Classical Versus Lateral Sagittal Infraclavicular Brachial Plexus Block: Comparison of Anesthetic Time, Efficacy and Patient's Acceptance.

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Abstract:

Background: Infraclavicular brachial plexus block (ICB) has recently become a technique of increasing interest because it is possible to cover all sensory territories of the distal part of the upper limb with only one puncture. Lateral sagittal ICB has the over advantages of both simplicity and the lower risk of complications.

Aim of the study: To compare between lateral sagittal and classical ICB in regard to anesthetic time (i.e. performance time + onset time + duration of action the block), efficacy (successful block of the four major nerves of the arm), and patient's acceptance.

Patients & Methods: Forty adult patients of ASA I or II scheduled for elective surgery of the hand, forearm, or distal arm were enrolled in this study. Patients were divided into two equal groups according to the technique used for ICB: the classical ICB block was performed in the first group (group V), and lateral sagittal ICB for the second one (group L). Bupivacaine 0.5% in a dose of 2 mg/kg was used in all patients.

Results: Performance time and onset of sensory and motor blockades were significantly less in the (L) group than (V) group. Duration of analgesia and motor blockade were significantly more prolonged in the (L) group than (V) group. Rates of success and patient acceptance were higher in (L) group.

Conclusion: Lateral sagittal ICB is superior to the classical vertical ICB technique on providing shorter performance time, more rapid onset time, longer duration of action, and higher rates of success and satisfaction of patients with lower incidence of complications.

Key words: Lateral sagittal infraclavicular, efficacy, acceptance.

Introduction:

Brachial plexus block provides many advantages, and may be performed with many approaches.[1-4] Different modifications of infraclavicular brachial block (ICB) have been described since 1973,[5] and have recently become techniques of growing interest, although the optimal infraclavicular approach remains unclear.[6-13] ICB vary in their site of needle insertion, needle direction, single or multiple neuro-stimulation, and success and complication rates.[3-14] These techniques have become popular because of the relatively easily identified anatomic surface landmarks, reliable distribution of blockade with only one puncture, ability to perform the block regardless of the position of the patient's arm, avoidance of the neurovascular structures of the neck, and low risk of respiratory complications, such as phrenic nerve blockade and pneumothorax.[3,15-17]

The classical vertical ICB was originally determined to be a procedure that is safe and with low-risk, easy on the patient, and simple for the anesthesiologist to perform.[3, 5, 18]

Lateral sagittal ICB is a relatively recent paracoracoid approach described by Klaastad[19] in 2004, and has the over advantages of both simplicity and much lower risk of pulmonary and vascular puncture complications.[3, 20, 21]

The aim of this study was to compare the classical with lateral sagittal ICB in regard to anesthetic time (i.e. performance time + onset time + duration of action the block), efficacy (successful block of the four major nerves of the arm), and patient acceptance.

Patients and methods:

After approval by the local ethical committee and written informed consent, forty adult patients of ASA I or II of both sexes scheduled for hand, forearm, and distal arm elective surgery were enrolled in this prospective study.

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Patients were divided into two equal groups according to the used block technique: the classical vertical ICB was performed in the first group (group V, n=20), and lateral sagittal ICB for the second group (group L, n=20). Exclusion criteria included any contraindication to regional anesthesia, pregnancy, inability to cooperate, pre-existing motor or sensory deficit in the operated limb, or previous allergic reaction to amide local anesthetics.
Midazolam (0.03-0.04 mg/kg) was given IV one hour preoperatively. In the operating theatre, all patients were attached to multi-channel monitor for standard monitoring. All blocks were performed by an experienced senior anesthesiologist with a nerve stimulator (BRAUN® Stimuplex® HNS-11; B-Braun, Melsungen, Germany) and insulated needles.

For both techniques, the nerve stimulator was initially set at 1 mA, 0.1 second and 2 Hz. The current amplitude then was decreased gradually as the tip of the insulated needle approaches the nerve until the desired twitch response is obtained at a current output ranging from 0.2 to 0.3 mA. The desired motor twitch response was the peripheral contractions of the extensors or flexors of the wrist and/ or finger muscles. If such stimulation was not obtained after 20 minutes, the technique was considered a failure. R-bupivacaine 0.5% (Laboratoire Delmas, Lyon-France) in a dose of 2 mg/kg was used to block the brachial plexus in all patients.

For classical vertical ICB (group V), patients were placed in supine position, with the hand of the side to be blocked positioned in a relaxed manner on the abdomen. The puncture site was located at the midway point between the ventral apophysis of the acromion and the jugular fossa. It was checked by placing the index finger in the infraclavicular fossa. The puncture site was located directly beneath the clavicle just medial to the finger, and was infiltrated with 2-3 ml of 1% lidocaine after local steralization. A 55 mm long, 18 gauge insulated needle (Contiplex D, B-Braun Melsungen AG, Japan) was connected to the nerve stimulator and advanced vertically (antero-posterior) until the desired motor response is observed. In the absence of the desired response, the needle was redirected either cephalic or caudally but not medially (to avoid the pleura) to get the response. Then, the calculated dose of bupivacaine was injected after negative aspiration.

The lateral sagittal ICB (group L) was performed in supine position with head turned away from the limb to be blocked, and the land mark was the coracoid process. Using a sterile technique, a local skin infiltration with 2-3 ml of 1% lidocaine was done just medial to this point. A 100 mm long, 21 gauge insulated needle (Stimuplex A, B-Braun Melsungen AG, Japan) was attached to the nerve stimulator, and was placed at this point at 10-30 degree within the sagittal plane and with caudal orientation, and was advanced until the desired motor response is obtained. The anesthetic drug was then injected.
A successful block (efficacy) was defined as the absence of pinprick response in all four major nerves (ulnar, median, radial, and musculocutaneous) distal to the elbow within 30 minutes after injection of the local anesthetic solution.

The performance time (the time elapsed between insertion of the insulating needle till its withdrawal after injection of the anesthetic drug) was measured. The onset of sensory block (the time elapsed between injection of the anesthetic drug till disappearance of sharp pain by pin prick test along the areas supplied by the main four branches of the brachial plexus) was evaluated every 3 minutes, and then compared to the same stimulation on the contra-lateral side.

Onset of motor blockade (the time elapsed between injection of the anesthetic drug and complete motor block) was assessed every 3 minutes by asking the patient to adduct the shoulder and flex the forearm and hand against gravity, and then compared to the contra-lateral side. Duration of sensory (the time elapsed between injection of the anesthetic drug and onset of pain requiring analgesia) and motor (the time elapsed between injection of the anesthetic drug and complete return of motor power) blockade was evaluated every hour after surgery.

Patient acceptance for the used block was assessed postoperatively in the post-anesthesia care unit by asking the patients if they would choose the same regional anesthetic technique or preferring general anesthesia for future similar surgery.

All patients were followed up postoperatively for 24 hours, and any related complication was reported.

Statistical comparisons were performed using unpaired Student's t-test for inter-group comparisons of the data obtained. Results are expressed as means ± SD, and *P* value < 0.05 was taken to be statistically significant.

Results:

There were no statistically significant differences between the two groups regarding demographical data (table-1).

Performance time and onset of sensory and motor blockades were significantly less in the (L) group than (V) group. Duration of analgesia and motor blockade were significantly more prolonged in the (L) group than (V) group. Rates of success and patient acceptance were higher in (L) group. Total doses of injected bupivacaine and duration of surgery were similar in both groups, (table-2).

In group (V), the numbers of distal arm, forearm, and hand surgeries were 3, 5, and 12 surgical procedures, respectively. The corresponding numbers of operations in group (L) were 2, 7, and 11.

In group (V), 7 patients showed ulnar nerve response, 4 patients showed median nerve response, and 8 patients showed radial nerve response (one patient did not show the desired distal motor response but a forearm flexion (musculocutaneous nerve response), and was managed by general anesthesia). The corresponding nerve responses in group (L) were 10, 4, and 6 patients respectively (the block was successful in all patients).

Three patients in group (V) had vascular punctures and one patient experienced a vasovagal attack compared to one patient in group (L) had a vascular puncture. Of the 19 patients who received a successful block in group (V), only one patient (who developed a vasovagal attack) was not satisfied with the block, and preferred general anesthesia for any future surgery. All patients in group (L) were satisfied with the block and would choose it for future similar surgery.

Table 1: Demographic characteristics of patients in both groups:

Parameter	Group (V)	Group (L)	*P* value
Age (years)	28.55 (± 7.2)	30.6 (±8.4)	0.412
Weight (kg)	70.4 (±9.18)	75.3 (±8.76)	0.117
Height (cm)	168 (±6.43)	171 (±7.53)	0.238
Sex M/F	11/9	12/8	--
ASA I/II	18/2	16/4	--

Values are expressed as mean (± SD), or total numbers.

Table-2: Anesthetic and surgical data in (V) and (L) groups:

Parameter	Group (V)	Group (L)	*P* value
Performance time (minutes)	10.61 (±3.15)	5.30 (±1.17)	<0.0001
Dose of injected bupivacaine (mg)	140 (±18.3)	150 (±17.5)	0.0861
Onset of sensory blockade (minutes)	18.63 (±5.10)	12.10 (±2.83)	<0.0001
Onset of motor blockade (minutes)	26.37 (±3.83)	16.9 (±4.79)	<0.0001
Duration of surgery (minutes)	86 (±36.7)	83.5 (±35.6)	0.832
Duration of sensory blockade (minutes)	614.4 (±151.4)	906.9 (±196.4)	0.0002
Duration of motor blockade (minutes)	344.3 (±94.78)	436.2 (±89.65)	0.0036
Success rate	95%	100%	
Vascular puncture	15%	5%	
Patient's acceptance	94.7%	100%	

Values are expressed as mean (± SD), or total percentage.

Discussion:

This study showed that the lateral sagittal ICB by the coracoids approach (group L), can provide a highly consistent brachial plexus anesthesia for upper extremity surgery, as compared to the vertical ICB approach (group V). Several favourable characteristics of the lateral sagittal ICB were approved in this study including quicker performance time, more rapid onset, more prolonged duration of action, higher success rate, and lower incidence of complications than vertical ICB technique.

Decreasing the performance time may improve patient readiness for surgery and the operating room turnover time.[2, 22] In this study, the time to perform the block was shorter in the (L) group (5.3 min) than in the (V) group (10.53 min). This might be due to the easier identification of the anatomic landmarks (coracoids process) and the fact that the potential risk of vascular and pleural punctures is kept minimum by lateral approach when compared with the vertical infraclavicular approach.[5,7,15,16,23] Although in this study no case of pleural puncture was faced, but theoretically the more medial needle insertion site for vertical ICB approach carries a greater risk of pneumothorax, especially in thin and short females.[1,6,7,15,16,19-21]

The performance time 5-minute difference between the two groups in the current study is likely to be clinically important for both patients and busy anesthesiologists. Withdrawal and redirection of the stimulating needle to elicit muscular twitches indeed increases the performance time as well as patient discomfort with the classical vertical approach, and increases pain at the fracture site induced by muscle contractions.[17,24] Patient comfort during regional anesthesia is an important issue, and a recent review article did examine this issue and provided recommendations in this regard.[17] A simpler technique using a reduced number of arm movements might be desirable, especially in trauma patients,[4,17, 24] and probably explains the significant acceptance rate (100%) with (L) group. It is also likely that the shorter the time to perform a highly efficient block, the greater the patient's confidence in regional anesthesia, explaining why all patients who had lateral sagittal block preferred to receive the same technique for future similar surgery.

The ever-expanding role of ultrasound in regional anesthesia may contribute to enhanced patient comfort and satisfaction by decreasing the number of needle passes required and avoids the uncomfortable muscle twitches associated with electrical stimulation.[4, 17]

Sauter[20] reported a performance time of 4.3 min (± 1.3) for lateral ICB, and found no significant differences when the block is guided by ultrasound (4.1 min (± 1.3). However, other investigators[25] reported a significant difference in performance time with ultrasound-guided nerve stimulation (3.1 min ± 1.6) than the nerve stimulation alone (5.2 min ± 4.7). A more recent study[4] reviewed 13 randomized controlled trials comparing the performance time using ultrasound guidance with electrical neurostimulation for peripheral nerve block, and had reported a mean of 1 minute less time.

A significant difference in onset time was found between the two studied groups. A comparison with times recorded by other authors is difficult because different types and doses of local anesthetic solutions, and different injection techniques were used in the various previous studies.[20,26,27] The longer onset time in the (V) group could be attributed to the more proximal approach of the nerves (cords), whereas in group (L) it is associated with a more peripheral nerve approach.

The optimal hand and wrist twitch responses for group (V) were obtained by stimulating the ulnar (35%), median (20%) and radial (42%) nerves, and the corresponding responses for group (L) were (50%), (20%) and (30%). Minville[28] reported that for both techniques a radial response (54%) resulted in a slightly more reliable success rate than with median (35%) and ulnar (11%) responses. Lecamwasam[29] reported a higher success rate when the posterior cord or multiple cords are stimulated, and an incidence of failure rates of 5.8% for posterior, 15.4% for medial, and 28.3% for lateral cords.

It is very important to look specifically for a distal motor response with the infraclavicular approach. Borgeat,[8] using a different infraclavicular approach, reported a success rate of 44% when a proximal motor response was accepted for local anesthetic injection, compared to 97% when they looked specifically for a distal motor response. Finger flexion is considered by Borgeat[8] as the motor response giving the best block results because, when this motor response is obtained, the needle is located approximately at the centre of the cords. The current study, and others,[9,13] are in agreement with this notion.

Fitzgibbon[30] mentioned that a musculocutaneous nerve motor response (forearm flexion) is not adequate for an infraclavicular plexus block, and we agree with this as the block was failed in the patient who showed only proximal response to neuro-stimulation in (V) group. However, in a review article on neuro-

stimulation[31] the authors stated that a musculocutaneous motor response is adequate while using the infraclavicular approach. In 1973 when Winnie[18] commented the new Raj's approach, he pointed out to the fact that the coracoid region is where the musculocutaneous nerve leaves the sheath of the plexus. This view that the musculocutaneous nerve leaves the plexus early and probably explains why we should not rely on a forearm flexion as an adequate motor response when performing an infraclavicular block.

The duration of sensory and motor blockade was longer in group (L) than group (V), and no previous comparable study between the two techniques regarding the duration of blockades could be found.

In the current study, the success rate was 95% in group (V) and 100% in group (L). Several previous studies have been performed with fluctuating success rates of 53%,[(12)] 83%,[32] > 90%,[5,7,8,10,13] and 100%.[9,11] Recently, the ultrasound imaging has been used to improve the efficacy and success rates of peripheral nerve blocks, and also to decrease the risk of vascular puncture.[4,14,20,25] Some of these studies reported increases in success rate from 85% to 95%[20] and from 57% to 86%[25] when ultrasound guidance is applied.

Three patients (15%) in group (V) and one patient (5%) in group (L) in this study got vascular punctures during block performance. Some of the reported incidences of vascular puncture in previous studies were 0.6%,[6] 2%,[8,28] 10%,[7, 13] 17% [12], and 50%.[10] In the study by Sauter[20] the blood aspiration was reported in 5% and 33% of patients with and without the ultrasound guidance, respectively.

Conclusion:

We concluded that the lateral sagittal ICB is superior to the classical vertical ICB technique on providing shorter performance time, more rapid onset time, longer duration of action, and higher rates of success and satisfaction of patients with lower incidence of complications.

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