Postoperative Analgesia for the Surgical Correction of Congenital Clubfoot. Comparison between Peripheral Nerve Block and Caudal Epidural Block

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INTRODUCTION

Surgical procedures for correction of congenital clubfoot cause severe postoperative pain, requiring the association of safe and prolonged analgesia techniques with general anesthesia.

Regional blocks in pediatrics have shown a great improvement over the last several years thanks to technical developments, new equipment, and increased information on the

safety and pharmacology of local anesthetics in children and infants[1]. They represent an essential component of pediatric anesthesia. Regional blocks promote a reduction in the intraoperative need of general anesthetics and in many cases they are the best choice of postoperative analgesia regardless of the age and comorbidities of the child[2].

Caudal epidural block is widely used in children undergoing lower limb orthopedic procedures. When adequate training and equipment are available, caudal epidural block is highly effective and safe[3]. In pediatrics the relatively short duration of postoperative analgesia, which often leads to excessive consumption of analgesics, is the main limitation of this technique[4]. Since it is easy to perform and anesthesiologists are familiar with the technique, caudal block is used even in those cases where conditions allow the use of peripheral nerve blocks that ultimately are associated with a low incidence of complications and prolonged postoperative analgesia[1,5]

The objective of the present study was to compare the duration of postoperative analgesia and opioid consumption in the first 24 postoperative hours of caudal epidural block and peripheral nerve blocks in children undergoing corrective surgery for unilateral congenital clubfoot.

METHODS

This study was approved by the Ethics on Research Committees of the Rede S.A.R.A.H. de Hospitais de Rehabilitação. After parents signed the informed consent, consecutive patients with physical status ASA I and II scheduled for surgical correction of congenital clubfoot were included in this study between June 2006 and March 2008.

Patients who did not agree to participate and those with associated neurological disorders and contraindications for regional blocks were excluded from the study.

Patients were separated into four groups based on a computer-generated random table presented in opaque and sealed envelopes. Random distribution was performed in eight-patient blocks. The anesthesiologist responsible for the case was informed about the group the patient belonged to only at the time of the surgery.

All patients underwent general inhalational anesthesia after which they were distributed in four groups according to the regional block technique: caudal block (ACa); sciatic and femoral nerves block (IF); sciatic and saphenous nerve block (IS); and sciatic nerve block with infiltrative anesthesia of the medial incision (IL).

All children were premedicated with oral midazolam 0.6 to 0.8 mg.kg^{-1} 40 minutes before induction of anesthesia. After placement of monitoring with cardioscope, pulse oximeter, non-invasive blood pressure, capnograph, and gas analyzer, general inhalational anesthesia was induced by face mask with sevoflurane in a mixture with oxygen and nitrous oxide at a 1:1 proportion. After placement of peripheral venous access and tracheal intubation, anesthesia was maintained with the

same agents with spontaneous ventilation on the Rees-Baraka system with distal entrance of fresh gas. The expired fraction of sevoflurane was maintained at 0.8 and 1 MAC.

Patients who underwent caudal block (ACa group) were placed on ventral decubitus and the sacral hiatus was punctured with a 20G Tuohy needle. The epidural space was identified by the loss of resistance technique.

Patients were placed in dorsal decubitus for the femoral nerve block; a 50-mm short-beveled electrically isolated needle connected to a peripheral nerve stimulator was introduced in the inguinal fold, 0.5 to 1 cm lateral to the femoral artery. The objective was to identify the best motor response of the femoral quadriceps muscle with a stimulation current of 0.3 to 0.5 mA.

For the sciatic nerve block, patients were placed on lateral decubitus, maintaining the limb to be operated in the non-dependent position. The classical Labat posterior approach with the greater trochanter and posterior superior iliac spine as anatomical references was used. A 50-mm short-beveled electrically isolated needle connected to the peripheral nerve stimulator was used. The objective was to identify the best motor response of the foot and toes with a stimulating current of 0.3 to 0.5 mA.

Saphenous nerve block was performed by a ring-shaped deep subcutaneous infiltration with a 0.8 x 25 needle at the level of the tibial tuberosity, from the medial surface of the tibial condyle to the upper dorsomedial face of the calf.

In the cases in which local anesthesia was associated with sciatic nerve block, the surgeon infiltrated the skin and subcutaneous tissue of the medial aspect of the foot with local anesthetic just before the incision.

A total of 1 mL.kg^{-1} of 0.35% ropivacaine was used in all blockades. The entire volume was administered in the caudal block, while in patients who underwent combination blocks, 70% of the total volume was administered in the sciatic nerve block and the remaining 30% was used in the femoral or saphenous nerve block, or to infiltrate the medial incision. All patients underwent unilateral posterior medial release of congenital clubfoot on ventral decubitus and with a pneumatic tourniquet applying 180-mmHg pressure on the root of the thigh of the operated limb.

Systolic and diastolic pressure and the heart rate were recorded in eleven moments from anesthesia induction until the beginning of the surgery. Those parameters were used to evaluate the effectivity of the blockade.

At the end of the surgery all patients received intravenous dypirone 20 mg.kg^{-1}, and a plaster cast was placed on the operated limb. The duration of ischemia and of the surgery was recorded.

In all cases oral dypirone and acetaminophen every 6 hours were prescribed.

Patients were evaluated regarding pain severity, opioid consumption, and the presence of adverse events in six predetermined moments and whenever the nurses were called

in the first 24 postoperative hours. The first evaluation was done when the patient arrived at the post anesthetic care unit and subsequent evaluations at four, six, eight, 12, and 24 hours after the blockade. An anesthesiologist who was not aware of the anesthetic technique used was responsible for those assessments.

Evaluation of postoperative pain was based on the CHIPPS (Children's and infants' postoperative pain scale) observational system[6,7]. Patients with a mean score greater than four were medicated with 0.19 mg.kg^{-1} of oral morphine.

Besides postoperative pain scores, the presence of vomiting and the need to open the cast were also recorded. At the end of 24 hours, the total dose of morphine administered was recorded.

The non-parametric Fisher Exact test was used to analyze the relationship among the parameters observed through frequency analysis. Analysis of Variance (ANOVA) and the Kruskal-Wallis test when ANOVA hypothesis were not meet were used to evaluate differences among numerical parameters. A level of significance of 5% was adopted. Data were analyzed using the SPSS version 13.0 software.

RESULTS

During the study period, 120 patients were separated into four groups. Two patients, one in the IS group and one in the IL group were excluded from the study due to evidence of failure of the sciatic nerve block, which required the intravenous administration of fentanyl and institution of controlled mechanical ventilation. Thus, 118 children participated in the study and they were distributed as follows: ACa group (n= 30), IF (n= 32), IS (n= 28), and IL (n= 28).

All four groups were similar regarding age, weight, physical status (ASA), and gender (Table I).

Blood pressure – systolic and diastolic – and heart rate had similar behavior in all four groups, without statistically significant differences after the blockade and after the surgical incisions (posterior and medial).

Mean pain scores on the third evaluation, 6 hours after the blockade, were significantly lower in the IL group when compared to the ACa group, but not to the other two groups (Table II). Mean scores in the remaining evaluation periods were not significantly different among all groups.

Table I – Demographic Characteristics of the Patients Included in the Study.

	ACa (n = 30)	IF (n = 32)	IS (n = 28)	IL (n = 28)
Gender (F/M)	13/17	12/20	15/13	8/20
Age (months) *	15 ± 4.8	19 ± 12	17 ± 7.2	16 ± 8.4
Weight (kg) *	9.9 ± 1.6	10.6 ± 2.1	10.6 ± 2.2	10.2 ± 1.7
Physical status				
ASA I	23	28	25	27
ASA II	7	4	3	1
Duration of surgery (min) *	84 ± 30	90 ± 24	90 ± 18	90 ± 24
Duration of ischemia (min) *	82 ± 22	92 ±25	86 ± 15	88 ± 19

*Data expressed as Mean ± SD
ACa – epidural caudal group; IF – sciatic femoral group; IS – sciatic saphenous group; IL – sciatic local group

Table II – Mean Pain Scores in Each Group on Six Evaluation Moments after the Blockade.

	ACa (n = 30)	IF (n = 32)	IS (n = 28)	IL (n = 28)
PACU	1.8 ± 2.90	2.59 ± 2.95	2.26 ± 2.41	2.25 ± 2.17
4 Hours	1.0 ± 2.34	0.45 ± 1.17	0.32 ± 0.74	0.89 ± 2.31
6 Hours	1.66 ** ± 3.03	0.75 ± 1.68	1.16 ± 2.51	0.11 ** ± 0.57
8 Hours	1.63 ± 3.31	1.39 ± 2.65	2.64 ± 3.65	0.89 ± 1.93
12 Hours	1.42 ± 2.73	0.96 ± 2.13	0.88 ± 2.35	2.32 ± 3.70
24 Hours	0.61 ± 1.19	0.80 ± 2.00	0.64 ± 2.19	0.90 ± 1.91

Data expressed as Mean ± SD
ACa – epidural caudal group; IF – sciatic femoral group; IS – sciatic saphenous group; IL – sciatic local group; PACU – post-anesthetic care unit; ** p = 0.009

Table III – Patients in whom the Plaster Cast had to be Opened and Incidence of Vomiting in each Group.

	Open the cast	Vomiting
ACa (n = 30)	7 (23.3%)	4 (13.3%)
IF (n = 32)	6 (18.75%)	9 (28.12%)
IS (n = 28)	9 (32.14%)	4 (14.28%)
IL (n = 28)	9 (32.14%)	6 (21.42%)

ACa – epidural caudal group; IF – sciatic femoral group; IS – sciatic saphenous group; IL – sciatic local group

The first dose of morphine was administered at the post-anesthetic care unit to seven patients in the ACa group, eight in the IF group, five in the IS group, and four patients in the IL group, but significant differences were not observed among the study groups.

The mean time between the blockade and the first dose of morphine was 6.16 hours in the ACa group, 7.05 hours in the IF group, 7.58 hours in the IS group, and 8.18 hours in the IL group, but differences among the groups were not statistically significance.

The study groups did not differ regarding the total consumption of morphine. In the four groups, the mean morphine consumption was 0.3 ± 0.2 mg.kg^{-1}.d^{-1}. The number of patients who did not receive morphine was similar in all four groups (five in ACa, four in IF, five in IS, and two in IL).

The study groups did not show differences in the incidence of postoperative vomiting and the need to open the cast (Table III).

The need to open the cast was less frequent in patients whose morphine consumption was equal to zero than in those who received one or more doses of morphine, and this difference was statistically significant ($p = 0.04$).

The incidence of vomiting did not differ among patients who received morphine and those who did not.

Accidents or complications related to the regional block techniques were not observed.

DISCUSSION

The posterior medial release of congenital clubfoot is associated with severe postoperative pain in the first 24 hours. For this reason, general anesthesia combined with regional blocks is commonly used[8]. The advantages of peripheral nerve blocks include reduced incidence of adverse events (urinary retention and hypotension), anesthesia restricted to the area involved, and high degree of safety[5]. Data in the literature on the safety of regional pediatric blocks have demonstrated that even when they are performed in children under general anesthesia, neuroaxis blocks are associated with very low complication rates[9,10]. In this study the presence of complications or clinically significant adverse events was not observed. Regional blocks were per-

formed after general anesthesia and therefore it is not possible to firmly state that patients did not develop paresthesias. The peripheral nerve stimulator is used to avoid direct mechanical contact with the nerve, allowing its identification without causing damage. The postoperative evaluation of transitory deficit secondary to damages close to the peripheral nerve was limited considerably because of the population we were dealing with (pediatric patients) and the presence of the plaster cast.

Besides the safety and adverse events, comparison of any analgesia method should evaluate the efficacy by using pain scores and analgesic consumption, patient satisfaction, the impact of the analgesia on functional recovery, and postoperative complications[11]. In the absence of objective tools, pain evaluation in children is influenced by the knowledge and personal impressions of the observer. Several score systems to quantify postoperative pain in pediatric patients have been developed and validated. The scale used in the present study, CHIPPS, has elevated sensitivity and specificity to determine the postoperative analgesic demand[6,7].

The anesthesiologist responsible for the postoperative evaluations was not always the same; however, the evaluator was never aware of the anesthetic technique used, indicating an independent evaluation. Patients were initially evaluated upon arrival to the recovery room. At that moment, several children were agitated and crying when they awoke from anesthesia. The absence of a family member, the strange environment, hunger, changes in body temperature, the presence of peripheral venous access among other factors were considered as contributing for the discomfort of pediatric patients who had just regained consciousness. Therefore, it is not possible to state that the child was in fact in pain even with a score greater than four in the observational scale.

Mean analgesia time was similar in all four groups. In the review of the literature undertaken to plan the present clinical assay, studies comparing caudal epidural block and peripheral nerve blocks for postoperative analgesia in pediatric orthopedic surgeries were not found.

The initial hypothesis of the present study was that peripheral nerve blocks would provide significantly longer analgesia than caudal block. However, the results did not show differences among the techniques evaluated.

The duration of analgesia seems to be shorter in children than in adults[11]. A study in rats demonstrated that the duration of sciatic nerve block is proportional to the absolute dose of the local anesthetic. When doses based on body weight were used the duration of the blockade was shorter in rat infants than in adult rats. While the dose of local anesthetic capable of producing cardiovascular or central nervous system toxicity is proportional to body weight, the effective dose to produce nerve block is only weakly dependent on body size[12-14]. In the present study, 3.5 mg.kg^{-1} of ropivacaine was used, but some studies have demonstrated that the maximal safe dose of ropivacaine recommended is greater than 4 mg.kg^{-1} [15].

Differences in mean morphine consumption were not observed among the study groups. It has been demonstrated that the use of morphine is safe and effective in children of all ages. The recommended oral dose varies from 0.2 to 0.4 mg.kg^{-1} every four hours[16], and the bioavailability of the drug is lower due to first-pass metabolism in the liver and bowel[17-19]. Despite this fact, using the lower recommended oral dose of morphine according to the scores achieved was effective providing comfort to the patients after the analgesic effect of the blockades wore off, with a low incidence of adverse events. Besides pain relief, a mild sedative effect was observed after the administration of morphine[20]. This can be useful for children who are irritated during postoperative follow-up due to the discomfort of immobilization.

Alternatively, continuous regional blocks can provide greater analgesia and lower opioid consumption when compared to single-injection techniques. On the other hand, the difficulty to maintain the position of the catheter can limit its application[11]. The use of opioids and other adjuvant associated with the local anesthetic is also an alternative to prolong the duration of analgesia[2,21,22].

Plaster cast immobilization can cause compartment syndrome and pressure sores[23]. Case reports in the literature have demonstrated that epidural block with low concentration of the local anesthetic in children does not mask the symptoms of compartment syndrome. Serial exams of the operated limb, even in the presence of adequate analgesia, are recommended[17]. In case of persisting pain, the cast should be removed and the area examined[23]. In the present study, the use of low concentration ropivacaine (0.35%) and serial postoperative evaluations allowed early detection of cases in which the plaster cast might be causing more pain and discomfort than expected. It was observed that the need to open the cast for decompression and to improve perfusion was higher in patients with higher morphine consumption in the first 24 hours. It is possible that the lack of effectiveness of morphine in those cases, associated with changes in the extremity on physical exam, worked as a presumptive indicator of tissue damage secondary to cast compression. To conclude, differences between peripheral nerve blocks and caudal epidural block regarding the duration of postoperative analgesia and morphine consumption in the first 24 hours after anesthesia were not observed in the present study.

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RESUMEN

Rodrigues MR, Paes FC, Duarte LTD, Nunes LGN, Costa VV, Saraiva RA - Analgesia Postoperatoria en Corrección Quirúrgica de Pie Jorobado Congénito. Comparación entre Bloqueo Nervioso Periférico y Bloqueo Epidural Caudal.

***JUSTIFICATIVA Y OBJETIVOS**: El procedimiento de corrección de pie jorobado congénito (PJC), debuta con dolor postoperatorio in-*

tenso. La técnica más utilizada en niños es la epidural caudal asociada a la anestesia general. Posee la limitante de una corta duración de la analgesia postoperatoria. Los bloqueos de nervios periféricos han sido indicados como procedimientos con una baja incidencia de complicaciones y un tiempo prolongado de analgesia. El objetivo del estudio actual, fue comparar el tiempo de analgesia de los bloqueos nerviosos periféricos y del bloqueo caudal y el consumo de morfina, en las primeras 24 horas después de la corrección de PJC en niños.

MÉTODO: Estudio randómico doble ciego, en niños sometidos a la intervención quirúrgica para liberación posteromedial de PJC, ubicadas en cuatro grupos conforme a la técnica anestésica: caudal (ACa); bloqueos isquiático y femoral (IF); bloqueos isquiático y safeno (IS); bloqueo isquiático y anestesia local (IL), asociados a la anestesia general. En las primeras 24 horas, los pacientes recibieron dipirona y paracetamol vía oral y fueron evaluados por un anestesiólogo que no conocía la técnica usada. Conforme a las puntuaciones de la escala CHIPPS (Children's and infants postoperative pain scale), se administraba morfina vía oral (0,19 mg.kg^{-1} por día).

RESULTADOS: Fueron estudiados 118 niños distribuidos en los grupos ACa (30), IF (32), IS (28) IL (28). El tiempo promedio entre el bloqueo y la primera dosis de morfina fue de 6,16 horas en el grupo ACa, 7,05 horas en el IF, 7,58 horas en el IS y 8,18 horas en el IL. El consumo de morfina fue de 0,3 mg.kg^{-1} por día en los cuatro grupos. No hubo diferencia significativa entre los grupos.

CONCLUSIONES: Los bloqueos nerviosos periféricos no promovieron un tiempo más elevado de analgesia, ni tampoco una reducción en el consumo de morfina en las primeras 24 horas, en niños sometidos a la corrección de PJC cuando se les comparó con el bloqueo epidural caudal.