



2009 OTA Annual Meeting
Manchester Grand Hyatt
San Diego, CA

(#S9): Mini Symposium:
Treatment of Orthopaedic Infections

Elizabeth H, Level II

1:15pm – 2:45pm
Saturday, October 10, 2009

Moderator: William T. Obrebsky, MD

Faculty: Jeffrey O. Anglen, MD
Andrew H. Schmidt, MD

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Disclosure: Faculty disclosure can be found starting on page 67 of the 2009 OTA Annual Meeting program.

**OTA Symposium 2009
Postop Wound Infections**

**Jeff Anglen MD
Andrew Schmidt MD
William Obrebskey MD MPH**

Predictors and Diagnosis of Early and Late Post-op Infections

Andrew Schmidt, MD

Predictors of infection after internal fixation

It is generally accepted that infection rates are increased in the following circumstances:

- Open fractures
- Malnourished patients
($<$ WBC, $<$ albumin, $<$ Pre-albumin)
- Diabetics
- Peripheral vascular disease
- Immunocompromised patients, incl HIV.
- Transfusion
- EtOH abuse
- Medical co-morbidities

Thanni et al (2004): Evaluated SSI in 90 consecutive patients. Predictors of infection were:

- Duration of operation longer than 120 minutes (OR 2.25, 95% CL 0.48-10.16),
- Male gender (OR 2.01, 95% CL 0.44-10.45),
- Injury-operation interval less than six months (OR 2.00, 95% CL 0.22-46.08),
- Fracture fixation with plates and screws (OR 1.51, 95% CL 0.36-6.40),
- WBC $<$ 5,000/mm³ (OR 1.50, 95% CL 0.15-16.37),
- Preoperative urinary catheterization (OR 1.48, 95% CL 0.00-16.19),
- Postoperative urinary catheterization (OR 1.24, 95% CL 0.29-5.00).

Diagnosis of Implant – associated infection

- An infected fracture should be considered in anyone with persistent pain or delayed union of a fracture treated with internal fixation.

Tibial Infections After IM Nailing

Three presentations:

- 1) Fever with localized pain, swelling, and erythema at the fracture site without

abscess formation.

- 2) Obvious purulence at the fracture site.
- 3) Delayed presentation with purulent drainage from the fracture site.

Laboratory studies

- Elevations in total leukocyte count, ESR, or C-reactive protein.
- A rising CRP after 48 hours is predictive of a septic complication.

C-Reactive Protein in Patients Undergoing Surgery for Fractures

Two studies: Scherer et al 2001, Neumaier and Scherer 2008

Scherer et al 2001:

- 330 trauma patients undergoing fracture repair had pre-op and at least 3 postop CRP levels done.
- Peak value occurred on POD # 2. Magnitude proportional to surgical trauma.
- Patients with complications had a second rise in CRP, 7/9 infections had increasing CRP before onset of sx.
- A cut-off level of 14 mg/dL on the fourth day after surgery was recorded for the patients with deep wound infection.

Neumaier and Scherer 2008

- 787 patients
- Similar findings to earlier study, except that for deep wound infection, a cutoff level of 96 mg/L (sensitivity 92%, specificity 93%) after the fourth day of surgery was recorded.

Imaging studies are generally nonspecific

- Periosteal new bone, demineralization, or a sequestrum may be seen in chronic infections.
- Indium scans and MRI may also be useful, but are infrequently diagnostic.

There are no specific confirmatory tests other than the finding of bacteria on gram stain or culture.

Methods to Improve Diagnosis

- Sonication of surface dislodges adherent bacteria and improves increased yield 5X
- Examination of sonicated samples by immunofluorescence microscopy and PCR increased yield 10X

Detection of Biomaterial-Associated Infections...

- 22 cases of suspected infected prostheses
- Routine cultures of swabs or pieces of tissue + 41%

- Prolonged culturing + 64%
- Extensive culturing of scrapings from implant surface + 86%

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Treatment of Early Post op Wound Infections

William T Obrebskey MD MPH

- I. Treatment of early post operative wound infection
 - a. Incidence 1% to 20%.
 - b. Fractures - open continuation, multiple operations, soft tissue damage or loss, foreign bodies, malnutrition, dead space, and blood supply.
 - c. Quandary -
 - a. Stability – Union
 - b. Debridement – Eradication,
 - c. To remove or not remove implants. That is the question

- II. Options
 - a. PO antibiotics
 - b. Debride, leave implants, and Antibiotics, time – 2, 4, 6, 12 weeks
Remove all implants.
 - c. Debride and Exchange Implants
 - d. Debride, remove Implants, Antibiotic until infection eradicated, replace Implants

- III. Morbidity
 - a. Time

- b. Pain (Unstable Fracture)
- c. Multiple Operations
- d. Amputation

IV. Data

- A. Trebse R, J Bone Joint Surg Br; 2005.
 - 24 patients with infection of stable implant present < 1 year
 - All culture positive and OR debridement in 71%
 - Antibiotic 2-4 weeks and total IV/PO 3 months
 - Implants: Prostheses – 20, hip 17, knee- 3, ankle- 1, fx orif -4
 - Outcomes – 20/24 no recurrence -83%, all failures- prostheses
- B. Infections associated with orthopedic implants. Trampuz A. Widmer AF. Current Opinion in Infectious Diseases. 19(4):349-56, 2006 Aug.
 - Debride, retain and suppression – 60 % success at 2 years, no rifampin used (21, 22)
 - Debride, single stage exchange – 85% success (23-26)
 - Debride and 2 stage revision - > 90% success (27-29)
- C. Rightmire E, Zurakowski D, Vrahas M. Acute infections after fracture repair: management with hardware in place. Clin Orthop Relat Res. 2008 Feb;466(2):466-72.
 - 69 Pts s/p ORIF w/in 4 months, 17 did **not** have OR debridement
 - 68% (47/69) successful suppression til union
 - 36% (18-47) had late deep infx
 - 32% (22/69) Failed: 8 nonunions, 6 casted, 2 bone graft, 3 ex fix, 2 girdlestones
 - Smoking predicted failure: 79% vs 52%
- Berkes, M Obremskey, WT et al. Treatment of Early Post op Wound Infections. OTA 2008.
 - 123 pts s/p ORIF < 6 weeks with OR debridement and culture positive bacteria
 - IV/po antibiotics 6-12 weeks
 - 72% fractured healed w/o other surgery
 - 30% required HW removal late due to recurrence
 - 64% total no further surgery
 - 6% amputation
 - Failure predicted by IMN, pseudomonas, open fx, lower extremity fx
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- Debridement and antibiotics – approx 85% “success”
 - Exchange implants – 91%
 - Remove implants if “loose” or resistant organisms: MRSA, enterocci, pseudomonas, fungi
 - Antibiotics for 3 mos if metal retained
 - Consider removal of implants after union, stop antibiotics for 2 weeks prior
- Zimmerli W, et.al.. JAMA 1998; 279:1537–1541
 - RCT of infected prostheses s/p debridement and 2 weeks IV
 - Cipro and placebo 58% retention
 - Cipro and rifampin 100% retention

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Treatment of Post-fracture Osteomyelitis

Jeff Anglen, MD

- I. Definition
- II. Diagnosis
 - a. Clinical
 - i. Typical signs of infection: drainage, erythema, recurrent swelling
 - ii. More subtle signs: skin changes
 - iii. Pain
 - iv. Stable (healed bone) vs. Unstable (Nonunion)
 - b. Imaging
 - i. Initial Radiographs
 - ii. Nuclear
 - 1. Technetium Polyphosphate
 - 2. Indium labeled leukocytes
 - iii. MRI
 - iv. Fluorodeoxyglucose positron scanning (FDG-PET)

Modality	Sensitivity	Specificity
PET	96% (88-99)	91% (81-95)
Bone Scan	82% (70-89)	25% (16-36)
Leukocyte Scan	61% (43-76)*	77% (63-87)
Combined scan	78% (72-83)	84% (75-90)
MRI	84% (69-92)	60% (38-78)

* LS – periph	84% (72-91)	80% (61-91)
Radiography	60% (28-86)	67% (36-89)
Gallium	80% (44-96)	42% (17-71)
CT	67% (24-94)	50% (3-97)

- c. Laboratory
 - i. C-reactive protein – best indicator for treatment monitoring
 - ii. ESR, WBC
- III. Treatment Plan
 - a. Goals
 - Define success: healed wound, functional limb
 - b. Staging
 - Eliminate infection first, restore live covered wound, reconstruction of function
 - c. Expectations
 - i. 44/46 patients healed at 5 years, with 38/42 returning to work after Rx for tibial osteomyelitic (Siegel et al.)
 - ii. Success rate varies with Host condition
 - Ciorny: 1,966 pts overall success rate 84%
 - A-host: 96% B-host: 73%
- IV. Surgical
 - a. Drain the pus
 - b. Debride
 - i. Remove foreign material completely
 - ii. Resect bone and soft tissues to live margins
 - iii. Dead space management – spacers and Masquelet membranes
 - c. Cover
 - i. Within a week
 - 1. Bead pouch
 - 2. VAC
 - ii. DPC
 - iii. Local flaps
 - iv. Distant flaps
 - d. Manage Defects
 - i. Grafts
 - ii. Ilizarov: transport or shortening/lengthening
 - e. Chop
- V. Antibiotics
 - a. Systemic
 - i. Choice of drug
 - 1. based on culture results from good samples

2. Some initial regimens:

Organism	First Choice	Alternatives
Staphylococcus aureus (meth sens)	Oxacillin or Clindamycin	1 st gen cephalosporin or vancomycin
MRSA	Vancomycin plus rifampin	Linezolid, Bactrim, Minocycline plus rifampin
Streptococci (Pcn sensitive)	Penicillin G	Clindamycin, Erythromycin, vancomycin or ceftriaxone
Strept pneumoniae (Pcn intermediate)	Ceftriaxone	Erythromycin, Clindamycin or Levofloxacin
S pneumoniae (PCN resistant)	Vancomycin	Levofloxacin
Enterococcus sp.	Ampicillin or Vanc	Amp-sulbactam, Linezolid
Enteric Gram neg rods	Fluoroquinolone	3 rd gen cephalosporin
Serratia or Pseudomonas aeruginosa	Levofloxacinin, cefepime plus fluoroquinolone	Ertapenem
Anaerobes	Clindamycin	Amoxicillin-clavulanate, or Metronidazole
Mixed aerobes and anaerobes	Amoxacillin-clavulanate	Ertapenem

Table from OKU Traum 3

ii. Duration/route of treatment

1. IV at least 2 weeks.
2. total duration controversial 2-6 weeks?
3. longer for suppression
4. agents with good bioavailability by oral route:
Fluoroquinolones, Metronidazole, Linezolid, rifampin, Trimethoprim-Sulfamethoxazole
5. Fluoroquinolones vs. Beta-Lactams: 7 studies suggest no difference (Karamanis et al, 2008)

b. Local

- i. Antibiotic bead and rods
- ii. Absorbable drug delivery systems

c. Do you need an ID consultant?

- i. Is she part of a dedicated osteomyelitis team?
- ii. Does she have a particular interest in Orthopaedic infection?

VI. Supportive Therapies

- a. Tobacco cessation

- b. Nutritional Support
- c. Supplements and Immune boosters
- d. Hyperbaric Oxygen
- e. Electromagnetic

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