Journal of Clinical and
Medical Images

Case Series

ISSN: 2640-9615 | Volume 5

Single Injection of Combined Paravertebral and Erector Spinae Plane Block for Thoracoscopic Surgery

Zhang Y*

Department of Anesthesiology, The Second Affiliated Hospital of Anhui Medical University, Hefei 230601, China

***Corresponding author:**

Ye Zhang,
Department of Anesthesiology, The Second Affiliated Hospital of Anhui Medical University, Hefei 230601, china,
E-mail: zhangye_hassan@sina.com

Received: 20 Feb 2021
Accepted: 10 Mar 2021
Published: 14 Mar 2021

Keywords:

Thoracic paravertebral block; Erector spinae plane block; Combined, Thoracoscopic surgery

Citation:

Zhang Y et.al. Single Injection of Combined Paravertebral and Erector Spinae Plane Block for Thoracoscopic Surgery. J Clin Med Img 2021; V5(6): 1-5.

1. Abstract

Thoracic Paravertebral Block (TPVB) and Erector Spinae Plane Block (ESPB) are widely used to administer analgesia in thoracic surgery. However, concerns regarding side effects such as hypotension, risk of puncture and unpredictable injectate-spread led to questions. We first performed a single-injection technique of combined TPVB and ESPB at the T5 vertebra, which provided satisfactory pain-control during thoracoscopic surgery. Magnetic resonance imaging confirmed appropriate transverse spread of the injectate into the paravertebral space, erector spinae plane, intercostal space and neural foramen; with additional vertical spread across five dermatome levels. This combined nerve block can be expected as a simple, safe, and efficient technique for thoracic analgesia.

2. Introduction

Thoracic Paravertebral Blockade (TPVB) involves injection of Local Anesthetic (LA) into a wedge-shaped space that sits lateral to the spinal nerves, where they emerge from the intervertebral foramina. A single-injection TPVB procedure could elicit sensory loss in three to six dermatome levels [1], and produced ipsilateral somatosensory and sympathetic nerve blockade, which is effective for anesthesia and analgesia in thoracic surgery [2]. Disadvantages such as sympathetic complications, specifically hypotension, bradycardia, and inefficient epidural spread [3,4], have led to the use of indirect TPVB approaches. For example, erector Spinae Plane Block (ESPB) is a method of indirect TPVB, which was first reported by Forero et. al, in 2016.5 ESPB has shown to be a safe and effective analgesic method for use in the thoracic region since large volumes of LA can be injected between the thoracolumbar fascial planes and beneath the Erector Spinae Muscle (ESM), which is far away from the pleura [6]. However, due to variable LA spread, efficacy of ESPB exhibits wide fluctuations and an unpredictable analgesic effect [7,8]. Hence, the combination of ESPB and TPVB, could be an effective alternative. To date, no studies describe the technique of combined TPVB and ESPB. Herein, we report two cases of this combined method and evidence from Magnetic Resonance Imaging (MRI) to confirm its presumed mechanism of action. Written informed consent was obtained from both patients for publishing this case report.

3. Case Reports

3.1. Case 1

A 19-year-old man, 168 cm in height and weighing 62 kg {body mass index (BMI) of 22.0 kg/m2} was scheduled for an elective thoracoscopic left pulmonary lobectomy. The patient presented with no comorbidities and unremarkable physical examination.

Combined TPVB and ESPB was chosen for local anesthesia administration, and the injectate (0.5% ropivacaine and 60 µg of dexmedetomidine) was diluted to 30 mL. The patient was placed in a right lateral decubitus position. After anatomical landmark identification and standard aseptic technique, a high-frequency (6-13 hz) linear ultrasound transducer (HFL 38, sonite, US), within a sterile sheath, was placed on the patient in a longitudinal and partial oblique position with respect to the vertebral column. The tip of the T5 transverse process, the overlying ESM, the apex of the paravertebral space, and the pleura were identified. The skin was anesthetized with 3 mL of lidocaine (2%) and using ultrasound guidance, a 17-gauge 80 mm block Tuohy needle was inserted in-plane to the ultrasound beam, in a partial oblique and lateral-to-medial direction. The tip of the needle was advanced beyond the internal intercostal membrane and displacement of the pleura, in response to 1 mL of normal saline, was used to assess correct needle-tip position. Upon confirmation, 5 mL of LA was injected (Figure 1 A). The needle was withdrawn and adjusted such that the point came into contact with the tip of the T5 transverse process. Correct needle tip position was confirmed by hydrodissection with 2 ml of normal saline and visualizing linear fluid spread that lifted the ESM off the transverse process. Then, 25 mL of LA was injected in a cranial-to-caudal direction into the facial plane (Figure 1 B). No catheter was inserted.

Thereafter, the distribution pattern of LA was evaluated by analysis of the T2-weighted, fluid-sensitive MRI of the axial and sagittal plane. In the axial plane, the injectate was identified in the left paravertebral space, ESM fascial plane, intercostal space, and neural foramen (Figures 2 A and B). The sagittal plane image indicated that the injectate spread 5 levels (T3 to T8) in the ESM fascial plane (Figure 2 C). After MRI, we physically tested the sensory block area starting at T5, at the midclavicular line, and extending over the anterolateral thoracic wall, in a cranial and then caudal direction. The patient exhibited a loss of cold sensation from T2 to T8.

The patient received a right-sided double-lumen endotracheal intubation and was given propofol-remifentanil anesthesia during the surgery. Additionally, 30 μg of sufentanil was administered. The surgery lasted approximately 3 hours, and the patient did not report any pain upon waking. In the Anesthesia Intensive Care Unit (AICU), pain intensity was assessed by a numerical rating scale (NRS; 0–10) at different time intervals (0.5, 1, 2, and 4 h after surgery). The patient reported an NRS score ranging between 0–1 suggesting that the pain was well-controlled, and the patient required no rescue analgesia during his AICU stay. No episodes of postoperative nausea or vomiting were reported. During recovery, diclofenac sodium administration was titrated within the first 24 hours. The patient reported an NRS score of 0–1, both during rest and movement in the 72-hour post-surgery, and was discharged on postoperative day 4 without any major complications.

3.2. Case 2

A 63-year-old man, 170 cm in height and weighing 76 kg (BMI 26.3 kg/m2) underwent an elective right thoracoscopic pulmonary lobectomy. He had a history of mild hypertension which was well controlled by a balanced diet.

The patient was placed in a left lateral decubitus position for the procedure. Using the same protocol as described above, 5 and 25 mL of LA was injected into the paravertebral space and the ESM fascial plane, respectively, in a caudal-to-cranial direction. He was intubated with a right-sided double lumen endotracheal tube and given 40 μg of sufentanil, intraoperatively. After the surgery, the patient required Patient-Controlled Intravenous Analgesia (PCIA) which was programmed with 100 μg of sufentanil diluted in 100 mL (3 ml bolus, with a lockout time interval of 15 minutes and a 1hour limit of 12 mL, without any baseline infusion). During his 4-hour stay in the AICU, the patient reported an NRS score of 0-2 during rest, and a 3 when coughing, without necessitating any rescue analgesics. During the 72-hour recovery period, his pain intensity reached an NRS score of 1, which may have been due to the 35 μg of sufentanil given to him in the PCIA, in the first 24 hours. Other analgesics were not required. He was discharged on postoperative day 4 without any major complications.

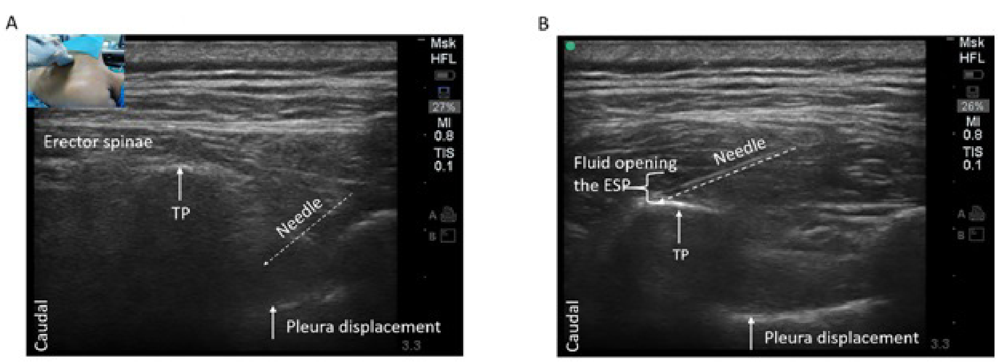

Figure 1: Performance of the TPVB and ESPB in Case 1. The transducer was placed on the patient in a longitudinal and partial oblique position to the T5 vertebral column (top left corner). (A) TPVB, the needle (dashed line) was inserted in-plane with the ultrasound beam to advance beyond the internal intercostal membrane. Correct needle-tip position was confirmed by the displacement of the pleura, after normal saline administration (right vertical arrow). (B) ESPB, the needle (dashed line) was withdrawn and adjusted such that the point came into contact the tip of the T5 transverse process (left vertical arrow). Correct needle-tip position was confirmed by hydrodissection with normal saline and visualization of linear fluid spread, that lifted the ESM off the transverse process (brace). TPVB, thoracic paravertebral block; ESPB, erector spinae plane block; TP, transverse process; ESM, erector spinae muscle

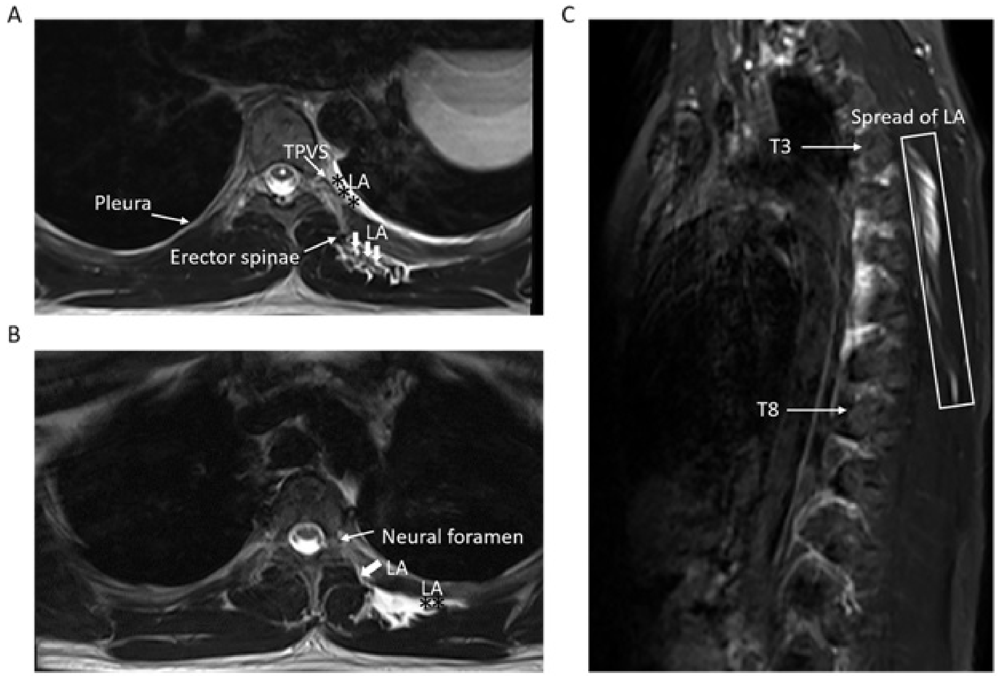

Figure 2: Magnetic resonance imaging of Case 1 after combined TPVB and ESPB. (A) Axial T2-weighted fluid-sensitive magnetic resonance imaging at the vertebra, where local anesthetic can be detected inside the left paravertebral space (black asterisk) and the ESM fascial plane (bold arrow). (B) Axial view of the vertebra. The injectate was detected spreading into the intercostal space (black asterisk) and in route to the neural foramen (bold arrow). (C) Sagittal T2-weighted fluid-sensitive magnetic resonance imaging of the thoracic vertebra, where the local anesthetic can be detected in the fascial plane beneath the erector spinae muscle from the T3 to T8 vertebra (rectangular box). TPVB, thoracic paravertebral block; ESPB, erector spinae plane block; PVS, paravertebral space; LA, local anesthetic; ESM, erector spinae muscle.

4. Discussion

We report two cases of thoracoscopic surgery using combined TPVB and ESPB, with a single injection at the T5 vertebra. Both patients showed satisfactory pain control and had an uneventful recovery.

A single-injection TPVB increased patient satisfaction rates when associated with a shorter procedure [9]. Dexmedetomidine, when used as an adjuvant to LA, enhanced the quality and duration of sensory blockade [10]. However, large volumes of LA would unnecessarily expose patients to additional risks related to a wide epidural space or contralateral-sided spread of LA [11]. Thus, placing the solution in the fascial plane, beneath the ESM, as an indirect TPVB has been suggested as an applicable alternative [6]. Nevertheless, the ESM is a bundle of muscles and tendons, and the interspace of the transverse process is bound with intertransverse connective tissues [5,12]. As such, individual anatomical differences may lead to varying degrees of LA penetration, which makes the ESPB unpredictable, and sometimes only partially successful [7,8]. Inspired by combined spinal and epidural anesthesia, we injected a low volume of LA into the paravertebral space, while storing the solution in the fascial plane. The needle track may form a tunnel which facilitates continuous LA penetration into the paravertebral space (Figure 3). As expected, both patients reported satisfactory pain relief even during coughing, in the 72-hour follow-up period.

In case 1, MRI confirmed that LA spread to five vertebral levels, T3 to T8. However, sensory loss was found from levels T2 to T8, which was inconsistent with the MRI findings. Similar results were published by Marhofer et. al, [13] the sensory distribution of TPVB was significantly larger compared with the spread of LA as observed via MRI. The discrepancy between the distribution of LA seen in the MRI and the somatic blockade effects might be explained by the fact that MRI is a static method of visualization, and a dynamic redistribution and second vertical spread of LA in the fascial plane might happen over time, and cannot be detected using MRI. Cadaver studies showed that the injectate, either in the paravertebral space or the ESM fascial plane, could be detected in the epidural space, intercostal spaces, and in the contralateral side [7,8,11,14]. In our in vivo MRI study, LA was detected in the intercostal space and the neural foramen. Taken together, these results indicate that LA distribution from the paravertebral space or ESM fascial plane is complex.

It is worth noting that the patient, in Case 2, experienced less sensory loss than the one in Case 1. In addition to individual anatomical differences, we assume that caudal-to-cranial injection may slow or even limit the spread of LA. This phenomenon is consistent with Marhofer's study which also exhibited less sensory loss after TPVB when administered from a caudal-to-cranial direction [13].

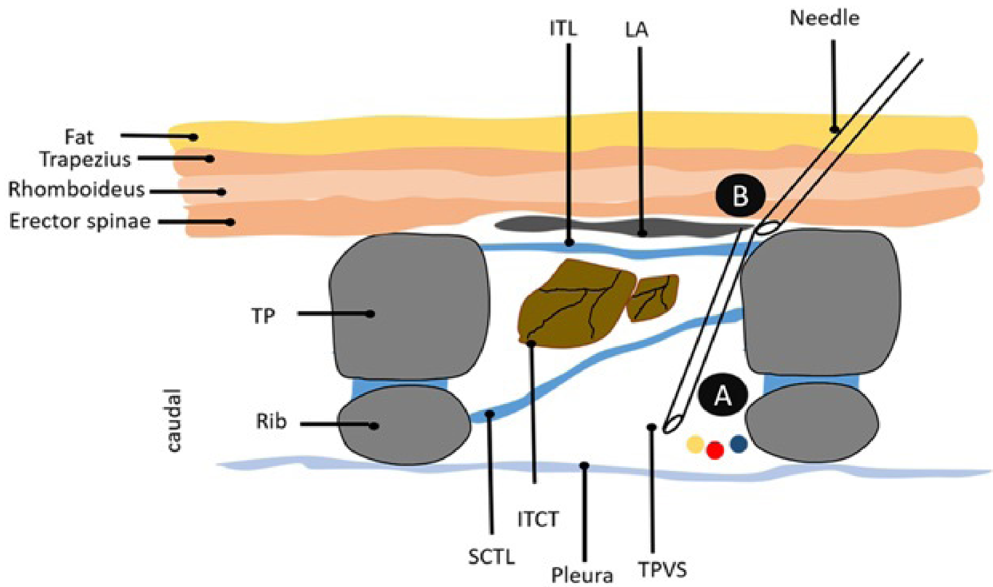

Figure 3: Schematic diagram of the possible mechanism facilitating the spread of the injectate from a single injection of combined TPVB and ESPB. The needle track (circle A) may form a tunnel which facilitates continuous LA penetration into the paravertebral space from the ESM fascial plane, which contains large volumes of LA, through the intertransverse ligament, intertransverse connective tissues, and superior costotransverse ligament (circle B). TPVB, thoracic paravertebral block; ESPB, erector spinae plane block; ESM, erector spinae muscle; ITL, intertransverse ligament; LA, local anesthetic; TP, transverse process; SCTL, superior costotransverse ligament; ITCT, intertransverse connective tissues; PVS, paravertebral space.

There are some limitations in this case report. First, we did not conduct MRI in case 2. Second, we used dexmedetomidine as the adjuvant in the LA. Thus, we cannot exclude the potential effect of dexmedetomidine as a contributor to pain-relief in these cases. Further prospective randomized controlled clinical trials will be conducted to accurately assess the effects of this combined technique in our future work.

In summary, these two cases illustrate that combined TPVB and ESPB with a single injection, may provide a relatively safe, simple, and effective regional anesthesia technique for thoracoscopic surgery. Further clinical studies are warranted to establish the efficacy and functional mechanism of this approach, particularly in thoracic surgery.

5. Aknowledgements

The authors are grateful to the participating patients, as well as to Qin Li, Xiaoxiao Li for their excellent help with patient organization and nursing assistance.

References:

1. Naja ZM, El-Rajab M, Al-Tannir MA, Ziade FM, Tayara K , Younes F, et al. Thoracic paravertebral block: influence of the number of injections. Reg Anesth Pain Med. 2006; 31: 196-201.
2. D'Ercole F, Arora H, Kumar PA. Paravertebral Block for Thoracic Surgery. J Cardiothorac Vasc Anesth. 2018; 32: 915-27.
3. Terkawi AS, Tsang S, Sessler DI, Terkawi RS, Nunemaker MS, Durieux ME, et al. Improving Analgesic Efficacy and Safety of Thoracic Paravertebral Block for Breast Surgery: A Mixed-Effects Meta-Analysis. Pain Physician. 2015; 18: E757-80.
4. Pace MM, Sharma B, Anderson-Dam J, Fleischmann K, Warren L, Stefanovich P. Ultrasound-Guided Thoracic Paravertebral Blockade: A Retrospective Study of the Incidence of Complications. Anesth Analg. 2016; 122: 1186-91.
5. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The Erector Spinae Plane Block: A Novel Analgesic Technique in Thoracic Neuropathic Pain. Reg Anesth Pain Med. 2016; 41: 621-7.
6. Forero M, Rajarathinam M, Adhikary S, Chin KJ. Continuous Erector Spinae Plane Block for Rescue Analgesia in Thoracotomy After Epidural Failure: A Case Report. A A Case Rep. 2017; 8: 254-6.
7. Ivanusic J, Konishi Y, Barrington MJ. A Cadaveric Study Investigating the Mechanism of Action of Erector Spinae Blockade. Reg Anesth Pain Med. 2018; 43: 567-71.
8. Dautzenberg K, Zegers MJ, Bleeker CP, Tan ECTH, Vissersm KCP, van Geffen GJ, et al. Unpredictable Injectate Spread of the Erector Spinae Plane Block in Human Cadavers. Anesth Analg. 2019; 129: e163-6.
9. Uppal V, Sondekoppam RV, Sodhi P, Johnston D, Ganapathy S. Single-Injection Versus Multiple-Injection Technique of Ultrasound-Guided Paravertebral Blocks: A Randomized Controlled Study Comparing Dermatomal Spread. Reg Anesth Pain Med. 2017; 42: 575-81.
10. Xu J, Yang X, Hu X, Chen X, Zhang J, Wang Y. Multilevel Thoracic Paravertebral Block Using Ropivacaine With/Without Dexmedetomidine in Video-Assisted Thoracoscopic Surgery. J Cardiothorac Vasc Anesth. 2018; 32: 318-24.

11. Conacher ID. Resin injection of thoracic paravertebral spaces. Br J Anaesth. 1988; 61: 657-61.

12. Chen N, Qiao Q, Chen R, Xu Q, Zhang Y, Tian Y. The effect of ultrasound-guided intercostal nerve block, single-injection erector spinae plane block and multiple-injection paravertebral block on postoperative analgesia in thoracoscopic surgery: A randomized, double-blinded, clinical trial. J Clin Anesth. 2020; 59: 106-11.

13. Marhofer D, Marhofer P, Kettner SC, Fleischmann E, Prayer D, Schernthaner M, et al. Magnetic resonance imaging analysis of the spread of local anesthetic solution after ultrasound-guided lateral thoracic paravertebral blockade: a volunteer study. Anesthesiology. 2013; 118: 1106-12.

14. Adhikary SD, Bernard S, Lopez H, Chin KJ. Erector Spinae Plane Block Versus Retrolaminar Block: A Magnetic Resonance Imaging and Anatomical Study. Reg Anesth Pain Med. 2018; 43: 756-62.