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Research Article

Comparison of levobupivacaine with ropivacaine for supraclavicular brachial plexus block

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ABSTRACT

Background: Peripheral nerve blocks have assumed a prominent role in modern anaesthesia practice as they provide ideal operative conditions without any general anaesthesia or adverse haemodynamic effects. When compared with ropivacaine, levobupivacaine is a newer, safer, longer acting local anaesthetic with rapid onset and prolonged duration of analgesia and similar or more pronounced nerve blocking effects, depending on the concentration. Hence the present study is aimed to compare the effectiveness of 0.5% levobupivacaine and 0.5% ropivacaine in supraclavicular brachial plexus block.
Methods: The present study was a prospective, randomized, double blind comparative study of 60 patients with ASA grade I, II of either sex, between the ages 18 years to 60 years. They were enrolled and randomly divided into two groups. Supraclavicular brachial plexus block was given for upper limb surgeries using 0.5% levobupivacaine (Group L) or 0.5% ropivacaine (Group R). The onset of sensory and motor block, their duration, and possible adverse events were recorded and compared for both groups.
Results: Significant earlier onset of sensory blockade (p=0.027) and motor blockade (p=0.01), prolonged duration of sensory and motor blockade (p=0.0001) was observed in group of patients receiving levobupivacaine compared to ropivacaine. The time for first rescue analgesia required post operatively was much longer in Group L(13.2333±1.1651hr) as compared to Group R(10.8667±0.91852 hr) and the difference was significant (p=0.0001).Intraoperatively throughout the study heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were comparable in both the groups and found no statistically significant difference (p >0.05). The heart rate, systolic and diastolic blood pressure for both the groups were compared postoperatively and observed no statistical significant difference (p >0.05). No adverse effects were observed in both the groups.
Conclusions: 0.5% levobupivacaine used in supraclavicular brachial plexus block for upper limb surgeries provides rapid onset of sensory and motor blockade and prolonged duration of analgesia compared to 0.5% ropivacaine.

Keywords: Supraclavicular brachial plexus, Levobupivacaine, Ropivacaine, Upper limb surgeries

INTRODUCTION

Recently peripheral nerve block anaesthesia has become popular against general anaesthesia as it is devoid of side effects of intubation and muscle relaxants and systemic haemodynamic changes. This type of anaesthesia is particularly advantageous in case of prolonged orthopedic, plastic reconstructive surgeries and in emergency surgeries where the patients are full stomach, not adequately starving and in high risk patients. This technique not only provides anaesthesia but also post-operative analgesia.[1]

Peripheral nerve block anaesthesia had many advantages over general anaesthesia such as cost effective, favourable postoperative recovery profile, preserves CNS functions and prevents complications of intubation, laryngoscopy and muscle relaxants. Recently nerve

locators with ultrasound guidance technique is being used for proper nerve localization and optimal needle placement thus minimising unpleasant paraesthesia and also reducing any incidence of neural damage, with higher rate of block success and faster onset times.[2,3]

Local anaesthetic drugs are used to provide analgesia in regional block technique. Bupivacaine and lignocaine are most commonly used drugs for brachial plexus block. The cardiotoxicity shows enantioselectivity, it is more pronouncedwith R (+) racemic bupivacaine. The S (-) enantiomers- levobupivacaine and ropivacaine are less cardiotoxic.

There are four approaches to the brachial plexus block- the interscalene, supraclavicular, infraclavicular, and axillary approach. Among these approaches, the supraclavicular approach is associated with a rapid onset of anaesthesia and a high success rate.[4,5]

The decreased cardiovascular and central nervous system toxicity makes ropivacaine an interesting alternative to bupivacaine in procedures requiring large doses of local anaesthetic. Studies on animals revealed that compared with ropivacaine levobupivacaine had similar or more pronounced nerve blocking effects, depending on the concentration. Hence the present study is aimed to compare the effectiveness of 0.5% levobupivacaine and 0.5% ropivacaine in supraclavicular brachial plexus block in terms of onset and duration of sensory and motor blockade, duration of analgesia, requirement of post-operative analgesia and complications, if any.

METHODS

Study design and sampling size

The present study was prospective, randomized, double blind comparative study including 60 patientswith ASA grade I, II of either sex, between the ages 18 years to 60 years scheduled for upper limb surgeries of fracture radius ulna, post burn contracture release, debridment and tendon repairs were included in the study. Exclusion criteria were patients not giving consent, existence of peripheral neuropathy, bleeding disorders, local cutaneous infections, and patient with hypersensitivity to either of the drugs used in the study and pregnant women and lactating mothers.

After obtaining approval from institutional ethics committee and informed consent from patients fulfilling the inclusion criteria, cases were divided randomly into two groups: Group L: Receiving Inj. levobupivacaine hydrochloride 0.5% 30cc and Group R: Receiving Inj. ropivacaine hydrochloride 0.5% 30cc. Each individual was allocated to respective group by computer generated randomization chart. Neither patients nor observer were told about the drug injected. Decoding of serial numbers and drug solutions received by the patients was done at the end of study.

A thorough preoperative evaluation was performed. The patient was subjected to thorough general and systemic examination and was investigated haemoglobin, complete blood count, bleeding time, clotting time, chest X ray, ECG, RFT and LFT.

After the patient was taken on operation table, and monitored using pulseoximeter, cardioscope and noninvasive blood pressure monitors. An intravenous access was secured using an in-dwelling cannula of appropriate size. Oxygen supplementation was given with nasal cannula at 2litres/min. Brachial plexus block was performed by supraclavicular approach.

Patient was positioned supine with head turned about 30 degree to contralateral side. After palpating the interscalene groove and tracing it to the most inferior point, which is just posterior to the subclavian arterial pulse, the latter can be felt in the plane just medial to the midpoint of the clavicle.

Then local infiltration with plain 2% 2cc lignocaine was given to minimize needle pain. A 22G, 50 mm stimuplex needle with the nerve stimulator was directed just above and posterior to the subclavian arterial pulse and directed caudally at a very flat angle against the skin. The needle was advanced until the flexion of finger was noted.

If contraction was still observed with the intensity of stimulating current decreased to 0.5mA, then following protocol was followed: Group L received 30 cc of 0.5% injection levobupivacaine hydrochloride and Group R received 30 cc of 0.5% injection ropivacaine hydrochloride. If the rib was encountered without paraesthesia or if blood was encountered, the needle was withdrawn and the landmarks as well as the plane of needle insertion path were re-evaluated.

Patients were evaluated to determine the loss of arm abduction (deltoid sign as sign of successive motor blockade). Sensory block was assessed by pin prick over the surgical site. Failure of loss of arm abduction or pain at surgical site after 30 min was considered to be block failure and hence general anaesthesia was given to those patients and thus was excluded from the study. After evidence of successful motor and sensory block, surgery was performed.

Patients were monitored every hourly for 10 hours for heart rate, blood pressure, $Sp0_2$, onset of sensory block, onset of motor block, duration of sensory block, duration of motor block, sedation score and complications if any, then after 10 hours patients were shifted to ward and they were asked to note the time of requirement of first rescue analgesic.

Post-operative pain was also assessed by using visual analog scale (VAS) and patients satisfaction regarding the blockade were noted that are graded as Grade 4 - Excellent - no complaints from patients, Grade 3 - Good - minor complaints with no need for supplement or rescue

analgesia, Grade 2-Moderate - complaint that require rescue analgesia and Grade 1-Unsuccesful-patient requiring general anaesthesia.

Statistical analysis

An unpaired t test were used to compare the demographic variables, intraoperative haemodynamic variables, onset and duration of sensory and motor block, pain scores by VAS, rescue analgesic requirement between the 2 groups. A p value of <0.05 were considered as statistically significant.

RESULTS

Table 1 shows gender and weight was comparable in both the groups and no statistical significant difference was found.

Table 1: Comparison of study group as per age (years) and weight (kg).

Variable	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
Age (years)	30	34.3333	12.23148	30	35.5333	10.23090	1.707	0.682
Weight (kg)	30	61.8667	10.83651	30	58.7333	8.30012	1.770	0.214

Table 2: Duration of surgery (hours).

Duration (hours)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
Duration of surgery (hrs)	30	2.00	0.54	30	2.13	0.72	0.812	0.420

Table 3: Comparison of onset of sensory block (min) and motor block (min) among study groups.

Duration (hours|)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
Sensory Block	30	8.60	1.522	30	9.533	1.655	0.08	0.027
Motor Block	30	13.133	2.012	30	14.60	2.252	0.324	0.01

Table 4: Comparison of duration (hours) of sensory and motor block among study groups.

Duration (hours)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
Sensory Block	30	12.116	0.715	30	11.266	0.751	1.68	0.0001
Motor Block	30	11.316	1.021	30	8.50	0.415	12.71	0.0001

Table 5: Comparison of intraoperative heart rate (per min) at various time intervals.

Heart rate (per min)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
Pre op	30	80.533	11.337	30	80.266	8.847	3.907	0.919
0 min	30	80.133	9.655	30	80.566	9.077	0.324	0.858
5 min	30	80	9.727	30	79.766	7.877	1.475	0.919
10 min	30	79.2	9.932	30	81.666	8.129	1.467	0.297
15 min	30	79.2	9.959	30	80.566	8.294	1.253	0.566
20 min	30	78.066	9.677	30	80.4	7.959	2.343	0.312
25 min	30	77.066	9.062	30	79.8	7.193	1.254	0.201
30 min	30	75.266	11.258	30	78.433	7.351	2.557	0.202
45 min	30	75.2	8.623	30	78.866	7.659	0.447	0.087
60 min	30	76.4	8.459	30	78.033	7.355	0.845	0.428
75 min	30	76.4	8.779	28	79	7.333	0.303	0.228
90 min	30	76.133	8.500	28	79.178	6.809	1.155	0.140
105 min	28	77.642	8.828	20	78.8	7.068	2.199	0.630
120 min	28	78	8.572	20	78.8	6.748	2.024	0.730
135 min	16	78.5	9.507	9	81.222	5.093	4.448	0.436
150 min	16	79.875	10.892	9	80.222	5.517	4.728	0.930
180 min	12	77.166	8.200	3	85.333	3.055	2.836	0.122

Table 6: Comparison of intraoperative SBP (mm Hg) at various time intervals.

SBP (mm of Hg)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
Pre op	30	122	11.459	30	118.73	9.183	2.206	0.228
0 min	30	122.66	11.170	30	118.86	8.282	4.585	0.140
5 min	30	123.6	9.789	30	123.66	7.857	2.652	0.112
10 min	30	122.8	9.315	30	122.8	7.174	4.759	0.123
15 min	30	122.33	8.421	30	121	7.046	2.922	0.110
20 min	30	122.2	9.177	30	118	7.878	0.936	0.062
25 min	30	121.2	8.953	30	118.1	7.590	1.611	0.153
30 min	30	120.73	8.427	30	118.13	6.393	2.113	0.183
35 min	30	121	8.546	30	117.53	6.709	1.498	0.086
40 min	30	119.93	9.705	30	117.4	5.493	3.703	0.218
45 min	30	120.13	7.789	30	117.63	5.768	1.165	0.163
60 min	30	119.53	7.214	30	116.6	6.584	0.033	0.105
75 min	30	118.86	7.233	28	116.96	6.697	0.159	0.304
90 min	30	118.06	7.638	28	117.14	5.509	4.367	0.602
105 min	28	118.42	7.470	20	115	4.565	5.357	0.075
120 min	28	118.21	7.187	20	115.6	5.566	0.784	0.181
135 min	16	118.25	5.360	9	115.66	7.648	4.626	0.332
150 min	16	118.75	6.526	9	116	5.830	0.046	0.305
180 min	12	118.16	6.685	3	118	7.211	0.068	0.970

Table 7: Comparison of intraoperative DBP (mm Hg) at various time intervals.

DBP (mm of Hg)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
Pre op	30	76.66	6.221	30	76.56	4.399	1.688	0.157
0 min	30	76.33	6.149	30	78.6	4.391	2.288	0.143
5 min	30	77.73	7.348	30	78.33	4.381	5.077	0.125
10 min	30	75.2	14.147	30	76.46	4.868	2.666	0.125
15 min	30	77.03	6.206	30	77.8	3.872	11.921	0.117
20 min	30	76.73	7.620	30	78.46	14.055	0.018	0.555
25 min	30	76.33	7.521	30	74.36	5.075	4.994	0.118
30 min	30	75.86	7.257	30	74.3	5.608	4.619	0.120
35 min	30	76.06	7.399	30	76.8	5.384	4.167	0.106
40 min	30	75.33	7.072	30	75.93	5.152	5.168	0.123
45 min	30	74.8	7.289	30	74.6	4.903	4.471	0.143
60 min	30	74.53	7.370	30	74.3	4.757	9.281	0.120
75 min	30	74.13	6.906	28	74.53	4.582	8.486	0.321
90 min	30	74	6.411	28	73.46	4.992	4.222	0.110
105 min	28	73.64	6.395	20	72.9	3.654	5.716	0.240
120 min	28	73.35	6.712	20	72.45	5.155	3.107	0.201
135 min	16	75.62	7.051	9	78.11	4.255	4.339	0.348
150 min	16	76.75	6.806	9	78.22	4.294	6.748	0.565
180 min	14	76.85	6.212	3	81	1.000	6.859	0.279

Table 8: Comparison of time for rescue analgesia (hours) among study groups.

Time for first rescue analgesia (hour)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
	30	13.233	1.1651	30	10.866	0.9185	2.554	0.0001

Duration of surgery (hours) in both the groups were comparable. No statistically significant difference was found as given in Table 2. Table 3 shows the significant earlier onset of sensory (p=0.027) and motor blockade (p=0.01) in Group L (8.60±1.522 min), (13.133±2.012 min), than in Group R (9.533±1.655 min), (14.60±2.252 min) respectively. It was observed from Table 4 that the duration of sensory and motor blockade was longer in Group L as compared to Group R and found to be

statistically significant (p=0.0001). Intraoperatively throughout the study heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were comparable in both the groups and found no statistically significant difference (p >0.05) as given in Table 5, 6 and 7. Table 8 shows that time for first rescue analgesia required post operatively was much longer in Group L (13.2333±1.165hours) as compared to Group R (10.8667±0.91852 hours) and the difference was significant (p=0.0001).

The heart rate, systolic and diastolic blood pressure for both the groups were compared postoperatively and observed no statistical significant difference among the groups as given in Table 9-11.

Table 9: Comparison of postoperative HR (per min) at various time intervals.

Heart Rate (per min)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
0 hour	30	78.4	9.372	30	79.433	7.228	4.425	0.634
1 hour	30	78.933	9.652	30	78.7	6.793	5.205	0.914
2 hour	30	78.333	8.583	30	78.666	7.359	1.726	0.872
3 hour	30	79.666	8.805	30	78.7667	6.526	2.221	0.655
4 hour	30	79.133	10.016	30	77.4	5.775	4.026	0.415
5 hour	30	79.466	8.896	30	77.766	5.494	3.624	0.377
6 hour	30	78.866	8.365	30	77.733	5.297	4.865	0.533
7 hour	30	79.6	10.404	30	77.5	5.923	13.428	0.341
8 hour	30	79.43	10.176	30	77.666	6.582	9.481	0.428
9 hour	30	79.166	10.252	30	77.9	6.582	9.415	0.571
10 hour	30	80	10.075	28	77.9	5.850	10.665	0.328

Table 10: Comparison of postoperative SBP (mmHg) at various time intervals.

SBP (mm of Hg)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
0 hour	30	120.666	10.678	30	117.433	6.755	4.764	0.166
1 hour	30	119.6	19.200	30	116.766	6.262	2.790	0.445
2 hour	30	120.866	9.361	30	117.066	6.528	5.345	0.073
3 hour	30	121.066	9.638	30	116.866	6.616	6.008	0.054
4 hour	30	121.133	9.137	30	121.266	5.057	10.205	0.057
5 hour	30	121.6	9.103	30	118.133	5.769	6.567	0.083
6 hour	30	121.533	8.232	30	117.866	6.382	3.733	0.059
7 hour	30	122.466	7.942	30	119.033	6.0257	3.134	0.064
8 hour	30	121.666	7.145	30	118.666	6.221	0.549	0.088
9 hour	30	121.733	6.982	30	118.866	5.721	1.995	0.087
10 hour	30	122.733	8.525	30	122.033	6.477	3.361	0.089

Table 11: Comparison of postoperative DBP (mmHg) at various time intervals.

DBP (mm of Hg)	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
0 hour	30	77.266	5.999	30	78	6.197	0.006	0.643
1 hour	30	77.333	6.244	30	78.4	5.858	0.674	0.498
2 hour	30	76.8	6.819	30	78.266	6.269	0.697	0.389
3 hour	30	76	7.3718	30	78.266	5.871	1.842	0.193
4 hour	30	76.066	7.380	30	77.533	5.992	0.855	0.402
5 hour	30	75.666	7.791	30	76.8	5.365	3.017	0.514
6 hour	30	75.666	7.7741	30	77.233	5.237	4.188	0.364
7 hour	30	75.4	7.223	30	77.2	4.859	2.462	0.262
8 hour	30	75.066	6.638	30	77.2	5.548	0.508	0.182
9 hour	30	76.266	7.588	30	77.3	5.724	2.246	0.554
10 hour	30	75.666	6.477	30	77.066	4.856	1.864	0.347

Table 12: Comparison of postoperative pain score at various time intervals.

Post op pain score	Group L			Group R			Unpaired T test	P value
	N	Mean	SD	N	Mean	SD		
0 hour	30	0	0.0	30	0	0.0	-	-
1 hour	30	0	0.0	30	0	0.0	-	-
2 hour	30	0	0.0	30	0	0.0	-	-
3 hour	30	0	0.0	30	0	0.0	-	-
4 hour	30	0	0.0	30	0	0.0	-	-
5 hour	30	0	0.0	30	0	0.0	-	-
6 hour	30	0	0.0	30	0	0.305	16.313	0.078
7 hour	30	0	0.0	30	0.2333	0.626	22.032	0.046
8 hour	30	0	0.0	30	0.6333	0.808	75.264	0.0001
9 hour	30	0.333	0.479	30	1.8	0.996	6.201	0.0001
10 hour	30	1.166	0.530	30	3.1	0.661	0.767	0.0001

From Table 12 it is evident that both the groups had comparable VAS scores upto 7 hour postoperatively, but from 8 to 10 hour postoperatively Group L had lower VAS score when compared to Group R. This difference was statistically significant ($p<0.05$), but clinically there was no difference between the two groups.

DISCUSSION

Peripheral nerve blocks are cost effective anaesthetic techniques used to provide anaesthesia and analgesia by avoiding airway instrumentation and haemodynamic changes of general anaesthesia. Patients satisfaction, safety, growing demand for cost effective anaesthesia and a favourable postoperative recovery profile have resulted in increased demand for regional techniques.[6,7]

Among various types of brachial plexus block the supraclavicular approach has been considered the most efficacious.It is often described as "spinal anaesthesia for upper extremity" because of its ubiquitous application for upper extremity surgery characteristically associated with a rapid onset of anaesthesia, high success rate, complete and predictable anaesthesia for upper extremity.

Bupivacaine is commonly used local anaesthetic drug for brachial plexus block because of its long duration of action and a favourable ratio of sensory to motor neural block. However, its toxicity is a concerning issue especially when larger doses are used in peripheral nerve blocks or prolonged infusions for postoperative analgesia.[8,9]

Hence the need of a new drug with wider safety margin, and desirable pharmacokinetic properties of bupivacaine was felt. The decreased toxicity of levobupivacaine is attributed to its S enantiomer and faster protein binding rate. Ropivacaine is a long acting pure S enantiomer is considered to be less cardiotoxic than bupivacaine with similar pharmacodynamics properties. It is less likely to penetrate large myelinated motor nerve fibers, resulting in a relatively reduced motor blockade.

The present study was performed to evaluate the efficacy of 0.5% levobupivacaine and 0.5% ropivacaine in supraclavicular brachial plexus block in patients undergoing upper limb surgeries with emphasis on comparison of onset, duration of sensory and motor block and to monitor the haemodynamic stability of two drugs. Monitoring for side effects during the procedure was also done.

In the present study, classical approach technique of supraclavicular brachial plexus block with the aid of a nerve stimulator was used. The study drug was injected when flexion movement was seen at the fingers at the intensity of stimulating current of nerve stimulator of upto 0.5 mA. In our study, none of the patients developed any feature of cardiovascular or central nervous system toxicity, did not received general anesthesia or sedation before administration of block and not complained about incomplete action or failure of technique.

The statistically significant mean onset of sensory and motor blockade was observed earlier in group of patients received levobupavacaine compared to patients received ropivacaine.Similar results were observed by Mageswaranand Choy.[10] On the contrary, Nodulas et al found that both 0.5% Levobupivacaine and 0.5% ropivacaine had similar onset of action.[11]

In our study, the duration of sensory and motor blockade was prolonged in Group L as compared to Group R. This difference in duration of motor blockade was found to be statistically significant ($p=0.0001$). This observation is similar to the results of Casati et al.[12]

Similarly in the study conducted by Deshpande et al, they found the onset of sensory and motor block early with levobupivacaine 0.5% with a statistically high significance. The duration of sensory, motor block and postoperative analgesia was prolonged with levobupivacaine as compare to 0.5% ropivacaine in supraclavicular brachial plexus block.[13] The time between the supraclavicular block administration and onset of pain

(VAS >4) requiring the administration of a rescue analgesic, was measured as the duration of analgesia. Injection diclofenac 75 mg (i.v.) was given if the VAS was >4. The time for first rescue analgesia was 13.233±1.1651 hours in group L which was more as compared to Group R (10.866±0.9185 hours) and the difference was statistically significant (p=0.0001).

The VAS was lower in patients who received Levobupivacaine. This difference in pain scores was found to be statistically significant (P<0.05) especially from 8th hour onwards. Cline et al and Fournier et al had made similar observations.[14,15]

In the present study, intra operative and postoperative haemodynamic parameters were also studied. The pulse rate, systolic blood pressure, diastolic blood pressure and oxygen saturation were comparable in both the groups' intra operatively and post operatively. They were found to be statistically insignificant (p>0.05).Similar results related to haemodynamic parameters was found in study conducted by Deshpande et al, and found that there was no significant difference between both the groups heart rate and blood pressure, ECG and SPO_2 were maintained throughout the surgery.[13] The same findings are also observed by Fusun et al.[16]

In this study the patients were monitored postoperatively for any complications like hypotension, bradycardia, postoperative pain, paraesthesia, myonecrosis, headache, allergic reactions if any. No complications had been reported at the dosages used in present study and our results are also in accordance with the findings reported.Thus, in general, levobupavacaine showed a better quality of analgesia with a shorter onset and prolong recovery time for both sensory and motor blockade in comparision to ropavacaine.

CONCLUSION

From the present study, conclusions were drawn that 30 ml of 0.5% levobupivacaine provides rapid onset of sensory and motor blockade, prolonged sensory and motor blockade as compared to 30 ml of 0.5% ropivacaine in supraclavicular brachial plexus block. The long duration of sensory block associated with good analgesia and less toxicity of levobupivacaine makes it a better choice for upper extremity blocks.

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