Laparoscopic Posterior Versus Lateral Transversus Abdominis Plane Block in Gynecology

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ABSTRACT

Background and Objectives: Transversus abdominis plane (TAP) block is a safe and effective type of regional anesthesia technique used in laparoscopic gynecologic surgery to minimize postoperative pain. Our study aimed to compare the analgesic effects of the posterior versus lateral approaches to laparoscopic-assisted TAP block in minimally invasive gynecologic surgery.

Methods: We performed a randomized controlled trial with 82 patients allocated to either posterior (n = 38) or lateral (n = 44) TAP block groups. Laparoscopic-assisted posterior or lateral TAP block was administered using liposomal bupivacaine mixture. All subjects were asked to fill out a questionnaire, which included postoperative pain scores at 6 h, 12 h, 24 h, 48 h, and 72 h, as well as narcotic utilization postoperatively. Both groups were compared for postoperative pain scores, opioid consumption, perioperative, and demographic characteristics.

Results: A total of 67 patients were analyzed in our study (n = 33 in posterior arm, n = 34 in lateral arm). Demographic characteristics including race, body mass index, comorbidities, American Society of Anesthesiologists classification, pre-operative diagnosis, complication rates, length of stay, and estimated blood loss were comparable between the two groups. The distribution of different operative procedures was similar between the two groups. There was no statistically significant difference in pain scores at 6 h, 12 h, 24 h, 48 h, and 72 h postoperatively between the two groups. However, patients receiving posterior TAP had a significant reduction in narcotic intake ($p = 0.0009$).

Conclusion: Laparoscopic-assisted TAP block is a safe and effective option for regional analgesia in laparoscopic gynecologic surgery. Posterior TAP block may help to reduce narcotic usage postoperatively.

Key Words: Minimally invasive gynecologic surgery, Analgesia, Posterior or lateral transversus abdominis plane block.

INTRODUCTION

Laparoscopic surgery has become the favored approach for most gynecologic procedures in the 21st century. One of the main goals of minimally invasive surgery is to promote quicker recovery with improved pain control and shorter hospital stay.[1] In the height of the opioid epidemic, with an estimated 40% of all opioid-related deaths due to overdose involving prescribed opiates, there has been special focus on optimization of postoperative pain control with opioid-free anesthesia.[2] Gynecologic surgeons have embraced protocols such as Enhanced Recovery after Surgery (ERAS), which promote multimodal analgesia, including regional and neuraxial techniques, with the goal of limiting opioid use during the postoperative period.[2–5]

Transversus abdominis plane (TAP) block was first described in 2001, as a regional anesthesia technique, used to alleviate somatic pain in lower abdominal surgery.[6] The relevant anatomical landmarks for a TAP block include the Petit triangle, bordered posteriorly by the medial edge of the latissimus dorsi muscle, anteriorly by the lateral edge of the external oblique muscle, and inferiorly by the iliac crest.[6] This technique involves injection of a local anesthetic solution into a plane between the internal oblique muscle and transversus abdominis muscle, targeting anterior rami of thoracolumbar nerves originating from the T6 to L1 spinal roots, which provide sensory function to the

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anterolateral abdominal wall.[7] Traditionally, TAP block has been performed under ultrasound guidance using one of four different approaches, targeting different areas of the anterior abdominal wall: subcostal TAP block provides analgesia to the anterior cutaneous branches of the thoracolumbar nerves T6–9, oblique subcostal TAP block delivers analgesia to anterior cutaneous branches T6-L1, posterior TAP block targets anterior cutaneous branches T9–12, and the lateral/mid-axillary technique blocks the anterior cutaneous branches T10–12. The analgesic effects obtained with TAP block extend from the anterior abdominal wall and parietal peritoneum to the lateral cutaneous branches of T9-L1.[8]

Laparoscopic-assisted TAP block was first described in laparoscopic nephrectomies.[9] Chetwood et al. defined a laparoscopic-assisted technique using classic TAP block anatomical landmarks.[9] On injection of local anesthetic, "Doyle's internal bulge sign" was seen as the transversus abdominis muscle and peritoneum were pushed internally. The internal bulge, seen after TAP injection, serves as the desired endpoint for this technique.[8–9] Since 2011, laparoscopic-assisted TAP block has gained popularity as an alternative way to administer anesthetic solution safely and efficiently, without requiring additional equipment.

TAP block has been shown to reduce postoperative opioid requirements, opioid-related side effects, and lower pain scores.[8,10] In laparoscopic gynecologic surgery, studies also showed lower opiate requirements as well as higher rate of same-day discharge with patients receiving TAP block compared to patient-controlled analgesia and opiate-only regimens.[11–12]

In terms of efficacy, previous studies have been performed comparing ultrasound-guided versus laparoscopic-assisted TAP block. Two randomized noninferiority clinical trials showed the laparoscopic approach to be noninferior to ultrasound-guided TAP block.[13–14] Furthermore, the efficacy of laparoscopic TAP block was also compared to port-site injections in a number of studies, which showed mixed results, warranting continued investigation.[15–17] TAP block-related complications are extremely rare, including transient femoral nerve palsy, anesthetic systemic toxicity, bowel hematoma, and liver laceration.[18–19] Prior studies have shown that the majority of TAP block complications resulted from incorrect needle placement and suggested lower complications with direct visualization.[18]

In gynecologic surgery, both lateral and posterior TAP block approaches have been used to provide analgesia. Thus far, both anesthesiologists and surgeons have chosen arbitrarily whether to utilize lateral versus posterior approach to TAP block. There have been a limited number of studies comparing efficacy of posterior versus lateral approaches of TAP block. For instance, in a meta-analysis of 12 randomized controlled trials including over 600 patients who underwent low transverse abdominal incision and received either ultrasound-guided posterior or lateral TAP block, morphine consumption was significantly lower during the first 12 to 24 h ($p = 0.02$) and 24 to 48 h ($p = 0.03$) in patients receiving posterior TAP block.[20] Posterior TAP block was also associated with lower pain scores at 24, 36, and 48 h compared to the lateral TAP group.[20] More recently, Faiz et al. performed a randomized controlled trial comparing ultrasound-guided posterior versus lateral TAP in patients undergoing Cesarean delivery.[21] Similarly, the authors found that posterior TAP was associated with lower pain scores postoperative.[21] However, these studies only evaluated patients undergoing laparotomy.

In patients having laparoscopic gynecologic surgery, a few studies have suggested improved pain scores with ultrasound-guided posterior TAP block. In 2013, Takeda et al. conducted a small randomized controlled trial with 20 patients undergoing laparoscopic gynecologic surgery and found significantly lower pain scores in those who received ultrasound-guided posterior block compared to lateral block.[22] Similar findings were seen in a retrospective study of 67 patients undergoing laparoscopic gynecologic surgery.[23] Posterior TAP block provided more effective analgesia compared to lateral TAP block based on statistically significantly lower pain scores ($p < 0.0001$).[23]

Although prior studies have demonstrated improved pain control with ultrasound-guided posterior TAP block, there is a paucity in the literature comparing the efficacy of lateral versus posterior laparoscopic-assisted TAP block. Moreover, studies previously conducted to evaluate the different TAP approaches in gynecologic surgery were retrospective or contained a small number of patients. Therefore, our study aimed to compare the analgesic effect of laparoscopic-assisted lateral TAP block versus posterior approach in randomized patients undergoing laparoscopic gynecologic surgery.

MATERIALS AND METHODS

Following approval from the institutional review board, patients undergoing laparoscopic gynecologic surgery at our institution were randomized to receive either the lateral TAP block or posterior TAP block through laparoscopic-guided administration. Assignments were made through block randomization using randomization software application in blocks of four. Patients were consented for participation in the study and were blinded to the type of TAP block administered.

Sample size was derived from a preliminary study that separately observed reductions in the pain score by 1.5 and 0.8 with the posterior and lateral TAP blocks, respectively. Assuming a power of 85%, with two-sided α level of 0.05, an estimated 65 patients were required for comparison. To account for 15% drop out, a total of 82 patients were recruited for this study (**Figure 1**).

Patients above 18 years of age undergoing major laparoscopic/robotic-assisted laparoscopic gynecologic surgery were enrolled. Surgeries included hysterectomy with or without bilateral salpingo-oophorectomy, adnexal surgery, myomectomy, and gynecologic cancer staging. All surgeries and TAP blocks were performed by two minimally-invasive gynecology oncology surgeons, with similar experiences, in an academic-affiliated community hospital. Based on the ERAS protocol in our institution and prior publications, all postoperative patients received acetaminophen 650 mg every 6 h, ibuprofen 800 mg every 8 h, gabapentin 300 mg every 8 h, and ketorolac 15 mg once immediately postoperatively, as long as there were no contraindications.[4–5] In addition, other components of the ERAS protocol utilized in our institution included preoperative high carbohydrate diet, early ambulation, and same-day discharge as long as clinically appropriate.

Patients with coagulopathy, chronic pain syndrome, chronic opioid use, alcohol dependency, and allergy to local anesthetic agents were excluded from the study. Also excluded were patients who were unable to consent independently, those having difficulty with verbal communication, and planned laparoscopic procedures that were converted to laparotomy. Informed consent was obtained in the preoperative unit, and a questionnaire for the Numeric Pain Rating Scale was given to the patient. Patients were asked to complete the questionnaire at 6 h, 12 h, 24 h, 48 h, and 72 h after the procedure, during rest. Additionally, a questionnaire reviewing narcotic use and postoperative pain management was given to the patient.

To prepare the injection, a mixture of 20 ml of liposomal bupivacaine and 20 ml of 0.5% bupivacaine HCl was made. At the completion of the primary surgical procedure, the medication was placed into a 20 ml syringe attached to a 20-gauge spinal needle for each side. For the lateral TAP block, the iliac crest was palpated, and the needle was introduced between the costal margin and the iliac crest at the mid-axillary line (**Figure 2**). For the posterior TAP block, the Petit triangle was targeted, which is bordered by the iliac crest, external oblique muscle, and the latissimus dorsi muscle (**Figure 2**). Twenty ml of the liposomal bupivacaine and bupivacaine HCl mixture was infiltrated into each side. To gauge the depth of the injection, the needle was first advanced to the level of the peritoneum, and a small amount of the medication was infiltrated, creating a fluid bubble. The needle was then drawn back slightly to reach the transversus abdominis plane. As the medication entered the plane between the fascia, an internal bulge could be appreciated laparoscopically, described in previous studies as "Doyle's bulge sign" (**Figure 3**).[8–9]

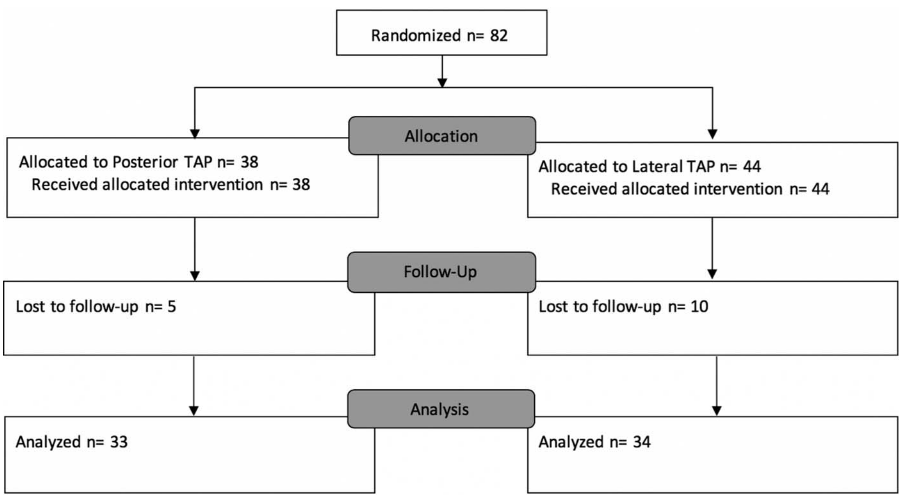

Figure 1. Flow diagram of randomization (Consolidated Standards of Reporting Trials, CONSORT).

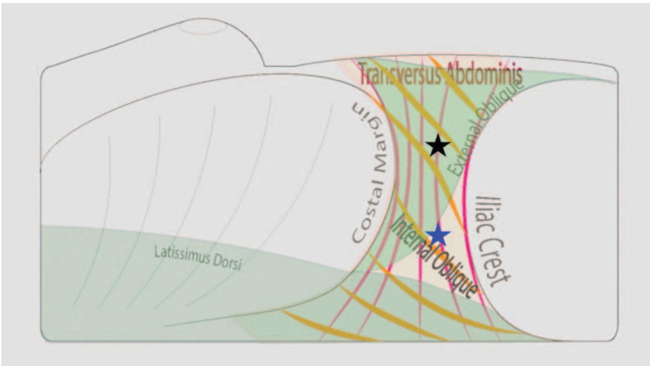

Figure 2. Illustration of laparoscopic-assisted lateral and posterior TAP block. Lateral and posterior TAP blocks are represented by black and blue stars, respectively.

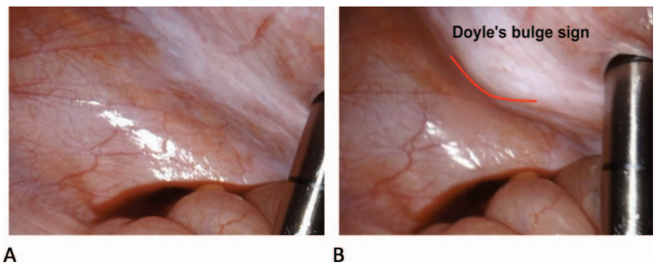

Figure 3. "Doyle's Internal Bulge Sign" in laparoscopic-assisted TAP block. A: Intraperitoneal view at location of posterior TAP block. B: "Doyle's bulge sign" is seen after injection of liposomal bupivacaine/bupivacaine HCl mixture.

The Numerical Rating Pain Score questionnaire was collected at the routine postoperative visit in the office, which was scheduled two weeks after surgery. Review of the electronic medical record was conducted to retrieve demographic information.

Statistical analysis was performed using SAS software© v 9.4 (SAS Institute Inc., Cary, NC). Patient demographics, preoperative diagnosis, type and length of surgery, complications, and American Society of Anesthesiologists (ASA) classification were analyzed using X-square and Fisher's Exact test. The Wilcoxon Rank Sum and Student's T-test were utilized to compare pain score and narcotic use.

RESULTS

A total of 82 patients were recruited for this study and were randomized to 38 subjects in the posterior TAP block group and 44 patients in the lateral TAP block group. Five and 10 patients were lost to follow up from the posterior and lateral groups, respectively. We analyzed a total of 33 patients, who received the posterior TAP block and 34 patients, who received the lateral TAP block (**Figure 1**).

Race and body mass index were similar in the two groups (**Table 1**). The subjects in the posterior TAP block group were older, with a mean age of 56.6 as compared to 49.6 in the lateral group ($p = 0.03$). Patients were described as having either no medical comorbidities or any of the following: history of cerebrovascular accident, diabetes, multiple sclerosis, or degenerative joint disease. ASA classification was also recorded for each patient. There was no statistical difference between the lateral and posterior TAP block groups for medical comorbidities or ASA classification (**Table 1**).

The preoperative diagnoses were categorized into pelvic mass, abnormal uterine bleeding, Breast cancer gene (BRCA) carrier status, cervical dysplasia, and gynecologic cancer. The types of procedure included total laparoscopic hysterectomy with or without bilateral salpingo-oophorectomy with or without robotic assistance, total laparoscopic hysterectomy with bilateral salpingo-oophorectomy and lymph node dissection with or without robotic assistance, laparoscopic staging without hysterectomy, laparoscopic myomectomy, and laparoscopic removal of the adnexa. No significant difference was found in the preoperative diagnosis or type of procedure between the lateral and posterior TAP block groups (**Table 1**).

Length of surgery was longer in the lateral TAP block arm, with mean surgical time of 143.0 min compared to 105.7 min for the posterior arm ($p = 0.02$).

There was no significant difference in the surgical complication rate, which included incidental cystotomy, hematoma, blood transfusion, and lymphocyst formation between the two treatment groups (**Table 2**). Furthermore, none of the patients enrolled in this study experienced transient femoral nerve palsy, anesthetic systemic toxicity, bowel hematoma, or liver laceration. Similarly, the lengths of stay, which ranged from same-day discharge to 2 postoperative days, as well as estimated blood loss were comparable between the lateral and posterior groups (**Table 2**).

There was no statistically significant difference in the pain scores in 6 h, 12 h, 24 h, 48 h, and 72 h postoperatively between the two arms of the study (**Table 3**). However, a significant reduction in narcotic intake was seen in the posterior group ($p = 0.0009$) (**Figure 4**).

Table 1.
Patient Demographics

	Posterior TAP Block (n = 33)	Lateral TAP Block (n = 34)	*p*
Mean age, years, (SD)	56.6 (12.6)	49.6 (13.5)	0.03
Mean BMI, kg/m^2, (SD)	31.5 (8.2)	31.6 (7.5)	0.97
Race			
White	23	24	
Non-White	8	10	
			0.75
Pre-operative diagnosis			
Pelvic mass	6	12	
AUB, endometrial hyperplasia	14	13	
BRCA gene carrier	2	1	
Cervical dysplasia	2	2	
Gynecologic cancer	9	6	
			0.54
Comorbidities			
None	20	24	
Stroke history	1	1	
Type 2 Diabetes	4	2	
Other	8	7	
			0.79
ASA Classification			
1	3	8	
2	19	14	
3	11	12	
			0.24

TAP, transverse abdominis plane; SD, standard deviation; BMI, body mass index; AUB, abnormal uterine bleeding; BRCA, breast cancer; ASA, American Society of Anesthesiologists.

DISCUSSSION

Our study found significantly lower postoperative narcotic use in patients receiving posterior TAP block compared to the lateral approach. Although pain scores were not statistically significantly different between the two laparoscopic TAP block groups, our findings support superior analgesic effect of laparoscopic-assisted posterior TAP block compared to lateral TAP block. Furthermore, this study also demonstrated laparoscopic-assisted TAP block is a safe technique, under direct visualization which avoids the risk of intra-abdominal organ injury. Surgical complication rates were very low and non-statistically significant between the two treatment groups.

Strengths of this study include randomization of subjects into the two TAP block groups, reduction in intraoperative variability with cases being performed by two minimally invasive gynecology oncology surgeons only, and use of multimodal pain regimen in all patients enrolled. Additionally, previous studies used shorter acting anesthetics such as bupivacaine, while our study used liposomal bupivacaine, which may provide longer analgesic effect.

Our study also has a number of limitations. First, a possible source of bias includes lack of generalizability of data from our institution to other populations. In particular, our study excluded chronic pain patients and should not be generalized to this patient population, given potentially

Table 2.
Surgical Outcomes

	Posterior TAP Block	Lateral TAP Block	*p*
Type of operation			
TLH BS/BSO	17	16	
Robotic assisted TLH BS/BSO	7	7	
Laparoscopic staging	3	0	
Laparoscopic myomectomy	0	4	
Laparoscopic BSO	6	7	
			0.15
Mean operative time (SD)	105.7 (44.1)	143 (75.5)	0.02
Mean estimated blood loss (SD)	43.3 (72.7)	62.4 (129.5)	0.85
Length of hospitalization (days)			
0	21	19	
1	9	13	
2	3	2	
			0.63
Complications			
None	31	32	
Cystotomy	1	1	
Hematoma	1	0	
Lymphocyst	0	1	
			1

TLH, total laparoscopic hysterectomy; BS/BSO, bilateral salpingectomy or bilateral salpingo-oophorectomy; SD, standard deviation.

Table 3.
Comparison of Pain Scores After 6, 12, 24, 48, and 72 hours after Surgery, Expressed as Medial Values (Interquartile Range)

Hours after surgery	Posterior TAP block	Lateral TAP block	*p*-value
6	4 (5)	5 (4)	0.3
12	3 (3)	4 (4)	0.1
24	3 (3)	3 (4)	0.17
48	2 (4)	2 (5)	0.4
72	2 (3)	2 (3)	0.36

TAP, transverse abdominis plane.

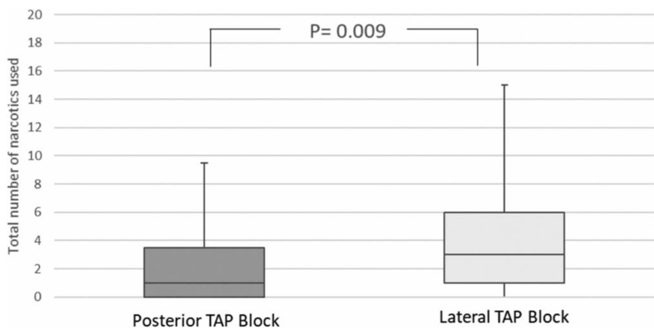

Figure 4. Total number of narcotics used in the postoperative period, expressed in median values.

different pain tolerance and response to pain relievers. Ideally, patients would have been age-matched to eliminate confounders from the study. Moreover, the lateral TAP block group had significantly longer operative time compared to the posterior group. Increased operative time was not due to the TAP procedure itself, given either block was administered using the same injection technique except for different anatomical landmarks, which can be easily accessed during the procedure. However, patients may have experienced worse postoperative pain due to longer, more complex procedures. Another potential source of bias in the study includes survey-based data collection with patient recorded narcotic consumption.

Future studies should consider objective data collection on narcotic use postoperatively.

As we continue to optimize pain regimens by minimizing the amount of narcotic medications administered to patients in the perioperative period, it is crucial to better understand and utilize narcotic-free anesthetics for pain relief. ERAS pathways have been adopted by different specialties including obstetrics and gynecology.[2–3] The utility of TAP block in improving postoperative pain has been previously shown in gynecologic surgeries and Cesarean deliveries.[19–22] Given different techniques are used to administer TAP block, our study was designed to compare the efficacy of laparoscopic-assisted lateral versus posterior TAP block. Our randomized trial results showed lower narcotic consumption after posterior TAP block. Lower narcotic requirement in the posterior group may suggest that this approach is more effective in relieving visceral pain, pending further investigation. Future studies with more diverse sample population, are warranted to advance our understanding of narcotic-free pain regimens.

CONCLUSION

In summary, our study found that posterior laparoscopic-assisted TAP block may decrease postoperative narcotic usage in minimally invasive gynecologic surgeries as part of a multimodal analgesic protocol.

References:

1. Wong M, Morris S, Wang K, Simpson K. Managing postoperative pain after minimally invasive gynecologic surgery in the era of the opioid epidemic. *J Minim Invasive Gynecol.* 2018; 25(7):1165–1178.

2. Mark J, Argentieri DM, Gutierrez CA, et al. Ultrarestrictive opioid prescription protocol for pain management after gynecologic and abdominal surgery. *JAMA Network Open.* 2018;1(8): e185452.

3. Modesitt SC, Sarosiek BM, Trowbridge ER, et al. Enhanced recovery implementation in major gynecologic surgeries. *Obstet and Gynecol.* 2016;128(3):457–466.

4. Kalogera E, Bakkum-Gamez JN, Jankowski CJ, et al. Enhanced recovery in gynecologic surgery. *Obstet Gynecol.* 2013; 122(2 Pt 1):319–328.

5. Hah J, Mackey SC, Schmidt P, et al. Effect of perioperative gabapentin on postoperative pain resolution and opioid cessation in a mixed surgical cohort: a randomized clinical trial. *JAMA Surg*. 2018;153(4):303–311.

6. Rafi AN. Abdominal field block via the lumbar triangle revisited. *Anaesthesia.* 2012;67(12):1399–1401.

7. Tsai HC, Yoshida T, Chuang TY, et al. Transversus Abdominis Plane Block: An Updated Review of Anatomy and Techniques. *Biomed Res Int.* 2017;2017:8284363.

8. Young MJ, Gorlin AW, Modest VE, Quraishi SA. Clinical implications of the transversus abdominis plane block in adults. *Anesthesiol Res Pract.* 2012;19:731645.

9. Chetwood A, Agrawal S, Hrouda D, et al. Laparoscopic-assisted transversus abdominis plane block: a novel insertion technique during laparoscopic nephrectomy. *Anaesthesia*. 2011; 66:317–318.

10. Zhao X, Tong Y, Ren H, et al. Transversus abdominis plane block for postoperative analgesia after laparoscopic surgery: a systematic review and meta-analysis. *Int J Clin Exp Med.* 2014; 7(9):2966–2975.

11. Kawahara R, Tamai Y, Yamasaki K, Okuno S, Hanada R, Funato T. The analgesic efficacy of ultrasound-guided transversus abdominis plane block with mid-axillary approach after gynecologic laparoscopic surgery: a randomized controlled trial. *J Anaesthesiol Clin Pharmacol.* 2015;31(1):67–71.

12. Seagle B-L, Miller ES, Strohl AE, Hoekstra A, Shahabi S. Transversus abdominis plane block with liposomal bupivicane compared to oral opioids alone for acute postoperative pain after laparoscopic hysterectomy for early endometrial cancer: a cost-effectiveness analysis. *Gynecol Oncol Res Pract*. 2017;4:12.

13. Park SY, Park JS, Choi GS, Kim HJ, Moon S, Yeo J. Comparison of analgesic efficacy of laparoscope-assisted and ultrasound-guided transversus abdominis plane block after laparoscopic colorectal operation: a randomized, single-blind, non-inferiority trial. *J Am Coll Surg.* 2017;225(3):403–410.

14. Wong DJ, Curran T, Poylin VY, Cataldo TE. Surgeon-delivered laparoscopic transversus abdominis plane blocks are non-inferior to anesthesia-delivered ultrasound-guided transversus abdominis plane blocks: a blinded, randomized non-inferiority trial. *Surg Endosc*. 2020;34(7):3011–3019.

15. Kargar R, Minas V, Gorgin-Karaji A, et al. Transversus abdominis plane block under laparoscopic guide versus port-site local anaesthetic infiltration in laparoscopic excision of endometriosis: a double-blind randomized placebo-controlled trial. *BJOG*. 2019;126:647–654.

16. Hutchins J, Argenta P, Berg A, Habeck J, Kaizer A, Geller MA. Ultrasound-guided subcostal transversus abdominis plane block with liposomal bupivacaine compared to bupivacaine infiltration for patients undergoing robotic-assisted and laparoscopic hysterectomy: a prospective randomized study. *J Pain Res*.2019;12:2087–2094.

17. El Hachem L, Small E, Chung P, et al. Randomized controlled double-blind trial of transversus abdominis plane block versus trocar site infiltration in gynecologic laparoscopy. *Am J Obstet Gynecol.* 2015;212(2):182.e1–9.

18. Manatakis DK, Stamos N, Agalianos C, Karvelis MA, Gkiaourakis M, Davides D. Transient femoral nerve palsy complicating "blind" transversus abdominis plane block. *Case Rep Anesthesiol.* 2013;874215.

19. Lancaster P, Chadwick M. Liver trauma secondary to ultrasound-guided transversus abdominis plane block. *Br J Anaesth.* 2010;104(4):509–510.

20. Abdallah FW, Laffey JG, Halpern SH, Brull R. Duration of analgesic effectiveness after the posterior and lateral transversus abdominis plane block techniques for transverse lower abdominal incisions: a meta-analysis. *Br J Anaesth.* 2013;111(5):721–735.

21. Faiz S, Alebouyeh M, Derakhshan P, Imani F, Rahimzadeh P, Ashtiani M. Comparison of ultrasound-guided posterior transversus abdominis plane block and lateral transversus abdominis plane block for postoperative pain management in patients undergoing cesarean section: a randomized double-blind clinical trial study. *Journal of Pain Research.* 2018;11:5–9.

22. Taketa Y, Fujitani T, Irisawa Y, Sudo S, Harada Y, Takaishi K. Comparison of analgesic efficacy between posterior and lateral transversus abdominis plane block techniques for laparoscopic gynecological surgery. *Masui.* 2015;64(10):1015–1022.

23. Yoshiyama S, Ueshima H, Sakai R, Otake H. A posterior TAP block provides more effective analgesia than a lateral TAP block in patients undergoing laparoscopic gynecologic surgery:a retrospective study. *Anesthesiol Res Pract.* 2016:4598583.