

Superficial Radial Artery – A Case Report

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Abstract

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. Variations in the vascular system of upper limbs are relatively common, and occur at the level of the axillary, brachial, radial, and ulnar arteries as well as in the palmar arches. During a dissection of the right upper extremity, an abnormal high origin of the radial artery was found. A high radial branch from the brachial artery was found in a middle aged male during routine dissection course. The brachial artery and its branches were dissected carefully and the anomaly was documented with a photograph. Usually the axillary artery continues as brachial artery beyond the lower margin of teres major muscle and the brachial artery terminates in the cubital fossa by dividing into the ulnar and the radial arteries. 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. This high origin of radial artery and the abnormal course of the radial artery is of interest to clinicians; in particular vascular and plastic surgeons and radiologists.

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

Introduction

The brachial artery is a continuation of the axillary artery, beyond the distal border of the teres major muscle. It ends about a centimetre distal to the elbow joint at the level of neck of radius, by dividing into lateral radial artery and medial ulnar artery. In the upper part of the forearm, the radial artery lies under the cover of the brachioradialis muscle and in the lower part it becomes superficial under the cover of the skin and fascia. Brachial artery is used in routine procedures like, blood pressure recordings and arteriography of different parts of body. Distal part of brachial artery is chosen for pulsed Doppler sonography measurements. According to Compendium of Human Anatomic Variation, major variations are present in about 25% of the subjects studied for the brachial artery. Frequently the artery divides more proximally into radial, ulnar and common interosseous arteries. Most often radial arises more proximally, leaving a common trunk for ulnar and common interosseous. Variation in the branching pattern of brachial artery is noteworthy for vascular surgeons particularly in cases involving traumatic injuries. Radiologists also must be aware of these kinds of variations during various imaging studies. These variant configurations of arteries are very important for diagnosis and treatment of diseases of the upper limb, challenging the surgeons for surgical interventions and radiologists to interpret normal and contrast radiographs pertaining to these vessels. The superficial arteries of the upper extremity can be mistaken for veins, potentially leading to intraarterial injections instead of the intended intravenous injections causing injury to the artery (1,2).

Case report

During routine dissection of the right upper extremity, in a middle aged male cadaver, an abnormal high origin of the radial artery was found in the middle third of the arm. However, the ulnar and common interosseous arteries were given off by the brachial artery in the cubital fossa about a centimeter distal to elbow joint at the level of neck of the radius. From its origin from the brachial artery in the middle third of the arm the superficial radial artery followed the brachial artery and median nerve to enter the cubital fossa, where it gave the radial recurrent branch. In upper part of forearm, it ran along medial margin of brachioradialis muscle in the superficial plane lying on the structures forming the radial bed. In lower part of forearm and beyond that it had the same course as is normally seen. The superficial radial artery was cleaned and photographed. However, such anomaly was not found in the opposite limb.

Discussion

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. Thus any of the factors affecting during development of limb vessels will lead to anomalies in the level of division of major arteries. These variations are having practical importance for the radiologists, cardiologists and orthopaedic and vascular surgeons (2).

Variations in the vascular system of upper limbs are relatively common, with considerable significance towards the clinical and surgical point of view. Variation of arteries of upper limbs can be found along the axillary, brachial, radial, ulnar arteries or superficial palmar arch in the hand. Among these variations, the most common is high origin of the radial artery from either the axillary or brachial arteries. The term brachioradial artery is used to describe the case when the radial artery takes up a high origin either from the axillary, upper, middle, or lower thirds of the brachial artery. Such anomalous blood vessels may be due to the choice of unusual paths in the primitive vascular plexuses, the persistence of vessels that normally obliterates the disappearance of vessels normally retained, incomplete development and fusions, or absorptions of the parts usually distinct. Knowledge of the significance of both normal and variant anatomies of the artery is a must for accurate diagnosis and treatment (3).

Anomalies of the forelimb arterial tree are fairly common. The unusually short segment brachial artery with its high up division into radial and ulnar arteries can be explained in the light of embryological development. 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. 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. Diagnostically this type of variation may disturb the evaluation of angiographic images. Further knowledge of such variation has got clinical importance especially in the field of orthopaedic, plastic and vascular surgeries. Last but not the least, 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 (4).

Variations in arterial patterns of upper limb in adult human body have been frequently observed either in routine dissections or in clinical practice. Embryologically 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 (5).

Variations in the vascular patterns are usually the result of developmental anomaly during the formation of blood vessels in any part of the body. The incidence of superficial radial artery is most frequent variation and is observed to be 14.26% in cadaveric studies and 9.75% in angiographic studies. This variation may cause difficulties while measuring the blood pressure and it may disturb the evaluation of angiographic images. Interventionally accidental puncture of superficially placed arteries may occur while attempting the venepuncture. It is prone for injury during limb surgeries (6).

Anomalous origin of radial artery is often encountered in the general population and usually presents no problem in angiography conduction. Failures could be the result of a relative small artery size promoting spasm after catheter manipulation. Immediate recognition of this pattern and prophylactic injection of vasodilators into the brachial artery, have the potential of becoming a promising every day routine practice in transradial coronary angiography procedures (7).

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. The RA branches from the axis artery at the 17- 18 stage. Once the radial artery is established, the median and interosseous arteries regress. So variations in arterial pattern of the upper limb could be caused by mutation or abnormal expression of these genes. Simultaneous occurrence of variations in the origin and course of superficial radial artery along with origination of recurrent radial artery from brachial artery are clinically significant for diagnostic, interventional and surgical procedures as described in clinical significance section. Thus knowledge of the variations of the radial artery is of paramount importance to vascular surgeons, radiologists and anatomists (1).

Variations in the vascular patterns are usually the result of developmental anomaly during the formation of blood vessels in any respective part of the body. The earliest studies of variations in the arterial system have been given by Senior and Singer. According to Singer the adult pattern of arterial system develops from the axial artery, which arises from the 7th cervical intersegmental artery which gradually gives rise to other branches supplying the upper limb. The proximal portion of axial artery above the level of teres major forms the axillary artery and beyond its level continues as brachial artery. Distally, in the cubital fossa it continues as interosseous artery. The radial and ulnar artery arises late in the development and gets established; subsequently interosseous artery reduces in size and becomes a branch of ulnar artery. The incidence of superficial radial artery is most frequent variation and is observed to be 14.26% in cadaveric studies and 9.75% in angiographic studies (8).

The axis artery of upper limb-bud is derived from the lateral branch of seventh intersegmental artery (subclavian). Proximal part of main trunk forms an axillary continuing as brachial artery and its distal part persists as the anterior interosseous artery. The radial and ulnar arteries are last arteries to appear in the forearm; at first, the radial artery arises more proximally than the ulnar artery from the main trunk and crosses in front of the median nerve. Later, the radial artery establishes a new connection with the main trunk at or near the level of origin of the ulnar artery. The upper portion of its original stem usually disappears to a large extent. Thus radial and ulnar arteries arise at same level. In this case, the proximal origin of radial artery fails to disappear, and the radial artery does not establish new connection with main trunk near the origin of ulnar artery. Thus the radial artery originates at a higher level and main artery of the limb continues as ulnar artery. The clinical application of superficial radial artery include:

- a) This variation may cause difficulties while measuring the blood pressure.
- b) Diagnostically it may disturb the evaluation of angiographic images.
- c) Interventionally accidental puncture of superficially placed arteries may occur while attempting the venepuncture.

d) It is prone for damage during orthopedic and plastic surgeries.

When aberrant arteries are present it may be mistaken for a vein or in case of injury may cause severe bleeding. Hence, the anomalies in origin and course of principal arteries have practical importance for orthopedicians, radiologists and vascular surgeons (9).

The radially artery is clinically very important. Radial artery can be used as an arterial or pedical graft in the arm reconstructive surgeries. So care has to be taken while performing surgeries. Radial artery is used in harvesting by-pass-graft in case of coronary arterial vasospasm. As well as being important in surgical approaches arterial variations could pose problems in positioning the catheter in angiographic approaches during arterial grafting or while evaluating angiographic images. Radial artery cannulation may be related to a high risk of tissue gangrene or amputation. But in the absence of normal radial artery the superficial can be mistaken for a vein and accidental injection of certain drugs in this artery may cause reflex vascular occlusion resulting in disastrous gangrene of hand. When the superficial radial artery is present it has clinical significance not only in surgical approaches but also because of its relationship to the median nerve. Median nerve compression caused by the artery could be easily be confused with more common causes such as radiculopathy and neuropathies (10).

Striking anatomical variations in the origin and course of major arteries of the upper limb have always been of interest among anatomists, hand surgeons and radiologists. The high origin of the radial artery is the most frequent anomaly in the arterial pattern of upper limb of human beings (incidence of 14.27% in dissected material), whereas a superficial ulnar artery has been reported in 2% of cases. Accurate and detailed knowledge of the relationships and possible anatomical variations of the arterial branching pattern of the upper extremity is vital during reparative surgery in this region. In addition, trauma in this area may lead to a life threatening haemorrhage from these aberrant vessels. Inadequate knowledge of the anatomical variations of the arterial pattern may render surgery difficult (11).

Conclusion

Any factors affecting during development of limb vessels will lead to anomalies in the level of division of major arteries. Hence, knowledge of these variations has got clinical importance in the field of orthopaedic, vascular re-constructive surgeries and also helpful in evaluation of angiographic studies. Superficial course of ulnar and radial artery makes it more vulnerable to traumatic injuries and more accessible to catheterization. Immediate recognition of this pattern and prophylactic injection of vasodilators into the brachial artery, have the potential of becoming a promising every day routine practice in transradial coronary angiography procedures.

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Figure 1: Superficial radial artery

1. Deltoid muscle
2. Brachial artery
3. Superficial radial artery
4. Biceps brachii
5. Bicipital aponeurosis
6. Radial recurrent artery
7. Superficial radial artery
8. Medial nerve

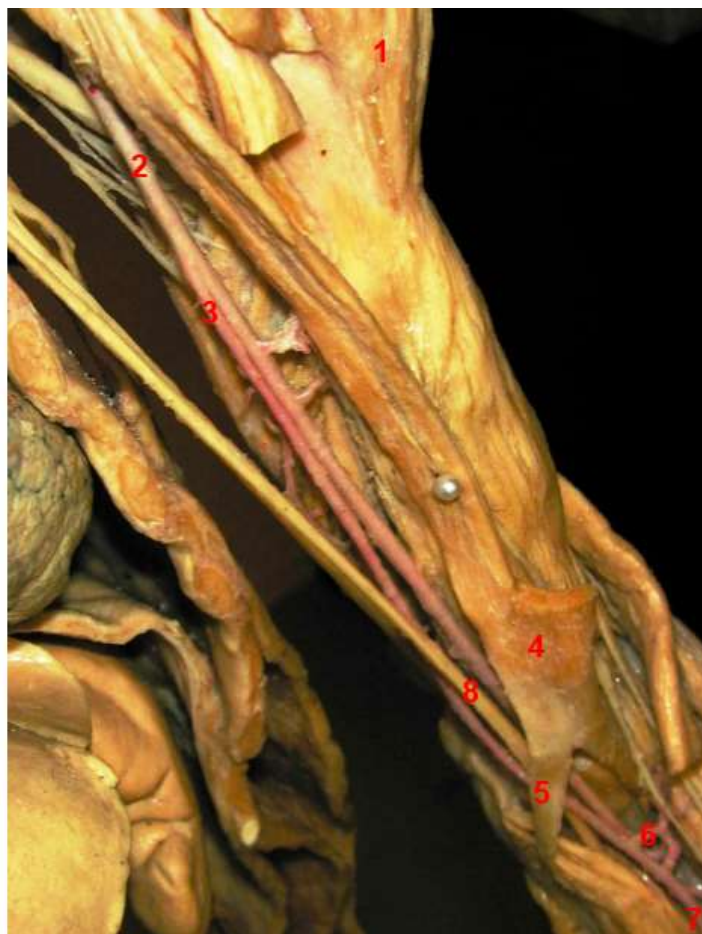


Figure 1: Superficial radial artery

