



E-ISSN: 2707-8353
P-ISSN: 2707-8345
IJCRO 2022; 4(1): 100-102
Received: 30-11-2021
Accepted: 16-01-2022

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The persistent median artery: A case report of maintained perfusion to the hand after laceration to radial and ulnar arteries

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DOI: <https://doi.org/10.22271/27078345.2022.v4.i1b.103>

Abstract

A 60-year-old male presented after a self-inflicted volar wrist laceration resulting in complete transection of his radial and ulnar arteries. Despite this, his hand remained well-perfused on physical examination. Intra-operatively, an intact persistent median artery (PMA) was discovered within the carpal tunnel. As a remnant of an embryonic structure, the PMA is an anatomic variant which can persist and contribute to the blood supply of the hand and even allow for adequate perfusion in the setting of concurrent radial and artery injury.

Keywords: 60-year-old male, ulnar arteries, Persistent Median Artery (PMA)

Introduction

The perfusion status of the hand is a pivotal consideration when managing upper extremity trauma, particularly when evaluating lacerations and penetrating trauma. Blood flow to the hand originates in the arm as the brachial artery, which bifurcates at the level of the bicipital tuberosity into radial and ulnar arteries. The common interosseous artery typically branches off of the ulnar artery, and then further divides into an anterior and posterior interosseous artery, although considerable anatomic variations exist. The radial artery travels distally along the radial aspect of the forearm between the brachioradialis and the flexor carpi radialis before entering the hand. The ulnar artery runs deep to the flexor carpi ulnaris along the length of the forearm before entering the hand through Guyon's canal. Within the hand, the ulnar and radial arteries predominately form the superficial and deep palmar arches, respectively, and provide blood flow to all digits ^[1].

In the setting of an isolated radial or ulnar arterial injury in the forearm, the well-developed anastomotic palmar arches, when complete, can perfuse the entire hand. Aftabuddin *et al.* identified 96 patients who sustained an acute isolated injury to either the radial or ulnar artery and reported no instances of hand ischemia. Additionally, all hands maintained perfusion throughout follow-up regardless of whether the injured vessel was repaired or ligated ^[2]. On the other hand, injury or ligation to both infrabrachial arteries is associated with critical limb ischemia and limb loss due to lack of adequate collateral circulation ^[3]. We present a case in which a traumatic laceration occurred to both the radial and ulnar arteries at the level of the wrist, yet the hand remained well-perfused secondary to a persistent median artery (PMA).

The patient was informed that data concerning the case would be submitted for publication, and consent was obtained.

Case Report

A 60-year-old right hand dominant male with a medical history significant for smoking, polysubstance abuse, schizophrenia, and hypertension presented to an outside hospital after a self-inflicted laceration to the volar aspect of his right wrist. At that time, he was evaluated by a vascular surgeon who noted pulsatile bleeding of both the radial and ulnar arteries, despite reported adequate perfusion. Subsequently, both vessels were ligated with vessel clips in the emergency department. The patient was then transferred to our academic medical center for higher acuity surgical management.

Evaluation of the patient in the emergency department demonstrated an obtunded male with a 9 cm laceration at the right volar wrist crease. The radial and ulnar arteries were confirmed to be ligated with vessel clips with noted pulsations at the proximal stumps. All digits were

noted to be warm and well-perfused with a capillary refill of less than 2 seconds. Additionally, each proper digital artery was easily identified with strong doppler signals. A sensory and motor examination of the hand could not be obtained due to the patient's drug intoxication and altered mental status. Given the hand's adequate distal perfusion, formal surgical exploration was deferred until medically stable.

The following morning, the patient was taken to the operating room for irrigation and debridement with arterial repair. Exploration of the wound demonstrated complete transection of the radial and ulnar arteries with vessel clips on the proximal stumps (Image 1). Complete laceration of the flexor carpi radialis, flexor carpi ulnaris, and palmaris longus tendons and the palmar cutaneous branch of the median nerve was identified. The traumatic laceration was then extended distally via an extended carpal tunnel approach. The transverse carpal ligament was released, revealing a PMA accompanied by a bifid median nerve (Image 2). The bifid median nerve was neurolysed and found to be without identifiable injury. The PMA was noted to be patent, pulsatile, and providing flow to the palmar arches.

Next, repair of the radial and ulnar arteries was performed using 9-0 nylon interrupted sutures under microscopic magnification. Adequate perfusion of all digits was maintained and the wound was irrigated and closed with 4-0 chromic sutures. A standard sterile dressing with a dorsal blocking splint was then applied. He was admitted post-operatively for intravenous antibiotics and serial examination which demonstrated a well-perfused hand and digits. He was subsequently discharged on a daily aspirin 325mg for 30 days.

The patient's post-operative course was complicated by wound dehiscence requiring return to the operating room for irrigation and debridement. At that time, both radial and ulnar repairs were noted to be intact with maintained flow. The incision was partially closed with 3-0 nylon sutures. A 3cm by 5cm area without exposed neurovascular structures was unable to be closed primarily; therefore, a synthetic wound matrix was placed. The patient returned to clinic 14 days later at which time the nylon sutures were removed and the central area was found to be healing appropriately. At 2 months, the patient's wound was well-healed with adequate re-epithelialization. On examination, he demonstrated near complete wrist and finger range of motion. All fingers remained well-perfused throughout his entire follow-up period.



Image 1: Intra-operative photo showing transected radial and ulnar arteries with a well-perfused hand



Image 2: Extended carpal tunnel view showing bifid median nerve and persistent median artery

Discussion

The median artery is a transitory vessel normally present during early embryonic development, initially serving as the main blood supply to the hand [4-7]. As the radial and ulnar arteries develop, the median artery usually regresses via apoptosis around the 8th week of gestation. However, in a minority of the population, this artery may persist into adulthood.

In a 2012 cadaveric study of adult upper extremities, the PMA was identified with a prevalence of 6.6% [8]. Similarly, a 2009 review article presented 27 studies which collectively demonstrated a prevalence of 6.8% (0.6-44.2%) amongst all ages, with higher prevalence rates occurring in neonate cadavers and lower rates in adult cadaver studies.⁹ A PMA can contribute to pronator syndrome, anterior interosseous nerve (AIN) syndrome, or carpal tunnel syndrome, especially in the case of thrombosis, aneurysm, or atherosclerosis of the PMA [6, 10].

The origin and palmar termination of the PMA in the hand is highly variable. The PMA has been described as arising from the ulnar artery, common interosseous artery, anterior interosseous artery, radial artery, and even the brachial artery [7, 11]. Most commonly it arises from either the ulnar or common interosseous arteries [7, 11]. Furthermore, different patterns of the PMA contribution to the superficial palmar arch have been identified as well [4, 12]. Eid *et al.* describes three main patterns of PMA contribution to the SPA, which include the median-ulnar, radial-median-ulnar, and radial-median patterns [4].

Here, the patient sustained a traumatic laceration to both his radial and ulnar arteries, yet his hand remained well-perfused due to the presence of a patent PMA. A case report published in 2021 described a similar presentation of traumatic laceration to both the radial and ulnar arteries with intact perfusion to the hand; however, the PMA was not identified intra-operatively and was only noted on CT angiogram (CTA) post-operatively after both radial and ulnar arteries were ligated [13]. In that case, the CTA showed the PMA as a continuation of the anterior interosseous artery and terminated in the palm with an incomplete superficial palmar arch. Our case differs in that the PMA

was surgically identified within the carpal tunnel and both radial and ulnar arteries were surgically repaired.

A 2020 case series presented two cases of well-perfused hands in the setting of combined radial and ulnar artery transections^[14]. The first case involved a self-inflicted knife laceration to the volar wrist resulting in complete transection of the radial and ulnar arteries. An emergent CTA showed flow through the palmar arch was maintained via the anterior interosseous artery and a small branch off the distal ulnar artery. The second case involved a machete injury to the volar wrist resulting in transection of the radial and ulnar arteries with a well-perfused hand. After both vessels were repaired, delayed CTA was obtained demonstrating acute failure of the arterial repairs with retrograde flow from an anterior interosseous artery to an intact palmar arch^[14]. In neither case was a PMA identified within the carpal tunnel.

In general, loss of either the radial or ulnar artery can occur with the patient maintaining distal perfusion without limb-threatening ischemia due to a robust distal anastomosis of the palmar arches and collateral circulation. However, loss of both the radial and ulnar arteries is not well tolerated and requires emergent arterial repair to restore perfusion. There is a 39.3% amputation rate observed in cases of traumatic injury to both arteries compared to less than 5% when a single artery is transected^[15]. Here, we present a rare case in which the hand maintained perfusion via the persistent median artery despite transection to both the radial and ulnar arteries.

The case presented here demonstrates that in rare instances, the hand can maintain adequate distal perfusion via collateral flow by means of anatomic variants. In our case, despite concomitant transection to both the radial and ulnar arteries, the PMA located within the carpal tunnel preserved perfusion to the hand. This case adds to the body of literature describing anatomic variations in upper extremity vasculature and their clinical relevance.

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