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POSTOPERATIVE PAIN MANAGEMENT IN ADULT PATIENTS UNDERGOING PULMONARY LOBECTOMY THROUGH THORACOTOMY FOR BRONCHIECTASIS: A NARRATIVE REVIEW

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ABSTRACT **Background:** Pulmonary lobectomy remains an important surgical treatment for selected patients with localized bronchiectasis who have persistent symptoms, recurrent infections or complications despite optimal medical management. Open thoracotomy is associated with significant postoperative pain due to rib retraction, intercostal nerve injury, muscle division and pleural irritation. Effective postoperative analgesia is particularly important in bronchiectasis patients because adequate coughing, deep breathing and airway clearance are essential for preventing postoperative pulmonary complications.**Objective:** To review current evidence and available strategies for postoperative pain management following pulmonary lobectomy performed through open thoracotomy for bronchiectasis in adults.**Methods:** A narrative review of relevant literature addressing thoracotomy-related pain, regional anaesthesia, systemic analgesia, multimodal pain management and enhanced recovery after thoracic surgery was undertaken.**Discussion:** Thoracic epidural analgesia and thoracic paravertebral blockade are established regional analgesic techniques for open thoracotomy. Multimodal analgesia incorporating paracetamol, non-steroidal anti-inflammatory drugs (NSAIDs), regional anaesthesia and opioids for rescue analgesia provides effective pain relief while minimizing opioid-related adverse effects. Newer techniques, including erector spinae plane blocks and intercostal nerve blocks, offer additional options when conventional regional techniques are contraindicated or unavailable.**Conclusion:** Individualized multimodal analgesia is essential following pulmonary lobectomy for bronchiectasis. Effective pain control facilitates respiratory physiotherapy, airway clearance, early mobilization and recovery while potentially reducing postoperative pulmonary complications and chronic post-thoracotomy pain.

KEYWORDS : Bronchiectasis; Pulmonary Lobectomy; Thoracotomy; Postoperative Pain; Thoracic Epidural Analgesia; Paravertebral Block; Multimodal Analgesia.

INTRODUCTION

Bronchiectasis is a chronic respiratory disorder characterized by irreversible dilatation of the bronchi, recurrent respiratory infections and impaired mucociliary clearance. Although medical management, including antibiotics, bronchodilators and airway clearance techniques, remains the mainstay of treatment, surgical resection may be indicated in selected patients with localized disease, recurrent infections, significant haemoptysis or persistent symptoms despite optimal medical therapy.

Pulmonary lobectomy is one of the commonly performed surgical procedures in patients with localized bronchiectasis. Although minimally invasive approaches are increasingly used, open thoracotomy remains necessary in selected patients, particularly in the presence of dense pleural adhesions, chronic inflammation or complex hilar anatomy.

Thoracotomy is associated with considerable postoperative pain resulting from surgical incision, muscle division, rib spreading, intercostal nerve injury and chest tube placement. Unlike many other surgical procedures, thoracic surgery directly affects respiratory mechanics. Pain can cause splinting of the chest wall, reduced tidal volume, ineffective coughing and impaired clearance of bronchial secretions.

These consequences are particularly important in bronchiectasis patients, who frequently have pre-existing impaired mucociliary clearance and chronic airway colonization. Inadequate analgesia may increase the risk of atelectasis, retained secretions, pneumonia and respiratory failure.

Therefore, postoperative pain management following thoracotomy for bronchiectasis requires a comprehensive approach that provides adequate analgesia without compromising respiratory function.

PATHOPHYSIOLOGY OF POST-THORACOTOMY PAIN

Post-thoracotomy pain has several components, including somatic, visceral and neuropathic pain.

Somatic pain originates from the skin incision, muscles, ribs and intercostal structures. Rib spreading during thoracotomy may produce significant tissue trauma and compression or injury of the intercostal nerves.

Visceral pain results from manipulation of the pleura, lung parenchyma and hilar structures. Chest drains may further contribute to postoperative discomfort.

Neuropathic pain develops primarily due to intercostal nerve injury, producing burning sensations, paraesthesia, numbness or shooting pain along the thoracotomy incision.

Acute postoperative pain is clinically important because it may interfere with coughing, deep breathing, mobilization and respiratory physiotherapy.

Furthermore, inadequately controlled acute pain may contribute to central sensitization and the development of chronic post-thoracotomy pain syndrome. Chronic pain following thoracotomy has been reported in approximately 25–60% of patients, although incidence varies considerably between studies and assessment methods [1].

IMPORTANCE OF PAIN MANAGEMENT IN BRONCHIECTASIS PATIENTS

Effective postoperative analgesia has particular significance in patients undergoing lobectomy for bronchiectasis.

These patients may have chronic sputum production, recurrent respiratory infections, compromised pulmonary function and reduced respiratory reserve.

Following lobectomy, the remaining lung tissue must compensate for the reduction in functional lung volume. Adequate analgesia is essential to facilitate:

- Effective coughing and expectoration.
- Deep breathing and lung expansion.
- Early mobilization.
- Participation in chest physiotherapy.
- Prevention of atelectasis and retained secretions.
- Reduction in postoperative respiratory complications.

The management of pain should therefore aim not merely to reduce numerical pain scores but also to restore functional respiratory capacity.

REGIONAL ANALGESIC TECHNIQUES

Regional anaesthesia forms the cornerstone of postoperative pain management following open thoracotomy.

a) Thoracic Epidural Analgesia

Thoracic epidural analgesia has traditionally been considered the gold standard for pain relief following open thoracotomy. It involves the administration of local anaesthetics, commonly combined with opioids, into the thoracic epidural space through an indwelling catheter.

Commonly used combinations include bupivacaine or ropivacaine with fentanyl or other suitable opioids.

Advantages include:

- Effective analgesia at rest and during coughing.
- Improved chest wall comfort.
- Reduced systemic opioid requirements.
- Facilitation of deep breathing and respiratory physiotherapy.

However, epidural analgesia has certain limitations, including hypotension, urinary retention, motor blockade, pruritus and the possibility of inadequate or unilateral analgesia. Coagulation abnormalities, infection at the insertion site and certain anticoagulation therapies may contraindicate its use. Careful haemodynamic monitoring and assessment of anticoagulation status are essential.

b) Thoracic Paravertebral Block

Thoracic paravertebral blockade involves administration of local anaesthetic adjacent to the thoracic spinal nerves as they emerge from the intervertebral foramina. It may be performed as a single-injection technique or through a catheter for continuous infusion. Paravertebral analgesia provides unilateral segmental analgesia corresponding to the surgical site. Compared with thoracic epidural analgesia, it is associated with less sympathetic blockade and generally fewer episodes of hypotension, urinary retention and other minor complications.

A Cochrane systematic review demonstrated comparable analgesic efficacy between thoracic epidural and paravertebral blockade following thoracotomy, with a more favourable minor complication profile for paravertebral blockade [2].

Both techniques are valuable options, and selection should depend on patient characteristics, contraindications and institutional expertise.

c) Erector Spinae Plane Block

The erector spinae plane (ESP) block is a relatively newer regional analgesic technique. Local anaesthetic is deposited deep to the erector spinae muscle, adjacent to the transverse processes. It may be performed as a single-shot injection or continuous catheter technique.

Potential advantages include:

- Relatively straightforward ultrasound-guided administration.
- Reduced risk of haemodynamic instability.
- Potential coverage of multiple thoracic dermatomes.
- Utility when epidural or paravertebral techniques are unsuitable.

However, evidence supporting ESP block specifically for open thoracotomy remains less extensive than that for established techniques. It should be considered an alternative when thoracic epidural or paravertebral blockade is not feasible.

d) Intercostal Nerve Block

Intercostal nerve blockade involves local anaesthetic administration around the intercostal nerves supplying the surgical incision. It may be performed intraoperatively by the surgeon or anaesthesiologist. Although it provides effective localized analgesia, its duration may be limited when a single injection is used.

Continuous catheter techniques or repeated administration may provide prolonged analgesia in selected patients.

e) Other Regional Techniques

Other options include serratus anterior plane block and rhomboid intercostal block. These techniques may provide additional analgesic coverage of the lateral chest wall. Their role in open thoracotomy is evolving, and they are generally considered alternatives when established first-line techniques cannot be performed.

SYSTEMIC MULTIMODAL ANALGESIA

Multimodal analgesia combines medications with different mechanisms of action to achieve adequate pain relief while reducing the adverse effects associated with individual drugs.

a) Paracetamol

Paracetamol is an important component of postoperative analgesia. It may be administered orally or intravenously, depending on the patient's clinical condition. Regular administration provides baseline analgesia and reduces opioid requirements.

It is generally well tolerated, although dose adjustment is necessary in patients with significant hepatic impairment or other risk factors for toxicity.

b) Non-Steroidal Anti-Inflammatory Drugs

NSAIDs, including ibuprofen, diclofenac and other suitable agents, reduce inflammatory pain through inhibition of cyclooxygenase enzymes. They provide useful additional analgesia when combined with paracetamol and regional techniques.

However, renal function, bleeding risk, gastrointestinal complications and individual contraindications should be considered before administration. COX-2-selective inhibitors may be considered in suitable patients.

c) Opioids

Opioids remain useful for the management of moderate-to-severe postoperative pain. Morphine, fentanyl and tramadol may be used according to institutional protocols and patient requirements. Patient-controlled analgesia (PCA) is an effective method of opioid administration in selected patients.

However, opioids should preferably be reserved for breakthrough or rescue analgesia within a multimodal regimen. Excessive opioid administration may produce respiratory depression, sedation, nausea, vomiting and impaired cough. These adverse effects are particularly undesirable in bronchiectasis patients because effective respiratory clearance is essential for postoperative recovery.

d) Adjunctive Analgesic Agents

Gabapentinoids, ketamine and other adjuvant drugs have been investigated for postoperative thoracic pain. Gabapentin and pregabalin may have a role in selected patients with neuropathic pain, although routine perioperative use is limited by uncertain benefit and potential sedation or respiratory adverse effects.

Low-dose ketamine may be considered in selected patients with severe pain or high opioid requirements under appropriate monitoring. The routine use of these agents should be individualized rather than considered mandatory.

ENHANCED RECOVERY AFTER THORACIC SURGERY

Enhanced Recovery After Surgery (ERAS) protocols emphasize coordinated perioperative care to improve surgical outcomes and reduce complications.

The ERAS Society and European Society of Thoracic Surgeons recommend multimodal analgesia as an important component of enhanced recovery following lung surgery [3].

In patients undergoing lobectomy for bronchiectasis, an enhanced recovery approach should include:

1. Preoperative assessment of respiratory function, comorbidities and existing analgesic requirements.
2. Selection of an appropriate regional analgesic technique.
3. Regular administration of paracetamol and NSAIDs when appropriate.
4. Restriction of systemic opioids to rescue analgesia.
5. Early postoperative extubation when clinically appropriate.
6. Early mobilization and respiratory physiotherapy.
7. Effective airway clearance and sputum management.
8. Regular assessment of pain at rest and during coughing.

Pain assessment should ideally include validated numerical rating scales, together with evaluation of functional recovery.

The ability to cough effectively, take deep breaths and participate in physiotherapy should be considered important indicators of successful analgesia.

PREVENTION OF CHRONIC POST-THORACOTOMY PAIN

Chronic post-thoracotomy pain remains an important complication following open thoracic surgery. It may persist for months after surgery and can interfere with sleep, physical activity and quality of life. Intercostal nerve injury is considered one of the major contributing mechanisms [4]. Prevention should begin during the perioperative period.

Strategies include:

- Appropriate selection of regional analgesic techniques.
- Adequate control of acute postoperative pain.
- Minimization of unnecessary intercostal nerve trauma.
- Regular reassessment of analgesic requirements.
- Early identification of neuropathic pain symptoms.
- Appropriate follow-up after hospital discharge.

Patients with persistent burning, shooting or neuropathic pain may require specialist pain assessment and individualized treatment.

RECOMMENDED APPROACH TO POSTOPERATIVE PAIN MANAGEMENT

Based on the available thoracic surgery literature, a practical multimodal approach following open lobectomy for bronchiectasis may include:

Preoperative period: Assessment of pulmonary function, comorbidities, renal function, coagulation profile and analgesic requirements. Patient education regarding postoperative pain management and respiratory physiotherapy.

Intraoperative period: Thoracic epidural analgesia or thoracic paravertebral catheter placement, depending on patient suitability and institutional expertise. Regular paracetamol and an NSAID or COX-2-selective inhibitor may be administered when appropriate.

Immediate postoperative period: Continuation of regional analgesia with regular systemic non-opioid analgesics. Opioids should be available for rescue analgesia.

Subsequent postoperative period: Regular pain assessment, adjustment of analgesic medication, early mobilization, deep breathing exercises and effective airway clearance.

Follow-up: Assessment for persistent pain, neuropathic symptoms and functional limitations.

The 2026 updated PROSPECT recommendations for open thoracotomy support either thoracic epidural analgesia or paravertebral blockade as first-line regional techniques, together with basic systemic analgesia [5].

DISCUSSION

Postoperative pain management following pulmonary lobectomy for bronchiectasis presents specific challenges because the consequences of inadequate analgesia extend beyond patient discomfort.

In these patients, pain can compromise respiratory mechanics and interfere with the clearance of infected bronchial secretions.

Although much of the available evidence is derived from thoracotomy performed for lung malignancies and other thoracic conditions, the principles of chest wall analgesia are applicable to open lobectomy for bronchiectasis.

Thoracic epidural analgesia and paravertebral blockade remain the most established regional techniques. The choice between them should be individualized according to clinical circumstances and expertise.

Newer regional techniques, particularly ESP block, offer additional possibilities, although further comparative studies are required to establish their effectiveness in open thoracotomy.

An important limitation of the existing literature is the lack of randomized controlled trials specifically evaluating postoperative analgesic strategies in adults undergoing lobectomy for bronchiectasis.

Future research should investigate the relationship between different analgesic techniques and clinically relevant outcomes, including pain during coughing, opioid consumption, pulmonary complications, duration of hospitalization, chronic pain and quality of life.

CONCLUSION

Effective postoperative pain management is a fundamental component of successful recovery following pulmonary lobectomy through open thoracotomy for bronchiectasis.

A multimodal analgesic strategy combining regional anaesthesia, non-opioid systemic medications and rescue opioids provides an effective approach to postoperative pain control.

Thoracic epidural analgesia and paravertebral blockade remain the preferred regional techniques, while ESP and intercostal nerve blocks provide alternatives in selected patients.

In bronchiectasis patients, adequate analgesia is particularly important for maintaining effective coughing, airway clearance, respiratory physiotherapy and early mobilization.

An individualized, multidisciplinary approach involving anaesthesiologists, thoracic surgeons, pulmonologists and physiotherapists is therefore essential to optimize postoperative outcomes and improve patient recovery.

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