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Evaluation of Supraclavicular Brachial Plexus Nerve Block with Patient Controlled Intravenous Analgesia for Post-Operative Pain Management in Patients with Forearm Surgery

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ABSTRACT

Objective: To compare the efficacy of supraclavicular brachial plexus block with patient-controlled intravenous analgesia (PCIA) for post-operative pain management in forearm surgery.

Study Design: Comparative Cross-Sectional Study.

Place and Duration of Study: Department of Anesthesia, Combined Military Hospital, Kharian Pakistan, from Sep 2018 to Nov 2019.

Methodology: Eighty-two adult patients, of ASA Class I and II, were enrolled and were randomly divided into two equal groups using computer-generated random numbers. General anaesthesia was administered to both groups. Additionally, Group-A (n=41) received supraclavicular brachial plexus block while Group-B (n=41) received patients-controlled analgesia. Post-operative pain was assessed using a 10 cm visual analogue scale (VAS). The pain scores were noted after complete recovery from general anaesthesia at 5 minutes, 6, 12 and 24 hours.

Results: The pain score was found to be significantly lower in Group-A (supraclavicular brachial plexus block) as compared to Group-B (patients-controlled analgesia) at 6, 12 and 24 hours ($p<0.05$) while the non-significant difference was noted at 5 minutes ($p>0.05$).

Conclusion: Significantly, better pain control was noted in supraclavicular brachial plexus block compared to patients'-controlled analgesia in post-operative pain management.

Keywords: Forearm Surgery, Post-Operative analgesia, Patient-controlled intravenous analgesia (PCIA) Supraclavicular brachial plexus block.

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INTRODUCTION

In upper limb surgeries, general anaesthesia is commonly performed as surgical anaesthesia compared to regional anaesthesia (RA), especially in low-resource settings where expertise and equipment are deficient.[1] The RA, specifically peripheral nerve blocks, offers increased pain control in the immediate post-operative period.[2,3] Brachial plexus block (BPB) is a common technique for upper limb surgeries. The BPB is applied either via Supraclavicular, Infraclavicular or Axillary approaches depending on the site of upper limb surgery, providing good intraoperative and post-operative analgesia.[4] Hence decreases complications like stress response which leads to high blood pressure and complicates the management of blood sugar and immobilization. Post-operative analgesia leads to early ambulation.[5] Nowadays, Ultrasonography for peripheral nerve block offers more accuracy and minimizes tissue injury and inadvertent intravascular injection. The volume and systemic toxicity related to local anaesthesia are also reduced using ultrasound.[6]

Supraclavicular brachial plexus block is a reliable and efficient option for general anaesthesia with minimal side effects.[7] Numerous adjuvant with local anaesthetic agents reduces the onset of time and increases the duration of peripheral nerve blocks.[8] Bupivacaine is a long-acting local anaesthetic which minimizes pain by obstructing the transmission of pain signals to the dorsal horn of the spinal cord. Further, it prevents sodium influx by binding with sodium channels and blocks nerve depolarization.[9]

Only a single study on this topic shows that the supraclavicular brachial plexus block was superior in terms of analgesia and side effects.[10] As there is a dearth of literature on this topic, the present study is designed to compare supraclavicular brachial plexus block versus Nalbuphine delivered through PCIA among patients undergoing forearm surgery.

METHODOLOGY

This comparative cross-sectional study was conducted at the Department of Anesthesia and Intensive care Unit Combined Military Hospital, Kharian

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Pakistan after formal approval from Hospital Ethical Review Committee. This study was conducted from June 2018 to November 2019. The sample size was calculated by using the WHO sample size calculator (7.4b), taking mean supraclavicular brachial plexus block (1.3±0.5) versus patient-controlled analgesia (2.9±0.8), level of significance (α)=5%, Power of test (1-β)=80%.[11] Patients were enrolled after taking informed written consent.

Inclusion Criteria: Patients aged 18-60 years, of either gender having ASA Class I and II, undergoing forearm surgeries, were included in this study through non-probability consecutive sampling.

Exclusion Criteria: Patients with a history of allergic reaction to local anaesthetic were excluded. Moreover, patients on anticoagulants or antiplatelet therapy or with coagulopathy, moderate to severe Renal insufficiency (Creatinine more than 1.5mg/dl), hepatic disease, infection at the site of the block, pregnancy and neuromuscular disorders were also excluded from the study.

All 82 patients were randomly divided into two equal groups, i.e. Group-A (n=41) and Group-B (n=41), using a computer-generated random number. Preoperatively all patients were assessed along with routine preoperative investigations, including laboratory investigations (complete blood picture, Prothrombin time, Partial thromboplastin time, urea and creatinine), chest x-ray and electrocardiogram. Patients included in this study were explained about the study procedure. Additionally, Patients in Group-A received ultrasound-guided supraclavicular brachial plexus nerve block, and Group-B patients received Patent Controlled Intravenous Anesthesia (PCIA) method, respectively.

In both groups, general anaesthesia was started with premedication with metoclopramide 10mg and Nalbuphine 5mg. Induction was given with 2-2.5 mg/kg Propofol. Injection Atracurium 0.4-0.6mg/kg was used as a muscle relaxant for intubation. Maintenance was performed with 100% oxygen and 1-1.5% Isoflorane. All patients were monitored during the procedure using pulse oximetry, non-invasive blood pressure & electrocardiogram. Uneventful recovery was noted in all patients in the immediate post-op period.

In Group-A the supraclavicular brachial plexus block was performed before general anaesthesia. Ultrasound-guided supraclavicular brachial plexus block was performed in the operating room (OR) under a complete aseptic technique with an Injection of Bupivacaine 0.25% 25-35ml.

In Group-B, Post-operatively patient-controlled analgesia was done with the Injection of Nalbuphine by using an Accufuser inserted in an 18 G cannula administrated as a fixed rate (3ml/hr base rate, 1mg bolus, 10 minutes lockout time) in 100 ml Accufuser. All those patients enrolled in the PCIA-Group were trained to use a self-controlled analgesic pump before induction of anaesthesia.

All patients of both groups were monitored in a post-operative ward with standard monitoring of ECG, Blood pressure, pulse oximetry and respiratory depression. After complete recovery from general anaesthesia, the post-operative pain was assessed using a visual analogue scale (VAS) ranging from 0 to 10. The lower VAS value indicated a lower, while the higher value indicated a higher pain level. Pain scores were recorded at 5 minutes, 6 hours, 12 hours, and 24 hours after the recovery, i.e., after the regain of consciousness. In addition, any adverse events like pneumothorax, hematoma, hypotension, bradycardia, tachycardia, nausea, vomiting, and hypoxemia were recorded. Patients with a VAS score of 5 or more were treated injection morphine 5 mg bolus stat injection, and data were recorded accordingly.

Statistical Package for Social Sciences (SPSS) version 22.0 was used for the data analysis. Mean, and standard deviation were calculated for quantitative variables like age, weight, height, BMI, disease duration, and VAS score at 5 minutes, 6 hours, 12 hours, and 24 hours. Frequency and percentages were calculated for gender, ASA status and adverse events. Inferential statistics were explored using an independent t-test for quantitative variables and a chi-square test for qualitative variables. The *p*-value lower than or up to 0.05 was considered as significant.

RESULTS

Out of the 82 patients, the mean age of the patients in Group-A (SBPNB-Group) was 35.27± 2.92 years, while the mean age in Group-B (PCIA-Group) was 35.29±1.12years. Males were insigni-ficantly higher in the SBPNB-Group than in the PCIA-Group (*p*-value 0.557). The mean BMI of the patients was insignificantly higher in the PCIA-Group com-pared to a SBPNB-Group, i.e. 27.23±5.11 vs 26.74±5.23 kg/m^2 respectively, *p*-value 0.667, 95% CI -2.76 to 1.78. ASA Class-I was insignificantly higher in the SBPNB-Group than in the PCIA-Group (*p*-value 0.182) (Table-I).

Table-I: Demographic Profile of the Study Patients (n=82)

Variables	Supraclavicular Brachial Plexus Block-Group (n=41)	Pcia-Group (n=41)	*p*-value	95% CI
	Mean±SD	Mean±SD		
Age, years	35.27±2.92	35.29±1.12	0.960	-0.99 to 0.95
Weight, kg	57.02±1.97	56.91±2.40	0.811	-0.85 to 1.09
Height, m	1.54±0.06	1.52±0.05	0.224	-0.01 to 0.04
BMI, kg/m2	26.74±5.23	27.23±5.11	0.667	-2.76 to 1.78
Duration of surgery, min	165.78±8.74	166.36±8.10	0.754	-4.29 to 3.12

The mean difference of Visual Analog Score (VAS) between Group-A (supraclavicular brachial plexus block) and Group-B (PCIA-Group) showed significantly lower pain at 30 minutes (*p*-value 0.004, 95% CI: 0.16 to 0.81), at 6 hours (*p*-value 0.004, 95% CI 0.18 to 0.93), at 12 hours (*p*-value <0.001, 95% CI: 0.41 to 1.05), and at 24 hours (*p*-value 0.004, 95% CI: 0.17 to 0.85). The pain scores were also measured with respect to time. The significant difference in the pain score was observed (*p*-value <0.001) (Table-II).

Table-II: Mean difference of Visual Analogue Scale (VAS) Score in the Study Groups (n=82)

Visual Analogue Scale (VAS)	Overall	Supraclavicular Brachial Plexus Block-Group (n=41)	PCIA-Group (n=41)	*p*-value	95% CI
		Mean±SD	Mean±SD		
5 min	3.96± 0.89	3.91± 0.94	4.02± 0.85	0.541	-0.27 to 0.52
6 hours	1.38± 0.89	1.09± 0.88	1.65± 0.82	0.004	0.18 to 0.93
12 hours	1.12± 0.82	0.75± 0.73	1.48± 0.74	<0.001	0.41 to 1.05
24 hours	0.91± 0.82	0.65± 0.61	1.17± 0.86	0.004	0.17 to 0.85

Other complications like tachycardia, bradycardia, pneumothorax, hematoma and hypoxia were observed in none of the patients in both group. A significantly higher proportion of vomiting was found among patients in the PCIA-Group (n=31, 75.6%) as compared to the SBPNB-Group (n=8, 19.5%) (*p*-value: 0.001) (Table-III).

Table-III: Comparison of Nausea and Vomiting in the Study Groups (n=82)

Groups	Nausea & Vomiting		*p*-value
	Yes (n=39)	No (n=43)	
Supraclavicular Brachial Plexus Block-Group (n=41)	8 (19.5%)	33 (80.5%)	0.001
Patient Controlled Intravenous-Group (n=41)	31 (75.6%)	10 (24.4%)	

DISCUSSION

In our study, the mean difference in pain score between the Supraclavicular Brachial Plexus Nerve Block-Group and PCIA-Group showed considerably lower pain at 30 minutes, at 6 hours, at 12 hours, and 24 hours. Similar findings were reported in previously published literature. According to a study conducted by El Shafei *et al*. in 2018, the pain score was considerably lower in supraclavicular brachial-plexus nerve block as compared to the patients receiving PCIA.[10]

Other studies reported supraclavicular brachial plexus method has many advantages over general upper extremity anaesthesia, including lower therapy pressure, increased blood circulation to the leg, and concomitant outpatient distribution.[11-13] Moreover, it is an excellent method for optimum operating conditions with full muscle relaxation, hemodynamic stabilization and related sympathetic block for upper extremist operations.[2,14-16]

In our study, nausea and vomiting were the only adverse effects noted in both groups. A considerably lower presence was noted in the supraclavicular brachial plexus nerve block. Similar findings were reported by El-Shafei *et al*.[10] In a study conducted by Chiruvella *et al*. several complications like nausea, vomiting, pruritis, and sedation were reported.[17] The author further stated that no active management is required in nausea except to increase the level of fluid transfusion. In another study, urinary retention, shivering, hypotension, and respiratory depression were the observed complications, in addition to nausea, vomiting, and pruritis.[18]

The recovery quality is considered important for patient health evaluation after surgery. Although the recovery improvement is not limited to painlessness, an important part of the recovered state is adequate pain relief. In a study, it is reported that the improved outcome in terms of the quality of recovery was remarkably reported in patients with a low level of post-operative pain.[19]

In our study, we used Bupivacaine, a long-acting local anaesthetic, to reduce pain by preventing the dorsal horn signals of the spinal cord. Studies reported that various local anaesthetic adjuvants reduce the time to start and increase the duration of peripheral nerve blocks. However, many anesthesiologists use large amounts of local anaesthesia during the supraclavicular plexus block to increase their success rate and extend the sensory and motor blocks.[20] However, this results in the unusual spread of

complications such as Horner's syndrome and increases the likelihood of systemic local anaesthetic toxicity. In addition, lower volumes of local anaesthetic may result in a shorter or incomplete block length. The supraclavicular block controlled by ultrasound makes an appropriate block with a lower volume of local anaesthesia than the blind techniques.

LIMITATIONS OF STUDY

This study findings could be observed in light of the limitation that the sample size was relatively small, so the conclusions could not be generalized. Nonetheless, a study in the literature has shown that nationally and internationally, there needs to be more information on this matter. Therefore, we recommend further large-scale multicenter studies to prevent the results of this study.

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CONCLUSION

The efficacy of supraclavicular brachial plexus block was found to be higher for forearm post-operative pain management.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

MA & AA: Conception, Study design, drafting the manuscript, approval of the final version to be published.

AA & KIT: Data acquisition, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

MZT & SS: Drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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