A Trial on Post-Operative Pain Management in Pediatric Inguinal Hernia Repair: Us-Guided Tap Versus Us-Guided Iliohypogastric/Ilioinguinal Block

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Abstract

Introduction: Purpose here, we included two groups of patients with inguinal hernia requiring surgical repair. We performed ultrasound-guided (US-guided) transversus abdominis plane (TAP) block on one group and US-guided Iliohypogastric/ilioinguinal (IN/IH) block on the other. We compared the results obtained from each group to compare the efficiency of each method in managing post-operative pain.

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Materials and Methods: In this prospective blinded controlled clinical trial, after approval of local ethics committee and randomization of the patients, 25 patients were included in each group. Peripheral nerve blocks (TAP block or IH/IN) were performed under the US guide. Patient pain scores, additional analgesic requirements, and complication rates were documented and compared.

Results: No statistical differences were found regarding demographic characteristics. Cardiopulmonary monitoring showed no complications in any of the groups. The IN/IH block group reported significantly lower pain scores than the TAP groups (immediately and 1 hour after; P: 0.02 and 0.03, respectively). Performing the TAP block took substantially longer (P= 0.04).

Conclusion: IN/IH block results in better pain management following pediatric inguinal hernia repair.

Keywords

- Pediatric inguinal hernia
- Abdominal surgery
- Herniorrhaphy
- Transverse abdominis block
- Ilioinguinal/iliohypogastric nerve block

Introduction

Inguinal hernia repair is one of the most commonly performed surgeries around the globe, affecting 3% of the pediatric population and 10% of premature neonates.[1]

These patients might suffer from moderate to severe pain following hernia repair ,and up to 54% of cases may develop chronic pain in case of improper management.[2]

Two common types of post-repair pain include nociceptive pain, an inflammatory pain caused by somatic and visceral tissue damage, and neuropathic pain caused by direct injury to the local nerves, such as iliohypogastric and ilioinguinal nerves.[3] Risk factors for developing chronic pain are immediate post-operative local pain,

nerve injury during operation, and improper pain management after surgery.[4] Therefore, various anesthetic techniques are used for inguinal hernia repair for practical postoperative pain management, decreasing unwanted complications and leading to a shorter hospital stay, such as general anesthesia, neuraxial analgesia, local infiltration with long-acting anesthetics in the surgical field, and blocking ilioinguinal/iliohypogastric (IN/IH) nerves.[5] Anesthetists use two techniques for regional nerve blockade. The first method performs field blocking at the transverse abdominis plane (TAP). The second method contains a truncal blockade of IN/IH.

Both of these methods might be performed blindly using anatomical landmarks or ultrasound guidance (US).[6] While performing the block using landmarks is quicker and easier, it has a lower success rate and a higher risk of injuring adjacent structures compared to US-guided blocks.[7] The transverse abdominis plane (TAP) block involves blocking the anterior ranches of the T7 to L1 spinal nerves, which innervate the front of the abdominal wall. In contrast, the ilioinguinal and iliohypogastric (IN/IH) nerves, which originate from T12 to L1 spinal nerves, are primarily responsible for immediate pain following inguinal hernia repair. The TAP block is used in various abdominal surgeries, including appendectomy, renal transplantation, and prostatectomy, while the IN/IH block is used in more targeted procedures such as herniorrhaphy, orchiopexy, and circumcision.[3-8]

Prior studies on pediatric populations have widely evaluated postoperative pain management using conventional IN/IH block in comparison to US-guided IN/IH block[9], traditional and US-guided TAP block[10], and general anesthesia.[11] However, only a few studies have compared the efficiency of US-guided TAP versus US-guided IN/IH block in pediatric patients.[12-13]

Therefore, here we included two groups of patients with inguinal hernia requiring surgical repair. We performed US-guided TAP on one group and US-guided IN/IH block on the other. We compared the results obtained from both groups to compare the efficiency of each method in managing post-repair pain.

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Materials and Methods

In this randomized clinical trial pediatric patients undergoing inguinal hernia repair during 2019-2021 in a Pediatric Hospital affiliated with Tabriz University of Medical Sciences were included. This study was written according to the Consolidated Standards of Reporting Trials (CONSORT) statement.

Participants were divided into two groups; the first group underwent the TAP block, and the second group underwent IN/IH block. According to Kamal et al[2], with a statistical power of 80% and a type one error of 5%, the sample size resulted in 22 patients. By adding 10% as lost t0 in the follow-up, 25 patients were included in each group.

Inclusion criteria were age between 2-12 years, ASA physical status I and II, and confirmed diagnosis of inguinal hernia requiring surgical repair. Exclusion criteria were an allergic reaction to local anesthetics, skin infection at the injection site, and parental unwillingness for regional block.

Before the operation, using the online randomization tool at www.start.vbc.ca/nrolin/statssize/bz.htmf, patients were divided into TAP and IN/IH groups to perform the regional anesthesia. Two anesthetists performed anesthesia and blocks, and one surgeon performed all the repairs.

Technique

On the operation day, patients were premedicated with 0.05 mg/kg of midazolam and 1mg/kg of fentanyl. Anesthesia was induced using 0.05 mg/kg lidocaine and 3 mg/kg propofol. Laryngeal mask airways (LMA) with appropriate sizing were inserted. For maintenance of anesthesia, sevoflurane 2-5% combined with NO_2O_2 was used with a flow rate of 4 lit/min.

We performed ultrasound using Sono Site, M-turbo, Bo Thell, WA, USA. The probes used Broadband Linear Array and HocRey Sticr (Slax/13-6 MHz).

All patients were in the supine position. Skin disinfection was obtained using a 5% alcoholic povidone-iodine solution, and a plastic sheath covered the probe. We applied a sterile gel on the skin.

In patients with bilateral inguinal hernia repair and surgical incision passing midline, the blocks were performed bilaterally in both groups, with precaution

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to maintain bupivacaine doses below the toxic amount (2 mg/kg).

In both groups, cardiopulmonary monitoring, including systolic and diastolic blood pressure (BP), heart rate (HR) via electrocardiography (ECG), and oxygen (O_2) and (carbon dioxide) CO_2 saturations were performed before, during, and after anesthesia continuously, and in the recovery room repeatedly with 10 minutes intervals. The findings were recorded.

IN/IH block

In the IN/IH group, we placed the probe on the line between ASIS and umbilicus horizontally, as the lateral end of the probe sticks to the ASIS. Based on the patient's age, we used a 20-22 needle to puncture the plane from medial to lateral. After the needle reached the fascia between internal oblique (IO) and transverse abdominis (TA) in the real-time US, 0.2 mg/kg bupivacaine 0.25% solution was injected adjacent to the mentioned nerves, and a 'Kayak' sign was formed.

TAP block

In the TAP group, the probe was placed horizontally on the mid-axillary line between the iliac crest and the inferior rim of the 12th rib. After appropriately positioning the probe on the abdominal wall and visualizing the three muscle layers, a 20-22 needle punctured in-plane mediolaterally. After reaching the fascia between the IO and TA, 0.4 ml/kg of 0.25% bupivacaine solution was injected into the neuro-fascial space. A separation was observed between two muscle layers.

Pain assessment

Following surgery, the efficiency of the blocks was assessed using visual analog scaling (VAS) in patients 6-12 years (0: no pain and 10: severe pain) and the FLACC Behavioral pain assessment scale (face, legs, activity, cry, consolable) in patients 2-6 years. The pain scoring was performed in the post-anesthesia care unit and after transferring to the surgical ward at 60 minutes intervals by a blind anesthetist.

Patients with a score above 4 received 15 mg/kg oral or rectal acetaminophen.

Statistical analysis

We used IBM SPSS (inc Chicago, IL) version 16.00 for data analysis. An Independent T-test was used to compare independent quantitative data, and X^2 and Fischer's test was used to analyze qualitative data. Data distribution and scattering were assessed using Microsoft Excel 2017. A p-value less than 0.05 was considered statistical significance.

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Result

A total of 50 patients were included. Twenty-five patients were randomly included in the TAP group and 25 in the IN/IH group. Primary data are presented in **Table 1.**

Table 1: Basic data of the patients

Variable		TAP group (N= 25)	IN/IH group (N=25)	P value
Mean age (y)		5.27± 2.6	4.61± 2.2	0.351
Mean weight (kg)		20.56± 8.7	17.70± 5.7	0.186
ASA class		1	1	1.000
Required time for performing the blockage (min)		2.96±0.9	4.02± 2.3	**0.043**
No. of needle punctures	1	18	13	0.064
	2	7	9	
	3	0	3	

Bold represents statistical significance.

No statistical difference was found regarding age, weight, and ASA class between the two groups. However, performing the IN/IH block took longer, and the difference was statistically significant. The needle puncture times were not different between groups, with a P value equal to 0.064 and X^2 equal to 0.132 **(Table 1).**

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Cardiopulmonary monitoring results showed no statistically significant differences regarding HR, systolic and diastolic BP, and CO_2 pressure among the two groups.

Table 2 represents the results of the pain management immediately, one, two, and three hours after recovery. Patients of the IIN/IIH group reported significantly lower pain scores immediately and one hour after recovery with P values below 0.05 **(Table 2).**

Table 2: Post-recovery pain scores

Post-recovery pain score	TAP group (N=25)	IN/IH group (N=25)	P value
Immediately	1.44± 1.2	0.76± 0.8	0.026
First hour	1.76± 1.6	0.96± 0.9	0.039
Second hour	1.64± 1.3	1.36± 0.8	0.380
Third hour	1.38± 1.3	1.72± 0.8	0.630

Bold represents statistical significance.

However, in the second and third-hour post-recovery, the differences were not significant. No life-threatening side effects were seen in any of the patients.

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Discussion

TAP and IN/IH blocks affect the same anatomical structures; nonetheless, the TAP block is a field block while IN/IH block is a truncal block, showing the more focused target site of the latter. Thus, less medication volume is needed for the performance and efficacy of the IN/IH block.[14] According to the literature, numerous studies have studied the effects of these two blocks in inguinal hernia repair. Although many studies report a superiority for IN/IH block, there are still some contrary opinions.[14-17] In a systematic review in 2018 of controlled trials on the efficacy of regional block in pediatric abdominal surgeries, no superiority over general anesthesia was reported regarding inguinal hernia repair.[16] However, Kendigelen et al. reported more promising results from anesthesia with TAP block in pediatric inguinal hernia repair.[3]

In this randomized clinical trial, we compared the efficiency of two methods of nerve blocking before inguinal hernia repair in pediatric cases. Group one underwent TAP nerve blocking, and group two IN/IIH nerve blocking. We found no differences regarding demographic data and cardiopulmonary findings among the two groups. Although IN/IH blocking took statistically longer to perform, its analgesic results were more favorable, and patients of the second group reported significantly less pain after the operation.

Aveline et al. compared the pain control ability of ultrasound-guided TAP block with blind (no guide) IN/IH after inguinal hernia repair with mesh in adults using levobupivacaine 0.5%. Their results showed significantly better pain control in patients undergoing TAP immediately after the operation and in the six months follow-up.[5] Their results opposed our results which might be due to using different anesthetics and blindly performing IIN/IIH block with no US guide. According to the literature, when the anesthetist performs blockade using anatomical landmarks, in only 14% of the cases, the medication is injected right into the neuro-fascial space between the internal oblique and transverse abdominis, meaning an error rate as high as 84%.[18] In contrast, in the nerve block under the US guide, the probe precisely visualizes the injection site.

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However, the easy and timesaving performance of blind TAP block is one of the reasons for the popularity of this method among anesthesiologists. It can be performed by feeling a loss of resistance while passing the needle through the interior and exterior oblique muscles. Nevertheless, considering possible side effects of blind injection, such as post-operative urinary congestion and intra-abdominal organ perforations, the US guide not only increases pain control efficacy by allowing it to see the real-time of anesthetic in the exact target location, reduces side effects.[5]

Like this study, Kamal et al. compared US-guided TAP block with IN/IH block in inguinal hernia patients. Although their study population was adults aged 18-60, they obtained the same results, showing better pain control by IN/IH blocking after the operation.[2] The study population of Faez et al. also reported more satisfaction with IIN/IIH block than with TAP block in inguinal hernia repair.[19] Although the study population of both studies was adults, similar results have been reported in pediatric studies [Fredrickson]. Priyadarshini et al. compared these two blocks with the quadratus lumborum (QL) block in pediatric inguinal hernia repair. They showed better pain control results using IN/IH and QL than TAP. Although they obtained better results from QL than IN/IH, it should be considered that performing the QL block consumes significantly more time than the others.

In contrast, Okur et al. and Hosalli et al. obtained better pain management results with US-guided TAP than IN/IH in adult patients with inguinal hernia repair.[14-20] This diversity in results might be due to the performer's expertise and various pain-scoring methods.

The superiority of IN/IH block over TAP block has been reported in other abdominal procedures. As such, Yujin et al. performed the same comparison in cesarean patients by reviewing articles on this matter. Their evaluation showed better pain control using IN/IH block during the first 24 after surgery.[21]

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Conclusion

In conclusion, we resulted in lower pain scores following IN/IH block before inguinal hernia repair compared to TAP block. Performing the TAP block consumes less time than the other. No differences were found regarding patients' vital signs between the two groups.

Further studies with larger sample sizes in comparison of IN/IH block with the QL block under the US guide are suggested.

Ethical Consideration

Approval was obtained from the ethics committee of Tabriz University of Medical Sciences. The procedures used in this study adhere to the tenets of the Declaration of Helsinki. IRCT20190730044383N1 (date of registration: 18-02-2020)

Acknowledgment

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Conflict of interests

There is no conflict of interests

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