Towards safer reoperations: special aspects in aortic dissection

Hans-Joachim Schäfers*, Takashi Kunihara

Department of Thoracic and Cardiovascular Surgery, University Hospital of Saarland, 66421 Homburg/Saar, Germany

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Summary

Surgical treatment of acute aortic dissection has been largely standardized, but some patients develop late complications that require repeat surgery. The 10-year freedom from proximal and distal reoperation is approximately 70–80%, and the risk of proximal reoperation is approximately 10%. Aggressive resection of the aortic root has not been proven to eliminate the need for proximal reoperation, but it appears reasonable for pre-existent root dilatation. The coronary button technique has resulted in greater freedom from death and reoperation and thus appears advisable. The risk of distal reoperations seems generally lower than that of proximal operations (0–4%). Routine extension of replacement into the total arch in the initial operation is associated with increased risk, and it appears not to decrease the probability of reoperation. Aggressive replacement of the total arch may be justified only for connective tissue disease. The choice of thoracic incision is important for aortic reoperations. A median sternotomy provides excellent exposure to the proximal aorta. A posterolateral thoracotomy allows good exposure for distal arch or descending aorta but may be associated with pain-related pulmonary impairment. A bilateral thoracotomy gives easy access for arch and descending aorta but is associated with the highest degree of respiratory impairment. We use a median sternotomy in most instances and choose a bilateral thoracotomy for complex aortic pathology. A posterolateral thoracotomy seems preferable for most distal arch and/or descending aortic replacements. Since femoral arterial cannulation can contribute to an increased incidence of neurological complication, cannulation of the axillary artery appears advisable. We prefer implantation of a Dacron graft and to cannulate the graft. If the aorta is adjacent to the sternum, the patient is placed on cardiopulmonary bypass (CPB) before repeat sternotomy. The patient is cooled to a nasopharyngeal temperature of 28–30°C and at the time of sternotomy CPB is temporarily interrupted. We have not yet had to use transapical venting. Using these approaches we have been able to maintain a procedure-related mortality of 4%, which is not different from primary operations on an aneurysmatic aorta.

Keywords: Acute aortic dissection; Reoperation; Sternal re-entry; Cannulation; Coronary reattachment

1. Introduction

In the past three decades surgical treatment of acute aortic dissection type A has improved markedly and has been largely standardized. To date, only a few uncertainties seem to exist regarding acute management. Despite these improvements there is still considerable need for a late reoperation that has implications for the initial procedure and also the conduct of repeat procedures.

Since the first operation may be performed through a median sternotomy, concerns are raised when resternotomy is mandatory. In other words, should the aortic root be preserved or replaced in the initial operation? Should the entire aortic arch be replaced? Should the aortic root to arch be replaced simultaneously in patients with connective tissue disease such as Marfan’s syndrome? If reoperation is necessary, are certain approaches superior to others? These questions are the subject of continued controversy, and we would like to present some answers.

This brief review is written in the hope of giving a keynote to these persistent questions.

2. Proximal reoperations

Proximal reoperations, i.e. on the aortic root, become necessary mainly after supracoronary replacement of the ascending aorta. Different incidences have been reported, but most likely freedom from proximal reoperation 10 years after the initial operation is around 70% [1,2]. A mortality risk of proximal reoperation has been reported of approximately 10% [3,4]. The main causes of reoperation are aortic valve insufficiency or root enlargement due to persistence of dissection or tissue abnormality of the aortic wall [3,5,6]. In addition, the use of GRF adhesive has been associated with necrosis of the aortic wall and secondary dilatation of the root [7,8]. Aggressive resection of the aortic root in the initial...
approach has not proven to eliminate the need for proximal reoperation [2,9,10], and it is not clear whether the use of a potentially toxic adhesive is the main culprit or rather the pre-existence of aortic dilatation. Most importantly, the main goal of the primary operation is saving the patient’s life by a safe operation [11], and avoiding a mechanical heart-valve prosthesis seems to have advantages both in the conservative and operative treatment of these patients. On the other hand, the experience with Marfan’s syndrome and acute dissection has shown that the presence of connective tissue disease predisposes to later root dilatation [6,12].

We still use GRF adhesive or Bioglue for the root in conjunction with supracommissural aortic replacement whenever the root is of normal or near-normal size. If there is pre-existing root dilatation we liberally utilize valve-sparing root replacement when the aortic valve seems intact [13].

The technique of coronary artery reattachment in the initial procedure and reoperation is also a matter of debate. The coronary button technique has resulted in better long-term survival and greater freedom from reoperation than the original Bentall technique or the Cabrol modification [14,15]. Therefore we use the coronary button technique in all root replacements, both in the acute setting and in reoperations, should they become necessary.

3. Distal reoperations

The debate on optimal management of the dissected arch is still unsettled. Persistent perfusion of the distal false lumen has been repeatedly shown to have an impact on dilatation of the downstream aorta. Freedom from distal reoperation at ten years after the initial operation is slightly better than for the proximal aorta and is estimated at 80% [1,16—18]. The mortality risk of distal reoperations within the aortic arch seems to lower than that of proximal operations (0—4%), even though high mortality rates have been reported [3,18]. Routine extension of replacement into the total aortic arch in the initial operation has been propagated by some [19,20], but is associated with increased morbidity and mortality in the hands of most groups, including ours. Most importantly, it has not been shown to decrease the probability of reoperations significantly [10,20]. Recent advances of elephant trunk technique with or without distal fixation by means of a stent (open stent-graft or frozen elephant trunk) may facilitate staged replacement of the distal aorta [21,22] and thus decrease the risk of total arch replacement. At this point aggressive replacement of the total arch may be justified only in patients with connective tissue disease, i.e. Marfan’s syndrome [6,23].

4. Re-entry into the chest and cannulation

The primary goal of the reoperation is to get safe re-entry into the chest in repeat procedures on the proximal aorta, and catastrophic hemorrhage at re-entry carries a high mortality. In addition, the re-entry should be chosen to allow for the extent of aortic replacement that is dictated by the individual pathology. The type of re-entry also determines the potential cannulation sites for extracorporeal circulation.

Cannulation for cardiopulmonary bypass should be chosen carefully in order to have a safe re-entry and to avoid both malperfusion as well as embolic complications from dislodged thrombus, which is commonly present in the false lumen of the distal aorta [24].

The choice of incision primarily depends on the exact procedure planned, taking into consideration exposure, morbidity of the incision itself, and the options to minimize neurologic complications. As a rule, a median sternotomy provides excellent exposure for any procedure involving the proximal or total arch. A left posterolateral thoracotomy in the 4th or 5th intercostal space provides excellent exposure for the distal arch, especially if additional replacement is necessary on the descending aorta. However, it will reduce postoperative forced expiratory volume in 1 s by 20—30% [25]. A bilateral thoracotomy gives easy access for any procedure on the thoracic aorta except for more complex operations on the aortic root. In pulmonary surgery, however, it has shown to be associated with the highest degree of postoperative pain and pulmonary impairment. Also in aortic surgery its use has resulted in a high incidence of prolonged ventilatory support [26].

We thus use a median sternotomy in most instances of arch replacement if the distal anastomosis is at the level of or superior to the left pulmonary artery. In the remaining patients we would prefer the bilateral thoracotomy because of exposure, the possibility of antegrade perfusion, and facilitated deairing of left heart and aortic arch. A posterolateral thoracotomy is used primarily if there is distal arch involvement and the need for more extensive or complex descending aortic surgery.

The place of arterial cannulation has become an important aspect of aortic dissection surgery. Traditionally, femoral arterial cannulation has been the standard in most instances. In the past 10—15 years it has been realized that this can contribute to an increased incidence of neurological complications, possibly due to embolization of thrombus or atherosclerotic debris from the descending aorta during perfusion with retrograde flow. Consequently, cannulation of the right axillary artery either directly or via a short vascular graft anastomosed to the artery has become a preferred alternative, which is not only used in acute dissection, but also in the presence of arch aneurysm [27,28]. Alternatively, an old graft or the aneurysmatic aorta may be cannulated directly [4].

For these reasons, we have converted our cannulation site from femoral artery to the right axillary artery for every acute dissection and in some proximal aortic reoperations. We routinely connect an 8 mm graft to the axillary artery and cannulate the graft in order to minimize the risk of trauma to the axillary artery and facilitate decannulation [27,28]. Alternatively we cannulate the aorta directly downstream of the graft. Cannulation of the graft may be comparatively difficult.

An important consideration is the risk of catastrophic hemorrhage at the time of re-entry. If a median sternotomy is necessary and there is space between aorta and sternum, conventional opening and cannulation are preferred. If the aorta is adjacent to the sternum, the patient is placed on cardiopulmonary bypass by axillary and femoral cannulation before repeat sternotomy. The patient’s body temperature is
slowly reduced to 28–30 °C, and at the time of sternotomy extracorporeal circulation is temporarily interrupted. We have thus been able to manage all situations and have not yet had to employ transapical venting [29].

Using the combination of these approaches and considerations, we have been able to achieve a procedure-related mortality of 4%, which is not different from primary operations on an aneurysmatic aorta. It will have to be shown whether recent modifications, such as the frozen elephant technique, will be able to reduce mortality further without compromising on long term treatment success.

References


