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A Comparative Study between Bupivacaine and Clonidine Combination versus Bupivacaine (Plain) for Brachial Plexus blocks using Supraclavicular Approach

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Abstract

Background: Brachial plexus block achieves ideal operating conditions by producing complete muscle relaxation, maintaining stable intra-operative hemodynamics and associated sympathetic block. Usage of adjuvant drugs along with local anesthetic, to lower the dose of each agent and enhance analgesic efficacy and thereby reducing the incidence of adverse events is a routine practice in regional anesthesia. *Aim:* To assess the anesthetic and analgesic effect of adding clonidine with bupivacaine as a regional anesthetic agent for brachial plexus block during upper limb surgeries. *Methodology:* A prospective longitudinal study was conducted for a period of one year from the anesthesiology department of Vinayaka Missions Medical College Hospital Salem. A total of 60 patients were included for the study and it was divided into two groups. Group A patients received 25 ml of 0.5% bupivacaine and group B patients received 25 ml of 0.5% bupivacaine along with 0.2 ml (30 mcg) clonidine. Onsite time and the duration of sensory and motor block was recorded along with the duration of analgesia and the maximum number of doses of analgesics required were also noted. Vitals were recorded at intervals of 5 min for first 30 min, then after every 10 min till end of surgery, and then hourly after surgery. *Results:* The onset of sensory and motor block was found to be much quicker and prolonged for a longer duration among the patients who received bupivacaine along with clonidine and the difference in time duration was found to be statistically significant. Similarly, the post-operative analgesia effect was found to be longer (487.9 mins)among the group received bupivacaine with clonidine with a less number of additional requirement of analgesia dose (1.1 dose) whereas the analgesia effect among the group received bupivacaine alone was 303.6 mins with mean additional dose of analgesia of 2.4 and the difference was found to be statistically significant. Vital parameters were normal and were almost similar among both the groups. *Conclusion:* Thus, our study had demonstrated that addition of clonidine as an adjuvant drug along with bupivacaine as a regional anesthetic agent in supraclavicular brachial plexus block had significatly prolonged the duration of analgesia and improved the quality of anesthesia.

Keywords: Brachial plexus block, Bupivacaine, Clonidine, Analgesia.

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Introduction

Today, usage of regional anesthesia has become more common in the field of anesthesiology. Particularly for upper limb surgeries using brachial plexus block as a regional anesthesia has become a routine practice. Brachial plexus block achieves ideal operating conditions by producing complete muscle relaxation, maintaining stable intra-operative hemodynamics and associated sympathetic block [1]. In this approach the plexus is blocked at the site where it is most compactly arranged at the level of nerve trunks and so the the onset of action is rapid with a very high success rate for extending the duration of block [2,3].

Usage of adjuvant drugs along with local anesthetic, to lower the dose of each agent and enhance analgesic efficacy and thereby reducing the incidence of adverse events is a routine practice in regional anesthesia [4]. Drugs like morphine, pethidine, fentanyl, clonidine, dexamethasone, midazolam are commonly used along with local anaesthetic for this purpose [5]. However their use is limited because of side effects, like deep sedation respiratory depression and psychomotor effects. Drugs with minimal side effects are always looked for. Clonidine is a selective α2 adrenergic agonist with some α1 adrenergic property [6]. Clonidine possibly enhances or amplifies the sodium channel blockade action of local anaesthetics by opening up the potassium channels resulting in membrane hyperpolarization, a state in which the cell is unresponsive to excitatory input [7-9]. Because of this property clonidine has the effect in reducing the onset time, improving the efficacy of the block during surgery and extending postoperative analgesia and it is often related to the dose ranging between 0.1 and 0.5 μg/kg. Bupivacaine is the routine anesthetic drug used for regional anesthesia and in this study we assess the effectiveness of bupivacaine after adding clonidine as an adjuvant.

Aim

To assess the anesthetic and analgesic effect of adding clonidine with bupivacaine as a regional anesthetic agent for brachial plexus block during upper limb surgeries.

Methodology

A prospective longitudinal study was conducted for a period of one year from the anesthesiology department of Vinayaka Missions Medical College Hospital Salem. The study was started after getting the clearance from the institutional ethical committee and the informed consent was obtained from all the study subjects. Patients who have been posted for the upper limb surgeries and in the age group of 15 to 60 years and their systolic BP less than 140 mm hg and diastolic BP less than 90 mm hg were included for the study. Patients belonging to ASA class III and IV, history related to adverse events with clonidine, patients with medical complications like severe anemia, severe hypovolemia, shock and septicemia were excluded from the study. Patients with abnormal bleeding and clotting time along with patients on anticoagulant therapy were also excluded from the study. Patients were then randomly divided into two groups of 30 in each group, Group A patients received 25 ml of 0.5% bupivacaine and group B patients received 25 ml of 0.5% bupivacaine along with 0.2 ml (30 mcg) clonidine. On arrival in the operation room, baseline heart rate, blood pressure and oxygen saturation were recorded and monitored throughout the procedure. An intravenous line was secured in the unaffected limb and Ringer's lactate was started. Before the procedure, visual analogue scale (VAS) on 0-10 was explained to the patient for the assessment of pain where 0 denotes no pain and 10 denotes worst pain. All the patients received brachial plexus block through the supraclavicular approach. The goal of this block was to bring the tip of the needle in the proximity of the lower trunk, which was manifested by a twitch of the fingers in either flexion or extension. Sensory block (four nerve territories) was assessed by pin prick test using a 3-point scale and the motor blockade was determined by thumb abduction (radial nerve), thumb adduction (ulnar nerve), thumb opposition (median nerve), and flexion of elbow (musculocutaneous nerve) according to the modified Bromage scale on a 3-point scale. Onset time for the motor and sensory block was also recorded and then onwards both sensory and motor blocks were assessed at 15, 30, 45, 60, 90, and 120 min; and then hourly (even after surgery) after the completion of injection, until they had resolved. Vitals were recorded at intervals of 5 min for first 30 min, then after every 10 min till end of surgery, and then hourly after surgery. Sedation score was recorded according to modified Ramsay Sedation Scale. Adverse effects like hypotension, bradycardia, nausea, vomiting following the anesthetic drug were documented and the need for any other additional medications was also recorded. Diclofenac sodium was used as

the rescue analgesia for the patients who had the complaint of pain with VAS score of more than 3 and the time between the complete sensory block and the first analgesic request was recorded as duration of post operative analgesia (DOPOA).

All the data were eneterd and analysed using SPSS version 21. Mean and standard deviation was derived for all the parametric variables and student T test and chi-square test was used to assess the statistical inference between the two groups considering $p < 0.05$ as statistically significant.

Results

The demographic variable between the two groups was shown in table 1. It is seen from the table that the mean age was almost similar among both the groups and the proportion of males were more than females in both the groups and majority of the patients had ASA grading as grade I among both the groups and also the body weight between the two groups did not show statistical significant difference (Table 1). The onset of sensory block and motor block was found to be much early in the group which received bupivacaine with clonidine (5.1 mins and 8.4 mins) than that of the group received bupivacaine alone (11.2 mins and 19.9 mins) and similarly the duration of both sensory and motor block was prolonged among group B (bupivacaine plus clonidine) when compared to group A (bupivacaine alone) and this difference was found to be statistically significant (Table 2). The post-operative analgesia effect was found to be longer (487.9 mins) among the group received bupivacaine with clonidine with a less number of additional requirement of analgesia dose (1.1 dose) whereas the analgesia effect among the group received bupivacaine alone was 303.6 mins with mean additional dose of analgesia of 2.4 and the difference was found to be statistically significant (Table 3).

Table 1: Distribution of the demographic variables between the two groups

Demographic variable		Group A (n=30) (bupivacaine alone)	Group B (n=30) (bupivacaine plus clonidine)	p value
Age	Mean ± SD	33.7 ± 13.4	32.9 ± 15.2	0.728 *
Gender	Male	24	22	0.646 **
	Female	6	8	
Weight	Mean ± SD	69.6 ± 14.8	71.7 ± 16.1	0.814 *
ASA grade	Grade I	27	28	0.866 **
	Grade II	3	2	

*- p value derived by student T test
**- p value derived by Chi-square test

Table 2: Onset and duration of sensory and motor blockade among the two groups

Variable	Group A (n=30) (bupivacaine alone) (mean ± SD)	Group B (n=30) (bupivacaine plus clonidine) (m ean ± SD)	p value
Onset of sensory block (in mins)	11.2 ± 3.8	5.1 ± 2.8	<.001
Onset of motor block (in mins)	19.9 ± 5.4	8.4 ± 3.9	<.001
Duration of sensory block (in mins)	258.6 ± 79.9	432.5 ± 81.3	<.001
Duration of motor block (in mins)	289.8 ± 80.9	491.4 ± 78.2	<.001

p value derived by student T test

Table 3: Post-operative analgesia effect between the two groups

Variable	Group A (n=30) (bupivacaine alone) (mean ± SD)	Group B (n=30) (bupivacaine plus clonidine) (mean ± SD)	p value
Duration of post-operative analgesia (in mins)	303.6 ± 86.7	487.9 ± 92.3	<.001
Mean number of dosage of regional analgesia required in 24 hrs of Post – operative period	2.4 ± 1.1	1.1 ± 0.7	<.001

p value derived by student T test

Table 4: Heart rate measured between the two groups measured during intra and post-operative period

Heart rate	Group A (n=30) (bupivacaine alone) (mean ± SD)	Group B (n=30) (bupivacaine plus clonidine) (mean ± SD)	p value
0 min	76 ± 5.5	74 ± 4.8	0.817
5 mins	78 ± 6.8	79 ± 5.9	0.799
15 mins	82 ± 7.1	80 ± 6.5	0.651
30mins	80 ± 5.8	88 ± 7.4	0.0214
60 mins	78 ± 6.3	86 ± 6.8	0.0341
2 hrs	81 ± 8.1	80 ± 5.9	0.645
6 hrs	79 ± 7.9	81 ± 6.3	0.591
12 hrs	80 ± 6.6	78 ± 7.9	0.816
24 hrs	78 ± 5.9	77± 8.2	0.889

Table 5: Systolic blood pressure measured between the two groups measured during intra and post-operative period

Systolic BP	Group A (n=30) (bupivacaine alone) (mean ± SD)	Group B (n=30) (bupivacaine plus clonidine) (mean ± SD)	p value
0 min	128 ± 14.6	126 ± 16.2	0.714
5 mins	130 ± 16.2	124 ± 15.8	0.582
15 mins	126 ± 12.8	120 ± 14.5	0.359
30mins	126 ± 13.5	118 ± 13.9	0.0314
60 mins	124 ± 12.8	114 ± 12.1	0.0137
2 hrs	124 ± 11.9	120 ± 12.6	0.616
6 hrs	120 ± 10.8	118 ± 11.4	0.738
12 hrs	124 ± 11.2	122 ± 12.2	0.815
24 hrs	126 ± 10.6	124 ± 11.4	0.882

Table 6: Diastolic blood pressure measured between the two groups measured during intra and post-operative period

Diastolic BP	Group A (n=30) (bupivacaine alone) (mean ± SD)	Group B (n=30) (bupivacaine plus clonidine) (mean ± SD)	p value
0 min	82 ± 6.8	80 ± 6.1	0.818
5 mins	80 ± 5.9	78 ± 5.6	0.742
15 mins	78 ± 6.1	78 ± 7.1	1.000
30mins	77 ± 6.2	74 ± 6.4	0.0761
60 mins	78 ± 5.9	72 ± 5.8	0.0612
2 hrs	76 ± 6.4	74 ± 6.2	0.834
6 hrs	80 ± 5.8	78 ± 5.9	0.782
12 hrs	82 ± 6.4	82 ± 6.1	1.000
24 hrs	84 ± 5.4	85 ± 4.7	0.914

Table 7: SpO_2 measured between the two groups measured during intra and post-operative period

SPO2	Group A (n=30) (bupivacaine alone) (mean ± SD)	Group B (n=30) (bupivacaine plus clonidine) (mean ± SD)	p value
0 min	**98 ± 1.2**	99 ± 1.1	0.899
5 mins	98 ± 1.1	98 ± 0.9	1.000
15 mins	98 ± 0.8	96 ± 1.2	0.789
30mins	99 ± 1.4	98 ± 0.8	0.894
60 mins	96 ± 1.2	98 ± 1.1	0.815
2 hrs	98 ± 1.1	99 ± 1.2	0.808
6 hrs	99 ± 0.6	98 ± 0.8	0.899
12 hrs	98 ± 0.8	98 ± 1.1	1.000
24 hrs	99 ± 0.6	99 ± 0.8	1.000

Heart rate was measured at regular intervals for the first 24 hours and the heart rate did not show a statistical significant difference between the two groups except at the 30th and 60th minute reading in which the patients who received bupivacaine with clonidine showed a higher heart rate than the group which received bupivacaine alone (Table 4) and similarly during that period the systolic and diastolic BP of the bupivacaine with clonidine group showed a significantly lower BP than that of the patients receiving bupivacaine alone whereas all the other blood pressure readings taken between the two groups upto 24 hrs did not show a statistical significant difference (Table 5 and 6). Oxygen saturation measured over a period of 24 hrs between the two groups showed almost no difference the saturation was ranging between 97–99% throughout the entire period among the two groups (Table 7).

Discussion

Supraclavicular block often offers dense anesthesia of brachial plexus which helps in carrying out surgical procedures in the upper limb. This approach provides the best efficacy in providing a complete arm block just from a single injection. Bupivacaine, being a long acting amide is the preferred local anaesthetic drug commonly used for regional anesthesia. Along with a regional anesthetic drug using an adjunct like opioids, epinephrine, α2 adreno receptor agonist had become a routine practice among anesthetist to further improve the efficacy of the anesthetic agent and analgesia effect produced by the regional anesthesia. Clonidine is a α2 adrenoceptor agonist commonly used as as adjunct with the regional anesthesia. In the present study we compared the anesthetic and the analgesia effect between the two groups in which one group of patients received only bupivacaine as the regional anesthesia and for the other group along with bupivacaine, clonidine was given as adjunct and the anesthetic and analgesic effect was observed between the two groups. Anesthetic effect was assessed by the onset and duration of the motor and sensory block and the analgesic effect was assessed by the duration of analgesia and the number of additional analgesic drugs used for pain relief. Vital parameters like heart rate, blood pressure and SpO_2 were measured at regular intervals over a period of 24 hrs among both the groups to assess for any significant difference in the vitals after using an adjunct drug in regional anesthesia. In the present study the mean duration of onset of sensory and motor block among the group which received clonidine as an adjunct along with bupivacaine was 5.1 and 8.4 mins respectively and similarly the duration of sensory and motor block was 432.5 mins and 491.4 mins and the analgesic effect was seen for 487.9 mins with an additional number of analgesic dose of only 1.1, whereas among the group which received only bupivacaine drug without the adjunct the mean time of onset of sensory and motor block was 11.2 and 19.9 mins and the mean duration of sensory and motor block was 258.6 and 289.8 mins respectively and the post-operative analgesic effect was for 303.6 mins with a mean dose of anesthetic agent of 2.4. In our study we found a statistically significant benefit among the group which received clonidine as an adjunct drug than the group which received only bupivacaine. All the vital parameters measured between the two groups showed almost similar results and no adverse events was seen among the subjects in both the groups.

Chakraborty, *et al.,* Iohom, *et al.* and a meta-analysis study by Popping, *et al.* had shown that the onset of sensory block was much early among the group which received clonidine as a adjunct drug when compared with a placebo group [10-12]. Similarly onset of motor block was also found to be early in the studies done by Chakraborty, *et al.* and Iohom, *et al.,* whereas Popping *et al*. study showed no significant difference in the onset of motor block between the group received clonidine and the placebo [10-12].

The results of the study done by Iskandar, et al. and Cucchiaro, *et al.* was almost supporting our results mentioning that the duration of sensory block was more among the clonidine group compared to the placebo, whereas a study by Duma et al. did found a significant increase in the duration of sensory block in the clonidine group [13-15]. The results of our study related to the duration of motor block was almost in par with the studies done by Erlacher, *et al.* and Popping et al. quoting the duration of motor block was higher among the patients who received clonidine compared to placebo [12,16]. The prolonged analgesic effect in the clonidine group with lesser number of analgesic doses which was shown in our study was also proven by the studies done by Murphy *et al.* and Eledjam, *et al.* [17,18]. In the present study all the hemodynamic parameters were within the normal range among both the groups and it was substantiated by the study done by Culebras, *et al.* and Prashant Sirohiya *et al.*, where they found no bradycardia or hypotension among the group received clonidine [19,20].

Conclusion

Thus, our study had demonstrated that addition of clonidine as an adjuvant drug along with bupivacaine as a regional anesthetic agent in supraclavicular brachial plexus block had significatly prolonged the duration of analgesia and improved the quality of anesthesia in terms of onset and duration of sensory and motor block with hemodynamic stability and lack of side effects, thus making clonidine an attractive choice as an adjuvant to bupivacaine for supraclavicular brachial plexus block.

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