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Original Research Article

A Comparative Study between Bier's Block and Axillary Brachial Plexus Block for Upper Limb below Elbow Surgery

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ABSTRACT

BACKGROUND
In this study we aim to compare two regional Anaesthesia techniques - the axillary brachial plexus block and Bier's Block intravenous regional anesthesia (IVRA), with respect to the onset of analgesia, degree of sensory and motor blockade, duration of analgesia, and complications.

MATERIALS AND METHODS
The study was conducted on patients who were admitted to SVRRGGH, Tirupati for elective and urgent procedures of the upper limb below the elbow.

In the current study, 60 patients were randomized into two groups of 30 patients each. Group I received an axillary brachial plexus block, while Group II received Bier's block (IVRA). Patients were of either gender and between the ages of 18 and 50, came for either emergency or planned procedures below the elbow joint.

RESULTS
In comparing the duration of analgesia between the two atudy groups, the axillary block analgesia had a mean duration of 67.5 minutes while Bier's block lasted upto 46.8 minutes.

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CONCLUSION
With regard to the onset of analgesia, the quality of the analgesia, and the degree of motor blockade, IVRA appears to be a better alternative based on the conclusions of the current study and recommendations from prior references.

KEYWORDS
Axillary Branchial Plexus Block, Bier's Block, Lignocaine Hydrochloride.

INTRODUCTION

A widely used element of comprehensive anaesthetic treatment is peripheral blocking. Its function has been extended outside the operating room to include the management of chronic and post-operative pain. Peripheral neuronal blockade can increase the anaesthesiologist's toolkit for administering the best anaesthetic treatment. The most common method for noting the brachial plexus is the axillary approach since it is simple, dependable, and secure. August Bier developed this technique for intravenous regional anaesthesia in 1908. The brachial plexus block is often utilised to give upper extremity anaesthesia. There are four typical approach locations which are Axillary, supraclavicular, infraclavicular, and interscalene. By injecting a local anaesthetic into the vein while the circulation is cut off, intravenous regional anaesthesia is a straightforward technique for generating analgesia in the arm or leg.[1] His IVRA technique involved tying off a section of the arm with tourniquets and injecting a 0.5% procaine solution into a vein in that section. It was resurrected by Holmes in 1963 and is today recognised as one of the primary methods of anaesthesia for limb procedures. Holmes employed lidocaine, which seemed to provide more dependable anaesthesia than procaine. IVRA is a quick, easy, cost-effective, and time-saving process.

Aim and Objectives

This is a study to compare two regional anaesthesia techniques i.e. the axillary brachial plexus block and Bier's Block with respect to onset of analgesia, degree of sensory and motor blockade, duration of analgesia, and its complications.

MATERIALS AND METHODS

It is a prospective randomized comparative study. This study includes 60 patients, aged 18 to 50, of both genders, and admitted to SVRRGGH, Tirupati for elective and urgent procedures of the upper limb below the elbow.

Patients who have given written informed consent, had ASA I and II physical status, and were aged between 18 and 50 years were included in the study. The total study period was 1-2 years. The equipment used included standard monitoring devices (cardiac monitor, pulse oximeter, continuous blood pressure monitor). Advanced Cardiac Life Support (ACLS) supplies, drugs used for sedation (e.g., midazolam [Versed], fentanyl, and propofol [Diprivan]), and double-cuff automatic pneumatic tourniquet that can individually or simultaneously inflate or deflate both cuffs to preset pressures. As an alternative, ordinary blood pressure cuffs can be used if the dimensions of the arm can accommodate two appropriately sized cuffs between the axilla and the elbow without overlap. Lidocaine (without epinephrine), 1 mL/kg of 0.5% solution for upper extremity blocks, 2 mL/kg of the 0.25% solution for lower extremity blocks with two IV catheters, a 22-gauge line for the operative side and a 20-gauge line for the arm on the non-operative side were

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used. Sterile skin preparation solution (e.g., povidone-iodine), Tape, Elastic bandage of sufficient size to wrap the entire extremity distal to the tourniquet were also used for the procedure.

Inclusion and Exclusion Criteria

Elective and emergency surgical procedures of the upper limb below the elbow were the inclusion criteria. Those patients who did not meet the inclusion criteria were excluded. Additionally, patients who were extremely agitated and uncooperative, in shock, infected, had cellulitis, a history of local anaesthetic hypersensitivity; or were classified as ASA Grades III and IV were also excluded.

Study Design and Technique

A comparison of axillary brachial plexus block and intravenous regional anaesthesia were done. The patients were from general surgery and orthopedic specialty departments' inpatient units. Two groups of 30 patients each were chosen from among 60 patients between the ages of 18 and 50 who require both elective and emergency surgery of the upper extremity below the elbow. The surgical treatment was planned and done in less than 60 minutes time. All elective patients were got oral premedication the day before with 5 to 10 mg of diazepam. Ten to fifteen minutes before to the surgery, all patients received an intravenous injection of 0.1 mg/kg diazepam as premedication. Axillary brachial plexus block with 1% lignocaine and 0.6 mg/kg BW of adrenaline was administered to Group 1, where Group 2 was received intravenous regional anaesthesia of 0.5ml/kg BW of IVRA 0.5% lignocaine.

Axillary Plexus Block

The brachial plexus, which is made up of the lower cervical and upper thoracic spinal nerve roots, provides the skin and muscles of the shoulder and upper extremities.1) Interscalene block**:** Inter scalene blocks are used to anesthetize the shoulder, proximal upper arm, and lateral clavicle, targeting C5, C6, and C7 nerve roots, additionally the supraclavicular nerve (C3 and C4 nerve roots, sensory to cape of shoulder).[2,3] Interscalene block can be administered via a single-injection with ultrasound guidance or peripheral nerve stimulation, or as a continuous catheter-based infusion for prolonged analgesic effects.[2,3] Procedure using ultrasound guidance includes positioning of the patient on his back (supine) with the head slightly tilted away from the block toperform an ultrasound at the level of the cricothyroid (usually about 3-4 cm depth of penetration) to identify important local structures (carotid artery and internal jugular) associated with the C5, C6, and C7 nerve roots, which are adjacent to the C7 process, phrenic nerve, dorsal scapular nerve, long thoracic nerve, superficial cervical artery, and dorsal scapular artery are risk structures to avoid during needle advancement; enter at the level of the C6 root with a needle and aspirate to ensure that no vessel has been entered; inject a trial dose of anesthetic; then apply the remaining dose if no complications occur; and visualize anesthesia spreading from anterior to posterior covering C5, C6, and C7 nerve roots (adjust LA concentration to avoid exceeding maximum recommended dose) I.e. 4 to 10 ml for anesthesia and 5 ml for analgesia.

Procedure using Peripheral Nerve Stimulation

Insert a needle caudolaterally at the posterior border of the sternocleidomastoid muscle. Watch for appropriate fasciculation of the deltoid, biceps, and triceps. Aspirate to verify it is not done in a vessel and inject test amount of anesthetia. Inject remaining dose of anesthetia if no complications develop. Suggested dose of LA (adjust LA concentration to avoid exceeding maximum recommended dose) is 10-30 mL for anesthesia and 20 mL for analgesia.[3]

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Procedure using Continuous Catheter-based Infusion

In this procedure patient is in lateral decubitus position. Insert 18 gauge needle using in-plane technique about 1 cm lateral to ultrasound probe, and target nerve block to C5, C6 nerve roots. After negative aspiration, inject small amount of 0.2% ropivacaine with needle tip between C5 and C6 nerve roots and confirm visualized spread of anesthetic into interscalene groove (between anterior and middle scalene muscles). Inject additional 10 mL of LA to make room for catheter insertion. Insert 20 gauge catheter through 18 gauge needle and advance 2 cm beyond needle tip, then remove needle. Hydrolocate catheter tip using small amount of ropivacaine and adjust so final position of catheter tip is between C5 and C6 nerve roots (catheter has 6 side holes distributed at 1 to 2 cm from catheter tip).[4]

Suprascapular Brachial Plexus Blocks

Suprascapular blocks (often along with axillary blocks) are used to anesthetize the posterior, medial, and superior shoulder region when a diaphragm-sparing effect is needed, targeting the suprascapular nerve (C5 and C6 nerve roots).[5] Suprascapular Brachial plexus block may be administered using a landmark-based target, ultrasound guidance or peripheral nerve stimulation.

Procedure using Landmark-Based Target

Draw 1 line along the scapular spine superior border and another line parallel with the vertebral spine. Injection target is the suprascapular notch, located 2-3 cm toward the middle of the upper quadrant where the 2 lines cross.

Procedure using Ultrasound Guidance

Patient is seated with ipsilateral hand on contralateral shoulder. Position ultrasound transducer parallel to scapular spine at superior medial border of scapula. Move transducer cephalad and laterally, visualizing suprascapular fossa, then suprascapular notch, and suprascapular nerve. Insert needle to run parallel under long side of ultrasound probe.[5]

Procedure using Peripheral Nerve Stimulation

Patient is seated with arm in full adduction. Identify needle insertion point which is 2 cm medial and 2 cm cephalad to midpoint of a line connecting the lateral portion of acromion and medial end of spine of the scapula. Insert 22 gauge needle (connected to peripheral nerve stimulator), 4 to 6 cm in a lateral and caudal direction. Watch for appropriate fasciculation of the infraspinatus muscle (or patient reported knocking sensation in shoulder). if fasciculations or knocking sensation, aspirate and inject 15 mL of 0.75% ropivacaine. if no fasciculations or knocking sensation after 3rd attempt, direct needle deeper to bony surface of lateral supraspinous notch (landmark target), aspirate and inject 15 mL of 0.75% ropivacaine.[5,6]

Supraclavicular Brachial Plexus Blocks

Supraclavicular blocks are used to anesthetize the Brachial plexus trunks and divisions in the supraclavicular fossa (visualized as hyperechoic structures craniolateral to subclavian artery).[2,3] Supraclavicular brachial plexus blocks should be administered using ultrasound guidance, which can be used alone or in combination with peripheral nerve stimulation.[3] Procedure using ultrasound guidance in supine position with head turned away from the block ,place the ultrasound parallel to and behind the clavicle in the supraclavicular fossa. Identify the brachial plexus, subclavian artery, first rib and pleura. Straight needle in the plane from the lateral to the medial targeting junction of the subclavian artery, brachial plexus and first rib ("8-corner pocket") to provide ulnar nerve block. After negative aspiration, inject anesthetic. Consider additional

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injection inside plexus sheath between low echo structures. No ballooning of structures should occur after injection. Suggested dose for local anesthetics (LA) (adjust LA concentration to avoid exceeding maximum recommended dose) is 15 to 30 mL for anesthesia and 10 mL for analgesia. Peripheral nerve stimulation without ultrasound guidance is not recommended due to increased risk of pneumothorax.[3]

Infraclavicular Brachial Plexus Blocks

Infraclavicular blocks are used to anesthetize the lateral, posterior, and medial brachial plexus cords. Infraclavicular brachial plexus blocks can be administered with ultrasound guidance or peripheral nerve stimulation. Patient should be in supine position with head turned away from block and arm adducted or 90 degrees abducted.[3]

Procedure using Ultrasound Guidance

Place ultrasound sagittally below clavicle, mediocaudal to coracoid .Identify lateral, posterior, and medial brachial plexus cords grouped around the axillary artery in short-axis view (cross-sectional) .Direct needle in-plane from lateral to medial until positioned deeper to the axillary artery, adjacent to the posterior cord .Aspirate and inject test amount of anesthetic, then if there is no complications inject remaining dose of anesthetic (spread of anesthetic should be seen around cords of brachial plexus) .Suggested dose for local anesthetics (LA) (adjust LA concentration to avoid exceeding maximum recommended dose) is 20 to 30 mL for anesthesia and 10 to 20 mL for analgesia.

Procedure using Peripheral Nerve Stimulation

Needle puncture can be done in 2 ways. Directing needle anterior to posterior at the medial border of the clavipectoral (deltopectoral) triangle just below clavicle (watch for appropriate fasciculation of the extensors of lower arm and hand muscles from posterior cord stimulation). Directing needle in sagittal plane in triangle between coracoid process and clavicle (watch for appropriate fasciculations of pectoralis major and minor muscles, and biceps muscle from lateral cord stimulation). Aspirate, inject test amount of anesthetic, then inject remaining dose of anesthetic. Suggested dose for LA (adjust LA concentration to avoid exceeding maximum recommended dose) is 30 to 50 mL for anesthesia and 20 to 30 mL analgesia.[3]

Complications of Brachial Plexus Blocks

Complications of interscalene block may include[3] pneumothorax ,blockade of phrenic nerve resulting in diaphragmatic paralysis, spinal and/or epidural anesthesia ,vascular puncture of vertebral artery, superficial cervical artery, dorsal scapular artery, and suprascapular artery ,Horner syndrome .Complications of suprascapular brachial plexus block may include ,pneumothorax and damage to suprascapular nerve or vessels.[7] spread of anesthesia to posterior cord of brachial plexus with anesthesia of radial nerve, commentary can be found in.[6] Complications of supraclavicular block may include,[8] pneumothorax ,blockade of phrenic nerve resulting in diaphragmatic paralysis ,vascular puncture of subclavian artery, dorsal scapular artery, superficial cervical artery, and suprascapular artery .Complications of infraclavicular block may include[9] pneumothorax ,blockade of phrenic nerve resulting in diaphragmatic paralysis ,vascular puncture of axillary artery and vein, and cephalic vein, Horner syndrome (rare). Complications of axillary brachial plexus block may include injury to axillary artery and vein.[2,3]

IVRA (Intravenous Regional Anesthesia)

Wide portions of the distal portion of an extremity can be anaesthetized using intravenous (IV) regional anaesthesia, sometimes referred to as a Bier block. When done correctly, the Bier block

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is a safe substitute for local or hematoma infiltration and delivers anaesthetic that is superior to that produced by these other procedures. It also has the benefit of being technically easier to execute than other regional options (e.g., axillary or brachial plexus block).

Study Procedure

The patients were divided into two groups at random: Group 1 was given with axillary brachial plexus block to put them to sleep. Group 2 was IVRA-anesthetized.

1. Axillary Brachial Plexus Block**:** 2ml Skin Infiltration Syringe; 22G IV Cannula; 20ml and 10ml Syringes; 1% Xylocaine without Adrenaline Local Anaesthetic Agent.
2. IVRA**:** 20- and 22-gauge IV cannulas, Two tourniquets, an Esmarch's bandage, 20- and 5-ml syringes, 0.5% plain xylocaine (Xylocard), a cotton roll, and a local anaesthetic agent. At SVRRGGH Hospital in Tirupati, a comparison of axillary brachial plexus block and intravenous regional anaesthesia were done. The patients belong to general surgery and orthopaedic specialty departments' inpatient units were seen. Two groups of 30 patients each were chosen from among 60 patients between the ages of 18 and 50 who require both elective and emergency surgery of the upper extremity below the elbow. To promote good cooperation, the patient was informed about the technique's steps and how paraesthesia develops. The surgical treatment was chosen such that it may be completed in less than 60 minutes. All elective patients were got oral premedication the day before with 5 to 10 mg of diazepam. Axillary brachial plexus block with 1% lignocaine and 0.6 mg/kg BW of adrenaline was administered to Group 1, where Group 2 was received 0.5ml/kg BW of IVRA 0.5% lignocaine. The technique conducted in the major operation theatre.

Statistical Analysis

The Student T-test was used to evaluate the data. Statistics were considered significant at P values less than 0.05. Excel was used to code and enter data into the computer. Version 27 of the Statistical Package for the Social Sciences (SPSS) was used to conduct the necessary statistical analyses.

RESULTS

The beginning of analgesia (loss of sensation to pin prick), occurs earlier with IVRA, and the result was shown to be statistically significant. In contrast to brachial block, which had a mean 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. Although none of the patients exhibited grade III analgesia, the surgery could be completed without requirement of general anaesthesia (Table 2).

23.3% of patients with axillary block had Grade I blockage, while the remaining patients (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 (table 3). The comparison between brachial block and IVRA in terms of analgesia duration, Brachial block length ranged from 60 to 80 minutes, but IVRA duration ranged from 30 to 70 minutes, depending on when the tourniquet was released. The moment when the sensation returned 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 analgesia had a mean duration of 67.5 minutes as opposed to IVRA's 46.8 minutes (table 4). 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.

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Group	Range (MINS)	Mean ± S.D.	P Value
I	10-15	12.8 ±1.6	P < 0.001
II	2-5	3.7 ± 0.9	

Table 1: Onset of Analgesia After Drug Injection

Analgesia Quality	Group I		Group II	
	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

Motor Blockade Degree	Group I		Group II	
	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	Duration of range	Analgesia mean	(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

DISCUSSION

The present study compared axillary brachial plexus block with intravenous regional anesthesia with respect to onset of analgesia, degree of sensory and motor blockade, duration of analgesia and complications. The patients were taken from the inpatient section of the Department of General Surgery and Orthopedics. 60 patients between the ages of 18 and 50 who require either elective or emergency surgery of the upper limb below the elbow were divided into two groups of 30 patients each. Based on the inclusion criteria, participants were selected. The surgical technique was designed to be completed in 60 minutes or less. All patients undergoing elective surgery are pre-medicated the day before with 5-10 mg of diazepam orally. Complications are monitored both during and after surgery for 24 to 48 hours.

In this study, we observed that the mean duration of analgesia with axillary block was found to be 67.5 minutes compared to IVRA which was 46.8 minutes. And they found a statistically significant association (p-value < 0.05) between the duration of analgesia between the two groups. In a study conducted by Talikota Nagaraj et al. found that the mean duration of analgesia with axillary block was 66.1 minutes compared with IVRA, which was 48.1 minutes. And he found a statistically significant association between the two groups.[9]

Residual nerve block in intravenous regional anesthesia after tourniquet release was performed by C.J. Evans et al.[10] in 1974 found that there was a rapid return of sensation in the

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limb, but patchy anesthesia persisted for varying lengths of time. The duration of residual nerve block was measured in 6 volunteers receiving five different agents such as lignocaine, prilocaine, HS 37, etidocaine and bupivacaine. The duration of the block has been linked to the duration of effect of the drugs in clinical use. Analysis of venous blood from the blocked arm and the contralateral arm showed that significant amounts of injected drugs remain in the arm long after the tourniquet is released.[10] A comparative study by Vincent W.S. Chan William J Middleton of the Department of Anesthesia at the University of Toronto concluded that IV regional anesthesia may offer a more favorable patient recovery profile and shorter postoperative nursing care and hospital discharge times than general anesthesia or the brachial plexus block technique for hand surgery.[11] In 1994, Bolte et al administered a mini dose IVRA technique with low-dose lidocaine, i.e., 1.5 mg/kg without routine premedication for closed reduction of upper extremity fractures in 69 children aged 2 to 16 years. They concluded that mini-dose Bier block provides safe, reliable and cost-effective anesthesia for ambulatory reduction of pediatric upper extremity injuries.[12] In 1995, Blyth et al studied changing the injection site for Bier's block. They injected the drug into the antecubital fossa vein in a trauma setting to provide anesthesia of the upper extremity during manipulation of a distal radial fracture. They found no difference in anesthesia between this group and the other group, where the injection was applied to the dorsum of the hand, where they found little technical difficulty.[13] In this study, we observed complications such as axillary pain and discomfort in 2 patients in the axillary plexus block group, while bradycardia and hypotension were observed in 3 patients in the IVRA group, which normalized within 25 minutes. Similar results were observed in a study by Talikota Nagaraj et.al, they observed axillary pain and discomfort in 2 patients in the axillary plexus block group, while bradycardia and hypotension were observed in 3 patients in the IVRA group, which normalized within 25 minutes.[10] Gregory and Sullivan in 1996 contrasted IVRA with nitrous oxide analgesia for the management of juvenile forearm fracture. The groups were compared in terms of the patient's perception of pain, success of manipulation, safety and length of operation. They found no significant change in either group.[14] Lignocaine hydrochloride was the medication utilized, with concentrations of 1% in cases of brachial block and 0.5% in cases of IVRA. The dose and volume were adjusted for the patient's body weight while the concentration remained constant. With IVRA, analgesia began right away (in 3-5 minutes), but it took patients with axillary brachial blocks 10-15 minutes to feel any effects. 76.6% of IVRA patients had Grade I analgesia, compared to 53.4% of axillary brachial block patients, who had Grade I analgesia. 56.6% of IVRA patients had grade I motor block, compared to just 43.3% of axillary brachial block patients. In the present study we found that, the mean duration of analgesia with axillary block was found to be 67.5 minutes when compared to IVRA which was 46.8 minutes. 2–10 minutes after the tourniquet was released, the pain returned. Mild and transient complications with both procedures were discovered.

CONCLUSION

Regarding the onset of analgesia, the quality of the analgesia, and the degree of motor blockade, IVRA seems to be a better alternative following the conclusion of the current study and recommendations from prior references. Even though it is not as comparable as brachial blockade, more recent studies support the use of adjuvants to local anesthetics in IVRA, which improved the quality of blockade and the post-operative outcome with regard to analgesia. Analgesia lasted longer when the axillary brachial plexus was blocked. Pain alleviation was still more obvious with the introduction of the most recent approach of continuous brachial plexus blockage by catheter insertion.

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