ORIGINAL RESEARCH

Extension Of Brachial Plexus Block With 1.5% Lignocaine, Adrenaline And Buprenorphine: A Comparison With 1.5% Lignocaine And Adrenaline (A Study of 50 cases)

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ABSTRACT

Background: Brachial plexus block is a crucial technique in regional anesthesia for upper limb surgeries. The choice of local anesthetic and adjuncts impacts the quality and duration of the block. This study explores the extension of brachial plexus block using 1.5% Lidocaine and compares it with 1.5% Lidocaine-Adrenaline-Buprenorphine combination. **Methods:** Fifty patients undergoing elective upper limb surgery were randomly assigned to Group A (1.5% Lidocaine-Adrenaline) and Group B (Lidocaine-Adrenaline-Buprenorphine). Onset and duration of sensory and motor block, hemodynamic parameters, and adverse effects were recorded. **Results:** Group B exhibited a significantly longer duration of analgesia compared to Group A ($p < 0.001$), while the onset of block was similar. There were no significant differences in the degree of sensory block between the two groups, but patients in Group B experienced increased drowsiness ($p < 0.001$). Complications and the need for general anesthesia supplementation were comparable between the groups. **Conclusion:** Lidocaine-Adrenaline-Buprenorphine extends the duration of brachial plexus block with a similar onset compared to Lidocaine-Adrenaline. However, it is associated with increased drowsiness. This study highlights the clinical significance of Buprenorphine as an adjunct in upper limb regional anesthesia, offering prolonged analgesia with potential considerations for patient alertness during surgery.

Keywords: Brachial plexus block, Lidocaine, Adrenaline, Buprenorphine, anesthesia

INTRODUCTION

Brachial plexus block has long been a cornerstone in the practice of regional anesthesia, especially for surgeries involving the upper limb. This technique offers a localized and targeted approach to achieving anesthesia and analgesia, sparing the patient the systemic effects and complications associated with general anesthesia. The selection of the most appropriate local anesthetic and adjuncts in brachial plexus block is a critical decision for anesthesiologists and surgeons. In this study, we explore the extension of brachial plexus block with a particular focus on the use of 1.5% Lidocaine and compare its effectiveness when combined with Adrenaline and Buprenorphine [1-3].

1. **Significance of Brachial Plexus Block in Modern Anesthesia:** Brachial plexus block is an indispensable tool in modern anesthesia practice, allowing for the selective numbing of the upper limb while maintaining the patient's consciousness. Its use is widespread, encompassing a broad range of surgical procedures, from orthopedic surgeries like shoulder arthroplasty and carpal tunnel release to plastic and reconstructive surgeries, such as hand and wrist procedures. Beyond surgery, brachial plexus block has found utility in chronic pain management and diagnostic procedures.

In addition to the precise control it offers over upper limb anesthesia, brachial plexus block is known for its superior postoperative analgesic effect. The reduction in systemic opioids' requirements, which can be associated with significant side effects, makes this technique an essential component in the multimodal approach to perioperative pain management.

2. **Local Anesthetics and Adjuncts in Brachial Plexus Block:** The success of brachial plexus block depends not only on the skill of the practitioner but also on the choice of local anesthetic agents and adjuncts. Local anesthetics, such as Lidocaine, Bupivacaine, and Ropivacaine, have been widely employed to provide the primary block. The addition of Adrenaline, a vasoconstrictor, has been a common practice, as it enhances the duration and quality of the block by delaying systemic absorption [1-5].

The primary goal in optimizing brachial plexus block is to achieve a balance between the onset and duration of anesthesia. An ideal local anesthetic should provide rapid onset to facilitate surgery while maintaining a prolonged duration to ensure postoperative analgesia.

3. **The Role of Lidocaine in Brachial Plexus Block:** Lidocaine, a widely used local anesthetic agent, is valued for its rapid onset of action. Its use in brachial plexus block has been associated with quick establishment of sensory and motor block, enabling surgeons to proceed with the intervention efficiently. However, Lidocaine's relatively short duration of action may necessitate reinjection during longer procedures or hinder optimal postoperative pain control.
4. **Exploring Adjuncts to Extend the Block:** Given the limitations of Lidocaine, the search for adjuncts to extend the block's duration without compromising its onset has been a subject of ongoing research. The inclusion of Adrenaline, for instance, has been a conventional approach in this regard. Adrenaline not only prolongs the block but also reduces systemic absorption of the local anesthetic, thereby minimizing its potential toxic effects.

However, recent studies have introduced Buprenorphine, a partial μ-opioid receptor agonist, as an intriguing adjunct for brachial plexus block. Buprenorphine offers prolonged analgesic effects, making it an appealing option in the quest to extend the duration of the block. Moreover, it is associated with a lower risk of respiratory depression compared to full μ-opioid receptor agonists, which further enhances its safety profile in regional anesthesia [6-10].

5. **Objective of the Study:** This study aims to investigate the extension of brachial plexus block using 1.5% Lidocaine as the primary local anesthetic and to compare its efficacy when combined with different adjunct: Buprenorphine. Specifically, we will assess the onset and duration of sensory and motor block, as well as hemodynamic stability and adverse effects in each group.

The results of this study will contribute to the growing body of knowledge regarding the optimization of brachial plexus block, with a particular emphasis on the potential benefits of Buprenorphine in extending the duration of anesthesia while maintaining a favorable onset profile.

MATERIALS AND METHODS

Study Design and Participants: This prospective study aimed to assess the extension of brachial plexus block using two different adjuncts. A total of 50 patients scheduled for elective upper limb surgery were enrolled in the study, with each group consisting of 25 subjects. The patients, aged 18 to 65 years, were carefully screened to ensure they met the inclusion criteria. Exclusion criteria included patients with allergies to any study drugs, coagulopathies, pre-existing neurologic deficits, or contraindications to regional anesthesia.

Randomization and Blinding: Randomization was achieved using computer-generated random numbers, and the allocation sequence was concealed in sealed, opaque envelopes. The study was conducted in a double-blind fashion, with both the patients and the researchers assessing the outcomes unaware of the group assignment. Each patient's group allocation was performed by an independent anesthetist who was not involved in the data collection.

Group Assignments: Group A (n=25) received 1.5% Lidocaine-Adrenaline for brachial plexus block, while Group B (n=25) received Lidocaine-Adrenaline-Buprenorphine. All drug preparations were identical in appearance to ensure the blinding process.

Anesthetic Technique: Patients were positioned comfortably, and the skin was prepared in a sterile manner. After identifying the appropriate brachial plexus, a nerve stimulator-guided technique was employed to ensure accurate needle placement. In both groups, 20 mL of the respective drug solution was injected incrementally around the brachial plexus using a 22-gauge, short-bevel, insulated needle.

Outcome Measures: The primary outcomes included the onset and duration of sensory and motor block. Sensory block onset was defined as the time from the completion of the injection to the absence of a pinprick sensation in the ulnar, median, and radial nerve distribution areas. Motor block onset was recorded when there was complete loss of motor power in these nerve distribution areas.

The duration of sensory and motor block was defined as the time from the onset of block to complete sensory and motor recovery. Sensory recovery was assessed using the pinprick test, and motor recovery was assessed using the Modified Bromage Scale.

Secondary outcomes included monitoring of hemodynamic parameters, including blood pressure, heart rate, and oxygen saturation, before and after the block. Additionally, the occurrence of any adverse effects, such as local anesthetic systemic toxicity (LAST), was recorded.

Data Collection and Statistical Analysis: Data were collected by trained anesthesia staff and recorded on standardized data sheets. Statistical analysis was performed using appropriate software. Continuous variables were presented as means ± standard deviations, and categorical variables were presented as frequencies and percentages. Student's t-test was used for continuous variables, and chi-square or Fisher's exact test was used for categorical variables. A p-value less than 0.05 was considered statistically significant.

Ethical Considerations: This study was conducted in compliance with the principles of the Declaration of Helsinki and approved by the Institutional Review Board [Include institution name]. Informed consent was obtained from all participants, outlining the nature and purpose of the study, potential risks, and their right to withdraw at any point without consequences.

RESULTS

Table 1: Time of Onset of Analgesia

The time to onset of analgesia in both groups was closely matched. In Group I, which received 1.5% Lidocaine-Adrenaline, the mean onset time was 9.72 ± 1.942 minutes, with a range of 8 to 15 minutes. Group II, which received Lidocaine-Adrenaline-Buprenorphine, had a mean onset time of 9.0 ± 2.612 minutes, with a range of 7 to 17 minutes. The p-value for the comparison of onset times between the two groups was >0.05, indicating no statistically significant difference.

Table 2: Duration of Analgesia

The duration of analgesia in Group II, which received Lidocaine-Adrenaline-Buprenorphine, was notably longer than in Group I. Group I had a mean duration of 139.6 ± 44.672 minutes, with a range of 90 to 210 minutes. In contrast, Group II exhibited a mean duration of 607.2 ± 134.273 minutes, with a range of 440 to 870 minutes. The p-value for the comparison of analgesia duration between the two groups was highly significant ($p < 0.001$), indicating that the Lidocaine-Adrenaline-Buprenorphine combination significantly extended the duration of analgesia.

Table 3: Degree of Block in Both Groups

The degree of sensory block achieved in both groups is summarized in Table 3. In Group I, the majority of patients (92%) achieved a complete block (degree 0), with only a small proportion having an incomplete block (8%). In Group II, a similar degree 0 block was achieved in 88% of patients, while 12% experienced a more profound block (degree 1). There were no cases of partial blocks (degree 2) in Group II. The p-value for the comparison of sensory block degree between the two groups was not statistically significant ($p > 0.05$), indicating that the choice of adjunct did not significantly affect the degree of sensory block achieved.

Table 4: Degree of Drowsiness in Both Groups

Table 4 presents the degree of drowsiness experienced by patients in both groups. In Group I, all patients remained alert (degree 0), while in Group II, 10% of patients reported mild drowsiness (degree 1). Three patients (12%) in Group II experienced more significant drowsiness (degree 3). The p-value for the comparison of drowsiness degrees between the two groups was highly significant ($p < 0.001$), suggesting that the Lidocaine-Adrenaline-Buprenorphine group experienced a higher degree of drowsiness.

Table 5: Complications in Both Groups

Table 5 outlines the complications observed in both groups. In Group I, there was one case (4%) of arterial puncture. In Group II, complications were more prevalent, with one case (4%) of arterial puncture, one case (4%) of hematoma formation, and two cases (8%) of nausea/vomiting. Tachycardia occurred in four patients (16%) in Group II. The p-value for the comparison of complications between the two groups was not statistically significant ($p > 0.05$), suggesting that the incidence of complications was comparable between the groups.

Table 6: Intraoperative Requirement of Sedatives

Table 6 indicates that 20% of patients in Group I required the administration of sedatives during surgery, while no patients in Group II needed sedative supplementation. The p-value for this comparison was statistically significant ($p < 0.05$), indicating that patients in Group II had a reduced requirement for sedatives during surgery.

Table 7: Supplementation of General Anesthesia

In Table 7, it is evident that some patients in both groups required supplementation with general anesthesia. In Group I, 3 patients (12%) required this supplementation, whereas in Group II, 2 patients (8%) needed general anesthesia. The p-value for the comparison of general anesthesia supplementation between the two groups was not statistically significant ($p > 0.05$), suggesting that there was no significant difference in the need for general anesthesia between the groups.

Table 1: Time of Onset of Analgesia

Group	Mean ± SD (minutes)	Range (minutes)	p-value
Group I	9.72 ± 1.942	8-15	
Group II	9.0 ± 2.612	7-17	>0.05

Table 2: Duration of Analgesia

Group	Mean ± SD (minutes)	Range (minutes)	p-value
Group I	139.6 ± 44.672	90-210	
Group II	607.2 ± 134.273	440-870	<0.001

Table 3: Degree of Block in Both Groups

Degree of Block	Group I	Group II	p-value
0	23	22	>0.05
1	0	3	
2	2	0	
Total	25	25	

Table 4: Degree of Drowsiness in Both Groups

Degree of Drowsiness	Group I	Group II	p-value
0	25	12	<0.001
1	0	10	
2	0	0	
3	0	3	
Total	25	25	

Table 5: Complications in Both Groups

Complication	Group I	Group II	p-value
Arterial Puncture	1 (4%)	1 (4%)	>0.05
Hematoma Formation	0 (0%)	1 (4%)	
Nausea/Vomiting	0 (0%)	2 (8%)	
Tachycardia	0 (0%)	4 (16%)	
Total	1 (4%)	8 (32%)	

Table 6: Intraoperative Requirement of Sedatives

Group	No. of Patients	Percentage	p-value
Group I	5	20%	<0.05
Group II	0	0%	

Table 7: Supplementation of General Anesthesia

Group	No. of Patients	Percentage	p-value
Group I	3	12%	>0.05
Group II	2	8%	

DISCUSSION

The findings of this study shed light on the use of different adjuncts in extending brachial plexus block and their impact on the quality and duration of anesthesia. The results are integral in shaping clinical practices, especially in surgeries involving the upper limb. In this discussion, we will analyze the implications of these findings and their clinical significance.

Onset of Analgesia: The time of onset of analgesia in both Group I (1.5% Lidocaine-Adrenaline) and Group II (Lidocaine-Adrenaline-Buprenorphine) was remarkably similar. This similarity suggests that the addition of Adrenaline and Buprenorphine did not significantly affect the rapidity of onset of sensory and motor block. This observation is consistent with previous research, which also reported no significant difference in the onset of sensory block with and without Adrenaline [1-5].

Duration of Analgesia: The primary outcome of our study, the duration of analgesia, demonstrated a striking difference between the groups. Group II, receiving Lidocaine-Adrenaline-Buprenorphine, exhibited a significantly longer duration of analgesia compared to Group I. This outcome highlights the potential advantages of using Buprenorphine as an adjunct in brachial plexus block. The extended duration of analgesia observed in Group II is in line with the known prolonged analgesic effects of Buprenorphine, a partial μ-opioid receptor agonist [2-6].

Degree of Block: The degree of sensory block achieved in both groups was comparable. Most patients in both groups achieved a complete sensory block, and there was no statistically significant difference between the two groups. This indicates that the adjuncts, Adrenaline and Buprenorphine, did not

significantly influence the depth of sensory block achieved. These results are consistent with the goal of maintaining the effectiveness of sensory block while extending the duration.

Drowsiness: While the degree of sensory block remained similar, the degree of drowsiness significantly differed between the groups. Patients in Group II, receiving Buprenorphine, experienced a higher degree of drowsiness compared to those in Group I. This increased drowsiness could be attributed to the opioid effects of Buprenorphine, which is known to produce sedative effects [3,7-10]. It is crucial to consider this aspect in clinical practice, as patient comfort and alertness are significant factors in the choice of anesthesia technique.

Complications: The analysis of complications in both groups showed no significant differences. The incidence of complications, including arterial puncture, hematoma formation, nausea/vomiting, and tachycardia, did not significantly vary between the groups. This suggests that both Lidocaine-Adrenaline and Lidocaine-Adrenaline-Buprenorphine are well-tolerated options for brachial plexus block. However, the small sample size may have limited the ability to detect less frequent complications, and a larger study may be necessary to explore potential rare adverse events.

Intraoperative Sedative Requirement: The data revealed that a higher proportion of patients in Group I required intraoperative sedative supplementation (20%) compared to Group II (0%). This finding suggests that Lidocaine-Adrenaline-Buprenorphine may contribute to reduced intraoperative sedative requirements. Minimizing the need for sedation is advantageous as it can enhance patient comfort and reduce the risk of sedation-related complications.

Supplementation of General Anesthesia: The results indicate that a small proportion of patients in both groups required supplementation with general anesthesia. The need for general anesthesia supplementation did not significantly differ between the groups, further emphasizing the potential clinical applicability of both techniques.

Clinical Implications: Our study underscores the potential benefits of Buprenorphine as an adjunct in brachial plexus block. The extension of analgesia duration without compromising onset time is a promising development in regional anesthesia. However, the increased drowsiness associated with Buprenorphine use should be carefully considered, particularly in patients for whom maintaining alertness during the procedure is critical.

In conclusion, the choice of adjuncts in brachial plexus block plays a pivotal role in shaping the anesthetic profile. The Lidocaine-Adrenaline-Buprenorphine combination offers the advantage of prolonged analgesia, making it a valuable option for surgeries involving the upper limb. Nevertheless, clinical judgment should be exercised, considering patient factors and the specific requirements of the surgical procedure.

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