A COMPARATIVE STUDY OF ALKALINED AND PLAIN LOCAL ANESTHETIC ON ONSET, DURATION AND QUALITY OF BRACHEAL PLEXUS BLOCK BY SUPRACLAVICULAR APPROACH

Rajesh Kumar Yadav[1], Ajay Singh Thapa[2], Rakesh Sah[3]*

Affiliation

1. *Associate Professor, Department of Anaesthesiology and Critical Care, College of Medical Sciences – Teaching hospital, Bharatpur, Chitwan, Nepal*
2. *Assistant Professor, Department of Anaesthesiology and Critical Care, College of Medical Sciences – Teaching hospital, Bharatpur. Chitwan, Nepal*
3. *Lecturer, Department of Anaesthesiology and Critical Care, College of Medical Sciences – Teaching hospital, Bharatpur, Chitwan, Nepal*

ARTICLE INFO

Received : 19 May, 2022

Accepted : 26 August, 2022

Published : 15 November, 2022

ORA 315

DOI: https://doi.org/10.3126/bjhs.v7i2.49307

*** Corresponding Author**

Dr. Rajesh Kumar Yadav
Associate Professor
Department of Anaesthesiology & Critical Care
College of Medical Sciences Teaching Hospital,
Bharatpur, Chitwan, Nepal
Email:drrajeshyadav7@gmail.com
ORCID: https://orcid.org/0000-0002-0679-007X

Citation

A Comparative Study of Alkalined and Plain Local Anesthetic on onset, Duration and Quality of Bracheal Plexus Block by Supraclavicular Approach. Rajesh Kumar Yadav, Ajay Singh Thapa, Rakesh Sah. BJHS 2022;7(2)18. 1812-1815.

ABSTRACT

Introduction

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in term of such damage. The relief from pain is the essence of anesthesia. Peripheral nerve blocks provide longer and more localized pain relief than neuraxial techniques while also avoiding the side effects of systemic medication. This study was aimed to find the effectiveness of Study solution (addition of Sodium bicarbonate to 0.375% Bupivacaine)on onset time, duration and quality of Brachial Plexus Block.

Methodology

This study was conducted among 60 different patients undergoing surgical procedure of the upper limb. They were categorized into two different groups. The first group (Group1), 30 patients received Brachial Plexus block with 30 ml of study solution (0.375% Bupivacaine with 2ml of Sodium bicarbonate7.4%). The second group (Group 2) received 30 ml of 0.375 %plain bupivacaine only and the differences in onset, duration and quality of blockade were studied.

Result

The similarity of age between the two groups can be seen. In Group 1 the mean onset time of sensory blockade was 9.43 minutes and motor blockade was10.43 minutes when compared to Group 2 having sensory onset of minutes 23.93 and motor onset of 26.33minutes.Similarly, In Group I the mean duration of sensory blockade was 477.67 minutes and motor blockade were 467.67 minutes when compared to Group 2 having sensory duration of215.67 and motor duration of 205.67 minutes. The quality of sensory blockade was also better in group1 (P-Value:0.006).

Conclusion

Addition of Sodium bicarbonate to bupivacaine had significant clinical advantage over plain bupivacaine on onset time, duration and quality of sensory and motor blockade in brachial plexus block.

KEYWORDS

Brachial Plexus Block, Bupivacaine, Peripheral nerve blocks and Sodium bicarbonate.

INTRODUCTION

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in term of such damage.[1] It is one of man's compelling experience. The relief from pain is the essence of anesthesia. Since the discovery of local anesthetic drugs, the need for pain relief during surgery without loss of consciousness is appreciated more and more, both by anesthetists andsurgeons[2].

Peripheral nerve blocks provide longer and more localized pain relief than neuraxial techniques while also avoiding the side effects of systemic medication. Regional anesthesia of the extremities and of the trunk is a useful alternative to general anesthesia in many situations.[3]

In the upper limb, regional anesthesia may be used for elective as well as emergency procedures on the hand, forearm, and elbow.

Halsted first accomplished Brachial Plexus Block, when hefreed the cords and nerves of the brachial plexus after blocking the roots in the neck with cocaine solution.[4] Later studies revealed that the nerves supplying the arm and the forearm are geographically grouped closely together in the brachial plexus and a single injection could provide analgesia for the whole limb.[5,6] More and more anesthetists are practicing regional anesthetic techniques when ever possible so aim of this study to find out the effect of addition of 2 ml of Sodium bicarbonate7.4% to 0.375% Bupivacaine solution on onset time, duration of Brachial Plexus Block by Supraclavicular Approach.

METHODOLOGY

A comparative study was conducted in the department of Anesthesia of College of Medical Sciences, Bharatpur-10, Chitwan. Sample size was calculated using formula (n)=(Zα+Zβ)^2 σ^2/d^2= (1.96+0.84)^2 (1.9)^2/(9.25-8.25)^2=28.3024=29, Where Zα is the z- score value at 5% level of significance=1.96 and Zβ is the power of test, at 80% power its value is 0.84. Standard deviation was taken as 1.9 and mean difference was taken as 1.[12] Prior to the study ethical approval was taken form Institutional Review Committee of College of Medical Sciences (Ref. No. COMSTH-IRC/2019-1030). Patients were selected using simple random sampling (using random number table). Informed and written consents was taken from all the patients. Patients were randomly divided into two groups.

Group I:30 patients were injected with to 30 ml of 0.375% of Bupivacaine with sodium bicarbonate

Group II: 30 patients were injected with a 30ml of 0.375 % plain Bupivacaine.

Time of onset of sensory block was recorded using pinprick in skin dermatomesC4-T2 once in every minute for the first 30 minutes after injection and there after every 30 minutes till patient regained normal sensations. The same observer assessed the motor block at same time intervals. Onset of sensory block was the time of injection of drug to time of loss of pain on pinprick. Onset of motor block was from the time of injection to time of complete loss of movement.

Sensory block and motor block was assessed by Hollmen scale as:

Onset of sensory and motor block was defined as minimum of Grade 2 in Hollmen scale. Block was considered complete when sensory and motor score was Grade 3 in Hollmen scale. Duration of sensory block was the time in minutes from onset of analgesia (Hollmen scale Grade 2) to the recurrence of pain to pinprick. Duration of motor block was the time in minutes from the onset of paresis (Hollmen scale grade2) to the normal muscle function.

The quality of sensory and motor block was studied and graded as per whether the blocks were complete, incomplete or totally absent.

The usage of adjuvants after the block was graded according to whether the surgery was done under general anesthesia (Grade 2) due to complete failure of block, whether opioids or sedatives were used during intra operative period (Grade 1) or if adjuvants of any kind were not used throughout the surgery (Grade 0).

Collected data was check for completeness and accuracy. Then entered and analyze using SPSS-17. Data were analyzed using descriptive and inferential statistical tools. In the descriptive statistics mean, SD were used for continuous variables while for categorical variables frequency and percentage were used. In the inferential statistics to find the association between two groups Student t-test were applied. P-value <0.05 were considered as statistically significant.

An Inclusion Criteria includes:

1. ASA Grade 1 and 2 of either sex going for upper limb surgeries
2. 20 to 70 years of age.

An exclusion criterion includes

1. Patient's refusal
2. Progressive neurological disorders
3. Severe kidney, liver or respiratory dysfunction
4. History of bleeding disorders
5. History of hypersensitivity to local anesthetic drug.

A detailed preoperative assessment with respect to history and examination were performed

Investigations like Hemoglobin (Hb), Total count (TC). Differential count (DC),platelet count, Bleeding time (BT). Clotting time (CT). Random blood sugar, electrolytes, urine albumin, chest X-ray and Electrocardiogram (ECG) were obtained during PAC. Each patient was visited pre-Operatively the procedures were explained and the informed written consent was taken.

All the patients were premedicated the previous night with Diazepam 10 mg and again in the morning two hours before the scheduled time of operation with sips of water.

Each patient was randomly assigned to one of the two groups (30 patients each)

Preparation of study solution

Group I (Sodium bicarbonate group) received 30 ml of 0.375 % bupivacaine with Sodium bicarbonate. The drug solution was prepared by adding 2 ml of Sodium bicarbonate7.4% and 8ml distilled water i.e.total 10 ml to 20 ml of 0.5% bupivacaine.

Group II (Plain bupivacaine group) received 30 ml of 0.375% bupivacaine only.

Anaesthesia Technique: The block was given by supraclavicular approach where the patient lies supine, with the arm along

his body and the head slightly rotated on the opposite side. The supraclavicular area was aseptically prepared and draped. The physician was placed at the head of the patient, on the side to be blocked. Ultra sound guided BPB was performed under full aseptic measures.

Sensory block and motor block was assessed by Hollmen scale[11] as:

Grading of Sensory block

Grade: 1 Normal sensation of pinprick

Grade: 2 Pinpricks felt as a sharp pointed but weaker compared with same area inthe other upper limb

Grade: 3 Pinpricks recognized as touch with blunt object

Grade: 4 No perception of pinprick

Grading of Motor block:

Grade: 1 normal muscle function

Grade: 2 slight weaknesses in function.

Grade: 3 very weak muscle function.

Grade: 4 omplete loss of muscle function.

Comparison of quality of blockade was done, based on Hollmens scale and number of adjuvants used to complete operation

RESULT

This study was conducted among 60 different patients undergoing upper limb surgical procedure, they were categorized into two different groups that is 30 patients in each. The Group-1 patients received regional Block 30 ml of study solution (0.375% Bupivacaine with Sodium bicarbonate). The second group (Group 2) received 30 ml of 0.375%plain bupivacaine only and the differences in onset, duration and quality of blockade were compared.

The study population of the two groups was similar on the basis of demographic distribution.

Significant difference was noted between Sodium bicarbonate and Plain group on the following parameters:

Comparison of Onset of Sensory and Motor Blockade

In Group 1 the mean onset time of sensory blockade was 9.43 minutes and motor blockade were 10.43 minutes when compared to Group 2 having sensory onset of 23.93minutes and motor onset of 26.33minutes. It showed Onset of sensory and motor blockade compared to Sodium bicarbonate usage (P-value: < 0.001) statistically significant. (Table: 2)

Comparison of Duration of Sensory and Motor Blockade

In Group I the mean duration of sensory blockade was 477.67 minutes and motor blockade were 467.67 minutes when compared to group 2 having sensory duration of 215.67 and motor duration of 205.67 minutes which is (p- value < 0.001) statistically significant. (Table: 2)

Quality of Sensory and motor Blockade

Quality of sensory and motor blockade was better hence quality of anesthesia in bicarbonate group than plain Bupivacaine group as the number of adjuvants used in Group 2 were significantly higher as compared to Group 1 apart from this, In Group 2 patients 6.67% required conversion to GA while none of the patients in Group 1 required GA. (Table: 3)

Table 1: Distribution of Ages

Age in years	Group		Total	P-Value
	Group 1	Group II		
21-30	13 (43.34%)	16(53.34%)	29(48.34%)	0.96
31-40	9(30.0%)	3(10.0%)	12(20.0%)	
41-50	1(3.34%)	6(20.0%)	7(11.67%)	
51-60	2(6.67%)	5(16.67%)	7(11.67%)	
>60	5(100%)	0	5(8.34%)	
Total	30 (100%)	30(100%)	60(100%)	

Table: 2 Comparison of onset and duration of sensory and motor blockade

	Group	Mean	N	Std. Deviation	Min.	Max.	P-Value
Onset of motor Blockade (mins.)	With Sodium bicarbonate	10.43	30	1.633	8	13	<0.0001
	Plain	26.33	30	3.836	20	33	
Onset of sensory Blockade (mins.)	With Sodium bicarbonate	9.43	30	1.547	8	12	<0.0001
	Plain	23.93	30	3.503	18	30	
Duration of motor Blockade (mins.)	With Sodium bicarbonate	467.67	30	26.579	420	520	<0.0001
	Plain	205.67	30	18.134	170	240	
Duration of Sensory Blockade (mins.)	With Sodium bicarbonate	467.67	30	26.579	430	540	<0.0001
	Plain	215.67	30	18.134	180	250	

Table: 3 Comparison of Quality of Blocks

Group	Adjuvants not used/Grade: 0	Adjuvants Used/Grade: 1	Converted to GA/Grade: 2
Sodium bicarbonate Group	86.66%	13.34%	00.00
Plain Group	76.66%	16.67%	6.67%

DISCUSSION

In spite of enormous literature on the subject of analgesia, the contemporary practice of pain relief is still many years behind times. The search for newer analgesics and newer techniques continues. Supra clavicular brachial plexus block is a well-organized method of achieving analgesia in the arm, forearm and hand region.

The onset of blockade of Sodium bicarbonate group was earlier when compared to plain bupivacaine group. In our study the mean onset of sensory and motor blockade in Sodium bicarbonate group was 9.43 and 10.43 minutes respectively. Similarly, the mean duration of sensory blockade was 477.67 minutes and motor blockade were 467.67 minutes which is faster onset and longer duration when compared to pain bupivacaine group this could be explained by this addition of sodium bicarbonate to local anesthetics solution will raise the PH closer to PKa which shorten the latency, increases the intensity and prolong the duration of resultant neural blocked.[7]

The results of our study supported by the findings of Singh SP et al[8], carried out A Randomized double blind controlled trial, effect of alkalinized bupivacaine and fentanyl mixture in supraclavicular brachial plexus block resulted faster onset of block (7.25 +_1.07minutes), achieved complete block (25.6+-7.8 minutes) and prolong duration of analgesia (4.45+- 0.48Hours) as well as quality of block also significantly improved which is accordance with our study. Similarly Sodium bicarbonate has been used worldwide to reduce both onsets of action as well as pain on the injection. Vinay Mohan Kashyap et al[9], did randomized prospective trial of 100 patients aged 18–55 years who were given 3

nerve blocks (inferior alveolar, lingual, and long buccal) was designed to assess the effect of alkalinisation of the lignocaine solution with sodium bicarbonate. All patients were given 2% lignocaine hydrochloride with adrenaline 1:80,000 and 50 patients were randomly allocated for given 8.4% sodium bicarbonate in a 1/10 dilution. Pain was measured on a visual analogue scale (VAS). Results have confirmed the efficacy of the alkalinized local anaesthetic solution in reducing pain on injection and resulting in quicker onset of anaesthesia.

Curatolo, Michele MD et al[10], did a study on Twenty-four patients undergoing epidural blockade with 20 mL lidocaine 2% at L2-3 were randomly divided into three groups: lidocaine hydrochloride, lidocaine CO_2, and lidocaine plus 2 mL sodium bicarbonate 8.4%. Pain threshold after repeated electrical stimulation (five impulses at 2 Hz), pinprick, and cold test were performed at S1 and L4. Motor block was assessed. The addition of bicarbonate resulted in higher pain thresholds ($P < 0.0001$), faster onset of action ($P = 0.009$), and higher degree of motor block ($P = 0.004$) compared with lidocaine hydrochloride. They found no significant differences between lidocaine CO_2 and hydrochloride and concluded that the addition of sodium bicarbonate to lidocaine enhances the depth of epidural blockade, increases inhibition of temporal summation, and hastens the onset of block and enhances analgesia.

Dhananjay Ambike, Narendra P L et al[12]; hasconducted this study to evaluate the effects of addition of potassium chloride and sodium bicarbonate to lignocaine 1.5% on its onset and duration of action. In this study, the p H of lignocaine 1.5% with adrenaline was adjusted from 5.91 to 6.72 by the addition of 2 ml of sodium bicarbonate. Group B receiving alkalinized solution had a mean onset time of 4.10±0.9 mins as compared to control Group A which had a mean onset time of 9.10±1.5 mins. This difference is statistically significant $p<0.01$. SimilarlyThe duration of analgesia (sensory block) in the group receiving alkalised lignocaine Group B was 110±5.0 mins and motor block of 102±4.2 mins as compared to the group lignocaine with adrenaline Group A 88±8.2 minsand 81±7.5mins respectively. This difference is statistically significant $p<0.01$. Thus alkalization prolongs the duration of action of lignocaine. Which is accordance with our study.

CONCLUSION

The present study concludes that addition of Sodium bicarbonate to Bupivacaine had significant clinical advantage over plain Bupivacaine on onset time, duration and quality of sensory and motor blockade in brachial plexus block.

LIMITATIONS OF STUDY

1. We did not compare the drugs with the placebo group.
2. We did not study the side effects of the study drugs.
3. We could have studied the post - operative analgesic requirement in the two groups.

REFERENCES

1. WHO. Non communicable diseases. [Internet] 2019 [cited 2019 March 11]; Factsheet]. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
2. WHO. Noncommunicable diseases in the South-East Asia Region, situation and response, 2011: [cited 2019 April 12]; available from http://www.searo.who.int/nepal/mediacentre/ 2011_non_communicable_diseases_in_the_south_east_asia_region.pdf
3. Jha V, Wang AY-M, Wang H. The impact of CKD identification in large countries: the burden of illness. Nephrology Dialysis Transplantation. 2012;27(suppl 3):iii32-8. DOI: 10.1093/ndt/gfs113.
4. Nakamura K, Okamura T, Hayakawa T, Kadowaki T, Kita Y, Ohnishi H, et al. Chronic kidney disease is a risk factor for cardiovascular death in a community-based population in Japan. Circulation Journal. 2006;70(8):954-9. DOI: 10.1253/circj.70.954.
5. Ninomiya T, Kiyohara Y, Kubo M, Tanizaki Y, Doi Y, Okubo K, et al. Chronic kidney disease and cardiovascular disease in a general Japanese population: the Hisayama Study. Kidney international. 2005;68(1):228-36. DOI: 10.1111/j.1523-1755.2005.00397.x
6. Zhang QL, Rothenbacher D. Prevalence of chronic kidney disease in population-based studies: systematic review. BMC public health. 2008 Apr 11;8:117.DOI: https://doi.org/10.1186/1471-2458-8-117
7. Sharma SK, Dhakal S, Thapa L, Ghimire A, Tamrakar R, Chaudhary S, et al. Community-based screening for chronic kidney disease, hypertension and diabetes in Dharan. Journal of Nepal Medical Association. 2013;52(189):205-12. PMID: 23591297
8. J. H. M. Tordoir, P. Rooyens, R. Dammers, F. M. van der Sande, M. de Haan, and T. I. Yo, "Prospective evaluation of failure modes in auto genousradiocephalic wrist access for haemodialysis," Nephrology Dialysis Transplantation, vol. 18, no. 2, pp. 378–383, 2003. DOI: https:// doi.org/10.1093/ndt/18.2.378
9. P. Roy-Chaudhury, L. M. Spergel, A. Besarab, A. Asif, and P. Ravani, "Biology of arteriovenous fistula failure," Journal of Nephrology, vol. 20, no. 2, pp. 150–163, 2007. PMID: 17514619
10. M. K. Lazarides, G. S. Georgiadis, G. A. Antoniou, and D. N. Staramos, "A meta-analysis of dialysis access outcome in elderly patients," Journal of Vascular Surgery, vol. 45, no. 2, pp. 420–426, 2007. DOI: 10.1016/j.jvs.2006.10.035
11. Gupta A, Kumar V, Peswani A R, et al. (January 04, 2022) Outcomes of Arteriovenous Fistula Creation in Patients Undergoing Hemodialysis: An Indian Experience. Cureus 14(1): e20921. DOI:10.7759/cureus.20921
12. Allon M, Litovsky S, Young CJ, et al.: Medial fibrosis, vascular calcification, intimal hyperplasia, and arteriovenous fistula maturation. Am J Kidney Dis. 2011, 58:437-43. DOI: 10.1053/j.ajkd.2011.04.018
13. Venkat Ramanan, S., Prabhu, R.A., Rao, I.R. et al. Outcomes and predictors of failure of arteriovenous fistulae for hemodialysis. IntUrolNephrol 54, 185–192 (2022). https://doi.org/ 10.1007/s11255-021-02908-5
14. Allon M: Current management of vascular access. Clin J Am Soc Nephrol. 2007, 2:786-800. DOI:10.2215/CJN.00860207
15. Oprea A, Molnar A, Vlăduţiu D, Scridon T, Trifan C, Săcui D, Săsărman V, Mircea PA. Correlation between preoperative vein and artery diameters and arteriovenous fistula outcome in patients with end-stage renal disease. Clujul Med. 2018 Oct;91(4):399-407. DOI: 10.15386/cjmed-1080.
16. Sidawy AN, Spergel LM, Besarab A, Allon M, Jennings WC, Padberg FT, Jr, et al. The Society for Vascular Surgery: clinical practice guidelines for the surgical placement and maintenance of arteriovenous hemodialysis access. J Vasc Surg. 2008;48(5 Suppl):2S–25S. DOI: 10.1016/j.jvs.2008.08.042
17. Kucey AS, Engineer A, Albers SS. Outcomes of Patients Referred for Arteriovenous Fistula Construction: A Systematic Review. Int J Med Students. 2019 Sep-Dec;7(3):73-81.DOI 10.519
18. Salahi H, Fazelzadeh A, Mehdizadeh A, Razmkon A, Malek-Hosseini SA. Complications of arteriovenous fistula in dialysis patients. Transplant Proc. 2006;38:1261–1264. DOI: 10.1016/j.transproceed.2006.02.066