International Journal of Medical Research Professionals
P-ISSN: 2454-6356; E-ISSN: 2454-6364
DOI: 10.21276/ijmrp

IJMRP

Review Article

Post-Operative Pain Control for Paravertebral Block in Minimal Invasive Cardiac Surgeries

Sultan Ghazzay Alotaibi[1*], Rawaa Mahmoud Sulaiman[2], Muneeb Ammar Alnouri[3], Ahmed Khalid Bawazer[4]

[1]Cardiac Anesthesia Fellow, Anesthesiology Department, King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia.
[2]Palliative Medicine Fellow, Princess Norah Oncology Center/Palliative Care Service, King Abdulaziz Medical City, National Guard Health Affairs, King Abdulaziz Medical City, Jeddah, Saudi Arabia.
[3]Cardiac Anesthesia Fellow, King Khalid Cardiac Center/ Cardiac Anesthesiology Section, King Abdulaziz Medical City, National Guard Health Affairs, Jeddah, Saudi Arabia.
[4]Cardiac Anesthesia Fellow, Cardiac Anesthesiology Department, King Abdullah Medical City, Makkah, Saudi Arabia.

ABSTRACT

The scope of minimal invasive cardiac surgeries is broad and includes surgery for coronary revascularization, valve repair and replacement, removal of atrial masses, repair of atrial septal defects (ASDs), and atrial fibrillation (AF) ablation procedures. Paravertebral Block (PVB) involve injection of local anaesthetic in a space immediately lateral to where the spinal nerves emerge from the intervertebral foramina. This technique is being used increasingly for not only intra-operative and post-operative analgesia but also as a sole anaesthetic technique for carrying out various procedures. The objective of the present review was to assess post-operative pain control for paravertebral block in minimal invasive cardiac surgeries.

Keywords: Post-Operative, Pain Control, Paravertebral Block.

***Correspondence to:**
Dr. Sultan Ghazzay Alotaibi,
Cardiac Anesthesia Fellow,
Anesthesiology Department,
King Faisal Specialist Hospital and Research Center,
Jeddah, Saudi Arabia.

Article History:

Received: 10-12-2020, Revised: 29-12-2020, Accepted: 27-01-2021

Access this article online	
Website: www.ijmrp.com	Quick Response code
DOI: 10.21276/ijmrp.2021.7.1.001	

INTRODUCTION

The American Heart Association defines Minimally Invasive Cardiac Surgery (MICS) as cardiac surgery performed through a small chest wall incision that does not include a full sternotomy.[1] Minimally invasive cardiac surgery (MICS) is a surgical procedure with alternate minimal access incisions, on-pump beating heart techniques, off-pump valve repair devices, robotics, and/or transcatheter devices.[2] MICS is used in various cardiac surgeries, such as mitral valve repair (MVR), aortic valve repair (AVR), and minimally invasive direct coronary artery bypass (MIDCAB). MICS is expected to reduce surgical bleeding, duration of intubation, intensive care unit (ICU) stay and perioperative mortality.[2-4] Pain is one of the major concerns of any surgical patient entering in the intensive care unit (ICU). In cardiac surgical patients, pain seems to be higher on the first two days which is the usual length of stay at the cardiac ICU.[5] Paravertebral block (PVB) is a popular analgesic technique that has been proven successful for postoperative pain management in different surgical procedures, such as thoracotomies,[6,7] abdominal herniorrhaphy,[8] and lithotripsy,[9] with no opioid-related side-effects. PVB is a regional anaesthetic technique involving the injection of anaesthetic agents into the paravertebral space of the spine, specifically the space adjacent to the vertebrae anterior to the transverse process, posterior to the parietal pleura, medial to the intercostal space and lateral to the vertebral body and intervertebral foramen[10], and is an anaesthetic technique that is also used for analgesia following a wide range of surgeries, including cardiothoracic surgeries[11]. The continuous PVB is used when longer pain relief is required than that conferred by the single-injection PVB[12]. The positioning of the catheter in the continuous PVB is reported to be comparatively simple and can be done under direct vision.[13]

PRINCIPLES OF MICS

The surgical approach varies depending on the procedure. The majority require a thoracotomy, with or without single-lung

ventilation (SLV) and may involve positions other than strictly supine. This surgical access may require a more tailored analgesic technique to minimize postoperative pain. Without a sternotomy, direct visualization of the heart and the great vessels may not be possible. The use of transesophageal echocardiography (TEE) is therefore necessary to provide surgical and hemodynamic guidance throughout most MICS procedures. Arterial and venous cannulation are commonly performed via the femoral vessels, and cannula position is confirmed with TEE. Aortic cross clamping and myocardial protection, if necessary, can be achieved under direct vision with a special transthoracic clamping device followed by direct injection of cardioplegia into the aortic root or by inserting an endovascular balloon-tipped catheter (endoballoon) via the femoral or subclavian artery into the proximal ascending aorta and delivering cardioplegia through the distal tip of the catheter into the coronary ostia. Should retrograde cardioplegia be necessary, a coronary sinus catheter may be inserted, although the small surgical field can make this technically difficult and it is not frequently used. Postoperatively patients are managed in a similar fashion to traditional cardiac surgical patients. They are typically extubated within a few hours and their ICU length of stay is 24–48 hours.[14]

HISTORY OF PARAVERTEBRAL BLOCK

The concept of Paravertebral Block was pioneered by Hugo Sellheim of Leipzig in 1905. It was further refined by Lawen (1911) and Kappis (1919).[15] The technique however remained neglected till the late 1970s, when a renewed interest developed in the topic due to efforts from Eason and Wyatt who presented a reappraisal on Thoracic Paravertebral Block (TPVB).[16]

They found it to be an accurate, simple, and safe method which carried significant advantages over intercostal or epidural block. It was initially utilized as an alternative to spinal anaesthesia which would minimize the cardiovascular and respiratory effects of central neuraxial block. However, after its initial description PVB were used sparingly to provide anaesthesia and analgesia. Because of the ability to provide long-lasting unilateral anaesthesia, PVB have been successfully used to provide analgesia for multiple thoracic and abdominal procedures in both children and adults.[17]

ANATOMY OF THE PARAVERTEBRAL SPACE

The paravertebral space is a wedge-shaped anatomical compartment adjacent to the vertebral bodies. Klein et al (2004) described an endoscopic technique that permits imaging of the contents and boundaries of the thoracic paravertebral space in cadavers.[18] In the dorsal region, the paravertebral space is defined anterolaterally by the parietal pleura, posteriorly by the superior costotransverse ligament, medially by the vertebrae and intervertebral foramina, superiorly and inferiorly by the heads of the ribs. Within this space, the spinal root emerges from the intervertebral foramen and divides into dorsal and ventral rami. The sympathetic chain lies in the same fascial plane, just anterior to the intercostal nerve and communicates with it via the rami communicantes. Hence, PVB produces unilateral sensory, motor and sympathetic blockade.[19]

Each space is not an isolated structure but can communicate superiorly and inferiorly across the heads and necks of the ribs with the spaces above and below. Interposed between the parietal pleura and the superior costotransverse ligament is the endothoracic fascia, which is the deep fascia of thorax. This fascia divides the space into 2 compartments, anterior “extrapleural paravertebral compartment” and the posterior “subendothoracic paravertebral compartment”. The nerves are located behind this fascia.[19]

PARAVERTEBRAL BLOCK (PB)

A paravertebral block (PVB) should be placed at the T2– T4 level as the paravertebral space is generally largest there and thus minimizes the risk of causing a pneumothorax. There is less risk of epidural hematoma formation, particularly when using ultrasound, comparted to TEA, and it can be performed relatively quickly.[20,21] It has been demonstrated to reduce intraoperative and postoperative narcotic usage, lower pain scores and is as effective as TEA.[22] PVBs have also been used in transapical (TA) transcatheter aortic valve implantation (TAVI) and result in less opioid usage as well as decrease in AF rates while maintaining a smooth hemodynamic profile.[23,24]

PVB is also a well-accepted technique for post-thoracotomy pain relief.[25] It is safer and easier to perform than TEA and can be performed easily after induction of anaesthesia. PVB affects intercostal nerves, ipsilateral sympathetic chain, and posterior rami, which mediate backache from straining of posterior spinal muscles and ligaments. Continuous infusion of local anaesthetic provides effective analgesia, restores respiratory mechanics, and prevents early reduction of pulmonary functions.[26] This type of unilateral analgesia is required in robotic-assisted CABG. Moreover, its role in cardiac surgery has also been well documented by Dhole *et al.*[22] They found PVB to be as effective as TEA after minimally invasive direct coronary artery bypass grafting surgery. It has also been shown to be effective in postoperative analgesia after thoracotomy.[27] Hypotension and urinary retention are less frequently associated with PVB although the pain scores were comparable.[28] Moreover, there is no risk of epidural haematoma in the event of conversion to conventional CABG.

INDICATIONS FOR PVB

- Unilateral surgical procedures in the thoracoabdominal region
- Breast surgery
- Thoracic surgery
- Cholecystectomy
- Renal surgery
- Appendicectomy
- Inguinal hernia repair

Relief of Acute Pain

- Fractured ribs
- Liver capsule pain (trauma or ruptured cysts)

Relief of Chronic Pain

- Neuropathic chest or abdominal pain (post-surgical or post-herpetic)
- Complex regional pain syndrome
- Refractory angina pectoris
- Relief of cancer pain

Miscellaneous

- Therapeutic control of hyperhydrosis[29]

CONTRAINDICATIONS

- Local sepsis (cutaneous or intrathoracic);
- Tumours in the paravertebral space at the level of injection;
- Allergy to local anaesthetic drugs;
- Patient refusal.

Relative Contraindications Include

- Severe coagulopathy.
- Severe respiratory disease (where the patient depends on intercostal muscle function for ventilation);
- Ipsilateral diaphragmatic paresis;
- Severe spinal deformities (kyphosis or scoliosis).[30]

POST-OPERATIVE PAIN CONTROL FOR PARAVERTEBRAL BLOCK IN MINIMAL INVASIVE CARDIAC SURGERIES

Tahara S et al (2017) conducted a case series of continuous paravertebral block in minimally invasive cardiac surgery to assess whether CPVB could be used in open-heart surgery with fewer potential complications. They investigated medical records of the 87 adult patients who underwent MICS at Akashi Medical Center, Hyogo, Japan, between March 2009 and May 2016. They collected data of CPVB-related complications, postextubation respiratory failure, duration of intubation, and other analgesic use from hospital clinical records and observed no severe CPVB-related complications, such as hematoma, neuropathy, or abscess. PT-INR longer than 1.1 was associated with CPVB-related minor bleeding. Forty-three patients (47.4%) were extubated within 1 h after surgery, and there were no postextubation respiratory failures in any patients.[31]

The studies comparing the continuous PVB with epidural analgesia, early pain scores (measured between 4 and 8 h postoperatively) was reported in the studies conducted by Grider JS et al (2012)[32], Kobayashi R et al (2013)[33], Perttunen K et al(1995)[34] and late pain (measured 24 h postoperatively) was reported in the tudy conducted by Mehta Y et al ,(2008)[35], Pintaric TS et al(2011)[36], Raveglia F et al (2014)[37].

Patients who received a continuous PVB had a lower incidence of hypotension than those who received an epidural block in eight studies. No studies using other forms of analgesia reported hypotension. Patients who received a continuous PVB experienced less urinary retention than those who received an epidural block in 5 studies.[38-43] Two epidural studies reported zero incidence of urinary retention[44,45], and one placebo study reported that 7 patients had urinary retention in the continuous PVB group and 6 patients in the placebo group.[46]

Rahman SU et al (2016) conducted a study to determine the efficacy of parasternal injection of Bupivacaine on postoperative pain for early extubation in patients undergoing coronary artery bypass grafting. Results showed that parasternal wound infiltration of long acting local anesthetic Bupivacaine is an effective method of pain control after sternotomy. It facilitates early extubation with significant improvements in oxygenation and Visual Analogue Scale scales.[47]

CONCLUSION

PVBs are easy to perform, have a high success rate, and offer significant potential advantages to patients, compared with other regional techniques and opioid-based analgesia. PVBs are associated with a low rate of complications.

REFERENCES

1. Rosengart TK, Feldman T, Borger MA, et al. Percutaneous and minimally invasive valve procedures: a scientific statement from the American Heart Association Council on Cardiovascular Surgery and Anesthesia, Council on Clinical Cardiology, Functional Genomics and Translational Biology Interdisciplinary Working Group, and Quality of Care and Outcomes Research Interdisciplinary Working Group. Circulation 2008;117:1750-67.

2. Woo YJ, Seeburger J, Mohr FW. Minimally invasive valve surgery. Semin In Thorac Cardiovasc Surg. 2007;19:289–298. doi: 10.1053/j.semtcvs.2007.10.005.

3. Mehta Y, Arora D, Sharma KK, et al. Comparison of continuous thoracic epidural and paravertebral block for postoperative analgesia after robotic-assisted coronary artery bypass surgery. Ann Card Anaesth. 2008;11(2):91. doi: 10.4103/0971-9784.41576.

4. Dogan S, Graubitz K, Aybek T, et al. How safe is the port access technique in minimally invasive coronary artery bypass grafting? Ann Thorac Surg. 2002;74:1537–1543.1. doi: 10.1016/S0003-4975(02)03947-4.

5. White PF, Rawal S, Latham P, Markowitz S, Issioui T, et al. Use of a continuous local anesthetic infusion for pain management after median sternotomy. Anesth 2003; 99(4): 918-23.

6. Klein SM, Bergh A, Steele SM, Georgiade GS, Greengrass RA. Thoracic paravertebral block for breast surgery. Anesth Analg 2000;90:1402-5.

7. Klein SM, Pietrobon R, Nielsen KC, Steele SM, Warner DS, Moylan JA, et al. Paravertebral somatic nerve block compared with peripheral nerve blocks for outpatient inguinal herniorrhaphy. Reg Anesth Pain Med 2002;27:476-80.

8. Jamieson BD, Mariano ER. Thoracic and lumbar paravertebral blocks for outpatient lithotripsy. J Clin Anesth 2007;19:149-51.

9. Kuleszaa G, Tuyakovb B, Braczkowskab M, Onichimowskib D, Mayzner-Zawadzkab E. Paravertebral blockade - Underrated method of regional anesthesia. Pol Ann Med 2014;21:63-8.

10. Krediet AC, Moayeri N, van Geffen G-J, Bruhn J, Renes S, Bigeleisen PE et al. Different approaches to ultrasound-guided thoracic paravertebral block: an illustrated review. Anesthesiology 2015;123:459–74

11. King K, Chelly JE Paravertebral blocks: the evolution of a standard of care Anesthesiol News 2012;2012:1–8.

12. Fibla JJ, Molins L, Mier JM, Sierra A, Carranza D, Vidal G. The efficacy of paravertebral block using a catheter technique for postoperative analgesia in thoracoscopic surgery: a randomized trial. Eur J Cardiothorac Surg 2011;40:907–11.

13. Fibla JJ, Molins L, Mier JM, Sierra A,Vidal G.Comparative analysis of analgesic quality in the postoperative of thoracotomy: paravertebral block with bupivacaine 0.5% vs ropivacaine 0.2%.Eur J Cardiothorac Surg2008;33:430–4.

14. Knowles AC, Coddens J. Minimally invasive cardiac surgery. In: Mackay JH, Arrowsmith JE. editors. Core topics in cardiac anesthesia. 2nd ed. Cambridge: Cambridge University Press, 2012.

15. Richardson J. Fin-de-siecle renaissance of Paravertebral analgesia. Pain Rev. 1997;4:159–71.

16. Eason MJ, Wyatt R. Paravertebral thoracic block-a reappraisal. Anaesthesia. 1979;34:638–642.

17. Karmakar MK. Thoracic paravertebral block. Anesthesiology. 2001;95:771–80.

18. Klein SM, Nielsen KC, Ahmed N, Buckenmaier CC, Steele SM. In situ images of the thoracic paravertebral space. Reg Anesth Pain Med. 2004;29:596–99.

19. Batra RK, Krishnan K, Agarwal A. Paravertebral block. Journal of anaesthesiology, clinical pharmacology. 2011 Jan;27(1):5.

20. Yu S, Valencia MB, Roques V, et al. Regional analgesia for minimally invasive cardiac surgery. J Card Surg 019;34:1289-96.
21. Neuburger PJ, Ngai JY, Chacon MM, et al. A prospective randomized study of paravertebral blockade in patients undergoing robotic mitral valve repair. J Cardiothorac Vasc Anesth 2015;29:930-6.
22. Dhole S, Mehta Y, Saxena H, et al. Comparison of continuous thoracic epidural and paravertebral blocks for post-operative analgesia after minimally invasive direct coronary artery bypass surgery. J Cardiothorac Vasc Anesth 2001;15:288-92.
23. Okitsu K, Iritakenishi T, Iwasaki M, et al. Paravertebral block decreases opioid administration without causing hypotension during transapical transcatheter aortic valve implantation. Heart Vessels 2016;31:1484-90.
24. Poltak JM, Cobey FC, Augoustides JG, et al. Paravertebral analgesia in transapical transcatheter aortic valve replacement. Heart Lung Vessel 2015;7:217-23.
25. Hardy I, Ahmed S. Pain control following thoracic surgery. In: Ghosh S, Latimer R, editors. Thoracic anaesthesia- principles and practice. Oxford: Butterworth-Heinemann; 1999. p. 265-7.
26. Catala E, Casas JI, Unzueta MC, Diaz X, Aliaga L, Villar Landeira JM. Continuous infusion is superior to bolus doses with thoracic paravertebral blocks after thoracotomies. J Cardiothorac Vasc Anesth 1996;10:586-8.
27. Mathews PJ, Govenden V. Comparison of continuous paravertebral and extradural infusions for bupivacaine for pain relief after thoracotomy. Br J Anaesth 1989;62:204-5.
28. Perttunen K, Nilson E, Heinonnen J, Hirvisalo EL, Salo JA, Kalso E. Extradural, paravertebral and intercostal nerve blocks for post-thoracotomy pain. Br J Anaesth 1995;75:541-7.
29. Karmakar MK. Thoracic paravertebral block (review article). Anesthesiology 2001; 95: 771– 80
30. Tighe SQ, Greene MD, Rajadurai N. Paravertebral block. Continuing Education in Anaesthesia, Critical Care & Pain. 2010 Oct 1;10(5):133-7
31. Tahara S, Inoue A, Sakamoto H, Tatara Y, Masuda K, Hattori Y, Nozumi Y, Miyagi M, Sigdel S. A case series of continuous paravertebral block in minimally invasive cardiac surgery. JA clinical reports. 2017 Dec;3(1):1-5.
32. Grider JS, Mullet TW, Saha SP, Harned ME, Sloan PA. A randomized, double-blind trial comparing continuous thoracic epidural bupivacaine with and without opioid in contrast to a continuous paravertebral infusion of bupivacaine for post-thoracotomy pain. J Cardiothorac Vasc Anesth 2012;26:83–9
33. Kobayashi R, Mori S, Wakai K, Fukumoto K, Saito T, Katayama T et al. Paravertebral block via the surgical field versus epidural block for patients undergoing thoracotomy: a randomized clinical trial. Surg Today 2013;43: 963–9.
34. Perttunen K, Nilsson E, Heinonen J, Hirvisalo EL, Salo JA, Kalso E. Extradural, paravertebral and intercostal nerve blocks for post-thoracotomy pain. Br J Anaesth 1995;75:541–7.
35. Mehta Y, Arora D, Sharma KK, Mishra Y, Wasir H, Trehan N. Comparison of continuous thoracic epidural and paravertebral block for postoperative analgesia after robotic-assisted coronary artery bypass surgery. Ann Card Anaesth 2008;11:91–6.
36. Pintaric TS, Potocnik I, Hadzic A, Stupnik T, Pintaric M, Novak Jankovic V. Comparison of continuous thoracic epidural with paravertebral block on perioperative analgesia and hemodynamic stability in patients having open lung surgery. Reg Anesth Pain Med 2011;36:256–60.
37. Raveglia F, Rizzi A, Leporati A, Di Mauro P, Cioffi U, Baisi A. Analgesia in patients undergoing thoracotomy: epidural versus paravertebral technique. A randomized, double-blind, prospective study. J Thorac Cardiovasc Surg 2014;147:469–73.
38. Bimston DN, McGee JP, Liptay MJ, Fry WA. Continuous paravertebral extrapleural infusion for post-thoracotomy pain management. Surgery 1999;126:650–6.
39. El-Morsy GZ, El-Deeb A, El-Desouky T, Elsharkawy AA, Elgamal MA. Can thoracic paravertebral block replace thoracic epidural block in pediatric cardiac surgery? A randomized blinded study. Ann Card Anaesth 2012;15: 259–63.
40. Grider JS, Mullet TW, Saha SP, Harned ME, Sloan PA. A randomized, double-blind trial comparing continuous thoracic epidural bupivacaine with and without opioid in contrast to a continuous paravertebral infusion of bupivacaine for post-thoracotomy pain. J Cardiothorac Vasc Anesth 2012;26:83–9.
41. Gulbahar G, Kocer B, Muratli SN, Yildirim E, Gulbahar O, Dural K et al. A comparison of epidural and paravertebral catheterisation techniques in post-thoracotomy pain management. Eur J Cardiothorac Surg 2010;37: 467–72.
42. Matthews PJ, Govenden V. Comparison of continuous paravertebral and extradural infusions of bupivacaine for pain relief after thoracotomy. Br J Anaesth 1989;62:204–5.
43. Raveglia F, Rizzi A, Leporati A, Di Mauro P, Cioffi U, Baisi A. Analgesia in patients undergoing thoracotomy: epidural versus paravertebral technique. A randomized, double-blind, prospective study. J Thorac Cardiovasc Surg 2014;147:469–73.
44. Grider JS, Mullet TW, Saha SP, Harned ME, Sloan PA. A randomized, double-blind trial comparing continuous thoracic epidural bupivacaine with and without opioid in contrast to a continuous paravertebral infusion of bupivacaine for post-thoracotomy pain. J Cardiothorac Vasc Anesth 2012;26:83–9.
45. Pintaric TS, Potocnik I, Hadzic A, Stupnik T, Pintaric M, Novak Jankovic V. Comparison of continuous thoracic epidural with paravertebral block on perioperative analgesia and hemodynamic stability in patients having open lung surgery. Reg Anesth Pain Med 2011;36:256–60.
46. Helms O, Mariano J, Hentz JG, Santelmo N, Falcoz PE, Massard G et al. Intra-operative paravertebral block for postoperative analgesia in thoracotomy patients: a randomized, double-blind, placebo-controlled study. Eur J Cardiothorac Surg 2011;40:902–6.
47. Rahman SU, Siddiqi TA, Husain A, Yaseen R, Tanveer R, et al. Efficacy of Parasternal Injection of Bupivacaine on Postopeartive Pain for Early Extubation in Patients Undergoing Coronary Artery Bypass Surgery. J Cardiol Curr Res 2016; 6(4): 00210. DOI: 10.15406/jccr.2016.06.00210.

Source of Support: Nil.

Conflict of Interest: None Declared.

Cite this article as: Sultan Ghazzay Alotaibi, Rawaa Mahmoud Sulaiman, Muneeb Ammar Alnouri, Ahmed Khalid Bawazer. Post-Operative Pain Control for Paravertebral Block in Minimal Invasive Cardiac Surgeries. Int J Med Res Prof. 2021 Jan; 7(1):1-4. DOI:10.21276/ijmrp.2021.7.1.001