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A Study of Patterns in the Dorsal Venous Plexus and Veins of Upper Limbs in Humans

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Abstract

Context: The study of veins of the upper limbs in living humans and also the study of dorsal venous arch pattern in the upper limbs are important.

Aim: To study the patterns in the dorsal venous arch and superficial veins of upper limbs in humans.

Settings and Design: Present cross-sectional study was carried out at JN Medical College, Belgaum.

Methods: Institution based cross sectional study was carried out among 100 study subjects of age 18–70 years in whom the superficial veins were prominently seen. Tourniquet, Pencil, Rubber, measuring tape, Thread, Camera were used. A tourniquet was tied obliquely to slightly abducted arm inferomedially at the level of lower border of teres major and superolaterally up to greater tubercle of humerus. The superficial veins of upper limb were made prominent by asking person to flex and extend elbow and wrist alternately for 2–3 times. Superficial veins of the arm, forearm and hand were studied and the parameters of the veins like Site of origin of the vein, Variations of vein, Course and length of vein up to the tourniquet were noted down.

Statistical Analysis: The data was described as mean values and difference was assessed by using *t* - test.

Results: We observed five different patterns in cubital fossa. 11 different patterns were observed in right hand and 10 in left hand. The mean length (cm) of cephalic vein, basilic vein, median cubital vein and median vein of forearm in 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.

Conclusion: Five different patterns in cubital fossa. 11 different patterns were observed in right hand and 10 in left hand.

Keywords: Patterns; Dorsal venous arch; Veins; Upper limbs; Humans.

Introduction

The veins of the upper limb can be divided into superficial and deep groups. The superficial group of veins are variable in disposition and present in superficial fascia. The deep veins accompany the arteries as venae comitantes. The main superficial veins of the upper limb are cephalic vein, basilic vein, median vein of the forearm and the median cubital vein.[1] Similar to the dermatomoal pattern the logic for naming the main superficial veins of the upper limb cephalic (towards the head) and basilic (towards the base) become apparent when the limb is placed in the initial embryonic position.[2]

The superficial veins run away from pressure points and hence, they are absent in the palm, in the ulnar border of the forearm, in the back of the arm and trapezius region. The course of the veins is spiral from dorsal to ventral surface of the limb. The earlier a vein becomes deep it is better because

the venous return is associated by muscular compression. The load of the preaxial vein (cephalic) is greatly received by the more efficient postaxial vein (basilic) through a short-circuiting channel, the median cubital vein and partly by the deep veins through a perforator vein connecting the median cubital vein with the deep vein.[3]

The superficial veins of upper limb are accompanied by cutaneous nerves and superficial lymphatics and not by arteries. The superficial lymph nodes lie along the veins and the deep lymph nodes along the arteries.[3] The superficial and deep set of veins have valves but they are more in number in the deep veins than in the superficial veins.[2]

The study of veins of the upper limbs in living humans and also the study of dorsal arch pattern in the upper limbs are important. Hence present study was undertaken to study the patterns in the dorsal venous arch and veins of upper limbs in humans.

Materials and Methods

Institution based cross sectional study was carried out among 100 study subjects at the Anatomy Department of JN Medical College, Belgaum. Institution Ethics Committee approval was taken. The procedure of the study was explained in detail to the study participants and written informed consent was obtained from all the study participants for the present study.

Adults of age 18–70 years were included. Only those who were thin built and 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.

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

Materials used

Following material was used:

1. Tourniquet
2. Pencil
3. Rubber
4. Measuring tape
5. Thread
6. Camera

Procedure adopted

In case of 100 study subjects consent form was given and consent was taken for the study. A tourniquet was tied obliquely to the slightly abducted arm infero-medially at the level of lower border of teres major and supero-laterally up to greater tubercle of humerus. The superficial veins of upper limb were made prominent by asking the person to flex and extend the elbow and the wrist alternately for 2–3 times. Superficial veins of the arm, forearm and hand were studied and the parameters of the veins were noted down.

Following findings were noted:

1. Site of origin of the vein
2. Variations of vein
3. Course and length of vein up to the tourniquet

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 basilic vein was noted from ulnar end of dorsal venous network up to tourniquet. Dorsalvenous network pattern was studied. We did not take the help of any reference for this. We only noted different patterns and named them as type 1, 2, 3… till we found a total of 11 patterns.

Statistical analysis

The data was analyzed using mean values and standard deviation. For comparison of the mean values between two variables, student *t* - test was used. *p* - value < 0.05 was considered as statistically significant.

Results

Table 1 shows comparison of the length of the veins in cm in right and left upper limbs observed in 100 living persons. The mean length of cephalic vein in the left upper limb was 52.2 cm and the right upper limb was 51.7 cm. The mean length of basilic vein in the left upper limb was 50.5 cm and the right upper limb was 50.4 cm. The mean length of Median cubital vein in the left upper limb was 11.5 cm and the right upper limb was 11.9 cm. The mean length of Median vein of forearm in the left upper limb was 18.1 cm and the right upper limb was 17.6 cm.

Table 2 shows comparison of length of veins in cm in right and left upper limbs among the male and female. The mean length of cephalic vein in females in left upper limb was 51.6 ± 5.1 and in the right upper limb was 51.3 ± 3.6 and the difference was not statistically significant. The mean length of basilic vein in females in left upper limb was 50.8 ± 3.9 and in the right upper limb was 50.6 ± 4.1 and the difference was not statistically significant. The mean length of median cubital vein in females in left upper limb was 11.3 ± 1.7 and in the right upper limb was 12.7 ± 2.9 and the difference was not statistically significant. The mean length of median vein of forearm in females in left upper limb was 18.1 ± 4.4 and in the right upper limb was 17.9 ± 2.9 and the difference was not statistically significant. The mean length of cephalic vein in males in left upper limb was 53.2 ± 5.4 and in the right upper limb was 51.9 ± 4.5 and the difference was not statistically significant. The mean length of basilic vein in males in left upper limb was 50.4 ± 4.9 and in the right upper limb was 50.4 ± 4.2 and the difference was not statistically significant. The mean length of median cubital vein in males in left upper limb was 11.6 ± 2.4 and in the right upper limb was 11.6 ± 2.7 and the difference was not statistically significant. The mean length of median vein of forearm in males in left upper limb was 18.1 ± 3.7 and in the right upper limb was 17.5 ± 3.7 and the difference was not statistically significant.

Table 3 shows comparison of dorsal venous network pattern in right upper limbs among males and females. Type III pattern was the most commonly seen and maximum cases were seen in males. Type I, II, III, IV, V, VIII, IX and XI was seen predominantly in males compared to females. While in females only Type VII, was seen which was only one case observed in males. Type VI and X were seen equally in males and females. Overall type I, II, III were found to be the most common types followed by type IV, V and VI.

Table 4 shows comparison of dorsal venous network pattern in left upper limbs among males

Table 1: Comparison of the length of the veins in cm in right and left upper limbs in 100 living persons

Limb	Vein	Mean length in cm	Standard deviation
Left upper limb	Cephalic vein	52.2	5.3
	Basilic vein	50.5	4.7
	Median cubital vein	11.5	2.2
	Median vein of forearm	18.1	3.9
Right upper limb	Cephalic vein	51.7	4.2
	Basilic vein	50.4	4.1
	Median cubital vein	11.9	2.9
	Median vein of forearm	17.6	3.5

Table 2: Comparison of length of veins in cm in right and left upper limbs among the male and female

Vein	Left upper limb		Right upper limb		*t* - value	*p* - value
	Min-max	Mean ± SD	Min-max	Mean ± SD		
Length in female in cm						
Cephalic vein	46.5-60.5	51.6+5.1	45.5-60.5	51.3+3.6	0.257	0.798
Basilic vein	47.5-60.5	50.8+3.9	35.5-64	50.6+4.1	0.204	0.839
Median cubital vein	6.5-14.5	11.3+1.7	7-16.5	12.7+2.9	0.660	0.511
Median vein of forearm	11-28.5	18.1+4.4	10-29.5	17.9+2.9	0.159	0.874
Length in male in cm						
Cephalic vein	35-64.5	53.2+5.4	43.5-64.5	51.9+4.5	1.573	0.117
Basilic vein	38.5-64.5	50.4+4.9	40.5-58	50.4+4.2	0.038	0.969
Median cubital vein	7.5-18.5	11.6+2.4	5.5-11.5	11.6+2.7	0.046	0.963
Median vein of forearm	10-27.5	18.1+3.7	12.5-28.5	17.5+3.7	0.931	0.353

Table 3: Comparison of dorsal venous network pattern in right upper limbs among males and females

Pattern	Male	Female	Total
Type I	14	7	21
Type II	14	5	19
Type III	22	6	28
Type IV	6	3	9
Type V	4	2	6
Type VI	2	2	4
Type VII	1	2	3
Type VIII	2	1	3
Type IX	2	1	3
Type X	1	1	2
Type XI	2	0	2

Table 4: Comparison of dorsal venous network pattern in left upper limbs among males and females

Pattern	Male	Female	Total
Type I	9	9	18
Type II	10	6	16
Type III	10	4	14
Type IV	8	4	12
Type V	7	2	9
Type VI	6	2	8
Type VII	6	2	8
Type VIII	10	1	11
Type IX	2	0	2
Type X	2	0	2

and females. It was found that type I was seen equally i.e., nine cases each in females and in males. Overall also it was the most common type. Type II also overall there were 16 cases out of which majority i.e., 10 were seen in males and 6 cases was seen in females. Type III there were 14 cases out of which 10 were in males and 4 was in female. Type IV there were 12 cases out of which 8 were in males and 4 was in female. Type V there were 9 cases out of which 7 were in males and 2 was in female. Type VI there were 8 cases out of which 6 was in males and 2 was in female. Type VII there were 8 cases out of which 6 was in males and 2 was in female. Type IX there was only 2 case which was seen in male. Type X there was only 2 case which was seen in male.

Discussion

In a study on 50 specimens fixed in formalin to define the vascular territory of the acromiothoracic axis and for vascular flaps in plastic surgery it was found that cephalic vein had less tributaries in the deltopectoral groove. The cephalic vein was absent in 4% of the specimen.[4]

But in the present study, we did not find any absent cephalic vein. The median vein of forearm will bifurcate into two vessels one going to the basilic vein which is called the median basilic vein and this is used for giving intravenous injections. The vein is crossed by the anterior branch of the medial cutaneous nerve of the forearm. The nerve may be damaged by the needle or by irrigating fluids which enter the subcutaneous tissue instead of the vein. This will produce so much irritation of the nerve as to cause a reflex spasm of the muscles resulting in acute flexion of the forearm.[5]

In a biostatistical study on the arrangement of the superficial veins of the cubital fossa in Iraqis on 300 students, variations were found. The communication between basilic and cephalic veins was through a horizontal venous connection between one of the tributaries of these two veins. The median vein of the forearm divides into median cephalic vein and median basilic vein. A vein from the front of the forearm drains into the median basilic vein.

In one study of the mid-arm approach to basilic and cephalic vein cannulation under ultrasound guidance, it was found that taking a longitudinal view of the vein will allow easy visualization. For advancing needle, catheter or guide wire the use of cephalic and basilic vein as an approach using

ultrasonography was done in patients of heroin abuse, hypertension, hepatitis C, cirrhosis where all other veins were not visible on feet and ankles.[7]

In one study using cephalic and basilic vein in cubital fossa for palpating and inserting central venous catheters using ultrasound they used a transverse view of the vessels.[7]

In a stud of use of arterial reconstruction using the basilic vein from the zone of injury in pediatric supra condylar humeral fractures they recommended the neglected basilic vein as a donor graft for brachial artery repair. Basilic vein is selected as it is thin walled and there is decreased chance of spasm. Such thin walled vein is least favorable for long-term survival.[8]

The cubital veins are also used for introduction of cardiac catheters and to take blood samples from great vessels and chambers of heart. The veins may also be used for cardiac angiography.[9]

A study was done on 90 adult upper extremities of human cadavers to observe the pattern of the subcutaneous veins on the dorsum of the hand. The distribution of veins was not symmetrical in the dorsum of the hand. In 83.3% of the cases, the veins were arranged in two groups corresponding to the proximal halves of the second metacarpal bone and the second inter metacarpal space and area over the third metacarpal bone might be called vein lacking area. Crossing branches of veins were found in all the cases. There were three crossing branches in each case with internal diameter of 0.9 ± 0.2 mm. This study established that subcutaneous veins are arranged in two layers. They anastomose freely with veins of palmar aspect through intermetacarpal spaces. The average number of perforating branches was 3.9 and their internal diameters were 1 ± 0.4 mm, the perforating branch in first inter metacarpal space was wide and constant. In 70% of the cases venous valves were found which prevent blood flowing from dorsum to the palm of this hand.[10]

Median veins have diameter up to 10 mm and large veins have diameter greater than 10 mm, the wall of vein is made up of three layers: 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 fibers. Sometimes an elastic network surrounds endothelium, but these elastic fibers do not form lamina characteristics of an internal elastic lamina. Outside the tunica intima there is tunica media that contains smooth muscle cells in a loosely organized layer interwoven with collagen fibers and fibroblasts.[11]

The earliest vasculature of the limb bud is derived from endothelial cells arising from segmental branches of aorta, carinal veins and from angioblasts endogenous to the limb bud mesoderm. Initially limb vasculature consists of fine capillary network but soon some are enlarged resulting in large central artery that supplies blood to limb bud. From central artery the blood is distributed *via* a mesh of capillaries to the periphery and then collected into a marginal sinus which is located beneath the apical ectodermal ridge. Blood from the marginal sinus drains into peripheral venous channels.[12]

Conclusion

5 different patterns in cubital fossa were found, 11 different patterns were observed in right hand and 10 in left hand. This study will be helpful to the clinicians in performing various operative, diagnostic and therapeutic procedures.

Key Messages

This study will be helpful to the clinicians in performing various operative, diagnostic and therapeutic procedures.

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