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Evaluation of the Effects of Dexamethasone and Dexmedetomidine as Adjuvants to Bupivacaine in Supraclavicular Brachial Plexus Block in Upper Limb Surgeries

Enas A. Ali*, Mohamed I. Abdelgawad, Medhat L. Shaker, Reda A. Ismail

Anesthesia and Intensive Care Department, Faculty of Medicine, Suez Canal University, Egypt

Abstract

Background: **Supraclavicular nerve block is good alternative to general anesthesia for upper limb surgeries.** ***Aim:*** **This study aimed to compare the efficacy of bupivacaine plus dexamethasone versus bupivacaine plus dexmedetomidine as adjuvants on supraclavicular brachial plexus block characteristics including onset and duration of sensory and motor blockade, duration of postoperative analgesia and sedation score.** ***Patients and Methods:*** **This prospective, randomized, single-blind study was carried out on 44 patients with American Society of Anesthesiologists (ASA) grades I, II, III and IV, aged 18 to 60 years, of both sex, BMI less than 36 Kg/M2 and who scheduled for upper limb orthopedic surgeries, vascular surgeries and plastic surgeries. Patients were divided into two groups: Group I: 20 ml bupivacaine 0.5%+4mg dexamethasone. Group II: 20 ml bupivacaine 0.5%+ dexmedetomidine 1 µg/kg.** ***Results*****: Data was collected via a data collection sheet. In both groups the adjuvants prolonged duration of analgesia postoperative; however, dexamethasone decreased post operative opioids consumption up to 36 hours.** ***Conclusion:*** **Regarding comparison between dexmedetomidine and dexamethasone as an adjuvant to bupivacaine in ultrasound guided supraclavicular block, it could be concluded that the addition of dexamethasone to bupivacaine prolong the time of block and analgesia duration longer than dexmedetomidine. Both dexmedetomidine and dexamethasone have individually been shown to be beneficial as an adjuvant to bupivacaine**

Keywords**:** Supraclavicular block, dexamethasone, dexmedetomidine

Introduction

A different option for anesthesia with a great safety profile & few anesthetic medications is regional nerve block. The supraclavicular approach is the simplest & most reliable procedure for surgery below the shoulder joint & brachial plexus block is a well-used regional nerve block technique for perioperative anesthesia with analgesia for surgery of upper extremities [(1)]. For upper limb surgery, supraclavicular nerve block is a viable substitute for general anesthesia. By doing this, the complications associated with upper airway intubation &

**Corresponding Author: amanymandour2005@gmail.com*

general anesthetic medication use are avoided. Complete muscular relaxation, hemodynamic stability during surgery, & postoperative analgesia are all achieved[2].

First identified in 1957, bupivacaine is a strong local anesthetic that belongs to the amide group of local anesthetics & has distinct properties. Regional anesthesia, spinal anesthesia, & local infiltration all employ local anesthetics[3]

Various adjuvants have been employed to extend the duration of post-operative analgesia, minimize the onset times of blocks, & prolong regional blockade. To extend duration of block & postoperative analgesia, a number of adjuvants, including as opioids, midazolam, magnesium sulfate, dexamethasone & neostigmine, have been added to local anesthetics, albeit with the possibility of significant side effects[4].

it has been shown that adding dexamethasone or dexmedetomidine to peripheral nerve blockade based on local anesthetic prolongs the duration of impact. According to studies, block properties can be enhanced by adding dexamethasone or dexmedetomidine as adjunctive local anesthetics, either intravenously (iV) or perineurally [4,5].

Therefore, this study was conducted to assess & compare the effects of adjuvants for supraclavicular blocks, such bupivacaine with dexamethasone versus bupivacaine with dexmedetomidine, on the onset, duration of motor, sensory blockade & any side effects from the medication or procedure.

Patients & methods:

Study type: Randomized Single blind

Study setting: Operative theaters at Suez Canal University hospitals

Subjects: Adult patients undergoing upper limb surgeries

Inclusion criteria:

1. individuals having grades i, ii, iii, & iV on the American Society of Anesthesiologists (ASA)
2. From the age of 18 to 60
3. Both masculine & feminine sex
4. BMI of under 36 kg/m^2
5. Vascular, orthopedic, & plastic operations of the upper limb.

Exclusion criteria:

1. individuals having a past background of coagulopathy
2. individuals with a localized illness at the blockage site
3. individuals with psychiatric issues
4. Patients having allergies to research pharmaceuticals
5. Patients who declined to take part in the research; 6. Patients who took steroids regularly were not included.

The Suez Canal University Faculty of Medicine's Ethical Committee provided a protocol agreement. A permission form was also signed by each participant prior to their enrollment in the research. Following their enrollment, patients were assigned to one of two groups randomly:

Group I got 20 milliliters of bupivacaine 0.5% plus 4 milligrams of dexamethasone, while **Group II** received the same amount of bupivacaine 0.5% plus 1 µg/kg of dexmedetomidine (20 milliliters).

All patients were subjected to:

History, Examination, Anesthetic assessment, Lab investigations, Pre-anesthetic visit & Premedication.

Intraoperative management

The resuscitation medications & general anesthesia were ready to go. Patients were placed in the supine position, an IV cannula was inserted, & basic monitoring devices including an ECG, pulse oximeter, & noninvasive blood pressure monitor with Nihon Kohden monitor were attached. An infusion of ringer acetate was initiated for every patient. After washing the skin with either povidone-iodine or 2% chlorhexidine, the area was left to dry. After covering the probe with a sterile probe cover & adding more sterile gel to its exterior, the probe was covered with sterile gel.

The patient is positioned to do this block with their head raised between 30 & 45 degrees, with the edge of a cushion supporting their head without covering the block site. The head is turned slightly away from the side of the block. The operator should stand on the same side of the patient as the block, with the ultrasound machine on the opposite side. General anesthetic & resuscitation drugs were prepared. The patients were put to sleep, an IV cannula was installed, & basic monitoring equipment was connected, such as an ECG, a pulse oximeter, & a noninvasive blood pressure monitor with a Nihon Kohden monitor. Ringer acetate was started as an infusion for each patient. The skin was cleaned with 2% chlorhexidine or povidone-iodine, & then the region was allowed to dry. The probe was coated with sterile gel after being covered with a sterile probe cover & having extra sterile gel applied to its exterior. To do this block, the patient raises their head between 30 & 45 degrees, supporting it with the edge of a pillow without covering the block site.

Post operative assessment

A 10-point visual analog scale (VAS) score is used to evaluate pain. At the following times: at 0 h (the end of surgery), then 1, 2, 4, & 6 h postoperative up to 36 hours postoperative (0 being no pain & 10 being the greatest agony possible).

Statistical Analysis

Version 22 of the Statistical Package for the Social Sciences (SPSS) for Windows was used to conduct the statistical analyses. The qualitative variables were reported as frequency & frequency percentage, whereas the numerical data were expressed as mean & standard deviation (Mean ± SD). The Kolmogorov-Smirnov test was used to determine if the variables were normal. Categorical data were subjected to the Chi-squared test. $p<0.05$ deemed significant.

Results

Table 1 illustrates the insignificance of variations between the research groups with regard to age, gender, BMI, ASA class, & comorbidities. As seen in table 2, group I had greater mean SBP & lower mean DBP, MAP, & HR than group II, although the differences were not statistically significant. Serial SBP measurements revealed statistically substantial reductions in SBP within each group, but statistically negligible differences between the two groups. DBP serial measurements revealed statistically insignificant differences between the two groups, while statistical differences were also seen within each group. HR serial assessments revealed statistically substantial reductions in HR within each group, but statistically negligible differences between the two groups. Up to 24 hours following surgery,

serial VAS assessments revealed statistically negligible changes between the two groups; however, after 36 hours, group II exhibited a significant difference in their mean Vas score compared to group I. VAS revealed statistically significant differences among each group.

Table 1: Baseline characteristics of the study groups.				
Variables		Group I (n=22)	Group II (n=22)	P-value
Age (Years)		42.3 ± 14.8	39.6 ± 12.3	0.508[1]
Sex	Male n,(%)	14(63.6%)	14(63.6%)	1.00[2]
	Female n,(%)	8(36.4%)	8(36.4%)	
BMI (kg\m2)		20.7 ± 3.6	19.8 ± 2.5	0.309[1]
ASA Class ✓ I ✓ II ✓ III		11(50%) 7(31.8%) 4(18.2%)	9(40.9%) 13(54.6%) 1(4.5%)	0.158[3]
1.Student t test used. 2. Chi square test used. 3. Fisher exact test used. **Statistically significant as p<0.05.,* *Abbreviations: ASA; American Society of Anesthesiologists, BMI; body mass index.*				

Table 1 shows that age, gender, BMI, ASA class and comorbidities showed insignificant differences both study groups as p>0.05.

Table 2: Serial systolic measurements among the study groups.			
Systolic BP	Group I (n=22)	Group II (n=22)	P-value
At induction	129.1 ± 12.3	125.2 ± 11.3	0.284[1]
After 5 minutes	121.82 ± 13.23	120.0 ± 7.66	0.619[1]
After 10 minutes	121.59 ± 11.48	120.91 ± 7.66	0.818[1]
After 30 minutes	120.45 ± 8.85	117.5 ± 8.42	0.263[1]
After one hour	120.91 ± 10.87	116.59 ± 7.46	0.132[1]
After two hours	119.77 ± 11.39	115.68 ± 7.91	0.174[1]
After three hours	120.95 ± 11.69	117.86 ± 7.34	0.310[1]
P-value	**<0.001*[2]**	**<0.001*[2]**	
1.Student t test used. 2. Repeated measures ANOVA test used. **Statistically significant as p<0.05.* *Abbreviations: BP; blood pressure.*			

Serial measurements of SBP showed statistical insignificant differences between both groups as p>0.05, while within each group SBP showed statistically significant reduction as p<0.001.

Table 3: Serial diastolic measurements among the study groups.			
Diastolic BP	Group I (n=22)	Group II (n=22)	P-value
At induction	78.64 ± 8.34	79.09 ± 10.19	0.872[1]
After 5 minutes	75.91 ± 7.34	73.41 ± 6.79	0.248[1]
After 10 minutes	72.59 ± 5.61	71.82 ± 5.01	0.632[1]
After 30 minutes	72.27 ± 7.52	74.77 ± 6.63	0.249[1]
After one hour	74.32 ± 6.23	71.82 ± 3.95	0.119[1]
After two hours	74.55 ± 6.71	74.32 ± 8.21	0.920[1]
After three hours	75.10 ± 8.11	74.76 ± 6.79	0.886[1]
P-value	**0.015*[2]**	**<0.001*[2]**	
1.Student t test used. 2. Repeated measures ANOVA test used. **Statistically significant as p<0.05.* *Abbreviations: BP; blood pressure.*			

Serial measurements of DBP showed statistical insignificant differences between both groups as p>0.05, while within each group DBP showed statistically significant reduction as p<0.05.

Table 4: Serial MAP measurements results among the study groups.			
MAP	Group I (n=22)	Group II (n=22)	P-value
At induction	94.95 ± 9.02	93.77 ± 9.47	0.685[1]
After 5 minutes	90.91 ± 8.19	88.59 ± 6.89	0.674[1]
After 10 minutes	88.5 ± 6.33	87.45 ± 4.92	0.316[1]
After 30 minutes	87.05 ± 6.51	88.41 ± 5.59	0.544[1]
After one hour	88.41 ± 7.26	85.36 ± 3.09	0.460[1]
After two hours	89.23 ± 6.94	87.27 ± 7.42	0.077[1]
After three hours	89.76 ± 8.91	88.76 ± 6.27	0.372[1]
P-value	0.051[2]	**0.024*[2]**	
1.Student t test used. 2. Repeated measures ANOVA test used. **Statistically significant as p<0.05. Abbreviations: MAP; mean arterial pressure.*			

Serial measurements of MAP showed statistical insignificant differences between both groups as p>0.05, while within group II MAP showed statistically significant reduction as p=0.024.

Table 5: Serial HR measurements results among the study groups.			
HR	Group I (n=22)	Group II (n=22)	P-value
At induction	84.36 ± 11.62	86.36 ± 12.94	0.593[1]
After 5 minutes	78.95 ± 11.13	81.82 ± 8.99	0.353[1]
After 10 minutes	78.18 ± 11.35	80.32 ± 9.61	0.504[1]
After 30 minutes	75.0 ± 9.05	76.05 ± 7.66	0.681[1]
After one hour	74.05 ± 8.28	74.55 ± 5.89	0.819[1]
After two hours	75.23 ± 9.86	76.91 ± 7.53	0.528[1]
After three hours	76.10 ± 9.46	74.19 ± 6.09	0.442[1]
P-value	**0.009*[2]**	**<0.001*[2]**	
1.Student t test used. 2. Repeated measures ANOVA test used. **Statistically significant as p<0.05. Abbreviations: HR; heart rate*			

Serial measurements of HR showed statistical insignificant differences between both groups as p>0.05, while within each group HR showed statistically significant reduction as p<0.001.

Table 6: Serial VAS measurements results among the study groups.			
VAS	Group I (n=22)	Group II (n=22)	P-value
At end of surgery	0 ± 0	0 ± 0	--
After 15 minutes	0 ± 0	0 ± 0	--
After 10 minutes	0 ± 0	0 ± 0	--
After 30 minutes	0 ± 0	0 ± 0	--
After one hour	0 ± 0	0 ± 0	--
After four hours	0 ± 0	0 ± 0	--
After six hours	0 ± 0	0 ± 0	--
After eight hours	0 ± 0	0 ± 0	--
After 12 hours	0 ± 0	0 ± 0	--
After 24 hours	0.18 ± 0.59	0.64 ± 1.14	0.103[1]

After 36 hours	1.09 ± 1.6	3.73 ± 1.55	**<0.001*[1]**
P-value	**<0.001*[2]**	**<0.001*[2]**	

1.Student t test used. 2. Repeated measures ANOVA test used. P-value can`t be computed as SD of both groups zero.
**Statistically significant as p<0.05. Abbreviations: VAS; visual analog scale.*

Serial measurements of VAS showed statistical insignificant differences between both groups till 24 hours post-operative as p>0.05, while after 36 hours group II had significantly higher mean of Vas score than group I with statistically significant difference (p<0.001).
Within each group VAS showed statistically significant differences as p<0.001.

Discussion

Ultrasonography has made the supraclavicular block operation safer & easier to perform. With the goal of enhancing the duration & quality of supraclavicular block, a number of medications have been investigated as adjuvants to local anesthetics. Dexmedetomidine is more powerful than clonidine as an α2 agonist. Dexmedetomidine as adjuvant in nerve blocks prolongs duration of analgesia, as several investigations have demonstrated[6]. US guided supraclavicular brachial plexus use in upper extremity surgery has been demonstrated to provide an effective, reliable block, resulting in fewer complications, high patient and surgeon satisfaction, a reduction in postoperative analgesia & the length of time until the first analgesia request, a shorter hospital stay, & a lower financial burden[7]. We wanted to know how well dexmedetomidine and dexamethasone worked as adjuvants on block features, such as the duration of postoperative analgesia, the onset and duration of sensory & motor blockade, the post-operative pain level, & the sedation score. in this prospective, randomized, single-blind trial, 44 patients scheduled for upper limb orthopedic, vascular, and plastic operations (with American Society of Anesthesiologists grades I, II, III, and IV were studied. The patients ranged in age from 18 to 60 years, were of either sex, & had a BMi of less than 36 kg/M2. Two groups of patients were created: group i received bupivacaine with 4 mg of dexamethasone (n = 22). & group ii (20 ml of 0.5% bupivacaine with 1 µg/kg dexmedetomidine) (n = 22). According to the current study, dexamethasone produces greater drowsiness than dexmedetomidine, & both of them provide greater sedation after surgery. This is consistent with a recent prospective double-blind, randomized controlled experiment that had 30 individuals each group out of a total of 60 participants. Group 1 (dexmedetomidine group) and group 2, which was administered dexamethasone. According to the study, adding dexmedetomidine to bupivacaine considerably extended duration of both the block & the analgesic effect[8]. Additionally, trials that employed dexamethasone as an adjuvant to peripheral or regional nerve blocks in Los Angeles produced longer-lasting sensory & motor blockades[9,10]. in our investigation, we discovered that adding 1µg/kg of dexmedetomidine to 20ml of bupivacaine 0.5% decreased the intraoperative Dormicum dosage & resulted in a considerably lower postoperative VAS score. Extensive research has employed dexmedetomidine as a supplementary agent for local anesthetic (LA) in various peripheral & regional nerve blocks, demonstrating its superiority in enhancing the local anesthetic effec[11]. According to another research, dexmedetomidine's prolonged analgesic effect may be related to blocking the hyperpolarization-activated cation current (ih current), which keeps the nerve from going back to its resting membrane potential after becoming hyperpolarized, which would otherwise cause

it to fire & produce a new action potential. The unmyelinated C fibers (pain) seem to exhibit this current more so than the motor A α fibers. Thus, it is possible that inhibiting the (ih) current will have a greater impact on pain than on motor response, which might account for dexmedetomidine's ability to extend the effects of local anesthetics in peripheral nerve block[12,13]. According to research by Swain et al., adding dexmedetomidine can improve the analgesic effects & lengthen their duration when combined with ropivacaine & bupivacaine, two routinely used local anesthetics. Dexmedetomidine performed much better than clonidine as an adjuvant in supraclavicular blocks, according to an intriguing study. The metanalysis mainly looked at doses of dexmedetomidine for the brachial plexus, including 0.75 μg/kg, 1.0 μg/kg, & 100 μg[9]. According to Chinappa et al., dexmedetomidine as an adjuvant to ropivacaine accelerates the onset of sensory & motor block, increases the duration of SCBP block, & provides longer-lasting postoperative analgesia[14]. According to Waindeskar et al., the addition of dexmedetomidine to levobupivacaine during ultrasound-guided SCBP block with a quicker start of block, a longer sensory and motor block duration, & a considerably longer duration of analgesia[15]. A meta-analysis was conducted on nine randomized controlled studies with 801 participants, out of whom 393 patients were administered dexamethasone (4–10 mg). The authors noticed that when long-acting local anesthetic was combined with dexamethasone, the duration of analgesia was considerably extended[16]. Between the two groups, there was statistically insignificant difference in terms of demographic information or operational features. in relation to hemodynamic measures (HR, SBP,DBP,RR, & SPO2), the findings did not meet statistical significance, which consistent with the findings of Abdelnaim et al., Mangal et al., Bharti et al., & Hamada et al[8,17–19]. At 5, 10, 30, 60, 120, & 180 minutes, the dexmedetomidine group saw a drop in heart rate that was within normal range. Seven out of thirty patients experienced bradycardia (HR< 50 beats/min) when 100 μg dexmedetomidine was added to 0.5% levobupivacaine, according to Esmaoglu et al[20]. Despite the fact that the dexmedetomidine group in our research had lower heart rates (50–60 beats per minute), none of patients had bradycardia nor hypotension. This might as a result of the lower dosage of dexmedetomidine we utilized. in contrast to the control group, Almarakbi et al. observed a substantial drop in heart rate 60 minutes after administering of dexmedetomidine in TAP block. This effect lasted for 4 hours without causing hemodynamic instability. One possible connection between this medication side effect & post-synaptic activation of α2 adrenoceptors is possible[21]. in our study, patients receiving dexamethasone had lower VAS scores for pain than patients receiving dexmedetomidine; nonetheless, both groups' VAS levels were low throughout the course of 24 & 36 hours. This is consistent Hamada et al. research that discovered that although the patient was easily arousable, drowsiness was reported intraoperatively in 17 out of 30 patients in the dexmedetomidine group from 15 to 120 minutes. in most cases, the modified Ramsay sedation score for the dexmedetomidine group was 3/6 or 4/6, whereas it was 2/6 for the dexamethasone group[8]. With reference to our study's score of post-operative pain. in the first 24 hours, there was no statistically significant difference between the two groups; however, after 36 hours, the dexamethasone group's VAS score was considerably lower than dexmedetomidine group's. This is in line with Hamada et al. study, which showed that none of the patients experienced any documented side effects from the medications or block techniques, including nausea, vomiting, hemodynamic instability, damage to underlying structures, hematoma formation, infection, toxicity from local anesthetics, or pain[8]. The use of lignocaine or

adrenaline as an adjuvant to the block in their investigation may be the cause of this discrepancy with our results. Similar to this, Adinarayanan et al. observed that the dexamethasone group had a substantially longer sensory block & a significantly longer motor block than the dexmedetomidine group. The groups treated with dexamethasone & dexmedetomidine had similar levels of postoperative pain ratings & morphine intake[22]. Another study discovered that when 1 µg/kg dexmedetomidine or 8 mg dexamethasone is added as an adjuvant to 30 ml ropivacaine (0.5%) in ultrasound-guided SCBP block, the duration of the sensory & motor block is extended, the need for the first rescue analgesic is postponed, & the total amount of analgesics consumed over the course of a 24-hour period is significantly reduced. Compared to the control group, the SCBP block's quality is higher with no significant adverse effects[23].

Conclusion

Regarding comparison between dexmedetomidine and dexamethasone as an adjuvant to bupivacaine in ultrasound guided supraclavicular block, it could be concluded that the addition of dexamethasone to bupivacaine prolong the time of block and analgesia duration longer than dexmedetomidine. Both dexmedetomidine and dexamethasone have individually been shown to be beneficial as an adjuvant to bupivacaine.

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