

Ultrasound guided Transverses Abdominal Plane Block versus Ilioinguinal/Iliohypogastric Nerve Blocks for Postoperative Analgesia in Children Undergoing Lower Abdominal Surgery

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Abstract

Background

Pediatric patients undergo a variety of lower abdominalsurgical procedures that need adequate pain relief perioperatively. Ultrasound guided ilioinguinal/iliohypogastric nerve blockade and TAB block are common peripheral nerve block techniques used to alleviate pain in pediatric anesthesia. Ultrasound guidance, promote the visualization of important anatomy and can help overcome many of the traditional obstacles of in advert important structures injury in infant's delicate soft tissues when performing these blocks.

Objectives

To compare the efficacy of TAP blocks versus ilioinguinal/iliohypogastric nerve blockade on postoperative analgesia requirements after lower abdominal surgery.

Patients and Methods

Sixty children who were scheduled to undergo unilateral lower abdominal surgery were enrolled in this study. The patients were randomized into US guided TAP block Group (Group T) and US guided ilioinguinal/iliohypogastric nerve blocks (Group I). The surgery was allowed to start about 20 minutes after performance of the block. The children were assessed every 30 minutes in recovery room until discharge from the hospital. Postoperative analgesia was measured using (CHEOPS). The number of children who needed postoperative rescue analgesics and the duration of analgesia that was taken at the time when an analgesic was required were recorded. Presence of significant muscle weakness was assessed at 3 hours after the block.

Main Results

5 participants were excluded from the study, No significant differences were found between two groups as regard patients' characteristics, type of surgeries or duration of anesthesia. The average pain score during hospital stay for group T and group I showed no statistically significant difference all over the study except at 240 minutes after surgery it was significantly lower in group (T) when compared to group (I). The average time to first rescue analgesia and the duration of analgesia was longer in group (T) as compared to group (I). In recovery room, no differences were found between two groups as regard analgesic medication in PACU, analgesic medication at day-stay unit or at home, total dose of analgesics medication, incidence of PONV or any motor weakness.

Authors' Conclusions

TAP block is an easy regional nerve block technique that provides postoperative pain relief for longer duration as compared to ilioinguinal/iliohypogastric nerve blockade.

Introduction

There has been a recent increase in the use of regional anesthesia in pediatric patients [1]. This explosive growth, particularly in the use of truncal blocks, can be attributed in part to the refinement of anatomically based ultrasound imaging to facilitate nerve localization. Ultrasound guidance allows visualization of important anatomical structures and therefore can overcome the traditional obstacles of inadvertent important structures injury in infant's delicate soft tissues.

Ilioinguinal/iliohypogastric nerve blockade is one of the most common peripheral nerve block techniques in pediatric anesthesia and has been shown to be equally effective compared with caudal blockade for inguinal hernia repair [2-5]. Recently, the ultrasound transversus abdominis plane (TAP) block has gained popularity for intraoperative and postoperative pain management in a variety of abdominal surgical procedures in adult, pediatric and neonatal patients [6,7].

The present study has been carried out to prove that ultrasound guided TAP block provides more effective pain relief, easier technique and less complication than ilioinguinal/iliohypogastric (II/IH) nerve blockade in pediatric unilateral groin surgery. Analgesic consumption and postoperative untoward effects were tested as well.

Patients and Methods

After obtaining of our institutional ethics committee agreement of Mansoura University, a written informed consent from patient guardians was obtained. This double blind, randomized study was carried out in Mansoura University Children Hospital from May 2013 to August 2014. About 60 children (ASA I or II) who were scheduled to undergo unilateral lower abdominal surgery (mainly unilateral inguinal hernia and hydrocele) were enrolled in this study. Exclusion criteria included all patients with known allergy to local anesthetics, history of renal, hepatic, cardiac, or neurological diseases and severe diaper rash.

On arrival to preoperative room all patients were premedicated with intramuscular injection of 5 mg/kg of ketamine and 0.2 mg/kg atropine about 20 minutes before induction of anesthesia. General anesthesia was induced with 8% sevoflurane in 100% oxygen, via a facemask. After establishing a venous access, a classic disposable laryngeal mask airway (LMA) was placed when the patient was noted to be in an adequate plane of anesthesia.

Anesthesia was maintained with at least 2 MAC of sevoflurane in air and oxygen mixture. Intraoperative monitoring included ECG, heart rate, pulse oximetry, non invasive blood pressure and end tidal carbon dioxide concentration. Spontaneous ventilation was maintained so that end tidal capnography reading was 35 ± 5 mmHg.

Patients were randomly allocated by using medical registry number to one of two groups: US guided TAP block Group (Group T) and US guided ilioinguinal/iliohypogastric nerve blocks (Group I). In both groups 0.25% bupivacaine was used to perform nerve block in groups, 0.5 ml/kg for group (T) and 0.1 ml/kg for group (I).

All surgical procedures and anesthetic blocks were performed by the same surgeons, and anesthetists who have a good experience in US guided nerve block in children. Mandray DP-20 portable US unit and a 12 MHz linear probe were used. Time need from start of ultrasound scan until each block was completed was recorded.

In (group T), A high-frequency linear probe was placed on the abdomen lateral to the umbilicus. The probe could be shifted laterally to identify the three layers of the abdominal wall. The midpoint of the probe is placed at the midaxillary line. Next, a 22 G needle 40mm long was placed at or slightly medial to the anterior axillary line using an in-plane approach and also inserted into the plane between the internal oblique and the transversus abdominis muscles. Local anesthetic was injected into this potential space and the needle was handled so that local anesthetic dispersion was seen as an elliptical opening of the potential space [8].

In (group I), A high-frequency linear probe were used to identify the targeted nerves and surrounding anatomical structures and was then placed at the highest point of the iliac crest with the axis facing the umbilicus. This orientation provided a clear view of the relevant muscle layers and nerves as they ran in the TAP. After aseptic preparation of both the puncture site and the ultrasound probe, the block was then performed using "inplane technique" and an insulated 22G 40 mm needle. The needle was inserted toward the ilioinguinal and iliohypogastric nerves. After confirming spread between the muscles and proximity to the nerves, local anesthetic was injected into the space. Under direct visualization, the tip of the needle which was placed lateral to the nerve structures between in the TAP. The distribution of LA was monitored under real time ultrasonography, and in case of a misdistribution of the LA, the needle would have been repositioned [9].

Surgery was allowed to start about 20 minutes after performance of the block. When HR increase more than 20% above the baseline, or patient movement at skin incision or during the intraoperative period, were considered signs of inadequate analgesia. In these cases, fentanyl 1 µg/kg was given intravenously, and the case was excluded from the study. After completion of surgery, patients were transferred to the recovery room for postoperative monitoring of vital signs and evaluation of pain. The children were assessed every 30 minutes in recovery room until discharge from the hospital. Postoperative analgesia was measured using a modified Children's Hospital of Eastern Ontario Pain Scale (CHEOPS)[10].

Patients with modified CHEOPS score >6 were given rescue analgesia with 15 mg/kg paracetamol intravenously. Those with modified CHEOPS score of 4-5 were given paracetamol 15mg/kg as suppository. Pain scores were recorded every 10 minutes after administration of rescue analgesia to evaluate pain relief or need for further rescue analgesia. The number of children who needed postoperative rescue analgesics and the duration of analgesia that was taken at the time when an analgesic was required were recorded. Presence of significant muscle weakness was assessed at 3 hours after the block using four P's (push, pull, pinch, punt) method described by Neal [11].

Patients were discharged from the hospital 5 hours after surgery when they were pain free and there was no other medical reason to admit them to a surgical ward. The parents were involved in the clinical trial and invited to complete a postoperative chart with a simple pain scale (0 = no pain/child calm; 1 = minimum pain/child irritable; 2 = mild pain/child consolable; and 3 = severe pain/child inconsolable). Parents were instructed to give oral ibuprofen 10 mg/kg when pain scores were 2 or 3, and not more frequently than every 8 hours.

Need for postoperative vomiting rescue medication was recorded. Parents were contacted by the anesthesiologist not involved in the study on the day following discharge from the hospital, and were asked about the number of rescue analgesic administrations given.

Sample Size

We were planning a study of a continuous response variable from independent control and experimental subjects with 1 control(s) per experimental subject. In a previous study the response within each subject group was normally distributed with standard deviation 47. If the true difference in the experimental and control means is 41, we will need to study 22 experimental subjects and 22 control subjects to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05. 30 patients were thereby enrolled in each group.

Statistical Analysis

Data was assessed for normality by the Shapiro-Wilk W tests. By using SPSS software for Windows, version 18 (SPSS Inc, Chicago, IL, USA). Data was expressed as number, percentage median and range, mean and standard deviation. Independent sample t-test was used to compare continuous variables exhibiting normal distribution, and Chi-squared or Fisher exact test for non continuous variables. $P < 0.05$ is considered significant.

Results

Three patients from group (T) and two patients from group (I) were excluded from this study because their heart rate was increased with skin incision and additional fentanyl doses were given to them.

No significant differences were found between two groups as regard patients' characteristics, type of surgeries or duration of anesthesia (Table 1). Group (I) required significantly longer time to complete nerve block when compared to group (T) (Table 3). The average pain score during hospital stay for group T and group I showed no statistically significant difference all over the study except at 240 minutes after surgery it was significantly lower in group (T) when compared to group (I). The average time to first rescue analgesia and the duration of analgesia was longer in group (T) (254.5±47.2 minutes) as compared to group (I) (213±45.3 minutes) (Table 2,3 respectively).

In recovery room, three patients in group (T) required pain rescue medication compared to four patients in group (I) ($P > 0.05$). Similarly seven patients in the group (T) and eight patients in group (I) required pain rescue medication at day-stay unit or at home ($P > 0.05$). The difference between groups in the total dose of analgesics medication given to patients was not statistically significant (Table 3). Only two patient in both group (T) and group (I) were reported to have vomiting and received vomiting rescue medications. This difference was not significant ($P > 0.05$). None of the patients of either group had any motor weakness at 3 hours.

	Group (T) (n=27)	Group (I) (n=28)
Age (months)	39±14	37±13
Gender (M/F) (no)	17/10 (63/ 37)	15/13 (54/46)
Weight (kg)	15.1±2.9	14.7±3.1
Duration of surgery (minutes)	62.1±12.3	64.2±13.2
Type of surgery (no)		
Hernia repair	17 (63)	18 (64)
Hydrocele repair	12 (44)	10 (36)

Table (1): Patient criteria and operative details of the studied groups. Data are expressed as mean ± SD, number and (%).

	Group (T)	Group (I)
30 min after surgery	2 (2-4)	2 (2-4)
60 min after surgery	2 (2-4)	2 (2-4)
90 min after surgery	2 (2-4)	2 (2-4)
120 min after surgery	3 (2-4)	3(2-4)
150 min after surgery	3 (2-4)	3 (2-4)
180 min after surgery	2 (2-4)	3 (2-4)
210 min after surgery	3 (2-4)	3 (2-4)
240 min after surgery	5 (4-7)	7 (6-8)*

Table (2): CHOPS score, of the studied groups. Data are expressed as median and range.

	Group (T)	Group (I)
Time needed to complete each block (sec)	99 (74- 103)	157 (98-203)*
Patient received analgesics in PACU (no.)	3 (11)	4 (14)
Patient received analgesics in home (no.)	7 (26)	8 (29)
Total doses of paracetamol given ($\mu\text{g}/\text{kg}$)	49 \pm 13	58 \pm 14
Duration of analgesia (minutes)	254.5 \pm 47.2	213 \pm 45.3*
POV (no.)	2 (7)	2 (7)
Incidence of muscle weakness (no)	0 (0)	0 (0)

Table (3): Time needed to complete each block, patient received analgesia in PACU and home and total dose of opioids given Duration of analgesia and incidence of PONV of the studied groups. Data are expressed as mean \pm SD, number and (%) and median and (range).

Discussion

This prospective randomized double blinded study compared analgesic the effects and duration of postoperative analgesia of both ultrasound guided modified classic TAP block and ultrasound guided II/IH nerves block in children undergoing unilateral lower abdominal surgery. Unlike II/IH block, the time needed to fulfill TAP block was significantly shorter. Pain scores in early postoperative period during hospital stay for both groups showed no significant difference except at 240 minutes where patients in TAP block group showed significantly lower pain scores as compared to II/IH nerves block group. The duration of analgesia as defined in this study was consequently significantly longer in TAP block group than In II/IH group. Rescue analgesic requirements and postoperative vomiting in PACU and after discharge showed, however, no significant differences between both groups. None of the cases suffered from muscle weakness 3 hours postoperatively.

Improved Tap block compared to II/IH block may be explained by easiness of the approach making the ultrasound view clearer and hence confirmation of site of injection less effortful compared to II/IH block. This is emphasized by shorter time needed to complete TAP block when compared with II/IH block.

Both ilioinguinal and iliohypogastric nerves enter the transversus abdominus plane by penetrating the transversus abdominus muscle mid way between the iliac crest and the costal margin [12]. It is at that plane where both blocks used in this study perform their effects. However, other authors found that both nerves enter the TAP at the junction between the anterior and middle third of the iliac crest [13]. In the present study, a more anterior injection site was implemented to bring the TAP block in close proximity to both ilioinguinal and iliohypogastric nerves. With adequate volume of local anesthetic, it would be expected for TAP block thereby to have better results and longer duration of analgesia as proved by the present study. Both blocks were equally effective in the early postoperative phase until 4 hours postoperatively where TAP block showed significantly lower pain scores and longer duration of analgesia. There were, though, no differences in postoperative analgesic requirements both in PACU and at home favoring TAP block over II/IH block.

Fredrickson et al. [14] compared TAP block with II/IH block in pediatric patients and found II/IH block to be of significantly longer duration than TAP block. However in the later study, the investigator used a smaller volume of local anesthetic for TAP block (0.2 ml/kg) than the standard volume 0.5 ml/kg required for that block. In addition, cases requiring fentanyl intra-operative and showing signs of inadequate analgesia were not excluded from the study. Variation in the volume of injected local anesthetic in both blocks may have affected the results of the present study. However these volumes were chosen to fulfill the standard recommended volume for each block (15-18).

Conclusion

Ultrasound guided TAP block is an easy regional nerve block technique that provides postoperative pain relief for longer duration as compared to ultrasound guided ilioinguinal/iliohypogastric nerve blockade in children undergoing unilateral groin surgery.

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