

ISSN (P): 2521-3466
ISSN (E): 2521-3474
© Clinical Orthopaedics
www.orthoresearchjournal.com
2019; 3(3): 23-27
Received: 17-05-2019
Accepted: 19-06-2019

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Clavicle fracture surgery under regional anaesthesia: Comparing two different types of peripheral nerve blocks

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DOI: <https://doi.org/10.33545/orthor.2019.v3.i3a.156>

Abstract

Context: To know the innervation of the structures around the clavicle for clavicle fracture surgery.
Aim: To investigate the two different methods of regional anesthesia for internal fixation of clavicle fractures.

Methods and Material: 50 cases of clavicle fracture surgery were randomly divided into two groups of 25 patients each. Group I: Interscalene Brachial plexus block combined with superficial cervical plexus block; Group: II Interscalene Brachial plexus block combined with superficial cervical plexus block and deep C3 and C4 block. All patients were sedated with midazolam-2mg. Onset of analgesia (min), duration of analgesia (hrs) and time of first rescue analgesia (hrs) was recorded. Pain was recorded in VAS scale. Haemodynamic parameters were measured and side effects if any were also recorded. Total analgesic required during the first 6hrs postoperative period was also recorded.

Results: In group II onset of analgesia (min) was slightly quicker, though not of much significance, but analgesia was denser, duration of analgesia (hrs) longer and time of first rescue analgesia (hrs) was significantly longer than in Group I. In Group II use of analgesic drugs or number of cases converted to general anaesthesia was significantly lower than in group I.

Conclusion: Clavicle area of skin and structures around it are innervated by the cervical plexus and brachial plexus of which dominated mainly by the brachial plexus and some cervical plexus involvement. The joint use of deep and superficial cervical plexus block and brachial plexus is the ideal anaesthesia for clavicle fracture surgery.

Keywords: Brachial plexus block, clavicle fracture, C3 C4 deep plexus block, superficial cervical plexus block

Introduction

The contemporary literature surrounding the optimal regional anaesthetic technique for clavicle surgery which can provide superior intraoperative, postoperative analgesia and minimize systemic agents intraoperatively is lacking. Currently there is only small case series or case reports published or some authors have combined Regional with General Anaesthesia. [1, 2, 3] Larger, systematic trials have not yet been done in our knowledge. Controversy surrounds the primary sensory innervation of the clavicle. [4] Though there are many reports on post-operative analgesia after shoulder surgery but few trials have been done after clavicle surgery. [5, 6]

Materials and Methods

Present study was conducted in the department of Anaesthesiology R.G.Kar Medical College and Hospital Kolkata from 2014---2016. Hospital Ethics Committee approval was taken and informed consent was obtained from all the study patients. 50 patients of either sex belonging to ASA grade 1 were included in the study. Age group were in the range of 20-50 yrs and weight 50-70 kgs. Patients with COPD or any other respiratory compromise, allergic to the drugs used, geriatric age group, hypertensive, pregnant females and anticipated difficult intubation were excluded from the study. Patients were randomly allocated into two groups, randomization was done using a computer generated random number table002E

Group 1 (n=25): Interscalene Brachial plexus block combined with superficial cervical plexus block;

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Group 11(n=25): Interscalene Brachial plexus block combined with superficial cervical plexus block and deep C3 C4 block.

On arrival to the OT IV cannulation was done in all patients with 18 gauge needle. Monitoring was done for Blood Pressure, Pulse Rate, SpO₂, and ECG and the patients were explained the procedure. IV sedation was given with Inj Midazolam—2mg.

There is a confusing nomenclature in the articles about cervical plexus blocks. There have been various methods described for the proper injection technique in superficial cervical plexus blocks. The classical technique which we have used for superficial cervical plexus blocks was described as subcutaneous injection of the local anesthetic drug, which was found clinically effective for carotid endarterectomy.^[7] In some reports, superficial cervical plexus injections have been suggested to be “intradermal” (even more superficial) or subinvesting fascia injection which might be termed as the “intermediate cervical plexus block”

After proper antiseptic dressing the three proposed sites for Interscalene Brachial plexus block, cervical site for superficial cervical plexus block and C3, C4 block was infiltrated with 0.5% lignocaine solution. Group 1 received Interscalene Brachial plexus block combined with superficial cervical plexus block and Group 11 received Interscalene Brachial plexus block combined with superficial cervical plexus block and deep cervical only C3 C4 block. Blocks were given according to the standard protocol using the nerve muscle stimulator. 1.0 mA was used as a starting current intensity and only after eliciting the required jerks drugs were given. If motor response occurred below 0.5 mA and if the patient complained of paraesthesia the needle was withdrawn by 1 mm, and then drug was injected.

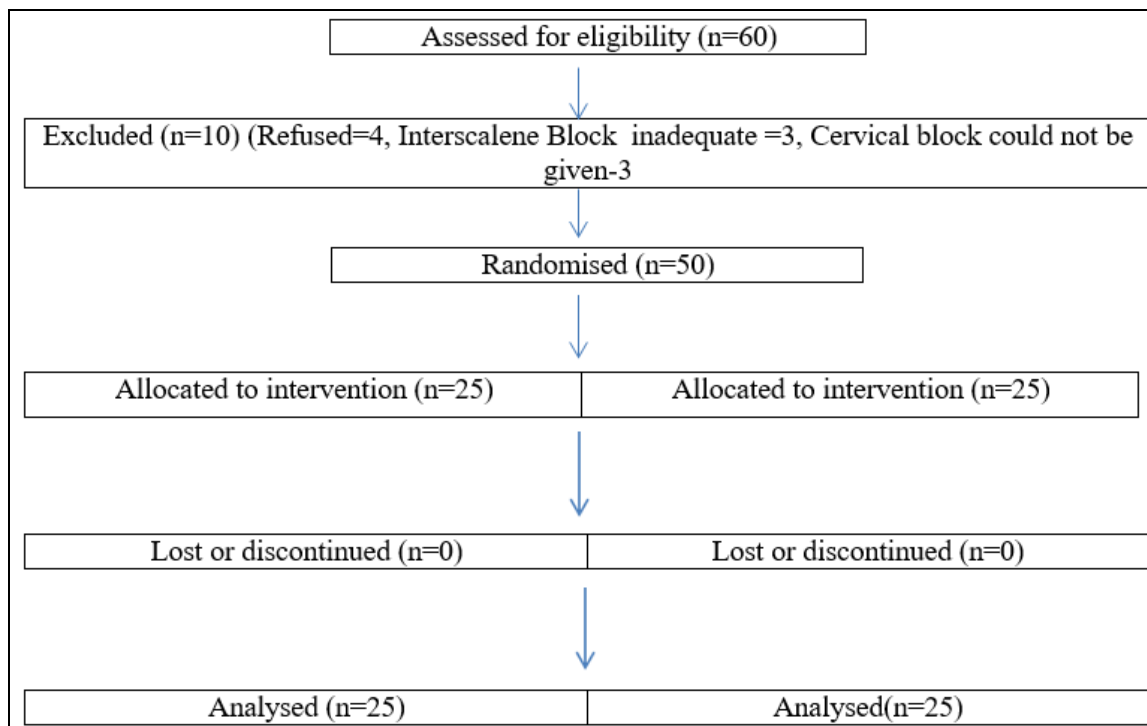
.Each patient received 40 ml of local anaesthetic solution consisting of 20ml of 0.25% Bupivacaine and 20 ml of 1% Lignocaine with 1 in 200000 adrenaline mixture divided in the two/three blocks. Precautions were taken to avoid complications like inadvertent injection into the vertebral artery, spinal nerve injury or injecting into the spinal cord so only 1–2 ml of local anaesthetic was injected to allow detection before continuing with the slow injection of 5 ml increments to a total volume of

40ml divided in the two/three blocks. Motor blockade was determined by loss of shoulder abduction, and sensory blockade was assessed using the pinprick test at the surgery site. The patient was also checked for pain with mobilization of the arm and palpation of the clavicle by the surgeon. A successful block was defined as one which did not necessitate conversion to general anesthesia. Surgeons were allowed to start the operation 15 -20 minutes after administering the block. Intravenous Fentanyl Citrate was used as rescue analgesic during OT and Intravenous Diclofenac was used as rescue analgesic postoperatively. If there was intolerable pain (VAS >5) or Fentanyl requirement more than 3 microgram / kg body weight the patient was converted to general anaesthesia.

Pain intensity was assessed using a 10-cm visual analog scale (VAS). Zero denoting no pain and 10 denoting intolerable pain

1. Pain was assessed after 15 minutes of administering the blocks to record the onset of analgesia, at skin incision, stripping the periosteum, plate and screw fixation, skin suturing and post-operative at 1 hr, 2hrs, 3hrs, 4hr, 5hrs and 6 hrs.
2. Use of rescue analgesic drugs intraoperative and postoperative period was noted
3. Thorough observation and follow-up for any adverse reactions were done, such as toxic reactions, recurrent laryngeal nerve block, Horner syndrome, spinal anaesthesia and pneumothora.
4. Haemodynamic parameters during OT and in the postoperative period was noted. Stastical Analysis—Data were collected and expressed as number and mean+/- and standard deviation. Stastical significance for continuous variables like Heart rate, Mean Arterial Pressure (MABP) was calculated using Independent Samples T Test. Group differences with nominal variables were analysed using Fishers exact test. A p value of <0.05 was considered to be statistically significant. IBM SPSS software Version 20 was used.

Results



Consort diagram for the flow off participants in each stage

A total of 50 patients were included in this study, Group I and Group II having 25 patients in each group. Patients of the study groups were comparable with respect to demographic data. While comparing the mean arterial pressure (MAP) in Table--1 it was found that there was a significant difference between the two groups during stripping of the periosteum, screw and plate fixation, skin suturing and till two hrs postoperatively, this is probably due to the stress caused by pain in the perioperative

period. In some patients the increase in MAP seen in Group I could not be lowered even with addition of analgesics, and in these patients if VAS also increased they were converted to general anaesthesia.

Group I there is increase in MAP and heart rate during stripping of the periosteum, screw and plate fixation, skin suturing and till 5 hrs postoperatively, this is probably due to the stress caused by pain in the perioperative period.

Table1: Comparing Mean Arterial Pressures (mm Hg) and Comparing Heart rate in (beats/minute) among the study groups at specified points of time during surgery (N = 50) Original

Time Interval	Gr I (Heart Rate)n=25	Group II (Heart Rate) n=25	P Value	Group I (MAP) n=25	Group II (MAP) n=25	p Value
Baseline	81.3±8.188	80.3±6.450	p = 0.601	90.5 ±6.174	88.4 ±5.028	p = 0.154
skin incision	80.6±6.688	75.8±16.914	p = 0.154	88.84±5.35	85.76±6.52	p=0.07
stripping the periosteum	109.84±7.41	89.40±0.24	P=0.007	98.2 ±5.020	90.3 ±7.530	p= 0.000
plate and screw fixation	94.08±4.18	83.76±0.04	p = 0.000	97.6 ±5.424	87.3 ±5.609	p= 0.000
skin suturing	91.45±7.13	74.35±7.20	p = 0.000	95.7±6.747	84.6±3.838	p = 0.000
post-operative at 1 hr	90.80±7.68	73.00±6.88	P=0.000	89.10±3.65	77.00±1.37	p = 0.000
post-operative at 2 hrs	86.50±5.68	70.10±7.50	p=0.000	87.00±5.00	74.12±2.48	p = 0.000
post-operative at 4 hrs	92.3±6.188	75.5±4.462	p = 0.000	88.6±4.00	80.3±2.33	p = 0.000
post-operative at 5 hrs	94.40±3.91	83.76±0.45	p = 0.000	90.4±5.12	78.3±2.43	p = 0.000
post-operative at 6 hrs	81.48±13.03	80.42±12.03	p=0.76	95.00±7.59	93.28±7.85	p=0.43

In the VAS score of the two groups there is statistically significant difference during stripping of the periosteum, screw and plate fixation, skin suturing and till 5 hrs postoperative, at 2

hrs postoperative there is no difference as the block has worn off by then.

Table 2: Comparing the VAS score among the study groups at specified points of time during surgery (N = 50) Original

Time Interval	Group I n=25	Group II n=25	p Value
Baseline	1.08±0.277	1.00±0.277	p=1.00
skin incision	2.44±0.583	2.36±0.636	p=0.64
stripping the periosteum,	4.10±1.94	2.37±0.25	p=0.000
plate and screw fixation	5.85±0.80	2.40±0.63	p=0.000
skin suturing	3.26±0.98	1.97±0.71	
post-operative at 1 hr	2.77±0.43	2.37±0.25	p=.011
post-operative at 2 hrs	3.22±0.88	1.96±0.17	p=0.000
post-operative at 4 hrs	2.27±0.45	1.10±0.52	p=0.000
post-operative at 5 hrs	2.83±0.38	2.53±0.87	p=0.039
post-operative at 6 hrs	5.84±0.374	5.64±0.490	p=0.880

In the Table 3 which compares the requirement of supplemental analgesic in the operative and postoperative period it is seen that more patients in Group I required Fentanyl during OT and also more patients of Group required Diclofenac in the postop period.

Patients of Group I had to be supplemented immediately with Diclofenac in the post op period where as in Group II Diclofenac was required only when the block wore off after 6 hrs of the block being given.

Table 3: Comparing the total amount of intraoperative and postoperative rescue analgesia required N=50 Original

	Group I n=25	Group II n=25	P value
Number of patients requiring Fentanyl	18	5	p=0.000
Number of patients requiring Diclofenac Sodium in the Post op period	20	3	p=0.000
Time of first post op Analgesic	60 min.	360 min.	p=0.000

Table 4: Conversion to General Anaesthesia Original

	Group I n=25	Group II n=25	p value
Converted to GA	10	1	p=0.018
No need to convert	15	24	p=0.000

Percentage of patients who had to be converted to General Anaesthesia was more in Group I.

Discussion

The shoulder area and the innervation of the clavicle is by both cervical and brachial plexuses. The cervical plexus supplies the skin above the clavicle, shoulder tip, and first two intercostal

spaces anteriorly through the superficial cervical plexus and supraclavicular nerves (C3–C4). The brachial plexus innervates the skin over the deltoid muscle through the upper lateral cutaneous branch of the axillary nerve, and the medial side of the arm and axilla through the medial cutaneous nerve of the arm and the intercostobrachial nerve (T2). The shoulder joint has rich innervation from the brachial plexus, which must be adequately blocked to allow surgery to proceed in the awake patient and also to provide adequate dynamic pain relief in the postoperative period. Suprascapular nerve supplies the acromioclavicular joint which also provides some innervation to the capsule and the glenohumeral joint. The inferior aspect of

the capsule and glenohumeral joint are supplied by the axillary nerve^[8]. There may, in addition, be a small variable contribution from the musculocutaneous and subscapular nerves. A common anatomical variation is a perforating branch of the supraclavicular n. that passes in the superior surface of the clavicle.

These nerves, alone or together may be responsible for pain transmission in clavicular fracture and surgery. One of the most common fractures to occur is a clavicular fracture, more typically in the middle third of the bone. While most medial and lateral fractures can be managed non-operatively if they remain stable, mid-shaft fractures can potentially have a higher degree of displacement with an increased incidence of malunion or non-union. Depending on the displacement and possible shortening of the involved fragments, surgery may be warranted. Neurovascular compromise may also be an indication for operative management. Peripheral nerve blocks used to anesthetize the clavicle include cervical plexus blocks, interscalene blocks, and combined cervical plexus-interscalene blocks. Clavicle surgery is usually performed under general anesthesia. Any regional anesthesia method for repair of a clavicle fracture is not commonly performed in current anesthesia practice^[9].

Although peripheral nerve blocks are commonly used for a wide variety of surgical procedures on the upper extremity, there are very few reports regarding regional anesthesia for surgery of the clavicle^[10]. Choosing the optimal nerve block to anesthetize the clavicle requires a thorough understanding of innervation, which remains controversial^[11]. The sensory innervation of the clavicle has been attributed to either the cervical or brachial plexus^[3,4].

Regional anesthesia (RA) is usually not sufficient to cover the entire clavicle and its sternal portion, even with increased volumes of local anaesthetic. The sitting position, necessary for clavicle surgeries, requires deep and efficient anaesthesia, due to the difficult airway access during surgery. The innervation of the clavicle and the overlying skin is between C3 and C6. The clavicle itself has been reported to be innervated either by C4, or by C5 and C6 (subclavian nerve). Studies have been done with a cervical plexus block combined with an interscalene block targeting the upper trunk (roots C5 and C6)^[12].

In our study we found that combining the interscalene brachial plexus block and superficial cervical plexus block is not sufficient to completely abolish pain during all steps of surgery and also in the post-operative period. The onset of the motor and sensory block was same in both the groups about 15 –20 minutes after the blocks were administered, Group I patients experienced pain during stripping of periosteum, screw fixation and also during suturing. Pain was so intense that a significant number of patients had to be converted to General Anaesthesia. In Group II deep cervical plexus block of C3 and C4 was the main deciding factor for control of pain and VAS score was low. In the first 6 hrs post-operative period also analgesic requirement for Group II patients was very low.

In interscalene and deep cervical plexus block chances of phrenic nerve, with associated ipsilateral hemidiaphragmatic paresis is there, therefore, bilateral interscalene blocks should never be performed. Our Patients were all ASA I with no co-existing respiratory disease, as it may cause respiratory embarrassment or failure, particularly in the supine patient. All patients tolerated the unilateral block well also Oxygen saturation was 100%. Patients were maintained in the deck chair or seated positions. Many complications are reported in many literatures but in our patients there were no complications due to

the block^[13].

Conclusion: For the purpose of analgesia cervical plexus block have been given in many cases of clavicular fracture but combining it with brachial plexus block (By the interscalene route) for the purpose of surgery has given us good results^[14,15]. From this we can conclude that combined cervical (Deep and Superficial) and brachial plexus block is a good alternative to general Anaesthesia in clavicular surgery. Our only limitation is we have tried this method in ASA 1 patients only.

Conflicts of interest-None

Acknowledgments-Post Graduate Trainees of the institute where the study was conducted

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