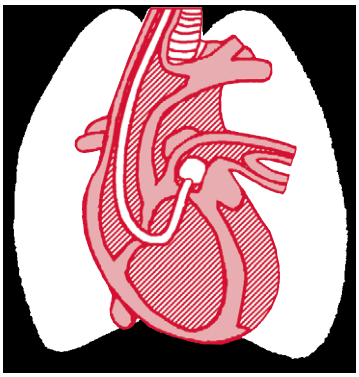

CASE CONFERENCE

Linda Shore-Lesserson, MD
Mark A. Chaney, MD
Section Editors

CASE 5—2010
Paravertebral Blockade for Cardiothoracic Surgery

Vanni Agnoletti, MD,* Emanuele Piraccini, MD,* Simone Tonini, MD,* Marco Taurchini, MD,† Marco Alifano, MD,‡ Giorgio Gambale, MD,* Yatin Mehta, MD,§ and E. Andrew Ochroch, MD, MSCE¶

PATIENTS UNDERGOING THORACOTOMY suffer from severe postoperative pain if analgesia is not managed appropriately. The pain of this surgery has multiple pathways and involves different nerves. Indeed, although the intercostal nerves are important in the etiology of post-thoracotomy pain, the vagus and phrenic nerves also carry mediastinal and diaphragmatic pleural stimuli, whereas the brachial plexus also is important in the generation of shoulder pain. The appropriate management of postoperative pain after thoracic surgery is important for ethical reasons yet may also improve the outcome of the patient by reducing morbidity and quickening recovery, thus reducing hospital costs. Respiratory function is indeed impaired as a result of thoracotomy and may be worsened by the effects of pain. Inadequately controlled postoperative pain reliably produces a reversible restrictive pattern of respiration, with decreases in vital capacity and functional residual capacity. The risk of pulmonary complications may be reduced by adequate postoperative analgesia, which allows deep breathing, coughing, and clearing of secretions. Because acute postoperative pain also may be a predictor of long-term chronic pain after thoracotomy, early and aggressive treatment of pain may help to reduce the high frequency of this complication.[1,2]

Thoracic paravertebral block is an old, safe technique that is effective in treating acute and chronic pain of unilateral origin from the chest and abdomen.[3] Because this technique is used infrequently, it is difficult to assess paravertebral blockade's true complication rate. Known complications from paravertebral block include vascular puncture, skin hematoma, pain at the site of injection (approximately 4%)[4] and pleural puncture or lung penetration (approximately 1%).[5-9] Recent clinical studies have suggested that paravertebral block provides comparable pain relief to epidural analgesia in patients undergoing thoracic and cardiac surgery, with a superior side effect profile (associated with fewer side effects than epidural analgesia in terms of hypotension and urinary retention).[10] In this case report, a patient undergoing thoracic surgery who experienced a potentially deadly complication associated with paravertebral blockade is described.

CASE REPORT*

A 55-year-old man (height, 180 cm; weight, 120 kg; body mass index, 37) with a right lower-lobe benign mass was scheduled for resection of the tumor via video-assisted thoracoscopy (VATS). His coexisting medical conditions were hypertension and obstructive sleep apnea syndrome. He had initiated continuous positive airway pressure (CPAP) 2 months before surgery (11 cmH_2O). His surgical history was remarkable for appendectomy and tonsillectomy as a youth. Preoperatively, he performed a sleep study (polysomnography), which revealed an apnea-hypopnea index greater than 30 per hour (severe dysfunction), with approximately 115 desaturation events per night (mean oxygen saturation, 84%; range, 58%-94%). He had normal preoperative blood test examinations (hemoglobin, 13.3 g/dL; hematocrit, 42.5%; platelets (PLT), 293×10^9/L; international normalized ratio, 1.0; glucose, 85 mg/dL; Na, 140 mmol/L; and K, 4.4 mmol/L) and normal preoperative spirometry (forced vital capacity [FVC], 4.4 L; forced expiratory volume, 13.0 L; forced expiratory volume in 1 second [FEV1]/FVC, 70%). Echocardiography showed a left ventricular ejection fraction of 55%, with normal size and function of the right and left ventricles and normal values of pulmonary artery pressure. He had a baseline blood pressure of 130/80 mmHg, heart rate of 67 beats/min, and an oxygen saturation of 90% (breathing room air). He was classified as a Mallampati grade III airway.

No preoperative medication was given to the patient. A junior anesthesiologist initiated general anesthesia (GA) with intravenous midazolam (0.025 mg/kg), propofol (1.6 mg/kg), fentanyl (2 μg/kg), and succinylcholine (0.8 mg/kg). Before the induction of GA, he called for a senior supervising physician to

From the ∗Emergency Department and †Department of Thoracic Surgery, G.B. Morgagni-Pierantoni Hospital, Forlì, Italy; ‡Department of Thoracic Surgery, Hôtel Dieu Hospital, Paris, France; §Medanta Institute of Critical Care and Anaesthesiology, Medanta The Medicity, Gurgaon, India; and ¶Department of Anesthesiology and Critical Care, University of Pennsylvania, Philadelphia, PA.

Address reprint requests to Vanni Agnoletti, MD, Emergency Department, Anesthesia and Intensive Care Unit, G.B. Morgagni-Pierantoni Hospital, Via Forlanini 34, Forlì 47100, Italy. E-mail: vanni.agnoletti@me.com

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*V. Agnoletti, E. Piraccini, S. Tonini, M. Taurchini, M. Alifano, and G. Gambale

be present (per protocol). The junior anesthesiologist tried unsuccessfully to intubate the patient after GA induction, and he then called for help after the first attempt because of the high level of difficulty (Cormack grade IV). The senior anesthesiologist tried direct laryngoscopy only once and decided to use a laryngeal mask airway (CTrach North America Inc, San Diego, CA) to ventilate the patient while waiting for the recovery of spontaneous breathing (occurred in about 10 minutes). It then was decided to use the fiberoptic bronchoscope for nasal intubation because of the impossibility of orotracheal intubation through the laryngeal mask airway. The senior anesthesiologist proceeded with nasal intubation using a single-lumen endotracheal tube (size 8.0) with a sedated and spontaneously breathing patient. No other intravenous drugs were used during this phase. The endotracheal tube was inserted between the vocal cords through the right nostril in about 15 minutes, with a high level of difficulty because of bleeding from tonsillar crypts. An additional 30 mg of intravenous propofol was administrated before the endotracheal tube was passed through the vocal cords. A Cohen flexitip 9.0 F bronchial blocker (Cook Medical, Bloomington, IN) then was used to obtain one-lung ventilation, and the patient was turned onto his left side.

Under fiberoptic guidance and in the lateral position, the bronchial blocker cuff was inflated, and 2 thoracic paravertebral blocks were performed at the T3 and T7 levels using the classic loss-of-resistance technique.[6] Spinous processes were identified at T3 and T7 levels, and a Neo Delta Ven (Delta Med, Viadana, Italy) 14-G needle was inserted 2.5 cm into the cephalic side of each spinous process. The tip of the needle was inserted deeply, searching for contact with the transverse process at the T3 and T7 levels. The paravertebral space was reached by walking off the transverse process (at T3 and T7), and it was identified via loss of resistance. The distance from each transverse process was around 2.0 to 2.5 cm, and a 10-mL solution of ropivacaine (5 mL, 50 mg) and saline (5 mL) was injected at each level. No problems performing the blocks were encountered, and no inadvertent intravascular placement of the needle, defined as positive aspiration of blood, was noted.

The surgeons then performed a right VATS using 3 small ports with a 30° angle of visualization (video camera) and removed the tumor from the right lower lobe very easily. At the end of surgery and late in the afternoon, the patient was transferred to the intensive care unit (ICU) in order to safely remove the endotracheal tube under controlled conditions pending ENT surgeon consult. After this consult, it was decided to keep the patient asleep until the day after (1st postoperative day) surgery to perform a nasoendoscopy study of the upper airways before extubation. However, neither anesthesiologists; ear, nose, and throat surgeons; nor pneumologists succeeded in performing a clear fiberoptic study of the upper airways at this time, so it was decided to wait an additional day to allow further reduction of the edema and obstruction. On the 2nd postoperative day, a verbal consent was asked of the patient to perform a surgical tracheostomy because of the anticipated persistent high risk of post-extubation respiratory distress. He agreed with this plan, and on the 3rd postoperative day (11 AM), an ear, nose, and throat surgeon performed the tracheostomy using a TrachoFlex Rusch (Rüsch Company, Germany) 7.5 size cannula, and the patient was then transferred out of the ICU.

Everything was absolutely fine until 9 PM on the 3rd postoperative day when abundant bleeding from the right chest (500 mL/h) suddenly started. The patient was moved to the operating room because of hemodynamic instability (blood pressure, 87/40 mmHg; heart rate, 120 beats/min, and oxygen saturation of 94%) and the surgeons performed an exploratory right anterolateral thoracotomy at the T6 intercostal space. Once again, lung separation was obtained via a Cohen bronchial blocker inserted through the tracheostomy. The surgeons found a bleeding source from an intercostal artery at the T6-T7 intercostal space at the costovertebral joint, and they stopped it using clips. The patient received 750 mL of homologous blood and 687 mL of autologous blood using a recovering blood system (Cell Saver 5, Haemonetics, Braintree, MA) from the surgical site (2,000 mL processed). After surgery, the patient was admitted to the ICU and supported with mechanical ventilation (800 mL of tidal volume, 10/min respiratory rate, 9 cmH_2O positive end-expiratory pressure, and 0.45 F_IO_2). He was weaned quickly from mechanical ventilation, and on the 9th postoperative day he was discharged from the ICU without any further complications. After 19 days, he left the hospital.

DISCUSSION

Thoracic paravertebral block (TPVB) has been used successfully in a wide variety of cardiothoracic procedures such as thoracotomy, thoracoscopy, CABG, and breast surgery. Its efficacy has been well documented despite the various incisions used for these interventions. Nevertheless, the best risk:benefit profile is obtained for surgeries requiring a unilateral approach. TPVB exerts its action by blocking intercostal nerves, thus it ensures good nociception control only for the stimuli conveyed by these nerves. However, there are other nerves involved that mediate postoperative pain. Appropriate postoperative pain management should consider these limits and change the strategy accordingly using a multimodal approach (considered the best analgesia technique for most cardiothoracic procedures). The multimodal approach is also indicated if other regional analgesia techniques (ie, thoracic epidural) are used because of similar limits in blocking all painful stimuli. A multimodal approach, including a regional technique, is universally considered superior to a pure intravenous analgesia technique in terms of quality of analgesia, postoperative pulmonary function, and side effects rate.[11]

A review published in 2003 by Soto and Fu[12] compared the gold standard thoracic epidural analgesia (TEA) and TPVB for thoracotomies and found no differences in terms of analgesia, drug requirement, or postoperative pulmonary function between the 2 techniques. Moreover, TPVB may be safer in terms of side effects and complications. Soto and Fu concluded that "intercostal analgesia should be instituted in patients who do not qualify for thoracic epidural analgesia." It is also suggested that a combination of continuous TPVB with local anesthetics (LAs) and patient-controlled analgesia intravenous morphine should be used in the postoperative period to provide effective analgesia after thoracic surgery.[13]

Many publications have focused attention on the equal clinical effectiveness, in terms of analgesia, between TPVB and TEA. Detterbeck[14] analyzed 17 trials including 619 patients, whereas Davies et al[15] analyzed 10 trials including 520 patients.