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MANAGEMENT OF COMPLEX CABG AND REDO AORTIC VALVE REPLACEMENT IN A HIGH-RISK PATIENT: A CASE REPORT

Anaesthesiology

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ABSTRACT

We present a case of a 67-year-old male with multiple comorbidities including hypertension, ischemic heart disease with low ejection fraction, chronic kidney disease and previous aortic valve replacement, who presented with acute decompensated heart failure and severe aortic regurgitation. Despite challenges including metabolic acidosis, renal dysfunction, and hemodynamic instability, the patient underwent successful coronary artery bypass grafting (CABG) and redo aortic valve replacement (AVR) with the aid of extracorporeal membrane oxygenation (ECMO) , and intra-aortic balloon pump (IABP) support, Intraoperative and Postoperative continuous renal replacement therapy (CRRT).

KEYWORDS

Coronary artery bypass grafting, Aortic valve replacement, Extracorporeal membrane oxygenation, Intra-aortic balloon pump, Renal replacement therapy, Heart failure, Redo Cardiac surgery

INTRODUCTION:

Coronary artery bypass grafting (CABG) and aortic valve replacement (AVR) are established surgical interventions for coronary artery disease and aortic valve disease respectively. These procedures are particularly challenging in patients with significant comorbidities. Old age, reduced ejection fraction, cardiomegaly, history of congestive heart failure, emergency operation, recent myocardial infarction, prolonged duration of cardiopulmonary bypass (CPB) or aortic clamping are risk factors associated with need for intraoperative inotropic support. Advanced supportive measures such as extracorporeal membrane oxygenation (ECMO), CRRT and intra-aortic balloon pump (IABP) are required to manage perioperative complications in these patients. This case report details the management and outcome of a high-risk patient undergoing CABG and Redo AVR.

Case Report:

A 67-year-old male with a history of hypertension, ischemic heart disease, and prior aortic valve replacement presented with acute decompensated heart failure with associated dyspnoea, fatigue, and orthopnoea and severe aortic regurgitation. He was admitted in ICU with anuria Echocardiography confirmed biprosthetic aortic valve in position with peak/mean gradient of 24/12 mmhg, severe aortic regurgitation and compromised left ventricular function i.e. EF 20%.

Revealed severe metabolic acidosis i.e. lactates >20mmol/l Echocardiography confirmed biprosthetic aortic valve in position with peak/mean gradient of 24/12 mmhg, severe aortic regurgitation and compromised left ventricular function i.e. EF 20%.

Given the complexity of the case, emergency surgery was only the solution and a decision was made to proceed with Redo AVR and CABG. Intraoperative challenges included maintaining hemodynamic stability, organ function, Metabolic and electrolyte balance and preventing coagulopathy. The Patient was shifted to OT with right IJV hemodialysis catheter in situ, left IJV triple lumen central line in situ, 20 G iv line in left hand and right radial arterial line in situ. Patient was on NIV support with FIO2 0.4, O2 saturation 100% and noradrenaline infusion on flow. After shifting to OT table, all monitors attached, radial artery line pressure and central venous pressure transduced. Left femoral arterial line was inserted under all aseptic precautions. Patient was premedicated with Pantoprazole 40 mg, Hydrocortisone 100 mg, Dexamethasone 8 mg and glycopyrrolate 0.2 mg followed by induction with buprenorphine, midazolam, etomidate and rocuronium. After oxygenating for 2 minutes, intubation done with 8mm endotracheal tube and confirmed on auscultation and ETCO2 (capnography). Right groin prepared for emergency CPB access and then redo sternotomy done. Transesophageal echocardiography was done which showed left ventricular dysfunction and intravalvular leak in bioprosthetic aortic valve and severe AR. Baseline abg was suggestive of metabolic acidosis which was corrected with sodium bicarbonate. After conduit dissection, 20000 units Heparin given, Aortic cannulation and right atrial cannulation was done. After confirming an ACT of 480 seconds patient was put on CPB.

Grafting was done on beating heart without cardioplegia. After cardioplegia, native bioprosthetic aortic valve was replaced with a 25 mm metallic valve. During CPB, the patient received 2 units of packed red blood cells (PRBCs). After closure of Aorta and ensuring return of sinus rhythm, an attempt was made to wean off CPB with the aid of high noradrenaline and adrenaline support. However, severe hypotension and lactic acidosis persisted. Despite high doses of noradrenaline, adrenaline, and the addition of vasopressin, the patient exhibited persistent hypotension due to left ventricular failure. Sodium bicarbonate infusion was initiated to correct the acidosis and potassium infusion for hypokalaemia. An intra-aortic balloon pump (IABP) was inserted through the right femoral artery. Post-IABP insertion, the patient was taken off CPB. but despite all efforts, hypotension persisted with development of right ventricular failure and so CPB was resumed. Continuous renal replacement therapy (CRRT) was initiated.

Given the development of right ventricular failure, a decision to initiate Veno-arterial ECMO was taken with central aortic and right femoral venous cannulation. After initiating VA-ECMO, hemodynamic stability was achieved and patient was taken off CPB. During the operation, partial reversal of heparin was done with protamine to maintain an ACT of 180-200 seconds. Haemostasis was achieved by transfusing blood and blood products, the sternum was closed, and the patient was transferred to the ICU with VA ECMO and IABP in situ, and high inotropic support (noradrenaline, adrenaline). CRRT was continued in the ICU.

On POD1, the patient's lactate levels gradually corrected from unrecordable levels above 20 mmol/L to 12 mmol/L. CRRT was continued, and sodium bicarbonate infusion was stopped. The patient was awake, following commands, moving all four limbs, and afebrile.

On POD3, Lactate levels decreased to 3 mmol/L. ECMO was discontinued and ECMO decannulation was performed in the operating room. The patient was vitally stable, and inotrope requirements decreased.

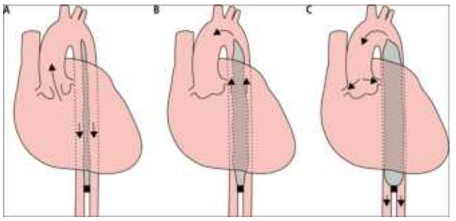
On POD4, the patient developed atrial fibrillation, which was treated with an amiodarone infusion. The patient was successfully weaned off ECMO, IABP, and CRRT. Lactate levels were normalized, and the patient remained vitally stable with low inotropic support. The patient remained in the ICU for a total of 10 days, after which he was transferred to the ward. He was discharged home in stable and good condition on POD15.

DISCUSSION:

This case highlights that how multiple modalities work together for a successful outcome in a high-risk cardiac surgery. The use of ECMO, IABP and CRRT was instrumental in maintaining hemodynamic stability during the perioperative period and patient's recovery. Multidisciplinary collaboration among cardiac surgeons, anaesthesiologists, perfusionist, intensivists and nursing staff was essential in achieving a favourable outcome.

Low cardiac output syndrome (LCOS) is a condition where the heart cannot pump enough blood to meet the body's needs, resulting in reduced oxygen delivery to tissues and subsequent hypoxia. It is the most common and serious complication and is associated with increased morbidity, short- and long-term mortality, and healthcare resource utilization. The most common definition of LCOS includes decrease in the cardiac index (CI) to<2.0 L/min/m2 and a systolic blood pressure of <90 mmHg, in conjunction with signs of tissue hypoperfusion (cold periphery, clammy skin, confusion, oliguria, elevated lactate level) in the absence of hypovolemia. Preoperative ventricular dysfunction, myocardial ischemia, poor myocardial preservation, reperfusion injury, valvular heart disease requiring repair or replacement, long aortic cross-clamp time and total cardiopulmonary bypass time, residual effects of cardioplegia solution and inadequate cardiac surgical repair or revascularization are some of the risk factors associated with the development of LCOS.

Intra-aortic balloon pump is the simplest, cost-effective, easy to implant and explant. The intra-aortic balloon inflates during diastole synchronously with aortic valve closure and the appearance of a dicrotic notch resulting in the displacement of blood from the thoracic aorta into the peripheral circulation that is followed by rapid deflation before the onset of systole. IABP assists the heart indirectly by decreasing the afterload and augments diastolic aortic pressure with subsequent enhancement in diastolic blood flow resulting in better perfusion of peripheral organs as well as possible improvement in the coronary blood flow. Theoretically, this results in improved diastolic pressure and reduced systolic aortic pressure by reducing the afterload, which subsequently results in decreased left ventricle wall stress reducing the myocardial oxygen demand.



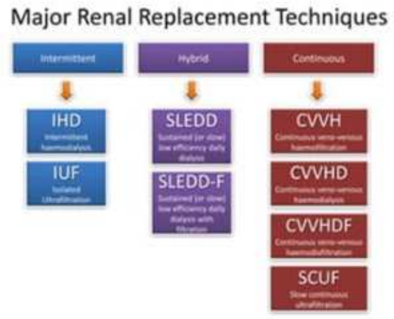
Advantages:
1. Improved coronary perfusion
2. Stabilization of hemodynamics
3. Enhanced cardiac output by combined effects of improved coronary perfusion and reduced afterload

Contraindications:
1. Aortic insufficiency
2. An aortic aneurysm or aortic dissection
3. Significant atheromatous plaques in descending Aorta

A trial conducted by Radakovic et al in 2022 concluded that 30-day survival was better with the addition of an IABP to VA-ECMO for Post-cardiotomy LCOS compared to VA-ECMO only. They also found higher weaning rates suggesting better myocardial recovery, less need for renal replacement therapy and no difference in complications when using both instead of only one mechanical circulatory support device.

A meta-analysis conducted by K. Pilarczyk et al in 2015 corroborates the clinical experience of cardiac surgeons that patients at high risk of developing LCOS may benefit from prophylactic implantation of an IABP.

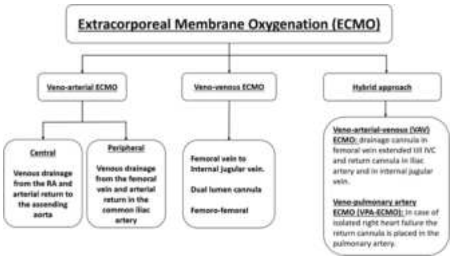
Continuous renal replacement therapy (CRRT) is a renal replacement method that includes intermittent hemodialysis and peritoneal dialysis. CRRT is performed through pump-driven Veno-venous extracorporeal circuits and acts as renal support through blood purification to allow solute and fluid homeostasis. It requires appropriate vascular access, pumps to allow blood circulation, a permeable membrane, and varying solutions to allow fluid balance.



Indications:
1. Volume overload
2. Metabolic acidosis
3. Electrolyte abnormalities
4. Hyperkalemia
5. Hyponatremia
6. Drug and toxin removal
7. Hyperphosphatemia
8. Uremia
9. Encephalopathy
10. Pericarditis
11. Persistent/progressive acute kidney injury

Extracorporeal membrane oxygenation consists of a circuit where blood is drained through a catheter from the venous vascular system, circulated in a pump outside the body, and reinfused into the other venous or arterial vascular system depending on the ECMO circuit type for circulation in the body. Cannulas made of plastic tubes are placed in veins or arteries in the groins, neck, or chest

Two basic types of ECMO: VV ECMO and VA ECMO



Indications for ECMO

Type	Description
Bridge to decision	Use of VA-ECMO in pts with drug-refractory acute circulatory collapse and at immediate risk of death to sustain life until a full clinical evaluation can be completed and additional therapeutic options can be evaluated
Bridge to recovery	Use of VA-ECMO to keep patient alive until intrinsic cardiac function recovers sufficiently to remove VA-ECMO
Bridge to candidacy	Use of VA-ECMO to improve end-organ function in order to make an ineligible patient eligible for transplantation/LVAD
Brigde to transplantation	Use of VA-ECMO to keep a patient at high risk of death before transplantation alive until a donor organ becomes available

PRINCIPAL INDICATIONS FOR THE TWO TYPES OF ECMO	
VA-ECMO	VV-ECMO
Cardiac arrest and cardiogenic shock	Pneumonia
Poisoning and drug overdose	ARDS
Pulmonary embolism	Pulmonary contusion
Hypothermia	Status asthmaticus
Massive pulmonary hemorrhage	Aspiration or inhalation injury
Bridge to transplant, to decision, to recovery, to candidacy	Drowing
Sepsis	

Contraindications:

Absolute	Relative
Acute intracranial haemorrhage	Advanced age
Massive stroke	Contraindications to anticoagulation
Active bleeding	Morbid obesity
Malignancy	End-stage liver disease
Severe aortic insufficiency/ aortic dissection (for VA-ECMO) immunosuppression	Mechanical ventilation for more than 7 days with $P_{plat} > 30$ cm H_2O and $FiO_2 > 90\%$

The incidence of refractory LCOS in adult cardiac surgical patients ranges from 0.5% to 1.5%. The first LCOS treatment step is pharmacologic. However, the overwhelming majority of LCOS is unresponsive to high dosages of inotropes. Therefore, intra-aortic balloon pump support is frequently adopted, even if this strategy presents well-known limitations, particularly during active resuscitation. As a direct consequence, VA-ECMO has been increasingly considered and applied in PCS. Such a temporary MCS is a salvage therapy, often representing the only prompt and life-saving technique in refractory LCOS cases. Although VA-ECMO support is a well-established and effective procedure in the presence of LCOS, the in-hospital mortality rate is still high, with an unsatisfactory in-hospital outcome. A meta-analysis conducted by Paolo Meani et al in 2019 reported in-hospital survival ranging from 24.8% to 52% in several case series, a 1-year survival ranging from 16.5% to 47.6% and gradually ranging from almost 10% to 37% when the late survival is considered.

These data clearly show how the majority of LCOS-ECMO patients die during the hospitalization, showing a fall in the mortality rate after being discharged. Although 60.5% of this cohort was successfully weaned from ECMO, only 26.3% survived to discharge. This would mean that achieving the discharge might be one of the most important predictors of good long-term outcome.

CONCLUSION:

The successful management of Redo cardiac surgery with coronary revascularisation and AVR in this high-risk patient highlights the necessity of a multidisciplinary approach and advanced supportive measures. Comprehensive preoperative evaluation, meticulous intraoperative management, and vigilant postoperative care are crucial for optimizing outcomes in complex cardiac surgeries.

REFERENCES:

1. Ahmed I, House CM, Nelson WB. Predictors of inotrope use in patients undergoing concomitant coronary artery bypass graft (CABG) and aortic valve replacement (AVR) surgeries at separation from cardiopulmonary bypass (CPB). Journal of cardiothoracic surgery. 2009 Dec;4:1-6.
2. Butterworth JF, Legault C, Royster RL, Hammon JW. Factors that predict the use of positive inotropic drug support after cardiac valve surgery. Anesthesia & Analgesia. 1998 Mar 1;86(3):461-7..
3. Radakovic D, Penov K, Hamouda K, Madrahimov N, Radakovic D, Bening C, Leyh RG, Aleksic I. Benefits of intra-aortic balloon pump support in patients with postcardiotomy shock requiring venoarterial extracorporeal membrane oxygenation. Life. 2022 Aug 5;12(8):1195.
4. Kralev A, Kalisnik JM, Bauer A, Sirch J, Fittkau M, Fischlein T. Impact of prophylactic intra-aortic balloon pump on early outcomes in patients with severe left ventricular dysfunction undergoing elective coronary artery bypass grafting with cardiopulmonary bypass. International Journal of Cardiology. 2023 Aug 15;385:8-15.
5. Kanchi M, Bangal K, Pvs P, Patangi SO. Extracorporeal membrane oxygenation (ECMO) for pulmonary and/or cardiopulmonary support—a brief review and our experience. Indian Journal of Surgery. 2023 Oct;85(Suppl 2):354-63.
6. Meani P, Matteucci M, Jiritano F, Fina D, Panzeri F, Raffa GM, Kowalewski M, Morici N, Viola G, Sacco A, Oliva F. Long-term survival and major outcomes in post-cardiotomy extracorporeal membrane oxygenation for adult patients in cardiogenic shock. Annals of cardiothoracic surgery. 2019 Jan;8(1):116.
7. Pilarczyk K, Boening A, Jakob H, Langebartels G, Markewitz A, Haake N, Heringlake M, Trummer G. Preoperative intra-aortic counterpulsation in high-risk patients undergoing cardiac surgery: a meta-analysis of randomized controlled trials. European Journal of Cardio-Thoracic Surgery. 2016 Jan 1;49(1):5-17.