Original Research

A PROSPECTIVE COMPARATIVE EVALUATION OF BIER'S BLOCK VERSUS AXILLARY BRACHIAL PLEXUS BLOCK FOR INFRA-ELBOW UPPER EXTREMITY PROCEDURES

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ABSTRACT

Background: Regional anesthesia is commonly used for upper limb surgeries below the elbow because of its effectiveness, safety, and reduced postoperative complications. Axillary brachial plexus block and intravenous regional anaesthesia (IVRA) are widely practiced techniques for such procedures. The present study was conducted to compare the efficacy and safety of these two regional anesthetic techniques.

Methodology: This prospective comparative study was conducted in the Department of Anaesthesiology at Sree Mookambika Institute of Medical Sciences from April 2025 to February 2026. A total of 60 patients aged between 18 and 50 years undergoing elective and emergency upper limb surgeries below the elbow were included in the study. Patients were divided into two groups of 30 each. Group I received axillary brachial plexus block using 1% lignocaine with adrenaline, while Group II received intravenous regional anaesthesia using 0.5% lignocaine. Parameters such as onset and duration of analgesia, quality of analgesia, motor blockade, and perioperative complications were assessed and compared. Statistical analysis was performed using Student's t-test, and a p-value less than 0.05 was considered statistically significant.

Results: The onset of analgesia was significantly faster in Group II (3.7 ± 0.9 minutes) compared to Group I (12.8 ± 1.6 minutes) with $P < 0.001$. Grade I analgesia quality was observed in 76.6% of patients in the IVRA group and 53.3% in the axillary block group. Denser motor blockade and prolonged duration of analgesia were observed in Group I. The mean duration of analgesia was significantly higher in Group I (67.5 ± 4.5 minutes) compared to Group II (46.8 ± 8.8 minutes) with $P < 0.001$.

Conclusion: Both axillary brachial plexus block and intravenous regional anaesthesia were effective techniques for upper limb surgeries below the elbow. IVRA provided rapid onset of analgesia, whereas axillary brachial plexus block offered prolonged postoperative analgesia and superior motor blockade.

Keywords: Axillary Brachial Plexus Block, Bier's Block, Intravenous Regional Anaesthesia, Upper Limb Surgery, Regional Anesthesia, Postoperative Analgesia.

INTRODUCTION

Regional anesthesia is widely employed for upper limb surgeries because it provides effective intraoperative anesthesia, prolonged postoperative analgesia, reduced opioid requirement, and early recovery when compared with general anesthesia. Among the various regional anesthetic techniques available for surgeries below the elbow, Bier's block, also known as intravenous regional anesthesia (IVRA), and axillary brachial plexus block are commonly practiced because of their simplicity, effectiveness, and safety profile. Both techniques are extensively used for orthopedic, plastic, and emergency surgical procedures involving the forearm and hand. However, each technique possesses distinct advantages and limitations, making comparative evaluation clinically important.

Bier's block was first introduced by August Bier in 1908 and remains a useful anesthetic technique for short-duration upper limb surgeries. The procedure involves intravenous injection of local anesthetic into an exsanguinated limb isolated by a tourniquet, resulting in rapid onset of anesthesia and muscle relaxation. The technique is relatively simple, economical, and easy to perform with minimal equipment. It is particularly advantageous in daycare surgeries due to rapid recovery and early discharge. Nevertheless, Bier's block is associated

www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 23-05-2026
Date Acceptance: 31-05-2026
Date of Publication: 30-06-2026

with certain drawbacks including tourniquet pain, limited postoperative analgesia, and potential risk of local anesthetic systemic toxicity following tourniquet release. August Bier

Axillary brachial plexus block is another widely accepted regional anesthetic technique for surgeries distal to the elbow. This approach blocks the terminal branches of the brachial plexus at the axillary level, producing reliable anesthesia of the forearm and hand. Compared with Bier's block, axillary block provides superior postoperative analgesia, prolonged pain relief, and reduced tourniquet discomfort. The introduction of nerve stimulators and ultrasound guidance has significantly improved the success rate and safety of the procedure. However, axillary brachial plexus block may require greater technical expertise, longer performance time, and delayed onset of anesthesia compared with intravenous regional anesthesia.

Selection of an ideal anesthetic technique for below-elbow upper limb surgery depends on several factors including duration of surgery, postoperative pain management, hemodynamic stability, patient satisfaction, recovery profile, and complication rates. Previous studies comparing Bier's block and axillary brachial plexus block have demonstrated variable findings regarding onset time, quality of anesthesia, duration of analgesia, patient comfort, and incidence of complications. Some studies have reported faster onset with Bier's block, whereas others have shown better postoperative analgesia and patient satisfaction with axillary block. Therefore, further comparative evaluation remains essential for determining the most effective and safe regional anesthetic technique for routine clinical practice.

The present study was undertaken to compare Bier's block and axillary brachial plexus block in patients undergoing upper limb surgeries below the elbow with respect to onset and duration of sensory and motor blockade, intraoperative hemodynamic parameters, postoperative analgesia, patient satisfaction, and perioperative complications. The findings of this study may help anesthesiologists choose the most appropriate regional anesthetic technique for distal upper limb surgeries while improving patient safety and perioperative outcomes.

Aim

To compare the efficacy and safety of Bier's block and axillary brachial plexus block in patients undergoing upper limb surgeries below the elbow.

Objectives

1. To compare the onset time of sensory and motor blockade between Bier's block and axillary brachial plexus block.
2. To evaluate the duration of sensory and motor blockade in both techniques.
3. To compare intraoperative hemodynamic stability among patients receiving the two regional anesthetic techniques.

METHODOLOGY

This prospective comparative study was conducted in the Department of Anaesthesiology at Sree Mookambika Institute of Medical Sciences over a period from April 2025 to February 2026. The study was carried out after obtaining approval from the Institutional Ethics Committee and informed written consent from all participating patients. The study population consisted of patients admitted under the Departments of General Surgery and Orthopaedics who required elective or emergency surgical procedures involving the upper limb below the elbow.

A total of 60 patients between 18 and 50 years of age were included in the study. Patients were randomly allocated into two groups consisting of 30 patients each. Group 1 patients received axillary brachial plexus block, while Group 2 patients received intravenous regional anaesthesia (IVRA) using Bier's block technique. The surgical procedures selected for the study were expected to be completed within 60 minutes duration.

Patients undergoing elective or emergency surgeries of the forearm, wrist, and hand were included in the study. Patients who were extremely anxious, agitated, or uncooperative were excluded. Patients with shock, cellulitis or infection at the site of injection, history of allergy or hypersensitivity to local anaesthetic drugs, bleeding disorders, peripheral vascular disease, and those belonging to American Society of Anesthesiologists (ASA) physical status Grade III and IV were also excluded from the study.

A detailed pre-anaesthetic evaluation was conducted for all patients prior to surgery. Baseline parameters including pulse rate, blood pressure, respiratory rate, and oxygen saturation were recorded. Routine investigations such as complete blood count, blood sugar, renal function tests, electrocardiogram, and other investigations relevant to the surgical condition were reviewed before surgery. Patients were explained about the anesthetic procedure, expected sensations during block administration, and possible complications in order to ensure adequate cooperation during surgery.

All elective patients received oral diazepam 5–10 mg as premedication on the night before surgery. In addition, intravenous diazepam 0.1 mg/kg body weight was administered to all patients approximately 10–15 minutes before shifting to the operating theatre. Standard monitoring including pulse oximetry, non-invasive blood pressure, and

electrocardiography was instituted for all patients during the procedure.

In Group 1, axillary brachial plexus block was performed under aseptic precautions using 1% lignocaine with adrenaline at a dose of 0.6 mg/kg body weight. The equipment used included sterile gloves, antiseptic solution, 22-gauge intravenous cannula, 2 ml skin infiltration syringe, and 10 ml and 20 ml syringes containing local anaesthetic solution. After identification of the axillary artery, the local anaesthetic solution was infiltrated around the brachial plexus sheath to achieve blockade of the median, radial, ulnar, and musculocutaneous nerves. The onset of sensory and motor blockade was assessed periodically before commencement of surgery.

In Group 2, intravenous regional anaesthesia was administered using Bier's block technique. Two intravenous cannulas were secured, one in the operative limb distally and another in the opposite limb for administration of fluids and emergency medications. The operative limb was elevated for several minutes and exsanguinated using an Esmarch's bandage. A double tourniquet was applied over adequate cotton padding. After inflation of the proximal tourniquet, 0.5% plain lignocaine at a dose of 0.5 ml/kg body weight was injected slowly into the venous cannula of the operative limb. Adequate sensory and motor blockade was confirmed before surgery. Tourniquet inflation time and occurrence of tourniquet pain were noted.

The onset and duration of sensory and motor blockade, quality of intraoperative analgesia, hemodynamic parameters, postoperative pain relief, patient satisfaction, and complications such as hypotension, bradycardia, nausea, vomiting, local anaesthetic toxicity, and tourniquet pain were recorded and compared between the two groups.

All collected data were entered into Microsoft Excel and analyzed statistically. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were represented as percentages and proportions. Statistical comparison between the two groups was performed using Student's t-test for continuous variables and Chi-square test for categorical variables wherever applicable. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Group	Range(MINS)	Mean±S.D.	PValue
I	10-15	12.8 ±1.6	P <0.001
II	2-5	3.7 ± 0.9	
Table1: Onset of Analgesia After Drug Injection			

AnalgesiaQuality	GroupI		GroupII	
	No.	%	No.	%
I	16	53.3	23	76.6
II	14	46.7	7	23.3
III	NILL	NILL	NILL	NILL
Total	30	100	30	100
Table 2: Analgesia Quality				

MotorBlockadeDegree	GroupI		GroupII	
	No.	%	No.	%
I	7	23.3	17	56.6
II	23	76.7	13	43.3
III	-	-	-	-
TOTAL	30	100	30	100
Table 3: Motor Blockade Degree				

Group	Durationofrange	Analgesiamean	(min)S.D.	Significance
I	60 – 76	67.5	4.5	P <0.001*
II	30 – 62	46.8	8.8	
Table 4: Comparison of the Two Study Groups' Duration of Analgesia				

The beginning of an Algeria (loss of sensation to pinprick), occur sear lire with IVRA, and the result was shown to bestatistically significant. In contrast to brachial block,which had amean onset of analgesia of 12.8 mins, IVRA had a mean onset of 3.7 mins. (Table 1). 53.3% of patients getting an axillary block experienced grade I analgesia, compared to 76.6% of individuals undergoing IVRA.AlthoughnoneofthepatientsexhibitedgradeII Ianalgesia,thesurgerycouldbecompleted without requirement of general anaesthesia (Table 2).
23.3%ofpatientswithaxillaryblockhadGradeIblock age,whiletheremainingpatients(76.7%) had Grade II blockade. When treated with IVRA, 56.6% of patients experienced Grade I motor blockage, while 43.3% experienced Grade II blockade. None of the patients had grade III motor block(table3).Thecomparisonbetweenbrachial blockandIVRAintermsofanalgesiaduration,
Brachial block length ranged from 60 to 80 minutes, but IVRA duration ranged from 30 to 70 minutes,dependingonwhenthetourniquetwasreleas ed.Themomentwhenthesensationreturned was recorded. It was measured as the time between the release of the tourniquet and the moment when the patient first complained of discomfort. Anesthesia can be worn for 2 to 10 minutes at a time. According to the comparison of the two study groups' duration of analgesia, axillary block analgesiahad ameandurationof67.5 minutesas opposedto IVRA's46.8minutes (table4).Two patients in the axillary plexus block group reported axillary pain and discomfort at the axillary area, while three patients in the IVRA group experienced bradycardia and hypotension, which resolved after 25 minutes.

DISCUSSION

In the present study, the onset of analgesia after drug injection was significantly faster in Group II patients who received intravenous regional anaesthesia (IVRA) when compared to Group I patients who underwent axillary brachial plexus block. The mean onset time of analgesia in Group I was 12.8 ± 1.6 minutes, whereas in Group II it was 3.7 ± 0.9 minutes, which was statistically highly significant ($P < 0.001$). The rapid onset observed in IVRA may be attributed to the direct delivery of local anaesthetic into the venous circulation of the isolated limb, resulting in quick diffusion into peripheral nerves. Similar findings were reported in earlier studies comparing Bier's block and peripheral nerve blocks for short-duration upper limb surgeries. [8,9]
The quality of analgesia observed during surgery was satisfactory in both groups. In Group I, 53.3% of patients demonstrated Grade I analgesia quality while 46.7% had Grade II analgesia. In Group II, 76.6% of patients achieved Grade I analgesia and 23.3% showed Grade II analgesia. No patient in either group experienced Grade III inadequate analgesia. These findings indicate that both anesthetic techniques provided adequate intraoperative pain relief for surgeries below the elbow. However, a greater proportion of patients in the IVRA group achieved superior analgesia quality, likely due to the rapid and dense nerve blockade produced by the technique. Previous investigators have similarly demonstrated excellent surgical anesthesia with Bier's block in short surgical procedures involving the distal upper limb. [10]
Motor blockade was also evaluated in both study groups. In Group I, 76.7% of patients achieved Grade II motor blockade while 23.3% had Grade I blockade. In contrast, Group II demonstrated a higher proportion of Grade I motor blockade (56.6%) with 43.3% exhibiting Grade II blockade. The results suggest that axillary brachial plexus block produced a denser and more profound motor blockade compared to IVRA. This could be explained by the direct action of local anesthetic around the terminal branches of the brachial plexus, resulting in more effective neural conduction blockade. Similar observations have been documented in studies evaluating peripheral nerve blocks for orthopedic and hand surgeries. [11]
The duration of analgesia was significantly prolonged in Group I compared to Group II. Patients who received axillary brachial plexus block experienced analgesia lasting between 60 and 76 minutes with a mean duration of 67.5 ± 4.5 minutes, whereas patients receiving IVRA had analgesia lasting between 30 and 62 minutes with a mean duration of 46.8 ± 8.8 minutes. The difference was statistically highly significant ($P < 0.001$). The prolonged postoperative analgesia observed with axillary block may be attributed to sustained action of the local anesthetic around the brachial plexus sheath. In contrast, analgesia in IVRA rapidly diminishes after tourniquet release due to systemic washout of the anesthetic agent. Similar findings were reported by multiple comparative studies which concluded that axillary brachial plexus block provides superior postoperative pain relief when compared with Bier's block. [12,13]
Overall, both techniques were found to be effective and safe for upper limb surgeries below the elbow. IVRA offered the advantage of rapid onset and technically easier administration, making it suitable for short-duration procedures. However, axillary brachial plexus block provided superior duration of analgesia and denser motor blockade, thereby offering better postoperative comfort and patient satisfaction. The choice of anesthetic technique should therefore depend on the duration of surgery, postoperative analgesic requirement, available expertise, and patient characteristics.

CONCLUSION

Both axillary brachial plexus block and intravenous regional anaesthesia (Bier's block) were found to be effective and safe techniques for upper limb surgeries below the elbow. Intravenous regional anaesthesia provided a significantly faster onset of analgesia and satisfactory intraoperative anesthesia, making it suitable for short-duration surgical procedures. However, axillary brachial plexus block produced denser motor blockade and significantly prolonged duration of postoperative analgesia compared to IVRA. Therefore, axillary brachial plexus block may be preferred when prolonged postoperative pain relief is desired, whereas IVRA remains a simple and effective option for brief surgical interventions requiring rapid onset of anesthesia.

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How to cite this article: Dr. Srinivasan. R, Dr. Dineshkumar. S, A PROSPECTIVE COMPARATIVE EVALUATION OF BIER'S BLOCK VERSUS AXILLARY BRACHIAL PLEXUS BLOCK FOR INFRA-ELBOW UPPER EXTREMITY PROCEDURES, Asian J. Med. Res. Health Sci., 2026; 4 (2): 1393-1397.

Source of Support: Nil, Conflicts of Interest: None declared.