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Original Research Article

A Comparison of Analgesic Efficacy of Bupivacaine 0.5% with Dexamethasone and Bupivacaine 0.5% Alone in Supra Clavicular Brachial Plexus Block

Ajay Prajapati[1], Vidhi Patel [2], Parth Pandya[3], Bansi Thakkar[4]*, Kaushik Prajapati[5]

[1,5]Assistant Professor, Department of Anesthesia, GMERS Medical College, Vadnagar, Gujarat, India
[2,4]Assistant Professor, Department of Anesthesia, Nootan Medical College & Research Centre, Visnagar, Gujarat, India
[3]Assistant Professor, Department of Anesthesia, Parul Institute of Medical Sciences & Research, Vadodara, Gujarat, India

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Corresponding Author: Dr. Bansi Thakkar
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Abstract:

Introduction: The analgesic effects of injection of local anesthetic in supraclavicular block for upper limb surgeries are time limited. Bupivacaine is a local anesthetics used in brachial plexus block. It is widely believed that dexamethasone improves the quality and duration of peripheral nerve block over local anesthetic alone This study evaluated the efficacy of bupivacaine, with or without dexamethasone, in blocking the brachial plexus in patients undergoing upper limb surgeries. Group S received a solution consisting of 0.5% bupivacaine mixed with normal saline, while Group D received a solution consisting of 0.5% bupivacaine supplemented with dexamethasone.

Methods: The analysis of demographic data showed that there were no differences in age, weight, sex distribution, or ASA grade among the groups. The duration of the surgical operation was similar across the various groups. Group D had a faster onset of sensory and motor block compared to Group S.

Results: In Group D, the onset of the sensory block occurred at an average time of 3.90 ± 0.84 minutes, whereas in Group S, it occurred at an average time of 5.10 ± 0.92 minutes ($p < 0.0001$). In Group D, the motor block started after an average of 5.50 ± 1.04 minutes, whereas in Group S, it started after an average of 6.50 ± 0.82 minutes ($p = 0.0001$). Group D had a much higher level of sensory and motor block than Group S ($p < 0.0001$).

Conclusion: In summary, the combination of dexamethasone and bupivacaine for brachial plexus block resulted in a faster onset and stronger effect on both sensation and movement compared to utilizing bupivacaine alone. However, there was no noticeable difference in the duration of the surgical operation between the two groups. The findings suggest that dexamethasone might enhance the efficacy of bupivacaine for brachial plexus block in upper limb surgeries.

Keywords: Dexamethasone, Bupivacaine, Pre-medication, Sensory and motor block.

Introduction

Ultrasound-guided supraclavicular brachial plexus blocks are often used as an anesthetic method for procedures involving the upper limb. They have several benefits compared to general anaesthesia, such as inhibiting the activity of sympathetic nerves [1], improved postoperative pain control [1], significant rates of success [1], and reduced adverse reactions [1]. The supraclavicular approach is a widely used and dependable technique for anesthetizing the arm below the shoulder during surgical procedures [1]. Nevertheless, the utilization of just local anesthetic in this method does not provide enduring pain alleviation after the surgical procedure [1]. In order to prolong the alleviation of pain after a surgical procedure, medical professionals have the option of using durable regional anesthetics, such as bupivacaine [1]. Adjuvants refer to drugs that are included into local anesthetic in order to enhance its efficacy [1]. An optimal supplement for brachial plexus blocks should include the following characteristics: prolong analgesia without adverse reactions [1], extended muscular weakness (crucial for surgical procedures) [1] and enable physicians to administer less amounts of local anesthetic [1]. Regrettably, research on other substances used as adjuvants, such as opioids, clonidine, and neostigmine, has shown inconsistent outcomes or adverse reactions [2]. Dexamethasone, a potent corticosteroid drug, has shown in animal experiments its ability to prolong the duration of

nerve blocks [3]. When administered with bupivacaine in humans, it has the potential to enhance pain management [3]. The precise mechanism of action of dexamethasone remains uncertain, however it is hypothesized to potentially involve in modulating pain signals via influencing nerve cells and potassium channels [3], constricting blood vessels to decrease the rate at which local anesthetic is absorbed [3], and decreasing systemic inflammation in the body [3].

The objective of our study: This study conducted a comparison between the efficacy of mixing dexamethasone with bupivacaine in ultrasound-guided supraclavicular brachial plexus blocks for upper limb surgery, and the use of bupivacaine alone [3]. Peripheral nerve blocking is a crucial method for attaining the best possible surgical conditions. The history of this goes back to 1884 when Dr Karl Koller was the first to use local anaesthesia for ocular procedures. Kulenkampf subsequently established the supraclavicular technique for brachial plexus blockage, which involves targeting a tightly organized region that requires less anaesthesia solution and results in a faster start of the effect.

Bupivacaine, renowned for its extended duration of action, is the favoured choice among various local anaesthetics in this particular context. In order to enhance pain-relieving properties, several substances such as opioids, Clonidine, Neostigmine, and Midazolam have been used in brachial plexus blocks (Brummett and Williams, 2011). Dexamethasone, a synthetic molecule with glucocorticoid and anti-inflammatory characteristics, has garnered interest due to its potential as a supplementary agent to bupivacaine. The objective of this research was to assess the efficacy of combining dexamethasone with bupivacaine (0.5%) in comparison to utilizing bupivacaine (0.5%) alone for supraclavicular brachial plexus block [4].

Material and Methods

This study examined the efficacy of including dexamethasone into a nerve block for surgical procedures involving the upper limb. The research was conducted with meticulous control and focused on the following crucial aspects:

Study Design: Prospective, randomized, controlled clinical trial. Participants: The study included a total of 60 patients, ranging in age from 18 to 60 years old, with ASA I & II physical status.

Procedure: Elective surgeries on the upper limb (lower arm, elbow, and forearm) were performed utilizing a supraclavicular brachial plexus block. The predicted length of the surgery is 150 minutes.

Inclusion Criteria: Participants must provide written informed permission. They must not be pregnant, have any allergies to local anaesthetic, suffer from neuropathy, mental problems, blood disorders, or take anticoagulant medication.

Additionally, they should not have any brachial plexus concerns or local infections at the injection site. Randomization refers to the process of selecting or assigning elements or individuals to different groups or conditions in a random manner.

The patients were allocated into two groups of 30 each using computer software. Group S (Standard): Administered a 25 ml injection consisting of 23 ml of 0.5% bupivacaine and 2 ml of 0.9% saline. Group D, which received Dexamethasone, was given an injection consisting of 0.5% bupivacaine (23 ml) and dexamethasone (8 mg, 2 ml), resulting in a total injection volume of 25 ml.

This methodology enables researchers to assess the comparative efficacy of the two nerve block alternatives (with and without dexamethasone) while reducing bias.

Results

Table 1: Demographic data

Parameters	Group D readings	Group S readings	p Value	Inference
Age parameter (Years)	36.07 ± 9.93	37.47 ±10.02	0.59	NS
Weight parameter (Kg)	66.27 ± 6.56	65.57 ± 6.77	0.69	NS
Sex(M/F)	18:12	19:11	0.79	NS
ASA Grade I&II	22&8	24&6	0.54	NS

Table 1 presents the background information of the two groups, Group D and Group S that participated in the clinical trial. For the sake of comparisons, it is crucial to establish groups that are comparable. Fig 1 provides data on age, weight, sex, and general health condition. Here is an analysis of the information discovered by the individual: Age: The two groups had comparable mean ages (about 36-37 years old) without any disparity. The average weights of both groups were similar, with no statistically significant difference noted. The average weight was about 65-66 kg. Sex: The male-to-female ratio was similar amongst the groups. Health Status (ASA Grade): Both groups had a comparable proportion of patients across various health categories (ASA I and II).

Table 2: Time duration of surgery

Parameters	Group D readings	Group S readings	p Value	Inference
Time Duration of performing Surgery in mins	110.17 ± 20.28	108 ± 17.30	0.66	NS

Table 2 illustrates the duration of procedures in each group (Group D and Group S). The significance of this lies in the fact that the duration of surgery might have an impact on several other results. Fig 2 provides us with the following information: The duration of procedures in both groups was almost equal, with an average length of roughly 108-110 minutes. There was no statistically significant disparity in the duration of surgeries across the groups. Both groups had comparable durations for their surgical procedures. This is advantageous since it indicates that any discrepancies seen in the study's findings are less likely to be attributed to the duration of the procedures. Table 2 provides a context for comprehending the actual impacts of the treatments being examined on each group.

Table 3: Onset of sensory and motor block

Parameters	Group D readings	Group S readings	p Value	Inference
Onset of Sensory Block (min)	3.90 ± 0.84	5.10 ± 0.92	<0.0001*	S
Onset of Motor Block (min)	5.50 ± 1.04	6.50 ± 0.82	0.0001*	S

Table 3 researches into how long it took for anesthesia to start working in each group (Group D and Group S). A faster-acting anesthesia can be beneficial during surgery. The table focuses on two key measurements: Sensory block: This refers to how long it took for feeling to be numbed. Motor block: This refers to how long it took for muscle movement to be blocked. Here's what the table shows: Anesthesia worked much faster in Group D compared to Group S: Sensation: On average, it took 3.9 minutes for Group D to feel numb, compared to 5.1 minutes for Group S. This difference was statistically significant, meaning it's likely not due to chance. Muscle Movement: Muscle movement block also came on faster in Group D (around 5.5 minutes) compared to Group S (around 6.5 minutes). Again, this difference was statistically significant. In simpler terms, the medication given before surgery in Group D led to anesthesia taking effect much faster than in Group S for both sensation and movement. This could potentially impact how anesthesia is managed during surgery and how well surgeries go for patients having upper limb surgeries (surgeries on the arms and hands).

Table 4: Peak of sensory and motor block

Parameters	Group D readings	Group S readings	p Value	Inference
Peak of Sensory Block time duration (min)	9.40 ± 0.93	11.50 ± 0.78	<0.0001*	S
Peak of Motor Block time duration (min)	12.30 ± 1.32	15.87 ± 1.17	<0.0001*	S

Table 4 looks deeper into how well the anaesthesia worked in each group (Group D and Group S) by looking at the peak block. Here, "peak block" refers to the strongest effect of the anaesthesia: Peak Sensory Block: This is how numb the feeling became. Peak Motor Block: This is how weak the muscles became. Sensory Block: Group D achieved a higher level of numbness compared to Group S (around 9.4 minutes vs 11.5 minutes). This difference was statistically significant; meaning it likely was not due to chance. Motor Block: Group D also achieved a greater degree of muscle weakness compared to Group S (around 12.3 minutes vs 15.9 minutes). Again, this difference was statistically significant. In simpler terms, the medication given before surgery in Group D led to stronger anaesthesia overall, with both numbness and muscle weakness reaching a higher level compared to Group S. This could potentially influence how anaesthesia is managed during surgery and how well surgeries go for patients having upper limb surgeries (surgeries on the arms and hands).

Table 5: Duration of motor & sensory block analysis and time of first rescue analgesia

Parameters involved in the study	Group D	Group S	P value	inference
Time Duration of Motor Block (min)	598.17 ± 28.05	460 ± 22.89	<0.0001	S
Time Duration of sensory block(min)	807.50±24.45	510±17.86	<0.0001	S
Time to first rescue analgesia(min)	1010 ± 40.66	580 ± 24.91	<0.0001*	S

Table 5 revealed that participants in Group D, who were administered a medication, had a significantly prolonged duration of leg numbness and weakness compared to the control group, Group S, with the former group enduring this condition for almost twice as long. Additionally, they had an extended duration of pain alleviation prior to requiring additional medicine.

Perioperative complication: Any complications related to drugs and procedure, hemodynamic and neurological complications were not seen in either of the groups. Only one patient from group S had shivering in intraoperative period for which no pharmacological interventions were required only treated with warm blanket

Discussion: This research conducted a comparison between a novel analgesic and a pre-existing one specifically for alleviating pain after shoulder surgery. This study used a randomized controlled trial design to examine the efficacy of perineural liposomal bupivacaine, a novel pain treatment, in comparison to the established medicine, bupivacaine with dexamethasone. Both medications are administered in close proximity to nerves (perineurally) in order to inhibit pain. Dexamethasone, a corticosteroid medication, is often used to prolong the analgesic properties of bupivacaine [5-8]. Observations: The mean pain ratings over a span of three days were comparable in both groups. Both groups had analgesia that persisted for more than 24 hours. The groups did not exhibit any disparities in: Duration of analgesic efficacy, Restoration of muscular and sensory function. Prescribed dosage of analgesic opioid drug: The researchers selected liposomal bupivacaine due to its documented ability to prolong analgesic effects after surgical procedures, as shown by previous studies [5-8]. Dexamethasone is often used as a means to obstruct the brachial plexus nerves in order to provide prolonged pain relief. The efficacy of this approach has been firmly established, as shown by several studies [5-8]. Research indicates that the combination of perineural dexamethasone and bupivacaine may provide extended pain relief compared to the use of systemic dexamethasone for peripheral nerve blocks [10-12]. The unique aspect of our study: This study is a unique randomized controlled experiment that compares the use of perineural liposomal bupivacaine with perineural dexamethasone for interscalene nerve blocks. There is just one further research that has been published on this particular subject [9].

The research discovered comparable pain reduction over a span of one week using liposomal bupivacaine. However, it did not evaluate the practical significance of this disparity [9]. The objective of our research was to evaluate the tangible advantages of liposomal bupivacaine in comparison to bupivacaine combined with dexamethasone. Previous research has compared liposomal bupivacaine to plain bupivacaine, but not particularly to bupivacaine combined with dexamethasone [13-15]. Security: Both medications have the potential to induce phrenic nerve paresis, which is characterized by a decline in the strength of the diaphragm muscle [17].

The results of our research indicate that there was no statistically significant disparity in respiratory distress across the various groups. The occurrence of hoarseness was more prevalent in the group that received liposomal bupivacaine. Both groups did not encounter any significant adverse effects. There is a scarcity of studies on the use of liposomal bupivacaine for interscalene nerve blocks [9,15]. The limitations of our investigation are as follows: We did not evaluate the duration of patients' stay in either the recovery room or the hospital [18]. The objective of our study was to assess the efficacy of perineural liposomal bupivacaine compared to the traditional method of using bupivacaine with dexamethasone for pain control during the first three days after surgery [18]. Benefits of using brachial plexus blocks for surgical procedures involving the upper limb: Prevents the occurrence of problems associated with the insertion of tubes into the airway (upper airway instrumentation) [19]. Advantages: More economical [19]. Ensures sufficient pain management during surgical procedures [19], relatively safe with a minimal likelihood of problems [19], provides effective pain treatment after surgery (postoperative analgesia) [19].

Conclusion

Overall, the use of dexamethasone with bupivacaine for brachial plexus block led to a notably quicker initiation and greater intensity of sensory and motor block, as comparison to utilizing bupivacaine alone, for patients having upper limb surgeries. These findings suggest that dexamethasone may augment the efficacy of bupivacaine in brachial plexus block, resulting in a faster and more profound block. Nevertheless, despite these advantages, there was no discernible disparity in the length of the surgical operation between the two groups. This implies that while dexamethasone may enhance block qualities, it may not have an effect on the overall surgical timeline. Additional investigation is necessary to examine the possible advantages of using dexamethasone to enhance brachial plexus block for procedures involving the upper limb.

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