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Prospective Surveillance of Post-Operative Surgical Site Infection in Orthopedic Patients Undergoing Hip Procedures - Lessons Learnt Over A Seven-Year Surveillance Program

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ABSTRACT

Objectives: Surgical site infection (SSI) is an important complication of surgical intervention. The establishment of evidence-based surveillance programs have been shown in multiple studies to reduce the rates of surgical site infection in these high-risk procedures. The monitoring of SSI rates can be used to assess the quality of the service provided to patients. The aim of this study was to develop a prospective SSI surveillance program in orthopaedic patients undergoing hip procedures in Connolly Hospital Blanchardstown (CHB) to permit estimation of the magnitude of SSI risks among hospitalised patients, analyse and report SSI surveillance data and provide risk-adjusted SSI rates and the identification of SSI trends.

Method: Prospective SSI surveillance of orthopaedic patients undergoing hip procedures in CHB commenced in July 2011. A surveillance form, based on the surveillance form used for SSI surveillance in orthopaedic patients in the UK, was designed by Infection Prevention and Control (IPCT) and Orthopaedic Teams. Data analysis is carried out by the IPCT and discussed with all relevant individuals and groups.

Results: Total patient numbers from July 2011-December 2015 (excluding July-Dec 2013 and July-Dec 2014) was 414. Screening for preoperative risk factors included compound fractures, pathological fractures, diabetes, smoking or peripheral vascular disease. 6 patients were recorded to have SSI over this period. Cemented hip hemiarthroplasty was the most common procedure performed.

Conclusion: SSI remained low in our prospective study. This surveillance program results in improvements of practice, such as optimisation of surgical prophylaxis used in CHB, and allows us to monitor trends in SSI rates and quality of care provided to our patients.

Abbreviations: SSI: Surgical Site Infection; CHB: Connolly Hospital Blanchardstown; IPCT: Infection Prevention and Control; HCAI: Healthcare Associated Infection; HIQA: Health Information and Quality Authority; IHFD: Irish Hip Fracture Database; INOR: Irish National Orthopaedic Register; CDC: Disease Control and Prevention; ASA: American Society of Anesthesiologists; CST: Core Surgical Training; MRSA: Methicillin Resistant Staphylococcus Aureus

Introduction

Surgical site infections (SSI) are a significant complication of surgical intervention and are the most frequent healthcare associated infection (HCAI) in the Republic of Ireland [1]. There is an increasing demand from national bodies for consistent valid data collection of HCAIs. The rate of SSIs is an important indicator of patient care. The establishment of infection prevention and control surveillance programs have been shown to reduce rates of SSI [2-5]. In the UK, since July 2004, NHS trusts undertaking orthopaedic surgical procedures are required to carry out SSI surveillance in orthopaedic procedures. In Ireland, the Health Information and Quality Authority (HIQA) [6], recommend that hospitals should ensure the monitoring of all SSIs; however this has not being widely adopted. Currently, no established national reporting system exists for SSI, deep infection or patient reported infection in Ireland. This is despite two national orthopaedic databases, the Irish Hip Fracture Database (IHFD) and the Irish National Orthopaedic Register (INOR) [7,8]. These databases are in existence, but neither collect SSI data and as such it falls to local orthopaedic units or the investigative influences of HIQA.

The aim of this study was to establish a de nova prospective multi-disciplinary surveillance program of orthopaedic hip procedures, including both elective and trauma patients, in a major teaching hospital and to use data generated to measure performance and which could act as a template for other hospitals to follow. This surveillance program allows comparison of results with other service providers nationally and internationally; and assists in monitoring the impact of any new intervention introduced in surgical practice. This study presents the SSI surveillance data on patients undergoing hip procedures in a major teaching hospital over a seven year period from 2011-2018.

Materials and Methods

A surveillance form (**Appendix 1**), based on the surveillance form used for SSI surveillance in orthopaedic patients in the UK, was designed by the Infection Prevention and Control and Orthopaedic teams. This form involved the prospective collection by members of the orthopaedic team (predominantly interns and senior house officers), of patient and procedure related data pre-, intra- and post-operatively on all patients undergoing hip procedures. The patient group included those presenting for elective operations following attendance at outpatient clinic or patients presenting to the Emergency Department following trauma. On admission, the standardised form was included in the patient's medical record. The details included on the form were of patient demographics, the nature of the injury sustained, proposed type of hip operation, anaesthetic type, and other possible patient risk factors for developing a SSI, e.g. diabetes mellitus, smoking history etc. Active surveillance was undertaken and data was then collected prospectively during their inpatient stay by the intern or senior house officer of the orthopaedic team and by hospital surveillance staff. If there was a concern for SSI, the patient was reviewed by a senior member of the team (Orthopaedic Specialist Registrar, Orthopaedic Consultant and/or Microbiology Consultant). Inter-observer variation was not recorded. SSIs were defined according to a standard set of clinical criteria for infections that affect the superficial tissues (skin and subcutaneous layer) of the incision and those that affect the deeper tissues (deep incisional or organ-space). These are based on the definitions established by the US Centers for Disease Control and Prevention (CDC) [9] (**Appendix 2**). Data analysis and reporting was carried out by surveillance scientists and members of the Infection Prevention and Control Team. The findings were then fed back to relevant individuals and groups, via six monthly reports and presentations at team meetings, to improve patient care and to extend and build upon this data.

Results

Patient Demographics

The total number of patients included in the surveillance program over the seven-year period was 648; of these 44% were male and 66% were female. The largest group of patients were aged between 76-85 and within that age group there were nearly double the number of female presentations than male (Figure 1).

Pre-Operative Surgical Site Infection Risk Factors

Pre-operative key patient and surgery-related SSI risk factors included compound open fractures (n=7), compound fracture and smoker (n=1), pathological fractures (n=14), peripheral vascular disease (n=22), diabetes (n=47), smoker (n=76), smoker and diabetes (n=3). A range of risk factors were also captured through the SSI surveillance programme via the American Society of Anesthesiologists (ASA) score [10]. This is the patient's pre-operative physical status, with higher scores indicating severe systemic disease. 7% of patients had an ASA of one, 46% an ASA of two, 38.4% an ASA of three, 3% an ASA of four and 0.3% of patients had an ASA of five.

Intra-Operative Details

88% of patients had their proposed operation either on the day of admission or the day following admission. Hip procedures performed are illustrated in (Figure 2). The most common procedure was a cemented hemiarthroplasty for intracapsular neck of femur fractures followed by a dynamic hip screw, usually for intertrochanteric proximal femur fractures.

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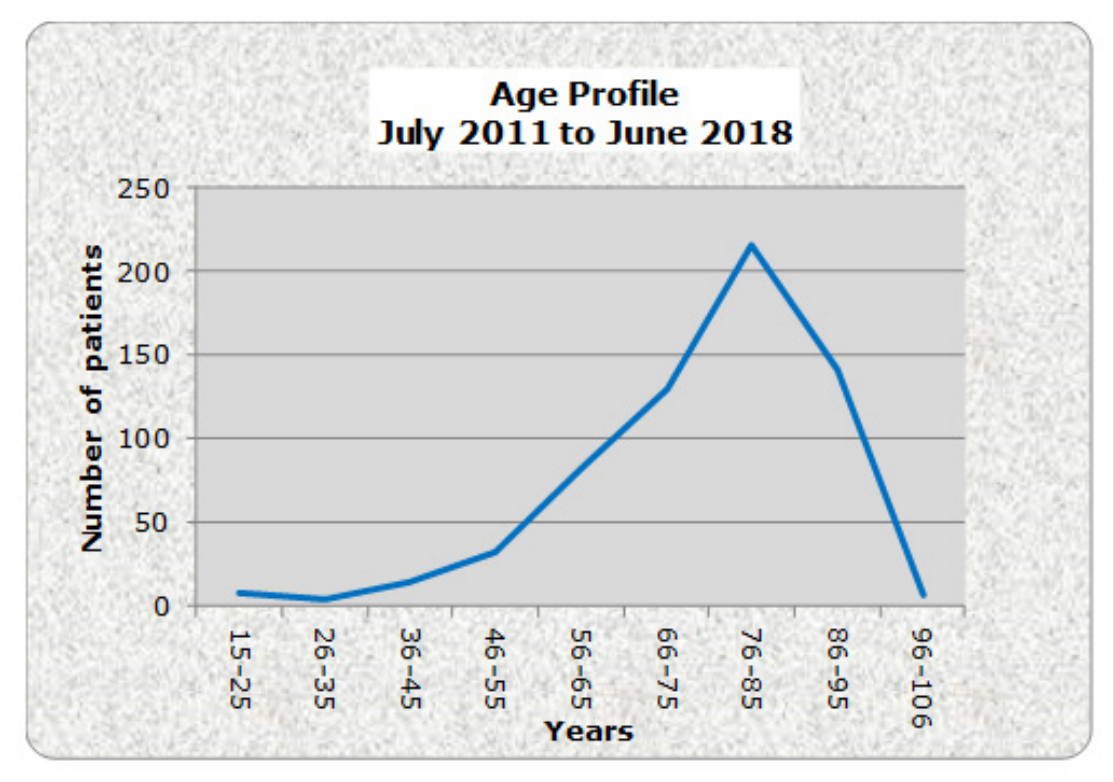

Figure 1: Age profile of patients included in study.

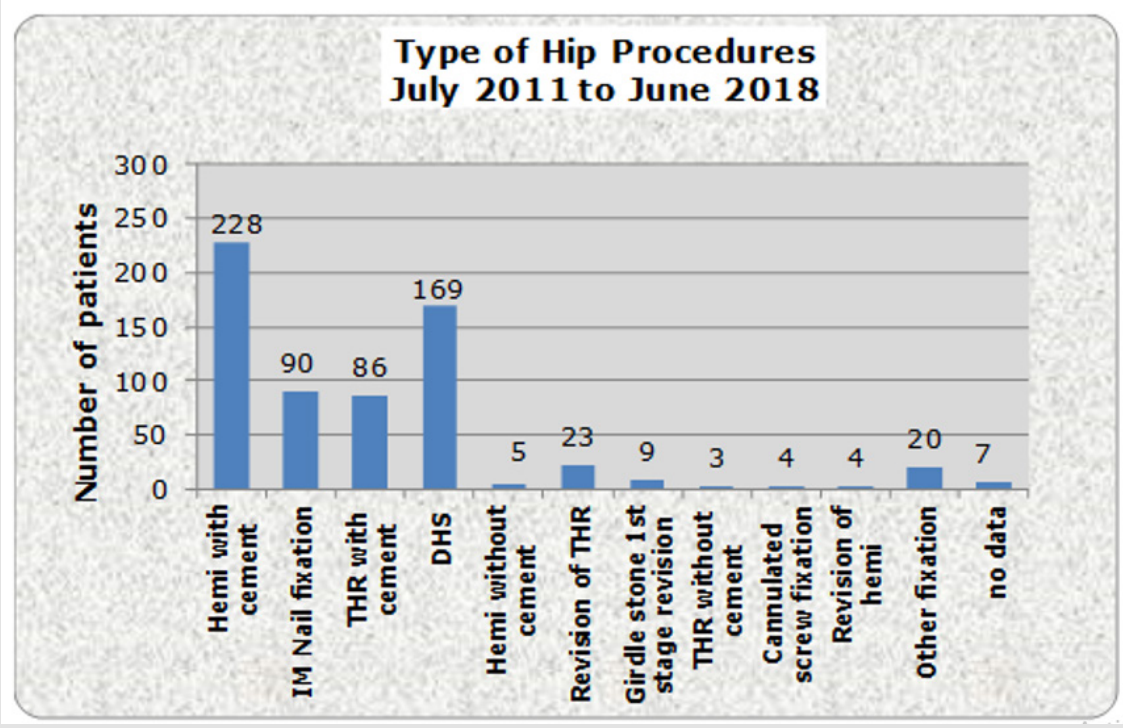

Figure 2: Type of hip procedures performed.

Surgeon Details

49% of cases were performed by specialist registrars (SpRs) in orthopaedics. 36% of cases were performed by a consultant orthopaedic surgeon. The remaining 15% were performed by registrars in orthopaedics or senior house officers [11] on the Irish national core surgical training (CST) scheme. 74% of procedures performed by SpRs, registrars or SHO's were directly supervised by consultant orthopaedic surgeons.

Duration of Surgery

70.5% of procedures were performed in under 90 minutes, 17% between 91-120 minutes and 10.5% took longer than 2 hours to completion. No data was recorded for the remaining 2% of procedures.

Anaesthesia & Prophylactic Antibiotics

64% of patients had regional/spinal anaesthesia, 30% had general anaesthesia and no data was collected for the remaining 6%. 88% (571) of patients received three doses of 1.5g cefuroxime intravenously, in accordance with the local antimicrobial guidelines, starting 0-30 mins before surgery with two further doses eight hours apart post-operatively. The remaining patients received vancomycin or teicoplanin with teicoplanin being the glycopeptide used post 2015. 90.5% (n=587) of patients had received an intravenous antibiotic 0-30 minutes prior to the first incision. 88% (n=571) had their peri-operative antibiotic stopped within 24 hours of the procedure. 1.7% (n=11) had antibiotic prophylaxis for 48 hours and 5.2% (n=34) of patients had antibiotic coverage for more than 48 hours.

Surgical Site Infection

In total, 1.2% (n=8) of patients developed surgical site infections during the surveillance period. Details of those patients who developed a SSI is outlined in (Table 1). Four superficial incisional SSI, three deep incisional SSI and one deep/organ space SSI were recorded. As the study was limited to the patients in-patient stay, the long term outcomes for these 8 SSI are not known due to resource limitations but all recovered from the acute infection following appropriate antimicrobial treatment. Six SSI's were in female patients and seven occurred in patients aged older than 66 years. Three patients developed SSI due to MRSA. These patients had been known to be previously colonised with MRSA (one patient had been transferred from a nursing home), however in each of the three cases the patients received cefuroxime as peri-operative prophylaxis (without addition of glycopeptide (vancomycin or teicoplanin) to cover MRSA colonization).

Table 1: Surgical Site Infection features (n=8).

Year	2012	2013	2014	2015	2016	2017	2018
SSI (number)	1	2	2	1	0	2	0
Bacteria isolated	MRSA	1. MRSA 2. No bacteria isolated	1.No growth 2.*Enterococcus species* and *Staphyloccus haemolyticus*	*Staphylococcus haemolyticus* and *Enterocccus faecalis*		1.MRSA 2.*Staphylococcus aureus*	
Procedure	DHS	1. IM Nail 2. Revised hemiarthroplasty	1.DHS 2.DHS	Hemiarthroplasty with cement		1. THR (revised from a DHS). 2. Hemiarthroplasty with cement	
Gender	Female	1. Male 2. Female	1. Female 2. Female	Female		1. Male 2. Female	
Age	86-95	1. 66-75 2. 76-85	1. 66-75 2. 66-75	86-95		1.66-75 2.56-65	
ASA	2	1.3 2.3	1. 2 2. 2	2		1. 3 2. 3	
IV Antibiotic Prophylaxis	Cefuroxime (0-30 mins)	1. Cefuroxime (0-30 mins) 2. Cefuroxime (0-30 mins)	1.Cefuroxime (0-30 mins) 2. Cefuroxime (0-30 mins)	Cefuroxime (0-30 mins)		1. Cefuroxime (0-30 mins) 2. Cefuroxime (0-30 mins)	

Note: MRSA = methicillin resistant Staphylococcus aureus; IM= intramedullary; THR = Total Hip Replacement; DHS = Dynamic Hip Screw; - = Not documented.

Discharge Details

55% (n=356) of patients were successfully discharged home after their operation. 29.3% (n=190) of patients were in need of further rehabilitation before going home and were transferred to a step down unit for further rehabilitation when beds were available. 1.7% (n=11) of patients died over the course of their hospitalisation. 27% of patients were discharged within one week, and 67% by two weeks.

Discussion

SSIs increase morbidity and mortality after hip procedures. The risk of developing a SSI after a hip procedure is multifactorial and can be influenced by a number of factors: obesity [12], age, smoking, diabetes, kidney disease, blood loss, surgical technique, antibiotic prophylaxis, method of wound closure and type of procedure [13]. Surveillance is effective in decreasing the frequency of infection after primary total hip arthroplasties with feedback of SSI rates to the front-line staff having the potential to improve surgical outcomes [14]. The impact of an SSI for patients undergoing hip replacement can be devastating. SSI programs have been selected by NHS trusts in the UK as their number one priority for future surveillance due to the impact of the infections on patients and the perceived preventability of these infections [15,16]. Although infection rates are very low (approximately 1%) for these clean surgical procedures, the burden of infection is substantial, as they are very common procedures with 3,751 hip fractures recorded in Ireland in 2018 [17] and at least 4,500 hip replacements performed in Ireland each year [18]. The potential burden can be observed with the high impact of revision surgery, its associated high cost and the potential for long term disability.

During this study, there were eight patients who, based on CDC definitions, were recorded to have developed an SSI between July 2011 and June 2018 (Table 1). These infections were defined as four superficial incisional SSI, three deep incisional SSI and one deep/organ space SSI. This overall crude infection rate of 1.2% is in line with UK hospital trusts [15]. However, This study recorded rates of SSI for all hip procedures and not just prosthetic or other defined procedures. The most common causative pathogen was methicillin resistant Staphylococcus aureus (MRSA) which was detected in three patients and the most common procedure associated with a SSI was a DHS in four patients. Of the patients who developed a postoperative MRSA SSI, three received cefuroxime prophylaxis, highlighting the need for timely MRSA screening and altering of antibiotic prophylaxis in patients colonized with MRSA. Such learnings were captured as part of this surveillance program and feedback provided to relevant team members in a timely fashion. Six SSI developed in female patients and sevenall patients were greater than 66 years old. As in the majority of hospitals in Ireland, pre-operative MRSA screening in our hospital is undertaken by culture based methods and often screens are not complete for patients admitted acutely who require surgery. This highlights the need for hospitals to resource the use of molecular screening techniques to improve turnaround time on these samples. During the surveillance period it was initially noted that vancomycin was being used for surgical prophylaxis when a glycopeptide antibiotic was required. Teicoplanin (at a dose of 12mg/kg) is the glycopeptide antibiotic of choice for surgical prophylaxis as it has a faster infusion time than vancomycin and achieves rapid serum levels. Where a glycopeptide antibiotic was indicated there was an increased use of teicoplanin in comparison to vancomycin over the latter years of the study period and following discussion between orthopaedic and microbiology teams. The pivotal role of surveillance is supported by studies showing that well-organised surveillance programs, with feedback of SSI rates to surgeons, was associated with significant reductions in postoperative infection [2,4,19]. Infection rates have a significant impact on hospital resources, length of stay and patient outcome. The data collected here can be used to improve SSI rates, reduce patient morbidity and allow for hospital resources to be used more effectively.

The surveillance system is simple and flexible and data is collected prospectively, facilitating more accurate data collection. Limitations of this study included the absence of extended post discharge surveillance. The CDC recommends post discharge surveillance should extend to 30 days post-surgery (and for 1 year if the operation involves an implant); however due to current resources, patients in this study were only followed up for the duration of their in-patient stay and the long term outcomes of the 8 patients who developed SSI during the study period are not recorded. Patients readmitted due to SSI to the same hospital were however captured on readmission. This limitation represents the reality for many hospitals undertaking surveillance programs and highlights the need for fully resourcing these programs. There have been brief periods of incomplete data collection, due to staff resources or due to rotation of orthopaedic teams. BMI information was also not included as a potential patient risk factor which has been shown to increase the likelihood of developing SSI [20] and will be included in further data collection for our surveillance programme. This surveillance program has influenced changes to help reduce adverse outcomes following hip surgery and improve patient care. Hospitals should develop and optimising a prospective SSI surveillance program and a national standardised surgical site surveillance program should be established in Ireland along the lines of surveillance programs currently performed in the UK [21]. For sustainability, these programs need to be fully resourced to continue to function to their optimum and provide accurate, timely data to influence change and improve patient outcomes.

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