Extrapleural pneumonectomy - perioperative anaesthetic conduct

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Malignant mesothelioma is a rare tumour arising from mesothelial lining that mostly occurs in the pleura with survival of around 12 months.[1] Extrapleural pneumonectomy, which is the mainstay of treatment for locally advanced malignant pleural mesothelioma, presents a great challenge to anaesthesiologists as it can be associated with high perioperative morbidity and mortality. We present a case report on anaesthetic management for extrapleural pneumonectomy in a 64-year-old patient with advanced malignant pleura mesothelioma. Our case report highlights: crucial role of anaesthetic management in reducing perioperative complications by better knowledge of physiology and technical aspects of the surgery; issues and challenges related to the anaesthetic management such as invasive monitoring, lung isolation, protective lung ventilation strategy, appropriate fluid management and adequate analgesia to enable extubation post-surgery in the operating room; high vigilance for diagnosing life-threatening complications such as cardiac herniation; team working and collaboration with surgeon to improve patient outcome and post-operative monitoring and management.

Keywords: anaesthetic management; extrapleural pneumonectomy; malignant mesothelioma; challenges; perioperative complications

Introduction

Extra-pleural pneumonectomy (EPP), which is the mainstay of treatment for locally advanced malignant pleural mesothelioma, presents a great challenge to anaesthesiologists because it is associated with high perioperative morbidity and mortality.

Case report

A 64-year-old male, a smoker and former shipyard worker, presented with weight loss (7kg in 2 months) with no exertional dyspnoea or chest discomfort. A left pleural effusion was noted on chest X-ray (Figure 1). CT thorax revealed moderate left pleural effusion with pleural thickening and calcified plaque in the left hemi-thorax (Figure 2). Histology of the pleural biopsy demonstrated epithelioid mesothelioma. One month later, the patient was scheduled for left EPP.

In the operating theatre, 2 large bore peripheral intravenous (IV) catheters, intra-arterial cannula and central venous catheter were sited. Thoracic epidural was inserted at T10/11 level.

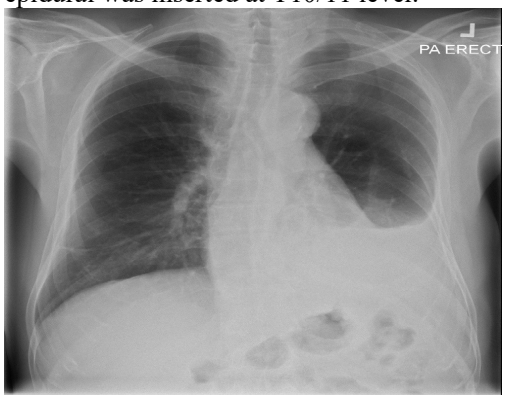

Figure 1: CXR at presentation

Figure 2: CT thorax at presentation (calcified plaque indicated by red arrow)

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https://orcid.org/0000-0002-1223-6809
Received: 17/04/2018
Accepted:12/06/2018
DOI: http://doi.org/10.4038/slja.v26i2.8335

Anaesthesia was induced using i.v. etomidate, midazolam, fentanyl and atracurium, and the patient was intubated with right-sided Bronchocath double-lumen tube (DLT) 41Fr (patient's height was 171cm). Anaesthesia was maintained with oxygen/air and sevoflurane.

One-lung ventilation (OLV) was commenced with FiO_2 0.6, tidal volume 5-6ml/kg, rate 10/min and PEEP 0cmH_2O. His peak airway pressure was 20cmH_2O while on OLV. Patient was placed in right lateral position for left thoracotomy. Boluses of ropivacaine 0.2% mixed with fentanyl 2mcg/ml were given epidurally. The surgery constituted EPP, pericardiectomy, left hemidiaphragm resection and repair using a poly tetrafluoroethylene graft. A left chest drain was inserted.

During the surgery, intermittent boluses of IV phenylephrine and noradrenaline infusion (maximum of 0.12mcg/kg/min) were required to maintain mean arterial pressure above 70mmHg. Central venous pressure was 8-12mmHg. Haemoglobin level was 9.2g/dL on point-of-care testing. Surgical duration was 270mins and blood loss was 400ml. 1.8L of fluid was administered intra-operatively (1000ml Hartmann's solution, 500ml albumin 5% and 279ml packed red cells). IV furosemide 10mg was administered before commencing blood transfusion. Forced-air warming blanket and warm fluids were used to maintain core temperature above 35.5°C.

After completion of surgery, the patient was extubated and transferred to the intensive care unit. He remained stable haemodynamically and noradrenaline was tailed off after 8 hours. On post-operative day 1, a sinus tachycardia developed (heart rate of 105-115/min) with no ischaemic changes and responded well to digoxin. The patient was comfortable on continuous thoracic epidural infusion and participated in physiotherapy actively. Serial chest x-rays showed no mediastinal shift. Epidural catheter and chest drain were removed on post-operative day 3 and oxygen supplementation weaned off. The patient was discharged from hospital on post-operative day 10 following an uneventful post-operative stay.

Discussion

Mesothelioma correlates highly with asbestos exposure.[2] Patients with pleural mesothelioma present with dyspnoea, chest pain or pleural effusion. The median survival is less than one year if untreated.[1] Tumour of epitheloid subtype generally has better prognosis compared to those of biphasic and sarcomatoid subtypes.[3]

EPP involves en-bloc resection of lung, part of the ipsilateral diaphragm, parietal pleural and pericardium. Anaesthetic management is crucial in reducing the perioperative complications by understanding the technical aspects and physiological changes associated with EPP, these include: prolonged duration of surgery, physiology and complications of OLV, blood loss resulting in unstable haemodynamics and acid-base and electrolyte imbalance, temperature variations and arrhythmias due to direct mechanical handling of the heart. In recent times, surgery is also merged with hyperthermic intra-thoracic chemotherapy to attain microscopic tumour control and improved survival.[4]

Thoracic epidural catheter is commonly placed to minimize risk of pulmonary dysfunction related to the large surgical incision and to facilitate early post-operative recovery as seen in our patient. Large bore intravenous access is established, and blood products should be available in operating theatre given the potential risk of significant blood loss. The potential of rapid intra-operative haemodynamic changes and arrhythmias indicates invasive cardiovascular monitoring.

No single anaesthetic technique has been shown to be superior for EPP. A cardio-stable intravenous induction technique with etomidate, midazolam and fentanyl was chosen to minimize myocardial depression. We aimed for early on-table extubation in order to minimize bronchial stump pressure and to reduce risk of ventilator-induced lung injury or ventilator-associated pneumonia to the non-resected lung. Hence, we chose the short-acting inhalational agent, sevoflurane and gave intermittent epidural top-ups of local anaesthetic to limit the use of long-acting opioids. This technique minimised the risk of respiratory depression and sedation during emergence.

Lung isolation can be achieved using DLT or endobronchial blocker. In our patient, we had chosen a right-sided DLT in view of left EPP and normal airway assessment. During OLV in the lateral decubitus position, patients often show restrictive physiology in the dependent lung imposed by the weight of the tumour and surgical

pressure during dissection.[5] In order to prevent acute lung injury, we ventilated the dependent lung with tidal volume of 5-6ml/kg and kept peak airway pressure below 30cmH_2O.[6]

Hypotension may occur during induction, dissection and repositioning.[5] During induction, vasodilatory effects of some anaesthetic agents and sympathetic blockade from thoracic epidural may contribute to hypotension. Thus, vasoconstrictors may be required at this stage. During the dissection phase, hypotension may be contributed by blood loss, insensible losses, compression from tumour or surgical retraction. This phase is temporary and should be managed with goal-directed fluid therapy, point-of-care haematocrit testing and appropriate use of vasopressors. It has been shown that liberal fluid administration increased risk of coagulopathy, post-operative acute lung injury and increased mortality.[7]

During the emergence phase when repositioning from lateral decubitus to supine, cardiac herniation may occur especially after pericardial resection in right-sided EPP. Other causes include tight pericardial patch and shifted mediastinum following closure. In our patient, the cause of hypotension was likely multi-factorial: blood loss, decreased venous return from surgical compression and vasodilatory effects of anaesthetic agents.

The incidence of atrial arrhythmia is 44.2% following EPP.[8] Our patient developed a sinus tachycardia. We excluded correctable causes such as pain, dehydration, anaemia, sepsis or electrolytes and metabolic abnormalities before treating with digoxin.

In summary, anaesthetic management of EPP involves lung isolation with protective lung ventilation strategy, central neuraxial blockade and control of haemodynamics. It also requires close collaboration between surgeons and anaesthesiologists to improve patients' outcome.

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