

Research Article

The Long Term Outcome of MRSA Infection in Elective Orthopaedic Surgery a Longitudinal Population Study in a District Hospital

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Abstract

This study looked at long term morbidity and mortality prospectively following MRSA infection over an 18 year period in patients undergoing elective surgery in a 600 bedded district general hospital. A database identified 36 cases following elective surgery (21 hip replacements, 14 knee replacements and 1 shoulder) from 1994 when the first case occurred until the end of June 2012 with a mean follow up period of 14.2 (0.4-18.1) years. MRSA occurred in 0.0012% of all our admissions within the hospital with 0.005% of hip and knee replacements.

Nine (0.0012%) of the joint replacements (5 hips and 4 knees) undergoing two stage revision surgery for deep MRSA infection in comparison to twenty eight (0.0025%) revisions for deep infections from other organisms in 7,203 cases over 18 years.

In our study there was an increase in the mortality at 6% in patients who had an MRSA infection and 5% in other infected cases. This was six times higher than the baseline rate for the unit as a whole. Having an MRSA infection in hospital delayed the discharge of the patient by an average of 8.2 days and 29 (81%) of the 36 cases required further surgery to control the effects of the infection at the surgical site. The chance of further surgery was 24% higher than for joint replacements infected with other organisms in the same period and double the rate of local flaps were required in knee replacements than for other infections.

The presence of multiple co-morbidities appeared in those requiring further interventions especially diabetes, immunosuppression, cardiac and respiratory compromise. This may have accounted the excess mortality.

Superficial infections did not affect a patient's functional score in the long run but patients requiring more than one washout had a higher morbidity, limited mobility, often multiple operations and a much worst psychological outcome with high levels of anxiety and depression.

Introduction of pre-operative screening has reduced the risk of infection. Continued vigilance is required to prevent this infection and its long term sequelae particularly in those with multiple co-morbidities.

Keywords: Infection; MRSA; Orthopaedic

Introduction

Prosthetic joint infection is a devastating complication often requiring multiple operations and revision surgery to control the infection. Identification of the organism contributing to the infection is important in enabling appropriate antibiotic treatment to clear the infection [1]. Resistant organisms make this more difficult to achieve [2]. Methicillin resistance and infections caused by other resistant organisms represent a growing problem and an ever increasing challenge for health-care professionals. There have been significant initiatives to reduce the impact of MRSA and Clostridia infections including hand hygiene, deep cleaning and preoperative screening. Patients are now aware of these hospital 'superbugs' and perceive the development of this infection as being avoidable particularly in elective surgery [3]. The rate of MRSA infection has been quoted on

national television as being as high as one in seventy five following hip replacement with inferred disastrous consequences.

The purpose of this study was to determine the rate of infection over the time that this infection was first detected in the hospital in 1994, the risk factors for infection, the interventions required and the long term morbidity both physically and emotionally. This was compared to the outcome for other revision cases due to other organisms.

Methicillin-Resistant Staphylococcus Aureus (MRSA) infection following orthopaedic surgery have been widely reported as a cause of increased length of stay [4,5] and wound problems particularly in proximal femoral fractures as outlined by Nixon and co-authors in [6] 2006 although the mortality rate was not affected.

Shams and Rapp, [7] from Lexington in America in 2004 suggest that orthopaedic implants and fracture fixation devices colonised by MRSA are difficult to treat. Preoperative eradication of MRSA colonisation was recommended in the five per cent of patients found to be affected on screening in order to decrease the incidence of postoperative infections [8,9]. Hassan and co-authors [10] in 2008 found for orthopaedic patients that colonisation was not confined to high risk groups lending support to the need for widespread screening to prevent morbidity and mortality. The impact of screening was thought to have been marked and this is also assessed in this study.

Few studies [11,3,6] have looked at the long term consequences of MRSA colonisation or infection on a patient’s functional outcome. The commonly held belief is that once MRSA has occurred the result of the procedure will be poor in the long term. The authors have undertaken a longitudinal study reviewing the joint replacement patients that have had a positive swab result for MRSA and a wound infection and who had orthopaedic procedures from the first recorded case in 1994 to the present day in order to answer these concerns by comparing them to control groups of a similar number matched for age and sex in cases not affected by infection and to those affected by other infections.

Materials and Methods

Queen’s Hospital in Burton is a six hundred bed district general hospital providing medical care to a population of two hundred and fifty thousand people. The orthopaedic department performs on average four hundred arthroplasty procedures in the shoulder, knee and hip per year.

All MRSA cases within the hospital were recorded and monitored by the microbiological team and the outcome of the infection noted. All of these patient’s demographics, clinical details of presentation, investigation and treatment were initially reviewed by retrospectively analysing the in-patient notes, computer records, radiographs and special investigations.

The first MRSA case at Queen’s Hospital was in 1993 in general surgery and in 1994 in orthopaedics. In between 1994 and 2008, 163 consecutive patients with a positive MRSA swab and possible post-operative wound infection were identified and subsequent progress recorded. There were 36 cases following elective surgery (21 hip replacements, 14 knee replacements and 1 shoulder) with a mean age was 79.4 (55-87) years at the time of surgery. There were twenty five females and eleven males. Seven patients were in full time employment, with two being involved in manual jobs. Seven patients were subsequently noted to have positive MRSA swabs from admission.

The co-morbidities were noted enabling the patient’s ability to respond to infection to be classified according to Cierny-Madar’s description from 1984.

The surgical site was inspected and the possible local contamination graded independently of the surgeon using a locally designed wound review system. This assesses erythema, swelling and discharge in relation to the wound and presence or absence of a fever (Table 1).

All patients were reviewed clinically independent of the surgeon

Table 1: Wound contamination grading.

Grade	Appearance	Presence of Fever
0	Normal	None
1	Local erythema (up to 1cm)	None
2	Widespread erythema	None
3	Erythema and discharge	None
4	Erythema	Present
5	Erythema, discharge	Present

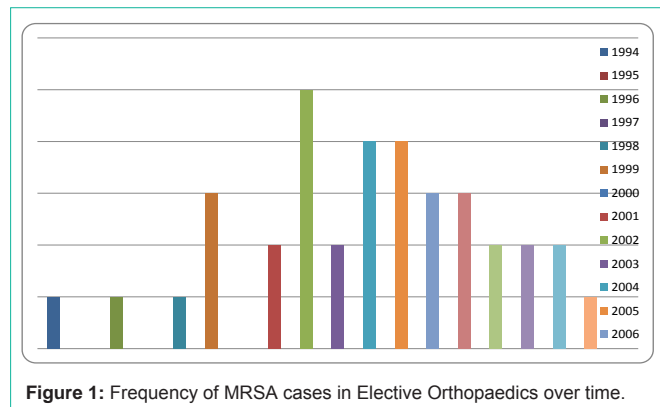


Figure 1: Frequency of MRSA cases in Elective Orthopaedics over time.

Table 2: Co-morbidities.

Diabetes Mellitus	16
Immunocompromised patients	9
Rheumatoid arthritis	7
Patients on steroids	10
Previous history of MRSA infection	4
Smoking	23
Heart failure	12
Renal compromise	9
COPD	13

and scored using the system recognised by the relevant orthopaedic sub-specialty society in 2007. For example the Knee Society Score for the knee. These scores were compared to pre-operative values wherever possible for each patient. A thermometer score was used to assess functional outcome from the Euroqol D5 assessment tool. Comparison was made to patients who had the same procedures using the same scoring systems but who did not have a positive MRSA swab or infection in age and sex matched groups.

During the same period there were 176 patients with positive swabs associated with possible wound problems knee and hip replacements.

Results

Over the eighteen year study period from 1994 to 2012, 163 (0.29%) of 54 521 admissions to the orthopaedic department had MRSA infection (Table 1). The frequency of new MRSA cases detected per year varies with 17 (10.4%) were identified within the first forty eight hours of admission and the rest within ten days (Figure 1). A significant proportion 27 (16.56%) had co-morbidities affecting their host response allowing a Cierny-Mader classification to be established.

Half these cases (18) had pre-operative screening and negative swabs but there were four cases that had undergone eradication therapy previously following a previous hospital admission.

The co-morbidities were noted enabling the patient's ability to respond to infection to be classified according to Cierny-Madar's description from 1984 (Table 2). In this factors in the host are identified, both local and systemic, that will alter the treatment plan and are of significance in the prognosis. An A host is a normal otherwise healthy patient who can tolerate the treatment proposed. The C host by contrast has numerous factors that may lead to a decision to amputate or suppress infection and not seek to eradicate it by other means. The B host is also compromised by systemic or local factors that will make treatment more difficult.

A database identified 36 cases following elective surgery (21 hip replacements, 14 knee replacements and 1 shoulder) from 1994 when the first case occurred until the end of June 2012 with a mean follow up period of 14.2 (0.4-18.1) years. MRSA occurred in 0.0012% of all our admissions within the hospital with 0.25% of hip and knee replacements. Infection occurred in 83 cases in total for hip replacement and 93 cases in the knee in the unit and this includes the MRSA cases. Over the same time frame 3313 elective hip and 3890 knee replacements were performed in total.

Having an MRSA infection in hospital delayed the discharge of the patient by an average of 8.2 days and 29 (81%) of the 36 cases required further surgery to control the effects of the infection at the surgical site. The chance of further surgery was 24% higher than for the 140 joint replacements infected with other organisms in the same period.

Nine (0.0012%) of the joint replacements (5 hips and 4 knees) undergoing two stage revision surgery for deep MRSA infection in comparison to eighteen (0.0025%) revisions for deep infections from other organisms in 7,203 cases over 18 years.

Total hip replacements

Two of the hip replacement (6%) patients died in hospital from cardiac compromise while MRSA clear following eradication treatment. Both were ASA grade three patients. This is in comparison to thirty cases in total in the unit giving an underlying mortality rate for total hip replacement of 0.009% and in four other infected cases 5%. In our study there was no demonstrable effect on the mortality of the patients who had an MRSA infection in comparison to other infections but it did cause an almost six times rise in comparison to the uninfected patients.

Further surgery was required in seventeen cases with only four settling with eradication treatment. This latter group had a prolonged stay in hospital by 3.4 (1-12) days longer than the unit average of 5.1 days. In the further surgery group seven cases were noted to have red and inflamed wounds during the admission when the prosthesis was inserted delaying discharge by 12.7 (3-34) days.

Readmissions were required 3.7 (1-15) for these cases with a higher rate 5.2 (3-15) in the cases that went on to require two staged revision.

The chance of further surgery was 24% higher than for joint replacements infected with other organisms in the same period.

There were eight cases that had what appeared to have a superficial infection that were treated by aggressive wound debridement, washout and antibiotic treatment for a minimum period of six to twelve weeks depending on the microbiologists advice without the need for further surgery. Debridement was required to address the wound a maximum of two occasions. These cases had better host response characteristics being classified as Cierny grade B hosts. The outcome in this group was similar to the twenty cases with superficial infections from other organisms. No further intervention was required by the final review an average of 8.5 years following surgery with the average Harris Hip Score noted as 72 (54-91).

There were five deep infections in total hip replacement patients necessitating revision surgery within 7.8 (3-24) months after the first operation. Despite a minimum of two debridement and washout procedures these individuals required a staged revision. These cases had the most interventions one having 11 before staged revision. An uncemented prosthesis was inserted while all these three Cierny grade C hosts received intravenous vancomycin. One case went onto require a Girdle stones procedure. At final review the mean Harris Hip Score was noted to be 59 (35-82).

Total knee replacement

One knee replacement (7%) patient out of fourteen died in hospital from a pulmonary embolus seven days after surgery with eradication treatment just commenced for a positive swab on screening. The patient had no real co-morbidities or risk factors. This is in comparison to eighteen cases in total in the unit giving an underlying mortality rate for total hip replacement of 0.005% and in four other infected cases 5%. In our study there was no demonstrable effect on the mortality of the patients who had an MRSA infection in comparison to other infections but it did cause an almost fourteen times rise in comparison to the uninfected patients.

The infected knee replacement patients remained in hospital for 23 (13-83) days in comparison to the department average of 7.5 (3-43) days.

Further surgery was required in twelve cases with only three settling with eradication treatment. This latter group had a prolonged stay in hospital by 5.4 (3-18) days longer than the unit average of 5.7 days. This was mainly due to persistent oozing and a positive swab. No debridement operations or revisions were required in these host A cases and at 3.7 (0.8-11) years after the Knee Society Score averaged 145 (120-189).

In the further surgery group six cases were noted to have red and inflamed wounds during the admission when the prosthesis was inserted delaying discharge by 17.7 (5-59) days.

Readmissions were required 2.9 (2-7) for these cases with a higher rate 4.2 (3-7) in the cases that went on to require two staged revision.

The chance of further surgery was 26% higher than for joint replacements infected with other organisms in the same period where 68 (10%) of 79 cases underwent debridement, revision or washout procedure's, with seven requiring plastic surgical flaps. Three (21%) were required in the MRSA group.

There were eight cases that had what appeared to have a superficial infection that were treated by aggressive wound debridement,

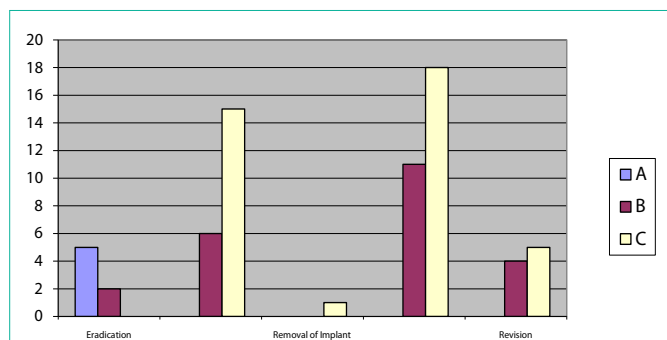


Figure 2: Further interventions in MRSA contamination in trauma patients.

washout and antibiotic treatment for a minimum period of six to twelve weeks depending on the microbiologists advice without the need for further surgery. Debridement was required to address the wound a maximum of two occasions. These cases were classified as Cierny-Mader grade B and C hosts. The outcome in this group was similar to the fifty cases with superficial infections from other organisms. No further intervention was required by the final review an average of 7.5 years following surgery with the average Knee Society Score averaged 125 (110-189).

There were four deep infections in total knee replacement patients necessitating revision surgery within 9.2 (7-24) months after the first operation. Despite a minimum of three debridement and washout procedures these individuals required a staged revision. These cases had the most interventions and four required plastic surgical intervention to get control of the infection and skin cover. A further stemmed cemented prosthesis was inserted while all these three Cierny-Mader grade C hosts received intravenous vancomycin. No further intervention was required by the final review an average of 5.5 years following surgery with the average Knee Society Score averaged 95 (80-119).

Shoulder replacement

An MRSA superficial infection occurred in one case out of 230 cases performed in the department within the last ten years in the same time period there were five other superficial infections all were classified as Cierny-Mader A hosts. No cases required further surgery and appeared to recover similarly to patients not affected by infection.

At the patients last review after an average of 4.4 years pain free flexion was achieved to an average of 125 degrees, and abduction to an average of 140 degrees. Abduction strength achieved was an average of 5.9 kilograms postoperatively. Constant scores averaged 72 achieving 78 percent of that of the normal shoulder.

Perceived health state following MRSA infection

The perceived health scores were undertaken in a random sample of 15 cases of superficial infections who had undergone debridement procedures and averaged 47% in comparison to 89% for a similar mix of hip and knee replacements in unaffected cases and 62% in the other infected groups (Figure 3).

Figure 4 demonstrates an example of the thermometer assessments that show significant feelings of anxiety and depression contribute to this perceived poor health state despite evidence that the infection had been cleared.

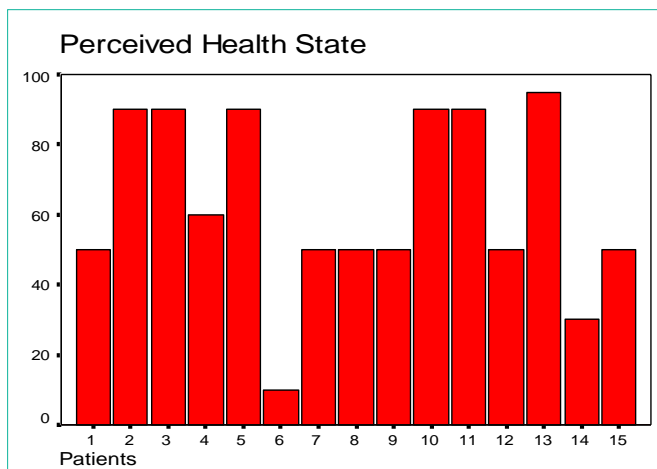


Figure 3: Perceived health state in elective surgery patients following MRSA infection.

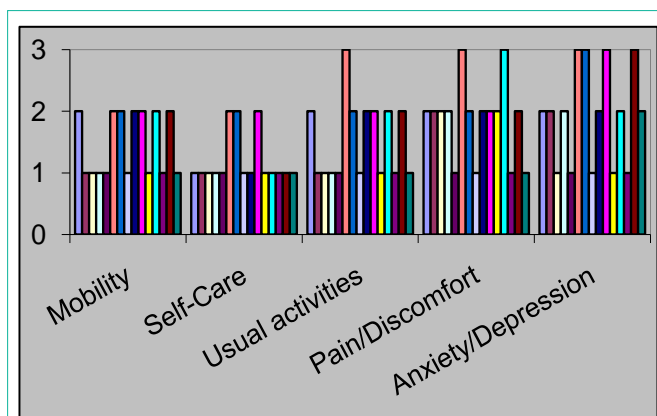


Figure 4: Thermometer functional scores using the thermometer scales.

In our study anxiety was the commonest postoperative complication in this group of patients with 65% of our patients having some sort of psychological problem. Eighty percent of them described feeling anxiety and concerned. Anecdotally one case a family attributed an acute fatal ischemic cardiac event as being attributable to postoperative anxiety over developing superbug infection from MRSA in a patient who did not even have this infection.

Discussion

Prosthetic replacement has been shown to significantly improve a patient’s quality of life. Complications affect the outcome and also the individual’s perception of their own health and function. MRSA infection increases the morbidity rate in comparison to uninfected cases [1,3] with lower outcome scores and significantly in this study long term feelings of anxiety and depression. Superficial infections responded well to antibiotics when the patient was healthy or antibiotics with occasional need for debridement or the wound in those individuals with well controlled disease or immunocompromised. There was considerable anxiety within this group of patients and a level of depression. It appeared particularly prolonged in the MRSA group which may reflect the persistent coverage of this topic in the media [14,15,16].

Previous authors such as Nixon et al., [6] in 2006 show that

the mortality rate particularly in proximal femoral fractures is not affected by MRSA infection. In our study there was an increase in the mortality at 6% in patients who had an MRSA infection and 5% in other infected cases. This was six times higher than the baseline rate for the unit as a whole. Part of this may relate to the need for multiple operations in cases with poor cardiovascular reserve.

The long term hip scores for the hip and knee replacements compare well with those in the literature for other infected cases. Having an MRSA infection in hospital delayed the discharge of the patient by an average of 8.2 days and 29 (81%) of the 36 cases required further surgery to control the effects of the infection at the surgical site. The chance of further surgery was 24% higher than for joint replacements infected with other organisms in the same period and double the rate of local flaps were required in knee replacements than for other infections.

Length of hospital stay was increased while superficial wound infections were brought under control and one hundred and four re-admissions were required within the MRSA group on 2-9 occasions per case this was similar to a rate of 2.3 in the infected group. Controlling these infections remains difficult and requires multiple procedures to achieve [17]. All infections within the MRSA group were controlled within eighteen months maximum.

Length of stay however is increased as with other infections in orthopaedic surgery and this is comparable to other infections and what has been seen by other authors [13,18].

Patients with poor host response do poorly as would be anticipated. Therefore this low pathogenic organism causes problems in the ill and debilitated [14,19,20].

Aggressive treatment of the superficial infection is important particularly in knee replacements. Deterioration of the skin was associated with deeper infection and the need to exchange the whole implant. Early involvement of plastic surgical colleagues may enable better skin coverage and infection clearance.

The superficial infection patients should be reassured as the long term results are good once the local infection is cleared. Further surgery for superficial infections also had a reasonable outcome which with aggressive early washout and wound debridement surgically and with antibiotics.

But one of the major findings in our study was the fact that the major consequence of the postoperative MRSA infection is psychological. In our analysis we found that anxiety was the commonest postoperative complication in this group of patients with 65% of our patients having some sort of psychological problem. Eighty per cent of them described feeling anxiety and concerned.

This study shows that percentage of cases requiring revision surgery was not higher for MRSA 25% cases in the long term in comparison to cases infected by other organisms at 22%.

The frequency of cases appears to be reducing with the introduction and monitoring of hand hygiene, deep cleaning and pre-operative screening [21,11,22]. Given the morbidity and excess mortality associated caused by developing infection in replacements this is important from a patients perspective this is important. There are also significant cost implications and reducing levels of MRSA

infection will improve the health economics [23,24,2] of treating patients with replacements.

In conclusion as for other studies of outcome of infected joint replacements MRSA appears to adversely affect mortality and morbidity. Superficial infections did not affect a patient's functional score in the long run but patients requiring washouts had a higher morbidity, limited mobility, often multiple operations and a much worst psychological outcome with high levels of anxiety and depression. Revision often required plastic surgical input for knee replacements in MRSA infections. Aggressive early treatment is advised to prevent infection becoming deep seated and more significant morbidity.

Anxiety and other psychological disturbances are common however in those infected or contaminated by MRSA and maybe the major morbidity in the long run.

Flow Chart:

1. Total number of admission to orthopaedic Department:	54521
2. Number of patients having MRSA infection:	163
3. Number of patients having MRSA infection Undergoing elective orthopaedic procedures:	36
4. Number of patients having hip replacements Who had MRSA	21
5. Number of patients having knee replacements Who had MRSA	14
6. Number of patients having shoulder replacements Who had MRSA	01

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