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Original Research Article

Perioperative hemodynamic effects of dexmedetomidine as an adjuvant to 0.2% ropivacaine in ultrasonography guided interscalene brachial plexus block for elective shoulder arthroscopic surgeries under general anaesthesia: a prospective observational study

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ABSTRACT

Background: 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.
Methods: The study was conducted from February 2020 to October 2021 after obtaining approval from the institutional ethics committee. The study was a prospective observational study.
Results: 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. Comparison of postoperative MAP (mmHg) in two groups at various intervals of time was observed and found to be statistically significant (p value of <0.05). Comparison of postoperative heart rate (beats/min) among two groups at various intervals of time was statistically significant (p value of <0.05).
Conclusions: We can conclude that preoperative inter-scalene block given reduces the analgesic requirement intraoperatively as well postoperatively. And 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.

Keywords: Dexmedetomidine, Arthroscopy, Ropivacaine, Hemodynamics

INTRODUCTION

Peripheral nerve blocks are frequently used as an 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] Preclinical and clinical studies have described prolonged duration of analgesia when dexmedetomidine was added to bupivacaine, levobupivacaine, or ropivacaine for peripheral perineural blocks.[7-14] Hemodynamic effects have been variable with some studies showing reversible lowering of heart rate and blood pressure and others showing no differences from control.[15,16] Inter-scalene brachial plexus block is one of the most widely practiced regional anaesthetic technique for shoulder surgeries and it provides fewer side effects. 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.[17] Of all blocks, employed for post-operative pain after shoulder surgery, the inter-scalene block (ISB) is the most widely used block. Various local anesthetics (LAs) such as lignocaine and bupivacaine have been used for administering the blocks. Ropivacaine, a newer local anaesthetic, has been increasingly used nowadays in different concentration for peripheral nerve blocks. Recently, dexmedetomidine, a novel α2 agonist, having more affinity to α2 when compared to α1, is widely used as an adjuvant with various local anaesthetics in peripheral nerve blocks to decrease the time of onset and increase the duration of block. Various local anaesthetics used previously have short duration of sensory and motor block and short duration of analgesia. Bupivacaine being most potent is used frequently, but it has high cardiac toxicity potential. Ropivacaine, a long-acting amide is a newer drug with a safer cardiac profile.[18]

Due to its unique pharmacological properties and fewer side effects, it is now preferred by anesthesiologists for peripheral nerve blocks. In recent years, the addition of various adjuvants to local anaesthetic solution has been acclaimed to increase the efficacy and duration of block while minimizing the systemic adverse effects as it reduces the total dose of local anaesthetic used. Dexmedetomidine, an α2-adrenoceptor agonist, has become well known as an adjuvant to local anaesthetic. The present study was taken up to evaluate the perioperative hemodynamic effects of inter-scalene block using combination of dexmedetomidine with ropivacaine and ropivacaine alone.

METHODS

Study approach

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.

Study design

The study was a prospective observational study.

Study population

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.

Inclusion criteria

Patients who give consent for enrollment in a study undergoing shoulder arthroscopy, patients aged between 18-60 years, and ASA I and II were included in the study.

Exclusion criteria

Patients having body mass index (BMI) >30 kg/m^2, mental illness, chronic obstructive pulmonary disease or any respiratory disease, coagulopathy, prior trauma, neuropathy and myopathy were excluded.

Methods used

A total of 50 patients were observed for perioperative hemodynamic changes and postoperative analgesia who had received 20 ml (0.2%) ropivacaine with 50 g dexmedetomidine (group 1) and patients who had received 20 ml (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. 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, SpO_2 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 ultrasonography (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 extravascular 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 minutes 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 IV], injection fentanyl [1.5 to 3 µg/kg IV], injection atracurium [0.5 mg/kg iv] 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. The following observations were made in postoperative period. Hemodynamic parameters such as heart rate (bpm), systolic blood pressure (mmHg), diastolic blood pressure (mmHg), mean arterial pressure (mmHg) and SpO_2 (%) were monitored postoperatively up to 24 hours.

RESULTS

Hemodynamic parameters

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 1).

Similar to the heart rate association of mean intraoperative systolic blood pressure (SBP) among two study groups was statistically significant at all-time intervals (p value of <0.05) except at baseline where the mean SBP (mmHg) was 124.12 and 123.36 in group 1 and group 2, respectively (p value of >0.05) (Table 2).

Comparison of intraoperative diastolic blood pressure (DBP) among two study groups was found to be statistically insignificant at baseline (p value of 0.208). At all other time intervals significant statistical difference was obtained among two groups with regard to diastolic blood pressure (mmHg) (p value of <0.05) (Table 3).

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 4).

Comparison of intra-operative SpO_2 (%) was also observed in the present study among two groups and the difference observed was statistically insignificant (p value of >0.05) (Table 5).

Comparison of postoperative heart rate (beats/min) among two groups at various intervals of time was statistically significant (p value of <0.05) (Table 6).

Comparison of postoperative SBP (mmHg) among two groups at various intervals of time was observed and found statistically significant (p value of <0.05) (Table 7).

Comparison of postoperative DBP (mmHg) among two groups at various intervals of time was done and was found statistically significant (p value of <0.05) (Table 8).

Comparison of postoperative MAP (mmHg) in two groups at various intervals of time was observed and found to be statistically significant (p value of <0.05) (Table 9).

Comparison of postoperative oxygen saturation (%) among two groups at various intervals of time was statistically insignificant (p value of >0.05) (Table 10).

Table 1: Comparison of intra-operative heart rate (beats/min) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
Baseline	76.84	4.44	75.60	3.75	0.292
5	73.60	4.03	79.28	3.71	<0.001*
10	69.88	3.44	80.56	3.55	<0.001*
15	67.56	3.94	78.92	3.59	<0.001*
30	65.40	5.04	79.64	5.16	<0.001*
60	68.28	4.11	77.12	3.38	<0.001*
90	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

Table 2: Comparison of intra-operative SBP (mmHg) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
Baseline	124.12	4.23	123.36	3.00	0.467
5	121.12	2.71	127.24	2.37	<0.001*
10	117.36	3.34	130.40	3.10	<0.001*

Continued.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
15	115.44	2.60	132.84	2.53	<0.001*
30	116.28	3.52	131.16	3.86	<0.001*
60	117.80	3.70	128.08	3.50	<0.001*
90	120.16	3.01	125.32	2.56	<0.001*

*Statistically significant difference (p value<0.05); p value by student's independent t-test

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

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
Baseline	81.84	4.63	80.28	3.98	0.208
5	79.56	3.27	84.16	3.29	<0.001*
10	76.04	2.78	85.56	3.08	<0.001*
15	73.68	3.44	87.72	4.12	<0.001*
30	74.08	3.91	86.28	2.76	<0.001*
60	76.48	2.00	84.08	2.10	<0.001*
90	79.64	4.00	83.92	4.19	0.002*

*Statistically significant difference (p value<0.05); p value by student's independent t-test

Table 4: Comparison of intra-operative MAP (mmHg) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
Baseline	95.93	3.30	94.64	3.08	0.160
5	93.41	2.37	98.52	2.48	<0.001*
10	89.80	2.05	100.50	2.49	<0.001*
15	87.60	2.64	102.75	2.74	<0.001*
30	88.15	3.00	101.24	2.57	<0.001*
60	90.26	1.97	98.75	1.87	<0.001*
90	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

Table 5: Comparison of intra-operative SpO_2 (%) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
Baseline	97.72	0.94	98.20	0.87	0.166
5	98.32	0.75	98.48	0.87	0.490
10	98.08	0.81	97.96	0.84	0.610
15	98.28	1.43	98.20	1.04	0.822
30	98.52	0.71	98.32	0.75	0.339
60	98.08	1.15	97.92	0.95	0.595
90	98.68	0.95	98.56	0.96	0.658

*Statistically significant difference (p value<0.05); p value by student's independent t-test

Table 6: Postoperative heart rate (beats/min) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
0	75.92	5.06	78.48	5.07	0.048*
0.5	74.76	3.78	79.08	4.95	0.001*
1	72.96	4.95	78.16	4.44	<0.001*
2	71.48	4.45	76.52	5.17	0.002*
4	73.32	5.75	77.52	4.70	0.007*
8	72.20	5.15	78.68	5.87	<0.001*

Continued.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
12	74.60	4.50	80.80	6.65	<0.001*
16	76.68	5.16	80.76	5.64	0.012*
20	77.96	5.27	81.28	6.88	0.042*
24	78.52	5.28	82.36	7.13	0.037*

*Statistically significant difference (p value<0.05); p value by student's independent t-test

Table 7: Postoperative SBP (mmHg) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
0	123.84	6.69	127.28	6.16	0.013*
0.5	122.48	8.21	126.12	6.40	0.036*
1	120.04	5.88	126.80	3.43	<0.001*
2	119.96	6.21	125.20	5.68	0.003*
4	119.44	5.68	127.24	4.31	<0.001*
8	121.44	4.88	126.88	4.51	<0.001*
12	123.72	5.74	128.16	5.75	0.009*
16	125.52	5.69	130.72	4.50	0.001*
20	124.00	5.45	132.12	5.39	<0.001*
24	125.68	5.44	131.56	5.36	<0.001*

*Statistically significant difference (p value<0.05); p value by student's independent t-test

Table 8: Comparison of postoperative DBP (mmHg) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
0	81.72	7.88	84.44	7.33	0.047*
0.5	81.24	8.13	85.04	8.06	0.039*
1	79.88	8.12	85.44	9.17	0.028*
2	78.04	8.96	84.16	9.47	0.023*
4	78.92	10.00	86.88	8.30	0.004*
8	79.84	9.45	85.84	9.09	0.027*
12	81.72	8.66	86.92	7.70	0.029*
16	84.52	8.18	88.08	8.90	0.032*
20	84.12	8.18	89.80	8.89	0.023*
24	85.84	8.38	89.36	8.83	0.031*

*Statistically significant difference (p value<0.05); p value by student's independent t-test

Table 9: Comparison of postoperative MAP (mmHg) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
0	95.76	5.57	98.72	5.74	0.046*
0.5	94.99	7.02	98.74	6.44	0.029*
1	93.27	6.60	99.23	6.94	0.003*
2	92.01	6.73	97.84	7.08	0.004*
4	92.43	7.81	100.34	6.01	<0.001*
8	93.70	6.82	99.51	6.25	0.003*
12	95.72	6.52	100.66	5.95	0.007*
16	98.18	6.07	102.30	6.40	0.024*
20	97.41	6.23	103.91	6.69	0.001*
24	99.12	6.39	103.43	6.61	0.031*

*Statistically significant difference (p value<0.05); p value by student's independent t-test

Table 10: Comparison of postoperative oxygen saturation (%) among two groups.

Time interval (min)	Group 1		Group 2		P value
	Mean	+SD	Mean	+SD	
0	96.28	1.40	96.36	1.41	0.841
0.5	96.28	1.31	96.64	1.32	0.337
1	96.44	1.39	96.40	1.41	0.920
2	96.40	1.22	96.44	1.26	0.910
4	96.32	1.18	96.36	1.22	0.907
8	96.24	1.36	96.12	1.33	0.754
12	96.48	1.39	96.52	1.33	0.917
16	96.44	1.39	96.44	1.39	1.000
20	96.36	1.22	96.28	1.17	0.814
24	96.44	1.39	96.08	1.29	0.346

*Statistically significant difference (p value<0.05); p value by student's independent t-test

DISCUSSION

The present study was undertaken to assess the analgesic efficacy, safety and longevity of dexmedetomidine as an adjuvant to ropivacaine in inter-scalene block. Side effects like hypotension, bradycardia, hypoxemia, nausea and vomiting were used for assessment of safety. 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 SpO_2 (%) was also observed among two groups and the difference obtained was statistically insignificant (p value of >0.05).

Jung et al did a study in which patients who received perineural dexmedetomidine showed lower blood pressure and heart rate intraoperatively.[19] Gillespie et al 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.[20]

Esmaoglu et al 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).[10] 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 et al conducted a study to investigate the effect of adding dexmedetomidine to ropivacaine for lumber plexus and sciatic nerve block.[21] 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 et al conducted a study to find out the effect of adding dexmedetomidine to bupivacaine for supraclavicular block.[22] 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 et al and Agarwal et al.[19,23]

Limitations of the study is only prospective with small sample size.

CONCLUSION

We can conclude that preoperative inter-scalene block given reduces the analgesic requirement intraoperatively as well postoperatively. And the hemodynamic changes in patients who received dexmedetomidine in combination with ropivacaine had a favourable reduction in both heart rate and blood pressure without causing any major side effect.

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