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Dexmedetomidine-bupivacaine versus ketamine-bupivacaine for ultrasound guided supraclavicular brachial plexus nerve block in upper arm orthopedic surgeries

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Abstract--Background: Seeking for efficient adjuvants to the regional nerve block is still under research, with medication that increases the time of analgesia but with lesser side effects. Objectives: The purpose of this research was to study the safety and efficacy of different additives, namely dexmedetomidine and ketamine when added to bupivacaine in ultrasound-guided supraclavicular block, to assess the onset and duration of sensory and motor block, sedation score, pain scale and to explore side effects dexmedetomidine and ketamine when added to bupivacaine in ultrasound-guided supraclavicular block. Patients and methods: This clinical study was carried out on 60 American Society of Anesthesiologists (ASA) I and II patients, aged 18–60 years, scheduled for upper limb orthopedic surgeries under supraclavicular brachial plexus block. Patients were randomly divided into two groups (30 patients each): group D received dexmedetomidine and bupivacaine and group K received ketamine and bupivacaine. Result: Regarding duration of sensory and motor block and duration

of analgesia,) group D showed statistically significant longer duration values (413.97 ± 87.31 , 472.24 ± 90.06 and 456.21 ± 97.99) respectively compared with group K (227.00 ± 48.36 , 292.67 ± 59.13 and 289.67 ± 62.50) respectively (P value < 0.05). Conclusion: The addition of $1\mu\text{g/kg}$ dexmedetomidine to bupivacaine 0.25% in supraclavicular brachial plexus block was effective in increasing the sensory and motor duration of the block, as well as providing adequate postoperative analgesia when compared to ketamine. We also concluded that dexmedetomidine and ketamine both effectively produced postoperative analgesia.

Keywords---dexmedetomidine, ketamine, bupivacaine, ultrasound-guided, supraclavicular block, supraclavicular brachial, plexus block.

Introduction

Surgeries of the upper limb are commonly done using peripheral blocks such as the supraclavicular brachial plexus block which provides effective anesthesia (1, 2). Seeking for adequate adjuvants to the regional nerve block is still under research, with medication that increases the time of analgesia but with lesser side effects (2). Drugs such as opioids, naloxone, clonidine, midazolam, dexmedetomidine, epinephrine, and dexamethasone have been used along with local anesthetics for this purpose with varying degrees of success (3). The purpose of this research was to study the safety and efficacy of different additives, namely dexmedetomidine and ketamine when added to bupivacaine in ultrasound-guided supraclavicular block, to assess the onset and duration of sensory and motor block, sedation score, pain scale and to explore side effects dexmedetomidine and ketamine when added to bupivacaine in ultrasound-guided supraclavicular block.

Patients and Methods

This prospective, double blind randomized control trial was done in south valley university hospital at the time period from January 2020 to may 2022, this clinical study was carried out on 60 American Society of Anesthesiologist (ASA) Grade I and II patients of either sex, aged 18–60 years, undergoing upper limb orthopedic surgeries under supraclavicular brachial plexus block. The study was conducted in two groups of 30 patients each. The patients were randomly allocated into two groups: Group D (n:30) : Bupivacaine 0.25% + dexmedetomidine $1\mu\text{g/kg}$. Group K (n:30): Bupivacaine 0.25% + ketamine 1mg/kg .

Inclusion Criteria

18 years to 60 years of age, American Society of Anesthesiologists I and II status and elective upper limb orthopedic surgeries.

Exclusion Criteria

American Society of Anesthesiologists 3- 4 status, morbid obesity ($\text{BMI} > 40$), presence of a severe or systemic bacterial infection, bleeding disorders,

uncontrolled diabetes mellitus, pregnancy and patients with known allergy to the studied drugs were also excluded.

Methodology

After approval from south valley university hospital ethical committee, Written and informed consent was obtained from 60 patients undergoing elective upper limb surgery including arm, forearm, and hand fractures. All patients included were allocated randomly (using computer-generated number lists and opaque sealed envelopes) into two groups. Patients' assessment and observation were recorded by a second blinded researcher both in the operating theatre and recovery room. Patients were randomly allocated into the following groups: Group (D) received 30 ml bupivacaine 0.25% with 2 ml (100 µg) dexmedetomidine. Group (K) received 30 ml bupivacaine 0.25% with 2 ml (100 mg) ketamine. All patients fasted 6 hours and received 150 mg ranitidine and 4 mg ondansetron slowly intravenously through an 20G cannula which was inserted peripherally 20 min before the block in the unaffected limb. Intravenous normal saline (NS) solution infusion 6–8 ml/kg was started. They were pre-medicated with intravenous midazolam 0.02 mg/kg. Standard monitoring were connected, and baseline vital readings were recorded before performing the block. Oxygen was supplied with a nasal cannula intra-operatively. All the patients received brachial plexus block through the supraclavicular approach by an experienced anesthesiologist different from the one assessing the patient intra- and post-operatively. Both were blinded to the treatment groups. Neural localization was achieved by using an ultrasound (sonosite) electronics HS-2100 . Portable ultrasound machine with linear probe 6–13 MHz probe. Intra-operative parameters included assessment of the sensory, motor block, sedation, and complications.

Data collection

Demographic characteristics

Age, gender and BMI

Clinical data

- Hemodynamic data: collected (baseline- after block-after skin incision and every 15min during surgery) include: Heart rate (HR), mean arterial blood pressure (MAP) and arterial oxygen saturation (Spo2).
- Onset and duration of sensory block which is time between the complete sensory block and the first postoperative pain.
- Onset and duration of motor block (The time between the complete motor paralysis and complete recovery of motor function).
- dSedation score by using Ramsay sedation score, quality of operative conditions (satisfaction score) was assessed according to the following numeric scale (4).
 - Grade 4: (Excellent) No complaint from patient
 - Grade 3: (Good) Minor complaint with no need for the supplemental analgesics

- Grade 2: (Moderate) Complaint that required supplemental analgesia
- Grade 1: (Unsuccessful) Patient given general anesthesia.
- Postoperative pain by visual analog pain scale (VAS score)

Intraoperative adverse effects

Hypotension, bradycardia, nausea and vomiting.

Sample size

was calculated using the Steven K. Thompson equation, and total sample size is 60 cases.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Data were tested for normal distribution using the Shapiro Walk test. Qualitative data were represented as frequencies and relative percentages. Chi square test (χ^2) to calculate difference between two or more groups of qualitative variables. Quantitative data were expressed as mean $\pm$ SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data). P value < 0.05 was considered significant.

Results

This study was conducted on 60 adult patients admitted to orthopedic surgery department of south valley university hospitals. The patients were randomly divided into two groups: Group D(n=30) received the study drug dexmedetomidine and Group K(n=30) received the study drug ketamine.

The demographic characteristics

were comparable in the two studied groups with no statistically significant difference Table (1).

Regarding patients hemodynamic data

The statistical analysis did not show any significant differences among the two studied groups regarding heart rate (HR) mean arterial pressure (MAP) and oxygen saturation (SPO2). Concerning the onset of sensory block, There were no significant difference between both groups ((P value> 0.05) while the onset of motor block in group D showed statistically significant faster onset (13.46 ± 3.31) compared with group K (16.83 ± 1.37) (P value< 0.05) (table 2). Regarding duration of sensory and motor block and duration of analgesia,) group D showed statistically significant longerduration values (413.97 ± 87.31 , 472.24 ± 90.06 and 456.21 ± 97.99) respectively compared with group K (227.00 ± 48.36 , 292.67 ± 59.13 and 289.67 ± 62.50) respectively. (P value< 0.05) (table 2). Regarding duration of surgery there was no statistically significant difference between both

groups (P value > 0.05) (table 2). According to Ramsay sedation score group D parameters showed statistically significant better values (3.71 ± 0.5) compared with group K (2.5 ± 0.59) with (P value < 0.05) throughout the operation these result indicate the optimum sedative effect of dexmedetomidine than ketamine (table 3). According to satisfaction score group D parameters showed statistically significant better values (3.0 ± 0.01) than group K (2.4 ± 0.2) with (P value < 0.05) at the end of the operation (table 3).

The group D parameters showed statistically significant lower values (1.5 ± 0.3 , 3.9 ± 0.3 and 4.35 ± 0.5) compared with group K (3.4 ± 0.7 , 4.7 ± 0.4 and 4.9 ± 0.62) at 6h, 12h and 18h postoperative respectively (P value < 0.05) while the readings of VAS at 1h post operative was not significant different (P value > 0.05). (Figure 1). The time to first analgesic request was significantly more in group D (440.2 ± 121.2) than group K (251.7 ± 57.1) (P value < 0.05) but the total doses of diclofenac sodium were significantly lower in group D (100 ± 42.56) than group K (160.5 ± 44.7) and (P value < 0.05) (Figure 2). Table (4) shows Intraoperative and postoperative complications. In D group, the incidence of nausea and vomiting was more 6.7%, the incidence of Bradycardia was 10% and incidence of Hypotension was 10%. While In K group, there were no incidence of Nausea and vomiting or Hypotension and low incidence of Bradycardia 3.3% with no significant difference between both groups (P value > 0.05).

Table 1
Demographic characteristics among the studied groups

		Group (D) (n = 30)		Group (K) (n = 30)		P-value
		N	%	N	%	
Sex	Male	16	53.3 %	17	56.7%	0.71 (NS)
	Female	14	46.7 %	13	43.3%	
BMI		26.5 ± 1.32		26.6 ± 1.22		0.67 (NS)
Age		32.3 ± 3.3		32.7 ± 3.8		0.45 (NS)

(NS) no statistically significant difference P value ≥ 0.05

*P value < 0.05 is significant,

P value < 0.01 is highly significant

SD: Standard deviation,

^zMWU = Mann- Whitney U test

X²= Chi- Square test

Table 2
Sensory block and motor block among the studied groups

	Group (D) (n = 30)	Group (K) (n = 30)	P-value
Duration of surgery (minutes)	97 ± 17.53	95.08 ± 10.48	0.784(NS)
Onset of Sensory block (minutes)	11.22 ± 1.38	13.35 ± 1.23	0.53(NS)
Onset of Motor block (minutes)	13.46 ± 3.31	16.83 ± 1.37	0.008*

Duration of sensory block(min)	413.97±87.31	227.00±48.36	0.002*
Duration of motor block(min)	472.24±90.06	292.67 ±59.13	0.02*

(NS) no statically significant difference P value $\geq 0,05$

*P value < 0.05 is significant

P value < 0.01 is highly significant

SD: Standard deviation

^zMWU = Mann- Whitney U test

X²= Chi- Square test

Table 3
Sedation Score and Satisfaction score among the studied groups

	Group (D) (n = 30)	Group (K) (n = 30)	P-value
Satisfaction score	3.0± 0.01	2.4± 0.2	0.0001 *
Ramsay Sedation Score	3.71 ± 0.5	2.5± 0.59	0.04 *

(NS) no statically significant difference Pvalue $\geq 0,05$

*P value < 0.05 is significant

P value < 0.01 is highly significant

SD: Standard deviation

^zMWU = Mann- Whitney U test

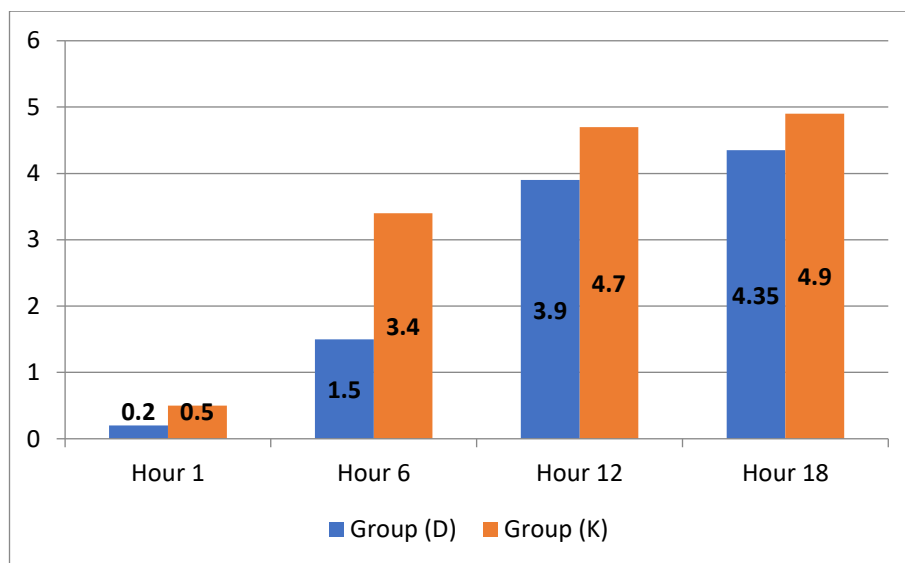


Fig. 1. VAS among the studied group

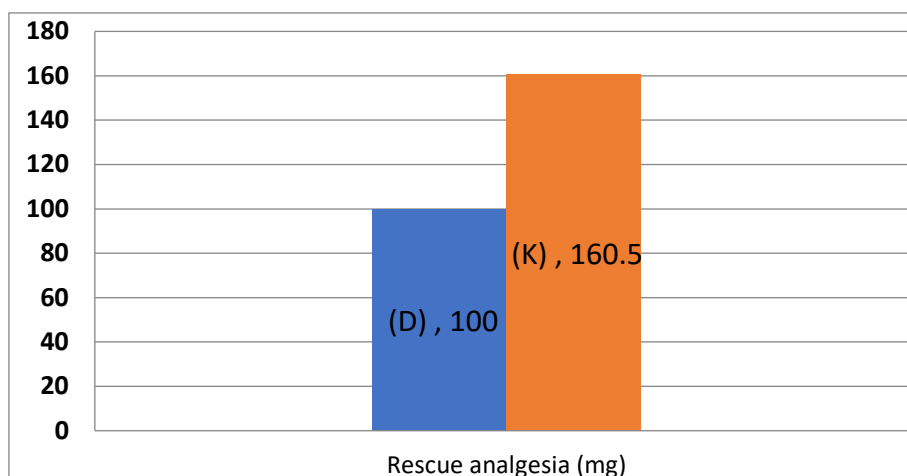


Fig 2. Rescue analgesia (mg) among the studied groups

Table 4
Intraoperative adverse effects

	Group (D) (n = 30)		Group (K) (n = 30)		P-value
	N	%	N	%	
Nausea and vomiting	2	6.7%	0	0	0.15
Bradycardia	3	10%	1	3.3%	0.30
Hypotension	3	10%	0	0	0.07

(NS) no statically significant difference Pvalue $\geq 0,05$

*P value < 0.05 is significant

P value < 0.01 is highly significant

SD: Standard deviation

^zMWU = Mann- Whitney U test

Discussion

The techniques of regional anesthesia have become very popular as they provide several advantages in comparison with general anesthesia and systemic analgesia. They provide perfect pain control, decreased complications, and reduced post-anesthesia care unit stay (5). The results of the present study showed that: adding of $1\mu\text{g/kg}$ dexmedetomidine to bupivacaine for ultrasound-guided supraclavicular brachial plexus block had led to shortening of the onset of motor block, prolongation of the duration of motor and sensory block and increase the duration of postoperative analgesia when compared with another adjuvant ketamine(1mg/kg). also, dexmedetomidine administration had sedative effect and reduced the amount of total analgesic rescue. In accordance to the onset of motor block among the studied groups. the study done by Mohmed et al. (6) who study 75 adult patients undergoing elective operations of the elbow, forearm, wrist, or hand were randomly allocated into three groups of 25 patients each. Group K (ketamine group) received 40 ml 0.25% bupivacaine contain 1

mg/kg ketamine, group D (dexmedetomidine group) received 40 ml 0.25% bupivacaine contain 1 µg/ kg dexmedetomidine, and group C (control group) received 40 ml 0.25% bupivacaine in which the onset of sensory and motor block was rapid in the dexmedetomidine group as compared to the ketamine group.

Also, the study of Esmaoglu et al. (7) whose study was on the effect of dexmedetomidine added to levobupivacaine in axillary brachial plexus block in which there was rapid onset of sensory and motor block. Contrary to our result the study of Hashim and Hassan (8) which was done in Ain Shams University hospitals on 60 patients divided equally into three groups, receiving dexmedetomidine (DB), ketamine (KB), and fentanyl (FB) respectively with bupivacaine in supraclavicular plexus block there was no statistically significant differences between the three groups. Also, the study done by Gandhi et al. (9) who studied the use of dexmedetomidine along with bupivacaine for brachial plexus block in which the onset of sensory and motor block was prolonged in the group with dexmedetomidine as compared to the control group.

Lastly, Sabra et al. (10) who studied 60 patients allocated for elective upper limb surgeries by axillary block and were divided into two equal groups. Group D received 1µg/kg dexmedetomidine and group K received 2 mg/kg ketamine added to bupivacaine 0.25% (25 ml). There was no statistically significant difference regarding the onset of sensory and motor block. As regard the duration of sensory and motor block Mohamed et al. (6) was accordance with our study as they concluded that the duration of sensory and motor block was significantly prolonged in patients receiving dexmedetomidine. Also, sensory and motor block durations were also significantly prolonged in the study done by Hashim and Hassan (8). And this consistent with Sabra et al. (10) who showed that the addition of dexmedetomidine effectively and significantly prolonging the motor and sensory duration.

Lastly, Biswas et al. (11) who studied the effect of adding 1 ml (100 µg) dexmedetomidine to 35 ml of levobupivacaine 0.5% showed that the sensory and motor block durations were also significantly prolonged. Regarding to Sedation Score among the studied groups. Dexmedetomidine group had more sedative effect than ketamine group. Our results were supported by study of Hashim and Hassan (8) as they assessed the intra-operative sedation level using a 4-point and The results indicate that the optimum sedative effect was with dexmedetomidine followed by ketamine Also Mohamed et al. (6), and Sabra et al. (10) recorded The sedation score by using Ramsay sedation scale and they concluded the Dexmedetomidine group had more sedative effect than ketamine. Lastly, Swami et al. (2) comparing the addition of dexmedetomidine and clonidine to bupivacaine in supraclavicular plexus block on measuring sedation level showed that 80% of patients experienced level 4 sedation in the dexmedetomidine group in comparison with 40% in the clonidine group.

Regarding our outcomes for assessment of postoperative pain score (VAS score) which showed that pain score was reduced in Dexmedetomidine group than ketamine and this was accordance with Mohamed et al. (6) as they reported that the VAS readings were significantly lower in dexmedetomidine group than ketamine group. While the study of Hashim and Hassan (8), reported that there

was no significant difference between Dexmedetomidine group and Ketamine group during assessment of VAS score. The total amount of rescue analgesia given over the first 24 hour was least in the dexmedetomidine group followed by the ketamine group and these results were in consistent with Hashim and Hassan (8) which indicated that prolonged postoperative analgesia in the dexmedetomidine group and ketamine group more than the fentanyl group. As regard the intraoperative complications as (nausea and vomiting, bradycardia and hypotension) There was insignificant difference between both groups. Our results were supported by study of Hashim and Hassan (8) as they reported the incidence of intraoperative complications between the groups also showed no significant difference.

Conclusion

The addition of 1µg/kg dexmedetomidine to bupivacaine 0.25% in supraclavicular brachial plexus block was effective in increase the sensory and motor duration of the block, as well as providing adequate intra-operative analgesia when compared to ketamine. We also concluded that dexmedetomidine and ketamine both effectively produced post-operative analgesia.

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