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## ORIGINAL ARTICLE

# Comparison Between Ultrasound-guided Axillary Brachial Plexus Block Versus Intravenous Regional Block in Forearm Surgeries

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## Abstract

**Background:** Regional anaesthesia is particularly effective because it blocks the transduction, transmission, and modification of afferent nociceptive stimuli, inhibits the activation of neurohormones, and prevents the central nervous system from winding up and becoming sensitised (CNS).

**Aim:** This study aims to compare between brachial plexus block 'axillary approach' and regional intravenous block in forearm surgeries regarding the quality of surgical analgesia and relief of postoperative pain.

**Patients and methods:** The local ethical committee accepted this prospective, randomised, single-blinded clinical trial, which was carried out in Cairo's Al-Azhar University Hospitals for Boys.

**Results:** Our data showed a statistically significant difference in mean postoperative opioid intake between the two groups (mg). In terms of negative consequences, our findings showed a statistically significant difference between the two groups. Moreover, there were no patients with Horner's syndrome, pneumothorax, vascular puncture, visual or auditory disturbances, CNS tremors or residual motor defects.

**Conclusion:** From findings of our results, we can conclude that Ultrasound Guided Brachial Plexus Block (Axillary approach) group (BPBAA) is more effective than Intravenous Regional Block (IRVB), with less need for opioids, fewer complications and more patient satisfaction.

**Keywords:** Forearm, Regional block, Surgeries, Ultrasound-guided axillary brachial plexus block

## 1. Introduction

Due to the inhibition of neurohormonal activation, blockade of transduction, transmission, and modification of afferent nociceptive stimulation, and inhibition of central sensitization and winding up of the central nervous system, regional anaesthesia is particularly effective (CNS).<sup>1</sup>

Adding ultrasound to peripheral nerve block in the past decade has done a revolution in this area. It leads to turning it from a precise skill which only a limited number of doctors can master to objective one which can be learnt and transferred to other doctors. Modern perioperative multimodal analgesia includes peripheral nerve blocks as a key element.<sup>2</sup>

At and below the elbow, the axillary brachial plexus block offers anaesthesia for surgery (ABPB). Since the nerves are on the surface, it is simpler to perform than inter scalene (such as phrenic nerve block, spinal cord or vertebral artery puncture) or supraclavicular (such as pneumothorax) treatments. The only significant dangers are unintentional intravascular and intra-neural injections. Numerous ABPB approaches have been documented, including paraesthesia-seeking, nerve-stimulating, perivascular, trans-arterial, and ultrasound-guided ones.<sup>3</sup>

Intravenous regional anaesthesia is a loco-regional anaesthetic technique that can be used to anaesthetize distant limbs with the use of a tourniquet and intravenous injection of a LA distal to it.<sup>4</sup>

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Therefore, we contrast regional intravenous block with brachial plexus block using an axillary route during forearm procedures. This study compares the effectiveness of surgical analgesia and postoperative pain reduction between brachial plexus block 'axillary approach' and regional intravenous block during forearm procedures. The length and level of postoperative analgesia attained by each form of a block, as indicated by the first analgesic request, were the main study outcomes. Additionally, the total amount of morphine used in the first 24 h and the VAS pain score was used to gauge the degree of discomfort. Patient satisfaction and any negative effects or problems were the secondary outcomes.

## 2. Patients and methods

The local ethical committee accepted this prospective, randomised, single-blinded clinical trial, which was carried out in Cairo's Al-Azhar University Hospitals for Boys.

**Ethical considerations:** The Research Ethics Committee applied for approval of the procedure. Every participant was made aware of the study's purpose and how it would benefit both him and the wider community. Written consent was taken from all participants before including them in the study and they have the right to refuse without effect on their management.

There were (60) patients in the trial, divided into two groups: Team A: utilising ultrasound to guide an axillary approach for a brachial plexus block (BPBAA): In thirty cases, an ultrasound-guided axillary block was carried out before the surgery. Regional Intravenous Block (IRVB): Before the procedure, Group B (30) cases had a regional intravenous block.

**Sampling:** The G power software 3.1.9.4 was used to determine the necessary sample size. Considering past research on the length of the two blocks (Nishiyama, 2019).

**Randomization:** Through the use of computer-generated random numbers placed in two distinct opaque envelopes, which were opened by the research investigator just before the block, an equal number of patients were randomly assigned to receive either an axillary brachial block or a regional intravenous block. Each block was administered by the same anesthesiologist. The trial's functional data collectors were not made aware of the randomization until it was too late.

**Inclusion criteria:** Patients' acceptance to join the study, age: between 21 and 60 years, Body Mass Index (BMI) < 30 kg/m<sup>2</sup>, ASA physical status I and II.

**Exclusion criteria:** Patient refusal, patient with coagulation disorders, infection at the site of injection, patient's sensitivity to the used drugs and patients with a history of analgesics dependence.

### 2.1. Methods

**Preoperative preparation:** The pre-anaesthetic assessment was performed with Full history taking including Personal history, any complaints, past medical and past surgical history and family history.

**Routine Investigations:** CBC, coagulation profile, Renal and hepatic function test, urine analysis, random blood glucose.

5 ml of 1% lidocaine for local anaesthesia should be administered before venous access placement. Atropine 0.01 mg/kg, metoclopramide 0.1 mg/kg, and famotidine 0.2 mg/kg were given intravenously (IV) to all patients as preoperative medications. As a preload, Ringer's lactate solution (20 ml/kg) was injected for 15 min Patients were put to sleep using fentanyl 1 mg/kg and IV midazolam 0.03 mg/kg.

Mean arterial blood pressure (MAP), heart rate (HR), and oxygen saturation (PO<sub>2</sub>) baseline measurements were taken during preoperative monitoring.

### 2.2. Anaesthetic techniques

**Anaesthetic Techniques for brachial plexus block (Axillary approach):** The elbow was flexed to uncover the armpit while the arm was remotely turned over 90° for the patients in Gathering A. The axillary conduit and its environmental factors were noticed utilizing a direct test situated in the axillary wrinkle opposite the axillary course. A variety of Doppler



Fig 1. As per US exhortation, an axillary brachial plexus block.

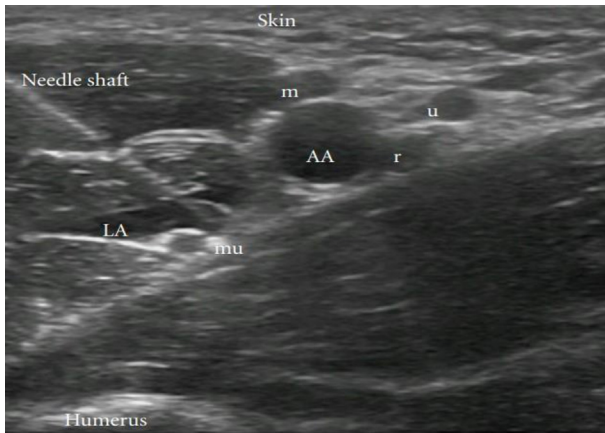


Fig 2. An axilla ultrasound scan.

filter uncovered the presence of the axillary corridor [Fig. 1](#).

The right, left, and back of the axillary supply route were invaded with sedatives utilizing a 50 mm 22-measure Sprotte needle (Nanoline, PAJUNK, Germany) embedded under constant ultrasound direction. 5 ml of 1% lidocaine was used before the needle was inserted. Following that, 5 ml of the local anaesthetic medication was administered to the axillary artery's side. A local anaesthetic was injected above, below, and behind the axillary artery [Fig. 2](#).

AA stands for axillary artery, LA for local anaesthetics, R for the radial nerve, M for the median nerve, and U for the ulnar nerve. The entire length of the needle shaft is visible under ultrasonography in this in-plane method.

To inject 5 ml of the local anaesthetic medication into the side of the axillary artery, the block needle was then removed and reinserted in-plane beneath the ultrasound probe.

### 2.3. Anaesthetic techniques for regional intravenous anaesthetics

For the patients in the IVRA group, a double tourniquet with an elastic bandage wound was applied after inserting a 20-gauge intravenous cannula under local anaesthesia and 1 ml of 1% lidocaine in the dorsum of the hand that was designated for surgery [Fig. 3](#).

**Method of evaluation:** A motor evaluation was assessed using MRC grade for motor power assessment, as our patients will undergo an operation on the forearm, so the movement was pronation and supination.

**Sensory evaluation:** Sensory evaluation was conducted using the Hollmen scale for the sensory block.

**Postoperative pain evaluation:** Postoperative pain was evaluated using a numeric pain scale (NPRS) in 1, 12, 24, and 48 h postoperatively.

**Postoperative pain:** Postoperative pain was assessed by the NPRS pain Mean arterial blood pressure, heart rate and oxygen saturation were measured on arrival in the postoperative anaesthesia care unit (time 0) and at 30, 60, 90 min, 2, 4, 6, 8, 12, and 24 h postoperatively (Oxygen saturation was measured in the postoperative anaesthesia care



Fig. 3. First, the dorsum of the hand was inserted with a 20-gauge intravenous cannula. When patients complained of tourniquet pain, the distal tourniquet was inflated while the proximal one was deflated. Even if the IVRA group's surgery did not end within 60 min, the tourniquet was removed after at least 60 min had passed after inflation. Both techniques' patients were instructed to describe any systemic side effects of local anaesthetics, such as circumoral or tongue numbness, visual or auditory impairment, lightheadedness, tinnitus, dysrhythmia, or convulsions, as well as the effectiveness of the analgesia. Measured Parameters: Patient demographic data and Quality of analgesia score.



Table 1. Demographic data of the two studied groups.

	BPBAA (N = 30)	IRVB (N = 30)	t	P
Age (years)				
Mean $\pm$ SD	44.53 $\pm$ 12.47	42.68 $\pm$ 11.34	0.601	0.551
BMI (kg/m <sup>2</sup> )				
Mean $\pm$ SD	26.72 $\pm$ 3.41	26.91 $\pm$ 3.28	0.220	0.827
Sex				
Female	20 (66.7%)	17 (56.7%)	0.635	0.426
Male	10 (33.3%)	13 (43.3%)		

unit during the first 6 h) and after 3 h from the last dose of morphine.

The duration of the block (defined as the period between executing the block and when the first analgesia request is made).

Patient satisfaction was assessed on a four-point scale (1, excellent; 2, good; 3, fair; 4, poor).

Any adverse effects or complications were recorded.

#### 2.4. Statistical analysis

All information was gathered, organized, and genuinely broken down involving MedCalc 13 for Windows and SPSS 22.0 for Windows (SPSS Inc., Chicago, IL, USA) (MedCalc Programming bvba, Ostend, Belgium). The  $\chi^2$  test and Fisher precise were utilized to compute the distinction between the subjective factors as given. The free T-test and Mann–Whitney test were utilized to analyze the distinctions between quantitative factors in two gatherings for parametric and non-parametric factors, separately. P values 0.05 demonstrate importance, p 0.001 shows an exceptionally massive contrast, and  $P > 0.05$  show non-huge contrasts in every factual examination, which were each of the two-followed.

### 3. Results

The following are the results of the clinical study to evaluate and compare between ultrasound-guided brachial plexus block, and axillary approach versus the regional intravenous block for operations on the forearm surgeries.

The last form will make the results easier to interpret. As regards age, BMI, and sex, the present demographic data have not shown any statistically significant difference between both groups. This table shows that there is no significant difference between the two studied groups regarding age, BMI, and sex ( $P > 0.05$ ) (Table 1), Fig. 4.

As regards comorbidities, such as hypertension, diabetes mellitus, cardiac or renal diseases, and smoking, our data have not shown any statistically significant difference between both groups (Table 2).

As regarding ASA and Operative time, our data have not showed any statistical significant difference between both groups. There was 17 I ASA compared to 19 in BPBAA group compared to IRVB. The mean Operative time (min) was  $49.83 \pm 20.52$  in BPBAA group compared to  $46.65 \pm 16.2$  in IRVB Fig. 5.

Baseline Mean arterial blood pressure was  $91.38 \pm 5.34$  in BPBAA compared to  $92.72 \pm 5.62$  in IRVB. 90 min Mean arterial blood pressure was  $86.72 \pm 3.75$  in BPBAA compared to  $89.4 \pm 5.16$  in IRVB. 4 h Mean arterial blood pressure was  $88.45 \pm 3.46$  in BPBAA compared to  $88.63 \pm 3.58$  in IRVB. 24 h Mean arterial blood pressure was  $84.35 \pm 2.15$  in BPBAA compared to  $84.2 \pm 2.41$  in IRVB Fig. 6.

Baseline Heart Rate was  $91.8 \pm 4.17$  in BPBAA compared to  $93.5 \pm 3.51$  in IRVB. 90 min Heart Rate was  $81.93 \pm 3.43$  in BPBAA compared to  $86.27 \pm 4.23$  in IRVB. 4 h Heart Rate pressure was  $84.91 \pm 3.54$  in BPBAA compared to  $85.27 \pm 3.47$  in IRVB. 24 h Heart

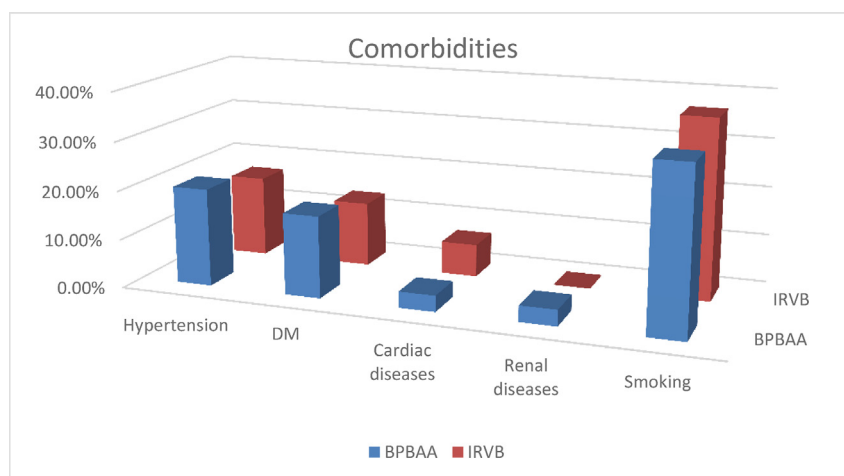


Fig. 4. Comorbidities between the study groups.

Table 2. Operative characteristics of the two studied groups.

	BPBAA (N = 30)	IRVB (N = 30)	$\chi^2/t$	P
ASA				
I	17 (56.7%)	19 (63.3%)	0.278	0.598
II	13 (43.3%)	11 (36.7%)		
Operative time (min)				
Mean $\pm$ SD	49.83 $\pm$ 20.52	46.65 $\pm$ 16.28	0.454	0.652

Rate was  $81.55 \pm 2.76$  in BPBAA compared to  $82.27 \pm 2.63$  in IRVB Fig. 7.

4 h NPRS of pain was  $1.68 \pm 0.632$  in BPBAA compared to  $2.11 \pm 0.702$  in IRVB. 6 h NPRS of pain was  $1.89 \pm 0.783$  in BPBAA compared to  $2.32 \pm 0.755$  in IRVB. 8 h NPRS of pain was  $2.38 \pm 0.724$  in BPBAA compared to  $2.94 \pm 0.915$  in IRVB. 24 h NPRS of pain was  $3.87 \pm 0.971$  in BPBAA compared to  $4.18 \pm 1.12$  in IRVB Table 3.

As regarding Clinical characteristics (Sensory block duration, Motor block duration, Analgesia time and Number of patients with additional fentanyl), our data have showed statistical significant difference between both groups Fig. 8.

As regarding Mean postoperative opioid (mg) consumption, our data have showed statistical significant difference between both groups Fig. 9.

As regarding Adverse effects, our data have showed statistical significant difference between both groups. Moreover, there were no patients with horner's syndrome, pneumothorax, vascular puncture, visual or auditory disturbances, CNS tremors or residual motor defects Table 4.

As regarding Satisfaction distribution, our data have showed statistical significant difference between both groups.

#### 4. Discussion

In ambulatory hand surgery, regional anaesthesia has gained popularity as a general anaesthetic substitute. Regional anaesthetic facilitates quicker healing and shorter hospital stays, which lowers healthcare expenses. The primary objective of this study was to examine the effectiveness of surgical analgesia and the reduction of postoperative pain after forearm procedures using the brachial plexus block 'axillary approach' versus regional intravenous block. In the current study, there were (60) patients in 2 groups: Group A: Brachial Plexus Ultrasound Guided Block (Axillary Approach) group (BPBAA): 30 cases underwent axillary blocks that were guided by ultrasound prior to surgery. Group B: Intravenous Regional Block (IRVB): Before the procedure, 30 subjects underwent regional intravenous block. The trial lasted somewhere between six and twelve months. The ongoing segment information have not uncovered any genuinely tremendous contrasts between the two gatherings regarding age, BMI, or sex. In the BPBAA bunch contrasted with IRVB, there were 20 females rather than 1 female in particular. Concentrate by Teunkens *et al.*, 5 which revealed that their patients went through either IVRA or an axillary block, affirmed the current discoveries. As to, sex, weight, and level, there was no genuinely huge contrast between their review groups. The present work showed that as respects comorbidities, for example, hypertension, diabetes mellitus, cardiovascular or renal infections, and smoking. The current information has not shown any genuinely huge distinction between the two gatherings.

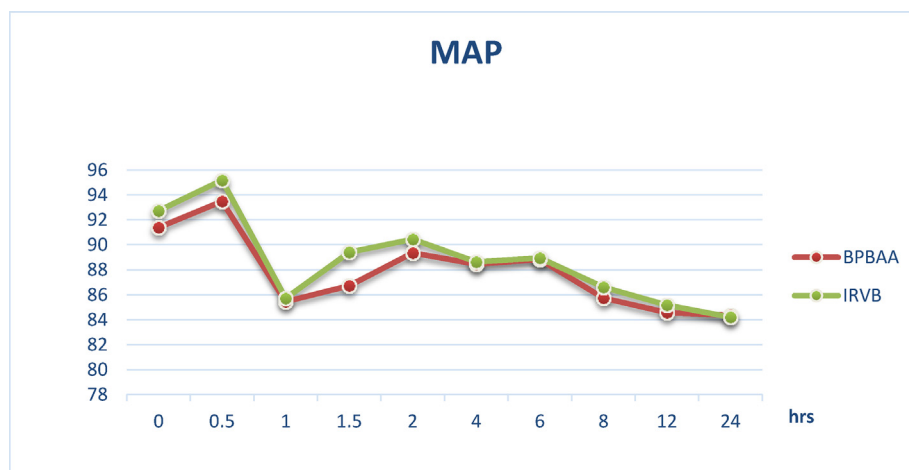


Fig. 5. MAP of the two studied groups.

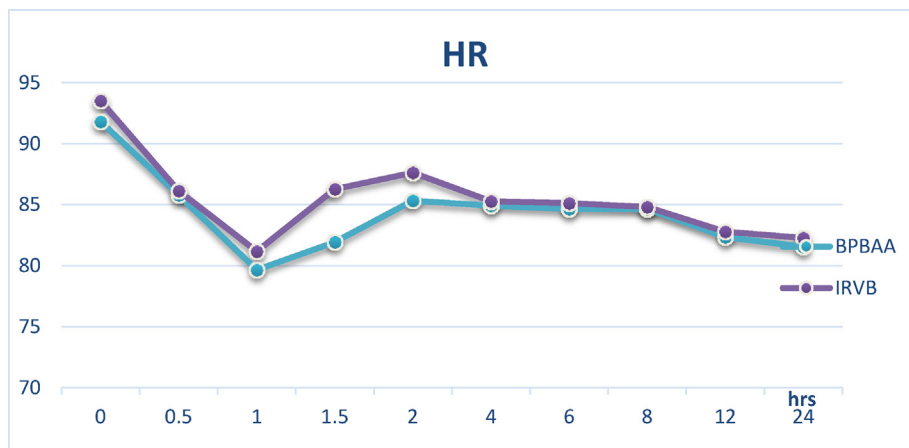


Fig. 6. HR of the two studied groups.

The most predominant co-dismal circumstances in the concentrate by Vaughn *et al.*,<sup>5</sup> were hypertension (44%), gastroesophageal reflux sickness (38%), sorrow or nervousness (32%), and hyperlipidemia (26%). The ongoing examination observed that there was no genuinely tremendous contrast in ASA or functional time between the two gatherings. Teunkens *et al.*<sup>6</sup> 's review, which tracked down no measurably tremendous contrasts between bunches with respect to ASA, upholds this. In a way like this, Chan *et al.*<sup>7</sup> showed that neither the ASA nor the sort or length of medical procedure varied genuinely between gatherings. In this examination, following an hour and a half, Between the two gatherings, there were genuinely tremendous

contrasts in mean blood vessel pulse and pulse. The discoveries uncovered no genuinely huge distinction in the hour and a half  $SO_2$  changes between the two gatherings. Information from the NPRS for torment at 4 h, 6 h, and 8 h neglected to uncover a genuinely huge distinction between the two gatherings.

In any case, in the preliminary by Teunkens *et al.*,<sup>6</sup> the IVRA gathering's VAS scores were recognizably higher without an expansion in the prerequisite for extra analgesics. Following 24 h, there were no way to see a progressions in torment levels or the necessity for additional analgesics across the groups. The results got by VAS scores in examination with NPRS would be not exceptionally exact yet might be

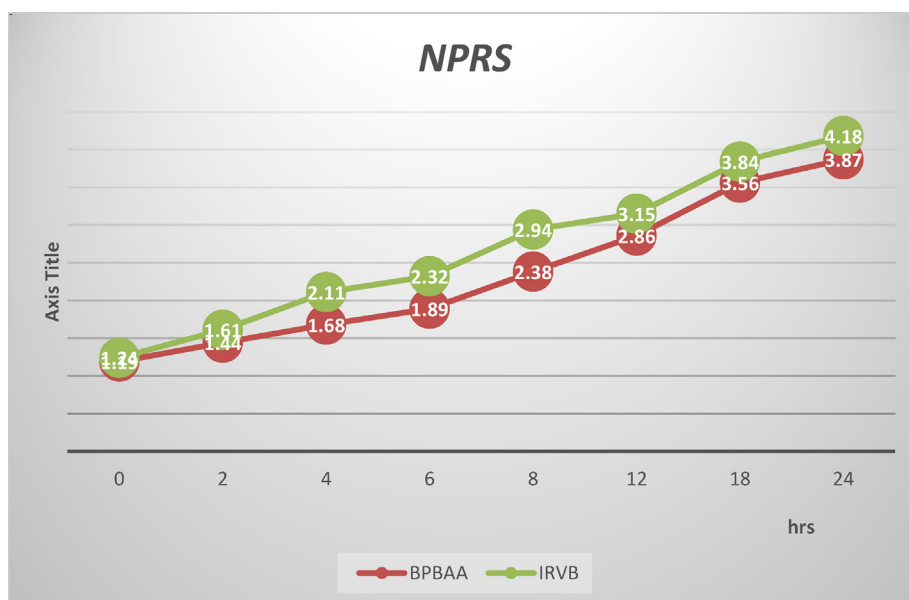


Fig. 7. NPRS of pain of the two studied groups.

Table 3. Clinical characteristics among the two studied groups.

	BPBAA (N = 30)	IRVB (N = 30)	t	P
Sensory block duration (min)				
Mean $\pm$ SD	54.86 $\pm$ 20.91	42.71 $\pm$ 18.45	2.39	0.020
Motor block duration (min)				
Mean $\pm$ SD	39.16 $\pm$ 10.34	31.29 $\pm$ 9.82	3.02	0.004
Analgesia time (min)				
Mean $\pm$ SD	55.2 $\pm$ 21.63	42.93 $\pm$ 18.6	2.36	0.022
Number of patients with additional fentanyl	9 (30%)	2 (6.7%)	5.46	0.020

of clinical importance While in the investigation of Badiea *et al.*,<sup>8</sup> torment scores were fundamentally higher in bunch A (had general sedation) in contrast with bunch B (got ultrasound-directed axillary block) at 6, 12, and 18 h postoperatively. At 2, 4, and 24 h after the procedure, there was little difference between the two groups.

In addition, Lee *et al.*<sup>9</sup> discovered that patients who underwent an axillary brachial plexus block experienced less pain at 2 and 6 h after a surgery than those who underwent general anaesthesia. However, after 6 h, the VAS scores in the two groups were equal. The current review showed that in regards to Clinical attributes (Tangible block term, Engine block span, Absence of pain time and Number of patients with extra fentanyl), our information have showed measurable huge distinction between the two gatherings.

In a past report completed by Schoenmakers *et al.*,<sup>10</sup> contrasting 40 ml and 15 ml mepivacaine 1.5% for ABPB, we revealed that the volume/portion decrease

of 62.5% brought about a more limited generally length of tactile and engine block of separately 17% and 19%. In Fenten *et al.*<sup>11</sup> review they, tracked down that a portion decrease of 33% didn't bring about a decrease of block span (Gathering A versus Gathering C).

In a review led by Chazapi *et al.*,<sup>12</sup> During beneath the elbow a medical procedure under ultrasound-directed axillary brachial plexus block, 40 patients were haphazardly randomized to get either 30 ml of ropivacaine 0.75% with 2 ml of saline (Gathering A,  $n = 20$ ) or 30 ml of ropivacaine 0.75% with 2 ml of dexamethasone (4 mg). They tracked down no distinction in the middle periods for the beginning of the tangible and engine blocks between the two gatherings. The ongoing review showed that as in regards to Mean postoperative narcotic (mg) utilization, our information has shown the measurable tremendous distinction between the two gatherings. Being less in the BPBAA bunch. Our outcomes were upheld by the investigation of Chan *et al.*,<sup>7</sup> as they announced that after a medical procedure,

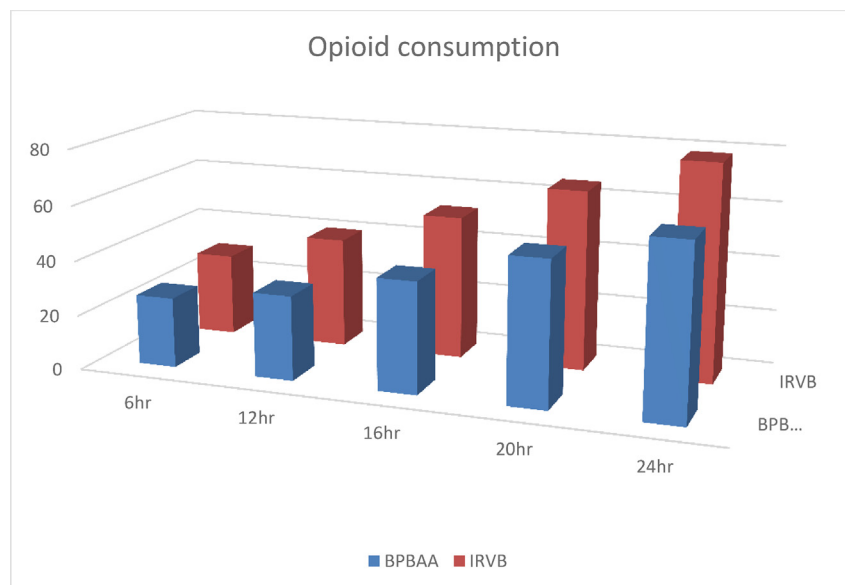


Fig. 8. Mean postoperative opioid (mg) consumption of the two studied groups.



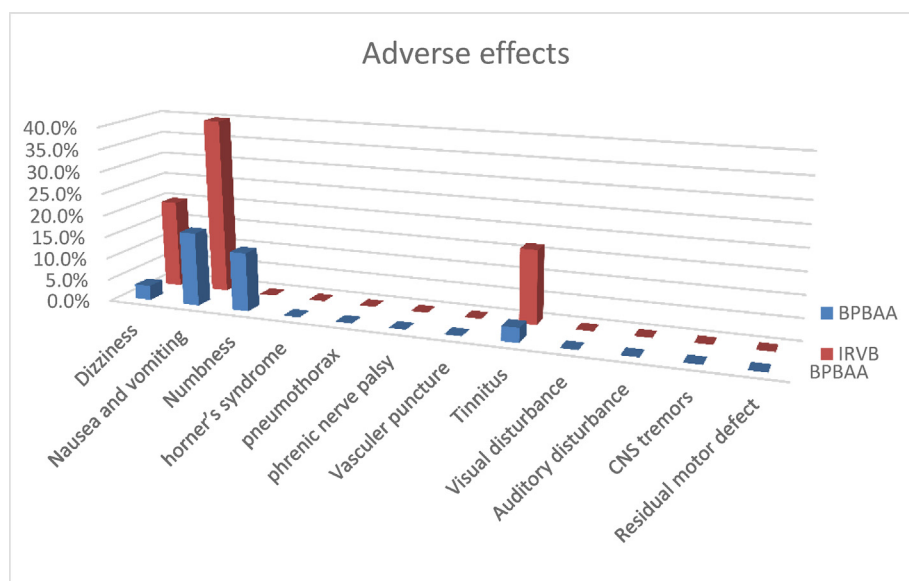


Fig. 9. Adverse effects of the two studied groups.

Table 4. Satisfaction distribution among the studied groups.

	BPBAA (N = 30)	IRVB (N = 30)	$\chi^2$	P
Excellent	22 (73.3%)	9 (30%)	12	0.008
Good	6 (20%)	17 (56.7%)		
Fair	2 (6.7%)	3 (10%)		
Poor	0	1 (3.3%)		

Significantly more patients in the GA group (85%) required narcotic analgesics for their pain than those in the IVRA (51%) or BPB (43%) groups ( $P$  0.05).

Present results showed that as regards Adverse effects, present data have shown statistical significant differences between both groups. There were 3 failed blocks in BPBAA while there was not any failed anaesthesia in IRVB techniques. As regards satisfaction distribution, our data have shown statistical between both groups.

However, in the study of Teunkens *et al.*,<sup>6</sup> In terms of hemodynamic condition, the prevalence of PONV, and the requirement for antiemetics, groups were consistent at all times. There were no significant negative effects or long-lasting brain impairment. In the study of Chan *et al.*,<sup>7</sup> The GA group had the highest rate of cases requiring antiemetic medication for nausea and vomiting.

#### 4.1. Conclusion

The Ultrasound Guided Brachial Plexus Block (Axillary Approach) group, according to our findings (BPBAA) is more effective than Intravenous Regional Block (IRVB), with less need for opioids, less complications and more patient satisfaction.

#### Disclosure

The authors have no financial interest to declare the content of this article.

#### Authorship

All authors have a substantial contribution to the article.

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#### Conflict of interest

The authors declared that there were no conflicts of Interest.

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