Original article

Preventing methicillin-resistant *Staphylococcus aureus* infection in joint replacements: a new problem requiring old solutions

Jason R Harvey, John EC Benfield

Department of Orthopaedics, North Hampshire Hospital, Basingstoke, UK

Aim: To analyse prospectively the prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA) colonisation and infection in wounds and surgical vacuum drains.

Methods: The study group was 100 patients undergoing primary total hip and total knee replacements in a single orthopaedic unit.

Results: Two patients had undergone revision joint surgery within the same unit in the year prior to the study due to confirmed MRSA infection. Following a change in the unit's infection control policy, joint replacement surgery continued within the unit even when there were cases of active MRSA present on the same ward. None of the patients undergoing joint replacement grew MRSA in their postoperative drain tips or wound cultures.

Conclusions: It is safe to continue with joint replacement surgery when other patients on the same ward have active MRSA as long as strict infection control measures are followed as outlined.

Key words: Hip replacement total – Knee replacement total – Staphylococcal infection – Methicillin resistant

Methicillin-resistant *Staphylococcus aureus* (MRSA) was first reported in 1961 by the Staphylococcus Reference Laboratory. Since the 1990s, MRSA has become an increasing problem within hospitals in the UK.¹ There is increasing evidence that the dissemination of MRSA leads to additional *S. aureus* infections and not just a substitution of infections caused by methicillin-sensitive strains.² MRSA affects the most vulnerable patients and has major implications on mortality and morbidity of both elective and trauma orthopaedics. The importance and the ability to control MRSA infection has been shown within the Scandinavian countries.³

This study set out prospectively to establish the prevalence of MRSA infection and colonisation of post-operative surgical wounds of patients undergoing primary joint replacements in a single orthopaedic and trauma unit

that had previously revised joint replacements for confirmed MRSA infections. Following the presentation of the infected cases, basic infection control measures were reviewed, both in the operating theatres and on the orthopaedic wards and their importance re-emphasised to all relevant staff. Patients with confirmed or suspected MRSA infection were isolated in separate side rooms and were barrier nursed. The number of staff within the operating theatre during a joint replacement was kept to the minimum and access to the theatre during the operation was restricted. Existing measures including laminar flow theatres,⁴ disposable drapes and gowns,⁵ as well as the double gloving technique⁶ were continued. The antibiotic policy within the unit was revised. These measures were in place throughout the study.

Table 1 Organisms isolated from swabs and drain tip culture

	Inner drain 1	Outer drain 1	Inner drain 2	Outer drain 2	Inner drain 3	Outer drain 3	Swab	Swab and broth	Total
<i>Acinetobacter</i>	1	0	1	0	0	0	0	0	2
<i>Enterococcus</i>	0	3	1	1	0	0	1	5	11
Coliform	1	1	0	0	0	1	0	0	3
Coagulase-negative <i>S. aureus</i>	18	28	19	21	2	4	1	15	108
<i>S. aureus</i>	0	0	0	0	0	0	1	2	3
No growth	80	70	41	38	7	4	97	79	416
MRSA	0	0	0	0	0	0	0	0	0

Patients and Methods

A total of 100 patients undergoing primary joint replacements within a single unit between April 1997 and June 1998 were entered into the trial. Inclusion depended upon the availability of the microbiology staff to process the cultures. Any patients who had undergone previous surgery within the operative region were excluded from the trial. The patients were operated on by a number of different surgeons and thus the number of vacuum drains inserted and the timing of the removal of the drains, (between 24–48 h) was determined by the individual surgeon's preference.

The three wards within the orthopaedic unit are all interconnected and cannot be isolated from each other. If any patient within the orthopaedic unit had an MRSA infection, then 400 mg of Teicoplanin was given intravenously at induction of anaesthesia. Otherwise, all patients received 1.5 g of cefuroxime at induction and two further doses of 750 mg of cefuroxime, 8 h and 16 h postoperatively. The surgical wound dressings were left undisturbed until the designated time for removal of the drains. In every case, the first author inspected the wounds and took the microbiology samples personally using aseptic techniques.

A microbiology swab was moistened with normal saline and the whole length of the surgical wound swabbed. Each of the drains were then removed and each drain had two sections removed that were then placed separately into bottles containing Blood Culture Broth (Oxoid Ltd). The tip deepest within the wound was labelled inner drain and the section of drain that was either side of the skin was labelled outer drain. The microbiology samples were then processed in the laboratory.

Upon receipt, each patient sample was assigned a study number and the information recorded. The swab was cultured onto Blood Agar Plates and incubated at 37°C for 18 h; the tip of the swab was cut off into a universal bottle containing broth and incubated with the bottles containing the drain tips for 18 h at 37°C.

After incubation, each of the bottles was sub-cultured onto Blood Agar and MacConkey Agar plates and incubated for 18 h at 37°C. The plates were assessed for growth

after incubation and the isolates were identified using morphological appearance and other standard techniques. When *S. aureus* was isolated, its sensitivity to methicillin was determined.

Results

Of the study group, 56 patients underwent total hip replacement while 44 had a total knee replacement. Thirty-three received Teicoplanin prophylaxis, the remaining 67 had three doses of Cefuroxime as per protocol. All the wounds were clean and showed no clinical sign of infection at the initial inspection.

There were a total of 543 individual cultures made from the wound swabs and drain tips; 416 cultures showed no growth. The organisms isolated were coagulase-negative *Staphylococci* (108), *Enterococcus* (11), *S. aureus* (3), coliforms (3) and *Acinetobacter* (2). The isolated organisms were colonising the wounds and not causing infection. There were no isolates of MRSA either from skin swabs or from the drain tip cultures. These results are summarised in Table 1.

Discussion

The incidence of MRSA infection within the hospitals of England and Wales has been increasing significantly over the last decade.¹ In 1995, 13.2% of *S. aureus* isolated in blood or cerebral spinal fluid were methicillin resistant compared to 1.5% in 1989–1991. There is also increasing evidence that the dissemination of MRSA leads to additional *S. aureus* infections and not just a substitution of infections caused by methicillin-sensitive strains.² Other countries such as The Netherlands and Denmark have managed to control this epidemic.³ These countries tend to be more restrictive in antibiotic use, to apply stricter infection control measures and to have better ratios of nurses to patients in their health care institutions.¹⁰

Coello *et al.*⁷ determined the excess cost of hospital-acquired infections occurring in orthopaedic patients and found them to be significant. In 1983, Dregghorn and Hamblen⁸ highlighted the high cost of revision joint surgery, particularly in infected cases. The British

Orthopaedic Association (BOA) guidelines⁹ on sterile procedures during operations state that revision surgery for infection is time consuming, costly and erodes resources available for primary joint replacement. The 1998 Working Party report on guidelines for MRSA infection¹¹ stated that hospital-wide control programmes, antibiotic policies and good practice are key measures in minimising hospital-acquired infections including MRSA. In 1999, the BOA published guidelines on sterile procedures in operating theatres,⁹ it re-iterated the established basic infection control procedures that should occur in every orthopaedic theatre. An editorial in the *Journal of Bone and Joint Surgery*¹² also highlighted the need to maintain established operating theatre protocol. The audit of operating theatre practice carried out by Madhavan *et al.*¹³ showed that many theatres within the UK do not following simple infection guidelines.

None of the 100 patients within this study were infected or colonised with MRSA. In 33 of the cases at the time of surgery, there were patients on the orthopaedic wards with confirmed MRSA infection.

We attribute our successful infection control to the revised protocol.

Conclusions

Joint replacements can continue safely in an orthopaedic unit that has patients with active MRSA infection, even if the infected patients are on the same ward as those that are having joint replacement surgery, but only if strict infection control measures are implemented both on the wards and in theatre. This is the continued policy within our unit. We must aim to reduce the spread of all infections including MRSA to enable continued safe joint replacement surgery. Reports of vancomycin-resistant *S. aureus*^{14,15} are of particular concern to future joint replacement surgery.

References

1. Speller DC, Johnson AP, James D, Marples RR, Charlett A, George RC. Resistance to methicillin and other antibiotics in isolates of *Staphylococcus aureus* from blood and cerebrospinal fluid, England and Wales, 1989–95. *Lancet* 1997; **350**: 323–5.
2. Casewell M. New threats to the control of methicillin resistant *Staphylococcus aureus*. *J Hosp Infect* 1995; **30** (Suppl): 465–71.
3. Ayliffe GAJ. The progressive spread of methicillin resistant *Staphylococcus aureus*. *Clin Infect Dis* 1997; **24** (Suppl 1): S74–9.
4. Lidwell OM, Lowbury EJJ, Whyte W. Effect of ultraclean air operating theatres on deep sepsis in the joint after total hip or knee replacement: a randomised trial. *BMJ* 1982; **285**: 10–4.
5. Whyte W, Bailey PV, Hamblen DL, Fisher WD, Kelly IG. A bacteriological occlusive clothing system for use in the operating room. *J Bone Joint Surg Br* 1983; **65**: 502–6.
6. McCue SF, Berg EW, Saunders EA. Efficacy of double gloving as a barrier to microbial contamination during total joint arthroplasty. *J Bone Joint Surg Am* 1981; **63**: 811–3.
7. Coello R, Glenister H, Fereres J, Bartlett C, Leigh D, Sedgwick J *et al.* The cost of infection in surgical patients: a case control study. *J Hosp Infect* 1993; **25**: 239–50.
8. Dregghorn CR, Hamblen DL. Revision arthroplasty: a high price to pay. *BMJ* 1989; **285**: 648–9.
9. British Orthopaedic Association. *The British Orthopaedic Association recommendation on sterile procedures in operating theatres*. London: BOA, 1999.
10. Struelens MJ. The epidemiology of antimicrobial resistance in hospital acquired infections: problems and possible solutions. *BMJ* 1998; **317**: 652–4.
11. Anon. Revised guidelines for the control of methicillin-resistant *Staphylococcus aureus* infection in hospitals. *J Hosp Infect* 1998; **39**: 253–90.
12. Hughes SPF, Anderson FM. Infection in the operating room. Editorial. *J Bone Joint Surg Br* 1999; **81**: 754–5.
13. Madhavan P, Blom A, Kargkevraakis B, Pradeep M, Huma H, Newman JH. Deterioration of theatre discipline during total joint replacement – have theatre protocols been abandoned. *Ann R Coll Surg Engl* 1999; **81**: 262–5.
14. Johnson AP. Intermediate vancomycin resistance in *Staphylococcus aureus*: a major threat or a minor inconvenience. *J Antimicrob Chemother* 1998; **42**: 289–91.
15. Michel M, Gutmann L. Methicillin-resistant *Staphylococcus aureus* and vancomycin resistant enterococci: therapeutic realities and possibilities. *Lancet* 1997; **349**: 1901–6.