ORIGINAL ARTICLE

Epidural Analgesia for Better Pain Control After Surgery in Children

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Abstract

Introduction: Postoperative pain in children is sometimes inadequately prevented and treated. Analgesics are mainly administered through the intravenous route, yet regional analgesia can also be used. The purpose of this study is to better understand the effects of combining epidural with standard analgesia in achieving postoperative pain relief.

Methods: Retrospective chart review of postoperative pediatric patients, following genitourinary surgery, admitted to an acute care pediatric unit during a 5-year period. Demographic and clinical variables were collected, including pain evaluation and analgesia in the first three days. Two groups were considered, group A for standard analgesia and group B for standard and epidural analgesia.

Results: Thirty-nine postoperative admissions were analyzed from 34 patients (group A - 15, group B - 24). Median age was 2.29 years old (minimum 0.46, maximum 13.17) with 60% males (group A) and 6.19 years old (minimum 0.38, maximum 17) with 75% males (group B). Median sum of pain intensity score was lower in group B (1 *vs.* 0.43, $p = 0.049$) and fewer ketorolac and morphine doses were administered in group B (2 *vs.* 1, $p = 0.044$; 2 *vs.* 0, $p = 0.014$). No important side effects were noted in either group. An epidural catheter was in place for a mean time of 50 hours. Length of stay was similar in both groups.

Discussion: Better pain relief was achieved through epidural analgesia, carrying no associated complications, and allowing lower use of rescue medication. These results are similar to the published literature, reinforcing that this type of analgesia should be explored as an alternative in children.

Keywords: Adolescent; Analgesia, Epidural; Child; Pain Management; Pain Measurement; Pain, Postoperative/drug therapy

Introduction

Pain is, by definition, a distressing experience associated with actual or potential tissue damage with sensory, emotional, cognitive, and social components.[1] Although access to pain management is a fundamental right as claimed by the declaration of Montreal (2010), pain management is still ineffective in many settings and particular groups, such as the pediatric population.[2]

Acute postoperative pain causes immediate effects in multiple organ systems, leading to pulmonary, cardiovascular, gastrointestinal and urinary dysfunction, impaired muscle function, neuroendocrine, and immune and metabolic changes.[3] Furthermore, behavior fluctuations can be reported, affecting the mood, sleep, and appetite.[3,4]

According to the latest scientific research, undertreated pain in children can have long-term deleterious effects, both psychologically and physiologically.[4] The consequences of inadequate pain treatment at early ages can be seen later in life. Negative experiences influence the perception of pain in subsequent painful procedures to the extent that later analgesia will be less effective.[5] In addition, as adults, individuals who have experienced pain in childhood seem to be more prone to chronic pain.[4,6] These facts reinforce the need to be relentless in what concerns pain management, right from the beginning.

Accessing pain in the pediatric population can be challenging, particularly at younger ages and in the postoperative setting.[7] Health care professionals should be sensitized to this matter and be able to adequately use the assessment tools, such as the face, legs, activity, cry, consolability scale (FLACCS), the Wong-Baker faces pain rating scale (WBFPRS), or the numeric pain rating scale (NPRS).[8] The metrics are on a 0 to 10 interval, where 0 represents no pain and 10 the worst possible pain. Age should be taken into consideration, but other factors determine the choice of the most appropriate

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scale, including stage of development, clinical condition, cultural concerns, and social background.[3,9]

In Portugal, following the 2003 directives of Direção Geral da Saúde, pain is considered the fifth vital sign. Therefore, its systematic registry should be a rule in all health care institutions, applying one of the international validated scales for this purpose.[10]

Several authors have established the effectiveness of combining distinct therapeutic interventions, with different mechanisms of action, to obtain a multimodal approach for better pain control.[9,11,12] Although the main route of analgesic administration remains intravenous, regional analgesia through epidural catheters seems to be a good complement for acute pain management.[13,14]

Historically speaking, the first report of regional analgesia in children dates back to 1900 with Bainbridge.[15] Yet, regional analgesia is still underused. The latest published data considering this method reports a reduction in opioids usage and a more optimal control of pain.[16]

The aim of this study was to compare standard intravenous analgesia alone with standard analgesia coupled with epidural analgesia in order to control postoperative pain in a selected pediatric population admitted to an acute care pediatric unit, following genitourinary surgery.

Methods

Study population, period, and design

Retrospective chart review of postoperative pediatric patients, admitted to an acute care pediatric unit in Portugal, from January 2013 to December 2017. Only patients following genitourinary surgical procedures were selected.

Demographic and clinical variables were collected, including pain evaluation and analgesia in the first three days, available on the daily nursing records sheet.

Two groups were considered:

- Group A - standard analgesia only;
- Group B - standard analgesia combined with epidural analgesia.

Standard postoperative analgesia included: intravenous acetaminophen four times per day, plus non-steroid anti-inflammatory drugs (NSAID), ketorolac or metamizole three times per day, and morphine when necessary. Epidural analgesia included ropivacaine or levobupivacaine with or without an opioid (morphine, fentanyl and tramadol). The choice of drugs for epidural analgesia as well as the duration of epidural catheter was made by the anesthetist responsible.

Assessment tools, definitions, and variables

Assessment tools used for pain evaluation were the validated scoring scales, FLACCS, WBFPRS, and NPRS, individually chosen to best suit each patient. Moderate and severe pain was considered with scores above 5.

Data collected included sex, age, type of surgical procedure, evaluation of pain (3-4 times per shift, which accounted for 9-12 evaluations per day), and administered drugs throughout the first three days following surgery. Epidural catheter duration in place, side effects, and length of stay were also considered.

The two main outcomes considered were the need to use rescue analgesia and mean pain intensity scores (PIS). Rescue analgesia included metamizole, ketorolac, and morphine. Mean PIS was calculated on the first three postoperative days, counting all daily pain evaluations, even those with a score of 0.

Statistical analysis

Quantitative variables were expressed as median and interval values and qualitative variables as absolute values and percentages.

SPSS version 25.0® software was used to analyze the data collected, using non-parametric tests, given the non-normal distribution. Values for $p < 0.05$ were considered statistically significant.

Results

Population characteristics

The analysis included 39 post-operative admissions, corresponding to 34 patients, whose characteristics are described in Table 1. Group A (standard analgesia) had 15 patients, nine males (60%), and median age was 2.29 years old (minimum 0.46, maximum 13.17). Group B (epidural analgesia) had 24 patients, 18 males (75%), and the median age was 6.19 years old (minimum 0.38, maximum 17). No differences in sex, age, or surgical procedures distribution.

Until 2014, standard analgesia represented more than 70%. In 2015, epidural analgesia took over 50% of the cases, and since 2016, the choice has been predominantly epidural analgesia, accounting for more than 90% in the last two years studied.

Concerning group B, ropivacaine was the anesthetic agent of choice, used in 20 cases. Levobupivacaine was used in the other four. An opioid additive was used in 12 cases: morphine (n = 8), fentanyl (n = 3) and tramadol (n = 1).

Epidural catheter was in place for a mean time of 50 hours, with the following distribution throughout the first three days: 91.67% at 24 hours, 45.83% at 48 hours, and 12.5% at 72 hours.

Table 1. Population description

Characteristics	Group A	Group B	Total
Sex, n (%)			
Male	9 (60)	18 (75)	27 (69.2)
Female	6 (40)	6 (25)	12 (30.8)
Total	15 (100)	24 (100)	39 (100)
Age, years			
Median	2.29	6.19	4.66
Minimum	0.46	0.38	0.38
Maximum	13.17	17	17
Surgical procedure, n (%)			
Ureteric reimplantation	6 (40)	7 (29.17)	13 (33.33)
Pyeloplasty	5 (33.33)	7 (29.17)	12 (30.77)
Hypospadias repair	2 (13.33)	6 (25)	8 (20.51)
Heminephrectomy	2 (13.33)	2 (8.33)	4 (10.26)
Clitoroplasty	0 (0)	1 (4.17)	1 (2.56)
Nephroureterectomy	0 (0)	1 (4.17)	1 (2.56)
Length of stay, days			
Median	6	6	6
Minimum	2	1	1
Maximum	9	10	10

Group A - standard analgesia only. Group B - epidural analgesia plus standard analgesia. There was no significant statistical difference between the two groups.

The length of the pediatric intensive care unit stay was similar in both groups, with a median of 72 hours (minimum 29, maximum 175) in group A and 73 hours (minimum 2, maximum 240) in group B. The length of the overall hospital stay was also alike in both groups, with a median of 6 days in group A (minimum 2, maximum 9) and group B (minimum 1, maximum 10).

Rescue analgesia and pain control

Globally, less rescue analgesia was administered in group B, as shown in Table 2. The mean doses needed were lower in this group for every drug considered during the first three postoperative days (no statistical difference).

The most significant differences were noted at the end of the first three days following surgery for ketorolac (2 *vs.* 1) and morphine (2 *vs.* 0). Both were considered statistically significant with $p = 0.044$ and $p = 0.014$, respectively. This was especially relevant for morphine, which was also significantly less used on day 2 (1 *vs.* 0, $p = 0.004$).

In general, pain control was more effective in group B, as shown in Table 3. Median PIS was lower in group B for all three days, with statistical significance when considering the three days together (1 *vs.* 0.43, $p = 0.049$).

Absence of pain (percentage of pain score = 0) was more common in group B (66.7% *vs.* 73.3%, $p = 0.021$ at three days). Registries of moderate and severe pain (percentage of pain score ≥ 5) were more prevalent in group A (10% *vs.* 5% at three days) (no statistical significance).

Side effects and other variables

No important side effects were noted in either group. Two cases of nausea and vomiting were reported, one in each group, which were related to opioid use. Both resolved rapidly with the administration of ondansetron, with no recurrence.

Accidental exteriorization of the epidural catheter occurred in one patient.

Discussion

This study showed that pain relief was better achieved joining epidural analgesia with standard analgesia, allowing a lower use of rescue medications, particularly opioids. The main concern behind opioid use is the fact that these are major contributors to adverse reactions. These include the typical nausea and vomiting, along with increased risk of respiratory depression or errors in administration/prescription.[16]

The differences between the two groups were most noticeable in the first two days, most likely caused by the

Table 2. Administration of rescue analgesia

Variables	Group A	Group B	*p*
	Median doses administered (minimum-maximum)		
Metamizole			
Day 1	0 (0-3)	0 (0-3)	0.444
Day 2	0 (0-3)	0 (0-3)	0.743
Day 3	0 (0-1)	0 (0-3)	0.557
3 days	0 (0-7)	0 (0-8)	0.923
Ketorolac			
Day 1	1 (0-3)	0 (0-3)	0.053
Day 2	0 (0-3)	0 (0-3)	0.151
Day 3	0 (0-3)	0 (0-3)	0.058
3 days	2 (0-9)	1 (0-9)	**0.044**
Morphine			
Day 1	0 (0-4)	0 (0-2)	0.058
Day 2	1 (0-5)	0 (0-5)	**0.004**
Day 3	0 (0-2)	0 (0-2)	0.120
3 days	2 (0-9)	0 (0-3)	**0.014**

Group A - standard analgesia only. Group B - epidural analgesia plus standard analgesia.

Table 3. Pain control along the first three days following surgery

Variables	Group A	Group B	*p*
PIS	Median value (minimum-maximum)		
Day 1	1 (0-5.1)	0.28 (0-2.6)	**0.041**
Day 2	1.11 (0-5.1)	0.73 (0-2.54)	0.205
Day 3	0.75 (0-4.5)	0.23 (0-5.43)	0.327
3 days	1 (0.21-4.6)	0.43 (0-2.29)	**0.049**
Pain = 0	Median percentage (minimum-maximum)*		
Day 1	60 (0-90)	60 (20-100)	0.343
Day 2	70 (30-100)	85 (30-100)	**0.037**
Day 3	70 (0-100)	85 (30-100)	0.262
3 days	66.7 (13.3-76.7)	73.3 (40-100)	**0.021**
Pain ≥ 5	Median percentage (minimum-maximum)*		
Day 1	10 (0-40)	0 (0-30)	0.051
Day 2	10 (0-100)	0 (0-40)	0.174
Day 3	10 (0-40)	0 (0-40)	0.304
3 days	10 (0-60)	5 (0-23.3)	0.079

PIS - pain intensity score.
* Nine to 12 evaluations were performed daily.
Group A - standard analgesia only. Group B - epidural analgesia plus standard analgesia. PIS calculated as a mean sum of the pain intensity scores.

removal of the epidural catheter by the end of the second day in most cases. These increased benefits when using combined strategies have been extensively described in the literature regarding multimodal analgesia in the perioperative scenario,[17,18] and support the conclusion of this work. Anesthetists experience in this field has increased significantly in the past few years, allowing for a more routinely use of the technique. Alongside, acute care pediatric units are more familiarized with the procedure, being able to properly monitor a patient receiving continuous epidural analgesia.[19] This close monitoring is mainly aimed at preventing complications or early detecting them and should be carried out by experienced teams in controlled settings.

Although the procedure has so far had rare adverse outcomes, and mainly minor, which was also true in this study, more studies should be performed to reassure its safety.[19-25] An incidence of 7.6 complications

in 1,000 epidurals was reported in one of the largest series to date (17,372 epidurals).[23] This rate was higher in neonates, and local skin infection and drug error were the most frequent, both potentially preventable. Longer duration of catheterization was linked to a higher epidural site infection, as was the thoracic placement of the epidural catheter and epidural analgesia used as treatment for chronic pain.[23-25] These features, along with the fact that most cohorts included various surgical procedures, probably explains the differences compared to our findings. It would be interesting to have a national registry of children receiving epidural infusion analgesia, similar to the one in the UK and Ireland[24] to better understand the epidemiology, effectiveness, and morbidity concerning the procedure.

The authors understand the limitations of this retrospective study, along with the small size of the sample. The reduced number of patients exclusively on standard analgesia is explained by almost all cases being selected for epidural analgesia over the last 2-3 years. Nevertheless, the results are similar to those of other authors, reinforcing that this type of analgesia should be explored as an alternative in children.

This study did not take into consideration several biopsychosocial aspects which are known to influence a child perception of pain, such as culture, ethnicity, socioeconomic status, family background, disabilities, and previous painful experiences.[26] It would also be interesting to access pain after hospital discharge. Prospective studies are needed to better understand the impact of epidural analgesia on pain control in the pediatric population, overcoming some of the exposed reservations and limitations.

WHAT THIS STUDY ADDS

- This study adds a piece of evidence on the efficacy and safety of epidural analgesia on post-operative pain control in children, reinforcing its potential to reduce the use of rescue drugs and enabling more pain-free time.

Conflicts of Interest

The authors declare that there were no conflicts of interest in conducting this work.

Funding Sources

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Protection of human and animal subjects

The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Provenance and peer review

Not commissioned; externally peer reviewed

Confidentiality of data

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

Awards and presentations

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Analgesia Epidural para Melhor Controlo da Dor Pós-Operatória em Crianças

Resumo:

Introdução: A dor no pós-operatório em crianças deve ser prevenida sempre que possível e tratada adequadamente. Os analgésicos são administrados maioritariamente por via endovenosa. A analgesia regional através de cateteres epidurais pode ser uma alternativa no controlo da dor e é ainda pouco utilizada.

O objetivo deste trabalho foi comparar a analgesia regional através de cateteres epidurais com a analgesia endovenosa padrão isoladamente para controlo da dor no pós-operatório de doentes admitidos numa unidade de cuidados intensivos pediátricos.

Métodos: Revisão retrospetiva dos processos de doentes admitidos após cirurgia génito-urinária entre 2013 e 2017. Recolhidos os dados demográficos e as variáveis clínicas, incluindo avaliação da dor e analgesia administrada nos primeiros três dias. A mediana da intensidade da pontuação de dor foi calculada nos primeiros três dias de pós-operatório. Foram considerados dois grupos (grupo A - analgesia padrão, grupo B - analgesia padrão e analgesia epidural).

Resultados: Foram analisadas 39 admissões pós-operatórias de 34 doentes (grupo A - 15, grupo B - 24). A mediana de idades foi 2.29 anos (mínimo 0,46, máximo 13,17) com 60% do sexo masculino (grupo A) e 6,19 anos (mínimo 0,38, máximo 17) com 7,5% do sexo masculino (grupo B). A mediana da intensidade da pontuação de dor foi mais baixa no grupo B (1 *vs* 0,43, p = 0,049). Foi administrado menos cetorolac e menos morfina (2 *vs* 1, p = 0,044; 2 *vs* 0, p = 0,014) no grupo B. Não se registaram efeitos adversos importantes em nenhum dos grupos. Os cateteres epidurais ficaram colocados em média 50 horas. O tempo de internamento foi semelhante em ambos os grupos.

Discussão: O controlo da dor no pós-operatório de cirurgias génito-urinárias foi melhor com a analgesia epidural, permitindo uma menor utilização de terapêutica de resgate, sem complicações associadas. A analgesia epidural parece ser um método seguro e eficaz neste grupo etário.

Palavras-Chave: Adolescente; Analgesia Epidural; Criança; Dor Pós-Operatória/tratamento farmacológico; Medição da Dor; Tratamento da Dor