

# Ultrasound guided rectus sheath blockade compared to peri-operative local anesthetic infiltration in infants undergoing supraumbilical pyloromyotomy

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## ABSTRACT

**Background:** Provision of appropriate analgesia for supraumbilical pyloromyotomy in infants is limited by concerns about sensitivity to opioids and other medication groups, due to immature metabolism. Local anesthetic infiltration and ultrasound guided rectus sheath blockade are two techniques commonly employed to provide perioperative analgesia. The aim of this review was to compare the quality of post-operative analgesia afforded by these two techniques. **Materials and Methods:** A retrospective chart analysis of hospital records of all patients who underwent supraumbilical pyloromyotomy at a tertiary pediatric hospital between March 2009 and February 2011. Analysis of the anesthetic technique employed and post-operative acetaminophen requirements were performed. Additional information as to time to first post-operative feed, any complications and time of discharge from the hospital were collected by reviewing the post-operative nursing notes. **Results:** A total of 30 patients underwent supraumbilical pyloromyotomy during this period. A total of 18 received local anesthetic infiltration at the end of the procedure and 12 patients underwent ultrasound guided pre-incisional rectus sheath block for post-operative analgesia. Patients who had post-operative local anesthetic infiltration had a median (range) of 2 (1-3) doses of acetaminophen in the first 24 h. In the group of patients who received a rectus sheath block, the median (range) number of doses of acetaminophen in the first 24 h was also 2 (1-3). There were no differences in time to first feed and time to hospital discharge between the groups. The volume of local anesthetic administered was significantly smaller in the group receiving analgesia via rectus sheath block. **Conclusion:** Local anesthetic infiltration and pre-incisional ultrasound guided rectus sheath block provide similar degrees of post-operative analgesia. There were no differences between the two groups in time for first post-operative feed and time to hospital discharge.

**Key words:** Analgesia, pyloromyotomy, ultrasound

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## INTRODUCTION

Congenital hypertrophic pyloric stenosis is one of the common conditions requiring surgery in early infancy. It is characterized by hypertrophy of the circular muscular layer of the pylorus, leading to gastric outlet obstruction.

Definitive surgical treatment is to release the pyloric obstruction by a longitudinal incision through the muscular layer of the pylorus, generally approached by either a supraumbilical incision or as a laparoscopic procedure.<sup>[1]</sup> This procedure is usually carried out in the 1<sup>st</sup> month of life, following appropriate fluid and electrolyte resuscitation.

Adequate analgesia following open pyloromyotomy is limited by concerns related to small infant physiology. Opioids are generally avoided due to the risk of accumulation due to immature metabolism and non-steroidal anti-inflammatory drugs may have substantial renal side-effects. Acetaminophen is usually the primary post/intra-operative analgesic available. Subcutaneous infiltration of local anesthetic close to the incision provides

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an alternative modality, but care must be taken with the dose of agent administered. This technique may only provide analgesia for skin and subcutaneous tissues, but not from the deeper tissues along the line of surgical dissection. The adequacy of this technique in providing analgesia following pyloromyotomy is not entirely clear.<sup>[2-4]</sup>

There is some evidence that poorly controlled acute pain in neonates can potentially cause hyperalgesia, aberrant pain perception and possibly chronic pain states.<sup>[5,6]</sup>

Pre-incisional ultrasound guided rectus sheath block<sup>[7]</sup> may be an alternative to local anesthetic infiltration technique as it provides adequate dermatomal block for the peri-umbilical operations<sup>[8,9]</sup> especially if the intra-operative use of opioids is undesirable or to be avoided.

Both post-surgical subcutaneous infiltration of local anesthetic and pre-incisional ultrasound guided rectus sheath block have been performed in our institution dependent on surgical and anesthetic preference. We performed a retrospective review to determine if there were any differences in quality of analgesia provided.

## MATERIALS AND METHODS

A retrospective review of hospital records for all pyloromyotomies performed in this tertiary pediatric hospital between March 2009 and February 2011 was conducted. The Institutional Review Board was contacted and it was advised that a formal ethical approval was not necessary for this retrospective survey of existing clinical practice. Primary aim was to assess the quality of post-operative analgesia following open supraumbilical pyloromyotomy. The time to first feed after the operation and time to hospital discharge following the procedure were also reviewed.

The current anesthetic practice at this hospital for open pyloromyotomy is either an inhalational induction of anesthesia or a rapid sequence induction, depending on individual anesthesiologist's preference. All patients were appropriately resuscitated prior to anesthesia and had intravenous access in place. Patients received intravenous acetaminophen in a dose of 7.5 mg/kg intra-operatively. Further analgesia was provided by either a subcutaneous infiltration of 0.5 ml/kg of 0.25% L-bupivacaine or an ultrasound guided pre-incisional rectus sheath block with injection of 0.2-0.4 ml/kg of 0.25% L-bupivacaine. The method of analgesia depended on surgical and anesthetic preference and experience. Subcutaneous infiltration was performed by the surgeon at the end of the procedure under direct vision. Ultrasound guided rectus sheath block was

performed by one of two experienced anesthesiologists. A Sonosite Micromaxx machine with a 25 mm 13-6 MHz probe was utilized. Under sterile conditions, a 24G regional block needle was guided into the posterior rectus sheath at the level of the umbilicus, using an in-plane technique. Equal amounts of local anesthetic were deposited on each side. As per our standard protocol, any patients where the intra-operative heart rate rose by more than 10% of baseline received 1 mcg/kg fentanyl as rescue.

All patients were prescribed oral acetaminophen post-operatively at 15 mg/kg to be administered in 4-6 h intervals as required. This was based on pain assessment protocol using FLACC. A FLACC score of >4 resulted in administration of acetaminophen.

## Statistical analysis

Results for the two groups were compared using the Mann-Whitney U-test for non-parametric data.  $P < 0.05$  were considered to be statistically significant.

## RESULTS

A total of 30 patients who had undergone open pyloromyotomy through a supraumbilical incision between March 2009 and February 2011 were identified. 18 patients received subcutaneous infiltration of 0.25% L-Bupivacaine at the end of the surgical procedure and 12 patients received pre-incisional ultrasound guided rectus sheath blocks. Patient demographics and results are summarized in Table 1. There were no significant differences between the two groups in terms of demographics or primary outcome measures. There was a significantly lower volume of local anesthetic administered to the ultrasound guided rectus sheath patients ( $P < 0.001$ ). No patient required fentanyl in the peri-operative period.

## DISCUSSION

Pediatric regional anesthetic techniques have been proven to offer beneficial analgesia in the peri-operative period.<sup>[10]</sup> Rectus sheath blocks have previously been found to be useful for peri-umbilical surgery in children.<sup>[11,12]</sup> In one recent study, ultrasound guided rectus sheath block was shown to provide superior intra-operative analgesia compared with local anesthetic infiltration for umbilical hernia repair, but failed to show a statistically significant difference in post-operative analgesic consumption. There is renewed interest in rectus sheath and other anterior abdominal wall nerve blocks in children, largely due to increasing use of ultrasound in the practice of pediatric regional anesthesia.<sup>[10,13]</sup> Compared with some of the other techniques that have been recently described for providing

**Table 1: Description of patient population studied and primary outcomes. (NS =  $P > 0.05$  as determined by Mann-Whitney U-test)**

	Local infiltration at closure	Pre-operative ultrasound guided rectus sheath block	Difference between groups
Number of patients	18	12	—
Age (mean±SD)	32.3 (15.8) days	33.4 (18.4) days	NS
Weight (mean±SD)	3.6 (0.6) kg	3.8 (0.42) kg	NS
Mean dose of local anesthetic (mg/kg)	2.05	1.1	<0.001
Time to first analgesia (median/range)	4.9 (3.8-7.8) h	4.7 (2.9-7.9) h	NS
Doses of paracetamol in first 24 h (median/range)	2 (1-3)	2 (1-3)	NS
Time to hospital discharge (median/range)	64.5 (47.1-72.8) h	62.9 (39.8-93.4) h	NS

SD: Standard deviation

analgesia following pyloromyotomy,<sup>[14-16]</sup> ultrasound provides a means of safely delivering local anesthetic under direct visualization. This is particularly important when caring for small infants.

This review suggests that both methods provide good quality analgesia following open pyloromyotomy. This is reflected by an average administration of only two doses of acetaminophen in the first 24 h following operation in both the local anesthetic infiltration and rectus sheath block patients. These findings are similar to those of an audit of 72 cases of open pyloromyotomy receiving intra-operative local anesthetic infiltration, where the mean requirement of post-operative acetaminophen was 1.91 (Standard deviation-1.56) doses.<sup>[3]</sup>

There were no significant difference in the number of doses or the time to first dose of post-operative acetaminophen between those who received intra-operative local anesthetic infiltration and those who underwent a rectus sheath block. There was also no significant difference between the time to first post-operative feed and time to discharge from the hospital between the two analgesia techniques. Surgical preference determines the time to first feed, commonly until at least 12 h post-operatively at this hospital.

The incidence of complications following regional anesthetic blocks in children has been shown to be low<sup>[17]</sup> and there were no complications in our patients. Although there is no clear evidence that ultrasound guided blocks prevent complications, visualization of the anatomical structures with ultrasound should allow more accurate delivery of the local anesthetic solution as well as allowing an adequate block with lower local anesthetic volumes.<sup>[18-20]</sup> Although we accept that an ultrasound guided block in a small infant may be viewed with concern, the simplicity of the technique allows aptitude to be rapidly gained. Local infiltration required an average dose of 0.8 ml/kg of 2.5 mg/kg L-bupivacaine. For the ultrasound guided blocks, almost half this dose (0.44 ml/kg) was required for

at least an equal effect. This may represent a substantial advantage in very young children, especially ex-premature infants. These patient groups may have limited ability to metabolize a large load of local anesthetic, due to immature renal and hepatic function, most importantly low levels of plasma protein binding.<sup>[21]</sup>

Post-operative local anesthetic infiltration does not provide any intra-operative analgesia. An appropriately placed, pre-operative regional block will provide a degree of analgesia for the operative procedure, however. This was the conclusion from a comparative study of local anesthetic infiltration versus rectus sheath block for older children undergoing umbilical surgery.<sup>[9]</sup> Our experience of ultrasound guided rectus sheath block is in agreement with a recently published case review, which showed effective intra and post-operative analgesia.<sup>[22]</sup>

Although this study did not record response to incision as an indicator of adequacy of intra-operative analgesia, it is appropriate that sufficient analgesia was provided for the procedure. It is well-established that early exposure to pain, particularly in preterm neonates, can lead to the development of aberrant pain behavior in adulthood.<sup>[23]</sup> Pre-operatively placed local anesthetic offers an effective means of avoiding exposure to painful stimuli in very young children.

There are limitations to this study that arise from variations in clinical practice of individual anesthesiologists. It is based on information gained retrospectively from hospital records. It can be difficult to assess pain in infants, making nurse initiated analgesia provision reliant on experience as well as objective pain scores. Behavioral markers and physiological parameters may not always accurately reflect pain in neonates. Ability to respond to pain also depends on other factors such as neurobehavioral state and postnatal age.<sup>[24,25]</sup>

From the results of this retrospective review, post-operative pain following supraumbilical pyloromyotomy is well-

managed irrespective of which of two local anesthetic techniques are employed. Ultrasound guided rectus sheath block provides comparable analgesia to local anesthetic infiltration and can be considered as an alternative technique for providing post-operative analgesia in these cases. It is particularly notable that adequate analgesia is provided by the ultrasound technique using significantly less local anesthetic.

It is also possible that the pre-operative analgesia afforded by an ultrasound guided rectus sheath block may have a beneficial role in the context of avoiding developing chronic pain syndromes in later life. Such a hypothesis requires a more substantial longitudinal analysis.

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