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Efficacy of Transversus Abdominis Plane Block and Rectus Sheath Block in Laparoscopic Inguinal Hernia Surgery

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We aimed to assess the efficacy of transversus abdominis plane (TAP) block and rectus sheath (RS) block in patients undergoing laparoscopic inguinal hernia surgery. Few studies have addressed the efficacy and safety associated with TAP block and RS block for laparoscopic surgery. Thirty-two patients underwent laparoscopic inguinal hernia surgery, either with TAP and RS block (Block$^+$ group, n = 18) or without peripheral nerve block (Block$^-$ group, n = 14). Preoperatively, TAP and RS block were performed through ultrasound guidance. We evaluated postoperative pain control and patient outcomes. The mean postoperative hospital stays were 1.56 days (Block+ group) and 2.07 days (Block$^-$ group; range, 1–3 days in both groups; $P = 0.0038$). A total of 11 patients and 1 patient underwent day surgery in the Block$^+$ and Block$^-$ groups, respectively ($P = 0.0012$). Good postoperative pain control was more commonly observed in the Block$^+$ group than in the Block$^-$ group ($P = 0.011$). TAP and RS block was effective in reducing postoperative pain and was associated with a fast recovery in patients undergoing laparoscopic inguinal hernia surgery.

Key words: TAP block – RS block – Inguinal hernia – Laparoscopic surgery

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Inguinal hernia repair is one of the most frequently performed surgical operations. The debate regarding the best repair technique for inguinal hernia is ongoing. Several trials have compared the efficacy of the Lichtenstein and laparoscopic approach for inguinal hernia repair.[1–6] Laparoscopic repair of inguinal hernia has certain advantages over open repair, such as reduced postoperative pain and morbidity, early recovery, rapid return to work, and better quality of life.[3–7] Several strategies have been reported to ameliorate postoperative pain in laparoscopic surgery.[8]

The transversus abdominis plane (TAP) block is a regional anesthetic technique that provides analgesia to the parietal peritoneum as well as to the skin and muscles of the anterior abdominal wall.[9,10] Despite a relatively low risk of complications and a high success rate using modern techniques, TAP block remains overwhelmingly underused. Although the technique is technically straightforward, it has not been adopted in clinical practice.[9,11] Moreover, rectus sheath (RS) block has been reported to be effective for pain management in patients undergoing umbilical hernia repair surgery.[12]

Generally, in laparoscopic inguinal hernia surgery, the sites of port incision are on the umbilical and bilateral middle abdomen. Those sites are associated with considerable postoperative discomfort. Thus, we performed TAP and RS block to ameliorate postoperative pain and improve patient outcomes. Here, we aimed to assess the efficacy of TAP and RS block in patients undergoing laparoscopic inguinal hernia surgery.

Materials and Methods

Patients and study design

A retrospective analysis was performed of 32 men with inguinal hernia who underwent laparoscopic hernia surgery with or without TAP and RS block at the Department of Surgery, Misugikai Sato Hospital, between June 2012 and February 2014. We started laparoscopic surgery for inguinal hernia in June 2012, and TAP and RS block with laparoscopic hernia surgery in January 2013. Written informed consent was obtained from all patients. Approval was obtained from the designated review board of the institution.

The 32 patients were categorized into two groups: those who underwent TAP and RS block ($Block^+$ group) and those who did not ($Block^-$ group). All surgical procedures were performed by the same surgeon using the laparoscopic transabdominal preperitoneal repair technique. All TAP and RS block procedures were performed preoperatively by the same surgeon, who was experienced in ultrasound-guided locoregional anesthesia.

Data recorded included demographic profile, preoperative and intraoperative variables, postoperative complications, and hospital stay. Surgery was performed at the day of admission. Postoperative pain control was evaluated during the physical examination performed at 3 hours after surgery. To assess the level of pain, an independent observer (nurse) asked the patient to grade his pain on a 3-point scale (good, fair, or bad) during hospital stay as described before.[11] The patients were discharged from the hospital when their pain was under control at rest and during movement.

TAP block

Patients were positioned in the supine position. The abdominal wall was scanned using a linear array transducer probe in the multibeam mode, connected to a portable ultrasound unit. The ultrasound probe was positioned laterally towards the anterolateral part of the abdominal wall between the iliac crest and the subcostal margin. The probe was oriented perpendicular to a line joining the anterior superior iliac spine and the inferior rib, to obtain a transverse view of the abdominal layers (from superficial to deep: external oblique muscle, internal oblique muscle, transversus abdominis muscle, and peritoneal cavity). An 80-mm, 22-gauge short-bevel needle was advanced from an anterolateral to a medial direction using the in-plane insertion with ultrasound real-time assessment. The progression of the needle, visible as a bright hyperechoic line, was assessed under direct ultrasonography. The insertion site was defined between the aponeurosis of the internal oblique and transversus abdominis muscles. During insertion, the transducer was moved with careful manipulation to continuously visualize the shaft and the tip of the needle and the aforementioned structures. When the tip was correctly located in the targeted plane, 10 mL of 0.3% ropivacaine was injected with intermittent aspiration, and the correct placement of the needle was confirmed as a dark shadow between the aponeurosis of the internal oblique and transversus abdominis muscles, pushing the muscle deeper (Fig. 1a). The aponeurosis of the internal oblique

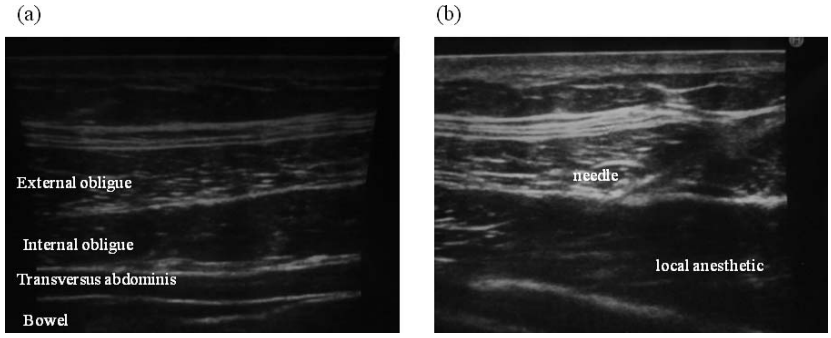

Fig. 1 (a) Abdominis wall layers before needle insertion. (b) Ropivacaine infusion during TAP block.

muscle was moved anteriorly after anesthetic injection (Fig. 1b).

RS block

The abdominal area at the lateral border of the rectus muscle and approximately 1 cm cephalad to the umbilicus was prepped and draped bilaterally. A surgeon placed a 22-gauge needle using an in-plane technique under ultrasound guidance as described above. The needle tip was placed close to the lateral border of the rectus sheath between the posterior rectus sheath and the rectus muscle. The spread of the local anesthetic was visualized between the rectus sheath and the rectus abdominis muscle under ultrasound guidance. The same procedure was repeated on the opposite side. A predetermined volume of 0.3% ropivacaine was injected (Fig. 2a and 2b).

Surgical procedure and postoperative management

Under general anesthesia using propofol and remifentanil during surgery, a 10-mmHg pneumoperitoneum was created with carbon dioxide through a minilaparotomy incision at the umbilicus. A standard 10-mm trocar was placed through the umbilicus for insertion of a 10-mm 30° laparoscope. Two additional 5-mm trocars were placed at the same level, approximately 5 to 6 cm on either side of the umbilicus. The peritoneal flap was raised. The anatomic structures, including Cooper ligament, inferior epigastric vessels, and the hernia sac, were defined. After the reduction of the hernial sac and identification and satisfactory anatomic delineation of the vas deferens and cord structures, Bard 3DMax Mesh (Medicon, Osaka, Japan) was introduced via the umbilical port into the abdomen. The size of mesh was medium. The entire myopectineal orifice was covered with the mesh. The upper part of the mesh was fixed in place with tacks (AbsorbaTack fixation device, Covidien, Massachusetts). The peritoneal flap was closed using 3-0 polydioxanone sutures.

No opioid was used postoperatively. Nonsteroidal anti-inflammatory drug was given in 6 hours if pain relief was inadequate.

Statistical analysis

We conducted the following analyses using Excel (Microsoft, Redmond, Washington) and Statcel2 (OMS Publisher, Saitama, Japan). The χ^2 test was used to compare categoric data, such as patient characteristics and surgical outcome. Student *t*-test was used to compare continuous data. A *P* value of <0.05 was considered statistically significant.

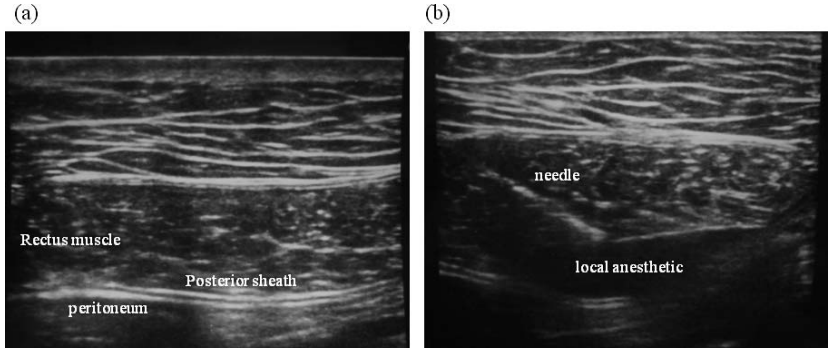

Fig. 2 (a) Abdominis wall layers before needle insertion. (b) Ropivacaine infusion during RS block.

Table 1 Demographic and clinical characteristics of patients who underwent laparoscopic inguinal hernia surgery

	Patients with inguinal hernia (n = 32)		
	Block$^+$ (n = 18)	Block$^-$ (n = 14)	*P* value
Age, y, median (range)	62.16 (36–81)	65.21 (34–83)	0.4842
Hernia side			0.138
Right	10	12	
Left	8	3	
Body mass index	22.99 (20.01–25.95)	22.39 (18.93–25.71)	0.3625
ASA score			0.82
I	11	8	
II	7	6	
III	0	0	

ASA, American Society of Anesthesiologists.

Results

Ultrasound-guided direct visualization showed correct placement of the local anesthetic in all cases. Patient characteristics at baseline are shown in Table 1. Demographic and clinical characteristics were similar between the two groups. The surgical outcomes are summarized in Table 2. The median total operative times were 72.28 minutes (range, 54–123 minutes) and 81.87 minutes (range, 56–150 minutes) in the Block$^+$ and Block$^-$ groups, respectively ($P = 0.054$). The amount of intraoperative bleeding was minimal in both groups. In the Block$^+$ group, the hernia type was direct, indirect, and mixed in 4, 12, and 2 patients, respectively. In the Block$^-$ group, the hernia type was direct and indirect in 5 and 9 patients, respectively. No patients had local anesthetic–related postoperative complications. There were no severe surgery-related postoperative complications. One patient had postoperative wound bleeding, which was treated conservatively. The mean postoperative hospital

Table 2 Surgical outcomes of patients who underwent laparoscopic inguinal hernia surgery

	Patients with inguinal hernia (n = 32)		
	Block$^+$ (n = 18)	Block$^-$ (n = 14)	*P* value
Operative time, min, median (range)	72.28 (54–123)	81.87 (56–150)	0.054
Hernia type			0.93
Direct	4	5	
Indirect	12	9	
Both	2	0	
Complications			ND
Wound bleeding	1	0	
Urinary retention	0	0	
Wound infection	0	0	
Postoperative chronic pain	0	0	
Nausea			ND
Severe	0	0	
Mild	0	0	
None	18	14	
Postoperative pain control (patient satisfaction)			0.011
Good	17	8	
Fair	1	6	
Bad	0	0	
Hospital stay, d, median (range)	1.56 (1–3)	2.07 (1–3)	0.038
Day surgery	11	1	0.0012

ND, no data.

stays were 1.56 and 2.07 days (range, 1–3 days in both groups) in the Block$^+$ and Block$^-$ groups, respectively ($P = 0.038$). A total of 11 patients and 1 patient underwent day surgery in the Block$^+$ and Block$^-$ groups, respectively ($P = 0.0012$). With regard to postoperative pain control after surgery (patient satisfaction), in the present study we achieved good results in most of our patients. The number of patients reporting good pain control was significantly higher in the Block$^+$ group than the Block$^-$ group (17 versus 8; $P = 0.011$).

Discussion

Laparoscopic inguinal hernia repair was first reported in 1990.[13] The technique has been refined into an attractive alternative to open hernia repair. In laparoscopic inguinal hernia surgery, the sites of port incision are associated with considerable postoperative discomfort. De Oliveira *et al*[8] reported the effect of TAP block on the reduction of postoperative pain in laparoscopic surgical procedures. TAP block reduced early pain at rest, late pain at rest, and postoperative opioid consumption.[8] In open hernia surgery, the efficacy of TAP block has been reported previously.[11] Compared with conventional local anesthesia, the combination of TAP block with local anesthesia showed a higher efficacy in obtaining adequate anesthesia and postoperative pain control for hernia repair.[11] In addition, we performed RS block for pain control in the umbilical site. RS block has been assessed as a modality for pain management in umbilical hernia repair.[12,14,15] Isaac *et al*[14] compared RS block with local anesthetic infiltration and found no difference in postoperative opioid use and pain scores between the two modalities. However, similar to our study, Gurnaney *et al*[12] found that ultrasound-guided RS block provided better analgesia than local anesthetic infiltration in umbilical hernia repair cases; furthermore, it can provide real-time information on the needle tip location and the local anesthetic delivery to the desired location.

Some complications, such as puncture of intraperitoneal viscera, have been documented after a blind TAP block.[16,17] McDermott *et al*[18] reported that that the needle tip and local anesthetic spread were in the correct plane only in 17 of 72 injections (23%) in 36 patients. In the remaining 55 patients, the needle tip was located in the subcutaneous tissue in 1 patient, the external oblique muscle in 1 patient, between the external and internal oblique muscles in 5 patients, the internal oblique muscle in 26 patients, the transversus abdominis muscle in 9 patients, and the peritoneum in 13 patients. TAP block was performed bilaterally using the standard landmark-based blind technique, and ultrasonography was used to detect the needle position and local anesthetic spread in their study. The use of ultrasound may reduce such complications. In the present study, we did not observe any complications. The use of ultrasound guidance has been shown to improve the success rate for the application of not only RS block, but ilioinguinal block and TAP block as well.[12]

In the present study, we used a combination strategy of TAP block and RS block. Patients experience pain or discomfort at the injection site when a large amount of anesthetic is injected in a single area. Moreover, injecting a great amount of local anesthetic at a single site may result in postoperative hematoma. Therefore, we combined these two block methods. This combination strategy was considered to be feasible and safe, and it did not cause postoperative complications, excess pain, or discomfort.

Thus, we report that laparoscopic surgery with TAP and RS block reduced postoperative pain in laparoscopic inguinal hernia surgery. Milone *et al*[11] reported that TAP block is effective in reducing pain after open inguinal hernia repair. To our knowledge, this is the first report to demonstrate the efficacy of TAP and RS block in laparoscopic inguinal hernia repair. There is significant evidence to support that this combination strategy causes less postoperative pain, at least in the immediate postoperative period.[19]

However, some limitations of the present study need to be addressed. The relatively small sample size and the presence of uncertain factors affecting the clinical outcome imply that our results may be inconclusive. Namely, all of the patients enrolled were men, and therefore these results cannot be extrapolated to women. Furthermore, pain is a difficult parameter to assess because individual variations, personal expectations, and social implications all affect pain perception and expression.[20] In our retrospective study, we evaluated only the 3-point scale during the hospital stay. However, the pain scores need to be represented in a more cohesive fashion, like visual analogue or Likert scale. And hospital stay is also a difficult parameter to assess because it is largely affected by local social

traditions, the health care system, and the patients' housing conditions.

In conclusion, TAP block and RS block were effective in reducing postoperative pain and hospital stay in patients undergoing laparoscopic inguinal hernia surgery. Further studies are needed to confirm our results.

Acknowledgments

Katsushi Takebayashi and Masakata Matsumura contributed equally to this article.

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