# First 300 Cases Of Pediatric Regional Anesthesia In Venezuela (Caudal, Spinal And Peridural)

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**Citation**

C Rea, M Escalona, J Churion, R Pastrana. *First 300 Cases Of Pediatric Regional Anesthesia In Venezuela (Caudal, Spinal And Peridural)*. The Internet Journal of Anesthesiology. 1999 Volume 4 Number 4.

**Abstract**

Until 1997, only general anesthesia was used for pediatric surger
Many complications occurred with this method, which could have
d a regional anesthetic technique been used. The objectives of th
A) To demonstrate that REGIONAL ANESTHESIA has the following char
1. It is useful in children, causing minimal hemodynamic and resp
.
2. It is easy to administer, safe, less costly, allows quick reco
mobilization of the patient.
B) Stimulate the development of regional anesthesia techniques in
ery in Venezuela.

We present a historic review, the indications, contraindications,
sadvantages, technique, complications, methods, including the dos
ed for REGIONAL ANESTHESIA IN CHILDREN. Then we present a prospec
300 cases of regional anesthesia administered to children aged 12
of which 208 were males and 92 females; 240 ASA I and 60 ASA II.
ia was used in 150, spinal anesthesia in 104, and peridural anest
r abdominal and lower limb surgeries. The youngest patient was a
f 47 days of age; the oldest was 12 years old. The mean age was 5
lowest weight was 2.4 kg; the highest weight 45 kg, the mean bein
imal changes of systolic, diastolic, mean blood pressures, and he
bserved. There were no significant fluctuations in respiratory ra
had 8.3% rate of technique errors and 6.33% of adverse effects.
ic surgeons regarded the anesthetic technique as good.

REGIONAL ANESTHESIA in children causes minimal hemodynamic and re
es, is easy, safe and cost effective. It allows early mobilizatio
bdominal and lower extremity surgery with a wide margin of safety
cations.

## INTRODUCTION

A better knowledge of the pharmacokinetics and pharmacodynamics of local anesthetic substances in infants and children, the development of regional anesthetic techniques, as well the availability of better equipment specifically designed for children, have all allowed the implementation of regional anesthesia in pediatric surgery ([1], [2], [3]).

**Figure 1**

Image 1: Regional anesthesia in pediatric surgery

In recent years, the use of regional anesthesia in pediatric surgery is more frequent due to the growing number of premature infants who are discharged with chronic and acute morbidities that need to be operated on. These infants are at a greater risk of developing respiratory failure and postoperative apnea compared to term infants of the same age. When regional anesthesia is given to older children, some variables such as the intervention site, age, presence of chronic disease, cooperativeness and parental preferences should be considered (2, 4, 5, 6, 7, 8).

Among the regional anesthetic techniques, spinal (subarachnoid), peridural (epidural), and caudal, we chose preferentially the caudal approach because of the ease and safety of reaching the peridural space through this route in children (9). If all these techniques are correctly used and the anatomy of the patient is normal, there is minimal risk of perforation of the dura when using caudal or peridural anesthesia and/or risk of damage to the spinal cord when performing the spinal anesthesia. This is also true for newborns that have a more caudal extension of the dura compared to adults (9, 10).

## HISTORY

The origins of regional anesthesia go back to 1899 when August Bier (considered the father of regional anesthesia) discovered the “cocainization of the spinal cord”. In May 1900, Baimbridge published a report on spinal anesthesia in an infant of three months for the repair of a strangulated hernia. The biggest modern series of spinal anesthesia was published in 1909 by Tyrell-Gray, a British surgeon who described 300 procedures used for below-the-diaphragm surgeries (11, 2).

Pediatric spinal anesthesia continued to be popular in the forties and fifties. The textbook of pediatrics by Leigh and Belton demonstrated that 10% of all anesthetic procedures practiced in children at the Vancouver General Hospital were spinal techniques, including pulmonary lobectomies and pneumonectomies (11). The appearance of neuromuscular blocking agents and the development of volatile anesthetics in the forties shifted the techniques toward general anesthesia (11). However, spinal pediatric anesthesia did not dissapear.

Thereafter, in 1983, in the American Society of Anesthesiologists Regional Anesthesia Breakfast Panel, Abajian et al started the “frenzy” of modern pediatric spinal anesthesia when they reported 81 cases in 78 infants (11).

In 1901, Sicard and Cathelin introduced independently the caudal approach in the anesthetic practice. In 1909 Von Stoeckell administered caudal blocks for obstetric pain. However, the patients reported unsatisfactory analgesia due mainly to limitations of the harmacologic compound (7). The first publication that mentions this technique in children was written by Campbell in 1933 and the second one by Leigh and Belton in 1951 (3). Subsequently, Fortuna (1963) in Brazil, Melman (1973) in Mexico, Takasaki (1977) in Japan, Ecoffey (1985) in France, and Rash (1995) in USA, introduced these techniques in their countries.

In 1954, Rouston F G in Canada (Canadian Anesthesia Society) and Stringer R M first described in Anesthesia and Analgesia lumbar epidural anesthesia for inguinal hernia repair in infants and children in (13).

**Figure 2**

Image 2: Regional anesthesia in pediatric surgery

## INDICATIONS

a) Preterm children of less than 60 weeks of age post conception; infants with bronchopulmonar dysplasia, apnea or need for ventilatory support. All of these have a greater risk of apnea and hemodynamic instability when recovering from general anesthesia.

b) Children with history of malignant hyperthermia or significant risk of it.

c) Children with chronic disease of the airways like asthma of cystic fibrosis.

d) Children with acute respiratory conditions.

e) For surgeries with a level below T4 and a duration less than 90 minutes, such as umblilical and inguinal hernia repairs, perineal surgery, lower extremity surgeries, orchidopexia, hypospadias, skin grafts, anal surgery, phimosis, cystoscopy, colostomy for imperforated anus, rectal biopsy, etc. (1, 9, 10, 14, 15, 16, 17).

**Figure 3**

Images 3 to 5: caudal, spinal and peridural anesthesia in pediatric patients

**Figure 7**

Image 7: Spinal anesthesia

**Figure 8**

Image 8: Peridural anesthesia

## CONTRAINDICATIONS

a) Presence of a significant spinal defect

b) Infection of the skin or subcutaneous tissue in the punction area.

c) Coagulation defects

d) Neurological defects in growth, as well as demyelinating disease of the CNS.

e) Refusal of the parents

f) Allergy to local anesthetics

g) Severe hypovolemia

h) Uncontrolled convulsions (2, 9, 16, 17, 18, 19).

## ADVANTAGES

a) Regional nerve block causes deep muscle relaxation below the level of block.

b) Regional anesthesia eliminates the bradycardic response to mesenteric manipulation or handling of the umbilical cord during genitourinay operations or lower abdominal surgeries.

c) Flaccid limbs after tendon or nerve repairs in very young children who are unable to cooperate for postoperative instructions about strict rest of the affected limb.

d) Hypotension is very unusual in children of 7-10 years of age due to the fact that resting sympathetic tone is lower than in adults and they have reduced blood volume in the lower extremities (1, 2, 9, 10)

## DISADVANTAGES

a) Anesthetic block disappears faster in children than in adults.

b) Is regional anesthesia more time-consuming than general anesthesia by itself?

c) Special skills and training are required

d) Two operators are needed to perform these techniques: one to hold the child in adequate position and take care of the airway; another to perform the technique (2).

## COMPLICATIONS

## CAUDAL

a) Subcutaneous injection (2.8%-23.2%): is the most frequent complication; a weal appears and can be seen readily. If this is noted before the complete dosage is given, a second attempt can be undertaken trying not to exceed the toxic dose with both injections.

b) Vascular puncture (1%-2%): if this happens, irrigate the needle and advance or withdraw. If no blood is obtained inject the test dose. If no intravascular response is produced, administer the complete dose.

c) Intrathecal injection (1:100-500): Its incidence is low due to:

1. short introduction of the needle
2. Due to the fact that the dural sac does not occupy all the caudal epidural space and therefore the position of the needle can take place parallel to the dural sac reducing the risk of puncture. This is different from the lumbar approach in which the needle and the dura mater are perpendicular.

d) Intraosseous injection: is equivalent to intravenous injection. In 1972, DiGiovanni and Mc Gown in 1972 showed that the gauge of the needle does not avoid the risks of intraosseous puncture, especially when a contact is seeked with the posterior side of the anterior part of the sacrum.

e) Dissection of the anterior and posterior subperiostium of the sacrum: causes an easy initial injection of the anesthetic, followed be the impossibility of administering the rest of it.

f) Perforation of the rectum: can happen if the needle has been angulated excessively and is forcibly inserted, or if the needle is accidentally placed in between the sacrum and coccix. This is very unlikely to happen in skilled hands. If this happens the procedure should be stopped and the child should be given antibiotics and a low residue diet.

g) Hematoma: can happen after the perforation of a peridural vein but is inconsequential.

h) Urinary retention: is a rare complication and is related to the anesthetic concentration and the type of intervention. Its incidence is higher in circumcision.

i) Inadequate block (3.5%-9.5%): is due to a bad technique or to insufficient volume of anesthetic.

j) Intracranial hypertension: has been described after the administration of bupivacaine by the caudal route with loss of consciousness and respiratory arrest. The cause can be a too quick administration of the anesthetic. A slow injection is therefore recommended.

k) Convulsions: can happen with both, lidocaine and bupivacaine, when given at high doses, with a continuous drop infusion, or when the anesthetic is injected directly into a blood vessel. (3, 9, 14, 20).

## SPINAL

a) Vascular puncture: If blood is obtained from the needle, wait until the fluid clears and then inject the anesthetic. If this does not happen then go to other intervertebral space and repeat the procedure.

b) Inadequate block: happens with poorly experienced operators and may be due to poor technique or wrong calculation of the dosage.

c) Nausea and vomiting: can happen in some patients to whom inadequate amounts of fluids have been infused.

d) Headache: is a complication that is seen more frequently in older children and is related to the caliber of the needles used for the injection.

e) Hypotension: can happen when inadequate volumes of fluids have been infused and when the anesthetic level is high. It is mostly seen in older children (older than 7 years).

f) Local and systemic infection: can happen if adequate aseptic techniques are not followed (1, 16, 17, 19).

## PERIDURAL

a) Vascular puncture: If this happens repeat the procedure at another intervertebral space and perform the injection.

b) Total spinal blockade: The first sign of this is a change in respiratory rate. Changes in blood pressure are not necessarily seen. Anisocoria and apnea can be present. The management consists in intubation and ventilation of the patient and 100% FiO2 oxygen administration, until the effects of the blockade terminate; this can last for 30 to 120 minutes. After the problem is controlled surgery may be resumed.

c) Faulty placement of the needle: If the peridural space is not accessed, the anesthetic substance will be placed outside of the space and there will not be a block.

d) Puncture of the dura mater: This is not dangerous by itself. If the anesthesiologist notices that this is happening, he should go to other space and be very careful when injecting the local anesthetic to avoid total spinal blockade. This complication may cause headache that can be treated with a blood patch.

e) Unilateral blockade: may happen occasionally, possibly due to a fibrous septum that impedes the diffusion of the anesthetic.

f) Hypotension: is quite rare in infants but signals other complications.Treatment is the same as with adults.

g)Epidural hematoma: is a complication secondary to puncture of a peridural vein. Correct diagnosis allows adequate management, possibly evacuation of the hematoma.

h) Infection: happens occasionally at the entry site of the catheter when used for several days for postoperative analgesia or when adequate aseptic care of this area has not been taken. (9, [21,22, 23])

## METHODS

After approval by the Postgraduate Training Committee of Anesthesiology of H.G.O. “Jose Gregorio Hernandez” Los Magallanes de Catia-Caracas Venezuela, 300 hundred patients were studied, all 12 years old or younger, ASA I and ASA II, in longitudinal fashion, as they were scheduled electively or urgently for surgery. All operations were below the diaphragm. Electrocardiogram and blood pressure were monitored as well as pulse oximetry. Systolic, diastolic, mean blood pressures were obtained, also cardiac and respiratory rates. All of these were monitored every 5 minutes during the first 30 minutes and then every 15 minutes. An intravenous line was placed in all children for administration of drugs and for fluid infusion including 0.45% dextrose for infants and Lactated Ringer solution for older children. First midazolam ( 0.2 mg/kg of weight) and then active mask oxygen was administered. One minute before placement in lateral decubitus position, an injection of ketamine (2 mg/kg weight) was given.

## TECHNIQUE

## CAUDAL

The patient is placed in left lateral decubitus position, either by the pediatric surgeon or the anesthesiologist, and oxygenated with the mask. Then, the sacrococcigeal area is cleaned with Povidone solution. The sacral hiatus is localized and punctured with the needle or scalp at a right angle until touching the ventral wall of the sacrum. Then, the needle is withdrawn some millimeters, inclined until putting it in horizontal and then advanced cephalad while aspirating. If there is no CSF or bloody return, an injection of 1 to 2 ml of air is given. If there no formation of a weal in the subcutaneous tissue, the anesthetic is injected slowly ([24, 25, 26, 27]).

**Figure 6**

Image 6: Caudal anesthesia

To calculate the volume and dose of the anesthetics we used the following Formulas (2, [28]):

Volume = 0.1 ml of anesthetic solution X body weight X number of spinal segments to be blocked

The dosage of the anesthetic was calculated in the following manner:

Bupivacaine: 3 mg/kg of body weight

Lidocaine: 7 mg/kg of body weight (2, 15,18, [29, 30]) After the administration of the anesthetic, the limbs of the patient are restrained and adequate anesthetic level is awaited for 10 to 15 minutes and, after pertinent testing, surgery is started. During surgery, sedation is maintained using midazolam at 0.1 mg/kg as necessary and the patient is kept with continuous oxygen administration by a mask close to the face.

## MATERIALS

a) Sterile field

b) 20 ml syringe

c) 3 ml syringe

d) A needle or a scalp vein needle 23 gauge

e) Sterile gauze

g) Povidone

## SPINAL

The technique of lumbar puncture for subarachnoid blockade is different in infants compared to adults, due to the fact that the conus medullaris of the newborn ends at the level of L2-L3 instead of T12-L1. Therefore the ideal spaces to perform de lumbar puncture are: L3-L4, L4-L5, L5-S1, the two latter ones being the safest (2, 9, 11, 31, 19).

After placement of the patient in the left lateral decubitus, the area is cleaned with antiseptic solution and sterile drapes are applied. The selected intervertebral space is punctured using a spinal 22 or 25-gauge needle, 2.5 to 5 cm long. After obtaining CSF, a tuberculin syringe is attached to the needle without aspirating to avoid the dilution of the anesthetic. Then, the anesthetic is injected with a speed of 0.5 ml/second for higher abdominal surgery, or somewhat slower for lower abdominal surgery. The needle is not withdrawn until 5 seconds after the local anesthetic injection. 2 minutes are necessary to obtain adequate anesthesia. If the aspirate was bloody or pink, another aspiration is performed to see if it turns transparent. If so, the anesthetic is injected. If more blood appears or the CSF is not transparent the puncture is repeated at another space level (2, 9, 11 and 19)

**Figure 9**

Images 9 to 11: Epidural anesthesia

Dosages and medicaments used by us:

- 5% lidocaine: 2 mg/kg weight + epinephrine (syringe flush) (2, 16, 19)

or

- Bupivacaine: 0.4 mg/kg weight (9, 14)

After giving the anesthetic to the patient, he/she is put supine position. After waiting one minute, sensory tests are performed to verify the desired anesthetic level. Once this is obtained surgery proceeds.

The children are maintained with mask oxygen administration, close to their face and sedated with midazolam 0.1 mg/kg weight as needed until surgery is done.

Materials

a) Sterile field

b) 1 ml tuberculin syringe

c) 22 or 25 gauge spinal needle

d) Sterile gauze

e) Povidone (solution)

## PERIDURAL

In order to find the peridural space we used the “loss of resistance technique”. After placing the patient in lateral decubitus, the area around the intervertebral space is cleaned. Local anesthetic is administered (2% lidocaine). A Tuohy #18 needle is then introduced and slowly advanced keeping in mind that the younger the child the closer the structures are from the skin (ligamentum flavum, epidural space). One ml of air is pushed with the syringe to test the resistance while advancing until the epidural space is reached when the air enters easily without resistance. After this, aspiration is performed to test if a vessel or the subarachonoid space had been punctured. If this testing is negative, the air bubble test is repeated with 3 ml of anesthetic solution. If these test is positive the rest of the anesthetic is injected slowly, aspirating on and off to verify if the needle is still in the peridural space. The peridural catheter is then placed, aspirating to verify that there is no blood of CSF. 2 ml of local anesthetic are introduced to verify if the catheter is permeable. The catheter is then fixed to the skin and surgery is started after 15 waiting time (2, 21,32, 33)

**Figure 10**

The patient is kept sedated with 0.1mg/kg weight midazolam as needed and oxygen is administered via a face mask throughout the procedure.

The formula to calculate the volume of anesthetic solution is the one given by Dr. Rash and Hosta (2, 14):

Volume of local anesthetic = 0.05 ml X kg weight X number of spinal segment to be blocked

The dose of local anesthetic used was:

Lidocaine = 7 mg/kg weight

If surgery was prolonged given 50% of the initial dose of lidocaine was given (according to volume and body weight). At the end of the operation 0.125% bupivacaine is administered through the peridural catheter at half of the volume calculated for the initial dose of the anesthetic.

**Figure 11**

**Figure 12**

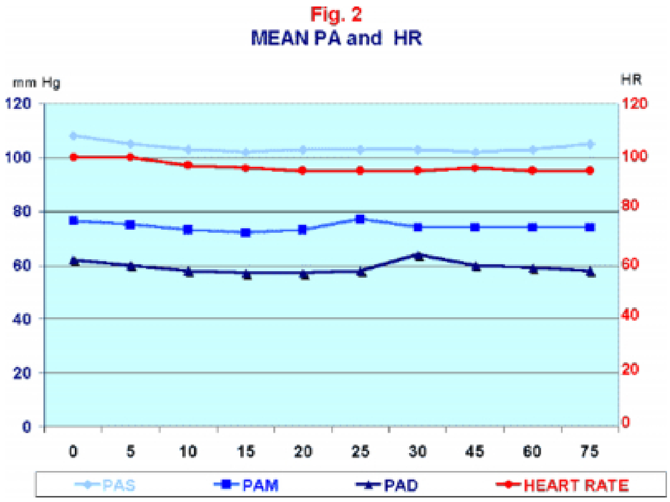
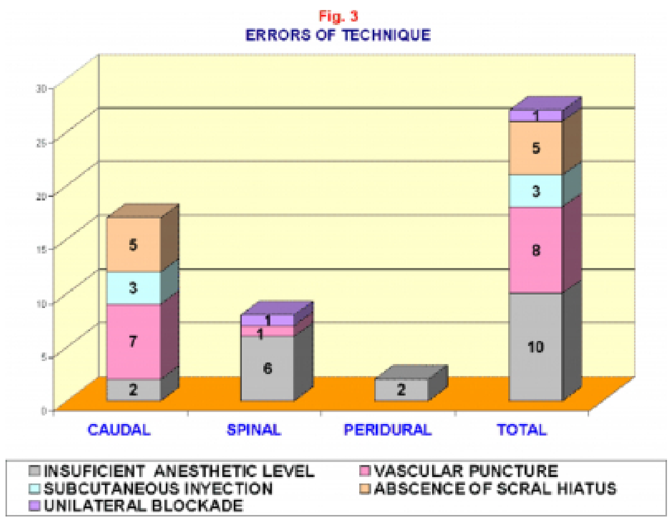



**Figure 13**




Materials

We used the Duracef kit that contains:

a) 20 ml syringe

b) 3 ml syringe

c) 5 ml syringe for the resistance test

d) Touhy needle # 18

e) Peridural catheter # 18

f) Needles 18, 21 and 23 gauge

g) Sterile field

h) Povidone, gauze and adhesive tape.

## RESULTS

Table I presents the patients studied by sex and ASA classification. It can be seen that 50% of them underwent caudal anesthesia, 34.67% spinal anesthesia, and 15.3% epidural anesthesia.

69.33% of patients were males and 30.67% were females. 80% of them were ASA I; 20% were ASA II of which the great majority were asthmatics.

In Table II we present data refered to age, weight and operation time. We present here the youngest age, the mean age and the oldest age. When referring to age we use different units. For instance, the youngest child of 47 days of age has 0.13 years. Likewise regarding weight and time we present the minimum, mean and maximum.

Most of the surgeries performed were inguinal hernia repairs, followed by umbilical hernia repair and a combination of both. We want to highlight the case of pyloric stenosis correction using caudal anesthesia. There were 2 femoral fractures which were operated with caudal and peridural anesthesia respectively. Combination of peridural and general anesthesia was used in the case of Hirschsprung’s disease in which a catheter was left for 48 hours for post-operative bupivacaine analgesia.

The mean values for systolic and diastolic blood pressure, mean pressures and heart rate are presented in figure 2.

**Figure 14**

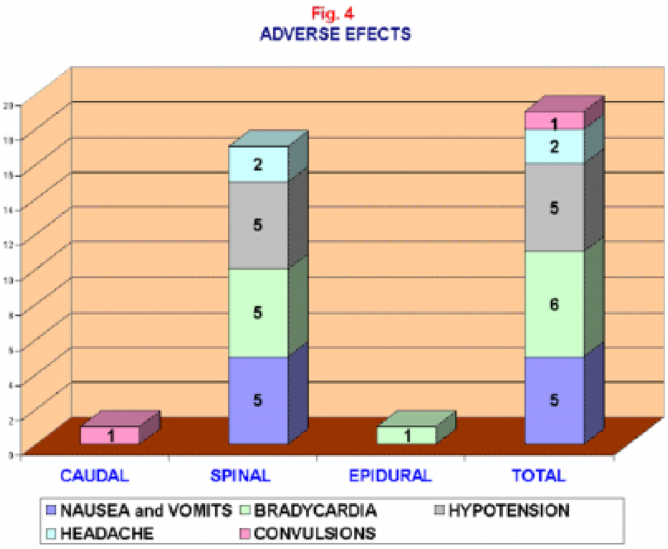



Fig. 3 shows that of errors of technique occurred in 9%.

**Figure 15**

| | Caudal | Spinal | Peridural | Total |
|---|---|---|---|---|
| Number of patients | 150 | 104 | 46 | 300 |
| Males | 48 | 32 | 12 | 92 |
| Females | 102 | 72 | 34 | 208 |
| ASA I | 119 | 84 | 37 | 240 |
| ASA II | 31 | 20 | 9 | 60 |

Adverse effects of the techniques occurring 6.33% of the patients studied are presented in fig. 4.

**Figure 16**

| | Age | Weight | Procedure Time |
|---|---|---|---|
| | Youngest/ Mean/ Oldest | Minimum/ Mean/ Maximum | Minimal/Mean/Maximal |
| Caudal Anesthesia | 47 days/4.2 years/12 years | 2.4 Kg/17.5 Kg/34.2 Kg | 15 min/58.2 min/120 min |
| Spinal Anesthesia | 3 months/6.4 years/10 years | 6.8 Kg/22.09 Kg/45 Kg | 10 min/38.1 min/75 min |
| Peridural Anesthesia | 1year 5 mo/6.76 years/12 years | 11 Kg/23.25 Kg/36 Kg | 15 min/56.7 min/120 min |
| Total Regional | 47 days/5.36 years/12 years | 2.4 Kg/19.95 Kg/45 Kg | 10 min/48.6 min/120 min |

TABLE I

Anesthetic Technique, Sex and ASA classification

{image:15}

TABLE II

Age, Weight, Procedure Time (minimum, mean and maximum)

{image:16}

## DISCUSSION

In the present study we demonstrated that caudal anesthesia with lidocaine at 7 mg/Kg weight and bupivacaine at 3 mg/Kg produce adequate anesthesia for lower abdominal surgery, for surgery at epigastric level, and postoperative analgesia. Likewise it is shown that subarachnoid anesthesia with hyperbaric lidocaine (5%) at a dose of 2 mg/Kg weight, or bupivacaine (0.5%) at a dose of 0.4 mg/Kg weight, is useful to perform surgeries in the abdomen and lower limbs. The level of anesthesia achieved reached T4, resulting in sensory and motor blockade able to keep the patient in an optimal anesthetic plane. Also we demonstrate that continuous peridural anesthesia with an initial dosage of 7mg/Kg of lidocaine, repeating half of this dosage in the case of prolonged operative time, is useful for procedures of the abdomen and lower limbs (giving bupivacaine 0.125% at the end of surgery for postoperative analgesia). All of this is coincident with other authors' findings and reports (1, 2, 9, 40).

To calculate the necessary volume and the dosages of the anesthetics for blockade of a determined number of spinal levels either for the caudal block or the peridural block we used the formula described in the article by Dr. Rash (2, 28). However, other formulas are mentioned in the literature for the dosage and total volume of the anesthetic (14, 34, 35, 36). For spinal anesthesia we flushed the syringe with epinephrine and used a dose of 2 mg/Kg of lidocaine. This dose was obtained by averaging the dosages used by different authors. (1, 2, 21, 42)

In our study, the dose and volume of anesthetic was enough to keep an ideal anesthetic plan allowing the surgeon to perform surgeries without complications. All doses utilized were below the toxic concentrations that might lead to dangerous plasma levels(3, 30, 34, 37).

For caudal anesthesia we used the combination of lidocaine and bupivacaine to obtain a quick start of anesthesia, motor blockade and persistence of analgesia postoperatively. This combination was used successfully by other authors (29, 38). Lidocaine prevents the toxic effects of bupivacaine, although some authors state that this mixture adds up the toxic effects of both medications (9). We did not find any summation of toxic effects in using these medicaments.

For spinal anesthesia we noted that lidocaine at 5% with previous flushing of the syringe with epinephrine, allowed us to obtain a maximum anesthetic time of 75 minutes. Anesthesia may last as long as 90 minutes (14) when using this combination. Others refer a mean duration of 58 minutes (41, 42).

For peridural anesthesia we used 0.125% bupivacaine at the end of surgery at half of the calculated volume from the beginning of surgery, which gave us approximately 6 hours of postoperative analgesia.

One of the objectives of the study was to demonstrate that regional anesthesia produces minimal hemodynamic changes when neglecting the sympathetic agonistic effect of epinephrine causing tachycardia when injected intravenously (9). This could significantly modify our results. Nevertheless we believe that combinations with epinephrine can be used, as well as sodium bicarbonate and other drugs that may help improve anesthesia (10, 30).

The changes in systolic, diastolic and mean blood pressures were minimal. This is because sympathetic vascular tone at rest in children is less than in adults (1, 40). Heart rate was kept at normal range because regional anesthesia eliminates the bradycardic response to mesenteric or spermatic cord manipulation during urogenital surgery or lower abdominal surgery (2). Respiratory rate and pulse oximetry did not suffer significant changes, which is coincident with other authors (29, 6).

Errors of technique (Fig. 4) were the infiltration of subcutaneous tissue (03 cases, 1%) and vascular puncture (08 cases, 2.67%). These are minor complications that not alter the techniques or the general status of the patient (35). We had 10 cases of insufficient anesthetic level, due to miscalculation of the number of dermatomes to be blocked in caudal and peridural anesthesia's and poor calculation of the dosage in the cases of spinal anesthesia. In 5 cases we did not find the sacral hiatus, 3.3% of caudal anesthesia's given, less than the rate cited by other authors of 20% and above others that give 1% of failures (39). There was one case of lateralization in spinal anesthesia that was caused by prolonged placement of the patient in left lateral decubitus.

The majority of adverse effects (Fig. 3) occurred in patients receiving spinal anesthesia and consisted of postspinal tap headache probably due to the use of a large spinal needle as described by Claude Saint Maurice (9) and Blaise G (44). Bolder posted that post spinal tap headache only occurs in children older than 13 years, being less frequent in younger ones (45). Our patients were treated symptomatically with analgesics. Five patients experienced nausea and vomiting, which coincides with a report from Blaise (44). They were treated with metoclopramide 0.2 mg/Kg. Five patients has bradycardia treated with atropine 0.02 mg/Kg. This side effect was not reported by other authors possibly because they premedicated their patients with atropine. Six patients had hypotension, which was corrected with administration of fluids, at 10 ml/Kg with 0.9% saline. One child without medical history presented convulsions probably secondary to hypoxia. This occurred 15 minutes after the injection of the anesthetic when the oximeter showed an oxygen saturation of 67%. The child was given oxygen and diazepam intravenously. Surgery was continued and a follow up EEG 24 hours later was normal and the child was then discharged.

Age, weight and sex are not limiting factors for the administration of the techniques. Age range was 47 days to12 years and weight range was 2.4 kg to 45 kg We observed that the younger the patient the more effective the anesthesia is. There were less changes in arterial pressure and heart rate (43). We had a male premature of 47 days of age that needed urgent hernia repair and could not be intubated; he was operated with caudal anesthesia. We had a 2 month old female infant that weighed 2,400 g and needed repair of pyloric stenosis. She had had respiratory distress when born and stayed intubated in intensive care (UTIN). She was discharged with a diagnosis of pulmonary dysplasia. She was given caudal anesthesia without using midazolam or ketamine. The youngest patient with spinal anesthesia was an infant of 3 months of age weighing 6.8 Kg. The youngest patient with peridural was 17 months old and weighed 11.8 Kg; he had Hirschsprung's disease and was the only patient that received combined anesthesia consisting of general anesthesia and intubation. He needed postoperative analgesia with 0.125% bupivacaine for 72 hours.

No other types of complications were observed. No local infections occurred probably because of careful and aseptic cleansing before the punctures, as described by Saint Maurice C. (9). We observed no case of intraoperative apnea. The latter is frequent in prematures or children with pulmonary dysplasia This was described by Dr. Harnick who observed episodes of apnea in one case of 20 patients (6).

Recovery in the postoperative ward lasted 1 to 2 hours, (keeping postoperative analgesia in patients that received caudal and peridural anesthesia). These patients had their oral intake tested and were discharged from recovery if they did not experience nausea and vomiting. Patients with spinal anesthesia received analgesic suppositories or intravenous analgesia. Their recovery took the same time.

The opinion of the pediatric surgeons about regional anesthetic techniques varied between good and excellent.

Subarachnoid anesthesia has the advantage that the blockade is effective within the 2 first minutes compared to other techniques with wait times of 15 minutes (9, 14).

## CONCLUSSION

The techniques of regional anesthesia are:

a) Safe because they provide adequate anesthesia without major complications, avoiding particularly those of intubation of the airways.

b) Easy to apply as long as they are performed by anesthesiologists experienced in techniques of regional pediatric anesthesia or residents who have received adequate training.

c) Cost effective, because the material and anesthetics used are minimum.

The combination of lidocaine and bupivacaine in caudal and peridural anesthesia allows a quick start of anesthesia and also prolongs its duration. In addition, it is useful for postoperative analgesia, without summation of toxic effects. On the contrary, lidocaine counteracts the cardiovascular toxic effects of bupivacaine.

Hemodynamic changes are minimal (systolic, diastolic, mean blood pressures and heart rate), without variations of respiratory rate and pulse oximetry.

Only a few side effects were observed using these regional techniques. They were easily treated allowing quick recovery and mobilization of the patient. The use of such techniques is recommended in same day surgeries and in older patients undergoing infradiaphragmatic surgeries that last between 75 to 120 minutes.

Regional techniques are also indicated for analgesia in the postoperative period in patients who received general anesthesia.

We conclude that the described techniques were used very successfully. Each technique had different indications: depending on the type and duration of surgery or the need of short or long postoperative analgesia. Other important factors to be considered are the skills and experience of the anesthesiologist with a particular technique, the available anesthetics and the necessary material for one or other technique.

## ACKNOWLEDGMENTS

We thank Dr. Miguel Cabrera M. D., from Lawrence MA USA, for the translation of this study into English.

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