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Original Research Article

Assessment of the Efficacy of Addition of Dexmedetomidine to Levobupivacaine in Brachial Plexus Block: Comparative Study

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Abstract

Aim: The aim of the present study was to assess the effect of levobupivacaine 0.5% alone and with dexmedetomidine 100 µg as an adjuvant to levobupivacaine 0.5% on the onset and duration of sensory and motor block, the duration of perioperative analgesia, complications and sedation score.

Methods: This comparative study was carried out on 50 patients at Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar for the period of one year after getting the institutional human ethical committee concurrence. Patients posted electively for upper limb orthopedic and soft tissue lesion, between the age of 18 and 60 years of any gender, weighing above 60 kilograms with ASA Grade I and II and those who fulfilled the selection criteria and those who gave consent to participate in the study were included in the study.

Results: In the LD group males and females were 60% and 40% respectively. In LS group, it was 52% and 48% respectively. There was no statistical significance between the two groups. The average age of study participants was 32.1 vs 30.3 in LD and LS group respectively. The mean weight of study participants in study and control group was 64.4 vs 63.2 respectively. Both the results were statistically significant. duration of onset of sensory and motor block was nearly 4 min earlier in LD group compared to LS group. (5.32 vs 9.17 min) Onset of motor blockade was also 4 minutes earlier in LD group compared to LS (8.35 vs 12.28 min). The mean duration of sensory block (531 vs 921 min) and motor block (553 vs 943 min) were 390 minutes lesser respectively between both the groups. The duration post-operative analgesia was 402 min lesser between both the groups (578 vs 980 min). All the results are statistically significant.

Conclusion: Dexmedetomidine added to levobupivacaine provides better anesthetic and analgesic care in upper limb surgeries done using brachial plexus block.

Keywords: Dexmedetomidine, Levobupivacaine, Analgesia, Sensory Block, Motor Block.

Introduction

Supraclavicular brachial block is the popular and widely used nerve block technique for perioperative anesthesia and analgesia for surgery of upper extremity. The block is performed at the level of distal trunks and origin of the divisions, where the brachial plexus is confined to its smallest surface area, thus producing a rapid and reliable blockade of brachial plexus. Local anesthetics are compounds that have the ability to interrupt the transmission of the action potential of excitable membranes by binding to specific receptors in the Na+ channels. Large volumes of local anesthetics required to produce desirable effects may result in systemic side effects. [1] Adjuvants have been added to increase analgesia and reduce total dose of local anesthetics used minimizing the risk for local anesthetic toxicity.

For surgeries on the upper limb, brachial block (BB) is more advantageous than general anesthesia (GA) as it provides ideal conditions for the surgery and satisfactory analgesia extending to the postoperative period. Ultrasound‑guided BBs offer the advantages of proper nerve localization, optimal needle placement, and a higher rate of success of the block. [2,3] Till a few years back, bupivacaine was the most commonly used local anesthetic agent for BB as it provided a dense motor and sensory block of long duration. However, recently, there are several case reports of occurrence of central nervous system and cardiovascular system toxicity following inadvertent intravascular injection of bupivacaine.

Levobupivacaine has the duration of action ranging from three to eight hours and hence it is the most commonly used local anesthetic drug. [4] This anesthetic drug has established itself as cheaper and safer for many years. [5] But patchy or incomplete analgesia and delayed onset are few of the practical constraints. Few drugs are added to levobupivacaine in trial to decrease these limitations, to upsurge the quality, prolong the duration of action and analgesia. To prolong the duration of brachial plexus block and improve the quality, vasoconstrictors like -adrenergic agonists, hyaluronidase, neostigmine, opioids, can be utilized. But these vasoconstrictors have been found to cause certain side effects. There arise the need to identify the ideal additive and many researchers tried the novel alpha 2 adrenergic agonists.

Alpha 2 adrenergic agonists not only decrease the requirements of intraoperative anesthetic agents, but also they have cardiovascular stabilizing properties, sympatholytic analgesic and sedative property. In order to reduce the time of onset of nerve block, to prolong the duration of block and to improve the quality of blockade, these can be given in peripheral nerve blocks, intrathecal, epidural either alone or with local anesthetic agents. [4,6] An 2 receptor agonist, dexmedetomidine, is eight times more sensitive than clonidine. [7,8] Researches have found that dexmedetomidine, when used in many animals and humans had improved the onset and duration of motor/ sensory blockade. When used as an adjuvant to local anesthetic agents in peripheral nerve blocks, it has increased the duration of analgesia. [9–16]

The aim of the present study was to assess the effect of levobupivacaine 0.5% alone and with dexmedetomidine 100 μg as an adjuvant to levobupivacaine 0.5% on the onset and duration of sensory and motor block, the duration of perioperative analgesia, complications and sedation score.

Materials and Methods

This cross-sectional comparative study was carried out on 50 patients at Sri

Krishna Medical College & Hospital, Muzaffarpur, Bihar for the period of one year after getting the institutional human ethical committee concurrence. Patients posted electively for upper limb orthopedic and soft tissue lesion, between the age of 18 and 60 years of any gender, weighing above 60 kilograms with ASA Grade I and II and those who fulfilled the selection criteria and those who gave consent to participate in the study were included in the study. Patients with chronic kidney disease, hypertension, pregnant women, uncontrolled diabetes mellitus, cerebrovascular accident, COPD, coronary artery disease on anticoagulants, those with history of bleeding disorders, and those who were allergic to amide local anesthetics /alpha 2 agonist were excluded from the study.

A pre-anesthetic checkup including complete history, general and systemic examination and fitness was assessed for all patients. Complete hemogram like RBC, WBC counts, platelets and other tests like blood urea, random blood sugar, bleeding time, clotting time, serum creatinine and ECG is mandatory if the subject is more than 45yrs. Patients were informed to be on nil per oral after 8 pm on the previous day of surgery. The participants were divided randomly into two groups of thirty each using sealed envelope technique.

The first group (LD group) was administered 1 ml (100µg) dexmedetomidine with 39 ml of 0.5% Levobupivacaine. The second group was given 1 ml of 0.9% normal saline and 39 ml of 0.5% Levobupivacaine as anesthetic agent. Once the study participant entered the operation theatre, the chief consultant had used the pre assigned 30 envelope for each group in the pre shuffled order. Neither the investigator nor the patient knew which group they were assigned (double blinding).

The vital signs like respiratory rate, heart rate, systolic and diastolic blood pressure, pulse rate and oxygen saturation were monitored and noted immediately on entering the OT. Ringer lactate was started in the already secured intravenous line. Brachial plexus block was applied through the supraclavicular approach.

Nerve locator (Fisher and Paykel, New Zealand) was used for neural localization and it was achieved by connecting to a 22 G, 50-mm-long stimulating needle (Stimuplex, Braun, Germany). The location end point was a distal motor response with an output lower than 0.5 milliamperes in the median nerve region. Local anaesthetic solution in the labelled coded syringe was injected following negative aspiration.

Pin prick method was used to assess the sensory block. Sensory onset was considered when there was dull sensation to pin prick along the distribution of any two of the following nerves like musculocutaneous nerve, radial nerve, median nerve, ulnar nerve. When there was complete loss of sensation to pin prick, we can consider it as complete sensory block. Modified Bromage scale. Motor and sensory blocks were assessed for 30 minutes for every 3 minutes until after injection, and then every 30 minute until they have resolved.[17] Saturation of oxygen (SpO2), heart rate, diastolic blood pressure, systolic blood pressure, were noted at 0, five, ten, fifteen, Thirty, sixty, ninety and one twenty minutes. Side effects like heart rate less than fifty per min (bradycardia) and blood pressure less than 20% with respect to resting conditions (hypotension) were treated with appropriate measures. Then we noted the period of motor and sensory blocks once the surgery is started.

When the subject's visual analogue score >5, a rescue analgesia like intramuscular diclofenac sodium 75mg (1.5 mg/kg) was administered. Ramsay Sedation Scale (RSS) was used to assess the sedation before the block and 15 min then after.

All the data noted was entered in Microsoft excel sheet and was double checked. SPSS 16 software was used to analyze the collected data. The categorical variables were tabulated as frequency and percentages. Continuous variables were presented as Mean Standard deviation. Independent sample T- test was used to measure the association between the vitals at different times. Chi-square test was applied to assess the relationship between the categorical variables. P<0.05 was considered as statistically significant.

Results

Table 1: Association between various parameters between groups

Parameter	Subclassification of the parameter	LD group N %	LS group N %	Chi square	P value
Gender	Male	15 (60)	13 (52)	3.787	0.050
	Female	10 (40)	12 (48)		
Post-operative analgesia requirement	Not needed	25 (100)	0	60	<0.001
	Needed	0	25 (100)		
Sedation score	Sleeping but arousable	18 (72)	0	34.76	<0.001
	Slightly drowsy	7 (28)	25 (100)		

In the LD group males and females were 60% and 40% respectively. In LS group, it was 52% and 48% respectively. There was no statistical significance between the two groups. All the study participants in LD group did not require post-operative analgesia while all in LS group were given Postoperative analgesia. 28% in LD group were slightly drowsy compared to 100% in LS group. Both the results are statistically significant.

Table 2: Comparison of mean values of various parameters between both groups

Parameter	Group	Mean	SD	Mean diff	T value	P value
Age (years)	LS	30.3	11.1	1.80	0.595	0.554
	LD	32.1	12.3			
Weight in kgs	LS	63.2	4.2	1.20	1.259	0.210
	LD	64.4	3.1			
Onset of sensory block (min)	LS	9.17	0.889	3.820	15.464	<0.001
	LD	5.32	1.020			
Onset of motor block (min)	LS	12.28	1.06	3.93	9.66	<0.001
	LD					
Duration of sensory Block (min)	LS	921.72	37.328	390.72	-33.013	<0.001
	LD	531	53.0			
Duration of Motor Block (min)	LS	943.14	34.68	389.31	-35.503	<0.001
	LD	553.83	49.037			
Duration of Post Op Analgesia (min)	LS	980.69	46.823	402.69	-30.863	<0.001
	LD	578	53.989			

The average age of study participants were 32.1 vs 30.3 in LD and LS group respectively. The mean weight of study participants in study and control group was 64.4 vs 63.2 respectively. Both the results were statistically significant. duration of onset of sensory and motor block was nearly 4 min earlier in LD group compared to LS group.(5.32 vs 9.17 min) Onset of motor blockade was also 4 minutes earlier in LD group compared to LS (8.35 vs 12.28 min). The mean duration of sensory block (531 vs 921 min) and motor block (553 vs 943 min) were 390 minutes lesser respectively between both the groups. The duration post-operative analgesia was 402

min lesser between both the groups (578 vs 980 min). All the results are statistically significant.

Table 3: Comparison of heart rates between both groups at different time intervals

Time (Min)	LS Group		LS Group		Mean diff	T value	P value
	Mean	SD	Mean	SD			
0	85.21	8.01	84.92	8.32	0.29	0.138	0.891
5	83.56	7.51	79.56	6.68	4	2.18	0.033
10	81.88	7.51	76.85	6.54	5.03	2.752	0.008
15	79.32	7.65	72.35	6.72	6.97	3.749	<0.001
30	76.65	7.85	69.80	6.23	6.85	3.711	<0.001
45	75.15	6.8	67.32	6.12	7.83	4.669	<0.001
60	75.12	6.23	67.15	5.82	7.97	5.120	<0.001
75	78.35	8.89	71.15	6.88	7.23	.508	<0.001
90	79.82	7.86	71.59	7.02	8.23	4.277	<0.001
120	82.01	8.35	73.25	7.89	8.76	4.177	<0.001

Table 4: Comparison of mean values of systolic BP between both groups

Time (Min)	LS Group		LS Group		Mean diff	T value	P value
	Mean	SD	Mean	SD			
0	131.12	9.32	134.68	9.67	3.56	-1.044	0.301
5	126.32	5.81	124.36	5.32	1.96	1.363	0.178
10	121.47	6.25	115.89	6.67	5.58	3.344	<0.001
15	122.12	5.98	114.21	5.26	7.91	5.395	<0.001
30	120.10	5.54	113.95	5.98	6.15	4.146	<0.001
45	121.15	6.23	112.22	5.65	8.93	5.816	<0.001
60	122.25	8.13	114.26	6.65	7.99	4.167	<0.001
75	125.51	9.69	114.55	7.86	10.96	4.811	<0.001
90	126.71	9.36	115.63	8.02	11.08	4.728	<0.001
120	128.32	9.12	117.21	9.11	11.11	4.721	<0.001

Table 5: Comparison of mean values of diastolic BP between both groups

Time (Min)	LS Group		LS Group		Mean diff	T value	P value
	Mean	SD	Mean	SD			
0	81.32	9.21	79.68	8.32	1.64	0.724	0.470
5	79.25	8.32	76.85	7.68	2.4	1.161	0.25
10	75.35	6.32	71.32	5.68	4.03	2.598	0.010
15	73.22	6.32	69.52	5.82	3.7	2.359	0.020
30	73.52	6.18	68.12	5.37	5.4	3.613	<0.001
45	73.11	6.23	67.82	5.92	5.29	3.378	<0.001
60	74.73	7.12	67.25	5.85	7.48	4.446	<0.001
75	75.63	7.36	67.03	6.20	8.6	4.895	<0.001
90	77.25	8.59	71.23	8.11	6.02	2.791	<0.001
120	79.26	9.24	72.26	8.36	7	3.077	<0.001

The diastolic blood pressure, systolic blood pressure, heart rate was comparatively maintained lesser than baseline for LD group from fifth min after induction of drug till two hours. (Tables 3, 4 and 5). Twenty percent of study population in LD group had bradycardia compared to none in LS group (chi-square value - 6.667; P value – 0.009). Bradycardia was noted in 20% if the study

population. No other adverse effects were recorded in the study subjects.

Discussion

Brachial plexus block is one of the peripheral nerve blockades used for upper limb surgeries. It has many advantages over general anesthesia such as effective analgesia with good motor blockade, awake patients, extended postoperatively analgesia, early mobilization, no airway manipulation, and avoiding polypharmacy. Recent interest in ultrasound-guided supraclavicular blocks may be due to (1) easy image acquisition relating to superficial location of brachial plexus at this level; (2) identifying pleura thus minimizing the risk of pneumothorax; (3) shortening the block performance time; (4) reducing the number of needle pricks. (5) shortening of block onset time. (6) reducing accidental vascular puncture. (7) allowing dose reduction of local anesthetic, and (8) enhanced block quality. [18,19]

Dexmedetomidine 100 µg when used as an adjuvant to levobupivacaine 0.5% reduces the onset of sensory and motor blockade, prolongs the analgesic effect of motor and sensory block. The mechanism of action of α2 agonists causing sedation and analgesia is not completely known, but it seems to have multifactorial. Centrally, α2 agonists inhibits the substance P release at dorsal root neuron in the pain pathway and activates α2 adrenoceptors in the locus coeruleus and thereby causing analgesia and sedation. Peripherally, α2 agonists decrease the release of noradrenaline, produce analgesia and produces α2 receptor- independent restraints on nerve action potentials. Activation of cation current by hyperpolarization causes the peripheral action of dexmedetomidine. For subsequent firing the nerve will not return from hyperpolarized state to resting membrane state. [16–19] Studies done by various other authors have also showed that addition of dexmedetomidine reduces the onset time of motor and sensory block and prolongs the duration of postoperative analgesia. [17,20–24] Addition of dexmedetomidine improves the hemodynamic stability of the patients. Similar findings were obtained in the several other researchers conducted worldwide. [25–27] Bradycardia was noted in one fifth of the patients who were administered dexmedetomidine. Which coincides with the findings of Talke et al. [28,29]

Conclusion

The onset of motor and sensory blockade was reduced when dexmedetomidine was used as an adjuvant to 0.5% levobupivacaine and it also prolongs the duration of analgesia. It provides a good intraoperative sedation as well and helps to reduce the postoperative analgesic requirement. However, dexmedetomidine may cause bradycardia in limited cases, which is reversible with atropine. Hence, we conclude from the study dexmedetomidine can be an ideal adjuvant for levobupivacaine for upper limb surgeries applying brachial plexus block.

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