Vascular Hand Trauma

praz patcha, md

16 April 2015
Case

20M punched through plate glass; Tourniquet in place by EMS; Jagged transverse volar and dorsal wrist lacerations;

Level 2 trauma activation;
Case

HR 100  BP 115/70  100%RA

Primary survey otherwise negative

Isolated R wrist volar laceration with radial arterial bleeding, controlled with direct pressure;

Doppler detectable palmar arch; +cap refill; warm;

Absent flexion of digits 2-5; +Adduction of thumb;
Exploration of wound; Planned ligation of radial artery;

Ends controlled; Brisk back bleeding;

Confirmed doppler signal in arch;

Ligated;
Ulnar artery also out;

Arch still dopplerable, with no hard signs of ischemia;

Vascular called;
OR

Distal saphenous harvest;

Saphenous in-situ interposition graft repair of radial artery;

Hand consultation, confirms median n, and majority of flexor tendons transection;
Post-op Course

Uncomplicated

Discharged with palpable pulse

Planned outpt median nerve, flexor tendon repair
The Hand

Superficial palmar arch
Adequate collateral flow: 78.5%
Inadequate collateral flow: 21.5%

Deep palmar arch
97%
3%
Radial vs Ulnar a.

Ulnar continues as Superficial palmar arch;

Radial continues as Deep palmar arch;

Multiple studies...
Radial and ulnar artery dominance in normal digits.

Kleinert JM, Fleming SG, Abel CS, Firrell J.

Abstract
Pulse volume plethysmography was done on 1249 digits in 125 volunteers to determine relative blood flow to each digit. Twenty-five volunteers with diminished pulse contours (24:1 female to male); 20% of these had cold intolerance compared with 1% of the remaining volunteers. The 20% without vasospasm were used to calculate vessel dominance by comparing pulse volume plethysmography amplitudes during radial or ulnar compression. Only 5% were found to have ulnar artery dominance (ie, pulse volume plethysmography amplitude larger during radial artery compression) in all digits, and 28% were found to have complete radial artery dominance. Ulnar dominance in three or more digits was seen compared with 57% with radial artery dominance; 21.5% had equal dominance. Overall, 87% of thumbs and 70.5% of index, 60% of long, 53% of ring, and 52% of small fingers were radial dominant.
Vascular Dominance in the Forearm

Max Haerle, M.D., Hans-Martin Häfner, M.D., Klaus Dietz, Ph.D., Hans-Eberhard Schaller, M.D., and Francesco Brunelli, M.D.

Tübingen, Germany, and Paris, France

The dominance of the radial or ulnar artery at the forearm level and their contributions to the circulation of the hand remain a matter of contention. Therefore, the authors proposed to investigate the predominance of one of these arteries first by anatomic studies on 40 fresh cadaver upper extremities, and then by dynamic studies. The dynamic studies included color Doppler sonography in 22 individuals (44 hands) and five-channel plethysmography in 40 individuals (40 right hands). It was found that the ulnar artery is dominant at the elbow, but after originating its collateral branches, the radial artery becomes donor-site morbidity are frequently reported after radial artery damage or after removing the radial artery. However, amazingly divergent variations between these complication rates can be found in the literature. The use of the ulnar artery in reconstructive surgery is possible but not very popular, even if low donor-site morbidity has been generally reported in the literature.
Median Interosseous a.

Cadaveric studies range from 5 to 15% palmar variant;

Embryonic arterial variant; Regresses in most people;
Microcirculation Regulation

Autonomics

- travel via arteries!
- $\alpha_1 \alpha_2 \beta_2$
- Nitric Oxide

Metabolic

- metabolite mediated
- adenosine, calcium
Microcirculation Regulation

Myogenic

– transmural pressure / stretch receptor mediated
– corrects for posture
– minimizes edema secondary to limb dependency
Assessment

Presence of distal pulses does NOT r/o injury;

- 25% of brachial injuries
- 50% of radial/ulnar injuries

HAVE PULSES due to

- backflow
- wave transmission

www.downstatesurgery.org
Assessment

80% of injuries are penetrating

But beware of blunt vascular injury!
  – undetected intimal injury
  – delayed thrombosis

  – high velocity GSW
  – supracondylar humeral fracture
  – elbow dislocation, fracture
What to do?

Clinically significant vascular injury:

Immediately EXPLORE

– except

• threat to patient life
• multi-level injury
• extensive thrombosis or embolus suspected
Intraop Assessment

Qualitative

- cap refill
- hand-held doppler
- backflow (+++ is good, +/- equivocal)

Quantitative

- digital plethysmography
- digital BP, DBI > 0.7
Historically Speaking

100% thrombosis rate of forearm primary vascular repairs!

1 paper - 1967
Present Evidence

Patency rates vary from 47% to 93%;

Use of vein graft does not reduce UE patency;

Factors that predispose failure:
- poor soft tissue coverage
- low grade infection
- high distal stump pressure
Intraop Assessment is concerning;

All **critical injuries** as defined by:

– axillary or proximal brachial injury
– radial OR ulnar injury with hard signs
– radial AND ulnar injury
Relative Indications to Recon

Combined nerve injury;

Extensive distal injury;

Technical ability to repair, without patient harm;
Types of Repair

Primary
- requires tension to be minimal after mobilization

Vein graft
- can be used in any iteration
- can be helpful to move anastamosis out of injury zone

Synthetic
- dismal patency below 6mm
Compartment Syndrome - Hand

Clinically difficult to discern due to small size;

Pulses not relevant due to shallow path of vessels;

Only requires 15-20mmHg;
Compartment Syndrome - Hand

10 compartments

- dorsal interosseous (4)
- palmar interosseous (3)
- adductor pollicus
- thenar + hypothenar

Release carpal ligament, 2 dorsal incisions
References


www.downstatesurgery.org