Infection in total joint replacements

WHY WE SCREEN MRSA WHEN MRSE IS THE PROBLEM?

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A retrospective review of MRSA screening showed that of a total of 8911 patients screened pre-operatively between May 1996 and February 2001, 83 (0.9%) had MRSA isolated from one source or another. During the same period, 115 (13.6%) of 844 positive tissue samples taken during surgery grew Staphylococcus aureus. Of these only 1 (0.01%) was reported to be methicillin-resistant (MRSA). However, a total of 366 (43.4%) isolates from tissue samples were reported as coagulase-negative staphylococci (C-NS). Of these, 312 samples were tested for methicillin sensitivity, of which 172 (55.1%) were found to be resistant.

Staphylococcus epidermidis is the most prevalent and persistent species found on most skin and mucous membranes, constituting 65% to 90% of all staphylococci. Most isolates in tissue samples were found to be methicillin-resistant coagulase-negative staphylococcus (55.1%). Hence, it may be appropriate to undertake screening for methicillin-resistant Staphylococcus epidermidis in addition to that for MRSA.

Methicillin-resistant Staphylococcus aureus (MRSA) is an organism which has shown multiple resistance to drugs including beta-lactam antibiotics and cephalosporins.\(^1\) It can colonise the human body without invasion and can cause various hospital-acquired infections ranging in severity from mild to life-threatening.\(^2\) Since it is often implicated in large outbreaks, this organism can be difficult to control and can lead to closure of entire units. Hence, in May 1996, routine screening for MRSA was started in our centre for all pre-operative patients.

It is well recognised that coagulase-negative staphylococcus (C-NS) can cause considerable clinical infection. The most common species, Staphylococcus epidermidis, infects implants and prosthetic heart valves.\(^3\) Infection by methicillin-resistant Staphylococcus epidermidis (MRSE) follows its colonisation of the skin and even clothes of patients and hospital staff.\(^4\) There is documented evidence of deep infection by this organism and in a prospective study it was grown from skin swabs.\(^5\)

We have retrospectively reviewed the incidence of MRSA at pre-operative screening and correlated this with the positive cultures of tissue samples retrieved during primary and revision joint replacement surgery over a period of five years.

Patients and Methods

MRSA screening. We reviewed the MRSA screening results of 8911 patients who underwent elective joint replacement between May 1996 and February 2001. They were screened pre-operatively by taking swabs from the nose, throat, perineum and sometimes the wound or catheter site, if any. Multiple samples from the same patient were counted as one. Screening was considered to be positive if at least one of the samples showed growth of the organism.

Deep infection. We reviewed the bacteriological records of 2510 tissue samples collected at surgery during the same five-year period. This included both primary and revision hip and knee arthroplasties. All procedures were done within a Charnley-Howarth enclosure using body-exhaust suits.

All patients undergoing primary arthroplasty received routine pre-operative antibiotic prophylaxis of intravenous cephalosporins, typically cefuroxime 1.5 g at the time of induction and a further two doses of 750 mg, eight and 16 hours after the first dose. The specimens were taken only when there was macroscopic suspicion of infection, such as increased fluid in the joint space.
Tissue samples were retrieved at all revision joint replacement procedures. This included three to five samples from subcutaneous tissues, and around the greater trochanter, joint capsule, acetabulum and femur. Prophylactic antibiotics were administered after the specimens had been collected. As before, deep infection was established if at least one sample was reported as positive and multiple positive samples from the same patients were considered as one.

**Results**

The results of the MRSA screening are shown in Table I, where the percentage of positive screenings varied from a minimum of 0.5% in 1998 to a maximum of 1.8% in 2001. The results for the 2001 samples are taken until February 7 only. On average only 0.9% of patients were found to be positive for MRSA as a result of screening.

Table II shows the results of MRSA isolation in tissue samples. Of 2510 tissue samples, 844 (33.6%) grew an organism. Of these, in 115 (13.6%), it was *Staphylococcus aureus*. None was methicillin-resistant except one in the year 2001. However, Table III shows that 366 (43.4%) of the total number of tissue samples were reported as growing a coagulase-negative staphylococcus. Of these, 312 were tested for methicillin resistance and 172 (55.1%) were found to be positive.

A parallel study carried out at this centre has shown that in a series of 337 one-stage revision hip replacements, the joints with methicillin-sensitive organisms (106) showed better survivorship (82.8 months) compared with those (50) with methicillin-resistant organisms (52.9 months), taking re-infection as the end-point (Fig. 1).

**Discussion**

Deep infection after total joint replacement is painful, disabling and costly and has a mortality rate which varies between 7% and 62%. Appropriate prophylaxis has a major role in reducing infection. This depends on proper preparation of the patient and surgeon, antibiotic prophylaxis, the surgical technique and the control of resistant organisms. Pre-operative screening remains the mainstay of the isolation of patients colonised with resistant organisms. MRSA has shown to have multiple drug resistance. A study from Hong Kong has shown that the average cost of antimicrobial therapy per patient with MRSA bacteraemia is £440 compared with £60 for patients with methicillin-sensitive *Staphylococcus aureus*. The extra cost is related to the more expensive antimicrobials required and the longer treatment.

In addition to the cost of treatment, the outcome is worse in resistant organisms. It is evident from our Kaplan-Meier curve (Fig. 1) that methicillin-sensitive C-NS has been shown to have better survivorship compared with methicillin-resistant C-NS.

The results of the five-year screening programme showed that only 0.9% of the patients were positive for MRSA.
before operation. This is comparable to the results of Papia et al\(^9\) which showed an incidence of 1.3%. Moreover, from the deep tissue cultures only one patient's sample of 2510 was reported to have MRSA, which supports the effectiveness of the screening programme. Early identification and treatment prevent catastrophic deep infection in patients undergoing elective joint replacement surgery. On the other hand, 43.4% of the tissue samples were reported to be C-NS, most of which were methicillin-resistant. The proportion of C-NS in infected hip arthroplasties varies from 5% to 70%.\(^9\) James et al\(^5\) found Staphylococcus epidermidis to be the commonest organism cultured in revision total hip replacements. Approximately 65% to 90% of all C-NS on human skin and mucous membranes is Staphylococcus epidermidis.\(^4\) It can be safely assumed that most deep infections are due to MRSE. It has been shown that infections in immunocompromised patients and in patients with indwelling prosthetic devices are often caused by hospital strains of Staphylococcus epidermidis resistant to methicillin.\(^11\) This could be due to colonisation of the prostheses by these organisms, which can exist in a protective biofilm around the implant.\(^12\)

The overwhelming success of the MRSA screening programme in preventing deep infection has led us to consider screening for MRSE. Early detection and appropriate treatment would prevent the increased incidence of MRSE in deep prosthetic infections. This may also have a bearing on the antibiotic prophylaxis policy. Hedin\(^11\) showed that of 54 staff members screened, 13 had infection with this organism in the skin or mucous membranes and that 82% of the clothes were contaminated. Moreover, the prospective study by James et al\(^5\) showed that in screening of preoperative patients 25% of skin swabs were positive for MRSE. This shows the importance of screening for this resistant strain of staphylococcus.

The cost-effectiveness of such a screening programme is important. Papia et al\(^9\) showed that if early identification of MRSA in colonised patients prevented nosocomial transmission of the organism to as few as six new patients, the screening programme would save money. In our study, the number screened to detect one such pathogen has been very high, which may not balance the additional cost involved in treating one subsequent infection due to MRSA. Based on our findings, efficiency could be improved by screening for methicillin-resistant C-NS.

Moreover, a screening strategy targeted at patients at risk of harbouring MRSA has similar sensitivity and is more cost-effective than a strategy of systematic screening of all hospitalised patients to identify MRSA carriers.\(^9\) Patients at high risk include those who have had prolonged pre-operative hospitalisation, have been transferred from other hospitals, or have chronic wounds or an indwelling catheter. It is necessary to add MRSE screening to the existing MRSA screening programme, at least in such high-risk patients.

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References