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Caudal Anesthesia in Surgical Interventions of the Lower Extremities in Children

Nasibova EM

Azerbaijan Medical University, Baku, Azerbaijan

Corresponding author: Nasibova EM

doc.nasibova.esmira@gmail.com

Azerbaijan Medical University, Baku, Azerbaijan.

Tel: +99412-597-38-98

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Abstract

Aim of the study: Comparative study of the effects of bupivacaine and ropivacaine in caudal anesthesia in surgical interventions of the lower extremities in children.

Material and methods of the study: The study included 59 children operated on for congenital dislocation of the hip, correction of various deformities of the pelvic bones, clubfoot, etc. All patients were divided into 2 groups depending on the type of local anesthetic used: Group I (n=39) was anaesthetized with caudal with ropivacaine and intravenous anesthesia with propofol, group II (n=20) - caudal block was performed with bupivacaine.

Results of the study: At the first stage of the

study, the indices of central hemodynamics in both groups after the corresponding preoperative preparation were stable and corresponded to their mean age values. At the II and III stages of the study (skin incision and the most traumatic moment of the operation), the decrease in heart rate was observed at 13-16%, respectively, and the SI and AD mean declined unreliably. These changes are due to a sympathetic blockade caused by caudal administration of local anesthetics, which did not cause a significant reduction in SI because children were given infusion therapy at a rate of 10-12 ml/kg/h. At the third stage of the study (12 hours after the operation), the hemodynamic parameters remained stable in patients of the I group, did not differ significantly from the baseline data, which was explained with prolonged action by the action of the caudal block with ropivacaine. And in group II patients (caudal block with bupivacaine) at the third stage of the study (after 12 hours after the operation) a significant increase in heart rate was observed by 38%, SI - by 27% and ADDred. - by 11%. Therefore, patients of this group for the purpose of anesthesia in the postoperative period were prescribed tramadol in age dosages. The level of cortisol in patients of both groups in the II and III stages of the study was reduced by 26% and 23%, respectively, which confirmed the adequacy of these anesthesia techniques for surgical interventions of the lower extremities.

Conclusions:

1. Caudal anesthesia with 0.75% solution of ropivacaine is a highly effective, reliable and safe method of anesthesia in traumatic operations of the lower extremities in children.
2. Caudal administration of a 0.75% solution of ropivacaine provides a prolonged sensory and motor block.
3. The superiority of caudal anesthesia with a 0.75% solution of ropivacaine over anesthesia with a 0.5% solution of bupivacaine is due to its more potent local anesthetic effect, as evidenced by a wider sensory block and deeper motor blockade with ropivacaine.

Keywords: Caudal Block; Ropivacaine; Bupivacaine

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Introduction

In the last decade, regional blockades form an integral part of anesthesia practice in traumatology and orthopedics. Currently, 60-80% of these operations in adults are performed under a regional operation [1-3]. Our numerous experience of using regional blockades in children gives us reason to believe that the methods and principles of regional anesthesia used in adults are also applicable in pediatric practice and are the most physiological and effective in operations on the lower extremities. In pediatric anesthesia practice, a "balanced regional anesthesia" is widely used, which is understood as a combination of general and regional anesthesia. The use of regional blockades can significantly reduce the consumption of inhalation and intravenous anesthetics, analgesics and muscle relaxants, which significantly improves the controllability of general anesthesia. The ultimate goal of combining general and regional anesthesia is to take advantage of each of the individual methods without increasing the degree of overall risk. In our practical activities with surgical interventions of the lower limbs, we most often use caudal anesthesia. The effectiveness and safety of caudal anesthesia largely depends on an adequate choice of local anesthetic. With the advent of such local anesthetics as bupivacaine and ropivacaine in clinical practice, interest in caudal anesthesia in pediatric anesthesia increased [4-6]. Analyzing the numerous literature, we found only isolated reports on the comparison of the effects of bupivacaine and ropivacaine in caudal anesthesia in children [7-10].

Aim of the Study

Comparative study of the effects of bupivacaine and ropivacaine in caudal anesthesia in surgical interventions of the lower extremities in children.

Material and Methods of the Study

The study was conducted in the surgical clinic AMU from 2014 to 2017. The study included 59 children operated on for congenital dislocation of the hip, correction of various deformities of the pelvic bones, clubfoot, especially in young children, reconstructive surgery for femoral fractures, shin bones with metalloesteosynthesis for neoplasms of the lower extremities (surgery for biopsy of formations femoral and tibia bones, removal of tumors of soft tissues of the thigh and lower leg, removal of exostosis of the tibia). The age of the patients varied from 3 months to 16 years. All the children belonged to the I-II class in ASA. The duration of the operation was from 30 minutes to 3.5 hours. All patients were divided into 2 groups depending on the type of local anesthetic used: Group I (n=39) a caudal block with ropivacaine and intravenous anesthesia with propofol was selected by anesthetics, group II (n=20) - caudal block was performed with bupivacaine. Premedication in both groups was standard and was performed in a preoperative set. In the presence of parents, children over 6 months of age were injected intravenously with propofol at a dose of 2 mg/kg and the child in a half-sleep state was delivered to the operating unit. On the operating table, all patients underwent standard monitoring. Then the patient was shifted to the left block and after additional intravenous injection of propofol proceeded to implement the caudal block. During the anesthesia, all patients were treated with oxygen inhalation with FiO_2 2 ml/h. During the entire operation, sedation was carried out with propofol at a rate of 3 mg/kg/hr using a perfusor.

As is known, nociceptive stimuli cause a reflex activation of the sympathetic nervous system, which is considered as part of the overall defensive response of the organism in response to stress. Therefore, in order to determine the adequacy of the anesthesia procedures, we studied the indices of central hemodynamics and stress markers (cortisol and glucose in the blood) in 4 stages of the study: Stage I-operation (skin incision), stage II - the most traumatic stage of the operation, Stage III - end of operation (application of cutaneous sutures), Stage IV-12 hours after surgery .

Technique for conducting the caudal block

Caudal anesthesia in children is performed in the supine position on the left side, slightly brought to the chest and abdomen by the thighs and knees. The skin in the area of the sacrum and the puncture site is treated with an antiseptic and covered with sterile sheets for conducting the caudal block. Technique of puncture: the index finger of the left hand palpates hiatus sacralis, the other hand takes the needle by the pavilion (like a pen), the cut is directed to the side. The needle is introduced first at a right angle to the skin surface (70-90°). After a sense of loss of resistance, the pavilion of the needle is brought closer to the surface of the skin and injected at an angle of 20-30° to 2-3 mm into the caudal canal. In our practical work, we have long been successful in applying the so-called "the no turn technique", which consists in puncturing the sacrococcygeal ligament at an angle of 60 degrees. After the introduction of the needle, it is necessary to carefully inspect the pavilion for 10-15 seconds and make sure that there is no blood or cerebrospinal fluid. When blood appears in the pavilion of the needle, the latter is extracted and retried with a new needle. Then, the needle is intercepted the fingers of the left hand and leaning with the base of the palm on the surface of the sacrum, carefully fixing its position during the entire time of administration of the anesthetic. The syringe is connected with the other hand, the first aspiration test is performed and the injection of the local anesthetic dose (0.5-1.0 ml) is started, after which the monitored parameters (HR, BP, ECG) are evaluated for 30-40 seconds. At normal values of hemodinamy, the full dose of the drug is then administered within 60-90 seconds (too rapid injection - the risk after the introduction of the drug, the needle is removed and the child is placed on a horizontal position of increasing intracranial pressure, slow

introduction - lateralization of the block). As a result of long-term and numerous application of the caudal block, we titrated the optimal doses of local anesthetics in operative interventions of the lower extremities **(Table 1)**.

In the postoperative period, we studied the duration and quality of anesthesia with caudal block using different scales. So in infants, we used the CRIES scale to assess postoperative pain (Krechel S.W., Bildner S., 1995). The total score for the CRIES scale is calculated as the sum of the scores for all five criteria **(Table 2)**. The maximum score is 10, the minimum score is 0, the higher the score, the greater the pain. And in older children (>6 years), the duration of the analgesic effect of the caudal block was studied using the Hannalah (1987) scale **(Table 3)**. For children over 6 years of age, it is 10 points, where 0 means no pain, and 10 means severe pain.

Results of the Study

In the implementation of the caudal block, no serious complications were noted. Accidental entry into the blood vessel during the caudal block did not have any effect, since no local anesthetic was administered. In our study, out of 59 children operated using the caudal block, this complication occurred only in 3 patients (5%). In this case, repeated entry into the vessels of caudal space was not noted. The expected puncture of the dura mater occurs usually due to excessive penetration of the needle into the caudal canal, due to improper technique of block holding. None of the patients had this complication.

At the first stage of the study, the indices of central hemodynamics in both groups after the corresponding preoperative preparation were stable and corresponded to their mean age values **(Table 4)**. At the II and III stages of the study (skin incision and the most traumatic moment of the operation), the heart rate was reduced by 13-16%, respectively, while the cardiac index and mean arterial pressure values declined unreliably. These changes are due to a sympathetic blockade caused by caudal administration

Table 1 Characteristics of local anesthetics used by us.

Local anesthetic	%	Dose (mg/kg)	Time of approach (min)	Duration of anesthesia (min)
Bupivacaine	0.5	2.5	15	320
Ropivacaine	0.75	3	12	720

Table 2 CRIES Scale.

Options	Characteristics	Points
Cry	There is no crying, or the child cries, but the crying tone is not high	0
	The child cries, the tonality of crying is high, but the child can be soothed	1
	The child cries, the tonality of crying is high, but the child can be soothed	2
Oxygen therapy	Not required	0
	SpO_2>95% maintenance requires oxygen therapy with FiO_2<30%	1
	SpO_2>95% maintenance requires oxygen therapy with FiO_2>30%	2
Increasing the values of vital parameters	Heart rate and blood pressure less or the same as before the operation	0
	Heart rate and blood pressure increased, but less than 20% from the preoperative level	1
	Heart rate and blood pressure increased by more than 20% from the preoperative level	2
Facial expression	No grimaces of pain	0
	There is only a grimace of pain	1
	The grimace is combined with sounds not related to crying (moaning, wheezing, groaning)	2
Sleep	The child has a long dream	0
	Frequently wakes up	1
	He is always awake	2

Table 3 Scale of pain for assessing the effectiveness of postoperative analgesia (Hannallah Broadman).

Indicators	Criteria	Number of Points
Arterial Pressure	+ 10% of the preoperative level	0
	>20% of the preoperative level	1
	>30% of the preoperative level	2
Scream	Lack of screaming	0
	Shouts, but responds to touch, question	1
	Shouts, no reaction	2
Movement	The body is relaxed, does not move	0
	Muscle stiffness, forced position	1
	Restless chaotic movements	2
Excitation	Sleeps or is in a restful state	0
	Mild excitement	1
	Pronounced excitement	2
Verbal reaction	Sleeps or complains of pain	0
	Non-localized pain	1
	Localized pain	2
Total number of points		10

Table 4 Dynamics of indices of central hemodynamics.

Group of patients	Stages of research	Heart rate (sec-1)	$BP_{aver.}$	Cardiac Index l/ (min × m^2)
I (caudal block with ropivacaine)	I stage (skin incision)	108.6 ± 3.2	62.1 ± 2.2	2.81 ± 0.31
	II stage (traumatic moment of operation)	88.2 ± 2.8	60.2 ± 2.4	2.76 ± 0.28
	Stage III (end of operation)	76.1 ± 2.6	58.3 ± 2.6	2.74 ± 0.26
	Stage IV (12 hours after surgery)	98.5 ± 3.8	61.4 ± 2.8	2.79 ± 0.33
II (caudal block with bupivacaine)	I stage (skin incision)	106.5 ± 3.4	61.2 ± 2.4	2.83 ± 0.32
	II stage (traumatic moment of operation)	86.4 ± 3.1	86.4 ± 3.1	2.81 ± 0.32
	Stage III (end of operation)	84.5 ± 3.2	61.5 ± 2.6	2.79 ± 0.31
	Stage IV (12 hours after surgery)	147.5 ± 7.2	68.2 ± 5.4	3.59 ± 0.15

Table 5 Dynamics of indicators of stress markers.

Group of patients	Stages of research	Cortisol (μmol/l)	Glucose (mmol/l)
I (caudal block with ropivacaine)	I stage (skin incision)	238.2 ± 16.11	3.86 ± 0.12
	II stage (traumatic moment of operation)	196.4 ± 21.32	3.88 ± 0.11
	Stage III (end of operation)	196.4 ± 20.18	3.86 ± 0.10
	Stage IV (12 hours after surgery)	232.4 ± 1 4.11	4.02 ± 0.14
II (caudal block with bupivacaine)	I stage (skin incision)	236.1 ± 15.12	3.76 ± 0.14
	II stage (traumatic moment of operation)	232.1 ± 14.11	3.88 ± 0.12
	Stage III (end of operation)	232.1 ± 14.12	3.96 ± 0.19
	Stage IV (12 hours after surgery)	369.18 ± 28.32	6.42 ± 0.13

of local anesthetics, which did not cause a significant reduction in SI because children were given infusion therapy at a rate of 10-12 ml/kg/h.

At the III stage of the study (12 hours after the operation), the hemodynamic parameters remained stable in patients of the I group, did not differ significantly from the baseline data, which was explained with prolonged action of the caudal block with ropivacaine. And in group II patients (caudal block with bupivacaine), a significant increase in the heart rate by 38%, cardiac index by 27% and mean arterial pressure by 11% was observed at stage III of the study (12 hours after the operation).

Therefore, patients of this group for the purpose of anesthesia in the postoperative period were prescribed tramadol in age dosages. The level of cortisol in patients of both groups in the II and III stages of the study was reduced by 26% and 23%, respectively, which confirmed the adequacy of these anesthesia techniques for surgical interventions of the lower extremities. In the evaluation of postoperative pain according to the Hannalah scale in Group I patients, the score was 3, and in Group II patients it exceeded 7-8 points. And this testifies to the appearance of intolerable pain in patients who had a caudal block with bupivacaine **(Table 5)**.

Conclusion

1. Caudal anesthesia with 0.75% solution of ropivacaine is a highly effective, reliable and safe method of anesthesia in traumatological operations of the lower limbs in children.
2. Caudal administration of a 0.75% solution of ropivacaine provides a prolonged sensory and motor block.
3. The superiority of caudal anesthesia with a 0.75% solution of ropivacaine over anesthesia with a 0.5% solution of bupivacaine is due to its more potent local anesthetic effect, as evidenced by a wider sensory block and deeper motor blockade with ropivacaine.

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