Editorial

Expanding clinicians' armamentarium for regional pain control after thoracic surgery

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Significant post-operative pain is a major issue in thoracic surgery patients. As the most common symptom after thoracic surgery, uncontrolled pain can have myriad negative sequelae, from reduced pulmonary function, poor mobilization and increased length of stay to elevated risk of developing chronic pain and new opioid dependence (1,2). Regional anesthesia is a cornerstone of multimodal analgesia in thoracic surgery and it is important for the surgeon, as well as the anesthesiologist, to be intimately familiar with the available options. Optimal regional anesthesia modality is highly-debated. Epidural anesthesia has been the paradigm for many years but guidelines are evolving; the European Society for Regional Anesthesia (ESRA)'s guidelines now recommend against epidural anesthesia for video-assisted thoracoscopic surgery (VATS), instead recommending paravertebral or erector spinae plane blocks (3). After considering patient factors and contraindications, regional anesthesia choice is highly operator and institution-dependent, resulting in a wide variety of training patterns and attendant inexperience with the breadth of available options (4). Sertcakacilar *et al.* provide us with an excellent narrative review of the available regional anesthesia options for thoracic surgery, necessarily expanding the clinician's post-operative pain control armamentarium (5).

In their narrative review, Sertcakacilar *et al.* perform a broad literature review and summarize current regional anesthesia modalities, covering thoracic epidural anesthesia (TEA), thoracic paravertebral block (TPVB), intercostal nerve block (ICNB), and fascial plane blocks, including erector spinae plane block (ESPB), serratus, pecto-intercostal, pectoral nerve, and parasternal blocks. They specifically include placement techniques with key anatomic considerations, clinical indications and contraindications, and a limited discussion of the advantages and disadvantages of each modality. The authors provide a fair and balanced overview of each modality without evidence of bias, largely confining their discussion of advantages and disadvantages of each modality to published results of randomized trials and meta-analyses. Their review is distinguished by an exceptionally detailed review of thoracic innervation and accompanying images of external landmarks and ultrasound-guided block placement. After reviewing the literature, the authors ultimately conclude that further studies are needed that evaluate the comparative effectiveness of newer block techniques, such as ICNB and fascial plane blocks, with more traditional methods, such as TEA and TPVB.

As a narrative review, their work necessarily lacks a clear hypothesis, the ability to answer specific questions, and a systematic assessment of study quality with risk of

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bias. Sertcakacilar *et al.* touch on the divide between meta-analysis and narrative review, and their neutrality is both an advantage and a disadvantage. While they provide a broad, impartial perspective on the subject of thoracic regional anesthesia, their main shortcoming is the paucity of interpretation and critique with the occasional failure to report major study findings. For example, even though they cite Yeung *et al.*'s Cochrane review, they do not describe the study's results: TPVB offers comparable analgesia to TEA with fewer complications (6). Pivotal study results, such as those leading ESRA to recommend TPVB over TEA, should be emphasized. Similarly, despite a comprehensive reference list, they often do not use their references effectively to answer fundamental questions: (I) Does the modality successfully control post-operative pain? (II) Is the pain control superior to standard of care? And (III) Who should get this block and when? (i.e., indications, contraindications, advantages, and disadvantages). Readers would benefit from a more robust qualitative assessment to help guide choice of regional anesthesia. In instances where data is lacking, their review could be reinforced by explicit mention of their own experience. By combining their own experience with more thoughtful interpretation of study results, they could help their audience form a more nuanced understanding of each modality's comparative advantages and disadvantages. Beyond patient-specific contraindications, important limitations of regional anesthesia include hypotension, catheter failure rate, and risk of complications directly related to the catheter and its placement. Hypotension is particularly relevant in thoracic patients who are maintained relatively hypovolemic with more cephalad epidurals. Hypotension can limit ambulation, prolong length of stay and result in analgesic failure requiring epidural removal or reduction of anesthetic level to non-therapeutic ranges. Their review would benefit from further discussion of the comparative advantages of each block on blood pressure, experiential or data-driven. Similarly, although the authors mention the potential for catheters to malfunction or become displaced, noting a 30% failure rate for TEA, they do not clarify how this risk varies between regional anesthesia modalities. Finally, regarding catheter-related complications, although Sertcakacilar *et al.* note the potential for infection and hematoma with several modalities, they fail to highlight that most recent meta-analyses find low infection rates and hematomas regardless of modality with no evidence of increased risk for TEA (4,7). In avoiding experiential recommendations and failing to emphasize seminal results, their narrative review may leave readers more uncertain about optimal use of less traditional blocks.

There are numerous observational and smaller randomized control trials studies comparing regional anesthesia modalities in thoracic surgery. In this setting, meta-analyses may be most informative. Three recent meta-analyses address comparative advantages of regional anesthesia modalities. Most recently, Spaans *et al.* performed a meta-analysis of regional pain control modalities in thoracoscopic surgery [video (VATS) or robotic-assisted (RATS)], specifically comparing mean pain scores at 24, 48 and 72 hours for four distinct groups: TEA, continuous unilateral infusion of locoregional analgesia, single-shot locoregional analgesia and systemic analgesia alone (7). All study types were included and the comparator group for the included studies was not defined. Although at face value their analysis appears to show that unilateral locoregional techniques have comparable pain control to TEA (albeit with increased rescue analgesia), shorter lengths of stay and less post-operative nausea and vomiting, they ultimately conclude there is excessive study heterogeneity to draw conclusions. Sandeep *et al.* similarly evaluate pain control between modalities for VATs, but narrow their inclusion criteria to randomized controlled trials in which two or more types of regional anesthesia are compared, resulting in limited study overlap between Spaans' and Sandeep's analyses (1). Only 6 of the 38 analyzed studies included TEA as one of the comparator groups with comparison predominantly between TEA and TPVB. In their study, TEA did not provide superior pain control. However, when TPVB, ICNB, and ESPB were compared, morphine consumption and pain scores at 24 and 48 hours were lowest for TPVB, followed by ICNB, and then ESPB. Finally, Guerra-Londono *et al.* performed a meta-analysis comparing ICNB to other regional anesthetic modalities in cardiothoracic surgery patients, finding ICNB to be clinically non-inferior to TEA or TPVB with regards to pain reduction in the first 24 hours (8). ICNB became clinically inferior to TPVB, but not TEA, at 48 hours. Furthermore, ICNB had opioid-sparing effects but TEA and TPVB were associated with larger decreases in opioid requirements. TPVB and ICNB were associated with lower rates of hypotension. These meta-analyses indicate that TEA should not always be the gold-standard compared to other regional techniques. Other modalities warrant consideration as first-line for post-thoracic surgery analgesia. Furthermore, even though ESRA propounds TPVB and ESPB for regional analgesia after VATS, these results suggest ICNB should be included as well.

For patients undergoing thoracic surgery, ICNB is unique because it is usually placed intra-operatively by the surgeon, rather than pre-operatively by the anesthesia team. In 2002, a randomized controlled trial found ICNB was more effective than TEA at controlling post-thoracic surgery pain in the first 24 hours, after which TEA became more effective (9). However, in this study, plain local anesthetic was used. With the advent of less-invasive thoracic surgery (VATS and RATS), as well as liposomal bupivacaine, there has been increased interest in whether ICNB with liposomal bupivacaine might be the optimal post-VATS or RATS pain control strategy. In addition to decreased post-operative hypotension and increased safety profile in coagulopathic patients, ICNB with liposomal bupivacaine is less resource-intensive; it does not require anesthesiologist placement or monitoring throughout the hospital stay. The price of liposomal bupivacaine is noteworthy, but there are likely net cost-savings when considering the cost of human resources and delayed operation starts.

To our knowledge, there are not any randomized controlled trials directly comparing ICNB using liposomal bupivacaine to TEA or TPVB for thoracic surgery patients. Retrospective analyses suggest that a direct comparison is warranted in thoracic surgery patients. Sheets *et al.* found that traumatic rib fracture patients receiving ICNB with liposomal bupivacaine were intubated less frequently and had shorter intensive care unit and overall hospital stays than patients with TEA (10). Similarly, a randomized controlled trial demonstrated that a single liposomal bupivacaine block provided comparable pain control to an indwelling peripheral analgesic catheter placed in a similar space for patients undergoing surgical stabilization of rib fractures (11). Another large retrospective analysis of patients undergoing abdominal surgery discovered that patients who received liposomal bupivacaine blocks had shorter lengths of stay, lower rates of readmission and lower rates of post-surgical hypotension and vasopressor use than those who received epidural analgesia (12). Given these promising results, a direct comparison between ICNB with liposomal bupivacaine and standard of care (TEA or TPVB) among thoracic surgery patients is needed. Even non-inferiority pain control results could revolutionize post-operative analgesic strategies given the significant complications associated with TEA and the time-costs associated with placing and maintaining epidurals and other regional blocks.

In our institution, we use ICNB with liposomal bupivacaine as the first-line regional anesthesia modality for VATS and RATS patients. In our experience, ICNB with liposomal bupivacaine provides adequate analgesia in this surgical group, reduces length of stay and avoids neuraxial anesthesia-related hypotension (13,14). However, for open cases, our approach to post-operative pain control is more traditional. For thoracotomy patients, we typically use TEA and reserve TPVB or ESPB for patients with contraindications. As previously stated, these practice patterns are based on our system's collective experiences and preferences.

In summary, the placement of all regional anesthesia modalities can be highly institution and operator-dependent with variable outcomes, and there is generally greater familiarity with more traditional modalities, such as TEA. Sertcakacilar *et al.* provide their readers with the necessary information to familiarize themselves with more novel modalities, including a multitude of fascial plane blocks. We concur that further studies to delineate comparative advantages, particularly for ICNB with liposomal bupivacaine versus TEA or TPVB, would be ideal. Greater clinician-driven study and understanding of regional anesthesia modalities will only further enhance patient-centered care and outcomes.

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