

EFFECTS OF INTRAVENOUS REGIONAL ANESTHESIA AND AXILLARY NERVE BLOCK METHODS ON PATIENT SATISFACTION AND SURGICAL COMFORT IN HAND SURGERY

El Cerrahisinde İntervenöz Rejyonel Anestezi ve Aksiller Sinir Bloğu Yöntemlerinin Hasta Memnuniyeti ve Ameliyat Konforuna Etkisi

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ABSTRACT

Objective: Regional anesthesia methods used in hand surgery have become popular due to their rapid discharge time, high patient satisfaction, and low costs compared to general anesthesia. Today, many regional techniques are traditionally used for hand surgery. Among these techniques, intravenous regional anesthesia (IVRA) and axillary brachial plexus block (ABPB) represent two clinically established approaches. This study was designed to compare IVRA and ABPB with regard to patient satisfaction outcomes and perioperative comfort measures in hand surgery procedures.

Material and Methods: Following ethics committee approval, 80 patients aged between 18 and 75 years with American Society of Anesthesia (ASA) physical status I-III were prospectively and randomly enrolled in this study. We compared both groups for procedure duration, preoperative waiting time, operative time, sensory and motor blockade resolution times, sedation and analgesic requirements, time to discharge, and post-discharge patient satisfaction levels.

Results: The procedure duration was longer in the IVRA group, while the time from procedure to surgical onset was longer in the ABPB group ($p<0.05$). Sensory and motor block resolution times were significantly longer in the ABPB group ($p<0.05$). Postoperative analgesic requirements were lower in the ABPB group ($p<0.05$). No statistically significant difference was found between the groups in terms of patient satisfaction.

Conclusion: While axillary brachial plexus blockade demonstrated superior postoperative analgesic efficacy and prolonged motor blockade duration relative to intravenous regional anesthesia, it was associated with significantly extended preoperative waiting periods. These clinical characteristics suggest that axillary blockade may represent the preferred regional anesthetic technique for hand and wrist surgical procedures when performed by experienced practitioners.

Keywords: Hand Surgery; Axillary Block; Intravenous Anaesthesia

ÖZET

Amaç: El cerrahisinde uygulanan rejyonel anestezi yöntemleri genel anestezi ile kıyaslandığında, hızlı taburculuk süresi, yüksek hasta memnuniyeti ve düşük maliyetleri nedeniyle popüler hale gelmiştir. Günümüzde el cerrahisi için geleneksel olarak birçok bölgesel teknik kullanılmaktadır. Bunlardan ikisi intravenöz bölgesel anestezi (IVRA) ve aksiller brakial pleksus bloğu (ABPB) olarak tanımlanmaktadır. Çalışmamızın amacı bu iki yöntemi hasta memnuniyeti ve cerrahi konfora etkili faktörler yönünden karşılaştırmaktır.

Gereç ve Yöntemler: Etik kurul onayı sonrasında Amerikan Anestezi Derneği (ASA) I-III sınıfında, 18-75 yaş arasında 80 olgu, prospektif ve randomize olarak bu çalışmaya dahil edildi. Her iki grupta da işlem esnasından başlamak üzere, işlem süresi, bekleme süresi, ameliyat süresi, duyuşsal ve motor blok bitiş zamanı, sedasyon gereksinimi, analjezik ihtiyacı, taburculuk süresi, taburculuk sonrası hasta memnuniyet düzeyi açısından karşılaştırma yapıldı.

Bulgular: İşlem süresi IVRA grubunda aksiller blok grubundan daha uzundu ($p<0,05$). İşlem sonrasında cerrahi başlayıncaya kadar geçen süre, aksiller blok grubunda daha uzundu ($p<0,05$). Duyuşsal ve motor blok bitiş zamanı aksiller blok grubunda daha uzundu ($p<0,05$). Postoperatif analjezik ihtiyacı aksiller blok grubunda daha düşüktü ($p<0,05$). Hasta memnuniyeti açısından her iki grup arasında fark bulunmadı.

Sonuç: Aksiller sinir bloğu IVRA ile kıyaslandığında, daha düşük postoperatif analjezik ihtiyacı ve daha uzun motor blok süresi sağlamasına rağmen, hastalar için işlem sonrası daha uzun bekleme süresine neden olur. El ve el bileği cerrahisinde anestezi uzmanının deneyim ve tecrübesine göre aksiller sinir bloğu, IVRA yöntemine tercih edilebilir.

Anahtar Kelimeler: El Cerrahisi; Aksiller Blok; İntervenöz Anestezi

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INTRODUCTION

Regional anesthesia (RA) methods used in hand surgery have become more popular due to their rapid discharge time, high patient satisfaction, and low costs compared to general anesthesia (GA) (1). Two RA techniques are commonly employed in contemporary hand surgery practice. These are defined as intravenous regional anesthesia (IVRA), Bier Block, and axillary brachial plexus block (ABPB). IVRA was first described by the German surgeon August Karl Gustav Bier in 1908 (2). This method is a simple technique that allows early discharge from the hospital with a high success rate, low incidence of complications, and rapid onset and completion of the block. Possible disadvantages of IVRA include limited duration of effect, inadequate muscle relaxation, and the risk of systemic toxicity of the local anesthetic (3). ABPB was described in 1884 by Dr. Halstead et al. as an axillary approach to the brachial plexus nerve block (4). It is an effective technique for surgical applications on the elbow, forearm, and hand. However, it is not recommended for surgical procedures that involve the forearm. The disadvantages of this block include the possibility of increasing preexisting nerve damage, including long-term numbness, paresthesia, or motor weakness (5). Compared to IVRA and ABPB, it demonstrates prolonged analgesic duration and reduced postoperative analgesic requirements, albeit with potentially extended time to discharge readiness. Other disadvantages include a slower onset than IVRA, a longer learning curve, and a higher failure rate (6). One of the critical points in IVRA is the risk of systemic LA toxicity. Therefore, the amount of LA should be minimized. For this purpose, the use of a forearm tourniquet instead of a standard upper arm tourniquet can result in an increase in the safety margin for patients by almost halving the local anesthetic (LA) requirements. However a forearm tourniquet can also cause a narrowing of the surgical field (7). Comparative studies evaluating the analgesic efficacy and safety profiles of IVRA and ABPB utilizing upper arm tourniquet application remain limited in the current literature (8). The comparison of the IVRA and ABPB methods in terms of patient satisfaction and patient comfort during surgery and postoperatively has not been done comprehensively. The primary aim of our study is to compare these two methods in terms

of the factors affecting the length of hospital stay and patient satisfaction, and the secondary aim is to evaluate these two methods in terms of complications.

MATERIALS AND METHOD

Before the study, approval from the Ethics Committee of Ömer Halisdemir University Faculty of Medicine, numbered 2020/61, was obtained. 80 patients aged 18-75 years, with physical status according to the American Society of Anesthesia (ASA) I-III class, who were hospitalized for single hand and wrist surgery in the orthopedic clinic, were prospectively and randomly included in the study. The entire study was conducted by the principles of the Declaration of Helsinki. The study plan was explained to all patients in detail and informed patient consent was obtained. While the patients were in the preoperative preparation unit before the operation, the anesthesia method to be used for the patients was determined by the single envelope drawing method. Patients who were excluded from the study for various reasons are indicated in the Consort flow diagram (Figure 1).

Patients to be excluded from the study were those with a history of anticoagulant use, those with a history of allergy to diclofenac or local anesthetics, patients who

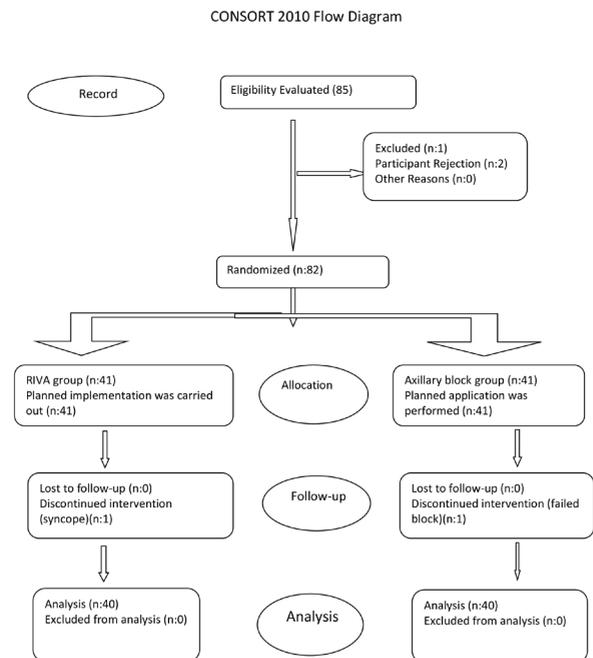


Figure 1. Consort flow diagram

would undergo surgery on both hands, those with an infection at the needle entry site, and those with systolic blood pressure over 170 mmHg and those who needed a tourniquet during the procedure.

Group 1: For IVRA, a tourniquet was placed on the upper arm of the patient, who was sedated with 2 mg midazolam. The exsanguination of the limb was achieved with an esmarch, and the bandage was held at 90° for 3 minutes to drain the upper limb blood. Blood pressure was measured on the patient's other arm. The proximal tourniquet cuff was inflated to a pressure exceeding the patient's baseline systolic blood pressure by 100 mmHg. Circulatory isolation of the surgical site was confirmed by the absence of operative arm, radial and ulnar pulses, and pulse axisometry (9). The IVRA protocol involved slow infusion (over 90 seconds) of 40 mL of 0.5% lidocaine hydrochloride solution, diluted with normal saline, via a 22-gauge peripheral intravenous catheter. After the procedure, the sensory block was assessed with a 23 g needle. After sufficient anesthesia was achieved, the distal tourniquet was inflated to the predetermined pressure at the 15th minute, and then the proximal tourniquet was deflated to provide a painless tourniquet area (10) (Figure 2).

Group 2: Patients who were to undergo axillary block were sedated with 2 mg midazolam before the procedure. For the procedure, the arms were abducted to 90°, and the forearm was flexed to 90°. The median, ulnar, and radial nerves surrounding the axillary artery and the musculocutaneous nerve in the

fascial layers between the biceps and coracobrachial muscles were identified using ultrasound. LA of the puncture site was achieved by subcutaneous injection of 2 ml of 1% lidocaine. The needle (Pajunk 360 0.71 × 50 mm; G 22; Pajuk Medical China) was inserted into the axilla under ultrasonography (US) guidance with the probe in the plane, and after the first motor response was obtained in the target nerve (set to 0.5 mA) with both ultrasound and neurostimulation, the needle was slowly advanced and the intensity was reduced to 0.3 mA. Motor responses prompted slight needle withdrawal to mitigate intraneural injection risk, followed by redirection to sequentially localize the median, ulnar, musculocutaneous, and radial nerves using identical technique parameters (Figure 3).

After obtaining an appropriate stimulation response, 10 ml for each nerve, 2% lidocaine (10 mg/ml) 15 ml, 0.5% bupivacaine (20 mg/ml) 15 ml, 10 ml of saline, a total of 40 ml of solution was infiltrated around the nerve sheath under ultrasound imaging (11). The adequacy level of the sensory block was evaluated as the end of the discrimination of hot and cold sensations in the wrist, and the adequacy level of the motor block was accepted as the absence of finger movements in the relevant nerve innervation region for the radial, ulnar, and median nerves. The operation was allowed to begin when there was a sufficient block in all incision areas where the surgery would take place. In both groups, 100 mg diclofenac sodium IM was routinely administered at the end of the motor block. For patients experiencing severe pain (visual analog



Figure 2A: Intravenous regional anesthesia (IVRA) application image.



Figure 2B: Intravenous regional anesthesia (IVRA) application image.

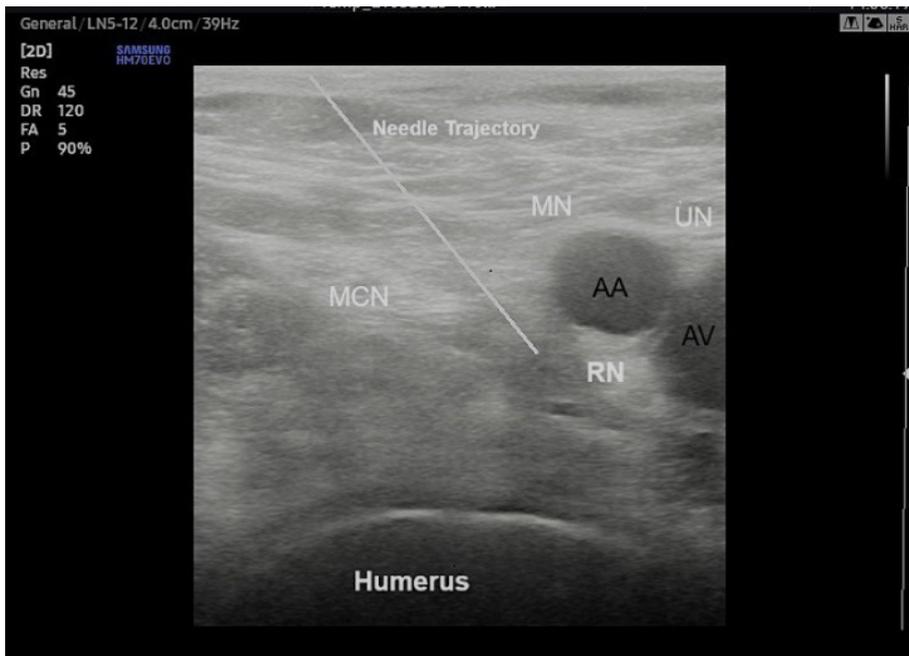


Figure 3. Ultrasonographic image of axillary brachial plexus block

scale value 4 and above), supplemental analgesia was administered, with subsequent quantification of analgesic requirements. In both groups, a comparison was made in terms of procedure duration, waiting time, surgery duration, tourniquet duration, postoperative additional analgesic requirement, sensory and motor block start and end time (pinprick test, ability to perform finger movements), hospital stay, and patient satisfaction level before discharge, starting during the procedure. In addition, intraoperative side effects such as panic attacks, hyperventilation, venous congestion, dizziness, tinnitus, fainting, and complications such as postoperative numbness, motor block duration, and nerve damage were observed.

At the end of the operation, the patients were scored as follows: 4 = (Excellent) = no complaints about pain, 3 = (Good) = minor complaints that do not require supplementary analgesics, 2 = (Moderate) = complaints that require additional analgesics, 1 = (Fail) = patients who were given GA.

Statistical Analysis

Statistical analyses were performed using the SPSS for Windows version 22.0 (Armonk, NY:IBM Corp.) package program. Numerical variables were summarized with

mean±standard deviation. The normality of numerical variables was examined using the Kolmogorov-Smirnov test. In comparing variables with normal distribution between groups, the t-test was used in independent groups. For variables where normality was not achieved, the Mann-Whitney U-test was used. In the statistical significance assessment between categorical variables, the chi-square test and Fisher's exact test were used. The significance level was taken as $p < 0.05$. The G power test was used to determine the sample size. In the study of Chan, Vincent W et al. named "A Comparative Study of General Anesthesia, Intravenous Regional Anesthesia, and Axillary Block for Outpatient Hand Surgery: Clinical Outcome and Cost Analysis", based on the length of hospital stay, the Type error amount was 0.05, the power of the test was 0.70, the effect size was 0.5, and the minimum sample size required in both groups was calculated as 78 in total, equal in both groups (12).

RESULTS

There was no difference in demographic data between the groups (Table 1). Procedure time was longer in the IVRA group than in the axillary block group ($p < 0.05$). The time from the procedure to the start of surgery

was longer in the axillary block group ($p < 0.05$). No difference was found between the groups in terms of operation times. No statistically significant intergroup differences were observed in either time to discharge eligibility ($p > 0.05$). Sensory and motor block completion time was longer in the axillary block group ($p < 0.05$). The postoperative analgesic requirement was lower in the axillary block group ($p < 0.05$). (Table 2). During the study, we observed dizziness in two patients in the IVRA group, tinnitus in one patient, and partial seizures in one patient, and we postponed surgery and excluded this patient from the study. In the axillary block group, short-term syncope was observed during the procedure in one patient, and prolonged numbness in the arm lasting 48 hours postoperatively was observed in one patient. While adequate surgical anesthesia was achieved in all patients who underwent block in the IVRA group, one participant in the axillary block group was excluded from the study due to an unsuccessful block.

DISCUSSION

LA and RA in upper extremity surgery have many clinical and practical advantages over GA. RA methods applied to the upper extremities have improved significantly compared to the initial applications. In hand and wrist surgery, isolated blocks of the target nerve that provide innervation to the surgical area, blocks of the brachial plexus at different levels, and Bier blocks using the intravenous injection method are generally used to provide postoperative analgesia and to create anesthesia at a level where surgery can be performed. In the COVID-19 pandemic experienced in recent years, the patient's desire to avoid GA by aiming for minimal contact with the airway and practices aimed at reducing opioid consumption all over the world have brought RA to the forefront (13). Sivrikaya et al. In their study comparing IVRA and infraclavicular block using prilocaine in forearm surgery. They observed that infraclavicular block provided better results, especially in terms of procedure time, initial analgesic requirement and patient satisfaction, that infraclavicular block under surgical US guidance could

Table 1. Demographic Data

Variable	IVRA (n = 40)	ABPB (n = 40)	p-value
Gender (Female / Male) *	13 / 27	18 / 22	0.251
Age (years) **	43.9 ± 17.02 (19–84)	47.7 ± 15.76 (18–72)	0.310
Weight (kg) **	77.6 ± 8.5	74.5 ± 8.6	0.093
Height (cm) **	170 ± 9.1	171 ± 7.8	0.508
Diagnosis, n (%)*			
Fracture	16 (40%)	21 (52.5%)	0.262
Soft tissue injury	20 (50%)	13 (32.5%)	0.112
Tumor / Vascular surgery	4 (10%)	6 (15%)	0.499

Data are presented as mean ± standard deviation (SD), range or number (%). **Mann–Whitney U test. *Pearson’s Chi-square test. p-value < 0.05 was considered statistically significant. IVRA: Intravenous regional anesthesia. ABPB: Axillary brachial plexus block, kg:kilogram, cm:centimeter

Table 2. Patient Data

Variable	IVRA (n = 40)	ABPB (n = 40)	p-value
Procedure T (min)&	6.55±1.03	5.95±1.30	0.029
Waiting T (min)*	11.33±2.06	30.43±5.03	0.001
Operation T (min)*	52.50±8.91	53.75±8.22	0.516
Motor Block T (min)&	16.60±4.99	235.50±58.17	0.001
Sensory Block T (min)&	14.00±3.95	254.00±58.38	0.001
Patient Satisfaction &	3.58(2-4)	3.55(2-4)	0.827
Discharge Time (h)&	17.55(8-24)	16.90(8-24)	0.463
Postop analgesia req. (no/yes)**	19/21	30/10	0.012
Complication**	3/38	2/38	0.644

Data are presented as mean ± standard deviation, median (range), or number (%). & Mann–Whitney U test. * Independent samples t-test. ** Pearson’s Chi-square test. p-value < 0.05 was considered statistically significant. T: Time, min:minute , req: requirement. IVRA: Intravenous regional anesthesia. ABPB: Axillary brachial plexus block

be preferred in short-term upper extremity surgery. In our study, procedure time was shorter, and the postoperative analgesic requirement was lower in the ABPB group (14). In our study, we evaluated additional analgesic requirements until discharge instead of rescue analgesic application time because the long effect duration of the procedure applied in the axillary block group is an expected result in the long initial analgesic usage period.

IVRA represents a well-established surgical anesthetic technique characterized by high success rates and a favorable learning profile (15). In contrast, ABPB demonstrates comparatively lower success rates and requires more extensive technical training. Evidence suggests that ultrasound-guided application may enhance the success rate of ABPB procedures (16). In our study, the success rate of axillary nerve block applied with US guidance was high.

Single-shot upper extremity blocks have an effective duration of anesthesia lasting hours when performed with long-acting local anesthetics (bupivacaine, levobupivacaine, or ropivacaine). While the analgesic effect disappears within the long-acting local anesthetic duration (6-10 hours), this effect can be prolonged by some adjuvant drugs added to the injection solution. In our study, we used lidocaine, which is relatively intermediate-acting, in both groups and bupivacaine together with lidocaine in the ABPB group, and we did not add any adjuvant drugs. The duration until complete motor block resolution and sensory block termination were significantly prolonged in the ABPB compared to the IVRA group (17).

Although IVRA is an easy method to apply, it is a method that requires attention to applications such as local anesthetic concentration, tourniquet pressures, and the time it takes to release the distal tourniquet pressure. Dizziness and seizures, rarely rhythm disturbances, loss of consciousness, tinnitus, etc. have been reported after IVRA application. In our study, we observed dizziness in two patients, tinnitus in one patient, and partial seizure findings in one patient (18). Prior to the availability of ultrasound the risks of complications and failure of RA made GA a more desirable option for anesthesiologists inexperienced in the practice of RA. US has revolutionized the practice of RA. By visualizing needle entry throughout the

procedure, the relationship between the anatomical structures and the needle can reduce the incidence of complications. In addition, direct visualization of the spread of LA around the nerves provides instant feedback regarding the likely success of the block.(19) It has been reported that the use of high-resolution US during peripheral nerve block applications can reduce the complication rate (20). In our study, we preferred to apply an axillary block under US guidance. Apart from a short-term loss of consciousness in one patient, which probably occurred due to observing the injection procedure, only one patient experienced numbness in the wrist that ended at the 48th hour. It could not be established whether this complaint was due to the peripheral nerve block procedure or the surgical procedure.

Anthony D. Hade et al. reported in their study on 979 patients who underwent peripheral nerve block that 108 patients were dissatisfied and that rebound pain, procedural discomfort and severe pain in the post-anesthesia care unit were prominent factors that could cause dissatisfaction (21). Another study investigating the effects of IVRA and ABPB on patient satisfaction reported high patient satisfaction, with no significant difference between the two groups (7). This study found comparably high patient satisfaction scores in both treatment groups. The combined protocol of procedural sedation with standardized analgesia and effective motor blockade likely contributed to these favorable patient-reported outcomes.

Postoperative opioid use is also common in upper extremity surgery. Multimodal pain management may be an effective method to reduce postoperative opioid consumption, because young patients with a history of substance abuse may exhibit opioid abuse behavior after surgery (22). Therefore, the use of regional blockade anesthesia, especially with long-acting agents or indwelling catheters, may help manage postoperative pain. Therefore, regional blocks such as axillary block are gaining popularity.

This study evaluated both anesthetic techniques exclusively as peripheral nerve blocks, with no comparative analysis of intraoperative hemodynamic parameters. Patient satisfaction assessments were conducted immediately before discharge, eliminating the need for post-discharge recall.

CONCLUSION

ABPB provides lower postoperative analgesic requirement and longer motor block duration compared to IVRA, but it causes longer waiting time for patients after the procedure. Both methods provide high patient satisfaction levels with no statistically significant difference. Axillary nerve block may be preferred to the IVRA method in hand and wrist surgery depending on the experience and expertise of the anesthesiologist.

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The authors declare that they have no conflict of interest to disclose

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