ORIGINAL ARTICLE

Comparison of clinical effects of prilocaine, dexamethasone added to prilocaine and levobupivacaine on brachial plexus block

Aykut Saritas,[1] Cemil Sabuncu[2]

Abstract

Objective: To determine whether the addition of 8mg dexamethasone to axillary brachial plexus block would prolong the duration of sensory and motor block in patients undergoing hand and forearm surgery.

Methods: The prospective, randomised, double-blinded study was conducted at the Eskisehir Osmangazi University Medical School, Turkey, from October 2008 to December 2009. It comprised 45 American Society of Anaesthesiologists grade I and II patients under elective surgery of the hand and forearm. The patients were randomly divided into 3 groups: 5 mg/kg of 2% prilocaine was applied to Group 1; 5mg/kg of 2% prilocaine +8mg of dexamethasone (2ml) was applied to Group 2; and 1.5mg/kg 0.5% levobupivacaine was applied to Group 3. Sensory and motor block onset time as well as the duration of motor and sensory block of those were monitored and recorded. SPSS 15 was used for statistical analysis.

Results: Of the 45 patients, 27 (60%) were men and 18 (40%) were women. There was no significant difference among the groups in terms of demographic data. Based on the duration of motor and sensory block, similar periods of time in Group 1 and Group 2 were noted, whereas this period was statistically different and significantly longer in Group 3 ($p \leq 0.001$). There were no complications encountered.

Conclusion: The addition of dexamethasone to prilocaine prolonged the duration of sensory and motor block. It could be used as an effective adjuvant agent. Levobupivacain could be a more appropriate local anaesthetic in post-operative analgesia and prolonged surgical procedures.

Keywords: Prilocaine, Dexamethasone, Levobupivacaine, Axillary block. (JPMA 64: 433; 2014)

Introduction

Brachial plexus block is a method which provides quite a good analgesia for many surgical or orthopaedic procedures of the arm. Brachial plexus block applied with axillary approach is a safe method which is well tolerated by patients and local anaesthetics are the main drugs used for the blockade.[1]

Tramadol,[2] clonidine,[3] sodium bicarbonate,[4] fentanyl,[5] epinephrine,[6] buprenorphine,[7] dexamethasone,[8,9] parecoxib,[10] magnesium[11] and dexmedetomidine[12-14] were used in order to provide a longer efficacy in lower anaesthetic doses to void from toxicity, to reduce the time to start the operation, to improve the quality of analgesia and anaesthesia.

Addition of long-acting glucocorticoids was used in treatment of chronic pain through stimulating vasoconstrictor and anti-inflammatory effects characterised by steroids and they were tested with some animal or human studies. Recently, dexamethasone microspheres added to local anaesthetics were reported to prolong anaesthesia time. However, studies about the steroids added to local anaesthetics for peripheral blocks are limited.[15,16]

Blockade prolonging effect of glucocorticoids arises from their anti-inflammatory potential. This effect is inhibited by cortexolone, a glucocorticoid antagonist. Dexamethasone does not lead to block alone.[17] Dexamethasone added to local anaesthetics was seen to prolong axillary block time in animal and human studies. The current study hypothesised that the addition of dexamethasone to prilocaine would prolong the duration of analgesia after axillary brachial plexus block for patients undergoing hand and forearm surgery. Also, it tried to clinically investigate prilocaine, dexamethasone added to prilocaine and levobupivacaine effects of the onset and duration of sensory and motor block in axillary nerve block done through a peripheral nerve stimulator.

Patients and Methods

The randomised double-blinded prospective study was performed at the Department of Anaesthesiology and Reanimation, Eskisehir Osmangazi University Medical School, Turkey, between October 2008 and December 2009 after institutional ethics committee approval and

[1]Department of Anesthesiology and Reanimation, Prof. Dr. A. Ilhan Özdemir Public Hospital, Giresun, [2]Department of Anesthesiology, Prof. M.D., Eskisehir Osmangazi University Medical School, Eskisehir, Republic of Turkey.
Correspondence: Aykut Saritas. Email: aykut26tr@hotmail.com

written informed consent of the patients had been obtained. A total of 45 patients aged between 18-60 years undergoing elective hand and forearm surgery and who were in American Society of Anaesthesiologists (ASA) I-II risk group were included in the study. Patients who had severe hepatic, renal, cardiovascular disorders, known allergy and electrolyte imbalance, who were pregnant, unwilling for participation or showing lack of cooperation and patients who were switched to general anaesthesia due to unsuccessful block were excluded.

The patients were randomly divided into three equal groups. Randomisation was done by a computer-generated table of random numbers and the patients were not informed about their groups. Group 1 was administered 5mg/kg of 2% prilocaine; Group 2 was administered 5mg/kg of 2% prilocaine +8mg of dexamethasone (2ml); and Group 3 was administered 1.5mg/kg 0.5% levobupivacaine. Drugs in all groups were completed to 40cc with 0.9% sodium chloride (NaCl) and brachial plexus block was applied with axillary approach. An anaesthesiologist not involved in the performance of axillary block or collection of data prepared all the local anaesthetic mixtures and adjuvant drugs and labelled them using the computer-generated random number.

Patients were not given any pre-medication before the operation. On arrival at the operating room, standard monitoring was established (pulse oximetry, electrocardiography, heart rate and non-invasive arterial blood pressure monitoring) and oxygen was delivered via a Venturi facemask at a rate of 3 L/min. All patients were inserted a 20G canulla into a peripheral vein in the contralateral arm and 0.9% NaCl infusion was started. The arm which had to be operated upon was taken to 90 degrees of abduction and the forearm was taken to approximately 90 degrees of flexion, 1 ml of lidocaine injection was given after the operative field had been cleaned and axillary artery was palpated. We used a nerve stimulator (Stimuplex®; Braun, Melsungen, Germany) with 50mm of stimuplex needle (stimuplex®; braun, Germany) for precise localisation of the brachial plexus. The nerve stimulator frequency was set at 2Hz and the intensity of the stimulating current was initially set to deliver 2mA and was then gradually decreased. The position of the needle was considered to be acceptable when an output current $\leq$0.5mA still elicited a slight distal motor response in each of the nerve distributions (thumb opposition for median, thumb abduction for radial, thumb adduction or ulnar deviation of the hand for ulnar, and flexion of forearm on the arm for musculocutaneous nerves). At this time, the local anaesthetic mixture, 2ml less than the total volume prepared, was injected in increments after negative aspiration for blood and air. In order to avoid intravascular injection, negative aspiration was performed every 3.0-4.0 ml, during injection of the local anaesthetic. The remaining 2ml was diluted to 4ml and used for intercostobrachial nerve block to prevent tourniquet pain. The patients with inadequate block, or block failure in a nerve distribution region were excluded. One anaesthesiologist performed all nerve blocks by the same nerve stimulator technique.

Heart rate, arterial blood pressure (systolic, diastolic and mean arterial pressures), and oxygen saturation were recorded just before the block and at regular intervals thereafter. All measurements were recorded on the Osmangazi University Anaesthesiology Operation Form and the Working Registration Form.

Demographic data, sensory and motor block onset time, duration of sensory and motor block were also recorded by assesing sensory block by pinprick test using a 3-point scale: 0 = normal sensation; 1 = loss of sensation of pinprick (analgesia); 2 = loss of sensation of touch (anaesthesia), and motor blockade using a Bromage scale (0: no movement; 1: finger movement; 2: wrist flexion; 3: elbow flexion). Sensory and motor blocks were evaluated every 5 minutes until 30 minutes after injection, and then every 30 minutes after surgery, until they had resolved. Sensory and motor block onset time was considered as the time between finishing injection of local anaesthetic and to no response to the pinprick test and full paralysis. Duration until the same sensation was felt on the contralateral arm and the first pain post-operatively was accepted as sensorial block time. Duration until recovery of all movements after motor block had occured was defined as motor block time. Pain levels at post-operative period were assessed using a 10cm visual analogue scale (VAS) from 0 (no pain) to 10 (severe pain). The patients and the anaesthesiologists who performed the block and who collected patient data were blinded to the mixture used or group allocation.

Patients were followed up for potential side effects (nausea, vomiting, methemoglobinaemia, cardiovascular issues). When the patient first complained of pain after operation, intramuscular (IM) injection diclofenac sodium 1mg/kg was given.

Analysis of all data was done using SPSS 15.0 and Stigmastat 3.1 package programmes. Constant quantitative data was defined as frequencies, percentages, mean and standard deviation, while qualitative data was defined as frequencies and ratio. Constant variables composed of independent and repeated measurements and showing normal distribution

were analysed with one-way analysis of variance (ANOVA) and one-way repeated measures ANOVA. Independent and repeated data not showing normal distribution was analysed with Kruskal-Wallis and Friedman tests. Tukey and Fisher least significant difference (LSD) methods were used in multi-comparison of these tests. Chi-square test was done for categorical data sets. A p level of <0.05 was accepted as statistically sigificant.

Results

In terms of demographic data, there was no significant difference among the three groups (p>0.05) (Table-1). Likewise, no significant difference was found among the groups in terms of systolic, diastolic and mean arterial pressures on control and during operation (p>0.05).

Motor block and sensorial block onset times were found as 5 (5-15), 5 (5-15), 15 (15-25) in the three groups, respectively. While similar times were found between Group 1 and Group 2, the time period was longer in Group 3. The difference was statistically significant in terms of both sensorial and motor block onset times (p<0.001) (Table-2).

Motor and sensorial block times were evaluated in minutes. A statistically significant difference was found between group in terms of block times (p<0.001). Motor and sensorial block times were longer in Group 3 compared to Group 1 and Group 2; while motor and sensorial block times were longer in Group 2 compared to Group 1 (p<0.001) (Tables 3, 4).

No side effects were seen in patients.

Table-1: Demographics.

	Group 1 (n:15)	Group 2 (n:15)	Group 3 (n:15)
Age (year)	40.8 ± 9,1	40.4 ± 9.3	39.6 ± 6.8
Gender (f/m)	6/9	7/8	5/10

Table-2: Motor and sensorial block onset times (min).

	Group 1	Group 2	Group 3
Motor block onset time (min)	5 (5-10)	5 (5-10)	15 (15-20)*
Sensorial block onset time (min)	5 (5-10)	5 (5-10)	15 (10-15)*

Data are given as median, 25%-75%. Kruskal-Wallis one way variance analysis (p<0,001*).

Table-3: Duration of sensorial block (min).

	Group 1	Group 2	Group 3
Duration of sensorial block	216.7±35.8	380±50.9*	502.3±64.2*

Data are given as mean ± SD (p<0,001*).

Table-4: Duration of motor block (min).

	Group 1	Group 2	Group 3
Duration of motor block	135 (120-180)	300 (265-350)*	380 (311-400)*

Data are given as median, 25%-75%. Kruskal-Wallis one way variance analysis (p<0,001*).

Discussion

Propeties of an ideal drug used for peripheral nerve block are rapid sensorial block onset time, earlier recovery of motor block than sensorial block, and the patient's ability to move the extemity during analgesia.[18] Various adjuvants are added to local anaesthetics in order to ensure these properties.

A study[8] reported that 8mg of dexamethasone added to lidocaine in intravenous regional anaesthesia in 75 patients did not change sensorial and motor block onset time. However, it significantly prolonged durations of sensorial and motor block.

Another study[19] concluded that 8mg of dexamethasone added to mepivacaine prolonged duraton of analgesia. However, it did not reduce sensorial and motor block onset times in 45 patients undergoing hand and forearm operations.

One study[20] showed that dexamehasone added to bupivacaine prolonged the duration of sensorial and motor block in interscalene brachial plexus block. It also showed that VAS scores on 24 hour was lower in dexamethasone group, but were similar on 48 hour. It reported that dexamethasone reduced opioid use by prolonging the sensorial block time.

Another study[16] concluded that dexamethasone added to levobupivacaine improved post-operative analgesia in brachial plexus block. Although analgesic mechanism of corticosteroids is not fully understood, but corticosteroids are known to have functional and structural effects on normal peripheral nerve fibres.[21,22] However, steroids were reported to stimulate vasoconstriction and thereby reduced absorption of local anaesthetic.[9] One study[23] reported that steroids inhibited synthesis and secretion of some inflammatory mediators and thereby the duration of analgesia stood prolonged.

A study[9] investigated the influences of dexamethasone added to lidocaine in 60 patients undergoing elective hand and forearm surgery. It reported that 8mg dexamehasone was seen to prolong the duration of sensorial and motor block, but did not affect block onset time. It was suggested that steroid addition is not

indicated in all patients and also care must be taken in patients with diabetes, hyperglycaemia and infection. The current study concluded that 8mg dexamerhasone prolonged duration of blockade, but did not change block onset time. And any diseases or symptoms which affect steroid use as diabetes mellitus, hyperglycaemia or infection were not seen.

In our study, we saw that rapid block onset time was an advantage, but short duration of action was a disadvantage of prilocaine. Dexamethasone added to prilocaine may be a good option in axillary brachial plexus blockade as it significantly prolonged the duration of motor and sensorial block and reduces block onset time and also no side effects were seen in patients. Block onset time of levobupivacaine was longer than that of prilocaine and it may reduce additional analgesic use in axillary brachial plexus blockade due to long sensorial blockade effect.

Conclusion

The addition of dexamethasone (8mg) to prilocaine in axillary brachial plexus block prolonged the duration of sensory and motor blockade. Dexamethasone may be used as an effective adjuvant agent. Besides, levobupivacaine is a very effective and safe local anaesthetic in long surgical interventions due to its post-operative analgesic effect and satisfactory sensorial and motor block.

Acknowledgements

We are grateful to the anaesthesia nurses of Osmangazi Üniversity Medical School.

References

1. Kayhan Z. Klinik Anestezi, Genisletilmis 3. Baski. Istanbul, Logos Yayincilik 2004; 503-29.
2. Kapral S, Gollmann G, Waltl B, Likar R, Sladen R, Weinstabl C, et al. Tramadol Added to Mepivacaine Prolongs the Duration of an Axillary Brachial Plexus Blockade. Anesth Analg 1999; 88: 853-6.
3. Culebras X, Van Gessel E, Hoffmeyer P, Gamulin Z. Clonidine combined with a long acting local anesthetic does not prolong postoperative analjesia after brachial plexus block but does induce hemodynamic changes. Anesth Analg 2001; 92: 199-204.
4. Contreras-Dominguez V, Carbonell-Bellolio P, Sanzana-Salamanca E, Ojeda-Grecie A. Addition of sodium bicarbonate and/or clonidine to mepivacaine: influence on axillary brachial plexus block characteristics. Rev Esp Anesthesiol Reanim 2006; 53: 532-7.
5. Nishikawa K, Kanaya N, Nakayama M, Igarashi M, Tsunoda K, Namiki A. Fentanyl improves analjesia but prolongs the onset of axillary brachial plexus block by periferal mechanism. Anesth Analge 2000; 91: 384-7.
6. Dogru K, Duygulu F, Yildiz K, Kotanoglu M, Madenoglu H, Boyaci A. Hemodynamic and Blockade Effects of High/Low Epinephrine Doses During Axillary Brachial Plexus Blockade With Lidocaine 1.5%.Regional Anesthesia and Pain Medicine 2003; 28: 401-5.
7. Candido K, Winnie A, Ghaleb A, Fattouh M, Franco C. Buprenorphine Added to the Local Anesthetic for Axillary Brachial Plexus Block Prolongs Postoperative Analgesia.Reg Anesth Pain Med 2002; 27: 162-7.
8. Bigat Z, Boztug N, Hadimioglu N, Cete N, Coskunfirat N, Ertok E. Does dexamethasone improve the quality of intravenoz regional anestesia and analjesia A randomized, controlled clinical study. Anesthesia Analgesia 2006; 102: 605-9.
9. Movafegh A, Razazian M, Hajimaohamadi F, Meysamie A. Dexhametazone added to lidocine prolongs axillary brachial plexus blockade. Anesth Analg 2006; 102: 263-7.
10. Liu X, Zhao X, Lou J, Wang Y, Shen X. Parecoxib Added to Ropivacaine Prolongs Duration of Axillary Brachial Plexus Blockade and Relieves Postoperative Pain. Clin Orthop Relat Res 2013; 471: 562-8.
11. Dogru K, Yildirim D, Ulgey A, Aksu R, Bicer C, Boyaci A. Adding magnesium to levobupivacaine for axillary brachial plexus block in arteriovenous fistule surgery. Bratisl Lek Listy 2012; 113; 607-9.
12. Esmaoglu A, Yegenoglu F, Akin A, Turk CY. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Anaesth Analg 2010; 111: 1548-51.
13. Marhofer D, Kettner S, Marhofer P, Pils S, Weber M, Zeitlinger M. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study Br J Anaesth 2013; 110: 438-42.
14. Swami S, Keniya V, Ladi S, Rao R.Comparison of dexmedetomidine and clonidine as an adjuvant to local anaesthesia in supraclavicular brachial plexus block. Indian J Anesth 2012; 56: 243-9.
15. Kopacz DJ, Lacouture PG, Wu D, Nandy P, Swanton R, Landau C. The dose response and effects of dexamethasone on bupivacaine microcapsules for intercostal blockade (T9 to T11) in healthy volunteers. Anesth Analg 2003; 96: 576-82.
16. Kim YJ, Lee GY, Kim DY, Kim CH, Baik HJ, Heo S. Dexamathasone added to levobupivacaine improves postoperative analgesia in ultrasound guided interscalene brachial plexus blockade for arthroscopic shoulder surgery. Korean J Anesthesiol 2012; 62: 130-4.
17. Castillo J, Curley J, Hotz J, Uezono M, Tigner J, Chasin M, et al. Glicocorticoids prolong rat sciatic nerve blockade in vivo from bupivacaine microspheres. Anesthesiol 1996; 85: 1157-66.
18. Petronella RMJ, Amanda JV, Dudley JB, Philip MH. A comparison of 1% prilocaine with 0.5% ropivacaine for outpatient-based surgery under axillary brachial plexus block. Anaesth Analg 2001; 93: 187-91.
19. Parrington SJ, O'Donnell D, Chan VW, Brown-Shreves D, Subramanyam R, Qu M, et al.Dexamethasone added to mepivacaine prolongs the duration of analgesia after supraclavicular brachial plexus blockade. Reg Anesth Pain Med 2010; 35: 422-6.
20. Vieira PA, Pulai I, Tsao GC, Manikantan P, Keller B, Connelly NR.Dexamethasone with bupivacaine increases duration of analgesia in ultrasound-guided interscalene brachial plexus blockade. Eur J Anaesthesiol 2010; 27: 285-8.
21. Johansson A, Hao J, Sjölund B. Local corticosteroid application blocks transmission in normal nociceptive C-fibres. Acta Anaesthesiol Scand 1990; 34: 335-8.
22. Haimovic IC, Beresford HR. Dexamethasone is not superior to placebo for treating lumbosacral radicular pain. Neurology 1986; 36: 1593-4.
23. Stan T, Goodman EJ, Bravo-Fernandez C, Holbrook CR. Adding methylprednisolone to local anesthetic increases the duration of axillary block. Reg Anesth Pain Med 2004 29: 380-1.