Vascular Injuries Related to Posterior Knee Dislocations

Feiran Lou MD. MS.
12/19/2013

Kings County Hospital
Department of Surgery
Case

64 yo woman transferred from UHB to KCHC s/p trip and fall from standing height with right knee posterior dislocation s/p reduction by orthopedics. No distal pulses, motor, or sensation in RLE on arrival to UHB. After reduction had 1+ distal pulse but did not regain sensation or motor function below knee

PM/SH: Morbid obesity, HTN, pancreatitis, lap chole, right shoulder surgery, exploratory laparotomy for fibroids
Meds: does not recall, no anticoagulation
Allergy: shellfish
Case

PE
Afebrile, 125/79, 79, 15, 100%
A&O X 3, obese
CTAB
RRR, S1, S2
abd: soft, tender b/l upper quadrants, ND

RLE: Cast in place, - DP, - PT, 2+ femoral, No sensation distal calf $\rightarrow$ foot, no motor function in foot, sluggish cap refill, skin pale, cool
LLE: 2+ DP, 2+ PT, 2+ femoral, + motor, + sensation
Studies

Labs
CBC 27/10.8/32.7/267
BMP 145/3.3/106/19/21/0.85/212
LFT WNL
VBG Lactate 5.3

CT abdomen and RLE CTA performed
Intraoperative Course

- Complete transections of popliteal artery and vein above knee
- Dissection of artery down to below knee
- Gore-Tex interposition graft
- Four-compartment fasciotomy
- External fixation by orthopedics
Postoperative Course

- Prolonged intubation secondary to aspiration and fluid overload
- Rhabdomyolysis, SIRS, AKI, liver necrosis, C. Diff infection
- Palpable distal pulses
- No return of motor or sensory function
- Currently with wound vac to fasciotomy sites and awaiting placement to rehab facility
Traumatic Knee Dislocations

- Uncommon injury
- High-velocity blunt trauma: MVA, falls
- Definition:
  - Complete loss of the tibiofemoral articulation
  - Injury of multiple ligaments with multidirectional instability after one trauma (ACL, PCL, LCL, MCL)
  - Even when reduced on initial presentation
Related Injuries

- **Vascular injuries 20-40%: artery and vein**
  - Repair <6hrs $\rightarrow$ 11% amputation
  - Repair > 8hr $\rightarrow$ 86% amputation
- **20% of those with concomitant vascular injury require amputation**
- **Rarely simple lacerations**
  - Extensive intima disruption $\rightarrow$ full thickness
  - Intimal tears $\rightarrow$ delayed thrombosis $\rightarrow$ ischemia
- **Nerve injuries 16-43%**
  - Most *common peroneal* nerve, also tibial nerve
Mechanism of Vascular Injury
Physiology of Ischemia

- Failure of oxygen delivery $\rightarrow$ depletion of ATP $\rightarrow$ anaerobic metabolism $\rightarrow$ ↑lactate
- ↑ cell membrane permeability
- Cellular edema $\rightarrow$ necrosis
- Irreversible damage to skeletal muscle $\sim$6 hrs
- Peripheral nerves more vulnerable $\rightarrow$ first manifestations of ischemia
  - Nerve injuries 50% of extremity vascular trauma
  - Most important determinant of long-term limb disability
Physiology of Reperfusion Injury

- Ischemia
  - ATP
    - AMP
      - Adenosine
        - Inosine
          - Hypoxanthine
          - Xanthine Oxidase
            - Xanthine Dehydrogenase
              - Oxidants
                - Proteases
                  - Granulocytes
                    - LOOH
                      - OH
                        - Fe^{3+}
                          - LH
                            - Urate + O_2 + H_2O_2
Diagnosis of Vascular Injury

- Pulse Exam?
- ABI?
- Arterial angiography?
- CTA?
Does the Pulse Examination in Patients with Traumatic Knee Dislocation Predict a Surgical Arterial Injury? 
A Meta-analysis

Christopher J. Barnes, MD, Ricardo Pietrobon, MD, and Laurence D. Higgins, MD

• 284 patients

• Abnormal pedal pulse
  – Sensitivity 79% (95% CI 64-89%)
  – Specificity 91% (95% CI 61-83%)

• Abnormal pedal pulse is **not** sensitive enough to detect a surgical vascular injury
Angio vs. serial exams

- Dye allergies
- Renal dysfunction
- Hemorrhage
- Pseudoaneurysms
- Thrombosis
- Cost

Observer variability
Frequent evaluations

- Normal pulse, well-perfused limb

- Arteriogram

- Inpatient observation with serial physical exams
Popliteal A. Repair

- Prep and drape both groins and LE
- Contralateral saphenous vein is the conduit of choice
- Medial incision: posterior femur ➔ posterior tibia
  - Division of the medial head of the gastrocnemius, sartorius, and the semimembranosis and semitendinosus muscles
- Posterior S incision: limited
Above Knee Exposure
Below Knee Exposure
Repair of Popliteal Artery Injury

- Proximal and distal control
- Careful debridement of all injured vessel wall
- Tension-free repair
  - Ideally saphenous veins interposition
  - PTFE can be used
- Perform vascular repair first or place shunts for fixation
- 4-compartment fasciotomy as needed
Knee Dislocations With Vascular Injury: Outcomes in the Lower Extremity Assessment Project (LEAP) Study

Brendan M. Patterson, MD, Julie Agel, MA, ATC, Marc F. Swiontkowski, MD, Ellen J. MacKenzie, PhD, Michael J. Bosse, MD, and the LEAP Study Group

- Multi-institution prospective study of severe blunt lower extremity injuries (level I trauma centers)
- 18 subjects with knee dislocations + popliteal artery injuries → surgical repair
- Nearly 1 in 5 ultimately required amputation (4/18)
• Longer avg ischemia time 7.25 hr in amputation group (vs 4.7 hr without amp)
• Moderate level of disability at 2 years (Sickness Impact Profile Score 7.0)
• 90% with residual knee instability
• 30% with decreased range of motion
Conclusions

- Approximately 30% of patients with knee dislocations have concomitant vascular injuries
- **High level of suspicion is key!**
- Normal pulse exam on initial presentation does not rule out arterial injury
- Patients with signs of ischemia require emergent surgical repair without angiography
- Patients who sustain limb-threatening knee dislocations have a moderate to high level of disability after injury
Common Vascular/Neuro Injuries

- Posterior shoulder dislocation
  - Axillary artery
- Midshaft humerus fx
  - Radial nerve
- Elbow dislocation/Distal humerus fx
  - Brachial artery
- Anterior hip dislocation
  - Femoral artery
Nerve Injuries Cont.

• MC injured nerve with lower extremity fasciotomy
  → **Superficial peroneal n** (foot eversion)

• Footdrop after lithotomy position or after crossing legs for long periods
  → **Common peroneal n.**
A 24 yo man presents with an obvious angulation deformity of the right leg after a motorcycle crash. After reduction of the injury, the right distal calf and foot remain mottled and cool to touch. The DP and PT pulses are not detectable. An angiogram is obtained.
Which of the following is the next best step in management of this patient?

a. Infusion of urokinase via the femoral artery
b. Catheter thrombectomy via the femoral artery
c. Open exploration of the popliteal fossa
d. Four-compartment fasciotomy of the calf
e. Stent placement of the popliteal artery