Review Article

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Variations in the Median Cubital Vein: A Conceptual Review

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Abstract

The median cubital vein, connecting the basilic and cephalic veins in the cubital fossa, is used for routine clinical procedures such as phlebotomy, insertion of intravenous cannulas, critical investigations, cardiac angiography and stent placement. Numerous variations regarding the arrangement of the median cubital vein are mentioned in the literature, such as classical or N-type, M-type, I-type, absence of cephalic vein in the arm, doubled median cubital vein, median cubital vein as the venous arch. In majority of the population either classical type or N-type variation has been documented. Significant percentage of the population have an absence of median cubital vein, replaced by the median cephalic and median basilic veins. Geographical differences in frequencies of variations of the median cubital vein have also been documented. In the background of the clinical utility, it rises paramount importance for medical personnel to know about the anatomical variations of the cubital vein. Lack of awareness would incur needless harm and suffering to the patient and delay investigation and treatment modalities. Therefore, we intend to do a comprehensive review of the variations in the median cubital vein.

Keywords: Median cubital vein, Superficial veins of the forearm, Variations, Patterns.

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Introduction

In humans, cephalic and basilic veins are the major veins present in the forearm and arm; with cephalic vein running laterally and basilic vein running medially. The median cubital vein (MCV) is a superficial vein situated in the cubital fossa, arising from the cephalic vein of the forearm, distal to the elbow, travels proximally and medially to drain into the basilic vein of the arm. It is also joined by a branch from the deep veins.[1] MCV is present in the superficial fascia, lying over the bicipital aponeurosis, forming the roof of the cubital fossa, separated from the brachial artery and median nerve by the bicipital aponeurosis.[2]

The median cubital vein is commonly used for venous withdrawal of blood, also called venepuncture, a routine procedure required for obtaining blood samples for most investigations. MCV is specifically preferred over the cephalic vein and basilic vein despite the latter being superficially located. The cephalic vein tends to roll and slip during venepuncture and shares proximity to lateral antebrachial cutaneous nerve. Similarly, the basilic vein is located close to the brachial artery and medial antebrachial cutaneous nerve. But MCV does not roll due to the presence of perforating deep vein anchoring to the bicipital aponeurosis and is also protected from the brachial artery and median nerve beneath by bicipital aponeurosis, which acts as a guide to venepuncture.[3–5] Wrong venepunctures can lead to bruising, hematoma and nerve damage. Therefore, MCV is of great importance for performing venepuncture.[6]

Venepuncture is also routinely utilised during blood donation by the donors and for the blood transfusion to the patient. It is also commonly used for the administration of intravenous injections and insertion of cannulas. MCV is also utilised for cardiac catheterisations, needed for diagnostic purposes such as cardiac angiography and interventional purposes such as cardiac angioplasty and stent placement in the coronary arteries. MCV is also harvested for vascular graft. The cephalic and basilic veins are essential for creating arteriovenous fistulas, critical for haemodialysis in patients with chronic kidney disease.[2,7]

Many variations of MCV were described in the literature in the past. There were several articles by the authors in different

countries worldwide to observe and analyse the variations of MCV and differences in frequencies of variations in respective geographical locations. In the background of such clinical importance, variations of MCV are to be well known to the doctors, nursing staff, phlebotomists and other health care personnel. In contrast, there appears a huge information gap with respect to this in the standard curriculum of medical training.

Subjects and Methods

The data was collected from PubMed and Google scholar databases published between 2008 and 2021 along with an article from 1994. The keywords used were 'median cubital vein' and 'variations,' 'median cubital vein' and 'patterns,' 'cubital fossa' and 'variations,' cubital fossa' and 'veins.' The articles in English, with full text were included. Articles in other languages and in English with abstract only were excluded.

Review

Methods used by various authors

Some studies demonstrated the venous arrangement of cubital fossa in human cadavers. Others observed the variations of the median cubital vein in living humans. The method of study in cadavers was by dissection, whereas in the living humans was with the help of tourniquet or sphygmomanometer cuff and handheld illuminator.

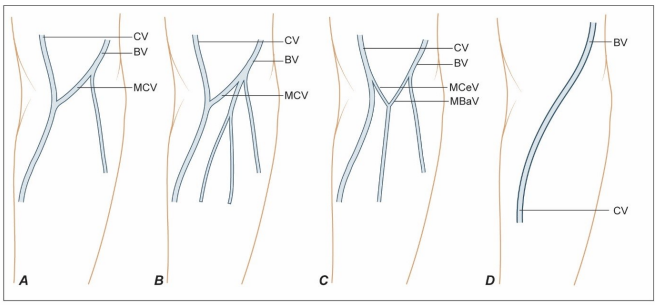

Figure 1: A,B: Usual pattern of median cubital vein - MCV joining cephalic and basilic veins (N-type or H-type); C: MCV replaced by median basilic and median cephalic veins (M-type or Y-type); D: Poor development of cephalic vein in the arm (BV: basilic vein, CV: cephalic vein, MCV: median cubital vein)

MCV Joins cephalic and basilic veins (N-type or H-type)

The most common presentation of the median cubital vein observed was typically described as classical or N-type or H-type arrangement [Figure1A,B],[5] based on the pattern formed by the cephalic, median cubital and basilic veins. In the cubital fossa, the vein was found connecting both the superficial veins of the forearm, cephalic and basilic vein. The median cubital vein was found lying over the bicipital aponeurosis. This pattern has the least concerns concerning injury during clinical procedures such as phlebotomy. Vasudha et al. found the prevalence to be 96% in the living population and 88% in cadavers in a study conducted in India.[7] In Japan, Mikuni et al. found it to be 83% in cadavers; Yamada et al. found it 56.7%.[3,8] In India, Jiwane et al. found it to be 51% of the living population.[9] Bekel et al. observed it to be 58.5% in the living in Ethiopia,[10] Vucinic et al. found it to be 36.97% in Serbia.[11] In India, Das et al. found it to be 29% in the living,[12] Dhan et al. found it to be 28.75% in living and 25% in cadavers.[13] In Brazil, it was found to be the least 9%.[14] There were significant differences in the percentage of the population varying with geographical location. The prevalence ranged between 9% found in brazil to 96% found in India, as described in [Table 1].

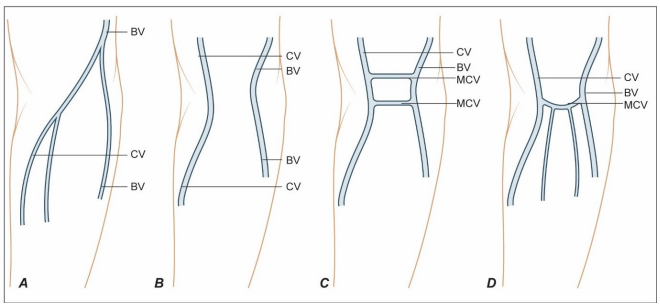

Figure 2: A: Poor development of cephalic vein in the arm; B: No communication betweenbasilic and cephalic veins (I-type or O-type); C: Double MCV; D: MCV as venous arch (BV: basilic vein, CV: cephalic vein, MCV: median cubital vein)

MCV Replaced by median basilic and median cephalic veins (M-type or Y-type)

The median cubital vein was found absent in a significant proportion of the population worldwide. Instead, the vein was replaced by the median basilic and cephalic veins draining into the basilic and cephalic veins respectively, forming an M-type or Y-type pattern [Figure 1.C]. Some studies further classified them based on the veins draining into the median basilic and cephalic veins. The median vein of the forearm (MVF) was found in some populations in the midline of the forearm, which is divided into two veins at the cubital fossa, median basilic veins and median cephalic vein, which drained into basilic and cephalic vein in the arm. In the remaining population, the cephalic vein was divided into median basilic veins and median cephalic vein, which drained into basilic and

Table 1: MCV joins cephalic andbasilic veins (N-type or H-type)

Year	Author	Type	Sample size	Country	Prevalence
2019	Dhan et al.	Cadaveric & Living	100	India	C-25% L-28.75%
2019	Das et al.	Living	396	India	L-29%
2018	Pires et al.	Living	200	Brazil	L-9%
2018	Bekel et al.	Living	800	Ethiopia	L-58.5%
2017	Jiwane et al.	Living	300	India	L-51%
2016	Vucinic et al.	Living	338	Serbia	L-36.97%
2015	Lee et al.	Living	353	Korea	L-50.1%
2014	Rababah et al.	Living	264	Jordanians	F-45.4% M-51.5%
2013	Ukoha et al.	Living	270	Nigeria	L-28%
2013	Vasudha et al.	Cadaveric & Living	250	India	C-88% L-96%
2012	Mikuni et al.	Cadavers	128	Japan	C-83%
2008	Yamada et al.	Cadavers	66	Japan	C-56.7%
1994	Dharap et al.	Living	532	Malaysia	F-78.2% M-62.4%

Table 2: MCV replaced by medianbasilic and median cephalic veins (M-type or Y-type)

Year	Author	Type	Sample size	Country	Prevalence
2019	Dhan et al.	Cadaveric & Living	100	India	C-35% L-35%
2019	Das et al.	Living	396	India	L-33.6%
2018	Pires et al.	Living	200	Brazil	L-25%
2018	Bekel et al.	Living	800	Ethiopia	L-8.9%
2017	Jiwane et al.	Living	300	India	L-39%
2016	Vucinic et al.	Living	338	Serbia	L-53%
2015	Lee et al.	Living	353	Korea	L-46.7%
2014	Rababah et al.	Living	264	Jordanians	F-16.6% M-18.2%
2013	Ukoha et al.	Living	270	Nigeria	L-33%
2013	Vasudha et al.	Cadaveric & Living	250	India	C-2% L-4%
2012	Mikuni et al.	Cadavers	128	Japan	-
2008	Yamada et al.	Cadavers	66	Japan	C-41.7%
1994	Dharap et al.	Living	532	Malaysia	F-11.5% M-18.8%

cephalic veins in the arm. As tabulated in table 2, Jiwane et al. in India found 39% of the population to have this variation which was a significant finding. Out of this, 11% showed the median vein of forearm bifurcating into median basilic veins and median cephalic vein, which subsequently drained into the basilic vein and accessory cephalic vein respectively. Rest, 28% population, had cephalic vein in the forearm bifurcating into median basilic veins and median cephalic vein, which drained into the basilic vein and accessory cephalic vein.[9] Highest proportion was found in Serbia with 53% of the living population and in Korea with 46.7% of living.[15] Higher proportions were also demonstrated in studies in Japan and three studies in India and their prevalence is 41.7%, 39%, 35% and 33.6% respectively.[3,9,12,13] Lesser proportions were found in Jordan, Malaysia and they were around 16–18% and 11–18%.[16,17] The least proportion was found in a study conducted in India, where it was 2–4%.[7] These findings are significant with respect to the phlebotomy procedures. The newly trained doctors, nurses, phlebotomists should be aware of this variation being present in nearly 40% of the population,

Table 3: Poor development of cephalic vein in the arm

Year	Author	Type	Sample size	Country	Prevalence
2019	Dhan et al.	Cadaveric & Living	100	India	-
2019	Das et al.	Living	396	India	L-17.82%
2018	Pires et al.	Living	200	Brazil	L-17%
2018	Bekel et al.	Living	800	Ethiopia	L-14%
2017	Jiwane et al.	Living	300	India	L-3%
2016	Vucinic et al.	Living	338	Serbia	L-1.77%
2015	Lee et al.	Living	353	Korea	L-2%
2014	Rababah et al.	Living	264	Jordanians	F-13.6% M-5.3%
2013	Ukoha et al.	Living	270	Nigeria	L-15%
2013	Vasudha et al.	Cadaveric & Living	250	India	C-4%
2012	Mikuni et al.	Cadavers	128	Japan	-
2008	Yamada et al.	Cadavers	66	Japan	C-1.7%
1994	Dharap et al.	Living	532	Malaysia	F-1% M-2.9%

Table 4: No communication between basilic and cephalic veins (I-type or O-type)

Year	Author	Type	Sample size	Country	Prevalence
2019	Dhan et al.	Cadaveric & Living	100	India	C-5% L-3.75%
2019	Das et al.	Living	396	India	L-4.3%
2018	Pires et al.	Living	200	Brazil	L-18%
2018	Bekel et al.	Living	800	Ethiopia	L-18.6%
2017	Jiwane et al.	Living	300	India	L-9.3%
2016	Vucinic et al.	Living	338	Serbia	L-5%
2015	Lee et al.	Living	353	Korea	L-1.1%
2014	Rababah et al.	Living	264	Jordanians	F-12.8% M-13.6%
2013	Ukoha et al.	Living	270	Nigeria	L-4.1%
2013	Vasudha et al.	Cadaveric & Living	250	India	C-4%
2012	Mikuni et al.	Cadavers	128	Japan	C-7%
2008	Yamada et al.	Cadavers	66	Japan	C-0%
1994	Dharap et al.	Living	532	Malaysia	F-7.3% M-8.8%

demanding caution during palpation of the veins. In lack of this understanding, repeated blind attempts at withdrawing blood from the median cubital vein would prove unsuccessful, causing unnecessary pain and discomfort to the patient.

Poor development of cephalic vein in the arm

Many studies across the world have demonstrated the absence of cephalic vein in the arm or poorly developed cephalic vein in a small percentage of the population [Figure 1.D, 2.A]. They found basilic vein in the forearm in most of these variations. They observed one of the types where the cephalic vein of the forearm drained into basilic vein in the cubital fossa, which continued in the arm along with a rudimentary cephalic vein in the arm. Another type showed a complete absence of the cephalic vein in the forearm. As observed in table 3, the highest proportion among all studies was documented by Das et al. in India where it was 17.82%,[12] followed by Brazil where it was 17%.[14] Further higher proportions were found in Nigeria, Ethiopia and Jordan to be 15%,14% and 5–13.6% respectively.[10,16,18] Lesser proportions were found in

Table 5: Double MCV

Year	Author	Type	Sample size	Country	Prevalence
2019	Dhan et al.	Cadaveric & Living	100	India	C-20% L-20%
2019	Das et al.	Living	396	India	L-16.9%
2018	Pires et al.	Living	200	Brazil	L-0%
2018	Bekel et al.	Living	800	Ethiopia	-
2017	Jiwane et al.	Living	300	India	0.3%
2016	Vucinic et al.	Living	338	Serbia	L-2.95%
2015	Lee et al.	Living	353	Korea	-
2014	Rababah et al.	Living	264	Jordanians	F-0% M-1.1%
2013	Ukoha et al.	Living	270	Nigeria	-
2013	Vasudha et al.	Cadaveric & Living	250	India	-
2012	Mikuni et al.	Cadavers	128	Japan	C-11%
2008	Yamada et al.	Cadavers	66	Japan	-
1994	Dharap et al.	Living	532	Malaysia	F-0% M-0.6%

Table 6: MCV as venous arch

Year	Author	Type	Sample size	Country	Prevalence
2019	Dhan et al.	Cadaveric & Living	100	India	-
2019	Das et al.	Living	396	India	-
2018	Pires et al.	Living	200	Brazil	3%
2018	Bekel et al.	Living	800	Ethiopia	
2017	Jiwane et al.	Living	300	India	0.03%
2016	Vucinic et al.	Living	338	Serbia	
2015	Lee et al.	Living	353	Korea	-
2014	Rababah et al.	Living	264	Jordanians	F-11.4% M-9.8%
2013	Ukoha et al.	Living	270	Nigeria	-
2013	Vasudha et al.	Cadaveric & Living	250	India	-
2012	Mikuni et al.	Cadavers	128	Japan	-
2008	Yamada et al.	Cadavers	66	Japan	-
1994	Dharap et al.	Living	532	Malaysia	F-2% M-6.5%

other studies from India, Korea, Serbia and Malaysia and they amount to 3–4%, 2%, 1.77% and 1–3% respectively,[7,9,11,15,17] Least was found in Japan and it was only 1.7%.[3]

No communication between basilic and cephalic veins (I-type or O-type

Surprisingly in some percentage of the population, there was no communication between the basilic and cephalic veins in the cubital fossa or anywhere in the arm or forearm, called I-type or O-type [Figure 2.B]. In these individuals, the basilic and cephalic veins were found running parallelly all along their course in the forearm and arm. Eventually, the cephalic vein was found draining into the axillary vein. I-type is a significant finding to be borne in the minds of health care workers during repeated failures in blood sampling or accessing the median cubital vein. From the above mentioned facts, we could envisage that blind changing of the phlebotomy site, in the middle of the cubital fossa, during situations where the vein could not be palpated/visualised would not help and rather would delay the investigation or treatment. It was found

in 18.6% population in Ethiopia, 18% in Brazil, 12–13% in Jordan, 9.3% in India, 7% in a study in Japan, 7–8% in Malaysia, 5% in Serbia, 4% in Nigeria, least in Korea and another study of Japan to be 1% and 0% respectively, as described in [Table 4]. [3,8–11,14–18]

Double MCV

Rarely two median cubital veins were found by some authors in the world (Fig.2.C). Prevalence, as tabulated in table 5, was found to be as high as 20% and 16% in India observed by Dhan and Das respectively,[12,13] 11% in Japan, 1.1% in males in Jordan, 0.6% in males in Malaysia, 0.3% in another study in India, 0% in Brazil.[8,9,14,16,17] Caution is advised, especially when cannulating the median cubital vein, for invasive procedures such as cardiac angiography and angioplasty with stent placement.

MCV as venous arch

In a small percentage of the population, the median cubital vein was found to be present as a venous arch in the cubital fossa, with convexity facing downwards [Figure 2.D]. Prevalence was observed in table 6 as 11% in females of Jordan, 9.8% in males of Jordan, 3% in Brazil, 2% in Malaysia, 0.03% in India.[9,14,16,17]

Conclusion

The variations of the median cubital vein are of utmost importance because of the routine procedures and important clinical investigatory methods that require access to the median cubital vein. Majority of the population has the classical or N-type pattern of the median cubital vein arising from the cephalic vein and draining into the basilic vein. Around 40% population do not have median cubital vein, instead they have median cephalic and median basilic veins. Around 10% have no communication between cephalic and basilic veins. Rarely cephalic vein can be absent in the arm or double median cubital vein or median cubital vein as venous arch can be found. Therefore, thorough knowledge of the variations must be incorporated into the curriculum of training the healthcare workers.

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