Work in progress report - Aortic and aneurysmal

Modified partial aortic root remodeling in acute type A aortic dissection

Tatsuhiko Komiya*, Nobushige Tamura, Genichi Sakaguchi, Taira Kobayashi

Department of Cardiovascular Surgery, Kurashiki Central Hospital, 1-1-1 Miwa, Kurashiki City, Okayama, 710-8602, Japan

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Abstract

Emergency surgery for acute type A dissection is extremely difficult when the sinuses of Valsalva are widely dissected. Indications for the various proposed surgical approaches are controversial. Here, we describe modified partial aortic root remodeling to overcome bleeding. We retrospectively reviewed 13 consecutive patients who underwent the following operative procedure. We did not resect the sinus but sutured a U-shaped Dacron patch to the inside of the sinus to reinforce the dissected weakened wall. The indications for reconstruction of the aortic root with this technique are extension of an intimal tear into a sinus, a fully dissected sinus as far as the level of the aortic annulus or mild annuloaortic ectasia. One patient died of multiorgan failure. No patient had more than mild aortic regurgitation. Mean follow-up duration was 22 months and there was no late death. Two patients underwent repeated surgery due to graft infection and redissection. Our modified partial aortic root remodeling technique might be a useful surgical procedure if one or two Valsalva sinuses are affected in type A acute aortic dissection.

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1. Introduction

The sinuses of Valsalva require surgery when dissection is extensive within the sinuses or the coronary ostia during type A acute aortic dissection (AAD). The Bentall type operation rather than repair of the dissected aortic root reportedly yields high survival and low proximal reoperation rates [1]. However, the need for a mechanical valve might cause bleeding and potential thromboembolic events. Because most patients with aortic dissection have fundamentally normal aortic valve architecture, these otherwise normal valves should be retained whenever possible. This approach might be suitable for patients in whom an anticoagulant is not required. Various techniques have been proposed to preserve the integrity of the aortic valve and sinuses with good outcomes [2, 3].

Most operations are conducted at night by surgeons with varying surgical experience. Prolonged operation times for valve reconstruction and the demanding technique applied under emergency conditions might confer an additional risk factor upon patients. Whether these more extensive procedures with possible additional operative risk can be justified from the viewpoint of potential long-term benefits remains controversial.

Mildly dilated sinuses may not require replacement during valve-sparing surgery. Moreover, the non-coronary sinus is the most commonly affected in the standard type of dissection, followed by the right and left in that order. Thus, partial remodeling would be sufficient for some patients. Intractable hemorrhage frequently arises from long suture lines. We modified the partial aortic root remodeling technique by attaching a Teflon patch inside the sinus to overcome bleeding.

2. Patients and methods

We retrospectively reviewed 13 consecutive patients with AAD who underwent emergency surgery using our modified partial aortic root remodeling technique between 2003 and 2006 at our institution. We performed 72 operations for AAD during this period. The mean age was 61.6 ± 19.1 years and ranged from 35 to 89 years. Three patients were in a preoperative state of cardiac tamponade and one patient had already been intubated. One patient developed pulmonary edema due to acute myocardial infarction. The preoperative degree of AR was evaluated by echocardiography and judged as mild and as moderate in four and in two patients, respectively. None of the patients had Marfan syndrome. During the same period we performed the Bentall type operation in two patients whose sinuses were more than moderately dilated and one patient had already been intubated. One patient developed pulmonary edema due to acute myocardial infarction. The preoperative degree of AR was evaluated by echocardiography and judged as mild and as moderate in four and in two patients, respectively. None of the patients had Marfan syndrome. During the same period we performed the Bentall type operation in two patients whose sinuses were more than moderately dilated and who had severe AR.

2.1. Surgical technique

Cardiopulmonary bypass was established by femoral artery and bicaval cannulation. Systemic cooling to a bladder temperature of 25 °C was initiated. The ascending aorta
was transected during a brief period of circulatory arrest and the intraaortic pathology was examined. We clamped the distal portion of the ascending aorta while carefully avoiding dislodging the thrombus in the false lumen. Retrograde cardioplegic solution was injected into the coronary sinus to achieve cardiac arrest and the sinuses of Valsalva were examined in detail.

Our indications for reconstruction of the aortic root with the modified partial remodeling technique are extension of an intimal tear into a sinus, a fully dissected sinus as far as the level of the aortic annulus, or mild annuloaortic ectasia. We did not resect the sinus wall but inserted a U-shaped Dacron patch within the sinus and fixed it to the annulus with several mattress sutures (Fig. 1). Accurate suturing to the true annulus and external support with a felt strip is important. Thus, the patch served as an internal support for the diseased sinus (Fig. 2). When the right coronary sinus was involved, a small hole was created in the patch and the coronary artery button was sutured to the patch with the surrounding sinus wall.

A Dacron tube was then sutured to the proximal portion of the aorta and the distal margin of the Dacron patch was fixed with this suture. Circulatory arrest was then achieved and the aortic clamp was removed. Selective arch vessels were perfused and the dissected aortic tissue that contained an intimal tear was resected and then distal graft-to-aortic anastomosis was completed. Gelatin-resorcinol-formaldehyde-glue (GRF-glue) was used to reattach the dissected layers.

During the inspection inside the aorta, the right coronary ostium was found to be completely avulsed in two patients. The proximal portion of the artery had to be ligated and an aortocoronary bypass with a saphenous vein graft was established. Because there had been an intimal hole, the right coronary sinuses were repaired with a Dacron patch by the same technique. In another patient who developed acute myocardial infarction due to dissection into the left main stem, the dissected sinus tissue around the coronary ostium was attached by some pericardium-pledgeted sutures.

With respect to treating the sinus of Valsalva, the non-coronary and right coronary sinuses were repaired and the less dilated left sinus was left intact in two patients with mild annuloaortic ectasia.

3. Results

There was one operative death. In this patient general convulsion and transient severe hypertension preceded massive bleeding from the chest tubes. The untreated right coronary sinus was disrupted at re-operation although the reconstructed non-coronary sinus remained intact. This patient died of multiorgan failure. In one patient left ventricular motion became significantly altered during warming phase and additional emergency aortocoronary bypass grafting with a saphenous vein was required. The angiogram and CT before discharge demonstrated that there was no coronary artery lesion and no proximal dissection was found. The other major complications comprised resternotomy from bleeding \((n=1)\), mediastinitis \((n=1)\) and stroke \((n=1)\). None of the patients had more than mild AR at the time of discharge from the hospital.

The mean follow-up duration was 22 months and no late death occurred. Despite the absence of signs of congestive heart failure, AR recurred in one patient 22 months later. Two patients underwent reoperation, one after six months due to graft infection. At reoperation the sinus segment of the graft was completely healed and the native aortic valve leaflets were free of interference. Only the infected midportion of the prosthesis was replaced and infection did not recur thereafter. Another patient developed redissection in the untreated left sinus 16 months later. At reoperation, the treated non-coronary sinus had completely healed and redissection was not associated with the first sinus repair. The small communications to the false lumen in the left sinus were closed with several stitches.
4. Discussion

Supracommissural replacement of the ascending aorta for AAD is probably the easiest and quickest approach but leaves diseased aortic tissue in situ. Possible re-dissection or aneurysm formation from the aortic root could present a vital risk for the patient and require a further operation [2].

Historically, composite grafts have been used primarily in the presence of irreversible aortic root dissection, when the frailty of tissues jeopardizing hemostasis and residual aortic incompetence are concerns. The proximal reoperation rate tended to be lower after composite root replacement. However, the risk of bleeding and possible thromboembolic events after mechanical valve replacement causes complications with an annual incidence of 2%–4% [2]. Of the AAD patients, the ratio of composite graft replacement is widely varied from 5 to 30%. This apparently indicates there is no clear-cut indication. Our policy is to preserve own aortic valve whenever possible.

Attaching acute dissected aortic sinuses with GRF glue has proven extremely useful during initial emergency surgery for AAD [4] and some have stressed that emergency aortic replacement with GRF glue results in reasonable early and late mortality rates [5]. This type of glue releases sufficient amounts of glutaraldehyde that can induce cytotoxic effects both in vitro and in vivo [6]. Histopathology has shown the disappearance of nuclei from medial smooth muscle cells [7], or the complete disappearance of intima and media and aggregation of macrophages in necrotic tissue [8]. Although glutaraldehyde guarantees powerful adherence to tissues and synthetic materials, its toxic potential that might lead to pseudoaneurysmal formation and AR is a significant concern. We used GRF glue routinely in the past, but we also had to repeat the surgery again to repair pseudoaneurysms that arose from the proximal suture line, indicating a need for altering our strategy.

A valve-sparing technique has recently been proposed as an alternative surgical approach to treating AAD. Most patients with dissections have fundamentally normal aortic valve architecture that has been disrupted by the dissection process propagating to the aortic annulus. Such otherwise normal valves should be retained whenever possible. Complete removal of diseased tissue and avoidance of lifelong anticoagulation are clear advantages for treating aortic root pathology in patients with morphologically unimpaired valve cusps [2].

Yacoub and colleagues performed remodeling operations in 49 patients with AAD. The mortality rate was 18.4% [9]. Erasmi and associates performed remodeling in 21 patients and reimplantation in 15. They found that the outcomes of both techniques were similar [10]. Kallenbach and colleagues performed reimplantation in 48 patients and found a high failure rate of remodeled aortic valves in AAD [2]. Graeter and associates reported that freedom from AR at 2 years was 100% in the reimplantation group and 90.9% in the remodeled group. All patients in both groups remained free of proximal reoperation at 2 years [3]. However, whether valve-sparing should be used in emergency patients presenting with AAD remains unclear. Prolonged surgical duration for valve reconstruction and technically demanding procedures applied under emergency conditions might confer additional risk upon unstable patients who might benefit more from a short and simple operation. Bleeding from a long suture line is a disadvantage of the remodeling procedure. De Oliveira and colleagues reported a re-thoracotomy rate of 3% with reimplantation and of 18% with remodeling in patients with Marfan syndrome [11].

The partial aortic root remodeling technique is particularly advantageous for patients who do not require replacement of all sinuses. Normal or mildly dilated sinuses need not be replaced. Thus, sometimes only one or two sinuses may require replacement. The most frequently affected sinus of Valsalva is the non-coronary sinus, followed by the right and left in that order [12].

We modified this technique as follows. Without resecting the sinus wall we attached a patch inside the sinus to reinforce the dissected weakened wall. This avoids uncontrollable bleeding from deep suture lines. We confirmed that the Teflon patch was securely attached within the sinus in two patients who underwent repeat surgery, and that did not interfere with the aortic valve leaflet. Urbanski described a similar remodeling technique. He resected the distorted sinus and sewed a tear-drop shaped patch with a running suture to the annulus. However, the deep suture line is likely to bleed using this technique [13].

Our technique has the following limitation. Diseased, residual untreated sinus tissue is left behind and thus future re-dilation or re-dissection can occur. No clear criteria can determine whether or not a sinus tissue can be preserved. For this type of operation, the amount of dissection and dilatation of the aortic root must be assessed in detail.

In conclusion, our modified partial aortic root remodeling operation might be a useful strategy for acute type A aortic dissection in patients with one or two affected Valsalva sinuses.

References

The technique presented [1] is not really original since others (some cited, some others not cited by the present authors) have already presented very similar procedures. The technique is presented as a modification of the Yacoub procedure; however, it rather seems a modified maneuver of proximal stump reinforcement, where Dacron is used inside the sinus instead of Teflon and it is extended to the full height of the sinus. Every technical innovation is welcome in cardiac surgery as far as it adds to the safety and effectiveness of surgical correction of cardiovascular diseases. We have some concerns regarding the safety of this procedure, especially in terms of risk of valve leaflets distortion and, in case of coronary sinus repair also of ostial impingement. In fact the authors claimed that ‘problems developed in the coronary arteries’ in some patients, without specifying the mechanisms by which those problems occurred. Furthermore, the effectiveness of this procedure needs confirmation in the long-term follow-up, considering the risk of root dilatation, which is not lower than after traditional Yacoub procedure. Pseudoaneurysm could develop from the suture line fixing the patch to the sinus wall, especially proximally. Given the greater technical simplicity of the Bentall procedure, the authors’ implicit argument that inexpert surgeons are often involved in emergency surgery for type A dissection does not support preference of their technique.

Reference