The Impact of MRSA on Vascular Surgery


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Objectives: to investigate the prevalence of MRSA infection in patients treated in a major vascular unit and examine its consequences.

Design and Methods: a retrospective case-note review was performed.

Results: during the period 1993 to 2000, a total of 172 patients (4.4% of total) were positive for MRSA. Of these 97 were colonised and 75 were infected by MRSA. The proportion of wound or graft infections caused by MRSA has increased (4% in 1994 to 63% in 2000). Three patients developed native artery infection (one following aortic stent insertion and 2 following embolectomy). All patients with aortic graft infection died. All patients with infected prosthetic infrainguinal bypass ended up with an amputation.

Conclusion: the prevalence of MRSA infection is increasing. Infection of aortic grafts appears to be uniformly fatal and lower limb graft infection is associated with high limb loss.

Key Words: MRSA; Vascular surgery; Graft infection; Outcome.

Introduction

Staphylococcus aureus is a highly virulent and ubiquitous pathogen. It is the commonest cause of surgical wound infections. After the initial success of penicillin in treating S. aureus, resistance began to emerge and now up to 80 percent of isolates are penicillin resistant. The introduction of β-lactamase resistant semisynthetic penicillins in the 1960s provided temporary respite until the emergence of methicillin-resistant S. aureus (MRSA). In recent years MRSA has become endemic in hospitals in Europe and U.S.A. The increasing prevalence of MRSA is a major threat in arterial surgery and poses a considerable therapeutic challenge. This paper reports the prevalence of MRSA in a major teaching hospital vascular unit and the consequences of infection with this organism are discussed.

Patients and Methods

A retrospective study was undertaken to assess the prevalence of MRSA and the consequences of MRSA wound and graft infections. Patients positive for MRSA were identified from the Leicester Royal Infirmary (LRI) Vascular Studies Unit audit (prospective data collection on admissions), and microbiology records for the period January 1993 to December 2000. The case notes of all patients were retrieved and reviewed to obtain data on presentation, diagnosis, treatment, complications and survival. Patients were not routinely screened for MRSA prior to admission except for those transferred from other hospitals. However, there was a routine policy of screening all patients admitted to the intensive care or the high dependency unit. All patients underwent surgery in LRI. Antibiotic prophylaxis comprised of 3 doses of intravenous ceftroxime (750 mg) and metronidazole (500 mg) in all patients undergoing arterial surgery. The first dose was administered at induction of anaesthesia and subsequent 2 doses were given at 8 h intervals postoperatively.

For the purposes of this study, colonisation was defined as patients who were swab positive for MRSA with no clinical evidence of infection. Patients were considered to be infected if there was clinical evidence of infection at the cultured site. Graft infection was defined as positive MRSA culture from fluid or pus in direct contact with the graft. Data was analysed by using the total number of arterial procedures performed as the denominator. However, this figure excluded those patients undergoing angioplasties or varicose vein surgery, but included patients with venous ulcers undergoing surgery.
MRSA colonisation and infection during the study period for aortic procedures, carotid endarterectomy and infrainguinal reconstructions are shown in Table 1.

Table 2 gives a summary of the 75 patients with MRSA infection. Three patients presented with Dacron patch infection following carotid endarterectomy. In one patient, the infected Dacron patch was removed, and the common carotid, internal carotid and external carotid arteries were excised and ligated under transcranial Doppler monitoring. The second patient presented 2 years post carotid endarterectomy with a discharging sinus overlying the carotid patch. The internal carotid was found to be occluded on Duplex scanning. The Dacron patch was removed, and the external and common carotid arteries were ligated. Both of these patients made an uneventful recovery. The third patient underwent excision of the infected carotid artery and a vein graft was inserted. This patient survived but developed a hemiparesis. In elective aortic aneurysm surgery 3 patients had been treated by endovascular technique. One of these developed a false aneurysm at the site of insertion of the endovascular device, this was repaired and the patient survived. The second patient developed a crossover graft infection after endovascular aortic aneurysm repair with an aorto-uni-iliac device and died. The third patient developed a groin wound infection which resolved with a 6 week course of intravenous vancomycin therapy (1 g twice daily with monitoring of levels to guide dosage and avoid toxicity). One patient developed intra-abdominal sepsis after an aorto-bifemoral graft and died. All patients with aortic graft infection following repair of a ruptured aneurysm and reconstruction for occlusive aortic disease died.

Twenty-five of the patients undergoing lower limb procedures had wound infections and 6 of these died from unrelated causes. Two patients developed a primary arterial infection after a femoral embolectomy. Both presented about 2 weeks after the primary procedure with arterial rupture and haemorrhage. In the first patient this was repaired with a vein patch. However, 5 days later the vein patch ruptured and an obturator bypass (with PTFE) was performed. The limb was salvaged and the patient survived. The second patient underwent ligation of the femoral artery and an above knee amputation. The amputation stump also became infected with MRSA. He declined further surgery and died of MRSA sepsis. Eight patients developed graft infections. One of these was a Dacron iliofemoral crossover, and the patient required an above knee amputation and survived. Two patients had infected PTFE femoropopliteal bypass grafts. The

![Fig. 1. Proportion (%) of MRSA positive patients by year from 1994-2000.](image1)

![Fig. 2. Number of patients with colonisation or clinical infection by MRSA.](image2)

**Results**

The first MRSA positive patient in the Leicester Royal Infirmary vascular unit was identified in 1993. During the 8 year period from 1993 to 2000, a total of 172 patients were positive for MRSA. This represented 4.4% of the patients passing through the vascular unit during the study period. Of the 172 patients, 97 were colonised and 75 were infected by MRSA. The number of MRSA positive patients has increased yearly (Fig. 1), from 6 (1%) patients in 1994 to 28 (6.8%) patients in 2000. Each year, roughly 50% of the MRSA positive patients have developed a clinical infection (Fig. 2).

The overall wound and graft infection rate has remained similar over the years (5% in 1994 versus 4.6% in 2000). However, the proportion of wound or graft infections caused by MRSA has increased from 1/28 (4%) in 1994 to 12/19 (63%) in 2000. The risks of
Table 1. Incidence (%) of MRSA carriage, infection and graft infection during the period 1993–2000.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>MRSA carriage</th>
<th>MRSA infection</th>
<th>MRSA graft infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid endarterectomy</td>
<td>0.5</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Aortic procedure</td>
<td>5</td>
<td>3</td>
<td>0.7</td>
</tr>
<tr>
<td>Lower limb arterial procedure</td>
<td>7</td>
<td>3</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Table 2. Summary of the 75 MRSA infections.

<table>
<thead>
<tr>
<th>Type of procedure</th>
<th>No.</th>
<th>Site of MRSA sepsis</th>
<th>Outcome</th>
<th>Median (range) hospital stay in days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachial embolectomy</td>
<td>1</td>
<td>Wound</td>
<td>Resolved</td>
<td></td>
</tr>
<tr>
<td>Carotid endarterectomy</td>
<td>3</td>
<td>Dacron patch</td>
<td>1 hemiparesis</td>
<td>22 (15–38)</td>
</tr>
<tr>
<td>Elective AAA repair</td>
<td>21</td>
<td>Septicaemia (3)</td>
<td>4 died*</td>
<td>24 (9–87)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Groin false aneurysm (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intra-abdominal sepsis (1)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruptured AAA repair</td>
<td>11</td>
<td>Pneumonia (5)</td>
<td>3 died**</td>
<td>33 (13–80)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wound (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Septicaemia (3)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aortic occlusive disease</td>
<td>4</td>
<td>Wound (2)</td>
<td>2 died***</td>
<td>26 (12–260)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graft (2)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower limb surgery</td>
<td>35</td>
<td>Wound (25)</td>
<td>9 died</td>
<td>30 (13–90)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Primary arterial infection (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Graft (8)</td>
<td>6 amputations</td>
<td></td>
</tr>
</tbody>
</table>

The prevalence of MRSA appears to be steadily increasing which is reflected in our figures and those reported from other vascular units. In Trent in 1998, 20% of S. aureus causing bacteraemia were methicillin resistant whereas the overall figure for England and Wales, was 32%. In the United States, MRSA has also increased at an alarming rate since the 1980s. In 1984, the overall proportion of S. aureus resistant to methicillin was approximately 5%, but this increased sharply to 29% by 1991. This has considerable implications in terms of hospital costs. Our results suggest a prolonged hospital stay in some patients although we have not used a control group for comparison. One study from the U.S.A. has shown that patients with serious MRSA infection stayed in hospital an average of 12 days longer and had an average hospital cost of £3200 greater than comparable patients with methicillin-susceptible S. aureus infections. The increase in MRSA cases in our unit has occurred despite isolation of MRSA cases and the implementation of appropriate guidelines.

The greatest impact of hospital MRSA infections is likely to be in areas such as vascular surgery which utilise prosthetic graft materials and where the patient population is frail and debilitated. Infection of aortic grafts appears to be uniformly fatal. Infection of lower limb bypass grafts is either fatal from overwhelming sepsis or leads to limb loss. Limb salvage may be possible in some patients by total graft excision and revascularisation of the limb with autogenous vein graft routed through clean tissue planes. The most worrying finding in our study was the ability of MRSA to destroy native artery (3 patients with primary closure of a femoral arteriotomy) and the susceptibility of vein grafts to MRSA infection. Native artery MRSA infection has not been reported previously. Whether this represents a genuinely increased pathogenicity of MRSA compared to methicillin-sensitive S. aureus or simply reflects the relatively poor activity of vancomycin against MRSA is uncertain.

Until recently, vancomycin has been the only uniformly effective treatment for staphylococcal infections. However, intermediate resistance to glycopeptides has now been reported from Japan and the
United States in 4 patients. All of these cases had prior infections with MRSA, for which they received repeated and prolonged vancomycin therapy. Therefore vancomycin should only be used when appropriate and essential. The emergence of glycopeptide resistance could produce morbidity and mortality similar to that caused by S. aureus infections in the era before antibiotics became available. Fortunately, to date all S. aureus isolates with intermediate resistance to glycopeptides have been susceptible to alternative agents such as the groups of new quinolones, oxazolidinones, quinupristin-dalfopristin, various combinations of antibiotics, and new investigational compounds. Quinupristin-dalfopristin (Synercid, Rhone-Poulenc-Rohrer, Collegeville, Pennsylvania) and linezolid (Zyvox, Pharmacia & Upjohn Limited, Milton Keynes, UK) have now been licensed in the U.K. and the U.S.A. and add to the antimicrobial armamentarium against MRSA. Future hopes rely on the development of a protective vaccine.

Approximately 50% of the patients who were MRSA positive developed clinical infection. In such patients if surgery is unavoidable, it would be sensible to attempt eradication of MRSA prior to surgery. In those patients in whom elective surgery is being undertaken, there should be reconsideration of the risk/benefit ratios of reconstructive surgery. In lower limb occlusive disease angioplasty, if possible, may be a lower risk alternative. The routine use of vancomycin as prophylaxis remains controversial and has not been adopted in our unit. Selective use should be undertaken with advice from the microbiologists. Also routine measures to eradicate or “search and destroy” whenever an MRSA is cultured, in the absence of clinical sequelae, is probably not justified and may waste scarce resources.

At present the best approach is that of prevention by scrupulous hand washing and the prompt adherence to recommended guidelines for isolation in conjunction with the hospital infection control team. There is little doubt now that MRSA infection in vascular patients is a serious and disastrous complication. Successful management and containment of MRSA infections requires a multidisciplinary approach involving the nursing staff, medical staff and the infection control team.

Acknowledgements

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References