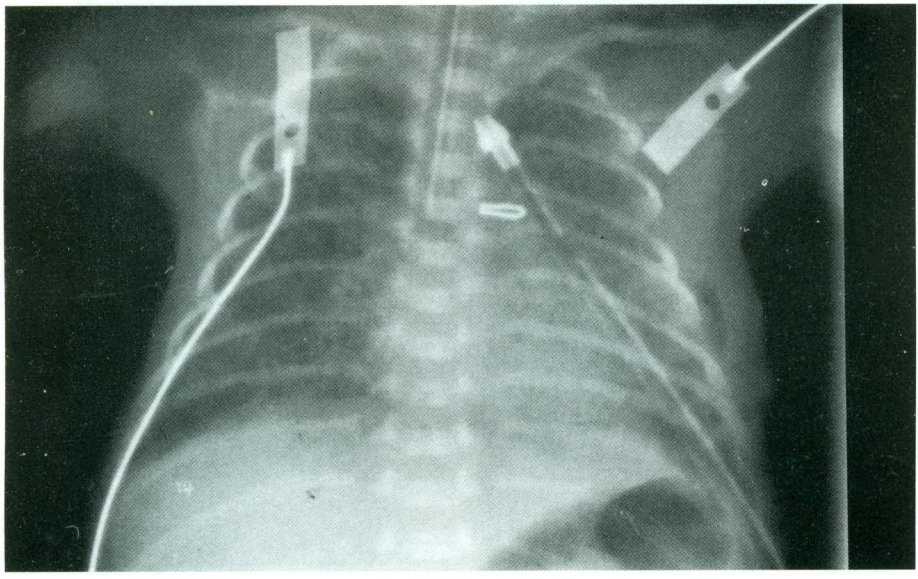


Fig. 6: Postoperative chest X-ray showing clips at the site of the ductus, reduction in cardiac size and improved pulmonary vascularity as compared to figure(1)

bleeding. Other complications include thrombocytopenia, bleeding dyscrasias and hyperbilirubinemia(7).

Conversely surgical closure of PDA has been shown to be relatively safe, with low morbidity and even no mortality in premature infants(6,8). Surgical closure is a major procedure, and transporting a sick premature infant to the operating theatre may be stressful. For this reason some advocate performing the surgery in the neonatal intensive care in an open incubator(6). The transport incubator that we used to carry our patients to the operating theatre was very convenient and we had no problem in transport.

We advocate clip closure versus suture ligation. The use of hemoclips is associated with minimal dissection(4), decreased risk of bleeding, and rapid duct occlusion with minimal pulmonary manipulations. The entire procedure usually takes less than 40 minutes, this technique is simple, rapid and reliable. In our experience there was no bleeding problems and no evidence of post-operative ductal patency in consistence with other authors experiences(6,8)

In our experience closure was done at a mean age of 26.3 days. Actually this indicates either a delay in diagnosis or a delay in referral for consideration of surgical closure. This observation is of importance as it is now set-

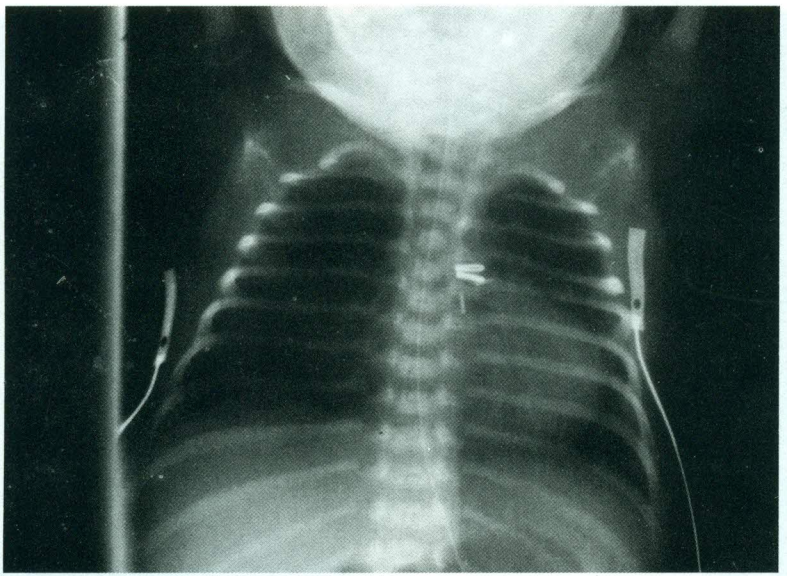


Fig. 7: Postoperative chest X-ray showing clip at the site of the cluctus, intercostal tube in place and patient is still on ventilator. However, pulmonary vascularity shows marked improvement if compared to the preoperative (Figure2)

tled that early closure of the ductus results in the best outcome.

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Whole Body Oxygen Consumption in Two groups of patients Undergoing Cardiac Surgical Procedures

Abstract

Whole body oxygen consumption was calculated during extracorporeal circulation in two groups of patients. The first group included 54 patients with ischaemic heart disease. It this group, whole body oxygen consumption was found to be 98.3±16.3 ml min/1 m^2 during the high blood flow normothermic phase of bypass. The second group included 30 patients with valve disease. In this group, whole body oxygen consumption was found to be 82.1±18.3 ml/min./ m^2 during the high blood flow normothermic phase. There was a highly significant difference between the values of whole body oxygen consumption in both groups ($p<0.0001$). These results suggest that the perfusion flow rates should be higher in patients with ischaemic heart disease than in those with valve disease.

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Introduction

An adequate supply of oxygen is necessary to support life. The majority of the body's oxygen requirement is carried in blood in combination with haemoglobin, and is associated with configurational changes in the protein molecule (1). A small part is carried as physically dissolved gas or as bicarbonate ions. (2).

Whole body oxygen consumption (VO2) is affected by many factors. One of these factors is body temperature. For each 1°C in body temperature there is an increased VO2 requirement of about 15% (3). The reverse occurs with decreasing body temperature. Specifically during extracorporeal circulation (ECC), it has been shown that VO2 is related to perfusion flow rate during normothermia as well as during hypothermia (4), and has been noted to decrease with increased haemodilution (5). Oxygen consumption is directly related to the arteriovenous oxygen content difference (6). In addition, Taylor et al have demonstrated that VO2 is higher with pulsatile compared with nonpulsatile perfusion (7,8,9). VO2 is also affected by the type of circulation; it is higher in standard, and lower in partial (venoarterial), extracorporeal circulation. (10)

Abnormally low values of VO2 are consistent findings when the arterial blood is

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desaturated (11). Respiratory and metabolic alkalosis increase VO2, and the reverse occurs with respiratory and metabolic acidosis (12). An increase in the partial pressure of carbon dioxide (PCO2) in the blood tends to increase VO2 because oxgen is given up more readily to the tissues, (13) and vice versa. (14)

General anaesthetic agents may be associated with a decrease or an increase of VO2 (15). There is a decrease in VO2 of approximately 15% under general anaesthesia during normothermia when compared with values when the patient is awake (16). Halothane reduces VO2 by its presence at intracellular sites depressing metabolic rate, by lowering body temperature and arterial blood pressure, and by inducing muscle relaxation (17).

A depression of blood pressure to 50 mmHg results in a decrease in VO2 to about one-half of control value, (18) and an increase in blood pressure increases VO2 a little (19). Vasodilators such as arfonad (ganglionic blocking agent) are associated with a significant increase in VO2 when used to produce vasodilatation during bypass (20). There is a slight increase in VO2 following noradrenaline administration (19). Isoproterenol (isoprenaline) intravenous infusion increases VO2 by 30% (3) VO2. is also affected by the state of the cardiovascular system. It decreases when there is an unreplaced loss of blood during perfusion (21).

VO2 is influenced by age. For an adult, the average value in the awake state is 3.5 ml/min/Kg. For a newborn this value is 6.5 ml/min/Kg (22).

It is therefore known that numerous factors affect VO2. However little is known about the oxygen requirements of different groups of patients subjected to cardiac surgery; these patients having different underlying pathologies. The aim of this study was to carry out such a comparison.

Patients and Methods

Patients

This study was undertaken on patients submitted for cardiopulmonary bypass in the Regional Cardiothoracic Centre in Freeman Hospital, Newcastle upon Tyne, between 1987 and 1989. Standard cardiopulmonary bypass (CPB) procedures were used in all patients, with moderate systemic hypothermia (mean temperature 28°C). The patients were divided into two groups; ischaemic heart disease group (54 patients) and valve disease group (30 patients). All patients were anaesthetised by the same anaesthetist.

The ischaemic group included 43 males and 11 females. The mean age was 57 year. The valve disease group included 18 females and 12 males. The mean age was 59 years.

Methods

Whole body oxygen consumption (VO2) was determined during the high blood flow normothermic phase at an average perfusion rate of 2.4 ml/min/m^2 and an average temperature of 35-37 C° just before the end of

bypass.

Perfusion flow rate was calculated from the calibrated pump flow. The body surface area was derived from the special charts using body weight and height.

The body temperature was estimated using thermistor probes in the nasopharynx, arterial and venous blood lines, and recording the average temperature value.

The blood gas analysis was carried out on an arterial and a venous sample immediately after sampling. A Blood gas Manager 1321 (Instrumentation Laboratory, BGM Blood Gas Analyser) was used for blood gas measurements. The packed cell volume (PCV) was determined by the Hawksley Microhaematocrit Reader after separation of the packed cell from the plasma using the Microhaematocrit Centrifuge. Haemoglobin was assessed for each sample by dividing the packed cell volume by three.

A standard perfusion technique with roller pump heads, non pulastile perfusion, and membrane oxygenators were used in every case. Membrane oxygenators were used because they enable superior control of blood gases with independent control of pa02 and paCO2 (24).

Clinically both groups were similar. There were no significant differences between the ischaemic heart disease and valve disease groups for age (57±9 v 59±12), systolic blood pressure (73±20 v 75±19 mmHg) or diastolic blood pressure (64±14 v 62±13 mmHg).

body surface area, and whole body oxygen consumption in individual patients. Table 3 gives the correspondings values in each patient in the valve group.

	Ischaemic disease	Valve disease
No. of patients	54	30
Mean VO2	98.3	82.1
Standard D	16.3	18.3
SE of Mean	2.2	3.3

There was however a small difference during surgery in perfusion flow (2.4±0.1 v 2.3±0.3 l/min). Nevertheless even though this difference is statistically significant ($p<0.05$) the rates lie within the normal range expected during surgery and is unlikely to contribute to the significant difference in whole body oxygen consumption measured in this study.

Whole body oxygen consumption (VO2) was calculated using the standard Fick's principle:

VO2 = (CaO2 - CvO2) * Perfusion flow rate/body surface area where:

Ca O_2 = Arterial oxygen content.

Cv O_2= Venous oxygen content.

Oxygen content was calculated from the formula :

CO2 = Hb * 1.34 * (02 Saturation/100) + Pa02 * 0.003 where :

Hb = Haemoglobin in g/dl of blood.

Pa02 = Oxygen partial pressure in blood in mmHg, and 0.003 is a constant. Data ana-

Table 2 (Ischaemic group)

No	Arterial O2 Content ml %	Venous O2 Content ml %	A-V O2 Cont. Difference ml %	Perfusion Flow Rate L/min	Body Surface Area m2	Whole Body O2 Consuption ml/min/m2
1	10.6	7.2	5.0	4.59	1.91	119.7
2	12.6	8.8	3.6	4.48	1.87	86.6
3	11.5	7.8	3.4	4.64	1.91	83.8
4	10.6	6.0	3.9	4.51	1.75	100.4
5	14.8	8.1	5.7	4.69	1.96	137.3
6	13.0	10.1	2.7	4.55	1.86	66.7
7	12.5	7.2	4.0	3.63	1.52	95.6
8	11.5	7.1	3.5	4.19	1.74	83.9
9	12.0	7.6	5.2	4.42	1.87	122.4
10	12.2	8.0	4.0	4.58	1.93	96.1
11	14.0	10.5	3.8	4.42	1.83	93
12	10.3	6.0	3.4	3.92	1.51	87.4
13	14.0	10.1	3.7	5.17	2.18	88.4
14	10.5	7.1	3.5	4.25	1.75	85.2
15	8.1	8.8	3.8	5.42	2.08	98.3
16	10.1	10.2	3.0	4.42	1.81	72.9
17	16.9	10.5	4.3	4.08	2.10	84.2
18	13.3	8.9	3.6	4.65	1.93	86.1
19	11.9	9.3	4.5	3.47	1.62	96.7
20	9.0	9.8	3.7	4.32	1.78	89.6
21	11.7	9.7	4.1	4.79	2.00	99.2
22	13.5	9.4	3.9	4.60	1.94	91.9
23	10.7	7.9	4.8	3.39	1.40	115.7
24	10.6	6.5	4.2	4.07	1.66	102.4
25	13.0	7.1	5.6	4.57	1.92	133.1
26	11.7	8.9	4.2	4.53	1.87	102.5
27	12.9	9.8	4.0	4.31	1.94	88.2
28	13.5	9.5	4.4	3.73	1.72	94.6
29	12.7	8.6	4.0	4.58	1.93	95.6
30	15.9	10.9	4.5	4.22	1.73	110.5
31	12.4	7.4	5.0	4.30	1.81	117.8
32	13.2	4.6	3.7	4.72	1.94	91.1
33	12.4	7.8	4.3	4.77	1.96	105.6
34	15.0	9.0	5.2	5.15	2.30	116.4
35	13.2	6.9	3.8	3.71	1.53	93.2
36	13.5	8.0	4.5	4.17	1.70	110.5
37	14.5	10.2	2.8	4.46	1.83	69.1

Continued on 10

Table 2 (Ischaemic group) (Continue)

No	Arterial O2 Content ml %	Venous O2 Content ml %	A-V O2 cont. Difference ml %	perfusion Flow Rate L/min	Body surface Area m2	Whole Body O2 consuption ml/min/m2
38	11.5	8.4	2.9	4.11	1.82	65.8
39	14.9	10.3	4.4	4.70	1.94	107.1
40	11.1	6.9	4.2	3.99	1.67	101.4
41	14.6	9.3	4.5	4.24	1.75	108.7
42	13.0	7.6	3.8	4.48	1.86	91.6
43	10.5	10.3	3.9	3.61	1.60	88.6
44	12.4	8.6	4.2	4.45	1.85	101.1
45	11.4	7.6	3.5	4.20	1.78	82.7
46	14.4	9.7	4.0	4.77	2.06	93.1
47	14.1	9.0	3.9	4.54	1.89	94.7
48	12.5	8.8	4.6	4.68	1.97	109.5
49	14.6	8.4	6.1	4.35	1.80	146.8
50	12.2	9.0	4.1	4.39	1.82	99.3
51	13.3	10.6	3.6	4.75	1.87	92.1
52	14.5	11.7	4.2	4.35	1.94	94.3
53	10.7	6.9	4.1	3.82	1.64	96.1
54	12.0	8.1	4.9	5.02	2.02	122.5
Mean	12.6	8.6	4.1	4.39	1.84	98.3
SD	1.7	1.3	0.7	0.42	0.17	16.3
SE of mean	0.2	0.2	0.1	0.06	0.02	2.2

lysis was done using an Opus PC3 Personal Computer.

Results

The number of patients, the mean value of VO2, the standard deviation, and the standard error of mean for both groups are given in Table 1.

Significant differences ($p<0.0001$) were found between the oxygen consumption in the two surgical groups. In the ischaemic group, table 2 gives the A-V 02 content differences, perfusion flow rates, body surface area, and whole body oxygen consumption in individual patients. Table 3 gives the corresponding values in each patient in the valve group.

Discussion

Whole body oxygen consumption (VO2)

Table 3 (Valve group)

No	Arterial O2 Content ml %	Venous O2 Content ml %	A-V O2 Cont. Difference ml %	Perfusion Flow Rate L/min	Body Surface Area m2	Whole Body O2 Consuption ml/min/m2
1	12.9	9.3	3.5	4.54	1.83	80.1
2	13.2	7.8	3.8	4.25	1.74	83.4
3	10.7	7.4	2.7	3.95	1.64	58.7
4	8.8	6.9	4.5	4.21	1.74	95.2
5	8.6	5.2	3.4	3.75	1.54	71.9
6	14.5	10.1	4.0	4.98	2.08	92.2
7	15.8	10.5	4.1	3.17	1.41	76.3
8	14.1	10.7	3.0	4.77	1.75	74.1
9	10.6	7.0	3.4	4.54	1.93	74.7
10	11.6	6.7	3.6	3.38	1.77	68.2
11	12.8	7.8	4.1	4.49	1.72	98.7
12	10.6	5.6	5.4	4.02	2.00	102.6
13	10.2	8.5	4.2	4.17	1.69	89.9
14	12.3	8.2	4.1	3.83	1.57	93.0
15	11.1	7.6	3.7	4.31	1.65	84.0
16	12.0	6.3	4.2	2.71	1.63	70.3
17	14.0	11.2	2.8	3.36	1.87	49.4
18	14.6	11.2	2.6	4.80	2.02	62.1
19	11.6	9.4	3.4	4.59	1.90	82.5
20	12.2	7.6	3.5	3.55	1.47	84.1
21	10.6	5.9	4.9	4.36	1.78	119.4
22	15.5	9.1	2.7	3.52	1.46	65.4
23	16.0	10.1	3.9	3.44	1.40	95.4
24	12.8	10.5	2.7	3.52	1.45	65.6
25	12.3	8.3	3.1	4.40	1.84	73.5
26	13.2	6.9	4.6	3.14	1.97	67.2
27	12.1	8	2.8	3.74	1.73	61.6
28	10.7	6.4	3	4.12	1.62	73.1
29	10.7	7.9	2.7	4.18	1.78	63.2
30	11.8	7.4	2.0	4.14	1.71	49.6
Mean	12.2	8.2	3.5	4.00	1.72	82.1
SD	1.9	1.7	0.8	0.56	0.18	18.3
SE of Mean	0.4	0.3	0.1	0.10	0.03	3.3

is an accurate indicator for the adequacy of perfusion during cardiopulmonary bypass at normothermia. However, it is not reliable during hypothermia as it indicates oxgen delivered to the tissues and not the tissue oxgen requirement (25). VO2 has been calculated in many studies. Adolph and Lawraw calculated VO2 experimentally in rats in 1950 (26). Clowes et al (1958) calculated VO2 in experimental work on Mongrel dogs and in 9 adults (18). Raison et al (1970) in their series of 52 patients of different cardiac pathology found it to be 140 ml/min/m^2. (27). In Raison's study, VO2 was calculated as the mean for all patients where the patients were not divided into groups. Fox et al (1982) reviewed VO2 in 17 patients with ischaemic heart disease. They found it to be 160 ml/min/m^2 (28). Hickey and Hoar (1983) calculated VO2 in 12 patients with ischaemic heart disease (16). Their calculated values for VO2 in this group were 83.3±14.6 ml/min/m^2. In the majority of studies VO2 has been examined in mixed groups of cardiac surgical patients. In the available literature, no comparison has been found between values of VO2 in patients with ischaemic heart disease and valve disease.

Our study divided our patients into two groups according to the cardiac pathology, and compared the mean values of VO2 in both groups. The mean values of VO2 were 98.3, and 82.1 ml/min/m^2 in ischaemic, and valve disease groups respectively. We found that there was significant difference ($p<0.001$) between the values of whole body oxygen consumption during the high flow rewarming phase in both groups of patients. The cause of the difference found in this study cannot yet be explained. Further studies are necessary to uncover the main factor causing this difference.

These data may be of value in improving the perfusion technique, and suggest that perfusion flow rates should in general be higher in patients with ischaemic heart disease than in those with valve disease.

Conclusion

We conclude from this study that whole body oxygen consumption is higher in ischaemic heart disease group than in the valve replacement group during the high flow warm stage of perfusion. This difference is significant ($p<0.001$). For this reason we recommend the use of higher perfusion flow rates in the ischaemic heart disease group during the high flow warm stage of perfusion.

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Resection of Primary Sternal Tumours

Abstract

This study included 8 patients with primary sternal tumours; 5 had chondrosarcoma, one rhabdomyosarcoma, one malignant fibrous histiocytoma and one malignant non-Hodgkin's lymphoma. Partial sternal resection was performed in 7 patients and total sternal resection was performed in one patient. For all patients skeletal reconstruction using prolene mesh was done. In one patient, soft tissue reconstruction using unilateral pectoralis major muscle flap was done to cover the mesh. No postoperative ventilatory support was required and the chest wall stability was satisfactory in all cases. It was concluded that proper management of primary sternal tumours depends upon early diagnosis, adequate aggressive resection and chest wall reconstruction for which simple prolene mesh is very satisfactory. Core needle biopsy is also recommended before doing any sternal resection to avoid major resections for patients with metastasis or some soft tissue tumours as malignant lymphoma.

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Introduction

Chest wall tumours include benign or malignant tumours of the bony skeleton (sternum and ribs) or soft tissues. Malignant chest wall tumours may be primary or secondary representing metastasis or direct invasion from the lung, pleura, breast or mediastinum. Primary sternal tumours represent about 15% of all chest wall tumours (1). Almost all sternal tumours are malignant and more common to be metastatic than primary (2,3).

Adequate surgical resection of these primary tumours represent the only hope of cure, (4-8). However, the problem in management of these tumours is not in the resection itself but in how to reconstruct the remaining defect (9-14). This study reviews the advances in sternal resection and reconstruction and our experience in this field.

From Cardiothoracic Surgery Unit, Alexandria Faculty of Medicine

Material and Methods

This study included 8 patients having primary sternal tumours. Two were females and 6 were males with ages ranging from 22-58 years.

All patients presented by sternal swellings involving the body of the sternum in 6 cases and manubrium and upper body in two cases.

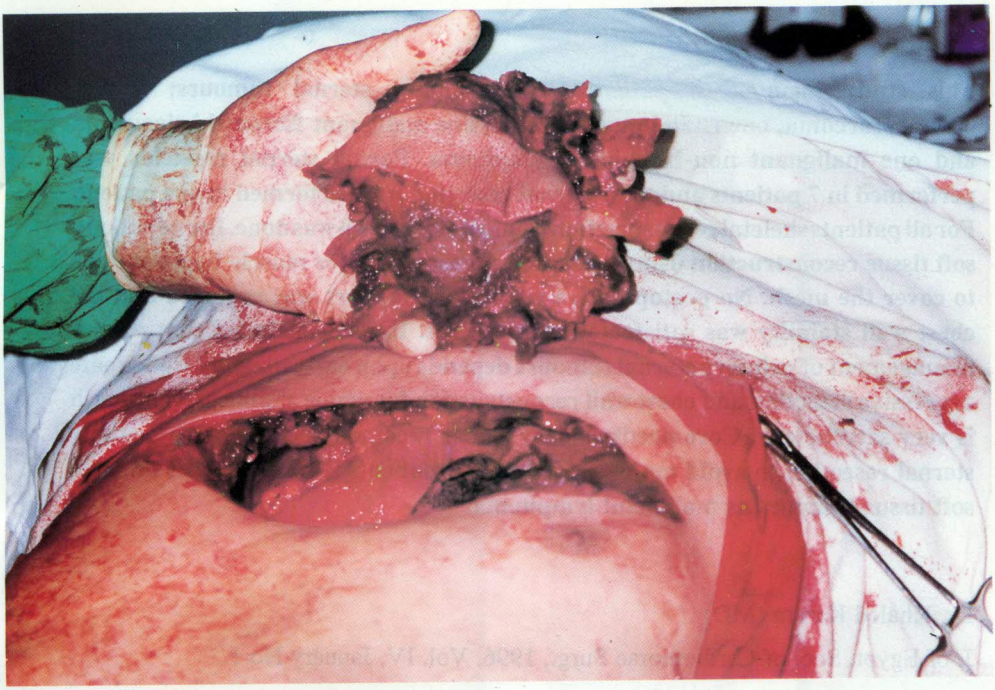

Fig.1: Resected tumour in the body of the sternum with removal of the costal cartilages bilaterally.

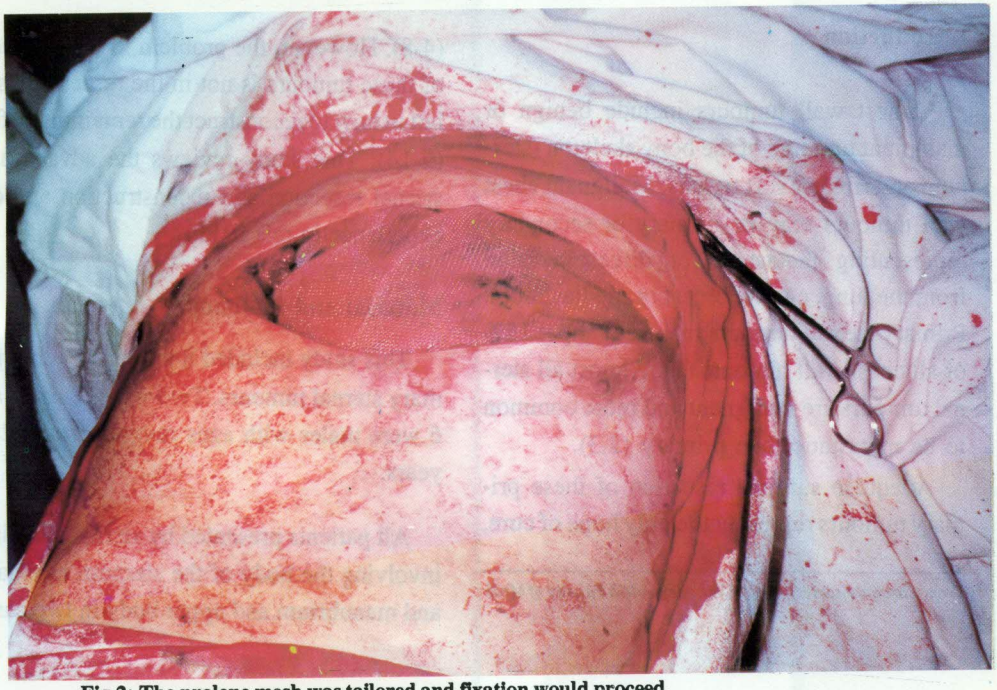

Fig.2: The prolene mesh was tailored and fixation would proceed.

No evidences of primary tumours elsewhere were present. All patients had plain X-ray chest Posteroanterior, lateral and sternal views and 6 patients had CT chest.

Three patients had previous incisional biopsies before referring to surgery; one proved to be rhabdomyosarcoma, one malignant fibrous histiocytoma and the third was inconclusive but proved later after resection to be malignant non Hodgkin's lymphoma.

Partial sternal resection with prolene mesh repair was done in one patient who presented by large sternal tumour and no evidences of primary tumours elsewhere. The pathological report proved to be metastatic adenocarcinoma the primary tumour of which remained occult. This case was excluded from this study.

All the patients included in the study were submitted to sternal resection, partial in 7 cases and total in one. The incision was elliptical midline in 6 cases and transverse in two. The transverse one was chosen when the tumour had more lateral than vertical extension. En bloc resection was done of the tumour with 2-4 cm safety margin involving the sternum, costal cartilages bilaterally and any attached pericardium, lung or thymus (Figure 1). Prolene mesh of suitable size was placed and fixed by interrupted zero prolene sutures all around with sufficient tension (Figure 2). Both pleural cavities were drained by intercostal tubes under water seal. The wound was closed, subcutaneous and skin without drains. Since no case had tumour skin invasion, no major skin excision was done and no case required skin flaps. In only one case, after fixation of the prolene mesh, the mesh was covered by right pectoralis major muscle flap after cutting the insertion of the muscle in the humerus. In this case, the defect was large and our aim was to cover the large mesh to give additional support to it.

All patients were transferred to ICU for one postoperative day.

Results

Pathological reports of the 8 cases showed 5 cases of chondrosarcoma, one of rhabdomyosarcoma, one of malignant fibrous histiocytoma and one case of malignant non-Hodgkin's lymphoma of diffuse mixed small and large cell. One case proved to be metastatic adenocarcinoma from elsewhere and was excluded from the study.

The postoperative period was generally smooth. No patient required ventilatory support as evidenced by serial determinations of blood gases. The intercostal tubes were removed 4-6 days postoperatively. No wound sepsis was detected. Chest wall stability was good.

During follow up, one patient who had rhabdomyosarcoma died 6 months later of local recurrence accompanied by left malignant pleural effusion. It was the first case done in this series, and probably the resection done was not adequate enough. Another patient with chondrosarcoma died 8 months later with lung secondaries. All remaining pa-

tients are well after 1-3 years follow up.

Discussion

Primary chest wall tumours represent a panorama of bone and soft tissue tumours. However, the commonest benign tumours are cartilaginous (chondroma and osteochondroma) and desmoid tumours and the commonest malignant tumours are malignant fibrous histiocytoma, chondrosarcoma and rhabdomyosarcoma (2,3). The commonest primary sternal tumor is chondrosarcoma as confirmed in this study (1). Chondroma of the sternum is reported rarely to occur. All sternal tumours should be considered malignant until proven otherwise (3).

Concerning the impact of pathology on resection; chondrosarcoma tends to be relatively slowly growing spreading by local invasion accordingly en bloc excision with a relatively smaller safety margin of 2 cm is sufficient (1,6,7,9). On the other hand, osteogenic sarcoma and malignant fibrous histiocytoma are more malignant spreading within marrow and along tissue plains as periosteum and parietal pleura. So a wider safety margin not less than 4 cm with removal of the entire bone is indicated (6,7). For Ewing's tumour, children rhabdomyosarcoma and osteosarcoma after accurate diagnosis the plan of management is vigorous chemotherapy and adjuvant operation (5). In this concern it is important to remember that chondrosarcoma is resistant to irradiation and that local recurrences are best managed by another adequate resection rather than by irradiation or chemotherapy (5).

Primary sternal tumours generally present by a painless mass that becomes painful. Metastatic masses because of their higher doubling time and some rapidly growing primary tumours present by pain followed by appearance of a mass. Plain X-ray chest lateral view, CT scan and MRI are helpful in diagnosis of sternal tumours. Bone survey may be required when metastases are suspected.

Core needle biopsy is recommended before doing any sternal resection. This avoids doing resections for patients with metastasis from unknown primary and for patients with some soft tissue tumours as malignant lymphoma for which local irradiation and chemotherapy may be curative. But however, it should be always remembered that needle biopsy tends to diagnose low grade malignancies as chondrosarcoma as being benign (2,3). Insisting on doing needle biopsy before resection may have avoided doing resections for the case of metastasis from occult adenocarcinoma and for the case of malignant non-Hodgkin's lymphoma met with in the present study.

The goal of management of primary sternal tumours is adequate surgical resection followed by dependable reconstruction (4,6,7). Chest wall resection involves partial or total sternectomy with a wide free margin of 2-4 cm, with the corresponding costal cartilages bilaterally and the attached structures

from the lungs, thymus or pericardium (4). A wider safety margin of 4 cm was found to be accompanied by a better 5 years survival of 56% compared to 29% 5 years survival if the safety margin was only 2 cm (7).

Chest wall reconstruction following sternal resection has two components; skeletal reconstruction aiming at chest wall stability and soft tissue reconstruction aiming at covering of the defect and replacement of skin loss.

Over the last four decades, different materials were used for skeletal reconstruction of sternal defects (1.9-12). Fascia lata supported by autogenous ribs was the earliest material used (1). However, it requires multiple skin incisions and longer operative time. Other materials were used but each had its disadvantages. Tantalum plate is impermeable and even if perforated it will encourage serous collections and infection. Tantalum mesh tends to fragment encouraging herniation. Stainless steel mesh, although superior to tantalum, yet by its rigidity, it may project through the skin or erode adjacent blood vessels. Nylon tends to lose its tensile strength because of its hydrophilic properties. Ivalon sponge excites extreme degree of body reaction with subsequent shrinkage. Marlex mesh had the disadvantage of being rigid in one dissection only when placed under tension (9).

The commonest three protheses used now as sternal substitutes are the sandwich prothesis, Gore-Tex (PTFE) soft tissue patch (2 mm) and prolene mesh (2,3). The sandwich prothesis consists of two layers of marlex meshes and in between a layer of methylmethacrylate (10,11). However, this prothesis is expensive, complex and the added rigidity is not necessary (4). The Gore-Tex patch although preferred by some authors, it is expensive, not easily available and impermeable with the danger of encouraging serous collections and infection (4). Prolene mesh is permeable, strong in all directions, inert, flexible, single, available and less expensive. It was the prothesis used in this study and others with good results (4).

Soft tissue reconstruction after sternal resections can be done using omentum or muscle and myocutaneous (random, pedicle and free) flaps especially pectoralis major and rectus abdominis flaps and the recently introduced tensor fascia lata myocutaneous free flap (2,3,11,14). Soft tissue reconstruction is only required in the presence of major soft tissue and skin loss, skin ulceration, irradiation or infection. It was required in only one case in the present study.

Sticking to the criteria of early diagnosis, aggressive adequate resection and immediate dependable reconstruction the reported 5-year survival after resection of primary sternal tumours is 54-67% and 10-year survival is 38-50% (6,7).

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Video-Assisted Thoracoscopic Dorsal Sympathectomy for Hyperhidrosis

Abstract

Hyperhidrosis can be defind as sweating that is clinically noticeable under conditions where it would not normally be expected or is excessive in response to heat or emotional stimuli.

Previous methods of treatment included either medical treatment in mild forms or surgical treatment which is the definitive or final treatment. Kux (1951) described electro cautery of the sympathetic nerve, but his technique has not been widely used. Interest was reviewed in this method by Cloes et al. 1991 using video-assisted thoracoscopic (VAT) surgery.

In this series, we presented our initial experience in performing bilateral staged thoracoscopic sympathectomy for 9 patients with hyperhidrosis. Age was 20-31 (mean 23.6 years) 6 were Males & 3 Females All patients were of high culture class. They were operated upon in the General Surgical Department, Faculty of Medicine, Cairo University and some private hospitals in the period from January 1994 till May 1995.

The VAT operative time ranged from 40-90 minutes, (mean 45.3 minutes). We had a success rate of 89% with immediate improvement of symptoms extending up to 3 months of close follow-up. Hospital stay ranged from 2 to 4 days. (mean of 2.7 days). No major complications occurred but delayed complications were present in the form of compensatory sweating in two patients (22%), gustatory sweating in one patient (11%).

The results of video-assisted thoracoscopic (VAT) dorsal sympathectomy compare favorably with those from all other open techniques. It has the added advantage of simple access of T4 ganglion which is important in the control of axillary sweating.

The short hospital stay and early return to work are significant psychological and financial additional benefits. It offers minimal postoperative discomfort and excellent cosmetic results.

All other open surgical techniques have been regarded as too extreme in relation to this problem. The VAT approach seems to offer the ideal surgical solution with excellent results, minimal complications and a shorter hospital stay.

This study represent our early experience which is expected to improve with performing more cases to perfect this technique.

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Introduction and Aim of Work

Hyperhidrosis can be defined as sweating that is clinically noticeable under conditions where it would not normally be expected or is excessive in response to heat or emotional stimuli (Cagel et al., 1979).[1] Not only does it cause psychological and social problems but it may also result in occupational and educational difficulties (Kux, 1978).[2]

Medical treatment is usually restricted to mild cases while surgical treatment is the definitive and final treatment (Shelly et al., 1978)[3].

Thoracic sympathectomy for hyperhidrosis was performed first by Kotzareff in 1920 using open surgery (Kotzareff, 1920).[4] Kux described in 1951 a method for thoracoscopic electrocautery of the sympathetic nerve, but his technique has not been widely used (Kux, 1951).[5]

Interest was again reviewed in this method during the last decade and a further simplification using video-assisted thoracoscopic (VAT) sympathectomy was described in 1991 by (Cloes et al., 1991).[6]

Bilateral open thoracic sympathectomy for the treatment of hyperhidrosis carries the risk of complications, pain and long convalescence. Few people with hand sweating are willing to pay that price (Kux et al., 1978)[2].

Since the introduction of VAT sympathectomy, it has been described as a simple, fast and safe procedure for sympathetic denervation of the hand and arm in treatment of hyperhidrosis (Closs et al., 1991)[6].

The aim of this work, is to evaluate our early experience in Kasr El-Eini Faculty of Medicine, Cairo University and some private centers, in treatment of hyperhidrosis by means of a bilateral staged thoracoscopic sympathectomy.

Patients and Methods

This study included 9 patients with hyperhidrosis (palmar and axillary), which led them to considerable psychological and social disturbances. Some patients were operated upon in the General Surgical Department, Faculty of Medicine, Cairo University and some patients were operated upon in some private centers in the period from January 1994 till May 1995.

All the patients in this study were subjected to the following:

1. Thorough medical history and complete physical examination making sure this hyperhidrosis is not secondary to an underlying systemic illness e.g. diabetes mellitus, thyrotoxicosis, pheochromocytoma and carcinoid tumors.

2. Routine laboratory investigations.

3. Specific laboratory investigations if secondary hyperhidrosis is suspected e.g. thyroid function tests, blood sugar curve.

4. Routine chest x.ray (P-A view) to make sure that there are no adhesions in the pleural cavity.

5. A written consent from the patient about the expected results and possible complications which may occur.

Operative Technique

It must be noted that all our patients were subjected to bilateral surgery with an interval of 4-5 weeks between both after ensuring the success of the first operation, which encouraged the patient to accept performing surgery on the contralateral side.

Position and Anaesthetic Technique:

Patient was anaesthetized using a double-lumen endotracheal tube and was placed on the operating table with both arms abducted to 90 degrees. A head-up position facilitated the apex of the lung to fall away on deflation.

Operative Technique

A one cm incision was made in the anterior axillary line over the fifth space. The thoraco-port was inserted through this incision. After deflation of the lung, the thoracoscope was inserted, the entire hemithorax was visualized. The upper sympathetic chain was then easily visualized lying over the neck of ribs, from the 2nd to the 6th ganglia.

Next, two other incisions were made for 10 and 5 mm. trocars in the 3rd intercostal space in the anterior and posterior axillary lines, respectively. These trocars were inserted under direct vision, through these trocars were inserted the grasp dissector, and suction/irrigator when appropriate.

The pleura overlying the sympathetic chain was incised using the scissors or coagulator. The ganglia lying over the ribs were electrocoagulated. The ganglia involved included the lower 1/3 of the stellate ganglion to T4 ganglion and their interconnecting fibers.

The lung was then reinflated under direct vision, the skin incisions were closed and chest tube was then placed. The chest tube was removed on the next day after doing a chest X-ray to ensure complete lung inflation. The patient was discharged on the third day.

Follow-up

The results of operation appeared immediately after full recovery from anaesthesia with no sweating occurring.

The patient then came for follow-up after 2 weeks and then after 4 weeks before performing sympathectomy on the contralateral side.

Contralateral Sympathectomy

This was perfomed 5 weeks later and the patient was really encouraged from the results of the first operation.

Follow-up for bilateral procedures was done for a period of 3 months postoperatively.

Results

Personal data:

Age: all the patients were young, age ranging from 20-31years old with a mean of 23.6 years.

Sex: 6 patients were males and 3 were females.

Profession:

This was an important factor which made our patients seek medical advise due to social, psychological and occupational discomfort resulting from hyperhidrosis:

2 patients were lawyers

2 patients were accountants

1 patient was a doctor

1 patient was an engineer

3 patients were students

All our patients had primary or idiopathic hyperhidrosis i.e. not secondary to any systemic illuness.

Operative data:

Operating time for every side ranged from 40 to 90 minutes with a mean of 45.3 minutes. The long operating time was in the first 3 cases and then gradually decreased with more experience.

Hospital stay:

The hospital stay ranged from 2 to 4 days with a mean of 2.7 days.

Immediate results:

Technical failure occurred in the first patient but only unilaterally (in the second operation) (11%), but starting from the second patient the immediate results were excellent with complete disappearance of hyperhidrosis and the patients were able to resume normal activity within one week postoperatively.

Delayed results:

Follow-up for a postoperative period of 3 months revealed no recurrence in any of our patients.

Complications:

1. Immediate: no major complications necessitating open surgery occurred.

2. Delayed:

a) Compensatory sweating: this occurred in 2 patients (22%) over the trunk and upper thighs but was well tolerated and caused no major inconvenience to both patients.

b) Gustatory sweating: this occurred in one patient (11%) where the patient experienced a sensation of sweating on eating without actual sweating, but was of minor inconvenience in comparison to his original complaint.

Discussion

Hyperhidrosis is both a physiologic and social handicap. Wet palms give a false impression of uncertainty and nervousness, which often leads to social isolation. This was present to a large extent in most of our patients. All the patients included in this study had previously sought help, but the open operation has been regarded as too extreme in relation to the problem.

It was important to distinguish secondary hyperhidrosis due to an underlying systemic illness (e.g. diabetes, thyrotoxicosis) from idiopathic or primary hyperhidrosis, which usually occurs early in adolescence and is

characterized by excessive sweating in hands, axillae or both which was the case in all our patients.

Preoperative chest X-ray was done to exclude any lung pathology especially that which might predispose to adhesions. If encountered simple adhesions were easily divided endoscopically.

As regards the operative time, it ranged from 40 to 90 minutes with a mean of 45.3 minutes, this is considered a relatively long time in comparison to Cloes et al., 1991 and Olcott et al., 1991, where the mean operative time was 25 minutes, but this work represents our early experience (9 cases) in comparison to 500 cases performed by Cloes et al., and 320 cases by Olcott et al., (Closs et al., 1991)6, (Olcott et al., 1991)7.

As regards the average hospital stay it was 2.7 days and this is comparable with Cloes et al., 1991 (6) and Olcott et al., 1991 (7).

As regards the results, one of the fascinating events about thoracoscopic sympathectomy is that both the patient and surgeon appreciate the results immediately after recovery from anaesthesia and this encourages the patient to accept the second operation on the contralateral side after 4-5 weeks.

The immediate success rate in our operations was 89%. These results are comparable with those of Cloes et al., 1991)6, with a success rate of 93%, although this work represents our early experience. Failure occurred in one case and on one side only, most probably due to failure to visualize properly the sympathetic chain which was covered by excessive fat.

Concerning complications or side effects, we had 2 problems which are common after all sympathectomies regardless the technique:

1. Compensatory sweating: This occured in 22% of our patients and occurred over the trunk and upper thighs, but was very mild and caused no discomfort to our patients. The mechanism of compensatory sweating is not exactly kown but it most probably represents a thermoregulatory mechanism (Edmonson et all., 1992)8. The incidence of compensatory sweating in this study confiirms with those of Byrne et al., 1990, which was approximately 20%, (Byrne et al., 1990)9.

2. Gustatory sweating: This occurred in 11% of our patients with the patient complaining of the sensation of sweating when he eats, without actual sweating, but this complaint was a minor nuisance to our patients in comparison to their original complaint. The exact mechanism of occurrence of gustatory sweating is still unclear (Kux et al (1978)(2).

It must be noted that Horner's syndrome did not occur in any of our cases in comparison to all other open surgical techniques. This can be explained by the fact that in VAT sympathectomy the stellate ganglion is well protected by the dome of the pleura and only the distal one third is visible to the endoscopy

preventing its damage during sympathectomy (Cloes et al., 1991)5.

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INTERNET

REVIEW LITERATURE

TRANSPOSITION OF GREAT VESSELS-SURGERY-1990-1995

Transposition of great vessels with position anomaly of the atrioventricular valves or chordae: echocardiographic aspects and surgical correlations .

Piot-JD; Rey-C; Serraf-A;Touchot-A;Sousa-Uva-M; Lacour-Gayet-F;Planche-C
Arch.-Mal-Coeur-Vaiss., 1995 May;88(5):699-70

The authors report the echocardiographic appearances of 27 cases of transposition of the great arteries (TGA) with ventricular septal defect (VSD) (including the Taussig-Bing malformation) complicated by displacement of one or both atrioventricular valves and/or chordae tendinae diagnosed between September 1985 and September 1994. An anatomical repair was performed in 21 cases and allowed accurate correlation of the echocardiographic and peroperative findings; a cavo- bipulmonary conduit or a palliative procedure was performed in 6 cases. The cases were classified in 3 groups: group1:16 children with isolated tricuspid valve abnormalities; groupII: 7 cases of mitral valve straddling; groupIII: 4 cases of displacement of both atrioventricular valves and/or their chordae. The cases of group I were divided into 3 subgroups: subgroup la with insertion of the tricuspid chordae on the infundibular septum (7 cases); subgroup Ib with isolated overriding of the tricuspid valve (2 cases); subgroup Ic straddling with or without overriding of the tricuspid valve (7 cases). In all three groups, there were 10 cases of straddling of the tricuspid and 11 cases of straddling of the mitral valve: 9 type A, 3type B and 9 type C of Tabry's classification. Echocardiography misdiagnosed one case of type A straddling of the tricuspid valve for a type A overriding and straddling of the mitral valve. The ventricular septal defect was situated in the admission septum in the 10 cases of straddling of the tricuspid; in the 11 cases of straddling of the mitral valve the chordae passed through the superior anterior part of the interventricular septum.

Systemic pulmonary shunts in the neonatal period. Short and medium-term results.

Chantepie-A; Cheliakine-Chamboux-C; Aupart-M; Bry-P; Vaillant- MC; Marchand-M
Arch- Mal- Coeur- Vaiss. 1995 May; 88(5): 693-8

Systemic pulmonary shunts were performed in 41 consecutive neonates with congenital cyanotic heart disease between 1981 and 1992. The lesions comprised pulmonary atresia with intact interventricular septum (16 cases) , pulmonary atresia with ventricular septal defect (9 cases), tetralogy of Fallot (5 cases), transposition of the great arteries (3 cases) and different complex cardiac lesion (8 cases). A polytetrafluoroethylene tube was used in 40 neonates, 5 mm in diameter in 39 cases, anastomosed to the subclavian artery in 21 patients (group A) and on the ascending aorta or innominate artery in 19 patients (group B). A retrospective analysis of the results was undertaken in all patients with a mean follow-up period of 6.5 years (range: 19 months-12.5 years). There were 4 early deaths (9.7%) and 8 late deaths (19.5%) giving a total mortality of 29.2%. Of the late deaths, 4 occurred in the first year, 3 suddenly at home and 4 in relation with the surgical correction. Occlusion of the shunt was suspected in only one case. The actuarial survival rate was 78% at one year, 75.5% at 7 years and 66% at 10 years. Eleven of the 12 deaths were in children with pulmonary atresia with intact interventricular septum (8 cases) and complex cardiac malformations (3 cases). Early complications were observed in 15 of the 37 survivors of the initial procedure. Cardiac failure occurred in 83% of group B and 22% of group A ($p<0.01$). The probability of shunt efficacy was 89% at 1 year, 63% at 2 years and 45% at 3 years.

Surgical treatment of transposition of great arteries with interrupted pulmonary artery: a rare association of embryopathies.

Pannu-HS; Prakash-KS; Nahar-R; Murthy- KS; Rajan-S; Rao-SG; Karnan-R; Singh-K; Cherian- KM
J Card-Surg. 1995 May; 10(3): 264-9

The first case of TGA with VSD, and interrupted LPA and its successful surgical treatment is being reported along with a review of the relevant literature. The

dominant presenting clinical features have been explained and an attempt has been made to explain the paucity of records in regardn to this embryopathy. An arterial switch for TGA and a glutaraldehyde pretreated autologous pericardial roll for repair of interrupted LPA were carried out. Pre-and postoperative hemodynamics and angiography data are also presented.

Successful surgical treatment of total cavopulmonary connection on a 4 -year- old boy with complete transposition of the great arteries and hypoplastic left ventricle.

Shiono- N; Takanashi-Y; Yoshihara- K; Tokuhiro- K; Suzuki- N; Komatsu -H SO- Source (Bibliogrraphic Citation): Nippon- Kyobu- Geka- Gakkai- Zasshi. 1995 Jun; 43(6): 884-8

A four- year- old boy with complete transposition of the great arteries, intact ventricular septum and hypoplastic left ventricle, underwent total cavopulmonary connection after two palliative operations; B-T shunt and central shunt. He had undergone cardiac catheterization three times; four months after birth, and at two and four years of age. LVEDV (% normal) were calculated 31%, 26%, 27%, and RVEDV (% normal) were 226%, 115% & 105% respectively. PA index increased from 178 to 230 and further to 380. This case indicates that intracardiac repair is possible, if appropriate palliative operations suitable for patient's cardiac function and pulmonary artery morphology are applied.

Coronary artery abnormalities detected at cardiac catheterization following the arterial switch operation for transposition of the great arteries.

Tanel- RE; Wernovsky- G; Landzberg- MJ; Perry-SB; Burke -RP SO- Source (Bibliographic citation): Am- J- Cardiol. 1995 Jul 15; 76(3): 153-7

Because the arterial switch operation has become the routine surgical approach for transposition of the great arteries, there is increasing awareness of adverse sequelae in some survivors. For the arterial switch to be considered the procedure of choice for transposition of the great arteries, long - term patency and normal function of the translocated coronary arteries must be achieved. We reviewed the cineangiograms and

hemodynamic data in 366 patients who underwent postoperative catheterization after arterial switch operation. Of these, 13 patients (3%) had previously unsuspected coronary abnormalities diagnosed angiographically. No patient had noninvasive evidence of resting systolic dysfunction. Findings included left main coronary artery stenosis (n=3) or occlusion (n=2), anterior descending coronary artery stenosis (n=1) or occlusion (n=2), right coronary artery stenosis (n=1) or occlusion (n=1), and small coronary artery fistulas (n=3). One patient died suddenly 3.3 years after surgery, 1 patients is lost to follow-up, and the remaining 10 patients are alive and asymptomatic up to 11 years after surgery.

Postoperative pulmonary stenosis after arterial switch operation, comparison in three methods of pulmonary reconstruction: modified Pacifico, autologous pericardial patch, and equine pericardial patch.

Imoto- Y; Kado- H; Asou-T; Shiokawa-Y; Miyakey Yasuda- H; Nakano- T; Imasaka- K; Yasui-H

Kyobu- Geka. 1995 Jun; 48(6):433-8; discussion 438-41

To prevent postoperative pulmonary stenosis in arterial switch operation for transposition of the great arteries, pulmonary reconstruction without patch augmentation (modified Pacifico method: Pa- group) and reconstruction using W-shaped fresh autologous pericardium (AW- group) were introduced instead of the former method using equine pericardium (XW-group). Postoperative pulmonary stenosis (RV-PA pressure gradient greater than 30 mm Hg) was not seen among the 17 cases in the Pa-group (0%), and was seen in 2/14 (14.3%) in the AW- group and in 4/14 (29%) in the XW- group. Progressive increase in pressure gradient was seen in the XW- group in the midterm cardiac catheterization ($p<0.01$), but such tendency was not observed in the Pa-group and the AW- group. Sectional area at the pulmonary valve ring, at the anastomotic site in the main pulmonary artery, and at the pulmonary branches just distal to the bifurcation, standardized by the body surface area, increased in the Pa- group and the AW-group, but were unchanged or slightly decreased in the XW- group in the midterm cardiac angiography. We believe that postoperative pulmonary stenosis can be best avoided if modified Pacifico method is used. The cases in which postoperative pulmonary stenosis or coronary artery compression is anticipated such as those with side- by- side aortopulmonary relationship or after pulmonary artery banding, should be operated

upon using fresh autologous pericardial patch.

A study in ventricular- ventricular interaction. Single right ventricles compared with systemic right ventricles in a dual-chamber circulation.

Fogel-MA; Weinberg-PM; Fellows- KE; Hoffman- EA
Circulation. 1995 Jul 15; 92(2): 219-30

Background: Ventricular Ventricular interaction is known to occur in normal human heart. To determine whether it plays a role in the function of single right ventricles, systemic right ventricles were compared with and without a left ventricle mechanically coupled to it.

Methods and results: A noninvasive magnetic resonance tagging technique (spatial modulation of magnetization [SPAMM]) that lays intersecting stripes down on the myocardium was used to examine 18 patients with systemic right ventricles: 7 with a single right ventricle who have undergone the Fontan procedure (age, 38.8 ± 8.9 months) and 11 with transposition of the great arteries who have undergone an atrial inversion operation (age, 16.3± 3.9years). The motion of the intersection points was tracked through systole to determine regional twist and radial shortening. Shortening rates also were evaluated Finite strain analysis was applied to the grid lines using Delaunay triangulation, and the two - dimensional strain tensor and principal E1 strains were derived for the various anatomic regions. Basal and apical short-axis planes through the ventricular wall were categorized into four distinct regions spaced equally around the circumference of the slice. We observed the following results. (1) Strain was greatest and heterogeneity of strain was least in patients with transposition of the great arteries who were status post atrial inversion operation (six of eight regions). Marked differences were noted in the distribution of strain within a given region, from endocardium to epicardium, and from atrioventricular valve to apical plane between patient subtypes and those with a normal left ventricle. (2) Contrary to the normal subject studied by the use of the same method, for both patient subtypes, there was counterclockwise twist in one region, clockwise twist in the posterior or inferior wall, and a transition zone of no twist at which the two regions of twist met. Normal human adult left ventricles studied in short- axis twist uniformly counterclockwise as viewed from apex to base. (3) Radial inward motion was greatest in the superior wall of both types of systemic right ventricle. The inferior walls of Fontan patients and the posterior (i.e., septal) walls

of patients with transposition of the great arteries, status post atrial inversion, moved paradoxically in systole. The shortening rate at the atrioventricular valve of patients with transposition of the great arteries, status post atrial inversion, was significantly lower than at the apex or in Fontan patients.

Conclusions:

Marked differences in regional wall motion and strain were demonstrated in systemic right ventricles, depending on whether a left ventricle was present to augment its function .Ventricular- ventricular interaction appears to play an important role in affecting the biomechanics of systemic right ventricles. These observations were markedly different from those in the normal systemic left ventricle. These techniques demonstrate tools with which we can begin to evaluate surgical outcomes using regional myocardial mechanics and may provide a clue to single right ventricle failure.

Alternatives in biventricular repair of double - outlet left ventricle.

DeLeon- SY; OW-EP; Chiemmongkoltip- P; Vitullo-DA; Quinones- JA; Fisher- EA; Bharati- S; llbawi- MN; Pifarre- R

Ann- Thorac- Surg. 1995 Jul; 60(1): 213-6

Wide variation in morphology of double-outlet left ventricle allows numerous surgical alternatives that require sorting out to develop a more organized approach. There is a high association between tricuspid abnormalities and right ventricular hypoplasia with double-outlet left ventricle that calls for either Fontan- type procedure or biventricular repair. With pulmonic stenosis, biventricular repair has been accomplished using right- sided conduits. When pulmonic stenosis is mild or absent, repair techniques without conduits depend on the commitment of the ventricular septal defect (VSD). With subaortic VSD and mild pulmonic valvar stenosis, we successfully performed translocation of the main pulmonary artery and valve to the right ventricle on 2 patients (ages 32 and 8 months). Both patients are doing well 2 years and 1 year postoperatively. Others have successfully connected the right ventricle to the pulmonary artery with intraventricular baffle by enlarging a subaortic VSD or when the VSD is either subpulmonic or doubly committed. With subaortic VSD, although it has not been reported, biventricular repair can also be accomplished using a right ventricle-to- aorta baffle combined by either atrial or arterial switch. We believe that a simplified management plan can be formed in double outlet left ventricle based on the size of the right ventricle, presence of pulmonic stenosis, and commitment of the VSD. Whenever possible, translocation of the main pulmonary artery and valve or intraventricular repair should be accomplished in double- outlet

right ventricle minimizing the use of right-sided conduits and reoperation.

Non- invasive and invasive assessment of the function of aortic valve homografts in infancy and childhood.

Kadar-K; Lozsadi- K; Hartyanszky-I; Huttl- T; Haan- A; Piskothy- A; Kornyei- V
Orv- Hetil. 1995 Jun 25; 136(26): 1381-4

Study population involved 21 pts with complex congenital heart disease after corrective surgery using homograafts between the years 1986 and 1992. Diagnoses included double outlet right ventricle, tetralogy of Fallot, transposition of great arteries, truncus arteriosus, pulmonary atresia with VSD, corrected transposition with pulmonary stenosis, and absent pulmonary valve. Pts. age at surgery ranged from 18 days- to 15 Yrs mean, 6.7 Yrs. Time interval between surgery and diagnostic procedures was 8 days- 6 Yrs (mean 11 months). All pts were studied by Echo/Doppler. 2 pts by TEE and 3 pts by MRI. 6 pts had cardiac catheterisation. Distal (5) or proximal (1) stenosis was present in 6 cases. The severity and the type of stenosis was correctly identified by noninvasive technique compared to invasive findings. Homograft valve regurgitation was mild (4) or moderate (3). In two pts severe insufficiency was associated to homograft endocarditis. Postoperative residual shunts were found in 8 pts. Homograft stenosis can correctly be diagnosed using Echo/Doppler technique. Distal stenosis was more frequent than proximal. Homograft tends to become insufficient, but severe incompetence did not occur except in endocarditis.

Modified Blalock- Taussig shunt using a saphenous vein allograft. Five-year experience.

Bogats-G; Kertesz- E; Katona- M; Toszegi- A; Simonfalvi- I; Kovacs-G
Orv-Hetil. 1995 Jun 11;136(240: 1263-6

From July 1989 to June 1994 23 modified Blalock- Taussig shunts were performed using allograft saphenous veins. Veins stored in Hank's solution were implanted in 8, and cryopreserved ones were used in 15 cases. No operative death, bleeding, or infectious complication has occurred. There were 2 early and 2 late deaths, none was related to shunt occlusion. Clinical, angiographic and echocardiographic investigations proved that

the rest of the shunts are still patent and functioning well after an average of 30 months follow up. Histological studies showed that donor cells have been replaced after several months with recipient cells both in the wall and at the luminal surface of the grafts. No difference was found between veins stored in Hank's solution and cryopreserved grafts concerning clinical outcome and histology.

Anatomic correction of transposition of great vessels with entire interventricular septum. Initial results.

Garcia- Hernandez- JA; Caceres- Espejo- J; Barrera Santaana- M; Leon- Leal- JA; Grueso-Montero- J; Santos- de- Soto- J; Alvarez- Madrid- A; Romero- Parreno- A; Gil- Fournier-Carazo- M

Rev- Esp- Cardiol. 1995 May; 48(5): 333-40

Introduction.

Optimal management for patients with simple transposition of great arteries is currently the arterial switch operation. We review our initial experience to evaluate the results.

Method:

From 1988 to 1993, 21 children with simple transposition of the great arteries underwent arterial switch operation. Mean age at surgery was 10.5+/- 5.6 days, excluding two cases with two- stage arterial switch and one with late diagnosis. Patent ductus arteriosus was present in 12 cases, and a small ventricular septal defect in two. The coronary artery pattern was unusual in 9 cases. Balloon atrial septostomy was performed in 19 cases, seven of them using two- dimensional echocardiography. It was considered no necessary in the remaining two, with a large ductus arteriosus.

Results:

Total circulatory arrest was used in 13 patients (mean time 29.7+/-22.6 min). Three patients died in the early postoperative period (14.3%) in a refractory cardiac failure, one of them secondary to myocardial necrosis. The coronary artery pattern was unusual in two of died patients. All patients but three were in sinus rythm. Mean age at follow-up was 21 months (follow-up range 2 months to 5 years). Seventeen of surviving patients are in a functional state grade I and one in grade II of NYHA. There haven't been late deaths.

Conclusion: These results compared with the ones of atrial switch operation, have encouraged to us to use the arterial switch operation in all children with simple transposition of the great arteries. Increasing

experience will likely lead to improve our results.

Combined atrial and arterial switch procedure for congenital corrected transposition with ventricular septal defect.

Stumper- O; Wright- JG; De- Giovanni- JV; Silove- ED; Sethia- B; Brawn- W,J
Br. Heart- J. 1995 May; 73(5): 479-82

Objectives

A combined atrial and arterial switch procedure was performed in selected patients with congenitally corrected transposition to establish the morphological left ventricle as the systemic ventricle. Immediate and early follow up results are presented.

BACKGROUP- Progressive right ventricular dysfunction and tricuspid regurgitation are common in patients with congenitally corrected transposition who undergo repair of associated lesions. A surgical procedure which re-establishes the left ventricle as the systemic ventricle should improve functional results.

Methods: Four symptomatic children aged from 9 months to 3 years 1 month (mean 2 years 3 months) with congenitally corrected transposition and ventricular septal defect underwent both an atrial and arterial switch procedure and were followed up for a mean of 12 months (range 6-21 months).

Results: There were no early or late deaths. Conduction abnormalities worsened in two patients. Hospital stay ranged from 8 to 17 days(mean 13 days). The cardiothoracic ratio decreased from a mean (range) of 0.65 (0.6 to 0.71) to 0.58 (0.52 to 0.6). Currently, three patients are in functional class I and one child is in functional class II.

Conclusions: The combination of an atrial and an arterial switch procedure in symptomatic children with congenitally corrected transposition establishes the left ventricle as the systemic ventricle. The initial experience is encouraging with excellent immediate and early follow up results.

Magnetic resonance tomography findings in adult patients with congenital corrected transposition of great arteries.

Sunger-B; Sechtem- U; Schicha-H
Z- Kardiol. 1995 Apr; 84(4): 316-22

In four adult patients with congenitally corrected transposition (C- TGA) of the great arteries the typical anatomy and relevant additional lesions such as perimembranous ventricular septal defect stemesis (n=3), secundum atrial septal defect (n=2), sub- valvular pulmonic stenosis (n=3) and pulmonary artery dilatation (n=4) and/or relevant tricuspid tricuspid valve insufficiency (n=3) were depicted by magnetic resonance imaging (MRI) using spin-echo and gradient- echo techniques. The severity of the additional lesions could be evaluated qualitatively. Therefore, in cases of C- TGA magnetic resonance imaging may provide additional information or in selected patients may serve as a useful alternative to conventional imaging techniques such as echocardiography and angiocardiography.

Successful term pregnancy after Mustard operation for transposition of the great arteries.

Rousseil- MP; Irion- O; Beguin- F; Jaques- O; Adamec- R; Lerch- R; Friedli- B; Eur- J-
Obstet- Gynecol- Reprod- Biol. 1995 Mar; 59(1): 111-3

Transposition of the great arteries is a complex cardiac malformation with poor prognosis without surgical correction. Since the introduction of surgical procedures such as the intra- auricular reorientation of the venous return (Mustard procedure), an increasing number of patients may reach adulthood and experience pregnancy. Because long-term complications after the Mustard operation include systemic heart failure, arrhythmias, venous return stenosis and pulmonary edema, hemodynamic changes during pregnancy and delivery may potentially engender life- threatening complications in these patients. We report the case of a 24- year- old primigravida who underwent a Mustard procedure at the age of 2 years for transposition of the great vessels, and who carried out a full- term pregnancy. The pregnancy was uneventful until the 34th week, when the woman developed signs of moderate right ventricular failure and frequent episodes of accelerated junctional thythm. Digitalization improved symptoms and elicited return to normal sinus rhythm. The patient delivered at term by elective Cesarean section, under close hemodynamic monitoring.

Concomitant repair of complete atrioventricular canal defect and transposition of the great arteries in an infant.

Roughneen- P; Mahmoudian- MH; Ott- DA: Cardiovasc- Surg. 1995 Feb; 3(1): 78-80

The case of an infant who was born with the rare presentation of complete atrioventricular canal defect and transposition of the great arteries is described. The patient underwent pulmonary banding at the age of 2 months, followed by concomitant arterial switch and repair of the atrioventricular canal defect at 20 months. Palliative banding allowed for the infant to grow and thus facilitated the later successful repair of these congenital defects.

Double aortic arch in d- transposition of the great arteries complicated by tracheobronchomalacia.

Tuma- S; Slavik- Z; Tax- P; Hucin- B; Skovranek- J: Cardiovasc- Intervent- Radiol. 1995 Mar- Apr; 18(2): 115-7

Simultaneous occurrence of d- transposition of the great arteries and aortic arch malformations is very rare. A case of this malformation, the fourth case reported in the literature, is described. Despite successful surgery, tracheobronchomalacia was fatal at the age of 7 months.

Arterial switch and resection of hepatic hemangioendothelioma.

Robbins- RC; Chin- C; Yun- KL; Berry- GJ; Bernstein- D; Reitz- BA:
Ann- Thorac- Surg. 1995 Jun; 59(6): 1575-7

We report on the management of a neonate undergoing arterial switch for transposition of the great arteries and concomitant resection of a hepatic infantile hemangioendothelioma. A preoperative aortogram demonstrated the arterial supply of the hepatic hemangioendothelioma. A preoperative aortogram demonstrated the arterial supply of the hepatic haemangioendothelioma. Pulmonary artery hypertension and myocardial ischemia were noted after separation from cardiopulmonary bypass. Resection of the hepatic malformation produced an immediate reduction in pulmonary hypertension and resolution of the myocardial ischemia. The patient had an uneventful postoperative recovery.

Surgical management of tricuspid malinsertion in the Rastelli operation: conal flap method.

Niinami- H; Imai- Y; Sawatari- K; Hoshino- S; Ishihara- K; Aoki- M:
Ann- Thorac- Surg. 1995 Jun; 59(6): 1476-80

From June 1986 to May 1994, 25 patients underwent the Rastelli operation for complete transposition of the great arteries with ventricular septal defect and pulmonary stenosis or atresia. Fourteen patients whose tricuspid valve chordae were normal underwent the conventional Rastelli procedure (conventional group), whereas 11 patients who had tricuspid malinsertion into the infundibular septum underwent the Rastelli operation concomitant with mobilization of the infundibular septal flap, with the tricuspid valve chordae, to the right ventricular side of the intraventricular conduit (conal flap method) (conal flap group). In relation to the mobilization of the tricuspid valve chordae, right heart function and tricuspid regurgitation were compared between the two groups. There was one early death after the convention al Rastelli procedure and no early death after the Rastelli operation with a conal flap. There was one late death in the conventional group and two late deaths in the conal flap group. The mean follow- up was 50.8±5.1 months in the conventional group and 54.9±7.5 months in the conal flap group (p=0.43). Reoperation was necessary for 1 patient in the conal flap group during follow-up. At the most recent follow-up, all patients in both groups were in New York Heart Association functional class I. Tricuspid regurgitation was estimated from the echocardiograms. Mild to moderate regurgitation was noted in 6 patients in the conventional group and 8 in the conal flap group. However, postoperative right heart catheterization data did not show any significant differences.

Outcome of anatomical correction of transposition of the great vessels in the neonatal period.

Zabala- Arguelles- JI; Zunzunegui- Martinez- JL; de- Tomas- E; Garcia- Fernandez- EJ; Maroto- Monedero- C; Maroto- Alvaro- E; Vazquez- Lopez- P; Arcas- Mena- R:
Cir- Pediatr. 1995 Jan; 8(1): 7-10

Between February 1992 to January 1994, anatomic correction was performed on 15 patients with transposition of the great arteries and intact ventricular septum. The

mean age was 8.3±2.9 days and the mean weight 3.39±0.39 Kg. Before the operation, 13 patients (86.6%) received prostaglandin E 1 infusion and 13 patients (86.6%) underwent Rashkind septostomy. Mean aortic cross-clamps was 56±11 minutes and mean cardiopulmonary bypass was 108±91 minutes. Hospital mortality rate was 13%. Mean discharge from ICU was 13.1±12.3 days and discharge of hospital was 17.8±7.5 days. The mean follow up period was 11.4 months. All the patients remained asymptomatic with adequate psychomotor and ponderal development. All patients remained in sinus rhythm. Pulmonary suture gradient was over 60 mm Hg in five patients (33%). One patient needed reintervention and four pulmonary artery angioplasty (PAA) that was successful. In the midterm follow-up pulmonary stenosis suture was the most common complication. If the stenosis is severe, PAA should be the initial approach.

Intellectual function and age of repair in cyanotic congenital heart disease.

Oates-- RK; Simpson- JM; Cartmill- TB; Turnbull- JA:
Arch- Dis- child. 1995 Apr; 72(4): 298-301

Eighty one children, comprising 51 with tetralogy of Fallot and 30 children with transposition of the great arteries (TGA) were assessed using the Wechsler intelligence scale for children-revised, and a battery of neuropsychological measures. They were compared with a group of 33 children who had surgery for ventricular septal defect. All chiidren were aged over 10 years when reviewed and were in good health, attending normal schools. No significant negative correlation was found between any component or subtest of the IQ scores and operating age. There was no evidence of a detrimental effect of older age at operation in the childeren who had cyanotic heart disease as assessed by neuropsychological measures. Delaying surgery for children with TGA or tetralogy of Fallot does not appear to adversely affect their intellectual development. This finding may provide reassurance in cases where surgery has to be delayed for medical, social, or economic reasons.

Cognitive development of children and adolescents after correction of transposition of great vessels.

Jedlicka- Kohler- I; Sinko- Sanz- K; Schlemmer- M; Wimmer- M:
Klin- Padiatr. 1995 Mar- Apr; 207(2): 68-72

Background: To study the effect of transposition of the great arteries on later cognitive functioning. Patients: Twenty eight children and adolescents underwent psychometric testing 3.5 to 13.7 years following operation.

Methods: A battery of intelligence, attention and visual memory tasks as well as the Draw-a- Man- Test were administered. Parents completed standardized questionnaires on developmental milestones.

Results: Both, mean verbal (93±15) and performance IQs (97±21)were normal. The length of interval between operation and psychologic test but not age at repair was a significant predictor of intelligence quotient. Half of the children (9/18) showed attention deficits, 7/11 (64%) were identified as suspect of brain dysfunction. Performance on the Draw-a-Man- Test disclosed 12(43%) as slightly mentally retarded.

Conclusions: (1) Cognitive functions in children with TGA are more impaired than suggested by the results of intelligence tests. (2) Psychological and neurologic follow-up should be mandatory from early on. (3) Previous studies have overestimated children's intelligence due to unrecognized changes of test norms.

Images in cardiovascular medicine. Transesophageal ultrasound imaging during stent implantation to relieve superior vena cava- to-intra- atrial baffle obstruction after mustard repair of transposition of the great arteries.

Ge- S; Shiota- T; Rice- MJ; Hellenbrand- WM; Sahn- DJ: Circulation. 1995 May 15; 91(10): 2679-80

Late re- interventions following arterial switch operations in transposition of the great arteries. Incidence and surgical treatment of postoperative pulmonary stenosis.

Spiegelennberg- SR; Hutter- PA; Van- de- Wal- HJ; Hitchcock- JF; Meijboom- EJ; Harinck-E: Eur- J- Cardiothorac- Surg. 1995; 9(1): 7-10; discussion 10-1

Seventy- six patients were studied after arterial switch operation (ASO) between May 1977 and February 1992. Pulmonary artery reconstruction was initially performed by: conduit interposition in 5 patients, direct main pulmonary artery anastomosis and button patches in 60 patients, and pantaloon- like patch repair in 11 patients . Pulmonary stenosis developed in 17 patients (22%), requiring a total of 26 late re- interventions. Re- intervention was required in four out of five paatients operated with pulmonary artery conduits, 11 out of 60 with a button patch repair and 2 out of 11 following pantaloon--type repair. In this series pulmonary artery stenosis (PS) involving the pulmonary valve occurred in 9/17 patients. Involvement of the pulmonary valve was related to the technique of pulmonary artery reconstruction. In these patients surgery is necessary. Balloon angioplasty can be a valuable tool when the stenosis is more distal. The incidence of PS was not influenced by the type of reconstruction or the use of Lecompte's maneuver.

Modification of the Senning repair in a case of transposition of the great arteries with juxtaposition of the atrial appendages.

Dihmis- WC; Eldridge- J; Jordan- SC; Wisheart- JD:
Eur- J- Cardiothorac- Surg. 1995; 9(1): 50-1

A further modification of the Senning operation is described in a case of transposition of the great vessels with juxtaposition of the atrial appendages in which the right atrial appendage was excised and used as a free graft in the construction of the venous pathways.

Late results of systemic atrioventricular valve replacement in corrected transposition.

van- Son- JA; Danielson- GK; Huhta- JC; Warnes- CA; Edwards- WD; Schaff- HV; Puga- FJ; Ilstrup- DM:

J- Thorac- Cardiovasc- Surg. 1995 Apr; 109(4): 642-52; discussion 652-3

From December 1964 to October 1993, 40 patients (aged 5 months to 70 years, mean 21.8 years, median 13.6 years) with corrected transposition and systemic atrioventricular valve insufficiency underwent replacement (n=39) or repair (n=1) of the systemic atrioventricular valve. Thirty- nine patients had situs solitus and 1 had situs inversus. Associated anomalies included Ebstein's malformation of the systemic atrioventricular valve (n=22), ventricular septal defect (n=19), and pulmonary stenosis (n=14). Preoperatively, 16 patients (40%) had complete heart block and 27 patients (67.5%) were in New York Heart Association functional classes III and IV. The early mortality was 10.0% (n=4) and 8 patients died subsequently. The principal cause of death in all 12 patients was systemic ventricular failure. Overall survival including early mortality was 78.0% at 5 years and 60.7% at 10 years; survival excluding early mortality was 86.7% at 5 years and 67.5% at 10 years. Survivorship correlated with preoperative systemic ventricular ejection of 44% or more ($p<0.001$) and later interval of operation (9 deaths in 15 patients before 1981 versus 3 deaths in 25 patients subsequently) ($p=0.06$). There were no cases of surgically induced complete heart block. Two patients underwent late reoperations related to the systemic atrioventricular valve prosthesis. Follow-up extended to 26.0 years (median 4.7 years). At last follow-up, 18 of the 28 survivors were in New York Heart Association functional class I, 9 were in class II, and 1 was in class III. We conclude that the results of systemic atrioventricular valve replacement in corrected transposition have improved significantly during the past decade. To preserve systemic ventricular function, we suggest operation be considered at the earliest sign of progressive ventricular dysfunction as assessed by serial clinical evaluation and echocardiography.

A successful modified Aubert procedure for transposition of the great arteries with a special coronary artery pattern- a case report.

Nomura- K; Nakamura- Y; Yamagishi- M: Nippon- Kyobu- Geka- Gakkai- Zasshi. 1995 Feb; 43(2): 281-5

Transplantation of the coronary arteries is an essential and critical part of the arterial switch operation, which is considered to be the treatment for most neonate with transposi-

tion of the great arteries. The presence of an intramural segment of coronary arteries, close coronary ostia adjacent to each other increases the risk of coronary twisting and kinking after transplantation. This case has an unusual coronary anatomy characterized by two coronary ostia arising from the same aortic cusp, intramural segment in a proximal part of the left anterior descending coronary artery (LAD) and slit- like narrow ostium of LAD. This neonate was successfully operated on using Aubert modification which is the arterial switch .operation without coronary transplantation. In this method, the reconstruction of the new pulmonary trunk must be accomplished by direct anastomosis of the posterior wall in order to allow for a growth of pulmonary artery. Because of a patch retraction which was used to create its anterior wall, pulmonary stenosis may occur. In case of reoperation for pulmonary stenosis, we have only to enlarge the anterior part of the pulmonary artery to take down the stenosis. Coronary transplantation should be avoided in TGA neonate with an unusual coronary anatomy including intramural coronary artery and closed coronary ostia adjacent to each other.

A case of acquired von Willebrand disease due to pulmonary stenosis after Jatene's operation.

Shimizu- H; Katogi- T; Kato- Y; Katada- Y; Takeuchi- S; Kawada- S: Nippon- kyobu-Geka- Gakkai- Zasshi. 1995 Feb;43(2): 260-4

The case of a 9-year-old girl with pulmonary stenosis complicated by acquired bleeding tendency after Jatene's operation is reported. Coagulation study revealed that platelet count and von Willebrand factor were reduced. Catheterization study revealed severe pulmonary stenosis, the pressure gradient between the right ventricle (RV) and pulmonary artery (PA) being 190 mm Hg. A link between pulmonary stenosis and bleeding tendency was suggested and the patient was diagnosed as having acquired von Willebrand disease due to activated platelet/von Willebrand factor interactions enhanced by "shear stress" at the site of pulmonary stenosis. Right ventricular outflow reconstruction was done when she was 9 years-old. Due to a protocol based on the results of the challenge test that we instituted to determine the efficacy and effective duration of blood derivatives and hemostatic agents, perioperative massive bleeding was avoided. Bleeding tendency disappeared and coagulation study findings normalized with correction of the abnormal hemodynamic state.

The anatomical correction of transposition of the great arteries in the neonatal period.

Caffarena- Calvar- JM; Gomez- Ullate- JM; Malo- P; Minguez- JR; Carrasco- JI; Tomas-E; Garcia- E; Caffarena- Raggio- JM

Rev- Esp- Cardiol. 1995 Mar; 48(3): 187-93

Introduction and objectives. Anatomic correction of transposition of the great arteries in simple and complex form is theoretically the only procedure which offers the possibility of real cure to the problem. We report there our operative results and mid-term follow-up with this approach.

Methods: From June 1989 to February 1994, anatomical surgical correction was performed in 41 patients in the neonatal period, 31 with simple TGA and 9 patients with transposition associated with ventricular septal defect. We report our preoperative management, anatomic findings and surgical technique.

Results: Our initial experience with the arterial repair was associated with a high operative mortality. The actuarial survival rate was 74% at 56 months. Hospital mortality of the last 31 patients was 12.9%. Intermediate-term follow-up was 18 months. No late deaths. One patient underwent reoperation for supravalvular pulmonary stenosis. All survivors are in functional classI. The only significant risk factor of in- hospital mortality was the time of surgery (learning curve).

Conclusion: The initial experience with arterial repair is associated with a difficult learning curve. Primary repair must be performed during the newborn period in simple and complex transposition. Mid-term results are very encouraging. Longer follow-up is necessary to secure this technique and to render obsolete all other types of repair.

Catheter interruption of atrioventricular conduction using radiofrequency energy in a patient with transposition of the great arteries.

Russell- MW; Dorostkar- PC; Dick- M- 2nd; Craenen- J; Franklin- W; Armstrong-B

Pacing- Clin- Electrophysiol. 1995 Jan; 18(1 pt 1): 113-6

Percutaneous catheter mapping and radiofrequency ablation of the AV node- His bundle system(with subsequent transvenous endocardial ventricular pacing) were performed on an 18- year-old woman with transposition of the great arteries and intact

ventricular septum and chronic arrhythmias 15 years following a Mustard operation. Exclusion of the AV conduction tissue from the systemic venous circulation by the complex anatomy and the Mustard repair was circumvented by a retrograde approach across the aortic valve to the morphological right ventricle yielding access to the AV node- His bundle system.

Arterial switch for pulmonary venous obstruction complicating Mustard procedure.

de- Jong-PL; Bogers - AJ; Witsenburg-M; Bos-E
Ann- Thorac- Surg. 1995 Apr; 59(4): 1005-7

Two patients underwent an arterial switch procedure for the relief of severe pulmonary venous obstruction complicating a Mustard procedure. Without preparatory pulmonary banding, both patients had adequate left ventricular function due to secondary pulmonary hypertension. At 8 and 4 years after the procedure, both patients are in New York Heart Association function class I, with echocardiographic evidence of good left and right ventricular function

The left- sided atrioventricular replacement of corrected transposition of the great arteries through a left thoracotomy.

Kubota- H; Kotsuka- Y; Yagyu- K; Kawauchi- M; Tanaka- O; Koseni- K; Kaneko- Y; Furuse- A
Kyobu- Geka. 1995 Mar; 48(3): 224-7

In a 17- years- old female with dextrocardia and corrected transposition of the great arteries, whose VSD and PFO had been surgically closed through median sternotomy two years previously, the left- sided atrioventricular valve replacement was performed for its severe insufficiency. The left anterolateral thoracotomy was chosen to have good visual field and to prevent unnecessary dissection of the adhesion. The postoperative course was uneventful.

Surgical treatment of transposition of the great arteries with intact ventricular septum associated with left ventricular outflow obstruction.

Shin'oka- T; Imai- Y; Hoshino- S; Seo- K; Terada- M; Misumi- H; Ohta- J; Sugiyama- Y
Kyobu- Geka. 1995 Mar; 48(3): 175-9; discussion 180-3

Thirteen patients have undergone surgical treatment for transposition of the great arteries (TGA) with intact ventricular septum (IVS) associated with left ventricular outflow obstruction (LVOTO) in our institute. Ages at operation ranged from three months to six years (mean 9.2±4.7 months). Of these patients, seven had dynamic type LVOTO (group I), and six had organic LVOTO (group II). Preoperative left ventricular end-diastolic volume was significantly smaller in group II (78±13% of normal) than control group (135±53% of normal). Preoperative pressure gradient between the pulmonary artery and left ventricle was significantly greater in group II (55.8±3.2 mm Hg) than group I (35.2 ±3.9 mmHg). In group I, II patients underwent two-stage ASO, the other 5 patients underwent Senning operation. The reason for the Senning operation were era before introduction of ASO in our institute (1983) or unsuccessful training of the left ventricle. In group II, all but one patient underwent Senning operation, the other underwent a successful Fontan operation with Damus anastomosis because of too small left ventricle (LVEDV: 49% of normal). Techniques to correct LVOTO at the definitive operation included ventriculotomy (n=4) and pulmonary valvotomy (n=2). One patients in group II underwent a Fontan operation with Damus anastomosis due to an underdeveloped left ventricle (LVEDV: 49% of normal). There was no early or late death. The postoperative pressure gradients disappeared or reduced to trivial levels in all patients. At present no LVOTO has developed in any of the patients.

Arterial switch operation and pulmonary artery banding in infants [letter].

Flamm-SD; Jutras-LC:
Circulation. 1995 Apr 1; 91(7): 2094-6

The follow-up of transposition of the great arteries corrected by Senning's technic.

Blanch-P; Gomez-Hospital-JA; Serrano-M; Lozano-C; Girona-J; Casaldaliga-J
Rev-Esp-Cardiol. 1995 Jan; 48(1) 42-8

INTRODUCTION AND OBJECTIVES. The incidence of late complications after a physiological correction of the patients with transposition of the great arteries (D-TGA) is very significant, due to the alternative operation of the arterial switch. METHODS. We studied 125 patients with D-TGA, treated with Senning surgical correction between December of 1978 and November of 1990. Surgery was performed at a mean age of 11.7 months (from 7 days to 11.2 years), and the postoperative mean follow-up was 7.3 years (from 1.4 to 14.3 years). We analyzed their evolutive clinical condition, ECG, Holter and echocardiogram-Doppler. Four groups were defined: A) Simple, 48.8%. B) Associated with ventricular septal defect, 22.4%. C) With pulmonary stenosis, 15.2%. D) Both anomalies, 13.6%.

RESULTS. Sixteen children died (12.8%), 11 of them on the postoperative period. The remaining 5 patients died, at a mean time of 34.3 months after surgery, because they were in cardiac failure. All of patients had enlargement of right ventricle and tricuspid regurgitation was observed in 39 children. There were 3 reoperations. Atrioventricular block was observed in 5.7% of the patients, 33.3% were not in sinus rhythm, 6.6% had atrial flutter-fibrillation, sinus node dysfunction was observed in 24.7%, and five permanent pacemakers were implanted (4.7%).

CONCLUSIONS. The later mortality is not high, and the clinical outcome is good, but the frequent rhythm disturbances and enlargement of the right ventricle could let us conclude the hypothesis that anatomical correction is an optimal altermative procedure.

Balloon dilatation of stenosed pulmonary venous atrium after the Senning procedure.

Kajita-LJ; Brito-Junior-FS; Veloso-WU; Rati-MA; Arie-S
Am-Heart-J. 1995 Mar; 129(3):618-20

Status of the left ventricle after arterial switch operation for transposition of the great arteries. Hemodynamic and echocardiographic evaluation.

Colan-SD; Boutin-C; Castaneda-AR; Wernovsky-G

J- Thorac- Cardiovasc- Surg. 1995 Feb; 109(2): 311-21

Background: The potential for improved preservation of systemic ventricular function represents an important reason for the increasing popularity of the arterial switch operation. In support of this expectation, prior studies in patients early after arterial switch operation have found normal ventricular contractility and function. This study was conducted to extend those observations to up to 10 years of follow-up and to directly examine the effects of a coexisting ventricular septal defect or short-term preparatory banding of the pulmonary artery before the arterial switch operation

Methods: Patients operated on from 1983 through 1991 were included. Echocardiographic and catheterization data were collected as part of a prospective evaluation of outcome in all patients who undergo the arterial switch operation at Boston Children's Hospital, with inclusion of data from the most recent cathterization only. Echocardiograms performed at least 6 months after the operation were included, with assessment of both the most recent status as well as serial trends. Whenever possible, echocardiographic evaluation included data necessary to perform analysis of ventricular mechanics including indices of afterload, preload, and contractility. Comparison was made normal values and between subgroups defined on the basis of an arterial switch operation with or without ventricular septal defect and those who had a rapid two-stage arterial switch operation.

RESULTS: Invasive measures of left and right ventricular filling pressures, cardiac index, and pulmonary vascular resistance did differ among the three groups.

Overall, echocardiographic left ventricular end-diastolic dimension, wall thickness, mass, afterload (end-systolic wall stress), function (fractional shortening and rate-corrected velocity of fiber shortening), contractility (stress-velocity and stress-shortening relations), and preload were normal, and none of these variables was different between the groups with and without a ventricular septal defect. Serial evaluation indicated a slight but significant trend toward ventricular dilatation, perhaps related to a relatively high incidence of at least mild aortic regurgitation (30%). In contrast, in the rapid two-stage group the echocardiographic indices of left ventricular function (fractional shortening and velocity of fiber shortening) and contractility (stress-velocity and stress-shortening relations) were found to be mildy but significantly reduced compared with nor-

mal subjects and with the other arterial switch operation groups. Over the duration of follow-up encompassed by this study, no tendency toward progressive depression of function was seen.

CINCLUSIONS: As the length of observation after the arterial switch operation continues to increase, left ventricular size, mass, functional status, and contractility continues to be normal, with no evidence of time-related deterioration of function. As previously reported, the rapid two-stage arterial switch operation does represent a higher risk for mild impairment of myocardial mechanics.

Arrhythmias and intracardiac conduction after the arterial switch operation.

Rhodes-LA; Wernovsky-G; Keane-JF; Mayer-JE Jr; Shuren-A; Dindy-C; Walsh- EP
J- Thorac-Cardiovasc-Surg. 1995 Feb; 109(2): 303-10

Intraatrial baffling procedures such as the Mustard or Senning repair or transposition of the great arteries have been associated with a high incidenec of cardiac arrhythmias. These abnormalities are thought to arise from trauma to the sinus node and atrial muscle during the procedure. In the arterial switch operation, there is little intraatrial manipulation other than the repair of the atrial septal defect. In theory, rhythm disturbances after the arterial switch operation should be less prevalent. From January 1, 1983, to December31, 1990, 390 patients (230 with intact ventricular septum and 160 with a coexisting ventricular septal defect) underwent an arterial switch operation. Electrocardiograms and 24-hour Holter monitor studies were obtained in the 364 survivors at hospital discharge and during follow-up. Limited intracardiac electrophysiologic studies were performed 6 to 12 months after the operation.

Results: Atrioventricular node function was preserved in most patients; seven patients (2%) had first-degree, two (0.7%) second-degree, and five (1.7%) had complete atrioventricular block (all with coexisting ventricular septal defect). All five patients with complete heart block received a permanent pacenent pacemaker. In those patients not having a perrmanent pacemaker, sinus rhythm was present in 96% on the surface electrocardiogram and 99% during 24-hour Holter monitor studies (1 month to 8.5 years, mean 2.1 years after the operation). Intracardiac electrophysiologic studies (n= 158) demonstrated normal corrected sinus node recovery times and AH intervals in 97% of patients.Atrial ectopy was present in 152of 172 (81%) patients, with the majority (64%) of patients having only occasional premature beats without repetitive forms. Ventricular ectopy was a frequent finding during 24-hour

monitoring. At hospital discharge 70% had ventricular ectopy; these values fell to 57% (in patients with intact ventricular septum) and 30% (in patients with a coexisting ventricular septal defect) at follow-up. In the early postoperative period, there were 25 episodes of supraventricular tachycardia (14 of which required therapy) 6 episodes of junctional ectopic tachycardia, and 9 episodes of ventricular tachycardia. The incidence of supraventricular tachycarida had fallen to 5% at follow-up, with no atrial flutter or fibrillation noted. Three patients had ventricular tachycardia on follow-up Holter studies. In summary, our results confirm the theoretical advantages of anatomic correction over atrial level correction of transposition of the great arteries with respect to preservation of sinus node function and low incidence of clinically significant tachyarrhythmias.

Factors influencing early and late outcome of the arterial switch operation for transposition of the great arteries.

Wernovsky-G; Mayer-JE Jr; Jonas-RA; Hanley-FL; Blackstone-EH; Kirklin-JW; Castaneda-AR

J-Thorac-Cardiovasc-Surg. 1995 Feb; 109(2): 289-301; discussion 301-2

Between January 1983 and January 1992, 470 patients underwent an arterial switch operation at our institution. An intact (or virtually intact) ventricular septum was present in 278 of 470 (59%); a ventricular septal defect was closed in the remaining 192.

Survivals at 1 month and 1, 5, and 8 years among the 470 patients were 93%, 92%, 91%, and 91%, respectively. The hazard function for death (at any time) had a rapidly declining single phase that approached zero by one year after the operation. Risk factors for death included coronary artery patterns with a retropulmonary course of the left coronary artery (two types) and a pattern in which the right coronary artery and left anterior descending arose from the anterior sinus with a posterior course of the circumflex coronary. The only procedural risk factor identified was augmentation of the aortic arch; longer duration of circulatory arrest was also a risk factor for death. Earlier date of operation was a risk factor for death, but only in the case of the senior surgeon. Reinterventions were performed to relieve right ventricular and/or pulmonary artery stenoses alone in 28 patients. The hazard function for reintervention for pulmonary artery or valve stenosis revealed an early phase that peaked at 9 months after the operation and a constant phase for the duration of follow-up. Incremental risk factors for the early phase included multiple ventricular septal defects, the rapid two-stage arterial switch, and a coronary pattern with a single ostium supplying the right coronary and left anterior

descending, with a retropulmonary course of the circumflex. The need for reintervention has decreased with time. The arterial switch operation can currently be performed early in life with a low mortality risk (<5%) and a low incidence of reintervention (< 10%) for supravalvular pulmonary stenosis. The analyses indicate that both the mortality and reintervention risks are lower in patients with less complex anatomy.

Aortic translocation for D-TGA associated with LVOTO and VSD.

Kandeel-M; Kumar-N; Prabhakar-G; al-Halees-Z; Duran-CM
Ann-Thorac-Surg. 1995 Feb; 59(2): 515-7; discussion 517-8

Aortic translocation is a useful surgical option in certain difficult subsets of transposition of great arteries with ventricular septal defect and left ventricular outflow tract obstruction. We report here the use of this technique with pulmonary homograft reconstruction of right ventricular pulmonary artery continuity in a child with transposition of the great arteries, left ventricular outflow tract obstruction, and restrictive ventricular septal defect.

A bicuspid pulmonary valve is not a contraindication for the arterial switch.

Uemura-H; Yagihara-T; Kawashima-Y; Yamamoto-F; Nishigaki-K; Matsuki-O; Kamiya-T; Ho-SY; Anderson-RH
Ann-Thorac-Surg. 1995 Feb; 59(2): 473-6

There are no obvious criteria concerning the optimal repair for complete transposition with bicuspid pulmonary valve if neither the organic changes in the valve nor the pressure gradient between the left ventricle and the pulmonary trunk are severe. Instead of intraatrial switching or intraventricular rerouting in such circumstances, we have proceeded to the arterial switch procedure in 6 patients with an adequate diameter of the pulmonary valve (greater than 100% of the calculated normal aortic orifice). Postoperative catheterization (at approximately 8 months after the procedures) showed no pressure gradient between the left ventricle and the neorta except for a finding of 34 mmHg difference in 1 patient who had undergone simultaneous subpulmonary myotomy. Echocardiography (7 years later in the longest follow-up) has shown no more than slight

regurgitation across the bicuspid neoaortic valve with no progressive increase of blood velocity across the valve. From these results in the middle term, we conclude that the arterial switch procedure remains an option of choice for patients with initially bicuspid pulmonary valve, provided there is no severe subpulmonary stenosis.

Developmental and neurologic status of children after heart surgery with hypothermic circulatory arrest or low-flow cardiopulmonary bypass.

Bellinger-DC; Jonas-RA, Rappaport-LA; Wypij-D; Wernovsky-G; Kuban-KC; Barnes-PD; Holmes-GL; Hickey-PR; Strand-RD; et-al

N-Engl-J-Med. 1995 Mar 2; 332(9): 549-55

BACKGROUND. Deep hypothermia with either total circulatory arrest or low flow cardiopulmonary bypass is used to support vital organs during heart surgery in infants. We compared the developmental and neurologic sequelae of these two strategies one year after surgery.

METHODS. Infants with D-transposition of the great arteries who underwent an arterial-switch operation were randomly assigned to a method of support consisting predominantly of circulatory arrest or a method consisting predominantly of low-flow bypass. Developmental and neurologic evaluations and magnetic resonance imaging (MRI) were performed at one year of age. RESULTS. Of the 171 patients enrolled in the study, 155 were evaluated. After adjustment for the presence or absence of a ventricular septal defect, the infants assigned to circulatory arrest, as compared with those assigned to low-flow bypass, had a lower mean score on the Psychomotor Development Index of the Bayley Scales of Infant Development (a 6.5-point deficit, P = 0.01) and a higher proportion had scores < or = 80 (i.e., 2 SD or more below the population mean) (27 percent vs. 12 percent, P=0.02). The score on the Psychomotor Development Index was inversely related to the duration of circulatory arrest (P = 0.02). The risk of neurologic abnormalities increased with the duration of circulatory arrest (P=0.04). The method of support was not associated with the prevalence of abnormalities on MRI scans of the brain, scores on the Mental Development Index of the Bayley Scale, or scores on a test of visual-recognition memory. Perioperative electroencephalographic seizure activity was associated with lower scores on the Psychomotor Development Index (P = 0.002) and an increased likelihood of abnormalities on MRI Scans of the brain (P < 0.001).

CONCLUSIONS. Heart surgery performed with circulatory arrest as the

predominant support strategy is associated with a higher risk of delayed motor development and neurologic abnormalities at the age of one year than is surgery with low-flow bypass as the predominant support strategy.

MR velocity mapping of tricuspid flow in healthy children and in patients who have undergone Mustard or Senning repair.

Rebergen-SA; Helbing-WA; van-der-Wall-EE; Maliepaard-C;;; Chin-JG; de-Roos-A
Radiology. 1995 Feb; 194(2): 505-12

PURPOSE: To determine the feasibility and accuracy of measuring tricuspid volume flow with magnetic resonance (MR) velocity mapping in healthy children and in patients after a Mustard or Senning repair. MATERIALS AND METHODS: MR studies were performed in 14 healthy children (mean age, 12 years ± 3) and in 12 patients (mean age, 17 years ± 5) late after a Mustard or Senning repair. MR measurements of tricuspid volume flow were validated against right ventricular stroke volumes measured tomographically. Diastolic filling parameters were derived from the flow measurements. RESULTS: Tricuspid volume flow and right ventricular stroke volume showed close agreement in the healthy children (r=.98) and in the patients (r=.94). Children after Senning repair, compared with healthy children, showed a delayed and higher peak tricuspid flow rate during early filling and a lower peak flow rate during atrial contraction (P <.05). CONCLUSION: MR measurement of tricuspid flow is feasible and accurate in healthy children and in patients after a Mustard or Senning operation, who often demonstrate abnormal tricuspid flow patterns.

ANNOUNCEMENTS OF THE SOCIETY

Vol. IV, No 1 January 1996

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

1- The Different Symposia held in :

1- Imbaba National Institute on 29.6.1996

(Dr. Sherif Abdel Hady)

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)

4- Zagazig University on 7.11.1996

(Dr. Essam Abdel Wahid)

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1- Gibbs, D.L Cefoperazone a mircobiological, pharmacological, and clinical review . Internal Medicine ; 2 (3), 1983: 1-6.

2- Physician's Desk Reference, ed. 40, 1986

3- GreenField, RA et al: Pharmacokinetics of cefoperazone in patients with normal and impaired hepatic and renal function. Reviews of infectious diseases ; 5, (suppl), 1983: S 127- 136

Prescribing Information

INDICATIONS

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

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WARNINGS

Before therapy with CEFOBID is instituted, careful inquiry should be made to determine whether the patient has had previous hypersensitivity reactions to cephalosporins, penicillins or other drugs. This product should be given cautiously to penicillin-sensitive patients. Antibiotics should be administered with caution to any patient who has demonstrated some form of allergy, particularly to drugs.

If an allergic reaction occurs, the drug should be discontinued and the appropriate therapy instituted. Serious anaphylactoid reactions require immediate emergency treatment with adrenaline, Oxygen, intravenous steroids, and airway management, including intubation, should be administed as indicated.

PRECAUTIONS

General

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

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

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

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

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

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

As with other antibiotics, overgrowth of nonsusceptible organisms may occur during prolonged use of CEFOBID. Patients should be observed carefully during treatment.

Drug Laboratory Test Interactions

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

Usage During Pregnancy

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

Usage in Nursing Mothers

Only small quantities of CEFOBID are excreted in human milk. Although cefoperazone passes poorly into breast milk of nursing mothers, caution should be exercised when CEFOBID is administered to a nursing mother.

Usage in Paediatrics

CEFOBID had adverse effects on the testes of prepubertal rats at all doses tested. Subcutaneous administration of 1000 mg. per kg. per day (approximately 16 times the average adult human dose) resulted in reduced testicular weight, arrested spermatogenesis, reduced germinal cell population and vacuolation of Sertoli cell cytoplasm. The severity of lesions was dose dependent in the 100 to 1000 mg/kg per day range; the low dose caused a minor decrease in spermatocytes. This effect has not been observed in adult rats. Histologically the lesions were reversible at all but the highest dosage levels. However, these studies did not evaluate subsequent development of reproductive function in the rats. The relationship of these findings to humans is unknown.

Usage in Infancy:

CEFOBID has been effective, used in infants. It has not been extensively studied in premature infants and neonates. Therefore in treating premature infants and neonates potential benefits and possible risks involved should be considered before instituting therapy (See Usage in Paediatrics).

CEFOBID does not displaced bilirubin from plasma protein binding sites.

ADVERSE REACTIONS

Hypersensitivity: As with all cephalosporins, hypersensitivity manifested by maculopapular rash, urticaria, eosinophilia and drug fever has been reported. These reactions are more likely to occur in patients with a history of allergies, particularly to penicillin.

Hematology: Slight decreases in neutrophils have been reported. As with other beta-lactam antibiotics, reversible neutropenia may occur with prolonged administration. Some individuals have developed a positive direct Coombs test during treatment with cephalosporin antibiotics. Decreased hemoglobins or hematocrits have been reported, which is consistent with published literature on other cephalosporins. Transient eosinophilia has occured, and hypoprothrombinemia has been reported (See Precautions section on vitamin K deficiency).

Liver: Transient elevation of SGOT, SGPT and alkaline phosphatase levels have been noted.

Gastrointestinal: Altered bowel habits (loose stools or diarrhea) have been reported. Most of these events have been mild or moderate in severity. In all cases, these symptoms responded to symptomatic therapy when therapy was stopped.

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

DOSAGE AND ADMINISTRATION

The usual adult daily dosage of CEFOBID is 2 to 4 grams per day administered in equally divided doses every 12 hours. In severe infections the dosage may be increased to a total of 8 grams per day in equally divided doses every 12 hours. Twelve grams per day have been administered in equally divided doses every 8 hours and usage of up to 16 grams per day in divided doses has been reported without complications. Treatment may be started before results of susceptibility testing are available.

The recommended dosage for uncomplicated gonococcal urethritis is 500 mg intramuscularly as a single dose.

Because renal excretion is not the main route of elimination of CEFOBID, patients with renal failure require no adjustment in dosing when usual dosages (2-4 g. daily) are administered. For patients whose glomerular filtration rate is less than 18 ml/min or whose serum creatinine level is greater than 3.5 mg/dl, the maximum dosage of CEFOBID should be 4 grams per day.

Solutions of CEFOBID and aminoglycoside should not be directly mixed, since there is a physical incompatibility between them. If combination therapy with CEFOBID and an aminoglycoside is contemplated (See INDICATIONS section) this can be accomplished by sequential intermittent intravenous infusion provided that separate secondary intravenous tubing is used, and that the primary intravenous tubing is adequately irrigated with an approved diluent between doses. It is also suggested that CEFOBID be administered prior to the aminoglycoside.

In infants and children a 50 to 200 mg/kg/day dosage of CEFOBID should be given in two administrations (every 12 hours) or more if necessary. For neonates aged less than 8 days, the drug should be given every 12 hours. A dosage of up to 300 mg/kg/day has been used to treat some infants and children with severe infections, including several with bacterial meningitis, without complication.

Intravenous Administration:

Vials of CEFOBID sterile powder may be initially reconstituted with a minimum of 2.8 ml per gram of cefoperazone of any compatible reconstituting solution appropriate for intravenous administration. For ease of reconstitution the use of 5 ml of compatible solution per gram of CEFOBID is recommended.

For intermittent intravenous infusion each one-or two-gram vial of CEFOBID should be dissolved in 20 to 100 ml of a compatible sterile intravenous solution and infused over a period of 15 minutes to one hour. If sterile water for injection is the preferred diluent, no more than 20 ml should be added to the vial.

For continuous intravenous infusion, each gram of CEFOBID should be dissolved in either 5 ml of Sterile Water for Injection or Bacteriostatic Water for Injection and the solution added to an appropriate intravenous diluent.

For direct intravenous injection, the maximum dose of CEFOBID should be two grams per administration for adults and 50 mg/kg per administration for children. The drug should be dissolved in an appropriate diluent to give a final concentration of 100 mg/ml and administered over a period of no less than three minutes to five minutes.

Intramuscular Administration

Sterile Water for Injection of Bacteriostatic Water for Injection may be used to prepare CEFOBID for intramuscular injection. When concentrations of 250 mg/ml or more are to be administered, a lidocaine solution should be used. These solutions should be prepared using a combination of Sterile Water for Injection and 2% Lidocaine Hydrochloride Injection that approximates a 0.5% Lidocaine Hydrochloride Solution. A two-step dilution process as follows is recommended: First, add the required amount of Sterile Water for Injection and agitate until CEFOBID powder is completely dissolved. Second, add the required amount of 2% lidocaine and mix.

The drug should be given by deep intramuscular injection into the large muscle mass of the gluteus maximum or anterior thigh.

Reconstituted CEFOBID solutions may be stored in plastic syringes, or in flexible plastic parenteral solution containers.

Frozen samples should be thawed at room temperature before use. After thawing, unused portions should be discarded. Do not refreeze.

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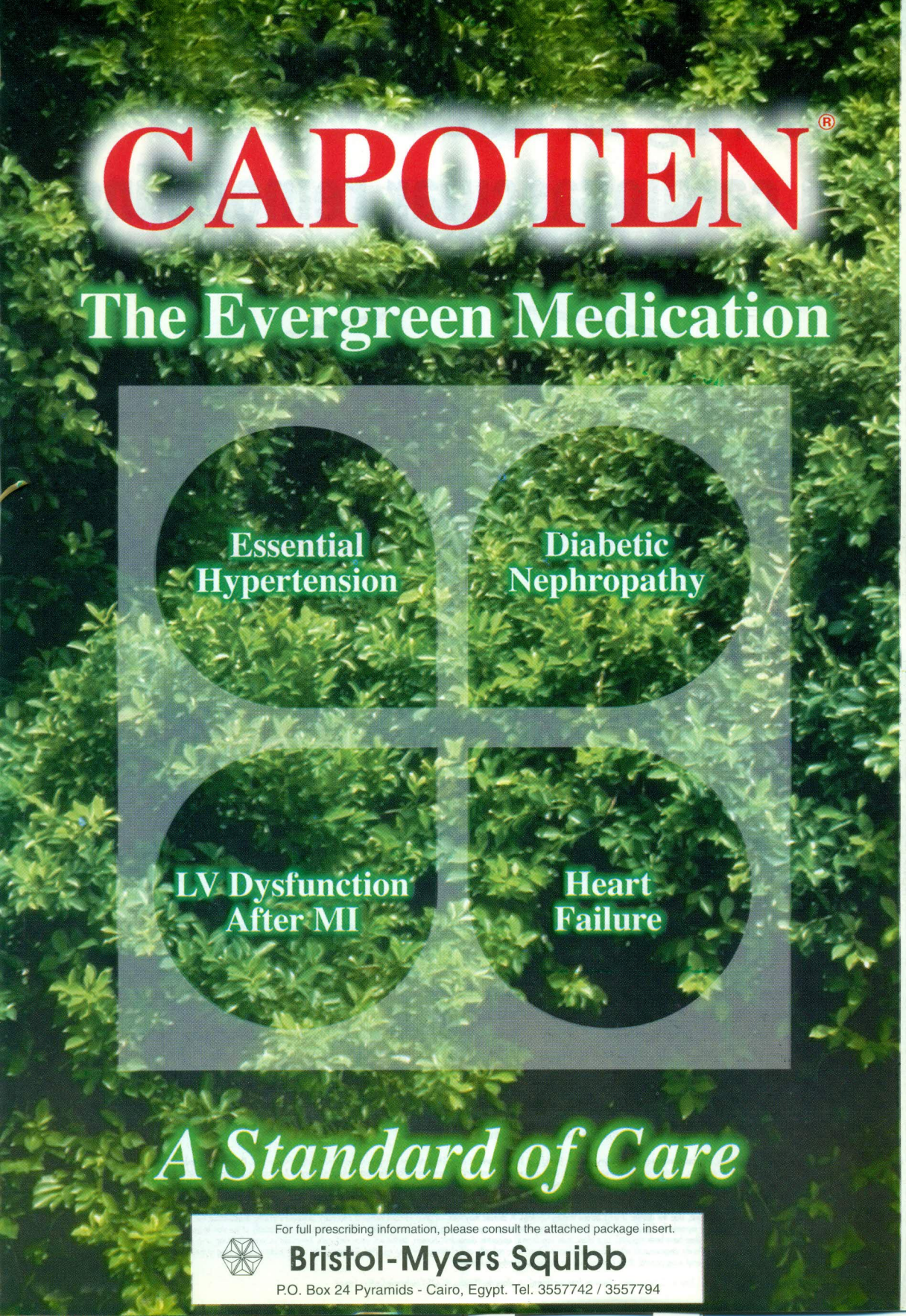
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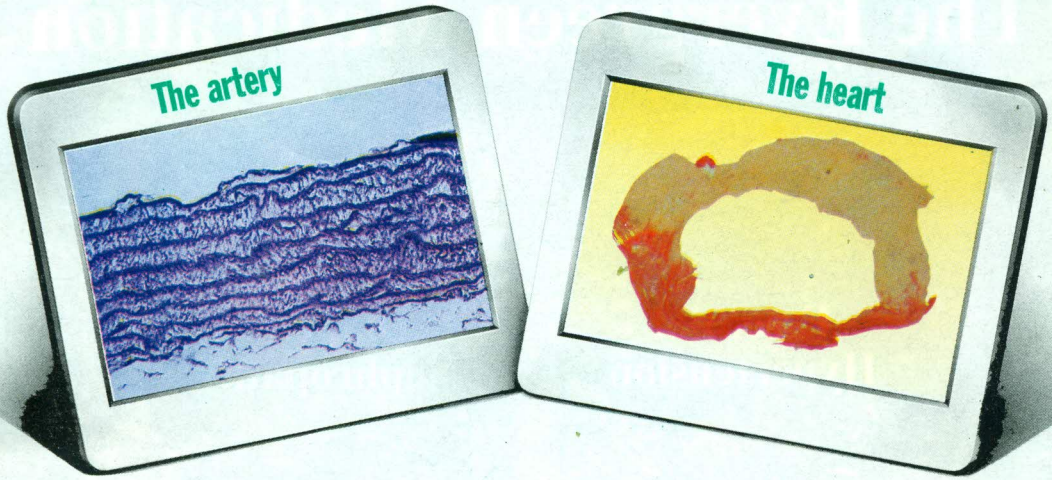

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COVERSYL® 4 mg

PERINDOPRIL

in hypertension and heart failure...

...cardiovascular remodeling is a key pathogenic feature. Coversyl 4 mg actively combats cardiovascular remodeling by correcting the structural and functional alterations of the heart and artery.[1-4]

Coversyl 4 mg is a true once daily ACE inhibitor with guaranteed antihypertensive efficacy right up to 24 hours post dose.[5]

In heart failure, Coversyl 4 mg (half-a-tablet) offers a safer start to treatment thanks to an absence of significant hypotensive first-dose response.[6]

With its original properties, Coversyl 4 mg is a high-performance ACE inhibitor in both its indications.

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

Coversyl is a long-acting ACE inhibitor. **International nonproprietary name** : Perindopril. **Indications :** Essential hypertension. Congestive heart failure (adjunctive therapy). **Dosage and administration :** *Hypertension :* 4 mg once a day in the morning. If necessary, the dose may be increased to 8 mg after one month of treatment. Coversyl should be taken before food. *Congestive heart failure :* Coversyl should be started under close medical supervision at a starting dose of 2 mg in the morning. This may be increased to 4 mg once blood pressure acceptability has been demonstrated. *Elderly patients :* start treatment at 2 mg daily. **Contraindications :** Children. Pregnancy. Lactation. Patients with a history of hypersensitivity to Coversyl. **Precautions :** Assess renal function before and during treatment where appropriate. Renovascular hypertension. Surgery/Anesthesia. Renal insufficiency : the dose should be cautiously adjusted in accordance with the creatinine clearance *(refer to complete data sheet)*. Symptomatic hypotension is rarely seen, but is more likely in volume-depleted patients, those receiving diuretics, or with the first two doses. In diuretic-treated patients, stop the diuretic 3 days before starting Coversyl. A diuretic may later be given in combination if necessary; potassium-sparing diuretics are not recommended. Combination with neuroleptics or imipramine-type drugs may increase the hypotensive effect. Serum lithium concentrations may rise during lithium therapy. **Side effects :** Rare and mild, usually at the start of treatment. Cough, fatigue, asthenia, headache, disturbances of mood and/or sleep have been reported. Less often, taste impairment, epigastric discomfort, nausea, abdominal pain, and rash. Reversible increases in blood urea and creatinine may be observed. Proteinuria has occurred in some patients. Rarely, angioneurotic edema and decreases in hemoglobin, red cells, and platelets have been reported. **Composition :** Each tablet contains 4 mg of the tert-butylamine salt of perindopril.
Presentation : Packs of 30 tablets of Coversyl 4 mg (scored). *Refer to data sheet for complete prescribing information.*

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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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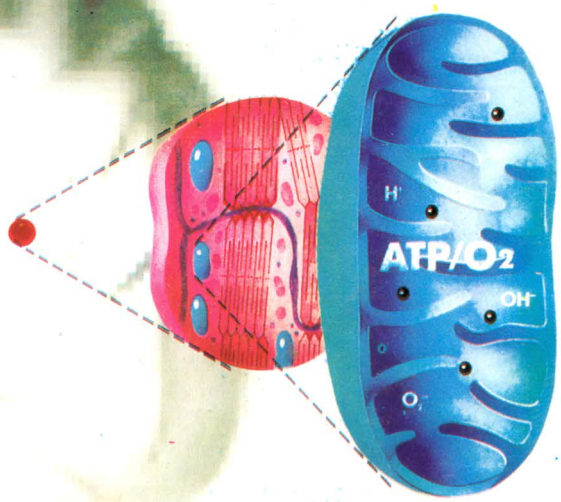

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