

## Continuous Transversus Abdominis Plane block versus caudal epidural analgesia in paediatric patients undergoing abdominal surgeries for Wilms' tumours

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**Abstract: Background:** Caudal epidural analgesia is the most common postoperative analgesia used in paediatrics undergoing abdominal surgeries being simple and safe. However, the analgesia provided by this technique lasts only for the duration of action of the local anaesthetics. The aim of this study was to compare between continuous transversus abdominis plane block and single dose caudal epidural analgesia regarding duration of analgesia, total morphine consumption, and postoperative pain in paediatric patients undergoing nephrectomy for renal nephroblastoma tumours. **Methods:** Sixty paediatric patients with renal nephroblastoma and scheduled for surgical excision were enrolled in this study. Patients were randomly allocated into either **C- group** in which caudal block was done at the end of surgery or **T- group** in which epidural catheter was inserted into the dissected plane between transversus abdominis and internal oblique muscles to receive continuous TAP block on the side of surgical incision. (30 patients each). The primary endpoint was Duration of analgesia from time of discontinuation of anaesthesia till 1st intravenous morphine dose. The secondary endpoints included the total morphine consumption, the intensity of pain throughout the study period (48 hours after operation); the sedation and the duration of motor block which was assessed by observing the time the patients began to move their legs from discontinuation of anaesthesia. During the study, intravenous morphine 50 µg/kg was administered when FLACC score > 3. **Results:** the first narcotic period needed was significantly longer (P< 0.05) in T group (13 h) than in C group (4 h). The mean morphine consumption within 24 hrs after surgical operations was higher significantly in control (2.76 ± 1.2) than that in T group (1.32 ± 1.1) (P< 0.05). Meanwhile, the mean morphine consumption lowered significantly in the second postoperative day in both groups than that in the first day postoperative. However, In the same day, a non-significant difference not detected between the two groups (0.75 ± 0.32 in C group versus 0.64 ± 0.12 in T group). In group (T) The average pain scores were steadily lesser, but merely with statistically significant difference from 12 hours till 36 hours postoperatively. **Conclusion:** the continuous transversus abdominis plane block as a part of multimodal analgesia has a possible role in improving the analgesic action and decreasing the required dosage of narcotics during the first 24 h post-surgical operation more than the single dose caudal analgesia in paediatric patients undergoing abdominal surgeries.

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**Key words:** TAP block, Continuous TAP block, Caudal block

### 1. Introduction:

Abdominal surgeries are associated with tissue and peripheral nerve injuries that stimulate a cascade of events in the form of nociception and inflammatory reaction accompanied by higher concentrations of various biological mediators in the injured tissue. These mediators include prostaglandins, bradykinins, substance P and cytokines<sup>1</sup>

Postoperative pain after abdominal surgeries comprises unpleasant sensory and emotional experience associated with neuroendocrine and immune response which result from surgical stress, tissue damage as well as anesthesia.<sup>2,3</sup>

So, effective postoperative pain control is considered as a cornerstone in the care of the surgical patients aiming to alleviate their pain experience as well as attenuation of the pain induced physiological alterations. Good postoperative pain control is associated with increased patient satisfaction, decreased in hospital stay period, earlier utilization and decreased hospital charges<sup>4,5</sup>.

Single dose caudal epidural analgesia is the most common postoperative analgesia used in paediatrics undergoing abdominal surgeries being simple and safe.<sup>6</sup> However, the analgesia provided by this technique lasts only for the duration of action of the local anaesthetics.<sup>7</sup> Administration a mixture of two

drugs 1 ml/kg bupivacaine with 0.5 mg/kg ketamine prolonged the duration (12.5 h) of action of caudal analgesia than treatment with 1 ml/kg bupivacaine and 2 µg/kg clonidine (3.2 h) in children after lower body surgery<sup>7</sup>

Anatomically, the abdominal wall composed of three layers of muscles, the external oblique, the transversus abdominis and the internal oblique, in addition to their allied fascial sheaths. Also, the central abdominal wall consists of the rectus abdominis muscles, in addition to allied fascial sheath. The muscles in the abdominal wall are supplied by spinal afferent nerves that passed within the transversus abdominis and internal oblique muscles to reach the rectus abdominis muscle.<sup>8</sup>

A local regional nerve block represented in transversus abdominis plane (TAP) block, has appeared as an encouraging method for reducing the resulting pain usually arisen post-surgical incision and the published literature revealed that TAP block reduced significantly the required postoperatively the doses of opioids.<sup>9,10,11,12</sup>

As the analgesic effect of the TAP block fades within few hours after surgery<sup>13</sup>, a hopeful method to the delivery of analgesia after abdominal incision, via continuous blocking of the sensory nerve supply to the anterior abdominal wall through insertion of a catheter in plane under surgical vision.

The aim of this study was to compare between continuous transversus abdominis plane block and single dose caudal epidural analgesia regarding duration of analgesia, total morphine consumption, and postoperative pain in paediatric patients undergoing nephrectomy for renal neuroblastoma tumours.

## 2. Patients and Methods:

After approval of the institutional Ethics Committee of the National Cancer Institute- Cairo University, and written informed parental consent, sixty paediatric patients aged 2 - 6 years ASA physical status I – III and scheduled for surgical excision of neuroblastoma tumour were enrolled in this study. Patients were excluded if there was history of allergy to amide local anaesthetics or morphine, or contraindication to regional blockade (coagulation disorders, local infection, sepsis and mental disorders). After sedation with midazolam (0.05 mg/kg IV) in the preoperative holding area, patients were transferred to the operating theatre. Pre oxygenation with 100% oxygen for 3 minutes was applied to all patients during which non-invasive monitoring which are incorporated into the anaesthesia work station (Datex-Ohmeda, S/5 Avance Anaesthesia Machine USA) including non-invasive blood pressure, ECG, pulse oximetry (SpO<sub>2</sub>) were applied for continuous monitoring. All patients

received a standardized anaesthesia. Intravenous induction of anaesthesia was achieved with propofol (2 -3 mg/kg), fentanyl (2µg/kg), and atracurium (0.5 mg/kg) to facilitate endotracheal intubation. Volume controlled ventilation was applied to all patients using fresh gas flow (FGF) at 2 L/min with 45 % of oxygen in medical air. Tidal volume was set at 8 mL/kg and with respiratory frequency adjusted in order to maintain an end-tidal CO<sub>2</sub> (Et CO<sub>2</sub>) between 30-35 mmHg. Morphine (0.15 mg/kg) was administered intravenously to all patients immediately after applying the mechanical ventilation and 15 minutes before the surgical incision. Anaesthesia was maintained using 1- 1.5 MAC sevoflurane in oxygen and air. Minimum alveolar concentration (MAC) of sevoflurane was recorded by the anaesthetic machine in real -time for MAC-hour calculation which is the average MAC length of exposure.

Using an envelope technique, patients were randomly allocated into one of either group (30 patients each) C- group in which caudal block was done at the end of surgery and before awakening from anaesthesia; or T- group in which epidural catheter was inserted by the surgeon during closure of the surgical incision into the dissected plane between transversus abdominis and internal oblique muscles to receive continuous TAP block on the side of surgical incision.

For patients in the C group, after skin closure, the patients were kept anaesthetised; received single dose caudal analgesia (1 ml/kg, 0.25% levobupivacaine). The patients were laid in the left lateral position with the knees drawn up to the chest and complete aseptic technique was applied. A needle 22 g was introduced in a slightly cranial direction through the sacral hiatus. When a click was felt as the needle pierces the sacrococcygeal membrane, the needle was then directed cranially. Injection of the local anaesthetic was proceeded after aspiration to ensure the absence of blood/cerebrospinal fluid and while feeling for inadvertent subcutaneous injection with the other hand.

For patients in the T group, at the end of surgery just before skin closure, the attending surgeon dissected the upper edge of the surgical incision creating small space between the transversus abdominis and internal oblique muscles. A multi-orifice G20 epidural catheter was inserted into the dissected fascial plane between the transversus abdominis and internal oblique muscles through a 9 cm 17 - G epidural needle (Portex™ Epidural Minipack, Smiths Medical Australasia Pty, Brisbane, Australia) which introduced through a new puncture at the lateral end of the incision, about 2 cm from the upper edge of the skin incision passing through the skin, subcutaneous tissue, external oblique and

internal oblique muscles. After removing the needle and leaving 6 – 7 cm of the catheter in the space and securing the catheter to the skin, skin closure was completed. (Fig. 1) A bolus of 0.25% levobupivacaine at a dose of 0.5 ml/kg was administered followed by an infusion of 0.125% levobupivacaine set at 1.5 ml/h injected into the catheter which was taped to the skin for 48 hour.



**Figure (1).** An epidural catheter through the epidural needle in the space between the internal oblique and transversus abdominis muscles

After establishing the caudal block or the continuous TAB block catheters, sevoflurane was discontinued and patients were given 100% oxygen with a flow rate of 6 L/min and received acetaminophen (peralgan) 10 mg/kg which was then supplemented every 8 hours.

After emergence from anaesthesia, all patients were transferred to the postanesthesia care unit (PACU). The presence and severity of pain and nausea were assessed systematically by the resident in charge on arrival to PACU (0 hour) and then at 2, 4, 6, 12, 24, 36 and 48 hours after surgery. FLACC scale was used to assess pain intensity<sup>14</sup> (Table 1). Intravenous morphine 50 µg/kg was administered when FLACC score > 3.

Assessments of sedation was made using an objective score based on eye opening (eyes open spontaneously = 0, eyes open in response to verbal stimulation = 1, eyes open in response to physical stimulation = 2)<sup>15</sup>. The patients were considered to be sedated if they had a sedation score > 0 at any postoperative time point.

**Table 1: FLACC scale**

Behaviour	0	1	2
<b>Face</b>	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
<b>Legs</b>	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
<b>Activity</b>	Lying quietly, normal position, moves easily	Squirming, shifting, back and forth, tense	Arched, rigid or jerking
<b>Cry</b>	No cry (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams, sobs, frequent complaints
<b>Consolability</b>	Content, relaxed	Reassured by touching, hugging or being talked to, distractible	Difficult to console or comfort

0= Relaxed and comfortable; 1-3 = Mild discomfort; 4-6 = Moderate pain; 7-10 = Severe discomfort/pain

The primary endpoint of this study was Duration of analgesia from time of discontinuation of anaesthesia till 1st intravenous morphine dose. The secondary endpoints included the total morphine consumption, the intensity of pain throughout the study period (48 hours after operation); the sedation and the duration of motor block which was assessed by observing the time the patients began to move their legs from discontinuation of anaesthesia.

#### Statistical Analysis:

Data were analysed using the Statistical Package for Social Sciences for windows (SPSS 13.0.1; SPSS Inc; Chicago, II, USA).

Quantitative variables were expressed as means ± SD. Categorical variables were expressed as number

(%). Student t test was used to compare continuous variables between groups. Categorical variables were compared using the chi-square test or Fisher's exact test as appropriate. P<0.05 was considered to indicate statistical significance.

#### 3. Results:

This prospective, comparative, randomized clinical study was conducted in National Cancer Institute – Cairo University between June 2013 and December 2017. Data were normally distributed. Baseline demographic data including age, sex, height and weight as well as surgical and anaesthesia duration and MAC hour isoflurane were comparable in both groups (Table 2)

**Table 2. Patients' characteristics**

	<b>C – Group</b> n = 30	<b>T – Group</b> n = 30
<b>Age (Year)</b>	9.8 ± 2.42	9.1 ± 2.62
<b>Male/Female</b>	18 / 12	20/10
<b>Weight (kg)</b>	33.23 ± 5.91	34 ± 6.74
<b>Height (cm)</b>	126.32 ± 12.56	131.22 ± 8.65
<b>Surgery duration (min)</b>	86.4 ± 10.2	95.21 ± 5.7
<b>Anaesthesia duration (min)</b>	172.4 ± 6.71	169.2 ± 7.4
<b>MAC hour Isoflurane</b>	1.46 ± 0.34	1.43 ± 0.12

Data are expressed as mean ± SD or ratio \* P < 0.05 in comparison to C Group

The obtained results revealed that the time needed for the administration of the 1<sup>st</sup> narcotic was significantly varied (P < 0.05), it averaged 13 and 4 hrs in T and C groups, respectively. The minimum analgesic duration in the T group was 9.5 hours achieved by 2 patients versus 3.5 hours by 8 patients in C group (P < 0.05). Meanwhile, the maximum duration of analgesia was 17 hours by 7 patients in T group versus 7 hours by 3 patients in the C group (P < 0.05). The mean morphine consumption was significantly greater (P < 0.05) in C group (2.76 mg ± 1.2) than that in T group (1.32 mg ± 1.1) in the first 24 hours post-incision. Meanwhile, the mean morphine consumption lowered significantly in the second

postoperative day in both groups compared to that in the first postoperative day. However, a non-significant variation was recorded among the two groups, regarding the same day (0.75 ± 0.32 in C group versus 0.64 ± 0.12 in T group) (Table 3)

The median sedation scores in the first 2 hours postoperatively were non-significant difference between groups 0 (0-1) and 0 (0-1) in T group and C group, respectively. Thereafter, all patients in both groups were fully alert throughout the study. Spontaneous leg movements were noticed immediately during recovery in all patients in both groups.

**Table 3. First requirement to morphine and mean morphine consumption**

	<b>C group</b>	<b>T group</b>
First requirement to morphine (h)	4 (3.5, 7)	13 (13, 17)
Mean morphine consumption in first postoperative day (mg)	3.76 ± 1.2	2.32 ± 1.1
Mean morphine consumption in second postoperative day (mg)	1.75 ± 0.32	1.64 ± 0.12

Data are represented as median (range) or mean ± SD\* P < 0.05 in comparison to C group

With respect to the average pain scores it was steadily decreased in group (T), with statistically significant difference from 12 hours till 36 hours

postoperatively. Then, the median pain scores returned non significant between groups. (Table 3).

**Table 4. The median pain scores in groups under study**

<b>Time postoperatively</b>	<b>C Group</b>	<b>T Group</b>
<b>0h</b>	0 (0 -1)	0 (0 -1)
<b>2 h</b>	0 (0 -1)	0 (0 -1)
<b>4 h</b>	1 (1 -4)	0 (0 -2)
<b>6 h</b>	2 (2-4)	0 (0 -2)
<b>12h</b>	4 (2 -4)	2 (0 -3)*
<b>24 h</b>	3 (3 -5)	3 (1-4) *
<b>36 h</b>	3 (3 -4)	2 (1-4) *
<b>48 h</b>	2 (1-2)	2 (0 -1)

Data are represented as median (1<sup>st</sup>, 3<sup>rd</sup> quartiles)

\* P < 0.05 in comparison with C group

#### 4. Discussion

Paediatrics undergoing abdominal surgical procedures experience postoperative pain at variables

degrees of intensities. Caudal neuroaxial blockade is often the preferred perioperative pain control strategies. However, this block lasts only for hours<sup>7</sup>

and may not cover the whole postoperative period. In addition, it may be contraindicated in some circumstances.

A postoperative pain following abdominal surgery is mainly due to the surgical incision<sup>16</sup>. Abdominal wall field blocks are effective strategy to counteract the postoperative surgical incision pain.<sup>17</sup>

TAP blocks may be valuable, regardless of increasing credit of the different clinical states any where its practice between anaesthetists still inadequate. Limited number of studies were found comparing continuous TAP block with caudal analgesia in paediatrics.<sup>18,19</sup>

Our study demonstrates the efficacy of continuous ipsilateral TAP block as part of multimodal analgesic technique in paediatric patients undergoing abdominal surgeries as indicated by the prolonged postoperative period with pain control without opioid requirement, lower morphine consumption in the first 24 hours postoperatively as well as better pain score.

The TAP block was done on the same site of surgical incision only as the incision did not pass the midline.

The patients in T groups remained with low pain intensity for about 15.5 hours postoperatively in spite of the TAP block as reported from many studies offers blockade of sensation/ nociception from the wall of abdominal muscles but not those from the abdominal organs<sup>9</sup>. This can be explained as the block was achieved as part of a multimodal analgesia approach. This may indicate that the major component of postoperative pain might be related mainly to the nociceptive input from the abdominal wall incision as well.

As the analgesic effect of a single dose TAP block fades postoperatively after few hours, we administered continuous infusion of local anaesthetic via the TAP catheter to prolong the analgesic effect. Under direct vision of the surgeon, the catheter was introduced into the TAP plane between the internal oblique and the transverse abdominis muscles in the upper edge of the surgical incision. This ensures the proper placing of the catheter in the correct anatomical place.

Jankovic and his colleagues compared continuous transversus abdominis plane block in renal transplant recipients with 35 formerly inspected individuals who receiving merely morphine PCA. TAP block decreased the average morphine (IV) doses needed to about 80% and 50% PCA duration while pain scores were no different during the 1<sup>st</sup> 24 hrs postoperatively. And they favoured this method, due to the possibility of observing the site of insertion of TAP catheter in appropriate manner catheter and therefore, extends the effect of analgesic for long time of TAP block<sup>13</sup>

Taylor et al.<sup>20</sup> described two cases (5 and 7 years old) of bladder surgery with spinal dysraphism who achieved excellent perioperative analgesia by using 0.3 ml/kg bupivacaine (0.25%), and giving 0.1% bupivacaine by an infusion at a rate of 4ml/hr via TAP catheters.

In another randomized controlled trial on 40 paediatric patients undergoing appendectomy operation, an ipsilateral TAP block reduced the total morphine consumption by 50% and the interval morphine requirements for up to 24 hours after surgery with no morphine consumption over the second 24 postoperative hours. Also the time to the first request for supplemental opioid analgesia was delayed. These results come in agreement with our results<sup>21</sup>. In a systemic review and meta analysis by John et al in 2012<sup>21</sup>, the authors concluded that transversus abdominis plane block lowers the narcotic requirements within the first day postoperatively with significant reduction in cumulative morphine use during the first 48 hours.

Desgranges et al.<sup>22</sup> also concluded the successful use of an ipsilateral oblique subcostal TAP catheter in the management of pain post incision in a 4-year-old child underwent upper abdominal surgery. They administered a bolus dose of 0.5 ml/kg of 0.25% levobupivacaine, then by 0.125% levobupivacaine infusion at a rate of 1.5 ml/h.

One of the weaknesses in our study is that Pain was evaluated by behavioural way not by using other methods such as self report tool because the application in young age population.

**It is concluded that,** the continuous transversus abdominis plane block as a part of multimodal analgesia has the probable role in improving the analgesic effect and decreased the needed doses of narcotics particularly during the first 24 h postoperatively more than the single dose caudal analgesia in paediatric patients undergoing abdominal surgeries.

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