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ORIGINAL ARTICLE

Efficacy of Ultrasound Guided Supraclavicular Brachial Plexus Block Combined with Superficial Cervical Block in Shoulder Surgeries

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ABSTRACT

Background: Brachial plexus block is a useful alternative to general anesthesia for upper limb surgeries providing complete muscle relaxation and stable intra- operative hemodynamics. This study aimed to detect whether ultrasound guided supraclavicular brachial plexus block combined with superficial cervical plexus block is safe and effective for shoulder surgeries or not. **Methods:** A prospective clinical observational study for detecting efficacy of ultrasound guided supraclavicular brachial plexus block combined with superficial cervical plexus block in shoulder surgeries. Forty-two patients in the age group of 21–60 years undergoing shoulder surgery were assigned to one group. All patients received 30 mL volume of local anesthetics (Lidocaine 2% + bupivacaine 0.5% 1:3 mixture) for supraclavicular block and 10 mL volume of local anesthetics for superficial cervical block. All patients were assessed for: hemodynamics respiratory rate, O2 saturation, sensory block grade, motor block grade, postoperative pain, time for the 1st call for analgesia, the total dose of ketorolac (mg) given in 12 hours after surgery, incidence of failure of sensory and motor block and postoperative complications. **Results:** As regards mean arterial blood pressure, mean heart rate, oxygen saturation and respiratory rate there were no significant changes. Regarding sensory and motor block assessment, majority 95.2% had Bromage scale III and sensory block grade zero. As regard the postoperative pain, mild pain (VAS 2) occurred which was increasing gradually during 1st 12 postoperative hours. **Conclusions:** Ultrasound guided supraclavicular brachial plexus block combined with superficial cervical plexus block is safe and effective for shoulder surgeries.

Keywords: shoulder surgery, ultrasound gui ded, supraclavicular brachial plexus block, superficial cervical plexus block, regional anesthesia.

INTRODUCTION

Brachial plexus block is a useful alternative to general anesthesia for upper limb surgeries, providing complete muscle relaxation, stable intra- operative hemodynamics, and a smooth transition to postoperative pain relief [1]. The most significant advantage of regional anesthesia for surgery of the upper extremity is the prolonged postoperative analgesia that a nerve block can provide [2].

Many approaches to brachial plexus block have been described, but the supraclavicular approach is the easiest and most effective method for anesthesia and management of perioperative pain in surgery below the shoulder joint because in SCBPB the Trunks of the Brachial plexus are blocked, so it means complete covering for the distal and proximal parts of the upper limb without ulnar sparing as in the infraclavicular approach and without distal sparing as in interscalene approach [3].

Supraclavicular brachial plexus block (SCBPB) was not used for shoulder arthroscopic surgery because it had been believed that the suprascapular nerve, which innervates 70% of the shoulder joint, could not be blocked by SCBPB [4], but a large prospective study

demonstrated the clinical effectiveness of SCBPB for shoulder surgery [5].

The ultrasound (US)-guided technique gives the best quality of regional block, irrespective of the approach, most probably due to the visualization of the targeted structures (for example, nerve, sheath, or inter-fascial space), as well as the visualization of the needle and the spread of the local anesthetic after the injection [6].

The rationale for using superficial cervical plexus block is that the brachial plexus supplies all the motor and most of the sensory functions of the shoulder, except the cephalad cutaneous areas of the shoulder, which are innervated by the supraclavicular nerves, originating from the superficial cervical plexus (C3-C4).

This study aimed to assess the hemodynamic characteristics, quality of sensory and motor block, and postoperative pain in shoulder surgeries using ultrasound-guided supraclavicular brachial plexus block combined with superficial cervical plexus block.

METHODS

After obtaining approval from the scientific committee of the anesthesia and surgical intensive care department and the institutional review board (IRB) of faculty of medicine, Zagazig University. Written informed consents were obtained from all participants. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

This prospective clinical observational study was carried out at Zagazig University Surgical Hospitals from August 2018 to February 2019.

Forty-two patients undergoing shoulder surgery were assigned to one group. Forty mL of local anesthetic mixture (Lidocaine 2% + bupivacaine 0.5% at a ratio of 1:3 respectively) was prepared. All patients received 30 mL of the local anesthetic mixture for supraclavicular block and 10 mL of local anesthetic mixture for superficial cervical block. Two cases were excluded due to failure of the sensory block, and general anesthesia was started.

Inclusion criteria: Age range of 21-60 years of both sexes. Physical status: American Society of Anesthesia classification (ASA) I or II, body mass index (BMI) < 35 kg/m^2. Operations included shoulder procedures such as shoulder fracture dislocation and shoulder arthroscopy. Duration of surgery was not expected to last more than 2 hours. Exclusion criteria were patients refusing regional block, patients with known allergy to study drugs, patients with peripheral neuropathy, drugs addiction, patients with chronic pain or on regular medication with analgesic drugs, mentally challenged or non-cooperative patients, patients receiving anti-coagulant therapy or suspected coagulopathy (INR >1.4), patients with psychiatric disorders, and who had local contraindications to regional anesthesia (skin infection, skin disease, hematoma).

All patients were visited a day before the surgery and all the details of the anesthetic procedure were explained. Parameters such as mean arterial blood pressure (MAP), heart rate (HR), respiratory rate (RR), and oxygen saturation (SpO_2) were recorded as baseline readings. All patients were kept fasting before the operation (8 h for fatty meal, 6 h for light meal, and 2 h for clear fluids).

On arrival to the operating room, standard monitors were attached. An 18-gauge intravenous cannula was inserted on the limb opposing the site of surgery (opponent limb). A transportable ultrasound system (M-Turbo, Sonosite, Bothwell, USA) with the superficial linear array 8-12 MHz transducer was used to guide local anesthetic block for all patients.

During the supraclavicular brachial plexus block: the patient lied in a supine position with a pillow under the shoulder of the operated limb. Sterile preparation of the skin and ultrasound probe was done. Skin local anesthesia was done using 1cm of lidocaine 2%. Gel was applied, and the transducer was placed in a sagittal plane behind the middle third of the clavicle in the supraclavicular fossa to visualize the brachial plexus, which was seen as an oval hypoechoic structure (lateral and posterior to the pulsatile subclavian artery and superior to the first rib). Insertion of the needle in-plane from lateral to medial and injection of lidocaine-bupivacaine

mixture was done. A medio-lateral needle direction aimed to avoid pleural puncture in cases in which the needle was poorly visible with ultrasound. Thirty mL of the lidocaine-bupivacaine mixture solution was infiltrated at two puncture sites. The optimal injection site had been described as being in the 'corner pocket', which is bordered by the first rib inferiorly, the subclavian artery medially, and the brachial plexus superiorly. The other site was superior to the plexus.

During the superficial cervical plexus block: This block was typically performed in the supine or semi-sitting position, with the head turned slightly away from the side to be blocked to facilitate operator access. However, any patient position that allowed comfortable placement of the ultrasound transducer and needle advancement was appropriate.The transducer was placed over the lateral side of the neck at the midpoint of the posterior border of sternocleidomastoid muscle (SCM). The needle was introduced in-plane from the posterior aspect through the skin and platysma then 10 ml of local anesthetic mixture was deposited just behind the posterior border of SCM.

Mean arterial blood pressure (MAP), mean heart rate (HR), respiratory rate (RR) and (SPO_2) of the patients were recorded at 5 minutes interval for the first 15 minutes and then every 15 minutes for the remaining time of the surgery.

Sensory block was assessed in the distribution of each of the major peripheral nerves (axillary, radial, ulnar, medial brachial cutaneous, medial antebrachial cutaneous, musculocutaneous, and median nerves) and around the shoulder by pinprick using a sterile blunt-end 25-gauge needle at 0, 2, 5, 10, 15, 20, and 30 min after the block. Sensory block was graded according to a 3-point scale: (0= complete block (no sensation), 1 = partial block (decrease sensation), 2 = no block (normal sensation) [7]. Motor block was assessed using Modified Bromage Scale [8] (Figure 1). The patient was considered ready to undergo the surgical procedure at score 3 of Bromage Scale and sensory grade 0. The incidence of failure of motor and sensory block was recorded. General anesthesia was induced in case of insufficient motor and/or sensory block (Bromage <3 or sensory block grade 2) after 30 minutes of the block, and the patient was excluded from the study.

Duration of sensory block, defined as the time between the end of injection of local anesthetics in supraclavicular block and the return of dull pain and VAS<3 was recorded (TendS).

Duration of motor block, defined as the time between the end of injection of local anesthetics in supraclavicular block and the return of movement was recorded (TendM) (Bromage =0).

Postoperative pain was evaluated and recorded based on a visual analogue scale [9]. On a scale of 0-10, the patient was asked to quantify postoperative pain as the following from: 0: No pain to 10: Maximum/worst imaginable pain.

Time of the first call for analgesia (starting from the block until VAS ≥ 3) was recorded, and ketorolac 30mg IM was given.

The total dose of ketorolac given 12 hours after surgery was recorded.

Postoperative nausea and vomiting, Horner syndrome, respiratory depression, circumoral tingling and numbness, arrhythmia, or any other complications were recorded if they occurred.

Sample size:

A comprehensive sample was taken, which included most cases (according to inclusion criteria) undergoing shoulder surgery during a period of 6 months (7 cases per month), sample equal 42 cases.

Statistical analysis

Data collected throughout history, basic clinical examination, laboratory investigations, and outcome measures were coded, entered, and analyzed using Microsoft Excel software. Data was then imported into Statistical Package for the Social Sciences software for analysis (SPSS version 20.0). According to the type of data, qualitative data were represented as numbers and percentages and analyzed by the Chi square test, quantitative data were represented by mean ± SD and analyzed by the t test. The following tests were used to test differences: differences between quantitative data were compared by paired t test and differences between qualitative

data were compared by sign test. P value was set at <0.05 for significant results and <0.001 for highly significant results.

RESULTS

The characteristics of patients in the current study (in terms of age, sex, and ASA grading), type of surgery, and duration of surgery showed no statistically significant differences between patients of the studied group **[Table 1].**

There were no statistically significant differences as regards mean arterial pressure (MAP) between patients of the studied group at different times of the study with a P value >0.05 **[Table 2].**

There were no significant differences as regards mean heart rate (HR) between patients of the studied group at different times of the study with a P value >0.05 **[Table 3].**

There were no statistically significant differences as regards oxygen saturation (SPO_2) between patients of the studied group at different times of the study (P >0.05 **[Table 4]**.

The majority of patients in the group of the current study (95.2%) had Bromage scale III and sensory block grade zero **[Table 5]**.

First call for analgesia between patients of studied group was postoperative with a minimum of 135 minutes and a maximum of 240 minutes starting from the end of the injection of the block (zero time).

Patients experienced no pain during the early postoperative time, then mild pain occurred which increased gradually during 1st 12 postoperative hours. Visual analogue scale (VAS) score from 10 minutes till 12 hours: start as 0.0 (0-2) and end as 0 (0-3), with significant change (P <0.05) between 10 minutes and 40 minutes, 50 minutes, and 60 minutes. And there was a significant change (P <0.05) between 10 minutes and 2 hours and 4 hours, there were significant differences between 12 hours and 50, 60 minute and between 12 hours and 2 and 4 hours **[Table 6]**.

Regarding total dose of ketorolac given in 12 hours after surgery, 28 patients needed only one dose (30mg) while 12 patients needed 2 doses (60mg) of ketorolac. These results indicate that the majority of patients needed one dose of ketorolac in 1st 12 postoperative hours with highly statistically significant difference (p<0.001) when compared to those who needed 2 doses during the same time.

As regards failure rate, failure occurred only in 2 cases 4.8% (sensory block grade 1) and general anesthesia was started. The failure occurs in 2 cases of shoulder arthroscopy which need posterior incision as suprascapular nerve may be spared (sensory block grade 1).

As regards postoperative complications, there weren't any complications between patients of studied group.

Table (1): Patient characteristics in the studied group

Variables			
Age (years)	37.29 ±7.14		
Sex		**N**	**%**
	Male	23	54.8
	Female	19	45.2
ASA (American society of anesthesiology)	**I**	42	100
	II	0	0
Duration of surgery (min)	107±11		
Type of operation	38 cases were shoulder fracture dislocation, 2 cases were shoulder arthroscopy (anterior incision) 2 cases were shoulder arthroscopy (posterior incision) [which were excluded]		

Table (2): MAP changes (mmHg) in the studied group during intraoperative time

Time	MAP (mmHg)
Zero	77.85±8.7
5 minutes	80.14±10.43
10 minutes	81.45±7.73
15 minutes	82.3±6.03
30 minutes	79.54±8.39
45 minutes	78.85±7.46
60 minutes	77.4±7.98
75 minutes	78.33±7.02
90 minutes	81.26±5.76
105 minutes	80.59±5.46
120 minutes	80.26±6.16

Table (3): Mean heart rate changes in the studied group during intraoperative time

Time	HR(b/min)
Zero	75.61±9.1
5 minutes	81.16±10.4
10 minutes	83.33±10.38
15 minutes	81.54±8.6
30 minutes	78.47±5.42
45 minutes	78.4±6.62
60 minutes	75.09±7.73
75 minutes	78.69±5.83
90 minutes	77.52±3.18
105 minutes	77.07±5.05
120 minutes	76.78±5.09

Table (4): SPO_2 changes (%) in the studied group during intraoperative time

Time	SPO2 (%)
Zero	98.64±0.79
5 minutes	98.95±0.96
10 minutes	98.59±0.76
15 minutes	98.64±0.82
30 minutes	98.64±0.79
45 minutes	98.61±0.79
60 minutes	98.61±0.78
75 minutes	98.59±0.77
90 minutes	98.61±0.81
105minutes	98.65±0.80
120 minutes	98.66±0.78

Table (5): Sensory and motor block assessment of patients of the studied group

		N	%
Sensory block	**0**	40	95.2
	I	2	4.8
Bromage scale	**I**	0	0
	III	42	100.0
	Total	42	100.0

Table (6): VAS SCORE distribution in the studied group at different times

The first 12 postoperative time	VAS
10 minutes	0.0 (0-2)
20 minutes	0.0 (0-3)
30 minutes	1 (0-2)
40 minutes	1 (0-2) *
50 minutes	2 (0-2) *
60 minutes	3 (0-4) *
2 Hours	2 (0-3) *
4 Hours	2 (1-2) *
6 Hours	1 (0-2)
8 Hours	1 (0-2)
10 Hours	0 (0-3)
12 Hours	0 (0-3)

DISCUSSION

The present study was designed to assess efficacy of ultrasound guided supraclavicular brachial plexus block combined with superficial cervical plexus block in shoulder surgeries (e.g. shoulder fracture dislocation and shoulder arthroscopy).

Regarding mean arterial blood pressure, there were no significant changes between patients of the studied group at different times of the study. This agrees with the results obtained by De Tran et al. [10], who stated that there were no statistical differences between patients as mean arterial blood pressure shows slight increase in the first 15 minutes (about 10 mm Hg from the baseline), followed by gradual decrease to be within the normal range.

Heart rate showed no significant change between patients of studied group at different times of the study. This disagree with the results obtained by other studies [11, 12], who reported a gradual decrease in HR (about 20 bpm from baseline) due to the abrupt withdrawal of sympathetic tone with concomitant enhanced parasympathetic tone (Bezold-Jarisch reflex).This variation in results might be due to restricted type of operation in their study (shoulder arthroscopy) which require sitting position with concomitant augmentation in Bezold-Jarisch reflex, their use of preoperative fentanyl and their additional interscalene block which all decreasing sympathetic tone.

Respiratory rate and SPO_2 showed no significant changes between patients of studied group at different times of the study, which comes in concomitance with the results obtained by De Tran et al. [10], who reported slight increase in RR which then returned to normal. Meanwhile, by examining Oxygen Saturation, results were within normal range.

As regards sensory and motor block assessment in the present study, 95.2% had Bromage scale III and sensory block grade zero. This agrees with the results obtained by Franco and Vieira,[13], which revealed that the supraclavicular approach has an advantage where the brachial plexus elements are tightly grouped, which facilitates a single point injection and is believed to result in very rapid onset and powerful block.

Duration of sensory block in the current study was around 3 hours, which is in concomitance with the results obtained by Nishiyama, [14], who reported that sensory block duration ranged from 3 to 4 hours when performing brachial plexus block using similar drugs and doses.

The duration of motor block in the present study ranged from 3 to 4 hours. This agrees with the findings of Coskun and Mahli, [15], who reported that motor block duration ranged from 3 to 5 hours in brachial plexus block through supraclavicular approach.

The first call for analgesia between patients of studied group was postoperative with a minimum of 135 minutes and a maximum of 240 minutes starting from the end of injection of the block (zero time). This disagree with Arcand et al. [16], who reported that 1st use was intraoperative at the beginning of surgery, this difference is due to their restricted type of operation which was shoulder arthroscopy which need the posterior incision which may be spared (sensory block grade 1).

As regards postoperative pain, patients in the current study experienced no pain during the early postoperative time, followed by mild pain which was increased gradually during 1st 12 postoperative hours. VAS score from 10 minute till 12 hours: start as 0.0 (0-2) and end as 0 (0-3), with significant change ($P < 0.05$) between 10 minutes and 40 minutes, 50 minutes, and 60 minutes. And significant change ($P < 0.05$) between 10 minutes and 2 hours and 4 hours, there were significant differences between the end and 50, 60 minute and also between end and 2 and 4 hours. Fahmy and Hakim, [17], reported that statistical analysis of the visual analogue postoperative pain scoring in the first 12 hours revealed non-significant differences between patients who received ultrasound guided interscalene block as well as those who received ultrasound guided supraclavicular brachial plexus blocks combined with superficial cervical block.

Regarding total dose of ketorolac given in 12 hours after surgery, 28 patients needed only one

dose (30 mg), while 12 patients needed 2 doses (60mg) of ketorolac. This agree with Dewees et al. [18], who reported that analgesic requirements were minimal from 1 to 3 doses.

Regarding failure rate, failure in the current study occurred in 2 cases of shoulder arthroscopy which need posterior incision 4.8% (sensory block grade 1), and general anesthesia was started. Cornish [19] in his study reported that all blocks were successful, and no cases were converted to general anesthesia. Failure in 2 cases of our study was explained by that in shoulder arthroscopy which need posterior incision patients felt pain during skin incision as suprascapular nerve may be spared (sensory block grade 1) and preoperative analgesia was needed, which wasn't included in our study, so it was considered as failure of block.

CONCLUSIONS

From the results of this study, we concluded that ultrasound guided supraclavicular brachial plexus block combined with superficial cervical plexus block is effective in shoulder surgeries as shoulder fracture dislocation and shoulder arthroscopy which need anterior incision.

Limitations of the study

The efficacy of ultrasound guided supraclavicular brachial plexus block combined with superficial cervical block in shoulder surgeries is limited by shoulder arthroscopy which need posterior incision as suprascapular nerve may be spared. it is also limited by not comparing the results to results of a standard technique (interscalene block)

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Conflict of interests:

The authors state that there is not any conflict of interests to disclose.

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