AAST Acute Care Surgery Didactic Curriculum

Brachial Artery Injury

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Anatomy

Highlights:

- Brachial artery arises from the axillary artery at the border of the trees major
- Relatively long, superficial, and travels medial to the humerus with adjacent nerves.
    - median nerve (superiorly and laterally)
    - ulnar and radial nerves (medially).
- Three main branches provide additional collateral flow:
    - profound brachii, superior ulnar, and inferior ulnar
- Terminates ~ 3–5 cm below the elbow skin crease, then divides into radial & ulnar arteries.
- Distribution of injury (proximal, middle, and distal): each equally injured a third of the time.
    - risk of limb loss is approximately 2 times greater after ligation of the common brachial when compared to the superficial brachial artery.

Injury/Disease Demographics

Highlights:

- One of the most frequently injured peripheral vessels injured (15-30%)
    - most common mechanism is penetrating injury (95%): gunshots, stab, glass, fractures.
    - Blunt injury is infrequent but can occur with supracondylar humerus fractures with anterior displacement or elbow dislocation.
- Degree of ischemia is related to the location of injury to the profunda brachii.
- Survival rates are high ranging from 95% to 100%
    - Deaths with brachial artery injuries are from associated injuries.

Clinical Presentation and Diagnosis

Highlights:

- The diagnosis of upper extremity arterial injury is often made clinically.

- Traditional hard signs of vascular injury include: absent/diminished pulses, active (pulsatile) bleeding, distal ischemia, expanding/pulsatile hematoma, and a thrill or bruit.
    - Pulse deficit (> 50%) is the most common finding on exam.

- Brachio–brachial indices (BBI) should be obtained (uninjured contralateral extremity)
    - abnormal arterial pressure index < 0.9 requires imaging if hemodynamically stable.
        - Computed tomography angiography (CTA): to localize and confirm the diagnosis.
        - Doppler ultrasound
        - Arteriogram

- Common radiographic findings include occlusion, intimal tears, and pseudoaneurysms

- Concomitant arterial and venous injury represents 20-40% of all vascular injury.
- Arterial or venous bleeding can be controlled with direct digital pressure or by application of a tourniquet however venous bleeding can be exacerbated.
- Absent pulses with of the upper extremity can be assessed with a CTA
- If normal perfusion does not return with resuscitation and fracture reduction, CTA is warranted.
    - helpful to identify brachial artery lesions and assist with operative planning.
        - multidiscipline approach with orthopedics or plastic surgery complex fractures, crush injuries, extensive tissue loss requiring coverage.
- Concomitant nerve is present in nearly 60% of brachial artery injuries.
    - If feasible, a thorough neurologic examination must be completed.
    - median nerve injury ~ 60-80% cases followed an ulnar nerve (23%), radial (12%), and musculocutaneous nerve injuries (4%)
        - multiple nerve injuries occurring in a little over 10%
        - long-term disability is secondary to nerve injuries.

Currently there is no role for endovascular stenting for brachial artery injuries.

Operative Exposure and Management

Highlights:

- Open exposure and brachial artery repair is the best approach to this injury.
- The exact method of repair is determined by the extent of the injury.
- Ischemia to reperfusion should be limited with early restoration of flow.
- Prep the upper anterior chest, shoulder, and extremity to allow incisions for vascular control and if necessary, fasciotomies.
    - An uninjured lower extremity is prepped for saphenous vein harvest.

- A longitudinal incision is made over the bicipital sulcus then extended with a laterally oriented S-curve across the antecubital fossa.
    - the brachial artery dives below the bicipital aponeurosis, which should be divided.
    - temporary silastic shunts can be used to restore perfusion.
        - Setting of damage control, complex injuries and assoc. fractures
- Types of brachial artery injuries:
    - In decreasing frequency: transections, lacerations, thrombosis, pseudoaneurysm, intimal flaps, and pseudoaneurysms, arterio-venous (AV) fistulas
- General vascular principles are employed following proximal/distal control of vessel.
    - exploration of injured arterial segment
    - consider temporary intra-luminal shunts.
    - orthopedic assessment and stabilization
    - appropriate size fogarty for thrombectomy prior to reconstruction
    - debridement of non-viable vessel
    - revascularization methods: tension free, polypropylene sutures
        - primary repair
        - vein patch
        - reversed autogenous saphenous vein.
        - PTFE graft are rare, considered if no suitable autogenous vein available.
        - if poor conduit, acute thrombosis, or adequacy of flow → angiography.
        - Continued evaluation for upper extremity compartment syndrome
- Rates of fasciotomies range from 15-30%.
    - Consider if ischemia greater than 4-hours.
    - clinical determination of tight compartments, presence of combined arterial and venous injuries, and/or associated open or closed fractures.
        - Normal compartment pressures 0 to 9 mmHg
        - Pressures 25-30 mmHg are considered elevated → fasciotomies.
    - Volar incision allows for decompression of the anterior compartment of forearm. A curvilinear incision and should be carried down through the carpal tunnel. The dorsal incision permits decompression of the posterior compartment and is a more linear incision.

- Currently there is no role for endovascular stenting for brachial artery injuries.

No conclusive data on the role of anticoagulation or anti-platelet therapy after upper extremity vascular repair and therefore, outside of center specific inpatient DVT prophylaxis, post-operative heparinoid nor aspirin therapy is not administered.

Figure 1: Left upper extremity shotgun injury with a torniquet (arrow) in place.

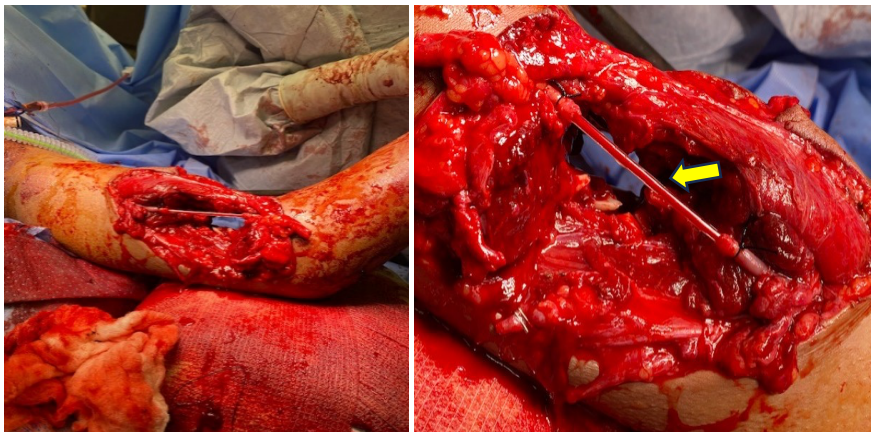

Figure 2: Left upper extremity shot gun injury with extensive soft tissue loss and placement of a 10 French Argyle™ shunt in the proximal and distal ends of the brachial artery.