Egyptian Journal of Anaesthesia (2014) **30**, 273–278

Egyptian Society of Anesthesiologists

Egyptian Journal of Anaesthesia

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Research Article

Ultrasound guided transversus abdominis plane block in pediatric patients undergoing laparoscopic surgery

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Received 27 December 2013; revised 20 January 2014; accepted 24 January 2014
Available online 12 February 2014

KEYWORDS

TAP block;
Laparoscopic pediatric surgery;
Postoperative pain;
Hemodynamic changes

Abstract *Objective:* To assess safety and effectiveness of ultrasound-guided TAP block in children undergoing laparoscopic surgery for undescended testis.
Subjects and methods: This randomized controlled trial involved 108 children, 3–7 years old, randomly allocated into one of two equal groups; TAP Group and Control Group. All children received general anesthesia using propofol 1.5–2.5 mg/kg, atracurium 0.5 mg/kg and fentanyl 2 μg/kg. TAP Group received 0.5 ml/kg of ropivacaine 0.375% bilaterally under ultrasound guidance and control group received regular analgesics. Quality of analgesia was assessed using Children's Hospital Eastern Ontario Pain Scale (CHEOPS) and Objective behavioral pain score (OPS). The primary outcome measures were hemodynamic parameters and degree of pain. Secondary outcome measures were intraoperative fentanyl requirement, postoperative rescue analgesia (time and dose), complications, hospital stay and degree of satisfaction of patients and their parents.
Results: TAP block group had significantly lower intraoperative fentanyl dose ($p < 0.001$), significantly longer time to first postoperative request of analgesic ($p < 0.001$), lower analgesic dose during the first postoperative 24 h ($p < 0.001$) and lower pain scores along the whole 24 postoperative hours. Mean arterial pressure and heart rate were within the clinically accepted range in the two groups. Parents' satisfaction was significantly higher ($p < 0.001$) in the TAP block group.
Conclusion: TAP block under ultrasound guidance was easy, safe, reliable and effective analgesic in children undergoing laparoscopic surgery for undescended testis.

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Peer review under responsibility of Egyptian Society of Anesthesiologists.

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1. Introduction

In recent years an increasing number of pediatric surgical cases are being managed successfully by laparoscopic technique [1]. Although abdominal laparoscopic surgery, a widely performed surgery, is known for less pain compared to that of laparotomy, many patients actually still complain of considerable postoperative pain [2,3].

1110-1849 http://dx.doi.org/10.1016/j.egja.2014.01.011

The benefits of adequate analgesia include a reduction in the stress response of surgery, reduction in the perioperative morbidity and reduction in certain types of surgery improved surgical outcome. Effective pain control can also facilitate rehabilitation and accelerate recovery from surgery [4,5]. Regional anesthesia techniques are commonly advocated for pain control in pediatric surgical practice as they decrease parenteral opioid requirements and improve the quality of postoperative pain control as well as patient-parent satisfaction [6].

A substantial component of the pain experienced by patients after abdominal surgery is derived from the abdominal wall incision. The abdominal wall is innervated by nerve afferents that course through the transversus abdominis neurofascial plane [7]. Abdominal field blocks have been used in anesthesia for surgery involving the anterior abdominal wall for several decades. Many blocks in this area are either difficult or high risk when performed blind, but ultrasound renders them very accessible and safe to perform [8].

The Transversus Abdominis plane (TAP) block was first described in 2004 by McDonnell et al. [9] and ultrasound-guided technique was subsequently popularized by Hebbard et al. [8] TAP block is a regional anesthetic technique that blocks neural afferents of the anterolateral abdominal wall. Using anatomical landmark guidance or with the aid of ultrasound (US), local anesthetic is injected into the transversus abdominis fascial plane, where the nerves from T6 to L1 are located [9].

Randomized controlled trials have demonstrated the efficacy of TAP block in providing postoperative analgesia for up to 24 h after lower abdominal surgery [10–13].

The aim of this study was to compare ultrasound-guided TAP block versus conventional analgesia as regards the degree of pain relief and effect on hemodynamic stability in children undergoing laparoscopic surgery for undescended testis.

2. Subjects and methods

This randomized controlled trial involved children scheduled for laparoscopic surgery for undescended testis in Abu El-Reesh Pediatric Hospital, Cairo University during the period from February 2012 to June 2013. One-hundred and fifty children had laparoscopic procedures during this period; 42 were excluded; 18 refused to participate and 24 had one or more of exclusion criteria. The study included the remaining 108 children. After approval of the study by the local Ethical Committee, parents (or guardians) of all participating children provided an informed consent to share in the study. Participants were 3–7 years old, ASA I-II and were randomized using computer generated table ensuring allocation concealment into one of two groups; group I (TAP Group) and group II (Control Group).

Participants refusing regional block and those having bleeding disorders, skin lesions or wounds at the site of proposed needle insertion, evidence of peritonitis, septicemia and hepatic disease or enlargement in addition to those who required emergency procedures were excluded from the study.

2.1. Anesthesia procedure

EMLA cream was applied to the site of venous puncture 1 h before surgery. After insertion of venous access, all children received premedication in the form of atropine at a dose of 0.01–0.02 mg/kg. Perioperative monitoring included continuous ECG, pulse oximetry, non-invasive arterial blood pressure, capnography and temperature monitoring. Baseline reading (T0) of heart rate, systolic and diastolic blood pressure was recorded after monitor attachment.

General anesthesia was induced using propofol 1.5–2.5 mg/kg over 20–30 s as tolerated, atracurium 0.5 mg/kg to facilitate endotracheal intubation and fentanyl 2 μg/kg. Anesthesia was maintained using isoflurane (1 MAC) and atracurium supplements were given to maintain muscle relaxation.

Participants of TAP group ($n = 54$) received 0.5 ml/kg of ropivacaine 0.375% bilaterally and those of control group ($n = 54$) received regular analgesics. The patient was not aware of group allocation as the TAP block was done after induction of anesthesia. An independent anesthesiologist conducted postoperative assessments and was not aware of group allocation.

2.2. TAP block procedure: (Fig. 1)

The procedure was done under ultrasound guidance using SonoSite M Turbo (USA) with linear multi-frequency 13–6 MHz transducer (L25x13–6 MHz linear array) scanning probe. Stimuplex D needles (B Braun, Germany) were used.

With the patient in the supine position, the site of the ultrasound and needle entry was sterilized. The TAP block was performed laterally behind the midaxillary line between the iliac crest and the most inferior extent of the ribs. The plane between the internal oblique and transversus abdominis muscle was located around the midaxillary line with the probe transverse to the abdomen. Anteriorly, *the Stimpex* 35–50 mm needle was passed to come perpendicular to the ultrasound beam and placed between transversus and internal oblique posterior to the midaxillary line. Then, the local anesthetic was injected as a bolus of 0.5 ml/kg ropivacaine 0.375%.

An increase in heart rate and or arterial blood pressure by more than 20% of baseline values in response to surgical stimulus or thereafter throughout the whole operation warranted administration of intravenous fentanyl (0.5 μg/kg). After completion of surgical procedure anesthesia was discontinued, muscle relaxant reversed using atropine 0.02 mg/kg and 0.05 mg/kg of prostigmine and children received diclofenac sodium 1 mg/kg suppository, extubated and transferred to PACU.

The duration of surgery (time from skin incision till extubation) was recorded. Quality of analgesia was assessed immediately postoperatively and then at 2, 4, 8, 12 and 24 h postoperatively using Children's Hospital Eastern Ontario Pain Scale (CHEOPS) [14] and Objective behavioral pain score (OPS) [15] scores. Proparacetamol (perfalgan) 15 mg/kg IV was given as rescue analgesia for patients if OPS was >5 or CHEOPS score >6.

The CHEOPS is a behavioral scale intended for children ages 1–7. It was originally developed for children in the PACU. It encompasses six indicators (Table 1). Children should be observed for 1 min in order to fully assess each indicator. The score ranges from 4 to 13. A score $\geqslant 10$ is usually used as an indication to treat pain. However, this should be decided on an individual basis for each patient. In the current study we administered rescue analgesia if the score is above 6 to guard against irritability and agitation.

The primary outcome measures were hemodynamic parameters; blood pressure and heart rate measured at: baseline (T0),