Section: Cardiovascular Anaesthesia

Case Series

PERIOPERATIVE ANAESTHETIC MANAGEMENT OF AORTOBIFEMORAL BYPASS GRAFTING: A CASE SERIES

Alisha P V[1], Deva Ram[2], Abhinav Singh[3], Bharat Choudhary[4], Amit Choudhary[5], Subhash Balara[6]

[1]*Senior Resident, Department of Anaesthesia, Dr. S.N. Medical College, Jodhpur, Rajasthan, India*
[2]*Assistant Professor, Department of Cardiovascular & Thoracic Surgery, Dr. S.N. Medical College, Jodhpur, Rajasthan, India*
[3]*Associate Professor. Department of Cardiovascular & Thoracic Surgery, Dr. S.N. Medical College, Jodhpur, Rajasthan, India*
[4]*Assistant Professor, Department of Anaesthesia, Dr. S.N. Medical College, Jodhpur, Rajasthan, India*
[5]*Assistant Professor, Department of Cardiovascular & Thoracic Surgery, Dr. S.N. Medical College, Jodhpur, Rajasthan, India*
[6]*Professor, Department of Cardiovascular & Thoracic Surgery, Dr. S.N. Medical College, Jodhpur, Rajasthan, India*

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Corresponding Author:
Bharat Choudhary,
Assistant Professor, Department of Anaesthesia, Dr. S.N. Medical College, Jodhpur, Rajasthan, India.

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ABSTRACT

Aortobifemoral bypass grafting remains the standard open surgical procedure for revascularization in advanced aortoiliac occlusive disease, offering excellent long term patency. However, the surgery presents unique anaesthetic challenges arising from major aortic manipulation, profound hemodynamic shifts during cross clamping and declamping, systemic anticoagulation, and postoperative analgesia. We report a case series of four patients with extensive aortoiliac occlusive disease who underwent open aortobifemoral bypass grafting under general anaesthesia. A standardized perioperative management strategy was followed, incorporating invasive arterial blood pressure monitoring, central venous pressure monitoring, goal directed fluid therapy, activated clotting time–guided anticoagulation, and careful pharmacologic modulation with vasodilators and inotropes during clamping and reperfusion. Renal protection was achieved by maintaining adequate intravascular volume and systemic perfusion, avoiding prolonged hypotension and maintaining adequate urine output and acid–base balance. Postoperative analgesia was provided with intravenous paracetamol and a transdermal diclofenac patch as part of a multimodal analgesic regimen. All procedures were completed successfully without major hemodynamic instability, cardiac or renal complications, or perioperative mortality. This case series highlights that meticulous perioperative planning, vigilant hemodynamic and anticoagulation management, renal protective strategies, and multimodal analgesia can ensure safe anaesthetic conduct and favourable outcomes in patients undergoing aortobifemoral bypass grafting.

Keywords: Aortobifemoral bypass grafting, Aortic cross clamp, Goal directed fluid therapy, Multimodal analgesia.

INTRODUCTION

Peripheral arterial disease (PAD) represents a common manifestation of systemic atherosclerosis and is associated with significant cardiovascular morbidity and functional limitation. It predominantly affects the elderly population and is commonly associated with coexisting conditions like coronary artery disease, diabetes mellitus, hypertension and chronic kidney disease. Among the modifiable risk factors, smoking remains the most important and consistently implicated factor with a strong association with disease onset, progression, and adverse outcomes.[1]

The Trans-Atlantic Inter-Society Consensus (TASC II) classification guides revascularization in aortoiliac occlusive disease, recommending endovascular therapy for TASC A and B lesions and surgical revascularization for more complex TASC C and D lesions. Endovascular techniques, including percutaneous transluminal angioplasty offer lower perioperative morbidity and faster recovery. In contrast, open surgical procedures such as

aortobifemoral bypass, aortoiliac endarterectomy, and extra-anatomic bypass provide superior long-term patency, particularly in extensive disease.[2]

Aortobifemoral bypass grafting poses significant anaesthetic challenges, necessitating meticulous perioperative planning and vigilant monitoring. The application and release of the aortic cross-clamp result in marked haemodynamic alterations, including an increase in systemic vascular resistance and afterload during clamping, followed by hypotension and metabolic disturbances upon unclamping.[3] These changes may compromise myocardial function and end-organ perfusion, particularly in patients with underlying cardiovascular disease. Effective management therefore involves preoperative evaluation especially cardiac status along with specific investigation like computed tomography (CT) angiography of abdomen and bilateral lower limb and perioperative optimisation of intravascular volume, appropriate use of vasoactive agents, and continuous haemodynamic monitoring. In addition, strategies aimed at preserving renal perfusion, maintaining normothermia, and providing adequate perioperative analgesia are essential to minimise complications and improve outcomes in this high-risk population.[4]

While surgical outcomes of Aortobifemoral bypass grafting have been widely studied and reported, there is comparatively limited emphasis on detailed perioperative anaesthetic management. In this context, we present a case series of patients undergoing aortobifemoral grafting, with emphasis on anaesthetic considerations, intraoperative challenges, and perioperative management strategies relevant to contemporary anaesthesia practice.

CASE SERIES

Case 1: A 76-year-old male presented with complaints of pain in the right lower limb for 6 months associated with discolouration of the right toes for one month, which had progressed to gangrene of the right toe suggestive of acute on chronic limb ischemia. Patient had a history of chronic smoking with smoking index of 250 and treated pulmonary tuberculosis. Preoperative echocardiography revealed global left ventricular hypokinesia with an ejection fraction of 30 – 35%. CT angiography of aorta and bilateral lower limbs revealed diffuse atherosclerotic disease of the abdominal aorta with 20–25% luminal narrowing and distal aortic thrombosis. Bilateral external iliac artery thrombosis with distal reconstitution was noted, along with 25–30% narrowing of the common femoral arteries and 50–60% narrowing of the superficial femoral arteries, with multilevel distal arterial disease.

Case 2: A 66-year-old male presented with pain in bilateral lower limbs for three months. Patient had a history of chronic smoking with smoking index of 300. Preoperative echocardiography revealed mild concentric left ventricular hypertrophy with preserved systolic function and grade 1 diastolic dysfunction. CT angiography revealed a prior infrarenal aortic stent with absent contrast opacification, suggestive of stent thrombosis. There was 50–60% stenosis of the right and 30–40% stenosis of the left common femoral arteries, with 30–40% bilateral superficial femoral artery stenosis and 15–20% right popliteal artery stenosis. Distal right posterior tibial and peroneal arteries showed non-opacification suggestive of thrombosis, with faint opacification of the dorsalis pedis artery

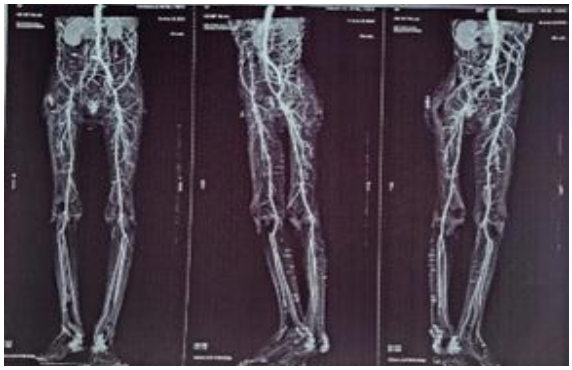

Figure 1: CT angiography with three-dimensional volume rendered reconstruction showing diffuse atherosclerotic involvement of bilateral lower limb arteries, with significant luminal narrowing in the common and superficial femoral arteries, more pronounced on the right side. Distal right sided arteries show reduced contrast opacification suggestive of thrombosis, while left-sided arteries are preserved (Case 2).

Case 3: A 63-year-old male presented with a non healing wound over the right foot for 3 months associated with gangrene over the right great toe. He also reported rest pain in right lower limb for 1 month. Patient had a history of chronic smoking with smoking index of 300. CT angiography of the aorta and bilateral lower limbs revealed diffuse atherosclerotic disease involving the abdominal aorta and bilateral iliac arteries 20-30%, with significant luminal narrowing/occlusion predominantly involving the right common and external iliac arteries 50-60%. The right lower-limb arterial system demonstrated multilevel atherosclerotic disease with reduced distal contrast opacification, consistent with severe peripheral arterial disease. The left-sided arterial circulation was relatively better preserved, with comparatively maintained distal opacification.

Case 4: A 71-year-old male presented with decreased sensation in the left lower limb for 9 months. Patient was a known case of hypertension for 10 years on treatment and has a history of smoking with smoking index 280. CT angiography demonstrated diffuse atherosclerotic disease involving the descending thoracic and infrarenal abdominal aorta, with 30–40% luminal compromise of the infrarenal aorta. A filling defect involving the left common iliac artery over approximately 3.8 cm

was noted, suggestive of complete thrombosis, with distal reconstitution through collateral vessels. Significant stenosis of the proximal celiac trunk and superior mesenteric artery (SMA) was also noted.

Anaesthetic Management: All four patients underwent a thorough preoperative evaluation, including a detailed clinical assessment, relevant laboratory investigations including coagulation profile. Preoperative optimisation of comorbidities done. Written informed consent for surgery and anaesthesia was obtained. Patients were counselled regarding smoking and tobacco cessation as part of prehabilitation. Fasting was ensured according to institutional preoperative fasting protocol.

The patient was received in the operating theatre, identity along with the planned procedure was confirmed. Standard ASA monitors were applied, including continuous ECG, non-invasive blood pressure, pulse oximetry, and temperature monitoring. Baseline vital parameters were recorded.

Intravenous access was secured using wide bore peripheral cannula, and intravenous maintenance fluids were initiated. For beat-to-beat blood pressure monitoring and arterial blood gas analysis (ABG), under all aseptic precautions a right radial arterial line established under 2% lignocaine, baseline ABG and activated clotting time (ACT) done. All patients underwent general endotracheal anaesthesia (GETA). Nasopharyngeal temperature probe inserted for temperature monitoring. A central venous 7 French triple lumen catheter was inserted in the right internal jugular vein to facilitate central venous pressure monitoring and administration of vasoactive agents under ultrasound guidance.

Intraoperative Management: Anaesthesia was maintained with a balanced technique using inhalational agents, opioid and intermittent neuromuscular blockade. Continuous monitoring included ECG, invasive blood pressure, SpO2, EtCO2, temperature, urine output, central venous pressure (CVP) and pulse pressure variation (PPV).

To facilitate rapid titration in response to intraoperative haemodynamic changes, nitroglycerine (50 mg diluted to 50 mL with normal saline; concentration, 1 mg/mL) and noradrenaline (4 mg diluted to 50 mL with normal saline; concentration, 80 µg/mL) were prepared and administered using infusion pumps.

Systemic anticoagulation was achieved with intravenous heparin of 100 IU/kg 5 minutes prior to partial aortic clamping, and anticoagulation adequacy was assessed using ACT maintained within target value (250-300).

Haemodynamic stability was maintained with goal directed fluid therapy guided by PPV along with CVP. Blood loss was closely monitored and replaced appropriately. Sodium bicarbonate intravenously was given to correct metabolic acidosis, if detected on ABG analysis. Special attention was given during aortic declamping, anticipating hemodynamic fluctuations. Adequate intravascular volume status was ensured, and vasoactive support was used as required.

Surgical Technique: Considering the extent of aortoiliac occlusive disease and clinical presentation, an open aortobifemoral bypass grafting was planned. Under general anaesthesia, the abdomen and bilateral groins were prepared and draped in sterile fashion. Bilateral groin incisions were made and the common femoral, superficial femoral, and profunda femoris arteries were dissected, looped and controlled. A midline laparotomy was performed, and the infrarenal abdominal aorta was exposed via a transperitoneal approach. Bilateral retroperitoneal tunnels were created extending from the aortic bifurcation to the femoral incisions following the iliac vessels. The aorta was carefully dissected and looped using vascular loops proximally and distally, and systemic heparinisation was done with intravenous heparin (100 IU/kg) and target ACT was achieved prior to partial side biting aortic clamping. Following clamping, a vertical aortotomy was performed.

A bifurcated corrugated Dacron graft of 12 * 6 mm in two cases and 14 * 7 mm was used in the third case. The proximal end-to-end anastomosis was fashioned between the graft and infrarenal abdominal aorta. The graft limbs were then passed through the retroperitoneal tunnels to the groins, and distal end-to-side anastomoses were performed with the bilateral common femoral arteries. In the last case the patient had SMA stenosis along with aortoiliac disease, hence in this particular case we did Aorto-SMA and concomitant unilateral left aortoiliac anastomosis. Transverse colon was reflected, root of mesentery approach and dissected. SMA identified and looped. Bifurcated Dacron graft of size 12*6 mm was used. One limb of the graft was anastomosed to SMA in end to side fashion and the other limb was anastomosed to left external iliac artery also in end to side fashion. Following restoration of flow, distal perfusion was confirmed with satisfactory pulsations and pulse oximetry. Haemostasis was secured, and all incisions were closed in layers over abdominal drain.

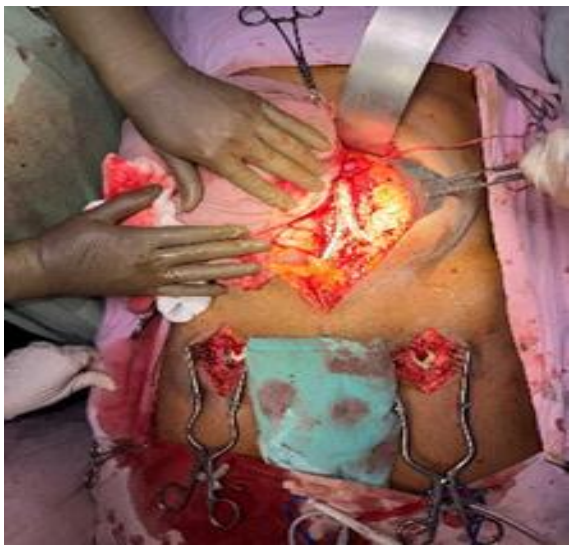

Figure 2: Bifurcated Y shaped Dacron graft insitu after aortobifemoral bypass grafting

Postoperative Care: Following surgery, the patient was transferred to the intensive care unit for continued ventilatory and hemodynamic support. Close monitoring was instituted, including serial arterial blood gas analysis to assess ventilation, oxygenation, surgical drain output and evolving metabolic status, allowing prompt identification and correction of any derangements.

Weaning from mechanical ventilation was considered once the patient demonstrated sustained hemodynamic stability, adequate respiratory function, and satisfactory gas exchange. Additional prerequisites for extubation included minimal bleeding, preserved distal limb perfusion confirmed by palpable peripheral pulses, and normalization of metabolic parameters, particularly acid-base balance.

Post operative analgesia was achieved using an opioid sparing multimodal approach with intravenous non-opioid analgesics like paracetamol 15 mg/kg intravenously every 6 hours and a transdermal patch of diclofenac 200mg once the patient is shifted to intensive care unit, providing effective pain relief while minimizing opioid related adverse effects.

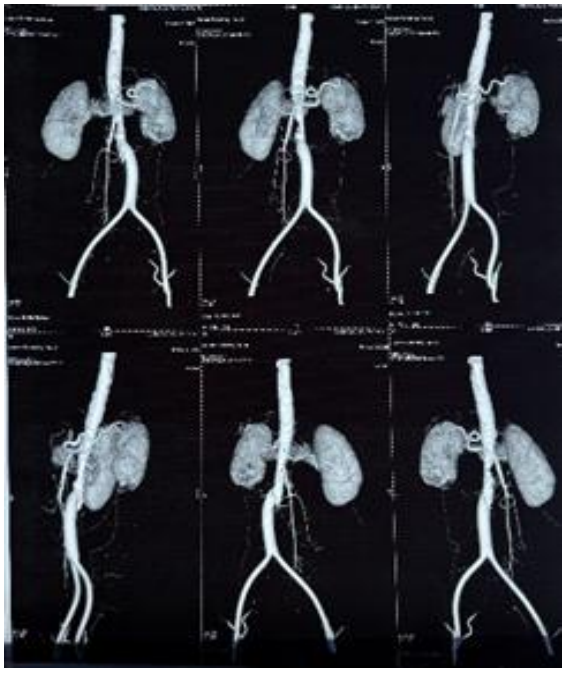

Figure 3: Post operative CTA with normal contrast opacification of the graft of case 2

Summary of all cases presented in table

Table 1: Summary of Clinical and Perioperative Characteristics

Variable	Case 1	Case 2	Case 3	Case 4
Age / Sex	76y/Male	66y/Male	63Y/ Male	71Y/ Male
Symptoms (Duration)	Right lower limb pain with great toe discolouration (6 months)	B/L Lower limb pain (3 months)	Non healing wound and pain in the right foot (3 months); Rest pain for 1 month	Decreased sensation in left lower limb (9 months)
CT angiography	Diffuse aortoiliac disease with significant infrarenal aortic compromise bilateral external iliac artery thrombosis and common femoral artery narrowing	Diffuse aortoiliac and lower-limb arterial disease with thrombosed infrarenal aortic stent and right iliac occlusion	Diffuse aortoiliac atherosclerotic disease with significant right-sided common and external iliac arterial occlusion	Diffuse aortoiliac atherosclerotic disease with infrarenal aortic compromise and complete left common iliac artery thrombosis, significant proximal coeliac trunk and SMA stenosis
ASA/ Metabolic Equivalents (METS)	III/4	II/5	II/5	II/5
Procedure	Aortobifemoral Grafting	Aortobifemoral grafting	Aortobifemoral grafting	Aorto -SMA and concomitant unilateral left Aortoiliac anastomosis.
Graft	Dacron 12 * 6 mm	Dacron 12 * 6 mm	Dacron 14 * 7 mm	Dacron 12 * 6 mm
Anaesthesia	GETA	GETA	GETA	GETA
Monitoring	Standard ASA monitoring, ACT, ABG, CVP, PPV	Standard ASA monitoring, ACT, ABG, CVP, PPV	Standard ASA monitoring, ACT, ABG, CVP, PPV	Standard ASA monitoring, ACT, ABG, CVP, PPV
Anticoagulation	Heparin 100 IU/kg	Heparin 100 IU/kg	Heparin 100 IU/kg	Heparin 100 IU/kg
Partial Clamp	18 mins	20 minutes	20 minutes	22 minutes

duration (18- 22 minutes)				
Outcome	Uneventful	Uneventful	Uneventful	Uneventful

DISCUSSION

Aortobifemoral bypass grafting remains a well-established and durable surgical intervention for advanced aortoiliac occlusive disease. Although several open revascularisation techniques like aortoiliac bypass grafting and other extra anatomic bypass techniques like axillo-bifemoral, descending thoracic aortobifemoral bypass demonstrate comparable long-term patency, their perioperative risk profiles vary considerably. Aortoiliac endarterectomy is generally associated with lower morbidity and is typically reserved for localized disease, whereas bypass procedures are employed in more extensive or diffuse atherosclerotic pathology.[5]

Perioperative anaesthesia management of these patients is largely governed by the physiological alterations associated with aortic cross-clamping and subsequent declamping. Continuous invasive arterial pressure monitoring was particularly important in our patients undergoing aortobifemoral bypass, given the marked hemodynamic changes associated with aortic cross-clamping and subsequent unclamping. Beat-to-beat monitoring facilitated timely recognition and management of the hypertensive response during clamping and hypotension following declamping. The arterial line also enabled serial arterial blood gas analysis to monitor the metabolic and acid–base consequences of distal ischemia and reperfusion. [1,3]

Cross-clamping produces an abrupt increase in systemic vascular resistance and left ventricular afterload, leading to elevations in mean arterial pressure and myocardial wall stress.[6] The magnitude of these changes is influenced by factors such as the level and duration of clamping, adequacy of collateral circulation and preexisting cardiac function. In our series in one patient cross-clamping was associated with a hypertensive response during clamping which was effectively managed with nitroglycerin iv infusion. Continuous invasive arterial monitoring is therefore essential to guide timely pharmacologic interventions and prevent myocardial ischemia or ventricular dysfunction.

Another important consideration is the risk of renal and distal organ hypoperfusion during aortic cross-clamping. The degree of distal ischemia is influenced by the level and duration of clamping and the adequacy of collateral circulation. Maintenance of adequate perfusion pressure, avoidance of prolonged hypotension, monitoring of urine output, and correction of significant metabolic disturbances are therefore important components of perioperative management. [7,8]

Release of the aortic cross clamp marks a critical transition with complex hemodynamic and metabolic consequences. The sudden fall in systemic vascular resistance following reperfusion causes hypotension, while pooling of blood into previously ischemic vascular territories reduces venous return and cardiac output. Concurrent washout of lactic acid and vasoactive metabolites from the distal circulation often precipitates metabolic acidosis, myocardial depression, and transient dysrhythmias.[4] Transient falls in systolic blood pressure were observed in two patients but responded promptly to volume expansion and low dose noradrenaline infusion. The clamp was released gradually to allow controlled reperfusion and hemodynamic adaptation.

Continuous infusion of sodium bicarbonate has been preferred over bolus administration for the prevention of systemic acidosis.[9] In our series, sodium bicarbonate was given if ABG showed metabolic acidosis. So, a proactive strategy combining graded clamp release, pre-emptive volume loading, and correction of acid–base imbalance remains the cornerstone of safe anaesthetic management during declamping in aortic surgery.

Postoperative analgesia in our series was managed using a multimodal, opioid-sparing regimen comprising intravenous paracetamol and a transdermal diclofenac patch. The use of agents with complementary analgesic mechanisms may provide satisfactory pain relief while reducing the need for systemic opioids. Clinical studies evaluating transdermal diclofenac as an adjunct to postoperative analgesia have reported improved pain control and reduced requirements for rescue analgesics compared with conventional analgesic therapy.[10]

A key limitation of this case series is it does not allow broad statistical interpretation. Variations in patient comorbidities and intraoperative factors may have contributed to differences in hemodynamic responses. Nevertheless, this study contributes important perspectives on anaesthetic management during aortobifemoral bypass surgery and emphasises measures that support hemodynamic stability and enhance recovery in complex vascular cases.

CONCLUSION

Aortobifemoral bypass surgery presents complex anaesthetic challenges, particularly during aortic clamping and reperfusion. Our experience highlights that anticipating these physiological changes, understanding the surgical steps, and maintaining close surgical–anaesthetic coordination are central to achieving haemodynamic stability and adequate organ perfusion. A structured approach to monitoring, fluid and vasoactive therapy,

anticoagulation, and postoperative analgesia may facilitate safe perioperative management and favourable outcomes in these high-risk vascular patients.

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