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Research Article

Relation of the Cubital Veins Used for Intravenous Access in Reference to Anatomical Landmarks of the Cubital Fossa

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Abstract

Background and Objectives: A peripheral intravenous access is commonly required in patients presenting to emergency room in order to collect blood specimens and to provide a route for intravenous medication and fluid administration. However, this procedure is occasionally associated with certain challenges. The present study has been conducted to explore the anatomic characteristics of cubital veins located in the cubital fossa through assessment of their relative location to certain anatomic landmarks.

Materials and Methods: Patterns of superficial veins of the cubital fossa were studied in 80 male and female students from a health sciences school.

Results: Several variations of the cubital veins were found. The mean distance between the outer and inner MCV to the reference central point was 1.33±0.95 cm (range: 0-4.5) and 1.33±0.96 cm (range: 0-3.54), respectively.

Conclusion: A thorough knowledge on the regional venous anatomy of the cubital fossa will aid in providing more efficient intravenous access routes.

Keywords: Angle, Cubital Vein, Cubital Fossa, Distance, Intravenous Access

Background and Objectives

Acquiring an intravenous (IV) access, particularly in emergency rooms and in other clinical settings is a very common procedure that may occasionally be problematic for healthcare professionals. Frequently a component of a life-saving intervention, this chore generally involves the nurse as the most skilled individual to establish an access route. Despite this fact, failure is always an option even for the most skilled Emergency Nurse (EN). There are several factors including the number and proportion of successful attempts, time to completion, and complication rate, which should be taken into account regarding this procedure.

Certain patient groups (e.g. very young patients, those with excessive subcutaneous fat, IV drug addicts, individuals with edema, or those who require frequent hospital admission) may pose extra difficulties for physicians, even for the experienced ones. Not only the problem may arise from the fibrotic or thrombotic changes precluding visibility of normally visible veins in the upper extremities, but also presence of excessive fat or edema may hinder palpation or visualization.

Longitudinally imaging the Basilic Vein of the Forearm (BVF), which is located beneath the deep fascia in the mid-arm, offers an alternative approach. The Cephalic Vein of the Forearm (CVF) is another alternative as it has no arteries or nerves in its adjacency [1].

Despite studies examining the variations of the forearm veins, no studies have specifically looked at the position of the veins of the forearm or the angles of the superficial veins of the cubital fossa [2-5].

The aim of this study was to identify the location and angulation of cubital veins in relation to certain anatomical reference points. This approach has the potential to provide useful information for constructing arteriovenousfistulas for hemodialysis in particular and for vascular access routes in general.

Materials and Methods

This study has been conducted to examine the anatomic characteristics and angulation of the superficial veins of the cubital fossa as well as the distance between the reference central point and these veins used in intravenous applications.

Design

This descriptive study carried out between April and July 2007 was designed to examine the superficial veins of the cubital fossa in both forearms in 80 students randomly selected among a group of university students. All patients provided informed consent prior to study entry and official permissions were obtained from the university.

Measurements

After a non-latex tourniquet was placed at the upper limb at the level of the arm the following veins were photographed using a Canon Ixus digital camera: Cephalic Vein of Forearm (CVF), Basilica Vein of Forearm (BVF), Median Cubital Vein (MCV) and Median Antebrachial Vein (MAV). For study purposes two lines were drawn, i.e. one horizontal line between medial and lateral epicondyle of humerus and a vertical line passing through midline perpendicular to that horizontal line. The intersection of the two lines was referred to as the reference central point. The distance between MCV and this central point and the acute angle between MCV and the horizontal line were measured.Image software was used for performing angular measurements(http://rsb.info.nih.gov/ij)[6]. It represents a public domain java image processing software, based on the original concept of NIH Image for the Macintosh or Windows. It may be utilized either as an online applet or can be downloaded in any computer that has a Java virtual machine. Its open architecture allows flexible use of Java plug-ins. Using its built-in editor, Java complier and plugins for acquisition, analysis or processing can be performed according to user requirements. In addition, plugins designed by the users make it possible to figure out nearly all image analysis or processing problems. In addition, the source code is free[6,7].

Data Analysis

Data were analysed using SPSS version 12.0 (SPSS Inc., Chicago, IL, USA) and descriptive statistics were calculated.

Results

Several variations of the cubital veins were found. The commonest type was that the MAV divides in the cubital fossa into 2 veins, one of which joins the BVF, and the other the CVF. BVF was solitary in all samples with an origin in the ulnar side of the dorsal venous network. It followed an upward course in the ulnar side of the posterior forearm, and then below the cubitus it inclined forward to the anterior surface, where it joins MAV or intermediate basilicveinin 67.5% (108/160) or 20% (32/160) of the cases, respectively. We found that the BVF was absent in 2.5 % (4/160) of the cases.

The mean distance of the outer MCV to the central point was 1.33 ±0.95 cm (range 0-4.5). The angle it forms with the horizontal line was 74.55±20.520(range 32-1250). The mean distance between the inner MCV and the central point was 1.33±0.96 cm (range 0-3.54). The angle it forms with the horizontal line was 72.89 ±20.450 (range 39-139o).

Discussion

Obtaining an intravenous access route may sometimes present certain difficulties in the emergency room or other clinical settings due to a number of different factors such as the body habitus, history of injection drug use, or underlying medical problems, consequently necessitating the placement of a central line access.

Venous structures in the cubital fossa exhibit a certain degree of variation [8-11], which not only pose some difficulties in identifying a suitable venipuncture site but also raise concerns regarding a possible injury to adjacent structures. Until now, although several studies have investigated the relative safety of a number of different venous access sites at the cubital fossa, no single area with maximum safety has been indentified. For instance, in the study by Yamada et. al. the median cubital vein near the cephalic vein was identified as the site associated with the lowest risk of nervous injury [8]. Similarly, Mikuni et al. proposed that the area extending between the middle segment of the median cubital vein to its confluence with the cephalic vein was a relatively safer site for venipuncture site [9]. Alves et al. also identified median cubital vein as the best puncture site [11]. In this context, the reference points used in this study (the central point and the horizontal axis) and their relation to the median cubital vein may provide additional important information with regard to identification of a safe site for venipuncture.

Published reports on alternative techniques for establishing peripheral intravenous access routes are few in number. The favored conduit for central venous access in 1960s, when right heart catheterization was developed, was the basilic vein[12,13]. In the majority of individuals, while the superficial segment of this vein receives lateral tributaries from the intermediate cubital vein, it also receives tributaries from the intermediate basilic vein and, more occasionally, from the intermediate vein of the forearm[14,15].

In a previous work from India examining the venous pattern of the cubital fossa in a total of 300 Hindus, 0.5% of the individuals had no basilic vein[16]. Similarly, 1% of the cases had no basilic vein in a study involving 200 Nigeriens[17]. On the other hand, in 60% of the participants, intermediate basilic vein of the forearm was present[18]. A collateral vein found in 56.7% of the cadaveric samples, which was referred to as the "accessory axillary vein". This vein is the axillary extension of the lateral, common, or deep brachial veins in 55.9%, 32.4%, or 11.8% of the individuals, respectively. The reported diameter of the basilic vein in the arm was 2.6 mm near the axilla [19,20]. Baptista et al. [21] studied twenty-six arms from 13 cadavers and found that the basilic vein was always present and single. This vein was joined by the intermediate cubital vein in 69.8% of the cases.

In a multitude of studies, the usefulness of ultrasound guidance in the establishment of central venous access has been clearly demonstrated[22,23]. Agency for Healthcare Research and Quality has recently recommended real-time ultrasound guidance for all central venous access procedures, and therefore such guidance may be more commonly practiced in the emergency rooms in the coming years [24].Keyes et al. were the first authors to demonstrate the success of ultrasound guidance in obtaining a peripheral venous access route in patients with ED[25]who showed a successful cannulation rate of 91%.These investigators showed a successful cannulation rate of 91%. However, it should be borne in mind that this study had no control group. Similarly, a success rate of 94% was found in another study that was observational in nature [26].

In conclusion, clinical experience is not always enough to deliver an IV line in an ER setting. Knowledge of anatomic guide signs are important,a sound knowledge and understanding of the variations of regional venous anatomy can increase the possibility of obtaining an efficient IV access route in the forearm with minimal risk of complications.The use of U/S as an everyday practice before attempting to place the iv line is essential in minimizing patient stress and buying time for the "Golden Hour" of resuscitation.

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