Original Article

Indian Journal of Anaesthesia and Analgesia
Volume 4 Number 2, April - June 2017 (Part–1)
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.4217.20

Comparison of Butorphanol and Buprenorphine as an Adjunct to Local Anaesthetic Solution in Brachial Plexus Block

Hareesh S.B.*, Sangeetha D.*

Abstract

Introduction: The supraclavicular brachial plexus is one among the most popular regional nerve blocks performed. The easy and predictable landmarks make it a popular approach. The advantages are –It provides long lasting post operative analgesia, there by reducing the systemic analgesic requirement; it aids in early ambulation, overcoming the disadvantages of general anaesthesia. *Methodology:* 60 patients undergoing upper limb surgery lasting more than thirty minute were included in the study. The elective surgical interventions were internal fixation of bones with plates and screws, excision of bone cysts, reconstructive and other surgeries involving upper limb *Results:* Onset of sensory blockade (time between injection and total abolition of pinprick response) was 20.47+/-3.64 min in group A and 19.49+/-4.90 min in group B. However there was no significant change in time of onset (p=0.373). Duration of sensory blockade (the time between injection and complete recovery from sensory disturbance) was comparable in both groups (group A 385.67+/-66.67 min, group B 380.50+/-80.15 min) without any statistical significance (p=0.787). *Conclusion:* There was no statistical significance in terms of onset, durations of surgery, sensory blockade and motor blockade between the two groups However the average duration of analgesia were 14.13+/-8.41 hrs and 22.18.+/-12.13 hrs in groups A and B respectively, showed statistical significance.

Keywords: Butorphanol; Buprenorphine; Brachial Plexus Block.

Introduction

The alleviation of pain is the main concern of anaesthesiologist and has received tremendous focus in this evolving field of medicine. Many methods, many drugs and many routes have been tried for this purpose. Fundamental to modern neural blockade is the concept that pain is a sensory warning conveyed by specific nerve fiber, amenable in principle, to modulation or interruption anywhere in the nerve's pathway [1,2].

Pain relief after upper limb surgery can be achieved by various regional anaesthetic techniques. The supraclavicular brachial plexus is one among the most popular regional nerve blocks performed. The easy and predictable landmarks make it a popular approach [3]. The advantages are – It provides long lasting post operative analgesia, there by reducing the systemic analgesic requirement; it aids in early ambulation, overcoming the disadvantages of general anaesthesia.

The limitations of local anaesthetics are-slower onset of action, shorter duration of action, and prolonged motor and sensory blockade. Different adjuncts have been tried to fill the lacunae created by the local anaesthetics. The novel approaches are, alkalinization of local anaesthetics, carbonation, addition of opiates, calcium channel blockers (verapamil), clonidine. The existence of opioid receptors in peripheral nerve tissue has led to investigation of incorporating small doses of opioids in peripheral nerve blocks, hoping to achieve analgesia with minimal central side effects. Hence pain relief using opioids admixed with local anaesthetics for peripheral nerve block has been tried [4].

Author's Affiliation:
*Assistant Professor, Department of Anaesthesiology, Institute of Nephrourology, Victoria hospital campus, Bangalore-560002, Karnataka, India.

Corresponding Author:
Hareesh S.B., Assistant Professor, Department of Anaesthesiology, Institute of Nephrourology, Victoria Hospital Campus, Bangalore-560002, Karnataka, India.
E-mail: hareeshsb95@gmail.com

Received on 08.02.2017
Accepted on 13.02.2017

Buprenorphine, a semi synthetic thebaine congener is thirty to thirty five times more potent than morphine. It has a longer duration of action due to high affinity to mu receptor. Butorphanol, a synthetic opioid analgesic is five to eight times more potent than morphine. It has comparatively lesser incidence of systemic side effects. Therefore a comparative study with Butorphanol and Buprenorphine as adjuncts to local anaesthetics in brachial plexus block through supraclavicular approach for upper limb surgery is desired to improve the onset, quality and duration of analgesia [5].

The objective of the study is to compare the duration of sensory and motor blockade along with the duration of analgesia between Butorphanol and Buprenorphine

Methodology

60 patients undergoing upper limb surgery lasting more than thirty minute were included in the study. The elective surgical interventions were internal fixation of bones with plates and screws, excision of bone cysts, reconstructive and other surgeries involving upper limb.

Inclusion Criteria

Patients with ASA1 and II physical status, within the age group of 18 to 60 years, of both sexes undergoing elective surgeries were included in the study.

Exclusion Criteria

Patients with age less than 16 and greater than 60 year, patients with coagulopathy or on anti coagulants; patients with peripheral neuropathy; patients who had received opioid in the past twelve hours; patients with history of substance abuse, local cutaneous infections; pregnant patients; patients with allergy to local anaesthetics, butorphanol and buprenorphine; ASA class III and IV patients; patients undergoing emergency surgical procedures were excluded from the study.

Preoperative Preparation

The study protocol was approved by the hospital ethical committee. All the patients underwent thorough preanaesthetic evaluation on the day prior to surgery. All systems were 39 examined including airway and the surface anatomy where the block was going to be given. The anaesthetic procedure to be carried out was explained. They were informed about development of paresthesia. Patients were reassured to alleviate their anxieties. A written informed consent was taken. They were educated regarding the visual analogue scale. All the patients were fasted overnight. All of them received oral diazepam 10 mg and tablet ranitidine 150mg night before the surgery.

Basic laboratory investigations were conducted including haemogram, urine analysis and whenever needed chest X-ray, electrocardiogram, blood sugar.

Method of Collection of Data

Supraclavicular brachial plexus block was carried out as an elective procedure on the patients undergoing upper limb surgery. Sixty patients were randomly allocated into two groups (group A, n=30 and group B, n=30) in double blind fashion. All drugs solutions were prepared by an anaesthesiologist not involved in administration of anaesthesia, patient care and data collection.

Group A (n=30): Received brachial plexus block with 1% lignocaine plain at the dose of 2mg/kg body weight and 0.5% bupivacaine 2mg/kg along with inj butorphanol 0.03mg/kg to the solution. 40

Group B (n=30): Received brachial plexus block with1% lignocaine plain at the dose of 2mg/kg body weight and 0.5% bupivacaine 2mg/kg along with buprenorphine 3 mcg/kg into the solution.

Results

A prospective, randomized, comparative study consisting of 30 patients in Group A (Butorphanol) and 30 patients in Group B (Buprenorphine) is undertaken to study the change pattern of hemodynamics, pain score by VAS, duration of analgesia, duration of sensory, duration of motor blockade and side effects.

The Table 1 shows that the average age was 33.37+/-10.97 yrs in-group A and 35.07+/-10.98 yrs in-group B. The average weights of the patients were 60.40+/-8.62 kgs in-group A and 63.33+/-9.48 in-group B respectively. Both groups had predominantly male patients, accounting for nearly 2/3 of the total study population in each group. There was no significant difference in age, weight and sex distribution.

Table 1: Comparison of demographic parameters

Demographic parameters	Group A (n=30) Mean ± SD	Group B (n=30) Mean ± SD	P value
Age in years	33.47±10.97	35.07±10.98	0.575
Weight in kg	60.40±8.62	63.33±9.48	0.215
Sex	Male=20 (66.7%) Female=10(33.3%)	Male=21(70.0%) Female=9 (30.0%)	0.781
Inference	Samples are age, sex and Weight matched with P>0.05		

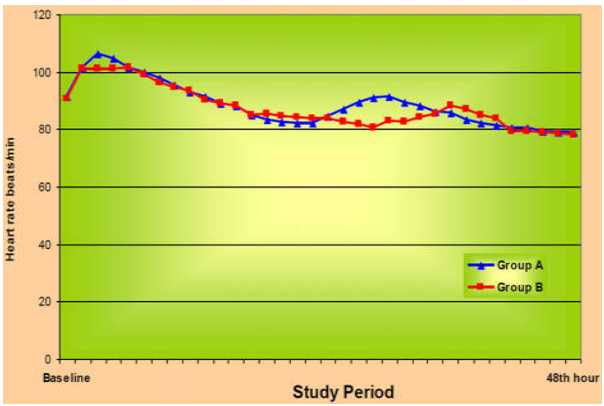

Fig. 1: Comparison of Heart rate

This chart comparing the heart rate pattern of both groups show statistical significance at 10th to 13th hour of the study period although they are within an acceptable clinical range.

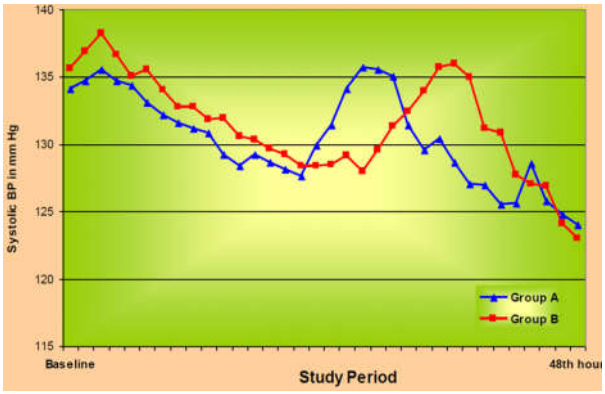

Fig. 2: Comparison of SBP

In this chart the compared systolic blood pressure changes between two groups show statistical significance between 9th to 11th and 14th, 15th, 16th, 18th, 20th and 24th hours.

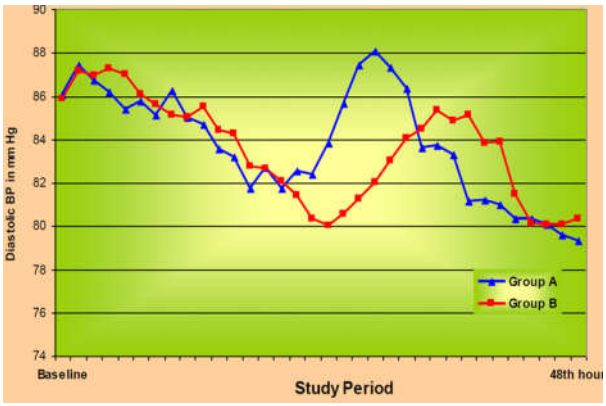

Fig. 3: Comparison of DBP

The compared diastolic blood pressure between two groups show statistical significance between 8th to 12th hrs and 18th, 20th and 24th hrs.

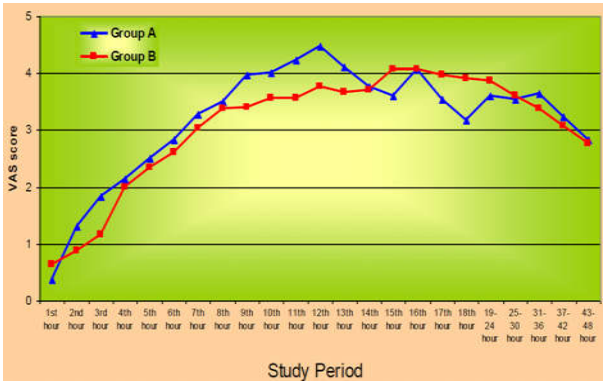

Fig. 4: Comparison of VAS

The patients were assessed for postoperative pain using visual analogue scale score. The above graph compares the VAS scores between the two groups with statistical significance at 3rd, 9th, 11th to 13th, 17th and 18th hrs of the study period.

Table 2: Comparison of Study parameters between two groups

Study parameters	Group A (n=30) M	Group A (n=30) SD	Group B (n=30) M	Group B (n=30) SD	P value
Time of onset (Minutes)	20.47	3.64	19.47	4.90	0.373
Duration of Surgery (minutes)	79.50	26.27	84.33	37.27	0.564
Duration of Sensory blockade (minutes)	385.6	66.67	380.5	80.15	0.787
Duration of motor blockade (minutes)	367.4	71.43	360.0	77.87	0.705
Duration of analgesia (hours)	14.13	8.41	22.18	12.13	0.004

The average time of onset was 20.47+/-3.64 min in-group A and 19.49+/-4.90 min in-group B. The average duration of surgeries were 79.50+/-26.27min and 84.33+/-37.27 min in groups A and B respectively. The observed average duration of sensory blockade was 385.67+/-66.67 min in group A and 380.50+/-80.15 min in group B. The average duration of motor blockade was 367.40+/-71.43 in group A and 360.0+/-77.87 min in group B respectively. There was no statistical significance in terms of onset, durations of surgery, sensory blockade and motor blockade between the two groups. However, the average duration of analgesia were 14.13+/-8.41 hrs and 22.18.+/-12.13 hrs in groups A and B respectively, showed statistical significance. The group B showed prolonged analgesia produced by addition of buprenorphine to local anaesthetics.

Discussion

Varieties of receptors mediate nociception in peripheral sensory nerve fibers. The knowledge of these receptors has been used in the form of various adjuncts administered along with local anaesthetics. These adjuncts may not only prolong the analgesic duration but also thought to reduce the systemic analgesic consumption as well as their side effects. To prolong perioperative analgesia various adjuncts such as opioids, clonidine, verapamil, neostigmine and tramadol have been tried [6]. Although the role of opioid as an adjunct has been debated over a long period, it is still in regular use. The objective of this study was to compare the analgesic efficacy between Butorphanol and Buprenorphine as adjuncts to local anaesthetics in brachial plexus block.

The study was a prospective, randomized, double blind study carried out at Victoria hospital, Bowring and Lady Curzons hospitals, Bangalore. Sixty patients belonging to ASA I and II physical status patients undergoing upper limb surgeries were included in the study. Patients were divided into two groups of thirty each.

Group A received 1% lignocaine plain (2mg/kg body weight)and 0.5%bupivacaine plain (2mg/kg body weight) with butorphanol at 0.03mg/kg body weight, where as Group B received 1% lignocaine plain (2mg/kg body weight) and 0.5%bupivacaine plain (2mg/kg body weight) with buprenorphine at 3 mcg/kg body weight.

In our study we observed that there was no change in the time of onset of sensory blockade between two groups. This was similar to the observation done by Eric J. Veil [7], who found no change in onset time when morphine and buprenorphine were added to 0.5% bupivacaine into brachial plexus sheath. However Fletcher et al [8] had an early onset of block with fentanyl. The pH of the injected solution around the nerve would certainly influence the onset of action.

The other block characteristics like duration of sensory and motor blockade were similar in both groups. It was observed by the studies conducted by Eric J.Veil [7] , Kardash et al [9]and Henri Racz et al [10] that addition of morphine to local anaesthetic solution for axillary block did not change the onset time.

We observed that addition of buprenorphine to local anaesthetic solution produced much longer acting analgesia (22.18+/-12.13 hrs) than produced by addition of butorphanol (14.13+/-8.41 hrs). Bazin et al [11], had observed a similar duration of analgesia(median 20 hrs) on buprenorphine administration. In a similar way Candido et al [12] has observed duration of analgesia produced with buprenorphine 3 times longer than that produced by local anaesthetics alone. Wajima et al [13] has also found satisfactory and prolonged analgesia with butorphanol administered as continuous intrabrachial infusion. The prolonged analgesic duration observed with buprenorphine may be attributed to its high affinity for the mu opioid receptor and high lipid solubility, which favors easy penetration through the axonal myelin and nerve membrane. The other factor that might have influenced the protracted analgesia of buprenorphine, was its potency. Buprenorphine is 33 to 35 times more potent than morphine when compared with butorphanol which is only 3.5 to 7 times more potent.

The proposed different mechanisms for the opioid mediated analgesia are- It has more of a central action than direct peripheral action. The transport of the administered drug into extradural or subarachnoid space either by diffusion or by the centripetal axonal transport results in central action. The presence of bidirectional axonal transport of opioid binding receptor has been already confirmed. This thought has been questioned by Dahl et el [14]. He compared the effects of morphine injected extradurally with that injected perifemorally. He concluded that if centripetal axonal transport exists it was clinically not significant. Christen et al later confirmed that morphine concentration in CSF were similar after perifemoral or i.m injection.

The expression of opioid receptors during the time of inflammation has been the other proposed

mechanism of action. Mays et al [15] obtained long lasting pain relief of up to 24 hrs when 6mg of morphine was given in 30 ml of saline into brachial plexus sheath, for chronic pain relief. But most of the studies conducted for the post operative pain relief, during minimal inflammation, have come out with better analgesic durations. The electrophysiological study results with morphine, pethidine, fentanyl or sufentanil have suggested that opioids may exert a nonspecific action on nerves by impairing sodium and potassium conduction.

The presence of variety of receptors and the difference in the affinity of the administered drug to the receptor can be alternative explanation to the longer duration of analgesia produced by buprenorphine than butorphanol. Buprenorphine has high affinity for mu–opioid receptor where as butorphanol is kappa agonist with moderate affinity. Gobeaux et al in his first study observed a significant reduction in time of onset with fentanyl 0.1mg administered into axillary sheath along with local anaesthetics. However there was no prolongation of analgesic duration. In his second study he found prolonged analgesia with pethidine100 mg without any change in onset time. They concluded that varying results were due to greater lipid solubility of fentanyl and pethidine compared to morphine. The same fact allows greater distribution of the drug at the site of action as afferent nociceptive fibers are surrounded by a layer of myelin which presents a significant obstruction to water soluble agents.

We found no significant difference with respect to side effects like nausea, vomiting numbness between the two groups. At the same time there were no incidences of pruritis, respiratory depression or urinary retention.

The significant changes observed with respect to hemodynamic parameters were due to variability in the onset of pain between the two groups. The early raise of heart rate and blood pressure in group A were due to analgesic wear off. The same occurred in group B in the later period .On an average the number of supplemental Diclofenac sodium injections received were two in group A , where as patient's in group B received one supplement over 48 hrs.

From our study we observed that Buprenorphine may be a superior adjunct than butorphanol when administered with local anaesthetic solutions into brachial plexus sheath for providing peri-operative analgesia following upper limb surgeries. In our study we did not have a control group and the pH of the administered solutions was not studied which are the other important factors that influence block characteristics as mentioned earlier.

Although the analgesic properties of the opioids have been studied with the establishment of peripheral opioid receptor, it awaits further studies to establish the local anaesthetic action of the opioids. This could be established by using varying drug concentrations of opioids administered alone in the regional techniques.

Conclusion

In conclusion, Buprenorphine (3 mcg/kg body weight) is superior to butorphanol (0.03 mg/kg body weight), as an adjunct to local anaesthetic solution when administered into brachial plexus sheath for perioperative analgesia during upper limb surgery.

References

1. Atkinson RS, Rushnman GB, Davies. Regional Anaesthesia in Lee's synopsis of anaesthesia.11th ed. Butterworth Heinnman publisher 1993.p.642-648.
2. David L. Brown B. Raymond Fink. The History of Neural Blockade and Pain Management. Michael J Cousins, Phillip O, Bridenbaugh's Neural blockade in clinical anesthesia and management of pain. 3r ed. Lippincott-Raven publisher; 1998.p.3-25.
3. Downing JW, Leary WP, White ES. Buprenorphine: A new potent long acting synthetic analgesic, Comparison with morphine. Br J Anaesth, 1977; 49: 251-255.
4. Young WS, Wamsley JK, Zarbin MA, Kuhar MJ. Opioid receptors undergo axonal flow. Science, 1980; 210:76-77.
5. Fields HL, Emson PC, Leigh BK, et al; Multiple opiate receptor sites on primary afferent fibers. Nature, 1980; 284:351-353.
6. DB Murphy, CJ McCartney, VW Chan. Novel analgesic adjuncts for brachial plexus block; a systemic review. Anesth Analg, 2000; 90:1122-8.
7. Viel EJ, Eledjam JJ, Coussaye JE, D' Athis F. Brachial plexus block with opioids for post operative pain relief: Comparison between buprenorphine and morphine. Reg Anesth, 1989; 14:274-8.
8. Fletcher D, Kuhlman G, Samii K. Addition of fentanyl to 1.5% lidocaine does not increase the success of axillary block. Reg Anesth, 1994; 19:183-8.
9. Kardash K, Schools A. Effects of brachial plexus fentanyl on supraclavicular block. Reg Anesth, 1995; 20:311-5.

10. Racz H, Gunning K, Santa D. Evaluation of effect of perineuronal morphine on the quality of post – op analgesia after axillary plexus block Anesth Analg, 1991; 72:769-72.
11. Bazin JE,Massoni C,Groslier D.The addition of opioids to local anesthetics in brachial plexus block. Anaesthesia, 1997; 52:858-62.
12. Candido KD, Franco CD, Khan MA. .Buprenorphine added to local anesthetic for brachial plexus block to provide postoperative analgesia in outpatients.Reg Anesth Pain Med. 2001; 26(4):352-356..
13. Wajima Z, Shitara T,Nakajima C, Kim NK.Comparison of continuous brachial plexus infusion of butorphanol,mepivacaine and mepivacaine-butorphanol mixtures for postoperative analgesia. Br J Anesth, 1995; 75:548-551.
14. Dahl JB, Daugaard JJ,Kristofferson E,Johannsen HV, Dahl JA. Perineuronal morphine: a comparison with epidural morphine. Anaesthesia, 1988; 43:463-465.
15. Mays KS, Schnapp M, Lipmann JJ, North WC .Local analgesia without anesthesia using peripheral perineural morphine injections. Anesth Analg, 1987; 66:417-4203.