CASE CONFERENCE

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Paravertebral Catheter-Based Strategy for Primary Analgesia After Minimally Invasive Cardiac Surgery

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PORT-ACCESS MINIMALLY INVASIVE cardiac surgery (PACS) has potential advantages when compared with traditional sternotomy techniques. These include smaller surgical incision, reduced trauma and blood loss, and shorter length of hospital stay.[1,2] Typically, PACS procedures are performed through a right anterior minithoracotomy or hemisternotomy, and postoperative pain commonly is managed primarily using intravenous analgesics, usually with an on-demand opioid or opioid-based patient-controlled analgesia (PCA).

When an opioid is chosen as the primary strategy, particularly an intravenous PCA, benefits include ease of use, availability, and improved patient satisfaction, compared with on-demand pain treatment. Common adverse effects to opioid-based strategies include respiratory depression, delirium, and gastrointestinal dysfunction, which substantially can inhibit postoperative recovery and potentially cause harm to the aging and comorbid population that represents many cardiac surgery patients. In addition, minithoracotomy incisions used during PACS procedures also involve an increased risk of chronic pain, which is not prevented or reduced by an opioid-only strategy.[2–4] Analgesic strategies that reduce opioid consumption and improve long-term outcome after PACS, including regional or neuraxial anesthetic techniques, are desirable to reduce this complication and improve outcomes from PACS procedures.

For thoracic surgery patients, regional analgesia delivered through thoracic paravertebral (PV) or epidural catheters provides high-quality analgesia for post-thoracotomy pain and is associated with reduced overall complication rates relative to parenteral opioids.[5–14] Published studies indicate that thoracic PV and epidural-based analgesia delivery of continuous local anesthetic infusions are approximately of equal value for pain control, but PV catheters are associated with fewer side effects, including hypotension.[15–17] The advantages of regional techniques involving the neuraxis always must be contrasted against their associated risk of epidural hematoma, particularly related to anticoagulation used during cardiopulmonary bypass (CPB). To avoid the risk of epidural hematoma, an alternate approach to neuraxial regional analgesia includes PV catheter placement.

Although the usefulness of PV catheters have been confirmed for post-lung resection thoracotomy analgesia, their value for PACS patients is unclear. Here, the clinical course of 3 cardiac surgery patients undergoing PACS with PV catheters inserted for primary analgesia is described. These examples are reviewed in the context of existing literature and also serve to highlight the challenges of postoperative analgesia for PACS patients.

CASE PRESENTATIONS*

After institutional review board approval, the electronic medical records of 3 patients undergoing PACS surgery procedures involving right minithoracotomy and PV catheter-based postoperative analgesia were reviewed. All surgeries were performed at a single institution between May 2012 and July 2012. The typical anesthetic and surgical techniques common to all 3 patients are described initially, followed by unique aspects of each case.

After discussion with the attending surgeon, informed consent was obtained for general anesthesia and PV catheter placement for adult patients undergoing elective PACS surgery with a low risk of sternotomy and normal coagulation profile. Two right-sided PV catheters were placed in the operating room by the primary anesthesia team before induction, at T2-3

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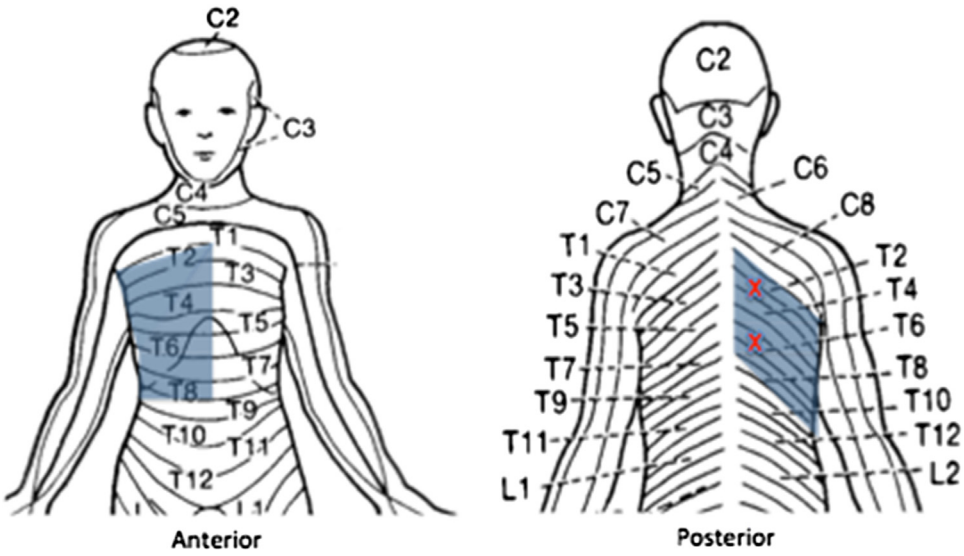

Fig 1. Expected sensory blockade after placement of 2 right-sided T3 and T6 level paravertebral catheters. Sensory blockade is shown with associated dermatomal spread in blue, while the red x shows locations of the paravertebral catheters.

and T5-6. Location of the catheters as well as dermatomal distribution of the sensory block can be seen in Figure 1. Each patient was placed in a sitting position, and routine monitors were applied. After mild sedation, a 20-G polyamide multiorifice catheter (Braun Medical, Bethlehem, PA) was placed in the PV interspace ipsilateral (right-sided) to the planned surgical incision using a standard approach as follows. The location of the right T3 and T5 transverse processes was estimated on the back using anatomic landmarks and identified by placing a 25-G spinal needle perpendicular in all planes to the skin 2.5 cm right of midline. An 18-G Tuohy needle then replaced this spinal "finder" needle. The Tuohy needle tip was then redirected slightly caudally and advanced 1 cm further (deep to the transverse process). A "hanging drop" of preservative-free saline then was suspended on the Tuohy needle, and the patient was instructed to inhale, then exhale. Drop observation during this maneuver is key to interpret needle tip location: (1) complete disappearance of the drop indicates intrapleural location (excessive advancement), (2) no drop movement with breathing suggests insufficient needle advancement, and (3) drop movement inward with spontaneous inhalation and outward with exhalation confirms location of the needle tip in the PV space. After the PV space was located, a positive "loss-of-resistance test" adds confidence of the location of the needle and expansion of the space then is achieved with injection of 5 to 10 mL of preservative-free 0.9% saline. With modest pressure, the catheter then was threaded 5 cm beyond the needle tip. After a negative "aspiration test" and lack of abnormal response to a rapidly injected local anesthetic test dose (3 mL 1.5% lidocaine with 1:200,000 epinephrine), the catheter is taped securely. These maneuvers then are repeated to achieve placement of a right-sided T5-T6 PV catheter.

After successful placement of the PV catheters and with the patient positioned supine, a general anesthetic was initiated in the typical fashion described here. The primary anesthesia team confirmed appropriate intravenous access and standard monitoring as well as the presence of functioning external defibrillator pads. After placement of a preinduction, 20 G left radial arterial line, induction was achieved using fentanyl, midazolam, propofol, and nondepolarizing muscle relaxant (dosages dependent on the anesthesiologist), and the airway was secured with an endotracheal tube. Maintenance anesthesia was provided with inhaled isoflurane and estimated total opioid doses intraoperatively were approximately 50% of a typical procedure, with most administered during induction. A right internal jugular multilumen access catheter was placed under ultrasound guidance after full sterile prep and drape using the Seldinger technique. Other monitoring applied included a near-infrared spectroscopy cerebral oximetry monitor and transesophageal echocardiography. A right bronchial blocker was placed to achieve lung isolation for better surgical visualization through the right anterior thoracotomy.

With adequate anesthesia and the chest sterilely prepped and draped, time-out was performed and antibiotics confirmed to be given within an appropriate time frame. In a fashion typical for PACS, a 6-cm right anterior thoracotomy was made in the 4th intercostal space. CPB was initiated via the ascending aorta and the right femoral vein using an accessory port in the 2nd intercostal space. Heparin was administered to ensure that activated clotting time was maintained for more than 400 seconds before initiation and maintenance of CPB. On CPB, the calculated goal flow was 2.4 L/min/m,^{2} with adequacy determined by near-infrared spectroscopy monitoring, and mean arterial pressure goals were maintained between 65 and 85 mmHg. Temperature goals included cooling to 28°C for the application of the cross-clamp on the ascending aorta. The heart was arrested with anterograde and retrograde blood cardioplegia. The left atrium was opened for repair or replacement of the mitral valve and the right atrium opened for repair or replacement of the tricuspid valve. The heart was de-aired and atrial pacing wires placed, after which weaning from CPB occurred without difficulty. Transesophageal echocardiography was used throughout the procedure but specifically in the post-bypass period to assess the adequacy of the surgical repair,