Lidocaine 0.5% spinal anaesthesia: a hypobaric solution for short-stay perirectal surgery

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The efficacy of subarachnoid injection of 8 ml lidocaine 0.5% was assessed in ten outpatients having perirectal surgery in the jackknife position. This solution is hypobaric, with a baricity 0.9985 ± 0.0003 (mean $\pm$ SD). Injections were made with the patient in the surgical position (with the upper torso at a 15° downward inclination). Sensory level was tested by pinprick. Times to two-segment regression, to complete resolution of sensory analgesia, to urination, and to discharge from the recovery room were recorded. All injections produced effective anaesthesia for surgery. Lidocaine 0.5% behaves clinically as a hypobaric solution. Dermatome levels remained low (T_{11} to L_5) while the patients were in the surgical position (head down), but rose two to six dermatomes if the patient's head was elevated after surgery. Time to two-segment regression was 97 ± 36 min, time until regression to S_1 was 116 ± 22 min, time to complete resolution of sensory blockade was 151 ± 23 min, time to urination was 197 ± 64 min, and time to discharge from the recovery room was 205 ± 45 min. Lidocaine 0.5% provides effective spinal anaesthesia of short duration appropriate for outpatient surgical procedures. Dermatome sensory spread of anaesthesia, and our measurements of specific gravity, indicate that this solution is hypobaric. It appears that changes in position can alter the spread of analgesia for at least one hour after injection and, thus, we caution against elevating the patient's head in the immediate postoperative period.

On a étudié l'efficacité d'une injection sous-arachnoïdienne de 8 ml de lidocaïne 0,5% hypobare (baricité de $0,9985 \pm 0,0003$)

Key words

ANAESTHETICS, LOCAL: lidocaine;
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chez dix patients admis pour une chirurgie péri-rectale en position de Depage (« jackknife position »). L'injection de lidocaïne a été faite chez le patient en position chirurgicale et le niveau d'anesthésie fut mesuré par piquage. Toutes les injections ont entraîné une anesthésie efficace, le niveau n'excédant pas D11 (D11 à L5) tant que le patient est demeuré en position chirurgicale. Le redressement du patient à la fin de la chirurgie a entraîné une augmentation du niveau d'anesthésie de deux à six dermatomes. Le temps de régression de deux segments, le temps de régression à S_1 et le temps de résolution complète du bloc sensitif ont été respectivement de 97 ± 36 min, 116 ± 22 min et 151 ± 23 min. Le temps de miction a été de 197 ± 64 min et le temps de départ de la salle de réveil de 205 ± 45 min. La lidocaïne 0,5% procure une anesthésie rachidienne efficace et de courte durée qui convient bien au patient opéré en externe. En raison du caractère hypobare de la solution, on ne devrait élever la tête du patient que plus d'une heure après l'injection.

Hypobaric spinal anaesthesia is commonly used for patients having perirectal surgery in the prone (jackknife) position at our institution. Typically, a potent anaesthetic with a long duration such as tetracaine is utilized. Shorter acting agents are generally less potent and have traditionally been considered ineffective at dilutions necessary for hypobaricity.¹ However, we have found low concentrations of lidocaine (0.5%) to be effective for perirectal operations of short duration. This study was designed to define the characteristics of spinal anaesthesia produced by lidocaine at 0.5% concentration.

Methods

Before beginning this study we reviewed the literature regarding isobaric and hypobaric solutions of lidocaine,²⁻⁴ and performed an unblinded evaluation of the clinical characteristics of spinal anaesthesia performed with lidocaine at 0.5, 1.0, and 2.0% concentrations. Consistent with the previous studies, our clinical impression was that the 2% solution appeared to be isobaric and peak sensory block height was minimally affected by patient position.

The 1% solution usually behaved as if hypobaric, but not in all patients. A few patients receiving the 1% solution had high thoracic dermatomal levels of analgesia despite head-down positioning. Finally, the 0.5% solution appeared to be consistently hypobaric, and reliably produced surgical anaesthesia. We initially selected 40 mg because it seemed like a reasonably low dose. However, subsequent to completing this study we have successfully utilized 30 mg in an additional ten patients.

After receiving approval from the institutional review board, we prospectively evaluated the efficacy of lidocaine 0.5% spinal anaesthesia for outpatient perirectal surgery in ten patients. Patients received premedication intravenously with fentanyl 0–100 µg and/or midazolam 0–2 mg for sedation and were placed in the jackknife position with the head down at 15° from horizontal. Lumbar puncture was performed at the L₂₋₃ or L₃₋₄ interspace with either a 26 g Quincke or a 22 g Greene point needle and 0.2 ml of CSF was aspirated both before and after injection of the local anaesthetic to confirm placement. The lidocaine solution was prepared by adding 6 ml of sterile water to 2 ml of 2% lidocaine (preservative-free). The entire 8 ml of local anaesthetic (40 mg) was injected in each patient at a standardized rate of 0.5 ml per second. Patients remained in the jackknife position during surgery and were transported in the supine position to the recovery room. Sensory dermatome level of analgesia was determined by pinprick with an 18 g needle at 3, 5, 10, and 15 min and every 15 min until resolution to S₃. We also recorded the time to urination and time until the patient was ready for discharge. Criteria for discharge in our outpatient surgery department include stable blood pressure, good ventilation, alertness, and the ability to ambulate, void, and take fluids by mouth. Spinal anaesthesia was considered successful if the patient did not have surgical pain during the operation. Specific gravity determinations were made with a refractometer on six solutions of lidocaine 0.5% and on the CSF of six patients. The refractometer was calibrated with sterile water and all measurements were made at 25° C.

Results

Patients were of age 35 ± 7 (mean $\pm$ SD) yr, weight 75 ± 10 kg, and height 175 ± 10 cm. All operations were for perirectal surgery (Table I). Duration of surgery ranged from 15 to 55 min (21 ± 10 min). All blocks were successful for the surgical procedure. There was adequate surgical relaxation for anal dilatation in all cases. The maximal cephalad spread of sensory anaesthesia during surgery, while in the jackknife position, ranged from the L₅ to the T₁₁ dermatome (Figure 1). Four patients were placed in a sitting position in the recovery room after which the sensory level rose 2–6 dermatomes (Figure 1). This rise in sensory level occurred in one patient when the

TABLE I Perirectal surgical procedures performed in the jackknife position

Operations	Number
Haemorrhoidectomy	3
Incision and drainage	2
Condyloma removal	2
Fistulotomy	1
Sphincterotomy	1
Rectal tumour excision	1

FIGURE 1 Comparison of peak block height during surgery in the jackknife position and while supine or head up in the recovery room. When patients were placed head up in the recovery room (four of ten patients), block height rose from two to six dermatome levels. Thus, position changes explain the higher block heights observed in the recovery room.

upper torso was elevated 60 min after the block was placed. Subsequently, all patients were placed supine in the recovery room and the block heights did not rise more than one or two dermatomes from the peak level measured during surgery.

Sensory level of anaesthesia regressed two dermatomes from the peak block height in 97 ± 36 min, regressed to the S₁ dermatome in 116 ± 22 min, and completely resolved in 151 ± 23 min after the local anaesthetic was injected (Figure 2 and Table II). Time to urination was 197 ± 64 min. Time to discharge from the recovery room was skewed by one patient who spent 900 min in the recovery room for treatment of pain and subsequent nausea secondary to the narcotics. However, this patient met all other criteria for discharge when he voided 325 min after the local anaesthetic was injected. This data point was omitted from the analysis. Discharge times for the remaining nine patients averaged 205 ± 45 min after the spinal block was placed.

FIGURE 2 The change in sensory dermatome level as noted by pinprick over time (values are mean $\pm$ SD). Peak sensory block heights measured between 15 and 60 min were not significantly different.

TABLE II Duration of surgery and times for regression of sensory block height (assessed by pinprick) measured from the time of subarachnoid injection of lidocaine. Times are mean $\pm$ SD

Variable	Time (min)
Surgery duration	21 $\pm$ 10
Sensory regression	
– two segment	97 $\pm$ 36
– to S1	116 $\pm$ 22
– resolution	151 $\pm$ 23
Urination	197 $\pm$ 64
Discharge	205 $\pm$ 45

Specific gravity for lidocaine 0.5% was 1.0038 ± 0.0002 and for the CSF was 1.0053 ± 0.0001 . Thus the baricity of lidocaine 0.5% is 0.9985 ± 0.0003 .

Discussion

This study attempted to answer two questions: (1) Can dilute solutions of lidocaine produce effective spinal anaesthesia? (2) Are these dilute solutions hypobaric? Previous authors have stated that hypobaric solutions of short-acting local anaesthetics dilute anaesthetic potency "to the point that muscle relaxation is usually incomplete and sensory anaesthesia becomes too brief."¹ However, we had no problems with the former, and used the latter to our benefit. Specifically, lidocaine 0.5% provided effective spinal anaesthesia for all of our patients. No patient felt pain during the surgery, and none required supplementation with intravenous or inhalational anaesthetics. We have used this concentration of lidocaine in over 60 patients to date with good success and find it provides adequate anaesthesia for perirectal surgery when performed in the jackknife position. We conclude that lidocaine 0.5% is effective for spinal anaesthesia.

The dramatic effect that patient position had on spread of sensory anaesthesia suggests that this solution is hypobaric. When the patients were positioned with their head lower than their buttocks, the spread of sensory anaesthesia was consistently confined to the lower dermatomes (T₁₁ or lower). However, when patients were placed head up in the recovery room, the sensory level of analgesia rose two to six dermatomes. The clinical behaviour indicates that lidocaine 0.5% is hypobaric. Furthermore, specific gravities of the six CSF samples were all greater than those measured for the lidocaine solutions, and the mean baricity of 0.9985 is consistent with current definitions of hypobaricity.¹

It may be difficult for some readers to understand why the concentration of lidocaine, after dilution in CSF, is any different after 8 ml of 0.5% lidocaine than it would be after 2 ml of 2%. Why should the spread of anaesthesia differ? Indeed, previous research has demonstrated that the total dose of local anaesthetic is more important in predicting the spread of anaesthesia than is volume or concentration of the anaesthetic solution.⁵⁻⁷ However, these studies evaluated local anaesthetic solutions which are clinically isobaric. Since the spread of isobaric solutions is minimally affected by patient position, it is no surprise that dose becomes the most important factor.⁸ In contrast to these studies, the clinical utility of hypobaric and hyperbaric local anaesthetic solutions resides in the fact that patient position can be manipulated to influence the spread of spinal anaesthesia. For example, perineal anaesthesia is commonly achieved with a "saddle block" spinal anaesthetic, wherein a hyperbaric solution is administered to a patient in the sitting position, the solution gravitates to the most dependent portion of the spinal canal, and anaesthesia is confined to the sacral dermatomes. Thus, use of a hypobaric lidocaine solution may not alter the ultimate concentration of lidocaine after dilution with CSF, but can alter the distribution of lidocaine within the subarachnoid space when the patient is placed in a head-down position, and thus, alter the spread of spinal anaesthesia.

Although we expected position to affect the spread of lidocaine anaesthesia during the period immediately after injection, we were surprised that this solution continued to behave as if it were hypobaric 60 min after injection into the subarachnoid space. Upon review of the literature, we could not find any data regarding the time required for hypobaric solutions of local anaesthetic to mix with CSF. Our clinical impression when using hypobaric tetracaine is that changes in patient position will affect the spread of anaesthesia for only the first 10 to 20 min after injection. However, we must caution that we have not specifically and systematically studied this relationship. Perhaps the prolonged hypobaricity we observed is specific to lidocaine. If so, it may be explained by the relatively low lipid

solubility, and thus higher water solubility, of lidocaine when compared to tetracaine. These characteristics would result in slower penetration into the spinal cord and might prolong lidocaine concentrations in the hypobaric solution. Another possibility is that the increase in block level may have resulted from other factors, such as movement and straining by the patient. This possibility seems unlikely. All patients were moved from the operating room to the recovery room in the same way, yet the large rises in sensory level of analgesia were only noted in those patients who were placed in the head-up position. In view of our results, we caution that patients should remain supine for a minimum of one hour after injection to minimize cephalad migration of time block.

In conclusion, we have shown that 8 ml of lidocaine 0.5% produces effective spinal anaesthesia for perirectal surgery in the jackknife position. The effect that changes in patient position have on the spread of sensory anaesthesia indicate that this solution is clinically hypobaric. We caution that patients should remain head down (Trendelenburg position) or supine for at least one hour after injection to minimize cephalad migration of the block.

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