

COMPARISON OF HYPOBARIC, NEAR ISOBARIC AND HYPERBARIC BUPIVACAINE FOR SPINAL ANAESTHESIA IN PATIENTS UNDERGOING KNEE ARTHROSCOPY

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SUMMARY

The result of most of the studies on the effect of volume, concentration or total dose of local anaesthetic on spread of spinal anaesthesia support the assumption that total dose is more important than the volume. We compared low dose bupivacaine (6 mg) 0.5% (plain, near isobaric), hyperbaric 0.5% in 8.7% dextrose and 0.18% solutions (hypobaric) as the sole anaesthetic to achieve predominantly unilateral spinal anaesthesia for knee arthroscopy. Drugs were administered at the L3-4 interspace with the patient in the lateral position. Patients remained in this position for 20 minutes before being turned supine for the operation. Spinal block was assessed by pin prick and modified bromage scale and compared between the operated and non-operated sides. The haemodynamic changes were similar between groups and no significant changes were found in spread and duration of sensory and motor block. ($p > 0.05$)

The level of sensory analgesia, degree of motor block and duration of subarachnoid block were similar with low (1.2 ml) or high (3.4 ml) volumes though the block was more unilateral with hypobaric or hyperbaric than isobaric solutions.

Keywords : Anaesthesia, Regional, Spinal, Bupivacaine, Ambulatory, Arthroscopy, Knee.

Introduction

Ambulatory surgery demands good surgical anaesthesia with rapid recovery from sensory and motor block.¹ Unfortunately, the use of lidocaine, the local anaesthetic of choice for spinal anaesthesia in ambulatory settings, has been questioned with concerns about possible neurotoxicity.^{2,3}

In contrast to these troubling reports, the record of spinal bupivacaine has remained relatively untainted. Hampl et al⁴ reported 37% incidence of radicular symptoms of pain/or dysesthesias in buttocks, thighs or lower limbs after spinal anaesthesia with 5% lidocaine in 7.5% glucose as opposed to 1 of 150 patients who received 0.5% bupivacaine in 8.5% glucose.

It has long been known that the duration of spinal anaesthesia is proportional to the total dose of local anaesthetic⁵ so there is an increasing interest in the use of small doses of bupivacaine for spinal anaesthesia. Kussniemi and Pihlajamaki et al⁶ used low dose bupivacaine

(6 mg) either as plain (0.5%) or hypobaric (0.18%) solution to achieve predominantly unilateral spinal anaesthesia for day case arthroscopy. We have compared these with the low dose hyperbaric 0.5% bupivacaine, which is commonly available to us for use.

Patients and methods

We studied 60, ASA grade 1 and 2 non-premedicated cases, aged 20-60 years undergoing knee arthroscopy using spinal block as the sole anaesthetic. In all the patients, a thigh tourniquet inflated to a pressure of 300 mmHg was used to provide a blood less field. Informed consent from the patients was obtained.

Before instituting the spinal block, a peripheral venous cannula was placed. A bottle of Ringer's lactate solution was run at the rate just to keep the cannula patent. Heart rate and blood pressure were measured at 5 minute intervals before, during induction, during surgery and recovery by an automated oscillotomometer. Arterial O₂ saturation was recorded by pulse oximetry. If the systolic pressure decreased more than 50 mmHg from the initial value or to 90 mmHg, a vasopressor [Mephenteramine, (3 mg)] was given intravenously. Bradycardia of less than 50 beats min⁻¹ was treated with intravenous atropine.

Twenty patients each were randomly assigned to receive either 1.2 ml of 0.5% bupivacaine [Group B: S. G. 1.003 gm ml⁻¹ at 25°C], 3.4 ml 0.18% bupivacaine [Group A: 1.8 ml of plain 0.5% bupivacaine + aqua ad 5 ml; S. G. 0.997 gm ml⁻¹ at 25°C] or 1.2 ml of hyperbaric 0.5% bupivacaine [Group C: S. G. 1.024 gm ml⁻¹ at

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25°C]. The patients who were randomized to receive near isobaric or hypobaric solutions were given a subarachnoid block with the operating side up in the lateral position while those who were to receive hyperbaric solution were positioned with the operating side down.

Using an aseptic technique, a 25G Quincke needle was introduced in the midline at L₃₋₄ interspace, with the patient in the lateral position. Once a free flow of cerebrospinal fluid was obtained, the selected solution was injected using luer lock syringes within 10 seconds. The anaesthetic solution was injected without aspiration or barbotage at the beginning or end of the injection. The patients stayed in this position for 20 minutes before being turned supine.

Assessment of the motor and sensory block were made by the anaesthesiologist at the following times: after turning the patient supine, immediately after the operation, 2 hours post-spinal injection and every 30 minutes thereafter until there was no motor block. Myotomes from L₂-S₁ (hip flexion, knee extension, ankle dorsiflexion, great toe dorsiflexion and ankle plantar flexion) were tested. A score of '0' was assigned for no block and 1 for complete block or for uncoordinated movement. The total score was calculated for each side; the maximum being 5/5 points. The level of sensory anaesthesia was defined as loss of sharp sensation to pinprick and was recorded bilaterally in the mid-clavicular line and the regression of sensory and motor block was compared between the operated and non-operated sides.

All patients received diclofenac 75mg i.m. at the end of the operation unless there was any contraindication. The patients were asked to indicate the time they felt that the anaesthetic had completely worn off and the time of micturition. Postoperatively, the patients were allowed orally and to sit up if they felt like. They were discharged with an escort if they were able to drink, dress, walk and pass urine.

Follow up was done on the third day and one week postoperatively by the surgeon who inquired about postoperative headache as well as postoperative pain/dysesthesia in the buttocks or lower limbs and any positive cases were referred back to us.

Mean, standard deviation and frequency distribution of the variables were calculated for all the groups studied. Two-way analysis of variance (parametric and non-parametric) and one-way ANOVA (parametric and non-parametric) with post hoc analysis were performed to see the trend and any significant difference among the groups. A p value of less than 0.05 was considered statistically significant.

Results

The patients' characteristics and duration of surgery are listed in Table I. There was no difference between the groups with regard to age, weight or duration of surgery.

Table - I : Patients characteristics and duration of surgery [All values are mean (SD)]

	Group A 3.4 ml (0.18%)	Group B 1.2 ml (0.5% plain)	Group C 1.2 ml (0.5% heavy)	p value
Women/men	3/17	6/14	4/16	
Age (years)	28.25±7.81	33.35±12.75	26.95±7.74	0.098
Weight (kg)	61.9±10.03	60.6±10.69	68.75±13.72	0.07
Duration of Surgery (min)	38.65±15.59	34.35±5.14	32.2±6.02	0.13

The results of sensory block assessment are shown in Fig. 1. There was no statistically significant difference between the treatment groups but both the hypobaric and hyperbaric solutions spread to 2 dermatomes higher than the plain solution. Unilaterality of both the motor and sensory block was maximum with hypobaric solution (18 patients: 90%). Sensory block was obtained bilaterally in all patients with plain solution, which receded on the non-operated side by the end of 2 hours. Motor block was unilateral in 50% of the patients with plain solution. With hyperbaric solution, motor block was completely unilateral in 12 patients (60%) but the sensory block was only in 7 patients (35%).

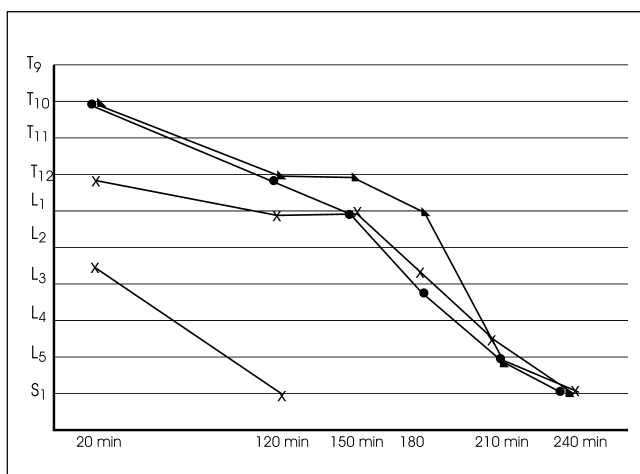


Fig 1 : The median upper limit of sensory block on the operated and non-operated sides at times shown before and after the operation. Grp A (n=20) hypobaric, Grp B (n=20) isobaric, Grp C (n=20) hyperbaric (6mg) for spinal anaesthesia.

●—● Grp A operated side ▲—▲ Grp B operated side
 ×—× Grp C operated side ×—× Grp B non operated side

Motor block assessments are shown in Fig. 2. The motor block between the operated and non-operated sides was significantly different at all testing times irrespective of the solution used. Time to full regression of anaesthesia was 258 ± 53.9 minutes, 298 ± 71 minutes and 268 ± 57 minutes in groups A, B and C, respectively and the difference was not statistically significant ($p=0.074$).

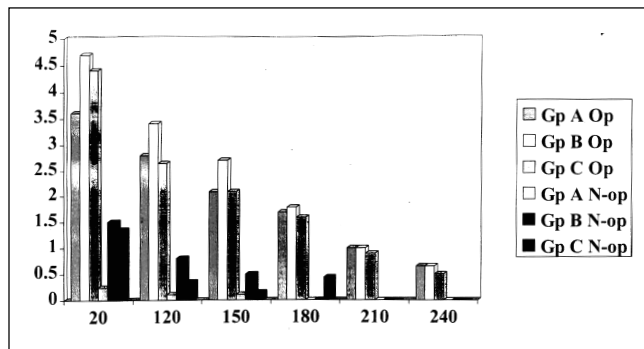


Figure 2 : The motor block score (modified Bromage scale; mean \pm SD) on the operated and non-operated sides in patients receiving hypobaric (group A; n=20, isobaric (group B; n=20) and hyperbaric (group C; n=20) bupivacaine (6 mg) for spinal anaesthesia)

Mean time to first passing urine was similar in group A and C (274.5 ± 45 minutes and 279 ± 56 minutes, respectively) but significantly longer in group B (379 ± 98 minutes) ($p < 0.001$).

There were no significant haemodynamic changes warranting treatment at any time. One patient of group B came back after 48 hours with complaints of headache with postural changes. He gave a history of not taking sufficient oral fluids in the hot month of July and improved after being administered 1.5 L of Ringer lactate solution fast, intravenously. This was followed by Tab. Nimuselide 100 mg 1 b.d. for 3 days.

Discussion

Bupivacaine is a long acting potent local anaesthetic agent. The amount of local anaesthetic usually used for subarachnoid block is an overdosage in relation to the minimum concentration required to block various types of nerve fibres. The major determinants of spread of intrathecally administered solutions are their dose, volume, concentration and baricity. The dose, volume and concentration of an anaesthetic agent are inter-related as the dose is a product of the volume and concentration. In the present study, we used three solutions of different baricity but in the same doses (6 mg) for knee arthroscopy and compared their effect in an attempt to recommend an ideal solution for short duration surgery, allowing the patient to be discharged on the same day. Our results indicate that a mainly

unilateral motor and sensory block can be obtained with less hypobaric solution when the patients remain in lateral position (operating side up) for 20 minutes after injection of the local anaesthetic and also by hyperbaric solution with the operating side down.

This study suggests that plain 0.5% bupivacaine (near isobaric) is slightly hypobaric and confirms the view of Covino et al.⁷ Unilateral block has also been reported with 8 mg hyperbaric solution.⁸ The upper level of blockade does not seem to change after late posture changes when low doses are used. Larger doses of plain or hyperbaric solution change the level and unilaterality of anaesthesia with movement even after 60-120 minutes of intrathecal injection.^{9,10}

The upper level of sensory blockade was generally about two segments higher in Group A and Group C as compared to Group B. It tends to indicate that near isobaric solutions tend to remain at the place of injection with less likelihood of upward migration. Unilaterality of anaesthesia was seen more in the hyperbaric and hypobaric groups as compared to the near isobaric group.

We used a 25G Quincke disposable needle for the block and the incidence of PDPH was 1/60 (1.6%). However, a lower incidence of PDPH has been reported with the use of 25G Sprotte needles which have a solid conical tip and a lateral eye.¹¹

The recent reports of transient neurological symptoms after lignocaine spinal anaesthesia have prompted us to search for alternatives to it for day care procedures. Transient neurological symptoms have been reported after hyperbaric bupivacaine spinal anaesthesia.^{4,12} No evidence of such symptoms were found in our study.

The haemodynamic changes were slight which is in accordance with results from previous studies.⁶ Low doses of the drug and the possibility of fewer blocked segments limiting the extent of sympathetic block may be the reason for this.

The mean time to first passing of urine was longer than the mean time to complete resolution of the motor and sensory block. This is in accordance with the studies of Tarkkila et al and Ben David et al.^{12,13} whose subjects were able to walk before they could micturate. We advised the patients to not attempt to pass urine before they had a natural urge to do so.

We conclude that low dose hypobaric, hyperbaric and near isobaric solutions are suitable for day care arthroscopic knee surgery in ASA grade 1 and 2 adult patients.

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