



## Intercostal nerve protection to prevent post-thoracotomy pain

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Posterolateral thoracotomy is a commonly used surgical approach to access thoracic structures for non-cardiac surgery. This incision involves transection of major muscles and retraction of ribs against resistance. In spite of “effective” postoperative analgesic measures including epidural analgesia or patient controlled analgesia, many patients have considerable acute and chronic postoperative pain which may lead to increased post-operative complications, especially pulmonary complications, increased consumption of analgesics, prolonged hospital stay and delayed functional recovery (1). Several factors such as presence of pre-operative pain, psychological factors, intra- and post-operative pain management techniques and surgical approach have been postulated to contribute to the development of post-thoracotomy pain (1,2). Of these, since surgical approach is most amenable to manipulation, it has been the subject of considerable research on this topic. Studies comparing muscle-sparing with muscle-cutting incisions, rib resection versus rib-preserving approaches and minimally invasive (video-assisted thoracoscopic) surgery versus open thoracotomy have found no conclusive evidence to implicate any of these interventions as being pivotal in decreasing post-thoracotomy pain (1).

Since chronic post-thoracotomy has significant neuropathic components, the etiological role of intercostal nerve injury cannot be ignored (2). It is therefore logical that current research towards reducing post-thoracotomy pain is focused on methods to prevent damage to the intercostal neurovascular bundle during surgery.

During a standard thoracotomy, the intercostal nerves may be damaged at several time points: during rib spreading (especially to the nerve running along the inferior border of the upper rib of the interspace), direct trauma during surgery to the neurovascular bundle and during rib approximation (to the nerve running along the inferior border of the lower rib of the interspace). Techniques devised to protect the intercostal nerve from damage include the use of intercostal muscle flaps and intracostal sutures (3,4).

The focus of prior research on post-thoracotomy pain has been to decrease or prevent intercostal nerve injury. Cerfolio adopted the intracostal technique for thoracotomy closure and found decreased pain when compared to standard pericostal method of closure (4). Bayram, in a similar study, also found decreased acute pain and analgesic consumption but failed to study the effect on chronic pain (5) Cerfolio, in two randomized studies, showed that harvesting the intercostal muscle flap decreased the chances of injuring the intercostal nerve; however, these studies had some limitations—unblinded assessors and lack of intention-to-treat analysis (4,6). Wu and Allama attempted to combine these nerve preservation techniques and found no impact on pain in the long term (7,8). There was some benefit in the acute pain scores but multiple comparisons could have produced false positive results. Many of these studies did not blind subjects and/or assessors while evaluating pain. Since pain is a subjective and patient-reported outcome with high inter-individual variations, the assessment of pain remains complex and prone to bias if subjects and assessors

are not blinded.

We hypothesized that the incidence of chronic post-thoracotomy pain could be reduced by limiting intraoperative intercostal nerve damage by combining two steps—harvesting an intercostal muscle flap to avoid retraction injury intraoperatively and by avoiding pressure on the lower intercostal nerve during closure by using intracostal sutures—as compared to standard rib retraction and rib approximation with pericostal sutures. Therefore, we conducted a patient and assessor-blinded parallel-group randomized study where 90 patients undergoing posterolateral thoracotomy were randomized to either standard group (where patients underwent conventional muscle-cutting thoracotomy and rib spreading with pericostal closure at the end of the procedure) or nerve-sparing group (where an intercostal muscle flap was dissected during incision and rib approximation was done using intracostal sutures) (9). The primary outcome of this study was to evaluate acute post-operative pain. Secondary outcomes included comparison of the incidence of chronic post-thoracotomy pain and the need for analgesics in the post-operative period. We found no difference for any of the outcomes between the standard and nerve sparing thoracotomy groups. The worst and average pain scores were similar in both groups, with 84% of the patients in both groups experiencing maximum pain on the first post-operative day. More than 40% patients in both the groups had chronic pain. This probably suggests that the etiology of post-thoracotomy pain is multi-factorial and preservation of the neurovascular bundle alone may not be adequate to prevent or reduce post-thoracotomy pain. A best-evidence topic paper by Visagan *et al.* reviewed all the available literature on the philosophy of sparing the intercostal nerve and concluded that some form of protection should be offered to the nerve during thoracotomy incision and closure (10). Future research on this topic should focus on a multi-modal approach incorporating pre-, intra- and post-operative factors for the prevention and management of post-thoracotomy pain.

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### Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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