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CASE REPORT AND PREVALENCE STUDY

High Bifurcation of the Brachial Artery and Superficial Ulnar Artery: A Case Report and Prevalence Study in a Donor Population

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Abstract

Objectives: To describe the prevalence of a high bifurcation of the brachial artery and a superficial ulnar artery in a donor population of 17 individuals, the rare occurrence of both variations in one of the 17 individuals, and to explore the clinical, surgical, and embryological significance of both types of anatomical variations.

Methods: During routine anatomical dissection of 17 formalin-fixed cadavers at Rocky Vista University College of Osteopathic Medicine-Southern Utah, 34 upper limbs were examined bilaterally for vascular anomalies. Standard dissection techniques were used to assess the origin, course, and branching of the brachial, radial, and ulnar arteries.

Results: A unilateral case was identified with a high bifurcation of the brachial artery occurring approximately 2.54 cm distal to the teres major muscle. The ulnar artery coursed superficially over the forearm flexor mass before rejoining its typical path. The common interosseous artery originated anomalously from the radial artery. This combined vascular variation was found in one of the 34 upper extremities (2.94%), while high bifurcation alone was present in four of the 34 upper extremities (11.7%). Embryological review suggests abnormal regression or persistence of axial arterial branches may contribute to such variations.

Conclusion: Although rare, recognition of a high bifurcation of the brachial artery with a superficial ulnar artery is critical for preventing complications during venipuncture, catheterization, and vascular surgery. This case underscores the importance of anatomical education and preoperative imaging when encountering vascular anomalies.

Key Words: *High bifurcation; Superficial ulnar artery; Brachial artery variation; Embryology; Upper limb anatomy; Vascular anomaly*

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Introduction

Perfusion of the upper extremity primarily originates from the axillary artery, with minor contributions from the subclavian artery to the shoulder. The axillary artery transitions into the brachial artery as it crosses the inferior border of the teres major muscles. The terminal branches of the brachial artery include the radial and ulnar arteries. These typically branch off the brachial artery within the distal cubital fossa. The ulnar artery provides blood flow to the forearm via the common interosseous artery (CIA) and subsequent anterior and posterior interosseous branches. The radial artery and ulnar artery continue into the hand to provide the terminal perfusion of the upper extremity as the deep and superficial palmar arterial arches [1].

Arterial variations have been described but are rarely taught in medical school education. Deviations from the typical perfusion patterns may result in medical complications due to a poor understanding of where critical patterns of blood flow exist. Superficial ulnar arteries and high branching origins of the ulnar artery have been well described as types of upper extremity arterial variations but cases of both occurring simultaneously are rare [2-4].

Superficial ulnar arteries are classified as branches of the brachial artery that course superficial to the common flexor tendon mass. Ulnar arteries of high origin are those that bifurcate from the brachial artery proximal to the cubital fossa. Superficial ulnar arteries occur in less than 10% of patients and ulnar arteries of high origin are one of the most common brachial artery anomalies [5]. The combination of both anomalies results in a presentation that is infrequently observed (3% of patients) [6].

The aim of this paper is to document a rare anatomical variation involving a high bifurcation of the brachial artery coupled with a superficial ulnar artery, and to discuss its embryological origins, clinical significance, and implications for surgical practice.

Case Presentation

During routine dissection of the right upper extremity of a male formalin fixed donor, we encountered a unilateral high bifurcation of the brachial artery that continued into an ulnar artery that was superficial to the flexor forearm (Figures 1-2). The ulnar artery split from the brachial artery approximately 2.54 cm distal to the teres major muscle and coursed alongside the medial brachium passing superficial to the cubital tunnel in close proximity to the ulnar nerve. The arterial course continued superficial to the common flexor tendon before reentering the flexor forearm between the flexor carpi ulnaris muscle and extensor carpi ulnaris muscle to complete its typical course into the hand and phalanges through the ulnar tunnel (Figure 3).

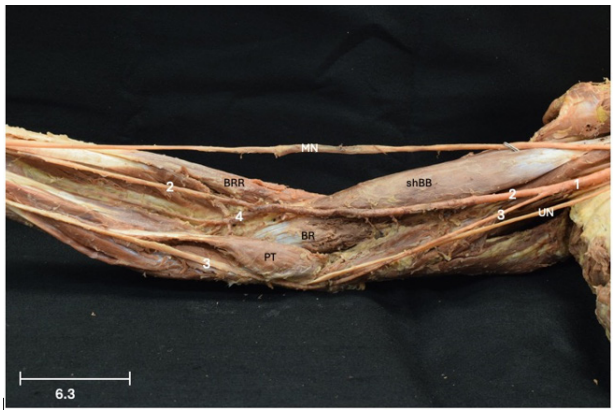

Figure 1) *Unilateral high branching brachial artery (1) with superficial ulnar artery (3). Radial artery (2) providing contributions to the common interosseous artery (4).*

Abbreviations: *BRR: Brachioradialis; shBB: Short head of Biceps Brachii; BR: Brachialis; PT: Pronator Teres (reflected)*

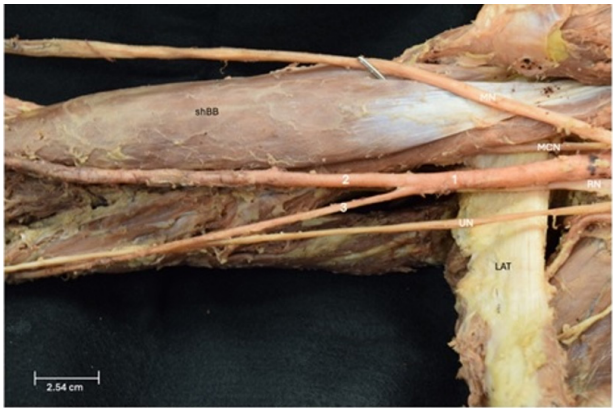

Figure 2) *Unilateral high branching artery (1) with median nerve (nm) reflected.*

Abbreviations: *MN: Median Nerve; MCN: Musculocutaneous Nerve; RN: Radial Nerve; UN: Ulnar Nerve; shBB: Short head of Biceps Brachii; LAT: Latissimus Dorsi*

Figure 3) *Superficial ulnar artery (3) coursing over the common flexor tendon. Radial artery (2) providing contributions to the common interosseous artery (4).*

Several branches of the cubital anastomosis were readily identifiable, exhibiting slight variation (Figure 4). The primary anomaly in this region was the CIA arising directly from the posteromedial aspect of the radial artery near the radial tuberosity, rather than originating from the ulnar artery. The CIA gave rise to both anterior and posterior interosseous branches, as well as the interosseous recurrent artery. Additionally, collateral circulation from the ulnar artery was maintained via the superior ulnar collateral artery, which was confirmed to anastomose with the posterior ulnar recurrent artery. However, due to this anomalous branching pattern, the anterior ulnar recurrent artery and the radial recurrent artery were disrupted and could not be preserved.

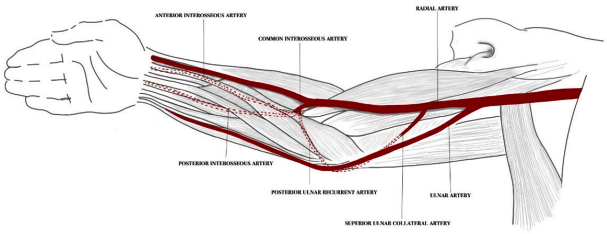

Figure 4) *Anatomical drawing depicting unique anomalous arterial branching pattern.*

No other anatomical anomalies or upper extremity pathologies were noted. The donor was a White male with a reported cause of death coronary artery disease, hypertension, and hyperlipidemia. No additional identifying information was available. Seventeen total donors were dissected, and bilateral upper limbs were examined for high branching brachial arteries as well as superficial ulnar arteries. In the present case, the identified anomaly involved both a high bifurcation of the brachial artery and a superficial ulnar artery, which was observed in 1 of the 34 upper limbs examined (2.94%). Additionally, high bifurcation of the brachial artery alone, without a superficial ulnar artery, was identified in 4 of the 34 limbs (11.7%).

Discussion

Embryological origin of peripheral arteries

The arterial pattern of the upper limb develops during embryogenesis through a series of complex vascular remodeling events involving the axial artery. From days 26 to 52 of embryogenesis, the limb bud initially contains an unrefined network of capillaries. The primary axial artery, derived from the seventh cervical intersegmental artery and continuous with the dorsal aorta, extends into the limb bud. Under the influence of growth factors, the capillary network begins to anastomose with the axial artery, with the location of these connections shaping the eventual branching pattern. As the limb elongates, the axial artery gives rise to the brachial artery, and subsequent branching

forms the radial and ulnar arteries by the 6th to 8th weeks of gestation [5].

Variations, such as high bifurcation of the brachial artery or the presence of a superficial ulnar artery, arise from deviations in the regression, retention, or anastomosis of primitive vascular channels. These anomalies underscore the adaptive and dynamic nature of vascular development in the upper limb [7].

Clinical significance

Recognizing anomalous vascular perfusion is critical for patient safety, as deviations from normal blood flow patterns can increase the risk of iatrogenic injury during procedures such as venipuncture, arteriovenous fistula formation, or arterial cannulation. Arteries located in vulnerable positions, such as the ulnar artery coursing superficial to the flexor muscles in this case, are more prone to injury, and even minor trauma can result in significant blood loss. This risk is particularly heightened in patients who use intravenous drugs, as superficial arteries can be mistaken for veins, leading to accidental arterial injections that may damage capillary beds and cause severe complications such as tissue necrosis or gangrene [8]. Clinicians must understand these vascular variations to reduce misidentification and prevent procedural complications.

The presence of vascular anomalies, such as a high brachial artery bifurcation with a superficial ulnar artery, introduces significant challenges during surgical and arterial interventions. These anomalies, while rare, demand heightened clinical awareness and careful procedural planning to mitigate potential complications. The abnormal course of the radial artery in the presence of a superficial ulnar artery increases the risk of limb ischemia, particularly during procedures such as coronary artery bypass grafting (CABG) [9].

In recent years, the radial artery has become a common secondary conduit for CABG due to superior patency rates and improved long-term survival compared to the great saphenous vein [10]. However, this described vascular anomaly has critical implications for radial artery harvest. Specifically, the high bifurcation of the brachial artery, combined with the anomalous course of the superficial ulnar artery, places the collateral circulation and critical ischemic zones at heightened risk during dissection and vessel harvesting.

In cases where anomalies are detected, alternative conduit options such as the saphenous vein or the internal thoracic artery should be considered to reduce the risk of ischemic complications. If radial artery harvesting proceeds, meticulous intraoperative techniques are essential [11]. The preservation of collateral branches and careful dissection along the anomalous arterial course can minimize the risk of disrupting critical blood flow pathways.

Preoperative imaging, such as Doppler ultrasound or angiography, should be considered in patients undergoing vascular access, arterial graft harvesting, or upper limb surgery to identify potential vascular anomalies and guide safe procedural planning. Surgeons performing orthopedic, plastic, or reconstructive procedures must remain vigilant to prevent iatrogenic arterial injury, which could result in ischemia, graft failure, or excessive bleeding [12]. The identification of these vascular anomalies underscores the importance of a tailored approach to surgical planning and execution. Future studies investigating the incidence and outcomes of arterial interventions in patients with anomalous vascular anatomy may provide further insights into optimizing patient care and improving surgical outcomes.

Conclusion

Understanding the normal arterial anatomy of the upper extremity, which includes the axillary artery transitioning into the brachial artery and then branching into the radial and ulnar arteries, is fundamental to effective medical practice. Awareness of arterial variations such as superficial ulnar arteries and high-origin ulnar arteries is crucial as these deviations from the typical pattern are not always emphasized in medical education.

In this case study, we identified a rare combination of a high bifurcating brachial artery and a superficial ulnar artery during dissection. This anomaly underscores the importance of recognizing unusual arterial patterns to prevent potential complications, such as iatrogenic injuries from procedures or misidentification during clinical interventions. Such variations, though less common, can significantly impact patient care and outcomes, highlighting the need for comprehensive anatomical knowledge and heightened awareness in clinical practice.

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References

1. Ghouri MA, Gupta N, Bhat AP, et al. CT and MR imaging of the upper extremity vasculature: pearls, pitfalls, and challenges. Cardiovasc Diagn Ther. 2019;9:S152-73.
2. Marques E, Bordoni B. Anatomy, Shoulder and Upper Limb, Ulnar Artery. StatPearls Publishing, Treasure Island, Florida, USA. 2025.
3. Tsoucalas G, Eleftheriou A, Panagouli E. High Bifurcation of the Brachial Artery: An Embryological Overview. Cureus. 2020;12:e7097.
4. Quadros LS, Bhat N, D'Souza AS. Superficial Ulnar Artery: A Case Report of its Unusual Course. Malays J Med Sci. 2015;22:65-7.
5. Rodríguez-Niedenführ M, Vázquez T, Nearn L, et al. Variations of the arterial pattern in the upper limb revisited: A morphological and statistical study, with a review of the literature. J Anat. 2001;199:547-66.
6. Moore KL, Agur AM, Dalley AF, et al. Grant's Dissector, 15th Ed. + Essential Clinical Anatomy, 4th Ed. Lippincott Williams & Wilkins, Pennsylvania, USA.2015.
7. Khalid N, Bordoni B. Embryology, Great Vessel. StatPearls Publishing, Treasure Island, Florida, USA. 2023.
8. Rose B, Powell TG, Jones M, et al. Case reports of heroin injection site necrosis: a novel antecedent of nicolau syndrome. Cureus. 2022;16:14:e29235.
9. Bojakowski K, Zawadzki M, Mruk B, et al. Critical hand ischemia after radial access for coronary angiography - case report. Pol J Radiol. 2017;12:82:19-23.
10. Gaudino M, Benedetto U, Fremes S, et al. Radial-Artery or Saphenous-Vein Grafts in Coronary-Artery Bypass Surgery. N Engl J Med. 2018;378:2069-77.
11. Adnan G, Yandrapalli S. Radial Artery Coronary Bypass. StatPearls Publishing, Treasure Island, Florida, USA. 2024.
12. Cheng B, Tian J, Peng Y, et al. Iatrogenic wounds: a common but often overlooked problem. Burns Trauma. 2019;1:7:18.