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Case report
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Awake cardiopulmonary bypass under neuraxial anaesthesia for elective posterior mediastinal mass excision

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Abstract

A pre-existing compression of the airways and/or great vessels secondary to a large mediastinal mass, risks respiratory and haemodynamic compromise in which complete airway obstruction and cardiovascular collapse are anticipated. Most of the literature routinely recommends having cardiopulmonary bypass (CPB) on stand-by with the perfusionists on ready mode and machine primed. Establishment of awake CPB for mediastinal tumour resection has been scarcely reported, with most being done under local anaesthesia (LA). We report a case of 65-year-old woman with a large, asymptomatic, right posterior mediastinal tumour scheduled for elective surgical excision in our centre. The surgery in the previous hospital, which had no CPB service, was postponed after the patient experienced haemodynamic and ventilatory events. In view of the events, we opted for early initiation of CPB prior to general anaesthesia to avoid delays in activating stand-by CPB. The cardiothoracic surgical team specifically wanted a smooth femoro-femoral cannulation, hence neuraxial anaesthesia was performed. This unconventional approach of awake CPB under neuraxial block provides a favourable cannulation site compared to a field infiltrated with LA, anaesthesia maintenance if cannulation is required contralaterally, and predictable analgesia for the awake patient throughout the procedure.

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Introduction

Anaesthetic management for mediastinal mass is known to be challenging, predominantly due to concerns of respiratory and haemodynamic stability. Haemodynamic perturbation, inability to ventilate, or both, could ensue from induction of general anaesthesia (GA) in cases involving a large mediastinal mass. Awake cardiopulmonary bypass (CPB) provides a method to control both the airway and haemodynamics. Most of the literature merely recommends having CPB on stand-by with the perfusionists on ready-mode and machine primed. On the other hand, our case illustrates the initiation of CPB under neuraxial anaesthesia prior to mediastinal mass resection.

Case report

A 65-year-old woman with underlying diabetes mellitus, hypertension, and bronchial asthma was referred to our facility for further management of her mediastinal mass. Three months prior to this admission, she presented to the primary centre with joint pain in the right knee requiring ward admission. A large right mediastinal mass was inadvertently found on the routine chest X-ray. Upon further questioning, she was asymptomatic and denied any compression symptoms. Initial contrast enhanced computed tomography (CECT) showed a right posterior mediastinal mass compressing the airway. Ultrasound-guided biopsy subsequently revealed a benign spindle cell tumour.

The primary attending hospital scheduled this case for a tumour excision. However, the patient developed superior vena cava obstruction after gas induction. The team proceeded with awake fibreoptic intubation via flexometallic endotracheal tube, but was unable maintain ventilation. Therefore, the patient was extubated and the surgery postponed.

The case was subsequently referred to our unit. Repeat CECT (Fig. 1) showed mechanical compression from the right thoracic mass seen from T3 extending progressively towards the carina until the right main bronchus, as well as compression of the right brachiocephalic vein. Magnetic resonance showed a large right posterior mediastinal mass with local effect, erosion of T3 vertebral body,

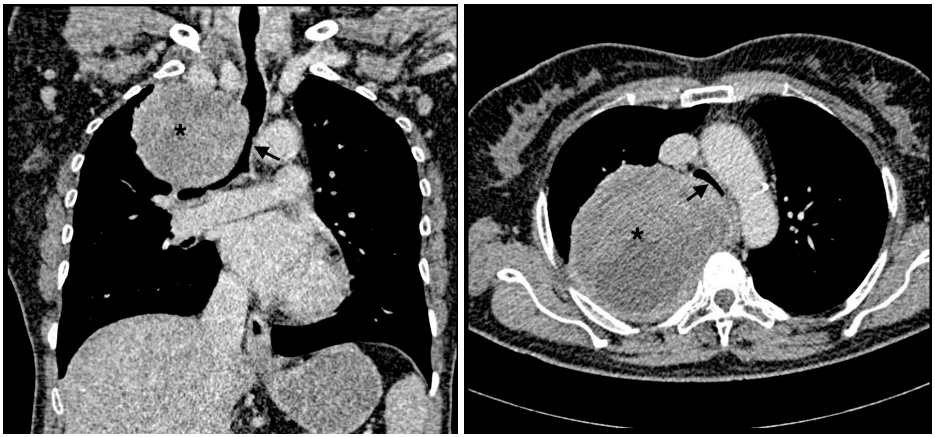

Fig. 1. (A) Contrast-enhanced CT of the thorax in coronal plane showing large heterogeneously enhancing mass (*) occupying upper thorax compressing the trachea, carina, and right main bronchus (arrow). *(B)* Contrast-enhanced CT of the thorax in axial plane showing large heterogeneously enhancing mass (*) occupying the upper thorax compressing the trachea (arrow).

and intraspinal extension of the mass into the right aspect of the spinal canal with minimal compression of the spinal cord and no cord involvement or myelopathy.

Pulmonary function test results were 46% for forced expiratory volume (FEV1), 45% for forced vital capacity (FVC), and 84% for FEV1/FVC. Echocardiography showed left ventricular ejection fraction of 58%, grade 1 diastolic dysfunction, and trivial regurgitation of mitral, tricuspid and pulmonary valves. An excision of posterior mediastinal tumour was planned, and consent for high-risk surgery and anaesthetic was obtained. The multidisciplinary team decided to initiate CPB prior to GA to avoid delays in activating stand-by CPB.

No premedication was administered to the patient. In the operation theatre, standard American Society of Anesthesiologists (ASA) monitors were placed; 18-G intravenous and 20-G arterial cannulas were secured in the left brachial vein and right radial artery, respectively. Neuraxial anaesthesia with 10 mg of hyperbaric bupivacaine was injected intrathecally in L4/ L5 using 27-G Pencan (B. Braun, Melsungen, Germany) in a sitting position. A central venous catheter was then inserted in the left femoral vein under ultrasound guidance. Subsequently, cannulation in the right femoral vein and right femoral artery was performed via open technique by the surgeon. All procedures were smooth and single attempt. The patient was preoxygenated with 100% oxygen while a three-quarter flow of normothermic CPB was initiated after full heparinisation of 20,000 IU (400 IU/ kg) was administered, achieving an activated clotting time (ACT) of 424 seconds,

Fig. 2. (A) Fibreoptic bronchoscopy image post-intubation shows slit-like opening of the right main bronchus. *(B)* Fibreoptic bronchoscopy image of bronchial lumen of left DLT (black arrow) and right main bronchus (red arrow) collapsed during positive pressure ventilation.

3.5 times the baseline ACT value. Right after the onset of CPB, fentanyl 100 µg, propofol 50 mg, midazolam 2 mg, and suxamethonium 50 mg were administered intravenously. Intubation was achieved on the first attempt using a C-MAC video laryngoscope (KARL STORZ SE, Tuttlingen, Germany) with a double lumen endotracheal tube. Bronchoscopy was performed to ensure proper placement of the endotracheal tube and revealed external compression from the end of the tracheal lumen extending towards the right main bronchus and appearing a as slit-like opening of the trachea (Fig. 2). Conversion to full flow CPB was established after the monitor showed hypotension and sustained 20% reduction from baseline cerebral oximetry value. Mechanical ventilation was subsequently terminated.

Intraoperatively, anaesthesia was maintained with sevoflurane 1.5–1.7% minimum alveolar concentration of 0.9 from the CPB and Target-Controlled Infusion remifentanil 2-3 ng/ml. Haemodynamics were supported with low infusion of noradrenaline to achieve a mean arterial pressure target > 65 mmHg. Surgery started when oxygenation and haemodynamics were well controlled. A firm, well-defined and well-encapsulated posterior mediastinal mass (9 cm x 11 cm) was excised. Subsequently, the patient was able to be separated from the CPB (bypass time 172 minutes) with low-dose noradrenaline support reversed with protamine.

After a few minutes, the patient required increasing inotropic support. The surgeon noted bleeding at the spinal venous plexus involving the foramen. Haemostasis was attempted but could not contain the bleeding. The patient had pulseless electrical activity with intermittent ventricular fibrillation. Internal and external defibrillation as well as cardiac massage were applied for more than 40 minutes. Catastrophic bleeding ensued and after full resuscitation, we decided to proceed no further.

Discussion

Cases of large mediastinal tumour present significant risks in maintaining a patent airway. It is not rare to encounter total occlusion of the airway after induction of GA in such cases. Airway obstruction has been recognized to be due to the loss of the tethering effect of the expanded lungs on the airways from a reduction of the inspiratory muscle tone as well as the lung volume. Neurogenic tumours constitute 67% of posterior mediastinal mass cases,[1] which seldom lead to airway problems. Meanwhile, we had a distinct scenario for our patient. She was asymptomatic preoperatively but developed superior vena cava obstruction after gas induction and ventilation difficulties upon left lateral position during her first elective surgery. Compression of the airway and intrathoracic structures in a patient with mediastinal mass may depend on patient position; thus, it is pivotal to identify the most comfortable position for the patient preoperatively.[2]

The literature contains limited reports on the prophylactic use of CPB in posterior mediastinal mass cases, most of which typically propose having a stand-by CPB during surgery. Elective CPB for non-cardiac cases has been reported in head and neck surgery as well as tracheal resection,[3,4] but only a few cases have been reported exclusively for airway and haemodynamic management.[5,6] Surman *et al.* suggested considering CBP for high-risk, non-cardiac, surgical cases involving the thorax and great vessels, as it allows for haemodynamic stabilisation when unexpected impediments occur.[6] CPB allows the surgical team safe sternal entry and aids mass resection while preserving haemodynamic stability.[5,7]

We successfully performed a neuraxial anaesthesia and initiated an awake CPB for a patient with a large posterior mediastinal mass. Anticipating ventilatory difficulty, we opted to initiate CPB before GA induction and for the surgery to be done in supine position. Neuraxial anaesthesia in patients undergoing heparinisation for CPB is still a matter of debate. It is pivotal to weight the relative risk and benefit of neuraxial anaesthesia in such patient.

A prospective, randomised study concluded that the time maintained in sitting position after spinal anaesthesia has considerable effect on the localisation of the drug along with lesser sensory and motor blockade and ensures safe haemodynamics.[8] Spinal block was chosen over one-sided regional anaesthesia to block the femoral bilaterally in anticipation of difficult cannulation on one side. After the intrathecal injection, we confirmed the distribution of the block have reached the L1 and L2 dermatomes, covering the puncture site at the femoral area before proceeding with the cannulation.

Our patient received 10 mg of hyperbaric bupivacaine intrathecally over L4/L5 to ease femoro-femoral cannulation by the surgeon. The rationale of the subarachnoid block is to avoid local tissue and structural distortion after LA infiltration in order to ensure a predictable analgesia for presurgical femoro-femoral cannulation and avoid difficult cannulation. Furthermore, this technique provides comfort to the awake patient throughout the procedure as adequate anaesthesia can be maintained in case of contralateral cannulation.

Neuraxial block can be performed in sitting or lateral position; hence, it is suitable for patients with posterior mediastinal mass since they are rarely symptomatic in sitting position. In addition, subarachnoid block is a common procedure with which all anaesthetists are familiar and does not require the level of practice required for regional block. Neuraxial block possess well-known contraindications and limitation such as in uncorrected hypovolemia, increased intracranial pressure, fixed cardiac output states, coagulopathy and sepsis. Consequently, this technique might not be appropriate for emergency case where patient is hemodynamically unstable.

A review has recommended certain precautions to minimise the risk of neuraxial block as well as heparinisation in CPB, where time from instrumentation to systemic heparinisation should exceed 60 minutes.[9] Weiner *et al.* found no complications related to neuraxial anaesthesia in a series of 714 patients undergoing surgery for congenital heart disease using CPB, including 466 patients in whom the interval from neuraxial anaesthesia to full heparinisation was less than 1 hour.[10] As per our planning, heparinisation was performed 60 minutes after spinal puncture. To avoid or minimise the risk of complications from neuraxial anaesthesia, such as spinal haematoma, we planned for GA induction an hour after the spinal puncture. Therefore, the surgeon was not in a rush to cannulate and preparation for general anaesthesia and CPB initiation were not hurried.

We administered 400 IU/kg (20,000 IU) heparin after the femoral cannulation which was well beyond 1 hour from the spinal puncture. The CPB, subsequently, was initiated early prior to induction of GA. This is therefore, to mitigate the potential hemodynamic and airway compromise during GA. The CPB was escalated to full flow when we detected the hemodynamic attenuation after GA. Weaning from CPB started as soon as the mediastinal mass was excised and later CPB terminated while the patient was on low-dose inotropic support. Unfortunately, catastrophic bleeding from spinal venous plexus occurred. Going back on CPB was an option; however, we decided against it as the surgeon was worried about re-heparinising the patient, which could have worsened the ongoing bleeding.

Although the initiation of CPB under neuraxial anaesthesia was successful, the outcome of the surgery was not. For similar posterior mediastinal mass cases, we strongly recommend a proper multidisciplinary team discussion involving the radiologist and spine surgeon to discuss the feasibility of preoperative prophylactic embolization of the spinal venous plexus. Using intraoperative cell salvage and delaying CPB termination could increase the chance for successful resuscitation in anticipation of delayed intraoperative bleeding. All in all, our approach of CPB under neuraxial anaesthesia effectively provided adequate and guaranteed analgesia during peripheral bypass cannulation for awake CPB. We therefore recommend this method if early initiation of CPB is considered.

Declarations

The patient consented to the publication of the clinical data and images contained in this case report.

Competing interests
None to declare.

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References

1. Rahman AR, Sedera MA, Mourad IA, Aziz SA, Saber TK, Alsakary MA. Posterior mediastinal tumors: outcome of surgery. J Egypt Natl Canc Inst. 2005 Mar 1;17(1):1-8. Available from: https://pubmed.ncbi.nlm.nih.gov/16353076/
2. Lalwani P, Chawla R, Kumar M, Tomar AS, Raman P. Posterior mediastinal mass: do we need to worry much? Ann Card Anaesth. 2013 Oct 1;16(4):289-92. https://doi.org/10.4103/0971-9784.119183
3. Geffin B, Bland J, Grillo HC. Anesthetic management of tracheal resection and reconstruction. Anesth Analg. 1969 Sep 1;48(5):884-94. Available from: https://pubmed.ncbi.nlm.nih.gov/4897747/

4. Kar P, Malempati AR, Durga P, Gopinath R. Institution of cardiopulmonary bypass in an awake patient for resection of tracheal tumor causing near total luminal obstruction. J Anaesthesiol Clin Pharmacol. 2018 Jul 1;34(3):409-11. https://doi.org/10.4103/0970-9185.235633
5. Said SM, Telesz BJ, Makdisi G, Quevedo FJ, Suri RM, Allen MS, Mauermann WJ. Awake cardiopulmonary bypass to prevent hemodynamic collapse and loss of airway in a severely symptomatic patient with a mediastinal mass. Ann Thorac Surg. 2014 Oct 1;98(4):e87-90. https://doi.org/10.1016/j.athoracsur.2014.05.045
6. Surman TL, Worthington MG, Nadal JM. Cardiopulmonary Bypass in Non-Cardiac Surgery. Heart Lung Circ. 2019 Jun 1;28(6):959-69. https://doi.org/10.1016/j.hlc.2018.10.005
7. Sendasgupta C, Sengupta G, Ghosh K, Munshi A, Goswami A. Femoro-femoral cardiopulmonary bypass for the resection of an anterior mediastinal mass. Indian J Anaesth. 2010 Nov 1;54(6):565-8. https://doi.org/10.4103/0019-5049.74293 https://pmc.ncbi.nlm.nih.gov/articles/PMC3016580/
8. Neeta S, Sunil BV, Sonal Bhat SK, Madhusudan U. Saddle block spinal anesthesia and its effect on hemodynamic status and analgesia. Indian J Clin Anaesth. 2018 Apr;5(2):266-71. Available from: https://pdf.ipinnovative.com/pdf/6707
9. Horlocker TT, Vandermeuelen E, Kopp SL, Gogarten W, Leffert LR, Benzon HT. Regional anesthesia in the patient receiving antithrombotic or thrombolytic therapy: American Society of Regional Anesthesia and Pain Medicine Evidence-Based Guidelines. Obstet Anesth Dig. 2019 Mar 1;39(1):28-9. https://doi.org/10.1097/00005207-201903000-00002
10. Weiner MM, Rosenblatt MA, Mittnacht AJ. Neuraxial anesthesia and timing of heparin administration in patients undergoing surgery for congenital heart disease using cardiopulmonary bypass. J Cardiothorac Vasc Anesth. 2012 Aug 1;26(4):581-4. https://doi.org/10.1053/j.jvca.2012.03.010