

Assessment of Patterns of Dorsal Venous Plexus and Veins of the Upper Limb

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ABSTRACT

BACKGROUND

Superficial and deep group of veins form the upper limb veins. In this study, we evaluated patterns in the dorsal venous plexus and veins of upper limbs.

METHODS

This prospective observational study conducted from October 2019 to May 2020 comprised of 52 adults with age ranging from 18 – 60 years of both genders were recruited in the study. The materials used in the study was thread, rubber, pen or pencil (marker in some cases), tourniquet, measuring tape and camera. The researchers tied a tourniquet in an oblique fashion after making the arm abducted superolaterally up to greater tubercle of humerus and inferomedially extending up to the level of lower border of teres major. The subjects were instructed to continuously flex and extend the forearm for 2 – 3 times and this helped in making the superficial veins of upper limb more prominent. Site of origin, variations, course and length of vein were recorded. The length of the cephalic vein and basilic vein was noted. Dorsal venous network pattern was studied.

RESULTS

The mean length of left cephalic vein was 53.2 ± 5.1 cm and right was 53.1 ± 4.9 cm, left basilic vein was 50.6 ± 4.8 cm and right was 50.2 ± 4.3 cm, left median cubital vein was 11.8 ± 4.2 cm and right was 11.2 ± 3.7 cm and left median vein of forearm was 18.4 ± 1.7 cm and right was 18.1 ± 1.9 cm. Within left and right veins, a non-significant difference was observed ($p > 0.05$). the most common pattern of venous plexus was type I seen in 14 on left side and 16 on right side and type II seen on 10 on left side and 12 on right side.

CONCLUSIONS

There were eleven different pattern of dorsal venous plexus in study population.

KEY WORDS

Cubital, Dorsal Venous Plexus, Veins

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BACKGROUND

Upper limb veins are classified into deep and superficial groups. The superficial group is variable in disposition and present in superficial fascia. Venae comitantes are represented by deep veins.¹ Basilic vein, cephalic vein, median cubital vein and the forearm median vein are the main superficial veins of the upper limb.² The term cephalic was given based on its direction towards head and similarly basilica vein was named so as it is present towards the base. This nomenclature becomes obvious during early embryonic limb position.³

The cephalic vein arises from the dorsal venous arch of the hand, winding around the radial corner of the forearm, ascending in the arm on the lateral side of the biceps brachii muscle and finally piercing the underlying fascia at the shoulder region draining into the axillary vein. On the medial side of the dorsal venous arch, basilic vein origins and in 53 % cases and this vein is an important venous outlet.⁴ This vein ascends along the medial aspect of the forearm and finally pierces the deep fascia at the site of elbow or at about the mid portion of the arm. At the site of lower margin of teres major / subscapularis muscle, it continues upwards as the axillary vein after joining the venae comitantes of the brachial artery.⁵ The median cubital vein links the basilic vein and the cephalic vein. Finally, it lies at the cubital fossa just superficial to the bicipital aponeurosis.⁶

The cubital fossa is seen superficially at the anterior aspect of the elbow. The cubital fossa is the site for abundance of fat. The middle site of upper extremity is commonly used for venous blood sampling, transfusion and intravenous drug therapy. There is variation of veins in the middle portion of upper limb. Superficial cubital veins variation has been seen in various races. There should be proper knowledge of obtaining blood. In the middle upper extremity, the commonly selected sites for venipuncture are basilic, cephalic, median antebrachial and median cubital veins. These veins are usually used for venipuncture, as they are well supported by connective tissue and muscular tissue, visible, and easy to palpate.⁷ The utility of cubital veins is also for introduction of catheters at cardiac chambers and for withdrawing blood samples.

Anson et al⁸ figured out that there is two layered superficial fascia at the dorsum of the hand. Only small number of vessels are present at the superficial layer which are piercing on their way to the skin. Moreover, deep layers are seen to be transmitting the superficial vessels.

Vucinic et al⁹ observed that superficial veins at the upper middle limb are having great variations in their existence and organisation. In case of surgical procedures like revascularization microsurgery procedures, the superficial veins are surgically and clinically important and also in arterial bypass surgery together with intravenous injections or drug therapy. They examined the designs of superficial veins of upper middle limb in 169 healthy volunteers. A band was applied at the middle surface of the arm and a sketch made of the shape of veins. They observed that they took about 1 - 3 minutes for each upper limb. They then inspected the 338 drawings looking for alike patterns. They observed that nine patterns of upper middle extremity veins. The most common was an 'N'-shaped pattern (97 / 338, 29 %) followed by 'M'-shaped pattern (115 / 338, 34 %). The conclusion was that there were only nine basic patterns of upper middle extremity

in case of venous anatomy, although some are more common than others. The impact of this knowledge is that it should help in those cases which are in need of venous access for medical procedures (cardiac catheterization, transfusion, venepuncture, placement of dialysis access, infusion etc). Therefore, we planned the present study to assess patterns in the dorsal venous plexus and veins of upper limbs.

METHODS

This prospective observational study conducted from October 2019 to May 2020 comprised of 52 adults with age ranging between 18 – 60 years of both genders. Thin built individuals in whom the superficial veins could be seen prominently were included. Obese individuals were not included as the superficial veins could not be seen prominently. All were informed and their consent was taken for the study. A random sampling for the selection of patients was performed. Institutional ethical clearance was obtained after explaining the study.

Inclusion Criteria

1. All willing healthy adults.
2. Both the sexes.
3. Age 18 – 70 years.
4. Thin built and muscular adults in whom the superficial veins could be seen prominently seen.

Exclusion Criteria

1. Not willing to participate in the present study.
2. Age less than 18 years.
3. Obese individuals.
4. Not able to see the superficial veins prominently.
5. Diseases of the upper limbs.

Demographic profile was recorded. The materials used in the study was thread, rubber, pen or pencil (marker in some cases) tourniquet, measuring tape and camera. The researchers tied a tourniquet in an oblique fashion after making the arm abducted superolaterally up to greater tubercle of humerus and inferomedially extending up to at the level of lower border of teres major. The subjects were instructed to continuously flex and extend the forearm for 2 – 3 times and this has helped in making the superficial veins of upper limb more prominent. Site of origin of the vein, variations of veins, course and length of veins were recorded. The length of the cephalic vein and basilic vein was noted. Dorsal venous network pattern was studied. Type of dorsal venous plexus as type I to XI was noted as classification given by Gahlot et al. Data thus obtained was the analysed on statistical software.

After noting down all these parameters of the superficial veins of the upper limbs the results were obtained.

The length of the cephalic vein from radial end of dorsal venous network up to the tourniquet tied at the level of greater tubercle of humerus was noted. The length of basilica vein was noted from ulnar end of dorsal venous network up to tourniquet. Dorsal venous network pattern was studied.

Statistical Analysis

Data thus obtained was tabulated for correct inference. It was expressed as mean ± SD. All parametric data was assessed used student t-test and non-parametric data was assessed used chi-square or Fisher Exact test. SPSS version 20.0 software was used for this study. A value of 0.05 was designated as significant.

RESULTS

Gender	Males	Females
Number (Percentage)	32 (61.5 %)	20 (38.5 %)
Total- 52		

Table 2 Distribution of Patients

The study was conducted on 52 subjects. Table I shows that out of 52 patients, the number (percentage) of males were 32 (61.5 %) and females were 20 (38.5 %). The chi-Square test was applied on it and no significant results was found (p > 0.05).

Veins	Left Mean (cm) ± SD	Right Mean ± SD	P Value
Cephalic	53.2 ± 5.1	53.1 ± 4.9	0.15
Basilic	50.6 ± 4.8	50.2 ± 4.3	0.19
Median Cubital Vein	11.8 ± 4.2	11.2 ± 3.7	0.12
Median Vein of Forearm	18.4 ± 1.7	18.1 ± 1.9	0.23

Table 2. Length of Veins of Upper Limb

Table II shows that mean length of left cephalic vein was 53.2 ± 5.1 cm and right was 53.1 ± 4.9 cm (p = 0.15), left basilic vein was 50.6 ± 4.8 cm and right was 50.2 ± 4.3 cm (p = 0.19), left median cubital vein was 11.8 ± 4.2 cm and right was 11.2 ± 3.7 cm (p = 0.12) and left median vein of forearm was 18.4 ± 1.7 cm and right was 18.1 ± 1.9 cm (p = 0.23). Within left and right veins, a non-significant difference was observed (p > 0.05).

Type	Left	Right	P Value
I	14	16	0.82
II	10	12	0.81
III	8	5	0.03
IV	4	3	0.90
V	3	2	0.91
VI	2	2	1
VII	2	2	1
VIII	1	2	1
IX	3	1	0.02
X	2	1	0.16
XI	3	3	1

Table 3. Dorsal Venous Network Pattern

Table 3 shows that pattern of left dorsal venous plexus was type I in 14, II in 10, III in 8, IV in 4, V in 3, VI in 2, VII in 2, VIII in 1, IX in 3, X in 2, XI in 2 and XII in 1. On right side, type I in 16, II in 12, III in 5, IV in 3, V in 2, VI in 2, VII in 2, VIII in 1, IX in 1, X in 1, XI in 2 and XII in 2. A non-significant difference was (p > 0.05) was observed on applying chi-square test.

DISCUSSION

The superficial veins of upper limb are associated with cutaneous nerves and superficial lymphatics.⁶ The superficial

lymph nodes lie along the veins and the deep lymph nodes along the arteries.¹⁰ The superficial and deep set of veins have valves but they are more in number in the deep veins than in the superficial veins.¹¹

We found that mean length of left cephalic vein was 53.2 cm and right was 53.1 cm, left basilic vein was 50.6 cm and right was 50.2 cm, left median cubital vein was 11.8 cm and right was 11.2 cm and left median vein of forearm was 18.4 cm and right was 18.1 cm. Fazal et al¹² found 11 different patterns of dorsal venous plexus in right and 10 in left hand. The mean length (cm) of cephalic vein, basilica vein, median cubital vein and median vein of left upper limb of females was 51.6, 50.8, 11.3, 18.1 respectively, in left upper limb of males was 53.2, 50.4, 11.6, 18.1 respectively, in right upper limbs of female was 51.3, 50.8, 12.7, 17.9 respectively, and in right upper limbs of male was 51.9, 50.4, 11.6 and 17.5 cm respectively. These differences were statistically not significant.

We found that pattern of left dorsal venous plexus was type I in 14, II in 10, III in 8, IV in 4, V in 3, VI in 2, VII in 2, VIII in 1, IX in 3, X in 2 and XI in 3. On right side, type I in 16, II in 12, III in 5, IV in 3, V in 2, VI in 2, VII in 2, VIII in 1, IX in 1, X in 1, XI in 3 and XII in 2. Four types of superficial venous patterns were identified in the cubital fossa in the study of Bekel et al.¹³ From the total of 800 studied arms 58.5 %, 18.6 %, 14 %, 8.9 % had type 1, type 2, type 3, and type 4 patterns respectively. In the majority of studied subjects, the venous patterns go with the findings of former studies. However, some rare venous patterns were also identified.

Volla et al¹⁴ included 90 adult upper extremities of human cadavers and determined subcutaneous venous patterns on the dorsum of the hand. Approximately in 83.3 %, the veins were arranged in two groups in relation to second metacarpal bone and the second inter metacarpal space. The area over the third metacarpal bone might be called vein lacking area. In all the cases, crossing branches of veins were seen. There was internal diameter of 0.9 ± 0.2 mm with three crossing branches in each case. Authors suggested that subcutaneous veins are arranged in two layers.

The median veins were observed to have a mean diameter of 10 mm and large veins have diameter > 10 mm. The wall of veins is formed by tunica intima, tunica media and tunica adventitia. The innermost layer is called the tunica intima. The tunica intima includes the endothelium and its basal lamina and reticular fibres. Sometimes an elastic network surrounds endothelium, but these elastic fibres do not form characteristics of an internal elastic lamina. There is tunica media which is present outside the tunica intima that contains smooth muscle cells that are loosely organized layers interwoven with collagen fibres and fibroblasts.¹⁵

Zhang et al studied patterns of the subcutaneous veins in the dorsum of the hand in 90 adult cadavers. Results showed that in 83.3 % of the cases, the veins were arranged in two groups, radial and ulnar, above the transverse midline of the dorsum. There were crossing branches of veins with mean internal diameters of 0.9 ± 0.2 mm. Similarly, internal diameter of perforating branches was 1.0 ± 0.4 mm and the average number was 3.9. The internal diameter of perforating branch in the first intermetacarpal space was 1.8 ± 0.3 mm. 70 % perforating branches showed venous values. Wyss et al¹⁶ in their study found 0.5 - 1.3 mm branched veins of small calibre. The deep layer is composed of 1.5 - 2.5 mm large veins. The

mean calibre was 0.9 ± 0.3 mm and 1.4 ± 0.5 mm in the superficial layer and in deep layer respectively.

The earliest vasculature of the limb bud is resultant from the endothelial cells arising from segmental branches of carinal veins, aorta and from angioblasts endogenous to the mesoderm of the limb bud. Initially, the vasculature of the limb comprises of fine capillary system but later on some are enlarged that are framed into a large central artery supplying blood to the limb bud. From central artery the blood is circulated via a bunch of capillaries to the periphery and then received into a marginal sinus which is present beneath the apical ectodermal ridge. Finally, the blood from the marginal sinus pipes into peripheral venous channels.

CONCLUSIONS

The present study conducted will be helpful to the physicians and surgeons in performing various therapeutic, diagnostic and operative procedures. Eleven different patterns of dorsal venous plexus were observed in the study population. Study of the arrangement of superficial veins in the cubital fossa in our environment is vital to be aware their patterns and prevalence, which would be very useful to health professionals who approach these superficial veins, especially under emergency conditions.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

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