Case Report

Triple regional anaesthesia technique in resection of left pleuropulmonary sarcoma and left subclavian artery bypass

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Summary

A 28-year-old woman presented for excision of a left-sided pleuropulmonary sarcoma which was adherent to her left subclavian artery and mediastinum. A left upper lobe wedge resection was performed via a median sternotomy and a left carotid artery-to-left subclavian artery bypass was performed through a left supraclavicular incision. We report on a triple regional anaesthesia technique to provide postoperative analgesia. We inserted bilateral transverse thoracic plane catheters for continuous local anaesthetic infusion and performed bilateral subcostal transversus abdominis plane blocks for drain site analgesia. A left superficial cervical plexus block was performed to cover pain from the supraclavicular incision. Anteromedial chest wall blocks are an emerging analgesic technique for sternotomy and were successfully used as part of a combined regional anaesthetic for a patient undergoing complex thoracic surgery.

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Introduction

Pleuropulmonary synovial sarcomas are rare and carry a poor prognosis due to their nature of having a high grade and rapid rate of metastasis [1]. Evidence pertaining to the management of the condition is also limited to case studies due to its rarity. Pleuropulmonary sarcoma may occur anywhere within the chest cavity and may involve mediastinal structures, necessitating median sternotomy for surgical access.

Although the majority of median sternotomies are performed for cardiac surgery, the technique is employed occasionally to facilitate other forms of intrathoracic surgery. Thoracic epidural analgesia for median sternotomy when cardiopulmonary bypass is anticipated is not widely practised due to perceived concerns regarding epidural haematoma formation following systemic heparinisation [2]. Other techniques which have been described for postoperative analgesia in median sternotomy include bilateral paravertebral blocks, intrapleural blocks and intercostal blocks.

Recently, anteromedial chest wall blocks have emerged as a novel analgesic strategy for poststernotomy pain. Analogous to abdominal plane blocks such as the transverse abdominis plane (TAP) block, anteromedial chest wall blocks aim to deposit local anaesthetic in a fascial plane between the anterior thoracic muscles where anterior divisions of intercostal nerves are located. Examples of these blocks are the transverse thoracic muscle plane (TTP) block and the subpectoral interfascial plane (SIP) block. The TTP block was originally described as an adjunct to pectoral nerve blocks in order to confer anteromedial cutaneous cover for awake breast resection [3]. Both TTP and SIP blocks have shown efficacy following median sternotomy [4].

Concern has been raised with the deeper TTP block for coronary artery bypass surgery as the internal mammary artery travels in this plane and its mobilisation may make it vulnerable to injury from the block needle. Both TTP and SIP blocks target somatic afferents only and therefore these techniques do not confer visceral analgesia. Additional analgesia is, therefore, required to cover pain mediated via pleural and mediastinal drains emerging from the upper abdomen which are commonly inserted following cardiac surgery.

Report

A 28-year-old woman was admitted for elective left upper lobe wedge resection and left subclavian artery bypass. She had originally presented with a 2-week history of haemoptysis and weight loss. Computed tomography scanning revealed a large apical mass applied to the left upper lobe and encasing the proximal left subclavian artery encroaching on the mediastinum. There was no evidence of metastatic disease. Biopsy revealed pleuropulmonary sarcoma. A combined thoracic and vascular approach was planned. There was a high risk of significant haemorrhage and the possibility of cardiopulmonary bypass. Anaesthetic induction was with midazolam 2 mg, remifentanyl $0.2 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$ and a starting propofol target-controlled infusion (TCI) effect-site concentration of $7 \mu\text{g} \cdot \text{ml}^{-1}$. Muscle relaxation was achieved with vecuronium 10 mg. A 35-Fr left-sided double-lumen tube was inserted with the position confirmed bronchoscopically. After induction of anaesthesia, bispectral index monitoring was applied and an arterial line and right internal jugular central venous catheter were inserted. Anaesthesia was maintained with TCI propofol at $4 \mu\text{g} \cdot \text{ml}^{-1}$ and remifentanyl at $0.1 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$. Her lungs were ventilated using volume-controlled ventilation in an oxygen–air mixture. A left common carotid-to-left distal subclavian artery bypass was performed through a left supraclavicular incision, and a wedge resection of the left upper lobe was completed. Left pleural and mediastinal drains were inserted, with the total time on one-lung ventilation being 4 h and 35 min. Total left carotid cross-clamp time was 44 min. The patient was haemodynamically stable throughout and blood loss was not significant. Paracetamol 1 g and morphine 5 mg were administered on closing the wounds.

At the end of the operation, ultrasound-guided continuous TTP blocks were performed bilaterally. A high-frequency linear ultrasound transducer SonoSite II (FUJIFILM SonoSite, Bothwell, WA, USA) was placed parasternally in a longitudinal orientation at the level of the fourth rib. An 18G Tuohy needle (Eposcan® Braun Germany) was advanced in-plane in a caudal-to-cranial direction (Fig. 1). Initially, a saline 10 ml bolus was used to hydrodissect the plane between the innermost intercostal muscle and the transversus thoracic muscle. Once the needle tip was in the transverse thoracic plane, a catheter was advanced and a bolus of 20 ml levobupivacaine 0.25% was administered bilaterally.

Next, bilateral ultrasound-guided subcostal TAP blocks were then performed with 20 ml levobupivacaine 0.25% injected to each side using a 50-mm 22G SonoPlex needle (Pajunk Medizintechnologie GmbH, Geisingen, Germany) needle. Finally, an ultrasound-guided left superficial cervical plexus block was performed with 10 ml levobupivacaine 0.25%. The patient was extubated successfully at the end of the procedure. No additional morphine was required in recovery and numerical rating pain score (NRS) was 2/10. Intravenous fentanyl patient-controlled analgesia (PCA) was commenced with 15 μg bolus with a 5-min

Figure 1 Longitudinal right parasternal image at the level of the fourth rib. Local anaesthesia is seen spreading cephalad and caudad in the transverse thoracic plane between the internal intercostal muscles superficially and the deeper transversus thoracic muscle. Also visible is the inserted catheter in the plane. IIM, internal intercostal muscle; LA, local anaesthetic; PMM, pectoralis major muscle; TTP, transverse thoracic muscle.

lockout. The TTP catheters were attached to a Y-connector and an infusion of 0.125% levobupivacaine was commenced at $10 \text{ ml} \cdot \text{hr}^{-1}$. Numerical rating pain scores at rest and on movement were 0 and 2, respectively, at 6 h, 12 h and 24 h. Total fentanyl consumption in the first 24 h postoperatively was 1050 μg . The majority of demand presses for the PCA occurred after 12 h.

The patient complained of visceral-type pain, worse on inspiration and located deep centrally in her chest and radiating to the epigastric area. The pain increased at 14 h postoperatively and was felt to be secondary to the presence of the chest drains once the effects of the subcostal TAP blocks started to subside. The PCA and TTP infusion catheters were discontinued on postoperative day two when rest and movement NRS pain scores were both 2/10. Although pain scores for the supraclavicular incision were not recorded, when specifically asked about this wound the patient described excellent pain relief for the first 16 h. She complained of no pain around the median sternotomy wound for the duration of the TTP infusions.

Discussion

We provided postoperative analgesia that was targeted to cover three areas of surgical incisions: the sternotomy, subcostal chest drains and the supraclavicular incision.

The primary analgesic consideration was the median sternotomy. Due to the potential for cardiopulmonary bypass and systemic heparinisation, neuraxial anaesthesia was avoided. In addition, when discussing analgesia for the operation, the patient was not keen on undertaking the risks associated with thoracic epidural. Parasternal plane block techniques were discussed with the patient and she was agreeable.

The second analgesic consideration was the left supraclavicular incision. As this region is innervated by the supraclavicular nerve, a branch of the cervical plexus, we elected to perform an ultrasound-guided superficial cervical plexus block. Superficial cervical plexus block has established efficacy in carotid endarterectomy and clavicular surgery [5]. In this patient the analgesia of the neck wound was excellent.

The final analgesic consideration was related to the two chest drains. In this patient, a left pleural and a mediastinal drain were inserted and exteriorised through the upper abdomen. In this case, we decided to use bilateral subcostal TAP blocks to facilitate postoperative analgesia. The subcostal TAP block aims to deposit local anaesthesia within the transversus abdominis plane in the subcostal region as the transverse abdominis inserts laterally under the rectus abdominus. The block has been shown to reliably block dermatomes T6–T10 with an occasional block to T12 [6]. In this case, the patient experienced excellent drain site analgesia up to 12 h postoperatively, suggesting the efficacy of subcostal TAP blocks.

The transverse thoracic muscle is a thin muscle arising from the posterior surface of the sternum, meaning this muscle actually lies within the thoracic cavity. It inserts into the lower and posterior surfaces of the costal cartilages of the second to sixth ribs bilaterally. It is supplied by the anterior rami of the thoracic spinal nerves. This muscle does not have a crucial role in respiration, but its contraction contributes a small amount to exertional expiration by decreasing the transverse diameter of the thorax. It becomes continuous with the intercostal muscles as it inserts into the ribs. The TTP block aims to deposit local anaesthetic between the transverse thoracic muscle and the internal intercostal muscle, blocking the anterior branches of the second to sixth intercostal nerves. These nerves travel anteriorly in this plane and subsequently penetrate the intercostal muscles to innervate the parasternal region. It is important to note that the internal mammary artery also courses through this plane.

The TTP block is a novel technique for which evidence hitherto has been limited to case reports. Ueshima et al. reported using bilateral TTP continuous blocks in two sternotomy cases, describing excellent postoperative analgesia [7]. The same authors later reported having performed 229 TTP blocks with two complications, both of which were block needle insertion site local infection [8]. It was on this basis that we proposed the technique for postoperative analgesia in our patient.

The TTP block has several limitations. It does not provide any visceral analgesia. Although excellent analgesia of the sternal wound may be achieved, pain arising from the parietal pleural following incision and the presence of chest drains will not be affected. Another limitation is the potential for accidental puncture of the internal mammary artery, which is of increased risk when it has been mobilised for cardiac anastomosis. Conceivably the TTP block could be less efficacious in this scenario due to the disruption of thoracic muscle planes. This was not a concern in our patient, although we did remain vigilant for the artery during ultrasound. Furthermore, this block carries the potential of pneumothorax as the thin transversus thoracic muscle is situated at an area where intercostal muscles are very thin and lie close to the pleura. Due to these risks it has been suggested that the more superficial SIP block be used instead as the same anterior somatic afferents must pass through the plane between the intercostal muscles and pectoralis major in order to innervate the sternal region [9]. In doing so the internal mammary artery

is therefore avoided and the pleura are separated from the block site by a further two muscle layers. In our centre, we have now performed more than 50 SIP blocks for median sternotomy and cardiac surgery.

In conclusion, we report the successful use of three regional anaesthetic techniques for the peri-operative analgesic management of a patient undergoing complex thoracic surgery. This combination of techniques holds significant potential in the future.

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