Egyptian Journal of Anaesthesia (2014) **30**, 39–45

Egyptian Society of Anesthesiologists

Egyptian Journal of Anaesthesia

www.elsevier.com/locate/egja
www.sciencedirect.com

Research Article

Transversus abdominis plane block: The analgesic efficacy of a new block catheter insertion method

Tarek F. Tammam *

Department of Anesthesia and Intensive Care, Faculty of Medicine, Suez Canal University Hospital, Ismailia, Egypt

Received 15 May 2013; revised 21 July 2013; accepted 30 July 2013
Available online 27 August 2013

KEYWORDS

Regional analgesia;
Transversus abdominis plane block;
Technique;
Catheter placement

Abstract *Background:* Local anesthetic (LA) administration via a correctly placed block catheter could help optimum deposition in the transversus abdominis plane (TAP). The aim of the study is to assess the postoperative analgesic efficacy of TAP block achieved by initially injecting the LA through a catheter placed by ultrasound-guided Seldinger catheter insertion approach (USCIA).
Methods: Fifty patients scheduled for open inguinal hernia repair were randomized into two groups. Group USCIA: Patients received USCIA-TAP block. Group control: Patients did not receive TAP block. All patients received patient-controlled intravenous morphine postoperatively. The analgesic efficacy of USCIA-TAP block was assessed measuring the total amount of postoperative morphine requirements over the first 48 h postoperatively. Pain scores and level of patient satisfaction with pain relief after surgery were noted.
Results: The mean cumulative morphine requirement over the first 48 postoperative hours was significantly lower in USCIA group in comparison with the Control group (18.1 ± 4.1 vs. 57.9 ± 5.3 mg). The success rate of USCIA-TAP block catheter placement was 88%. The pain score of USCIA group was significantly lower at 3, 6, 12, and 24 postoperative hours compared with the Control group. The USCIA group had a significantly higher rate of satisfaction with regard to pain control in comparison with the Control group at the 12th and 24th postoperative hours (9 {8–10} vs. 6 {5–7} and 9 {8–10} vs. 7 {6–8}, respectively).
Conclusion: The use of a single dose of USCIA-TAP block reduced the total amount of morphine requirement over the first 48 postoperative hours for patients undergoing abdominal surgery.

1. Introduction

Transversus abdominis plane (TAP) block relies on deposition of the local anesthetic solution at a neurovascular plane between the internal oblique and transversus abdominis muscles [1]. Unsuccessful TAP block could be attributed to imprecise injection of the local anesthetic (LA) solution relative to the transversus abdominis plane. The inaccurate LA deposition can be a consequence of both landmark-guided [2] and

* Address: Department of Anesthesia and Intensive Care, Suez Canal University Hospital, Egypt. Tel.: +20 1099122663.
E-mail address: tarek1367@hotmail.com
Peer review under responsibility of Egyptian Society of Anesthesiologists.

Production and hosting by Elsevier

1110-1849 © 2013 Production and hosting by Elsevier B.V. on behalf of Egyptian Society of Anesthesiologists.
http://dx.doi.org/10.1016/j.egja.2013.07.008

ultrasound-guided techniques [3]. Administration of the LA via the block needle could not guarantee accurate deposition in the true plane [2]. The block needle tip may not remain exactly in the correct neuro-fascial plane resulting in variable degrees of LA deposition. Ultrasound assessment of the landmark-guided TAP blocks verified inaccurate placement of the administered LA relative to the transversus abdominis plane [4]. Ultrasonic imaging allows for a more accurate injection of the LA at the correct neurovascular plane. However, it is relatively difficult to accurately assess the pattern of LA spread relative to the TAP by the 2-dimensional ultrasound.

Local anesthetic administration via a correctly placed TAP block catheter could help optimum LA deposition in the right plane. The traditional method of catheter placement has a high rate of secondary block failure [5]. This could be attributed to catheter tip misplacement [6] or catheter dislodgement [7]. An alternative intervention technique, using the principle of Seldinger method [8] for inserting the TAP block catheter with the help of ultrasound (ultrasound-guided Seldinger catheter insertion approach), can ensure proper catheter placement with accurate LA deposition. It can thus be hypothesized that the TAP block provided by initially injecting the LA through the catheter (USCIA) could provide effective postoperative analgesia. The aim of this study is to assess the postoperative analgesic efficacy of the TAP block achieved by injecting the LA through the catheter placed by the ultrasound-guided Seldinger catheter insertion approach (USCIA).

2. Patients and methods

Approval of the hospital's Research Ethics Committee and written informed consent from the patients regarding the TAP block with detailed explanation of the technique, effects, and possible complications of the procedure were obtained. Fifty patients between the ages of 18 and 50 years with ASA physical status I–II scheduled for elective unilateral open repair of inguinal hernia under general anesthesia were enrolled in a prospective, randomized clinical trial. The study was conducted from January 2012 to February 2013. Patients with history of allergy to local anesthetics, coagulopathies, obesity (BMI $> 30\ kg/m^2$), or refusal in addition to those on chronic analgesic therapies were excluded from the study. The allocation sequence was generated by a random number table. Group allocation was concealed in sealed, opaque envelopes that were not opened until patient consent had been obtained. Patients included in the study were randomized for postoperative analgesia into two groups. In Group USCIA ($n = 22$), patients received TAP block using ultrasound-guided Seldinger catheter insertion approach, and in Group control ($n = 23$), patients did not received TAP block. All patients received postoperative patient-controlled intravenous analgesia (PCA).

General anesthesia was standardized in both groups. Patients were pre-medicated with oral midazolam (7.5 mg) 30 min before the surgery. Standard monitoring of electrocardiogram, non-invasive blood pressure, and peripheral oxygen saturation were established. General anesthesia was induced with sufentanil 0.2 mg/kg, propofol 2 mg/kg, and cisatracurium 0.1 mg/kg. Anesthesia was maintained with 1 MAC sevoflurane in an oxygen/air mixture (40:60). The bispectral index was maintained within the range of 40–60, and the end-tidal carbon dioxide partial pressure was maintained within the range of 30–40 mmHg. At the end of surgery, residual neuromuscular blockade was pharmacologically antagonized with neostigmine (50 μg/kg) and glycopyrrolate (10 μg/kg).

Ultrasound-guided Seldinger catheter insertion approach (USCIA) for TAP block (USCIA-TAP block): All TAP catheters were inserted before surgery by one anesthesiologist, to minimize the effect of operator experience on the success rate and the rate of mechanical complications. The catheter placement was performed on the operating table under complete aseptic technique with the patient in a supine position, using a linear array transducer with adjustment of frequency (13–6 MHz), depth and gain to spot the best view. The ultrasound (Sonosite Inc., Bothel, Washington, USA) probe was initially placed in a plane transverse to the antero-lateral abdominal wall at a level midway between the lower costal margin and iliac crest. The ultrasonographic visualization of the abdominal wall layers was considered satisfactory when the external oblique abdominis muscle, internal oblique abdominis muscle, transversus abdominis muscle, and the transversus abdominis plane were clearly identified in the region of the mid-axillary line. After local infiltration with 2 ml lidocaine (10 mg/ml), a 17 gauge Tuohy needle (HS Hospital Service S.P.A., via Angela vacchi, Aprillia, ITALY) was introduced 3 cm medial to the ultrasound probe. Under real-time ultrasound guidance, the Tuohy needle was advanced in-plane with the transducer at an angle of approximately 45° to the skin. The needle tip was advanced slowly (with the needle bevel facing anteriorly) in a medial to lateral direction toward the target plane (TAP) at the mid-axillary line. Once the needle tip was presumed to be in the correct position, boluses of 5 mL normal saline were injected as required to distend the plane. The right position of the needle tip was confirmed by expansion of transversus abdominis plane as a dark shadow between the internal oblique and the transversus abdominis muscles. A 0.81 mm, 45 cm guide wire (FlexTip; Arrow International, Reading, PA) was passed through the Tuohy needle and advanced into the transversus abdominis plane. The needle was then withdrawn, while maintaining the guide wire under ultrasound view to ensure its correct position, after which a tissue dilator was passed over the guide wire. Following removal of the dilator, a 14 gauge, 16 cm single lumen catheter (FlexTip Catheter; Arrow International, Reading, PA) was passed over the guide wire and advanced inside the transversus abdominis plane. The guide wire was then removed leaving the catheter within the plane. The catheter was secured to the skin, connected to a bacterial filter, and covered with a clear occlusive dressing. Successful catheter placement was defined as correct placement of the TAP catheter within the transversus abdominis plane under real-time ultrasound, confirmed by (a) smooth injection of the saline solution through the catheter with expansion of the transversus abdominis plane, seen as a dark shadow between the internal oblique and the transversus abdominis muscles, and (b) by inserting the TAP catheter 8 cm within the transversus abdominis plane [measured by following equation: Length of the catheter at the level of the skin minus the length of the inserted needle from the skin till the level of the transversus abdominis plane]. If the catheter could not be placed within 30 min from the time the ultrasound probe first touched the patient's skin until insertion of the catheter and removal of the guide wire, the procedure was considered as an insertion failure. These cases were excluded from the study. At the end of surgery and after an aspiration test, twenty milliliters of plain bupivicaine (2.5 mg/ml) was slowly and incrementally

administered through the catheter under real-time imaging. The straight course of block catheters inserted by USCIA was confirmed by an abdominal X-ray-lateral view.

Proper use of the PCA device was explained to the patients during the preoperative anesthetic assessment. In the post-anesthetic care unit, analgesia was maintained using 1 mg i.v. morphine in 8 min intervals till pain decreased to $\leqslant 3$ points on a numerical rating scale (NRS) at rest. Subsequently, analgesia was maintained in the ward using intravenous patient-controlled analgesia (IV-PCA), 1 mg morphine bolus on demand with an 8 min lock-out interval for a period of 48 h postoperatively. Sedation score, nausea and vomiting score, and cumulative dose of morphine were documented regularly at 3 h time interval on an observation chart. Patient demographics, the duration of surgery, patient's ASA physical status, and study outcomes were documented by independent investigators who were not involved in the catheter placement procedure and were blinded to the group assignment.

2.1. Primary outcome

The analgesic efficacy of USCIA-TAP block was assessed by administrating the initial LA dose through the catheter and then measuring the total amount of i.v. morphine consumed over the first 48 h postoperatively. The cumulative dose of morphine at 6, 12, 24, 36, and 48 h post-surgery were recorded. Secondary outcome measurements included the TAP catheter insertion success rate and pain scores during the first 48 h postoperative. The level of patient satisfaction with respect to postoperative pain control was also measured using the numerical rating scale (0, no satisfaction and 10, maximum satisfaction) at 12, 24, 36, 48 h after surgery.

All the patients were asked to rate their postoperative surgical pain at rest and on coughing using the numerical rating scale (NRS) (NRS: 0 = no pain, 10 = worst pain) at regular predefined time intervals (1, 3, 6, 12, 24, 36, and 48 h) after surgery. Incidence of complications during and after the block procedure (bruising, blood aspiration, hematoma, abdominal organ injury, fluid leakage, catheter occlusion, or catheter dislodgement) was documented by an investigator blinded to the aim of the study. The insertion site was also checked once a day for local signs of infection. The incidence of opioid-related side effects such as episodes of nausea and vomiting (PONV), urinary retention, and pruritus during the first 48 postoperative hours was also recorded by directly asking the patient at 8 h time intervals. Ondansetron 4 mg i.v. was offered to any patient who complained of nausea or vomiting.

The sample size calculation was based on the assumption that the patients undergoing open inguinal hernia repair required 60 mg morphine over 48 h postoperatively with a standard deviation of 12 mg (pilot studies). Based on a power of 80%, and to obtain a statistical significance of $p < 0.05$ for 25% of reducing morphine consumption, the minimum number of patients needed was 19 in each group. The sample size was increased to 25 patients in each group to minimize any effect of data loss and considering the patients that might be excluded.

2.2. Statistical analyses

Data were analyzed using Statistical Package for the Social Sciences (SPSS) program, version 12.0 (SPSS Inc, Chicago, IL). The data were presented as mean ± standard deviation (SD) for normally distributed continuous variables and as median (range) for not normally distributed continuous quantitative or ordinal variables. Paired Student, *t*-test or Mann Whitney test were used for group comparisons. Categorical variables were statistically analyzed by chi square analysis or Fisher's exact test. A *p*-value of less than 0.05 was considered statistically significant.

3. Result

Fifty patients were entered into the study. Three patients in the USCIA group were excluded after enrollment due to unsuccessful block catheter placement and two more patients in the Control group were excluded because of patient refusal to use the PCA device after six postoperative hours (one patient) and earlier patient hospital discharge (one patient). The USCIA and Control groups were comparable in terms of patient's characteristics and duration of the surgery (Table 1).

The difference in the time to first rescue dose of analgesic administration between the USCIA group (25.9 ± 5.3 min) and the Control group (24.1 ± 5.4 min) was not statistically significant. All USCIA-TAP blocks were performed by a linear ultrasound probe (13–6 MHz). Ultrasound visualization of the internal oblique abdominis muscle, transversus abdominis plane, and transversus abdominis muscle was possible in all patients of the USCIA group. The success rate of block catheter placement using USCIA was 88%. Failure of block catheter placement was attributed to difficultly in advancement of the guide wire into the transversus abdominis plane (in two patients) and catheter insertion less than 8 cm (in one patient). All the successfully placed block catheters were advanced 8 cm beyond the needle tip and the guide wires were smoothly inserted into the transversus abdominis plane after hydro-dissection (Fig. 1A–C). The block catheter insertion was facilitated by a tissue dilator in all cases (Fig. 1D). The advancement of block catheter within the transversus abdominis plane was followed by ultrasound in all cases (Fig. 1E). The straight course of the successfully placed catheters within the transversus abdominis plane was confirmed by abdominal X-ray-lateral view (Fig. 2A and B). The catheter was removed uneventfully after 48 postoperative hours.

The USCIA-TAP block significantly reduced the cumulative postoperative morphine consumption at all time intervals in comparison with the Control group (Table 2). The mean cumulative morphine requirement over the first 48 postoperative hours was significantly lower in the USCIA group (18.1 ± 4.1 mg) in comparison with the Control group (57.9 ± 5.3 mg) (Table 2). It was recorded that 54.5% of patients in the USCIA group did not require any additional analgesia from the 6th to 24th postoperative hour, whereas all the patients in the Control group received supplemental opioids in the same period.

The postoperative pain score of the USCIA group was significantly lower, both at rest and during cough at 3, 6, 12, and 24 postoperative hours compared with the Control group (Table 3). However, there were no significant difference in the pain scores between the USCIA group and the Control group in the first and 48th postoperative hours (Table 3). The patients in the USCIA group had a significantly higher rate of satisfaction with regard to postoperative pain control in comparison

Table 1 Patients' demographics and clinical characteristics of groups.

Parameters	Group USCIA (n = 22)	Group control (n = 23)
Age (yr)	39 ± 11.4	37 ± 10.8
Weight (kg)	75.5 ± 8.3	77.4 ± 9.1
Height (cm)	173.6 ± 5.2	175.3 ± 6.5
ASA physical status I/II (n)	17/5	17/6
M/F (n)	18/4	19/4
Duration of surgery (min)	69.3 ± 11	67.9 ± 13.5
Time to first analgesic administration (min)	25.9 ± 5.3	24.1 ± 5.4

Values are presented as mean ± SD or absolute numbers, as indicated. There were no significant differences between groups. Abbreviation: Male, M; female, F; N, number, USCIA, ultrasound-guided Seldinger catheter insertion approach; ASA, American Society of Anesthesiologists.

with the Control group at the 12th and 24th postoperative hours (9 {8–10} vs. 6 {5–7} and 9 {8–10} vs. 7 {6–8} respectively) (Table 4).

There was no incidence of hematoma, bruising, fluid leakage, catheter kinking, catheter occlusion, inadvertent catheter dislodgement, or any local sign of infection in the USCIA group over the 48 postoperative hours. Serosanguineous fluid was observed at the needle hub during guide wire insertion in 13.6% of cases. In these cases, the guide wire was removed and blood aspiration test done which was negative. After this, five mL of normal saline solution was injected through the needle and the block procedure was continued. In all the cases, after catheter insertion, negative blood aspiration was confirmed before local anesthetic injection. There were no significant differences observed in the incidence of opioid-related side effects (sedation, PONV, pruritus, and urinary retention) between the USCIA and Control groups during the 48 h study period. Differences in the incidence of PONV in the Control group (8.7%) and the USCIA group (4.5%) were statistically insignificant. All cases of PONV were treated with Ondansetron 4 mg i.v. One patient in the Control group complained of pruritus that resolved without treatment.

4. Discussion

Transversus abdominis plane (TAP) block is a relatively new method for postoperative analgesia following abdominal surgery. It provides somatic analgesia of the antero-lateral abdominal wall without motor blockade [9]. In the current study, the TAP block was performed using a new technique, ultrasound-guided Seldinger catheter insertion approach (USCIA). The USCIA-TAP block significantly reduced the i.v morphine requirements and the pain scores over the first 48 h after surgery. It also improved the patient satisfaction with respect to the postoperative pain control. It was also recorded that 54.5% of patients in the USCIA group did not require any additional analgesia from the 6th to 24th postoperative hour, completely avoiding the use of PCA morphine.

The TAP block was recognized as an effective component of multi-modal postoperative analgesia [10,11]. A meta-analysis of clinical trials recorded that the use of TAP block reduces opioid consumption and improves pain scores [12]. Although the studies supported the analgesic advantages of the TAP block [10,11,13,14], others have failed to demonstrate any benefit [15,16]. It was noted that the ultrasound guided TAP block failed to improve analgesia after gynecological cancer surgery with midline incisions [16]. It was also reported that the TAP block had inferior postoperative analgesia following caesarean section when compared with intrathecal morphine [17,18]. The success of the TAP block is both volume dependant and relies on optimal distribution of the LA within the neurovascular plane. Inaccurate deposition of the LA solution relative to the transversus abdominis plane could reduce the analgesic efficacy of the block and could explain its variable outcome. The inaccurate LA deposition relative to the true plane can be a consequence of both landmark-guided [2] and ultrasound-guided techniques [3]. The ultrasonic imaging allows for a more accurate deposition of the LA into the correct plane. However, it is difficult to accurately assess or quantify the LA spread in the transversus abdominis plane by the 2-dimensional (2D) ultrasound, since it has limitations in viewing 3D anatomy. Administration of the LA via a correctly placed TAP block catheter can increase the chance of greater LA deposition in the right plane and the chance of larger LA volume in direct contact with the abdominal wall neural afferents. This could explain the effective postoperative analgesia provided by USCIA – TAP block. The prolonged analgesic effect after the USCIA-TAP block may relate to the fact that the transversus abdominis plane is relatively poorly vascularized, and therefore, drug clearance may be slowed [11]. The duration of analgesic effect after TAP block has been demonstrated for up to 48 h postoperatively, after a variety of surgeries including abdominal caesarean section, hysterectomy, retropubic prostatectomy, and open colorectal surgery [11,19].

In the current study, the TAP catheter was successfully placed within the transversus abdominis plane in 88% of the cases. Using the principle of Seldinger method [8] for inserting the TAP block catheter with the help of ultrasound can ensure proper catheter placement. The Seldinger approach is the method of percutaneous insertion of a catheter to obtain safe access to a potential space or cavity. It is named after Dr. Sven-Ivar Seldinger who introduced the procedure in 1953 [8]. Insertion of the TAP catheter over a guide wire is a major advantage of the USCIA as it can ensure straight forward catheter placement with less risk of coil or kink. The catheter used is echogenic and thus readily visible during ultrasound guidance of the block procedure. The straight course of all catheters inserted by USCIA was followed visually by the ultrasonic imaging technique and then confirmed by the abdominal X-ray-lateral view. The round-tipped guide wire and the TAP catheter were smoothly inserted into the transversus abdominis plane after hydro-dissection. Administration of the saline solution into the plane leads to mechanical separation and expansion of the fascial layers. The failure of correct

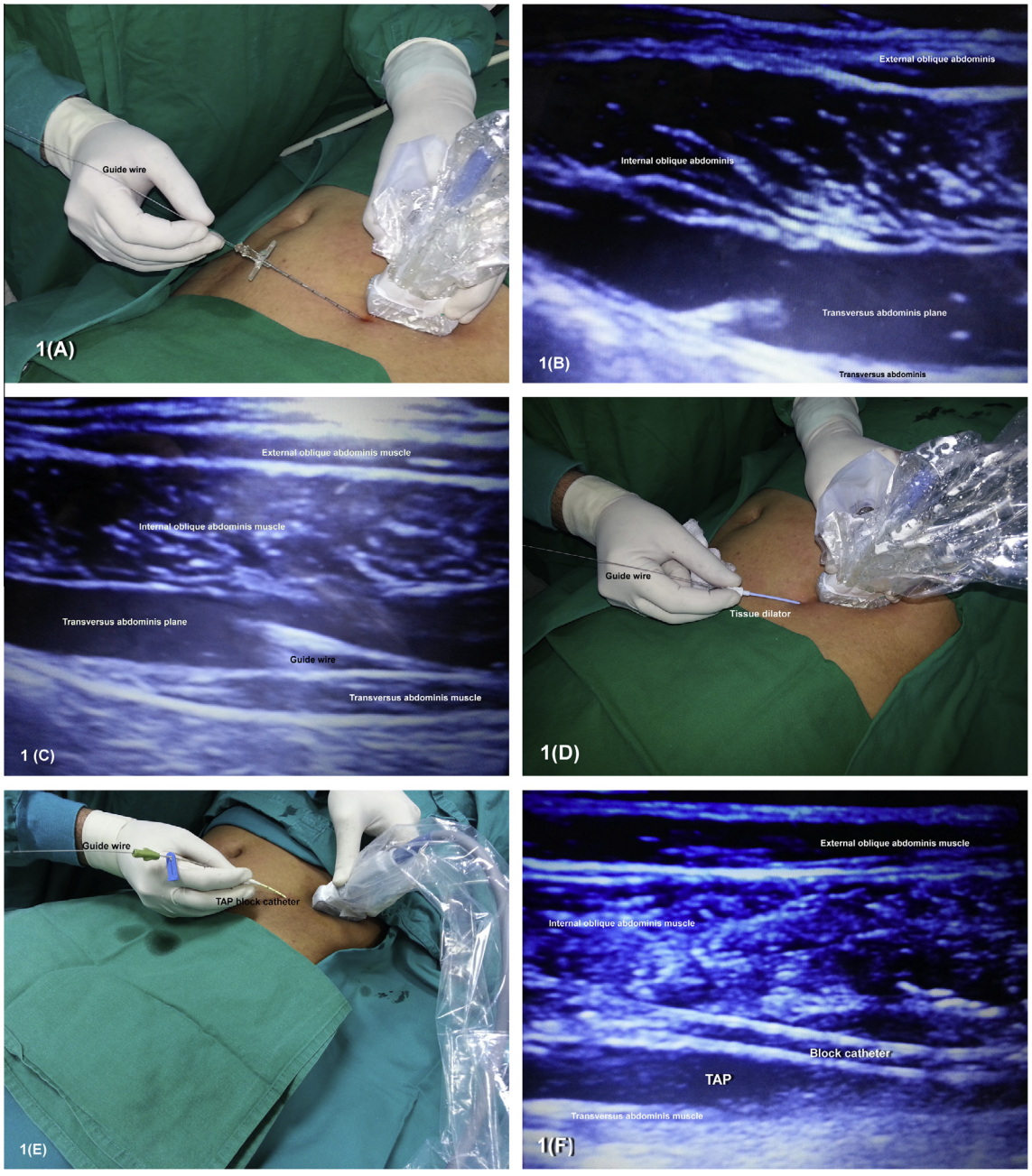

Figure 1 Steps of ultrasound-guided Seldinger catheter insertion approach (USCIA) and their corresponding ultrasound images. (A) Tuohy needle was inserted into the transversus abdominis plane and the guide wire was passed through the needle. (B) Expansion of transversus abdominis plane as a dark shadow after saline injection. (C) Advancement of guide wire within the transversus abdominis plane. (D) Tissue dilator was passed over the guide wire. (E) Block catheter was passed over the guide wire. (F) Advancement of the block catheter into the transversus abdominis plane.

catheter placement can be attributed to poor hydro-dissection. Although there is limited information on the incidence of catheter insertion failure in TAP blocks, a relatively low success rate (50%) in terms of catheter placement has been reported [20]. Using the conventional block techniques, it is occasionally difficult to control catheter placement into the potential space between the internal oblique and transversus abdominis muscles [20], regardless of whether the TAP catheter was inserted blindly or with ultrasound guidance. This may be because the transversus abdominis plane represents an anatomical potential space where the muscle layers lie tightly against one another [1]. As a result, the block catheter may be mal-positioned with a substantial risk of kink, rotation or coiling [21,22]. Also, the flexible catheters rarely remain within a 2-dimensional ultrasound view, making it difficult to observe catheter-tip placement relative to the target plane. As a result, an incorrect block catheter placement can remain undetected till evidenced by secondary block failure.

The reliability of the postoperative analgesia provided by USCIA-TAP block could make this technique beneficial in

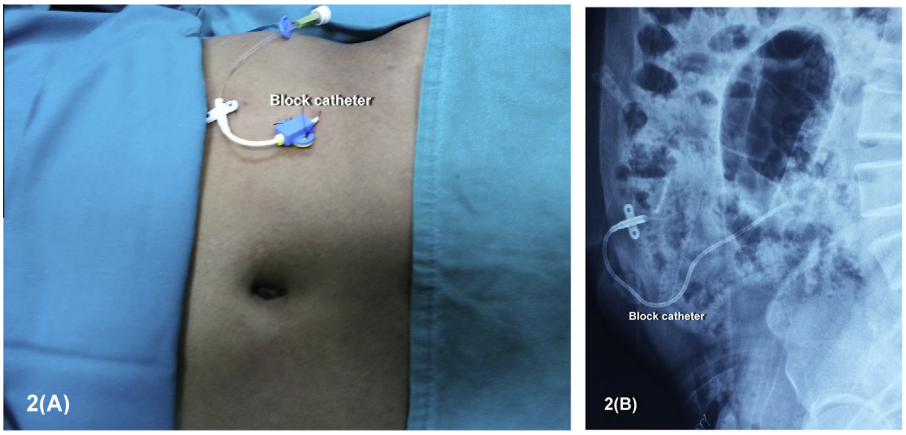

Figure 2 The TAP block catheter and its corresponding X-ray image. (A) The TAP block catheter was secured to the skin. (B) Straight course of the block catheter was confirmed by an abdominal X-ray-lateral view.

Table 2 Cumulative postoperative morphine requirements (mg) over the first 48 postoperative hours.

Time intervals	Group USCIA (n = 22)	Group control (n = 23)
6 h	5.7 ± 1.9*	12.7 ± 3.5
12 h	8.1 ± 2.3*	24.9 ± 4.5
24 h	10.7 ± 3.7*	36.7 ± 5.3
36 h	15.5 ± 4.3*	48.1 ± 4.7
48 h	18.1 ± 4.1*	57.9 ± 5.3

Values are reported as mean ± SD (M ± SD). Abbreviation: USCIA, ultrasound-guided Seldinger catheter insertion approach.
* P-value significant as compared to the Control group.

Table 3 Postoperative pain scores using a numerical rating scale (NRS); at rest (NRS-R) and during coughing (NRS-C) over the first 48 postoperative hours.

Time intervals	Group USCIA (n = 22)	Group control (n = 23)	Group USCIA (n = 22)	Group control (n = 23)
	NRS-R	NRS-R	NRS-C	NRS-C
1 h	6 (5–7)	6 (5–8)	7 (6–8)	7 (7–8)
3 h	2 (1–4)*	5 (4–7)	3 (2–4)#	7 (6–7)
6 h	2 (0–2)*	4 (3–6)	2 (1–3)#	6 (4–6)
12 h	1 (0–2)*	4 (3–5)	2 (1–3)#	5 (4–6)
24 h	1.5 (0–2)*	3 (2–4)	1 (1–2)#	4 (3–5)
36 h	1 (0–2)	2 (0–3)	1 (1–2)#	3 (2–4)
48 h	1 (0–2)	1 (0–2)	2 (1–2)	2 (1–3)

Values are reported as median (range). Abbreviation: NRS: numerical rating scale; USCIA-TAPB: ultrasound-guided seldinger catheter insertion approach-transversus abdominis plane block.
* P-value significant as compared to the Control group at rest.
# P-value significant as compared to the Control group during cough.

Table 4 Level of patient satisfaction concerning postoperative pain control using a numerical rating scale.

Time intervals	Group USCIA (n = 22)	Group control (n = 23)
12 h	8 (8–10)*	6 (5–7)
24 h	9 (8–10)*	7 (6–8)
36 h	9 (8–10)	9 (8–10)
48 h	9 (8–10)	9 (8–10)

Values are reported as median (range). Abbreviation: USCIA, ultrasound-guided Seldinger catheter insertion approach.
* P-value significant as compared to the Control group.

patients undergoing abdominal surgeries. The potential risk of tissue injury with TAP block is ever present whichever approach is used. Block needle adjustment or repositioning can lead to serious complications. The incidence of colonic and inadvertent liver injury has been recorded [23,24]. In the current study, the TAP block catheters were placed with few clinically significant complications. Real-time visualization by ultrasound of the catheter insertion maneuver could increase the safety of block performance. The use of USCIA-TAP block made no apparent impact on the incidence of overall opioid-related side effects. The incidence of opioid-related side effects were not significantly altered by the use of TAP blocks

in many previous studies [24,15], while other studies have claimed that opioid-derived adverse effects such as nausea and vomiting can be reduced by using the TAP block [25,26].

4.1. Study limitations

The current study was not double blinded and its findings are equipment dependent; the ideal equipments (catheter, needle, and guide wire) for USCIA are yet to be identified. The study examined only a single injection block and thus the analgesic efficacy of the USCIA-TAP block using continuous infusion or repeated boluses of LA needs to be explored. A randomized controlled trial can also help to compare the analgesic efficacy, the dermatome involvement, and the catheter insertion success rate of the USCIA vs. the traditional method.

4.2. Conclusion

The use of a single dose of USCIA-TAP block reduced the total amount of morphine requirement over the first 48 postoperative hours for patients undergoing abdominal surgery.

Conflict of interest

The author declare that there are no conflicts of interest.

References

[1] McDonnell JG, O'Donnell BD, Farrell T, Gough N, Tuite D, Power C, et al. Transversus abdominis plane block: a cadaveric and radiological evaluation. Reg Anesth Pain Med 2007;32:399–404.

[2] McDermott G, Korba E, Mata U, Jaigirdar M, Narayanan N, Boylan J, Conlon N. Should we stop doing blind transversus abdominis plane blocks? Br J Anaesth 2012;108:499–502.

[3] Charlton S, Cyna AM, Middleton P, Griffiths JD. Perioperative transversus abdominis plane blocks for analgesia after abdominal. Cochrane Database Syst Rev 2010;8(12):CD007705.

[4] Weintraud M, Marhofer P, Bösenberg A, Kapral S, Willschke H, Felfernig M, Kettner S. Ilioinguinal/iliohypogastric blocks in children: where do we administer the local anesthetic without direct visualization? Anesth Analg 2008;106:89–93.

[5] Ilfeld BM, Morey TE, Wright TW, Chidgey LK, Enneking FK. Continuous inter-scalene brachial plexus block for postoperative pain control at home: a randomized, double-blinded, placebo-controlled study. Anesth Analg 2003;96:1089–95.

[6] Salinas FV. Location, location, location: continuous peripheral nerve blocks and stimulating catheters. Reg Anesth Pain Med 2003;28:79–82.

[7] Ilfeld BM, Sandhu NS, Loland VJ, Suresh PJ, Mariano ER, Madison SJ, Bishop ML, Schwartz AK, Lee DK. Ultrasoundgui-ded (needle-in-plane) perineural catheter insertion: the effect of catheter insertion distance on postoperative analgesia. Reg Anesth Pain Med 2011;36:261–5.

[8] Seldinger SI. Catheter replacement of the needle in percutaneous arteriography; a new technique. Acta Radiologica 1953;39:368–76.

[9] Abrahams MS, Aziz MF, Fu RF, Horn JL. Ultrasound guidance compared with electrical neuro-stimulation for peripheral nerve block: a systematic review and meta-analysis of randomized controlled trials. Br J Anaesth 2009;102:408–17.

[10] McDonnell JG, O'Donnell B, Curley G, Heffernan A, Power C, Laffey JG. The analgesic efficacy of transversus abdominis plane block after abdominal surgery: a prospective randomized controlled trial. Anesth Analg 2007;104:193–7.

[11] McDonnell JG, Curley G, Carney J, Benton A, Costello J, Maharj CH, Laffey JG. The analgesic efficacy of transverses abdominis plane block after cesarean delivery: a randomized controlled trial. Anesth Analg 2008;106:186–91.

[12] Abrahams MS, Horn J-L, Noles M, Aziz MF. Evidenc-based medicine. Ultrasound guidance for truncal blocks. Reg Anesth Pain Med 2010;35:S36–42.

[13] Hivelin M, Wyniecki A, Plaud B, Marty J, Lantieri L. Ultrasound-guided bilateral transversus abdominis plane block for postoperative analgesia after breast reconstruction DIEP flap. Plast Reconstr Surg 2011;128:44–55.

[14] Aveline C, Le Hetet H, Le Roux A, et al. Comparison between ultrasound-guided transversus abdominis plane and conventional ilioinguinal/iliohypogastric nerve blocks for day-case open inguinal hernia repair. Br J Anaesth 2011;106:380–6.

[15] Costello JF, Moore AR, Wieczorek PM, Macarthur AJ, Balki M, Carvalho JC. The transversus abdominis plane block, when used as part of a multimodal regimen inclusive of intrathecal morphine, does not improve analgesia after cesarean delivery. Reg Anesth Pain Med 2009;34:586–9.

[16] Griffiths JD, Middle JV, Barron FA, Grant SJ, Popham PA, Royse CF. Transversus abdominis plane block does not provide additional benefit to multimodal analgesia in gynecological cancer surgery. Anesth Analg 2010;111:797–801.

[17] Kanazi GE, Aouad MT, Abdallah FW, et al. The analgesic efficacy of subarachnoid morphine in comparison with ultrasound-guided transversus abdominis plane block after cesarean delivery: a randomized controlled trial. Anesth Analg 2010;111:475–81.

[18] McMorrow RC, Ni Mhuircheartaigh RJ, Ahmed KA, Aslani A, Ng SC, Conrick-Martin I, Dowling JJ, Gaffney A, Loughrey JP, McCaul CL. Comparison of transversus abdominis plane block vs. spinal morphine for pain relief after Caesarean section. Br J Anaesth 2011;106:706–12.

[19] Yarwood J, Berrill A. Nerve blocks of the anterior abdominal wall. Cont Edu Anaesth Crit Care Pain 2010;10(6):182–6.

[20] Jankovic Zorica B, Pollard Stephen G, Nachiappan Meyyappan M. Continuous transversus abdominis plane block for renal transplant recipients. Anesth Analg 2009;109:1710–1.

[21] Burgher AH, Hebl JR. Minimally invasive retrieval of knotted non-stimulating peripheral nerve catheters. Reg Anesth Pain Med 2007;32:162–6.

[22] David M. Knotted peripheral nerve catheter. Reg Anesth Pain Med 2003;28:487–8.

[23] Farooq M, Carey M. A case of liver trauma with a blunt regional anesthesia needle while performing transversus abdominis plane block. Reg Anesth Pain Med 2008;33:274–5.

[24] Lancaster P, Chadwick M. Liver trauma secondary to ultrasound-guided transversus abdominis plane block. Br J Anesth 2010;104:509–10.

[25] McDonnell JG, Laffey JG. The transversus abdominis plane block. Anesth Analg 2007;105:282–3.

[26] Randall IM, Costello J, Carvalho JCA. Transversus abdominis plane block in a patient with debilitating pain from an abdominal wall hematoma following cesarean delivery. Anesth Analg 2008;106:1928.