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"COMPARISON OF PARAESTHESIA GUIDED TECHNIQUE AND ULTRASOUND GUIDED TECHNIQUE FOR SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERIES"

Anaesthesiology

Dr. Vaibhavi V. Mendapara — Junior Resident, Department of Anaesthesiology, Gujarat Adani Institute of Medical Sciences, Bhuj, Gujarat, India.

Dr. Vivek N. Kadavala — Junior Resident, Department of Anaesthesiology, Gujarat Adani Institute of Medical Sciences, Bhuj, Gujarat, India

Dr. Ramnandan Prasad — Professor And Head, Department Of Anaesthesiology, Mmimsr, Mullana, Ambala, Haryana

Dr. Neel Joshi* — Consultant and intensivist at Sterling Hospital, Gandhidham, Kachchh. *Corresponding Author

ABSTRACT

Introduction: Brachial plexus block provides good amount of analgesia and anaesthesia for surgeries of upper limb below mid-arm. Ultrasound aid is gaining popularity for better outcome. **Material and methods:** After obtaining institutional ethical committee approval and informed written consent this study was conducted in 80 patients, randomly divided in two groups belongd to either conventional technique or ultrasonography aided technique to receive Supraclavicular brachial plexus block. They were compared in terms of time to complete the procedure, sensory and motor characteristics and any complications related to procedure. **Result:** Demographic data and vitals were comparable among both the groups. Time to complete the procedure was more with ultrasonography aid. Onset was faster and duration was prolonged for both sensory and motor blockade with ultrasonography(USG) guided technique. Lesser complications were observed with ultrasonography group. Blockade with USG were 100% successful. **Conclusion:** Ultrasonography aided blocks are more accurate and safe compared to conventional technique but required thorough knowledge of sonoanatomy and basic principles of sonography use.

KEYWORDS

Ultrasonography, Supaclavicular block, sensory and motor blockade

INTRODUCTION:

Pain is always underestimated and undertreated. The relief of pain during surgery is the main part of anaesthesia. Regional nerve blocks prevent the unwanted stress of laryngoscopy and tracheal intubation and the adverse effects of general anesthetic drugs[1]. It provides better intraoperative and prolonged postoperative pain relief. Minimizing the stress response and minimizing anaesthetics drug requirements are beneficial to the patients with various cardio respiratory comorbidities.

Brachial plexus blocks provide a wonderful alternative to general anaesthesia for upper limb surgeries. They achieve near-ideal operative conditions by providing complete and prolonged pain relief, muscle relaxation, maintaining stable intra- operative hemodynamics and adequate sympathetic block.

The paraesthesia guided subclavian perivascular technique being a blind technique may be associated with higher failure rate, injury to nerves and vascular structures. To minimize these drawbacks, various techniques and approaches were described. Among them, ultrasound visualization of anatomical structure is the only method offering safe block of superior quality by optimal needle positioning[2]. Ultrasound has improved success rate with excellent localization and improved safety margin[3].

In our experience paraesthesia guided supraclavicular brachial plexus block is an excellent technique in case of morbidly obese patients. In these patients, sometimes one cannot appreciate the anatomy on ultrasound and it is difficult to find brachial plexus. We can use paraesthesia guided technique in these patients.

In countries like India where we do not have ultrasound machines in majority of private clinics and operation theatres, paraesthesia guided technique for supraclavicular brachial plexus block is highly effective and reliable.

This study was designed to compare the time honored, well proven conventional subclavian perivascular approach after eliciting paraesthesia and the recently popularizing ultrasound guided technique for supraclavicular brachial plexus block with regards to time taken for the procedure, onset and duration of block, success rate, overall effectiveness of the block and incidence of complications involved.

MATERIAL AND METHODS:

After obtaining approval from the institutional ethical committee and written informed consent from patients, this prospective, randomized double blind clinical study was conducted in 80 ASA grade I or ASA grade II patients, aged from 17 to 60 years who underwent elective upper limb surgeries under supraclavicular block at Department of Anaesthesiology, G. K. General Hospital and Gujarat Adani Institute of Medical Sciences, Bhuj.

Patients not willing to participate in study and having coagulopathy, peripheral neuropathy, local injection site infection and allergy to local anaesthetics were excluded from the study.

Patients were randomly allocated into one of the two groups of 40 patients each using computer generated random number sequence and hide into sealed opaque envelope.

Group-P (n=40):
Supraclavicular brachial plexus block given by paraesthesia guided subclavian perivascular technique.

Group- US (n=40):
Supraclavicular brachial plexus block given with ultrasound guidance.

Block was performed with 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with adrenaline 1:2,00,000 in both the groups.

Preanaesthetic evaluation:
All the patients underwent thorough pre-anesthetic evaluation and ASA risk was stratified. The patients were stabilized if there was any significant comorbid medical illness. Basic investigations such as Haemoglobin (Hb)%, bleeding time, clotting time, serum urea, serum creatinine, blood sugar, blood grouping and cross matching, Urine: albumin, sugar and microscopy, Electrocardiography (ECG) and chest X-ray PA view were done. All the patients were kept nil per oral as per the fasting guidelines.

In the operating room :
Peripheral intravenous line was accessed using 18G intravenous cannula. All the patients were premedicated with injection glycopyrrolate 8µg/kg intravenously. Intravenous fluid was started for all patients.

Monitors:
Pulse oximetry, non-invasive blood pressure monitor on the opposite upper limb and electro-cardiogram (ECG) were connected and baseline parameters were recorded for all patients.

Assessment Of Parameters:
All the patients were monitored for

1. Time taken for the procedure - Calculated from the time of insertion of needle to its removal.
2. Onset of sensory blockade – Time interval between administration of drug and perception of pin prick as touch (Hollme's scale 3) in any one of the major nerve distribution area.
3. Duration of sensory blockade - The time elapsed between the injection of drug and appearance of pain requiring analgesia (Hollmen's scale less than or equal to 1) in all the 4 major nerve distribution areas.
4. Onset of motor blockade – time interval between administration of drug and loss of flexion or extension movements in the arm. (Lavoie's scale 3)
5. Duration of motor blockade - the time elapsed between injection of drug and complete return of muscle power. (Lavoie's scale 1)
6. Overall effectiveness of block - Intended surgical procedure being able to be performed with no sedation.
7. Success Rate - All the totally and partially effective blocks were considered as successful blocks in this study.
8. Heart rate, non-invasive blood pressure and oxygen saturation were monitored and recorded at 0, 3, 6, 10, 15, 20, 30, 45, 60, 90, 120, 240, 480 minutes
9. Incidence of complications.

Assessment Of Sensory Blockade By Hollmen's Sensory Scale[4]:
Sensory and motor block was assessed once in every minute for initial 5 minutes and then every 2 minutes up to 10 minutes, then every 5 min utes for 30 minutes.

1. Normal sensation of pin prick.
2. Pinprick felt as sharp pointed but weaker compared to the area in the opposite limb.
3. Pinprick recognized as touch with blunt object.
4. No perception of pin prick.

Assessment Of Motor Blockade By Lavoie's Scale[5]:
Grade 1- 0% – flexion and extension in both the hand and arm against resistance
Grade 2 - 33%- flexion and extension in both the hand and arm against gravity but not against resistance.
Grade 3- 66%- flexion and extension movements in the hand but not in the arm.
Grade 4- 100%- No movement in the entire upper limb.

Partially effective:
Intended surgical procedure being able to be performed with minimal sedation. When required, injection pentazocine (0.5 mg/kg) bolus dose and intermittent doses of injection ketamine (0.5 mg/kg) was given intravenously to supplement the anaesthesia.

Failed block:
Intended surgical procedure not being able to be performed under the block and required conversion to general anaesthesia.

Statistical analysis:
Data were collected in case record form. Plotted in Excel sheet. Data were analyzed using formula in Microsoft excel 2007. Quantitative data were analyzed with t-test while chi-square test was used for qualitative data. $P < 0.05$ considered statistical significant.

RESULTS:
Demographic data (Table 1) and vital parameters (Figure 1,2,3) were comparable between the two groups.

Sensory and motor characteristics comparison and time taken to complete the procedure was as per the table 1.

Table 1: Comparison of the demographic data and block characteristics between two groups

	Group P	Group US	P Value
Age (mean ± SD)	39.35 ± 13.61	39.17 ± 16.16	0.96
Gender (Male/Female)	29 / 11	27/13	0.6
Time taken for the procedure (min) (Mean ± SD)	5.75 ± 3.05	8.75 ± 2.27	< 0.0001*
Onset of sensory block (min) (Mean ± SD)	10.27 ± 3.70	8.01 ± 2.59	0.0022*
Duration of sensory block (hours) (Mean ± SD)	5.48 ± 1.01	6.18 ± 0.99	0.0025*
Onset of motor block (min) (Mean ± SD)	12.67 ± 3.71	10.24 ± 3.17	0.0023*
Duration of motor block (min) (Mean ± SD)	5.11± 1.09	5.76 ± 0.81	0.0033*
Effectiveness of block (Total / Partial / failed)	30 / 7 / 3	39 / 1 / 0	0.013*

***- $P < 0.05$ – statistically significant**

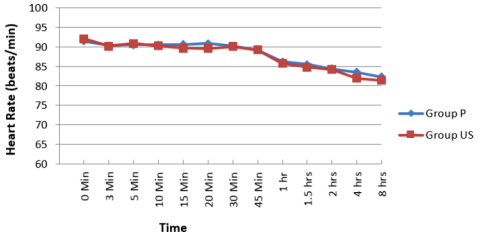

Figure 1: Comparison of Heart rate between two groups

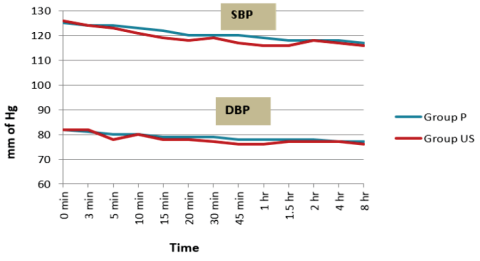

Figure 2: Comparison of blood pressure between the two groups.

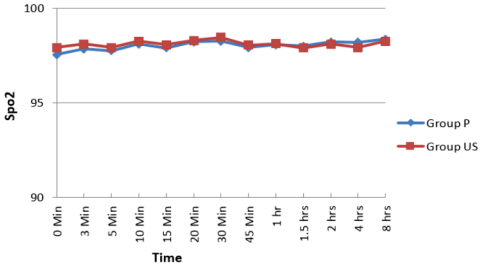

Figure 3: Comparison of peripheral arterial oxygen saturation

The only observed complication was arterial puncture, 1 in ultrasound group and 5 in conventional technique group. No other complication observed in either group.

DISCUSSION:
Demographic data were comparable between two groups in our study. Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure and oxygen saturation were comparable between the groups in our study (p>0.05). Similar results were found in study by **Gajendra Singh et al[6].**

The mean time taken for ultrasound guided supraclavicular block in our study was 8.75 ± 2.27 minutes and for paraesthesia guided technique it was 5.75± 3.05 minutes. The p value was 0.0001. Hence, paraesthesia guided technique is significantly faster to perform than ultrasound guided technique (p<0.005). The time delay in ultrasound guided technique was found to be due to the variable sonoanatomy, difficulty in orienting the shaft and the tip of the needle longituidinal to the probe and due to the difficulty in keeping the probe at one point. Our results are comparable with the study by **Gajendra Singh et al[6]** (10.1± 1.15 minutes vs 5.43± 1.45 minutes), **Veeresham et al[7]** (9.97±2.44 minutes vs 5.37±1.45 minutes) for USG guided and paraesthesia guided block respectively. ($P < 0.0001$) in both the studies. The mean onset time for sensory blockade in ultrasound group (US) was 8.01±2.59 minutes and in paraesthesia group it was

10.27±3.70 minutes. The difference between the two groups was statistically significant with a 'p' value of 0.0022. This can be due to the direct visualization of structures in ultrasound group. Moreover, we can administer the drug intrafascially with ultrasound guidance. **Sivashanmugham et al**[8], in their study inferred that the injection of local anaesthetic solution intrafascially resulted in more faster onset of block than an extrafascial injection. In a Study by **Shweta S. Mehta et al**[9], the onset of sensory blockade was significantly faster in ultrasound guided technique (6.64±0.89 minutes) than conventional nerve stimulator technique (9.64±1.14 minutes). Wherever results by **Gajendra Singh et al**[6] (10.83 ± 2.94 minutes vs 11.60 ± 3.48 minutes), **Veeresham et al**[7] **(**11±2.97 minutes vs 11.27±3.48 minutes) for USG guided and paraesthesia guided block respectively. They do not found statistically significant difference between the sensory onset time between the two groups.

The mean onset of motor block in conventional technique was 12.67±3.71 minutes and in ultrasound group was 10.24±3.17 minutes. ($p < 0.0023$) Similar kind of results were found by **Gajendra Singh et al**[6] (14.56±4.49 minutes vs 16.8±3.43 minutes) and **Mithun Duncan et al**[10]. The reason for this discrepancy in the onset time was found to be due to the direct real time visualisation of plexus sheath with the help of ultrasound and level of expertise with the use of ultrasonography and knowledge of sonoanatomy.

The mean duration of sensory blockade in ultrasound group (US) was 6.18 ±0.99 hours and in paraesthesia group it was 5.48 ± 1.01 hours. ($P<0.05$) Similar kind of results were obtained by **Gajendra Singh et al**[6] (397.93 ± 67.32 minutes vs 352.22 ± 87.50minutes), **Veeresham et al**[7] **(**444.16±116 minutes vs 393.2±95.33 minutes) for USG guided and paraesthesia guided block respectively.

The mean duration of motor blockade in group US was 5.11±1.09 hours and in group P, it was 5.76±0.81 hours. The difference between the two groups was statistically significant with p value of 0.0033 ($p < 0.05$). Comparable duration found in study by **Gajendra singh et al**[6], (343.45 ± 60.84 minutes vs 305.19 ± 60.08 minutes).

Out of the 40 cases studied under ultrasound group, 39 blocks were complete and 1 block was inadequate with sparing of ulnar nerve segment, none of the patients had failed block. Thus 97.5% of patients attained complete block, 2.5% had partial blockade and 0% failure.

Out of the 40 cases studied under subclavian perivascular approach 30 blocks were complete, 7 were partial and 3 totally failed blocks. Thus statistically 75% of patients attained complete block, 17.5% had partial blockade and 7.5% failure. So the success rate was 92.5% in conventional subclavian perivascular technique and 100% in ultrasound guided technique. Results are comparable to studies by other authors[6,11,12]. Result was statistically not significant but clinically it impact the overall patient satisfaction.

Explanation to this difference - can be due to needle migration while injecting the drug in case of conventional paraesthesia technique and also due to real time imaging possibility with ultrasound. Moreover, we can change the needle direction under ultrasound guidance while injecting the drug.

The only complication observed in our study was vascular puncture. 1 in ultrasound group and 5 in paraesthesia group, which was managed by superficial compression for 15 minutes. No other complication was elicited in this group. The difference between the two groups was not statistically significant with p value 0.16($p>0.05$). Similar pattern seen in studies by **Chethananda et al**[13], **Yuan JM et al**[14]**, Gajendra singh et al**[6]and **Veeresham et al**[7].

Gauss et al[15], reported an incidence of pneumothorax in 4 out of 6366 patients in ultrasound guided supraclavicular block. i.e., the incidence is 0.06%. They quoted that the incidence of pneumothorax in ultrasound group in their study, may be due to faulty image setting, inability to obtain the view of needle tip and inadequate supervision by inexperienced trainee anaesthesiologists. One rare incidence, massive hemothorax was reported by **Shivkumar singh et al**[16] with perivascular paraesthesia technique. Another rare incidence, bronchospasm was reported by **Rohini Bhat et al**[17] following conventional supraclavicular brachial plexus block. **Kaufmann et al**[18] reported that 7 patients presented with severe nerve injury, established in paraesthesia technique. The patient histories suggest that the condition, in most cases could have been avoided if careful attention had been given to the occurrence of pain during the nerve block.

In our study, the complications were statistically insignificant between the conventional and ultrasound group. This is probably due to the use of short 5 cm Huber-point needle, the injection of drug immediately after eliciting paraesthesia and avoidance of too much medial direction of needle to elicit paraesthesia in all cases in conventional group.

To conclude this study, higher success rate of complete blockade with lesser complications can be achieved with aid of ultrasound than with conventional technique for supraclavicular brachial plexus block. Though there were statistically significant difference in onset and duration of sensory and motor blockade and time taken to complete the procedure, in clinical scenario it was of little difference.

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