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Case Report

Rare constellation of unilateral superficial ulnar artery, variant common interosseous artery, and unilateral agenesis of palmaris longus

Prabhjot Singh[1], Hare Krishna[2], Kumar Sambhav[1], Surajit Ghatak[2]

1 *All India Institute of Medical Sciences Bilaspur, Bilaspur, India*
2 *All India Institute of Medical Sciences, Jodhpur, Rajasthan, India*

Corresponding author: Hare Krishna, All India Institute of Medical Sciences Jodhpur, Rajasthan, India; Email: hareskmch@gmail.com

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Abstract

Arterial pattern variations of the upper limb are not uncommon. During a routine dissection of an 85-year-old male cadaver, we observed a rare constellation of a unilateral superficial ulnar artery (SUA) arising from the distal brachial artery and a low common interosseous artery (CIA) arising from the radial artery (RA) combined with the unilateral agenesis of palmaris longus (PL) in the right upper limb. The combined presence of SUA, variant CIA, and absent PL in one upper limb has not yet been reported. Such arterial variations can complicate surgeries and interventions. SUA is prone to misinterpretation as a vein, accidental cannulation, and inadvertent intraarterial drug injections leading to gangrene and loss of limb. Meticulous care of the SUA is warranted during reconstructive free forearm flap surgeries involving RA. However, the unilateral absence of PL does not result in any significant functional loss. This rare constellation should assist clinicians in reconstructive and diagnostic procedures.

Keywords

arterial variation, palmaris longus, radial artery, superficial ulnar artery

Introduction

The superficial ulnar artery (SUA) is a rare branch that may arise from the axillary, brachial, or superficial brachial arteries and courses superficial to the flexor muscles of the forearm, with an incidence of 0.7 to 9.4%.[1,2] The common interosseous artery (CIA) usually originates high origin from the ulnar artery **(Fig. 1A)**.[3] Palmaris longus (PL) is a slender, fusiform muscle that commonly exhibits anatomical variations. The most frequent variation is the complete absence of palmaris longus, followed by reversed, duplicated, or hypertrophied heads.[4,5]

This report presents a rare combination of a unilateral SUA arising from the distal brachial artery, a low common interosseous artery originating from the radial artery, and unilateral agenesis of the palmaris longus, which has not been documented in the literature to date.

Case description

During a routine upper limb dissection at the All India Institute of Medical Sciences (AIIMS), Jodhpur, an 85-year-old male cadaver was found to have a unilateral absence of palmaris longus (PL), a unilateral superficial ulnar artery (SUA) with distal origin, and a low CIA in the right upper limb. The other flexor muscles of the forearm were present with normal origin, course, and insertion. There was no evidence of scars, stumps, or an earlier presence of PL, and no signs of graft procedures were noted.

The SUA was observed to originate from the brachial artery (BA) 2.3 cm distal from the horizontal line (HL) connecting the medial and lateral epicondyles (the landmark used for measurements) ***(Fig. 1A, B)****. At a distance of 1.2 cm distal from the site of origin of SUA, i.e., 3.5 cm from the HL, CIA was observed to arise from RA relatively lower than its common origin* ***(Figs 1B, 2, 3)****. The SUA crossed the flexor carpi radialis from the lateral side to the medial side at 7.5 cm from the HL, coursing up to the wrist. Here, it passes superficially to the flexor retinaculum and immediately lateral to the ulnar nerve.*

RA was observed to give origin to CIA 3.5 cm from HL, which normally courses to divide into three branches, namely the anterior ulnar recurrent artery (AURA), the posterior interosseous artery (PIA), and the anterior interosseous artery (AIA) in proximal to distal order ***(Figs 1B, 4)****. The PIA pierced the interosseous membrane and coursed to the extensor compartment of the forearm. The AIA coursed along the interosseous membrane in the flexor compartment of the forearm. On the left forearm, the CIA was observed to take origin from the ulnar artery (UA) and was found to have a normal course and divisions.*

In this study, the anatomical quality assessment (AQUA) tool was used for the quality assessment of the case report ***(Table A1)****.*[6]

Discussion

This case report ascertains the unilateral presence of distal SUA and unilateral agenesis of PL with coexisting low CIA arising from the RA in the right upper limb.

The agenesis of PL could be sporadic or hereditary or be a part of dysmorphic syndrome, viz., Holt-Oram syndrome, Fyns syndrome, velocardiofacial syndrome, etc.[7] This can be explained by an abnormal embryological cleavage of the superficial layer of flexors, which could lead to the absence of PL, which could be influenced by gene modifications associated with muscle development.[8] During the development of upper limb muscles, the somatic cells of the paraxial mesoderm transform into muscle cells, which are regulated by positive and negative signals from surrounding tissue, essential for gene activation. These cells must be pre-committed to myogenic lineage through transcription factor PAX3.[9] Any disturbances in the myogenic regulatory transcription factor may lead to this type of variation.[10] As believed previously, the arteries have multiple plexiform sources wherein anomalies of forearm vasculature occur due to the temporal succession of the emergence of principal arteries, anastomoses, and periarticular networks, followed by the recession of initially functioning dominant paths.[11,12] Recently, another theory stated that the embryological basis can be attributed to normal capillary plexus differentiation, maintenance, and enlargement of capillary plexus coupled with regression of other vessels.[13] However, it has not been elucidated as to what factors influence differentiation, enlargement, and regression of vasculatu re.[13]

The CIA was also observed to have a relatively distal origin from the RA, 3.5 cm from HL. Whereas previous studies have reported a high origin of the CIA, usually arising from the UA. Few authors have reported the CIA originating from RA.[3]

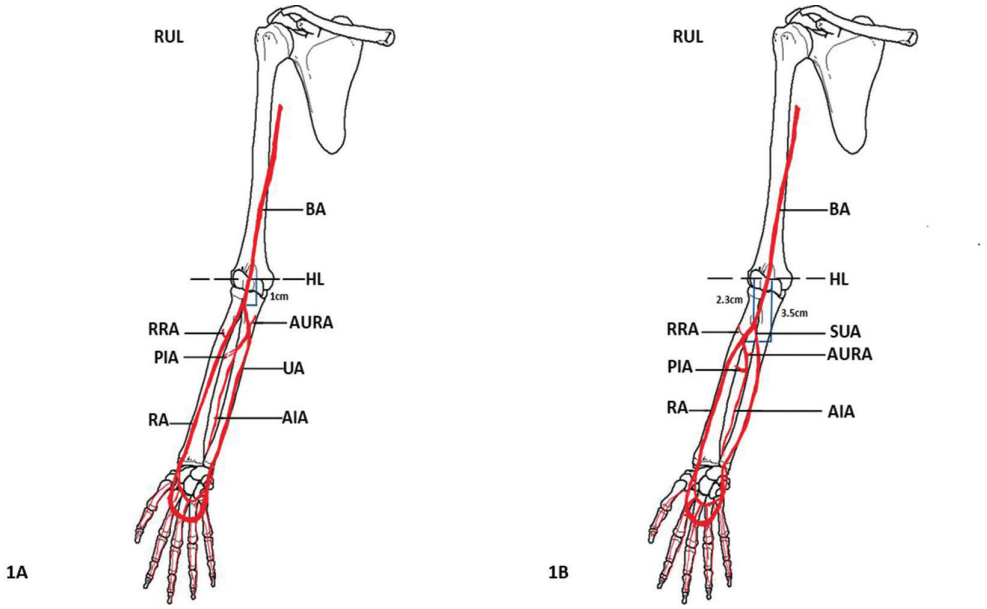

Figure 1A. Schematic representation of the normal arterial branching pattern of the right upper limb (RUL).
Figure 1B. Schematic representation of the variation observed in the case report. Unilateral superficial ulnar artery (SUA) originating 2.3 cm distal to a horizontal line (HL), low common interosseous artery (CIA) arising from radial artery (RA) 3.5 cm distal to HL, and branches of CIA in proximal to distal order, namely anterior ulnar recurrent artery (AURA), posterior interosseous artery (PIA), and anterior interosseous artery (AIA).

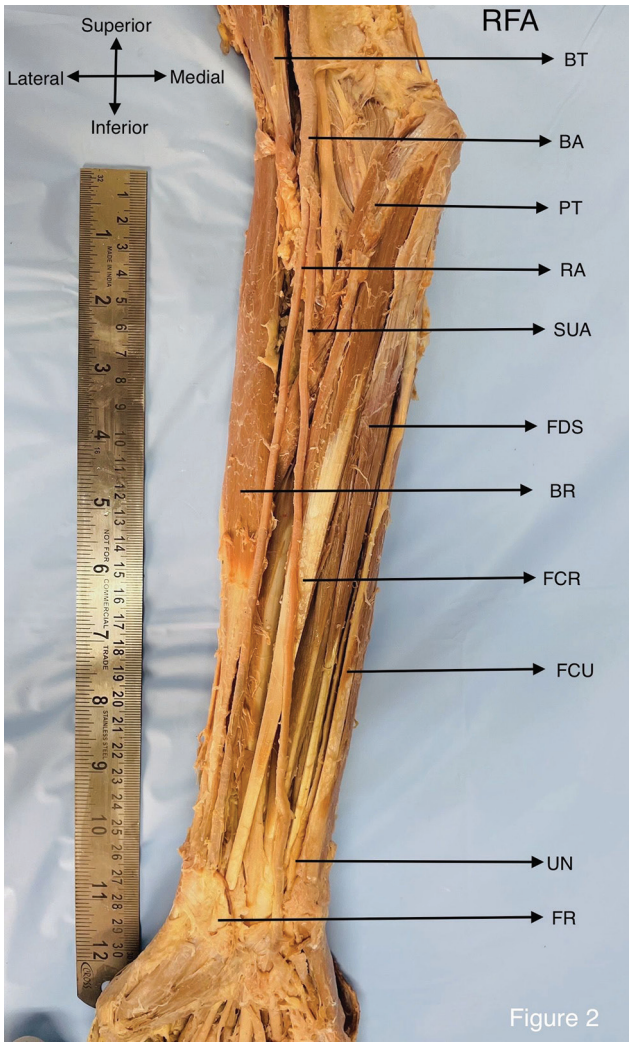

Figure 2. Right forearm depicting the presence of superficial ulnar artery along with the absence of palmaris longus. RFA: right forearm; BT: biceps tendon; BA: brachial artery; PT: pronator teres; RA: radial artery; SUA: superficial ulnar artery; FDS: flexor digitorum superficialis; BR: brachioradialis; FCR: flexor carpi radialis; FCU: flexor carpi ulnaris; UN: ulnar nerve; FR: flexor retinaculum.

Figure 3. Right forearm showing the presence of superficial ulnar artery and low common interosseous artery. RFA: right forearm; BA: brachial artery; MN: medial nerve; SUA: superficial ulnar artery; RRA: recurrent radial artery; CIA: common interosseous artery; RA: radial artery; PT: pronator teres; BR: brachioradialis; FCR: flexor carpi radialis.

An interesting concurrence has been observed between the variants of PL and arterial variants by various authors.[14-16] Yadav et al. concluded that the presence of SUA with unilateral absence of PL seems to be coherent with our finding.[15] But another study reported the presence of PL along with SUL.[16] The combined consequence of developmental arrest of the arterial system and limb development with genetic factors may have played a significant role in the variant of SUA and PL.[3]

Knowledge of this type of variation in the arteries of the upper limb is crucial to avoiding issues with the following methods and procedures:

1. Invasive Cardiology: SUA variations may cause complications during radial artery catheterization procedures. SUA could be confused for a vein during access, which could result in unintentional arterial cannulation or extravasation of contrast agents. When harvesting radial arteries for coronary artery bypass grafting, there may be an unintentional division of SUA.[2]

2. Vascular Surgery: Due to its aberrant location, the SUA is more likely to sustain an injury during upper limb surgeries like fasciotomy for compartment syndrome, which might result in bleeding.[1,2] Furthermore, knowledge of the variation in CIA origin is essential to prevent complications during reconstructive vascular procedures.

3. Vascular Access: Mistaken administration of drugs in SUA may lead to dreadful consequences such as gangrene and loss of limb.[1]

4. Arteriovenous (AV) fistula: Dartnell et al. observed the mean diameter of SUA was 6 mm; however, SUA instances were observed as wide as 8 mm.[2] Due to its superficial course and adequate diameter of SUA, it can potentially be used for the creation of AV fistulas in chronic renal failure patients for dialysis procedures.

5. Plastic and Reconstructive Surgery: SUA variations are very significant in free radial forearm flap procedures. A Doppler examination must be done to ensure the patency of the UA of the forearm before raising a free radial forearm flap. The forearm's blood supply will depend on the

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Figure 4. Right forearm depicting the bifurcation of the brachial artery into superficial ulnar artery and radial artery, 2.3 cm from the horizontal line between medial and lateral epicondyles and low common interosseous artery, arising 3.5 cm from the radial artery from the horizontal line. AURA originated from proximal CIA. RFA: right forearm; BA: brachial artery; BT: biceps tendon; MN: median nerve; SUA: superficial ulnar artery; AURA: anterior ulnar recurrent artery; RA: radial artery; CIA: common interosseous artery; PIA: posterior interosseous artery; AIA: anterior interosseous artery; PT: pronator teres; FCR: flexor carpi radialis; BR: brachioradialis; ME: medial epicondyle; LE: lateral epicondyle; * site of bifurcation of brachial artery.

UA after raising the flap with RA. Therefore, before undergoing such procedures, it is crucial to observe the course of UA. If PL is absent, it has also been proposed that one should search for SUA traps during the free radial forearm flap surgery.[15]

6. Emergency Medicine and Trauma Care: The superficial placement of SUA raises the risk of injury, which could result in vascular compromise or bleeding. Prompt detection and treatment of such abnormalities are essential to avert potentially fatal consequences.

7. Radiological Imaging and Diagnostics: Before upper limb procedures, these variations should be routinely evaluated utilizing contemporary imaging modalities, such as Doppler ultrasonography, computed tomography angiography (CTA), or magnetic resonance angiography (MRA).

Conclusion

Due to the significant clinical importance of SUA, CIA, and PL variations, clinicians need to look out for these anomalies to enhance patient safety and clinical outcomes. To support evidence-based procedures across several healthcare fields, this case emphasizes the necessity of continued anatomical research and documentation.

Ethics statement

The authors state that every effort was made to follow all local and international ethical guidelines and laws that pertain to the use of human cadaveric donors in anatomical research.

Author contributions

Prabhjot Singh: performed cadaveric dissection and conceived the idea, prepared manuscript; Hare Krishna: Supervised the study and interpretation of variations, wrote, edited and critical review of the manuscript; Kumar Sambhav: design of the study, preparation, and draft of the manuscript; Surajit Ghatak: critical review.

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Competing interests

The authors have declared that no competing interests exist.

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Table A1. List of domains with their signaling questions and risk of bias judgment as included in the revised version of the AQUA tool [6]

Domains and questions	Options		
	Yes	**No**	**Unclear**
Domain 1: OBJECTIVE(S) AND SUBJECT CHARACTERISTICS			
Was (Were) the objective(s) of the study clearly defined?	Yes		
Was (Were) the chosen subject sample(s) and sample size appropriate for the objective(s) of the study?	Yes		
Are the baseline and demographic characteristics of the subjects (age, sex, ethnicity, healthy or diseased, etc.) appropriate and clearly defined?	Yes		
Could the method of subject selection have in any way introduced bias into the study?		No	
	RISK: LOW		
Domain 2: STUDY DESIGN			
Does the study design appropriately address the research question(s)?	Yes		
Were the materials used in the study appropriate for the given objective(s) of the study?	Yes		
Were the methods used in the study appropriate for the given objective(s) of the study?	Yes		
Was the study design, including methods/techniques applied in the study, widely accepted or standard in the literature? If "no", are the novel features of the study design clearly described?	Yes		
Could the study design have in any way introduced bias into the study?		No	
	RISK: LOW		
Domain 3: METHODOLOGY CHARACTERIZATION			
Are the methods/techniques applied in the study described in enough detail for them to be reproduced?	Yes		
Was the specialty and the experience of the individual(s) performing each part of the study (such as cadaveric dissection or image assessment) clearly stated?	Yes		
Are all the materials and methods used in the study clearly described, including details of manufacturers, suppliers etc.?	Yes		
Were appropriate measures taken to reduce inter- and intra-observer variability?	Yes		
Do the images presented in the study indicate an accurate reflection of the methods/techniques (imaging, cadaveric, intraoperative, etc.) applied in the study?	Yes		
Could the characterization of methods have in any way introduced bias into the study?		No	
	RISK: LOW		
Domain 4: DESCRIPTIVE ANATOMY			
Were the anatomical definition(s) (normal anatomy, variations, classifications, etc.) clearly and accurately described?			
Were the outcomes and parameters assessed in the study (variation, length, diameter, etc.) appropriate and clearly defined?	Yes		
Were the figures (images, illustrations, diagrams, etc.) presented in the study clear and understandable?	Yes		
Were any ambiguous anatomical observations (i.e., those likely to be classified as "others") clearly described/depicted?	Yes		
Could the description of anatomy have in any way introduced bias into the study?		No	
	RISK: LOW		