The Efficacy and Safety of Epidural-Based Analgesia in a Case Series of Patients Undergoing Lung Transplantation

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Objective: **Successful pain management after lung transplantation is critical to ensure adequate respiratory effort and graft expansion. The authors investigated whether thoracic epidural analgesia (TEA) provided adequate pain control after lung transplantation without added morbidity.**

Design: **Retrospective review.**

Setting: **University teaching hospital.**

Participants: **One hundred twenty-three patients who presented to this institution for lung transplantation from January 2008 to June 2013.**

Interventions: **Patient demographics, postoperative pain scores, and epidural-related complications were abstracted from the institutional electronic database. The authors used the previously validated Quality of Recovery (QoR) score and Visual Analog Scale (VAS) as measures of recovery.**

Measurements and Main Results: **Of the 123 patients who underwent lung transplantation in this time frame, 119 patients had thoracic epidurals placed for postoperative analgesia. The mean age was 49.4 years (range, 18–73), and 60 (50.4%) were male. The most common indications for transplant were pulmonary fibrosis (33.6%), cystic fibrosis (26.1%), and chronic obstructive pulmonary disease (20.2%). The median length of stay in the intensive care unit and duration of mechanical ventilation were 21 and 1.2 days, respectively. Eight (6.7%) patients experienced postoperative pulmonary compromise (eg, pneumonia, prolonged intubation). No serious complications were associated with TEA placement. On days 1, 3, and 7 after TEA placement, the mean QoR was 7.6, 9.4, and 9.7, and the mean VAS was 2.5, 2.1, and 2.0, respectively.**

Conclusions: **In this case series, the authors observed excellent analgesia and no serious complications associated with TEA. Therefore, an epidural-centric approach to pain control after lung transplantation should be considered in appropriate patients.**

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KEY WORDS: Lung transplant, pain management, epidural, analgesia, safety, efficacy, complications

THORACIC EPIDURAL ANALGESIA (TEA) increasingly has been shown to improve outcome in patients after lung transplantation and has become the most widely used interventional technique to provide pain control in this patient population.[1,2] The surgery involves either a posterolateral thoracotomy or bilateral thoracosternotomy (clam-shell) incision, both of which are notable for causing intense pain. The latter results in substantially more chest wall discomfort for the patient. The source of the pain is multifactorial, but it is caused in great part by stretching of the intercostal muscles, prolonged rib retraction, manipulation of the lungs and pleura, and placement of large-bore chest tubes.[1] The pain has both nociceptive and neuropathic components that are aggravated by respiration and coughing.[3] Undertreated pain in lung transplant patients results in poor respiratory effort and the subsequent development of pneumonia and atelectasis. Pain also can cause an uninhibited perioperative surgical stress response that has the potential to trigger and perpetuate postoperative myocardial ischemia and arrhythmias, increase peripheral vascular resistance, reduce splanchnic blood flow, and ultimately prolong intensive care unit (ICU) stay.[4,5] Adequate pain control is crucial to facilitate weaning of patients from mechanical ventilation and promote appropriate breathing and handling of bronchial secretions once the patient has been extubated.[6]

The benefit of using TEA for treating thoracotomy-based pain after lung transplantation is well established. In a recent best evidence topic review, four of five studies that addressed TEA and postoperative outcomes in lung-transplant patients showed reduced duration of mechanical ventilation, shortened length of ICU stay, and decreased number of respiratory complications, including pneumonia, in patients with epidural-based pain control.[7] Thoracic epidurals also have been shown to improve patient satisfaction. This benefit especially is important in lung transplantation because, in comparison with patients undergoing a thoracotomy for other thoracic procedures, patients undergoing lung transplantation have been shown to experience less adequate pain control with epidural or systemic analgesics.[6] A 2005 meta-analysis by Wu et al[8] showed that until the third day, epidural analgesia was significantly superior to intravenous (IV) patient-controlled analgesia (PCA) for controlling pain. Following acute postsurgical pain, Gottschalk et al[9] found that half of all thoracotomy patients developed chronic pain at the surgical site. Epidural analgesia has the potential to reduce the development of chronic pain, as evidenced in a study by Senturk et al[10] that compared IV PCA and epidural analgesia in postthoracotomy patients.

Despite the proven benefits of epidurals in this patient population, concern exists about the risks of the procedure in this immunocompromised demographic. Although complications, such as epidural hematoma and abscess are rare, their potentially devastating clinical impact has resulted in limitations in the use and duration of TEA. To date, no studies have demonstrated the safety of using epidural catheters for prolonged periods of time in lung transplant patients. Therefore, the authors sought to evaluate the safety and efficacy of using

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TEA until chest tube removal for postoperative analgesia in a case series of lung transplant patients at this institution.

METHODS

The authors conducted a retrospective analysis of all patients who underwent unilateral or bilateral lung transplantation at this institution from January 2008 to June 2013. After the appropriate institutional review board approval was obtained, various demographic variables, including age, gender, race, and prior opioid use, were abstracted from the electronic medical record. Various operative variables, including ASA class and utilization of cardiopulmonary bypass (CPB), were confirmed by reviewing the operative and anesthesia records.

At this institution, epidurals are placed in lung transplant patients in the ICU immediately after surgery to facilitate earlier extubation and minimize the dose of opioids needed to control pain. Although evidence suggests that it is safe to place the epidurals preoperatively, after discussion with surgical colleagues about the risks and benefits of doing so, the authors have made it their practice to place all epidurals as early as possible in the postoperative period. By doing this, the risk of patients developing an early epidural hematoma when they are fully heparinized for CPB is avoided; however, the patients have difficulty communicating discomfort during epidural placement because of intubation and sedation. From a review of medical records, the authors collected information regarding the postoperative day of epidural placement and the degree of sedation used during the procedure. They further classified the level of sedation by reviewing the nursing flow sheets to determine the stimulus needed for arousal during and after the procedure. From this information, the authors classified sedation according to ASA definitions.[11] Of the four criteria used for determining sedation level (responsiveness, airway, spontaneous ventilation, and cardiovascular function), the authors used only responsiveness as a parameter for sedation classification because the patients' airways and pulmonary function were altered from recent surgery. Patients with a normal response to voice were labeled as having minimal sedation, patients who had a purposeful response to verbal or tactile stimulation were labeled as having moderate sedation, patients with a purposeless response only after repeated or painful stimuli were labeled as being deeply sedated, and patients who were unarousable were labeled as being under general anesthesia.

Standard American Society for Regional Anesthesia guidelines for anticoagulation with neuraxial anesthesia were followed for the placement of epidural catheters.[12] Typically, the epidural was placed by a resident or fellow and a regional anesthesia faculty member. Individuals who placed the epidural followed aseptic technique for prevention of infectious complications. These measures included removing jewelry; washing hands; and wearing caps, masks, and sterile gloves.[13] In addition, doctors routinely wear sterile gowns when placing epidural catheters in lung transplant patients. Members of the Acute Pain Service (APS), which included anesthesia residents, fellows, and attending anesthesiologists, placed nontunneled thoracic epidurals using landmarks and the loss-of-resistance technique. All epidural infusions consisted of bupivacaine, 0.125% or 0.0625%. Infusions were initiated with a continuous dose of bupivacaine, 0.125%, at 4-to-6 mL per hour with demand doses of 3-to-5 mL every 10 minutes. The concentration of bupivacaine was decreased to 0.0625% if patients became hypotensive, in an effort to decrease the degree of sympathectomy. If pain persisted despite adequate epidural coverage, fentanyl, 5 μg/mL, was added to the epidural infusion. APS adjusted these settings as needed to optimize pain control while minimizing side effects, such as hypotension, sedation, and upper extremity numbness. While the catheter remained in place, the APS followed patients daily by conducting focused interviews and physical exams to assess for adequacy of pain control, quality of recovery, and potential epidural-related complications. If the epidural site became red, standard practice was to remove the epidural immediately and initiate antibiotics. The APS team carefully followed the America Society for Regional Anesthesia guidelines for neuraxial blocks and anticoagulation in patients with suspicion of an epidural hematoma and followed up with frequent neurologic examinations for several days. To minimize the use of opioids for pain control, epidural analgesia was continued until the chest tubes were removed. The authors reviewed APS notes on randomly chosen days 1, 3, 7, 10, and 21 after epidural catheter placement to document each patient's progression. Once the epidural analgesia ceased, patients were transitioned to oral or IV pain medications. Patients were no longer followed by APS once epidurals were removed unless they had additional pain control needs that could not be addressed by the surgical team. Epidural-related complications, such as malfunction, migration, early removal, infection, paresthesia, and upper extremity motor weakness, were noted.

The authors utilized the previously validated Quality of Recovery (QoR) score and Visual Analog Scale (VAS) as measures of recovery after surgery and anesthesia.[14] They gathered information from APS notes and nursing flow sheets to estimate each patient's QoR score; however, because the study was retrospective, they were not able to survey the patients directly. Therefore, they used medical records to score six of the nine components of the QoR survey (Table 1). These included items 3 (being able to understand instructions and advice; not being confused), 5 (being able to pass urine and having no trouble with bowel function), 6 (being able to breathe easily), 7 (being free from headache, backache, and muscle pains), 8 (being free from nausea, dry-retching, or vomiting), and 9 (being free from experiencing severe pain or constant moderate pain). The authors were unable to assess the remaining three components of the QoR survey: 1 (having a feeling of general well-being), 2 (having support from others, especially doctors and nurses), and 3 (being able to look after personal toilet and hygiene unaided). Because these items were not scored, the survey was reduced from nine items with a maximum score of 18 to six items with a maximum score of 12. For a detailed description of the scoring used for QoR, please see the addendum.

To further assess the quality of pain control, the authors ascertained the patients' VAS scores. Patients were assigned a score to their level of pain, with 0 corresponding to no pain and 10 corresponding to the worst pain imaginable. These VAS pain scores were recorded by nursing staff several times during a 24-hour period. The frequency of recording ranged from every 4 hours or more in the ICU to once every nursing shift on a regular floor. To document each patient's VAS pain

Table 1. Components of the QoR Survey

Components Assessed	Components Not Assessed
#3 – Being able to understand instructions and advice; not being confused	#1 – Having a feeling of general well-being
#5 – Being able to pass urine and having no trouble with bowel function	#2 – Having support from others, especially doctors and nurses
#6 – Being able to breathe easily	#4 – Being able to look after personal toilet and hygiene unaided
#7 – Being free from headache, backache, and muscle pains	
#8 – Being free from nausea, dry-retching, or vomiting	
#9 – Being free from experiencing severe pain or constant moderate pain	

Abbreviation: QoR, Quality of Recovery.

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