Original article

Anesthetic Management of Thoracic & Abdominal Aortic Surgery in a Tertiary Level Teaching Hospital

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Abstract

Introduction: Aortic aneurysm surgeries are one of the most challenging surgeries from anesthetic point of view, not only because the patients have extremes of hemodynamic stresses perioperatively, but also because of the association of various co-morbidities. This demands meticulous attention & extreme caution in perioperative and postoperative management of the patients. This study focuses on various strategies adopted in our center for various organ protection perioperatively and postoperatively.

Methods: This is a retrospective analytical study of the outcome of the patients undergoing thoracic and abdominal aortic aneurysm surgeries of two years duration in a tertiary level teaching hospital.

Results: Total number of aortic aneurysm surgeries in two years was twenty among which 3 were thoracic and 17 were abdominal aortic aneurysm (Suprarenal – 5, Infrarenal – 12). 4 patients had renal dysfunction. Survival was 17 (85%) among which 12 (70%) were operated electively and 5 (30%) had emergency surgeries.

Conclusion: Management of the patients' in this center following evidence based guidelines perioperatively and postoperatively yielded comparable outcome of the patients to other centers with long term experiences.

Keywords: Abdominal, aortic aneurysm, acute kidney injury, thoracic, spinal cord ischemia

Introduction

Aortic aneurysm surgeries, either thoracic or abdominal or both are one of the most challenging surgeries from anesthetic point of view, not only because the patients have extremes of hemodynamic stresses perioperatively with immediate and long-term impact on major systems of the body, but also because of the association of various co-morbidities that the patients usually exhibit[1]. Various co-morbidities have direct impact on outcome of the patients[2]. This demands meticulous attention & extreme caution in perioperative and postoperative management of the patients with focus to each and every systems of the body to reduce neurological, renal, cardiovascular & respiratory problems.

Elective or emergent surgery of the patients with or without ruptured aortic aneurysm is the single most independent predictor of outcome of the patient, with 50% mortality in the patients with ruptured aortic aneurysm[3].

Development in various anesthetic techniques and monitoring equipments, better understanding of the physiology, organ protection techniques, precision

diagnosis by the radiological suites, early and advanced surgical interventions, and care of the patients in critical care units have significantly contributed to the reduced mortality and morbidity in the modern era[4].

This study focuses on the anesthetic management implied in one of the tertiary level centre of Nepal for the perioperative and postoperative management of aortic surgeries, and discusses various techniques related with outcome of the patients with other centers with long term experience.

Methodology

This is a retrospective analytical study of the outcome of the patients undergoing thoracic and abdominal aortic aneurysm surgeries, and discussion related with various perioperative anesthetic techniques and postoperative management strategies implied in our center in two years from 13th April 2012 to 13th April 2014 (1st Baisakh 2069 to 30th Chaitra 2070 B.S.) after ethical approval from Institution Review Board (IRB).

Data were collected from patients' file from record section and verified with registries from operation theatre, anesthetic record sheet and records from critical care units. Data were entered in a predesigned form in Microsoft Excel file.

Results

Total number of cases in two years was twenty. Among them, 3 patients had thoracic aortic aneurysm and 17 patients presented with abdominal aortic aneurysm (Suprarenal – 5, Infrarenal – 12). 6 (30%) patients were operated on emergency basis, while remaining were operated as elective patients. The survival rate was 17 (85%) among which 12 (70%) were operated electively and 5 (30%) had emergency surgeries. Among all, 11 patients were hypertensive, 2 patients had chronic obstructive airway disease and 1 patient had diabetes mellitus.

Table 1 Demography of patients and other variables

Variables	Mean ± SD
Age (years ± SD)	50 ± 15
Height (cm ± SD)	160 ± 10
Weight (kg ± SD)	59 ± 15
Duration of surgery (mins ± SD)	288 ± 128
Duration of cross-clamp (mins ± SD)	66 ± 44

Table 2 Survival rate of patient according to different variables

	Total patients (20)	Survived (17, 85%)	Expired (3, 15%)
Gender			
Male	14 (70%)	11 (65%)	3 (35%)
Female	6 (30%)	6 (100%)	0
Type of Surgery			
Elective	14 (70%)	12 (86%)	2 (14%)
Emergency	6 (30%)	5 (83%)	1 (17%)
Anatomy			
Thoracic	3	3 (100%)	0
Abdominal	17	14 (82%)	3 (18%)
Suprarenal - 5, Infrarenal - 12			

Table 3: Postoperative renal dysfunction status

Post op Renal dysfunction		Aortic aneurysm		Remarks
		Thoracic	Abdominal	
Acute Kidney Injury (AKI)	3	1	2	Resolved in post operative period
Acute Renal Failure (ARF)	1		1	Death on 2nd POD

The patients with renal dysfunction (Table III) had cross clamp times of 23, 66, 72, and 177 mins. The patient who developed ARF had cross clamp time of 72 mins.

1 patient presented with ruptured abdominal aortic aneurysm who could not be saved. 3 patients presented with dissection of abdominal aortic aneurysm, among which 1 patient had AKI which resolved later. Other 2 had uneventful postoperative course.

4 patients were operated under partial bypass, with separate canula for renal perfusion. 3 patients had lumbar drain, in which cerebrospinal fluid (CSF) pressure was maintained around 6 - 8 mm of Hg.

Average cross clamp time was 66 (± 44) mins and average duration of surgery was 288 (± 128) mins.

Discussion

Aortic aneurysm surgeries are challenging from anesthetic point of view due to several factors one of which is association of various co-morbidities that the patients usually exhibit[1]. Patients' co-morbidities have direct influence on outcome of the patients[2,5,6]. Extra vigilance is warranted in perioperative and postoperative management of the patients with focus to each and every systems of the body to reduce neurological, renal, cardiovascular & respiratory problems.

Aortic cross clamping is one of the major factors that is directly related with the morbidity of the patients with deleterious side effects in different systems, primarily renal and spinal cord. The site of the clamp influences its effect on cardiovascular system and other related systems. Proximal positions of the clamp have more deleterious effect in the cardiovascular system[7]. In our center, to counteract the effect of aortic cross clamp we use the maneuvers like deepening plane of anesthesia, nitroglycerine bolus and infusions, beta blocker bolus doses and occasionally sodium nitroprusside infusion if the clamp is too proximal. For patients with ejection fraction less than 50%, transesophageal echocardiography (TEE) was used to assess the cardiac function. TEE was used in 6 patients.

This study has combination of thoracic & abdominal aortic surgeries. All the three thoracic aneurysm patients had lumbar drain to maintain CSF pressure at around 6 to 8 mm of Hg to prevent spinal cord ischemia. Central venous pressure was maintained at higher levels of 8 – 10 mm of Hg. CSF drainage is one of the methods to prevent spinal cord ischemia[5]. In a systemic review of randomized controlled trials, it was found that CSF drainage is useful in preventing spinal cord ischemia[8]. Other methods are spinal cord hypothermia obtained by washing with cold normal saline via lumbar drain catheter, intercostals artery reimplantation, selective perfusion through arteria radicularis magna and maintenance of hypertension proximal to cross clamp[9]. We also maintained mild hypothermia during surgery with core body temperature at 32°C.

In our center, mannitol is used at the dose of 0.75 gm/kg around 25 – 30 minutes before application of aortic cross clamp. Mannitol is believed to reduce not only reperfusion injury of kidneys and other organs, but also prevents spinal cord reperfusion injury [8,9].

Spinal cord ischemia may be detected earlier by other investigation modality like Somatosensory Evoked Potentials (SSEP) which is considered to have good sensitivity for this purpose[10]. Since we do not have this facility we could not use this method.

Renal insufficiency is another one of the dreaded complication of thoraco-abdominal aortic surgeries, which is also regarded as one of the predictor determining the outcome of the patients[3,11,12]. In this study the incidence of renal insufficiency was 20% (1 – ARF, 3 AKI), among which one patient, who developed acute renal failure, had mortality on second postoperative day (POD). Decreasing cross clamp time, optimal volume loading before cross clamp, mannitol infusion, cold renal perfusion of renal arteries during left heart bypass are few methods to prevent renal injury [6,13,14]. In our center, four patients had cold renal perfusion with blood with separate canula. In the study by Scott et al, cold renal perfusion of kidneys with ringer's lactate or blood yielded similar results[14]. Acetylcysteine has also been used for the renal protection[15].

Incidence of acute renal failure after aortic cross clamping has been reported to be 0.2 – 3 %. [16]. Renal perfusion is decreased not only in supra-renal aortic cross clamping but also in infra-renal aortic cross clamping[17]. So all the available multimodal protective strategies should be applied in both suprarenal and infrarenal aortic cross clamping. The best documented method to overcome all those problems is shortening aortic cross clamp time. In this study average aortic cross clamp time is 66 mins (Range 20 – 177 mins). Longer the cross clamp time, greater are the effects in different organs of the body including derangements of metabolic system[10].

All the patients included in this study received blood and blood product transfusions. To reduce the incidence of intraoperative and postoperative bleeding, in our center we use tranexamic acid at the dose of 20 mg/kg bolus intraoperatively and continue as intermittent bolus doses postoperatively upto second postoperative day as blood transfusion is a known indicator to increase morbidity and mortality of the patient[18]. Tranexamic acid has been proven to reduce the incidence of intraoperative & postoperative allogeinic blood transfusion[19]. In some of the cases, partial bypass with reservoir was used for collection of blood from surgical site which allowed for autologous transfusion, which is also common technique to prevent allogeneic blood transfusion[19]. We used partial bypass with reservoir in 4 patients. Cell saver has also been used for this purpose, but we do not have this facility[20].

Before cross-clamp release, the patients were infused with 500 to 1000 ml of ringer's lactate solution. This technique is found to decrease the incidence of hypotension after aortic cross clamp release[7]. After release of clamp, if hypotension occurred and is refractory to more fluid boluses and noradrenaline bolus doses, clamps were reapplied and then

released gradually. Such patients were maintained with low doses of noradrenaline infusions.

Neurological deficits were not observed in this study. In other studies neurological deficits were recorded to be 16%. The author found that the predictors for neurological deficit were total aortic clamp time, extent of aorta repaired, aortic rupture, patient age, proximal aortic aneurysm and renal dysfunction[6]. Cina CS et al have reported the neurological deficits of 12% and 33% in patients with and without cerebrospinal fluid drainage respectively.[8]

After completion of the procedure, patients were transferred to cardiothoracic intensive care unit, and mechanically ventilated till patients were stable with one or two ionotropes and there were no significant bleeding. Patients were extubated, once the criteria were met. We have practice of fast track extubation in intensive care unit, as it gives time for observation and stabilization of the patient. Immediate extubation in operation theatre does not provide any added benefit[21].

Conclusion

Aortic aneurysm surgeries are most challenging from anesthetic point of view. Evidence based medicine practice helps to manage patients more efficiently and with good outcome. This study presented the efficient management of the patients' perioperatively and postoperatively with the results comparable to other centers with long term experiences.

Conflict of interest: None declared.

References

1. Cina C., Clase C. M., Bruin G. A cohort study of coagulation parameters and the use of blood products in surgery of the thoracic and thoracoabdominal aorta. J. Vasc. Surg. Mar 2001; 33 (3): 462-8.
2. Jamieson WRE, Janusz MT, Miyagishima RT et al. Influence of ischemic heart disease on early and late mortality after surgery for peripheral occlusive vascular disease. Circulation (Supplment I) 1982; 66: 92-97.
3. Svensson L. G., Crawford E. S., Hess K. R., et al. Experience with 1509 patients undergoing thoracoabdominal aortic operations. J. Vascular Surgery 1993; 17, 357-370.
4. Anthony J. Cunningham. Abdominal aortic surgery: Anesthetic implications. The Yale Journal of Biology and Medicine 1991; 64: 309-327
5. Johnston KW. Multicenter prospective study of nonruptured abdominal aortic aneurysm. Part II. Variables predicting morbidity and mortality. J Vasc Surg. 1989 Mar; 9(3):437-47.
6. Lars G. Svensson, E.Stanley Crawford, Kenneth R. Hess et al. Experience with 1509 patients undergoing thoracoabdominal aortic operations. Journal of Vascular Surgery February 1993; 17(2):357–370.
7. Silverstein PR, Caldera DL, Cullen DJ et al. Avoiding the hemodynamic consequences of aortic cross clamping and unclamping. Anesthesiology 1979; 50:462-466.
8. Cinà CS, Abouzahr L, Arena GO et al. Cerebrospinal fluid drainage to prevent paraplegia during thoracic and thoracoabdominal aortic aneurysm surgery: a systematic review and meta-analysis. J Vasc Surg. 2004 Jul; 40(1):36-44.
9. Hollier LH, Money SR, Naslund TC et al. Risk of spinal cord dysfunction in patients undergoing thoracoabdominal aortic replacement. Am J Surg. 1992 Sep; 164(3):210-3.
10. Glen S. Murphy, Jeffery S. Vender. Monitoring the anesthetized patient. Clinical Anesthesia, Barash, 5th Edition, Lippincot Williams & Wilkins, 1397 – 1437.
11. Manabu Shiraishi, Kei Aizawa, Yasuhito Sakano et al. Predictive Factor for mortality and morbidity of abdominal aortic aneurysm repair. Arch Clin Exp Surg. 2013; 2(1): 8-15.
12. Joseph MG, McCollum PT, Lusby RJ. Abnormal pre-operative creatinine levels and renal failure following abdominal aortic aneurysm repair. Aust N Z J Surg 1989; 59: 539-541.
13. Harry L. Bush Jr, Jack B. Huse, Willard C. Prevention of renal insufficiency after abdominal aortic aneurysm resection by optimal volume loading, Arch Surg. 1981; 116 (12): 1517-1524.
14. Scott A. LeMaire, Marisa M. Jones, BS Lori D. Conklin. Randomized comparison of cold blood and cold crystalloid renal perfusion for renal protection during thoracoabdominal aortic aneurysm repair. Journal of Vascular Surgery 2009; 49(1): 11–19.
15. Cina C., Jhirad R., Laganà A., Hashem M., et al. Acetylcysteine: An adjunct for renal protection in thoracoabdomical aneurysm repair. Gazzeta Medica Italiana 2004 Dec; 163 (6), 233-8.

16. Cunningham AJ: Anaesthesia for abdominal aortic surgery: A review (Part I). Can J Anaesthesia 1989; 36:426-444.

17. Gamulin Z, Forster A et al. Effect of infrarenal aortic cross clamping on renal hemodynamics in humans. Anesthesiology 1984; 61: 394-399.

18. Ho P, Ting AC, Cheng SW. Blood loss and transfusion in elective abdominal aortic aneurysm surgery. ANZ J Surg. 2004 Aug; 74(8): 631-4.

19. M. Hashem, C.S. Cina. Anaesthesia for surgical repair of thoracoabdominal aortic aneurysms. Acta Anaesth. Belg. 2007; 58: 45-54.

20. Casati V, Sandrelli L et al. Hemostatic effects of tranexamic acid in elective thoracic aortic surgery: a prospective, randomized, double-blind, placebo-controlled study. J Thorac Cardiovasc Surg. 2002 Jun; 123(6): 1084-91.

21. Cohen J, Loewinger J, Hutin K et al. The safety of immediate extubation after abdominal aortic surgery: a prospective, randomized trial. Anesth Analg 2001 Dec;93(6): 1546-9.