

Case Report**Clinico-embryological consideration of the persistent Superficial Ulnar Artery (SUA)**Sreeja. M T¹, Leo Rathinaraj. A S²¹Department of Anatomy, University of Hail, Saudi Arabia²Department of Physical Therapy, University of Hail, Saudi Arabia

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ABSTRACT

Variations in the branching pattern of the upper limb arterial system are well documented. Superficial ulnar artery is a rare variation in the upper limb that arises usually from the brachial or axillary artery and runs superficial to the muscles originates from the medial epicondyle. During the routine educational dissection of the left upper limb of a male cadaver shows a variation in the branching pattern of brachial artery which gives off an unusual artery about 14.5 cm above the cubital fossa, runs downward medially to the medial nerve on the arm, reaches the forearm after crossing the muscles originates from the medial epicondyle, reaches the hand by passing superficial to the flexor retinaculum and ends in the palmar arch. Throughout its course this abnormal artery runs superficial and gives no branches. The ulnar artery and the other arteries of the left limb are normal. The right upper limb shows the normal branching pattern as explained in the standard anatomical textbook. We concluded this abnormal artery as the persistent superficial ulnar artery in accordance with Poterat's development of upper limb arteries. Sound knowledge about the normal and the abnormal branching pattern of the arterial system is vital for vascular and reconstructive surgery and also in angiographic screening. Superficial presence of this abnormal artery has many clinical implications also.

Keywords: Ulnar artery, persistent Superficial Ulnar Artery (SUA), Arterial variation**INTRODUCTION**

Variations in the course, origin and branching pattern of the upper limb arterial system are well documented in the literature [1-8]. Arterial system of the upper limb starts with the axillary artery, which is a direct continuation of the subclavian artery, the axillary artery extends in the arm as brachial artery which usually terminates at the level of the radial neck in the cubital fossa and divides into radial and ulnar artery [2]. Superficial Ulnar Artery [SUA] is well known but a rare variation in the upper limb arterial system, which arises from the brachial or axillary artery and runs superficial to the muscles originates from the medial epicondyle of humerus [10-12]. Bianchi [1943] reported that the SUA may originate from the axillary artery [usually known as superficial brachio-ulnar artery], or often from the brachial artery in the arm or cubital fossa, or rarely from superficial brachial artery which continues as the radial artery [3,6,13-20]. SUA is documented by different researchers around the world with the incidence between 0.7% to 9.38% and the clinical anatomist and surgeons are aware of this [3,6,21-23]. It runs deep or superficial to the bicipital aponeurosis and then runs superficial or deep to the deep fascia which covers the forearm flexor muscles. The course of this SUA is sometime

altered by the Palmaris longus muscle, when this muscle is present the SUA lies deep to it [15].

Though the accidental injury to artery by intra-arterial injection is rare, this faulty trauma to the vessel may end in amputation of the forearm and fingers [24]. Clinically, in the reconstruction surgery using free forearm flap on the radial artery, if the SUA is present there may be a risk of ligating or cutting it instead of the superficial vein which may cause circulatory disorder in the hand.

METHODOLOGY

During the routine educational dissection study for the practical demonstration of the medicine students in the year 2012, we found this unique variation in the left upper limb of a 60 year old male cadaver in the department of Anatomy, MIMSR medical college, Latur. The cadaver was examined and does not have any pathological lesion, traumatic lesions or surgical procedure in the axilla, arm, forearm and hand.

OBSERVATION

The dissection of the axilla, arm, forearm and the hand region was done as explained by the Romanes in the textbook of Cunningham's manual

of practical anatomy [27]. After dissection the arterial system of the upper limb is exposed and cleaned, the branching pattern and the course was then noted and reported in this study. An unusual branch of brachial artery, named by the previous researchers as superficial ulnar artery is reported and the entire course was exposed and photographed for the research documentation. The SUA arise 14.5cm proximal to the cubital fossa, descends down towards the medial epicondyle of humerus and reaches the forearm. Throughout its course in the forearm, it runs medially and reaches the hand by passing superficial to the flexor retinaculum. Finally it terminates into the superficial palmar arch in hand. Throughout its course this reported artery does not give any branches (Fig.1). Whereas the brachial artery proper [Normal] descends down to the cubital fossa and divides into radial and common interosseous artery in the fossa. The course of radial artery is normal. The common interosseous artery runs deep and divides into anterior and posterior interosseous artery. There were no anastomoses between the superficial ulnar artery and the brachial, radial or common interosseous arteries. The right upper limb shows the normal branching pattern as explained in the standard anatomical textbook [27-29].

Fig.1: Persistent Superficial Ulnar Artery

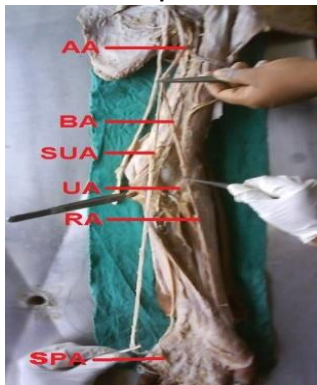


Fig. 2: Development of arteries of the upper limb [Explained by Singer-1933]

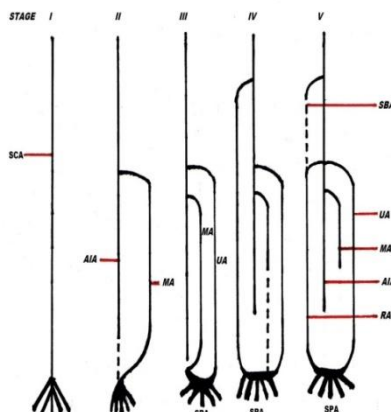


Fig.3: Development of upper limb arteries [Redraw from Poteat 1985]

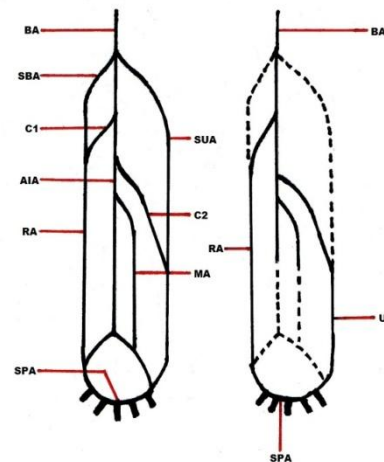
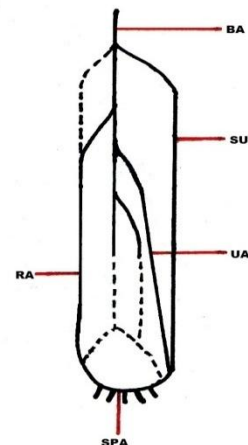


Fig.4: Persistent superficial ulnar artery [Poteat's theory]



DISCUSSION

Sound knowledge about the origin, course and the branching pattern is important for the clinicians as it is important for the clinical practice. Uglietta JP & Kadir S [1989] in their arteriographic study about the variations in the upper limb arterial system concluded the incidence of 11-24.4% of abnormal artery and its pattern in the upper limb of human [8]. In this, the previous research reports around the world recorded the incidence of superficial ulnar artery [SUA] is between 0.7% to 9.4% [Tab.1]. This variation is very common in Indians [15] whereas rare among Japanese [3]. This shows that the incidence of these variations may be due to the racial factors. Literature shows that these SUA may arise from the axillary artery and very often from the upper part of the brachial artery as explained in the present study. SUA can also originates from the inferior segment of the brachial artery [3,6,17]. In case of the high origin like the one explained in our study, Rodriguez-Niedenfuhr M et al [2001] and Nakatani

T et al [1996] reported that the SUA descends over the muscles arising from the medial epicondyle, passes deep to the deep fascia, but in our variation it was superficial throughout its course [10,18]. Though this variation is usually unilateral, few researchers documented bilateral presence of the SUA [30,31]. In bilateral report, it is often seen in females than males [10].

Table: 1. Incidence of the superficial ulnar artery

Author	Year	Limbs studied	Country	Incidence [%]
Adachi B [3]	1928	1198	Japan	0.7
Hazlett JW [17]	1949	542	Canada	2.7
McCormack LJ et al [6]	1953	750	USA	2.26
Fadel RA & Amonoo-Kuofi HS [16]	1996	72	Egypt & Saudi Arabia	2.8
Couloumna et al [21]	1934	144	France	3.4
Rodriguez-Baeza et al [7]	1995	150	Spain	5.3
Quain [23]	1844	422	Britain	6.8
Devansh D [15]	1996	32	India	9.38

Senior HD [1926] and Singer E [1933] proposed 5 stages in the model development of the upper limb arteries (Fig.2). According to this model, the axial system develops first and the other branches develop from this system later. In an adult, axillary artery, brachial artery and the anterior interosseous artery are included in this axial system. In stage 2, the median artery arises from the anterior interosseous artery and in stage 3, the ulnar artery originates from the brachial artery. In the stage 4, the superficial brachial artery develops from the axillary artery and continues down in the forearm as radial artery. Finally in the stage 5, the median artery regress and an anastomoses forms between the brachial artery and the superficial brachial artery, later the proximal segment of the superficial brachial artery regress and gives rise to the definitive radial artery [32&33]. Williams Peter in his text about the arteries of the upper limb stated that this temporal succession of emergence of principal arteries is the reason for the formation of anomalies in the forearm vasculature [12].

The research report of Rodriguez et al [2001] challenges this sprouting theory and their findings suggested that the branching pattern of the upper limb artery develops from an initial capillary plexus by the proximal and distal differentiation, either by maintenance, enlargement and differentiation of

certain capillary vessels or by the regression of other artery. Thus their study concluded that the embryology behind these variations in arterial system may be due to the modification of normal capillary by maintenance or regression [34]. Keen JA [1961] reported that the genetic factors also influences these variations besides other factors like position in uterus, first limb movement and abnormal muscle development [35].

Poteat WL [1986] modified the Singer's model of development and his theory proposed a switch of stage 2 and 3 by making the ulnar artery as the second one to originate in the arm. Thus the ulnar artery develops like the radial artery [a 'Superficial Ulnar Artery system' of high origin, which anastomoses with the deep artery before the proximal segment atrophies] (Fig.3). Poteat explains the presence of this SUA as the persistence of the embryological vessels due to a hemodynamic predominance of the superficial over deep arterial system at the origin of the ulnar artery. We can conclude our present research report with regard to Poteat's model of development as follows: the anastomotic connection between the brachial and superficial ulnar artery become the ulnar artery but the portion of the SUA proximal to this anatomical connection failed to disappear, persisted as the documented variation [Superficial Ulnar Artery – SUA] (Fig.4). Normally as well in this documented report, the radial artery develops due to the formation of the superficial brachial artery and the anastomosis between the superficial brachial and brachial artery and the disappearance of the proximal part of the superficial brachial a.

CLINICAL SIGNIFICANCE

Superficial ulnar artery is clinically important for the clinicians in their practice for both accurate diagnosis and effective management of therapy. Superficially present SUA like the one reported in this study has its advantage like more accessible for cannulation to administer the drugs but also has the disadvantage of more vulnerable to trauma or injury. Accidental injury to the superficial veins when administering intra-arterial injection to the patients may end in gangrene and in some cases even amputation [17,24]. SUA may produce a superficial pulse and by mistake it can cause a hazardous veinpuncture [17]. This can also make a route for accidental intra-arterial injection or ligature instead of vein in the upper limb especially in cubital fossa and forearm where it accompanies or crosses the subcutaneous veins [17,19,26]. Radiographically, this SUA may lead to a misinterpretation of incomplete angiographic picture [37]. During the brachial artery catheterisation, the presence of this artery can be a problem for

accurate catheterisation [38]. SUA especially the one which has the superficial orientation throughout its course like the present one is having more clinical significance for the surgeons when performing the free forearm flap. This SUA may be accidentally ligated during the elevation of radial forearm flap, leading to the interruption of the circulation in hand, though the Allen's test shows satisfactory circulation to the hand by the patent ulnar artery [25,26]. In contrary the presence of this abnormal SUA is beneficial to the surgeons as it can be used to irrigate the forearm flap [15]. If this SUA can be detected before this procedure, it can be used for easy and fast elevation of the forearm flap with intact neurosensory potential [15]. Clinical ignorance of this anatomic variation in the upper limb arterial system may cause severe circulatory disturbance in the hand [15,25,26,39].

CONCLUSION

Presence of the Superficial Ulnar Artery is a rare variation in the upper limb arterial system. But its occurrence is having much clinical significance. Thus a sound knowledge of this variation is clinically important for radiologist, orthopedician, plastic surgeon and clinical anatomist and prior detection of this anomaly will help them in planning any procedure in the upper limb. Similarly it is important for the Physicians, nurses and allied health professional during intravascular cannulation. We advise palpation of the pulse over the cannulation site before penetration of the needle into the skin as this may reduce the risk of damage to the artery which may lead to bleeding.

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