SUPERFICIAL RADIAL ARTERY: CASE REPORT USING MDCT ANGIOGRAPHY

Summary:
According to data from the literature the variations in the arterial anatomy of the upper extremities occur in up to one in five patients, and the variability of the arteries in the arm is reported to one in four patients. The prevalence of the superficial radial artery with origin at the level of brachial artery is one of the rare anatomical variation in this group. In this study, the authors describe a rare case of a 78-year-old female with the presence of the right superficial radial artery originating from brachial artery to 28.2 mm below the origin of profunda brachii artery and 57.5 mm below the origin of the common trunk of origin of circumflex humeral arteries. The brachial artery bifurcates into anterior and posterior interosseous arteries. In the lower part of the forearm the anterior interosseous artery borrows the ulnar artery path, but stops above the Guyon canal, and does not participate to achieve the arterial palmar arches. In the formation of the arterial palmar arches participates only the superficial radial artery. These aspects are particularly important in planning the surgical and microsurgical procedures in the arm and forearm.

Keywords:
upper limb, arteries, variations, radial superficial artery, brachial artery, anterior interosseous artery, posterio interosseous artery.

Rezumat:
Conform datelor din literaturã, variaþiile anatomice arteriale ale memrelor superioare apar cu o frecvenþã de pânã la unul din cinci pacienþi, iar variabilitatea arterelor braþului este raportatã la unul din patru pacienþi. Prevaþenþa arterei radiale superficiale cu originea la nivelul arterei brahalale este una dintre variaþiile anatomice rare în acest grup. În acest studiu, autorii descriu un caz rar la o femeie de 78 de ani, cu prezenþã arterei radiale superficiale drepte care provine din artera brahalã la 28,2 mm sub originea arterei brahalã profunde și 57.5 mm sub originea trunchiului comun de origine a arterelor circumflexe humerale. Arteria brahalã se bifurcã în arterele interosose anterioarã ºi posterioarã. În partea inferioarã a antebraþului, artera interosoaºa anterioarã împreunã traiectul arterei ulnare, dar se opreºte superior de nivelul canalului lui Guyon, ºi nu participã la realizarea arcadelor arteriale palmarã. La formarea arcurilor arteriale palmarã participã numai artera radialã superficialeº. Aceste aspecte sunt deosebit de importante în planificarea procedurilor chirurgicale ºi microchirurgicale la nivelul braþului ºi antebraþului.

Cuvinte cheie:
membru superior, artere, variaþii, artera radialã superficialã, artera brahalã, artera interosoaºa anterioarã, artera interosoaºa posterioarã.

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INTRODUCTION

The variations in the arterial anatomy of the upper extremities occur in up to one in five patients [1], and the variability of the arteries in the arm is reported to one in four patients [2]. Individual variations in the branching pattern of the arteries in the arm are an important in practical viewpoints because a large number of vascular invasive and non-invasive imaging and surgical procedures, are performed in the upper limb [1, 3, 4]. Some of the first presentations of variations in the branching pattern of the arteries in the arm were those of Laurentius in 1600 [quoted by [5]], Quain [6], Krause [7], Bayer [8], Mler [9] and Adachi [10].

According to Loukas et al. [11], the radial artery, though smaller than the ulnar artery, is the direct continuation of the brachial artery that descends along the lateral aspect of the forearm to the wrist where it is palpable between the flexor carpi radialis medially and the distal end of the radius, pass through the first interosseous space and participate to the formation of the palmar arches. There are few anatomical variations of the origin of the radial artery described in the anatomical and surgical literature. A small number of anatomic variations of the radial artery origin have been described in anatomical and surgical literature: axillary origin [12, 13], thoracoacromial trunk origin [11], brachial origin of the radial artery [14, 15] and absent radial artery with codominant median and ulnar arteries [16].

The radial artery, having a “high origin” over the intercondylar line, is called: brachioradial artery [17], superficial brachioradial artery [13, 18, 19] and superficial radial artery [21]. In this paper we use the term superficial radial artery, specifying also the brachial origin. Compared with the prevalence of the superficial ulnar artery of 0.7–9.4% in the population [22], the superficial radial artery with origin at the level of brachial artery is only 0.2% [23].

Here, we report an extremely rare variant of the superficial radial artery arising from the brachial artery in the upper one third of the arm, highlighted by MDCT angiography.

CASE REPORT

We report a 78-year-old female who presented to the Neuromed Diagnostic Imaging Centre with peripheral vascular disease of the upper right limb. Using MDCT angiography (64-slice MDCT system; SOMATOM Sensation, Siemens Medical Solutions, Forchheim, Germany), the patient was found to have a superficial radial artery with brachial origin. The reconstructed image datasets were transferred to Syngo MultiModality Workplace, Siemens Medical Solutions offline workstation for post-processing. Peculiarities of the branching pattern of the upper limb arterial tree were analyzed as 3D volume-rendering technique (VRT) reconstructions, and 3D maximum-intensity projection (MIP) reconstructions.

VRT and MIP examinations clearly highlight the upper right limb arterial tree, from axillary fossa to radiocarpian level. The anterior and posterior humeral circumflex arteries form a common trunk of origin. Profunda brachii artery originates from brachial artery to 29.3 mm below the origin of the common trunk of origin of circumflex humeral arteries. The superficial radial artery originates from brachial artery to 28.2 mm below the origin of profunda brachii artery and 57.5 mm below the origin of the common trunk of origin of circumflex humeral arteries.

With a total length of 445 mm, from the brachial origin to the point of passing the first intermetacarpian space, the superficial radial artery is the only source that forms the arterial palmar arches (superficial and deep). Brachial artery has a total length of 231.5 mm. Spacing to 44 mm below the elbow joint interline, the brachial artery bifurcates into anterior and posterior interosseous arteries. To 15.5 mm below the elbow joint interline from superficial radial artery arises the radial recurrent artery. To 23.7 mm below same interline from brachial artery arises the ulnar recurrent artery. In the proximal portion (at the level of origin of the common trunk of circumflex humeral arteries) the brachial artery has an endoluminal diameter of 4.5 mm. In the middle part (at the level of origin of the superficial radial artery) the brachial artery has an endoluminal diameter of 3.9 mm. The superficial radial artery has at origin an endoluminal diameter of 2.2 mm. In the lower part of the forearm the anterior interosseous artery borrows the ulnar artery path, but stops above the Guyon canal, and does not participate to achieve the arterial palmar arches.

DISCUSSIONS

The definitive arterial pattern of the upper limb results from the remodelling of the complex primitive networks. In humans embryo the arteries as originating from an initial capillary network associated with each of the principal nerves of the brachial plexus. Earlier study of Mler [9] considered that the arterial network of the upper limb were formed by the union of superficial and deep pathways. In opposition with this theory, the study of
Singer [25] suggested that the arterial network of the upper limb arise from a single axial channel which represents the brachial and interosseous arteries. The developmental study of Rodriguez-Neidenf et al. [21] clearly show that the development of upper limb arterial system occurs between stages 12 and 21 of embryonic development. In the first part of this period (stages 12-17) to produce slow development of the dispersed capillary network within the undifferentiated mesenchymal tissue. In the second part of this period (stages 18-21) produce the individualization and building of the main arterial trunks of the upper limb (brachial, radial, ulnar and interosseous arteries). Variations in the branching pattern of these major arterial trunks of the upper limb is derived from early development of the primitive arterial network. In our case, this superficial radial artery originating from the proximal portion of the arm, may be due to in persistent side of the superficial radial arterial network (according to theory M ler [9]).

In our case the superficial radial artery originates on the medial aspect of the brachial artery (in his proximal part), in the brachial channel. In the middle portion of the arm, the superficial radial artery crosses anterior the brachial artery, is placed above the brachioradial muscle and then placed in “the trench pulse”. In this case, superficial radial artery is the only arterial trunk from the lateral board side of the forearm, not accompanied by proper radial artery.

The superficial position of the radial artery originated from axilar or brachial artery makes it more vulnerable to trauma and of thus haemorrhages. Early report of Morris et al. [26], highlights the unfortunate possibility for inadvertent intraarterial drug administration owing to its proximity to the cephalic vein. It is well known use distal radial artery in achieving of native arteriovenous fistula for hemodialysis in end-stage renal disease patients. Weyde et al. [27], reveal that the presence of radial artery variations (exemple – the presence of superficial radial artery) not restrict the successful creation of hemodialysis forearm arteriovenous fistula.

Alameddine et al. [28] reveal that the radial artery has gained wide acceptance as a useful vascular conduit for coronary artery bypass grafting with a very good midterm patency rate. The presence of the anatomic variations of the radial artery may complicate or contraindicate the use of superficial radial artery in this type of surgical procedure. In this case, this type of surgery is contraindicated because the superficial radial artery is the only source of blood supplying the arterial palmar arches; while the interosseous arteries do not participate at the vasculature of the hand.

**Fig.1.** MDCT angiography of the upper right limb with the presence of superficial radial artery with origin in the proximal portion of the brachial artery. A - 3D volume-rendering technique (VRT) reconstructionos after subtraction of the osteo-articular structures of the arm, elbow and forearm; B - 3D maximum-intensity projection (MIP) reconstructions. Anterior aspect.

The radial forearm fasciocutaneous free flap [29] and reverse radial artery fascial flap [30, 31], are methods commonly used in plastic and reconstructive surgery, in soft tissue defects in coating medium size and various locations. Use as arterial pedicle for these flaps of the superficial radial artery and not complicating the development and the evolution of these flaps, provide the ulnar artery to be present and to have a normal distribution. In this case, use the superficial radial artery as pedicle, would lead to a significant decrease of vascularization of the hand, and the method should be contraindicated.

CONCLUSIONS

Occurrence of the superficial radial artery is a rare variation, but has great meaning from clinically point of view. The knowledge of this variation is important for plastic and reconstructive surgeons, but also for other medical specialties. Making preoperative MDCT angiography examination, eliminate the risk of major surgery in the presence of the superficial radial artery, which could lead to deprivation distal vasculature of the forearm and hand.

References: