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"Comparative Study of Addititon 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

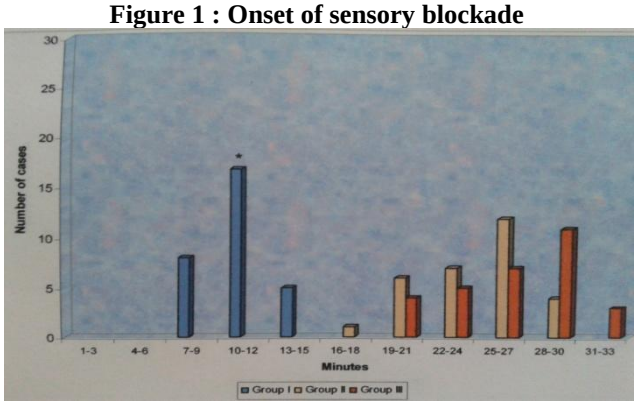
The three groups of thrity each.

Group 1 received 30 ml of 0.375% of Bupivacaine with 0.2mmol of potassium chloride

Group 2 received 30 ml of 0.375% of Bupivacaine with 0.2 ml of sodium bicarbonate
Group 3 received 30 ml of 0.375% of plain Bupivacaine
Sensory blockade were determined by pinprick test in the C4-T2 skin dermatomes
Motor blockade was graded according to the movement of upperlimb by the patient.

III. Results

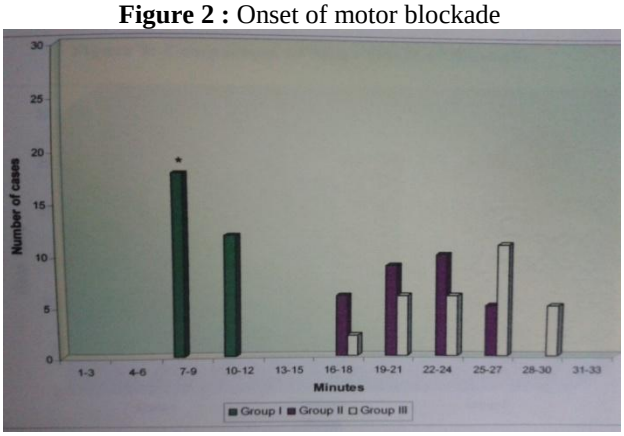
Figure 1 : Onset of sensory blockade



p<0.001 very highly significant

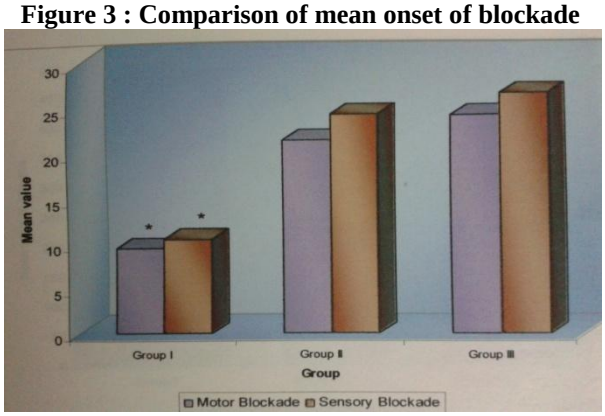
The main onset time of sensory blockade in group 1 was 10.43 minutes when compared to group 2 (24.16 min) and group 3 (26.33 min)

Figure 2 : Onset of motor blockade



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)

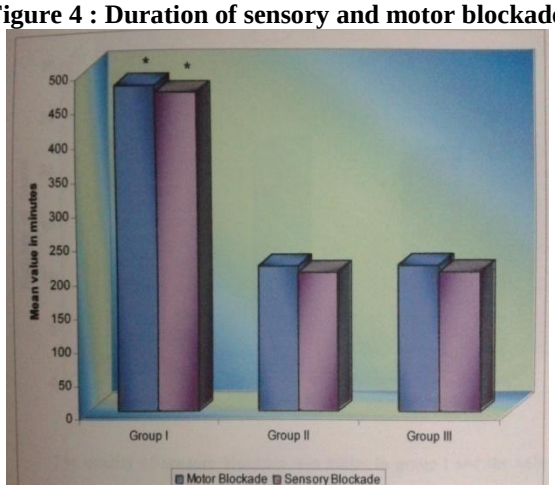
Figure 3 : Comparison of mean onset of blockade



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 <0.001which is statistically highly significant

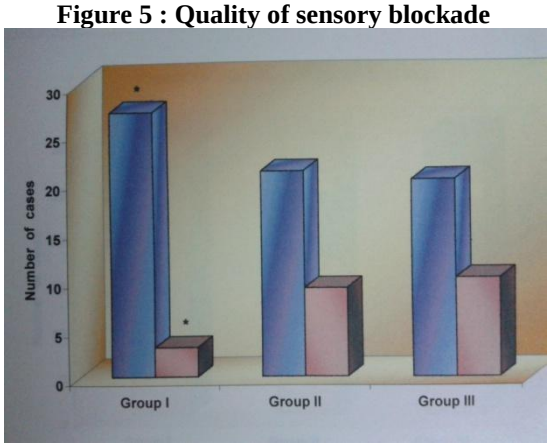
Figure 4 : Duration of sensory and motor blockade



p<0.001 very highly significant

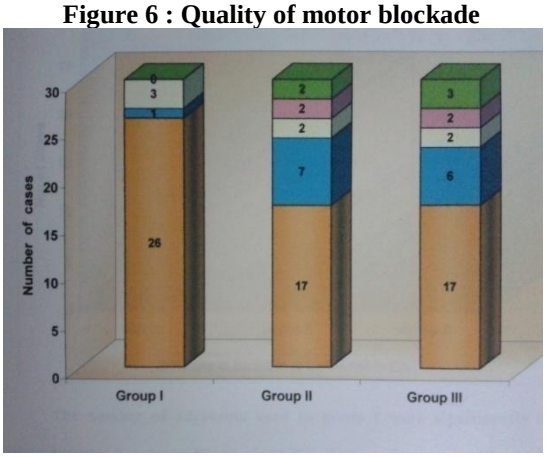
The duration of both sensory and motor block was prolonged in group 1 when compared to group 2 and group 3. The p value was <0.001which is very highly significant

Figure 5 : Quality of sensory blockade



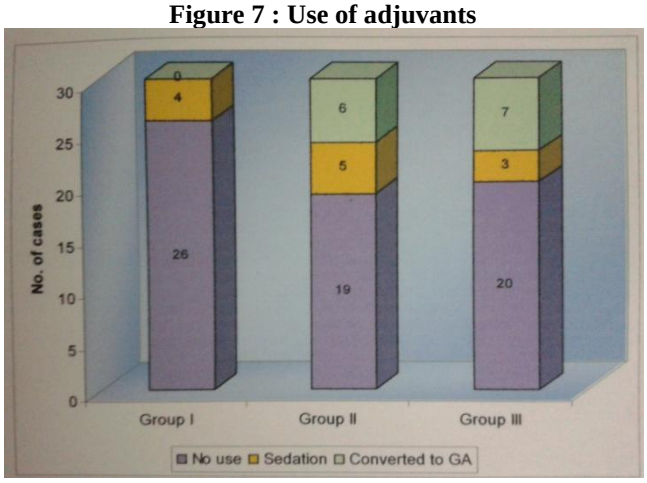
The quality of sensory blockade was better in group 1 and the value was statistically significant when compared with group 2 or group 3

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

Figure 7 : Use of adjuvants



The number of adjuvants used in group 1were significantly less when compared with group 2 and group3. 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

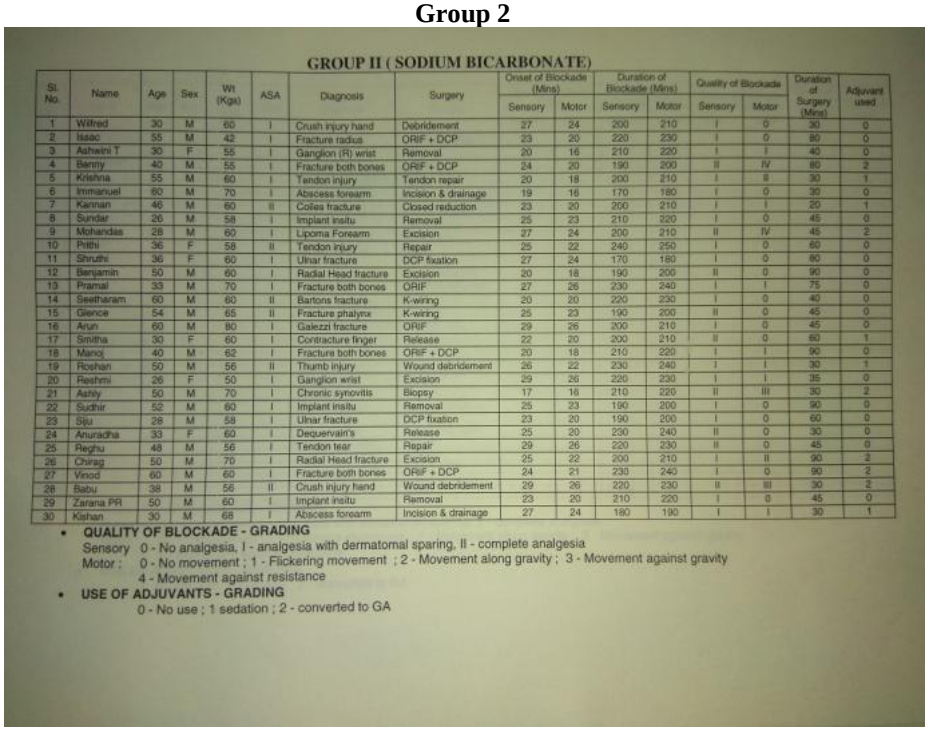
Group 1

MASTER CHART
GROUP I (POTASSIUM)

Sl. No.	Name	Age	Sex	Wt (Kgs)	ASA	Diagnosis	Surgery	Onset of Blockade (Mins)		Duration of Blockade (Mins)		Quality of Blockade		Duration of Surgery (Mins)	Adjuvant used
								Sensory	Motor	Sensory	Motor	Sensory	Motor		
1	Sanjeeva	28	M	60	I	Cut injury (L) hand	Tendon repair	10	10	460	470	I	0	45	0
2	Satish	30	M	56	I	Ganglion (R) hand	Excision	10	8	430	440	II	II	35	1
3	Wilson	50	M	60	I	Fracture radius	ORIF + DCP	13	12	520	530	I	0	90	0
4	Padmaja	55	M	61	I	Fracture phalynx	K-wiring	11	10	450	460	I	I	35	0
5	Mathew	40	M	56	I	Crush injury hand	Debridement	11	10	460	470	I	0	55	0
6	Chandraraj	42	M	55	I	Colles fracture	Closed reduction	12	12	450	460	I	0	20	0
7	Raman	60	M	50	I	Ulnar fracture	DCP fixation	8	8	445	455	I	0	65	0
8	Aisamma	52	F	60	II	Dequervain's	Release	11	10	465	475	I	0	30	0
9	Celine Tellis	40	F	60	I	Trigger Finger	Release	10	8	430	440	I	0	30	0
10	Wilfred	30	M	48	II	Crush injury hand	Debridement	11	9	490	500	I	I	45	0
11	Abdul	30	M	59	I	Radial Head fracture	Excision	8	8	440	450	I	0	90	0
12	Jeneta	45	F	50	I	Carpal tunnel synd	Release	10	8	420	430	I	0	75	0
13	Jainabi	50	F	58	I	Wrist ganglion	Excision	13	12	450	460	I	0	40	0
14	Kamala	42	F	49	I	Tendon injury	Tendon repair	8	8	500	510	I	0	35	0
15	Kantappa	32	M	58	II	Contracture finger	Release	13	12	520	530	I	0	45	0
16	Laxmi	50	F	57	I	Wrist ganglion	Excision	11	11	480	490	I	0	45	0
17	Damodharan	50	M	52	I	Crush injury hand	Wound debridement	11	9	480	490	I	0	50	0
18	Somayya	50	M	56	I	Abscess forearm	Incision & drainage	10	8	500	510	I	0	30	0
19	Narayana	32	M	64	I	Tendon injury	Tendon repair	9	8	480	490	I	0	45	0
20	Yamuna	50	F	55	I	Colles fracture	Closed reduction	8	8	460	470	II	II	20	1
21	Naveen	28	M	48	II	Bartons fracture	K-wiring	9	9	450	460	I	0	45	0
22	Thimappa	40	M	58	I	Smiths implant insitu	Implant removal	10	8	460	470	I	0	60	0
23	Rukmayya	40	M	65	I	Fracture ulna	ORIF	13	12	510	520	I	0	45	0
24	Thomas	50	M	52	I	Radius fracture	Closed reduction	12	10	490	500	I	0	20	0
25	Fathima	56	F	56	II	Carpal tunnel synd	Release	8	8	460	470	I	0	80	0
26	Mohammed	31	M	60	I	Lipoma Forearm	Excision	10	9	500	510	I	0	45	0
27	Marcel	42	M	57	II	Fracture phalynx	K-wiring	13	12	470	480	I	0	45	0
28	Sunil	22	M	53	I	Colles fracture	Closed reduction	10	8	460	470	I	0	20	0
29	Sekar	25	M	60	II	Ganglion wrist	Excision	9	9	450	460	II	II	35	1
30	Babu	39	M	58	I	Fracture both bones	ORIF	11	9	450	460	I	0	90	1

- **QUALITY OF BLOCKADE - GRADING**
  Sensory 0 - No analgesia, I - analgesia with dermatomal sparing, II - complete analgesia
  Motor : 0 - No movement ; 1 - Flickering movement ; 2 - Movement along gravity ; 3 - Movement against gravity
  4 - Movement against resistance
- **USE OF ADJUVANTS - GRADING**
  0 - No use ; 1 sedation ; 2 - converted to GA

Group 2

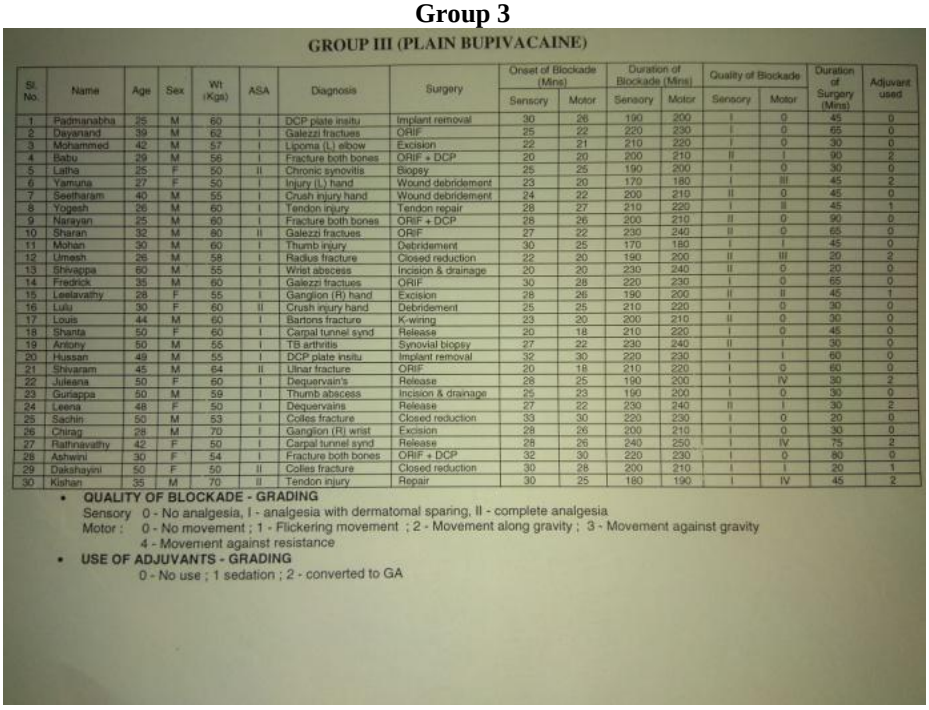


GROUP II (SODIUM BICARBONATE)

Sl. No.	Name	Age	Sex	Wt (Kgs)	ASA	Diagnosis	Surgery	Onset of Blockade (Mins)		Duration of Blockade (Mins)		Quality of Blockade		Duration of Surgery (Mins)	Adjuvant used
								Sensory	Motor	Sensory	Motor	Sensory	Motor		
1	Wilfred	30	M	60	I	Crush injury hand	Debridement	27	24	200	210	I	0	30	0
2	Isaac	55	M	42	I	Fracture radius	ORIF + DCP	23	20	220	230	I	0	80	0
3	Ashwini T	30	F	55	I	Ganglion (R) wrist	Removal	20	16	210	220	I	I	40	0
4	Benny	40	M	55	I	Fracture both bones	ORIF + DCP	24	20	190	200	II	IV	80	2
5	Krishna	55	M	60	I	Tendon injury	Tendon repair	20	18	200	210	I	II	30	1
6	Immanuel	60	M	70	I	Abscess forearm	Incision & drainage	19	16	170	180	I	0	30	0
7	Kannan	46	M	60	II	Colles fracture	Closed reduction	23	20	200	210	I	I	20	1
8	Sundar	26	M	58	I	Implant insitu	Removal	25	23	210	220	I	0	45	0
9	Mohandas	28	M	60	I	Lipoma Forearm	Excision	27	24	200	210	II	IV	45	2
10	Prithi	36	F	58	II	Tendon injury	Repair	25	22	240	250	I	0	60	0
11	Shruthi	36	F	60	I	Ulnar fracture	DCP fixation	27	24	170	180	I	0	80	0
12	Benjamin	50	M	60	I	Radial Head fracture	Excision	20	18	190	200	II	0	90	0
13	Pramal	33	M	70	I	Fracture both bones	ORIF	27	26	230	240	I	I	75	0
14	Seetharam	60	M	60	II	Bartons fracture	K-wiring	20	20	220	230	I	0	40	0
15	Glence	54	M	65	II	Fracture phalynx	K-wiring	25	23	190	200	II	0	45	0
16	Arun	60	M	80	I	Galezzi fracture	ORIF	29	26	200	210	I	0	45	0
17	Smitha	30	F	60	I	Contracture finger	Release	22	20	200	210	II	0	60	1
18	Manoj	40	M	62	I	Fracture both bones	ORIF + DCP	20	18	210	220	I	I	90	0
19	Roshan	50	M	56	II	Thumb injury	Wound debridement	26	22	230	240	I	I	30	1
20	Reshmi	26	F	50	I	Ganglion wrist	Excision	29	26	220	230	I	I	35	0
21	Ashly	50	M	70	I	Chronic synovitis	Biopsy	17	16	210	220	II	III	30	2
22	Sudhir	52	M	60	I	Implant insitu	Removal	25	23	190	200	I	0	90	0
23	Siju	28	M	58	I	Ulnar fracture	DCP fixation	23	20	190	200	I	0	60	0
24	Anuradha	33	F	60	I	Dequervain's	Release	25	20	230	240	II	0	30	0
25	Reghu	48	M	56	I	Tendon tear	Repair	29	26	220	230	II	0	45	0
26	Chirag	50	M	70	I	Radial Head fracture	Excision	25	22	200	210	I	II	90	2
27	Vinod	60	M	60	I	Fracture both bones	ORIF + DCP	24	21	230	240	I	0	90	2
28	Babu	38	M	56	II	Crush injury hand	Wound debridement	29	26	220	230	II	III	30	2
29	Zarana PR	50	M	60	I	Implant insitu	Removal	23	20	210	220	I	0	45	0
30	Kishan	30	M	68	I	Abscess forearm	Incision & drainage	27	24	180	190	I	I	30	1

- **QUALITY OF BLOCKADE - GRADING**
  Sensory 0 - No analgesia, I - analgesia with dermatomal sparing, II - complete analgesia
  Motor : 0 - No movement ; 1 - Flickering movement ; 2 - Movement along gravity ; 3 - Movement against gravity
  4 - Movement against resistance
- **USE OF ADJUVANTS - GRADING**
  0 - No use ; 1 sedation ; 2 - converted to GA

Group 3



GROUP III (PLAIN BUPIVACAINE)

Sl. No.	Name	Age	Sex	Wt (Kgs)	ASA	Diagnosis	Surgery	Onset of Blockade (Mins)		Duration of Blockade (Mins)		Quality of Blockade		Duration of Surgery (Mins)	Adjuvant used
								Sensory	Motor	Sensory	Motor	Sensory	Motor		
1	Padmanabha	25	M	60	I	DCP plate insitu	Implant removal	30	26	190	200	I	0	45	0
2	Dayanand	39	M	62	I	Galezzi fractues	ORIF	25	22	220	230	I	0	65	0
3	Mohammed	42	M	57	I	Lipoma (L) elbow	Excision	22	21	210	220	I	0	30	0
4	Babu	29	M	56	I	Fracture both bones	ORIF + DCP	20	20	200	210	III	I	90	2
5	Latha	25	F	50	II	Chronic synovitis	Biopsy	25	25	190	200	I	0	30	0
6	Yamuna	27	F	50	I	Injury (L) hand	Wound debridement	23	20	170	180	I	III	45	2
7	Seetharam	40	M	55	I	Crush injury hand	Wound debridement	24	22	200	210	II	0	45	0
8	Yogesh	26	M	60	I	Tendon injury	Tendon repair	28	27	210	220	I	II	45	1
9	Narayan	25	M	60	I	Fracture both bones	ORIF + DCP	28	26	200	210	II	0	90	0
10	Sharan	32	M	80	II	Galezzi fractues	ORIF	27	22	230	240	II	0	65	0
11	Mohan	30	M	60	I	Thumb injury	Debridement	30	25	170	180	I	I	45	0
12	Umesh	26	M	58	I	Radius fracture	Closed reduction	22	20	190	200	II	III	20	2
13	Shivappa	60	M	55	I	Wrist abscess	Incision & drainage	20	20	230	240	II	0	20	0
14	Fredrick	35	M	60	I	Galezzi fractues	ORIF	30	28	220	230	I	0	65	0
15	Leelavathy	28	F	55	I	Ganglion (R) hand	Excision	28	26	190	200	II	II	45	1
16	Lulu	30	F	60	II	Crush injury hand	Debridement	25	25	210	220	I	0	30	0
17	Louis	44	M	60	I	Bartons fracture	K-wiring	23	20	200	210	II	0	30	0
18	Shanta	50	F	60	I	Carpal tunnel synd	Release	20	18	210	220	I	0	45	0
19	Antony	50	M	55	I	TB arthritis	Synovial biopsy	27	22	230	240	II	I	30	0
20	Hussan	49	M	55	I	DCP plate insitu	Implant removal	32	30	220	230	I	I	60	0
21	Shivaram	45	M	64	II	Ulnar fracture	ORIF	20	18	210	220	I	0	60	0
22	Juleana	50	F	60	I	Dequervain's	Release	28	25	190	200	I	IV	30	2
23	Guriappa	50	M	59	I	Thumb abscess	Incision & drainage	25	23	190	200	I	0	30	0
24	Leena	48	F	50	I	Dequervains	Release	27	22	230	240	II	I	30	2
25	Sachin	50	M	53	I	Colles fracture	Closed reduction	33	30	220	230	I	0	20	0
26	Chirag	28	M	70	I	Ganglion (R) wrist	Excision	28	26	200	210	I	0	30	0
27	Rathnavathy	42	F	50	I	Carpal tunnel synd	Release	28	26	240	250	I	IV	75	2
28	Ashwini	30	F	54	I	Fracture both bones	ORIF + DCP	32	30	220	230	I	0	80	0
29	Dakshayini	50	F	50	II	Colles fracture	Closed reduction	30	28	200	210	I	I	20	1
30	Kishan	35	M	70	II	Tendon injury	Repair	30	25	180	190	I	IV	45	2

- **QUALITY OF BLOCKADE - GRADING**
  Sensory 0 - No analgesia, I - analgesia with dermatomal sparing, II - complete analgesia
  Motor : 0 - No movement ; 1 - Flickering movement ; 2 - Movement along gravity ; 3 - Movement against gravity
  4 - Movement against resistance
- **USE OF ADJUVANTS - GRADING**
  0 - No use ; 1 sedation ; 2 - converted to GA

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[30].In contrast to our study ,the delayed onset of blockade in the study by Prris and Chamber was due to 0.25% bupivacaine in relation to 0.375% bupivacaine.

In our study comparison between sodium carbonate and plaine bupivacaine group showed statistical significance. The results of our study were in accordance with Bedder et al[25],who also found that alkalinization of bupivacaine did not shorten the onset time when compared with plain bupivacaine, whereas Hilgier et al[19] 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[30] 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[9] al;so 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 Parris and Chamber[20.]

Clinical studies of Galindo[44] 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[43] 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 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

V. Conclusion

The present study **"Comparative study of addition of potassium chloride amd 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 alkalanized bupivacaine and plain bupivacaine. But alkalanization of bupivacaine did not confer any added benefitwhen compared to plain bupivacaine

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