The New Labcor-Santiago Pericardial Bioprosthesis

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ABSTRACT The Labcor-Santiago pericardial valve has been designed to minimize mechanical stress and to avoid abrasion wear, at the same time preserving the concept of mounting the pericardium outside the posts for full orifice opening. The new design has preserved the traditional superior hemodynamic performance of pericardial valves, avoiding abrasion by careful padding of the stents and introducing a new concept of cusp attachment in order to increase mechanical durability. Since June 1980, 46 patients received 46 Labcor-Santiago valves: 29 in the aortic position and 17 in the mitral position. Mean age was 65.5 years. Eighty percent of the patients were women. New York Heart Association Functional Class III-IV was present in 76% of patients. Hospital mortality has been 12.5%, with 31% undergoing concomitant procedures. No anticoagulation was administered and there has been one thromboembolic event. Echo-Doppler assessment yielded the following in the aortic position: effective orifice area for 19-mm size = 1 cm²; for 21-mm size = 1.2 cm². Mean systolic gradient for 19-mm size = 14.7 mmHg; for 21-mm size = 11.2 mmHg. In the mitral position: effective orifice area for 27-mm size = 2 cm²; for 29-mm size = 2.3 cm². Mean diastolic gradients for 27-mm size = 4.8 mmHg; for 29-mm size = 3.3 mmHg. The low-profile flexible stent, the streamlined shape without outside prosthetic material, and the anatomical sewing rim allow a comfortable implantation of the Labcor-Santiago valve, particularly in the small aortic annulus. It is hoped that this new design will contribute to an increase in in vivo mechanical durability.

Despite continuous improvement in the design and function of artificial valves, there still remains the fact that the ideal permanent substitute does not exist.

The awareness of imperfection, coupled with a better understanding of the different modes of failure, has led to the development of new generation valves during the past few years.

The pericardial xenograft valve was introduced in clinical practice in 1971 by Ionescu1 as a three-leaflet valve constructed from a biological membrane, which is readily available and biocompatible following specific chemical treatment. This pericardial valve concept departed completely from previous biological valves, being entirely manmade and lending itself to an infinite diversity of permutations of shape.

Low thrombogenicity in the absence of chronic anticoagulation is the main aim of biological
substitutes in valve replacement. In this sense, pericardial valves have demonstrated excellent long-term results.24 In the same manner, these valves have proven to have in vitro and in vivo hemodynamic advantages over porcine valves, and similar performance to the best mechanical valves.5-10 These positive aspects prompted the initiation of our clinical experience with the Ionescu-Shiley valve (Shiley Inc., Irvine, CA, USA) in January 1977.

During these years, two different modes of primary valve dysfunction have been basically identified: mechanical (with tears, ruptures, and perforations); and metabolic (fibrillation, stenosis, and calcification). With pericardial valves, the mode of mechanical failure has been extensively reported.11-14 Our own observations seem to corroborate that the most common mechanism of failure and tear involved defects at the site where the cusp is affixed to the post. It is also assumed that the nonendothelialization fabric of the inner surface of the valve is responsible for the abrasion.12,14

Based on these considerations and with the aim of improving mechanical durability, a new three leaflet covered pericardial bioprosthesis has been developed at the University of Santiago and manufactured by Labcor Laboratorios (Belo Horizonte MG, Brazil). The present report describes the new valve design and development, the initial clinical results, and the hemodynamic comparative evaluation.

**MATERIALS AND METHODS**

**Valve design**

The new Labcor-Santiago pericardial bioprosthesis is characterized by a low-profile three leaflet valve mounted in a flexible stent of acetyl copolymer (Celcon14, Hoechst Celanese Co., Charlotte, NC, USA) covered with a soft Dacron fabric (Fig. 1).

The fixation of the selected pericardium is processed with purified glutaraldehyde in phosphate buffered saline solution at pH 7.4 without pressure. The tissue for mounting meets exact specifications for uniformity and thickness according to valve sizes, and individual cusp shape is precisely determined by a precut pattern of the pericardial tissue.

The inner surface of the valve has been selectively covered with a thinner layer of pericardium, and a new concept of attachment of each individual cusp to the post is introduced in order to lessen the cusp stress at this site and to increase coaptation area. The new bioprosthesis presents a streamlined supra-anular configuration with a scalloped sewing ring, preserving the concept of outside mounting for full orifice opening, and there is no prosthetic material in the outer part of the stent.

All completed valves are visually inspected for accurate placement of sutures, and all valves undergo in vitro testing to ensure proper closure at physiologic flow rates.

Standard in vitro testing—pressure drop, regurgitant volumes, and energy losses in pulsatile flow, as well as downstream velocity profiles by laser Doppler anemometry—has demonstrated satisfactory results when compared with other available pericardial valves.

**Patient population**

The clinical implantation of the Labcor-Santiago pericardial bioprosthesis commenced in June 1990. Since then, 40 patients have received 46 valves (Table 1). Mean age was 65.6 years (range 32-81). Seventy-eight percent of patients were men.
the patients were women. Average body surface area was 1.81 m² (range 1.34 to 1.74). There were 22 aortic valve replacements, 11 mitral valve replacements, and 7 multiple valve replacements. Overall there were 26 bioprostheses in the aortic position and 17 in the mitral position. One patient with multiple replacement had another type of pericardial valve implanted in the mitral position.

New York Heart Association (NYHA) Functional Class III–IV was present in 76% of patients. Concomitant cardiac procedures were performed in 31% of patients, mainly coronary artery bypass grafting and reoperations for dysfunctional bioprosthesis. No patient received anticoagulant treatment.

For aortic valve replacement, valves sizes were 19 mm and 21 mm in 72% of patients. For mitral valve replacement, all valves were 27 and 29 mm in size.

**Hemodynamic evaluation**

Standard M-mode and bidimensional pulsatil and continuous echocardiographic and Doppler studies were performed in 19 patients during the first 2 months after hospital discharge. The following parameters were obtained: peak systolic gradient (PSG), peak diastolic gradient (PDG), mean systolic gradient (MSG), mean diastolic gradient (MDG) in mmHg, and effective orifice area (EOA) in cm² for all sizes studied in mitral and aortic positions.

Results were expressed as individual values of each bioprosthesis studied and as the mean ± standard deviation, referred to each group by size and position.

In order to correlate the clinical hemodynamic performance of the Labor-Santiago pericardial bioprosthesis, we compared it with other commercially available pericardial valves of 19-mm size implanted at our center. The patients were selected for comparative analysis. All were in NYHA Functional Class I–II with a mean age of 63.5 years, and measurements were performed using the method previously described in a period of time not exceeding the third postoperative year. The different pericardial valves used for the comparative study are shown in Figure 1.

Five patients with a small size bioprosthesis (19–21 mm) undergoing aortic valve replacement were studied intraoperatively. After discontinuation of cardiopulmonary bypass and achievement of hemodynamic stability, an 18-gauge needle directly attached to a disposable transducer was placed in the left ventricle and ascending aorta. Simultaneous recordings were obtained and pressure gradients calculated. Three cardiac cycles were used for each determination.

**Patient follow-up**

Operative mortality was defined as death occurring within 30 days after operation. Follow-up data was obtained through direct patient contact. Data collected was entered into a computer-assisted reporting system. Two computer...

![Figure 1](image-url)  
*Left* The inflow aspect of the Labor-Santiago valve.  
*Right* The supra-annular configuration of the Labor-Santiago valve.
compatible forms, a patient registration form and a follow-up form, are completed for each patient. These source documents provided for the standardized reporting of each patient’s clinical status, pre- and postoperatively. Follow-up was 100% complete.

RESULTS

Clinical results

Hospital mortality has been 12.5% (5 patients). Three patients suffered multiple valve surgery; one was a reoperation for bioprosthetic mitral valve dysfunction with associated tricuspid annuloplasty and the other was a case of single mitral valve replacement. The cause of death in three cases was low cardiac output: in one case renal failure, and in another one respiratory insufficiency.

Only one valve-related event was documented during this short follow-up period, a thromboembolism in a mitral replacement case 3 months after surgery. The patient was left with residual neurological deficit. All patients except one are in NYHA Functional Class I–II following surgery.

HEMODYNAMIC RESULTS

Echo-Doppler evaluation

The mean values for PSG, PDG, MSG, MDG, and EOA for all sizes studied in the mitral and aortic positions are shown in Table 2. The distribution of mean gradients and EOA for aortic and mitral positions are shown in Figures 2 and 3. Figure 4 shows the mean gradient and EOA of the different pericardial bioprostheses (19-mm size) studied comparatively.

Direct intraoperative evaluation

Five patients submitted to aortic valve replacement (2 of the 19-mm size and 3 of the 21-mm size) were evaluated intraoperatively. The peak-to-peak gradient was 18 mmHg for the 19-mm valves and 13.6 ± 0.7 mmHg for the 21-mm size.

DISCUSSION

The principal advantage of biological valves is

<table>
<thead>
<tr>
<th>Valve Size</th>
<th>PSG (mmHg)</th>
<th>MSG (mmHg)</th>
<th>EOA (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>25.0 ± 3.3</td>
<td>14.7 ± 2.5</td>
<td>1.05 ± 0.1</td>
</tr>
<tr>
<td>21</td>
<td>19.5 ± 2.4</td>
<td>11.2 ± 2.8</td>
<td>1.2 ± 0.08</td>
</tr>
<tr>
<td>23</td>
<td>16.5 ± 3.4</td>
<td>9.5 ± 2.2</td>
<td>1.4 ± 0.14</td>
</tr>
<tr>
<td>25</td>
<td>16</td>
<td>7</td>
<td>1.7</td>
</tr>
<tr>
<td>27</td>
<td>8 ± 2</td>
<td>4.6 ± 0.5</td>
<td>2.0 ± 0.1</td>
</tr>
<tr>
<td>29</td>
<td>7.3 ± 1.1</td>
<td>3.5 ± 0.5</td>
<td>7.3 ± 0.1</td>
</tr>
</tbody>
</table>

PSG = peak systolic gradient in mmHg; MSG = mean systolic gradient in mmHg; EOA = effective orifice area in cm²; PDG = peak diastolic gradient in mmHg; MDG = mean diastolic gradient in mmHg.

Figure 2. Mean diastolic gradient (MDG) in mmHg and effective orifice area (EOA) in cm² for each mitral valve by size.

Figure 3. Mean diastolic gradient (MDG) in mmHg and effective orifice area (EOA) in cm² for each aortic valve by size.

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Figure 3. Mean systolic gradient (MSG) in mmHg and effective orifice area (EOA) in cm² for each aortic valve by size.

Figure 4. Aortic mean peak systolic gradient (PSG) and aortic mean effective orifice area (EOA). B = Bioflo bioprosthesis; C-E = Carpenter-Edwards pericardial bioprosthesis; I-S = Ionescu-Shiley bioprosthesis; L = Labcor standard bioprosthesis; L-S = Labcor-Santiago bioprosthesis; M = Mitroflow medical bioprosthesis.

freedom from anticoagulation on a permanent basis.

In 1971, Ionescu and his associates used glutaraldehyde preserved bovine pericardium mounted on a stent to fashion a valvular prosthesis. This bioprosthesis manufactured by Shiley was widely used since 1976 as the Ionescu-Shiley pericardial xenograft until 1987.

The three-leaflet valve was designed based on the concept of outside mounting for full orifice opening and, throughout the years, has demonstrated low intrinsic thrombogenicity in the absence of chronic anticoagulation. This favorable aspect achieved with the pericardial valves appears to be due to its design and tissue. The regular streamlined structure confers synchronous opening and closing characteristics and performs adequately, even in the presence of low flow rates. The superior hemodynamic performance of these pericardial valves, which is reflected in a larger effective orifice for any given annulus size and lower transvalvular gradients at different flow rates, in vitro and in vivo, is most noticeable in patients with a small aortic annulus, as recently reported by Bojar et al.
Other pericardial designs have demonstrated a hemodynamic behavior less favorable than the Ionescu-Shiley valve, particularly in small sizes. The withdrawal of this valve from the market in 1987 created a problem in bioprosthetic valve selection for this particular group of patients. At the same time, long-term durability of this type of valve has been affected by a particular mode of failure related to its structural design, tears, and ruptures due to abrasion and inadequate commissural stitch fixation.11,12,14

In our own experience with valves of the Ionescu-Shiley type, primary dysfunction due to mechanical failure has reached almost 50% of all dysfunctions at a mean duration of 80 months. This fact has been corroborated by other groups, suggesting that modifications in valve structure are required in order to achieve a longer mechanical valve performance.19,20

We have been involved in the clinical use of pericardial valves for over 14 years, mainly due to our peculiar demographic patient characteristics, patients unsuitable for chronic anticoagulation with small body surface areas, geographic dispersion, and relatively low social and economic standards. All these considerations prompted us to design and develop, in conjunction with Laboro Laboratories, a new generation pericardial valve with potential improvements that may achieve longer durability in vivo, at the same time preserving the traditional superior hemodynamic characteristics based on the concept of a three leaflet outside mounting valve.

As mentioned previously, there has been accumulating evidence in the literature of premature intrinsic failure of the Ionescu-Shiley valve types due to leaflet tears generated by abrasion. To avoid this problem due to the nonendothelialization of the fabric, the new Laboro-Santiago valve has been selectively covered with a thin layer of pericardium in its inner surface.

In vitro studies with accelerated fatigue testing have shown that, in this way, abrasion of the leaflets is eliminated and improved durability in several million cycles is obtained.19,20 During development, however, several prototypes were studied and we noticed that indiscriminate paddling substantially increases the pressure drop, leading to a reduction in EOA. Doppler ultrasound comparative studies performed at our center have shown that with the Bioflo bioprostheses (Biomedical Systems Ltd., Strathclyde, Scotland), a new generation peddled pericardial valve, unacceptable gradients in small sizes are generated.18

The assessment of our failed valves suggests a primary role for the commissural/suture-alignment stitch as the site of initial cusp wear and tear, as has been postulated by Walley and Keon.11 We have paid special attention to these observations, particularly after noticing that the low-profile Ionescu-Shiley valve with a modified suture-alignment stitch failed in the same manner and proportion, despite the improved results obtained in vivo.14

A new concept of cusp attachment was introduced in the Laboro-Santiago valve by directly stitching the pericardium to the post and passing a small area of pericardium above the post so that the suture at that point does not wear the pericardium, at the same time increasing the coaptation area and maintaining the curvature in the affixed area.

Different variables such as leaflet height, coaptation depth, leaflet mass density, spherical leaflet shape, commissural suture-alignment fixation, tissue thickness for cusps and covering, fiber orientation, anatomically contoured sewing rim, and streamlined shape without outside prosthesis material were all considered in order to achieve what we believe to be the optimal combination.

The determination of gradient measurements in asymptomatic patients is helpful in establishing a norm for the evaluation of bioprosthetic valve function. It should be kept in mind, however, that the maximum instantaneous gradient calculated from the flow velocity with continuous-wave Doppler studies is routinely higher; often by 10 to 20 mmHg, than pull-back peak-to-peak gradients determined at cardiac catheterization.5

The clinical evaluation of the Laboro-Santiago valve commenced in June 1990 after the in vitro studies. To date, 40 patients have been entered into the clinical trial. Hospital deaths have not been valve related, and there has been only one thromboembolic event, which occurred during
the high-risk period after surgery in a patient with previous left atrial thrombosis. In our comparative study with several available pericardial valves implanted at our center, we have been able to demonstrate satisfactory hemodynamic results with the Labor-Santiago valve, particularly in cases with an aortic annulus of 19-mm size. This data is only improved on by the Ionescu-Shiley valve with regard to gradients but it is similar when considering EOA.

The low-profile flexible stent, the streamlined shape without outside prosthetic material, and the anatomical sewing rim allow an easy implantation of this bioprosthesis, particularly in the small aortic annulus.

At this early stage, our clinical results are encouraging and the hemodynamic function of the valve is similar to the best pericardial valves, but confirmation of the improved durability obviously must await longer term follow-up.

REFERENCES


Tissue Valves in Young Patients—A Recipe for Disaster

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ABSTRACT Between 1984 and 1987, tissue valves were used for valve replacement in 37 patients < 20 years of age. In 26 patients, porcine valves were used and in 11 patients, antibiotic sterilized allografts were used. Follow-up of these patients is from 3 to 8 years. In the xenograft series, 13 patients developed documented aortic stenosis of the valve resulting in death or reoperation, and three patients died in circumstances strongly suggesting prosthetic dysfunction. In the group where homografts were used, four patients have developed valve degeneration. Of the 37 patients in whom tissue valves were used, only 11 are currently well with the original prosthesis. In sharp contrast we have a group of 55 young patients in whom a tilting disc valve (Medtronic Hall) was implanted between 1983 and 1987. During the period of follow-up, there have been three episodes of thrombotic valve obstruction of which one was fatal. There have been three systemic emboli, and actuarial freedom from valve-related death, reoperation, or thromboembolism is predicted at 86% at 7 years. In our experience, allografts and xenografts have been found totally unsatisfactory in young patients. Their use should be abandoned in favor of mechanical valves in this age group.

The choice of a replacement device for valve replacement in children and young adults presents many difficulties. In a third world population these difficulties are compounded by poor patient compliance, making the control of anticoagulation uncertain. Between 1983 and 1987, we managed rheumatic valve disease by valve replacement in 92 patients under the age of 20. During this period, aortic allografts, porcine heterografts, and the Medtronic Hall tilting disc valve (Medtronic, Inc., Minneapolis, MN, USA) were used. The purpose of this study is to evaluate our experience with these valves.

MATERIAL AND METHODS

In 1984 a new generation tissue valve (The Intact Bioprosthesis) became available for clinical use, and between 1984 and 1987 this device was implanted in 26 patients. During the same period, antibiotic sterilized homografts were implanted in 11 patients. Between 1983 and 1987, the Medtronic Hall valve was implanted in 55 patients. These three groups comprised the clinical material for this study. Most of the patients were in the New York Heart Association functional Class III or IV preoperatively. Atrial fibrillation was present in only five patients. One patient has been lost to follow-up, which is 98.9% complete. All operations were carried out using conventional cardiopulmonary bypass, moderate hypothermia, and crystalloid cardioplegia. Actuarial curves were constructed using the method proposed by Kaplan and Meier.


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Tissue Valves in Young Patients

Results

Porcine xenografts

There were 26 patients in this group and the clinical characteristics are listed in Table 1. None of these patients has been lost to follow-up. Of these 26 patients, 16 developed documented or presumptive evidence of calcific stenosis, and only four patients are currently well with normally functioning valves (Table 2).

Aortic allografts

There were 11 patients in this group, one of which has been lost to follow-up. Valves were placed “freehand” in the aortic position and stented valves were placed in the mitral position. The clinical characteristics are detailed in Table 1. This group has been followed for 3 to 5 years (Table 2) and five patients are currently well with normally functioning valves. Four patients developed valve degeneration and in three of these patients, valve degeneration was associated with calcification of the cusps. Two of these four patients are currently alive, having survived reoperation.

The actuarial survival of the xenograft and allograft groups is shown in Figure 1. There is no significant difference. Comparison of valve-related complications is shown in Figure 2. This data suggests that the allograft performs considerably better than the xenograft. Although the number of allografts is small and the data may be challenged on these grounds, we no longer use allografts in young patients.

Medtronic Hall valve

There were 65 patients in this group and their characteristics are shown in Table 1. During the

![Figure 1. Actuarial curves showing patient survival for allografts (A), xenografts (Xen), and Medtronic Hall (M-H) valves.](image)

![Figure 2. Actuarial curves showing freedom from all valve-related complications for allografts (A), xenografts (Xen), and Medtronic Hall (M-H) valves.](image)
period of follow-up, there have been eight valve-related complications of which four were fatal (Table 3). The actuarial survival of this group at 7 years is 85% (Fig. 1) and freedom from valve-related complications is 82% (Fig. 2).

**DISCUSSION**

Children and young adults present special problems when strategies for dealing with valve disease are formulated. While valve repair would appear to be the best option in young patients, this form of management has been found to be unsatisfactory when the pathology is on a rheumatic basis.2,3 Ongoing and recurrent rheumatic fever results in breakdown of the repair within a short time, and there is unfortunately no alternative to valve replacement in this group. The control of anticoagulation is difficult in children and, in our patients who are largely from the third world section of our population, it is usually impossible. Furthermore, anticoagulation in children increases the likelihood of bleeding because of the increased liability to trauma. When tissue valves were introduced in the early 1970s, they were regarded as the valve of choice in children because they obviated the need for the use of anticoagulants. It soon became apparent that they were subject to early degeneration and most surgeons discontinued their use in children.4,5 The Intact Bioprosthesis became available for clinical use in 1984. It was treated to mitigate against calcification and, in the belief that this treatment would be effective, we implanted the valve in a number of children and young adults. The results were appalling. In 16 patients, accelerated calcification occurred and only four of the 26 patients are currently well with normally functioning valves. The rate at which clinical deterioration occurred was alarming. Deterioration was extremely rapid and was often measured in days rather than weeks. Many patients presented in acute pulmonary edema and repeat surgery was undertaken as an emergency procedure. There is a commonly held view that tissue valves fail slowly, providing ample time for repeat surgery. While this may be true for adults, it is certainly not so for young patients.

In the small group of patients in whom allografts were used, calcification occurred. Early

| Table 3: Medtronic Hall Valve: Late Mortality and Morbidity |
|----------------|----------------|
|                | Fatal | Nonfatal |
| Clotted Valve  | 2     | 1       |
| Embolus        | 1     | 2       |
| Anticoagulant Bleed | 1 | 1       |
| Not Valve Related | 3 |           |
| Total          | 7     | 4       |

Long-term results (3-5 years) of 55 patients undergoing valve replacement with the Medtronic Hall valve:

calcification of the cusps of allografts is unusual, and it may well be that the third world population that forms the subject of this study has a greater susceptibility to calcification. While allografts appear to be more successful than xenografts in young patients, it is our view that all biological valves are unsuitable for use in this group of patients.

During the period of study, the Medtronic Hall valve was used in 55 patients. The results in this group are excellent and at 7 years the actuarial survival is 85% (Fig. 1), and 82% of patients are free from valve-related complications (Fig. 2). The low rate of valve-related complications has been recorded in the face of poor compliance with anticoagulants, with only 16% of our patients being regarded as adequately anticoagulated. This low rate of thrombosis and embolism requires explanation. Most of our patients are in sinus rhythm and, in most, the heart returns to normal or near normal size following surgery. Most, being young, are very active and the increased physical activity results in blood crossing the valve at a greater velocity, producing a greater “wash back” effect. The freedom from valve-related complications for the Medtronic Hall valve, the allograft, and the xenograft are compared actuarially in Figure 2. This data highlights the unsuitability of tissue valves in children and young adults.

**CONCLUSION**

We have shown that a new generation porcine valve that has been treated to mitigate against calcification has nevertheless calcified early. While allografts have performed better than
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xenografts, and although our numbers are small, we believe that the allograft is also unsuitable for use in children. It is our view that tissue valves are contraindicated in children and young adults and that their use should be abandoned in favor of mechanical valves. In our experience, the Medtronic Hall valve has been shown to be a satisfactory replacement device in this challenging group of patients.

REFERENCES


Long-Term Results After Right Ventricular Outflow Tract Reconstruction with Porcine Bioprosthetic Conduits

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ABSTRACT From 1975 to 1990, a total of 110 patients were operated for complex cardiac malformations with impaired pulmonary artery perfusion using porcine valved right heart to pulmonary artery conduits. Twelve- to 30-mm porcine valved conduits (Hancock or Carpentier-Edwards) were implanted at the age of 4 weeks to 28 years (mean 4.3 years). The patients' body weights were 2.9–68 kg (mean 15.3 kg). Early mortality was 5.5% (six patients), late mortality was 12.7% (14 patients), and 90 patients could be included in this long-term follow-up (426 patient-years). So far, 41 of the conduits had to be exchanged 4 months to 15 years (mean 6.5 years) after the first implantation. Forty-nine of the conduits are still in place. At reoperation, 38 patients received an allograft; three patients, reoperated before 1982, had a second xenograft. The main reason for porcine conduit malfunction was degeneration and/or calcification of the valves. In 11 patients, however, with 12- and 14-mm conduits implanted at a mean age of 3.1 years, a reoperation was necessary after a mean time of 6.8 years because these children had "outgrown" the conduit and needed a bigger one. We conclude that even though allografts seem to be the conduit of choice for right ventricular outflow tract reconstruction, our clinical experience shows that porcine valved conduits can be used just as well since most of them function sufficiently well for as long as 5 to 10 years, and early valve failure is relatively rare.

The use of valved conduits is a clinically well-established method for the reconstruction of the right ventricular outflow tract (RVOT) in patients with impaired pulmonary artery perfusion due to cyanotic congenital anomalies. Xenografts, as well as allografts and in some cases also non-valved conduits, were used for this purpose. Over the last years, the use of allografts has been favored by most surgeons and their results seem to be encouraging. But there were also studies that showed no significant differences between the long-term performance of allografts and xenografts.1 We therefore analyzed our experience with xenografts with respect to their long-term performance and durability.

MATERIALS AND METHODS

Between July 1975 and December 1990, 110 patients received extracardiac porcine valved conduits (Hancock [Medtronic, Inc., Minneapolis, MN, USA] and Carpentier-Edwards [Baxter Healthcare Corp., Edwards CVS Division, Irvine, CA, USA]) (sizes 12–30 mm) for the reconstruction of the RVOT. Six patients died early (up to 30