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LIDOCAINE FOR DORSAL SPINAL ANESTHESIA FOR AMBULATORY ORTHOPEDIC FOOT SURGERY. A COMPARATIVE STUDY BETWEEN ISOBARIC AND HYPOBARIC SOLUTIONS

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ABSTRACT

Background: Foot surgeries can be performed with the patient in a position of dorsal decubitus, lateral position or ventral decubitus. This study aimed at evaluating the feasibility of performing orthopedic foot surgery in decubitus ventral in outpatient settings with two different solutions of lidocaine. **Methods:** Two groups of 40 patients, physical status ASA I-II, undergoing foot surgical procedures in a jack-knife position, received 50 mg 2% isobaric lidocaine or 24 mg 0.6% hypobaric lidocaine. Sensory and motor blockade and the need for analgesics were evaluated. Patients were followed until third postoperative day and questioned whether they experienced postdural puncture headache, degree of satisfaction or temporally transitory neurological symptom. **Results:** The latency time was almost the same regardless of the solutions. All patients with 50 mg isobaric lidocaine and 24 mg hypobaric lidocaine presented sufficient anesthesia for the surgical procedure without need for anesthesia complementation. At 15 minutes all patients with isobaric or hypobaric had thoracic levels of anesthesia. The hypobaric solution provided a more homogeneous cephalic dispersion. Proprioception was observed in all patients with hypobaric lidocaine and none with isobaric lidocaine. There is significant difference between solutions to achieve different degrees of motor block. Complete motor blockade occurred in all patients with isobaric lidocaine. In the hypobaric lidocaine group, 85% of the patients did not present any degree of motor blockade. The analgesia time being significantly higher at isobaric (107 min) than at hypobaric (66 min). Hypotension and post-puncture headache occurred in only one patient. There was no hypotension or bradycardia in both groups. The degree of satisfaction was significantly higher with hypobaric lidocaine. No neurological complications were observed in all patients studied. **Conclusions:** Spinal block performed in the Jack-Knife position provide surgical analgesia with complete motor block with isobaric lidocaine and without motor block with hypobaric lidocaine for foot surgery. Most importantly, it allowed the patient to remain in this position, providing for better surgical exposure for surgeon and tranquility and safety for the patient. In our study, with hypobaric lidocaine all patients went from the operating table to the stretcher without help, and better degree of satisfaction.

KEYWORDS: ANESTHETIC, Local: lidocaine: ANESTHETIC TECHNIQUE, Regional: isobaric spinal block. Regional: hypobaric spinal block. SURGERY: Orthopedic.

INTRODUCTION

Foot operations (calcaneous fracture, hallux valgus, debridement, pulling out of nails, etc.) are performed for many reasons. Foot surgeries can be performed with the patient in a position of dorsal decubitus, lateral position or ventral decubitus. Today, regional anesthesia in the lower extremities is considered preferable to general anesthesia. Postoperative recovery is faster in cases involving regional anesthesia and the hospital costs are lower.[1] Regional anesthesia methods in the lower extremity include central blocks (spinal and epidural anesthesia) or peripheral nerve blocks where anesthetics are injected locally to nerves and plexus. Among these, the spinal anesthesia method is most commonly used in lower extremity operations.[2,3] Spinal anesthesia can be blocked in three different ways: the first, with patients in the lateral position; the second with patients in the sitting position, and finally the third, with patients in the prone position.[4]

In our institution, some orthopedic surgeries of the foot are usually performed in Jack-Knife position under spinal anesthesia. Lidocaine has been used for spinal anesthesia since 1949, seemingly without causing concern.[5] In this way, lidocaine is a good option for ambulatory surgeries, being used as a hypobaric[6], hyperbaric[7] or isobaric solution.[8] Using isobaric lidocaine has been demonstrated that small-dose lidocaine spinal anesthetic technique provided effective anesthesia for short duration outpatient orthopaedic surgery.[8] Isobaric lidocaine, in a fixed dose of 60 mg produced effective spinal anesthesia, with good cardiocirculatory stability, low complications incidence but a wide variation in the upper level of sensory block.[9]

In a study of several doses of 0.6% hypobaric lidocaine (3, 4 and 5 mL) in 150 patients for anorectal surgery, only 14 (9.3%) patients were unable to succeed the proprioception test.[6] Due to the maintenance of proprioception in almost all patients with hypobaric lidocaine, the comparison protocol with isobaric lidocaine included the non-use of tourniquet in the lower limbs.

This study is aimed to compare the two lidocaine anesthetic solution used for orthopedic surgery in Jack-Knife position without tourniquet, with respect to their surgical features, complications, recurrence and patient satisfaction level.

METHODS

After registration in the Brazil Platform (CAAE: 73719517.2.0000.5186) and approval by the Ethics and Research Committee and their informed consent, patients of both sexes, aged 20 to 60 years, weight 50 to 80 kg, height 150 to 180 cm, ASA physical status I and II patients, scheduled for outpatient orthopedic surgery in the prone jack-knife position were enrolled in this randomized double blind study.

Utilizing the significant level of 5% and an error limit 0.10 the sample size was 62 patients. Eight more patients were added to totalize a sample of 80 patients in two groups of 40 patients. Exclusion criteria were hypovolemia, coagulation disorders, infection and refusal of the proposed method. As part of the program Acerto, the patient took a single 200 mL carbohydrate drink orally (Fresubin Jucy®) two hours before surgery.

Exclusion criteria were neurological or neuromuscular diseases, infection at the intended site of spinal needle insertion, hypersensitivity to amide local anaesthetic and refusal of the proposed method. The ECG and pulse oxymetry were continuously monitored and measurements of heart rate and blood pressure were recorded. Patients were not premedicated. An IV infusion of lactated Ringer's solution was begun on arrival in the operating room, but no fluid loading was used before spinal anaesthesia. Patients received 50 to 100 µg fentanyl IV several minutes before positioning for lumbar puncture. Minimum fluid volume was intravenously injected in the intraoperative period, always below 500 mL.

Randomization was done with the help of a computer generated schedule followed by preparation of coded envelopes. Group 1 lidocaine 2% isobaric (specific gravity at 37ºC of 0.9995 g/ml) 50 mg (2.5 mL) and Group 2 lidocaine 0.6% hypobaric (specific gravity at 37ºC of 0.9980 g/mL) with 24 mg (4 mL) were prepared as from 30 mg 2% isobaric lidocaine plus 3.5 mL sterilized bi-distilled water. The solutions were specially prepared for the study by Cristália Produtos Químicos e Farmacêuticos Ltda (Brazil).

After cleansing the skin with alcoholic chlorhexedine, subarachnoid puncture was done with the patient in the prone Jack-Knife position with a 25 cm pillow placed under the abdomen. A midline approach at L_3-L_4 was used after subcutaneuos local anesthetic infiltration with lidocaine 1%, using a 27G Quincke needle (B.Braun Melsungen) without introducer. After appearance of CSF to confirm needle placement, 2.5 mL of lidocaine 2% isobaric or 4 mL of lidocaine 0.6% hypobaric both at 1 mL/15s were administered.

Blockade onset was evaluated by loss of sensitivity in the buttocks immediately after the injection of hypobaric lidocaine by pinprick using the stylet of the needle. Light touch was assessed with a cotton wool wet in alcohol along the mid-axillary line, outer aspects of the thigh, leg and foot. Proprioception was tested at the big toe by asking the patient to identify movements of the toe without looking at 15 minutes. The block was then evaluated by another anesthetist at 5, 10, and 15 minutes. Assessment of the motor blockade was done at 5, 10, and 15 minutes after spinal block, using the modified Bromage scale (0 to 3) (6): 0 = free movement of the lower limbs; 1 = unable to raise extended limb; 2 = unable to bend the knee; 3 = unable to move the ankle. The duration of the analgesia was defined as the length of time it took for the patient to regain perineal sensibility. The duration of the motor blockade was defined as the length of time it took until the patient fully recovered muscular activity. At the end of the surgery, the ability of the patient to move to the stretcher by himself was evaluated.

Hemodynamic parameters were evaluated every three minutes in the first 15 minutes, and every five minutes until the end of the surgical procedure. Hypotension was defined as a reduction in systolic blood pressure greater than 30% of baseline values. Bradycardia was defined as a reduction in heart rate below 50 bpm. Every patient received oxygen (2 to 3 L/min) through a nasal catheter. Sedation during the procedure was maintained with small doses of midazolam (0.5 to 1 mg). Fentanyl (50 µg) would be administered if the patient complained of discomfort.

After the end of surgery, in the position of ventral decubitus, sciatic nerve block was performed in the popliteal region with neurostimulator (HNS12, B.Braun Melsungen) and needle A50 and injection of 30 mL of 0.25% levobupivacaine (Cristália Produtos Químicos e Farmacêuticos Ltda) for postoperative analgesia. At the blocking, the patient underwent surgical table to the unaided stretcher. It remained in the PACU for 60 minutes until the completion of sensitive blockade, having been to the ward, after received 200 mL of supplement (Fresubin Jucy®).

During the preanesthetic visit, patients who participated in two types of spinal anesthesia were explained; one with the possibility of continuing to move the legs and another with complete motor blockage of the legs. This data should be related to patient satisfaction. Before being discharged from the clinic, an anesthesiology resident recorded the patient's satisfaction with the technique that was classified as good, satisfactory, or bad. After the operation, patients were transferred to the post-anaesthetic care unit (PACU) for continuous monitoring of vital signs and regression of block. Patients were discharged when they were awake, able to walk unaided, and had stable signs for at least 1 h. Follow-up of the patients at home was done using a questionnaire asking about post-dural puncture headache (PDPH) or any transient neurologic symptom (TNS), and up to the 30th day regarding any permanent neurological complication.

Statistics

Wilcoxon-Mann-Whitney's non-parametric test was used to compare the equality of the median distribution of demographic variables, motor blockade and cephalic dispersion level. Chi-square tests and Fisher's exact test were used to compare the categorical variables. The degree of association was used the Contingency Coefficient. The chosen significance level was α=0.05.

RESULTS

The two groups were similar in relation to age, weight and height (Table I). The latency time was almost the same regardless of the lidocaine solutions of injected isobaric or hypobaric (Table I). Using the Wilcoxon-Mann-Whitney test there is no significant difference in the latency time of the both solutions. All patients in Group 1 (50 mg lidocaine isobaric) and Group a (24 mg lidocaine hypobaric) presented sufficient anesthesia for the surgical procedure without need for anesthesia complementation.

The cephalic dispersion of analgesia assessed in the posterior regions of patients according to a proposal in a recent published.[3] At 15 minutes analgesia was detected in the thoracic dermatomes in all patients with 2.5 mL (50 mg isobaric) and 4 mL (24 mg hypobaric). At 15 minutes the maximum diffusion was obtained in 100% of the patients, being significantly higher with isobaric solution (Mode=T9) than hypobaric solution (Mode=T11) (Figure 1). The hypobaric solution provided a more homogeneous cephalic dispersion. There is a significant association between increase dose and cephalic dispersion of analgesia (p-Value=0.0000, Contingency Coefficient=0.6153). No patient who received 2% isobaric lidocaine was able to perceive proprioperception testing, while all patients with 0.6% hypobaric lidocaine were able to identify the touch on the big toes.

The different degrees of motor block at 5, 10 and 15 minutes with both solutions are in Table II. There is significant difference between solutions to achieve different degrees of motor block. Complete motor blockade occurred in all patients with the 50 mg dose of isobaric lidocaine. In the 24 mg hypobaric lidocaine group, 85% of the patients did not present any degree of motor blockade.

The duration of analgesia and motor blockade are shown in Table III. The analgesia time ranged from 90 to 135 minutes with isobaric lidocaine, being significantly higher at hypobaric lidocaine from 50 to 90 minutes. The time of the motor block ranged from 75 to 115 min with isobaric lidocaine. There was no motor blockade in patients with hypobaric lidocaine. There was a significant difference in the ability to move from the surgical table to the transport bed. Only 7 patients switched from the surgical table to the transport bed with lidocaine isobaric, while all patients in the lidocaine hypobaric group moved from surgery to the transport bed. The reduction of almost 50% in the lidocaine isobaric dose (50 mg) to the hypobaric solution (24 mg) provided a faster recovery of the motor block, what permitted all of patients to move from the table to the stretcher, what made of this technique an excellent indication for ambulatory surgery. The small-dose solution may have an advantage in ambulatory patients because of the earlier recovery of motor and sensory function.

There is a significant association between increase dose and duration of analgesia and motor blockade (test Kruskal-Wallis $p<0.01$). Using the Wilcoxon-Mann-Whitney test ($w=1598$, $p=0.0000$) suggests that the sensitive blocking time is longer than the motor blocking time with all doses used. Using the Spearman correlation ($r=0.8442$) shows a strong association in which sensory blockade is longer lasting than motor blockade.

There was a significant difference (Chi-Square Test) in the degree of satisfaction in not having motor block in the different groups, being greater with lidocaine hypobaric (Table IV).

There was no hypotension or bradycardia in both groups. Post-puncture headache was observed in a patient in the isobaric lidocaine. All patients had complete anesthesia recovery. Tourniquet was not used in any patient from both groups because of the protocol. The mean analgesia provided by sciatic nerve block in the popliteal region was 18 hours. No neurological complications were observed in all patients studied, TNS or permanent neurological.

Table I: Demographics dates and latency time.

Dates	Lido ISO	Lido HIPO	P Value
Age (ys)	38.37±10.59	40.57±11.78	0.3072
Weight (kg)	66.12±7.34	68.25±6.60	0.0843
Height (cm)	167.42±3.89	168.63±6.58	0.2312
ASA: I/II	29 / 11	25 / 15	0.4743*
Latency time (min)	1:07±0:23	1:05±0:06	0.5092

* Fisher´s Exact Test

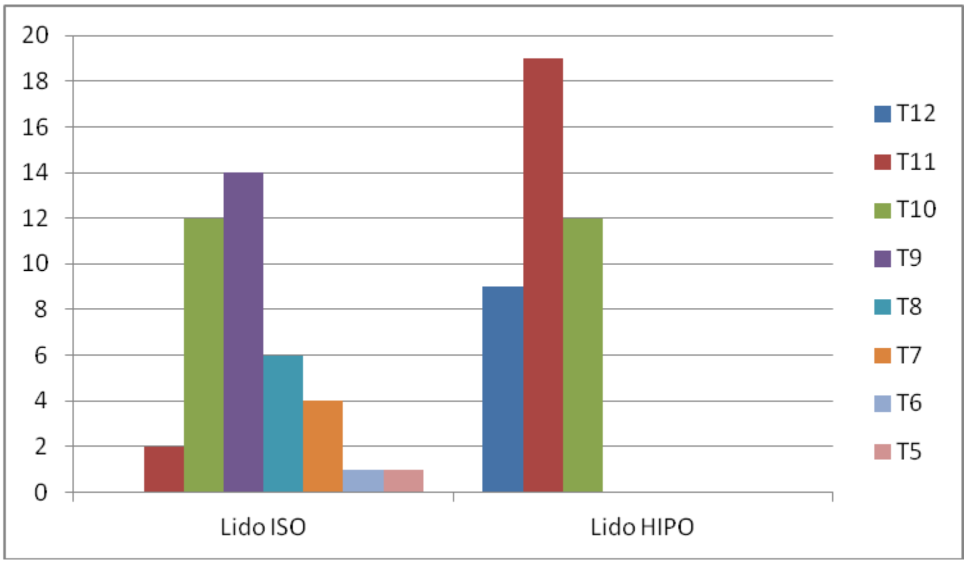

Figure 1: Maximum cephalic dispersion at 15 minutes.

Table II: The different degrees of motor block up 15 minutes.

Motor Block	Lido ISO			Lido HYPO		
	5min	10min	15min	5min	10min	15min
0	0	0	0	39	34	34
1	40	8	0	1	6	6
2	0	32	0	0	0	0
3	0	0	40	0	0	0

Table III: The duration of analgesia and motor blockade.

Time	Lido ISO	Lido HIPO	P-Value
Sensitive (min) (Minimum-Maximum)	107.90±12.23 (90 – 135)	66.62±8.19 (50 – 90)	0.0000
Motor Block (min) (Minimum-Maximum)	96.77±9.95 (75 - 115)	Did not occur	-

*** Wilcoxon-Mann-Whitney**

Table IV: Degrees of satisfaction with the technique.

Satisfaction	Lido ISO	Lido HIPO	P Value	Contingency
Good	0	40	0.0000	0.7071
Satisfactory	7	0		
Bad	33	0		

*** Chi-Square Test**

DISCUSSION

The result of our study shows that 50 mg of 2% isobaric lidocaine or 24 mg of 0.6% hypobaric lidocaine can provide adequate spinal anesthesia for short ambulatory orthopedic foot surgery procedures for patients requiring the prone jack-knife position. The onset of action was rapid with both solutions and duration of action was dose dependent. The dose of 0.6% hypobaric lidocaine blocked only the posterior nerve roots in all patients while 2% isobaric lidocaine blocks both the sensory and motor roots in all patients. No patient felt pain during the surgery, and none required supplementation with intravenous anesthetic.

By definition, baricity is the ratio between injected solution density and CSF density. Local anaesthetics density may be decreased by water dilution. The densities of the different local anesthetics and adjuvants frequently used in spinal anesthesia were evaluated using the latest generation densimeter, demonstrating that some solutions are marketed as isobaric, but in reality they are hypobaric solutions.[10] The density of the 2% lidocaine prepared as isobaric has the density of 0.99900 g/mL and 0.6% lidocaine has the density of 0.99950 g/mL, both fell below the lower limit of the CSF.[10]

Posterior radicles form sensory roots and anterior radicles form motor roots. To perform the puncture with patients in the prone position a pillow has to be placed under the abdomen to correct the lordosis and increase spinal interspace, and dose and type of anesthetics were injected in this position aiming at inducing spinal anesthesia. In this study the isobaric solution provided sensory and motor root anesthesia in all patients, while the hypobaric solution provided only sensory anesthesia in all patients. Due to the hypobaricity of 2% isobaric lidocaine, there was a predominance of the posterior roots resulting in a greater sensory blockade than the motor blockade.

With 75 mg of 5% hyperbaric lidocaine, the upper analgesia level remained between T1 and T5 in 90% of patients.[11] Equipotent doses of 2% isobaric lidocaine induced the same sensory block level.[12] With 2% plain lidocaine in dorsal decubitus, the level of analgesia remained below T7 from 70%[13] to 88% of patients.[14] In this study in the position of ventral decubitus, using a fixed dose of 50 mg (2.5 mL) of 2% isobaric lidocaine the cephalic dispersion was less homogeneous than the 24 mg (4 mL) 0.6% hypobaric lidocaine.

Transient neurological symptoms after spinal anesthesia are characterized by postoperative pain or dysesthesia in hips or lower extremities. Results of a broad multicentric study suggest that the lithotomy position and early ambulation in outpatient surgery are predisposing factors for transient neurological symptoms.[15] The occurrence of TNS after spinal anesthesia appears to be related to the type of local anesthetic used.[16] In a recent study it was shown that the incidence of TNS after spinal anesthesia was much less after levobupivacaine, bupivacaine and articaine than after lidocaine, in various types of surgery and was inserted in the sitting position.[17] No temporary neurological symptoms were observed in this study with isobaric lidocaine or hypobaric lidocaine solutions. Another factor which might have contributed to the absence of these symptoms in our study was the prone position for the surgery, the same observed with isobaric[3] and hypobaric lidocaine.[6]

There was no urinary retention in our study, similar to the results obtained with isobaric[3] and hypobaric lidocaine.[6] The incidence of post-dural puncture headache should not be a limiting factor for choosing spinal anesthesia if fine needles are used. Our study has used 27G cut needles and this complication was observed in only one patient in the isobaric group. Hypotension during neuraxial block is caused by vasodilatation, with predominance of venous dilatation and consequent decrease in venous return and cardiac output. The level of hypotension is related to the level of the blockade. Head-down position during surgery may have also contributed to prevent hypotension and hypotension was seen in only one patient.

One advantage of minimum motor block observed with hypobaric lidocaine was patients' ability to go from the operating table to the stretcher and of early ambulating. Isobaric lidocaine induces total motor block with patients' immobility, allowing for hospital discharge only after total blockade recovery. Patients undergoing spinal anesthesia with hypobaric lidocaine had a significantly better degree of satisfaction than patients receiving isobaric lidocaine, mainly because of lack of motor blockage of the lower limbs.

Our study has concluded that spinal block performed with the patient in the jack-knife position provided surgical analgesia with the complete motor block in all patients with 50 mg with 2% isobaric lidocaine and without motor block in all patients with 24 mg 0.6% hypobaric lidocaine. Twice the dose of the isobaric solution provided 40% longer analgesia. Most importantly, it allowed the patient to remain in this position, providing for better surgical exposure for surgeon and tranquility and safety for the patient. In our study, with hypobaric lidocaine all patients went from the operating table to the stretcher without help, and better degree of satisfaction.

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