Sri Lanka Journal of Medicine **SLJM**

Original Research

Citation: Arudchelvam J., Rajiev BJ., Gurusamy K., 2024. Study On Cubital Vein Dimensions of Patients Presenting for Dialysis Access Surgeries to A Single Unit in Sri Lanka. An Imaging-Based Study. Sri Lanka Journal of Medicine, pp 40-44.
DOI: https://doi.org/10.4038/sljm.v33i2.521

Study On Cubital Vein Dimensions of Patients Presenting for Dialysis Access Surgeries to A Single Unit in Sri Lanka: An Imaging-Based Study

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ABSTRACT

Introduction: There are many patients with chronic kidney disease in need of renal replacement therapy (RRT) at present in Sri Lanka. Main mode of RRT is haemodialysis through an arteriovenous fistula (AVF). The diameter of the veins used for the AVF is important for its success. This study focuses on the dimensions of cubital veins.

Methodology: This is a prospective study done at the National Hospital of Sri Lanka Colombo (NHSL) from June to July 2020. Patients referred for AVFs were included. Data on patients' age, gender, height, dominant hand, and diameters of the veins were collected. The diameters were measured at elbow crease using ultrasound scan.

Results: Sixty-seven patients were included with 34 (50.7%) females. Mean age was 44.63 years (interquartile range [IQR] 50.0-57.5). The mean diameters of the cephalic vein (CV) and the basilic vein (BV) were 3.57mm (IQR 2.6 - 4.25) and 3.36mm (IQR 4.0 - 3.98). The mean diameters of the median cubital vein (MC) and the median basilic vein (MB) were 4.95 mm (IQR 3.45 - 6.3) and 3.54 mm (IQR 2.7- 4.25). The MC diameter was significantly larger than CV and BV diameters (p=0. 0001). The mean diameter difference of CV and BV of patients less than or more than 158 cm height were not statistically significant (p=0.29 and 0.16).

Discussion: Guidelines recommend a vein diameter of 2.5 mm for a successful AVF creation. The best way to assess the diameter is the ultrasound imaging. This study shows that the diameter of the veins around the elbow varies. Therefore, imaging of the veins is essential prior to AVF creation.

Keywords: Arteriovenous fistula, renal replacement therapy, hemodialysis

INTRODUCTION

In Sri Lanka, there are many patients with chronic kidney disease (CKD) who are in need of renal replacement therapy (RRT) (1).The number of patients with end stage renal failure is increasing. One of the reasons for this is the increased prevalence of non-communicable diseases like diabetes mellitus. In areas like the north central province (NCP), there are many patients with CKD due to CKD of unknown aetiology (CKDu). CKDu is estimated to affect about 15% of the population in

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Received: 2023-06-21 **Accepted revised version: 2024-07-30** **Published: 2024-07-30**

NCP. At the Teaching Hospital Anuradhapura (THA), there were 18400 registered patients with CKD in 2016, with 280 patients on haemodialysis (1). Similarly at the National Hospital of Sri Lanka Colombo (NHSL), there were 3023 patients on dialysis in 2017 (2).

End stage renal failure patients undergo RRT either by haemodialysis or peritoneal dialysis. The two main options for haemodialysis are central venous lines and arteriovenous fistulas (AVF). The most common technique of haemodialysis in Sri Lanka is by an AVF. Therefore, there are many AVFs created at the vascular and transplant units across the country. The common types of AVFs created in Sri Lanka are the, brachio cephalic (BC) (Figure 1), radio cephalic (RC) and the brachio basilic (BB) AVF (3). Of these, the BC AVF is the commonly performed procedure in our unit (3). Therefore, the veins in the cubital region (CUBV) are commonly used.

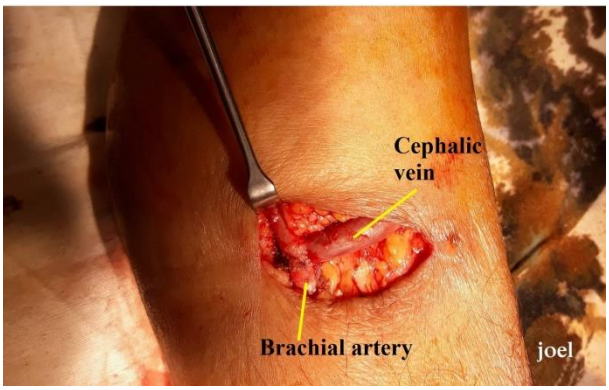

Figure 1: Brachiocephalic (BC) AVF

The success of an AVF depends on technical and patient related factors. The diameter of the veins used for the AVF creation, is one of the most important factors influencing its success. Therefore, it is important to select the ideal vein with adequate diameter for AVF creation. Studies describing the cubital vein dimensions in the Sri Lankan population are lacking. This study focuses on the dimensions of CUBV on patients referred for dialysis access surgeries to a single unit.

METHODOLOGY

This is a prospective descriptive cross-sectional study done at the vascular and transplant unit B of the NHSL from June to July 2020. The objective of this study was to determine the normal diameters of the upper limb veins commonly used for the creation of AVF for dialysis access. Patients who were referred for AVFs were included. Upper limbs with previous failed AVFs and thrombosed veins were excluded. Data on patients' age, gender, height, dominant hand, and diameters of cephalic vein (CV), basilic vein (BV), and other CUBV were obtained. CUBV were distended by applying a tourniquet to the upper arm and hand exercise (the patients were asked to clench and release the hand for at least 10 times until the veins became maximally distended). The diameters were measured at the elbow crease using ultrasound scan (ZONARE ultrasound system) using high-frequency liner probe (Linear-array ultrasound transducer - L10-5 - 5.0 MHz. - 1.0 MHz.) after freezing the image. All the scans were done by the consultant vascular surgeon. The measurements were done with the inbuilt callipers in the ultrasound scan machine. The wall-to-wall diameters (from outer wall to outer wall) were measured at two perpendicular planes and the average was obtained. Data are presented as mean and interquartile range (IQR) unless otherwise noted.

RESULTS

Sixty-seven upper limbs were included. Thirty-four (50.7%) limbs were from females and 33 (49.2%) limbs were from males. Mean age was 44.63 (50.0-57.5) years. The mean diameter of the cephalic vein (CV) was 3.57 mm (2.6 - 4.25 mm) and the mean diameter of the basilic vein (BV) was 3.36 mm (4.0 - 3.98 mm). The mean diameter of the median cubital vein (MC) was 4.95 mm (3.45 - 6.3 mm) and the mean diameter of the median basilic vein (MB) was 3.54 mm (2.7- 4.25 mm). The MC diameter was significantly larger than CV and BV diameters (p =0.0001).

Mean diameter of CV in males was 3.65 mm (3.1 - 4.28 mm) and the mean diameter of the CV in females was 3.35 mm (2.48 -3.95 mm). The mean diameter of BV in males was 3.44 mm (2.48 -3.95 mm) and the mean diameter of the BV in females was 3.29 mm (3.45 - 6.3 mm). These differences in the diameter between males and females were not statistically different (p=0.51 and p=0.57). There were 88.1% of patients who were right dominant. The mean diameter of the BV in the dominant limb was 3.50 mm (2.7 - 4.1 mm) and the mean diameter of the BV in the non-dominant limb was 3.22 mm (2.35 - 3.9 mm). However, this difference was also not statistically significant (p=0.13).

The mean diameter of the CV in the dominant limb was smaller i.e. 3.42 mm (2.4 - 3.65 mm) than the mean diameter of the CV in the non-dominant limb [3.57 mm (3.09 - 4.42 mm)]. However, this difference was not statistically significant (p=0.072).

The mean and the median heights of the patients were 160.35 cm and 158 cm (range 148-184). The mean diameter of CV of patients less than or equal to 158 cm tall and more than 158 cm tall were 3.46 mm (range 1.3-7.8 mm) and 3.65mm (range 1.4-5.5 mm) respectively, however this difference was not statistically significant (p=0.29). Similarly, the mean diameter of BV of patients less than or equal to 158 cm height and more than 158 cm height were 3.46 mm (range 1.4-5.25 mm) and 3.53mm (range 2.0-7.25 mm) respectively. These differences were also not statistically significant (p=0.16). The results are summarised in Table 1.

Table 1. Summary of the venous diameters

Vein diameter		**Mean (Interquartile range)**	**P value**
Cephalic vein (CV)		3.57 mm (2.6 - 4.25)	
	CV in males	3.65mm (3.1 - 4.28)	0.51
	CV in females	3.35mm (2.48 -3.95)	
Basilic vein (BV)		3.36mm (4.0 - 3.98)	
	BV in males	3.44 mm (2.48 -3.95)	0.57
	BV in females	3.29mm (2.62 - 3.68))	
Median cubital vein (MC)		4.95 mm (3.45 - 6.3)	0.0001
Median basilic vein (MB)		3.54 mm (2.7- 4.25)	0.092
BV in the dominant limb		3.50 mm (2.7 - 4.1)	0.13
BV in the non-dominant limb		3.22 mm (2.35 - 3.9)	
CV in the dominant limb		3.42 mm (2.4 - 3.65)	0.072
CV in the non-dominant limb		3.57 mm (3.09 - 4.42)	

DISCUSSION

AVF is the best option for haemodialysis. It is associated with less infections and thrombosis related complications when compared with the central venous catheters. Therefore, it is preferred and commonly used for haemodialysis.

The superficial veins at the cubital fossa are frequently used for the AVF creation in our unit. The CV runs on the lateral aspect of the forearm, cubital fossa and the arm. The BV runs on the medial aspect of the forearm, cubital fossa and the arm. The median vein of the forearm (MVF)

generally divides into a median cephalic vein (MCV) and the median basilic vein (MBV), these veins drain into the CV and BV respectively. This is called the “M” type pattern. This is the commonest type. However, variations occur in the cubital vein anatomy. In the common variant the median cubital vein (MC) connects the CV to the BV. This is called the “H” type pattern.

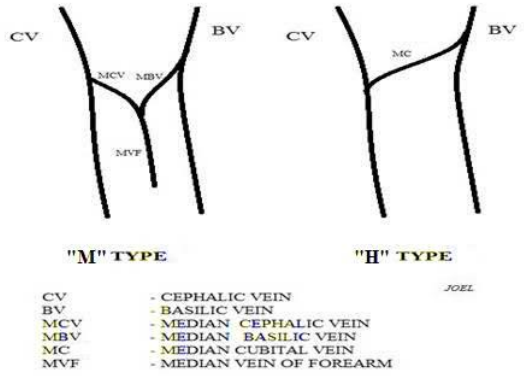

Figure 02: Anatomy of the cubital vein

The cubital vein dimensions are one of the main determinants of the outcome of the AVF creation surgery. The existing guidelines recommend a vein diameter threshold of 2.5 mm and the arterial diameter threshold of 2.0 mm for a successful AVF creation. (4) (5). One series reported 76% successful maturation for AVFs created with veins of more than 2.0 mm diameter and only 16% maturation for veins less than 2.0 mm diameter (6). Another study done on 348 patients undergoing AVF creation also showed that veins with the large diameter undergoes maturation at a higher rate (7).

The best way to assess the venous diameter is the ultrasound imaging. Because the clinical assessment of the proper diameter of the vein is difficult due to the skin fat layer thickness and the status of the distension of the vein. Studies have shown that the AVF creations planned with preoperative ultrasound scan imaging have better outcome. For example, in one follow up study, AVFs done with preoperative ultrasound scanning had a maturation rate of 71% compared to 69% success rate for AVFs created without preoperative ultrasound scan (8).

CONCLUSIONS

This study shows that the diameter of the veins around the elbow varies. The elbow veins are the most frequently utilized veins for the AVF creation in NHSL. Therefore, ultrasound mapping of the veins is essential prior to the procedure to identify the best vein with large diameter and suitable anatomy to perform a successful AVF.

Author declaration

Authors' contributions:
Study concept and design: A.J.; Acquisition of data, analysis: B.J.R. and K.G..; Interpretation of data: J.A.; Drafting of the manuscript and Study supervision: A.J.

Conflicts of interest:
The authors declare that there is no conflict of interest.

Funding statement:
Self-funded

Statement on data availability:
In the possession of the corresponding author.

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