Surgical treatment of dilated cardiomyopathy with conventional techniques

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Abstract

Objective: We review our surgical experience using different conventional surgical techniques in the surgical treatment of the dilated cardiomyopathy (DCMP) in non-transplant eligible patients. Methods: In this series we included patients who fit the following criteria: ejection fraction \( \leq 35\% \); end diastolic volume \( \geq 110 \text{ ml/m}^2 \); enlargement of the base of the heart (maximal mitral diameter \( \geq 22 \text{ mm/m}^2 \)) with functional mitral regurgitation; mitral surgery to be performed in every case. Moreover, two groups were considered. (A) Normal or moderately impaired right ventricular function; PAP \( \leq 45 \text{ mmHg} \); elective or semielective surgery. (B) Severely impaired right ventricular function; PAP \( \geq 45 \text{ mmHg} \); severe organ failure; dependency on IABP and/or inotropes; need of ICU stay. From January 1990 to September 1998, 66 patients underwent isolated mitral valve surgery \( (n=30) \); in the remaining 36 the Batista operation \( (n=21) \) or exclusion of akinetic areas \( (n=15) \) were associated. The etiology was ischemic in 42, idiopathic in 23 and post-valvular in one.

Results: When isolated mitral valve surgery was performed, early mortality in group A \( (n=22) \) was 0, in group B \( (n=8) \) 50%. Overall 5-year survival was 70.0 \( \pm 8.4 \) in group A 81.8 \( \pm 8.2 \), and in group B 37.5 \( \pm 17.1 \). When the Batista operation was performed, early mortality in group A \( (n=13) \) was 23.1\%, in group B \( (n=8) \) 75\%. Overall 2-year survival was 42.9 \( \pm 10.8 \) in group A 61.5 \( \pm 13.5 \) and in group B 25.0 \( \pm 15.3 \). When akinetic areas were excluded, early mortality in group A \( (n=11) \) was 18.2\% and in group B \( (n=4) \) 100\%. Overall 1-year survival was 53.3 \( \pm 12.9 \), in group A 72.7 \( \pm 13.4 \).

Conclusion: Group A patients have better results in every cohort of patients considered. Even if patients selection seems to be the most important variable for early mortality and late survival, isolated mitral valve surgery, when feasible, provides the best early and late results. © 1999 Elsevier Science B.V. All rights reserved.

Keywords: Dilated cardiomyopathy; Batista operation; Mitral surgery

1. Introduction

The introduction into the surgical armamentarium of the Batista operation [1] opened new horizons to the treatment of the dilated cardiomyopathy (DCMP) using conventional surgical techniques. Even if the long term results are not yet assessed, there is clear evidence that in some patients with DCMP, that are not eligible for heart transplant, acceptable palliation can be obtained with different strategies. Unfortunately, as there is no general agreement, these strategies vary according to the etiology of the DCMP and to the preference of the surgeon.

We reviewed our surgical experience in non-transplant candidate patients to evaluate the midterm results of the different techniques utilized during the last few years. We tried to identify the subgroups of patients that can benefit from a specific surgical technique.

2. Materials and methods

2.1. Patients’ selection

From January 1990 to September 1998, 66 patients with DCMP underwent surgical palliation of their disease using different techniques.

As in the literature there is no clear definition of DCMP, we included in this series, for surgical purposes, all the patients that fit the following criteria:

1. ejection fraction equal or less that 35\%
2. end diastolic volume (at the echocardiography) higher than 110 \text{ ml/m}^2
3. enlargement of the base of the heart (maximum mitral diameter, at the echocardiography, higher than 22 \text{ mm/m}^2) with functional mitral regurgitation
4. for the above reason, mitral valve surgery (repair or replacement) to be performed in every patient.

The etiology of the DCMP was post-ischemic in 42 patients, idiopathic in 23 patients and secondary to a severe aortic regurgitation in one. In Table 1 some of the pre-operative data are shown.

Independently from the etiology, the patients were divided into two groups. Group A included patients: (a) with normal or moderately impaired right ventricular function; (b) with mean PAP equal to or less than 45 mmHg; and (c) who underwent elective or semi-elective surgery.

Group B included patients: (a) with severely impaired right ventricular function; (b) with mean PAP higher than 45 mmHg; (c) with severe organ failure (kidney or liver); (d) dependent on IABP and/or high dose of inotropes; and (e) who needed ICU stay, with or without mechanical ventilation.

2.2. Surgical strategies

The remodeling of the left ventricle was obtained chronically in 30 patients, where only mitral valve surgery was performed. In the remaining 36, together with mitral valve surgery, acute left ventricular reshaping was obtained with the Batista (21 patients), the Dor (seven patients) or the Guilmet (eight patients) techniques.

2.2.1. Mitral valve repair

Mitral valve repair (34 cases) was obtained with a posterior annuloplasty using a segment of gluteraldehyde treated homologous pericardium. The U sutures were placed between the two commissures (both included). The pericardium was measured and each centimeter marked with a sterile pen; a distance equal to 52 mm was used to include all the sutures. With this technique, the mitral diameter was reduced to about 26–28 mm.

2.2.2. Mitral valve replacement

Mitral valve replacement (32 cases) was obtained with different techniques and surgical approaches. The valve was approached through the interatrial septum or the superior approach in 12 cases. In all the patients the posterior leaflet was always left in place. The anterior leaflet was not resected, but split in the middle and brought to the annulus by means of prosthetic sutures in 11 patients. In the latter patient, only the middle portion was resected and a triangle in correspondence with the papillary muscles was left. The prosthetic sutures (pledget U stitches from the atrium) at that level were used to bring the papillary muscles toward the annulus. In the remaining 20 patients, the valve was replaced via a left ventricular incision during the Batista operation.

2.2.3. Tricuspid annuloplasty

Tricuspid annuloplasty (23 patients) was obtained with the De Vega technique, but using a 2/0 Ticron suture.

2.2.4. Batista technique

A longitudinal portion (from the apex to near the atrioventricular groove) of the left ventricle, between the papillary muscles which were often included, was excised in order to reduce the volume. The incision, triangular with the base parallel (distance about 2 cm) to the left atrioventricular groove, was closed with a double suture and two Teflon felt strips.

2.2.5. Dor technique

The Dor technique was always used as previously described by Dor, 1989 [2]. However, in five patients, the patch was not used, but the volume reduction was achieved using three purse strings (Prolene 1).

2.2.6. Guilmet technique

Described in 1987 [3], there has been an increase in interest recently on this technique, as it is the only one that can exclude nearly selectively the interventricular septum, if this is the main cardiac structure involved in the myocardial infarction. The oblique suture of the free wall on the septum allows its partial exclusion, moving in the same time the apex 2–3 cm to the left side.

2.3. Operative and post-operative management

Every patient had systemic and central venous pressure monitoring, as well as pulmonary artery pressure and cardiac output measurement with a Swan-Ganz catheter. Inotropes and IABP, when present, were discontinued only when the cardiopulmonary bypass began. Starting in 1991, warm perfusion was used in every case. Only in two cases (Batista operation) was surgery performed on a beating heart. In the remaining cases intermittent antegrade warm blood cardioplegia [4] was used. In the first two cases cold perfusion and intermittent antegrade cold blood cardioplegia was used.

A few minutes before aortic unclamping, dobutamine (5 μg/kg per min) and nitroglycerine or nipride or enoximone were started and continued for a few days. If necessary, an IABP was inserted and a low dose of adrenaline was added. All the patients had a TTE in the operating room; the probe was left in place for the first few hours in the post-operative period. A TTE was repeated at least once a day,
more, if necessary. The patients were extubated with the IABP and/or inotropes still working. From the ICU they were transferred to the surgical ward and from there to the cardiology ward.

2.4. Follow-up

All patients were followed-up at our outpatients clinic every 3–6 months. A clinical evaluation was performed as well as a TTE. Every 6th month, if possible, a TEE was obtained. The follow-up is 100% complete.

2.5. Statistical analysis

Results are expressed as mean value ± SD unless otherwise indicated. Statistical analysis comparing two groups was performed with unpaired two-tailed t-testing for the means or $\chi^2$ test for categorical variables. Survival and event free survival curves were obtained with the Kaplan–Meier method (BMDP 1 L software). The statistical significance was calculated with the Mantel–Cox test and $z$-test. $P$ values $< 0.05$ were considered significant.

3. Results

3.1. Chronic left ventricular remodeling (isolated mitral surgery)

Thirty patients underwent isolated mitral valve surgery. Mean age was $65.4 \pm 10.8$ years, mean NYHA Class was $3.8 \pm 0.4$ and mean ejection fraction was $29.1 \pm 5.4$. Table 2 shows some pre-operative data of the patients in Group A (22) and in Group B (8).

Thirty day mortality was 0 in Group A and 50% (four patients) in Group B ($P < 0.02$). Causes of death were multiple organ failure (one patient) and heart failure (three patients). Mean follow up was $34 \pm 32$ months (2–107) in Group A and $21 \pm 38$ months (6–107) in Group B. During this period six patients died in Group A (one from myocardial infarction; one from acute aortic dissection; and four from heart failure) and one in Group B (heart failure). Clinical results in Groups A and B are shown in Table 3 and survival rates are shown in Fig. 1. In Group A, eight of 16 survivors improved by one NYHA Class and two improved by two NYHA Classes, while in six the NYHA Class remained unchanged at the moment of the latest follow-up. In Group B, two of the three survivors improved by one NYHA Class and the remaining survivor improved by two NYHA Classes.

3.2. Acute left ventricular reshaping

Thirty-six patients underwent both mitral surgery and left

![Fig. 1. Chronic left ventricular remodeling. Survival in Groups A and B.](image)
ventricular reshaping. Mean age was 65.2 ± 6.7, mean NYHA Class was 3.7 ± 0.4 and mean ejection fraction 24.7 ± 6.1. In Table 4 the surgical details are shown.

3.2.1. Batista operation

Twenty-one patients underwent the Batista operation; 13 of them were in Group A and eight in Group B (Table 5). Thirty day mortality was 23.1% (three patients, myocardial infarction, heart failure and sudden death) in Group A and 75% (six patients: heart failure in four; pneumonia in one; and multiple organ failure in one) in Group B. Mean follow up was 8 ± 8 months and 6 ± 8 months in Groups A and B, respectively. During this period two patients died in group A (septicemia and heart failure) and one in group B (stroke). Clinical results in Group A and B are shown in Table 6 and survival is shown in Fig. 2. In Group A six out of the nine survivors improved by one NYHA Class, and two improved by two NYHA Classes. Of the remaining passengers, one is unchanged and the other is in the waiting list for a heart transplant.

3.2.2. Exclusion of akinetic areas

Fifteen patients underwent exclusion of akinetic area, using Dor (seven cases) or Guilmet technique (eight cases); 11 of them were in Group A and four in Group B (Table 7). Thirty day mortality was 18.2% (two patients with heart failure) in Group A and 100% (three patients with heart failure, and one with multiple organ failure) in Group B. Mean follow-up was 9 ± 2 months in Group A. During this period one patient died (myocardial infarction).

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<thead>
<tr>
<th>Table 4</th>
<th>Acute left ventricular reshaping, surgical details</th>
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<tr>
<td><strong>Batista operation</strong></td>
<td><strong>Group A (n = 13)</strong></td>
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<tr>
<td>+ MV repair</td>
<td>21</td>
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<td>+ MVR</td>
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<td>+ MVR + Tr repair</td>
<td>7</td>
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<tr>
<td>+ CABG</td>
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<td><strong>Exclusion of akinetic areas</strong></td>
<td><strong>Group A (n = 13)</strong></td>
</tr>
<tr>
<td>+ MV Repair</td>
<td>8</td>
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<td>+ Tr repair</td>
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4. Discussion

The treatment of dilated cardiomyopathy using conventional techniques has gained new interest after the introduction of the Batista operation. However, a clear surgical identification of the patients to be included in this group was lacking. A definition was needed, especially in the field of post-ischemic DCMP, as the border with the left ventricular aneurysm has to be focused.

Our inclusion criteria try to identify the patients to be considered in this group. The presence of functional mitral valve regurgitation, due to incomplete valve closure, is a key point, as it is caused by different mechanisms, all related to left ventricular enlargement and dysfunction: papillary muscles and adjacent ventricular wall dysfunction and outward displacement, dilation of the mitral annulus, reduced force to close the mitral valve [5,6]. Left ventricular dysfunction without dilation fails to cause incomplete mitral valve closure, whereas the determinant of functional mitral valve regurgitation is left ventricular sphericity. Moreover, the presence of functional mitral regurgitation is a risk factor for functional impairment and early death [7].

We found also it necessary to divide our patients into two groups, according to the pre-operative characteristics. Right ventricular failure with or without pulmonary hypertension
is a factor that identifies the patients with expected poor early survival after surgery. The risk was also very high if IABP and/or inotropes were needed pre-operatively. Severe organ failure was also determinant of poor outcome. In this group of patients (Group B) surgical results were disappointing. Group A, on the contrary, included patients that, independently from the NYHA Class, had a right ventricle with normal or near normal function and mild to moderate pulmonary hypertension. These patients had a better outcome, independently from the surgical technique used (Fig. 4).

Reduction of the base of the heart using mitral annuloplasty or mitral valve replacement, sparing both papillary muscles, was used by us since 1990 in selected patients with satisfying results and good survival, especially in Group A. Recently, Bolling and coworkers [8] showed promising results in patients with DCMP of different etiology that had posterior mitral annuloplasty. This paper heavily supported the concept that a good palliation for DCMP could be obtained with chronic remodeling of the left ventricle, induced by means of reduction of the base of the heart together with mitral regurgitation correction.

Mitrval valve surgery and acute left ventricular reshaping provided good survival and functional improvement in Group A in patients treated with exclusion of akinetic areas; the same results, even if less satisfying, were obtained in Group A patients treated with the Batista operation.

Cumulating all the patients with idiopathic DCMP (Fig. 5), total 5-year survival was more than 50% and in Group A it was nearly 65%. In patients with post-ischemic DCMP the long term survival was even better (Fig. 6), with a total 5-year survival of nearly 60%, in Group A being 75%.

Surgical treatment of the DCMP using conventional techniques can be achieved with satisfying results, both in patients with idiopathic and post-ischemic cardiomyopathy. Good long term survival and acceptable functional results can be obtained both inducing chronic left ventricular remo-
deling or adding acute left ventricular reshaping in patients included in Group A.

Group B patients had the worse outcome, both early and late, with poor survival, even if the survivors functional results were acceptable.

In Group A patients lower early mortality was achieved in patients who had chronic left ventricular remodeling by means of isolated mitral valve surgery. Late improvement in NYHA Class was due to the reduction of mitral regurgitation, as, with time, both ejection fraction and left ventricular volumes remain unchanged.

In the same group of patients who underwent acute left ventricular reshaping together with mitral valve surgery, early mortality was higher, but improvement in NYHA Class was related not only to the reduction of the degree of mitral regurgitation or to its disappearance if the valve was replaced, but also to reduction of both left ventricular volumes (Batista operation) or to improvement of systolic function (exclusion of akinetic areas).

In conclusion, surgery for DCMP using conventional techniques can provide satisfying survival and functional palliation in selected patients and has to be considered in patients who are not eligible for heart transplant.

References