ORIGINAL ARTICLE

Acta Orthop Traumatol Turc 2013;47(1):32-37
doi:10.3944/AOTT.2013.2615

Coracoid versus lateral sagittal infraclavicular block

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Objective: The aim of this study was to compare block performance time and secondarily success rates of coracoid block (CB) and lateral sagittal infraclavicular block (LSIB).

Methods: This prospective study included 100 adult patients scheduled for upper limb surgery. Patients were randomly allocated to receive either a CB or LSIB. A local anesthetic mixture of 20 ml of levobupivacaine 5 mg/ml and 20 ml of lidocaine 20 mg/ml with 5 µg/ml epinephrine (total 40 ml) was administered after obtaining either a median, ulnar or radial nerve type response. Sensory block was tested at 10-minute intervals for 40 min.

Results: Block performance time (CB Group: 5.2±1.9 min, LSIB Group: 5.5±1.4 min) and block success rate (CB Group: 86%, LSIB Group: 92%) were similar in both groups. In the LSIB group, sensory block of the ulnar nerve at 10, 20 and 30 minutes and at the radial nerve at 20 minutes was significantly more intense than the CB group ($p<0.05$). There were four vascular punctures in the LSIB group.

Conclusion: Both block techniques were effective and performed in a similar time period.

Key words: Coracoid block; lateral sagittal infraclavicular block; nerve stimulation.

Infraclavicular block is a highly popular brachial plexus block which provides anesthesia of the whole arm distal to the mid-humerus. Since Raj et al.'s reintroduction of the infraclavicular block into clinical practice in 1973, the search for an easy to perform technique with a high success rate and improved safety profile has continued.[1] The coracoid block (CB), first described by Whiffler,[2] Kilka et al.'s vertical infraclavicular approach,[3] and the lateral sagittal infraclavicular block (LSIB) introduced by Klaastad et al.[4] have gained the most attention. These techniques vary in their puncture site, needle direction and incidence of complications and the optimal infraclavicular approach remains unclear. The CB approach is currently among the most popular techniques. We used Wilson's[5] coracoid approach as the description is more precise and the point of needle entry (2 cm medial and 2 cm caudal to the coracoid process) is easier to locate. Although relatively new, LSIB appears to be a promising technique with high block success rate (85 to 95%) and a good safety profile.[6-12]

No previous study has been published comparing two different infraclavicular block techniques to the best of our knowledge. Considering the high cost of operating room time, we believe that block performance time of brachial plexus blocks has importance in clinical practice. We hypothesized that direct needle entry during CB would result in shorter block performance time than LSIB which often requires needle redirections.

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Submitted: February 1, 2011 **Accepted:** November 22, 2012

Available online at
www.aott.org.tr
doi:10.3944/AOTT.2013.2615
QR (Quick Response) Code:

The aim of this study was to compare block performance time and secondarily success rates and possible complications of CB and LSIB.

Patients and methods

Ethical approval was provided by the Ethical Committee of Kocaeli University, Kocaeli, Turkey (Ethical Committee no. 13/4) on 26 July 2009 and written informed consent was received. This prospective, randomized and observer-blinded study included 100 patients (age range: 18 to 70) with ASA physical status 1 or 2 scheduled for elective hand, wrist and forearm surgeries. Patients with a disease that could prevent sensory block assessment of the upper extremity, coagulopathy, allergy to one of the study drugs, pregnancy or with previous surgical or trauma history that prevented the anatomic localization of the injection point and those who could not cooperate were excluded from the study.

Patients were randomly assigned to either the CB or the LSIB group using a list of random numbers and a sealed envelope opened prior to block administration allocating the patient to either the CB or LSIB group. All blocks were performed by the same anesthesiologist (SA) with experience in nerve blocks. Block performance time was limited to 10 min; if an appropriate motor response was not obtained in this time, the block was considered a failure and general anesthesia was administered. Sensory and motor block assessments were performed by a second anesthesiologist who was blinded to the technique performed.

Standard monitoring was applied (electrocardiogram, pulse oximetry, and noninvasive blood pressure), an intravenous catheter was placed into the opposite forearm and all patients received an infusion of intravenous Ringer's lactate before block application. Sedation was provided with 1-3 mg midazolam plus 25-100 µg of fentanyl, according to clinical judgment.

In the LSIB group, the infraclavicular block was performed as suggested by Klaastad et al.[4] The patient was placed in a supine position with relaxed shoulders with the arm to be blocked adducted and the hand positioned on the abdomen and head rotated slightly to the opposite direction. The anesthesiologist worked from behind the shoulder. A point where the clavicle meets the coracoid process was palpated with the point of needle insertion located at the intersection between the clavicle and the coracoid process. After antiseptic preparation of the area, the subcutaneous tissue that overlies this point was infiltrated with 2 ml of lidocaine 20 mg/ml. A 22G gauge, 80-mm, insulated needle (UniPlex Nanoline™; Pajunk, Geisingen, Germany) was used during all blocks. The stimulating needle was connected to the negative pole of the nerve stimulator (Stimuplex HNS 12; B Braun Medical, Melsungen, Germany) and set to deliver 1.5 mA current impulses of 0.1 ms duration at a frequency of 2 Hz. The needle was inserted caudally in a sagittal plane, 20° dorsally (downwards), until muscle twitches were observed in synchrony with the stimulation. If the desired response was not obtained, the needle was withdrawn subcutaneously and re-inserted at a steeper dorsal angle: first at 30° and then at 40°. A distinct distal motor response at a current output ranging between 0.3 and 0.5 mA was sought in all patients. During block performance a local anesthetic (LA) mixture containing equal volumes of levobupivacaine 5 mg/ml and lidocaine 20 mg/ml with 5 µg/ml epinephrine was used. In both groups a total of 40 ml of LA was administered. LA injection speed was approximately 1 mL/s.

For the CB group, the coracoid block was performed as suggested by Wilson et al.[5] The point of needle insertion was 2 cm medial and 2 cm caudad to the lateral tip of the coracoid process. The needle was directly posterior, perpendicular to the table. A distinct and clear motor response in the hand or the wrist was sought. Satisfactory positioning of the needle was obtained when stimulation by 0.3 to 0.5 mA elicited visible muscle contractions. The same LA mixture was used as in the LSIB group.

Block performance time was recorded by the anesthesia nurse assisting the anesthesiologist starting from needle insertion until completion of LA injections and withdrawal of the block needle.

Sensory block was assessed every 10 minutes for 40 minutes by an anesthesiologist blinded to the block technique. Sensory block of the axillary, musculocutaneous, radial, median, ulnar and medial cutaneous nerves of the forearm and the medial cutaneous nerve of the arm was assessed by pinching each sensory area with a plastic clamp and measured on the following scale; 0 points = pinprick received as painful, 1 point = analgesia for pinprick (tactile sensation), and 2 points = anesthesia for pinprick (no sensation). The total sensory score was calculated by adding the scores of all seven nerves.

Block success was defined as either anesthesia or analgesia of the five terminal nerves distal to the elbow at 40 minutes where no additional LA injection by the surgeon, supplementary nerve block at the axillary level or intravenous analgesic was required.

The median, radial, ulnar or musculocutaneous nerves which did not have analgesia or anesthesia were electrolocated in the axilla and supplemented after 40 minutes. General anesthesia was performed if more than two of these nerves remained unblocked.

Immediate complications (such as vessel puncture, painful paresthesia and symptoms of systemic LA toxicity) were recorded.

Using nerve stimulation, Sauter et al. reported that block performance time during LSIB was 4.3±1.3 minutes.[6] On the basis of this previous data, we calculated that we would need a sample size of 45 in order to decrease the block performance time of 1 minute with a statistical power of 0.95 and Type 1 error of 0.05. We included 50 patients in each group to increase the power of the study and also to secure patient dropouts for any reason. Values are expressed as mean±SD or absolute frequencies unless specified. Categorical data including sex, ASA status of the patients and type of surgery was analyzed and the success rates of blocks were compared using the chi-square test. Sensory block scores were compared using the Mann-Whitney U test. A p value <0.05 was considered statistically significant.

Results

There were no statistically significant differences between the groups regarding demographic data, type and duration of surgery or block performance time (Table 1 and 2). The number of needle redirections to obtain the appropriate motor response was similar in both groups (Table 1).

Median nerve type motor response was more frequently obtained in the CB group than the LSIB group (p<0.05) while ulnar nerve type motor response was more frequently obtained in the LSIB group than the CB group (p<0.05) (Fig. 1). The incidence of radial nerve type motor nerve response elicited in each group was similar (Fig. 1).

Block success rate was similar in both groups (Table 2). Satisfactory nerve stimulator response within 10 minutes was not obtained in one patient in the CB group; this was considered as block failure and the patient received general anesthesia. One patient in the CB group received radial nerve block supplementation at the axilla due to an incomplete block. An additional patient in the CB group experienced some pain during surgery despite having a successful block according to our assessment criteria. The patient underwent infiltration with LA of the operative area by the surgeon and received 100 µg of fentanyl IV and was comfortable during the rest of surgery. Four patients in both groups received general anesthesia due to block failure.

LSIB group patients had a significantly better block of the ulnar nerve at 10, 20 and 30 minutes of assessment (p<0.05) (Table 3) and a significantly better block of the radial nerve at 20 minutes (p<0.05). Block quality of all nerves were similar in both groups at 40 minutes. Total sensory scores were higher in the LSIB

Table 1. Demographic data, type and duration of surgery.

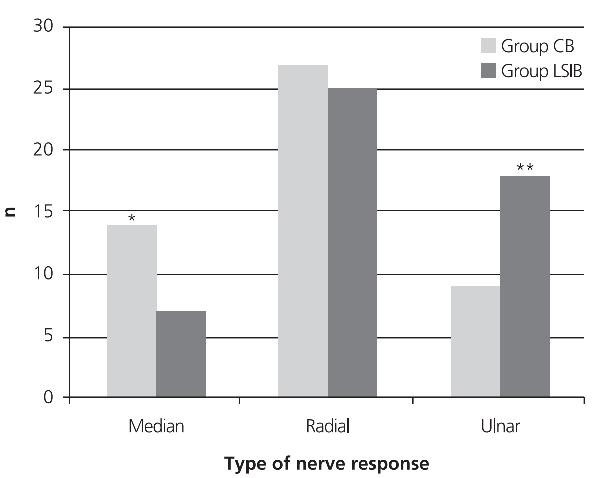
	Group CB (n=50)	Group LSIB (n=50)
Age (yrs.)	41±16	36±9
BMI (kg/m²)	26.4±5.3	25.2±6.4
Gender M/F (n)	33/17	37/13
ASA (1/2) (n)	40/10	45/5
Block performance time (min)	5.2±1.9	5.5±1.4
Number of needle redirections (n)	2.2±1.0	2.4±1.2
Block onset time (min)	13.8±5.8	14.1±6.4
Duration of surgery (min)	72±36	77±38
Type of surgery		
Hand/ elbow/ forearm (n)	26/14/10	30/11/9

Values are mean±SD and range or frequencies. *p<0.05.

Table 2. Block success and failure rates.

	Group CB (n=50)*	Group LSIB (n=50)*
Successful block	43	46
Block failures		
Incomplete block	1	–
Peripheral nerve supplementation	1	–
Intraoperative LA supplementation	1	–
General anesthesia	4	4

*There were no statistically significant differences between groups.



Data are shown as absolute frequencies. *Median nerve type motor response was more frequently obtained in the CB group than the LSIB group (p<0.05). **Ulnar nerve type motor response was more frequently obtained in the LSIB group than the CB group (p<0.05).

Fig. 1. Motor responses elicited by nerve stimulation.

Table 3. Anesthesia or analgesia for the cutaneous nerve distributions.

	10 minutes		20 minutes		30 minutes	
	CB Group	LSIB Group	CB Group	LSIB Group	CB Group	LSIB Group
Axillary	32/14/4	31/14/5	17/25/8	6/35/9	8/33/9	4/31/15
Radial	9/25/16	5/25/20	5/18/27	1/11/38*	4/7/39	0/7/43
Musculocutaneous	9/34/7	9/33/8	2/20/28	3/22/25	2/9/39	1/14/35
Median	3/38/9	7/28/15	2/20/28	2/17/31	2/6/42	2/5/43
Ulnar	10/36/4	8/25/17*	4/24/22	4/9/37*	3/15/32	3/4/43*
Medial cutaneous nerve of the arm	25/20/5	9/32/9	5/29/16	3/25/22	2/19/29	2/15/33
Medial cutaneous nerve of the forearm	4/27/19	4/27/19	3/14/33	1/11/38	3/3/44	1/6/43

Data are shown as absolute frequencies of no analgesia / analgesia / anesthesia. *p<0.05.

group than the CB group at 20 minutes of assessment (Table 4).

Vascular puncture was noted in four patients in the LSIB and none in the CB group. No cases of LA toxicity, hoarseness, dyspnea, residual paresthesia or Horner's syndrome were observed in any group.

Discussion

Anesthetic time, which includes block performance time and block onset time, is of utmost importance in improving operating room turnover. In our study, block performance time was similar in both the CB and LSIB groups. Although CB is described as a straight needle entry directly perpendicular to the skin, our results show that a similar number of needle redirections were necessary in both block types (Table 1). This similarity may be due to our acceptance of only ulnar, radial or median nerve type responses as appropriate motor response. Distal motor responses to nerve stimulation during infraclavicular block provide higher block success rate.[13] Administration of LA following posterior cord stimulation improves block success because of the central location of posterior cords among the three cords.[14] The study published by Rodriguez et al. showed that single stimulation of the posterior cord was superior to dual nerve stimulation in a coracoid block.[15]

In our study, LSIB performance time was 5.5 minutes, which is similar to earlier studies reporting average LSIB performance times of 4 to 6.4 minutes.[10,11] Reported CB performance times range between 5 to 11 minutes.[16,17] The relatively larger CB performance range may be due to the variation in the technique (single versus multiple stimulation) or clinician experience. On the other hand, LSIB is performed almost in a uniform manner without major modifications in the technique.[4,7] The experience of the practicing clinician is one of the most important factors regarding block performance time and success.[18] In our study, all blocks were performed by the same single experienced operator. The multiple injection techniques used to improve success in the different CB studies also contribute to a wider variation in block performance time.[19] When infraclavicular block was compared to axillary and humeral blocks by multiple stimulation technique in two different studies, infraclavicular block resulted in shorter block performance.[20,21] Similarly, in LSIB, double stimulation increases block performance time when compared to single stimulation technique (4.4 to 5.2 minutes, respectively).[12]

Block success rates were similar in both groups (CB group: 86% and LSIB group: 92%). Previous studies using nerve stimulation during LSIB performance have resulted in similar success rates that range between 89.5 to 92.5%.[7-12] Contrary to the fairly homogenous LSIB success rates, CB success rates are highly variable and range from 42 to 96%.[19,22] The relatively lower success rate of CB in some studies may be explained by the insufficient spread of LA to the medial cord from which the ulnar and the medial cutaneous nerves arise.[14,22] Because the medial cord is the most caudally located cord in most cases, it is more difficult to reach than the lateral or posterior cord with a vertical needle entry.[14,23] In our study, the ulnar nerve was significant-

Table 4. Total sensory block scores.

	CB Group	LSIB Group
10 minutes	6.5±2.7	7.5±3.1
20 minutes	9.4±3.2	10.6±2.7*
30 minutes	11.2±2.9	11.8±2.2
40 minutes	11.9±2.9	12.1±2.19

Data are presented as mean±SD. Loss of pain sensation was defined as analgesia and given one point for each nerve. Loss of touch sensation was defined as anesthesia and given two points for each nerve. A maximum of 14 points could be scored during every assessment. *p<0.05.

ly better anesthetized in the LSIB group than in the CB group at 10, 20 and 30 minutes (Table 3). Total sensory score was also significantly higher in the LSIB group at 20 minutes (Table 4). More frequent electrolocalization of the medial cord (ulnar nerve type motor response) during block performance and the deposition of LA at this site may result in the more improved block quality of the ulnar nerve in the LSIB group than the CB group (Fig. 1). Bloc et al. reported that the radial response was superior to the ulnar or median responses and that the ulnar response was superior to the median nerve type response.[24] Multiple injections increase CB success rates. Rodriguez et al. reported a higher success rate following triple injection (88%) compared to single injection (60%) technique during CB.[25] Minville et al., using a modified coracoid approach and double stimulation technique, reported block success rate reaching up to 96%.[22] We believe that when a relatively high dose (40 ml in our study) of LA is used, LA gradually diffuses towards the medial cord and the significant difference in block intensity diminishes at 40 minutes of assessment.

A motor response could not be obtained in one patient in the CB group. Similarly, Ilfeld et al. reported that they could not obtain appropriate finger motion in 14% of patients during CB.[13] Failure to obtain the desired motor response in a certain time period may also be responsible for CB's variable success rate. In all patients in the LSIB group, appropriate motor response could be obtained. The algorithm suggested by Klaastad et al.[8] could be useful to obtain appropriate motor response during LSIB.

While no vascular puncture was experienced in the CB group, there was an 8% incidence of vascular puncture in the LSIB group. Similar to block success rate, the incidence of vascular puncture is highly variable with CB, ranging from 0% to 50%.[2,25] On the other hand, the incidence of vascular puncture in LSIB has been reported between 2% to 20%.[7-9]

The experience of the practicing clinician is one of the most important factors regarding block performance time and success. In our study, all blocks were performed by the same single experienced operator. Although LSIB is a new procedure defined after CB, it's a reliable technique which can be performed easily and successfully in daily practice. The LSIB technique is more frequently performed in our clinic. The experience of the staff and resident anesthesiologists with LSIB at our clinic may have contributed to the shorter block performance time in the LSIB technique.

This study could only be completed after reaching a certain level of experience with the CB technique. The short period of time to gain adequate experience with CB was a limitation of this study.

In conclusion, block performance time was similar in both the CB and LSIB groups and both techniques were proven to be clinically effective. Improved anesthesia quality of radial and ulnar nerves and the overall sensory block score at 20 minutes may be considered as the advantages of LSIB.

Conflicts of Interest: No conflicts declared.

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