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## Case Report

# Traumatic proximal brachial artery injury selectively managed non-operatively: A case report and review of the literature

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## SUMMARY

A right hand dominant 18-year-old female with a body mass index greater than forty presented to the trauma bay after sustaining two gunshot wounds to her right upper extremity. On physical exam, she had doppler signals and she reported neuropathy in the right median nerve distribution. She had no active signs of bleeding and she was subsequently taken to computed tomography which revealed an abrupt proximal brachial artery opacification with distal reconstitution in addition to having air tracking into the axillary and subclavian arteries. She underwent further resuscitation with normalization of perfusion as her radial and ulnar arteries became palpable. Traditionally, proximal brachial artery injuries are managed by an open surgical approach, which has a morbidity associated with the surgical dissection. Additionally in this case, there was concern for a blast injury near the potential graft inflow site. This case report highlights a patient who sustained a proximal brachial artery occlusion that was managed medically with antithrombotic agents and serial exams.

## Introduction

The gold standard for a traumatic brachial artery thrombosis with a pulse deficit has been open repair [1,2], which requires a significant dissection with an associated morbidity. There is a limited role for non-operative management in non-occlusive arterial injuries without an immediate threat to limb viability [3]. This case highlights a traumatic proximally occluded brachial artery with reconstitution distally who was successfully managed non-operatively with a review of the available literature. It highlights the indications and the contraindications to a non-operative approach.

## Case history

An 18-year-old obesity class three female, who is a student, presented to the trauma bay as a police drop-off with multiple victims. She sustained two handgun ballistic injuries to her right upper extremity on the lower aspect of her anterior shoulder and on the posterior aspect of her brachium (Fig. 1). Her non-palpable right radial and ulnar arteries were difficult to assess due to her obesity. Signals in her radial artery, ulnar artery and palmar arch were present. There was no expanding hematoma or obvious arterial bleeding. She reported right median nerve paresthesia on both the palm and the palmar aspects of her first four digits without paresthesia proximally into her brachium or forearm. She reported pain near her ballistic sites but not distal to the injury. In addition, she

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reported slight cooling of her right hand, but on physical exam her hand was warm with good capillary refill and there was no pallor. She had complete range of motion against resistance in her shoulder, elbow, and wrist. In addition, she was able to pronate her arm without difficulty. She had full abduction, adduction, flexion, hyperextension of each of her metacarpophalangeal joints. She had full flexion and hyperextension of her interphalangeal joints. Her right thumb opposition was four out of five.

Computed tomography angiography (CTA) demonstrated an abrupt cut-off of her proximal brachial artery that persisted on delayed imaging along with air tracking into the axillary and subclavian arteries (Fig. 2). Reconstitution of flow occurred at the distal humerus with patent radial and ulnar arteries (Fig. 3). In addition, there were no underline fractures.

With a concern for traumatic occlusion, vascular surgery was consulted. After further discussion with the patient, vascular surgery deferred emergent right upper extremity bypass due to collateralization with a return of palpable pulses that occurred within 2 h of arrival and no symptoms of critical limb ischemia.

She was admitted to the trauma intensive care unit for hourly neurovascular assessments, initiation of antithrombotic agents and further imaging. Initially, her antithrombotic regimen included full dose heparin and 325 mg of aspirin; however, the next day her regimen was transitioned to prophylactic dose anticoagulation and 325 mg of aspirin due to a reevaluation of the risk for hemorrhage. Her wrist brachial index on the right was 0.68. In addition, she had lower extremity vein mapping performed. She had a repeat CTA approximately 22 h after her initial CTA with a redemonstration of the occlusion. She was monitored on an inpatient service for five nights and during this time her paresthesia and weakness improved. Her wounds received local wound therapy including packing with iodoform strips. She was cleared by both physical therapy and occupational therapy.

She was discharged from the hospital with the 325 mg of daily aspirin and a two-week follow-up with vascular surgery. In addition, she was referred to a peripheral nerve neurosurgeon for an outpatient electromyography (EMG). On both her two-week and her six-month follow-up visit, she did not report any rest pain or claudication, nor did she have any tissue loss. Her distal pulses remained palpable with a palmar arch signal. By her six-month exam, she no longer reported any paresthesia or cooling of her right hand, nor did she report any paresis. With clinical improvement, the EMG was never obtained.

## Discussion

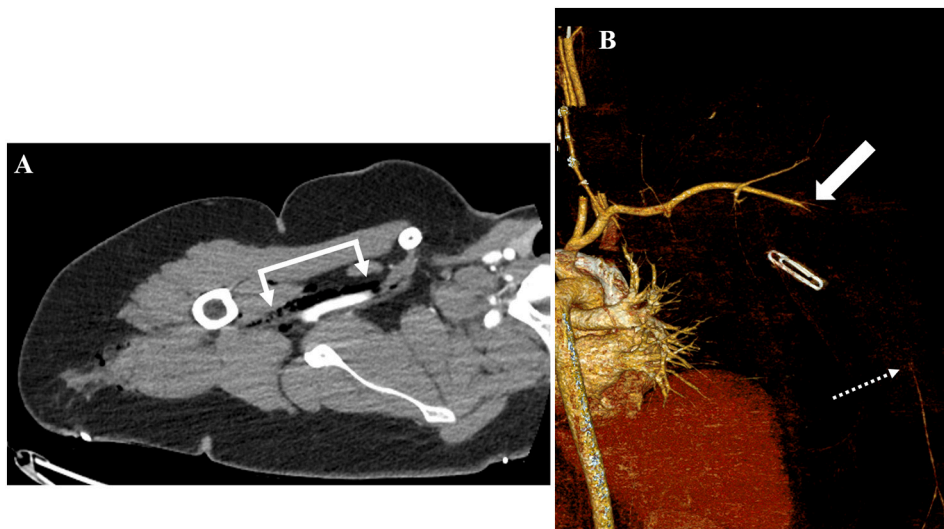
Management of major peripheral arterial injuries has evolved over the past 100 years. Modern advances in both surgical technique and endovascular approach have expanded the treatment options. Hard signs of vascular injury are clinically diagnosed and they mandate emergent operative exploration [4] or CTA in a hemodynamically stable patient [5]. Most preventable amputations are from a delayed diagnosis [6] of an arterial injury or from an inadequate or delayed fasciotomy [7,8].

This patient had a difficult pulse exam due to her body habitus [1]. She was hemodynamically stable without any hemorrhagic signs, and a CTA was expeditiously available which noted a proximal brachial thrombosis. Her pulse returned after resuscitation and the vascular service was consulted. She had no rest pain or claudication, allowing an expedited ultrasound. Her exam improved throughout her admission and her wrist brachial indices confirmed the collateralization noted on the CTA, although they were depressed.

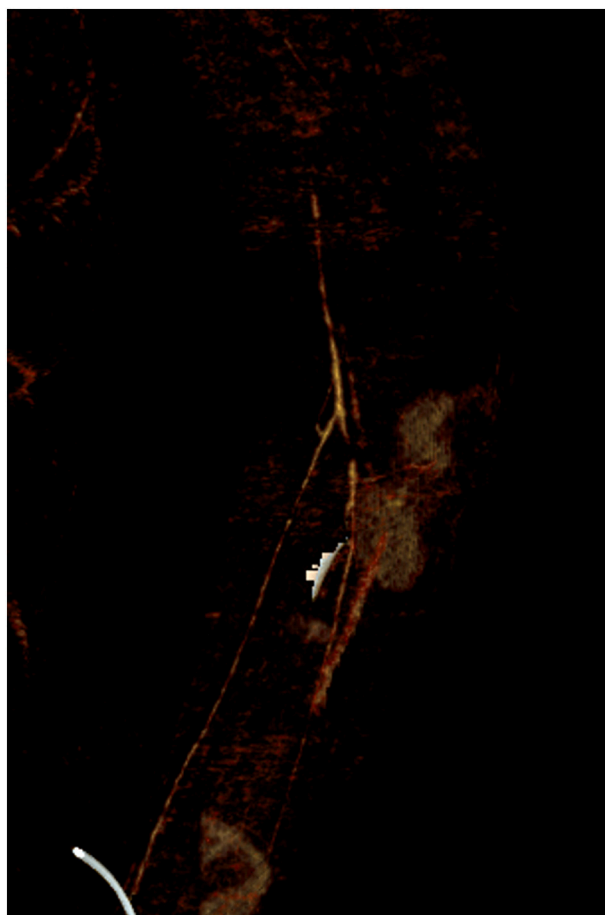
An interposition graft is a plausible treatment option; however, with the air tracking into the axillary and subclavian arteries, there was a concern for a blast injury that could have impacted graft inflow. Additionally, the dissection of her repair would have been extensive with an associated morbidity in her dominant arm. Vascular surgery discussed an operative repair; however, ultimately this



Fig. 1. Two handgun wounds. A) Wound located on the lower aspect of her anterior shoulder. B) Wound located on her posterior brachium.



**Fig. 2.** Initial computed tomography angiography (CTA) images performed during the trauma activation. A) Axial CTA demonstrating air tracking adjacent to the subclavian artery (bracket arrow). B) 3D Coronal CTA demonstrating that the proximal brachial artery was abruptly cut off (bold arrow) with reconstitution of flow at the distal humerus (dashed arrow).



**Fig. 3.** 3D Coronal CTA demonstrating reconstitution of flow at the distal humerus performed 22 h after arrival.

was deferred. The patient had no signs of acute limb threatening ischemia [9], thus her limb was not immediately threatened.

While her median nerve paresis and median nerve paresthesia can be a sign of acute limb ischemia [9], the location of the nerve is such that it runs alongside the brachial artery in direct line with the ballistic trajectory. Had she manifested other signs of critical limb ischemia, such as, rest pain, claudication, pulses not returning, or had her neurovascular exam worsened then her brachial artery would have been intervened upon during her hospital admission.

Initial assessment of a peripheral nerve injury from a gunshot wound is difficult, as the ballistic can create a blast wave thereby stretching the underline tissues. Here the decision was made to permit a delayed nerve repair in order to assess the full extent of her injury burden and to allow for spontaneous recovery of her median nerve [10]. Fortunately, she had full recovery therefore she was able to forgo a median nerve repair.

This case report serves to inform practicing clinicians about an uncommon management style of a traumatic proximal brachial artery injury. Nonetheless, there are several limitations. First, this report is not representative of all proximal brachial artery injuries. Since time is a determinant in limb salvage, she is unique in both presenting as a police drop-off, and being in the CT scanner within 10 min of arrival. While in the scanner, the case was discussed with a radiologist and a vascular surgeon. The vascular surgeon immediately discussed the case with several colleagues before ultimately making his decision, highlighting that an unconventional and complex decision requires an extensive discussion. This case cannot depict a patient with concomitant major venous injuries, underline fractures, blunt injury, widespread tissue destruction, shock, advanced age, or patients of different body compositions (i.e. increase in muscle mass that requires more perfusion). Second, it is plausible that this case has both reporting bias and recall bias.

## Conclusion

Historically, a traumatically injured proximal brachial artery with an abrupt cut-off has been managed by performing an open repair. This case informs future clinicians of a second plausible management style, closely observing the patient with medical management in a selective patient population.

## Author contributions

A.M.H. designed the study, searched the literature, and prepared the article including drafting of the article and critically revising the article.

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## Declaration of competing interest

I do not have any personal relationships or financial interest with regards to the authorship and/or publications of this manuscript.

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