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Subvalvular Septal Myectomy and Enlargement of the Narrow Aortic Root in Patients with Aortic Valve Replacement

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— Abstract —

In candidates for aortic valve replacement (AVR)it is our primary intention to implant the largest possible vale prosthesis of at least 23 mm in diameter in patients with severe valvular aortic stenosis. However, in many patients there is an additional subvalvular asymmetric septal hypertrophy which in some cases may cause an postextrasystolic increase of the LV-aortic gradient. Another component of the aortic stenosis syndrome is a narrow valvular ring, or a combination of both. After complete removal of the diseased valve and decalcification the narrow aortic ring (< 23 mm)can be widened firstly by transaortic subvalvular septal myectomy-(TSM)thus unfolding the left ventricular outflow tract(LVOT)and secondly by extending the oblique aortic incision into the aortic valve ring or further down into the anterior leaflet of the mitral valve. The sub-and supravlular defect will be closed by patch enlargement of the aortic root(PEAR)using autologous pericardium.

These techniques allow a considerable enlargement of the valvular ring of about 4 to 10 mm in circumference.

In a retrospective study using a computerized program, 847 patients with AVR(1980-1984)were reviewed to evaluate the intraoperative hemodynamic results mainly concerning relief of the transvalvular gradient. In 626 patients AVR was performed, 151 patients had double valve replacement(AVR+MVR), and 70 patients had AVR plus additional surgical procedures.

Concentrating on the AVR-group (n=626) there were 103 patients with TSM, 24 patients with PEAR and 20 patients with TSM+PEAR which demonstrated that in a total, of 147 patients of this groups(23.5 %) an additional procedure was necessary.

The Statistical evaluation of the intraoperative pressure measurements before and after AVR in relation to the size of the implanted prostheses indicated the lowest preoperative mean gradient in patients with AVR alone, the higest in patients who afforded TSM plus PEAR. However, after AVR the mean gradients in all three groups were very low(mean 5 to 10 mmHg).

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These data indicate that in patients with a narrow aortic ring and additional considerable ASH, TSM and PEAR are suitable techniques to enlarge the aortic root to enable the implantation of an adequate aortic valve prosthesis. Long-term controls have shown that autologous pericardium is a qualified graft material for the ascentding aorta.

Since the introduction of aortic valve replacement(AVR)for aortic valvular stenosis, the problem of a narrow aortic ring and implantation of an adequate sized valve prosthesis is evident. On the other side it is our primary intention to implant the largest possible prosthesis in relation to the means of the individual patient in order to reduce the transvalvular gradient as far as possible. Another restrictive component for this goal may be an additional secondary subvalvular asymmetric septal hypertrophy which is influencing the behaviour of the left ventricular outflow tract(LVOT), for instance postextrasystolically such imitating the so-called Brockenbrough phenomenon which is pathognomonic for patients with a hypertrophic obstructive cardiomyopathy(HOCM). In this situation it is our experience since the early seventies to follow mainly two techniques to render possible the implantation of an adequate sized valve prosthesis:

1. Transaortic subvalvular septal myectomy.
2. Oblique aortic incision into the middle of the noncoronary part of the aortic valve ring, in some cases also into the anterior aortic mitral valve leaflet, with subsequent patch enlargement of the aortic ring and root using autologous percadium.

In the following series of patients the aortic incision went only into the aortic valve ring, not into the anterior mitral valve leaflet.

Materials and Methods

In a retrospective study from 1980 to 1984 all patients with AVR were reviewed. Out of a total of 847 patients with AVR, 221 patients had combined procedures: one hundreds and fifty double valve replacement(AVR+MVR)and 70 had AVR plusaortocoronary bypass grafting(ACBG).

In the following we will concentrate on the 626 patients with single AVR.

Concerning operative indication, all patients with aortic valve disease belonged to clinical class III and IV(NYHA). All procedures were performed using the same techniques for extracorporeal circulation(general hypothermia 23~27℃, high flow perfusion, priming with Ringer's lactate, myocardial preservation (cold crystalloid Bretschneider cardioplegic solution)and surgical implantation by single vertical U-stitch technique after complete resection of the aortic valve and decalcification of the aortic ring and supra-and subvalvular region. For replacement of the aortic valve, three prosteses were used: Saint-Jude Medical, Björk-Shiley, and Ionescu-Shiley pericardial bioprosthesis. For adults it was our intention to implant at least a 23 mm prosthesis, except in small woman a 21 mm prosthesis.

In patients with a visible or functionally measur-able subaortic muscular stenosis (Brockenbrough phenomenon) transaortic subvalvular septal myocardial excision was preformed using the same technique as in patients with hypertrophic obstructive cardiomyopathy (HOCM)as proposed by Morrow[5].

For aortic root enlargement, autologous pericardium was sewn into the residual opening of the basic aortic incision during or after implantation of the prosthesis. During prosthetic valve implantation, the pericardial patch is placed between aortic ring and prosthesis with the vertical U-stitches. In cases after implantation of the prosthesis the pericardium is fixed by three to four horizontal U-stitches including the prosthetic ring, the aortic basis and a Teflon or Dacron-strip positioned outside the aorta for safe knotting of the suture. Afterwards both sides of the triangle shaped peri-

cardial patch are sewn into the oblique aortic incision.

In the years from 1980 to 1984 there were no significant differences between the numbers or patients per year with AVR alone, additional myectomy and/or pericardial patch enlargement. However, the distribution of the numbers of different surgical procedures in relation to the size of the implanted prosthesis indicates clearly the preference of the smaller valve ring sizes as 21, 23, and also 25 mm for the SJM-prosthesis(Figure 1). In most of our cases AVR was sufficient. Additional techniques were necessary to enable an implantation of a 21, 23, or 25 mm prostesis.

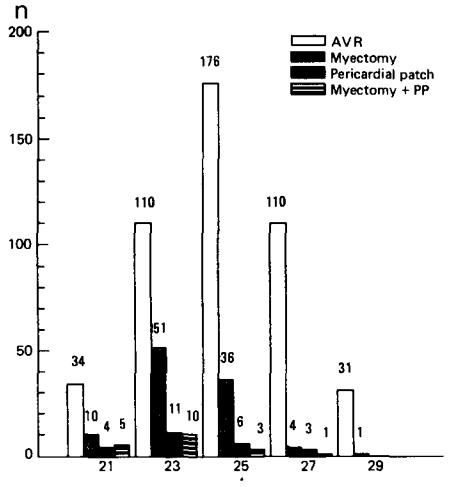

Fig. 1. Distribution of the different surgical procedures in relation to the size of the implanted prosthesis after AVR(n=626).

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The considerable number of additonal procedures in the larger valve size groups were performed in larger sized patients, in patients with postextrasystolic paradoxical pressure behaviour during intraoperative pressure documentation before going on bypass, in patients with visible massive subvalvular stenosis, or in consequence of an error of the surgeon in choosing the patient-adequate size of the prosthesis.

Concerning mean age of male and female patients, we found that female patients were usually older(56.7±3 years) than male patients (53.2±2 years).

Looking after the types of aortic prosthesis and their distribution, we found a general preference of the SJM-valve (Figure 2). Also in small-er sizes(21 to 25 mm)and in patients with additional procedures the SJM was preferred. As our indications for biopros-theses are limited to special; indications and to patients over 65 years of age.

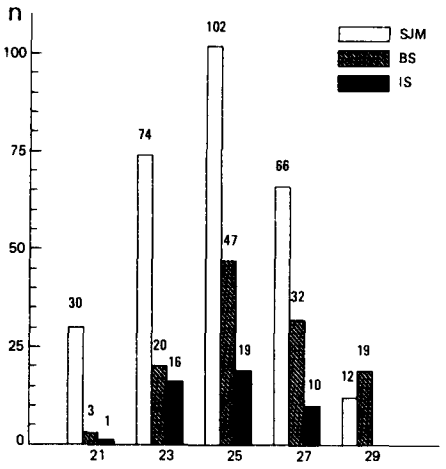

Fig. 2. Distribution of types of implanted prostheses in relation to size after AVR.(SJM=St. Jude Medical;BS=Björk-Shiley;IS=Ionescu-Shiley bioprosthesis).

Only 46 our patients receive a Ionescu-Shiley bioprosthesis. There was only one bioprosthesis size 21 implanted.

The total groups of patients demonstrated a significant difference of the mean gradients between the left ventricle and the ascending aorta before going on bypass in simultaneous pressure measurements (Figure 3). These mean gradients were about 65 mmHg in AVR, about 90 mmHg in AVR plus myectomy, and about 110 mmHg in AVR plus pericardial patch enlargement(PP) plus myectomy. Thus the highest gradients coincide clearly with the additional need of surgical procedures.

The intraoperatively measured mean gradients

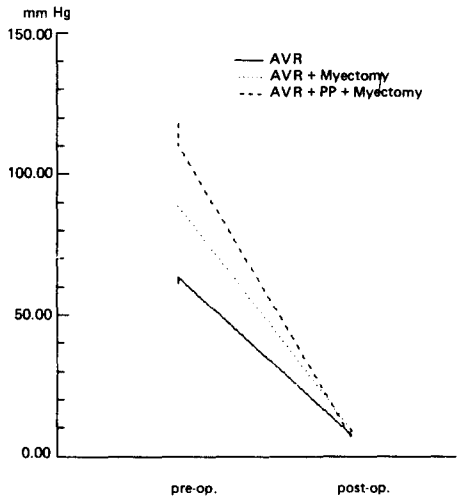

Fig. 3. Intraoperative mean pressure gradients between left ventricle and ascending aorta before and after AVR and additional surgical procedures. AVR n=479;AVR+myectomy n=103;AVR+pericardial patch(PP)+myectomy n=20.

after coming off bypass and after valve replacement demonstrate for all groups a nearly identical residual gradient of about 10 mmHg or less which is acceptable.

More detailed results could be demonstrated for the different prosthesis size groups implanted: 21, 23, 25 mm. For the 21 mm prosthesis the preoperative mean gradients were 73 mmHg for AVR(n=34)and AVR plus myectomy (n=10), whereas for AVR plus pericardial patch plus myectomy it was 172 mmHg (n=5). The intraoperative mean gradients after AVR were between 2 and 10 mmHg. For the 23 mm prosthesis we found significantly different preoperative gradients of about 75 mmHg for AVR (n=110), of about 100 mmHg for AVR plus myectomy(n=51), and about 120 mmHg for AVR plus myectomy plus pericardial patch (n=10). After AVR the mean gradients were about 10 mmHg. For the 25 and 27 mm sizes there no significant differences.

Concerning the early results we found an increasing risk for the patient with the performance of additionally necessary surgical procedures to implant an adequate sized valve substitute(Table 1). For single AVR hospital mortality was 3.5 per cent, however, for AVR plus mycetomy plus autologous pericarcial patch enlargement there were three deaths out of 20 patients resulting in a hospiatal mortaity of 15 per cent.

Table 1. Subvalvular Myectomy and Aortic Root Enlargement in AVR 1980—1984

Procedures	No. Patients	Hospital Mortality No.	Percent
AVR	479	17	3.5
AVR+SSM	103	2	1.9
AVR+PEAR	24	3	12.5
AVR+SSM+PEAR	20	3	15.0
Total	626	25	4.0

Discussion

Since the publications of the Mayo Clinic[3,7] it is known that autologous pericardium is a valuable patch material of right ventricular outflow-tract and aortic root enlargement. Later on Stenseth et al.[9] from the same institution reported about their tech-niques for managing patients with a narrow aortic root including a resection of subvalvular hypertrophic myocardium as an additional help. Also Gill and coworkers[2] from the Cleveland Clinic reported their experiences in patients with aortic valve disase and narrow aortic root (n=43) using SJM- prostheses and additional ventricular septal splitting which may allow to implant a larger prosthesis. However, they pointed out that this technique may cause an increased morbidity and mortality and that the long-term effects on cardiac function have not been investigated and are not really known. In an earlier publication of our group[8] we followed 28 patients 15 months to 10 years (mean 4 years) with autologous pericardial patch enlargement out of a group of 661 patients with AVR from 1970-1979.

Postoperative clinical controls as well as x-ray, angiography and computed tomography did not

indicate any complication from the implanted autologous patch graft. In our present series of patients(1980 to 1984)additional positive surgical experiences with HOCM influenced the surgical technique in patients with a narow aortic root distinctly. This resulted in a higher incidence of intraoperative myectomies because our previous impression confirmed that by transaortic subvalvular septal myectomy the narrow aortic valve ring may be better unfolded (dilated)for about four to eight mm in circumference which usually allows to implant a larger-sized valvular substitute. Only in selected cases with an extremely narrowed aortic ring(children, adolescents)we would extend the oblique aortic incision transverse the aoric valve ring into the anterior mitral leaflet, a technique described by Nicks et al[6].

Recently Dalichau et al[1] reported their late results following enlargement of narrow aortic root using autologous pericardium in 31 patients with a mean fooolw-up time of 52.5 months. In some patients a modivied Nicks procedure or an incision between the left and noncoronary sinus[4]was performed. There was no evidence of mitral valve functional disturbances, paravalvular leakage, or dysfunction of the pericardial patch.

In general, it is our experience that the described tehchniques of complete aortic valve resection and decalcification, subvalvular myectomy and patch graft enlargement of the aortic root using autologous pericardium usully allow the implantation of an adequate sized aortic valve substitute.

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