Disclosures

- Research Support
  - 3M
  - Aesculap
  - AO Spine
  - Biomet
  - Cempra
  - CeramTec
  - DePuy
  - Integra
  - Myoscience
  - NDRI
  - NIH
  - Novartis
  - OREF
  - Pfizer
  - Rotation Medical
  - Simplify Medical
  - Smith and Nephew
  - Stelkast
  - Stryker Orthopedics
  - Stryker
  - Tornier
  - Orthespace
  - Zimmer Biomet

- Consultant
  - DJO Surgical
  - Miami Device Solutions

- Royalties
  - DJO Surgical
  - Miami Device Solutions
  - Elsevier

- Research Support
  - Arthrex
  - Integra Life Sciences
  - Depuy
  - Zimmer

- Board Member/Adviser
  - Biedermann Lab for Orthopaedic Research at University of Pennsylvania
Mean = 0.98%

The Bigger Problem: How do we define infection???

New Definition for Periprosthetic Joint Infection
From the Workgroup of the Musculoskeletal Infection Society

Eric H. Padgett, MD, Mitchell Melancon, Ph.D., Matthew L. Ramsey, MD,
Gerald R. Williams, MD, Javad Parviz, MD, Surena Namdar, MD, MSc.

Prognostic Factors for Bacterial Cultures Positive for *Propionibacterium acnes* and Other Organisms in a Large Series of Revision Shoulder Arthroplasties Performed for Stiffness, Pain, or Loosening

Paul Peterson, MD, Evan Rothman, MD, Nestor Fung, MD, Andrew Maren, MD, Alexander Boliehen, MD, Barbara J. John, BS, William J. Watson, MD, and Frederick H. Hoffman, MD

- 56% positive cultures
- 70% positive for *P. acnes*

The more cultures you send, the more likely you are to get positive cultures

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*Propionibacterium acnes*: an underestimated etiology in the pathogenesis of osteoarthritis?

Ofer Levy, MD, Michael Orths, MBBS, BBD, ESL, Ortho-PE, MAA, E BPH, FACP, FACP, FRCR, E BPH, FACP, FACP, FRCR, E BPH, FACP, FACP, FRCR, E BPH, FACP, FACP, FRCR, E BPH, FACP, FACP, FRCR, E BPH, FACP, FACP, FRCR, E BPH, FACP, FACP

- N=55, 42% positive *P. acnes* joint cultures in primary arthritis

Propionibacterium acnes in primary shoulder arthroplasty: rates of colonization, patient risk factors, and efficacy of perioperative prophylaxis

Chuan Kang Koh, MBChB, Jonathan P. Mark, MD, FRCS, Durgaprasad Dwarakanath, MD, FRCS, Cameron G. Walker, MD, Peter C. Poon, MBChB, FRCS

- N = 22, 73% positive *P. acnes* deep and superficial cultures

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Propionibacterium Persists in the Skin Despite Standard Surgical Preparation

Michael J. Lee, MD, Paul S. Fossett, MD, Susan Raha, MD, PhD, Roger E. Rosenberg, PhD, Rob M. Ross, and Frederick H. Hoffman, MD

- 70% rate of persistence of Propionibacteria after skin preparation

Decolonization of Propionibacterium acnes from the skin of the shoulder with oral Doxycycline: a randomized controlled trial

Suren Namdar, Theresa Nicholson, Jared Parvizi, Matthew Ramsey

- No Drug: 22/37 positive *P. acnes* cultures (59%)
- Doxycycline: 16/37 positive *P. acnes* cultures (43%)
Diagnosis

Serum
Synovial Fluid
Tissue

Serum

The challenge of *Propionibacterium acne* and revision shoulder arthroplasty: a review of current diagnostic options

*J Shoulder Elbow Surg* (2016) 25, 1034–1040

Margaret V. Shields, BS<sup>5</sup>, Leyleh Abdullah, BS<sup>5</sup>, Surenza Namdari, MD, MS<sup>5</sup><sup>a</sup>

- **WBC, CRP, and ESR commonly normal**

Serum Interleukin-6 as a Marker of Periprosthetic Shoulder Infection


- **Sensitivity 14%, specificity 94%**

Synovial Fluid

Leukocyte esterase in the diagnosis of shoulder periprosthetic joint infection


Gregory N. Nelson, MD<sup>1</sup>,<sup>2</sup>,<sup>a</sup> E. Scott Paxton, MD<sup>3</sup>, Alexa Nazizikui, BS<sup>2</sup>, Gerald Williams, MD<sup>4</sup>, Mark D. Lazarev, MD<sup>5</sup>, Joseph A. Abboud, MD<sup>5</sup>

- **Sensitivity of 30% and a specificity of 67%**

α-Defensin as a predictor of periprosthetic shoulder infection


Salvatore J. Frangiamore, MD, MS, Anaz Saleh, MD, Matthew J. Groszo, MD, Mario Vardas Kavfas, MD, Carlos A. Higuera, MD, Joseph P. Zennotti, MD, PhD, Eric T. Rizzetta, MD

- **Sensitivity of 63% and a specificity of 95%**
On the horizon: cytokine profiles

Neer Award 2015: Analysis of cytokine profiles in the diagnosis of periprosthetic joint infections of the shoulder

Salvatore J. Frangialtio, MD; Asefa Selah, MD; Matthew J. Gonzalez, MD; Mario Fardis Kone, MD; Xiaochun Zhang, MD; Thomas K. Daily, MD; Thomas N. Bauer, MD; Kathleen A. Bonow, PhD; Joseph P. Lannett, MD, PhD; Eric T. Ritchell, MD

J Shoulder Elbow Surg (2017) 26, 186-196

Synovial Fluid

IL-6, TNF-α, and IL-2: sensitivity = 80% specificity = 93%

Need Tissue

Sensitivity of Frozen Section Histology for Identifying Propionibacterium acnes Infections in Revision Shoulder Arthroplasty


Arthroscopic Tissue Culture for the Evaluation of Periprosthetic Shoulder Infections

Primers designed to amplify a unique region of 16S rRNA gene in *P. acnes*
- Optimized to detect DNA
- 24 hour results

Our results show that *P. acnes* can be detected in practically all sample types

Possible Contamination from:
- the patient
- hospital personnel
- lab personnel
- during sample processing and analysis

**On the horizon: PCR / NGS**

**Neer Award 2017: A rapid method for detecting *Propionibacterium acnes* in surgical biopsy specimens from the shoulder**

Scott Holmes, MSc†, Ana M. Pena Diaz, MSc†, George S. Atthow, MD, FRSCC‡, Kenneth J. Faber, MD, FRSCC‡, David B. O’Gorman, PhD

**Propionibacterium acnes: Disease-Causing Agent or Common Contaminant? Detection in Diverse Patient Samples by Next-Generation Sequencing**

*J Clin Microbiol.* 2016 Apr;54(4):980-7
Sarah McNeely, Ana Fuerte-Menchaca, Laura Wisen, Thura Aziz-Ross, Simon Roth-Apel, Todd B. Kolls, Juan R. Montiel, Laura P. Bohannan, Jennifer E. Draws, Dan Long, Angela S. Biondo, David B. O’Gorman, Todd W. Kolls, Simon Roth-Apel

**Explant, Mechanical Debridement, Irrigation**
Future surgery after revision shoulder arthroplasty: the impact of unexpected positive cultures


Eric N. Padegimas, MD, Cassandra Lawrence, BS, Alexa C. Nazrivel, BA, Benjamin M. Znitiszowski, MD, Joseph A. Abboud, MD, Gerald R. Williams, MD, Surena Nandedar, MD, MS

• N = 28 culture positive, 89 culture negative
• 2 of 28 (7.1%) patients with UPCs required future surgery.
  • 1 case of positive cultures (1/6) during revision
• 18 of 89 (20.2%) patients without UPCs required 25 additional surgeries
  • 3 cases of positive cultures during revision

Abs Protocol:
• 18 of 28 (64.3%) patients received IV antibiotics for 6 weeks postoperatively
• 10 of 28 (35.7%) received a routine 2-week empirical antibiotic regimen

Antibiotics?
Single-Stage Revision Is Effective for Failed Shoulder Arthroplasty with Positive Cultures for Propionibacterium


Jack R. Wu, MD, Beth D. Cottrell, MD, Eric L. Whalen, MD, and Frederick A. Matsen III, MD

• N = 27 Culture positive, 28 Control
• 11% reoperation in both groups, 0 for infection
• Abs protocol:
  • High index of suspicion: IV ceftriaxone and IV vancomycin for 3 weeks
  • Low index of suspicion: oral amoxicillin and clavulane for 3 weeks
  • If 2+ cultures became positive: IV ceftriaxone and/or vancomycin and oral rifampin for 6 weeks followed by amoxicillin and clavulane or doxycycline for a minimum of 6 months

42% antibiotic side effects (GI, derm, leukopenia)

Dual-Stage Revision

• N = 22
• N = 15

• >70% converted to arthroplasties
• No difference in infection recurrence
• No difference in range of motion
• No reoperations for infection (mean 4 years)
Outcomes in the treatment of periprosthetic joint infection after shoulder arthroplasty: a systematic review

Gregory M. Nelson, MD, *, Daniel E. Davis, MD, Suresh Namdari, MD

<table>
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<th>% Failed Treatment</th>
<th>Antibiotics Only</th>
<th>&amp;O, Implant Retention</th>
<th>Resection</th>
<th>A/I Spacer</th>
<th>1-stage</th>
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Conclusions

Diagnosis
- No ideal serum test
- No ideal point of care testing
- Need tissue
- High rate of positive cultures in primary and revision surgery
- Cytokine Profiles/PCR / Next Generation Sequencing?

Treatment
- Explant, mechanical debridement, irrigation
- Single-stage sufficient for most, +/- antibiotics
- Dual-stage for obvious infection/aggressive organisms
- Alter treatment based on host?

Well I say we get drunk, cause I'm all out of ideas