



Original Research Article

Effect of Alkalinization of Mixture of Local Anaesthetics on Sensory Nerve Block in Patients Underwent Upper Limb Surgery

Manjunath K.R¹, Rupali Pramod Mahajan², Ramesh Kumar N³, Ravishankar V⁴

¹Assistant Professor, Department of Anesthesiology, Sapthagiri Institute of Medical Sciences & Research Centre, Bangalore, Karnataka.

²Junior Consultant, Department of Anesthesiology, Aruna Hospital, Jalgaon, Maharashtra.

³Associate Professor, Department of Anesthesiology, Sri Devaraj URS Medical College, Tamaka, Kolar, Karnataka.

⁴Assistant Professor, Department of Anesthesiology, Kerala Medical College, Palakkad, Kerala.

Corresponding Author: Manjunath K.R

Received: 04/10/2014

Revised: 17/11/2014

Accepted: 19/11/2014

ABSTRACT

Aim and objectives: To evaluate effectiveness of adding sodium bicarbonate to local anesthetic mixture on sensory nerve block in patients underwent upper limb surgery.

Materials and Methods: Study was done on 60 patients for a period of 12 months. Patients were divided into 2 groups of 30 each. Group-I: Bupivacaine (0.5%/15ml) + lignocaine (2%) with Adrenaline (15ml) + normal saline (10ml). Group-II: Bupivacaine (0.5%/15ml + lignocaine (2%/15ml) with Adrenaline (15ml) + Sodium bicarbonate (4ml) + normal saline (6ml). Two group's demographic data, onset of nerve block and duration of nerve block were recorded and compared. The present study ethically cleared by institutional human ethical committee of Apollo BGS hospital Mysore.

Results: Group-II showed increased duration of sensory nerve block compared to group-I. Group-II showed decrease in onset (8.03 min) of sensory block compared to group-I (13.50 min). Usage of adjuvant drugs are less in group-II compared with group-I.

Conclusion: Addition of sodium bicarbonate to local anesthetic mixture significantly decreases the onset of sensory nerve block with increase in the duration of nerve block.

Keywords: Adrenaline, Anaesthesia, Bupivacaine, Sensory nerve block, Lignocaine, Sodium bicarbonate.

INTRODUCTION

“Regional anaesthesia” is the term first used by Harvey Cushing in 1901 to describe pain relief by nerve block. [1]

Regional nerve blocks are based on the concept that pain is conveyed by nerve fibers, which are amenable to interruption anywhere along their pathway. Brachial plexus block has now evolved into valuable and safe alternative to general anaesthesia

for upper limb surgeries. It is a great tool in the anaesthetic armamentarium for relief of pain preoperatively, per-operatively and post operatively. Since its introduction by William Steward Halsted in 1885, who performed the block by exposing the roots, it has undergone many changes and modifications to arrive at a better technique.

Regional anaesthesia can reduce or avoid the hazards and discomfort of general anaesthesia including sore throat, airway trauma, and muscle pain. It also offers a number of advantages to outpatients undergoing surgery. These techniques provide analgesia without sedation, prolonged postoperative analgesia and allow earlier patient's discharge. Regional anaesthesia reduces the requirements of opioids. It reduces the incidence of postoperative nausea and vomiting. It can be used alone or in combination with sedation or as a part of balanced analgesia with general anaesthesia. [2]

In new trend of day care surgeries with minimal hospital stay and less financial burden on the patients, brachial plexus block seems to be a better alternative to general anaesthesia. The innervations of the upper limb are derived almost completely from the brachial plexus. Complete block can thus be achieved by means of a single injection. [3] Pain relief after upper limb surgery can be achieved by various regional anaesthetic techniques. The supraclavicular brachial plexus block is one among the most popular regional nerve blocks performed. The easy and predictable landmarks make it a popular approach.

Bupivacaine and lignocaine are the most commonly administered drugs in brachial plexus blocks, however, onset of action and duration of anesthesia are the limiting factors. To minimize these drawbacks, many drugs including buprenorphine, clonidine, morphine, verapamil, tramadol and dexamethasone have been co-administered with local anesthetic to improve the quality and duration of action. [4-8] One technique that may decrease this delay is referred to as 'alkalinisation' of the local anaesthetic solution. [9] This means adding a planned amount of a basic solution (typically sodium bicarbonate) to the local anaesthetic solution

before injecting it into the target tissues. This practice may also decrease the pain on injection of the solution. [10] Alkalinization of local anesthetic solution to speed the onset of action, with varying degrees of success has been studied by several workers. [11,12]

It is not clear yet whether freshly prepared alkalinised local anaesthetic mixture would improve the quality, onset and duration of supraclavicular brachial plexus block. This prospective study was a randomized, controlled trial to compare the onset, the quality and duration of analgesia with alkalinized-anaesthetic mixture with anaesthetics mixture alone in sensory nerve block in patients underwent upper limb surgery.

MATERIALS AND METHODS

Study design: Random sampling, computerized randomization, double blind, controlled trial.

Study settings: Department of Anaesthesiology, Apollo BGS Hospital, Mysore, Karnataka.

Study duration: 12 months

Inclusion criteria

- Age group: 18 to 60 years
- ASA Grade 1 and 2 of both Gender for elective surgery
- Orthopedic, plastic and reconstructive upper limb surgeries lasting more than 30 minutes

Exclusion criteria

- Age group: <18 yrs and >60 yrs
- ASA Grade 3 and 4,
- Weight < 30 kg or > 100 kg,
- Emergency surgeries,
- History of adverse reactions to local anaesthetic drugs,
- Progressive neurological disorders,
- Patient refusal ,
- History of bleeding disorders,
- Severe kidney or liver dysfunction,

- Patients having opposite side pneumothorax or collapsed lung,
- Patients having bilateral upper limb surgery.

Study groups

Study was done on 60 patients for one year. Total 60 patients were included in the study. All the patients were divided into two groups of 30 in each group.

Group-I: Bupivacaine (0.5%/15 ml) + lignocaine (2%) with Adrenaline (15 ml) + normal saline (10ml).

Group-II: Bupivacaine (0.5%/15ml) + lignocaine (2%) with Adrenaline (15 ml) + Sodium bicarbonate (4ml) + normal saline (6 ml).

Procedure

All patients visited and evaluated thoroughly on the day prior to surgery. During the preanesthetic evaluation a thorough evaluation of all the systems was undertaken. The anaesthetic procedure to be undertaken including development of paraesthesia was explained to the patients and an attempt was made to alleviate the anxiety of the patient. A written informed consent was taken. Preanesthetic preparation of patient was a period of overnight fasting. A meticulous airway assessment was done. Routine laboratory examinations were conducted including complete hemograms, urine analysis and whenever appropriate, blood sugar, ECG and chest X-ray. All drug solutions were prepared by an anaesthesiologist not involved in administration of anaesthesia, patient care and data collection.

Intravenous access was obtained in the limb opposite to that undergoing surgery with 18 G cannula. The following monitors were connected in the operating room to the patients: ECG monitor, Pulse oxymeter and Non-invasive blood pressure monitor. ^[13]

Each patient was made to lie supine without a pillow, arms at 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 side of the patient 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 used as a landmark. A filled 10ml syringe with a 23 gauge, 32 mm long needle attached was held in the right hand and the patient instructed to say “now” and not move as soon as he felt a “tingle” or “electric shock like” going down his arm. ^[14]

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 40 ml of the respective drug was injected depending on whether the patient was allotted to Group I or Group II.

Parameters were observed

The sensory block was recorded using pin prick in skin dermatomes C4–T2, once every 5 minutes for the first 30 minutes after injection and then once every 1hr for first 3hr, then every 30 minutes till the patient regained normal sensations. Onset time of sensory blockade, duration of sensory blockade, quality of block was assessed. Grades of quality of sensory blockade and grades of the usage of adjuvants were also recorded. ^[15]

Statistical analysis

The data was analyzed by SPSS (16.0) version software. Unpaired t test applied to find the statistical significant between the groups. P value less than 0.05 considered statically significant at 95% confidence interval. The data was expressed in MEAN±SD, number and percentage. [16]

RESULTS

The minimum age in groups I and II were 20 years. The maximum age in group I and II was 56 years and 55 years respectively. The mean age in group I and II were 37.96±10 and 35.16±10 years

respectively. There was no significant difference in age of patients between Group I and Group II (P > 0.05). In group-I 20 were males (10), females (10) and in group-II males (18) and females (12). The minimum body weight in groups I and II were 40 kg and 46 kg respectively. The maximum body weight in groups I and II were 79 kg and 77 kg respectively. The mean body weight in group I and in group II was 61.8 ± 10 and 69.9 ± 11 kg respectively. There was no significant difference in the body weight of patients between group I and group II (p > 0.05).

Table-1: Demographic data of group-I and group-II

Demographic data	Group-I		Group-II	
	Number	Percentage (%)	Number	Percentage (%)
Age (years)				
18-30	7	23.3	11	36.7
31-40	11	36.7	8	26.7
41-50	8	26.7	8	26.7
51-60	4	13.3	3	10.0
Mean age (MEAN±SD)	37.96±10.78		35.16±10.34	
Gender	Number	Percentage (%)	Number	Percentage (%)
Male	20	66.7	18	63.3
Female	10	33.3	12	36.7
Body weight (kg)	61.87±0.10		62.96±0.11	

Onset of blockade was faster in group II (8.03±1.41 min) compared to group I (13.5±2.25min). This difference was statistically significant.

Table-2: Comparison of onset of sensory blockage between group-I and group-II

Groups	Onset of sensory block (min) (MEAN±SD)	t value	P value
Group-I	13.50±2.25	11.26	0.001
Group-II	8.03±1.14*		

(*P<0.001 significant compared group-I with group-II)

Duration of blockade was longer in group II (8.15±1.65hours) compared to group I (7.24±1.34hours) and this difference was statistically significant.

Table-3: Comparison of mean duration time of sensory block between group-I and group-II

Groups	duration time of sensory block (hr) (MEAN±SD)	t value	P value
Group-I	07.24±1.34	-2.33	0.023
Group-II	08.15±1.65*		

(*P<0.001 significant compared group-I with group-II)

The quality of blockade was better in the group-II in which 70% patients had complete analgesia when compared to 53.3% in group-I. But this difference is not statistically significant.

Table-4: Comparison of quality of analgesia between group-I and group-II

Grade	Group			
	Group A		Group B	
	Number	Percentage (%)	Number	Percentage (%)
Grade 1	16	53.3	21	70.0
Grade 2	9	30.0	7	23.3
Grade 3	5	16.7	2	6.7
Total	30	100%	30	100%
P value	0.331			

(P value significant compared quality of analgesia between group-I and group-II)

Comparison of usage of adjuvant drugs between group-I and II showed statistically insignificant results.

Table-5: Comparison of use of adjuvant medications in patients between group-I and group-II

Adjuvant medications	Group			
	Group A		Group B	
	Number	Percentage (%)	Number	Percentage (%)
No use(A1)	16	53.3	21	70.0
Sedation(A2)	9	30.0	7	23.3
Converted to GA(A3)	5	16.7	2	6.7
Total	30	100%	30	100%
P value	0.331			

(P value significant compared quality of analgesia between group-I and group-II)

DISCUSSION

In recent years, there has been a growing interest in the practice of regional techniques and, in particular, peripheral nerve blocks for surgical anaesthesia and postoperative analgesia. The development of local anaesthetic agents with lower toxicity and long duration of action had contributed to this change. [17-20] Regional anaesthesia with single-shot or continuous peripheral nerve blocks can provide superior analgesia and a lower complication rate compared to parenteral anaesthetics. [21-23] Alkalinization appears most effective with commercially prepared epinephrine containing local anesthetics, probably because these solutions are formulated at a lower pH. Thus, the relative effects of raising pH are larger than with plain local anesthetic solutions. [24] Onset time of sensory blockade was faster in our study group. Our result showed that sensory block tended to last longer which was similar to observation of de Jong study. [25]

The present study used adjuvants in 23.4% of patients in study group while 30% patients in control group were given adjuvants. 10% of patients are converted to GA in case group and 3.4% patients in study group. In the study by Gormley W.P et. al adjuvants were used for 81.8% patients in control group and for 50% patients in alkalinized group. The decreased requirement of adjuvants suggests better quality of anaesthesia.

CONCLUSION

From our study we concluded that, addition of sodium bicarbonate as adjuvant to mixture of lignocaine and bupivacaine has showed faster onset of sensory block, better quality of sensory block and significant increase in duration of sensory block in patients underwent upper limb surgery.

REFERENCES

1. Hirsch NP, Smith GB. Harvey Cushing: His Contribution to Anesthesia. *Anesthesia and Analgesia* 1986;65:p.288-93.
2. Rawal N. Analgesia for day-case surgery. *British Journal of Anaesthesia* 2001; 87: p.73-87.
3. De Andres J, Sala-Blanch X. Peripheral nerve stimulation in the practice of brachial plexus anesthesia: a review. *Regional Anesthesia and Pain Medicine* 2001; 26: p.478-483.
4. Candido KD, Winnie AP, Ghaleb AH, Fattouh, MW et al. Buprenorphine Added to the Local Anesthetic for Axillary Brachial Plexus Block Prolongs Postoperative Analgesia. *Regional Anesthesia and Pain Medicine* 2002; 27(2): p.162-7.
5. Erlacher W, Schuschnig C, Orlicek F, Marhofer P et al. The effects of clonidine on ropivacaine 0.75% in axillary perivascular brachial plexus block. *Acta Anaesthesiologica Scandinavica* 2000; 44(1): p.53-7.
6. Reuben SS, Reuben JP. Brachial plexus anesthesia with verapamil and/or morphine. *Anesthesia and Analgesia* 2000; 91(2): p.379-3.
7. Kaabachi O, Ouezini, R, Koubaa W, Ghrab B et al. Tramadol as an Adjuvant to Lidocaine for Axillary Brachial Plexus Block. *Anesthesia and Analgesia* 2009; 108(1): p.367-70.

8. Estebe JP, Le Corre P, Clement R, Du Plessis L et al. Effect of dexamethasone on motor brachial plexus block with bupivacaine and with bupivacaine-loaded microspheres in a sheep model. *European Journal of Anaesthesiology* 2003; 20(4): p.305-10.
9. Quinlan JJ, Oleksey K, Murphy FL. Alkalinization of mepivacaine for axillary block. *Anesthesia and Analgesia* 1992;74: p.371-4.
10. Davies RJ. Buffering the pain of local anaesthetics: A systematic review. *Emergency Medicine* 2003; 15(1): p.81-88.
11. Tetzlaff JE, Yoon HJ, Brems J, Javorsky T. Alkalinization of mepivacaine improves the quality of motor block associated with interscalene brachial plexus anesthesia for shoulder surgery. *Regional Anesthesia and pain medicine* 1995; 20(2): p.128-32.
12. Capogna G, Celleno D, Costantino P, Muraton F et al. Alkalinization improves the quality of lidocaine-fentanyl epidural anaesthesia for caesarean section. *Canadian Journal of Anaesthesia* 1993; 40(5): p.425-30.
13. Neal JM. The upper extremity: Somatic block. In: Cousins MJ, Carr DB, Horlocker TT, Bridenbaugh PO editor. *Neural blockade in clinical anesthesia and management of pain medicine*. 4th ed. Philadelphia: Lippincott Williams and Wilkins; 2009. p. 326-37.
14. Roberts CP, Brown BR. International practice of anaesthesia. 1st ed. Oxford: Butterworth and Heinemann; 1996, 141.
15. Chow MY, Sia AT, Koay C, Chan Y W. Alkalinization of lidocaine does not hasten the onset of axillary brachial plexus block. *Anesthesia and Analgesia* 1998; 86(3): p.566-568.
16. Bedder MD, Kozody R, Craig DB. Comparison of bupivacaine and alkalized bupivacaine in brachial plexus anesthesia. *Anesthesia and Analgesia* 1988; 67: p.48-52.
17. Rodgers A, Walker N, Schug S, Mckee A et al. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials; *British Journal of Anaesthesia* 2000;321(7275), p.1493.
18. Buist RJ. A survey of the practice of regional anaesthesia; *journal of the royal society of medicine*.1990, 83(11): p.709-12.
19. Gonano C, Kettner SC, Ernstbrunner M, Schebesta K et al. Comparison of economical aspects of interscalene brachial plexus blockade and general anaesthesia for arthroscopic shoulder surgery. *British Journal of Anaesthesia* 2009;103(3), p.428-33.
20. Brull R, McCartney CJL, Chan VWS, Beheirye HE et al. Neurological Complications After Regional Anesthesia. *Anesthesia and Analgesia* 2007;104(4): p.965-74.
21. Cunningham NL, Kaplan JA. A Rapid-onset, Long-acting Regional Anesthetic Technique. *Anesthesiology* 1974; 41(5): p.509-511.
22. Hassan HG, Youssef H, Renck H. Duration of experimental nerve block by combinations of local anesthetic agents. *Acta Anaesthesiologica Scandinavica* 1993; 37 (1): p.70-74.

23. Moore DC, Bridenbaugh LD, Bridenbaugh PO, Thompson GE et al. Does Compounding of Local Anesthetic Agents Increase Their Toxicity in Humans? *Anesthesia and Analgesia* 1972;51(4): p.579-585.
24. Peterfreund RA, Datta S, Ostheimer GW. pH Adjustment of Local Anaesthetic Solutions with Sodium Bicarbonate Laboratory Evaluation of Alkalinization and Precipitation. *Regional Anesthesia and pain medicine* 1989; 14(6): p.265 – 270.
25. De Jong RH, Wagman IH, Physiological Mechanism of Peripheral Nerve Block by Local Anaesthetics, *Anaesthesiology* 1963; 24(5): p.684-95.

How to cite this article: Manjunath KR, Mahajan RP, Kumar RN et. al. Effect of alkalinization of mixture of local anaesthetics on sensory nerve block in patients underwent upper limb surgery. *Int J Health Sci Res.* 2014;4(12):162-168.

International Journal of Health Sciences & Research (IJHSR)

Publish your work in this journal

The International Journal of Health Sciences & Research is a multidisciplinary indexed open access double-blind peer-reviewed international journal that publishes original research articles from all areas of health sciences and allied branches. This monthly journal is characterised by rapid publication of reviews, original research and case reports across all the fields of health sciences. The details of journal are available on its official website (www.ijhsr.org).

Submit your manuscript by email: editor.ijhsr@gmail.com OR editor.ijhsr@yahoo.com