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A Comparative Study between Conventional Technique and Ultrasound Guided Interscalene Brachial Plexus Block in Upper Limb Surgeries

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Abstract

Background: The conventional technique of interscalene brachial plexus block being a blind technique may be associated with higher failure rates and injury to nerves and vascular structures. Ultrasound (US) visualization of anatomical structure is only method offering safe blocks of superior quality by optimal needle positioning. *Objectives:* To compare the success rate, time taken for the procedure, onset time, duration of blockade and complications of the conventional approach of interscalene brachial plexus block performed versus US guided route.

Keywords: Brachial Plexus Block; Conventional; Regional Anesthesia; Ultrasound.

Ultrasound (US) visualization of anatomical structures is the only method offering safe blocks of superior quality by optimal needle positioning. US allows direct visualization of peripheral nerves, the block needle, and local anesthetic distribution.

Hence, a study is planned for comparison of brachial plexus block by interscalene approach using conventional and US based technique.

Objectives

The main objectives of this study were to compare the effects of interscalene brachial plexus block using conventional blind technique and US technique in terms of:

1. Time taken for the procedure
2. Onset and duration of sensory blockade
3. Onset and duration of motor blockade
4. Success rate
5. Incidence of complications.

Materials and Methods

Sixty patients aged between 18 and 60 years admitted to GIMS Teaching Hospital, Gulbarga, undergoing upper limb surgery lasting more than 30 min were included in the study.

Method of Collection of Data

The patients were randomly divided into two groups of 30 patients each:

- Group 1: US (US guided) - To receive US guided interscalene brachial plexus block
- Group 2: (Conventional)-To receive conventional interscalene brachial plexus block.

Inclusion Criteria

1. Patients of either sex, aged between 18 and 60 years

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2. Patients with American Society of Anesthesiologists (ASA) Grade I and II physical status
3. Elective upper limb surgeries.

Exclusion Criteria

1. Patients <18 years and >60 years of age
2. Patient refusal
3. Patients with significant coagulopathy or peripheral neuropathy
4. ASA Grade III and IV patients
5. Allergy to local anesthetics.
6. Severe COPD

The study protocol was approved by the Institutional Ethical Committee.

Preanesthetic Evaluation

All the patients underwent thorough pre anesthetic evaluation on the day prior to surgery. All the patients were kept nil per oral as per the fasting guidelines. All of them received tablet alprazolam 0.5 mg and tablet ranitidine 150 mg night before the surgery. Written informed consent taken.

Investigations

The following investigations were done:

- Blood investigations: Hemoglobin (Hb)%, bleeding time, clotting time, urea, serum creatinine, blood sugar, blood grouping and cross matching
- Urine: Albumin, sugar and microscopy
- Electrocardiography (ECG) and chest X-ray posterior-anterior view depending on the age and associated comorbidities

Human immunodeficiency virus, hepatitis B surface antigen.

Preliminaries Included

Pre-medication: Injection midazolam 0.05 mg/kg given intravenous (IV) before the procedure and oxygen administered through nasal prongs @ 3L/min Local anesthetic used: 15 ml bupivacaine 0.5% + 15 ml lignocaine with adrenaline 2%.

Equipment

a. For the Procedure

A portable tray covered with sterile towels containing,

1. Disposable syringe – 20 ml, 10 ml, 5 ml
2. Disposable hypodermic needles of 5 cm length 22G-1 and 24 1
3. Bowl containing iodine
4. Sponge holding forceps
5. Towels and towel clips
6. Drugs: 0.5% bupivacaine 15 ml
7. 2% lignocaine with adrenaline 15 ml.

b. For emergency resuscitation.

The anesthesia machine, emergency oxygen source, pipeline O_2 supply, working laryngoscope appropriate size endotracheal tubes and connectors.

- Working suction apparatus with a suction catheter
- Airways (oropharyngeal)
- IV fluids.

Anesthetic Agents and Resuscitation Drugs

Monitors: Pulse oximetry, non-invasive blood pressure monitor on the opposite upper limb, respiratory rate, ECG.

US machine and probe are prepared for the procedure under all aseptic precautions.

Position and Landmarks. Placement of the patient supine with the head turned toward the nonoperative side. Identification of the cricoid cartilage, which indicates the C6 level. Palpation of the lateral border of the sternocleidomastoid muscle (SCM), and movement of the fingers laterally into the interscalene groove (between the anterior and middle scalene muscles).

Procedure

The patients were allocated to each group by computerized randomization. Parts are prepared for the block to be performed with iodine solution. Anatomical landmarks are identified, and skin wheal is raised using lignocaine 2% 3 ml solution. In Group 1 US, block is performed after real time visualization of the vessels, nerve and bone with in plane approach using 10 ml syringe containing local anesthetic. The local anesthetic is injected and the drug distribution in noted. This procedure was done using sonosite US machine with 13-6 MHz transducer by the in-plane approach using 22G needle. In Group 2, conventional interscalene

brachial plexus was performed by eliciting paresthesia, and when paresthesia was obtained,the needle was withdrawn about 1-2 mm, then the drug is injected.

The Various Parameters were Noted

- Time taken for the procedure
- Onset and duration of sensory neural blockade
- Onset and duration of motor blockade
- Success rate

Incidence of complications

Grading of Sensory Blockade

- 0 no pain
- + mild pain
- ++ moderate pain
- +++ severe pain.

Grading of Motor Blockade

- 0 no contraction
- 1 Flicker of contraction
- 2 Active movement with gravity eliminated
- 3 Active movement with gravity
- 4 Active movement with gravity and resistance
- 5 Normal power
- Data were collected every 3 min for first 15 min. Next every 5 min for 15 min and later every 10 min for 30 min and every 15 min till the end of surgery and every 30 min at least for 8 h post-operatively
- Assessment of complete recovery of both sensory and motor blockade was done for 8 h post-operatively.

Statistical Analysis

Results were statistically analyzed using Chi-square and Fisher exact test. Non parametric values were analyzed using Student's *t*-test.

Observation and Results

A prospective, randomized, comparative study was conducted in the Department of Anesthesiology and Critical Care, GIMS Teaching and General Hospital, Gulbarga on 60 patients aged between 18 and 60 years posted for upper limb surgeries.

There were no clinical or statistically significant differences in the demographic profile of patients in either group.

Age and Weight

The average age was 30.12±9.00 in Group 1 (US), and 33.30±10.10 years in Group 2. Youngest patient in our study group was 18 years, and oldest was 55 years. The average weights of the patients were 62.53±8.97 kg in Group 1 (US) and 60.66±10.09 in Group 2 respectively. There was no significant difference in age and weight between the two groups (Table 1, Figures 1 and 2).

Table 1: Comparison of age and weight distribution between the two groups

	Group	Group 1 (US)	Group 2	*P* value
Age (years)	Mean ± SD	30.12±9.952	33.30±10.99	0.245
Weight (in kg)	Mean ± SD	62.53±10.51	60.66±8.54	0.453

Table 2: Sex distribution between the two groups

Group	Group 1 (US)	Group 2	Test	*P* value
Sex				
Male	25	23	Fischer's exact test	0.3740
Female	5	7		

Table 3: Time taken for the procedure between the two groups

	Group	Group 1 (US)	Group 2	*P* value
Time taken for the procedure (min)	Mean	10.1	5.43	<0.0001
	SD	1.151	1.454	

Table 4: Onset of sensory block in the two groups

	Group	Group 1 (US)	Group 2	*P* value
Onset of sensory blockade (min)	Mean	10.83	11.60	0.3223
	SD	3.19	2.457	

SD: Standard deviation, US: Ultrasound

Sex Distribution

Both groups had predominantly male patients, accounting for more than 2/3 of the total study population in each group (Table 2 and Figure 3).

Time Taken for the Procedure

The mean time taken for the procedure to administer a block by eliciting paresthesia (Group 2) was 5.43 min, whereas using an US (Group 1), the time required for the same was 10.1 min. This was clinically and statistically significant (Table 3).

Onset of Sensory Blockade

The mean time of onset of sensory blockade in Group 1 (US) was 10.83 ± 2.94 min and 11.60 ± 3.48 min in Group 2. The slightly delayed onset of sensory blockade in Group 2 is however not statistically significant (Table 4).

Onset of Motor Blockade

The onset of motor block was within 14.56 ± 4.49 min in Group 1 (US) and 16.8 ± 3.62 min in US group. This difference is statistically significant (Table 5).

Duration of Sensory Blockade

In Group 1 (US) the mean duration of sensory blockade was 397.931 min and 352.22 in Group 2. The duration of sensory blockade was shorter in Group 2 when compared to Group 1 (US). This is considered statistically significant (Table 6).

Duration of Motor Blockade

The mean duration of motor blockade in group US was 343.448 ± 94.03 min and 305.19 in Group 2. The duration of motor blockade was shorter in Group 2 when compared to Group 1 (US), and it was statistically significant (Table 7).

Overall Effectiveness of the Block

The block was successful in 90% in US Group 1 and 70% of patients in Group 2. Of the remaining patients, partial block requiring additional sedation/analgesia was 6.66% in US group and 23.31% in Group 2. Total failure of block occurred in 3.33% in Group 1 compared to 6.66% in Group 2. These were comparable both clinically and statistically. This was not statistically significant (Table 8).

Table 5: Onset of motor blockade in the two groups

Group	Group 1 (US)	Group 2	*P* value
Mean (min)	14.566	16.8	0.0211
SD	3.8567	3.4280	

SD: Standard deviation, US: Ultrasound

Table 6: Duration of sensory blockade

Group	Group 1 (US)	Group 2	*P* value
Mean (min)	397.931	352.22	0.0321
SD	67.32508	87.501	

SD: Standard deviation, US: Ultrasound

Table 7: Duration of motor blockade in the two groups

Group	Group 1 (US)	Group 2	*P* value
Mean (min)	343.448	305.19	0.0216
SD	60.8438	60.088	

SD: Standard deviation, US: Ultrasound

Table 8: Overall effectiveness of the block

	Group 1 (US)	Group 2	Test	*P* value
Totally effective	27	21	Chi-square	0.5230
Partially effective	2	7	test	
Failure	1	2		
Total	30	30		

P>0.05, US: Ultrasound

Complications

Incidence of complications was as follows

Table 9: Complications between two groups

Complications	Count	Percent
Group 1 (US)		
Nerve injuries	0	0
Vessel puncture	0	0
Pneumothorax	0	0
Nil	30	100
Group 2		
Nerve injuries	3	10
Vessel puncture	3	10
Pneumothorax	0	0
Nil	24	80

US: Ultrasound

Discussion

The key to successful regional anesthesia is deposition of local anesthesia accurately around the nerve structures. In the past, electrical stimulation or paresthesia, which relied on surface landmark identification, was used for this. However, landmark techniques have limitations; variations in anatomy and nerve physiology, as well as equipment accuracy, have had an effect on success rates and complications. The introduction of US may go some way to changing this.

This study is intended to compare the conventional method by eliciting paresthesia with US guided interscalene brachial plexus block in terms of time taken for the procedure, onset and duration of sensory blockade, onset and duration of motor blockade, success rate and the incidence of complications

The mean time taken for the procedure to administer a block by eliciting paresthesia (Group 2) was 5.43 min, whereas using an US (Group 1), the time required for the same was 10.1 min. This was clinically and statistically significant..

The onset of sensory blockade in all the major nerve distributions was almost similar in the conventional and US groups in our study. Onset time of sensory block with the use of US in our study was 10.86 min and 11.60 min with the conventional method.

The present study showed that out of 30 patients in US group, 27 blocks (90%) were completely successful; two blocks (6.66%) were incomplete and needed supplementation; one block (3.33%) failed and required general anesthesia. Out of 30 patients in conventional group, 21 blocks (70%) were completely successful; 7 blocks (23.31%) were incomplete and needed supplementation; and 2 blocks (6.66%) failed and required general anesthesia.

In the present study, the onset of motor blockade was early in US Group 1 than in Group 2.

In our study we found that vessel puncture (10%)/nerve injury(RLN) (10%) occurred in the conventional group . whereas US group had no case of vessel puncture (0%) and no cases of nerve injury(0%). because US provides direct visualization of vessels around the plexus and also needle path. We can also take the help of Doppler to visualize the vessels.

Conclusions

From our study, it was concluded that:

- Success rate of the block was more with US group than conventional.
- Time taken for the block performed by US was longer than the conventional technique.
- Onset of sensory and motor blockade was little earlier in Group-1 (US) than in Group-2.
- Duration of sensory and motor blockade was greater in US group.
- Incidence of complications like vessel puncture and nerve injury was seen more in conventional method.

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