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# Supraclavicular Brachial Plexus Nerve Block versus Patient Controlled Analgesia for Post-Operative Pain Management in Forearm Surgery

**Mohamed Mohamed Nabil El Shafei, Mahmoud Hasan Mohamed Hasan, Ahmed Abd Eldayem Abd Elhak, Mai Mohamed Zakaria Abdelhamid**

Anesthesiology and Intensive Care Department, Faculty of Medicine, Ain Shams University

**Corresponding author:** Mai Mohamed Zakaria Abdelhamid, **Mobile:** 01112071838, **E-mail:** mai_zakaria256@yahoo.com

## ABSTRACT

**Background:** supraclavicular Brachial plexus block is an excellent method for attaining optimal operating conditions for upper limb surgeries by producing complete muscular relaxation, maintaining haemodynamic stability and the associated sympathetic block. **Aim of the Work:** the purpose of this study was to compare Supraclavicular Brachial plexus nerve block to patient controlled analgesia for postoperative pain management in forearm surgeries. Therefore, we performed a randomized study to compare the efficacy of Supraclavicular Brachial plexus nerve block with that of patient controlled analgesia. **Patients and Methods:** sixty-four patients presenting to Ain Shams University hospitals for forearm surgeries were enrolled in this prospective randomized study after providing written consents. Participants were instructed about the study protocol and visual analogue scale (VAS). Approval was obtained from the research ethics committee of anesthesia and intensive care department, at Ain Shams University. **Results:** the results of the study revealed that there is significant difference between supraclvicular brachial plexus block and patient controlled analgesia regarding the postoperative analgesia after forearm surgery. **Conclusion:** there is significant difference between supraclvicular brachial plexus block and patient controlled analgesia regarding the postoperative analgesia after forearm surgery. Significantly better pain control was observed in the supraclvicular brachial plexus block group. Patient satisfaction was greater in the supraclvicular brachial plexus block group. Nausea and vomiting were observed more frequently in patient controlled analgesia group.

**Keywords:** Patient controlled analgesia, peripheral nerve stimulation, subclavian artery, systolic blood pressure

## INTRODUCTION

Inadequate postoperative pain management has been correlated with poor functional recovery in some patients [(1)], and can activate a variety of biologic cascade systems, resulting in ileus, nausea, delayed mobilization and feeding, delayed hospital discharge, and unanticipated hospital readmission [(2)]. Opioids are considered the cornerstone for treatment of moderate-to-severe acute postoperative pain, and PCA is the most frequent mode of postoperative opioid administration [(3)]. However, potent opioids result in potential side effects, including ventilatory depression, drowsiness, sedation, nausea, vomiting, pruritus, urinary retention, ileus, and constipation are frequently observed during opioid PCA[(4)]. Because of these unwanted adverse effects, PCA is often discontinued despite insufficient pain management[(5)]. Patients consider nausea and vomiting to be the most undesirable postoperative complications [(6)]. Postoperative analgesia with fewer side effects is not only important for the patient but is also important for the surgeon. Brachial plexus block offers many advantages over general anesthesia for upper extremity surgery, including reduced surgical stress response, increased blood flow to the extremity (sympathectomy), better postoperative analgesia, earlier discharge for outpatients, and fewer side effects. The classical approaches (interscalene, supraclavicular, infra-clavicular, and axillary) have been described for many years [(7)]. Supraclavicular Brachial plexus block is an excellent method for attaining optimal operating conditions for upper limb surgeries by producing complete muscular relaxation, maintaining haemodynamic stability and the associated sympathetic block. They also provide extended postoperative analgesia with minimal side effects. In addition, it offers a better preservation of mental functions in elderly; decreased risk of aspiration due to intact pharyngeal and laryngeal reflexes; avoids difficult intubation; decreases postoperative complications associated with intubation and provides better postoperative analgesia without undue sedation facilitating early mobilization and discharge [(8)].

## AIM OF THE WORK

The aim of this study was to compare Supraclavicular Brachial plexus nerve block to patient controlled analgesia for postoperative pain management in forearm surgeries. Therefore, we performed a randomized study to compare the



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efficacy of Supraclavicular Brachial plexus nerve block with that of patient controlled analgesia.

## PATIENTS AND METHODS

Sixty-four patients presenting to Ain Shams University hospitals for forearm surgeries were enrolled in this prospective randomized controlled study after providing written consents. Participants were instructed about the study protocol and visual analogue scale (VAS). Approval was obtained from the research ethics committee of anesthesia and intensive care department, Ain Shams University. In this study all patients were preoperatively assessed for evaluation of their medical status.

**Inclusion Criteria:** Age 18-60 years. Elective operation. Six-hour fasting hours. Physical Status: ASA I and II patient after taking written and informed consent. No neurologic symptoms involving the upper extremities.

**Exclusion Criteria:** Refusal of procedure or participation in the study by patients. Physical status: ASA **III** or above. Renal insufficiency (Creatinine more than 1.5 mg/dl). Diabetes with significant peripheral neuropathy. History of patient controlled analgesia (PCA) discontinuation due to adverse effects. Patients who had severe bronchopulmonary disease. History of allergy to the study drug. Body mass index (BMI) more than 35. Patients with coagulation disorders. Patients on drugs (anti-coagulant and anti-platelet).

**Randomization Method:** Patients were assigned randomly using their serial numbers, provided by acomputer program into two equal groups: **Group A: (n = 32):** patients receiving ultrasound guided supraclavicular brachial plexus nerve block. **Group B: (n = 30):** patients receiving patient controlled analgesia.

**Anesthetic Management Plan:**

**Pre-operative Settings:** Routine preoperative investi-gations were done to all patient including laboratory investigations as (complete blood picture, Bleeding time, Prothrombin time and Partialthromboplastin time), chest x-ray and electrocardiogram.

**Intra-operative Settings:** In group A supra-claviculr block ultrasound guided was done in the operating rooms (OR) under complete aseptic technique with prophylactic antibiotics given 1 hour preoperatively. The supraclavicular block was performed before general anesthesia. The patients were monitored during the procedure using pulse oximetry, non-invasive blood pressure &ECG.

**Post-operative Settings:** In group B, patient controlled analgesia was done by using accufuser inserted in 18 G cannula administrated as fixed rate 4 ml/hr (infuse morphine 20mg, granisetrone 2mg, ketorolac 60mgat constant rate) and a bolus (0.5 ml with a lockout time 8 min) in 100 ml accufuser. Patients in both groups were kept under observation postoperatively to monitor vital signs (conscious level, blood pressure, heart rate, respiratory rate and pattern& any possible limb weakness or abnormal sensation). The patients were observed for any adverse effect and/or complication related to the procedure (e.g. pneumothorax, hematoma), or to the study drugs (e.g. hypotension) (i.e. 20% decrease from the baseline value), bradycardia (i.e. 20% decrease from the baseline value) or tachycardia (20% increase from the baseline value) nausea, vomiting, and hypoxemia (SpO2 <90%). Pain was assessed every 6 h for the next 24 h (0-6h, 6-12h, and 12-18h, 18-24).

**Statistical methods:** The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics (Statistical Package for Social Sciences) software version 18.0, IBM Corp., Chicago, USA, 2009. Descriptive statistics were done for quantitative data as minimum& maximum of the range as well as mean±SD (standard deviation) for quantitative normally distributed data, while it was done for qualitative data as number and percentage. Risk was measured using relative risk (rate in study group/ rate in control group). Inferential analyses were done for quantitative variables using Shapiro-Wilk test for normality testing, independent t-test in cases of two independent groups with normally distributed data. In qualitative data, inferential analyses for independent variables were done using Chi square test for differences between proportions and Fisher's Exact test for variables with small expected numbers. The level of significance was taken at P value < 0.050 is significant, otherwise is non-significant.

## RESULTS

**Table (1):** Demographic characteristics among the studied groups.

| Variables | Measures | Group-A (N=32) | Group-B (N=32) | P |
|---|---|---|---|---|
| **Age (years)** | **Mean±SD** | 40.5±7.5 | 38.3±8.0 | ^0.246 |
| | **Range** | 19.0–58.0 | 22.0–57.0 | |
| **Weight (kg)** | **Mean±SD** | 80.1±3.8 | 78.6±5.3 | ^0.225 |
| | **Range** | 73.7–88.7 | 70.1–89.8 | |
| **Sex (n, %)** | **Male** | 25 (78.1%) | 23 (71.9%) | #0.564 |
| | **Female** | 7 (21.9%) | 9 (28.1%) | |
| **ASA (n, %)** | **I** | 23 (71.9%) | 21 (65.6%) | #0.590 |
| | **II** | 9 (28.1%) | 11 (34.4%) | |
| **Surgery duration (minutes)** | **Mean±SD** | 176.4±10.0 | 178.0±8.6 | ^0.504 |
| | **Range** | 151.0–197.0 | 167.0–200.0 | |
| **Anaethesia duration (minutes)** | **Mean±SD** | 191.3±9.9 | 192.9±8.6 | ^0.486 |
| | **Range** | 166.0–211.0 | 182.0–215.0 | |

^Independent t-test, #Chi square test

No significant difference between the studied groups regarding demographic characteristics.

**Table (2):** Pain (VAS-10) among the studied groups.

| Time | Measures | Group-A (N=32) | Group-B (N=32) | ^P |
|---|---|---|---|---|
| **Hour-0** | **Mean±SD** | 1.3±0.5 | 1.6±0.5 | ^0.059 |
| | **Range** | 0.0–2.0 | 1.0–2.0 | |
| **Hour-6** | **Mean±SD** | 2.5±0.9 | 4.4±0.9 | ^**<0.001*** |
| | **Range** | 2.0–5.0 | 3.0–6.0 | |
| **Hour-12** | **Mean±SD** | 2.1±0.7 | 4.0±1.1 | ^**<0.001*** |
| | **Range** | 1.0–4.0 | 2.0–6.0 | |
| **Hour-18** | **Mean±SD** | 1.6±0.5 | 3.6±0.8 | ^**<0.001*** |
| | **Range** | 1.0–2.0 | 2.0–5.0 | |
| **Hour-24** | **Mean±SD** | 1.3±0.5 | 2.9±0.8 | ^**<0.001*** |
| | **Range** | 1.0–2.0 | 2.0–4.0 | |

| **Value of group-A over group-B in pain reduction** | | |
|---|---|---|
| **Time** | **Mean±SE** | **95% CI** |
| **Hour-0** | 0.3±0.1 | 0.0–0.5 |
| **Hour-6** | 1.9±0.2 | 1.5–2.4 |
| **Hour-12** | 1.9±0.2 | 1.5–2.4 |
| **Hour-18** | 2.0±0.2 | 1.6–2.3 |
| **Hour-24** | 1.7±0.2 | 1.3–2.0 |

^Independent t-test, *Significant, CI: Confidence interval

Table (2) and figure (1) show that: Pain was lower among group-Athan among group-B at all times, but the differences were significant at all times except hour-0.

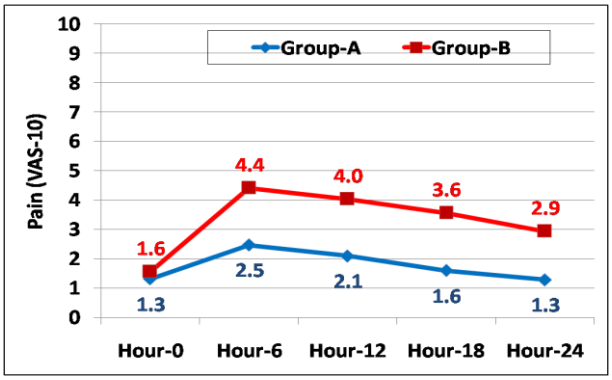


**Figure (1):** Pain (VAS-10) among the studied groups.

**Table (3):** Heart rate (beat/minute) among the studied groups.

| Time | Measures | Group-A (N=32) | Group-B (N=32) | ^P |
|---|---|---|---|---|
| **Hour-0** | **Mean±SD** | 75.7±4.2 | 77.4±4.0 | ^0.099 |
| | **Range** | 64.0–82.0 | 68.0–84.0 | |
| **Hour-6** | **Mean±SD** | 84.6±4.6 | 88.8±4.5 | ^**<0.001*** |
| | **Range** | 73.0–93.0 | 77.0–99.0 | |
| **Hour-12** | **Mean±SD** | 81.8±3.9 | 86.3±5.1 | ^**<0.001*** |
| | **Range** | 72.0–90.0 | 75.0–96.0 | |
| **Hour-18** | **Mean±SD** | 81.1±3.3 | 85.2±4.6 | ^**<0.001*** |
| | **Range** | 73.0–88.0 | 76.0–95.0 | |
| **Hour-24** | **Mean±SD** | 80.4±4.0 | 84.7±4.6 | ^**<0.001*** |
| | **Range** | 72.0–88.0 | 73.0–93.0 | |

| **Value of group-A over group-B in heart rate reduction** | | |
|---|---|---|
| **Time** | **Mean±SE** | **95% CI** |
| **Hour-0** | 1.7±1.0 | -0.3–3.8 |
| **Hour-6** | 4.2±1.1 | 1.9–6.4 |
| **Hour-12** | 4.4±1.1 | 2.2–6.7 |
| **Hour-18** | 4.1±1.0 | 2.1–6.1 |
| **Hour-24** | 4.3±1.1 | 2.2–6.5 |

^Independent t-test, *Significant, CI: Confidence interval

Table (3) and figure (2) show that: Heart rate was lower among group-A than among group-B at all times, but the differences were significant at all times except hour-0

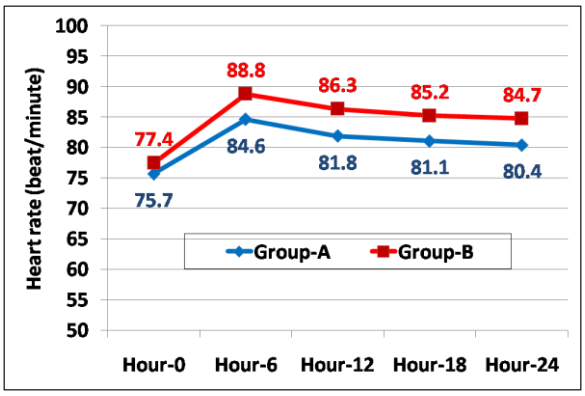

**Figure (2):** Heart rate among the studied groups.

**Table (4):** MBP (mmHg) among the studied groups.

| Time | Measures | Group-A (N=32) | Group-B (N=32) | ^P |
|---|---|---|---|---|
| **Hour-0** | **Mean±SD** | 67.4±4.1 | 69.3±4.4 | ^0.087 |
| | **Range** | 58.0–75.0 | 60.0–76.0 | |
| **Hour-6** | **Mean±SD** | 75.6±3.4 | 79.1±3.7 | ^**<0.001*** |
| | **Range** | 69.0–81.0 | 70.0–86.0 | |
| **Hour-12** | **Mean±SD** | 75.3±3.8 | 78.8±4.4 | ^**<0.001*** |
| | **Range** | 65.0–83.0 | 68.0–85.0 | |
| **Hour-18** | **Mean±SD** | 73.0±3.3 | 76.3±3.6 | ^**<0.001*** |
| | **Range** | 64.0–79.0 | 68.0–84.0 | |
| **Hour-24** | **Mean±SD** | 69.3±3.3 | 72.3±3.7 | ^**<0.001*** |
| | **Range** | 63.0–77.0 | 64.0–79.0 | |
| **Value of group-A over group-B in MBP reduction** | | | | |
| **Time** | | **Mean±SE** | **95% CI** | |
| **Hour-0** | | 1.8±1.1 | -0.3–4.0 | |
| **Hour-6** | | 3.5±0.9 | 1.7–5.2 | |
| **Hour-12** | | 3.5±1.0 | 1.4–5.5 | |
| **Hour-18** | | 3.3±0.9 | 1.6–5.0 | |
| **Hour-24** | | 3.1±0.9 | 1.3–4.8 | |

^Independent t-test, *Significant, CI: Confidence interval

Table (4) and figure (3) show that: MBP was lower among group-A than among group-B at all times, but the differences were significant at all times except hour-0.

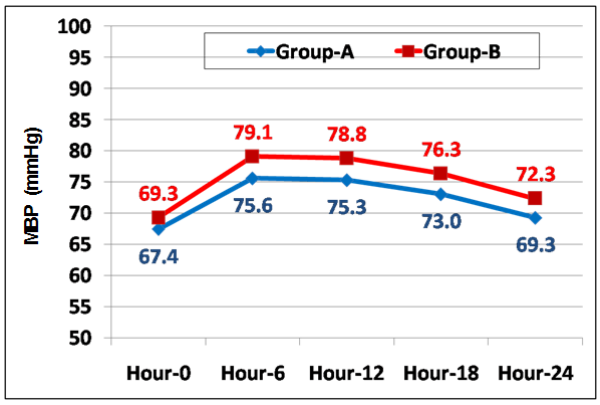


**Figure (3):** MBP among the studied groups.

**Table (5):** Extra analgesics among the studied groups.

| Requirement | Group-A (N=32) | Group-B (N=32) | #P | RR (95% CI) |
|---|---|---|---|---|
| **Required** | 2 (6.3%) | 15 (46.9%) | **<0.001*** | 0.18 (0.05–0.69) |
| **Not required** | 30(93.8%) | 17 (53.1%) | | |

#Chi square test, RR: Relative risk, *Significant, CI: Confidence interval

Table (5) and figure (4) show that: **Extra analgesics** were **significantly** less frequent among group-A than among group-B.

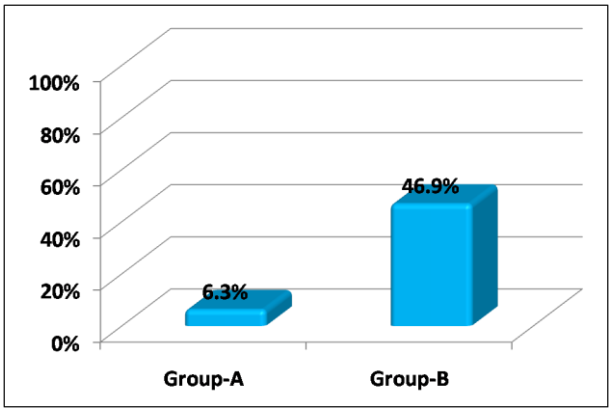


**Figure (4):** Extra analgesics among the studied groups.

**Table (6):** Side effects among the studied groups.

| Side effects | Group-A (N=32) | Group-B (N=32) | ^P | RR (95% CI) |
|---|---|---|---|---|
| **Nausea** | 4 (12.5%) | 10 (31.3%) | #0.070 | 0.51 (0.22–1.21) |
| **Vomiting** | 1 (3.1%) | 8 (25.0%) | **&0.026*** | 0.20 (0.03–1.27) |

^Chi square test, & Fisher's Exact test, RR: Relative risk, *Significant, CI: Confidence interval

Table (6) and figure (5) show that: Nausea and vomiting were less frequent among group-Athan among group-B, but the differences were significant only in vomiting.

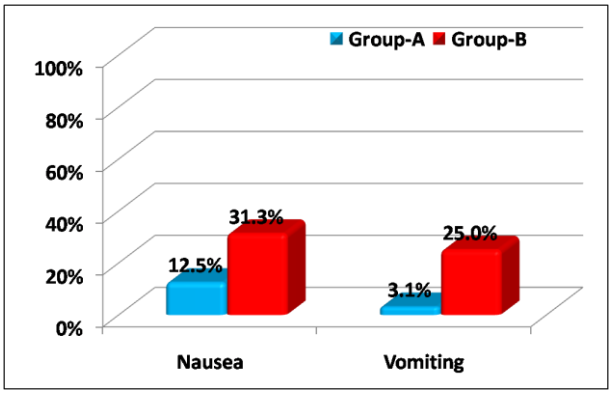


**Figure (5):** Side effects among the studied groups.

## DISCUSSION

Insufficient postoperative pain therapy is associated with poor functional recovery in some cases, and could trigger various of pathophysiological pathways, causing ileus,

nausea, delayed mobility and feeding, late discharge from hospital, and unexpected readmission. Opioids are the cornerstone management agent for moderate-to-severe acute postoperative pain, and patient controlled analgesia is the most commonly used protocol for postoperative administration of opioids. On the other hand, powerful category of opioids with pharmacologically high potency result in possible side effects, involving respiratory depression, nausea, vomiting, itching, urinary retention, ileus, and constipation are clinical issues commonly present when using opoids for patient controlled analgesia. Due to these arising clinical issues and undesirable side effects, patient controlled analgesia is often stopped regardless of inadequate management and control of pain [(9)]. Surgeons and cases consider postoperative pain management using analgesic techniques with minimal adverse side effects is crucial and of cornerstone importance. Brachial plexus block is characterised to have several clinical and surgical advantages more than general anesthesia for upper limb surgical procedures, involving decreased surgical physiological stress response, (sympathectomy caused by the technique causes increased blood flow to the limb leading to better postoperative analgesia, earlier recovery and hospital discharge for outpatients, and reduced side effects. The traditional analgesic techniques involve interscalene, supraclavicular, infraclavicular, and axillary have been described for various years[(10)]. Supraclavicular Brachial plexus block is an outstanding management methodology for maintaining most favourable operative environment for upper limb surgical interventions by causing complete muscular relaxation, with haemodynamic stability maintainence and the related sympathetic block.[(11)]. In a priorly performed research study conducted in a fashion similar to current research the efficiency of patient-controlled interscalene analgesia and patient-controlled intravenous analgesia (PCIVA) have been compared and contrasted in the management of post operative pain in 36 cases was investigated. In which, the general anesthetic procedure was uniform. After surgery, all cases were administered 2 mg intravenous morphine. The cases were then statistically randomized to obtain either patient-controlled interscalene analgesia or patient-controlled intravenous analgesia. The interscalene block was performed with 20 ml of 1% lidocaine. A catheter was entered within the interscalene muscular sheath and 20 min after the initial block, cases were administered a continuous infusion of 0.125 bupivacaine at rate of 4 ml/h that was supplemented by a of 3 ml bolus dose with a lockout time of15-min. While the other group of cases had been administered a bolus dose of1 mg morphine and had a lockout time of 7-min. resolution of pain was on a regular basis evaluated by usage of a visual analog scale. Patients satisfaction and side effects had been recorded. The research study period was finished 48 h after the ending the operative procedure. Relief of pain was statistically significantly better managed in the interscalene research groupat6, 12, 24, and 30 h after the completing the operative procedure ($P$<0.05). At 36, 42, and 48 h, on the other hand no statistical significant difference in pain scoring levels have been observed between the two research groups. Patient satisfaction was statistically significantly more in the in the patient-controlled interscalene analgesia research group ($P$<0.05). Vomiting and pruritus were displayed and revealed to be more frequently in the patient-controlled intravenous analgesia research group ($P$<0.05). No major complications occurred in any of the study patients. The use of the PCISA technique was uncomplicated and provided better pain relief than PCIVA in postoperative analgesia[(12)]. When we compare between our study and the previous study we found that: the study sample size in previous study was 36 patients in our study 64 patients, in their study all patients were administered 2mg intravenous morphine after surgery which would affect the result in 0-hour ,in their study the interscalene block was done by 20 ml 1% lidocaine and the continuous infusion by 0.125 bupivacaine at rate 4 ml/hour this involves large volumes of local anesthetic with a potential risk of toxicity and risk of dislodgement of the catheter[(13)], but they justified using continuous infusion by: Patients with an interscalene infusion of 0.125% bupivacaine had less of a reduction of diaphragmatic movement than patients who were given an infusion of 0.25% bupivacaine[(14)]and interscalene local anesthetic injections may produce ipsilateral vagus, phrenic, and recurrent laryngeal nerve blockade[(15)]. During continuous infusion, ipsilateral hemidiapragmatic paresis often persists until the end of the infusion[(16)]. Most

anesthesiologists often ignore phrenic nerve paralysis, because no clinical symptoms occur in patients who have no underlying lung disease[17]. In the PCISA (patient controlled interscalene analgesia) group, no patients demonstrated these findings. In the PCIVA (patient controlled intravenous analgesia) and PCISA groups, no patients showed any signs of opioid toxicity, respiratory depression, local anesthetic toxicity, cardiac depression or central nervous system excitation. Single-shot ISB (interscalene block) with a long-acting local anesthetic (bupivacaine) is more efficient than parenteral opioids, but too short-lasting for postoperative analgesia[18]. Continuous ISB provides better pain relief than parenteral (IM or IV PCA) opioids or single-shot ISB[18,19]. In our study, significantly better pain control was observed in the PCISA group.

## CONCLUSION

There is significant difference between supraclvicular brachial plexus block and patient controlled analgesia regarding the postoperative analgesia after forearm surgery. Significantly better pain control was observed in the supraclvicular brachial plexus block group. Patient satisfaction was greater in the supraclvicular brachial plexus block group. Nausea and vomiting were observed more frequently in patient controlled analgesia group. There is significant difference between the two groups in consuming extra analgesics as patient controlled analgesia group consuming more extra analgesics.

## CONFLICTS OF INTEREST

There are no conflicts of interest.

## REFERENCES


1. **Capdevila X, Barthelet Y, Biboulet P *et al.* (1999):** Effects of perioperative analgesic technique on the surgical outcome and duration of rehabilitation after major knee surgery Anesthesiology, 91 (1):8-15.
2. **Kehlet H (1994):** Postoperative pain relief – what is the issue? Br J Anaesth., 72 (4): 375-378.
3. **Carr DB, Miaskowski C, Dedrick SC *et al.* (1998):** Management of perioperative pain in hospitalized patients: a national survey J Clin Anesth., 10 (1):77-85.
4. **White PF (2002):** The role of non-opioid analgesic techniques in the management of pain after ambulatory surgery. Anesth Analg., 94 (3): 577-585.
5. **Gehling M, Hermann B and Tryba M (2011):** Meta-analysis of dropout rates in randomized controlled clinical trials. Der Schmerz, 25(3): 296-305.
6. **Macario A, Weinger M, Carney S *et al.* (1999):** Which clinical anesthesia outcomes are important to avoid? The perspective of patients Anesth Analg., 89 (3):652-658.
7. **Singelyn FJ (2000):** Brachial plexus block. Novel approaches and new indications? ESA refresher course lectures: 8th Annual Meeting; pp. 209–214.
8. **Singelyn FJ, Seguy S, Gouvernour JM (1999):** Interscalene brachial plexus analgesia after open shoulder surgery: continuous versus patient-controlled infusion. Anesth Analg., 89:1260–1270.
9. **Chandni M, Soni CM and Parikh H (2013):** Comparison of the motor and sensory block by ropivacaine and bupivacaine in combination with lignocaine in supraclavicular block. National Journal of Medical Research, 3 (4):353–57.
10. **Ecoffey C (2012):** Safety in pediatric regional anesthesia. Paediatr Anaesth., 22: 25–30.
11. **Bhalla T, Sawardekar A, Dewhirst E *et al.* (2013):** Ultrasound-guided trunk and core blocks in infants and children. J Anesth., 27: 109–123.
12. **Tuncer S, Tosun Z, Yosunkaya A *et al.* (2002):** Patient-controlled interscalene analgesia versus patient-controlled intravenous analgesia in postoperative analgesia after upper extremity surgery Eur J Plast Surg., 25:149–151.
13. **Ficarotta MR, Morey TE, Boezaart AP (2010):** Does "Opening the Perineural Space" before stimulating catheter placement for continuous nerve block add value in clinical practice? RegAnesth Pain Med., 35:245–8.

14. **Pere P (1993):** The effect of continuous interscalene brachial plexus block with 0.125% bupivacaine plus fentanyl on diaphragmatic motility and ventilatory function. Reg Anesth., 18:93–97.
15. **Kempen PM, O'Donnell J, Lawler R *et al.* (2000):** Acute respiratory insufficiency during interscalene plexus block. Anesth Analg., 90:1415–1416.
16. **Tuaminen M and Tarkilla P (1995)**: Diaphragmatic motion during continuous interscalene brachial plexus block. Reg Anesth., 20:543–544.
17. **Rau RH, Chan YL, Chaung HI *et al.* (1997)**: Dyspnea resulting from phrenic nerve paralysis after interscalene brachial plexus block in an obese male – a case report. Acta Anaesthesiol Sin., 35:113–118.
18. **Jochum D, Roedel R, Gleyze P *et al.* (1997):** Interscalene brachial plexus block for shoulder surgery. A prospective study of a consecutive series of 167 patients. Ann Fr Anesth Reanim., 16:114–119
19. **Borgeat A, Rewes E, Biasca N *et al.* (1998):** Patient-controlled interscalene analgesia with ropivacaine after major shoulder surgery: PCIA versus PCA. Br J Anaesth., 81:603–605.