Original Article

DOI: 10.17354/ijss/2016/187

Evaluation of the Post-operative Analgesia in Supraclavicular Brachial Plexus Block with 0.375% Plain Bupivacaine + 0.2 mmol Potassium Chloride (0.1 ml) as an Adjuvant

Neeraj Solanki[1], Juhi Saran[2], Mahesh Kashyap[3], H S Nanda[4]

[1]Post Graduate Trainee, Department of Anaesthesiology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India, [2]Professor, Department of Anaesthesiology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India, [3]Assistant Professor, Department of Anaesthesiology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India, [4]Professor and Head, Department of Anaesthesiology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India

Abstract

Introduction: The techniques of peripheral neural blockade were developed early in the history of anesthesia. It is approximately 130 years that brachial plexus block was first attempted that is, in 1884, Halstead injected the roots of the brachial plexus under vision, less than a year after Koller demonstrated the anesthetic properties of cocaine.

Materials and Methods: Patients were assigned into two groups. Group I (*n* = 50) received 30 ml 0.375% bupivacaine + 0.2 mmol potassium chloride (0.1 ml) and Group II (*n* = 50) received 30 ml 0.375% bupivacaine + 0.1 ml normal saline.

Results: This observation shows that the duration of the requirement of post-operative analgesia is significantly increased by the addition of 0.2 mmol of potassium chloride to 0.375% bupivacaine hydrochloride.

Conclusion: We conclude that potassium chloride when added to 0.375% bupivacaine for supraclavicular brachial plexus block increased the duration of post-operative analgesia.

Key words: Bupivacaine, Potassium chloride, Supraclavicular

INTRODUCTION

The international association for the study of pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage."[1,2]

It is always a subjective experience. Pain has been a major concern of humankind, and it has been the object of ubiquitous efforts to understand and to control it. Peripheral nerve block provides longer and more localized pain relief than neuraxial technique while also avoiding the side effects of systemic medications. Regional anesthesia of the extremities and the abdomen is a useful alternative to general anesthesia in many situations.[3]

Since the discovery of local anesthetic drugs, the anesthesiologists have become increasingly involved in the provision of post-operative analgesia; the need of pain relief during surgery without loss of consciousness which is appreciated more, both by anesthesiologists and surgeons.[4,5]

In the past two decades, two factors have brought about a reappraisal of regional techniques. First, a local block in combination with controllable sedation so that the patient stay awake during surgery, and second, realization has grown that excellent post-operative pain relief can be provided easily and in no time to the patient with an appropriate regional blockade.[6]

Access this article online

www.ijss-sn.com

Month of Submission : 02-2016
Month of Peer Review : 03-2016
Month of Acceptance : 03-2016
Month of Publishing : 04-2016

Corresponding Author: Dr. Neeraj Solanki, Department of Anaesthesiology, Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, Uttar Pradesh, India. Phone: +91-9458705963. E-mail: neerajsolanki6@gmail.com

The techniques of peripheral neural blockade were developed early in the history of anesthesia. It is approximately 130 years that brachial plexus block was first attempted that is, in 1884, Halstead injected the roots of the brachial plexus under vision, less than a year after Koller demonstrated the anesthetic properties of cocaine. 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.[7-9]

D. Kulenkampff introduced the technique of supraclavicular brachial plexus block a few months after Hirschel described the axillary approach.[10] Early reports indicated a frequent incidence of success with this block, but other practitioners soon reported complications such as pneumothorax and mediastinal emphysema. Several modifications of the supraclavicular block have emerged in an effort to avoid pneumothorax.[6]

Regional techniques have become the preferred choice of anesthesiologists whenever possible, reasons being:[7]

- Less interference with general body physiology. Stress-induced changes in body metabolism and hormonal milieu is minimal
- Relatively simple to administer and preserves consciousness and protective reflexes
- Reduced post-operative nursing care
- Mental function is preserved in an elderly patient
- Lesser quantity of drugs used as compared to general anesthesia, so fewer drug interactions and side effects
- Prolonged post-operative analgesia
- No risk of operation theater pollution as noted with inhalational agents.

Now a days, the neural blockade has become widely accepted and reliable technique to achieve analgesia and anesthesia in the area supplied by brachial plexus. Different local anesthetics are used for this purpose. Most widely used and easily available among which is bupivacaine. Due to its wide use and easy availability, this drug naturally lends itself as the first choice for study.[11]

Numerous routes to perform brachial plexus block have been described. They are:

- Supraclavicular
- Interscalene
- Infraclavicular
- Axillary.

The supraclavicular route was used in this study.[12-14]

The technique, however, is not without complications.

The limitations of local anesthetics are:

- Slower onset of action
- Shorter duration of action
- Reduced motor and sensory blockade.

Therefore, different adjuncts have been tried to fill the lacunae created by the local anesthetics. Various workers have investigated adjuvants including opioids, clonidine, neostigmine, hyaluronidase, dexamethasone, and bicarbonate.[15-19]

Alpha 2-adrenoreceptor agonists have been used a number of times for their sedative, analgesic, perioperative sympatholytic, and cardiovascular stabilizing effects.[20]

Subsequently, Aldrete *et al.,* in 1969, and Parris and Chambers, in 1986, also found some encouraging results using potassium with local anesthetics such as lignocaine and bupivacaine.[21]

Thus, we thought it worthwhile to try 0.2 mmol potassium chloride (0.1 ml) as an adjuvant with 0.375% bupivacaine (Group I) and its comparison with 0.375% bupivacaine (Group II) in supraclavicular brachial plexus block.

MATERIALS AND METHODS

- The study was conducted after obtaining approval from ethical, academic committee and a written informed consent from the patient.

The study will be conducted in two groups comprising of 50 patients in each group.

- Group I: 0.375% plain bupivacaine (30 ml) + 0.2 mmol potassium chloride (0.1 ml)
- Group II: 0.375% plain bupivacaine (30 ml) + 0.9% normal saline (0.1 ml).

The following group of patient will be excluded from the study:

- Patient not willing to get enrolled, in the study
- Age below 18 years or above 60 years
- Infection at block site
- Patient with clavicle fracture, bleeding disorder
- Patient with torticollis, pre-existing peripheral neuropathy
- Patient with systemic diseases such as diabetes mellitus and hypertension
- Patient with hyperkalemia
- Surgery duration >4-5 h.

Pre-operative Preparation

All the patients were visited and evaluated thoroughly on the day before the surgery. During the pre-anesthetic

evaluation, a thorough examination of all the systems was done; including the surface anatomy where the block was given. A meticulous airway assessment was carried out. The anesthetic procedure to be undertaken including the development of paresthesia was explained to the patients, and an attempt was made to alleviate the anxiety of patient. A written informed consent was taken. Pre-anesthetic preparation of a patient included a period of overnight fasting. Sedative and hypnotic were avoided as premedication, as well as in the intraoperative period routine investigations such as complete blood count, urine examination (routine and microscopy), bleeding time and clotting time, blood sugar level, blood urea level, serum creatinine, Chest X-ray, ECG, HIV, and HbsAg were done.

Brachial plexus block was given by supraclavicular approach. Neural localization was achieved by a nerve stimulator (Fisher and Paykel, New Zealand), connected to 22 G, 50 mm long stimulating needle. After negative aspiration, 30 cc of solution with and without adjuvants was given. A 3 min massage was given for even distribution of drug over brachial plexus.

Assessment

Sensory block

Sensory block was assessed by pinprick method in all dermatomal areas corresponding to radial, ulnar, median, and musculocutaneous nerves, every minute till complete sensory block.

Grading
1. Grade 0: Sharp pin felt
2. Grade 1: Analgesia, dull sensation felt
3. Grade 2: Anesthesia, no sensation felt.

Motor block

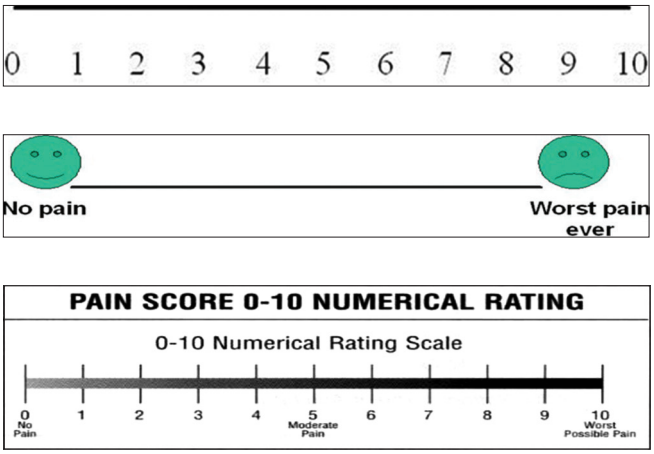
Motor block will be assessed on modified Bromage scale for upper extremity on a three-point scale.

Grading
1. Grade 0: Normal motor function with full extension of elbow, wrist, and fingers
2. Grade 1: Decreased motor strength with ability to move the fingers only
3. Grade 2: Complete motor block with inability to move fingers.

Operative quality

Operative quality will be assessed on the following numeric scale.
- Grade 4 (excellent): No complaint from patient.
- Grade 3 (good): Minor complaint with no need for supplemental analgesia.
- Grade 2 (moderate): Complaint that required supplemental analgesia.
- Grade 1 (unsuccessful): Patient given general anesthesia.
- Post-operative analgesia will assessed on VAS (visual analog score) from 0 to 10.
- Patient will not be shown the numbered scale.

OBSERVATION AND RESULTS



Numerical rating scale

RESULT

- In the present study, 100 ASA I and II patients of both sexes and different age group between 18 and 60 years were studied. All of them underwent upper extremity surgeries. The study included only those patients who had successful surgical anesthesia from the supraclavicular brachial plexus block alone. Patients who required general or local anesthesia supplementation or IV opioids or analgesics were excluded from the study.
- The study will be conducted in two groups comprising of 50 patients in each group.
- Group I (n = 50) received 30 ml 0.375% bupivacaine + 0.2 mmol potassium chloride (0.1 ml).
- Group II (n = 50) received 30 ml 0.375% bupivacaine + 0.1 ml normal saline.
- The mean age of Group I was 35.88 and in Group II was 39.52, respectively. Statistical analysis when compared between two groups for age was found to be insignificant ($P > 0.5$) (Table 1 and Graph 1).
- The mean height of Group I was 165.64 cm and in Group II was 165.84 cm, respectively. Statistical analysis when compared between two groups for height was found to be insignificant ($P > 0.5$) (Table 1 and Graph 1).
- The mean weight of Group I was 66.60 and in Group II was 67.64, respectively. Statistical analysis when

compared between two groups for weight was found to be insignificant ($P > 0.5$) (Table 1 and Graph 1).

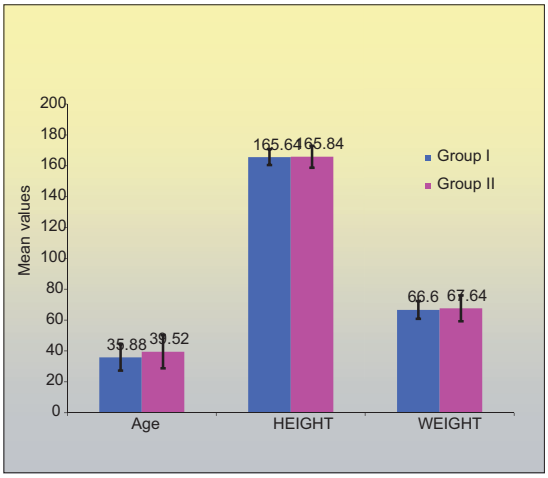
- There were 9 female patients in Group I as compared to 11 female patients in Group II, and there were 41 male patients in Group I as compared to 39 female patients in Group II. Statistical analysis when compared between two groups for sex was found to be insignificant ($P > 0.05$).
- The mean heart rate of Group I was 78.32 and in Group II was 78.36, respectively. Statistical analysis when compared between two groups for age was found to be insignificant ($P > 0.5$).
- The mean systolic blood pressure of Group I was 126.70 and in Group II was 128.72, respectively. Statistical analysis when compared between two groups for systolic blood pressure was found to be insignificant ($P > 0.5$).
- The mean diastolic blood pressure of Group I was 72 and in Group II was 75.32, respectively. Statistical analysis when compared between two groups for diastolic blood pressure was found to be insignificant ($P > 0.5$).
- The time of requirement of post-operative analgesia in Group I was 512.04 ± 28.80 as compared to in Group II was 240.90 ± 19.42 (Table 2 and Graph 2).
- Statistical analysis when compared between two groups for the post of analgesia was found to be significant ($P < 0.001$).

Table 1: Age, height, and weight distribution in two groups

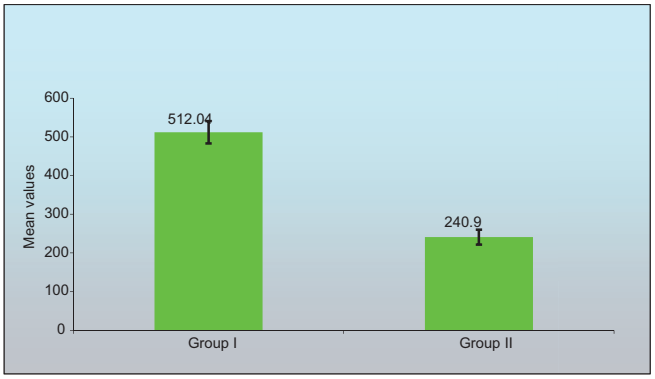
Variables	Mean±SD		*P* value
	Group I (*n*=50)	Group II (*n*=50)	
Age (years)	35.88±8.63	39.52±10.73	0.065
Height (cm)	165.64±5.20	165.84±7.10	0.873
Weight (kg)	66.60±5.79	67.64±8.39	0.473

Table 2: Requirement of post-operative analgesia

Variables	Mean±SD		*P* value
	Group I (*n*=50)	Group II (*n*=50)	
Post-operative analgesia (min)	512.04±28.80	240.90±19.42	<0.001



Graph 1: Comparison of Demographic profile of patients between Group I and Group II



Graph 2: Comparison of post-operative analgesia between Group I and Group II

DISCUSSION

The present study entitled to evaluate the post-operative analgesia in supraclavicular brachial plexus block with 0.375% plain bupivacaine + 0.2 mmol potassium chloride (0.1 ml) as an adjuvant' was undertaken on 100 patients of upper limb surgery to clinically assess the effects of adding small amounts (0.2 mmol) of potassium chloride to 0.375% bupivacaine hydrochloride on the onset, duration, and quality of supraclavicular brachial plexus block. Supraclavicular brachial plexus block was chosen because of its relative easiness and low incidence of serious complications.

Brachial plexus blockade provides ideal operating conditions for the surgeon with good analgesia and complete muscular relaxation and sympathetic block which reduces post-operative vasospasm, pain, and edema. Although bupivacaine has prolonged the duration of action its long latency makes it unsuitable for routine use in a busy clinical environment for giving brachial plexus block.

Potassium salts, as an adjuvant to local anesthetic, have been used with varying success for many years.[22,23] Since then, many authors have studied their effects on the local anesthetic and reported some encouraging results. In their study on the extradural blockade, Bramage and Michael[24] observed a shortened latency of spread, more intense quality of sensory block and increased the duration of block when 1% potassium chloride was added to 2% lignocaine. Parris and Chambers[25] and Khosa *et al.*[26] in

their study on axillary and supraclavicular brachial plexus block, respectively, and also reported better results by the addition of potassium chloride to bupivacaine solutions.

Distribution of Patient According to Age, Sex, and Weight

In the present study, age, sex, and weight of the patients were comparable in both the groups. Statistical analysis of age, sex, and weight when compared between two groups was not significant ($P > 0.05$).

Volume, Strength, and Dose of Bupivacaine Used

Mean volume of bupivacaine hydrochloride injected was 30.1 ml in Group II as compared to 30.1 ml in Group II for supraclavicular brachial plexus block. In Group I, 0.2 mmol of potassium chloride (0.1 ml) was added to bupivacaine hydrochloride before making the block. In the present study, bupivacaine hydrochloride was used in the strength of 0.375% in both the groups.

Parris and Chambers[25] used 40 ml of 0.25% bupivacaine solution irrespective of the weight of the patients with or without the addition of potassium chloride 0.2 mmol in their study on axillary brachial plexus block, whereas 30 ml of 0.37% bupivacaine irrespective of the weight of the patients with or without the addition of potassium chloride 0.2 mmol was used by Khosa *et al.*[26] in supraclavicular brachial plexus block.

Duration of Post-operative Analgesia

In the present study, mean duration for post-operative analgesia was 512.04 ± 28.80 min in Group I as compared to 240.90 ± 19.42 min in Group II. On comparing the results between two groups, they found to be significant statistically ($P < 0$).

This observation shows that the duration for post-operative analgesia is significantly increased by the addition of 0.2 mmol of potassium chloride to 0.375% bupivacaine hydrochloride.

Our results are comparable with those of Swetha,[27] who also reported an increase in duration of post-operative analgesia when 0.2 mmol potassium chloride was added to 0.375% bupivacaine for supraclavicular brachial plexus block.

Agarwal *et al.*[28] had reported the duration of post-operative analgesia to be 241 ± 51.2 min with 0.325% bupivacaine.

Above observation suggests that the addition of potassium chloride to bupivacaine prolongs the post-operative analgesia requirement. Aldrete *et al.*[21] attributed this delay in terms of the difference of potassium concentration, thus slowing the recovery of the resting potential. The local anesthetic deposited prevents its depolarization rendering it impermeable to Na ions, but K ions are allowed to migrate, due to different gradient existing on both sides of the membrane. Exogenous potassium outside the nerve will prevent such movement which causes delay in the repolarization, and thus the duration of anesthesia is prolonged.

Cardiorespiratory Changes

In the present study, cardiorespiratory changes were found to be minimal in most of the cases of both the groups. On statistical analysis, cardiorespiratory changes were found to be insignificant when compared between two groups.

No irregularities in pulse or blood pressure were recorded in any of the groups.

These observations suggest that the addition of small amounts of (0.2 mmol) of potassium chloride to 0.375% bupivacaine did not produce any significant cardiorespiratory changes. Other workers did not report any cardiorespiratory changes on brachial plexus block with the use of bupivacaine either alone or with potassium chloride.

Complications

No complications were reported in both the groups. Addition of potassium chloride to bupivacaine also did not produce any complications.

Bramage and Michael reported a case of convulsions following inadvertent perforation of spinal dura while performing extradural blockade and thereby injecting large concentrations of potassium into the subarachnoid space.

In our study, we have given the fixed dose of the study drugs irrespective of the patient's age, weight, or body surface area.

CONCLUSION

- Supraclavicular brachial plexus block is a useful method of providing anesthesia for surgery of upper limb.
- The method of blocking the brachial plexus by injecting at the highest point and applying digital pressure for 10 min immediately after giving the block, results in high success rate and low incidence of inadequate block.
- Bupivacaine hydrochloride provides long duration of action, but the latency of blockade is also prolonged.
- The duration of post-operative analgesia requirement of bupivacaine hydrochloride is significantly prolonged by the addition of 0.2 mmol of potassium chloride.
- Addition of 0.2 mmol of potassium chloride to 0.375%

bupivacaine hydrochloride does not have any effect on the quality of block.

- Cardiorespiratory changes are almost negligible with the use to 0.2 mmol of potassium chloride with bupivacaine hydrochloride.

REFERENCES

1. Abram SE. Chronic pain management. In: Barash PG, Cullen BF, Stoelting RK, editors. Clinical Anaesthesia. 5th ed. Philadelphia, PA: Lippincott Williams and Wilkins; 2006. p. 1449.
2. Mersky H, Albe-Fessard DG, Bonica JJ. Pain terms: A list with definitions and notes on usage. Pain 1979;6:249-52.
3. Michael FM. Peripheral nerve blockade. In: Barash PG, Cullen BF, Stoelting RK, editors. Clinical Anaesthesia. 5th ed. Philadelphia, PA: Lippincott William and Wilkins; 2006. p. 718.
4. Burnham PJ. Simple regional nerve block for surgery of the hand and forearm. J Am Med Assoc 1959;169:941-3.
5. Raj PP. The problem of postoperative pain. In: Ferrente FM, editor. Postoperative Pain Management. 1st ed. New York: Churchill Livingstone; 1993. p. 1-4.
6. Miller RD. Miller's Anaesthesia. 7th ed. Philadelphia, PA: Churchill-Livingstone Elsevier; 2010. p. 1-19.
7. Bazy L, Bluodin S. Local anaesthesia for brachial plexus. Anaesth Analg 1935;190.
8. Raj PP, Montgomery SJ, Nettles D, Jenkins MT. Infraclavicular brachial plexus block – a new approach. Anesth Analg 1973;52:897-904.
9. Thompson AM, Newman RJ, Semple JC. Brachial plexus anaesthesia for upper limb surgery: A review of eight years' experience 1988;13:195-8.
10. Kulenkampff D. Anesthesia of the brachial plexus. Zentralbl Chir 1911;38:1337-40.
11. Lund PC, Cwik JC. Bupivacaine – A new long acting local anaesthetic agent: A preliminary clinical and laboratory report. Anaesth Analog 1970;49:103-13.
12. Braud L, Papper EM. A comparison of supraclavicular and axillary technique of brachial plexus block. Anaesthesiology 1961;22:226.
13. Mackintosh RR, Mushin NN. Local Anaesthesia: Brachial Plexus. Edinburgh: Blackwell; 1944.
14. Winnie AP. Interscalene brachial plexus block. Anesth Analg 1970;49:455-66.
15. Jarbo K, Batra YK, Panda NB. Brachial plexus block with midazolam and bupivacaine improves analgesia. Can J Anaesth 2005;52:822-6.
16. Bazin JE, Massoni C, Bruelle P, Fenies V, Groslier D, Schoeffler P. The addition of opioids to local anaesthetics in brachial plexus block: The comparative effects of morphine, buprenorphine and sufentanil. Anaesthesia 1997;52:858-62.
17. Culebras X, Van Gessel E, Hoffmeyer P, Gamulin Z. Clonidine combined with a long acting local anesthetic does not prolong postoperative analgesia after brachial plexus block but does induce hemodynamic changes. Anesth Analg 2001;92:199-204.
18. Bone HG, Van Aken H, Booke M, Bürkle H. Enhancement of axillary brachial plexus block anesthesia by coadministration of neostigmine. Reg Anesth Pain Med 1999;24:405-10.
19. Keeler JF, Simpson KH, Ellis FR, Kay SP. Effect of addition of hyaluronidase to bupivacaine during axillary brachial plexus block. Br J Anaesth 1992;68:68-71.
20. Esmaoglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Anesth Analg 2010;111;1548-51.
21. Aldrete JA, Barnes DR, Sidon MA, McMullen RB. Studies on effects of addition of potassium chloride to lidocaine. Anesth Analg 1969;48:269-76.
22. Hoffmann A, Kochmann M. Verminderung der novokainkonzentration durch kaliumsulfat bie der lokalanasthesie. Dtsch Med Wschr 1912;38:2264.
23. Meeker WR. The potentiaton of navocaine solutions. J Lab Clin Med 1925;11:139.
24. Bramage PR, Michael FB. Quality of epidural blockade II: Influence of physic-chemical factors; hyaluronidase and potassium. Br J Anaesth 1966;38:857-65.
25. Parris MR, Chambers WA. Effects of the addition of potassium to prilocaine or bupivacaine. Studies on brachial plexus blockade. Br J Anaesth 1986;58:297-300.
26. Khosa DS, Thind SS, Gupta HK, Jain S. Effects of adding potassium chloride to lignocaine and bupivacane solutions on the onset time and duration of brachial plexus block. Indian J Anaesth 1990;38:119-22.
27. Swetha HR. Comparative study on the effect of adition of potassium chloride to bupivacaine on the on the onset time and duration of brachial plexus block. J Evidence Based Med Healthc 2014;1:1989-2001.
28. Agarwal S, Ritu A, Gupta P. Dexmedetomidine prolongs the effect of bupivacaine in supraclavicular brachial plexus block. J Anaesthesiol Clin Pharmacol 2014;30:36-40.

How to cite this article: Solanki N, Saran J, Kashyap M, Nanda HS. Evaluation of the Post-operative Analgesia in Supraclavicular Brachial Plexus Block with 0.375% Plain Bupivacaine + 0.2 mmol Potassium Chloride (0.1 ml) as an Adjuvant. Int J Sci Stud 2016;4(1):55-60.

Source of Support: Nil, **Conflict of Interest:** None declared.