BUTTERWORTH HEINEMANN

Ambulatory Surgery, Vol. 3, No. 2, pp. 79–82 1995

0966-6532/95 $10.00 + 0.00

0966-6532(95)00007-0

Postoperative pain control in paediatric ambulatory herniorrhaphy and orchiopexy using atraumatic intraoperative instillation of bupivacaine in comparison with rectal application of acetaminophen: a double-blind study

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Herniorrhaphy and orchiopexy are increasingly performed on an outpatient basis in paediatric surgery. In such cases, postoperative analgesia should receive special attention so that the hospital stay need not be unnecessarily prolonged due to side effects of the analgesic agents, such as sedation, respiratory depression or vomiting. Therefore, the present study is a randomized double-blind investigation to assess the effectiveness of atraumatic intraoperative instillation of bupivacaine in the surgical site and the rectal application of acetaminophen as a postoperative analgesic following herniorrhaphy and orchiopexy. Male patients between the ages of 3 and 6 yr who were scheduled to receive ambulatory herniorrhaphy or orchiopexy were included in the study. One hundred children in each of the herniorrhaphy and orchiopexy groups were treated respectively with acetaminophen or with bupivacaine as the postoperative analgesic. Atraumatic intraoperative instillation of bupivacaine into the surgical site proved to be significantly superior as a postoperative analgesic in both the herniorrhaphy and orchiopexy groups as compared to rectal application of acetaminophen (χ^2 test: herniorrhaphy group $P < 0.05$; orchiopexy group $P < 0.001$). For herniorrhaphy and orchiopexy in childhood, local atraumatic instillation of bupivacaine during surgery into the wound bed is a simple, easy to use and reliable method for postoperative pain control with no side effects.

Key words: Ambulatory paediatric surgery, orchiopexy, herniorrhaphy, postoperative pain control, bupivacaine, acetaminophen

Introduction

Herniorrhaphy and orchiopexy in paediatric surgery are increasingly performed on an outpatient basis[2]. The advantages of ambulatory surgery are not only its cost effectiveness, but also the lower rate of wound infections[3] and the obviation of separating the patient from his mother and family. Within several hours after surgery, the children can leave the hospital again. Postoperative analgesia should receive special attention in these cases, so that the hospital stay need not be unnecessarily prolonged due to the possible side effects of analgesia, such as sedation, respiratory depression or vomiting. The present study therefore investigates the effectiveness of the atraumatic intraoperative instillation of bupivacaine in the surgical site and the rectal application of acetaminophen as postoperative analgesics following herniorrhaphy and orchiopexy in the form of a randomized double-blind study.

Accepted: 13 April 1995
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Patients and methods

The investigation originally began as a placebo-controlled, randomized double-blind study accepted by the Ethics Commission of the University of Tübingen. However, this study was terminated after assessing a

small number of patients because we sometimes had horrible experiences in the recovery room (with patients in the placebo group). Consequently, we resumed the study as a randomized double-blind investigation without a placebo group.

The study included male patients between the ages of 3 and 6 yr who were scheduled to undergo ambulatory herniorrhaphy or orchiopexy.

Herniorrhaphy group (n = 200)

Group A: bupivacaine (n = 100)
When the children were waiting in the operating room, each received a placebo suppository. The intraoperatively exposed portion of the ilioinguinal nerve was moistened with 0.066 ml of bupivacaine 0.25% kg^{-1} bw. After subcutaneous suture, the wound edges were also moistened with 0.033 ml of bupivacaine 0.25% kg^{-1} bw.

Group B: acetaminophen (n = 100)
When the children had been called to the operating room, they all received 15–20 mg acetaminophen kg^{-1} bw as a rectal suppository. The ilioinguinal nerve as well as the wound edges were moistened intraoperatively with equivalent amounts of 0.9% saline solution.

Orchiopexy group (n = 200)

Group C: bupivacaine (n = 100)
For the most part the same procedure as used in Group A was followed, but with the additional instillation of 0.5–1.0 ml bupivacaine into the scrotal incision.

Group D: acetaminophen (n = 100)
For the most part the same procedure as used in Group B was followed, but with the additional scrotal application of 0.5–1.0 ml 0.9% saline solution.

Table 1 shows a summary of the procedures applied in the herniorrhaphy and orchiopexy groups. The children were postoperatively monitored at regular intervals, initially in the recovery room and then on the ward. They were asked about pain complaints in the presence of their parents.

Results

Herniorrhaphy

Group A: Ninety-three of the 100 children had no pain, three complained of weak pain and four of strong pain. These four children received 15–20 mg acetaminophen kg^{-1} bw rectally.
Group B: Eighty-four of the 100 children had no pain, five complained of weak pain and 11 of strong pain. These 11 children received an additional rectal dose of acetaminophen.

Orchiopexy

Group C: Ninety-one of the 100 children had no pain, two complained of weak pain and seven of strong pain. These seven children received acetaminophen rectally.
Group D: Sixty-two of the 100 children had no pain, six experienced weak and 32 strong pain. These 32 children received acetaminophen rectally.

With regard to pain relief, the χ^2 test produced significant differences in both the herniorrhaphy (P <0.05) and orchiopexy groups (P <0.001) showing bupivacaine to be superior.

Discussion

The systematic assessment of pain in infancy and early childhood is not only a difficult task but also extremely controversial[6]. We therefore consciously excluded these age groups and the recommended methods, asking instead 3–6-yr-old boys in the presence of their parents about the intensity of postoperative pain.

The advantages of postoperative pain control using analgesics with peripheral action, for example, acetaminophen, result from the simple application form of the suppository and from the paucity of side effects if

Table 1. Methods of postoperative pain control

	Herniorrhaphy (n = 200)		*Orchiopexy (n = 200)*	
	A (n = 100)	*B (n = 100)*	*C (n = 100)*	*D (n = 100)*
Preoperatively	Placebo supp.	Rectal 15–20 mg acetaminophen kg^{-1} bw	Placebo supp.	Rectal 15–20 mg acetaminophen kg^{-1} bw
Intraoperatively	Inguinal instillation 0.1 ml bupivacaine 0.25 % kg^{-1} bw	Inguinal instillation 0.1 ml 0.9 % saline kg^{-1} bw	Inguinal instillation 0.1 ml bupivacaine 0.25% kg^{-1} bw plus 0.5–1.0 ml scrotal bupivacaine 0.25%	Inguinal instillation 0.1 ml 0.9% saline kg^{-1} bw plus 0.5–1.0 ml scrotal 0.9% saline

Table 2. Possible regimens of postoperative pain control following herniorrhaphy and orchiopexy (summary)

Form of analgesia/ dosage	*Side effects*	*Complications*	*Advantages/ disadvantages*
Acetaminophen 15–20 (–50) mg kg^{-1} bw rectally, maximum 4 (3) times daily	Resorption times up to 4 h; rare: urticaria, bronchospasm	Haemolytic anaemia (G-6-P-DHG deficiency) Possible result of overdose: acute liver failure!	Easy application, can be continued at home without difficulty; only moderate analgesia
Opiates (titrated postop. iv application) Piritramid: 0.1–0.3 mg kg^{-1} bw Nalbuphine: 0.1–0.25 mg kg^{-1} bw	Sedation, nausea, vomiting. Rare: CNS effects (nervousness, dysphoria) cardiopulmonary actions, gastrointestinal effects, erythema, pruritus	Respiratory depression, acute longer postop. asthma attack (nalbuphine: sodium disulfide as solvent!)	Good analgesia; monitoring necessary; iv cannula should be left in situ
Caudal Anaesthesia Bupivacaine 0.25% For herniorrhaphy 1 ml kg^{-1} bw For orchiopexy 1.25 ml kg^{-1} bw (max. 20 ml, alternatively 0.15–0.2% solution)	Urinary retention, motor neural block (minimal using bupivacaine 0.125% with good analgesia (24))	Rare: Neural lesion, haematoma, infection at puncture site, perforation of dura. Intraosseous injection produces high plasma levels	Very good analgesia, reduction of anaesthetic agents when applied preoperatively; occasional technical problems with construction
Nerve blocks Bupivacaine 0.5% (ilioinguinal and femoral iliohypogastric nerves): 0.5 mg kg^{-1} bw = 0.1 ml kg^{-1} bw per nerve	Rare: Transitory paralysis of the nerve with gait difficulties	Very rare: neural lesion, perforation of peritoneum, haematoma	Very good analgesia preoperative application possible; blind puncture requires experience, low failure rate
Atraumatic intraoperative instillation of bupivacaine			
Bupivacaine 0.25–0.5%: 0.1–0.5 ml kg^{-1} bw	None known as of yet	None known as of yet	Postoperative analgesia very good; reduction of intraoperative anaesthetic agents

the recommended dosage is observed[5,9,14]. Following release from hospital 4–6 h after surgery, the parents can maintain postoperative analgesia easily using acetaminophen. As a direct postoperative analgesic, however, our study showed acetaminophen to be significantly less effective than bupivacaine in both the herniorrhaphy ($P < 0.05$) and even more obviously in the orchiopexy group ($P < 0.001$).

The intraoperative instillation of bupivacaine is technically simple, and side effects have not been observed as long as the recommended dosages are observed. Some authors[8,11] consider it to be equally effective to, for example, nerve blocks. The proven anti-inflammatory qualities of bupivacaine represent a further advantage of its use[13].

Table 2 shows a summary of the possible forms of postoperative pain control as well as of their side effects and possible complications. Opiates possess good analgesic effects[12], however, their possible side effects such as sedation, nausea, vomiting or even respiratory depression necessitating longer postoperative monitoring make them inappropriate for ambulatory paediatric surgery. Caudal anaesthesia and nerve blocks[1,4,7,8,10] are as effective as the atraumatic intraoperative instillation of bupivacaine, yet they require specific experience, are more time-consuming and not without side effects and complications. After more than 2500 intraoperative instillations of bupivacaine so far in infants and children up to the age of 14 yr, we have observed good analgesia with no side effects or complications. Local intraoperative instillation of bupivacaine into the wound bed is an uncomplicated, easily applied, reliable method of postoperative pain control without side effects that can be used in herniorrhaphy and orchiopexy.

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