Can early aortic root surgery prevent further aortic dissection in Marfan syndrome?

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Abstract

We reviewed 50 patients with Marfan syndrome who underwent surgery for aortic root pathologies comprising a root aneurysm without (n = 25; group A) and with (n = 25; group B) dissection. Aortic root repair included Bentall (n = 37) and valve-sparing (n = 13) procedures. Hospital mortality was 4.0%. Twenty-two patients required 36 repeat surgeries on the distal aorta. The main indication for re-intervention was the dilation of the false lumen. In group A, the distal aorta was stable for up to 7 years, but new dissection developed in 5 (33.3%) of the 15 patients who were followed up for >7 years after the root repair. Actuarial survival including operative mortality was 88.1 and 65.0% at 10 and 20 years, respectively; groups A and B did not significantly differ. Rates of freedom from all-cause death, new dissection or repeated aortic surgery were 60.1, 44.5 and 26.0% at 5, 10 and 15 years, respectively. Group A was significantly better than group B. Prophylactic aortic root repair apparently reduces the likelihood of overall adverse events, but it cannot guarantee the prevention of further aortic dissection. A multidisciplinary approach is needed for patients with Marfan syndrome.

Keywords: Aortic valve • Quality of life • Reoperation • Survival analysis

INTRODUCTION

Cardiovascular problems, such as aortic dissection and rupture, comprise the life-threatening aspects of Marfan syndrome. The aortic root is most frequently affected and the prophylactic surgical replacement of the aortic root might prevent further aortic catastrophe in most of such patients [1]. The present study verifies this hypothesis by clarifying the early and late results of aortic root operations in patients with Marfan syndrome.

METHODS

This study initially started with 55 patients who were diagnosed with Marfan syndrome according to the Ghent criteria [2] and who underwent aortic operations at our hospital between 1987 and 2010. Among these, we reviewed data from 50 (male, n = 33; female, n = 17; mean age at operation, 32.2 years; SD, 12.2; range, 15–65 years) patients who underwent surgery for aortic root pathology. The aetiology of aortic disease was the aortic root aneurysm without (n = 25; group A) and with (n = 25; group B) dissection (Table 1). Among the 25 patients with aortic dissection, 15 were acute (DeBakey I, II and II + III; n = 10, 3 and 2, respectively) and 10 were chronic (DeBakey I, II and III; n = 6, 1 and 3, respectively). Five patients had a history of aortic surgeries. The Bentall operation proceeded in 37 patients using composite valve-grafts. Concomitant procedures comprised aortic arch replacement (n = 4), coronary artery bypass (n = 5) and mitral valve replacement (n = 2). The remaining 13 patients underwent valve-sparing root repair (VSRR) comprising remodeling (n = 5) and re-implantation (n = 8). Among five remodelling surgeries, four were the David-III procedure [3], or remodelling with an external synthetic strip added at the basal ring to prevent further dilation of the annulus, and one David-II procedure, or original remodelling without the strip. Five of the eight patients who underwent re-implantation were treated with DePaulis grafts [4]. At the end of surgery, no dissection was evident in the aortas of 29 patients (aortic root aneurysm or DeBakey II dissection). Rates of survival and freedom from events were calculated using the Kaplan–Meier actuarial method.

RESULTS

Early results after aortic root repair

Two (4.0%) of the 50 patients died post-operatively while in hospital. One was a 50-year-old man who died of cardiac failure after emergency surgery consisting of the Bentall procedure and concomitant replacement of the aortic arch to treat acute aortic dissection and acute myocardial infarction. The other was a 60-year-old woman with a history of the Collin’s operation for acute aortic dissection who died of acute respiratory distress syndrome after the Bentall operation with concomitant coronary artery bypass grafting.
patients were treated medically during the acute phase. Chronic dissection is considered for elective repair when the diameter exceeds 5.0–5.5 cm, which is a lower threshold for surgical intervention than that used for the general population. Six such patients underwent surgery to treat the distal aorta during the chronic phase (2 months to 5 years after onset). The other two patients remained under observation because the diameter of the dissected aorta did not reach the reference value.

### Repeated operations on the residual aorta

To date, 22 patients have undergone 36 re-interventions on the residual aorta (28, 14, 3, 4, and 1 patients underwent 0, 1, 2, 3 or 4 re-interventions, respectively; Table 3). The interval between the initial and the second surgeries was 2–206 (mean 65) months; the second and the third, 2–232 (mean 83) months; the third and the fourth, 1–53 (mean 18) months; and the fourth and the fifth, 42 months. The re-intervention sites were the aortic root (n = 2), aortic arch (n = 11), descending (n = 8), thoraco-abdominal (n = 11) and abdominal (n = 3) aortas and an anastomosis of the coronary artery (n = 1).

Analysis by group showed that 4 (16.0%) of the 25 patients in group A underwent four re-interventions (one procedure per patient), whereas 18 (72.0%) of the 25 patients in group B underwent 32 re-interventions (0, 1, 2, 3 and 4 re-interventions and 7, 10, 3, 4 and 1 patients, respectively). Surgical indications for re-intervention in group A were new dissection (n = 3) and pseudo-aneurysm of the aortic root (n = 1), whereas those in group B were an enlarged false lumen (n = 27), new dissection (n = 3) and infection of a prosthetic valve-graft (n = 2).

### Late mortality and actuarial survival

One patient, in whom dissection developed during follow-up, died of multi-organ failure at re-intervention; the risk of death...
per re-intervention was 2.8% (1 death per 36 procedures). Six others died during the follow-up. The causes of death in two of them were related to aortic pathology, since one died of aortic rupture 12.6 years later, and the other suddenly died 4.7 years after the initial procedure (details unknown). The causes of death in the other four patients were unrelated to aortic disease and comprised subarachnoid haemorrhage (n = 1), cerebral haemorrhage (n = 1), pneumonia with myelodysplastic syndrome (n = 1) and infection (n = 1).

Overall actuarial survival including initial hospital mortality was 96.0 ± 2.8, 90.8 ± 4.4, 88.1 ± 5.1, 78.2 ± 8.0 and 65.0 ± 10.9% at 1, 5, 10, 15 and 20 years, respectively, after initial operation.

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**Actuarial event-free survival**

The overall rates of freedom from events defined as death due to any causes and/or reoperation on the residual aorta and/or new aortic dissection after initial operation for aortic pathology, respectively: 100 vs. 90.2, 100 vs. 79.0, 100 vs. 73.3, 88.9 vs. 65.2 and 61.0 vs. 65.2% at 1, 5, 10 and 15 years, respectively, after the initial procedure (Fig. 3). Event-free rates at 1, 5, 10 and 15 years after the initial operation were 100, 95.2 ± 4.7, 80.4 ± 10.5 and 45.2 ± 17.0%, respectively, in group A, and 66.1 ± 9.8, 28.8 ± 9.8, 14.4 ± 7.6 and 9.6 ± 6.4%, respectively, in group B (P < 0.0001; Fig. 4).

**DISCUSSION**

The aortic root is the most frequently affected in Marfan syndrome and it is usually repaired during the first operation. Replacement with a composite valve-graft prosthesis (the Bentall...
operation) or preservation (VSRR) comprise the two strategies for aortic root repair to manage the aortic valve. Which of these procedures should be applied to patients with Marfan syndrome remains controversial. The Mayo group reported that the Bentall procedure is superior to VSRR mainly because of a low reoperation rate [5]. The Johns Hopkins group previously reported excellent early and long-term results after the Bentall operation [6]. However, their largest and most recent study is more pro-VSRR, particularly when patients are re-implanted with a Valsalva graft [7]. No significant complications have occurred after VSRR to date in our series, whereas several complications, such as composite valve-graft infection requiring a redo operation, brain haemorrhage resulting in late death and other complications, occurred after the Bentall procedure. In addition, aortic valve competence has remained excellent after VSRR for up to 11 years of follow-up. The present study also found that VSRR seems promising even for Marfan syndrome as others have reported [8–10].

The surgical strategy for treating DeBakey I aortic dissection in patients with Marfan syndrome should be designed considering future procedures on the residual aorta. From this viewpoint, the total aortic arch replacement with an elephant trunk anastomosis in addition to root repair should be considered as the initial operation [11] when it can be safely performed.

The long-term survival rates were comparable between our patients with and without dissection, although significantly more re-interventions on the residual aorta were required in the group with dissection. We believe that careful monitoring of the entire aorta as well as appropriate and timely aortic surgery achieves a similar life expectancy between patients with and without aortic dissection.

The timing of the operation is another key concern regarding aortic root repair in Marfan syndrome. Girdauskas et al. [12] reported that type A aortic dissection during aortic root surgery is the only independent predictor of distal aortic reoperation. The present study also found a significantly greater likelihood of re-interventions during the follow-up in patients with than without aortic dissection. Aortic dissection is life-threatening at onset and it often extends the lesion from the aortic root to the whole aorta, which increases the likelihood of reoperation and late mortality. On the other hand, scheduled root repair is very safe. Thus, early aortic root repair with a smaller root diameter to prevent aortic dissection is clearly beneficial [13]. However, whether or not it can resolve all issues regarding future aortic catastrophe are debatable. New aortic dissection did not occur on the distal aorta in our series for up to 7 years. However, the prevalence of new dissection at or after 7 years was 33.3% in patients who had undergone prophylactic root surgery and 37.5% in those whose dissection was diminished after root repair. This fact indicates that the prevalence of new dissection is quite significant over the long term even after successful aortic root repair and close follow-up. Early repair of the aortic root appears preventive and beneficial but it cannot diminish the likelihood of future adverse events arising in patients with Marfan syndrome. That the entire aorta is affected by Marfan syndrome and that cardiovascular repair is palliative in such patients should be considered. Lifelong careful observation of the entire aorta, timely additional surgery (e.g. for the distal aorta and mitral valve), therapy with antihypertensive drugs including β-blockers [14], losartan [15] and others are also important to prevent further aortic catastrophe. We speculate that a multidisciplinary approach will soon further improve the life expectancy of patients with Marfan syndrome.

CONCLUSIONS

Aortic root repair is safe for treating patients with Marfan syndrome. Prophylactic aortic root repair apparently reduces the likelihood of overall adverse events, but it cannot guarantee that further aortic dissection will be prevented over a lifetime. A multidisciplinary approach is necessary to improve the life expectancy of patients with Marfan syndrome.

Conflict of interest: none declared.
REFERENCES


