

Ultrasound-guided rectus sheath block in children with umbilical hernia: Case series

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ABSTRACT

Background: Umbilical hernia repair, a common day-case surgery procedure in children, is associated with a significant postoperative pain. The most popular peripheral nerve blocks used in umbilical hernia repair are rectus sheath infiltration and caudal block. The rectus sheath block may offer improved pain relief following umbilical hernia repair with no undesired effects such as lower limb motor weakness or urinary retention seen with caudal block which might delay discharge from the hospital. Ultrasound guidance of peripheral nerve blocks has reduced the number of complications and improved the quality of blocks. The aim of this case series is to assess the post rectus sheath block pain relief in pediatric patients coming for umbilical surgery. **Methods:** Twenty two (22) children (age range: 1.5-8 years) scheduled for umbilical hernia repair were included in the study. Following the induction of general anesthesia, the ultrasonographic anatomy of the umbilical region was studied with a 5-16 MHz 50 mm linear probe. An ultrasound-guided posterior rectus sheath block of both rectus abdominis muscles (RMs) was performed (total of 44 punctures). An in-plane technique using Stimuplex A insulated facet tip needle 22G 50mm. Surgical conditions, intraoperative hemodynamic parameters, and postoperative analgesia by means of the modified CHEOPS scale were evaluated. **Results:** ultrasonographic visualization of the posterior sheath was possible in all patients. The ultrasound guided rectus sheath blockade provided sufficient analgesia in all children with no need for additional analgesia except for one patient who postoperatively required morphine 0.1 mg/kg intravenously. There were no complications. **Conclusions:** Ultrasound guidance enables performances of an effective rectus sheath block for umbilical hernia. Use of the Stimuplex A insulated facet tip needle 22G 50mm provides easy, less traumatic skin and rectus muscle penetration and satisfactory needle visualiza.

Key words: Anesthesia, analgesia, anesthetic techniques, peripheral nerve block, postoperative, regional, rectus sheath block, surgery, umbilical hernia, ultrasonography, umbilical

INTRODUCTION

Umbilical hernia repair is a common operation in pediatric surgery. It is carried out in children over 2 years old, usually under general anesthesia combined with a regional block (caudal block). It is almost always done as a day case procedure; a peripheral nerve block is usually the choice for postoperative pain relief. The rectus sheath block

was described in adults,^[1] has been used for laparoscopic surgery in gynecology,^[2] and is one of the currently used techniques in pediatric umbilical surgery.^[3] However, it may be associated with complications such as retroperitoneal hematoma and possibility of peritoneal puncture.^[4] The paraumbilical block^[5] was described in 11 pediatric patients to avoid these complications and to improve the success rate of the block.

Recently, direct ultrasonographic visualization of the brachial plexus,^[6] of the sciatic nerve in the popliteal fossa,^[7] the ilioinguinal/iliohypogastric nerves,^[8] and of rectus sheath^[9] has been done successfully in children and in infant.^[10]

The aim of this case series was to investigate the ultrasound visualization of the anatomy in the umbilical region in

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children and to evaluate postoperative pain relief following rectus sheath block.

METHODS

Approval of the IRB ethical committee (King Khalid University Hospital, King Saud University, Saudi Arabia) and informed consent from the parents were obtained in all cases. Twenty-two children, age range 1.5-8 years, ASA physical status I or II, scheduled for paraumbilical hernia repair on an outpatient basis, were included in this case series. None had a history of convulsion, neuromuscular disease, or hematological disorders.

No premedication was given. Intraoperative monitoring included, ECG, pulse oximetry, non-invasive blood pressure, and end tidal carbon dioxide concentration.

After general anesthesia was induced and venous access established, fentanyl 2 mic/kg was given and an appropriate size laryngeal mask airway was placed. Spontaneous ventilation with 1 MAC sevoflurane in a mixture of 50% air and oxygen was maintained in all cases throughout the procedure.

The ultrasonographic anatomy of the umbilical region was studied in each case, with 5-16 MHz US linear probe (Sonosite M TURBO). The probe positioned 1 cm above the umbilicus, adjustments in depth and gain were made in order to achieve the optimal sonographic view of both rectus abdominis muscle (RMs), their sheaths, and adjacent structures.

The sheath and lateral edge of the RM were localized, peritoneum and the aponeurosis of ipsilateral transverse abdominis (TM), internal and external oblique muscles (EOM and IOM) were identified [Figure 1]. After aseptic preparation of the puncture site, the ultrasound probe was covered with sterile TEGADERM film (3M Health Care St. Paul, MN, USA) and sterile ultrasound gel was used (ULTRA/PHONIC PHARMCEUTICAL INNOVATIONS, INC., NEW JERSEY, USA). The block was performed a facet tip needle (Stimuplex A insulated Needle 22G50 mm). The needle was introduced in the long axis parallel to the ultrasound probe [Figure 2] to reach the lateral border of the rectus muscle, and advanced slowly and carefully until the tip of the needle was seen just between the posterior aspect of the rectus abdominis and its sheath [Figure 3]. A single injection of plain bupivacaine 0.25%, 0.25 ml/kg was injected each side under the real-time ultrasound control.

Surgery was then proceeded and hemodynamic parameters were recorded. Intraoperatively, analgesia was evaluated and



Figure 1: Short-axis sonographic view of the periumbilical region shows: the rectus muscle surrounded by the rectus sheath (RS), internal oblique muscle (I.O), external oblique muscle (E.O), transversus abdominis muscle (T.A)



Figure 2: Needle tip and shaft visualization within the posterior rectus sheath fascial split by ultrasound during rectus sheath block and injection of local anesthesia, the rectus sheath (RS), internal oblique muscle (I.O), external oblique muscle (E.O), transversus abdominis muscle (T.A), local anesthesia (LA)



Figure 3: Needle position; in plane technique, the block needle is lateral to the ultrasound probe

fentanyl 1 mic/kg was planned to be administered if there is an increase in heart rate or blood pressure of >10% or an increase in respiratory rate of more than 20% following the skin incision or at any time during the procedure and was defined as insufficient analgesia.

At the end of the procedure, the laryngeal mask was removed and general anesthesia was discontinued. Children were taken to the post anesthesia care unit (PACU). Postoperative analgesia was evaluated by a blind investigator using the modified CHEOPS pain scale^[11] in the PACU every 10 min until discharge. Children who scored 5 or more at any of the evaluated times were to be given morphine 0.1 mg/kg IV. In the surgical wards, trained nurses recorded the time when the child first required additional paracetamol 20 mg/kg suppository as a supplement analgesia.

RESULTS

Demographic data were as follows: 14 females and 8 males, mean age 3.7 years (1.5-8 years) and mean weight of 16 kg (range 10-27 kg). Each received two punctures one on each side of the umbilicus, a total of 44 punctures in 22 patients. No increases in the heart rate or blood pressure were recorded intraoperatively, and no patient was given additional fentanyl. Different Surgeons performed the cases and assessed the surgical conditions as good in all the patients.

Peritoneum and the lateral edge of the rectus muscles were easily identified in all the cases and the punctures were performed without complication.

Only one child scored >5 in the modified CHEOPS Scale and was given morphine 0.1 mg/kg intravenous in the PACU. The ward nurses reported no supplement of analgesia. All patients were discharged without complications.

DISCUSSION

The umbilical area is innervated by the right and left 10th intercostal nerves, anterior rami of the 10th spinal thoracic roots. Each nerve passes behind the costal cartilage and runs between transversus abdominis and internal oblique muscles.

At the level of the linea semilunaris, the nerve perforate the rectus sheath posteriorly, innervate the rectus muscle, cross the muscle, and end as an anterior cutaneous branch supplying the skin of the umbilical area.^[12]

The rectus sheath block was first used in pediatric surgery by Ferguson *et al.* in 1996,^[3] the authors described that

the tendinous intersections of the rectus sheath are only anterior and do not extend through the thickness of the muscle, so a potential space would exist between the posterior aspect of its sheath.

This potential space would allow dispersion of LA at several levels, enabling an effect on several intercostal nerves, the puncture was performed on each side of the abdomen, just above and lateral to the umbilicus, half-to-1 cm medial to the linea semilunaris. The block proved to be effective and safe both for umbilical and paraumbilical hernia repair.^[3]

One year later, in 1997, Courreges *et al.* described a new technique to provide analgesia in 11 children undergoing the umbilical hernia repair: the paraumbilical block. The authors stated that the course of the cutaneous branch of the 10th intercostal nerve is variable, sometimes, it lies between the rectus abdominis muscle and the posterior wall of its sheath, but up to 30% of cases, the cutaneous branch of the 10th intercostal nerve could arise before the rectus sheath and run above the anterior wall of the rectus sheath in the subcutaneous space.^[5]

Smith, *et al.* suggested that infiltration by LA in the middle of the rectus muscle, both above and below the anterior wall of the sheath, would result in spread around the anterior cutaneous branches whatever the anatomical variation.^[2]

In recent years, high frequency ultrasonography is of increasing interest in regional anesthesia, as direct visualization of the anatomic structures allows optimal placement of the needle and thereby reduces the risk of inadvertent interneural, intravascular, or adjacent structures injury (peritoneum).

In our case series, we described an ultrasound-guided technique of the 10th intercostal nerve block using the facet tip needle, which is considered as safety measure.

Many anatomical variations of the point where the intercostal nerve pierces the rectus sheath, in order to avoid these variations, the 10th intercostal nerve is better to be blocked before it pierces the sheath, i.e. between the aponeurosis of the internal oblique muscle and the transversus muscle; however in this case series, we were not able to visualize the nerve due to several reasons. Firstly, because of the small size of the intercostal nerve, a higher ultrasound frequency probe is probably required to visualize such small nerves. Secondly, because of the course of the intercostal nerve before entering the rectus muscle. It is difficult to differentiate the nerve from the aponeurosis by ultrasonography because the nerve runs parallel to the muscular aponeurosis i.e., the nerve does

not cross the aponeurosis and thus makes it difficult to identify in between.

However, by using real-time imaging, the spread of the LA around the rectus muscle could be observed and as all blocks were clinically effective, we may assume that the LA was placed close enough to the nerve.

In this series, we used the in-line puncture needle in a longitudinal direction relative to the ultrasound probe because it is the only way to visualize the exact position of the needle tip and therefore ensured the needle tip was always outside the peritoneum.

CONCLUSION

Rectus sheath block is an effective and safe intra and postoperative analgesic approach in children. Ultrasound guidance enables performances of an effective rectus sheath block for umbilical hernia in the lateral edge of the rectus muscle. Use of the Stimuplex A insulated facet tip needle 22G 50 mm provides easy, less traumatic skin and rectus muscle penetration and satisfactory needle visualization by the ultrasound. The bilateral deposited of bupivacaine 0.25% 0.5ml/kg within the space between the posterior aspect of the rectus abdominis muscle and its sheath under real-time ultrasonographic guidance provides sufficient analgesia for umbilical hernia repair postoperatively.

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