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Original Research Article

Effect of Intravenous Dexmedetomidine or Midazolam in Patients Undergoing Upper Limb Surgeries under Supraclavicular Block

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Conflict of interest: Nil

Abstract:

Background: Brachial plexus block is frequently recommended for upper limb surgeries. Many drugs have been used as adjuvants to prolong the duration of the block. The present study was undertaken to compare the effect of intravenous dexmedetomidine or midazolam on the onset and duration of supraclavicular block with bupivacaine and lignocaine with adrenaline.

Method: Total 80 patients of age between 18-65 years with either sex belonging to ASA 1 and 2, scheduled for upper extremity surgery under supraclavicular brachial plexus block were included in the study. Patients were divided into two groups, group D (n=40) were patients who received Dexmedetomidine infusion and group M (n=40) patients received Midazolam infusion for sedation.

Results: The onset of sensory block was quicker in group D (10.58±1.32min) when compared to group M (19.8±1.11min), ($p<0.0001$). The duration of sensory block was more prolonged in group D (276±24.68min) than group M (239.25±25.86min). Time required for onset of motor block in midazolam group was high (28±1.43min) as compared to dexmedetomidine group (20.62±1.64min), ($p<0.0001$). However, the duration of motor block in group D was significantly higher (533.25±36.26min) compared to group M (259.5±25.01min), ($p<0.0001$). Addition of dexmedetomidine significantly prolonged the duration of analgesia (335.22±92.64min) in comparison to midazolam group (254.55±58.59min). The changes in heart rate and mean blood pressure were similar in both groups. Post-operative pain was significantly lower in group D as compared to group M, ($P<0.005$).

Conclusion: Dexmedetomidine when given intravenously as a sedative fastened the onset and prolonged the duration of sensory and motor blockade, as well as prolonged the duration of analgesia of brachial plexus block compared to intravenous midazolam.

Keywords: Supraclavicular Brachial Plexus Block; Dexmedetomidine; Midazolam; Bupivacaine; Sensory and Motor Blockade.

Introduction

Brachial plexus blockade (BPB) by supraclavicular approach is rapid onset and complete and predictable anesthesia for mid humerus, forearms, and hand surgery. This approach is also known as spinal anaesthesia of the upper limb because of its common application for upper limb surgical procedures. The compact structure of the plexus is an added advantage to nerve block at this level. Brachial plexus where the relatively compact trunks/ divisions track under the clavicle and over the first rib, residing posterior, lateral and cephalad to the subclavian artery [1]. Peripheral nerve blocks provide good operating conditions when it used optimally. They not only provide excellent intra operative anaesthesia but also good post-operative analgesia. However, BPB has benefits as compared with general anesthesia, as it helps in early mobilization, less postoperative respiratory complications, avoidance of poly pharmacy, safe, better surgical field, better hemodynamic profile, reduction in stress response and systemic analgesic requirements, opioid related side effects and general anaesthesia requirements [2-4]. Bupivacaine when used alone may provide

analgesia for 4-6 hours. For prolonged postoperative analgesia we may need to look into other options like –use of continuous infusion catheters or adding and additive to local anesthetic .[1,5] Various additives have been tried and are being studied for its safety and efficacy like – epinephrine [6] , opioids (fentanyl [7], buprenorphine [8], tramadol [9]), ketamine [10], α2 agonist (clonidine [11], dexmedetomidine [12,13]), steroids (dexamethasone [14]) etc. α2 agonists have analgesic, anxiolytic, sedative and sympatholytic properties, which makes it a better choice for local anesthetic. [1]

Dexmedetomidine, introduced in 1999 in US, is a more selective α2 agonist. It was initially approved for short term ICU sedation. Later on it was used for procedural sedation inside the operating room as well as outside the operating room. [15] Off label studies have shown that it has increased the duration of analgesia of local anesthetic when used as an adjunct in BPB.[16-20] But perineural use of dexmedetomidine is not approved by FDA.[21] Studies have also shown that dexmedetomidine and midazolam when added to local anaesthesia during subarachnoid block also resulted in prolonged duration of block. [3,22,23,24]

Dexmedetomidine has gained popularity in intra-operative sedation during regional procedures. Even midazolam, a water-soluble benzodiazepine, is widely used for sedation perioperatively. Surgery in an awake state however, increases patient anxiety, indicating a need for sedation during regional anaesthesia to improve patient well-being and increase satisfaction. Studies have shown that intravenous administration of dexmeditomidine or midazolam have resulted in prolonged duration of sensory and motor block after spinal anaesthesia. [25,26]

In our institute all the patients receiving supraclavicular block for the surgery receive either dexmedetomidine or midazolam infusion for sedation, amnesia and better patient satisfaction. But very few data is available on the effect of intravenous administration of these agents on the supraclavicular block characteristics. Hence we undertook this study to determine the effect of sedation with dexmedetomidine or midazolam on the onset and duration of supraclavicular block with bupivacaine and lignocaine with adrenaline.

Materials and Methods

After obtaining approval from Institutional Ethical Committee and written informed consent from all the patients, this prospective observational study was carried out in the Orthopaedic Surgery operation theatre during a study period from April 2021- December 2022. A total of 80 patients of either sex, age between 18 to 60 years, ASA grade I and II, who undergoing upper extremity surgery under supraclavicular brachial plexus block receiving Intravenous dexmedetomidine or Midazolam sedation during procedure were included in the study. Patients with allergy or hypersensitivity to local anaesthetics, dexmedetomidine and midazolam, BMI >35kg/m2, significant systemic illness, patient refusal or inability to consent, pregnant females, patients with significant psychiatric illness and pre-existing neurological deficits or neuropathy affecting brachial plexus, chronic pain syndrome, history of substance abuse, and current opioid use were excluded from the study.

Preoperatively patients were instructed about the visual analogue scale to assess their pain post operatively. As per routine operation theatre protocol monitors such as electrocardiography, non-invasive blood pressure, pulse oximetry were attached. Baseline parameter like heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and saturation (SPO2) were recorded. Patient was given either dexmedetomidine or midazolam infusion for sedation, as per consultant anaesthesiologist. As per routine protocol dexmedetomidine was given with loading dose of 0.5 µg kg−1 over 10 min, followed by maintenance infusion of 0.2 to 0.6 µg kg−1 h−1 until the end of surgery. Inj. Midazolam was given in the dose of 0.02-0.04 mg kg−1 in 10 ml of normal saline slowly, followed by maintenance infusion of 0.02- 0.04 mg kg−1 h−1 until the end of surgery. Patients receiving dexmedetomidine infusion were included in D Group and patients receiving midazolam infusion were included in M Group.

All patients were received Oxygen through a face mask at 4-6 L min-1 throughout the surgery. Once the patients were adequately sedated, they were given position for supraclavicular brachial plexus block. Patient was in supine position with head tilted to the opposite side with ipsilateral arm adducted of injection site and bolster below the shoulder to make the subclavian artery prominent. The skin was cleaned with betadine and spirit solution. The linear high frequency ultrasound transducer 5- 10MHz was inserted into a sterile sheath. Probe was applied parallel to the clavicle in the supraclavicular fossa. At this location, the subclavian artery was seen beating above the first rib; it cannot be compressed as opposed to the vein.

The brachial plexus was lateral to the subclavian artery with honeycomb appearance. Lignocaine 2% was infiltrated in the skin and subcutaneous tissue before the block (24-G needle). A 20-G stimuplex needle was advanced in plane under direct visualization toward the plexus sheath till its puncture and 25 ml of local anaesthetic solution (10 ml 2% Lignocaine plus adrenaline and 15 ml 0.5% Bupivacaine) was injected. The injected volume

gently expands the connective tissue surrounding the nerves, which is called hydro dissection. This allows a clear path for the needle, decreasing the chance of nerve damage by the needle. Aspiration done every 3-5 mL during injection to prevent vascular injection the end of the injection was considered as time 0. Neurological assessment (sensory and motor) was recorded at 1,3,5,10, 15,20,25,30, and 45 till complete loss of sensation and power.

Level of sedation was assessed by Ramsay Sedation score Sedation score was assessed at 1,3,5,10, 15,20,25,30, and 45 min then hourly till the end of surgery. Hemodynamic parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (PR) were recorded every 5minutes for 30minutes followed by every 30 minutes thereafter.

After completion of surgery, patients will be shifted to recovery and observed for 2 hours and later in the ward for 24hours. Duration of the surgery was noted. Hypotension was defined as fall in systolic blood pressure > 30% of the basal systolic blood pressure, and. Bradycardia was defined as decrease in heart rate < 50 beats per min.

Treatment given by the concerned anaesthetist was noted. Postoperatively sensory, motor block and sedation were assessed every 30 minutes till the block resolution and duration of sensory and motor block was recorded. Pain assessment in the postoperative period was done using visual analogue (VAS) score half hourly, being obtained by asking the patient to rate the intensity of pain perceived by him/her and express it on a numerical scale of 0 to 10, with 0-no pain (one extreme) and 10-worst pain possible (other extreme). Rescue analgesia was given when the VAS >4. Duration of analgesia was the time interval between end of injection and need for the first dose of rescue analgesia. Complications such as nausea, vomiting, headache, hemodynamic instability, sedation, hypotension, bradycardia, block-related side effects (residual numbness, persistent tingling or weakness in the arm, or forearm, and pain or bruising at the site of injection), any adverse reactions were noted.

Statistical Analysis

In a previous study for surgeries for arteriovenous fistula formation, who received either dexmedetomidine or midazolam sedation [3] , the mean duration of block was 11.9 (3.8)and 9.4(3.4) respectively. Using Open Epi software (version 3.01), with 95% confidence interval and 80% power the sample size was estimated as 33 for each group. Considering 10% dropout, 40 patients were studied in each group. The data analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0.

The comparison of the variables which were quantitative in nature were analysed using independent t test. The comparison of the variables which were qualitative in nature were analysed using Chi-Square test. P value less than 0.05 was considered as significant. If any cell had an expected value of less than 5 then Fisher's exact test was used.

Observations and Results

A total of 80 patients who underwent upper extremity surgery under supraclavicular brachial plexus block were included and divided into two equal groups. Both the groups were comparable and found no significant difference with respect to demographic data of patients and duration of surgery between group D and M as shown in table 1.

Table 1: Comparison of demographic profile of the patients and duration of surgery between group D and M

Demographic data		Group D	Group M	P value
Age (years)		48.1 ± 7.54	46.88 ± 7.97	0.482
Weight(kg)		58.58 ± 6.76	58.35 ± 7.41	0.888
Height(cm)		159.6 ± 5.11	159 ± 4.76	0.588
BMI (kg/m²)		22.97 ± 2.22	23.04 ± 2.42	0.845
Duration of surgery (minutes)		165 ± 29.61	165 ± 29.61	1.000
Gender	Male	27 (67.50%)	25 (62.50%)	0.639
	Female	13 (32.50%)	15 (37.50%)	
ASA grade	1	30 (75%)	30 (75%)	1.000
	2	10 (25%)	10 (25%)	

The onset of sensory block was quicker in the dexmedetomidine group than midazolam. The duration of sensory block was more prolonged in group D than group M. Time required for the onset motor block (minutes) in midazolam group was high. The duration of time taken to complete recovery from motor block (minutes) in group D was significantly higher as compared to group M, (p value <.0001). The total of duration of analgesia in group D was significantly higher as compared to group M. (p value<0.0001) as shown in table 2.

All patients were received Oxygen through a face mask at 4-6 L min-1 throughout the surgery. SpO_2 in both groups were comparable. (p value=1).

Table 2: Comparison of block characteristics and duration of analgesia between two groups

Characteristics (minutes)	Group D	Group M	P value
Time of onset of sensory block	10.58 ± 1.32	19.8 ± 1.11	<0.0001
Total sensory duration	276 ± 24.68	239.25±25.86	<0.0001
Time of onset motor block	20.62 ± 1.64	28 ± 1.43	<0.0001
Total motor duration	533.25 ± 36.26	259.5 ± 25.01	<0.0001
Duration of analgesia	335.22 ± 92.64	254.55 ± 58.59	<0.0001

The baseline value of heart rate and blood pressure were comparable in both groups and maintained during initial infusion of dexmedetomidine and midazolam group. The heart rate (per min) was found to be on lower side in group D (72.22 ± 8.31) than group M (80.35 ± 8.06) throughout the intraoperative period. Diastolic blood pressure was on lower side after 20 minutes of infusion in D group than group M. Though statistically significant but clinically there was no hypotension and bradycardia in any patient, (Figure 1).

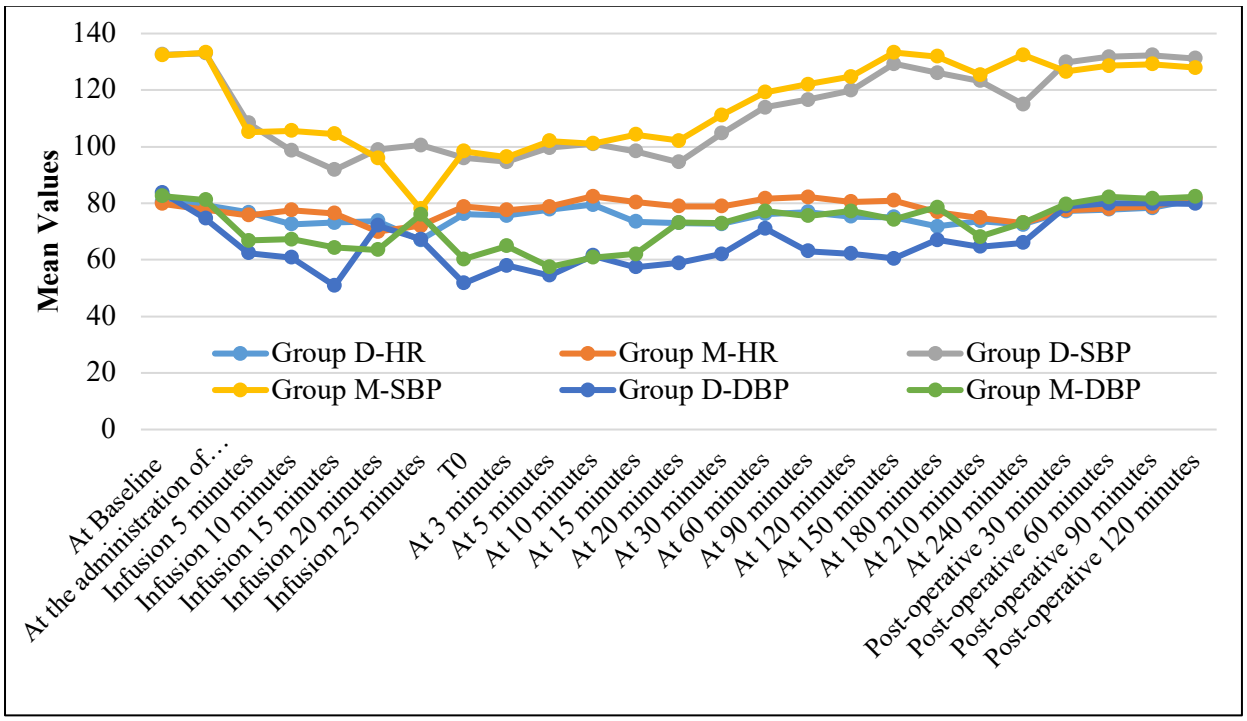

Figure 1: Comparison of haemodynamic parameters between two groups

Some of patient with Ramsay sedation score 1 was anxious and restless at start of procedure. After bolus dose of sedative agent patient was co-operative, oriented and arousable on stimulus. Patient who received midazolam infusion were more sedated than dexmedetomidine received patients. There was not statistically difference in Ramsay sedation score between two study groups by independent t test, (Figure 2).

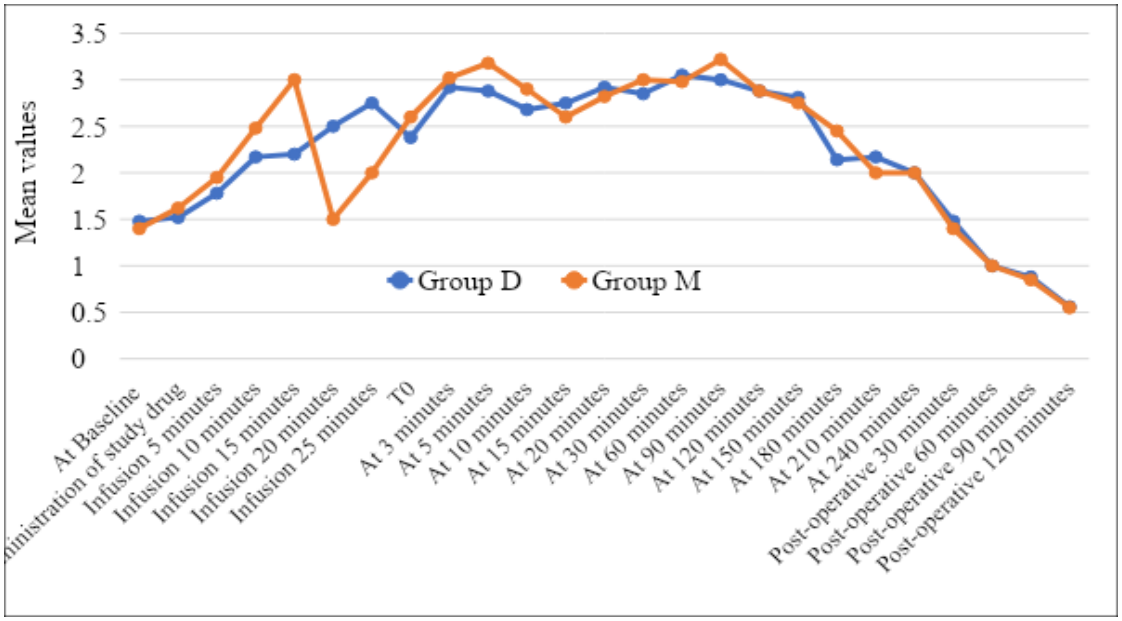

Figure 2: Comparison of sedation score between group D and M

Post-operative pain assessment with VAS score showed that pain was significantly lower in group D as compared to group M, (P value < 0.005) as depicted in figure 3. There was no complication reported in present study.

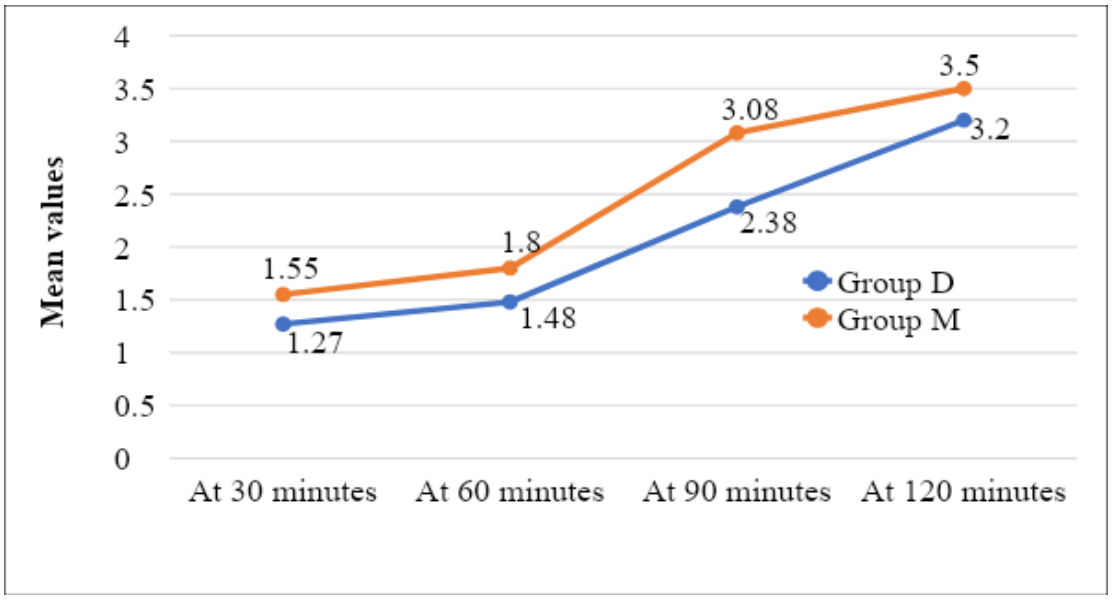

Figure 3: Comparison of post-operative VAS score between group D and M

Discussion

Prolonging the duration of sensory blockade with bupivacaine is desirable for better postoperative pain management and for avoiding opioids or nonsteroidal anti-inflammatory agents in the postoperative period. For quicker onset and prolonged duration of postoperative analgesia following supraclavicular brachial plexus block, additives such as opioids, dexamethasone, neostigmine, hyaluronidase, magnesium, benzodiazepines, and alpha agonists have been used [27]. It has been found that intravenous dexmedetomidine with spinal anaesthesia also hasten the onset and prolongs the duration of block [28]. We were using either dexmedetomidine or midazolam for sedation in patients undergoing surgery under supraclavicular BPB.

In the present study distribution of age and gender between group D and M were comparable and found no statistically significant difference between 2 group, (p value >0.05). Highest number of patients (45%) was found in age group 51-60 years. The mean body mass index (kg/m²) of group D was 22.97±2.22 and that of group M 23.04±2.42. Percentage of patient belonging in overweight was 22.5% and 25% in group D and M respectively. Distribution of ASA grade among patients was comparable between group D and M by using Chi

square test. Similar findings are reported in other studies [27,28]. The main findings of the present study where the onset of sensory block was quicker in the dexmedetomidine group than midazolam. Time of onset of sensory block (minutes) in group M was 19.8±1.11 min which was significantly higher as compared to group D 10.58±1.32 min. (p value <0.0001) and Time required for the onset motor block (minutes) in midazolam group was high; it was 28±1.43 min in the midazolam group and 20.62±1.64 min in the dexmedetomidine group, (p value <0.0001). There was a significance difference between the time of onset sensory and motor block in both groups. These results are comparable to the study conducted by Kumar G et al [27], and Shashikala TK et al. [29] on contrary a study by Katarzyna Rutkowska, Piotr Knapik et al [3], Kumar S et al [28] did not find any difference in the onset of sensory and motor block between the two groups.

However, the duration of sensory and motor block was more prolonged in group D than group M. Total sensory duration in group D was 276±24.68 min which was significantly higher as compared to group M 239.25±25.86 min, (p value <0.0001). Also, duration of time taken to complete recovery from motor block in group D was 533.25±36.26 min which was significantly higher as compared to group M 259.5±25.01 min, (p value <0.0001). These findings are in accordance with the study done by Kumar G et al [27], Shashikala TK K [29] et al and Mohasseb MAA et al [22].

The dexmedetomidine group had significantly prolonged duration of analgesia by an average of 335.22±92.64 min in comparison to midazolam group 254.55±58.59 min, (p value <0.0001). These results are in agreement with Kumar S et al [28], Shashikala TK et al [29] and B. Hong, C. Jung et al [30]. The baseline value of heart rate (per minute) was comparable in both groups and maintained during initial infusion of dexmedetomidine and midazolam group. The heart rate was found to be lower in the group D after 15 min of infusion (72.22±8.31) than group M (80.35±8.06) which was statistically significant. It remained on lower side compared to group M throughout the intraoperative period, though statistically significant but clinically patients in both groups were stable.

The baseline value of systolic and diastolic blood pressure was comparable in both the groups. Systolic blood pressures were comparable in both groups, diastolic pressure was on lower side after 20 minutes of infusion in dexmedetomidine group though statistically significant but clinically there was no hypotension in any patient. Similar findings are reported in previous studies[23,29] . Kumar S, Hussain M. et al[28] did not find a statistically significant difference in hemodynamic between dexmedetomidine and midazolam group, but the Incidence of episode of hypotension and bradycardia was recorded to be significantly greater in Group D (6 patients [12%] and 3 patients [4%] respectively) as compared to in Group M (2 patient [4%] and 1 patient [2%] respectively).

In the current study some of patients with Ramsay sedation score 1 was anxious and restless at start of procedure. After bolus dose of sedative agent patients were co-operative, oriented and arousable on stimulus. Patients who received midazolam infusion (3±0) were more sedated than dexmedetomidine group (2.2±0.9) patients. There was no statistically significant difference in Ramsay sedation score between two study groups. These results are similar to the study conducted by Kumar S et al [28]. In study by Boohwi Hong, Choonho Jung [30]et al patients of dexmedetomidine group were more sedated than midazolam group which was in contrary to our observation. There were no adverse effects in any of our patients in both the groups. But K. Rutkowska, Piotr Knapik et al (3) in their study, reported that some patients had headache, dry mouth and nausea more with dexmedetomidine group than midazolam.

Conclusion

Thus, from present study, we concluded that: dexmedetomidine when given intravenously as sedative fastened the onset of sensory and motor blockade, prolonged the duration of sensory and motor blockade, and duration of analgesia of brachial plexus block compared to intravenous midazolam.

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