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Title: Retro Superior costotransverse ligament space block as an effective analgesia after laparoscopic gastrectomy: a case report

Running title: Retro SCTL space block for gastrectomy

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2 **gastrectomy: a case report**

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1 **Abstract**

2 **Background:** The retro superior costotransverse ligament space (RSS) block, reported as a novel
3 target in paraspinal block, involves the spreading of local anesthetics into the thoracic paravertebral
4 space through slits around the superior costotransverse ligament . This blocks not only the dorsal rami
5 but also the ventral rami, achieving a reliable complete sensory blockade.

6 **Case:** We performed an RSS block at the T5, T7, and T9 levels on both sides for postoperative
7 analgesia in two patients who underwent laparoscopic gastrectomy. Both patients showed complete
8 sensory blockade from T4 to L1 on the anterior, lateral, and posterior chest walls in the recovery room.
9 The resting and dynamic pain scores were 0 at 30 min and 6 h postoperatively. The pain score
10 consistently remained below 3 throughout postoperative period.

11 **Conclusions:** The RSS block provided effective postoperative analgesia in laparoscopic gastrectomy
12 through definitive complete sensory blockade.

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

15

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

15

1 **Case reports**

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

5 ***Case 1***

6 A 94-year-old woman (height: 141.5 cm, weight: 56.8 kg, BMI: 28.4 kg/m²) was diagnosed with
7 advanced gastric cancer and underwent laparoscopic subtotal gastrectomy.

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

19 *Technique of RSS block*

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

24 After checking the rib and transverse process level, a transducer (X-porte, SonositeTM, USA)

1 was moved caudally to check the TPVS at the transverse process level. After moving the transducer
2 slightly more so that the inferior articular process (IAP) was visible, we used the pivot maneuver to
3 set the view so that the SCTL, IAP, and TPVS were all clearly visible.

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

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

20 ***Case 2***

21 A 71-year-old man (height: 154 cm, weight: 43.7 kg, BMI: 18.4 kg/m²), was diagnosed with early
22 gastric cancer and underwent laparoscopic distal gastrectomy with Roux-en-Y gastrojejunostomy.

23 The surgery was performed with five port sites under general anesthesia, similar to the surgery
24 of the patient described in the first case [1]. The duration of the surgery was 3 h and 20 min, with an

1 estimated blood loss of 100 ml. The patient received 5 mg of dexamethasone after the induction of
2 anesthesia; additionally, 1000 mg of propacetamol, 30 mg of ketorolac, and 0.3 mg of ramosetron
3 were administered 30 min before the end of the surgery. After the end of the surgery, an RSS block
4 was performed at the T5, T7, and T9 IAP levels. In addition, intravenous PCA with continuous
5 infusion and allowed bolus (fentanyl 9 µg/h, nefopam 60 mg, and ramosetron 0.6 mg) was started in
6 the PACU.

7 In the PACU, the resting and dynamic pain scores were 0. The patient showed a complete
8 sensory blockade of T3-L1/2 levels on both sides of the anterior and lateral chest walls. Additionally,
9 there was a notable sensory blockade in the dermatomes extending from T2 to L5 on the posterior
10 chest wall. The motor power of the hip and knee extension/flexion was spared, measuring as grade
11 4/5. At 6 h postoperatively, the resting and dynamic pain scores were 0 and 2 respectively, and sensory
12 blockade was noted at T4-L1 in both sides of the anterior chest wall and at T4-T8 in the lateral and
13 posterior walls. However, the patient required intravenous tramadol (10 mg) as a rescue drug at 8 and
14 13 h postoperatively owing to a Numeric Rating Scale (NRS) score of 4. The pain score remained
15 below 3 throughout the entire postoperative period, and the patient did not require additional rescue
16 analgesia until discharge.

17

1 **Discussion**

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

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

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

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

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

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Figure legends

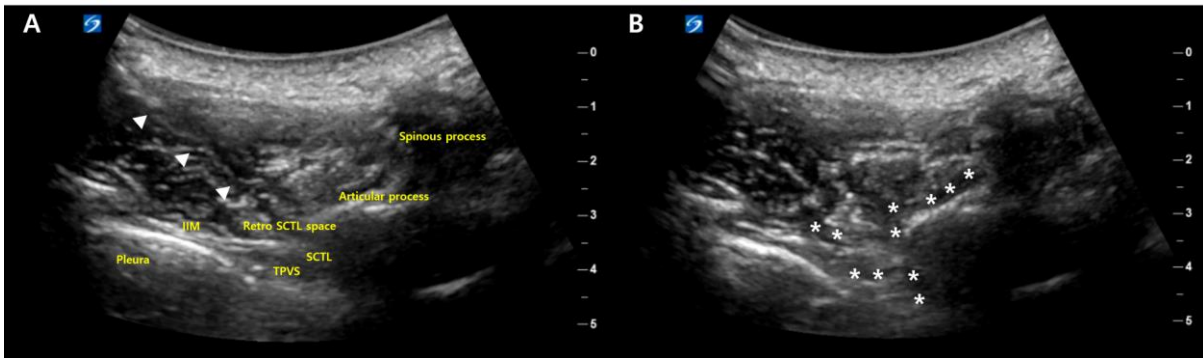


Fig. 1. Ultrasound image of RSS block. (A) The block needle inserted and positioned within the retro SCTL space. The block needle is indicated with a white arrowhead. (B) After completion of the LA injection, the spread of LA into the retro SCTL space, retrolaminar space, intervertebral space, and TPVS 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.