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Retro superior costotransverse ligament space block as an effective analgesia after laparoscopic gastrectomy -a case report-

Youngin Lee[1,2], Seunguk Bang[1,2], Jihyun Chung[1,2], Jookyoung Moon[1,2]

Department of Anesthesiology and Pain Medicine, [1]Daejeon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Daejeon, [2]The Catholic University of Korea, Seoul, Korea

Case Report

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Corresponding author:
Seunguk Bang, M.D., Ph.D.
Department of Anesthesiology and Pain Medicine, Daejeon St. Mary's Hospital, 64 Daeheung-ro, Jung-gu, Daejeon 34943, Korea
Tel: +82-42-220-9046
Fax: +0504-419-6077
Email: seungukb@catholic.ac.kr
ORCID: https://orcid.org/0000-0001-6609-7691

Background: The retro superior costotransverse ligament space (RSS) block, reported as a novel target in paraspinal block, involves the spreading of local anesthetics into the thoracic paravertebral space through slits around the superior costotransverse ligament. This blocks not only the dorsal rami but also the ventral rami, achieving a reliable complete sensory blockade.
Case: We performed an RSS block at the T5, T7, and T9 levels on both sides for postoperative analgesia in two patients who underwent laparoscopic gastrectomy. Both patients showed complete sensory blockade from T4 to L1 on the anterior, lateral, and posterior chest walls in the recovery room. The resting and dynamic pain scores were 0 at 30 min and 6 h postoperatively. The pain score consistently remained below 3 throughout postoperative period.
Conclusions: The RSS block provided effective postoperative analgesia in laparoscopic gastrectomy through definitive complete sensory blockade.

Keywords: Anesthesia; Local anesthetic; Nerve block; Paraspinal muscle; Postoperative pain; Thoracic vertebrae; Ultrasonography.

The retro superior costotransverse ligament space (RSS) block is a novel thoracic paraspinal block (TPSB) reported by Dr. Karmakar in 2022, targeting the fat-filled space in the retro superior costotransverse ligament (SCTL) space [1]. Moreover, TPSBs, as exemplified by the erector spinae plane (ESP) block, are currently widely used as part of postoperative multimodal analgesia owing to their ease of technique and analgesic potency compared to thoracic epidural blocks or thoracic paravertebral blocks. However, existing TPSBs have shown limitations owing to their variable and unpredictable effect, and their frequent failure to consistently provide sensory blockade in the anterior thorax [2-4]. In contrast, the RSS block not only blocks the dorsal and ventral rami but also achieves a higher reproducibility and more reliable sensory blockade by spreading through the gap around the SCTL with local anesthetic (LA) reaching into the thoracic paravertebral space (TPVS). We performed an RSS block for postoperative pain control in patients who underwent laparoscopic gastrectomy. This novel technique demonstrates effects that are entirely distinct from the previously known paraspinal nerve blocks, showing definite sensory blockade. We report two cases to detail our experiences in the clinical setting.

Case Reports

This report was approved by the Catholic University Hospital Institutional Review Board, Daejeon, Korea (DC23ZISI0080). We have obtained written consent from the patients regarding their agreement for publication.

Case 1

A 94-year-old woman (height: 141.5 cm, weight: 56.8 kg, body mass index [BMI]: 28.4 kg/m^2) was diagnosed with advanced gastric cancer and underwent laparoscopic subtotal gastrectomy.

The surgery was performed under general anesthesia with remifentanil and desflurane after standard monitoring. Furthermore, laparoscopic incisions were performed at the umbilicus, right upper quadrant, right lower quadrant, left upper quadrant, and left lower quadrant. The surgery lasted for 3 h and 15 min, with an estimated blood loss of 100 ml. According to the acute pain service's postoperative pain management protocol, 5 mg of dexamethasone, 1000 g of propacetamol, and 30 mg of ketorolac were administered 30 min before the end of the surgery. After the end of the surgery, an RSS block was performed at the levels of T5, T7, and T9 on both sides in the lateral decubitus position. In addition, intravenous patient-controlled analgesia (PCA) with continuous infusion and allowed bolus (fentanyl 10 μg/h, nefopam 60 mg, and ramosetron 0.6 mg) was started in the post-anesthesia care unit (PACU) using a PCA pump (Accufuser Plus™ WooYoung Medical).

Technique of RSS block

RSS block was performed using a transverse ultrasound imaging technique to objectively visualize the RSS. Initially, the patient was positioned in the right lateral decubitus position. After counting ribs and transverse processes to identify the target thoracic intervertebral levels, the target sites were marked on the body.

After checking the rib and transverse process level, a transducer (X-porte, Sonosite™) was moved caudally to check the TPVS at the transverse process level. After moving the transducer slightly more so that the inferior articular process (IAP) was visible, we used the pivot maneuver to set the view so that the SCTL, IAP, and TPVS were all clearly visible.

Once the desired ultrasound image was obtained, a 22-gauge echogenic needle (Ultraplex 360™, B Braun) was inserted using real-time ultrasound guidance with an in-plane approach from a lateral to medial direction. The tip of the needle was positioned within the RSS that appeared hypoechoic and located laterally to the IAP. Following a negative aspiration, 6 ml of 0.5% ropivacaine with 5 μg/ml of epinephrine was injected, and the distribution pattern of the LAs was monitored under real-time ultrasound. The same volume of LA was injected at each target intervertebral level by repeating the previous procedure. We vigilantly monitored for signs or symptoms of systemic toxicity caused by LAs, and no abnormal findings were observed.

In the PACU, 30 min after the RSS block, the resting and dynamic (deep breathing/coughing) pain scores were 0. The patient showed complete sensory blockade of T4-T10 (right) and T7-L1 (left) on the anterior chest wall, and T6-L1 (right) and T4-T10 (left) on the lateral and posterior chest wall, by pinprick test. At 6 h postoperatively, the resting and dynamic pain scores (NRS) were 0 and 1 respectively; the patient showed substantial sensory loss at T4-L1 on the entire chest wall compared to the extremities. She was very satisfied with the pain management protocol as her pain score remained below 3 throughout the entire postoperative day without the need for any additional rescue drugs.

Case 2

A 71-year-old man (height: 154 cm, weight: 43.7 kg, BMI: 18.4 kg/m^2), was diagnosed with early gastric cancer and underwent laparoscopic distal gastrectomy with Roux-en-Y gastrojejunostomy.

The surgery was performed with five port sites under general anesthesia, similar to the surgery of the patient described in the first case [1]. The duration of the surgery was 3 h and 20 min, with an estimated blood loss of 100 ml. The patient received 5 mg of dexamethasone after the induction of anesthesia; additionally, 1,000 mg of propacetamol, 30 mg of ketorolac, and 0.3 mg of ramosetron were administered 30 min before the end of the surgery. After the end of the surgery, an RSS block was performed at the T5, T7, and T9 IAP levels. In addition, intravenous PCA with continuous infusion and allowed bolus (fentanyl 9 μg/h, nefopam 60 mg, and ramosetron 0.6 mg) was started in the PACU.

In the PACU, the resting and dynamic pain scores were 0. The patient showed a complete sensory blockade of T3-L1/2 levels on both sides of the anterior and lateral chest walls. Additionally, there was a notable sensory blockade in the dermatomes extending from T2 to L5 on the posterior chest wall. The motor power of the hip and knee extension/flexion was spared, measuring as grade 4/5. At 6 h postoperatively, the resting and dynamic pain scores were 0 and 2 respectively, and sensory blockade was noted at T4-L1 in both sides of the anterior chest wall and at T4-T8 in the lateral and posterior walls. However, the patient required intravenous tramadol (10 mg) as a rescue drug at 8 and 13 h postoperatively owing to a Numeric Rating Scale (NRS) score of 4.

The pain score remained below 3 throughout the entire postoperative period, and the patient did not require additional rescue analgesia until discharge.

Discussion

The TPVS is bounded on the medial side by the vertebral body and intervertebral foramina, and on the anterolateral side by the parietal pleura. Posteriorly, it is positioned behind the SCTL. Anatomically, the RSS that constitutes the posterior part of the TPVS and is a crucial structure is bordered anteromedially by the IAP of the thoracic vertebrae and posterolaterally by the erector spinae muscle [5]. In this space, the medial and lateral branches of the dorsal ramus that dominate the sensation of the erector spinae muscle and the posterior thorax course through. Additionally, the proximal part of the ventral ramus travels within the space [6]. This space consists of fat and loose connective tissue, appearing as a hypoechoic structure on ultrasound imaging [7] (Fig. 1).

Sensory blockade assessment using pinprick testing in the recovery room revealed anesthesia from approximately T4/5 to L1 in the anterior, lateral, and posterior chest walls. This outcome involves the blockade of not only the dorsal ramus of the thoracic spinal nerve but also the lateral and anterior cutaneous branches of the ventral ramus. This effect demonstrates results identical to the analgesic efficacy and sensory blockade reported by Karmakar et al. [1], who initially identified the potential of the RSS block. The plausible mechanism for the analgesic efficacy provided by the RSS block is as follows. First, the dorsal ramus of the spinal nerve and the proximal part of the ventral ramus are present within the RSS. The LA injected into this space blocks these nerves. Additionally, the LA spreads into the TPVS, intercostal space, and intervertebral space through slits around the SCTL. Cho et al. [6] reported the nerves and structures observed within the RSS using 3D micro computed tomography (micro-CT) on cadavers. Additionally, various studies have noted the presence of gaps or slits at the medial and lateral edges of the SCTL, connecting to the intercostal space or TPVS [8,9]. Second, the loose connective tissue in the SCTL is not a watertight barrier and has fenestrations [8,10]. Therefore, the LA within the RSS spreads to the TPVS through these fenestrations, similar to the mechanism seen in TPSBs like the ESP block [11,12].

TPSBs were initially widely used as they presented a less challenging technique compared to thoracic paravertebral blocks or thoracic epidural blocks [11]. However, they were later revealed to have notable limitations, including variable and unpredictable block effects, as well as a low rate of blocking the anterior cutaneous branch of the intercostal nerve that dominates sensory innervation in the anterior thorax [3,4]. These limitations have imposed substantial constraints on clinicians explaining the validity of the procedure to patients.

The two patients indicated NRS scores of 0 in the PACU and at 6 h postoperatively; their respective NRS scores were 1 and 2, signifying successful postoperative pain control. The RSS block holds the potential to overcome all limitations associated with TPSB, positioning itself as a potential option for postoperative multimodal analgesia in laparoscopic abdominal surgery in the future.

We believe that the RSS block is a rising novel technique that provides reliable and effective analgesia, along with a definite complete sensory block, following laparoscopic gastrectomy. Further research is needed to evaluate the specific characteristics of the RSS block, and studies exploring its applicability to various indications are crucial for future developments.

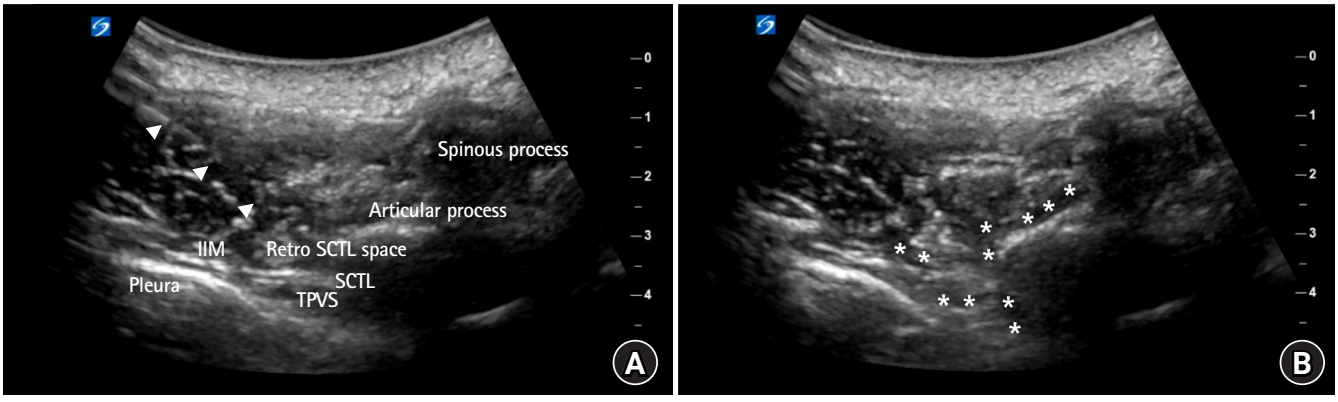

Fig. 1. Ultrasound image of RSS block. (A) The block needle inserted and positioned within the retro SCTL space. The block needle is indicated with a white arrowhead. (B) After completion of the LA injection, the spread of LA into the retro SCTL space, retrolaminar space, intervertebral space, and TPVS was observed. The spread of LA is indicated with asterisks (*). IIM: internal intercostal membrane, LA: local anesthetic, SCTL: superior costotransverse ligament, TPVS: thoracic paravertebral space.

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Conflicts of Interest

Seunguk Bang has been an editor for the *Korean Journal of Anesthesiology* since 2016. However, he was not involved in any process of review for this article, including peer reviewer selection, evaluation, or decision-making. There were no other potential conflicts of interest relevant to this article.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author Contributions

Youngin Lee (Data curation; Writing – original draft; Writing – review & editing)
Seunguk Bang (Conceptualization; Data curation; Funding acquisition; Writing – original draft; Writing – review & editing)
Jihyun Chung (Data curation; Writing – review & editing)
Jookyoung Moon (Data curation)

ORCID

Youngin Lee, https://orcid.org/0000-0002-5956-9459
Seunguk Bang, https://orcid.org/0000-0001-6609-7691
Jihyun Chung, https://orcid.org/0000-0003-1672-7442
Jookyoung Moon, https://orcid.org/0000-0002-9527-4236

References

1. Karmakar MK, Sivakumar RK, Sheah K, Pangthipampai P, Lönnqvist PA. The retro superior costotransverse ligament space as a new target for ultrasound-guided intertransverse process block: a report of 2 cases. A A Pract 2022; 16: e01610.
2. Sivakumar RK, Karmakar MK. Variable anterior spread of local anesthetic after erector spinae plane block (ESPB): time to turn the spotlight on the 'retro-SCTL space'. Reg Anesth Pain Med 2023; 48: 483-4.
3. Dautzenberg KH, Zegers MJ, Bleeker CP, Tan EC, Vissers KC, van Geffen GJ, et al. Unpredictable inectate spread of the erector spinae plane block in human cadavers. Anesth Analg; 129: e163-6.
4. Zhang J, He Y, Wang S, Chen Z, Zhang Y, Gao Y, et al. The erector spinae plane block causes only cutaneous sensory loss on ipsilateral posterior thorax: a prospective observational volunteer study. BMC Anesthesiol 2020; 20: 88.
5. Ardon AE, Lee J, Franco CD, Riutort KT, Greengrass RA. Paravertebral block: anatomy and relevant safety issues. Korean J Anesthesiol 2020; 73: 394-400.
6. Cho TH, Kim SH, O J, Kwon HJ, Kim KW, Yang HM. Anatomy of the thoracic paravertebral space: 3D micro-CT findings and their clinical implications for nerve blockade. Reg Anesth Pain Med 2021; 46: 699-703.
7. Karmakar MK, Sivakumar RK, Sheah K, Pangthipampai P, Lönnqvist PA. Quest for the elusive mechanism of action for the thoracic paraspinal nerve block techniques. Are we ignoring the anatomy of the "Retro Superior Costotransverse Ligament Space?". Anesth Analg 2023; 137: 458-65.
8. Luyet C, Eichenberger U, Greif R, Vogt A, Szücs Farkas Z, Moriggl B. Ultrasound-guided paravertebral puncture and placement of catheters in human cadavers: an imaging study. Br J Anaesth 2009; 102: 534-9.
9. Costache I, de Neumann L, Ramnanan CJ, Goodwin SL, Pawa A, Abdallah FW, et al. The mid-point transverse process to pleura (MTP) block: a new end-point for thoracic paravertebral block. Anaesthesia 2017; 72: 1230-6.
10. Klein SM, Nielsen KC, Ahmed N, Buckenmaier CC, Steele SM. In situ images of the thoracic paravertebral space. Reg Anesth Pain Med 2004; 29: 596-9.
11. Bang S. Erector spinae plane block: an innovation or a delusion? Korean J Anesthesiol 2019; 72: 1-3.
12. Chin KJ, Lirk P, Hollmann MW, Schwarz SK. Mechanisms of action of fascial plane blocks: a narrative review. Reg Anesth Pain Med 2021; 46: 618-28.