

Superficial ulnar artery – Case Report

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Abstract

Superficial ulnar artery is one among the rare variant form of ulnar artery. Ulnar artery, in its course, if it lies superficial over the flexor muscles of forearm it is known as superficial ulnar artery. The incidence of superficial ulnar artery given off by the axillary artery is estimated to be 0.7-2%. It is therefore considered as a rare occurrence. We report a unilateral case of high origin of superficial ulnar artery from the right axillary artery in a middle aged male cadaver. However such variation was not found on the opposite side. Accurate knowledge of these variation patterns is of considerable clinical importance in the conduct of reparative surgeries around the shoulder and fracture management of the humerus. These additional data of arterial anomalies to contemporary anatomical literature are of interest to clinicians, in particular vascular and plastic surgeons, orthopaedicians and radiologists. In addition knowledge of such variation is important for carrying out surgical procedure in the arm.

Keywords: axillary artery, brachial artery, radial artery, ulnar artery, superficial ulnar artery, arterial variations.

Introduction

Variations of the arterial patterns in the upper limb have been the subject of many anatomical studies due to their high incidence. Brachial artery is the main artery of the arm. It is a continuation of axillary artery at the lower border of teres major muscle. It usually terminates at the level of neck of radius in the cubital fossa by dividing into radial and ulnar arteries. Superficial ulnar artery is one among the rare variant form of ulnar artery. The overall incidence of superficial ulnar artery is reported to be 0.7% - 9.4%. We report a unilateral case of high origin of superficial ulnar artery from the axillary artery in a middle aged male cadaver. Knowledge of atypical superficial course of ulnar artery might be useful for cannulation but such a course is also prone to injuries leading to bleeding and ischemia. Therefore, it is important for radiologists, surgeons and phlebotomists to check for the persistence of superficial ulnar artery before performing any interventional procedures in the upper limb.

Case report

During routine dissection of the right upper limb for the undergraduate medical students we observed high origin of ulnar artery from the axillary artery in a middle aged male cadaver. It was superficial throughout its course. In the cubital fossa it was lying superficial to the bicipital aponeurosis. The brachial artery had normal course in the arm and within the cubital fossa it terminated by dividing into radial and common interosseous arteries at the level of neck of the radius. The superficial ulnar artery entered the palm by passing superficial to flexor retinaculum and terminated by dividing into superficial and deep palmar branches. Ulnar artery, in its course, if it lies superficial over the flexor muscles of forearm it is known as superficial ulnar artery. Superficial ulnar artery is one among the rare variant form of ulnar artery (Figure 1). The medical history of this male cadaver was not available. Following the dissection, the superficial ulnar artery was photographed. However such variation was not found in the opposite limb.

Discussion

The prevalence of anatomical variations involving major arteries of upper extremities reported to be 11-24%. Presence of unusual blood vessels may be due to the persistence of vessels that normally get obliterated during the process of development. Superficial ulnar artery frequently takes its origin from lower third of brachial artery but it is less frequent from the upper third. Very rarely it arises from middle third of brachial artery. The overall incidence of superficial ulnar artery is reported to be 0.7% - 9.4%. Very rarely superficial ulnar artery arises from the axillary artery and its occurrence is reported to be 0.7-2%. In the occurrence of superficial ulnar artery, the brachial artery commonly terminates as the radial and common

interosseous arteries. Hence, the adequate knowledge of these variations is important not only to anatomists, but also to radiologists, angiologists, orthopaedic and plastic surgeons (1).

Arterial variation in the upper limb was noted for the first time by von Haller in 1813. It is not uncommon to find variation in the branching pattern of arteries of the upper limb. The anomalies of various blood vessels of upper extremity can be explained on the basis of embryological development of the vascular plexus of limb buds. The early limb bud receives blood via inter segmental arteries, which contribute to a primitive capillary plexus. At the tip of the limb bud there is a terminal plexus that is constantly renewed in a distal direction as the limb grows. Later one main vessel supplies the limb and the terminal plexus; it is termed the axis artery. Arey and Jurjus mentioned six explanations for the variations in the blood vessels of upper limb:

1. The choice of unusual paths in the primitive vascular plexus.
2. The persistence of vessels which are normally obliterated.
3. The disappearance of vessels which are normally retained.
4. An incomplete development.
5. The fusion and absorption of parts which are normally distinct.
6. A combination of factors leading to an atypical pattern normally encountered (2).

Diversions from the typical anatomical arterial pattern of the upper limb are well documented and considered quite common, as they have an incidence of up to 20% in human adult limbs. Various authors have reported a total incidence of 0–9.38% for the superficial ulnar artery. Apart from the anatomical rarity of a superficial ulnar artery branching from the axillary artery, the persistence of such a vessel, which usually runs along and crosses over subcutaneous veins, is clinically important. A superficial ulnar artery may complicate intravenous drug administration with disastrous results, venopuncture in general and percutaneous brachial catheterisation. Owing to its course, it is more prone to injury, resulting in bleeding. Additionally, the artery may be mistaken for a vein and then for phlebitis, or near the distal end of the forearm it might be mistaken for a persistent median artery. Furthermore, the presence of a superficial ulnar artery complicates surgical procedures, such as the preparation of a free forearm flap with neurosensory potential and radial artery grafting for coronary bypass. Moreover, the superficial ulnar artery can cause misinterpretation of incomplete angiographic images and is clinically significant in arterial anastomosis performed for haemodialysis. The superficial ulnar artery may be diagnosed during routine and careful palpation of the antecubital fossa and forearm in clinical examination. Additionally, Doppler ultrasound provides a confident diagnosis of this anatomical variation. In view of this, knowledge of this variation is very important, not only to anatomists, but also to radiologists, angiologists and orthopaedic, plastic surgeons during their routine clinical practice.

The embryological interpretation of the development of a superficial ulnar artery is difficult, since neither anatomists nor embryologists have yet reached a unanimous conclusion. In humans three developmental theories have so far been proposed. The first suggested that the formation of the final and definite arterial pattern was the result of a remodelling of the complex primitive networks. According to the second, on the other hand, the sprouting theory, the arteries of the upper limb sprout from the axial artery. Another group, using three-dimensional reconstruction, studied the most representative stages in human embryos and proposed a third developmental theory. According to this, the arterial pattern of the upper extremity develops from an initial capillary plexus by a proximal-to-distal differentiation in the forearm with a posterior-anterior polarity, as a result of the maintenance, enlargement and differentiation of certain capillary vessels and the regression of others. Although the reasons for a modified arterial development have not yet been clarified, the presence of a superficial ulnar artery may be due to haemodynamic forces, chemical factors, foetal position in the uterus, first limb movements, and developmental arrest in the early stages and genetic predisposition (3).

A thorough knowledge of arteries of the upper extremity is necessary during vascular and reconstructive surgery and also in evaluation of angiographic images. Knowledge of origin, course and distribution of ulnar artery is important due to its clinical implications. Anatomic variations in the major arteries of the upper extremities have been reported in 11–24.4% of individuals. Presence of unusual blood vessels may be due to the persistence of vessels that normally get obliterated during the process of development. The overall

incidence of the superficial ulnar artery varies between 0.67% and 9.38% as reported in the various studies conducted throughout the world. The reported incidence of the superficial ulnar artery arising from the axillary artery varies between 0.7% and 2%. The bilateral presence of the superficial ulnar artery with a different origin on each side is even rarer. When the superficial ulnar artery is present, the brachial artery commonly terminates as the radial and common interosseous arteries. A superficial ulnar artery may complicate intravenous drug administration, venepuncture, and percutaneous brachial catheterization. Knowledge of this variation is very important to radiologists, orthopaedic & plastic surgeons for appropriately planning the operative procedures

In anomalous cases of a superficial ulnar artery, sometimes, the ulnar artery descends superficial to the forearm flexor muscles and reaches the wrist lateral to the ulnar nerve. Along with the radial artery, it supplies the structures in the forearm and hand, as well as the elbow and wrist joints. Although, variations of the upper limb arterial pattern are common, the presence of an ulnar artery of high origin is considered a rare anatomical variation with clinical significance. Its clinical importance should not be underestimated as several cases of intra-arterial injection of drugs and subsequent amputations have been reported. Developmentally, the upper limb bud is initially supplied by a vascular plexus derived from four or five consecutive intersegmental branches of the dorsal aorta. Very early in development, the seventh cervical intersegmental branch enlarges and becomes consolidated as the main artery (axis artery) to the developing upper limb bud. This axis artery gives rise to the subclavian, axillary, brachial, and interosseous arteries and to the deep palmar arch. Other arteries of the upper limb develop as sprouts of the axis artery. The developmental reason for the superficial ulnar artery in the present case may be due to the ulnar artery establishing a connection with the axis artery in the arm and the bifurcation of the brachial artery into the radial artery and common interosseous artery may be due to the posterior interosseous artery arising from the axis artery just distal to the connection of the radial artery with the axis artery in the cubital fossa region and the continuation of the main trunk (axis artery) between the radial and posterior interosseous arteries being the common interosseous artery. The reason for the variant superficial palmar arch may be due to the radial artery not linking up with the superficial palmar plexus in embryonic life. Knowledge of this variation is important, not only for surgeons but also for other medical and nursing staff because they commonly perform intravascular cannulations.

Anomalous blood vessels may be due to anomalies during the formation of blood vessels in any part of the body. According to Compendium of Human Anatomic Variation, major variations are present in about 25% of the subjects studied for the brachial artery. The variations in the form of high proximal division into terminal branches occur in the radial artery (15%), ulnar artery (2%) and common interosseous artery. This high division may occur at any point in the normal course of the vessel, but it is more common in the middle third. Anomalies of the forelimb arterial tree are fairly common. This is mainly because of their multiple and plexiform sources, the temporal succession of emergence of principal arteries, anastomoses and periarticular networks and functional dominance followed by regression of some paths. The early limb bud receives blood via inter segmental arteries, which contribute to a primitive capillary plexus. At the tip of the limb bud there is a terminal plexus that is constantly renewed in a distal direction as the limb grows. Later one main vessel supplies the limb and the terminal plexus; it is termed the axis artery. The aforesaid terminal plexus at the tip of the limb bud is separated from the outer ectodermal sleeve of the limb by an avascular zone of mesenchyme. This avascular region contains an extracellular matrix consisting largely of hyaluronic acid. Removal of this hyaluronic acid by hyaluronidase results in vascularization of the tissue since partial degradation products of hyaluronic acid are angiogenic. Thus ectodermal-mesenchymal interactions and extracellular matrix components are controlling the initial patterning of blood vessels within the limb. In the upper limb bud the axis artery is derived from the lateral branch of the seventh inter segmental artery (subclavian). The arterial trunk grows outwards along the ventral axial line and terminates in the deep plexus in the developing hand. Proximal part of the main trunk forms the axillary and brachial artery and its distal part persists as the anterior interosseous artery and the deep palmar arch. The radial and ulnar arteries are the latest arteries to appear in the forearm from the axis artery (brachial). Initially the radial artery arises more proximally than the ulnar artery. Later, it establishes a new connection with the main trunk at or near the level of origin of the ulnar artery and the upper portion of its original stem usually disappears to a large extent more proximally from the brachial artery leading to the formation of an unusually short segment and

slightly narrow brachial artery which bifurcated into radial and ulnar arteries at a more proximal level near the middle of the arm. It is pertinent to mention here that the normal vascular development including the patterning of the blood vessels is influenced greatly by local hemodynamic factors. Altered hemodynamic environment may give rise to variant patterning of blood vessels. Knowledge of this variation is important for the clinicians in day to day practice for measurement of blood pressure using sphygmomanometer cuff in the arm.

Variations in upper limb arteries are fairly common and have been reported by several authors. Majority of these variations occur in radial artery followed by ulnar artery. Brachial artery variations are less common. Though some cases of anomalous divisions of brachial artery in cubital fossa have been described but mid-arm variations in brachial artery are relatively of rare occurrence. Every anomaly in the peripheral vascular anatomy can be related to genesis, regression or persistence of one or other segment of the embryologic axial artery. The type of anomaly presented in this case is due to persistence of radial artery in the arm and failure of formation of communication between radial and axial arteries in cubital fossa. The superficial course of radial artery in upper part of forearm can be explained on the basis of haemodynamic mechanism between deep and superficial arteries in the forearm. Normally due to deep haemodynamic predominance, superficial terminal branches of radial artery undergo developmental arrest and deep part persists as normal radial artery. The superficial radial artery in right upper limb as seen in this case appears to be due to chance variations in haemodynamic factors which leads to regression of deeper vessels and persistence of one of the superficial terminal branches of radial artery.

The patterning of normal development of the skeleton, connective tissue and vessels of the upper limb in an embryo depend on normal expression of Shh, HoxD9-13, FGF10, Gli 3, Msx1, Nmyc and Slug. So the arterial pattern of the upper limb might have been controlled by these genes. So variations in arterial pattern of the upper limb could be caused by mutation or abnormal expression of these genes.

Conclusion

Arterial variations in the arm are of potential clinical implications as it is a frequent site of injury and also involved in many surgical and invasive procedures. Knowledge of atypical superficial course of ulnar artery might be useful for cannulation but such a course is also prone to injuries leading to bleeding and ischemia. Therefore, it is important for radiologists, surgeons and phlebotomists to check for the persistence of superficial ulnar artery before performing any interventional procedures in the upper limb, so that the detailed information about the arterial variations of this region will ensure competency and removing deficiency and ambiguity during diagnostic interventions and surgical procedures.

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Figure 1: High origin of ulnar artery (superficial ulnar artery)

- a. Axillary artery
- b. Brachial artery
- c. Superficial ulnar artery



Figure 1: High origin of ulnar artery (superficial ulnar artery)

