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"Comparative Study Of The Effects Of Three Different Volumes And Concentrations Of Levobupivacaine With Fixed Dosage On The Involvement Of The Diaphragm In Upper Limb Surgeries Using Ultrasound Guided Supraclavicular Block"

[1]Dr Ariyasundari Somasundaram, [2]Dr ArunaManaswini .M,[3] Dr Anand S
[1]*Postgraduate,Chettinad hospital and Research institute,Tamilnadu*
[2]*Senior Resident ,JIPMER ,Pondicherry,Tamilnadu.*
[3]*Professor,Chettinad hospital and Research institute,Tamilnadu*
Corresponding Author: Dr AriyasundariSomasundaram

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ABSTRACT: This Research paper is about comparing the effects of 15 ml of levobupivacaine 0.75%,20 ml of levobupivacaine 0.375 % and 30ml of levobupivacaine 0.25% with fixed dosage (75mg) on involvement of diaphragm in upperlimb surgeries using ultrasound guided supraclavicular block. A prospective double blinded and Randomised study was conducted in Chettinad hospital and Research institute,Kelambakkam among 75 participants selected for surgeries under ultrasound guided Supraclavicular block.Three groups ,Group A – 15 ml,Group B- 20 ml ,Group C- 30 ml of levobupivacaine with 25 participants were analysed for the period of March 2020 to April 2021. Using Microsoft Excel and analysis using SPSS version 20 data were entered and statistical analysis was done and we found that percentage of diaphragmatic movement excursion in Group A,B,C were 25.61+13.29, 33.76+9.76, 52.435+12.6 respectively. P value is 0.0001.We concluded that Diaphramatic movement reduction was lesser in Group A receiving 15 ml of levobupivacaine than Group B and C receiving 20 ml and 30 ml of levobupivacaine respectively

KEYWORDS: Diaphgram,Levobupivacaine.
Brachial plexus

I. INTRODUCTION

Regional anaesthesia has become a common place in many practices worldwide due to increasing evidence of patient benefit such as reduction in pulmonary [1]and thromboembolic complications[2] ,reduction in opioid consumption[3]as well as reduced pain and time to discharge and better quality of life in the immediate postoperative period. The increased popularity of regional anaesthesia has resulted in advancement in techniques and equipment.

Diaphragm is the major muscle of respiration supplied by phrenic nerve.Nerve roots for phrenic nerve are C3 to C5 . The brachial plexus is formed from the C5 to T1 nerve roots. These roots join to form the superior (C5, C6), middle (C7), and inferior trunks (C8, T1) above the clavicle. The brachial plexus can be blocked at multiple sites for varying effects. They are Interscalene, Superior trunk block(spares phrenic nerve), Supraclavicular, Infraclavicular, Axillary[3].

Phrenic nerve arises basically from the ramus – ventral of C4. There are also contributions from C3 and C5. It is present deeper in the paravertebral fascia . It lies behind and below the Sternocleidomastoid muscle . This nerve lies nearer to the plexus about 18 – 20mm near C5, which corresponds to the cricoid cartilage. It moves away about 3mm for every cm it moves downwards.[4]

Objectives of our study is to compare the effects of 15 ml of levobupivacaine 0.75%,20 ml of levobupivacaine 0.375 % and 30ml of levobupivacaine 0.375 % and 30ml of levobupivacaine 0.25% with fixed dosage (75mg) on involvement of diaphragm in upperlimb surgeries using ultrasound guided supraclavicular block

II .MATERIALS AND METHODS

The study was carried out the Department of Anaesthesiology, in Chettinad Hospital and Research Institute, Kelambakkam.

STUDY POPULATION: Participants selected for surgery under regional anaesthesia using ultrasound guided supraclavicular block in Department of Anaesthesiology, who met the inclusion criteria.

SAMPLE SIZE :This study was conducted for a period of one year and all the cases those who underwentsupraclavicular block during the study period were included in the study. Consecutive cases wereincluded in group A, group B and group

C in circular fashion. Hence a total of 75 cases were includedwith 25 cases in each group.

RANDOMIZATION AND BLINDING: Selected 75 participants were divided at random of three groups and each consists of 25 using a computer-generated randomization code. Blinding was achieved using a sealed envelope technique

STUDY DURATION: Data required for the experiment was collected for a period of 15 months from January 2020 to March 2021without any break. It covers all the four seasons of the year
INCLUSION CRITERIA ARE: 1. American Society of Anaesthesiologists (ASA) Grade – I, Grade –II and Grade III of status physical. 2. Age between 18 - 60 years. 3. Patients undergoing upper arm orthopedic and general surgery.

EXCLUSION CRITERIA ARE: 1. Severe Bronchopulmonary disease 2. Neurologic or neuromuscular disease 3. Disorders relating to coagulation 4. Infection occurring at the site of injection 5. Any prevailing allergy to the drug used 6. Body mass index more than 30kg/m^2

DATA COLLECTION TOOLS: The collected data for the experiment were recorded and documented with all the relevant parameters in a structured study proforma. The data are used for the experimental analysis.

STUDY METHODOLOGY :As soon as the approval obtained from Institutional Human Ethics Committee, the study participants were informed verbally and also through written communication. The participants also responded their consent verbally and through written communication. 75 study participants going through surgeries by using ultrasound guided supraclavicular block in Chettinad Hospital and Research Institute, Kelambakkam, Chennai meeting criteria were taken into account for the said study .
Group A – (n = 25) – Participants received Inj.Levobupivacaine 75 mg (0.5%) – 15 mL Group B – (n = 25) – Participants were administered Inj.Levobupivacaine 75 mg (0.325%) – 20 mL Group C – (n = 25) – Patients were administered Inj.Levobupivacaine 75 mg (0.25%) – 30 mL

All the patients undergoing upper limb surgeries would undergo pre-operative check up in the pre-anaesthetic assessment clinic by clinical examination and assessing the lab tests viz. Complete blood count Testing of renal parameters (serum urea and creatinine), Fasting blood glucose , blood group, coagulation profile, serum electrolytes and imaging studies like chest x-ray, ECG were assessed. After informed written consent patient will be advised fasting of eight hours for solid diet and two hours for oral clear fluids prior to surgery these conditions are mandatory for the said surgery

Patients were premedicated with tablet Alprazolam 0.5 mg and Ranitidine 150 mg orally on the night before surgery.

On the operative day, the respective patient would be shifted from the ward to the theatre. The drug to be administered was prepared by the anaesthesiologist who is not involved in the study .Inside the operation theatre basic routine monitors were attached and monitoring done intraoperatively . Intravenous access will be assessed for patency, if not present new access will be established and patient will be preloaded with Ringer lactate or Normal saline. Patient would be premedicated with 1µg/kg of Inj. Fentanyl and Inj.Midazolam (0.02mg/kg).

Skin will be disinfected and the field will be draped with a sterile cloth. The patient will be made to lie in lying down with the head to the opposite side about 30°. A high frequency ultrasound probe will be placed in the supraclavicular fossa. After this the subclavian artery and brachial plexus cluster will be scanned and visualized. Skin and subcutaneous tissue will be infiltrated with 1% lignocaine and the choice of volume of the study drug added with Inj.Dexamethasone (8mg) will be administered according to the computer-generated randomization code; once the nerve bundle sheath is visualized clearly, using an in-plane technique with a 23G Quincke needle

Half volume of the prepared solution will be injected in medial direction towards the corner pocket. And the remaining half volume of anaesthetic will be injected in the grape bunch like structure (plexus). The exact time of administering the drug is recorded.(figure 1)

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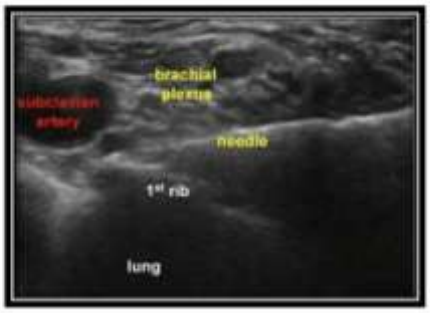

Figure 1 -Ultrasonographic anatomy of Supraclavicular approach brachial plexus (with the visualization of the needle)

Source: Sandeep Kusre, Andrew McEwen, Geena Matthew/ultrasound-guidedsupraclavicular-brachial-plexus-block/July 2018

Diaphragm function is evaluated by using B-mode ultrasonography. This gives information regarding the structure and the physical property of the object viewed. The visualization of the diaphragm movement is done by the ultrasound M-mode. M -mode shows the motion of the structure in a good resolution and records movements in relation to the time scale. Diaphragmatic involvement will be measured using a real-time M-Mode ultrasonography.

The patient will be made to lie in supine position; a convex probe is positioned down the rib margin in the line drawn from the mid-point of the clavicle and scanned using liver as acoustic window for right hemi diaphragm and spleen for left hemi diaphragm. In M-mode, diaphragm is viewed as a single thick echogenic line. The movement of the diaphragm from the resting position to deep inspiratory position is recorded before the supraclavicular block was administered which was considered as the baseline diaphragmatic excursion.

After Administration of the block the range of diaphragmatic movement was measured which was considered as Post procedure diaphragmatic excursion.

Diaphragmatic movement reduction(DMR) is the calculated difference in change in the amplitude of the movement of diaphragm before the block and after the block. Complete paresis is when the DMR is higher than 75%, absence of movement or movement which is paradoxical. Partial paresis is when the DMR ranges from 25 – 75%. No paresis is when the DMR is lower than 25%. Diaphragm movement was calculated in centimetres. DMR was measured in percentage. (figure 2)

STATISTICAL ANALYSIS : Using Microsoft Excel and analysis using SPSS version 20 data were entered and statistical analysis was done.
The participants who were selected as per the inclusion terms were scattered in random as three groups of 25 patients in each using a computer generated randomization code.

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The participants who were selected as per the inclusion terms were scattered in random as three groups of 25 patients in each using a computer generated randomization code.
Incidence of Diaphragmatic involvement were observed

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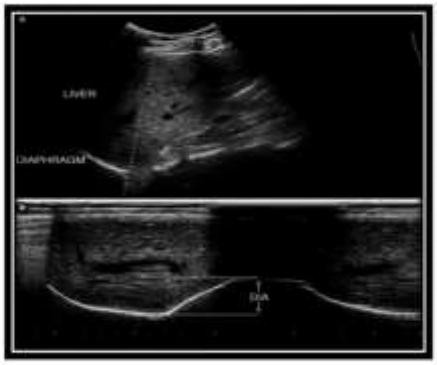

Figure 2: Visualization of the Diaphragm in B mode and its excursion in M mode

Source: Lloyd, T., Tang, YM., Benson, M. et al. Diaphragmatic paralysis: the use of M mode ultrasound for diagnosis in adults. Spinal Cord 44, 505–508 (2006)

ETHICAL CONSIDERATIONS: The Institutional Human Ethics Committee reviewed and approved the proposal entitled, "Comparative study of the effects of three different volumes and concentrations of levobupivacaine on the block characteristics in upper limb surgeries using ultrasound guided supraclavicular block". This was approved by the said authority as per said reference - IHEC No.: 633 / IHEC / 12 - 19 dated 25.01.2020

All the participants were involved in the study were informed through communication in the written form regarding the experimental observations and consent from them was obtained. The participants were informed not only of the risks but also the benefits involved. Before obtaining the consent the nature of the voluntary participation of the participants was informed. It was mutually agreed to maintain the confidentiality of the study.

III. RESULTS

DIAPHRAGMATIC MOVEMENT REDUCTION

Group	Obs	Rank Sum
Group A	24	551.0
Group B	25	758.00
Group C	26	1510.00

Table 1 :Kruskal-Wallis Equality-Of-Populations Rank Test Diaphragmatic Movement Reduction

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STUDY VARIABLES	Group A	Group B	Group C	p Value
Diaphragmatic Movement Excursion (in %)	25.61+13.29	33.76+9.76	52.435+12.6	0.0001
INTERQUANTILE RANGE	22.035-38.275	29.25-43.28	47.65-66.93	

Table 2 :Comparison of Group A, Group B and Group C on the basis of diaphragmatic involvement

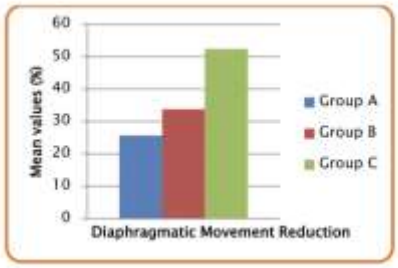

Figure 3 :Comparison of incidence of Diaphragmatic involvement in three groups

IV. CONCLUSION

Diaphramatic movement reduction was lesser in Group A receiving 15 ml of levobupivacaine than Group B and C receiving 20 ml and 30 ml of levobupivacaine respectively

SOME OF THE ADVANTAGES FROM THE ABOVE RESULTS

a. Good pain relief at surgical site
b. Diaphragmatic involvement was less with less volumes
c. Early mobilisation

V.DISCUSSION

The most common block given for peripheral nerve in upper limb surgeries is Brachial plexus block. If administration of the drug is performed in the trunk level of the plexus it is termed as supraclavicular technique. It gives the denser blockade as plexus is being blocked in the middle, this results in spreading local anaesthetics homogenously throughout the plexus. [5,6]

Among the different local anaesthetic agents there is significant difference in the characteristics such as time of initiation of action, duration of analgesia and its profile of safety if it is used in the brachial plexus block. In fact, Levobupivacaine is a newly developed drug which is long acting and it belongs to amide family. This is found to be consistently as efficacious as Bupivacaine. Moreover, it is found that Levobupivacaine has a better safety profile when it is used in Brachial plexus block.[7]

Diaphragm movement was assessed using M-mode of ultrasound immediately before initiating the procedure which was taken as baseline measure and it was being repeated after the procedure. The difference of these was considered as Diaphragmatic movement reduction . It was always expressed in percentage.

DIAPHRAMATIC EXCURSION

Movement of the Diaphragm is called as Diaphragmatic excursion. It can be visualized and assessed using ultrasound.[8]

VISUALIZATION: [9,10]1. Left Diaphragm is easier and uses liver as acoustic window. 2. Right

Diaphragm is comparatively difficult and the acoustic window here is spleen.

M – Mode: It records the consecutive patterns of the image over the time line and hence the motion of the object is seen. [11,12]

There are 4 different approaches: 1. Anterior subcostal view 2. Intercostal view 3. Posterior subcostal view 4. Subxiphoid view

DIAPHRAMATIC INVOLVEMENT

In this study, it is observed that the baseline diaphragmatic movement was similar but the diaphragmatic involvement and movement reduction was more in 30mL Levobupivacaine 0.75% group [Group C] having a mean value of 52.435±12.6 % in comparison with 20 mL Levobupivacaine 0.375% group [Group B] and 15 mL Levobupivacaine 0.25% [Group A] that has a mean of 33.76±9.76 % and 25.61±13.29 % respectively. It is significant statistically (p value 0.0001).

Diaphragm causing decreasing movement is by through spread of drug directly towards the Phrenic nerve or spread upwards reaching root of C4. It is said that the incidence of the diaphragm involvement is lesser in Supraclavicular block than Interscalene brachial plexus block because the former is performed in a lower level than the latter. Hence the spread of the local anaesthetic upwards (C4) is considered to be lesser which means the phrenic nerve involvement is lesser. And also, the plexus is situated from the phrenic nerve more caudally in the neck at the levels very lower than the cricoid carotid.

So, it is believed that the occurrence of phrenic nerve involvement becomes dependent on the amount of the drug. The usage of multiple injection technique helps in avoiding the spread of the drug medially. With stimulation of the nerve technique there might be accidental injection of the drug over the phrenic nerve which could avoided using ultrasound.(13)

Limitation of this study is there is diaphragmatic involvement in all the three groups.

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