

Outcome of Aortic Surgery in the setting of a tertiary care cardiac institute in Pakistan

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ABSTRACT

Aim: To review the outcome of aortic surgical procedures performed by one surgical team between November 2011 to January 2015.

Methods: The total number of patients was 31. Three patients had acute aortic dissection and were operated as emergency/salvage procedure. The remaining patients had elective surgery. Their median age was years. The surgical procedures included Bentall Operation (n=11), Bentall with aortic arch replacement (n=2), Bentall with mitral valve repair (n=1), Redo aortic valve replacement with reconstruction of aortic root (n=2), resection of Abdominal aortic Aneurysm (n=4), resection of Descending thoracic aneurysm (n=1), Repair of co-arcation of aorta (n=8), Repair of aneurysm at the origin of superior mesenteric artery and thrombo-endarterectomy of aortic bifurcation (n=1).

Results: The median bypass time for aortic root replacement was 175 min and the average cross-clamp time was 122 min. The median clamp time for thoracic and abdominal aortic procedure was 16 minutes. The postoperative ventilation time was 5 hours, the ICU stay was less than 24 hours, and the duration of hospital stay was 7-days. The median chest drainage was 390 ml while median number of blood transfusions included 1 unit of packed RBCs and 1.5 units of fresh frozen plasma. There were two deaths and both patients suffered from acute aortic dissection.

Conclusion: The data confirms highly rewarding outcome in aortic surgery in Pakistan. Paradoxically the referral for such operations is very limited which reflects general misunderstandings about the outcome in the minds of referring physicians. Moreover poor logistic and financial support might be another reason for patients not reaching the cardiac institutes.

Keywords: Aortic Surgery; Aortic Aneurysms; Aortic Dissection; Aortic Root Replacement

INTRODUCTION

Aortic Surgery is a highly challenging area of cardiac and vascular surgery. The natural history of aortic aneurysm confirms a formidable mortality and morbidity¹. It is estimated that in US these account for over 15000 deaths annually which include 9000 patients of abdominal aortic and 6000 thoracic aortic aneurysms^{2,3}. The surgery of aorta requires advanced level of surgical skills, modern infrastructure and highly dedicated team of professionals. It has undergone tremendous advancements in the developed world but is still extremely neglected in developing countries. It is well established that most of aneurysm related deaths occur in elderly men of age 65 and above^{4,5}. Therefore, it is expected that in Pakistan, the burden of aortic aneurysms is going to increase tremendously in the coming years as the life expectancy in the country is improving. There is a general impression in the country that aortic surgery has unacceptably high mortality. We report our results of aortic operations which duly challenge this general perception.

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PATIENTS & METHODS

All operations done from November 2011 to January 2015 by the team of surgeons led by the senior author (AJ) were included in the study. There were a total of 26 operations conducted at two centers namely CPE Institute of Cardiology (CPEIC) in Multan and Rawalpindi Institute of Cardiology (RIC) in Rawalpindi. The change of institution took place after the two main members of the team moved from CPEIC to RIC in April 2013.

The data was prospectively entered in the dedicated cardiac surgery database (Cascade Databases Lahore, Pakistan). Since the same database software was used in both institutes therefore the dataset had same variables.

In patients with aneurysm of ascending aorta, the operations were done on cardiopulmonary bypass using cannulation of femoral artery and direct cannulation of superior and inferior vena cavae. The coronary sinus was also cannulated for transfusion of cold blood cardioplegia.

In two cases where Bentall procedure was combined with replacement of aortic arch the cardiopulmonary bypass was established as mentioned above. The aorta was cross clamped and the aortic root was replaced at 32 C. The temperature

was lowered further down to 20 C and total circulatory arrest was done for replacement of arch after removing the cross clamp.

The repairs of coarctation were done by patch aortoplasty using patch of Dacron. These operations were done after mobilizing the distal portion of aortic arch, left subclavian artery and the descending aorta. The aorta was clamped below and above the coarctation and the aorta was opened longitudinally. The shelf of abnormal tissue was resected and the lumen was augmented with a patch of Dacron stitched with continuous stitches of 4/0 Prolene. In one case the segments of aorta above and below the coarctation were found to be dilated grossly. In this situation the coarctation was resected leaving posterior 1/3 of the wall of aorta intact. The continuity was restored by stitching the proximal and distal edges of the anterior 2/3 directly.

Four patients underwent repair of AAA. The operations were done without using cardiopulmonary bypass. The abdomen was opened through the midline laparotomy. The intestines were packed away from the midline. The aorta was approached through the peritoneal cavity. The aneurysm was dissected and mobilized. In three patients the aorta was clamped below the renal vessel and at the bifurcation. The sac was opened longitudinally and the clots were evacuated. A Hemashield graft was anastomoses and was wrapped within the aneurysmal sac. In one case the anastomoses had to be extended above the renal arteries. In this patient the aorta was exposed by mobilizing the duodenum. The aorta was dissected at its entry in the abdomen by dividing the hepatic ligaments and the aorta was clamped just below the diaphragm.

RESULTS

The Table 1 summarizes the descriptive statistics. Majority of patients were under 45 years of age (mean age 37.14 \pm 15.16 years). The Mean body weight (54.0 \pm 13.56kg) and body mass index (21.73 \pm 4.51 kg/m²) were well within normal range.

The most frequently performed procedure was Bentall aortic root replacement which was done in 14 patients. Out of these 14 patients 11 underwent isolated Bentall procedure while two had Bentall with replacement of aortic arch and in one patient Bentall Procedure was combined with mitral valve repair. This patient had severe mitral regurgitation due to grossly dilated mitral valve annulus. Mitral valve annuloplasty was done using a flexible ring [Table 2]. Two patients presented echocardiographic findings suggestive of aortic root abscesses with severe aortic regurgitation. One had a previous aortic valve replacement with a mechanical valve. His CT scan

was suggestive of two large cavities around the aortic root. During surgery he was found to have two pseudo-aneurysms arising from the aortic suture line of previous surgery. The prosthetic valve also had significant para-valvular leak. The old valve was explanted and new mechanical was implanted. The pseudo-aneurysms were excised and the aortic root was reconstructed with two patches of Dacron. The other patient had an aortic root abscess. Extensive debridement was done and the root was reconstructed using Bovine Pericardium after aortic valve replacement. Four patients underwent repair of abdominal aortic aneurysm and one had repair of thoracic aneurysm. In these five patients simple clamp and sew technique was used. The mean clamp time in these patients was 16 minutes.

Table 1: Descriptive statistics

Variable	Median	Mean	Standard Deviation
Age (years)	37	37.14	15.66
Weight (kg)	54	54	13.56
Height (cm)	159.5	158.21	12.01
Body Mass Index kg/m ²	21.22	21.73	4.51
Body Surface Area (m ²)	1.6	1.58	0.31
Bypass Time (min)	175	178.3	89.31
Cross Clamp Time (min)	122	116.5	50.35
ICU Stay (hours)	21	24.28	20.44
Ventilation Time (hrs)	4	10	22.78
Duration of Inotropes	5	6.21	4.89
Postop blood Loss (ml)	425	444.64	309.52
Use of blood units	1	1.5	1.7
Packed RBC	1	1.5	1.7
Fresh Frozen Plasma	2	2.07	1.77
Platelets	1	1.5	1.7
Hospital Stay (days)	6.5	7.36	4.36

The post operative recovery was pleasingly uneventful in 29 patients. Contrary to the common belief there was very minimal post-operative blood loss (mean 444.64 \pm 309.5 ml). Consequently, the use of blood products was also very limited. The mean number of packed RBCs transfused after surgery was 1.5(\pm 1.7). The fresh frozen plasma was used more frequently as compared to packed RBC i.e., 2.07(\pm 1.77). The median time on mechanical ventilation and inotropic support was less than 5 hours. The mean values of these times are higher due to two patients who expired after a prolonged stay on ventilator and inotropes. The ICU stay was similarly very short just like the routine open heart operations.

There were two deaths in this series. Both patients suffered from acute aortic dissection arising from ascending aorta and extending up to the bifurcation of aorta. These were salvage procedures as the patients had already developed multiple organ failure at the time of presentation. Both patients died of multiple organ failure eventually.

Table 2: Operative procedures

Procedure	n
Bental's Procedure	11
Bental Procedure+Aortic arch replacement	2
Bental Procedure + Mitral Valve Repair	1
Redo AVR+Aortic Root Reconstruction	2
Repair of Coarctation of Aorta	8
Repair of Thoracic Aortic Aneurysm	1
Repair of Abdominal Aortic Aneurysm	4
Repair of the Aneurysm at the origin of Superior Mesenteric Artery	1
Aorto-iliac Endarterectomy	1

DISCUSSION

The history of the surgical treatment of aortic aneurysms dates back to several centuries⁶. Numerous innovative methods were attempted to deal with this challenging situation. All these attempts were centered on either ligation^{7,8,9} or thrombosis of the aneurysm^{10,11}. The dealing of aortic problems by directly resecting the pathological site followed by reconstruction came into practice after the phenomenal operation reported by Crafoord and Nylin in 1944¹². They successfully conducted resection and end to end anastomosis of aorta in a case of Coarctation. This was followed by rapid progress in this field. The new challenge was to find an appropriate tube like prosthesis for interposition where direct end to end anastomosis was not possible. Robert Gross used a homograft for this purpose in 1948¹³. Arterial homografts were a great step forwards and many arterial banks were established. However, these efforts were limited by problems of availability, procurement, and preservation. For a short period of time Vinyon-N cloth¹⁴ was used as a plastic tube and this was followed by the use of other materials like Nylon, Teflon and Dacron¹⁵. None of these materials could stay for human use but the use of tubes made of synthetic fabric was established as a way forwards. Consequently, DeBakey and his group collaborated with a textile engineer namely Professor Thomas Edward, to develop seamless Dacron tube grafts of all sizes and shapes¹⁶. This revolutionized the vascular surgery and was in fact the dawn of modern aortic surgery. Since then aortic surgery has undergone tremendous progress. The latest landmark is the evolution of Thoracic Endovascular Aneurysm Repair (TEVAR). The multicenter experience from UK and the rest of Europe has shown it to be a safe and very practical option especially in patients with multiple co-morbidities¹⁷. The mid-term result of TEVAR has been reported to be superior than conventional surgical repair of descending thoracic aorta while open surgery still

remains the Gold Standard treatment of the ascending aorta and the arch of aorta¹⁸.

The success of any aortic surgery program depends on many factors. Proper infrastructure with availability of modern equipment and technical gadgets is the starting point. However, the real secret of success lies in the development of a thoroughly trained professional team.

The training background and the specialty of the operating surgeon plays a vital role in the outcome of abdominal aortic aneurysm surgery. Tu JV et al from Ontario reported on this particular aspect. They studied 5878 cases who underwent Abdominal Aortic Aneurysm (AAA) surgery between 1992 to 1996¹⁹. The operative odds of mortality were 62% higher when the surgery was performed by a general surgeon than when operated by a vascular or cardiac surgeon.

The experience in the developed countries has also confirmed that the outcome is positively related to larger number of operations done in a center. The report of Dimick JB has specifically highlighted this aspect in the management of abdominal aortic aneurysms in USA²⁰. They reviewed a sample of Nationwide data of 3912 patients who underwent AAA repair during 1997. The surgeons doing more than 10 operations per year were called high volume surgeons and those doing 10 or less per year were labeled as low volume surgeons. Similarly hospitals performing more than 35 AAA repairs annually were called high volume hospitals. The mortality was significantly low at the hands of high volume surgeons compared low volume surgeons. Similar figures were found in relation with the hospitals. The study also showed a significantly low mortality by the vascular and cardiac surgeons compared with general surgeons.

This has resulted in a trend of establishing dedicated centers and teams for this complex area of surgery. Moreover the advances in endovascular treatment have opened an entirely new avenue for future development.

The experience reported in this paper confirms that despite all the limitations highly satisfactory results can be achieved in this area. This small series has two deaths out of a total 31 patients. The patients who died were victims of acute dissection who were operated in a critical condition. One of them suffered from Marfan Syndrome. His dissection had started from aortic root and extended down to bifurcation involving the neck vessels. He underwent aortic root and arch replacement. The other patient was a pregnant young lady. Both of them died of multi-organ failure.

One of the main reasons for this success is the fact. The team leader in this series had undergone

structured training at the Cardio-thoracic Center in Liverpool, UK that has developed a dedicated aortic surgery program in the United Kingdom. The other members of surgical team included junior cardiac surgeons who were fully trained and qualified in general surgery as well as cardiac surgery. The experience of these surgeons gained while their training in General surgery played a defining role in the management of abdominal aortic procedures.

Our team has made a conscious effort to replicate the surgical techniques as well as the management protocols followed in the United Kingdom. Those areas where there were any limitations of resources and man-power, we improvised the situation according to our local circumstances.

Aortic surgery has not progressed in Pakistan due to several reasons. Nationally, we are not at the stage to establish independent dedicated centers for aortic surgery primarily due to lack of resources and manpower. Consequently the thoracic aortic surgery is conducted by a few cardiac surgeons who maintain a personal interest in this field while the surgery for abdominal aortic diseases is mostly done by few general surgeons. There is no data available to confirm the total number of aortic procedures done in the country. However, according to the figures presented by the database co-ordinator of the Pakistan Society of Cardiovascular & Thoracic Surgeons, only 61 aortic procedures were done across the whole country in the year 2014 by the members of (PSCVTS). Considering the contribution of all other vascular surgeons, the total number would not exceed a few hundred. In a country of over 180 million people, a total of 61 operations is an alarming situation. The most practical and economical way forward is to develop aortic surgery programs in the existing cardiac institutes in the country.

CONCLUSION

There is a lot of potential to develop aortic surgery in Pakistan. Highly satisfactory results can be achieved by developing dedicated Aortic Surgery Teams within the framework of existing Institutes of Cardiac Surgery in Pakistan.

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