# Analgesia for Hypospadius Repair in Children: A Comparison of Caudal Bupivacaine and Intravenous Morphine

*Khaled R. Al-Zaben* [1*]

**Abstract**

**Background:** The present study is a prospective randomized double-blinded study that was designed to evaluate and compare the effectiveness of postoperative pain control and the incidence of complications between caudal block and intravenous morphine in paediatric patients undergoing hypospadius repair**.**

**Methods:** Sixty patients aged 1-7 years were randomly allocated to two groups of thirty. One group received intravenous morphine 100 microgram/kg before the skin incision and the other had a caudal block with 0.5ml/kg bupivacaine 0.25% before the skin incision. All patients received standardized anaesthesia. Pain was assessed using a 0 - 10 scale at 0, 1, 2, 3, 4, 6, 8 and 24 postoperative hours. The time to the first analgesia, the number of paracetamol doses, the incidence of respiratory depression, vomiting, itching, motor weakness and urine retention were assessed during the first 24 hours.

**Results:** Pain scores were significantly higher in group M compared to group C on admission to the post-anaesthesia care unit and during the following 3 postoperative hours. There was no significant difference in pain scores between the two groups at 4, 6, 8 and 24 hours after surgery.

The time to the first analgesia was significantly lower in Group M compared to Group C. The total number of intraoperative fentanyl doses was significantly higher in Group M compared to group C, and there was no significant difference in the number of total paracetamol doses over the 24 postoperative hours between the two groups.

None of the sixty patients experienced postoperative respiratory depression, urine retention or motor weakness, but significantly more patients in Group M experienced vomiting and itching compared to Group C.

The degree of parent's satisfaction about the quality of postoperative analgesia and the side effects was better in the caudal group compared to the morphine group.

**Conclusion:** We conclude that caudal analgesia is more effective than intravenous morphine (100 microgram/kg) for postoperative pain control during the immediate postoperative period in children undergoing hypospadius surgical repair with a higher incidence of vomiting and itching in the morphine treated patients.

**Keywords:** Morphine, caudal block, hypospadius repair, pain.

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**1. Department of Anaesthesia and Intensive Care, Faculty of Medicine, University of Jordan, Amman, Jordan.**
**** Correspondence should be addressed to:***
**Khaled R. Al-Zaben**
**E-mail:** kalzaben@yahoo.com

## Introduction

Hypospadius repair in children is a painful surgical procedure that may require more than one modality of pain control including caudal anesthesia, administration of narcotic drugs and non-steroidal anti-inflammatory drugs with its potential complications and disadvantages .[1-3]

Opioid analgesics, especially morphine, are the commonest pharmacological choice for treating postoperative pain in children.[4] Although morphine is generally considered safe to use in paediatric patients,[5] physicians often hesitate to prescribe opioids to children because of the risk of undesirable side effects.[4,6]

A caudal epidural injection with local anaesthetic is a popular regional anaesthetic technique for infants and children undergoing infraumbilical operations.[7] These blocks are safe, fast and simple procedures, but still they have some limitations and complications.[1] Its administration before the surgical stimulus may prevent or attenuate postoperative pain.[8]

The aim of this randomized, double blinded, controlled trial was to compare the effect of a pre-incisional caudal block using 0.5ml/kg Bupivacaine 0.25% with 100 mic/kg intravenous morphine on postoperative pain, side effects and parents' satisfaction in children undergoing a hypospadius repair.

## Methods

The present study was carried out at the Jordan University Hospital, Amman, Jordan in the period from November 2010 to March 2011. After obtaining approval from the Scientific and Institutional Review Board Committee, an informed consent was taken from the parents of 60 ASA-1 children, aged 1-7 years which planned for a hypospadius surgical repair under general anaesthesia at the Jordan University Hospital. Children with a history of allergy to local anaesthetics or opioids, coagulopathy, local skin infections of the caudal area, or spinal diseases were excluded.

In the operating room, monitors for pulse oximetry, blood pressure, heart rate and end-tidal $CO_2$ were applied to each patient. After the induction of anaesthesia with sevoflurane and 50% nitrous oxide in oxygen, a gauge 22 intravenous catheter was sited. Fentanyl 1mic/kg was given intravenously and endotracheal intubation was facilitated by the administration of atracurium 0.5mg/kg. Anaesthesia was maintained with 2% sevoflurane in 60% nitrous oxide and 40% oxygen. Intraoperative fluid management comprised a lactated Ringers solution at a rate of 5-10 ml/kg/h.

A computer – generated randomization table was used to assign each patient to either the morphine group (Group M, N = 30) or the caudal group (Group C, N = 30). Group M recieved100 mic/kg intravenous morphine10 minutes before surgery. Group C received a caudal block with 0.5ml/kg of 0.25% bupivacaine under sterile conditions while the patient was in a lateral position, also10 minutes before surgery. In each case, the analgesic aim was to keep the heart rate and mean blood pressure within 80% - 120% of their baseline values. An intraoperative elevation of blood pressure or heart rate of more than 20% of the baseline was considered as inadequate analgesia and was treated with intravenous fentanyl 1 mic/kg boluses; the total number of additional fentanyl doses administered during the operation was recorded.

At the end of the procedure, a urine catheter was inserted by the surgeon, sevoflurane and nitrous oxide was discontinued, and the trachea was extubated. Patients were then sent to the post anesthesia care unit (PACU), where they were monitored and received oxygen delivered by a face mask for two hours.

During their stay in the PACU, patients' pain scores were monitored on admission and at 60 and 120 minutes post-operatively using an objective pain score (OPS) which uses five criteria: localization of pain, movement, crying, agitation and posture. [9] Each criterion was given a score between 0 and 2 with 2 being the worst, giving a total score between 0 and 10.

A postoperative pain score more than 4 was managed by the administration of 40 mg/kg paracetamol and 1mg/kg diclofenac sodium rectally.

The time to the first analgesic dose (time between the administration of the study drug and the administration of the first postoperative analgesic dose), pain scores, and complications like vomiting, itching, and respiratory depression (a decrease in peripheral oxygen saturation below 95% while breathing room air and require oxygen) were recorded by a qualified nurse who was blinded with respect to the patient's group allocation and purpose of the study. Motor blockade was assessed with a modified Bromage score (0 = no motor block, 1 = able to move legs, 2 = unable to move legs).

Children were discharged from the PACU after 2 hours in the paediatric hospital ward when they were calm, moving lower limbs and passing urine, and had no complaints of pain or vomiting. The postoperative pain scores in the ward were recorded by a blinded observer at 3, 4, 6, 8, and 24 hours after surgery. If the pain score was more than 4, it was managed by a qualified nurse with oral paracetamol 15 mg/kg with a minimum of 4 hours between doses and with a maximum daily dose of 90 mg/kg. The total number of paracetamol doses given to each patient and any complications in both groups during the first 24 postoperative hours were recorded.

The assessment of the acceptability of the analgesic technique was done 24 hours after surgery by asking the parents and older children (age > 5 years). Their satisfaction about the procedure was recorded as either: disappointed, adequate, good, satisfied or excellent.

**Statistical Analysis**

Statistical analysis was carried out using stat graphics centurion XV version 15.1.02 (Statpoint Inc., USA). Values are expressed as either mean and standard deviations or number of observations and percentages. T-tests were used to compare the numerical values (mean of age, weight, duration of surgery, pain score, number of paracetamol and fentanyl doses, and time to first analgesia) between the two study groups while chi-square tests were used for categorical values (vomiting, itching and parents' satisfaction) between the two study groups. A $P \leq 0.05$ was considered to be significant.

**Results**

A total of sixty patients were enrolled in the study in two groups of 30 each. The two groups were identical for age, weight and duration of surgery ($P > 0.05$) (table 1). Pain scores were significantly higher in the morphine group compared to the caudal group on admission to the postanaesthesia care unit and during the following 3 postoperative hours ($P < 0.05$). There was no significant difference in the pain scores between the two groups at 4, 6, 8, and 24 hours after surgery ($P > 0.05$) (Figure 1).

The time to the first analgesia was significantly lower in Group M (176 minute ± 111.3) compared to Group C (366 minute ± 123.4) ($P = 0.000$). The total number of intraoperative fentanyl doses were significantly higher in Group M (1.1 ± 0.96) compared to group C (0) ($P = 0.00$). But there was no significant difference in the number of total paracetamol doses over the 24 postoperative hours between the two groups ($P = 0.35$) (table 2).

None of the sixty patients experienced postoperative respiratory depression. All patients in the caudal group were able to move legs one hour after recovery, but significantly more patients in Group M experienced vomiting (33.3%) compared to Group C (6.7%) ($P = 0.000$). Also, there were more patients who had itching in Group M (16.7%) compared to Group C (10%) ($P = 0.000$) (table 3).
The degree of parents' satisfaction about the quality of postoperative analgesia and the side effects was better in the caudal group compared to the morphine group ($P < 0.05$) (table 4).

***Table (1): Demographic data.****

| | Group M (n=30) | Group C (n=30) | P value (t-test) |
|---|---|---|---|
| Age (years) | 4.7□3.87 | 3.5 □ 1.57 | P = 0.07 |
| Weight (kg) | 18.1□10.19 | 18.1 (10.19) | P = 0.07 |
| Duration of surgery (minutes) | 64.3 (21.03) | 61 (11.77) | P = 0.2 |

***Data are presented as mean ± SD, Group M: Morphine group, Group C: Caudal group.**
**P<0.05 is considered significant at a 95% confidence limit.**

***Table (2): Time to first postoperative analgesia, number of fentanyl doses in the operating room and number of paracetamol doses over 24 hours. ****

| | Group M | Group C | P-value (t-test) |
|---|---|---|---|
| Time to first analgesia (minutes) | 176± 111.3 | 366 ± 123.4 | P = 0.000 |
| Number of fentanyl doses in the operating room | 1.1± 0.96 | 0 | P = 0.000 |
| Number of paracetamol doses over 24 hours | 2.6□ 0.63 | 2.5□ 0.73 | P = 0.35 |

***Data are presented as mean ± SD.**
**P <0.05 is considered significant at a 95% confidence limit.**

***Table (3): Frequency of complications observed during the postoperative first 24 hours. ****

| Complication | Group M | Group C | P value (Chi-square ) |
|---|---|---|---|
| Vomiting number (%) | 10 (33.3%) | 2 (6.7%) | P = 0.000 |
| Itching number (%) | 5 (16.7%) | 3 (10%) | P = 0.00 |

***Data are presented as mean ± SD**
**P <0.05 is considered significant**

***Table (4): Distribution of the study groups by degree of parent satisfaction.***

| Degree of Parent Satisfaction | Group M Number (%) | Group C Number (%) |
|---|---|---|
| Disappointed | 4 (13.3%) | 0 (0%) |
| Adequate | 8 (26.7%) | 2 (6.7%) |
| Good | 10 (33.3%) | 2 (6.7%) |
| Satisfied | 7 (23.3%) | 14 (46.7%) |
| Excellent | 1 (3.3%) | 12 (40%) |
| Total | 30 (100%) | 30 (100%) |

***Difference is significant (chi -square test) P = 0.00006***

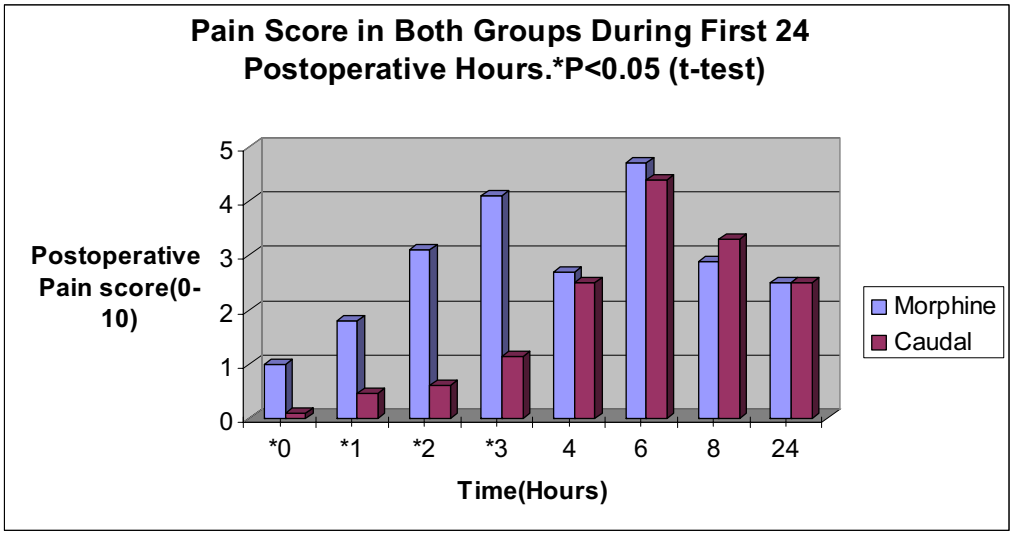


***Figure (1).***

**Discussion**

Creating a pain-free postoperative period in pediatric patients is an important objective for a pediatric anesthesiologist. In fact, adequate post-operative pain control is one of the major factors that determine when the patient can be safely discharged from the post anaesthesia care unit. The ideal peri-operative analgesic technique should be effective and safe and have minimal side effects.

Our study showed that a caudal block was more effective in controlling pain than the administration of intravenous morphine during the intraoperative period and for six postoperative hours**.** These results are consistent with the results of many studies which showed that the caudal block with a local anaesthetic produced effective postoperative analgesia in children with little need for postoperative opioids.[10] There was a credit in our study to the caudal block group over the intravenous morphine in terms of the amount of intraoperative analgesia and the duration of postoperative analgesia.

Although caudal analgesia offers several advantages when combined with general anaesthesia, including a lower volatile anaesthetic requirement, speed, comfortable emergence, and excellent analgesia with no major complications or neurological sequelae, [1] there are still some limitations of its use including the refusal of the procedure by the parents, limited duration of postoperative analgesia, postoperative motor weakness and urine retention.

The optimal concentration of a local anaesthetic should provide effective analgesia with minimal side effects. Kapsten et al [11] suggested that a 0.25% solution of bupivacaine may be the optimal concentration for caudal blocks because it provides effective analgesia without a delayed discharge from the hospital, while Vater and Wandless [12] reported a weakness in the lower extremities and delayed micturition in patients who received a caudal block with 0.25% bupivacaine in a volume of 0.5ml/kg. In our trial, we used the same volume and concentration of bupivacaine that was used by Vater and Wandless for patients who were admitted to the hospital for a few days and had a urine catheter in place. After a one-hour stay in the PACU, none of the caudal group patients had significant postoperative motor weakness that delayed their discharge from the PACU.

Opioids provide good postoperative pain relief and can be an alternative in patients who are refusing regional blocks, but their use is restricted because of the potential side effects which can lead to a delay in discharging the patients from the PACU. The use of nerve block techniques with local anesthetic agents may avoid many of the side effects related to the use of opioids.[13]

Respiratory depression is a serious known complication of narcotics use. It is particularly of concern to outpatient anesthetists working in developing countries with limited paramedical facilities and in children suffering from obstructive sleep apnea or other airway related problems.[14] However, in a retrospective study of 110 paediatric patients that had intravenous morphine infusion, the incidence of respiratory depression was found to be 0%.[15] In our study, none of the 30 patients who had iv morphine experienced postoperative respiratory depression.

Nausea and vomiting are well-known complications of opioids. In a systematic review done by Duedhal et al [16] about the use of morphine treatment in children with postoperative pain, they reported that morphine alone is not the most suitable analgesic for postoperative pain in paediatric patients as it does not have a superior analgesic effect, but it has a higher incidence of side effects, mostly nausea and vomiting, when compared with active control interventions. While Weinstein et al. in another study [17] concluded that the administration of a single dose of 0.1 mg/kg morphine after the induction of anesthesia in children undergoing inguinal surgery will decrease the need for postoperative analgesics, but the incidence of emesis was 56% in the morphine group versus 25% in the control group. In our study, the incidence of vomiting was lower than the one

reported by Weinstein et al., but it was still higher in the morphine group (33.3%) than the nerve block one (6.7%).

Parent's satisfaction about caudal analgesia compared favorably with intravenous morphine as 40% reported that caudal analgesia was an excellent mode for pain control compared to 3.3% in the morphine group due to the difference in the immediate postoperative pain control and the side effects. This was especially important for patients who had a staged-repair hypospadius.

In conclusion, our trial has shown that caudal analgesia is more effective than intravenous morphine in terms of postoperative pain control during the first 24 postoperative hours in children undergoing hypospadius surgery. Morphine analgesia had a higher incidence of opioid-related side effects. Further studies are needed to confirm the optimal effective doses of these two modalities of pain control in patients undergoing hypospadius repair.

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# تسكين الألم في عملية اصلاح الاحليل عند الاطفال: دراسة مقارنة بين احصار فوق الجافية باستخدام الببفاكين واستخدام المورفين عن طريق الوريد

**خالد الزبن**

**دائرة التخدير والعناية الحثيثة، كلية الطب، الجامعة الأردنية، عمان، الأردن**

**الملخص**

**الأهداف:** ان الدراسة هي دراسة مستقبلية – عشوائية بالتعمية، وقد صممت لتحديد ومقارنة مدى وفعالية السيطرة على الالم والاعراض الجانبية باستخدام طريقتي احصار فوق الجافية باستخدام الببفاكين وطريقة استخدام المورفين عن طريق الوريد في عمليات اصلاح الاحليل عند الاطفال.

**الطرق:** لقد تمت دراسة ستين مريضاً تتراوح اعمارهم بين 1–7 سنوات حيث تم تقسيمهم عشوائيا الى مجموعتين تتكون كل مجموعة من 30 مريضاً، اعطي المرضى في المجموعة الاولى(M) عقار المورفين بجرعة 100 ميكروغرام / كغم عن طريق الوريد قبل بدء الجراحة وأجري لمرضى المجموعة الثانية (C) احصار فوق الجافية باستخدام الببفاكين. % 25. بجرعة 0.5 مل / كغم قبل بدء الجراحة كذلك.

تم توحيد طريقة التخدير في كلتا المجموعتين، تم قياس درجة الالم باستخدام المقياس من 0–10 في الاوقات: عند الافاقة وعند الساعة الاولى والثانية والثالثة والرابعة والسادسة والثامنة والرابعة والعشرين بعد اجراء العملية. تم تسجيل المدة اللازمة لإعطاء اول جرعة لمسكن الالم وعدد الجرعات المستخدمة خلال اليوم الاول وتسجيل المضاعفات الجانبية التي حدثت من اقياء وهبوط في التنفس وحكة وضعف في عضلات الاطراف السفلية وحصر البول. وكذلك تم تقييم مدى رضا اهل الطفل عن طريقة تسكين الالم المستخدمة.

**النتائج:** لقد كان مقياس درجة الالم اعلى في مجموعة المورفين مباشرة بعد الافاقة وخلال الثلاث ساعات الاولى بعد العملية بينما لم يكن هناك فرق في درجة الالم بين المجموعتين خلال الساعات الرابعة والسادسة والثامنة والرابعة والعشرين بعد اجراء العملية. وكان الوقت المنقضي قبل الحاجة للجرعة الاولى لمسكن الالم أقصر في مجموعة المورفين كانت الحاجة لمسكن ال فينتانيل اثناء العملية أكثر في مجموعة المورفين.

لم يكن هناك فرق بين المجموعتين في عدد جرعات المسكن خلال ال 24 ساعة الاول بعد العملية.

لم يحدث هبوط في التنفس او حصر البول او ضعف في الاطراف السفلية في كلتا المجموعتين. لكن كانت نسبة حدوث الاقياء والحكة أكثر في مجموعة المورفين. وقد كانت درجة رضا اهل المريض عن درجة تسكين الالم والمضاعفات الجانبية بعد العملية أفضل في مجموعة الثانية (C) مقارنة مع مجموعة المورفين (M).

**الخاتمة:** نستطيع الاستنتاج بأن احصار فوق الجافية هو أكثر فعالية من استخدام المورفين الوريدي لمعاجلة الالم خلال فترة الثلاث ساعات الاولى بعد العمليات اصلاح الاحليل عند الاطفال. وان احتمالية حدوث الاقياء والحكة تزيد مع استخدام المورفين.

**الكلمات الدالة:** المورفين، احصار فوق الجافية، اصلاح الاحليل، الالم.