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The role of MRSA screening in joint-replacement surgery

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Abstract The aim of this prospective study was to determine the effect of screening for methicillin-resistant *Staphylococcus aureus* (MRSA), in patients undergoing total hip and knee replacements, on reducing hospital-acquired infections and the length of hospital stay. We included 395 patients admitted to the elective orthopaedic ward for hip and knee replacements (knee 210; hip 185) from 16 October 2000 to 15 October 2001. Group 1 included 164 admissions before 16 April 2001 when MRSA swabs were not compulsory. Group 2 included 231 admissions after 16 April 2001 when axillary, nasal and groin swabs had to be negative for MRSA. Four patients in group 1 had post-operative MRSA infection compared with none in group 2. The mean length of hospital stay decreased significantly from 10.43 days \pm SD 4.2 days in group 1 to 9.47 days \pm SD 2.6 days in group 2. There was a significant reduction in the incidence of hospital-acquired infections following the introduction of pre-admission screening.

Résumé Le but de cette étude prospective était de déterminer l'effet du dépistage du Staphylocoque Aureus Méthicilline Résistant (MRSA) chez des patients devant subir une prothèse de hanche ou de genou, sur la réduction des infections nosocomiales et la durée du séjour hospitalier. Nous avons inclus 395 malades admis pour rem-

placement prothétique de la hanche et du genou (genou 210 / Hanche 185) du 16 octobre 2000 au 15 octobre 2001. Le groupe 1 a inclus 164 admissions avant le 16 avril 2001 quand les écouvillonnages MRSA n'étaient pas obligatoires. Le groupe 2 a inclus 231 admissions après le 16 avril 2001 quand l'écouvillonnage axillaire, nasal et inguinal devait être négatif pour le MRSA. Cinq malades du groupe 1 ont eu une infection MRSA postopératoire, comparé à l'absence d'infection dans le groupe 2. La durée moyenne de séjour a diminué de 10.43 jours (\pm SD 4.2 j) dans le groupe 1 à 9.47 jours (\pm SD 2.6 j) dans le groupe 2. Il y avait une réduction significative de la fréquence des infections acquises à l'hôpital grâce au dépistage avant l'admission.

Introduction

Various strategies have been devised world wide to reduce the length of hospital stay in patients undergoing major joint replacement surgery. Patient education, integrated care pathways, pre-admission clinics, earlier patient mobilisation and improved discharge planning are all found to be highly cost effective [2, 10, 13]. One might logically think that a reduction in hospital-acquired infections should also reduce the length of hospital stay in the orthopaedic surgical patient. Methicillin-resistant *Staphylococcus aureus* (MRSA) is implicated in an increasing number of these infections and remains a major challenge for infection control professionals [14]. MRSA hospital infections are associated with high morbidity, mortality and cost of treatment [4]. The aim of this study was to determine the effect on the length of hospital stay in patients undergoing total hip and total knee joint replacements by making an elective orthopaedic ward MRSA free.

Patients and methods

Over a period of 12 months from 16 October 2000 to 15 October 2001, 395 patients were admitted to the elective

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orthopaedic ward for total hip and total knee replacements under eight orthopaedic consultants in our hospital. We present a prospective study of this consecutive group of patients. On 16th April 2001, it became mandatory that all patients admitted to the elective orthopaedic ward must be MRSA negative. We were therefore able to create two distinctive groups of patients: All patients admitted during the period 16/10/2000–15/04/2001, during which time MRSA swab negativity was not compulsory (group 1); and all patients admitted during the period 16/04/2001–15/10/2001, during which time MRSA swab negativity was compulsory (group 2).

After the introduction of the MRSA tests, all patients underwent swabbing of the axilla, nose, groin and any open wounds. This was performed in the outpatient clinic one week prior to admission. All three swabs had to be negative for MRSA in order for the patient to be eligible for admission. If any of the swabs returned positive for MRSA, topical treatment with mupirocin or povidone iodine or triclosan was instituted, depending on the site/s involved, and admission was delayed until three consecutive swabs from all the three sites were negative.

All patients in both groups were given prophylactic antibiotics. Intravenous cephazolin or cefuroxime was given one hour before skin incision and continued for two more doses 8 and 16 hours post-operatively. Anaesthetic, surgical and post-operative management were identical in both groups. All patients underwent physiotherapy to regain joint function and were discharged from the hospital when they were adequately mobile.

Outcome measures assessed were the incidence of overall and individual infective complications and the length of hospital stay. Continuous variables are expressed as means and standard deviations and categorical variables as counts and percentages. Fisher's exact test and un-paired Student's *t* test were used for statistical analyses.

Results

There were 395 patients enrolled in this study: 164 in group 1 and 231 in group 2. Two hundred and ten patients underwent total hip replacement, and 185 underwent total knee replacement. There were 148 men and 247 women aged between 48 and 79 years (Table 1). The indication for joint replacement was osteoarthritis in 381 patients, rheumatoid arthritis in 12, and ankylosing spondylitis in two. Nineteen patients suffered from diabetes mellitus.

Table 1 Demography of the patients in the two groups

	Group 1	Group 2
No. of patients	164	231
Men	58	90
Women	106	141
Mean age (range) in years	67.39 (51–79)	68.53 (48–77)
Total hip replacements	85	125
Total knee replacements	79	106

Table 2 Number of early post-operative complications in the two groups until initial discharge from the hospital

Type of complication	Group 1	Group 2
Surgical site infection	1	0
Lower respiratory tract infection	5	1
Urinary tract infection	8	7
Hip dislocation	0	1
Deep vein thrombosis	2	3
Pulmonary embolism	1	1
Total	17	13

Table 3 Number of patients and type of bacteria isolated from infective complications in the two groups.

SSI Surgical site infections, LRTI lower respiratory tract infections, UTI urinary tract infections, MRSA methicillin-resistant *Staphylococcus aureus*, MSSA methicillin-sensitive *S. aureus*, *E. coli* Escherichia coli

Isolate	Number of patients with hospital-acquired infections					
	SSI		LRTI		UTI	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
MRSA	1	–	3	–	–	–
MSSA	–	–	–	–	–	–
Pseudomonas	–	–	–	–	2	2
<i>E. coli</i>	–	–	–	–	6	5
No isolate	–	–	2	1	–	–
Total	1	0	5	1	8	7

Details of all complications during hospital stay are listed in Table 2. Using our criterion, admission to the elective ward was postponed on seven occasions in group 2, and in each of these, the planned operation was delayed by more than one week. One patient in group 2 died of pulmonary embolism after remaining in the intensive care unit. The overall incidence of hospital-acquired infections was 14 (8.5%) in group 1 and eight (3.5%) in group 2 ($p<0.05$). Four patients in group 1 had post-operative MRSA infection compared with none in group 2 ($p<0.05$) (Table 3).

The mean duration of hospital stay in group 1 was 10.43 days \pm SD 4.2 days (range 5–29 days) and in group 2, 9.47 days \pm SD 2.6 days (range 5–26 days). This reduction in the length of hospital stay was highly significant ($p<0.05$). The mean length of hospital stay excluding those who developed infective complications was comparable between the groups (9.6 days \pm SD 2.7 days in group 1 and 9.3 days \pm SD 2.3 days in group 2).

Discussion

The incidence of MRSA carriage varies widely in the community, with reports ranging from 1.6% [16] to 5.3% [15] in the United Kingdom. A significant proportion of these are acquired in the community [15]. Male gender, age more than 70, prior hospital admission, prior antibiotic treatment

and living in nursing homes are factors identified to increase the risk of MRSA acquirement [15]. The presence of open wounds, skin lesions, tracheostomy, orthopaedic implants, drains, catheters etc., are known risk factors for MRSA carriage after discharge from the hospital [1]. The nose and skin are the common sites of colonisation [15]. Though relatively harmless in the healthy individual, MRSA carriage is shown to increase the risk of invasive staphylococcal infections in patients with in-dwelling cannulae, catheters and other devices penetrating the skin or in those with skin lesions [6]. Serious infections in the form of pneumonia, soft-tissue infections, osteomyelitis and septic arthritis have been reported to occur in up to 29% of these people [7]. Endemic spread of these organisms in hospitalised patients is associated with high morbidity and mortality rates. Without appropriate control measures, persistence of the endemic strain within the care unit is also a reported problem [5].

An increasing number of hospital-acquired infections in the surgical patient are caused by MRSA [15]. Various strategies have been adopted for prevention and control of MRSA in the hospital setting. Strict hand washing using anti-microbial solutions [11, 16], swabbing all open wounds, contact isolation and treatment of MRSA carriers and cases [12], use of disposable gowns and gloves by all staff and visitors [11], patient and staff education [12], topical peri-operative nasal mupirocin and a shower or bath with 2% triclosan [18], strict usage of antibiotics in clinically well-defined cases only [11], a surgical-dedicated cohort facility [17] and increasing awareness of infection control measures among hospital staff are a few of these. Making the elective orthopaedic ward MRSA free by screening patients and instituting appropriate local treatment before hospital admission is not a new idea, but its effectiveness in reducing hospital-acquired infections is not clearly established.

Previous studies have looked into the role of MRSA screening in decreasing the incidence of orthopaedic surgical-site infections (SSI). De Lucas-Villarrubia et al. consider screening, along with other measures, to be highly effective [3]. However, a recent study by Khan et al. considers routine screening of patients with fractures of femoral necks for MRSA not to be cost effective [9]. They found no significant reduction in wound infection rates irrespective of whether these patients are MRSA carriers or not. But these studies looked into SSI only. We found screening before admission significantly reduced the incidence of hospital-acquired infections (8.5–3.5%). The most notable change was the reduction in the incidence of lower respiratory tract infections. An argument may be that in spite of this screening, patients can still get colonised or infected by MRSA from medical staff and visitors, as screening these groups is not practical. We did not find any MRSA infections in group 2 and hence we feel that this source of MRSA acquirement is negligible.

In the UK, the length of hospital stay for hip or knee joint replacement surgery varies widely between hospitals but is on average 10 days. Various strategies have been devised to reduce the hospital stay in joint replacement patients. Pa-

tient education, integrated care pathways, pre-operative assessment clinics, earlier patient mobilisation and improved discharge planning are all found to be extremely effective measures [2, 10, 13]. We have shown that reduction in hospital-acquired infections in the orthopaedic surgical patient by MRSA screening can lead to a decrease in the average length of hospital stay. This conclusion was drawn from the fact that the overall average length of stay decreased significantly from 10.43 to 9.47 days ($p=0.0049$), but the average length of hospital stay of patients without an infective complication remained the same in both groups ($p=0.1855$). Many factors contribute to increased hospital stay in surgical patients with infective complications. The time required for adequate control of the infection, isolation to the room with subsequent delay in the progress of regaining joint function and mobility to a safe level and side effects like diarrhoea from the use of antibiotics are just some of the reasons why discharge might be delayed. A recent report suggests that MRSA infection or colonisation can increase the length of stay by up to eight times in the orthopaedic patient [16].

According to our study, a reduction in infective complications and the subsequent decrease in the length of hospital stay should decrease the cost of treatment in elective orthopaedic admissions. The daily NHS expenditure on an acute bed in the UK is approximately £225 [8]. The additional expenditure in carrying out this screening was less than £10 per patient for three swabs and approximately £3 per patient for the additional swabs and local treatment of MRSA carriers, although this figure varies slightly from hospital to hospital. A reduction in the average length of stay by 1 day alone, in a hospital where approximately half of the elective orthopaedic surgeries are hip and knee joint replacements, will reduce the hospital expenditure by more than £200 per patient. There are additional savings on the costly antibiotics, other medicines and infection control measures. A recent report shows that MRSA SSI increases the overall hospital expenditure by approximately three times [4]. The increase in the number of joint replacements performed during the second six-month period of this study could partly result from earlier discharge of patients due to decreased infections and partly strict usage of orthopaedic beds for elective surgery. The compulsory MRSA negativity requirement effectively prevented acute medical and surgical admissions to the elective ward. This resulted in fewer cancellations due to a lack of elective beds.

We appreciate that there are limitations to this study. We have only looked into the infective complications during the initial hospital stay. Those patients who were treated in the community by their general practitioners and those who were admitted elsewhere with infective complications were not included. Also, we have not taken into account the seasonal variations in hospital-acquired infections, the entire duration of the study being only 12 months. However, the difference in the incidence of infections and the length of hospital stay between the two groups does suggest that it is worth carrying out further and more definitive studies in which all the admissions in both groups are included and

followed up in the community. From our study, we conclude that screening elective orthopaedic patients for MRSA decreases morbidity by reducing hospital-acquired infections and is highly cost effective.

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