

# SPINAL ANAESTHESIA FOR PELVIC SURGERY: LOW CONCENTRATIONS OF LIGNOCAINE AND BUPIVACAINE ARE EFFECTIVE WITH LESS ADVERSE EVENTS

JYOTSNA PUNJ\* AND R.M. KHAN\*\*

## Abstract

**Background:** The aim of this study was to compare the clinical efficacy of 5% lignocaine, 2.5% lignocaine, 0.5% bupivacaine and 0.25% bupivacaine in subarachnoid block for pelvic surgeries.

**Methods:** 80 adult ASA grades I and II patients of either sex between the ages of 18-60 yrs, undergoing routine pelvic surgery of short duration were included in this prospective, randomized double blind study. Patients were allotted by computer generated random number table into 4 groups of 20 patients each.

Group A (n = 20): injected with 2 ml of 0.5% hyperbaric bupivacaine

Group B (n = 20): injected with 2 ml of 0.25% hyperbaric bupivacaine

Group C (n = 20): injected with 5% hyperbaric lignocaine

Group D (n = 20): injected with 2.5% hyperbaric lignocaine

The following parameters were measured every five minutes till 60 minutes and then every 15 minutes till recovery.

1. Onset of sensory block assessed by pin prick method bilaterally at middle of the shin. Maximum height of sensory block noted.

2. Onset of motor block assessed by inability to raise the leg.

3. Duration of sensory block judged as time to first postoperative analgesic requirement by the patient.

4. Duration of motor block assessed by return to Bromage scale of 1.

5. Non invasive blood pressure (NIBP) and Heart Rate-

6. Complications if any were noted

-nausea, vomiting, headache, transient neurological symptoms

Statistical analysis was done with Kruskal-Wallis, Mann-Whitney tests and ANOVA test.

**Results:** The groups were comparable with respect to age, weight and male to female ratio (p <0.05).

Time to onset of sensory block in seconds in groups A, B, C and D was  $79.5 \pm 52.26$ ,  $104.24 \pm 24.53$ ,  $33.6 \pm 14.98$  and  $62.50 \pm 25.05$  respectively. 5% lignocaine was observed to have statistically

\* Associate Professor, All India Institute of Medical Sciences, New Delhi, India; Ex Resident, JN Medical College, Aligarh.

\*\* Ex Prof, JN Medical College, Aligarh.

Affiliation: JNMC, AMU Aligarh.

**Corresponding author:** Jyotsna Punj. E-mail: jyotsna\_punj@yahoo.com

significant shortest onset of sensory block compared to other three groups ( $p < 0.05$ ).

The mean onset of motor block in seconds was  $137.25 \pm 60.92$ ,  $240.75 \pm 73.31$ ,  $62.30 \pm 24.56$ ,  $119.5 \pm 56.51$  sec in Groups A, B, C and D respectively with 5% lignocaine observed to have statistically significant fastest onset of time compared to the other groups ( $p < 0.05$ ).

The upper dermatomal height reached was T8 or T9 in groups A, C & D. However in group B, the upper dermatomal height reached was T10.

Duration of sensory block in minutes was  $172.5 \pm 49.64$ ,  $146 p.00 \pm 35.87$ ,  $105.9 \pm 31.68$  and  $133.6 \pm 17.68$  in groups A, B, C & D respectively. 0.5% bupivacaine was observed to have the longest duration of sensory block compared to both the groups of lignocaine ( $p < 0.01$ ).

The duration of motor block in minutes was  $159.25 \pm 53.49$ ,  $137.4 \pm 15.71$ ,  $100.5 \pm 21.81$ ,  $110.0 \pm 27.76$  respectively in groups A, B, C & D. The duration of motor blockade with 0.5% bupivacaine was significantly more as compared to 5% and 2.5% lignocaine ( $p < 0.005$ ).

Nine, one, twelve and four boluses of intravenous boluses of ephedrine were required in Groups A, B, C & D respectively. Most of the boluses were required after 30 minutes in Group A as compared to 5% lignocaine wherein the doses were required in the initial 30 minutes post spinal.

Four boluses each of intravenous atropine 0.3 mg were required in 0.5% and 0.25% bupivacaine which was not statistically significant amongst the four groups.

Significantly more patients in 0.5% bupivacaine required intravenous boluses of ondansetron 4 mg; five in Group A, one each in Group B and C and none in Group D ( $p < 0.05$ ).

None of the patients showed transient neurological symptoms till 5 days postoperatively.

None of the patients of this series developed post spinal headache at any time till discharge of the patient from the hospital (8-10 days).

Conclusion: For subarachnoid block for pelvic surgeries longer than two hours 0.25% bupivacaine

is a better choice as compared to 0.5% bupivacaine. However for short duration surgeries lasting up to one hour, 2.5% lignocaine is a better choice as compared to 5% lignocaine as the lower concentrated solutions of bupivacaine and lignocaine are more haemodynamically stable compared to their higher concentrations and with similar duration of sensory and motor block.

**Keywords:** bupivacaine, lignocaine, spinal anaesthesia

**Key message:** 0.25% bupivacaine and 2.5% lignocaine are more haemodynamically stable with similar profiles of duration of sensory and motor block as compared to their higher concentrations (0.5% bupivacaine and 5% lignocaine).

## Introduction

August Bier in 1899 performed planned spinal analgesia for surgery and thus introduced a method of painless surgery without making the patient unconscious. Spinal anesthesia is a well established technique for pelvic surgery and is considered to be a technique of choice in many patients. A combination of 5% lignocaine and 0.5% bupivacaine, with or without adjuncts, has been traditionally used for this purpose<sup>1-8</sup>. However this is associated with extensive motor block. A prolonged motor block extending to the post operative period is undesirable as it requires urinary catheterization and delayed immobility of the patient causing discomfort and delayed discharge in day care surgeries.

Attempts have been made to reduce the intensity of motor block without sacrificing the sensory block necessary for surgical procedure. As such, some authors have studied low dose and/or low concentrations of bupivacaine and lignocaine in subarachnoid block (SAB)<sup>9-18</sup>. To our knowledge no studies have compared the clinical efficacy of 5% lignocaine, 2.5% lignocaine, 0.5% bupivacaine and 0.25% bupivacaine in patients undergoing pelvic surgery in a single study protocol.

The aim of this study was to identify any significant clinical benefit and thus to conclude from this study the local anesthetic with quickest onset of action with minimal motor but optimal sensory block

of reasonable length of time.

## Methods

After approval by our local research committee and ethical clearance from the Institute Review Board, 80 adult ASA grade I and II patients of either sex between the ages of 18-60 yrs, undergoing routine pelvic surgery of short duration were included in this prospective, randomized double blind study.

Exclusion criteria were unwilling patients, coagulopathies, cardiac disease, hypertensive patients, shock, neurological disorders, spinal deformity and patients with skin infection of back at the site of lumbar block.

Premedication consisted of 10 mg of oral diazepam and prophylactic antibiotics.

In the operating room, routine monitors of NIBP, ECG and pulse oximeter were attached to the patient. All patients were preloaded with 500 ml of a balanced salt solution. Under all aseptic precautions, after infiltrating the skin with local anesthetic, subarachnoid block (SAB) was performed with 24 G quincke needle at L4-5 subarachnoid space in the sitting position by an expert anesthesiologist.

Eighty patients were randomized to either of the four groups by a computer generated random number table into 4 groups of 20 patients each. The solutions were made in the OT by an anesthesiologist not involved in the study. The anesthesiologist performing the spinal anesthetic was blinded to the solution being injected. The four groups were:

Group A (n = 20): injected with 2 ml of 0.5% hyperbaric bupivacaine; Group B (n = 20): injected with 2 ml of 0.25% hyperbaric bupivacaine; Group C (n = 20): injected with 5% hyperbaric lignocaine; and Group D (n = 20): injected with 2.5% hyperbaric lignocaine.

Dilutions to 0.25% bupivacaine and 2.5% lignocaine were done with normal saline available in sterile ampoules under aseptic precautions by an anesthesiologist other than the anesthesiologist performing the SAB who was blinded to the drug used. The final baricity of the diluted local anesthetic solutions was assessed as hyperbaric by the department

of pharmacology before the study was initiated.

Intrathecal injections were performed during a 30 sec period in all groups. After completion of spinal anaesthesia block patients were immediately placed in supine position.

The following parameters were measured every five minutes till 60 minutes and then every 15 minutes till recovery.

1. Onset of sensory block assessed by pin prick method bilaterally at middle of the shin. Maximum height of sensory block noted.

2. Onset of motor block assessed by inability to raise the leg. Intensity of motor block assessed using modified Bromage scale: (0- no block, 1- inability to raise extended leg, 2- inability to flex the knee, 3- inability to flex the ankle joint or first digit of foot)

3. Duration of sensory block judged as time to first postoperative analgesic requirement by the patient.

4. Duration of motor block assessed by return to Bromage scale of 1.

5. Non invasive blood pressure (NIBP) and Heart Rate-

1. Fall in more than 20% systolic blood pressure from baseline treated with a bolus of intravenous ephedrine 6 mg and fall in HR of more than 20% from baselines treated with intravenous bolus of atropine 0.3 mg. The doses were repeated if necessary.

6. Complications if any-

1. -nausea, vomiting, headache

2. transient neurological symptoms noted everyday for first five postoperative days

Nausea/vomiting in the perioperative period was treated with IV ondansetron 4 mg.

Patients were advised to lie flat in bed for 24 hours postoperatively with no pillow and plenty of oral fluids were given after return of bowel movements. Vital parameters were monitored during this time.

## Statistical Analysis

The size of the sample was based on the results of a pilot study, and the intention was to show a

Table 1  
Demography

	Group A (n =20 ) 0.5% bupivacaine	Group B (n =20 ) 0.25% bupivacaine	Group C (n =20 ) 5% lignocaine	Group D (n =20 ) 2.5% lignocaine
Age (in years)	46.60 ± 16.81	45.30 ±15.84	49.25 ±22.42	44.25 ±14.35
Sex (M:F)	12:8	12:8	11:9	10:10
BMI (kg/m <sup>2</sup> )	32.03 ± 2.55	30.73 ± 2.35	31.01 ± 2.65	31.02 ± 2.35
Durtn of surgery (min)	65 ± 25	73 ± 23	67 ± 22	71 ± 21

P > 0.05

Values given as mean ± SD

significant difference in spread of anesthesia of 2 or 3 dermatomes with a SD of 2 dermatomes, with an a risk at 0.05 and a p risk at 0.20. Comparisons between groups for onset time of sensory and motor blockades and cephalad spread of sensory blocks were performed using Kruskal-Wallis and Mann-Whitney tests. The ability to obtain a complete motor blockade was compared using a contingency table between isobaric and hyperbaric solutions. MAP changes were compared using analysis of variance (ANOVA) for repeated measurements; ephedrine and crystalloid requirements and frequency of hypotension were compared using a contingency table. The significance level was set at p < 0.05.

## Results

The groups were comparable with respect to age, weight and male to female ratio (p < 0.05). (Table 1).

Time to onset of sensory block in seconds in groups A, B, C and D was 79.5 ± 52.26, 104.24 ± 24.53, 33.6 ± 14.98 and 62.50 ± 25.05 respectively. 5% lignocaine was observed to have statistically significant shortest onset of sensory block compared to other three groups (p < 0.05). 0.25% bupivacaine had statistically slower onset compared to both concentrations of lignocaine (p < 0.005). (Table 2).

The mean onset of motor block in seconds was 137.25 ± 60.92, 240.75 ± 73.31, 62.30 ± 24.56, 119.5

Table 2  
Onset and duration of sensory and motor block in the four groups

	Onset Sensory block (in seconds)	Onset Motor block (in seconds)	Duration Sensory block (in minutes)	Duration Motor block (in minutes)
Group A (n =20 ) 0.5% bupivacaine	79.5 ± 52.26	137.25 ± 60.92	172.5 ± 49.64 **	159.25 ± 53.49 **
Group B (n =20 ) 0.25% bupivacaine	104.3 ± 24.53	240.75 ± 73.31	146.00 ± 35.87	137.4 ± 15.71
Group C (n =20 ) 5% lignocaine	33.6 ± 14.98 *	62.30 ± 24.56 *	105.9 ± 31.68	100.5 ± 21.81
Group D (n =20 ) 2.5% lignocaine	62.5 ± 25.05	119.5 ± 56.51	133.6 ± 17.68	110.0 ± 27.76

\* fastest onset of sensory and motor block (p < 0.05)

\*\* longest duration of sensory and motor block (p < 0.05)

Values given in mean ± SD

± 56.51 sec in Groups A, B, C and D respectively with 5% lignocaine observed to have statistically significant fastest onset of time compared to the other groups (p <0.05). 0.25% bupivacaine had statistically slowest onset of motor block (p <0.001) amongst all the groups. (Table 2).

The upper dermatomal height reached was T8 or T9 in groups A, C & D. However in group B, the upper dermatomal height reached was T 10. Time to reach the upper dermatomal height was not noted.

Duration of sensory block in minutes was 172.5 ± 49.64, 146.00 ± 35.87, 105.9 ± 31.68 and 133.6 ± 17.68 in groups A, B, C & D respectively. 0.5% bupivacaine was observed to have the longest duration of sensory block however it was statistically longer only compared to both the groups of lignocaine (p <0.01). 5% lignocaine had the shortest duration however only statistically significant compared to both the groups of bupivacaine (p <0.005). (Table 2).

The duration of motor block in minutes was 159.25 ± 53.49, 137.4 ± 15.71, 100.5 ± 21.81, 110.0 ± 27.76 respectively in groups A, B, C & D. The duration of motor blockade with 0.5% bupivacaine was significantly more as compared to 5% and 2.5% lignocaine (p <0.005). 5% lignocaine had statistically shortest duration of motor block as compared to both concentrations of bupivacaine (p <0.005). (Table 2).

Mean pre-spinal pulse rate and MAP was not significantly different between the 4 groups.

Nine, one, twelve and four boluses of intravenous boluses of ephedrine were required in Groups A, B, C & D respectively. Most of the doses were required after 30 minutes in Group A whereas most of the doses with 5% lignocaine were required in the initial 30 minutes post spinal. (Table 3).

Four boluses each of intravenous atropine 0.3 mg were required in 0.5% and 0.25% bupivacaine which was not statistically significant amongst the four groups. (Table 3).

Significantly more patients in 0.5% bupivacaine required intravenous boluses of ondansetron 4 mg; five in Group A, one each in Group B and C and none in Group D. (Table 3).

None of the patients showed transient neurological symptoms till 24 hours postoperatively.

None of the patients of this series developed post spinal headache at any time till discharge of the patient from the hospital (8-10 days).

## Discussion

Study of patients undergoing various surgical procedures of different body regions are associated with variable blood loss making it difficult to associate changes in hemodynamics to the local anaesthetic agents alone. It was this which prompted us to include patients undergoing only pelvic surgery, thereby making a more conclusive cause and effect relationship

Table 3  
Total number of doses of ephedrine, atropine and ondansetron required

	Ephedrine bolus	Atropine bolus	Ondansetron
Group A (n = 20) 0.5% bupivacaine	9**	4	5*
Group B (n = 20) 0.25% bupivacaine	1	4	1
Group C (n = 20) 5% lignocaine	12**	0	1
Group D (n = 20) 2.5% lignocaine	4	1	0

\* 0.5% bupivacaine required significantly more boluses of ondansetron (p <0.05)

\*\* higher concentrations of both bupivacaine and lignocaine required more boluses of ephedrine as compared to their dilute concentrations (p <0.05)

between hemodynamic changes and the effect of spinal analgesia with different local anaesthetics.

A comparative analysis of duration of sensory block with different concentrations and volume of bupivacaine and lignocaine by different workers is variable with different studies. This is secondary to difference in methodology like volume and concentration of local anaesthetic used and methods of assessing the onset and duration of sensory and motor block.

The onset time of sensory block reported by Veering et al with 0.5% bupivacaine 3 ml was 3.7 min in 20-55 years group and 3.9 min in >55 yrs group nearly twice to that of the results obtained in this study. This could be because they sought onset of sensory block till it reached L1 in contrast to our sensory block assessment as the loss of pinprick sensation at mid shin which is L4<sup>13</sup>.

The onset time of sensory block of 0.25% bupivacaine as recorded by Chung et al as assessed by pin prick method to level of T 6 was 7.7 min when working with 3.2-3.6 ml (9-8-9 mg) of 0.25% bupivacaine which was considerably longer than this study (1.74 min). This could be attributed to recording of onset of sensory block of the drug to T 6 by Chung et al as compared to our level at L4<sup>19</sup>.

The onset time of sensory block of 0.5% bupivacaine as reported by Williams et al was 9 min which is significantly longer than ours i.e. 79.5 sec (1.33 min). This could be attributed to the difference in methodology of assessing the sensory block. Williams et al used ethyl chloride spray in place of needle pricks and waited till sensory block reached T 10 which was recorded as the onset time of sensory block<sup>20</sup>.

Ewart MC et al in 1987 found similar duration of sensory and motor block of 0.5% bupivacaine and 5% lignocaine at thoracic level whereas longer duration of sensory and motor block was found in sacral and lumbar segments with 5% lignocaine<sup>21</sup>. Though Pradhan 2010 didn't comment on the onset of the similar concentrations of these drugs, he found a

similar duration of sensory and motor block with both these drugs<sup>22</sup>. However it is worthwhile to note that these authors have used different volumes of drugs as compared to our study.

In our study the hemodynamic parameters of 0.5% bupivacaine and 5% lignocaine were similar which is in accordance to study by Pradhan 2010 and Ewart MC 1987 who found similar hemodynamic parameters between both the groups.

In the study by Williams N et al in 1995, comparing 2% lignocaine and 0.5% bupivacaine, found a lower HR and MAP with 2% lignocaine, however volumes used were different than our study.

David B diluted 0.5% bupivacaine to final 4 different concentrations and found 0.25% bupivacaine 3 ml to be most hemodynamic stable as compared to 0.5% bupivacaine 3 ml and found it suitable for long duration of surgeries<sup>23</sup>.

In our study subarachnoid blocks with both the lower concentrations of bupivacaine and lignocaine offered similar duration of motor and sensory block as compared to their higher concentration counterparts and were found to be more haemodynamically stable in pelvic surgeries compared to their higher concentrations of 0.5% bupivacaine and 5% lignocaine.

Though both concentrations of lignocaine had faster onset and duration of sensory and motor block as compared to both concentrations of bupivacaine. Also 0.5% bupivacaine caused more nausea and vomiting in the perioperative period compared to the other local anaesthetics.

Thus we conclude that in subarachnoid block for pelvic surgeries longer than two hours 0.25% bupivacaine is a better choice as compared to 0.5% bupivacaine. However for short duration surgeries lasting up to one hour, 2.5% lignocaine is a better choice as compared to 5% lignocaine as the lesser concentrated drugs of bupivacaine and lignocaine are more haemodynamically stable with similar profiles of duration of sensory and motor block.

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