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ORIGINAL ARTICLE

STUDY & EVALUATE THE COMPARISON OF PLAIN LIGNOCAINE AND LIGNACAINE WITH SODIUM BICARBONATE EFFECTS IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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ABSTRACT: BACKGROUND & AIMS: supraclavicular brachial plexus block is usually used to anaesthetize the upper limb for the purpose of upper limb surgeries. Drugs like Lignocaine, Bupivacaine are used for this block and some additives are added to prolong the duration and quality of blockade. The present study is aimed to evaluate the comparison of plain lignocaine and lignocaine with sodium bicarbonate in supraclavicular brachial plexus block by means of the onset time of sensory and motor blockade, the quality of sensory and motor blockade, and the duration of blockade. **METHODS:** Sixty patients aged between 18 and 60 years of physical status ASA 1 and 2 undergoing upper limb surgeries lasting more than 30 minutes were included in the study. The patients were randomly allocated into two groups. Supraclavicular brachial plexus block was performed after eliciting paraesthesia. The patients in Group I (n=30) received 25ml of 1% plain lignocaine (prepared by adding 12.5ml of distilled water to 12.5ml of 2% plain lignocaine. The patients in the Group II (study group) received 25ml of 1% alkalinized lignocaine (prepared by adding 3ml of 7.5% sodium bicarbonate and 9.5ml of distilled water to 12.5ml of 2% plain lignocaine). **RESULTS:** The present study entitled Comparison of effects of plain lignocaine and lignocaine with sodium bicarbonate on brachial plexus block concludes that, the onset time of sensory and motor blockade is lesser with sodium bicarbonate added lignocaine (4.13, 11.1minutes) when compared to plain lignocaine(9.73, 21.1minutes) in supraclavicular brachial plexus block, the quality of sensory and motor blockade is better with sodium bicarbonate added lignocaine, the duration of motor and sensory blockade was significantly prolonged when lignocaine with sodium bicarbonate was used in supraclavicular brachial plexus block.

KEYWORDS: Lignocaine, Sodium Bicarbonate, Supraclavicular brachial plexus block.

INTRODUCTION: Pain is the mechanism for alerting living being of a dangerous situation. The conquest of pain has been a great human quest. The present study is aimed to evaluate the comparison of plain lignocaine and lignocaine with sodium bicarbonate in supraclavicular brachial plexus block by means of the onset time of sensory and motor blockade, the quality of sensory and motor blockade, and the duration of blockade.

MATERIALS AND METHODS: The study protocol was approved by the hospital ethical committee. Sixty patients aged between 18 and 60 years of physical status ASA 1 and 2 undergoing upper limb surgeries lasting more than 30 minutes were included in the study. The

DOI: 10.18410/jebmh/2015/753

study was carried out at S. V. Medical College, Tirupati. The patients included were those undergoing orthopaedic, plastic and reconstructive surgeries. Preanaesthetic checkup of all the patients were done thoroughly on the day prior to the surgery. The patients were explained regarding the anaesthetic procedure to be undertaken including development of paraesthesia and the anxiety of the patient alleviated. A written informed consent was obtained. Preanaesthetic preparation of patient included a period of overnight fasting. All patients received oral diazepam 10 mg on the night before surgery. A meticulous assessment of airway was carried out. Inclusion criteria will be Patients between 18 and 60 years, of physical status ASA 1 and ASA 2 scheduled for upper limb surgeries were included after obtaining ethical clearance from the Institution and informed written consent from the patients. Exclusion criteria will be Patients with Cardiovascular diseases (Ischemic heart disease, hypertension, valvular heart disease) Neuromuscular disease, Thyroid diseases, Diabetes mellitus.

METHOD OF COLLECTION OF DATA: The patients were randomly allocated into two groups. Supraclavicular brachial plexus block was performed after eliciting paraesthesia. The patients in Group I (n=30) received 25ml of 1% plain lignocaine (prepared by adding 12.5ml of distilled water to 12.5ml of 2% plain lignocaine. The patients in the Group II (study group) received 25ml of 1% alkalinized lignocaine (prepared by adding 3ml of 7.5% sodium bicarbonate and 9.5ml of distilled water to 12.5ml of 2% plain lignocaine). The pH of the plain lignocaine was 6.45 and the pH of the Sodium bicarbonate added lignocaine was 7.55 as tested in Andhra Medical College Biochemical Laboratory. When the patient was brought to the operation theater Intravenous access was obtained in the limb opposite to that undergoing surgery with 18G cannula. ECG monitoring, Pulse oximetery, Noninvasive blood pressure were connected and monitored in all the patients.

PROCEDURE: Each patient was made to lie supine without a pillow, arms by the side, head turned slightly to the opposite side with the shoulders depressed posteriorly and downward by moulding the shoulders over a roll placed between the scapulae. The supraclavicular area was aseptically prepared and draped. The anaesthesiologist stood at the head end of the patient and towards the side the side to be blocked, facing the head of the patient. An intradermal wheal was raised approximately 1cm superior to the clavicle above the midclavicular point. The subclavian artery palpable in the supraclavicular fossa was used as a landmark. A filled 10ml syringe with a 23 gauge, 32mm needle attached was held in the right hand and the patient was instructed to say "now" and not move as soon as he felt a "tingle" or "electric shock like" going down his arm. The tip of the index finger was rested in the supraclavicular fossa directly over the arterial pulsation. The needle was inserted through the skin wheal and advanced slowly downward (caudal), rolled slightly inward (medially) and slightly backward (posteriorly), so that the shaft of the needle was almost parallel to the patient's head. With the index finger and thumb of the left hand, the hub of the needle was firmly held and the movement of the needle was controlled all the time. As soon as paraesthesia was elicited, the needle was fixed in position and 25ml of the assigned drug was injected after negative aspiration depending on whether the patient was allotted to Group I or Group II.

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OBSERVATIONS AND RESULTS: Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters. Mann Whitney U test has been used to find the significance between two groups for parameters on non-interval scale. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups. In the present study we analyzed statistical significance of the difference between group I(Plain lignocaine) and group II (lignocaine with sodium bicarbonate). A `p` value of >0.05 meant that the difference between the groups was insignificant. A `p` value of <0.05 was taken to be statistically significant; a value <0.01 was highly significant and a value <0.001 was very highly significant.

Age in Years		Group I (Plain Lignocaine)	Group II (Lignocaine with sodium Bicarbonate)
18 – 27	Number %	5(16.7%)	6(20.0%)
28 – 37	Number %	5 (16.7%)	7(23.7%) (23.3%)
38 – 47	Number %	8(26.7%)	9(30.0%)
48 – 57	Number %	7(23.3%)	4(13.3%)

Table 1: Age Distribution

The above table shows age distribution in Group I and Group II. The above table shows most of the patients were below 47yrs of age. The mean age was 43.53 and 39.50 respectively for groups I and II. The p value was 0.228 and it was statistically not significant. The two groups were similar in age distribution.

Sex	Group I (Plain Lignocaine)	Group II (Lignocaine with sodium bicarbonate)
Males	20	22
Females	10	8

Table 2: Sex distribution

The above table shows sex distribution between the Group I and Group II. Both groups had male predominance, p value was 0.573 and showed no significance

DOI: 10.18410/jebmh/2015/753

Weight in Kgs	Group I (plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)
30 – 39	1	1
40 – 49	10	6
50 – 59	15	17
≥ 60	4	6

Table 3: Weight Distribution

The above table shows weight distribution in Group I and Group II. There was no difference in the two groups in weight distribution of the patients. The mean weight in Group I was 50.63kg and Group II was 53.1kg. Most of the patients in Group I and II were in the range of 50 – 59 kgs, p value was 0.161 and was insignificant.

Onset time of blockade in minutes	Group I (plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)
3 – 4	0	23
5 – 6	1	7
7 – 8	4	0
9 – 10	19	0
11 – 12	5	0
13 – 14	0	0
15 – 16	1	0

Table 4: Onset of Sensory Blockade

The above table shows the onset of sensory blockade in Group I and Group II. The mean onset time of sensory blockade in the Group I was 9.73 minutes an in the Group II was 4.13 minutes

Onset time of blockade in minutes	Group I (Plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)
3 – 4	0	0
5 – 6	0	0
7 – 8	0	0
9 – 10	0	12
11 – 12	0	13

DOI: 10.18410/jebmh/2015/753

13 – 14	0	5
15 – 16	1	0
17- 18	2	0
19 - 20	7	0
21 - 22	14	0
23 -24	6	0

Table 5: Onset of Motor Blockade

The above table shows onset time of motor blockade in Group I and Group II. The mean onset time of motor blockade was 11.1 minutes and 21.1 minutes in the Group II and Group I respectively. Onset of sensory and motor blockade was earlier in Group II when compared with Group I. The p value was 0.001 and was statistically very significant.

		Group	
		I (plain Lignocaine)	**II (Lignocaine with sodium bicarbonate)**
Complete analgesia	Number %	9 (30%)	25 (83.3%)

Table 6: Quality of Sensory Blockade

Z = 5.456, p = 0.001. The above table shows Quality of Sensory Blockade in Group I and Group II expressed as percentage of patients showing complete analgesia. When quality of sensory blockade is compared between Group I and Group II 83.3% of patients in Group II showed complete analgesia whereas 30% of patients in Group I showed complete analgesia with a p value of 0.001, which was statistically significant.

		Group I (plain lignocaine)	**Group II (Lignocaine with sodium bicarbonate)**
GRADE 0	No movement	6	23
GRADE 1	Flickering movement	7	5
GRADE 2	Movement along gravity	13	2
GRADE 3	Movement against gravity	1	0
GRADE 4	Movement against resistance	2	0
	Total	**30**	**30**

Table 7: Quality of Motor Blockade

$X^2 = 34.789$ p = 0.001.

DOI: 10.18410/jebmh/2015/753

The above table shows Quality of Motor Blockade in Group I and Group II When quality of motor blockade was compared between Group I and Group II, 6 patients in Group I had grade 0 block, whereas 23 patients in Group II had grade 0 block. P value was 0.001 and was statistically highly significant. The quality of blockade was increased in Group II in compared to Group I.

Duration of blockade in minutes	Group I (plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)
70 – 79	15	0
80 – 89	9	1
90 – 99	6	11
100 – 109	0	8
110 – 119	0	6
120 – 129	0	4

Table 8: Duration of Sensory Blockade

The above table shows Duration of Sensory Blockade in Group I and Group II.

The mean duration of sensory blockade in Group II was 100.33 minutes where as in Group I was75 minutes.

Duration of blockade in minutes	Group I (plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)
70 – 79	7	0
80 – 89	14	0
90 – 99	6	0
100 – 109	9	12
110 – 119	0	11
120 – 129	0	7

Table 9: Duration of Motor Blockade

The above table shows duration of Motor Blockade in Group I and Group II.

The mean duration of motor blockade was 109 minutes in Group II and 83.83 minutes in Group I. The duration of both sensory and motor blockade was increased in the Group II as compared to Group I, p value was 0.001 which is very highly significant.

DOI: 10.18410/jebmh/2015/753

Time	Group I (plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)	P value
Baseline	93.17±5.52	93.95±4.35	>0.05
15 minutes	95.32±3.10	93.91±3.92	>0.05
30 minutes	94.22±.326	92.50±4.45	>0.05
45 minutes	93.75±3.22	92.30±5.15	>0.05
60 minutes	86.76±4.35	89.68±5.84	>0.05
75 minutes	84.07±12.09	80.70±7.25	>0.05
90 minutes	83.3±13.89	80.80±9.17	>0.05
105 minutes	86.60±6.09	85.58±7.09	>0.05
120 minutes	84.35±8.89	78.32±6.40	>0.05

Table 10: Mean Pulse Rate

The above table shows mean pulse rate in Group I and Group II. When comparing the mean pulse rate between the two groups the p values were > 0.05 and they were statistically not significant.

Time	Group I (plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)	P value
Baseline	93.17±5.37	93.95±4.30	>0.05
15 minutes	95.32±3.32	93.91±4.48	>0.05
30 minutes	94.22±3.09	92.51±4.86	>0.05
45 minutes	90.98±3.14	91.90±4.79	>0.05
60 minutes	92.60±4.63	90.38±4.01	>0.05
75 minutes	92.19±3.64	91.93±4.59	>0.05
90 minutes	93.23±4.58	91.90 ±4.11	>0.05
105 minutes	91.97±5.25	90.98±5.89	>0.05
120 minutes	88.85±6.12	89.33±4.89	>0.05

Table 11: Mean Arterial Blood Pressure

Above table shows Mean Arterial Pressure in Group I and Group II.When comparing the mean arterial pressure between the two groups the p values were > 0.05 and they were statistically not significant.

DOI: 10.18410/jebmh/2015/753

TIME	Group I (plain lignocaine)	Group II (Lignocaine with sodium bicarbonate)
Baseline	99.00±0.00	99.00±0.00
15 minutes	99.00±0.00	98.93±0.38
30 minutes	99.00±0.00	98.97±0.18
45 minutes	99.00±0.00	98.97±0.18
60 minutes	99.00±0.00	99.00±0.00
75 minutes	99.00±0.00	99.00±0.00
90 minutes	99.00±0.00	99.00±0.00
115minutes	99.00±0.00	99.00±0.00
120minutes	99.00±0.00	99.00±0.00

Table 12: Mean Oxygen Saturation

The above table shows mean oxygen saturation in Group I and Group II. When comparing mean oxygen saturation between Group I and Group II at baseline, 15minutes, 30minutes, 45minutes, 60minutes, 75miutes, 90minutes, 115 minutes, 120 minutes intervals, the mean oxygen saturation was 99 % in both the groups and this was statistically not significant.

DISCUSSION: Regional anaesthesia is becoming increasingly popular and brachial plexus block for upper limb surgeries is one of the commonly used nerve blocks. Selecting appropriate local anaesthetics for a given regional technique requires consideration of a number of factors including speed of onset, duration of action of local anaesthetics, duration of surgery, potency, the degree of muscle relaxation required and the duration of analgesia desired. Lignocaine hydrochloride is a safe local anaesthetic of moderate potency with a relatively early onset of action and of reasonable duration of action. The present study is an attempt to compare the relative efficacy of lignocaine hydrochloride (Group I) and lignocaine with sodium bicarbonate (Group II) on brachial plexus block by supraclavicular approach. Lignocaine is a weak base with a pKa of 7.61 at 36°C. As such, it exists at physiological pH in two forms: a charged, protonated molecule, and an uncharged base. Lidocaine is marketed at a pH between 5.0 and 7.0 since aqueous solubility is higher at this range of pH than at more physiological pH. The lidocaine molecule is most effective at blocking the sodium channel when it is protonated but it primarily gains access to the channel by diffusion through lipid membranes. The uncharged base is over 4,000 times more lipid soluble than its cation counterpart. The preponderance of charged lidocaine in the aqueous solution results in slow transfer of the lidocaine across lipid membranes and slows the onset of the block.

Methods of improving clinical efficacy of lidocaine in nerve blockade have been the subject of ongoing research and interest. Increasing the pH of the aqueous solution of lidocaine prior to

DOI: 10.18410/jebmh/2015/753

use has long been recognized as one such method. Investigations into the use of pH adjusted local anaesthetics have produced varied results in both epidural and perivascular nerve blocks.

The first clinical report of improved onset time of local anaesthesia following alkalinization was that of Gros[1] in 1910.

In the present study sixty patients of either sex aged between 18-60 years of ASA grade I or II posted for upper limb surgeries were divided into two groups. Each group contains 30 patients. Group I received 25ml of 1% plain lignocaine, Group II received 25ml of lignocaine with sodium bicarbonate. The parameters observed in the study were time of onset of action, duration of action, quality of blockade, use of adjuvants during intra operative period.

The present study conducted on 60 patients between the age group of 18 – 60 years. The age distribution was similar in both plain lignocaine group and lignocaine with sodium bicarbonate group. This was identical to the age distribution in the study by Gormley W.P.[2] Who studied 42 patients. Their study had mean age of 38.2 years in the control group and 34.6 years in the case group and there was no statistically significant difference between two groups. Capogna[3] studied only 20 patients with mean age of 43 years in pH adjusted group and 40 years in the plain lignocaine group. This study showed no statistically significant difference between two groups. The respective mean was 43.53 years and 39.5 years in the present study and no statistically significant difference between the two groups.

The sex distribution was 20 males and 10 females in the Group I and in the Group II there were 22 males and 8 females in the present study. The male to female ratio was 16/6 and 18/2 for the plain lignocaine group and pH adjusted group respectively in the study by Gormley W.P.[2] There was no statistically significant difference in the sex distribution between the two groups.

The study by Capogna[3] had a male to female ratio of 4/6 and 6/4 for the plain and pH adjusted group respectively. There was no statistically significant difference in the sex distribution

In the present study the mean weight of the patients in the Group I was 50.63kgs and in Group II it was 53.1kgs in our study. There was no statistically significant difference between two groups. This was similar to the study by Gormley W.P[2] which had patients with mean weight of 72.2kgs in the plain group and 76.5kgs in the pH adjusted group. There was no statistically significant difference in the weight distribution. The study by Radha sukhani[4] had patients whose mean weight was 68.01kgs and 72.5kgs for the control and pH adjusted group respectively. There was no statistically significant difference in weight distribution.

In the present study the onset time of sensory blockade was taken from the time of injection of the drug to the time of loss of pain sensation on pin prick. The mean onset time of the sensory blockade in lignocaine with sodium bicarbonate group was 4.13 minutes and in plain lignocaine group was 9.73 minutes. In the study by Capogna[3] the corresponding findings were 2.9 minutes and 4.0 minutes in the pH adjusted and plain group respectively. The earlier onset in their study is probably due to the reason that they used 2% plain lignocaine in their control group in relation to 1% plain lignocaine in our study. Gormley W.P[2] had similar findings where the mean onset time of sensory block was 3.20 minutes for case group and 6.0 minutes for control group. They studied by comparing the 1.5% lignocaine with 1 in 2,00,000 epinephrine (pH – 4.2) and alkalinized 1.5% lignoaine with epinephrine (pH – 7.2) on axillary plexus block.

DOI: 10.18410/jebmh/2015/753

Radha sukhani et al[4] in their studies compared 1% lignocaine hydrochloride with 1.1% lignocaine carbonate. The mean onset time of the sensory blockade was 3.18 minutes, 5.30 minutes in the case group and control group respectively.

In the present study the onset time of motor blockade was the time taken from the time of injection of drug to the complete loss of motor movements. The mean onset time of motor blockade in lignocaine with sodium bicarbonate group was 11.1 minutes, and in plain lignocaine group was 21.1 minutes. Radha sukhani[4] et al observed onset time of motor blockade was earlier (10.07±5.21 minutes) in carbonated lignocaine (pH = 6.8) than with the lignocaine hydrochloride (pH = 6.5) (20.75±9.30 minutes).Ruby et al[5] in their studies compared 20 ml of 2% lignocaine with adrenaline 1 in 2,00,000 (pH = 3.21) with 20 ml of alkalinized 2% lignocaine with adrenaline (pH = 6.67). The mean onset time of motor blockade in the study group was 13.8±4.74 minutes, and in the control group was 20.65 ± 5.22 minutes. In the present study the time to onset of blockade was earlier in lignocaine with sodium bicarbonate group when compared to plain lignocaine group.

Quality of the blockade was graded into complete, incomplete and failed blocks. In the present study complete analgesia occurred in 83.3% of patients in lignocaine with sodium bicarbonate group whereas in plain lignocaine group 30% of patients had complete analgesia. Complete motor blockade was seen in 76.6% of patients in lignocaine with sodium bicarbonate group where as in plain lignocaine group 20% of patients had complete motor blockade.

In the studies by NL.Cunningham[6] also had similar findings; complete motor blockade was seen in 75% patients in their pH adjusted group and in 44% patients in plain lignocaine group.

Radha sukhani[4] et al found 54% of patients had complete blockade with carbonated solution of lignocaine (pH = 6.5) but only 31% had such blockade in lignocaine hydrochloride group (pH = 4). In the present study quality of blockade was increased in lignocaine with sodium bicarbonate group than in the plain group. This increased intensity of motor and sensory block provided by the carbonate is attributed to the fact that when the free base of a carbonated solution is liberated, the carbon dioxide produced diffuses very rapidly across a nerve membrane, causing a fall in the intracellular pH and the production of a "cationic trap", which results in a marked increase in the amount of active cation available at the receptor sites on the sodium channels inside the nerve membranes. Furthermore, in addition to causing a "cationic trap" carbon dioxide may also have a direct stabilizing effect on the nerve membrane. This stabilizing effect of CO2 has been demonstrated in animal experiments by Catchlove.[6]

In the present study duration of sensory block was the time taken from the onset of analgesia to the recurrence of pain to pin prick. In this study the mean duration of sensory block for lignocaine with sodium bicarbonate group was 100.33 minutes, and for the plain lignocaine group was 75 minutes. In the studies by Ruby et al[5] the mean duration of sensory blockade for the pH adjusted group was 100.7 minutes and for the plain group it was 87.1minutes. Hilgier. M et al[7] compared 0.5% bupivacaine with epinephrine and alkalinized bupivacaine. The duration of surgical anaesthesia was significantly higher (10.5 hours) in pH adjusted group, and in the non-alkalinized group it was 4.35 hours.

In the present study duration of motor block was the time taken from the onset of paresis to the recurrence of motor movements. In this study the duration of motor block for lignocaine

with sodium bicarbonate group was 109 minutes and in the plain lignocaine group it was 83.83 minutes. This was similar to the study done by Ruby et al[5] where the duration of motor blockade for the pH adjusted group was 117.55 minutes, and in the plain group was 107.4minutes. Ririe. DG et al[8] compared 1% lignocaine with 1% lignocaine mixed with sodium bicarbonate in median nerve block. Their data suggested that addition of bicarbonate to lignocaine significantly increases the duration of block.

SUMMARY: A Clinical study of comparison of effects of plain lignocaine and lignocaine with sodium bicarbonate on brachial plexus block by supraclavicular approach was undertaken in King George Hospital, Visakhapatnam. Sixty patients of either sex aged between 18-60 years of ASA grade I and II posted for upper limb surgeries were divided into two groups. Each group contained 30 patients, Group I - received 25ml of 1% plain lignocaine, Group II - received 25ml of lignocaine with sodium bicarbonate. The parameters observed in the study were time of onset of block, duration of block, quality of blockade, supplementation during the intra operative period. In this study the onset time of sensory and motor blockade was earlier in lignocaine with sodium bicarbonate group compared to plain lignocaine group. The duration of sensory and motor blockade was prolonged in lignocaine with sodium bicarbonate group compared to plain lignocaine group. When the quality of sensory and motor block was compared between the two groups quality of blockade was better in lignocaine with sodium bicarbonate group compared to plain lignocaine group and the need for supplementation was decreased in lignocaine with sodium bicarbonate group compared to plain lignocaine group.

The study, summarizes that addition of sodium bicarbonate to lignocaine produced a block of more rapid onset, prolonged duration, better quality and decreased need for supplementation when compared to the block using the plain lignocaine.

CONCLUSION: The present study entitled Comparison of effects of plain lignocaine and lignocaine with sodium bicarbonate on brachial plexus block concludes that, the onset time of sensory and motor blockade is lesser with sodium bicarbonate added lignocaine when compared to plain lignocaine in supraclavicular brachial plexus block, the quality of sensory and motor blockade is better with sodium bicarbonate added lignocaine, the duration of motor and sensory blockade was significantly prolonged when lignocaine with sodium bicarbonate was used in supraclavicular brachial plexus block.

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