A Comparative Study of Ultrasound Guided Thoracic Paravertebral Block Versus Preemptive Surgical Incision Infiltration as Regards Postoperative Pain and Measuring the Depth of Thoracic Paravertebral Space in Pediatric Renal Surgery

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Abstract
Aim and Objective: We compared ultrasound guided single injection thoracic paravertebral block, and preemptive local infiltration at the site of surgical incision as regard postoperative pain, decreasing analgesic requirements, and prolonging the time to first request of analgesia. Also the feasibility of ultrasound in measuring the depth of thoracic paravertebral space in children undergoing renal surgery.

Material and Methods: 50 patients (2 to 10 years) scheduled to undergo open renal surgery were randomly assigned into one of two groups; one received ultrasound guided single injection thoracic paravertebral block with measuring the depth of thoracic paravertebral space, after induction of general anesthesia (group PVB), the other group received local infiltration of skin, subcutaneous tissue, and muscles after induction of general anesthesia and preemptively before surgical incision, (group SII). Postoperative pain scores, time to first request of postoperative analgesia and total number of rescue doses of postoperative analgesics, were assessed.

Results: The current study demonstrated that ultrasound guided single injection thoracic paravertebral block was superior to the preemptive surgical incision infiltration in children undergoing open renal surgery, as it showed lower CHEOPS and OPS scores, less need of postoperative rescue analgesia and longer time to first request. Depth of thoracic paravertebral space can be measured using ultrasound visualization, mean depth in cm was significantly correlated to age of patients included in the PVB group.


Introduction
AFTER having been proven that children perceive, respond and remember pain similarly to adults, several analgesic, especially for postoperative pain relief, have been proposed aiming at protecting children against metabolic, hemodynamic and psychological changes caused by surgical procedures. Pain evaluation has been considered a major difficulty in handling postoperative pain in children below 6 years of age, and this has led anesthesiologists to choose techniques that would promote analgesia even before emergence, thus helping this evaluation [1].

Paravertebral nerve blockade by injecting local anesthetic solution alongside the vertebral column produces ipsilateral analgesia, and has been advocated mainly in unilateral surgeries like thoracotomy, chest wall surgery, breast surgery and renal surgery. Although the efficacy of both the continuous and multilevel techniques of paravertebral blocks has been demonstrated, the use of single injection technique would further simplify the use of paravertebral blocks. Single injection paravertebral block (PVB) provided clinically relevant postoperative analgesia in children undergoing major renal surgery [2].

The routine use of wound infiltration with long-acting local anesthetics in addition to general anesthesia can improve postoperative pain management after a wide variety of surgical procedures. When administered before surgery, this simple technique can also decrease anesthetic and analgesic requirements during surgery, as well as reduce the need for opioid-containing analgesics postoperatively [3].

Patients and Methods
The study was done in the pediatric surgery unit of Cairo University Specialized Pediatric Hospital at 2014 – 2015.
The study was conducted after obtaining a written informed consent from the patient guardian and obtaining approval from the ethical committee. 50 patients aging 2 year to 10 years, undergoing open renal surgery were enrolled in randomized blinded study. Exclusion criteria included; neonates and infants, age group <2 years old, patients aged more than ten years, refusal of regional block or patients requiring emergency operation, bleeding disorders, impaired renal function (creatinine >1mg/dl, blood urea nitrogen >20mg/dl), renal transplantation, skin lesions, wounds, or infection at the site of proposed needle insertion, and developmental mental delay or neurological deficits.

Fifty patients were randomly allocated into two equal groups (n=25 each) using closed envelopes:

1- Paravertebral block group (PVB): Ultrasound guided single injection thoracic paravertebral block group (n=25).

After induction of general anesthesia, ultrasound guided thoracic paravertebral block with measuring depth of thoracic paravertebral space. All patients received ultrasound guided single injection thoracic paravertebral block as an adjunct to general anesthesia using 0.375% ropivacaine 0.5ml/kg injected as single injection at the level of T11-T12.

2- Surgical incision infiltration group (SII): Preemptive surgical incision infiltration group (n=25).

After induction of general anesthesia, patients received local infiltration of skin, subcutaneous tissue and, muscle at the site of surgical incision using ropivacaine 0.375% 0.5ml/kg preemptively before surgical incision.

Preoperative assessment:

Full clinical examination and detailed history were taken for proper selection of the patients. Laboratory work needed: Complete blood picture (CBC), prothrombin time (PT) & prothrombin concentration (PC); partial thromboplastin time (PTT), bleeding time (BT), clotting time (CT), liver function tests in the form of aspartate transferase (AST), alanine transaminase (ALT), kidney function tests in the form of blood urea nitrogen (BUN), serum creatinine, and serum Sodium and Potassium. Patient's date of birth, weight and height will be recorded. All patients were fasted four hours for milk feeding and 6 hours for ordinary food. Free clear fluids were allowed up to 2 hours before surgery.

Eutactic mixture local Anesthetic (EMLA) cream was applied to the site of venous puncture. After insertion of venous access, all children received premedication in the form of atropine at a dose of 0.01-0.02mg/kg intravenous. Perioperative monitoring included continuous electrocardiogram (ECG), pulse oximetry, non-invasive arterial blood pressure, and temperature monitoring.

General anesthesia was induced using intravenous injection of fentanyl 2ug/kg and sodium thiopental 3-5mg/kg over 20-30 seconds, atracurium 0.5mg/kg, to facilitate endotracheal intubation. Anesthesia was maintained using isoflurane (1 MAC) and atracurium 0.1mg/kg as required.

PVB group:

Operating room preparation & equipment:

The ultrasound machine and scanning probe were prepared before patient entry to the operating room.

- The ultrasound transducer was placed inside a sterile gloves (Fig. 1).
- Gel was applied generously between the transducer and inside of the gloves covering.
- A rubber band was wrapped around the transducer to avoid transducer movement inside the sheath during ultrasound scanning.
- Ample sterile gel was applied onto the skin surface over the target site to avoid any air trapped between the transducer and skin.

![Fig. (1): The ultrasound transducer surface is covered with a sterile gloves. The ultrasound machine is SonoSite M-Turbo (USA) (Fig. 2); the scanning probe with the linear multi-frequency 13-6 MHz transducer (1.25x13-6MHz linear array) was used.](image-url)
The pediatric tuohy needle (Perifix Ped) was used. Needle length was 5cm, size 18 gauge for older children and 20 gauge for smaller children with a medial stylet.

Fig. (2): The ultrasound machine SonoSite M-Turbo.

After induction of general anesthesia all patients were placed in the lateral decubitus position with the side to be operated upon upwards, with the head, neck, and legs are flexed to facilitate performing the ultrasound guided single injection paravertebral block.

After skin and transducer preparation, multifrequency 13-6 MHz transducer was placed in a transverse plane on the rib at the level of T1-T12, just lateral to the spinous process. The transverse process and rib were both visualized as a hyperechoic line with acoustic shadowing below it (Fig. 3). The transverse processes was identified as two dark lines, the parietal pleura as a bright structure running deep to the adjacent transverse processes, distinct from the deeper lung tissue. The superior costotransverse ligament was sometimes seen as a collection of homogenous linear echogenic bands alternating with echo poor areas running from one transverse process to the next. Depth of thoracic paravertebral was measured in (cm).

After local infiltration at the site of needle insertion 18G and 20G (for older children) tuohy needle was inserted at the outer (lateral) end of the transducer, in plane with the ultrasound beam. The bevel of the Tuohy needle tip was oriented upwards towards the transducer as this may reduce the risk of penetrating injurto the intercostal vessels, nerve or pleura in the event of inadvertent needle contact. The needle was advanced under real time ultrasound guidance and the tip penetration (Fig. 4) through the internal intercostal membrane and its entry into the thoracic paravertebral space (TPVS) was visualized. A pop was often felt as the needle penetrates the internal intercostal membrane.

Fig. (4): In-plane needle advance from lateral to medial.

Negative aspiration for blood was ensured then, 0.375% ropivacaine 0.5ml/kg was injected slowly in small increments as single injection at the level of T11-T12 into the TPVS. The TPVS was observed to distend, pushing the pleura downwards (ventrally) (Fig. 5).

Fig. (5): The thoracic paravertebral space appears distended after injection of local anesthetic.
**SII Group:**

General anesthesia was induced then all patients were placed in the lateral decubitus position and sterilization of the site of infiltration was done. Local infiltration of skin, subcutaneous tissue and muscle was done using ropivacaine 0.375% 0.5ml/kg. An increase in heart rate and or arterial blood pressure by more than 20% of baseline values in response to surgical stimulus or thereafter throughout the whole operation warranted the administration of intravenous fentanyl (0.5 μg/kg). After completion of surgical procedure and emergence from anesthesia, quality of analgesia was assessed immediately postoperatively then every two hours till 18 hours postoperatively.

After completion of the surgical procedure and emergence from anesthesia, all patients were referred to Post Anesthesia Care Unit (PACU). Quality of analgesia was assessed immediately postoperatively then every hour till 18 hours postoperatively.

**Measured parameters:**

- **Intraoperative measurements:**
  - Depth of thoracic paravertebral space in (cm.)
- **Postoperative measurement:**
  - Pain assessment was performed by using 2 pain score, that was performed at rest immediately postoperatively and at 2, 4, 6, 8, 12, and 18 hours postoperatively.
    - a. Children’s Hospital Eastern Ontario Pain Scale (CHEOPS).
    - b. Objective behavioral pain score (OPS) recorded immediately postoperatively and at 2, 4, 6, 8, 12, and 18 hours postoperatively.
  - Time to first request of postoperative analgesia.
  - Total number of rescue analgesic doses in the form of paracetamol (10–15mg/Kg).

**Results**

This study included fifty paediatric patients undergoing open renal surgery. Patients were randomly allocated into two equal groups (n=25). Patients’ flowchart is shown in Fig. (6).
The age and weight of patients in the two groups showed no significant differences ($p$-value >0.05). The age of the patients (in years) of group PVB was 4.67 ($\pm$2.569), and in group SII was 4.97 ($\pm$2.538). The weight of the patients (in kilograms) of group PVB was 4.77 ($\pm$6.544), while group SII showed 4.76 ($\pm$7.939). Gender showed no significant difference between the two study groups ($p$-value >0.05). Nineteen patients in group PVB were males, while 15 in group SII. Six patients in group SII were females, while 10 patients in group SII were Females. Most patients were scheduled for pyeloplasty; 36 patients, 18 in PVB group and 18 in SII group. Seven patients underwent operation for nephrectomy; 4 in PVB group and 3 patients in SII group. 7 patients underwent operation for open renal stone; 3 in PVB group and 4 in SII group.

**Intraoperative rescue analgesia:**

All the patients in the two groups didn't need rescue analgesia intraoperatively which was in the form of fentanyl 0.5 µg/kg I.V.

**Depth of thoracic paravertebral space:**

The mean Depth of thoracic paravertebral space (Table 1 & Fig. 7) at 2 years was 2.67 ($\pm$0.0754) cm, at 3 yrs was 2.83 ($\pm$0.072), at 4 was 2.96 ($\pm$0.052) cm, at 5 yrs was 3.22 ($\pm$0.028) cm, at 6 yrs was 3.32 ($\pm$0.028) cm, at 7 yrs was 3.34 ($\pm$0.005) cm, at 8 yrs was 3.42 ($\pm$0.024) cm, at 9 yrs was 3.53($\pm$0.032) cm, and at 10 yrs was 3.79 ($\pm$0.022). These values correlated with the age ($r$=0.5). Mean depth of TPVS (in cm) = 0.1275 x age (in yrs) + 2.5971.

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Depth of TPVS (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2–&lt;3</td>
<td>2.67 ($\pm$0.0754)</td>
</tr>
<tr>
<td>3–&lt;4</td>
<td>2.83 ($\pm$0.072)</td>
</tr>
<tr>
<td>4–&lt;5</td>
<td>2.96 ($\pm$0.052)</td>
</tr>
<tr>
<td>5–&lt;6</td>
<td>3.22 ($\pm$0.028)</td>
</tr>
<tr>
<td>6–&lt;7</td>
<td>3.32 ($\pm$0.028)</td>
</tr>
<tr>
<td>7–&lt;8</td>
<td>3.34 ($\pm$0.005)</td>
</tr>
<tr>
<td>8–&lt;9</td>
<td>3.42 ($\pm$0.024)</td>
</tr>
<tr>
<td>9–&lt;10</td>
<td>3.53 ($\pm$0.032)</td>
</tr>
<tr>
<td>10</td>
<td>3.79 ($\pm$0.022)</td>
</tr>
</tbody>
</table>

TPVS: Thoracic paravertebral space. Date are presented by mean ($\pm$SD).

By comparing the 2 pain scores (the CHEOPS & OPS) of the two groups immediately postoperative and then at 2, 4, 6, 8, 12 and 18 hours postoperatively revealed that there was significant difference between both groups (Fig. 8). Correlation between the two pain scores revealed that they are much correlated having a Pearson’s correlation coefficient ($r$>0.5). The correlation was statically significant with $p$-value <0.001.
Time to first request of rescue analgesia:

As regards the time of first request of postoperative analgesia (Table 2) which was in the form of paracetamol 15mg/kg I.V in group (PVB), the first request of rescue analgesia of 2 patients was at 3 hours postoperatively, while 2 patients needed the first rescue analgesia at 12 hours postoperatively, in group (SII) 21 patients received the first rescue dose at 7 hours postoperatively, 2 patients received the first rescue dose at 2 hours postoperatively. 1 patient received the first rescue dose at 4 hours postoperatively, and 1 patient had his first rescue analgesia at 5 hours postoperatively. The majority of patients in group (PVB) required no rescue analgesia and the time to first request of rescue analgesia was significantly longer.

Table (2): Time to 1st request of rescue analgesia among the two groups, data is presented as n (%).

<table>
<thead>
<tr>
<th>Time of 1st request</th>
<th>Group PVB (n=25)</th>
<th>Group SII (n=25)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>&gt;0.001</td>
</tr>
<tr>
<td>2-4</td>
<td>2 (8%)</td>
<td>3 (12%)</td>
<td>&gt;0.001</td>
</tr>
<tr>
<td>4-6</td>
<td>0</td>
<td>1</td>
<td>&gt;0.001</td>
</tr>
<tr>
<td>6-9</td>
<td>0</td>
<td>21 (8%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>10-12</td>
<td>2 (8%)*</td>
<td>0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>12-18</td>
<td>0</td>
<td>0</td>
<td>&gt;0.001</td>
</tr>
</tbody>
</table>


Number of doses and patients requiring postoperative rescue analgesia:

In this study the number of postoperative rescue analgesic doses (Table 3, Fig. 10) which was in the form of paracetamol 15ml/kg iv was significantly lower in the (PVB) group in group PVB 4 patients needed postoperative rescue analgesia, where 2 patients needed 3 rescue doses, while the other 2 patients both received a single dose making the total number of doses 8 for the PVB group. In group SII all patients needed postoperative rescue analgesia 21 patients received a single dose at these 22 patients received a total of 2 rescue analgesic doses, and 2 patient s received 3 doses. 1 patient needed 3 doses. Making the total number of doses 53 which was significantly higher than those in group PVB.

Table (3): Number of rescue doses among the two groups, data is presented as n (%).

<table>
<thead>
<tr>
<th>No. of doses</th>
<th>Group PVB (n=25)</th>
<th>Group SII (n=25)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>21 (84%)*</td>
<td>0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1</td>
<td>2 (8%)</td>
<td>0</td>
<td>&gt;0.001</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>22 (88%)*</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3</td>
<td>2 (8%)</td>
<td>3 (12%)</td>
<td>&gt;0.001</td>
</tr>
</tbody>
</table>


Discussion

This study demonstrated that ultrasound guided single injection thoracic paravertebral block, is superior to preemptive surgical incision infiltration as evidenced by lower pain scores, and decreased...
rescue postoperative analgesia, and longer time to first request of postoperative analgesia. Mean depth of thoracic paravertebral space correlated significantly with age of patients and an equation was derived where mean depth of TPVS (in cm) = 0.1275 x age(in yrs) + 2.5971. There were no significant difference between the two groups regarding intra and postoperative hemodynamics. There was no evidence of intra or postoperative complications.

In 1986, Anand et al. demonstrated that pain relief provided in the intraoperative period decreases morbidity. This paper changed the thinking and attitude of anaesthesiologists on pain management in children from no pain relief at all to aggressive pain management. Around the same time it was appreciated that regional anaesthesia (RA), produce excellent intraoperative analgesia. They are easy to perform and safe. In the last two decades their use has increased dramatically. In children regional analgesia is commonly used in conjunction with general anaesthesia.

The use of ultrasound provides many advantages compared to the blind technique. The ability to view the anatomical structures, the needle shaft, the tip of the needle, catheter, the spread of local anesthetic and possibly a shorter duration of interference, short startup time, long duration of the block, less local anesthetic volume, low failure and complication rate. The real-time ultrasound is very helpful in determining the exact distance of the tip of the needle, catheter, the spread of local anesthetic and possibly a shorter duration of interference, short startup time, long duration of the block, less local anesthetic volume, low failure and complication rate. The real-time ultrasound is very helpful in determining the exact distance of vertebral transverse process and parietal pleura depth from the skin to paravertebral space with sonographic measurements.

In the current study the ultrasound machine was SonoSite M-Turbo (USA); the scanning probe with a linear multi-frequency 13-6 MHz transducer (L25x13-6 MHz linear array) was used. The pediatric Tuohy needle (Perifix Ped) was used. Needle length was 5cm, size G 18 for older children and G 20 for smaller children with a medial stylet. After skin and transducer preparation, multi-frequency 13-6 MHz transducer was placed in an axial (transverse) plane on the rib at the level of T11-T12, just lateral to the spinous process. The transverse process and rib were both visualized as a hyperechoic line with acoustic shadowing below it. The transverse processes, the parietal pleura, and the superior costotransverse ligament were visualized. In-plane needle approach was used. Negative aspiration for blood was ensured then, 0.375% ropivacaine 0.5 ml/kg was injected slowly in small increments as single injection at the level of T11-T12 into the TPVS. The TPVS was observed to distend, pushing the pleura downwards.

The technique was consistent with that used in the blinded randomized interventional blind study of Gulsah and Zera et al., in which 40 patients undergoing percutaneous nephrolithotomy randomly divided into two groups. Group I patients received ultrasound guided thoracic paravertebral block with 0.5ml/kg bupivacaine 0.5% and group II patients received 15mg/kg paracetamol IV.

On the other hand, continues paravertebral block in pediatric population was addressed in some studies. In the study of Dutoit and Haile the purpose of this study was to describe the experience with continuous paravertebral blockade at the Mayo Clinic in pediatric patients age <18 years undergoing thoracic or chest procedures and report analgesic efficacy as well as technical approaches to the paravertebral block.

In the case report of Hazem and Aslam a six year old female child, weighing 13 kg was scheduled for patent ductus arteriosus ligation by a left lateral thoracotomy approach. The planned anesthetic was general anesthesia and placement of a continuous paravertebral block at the end of surgery for post operative analgesia. General anesthetic induced with propofol 30mg i.v, fentanyl 25µg i.v and atracurium 7mg i.v to facilitate endotracheal intubation, and was maintained with sevoflurane in oxygen and air. After skin closure, ultrasound scanning in the transverse plane was done with 25mm 6-13 MHz broadband linear array probe on a Sonosite micromaxx (Sonosite Inc, Bothwell, MA, USA) at the level of the skin incision just lateral to the thoracic spine. A 5cm, 19G Tuohy epidural needle was inserted infrane from the lateral to the medial side. 1.25mg/kg 0.25% bupivacaine was injected in incremental aliquots and the thoracic paravertebral space was observed to distend with the pleura moving ventrally. A catheter was inserted. The patient was comfortable, slept well the night of surgery and did not receive any rescue analgesia during the 48hr observation period.

Some studies used the landmark technique in pediatric patients as in the study of El-Morsy et al., in which 60 pediatric patients aged 1-24 months, scheduled for thoracotomy were randomly allocated into two groups. After induction of general anesthesia, thoracic epidural catheter was inserted in group E (epidural) patients and thoracic paravertebral catheter was inserted in group P (paravertebral) patients. Post operative pain score was re-
corded hourly for 24 hours. Plasma cortisol level was recorded at three time points. In P-group, after skin preparation, spinous processes were identified at T6-9 levels, and a 22G needle was inserted about 1.5-2.5cm lateral to the midline into the cephalic side of the spinous process, and the needle was advanced perpendicular to the skin, till encountering the costo-transverse ligament. After encountering the costo-transverse ligament the needle was advanced slowly using 2.5-5.0mA current until contraction of the abdominal muscles occurred. Injection of 0.2ml of the local anesthetic lead to cessation of muscular contraction. A catheter was inserted, and then bupivacaine 0.25% in a dose of 0.5ml/kg with fentanyl 1 µg/kg was given.

The CHEOPS (The Children's Hospital of Eastern Ontario Pain Scale) and the OPS (objective behavioral pain score); both of them includes many objective items however the OPS includes blood pressure as an item so it is considered as multidimensional pain score. The efficacy of postoperative analgesia in both groups was assessed immediately postoperative and 2, 4, 6, 8, 12, and 18 hours thereafter. There were significant differences between the ultrasound guided single injection thoracic paravertebral block group (PVB Group) and lower median scores than surgical incision infiltration group (SII Group) after 6 hours postoperative till the end of the current postoperative observational period (18 hrs) (p-value <0.001).

This result was consistent with the study of Naja et al. [11], eighty children were randomly allocated to receive either paravertebral block or ilioinguinal nerve block. Each block was evaluated in terms of intra-operative haemodynamic stability, postoperative VAS score at rest, on movement and during activity, requirement for supplemental analgesia and parental satisfaction Pain scores were found to be the same in the study of Berta et al. [2], in which fifty children aged 3-12yr were prospectively randomized to receive either paravertebral nerve block or combined general anesthesia with light sevoflurane anesthesia combined with standardized postoperative systemic analgesia. The two-way analysis of variance for repeated measurements of pain scores within the entire follow-up period showed a significant difference in favor of the PVB group. At each assessment time point, all three VAS pain scores (at rest, during movement, and during activity) were found to be lower in the PVB group compared with the GA/SA group.

Pain scores were found to be the same in the study of Ozcengz et al. [13], in which seventy children, aged 3-7, ASA 1-2, undergoing herniorrhaphy surgery were enrolled. The patients were divided into two groups. In group PVB patients received 0.2ml/kg levobupivacaine via paravertebral block and in group CB patients received 0.5ml/kg levobupivacaine caudally.

In the current study, the number of postoperative rescue analgesic doses; which was in the form of paracetamol 10-15mg/kg iv was significantly lower in the (PVB) group, in group PVB 21 patients didn’t need any postoperative rescue analgesia, 4 patients needed postoperative rescue analgesia, where 2 patients needed 3 rescue doses, while the other 2 patients both received a single dose making the total number of doses 8 for the PVB group. In group SII all patients needed postoperative rescue analgesia 22 patients received a total of 2 rescue analgesic doses, and 3 patients received 3 doses. Making the total number of doses 53 which was significantly more than those in group PVB.

This result was consistent with the prospective randomized controlled study of Splinter et al. [14], in which 36 children aged 3-16yr undergoing open appendectomy were included. Group I (SPVB) subjects received aRight somatic paravertebral block (SPVB) at T11, T12, and L1 using 0.2% ropivacaine 0.25mL/kg with epinephrine 1:200,000 preoperatively. Group II (Control) had only bandaids applied to skin Group I (SPVB) subjects required significantly less morphine than Group II (Control) patients Group I (SPVB) subjects required significantly less morphine than Group II (Control) patients.

It was also consistent with the study of Naja et al. [12], Analgesic consumption was significantly higher in the systemic analgesia group (88%) compared with the paravertebral nerve blockade group (32%) (p<0.001). Also in the prospective observational pilot study of Berta et al. [2], 24 children undergoing major renal surgery received a single injection low thoracic paravertebral block using a loss of resistance technique A successful block was achieved in 23/24 patients. The median duration of the block was 600 minutes, with 10 children not requiring any analgesia during the 12 hours observational period. In the current study preemptive local anesthetic infiltration with 0.5mg/kg 0.375% ropivacaine was done after in-
duction of general anesthesia. Low CHEOPS, OPS scores, and satisfactory analgesia was observed in the first 6hrs of the postoperative period. There are some studies that addressed the benefits of preemptive local anesthetic infiltration and compared it to postincisional or postoperative infiltration. In the study of Dahl et al. [15], 50 children aged 2-10 years scheduled for hernioplasty were randomly assigned into two groups. The pre-incisional group had a tendency towards faster awakening after the end of anaesthesia and a significantly lower OPS-pain score 30min after the operation than the postincisional infiltration groups (p<0.03).

The depth of thoracic paravertebral space was measured in the current study; were the mean depth in cms was obtained in different age groups included in the study. Depth from insertion point of needle on the skin to the thoracic paravertebral space was measured under real time ultrasound imaging. The skin - paravertebral space depth (S-PVS) depth was derived. Mean depth of TPVS (in cm) = 0.1275 x age( in yrs) + 2.5971 and hence depth of TPVS was significantly correlated with age of the patients. In the study of Lonnqvist(16), the actual skin depth to paravertebral (S-PVS) was determined in twenty pediatric patients. The S-PVS depth correlated well to patient weight (r=0.94) and S-PVS depth can be predicted by the following equation, S-PVS depth mm = 21.2+0.53 x (weight in kg) Also in the study of Vrushali and Ankit [17] 75 pediatric patients ranging from 2 days to 60 months, transverse probe paravertebral scan was done at C6, T1- T12, and lumber regions to determine optimal insertion point and depth for performing paravertebral block. The lateral distance from the transverse process and the depth from insertion point to the paravertebral space (reference point) were measured. Age and weight correlated very well with paravertebral depth. Prediction (regression) equation was determined were T1-T12 depth = 0.02 x wt + 0.03 x age + 1.02.

In the study of Yoo et al. [18], aimed to estimate the appropriate depth and distance for safe needle poisoning in children. The depth (D) from the skin to paravertebral space and the distance (A) from the spinous process to the needle entrypoint on the skin each measurement correlated significantly with age, weight, and height, but not with body mass index (BMI). A = 13.56 + (0.33 x Age in yrs) + (0.06 x weight in kg) + 0.47 x (gender; females=0 and males = 1); and D = 17.49 – (0.35 x age in years) + (0.55 x weight in kg).

However, in the study of Marhofer et al. [19] the PVS of 20 women undergoing breast cancer surgery was investigated with a high-frequency linear ultrasound transducer in the sitting position. Puncture depth was calculated as 30 (23-41) mm for the T3 level and 30 (23-48) mm for the T6 level. There were no clinically relevant correlations between demographic data and ultrasound measurements.

The current study demonstrated that ultrasound guided single injection thoracic paravertebral block was superior to the preemptive surgical incision infiltration in children undergoing open renal surgery, as it showed lower CHEOPS and OPS scores, less need of postoperative rescue analgesia and longer time to first request. Depth of thoracic paravertebral space can be measured using ultrasound visualization, mean depth in cm was significantly correlated to age of patients included in the PVB group.

References
Ultrasound Guided Thoracic Paravertebral Block in Pediatric Renal Surgery


