

Thoracic Epidural Analgesia and Acute Pain Management

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PAIN continues to be a significant problem for many patients after major surgery. In addition to improving patient satisfaction and decreasing pain scores, enhanced perioperative pain control can improve clinical outcomes. Thoracic epidural analgesia (TEA) remains a critical tool for anesthesiologists to use in acute pain management. TEA is particularly effective for reducing pain after thoracic and upper abdominal surgery and likely permits major surgical procedures to be performed on patients with moderate to severe comorbid diseases, who several years ago may have been determined to be too great a risk for surgery.

In the past 10 yr, peripheral nerve blockade has improved perioperative analgesia for patients undergoing extremity surgery. Although nerve blocks have reduced the use of continuous lumbar epidural analgesia, anesthesiologists must understand the indications, placement techniques, solutions administered, potential complications, and evidence-based outcomes for TEA in acute pain management.

Indications

Thoracic epidural analgesia remains a key component of anesthesia-based acute pain services and is used to treat acute pain after: thoracic surgery, abdominal surgery, and rib frac-

tures.¹ TEA is warranted when a moderate-to-large thoracic or upper abdominal incision is anticipated. TEA can also be a useful adjunct in fast-track surgery by optimizing pain relief, attenuating the surgical stress response, and allowing early mobilization. TEA using local anesthetic is an important component of fast-track colorectal procedures because it reduces the duration of postoperative ileus.² Table 1 provides a comprehensive list of open surgical procedures in which TEA can be used to treat postoperative pain. No unique contraindication to TEA exists that does not apply to all neuraxial procedures.

Few large studies have evaluated the role of TEA in minimally invasive surgeries such as laparoscopic abdominal surgery or video-assisted thoracoscopic surgery. Other than improved pain control, TEA has not been associated with improved outcomes compared with systemic opioids in patients undergoing laparoscopic colectomy.³ The ability of TEA to provide better analgesia than do systemic opioids in patients undergoing laparoscopic cholecystectomy remains a matter of controversy, but TEA has been associated with a higher incidence of adverse effects in elderly patients.⁴ TEA improved postoperative analgesia in patients undergoing laparoscopic sigmoidectomy⁵ and video-assisted thoracoscopic surgery,⁶ but differing opinions on the need for TEA for sigmoidectomy and thoracoscopic surgery remain. Because there are only small improvements in pain control and no other clear benefits for TEA in minimally invasive surgeries, we do not recommend using TEA for laparoscopic or thoracoscopic procedures.

Alternatives to TEA, such as paravertebral or transverse abdominis plane blockade, offer the advantages of providing unilateral analgesia with lower side-effect profiles; thus, these techniques have gained popularity. A meta-analysis of small, nonblinded trials demonstrated that paravertebral blocks provided comparable pain relief and were associated with less nausea and vomiting, urinary retention, failed blocks, hypotension, and pulmonary complications compared with TEA in patients undergoing thoracic surgery.^{7,8} In addition, paravertebral blocks were associated with fewer major complications in patients after pneumonectomy.⁹ Transverse abdominis plane blockade provides analgesia in patients undergoing selected abdominal surgeries, but no studies have compared transverse ab-

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Table 1. Open Surgeries in Which Thoracic Epidural Analgesia Can Be Used

Thoracic Surgery	Upper Abdominal Surgery	Colorectal Surgery	Urologic Surgery	Gynecologic Surgery
Thoracotomy	Esophagectomy	Colectomy	Cystectomy	Ovarian tumor debulking
Repair of pectus deformities	Gastrectomy	Bowel resection	Nephrectomy	Pelvic exenteration
Thoracic aortic aneurysm repair	Pancreatectomy	Abdominal perineal resection	Ureteral repair	Radical abdominal hysterectomy
Thymectomy	Hepatic resection		Radical abdominal prostatectomy	
	Abdominal aortic aneurysm repair			
	Cholecystectomy			

dominis plane blocks to TEA. Paravertebral and transverse abdominis plane blockade are options for thoracic or abdominal surgery, respectively, especially when TEA is contraindicated.

Technique

Beneficial effects of TEA require that catheter placement and the infusate be targeted at the thoracic segments innervating injured skin, muscle, and bone from which the nociceptive input originates (fig. 1). Most percutaneous approaches to

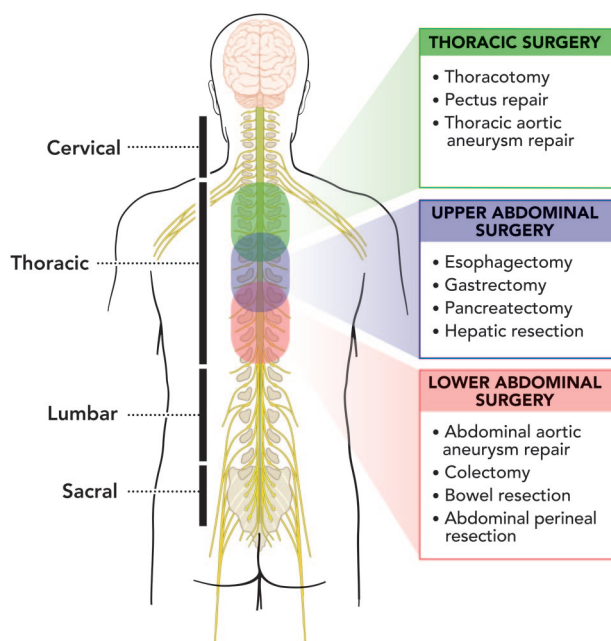


Fig. 1. Schematic of the adult spine. Regions of the spine that can be used to insert thoracic epidural catheters in a variety of surgeries are shown. The *green shaded oval* in the thoracic spine represents the region for insertion for patients undergoing thoracic surgical procedures. The *blue shaded oval* depicts the area of insertion for patients undergoing upper abdominal surgery. The *pink shaded oval* represents the area of insertion for patients undergoing lower abdominal surgery.

the thoracic epidural space use needle puncture guided by surface anatomic landmarks. The prominent C7 spinous process, the scapular spine (T3), and the inferior border of the scapula (T7) are useful landmarks used to approximate the puncture site to the intended segment. Use of these landmarks may vary among patients. For example, when performing an upper thoracic epidural placement in an obese patient, the scapula may be difficult to identify. Using the prominent C7 spinous process to estimate the targeted thoracic segment in obese patients may be useful. Counting up from the iliac crest can improve accuracy for lower thoracic (T10 to T12) epidural placement. Nevertheless, the exact vertebral interspace can be misplaced by one or two segments.¹⁰ Fluoroscopy can be used to guide placement at a precise segment and verify appropriate catheter position after injection of contrast media. Thus far, there is no evidence that using fluoroscopy for thoracic epidural placement improves safety or decreases adverse events. The use of ultrasound to facilitate epidural catheter placement is developing.

Intravenous access is obtained, monitors are placed, oxygen is administered, and sedative and analgesic drugs can be used. Because of the extreme caudad angulation of the thoracic spinous processes, a conventional midline approach to the thoracic epidural space can be difficult. A paramedian approach is required to place the needle consistently at most other thoracic epidural segments above T11. It is preferred that patients be placed in a sitting position with neck and upper back flexion before surgery. Details of the procedure are noted in figures 2, A–H, and 3, A–F.

In some cases, patients may not be able to be placed in a sitting position for thoracic epidural placement. This situation can be encountered in ventilated intensive care unit patients and those in the recovery room immediately after surgery. The same technique can be used in patients in a lateral decubitus position. Briefly, the patients are placed on the lateral edge of the bed or cart. In the lateral decubitus position, the approach of the needle can be from the floor

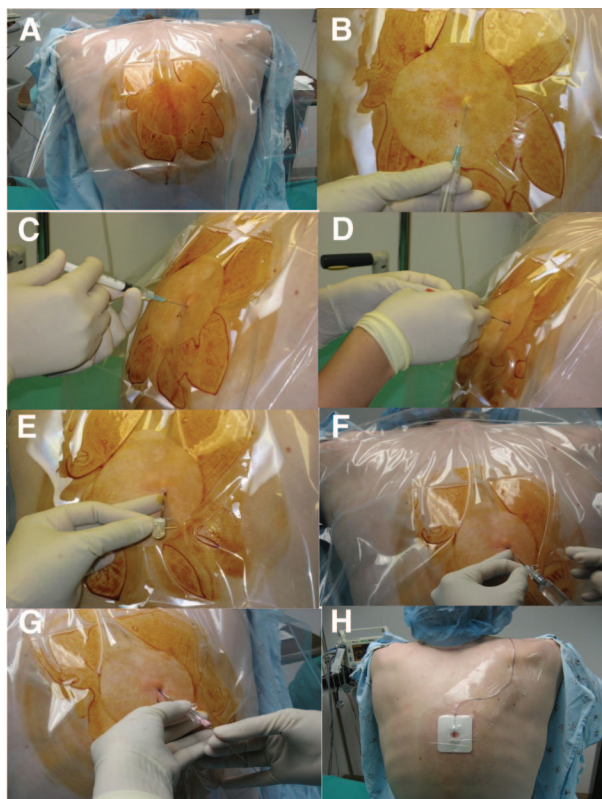


Fig. 2. Photographs of insertion of a thoracic epidural catheter in a patient. Place the patient in the sitting position with neck and upper back flexed. Widely prepare and drape the targeted thoracic segment(s) using sterile technique (A). Infiltrate the skin and subcutaneous tissues with local anesthetic approximately 1 cm lateral to the inferior aspect of the targeted spinous process with a 1.5-inch 25-gauge needle (B). With the infiltration needle, contact the ipsilateral lamina or transverse process and anesthetize the periosteum if possible. Perform local infiltration of subcutaneous tissues in both medial and cephalad directions to achieve adequate anesthesia of tissues at the intended path of the Hustead (or Tuohy) needle and epidural catheter (C). Introduce the epidural needle with the bevel directed cephalad perpendicular to the anesthetized skin and advance until the ipsilateral lamina or transverse process is contacted (D). If lamina is not contacted, care may be taken to avoid advancing the needle laterally, which will place the needle in the paravertebral space. The needle depth to the lamina is then noted, and the needle is withdrawn back to skin and advanced again slightly medially; this step is repeated until the needle contacts bone at a slightly more superficial (approximately 2–5 mm) depth than the original depth at the lateral lamina. This suggests the epidural needle tip is midline at the junction of the lamina and spinous process (not shown). The needle is withdrawn and advanced with the same medial angle but in small increments cephalad to the same depth (E). Either bone or ligamentum flavum is contacted. If bone is contacted, the needle is redirected cephalad and advanced. If bone is no longer contacted and the depth exceeds the depth previously noted, the epidural needle stylet is removed. The luer lock loss-of-resistance syringe is attached to the needle for loss of resistance (F). Once loss of resistance is attained, stabilize the epidural needle and thread the catheter (G). Secure the catheter using a sterile locking device and adherent dressings. For thoracotomies or thoracoscopies, avoid placing the dressings on the same side as the surgery (H).

toward the midline. Subsequent steps identifying midline and cephalad angulation are repeated.

Solutions Administered

The primary choices of analgesic agents to be infused for TEA include local anesthetics alone, opioids alone, or the combination of local anesthetics and opioids. The choice of a single agent or combination usually depends upon the characteristics of the patient.

Local Anesthetics

Local anesthetics alone can be used for epidural analgesia. Block *et al.*¹ demonstrated no better pain control using local anesthetic alone compared with local anesthetics and opioids, and using local anesthetics alone may decrease postoperative ileus in patients undergoing laparotomy.¹¹ However, the use of local anesthetics often is limited by hypotension. Local anesthetics can be used alone in patients with obstructive sleep apnea or intolerable opioid-related side effects, such as prolonged postoperative ileus or severe nausea and vomiting, while effective analgesia is provided. Opioids might be removed from the infusate in patients with mental status changes or reduced levels of consciousness in the perioperative period.

Combination Opioid and Local Anesthetics

Most often, epidural local anesthetics have been combined with epidural opioids with the aim of additive or synergistic analgesia while reducing the dose-related adverse effects of either drug alone. Combining thoracic epidural local anesthetics and opioids produces superior analgesia compared with using epidural opioids or local anesthetics alone.¹ However, close titration of epidural local anesthetic and opioid concentrations must be performed to attain a balance between providing optimal analgesia and avoiding unwanted side effects.

Opioid Only

No clear evidence favors the use of thoracic epidural opioids alone. TEA using opioids does not improve postoperative analgesia at rest compared with parenteral opioid therapy in postoperative patients.¹ In addition, pain with movement was minimally improved. Thus, using opioids alone for TEA does not appear to improve analgesia significantly compared with that seen with the use of parenteral opioids. Greater dosages than are used for local anesthetic-opioid combination therapy place patients at risk for opioid-related adverse effects. Systemic opioids are preferred when there is a perceived neurologic deficit that could be related to epidural local anesthetic administration. Opioids may be used alone for TEA when an epidural catheter has been placed and the patient's hemodynamic status is marginal (e.g., blood pressure 90/50 mmHg). In some cases, blood pressure improves later in the postoperative period, and local anesthetics can be added then.

Choice of Opioid

Lipid solubility is an important factor in selecting an opioid for epidural administration. When an opioid is administered

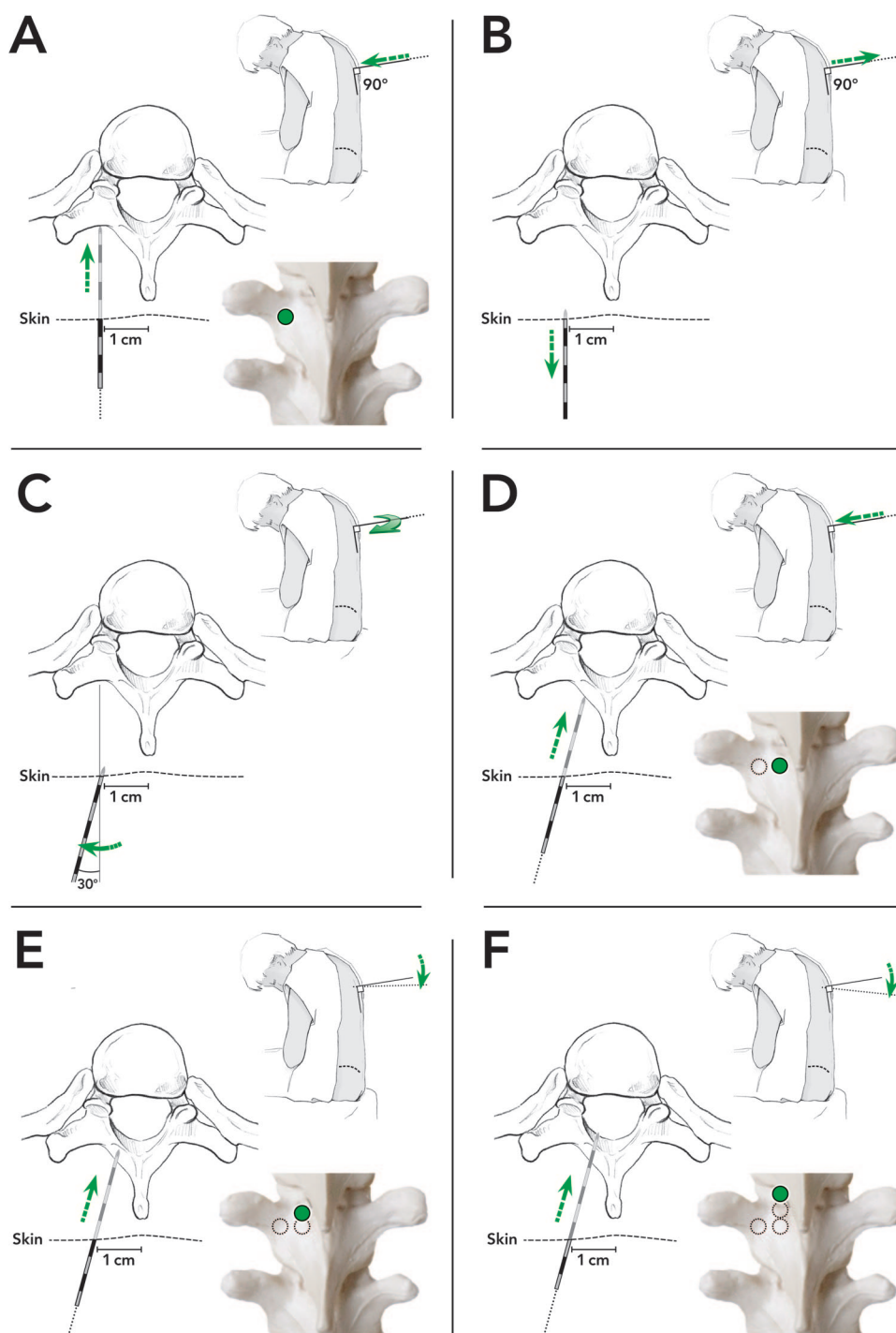


Fig. 3. Schematic of thoracic epidural catheter placement using transverse and posterior views of drawings of the thoracic spine. Hustead (or Tuohy) needle with the bevel directed cephalad is introduced perpendicular to the anesthetized skin approximately 1 cm lateral to the spinous process of the targeted segment and advanced until the ipsilateral lamina or medial transverse process is contacted. If lamina is not contacted, avoid advancing the needle laterally, which will place the needle in the paravertebral space. Note the needle depth to the lamina (A). Withdraw the needle back to skin (B). Readvance the needle slightly medially without a change in cephalocaudal direction (C). With advancement, lamina again should be contacted (D). Slight medial revisions of the needle are performed until the needle contacts bone at a slightly more superficial (~2–5 mm) depth than the original depth (A) of the lateral lamina. This suggests the epidural needle tip is midline at the junction of the lamina and spinous process. If the needle contacts bone much shallower than the original depth of the lateral lamina (1 cm or greater), it is likely the needle has contacted the posterior part of the spinous process and the angle is too medial. If this is the case, the needle should be withdrawn and repositioned slightly more lateral. After the correct medial angle is determined, the needle is withdrawn and advanced with the same medial angle but in small increments cephalad to the same depth as in D (E). If bone is contacted, direct the needle slightly more cephalad and advance. If bone is no longer contacted and the depth exceeds the depth previously noted, the epidural needle stylette is removed and loss-of-resistance technique is begun (F).

Table 2. Recommended Solutions for Thoracic Epidural Analgesia

Local Anesthetic	Opioid	Advantages	Disadvantages
Bupivacaine, 0.125%	None	↓ Nausea/Vomiting ↓ Pruritus ↓ Sedation ↓ Respiratory depression	↑ Hypotension ↑ Motor blockade
Bupivacaine, 0.1%	Hydromorphone, 5–10 µg/ml Or Fentanyl, 2–5 µg/ml	↓ Both hemodynamic and opioid side effects	—
Bupivacaine, 0.05%	Hydromorphone, 5–10 µg/ml Or Fentanyl 2–5 µg/ml	↓ Both hemodynamic and opioid side effects	—
Bupivacaine, 0.05%	Hydromorphone, 20 µg/ml Or Fentanyl, 5–10 µg/ml	↓ Both hemodynamic and opioid side effects	—
None	Hydromorphone, 20–40 µg/ml	↓ Hypotension ↓ Motor blockade	↑ Nausea/Vomiting ↑ Pruritus ↑ Sedation ↑ Respiratory depression

epidurally, it must cross the dura and arachnoid membrane to enter the cerebrospinal fluid to act within the spinal cord dorsal horn. This occurs by diffusion through the spinal meninges. Lipophilic opioids such as sufentanil and fentanyl remain longer within the epidural space by partitioning into epidural fat and thus are found in lower concentrations in cerebrospinal fluid compared with hydrophilic opioids such as morphine. During prolonged infusion of lipophilic opioids such as fentanyl and sufentanil, the plasma concentration and analgesic effect of these drugs are similar to that of an intravenous infusion. The addition of epinephrine (2 µg/ml) decreases the plasma concentration of epidural fentanyl and improves the analgesic effect when added to bupivacaine-fentanyl combinations.¹²

Conversely, hydrophilic opioids such as morphine and hydromorphone are found in high concentrations within the cerebrospinal fluid. This allows for more cephalad spread by passive cerebrospinal fluid movement to provide spinally mediated analgesia at sites distant from the infusion. However, rostral migration is associated with side effects such as respiratory depression, somnolence, and facial pruritus. The incidence of pruritus appears greater with the use of epidural morphine than with hydromorphone but may be minimized with the use of a continuous infusion *versus* a bolus.¹³ In summary, evidence suggests epidural administration of hydrophilic opioids should reduce parenteral drug concentrations, but diffusion to supraspinal sites may occur, whereas lipophilic opioid infusions such as fentanyl largely result in systemic effects that can be reduced by the administration of epinephrine. Few studies have compared clinical outcomes when infusing a hydrophilic *versus* a lipophilic opioid for TEA.

Choice of Local Anesthetic

Bupivacaine is commercially available as a racemic mixture of S(–) and R(+) enantiomers, but evidence suggests the R(+) enantiomer has greater cardiotoxicity. Some clinicians prefer

to use the S(–) enantiomer levobupivacaine because of a potentially lower cardiotoxic profile. Ropivacaine is another pure S(–) enantiomer that has been shown to be less cardiotoxic than bupivacaine. However, evidence has demonstrated no clinical advantage of ropivacaine or levobupivacaine over bupivacaine for TEA,¹⁴ and the potential reduction in toxicity may not be clinically significant because plasma bupivacaine concentrations during thoracic epidural infusions rarely approach toxic concentrations in adults.

Several different treatment protocols have been suggested for administering epidural local anesthetics with opioids. Curatolo *et al.*¹⁵ applied an optimization model in 190 patients to find the best dosage combination and infusion rates of bupivacaine and fentanyl for TEA in major abdominal surgery. The two optimal regimens were: (1) 13 mg/h bupivacaine with 25 µg/h fentanyl, and (2) 8 mg/h bupivacaine with 30 µg/h fentanyl. An infusion of bupivacaine with hydromorphone provides a cost-effective local anesthetic with an opioid that provides spinally mediated analgesia but less pruritus than morphine (table 2). Epidural clonidine can cause hypotension and sedation, which has limited its use in adult TEA.

Complications and Adverse Events Associated with TEA

Epidural placement in the thoracic spine is thought to be more hazardous than lumbar epidural placement because of the perceived increased risk of neurologic injury to the spinal cord. However, complications associated with TEA are relatively rare. In 4,185 patients undergoing TEA, the overall incidence of complications was 3.1%. This included unsuccessful catheter placement (1.1%), dural puncture (0.7%), postoperative radicular pain (0.2%), and peripheral nerve lesions (0.2%). Unintentional dural perforation was observed more often during lower thoracic (3.4%) than during mid (0.9%) or upper (0.4%) thoracic spine placements. No

epidural hematomas or abscesses were identified.¹⁶ An additional retrospective study involving 2,837 patients receiving TEA for cardiac surgery reported no epidural hematomas or abscesses and only two superficial skin infections at the site of insertion (0.07%).¹⁷ Other studies corroborate a lack of neurologic sequelae caused by TEA.¹⁸

Rare but devastating complications of epidural analgesia include neurologic injury from hemorrhagic and infectious etiologies. The incidence of epidural hematoma appears to be less than 1 in 150,000 patients and usually occurs in the presence of impaired coagulation.¹⁹ The most traumatic event likely to cause bleeding is epidural catheter placement, followed by catheter removal, needle placement, and daily catheter management.²⁰ Consensus statements for the administration of neuraxial techniques in the presence of anticoagulants have been published by the American Society of Regional Anesthesia.¹⁹ Carefully consider the properties of the specific anticoagulant before placement and removal of epidural catheters.

The incidence of epidural abscesses appears to be low. A epidural catheter colonization rate as great as 28% has been found,²¹ and usually staphylococcus is identified. However, few cases of epidural abscess associated with TEA have been reported.²² Factors likely influencing infection may include perioperative antibiotic use and duration of TEA use. The risk of infection appears to increase after the second day of epidural catheterization, and a longer duration of use has an incidence of local infection that approaches that of intravascular devices.²² We do not routinely remove epidural catheters for fever but consider sources of potential infection in patients receiving TEA. It is recommended that patients be monitored daily for signs and symptoms of infection and that the benefit-to-risk ratio be evaluated closely after catheterization day four. Vigilance for epidural hematoma and epidural abscess followed by early intervention if detected may limit sequelae.²⁰ Other complications of epidural analgesia also apply to TEA, including postdural puncture headache, back pain, and catheter migration (intravascular or intrathecal).

Adverse effects related to medications used in TEA include nausea, vomiting, pruritus, hypotension, urinary retention, sedation, and respiratory depression. Reports of dysesthesia, paresthesias, weakness, and local anesthetic toxicity are rare. Recent evidence suggests that use of a urinary catheter throughout the duration of TEA increases the incidence of urinary tract infection without causing a decrease in urinary retention.²³ Pleural puncture and pneumothorax, although likely underreported, appear to be rare.²⁴

Clinical Outcomes

Improved Pain Control

Thoracic epidural analgesia provides superior postoperative analgesia compared with parenteral opioids for thoracic and upper abdominal procedures.^{1,25} As reviewed by Block *et al.*,¹ TEA with local anesthetic alone or with opioid provided significantly better postoperative analgesia at rest and with activity for these selected surgeries.

It remains a matter of controversy whether TEA decreases the incidence of chronic postoperative pain. Long-term pain after thoracotomy (greater than 2 months) has an incidence of 30–50%.²⁶ The ability of TEA to decrease long-term thoracotomy pain, possibly *via* aggressive perioperative pain control, was suggested by early, small clinical trials. However, preemptive TEA initiated before surgical incision did not reduce the incidence of chronic postthoracotomy pain,²⁷ and this effect has not been reproduced in subsequent studies.²⁸

Reduced Pulmonary Complications

Thoracic epidural analgesia reduces pulmonary morbidity. A meta-analysis of randomized controlled trials contrasting TEA using opioids and local anesthetics with systemic opioids demonstrated a significant decrease in the incidence of atelectasis, pulmonary infections, hypoxemia, and overall pulmonary complications.²⁹ TEA can decrease the duration of tracheal intubation and mechanical ventilation by approximately 20%.³⁰ TEA appears to improve postoperative diaphragmatic dysfunction after thoracic and abdominal surgery by reducing the inhibitory effect of surgical injury on phrenic motor neuron activity.³¹ Recent studies indicate the incidence of pneumonia with the use of systemic analgesia has decreased from 34% to 12% over the past several decades, whereas the incidence of pneumonia with TEA remains approximately 8%.³² This decreased baseline risk of pneumonia after thoracic or abdominal surgery suggests the relative benefit of TEA has lessened.

Decreased Duration of Postoperative Ileus

It has been well-established that TEA with local anesthetics results in decreased duration of postoperative ileus compared with the use of systemic opioid therapy in patients undergoing abdominal surgery.^{33,34} Recovery of postoperative ileus occurs earlier when epidural local anesthetic is used alone compared with the use of a combination of epidural opioid and local anesthetic.¹¹ First, TEA may reduce systemic opioid-induced gastrointestinal hypomotility. Second, segmental neural blockade of thoracic dermatomes by TEA using local anesthetic inhibits both nociceptive afferent and sympathetic efferent activity while leaving the vagal parasympathetic innervation intact. This autonomic shift to increase parasympathetic tone may increase gastrointestinal motility and facilitate the resolution of postoperative ileus while not increasing the risk of anastomotic leakage.³⁵ TEA may lead to increased oral intake and improved mobilization,³⁴ but conflicting evidence exists regarding its effect on length to hospital stay,³³ which can be confounded by many factors, such as hospital discharge criteria.

Rib Fractures and Reduced Mortality

Rib fractures are a common injury among trauma patients, and evidence suggests TEA may improve outcomes in this patient population. A review of the National Trauma Data

Bank reported that a greater number of rib fractures correlated directly with increasing pulmonary morbidity and mortality. However, mortality was significantly less for patients who fractured two or more ribs and received TEA. This beneficial effect was most noticeable for patients with more than five rib fractures.³⁶ TEA also reduced mortality in elderly thoracic trauma patients compared with use of parenteral analgesia.³⁷ It is unlikely a randomized controlled trial would be undertaken in this patient population. Nevertheless, recent guidelines advocate TEA as the preferred analgesic technique in patients with multiple rib fractures.³⁸

Decreased Postoperative Catabolism

Some of the clinical benefits of TEA have been attributed to improved postoperative protein economy. TEA attenuates postoperative nitrogen excretion, amino acid oxidation, and decreased muscle protein synthesis while minimizing whole body protein catabolism in patients undergoing colorectal surgery. Muscle mass may be spared.³⁹

Cardiovascular Morbidity

Because TEA attenuates sympathetic nervous system activation after surgery, TEA was thought to provide better outcomes for patients at high risk for perioperative cardiac morbidity. Theoretically, the sympatholytic effects of TEA could be protective for perioperative myocardial ischemia and infarction. However, the magnitude of this effect is not likely clinically relevant. To optimize the reduction in cardiac sympathetic efferent activity, the TEA catheter should be placed at high thoracic levels (T1 or T2). There are few surgeries that benefit from TEA placed at T1 or T2. Although TEA can be used in patients at risk for adverse perioperative cardiac events to provide optimal analgesia, TEA does not replace β -adrenergic receptor blockade in high-risk patients.

In cardiac surgery patients, evidence suggests that TEA may be associated with earlier extubation, improved pulmonary function, fewer cardiac dysrhythmias, and reduced pain scores compared with conventional opioid therapy.⁴⁰ However, a meta-analysis demonstrated no difference in the rates of mortality or myocardial infarction.⁴¹ A retrospective review of TEA in off-pump coronary artery bypass graft surgery demonstrates similar results.⁴² There continues to be interest among anesthesiologists in the use of TEA in cardiac surgery patients, but beneficial effects on morbidity and mortality appear limited.⁴³

Other Outcomes

Although the increased use of TEA may permit surgeries on more high-risk patients, current evidence suggests that TEA does not improve perioperative mortality.³³ However, evidence suggests that TEA may be of benefit in decreasing mortality in patients incurring multiple rib fractures (see Rib Fractures and Reduced Mortality). In addition, the superior analgesic effects of TEA may lead to increased patient satisfaction,⁴⁴ recuperated functional exercise capacity, reduced

Table 3. Benefits of Thoracic Epidural Analgesia

- Superior perioperative analgesia compared with systemic opioids
- Decreased pulmonary complications
- Decreased duration of mechanical ventilation
- Decreased duration of postoperative ileus after abdominal surgery
- Decreased postoperative protein catabolism
- Decreased mortality in patients with multiple rib fractures

intensive care unit stay, and better health-related quality of life.³⁴ Thus, TEA may improve patient-oriented outcomes (table 3). It remains to be determined whether improved pain control with modalities such as TEA decreases the incidence and severity of persistent pain after surgery.²⁷ Similarly, future studies will continue to examine if TEA reduces the risk of cancer progression in selected patients.⁴⁵

Summary

Thoracic epidural analgesia, using local anesthetic and opioid combinations, remains a key tool for acute pain management in patients undergoing thoracic and upper abdominal surgery. TEA is beneficial by providing superior perioperative analgesia compared with parenteral opioids, decreasing pulmonary complications and duration of mechanical ventilation, decreasing postoperative catabolism, and decreasing the duration of postoperative ileus after abdominal surgery. In addition, TEA likely reduces morbidity and mortality in patients incurring multiple rib fractures. Complications associated with TEA appear to be rare. Thus, it continues to be imperative that anesthesiologists use TEA in selected patients for acute pain management.

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