



Anatomic aortic by-pass graft Technique for adult type aortic coarctation

Erişkin tipi aort koarktasyonunda Anatomik aort bypass greft tekniği

Aortic coarctation

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Öz

Amaç: Erişkinlerde aort koarktasyonu ve/veya hipoplastik arkus aorta operasyonlarında aortik klemplemeye bağlı spinal kord iskemisi ve rekürrent sinir laserasyonu tehlikesi nedeniyle en iyi yaklaşımın seçimi en büyük zorluklardandır. Bu çalışmada kardiyopulmoner bypass kullanılmadan sol posterolateral torakotomi ile 22 hastaya yapılan anatomik bypass tekniğini sunmaktayız. **Gereç ve Yöntem:** 2002 yılından bu yana 22 hastaya anatomik olarak konumlandırılmış arkus aorta - desendan aort bypass greft operasyonu uygulandı. Bu teknik için hasta seçimi, arkus aortanın side klemp için uygun boyutta olması, birden çok geniş intercostal arterlerle birlikte hipoplastik aortik istmus olması ve anlamlı intrakardiyak defektin olmaması olarak belirlendi. Ortalama yaş 25.9 idi. Ortalama sistolik kan basıncı istirahatte 57.3 mmHg ve tüm hastalarda üst ekstremitelerde hipertansiyonu mevcuttu. Ameliyat tekniği, sol torakotomi ile arkus aorta - desendan aorta bypass greft boyutunun 16 veya 26 mm çapta gerçekleştirilmekten ibaretti. **Bulgular:** Hiçbir mortalite veya morbidite görülmedi. Ortalama arteriel basınç gradienti 6.9 mmHg idi. 36.2 aylık takip periyodu boyunca herhangi bir olumsuz olay görülmedi ve tüm hastalarda antihipertansif ilaçlar azaltıldı. **Tartışma:** Erişkinlerde kompleks koarktasyon ve hipoplastik aortik arkus cerrahi tedavisinde sol torakotomi ile arkus aorta - desendan aorta bypass tekniği güvenli ve etkilidir.

Anahtar Kelimeler

Aort Koarktasyonu; Erişkin; Bypass Greft

Abstract

Aim: Operation for aortic coarctation and/or hypoplastic arch in adults represents a surgical challenge because of the hazard of spinal cord ischemia due to aortic cross-clamping, laceration of the recurrent nerve, and the choice of the best approach. We demonstrate the results of 22 operations of an anatomical bypass technique via left posterolateral thoracotomy approach without the establishment of cardiopulmonary bypass. **Material and Method:** Since 2002, 22 patients underwent anatomically positioned arcus aorta–descending aorta bypass grafting. Inclusion criteria for this technique were an aortic arch adequate size for partial exclusion with a side biting clamp, hypoplastic aortic isthmus with multiple large collateral intercostal arteries and the absence of significant intracardiac defects. Mean age of the patients was 25.9 years. Mean systolic pressure gradients at rest was 57.3 mmHg; upper extremity hypertension was present in all patients. The operative technique consisted of performing aortic arch–descending aorta bypass graft size 16 or 26 mm in diameter, via left thoracotomy. **Results:** There was no morbidity and mortality. Mean arterial pressure gradient was 6.9 mmHg. During a follow-up period of actually 36.2 months, no adverse event was noticed, and antihypertensive medication was reduced in all patients. **Discussion:** Aortic arch-to-descending aortic bypass via left thoracotomy is a safe and effective method for managing complex coarctation and hypoplastic aortic arch in the adult population.

Keywords

Aortic Coarctation; Adult; By-Pass Graft

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Introduction

Resection and end to end anastomosis is the gold standard technique of aortic coarctation in all age group patients. However, adult type aortic coarctation repair with this gold standard technique needs collateral vessels to be sacrificed and a long clamp time. At the end of the repair, paraplegia is a feared complication for each surgeon. This fear forced the surgeons for various repair techniques. Still, it is necessary to discuss some repairing procedures.

The main purpose of our study is to demonstrate the advantages and the efficacy of anatomically positioned aortic arch-descending by-pass grafting without cardiopulmonary by-pass with left postero-lateral thoracotomy.

Material and Method

Between 2002 and 2012, 15 male and 7 female patients, mean age 25.9 ± 12.6 underwent anatomically positioned aortic arch-descending aorta by-pass graft for treatment of aortic coarctation. Informed consent was received from the patients before starting work. Data of the patients included in the study are shown in table 1. Inclusion criteria for this technique were an aortic arch adequate size for partial exclusion with a side biting clamp, hypoplastic aortic isthmus with multiple large collateral intercostal arteries and the absence of significant intracardiac defects. Hospital records and follow-up examinations were re-

viewed in order to investigate pre and postoperative courses. Special attention was given to pressure gradient in pre and post coarctation segment based on echocardiography and cardiac catheterization data.

Four patients indicated coronary angiography, and none of our study group had coronary artery disease. Isthmic hypoplasia was accepted as isthmus / ascendant aorta ≤ 0.6 . All patients' ratios were in the range of isthmic hypoplasia.

Operation Technique

Operations were performed without cardiopulmonary by-pass. Left postero-lateral thoracotomies were performed along the 4th intercostal space. Aorta exposed 5-10 cm length at descending aorta and 5-7 cm at aortic arch. On a side note, we did not ligate any intercostal arteries. Systemic anticoagulation (heparin 1 mg/kg) was performed. We decided the graft material diameter as the diameter of the distal aortic arch (16-26 mm, Dacron tube graft). A side biting clamp was placed on the distal aortic arch. A tailored dacron graft of appropriate size was anastomosed end-to-side using running 4-0 prolene suture. The tissues in the coarctation area were left untouched. The graft was placed anatomically parallel to the native aorta. A fragment of the explant measuring 10-15 cm in length was used. A partial exclusion clamp was placed on the descending aorta. The anastomosis was performed end-to-side again with a running 4-0 prolene suture. After the clamp was released, heparin was antagonized with protamine. Operations were completed by draining the left pleural cavity. We never had to use one of the numerous methods of spinal cord protection.

Result

There was no morbidity and mortality. The intraoperative and postoperative hospital courses were uneventful in all patients. The patients were extubated over the immediate hours after surgery. Mean blood loss was 138.2 ± 122.8 ml. Mean extubation time was 4.2 ± 2.3 hours. Mean intensive care unit stay was less than 1 day and mean hospital stay was 5.6 ± 2.3 days. The preoperative mean gradient was 57.3 ± 18.3 mmHg. Mean coarctation gradient was 6.9 ± 8.7 mmHg after surgery (table 1). Antihypertensive treatment with a beta blocker and angiotensin converting enzyme was followed for 3 months postoperatively and then reduced according to blood pressure at rest and during exercise.

Follow up was performed at 3, 6, and 12 months postoperatively and then once a year using two dimensional echocardiography. Mean follow up time was 36.2 ± 21.6 months. There was no pathological finding on any of the anastomosis, and especially there was no case of pseudoaneurysm formation. All patients were free of symptoms, and no patients showed signs of heart failure after follow up.

Discussion

In 1973 Weldon et al. described tube by-pass grafting procedure, placing the graft from the transverse arch or left subclavian artery to the descending aorta. Since then tube by-pass grafting has been performed in various ways. Several reports describe the outcome of aorta by-pass grafting through combined left thoracotomy and median sternotomy [1].

Table 1. Patient informations

		Min.	Max.	Mean \pm s.s./n-%
Gender	22			
Male	15			
Female	7			
Age		16	57	$25,9 \pm 12,6$
Hospitalization (day)		5	20	$10,6 \pm 4,3$
Follow up (month)		2	67	$36,3 \pm 21,6$
Coarctation site	Distal arcus			1 4,5%
	Isthmus			9 40,9%
	Juxtraductal			11 50,0%
	Postductal			1 4,5%
Coroner arteria disease	No			22 100,0%
	Yes			0 0,0%
Coroner angiography	Normal			3 13,6%
	Plaque			1 4,5%
	none			18 81,8%
Valve disease	AR1			1 4,5%
	Bicuspid aort			10 45,5%
	MR1			1 4,5%
	none			10 45,5%
Incision	Median sternotomy			1 4,5%
	Left thoracotomy			21 95,5%
CPBP	No			22 100,0%
	Yes			0 0,0%
Complications	Hemorrhage			1 4,5%
	Chylotorax			1 4,5%
	Type III dissection			1 4,5%
	none			19 86,4%
Second operation	Revision			1 4,5%
	TEVAR			1 4,5%
	none			20 90,9%
Gradient (mmHg)		30	94	$57,3 \pm 18,3$
Control gradient (mmHg)		0	23	$6,9 \pm 8,7$
Extubation time (h)		2	10	$4,2 \pm 2,3$
Drainage (ml)		40	600	$138,2 \pm 122,8$

Complex forms of coarctation have been surgically approached by using anatomic repair and extra-anatomic bypass grafting. Anatomic repair may be complicated due to the need for extensive mobilization of the aorta, control of collateral blood vessels, damage to the recurrent laryngeal or phrenic nerves, chylothorax, and spinal cord ischemia [2]. Paraplegia remains the most feared complication of operation for aortic coarctation. The probability of spinal complications after coarctation repair is 0.5%. Older age is associated with an increased incidence of paraplegia. Authors reported an incidence of 5% for patients older than 11 years [1]. A side-biting aortic clamp allows continuation of blood flow to the posterior wall of the aorta and to the intercostal arteries, which, in turn, reduces the risk of paraplegia. Anatomic aortic bypass grafting was used, and no paraplegia and other serious complications occurred in our adult coarctation patients.

When anatomic repair is used, the increased mortality observed in this subset of patients. The mortality rate for repair of aortic recoarctation varies from 0 to 7% and is often due to massive intraoperative bleeding [1,3]. Postoperative morbidity is mostly due to phrenic or recurrent nerve damage, chylothorax, residual gradients and persistent hypertension [4]. We think that the technique is safe enough for intraoperative and postoperative bleeding. Anatomic aortic bypass graft was applied; there is no need for extensive dissection of the aorta. So, we did not see any nerve damage. Only one patient developed chylothorax and improved after medical treatment. There was no gradient increase at our patient group or any related symptoms.

Potential longterm complications include infection, pseudoaneurysm, graft narrowing with neointimal proliferation or thrombus and anastomotic dehiscence in patients who have considerable somatic growth after repair. So, we excluded the patients who have growth potential after repair, and we do not recommend aortic tube graft bypass repair for this group of patients. None of the patients required reoperation for late complications at a mean follow up of 36.2 ± 21.6 months.

We demonstrated our experience with aortic bypass tube graft via left thoracotomy and without the establishment of cardiopulmonary bypass for aortic coarctation with isthmic hypoplasia in selected patients. Aorto-aortic bypass grafting is a safer, less invasive and an effective method for correction of the coarctation in selected patients.

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Conflict of interest

None.

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