Surveillance and Management Strategies to Reduce Surgical Site Infection (SSI) in Hip and Knee Joints Arthroplasty at a Tertiary Arthroplasty Unit.

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Abstract

Superficial surgical site infection is recognised as a risk factor for deep joint infection in arthroplasty. Deep joint infections cause significant morbidity, adversely affecting a patient’s quality of life and are expensive to manage. Since the advent of arthroplasty there has been a drive towards reducing infection rates and managing risk. Our institution has adopted several strategies to improve our superficial surgical site infection rate including the development of BIU (Bone infection unit) a dedicated infection service, a patient hotline and adjustments to our surgical techniques (utilisation of 2% chlorhexadine for preparation of the skin, special wound protection Aquacel™ dressings, iodine impregnated drapes, and antimicrobial sutures). A review of infection rates before and after implementation of our strategy demonstrates a reported drop in superficial surgical site infection from 6.7% to 3.3%.

Keywords: Arthroplasty; Surgical Site Infection; Strategy; Management.

Introduction:

Deep joint infection (DJI) following arthroplasty remains a significant cause of morbidity, leading to poor outcome and quality of life for the affected patients (1–3). The financial impact of DJIs is also significant with costs being three times greater than the cost of a primary arthroplasty (4).

The incidence of DJI is widely reported to be up to 1% (5–7). One particular risk factor that has been proposed is a post-operative surgical site infection (SSI), the presence of which may lead to the development of a DJI either immediately or in the future (6,8,9). The rate of SSI is reported to be between 2 and 7% depending on the surgical procedure (10,11). In Charnley’s initial presentation of outcomes following arthroplasty, he described a DJI incidence of 3.8% (12) however subsequent changes in perioperative management including the implementation of clean air theatres dramatically reduced this to less than 1% (13). The ongoing battle against prosthetic infection has warranted scrutiny of every aspect of patient management from appropriate patient selection through to post-operative rehabilitation.

Early identification of superficial surgical site infection and appropriate treatment can help prevent the progression to a deep joint infection. In early post-operative infection targeted antimicrobial therapy on occasions with surgical debridement following tissue sampling provides the best chance to eradicate infection and potentially allow retention of the prosthesis (14). The presence of excessive serous wound ooze may often be the only indicator of infection along with a spreading cellulitis (8). These patients may present to their primary care provider with signs of surgical site infection following discharge from hospital. Quite often, these patients
are treated with empirical antibiotics for a presumed superficial infection by their general practitioner. This intervention can potentially affect the appropriate orthopaedic management of tissue sampling, surgical debridement and subsequent antibiotic therapy (15). This can lead to a situation of latency with partially treated infections grumbling on for many years with less management certainty.

Our institution is a tertiary unit, carrying out over 2000 primary hip and knee arthroplasties a year. As part of our routine service we have implemented multiple strategies to improve our unit’s infection rate. We have a specific Bone Infection Unit (BIU), which adopted a multidisciplinary approach to musculoskeletal infection and features senior clinicians in orthopaedics and microbiology with the assistance of specialist nurse practitioners who can implement ongoing patient care and management outside of the hospital environment. Moreover, we also receive referrals for patients from around the region for the management of either confirmed or suspected deep joint infection.

In addition to this we have worked towards standardizing protocols across our institution to minimize infection risk. This paper presents a chronological narrative of our strategy and the initial findings with respect to infections.

**Methods**

We performed a retrospective review of patients who underwent hip or knee arthroplasty (primary or revision) at a single tertiary orthopaedic centre. Two cohorts of consecutive patients were assessed and compared. Cohort I had surgery between 2009 and 2010 (2 years), while the Cohort II had surgery between 2011-2013 (3 years). Patients from both cohorts include those who had their primary procedure performed elsewhere and referred to us by primary care or other orthopaedic units. Service improvements specific to help tackle surgical site infection, and therefore deep joint infection, were implemented from the second quarter of 2011 and completed by the third quarter of 2013.

Pre-operative assessments of patient’s fitness for surgery included microbiology evaluation of MRSA colonization status (swabbed areas were groin, axilla and nasal cavities). Patients who tested positive for presence of MRSA were treated according to decolonization protocol which included chlorhexidine based scrubs and mupirocin ointment (16). The peri-operative changes implemented included the use of 2% chlorhexidine skin preparation, antimicrobial sutures, iodine-impregnated isolation drapes, Aquacel™ dressings. A dedicated post-operative wound care help-line with early post-hospital discharge review by our community team allowed for more focused surveillance, early detection of SSI and aggressive management. Our practice is in keeping with national guidelines (NICE CG74).

Post-operative surveillance for infection is a mandatory part of patient care. In joint arthroplasty early identification of infection offers the opportunity to retain implants through aggressive debridement, irrigation and antibiotic treatment (14) with success rates of 90% reported for patients with deep joint infections identified and treated within 30 days of index surgery (17).

Current surveillance techniques vary between institutions but in England include the collection of data for a minimum of thirty days post-operatively. This data is submitted nationally for central monitoring and includes any positive features of infection, including readmission (18).

**Post-operative Surveillance (June 2011)**

Methods for surveillance also vary from proactive patient follow-up (telephone or face to face) to patient reported questionnaires. There is a concern that current mandatory methods may under-report the incidence of surgical site infection if a patient is admitted elsewhere and is lost to initial follow-up. In arthroplasty surgery the implications of an SSI not being reviewed by the surgical team include the potential for mismanagement in primary care where empirical antibiotics may be started without any microbiology sampling leading onto a partly treated infection without cultures or sensitivities.

Our centre implemented a very strict surveillance regimen that included in depth education of patients for any signs or symptoms consistent with SSI. A telephone help-line was set up to allow patients with any concerns to contact the BIU through which rapid access clinic appointments were available. Rehabilitation was also continued for some patients by our community team following discharge, with members of team trained to identify and flag up any patients with potential SSI and to liaise with the infection control team.
Antimicrobial Suture (December 2012)

The use of anti-microbial skin sutures has been shown in several studies to reduce the incidence of superficial infection post-surgery. Animal studies (19) and human studies (20) have demonstrated the reduction in surgical site infections but also the potential cost benefit. Antimicrobial sutures have demonstrated a reduction in positive microbial cultures thus minimizing the risk of exogenous infection tracking into the joint.

Skin preparation – 2% Chlorhexidine (September 2013)

A study evaluating 2% chlorhexidine gluconate and 70% isopropyl alcohol versus an aqueous 10% povidone iodine for surgical site preparation demonstrated a significantly reduced rate of both superficial and deep incisional infections with the chlorhexidine preparation (21) but did not show any difference with organ-space infections.

Iodine-impregnated isolation drapes (December 2013)

Iodine-impregnated drapes have been shown to not only reduce the incidence of SSI but also to prevent contamination of the deeper parts of the wound with skin flora (22).

Aquacel™ Dressing (December 2013)

The use of silver in dressings has been proven to demonstrate anti-microbial properties and in the use of Aquacel™ the incidence of infection (especially in conjunction with antimicrobial sutures) should go down further (23).

Patients who had surgical site infection (SSI) were identified from the mandatory Public Health England (PHE) patient surveillance questionnaires in 2012 for the 2009-2010 cohort, and 2014 for 2011-2013 cohort. Furthermore, a local database that was established along with post-operative follow-up initiatives was also used to identify patients, included those who had SSI beyond the initial 30 days post-operative period and therefore might not be recorded by the PHE’s questionnaires.

Clinical records for all of these patients were reviewed to confirm clinical diagnosis of superficial infection. For patients who had revision arthroplasty, the cause for revision surgery was established and radiographs of the prosthesis were also reviewed. Patients who had revision arthroplasty due to presumed aseptic causes were excluded from this study for deep joint infection analysis, unless they had documented evidence of SSI.

Data collected include the total number of patients who underwent primary and revision hip and/or knee arthroplasty at our unit. The number of patients who were recorded as having an SSI within 30 days had further information drawn including details of any management. For the 2011-2013 cohort, treatments for those who were re-admitted within the first 30 days were also analyzed, and the time lapsed from the index procedure to revision procedure was recorded for those who underwent revision arthroplasty.

Results

We identified a total of 10,306 patients between 2009 to 2013 and divided into the following two groups

Cohort I

We identified 4051 patients who had primary or revision arthroplasty for hip and/or knee between 2009 and 2010 (Table 1 & 2). A total of 2997 patients completed the 30-day SSI questionnaire representing a return of 73.9%. Of these, 201 patients (6.7% of 2997) were found to have SSI based on the information from the questionnaire.

<table>
<thead>
<tr>
<th></th>
<th>Cohort I (2009-10)</th>
<th>Cohort II (2011-13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Patients</td>
<td>4051 Patients</td>
<td>6255 patients</td>
</tr>
<tr>
<td>Questionnaire Returns</td>
<td>2997 Patients (73.9%)</td>
<td>4942 patients (79.0%)</td>
</tr>
<tr>
<td>Superficial Infections (SSI)</td>
<td>201 Patients (6.7%)</td>
<td>163 patients (3.3%)</td>
</tr>
</tbody>
</table>

Table 1. Questionnaire return and SSI rate
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<table>
<thead>
<tr>
<th>Procedure Type</th>
<th>Cohort I (2009-10)</th>
<th>Cohort II (2011-13)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2009</td>
<td>2010</td>
</tr>
<tr>
<td>Primary Hip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Primary</td>
<td>1859</td>
<td>1806</td>
</tr>
<tr>
<td>Revision Hip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revision Knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Revision</td>
<td>179</td>
<td>207</td>
</tr>
<tr>
<td>Total Activity</td>
<td>2038</td>
<td>2013</td>
</tr>
</tbody>
</table>

Table 2. Total Unit Activity

Incidence of Surgical Site Infection - Primary Hip and Knee Procedures Only
(January 2009 – December 2015)

Figure 1. Improving SSI rates for Primary Hip and Knee Arthroplasty.
Cohort II

We identified 6255 patients who underwent arthroplasty between 2011 and 2013 (Table 1 & 2). Of the 6255 patients, 4942 patients (79.0%) completed and returned the 30-day SSI questionnaire. Of these, 163 patients (3.3%) were found to have SSI based on the information given on the questionnaire. Between mid-2011 and the end of 2013, the rates of SSI reduced from 9% to 1.4% and 4% to 0.25%, for primary knees and hips respectively (Figure 1).

Discussion

This focused and tactical approach towards reducing post-operative infection is marked by two key strategies; 1) improvement in peri-operative technique and 2) stringent post-operative surveillance and appropriate management.

Figure 1 demonstrates that at given points in time the implementation of various SSI interventions has led to an overall reduction in the presence of SSI in our primary arthroplasty patients. Clinically the improvement in surveillance has allowed for more accurate and consistent diagnosis of SSI. This strategy, along with instructions for patients to maintain close contact with our service if they have any concerns reduced primary care physicians’ input, saving them time and helping standardize management.

A key concern regarding primary care management of early post-operative complications in arthroplasty patients is the inappropriate prescription of antibiotics for suspected SSI. Even if appropriate, a surgical review is essential in order to determine risk of a DJI and planning if necessary for the collection of samples for microbiological culture prior to commencing antibiotics (15). Targeted therapy guided by microbiological sensitivities is vital to maximize the likelihood of eradication of infection, whereas empirical treatment (although necessary in acute systemic sepsis) may often allow infection to seed with adverse long-term outcomes (septic loosening) (15).

The use of anti-microbial sutures, 2% chlorhexidine spirit skin preparation, iodine impregnated drapes and Aquacel™ dressings were implemented based on published evidence (20–23) and the overall combination has contributed to a reduction in our SSI rates.

This strategy allowed more frequent reviews by surgical teams of their patients following discharge if there was any concern and although it contributed to more accurate evaluation and a reduction in the number of false positives, it is not clear as to what impact this may have had on the costs of surveillance.

Our questionnaire return rate, although marginally improved between the two cohorts still left between 20-25% of patients unaccounted for. Our evaluation has made the assumption that the non-responders were of similar demographic distribution and as such the infection rate was is representative and can be extrapolated.

Although it may be considered a strength that the wound-healing period is being so closely reviewed, a weakness is the fact that our review was limited to thirty days post-op. As part of ongoing strategy development, we are monitoring wound infections for up to one year post-operatively as part of routine follow-up.

The Philadelphia Consensus (9) formed expert panels covering all aspects of prosthetic joint infection from prevention through to management. This consensus was aimed at reaching agreement from an international panel of experts on the optimum management of PJI (prosthetic joint infection) through critical evaluation of the available evidence and expert opinion. Although not recognized as formal guidelines, it does offer an opportunity to standardize practice to optimize outcomes. Our current practice falls in line with the outcome of this consensus and with the 2014 update on SSI prevention strategies by Anderson et al (10).

This strategy implementation demonstrates an overall reduction in our SSI rates as a unit. This strategy is now part of our Trust policy and may be useful in developing other regional and local policies for a unified strategy to prevent surgical site infections.

Conflict of interest: None

References


18. Standards for microbiology investigations (SMI) - GOV.UK [Internet]. [cited 2017 Mar 15].


