The Challenges

- Infection Risks are Increased
  - Older
  - Sicker - Diabetes/obesity/other comorbidities
  - More difficult cases
- Public Reporting
- Public Awareness
- Pay For Performance
MEMORIAL HERMANN LIMITATIONS
RECONSTRUCTION OF MULTIPURPOSE AND OUGHT
PREVIOUSLY INFECTED
SICK PATIENTS: OBESITY, DIABETES, TRANSPLANT, HEMOPHILIA.
(THOSE OTHERS DON'T WANT)

Conclusion: Including revision surgeries in
the calculation of SSI rates can result in
higher infection rates for institutions that
perform a larger number of revisions.
Differences between primary and revision
surgeries should be considered in national
standards for the reporting of SSI.
CONCLUSION: Multiple patient comorbidities independently contribute to infection risk after TJA. Preoperative TJA infection risk stratification may be feasible and should be investigated further.

Conclusion: Previous fracture or remnants of internal fixation are major risk factors for SSI.

SO WHAT CAN WE DO?

Predisposing Factors and Patient Optimization

- **Obesity**: Malinzak - BMI>50; odd ratio 21.3 compared to cohort
  - MHH: BMI >45 not recommended.
- **ASA/Charlson Co-Morbidity**: Parvizi: correlate with PJI risk.
- **Glycemic control**: Marchant: HbA1C uncontrolled, odds ratio 2.31
  - Mraovic; Preop >112 is risk, post op day one >200 (2x risk).
  - MHH: HbA1C> 7. not recommended, Glucose >200 post op triggers review.
- **Nutritional Status**: Serum transferrin <200, Albumin< 3.5, total lymphocyte ct <1500/mm3 – Increased risk of PJI
- **Anemia**: greater risk of transfusion- Pulido: “transfusion is risk for PJI”
Predisposing Factors and Patient Optimization

- **Renal dialysis**: Sakalkale- high early complication rates in dialysis patients. (58%).
- **Stop antiplatelet** drugs at least one week preop.
- **Herbal meds**: Garlic, gingko biloba, Kava, St. Johns. Wort, Echinacea
- **Rheumatologic agents** - RA risk of PJI - 2.6X risk
  - Methotrexate- stop 1 wk before, hold for 2 weeks
  - Sulfasalazine/azathioprine- 1 wk prior
  - Leflunomide- 2 wk prior
  - Hydroxychloroquine- may treat perioperative.
  - Biologic response modifiers- etanercept etc- 2 weeks prior and 1-2 wk after.
  - Gout/ colchicine/Allopurinol/probenecid- continue up to morning of surgery.

CDC recommends shower with antiseptic solution at least the night before surgery: Mangram, Am J Inf Cont, 1999


Pre-OP Skin Cleansing

- Chlorhexidine-Alcohol vs. Povidone-Iodine for Surgical Site Antisepsis
- NEJM 2010
- 6 VA Hospitals
- 849 subjects
- CHG statistically reduced superficial and deep incisional infection, but not “deep organ” infections.
Preoperative Antibiotics

- ASHP Guidelines: Cefazolin or Cefuroxime recommended for lower extremity arthroplasty.
- Active against Staph species and enteric organisms.
- Cefazolin dose: 1 gm if <80kg or 2 if > 80kg. (2 for all?).
- Start within one hour before skin incision
- Repeat if 2.5X half life (about 4 hr) or if 70% circ vol blood loss.
- No evidence of efficacy greater than 24 hr post-op.
- Even if cath or drain.

Preoperative Antibiotics

- Indications for Vancomycin
  - Carrier or prior MRSA
  - Exposure to nursing home, dialysis unit, recent hospitalization (one year).
  - Health care workers
  - Penicillin Allergy (Consider Clinda, but be aware of C diff).
  - Must be given slowly, “Red Man” etc. Start 90 min pre-incision.
  - MHU uses weight base protocol.
  - Use with Cephalosporin if possible to cover non resistant Staph.

THE OR- LAMINAR FLOW OR HEPA FILTRATION? Facts!

- INFECTION REDUCED- ULTRACLEAN AIR AND BODY EVACUATION SUITS
- LAMINAR FLOW- REDUCTION IN AIRBORNE BACTERIAL COLONY FORMING UNITS (CFU’S)
- NO PROVEN REDUCTION IN INFECTION RATE PROVEN
- CDC Recommendations
  - Positive pressure relative to corridors
  - Greater than 25 air exchanges/hr (>3 fresh).  
  - Filter all air with filters of 90% efficiency
  - In non-LAF rooms, introduce air at ceiling and exhaust near floor.
Preventing Surgical Infection
Environmental Control

• Operating Room Environment
  • Lidwell 1982 - direct correlation between Deep SSI and the number of airborne micro-organisms.
  • Literature controversial - some studies show efficacy, some actually show increased risk. One issue if “other confounders”.
  UV Light
  Multiple studies show effectiveness, but harmful exposure to OR personnel 6-28X recommended levels.

Preventing Surgical Infection
Environmental Control

• Operating Room Environment
  • Laminar Flow – “Consider performing orthopedic implant operations in operating rooms with ultra clean air and body exhaust suites” – CDC
  • Laminar Flow - After decades of clean-air operating rooms, no uniform opinion about the efficiency in preventing infections has been achieved

Preventing Surgical Infection
Environmental Control

• American College of Healthcare Architecture
  • maintain positive pressure in the conventional operating room and provide greater than 15 operating room volumes exchanges per hour
  • Recommend HEPA Filtration
BODY EVACUATION SUITS

- Ritter, CORR 1999 - shedding of OR personnel directly related to contamination - but never shown to be related to SSI.
- PROTECTS PATIENTS FROM SHEDDING OF BACTERIA AND HAIR FROM EXPOSED SKIN, AND MUCOUS MEMBRANES OF OR PERSONNEL.
- Charnley showed 9% reduction to 1% SSI with LAF and Body Suit.
- Lidwell showed a 2.6x increase in SSI with standard OR gown.
- REVERSE ISOLATION MAYBE AN IMPORTANT CONSIDERATION.

Preventing Surgical Infection
Environmental Control - WASH YOUR HANDS!

- Operating Room Environment
- CDC recommends either:
  - Extensive use of antimicrobial soap scrub for several minutes OR
  - Alcohol-based hand rub.
  - MHH-Soap scrub for 3-5 minutes first scrub then CHG subsequently. (unless become contaminated-repeat soap scrub).

SURGEON-HAND SCRUB

- SCRUB WITH ANTIMICROBIAL SOAP FOR 2-6 MINUTES
- 10 MINUTES NOT NECESSARY AND MAY IRRITATE
- DRY HANDS AND APPLY ALCOHOL BASED PRODUCT
SURGEON-HAND SCRUB

- Alcohol based scrubs:
  - Immediate reduction in resident flora by 95% and 99% with repeated applications
  - Continues to lower counts during surgical procedure.

TIMING OF HAIR REMOVAL

- Shaving immediately before = 3.1% SSI rates
- Shaving ≤ 24 hrs before = 7.1% SSI rates
- Shaving > 24 hrs before = 20% SSI rates

If you need to shave - do it immediately before surgery!

HAIR REMOVAL

- Hair removal - method:
  - Safety razor: highest SSI rate - 3.1%
  - Depilatory or no hair removal: low SSI rate - 0.6%
  - Electric razor is alternative.
  - Do not use safety razor.

Tanner - Cochrane database, 2006 meta-analysis: lower SSI with clippers.
SCRUB ATTIRE AND OR BEHAVIOR

OPERATING ROOM ENVIRONMENT

- Operating Room Environment
  Anderson, Am J Inf Cont, 2012
  Traffic=contamination
  OR contamination-shedding
  - Keep doors closed and limit traffic in and out of the operating room
  - Eliminate needless activity
  - Eliminate needless personnel
  - Settle plate studies: number and movement in OR related to number of colonies.

Other Intraoperative Measures

- Skin/Deep knife: controversial literature; recently Schindler (JBJS Br 2006) found coag neg staph common on skin blades. Recommended routine changing of blade.
  - Glowing
    - Double vs triple controversial
    - Change frequently:
      - Al-Mabah – frequent change lowered risk of perforation/contamination
      - Dawson-Boring: 12% and 24% of gloves collected after draping and before opening the final components were contaminated.
      - Davis: JBJS Br, 1999: 28.7% gloves contaminated after draping.
  - PRP: no evidence of benefit in TKA (Peerbooms, ACTA Orthop 2009), (Diiorio, CORR, 2012), (Horstmann, 2011).
Patient Surgical Scrub

- vonEiff, NEJM 2011: 80% of HAI are S. aureus from patients own epidermis.
- Betadyne scrub and paint - proven effectiveness.
- Iodophor-in-alcohol proven effective and improves drape adhesion.

Incise Drapes

- Prevents bacterial penetration and lateral movement of bacteria.
- Bacteria do not multiply beneath the drape.
- Wound contamination reduced from 15% to 1.6%.
- Drapes in general, Blom showed only impermeable drapes are adequate.

Preventing Surgical Infection

Environmental Control

- Patient Environment
  - Monitor and maintain normal glycemia
  - Maintain normothermia (above 36 degrees) Lower temp-lower oxygen partial pressure and reduced T cell and neutrophil function.
  - Use of FAW has been questioned, but no real evidence exists.

CDC recommends; Room temp 68-73 F and 30-60% humidity.
Preventing Surgical Infection
Wound Environment

- Surgical technique
  - Minimize operative time
  - Maintain hemostasis, gentle handling of tissue, eradicate dead space, remove dead tissue and foreign bodies.
  - Peer review- surgical time > 2.5 hrs- exponential increase risk of PJI

Contamination Reduction

- Surgical Trays- Dalstrom- do not open until after skin prep and drape and then cover with sterile towel.
- Splash Basins- Multiple studies show contamination. Multiple authors recommend against use and against reuse of instruments from basin.
- Suction Tips- Robinson: 1993- up to 41% of suction tips are contaminated. Many authors recommend changing the tip.

Irrigation Techniques

- No evidence that antibiotic irrigation is effective in prophylaxis of infection in orthopaedic procedures.¹
- Betadyne solution found to be significantly better than normal saline alone.²
- Several studies show detergents and castile soap to lower bacterial counts.³,⁴

1. Roth et al, Pharmacotherapy 1981; 5:222-227
2. Cheng et. al., Spine 2005
4. Anglen et. al., Int Orthop, 2003
How Much Irrigation?

• One study found that 4 Liters of pulsatile lavage was needed to remove all particle of cement.


Pulse Lavage or Bulb Syringe?

• “Pulse lavage group-significantly lower infection rate” (Hargrove, J Hosp Inf, 2006)
• “High pressure pulsatile lavage-greater penetration of bacteria into tissue” (Counter-Hassinger, CORR, 2005).

DRAINS

• Theoretically reduce the risk of hematoma and thus infection.
• No clear evidence of any benefit.
• Raises concern of tract drainage and passageway of infection.
• One study showed increase risk of positive culture of drain if left in more than 24 hours.

DRAINS

- Study of bilateral total knees with and without drains.
- No difference in swelling, or persistent drainage, quadraceps function, or range of motion.
- Meta-Analysis
- Drains increase transfusion need post total hip and knee and has no major benefit.


DRAINS

- New Study in JOA 2010
- 143 THA's, 3 Groups
  - No drains
  - Drains for 24 Hours
  - Drains for 48 Hours
- No differences in Infection, Duration of Serous Drainage or Blood Loss
- Only difference was less thigh swelling and pain in drain group.

Suture Materials?

- Kirpantsev et. al., Vet.Q, 1997
  - Dog study
  - Monocryl vs. Vicryl
  - Less inflammation early but no difference late

Niemeyer et. al., Ann Plastic Surgery
- 281 Breast reduction cases compared Vicryl vs Monocryl
- Less inflammation and keloid formation with Monocryl

Justinger et. al., Surgery 2009
- Compared abdominal wound closure with Vicryl vs. Vicryl Plus (Triclosan)
- Vicryl 10.8% infection
- Vicryl Plus 4.9% infection
Anticoagulation

- Over anticoagulation- Increased risk of PJI

Local Vancomycin Powder

- Literature support for use in instrumented spine surgery. (Molinari, 2012; Sweet, 2011; O'Neill 2011)
- No current evidence for use in total joints.

Use of Antibiotic Cement

- Parvizi- meta-analysis: 50% decrease in primary and 40% decrease in revision THAs.
- Antibiotics elute from PMMA.
- Two distinct applications with different formulations.
  - Treatment: 4.0 – 10.0 gm per 40 gm PMMA.
  - Prophylaxis: 0.5 – 1.0 gm per 40 gm PMMA
  - Local antibiotic level far exceeds MIC for most bacteria.
Prophylaxis

- High dose ALPMMA aminoglycoside elution effective treatment.
- What about prophylaxis?
- Antibiotic bone cement has been approved by the Food and Drug Administration (FDA) in the United States for use in second stage revision of infected total joint arthroplasties.

Use of Antibiotic Cement

- Norwegian Arthroplasty Register 2006 - Revision rates in 56,275 cemented and uncemented primary THAs followed for 0-16 years.
- Risk of revision due to infection was the same for uncemented and cemented arthroplasties with antibiotic-loaded cement, but 1.8 times higher for cemented arthroplasties without antibiotic cement.
- Findings can be explained by reduced resistance to infection caused by the cement, which appears to be neutralized by adding antibiotic to the cement.

Antibiotic Cement Prophylaxis

- Antibiotic bone cement and systemic antibiotics was found to be significantly more effective in preventing deep infection than using systemic antibiotics alone or antibiotic bone cement ($P<0.001$).
- In more than 100,000 patients, no reports of an allergic reaction.
- Potential risks of resistance do not appear to have materialized.
- Potential ill affect: we will stop or accept fewer complex cases.
ANTIBIOTIC PROPHYLAXIS

• ANTIUBIOTIC CEMENT
  • Comparison of 178 total knees with Cefuroxime
    impregnated cement vs. 162 without added cement.
  • Both groups had 2 superficial infections.
  • The antibiotic cement group had no deep infections, but
    there were 5 in the control group.


CONCLUSIONS

• PUBLIC REPORTING IS HERE.
• PAY FOR PERFORMANCE IS HERE.
• TERTIARY CARE CENTERS HANDLE THE MOST
  DIFFICULT CASES AND THE RESULTS ARE COMPARED
  TO COMMUNITY HOSPITALS.
• SILVER LINING; WE ARE GETTING 100% SUPPORT
  FROM OUR ADMINISTRATION AND STAFF TO
  MINIMIZE SSI

THANK YOU!