Indian Journal of Clinical Anaesthesia 2023;10(4):382–385

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical Anaesthesia

Journal homepage: www.ijca.in

Case Report

Cardiac patient for lung surgery: Walking the tightrope

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ARTICLE INFO

Article history:
Received 04-09-2023
Accepted 09-10-2023
Available online 28-11-2023

Keywords:
Low ejection fraction
Thoracic surgery
Laparotomy
Anaesthesia management

ABSTRACT

A patient with poor cardiac function undergoing any surgery under any form of anaesthesia is at high risk for perioperative morbidity and mortality. Both open thoracic surgery and emergency laparotomy in these patients are associated with high incidence of postoperative pulmonary and cardiac complications. Perioperative assessment and multidisciplinary approach are key to managing such cases. Having a clear plan for induction, invasive monitoring, intraoperative fluid management and post-operative analgesia is important for a positive outcome. We present a case of an elective open pulmonary lobectomy and emergency laparotomy conducted within an interval of 7 days in a patient with adenocarcinoma lung and ischemic heart disease with ejection fraction of 10-15%, highlighting the perioperative challenges and management.

1. Introduction

Due to the increasing life expectancy, the number of lung cancer patients in the advanced age group being scheduled for surgery is on the rise. It is not unusual for the patient of lung cancer to have co-existing cardiovascular disease considering the several common risk factors among these two diseases like smoking, old age and lifestyle. Non-cardiac surgeries either elective or emergency, carry significant risk of perioperative morbidity and mortality in patients with pre-existing cardiac disease. Preoperative optimization, a multidisciplinary approach and a tailored management plan are crucial elements in handling such cases.

2. Case Report

A 73-year-old male weighing 69 kg and height of 160 cm diagnosed with adenocarcinoma of the right upper lobe scheduled for thoracotomy and right upper lobectomy presented to us for preoperative evaluation.

The patient was an ex-smoker, and diabetic, with a past history of ischemic heart disease and balloon angioplasty in 1998 on regular medications. He had received three cycles of immunotherapy with Pembrolizumab.

On general examination, his effort tolerance was up to 2 flights of stairs with metabolic equivalents (METs) > 4. Airway examination was normal with Mallampati grade I. Systemic examination revealed decreased air entry on the right side with normal cardiac examination. His blood investigations were within normal limits. An electrocardiogram (ECG) showed changes in the right bundle branch block with the left anterior hemi block. The two-dimensional echocardiogram revealed a dilated left ventricle with generalised hypokinesia, left

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https://doi.org/10.18231/j.ijca.2023.080

ventricular ejection fraction (EF) 10-15%, mild pulmonary artery hypertension and grade II left ventricular diastolic dysfunction. Pulmonary function tests showed a mixed obstructive and restrictive pattern with forced expiratory volume in 1 second (FEV1) 76% and diffusion capacity (DLCO) 60% of predicted. Lung perfusion scan showed the right upper lobe contributing 16% to total lung perfusion.

Before posting for surgery, a multidisciplinary team discussion was carried out with the patient and relatives by the primary surgeons along with the cardiologist and anaesthesia team. The high risk of perioperative adverse events was explained and appropriate consent was taken after counselling.

On the day of surgery, the patient was shifted to the operation theatre and standard non-invasive monitors were attached. All the emergency resuscitation drugs, defibrillator and equipment for intra-aortic balloon pump (IABP) placement were kept ready. Intravenous (IV) access was secured with 20G peripheral cannula and ringer's lactate started at 40 ml/h. A thoracic epidural was sited at T7-T8 intervertebral space in sitting position after local anaesthesia. The right internal jugular vein was cannulated under ultrasound guidance and the left radial arterial line was secured, both under local anaesthesia. Noradrenaline (4 mg in 50 ml normal saline) was attached to the central line. After preoxygenation, the patient was slowly induced with intravenous titrated doses of midazolam 1mg, fentanyl 40 μg and incremental sevoflurane up to 2% dial concentration in a mixture of oxygen and air. IV atracurium 35 mg was administered and the patient was intubated with a 37F left double-lumen endotracheal tube. The position of the tube was confirmed with a fibreoptic bronchoscope. The patient required a Noradrenaline (80 μg/ml) infusion of 4-5 ml/h during induction of general anaesthesia and positioning. All pressure points and eyes were protected with proper padding and the left lateral position was given for the surgery. One lung ventilation (OLV) was initiated by clamping the tracheal lumen and confirmed by auscultation. Intraoperatively anaesthesia was maintained with oxygen +air +sevoflurane with minimum alveolar concentration (MAC) of 0.8- 1.0 with intermittent boluses of atracurium. Infusion of noradrenaline at 4-7 ml/h was sufficient to keep the mean arterial pressure > 60 mmHg. Intraoperative analgesia was maintained with 20μg boluses of fentanyl and IV paracetamol 1 gram. Epidural dose of 90 μg of buprenorphine diluted in 8 ml normal saline was administered preoperatively. The procedure was uneventful. Intraoperative blood loss was approximately 500ml and urine output was 150ml in 3.5 hours of procedure. Post procedure double lung ventilation was resumed and patient was extubated after reversing the neuromuscular blockade. Vitals were stable on 3 ml/h of noradrenaline infusion. Patient was shifted to the intensive care unit (ICU) for observation. For post operative analgesia epidural infusion of 0.0625% levobupivacaine at 5 ml/h and IV paracetamol 1 gram 8 hourly were administered. Noradrenaline infusion was tapered and stopped on next day. Patient was started on oral feeds 24 hours post-surgery, mobilised and shifted to ward on post-operative day four when the epidural catheter was removed and he remained comfortable on oral analgesics.

On fifth day, the patient had abdominal distention with pain and decreased bowel sounds. Further evaluation with abdominal radiogram and computerised tomography with contrast revealed pneumoperitoneum and an emergency exploratory laparotomy was scheduled. After taking high risk consent, the patient was shifted to the operation theatre and non-invasive monitors were attached. IV fluid was started with ringer's lactate with a pre-existing 20G peripheral line. Modified rapid sequence induction was done with sevoflurane and IV midazolam 1mg, 50 μg fentanyl, 75 mg succinylcholine followed by intubation with 7.5mm endotracheal tube. Another 20G peripheral line and left radial arterial line were sited after induction. Anaesthesia was maintained with oxygen + air + sevoflurane with MAC of 0.8-1.0 and intermittent boluses of atracurium. Exploration revealed sigmoid bowel perforation of pre-existing diverticulosis. Primary closure of perforation with loop ileostomy was done. The procedure was uneventful with vitals remaining within normal limits throughout. Inotropic support was not required this time. Patient was extubated on table after reversing the neuromuscular blockade and shifted to ICU. Post-operative analgesia was maintained with IV analgesics. Patient was shifted to the ward on post-operative day four and got discharged from the hospital after a week.

After three months the patient was posted for ileostomy closure. The case was done under general anaesthesia with an endotracheal tube, with standard non-invasive monitors and peripheral venous access. No inotropic support was needed. And the hour-long procedure was uneventful with minimal blood loss. The patient was extubated and transferred to ICU for observation and careful fluid management in the immediate postoperative period. With the prior experience of the thoracic surgery, we were able to manage the other two procedures successfully.

3. Discussion

The overall perioperative outcome of the patient undergoing any surgery depends on patient-specific risk factors, the type and urgency of surgery and the quality of perioperative care. Pulmonary and cardiac complications are a major cause of morbidity and mortality after thoracic surgery with higher incidence in patients older than 70 years.[1] While acute respiratory failure is one of the main causes of death, arrhythmias especially atrial fibrillation with an incidence of 10-20% are one of the most common cardiac complications after lung resection.[2,3] The risk of major postoperative

cardiac complications occurring in the first 30 days after thoracic surgery is approximately 2-3% and are responsible for at least one-third of perioperative deaths.[4,5] Preoperative evaluation and risk stratification therefore is necessary for patient counselling, consent, optimum perioperative management and positive outcome of surgery.

The ASA physical status classification of our patient was grade IV.[6] The risk stratification according to the revised cardiac risk index (RCRI) was class III with a 6.6% risk of perioperative cardiac events.[7] Although RCRI is a commonly used risk score in non-cardiac surgery, it does not accurately predict cardiac events and/or mortality in lung resection. The Thoracic-RCRI (Th-RCRI) which is a modified version is more predictive in these cases.[4,5] As per Th-RCRI our patient belonged to Class B (1-1.5 points) with 5.8% of risk of cardiac complication. The American College of Surgeons/National Surgical Quality Improvement Program (ACS/NSQIP) risk calculator score of our patient showed above average risk for serious complications (17.5%) including cardiac complications (2.8%), pneumonia (6.6%), venous thromboembolism (1.8%), renal failure (1.2%).[8] Even though our patient had a considerable risk according to various indices, he had a non-progressive cardiac disease with good functional capacity (METs>4) at the time of presentation. Given the urgent nature of cancer surgery and stable cardiac disease on rational medical management, there was not much scope for further optimization.

Induction of anaesthesia is the most critical step in patients with poor cardiac reserve. Invasive blood pressure monitoring and central venous access prior to induction of general anaesthesia allows prompt correction of haemodynamic changes in response to induction agents and stressors like laryngoscopy and intubation. As it is important to maintain the forward flow in patients with low EF, using titrated doses of cardio-stable agents like fentanyl and sevoflurane is preferable for induction. Similarly, all IV drugs including muscle relaxants need to be given in slow titrated doses keeping in mind the slow arm to brain circulation. Etomidate can be used as an IV induction agent but it has concerns like adrenocortical suppression.[9] Propofol can cause hypotension and potentiate the conduction block.[10] For anaesthesia maintenance, sevoflurane or desflurane, both cardio-stable inhalational agents, can be used. Sevoflurane, in particular, offers potential cardio-protection benefits.[11] OLV itself is associated with various cardio-respiratory physiological changes. Hypoxic pulmonary vasoconstriction (HPV) accompanying OLV raises pulmonary vascular pressures, straining the right ventricle. Concurrently, hypercapnia and hypoxemia due to hypoventilation and ventilation/perfusion mismatch can lead to right ventricular dysfunction/failure or right ventricle injury.[12] However, these changes are usually well tolerated by patients without pre-existing pulmonary hypertension. Although HPV is inhibited in dose-dependent manner by all volatile inhalational agents, animal studies have failed to show a considerable effect of 1 MAC of sevoflurane on HPV.[13] There is no significant difference between isoflurane, sevoflurane and desflurane in inhibiting HPV at equivalent MAC doses.[14]

Intraoperative use of IABP in patients with low EF or cardiac failure for maintaining organ perfusion has been reported previously even in non-cardiac surgeries.[15,16] The present patient remained stable with low dose infusion of a single vasopressor. We did not require either IABP or defibrillator both of which were kept ready.

Fluid management in a setting of cardiac failure and major surgery with ongoing blood loss can be challenging. Cardiac output monitoring can help choose the right intervention between fluid administration and vasopressor use. But most of the commonly used techniques with parameters like pulse pressure variation are unreliable in the presence of an open thorax. Excessive perioperative fluid administration is a consistent risk factor for postoperative lung injury not only following pneumonectomy but also after lesser lung resections.[17] While a restricted fluid approach has been advocated for thoracic surgeries, it can increase the risks of hypovolemia and end-organ hypoperfusion, particularly kidney leading to acute kidney injury.[18,19] A restrictive fluid strategy (40ml/h) worked well for us as the blood loss was slow and gradual and an acceptable urine output of 0.5ml/kg/h was maintained throughout.

Another area of concern in the immediate postoperative period is maintaining optimal pain relief. Adequate analgesia not only helps in reducing post-thoracotomy pulmonary complications but also enhances recovery and aids early mobilisation. Further, it is of paramount importance to avoid tachycardia and hypertension in response to pain in a patient with poor cardiac reserve. Continuous thoracic epidural infusion with local anaesthetic and opioid or thoracic paravertebral block with local anaesthetic are considered the most effective analgesic techniques.[20,21] Caution has to be observed as an epidural infusion can cause hypotension with sympathetic blockade. A low concentration of local anaesthetic and supplementation with opioids can help achieve the balance between analgesia and stable haemodynamic.

In contrast to a planned surgery, an exploratory laparotomy carries a higher risk due to its emergent nature and the complications of sepsis. Vigilance for early signs and symptoms, prompt investigations and early exploration can prevent frank sepsis, septic shock, and electrolyte imbalance and reduce morbidity and mortality. While the principles of anaesthetising a patient with poor cardiac reserve remain the same, invasive monitoring is vital in the presence of pre-existing haemodynamic instability. It

is a guide to fluid management and vasopressor use and gives access for easy blood sampling for point of care investigations intraoperatively.

4. Conclusion

Anaesthetic challenges of managing a patient with poor cardiac function for a major thoracic surgery are manyfold. However, preoperative optimisation, multidisciplinary involvement and having a clear plan with alternatives for escalation go a long way in improving outcomes. A patient-centric approach from admission to discharge is essential as is a tailored management plan as per the patient's clinical status and the planned surgery.

5. Source of Funding

None.

6. Conflict of Interest

None.

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Cite this article: Divekar P, Saksena S, Tilak AS, Bhatti RS. Cardiac patient for lung surgery: Walking the tightrope. *Indian J Clin Anaesth* 2023;10(4):382-385.