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Ultrasound-assisted Transversus Abdominis Plane Block Versus Wound Infiltration for Postoperative Analgesia in Pediatric Patients Undergoing Inguinal Hernia Repair: A Randomized Controlled Trial

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Abstract: Background: Inguinal hernia repair is one of the most frequently performed surgical procedures in the pediatric population. Using optimal analgesic regimens provides safe and effective analgesia, reduce postoperative stress response and accelerate recovery from surgery. **Objectives:** to evaluate the analgesic effect of ultrasound guided TAP block compared with wound infiltration during the first 24 h after surgery in children undergoing inguinal hernia repair. **Design:** prospective, randomized, double-blinded and controlled study. **Setting:** Pediatric surgery department at Children's Ain Shams University Hospital, **Patients and Methods:** Sixty Children between 2 and 8 years of age undergoing unilateral inguinal hernia repair at Pediatric surgery department at Children's Ain Shams University Hospital, were randomized between TAP block group and wound infiltration group each of Thirty patients. **Measurements:** Pain scores, Time to rescue analgesia, Total analgesic drug requirements, and side effects were observed for 24 hours. **Results:** The duration of adequate analgesia was significantly higher in group A (TAP) compared to group B (Wound infiltration) *p-value <0.001.*

Twenty-Two (78.6%) patients in TAP group did not require any analgesic within the first 24 h compared with only ten patients (37%) in wound infiltration group. Also a statistically significant decreased number of patients of TAP group was found compared to wound infiltration group regarding the need for analgesia and total analgesic dose*sp-value <0.05*. The side effects were equally insignificant in both groups. **Conclusion:** US guided TAP block provided significantly prolonged postoperative analgesia, reduced postoperative analgesic requirements compared with wound infiltration and without any clinical side-effects during the first 24 h after surgery in children undergoing inguinal hernia repair. Both analgesic techniques are safe.

[Mohamed H. Shokeir, Ibrahim M. Esmat, Thabet A. Nasr, Sara M. El-kfafi. **Ultrasound-assisted Transversus Abdominis Plane Block Versus Wound Infiltration for Postoperative Analgesia in Pediatric Patients Undergoing Inguinal Hernia Repair: A Randomized Controlled Trial.** *Nat Sci* 2019;17(12):96-103]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 14. doi:10.7537/marsnsj171219.14.

Key words: Transversusabdominis Plane Block, wound Infiltration, postoperative Analgesia, children, inguinal hernia repair

1. Introduction

Although general anesthesia (GA) is the commonly used technique in children, regional anesthesia is used as an adjuvant for intraoperative and postoperative pain relief [(1)].

Of the various peripheral nerve block techniques available, the Transversus Abdominis Plane block (TAP block) is a rapidly evolving peripheral nerve block technique that provides effective analgesia during the postoperative period following abdominal surgeries [(2)].

Few studies on children concluded that the use of TAP block is a good alternative in pediatric patients for postoperative pain management in lower abdominal and infraumbilical surgeries [(3)].

To date, the efficacy of TAP block versus wound infiltration on postoperative analgesia remains controversial. Therefore, the main objective of the current study was to compare the efficacy and safety of TAP block versus wound infiltration for pain relief after surgery.

Aim of Work

The aim of this study was to evaluate the analgesic effect of ultrasound guided TAP block compared with wound infiltration during the first 24 hours after surgery in children undergoing inguinal hernia repair.

2. Patients and Methods

This prospective, randomized, double-blinded and controlled study was conducted on 60 Children with ages 2-8 years and physical status: ASA I or II undergoing unilateral inguinal hernia repair at Pediatric surgery department at Children's Ain Shams University Hospital, Cairo, Egypt during a period of 6 months from February 2019 to July 2019.

While children with a known history of allergy to any of the study drugs, bleeding disorders, muscle diseases and children with vertebral anomalies or any neurological deficits were excluded from the study.

Sampling Method:

Randomization was done by computer-generated number lists and use of sealed opaque envelopes.

Sample Size*:*

Sample size was determined based on a power of 90% and an alpha error of 5% assuming that a 20% prolongation of the time to first analgesic request is clinically significant. The calculated sample size in each group was 27. Thirty patients were included in each group to accommodate for possible dropouts.

Study Tools:

Portable US unit (SonoSite, Bothell, Washington, USA), a linear probe (high frequency 10-12MHz)23G 50mm needles with injection lines.

Ethical Considerations

The study was done after obtaining an approval from the research ethics committee of Faculty of Medicine, Ain Shams University and obtaining a written informed consent from the parents or guardians.

Study Procedures:

Pre-operative settings*:*

Sixty patients scheduled for unilateral inguinal hernia repair were assessed preoperatively in the form of evaluation of their medical history, physical examination, their laboratory investigations. Patients were randomly divided into two groups (n= 30 each).

Group A:

Patients of this group received US guided TAP block on the same side of surgery, patients were placed in supine position, linear ultrasound probe connected to a portable US unit (SonoSite, USA) was placed in the mid-axillary plane midway between the lower costal margin and the highest point of iliac crest. After skin disinfection, a 23G 50 mm needle with an injection line was inserted in plane with the probe. Once the tip of the needle was placed in the space between the internal oblique muscle and transverses abdominis muscle, and after negative aspiration, 0.5 ml/kg 0.25% bupivacaine was injected. The surgical procedure began 5 to 10 min after local anesthetic administration.

Group B:

Wound infiltration between the external aponeurosis and the skin was performed by the experienced surgeons during wound closure with 0.25% bupivacaine 2 mg/ kg.

Duration of surgery and anesthesia was recorded for all patients. Anesthesiologist who performed the block and the surgeon who did the infiltration were not present during the pain evaluation and collection of data. The parents were not informed about which group they were included in the study.

Intra-operative Setting

All patients received a standard anesthetic protocol. In the operating room, ECG, heart rate, non-invasive blood pressure, SpO2 and temperature were monitored. After preoxygenation, general anesthesia was induced either with 8% sevoflurane and 100% oxygen, or with propofol 2 mg/kg depending on the availability of venous access. In both groups, rectal paracetamol 15mg/kg was administered after induction of anesthesia. Dextrose 5% in 0.45% NaCl solution 10 ml/ kg/ h was given intravenously during surgery. Fentanyl 1μg/kg was given and after neuromuscular block was achieved with atracuriumbesylate 0.5mg/kg, the trachea was intubated. Anesthesia was maintained with Sevoflurane 2% and 100% oxygen. At the end of the operation, neuromuscular block was reversed with neostigmine and atropine. Extubation was done after fulfilling its criteria.

The following parameters were assessed and recorded postoperatively:

1-Hemodynamic monitoring:

Postoperative recordings also included vital signs (blood pressure, heart rate, respiratory rate) Blood pressure, heart rate and respiratory rate were recorded every 5 minutes for the first 15 minutes then every 15 minutes for the first 2 hours postoperatively.

2-Assessment of postoperative pain:

Pain scores were assessed using the modified Children's Hospital of Eastern Ontario Pain Scale (mCHEOPS) [(4)]. The mCHEOPS score was assessed for the 1st h, 2nd hr, 4th, 8th, the16thh and the 24th hour. Oral paracetamol 15mg /kg 6 hourly was administered if the mCHEOPS score was greater than or equal to 6 ($\geq$6). Patients were reassessed 30 min after oral paracetamol and those unresponsive were treated with intravenous morphine 0.05 /mg/kg as rescue analgesic.

3-Block failure:

Any case of failed block was recorded, but no cases were recorded in this study as the block was given by an expert anesthetist.

4- Complications and Adverse Effects:

During and after the procedure, any complications were recorded. Adverse effects including postoperative nausea, vomiting, hypotension, bradycardia and arrhythmia. Hypotension was defined as a 20% decrease in SBP compared with baseline and was treated with rapid infusion of fluids.

Bradycardia was defined as decreased heart rate below 70 b/m and was treated by atropine 0.01mg/kg., alsoan increase in respiratory rate was defined as RR> 35 breath /min.

Dexamethasone 0.01 mg/kg was given intravenously for nausea or vomiting.

Statistical analysis:

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done: Independent-samples t-test of significance was used when comparing between two means. Mann Whitney U test: for two-group comparisons in non-parametric data. Chi-square (χ^2) test of significance was used in order to compare proportions between qualitative parameters. Kaplan-Meier Survival Analysis: is a descriptive procedure for examining the distribution of time-to-event variables. Log rank test to compare time-to-event variables by levels of a factor variable. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: Probability (P-value) P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant. P-value >0.05 was considered insignificant.

3. Results

1-Demographic Data:

There was no statistically significant difference between group (TAP) and group (Wound infiltration) as regard demographic data and duration of surgery (min) as shown in table (1).

Table (1): Comparison between groups according to demographic data.

Demographic data	TAP Group *(n=28)*	Wound infiltration Group *(n=27)*	p-value
Age (years)	3.9±1.57	3.96±1.68	0.810¥
Sex			
Female	12 (42.9%)	10 (37.0%)	0.660#
Male	16 (57.1%)	17 (63.0%)	
ASA			
I	22 (78.6%)	21 (77.8%)	0.943#
II	6 (21.4%)	6 (22.2%)	
Duration of surgery (min)	30.79±7.19	32.70±5.47	0.272¥

t-Independent Sample t-test; p-value>0.05 NS

2-Vital Data:

There was no statistically significant difference between two groups as regard Post Operative vital data as shown in table (2).

Table (2): Comparison between groups according to vital data.

Vital Data	TAP Group *(n=28)*	Wound infiltration Group *(n=27)*	p-value¥
SBP (mmHg)	99.54±12.80	102.22±12.30	0.431
DBP (mmHg)	63.18±6.30	63.11±9.27	0.975
Heart rate (beat/min)	91.68±12.26	90.67±14.14	0.778
Respiratory rate	19.21±2.63	20.22±2.78	0.173

Using: Independent Sample t-test; p-value >0.05 NS;

3- Postoperative Pain:

There was statistically significant difference between group (TAP) and group (Wound infiltration) as regard postoperative mCHEOPS score as shown in table (3).

Table (3): Comparison between groups according to mCHEOPS.

mCHEOPs	TAP Group *(n=28)*	Wound infiltration Group *(n=27)*	Mean Difference (C.I. 95%)	p-value§
After 1 hr	3.21±1.26	5.81±1.39	2.6 (0.91-4.16)	**<0.001****
After 2hr	3.43±1.14	5.37±1.01	1.94 (0.68-3.10)	**<0.001****
1st 4 hrs	4.21±1.20	5.44±1.40	1.23 (0.43-1.97)	**<0.001****
After 8 hr	3.82±1.09	4.41±0.57	0.59 (0.21-0.94)	**0.016***
After 16 hrs	3.21±1.20	4.63±1.31	1.42 (0.50-2.27)	**<0.001****
After 24 hrs	2.29±0.90	3.56±1.19	1.27 (0.44-2.03)	**<0.001****

*§ Mann-Whitney test; **p-value <0.001 S*

The duration of adequate analgesia (mCHEOPS Score less than 6) was significantly higher in group (TAP) compared to group (Wound infiltration)

4-Time to first Analgesic Dose:

There was a statistically significant difference between group (TAP Group) and group (Wound infiltration) according to time to the first analgesic dose.

TAP Group showed significantly prolonged duration than wound infiltration group to the need for the first analgesic dose as shown in table (4).

Table (4): Comparison between groups according to time to rescue analgesic (hrs).

Time to rescue analgesic (hrs)	TAP Group *(n=28)*	Wound infiltration Group *(n=27)*	Mean Difference (C.I. 95%)	p-value¥
Mean±SD	1.21±1.13	0.67±0.76	0.54 (0.19-0.86)	**0.018***

*¥ Independent Sample t-test; *p-value <0.05 S*

5-Total requirements of Analgesia:

There was a statistically significant difference between two groups according to number of total analgesic doses.

Group (TAP) showed less need for analgesia and less cumulative analgesic doses than Group (Wound infiltration) as shown in figure (1).

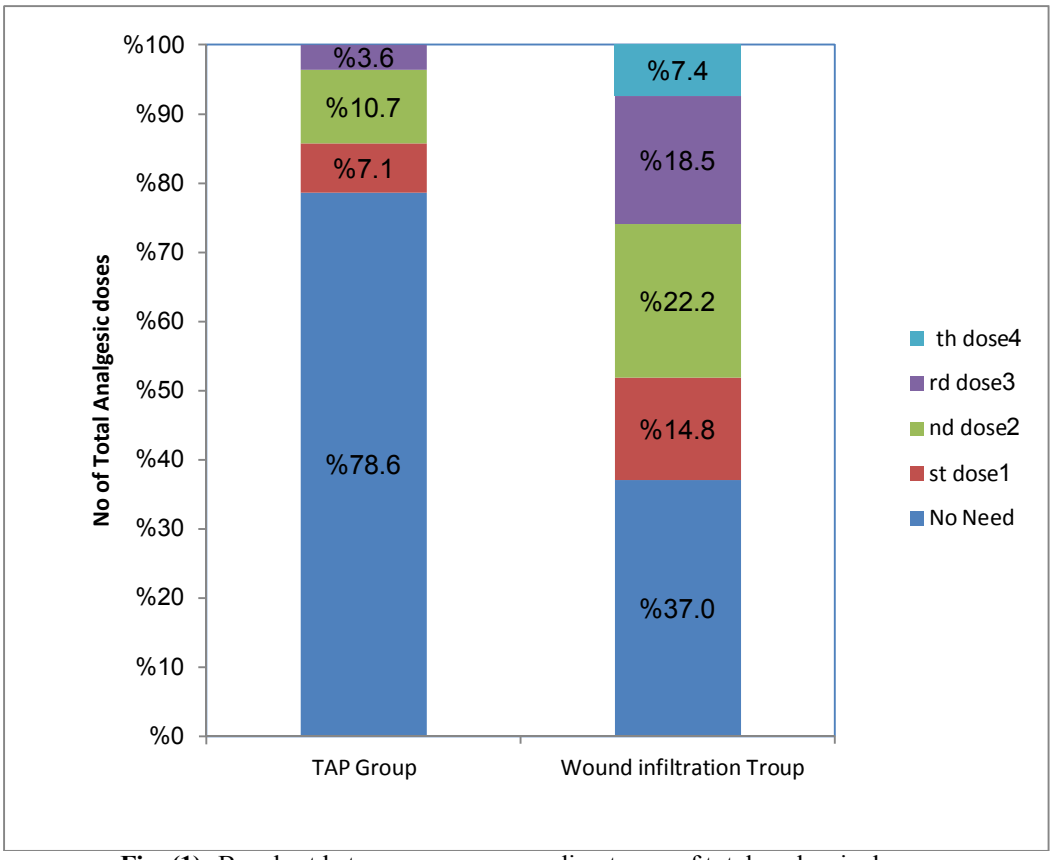

Fig. (1): Bar chart between groups according to no. of total analgesic doses.

Table (5): Comparison between groups according to cumulative dose of paracetamol (mg/kg).

Cumulative dose of Paracetamol (mg/kg)	TAP Group *(n=6)*	Wound infiltration Group *(n=17)*	p-value
Mean±SD	333.67±46.71	987.24±138.21	**<0.001****

No cases were found unresponsive to paracetamol recue dose thus no cases were treated with IV morphine as rescue analgesia.

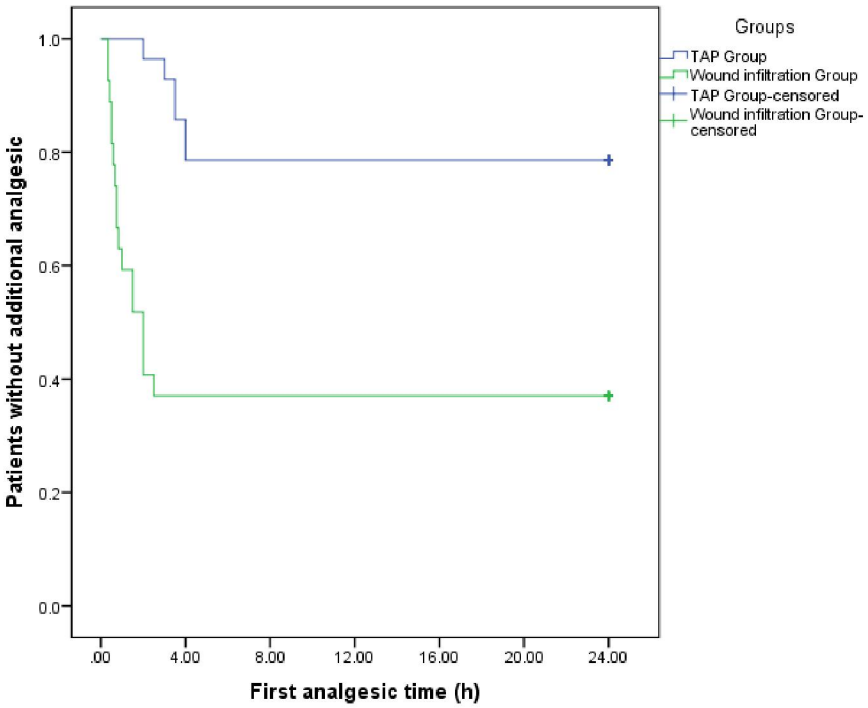

Fig. (2): Kaplan–Meier survival plot showing rate of analgesic during the first 24 postoperative hours. Number of patients are given as percentage. 17 patients in wound infiltration group (63%) requested additional pain relief compared to 6 patients in TAP group (21.4%) (Log-rank chi-squared = 13.693, p-value <0.001 HS).

6-Post Operative Adverse Effects:

There was no statistically significant difference between group (TAP) and group (Wound infiltration) regarding occurrence of post operative adverse effects as shown in table (6).

Table (6): Comparison between groups according to adverse effects.

Adverse effects	TAP Group *(n=28)*	Wound infiltration group *(n=27)*	p-value‡
Hypotension	3 (10.7%)	2 (7.4%)	0.965
Nausea	0 (0.0%)	2 (7.4%)	0.456
Vomiting	0 (0.0%)	0 (0.0%)	1.000
Bradycardia	0 (0.0%)	0 (0.0%)	1.000

‡Fisher's exact test p-value>0.05 NS;

Other complications as infection, local anesthetic toxicity were measured during operation and postoperatively but no cases were recorded as both blocks were given under complete aseptic conditions and doses of local anesthetics given were below 2mg/kg (maximum dose).

4. Discussion

This study showed that ultrasound-guided TAP block with high volume local anaesthetic 0.5 ml/kg 0.25% bupivacaine was significantly superior to wound infiltration with 0.25% bupivacaine 2mg/ kg, in terms of time to first analgesic requirement, total doses of analgesics in the first 24 postoperative hours, cumulative doses of paracetamol and pain scores at all times.

In this study, the dose of local anesthetic used in TAP block and infiltration were the same, but the volume is increased in TAP block as it is a compartment block. **Carney at al.** [13]

Wound infiltration involved a smaller volume of local anaesthetic, and this could have been an important factor as stated by **Sahin et al.** [3]

In wound infiltration which was performed blindly, local solution could be injected into subcutaneous layer or muscle plane, Thus, it may be assumed that injections to non target area could be the reason of inadequate analgesia.

The effects of wound infiltration appear to be short-lived, The perioperative administration of fentanyl and paracetamol would have helped to equilibrate the pain scores in the early postoperative period.

These results may be explained by differences in the two techniques used.

Kendigelen et al., [5]in a study on 80 patients to compare the analgesic efficacy of ultrasound-assisted transversusabdominisplane (TAP) block and wound infiltrationduring the first postoperative 24hours reported that the effective local anesthetic dose in TAP block intervention in pediatric patients is 1 to 2 mg/kg, supporting the used dose in the current study.

Suresh and Chan, [6] in an article describing a user-friendly approach to the placement of a TAP block in infants, children and adolescents suggested that, to avoid local anesthetic toxicity, maximum local anesthetic dose used should be 2 mg/kg in newborns and 3 mg/kg in children which was applied in this study.

Disma et al., [7] compared three different concentrations of levobupivacaine, 0.125, 0.25 and 0.375% for ilioinguinal and iliohypogastric block and they found that 0.4 ml kg_10.25% levobupivacaine provided satisfactory postoperative pain relief after inguinal hernia repair.

Consistent with this study**, Sujatha et al.** [8] in a study on sixty patients scheduled for hernia repair to compare the efficacy of postoperative analgesia of Ultrasound guided TAP block and IIIH block with wound Infiltration in patients undergoing open inguinal hernia surgery, stated that Ultrasound (USG)-assisted TAP block delivered a better analgesia in the postoperative period in inguinal hernia surgery compared to wound infiltration.

Sahin et al. [3]in a study on 57 children between 2 and 8 years old undergoing inguinal hernia repair, had applied TAP block to one group before surgery with 0.5 mL/kg 0.25% L-bupivacaine and to another group wound infiltration with 0.2 mL/kg 0.25% after the surgery and observed that analgesia was superior in TAP group as it provides a long period of postoperative analgesia and reduced analgesic use without any clinical side-effects after unilateral inguinal hernia repair in children, which is also **consistent** with this study.

These results were supported by the studies of **Khan et al., [9], Yu et al. [10], Kanojia and Ahuja [2], El Fawy and El-Gendy [11],** who reported that TAP block is a promising technique in alleviating postoperative pain especially when used as part of multi-modal analgesia regimen, as procedural simplicity of this block, along with reliable level of analgesia (T10–L1), longer duration as well as quality, with lesser opioid requirement and their side-effects makes the TAP block a good option for open appendectomy, inguinal hernia surgeries and lower abdominal surgeries in children compared to other modes of neuroaxial analgesia as caudal block or direct infiltration of the local anesthetic to the surgical incision site.

Partially consistent with this study, **Sujatha et al.** [8] who compared the efficacy of postoperative analgesia of ultrasound guided TAP block and ilioinguinal / iliohypogastric (IIIH) block with wound infiltration (WI) in patients undergoing open inguinal hernia surgery, reported that the time for first rescue analgesia was prolonged in TAP group compared to IIIH group, but total analgesic requirement within the first 24 h remained the same in both the groups with minimal side effects.

In contrast to this study, **Fredrickson et al.** [12]under US guidance, compared TAP blocks with ilioinguinal blocks in a study on 44 ASA I and II children undergoing elective inguinal surgery, more children in the TAP group reported pain in the recovery unit and required more analgesia in comparison with the ilioinguinal group. The discrepancy in the results of the TAP group with ours can be explained partially by the type of surgery as only hernia repair was explored in this study versus groin surgery (inguinal herniotomy, hydrocelectomy, orchidopexy) in the Fredrickson study.

Also in contrast *with this study* ***Ahmed and Rayan*** [1] in a study on 40 ASA I–II, 1–5-year-old children scheduled for elective unilateral open inguinal herniotomy that was designed to evaluate the efficacy of a US-guided TAP block and to compare it with a caudal block in unilateral day-case open inguinal hernia repair in children till the 4th hour post operative period concluded that US-guided TAP block is as effective as a caudal block in providing immediate postoperative analgesia in inguinal hernia repair.

The discrepancy in the results of with ours can be explained partially by the short postoperative pain assessment time, only 4 hrs post operatively.

There were limitations with this study as we did not consider a postoperative agitation effect of sevofluran.

Another limitation was the assessment of parental satisfaction that must have been followed over a period of one week by telephone calls, however, because of cultural reasons, this could not be done.

Conclusion

The current study revealed that US guided TAP block provided significantly prolonged postoperative analgesia, reduced postoperative analgesic requirements compared with wound infiltration and

without any clinical side-effects during the first 24 h after surgery in children undergoing inguinal hernia repair. Both analgesic techniques were safe.

References

1. Ahmed A and Rayan A: Ultrasound-guided transversus-abdominis plane block versus caudal block for postoperative analgesia in children undergoing unilateral open inguinal herniotomy: a comparative study. Ain-Shams J. of Anesthesiology 2016; 9:284–289.
2. Kanojia N and Ahuja S: Comparison of Transversus Abdominis Plane Block and Caudal Block for Postoperative Analgesia in Children Undergoing Lower Abdominal Surgery. International Journal of Science and Research (IJSR) 2015; 4(4); 1585-1587.
3. Sahen L, Sahin M, Gul R, et al: Ultrasound-guided Transversus Abdominis Plane block in children, Arandomised comparison with wound infiltration. Eur J Anaesthesiol 2013; 30:409–414.
4. Splinter WM, Semelhago L, Chou S.: The reliability and validity of a modified CHEOPS pain score. Anesth Analg 1994; 78: S413; (Abstract).
5. Kendigelen P, Tutuncu AC, Erbabacan E, et al. Ultrasound-assisted transversusabdominis plane block vs wound infiltration in pediatric patient with inguinal hernia: randomized controlled trial. J Clin Anesth. 2016;30:9–14.
6. Suresh S, Chan VW: Ultrasound guided transversusabdominis plane block in infants, children and adolescents: a simple procedural guidance for their performance. Paediatr Anaesth 2009;19:296-9.
7. Disma N, Tuo P, Pellegrino S, et al: Three concentrations of levobupivacaine for ilioinguinal/iliohypogastric nerve block in ambulatory pediatric surgery. J Clin Anesth 2009; 21:389–393.
8. Sujatha C, Zachariah M, Ranjan RV, et al.: Transversusabdominis plane block versus ilioinguinal/iliohypogastric nerve block with wound infiltration for postoperative analgesia in inguinal hernia surgery: A randomized clinical trial. Anesth Essays Res 2017;11:976-80.
9. Khan SM, Nawaz S, Delvi MB, Alzahrani T, et al. Intraoperative ultrasound guided transverses abdominis plane block in lower abdominal surgery. Int J Perioperative Ultrasound Appl Technol 2012;1(1):1–4.
10. Yu N, Long X, Lujan‐Hernandez JR, et al.: Transversusabdominis‐plane block versus local anesthetic wound infiltration in lower abdominal surgery: A systematic review and meta‐analysis of randomized controlled trials. BMC Anesthesiol 2014;14:121.
11. El-Fawy DM, El-Gendy HA.: Ultrasound-guided transversusabdominis plane block versus caudal block for postoperative pain relief in infants and children undergoing surgical pyeloplasty. Ain-Shams J Anesthesiology 2014; 07:177–81.
12. Fredrickson MJ, Paine C, Hamill J. Improved analgesia with the ilioinguinal block compared to the transversusabdominis plane block after pediatric inguinal surgery: a prospective randomized trial. Paediatr Anaesth 2010; 20:1022-1027.
13. Carney J, Finnerty O, Rauf J, et al. Ipsilateral transversusabdominis plane block provides effective analgesia after appendectomy in children: a randomized controlled trial. Anesth Analg 2010; 111:998-1003.

9/1/2019