Case Studies in Orthopedic Trauma Emergency Dept to Discharge

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Objectives

• Review AO principles of fracture management

• Identify factors that affect the timing & methods of fracture fixation

• Review diagnosis & treatment of compartment syndrome, an orthopedic complication found most commonly in tibial fractures

• Nurses will be better able to provide bedside teaching & anticipatory guidance to their orthopedic trauma patients
AO Philosophy & Evolution

Arbeitgemeinschaft fur Osteosynthesefragen/Association for the Study of Internal Fixation

AO founded in 1958 by a small group of Swiss colleagues and is now a worldwide surgical and scientific foundation/community

“Focus is on patients with musculoskeletal injuries and related disorders. The aim is to provide care that allows an early return to function and mobility.”
AO Principles

• fracture reduction & fixation to restore anatomical relationships

• fracture fixation providing stability as the “personality” of the fracture, the patient, & the injury requires

• Preservation of the blood supply to soft tissues and bone by gentle reduction techniques and careful handling;

• Early & safe mobilization and rehabilitation of the injured part and the patient as a whole.
Reduction

• Reduction is a procedure to restore a fracture or dislocation to the correct alignment

• When a bone fractures, the fragments displace or angulate

• For the fractured bone to heal without deformity the bony fragments must be re-aligned to their normal anatomical position
Reduction by Closed or Open methods

Closed reduction refers to manipulation of the bone fragments without surgical exposure (ie hang fingers in finger-traps to reduce/realign wrist fractures).

Open reduction is when fracture fragments are exposed surgically by dissecting the tissues. (ie internal plating of humerus fracture)

Once the fragments are reduced, the reduction is maintained by application of casts, traction or held by implants which may in turn be external or internal.

en.wikipedia.org/wiki/Reduction_(orthopedic_surgery)
Goals of External Fixation

• Align bones/fractures

• Get limb/bones out to length
  – muscles pull on bones to deform & shorten them
  – sharpe bony ends can put pressure on skin from inside

• Protect soft tissues
  – position external pins as far away from fracture site as possible (proximal tibia and into heel bone)
  – Avoid large incisions until soft tissues cool down
Case #1

42 yo M BIBA w Right knee pain s/p falling off of back of work truck (6ft). Unable to bear weight on R leg
No LOC, GCS 15

BP158/92, P70, RR16, Pain 8/10

Mechanism of Injury:
Fall from 6ft = (high energy)
Past Medical Hx: seizures > on carbamazepine

Past Surg Hx: none

Social Hx: housed, married with 2 children; works as cement mason

Substances: tobacco 3cigs/d; occas. marijuana

Last meal: dinner last evening & coffee @ 0700 this a.m.
PHYSICAL EXAM

- Acute Distress; A&Ox3

- **MSK**: deformity Right proximal tibia ++ EDEMA, SKIN INTACT (NO LACERATIONS)
  Unable to range knee or test joint stability due to tenderness/pain

- Motor: wiggles toes, exam limited by pain

- Sensory: intact extremities

- Pulses: 2+DP/PT Cap Refill: brisk
Hosp Day #1: AP of tibia & knee

- Tibial plateau fx
- Proximal tibial shaft comminuted fx
Lateral of Tibia
Lateral view of knee shows extension of fx lines into knee joint = “intra-articular fx”
CT scan is a 3D image used for pre-op planning.
This coronal cut shows lateral tibial plateau depressed fx.
ASSESSMENT

43 yo M s/p 6ft fall off truck with R proximal tibia fracture & lateral tibial plateau fracture, with significant early swelling

These fractures will require surgical fixation

Question is when & how?
PLAN

• NPO

• Pre-Op Labs; CBC, BMP, INR, seizure med level, tox screen, EKG, CXR

• Non-WeightBearing RLE in Long Leg splint

• Consent for Surgery

• External-Fixation today in OR

• MONITOR RLE COMPARTMENTS Q4H
Hospital Course

• Routine compartment checks due to tibial fx with early swelling

• Developed worsening pain with tense, non-compressible “soft tissues” @ around 6hrs after admission

• Pt was rushed to OR for two-incision (four-compartment) fasciotomies R lower leg
What is compartment syndrome?

How many of you are familiar with the term compartment syndrome?

How many of you have treated patients with compartment syndrome?

In a nutshell,
“compartment syndrome is too much stuff in a confined space & with a risk of tissue damage & death”
*the muscles surrounded by fascial tissues in the lower extremity
Compartment Syndrome

“Acute compartment syndrome (ACS) is defined by a critical pressure increase within a confined compartmental space, causing a decline in the perfusion pressure to the compartment tissue, which without timely diagnosis & treatment will lead to ischemia, necrosis & ultimately permanent disability to the affected region.”

(Duckworth & McQueen, JBJS, 2015)
4 Compartments of the Lower Leg

- Anterior
- Lateral
- Superficial posterior
- Deep Posterior

*arrows show where 2 incisions are made to release soft-tissues*
Quick-Facts: Acute Compartment Syndrome

• Fractures comprise ~69% of cases
  – other common causes in trauma cases are crush injuries, contusions, gunshot wounds

• Incidence of ACS is ~ 1 to 9% in tibial shaft fractures (most common)

• Found in both open & closed tibial shaft fractures

(Duckworth & McQueen, 2011)
ACS is an Orthopedic Emergency

ALL patients with tibial shaft fractures must be assessed for the development of the signs & symptoms of compartment syndrome both at PRESENTATION AND AFTER surgical treatment (i.e. after fracture fixation)
Ischemia Time

• **Ischemia <4 hrs**: muscle remains contractile

• **Ischemia >8 hrs**: IRREVERSIBLE DAMAGE to muscles/nerves (ie foot drop)
Signs/Symptoms of Compartment Syndrome

- Severe PAIN out of proportion to associated injury & refractory to analgesia; PAIN ON PASSIVE STRETCH (passively move the toes/ankle)

- SWELLING: with elevated compartment pressures

- PARASTHESIAS: can be due to nerve ischemia as it runs thru compartment or related to damage to nerve @ time of injury

- Paralysis: late sign

(Duckworth & McQueen, 2011)
Challenges of Diagnosis

- Must maintain a high index of suspicion for tibia fx, specific crush injuries, etc.
- Must perform serial examinations Ortho providers and RN
- Must document changes over time
- Be Extra Cautious
  - in unconscious/obtunded patients
  - regional anesthesia (nerve block, epidural)
  - high doses of pain medications
- An open fracture does not mean that compartments are decompressed
Role of Nursing Staff

• Recognize the risk of ACS

• Prompt communication w Provider re: significant worsening of pain, changes in CSM measurements, tight splints/dressings

• Stand-by when provider performing compartment checks (trend changes)

• Ask for assistance from Charge, experienced staff, if concerned for this complication
Hosp Day #1: PostOp > fractures stabilized w/ external fixator & fasciotomies performed
Back to Bedside

- Wound vac on fasciotomy incisions
- Plan for routine return to OR Q2-3 days to washout wounds & attempt closure of incisions
- DVT ppx: SQ enox
- IV Abx until fasciotomy incisions closed
- RN carry out routine CSM checks; begin pin-site care POD#2
- Activity:
  - Elevation in bed, NWB RLE (BRP, OK to start Rehab)
HD#3: Medial fasciotomy wound underwent delayed primary closure (DPC)
HD#3: Lateral fasciotomy after routine washout
Lateral fasciotomy wound (peroneal nerve center)
HD#3: Lateral fasciotomy wound with wound-vac as unable to close this OR visit
Back to Bedside

• Wound vac remains on lateral unclosed incision
• Transition to PO pain meds
• Teach pt pin-site care/enox injection
• Preparation for final wound closure & discharge to Home vs SNF
• Patient will return as Outpt for definitive fixation (once soft tissues recover) 1-2wks
• NWB RLE x 3mo after final fixation
34 Days after Injury Final fixation: ORIF Tibial plateau & Tibial shaft fx & removal of ex-fix
Factors which affect timing of surgery

Medical Stability: this pt was medically stable

Soft tissues: ++ EDEMA; NOT amenable to immediate surgical fixation (required ex-fix for temporary stability)

Complication: compartment syndrome (wait 2-3 wks until fasciotomy incisions closed/skin healed for Open reduction internal fixation (ORIF))

• Three trips to OR over 8days then DC to home
• Four total trips to OR
• Total Duration 34d fracture to definitive fix
Case #2

49 yr old M BIBA @ 2130 s/p Pedestrian vs Auto; struck on R side by car travelling ~20mph; launched 5ft, No LOC, GCS 15
Unable to bear weight on R leg.

BP133/85, P104, RR18, O2Sat 98%RA, Pain 10/10 & located RLE

Mechanism of Injury: Blunt Trauma by vehicle when walking across street (high-energy injury)
PMHx: +HIV, HL, hx anxiety, depression

Past Surg Hx: appendectomy

Social Hx: housed, lives alone; works as administrative assistant

Substances: no tobacco; remote hx PSA

Last meal: dinner 3.5h ago
AP & Lateral OPEN midshaft Tibia/Fibula fracture
**PE**

- Well appearing, NAD, A&Ox3

- **MSK:** deformity Right tibia/fibula anterior LACERATION mid-tibia, bone exposed = OPEN FX; MILD EDEMA,
  *unable to range or test joint stability due to tenderness/pain*

- Motor: full, exam limited by pain

- Sensory: intact extremities

- Pulses: 2+DP/PT Cap Refill: brisk
PLAN

• NPO
• PreOp Labs; CBC, BMP, INR, tox screen
• EKG/CXR
• IV ABX for OPEN FX; tetanus ppx
• Long Leg splint
• STAT CT Scan (pre-op planning)
• Consent for Surgery
• URGENT OR for washout of OPEN fx (goal within 6-8hrs of injury)
• MONITOR COMPARTMENTS Q4h
AP & Lat s/p IMN tibia & ORIF R tibial plateau fx
AP of Knee
Back to Bedside

- NWB RLE x 3months for complex tibia fx
- PO splint to protect incisions, offer mild compression
- ABx x 24-48h for Open Fracture
- Monitor Compartments Q2-4h x 48h PO
- Elevation in bed (BRP, begin rehab)
- Patient NOT STABLE for transfer or DC until Abx & Comp Checks are completed
12 Hrs Post-Op Compartments Measured

*Note shiny swollen Skin

Splint had been Progressively Loosened

- Pain worsening
- Numbness
- Compartments RLE very firm
- Chief examined pt
- Compartment pressures checked due to high suspicion in clinical exam
Hospital Course

• Compartment pressures equivocal

• Not taken to OR as exam improved over next few hrs

• Patient remained hospitalized to complete 48h of PO compartment checks & Abx

• Pain controlled w PO meds, worked w Rehab

• Patient stable for Transfer to SNF HD#4
Factors which affect timing of surgery

- **Medical Stability**: this pt was medically stable; Urgent OR on DOA for washout of OPEN fx
- **Soft Tissues pre-op**: min edema enabled early fx fixation
- **Soft tissues post-op**: ++ edema monitored closely x 48hrs for compartment syndrome
- **Complications**: none
- **Total Duration**: Admit to Fix to Discharge: 4Days
Case #3

72 yo M found down near outside stairs on hospital grounds & transported to ED

Injuries: TBI/concussion; R frontal laceration; rib fxs/R hemothorax
R intertrochanteric hip fracture
R humerus fracture (subacute)

Mechanism of Injury: unknown
Admitted to Trauma service/ICU
Past Medical Hx: HTN, HLD, bilateral inguinal hernias, BPH, HepC, personality d/o, remote IVDU & MJ, Vit-D def, genital warts; legally blind

Past Surg Hx: s/p R cataract extraction 12/15; s/p Left hip ORIF 2007

Social Hx: lives in SRO; has case mgr

Substances: +tobacco

Last meal: unknown
HD#1  R hip severe degenerative joint disease & min displaced femoral neck fracture
Severe degenerative joint disease R hip joint:
- Asymmetrical (worn down) femoral head
- Asymmetrical acetabulum
- No joint space
Minimally displaced hip fracture with severe osteoarthritis (degeneration) of the R hip

CT Scan

CT scan 3D reformatted
Right humerus fx (old): fx's rounded edges w/ sclerosis (white edges)
Assessment
72 yo blind M, found down with R hip fx & R humerus fx; previously independent ambulator

PLAN
• NWB RLE will need hip fixed as soon as possible
• WBAT RUE (chronic fracture) non-op treatment
• OR when Medically Cleared
HD#5 OR for R Total hip replacement
(poor bone quality required extra fixation of fractured bone intra-op)
R humerus fx (non-op treatment) in fx brace

Given the degeneration and chronicity of this humerus fx

Minimal pain per patient

No surgical intervention
**Hospital Course**

- HD#5 to OR (delayed due to medical issues)
- OR was complicated by arrhythmia
- Pt. returned to ICU for stabilization
- Treated for new onset Afib, GI bleed, new dx hypothyroidism, & delerium
- HD#7 transferred to Med Surg Floor
- Patient suffered from continued delerium which slowed progress with REHAB
Ortho PLAN:

- WBAT RLE, No hip precautions
- WBAT RUE in Fracture Brace
- DVT PPx enox 40mg SQ daily x14d
- PT/OT ASAP Post-Op
- HD#20 patient transferred to SNF
Role of Nursing

• In this case, delerium played significant role in delaying progress to get the patient up & out of bed in a timely fashion.

• He was started on new meds for Afib & for hypothyroidism & needed meds for pain.

• Nursing staff had full time job of redirecting the patient until he cleared & was able to respond to direction & teaching and was “safe” for transfer to SNF at Hospital Day #20.
After Discharge:

• Routine outpt clinic f/u

• started on Vitamin D supplement

• Will most likely never get R humerus reconstructed as this is a huge reconstructive surgery in a patient who may not be safe with poor vision (pain/limit in function) would be guide for any future surgery
Summary

These ortho cases represented different timelines, yet demonstrate how following the AO principles of

• anatomical reduction,
• fracture stabilization,
• careful handling of soft-tissues, &
• early mobilization

will guide most any fracture/trauma case from hospital admission to discharge.
My hope is that Nursing staff will recognize these basic orthopedic principles and be able to apply them to beside nursing from case to case.

Thank you!
References

A.D. Duckworth, M. McQueen; Diagnosis of acute compartment syndrome; Journal of Bone & Joint Surgery, 2011; 18.

https://www2.aofoundation.org

Babak Shadgan, MD, MSc,* Matthew Menon, MD,† David Sanders, MD,‡ Gregg Berry, MD,§ Claude Martin, Jr., MD, MBA,¶ Paul Duffy, MD,** David Stephen, MD,†† and Peter J. O’Brien, MD;

Current thinking about acute compartment syndrome of the lower extremity

http://Orthobullets.com/ Orthopedic teaching site for Residents
UptoDate