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Potassium Chloride as an Adjuvant to Lignocaine and Bupivacaine in Brachial Block for Orthopedic Surgeries

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Abstract

Background: Brachial Plexus block is the easiest and simplest form of providing anesthesia for upper limb surgeries. It is known that potassium added to local anesthetics can increase the extracellular concentration, time of depolarization and prolongation of action of the local anesthetics. With this in background, this study was designed to observe the effect of potassium chloride as adjuvant to local anesthetics on onset of sensory and motor blockade and qualitative block for analgesia.

Materials and Methods: Forty patients of ASA I and II of either sex, aged 17 to 61 years posted for upper limb orthopaedic surgeries received either plain Inj. Xylocaine 1.5% (A1), Inj. Xylocaine 1.5% with Inj. Potassium Chloride 0.2 mmol (A2), plain Inj. Bupivacaine 0.375% (B1) or Inj. Bupivacaine 0.375% with Inj. Potassium Chloride 0.2 mmol (B2) in Brachial Plexus block through Supraclavicular approach. Patients were assessed for the onset of sensory and motor blockade, duration of anaesthesia and post-operative analgesia.

Result: Groups A2 and B2 (potassium added groups) had faster onset of sensory and motor blockade, and prolonged duration of action than A1 and B1 (plain Xylocaine and Bupivacaine) groups. The quality of blockade was better in groups with added potassium, more so with Bupivacaine than with Xylocaine.

Conclusion: Addition of Potassium chloride to Xylocaine and Bupivacaine had significant clinical advantage over Plain drugs specially Bupivacaine on onset time, duration and quality of sensory and motor blockade in Brachial Plexus block.

Keywords: Lignocaine; Bupivacaine; Potassium chloride; Brachial Plexus block.

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Introduction

Brachial plexus block is the easiest and effective form of providing anesthesia and analgesia to the major part of upper limb for upper limb surgeries. It is even the safest in emergency procedures where associated conditions may not advocate the rationale of General Anesthesia. Regional Anesthesia still stands highest potential in safety if done in expert hands. Advantages of regional anesthesia like less

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operation theatre pollution, safe alternative where facilities of general anesthesia are not available and prolonged post-operative analgesia still advocate for its use over general anesthesia unless absolutely contraindicated. Brachial plexus block with one-point injection helps to anesthetize larger area of upper limb. Various factors affect the action of local anesthetic agents used for Brachial plexus block – patient factors, systemic disease, technical factors in administering the drugs for the block, drug induced side effects when more volume is used to facilitate dense block and many more to list. Various local anesthetic agents have been used for the brachial block – if physiological environment be facilitated to reversibly inhibit the nerve conduction it can definitely have its action on the duration of drug used for block. It is known that potassium concentration and glucose level extracellularly can increase the time of depolarization and can increase the action of the local anesthetics. So we attempted to provide a more physiological environment rather than vasoconstrictor drugs to facilitate early onset and prolonged duration of the local anesthetics.

With this in background, this study was designed to study the effect of potassium chloride if added as adjuvant to local anesthetics, instead of vasoconstrictors, on the action of local anesthetics in respect to onset of sensory and motor blockade, duration of total block to facilitate post-operative analgesia and the qualitative effect of the block.

Material and Methods

The present randomized double blind study was carried out in a tertiary Care Hospital in Gujarat. Forty patients of age group 17-61 years of either sex of ASA gr I and II posted for upper limb orthopedic surgeries of various types were included for the study. After a detailed preoperative history of the patients, thorough local and systemic examination (Table 4), & all the requisite preoperative investigations including the bleeding profile, patients were selected for the study with following Inclusion criteria: patients without any serious systemic illness and comorbid conditions, not on anticoagulants, and willing to be a part of the study and Exclusion criteria: Patients with uncontrolled systemic diseases, on anti-coagulants, unwilling for regional anesthesia, failed block. After premedication with Inj. Glycopyrollate 0.2mg, Inj. Midazolam 1mg, Inj. Tramadol 50mg, Inj. Ondansetron 4mg, patients were randomly allocated to be subjected to Supraclavicular Brachial block (Winnie)6 under strict aseptic and antiseptic blind technique to receive either:

- Group A1 (N=10): to receive Inj. Xylocaine 1.5% 25 ml
- Group A2 (N=10): to receive Inj. Xylocaine 1.5% 25 ml + Inj. KCl 0.2 mmol
- Group B1 (N=10): to receive Inj. Bupivacaine 0.375% 25 ml
- Group B2 (N=10): to receive Bupivacaine 0.375% 25 ml + Inj. KCl 0.2 mmol

After administering the block, the patients were observed for immediate inadvertant complications if any, time noted for the onset of sensory and motor blockade (Table 1), and the duration of the block per operative and in the post-operative period and hence the time for requirement of first rescue analgesia and the results in all the groups were compared using Student t test for mean and standard deviation.

Observation and Results

Forty patients of either sex (Table 2) of ASA gr I and II comparable in terms of age, weight (Table 2) posted for planned orthopedic surgeries of upper limb (Table 3) were selected for this study and were randomly divided in four groups of N=10 to receive either of the drug for Brachial plexus block through Supra clavicular approach:

- Group A1 (N=10): to receive Inj. Xylocaine 1.5% 25 ml
- Group A2 (N=10): to receive Inj. Xylocaine 1.5% 25 ml + Inj. KCl 0.2 mmol
- Group B1 (N=10): to receive Inj. Bupivacaine 0.375% 25 ml
- Group B2 (N=10): to receive Bupivacaine 0.375% 25 ml + Inj. KCl 0.2 mmol

It was observed that onset of sensory block in groupA2 (8.1 ± 2.1min) was faster than groupA1 (8.6 ± 1.86min). Also, it was faster in B2 group (7 ± 1.65min) than B1 group (14 ± 2.6min) . (Figure 1). The onset of motor block also showed earlier onset in group A2 (9.8 ± 1.87min) as compared to group A1 (10.4 ± 1.74min) and group B2 (10.9 ± 1.65min) as compared to group B1 (17.6 ± 2.86min) (Figure 2). The earlier onset of sensory and motor block was more significant in the patients receiving Inj. Bupivacaine with Inj. Potassium Chloride compared to Plain Inj. Bupivacaine, which was not that significant in Xylocaine groups.

Figure 4 and Figure 5 show the sensory and motor

block score achieved after the block in all the groups which were comparable as far as the success of the block was considered. We have found that depth of sensory and motor blockade was significantly better in groups with added potassium as compared to plain local anesthetic groups.

Figure 3 shows the mean duration of analgesia in all the four groups. The analgesia in the post-operative period was much more in group B2 as compared to group B1 but the difference between groups A2 and A1 was not much significant.

Fig. 1: Onset of Sensory Block in all Groups (Mean ± Sd).

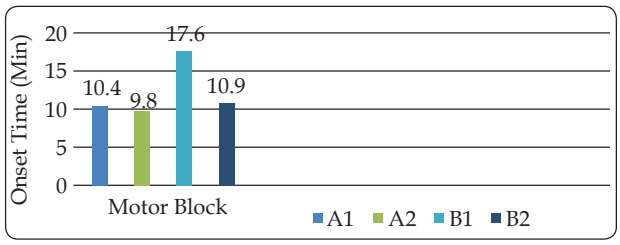

Fig. 2: Onset of Motor Block in all Groups (Mean ± Sd).

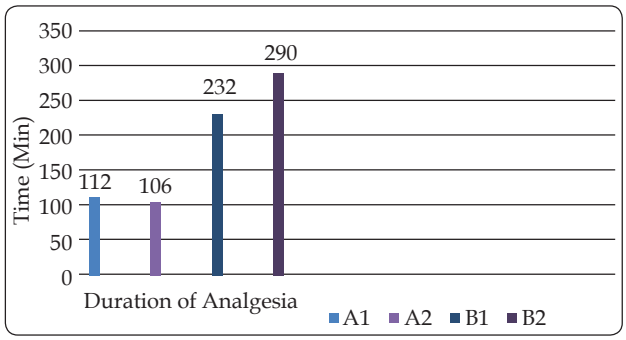

Fig. 3: Duration Of Analgesia (Mean ± Sd).

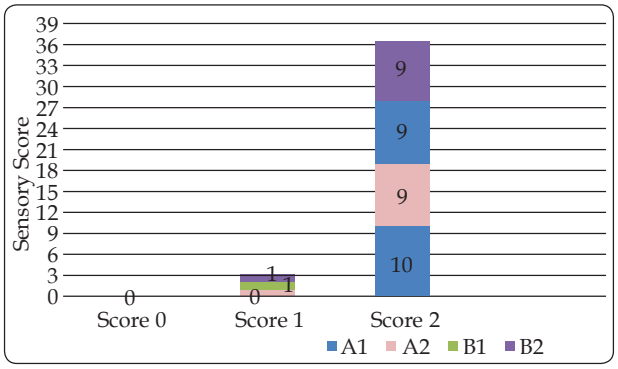

Fig. 4: Sensory Block Score.

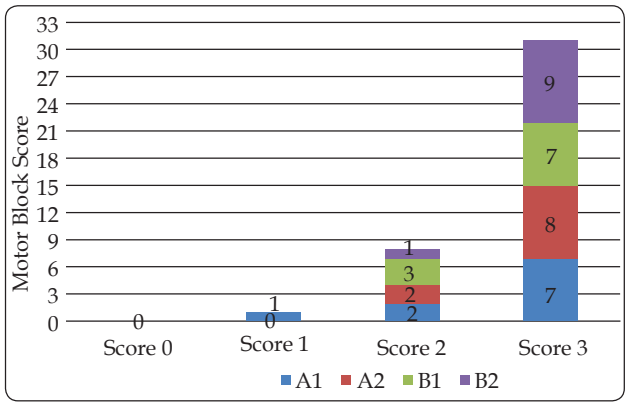

Fig. 5: Motor Block Score.

Table 1: Sensory And Motor Score.

Score	Sensory	Motor
0	Sharp Pain	Able to Move Arm Against Resistance
1	Pain on Touch	Inability to Move Wrist and Elbow Against Resistance
2	No Pain on Touch	Inability to Move Wrist and Elbow Against Gravity
3		Inability to Move Arm

Table 2: Demography Profile of Patients.

Age Group	Number of Patients	Percentage	Sex of the Patients	
Below 20	05	12.5	Male	Female
21-40	21	52.5	30	10
41-60	13	32.5		
Above 60	01	2.2		
Total	40	100	40	

Table 3: Planned Operative Procedure.

Sr. No.	Procedure	A1	A2	B1	B2	Total
1	Both Bone # Orif	02	03	06	05	16
2	Humerus Dcp Plating	01	03	03	02	09
3	K Wire Fixation of both Bone #	05			01	06
4	Tendon Repair	02	01	01	01	05
5	Sequestrectomy		01		01	02
6	Radial Head Excision		02			02
	Total	10	10	10	10	40

Table 4: Associated Medical Conditions.

Sr. No.	Procedure	A1	A2	B1	B2	Total
1	Pulmonary Koch's	02		03		05
2	Hypertensioin	02	03	04	01	10
3	Ischemic Heart Disease	03	03	02	04	12
4	Head Injury	01	01		01	03
5	Bronchial Asthma	02	03	03	02	10

Table 5: Complications.

Complications	Number of Patients	Percentage
Blood on Aspiration	02	5
Hematoma Formation	02	5
Total	04	10

Discussion

Brachial plexus block is widely used in practice for elective forearm and hand surgeries. It provides good intra- and post-operative analgesia. Many adjuvants have been added to local anaesthetic agents in an attempt to prolong their duration of action. Among them, addition of carbonated solution and potassium to local anaesthetic has stood the test of time. Addition of potassium chloride to local anaesthetic solutions increases the extracellular Potassium concentrations and depolarizes the membrane[3]. We conducted study on forty patients with demographic data in terms of age, weight and sex being similar in all groups posted for planned upper limb orthopaedic surgeries. After detailed assessment and explanation of the procedure,the patients were subjected to receive Brachial Plexus block with supraclavicular route (Winnie) bearing in mind complication of pneumothorax in the classical supra clavicular technique. The data collected was analysed for statistical significance by Student's t-test. The onset of the blockade in potassium group was significantly earlier when compared to plain bupivacaine group but not much significant as compared in the Lignocaine group. In our study, the mean onset of sensory and motor blockade in potassium group B2 was17.6 ± 2.86 and 10.9 ± 1.65 minutes, respectively. The results of our study support the findings of Parris and Chamber[7] (1966) who showed that addition of potassium chloride to bupivacaine significantly enhanced the onset of both sensory and motor blockade. In contrast to our study, the delayed onset of blockade proposed by Parris and Chamber[7] may be due to the lower concentration of bupivacaine (0.25%) when compared to our study (0.375%). Khosaand Gupta[5] also in a similar study found early onset of sensory and motor and prolonged duration of analgesia using KCl (5 mmol) as adjuvant with bupivacaine and no significant changes while using Lignocaine. We have found that depth of sensory and motor blockade was significantly better in potassium group when compared to other group. Local Anaesthetic agents are membrane stabilisers and efflux of potassium during the depolarisation prevents the propagation of the nerve impulse.[1,2] If the resting membrane potential is further lowered it will facilitate the halting of the impulse below the normal physiological 120mV. This is achieved by addition of potassium chloride in the extra cellular compartment which will cause some degree of depolarisation and enfeeblement of the membrane potential to prevent the passage of nerve impulse. Thus addition of potassium chloride as adjuvant will definitely shorten the onset time, prolong the duration of action and improve the quality of blockade in brachial plexus block by delaying the repolarisation.[3,4] Areas of further exploration like individual patient variations of anatomy, their response, different concentrations of potassium chloride, study of other agents and sites of blockade can be considered.[5-7]

Conclusion

The present study concludes that addition of potassium chloride to bupivacaine had a significant clinical advantage over plain bupivacaine on onset time, duration, and quality of sensory and motor blockade in brachial plexus block which was not seen with use of plain Inj. Xylocaine.

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