"Comparative Study of Addition of Potassium Chloride and Sodium Bicarbonate to Bupivacaine on the Onset Time And Duration Of Brachial Plexus Block"

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I. Introduction
Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. It is always a subjective experience. Regional anaesthesia has been used widely for upperlimb surgeries because it provides good post operative analgesia. Brachial plexus block has evolved into a valuable and safe alternative to general anaesthesia for upperlimb surgery. The main drawback of long acting drugs was delayed onset of action. To overcome this, an attempt was made to compare the effects of adding potassium chloride and sodium bicarbonate to Bupivacaine for the onset time and duration of sensory and motor blockade following supraclavicular brachial plexus block was carried out.

II. Materials And Methods
The present study is aimed to compare the addition of potassium chloride and sodium bicarbonate to bupivacaine in supraclavicular brachial plexus block. The following are assessed

- The onset of sensory and motor blockade
- The quality of sensory and motor blockade
- The duration of blockade
- To compare the results with that of plain bupivacaine of same concentration

Inclusion criteria: Ninety patients of age group 20-70 years of either sex, ASA 1 and ASA 2, Patients undergoing elective and emergency surgery of upperlimb

Exclusion criteria: progressive neurological disorders, severe kidney or liver function, history of bleeding disorders

Investigations: haemoglobin percentage, total count, differential count, erythrocytic sedimentation rate, random blood sugar, electrolytes, urine albumin, chest xray, echocardiogram were done

All patients were premedicated with pethedine 1mg/kg intra muscular 30 minutes before surgery. Each patient was randomly assigned to one of the three groups (30 patients each group)

Each patient was made to lie supine without a pillow, arms at the side, head turned slightly to the opposite side with shoulders depressed posteriorly and downward by moulding the shoulders over a roll placed between the scapulae. The supraclavicular area was aseptically prepared and draped. An intradermal wheal was raised approximately 1cm above the midclavicular point. The subclavian artery palpable in supraclavicular fossa was used as landmark. The tip of the index finger was placed directly over the arterial pulsation. A filled 10ml syringe with a 23 gauge, 32mm needle attached was held and patient was told to say "now", as soon as he felt a tingle or electric shock like sensation going down his arm. As soon as paraesthesia was elicited, the needle was fixed in position and after confirming negative aspiration of blood 30 ml of respective drug was injected depending on whether the patient was alloted to either of group 1,2 and 3

The person doing the procedure did not know whether the dilution contained sodium bicarbonate or potassium chloride

All values were expressed as mean ± or – standard deviation. Statistical comparison was performed by CHI-SQUARE test

The three groups of thirty each.
Group 1 received 30 ml of 0.375% of Bupivacaine with 0.2mmol of potassium chloride
**III. Results**

**Figure 1** : Onset of sensory blockade

![Graph showing onset of sensory blockade](image)

p<0.001 very highly significant

The main onset time of sensory blockade in group 1 was 10.43 minutes when compared to group 2 (24.16 min) and group 3 (26.33 min)

**Figure 2** : Onset of motor blockade

![Graph showing onset of motor blockade](image)

P<0.001 very highly significant

The mean onset time of motor blockade in group 1 was 9.43 minutes when compared to group 2 (21.46 min) and group 3 (23.93 min)

**Figure 3** : Comparison of mean onset of blockade

![Graph showing comparison of mean onset of blockade](image)

p<0.001 very highly significant
Onset of sensory and motor blockade was earlier in case of group 1 when compared with group 2 and group 3. The p value was <0.001 which is statistically highly significant.

Figure 4: Duration of sensory and motor blockade

p<0.001 very highly significant

The duration of both sensory and motor block was prolonged in group 1 when compared to group 2 and group 3. The p value was <0.001 which is very highly significant.

Figure 5: Quality of sensory blockade

The quality of sensory blockade was better in group 1 and the value was statistically significant when compared with group 2 or group 3.

Figure 6: Quality of motor blockade

The quality of motor blockade was better in group 1 and the value was statistically significant when compared with group 2 or group 3.
The number of adjuvants used in group 1 were significantly less when compared with group 2 and group 3. The p value was <0.05 which is significant.

The onset of blockade in potassium group was earlier when compared to groups with sodium bicarbonate or plain bupivacaine. In our study the mean onset of sensory and motor blockade in potassium group was 10.43 and 9.43 minutes respectively.

Alkalinization of bupivacaine did not shorten the onset time when compared with plain bupivacaine, whereas earlier onset of blockade in sodium bicarbonate group due to addition of epinephrine to 0.5% alkalinized bupivacaine.

The duration of sensory and motor blockade was significantly increased in potassium group when compared to other groups. We have found that depth of sensory and motor blockade was significantly better in potassium when compared to other groups.

The decreased requirement of adjuvants in potassium group when compared to other groups suggest greater quality of anaesthesia.

Increasing the pH of solution before injection, increases the amount of bupivacaine existing in the uncharged form and there by produce more rapid diffusion across perineuronal tissue barriers. Where as our study did not show any clinical advantage when compared to earlier studies probably because pH adjusted local anaesthetic solution were not close to the pKa value.

Group 1
IV. Discussion

Brachial plexus block is widely used in our practice for elective forearm and hand surgeries. It provides good intra-operative and post operative analgesia. Many substances have been added to local anaesthetic agents in attempt to prolong their duration of action. Addition of potassium chloride to local anaesthetic solution increases the extracellular potassium concentrations and depolarizes the membrane. Altering the pH of local anaesthetic solution by adding sodium bicarbonate produce more rapid diffusion across perinural tissue barriers. We conducted studies on ninety patients with demographic data in terms of age, weight, sex being similar in all age groups. The data collected was analysed for statistical significance by chi-square test. The onset of blockade in potassium group was earlier when compared to groups with sodium bicarbonate or plain bupivacaine. In our study the mean onset of sensory and motor blockade in potassium group was 10.43 and 9.43 minutes.
respectively. The results of our study support the findings of Khosa et al. In contrast to our study, the delayed onset of blockade in the study by Priris and Chamber was due to 0.25% bupivacaine in relation to 0.375% bupivacaine.

In our study comparison between sodium carbonate and plain bupivacaine group showed statistical significance. The results of our study were in accordance with Bedder et al., who also found that alkalinization of bupivacaine did not shorten the onset time when compared with plain bupivacaine, whereas Hilgier et al. found earlier onset of blockade in sodium bicarbonate group due to addition of epinephrine to 0.5% alkalinized bupivacaine.

The duration of sensory and motor blockade was significantly increased in potassium group when compared to other groups. This is in agreement with Khosa et al. findings who found prolonged duration of analgesia. We have found that depth of sensory and motor blockade was significantly better in potassium when compared to other groups. Bromage and Burfoot also found intense quality of blockade when potassium was added to lignocaine in epidural block.

The decreased requirement of adjuvants in potassium group when compared to other groups suggest greater quality of anaesthesia. The results of our study support the findings of Priris and Chamber.

Clinical studies of Galindo concluded the pH adjusted solution of local anaesthetics produced a more rapid onset of blockade with better quality of duration in epidural analgesia. Similarly Ritchie et al. showed increasing the pH of solution before injection, increases the amount of bupivacaine existing in the uncharged form and there by produce more rapid diffusion across perineural tissue barriers. Where as our study did not show any clinical advantage when compared to earlier studies probably because pH adjusted local anaesthetic solution were not close to the pKa value.

**V. Conclusion**

The present study “Comparative study of addition of potassium chloride and sodium bicarbonate to bupivacaine on the onset and duration of brachial plexus block” concludes that addition of potassium chloride to bupivacaine had significant clinical advantage over alkalinized bupivacaine and plain bupivacaine. But alkalinization of bupivacaine did not confer any added benefit when compared to plain bupivacaine.

**References**


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