Timing of Open Fracture Surgery

David Kahler MD
Prof Ortho Surg UVA
SEFS 30th Anniversary meeting, Jan 2017

Wound Basic Science

- Bacterial colonization and adhesion to bone is time dependent – Staph biofilm binds strongly to bone within 3 hours
- Contaminated wounds reach infective threshold (10^5 organisms/gram) about 5 hours after inoculation
- Foreign bodies (silk suture in experiments) decrease infective threshold 1,000 fold
- Pulsatile lavage loses efficacy three hours after bacterial inoculation in guinea pigs
- Guinea Pigs die if not debrided within 6 hours.

Points I would like to make:

- The 6-hour rule:
  When antibiotics are administered early, a 6-hour delay in formal debridement for an open fracture has not been shown to be an independent risk factor for infection.
  - Surgeon discretion should play a large role in the timing of initial wound debridement, and timing of wound closure
- The truth is, it depends
  - On severity of other injuries
  - On severity of contamination (open water and soil/farm equipment is bad)
  - On availability of implants, OR, and a good well-rested staff
- The choice to defer urgent surgery should not depend on whether it is more convenient for me, at potential increased expense and anxiety for the patient.

Orthopaedic Emergencies: A spectrum

- More emergent to less emergent:
  - Compartment Syndrome
  - Fracture with persistent vascular compromise or persistent skin compromise after closed reduction
  - Irreducible dislocation, or fracture dislocation (hip, knee, talus, or proximal humerus with plexus involvement)
  - Run-of-the-mill open fracture

Are Open Fractures Emergencies?

- The truth is, it depends
  - On severity of other injuries
  - On severity of contamination (open water and soil/farm equipment is bad)
  - On availability of implants, OR, and a good well-rested staff
- The choice to defer urgent surgery should not depend on whether it is more convenient for me, at potential increased expense and anxiety for the patient.

Disclosures

- I serve on the AOTK Computer Integrated Surgery Expert Group and receive travel expenses
- I was previously a consultant for BrainLAB Navigation.
- Speaker for Siemens Intraoperative 3D

University of Virginia Orthopaedic Surgery

Bacterial colonization and adhesion to bone is time dependent – Staph biofilm binds strongly to bone within 3 hours
- Contaminated wounds reach infective threshold (10^5 organims/gram) about 5 hours after inoculation
- Foreign bodies (silk suture in experiments) decrease infective threshold 1,000 fold
- Pulsatile lavage loses efficacy three hours after bacterial inoculation in guinea pigs
- Guinea Pigs die if not debrided within 6 hours.
Recent Culture Change

- 9 recent large retrospective studies and 2 prospective studies have shown no increase in infection rates between those treated within 6 hours and those treated between 6-24 hours (generally about 7% infection rate in both groups).
- Very early IV antibiotic therapy and tetanus prophylaxis are the priorities.

British NHS

- 1997: British Orthopaedic and Plastic Surgery organizations jointly endorsed a 6-hour rule for operative excision of the open fracture wound.
- 2009: The same bodies now endorse a 24-hour rule, provided that antibiotics were administered early.

The “Trauma Room” era

- If you have a guaranteed start at 0730, and there is not good evidence that emergent debridement improves outcomes, why come in at 2300 for an open tibia?
- But...
  - What if something else more urgent comes in – Pulseless pediatric supracondylar? Irreducible hip? A IIIC open tibia?
  - What if your patient’s daughter (law school student) has searched the internet and decided that you are being negligent? And found the three studies from the 1990’s that suggested a benefit with early surgery?

Selection and Surgeon Bias?

- I suspect that less severe open fractures were more likely to be deferred in the retrospective studies; bad, contaminated cases were likely treated ASAP.
- In my practice, I will do a more aggressive debridement and be less likely to do a primary closure in a delayed debridement case, potentially increasing morbidity and cost.
- Prospective Studies: Good surgeons get good results regardless of timing (hard to extrapolate results to all surgeons).

Primary Closure/Wound VAC

- Don’t get me started.
- Both have a role in selected cases...
- But VAC is overused, and probably shouldn’t be used acutely; has decreased the need for free flaps at the expense of increasing the infection rate.
- I fear that primary closure is done more for the benefit of the surgeon than the patient. When in doubt, I still favor a second look.
When our patients Google “open fracture emergency”

• 4th hit: AAOS Ortho Info
  – “...when a broken bone protrudes through the skin or a wound penetrates down to the broken bone...”
  – “An open fracture should be managed as soon as possible. Your doctor’s goal should be to prevent infection because infection can prevent fractures from healing and possibly lead to amputation of the limb.”

10th hit – Jeff Anglen, OTA 2010

• Lecture on open fracture wound care, available to all comers on OTA website
• The 11th Commandment: Open Fractures are Surgical Emergencies!
• (Plaintiff attorney Nirvana – how can you argue on the stand with the past President of the OTA?)

11th hit – AO Foundation.org

• “Thoroughness of debridement appears to more important than how quickly it is done (I suspect the hand of Kellam here)"

But then there’s the Bible...

• Wheeless’ Online Textbook of Orthopaedics, hit #13
  “Treat all open fractures as emergencies.”
• All of our residents and med students know that anything in Wheeless, or Miller’s review book, is the truth (ref 11th Commandment).
But then there’s the Bible...

- Wheeless’ Online Textbook of Orthopaedics, hit #13
- “Treat all open fractures as emergencies.”
- All of our residents and med students know that anything in Wheeless, or Miller’s review book, is the truth (ref 11th Commandment).

Changes during my career

- Less urgency to treat open fractures, especially in the face of other severe injuries or OR situation.
- But I still spend a long time on careful debridement, especially if treatment is delayed.
- And:
  - I don’t think of closing any wound primarily after 12 hours, or if there is:
  - obvious contamination/innoculation at the time of initial debridement
  - Delay in initial antibiotic treatment
  - Compromised host or tissue

New Frontiers

- Very Early Debridement
  - There is some evidence, including wound basic science, that perhaps we should consider a 2-hour rule in isolated severe open fractures.
  - There is also pretty good evidence that adjunctive local antibiotic therapy, applied directly to the wound bed, is beneficial. Research in progress.

Conclusion

- Let’s set a good example to our fellow physicians and trainees by doing the right thing, and getting open fractures to the OR when the patient is medically optimized and there are appropriate resources available.
- If we allow the culture of the OR to change too dramatically, we might not be able to get true emergencies in when we need to.