Comparison of Duration of Analgesic Effect of Nalbuphine and Morphine as an Adjuvant to Bupivacaine in the Supraclavicular Block under Ultrasound Guidance

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Abstract

Background: Although many studies are available in the literature that has analyzed the effects of morphine, nalbuphine, and other opioids, no study had compared the effects of nalbuphine versus morphine as an adjuvant to bupivacaine in the supraclavicular block under the guidance of ultrasound. Methodology: A randomized, double-blinded, prospective study was carried out on 60 patients of the American Society of Anesthesiologists Class I and II who were undergoing upper limb surgeries under the supraclavicular block. Patients were randomly allocated into two groups (n = 30). Group N received 20 ml of 0.5% bupivacaine with 50 μg.kg⁻¹ of nalbuphine, while Group M received 20 ml of 0.5% bupivacaine with 50 μg.kg⁻¹ of morphine. The characteristics of sensory and motor blocks, hemodynamic changes, duration of analgesia, adverse effects, and anesthetic requirements were studied at different time intervals. Results: In Group N, there was a statistically significant reduction in the time of onset of sensory block (9.9 ± 3.0 vs. 12.2 ± 2.6 min, P = 0.002) and motor block (14.4 ± 3.6 vs. 19.4 ± 3.6 min, P = 0.0005). The duration of sensory and motor blockade and duration of analgesia were comparable. There was no statistically significant difference regarding block characteristics and hemodynamic parameters. Conclusion: Nalbuphine when added to bupivacaine as an adjuvant had significantly shortened the time of onset of sensory and motor blockade than morphine. However, the duration of analgesia, sensory and motor blockade of nalbuphine versus morphine were comparable.

Keywords: Brachial plexus block, morphine, nalbuphine, supraclavicular block

INTRODUCTION

For upper limb surgeries, one of the regional anesthetic techniques usually performed is the supraclavicular brachial plexus block.[1] This block is performed at the level of trunks of the brachial plexus. The motor, sensory, and sympathetic fibers for the upper extremity are carried here.[2] The nerves are enclosed in a sheath of fascia from the neck to axilla.[1] To avoid the undesired effects of general anesthesia, the supraclavicular block is preferred as an alternative.[1]

Different techniques are used to perform the blockade like blind technique which relies on the surface landmark and positioning, nerve stimulator, and ultrasound-guided technique.[2] Ultrasound increases the success rate and reduces the injury to adjacent structures as well as nerve injuries. Besides, it has reduced the systemic toxicities of local anesthetic as the usage of ultrasound has minimized the volume of local anesthetic solutions used in the brachial plexus blocks.

Although the operative condition is good while we use a plain local anesthetic, the duration of postoperative analgesia is shorter.[1] Hence, various adjuvants are used to improve the duration of analgesia while reducing the dose and incidence of adverse reactions related to local anesthetics.[1]

We have compared the efficacy of analgesia and analgesic duration of action of nalbuphine, an agonist-antagonist opioid, and morphine, a pure agonist opioid, as adjuvants

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to bupivacaine. Although there are some studies in which morphine and nalbuphine were added with local anesthetics individually in the peripheral nerve blocks,\textsuperscript{1,4} to our knowledge, no study is available in the literature that had compared nalbuphine versus morphine as adjuvants to bupivacaine in the supraclavicular block. Hence, we took this study to analyze the effects of nalbuphine versus morphine as an adjuvant in the supraclavicular block.

**Methodology**

With the approval of the Institutional Ethical Committee, a total of 60 patients were randomly allocated to either of the two groups, named M and N. Patients, aged between 18 and 65 years with physical status of the American Society of Anesthesiologists (ASA) Class I and II of both sexes scheduled for surgeries around the elbow, forearm, and hand were enrolled in this study after obtaining the written and informed consent. Patients who have local site skin infections, psychiatric illness, coagulopathies, known allergies, and physical status ASA Class III and above were excluded from the study. Patients who satisfied the inclusion criteria were allotted to M or N group through the computer-generated randomization method. Group M patients received 20 ml of 0.5% bupivacaine with 50 µg.kg\textsuperscript{−1} of morphine made as 1 ml and given as a total volume of 21 ml and patients in Group N received 20 ml of 0.5% bupivacaine with 50 µg.kg\textsuperscript{−1} of nalbuphine made as 1 ml, thus a total volume of 21 ml [Flow Chart 1].

Under strict aseptic precautions with the guidance of ultrasound (SIEMENS ACUSON P300 machine with linear probe 10–12 MHz), 1–2 ml of local anesthetic is injected into the skin 1 cm lateral to the transducer. The supraclavicular block for elbow, forearm, and hand surgeries was performed after verifying the needle position and eliminating the intravascular needle placement. Anesthesia provider who was not aware of the local anesthetic mixture, deposited the drug over the brachial plexus after identifying the structures [Figure 1]. The sensory and motor blockade onset was checked with the 3-point scale method (0 = no sensory loss; 1 = no sensation to pinprick; and 2 = no touch sensation) and modified Bromage scale method (0 = normal muscle function; 1 = ability to move elbow; 2 = ability to move wrist; and 3 = complete block with inability to move fingers), respectively. The onset time was calculated from the cessation of drug administration to Grade 2 level blockade for the sensory component and Grade 3 level blockade for the motor component of the block. Intraoperatively, hemodynamic and respiratory parameters were also monitored.

The duration of sensory blockade was taken from the time of onset of sensory block until the pain reported first, whereas the duration of motor block was calculated from the onset of motor blockade up to complete mobility of the arm. Postoperatively, the pain was assessed with the help of the Numeric Rating Scale (1–10). Patients were also monitored for the side effects such as nausea, vomiting, and allergic reactions.

**Statistical analysis**

The IBM SPSS statistics software version 23.0, South Asia, was used to analyze the collected data. For the categorical variables, frequency analysis and percentage analysis were used; the mean and standard deviation were used for the continuous variables. The bivariate samples’ significant difference in independent groups was analyzed using the unpaired sample $t$-test. The categorical data significance was analyzed using the Chi-square test. The probability value of 0.05 for both of the above statistical tools was considered as significant.

**Results**

Demographic data of both the groups were comparable [Table 1].

The time of onset of sensory and motor block was significant in Group N compared to Group M. The onset of sensory and motor block in Group N was 9.9 ± 3.0 min and 14.4 ± 3.6 min, respectively, whereas in Group M, it was 12.2 ± 2.6 min and 19.4 ± 3.6 min with $P=0.002$ and $P=0.0005$, respectively. The duration of sensory block was 508.3 ± 124.2 min in Group N and 490 ± 75.8 min in Group M with $P=0.493$ [Table 2]. The duration of motor block was 482.6 ± 124.6 min in Group N and was 472 ± 83.9 min in Group M with $P=0.700$. The duration of sensory and motor blockade was statistically insignificant between the two groups [Table 2]. The side effects such as nausea, vomiting, and pruritus were also comparable between the two groups [Table 3].

**Discussion**

The supraclavicular block is one of the techniques preferred for surgeries in the upper limb, which was once described
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**Table 1: Demographic characteristics**

| Variables                  | Mean±SD | P   |
|----------------------------|---------|-----|
| Age (years)                | 39±13   | 36±14 | 0.416 |
| Gender (male/female in percentage) | 70/30 | 80/20 | 0.371  |
| Weight (kg)                | 57.4±5.5 | 59.5±9.0 | 0.281  |
| ASA (I/II)                 | 80/20   | 93.3±6.7 | 0.254  |

ASA=American Society of Anesthesiologist, SD=Standard deviation

**Table 2: Parameters studied (onset of sensory, motor blockade, and duration of sensory and motor blockade)**

| Parameters                     | Group M     | Group N     |  | P  |
|--------------------------------|-------------|-------------|---|-----|
| Onset of sensory block (min)   | 12.2±2.6    | 9.9±3       | 3.259 | 0.002 |
| Onset of motor block (min)     | 19.4±3.6    | 14.4±3.6    | 5.44 | 0.0005 |
| Duration of sensory block (min)| 490±75.8    | 508.3±124.2 | 0.89 | 0.493 |
| Duration of motor block (min)  | 472±83.9    | 482±124.6   | 0.388 | 0.700 |
| Duration of analgesia (min)    | 504±71      | 528±120     | 0.959 | 0.343 |

SD=Standard deviation

**Table 3: Side effects associated with morphine and nalbuphine**

| Side effects | Count (%) | Nalbuphine | Morphine |
|--------------|-----------|------------|----------|
| Nausea       | 3 (10)    | 5 (16.6)   |          |
| Vomiting     | 3 (10)    | 5 (16.6)   |          |
| Pruritus     | 0 (0)     | 0 (0)      |          |

Flow Chart 1: Consort flow diagram

80 patients selected for the study
Assessed for eligibility (n = 68)

Excluded (n = 8)
Failed to meet the inclusion criteria=5
Declined to participate=3
Randomized (n = 60)

Allocated to intervention (n=30)
Group N – 0.5% bupivacaine with 50µg.kg⁻¹ nalbuphine (21ml)
Analyzed (n = 30)

Allocated to intervention (n=30)
Group M – 0.5% bupivacaine with 50µg.kg⁻¹ morphine (21ml)
Analyzed (n=30)

and hemi-diaphragmatic paresis were reduced significantly under the ultrasound guidance. Similarly, in our study, these complications were avoided because all the blocks were performed under ultrasound guidance. A prospective study on the ultrasound-guided supraclavicular block was conducted by Sáinz López et al.[9] in which they concluded that there was a significant reduction in the requirement of local anesthetic volume. In our study too, we have used only 20 ml of 0.5% of bupivacaine with 50 µg.kg⁻¹ of nalbuphine or morphine made as 21 ml of total volume.

Zeng et al.[9] conducted a meta-analysis on comparing the analgesic effects and safety between morphine and nalbuphine in different routes of administration such as intravenous, intrathecal, and intramuscular in which they concluded that the analgesic effect of nalbuphine was similar to morphine. However, the side effects such as pruritus, nausea, and vomiting were observed more in the morphine group. In accordance with this meta-analysis, our study also observed that the analgesic effects of morphine and nalbuphine in the plexus block were comparable. Nevertheless, in contrast to that meta-analysis,[9] the side effects between nalbuphine and morphine were also comparable in our study which could be probably due to the site of injection (plexus block). In a prospective, randomized, double-blinded study, a significant reduction in the onset of sensory and motor blockade was observed by Nazir and Jain when comparing 30 ml of 0.375% bupivacaine and 30 ml of 0.375% bupivacaine with 1 ml (10 mg) of nalbuphine.[10] Furthermore, there was an enhancement in the duration of analgesia and motor blockade.[10] However, in our study, we observed that nalbuphine, even in the lower dose (3–4 mg in 60–80 kg weighing patients), had shortened the onset of sensory and motor blocks when compared to the equipotent dose of morphine. The duration of analgesia is about 7–11 h in the nalbuphine group of our study, which is in accordance with the study done by Gupta et al.,[1] where the duration of analgesia was about 7–9 h in the nalbuphine group. However,
they used 10 mg of nalbuphine (versus saline) as an adjuvant to 0.5% bupivacaine while we have used 50 µg.kg⁻¹ in this study. Abdelhaq and Adly Elramely⁴¹(11) observed that, the duration of analgesia, sensory, and motor blockade had increased with the addition of 20 mg of nalbuphine to 25 ml of 0.5% bupivacaine in the supraclavicular block than plain 25 ml of 0.5% bupivacaine. However, the duration of analgesia was slightly lesser in the nalbuphine group of our study when compared to Abdelhaq and Adly Elramely⁴¹(7–11 h vs. 13–15 h) which could be attributed to the lower doses used in our study. Furthermore, the “ceiling effect” could be the reason for no further increment in the duration of analgesia proportionate to the doses used by Abdelhaq and Adly Elramely.¹¹

Ilham et al.¹² conducted a randomized study in the supraclavicular block and observed that 30 ml of 0.5% plain bupivacaine had significantly reduced the onset of sensory and motor blockade when compared to 30 ml of 0.5% plain levobupivacaine. Jain et al.¹³ observed that the duration of sensory and motor blockade was prolonged on adding 0.3 mg of buprenorphine in 30 ml of 0.5% of ropivacaine when compared to the placebo group in the supraclavicular block.

Saryazdi et al.¹⁴ conducted a prospective, randomized, double-blinded study comparing morphine, buprenorphine, pethidine, and fentanyl as an adjuvant to lidocaine in the axillary block. They concluded that the duration and quality of block were better in morphine or pethidine than fentanyl or buprenorphine. However, in our study, the duration of analgesia, sensory, and motor blockade was comparable between nalbuphine and morphine as an adjuvant to bupivacaine. On comparing buprenorphine and morphine with 0.5% bupivacaine in the brachial plexus block, Viel et al.¹⁵ observed that the quality and duration of analgesia were superior in the buprenorphine group. Nonetheless, in our study, the duration of analgesia between morphine and nalbuphine was comparable. A study done by Bazzin et al.¹⁵ concluded that the duration of analgesia had improved when opioids such as morphine, buprenorphine, and sufentanil were added with the mixture of bupivacaine and lignocaine in the supraclavicular blocks.

Hence, to our knowledge, our study is unique in comparing nalbuphine versus morphine as an adjuvant to bupivacaine in the ultrasound-guided supraclavicular block, besides using the adjuvants on body weight basis, resulting in lower doses of them. We also believe that either morphine or nalbuphine in 50 µg.kg⁻¹ dose can be used as an adjuvant to local anesthetic in the brachial plexus blocks to provide a prolonged duration of analgesia in ambulatory surgeries also.

**Conclusion**

The supraclavicular brachial plexus block is a safer alternative to general anesthesia for upper limb surgeries. Due to the advancements in regional anesthesia with the use of ultrasound guidance, it is considered to be safer and more successful than the surface landmark approach. Nalbuphine, when added to bupivacaine, had significantly shortened the time of onset of sensory and motor blockade than morphine. However, the duration of analgesia, sensory and motor blockade of nalbuphine and morphine, are comparable.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

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