Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/12tw3819

A PROSPECTIVE STUDY OF COMPARING PERIOPERATIVE HEMODYNAMIC AND ANALGESIC EFFECTS OF COMBINATION OF DEXMEDETOMIDINE AND ROPIVACAINE WITH PLAIN ROPIVACAINE IN USG GUIDED INTERSCALENE BRACHIAL PLEXUS BLOCK FOR ELECTIVE SHOULDER ARTHROSCOPIC SURGERIES.

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Background

Abstract: Peripheral nerve blocks are frequently used as an alternative or adjuvant to general anesthesia and as a means of attenuating postoperative pain.

Aim: To observe and compare the effects of Dexmedetomidine and Ropivacaine combination with Ropivacaine alone on perioperative hemodynamic parameters and postoperative analgesia.

Methods: The present observational study was conducted in Bone and Joint Hospital, an associated hospital of Government Medical College, Srinagar from February 2020 to October 2021. 50 patients were observed in the study who underwent interscalene brachial plexus block for shoulder arthroscopic surgery 30 minutes before general anaesthesia. Patients were equally divided into two groups of 25 patients each using a computer generated sequence of random numbers in 1:1 ratio. Hemodynamic parameters such as heart rate (bpm), systolic blood pressure (mmHg), diastolic blood pressure (mmHg), mean arterial pressure (mmHg) and SpO2 (%) were monitored postoperatively upto 24hours. Patient's pain score was assessed using VAS (0–10)86. Patient's pain score using VAS was recorded every 3 hrs for 24 hours. Time for first rescue analgesic given and number of doses of rescue analgesics given were also recorded. Patient's satisfaction was assessed using Likert Satisfaction Scale. Side effects in the form of nausea, vomiting, hypotension, bradycardia and hypoxemia were recorded.

Results: Comparison of haemodynamic parameters among two study groups was found to be statistically significant at all-time intervals except baseline, but the difference were within safety limits. Statistically significant difference was obtained when postoperative haemodynamic

parameters were compared among two study groups but the difference was within safety limits. Duration of analgesia was high in Group 1 (dexmedetomidine + ropivacaine) compared to Group 2 (ropivacaine alone). Time of request for rescue analgesia was higher in Group 1 group as compared to Group 2. Analgesia was better and statistically significant at 6 hours, 9 hours, 12 hours, 15 hours and 21 hours ($p < 0.05$) postoperatively in Group 1 compared to Group 2. At all other time intervals the difference observed was statistically insignificant.

Conclusion: We conclude that preoperative inter-scalene block given by adding dexmedetomidine to ropivacaine reduces the analgesic requirement intraoperatively as well postoperatively with favorable hemodynamic changes.

Keywords: Peripheral nerve blocks, dexmedetomidine, ropivacaine, hemodynamics, Analgesia.

Introduction:

Peripheral nerve blocks are frequently used as an alternative or adjuvant to general anesthesia and as a means of attenuating postoperative pain. Although an increasing number of anesthesiologists are using peripheral nerve catheters for postoperative analgesia, single shot blocks are still more common. Ropivacaine has become the most commonly used long acting local anesthetic, and the duration of analgesia has been estimated to be 8 to 14 hours.[1–4] Most patients first report pain during night hours when access to care is limited. The use of opioids in anticipation of the return of pain during the night can lead to opioid-induced adverse effects, including nausea, vomiting, respiratory impairment, and sleep disturbance.[5,6]

Inter-scalene brachial plexus block is one of the most widely practiced regional anaesthetic technique for shoulder surgeries and it provides better analgesia, greater satisfaction and fewer side effects. When combined with general anaesthesia, it reduces intraoperative anaesthetic and analgesic requirements and provides postoperative analgesia. The addition of various adjuvants like α-2 agonists (dexmedetomidine), opioids, ketamine, neostigmine, magnesium sulphate, adenosine, and steroids to local anesthetics hasten the onset and prolong the duration of analgesia. Adjuvants to local anaesthetics improve the quality of analgesia, prolong duration of blockade and reduce the dose of local anaesthetics.[7-10]

Shoulder arthroscopy is a minimally invasive, ambulatory surgery useful for treating a variety of shoulder pathologies. But it is associated with severe post-operative pain, which causes significant discomfort to the patient and hence interferes with recovery and rehabilitation of the shoulder. [11] Of all blocks, employed for post-operative pain after shoulder surgery, the inter-scalene block (ISB) is the most widely used block. It has been reported to provide excellent post-operative analgesia. [12]

Material & methods

The study was conducted from February 2020 to October 2021 after obtaining approval from the Institutional Ethics Committee. The study was conducted in Bone and Joint hospital which is an associated hospital of Government Medical College, Srinagar. A total of 50 patients undergoing elective unilateral shoulder arthroscopic surgeries were observed after obtaining consent for enrollment in the study from patients and fulfilling the inclusion criteria of the study.

All patients were observed for perioperative hemodynamic changes and postoperative analgesia who had received 20ml (0.2%) Ropivacaine with 50 g Dexmedetomidine (Group 1) and patients who had received 20ml (0.2%) Ropivacaine alone (Group 2).

They were observed in one of the two groups using a computer generated sequence of random numbers in 1:1 ratio. The pre-anaesthetic check-up was done and written informed consent was taken. All the patients were explained regarding the VAS score. The patients were shifted 60 min prior to surgery to the holding up area of operation theatre. An intravenous access was established and all routine monitoring parameters (i.e., noninvasive blood pressure, heart rate, SpO2 and

electrocardiogram) were recorded. Patients were premedicated with midazolam (0.05 mg/kg IV). Baseline sensory assessment was done over the shoulder (C4 –top of the shoulder, C5 – lateral shoulder, C6 – thumb, C7 – third finger and C8 – fourth finger).

All the blocks were done under USG guidance. The patients were positioned supine with the face turned away from the side of the block and the neck slightly extended. An in-plane puncture through the middle scalene muscle was done. The C6 root was identified and the tip of the needle was kept infero-posterior to it. After
confirming extra vascular placement of the needle, drug was injected into the groove avoiding intravascular injection. The block was given by the trained consultant anesthesiologist.
The assessment of level and density of the block was done every 5 minutes from administration of drug until the readiness of the surgery. If the block was not effective after 30 minute from drug injection it was considered unsuccessful and excluded from study. After the blockade all patients received general anaesthesia using Propofol [2 to 2.5 mg/kg iv81, injection fentanyl [1.5 to 3 μg/kg IV],[13,14] injection Atracurium [0.5mg/kg iv]85 for induction and facilitation of endotracheal intubation. Intra-operatively hemodynamic parameters were monitored and recorded at specific intervals.
After finishing surgery patients were extubated in the operation theatre and shifted to recovery ward. All the patients stayed in the recovery ward for 24 hours post-surgery.

Statistical Analysis
The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS Version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as Mean±SD and categorical variables were summarized as frequencies and percentages. Graphically the data was presented by bar charts and pie diagrams. Student's independent t-test or Mann-Whitney U-test, whichever feasible, were employed for comparing continuous variables. Chi-square test or Fisher's exact test, whichever appropriate, was applied for comparing categorical variables. A P-value of less than 0.05 was considered statistically significant. All P-values were two tailed.

Results:
Insignificant relation was observed with respect to demographic parameters among the study population.

Table 1: Demographic profile of the study population

Variables	Group 1	Group 2	P Value
Age (Years)	**40.24±12.50**	**55.50±11.812**	**0.571**
Sex M/F	**15/10**	**17/8**	**0.556**
Weight (kgs)	**63.5±10.76**	**63.9±8.94**	**0.887**
ASA I/II	**19/09**	**17/8**	**0.529**
Duration of surgery	**58.4±13.84**	**59.6±12.92**	**0.753**

P-value by Student's independent t-test

Mean intraoperative heart rate (bpm) at baseline was 76.84 in Group 1 compared to 75.60 in Group 2 with an insignificant statistical difference (p value of 0.292). Statistically significant difference was found at all other time intervals when mean heart rate was compared among two study groups (p value of < 0.05) [Table 2].

Table 2: Intra-operative heart rate (beats/min) among two groups

Time interval	Group 1	Group 2	P-Value
Baseline	**76.84±4.44**	**75.60±3.75**	**0.292**
5 Min	**73.60±4.03**	**79.28±3.71**	**<0.001***
10 Min	**69.88±3.44**	**80.56±3.55**	**<0.001***
15 Min	**67.56±3.94**	**78.92±3.59**	**<0.001***
30 Min	**65.40±5.04**	**79.64±5.16**	**<0.001***
60 Min	**68.28±4.11**	**77.12±3.38**	**<0.001***
90 Min	**71.76±3.24**	**76.28±4.18**	**<0.001***

**Statistically Significant Difference (P-value<0.05); P-value by Student's independent t-test*

Comparison among two study groups with regard to mean arterial pressure (mmHg) was observed statistically significant at all time intervals (p value of <0.05). When compared at baseline the difference was statistically insignificant (p value of > 0.05) [Table 3].

Table 3: Comparison of intra-operative MAP (mmHg) among two groups

Time interval	Group 1	Group 2	P-Value
Baseline	**95.93±3.30**	**94.64±3.08**	**0.160**
5 Min	**93.41±2.37**	**98.52±2.48**	**<0.001***
10 Min	**89.80±2.05**	**100.50±2.49**	**<0.001***
15 Min	**87.60±2.64**	**102.75±2.74**	**<0.001***
30 Min	**88.15±3.00**	**101.24±2.57**	**<0.001***
60 Min	**90.26±1.97**	**98.75±1.87**	**<0.001***
90 Min	**93.15±2.87**	**97.72±2.98**	**<0.001***

**Statistically Significant Difference (P-value<0.05); P-value by Student's independent t-test*

Comparison of postoperative heart rate (beats/min) and postoperative MAP (mmHg) among two groups at various intervals of time was statistically significant (p value of < 0.05) [Fig 1].

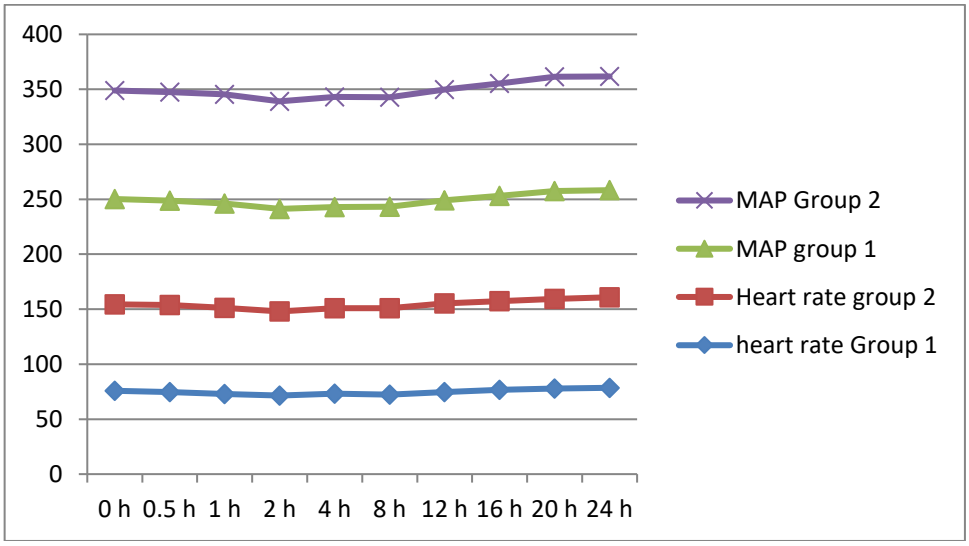

Fig 1

Comparison of VAS score was done among two groups at various time intervals. The difference obtained was statistically significant at 6 hours, 9 hours, 12 hours, 15 hours and 21 hours postoperatively (p<0.05). At all other time intervals the difference observed was statistically insignificant (p value of > 0.05) [Fig 2].

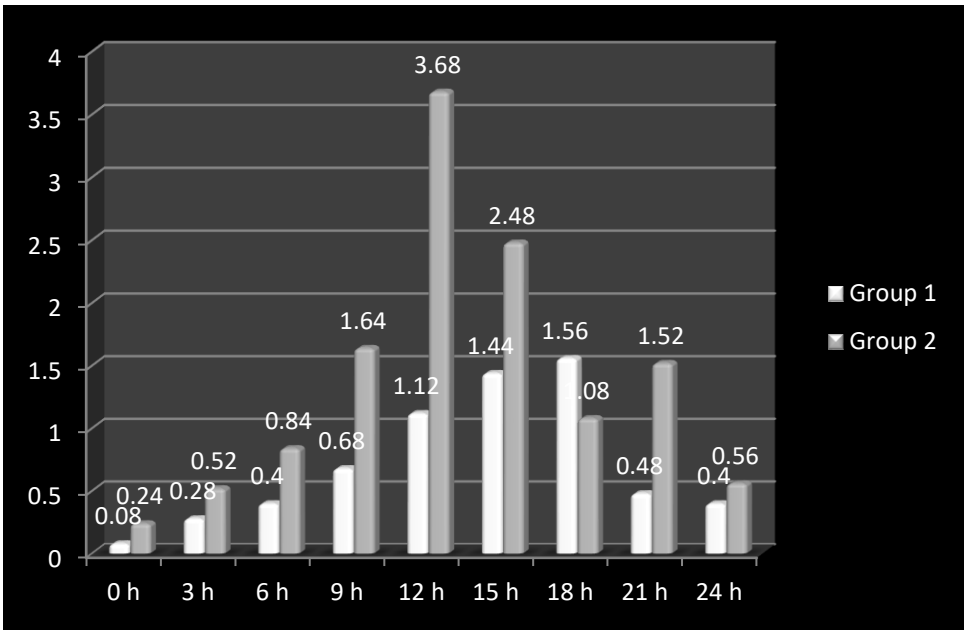

Fig 2

Duration of analgesia in hours was compared among two study groups and the difference observed was statistically significant (p value of < 0.001). Mean duration of analgesia was 17.3+1.39 hours in Group 1 compared to 13.1+1.47 hours in Group 2 [Fig 3].

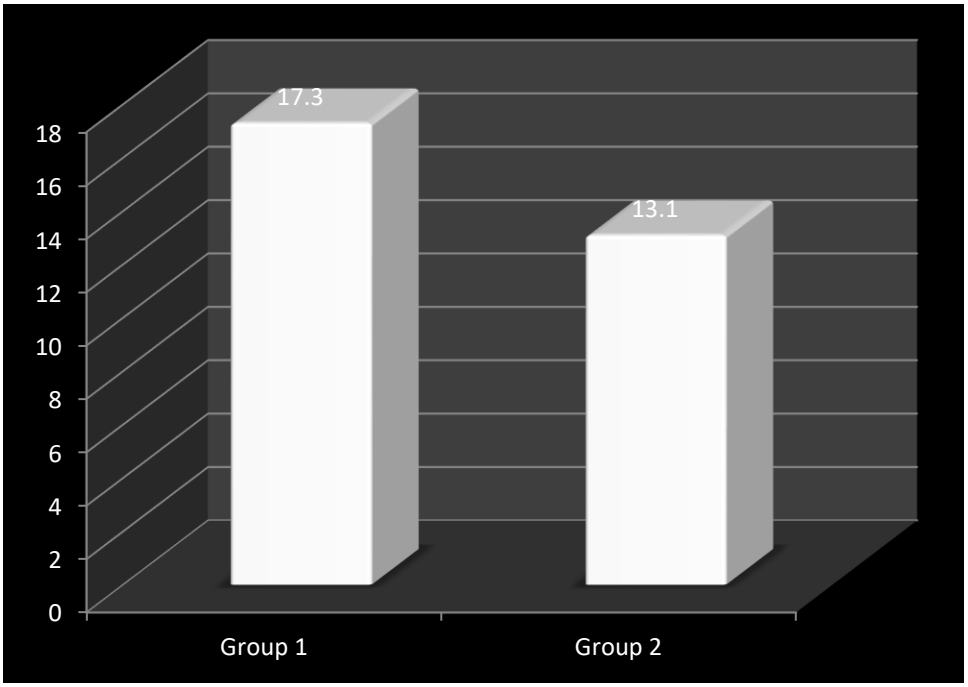

Fig 3.

Comparison of rescue analgesic doses among two study groups was done and the difference found was statistically significant (p value of <0.001). Out of 25 patients in Group 1, 17 (68%) patients did not require any rescue analgesia while 8 (32%) patients received one dose of rescue analgesia. Among 25 patients in Group 2, all the patients received rescue analgesia at different time intervals with 18 (72%) patients received one dose and 7 patients received two doses of rescue analgesia [Fig 4].

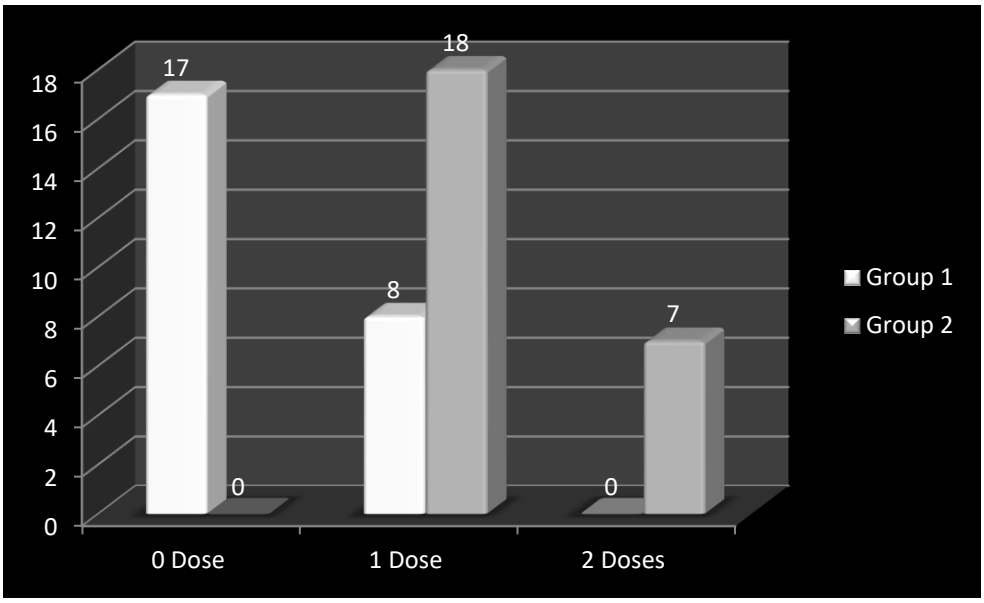

Fig 4

Patient satisfaction was assessed using Likert satisfaction scale. Very satisfied (5) score was observed in 64% (n=16) in Group 1 patients followed by somewhat satisfied (4) score in 7 (28%) patients and neither satisfied nor dissatisfied in 2 (8%) patients. In group 2, somewhat satisfied (4) score was observed in 14 (56%) patients followed by neither satisfied nor dissatisfied (3) score was observed in 9 (36%) patients, and, the least number of patient 2 (8%) in Group 2 observed very satisfied (5) score. Comparison of patient satisfaction score in two study groups was statistically significant (p value of <0.001) [Fig 5].

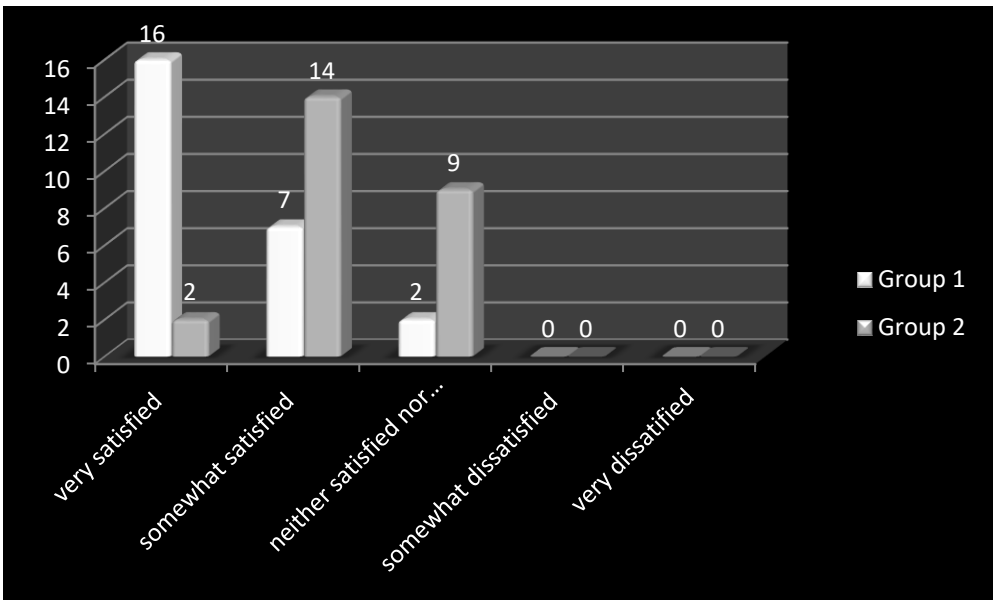

Fig 5

Discussion

Arthroscopic shoulder surgery can cause severe pain, especially during the first 24 postoperative hours.88 **Cho NS et al., (2007)** reported that resting pain in patients undergoing arthroscopic rotator cuff repair was very severe, with visual analog scale scores (VAS) of 7 to 9 immediately after surgery, VAS of 5 at 24 h postoperatively, and VAS of 4 to 5 for 84 h postoperatively despite administration of IV patient control analgesia (PCA) or an infusion of local anesthetics in the

subacromial space. Even with a long-acting local anesthetic like ropivacaine, if inter-scalene block (ISB) is performed during the daytime, patients would report their first episodes of severe pain during the night because of the limited duration of analgesia (DOA). Nighttime pain can cause sleep disturbance and lead to a vicious cycle of acute pain.[15,16]

Several clinical trials have investigated the beneficial effect of perineural dexmedetomidine on duration of analgesia, but mainly evaluated the effect of single doses. Because dexmedetomidine has a more pronounced effect in unmyelinated C fibers than in A fibers in terms of blocking the hyperpolarization activated current for hyperpolarization of the nerve, the duration of motor block was relatively less affected. [17-21]

In our study the demographic parameters among two groups were compared and found statistically insignificant. Comparison of intraoperative heart rate (bpm), systolic blood pressure (mmHg), diastolic blood pressure (mmHg) and mean arterial

pressure (mmHg) at various time intervals were done among two groups, which were statistically insignificant at base line, but at all other time intervals, the comparison of Heart rate (bpm), systolic blood pressure (mmHg), diastolic blood pressure (mmHg) and mean arterial pressure (mmHg) among two groups were statistically significant (p value of <0.05). Comparison of intra operative spO2 (%) was also observed among two groups and the difference obtained was statistically insignificant (p value of >0.05).

Jung HS et al., (2018) [22] did a study in which patients who received perineural dexmedetomidine showed lower blood pressure and heart rate intraoperatively. **Gillespie R et al (2012) [23]** suggested that patients can tolerate a 30% to 40% decrease in mean arterial pressure safely during shoulder arthroscopy and that the hypotension induced may have the benefit of allowing better visualization and decreasing blood loss. **Esmaoglu A et al., (2010) [17]** in their study evaluated the effect of adding dexmedetomidine to levobupivacaine for axillary brachial plexus blockade. In their study, heart rate, systolic arterial blood pressure and diastolic arterial blood pressure levels were significantly lower in dexmedetomidine group as compared to levobupivacaine group (p<0.05).

Comparison of postoperative heart rate (bpm), systolic blood pressure (mmHg), diastolic blood pressure and mean arterial blood pressure (mmHg) at various time intervals was done among two groups and was found statistically significant (p value of <0.05). Postoperative oxygen saturation (%) among two groups at various intervals of time was compared and found statistically insignificant with a p value of >0.05. **Wang CG et al. (2016) [24]** conducted a study to investigate the effect of adding dexmedetomidine to ropivacaine for lumber plexus and sciatic nerve block. Postoperative hemodynamic parameters like heart rate and blood pressure were lower in dexmedetomidine combination group compared to ropivacaine alone group and was statistically significant (p value of <0.05). **Nazir N, Jain S (2016) [25]** conducted a study to find out the effect of adding dexmedetomidine to bupivacaine for supraclavicular block. They concluded that hemodynamic parameters like heart rate, systolic blood pressure and diastolic pressure lowers on adding dexmedetomidine to local anaesthetics and the difference obtained in their study was statistically significant as compared bupivacaine alone. Postoperative lowering of heart rate and blood pressure was also observed by **Jung HS et al., (2018) and Agarwal S et al., (2014)**. [22,26]

In our study duration of analgesia in hours was compared among two study groups and the difference observed was statistically significant (p value of < 0.001). Mean duration of analgesia was 17.3+1.39 hours in Group 1 compared to 13.1+1.47 hours in Group 2. Statistically significant difference was observed when VAS score was compared among two study groups at various time intervals in our study. The difference in VAS score observed was statistically significant at 6 hours, 9 hours, 12 hours, 15 hours and 21 hours in postoperative time intervals (p value of < 0.05). At all other time intervals the difference observed was statistically insignificant (p value of > 0.05). Patients who received dexmedetomidine with ropivacaine showed significantly prolonged duration of analgesia than patients who received ropivacaine alone.

The mean duration of analgesia in patients in group 1 was about 4 hours longer than the patients in group 2. The analgesia was better in group 1 patients at 6, 9, 12, 15 and 21 hours post operatively as compared to group 2 which is statistically significant (p value of < 0.05). **Fritsch G et al., (2014) [27]** compared the effects of dexmedetomidine (150 g) with that of placebo in inter-scalene brachial plexus block for shoulder arthroscopy. The mean duration of the nerve block was 18-20 hours in the dexmedetomidine group and 14-16 hours in the ropivacaine group (p = 0.0001). Dexmedetomidine significantly hastened the time to sensory (p value of 0.04) and motor (p value of 0.002) block onset and also lowered pain scores for the first 14 hours.

Requirement of rescue analgesic doses among two study groups were compared and the difference found was statistically significant (p value of <0.001). Among 25 patients in group 1, 17 (68%) patients did not require any rescue analgesia and 8 (32%) patients received one dose of rescue analgesia. Among 25 patients in group 2, all the patients received rescue analgesia at different time intervals, with 18 (72%) patients received 1 dose and 7 (28%) patients received 2 doses of rescue analgesia. **Shekhar M et al., (2020)** conducted a study in which time to request of first rescue analgesia was prolonged in group Dexmedetomidine (930±83.45 min) than in group Dexamethasone (620±125.54 min), which was clinically and statistically significant. [28]
Postoperative side effects were seen in 3 patients in Group 1 and only in 1 patient in Group 2. Side effects included nausea in 2 (8%) patients in Group 1 compared to 1 (4%) patient in Group 2 while vomiting was observed in 1 (4%) patient in Group 1 only. The difference observed was statistically insignificant. **Bengısun ZK et al., (2014)** conducted a study in which the two postoperative side effects were nausea and vomiting. Nausea was observed in 18.2% in group LD compared to 21.7% in group L while vomiting was not seen in any of the patients in group LD compared to 8.7% patients in group L. **El-Boghadadly K et al., 2017** conducted a study and concluded that brachial plexus block cause dyspnea because of phrenic nerve palsy. Phrenic nerve palsy is caused by spreading of local anesthetic and its duration is determined by the duration of the local anesthetic effect. **Liu SS et al., (2010)** showed that clinically significant palsy may occur in up to 10% of the patients who underwent ultrasound-guided ISB. In a study by **Jung HS et al., (2017)**, 9 (9.27%) patients complained of dyspnea. [29-31, 22]

Our patients did not encountered any of these side effects which may be because of low dose of dexmedetomidine (50 g), low concentration and volume of the local anaesthetic. Bradycardia (HR <45 bpm) was experience by 6 patients including 1 (4.3%) patient each in Group R and Group D1 and 2 (8.3%) patients each in Group D2 and Group D3 respectively in a study done by **Jung HS et al., (2017)** and 0.5mg Atropine was administered to these patients. In our study none of the patients experience bradycardia heart rate <45 bpm that could be because of low dose of dexmedetomidine and lesser concentration and volume of ropivacaine used in the present study. [22]

In the study of **Jung HS et al., (2017)** One, two, and two patients in groups D1, D2, and D3, respectively, developed hypoxemia (SpO2 <93%) which could be because of phrenic nerve palsy and sedation due to dexmedetomidine systemic absorption. Hypoxemia was not found in any of the patients in our study which could be due to the usage of low dose dexmedetomidine and ropivacaine. [22]

Conclusion:

In present study, we can conclude that preoperative inter-scalene block given reduces the analgesic requirement intraoperatively as well postoperatively. By adding dexmedetomidine to ropivacaine the longevity of analgesia was prolonged as compared to ropivacaine alone. In addition, the hemodynamic changes in patients who received dexmedetomidine in combination with ropivacaine

had a favorable reduction in both heart rate and blood pressure without causing any major side effect.

Conflict of interest: Nil

Funding: Nil

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