



MINIMUM EFFECTIVE VOLUME OF A COMBINATION OF BUPIVACAINE AND LIGNOCAINE FOR SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING ULTRASOUND GUIDED TECHNIQUE

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ABSTRACT

Background: To determine the effective volume of a combination of bupivacaine and lignocaine for supraclavicular brachial plexus block using ultrasonography (USG).

Methods: This study is an intervention study to determine the minimum effective volume of a drug combination. The principle statistical method applied in this study is Staircase Up-down method as described by Dixon and Massey.()

Results: By using the log transformation of the data of required volume and outcome as successful or unsuccessful we have calculated EV 50 = 11 ml and EV 90 = 14 ml.

Conclusion: Minimum Effective Volume in 90% individuals (MEV 90) for a combination of 0.25% bupivacaine and 1% lignocaine for ultrasound guided brachial plexus block via supraclavicular approach is 14 ml.

KEYWORDS : Supraclavicular Brachial Plexus Block, USG, Minimum Effective Volume, Local Anaesthetic.

INTRODUCTION:

USG-guided supraclavicular block has enabled us to achieve a high rate of successful surgical anaesthesia and a low rate of complications and thus is now being considered a safe alternative to landmark techniques or nerve stimulator for both inpatients and outpatients.() Ultrasound guidance reduces the possible risk of pneumothorax and also allows a faster onset time of the block with a reduction of local anaesthetic (LA) dose. Ultrasound guidance has been shown to reduce the minimum effective volume (MEV) of LA for several peripheral nerve blocks.() Hence, this study was aimed to find out the minimum effective volume required in supraclavicular block to achieve adequate surgical anaesthesia for upper limb surgeries when bupivacaine and lignocaine are used in combination and the procedure is performed under ultrasound guidance.

MATERIALS AND METHODS:

This is an intervention study to determine the effective volume of a drug combination performed at Department of Anaesthesia & Critical Care of a tertiary care hospital. Duration of study was four months, from May 2018 to Aug 2018.

Inclusion Criteria:

- All individuals (ASA I, II and III) between the ages of 18 to 65 yrs requiring upper limb surgery under regional anaesthesia.
- Sample size – All patients meeting the inclusion and exclusion criteria. The results being generalized only to our tertiary care setting.

Exclusion Criteria:

- Anatomical abnormalities of the forearm identified by physical examination
- BMI ≥ 30 kg/m²
- Use of non-steroidal anti-inflammatory drugs during the last 2 weeks
- Known allergy or hypersensitivity against LA
- Coagulopathy
- Abnormalities in ECG that are considered clinically relevant like AV block or bradycardia
- Pregnancy

Procedure:

All patients were premedicated with 1mg midazolam IV and 1mcg/kg fentanyl IV. USG guided supraclavicular brachial plexus block (double injection technique) was performed with patient in semi-sitting position with the head rotated away from the site to be

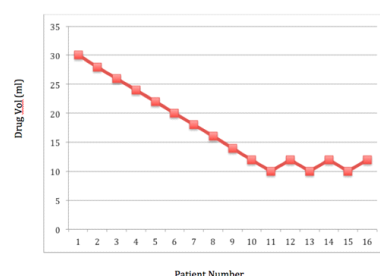
blocked and the shoulder pulled down. An initial volume of 30ml of solution containing 0.25% bupivacaine and 1% lignocaine (15ml 0.5% bupivacaine and 15ml of 2% lignocaine) which was subsequently varied by 2ml according to the response of the previous patients (step-up, step-down technique) was used. A successful block was defined as a block with adequate surgical anaesthesia in all dermatomes of upper limb to pinprick sensation. Unsuccessful block was defined as a block that required augmentation by other regional techniques (wrist block, local infiltration etc.) or conversion to general anaesthesia. Based on this, effective volume 50% (EV 50) of the drug combination was determined. The combination of drugs was used so that lignocaine brings about a quick onset of anaesthesia and bupivacaine maintains surgical anaesthesia for an adequate duration. USG Machine used was Sonosite Titan with a L38/10-5Mhz transducer. Needle used was 50mm 25G neuroplex needle.

Statistical Analysis:

Data was tabulated using Microsoft Excel 2011 for Mac. The principle statistical method applied in this study is Staircase Up-down method as described by Dixon and Massey.() As per this technique, experiments are conducted to estimate the threshold for an all-or-none response. Threshold is defined to be a point above which 50% of the subjects will respond and below which 50% of the subjects will not respond. Staircase designs, in particular up-and-down trials, produce median (ED50) estimates of given standard error with as few as one-fifth the number of subjects as the traditional designs with preset numbers of tests at each of several levels of stimulus.() Logistic regression and probit transformation were applied to estimate the minimum effective volume for a successful block in 90% of the patients.

RESULTS:

Graph I: Step-up/Step-down Graph:



By using the log transformation of the data of required volume and outcome as successful or unsuccessful we have calculated the logistic regression equation to find the effective volume.

The equation is:

$$Y = 67.22 \ln(x) - 113.01$$

For EV 50 and 90

By putting Y = 50 and 90 respectively

$$EV\ 50 = 11ml$$

$$EV\ 90 = 14ml$$

- Minimum Effective Volume in 50% individuals (MEV 50) for a combination of 0.25% bupivacaine and 1% lignocaine for ultrasound guided brachial plexus block via supraclavicular approach is 11ml.
- Minimum Effective Volume in 90% individuals (MEV 90) for a combination of 0.25% bupivacaine and 1% lignocaine for ultrasound guided brachial plexus block via supraclavicular approach is 14ml.

DISCUSSION:

Prior to the introduction of ultrasound guidance for brachial plexus blockade, often larger volumes of LA were used to improve the success rate of the block. In one of his publications, Winnie suggested that 40mL of LA was necessary to anaesthetize the brachial plexus. Some investigators have even used as much as 70ml local anaesthetic drug volume for brachial plexus block. Despite continuous efforts to improve block technique, 30ml to 50ml of LA remains in common clinical use. Ultrasound guided supraclavicular approach to the brachial plexus block has been described by several authors, the first being La Grange et al who in 1978 used Doppler ultrasound to indirectly facilitate needle positioning. With subsequent improvement in technology, in 1994 Kapral et al were the first to report direct needle, plexus and local anaesthetic visualization.

The major advantage of the supraclavicular approach is that the nerves are very tightly packed at this level. This makes the onset of the block fast and the blockade is deep. Hence, this technique has been nicknamed as "the spinal of the arm".

Staircase Up-down method as described by Dixon and Massey is a novel method that can be applied to such studies with small samples to determine effective doses of drugs.

To summarise, USG guided supraclavicular brachial plexus block has the advantage of being able to give lesser volume of drug solution and also increase the safety margin of the procedure. However, this procedure is dependent on the expertise of the anaesthesiologist performing the block and has some amount of training curve associated with it. Hence, a volume of 14-16ml with the above mentioned drug combination could be considered appropriate for USG guided supraclavicular brachial plexus blocks to achieve satisfactory surgical anaesthesia.

CONFLICTS OF INTEREST: None Declared

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