DOI: 10.7860/JCDR/2014/9795.5077

Original Article

Anatomy Section

Comparison of the Volar and Medial Approach in Peripheral Block of Ulnar Nerve at the Wrist – A Cadaveric Study

IVAN JAMES PRITHISHKUMAR[1], PRAISY JOY[2], CEPHAS SATYANANDAN[3]

ABSTRACT

Context: Two standard approaches are described to block the ulnar nerve at wrist. These include a) the traditional Volar approach where the needle is inserted lateral to tendon of flexor carpi ulnaris (FCU) b) Medial approach where the needle is inserted posterior to the tendon of FCU. Caution must be exercised to avoid puncture of the ulnar artery and/or intraneural injection of the ulnar nerve in both the approaches.

Aim: This study compares the volar and medial approach to the peripheral block of ulnar nerve at the wrist. The objective was two fold: a) to analyze the position of the ulnar nerve and the ulnar artery in relation to the Flexor Carpi Ulnaris tendon b) to assess the risk of injury to ulnar artery in both the volar and medial approach.

Settings and Designs: Twelve cadaveric upper limbs were used and both approaches compared by an observational study.

Materials and Methods: Two 18 G needles were inserted up to a depth of 7 mm using the standard volar and medial approach. The pattern of arrangement and positions of the ulnar artery and nerve in relation to FCU tendon were observed. The distance between the tip of needle and its proximity to the ulnar artery, and risk of injury were determined. Statistical analysis was done using SPSS for Windows, Version 16.0. Chicago, SPSS Inc.

Results: Three patterns of arrangement and position of the ulnar nerve and artery were observed. Puncture of ulnar artery was seen in 50% of cases in the volar approach as compared to no injury at all in the medial approach. The ulnar artery is highly liable to injury during the volar approach in type I and II and safe only in type III arrangement of ulnar artery. The medial approach showed no injury to the ulnar artery or nerve at a penetration depth of 7mm.

Conclusion: The medial approach is safer compared to volar approach for peripheral block of ulnar nerve at wrist.

Keywords: Medial approach, Peripheral block, Ulnar nerve, Wrist

INTRODUCTION

Anesthesia and/or analgesia is indicated in several surgical procedures involving the fingers, hand or wrist. The options available for patients undergoing hand surgery include general anesthesia, regional anesthesia such as brachial plexus block, or peripheral nerve blocks around all or specific nerves at the wrist. The type of anesthesia used often depends on the type and extent of injury, age of patient, prior medical history, affordability, availability of anesthetic facility and preference of the operating surgeon and anesthesiologist [1]. Peripheral nerve blocks at the wrist may be done to provide anesthesia for minor surgical procedures of the hand or may be given supplemental to a regional block or general anesthesia to provide adequate perioperative pain relief [2]. The advantages of regional anesthesia are many fold. These include absence of complications of general anesthesia including complications related to laryngoscopy and intubation, less expensive, technically easier to perform, quicker recovery from anesthesia,no postoperative nausea, no necessity to maintain the hemodynamic profile [3]. Regional blocks are preferable in high risk patients with poor pulmonary function and cardiorespiratory status [4].

Wrist block

The wrist, hand and fingers are supplied by the median nerve, ulnar nerve, dorsal cutaneous branch of ulnar nerve, radial nerve and to a lesser extent by the posterior interosseous and anterior interosseous nerves. Wrist block involves anesthetizing all or some of the nerves depending on the extent of surgery. Though peripheral block of nerves at the wrist is easy to perform based on easily available anatomical landmarks it is often under-utilized. Common indications for wrist block or isolated nerve block at the wrist include soft tissue injury, fractures involving bones of hand, arthrodesis of the metacarpophalangeal joint, metacarpal or phalangeal osteotomy, arthroscopy at the wrist, surgical correction of dupuytren's contractures, etc. Certain contra-indications include local infection, allergic reaction to the anesthetic agent, refusal by patient and bleeding disorders [5].

Course and surface landmarks of the ulnar nerve at wrist

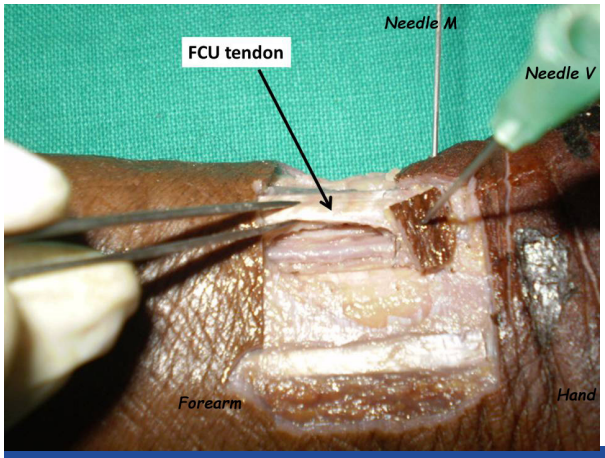
The ulnar nerve enters the forearm posterior to the medial epicondyle between the two heads of the flexor carpi ulnaris (FCU) muscle. In the forearm it lies undercover of the FCU accompanied by the ulnar artery. About 5 cms proximal to the wrist it gives off a dorsal branch which supplies the medial 1/3rd of dorsum of hand and dorsal aspect of medial 1 ½ fingers. At the wrist the ulnar nerve is situated beneath the tendon of FCU accompanied on its lateral aspect by the ulnar artery [6].

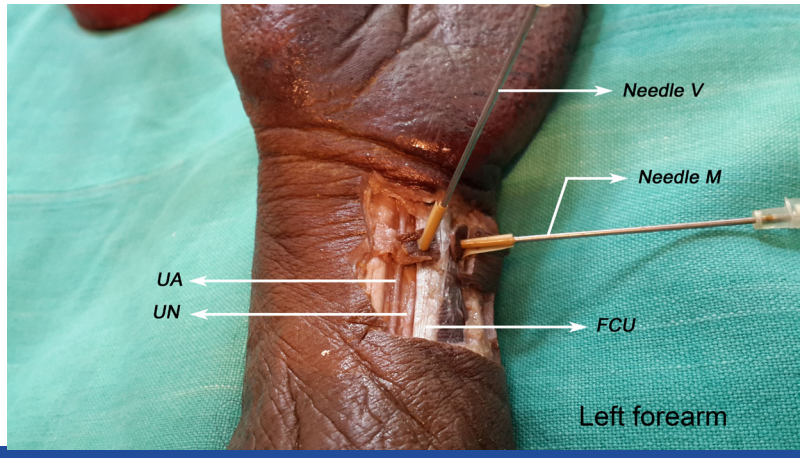
Approaches to Peripheral block of Ulnar nerve at the wrist

There are two standard approaches described to anesthetize the ulnar nerve [2,7].

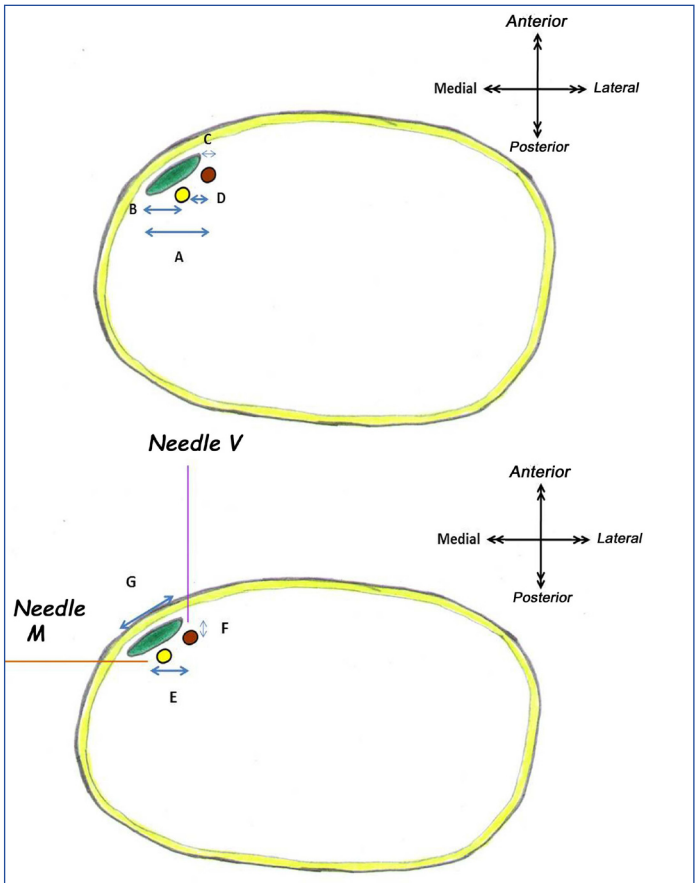
a) Volar approach – The tendon of flexor carpi ulnaris is palpated close to its insertion to the pisiform bone. A needle is inserted immediately lateral to the FCU tendon proximal to the wrist crease. As the needle is advanced it is important to aspirate to avoid injection into the ulnar artery.

b) Medial approach – Here the needle is inserted posterior to the tendon of FCU just proximal to the wrist crease. The needle is advanced horizontally. Any lancinating pain should be treated with caution to avoid injury to the ulnar nerve. An additional amount of local anesthetic fluid maybe administered subcutaneously on the dorsal aspect distal to the ulnar styloid to block the dorsal cutaneous branch of the ulnar nerve [5].

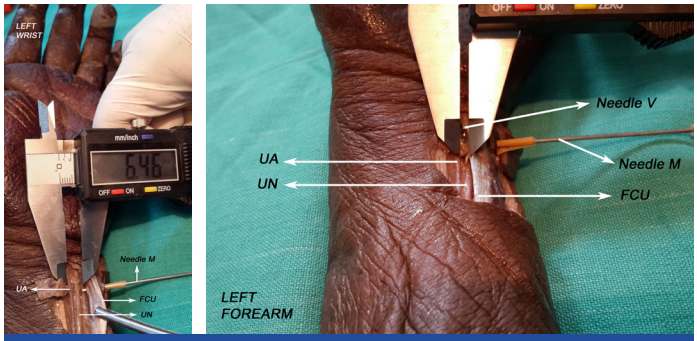




[Table/Fig-1]: Dissected specimen of Right forearm and wrist- Ulnar nerve and artery seen beneath the FCU tendon; Needle M in medial approach and needle V in volar approach seen. (FCU-Flexor Carpi Ulnaris) **[Table/Fig-2]:** Dissected specimen of Left forearm and wrist- Ulnar nerve (UN) and artery (UA) seen beneath the Flexor Carpi Ulnaris(FCU) tendon; Needle M in medial approach and needle V in volar approach seen



[Table/Fig-3]: Sketch of cross section of right forearm- showing measured variables A to G (A-Distance between the medial border of FCU and Ulnar artery; B-Distance between medial border of FCU to ulnar nerve; C-Distance between lateral border of FCU to ulnar artery; D-Distance between ulnar nerve and ulnar artery; E-Distance between the tip of needle to ulnar artery in medial approach; F-Distance between tip of needle to ulnar artery in volar approach; G-Width of the tendon of FCU)



[Table/Fig-4]: Distance 'F' between tip of needle and ulnar artery (UA) in volar approach (Left wrist) measured with a vernier caliper. (FCU-Flexor Carpi Ulnaris, UN-Ulnar nerve), **[Table/Fig-5]:** Distance 'E' between tip of needle and ulnar artery (UA) in medial approach(Left wrist). Flexor Carpi Ulnaris (FCU) tendon partly retracted (UN-Ulnar nerve)

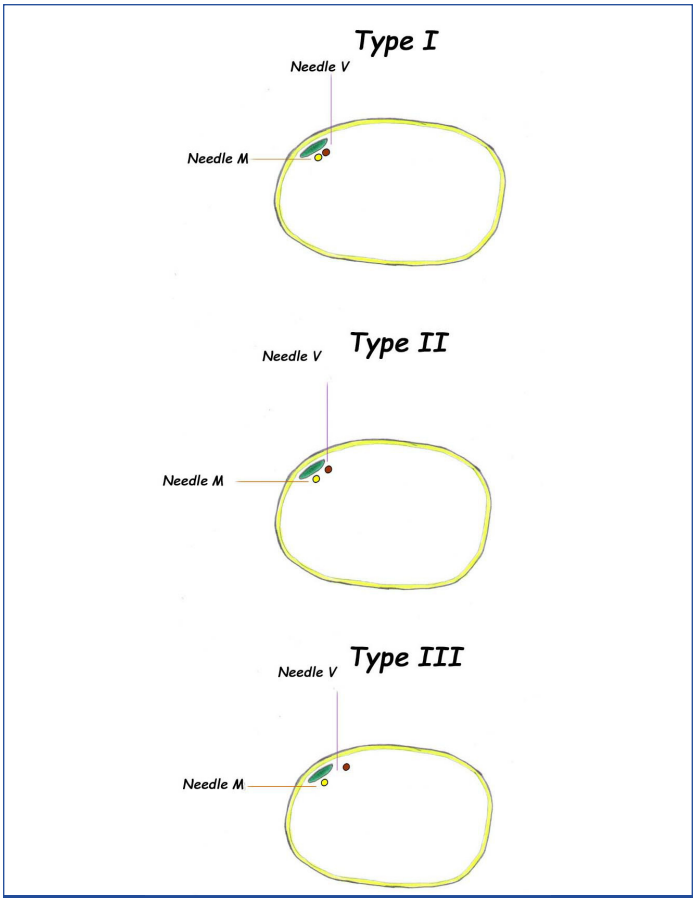
Measured values	Mean(mm	SD	Range (mm)
A	6.81	2.80	2.3 – 10.7
B	3.23	2.25	0.0 – 6.6
C	1.64	1.87	0.0 – 6.1
D	0.58	1.23	0.0 – 4.0
E	4.18	2.02	1.0 – 8.7
F	1.38	2.17	0.0 – 6.3
G	6.05	0.51	5.2 – 6.8

[Table/Fig-6]: Shows the measures of dispersion of measured variables: A-Distance between the medial border of FCU and Ulnar artery; B-Distance between medial border of FCU to ulnar nerve; C-Distance between lateral border of FCU to ulnar artery; D-Distance between ulnar nerve and ulnar artery; E-Distance between the tip of needle to ulnar artery in ulnar approach; F-Distance between tip of needle to ulnar artery in volar approach; G-Width of the tendon of FCU

This study compares the volar and medial approach to the ulnar nerve during peripheral nerve block at the wrist. The objective was twofold: a) to analyze the position of the ulnar nerve and the ulnar artery in relation to the Flexor Carpi Ulnaris tendon b) to assess the risk of injury to ulnar artery in the volar and medial approach during ulnar nerve block at wrist.

MATERIALS AND METHODS

Formal permission was obtained from the Institutional Review Board (IRB) for the conduct of the study. The study confines to the ethical standards of the Helsinki Declaration revised in 2000. Twelve cadaveric upper limbs (6 right and 6 left) donated to the Department of Anatomy for teaching and research purposes were used for the study. The FCU tendon and the pisiform bone were palpated and localized at the wrist. Two 18 G needles were inserted after the procedure was standardized- Needle 'V' was inserted up to a depth of 7 mm (marked off on the needle using stick tape) using the standard volar method immediately lateral to the Flexor Carpi Ulnaris (FCU) tendon. Another needle 'M' was inserted horizontally up to a depth of 7 mm (marked off on the needle using stick tape) by the standard medial approach behind the tendon of FCU, just proximal to the wrist crease. Skin incisions were carefully made around the site of insertion of needles and soft tissue dissected. The tendon of FCU and positions of ulnar artery and ulnar nerve were identified [Table/Fig-1,2]. The following measurements were taken using a vernier caliper [Table/Fig-3]: A-Distance between the medial border of FCU and Ulnar artery; B-Distance between medial border of FCU to ulnar nerve; C-Distance between lateral border of FCU to ulnar artery; D-Distance between ulnar nerve and ulnar artery; E-Distance between the tip of needle to ulnar artery in medial approach [Table/



[Table/Fig-7]: Sketch of Cross Sectionof Right forearm showing relative positions of the ulnar nerve, ulnar artery and tendon of Flexor Carpi Ulnaris(position of ulnar artery varies as one of three types in relation to the lateral border of FCU tendon - Type I, artery beneath the lateral half of FCU tendon; Type II, artery just outside the lateral border of FCU tendon; and Type III, artery far lateral to lateral border of FCU tendon)

Fig-4]; F-Distance between tip of needle to ulnar artery in volar approach [Table/Fig-5]; G-Width of the tendon of FCU. The data was entered into an excel sheet and statistical analysis done using SPSS for Windows, Version 16.0. Chicago, SPSS Inc.

RESULTS

Twelve cadaveric upper limbs were dissected after insertion of needles in standard volar and medial approaches. The measured variables are tabulated in [Table/Fig-6]. The ulnar nerve was constant in position and always situated beneath the medial half of the tendon of FCU in all cases [Table/Fig-7]. The position of the ulnar artery was always lateral to the ulnar nerve; however, the position of the ulnar artery varied as one of three predominant types in relation to the lateral border of the FCU tendon - Type I, where the artery was positioned beneath (undercover of) the lateral half of tendon of FCU; Type II, where the artery was just outside the lateral border of FCU tendon; and Type III, where the artery was positioned far lateral to the lateral border of FCU tendon [Table/Fig-7]. Puncture of the ulnar artery was seen in 50% of cases in the traditional volar approach as compared to absolutely no injury (0%) in the medial approach. The ulnar artery and the ulnar nerve (Type I) were situated completely beneath the tendon of FCU in 33.33% of cases. The ulnar artery was lateral to the tendon of FCU in 66 % of cases (in two cases being far lateral of type III). The ulnar artery is highly liable to injury during the volar approach in type I and type II and safe only in type III [Table/Fig-6]. The medial approach showed no injury to the ulnar artery or nerve at a penetration depth of 7mm. However, deeper insertion of the needle in the medial approach (≥ 10 mm) could cause damage to the ulnar nerve. The Ulnar artery situated lateral to the ulnar nerve is safely protected during the medial approach.

DISCUSSION

Anatomical complications of ulnar nerve block at wrist

Both the ulnar artery and ulnar nerve are at risk of injury during ulnar nerve blocks at the wrist. Since both these structures are close together often enveloped by fascia, anesthetists must be cautious to avoid puncture of the ulnar artery and intraneural or intravascular injections at this site [8]. These complications may be avoided by ultrasonographic localization of the ulnar artery and identifying the ulnar nerve lying medial to it [9-12]. The nerve may be traced proximally until the nerve and the artery are visualized separate from each other where the block can be performed to avoid risk of vascular injury. A nerve stimulator can be used additionally to confirm the location of the ulnar nerve [6].

The volar approach is more commonly used in clinical practice where the needle is inserted lateral to the tendon of flexor carpi ulnaris tendon; however, the ulnar artery is at risk of puncture here. Alternatively, the nerve may be approached using the medial approach where the needle tip is advanced posterior to the FCU tendon [3]. Puncture of the ulnar artery during the volar approach is seen in 50% of cases in the present study as compared to no injury using the medial approach. A similar study done by Lizamore et al., in South Africa on a predominantly Caucasian group (n=57), showed that puncture of the ulnar artery using the volar approach was seen in 36.8% compared to no injury (0%) using the medial approach [3]. In both the above studies, there is no injury to the ulnar artery using the medial approach as the ulnar artery is situated much lateral to the ulnar nerve. An insertion depth of 5-10 mm should not cause neurovascular injury.

Localization of ulnar artery by ultrasound is definitely safer prior to insertion of the needle [9,11,12]. However, ultrasonography or a nerve stimulator maybe unavailable in a smaller clinical set up where one has to rely clearly on the pulsations of the ulnar artery. This may be difficult and increase the chance of its injury. The current study certainly shows that the medial approach is far safer than the volar approach, and may be especially utilized in smaller set ups where there is non-availability of ultrasonography when coupled with a difficult localization of pulsations of ulnar artery.

CONCLUSION

The medial approach for peripheral block of ulnar nerve at the wrist is superior and safer compared to the volar approach.Risk of injury to ulnar artery is negligible in the medial approach. The ulnar nerve maybe safely anesthetized by inserting a needle behind the tendon of flexor carpi ulnaris to a penetration depth of 7-8 mm from the skin surface, one cm proximal to the wrist crease. An additional subcutaneous injection maybe administered anterior to the tendon of FCU to block the palmar cutaneous branch of the ulnar nerve.

REFERENCES

[1] American Society for Surgery of the Hand [Internet]. Chicago: American Society for Surgery of the Hand; 2013 [cited 2013 Nov 27]. Available from: http://www.assh.org/Public/HandConditions/Pages/HandSurgeryAnesthesia.aspx
[2] McCahon R, Bedforth N. Peripheral nerve block at the elbow and wrist. *Contin Educ Anaesth Crit Care Pain.* 2007;7(2):42–44.
[3] Lizamore N, Venter E, Boon JM. Alternative approaches for regional ulnar nerve blockade: a cadaveric study. *Clin Anat.* 2004;17(5):373–77.
[4] Mohr DN, Lavender RC. Preoperative pulmonary evaluation.Identifying patients at increased risk for complications. *Postgrad Med.* 1996;100(5):241–52.
[5] Brennan A, Jones M, Gordon J. Ultrasound-guided local anaesthetic blocks of the forearm. Tutorial of The Week 208 [Internet]; World federation of societies of Anesthesiologists; 2011 [cited 2013 Nov 27]. Available at:http://www.aagbi.org/sites/default/files/208-US-guided-local-anaesthetic-forearm-blocks.pdf
[6] Susan S, editor. Anatomical basis of clinical practice. London: Elsevier Churchill Livingstone; 2005.
[7] Zdenek K, Miroslav K, Jan S. Role of Sensory Innervation Variations for Wrist Block Anesthesia. *Arch Med Res.* 2001; 32 (2): 155-58.
[8] Earle AS, Blanchard JM. Regional anesthesia in the upper extremity. *Clin Plast Surg.* 1985;12(1):97–114.
[9] Liebmann O, Price D, Mills C, Gardner R, Wang R, Wilson S, et al. Feasibility of Forearm Ultrasonography-Guided Nerve Blocks of the Radial, Ulnar, and Median

Nerves for Hand Procedures in the Emergency Department. *Ann Emerg Med.* 2006 ;48(5):558–62.
[10] Snaith R, Dolan J. Ultrasound-guided peripheral upper limb nerve blocks for day-case surgery. *Contin Educ Anaesth Crit Care Pain.* 2011;11(5):172-76.
[11] Bhoi S, Chandra A, Galwankar S. Ultrasound-guided nerve blocks in the emergency department. *J Emerg Trauma Shock.* 2010;3(1):82–88.
[12] Gray AT, Schafhalter-Zoppoth I. Ultrasound guidance for ulnar nerve block in the forearm. *RegAnesth Pain Med.* 2003;28(4):335–39.

PARTICULARS OF CONTRIBUTORS:
1. Associate Professor, Department of Anatomy, Christian Medical College, Vellore, India.
2. Postgraduate Registrar, Department of Anatomy, Christian Medical College, Vellore, India.
3. Assistant Professor, Department of Anaesthesia, Christian Medical College, Vellore, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Ivan James Prithishkumar,
Associate Professor, Department of Anatomy, Christian Medical College, Vellore-632002, India.
Phone : 9486887811, E-mail : drivanjames@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **May 09, 2014**
Date of Peer Review: **Jul 14, 2014**
Date of Acceptance: **Aug 30, 2014**
Date of Publishing: **Nov 20, 2014**