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ORIGINAL ARTICLE

Comparison of Postoperative Duration of Analgesia in Patients Receiving Supraclavicular Brachial Plexus Block with and without Dexmedetomidine

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ABSTRACT

Introduction: For upper-limb orthopaedic surgery, supraclavicular brachial plexus block is routinely used and involves administering bupivacaine to the supraclavicular plexus. Recent studies claimed that the addition of dexmedetomidine to bupivacaine for supraclavicular brachial plexus block significantly prolonged the mean duration of postoperative analgesia. This study was necessitated by the fact that existing evidence was limited and there was no local published material to support the findings.

Objective: The objective of this study was to compare the postoperative duration of analgesia in patients receiving supraclavicular brachial plexus for upper limb surgeries block with and without dexmedetomidine.

Methods: This study was performed at the Department of Anesthesiology Lahore General Hospital, Lahore using randomized controlled trial. In this study, sixty patients between the ages of 18 and 60 and from both genders who underwent ultrasound-guided supraclavicular brachial plexus block for upper limb orthopedic surgery were randomly and equally divided into two treatment groups. The patients of Group-A received bupivacaine along with dexmedetomidine while those in Group-B received bupivacaine with normal saline for the block. Mean postoperative analgesia duration in minutes up to a VAS > 3 was the outcome variable. Each patient signed informed consent before the study.

Results: The patients' average age was 38.4±14.1 years and 37 (61.7%) were male and 23 (38.3%) were female. The significantly longer mean duration of postoperative analgesia (754.27±144.89 vs. 441.80±111.38 minutes with p-value less than 0.001) was observed in patients receiving dexmedetomidine in addition to bupivacaine as compared to bupivacaine alone. This significant mean duration was also recorded in various subgroups of age, gender, BMI, and duration of surgery.

Conclusion: The superiority of the combination of dexmedetomidine with bupivacaine was reported as compared to the conventional practice of bupivacaine alone in terms of significantly prolonged mean duration of postoperative analgesia. This novel combination may reduce the need for postoperative opioids and recommend it for future anesthetic practice.

Keywords: Supraclavicular Brachial Plexus Block, Dexmedetomidine, Post-Operative Analgesia

INTRODUCTION

For the past few decades, anesthesia techniques have improved and newer drugs have been introduced, which leads to a reduction in patient morbidity and mortality. One of these techniques is the Supraclavicular brachial plexus block for upper limb surgeries [1]. Brachial plexus is blocked in this technique at the level of the nerve trunk and hence, rapid analgesic and anesthetic effects can be achieved. There are extensive and continuous efforts by practitioners to enhance the effectiveness of postoperative analgesia and its postoperative duration [2].

Analgesia after surgery depends on the type of local anaesthetic used, whether as a sole agent like bupivacaine or with sub adjuvant to prolong analgesia and minimize the side effects. For procedures like upper limb surgeries intermediate to a long duration of analgesia is preferred over short-acting local anesthetic, e.g. lignocaine to prevent the repetition of doses[3]. However, recently, Dexmedetomidine an α-2 agonist has been incorporated into modern anesthesia techniques and procedures. Initially, it was primarily used for ICU sedation but its uses and advantages are considerably more promising than only sedation[4]. The data using Dexmedetomidine in various anesthesia techniques and ICU settings show that it can be used as an analgesic, anesthetic, sedative and as adjuvant in regional anesthesia with the least side effects[5]. This newer drug has minimal respiratory depression and potent analgesic effects that in the recent future, it can replace opioids from anesthesia practice due to its safety. However, its dosage while used alone or with traditional regional anesthetic is still questionable[6]. Palsule et al. (2017) used dexmedetomidine in supraclavicular block to examine its impact on block quality and analgesia duration and discovered that bupivacaine + dexmedetomidine provided significantly longer analgesia duration than bupivacaine and normal saline [7]. The duration of analgesia was 423.67±213.11 min in bupivacaine alone group vs. 735.67±283.72 min in bupivacaine plus dexmedetomidine combination. The results were found significant at 1% level of significance.

Postoperatively, there is no local published data present in this study to the best of our knowledge. Using Dexmedetomidine in combination with bupivacaine may provide more lasting pain relief. In order to better manage patients postoperatively, reduce the use of analgesics, promote early mobility, and shorten hospital stays, it is necessary to conduct this study in the local population. If it is found to be significantly effective, it will allow us to return patients to routine life activities sooner and reduce their length of hospital stay. It will also help in reducing the economic burden on the patient and health care facility.

MATERIAL AND METHODS

Study Design: In the current study, a randomised trial was employed.

Setting: The study was carried out at the Lahore General Hospital's Department of Anesthesiology.

Duration of Study: After the formal approval, the study would run for six months, from January 3, 2021, to July 9, 2021.

Sample Size: Using an 80 percent power of the test and a 95 percent confidence interval, a sample size of 60 patients was estimated (30 in each group) while taking the expected duration of postoperative analgesia in patients underwent upper limb surgery and receiving supraclavicular brachial plexus block to be 423.67±213.11 min vs. 735.67±283.72 in bupivacaine alone and bupivacaine plus dexmedetomidine groups respectively[7].

Sampling Technique: Selection of patients was based on non-probability, consecutive sampling.

Sample Selection:

Inclusion Criteria:

i. Patient populations aged varied from 18 to 60 years old and

undergoing upper limb surgeries.

ii. Patients who gave consent to participate in the study and followed ASA physical status I, II and III.

Exclusion Criteria:

i. Patients who had bleeding disorder history or taking anticoagulants.

ii. Patients with cardiac failure (ejection fraction <45% of normal) or renal impairment (serum creatinine >1.2mg/dl) as per investigation.

iii. Patients receiving adrenoreceptor agonist or antagonist.

iv. Patients have any neurologic deficit in the upper limb.

v. Patients have an allergy to local anesthetics.

vi. Pregnant women.

Data collection procedure: After formal approval, from the ethics review committee of the hospital, sixty patients (30 in each group) were selected who presented in the operating room of the Lahore General Hospital, Lahore. Each patient provided written informed consent and detailed medical history.

The lottery method which is a random method was used to divide these patients into the following two groups:

Group-A: bupivacaine 0.25% (34 ml) + dexmedetomidine 1µg/kg as a case group.

Group-B: bupivacaine 0.25% (34 ml) + normal saline 1 ml as a control group.

General anaesthesia was administered to each patient and was induced with propofol (2-3 mg/kg) and atracurium (0.5 mg/kg). Oxygen was used to maintain Anesthesia, isoflurane and atracurium (0.1 mg/kg). No opioid / NSAID was given. The patients were administered brachial plexus block by the supraclavicular route via the subclavian perivascular approach under ultrasound guidance and using a nerve stimulator. Under all aseptic precautions, the injection site was identified to be 1 cm behind the midpoint of the clavicle, (where the pulsation of the subclavian artery was felt) and infiltrated with 1 ml of 2% lignocaine subcutaneously. For ultrasound in-plane approach was used to avoid complications. The transducer was placed over the right supraclavicular fossa. The needle was inserted in-plane with the USG transducer and beam in lateral to medial direction. In this way, the needle shaft and tip were visualized in real-time as the needle was advanced towards the target nerves. We then confirmed the identity of nerves by electrical stimulator with nerves stimulator (Neurostim LA II, Hugo Sachs Electronik, type 220/1 with 22G x 2" Pajunk needle). 0.5 mA of output current was used to measure the distal motor response at the study's endpoint. Negative aspiration was performed every 5 ml during the injection of the drug solution in order to avoid intravascular injection. Postoperative analgesia duration was noted in accordance with the operational definition. All of the information, including the patient's demographics, was taken down and entered into the accompanying proforma. All the supraclavicular brachial plexus block and general anesthesia were given by the consultant having 2 years' experience to avoid bias and to prevent confounding variables. Rescue analgesia was given to patients as injection tramadol 1mg/kg.

Data analysis procedure: In order to conduct the analysis, all of the information was entered into and run through SPSS version 23.0.

1. The mean and standard deviation of numerical variables, such as age, BMI, duration of surgery, and postoperative analgesia duration, have been presented. When comparing the average duration of post-operative analgesia amongst the groups, an independent sample t-test was used and p-value less than 0.05 was considered statistically significant.
2. Categorical variables have been reported in terms of frequency and percentage.
3. Age, gender, body mass index (BMI), and surgery duration have all been taken into account as effect modifiers when analyzing the data. t-test was also performed to examine the statistically significant difference in these subgroups.

RESULTS

The individual age of patients varied from 18 to 60 years having a mean of 38.4±14.1 years. The current study included 37 (61.7 %) male patients and 23 (38.3 %) female patients. Further, BMI of patients varied from 22.6 to 34.4 Kg/m_2 with a mean of 28.7±3.4 Kg/m_2. Out of the total sample, 27 (45.0%) patients were obese (BMI ≥30Kg/m_2). The duration of surgery ranged from 60 to 120 minutes with a mean of 88.7±16.2 minutes as shown in Table 1. Two equal groups based on the duration of surgery were also made and found an almost equal distribution of patients in these groups.

The average age of the patients in both groups of the study was nearly identical (p-value = 0.957), mean BMI (p-value = 0.822) and mean duration of surgery (p-value = 0.925). Further, these two study groups also compared within the subgroups of age, BMI and duration of surgery. It was found that distribution of various subgroups based on age (p-value=0.793), gender (p-value = 0.791), BMI (p-value = 0.795) and duration of surgery (p-value = 0.796) were insignificantly different in both groups as shown in Table 2. It shows that possible confounding effects of baseline characteristics have been controlled.

Table 1: Baseline Characteristics of Study Sample

Characteristics	Participants n=60
Age (years)	38.4±14.1
18-39 years	58.3%)
40-60 years	25 (41.7%)
Gender	
Male	61.7%)
Female	23 (38.3%)
BMI (Kg/m2)	28.7±3.4
Non-Obese	55.0%)
Obese	27 (45.0%)
Duration of Surgery (minutes)	88.7±16.2
60-90 minutes	29 (48.3%)
91-120 minutes	31 (51.7%)

Table 2: Baseline Characteristics of Study Groups

Characteristics	Bupivacaine + Dexmedetomidine (n=30)	Bupivacaine + Normal Saline (n=30)	P-value
Age (years)	38.5±12.7	38.3±15.5	0.957
18-39 years	17 (56.7%)	18 (60.0%)	0.793
40-60 years	13 (43.3%)	12 (40.0%)	
Gender			
Male	19 (63.3%)	18 (60.0%)	0.791
Female	11 (36.7%)	12 (40.0%)	
BMI (Kg/m2)	28.6±3.3	28.8±3.6	0.822
Non-Obese	16 (53.3%)	17 (56.7%)	0.795
Obese	14 (46.7%)	13 (43.3%)	
Duration of Surgery (minutes)	88.9±17.9	88.5±14.5	0.925
60-90 minutes	15 (50.0%)	14 (46.7%)	0.796
91-120 minutes	15 (50.0%)	16 (53.3%)	

Chi-square test and Independent sample t-test, observed difference was statistically insignificant

Table 3: Analytical Differences between the Study Groups in Mean Duration of Post-Operative Analgesia

Post-operative Analgesia	Bupivacaine + Dexmedetomidine (n=30)	Bupivacaine + Normal Saline (n=30)	P-value
Duration (in minutes)	754.27±144.89	441.80±111.38	<0.001*

Independent sample t-test, * observed difference was statistically significant

The study's main goal is to compare the postoperative analgesia in two groups of study. It was found that the duration of postoperative analgesia ranged from 247 minutes to 979 minutes with a mean of 598.03±203.07 minutes. The mean duration of postoperative analgesia (754.27±144.89 vs. 441.80±111.38 minutes; p-value is less than 0.001) was found significantly higher

in patients who received dexmedetomidine and bupivacaine combination in comparison to bupivacaine alone as reported in Table 3. Similarly, a significant difference between the groups based on the patient's age, gender, BMI and duration of surgery was noted as reported in Table 4.

Table 4: Comparison of Mean Duration of Post-Operative Analgesia (minutes) between the Study Groups across various Subgroups

Duration of Post-Operative Analgesia (minutes)			
Subgroups	Bupivacaine + Dexmedetomidine (n=30)	Bupivacaine + Normal Saline (n=30)	P-value
Age			
18-39 years	757.18±146.64	446.61±119.30	<0.001*
40-60 years	750.46±148.43	434.58±103.03	<0.001*
Gender			
Male	753.74±132.32	440.22±95.05	<0.001*
Female	755.18±171.34	444.17±136.86	<0.001*
BMI			
Non-Obese	774.13±160.95	465.41±124.89	<0.001*
Obese	731.57±126.09	410.92±85.78	<0.001*
Duration of Surgery			
60-90 minutes	760.80±144.31	448.93±112.08	<0.001*
91-120 minutes	747.73±150.22	453.56±114.05	<0.001*

Independent sample t-test, * observed difference was statistically significant

DISCUSSION

Reducing side effects of opioid, increasing patient satisfaction, and reducing unplanned hospitalizations is all possible benefits of using upper extremity regional anesthetic techniques[8, 9]. Upper extremity block local anesthetic selection is heavily influenced by analgesic duration. Clonidine, dexamethasone, epinephrine, buprenorphine prolong the duration of intermediate-acting local anesthetics which are used as an adjunct to extend the duration and reduce the post-operative need for opioids [8]. As a result, a decrease in the possible complications like vomiting, nausea, and sedation associated with opioids can be observed and enables early recovery of patients [8, 9]Research Paper.docx.

In this study, the primary goal was to examine and compare the duration of analgesia in patients following surgery and receiving supraclavicular brachial plexus for upper limb surgery block with and without dexmedetomidine. The role of dexmedetomidine has been changing systematically over the last two decades. Food and Drug Administration (FDA) approved it in 1999, making it an α-2 receptor agonist for the first time ever. It was mainly introduced for sedation or short-acting analgesia of patients on mechanical ventilation[1, 9]. The first studies of dexmedetomidine as an adjuvant to local anaesthetics (AL) in regional blocks were conducted in 2004 after further understanding of its mechanism of action[1, 3]. Dexmedetomidine and bupivacaine for supraclavicular brachial plexus block have claimed to significantly increase the mean duration of postoperative analgesia, according to new research [7]. It is desirable as it reduces the need for postoperative opioids. Although there was some prior research, it was limited and there was no locally published material that necessitated this study.

For upper limb orthopedic surgery with supraclavicular brachial plexus block, the average age of the patients was 38.4±14.1 years. Our findings are consistent with a similar study where Deshpande et al. (2020) observed comparable mean age of 38.2±12.2 years in Indian patients undergoing upper limb orthopedic surgery[10]. In similar other Indian studies comparable mean age of 36.9±12.1 years, 37.0±12.2 years and 40.5±13.2 years have been observed by Verma et al. (2017), Goyal et al. (2008) and Mukherjee et al. (2014) respectively among such patients [11-13]. Ghali et al. (2019) reported comparable mean age of 39.2±11.7 years among Egyptian patients[14] while Akhondzade et al.(2017) reported it to be 37.0 ± 12.2 years in Iran [15]. Further, in our study, patients undergoing upper limb orthopedic surgery had a male to female ratio of approximately 1.6:1. Verma et al. (2017) reported a similar male superiority among Indian patients [11]. Deshpande et al. (2020), Mukherjee et al. (2014) and Goyal et al. (2008) also discussed similar male predominance among such patients and reported a male to female ratio of 1.7:1, 1.8:1 and 5:1 respectively in line with the present study [10, 12, 13]. This younger mean age and male predominance observed among such patients might correlate with the mechanism of injury i.e. road traffic accidents that frequently involve younger males.

The average duration of surgery in this study was 88.7±16.2 minutes. Mukherjee et al. (2014) found similar results with almost the same mean duration of surgery in Indian patients undergoing upper limb orthopedic surgery and reported it to be 87.5±30.5 minutes [13]. Ghali et al. (2019) also reported it to be 87.4±33.6 minutes in Egypt [14].

We observed that the mean duration of postoperative analgesia (754.27±144.89 vs. 441.80±111.38 minutes; p-value < 0.001) was significantly longer in patients receiving dexmedetomidine in addition to bupivacaine as compared to bupivacaine alone. Different subgroups based on patient age, gender, BMI, and duration of surgery all showed a significant difference. Our results are aligned with Palsule et al. (2017) who conducted a similar study in 60 Indian patients who underwent similar upper limb orthopedic surgery and found that the average duration of postoperative analgesia was significantly longer in those patients who received the addition of dexmedetomidine (735.67±283.72 vs. 423.67±213.11 minutes; p-value<0.001) [7]. Agarwal et al. (2014) in another similar trial involving 50 Indian patients reported a significantly prolonged mean duration of postoperative analgesia by combining bupivacaine with dexmedetomidine (776.4±130.8 vs. 241.4±51.2 minutes; p-value<0.001) [16]. Gandhi et al. (2012) had also reported similar findings in another study (732.4±95.1 vs. 194.8±60.4 minutes; p-value<0.0001) [17].

In our opinion, this is the first study of its kind in the local population and contributes to the published international research evidence on this research issue. Analgesia duration was significantly longer in patients undergoing upper limb orthopaedic surgery under ultrasound-guided supraclavicular brachial plexus block with the addition of dexmedetomidine to bupivacaine. This is desirable in anesthetic practice as it may reduce the need for postoperative opioids. In the light of this evidence, we advocate the preferred use of this novel combination of dexmedetomidine and bupivacaine in future anesthetic practice.

This study has the following strengths; a large sample size of 60 cases and its randomized study design. Further, the results were also stratified for various effect modifiers like age, gender, BMI, and duration of surgery in order to reduce the risk of bias. However, a major associated limitation in this study was that we didn't compare our findings to mean postoperative analgesic requirement between the groups. Moreover, the mean time required to full patient's recovery at the end of the procedure was not considered as that would affect the patient's rehabilitation and could establish the role of dexmedetomidine in future anesthetic practice.

CONCLUSION

Patients undergoing upper limb orthopaedic surgery under ultrasound-guided supraclavicular brachial plexus block experienced significantly longer mean postoperative analgesia than those who received conventional bupivacaine alone, indicating that this novel combination should be preferred in the future for anaesthetic use because it may reduce the need for postoperative opioids.

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