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Analgesia for thoracic surgery: the role of paravertebral block

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ABSTRACT

An appropriate post operative analgesia after thoracotomies is mandatory to improve the patient's outcome, reduce complications rate, morbidity, hospital cost and length of stay. In this paper we review the evidences regarding the use of paravertebral block for thoracic surgery.
In particular we examine the effect of paravertebral block compared to the other technique in four major issues: analgesia, complications rate, postoperative pulmonary function and transition from acute to chronic pain.
We conclude that paravertebral block is superior to intravenous analgesia in providing pain control and preserving postoperative pulmonary function while it is equal to thoracic epidural analgesia regarding this two issues. Paravertebral block has a better safety profile when compared to intravenous and thoracic epidural analgesia. Its effect on chronic pain incidence still needs further studies.

Keywords: *paravertebral block, postoperative analgesia, epidural analgesia, thoracic surgery, postoperative complications.*

Post-operative pain control is one of the major concerns in the post-operative care of patients undergoing thoracic surgery, especially when thoracotomy is required.
The pain associated with thoracotomy surgery can be severe involving multiple nerves emanating from various sources in the chest wall.
Indeed, the intercostal nerves are paramount in the conduction of these pain stimuli arising from skin and muscles incision as well as from ribs spread. The vagus and phrenic nerves also conduct pain stimuli originating in the mediastinal and diaphragmatic pleura, whereas in the generation of shoulder pain there is no precise localization of pain pathways, although involvement of the brachial plexus has been theorized. Intercostal nerves are also important for the transition from acute to chronic pain as they suffer by long time extrinsic compression by surgical instruments and often they get embedded into post surgical scars, these insults often cause a change in the pain from nociceptive to neurogenic and neurophatic.
A modern approach to pain control should consider the reduction or elimination of pain and suffering together with the consideration that reduced morbidity, length of stay and hospital costs markedly improve when pain management is successful (1-6).
Paravertebral block (PVB) is an old technique, first described in 1905 as an alternative to neuraxial block for obstetric procedures.
It is safe and effective in treating acute and chronic pain especially of unilateral origin from the chest and abdomen. It has been

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used in a variety of settings, including various types of surgery, trauma and chronic pain (1, 2, 4, 6-8).

In thoracic surgery PVB is placed at the level of the surgical thoracic incision, thus in most of the cases it is a unilateral block. The injection of local anesthetic (LA) in the paravertebral space produces analgesia because of direct contact of LA with the spinal nerve roots before they emerge from the intervertebral foramina. A small amount of LA spreads into the epidural space, thus a single injection usually has effects on multiple metamers (9-12).

Two techniques have been described to perform the block: with the "loss of resistance technique" the administration of the anesthetic occurs after the needle walks off the transverse process of the vertebra until the loss of resistance sensation is felt indicating the paravertebral space; with the "pre determined distance technique" the needle walks off the transverse process for 1-2 cm depending on the patient and the drug is easily injected into the paravertebral space. An injection can be performed for each metamers interested by the surgical incision or one or two punctures with a greater volume of solution can be performed by using the spread of the anesthetics over the metamers. Also, placement of a catheter in the paravertebral space facilitates continuous infusion of LA throughout the postoperative period, thus optimizing perioperative pain control. The catheter can be placed by the anesthesiologist in a blind manner and checked by the surgeon during the operation or placed by the surgeon under direct vision (this is the preferred technique in the institution of the first author). Bupivacaine, levobupivacaine or ropivacaine can be used as LA for PVB no one of them has the evidence to be superior over the others. For a classic thoracotomy in the institution of the first author (Forlì- Italy) we use Ropivacaine 0.375-0.5% for the 2 punctures performed at T3-T7 level and 0.2% for postoperative continuous infusion.

It is difficult to gauge the true complication rate; known complications from this block include vascular puncture, skin hematoma, pain at the site of injection (3.8%), and pleural puncture or lung penetration (1.1%-0.5%) (12-15). Thoracic PVB (TPVB) for thoracic surgery has been compared to other neuraxial/analgesic techniques, such as thoracic epidural analgesia (TEA) in terms of its effectiveness for postoperative pain control, incidence of postoperative respiratory function, complication rate and incidence of chronic pain.

TPVB provides better postoperative analgesia when compared to intercostal nerve blocks, intrapleural analgesia, spinal analgesia with opiates and intravenous (i.v.) opioid-based analgesia. This results in reduced postoperative pain and opioid requirement. Evidence for better pain control compared to TEA is controversial. Despite some reports demonstrating advantages of TVPB over TEA (5,16), the preponderance of the evidence shows equal clinical effectiveness between the two techniques (1-4, 6, 7, 12). Nevertheless it must be mentioned that most of the trials evaluating analgesia after thoracic surgery did not report data on the rate of satisfactory analgesia after 72 hours. It should be pointed out that best medical practice, resulting in the highest quality analgesia, aims to alleviate both surgical and non-surgical pain in a multimodal approach. In addition, other factors must be taken into account when comparing regional anesthesia techniques for thoracic surgery and the impact of thoracotomy and general anesthesia on postoperative pulmonary function: anesthesia-related (mechanical ventilation resulting in high airway pressures, alveolar collapse and recruitment, consequences of one lung ventilation on right heart function and pulmonary vessels); surgical-related (handling of lung parenchyma and chest

wall muscle retraction and resection); pain-related (abdominal muscle contraction, diaphragmatic block); mixed etiology-related (fluid shift, lung stiffness, cytokine release). All of the above exert a restrictive pattern on pulmonary function with a decreased vital capacity and functional residual capacity. The risk of pulmonary complications may be reduced by adequate analgesia sufficient to allow pain free deep breathing, coughing and clearing of airway secretions. Although several reports show less reduction of preoperative peak expiratory flow rate and forced expiratory volume in 1 second following thoracic surgery performed with TPVB compared to TEA, most of the meta-analyses done so far conclude that there is equal effectiveness (1, 2, 6, 12, 16-19). When performing a loco-regional anesthesia technique, patient safety is the primary outcome that every anesthesiologist should consider. TPVB carries some specific potential side effects, not present with other techniques, that make comparisons difficult to assess.

The failure rate of this technique has been reported to be between 6 and 10%, equal to TEA. The incidence of hypotension, urinary retention, itching, nausea and vomiting (7-17%) is lower than with i.v. analgesia or TEA. Other adverse events ascribed to TPVB for thoracic surgery include: pneumothorax (0.5%), pleural puncture (0.8%), and vascular puncture (4-6.8%). Ultrasound-guided TPVB has the potential to improve clinical efficacy while reducing the failure and iatrogenic complications rate via real-time visualization of the paravertebral space and neuraxial structures.

The inadvertent puncture of a major vessel is perhaps the most difficult TPVB related complication to manage. However, there might be over-reporting of the severity of this complication since the paravertebral space is highly vascularized and in the majority of cases the puncture involves capillary vessels (1, 4, 7, 10, 12-16). Damage of an intercostal artery or pulmonary hemorrhage seem to have a low incidence and, in the institution of the first author (Forlì-Italy), there was only one case of intercostal artery damage in more than 500 TPVB procedures performed over a 4 years period (14).

Since the severity of acute postoperative pain is also a predictor of long-term pain after thoracotomy, early and aggressive treatment of pain may help to reduce the currently high frequency of the post thoracotomy pain syndrome.

The intra and postoperative infusion of LA into the thoracic paravertebral and epidural space reduces the incidence of persistent or chronic pain in various settings, however there is still not a definitive conclusion on which technique results in better outcome (3, 5-7, 20).

There are multiple mechanisms involved in the transition from acute to chronic pain after thoracic surgery and the role of inflammatory response to noxious stimuli is of increasing interest. A Danish review on thoracic surgery for lung transplantation demonstrated that the rate of chronic pain following thoracotomy in this setting is significantly lower than thoracotomies in other settings. This may be ascribed to the reduced inflammatory response resulting from the immunosuppressive therapy (21).

Finally, TPVB is primarily used as single shot injection but can also be used with catheter techniques as previously described. A potential limitation related to the paravertebral catheter is that a variable amount of LA may spread into the epidural space depending on the position of the catheter tip and therefore the metameric extent of TPVB block could be difficult to predict.

The catheter can easily be displaced from the "small" paravertebral space during passive transfer and/or active mobilization of the patient if not properly managed. In

unilateral thoracic surgeries paravertebral block is placed to provide analgesia/anesthesia on one side, but could also be placed bilaterally for non-thoracic procedures such as prostatectomy. When used unilaterally, it results in less sympathectomy and consequently much less hemodynamic side effects when compared to TEA. There is also no motor block and no impact on bladder or bowel function. Regarding anticoagulation and the risk of epidural hematoma, there are no clear guidelines. Some centers are not concerned at all and do not apply ASRA (American Society of Regional Anesthesia and Pain Medicine) neuraxial guidelines when placing paravertebral blocks, others are more concerned.

In the institution of the second author (Miami-USA), they have decided that any block in close proximity to the spine can theoretically result in an epidural/spinal hematoma. Consequently, they uniformly apply ASRA guidelines to these blocks.

In conclusion, recent evidence suggests that in patients undergoing thoracic surgery TPVB has a similar pain relief and a superior safety profile when compared to TEA. A multimodal approach with i.v. oipioids infusion is recommended. Its use in chronic pain after thoracic surgery still needs to be evaluated.

REFERENCES

1. Wenk M, Schug SA. Perioperative pain management after thoracotomy. Curr Opin Anaesthesiol. 2011; 24: 8-12.
2. Gottschalk A, Cohen SP, Yang S, Ochroch EA. Preventing and treating pain after thoracic surgery. Anesthesiology. 2006; 104: 594-600.
3. Richardson J, Lonnqvist PA, Naja Z. Bilateral thoracic paravertebral block: potential and practice. Br J Anaesth. 2011; 106: 164-71.
4. Richardson J, Lonnqvist PA. Thoracic paravertebral block. Br J Anaesth. 1998; 81: 230-8.
5. Thavaneswaran P, Rudkin GE, Cooter RD, et al. Brief reports: paravertebral block for anesthesia: a systematic review. Anesth Analg. 2010; 110: 1740-4.
6. De Cosmo G, Aceto P, Gualtieri E, Congedo E. Analgesia in thoracic surgery: review. Minerva Anestesiol. 2009; 75: 393-400.
7. Davies RG, Myles PS, Graham JM. A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy--a systematic review and meta-analysis of randomized trials. Br J Anaesth. 2006; 96: 418-26.
8. Agnoletti V, Piraccini E, Ansaloni L, et al. Regional anesthesia in a developing country: an uncommon use of paravertebral block. Minerva Anestesiol. 2011; 77: 474-5.
9. Agnoletti V, Piraccini E, Corso R, et al. Methylene blue diffusion after multilevel thoracic paravertebral blocks. J Cardiothorac Vasc Anesth. 2011; 25: 5-6.
10. Daly DJ, Myles PS. Update on the role of paravertebral blocks for thoracic surgery: are they worth it? Curr Opin Anaesthesiol. 2009; 22: 38-43.
11. Vila H Jr, Liu J, Kavasmaneck D. Paravertebral block: new benefits from an old procedure. Curr Opin Anaesthesiol. 2007; 20: 316-8.
12. Joshi GP, Bonnet F, Shah R, et al. A systematic review of randomized trials evaluating regional techniques for postthoracotomy analgesia. Anesth Analg. 2008; 107: 1026-40.
13. Thomas PW, Sanders DJ, Berrisford RG. Pulmonary haemorrhage after percutaneous paravertebral block. Br J Anaesth. 1999; 83: 668-9.
14. Agnoletti V, Piraccini E, Tonini S, et al. Case 5-2010. Paravertebral blockade for cardiothoracic surgery. J Cardiothorac Vasc Anesth. 2010; 24: 867-74.
15. Naja Z, Lonnqvist PA. Somatic paravertebral nerve blockade. Incidence of failed block and complications. Anaesthesia. 2001; 56: 1184-8.
16. Scarci M, Joshi A, Attia R. In patients undergoing thoracic surgery is paravertebral block as effective as epidural analgesia for pain management? Interact Cardiovasc Thorac Surg. 2010; 10: 92-6.
17. Groeben H. Epidural anesthesia and pulmonary function. J Anesth. 2006; 2: 290-9.
18. Vogt A, Stieger DS, Theurillat C, Curatolo M. Single-injection thoracic paravertebral block for postoperative pain treatment after thoracoscopic surgery. Br J Anaesth. 2005; 95: 816-21.
19. Messina M, Boroli F, Landoni G, et al. A comparison of epidural vs. paravertebral blockade in thoracic surgery. Minerva Anestesiol. 2009; 75: 616-21.
20. Kairaluoma PM, Bachmann MS, Rosenberg PH, Pere PJ. Preincisional paravertebral block reduces the prevalence of chronic pain after breast surgery. Anesth Analg. 2006; 103: 703-8.
21. Wildgaard K, Iversen M, Kehlet H. Chronic pain after lung transplantation: a nationwide study. Clin J Pain 2010: 26; 217-22.

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