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Comparative Evaluation of Different Local Anaesthetics in Supraclavicular Brachial Plexus Block in Pediatric Patients

Savita Gupta

Assistant Profesor, Department of Anaesthesia, Government Institute of Medical Sciences, Greater Noida, Gautam Buddha Nagar, Uttar Pradesh 201310, India.

Abstract

Introduction: Peripheral neural blockade remains a well-accepted component of comprehensive anaesthetic care in adults, but nowadays it is gaining popularity for children also. This study aims toevaluate the onset, duration of action, hemodynamic changes and side effects if any of lignocaine 2% plain at 5 mg/kg, lignocaine 2% with epinephrine at 7 mg/kg and bupivacaine 0.5% at 2 mg/kg in children of age group 5-10 years. *Materials and Methods:* This was a prospective, randomized and double-blinded clinical trial study. 75 pediatric patients of ASA I/ II age group of 5-10 years of either sex, undergoing upper limb surgeries were distributed equally into three groups and given supraclavicular nerve block. Group L patients received lignocaine 2% plain at 5 mg/ kg, Group LE received lignocaine 2% with epinephrine (1:200000) at 7 mg/kg, and Group Breceived Bupivacaine 0.5% plain at 2 mg/kg body weight. *Results:* 0.5% plain Bupivacaine prolongs the duration of analgesia more than lignocaine 2% plain and lignocaine 2% with epinephrine 1:200000. There was no statistically significant difference in onset of sensory and motor blockade with lignocaine 2% or lignocaine 2% with epinephrine but it is prolonged with 0.5% bupivacaine. There was no significant occurrence of complication in all 3 groups. *Conclusion:* Lignocaine with or without epinephrine having the quick onset of action than bupivacaine 0.5% plain 2 mg/ kg is good for supraclavicular brachial plexus block in children but for the longer duration of surgery(>2 hr), bupivacaine remains the best option.

Keywords: Brachial block; bupivacaine; lignocaine; supraclavicular block.

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Introduction

Regional anaesthesia use in pediatric anaesthesia practice has increased the popularity of peripheral nerve blocks in children [1]. This expansion was in part due to the recognition of the need for better modalities of pain management in children as well as the demonstration of the safety of peripheral regional anaesthesia in children [1,2].

For upper limb surgeries, supraclavicular brachial plexus block is a known anaesthetic option. Among anesthetists there is an increased concern about local anaesthetic toxicity secondary to a narrow therapeutic window and the possibility of an iatrogenic injury related to the awake child's inability to cooperate with the procedure adds to the difficulty in children [3]. Prolonged reduction of pain and nausea and increased possibility of faster discharge from hospital when compared with GA are some of the clinical advantages of this option. The most common local anaesthetic drugs used for a brachial block are lignocaine and bupivacaine.

Corresponding Author: Savita Gupta, Assistant Profesor, Department of Anaesthesia, Government Institute of Medical Sciences, Greater Noida, Gautam Buddha Nagar, Uttar Pradesh 201310, India.
E-mail: dr.gsavita@gmail.com
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Many additives were tried and used to prolong the efficacy of these drugs, to speed up the onset of action and to limit their toxicity [4]. These additives are epinephrine, opioids, ketamine, neostigmine, tramadol, butorphenol etc. [5,6]. The present study was done to evaluate the onset, duration of anaesthesia, analgesia, sensory and motor blockade following various different local anaesthetics in supraclavicular brachial plexus blocks in children. The study was mainly focused on patient and surgeon comfort and avoidance of complication of general anaesthesia in the pediatric age group.

Materials and Methods

The present study was approved by the Institutional Review Board of our hospital and written informed consent of patients was taken. 75 ASA Grade I-II patients of either sex, aged 5-10 years undergoing routine or emergency upper limb surgeries were selected for the study at Gandhi Medical College, Bhopal. All patients under went a pre-anaesthetic checkup and particular emphasis was put on a history of present and past illness and sensitivity to the drugs particularly local anaesthetics. Proper history taking and thorough general and systemic examinations were carried out.

Inclusion criteria was ASA (American Society of Anaesthesiologists) grade I/II patients with age between 5-10 years. Exclusion criteria were patients who refused to participate in the study, infection at the proposed site of block, coagulopathies, allergy to local anaesthetics, severe pulmonary, cardiac, hepatic, renal or CNS disorder. In the present study, a block was not given for short procedures like close reduction or casting (requires only 5-15 min). After sedation with intranasal (0.05-0.25 mg/kg) Midazolam hydrochloride, the patient was transferred to the block room. A secure intravenous line was introduced, and through a face mask supplemental oxygen (4-6 l/min) was applied, followed by 0.5 mg/kg of intravenous propofol (Propofol 1% MCT/LCT Fresenius; Austria). Povidone-iodine 10% solution was used to prepare and drape the neck and supraclavicular region of the patient [7].

In present study, three groups (n=25) were investigated:Group L (lignocaine plain 2%) received 5 mg/kg body weight, Group LE (lignocaine 2% with epinephrine 1:200000) received 7 mg/kg body weight, and Group B (Bupivacaine 0.5% plain) 2 mg/kg body weight. For assigning the anaesthetic solution, a random-number table was generated through a computer-generated randomization list by an anaesthetist not otherwise involved in present study. Anaesthetist performing the procedure and observations were blinded to the treatment group.

Brachial plexus block was performed by the supraclavicular technique. The injection site was disinfected and infiltrated s.c. with 1 ml 2% lidocaine. A nerve stimulator (Stimuplex Dig RC; Germany) for localization of brachial plexus was used. The location end point was finger flexion or extension as the distal motor response with an output lower than 0.5 mA [8].

Monitoring of pulse rate, respiratory rate, oxygen saturation, blood pressure (systolic), sensory and motor blockade wasdone till 30 minutes at every 5 minutes, then till one hour at every 15 minutes and then upto 6 hours at hourly intervals and then every 2 hourly till effect remains. Sensory block onset was assessed as the time from injection to onset of analgesia in each of the major peripheral nerve distributions (ulnar, radial, medial and musculocutaneous).

Onset of Motor block was assessed by the time from injection to the inability of the patient to move fingers or raise the hand. If surgical manipulation could be performed without pain than the motor block was considered satisfactory. When the patient did not allow manipulation and general anaesthesia had to be given that was considered unsatisfactory [9,10]. Postoperative analgesia was assessed by Wong-Baker FACES pain rating scaleand defined as a time from onset of sensory block to a time when a patient has a pain rating scale ≥ 2. Any possible complications such as bradycardia, hypotension, convulsions, respiratory insufficiency, hematomas, headache, nausea, vomiting pneumothorax, pruritus and diaphragmatic paralysis were noted. In the circumstance of an inadequate or patchy block, the block was supplemented with general anaesthesia [11].

Assuming that the establishment of sensory and motor block occurred in 30 min and a standard deviation (SD) of 7 min with an α of 0.05, and a power of 80%, it was calculated that a sample size of 25 patients per group would be required to show a difference of 5 min for establishment of successful surgical block [12]. This sample size could also detect a 30% reduction in block success assuming a control block success of 70%. Statistical tests used for data was SPSS statistical software (version 18) [IBM Corp. NY, USA] presented in mean and SD and the groups were compared by one-way ANOVA. $p < 0.05$ was taken as statistically significant.

Result

The patients' age ranged from 5-10 years of age, the maximum number of cases being in 9-10 years age group in all 3 groups (Group L, LE and B) with the mean age of 8.32, 10 and 9.41 respectively. There was no significant difference among the three groups with respect to demographic parameters such as height, weight, and gender. Out of 75 patients, 51 were males and 24 were females. Group L, LE and B had 80%, 64% and 60% males respectively. For mean time of onset of sensory blockade, difference was statistically insignificant for group L ($p > 0.1$) and group LE ($p > 0.1$) but significant for group B ($p < 0.05$).

The mean duration of the sensory blockade in group L was 108.28±20.14, in group LE was 160.80±22.08 minutes and in the group B was 278.84±32.28 minutes. The mean onset time and duration of the motor blockade in three groups are discussed in [Table 1]. Duration of sensory as well as the motor block was significantly longer in group B than group L and group LE. The side-effect incidence of nausea was 4% in group L and incidence of vomiting was 4% in group B. No statistically significant change in mean pulse rate, mean systolic blood pressure, mean respiratory rate and mean oxygen saturation between all 3 groups at different time intervals during the study period ($p > 0.1$).

Discussion

Comprehensive anaesthesia care with a better patient outcome is the focus of all pre, peri and post-operative care. Peripheral nerve blocks allow patients to remain conscious, preserve their protective airway reflexes and are advocated in high-risk patients to reduce morbidity and mortality associated with general anaesthesia and polypharmacy.

All patients selected in the present study were between 5-10 years of age with majority group belonging to 8-10 years of age. As per our knowledge, no study has been done before for lignocaine 2% plain, lignocaine 2% with epinephrine and bupivacaine 0.5% in supraclavicular brachial plexus block in children of age group 5-10 years. No significant difference in mean time of onset of sensory blockade as well as mean time of onset of motor blockade in group L and group LE but was greater in group B. Bromageet al have shown that Bupivacaine had a longer onset of sensory and motor blockade than lignocaine plain which is similar to our study [9,13]. While Bernards et al have found that epinephrine added to lignocaine didn't affect the onset of sensory and motor blockade [14].

Duration of sensory as well as the motor block was significantly longer in group LE and longest in group B. One study [15], concluded a significant increase in time occurred with bupivacaine as compared to lignocaine, mepivacaine and prilocaine following brachial plexus block which is similar to this study. Mean duration of analgesia was statistically highly significant in group B, compared to group Las Ware et al found that degree of analgesia was significantly better in bupivacaine group when compared with lignocaine similar to the present study [11,16]. Athelail and colleagues found bupivacaine had a longer duration of analgesia than lignocaine with adrenaline used for digital nerve blocks [17].

Epinephrine was used with lignocaine for local anaesthesia to retard absorption, reduce toxicity and prolong analgesic activity. Addition of epinephrine to lignocaine decreases the rate of vascular absorption thereby allowing more anaesthetics molecules to reach the nerve membrane and thus improving the depth and duration of anaesthesia, as well as providing a marker for inadvertent intravascular injections [18,19,20].

In present study, we could not find the statistically significant change in mean pulse rate, mean systolic blood pressure, mean respiratory rate and mean oxygen saturation between all three groups at different time intervals during the study period ($p > 0.05$). Klein et al didn't observe any

Table 1: Onset and time to peak of sensory-motor blockade in three study groups

Block characteristics	Group L	Group LE	Group B
Onset time of sensory block (min)	13.12±3.78	12.6±3.04	18.28±3.02
Onset time of motor block (min)	6.4±2.69	6.64±2.78	15.92±3.30
Total duration of sensory block (score 0)(min)	108.28±20.14	160.80±22.08	278.84±32.28

Values are expressed as Mean±Standard Deviation (SD).

Group L = lignocaine plain 2% at 5 mg/kg, Group LE= lignocaine 2% with epinephrine 1:200000 at 7 mg/kg, Group B= Bupivacaine 0.5% plain at 2 mg/kg.

significant change in the hemodynamic parameter, respiratory rate or oxygen saturation [21].

Only one patient in group L develops nausea whileone patient in group B develops vomiting as side-effect which was mild and reversible. There was no statistically significant difference in the occurrence of complications among the three groups. Lignocaine with or without epinephrine having a quick onset of action than bupivacaine 0.5% plain is good for supraclavicular brachial plexus block in children but for a longer duration of surgery(>2 hr), bupivacaine remains the best option.

Conclusion

Lignocaine with or without epinephrine having the quick onset of action than bupivacaine 0.5% plain 2 mg/kg is good for supraclavicular brachial plexus block in children but for the longer duration of surgery (>2 hr), bupivacaine remains the best option.

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