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Research Article

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

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KEYWORDS

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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

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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