Pre-operative Patient Optimization in Total Joint Arthroplasty

Charles E. Claps DO
Total Joint Replacement and Reconstruction
Resurgens Orthopaedics
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Topics

- Why?
- How?
- Future?
Why?

• Patient outcomes
• Decrease infection
• Decrease costs
• Increase reimbursement
• Better outcomes = Happier patients = Happier surgeons
Patient Outcomes

• Pay for performance
  • Outcome measures driving reimbursement
  • Operating on high risk patients
    • Increased risk for complications
    • Decreased reimbursement

• Patient optimization
  • Optimize patients before sx
    • High and low risk patients
Periprosthetic Infection

- Periprosthetic Infection
  - Incidence\(^\text{y}\): 1.0% to 2.55%

- 2010: $566 Million/year
- 2020: $1.6 Billion/year

- 7% Mortality between 1\(^{\text{st}}\) & 2\(^{\text{nd}}\) stage of Revision Arthroplasty\(^\dagger\)

\(^\text{y}\)Kurtz JOA 2012
\(^\dagger\)Berend Clin Orthop 2013
How?
Total Joint Bundle

• Perioperative Periods of Patient Care:

  1) PREOPERATIVE

  2) INTRAOPERATIVE

  3) POSTOPERATIVE
Team approach

• Multi-disciplinary
  • Arthroplasty Surgeons
  • Anesthesiologists
  • Infectious Disease
  • Nurses / Therapists
  • Administrative Coordinators

• GOAL: Optimize Patient Outcomes after Arthroplasty
<table>
<thead>
<tr>
<th>Preoperative</th>
<th>Intraoperative</th>
<th>Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body mass index</td>
<td>Hair clipping in holding room</td>
<td>Dedicated total joint unit</td>
</tr>
<tr>
<td>&lt;40 kg/m²</td>
<td>Chlorhexidine wash</td>
<td>24 h of antibiotics</td>
</tr>
<tr>
<td>Hemoglobin A1c</td>
<td>Isopropyl alcohol wash</td>
<td>Standard wound care</td>
</tr>
<tr>
<td>&lt;7.0%</td>
<td>Minimize OR traffic</td>
<td>Chlorhexidine wash</td>
</tr>
<tr>
<td>Tobacco smoking</td>
<td>Exchange gloves before implanting</td>
<td>Aspirin for low-risk patients</td>
</tr>
<tr>
<td>&lt;0.5 packs/day</td>
<td>No “flushed” instruments</td>
<td>Follow-up</td>
</tr>
<tr>
<td>Chlorhexidine wash instruction</td>
<td></td>
<td>instruction phone call</td>
</tr>
<tr>
<td>MRSA screen</td>
<td></td>
<td></td>
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<tr>
<td>Risk factor labs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preanesthesia appointment</td>
<td>Dilute povidone-iodine solution wash</td>
<td></td>
</tr>
<tr>
<td>Surgeon risk factor assessment</td>
<td>Silver-impregnated dressing</td>
<td></td>
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</tbody>
</table>
Preoperative

• Initial Clinic Visit

• Checklist of Patient Risk Factors
  • Assign Level of Infection Risk

• Formulate Medical Optimization Plan
### Risk Factor Assessment

<table>
<thead>
<tr>
<th>Surgeon risk factor assessment</th>
<th>Yes/no</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical candidate based on examination and imaging</td>
<td></td>
</tr>
<tr>
<td>Patient factors to determine complication risk after TJA</td>
<td></td>
</tr>
<tr>
<td>Poor dentition</td>
<td>Yes/no</td>
</tr>
<tr>
<td>History of metal intolerance</td>
<td>Yes/no</td>
</tr>
<tr>
<td>BMI (&lt;40 kg/m²)</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Latest hemoglobin A1c (&lt;7.0%)</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Inflammatory arthritis</td>
<td>Yes/no</td>
</tr>
<tr>
<td>(SLE, RA, psoriasis)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Male/female</td>
</tr>
<tr>
<td>Smoking</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Prior skin infections or open wounds</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Previous TJA complication</td>
<td>Yes/no</td>
</tr>
<tr>
<td>History or MRSA infection/colonization</td>
<td>Yes/no</td>
</tr>
<tr>
<td>History of progressive neurologic disease</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Current anticoagulation use (coumadin, plavix, etc.)</td>
<td>Yes/no</td>
</tr>
<tr>
<td>History of obstructive sleep apnea</td>
<td>Yes/no</td>
</tr>
<tr>
<td>History of venous thromboembolism</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Surgical risk of complications</td>
<td>Minimal/low/moderate/high</td>
</tr>
</tbody>
</table>

TJA, total joint arthroplasty; BMI, body mass index; SLE, systemic lupus erythematosus; RA, rheumatoid arthritis; MRSA, methicillin-resistant Staphylococcus aureus.
Non-Modifiable Risk Factors

- Metal Sensitivity/Allergy
- Inflammatory Arthritides
- Previous TJA Complication
- Progressive Neurological Disease

Schnaser et al JOA 2015  
Schrama et al JOA 2015  
Cancienne et al JAAOS 2016  
Lachiewicz Watters JAAOS 2016
Modifiable Risk Factors

- Poor Dentition
- BMI > 40 kg/m²
- Diabetes Mellitus (Hemoglobin A1c)
- Tobacco Abuse
- MRSA History
- History of / Current Open Wounds
- Current Anticoagulation
- Obstructive Sleep Apnea
- DVT / PE History

Bozic et al JBJS 2012

Peersman et al Clin Orthop 2001
Moaz et al Clin Orthop 2015
Modifiable Risk Factors

• Poor Dentition
  • Sent to dentist for evaluation and management
Modifiable Risk Factors

- BMI >40
  - Referral to PCP
  - Setup with Nutritionist
    - Weight loss strategy development
  - Bariatric surgery evaluation
    - Last resort
  - Why?
    - BMI >40 associated with
      - DVT/PE
      - Infection
      - Readmissions
      - Post-op mortality
Modifiable Risk Factors

- HbA1c >7.0
  - PCP vs Endocrinologist referral
  - Why?
    - HbA1c >7 increased risk
      - Stroke
      - PE
      - Infection
      - Transfusion requirements
      - Prolonged length of stay
      - Mortality
Modifiable Risk Factors

- Smoking > 0.5 ppd
  - PCP referral for smoking cessation plan
  - Nicotine level monitoring
    - High risk patients

- OSA symptoms/history
  - Sleep study evaluation
    - Linked to increased length of stay and complications post-operatively
Modifiable Risk Factors

- Albumin <3.5 g/dL
  - Nutritionist consult
Pre-operative Nutrition – Assessment

• Albumin <3.5 g/dL
  • Most widely recognized
  • Simplest to obtain

• Anthropometric measurements
  • Indirect gauge of malnutrition
    • Body composition
  • Calf circumference
  • Arm muscle circumference
  • Triceps skinfold
Pre-operative Nutrition – Assessment

- Rainey-Macdonald nutritional index (RMNI)
  - $(1.2 \times \text{serum albumin}) + (0.013 \times \text{serum transferrin}) - 6.43$
  - Zero or negative score indicated nutritional depletion

- Mini Nutritional Assessment (MNA)
  - Show to be reliable in assessing malnutrition in geriatric population
  - Takes into account multiple variables
    - Dietary habits
    - Anthropometric measurements
Malnutrition & Infection risk

• Impairs wound healing
  • Hinders fibroblast proliferation
  • Decreases collagen synthesis

• Prolongs inflammation

• Decreases lymphocyte count
  • Impairs body’s ability to fight infection
Malnutrition & Joint Arthroplasty

• Bohl et al
  • Retrospective review of 49,000 TJA patients
  • Outcomes compared between patients with and without hypoalbuminemia
    • Albumin < 3.5 g/dL
    • 2x increase in surgical site infection
    • Increased risk for
      • Pneumonia
      • Longer length of stay
      • Hospital readmission

• Jaberi et al
  • Retrospective review of 11,000 TJA patients
    • 83 patients had persistent wound drainage and subsequent I and D with wound closure
    • Patients who failed I and D and had deep infection
      • 35% found to be undernourished
      • Success rate of I and D in undernourished population was 5%
Outcomes

• “A Bundle Protocol to Reduce the Incidence of Periprosthetic Joint Infections After Total Joint Arthroplasty: A Single-Center Experience”
  • Bullock et. al
  • 3 chronological period of care – Preoperative, Intraoperative, Postoperative
  • Utilized bundled protocol

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<td>Wake Forest Bundle Protocol by Operative Period.</td>
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<td>Preoperative</td>
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<td>Body mass index &lt;40 kg/m²</td>
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OR, operating room; MRSA, methicillin-resistant Staphylococcus aureus.
Outcomes

- “A Bundle Protocol to Reduce the Incidence of Periprosthetic Joint Infections After Total Joint Arthroplasty: A Single-Center Experience”
  - Bullock et. Al
  - Retrospective review of 3114 TJA patients
    - 2 years before bundle implementation, 2 years post-bundle
  - Results
    - 62% reduction in periprosthetic infection rate for THA (10 vs 4)
      - Not statistically significant
    - 92% reduction in periprosthetic infection rate for TKA (13 vs 1)
      - Statistically significant
Outcomes

• “Decreased Infection rates following total joint arthroplasty in a large county run teaching hospital: A single surgeon’s experience and possible solution”
  • Gottschalk et. Al
  • 900 bed level 1 trauma center
  • Previous infection rate of 12.9% for elective total joint replacement
  • Implemented Arthroplasty Preoperative selection criteria

Arthroplasty Preoperative Selection Criteria.

- Completes Appropriate Preoperative Consults with Anesthesia, Internal Medicine, Physical Therapy, Nutrition, Dentistry, and Social Work
- BMI < 36, or Weight Loss to a BMI < 36
- Non-Smoker or Quit with Two Negative Nicotine Tests
- Negative Inflammatory Markers (Assuming History of Infection or Previous Hardware in Place)
- HgA1c < 6.5 If Diabetic
- HIV on Antiretroviral Therapy Being Followed by Infectious Disease HIV Service with Current CD4 Count and Viral Load
Outcomes

• “Decreased Infection rates following total joint arthroplasty in a large county run teaching hospital: A single surgeon’s experience and possible solution”
  • Results
    • Postoperative infection rate dropped to 1.9% following pre-operative protocol implementation
    • Risk of infection was 87% lower in post-protocol group
    • Average length of stay decreased from 5.36 +- 2.44 to 4.52 +- 1.77
Outcomes

• “Implementation of Preoperative Screening Criteria Lowers Infection and Complications Rates Following Elective Total Hip Arthroplasty and Total Knee Arthroplasty in a Veteran Population”
  • Nussenbaum et. Al.
  • Implemented preoperative screening criteria for patients undergoing elective TJA
    • HbA1c <7
    • BMI <35
    • Hb >11
    • Albumin >3.5
  • Retrospective review of 520 consecutive TKA/THA compared to 475 TKA/THA post-screening
  • Determine if screening criteria lowered complication and infection rate
  • Did not change any other intra-operative or post-operative variables
Outcomes

• “Implementation of Preoperative Screening Criteria Lowers Infection and Complications Rates Following Elective Total Hip Arthroplasty and Total Knee Arthroplasty in a Veteran Population”
  • Nussenbaum et. Al.
  • Results
    • Complication rate reduced from 35.14% to 14.8%
      • TKA complications reduce from 33.1% to 15 %
      • THA complications reduce from 42.4% to 14.2%
    • Infection rates decreased from 4.4% to 1.3 %

![Fig. 1. Complication rates before and after screening criteria.](image)

![Fig. 2. Surgical site infection rates before and after screening criteria.](image)
Future

- New lab work
  - Vitamin D levels
    - Not currently used in our preoperative joint bundle
    - Common in trauma surgery
    - Levels easily obtained and optimized
    - Link between prohormone 25D and normal innate immune response

- Improvements in patient communication
Vitamin D

- “Vitamin D Insufficiency in Patients with THA: Prevalence and Effects on Outcome”
  - Lavernia et. Al.
  - Retrospective review of 60 THA’s
  - Analyzed plasma levels of 25-hydroxyvitamin-D3 levels
    - Normal vs insufficient groups
      - Used normal value of 20 ng/mL and 30 ng/mL
  - Compared hip scores between the two groups
- Results
  - Prevalence
    - 30 % using 20 ng/mL
    - 65% using 30 ng/mL
  - Pre-operative and post-operative Harris hip scores lower in the insufficient group
    - Only when using 30 ng/mL as normal
  - No difference in hip scores when using 20 ng/mL as normal
Vitamin D

- “Single-Dose, Preoperative Vitamin-D Supplementation Decreases Infection in a Mouse Model of Periprosthetic Joint Infection”
  - Hegde et. Al.
  - Mice given Vitamin D deficient (40 mice) or sufficient (20 mice) diet for 6 weeks
    - 20 mice in deficient group received “rescue dose” of Vitamin D 3 days before sx
  - Stainless steel implant surgically inserted into knee joint
    - Joint space inoculated with bioluminescent staph aureus
    - In vivo imaging used to monitor bacterial burden and neutrophil infiltration
  - Blood drawn for 25-Hydroxyvitamin D levels 3 days before sx and POD 0/14
  - Mice killed at POD 21
    - Colony forming units of staph measured after culture
    - Myeloperoxidase and Beta-N-acetylglucosaminidase assayed
      - Myeloperoxidase – neutrophil infiltration
      - Beta-N-acetylglucosaminidase – recruited macrophage activity levels
Vitamin D

• “Single-Dose, Preoperative Vitamin-D Supplementation Decreases Infection in a Mouse Model of Periprosthetic Joint Infection”
  • Hegde et. Al.
  • Results
    • Serum Vit D levels showed deficiency in diet deficient group
      • Repletion in “rescued” group
    • Deficient group
      • Significantly greater bacterial bioluminescence/neutrophil fluorescence
      • Colony forming units significantly greater
      • Myeloperoxidase activity higher
    • Beta-N-acetylglucosaminidase activity lower
      • Diminished activated macrophage recruitment
    • Rescued group
      • Significantly decreased bacterial burden and neutrophil infiltration
Pre-operative Communication

- Wake Forest Total Joint Bundle
  - Pre-operative clinic visit with surgeon
    - Education about procedure
    - Consent
    - Pre-operative lab work ordered
    - Surgical date chosen
    - Surgical education packet
      - Chlorhexidine body wash instructions
      - Expectations and pre-surgical instructions
      - Appointment dates
    - Introduction with total joint navigator
      - Constant communication with patient regarding upcoming surgery
Pre-operative Communication

- “Increasing Perioperative Communication With Automated Mobile Phone Messaging in Total Joint Arthroplasty”
  - Day et. Al.
  - Prospective pilot study of patients undergoing elective TJA
    - Investigated novel communication platform via an automated phone messaging system
      - Text message based
    - Compared patient satisfaction scores (Press Ganey and HCAHPS) between patient who did and did not receive automated messages
    - Evaluate patient satisfaction with mobile phone messaging system via post-participation surveys
Pre-operative Communication

- “Increasing Perioperative Communication With Automated Mobile Phone Messaging in Total Joint Arthroplasty”
  - Day et. Al.
  - 6 week timeframe
  - Starting at week 1 before surgery received phone text messages at following intervals
    - 1 week prior to surgery
    - 4 days prior to surgery
    - 2 days prior to surgery
    - Day before surgery
  - Pre-operative messages included information regarding
    - Date of surgery reminders
    - Encouraged patients to examine skin
    - Provided information regarding NPO and medication instructions
Pre-operative Communication

• “Increasing Perioperative Communication With Automated Mobile Phone Messaging in Total Joint Arthroplasty”
  • Day et. Al.
  • Post-operative messages
    • Began on POD 1 and continued daily for 2 weeks post-operatively
    • Activity after surgery
    • Pain control
    • Dressing changes
    • Monitoring for concerning signs and symptoms
    • Goals for discharge
  • All messages ended with the number for the orthopedic clinic and instruction to contact clinic if patient had any concerns
  • Patients also given the option to receive more information via text by typing back “more”
  • At 2 weeks post-op, patients received phone survey to obtain Press Ganey and HCAHPS scores
    • Compared these scores to other patients who received surgery by same physician within the past 3 years
    • Also given the option to leave messages regarding their opinions of text messaging service
Pre-operative Communication

• “Increasing Perioperative Communication With Automated Mobile Phone Messaging in Total Joint Arthroplasty”
  • Day et. Al.
  • Results
    • 30 patients in messaging group vs 26 control group
    • Statistically greater HCAHPS and Press Ganey scores in patients in the messaging group
    • 87% of patients felt messages helped them be more prepared for surgery
    • 100% felt messages kept them more informed
    • 97% would participate in message program again
  • Improves patient satisfaction
  • Potentially decreases need for actual phone calls by office staff during pre-operative and post-operative period
Conclusions

• Pre-operative optimization
  • Decrease infection risk
  • Improves patient outcomes
  • Potential for increased reimbursement
    • Bundle payments
    • Patient satisfaction scores
  • Outpatient TJA and orthopedic procedures increasing in prevalence
    • Pre-operative optimization importance increased
      • Patient selection
      • Outcomes

• Future
  • New lab values for improved optimization
    • Vitamin D
  • Patient communication advancements
    • Automated telecommunication
• Thank You!