Archives of Anesthesiology

ISSN 2638-4736

Volume 3, Issue 2, 2020, PP: 14-18

Minimum Effective Volume of A Combination of Ropivacaine and Dexmedetomidine for Supraclavicular Brachial Plexus Block Using Ultrasound and Nerve Stimulator Guided Technique for War Wounded Soldiers in the Covid Era

Dr. Saurabh Khurana, MD, DNB[1]., Dr. Shibu Sasidharan, MD, DNB*[2]., Dr. Babitha Shibu, DMRD[3]

[1]Asst. Prof, Department of Anaesthesiology and Critical Care, Command Hospital, Lucknow.

[2]Head, Department of Anaesthesiology and Critical Care, LEVEL 3 IFH, MONUSCO, Goma.

[3]Department of Radiodiagnosis, Ojas Hospital, Panchkula.

Corresponding Author: Dr. Shibu Sasidharan, Head, Department of Anaesthesiology and Critical Care, LEVEL 3 IFH, MONUSCO, Goma.

Abstract

Background: *Our objective was to find out the effective volume required in supraclavicular block to achieve effective surgical anaesthesia for upper limb surgeries in war wounded soldiers in India, when ropivicaine and dexmedetomidine are used in combination and the procedure is performed under ultrasound guidance and nerve stimulator confirmation.*

Methods: *Study done at a tertiary trauma military hospital in India. USG guided and nerve stimulator confirmed supraclavicular blocks were perfomed starting with initial volume of 30ml of solution containing ropivacaine (0.75%) plus dexmedetomidine 0.5mcg/ml which was subsequently varied by 3 ml according to the response of the previous patients (step-up, step-down technique). Based on this, effective volume 50% (EV 50) of the drug combination would be determined.*

Results: *Minimum Effective Volume in 50% individuals (MEV 50) for a combination of 0.75% ropivacaine and 0.5mcg/ml of dexmedetomidine for ultrasound and nerve stimulator guided brachial plexus block via supraclavicular approach is 11.30ml. Minimum Effective Volume in 90% individuals (MEV 90) for a combination of 0.75% ropivacaine and 0.5mcg/ml of dexmedetomidine for ultrasound and nerve stimulator guided brachial plexus block via supraclavicular approach is 20.48ml. Duration of block – 7.81 hrs (average), 8 hrs (median)*

Conclusions: *USG guided and nerve stimulator confirmed supraclavicular brachial plexus block has the advantange of being able to give lesser amount of drug solution and also increase the safety margin of the procedure. During the COVID times, the availability of drugs are restricted. Aerosol dispersion during intubation can also be avoided.*

Keywords: *Regional Anaesthesia, Ropivacaine, Dexmed, War wounded.*

Introduction

These are perilous times. The novel Corona Virus (COVID-19) has spilled unmeasurable health issues globally. Administering medical care involving aerosol generation is extremely dangerous. Hence the option to give general anaesthesia (GA) should be reserved to when it is the only choice. Involvement of military personnel in their operational roles have however not been affected by this. Trauma and war injuries still flock the emergency bay of most military centres.

Ultrasound-guided supraclavicular block has been associated with a high rate of successful surgical

anesthesia and a low rate of complications and thus is now being considered a safe alternative for both inpatients and outpatients.([1]) The introduction of ultrasound guidance techniques not only reduces the possible risk of pneumothorax but also allows a faster onset time of the block with a reduction of the local anaesthetic dose. Ultrasound guidance has been shown to reduce the minimum effective volume (MEV) of local anaesthetics for several peripheral nerve blocks.([2]) There have been recent studies suggesting profound prolongation of nerve block when dexmedetomidine has been used with long acting local anaesthetics like ropivacaine.([3]), ([4]) Hence, this study will aim to find out the effective volume required in supraclavicular block to achieve effective surgical anaesthesia for upper limb surgeries in war wounded soldiers in India, when ropivicaine and dexmedetomidine are used in combination and the procedure is performed under ultrasound guidance and nerve stimulator confirmation. This could be useful in conserving drugs during the limited availability during the COVID era, and also avoid aerosol generation during general anaesthesia (GA).

Materials And Methods

This study is an intervention study to determine the effective volume of a drug combination performed at the trauma centre of a military tertiary care hospital in India. Duration of study was six months, from Dec 2019 to June 2020.

Inclusion Criteria

- All soldiers (ASA I, II and III) between the ages of 18 to 50 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 m22;
- Use of non-steroidal anti-inflammatory drug during the last 2 weeks;
- Known allergy or hypersensitivity against ropivacaine,other amino-amide LAs, or dexmedetomidine;
- Coagulopathy;
- Abnormalities in ECG that are considered clinically relevant like AV block or bradycardia.
- Pregnancy

Procedure

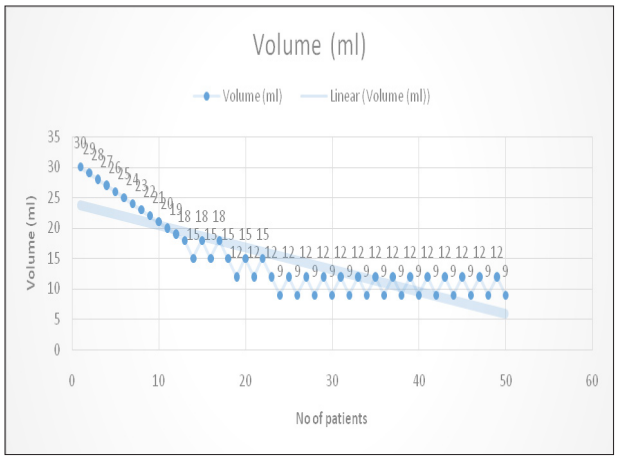
USG guided and nerve stimulator confirmed supraclavicular blocks were perfomed starting with initial volume of 30ml of solution containing ropivacaine (0.75%) plus dexmedetomidine 0.5mcg/ml which was subsequently varied by 3 ml according to the response of the previous patients (step-up, step-down technique). Based on this, effective volume 50% (EV 50) of the drug combination would be determined. USG Machine used was Sonosite Titan with a L38/10-5 Mhz transducer. Nervestimulator used was stimuplex Dig RC. Needle used was 50mm 25G neuroplex needle.

Statistical Analysis

Data was tabulated using Microsoft Excel 2011 for Mac. Analysis of data wasdone using appropriate statistical methods as described ahead. The principle statistical method applied in this study is Staircase Up-down method as described by Dixon and Massey. ([5]) 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. Examples are death, death in a fixed time period, shock, fibrillation, emesis. 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.([6]) 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*



Graphical representation of required volume of drug per patient

By using the log transformation of the data of required volume and outcome as successful and 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 as 90 respectively

EV 50 = 11.30 ml

EV 90 = 20.48 ml

The other variable analysed as part of the study was the duration of block as mentioned below:

- Duration of Block
  - Min – 6 Hrs
  - Max – 10 Hrs
  - Average – 7.81 Hrs
  - SD – 0.98 Hrs
  - Median – 8 Hrs
- Minimum Effective Volume in 50% individuals (MEV 50) for a combination of 0.75% ropivacaine and 0.5mcg/ml of dexmedetomidine for ultrasound and nerve stimulator guided brachial plexus block via supraclavicular approach is 11.30ml.
- Minimum Effective Volume in 90% individuals (MEV 90) for a combination of 0.75% ropivacaine and 0.5mcg/ml of dexmedetomidine for ultrasound and nerve stimulator guided brachial plexus block via supraclavicular approach is 20.48ml.
- Duration of block – 7.81 hrs (average), 8 hrs (median)

Discussion

Prior to the introduction of ultrasound guidance for brachial plexus blockade, larger volumes of local anesthetics (LA) were used to improve the success rate of the block. In his publication, Winnie suggested that 40 mL of LA was necessary to anesthetize the brachial plexus.([7])Some investigators have even reported using as much as 70ml local anaesthetic for brachial plexus block.([8]),([9]) Despite continuous efforts to improve block technique, 30 to 50 mL of LA remains in common clinical use.([10]),([11]) 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.([12]) With subsequent improvement in technology, in 1994 Kapral et al were the first to report direct needle, plexus and local anesthetic visualization.

COVID-19 pandemic puts every health care worker, and more so an anaesthesia team at risk because of the aerosols generated. Hence, regional anesthesia should be considered whenever possible, as per the patient conditions. 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. This has lead to this technique being nicknamed as “the spinal of the arm”.

Due to its unique pharmacologic properties and fewer side effects, ropivacaine is being preferred by an increasing number of anesthesiologists for peripheral nerve blocks. However, there are not many published studies on dexmedetomidine in combination with ropivacaine.([13]),([14])

In human beings, dexmedetomidine has been shown to prolong the duration of block and postoperative analgesia when added to local anaesthetics in various regional blocks.([15]),([16]) In humans, the benefits of adding dexmedetomidine to local anesthetics during

regional anesthesia and some peripheral nerve blockade procedures has been proven to be efficacious for the surgical patients. In the context of perineural adjuvants, the efficacy of dexmedetomidine, when administered peripherally, appears to be comparable with dexamethasone([17]),([18]) and exceeds that of clonidine([19]), magnesium and midazolam.

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.

In our study, we found out that the MEV 50 for a combination of 0.75% ropivacaine and 0.5mcg/ml of dexmedetomidine for ultrasound and nerve stimulator guided brachial plexus block via supraclavicular approach is 11.30ml& MEV 90 for this combination is 20.48ml.Duration of block – 7.81 hrs (average), 8 hrs (median)

USG guided and nerve stimulator confirmed supraclavicular brachial plexus block has the advantange of being able to give lesser amount of drug solution and also increase the safety margin of the procedure.

With this data procured over the past few months, a study with a larger sample size is planned.

Conclusion

In the current practice of regional anesthesia, reductions in the volume and dose of local anesthetic are important strategies to prevent systemic toxicity by local anesthetics. Lower volumes of LA may reduce the risk of toxicity as well as unwanted spread of LAs towards the centro-neuraxis and the phrenic nerve (diaphragmatic paralysis).

Therefore, the use of USG to determine the precise location of local anesthetic injection in peripheral nerve blocks has become increasingly frequent. The advancement in ultrasound equipment and methods has enabled the identification of vascular and neural structures with a very high accuracy leading to lower failure rate and reduction of local anesthetic dosage.

In this study the minimum effective volume of combination of 0.75% ropivacaine and dexmedetomidine 5mcg/ml for supraclavicular brachial plexus block has been found to be 11.30ml (MEV 50%) and 20.48ml (MEV 90%).

Ethical Approval and Consent to Participate

Taken

Consent For Publication

Given

Availability of data and materials

Yes

Authors' Contributions

All authors have contributed partly or wholly in all or atleast 3 of - Study conception and design, Acquisition of data, Analysis and interpretation of data, Drafting of manuscript, Critical revision.

Competing Interests

Nil

Funding

Nil

Acknowledgements

Nil

Authors' Information

As in title page

References

[1] Perlas A, Lobo G, Lo N, Brull R, Chan VW, Karkhanis R.Ultrasound-guided supraclavicular block: outcome of 510 consecutive cases. . Reg Anesth Pain Med. 2009 Mar-Apr; 34(2):171-6.

[2] Flohr-Madsen S, Ytrebø LM, Kregnes S, Wilsgaard T, Klaastad Ø. Minimum effective volume of ropivacaine 7.5 mg/ml for an ultrasound-guided infraclavicular brachial plexus block. Acta Anaesthesiol Scand. 2013 Apr;57(4):495-501.

[3] D. Marhofer, S. C. Kettner, P. Marhofer, S. Pils, M. Weber and M. Zeitlinger. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study. British Journal of Anaesthesia 110 (3): 438–42 (2013)

[4] F. W. Abdallah and R. Brull. Facilitatory effects of perineural dexmedetomidine on neuraxial and peripheral nerve block: a systematic review and meta-analysis. British Journal of Anaesthesia 110 (6): 915–25 (2013)

[5] W.J. Dixon. The up and down method for small samples. American Statistical Association Journal Dec 1965.

[6] Dixon JW. Staircase bioassay - the up-and-down method. Neu- rosci Biobehav Rev. 1991;15:47-50.

[7] Winnie AP. Interscalene brachial plexus block. Anesth Analg 1970;49:455– 66

[8] Janzen PR, Vipond AJ, Bush DJ, Hopkins PM. A comparison of 1% prilocaine with 0.5% ropivacaine for outpatient-based surgery under axillary brachial plexus block. Anesth Analg 2001;93:187–91

[9] Koscielniak-Nielsen ZJ, Rotboll Nielsen P, Risby Mortensen C. A comparison of coracoid and axillary approaches to the brachial plexus. Acta Anaesthesiol Scand 2000;44:274–9

[10] Borgeat A, Dullenkopf A, Ekatodramis G, Nagy L. Evaluation of the lateral modified approach for continuous interscalene block after shoulder surgery. Anesthesiology 2003;99:436–42

[11] Liu SS, Zayas VM, Gordon MA, Beathe JC, Maalouf DB, Paroli L, Liguori GA, Ortiz J, Buschiazzo V, Ngeow J, Shetty T, Ya Deau JT. A prospective, randomized, controlled trial compar- ing ultrasound versus nerve stimulator guidance for intersca- lene block for ambulatory shoulder surgery for postoperative neurological symptoms. Anesth Analg 2009;109:265–71

[12] La Grange P, Foster PA, Pretorius LK: Application of the Doppler ultrasound bloodflow detector in supraclavicular brachial plexus block. Br J Anaesth 1978; 50: 965-7

[13] Zhang Y, Wang CS, Shi JH, Sun B, Liu SJ, Li P, *et al*. Perineural administration of dexmedetomidine in combination with ropivacaine prolongs axillary brachial plexus block. Int J Clin Exp Med 2014;7:680-5.

[14] Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (a2 agonist drugs) as an adjuvant to local Anesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. Indian J Anaesth 2012;56:243-9.

[15] Marhofer D, Kettner SC, 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.

[16] Kanazi GE, Aouad MT, Jabbour-Khoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R, *et al*. Effect of low- dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. Acta Anaesthesiol Scand 2006;50:222-7.

[17] Vieira P, Pulai I, Tsao G, Manikantan P, Keller B, Connelly N. Dexa- methasone with bupivacaine increases duration of analgesia in ultrasound-guided interscalene brachial plexus blockade. Eur J Anaesthesiol 2010; 27: 285–8

[18] Cummings KC, Napierkowski DE, Parra-Sanchez I, et al. Effect of dexamethasone on the duration of interscalene nerve blocks with ropivacaine or bupivacaine. Br J Anaesth 2011; 107: 446–53

[19] Abosedira MA. Adding clonidine or dexmedetomidine to lidocaine during biers block: a comparative study. J Med Sci 2008; 8: 660–4

Citation: **Dr. Saurabh Khurana, Dr. Shibu Sasidharan, et al.** *Minimum Effective Volume of A Combination of Ropivacaine and Dexmedetomidine for Supraclavicular Brachial Plexus Block Using Ultrasound and Nerve Stimulator Guided Technique for War Wounded Soldiers in the Covid Era. Archives of Anesthesiology. 2020; 3(2): 14-18*