AMERICAN ASSOCIATION OF ORTHOPAEDIC SURGEONS

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Instructional Course
Lecture Handout

Course Number: 202

Course Title: Preventing Hospital Readmissions and Limiting the Complications Associated with Total Hip Arthroplasty

Location: Room W202

Date & Start Time: Mar 2 2016 8:00 AM

INSTRUCTORS WHO CONTRIBUTED TO THIS HANDOUT:

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2016 AAOS Annual Meeting-Orlando, FL
Instructional Course Lecture: 202
Wednesday, March 2, 2016
8:00-10:00 AM

Preventing Hospital Readmissions and Limiting the Complications Associated with Total Hip Arthroplasty

The socioeconomic value of THA continues to receive scrutiny. With increasing attention on hospital readmission after THA, there is a need to better understand and prevent complications responsible for readmission to the hospital.

Objectives:

1. Understand the most common reasons for readmission after THA.
2. Learn risk factors associated with greater likelihood of readmission.
3. Understand strategies to reduce risk of complications resulting in readmission.

Introduction: **Kevin Garvin, MD**, **Omaha, NE**

1. **William Healy, MD, Boston, MA** Standardization of THA Complications and Prevention of Perioperative THA Complications with an Embedded Internist (25 min)
2. **Kevin Garvin, MD, Omaha, NE** Prevention and Management of Infection and Wound Complications (25 min)
3. **Vincent Pellegrini, MD, Charleston, SC** Thromboembolic Disease and Cardiovascular Events: Effective Treatment Modalities with Low Risk (25 min)
4. **Richard Iorio, MD, New York, NY** Optimizing Patient Health Perioperatively and Preventing Readmission (25 min)
5. Questions and answers (20 min)

AAOS 2016 Instructional Course
Preventing Hospital Re-admissions and Limiting the Complications Associated with Total Hip Arthroplasty
Wednesday March 2, 2016--- 8:00-10:00 AM

"Standardization of THA Complications and Prevention of Perioperative THA Complications with an Arthroplasty Service Line Management Program"

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Patient outcome following total hip arthroplasty (THA) is generally excellent. However, complications associated with THA (anesthetic, medical, surgical, rehabilitation) can adversely affect patient outcome. Furthermore, complications following THA can be associated with hospital re-admission and increased cost for THA.

In the past, reporting of complications following THA was not standardized. In order to develop a standardized list of THA complications, the Hip Society THA Complications Workgroup surveyed the orthopaedic literature and proposed a list of THA complications with definitions and stratification. An expert opinion survey was used to test the applicability and reasonableness of the proposed THA complications and definitions with members of The Hip Society. The stratification system was developed from a validated grading scheme for complications of hip preservation surgery

One hundred five clinical members (100%) of The Hip Society responded to the THA Complications Survey. All the proposed complications and definitions were endorsed by the members ($P < 0.001$). Members also provided 568 comments and suggestions for improvement which were incorporated into the final proposal.

Nineteen THA complications and their definitions were endorsed by The Hip Society.

1. Bleeding
2. Wound Complication
3. Thromboembolic Disease
4. Neural Deficit
5. Vascular Injury
6. Dislocation/Instability
7. Periprosthetic Fracture
8. Abductor Muscle Disruption
9. Deep Periprosthetic Joint Infection
10. Heterotopic Ossification
11. Bearing Surface Wear
12. Osteolysis
13. Implant Loosening
14. Cup Liner Dissociation
15. Implant Fracture
16. Re-Operation
17. Revision
18. Re-Admission
19. Death

Complications can occur after surgical operations for many diverse reasons including an evolving disease process, a surgical error, a medical error, a nursing error, patient noncompliance with care, and events without error beyond physician and patient control such as falls or trauma. Adverse events after an operation or procedure are conditions which may compromise the process of care or the outcome of care, but not all adverse events are complications.

Complications and adverse events can be expected with surgical procedures at a small but finite incidence, despite the exercise of reasonable and safe care. Orthopaedic Surgery has a long tradition of learning from complications and adverse events, in order to prevent these unfavorable occurrences. If THA complications can be prevented or minimized, it is likely that patient outcomes from THA can be improved, hospital re-admissions can be reduced, and the cost of THA can be decreased.

Prevention of Complications with Arthroplasty Service Management

In order to improve quality, reduce complications, and reduce cost for TJA at Newton-Wellesley Hospital (NWH), orthopaedic surgeons implemented an Arthroplasty Service Line (ASL) Management Program in 2008. This program intended to reduce variation in TJA care at the hospital and improve hospital patient outcomes for TJA operations.

The ASL Management Program included:

- Pre-operative Evaluation and Education (education class, Internist evaluation, subspecialty consultation, risk management assessment, screening for pain management consultation, screening for community acquired bacteria, chlorhexidine showers, discharge planning)
- Hospital Care Protocols (prophylactic antibiotics, venous thromboembolic disease prophylaxis, pain management, blood management, Internist rounding, inpatient PT,)
- Post-acute Care (validated rehabilitation facilities, outpatient PT, TJA database).

In order to assess the impact of the ASL Management Program, the NWH TJA patient experience was compared to the hospital patient outcome of TJA patients in the University Health System Consortium (UHC). Five standardized UHC metrics (hospital length of stay, medical complications, orthopaedic complications, hip dislocations, thirty day hospital readmission) were evaluated. Data were compared between the two groups using Chi-square analyses.

The NWH hospital patient outcome was favorable when compared to UHC (Table 1). The Case Mix Index of the cohorts were similar. The average hospital length of stay was less at NWH. The rate of medical complications ($p<0.001$), orthopaedic complications ($p<0.001$), and hip dislocations ($p<0.004$) were reduced for NWH patients compared to UHC patients. The rate of thirty day hospital readmission for NWH patients was lower than for UHC patients, but this difference was not statistically significant.

During the last three decades, many hospitals and joint replacement practices have introduced clinical pathways, standardization, and reduction of variation in the delivery of TJA care. Utilization of these care models is not unique to NWH. When using the ASL Management Program, the NWH TJA experience compared favorably with a large standardized national database. Surgeons at NWH will continue to increase standardization of TJA care in the future.

NWH vs. UHC

TJA 2012-2014

	NWH	**UHC**	
N	**3010**	**342,809**	
CMI	**2.18**	**2.26**	
LOS	**2.86**	**3.06**	
Medical Complications	**307/10.2%**	**88183/25.72%**	**p<0.001**
Orthopaedic Complications	**512/17%**	**154043/46.94%**	**p<0.001**
Hip Dislocations	**17/0.56%**	**3707/1.08%**	**p<0.004**
30 Day Readmission	**1.63%**	**1.87%**	**p=0.181**

WLH
October 2015

ICL 202: Preventing Hospital Readmissions and Limiting the Complications Associated with THA

Prevention and Management of Infection and Wound Complications

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AAOS 2016
Orlando, FL

I. Introduction and background

Total hip arthroplasty is one of the most successful surgeries in all of medicine. Patients with disabling pain and limited function are able to return to a normal lifestyle with limited discomfort and these results are predictable for a long period of time.

Total hip arthroplasty and total knee arthroplasty have become so successful and common that approximately 1 million patients are treated annually. The cost of caring for such a large number of patients has made it among the largest hospital expenditures. Furthermore, the Centers for Medicare and Medicaid Services (CMS) has targeted a reduction in preventable hospital readmissions as a mandatory step toward establishing more efficient medical care. This is the second year CMS will target and penalize hospitals with unacceptable readmission rates of total joint arthroplasty patients.

The purpose of this presentation is:

- To report the factors associated with hospital readmission following total joint arthroplasty.
- To determine what the surgeon can do to lessen this risk of hospital readmission by addressing the at-risk patients and other at-risk factors that contribute to readmission.

II. Why are total hip and total knee patients readmitted?

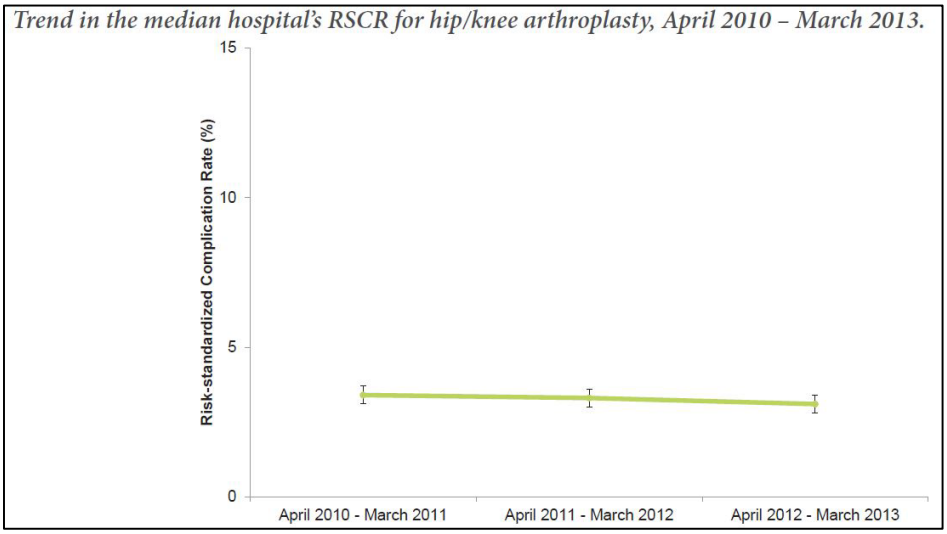
The reasons for hospital readmission for TJA patients can be grouped as those related to the prosthetic joint (prosthetic joint infection, periprosthetic fracture, dislocation, etc.) or those

Notes:

that are systemic in nature or extrinsic (thromboembolic disease, pneumonia, congestive heart failure, etc.).

It is important to first recognize that the complications associated with elective TJA have not increased and information suggests a slight decrease as reported by CMS. The risk-standardized complication rate from April 2010 to March 2013 dropped from a median of 3.4 to 3.1 percent. Similarly, the unplanned readmission rates after elective TJA dropped from a median of 5.4 to 4.8 percent.

Trend in the median hospital's RSCR for hip/knee arthroplasty, April 2010 – March 2013.



Median hospital's RSRRs for hip/knee arthroplasty, July 2010 – June 2013.

	Median (Range) Hospital's RSRR (%)		
	July 2010 – June 2011	July 2011 – June 2012	July 2012 – June 2013
Hip/Knee RSRR	5.4 (3.7, 8.1)	5.2 (3.6, 7.6)	4.8 (2.9, 7.3)

Graphs taken from https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Downloads/Medicare-Hospital-Quality-Chartbook-2014.pdf

Notes:

A recent meta-analysis by Ramkumar et al reported the cause and rates of unplanned readmission after primary total joint arthroplasty. Regardless of whether it is right or wrong, readmission for TJA is a highly scrutinized subject and it has been used as a measure for quality, despite the fact that the patients at risk for complications are seen by CMS to be equal to healthy patients who are at low risk for complications.

The authors of a recent meta-analysis divided the reasons for TJA readmission into four categories, identifying 120,272 hip surgeries that could be evaluated for 30-day readmission. The 30-day readmission rate was 5.6%. The authors also evaluated 192,380 hip surgeries and the 90-day readmission was 7.7%.

Merkow et al reported hospital readmissions using the ACS NSQUIP database. The most common reason for arthroplasty readmissions in the study was surgical site infection accounting for 18.8% of the unplanned readmissions.

Notes:

Study	No. Pts.	Readmission %	Reasons for Readmission	Risk Factors
Pugely et al 2013	8105 hips	4.2% 30-day	Wound infection (24.6%) Sepsis (8.2%) TED (11%) Heart arrhythmia (24%)	Obesity, Steroid use, Bleeding disorder, Dependent functional status, High ASA
Dailey et al 2013	3264 ortho surgeries	4.2% 30-day	SSI (34.3%) Wound complication (7%)	Widowed, Race (African Am., Am. Indian, Alaskan Native) Medicaid, ICU stay, Increased hospital stay (LOS)
Schairer et al 2013	988 hips	4.0% 30-day 7.0% 90-day	Dislocation (32%) SSI (23.5%) Hematoma (10.3%) Wound drainage (8.8%) Dislocation (0.7%) Medical reasons (25%)	Increased hospital stay (LOS)
Saucedo et al 2013	2524 hips	3.4% 30-day 7.8% 90-day	Infection (16%) Cellulitis/abscess (6%)	CAD, Medicare, Longer LOS, Low BMI <18.5, Age (<50 or >80 yrs)
Zmistowski et al 2013	5426 hips	5.3% 90-day	Infection (25.4%) Wound problems (10%) VTE (5.8%)	Race (African Am.) Sex (male), D/C to SNF, Increased hospital (LOS)
Mednick et al 2014	9441 hips	3.65% 30-day	SSI/wound DVT	BMI >40 Comorbidities
Ramkumar et al 2015	120,272 hips 3,278,635 knees ---------- 192,380 hips 272,419 knees	5.6% 30-day 3.3% 30-day ---------- 7.7% 90-day 9.7% 90-day	Joint specific (dislocation, fracture, bleeding, SSI) (39.3%)	
Merkow et al 2015	38,671 TJA	4.3% 30-day 90-day	Bleeding (6.3%) SSI (18.8%) DVT (6.3%)	
Raines et al 2015	9,902	8.4% 30-day	SSI (26.9%) VTE (23.5%) Pneumonia (15.8%)	Age, diabetes, high BMI, ASA class

III. Risk factors for readmission and prevention strategies

Risk factors for readmission contributing to surgical site infection, joint specific problems including dislocation, periprosthetic fracture, and thromboembolic disease have been more difficult to identify. Because of this, correcting these complications has proven challenging. Most frequently identified factors associated with readmission are obesity, diabetes, AFA class, steroid use, bleeding disorders and a long list of socioeconomic factors.

Potential areas for orthopaedic surgeons to help lessen these readmissions are also found in Ramkumar's table.

Notes:

Thromboembolic Disease	Joint Specific	Sequelae	Cardiac Dysrhythmia	Surgical Site Infection
Deep vein thrombosis	Trauma & atraumatic dislocation	Postoperative pain	Arrhythmia	Superficial infection
Pulmonary embolism	Prosthetic misalignment	Poor mobilization	Exacerbation of congestive heart failure	Deep infection
Thromboembolic disorder	Ligamentous laxity	Falling episodes		
	Periprosthetic fracture	Anemia and dizziness		
	Septic joint, periprosthetic infection or both	Hematoma		

Ramkumar et al, "Causes and Rates of Unplanned Readmissions after Elective Primary TJA: A Systematic Review and Meta-analysis". Am Jour Ortho, September 2015

A. Obesity is a particular challenge with the options including operating without any change in the patient's BMI, gastric bypass, or an educational program in helping patients achieve a lower BMI through diet. This information is included in the bibliography as well.

B. Decolonization is a second topic for consideration preoperatively. The purpose of a decolonization protocol is to eliminate or lower the bacteria load and thereby decrease the number of *Staphylococcus* PJIs. The clinical effectiveness of decolonization is listed in the table below.

Table 3. Studies of the Effect of Screening and Decolonization on SSI

Author, Year	Surgery Type	Study Design	Population	Control Type	End Point	No. SSI/No. Patients (%) Study Group	No. SSI/No. Patients (%) Control Group	*P* Value
Mupirocin alone								
Gernaat-van der Sluis et al, 1998 [14]	Ortho	Retro	Carriers	Historic	Any SSI	14/1044 (1.3%)	34/1260 (2.7%)	.02
					S aureus SSI	7/1044 (0.7%)	14/1260 (1.1%)	.3
Hacek et al, 2008 [16]	TJA	Retro	All patients	Historical or concurrent	*S aureus* SSI	7/912 (0.8%)	10/583 (1.7%)	NS
Kalmeijer et al, 2002 [17]	Ortho	Pro	All patients	Randomized	Any SSI	12/315 (3.8%)	14/299 (4.7%)	NS
			All patients		*S aureus* SSI	5/315 (1.6%)	8/299 (2.7%)	NS
Perl, 2002 [26]	Mixed	Pro	All patients	Randomized	*S aureus* SSI	43/1892 (2.3%)	46/1894 (2.4%)	NS
			Carriers		*S aureus* NOS	17/430 (4%)	34/439 (7.7%)	.02
			Carriers		*S aureus* SSI	16/432 (3.7%)	26/439 (5.9%)	NR
Mupirocin and chlorhexidine								
Rao et al, 2008 [20]	TJA	Pro	Carriers	Concurrent	*S aureus*	0/164 (0)	12/345 (3.5%)	.02
		Retro	All patients	Historic	SSI	9/636 (1.4%)	20/741 (2.7%)	
Rao et al, 2010	TJA	Pro	Carriers	Concurrent	*S aureus*	0/321 (0)	19/571 (3.3%)	.001
		Retro	All patients	Historic	SSI	17/1440 (1.2%)	20/741 (2.7%)	.009
Bode et al, 2010 [19]	Mixed	Random	All patients	Randomized	*S aureus* SSI	17/504 (3.4%)	32/413 (7.7%)	Yes
					Deep *S aureus* SSI	4/441 (0.9%)	16/367 (4.4%)	Yes
Harbarth, 2008 [27]	Mixed	Pro, crossover	All patients	Concurrent	Any MRSA infection	93/10,844 (0.9%)	76/10,910 (0.7%)	NS*
Kim et al, 2010[25]	Ortho	Pro	All patients	Concurrent	SSI	13/7019 (0.19%)	24/5293 (0.45%)	.009
					MRSA SSI	4/7019 (0.06%)	10/5293 (0.19%)	.03
Nixon et al, 2006 [15]†	Ortho	Pro	All patients	Historic	MRSA infection	10/1447 (0.7%)	17/1084 (1.6%)	.04

NOS indicates not otherwise specified; NS, not significant; Ortho, orthopedic; Pro, prospective; Retro, retrospective.
* No SSIs occurred in patients screened and decolonized as outpatients before surgery (see text for additional comments).
† Patients received mupirocin and triclosan (not chlorhexidine).

Rao, et al "Preoperative Screening/Decolonization for *Staphylococcus aureus* to Prevent Orthopaedic Surgical Site Infection: Prospective Cohort Study with 2-yr Follow-up" JOA, Vol 26(8):1501-07, 2011

It has also been shown that decolonization is cost effective and the most common strategy is to evaluate the patients and then treat those that are positive or colonized with *Staphylococcus*. (Ref: Courville)

In contrast, the challenges of decolonization are significant including managing a very high volume of patients, patient compliance, and the emergence of resistant pathogens.

C. Bleeding and anticoagulation are also problems

Recent studies have evaluated the types of anticoagulant and have found provocative information about anticoagulant compliance. Wang et al conducted an observational study of 17,714 patients (128 New York state hospitals) who underwent THA in 2008. Hospitals that were more compliant (≥97%) with Surgical Care Improvement Project (SCIP) VTE-2 measures (patients receiving VTE prophylaxis around the time of surgery) reported significantly higher infection rates compared to less compliant hospitals (1.6% vs 0.93%; $p< 0.001$). Interestingly, greater compliance with SCIP infection prevention measures was not associated with additional reductions in infection outcomes after total hip arthroplasty.

Similarly, a multi-center study by Jameson et al comparing low molecular weight heparins for thromboprophylaxis was recently published. English hospital trusts replaced low molecular weight heparin with rivaroxaban for prophylaxis in lower-limb arthroplasty. There were significantly fewer wound complications in the low molecular weight heparin group (2.81% vs 3.85%; $p=0.005$). There was no difference in rates of pulmonary embolism, major bleeding or all-cause mortality. Jensen et al also noted a greater number of wound complications (1.8% vs 3.94%; $p=0.046$) in patients receiving rivaroxaban compared to tinzaparin. The morbidity of repeat surgeries associated with rivaroxaban without a reported benefit of fewer pulmonary emboli events is of great concern. The concern is especially relevant as the control or comparison group treatment (low molecular weight heparin) has also been associated with increased wound drainage and infection when compared to other means of thromboembolic disease prevention.

Increased hospital length of stay and transfer to a rehabilitation center are also risk factors for readmission. Rapid recovery protocols and improved perioperative management may lessen these risks.

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D. Hospital readmission because of wound drainage

Wound complication and infection are amongst the most frequent reasons for hospital readmission. At the University of Washington Hospital, 35 of 102 surgical admissions (34.3%) were diagnosed with a surgical site infection. An additional 7 patients (6.8%) were admitted with a wound complication but without documented positive culture or antibiotic use. Saucedo et al studied a 5-year interval at their hospital with the purpose of identifying readmitted patients after total hip or knee arthroplasty. The top readmission diagnoses within 30 days were postoperative infection (16.4%) and other cellulitis or abscesses (6.3%). Combined, these two diagnoses were 22.7% and nearly 7 times more common than the next diagnoses of dislocation (3.4%), periprosthetic fracture (3.4%) and atrial fibrillation (3%). The authors were also able to identify risk factors (see Table).

Pugely et al reported the American College of Surgeons data on complications and readmissions. The data is part of the National Surgical Quality Improvement Program (NSQIP). The authors' data included a 1-year sample of 30-day readmissions. The readmission rate for total hip arthroplasty was 4.2%. The most common reasons for readmission were wound problem and infections (24.6%), thromboembolic phenomena (11.4%), systemic infections (8.2%), cardiac (2.4%) and renal (0.9%). The authors also reported a reoperation rate of 39.3% for patients after a total hip arthroplasty. Advanced age, elevated BMI, history of dyspnea, COPD, hypotension, steroid use, bleeding disorders, elevated serum BUN, decreased serum albumin, increased international ratio (INR), increased creatinine, increased ASA Class, and dependent functional class were also risk factors.

IV. Final recommendations

1. It is important for CMS to adjust the risk factors and provide a risk adjustment ratio for patients. It has been shown that patients with a low socioeconomic status do have a higher risk for readmission. The increased risk for readmission for this population may result in surgeons avoiding providing total joint arthroplasty for them. Avoiding surgery for this patient population is the wrong message.

2. Patients with elevated BMI must be informed of their increased risk for perioperative complications and hospital readmissions. It may be possible for those patients to change their lifestyle thus lowering their BMI.

3. Decolonization is a cost-effective treatment for patients.

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4. Anticoagulation and TED prevention are critically important. Increased readmission rates and increased reoperation for those patients with low molecular weight heparins and other aggressive anticoagulants have been documented in at least three studies. Our approach to thromboembolic prevention and treatment must be changed.

5. Several strategies including tranexamic acid have proven to be effective in decreasing surgical blood loss and the need for blood transfusion.

6. We must ask if it is possible for a perioperative management program to lower the readmission risk.

7. Postoperative programs to help patients manage their recovery, thus lowering the risk of readmission are important. For example, at New York University TED/VTE was a major reason for readmission. The surgeons created an outpatient intervention program to diagnose and treat patients thus preventing readmission. Future studies evaluating preoperative and postoperative continuity will help provide an answer as to their usefulness.

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Notes:

AAOS 2016 ICL 202
Preventing Hospital Readmissions and Limiting the Complications Associated with THA
Thromboembolic Disease and Cardiovascular Events: Effective Treatment Modalities with Low Risk

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Medical University of South Carolina

Wednesday, March 2, 2016
AAOS: Orlando, FL

Perioperative cardiac events, stroke, and venous thromboembolism constitute the predominant major non-orthopaedic complications for the patient after total hip replacement. Cardiac events are the most common but VTED is the most feared threat to the life of the patient. As hospital length of stay after total hip replacement has decreased over the past three decades, there is conflicting evidence about the impact on readmission rates. One recent Medicare claims data analysis from 2002-2007 noted an overall 30-day readmission rate of 6.8% after THA with a mean length of stay of 4.2 days; the 30-day readmission rate was 7.1% from 2002-2004 and decreased to 6.3% during 2005-2007 in that report. Conversely, a 1995-1996 Medicare database review reported an all-cause *90-day* readmission rate of only 4.6% after elective THA. By way of comparison, a Danish registry analysis of THA from 2004-2008 noted a declining length of stay from 6.3 to 3.9 days with a concurrent decrease in 90-day readmission rate from 14.5% to 10.9%. Our own review of the Nationwide Inpatient Sample (2002-2011) and State Inpatient Database (2009-2010) suggested an average all-cause 90-day readmission rate of 12.7% and reoperation rate of 2.7% after THA, with 4% related to the surgical site, including 1.4% for wound infection and 0.3% for bleeding, and 3.5% for systemic issues, including 1.25% for VTED-related events.

Classic teaching holds that venous thromboembolic disease following total hip arthroplasty is deserving of anticoagulant therapy and/or a vena cava filter in order to reduce the risk of fatal pulmonary embolism. This dictum is based on the assumption that approximately 20% of postoperative calf thrombi will propagate proximally to the thigh and 50% of proximal thrombi will embolization to the lung. Furthermore, proximal (above the venous trifurcation) thrombi have the greatest embolic potential of lower limb clots and historically predominated over calf thrombi after total hip arthroplasty. However, contemporary thromboprophylaxis has reduced the overall rate of symptomatic deep vein thrombosis to less than 5% after total hip arthroplasty, calf thrombi are more prevalent than thigh thrombi, and symptomatic pulmonary emboli occur in 1-2% with fatal pulmonary embolism in 0.1 to 0.5% of patients. In the lung, major embolic events can be fatal within minutes and minor emboli may be well tolerated from a hemodynamic perspective and clinically silent, but may be the forerunners of larger fatal emboli. It is important to recognize that symptomatic in-hospital thromboembolic events (0.53%), namely DVT (0.26%) and PE (0.14%), represent less than 15% of all VTE (2-5%) that occurs after THA; with contemporary anticoagulation prophylaxis 85% of events continue to occur after discharge.

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In more than 25 years since the last NIH conference on VTED, many new anticoagulant drugs have been introduced but the evidence for prevention of *fatal PE* after THA has changed very little. Randomized clinical trials have demonstrated a dramatic reduction in lower limb clots without similar reduction in fatal PE using potent new anticoagulants. Specifically, newer anticoagulants (fractionated heparins, synthetic pentasaccharide, and factor Xa and direct thrombin inhibitors) have all demonstrated substantial efficacy in reduction of venographic thrombosis when utilized as primary chemoprophylaxis after hip and knee arthroplasty but are uniformly associated with substantial peri-operative bleeding risk. On the other hand, low intensity warfarin (INR 2.0) and aspirin have each been associated with a prevalence of residual venographic clot that is up to 5 times greater than with these newer agents, but with a comparable *clinical* pulmonary embolism rate and the benefit of major bleeding complications that are two to three-fold *less than* the more potent anticoagulants. Extended low intensity warfarin prophylaxis continued for 6 weeks after total joint arthroplasty has been associated with a readmission rate for thromboembolic complications of 0.3% after THA and a major bleeding rate of 0.1%. Indeed, some authors have demonstrated all-cause mortality after total hip and knee replacement among patients who have been given potent anticoagulants, such as low molecular weight heparin, that was more than twice that in patients receiving only aspirin and pneumatic compression devices combined with regional anesthesia. Other authors have specifically reported the "failure" of ACCP-endorsed use of low molecular weight heparin prophylaxis; symptomatic deep venous thrombosis (3.8%), nonfatal pulmonary embolism (1.3%), persistent wound drainage resulting in readmission (4.7%) and reoperation (3.4%) occurred at rates exceeding prior experience with a prophylaxis regimen utilizing low intensity warfarin. Finally, direct factor Xa inhibitors have been associated with a rate of reoperation for drainage of hematoma after THA and TKA that is twice that seen with fractionated heparins. Not surprisingly, the orthopaedic community has been slow to adopt routine use of these newer agents and has favored a more balanced strategy that offers a lesser bleeding risk with comparable protection against <u>*clinical*</u> thromboembolic events. Low intensity warfarin, despite its variable dosing and need for monitoring, was still the VTE prophylaxis of choice for nearly 50% of all orthopaedic surgeons performing total joint arthroplasty in North America when last surveyed in 2010, prior to the release of the direct Xa and thrombin inhibitors. Likewise, in the absence of extensive clinical event data for PE, at that time nearly 15% of surgeons preferred aspirin as prophylaxis based largely on the strength of its negligible bleeding risk. Interestingly, surgeons who perform larger numbers of joint replacement procedures opt for thromboprophylaxis with the newer potent anticoagulants *less* frequently than those who perform fewer procedures. However, just as less intensive anticoagulation was gaining in popularity, a recent randomized trial comparing aspirin with warfarin using AAOS guidelines for VTE prophylaxis after THA and TKA was discontinued prematurely due to a clinical PE rate nearly eight fold greater in the aspirin group. Consequently, the ideal prophylaxis is yet to be determined; it must represent a *balance* between the risk of death from PE and major hemorrhage, the morbidity of bleeding associated with anticoagulation, and the preferences and risk tolerances of individual patients.

Perioperative cardiac events constitute approximately 50% of all causes for readmission after THA and are significantly reduced in patients with known, or those at risk for, coronary

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artery disease with the use of atenolol as a beta-blocker to protect the heart. Overall mortality is reduced nearly 5-fold over the first year after operation in atenolol-treated patients with the principal effect attributed to a reduction in cardiac death during the first six to eight months postoperatively. Similarly, combined cardiovascular outcomes were reduced by nearly 15% over the two year observation period in the treatment group. While recent data have suggested that more *selective* use of perioperative beta-blockade is prudent, survival and morbidity advantages persist in "at-risk" patients.

In 2012, the publication of results of two prospective randomized clinical trials concerning the use of aspirin to prevent *recurrent* venous thromboembolism may have stimulated a renewed interest in its use in the perioperative setting. In both the Aspirin for the Prevention of Recurrent Venous Thromboembolism [Warfarin and Aspirin (WARFASA)] study from Italy and Aspirin to Prevent Recurrent Venous Thromboembolism (ASPIRE) trial from Australia, patients with a first episode of unprovoked VTE within two years of enrollment were randomized to receive either aspirin 100 mg daily or placebo. Patients in both trials were enrolled only after completion of an initial period of 6 weeks to 24 months of standard oral anticoagulation therapy with warfarin or an acceptable alternative. In the WARFASA trial, which included 402 patients, aspirin reduced the risk of recurrent venous thromboembolism from 11.0% to 5.9% (hazard ratio .55; p=0.02) over a median treatment period of nearly two years. The ASPIRE trial included 822 patients and recurrent VTE was noted in 6.5% of patients assigned to placebo compared with 4.8% of patients who received aspirin (hazard ratio 0.74; p=0.09) over a median follow-up period of 37 months. Yet, despite the non-significant reduction in recurrent VTE in ASPIRE, patients receiving aspirin enjoyed a reduction in the composite of major vascular events (overall VTE, myocardial infarction, stroke, or cardiovascular death) from 8.0% to 5.2% per year (hazard ratio 0.66; p=0.01). Similarly, patients receiving aspirin experienced an *overall net clinical benefit* (defined as the aggregate of recurrent VTE, myocardial infarction, stroke, major bleeding, and all-cause mortality) with an event rate reduction from 9.0% to 6.0% per year (hazard ratio 0.67; p=0.01). In both studies there was no difference in major or clinically relevant non-major bleeding events between aspirin and placebo groups. The identical treatment regimens (100 mg aspirin daily) and very similar entry criteria and endpoints afford reasonable aggregation of the data from these two studies. Taken together, aspirin was associated with a 32% reduction in the recurrence of VTE (hazard ratio 0.68, p=0.007) and a 34% reduction in major adverse vascular events (hazard ratio 0.66; p=0.002), and it is important to note that this benefit accrued without an accompanying increase in the risk of adverse bleeding. Given this combination of efficacy in preventing VTE in the absence of a compromise in safety, as measured by untoward bleeding, the findings of these two studies might legitimately be expected to stimulate a re-evaluation of aspirin for VTE prophylaxis in the perioperative setting, perhaps in conjunction with contemporary methods of mechanical compression.

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ICL 202: Preventing Hospital Readmissions and Limiting the Complications Associated with THA

Wednesday, March 2, 2016 (8:00-10:00 AM).

Presentation Title: Optimizing Patient Health Perioperatively and Preventing Readmission

Richard Iorio, MD

-While TJA generally has favorable clinical outcomes in patients with advanced OA, there remains a risk of unfavorable outcomes. This includes operative and post-operative complications potentially leading to readmissions or revision surgery.

-Often these suboptimal outcomes are tied to comorbidities or complications associated with their TJA. Modifiable risk factors for poor clinical outcomes following TJA include: 1. morbid obesity, 2. poorly controlled diabetes and nutrition, 3. *Staphylococcus aureus* (*S. aureus*) colonization, 4. cardiovascular disease, 5. venous thromboembolic disease (VTED), 6. tobacco use, 7. neurocognitive, psychological and behavioral problems (including drug or alcohol, dependency) and 8. physical deconditioning and fall risk. Together, these eight modifiable risk factors significantly account for avoidable complications and poor clinical outcomes following TJA. Identifying and modifying these risk factors prior to surgery presents an opportunity to decrease avoidable complications, improve clinical outcomes, and decrease costs associated with unnecessary health services utilization following these procedures.

-Although some of these modifiable risk factors may be longstanding and recalcitrant to change, patients may express a renewed interest in addressing them if they stand in the way of obtaining TJA, a procedure they hope will result in dramatic changes in pain, physical function and quality of life. The prospect of undergoing TJA may therefore provide an opportunity (i.e. "teachable moment") to identify and manage such modifiable risk factors through shared decision making.

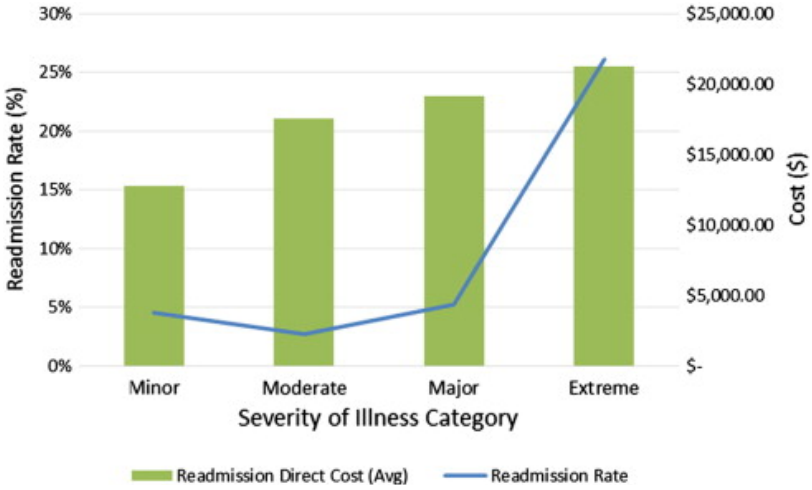
-Primary care physicians, internists and specialty physician involved in the pre-admission clearance process can all participate in decreasing these risk factors preoperatively.

-By implementing these risk factor optimization programs, we intend to lower our complications after TJA operation and our readmission rates.

- Our concept of a Perioperative Orthopaedic Surgical Home (POSH) to optimize patients preoperatively is the NYULMC plan to deal with these difficult patients

- **Comorbidity Prevalence in TJA patients**

Musculoskeletal comorbidities	73.8%
Hypertension	60.1%
Hyperlipidemia	55.3%
Tobacco use	22.0 %
Diabetes	19.2%
Depressive disorders	14.5%
Morbid Obesity	13.8%
Ischemic Heart Disease	13.5%
Dysrhythmias	10.8%
Valve disease	7.8%
Cerebrovascular Disease	4.4%
CHF	2.8%



Total Knee Arthroplasty	Total Hip Arthroplasty
BMI >40 + active smoking	BMI >40 + active smoking
BMI >30 + active smoking	Revision + active smoking
Revision + active smoking	*S. aureus* + Revision + active smoking
S. aureus + Revision + active smoking	*S. aureus* + BMI>30 + active smoking
S. aureus + BMI >30 + active smoking	

Characteristics of patients with multiple risk factors for SSI that need intervention based on evidence from Maoz et al and Crowe et al

-Additionally, the patients with comorbidities that did not have a readmission may have an increased risk of a complicated initial hospitalization
-506/2772 TJA patients had a length of stay of 7 days or longer with average costs of $32,609-

$84,678 per admission, substantially higher than our average of $24,000 during that time period

-The vast majority (95%) of increased length of stay or readmitted patients had at least 1 modifiable risk factor in their history. Additionally, about 50% had 2 or more modifiable risk factors.

- We have validated a POSH Readmission Scoring Tool which quantifies modifiable risk factors and predicts readmission risk, thus identifying patients who would benefit from surgery delay and risk factor optimization

	Risk Factor	Points on Risk Stratification Scale
1	**Infection risk factors:*Staphylococcus Aureus* colonization** Every patient is screened If positive for staphylococcus colonization: ▪ Nasal mupirocin or povidone-iodine, chlorhexidine gluconate (CHG) wipes, and appropriate antibiotic coverage ▪ If these requirements are not met then *hard stop* until protocol implemented	Hard Stop
2	**Smoking (Tobacco use)** All tobacco users will be enrolled in tobacco cessation program 4 to 8 weeks prior to surgery	1
3	**Obesity** BMI greater than 40: ▪ Enroll in nutritional counseling program ▪ Long-term weight loss program, and ▪ Undergo bariatric consult. BMI 35-40: ▪ Patients will be enrolled in nutritional counseling with consideration of acute weight loss program BMI 30-35: ▪ Enroll in nutritional counseling program	Hard Stop 2 1
4	**Cardiovascular Disease** Patient has history of coronary artery disease (CAD), stroke, peripheral vascular disease or VTED, age ≥60 years and 2 cardiac risk factors: renal insufficiency (CrCl < 60ml/min); Diabetes; chronic obstructive pulmonary disease; Hypertension; Recent smoker (<30 days); Cancer; Heart failure ▪ All qualifying patients will be enrolled in OPTIMIZE-OS peri-operatively	1
5	**Venous Thromboembolic Disease** History of pulmonary embolus or deep venous thrombosis: ▪ Consider inferior vena cava (IVC) filter or aggressive VTED management Has VTED risk factors: CVA, COPD, BMI >30, CAD, stroke, PVD, activated protein C resistance	2 1
6	**Neurocognitive, psychological and behavioral problems (including alcohol and drug dependency)** Alcohol abuse or chronic active narcotic dependency Neurocognitive deficits such as traumatic brain injury (TBI), active psychiatric illness, dementia etc. Score of 7 or more on catastrophizing, PHQ-9	 2 1 1
7	**Physical Deconditioning** Nonambulatory or needs assistance with transfers status Comorbidities affecting physical function and ambulation	2 1
8	**Diabetes** Fasting blood glucose >180 ▪ Must be corrected prior to surgery, consider referral to diabetic management clinic (endocrinologist) Hgb A1c > 8 ▪ Referred to diabetic management clinic (endocrinologist) Well controlled DM	Hard stop 2 1

POSH Risk Factor Scoring Tool

Risk Ratio at each POSH Readmission Scoring level (for the random set)

POSH Score	0	1	2	3	4	5	6	7	8
Readmitted (A)	21	36	37	45	49	43	24	9	5
None (B)	89	95	39	31	12	3	0	0	0
Ratio = A/B	0.24	0.38	0.95	1.45	4.08	14.33	-	-	-
OR (Linear)	0.19	0.41	0.89	1.94	4.21	9.14	19.86	43.12	93.64
OR (Non-Linear)	0.24	0.38	0.95	1.45	4.08	14.33	-	-	-
OR (Linear, Age)	0.18	0.40	0.90	1.91	4.56	10.23	20.20	44.68	104.24
OR (NL, Age)	0.23	0.37	0.95	1.48	4.26	15.21	-	-	-

-Patients with a POSH Score of 3 had a 1.94 times higher risk of readmission, and with a score of 4 had a 4.21 times higher risk of readmission.

-This represents an overwhelming opportunity for cost savings, improvement in care and improvement in quality of life for our TJA patients

-Optimization interventions based on modifiable risk factors

- MRSA Screening and Decolonization, weight based antibiotic dosing, and use of Vancomycin and Gentamycin in high risk patients
- Smoking cessation (hard stop)
- Cardiovascular Optimization and Stroke Prevention (using PT, High dose Statins, and ACE inhibitors perioperatively)
- Aggressive weight control (hard stop at a BMI of 40)
- Catastrophizing avoidance
- Drug and alcohol interventions
- Fall education prevention
- Physical deconditioning physical improvement interventions
- Diabetes control and nutritional interventions
- Screening for high risk VTED patients with thrombophyllia testing and risk stratification in order to avoid aggressive anticoagulation

Summary

- Modifiable risk factors do play a major role in outcomes post TJA. By addressing these issues and enrolling patients in a risk modification program prior to surgical intervention, we may be able to lower rates of complications associated with these procedures.

- In light of these findings, we are implementing a Peri-operative Orthopaedic Surgical Home (POSH) model that allows for risk stratification of TJA candidates and clinical treatment to mitigate modifiable risk factors in high-risk patients (morbid obesity, poorly controlled diabetes, malnutrition and hyperglycemia, smoking, *S. aureus* colonization, cardiovascular disease, venous thromboembolic disease, neurocognitive, psychological and behavioral problems (which include drug and alcohol dependency), and physical deconditioning of comorbidities affecting mobility and fall risk.

- At NYULMC HJD, we have incorporated a trans-departmental (anesthesia, internal medicine, pulmonary, cardiology, endocrine, nutrition, bariatrics, physical therapy and psychiatry) approach to decrease perioperative morbidity and mortality and decrease readmissions. In today's bundled payment and quality driven environment, it is no longer economically feasible to simply accept increased risk in poorly managed patients. We have chosen to take an active role in managing modifiable risk factors and will delay surgery until these risk factors are controlled. We are funding a risk stratification coordinator to facilitate management and optimization of modifiable risk factors.

- At NYULMC HJD we are in year 3 of the BPCI program. There were 721 Medicare primary TJA patients in year 1 (January 1, 2013 to December 31, 2013) and 785 in year 3 (June 1, 2014 to May 31, 2015) available for analysis. Average hospital length of stay was decreased from 3.58 days to 2.96 days. Discharges to inpatient facilities decreased from 44% to 28%. Number of readmissions at 30 days decreased from 7% to 5%; at 60 days decreased from 11% to 6.1%; and at 90 days decreased from 13% to 7.7%.

- Although improved care coordination can assist in increasing efficiency of care and controlling costs, it does not prevent all complications and readmissions. Patient selection and risk optimization is the key to decreasing readmissions and complications associated with patient related factors.

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