Periprosthetic Infection
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Common Scenarios
- Acute Infection (Less than 2 weeks of symptoms)
- Well Fixed Components
- 2 Stage for Infection
- The “Gold Standard”
- Single Stage Revision for Infection
- Gaining Traction
- Infected Unicompartmental Knee

Infection and Arthroplasty
- Remains one of the most common reasons leading to reoperation
- Sculco Instructional Course Lect 1993:
  - US per year, 3500-4000 cases of infxn
  - Overall annual cost of $150 – 200 million
- Kurtz et al JBJS 2009:
  - Inf 2 yrs after primary sx 1.63 % (vs 1.86% for TKA)
  - 2-10yrs post-op 0.59 % THA (vs 0.65% for TKA)
  - F>M
Infection

- Malinzak et al. JBJS 2009:
  - Risk factors:
    - BMI > 30
    - Morbidly obese pts (BMI > 50)
      - \( \text{odds ratio of 21.3} \)
    - DM
    - Nutrition
    - Immunocompromised pts
    - RA
    - Sickle-cell dz
    - Solid organ transplants

Infection Labs

- High clinical suspicion
- Spangehl JBJS 1999.
- Greidanus JBJS 2007:
  - CRP > 10 mg/L
  - ESR > 30 mm/hr
  - Synovial cell count > 2500/mm³
  - > 60% PMNs

Infection

- Ghanem et al.- multicenter study
  - Analyzed the synovial fluid, CRP, ESR
  - 429 R-TKA
  - Identified optimum diagnostic cutoff values for infection
  - Synovial fluid leukocyte count of > 1100 cells
  - Neutrophil percentage of > 64%
  - C-reactive protein level of > 10 mg/L (> 1 mg/dL)
  - ESR > 30 mm/hr.

Infection

- Ghanem et al. - multicenter study
- Synovial fluid leukocyte count and neutrophil percentage below the cutoff - NPV 98.2%
- Both above the cutoff values, 98.6% infected
- Neutrophil percentage and C-reactive protein level below the cutoff values
- Infection extremely rare

Musculoskeletal Infection Society Criteria

- Draining sinus
- Pathogen isolated from two separate tissue or fluid samples
- Four of six of the following criteria
  - Elevated ESR and CRP
  - Elevated synovial leukocyte count
  - Elevated synovial neutrophil percentage (PMN%)
  - Presence of purulence in affected joint
  - Isolation of microorganism in one tissue or fluid culture
  - >5 PMN/HPF in at least 5 HPF in tissue sample

Detection of Periprosthetic Infections With Use of Ribosomal RNA-Based Polymerase Chain Reaction

- versus the intrinsically high sensitivity of the DNA-based assay
  - Many false-positive results
- DNA that is present in dead bacteria or in the recombinantly prepared reagents would also be amplified and detected
- rRNA-based RT-qPCR demonstrated 100% specificity & positive predictive value
- Sensitivity equivalent to that of intraoperative culture
Infection

- Bergin et al.- Real-time reverse transcription polymerase chain reaction to detect viable bacteria
- Bacterial mRNA is broken down quickly after death
  - Detection of mRNA is more likely to be specific
  - mRNA detection method was able to identify both culturable and unculturable bacteria
  - Minimized the false-positive results associated with traditional polymerase chain reaction


Synovasure- Is this the Answer??

- I am not so sure at this time
- Personal experience
  - One Synovasure Neg- Cx ++ Ecoli
  - One Synovasure Neg- Cx ++ Staph Epi
  - One Synovasure Neg- Cx ++ MSSA
  - Dr Mollabashy- Synovasure Neg & MRSA ++
  - Recent Infected ACL Case- Synovasure Neg/ Neutrophil Elastase Positive??

What do I do?

- Rule out infection in all failed TJA
- Incidence ~ 0.5- 2%
- Organism Staph. epidermidis and aureus
- Predisposing factors-
  - Immuno-compromised states
  - Multiple prior surgeries
  - Concurrent infection at other sites (UTI, dental abscess, other implants)
  - Prolonged surgery
  - Prolonged wound drainage
Start with Labs

- Preoperative labs
  - WBC count - rarely useful
  - ESR >30 - sens-0.82; spec-0.85
  - CRP >10 - sens-0.92; spec-0.96
  - If both negative, probability of infection ~ 0
  - Xray: endosteal scalloping, periosteal reaction

- Intraoperative labs
  - Synovial fluid analysis >2500/ , >80% PMN

- Intraoperative labs (continued)
  - I like to do Cell count from aspirate at TOS
    - Intraoperative gram stain poor sensitivity (14%)
    - Intraoperative frozen section
      - >5 PMN/hpf - suggestive
      - >10 PMN/hpf - probable
      - Sens - 0.80-0.91; Spec - 0.94-0.99
  - Intraoperative cultures - Gold standard

- 2 stage exchange arthroplasty with antibiotic spacer
  - Gold standard
  - 2 debridements
  - 2 types antibiotic cement spacer (articulating / static)
  - Interval ESR, CRP, aspiration, frozen section
  - Salvage procedures: arthrodesis, girdlestone, disarticulation

- Outcomes
  - Single staged cementless/non antibiotic cement: 60% success rate (Depends)
  - Single staged with antibiotic cement: 83%
  - 2 staged cemented or cementless implantation: 90-95% (Maybe Not??)
Chronic Suppression of Periprosthetic Joint Infections with Oral Antibiotics Increases Infection-Free Survivorship
by Marcelo B.P. Siqueira, Anas Saleh, Alison K. Klika, Colin O’Rourke, Steven Schmitt, Carlos A. Higuera, and Wael K. Barsoum

J Bone Joint Surg Am
Volume 97(15):1220-1232
August 5, 2015
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Flowchart showing eligible cases of chronic antibiotic suppression and matched cases without suppression.

Defined as treatment with oral antibiotics for a minimum of six months following the initial course of intravenous Antibiotics

Elaborate statistical modeling to match cases

Kaplan-Meier infection-free prosthetic survival curves for suppression and non-suppression patient groups.

(1) subsequent surgical intervention for infection
(2) persistent fistula, drainage, or joint pain at the last follow-up visit
(3) death related to the periprosthetic joint infection. Any unresolved drainage at the last follow-up visit was considered a failure.
Kaplan-Meier infection-free prosthetic survival curves for subset cohorts.
Model compared the benefits of suppression between subsets
Infecting organism (methicillin-resistant S. aureus [MRSA] versus methicillin-sensitive S. aureus [MSSA] versus non-S. aureus), affected joint (hip versus knee), and type of surgery (irrigation and debridement with polyethylene exchange versus two-stage revision)

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Chronic Suppression of Periprosthetic Joint Infections with Oral Antibiotics Increases Infection-Free Survivorship

Who Gets the Most Benefit
1- Patients who underwent irrigation and debridement with polyethylene exchange
2- S. aureus infection

Who May Continue to have Trouble
1- Knee infection
2- Greater number of prior revisions → identified as variables associated with treatment failure

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The Fate of Spacers in the Treatment of Periprosthetic Joint Infection

- Gomez et al. retrospective
- 504 periprosthetic joint infections (326 knees and 178 hips)
- Resection for infection and placement spacer (either spacer block [72%] or articulating [28%])
- Multiple outcome variables
  - Demographic characteristics, type of spacer used
  - Microbiology of infective source, clinical course after spacer insertion
  - Comorbidities, and differences in reimplantation rates based on organism type and resistance were examined

- 417 (82.7%) of 504 cases were treated with reimplantation
- Reimplantation group
  - Sixty patients (14%) had a subsequent infection
  - Eighty-five were lost to follow-up
- First glance might seem to approach those in the literature
- Addition of the reinfections lowers the results
The Fate of Spacers in the Treatment of Periprosthetic Joint Infection

- Of the eighty-seven cases that did not undergo reimplantation
  - 15 - subsequent non-reimplantation surgical procedure
  - 72 - retained the spacer
- Of the patients who retained the spacer
  - 36 subsequently died – ave. 3 years after (5 initial hospitalization)
  - Summarize - almost 20% did not complete the second stage
  - Of those who did, 14% had a subsequent infection

What about Retained Spacer?

- 72 cases that retained the spacer,
  treatment “success” was 23.6% (17) at a minimum one-year follow-up
- Pts. With reinfection
  - 22.5% were infected with the same organism
  - Increased number of interim spacer exchanges in 76 pt resistant organism(s) (p = 0.02)

Highly concerning?

- Maybe we are not doing as well as we think
- Persistent infection?
  - Gomez et al. infections after the completion of the second stage, identified organism is different from that cultured at the time of the index explantation
  - ? considered a failure of the first stage. This “new” organism not cultured at the time of the original surgical procedure
- Possible?
The Fate of Spacers in the Treatment of Periprosthetic Joint Infection

Questions?
- Are periprosthetic joint infections more commonly polymicrobial?
- Are our culture techniques not sophisticated enough?
- When you treat the initial organism → non-identified organism proliferates?

Uni and INFXN
- *J Arthroplasty* 2012 Sep;27(8 Suppl):46-50
- Optimal cutoff values
  - 27 mm/h ESR
  - 14 mg/L for the C-reactive protein
  - 6200/μL for the synovial fluid WBC count
  - 60% for the differential

A Word on Single Stage?
- European experience
  - Germany/ France
    - (Cemented Hinges?)
  - Supplemental ABX delivery
  - F. Haddad MD
  - Recent Published Experience
  - AAOS 2016!!
In Summary - Treatment of Periprosthetic Joint Infection

- **Bottom Line at This Time**
- Rudimentary knowledge → optimum treatment of periprosthetic joint infection for any specific patient
- Sick patient / virulent organism → low probability of success
- What would be nice to know
  - Knowledge of the likelihood of success
  - Patient-specific criteria and infecting organism
  - Identification of a patient-specific infection-management algorithm
- **Not There Yet**

Thank You
First you need to think about it!
Scenarios that may present like infection?

69 yr M s/p R HR

- I&D 1 year postop for pain and swelling
- Brownish fluid, cultures negative
- Metal allergy tests inconclusive
- ESR=20; CRP=10.8
- Aspiration (-): 988 cells; 93% lymph
The wide spectrum of clinical problems associated with excess metal debris

Adverse Reactions to Metal Debris

- Metallosis
- Effusion/Burn
- Allergy
- AVN
- Infection
- Soft tissue necrosis
- Pseudotumourous mass

Infection must be ruled out as the first possibility. Other conditions such as femoral head AVN and soft tissue (post) irritation can mimic an allergic response.
Corrosion at the Head-Neck Taper as a Cause for Adverse Local Tissue Reactions After Total Hip Arthroplasty

- 10 patients underwent revision of a total hip arthroplasty
  - Primary or secondary diagnosis: corrosion at the modular femoral head-neck taper junction
  - Six onset: mean of 3.2 years (range, 0.7 to 8.7 years) after their index procedure presenting symptoms varied
  - Groin, anterior, lateral thigh pain, buttock pain, lateral hip pain weakness, palpable fluid collection lower-extremity swelling

56 F - R Hip Pain

- R THA 1 year prior
- Presents with pain and grinding in R Hip
Determine INFX is Present

Classification-Fitzgerald et al

- Stage I Acute post operative infection
  - first 6 months post op
- Stage II Delayed deep infections
  - 6-24 months post op
- Stage III Late hematogenous infection
  - >2yrs post op