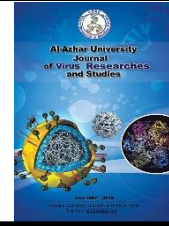




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### **Ultrasound-Guided TAP Block versus Ultrasound-Guided Caudal Block for Postoperative Analgesia in Pediatric Lower Abdominal Surgery :A Prospective Randomized Study**

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#### **Abstract**

In day care pediatric surgical units, lower abdominal operations such as herniotomy, appendectomy, and undescended testis are regularly performed. They are linked to considerable postoperative pain and discomfort. The purpose of this study is to compare post operative analgesic effectiveness of ultrasonography-guided caudal epidural block (USG CEB) versus ultrasonography-guided transverses abdominis plane (USG TAP) block in pediatric patients undergoing lower abdominal surgery. Forty patients undergoing lower abdomen surgery were randomly divided to two equal groups using sealed opaque envelopes: TAP group utilizing TAP block and caudal group using caudal epidural block. We compared the two groups in terms of total analgesia consumption in 24 hours, postoperative analgesia using Numeric Rating Scale (NRS-11), time to first rescue analgesia, and problems related to method or drugs employed. The TAP Group was statistically highly significant(p-value<0.001), less as regard total postoperative analgesic consumption than the Caudal Group until 12 hours after surgery, there was not statistically significant(p-value>0.05) difference between the two groups. However, 18 hours postoperatively, the caudal group had a greater NRS-11 than the TAP group. Need of analgesia was statistically significantly (p-value 0.003) faster in Caudal Group compared to TAP Group according to timing of first rescue analgesia. There was a statistically significant(p-value<0.05) difference between groups according to complication related to technique or drug used regarding delayed micturition and Motor block with higher complications in caudal group compared to TAP group. TAP block is more efficient and has less complications than caudal block in lower abdominal surgery.

**Keywords:** Ultrasonography Transversus Abdominis Plane Block, Caudal block.

#### **1. Introduction**

In pediatric surgical units, lower abdominal operations such as herniotomy, appendectomy and undescended testis are regularly performed. They cause substantial postoperative pain. A

multimodal approach to pain management is more effective (Amit et al., 2020) [1]. Because of its efficient sensory and visceral pain management, caudal epidural block (CEB) is the most favored method for

pediatric regional analgesia, however transversus abdominis plane (TAP) block is a developing abdominal wall regional anesthetic approach Mohammed et al., [2]. So, we proceeded this study to compare between USG TAP block and USG caudal block in lower abdominal pediatric surgery aiming to estimate total post operative analgesia, NRS-11 postoperative analgesia, time to first rescue analgesia, and complications related to the procedure or substance employed.

## 2. Patients and Methods

This is a prospective, randomized, double-blind to the observer with 40 patients scheduled for elective lower abdomen operations. After receiving clearance from the hospital's ethical committee and signed informed consent from the parents, this study was carried out at the department of Anesthesia at Al-Zahraa university hospital. Participants with ASA I-II physical status, aged 7-14 years, of both sexes, are randomly divided into two equal groups via sealed opaque envelopes, with 20 patients in each group: Ultrasound guided caudal block (USG CEB) and ultrasound guided transversus abdominis plane block (USG TAP). Patients with upper air way infection, allergy to bupivacaine, bleeding and coagulation disorders, history of developmental delay or mental retardation, type I diabetes and congenital spine anomaly or infection at the sacral or inguinal region were excluded from the study. A preoperative history, clinical examination, and any necessary routine investigations were carried out. Prior to surgery, patients had fasted of food for 6hrs and clear fluids for 2 hrs.

### 2.1 Premedication

Upon arrival in the preoperative room: a 22-gauge intravenous cannula was inserted. Ketamine 0.25- 0.5 mg/kg was given intravenously and Chloral Hydrate

25-50mg/kg was given orally as premedication 30 minutes prior to surgery.

### 2.2 Monitoring

All patients were monitored using standard ASA monitoring such as an ECG, pulse oximetry, non-invasive blood pressure, and a precordial stethoscope.

### 2.3. Induction of Anesthesia

The general anesthetic procedure was the same for all patients. Induction using 8 percent sevoflurane and 100% oxygen delivered through a face mask. Fentanyl (1mic/kg) was administered intravenously. Following deep anesthesia, an adequate size laryngeal mask airway was inserted. Anesthesia was maintained with 2-3 percent sevoflurane and 100% oxygen, and the patient was breathing spontaneously during the procedure. Dextrose 5% in 0.45% normal saline was administered at a rate of 5 ml/kg/h. Following the end of the surgery, all regional block procedures were executed. As a baseline, mean arterial blood pressure (MAP) and heart rate (HR) were measured after inserting a laryngeal mask. During the procedure, patients who had an increase in HR or MAP of more than 15% relative to baseline were given 1mic/kg of fentanyl. Both the caudal and transversus abdominis planes were blocked using an ultrasonic probe with a high frequency linear transducer. For either the Caudal Group or the TAP Group, all subjects received 0.25% bupivacaine. Patients in the Caudal group got 0.75 mL/kg of 0.25% bupivacaine (maximum volume 20 ml). This set of children was placed in a lateral decubitus position. The probe was placed transversely at the midline at the level of the coccyx to see the sacral hiatus as a hypoechoic region between two hyperechoic lines representing the sacrococcygeal ligament (SCL) superiorly and the dorsum of the pelvic surface of the sacrum inferiorly. To provide a longitudinal picture of the sacral

hiatus, the probe was rotated. Then, using an in-plane technique, a 50mm, 25-gauge needle was used to penetrate the SCL without advancing more than 5 mm into the sacral hiatus to avoid dural puncture, and local anesthesia was administered following negative aspiration. Patients in the TAP group were given 0.4 mL/kg of 0.25% bupivacaine (maximum volume 20 ml). TAP block was performed on a supine subject. Under complete aseptic technique, the ultrasonic probe is positioned on the abdomen wall at the level of the umbilicus on the ipsilateral or bilateral side of surgery, depending on the procedure. Following the identification of the rectus abdominis muscle, the probe was pushed laterally halfway between the iliac crest and the costal border until a view of the three abdominal wall muscle layers and their associated fascia was acquired. The in-plane method was used to implant a 50 mm 22-gauge needle between the internal oblique and transversus abdominis muscles. To avoid intravascular injection, bupivacaine was injected following negative aspiration. Following the completion of the block, general anesthesia was withdrawn, and the laryngeal mask airway was removed. Patients were transferred to the recovery room for continuous vital sign monitoring and pain evaluation. The Numeric Rating Scale (NRS-11) was used to measure postoperative pain at the following intervals: on arrival to the recovery room (0hr), at 2, 4, 6, 8, 12, 18, and 24 hours) from 0 to 10, where 0 indicates "no pain" and 10 represents "the greatest pain possible." Rescue analgesia in the form of 15 mg/kg intravenous paracetamol was given to the patient who was in pain (NRS>5). The total quantity of paracetamol used as a rescue analgesic in 24hrs, as well as the period between the first postoperative dosage of paracetamol, were noted. Children were discharged from the hospital after 24 hrs. if they met the discharge criteria in the form of full consciousness with stable hemodynamic

parameters, oral intake toleration, voiding, and walking in an appropriate manner for age with the absence of side effects.

## 2.4 Assessment Parameters

The primary outcome is to estimate the total analgesic consumption within 24 hours. Secondary outcomes were NRS-11 postoperative analgesia, time to first rescue analgesia, and complications related to the procedure or technique, or dose employed.

## 2.5 Sample Size Justification

MedCalc® version 12.3.0.0 program "Ostend, Belgium" was used for calculations of sample size, statistical calculator based on 95% confidence interval and power of the study 80% with  $\alpha$  error 5%. In a previous study, (El Mourad and Asmaa (2015) reported that the time for rescue analgesia requirement (h) was mean in Group C [5.27± 1.89] compared to Group T [7.2 ± 0.96] with p-value <0.001 highly significant. Therefore, it can be relied upon in this study. Based on this assumption, sample size was calculated according to these values produced a minimal samples size of 38 cases were enough to find such a difference. Assuming a drop-out ratio of 5%, the sample size will be 40 cases, who were subdivided into two groups; Caudal Group (n=20) and TAP Group (n=20).

## 2.6 Statistical Analysis

The data collected were analyzed with the statistical package for social sciences, version 23.0. (SPSS Inc., Chicago, Illinois, USA). The quantitative data were given in the form of mean, standard deviation, and ranges. The following tests were done independent-samples t-test was utilized when comparing two means & Mann Whitney U test was used to compare between two groups with non-parametric data, the Comparison between groups with qualitative data was done by using Chi-

square test and Fisher's exact test instead of Chi-square test only when the expected count in any cell less than 5, the confidence interval was set to 95% and the margin of error accepted was set to 5%.

### 3 .Results

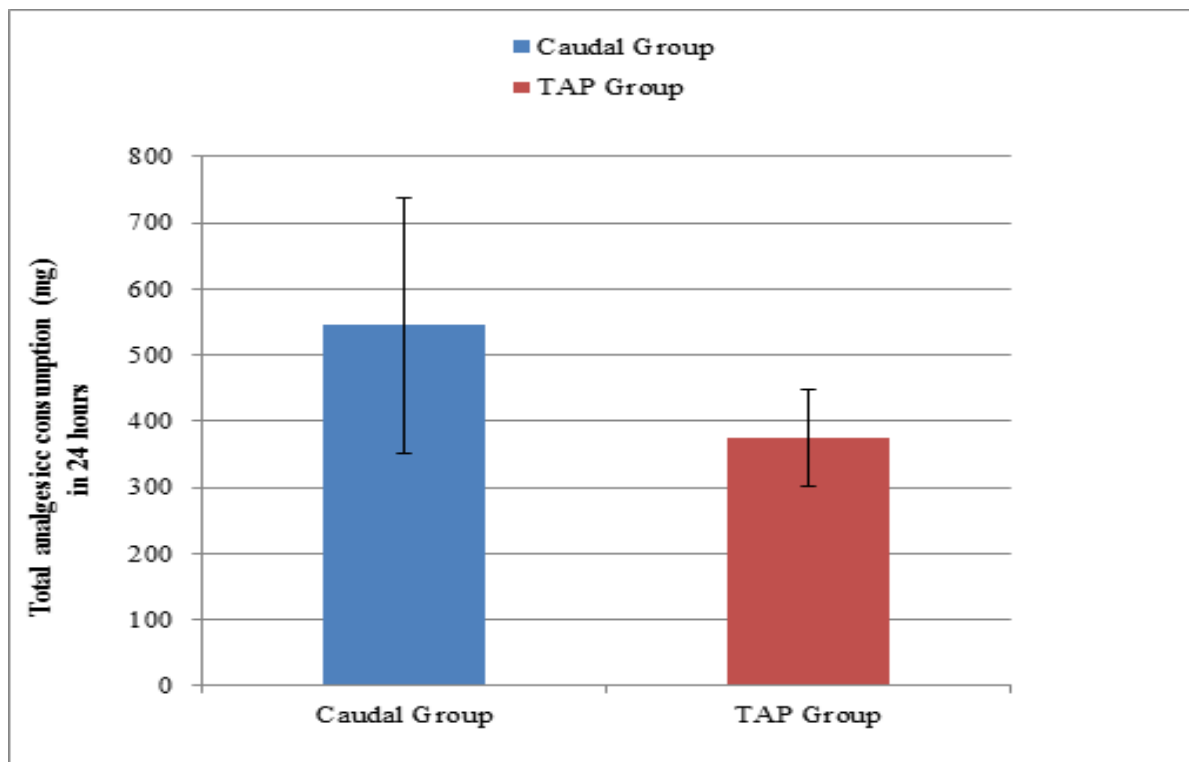
This study was carried out on forty patients were randomly divided by sealed opaque envelopes into two equal groups: Caudal

group and TAP group. There was no significant difference ( $p\text{-value}>0.05$ ) between the two groups according to demographic data Table 1. There was a highly statistically significant ( $p<0.001$ ). difference between two groups according to total analgesic consumption in 24hrs with the highest value was found in caudal group ( $544.50\pm 192.28$ ) compared to TAP Group ( $375.75\pm 73.40$ ) Figure .1.

**Table (1):** Comparison of gestation status and risk-factors of pre-term birth amid the studied groups.

| Demographic data                  | Caudal Group (n=20) | TAP Group (n=20) | Test value | p-value |
|-----------------------------------|---------------------|------------------|------------|---------|
| <b>Sex</b>                        |                     |                  |            |         |
| Female                            | 4 (20.0%)           | 4 (20.0%)        | FE         | 1.000   |
| Male                              | 16 (80.0%)          | 16 (80.0%)       |            |         |
| <b>Age (years)</b>                |                     |                  |            |         |
| Mean $\pm$ SD                     | 7.40 $\pm$ 0.99     | 8.10 $\pm$ 1.89  | t=1.467    | 0.151   |
| Range                             | 6-10                | 6-12             |            |         |
| <b>ASA</b>                        |                     |                  |            |         |
| I                                 | 17 (85.0%)          | 20 (100.0%)      | FE         | 0.072   |
| II                                | 3 (15.0%)           | 0 (0.0%)         |            |         |
| <b>Type of operation</b>          |                     |                  |            |         |
| Appendectomy                      | 6 (25.0%)           | 9 (40.0%)        | 7.892      | 0.246   |
| Open repair of undescended testis | 2 (5.0%)            | 0 (0.0%)         |            |         |
| Umbilical hernia repair           | 9 (45.0%)           | 11 (55.0%)       |            |         |
| Inguinal hernia repair            | 3 (15.0%)           | 0 (0.0%)         |            |         |

Using: *t*-Independent Sample *t*-test; FE: Fisher's exact test, *p*-value  $>0.05$  non-significant.



**Figure (1):** Comparison between caudal group and TAP group regarding total analgesic consumption in 24hrs.

There were no statistically significant differences between both groups until 12 hrs. postoperative. However, 18hrs postoperative, higher NRS-11 in Caudal group compared to TAP Group and these differences were statistically highly significant with p-value <0.001 Figure .2. Need of analgesia was statistically significantly faster in Caudal Group compared to TAP Group according to

timing of first rescue analgesia “hrs.”, with p-value <0.05 Significant Figure .3. There was a statistically significant difference between the two groups according to complication related to technique or drug used regarding delayed micturition and Motor block with p-value (p=0.009 and p=0.037) respectively. The higher complications in caudal group compared to TAP group Table .2.

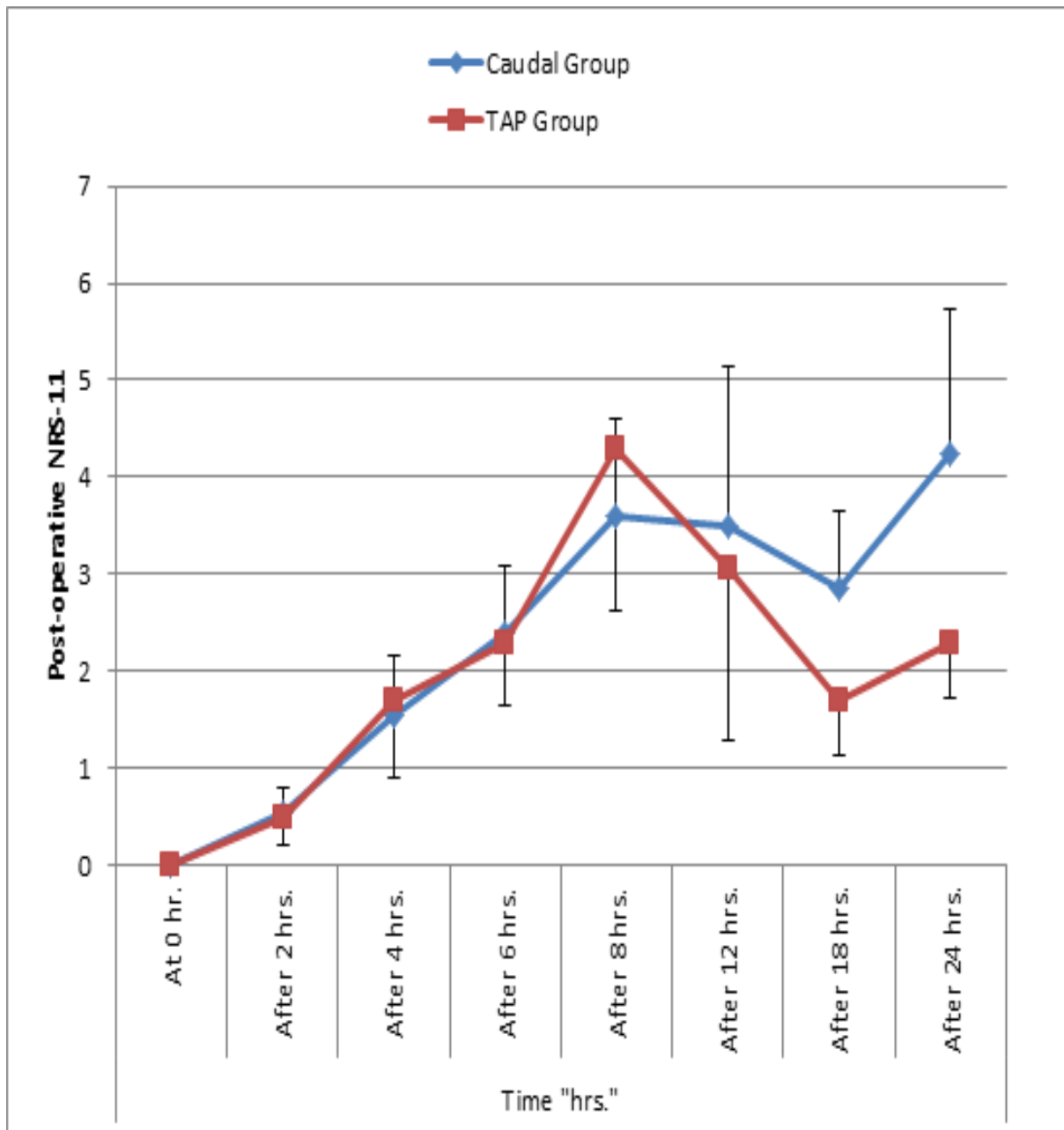
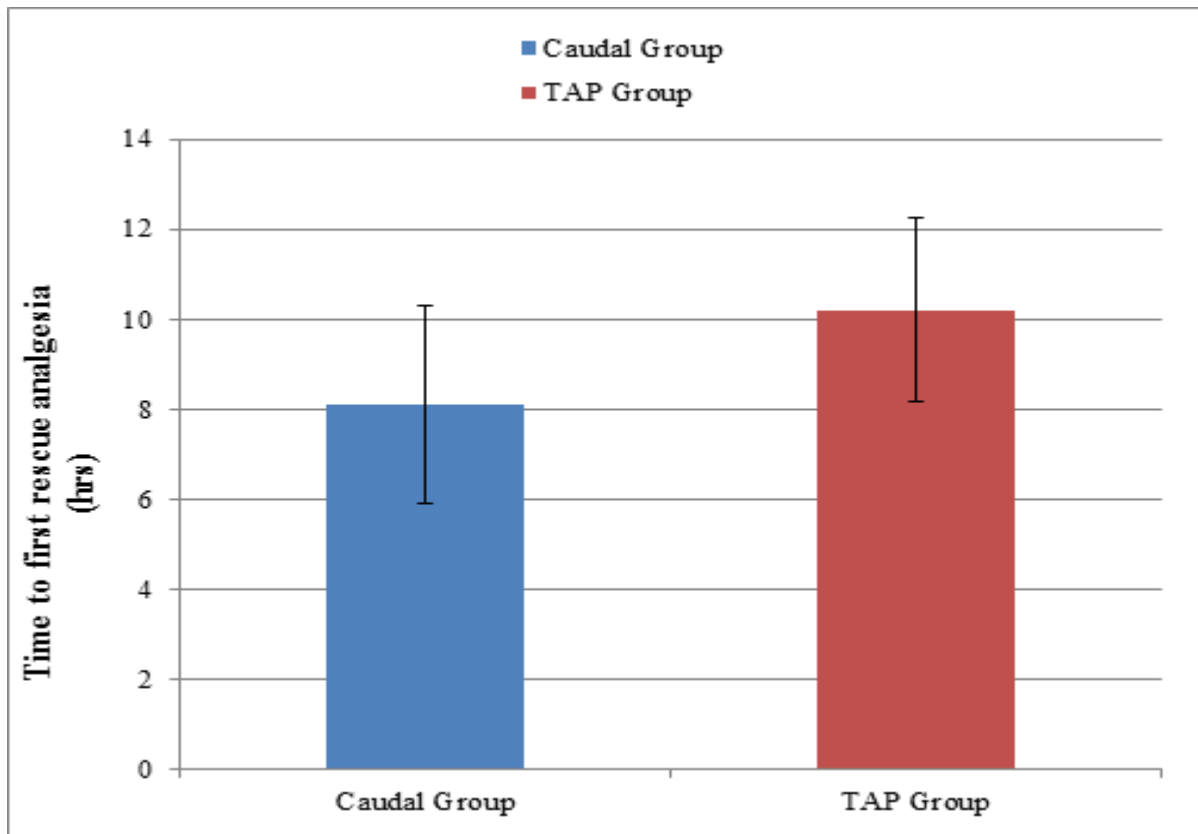


Figure (2): Comparison between caudal group and TAP group according to post-operative NRS-11.



**Figure (3):** Comparison between caudal group and TAP group regarding time to first rescue analgesia “hrs.”.

**Table (2):** The complications related to technique or drug used in both groups.

| Complication related to technique or drug used | Caudal Group (n=20) | TAP Group (n=20) | Test value | p-value |
|--|---------------------|------------------|------------|---------|
| Delayed micturition                            | 6 (30.0%)           | 0 (0.0%)         | 6.882      | 0.009   |
| Motor block                                    | 4 (20.0%)           | 0 (0.0%)         | 4.333      | 0.037   |
| Nausea and vomiting                            | 3 (15.0%)           | 2 (10.0%)        | 0.223      | 0.637   |

Using: FE: Fisher's exact test, p-value >0.05 NS; p-value <0.05 Significant

#### 4. Discussion

In our study there were no statistically significant variations in sex, age, ASA, or kind of surgery. and these findings are consistent with earlier research El Fawy 2014, Alsadek 2015, Reddy 2021, Fredrickson 2010, and Ahmed 2020 [3,4,5,6,7]. In our investigation, there was a highly statistically significant difference between two groups in terms of total analgesia consumption in 24 hours (p-

0.001). The caudal group had the greatest value (544.50 mg ± 192.28) compared to the TAP group (375.75 mg ± 73.40) our result may be explained as following: TAP blocks display rapid first phase absorption kinetics and can lead to elevated plasmatic concentrations of total and unbound fractions of local anesthetic, 50% shorter time to maximum serum concentration which most likely stems from the large,

highly vascularized absorptive surface area also accidental intramuscular injection (inside internal oblique or transverses abdominis muscle) could lead to even faster local anesthetic uptake.

Our results were supported by study of Alsadek et al. [4] which included sixty pediatric patients who had lower abdomen operations. These patients were separated into three groups: A (caudal), B (TAP), and C. (control). They reported that the need for postoperative rescue analgesia in the form of Paracetamol 15 mg/kg suppository was. In group A (TAP block group) only 3 patients needed rescue analgesia in the form of 2 doses, making the total number of doses 6. In group B (Caudal block group) all patients needed rescue analgesia with total number doses 21 which was significantly more than those in group A ( $p$  value  $< 0.001$ ), and 19 patients received single dose and single patient received 2 doses, and in group C (control group) all patients needed rescue analgesia with total number of doses 44 which was significantly more than those in group A and group B ( $p$  value  $< 0.001$ ), and 16 patients needed 2 doses and 4 patients needed 3 doses. And this agree with, Kumar et al. [5] study through 112 patients aged 2-8 years scheduled for inguinal hernia discovered that, Group T had a lower total dosage of rescue analgesic required in the first 24 postoperative hours, and this difference was statistically significant. Furthermore, Reddy et al., [5] demonstrated that as regards the need for post-operative rescue analgesia, they found that the requirements of ibuprofen rescue analgesia were statistically significantly higher in group A (CEB) group than in group B (TAP) group ( $P$ -value  $< 0.05$ ). In Group A (CEB group), nine patients needed rescue analgesia and mean total amount was  $254.44 \pm 58.97$  mg/24 hours, whereas, In Group B (TAB group), only four patients needed rescue analgesia in the form of a single dose and mean total amount was  $(187.5 \pm 29.86$  mg /24 hours). The current investigation found extremely

significant differences between the examined groups 18 hours postoperatively, with NRS-11 scores greater in the caudal group than in the TAP group, with  $p$ -value (0.001). And this agrees with the study of El Fawy and El Gendy [3] included 39 babies and toddlers who were scheduled for surgery pyeloplasty. The patients were split into two groups: Caudal ( $n = 19$ ) and TAP ( $n = 20$ ). TAP and caudal blocks resulted in identical pain scale scores in children receiving open pyeloplasty upon arrival at the PACU, at the time of discharge from the PACU, 14 hours and 22 hours postoperatively. They did find significantly lower pain levels in the TAP block group compared to the caudal group at different time points of pain evaluation over the 24-hour postoperative period. In their study, Alsadek et al. [4] they found that TAP, as compared to caudal, resulted in lower pain ratings and a lower demand for rescue analgesics from 6 to 12 hours after surgery. But, in the study of Sethi et al., [9] through 80 patients, aged 2-6 years scheduled for unilateral lower abdominal surgery with dose 0.75ml/kg of 0.25% bupivacaine in CEB group and 0.5ml/kg of 0.25% bupivacaine in TAP group, the median duration of postoperative analgesia was significantly greater in children who received CEB than those who were administered TAP block (group C: 362.5 minutes [172.5-693.75] vs group T: 210 minutes [108.75-362.5];  $P < .05$ ). This disagree with our study may be due to difference in age (our study in age 7-14yrs, his study in age 2-6yrs), difference in dose (our dose is 0.75ml/kg of 0.25% bupivacaine in CEB and 0.4ml/kg of 0.25% bupivacaine in TAP group but his study 0.75ml/kg of 0.25% bupivacaine in CEB and 0.5ml/kg of 0.25% bupivacaine in TAP group), difference in technique (our study included bilateral injection and his study is unilateral injection) and different time of injection (we injected at the end of operation after the surgeon finished but in his study the injection was after induction of anesthesia). Regarding first time of

rescue analgesia in our study need of analgesia was statistically significantly faster in Caudal Group compared to TAP Group according to timing of first rescue analgesia “hrs.”, with p-value <0.05 Significant. This agree with Ahmed et al. [7] study through 60 patients between 2-6 years scheduled for elective lower abdominal surgery discovered that all patients in the control group required rescue analgesia, compared to just 4 (20%) and 10 (50%) of patients in the TAP and caudal groups, respectively, and this was statistically significant (P<0.05). In terms of time to initial rescue analgesia, the control group demonstrated a statistically significant (P-value<0.05) difference from the TAP and Caudal groups. The time gap between administering the first rescue dosage of analgesia was shorter in the control group and longest in the TAP group. Reddy et al. [5] revealed through his study in 62 pediatric patients aged 2-10years undergoing lower abdominal surgeries that the time for the first analgesic request (primary result) was (4.590.59) hours in the CEB group. It was (7.481.35) hours in the TAP group. When the findings were compared using the independent sample t test, there was a statistically significant difference between the two groups with (p value 0.001). Our findings revealed a statistically significant difference between groups in terms of delayed micturition and motor block, with p-values (p=0.009 and p=0.037, respectively). The Caudal Group had more obstacles than the TAP Group. Elbahrawy and El-Deeb [10] found that in 75 children aged 1-7 years scheduled for day case unilateral lower abdominal surgeries when the TAP group was compared to the caudal group, the incidence of vomiting was statistically significantly lower in TAP Group and the parent satisfaction level was statistically significantly higher. Complications were only reported in the caudal block group, where two patients experienced bradycardia and one had hypotension, and

four patients had vomiting postoperatively, according to Reddy et al. [5]. There was no shivering, urine retention, or respiratory depression. Sedation was not shown to be a significant (p > 0.05) factor in either of the two groups. But In Alsadek et al. [4] study with 0.5ml/kg bupivacaine 0.25% in TAP group and 1ml/kg bupivacaine 0.25% in CEB group, no problems were observed in any group, either intra or postoperatively, in the form of hemodynamic instability, harm to underlying tissues, hematoma formation, infection, or postoperative nausea and vomiting. Patient and parent satisfaction were significantly higher in groups A and B (the TAP and caudal block groups) than in group C. (the control group) this disagreement with our study may be due to difference in age group(our study 7-14yrs and his study 2-7yrs), difference in dose(our study 0.4ml/kg bupivacaine 0.25% in TAP group and 0.75ml/kg bupivacaine 0.25% in CEB group vs his study 0.5ml/kg bupivacaine 0.25% in TAP group and 1ml/kg bupivacaine 0.25% in CEB group) and different time of injection( we injected at the end of operation after the surgeon finished but in his study the injection was after induction of anesthesia). Also, Kumar et al. [8] discovered through his study by 0.5ml/kg of 0.2% ropivacaine in TAP group and 1ml/kg of 0.2% ropivacaine in CEB group that in the postoperative phase, a total of 8 patients in Group T and 14 patients in Group C had nausea and vomiting, however this difference did not reach statistical significance. Other adverse effects were not recorded in either group, including hypotension, bradycardia, respiratory depression and urinary retention this disagree with our study and this may be due to difference in age group(our study 7-14yrs vs 2-8yrs in Kumar study) , difference in drug used(we used bupivacaine and Kumar used ropivacaine), different dose( we used 0.4ml/kg bupivacaine 0.25% in TAP group and 0.75ml/kg bupivacaine 0.25% in CEB group and Kumar used 0.5ml/kg of 0.2%



ropivacaine in TAP group and 1ml/kg of 0.2% ropivacaine in CEB group) and different time of injection( we injected at the end of operation after the surgeon finished but in his study the injection was after induction of anesthesia).

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## 6. Conclusion

TAP block is more efficient in terms of postoperative analgesia, requiring less total postoperative analgesia and had less postoperative side effects than caudal block.

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