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Original Article

Anaesthesia Section

Effect of Anaesthesiologists' Experience on Preferred Technique and Volume of Local Anaesthetic Administered for Brachial Plexus Nerve Block: A Retrospective Observational Analysis

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ABSTRACT

Introduction: Faculty and Residents are trained in peripheral nerve blocks guided by blind technique, Peripheral Neuro Stimulator (PNS) or Ultrasound (USG) guided technique. But due to unavailability of USG machine in all institutes and requiring special training, techniques used for peripheral nerve blocks vary from institute to institute.

Aim: To analyse the effect of anaesthesiologists' experience on preferred technique and Local Anaesthetic (LA) volume used for brachial plexus nerve block retrospectively.

Materials and Methods: In this retrospective observational study, 129 adults American Society of Anesthesiologists (ASA) grade I and II patients requiring brachial plexus nerve block for upper limb orthopaedic surgical anaesthesia for both elective and emergency surgery were divided into three groups for each year depending on technique for nerve block used. Group A: Received USG guided (Micromaxx Sonosite Inc, USA) brachial plexus nerve block. Group B: Received peripheral nerve stimulator (Inmed) guided brachial plexus nerve block. Group C: Received brachial plexus nerve block by traditional anatomical landmark based paraesthesia elicitation blind technique. Patients with inadequate surgical analgesia were given general anaesthesia and were categorised as failure rate. Year wise demographic data, type of technique used for giving brachial plexus nerve block, volume of drug used, failure rate, complications observed were collected and analysed by Student's t-test and Chi-square test.

Results: USG guided technique was the most prefered technique in both years (57.6%, n=38 in year 2018 and 49.2%, n=31 in year 2019). In remaining nearly half of the patients PNS and blind technique was used (PNS 24.2%, n=16 in year 2018 and 20.6%, n=13 in year 2019; blind technique 18.2%, n=12 in year 2018 and 30.2%, n=19 in year 2019). Significantly, less volume of LA drug (mL) was used in group A in year 2019 (16.43±6.07) than in year 2018 (22.34±4.75) ($p<0.001$). Failure rate in group A in year 2019 (3.2%) was significantly less than in year 2018 (5.2%), but the difference was insignificant in all three groups. In group A, no complications were observed in year 2019 while one incidence of hemidiaphragm paralysis was observed in year 2018, while in group B and C, complications were observed in both years.

Conclusion: USG guided nerve block was the most preferred technique for nerve block in the study institute. In 24 months observation period, with increasing experience with USG there was significant increase in success rate and decrease in the volume of LA administered and complications.

Keywords: Analgesia, Faculty, Pain, Ultrasound

INTRODUCTION

Brachial plexus nerve blockade is a time-tested technique for upper limb surgeries [1]. Success rate of nerve block, complication rate, patient comfort, number of needle insertions depend upon technique used for nerve block and experience of anaesthesiologists. Nerve block under real-time USG guidance is the gold standard in terms of nerve localisation, detection of vascular structures and pleura, needle tip control, distribution of injected drug, real time nerve visualisation, less volume of drug used and hence there are less adverse events [2]. Due to insufficient training during residency, unavailability of USG and PNS devices for anaesthesiologists in most of the hospitals, many anaesthesiologists are left with traditional paraesthesia elicitation technique.

The current study was an attempt to document the current trends in brachial plexus nerve block in the study institute. The authors were not able to find any such study from India. The collected data and interpretations may help in comparisons among different institutes and also help in revealing existing weak points and evaluation of currently running educational and training programmes which in turn will improve the structure, process and outcomes of regional anaesthesia practice for upper limb surgeries.

The primary objective of this study was to explore the practice and preferred method for brachial plexus nerve blocks in adult patients for orthopaedic surgeries and secondary objective was to determine changes in volume of drug used, failure rates and complications in two years time period.

MATERIALS AND METHODS

This retrospective observational study was done after taking approval from Institutional Ethical Committee in a tertiary care centre at a rural area of Haryana, India. Data from January 2018 to December 2019 was collected after checking entry registers and patient records. The duration of the study was from 1st July 2020 to 10th October 2020. Anaesthesiologists of the study institute attended USG guided nerve block workshops in year 2017.

Inclusion and Exclusion criteria: All adults ASA grade I and II patients requiring brachial plexus nerve block for upper limb orthopaedic surgical anaesthesia for both elective and emergency surgery were included in the study. Paediatric and pregnant patients, ASA grade more than II and patients requiring nerve block for postoperative pain relief were excluded from this study.

Standard combination of drugs (0.5% bupivacaine plain and 2%) lignocaine with dose calculated as per patient weight was given. Total 129 patients were divided into three groups for each year depending on technique for nerve block used.

Group A: Received USG guided (Micromaxx Sonosite Inc, USA) brachial plexus nerve block (n=38 in year 2018, n=31 in year 2019).

Group B: Received peripheral nerve stimulator (Inmed) guided brachial plexus nerve block (n=16 in year 2018, n=13 in year in 2019).

Group C: Received brachial plexus nerve block by anatomical landmark based traditional paraesthesia elicitation blind technique (n=12 in year 2018, n=19 in year 2019).

Patients with inadequate surgical analgesia were given general anaesthesia and were categorised as failure rate. Demographic data like age, sex, weight were noted. Data regarding technique used for giving brachial plexus nerve block, volume of drug used, failure rate, complications observed like localised haematoma, pneumothorax, haemothorax, LA toxicity, neural injury, Horner syndrome were collected.

STATISTICAL ANALYSIS

Mean and standard deviation were calculated for descriptive statistics of data. Both intra-group and inter-group comparisons were done. Chi-square test was used for categorical variables and student's t-test was used to analyse quantitative variables. A p-value <0.05 was considered significant. Data were analysed using Statistical Package for the Social Sciences (SPSS) version 20.0 software.

RESULTS

Out of total 1800 patients receiving anaesthesia for orthopaedic surgery during year 2018 and 2019, 129 adult patients required brachial plexus nerve block for upper limb orthopaedic surgical anaesthesia for both elective and emergency surgery. Patients were divided into three groups for each year according to technique for brachial plexus nerve block used. The groups were comparable in terms of age, gender and weight [Table/Fig-1].

Variables	Year 2018 n=66			Year 2019 n=63			p-value
	Group A (n=38)	Group B (n=16)	Group C (n=12)	Group A (n=31)	Group B (n=13)	Group C (n=19)	
Age$ (Years) (Mean±SD)	33.73±13.76	38.93±15.7	40.4±20.2	35.47±14.46	32.1±11.54	35.3±16.25	>0.05
Gender#							
Male n, (%)	28 (42.4)	11 (16.6)	8 (12.1)	24 (38.1)	9 (14.2)	14 (22.3)	>0.05
Female n, (%)	10 (15.1)	5 (7.5)	4 (6.3)	7 (11.1)	4 (6.3)	5 (7.9)	
Weight$ (kg) (Mean±SD)	75.5±6.9	73.9±7.0	69.9±9.8	72.8±7.6	71.2±7.1	74.0±8.2	>0.05

[Table/Fig-1]: Demographic profile.
p<0.05 significant; #analysed by Chi-square test; $analysed by Student's t-test

Number of patients in each group for both years was also comparable [Table/Fig-2]. Most preferred technique in both years was USG guided in year 2018 and 2019. In rest, nearly half of the patients PNS and blind technique was used.

Groups	Year 2018 (n=66)	Year 2019 (n=63)	p-value
Group A n (%)	38 (57.6)	31 (49.2)	0.340
Group B n (%)	16 (24.2)	13 (20.6)	0.623
Group C n (%)	12 (18.2)	19 (30.2)	0.111

[Table/Fig-2]: Number of patients with different techniques used (year wise).
Analysed by Chi-square test (p<0.05 is significant)

Volume of LA drug used (in millilitres) in group A was significantly higher in year 2018 (22.34±4.75) than in year 2019 (16.43±6.07) (p<0.0001). LA volume administered in group B and group C was not significant (p>0.05) [Table/Fig-3].

Failure rate for group A in year 2019 was lesser than year 2018, in group B was 18.75% in year 2018 and 15.4% in year 2019, and in group C was 25%, in year 2018 and 31.7%, in year 2019 but this difference was statistically insignificant [Table/Fig-4].

Groups	Year 2018	Year 2019	p-value
Group A (mL) (mean±SD)	22.34±4.75	16.43±6.07	<0.0001
Group B (mL) (mean±SD)	23.3±4.49	27.08±8.1	0.172
Group C (mL) (mean±SD)	29±8.5	30.3±9.3	0.756

[Table/Fig-3]: Volume of drug used.
Analysed by Student's t-test (p<0.05 is significant)

Groups	Year 2018	Year 2019	p-value
Group A n (%)	2 (5.2)	1 (3.2)	0.679
Group B n (%)	3 (18.75)	2 (15.4)	0.811
Group C n (%)	3 (25.0)	6 (31.6)	0.694

[Table/Fig-4]: Failure rate (Patients requiring general anaesthesia) (n,%).
Analysed by Chi-square test (p<0.05 is significant)

No complications were observed in group A in year 2019 while one incidence of hemidiaphragm paralysis was observed in year 2018. In group B, haematoma, hemidiaphragm paralysis and Horner syndrome were observed in both years. In group C, complications like pneumothorax was observed in year 2019, haemothorax was observed in year 2018, while haematoma, hemidiaphragm paralysis and Horner syndrome were observed in both years [Table/Fig-5].

Complications	Year 2018			Year 2019			p-value
	Group A	Group B	Group C	Group A	Group B	Group C	
Localised haematoma	0	3	4	0	2	5	>0.05
Pneumothorax	0	0	0	0	0	1	>0.05
Haemothorax	0	0	1	0	0	0	>0.05
Hemidiaphragm paralysis	1	1	2	0	3	3	>0.05
Horners syndrome	0	1	2	0	1	2	>0.05

[Table/Fig-5]: Complications observed (n).
Analysed by Chi-square test (p<0.05 is significant)

DISCUSSION

USG guidance is based on real-time visualisation of nerves and anatomical structures. With USG, movement of needle during insertion and LA distribution can be directly visualised, which not only ensures safety of the procedure and avoids complications but can also lead to reduction of the LA volume administered [3]. Performing a block under USG guidance requires skills. Inexperienced anaesthesiologists often use higher dose of LA to ensure success [4]. In this study, data was reviewed on brachial plexus nerve block for upper limb orthopaedic surgical anaesthesia for both elective and emergency surgery.

Among all brachial plexus nerve blocks performed in this study population, USG guided nerve block was the most preferred mode. However, on conducting interview of anaesthesiologists in the study institute, they told that they wanted to preserve their skills for blind technique fearing they would forget landmark based techniques if they had used USG for the same. Similarly, Argyra E et al., in year 2015 found limited use of USG guidance nerve block in Greece, vast majority of peripheral nerve block

were performed with the aid of PNS. Elicitation of paraesthesia is still advocated by a high percentage of physicians [5]. In a study conducted by Rukewe A and Fatiregun A in Nigeria, majority of anaesthesiologists (76.4%) had seen a peripheral nerve stimulator before, but only 31.4% of them used it in their practice. Most respondents (89%) rated their exposure to peripheral nerve blocks during their residency training as poor and in need of more education with a prediction that their use of regional anaesthesia would increase in the future [6]. According to Huang J and Gao H most anaesthesiologists (68.2%) in China performed peripheral nerve blocks by "blind" blocks. Only 32.8% used PNS and USG guidance. Blind technique for peripheral nerve blocks was popular in China and this was largely due to lack of tools (PNS, USG) or lack of knowledge and training [7].

In this index study, a trend of decreasing volume of LA administered was also observed with increasing experience in USG group. Authors have used 0.5% bupivacaine and 2% lignocaine mixture which was similar as in study by Gurkan Y et al., [8]. In this index study, mean volume of LA used for USG guided in year 2018 was 22 mL while in year 2019 it was 16 mL. The LA volume used was akin to a study by Yeniocak T and Canbolat N where also decreasing trend was observed [4].

In addition, highest failure rates and complications were observed in this index study in blind technique and lowest in USG guided group. In this index study, success rate of USG guided brachial plexus nerve block was increased from 94.76% to 96.77% in 24 months period while in a study by Yeniocak T and Canbolat N, success rate increased from 96.8% to 99.5% in 40 months period [4]. The lower success rate in this index study could be explained by lesser number of months and further increase in success rate is anticipated in future.

de Oliveira Filho GR et al., used phantom method and found overall success rate as 0.84 (0.64-0.92) [9]. Cicero S et al., found that the number of USG examinations are necessary to train sonographers to accurately examine foetal nasal bone varied from 40-120 examinations [10]. One of the studies by Konrad C et al., examining the number of brachial plexus blocks needed to attain a reasonable degree of proficiency with the technique estimated that to achieve a success rate of 87% at least 62 blocks should be performed. This number of blocks may not allow most residents to complete their nerve block learning curve before entering practice [11]. In this index study, failure rate in PNS guided was 18.75% in year 2018 and 15.4% in year 2019. In an article by Wilson AT, block failure was 35% in PNS guided and found that learning curve for USG guided regional anaesthesia is shorter than PNS [12]. A study by Honnannavar KA and Mudakanagoudar MS in year 2017 showed that out of 30 patients in USG group 80% was completely successful; 6.66% were incomplete and needed supplementation; 13.3% failed and required general anaesthesia. Out of 30 patients in conventional group, 66.66% were completely successful, 13.2% were incomplete and needed supplementation, and 20% failed and required general anaesthesia [13]. In this index study, the author also observed 25% failure rate in year 2018 and 31.6% failure rate in year 2019 which is similar to above cited study.

Yuan JM et al., found that USG decreases the risks of complete hemi-diaphragmatic paresis or vascular puncture and improves the success rate of brachial plexus nerve block compared with techniques that utilise percutaneous nerve stimulation for nerve localisation [14]. Bridenbaugh PO and Cousins MJ found the incidence of pneumothorax with the classic supraclavicular technique ranges from 0.5-6% and present study also showed similar rate of complications for the blind technique [15]. No patients from USG group in index study showed any clinical evidence of pneumothorax this is similar to findings by Honnannavar KA and Mudakanagoudar MS [13].

Limitation(s)

This study has certain limitations. First, the index study was started after completing the USG workshops that our anaesthesiologists have attended. Secondly, personal abilities and experiences could not be assessed. Thirdly, due to lack of information on retrospective data, time for performing nerve block, number of attempts for needle insertion, duration of sensory block could not be evaluated. More accurate results may be obtained by including more participants in future studies.

CONCLUSION(S)

The present study was an attempt to collect data on current practice on brachial plexus nerve block in adult orthopaedic patients in a tertiary care health centre in Haryana, India catering to rural population. It may offer data for further analysis and future comparisons. USG guided nerve block was the most preferred mode in our institute. With increasing experience in 24 months period, lesser volume of drug was administered with lesser failure rate and lesser complications. Further in index study, nearly half of blocks were still done with PNS and blind technique which have more failure rate and more complications than USG guided nerve block. This may be due to inadequate training and lack of equipments for trainings. Efforts towards comprehensive training programs and basic regional anaesthesia equipments including USG machine availability might add to the patient safety.

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