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# TO COMPARE THE EFFECTS OF ISOBARIC LEVOBUPIVACAINE AND HYPERBARIC BUPIVACAINE IN SPINAL ANESTHESIA FOR PATIENTS HAVING LOWER ABDOMINAL SURGERIES

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## Abstract

**Background:** To compare the effects of isobaric levobupivacaine and hyperbaric bupivacaine in spinal anesthesia for patients having lower abdominal surgeries. **Material and Methods:** Total of 80 patients, of either gender, with ASA grade I or II, aged between 18 and 65 years and weight between 48 and 88 kg, who were scheduled for elective lower abdomen were included in the study. The patients were categorized into two distinct groups: group B (n=40) and group L (n=40). Each group received either 3 ml of intrathecal hyperbaric bupivacaine or intrathecal isobaric levobupivacaine. Hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP), as well as oxygen saturation, were measured at several time points after the administration of the anesthetic agent. **Results:** The average time it took for the sensory block to start at the shin of the tibia was 1.21±0.41 minutes for the group receiving isobaric levobupivacaine (group L) and 1.12±0.41 minutes for the group receiving hyperbaric bupivacaine (group B), which was similar. The average duration of sensory block at the L1 level was 8.11±1.31 minutes in group L and 3.18±0.78 minutes in group B. Consequently group B established sensory block at the L1 level sooner and this difference was statistically significant ($p<0.001$). Furthermore, the average duration for the sensory block to reach the T10 level was 13.19±1.33 minutes in group L and 7.44±1.11 minutes in group B. This disparity was also shown to be statistically significant. In group L, the sensory block lasted considerably longer (213.15±5.67 minutes) compared to group B (195.23±5.15 minutes) with a p-value of less than 0.001. **Conclusion:** We concluded that the administering 3 ml of 0.5% isobaric levobupivacaine is a viable and safer substitute for 3 ml of 0.5% hyperbaric bupivacaine in spinal anesthesia for procedures involving the lower abdomen.

## INTRODUCTION

Spinal anesthesia is a straightforward, cost-effective and generally preferred method for lower abdominal surgery. It offers a quick onset of numbness and muscle paralysis, reduces the body's stress reaction and lowers the risk of blood clot formation. Although Bupivacaine is often used as a local anesthetic in spinal anesthesia, there have been recorded instances when accidental injection of bupivacaine into the blood vessels during attempted neuraxial anesthesia led to abrupt cardiac arrest that could not be revived.[1,2] Amide local anaesthetics possess a chiral center and occur as Levo S (-) and dextro R (+) stereoisomers. Out of the isomers, the dextro form was shown to be more poisonous.[3] Ropivacaine, the first levo enantiomer launched in the early 1990s, had a superior safety profile compared to bupivacaine. However, it possessed lower potency and hence could not surpass bupivacaine as a more favorable option. A newly released isomer called levobupivacaine has garnered attention because to its almost same potency to bupivacaine, but with a superior safety profile.[4,5] Currently, hyperbaric local anesthetic preparations are favored for spinal anesthesia due to their ability to induce a strong sensory and motor block, which starts working quickly. This is in contrast to simple solutions like bupivacaine, ropivacaine and


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levobupivacaine, which have a slower beginning.[6,7] Due to the unavailability of commercially prepared hyperbaric levobupivacaine in India, the process of adding glucose to make it hyperbaric in each instance is both burdensome and raises concerns about safety. In our nation, hyperbaric bupivacaine is considered the standard for spinal anesthesia. However, there is a lack of evidence comparing the effectiveness of intrathecal isobaric levobupivacaine and hyperbaric bupivacaine.[8,9] Hence, we conducted this research to evaluate the features of sensory-motor block, the hemodynamic profile and the occurrence of side effects between isobaric levobupivacaine and hyperbaric bupivacaine, both administered at a dosage of 15mg, in patients having lower abdomen surgery under spinal anesthesia. If isobaric levobupivacaine is shown to be clinically successful, it might serve as a superior alternative to hyperbaric bupivacaine in spinal anesthesia due to its reduced cardiotoxic and neurotoxic effects.[10]

## MATERIALS AND METHODS

Following clearance from the institutional ethics committee, a total of 80 patients, of either gender, with ASA grade I or II, aged between 18 and 65 years, and weight between 48 and 88 kg, who were scheduled for elective lower abdomen were included in the study. The patients were categorized into two distinct groups: group B (n=40) and group L (n=40). Each group received either 3 ml of intrathecal hyperbaric bupivacaine or intrathecal isobaric levobupivacaine. Patients with ongoing skin illnesses affecting the spine, spinal injuries, convulsions, hydrocephalus, coagulation disorders, major neurological conditions causing motor or sensory deficits, hypersensitivity to medications, unwillingness to participate, pregnancy or difficult behavior were not included in the study. A preanesthetic examination was conducted, during which the process of sub-arachnoid block was described to the patient and signed informed permission was acquired. A size 18G intravenous cannula was inserted and Ringer's Lactate solution (500 ml) was started in the operating room. The usual ASA monitors were connected and measurements were taken for baseline heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and oxygen saturation. The lumbar puncture procedure was carried out under stringent aseptic measures. A 25-gauge Quincke spinal needle was used to do the puncture in the L3-L4 intervertebral area using a midline approach while the patient was in a sitting posture. Patients were placed in a supine posture immediately after the injection of either intrathecal drug. Prior to commencing the surgery, patients were allocated into two groups by the use of a computerized random table. The medicine that was chosen for the treatment was concealed from the anesthesiologist who carried out the procedure and recorded the data in order to minimize any potential bias. The onset of sensory block was defined as the time it took from the entire administration of the local anesthetic agent to the point when there was a total absence of feeling in the shin of the tibia. The duration required to achieve full sensory blocking at the Ll and T10 levels was also recorded. The time required to reach the highest sensory level was measured using a 25-gauge hypodermic needle and the pin prick technique. A score of 0 indicated no feeling, a score of 1 indicated a sense of dull pressure, and a score of 2 indicated acute pain. The motor block was evaluated using the modified Bromage scale, which categorizes paralysis levels as follows: 0 (no paralysis), I (inability to lift extended legs), II (inability to bend the knee) and III (inability to flex the ankle). The onset time was measured as the duration from injection to reaching modified Bromage scale I. The assessment of complete motor block included measuring the duration required to reach a modified Bromage scale III. The total duration of the block was determined by measuring the time from the beginning of the block until the motor block was completely resolved. Hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP), as well as oxygen saturation, were measured at several time points after the administration of the anesthetic agent. These time points included immediately after injection (0 minute), and subsequently at 1, 2, 5, 10, 15, 30, 60, 90, 120, 150, and 180 minutes. Throughout the surgery, all patients received an optimal amount of intravenous fluid based on their hemodynamic characteristics. Patients were classified as hypotensive if their mean arterial pressure (MAP) dropped by more than 25% from the initial level. In such cases, they received intravenous ephedrine at a dosage of 6 mg, which was adjusted based on their individual reaction. If the heart rate (HR) dropped below 60 beats per minute, intravenous administration of atropine at a dosage of 0.02 mg/kg was administered. Complications including nausea, vomiting, bradycardia, hypotension, shivering, and headache were observed and managed accordingly. Following the completion of the surgical procedure, all patients were transferred to the recovery room and subjected to continuous monitoring. The patients' satisfaction was assessed by a series of questions and evaluated based on side effects and length of hospital stay.

**Statistical Analysis**

The statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS 25.0). The chi-square test was used to analyze qualitative data, whereas the unpaired t-test was used to analyze quantitative data. A P value less than 0.05 was deemed to be statistically significant. The sample size was determined to be 40 participants per group in order to detect a 10% variation in hemodynamic parameters.


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## RESULTS

The demographic characteristics of both groups were comparable in terms of age, weight, and male-to-female ratio (Table 1). The average time it took for the sensory block to start at the shin of the tibia was 1.21±0.41 minutes for the group receiving isobaric levobupivacaine (group L) and 1.12±0.41 minutes for the group receiving hyperbaric bupivacaine (group B), which was comparable. The average duration of sensory block at the L1 level was 8.11±1.31 minutes in group L and 3.18±0.78 minutes in group B. Consequently, group B established sensory block at the L1 level sooner, and this difference was statistically significant ($p<0.001$). Furthermore, the average duration for the sensory block to reach the T10 level was 13.19±1.33 minutes in group L and 7.44±1.11 minutes in group B. This disparity was also shown to be statistically significant. In group L, the sensory block lasted considerably longer (213.15±5.67 minutes) compared to group B (195.23±5.15 minutes) with a p-value of less than 0.001. [Table 2]

The time at which motor blockage (as measured by the Modified Bromage Scale- I) began was significantly sooner in group B (4.67±0.65 minutes) compared to group L (8.77±0.98 minutes) within group B. However, the duration of total motor blockage (Modified Bromage scale III) was significantly longer in group L (16.34±1.93 minutes) compared to group B (12.12±1.27 minutes), with a p-value of less than 0.001. The overall length of motor block in group L was 201.15±5.37 minutes, which was longer compared to group B with a duration of 184.44±5.47 minutes. This difference was highly significant, as shown in Table 2.

Both groups exhibited a gradual decline in heart rate (HR) from the initial value until the completion of the procedure. However, in group L, the drop was from 88.12±4.76 to 79.99±2.58 beats per minute, whereas in group B, it decreased from 87.11±4.13 to 67.06±2.44 beats per minute. The drop in heart rate was statistically significant from 5 minutes after drug injection to the end of the procedure. The decrease in heart rate was less in group L compared to group B, as shown in Table 3.

A decrease in average systolic blood pressure (SBP) was seen in both groups. In group L, SBP decreased from 125.02±4.45 mmHg to 118.12±2.65 mmHg while in group B, it decreased from 124.23±4.24 mmHg to 108.79±2.29 mmHg. Statistical significance was demonstrated from 5 to 120 minutes following medication injection, with a smaller decrease recorded in group L compared to group B (Table 4).

We found a decrease in the average diastolic blood pressure (DBP) from the initial value of 78.25±3.12 mmHg to 69.76±2.32 mmHg in group L and from 79.25±3.15 mmHg to 68.22±2.12 mmHg in group B. The statistical significance was seen at 10 minutes, 15 minutes to 120 minutes and 150 minutes but it was shown to be negligible at the conclusion of the procedure. Furthermore, group L had a smaller reduction in DBP compared to group B, as seen in Table 5. The mean arterial pressure (MAP) decreased from a baseline value of 93.97±3.65mmHg to 85.87±3.13mmHg in group L and from 94.88±3.68mmHg to 81.89±3.21mmHg in group B. Although there was a decrease in the average arterial pressure, it was statistically significant from 5 minutes to the completion of the procedure[Table 6]. There were no instances of respiratory trouble or a decrease in SPO2 below 90% during the procedure for any of the patients in either group[Table 7].

The only negative outcome detected throughout the trial was a decrease in blood pressure, with a prevalence of 25% in group B and 5% in group L. Additionally, bradycardia was reported in 12.5% of participants in group B.

**Table 1: Mean demographic data in group L and group B**

| Parameter | Group L | | Group B | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| **Age (years)** | 35.61 | 2.24 | 38.98 | 3.77 | 0.23 |
| **Weight (kg)** | 62.67 | 3.23 | 65.66 | 4.37 | 0.11 |
| **Gender** | | | | | 0.18 |
| **Male** | 32 | 80 | 30 | 75 | |
| **Female** | 8 | 20 | 10 | 25 | |

**Table 2: Comparison of sensory and motor blockade**

| Particulars | Group L | | Group B | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Onset of sensory block (min) | 1.21 | 0.41 | 1.12 | 0.41 | 0.11 |
| Sensory block at L1 level achieved (min) | 8.11 | 1.31 | 3.18 | 0.78 | <0.001 |
| Sensory block at T10 level achieved (min) | 13.19 | 1.33 | 7.44 | 1.11 | <0.001 |
| Maximum sensory level achieved (min) | 22.98 | 2.67 | 20.16 | 2.98 | <0.001 |
| Total duration of sensory block (min) | 213.15 | 5.67 | 195.23 | 5.15 | <0.001 |
| Onset of motor blockade by Modified Bromage Scale- 1(min) | 8.77 | 0.98 | 4.67 | 0.65 | <0.001 |
| Complete motor blockade achieved by Modified Bromage Scale-3 (min) | 16.34 | 1.93 | 12.12 | 1.27 | <0.001 |
| Total duration of motor block (min) | 201.15 | 5.37 | 184.44 | 5.47 | <0.001 |


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**Table 3: Comparison of pulse rate**

| Pulse rate per minute | Group L | | Group B | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Before premedication | 88.12 | 4.76 | 87.11 | 4.13 | >0.05 |
| Before induction | 94.37 | 4.41 | 93.75 | 4.33 | >0.05 |
| After induction (0 min) | 93.22 | 4.53 | 92.18 | 4.76 | >0.05 |
| 1 min | 91.88 | 3.84 | 90.45 | 3.11 | >0.05 |
| 2 min | 90.14 | 4.54 | 87.43 | 4.34 | >0.05 |
| 5 min | 88.65 | 3.54 | 81.32 | 3.22 | <0.001 |
| 10 min | 86.43 | 3.97 | 76.87 | 3.78 | <0.001 |
| 15 min | 85.01 | 3.67 | 72.33 | 3.27 | <0.001 |
| 30 min | 84.03 | 2.78 | 68.12 | 2.98 | <0.001 |
| 60 min | 82.43 | 3.76 | 67.04 | 3.91 | <0.001 |
| 90 min | 81.22 | 3.88 | 66.22 | 3.57 | <0.001 |
| 120 min | 83.37 | 3.67 | 66.66 | 3.88 | <0.001 |
| 150 min | 81.54 | 5.69 | 65.21 | 5.72 | <0.001 |
| 180 min | 79.99 | 2.58 | 67.06 | 2.44 | <0.001 |

**Table 4: Comparison of systolic blood pressure**

| Systolic blood pressure (mmHg) | Group L | | Group B | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Before premedication | 125.02 | 4.45 | 124.23 | 4.24 | >0.05 |
| Before induction | 125.02 | 4.45 | 124.23 | 4.24 | >0.05 |
| After induction 0 min | 124.76 | 4.76 | 123.99 | 4.45 | >0.05 |
| 1 min | 123.12 | 4.14 | 122.98 | 4.11 | >0.05 |
| 2 min | 122.02 | 4.26 | 121.01 | 4.18 | >0.05 |
| 5 min | 120.98 | 3.17 | 117.87 | 3.65 | <0.05 |
| 10 min | 119.65 | 3.27 | 114.22 | 3.66 | <0.001 |
| 15 min | 118.54 | 3.76 | 111.76 | 3.33 | <0.001 |
| 30 min | 118.06 | 2.98 | 110.02 | 2.58 | <0.001 |
| 60 min | 116.46 | 3.46 | 108.46 | 3.49 | <0.001 |
| 90 min | 115.89 | 3.76 | 108.12 | 3.55 | <0.001 |
| 120 min | 119.43 | 3.38 | 110.01 | 3.72 | <0.001 |
| 150 min | 118.88 | 5.87 | 110.76 | 5.44 | <0.05 |
| 180 min | 118.12 | 2.65 | 108.79 | 2.29 | <0.05 |

**Table 5: Comparison of diastolic blood pressure**

| Diastolic blood pressure (mmHg) | Group L | | Group B | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Before premedication | 78.25 | 3.12 | 79.25 | 3.15 | >0.05 |
| Before induction | 78.25 | 3.12 | 79.25 | 3.15 | >0.05 |
| After induction 0 min | 78.11 | 3.15 | 79.87 | 3.17 | >0.05 |
| 1 min | 76.86 | 3.19 | 78.89 | 3.23 | >0.05 |
| 2 min | 75.21 | 2.76 | 76.54 | 2.94 | >0.05 |
| 5 min | 74.54 | 3.08 | 73.21 | 3.11 | >0.05 |
| 10 min | 72.43 | 2.54 | 70.21 | 2.67 | <0.05 |
| 15 min | 71.06 | 2.87 | 68.81 | 2.77 | <0.001 |
| 30 min | 70.66 | 2.62 | 66.98 | 2.29 | <0.001 |
| 60 min | 70.67 | 2.76 | 66.43 | 2.83 | <0.001 |
| 90 min | 70.19 | 2.87 | 66.67 | 2.66 | <0.001 |
| 120 min | 70.54 | 2.98 | 67.77 | 2.88 | <0.001 |
| 150 min | 70.24 | 2.33 | 66.98 | 2.47 | <0.05 |
| 180 min | 69.76 | 2.32 | 68.22 | 2.12 | >0.05 |

**Table 6: Comparison of mean arterial pressure**

| Mean arterial pressure (mmHg) | Group L | | Group B | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Before premedication | 93.97 | 3.65 | 94.88 | 3.68 | >0.05 |
| Before induction | 93.97 | 3.65 | 94.88 | 3.68 | >0.05 |
| After induction 0 min | 93.65 | 3.11 | 94.45 | 3.13 | >0.05 |
| 1 min | 92.66 | 3.76 | 93.87 | 3.26 | >0.05 |
| 2 min | 90.59 | 3.15 | 91.12 | 3.22 | >0.05 |
| 5 min | 89.98 | 2.87 | 87.94 | 2.83 | <0.05 |
| 10 min | 87.77 | 2.65 | 84.65 | 2.67 | <0.001 |
| 15 min | 86.87 | 2.87 | 82.78 | 2.66 | <0.001 |
| 30 min | 86.38 | 2.56 | 80.98 | 2.75 | <0.001 |
| 60 min | 85.88 | 2.73 | 80.43 | 3.05 | <0.001 |


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| | | | | | |
|---|---|---|---|---|---|
| 90 min | 85.78 | 3.12 | 80.55 | 3.21 | <0.001 |
| 120 min | 86.58 | 3.08 | 81.49 | 3.09 | <0.001 |
| 150 min | 86.44 | 3.03 | 81.39 | 3.04 | <0.001 |
| 180 min | 85.87 | 3.13 | 81.89 | 3.21 | >0.05 |

**Table 7 Comparison of Spo2**

| Spo2 | Group L | | Group B | | P value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Before premedication | 99.03 | 3.54 | 99.19 | 3.24 | >0.05 |
| Before induction | 99.12 | 3.65 | 99.32 | 3.76 | >0.05 |
| After induction 0 min | 99.34 | 3.44 | 99.76 | 3.11 | >0.05 |
| 1 min | 99.58 | 3.06 | 99.81 | 3.27 | >0.05 |
| 2 min | 99.87 | 2.54 | 99.94 | 2.87 | >0.05 |
| 5 min | 99.99 | 3.13 | 99.98 | 3.17 | >0.05 |
| 10 min | 99.97 | 2.27 | 99.97 | 2.61 | <0.05 |
| 15 min | 99.98 | 2.54 | 99.97 | 2.44 | <0.001 |
| 30 min | 99.98 | 2.87 | 99.98 | 2.37 | <0.001 |
| 60 min | 99.96 | 2.98 | 99.97 | 2.33 | <0.001 |
| 90 min | 99.46 | 2.15 | 99.87 | 2.76 | <0.001 |
| 120 min | 99.66 | 2.91 | 99.67 | 2.18 | <0.001 |
| 150 min | 99.56 | 2.43 | 99.67 | 2.11 | <0.05 |
| 180 min | 99.12 | 2.18 | 99.32 | 2.18 | >0.05 |

**Table 8: side effects**

| Side effects | Group B | | Group L | | P-value |
|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | 0.12 |
| **Hypotension** | 10 | 25 | 2 | 5 | |
| **Bradycardia** | 5 | 12.5 | 0 | 0 | |

**Table 9: Satisfaction of the participants**

| | Group B | | Group L | | P-value |
|---|---|---|---|---|---|
| | Number | Percentage | Number | Percentage | 0.001 |
| Satisfaction | 38 | 95 | 36 | 90 | |

## DISCUSSION

The purpose of our research was to assess the effects of isobaric levobupivacaine and hyperbaric bupivacaine on spinal anesthesia in elective lower abdominal surgeries. Our findings indicate that isobaric levobupivacaine offers a prolonged period of sensory block and motor block together with enhanced hemodynamic stability in comparison to hyperbaric bupivacaine. The average time it took for the sensory blockage to reach the shin of the tibia, as well as the L1 and T10 levels, was identical when both local anesthetics were used. This finding is consistent with the results observed by previous researchers.[6,11] A comparable investigation with patients undergoing transurethral endoscopic surgery administered either 13.5 mg of hyperbaric bupivacaine or 13.5 mg of isobaric levobupivacaine revealed that the hyperbaric bupivacaine resulted in much faster initiation and cessation of motor and sensory blockade.[12] Furthermore, another investigation determined that hyperbaric Bupivacaine leads to a faster occurrence of medically important sensory and motor block in comparison to isobaric levobupivacaine or isobaric ropivacaine.[13] Our investigation revealed that the onset rate, namely at the shin of the tibia, was somewhat sooner with hyperbaric bupivacaine (1.12±0.41 minutes) compared to isobaric levobupivacaine (1.21±0.41 minutes). However, this difference was not statistically significant. Our research found that hemodynamic measures, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) dropped after the intrathecal injection of anesthetic drugs in both groups. However, the reduction was much greater when using hyperbaric bupivacaine. Unlike our investigation, another author discovered a statistically significant occurrence of hypotension. The greater dispersion of the block towards the head and the quick rise in the level of the block may account for the increased occurrence of substantial low blood pressure when using hyperbaric bupivacaine. However, it should be noted that a larger dosage of the medication (3.25 ml each) was administered in this study.[11] Additional research indicates that there is no discernible disparity in systolic blood pressure (SBP) among individuals who were administered these two substances. However, it is important to note that these trials used agents with similar baricity, meaning that both medicines were either isobaric or hyperbaric in nature.[9] There were no instances of respiratory trouble or a decrease in SPO2 below 90% during the procedure for any of the patients in either group. No significance occurrences of headache, nausea, vomiting, hypotension, bradycardia, chest


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discomfort, coughing, convulsions, respiratory depression, or procedure-related problems were seen in either group throughout our investigation.

## CONCLUSION

The intrathecal administration of either hyperbaric Bupivacaine or isobaric levobupivacaine was well tolerated and resulted in similar anesthesia for procedures involving the lower abdomen and lower limbs. The extended duration of sensory and motor blockage provided by isobaric levobupivacaine might be beneficial for procedures that need a longer duration. The prompt initiation of sensory and motor paralysis induced by hyperbaric bupivacaine may be used to achieve fast outcomes required in emergency surgical procedures. Our findings indicate that administering 3 ml of 0.5% isobaric levobupivacaine is a viable and safer substitute for 3 ml of 0.5% hyperbaric bupivacaine in spinal anesthesia for procedures involving the lower abdomen.

Limitation

This research has a limitation in terms of its small sample size. This investigation was conducted at a single center.

**Conflict of Interest:** The authors declare that they received no financial support and that they have no conflict of interests.

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