Reducing Deep Joint Infection in Hip Hemiarthroplasty—A Quality Improvement Project

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ABSTRACT

Objective: To improve the deep wound infection rate in patients undergoing hip hemiarthroplasty in our regional trauma center.

Methods: We conducted a retrospective audit of patients who had undergone hip hemiarthroplasty between January 2013 and July 2014 and found that in 750 hip hemiarthroplasties performed, 20 (2.7%) developed a deep infection, a figure in excess of the literature standard. In line with international consensus recommendations, 4 changes to our perioperative practice were implemented: standardized draping of the affected extremity, improved skin preparation using a 2% chlorhexidine gluconate solution, change of incision drapes to iodophor-impregnated adhesive film drapes, and the use of interactive wound dressing. We conducted staff education to highlight the impact of deep wound infection, introduce the changes, and underscore the importance of strict adherence to intraoperative sterility.

Results: One year after introducing the changes, we audited the period April 2015 to March 2016, during which time 457 hip hemiarthoplasties were performed. Five (1.1%) deep infections were identified.

Conclusion: Improvement in the perioperative care of our hip hemiarthroplasty patients has resulted in a reduced risk of the development of deep wound infection. This improvement was maintained in a third audit period, with continued implementation of these changes in practice.

Keywords: deep infection; hip hemiarthroplasty; quality improvement; proximal femoral fracture; risk reduction strategies.

Deep wound infection following hip hemiarthroplasty is a catastrophic outcome for the patient, resulting in a prolonged stay in hospital, a poor outcome and increased costs. There is limited evidence in the literature reporting early deep infection rates specific to hip hemiarthroplasty. A number of studies describe the incidence of deep infection in proximal femur fractures treated by arthroplasty and fixation [1], with only a single study reporting on solely hip hemiarthroplasty [2]. The reported incidence of early deep infection following hip hemiarthroplasty specifically varies from 1.6% [1] to 4.9% [2,3]. These figures are primarily provided by retrospective, descriptive studies, with variable lengths of follow-up.

Early deep infection occurs more frequently in hip hemiarthroplasty for trauma than elective total hip arthroplasty. This is thought to be due to several factors including the advanced age of hip hemiarthroplasty patients and their comorbid status, in addition to the shorter time frame in which to medically optimize trauma patients, including less opportunity to address nutritional elements known to impact recovery.

A number of prognostic factors have been identified as increasing the chance of developing a deep periprosthetic infection following hip hemiarthroplasty. Although these are debated they include cognitive impairment, high body mass index, development of wound hematoma post-operatively and increased operating time [8].

Many of the measures taken to reduce the risk of deep infection in arthroplasty have a limited evidence base, with a significant amount of practice based on expert opinion [10]. This is due to the difficulty in designing robust randomized controlled trials with sufficient numbers to identify

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significant trends. It is generally accepted that parenteral antibiotic prophylaxis [4] and antibiotic-loaded cement reduce the incidence of infection [5]. Increased theatre traffic has long been accepted as increasing bacterial counts in theatre [6]. Sterile skin preparation and draping with impermeable drapes and an iodophor-impregnated adhesive skin drape have been shown to reduce bacterial contamination and recolonization rates in vitro [4], although this has not resulted in a clinical reduction in deep periprosthetic joint infections. Other practices such as the use of laminar flow theatres are less well evidenced [7].

Following concerns regarding a perceived spike in infection rates in our hip hemiarthroplasty patients, the senior author, who is the training liaison officer for trauma and orthopedics in the hospital, convened a meeting with the first 2 authors regarding how best to investigate this potential issue. It was decided that an audit of practice should be conducted, as well as a literature review to assess acceptable infection rates within the literature and any potential areas for improvement.

Setting

The Royal Victoria Hospital in Belfast is one of the UK's largest dedicated trauma units, treating over 900 proximal femur fractures per year. Of these, approximately 500 are displaced intracapsular neck of femur fractures requiring hip hemiarthroplasty. Patients are managed on dedicated trauma wards, and in accordance with British Orthopaedic Association guidelines there is a focus on multidisciplinary rehabilitation including a fully integrated orthogeriatric service [8]. We routinely use a modular Exeter trauma stem (Stryker, Kalamazoo MI) prosthesis with gentamycin-loaded cement and an antibiotic prophylaxis regimen of flucloxacillin and gentamicin prior to incision, followed by 2 further doses of flucloxacillin over 24 hours. A preoperative checklist is conducted to ensure that antibiotics are administered prior to skin incision and that there are no concerns regarding equipment sterility. Four trauma theatres are run each weekday, prioritizing medically optimized proximal femoral fracture patients.

Quality Improvement Project

Pre-intervention Audit

A retrospective audit was carried out via interrogation of the Fracture Outcome Research Database (FORD) between January 2013 and July 2014. This is a prospectively collected database of demographic data and outcome measurements that is managed by a dedicated team employed by the institution. This ensures accurate documentation of hospital admissions for trauma, operations conducted, and outcomes, such as discharge destination and further procedures.

The search terms used were *wound washout, irrigation and debridement, first stage revision, girdlestone,* and *excision arthroplasty*. Exclusion criteria included washouts for septic arthritis of a native hip joint, open injuries, and repeated washouts on the same patient. Data were collected including demographics, comorbidities, surgeon level, ward, theatre and causative organism by reviewing the electronic and written records.

725 patients were identified who met the inclusion criteria and underwent a hip hemiarthroplasty. Of these, 20 had undergone a washout procedure for deep infection, a rate of 2.7%. There were 14 females, nine males, 12 were right hips, 8 left, with a mean age of 81 years (range, 66–92). The mean American Society of Anesthetists (ASA) score was 3.2 (range, 2–4). Fourteen infections were identified within 4 weeks postoperatively, 6 within 8 weeks. Nineteen out of 20 of the causative organisms isolated were sensitive to the standard prophylactic antibiotic regimen. There was no association identified with a particular theatre, presence of laminar flow, ward, or grade of operating surgeon.

Changes to Perioperative Practice

We met on 2 further occasions to discuss the findings of the literature review and strategy for improvement prior to institution of changes.

We reviewed the National Institute for Clinical Excellence (NICE) Clinical Guideline [9] and the "International Consensus on Periprosthetic Joint Infection" [10] to compare our perioperative practice to national and international recommendations. We identified that we were compliant with a large majority of recommended practices, for example using antibiotic prophylaxis, laminar flow theatres, and sterile disposable drapes. We defined an acceptable infection rate to be 1.6% following a comprehensive literature review [1–3].

Four potential changes to our perioperative practice were chosen based on our review of the clinical guide-

lines and consensus document. These were chosen due to the strong expert opinion that they commanded within the consensus document and their relative ease and speed of implementation.

- Standardized draping of the affected extremity using stockinette isolation and windowed drape towards patient's upper body.
- Use of a chlorhexidine gluconate (2% [w/v] in 70% [v/v] isopropyl alcohol) preoperative skin solution in theatre as a preliminary antiseptic skin preparation prior to formal preparation with povidone-iodine. Darouiche et al [11] demonstrated that preoperative cleansing of the patient's skin with chlorhexidine-alcohol is superior to cleansing with povidone-iodine for preventing surgical site infection. Subsequent studies have suggested that concurrent application of the 2 antiseptic agents confer a further potential benefit by reducing the number of viable colony forming organisms and, subsequently, deep surgical site infection [12,13].
- Change from non-impregnated adhesive incision drapes to Ioban (3M, St Paul, MN) (other manufacturers available) iodophor-impregnated adhesive incision drapes. Experimental studies have demonstrated a lower rate of skin recolonization with bacteria following the use of impregnated drapes compared to non-impregnated drapes [14,15] although this has not been correlated to rates of deep infection.
- Change from simple absorbent dressings to interactive wound dressings (Aquacel and Duoderm; ConvaTec Ltd., Flintshire, UK) (alternative manufacturers available). There is evidence to show that Aquacel and Duoderm dressings were associated with reduced rates of skin blistering and infection in elective arthroplasty [16].

We also felt that staff education would be important for implementing change. We presented the results of the initial audit at departmental and regional quality improvement meetings, demonstrating the need for change in practice. Following the literature search and decision to implement 4 changes, medical staff were re-educated at the departmental audit meeting on the rationale behind the changes being made. Via liaison with the nurse lead of trauma theatres, nursing and auxiliary staff underwent education sessions. These were small group sessions, with visual aids, designed to fit in to staff breaks to reduce disruption of their work. Groups consisted of 4 to 6 people per session. They were led by the authors and focused on highlighting the reasoning behind the changes in practices and answering any questions that staff had. During these sessions, a revision of good theatre etiquette was conducted. This included reinforcing basic theatre principles, for example, reducing theatre traffic, ensuring correct theatre dress and head coverings are worn at all times, highlighting the need to regularly wash hands and wear gloves when required, and to respect the sterile areas and instruments appropriately.

Results

A re-audit of hip hemiarthroplasties was conducted after a 12-month interval to allow proposed changes to become routine practice. Re-audit was undertaken retrospectively from April 2015 to March 2016 using the same methods and search strategy as before. 457 (male 43.3%, female 56.7%) hip hemiarthroplasty procedures were carried out in this time period with 5 deep infections occurring, a rate of 1.1%, demonstrating a statistically significant reduction in periprosthetic joint infection rate ($P = 0.03$, chi square test). There were 3 males and 4 females, with a mean age of 79 years (range 57–91), and mean ASA of 3.1 (range, 2–4). Two were right hips, 3 were left hips. Four infections occurred within 4 weeks and one at day 50. The overall mortality rate for those patients who developed deep periprosthetic infection within our study time frame was 28%.

Findings were presented at the regional audit meeting. This highlighted the positive impact of the changes to practice and stimulated discussion on further improvements to practice that could be instituted. Prior to implementation of any further changes to practice a re-audit was conducted over a further 12-month period. This demonstrated maintenance of an infection rate below the literature standard of 1.6% and a continued reduction in the initial audit rate of 2.7%

Lessons and Limitations

This quality improvement project demonstrates how simple changes can deliver large benefits to both pa-

tients and the health system. There is considerable variability in worldwide orthopedic practice, due in part to the limited evidence base for some perioperative infection precautions. This was the first attempt in Northern Ireland to quantify the effect of some of these precautions and to contribute to the evidence in support of their implementation. We acknowledge that the numbers involved in our project are small, and the effect size is likely to be overestimated. Factors contributing to this include the Hawthorne effect, improved staff awareness of postoperative infection, and that patients who either died or were treated conservatively did not undergo a washout procedure and therefore would not have been identified.

Institutional change is challenging. We selected the changes to practice that we felt would likely provide the largest benefit, with minimal cultural resistance. All materials (eg, Ioban drapes and Chloraprep skin solution) were already stocked in theatre suite and therefore did not have to undergo procurement procedures. Junior medical staff were instructed on strict standardised draping technique, as agreed by revision arthroplasty surgeons working within the unit.

We would advocate that theatre staff at every level are involved in this process from the outset in order to maximise the overall benefit. It is important that medical, nursing, and auxiliary staff are involved in decision making and implementation to facilitate uptake of new practices. All staff were re-educated on the impact of deep infections in these patients and the importance of perioperative practice in minimising these. Whenever resistance was met we addressed with open discussion and answering all questions to ensure staff understanding and acceptance.

Conclusion

Deep joint infection represents a significant cause of morbidity and mortality in the elderly population and a financial burden on the health service. The implementation of these simple perioperative interventions has achieved a significantly reduced rate of infection in a regional trauma center. Our interventions have been straightforward to implement, cost-effective and, most importantly, have demonstrated a significant, tangible benefit to our patients.

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