PERIPROSTHETIC FRACTURES AND INFECTIONS

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He is a graduate of the Harvard Combined Orthopedic Surgery Program, and the Arthroplasty Fellowship at the Massachusetts General Hospital. He has coauthored over a dozen book chapters, over 40 journal articles, and over 100 talks; serves as an associate editor for the Journal of Orthopedic Trauma, a reviewer for Clinical Orthopedics and Related Research and other Journals. He holds a PhD in Tissue Engineering and Regenerative Medicine.

Disclosures
I have no financial disclosures pertinent to this presentation.

PERIPROSTHETIC FRACTURE CARE

Total joint replacement is one of the most commonly performed and successful operations in orthopaedics as defined by clinical outcomes and implant survivorship.

Twenty-five-Year Survivorship of Two Thousand Consecutive Primary Charnley Total Hip Replacements

Factors Affecting Survivorship of Acetabular and Femoral Components
- Survivorship analysis of 2,000 primary total hip replacements.
- Good clinical outcomes and implant survivorship.
Of 58,521 Medicare beneficiaries who had elective primary THR between July 1995 and June 1996, 32,463 (55%) survived until January 2006. Over next 2 years, 215 (0.7%) patients developed a periprosthetic proximal femoral fracture.

Katz et al. BMC Musc Disord. 2014

Five years post-operatively, the rate of fracture was 0.9% after primary THR, 4.2% after revision THR, 0.6% after primary TKR and 1.7% after revision TKR. Periprosthetic fractures were more likely in females, patients aged > 70 and after revision arthroplasty.

Meek et al. JBJS Br. 2011

As the Number of Implants Placed Increases
the Number of Associated Fractures will Increase
PERIPROSTHETIC FRACTURES

Incidence of periprosthetic fracture about a total hip arthroplasty (THA) is variable, with multiple studies noting an incidence of 0.1% to 18%.

The prevalence of periprosthetic fracture about a THA continues to increase with time.

For patients older than 80 years, the risk of fracture increases to 4.4 times that of younger patients.

Loosening of THA femoral components may play a large role in the development of periprosthetic fracture. This has been borne out in biomechanical studies in synthetic and cadaveric femora. In one study, the authors found that 70% of the stems were considered to be loose at the time the patient sustained the fracture.

Osteoporosis is a known risk factor

In one study, 30 of 41 patients had pre-existing disease with periprosthetic distal femur fractures, including 16 with osteoporosis, seven with rheumatoid arthritis (RA) which required long-term steroid administration, and two with neurologic disorders of the lower extremities.
Bisphosphonates have been thought to reduce periprosthetic fracture risk. One study demonstrated decreased periprosthetic bone loss in patients undergoing TKA treated with alendronate. Despite these promising results, alendronate has not yet been demonstrated to decrease the risk of periprosthetic fracture.

There are reports of decreased periprosthetic bone loss seen after bisphosphonate administration, although short courses of bisphosphonates during the perioperative period may not have any effect on bone loss later.

Calcitonin has also been examined and may be of benefit. Parathyroid hormone is postulated to be of benefit as a result of its effects on bone mass, although this has not been proven.

In addition to osteoporosis, RA seems to be an independent risk factor for periprosthetic distal femur fracture. Whether the RA disease process is more important than the commonly used treatment regimens in the development of these fractures is unknown.

In one series of 16 patients with periprosthetic distal femur fractures, 12 had RA, and 10 of these patients were chronic steroid users.
**IS IT JUST JOINTS**

Periprosthetic fracture of the femoral shaft is a well-documented complication of treating intertrochanteric fractures with intramedullary devices.

Shorter versions of the gamma nail have been associated with higher rates of fracture than longer versions.

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**TAKE HOME MESSAGE**

Periprosthetic fractures = considerable health care resource utilization

Survival at 1 year is reported as low as 80% and mimics the mortality associated with hip fractures

3x higher risk of subsequent hospitalization

Prevention is probably the key with a holistic approach involving improved conditioning, home decluttering, and various medical adjuvants.

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**THE STORY OF SUCCESS**

2 million cases of hospital acquired infection annually in the United States

- more than half are associated with various implants
To Prevent Surgical Site Infections (SSIs):

**Before surgery:**
- Administer antimicrobial prophylaxis in accordance with evidence-based standards and guidelines.
- Treat remote infections wherever possible before elective operations.
- Avoid hair removal at the operative site unless it will interfere with the operation; do not use razors.
- Use appropriate antiseptic agent and technique for skin preparation.
- Before surgery:
  - Nasal screening and decontamination for Staphylococcus aureus carriers for select procedures (e.g., neurosurgery procedures with implants).
  - Screen preoperative blood glucose levels and maintain tight glucose control.

**During surgery:**
- Keep OR doors closed during surgery except as needed for passage of equipment, personnel, and the patient.
- During surgery:
  - Redose antibiotic at the 3 hr interval in procedures with duration > 3hr
  - Adjust antimicrobial prophylactic dose for obese patients (body mass index > 30).
  - Use at least 50% fraction of inspired oxygen intraoperatorically and immediately postoperatively in select procedure(s).

**After Surgery:**
- Maintain immediate postoperative normothermia.
- Protect primary closure incisions with sterile (sterile)
- Control blood glucose level during the immediate postoperative period (constant).
- Discontinue antibiotics according to evidence-based standards and guidelines.

**PERIPROSTHETIC INFECTION**

- Many signs and symptoms of infection overlap those of hematoma, loosening, and instability.
- High index of suspicion:
  - Prior joint arthroplasty
  - Malignant disease
  - Rheumatoid arthritis
  - Psoriasis
  - Diabetes (A1C)

**Concorded Conditions and Demographic Factors Associated With an Increased Adjunct Risk of Periprosthetic Joint Infection (In Decreasing Order of Significance):**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Risk Ratio (95% CI)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity</td>
<td>1.64 (1.09-2.46)</td>
<td>0.022</td>
</tr>
<tr>
<td>Cardiac Arthritis</td>
<td>2.52 (1.88-4.46)</td>
<td>0.002</td>
</tr>
<tr>
<td>Female Gender</td>
<td>0.95 (0.90-0.99)</td>
<td>0.0006</td>
</tr>
<tr>
<td>Renal Disease</td>
<td>0.25 (0.15-0.38)</td>
<td>0.027</td>
</tr>
<tr>
<td>Perioperative Vascular</td>
<td>0.28 (0.18-0.41)</td>
<td>0.007</td>
</tr>
<tr>
<td>Substance Abuse</td>
<td>0.07 (0.04-0.12)</td>
<td>0.025</td>
</tr>
<tr>
<td>Race (Black vs. White)</td>
<td>1.75 (1.19-2.55)</td>
<td>0.008</td>
</tr>
<tr>
<td>Race (Other vs. White)</td>
<td>1.62 (0.97-2.69)</td>
<td>0.089</td>
</tr>
<tr>
<td>Hypertension</td>
<td>0.74 (0.39-1.34)</td>
<td>0.376</td>
</tr>
<tr>
<td>Alcohol Use</td>
<td>0.52 (0.39-0.69)</td>
<td>0.0006</td>
</tr>
<tr>
<td>Prior Cardiac Disease</td>
<td>0.02 (0.00-0.12)</td>
<td>0.042</td>
</tr>
<tr>
<td>Malignancy</td>
<td>0.06 (0.04-0.10)</td>
<td>0.003</td>
</tr>
<tr>
<td>History of Any Disease</td>
<td>0.65 (0.47-0.93)</td>
<td>0.029</td>
</tr>
<tr>
<td>Priorate Disease</td>
<td>0.07 (0.04-0.14)</td>
<td>0.0006</td>
</tr>
<tr>
<td>Diabetes (A1C)</td>
<td>0.07 (0.02-0.14)</td>
<td>0.0006</td>
</tr>
</tbody>
</table>

**Conclusion:**

- The use of a comprehensive protocol, including prophylactic measures, surgical techniques, and postoperative care, is crucial in reducing the risk of periprosthetic joint infection.
LAB VALUES

WBC
>10,700 cells/ul <4 weeks from surgery
>1,700 cells/ul >4 weeks from surgery

ESR and CRP
When calculated by ROC analysis, the predictive cut-offs equalled to 31 mm/h for ESR and 2.05 mg/dl for CRP


CRP takes 21 days to return to normal after surgery
ESR takes 90 days

Leukocyte esterase

Aspiration
Lowest serologic values suggestive of infection
WBC >1,100 cells/ml
PMN >64%

MSIS CRITERIA FOR PJI

Major Criteria
1. Sinus tract communicating with prosthesis
2. Pathogen isolated by culture from two separate samples

Minor Criteria (4 of 6)
1. Elevated ESR and CRP
2. Elevated synovial WBC count
3. Elevated synovial PMN%
4. Presence of purulence in the affected joint
5. Pathogen isolated by culture in one sample
6. Greater than 5 neutrophils per high power field in five high power fields at 400x

Case Study

87 y.o. 9 years s/p THA for OA

• Pain, shortening and spontaneous drainage
Two Stage Surgical Protocol

- Stage I -
  - Explant of components, wide debridement
  - Multiple cultures to determine antibiotic
  - Vancomycin/Ceftriaxone early empiric
  - 6 weeks IV antibiotic, PICC line, VNA
  - 2 week antibiotic holiday
  - Repeat aspiration and decision

- Stage II –
  - Revision total hip arthroplasty
  - Question of long term suppression

https://youtu.be/PAHY6SwQ

Hacket et al JAAOS 2015

The estimated total hospital cost in the United States incurred for PJI treatment grew from $365 million in 2001 to $771 million in 2011 and will surpass $1.1 billion by 2015.

PROPHYLAXIS

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Antibacterial Drug</th>
<th>Route</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental</td>
<td>Cefazolin, cefuroxime, amoxicil</td>
<td>PO</td>
<td>1 hour prior to procedure</td>
</tr>
<tr>
<td>Intravenous</td>
<td>Cefazolin</td>
<td>IV</td>
<td>1 hour pre-operatively</td>
</tr>
<tr>
<td>Septicemia</td>
<td>Cefazolin</td>
<td>IV</td>
<td>1 hour pre-operatively</td>
</tr>
<tr>
<td>Parenteral</td>
<td>Cefazolin</td>
<td>IV</td>
<td>1 hour pre-operatively</td>
</tr>
<tr>
<td>Oral and/or parenteral</td>
<td>Cefazolin, cefuroxime, amoxicil</td>
<td>PO/IV</td>
<td>1 hour prior to procedure</td>
</tr>
<tr>
<td>Intravenous overnight</td>
<td>Cefazolin</td>
<td>IV</td>
<td>1 hour pre-operatively</td>
</tr>
<tr>
<td>Intravenous overnight</td>
<td>Cefazolin</td>
<td>IV</td>
<td>1 hour pre-operatively</td>
</tr>
</tbody>
</table>
TAKE HOME MESSAGE
Periprosthetic infection = DISASTER

0.5% rate = 5000 patients = $0.5 billion
Worst case scenario – amputation and death

PREVENTION
- smoking cessation
- management of diabetes/A1C
- weight loss/ BMI<40
- antibiotic prophylaxis +/-

High Index of Suspicion!

QUESTIONS

Thank you

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