When Do Readmissions for Infection Occur After Spine and Total Joint Procedures?

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Abstract

Background The episode-of-care concept promulgated by the federal government requires hospitals to assume the cost burden for all care rendered up to 30 days after discharge, including all readmissions occurring in that time. Although surgical site infections (SSIs) are a leading cause of readmission after total joint arthroplasties (TJA) and spine surgery, it is unclear whether these readmissions occur relative to the 30-day period.

Questions/Purposes We determined whether (1) most readmissions for SSIs occurred in 30 days, (2) the type of procedure performed affected the timing of readmission, and (3) the type of infecting organism influenced the timing of readmission.

Methods From our hospital database we identified 91 patients treated with elective TJAs and spine surgery from 2007 through 2010 who were readmitted with SSIs. Of the 91 patients, 46 had undergone spine surgery and 45 had TJAs. For each of these readmissions, we determined

the type of surgery, the length of time from initial discharge to readmission, and the type of infecting organism. **Results** Readmissions after spine surgery were more likely to occur within 30 days of discharge (80.4% for spine, 58.3% for TJAs). In the TJA cohort, there was a trend toward readmissions occurring within 30 days of discharge more often in the THA subset. We identified no correlation between type of infecting organism and timing of readmission.

Conclusions With the episode-of-care model, SSIs pose a substantial cost burden for hospitals since the majority would be included in the 30-day period included in the bundled reimbursement.

Introduction

Surgical site infections (SSIs) can be a devastating complication after elective total joint arthroplasty (TJA) and spine procedures and are a leading cause of readmission [8]. In addition, patients with SSIs use additional health-care resources including the possibility of multiple surgical procedures, long-term antibiotics, and lengthy hospital stays [9]. The episode-of-care concept promulgated by the federal government requires hospitals to assume the cost burden for all care rendered up to 30 days after discharge, including readmissions within that period [5]. With the advent of a 30-day episode-of-care model, the care associated with SSIs has the potential to create major costs to healthcare systems. For instance, elective spine surgery reportedly has a range of incidence of SSIs from 0.7% to 11.9% [7, 10, 13–15, 17]. The incidence of SSIs after elective TKA ranges from 1.1% to 2.2% [1, 11, 12] and from 0.3% to 1.1% after THA [12, 16].

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The financial risk to hospitals for assuming responsibility for care rendered in the postoperative period is substantial. To make an informed business decision regarding whether to participate in an episode-of-care-based reimbursement agreement, a hospital must understand the costs of services delivered in the entire episode of care, including costs associated with complications occurring during the postoperative period. In the case of postoperative SSIs, it is unclear to what degree the costs of associated infections would be included under the 30-day episode-of-care policy, or reimbursed separately as a later admission.

We therefore (1) determined whether most patients with SSIs were readmitted within 30 days of discharge, (2) determined whether the number of readmissions within 30 days differed according to the type of surgery performed, and (3) established the type of infecting organism that influenced the timing of readmission for a SSI.

Materials and Methods

We retrospectively reviewed our prospective hospital database and identified 5310 total joint operations and 3450 spinal operations performed between 2007 and 2010. Of these, 91 patients were readmitted to our hospital for SSIs during this period. The inclusion criteria for a SSI consisted of readmission for an infection deep to the fascia requiring antibiotics with or without surgical irrigation and debridement. Forty-six were readmitted after elective spine surgery. Six patients underwent cervical spine surgery, 36 had lumbar spine surgery, and four had scoliosis operations. The remaining 45 patients were readmitted after elective TJAs: 29 after TKAs and 16 after THAs (Table 1). The patients in each cohort had similar preoperative characteristics with respect to age, gender, and comorbidities (Table 2). Secondary procedures were performed in 95.7% (44/46) of patients readmitted after spine surgery and 93.8% (45/48) of patients readmitted after TJAs. No patients were recalled specifically for this study; all data were obtained from medical records and radiographs.

Table 1. Numbers of readmissions after elective spine and total joint surgery

Procedure	Total
Spine	46
Cervical	6
Lumbar	36
Scoliosis	4
Total joint	45
Knee	29
Hip	16

After obtaining approval from the Institutional Review Board, patient demographic data consisting of age, sex, and medical comorbidities were obtained from the patients' medical records. Perioperative and postoperative data gathered included type of surgery, site of surgery, whether the procedure was a revision, date of discharge from initial hospital stay, date of readmission, length of hospital stay on readmission, type of infecting organism, and need for additional surgical procedure. We analyzed the parameters using a one-tailed t-test for continuous variables and Fisher's exact test for categorical data. Microsoft Excel 2007 (Microsoft, Redmond, WA, USA) was used for all statistical analyses.

Results

Readmissions for SSIs within 30 days from discharge occurred at a higher ($p = 0.045$) rate after spine surgery compared with TJA. Of the 46 patients who were readmitted after elective spine surgery, 37 (80.4%) were readmitted within 30 days of discharge whereas 28 of 45 patients (62.2%) after elective TJAs were readmitted within 30 days. There was no difference ($p = 0.31$) in readmission rates between cervical and lumbar procedures. However, there was a trend ($p = 0.062$) in the cohort that had TJAs toward a higher 30-day readmission rate after THA. Readmission occurred within 30 days in 13 of 16 (81.3%) patients in the subset of patients who had undergone THAs. In contrast, only 15 of 29 (51.7%) patients in the TKA subset were readmitted within 30 days. The mean time to readmission in the THA subset was 32 days as compared with 58 days among the TKA subset.

The types of infecting organisms were widely varied (Table 3), and after consultation with an infectious disease physician at our institution, were divided according to pathogenicity with the group with highest pathogenicity consisting of methicillin-sensitive *Staphylococcus aureus* and methicillin-resistant *Staphylococcus aureus*. The organisms with higher pathogenicity did not have an impact on the timing of readmission ($p = 0.39$). The most common infecting organisms were *Staphylococcus* species, isolated in 62 of 91 patients (68.1%), and methicillin-resistant *Staphylococcus* species were identified in 16 of 91 patients (17.6%). Twenty-three patients (25.3%) had polymicrobial infections. No organisms were isolated in six patients (6.6%).

Discussion

Payers, led by the federal government, are rapidly moving toward the episode-of-care payment model. In this model,

Table 2. Patient demographics

Variable	Spine	Total joint	p value
Age (years)	53.4 (CI, 48.2–58.5)	59.1 (CI, 55.5–62.7)	0.08
Gender (female, male)	28, 18	25, 20	0.38
Active smoker	8	6	0.40
Diabetes mellitus	11	10	0.52
Hypertension	23	27	0.22
Coronary artery disease	6	6	0.60
Inflammatory arthritis	3	4	0.49

Table 3. Types of infecting organisms

Infecting organism	Number of readmissions
Coagulase-negative Staphylococcus (methicillin sensitive)	18
Coagulase-negative Staphylococcus (methicillin resistant)	8
Methicillin-sensitive Staphylococcus aureus	28
Methicillin-resistant Staphylococcus aureus	8
Enterococcus faecalis	10
Corynebacterium species	8
Escherichia coli	5
Propionibacterium acnes	5
Peptostreptococcus species	3
Group B Streptococcus	2
Acinetobacter species	2
Klebsiella pneumoniae	2
Proteus mirabilis	2
Fingoldia magna	2
Klebsiella oxytoca	1
Morganella morganii	1
Pseudomonas aeruginosa	1
Pasteurella multocida	1
Serratia marcescens	1
Streptococcus oralis	1
Clostridium perfringens	1
Candida albicans	1
Haemophilus aphrophilus	1
Leclercia adecarboxylata	1
No growth	6

all care rendered to a patient up to 30 days after discharge, including readmissions, will be the financial responsibility of the hospital. Several studies have addressed overall incidence of infection after elective spine and total joint procedures; however, few have examined the timing of those infections. Our study aimed to determine whether most patients with SSIs were readmitted within 30 days of

discharge and whether the number of readmissions within 30 days differed according to the type of surgery performed. Additionally, we examined if the type of infecting organism influenced the presentation of readmissions.

We note some limitations. First, while our study includes all patients readmitted to our institution during a 4-year period, we had small numbers of patients in each group because our infection rate is 0.9% for total joint surgeries and 2% for spine surgeries. Therefore, although our institution is high volume with more than 2000 total joint replacements and 1300 spine surgeries per year, the total number of infections is small (approximately 50 per year). This resulted in a limited ability to determine differences in readmission rates between the total joint and spine cohorts. Second, we included only patients who were readmitted to hospitals in our health system, and it is likely there were patients readmitted to outside facilities. We know that no patients with Medicare were readmitted to other institutions for SSIs. Our infection rate mirrors what has been reported in the literature for spinal surgery and TJAs [1, 7, 10–17]. As such the number of patients readmitted to other hospitals would not likely be large enough to affect the findings of our study. Thirty percent of our patients receive Medicare and our readmission rate to other institutions for infections is zero in 1 year. Each year we have one to two patients who are evaluated and admitted to other institutions for infections, then transferred to us for definitive treatment, however these patients are captured in our analysis (this information can be extrapolated to patients not receiving Medicare patients as well but not with absolute certainty). Additionally our institution has a large urban tertiary orthopaedic referral center for the tri-state. Owing to the expertise of our center, patients with postoperative infections whose index procedure was done at another institution (it is unlikely a small community hospital would treat one of our patients with infections) are referred to us for treatment.

We found readmissions within 30 days of discharge for SSIs were more likely to occur after elective spine surgery. The majority of this difference came from the TKA subset with the TJA group. Whereas greater than 80% of spine readmissions occurred within 30 days of discharge, only 51.7% of readmissions after TKAs occurred within 30 days. Huotari et al. [6], in a review of SSIs after THAs, TKAs, and open reduction and internal fixation of the femur, reported a median time to presentation of SSIs, including superficial infections, at 11 days, and 25 days for deep infections alone. Pull ter Gunne et al. [14], in a retrospective review of SSIs after spinal surgery, found that 72.7% of the SSIs, including superficial and deep infections, were identified in the outpatient setting an average of 28.7 days after the procedure was performed. Chikawa et al. [4], in a retrospective review of early deep SSIs,

defined as within 1 month from the initial surgery, reported an incidence of 1.1%; however, they did not address what percentage of all SSIs were early. Although Weinstein et al. [17], in a review of more than 2000 spinal procedures did not comment on the exact timing of readmission, 93% of their patients with postoperative infections presented with substantial wound drainage at an average of 15 days postoperatively. Our findings vary from those of Pulido et al. [12], who determined that only 27% of SSIs after TJAs occurred within the first 30 days postoperatively, and those of Peersman et al. [11] in which 29% of deep SSIs after TKA occurred within the first 3 months.

There was a trend for patients with SSIs after THAs to be admitted more frequently within 30 days of discharge compared with patients with SSIs after TKAs. This trend is consistent with the findings of Huotari et al. [6], who showed that a higher proportion of patients who had TKAs would present with SSIs after discharge from the hospital. The reason for the lower percentage of early readmissions in the TKA subset is unclear. One hypothesis for the disparity is that patients who have had TKAs may be treated more conservatively during the immediate postoperative setting. It is uncertain how many of these patients were treated on an outpatient basis with oral antibiotics before admission.

The infecting organism did not have an effect on the timing of readmission. Although Pulido et al. [12] reported 80% of their patients with acute infections after TJAs had staphylococcal isolates, they did not comment on the effect of the strain of bacteria on timing of the presentation of the SSI. Our microbiologic data are consistent with those from prior studies on SSIs after orthopaedic procedures [6, 12].

Whether 30 days is a sufficient time for the postoperative episode-of-care model remains uncertain. Although 80.4% of spinal infections and 81.3% of THA infections occurred within 30 days from discharge, only 51.7% of TKA infections were captured. If the episode-of-care model were to be extended to 60 days after discharge, 65.5% of patients with TKA infections requiring readmission would have presented, whereas greater than 93% of patients with SSIs after THAs and spinal procedures would have been readmitted. The results of extending the episode of care to 120 days would include 82.8% of readmissions for SSIs after TKAs.

We focused on the timing of readmissions after elective spine surgery and TJAs to highlight the financial risk when participating in episode-of-care agreements. The potential cost burden for healthcare providers created by readmissions for SSIs has the potential to be considerable if episode-of-care models were to be enacted. Whitehouse et al. [18], in a study on the effect of SSIs, reported an average of 14 days of additional hospital stay with readmission and more surgical procedures and rehospitalizations. In our study, 94.7% of the

readmitted patients required at least one secondary procedure during the hospital stay. With infection rates of approximately 1% to 2% after elective spine and TJAs and higher rates for revision surgeries, there is potential for substantial unreimbursed expenditure by healthcare systems. Bozic and Ries [2] and Calderone et al. [3] reported the average cost of treating an infected TJA to be approximately \$70,000 and \$100,000 for the treatment of an infected spinal fusion, respectively. This potential implication must be considered when participating in a payment system based on the episode-of-care model.

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