Audit

Reducing methicillin-resistant *Staphylococcus aureus* (MRSA) patient exposure by infection control measures

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Introduction: To assess the effectiveness of infection control measures (pre-admission screening and patient segregation) on reducing in-patient exposure to methicillin-resistant *Staphylococcus aureus* (MRSA).

Patients and Methods: A prospective case-control study in a district general hospital. All admissions to 3 wards over an 83-month period from September 1995 to July 2002 inclusive (a total of approximately 34,000 patients). Outcome measures were a statistical analysis of the difference in numbers of new cases of MRSA colonisation or infection between the 3 wards.

Results: There was a statistical significance in incidence of new MRSA cases between the ward with active infection control measures in place and the control wards.

Conclusions: The described infection control measures reduced the exposure of patients to MRSA. This reduces the risk of MRSA infection, which is of importance in orthopaedics, and has further benefits that may also be applied in other surgical specialties.

Key words: Methicillin resistance – Drug resistance, bacterial – Infection control – Hospital infections – MRSA

Infection remains a major problem in hospital practice, not least in orthopaedic surgery, where implant work demands the lowest contamination rate possible. Since September 1995, a system of infection control by patient segregation on one of two orthopaedic wards has been employed. From then, data have been collected on the incidence of new cases of methicillin-resistant *Staphylococcus aureus* (MRSA) on this ward and on two wards that use no specific infection control plan, to ascertain whether there is any benefit to such an infection control plan, and thus whether the exposure of patients on this ward to cross-colonisation or infection could be reduced.

Patients and Methods

The rate for MRSA colonisation or infection was recorded in patients on three wards in a busy district general

hospital (Queen Elizabeth Hospital, King's Lynn, Norfolk, UK) from screening swabs taken from in-patients resident for longer than 14 days and from all swabs taken from proven or suspected infected cases (e.g. discharging wounds).

It is current practice on one of the two orthopaedic wards (the case ward for this study) to separate the two 6-bedded bays furthest from the entry corridor, and thus furthest from general ward traffic, for use only by elective joint arthroplasty patients known by pre-admission screening to be MRSA-negative. The remaining adjacent three 6-bedded bays on the same ward are used for general orthopaedic admissions thought to be low-risk for MRSA-carriage, excluding patients transferred from other wards, those previously recent in-patients in any hospital, those known to have been MRSA-positive in the past, etc.

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The two control wards (control ward 1, general orthopaedics; control ward 2, general surgery) do not employ any specific segregation policy, and merely use routine infection control measures such as hand washing and barrier nursing if appropriate. Decontamination of bays, rooms or patient beds following documented MRSA infection/carriage is standard throughout the hospital.

There is a separate trolley for notes and X-rays for the isolation bays and separate nursing staff are allocated exclusively to these. Ward rounds are encouraged to start in these bays, moving to the low-risk bays second and the wards with no specific infection control measures last.

Results

The average number of new cases per month was: case ward, 1.17 (SD 1.41); control ward 1, 3.57 (SD 0.71); and control ward 2, 3.18 (SD 2.12). The average rate of throughput for the case ward was about 1600 patients per year, for the control 1 ward about 1150, and for control 2 ward about 1600.

Using Student's *t*-test analysing the monthly incidence, there is a statistical significance between the case ward and each of the control wards ($P < 0.05$). The significance level is, therefore, increased further in control 1 ward if contamination/infection per patient per year is considered.

Figures for the cumulative incidence of new cases of MRSA-positive carriage and/or infection per year are shown in Figure 1. It can be seen that during 1999 when there was a transient exponential rise in cases on the control wards, this trend was not mirrored on the case ward.

Discussion

Infection is the bane of surgeons' practice, none more so than in the field of orthopaedics. Moynihan¹ stated that 'every operation in surgery is an experiment in bacteriology'. The

infection rate following replacement arthroplasty surgery, a supposedly 'clean' procedure, is quoted at between 0.3–2% following total hip replacement and twice this after knee replacement.² Data reported to the Nosocomial Infection National Surveillance Scheme during 1997–1999 indicated that, in hip replacement surgery, over 50% of superficial and deep wound infections detected during the in-patient stay were due to *S. aureus*, and around 28% of all infections were due to MRSA. After total knee replacement, 8–10% of such infections were due to MRSA.³

Prophylactic administration of antibiotics is probably the single most effective method for reducing the prevalence of postoperative wound infection,⁴ although many other factors are contributory.⁵ The surgical treatment for prosthetic infection is similar for a variety of infecting organisms. However, antibiotic treatment must be tailored towards the sensitivities of the infectious agent and thus, when the infection is due to MRSA, only a small range of antibiotics can be considered, all of which have a higher rate of toxicity and side-effects than penicillins and cephalosporins. When considering prophylaxis for implant surgery, the precise choice of antibiotic must be based upon local, disease-specific information about common pathogens and their susceptibility patterns.⁶ To reduce the risk of MRSA infection in elective patients undergoing implant surgery, therefore, pre-admission screening and subsequent treatment to elimination is carried out in many units across the UK.⁷ However, on admission to hospital, even patients previously MRSA-negative may become transfected from a variety of sources.

It is known that transient colonisation of an individual by MRSA may occur. It follows that if an individual is only temporarily positive for MRSA, the risk of infection being passed onwards from such a person is lower than from an established carrier. For example, healthcare workers may become carriers during a shift only to become MRSA-free during off-duty periods. There is little data to advise as to

Figure 1 Comparison of incidence of new MRSA cases per year between case and control wards.

how quickly a transient carrier becomes a permanent carrier. It would seem logical, however, to assume that the longer an in-patient stay, the greater the chance of an individual patient becoming a true carrier for MRSA. As a marker for the MRSA incidence on each ward, we thus included patients for screening if their duration of in-patient stay was 2 weeks or greater.

A programme to control MRSA spread has been shown to be effective both in terms of incidence and numbers of patients requiring vancomycin.⁸ Transfer of patients between hospitals or between wards within a hospital is another cause of MRSA dissemination⁹ and we view such patients as MRSA-positive until proven otherwise. From our data, it can be seen that our three-tier system of patient segregation and bed allocation, and our policy of staff-patient hygiene measures have a beneficial effect in reducing the incidence of MRSA colonisation or infection in in-patients. This has several knock-on effects.

First, if elective patients are exposed to lower rates of MRSA colonisation in their neighbouring patients, their own risk of becoming MRSA-positive during their in-patient stay is reduced. This would imply that for implant surgery a prophylactic antibiotic regimen would not need to cover MRSA in its spectrum of activity. This has cost implications, as the usual choice, second-generation cephalosporins are cheaper than the glycopeptides which are active against MRSA (e.g. vancomycin, teicoplanin), and toxicity benefits as the rate of side-effects from cephalosporins is lower than from second-line agents.

If the prevalence of MRSA is low, the orthopaedic surgeons' confidence in using cephalosporins as opposed to an empirical change to the anti-MRSA glycopeptides will remain. This is important, as blanket usage of any antibiotic will inevitably lead to resistant strains emerging. Once vancomycin-resistant *S. aureus* (VRSA) and vancomycin-resistant *Staphylococcus epidermidis* (VRSE) become commonplace in the clinical setting, implant surgery must surely become viewed with greater caution.

Second, from the surgical viewpoint, in a health system in which there is ever increasing demand on bed occupancy from conflicting specialties, a number of 'ring-fenced' beds designated for specific, limited stay, elective patients will ensure a predictable throughput for that surgical unit over and above the less predictable acute admission workload. By putting stringent admission criteria on our elective orthopaedic patients, we have effectively achieved this ring-fencing in King's Lynn and, therefore, are less likely to have theatre lists cancelled because of a 'bed-crisis' at certain times during the year, lessening wasted resources in respect of both staffing and equipment requirements. For example, during 2001, only three orthopaedic lists were cancelled due to lack of available beds.

From the ward staff perspective, knowledge that a section of the ward is to remain MRSA-free maintains a raised awareness of hygiene measures, which may improve the general standard of hygiene in the unit as a whole. Although patient satisfaction with service or practice is much more difficult to measure, it would be reasonable to assume that patients and relatives would be pleased with such a policy and this would translate into greater confidence in the healthcare establishment as a whole. In a climate where healthcare professionals are increasingly under scrutiny, both internally by clinical audit and externally by the media, this must only be a constructive step. A recent study found that a majority of patients would be angry or afraid if they had acquired MRSA during a hospital admission.¹⁰

This study adds to the data supporting isolation, or at least segregation, of patients to reduce the cross-contamination rate of one particular pathogen, MRSA, although the data may be applicable to transfection by other bacteria. The end-point of the study is a positive swab culture from patients resident in a ward for longer than 14 days, as a marker of the infectivity of a particular ward. There must be some discrepancy between these two, which is a weakness of the study. Also, the false negative rate of the MRSA screen, although comparable between the wards, may confound the data. Despite this, however, there remains a significant difference in detected incidence of MRSA between the wards, suggesting that our infection control method is effective.

References

1. Moynihan BG. Infection acquired in hospitals. *Lancet* 1880; **2**: 885.
2. Fitzgerald Jr RH. Total hip arthroplasty sepsis. Prevention and diagnosis. *Orthop Clin North Am* 1992; **23**: 259-64.
3. NINNS Partnership. Surveillance of surgical site infection in English hospitals 1997-1999. London: Public Health Laboratory Service, 2000.
4. Heath AF. Antimicrobial prophylaxis for arthroplasty and total joint replacement: discussion and review of published clinical trials. *Pharmacotherapy* 1991; **11**: 157-63.
5. Hanssen AD, Osmon DR, Nelson CL. Prevention of deep periprosthetic joint infection. *J Bone Joint Surg Am* 1996; **78**: 458-71.
6. Scottish Intercollegiate Guidelines Network. Antibiotic prophylaxis in surgery. SIGN Publication number 45, 2000 <<http://www.sign.ac.uk>>.
7. Sanderson PJ. The role of methicillin-resistant *Staphylococcus aureus* in orthopaedic implant surgery. *J Chemother* 2001; **13** (Suppl. 1): 89-95.
8. Mishal J, Sherer Y, Levin Y, Katz D, Embon E. Two-stage evaluation and intervention program for control of methicillin-resistant *Staphylococcus aureus* in the hospital setting. *Scand J Infect Dis* 2001; **33**: 498-501.
9. Witte W, Braulke C, Heuck D, Cuny C. Analysis of nosocomial outbreaks with multiply and methicillin-resistant *Staphylococcus aureus* (MRSA) in Germany: implications for hospital hygiene. *Infection* 1994; **22** (Suppl 2): S128-34.
10. Hamour S, O'Bichere A, Peters JL, McDonald PJ. Patient perceptions of MRSA. *Ann R Coll Surg Engl* 2003; **85**: 123-5.