Journal of Pediatric Urology (2008) 4, 337–340

Journal of Pediatric urology

# The effectiveness of aerosolized intraperitoneal bupivacaine in reducing postoperative pain in children undergoing robotic-assisted laparoscopic pyeloplasty

D.A. Freilich [a], C.S. Houck [b], P.M. Meier [b], C.C. Passerotti [a], A.B. Retik [a], H.T. Nguyen [a,*]

[a] *Department of Urology, Children's Hospital Boston, 300 Longwood Avenue, Hunnewell-353, Boston, MA 02115, USA*
[b] *Department of Anesthesiology, Perioperative and Pain Medicine, Children's Hospital Boston, 300 Longwood Avenue, Hunnewell-353, Boston, MA 02115, USA*

Received 26 November 2007; accepted 29 April 2008
Available online 16 June 2008

**KEYWORDS**
Aerosolization;
Bupivacaine;
Intraperitoneal;
Postoperative pain;
Children;
Robotic-assisted laparoscopic pyeloplasty

**Abstract** *Objective:* To assess the effectiveness of aerosolized intraperitoneal bupivacaine in reducing postoperative pain in children. Laparoscopic surgery has decreased the severity of postoperative pain in children. However, children often experience abdominal and shoulder pain requiring significant amounts of opioids, potentially prolonging their hospitalization.
*Methods:* Forty-one consecutive patients undergoing unilateral robotic-assisted pyeloplasty between December 2005 and December 2007 were retrospectively reviewed to assess perioperative opioid requirements and length of hospitalization.
*Results:* In addition to standard-of-care perioperative analgesia, five patients received intraperitoneal aerosolized bupivacaine just prior to trocar removal, 17 patients received aerosolized bupivacaine just prior to incising the perirenal fascia, and 19 patients received no intervention. There was a significant reduction in postoperative opioid utilization when bupivacaine was administered at the beginning of the surgery (0.1 mg/kg vs 0.4 mg/kg, $P = 0.04$), but not at the end (0.3 mg/kg, $P = 0.25$), as compared to controls. All patients receiving aerosolized bupivacaine had a significantly shorter time in hospital (2.4 vs 1.4 days, $P = <0.01$).
*Conclusions:* The administration of intraperitoneal aerosolized bupivacaine just prior to incising the perirenal fascia appears to be a simple, effective and low-cost method to reduce postoperative pain in children undergoing laparoscopic pyeloplasty.


* Corresponding author. Tel.: +1 617 355 6842; fax: +1 617 730 0474.
*E-mail address:* hiep.nguyen@childrens.harvard.edu (H.T. Nguyen).

1477-5131/$34 
doi:10.1016/j.jpurol.2008.04.006

## Introduction

Minimally invasive surgery has decreased the severity of postoperative pain in children [1,2]. However, many patients still complain of diffuse abdominal pain after undergoing laparoscopic surgery. In addition, postoperative shoulder pain following laparoscopic surgery occurs in 35—63% of adult patients [3,4]. It has been speculated that the peritoneal stretching and diaphragmatic irritation associated with the surgically induced pneumoperitoneum may be the etiology of both of these types of pain. Postoperative treatment of this pain may require significant amounts of analgesia postoperatively and can potentially prolong the hospital stay.

There have been a number of studies investigating the use of local anesthetics administered intraperitoneally to reduce both shoulder tip and diffuse abdominal pain after laparoscopic surgery. Though the benefits of intraperitoneal irrigation with bupivacaine have been demonstrated in outpatient gynecological procedures [5—7], the results with instillation of intraperitoneal local anesthetics for other types of laparoscopic surgery have been mixed [8—12]. A recent meta-analysis of 24 randomized, controlled trials assessing intraperitoneal instillation of local anesthetic during laparoscopic cholecystectomy found a reduction in postoperative pain in only half of the studies and an overall reduction in visual analog scores of only 9 mm (out of a total of 100) in the treatment group [12]. There are a number of factors that may explain this variability including: (1) the site of instillation of the local anesthetic (e.g. subdiaphragmatic vs subhepatic), (2) timing of instillation, (3) dose and concentration of local anesthetic used, (4) amount of pain from non-visceral sites (i.e. incisions) as well as (5) the postoperative pain regimen.

Alkhamesi et al. [13] demonstrated that the closed and pressurized laparoscopic environment enables aerosolized therapeutics to uniformly spread throughout the peritoneal cavity. They subsequently used this method to administer bupivacaine during laparoscopic cholecystectomy and were able to show, in a randomized double-blind fashion, a significant reduction in postoperative opioid requirements and pain scores when compared to aerosolized saline or bupivacaine injected into the gallbladder bed [14]. In order to evaluate the efficacy of aerosolization of bupivacaine in pediatric patients, we utilized a sterile mucosal atomization device (Fig. 1) to administer a fine mist of bupivacaine into the peritoneal cavity during robotic-assisted laparoscopic pyeloplasty.

## Methods

We retrospectively reviewed all robotic-assisted laparoscopic pyeloplasties performed at our institution between December 2005 and December 2007. Forty-five patients were identified, of which 42 underwent a unilateral procedure and three a concurrent bilateral procedure. Those undergoing bilateral procedures were excluded from analysis. One patient in the aerosolized bupivacaine group was subsequently excluded, as his postoperative course was complicated by a stent migration and the need for additional surgery to remove and replace the stent.

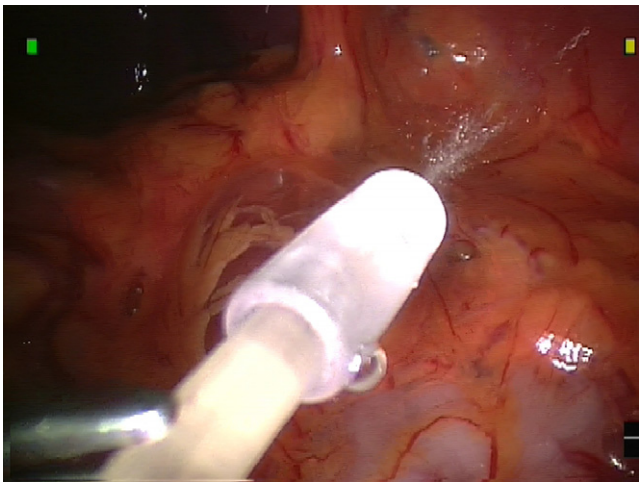

**Figure 1** Aerosolization of intraperitoneal bupivacaine.

Bupivacaine 1.25 mg/kg (maximum 75 mg) was mixed with sterile normal saline to achieve a volume of 30 mL. A sterile mucosal atomization device with an average particle size of 30 microns (MADett®, Wolfe-Tory Medical, Salt Lake City, UT, USA) was connected to a 30-mL syringe and introduced through the laparoscopic port. The device was then grasped by the robotic instrument, enabling the surgeon to rotate it to ensure complete coverage of the peritoneum. Finally, the bupivacaine was ejected, vaporizing the fluid into the peritoneum (Fig. 1). Intraoperative analgesia was provided by fentanyl and/or morphine and additional bupivacaine was injected subcutaneously around the port sites at the end of the procedure (maximum dose 1.25 mg/kg). Ketorolac was administered intravenously every 6 h, with the first dose at the end of surgery, as is routine at our institution. Postoperative analgesia was achieved with morphine and/or an oral opioid (i.e. codeine, hydrocodone and oxycodone) as needed.

Statistical analysis was performed with a one-sided *t*-test. Data were considered significant at a *P*-value $<0.05$.

## Results

Forty-one patients undergoing unilateral pyeloplasty for ureteropelvic junction obstruction were included in our analysis. Nineteen of the 41 patients did not receive aerosolized bupivacaine (six females, 13 males). Five patients received aerosolized intraperitoneal bupivacaine at the end of the surgery, just prior to removing the trocars (one female, four males). Seventeen patients received aerosolized bupivacaine immediately after placement of the laparoscopic ports (three females, 14 males). No patient had epidural analgesia or other nerve blockade, besides the previously described subcutaneous infiltration of the incisions. No patient required pain medications prior to surgery.

Perioperative findings and statistical analyses are detailed in Table 1. There was a significant reduction in postoperative opioid requirements (0.1 mg/kg vs 0.4 mg/kg, $P = 0.04$) and a significantly shorter length of hospital stay (2.4 vs 1.3 days, $P = <0.01$) when bupivacaine was