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Medical audit

Methicillin-resistant *Staphylococcus aureus* infection in vascular surgical patients

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***Background*: Methicillin-resistant *Staphylococcus aureus* (MRSA) infection is emerging as a major problem in vascular surgical practice. The aim of this study was to review the management of patients with MRSA infection complicating vascular surgical operations.**

***Methods*: Data were obtained from the vascular audit, case notes, intensive therapy unit (ITU) notes, high dependency unit (HDU) notes and microbiological records of patients who underwent either arterial reconstruction (n = 464) or limb amputation (n = 110) between April 1994 and October 1998.**

***Results*: Forty-nine vascular surgical patients developed clinical MRSA infection (9%). Clinical MRSA infection in patients who had undergone aorto-iliac reconstruction (n = 18) was associated with a 56% mortality (n = 10) and the most common infections were bacteraemia (55%) and pneumonia (50%). MRSA infection occurred in 17 patients who had undergone infra-inguinal bypass and was associated with a 29% mortality (n = 5). The most common site of MRSA infection was the groin wound (76%) leading to anastomotic dehiscence and death in one patient (11%) and necessitating wound debridement in 4 patients (22%). MRSA infection of the groin wound in the presence of a prosthetic graft (n = 3) led to anastomotic dehiscence in 2 patients, and graft excision in 2 patients. Similar complications were not observed in the presence of an underlying autogeneous long saphenous vein graft (n = 16). MRSA infection following major lower limb amputation (n = 14) was associated with death in 5 patients (36%). Wound infection in 10 amputees (71%) led to revision of the amputation to a higher level in 2 (14%) and wound debridement in 2 (14%).**

***Conclusions*: MRSA infection has a high mortality in vascular surgical patients in general, and following aorto-iliac reconstruction in particular. Autogeneous vein may confer some protection against local complications following groin wound infection. Strategies aimed at reducing the incidence of infection, including strict adherence to infection control procedures, may reduce the severity of this problem.**

Key words: MRSA – Vascular surgery

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Until recently, major infection was considered an uncommon but potentially serious complication of vascular surgery occurring in approximately 1% of vascular surgical procedures.[1] Over the last 10 years, however, methicillin-resistant *Staphylococcus aureus* (MRSA) has emerged as a serious infection in hospital-based practice,[2] which may complicate all forms of surgery but is particularly relevant to operations involving immunocompromised or debilitated patients or in operations involving implantable materials.[3–6] Initial reports would suggest that MRSA infection in vascular surgery has a poor outcome, particularly if prosthetic grafts become infected.[6–10] The aim of this study was to review the management of patients with MRSA infection complicating vascular surgical operations at a single institution and consider some of the factors affecting the outcome.

Patients and Methods

Patients who became MRSA positive (either clinical MRSA infections or MRSA positive swabs) after vascular surgical operations performed at Leicester General Hospital were identified from the vascular audit and microbiological, vascular ward and intensive therapy unit (ITU) or high dependency unit (HDU) records. The case notes were reviewed to determine the presentation, diagnosis and treatment of MRSA infections and associated morbidity and mortality. Patients who became MRSA positive following vascular procedures at other hospitals and were then transferred to Leicester General Hospital (for renal dialysis or ITU care) were excluded because of difficulties obtaining accurate data from other institutions. Patients who had become MRSA positive on previous hospital admissions were also excluded (*vide infra*).

Between April 1994 and October 1998, 464 major vascular reconstructions and 110 major lower limb amputations were performed. During this time period, 63 vascular patients had MRSA positive microbiological swabs or cultures. There were 47 males (75%) and 16 females (25%) with a group median age of 75 years (range 18–94 years). All patients had received routine pre-operative prophylactic antibiotics (usually three doses of intravenous co-amoxyclav [Augmentin; 1.2 g] or cefuroxime [750 mg]) and diabetic patients had also received 3 doses of 500 mg intravenous metronidazole. Therapeutic antibiotics were usually continued for 5 days in patients with tissue necrosis affecting the foot. Aortic and axillobifemoral grafts (Gelsoft, Sulzer Vascutek Ltd, Inchinnan, UK), were bonded with rifampicin by immersing the graft in 300 mg of rifampicin dissolved in 5 ml of sterile water for 10 min prior to implantation.

Hospital infection control policy for MRSA

The hospital infection control policy during the study was based on guidelines issued by the Combined Working Party of the British Society for Antimicrobial Chemotherapy and the Hospital Infection Society.[12,13] Patients on the vascular unit and other hospital wards were not routinely swabbed for MRSA unless a clinical outbreak occurred. However, clinical staff were educated on MRSA infection and the importance of hand washing with antiseptic soap or alcohol hand rub before and after each patient contact emphasised.

Vascular patients admitted to ITU or HDU underwent routine screening for MRSA with swabs from the nose, throat, perineum, and other sites if appropriate (wounds, intravenous and arterial lines, areas of abnormal skin, sputum and urine). Patients with MRSA positive swabs but no clinical infection were treated with mupirocin (Bactroban) nasal ointment 3 times a day and twice daily washes with 2% triclosan liquid soap (Aquasept) for 5 days. These patients were isolated in side rooms and all personnel in contact with the patient wore disposable latex gloves and plastic aprons. After completing this treatment, the patients had swabs taken twice a week from the relevant sites. If three consecutive negative swabs were obtained, a decision was taken on the need for continued isolation and the further swabs taken weekly whilst in hospital. Patients admitted to hospital with previous MRSA positive swabs and/or clinical MRSA infection were isolated in a side room and treated with mupirocin and triclosan until negative swabs were obtained. These patients were excluded from the study because of uncertainties of previous MRSA status. Patients with clinical MRSA infection were treated with appropriate antibiotics (usually intravenous vancomycin) together with mupirocin and triclosan following consultation with microbiologists.

Results

Forty-nine out of 574 vascular surgical patients developed clinical MRSA infection (9%). Of these 49 patients, 23 (47%) died in hospital including 10 (20%) who died directly as a result of MRSA sepsis. A further 14 patients had MRSA positive swabs or cultures detected during screening on the ITU[HDU or during ward outbreaks, but had no clinical evidence of MRSA infection and were excluded from analysis.

Table 1 Outcome in patients with clinical MRSA infection (n = 49)

	Aorto-iliac disease (*n* = 18)	Infra-inguinal (*n* = 17)	Amputation (*n* = 14)
Elective	11	10	7
Emergency	7	7	7
ITU stay-days (range)	12 (1–36)	2 (1–15)*	0
Hospital stay-days (range)	24 (13–62)**	38 (10–102)***	66 (18–138)
Postoperative day when MRSA isolated-day (median)	11 (4–28)	21 (7–103)	17 (1–90)
Mortality (%)	10 (56)	5 (29)	5 (36)

*4 out of 17 patients admitted to ITU; **1 patient transferred to another hospital on postoperative day 30;
***1 patient transferred to another hospital on postoperative day 19.

Table 2 Site of clinical MRSA infection (n = 49)

	Aorto-iliac Disease (n = 18)	Infra-inguinal (n = 17)	Amputation (n = 14)
Wound	3	13	10
Intra-abdominal	2		
Blood	10	2	1
Chest	9	1	
Graft	2*		
Leg ulcer		2	7

*Axillobifemoral grafts.

Table 3 MRSA infection related complications (n = 49)

	Aorto-iliac disease (*n* = 18)	Infra-inguinal (*n* = 17)	Amputations (*n* = 14)
Re-exploration	2		
Intra-abdominal sepsis	2		
Sepsis syndrome	6	2	1
Chest infection/prolonged ventilation	9		
Graft infection	2*		
Re-admission to hospital	2*	11	2
Amputation	1	1	2
Anastomotic bleeding	1*	1	
Graft excision	2*	0	
Wound debridement	0	4	2
Multiple organ failure	1		
Death from MRSA sepsis	4	5	1

*Axillobifemoral grafts.

Table 4 Non-MRSA related complications in patients with clinical MRSA infection (n == 47)

	Aorto-iliac disease (*n* = 23)	Infra-inguinal (*n* = 19)	Amputation (*n* = 17)
Cardiac	6	5	3
Amputation	1		
Gastrointestinal bleed	3		
Renal failure	11	1	
Pneumonia	10	4	3
Pulmonary embolus	1	2	
Wound infection	0	1	1
Re-operation	4	3	
Blocked graft	1	2	
Compartment syndrome	0	1	
Deep vein thrombosis	1		
Sepsis syndrome	4		
Multiple organ failure	3		
Cerebral infarction			1
Pancreatitis	2		

Aorto-iliac disease

Eighteen patients developed clinical MRSA infection following aorto-iliac reconstruction and included: aortic aneurysm repair 14, aortobifemoral grafting for arterial occlusive disease 2, and axillobifemoral bypass 2. Of these, 10 (56%) died in hospital including 4 patients who died from MRSA sepsis (one MRSA sepsis syndrome, one MRSA pneumonia, 2 abdominal MRSA sepsis), 3 from multiple organ failure, one from pulmonary embolus, one with acute left ventricular failure and one with respiratory failure (Table 1). The commonest sites of MRSA isolation were blood and sputum producing MRSA bacteraemia in 55% and MRSA lower respiratory tract infections in 50% (Tables 2 & 3). Of 9 episodes of MRSA bacteraemia following insertion of an aortic graft, 4 were associated with MRSA pneumonia and 2 with intra-abdominal MRSA sepsis (of which one also had MRSA pneumonia). The four remaining patients had no other identified site of MRSA sepsis although 2 had prolonged ventilation and haemofiltration for acute renal failure. MRSA infection occurred predominantly in debilitated ITU patients with a high number of non-MRSA related complications (Tables 1 & 4.). No patient was diagnosed with MRSA graft infection in this study and rifampicin-bonding, introduced midway through the study, was performed in 7 patients. One patient who underwent repeat laparotomy for intra-abdominal MRSA sepsis had no radiological evidence of graft infection or gross contamination of the graft (not rifampicin-bonded) on inspection, but had multiple MRSA infected collections secondary to infected haematoma. A second patient with intra-abdominal sepsis and no radiological evidence of graft infection (not rifampicin-bonded), underwent aspiration of an MRSA

infected subphrenic collection. Both patients eventually died of MRSA sepsis. Graft infection was not looked for using radiological imaging in other patients without overt signs of intra-abdominal sepsis.

Infra-inguinal arterial reconstruction

Seventeen patients developed MRSA infection following infra-inguinal reconstruction: The 17 infra-inguinal procedures comprised 2 above knee femoro-popliteal bypasses (one PTFE, one reversed saphenous vein, LSV), 4 below knee femoropopliteal reversed LSV bypasses, one common femoral endarterectomy with vein patch and 10 femorodistal bypasses (one PTFE, 9 reversed LSV). Five out of 17 died (29%); 4 from MRSA sepsis and one from anastomotic bleeding. Nine out of 17 patients (53%) with clinical MRSA infection following infra-inguinal bypass had significant non-MRSA complications (Table 4).

Thirteen patients (76%) developed MRSA groin wound infections. MRSA wound infections involving autogeneous vein grafts (n = 12) resolved with intravenous vancomycin therapy and included 4 (22%) who underwent limited wound debridement and 11 (61%) who required re-admission to hospital for treatment with intravenous antibiotics. There was no anastomotic bleeding in patients with MRSA wound infections complicating infra-inguinal vein grafts. One patient (11%) underwent amputation for persistent MRSA infection in diabetic leg ulcers despite a functioning vein graft.

MRSA infection of the groin wound in the presence of a prosthetic graft in (one PTFE, 2 rifampicin-bonded Dacron axillobifemoral grafts) resulted in anastomotic bleeding in 2 (one PTFE, one Dacron), death in one patient (PTFE) and graft excision in 2 (Dacron).

Major limb amputation

Fourteen patients who underwent leg amputation developed clinical evidence of MRSA infection. There were 5 above knee amputations, 8 below knee amputations and one supracondylar amputation of the femur with application of the patella to the bone end to achieve union (Gritti-Stokes) performed for chronic critical leg ischaemia (n = 16) and acute ischaemia secondary to a cardiac embolus (n = l). Of these, 5 died (36%); one from MRSA sepsis and 4 from ischaemic heart disease. Ten patients developed MRSA wound infection (71%) of whom 2 required wound debridement and 2 underwent amputation to a higher level, the rest being treated successfully with intravenous antibiotics (vancomycin).

Discussion

These data show that MRSA infection is a significant cause of morbidity and mortality following vascular surgical procedures. MRSA infection complicated 9% of all major vascular surgical cases and MRSA sepsis was the cause of death in 2% of all patients. This high level of MRSA infection reflects a growing problem (30 new cases of MRSA detected per month in Leicester in 1998) in the UK and elsewhere.[2] Given the problem with MRSA in Leicester, it is now our practice to include the risks of MRSA infection when obtaining informed consent from patients prior to surgery.

Clinical MRSA infection in patients following aorto-iliac reconstruction was associated with a poor outcome. MRSA infection has a higher morbidity compared to non-multiresistant infections[13,16] because it is more difficult to treat and is more prevalent in debilitated ITU patients with multiple postoperative complications.[13–17] The commonest sites of infection in this study, bacteraemia and pneumonia, are associated with a higher mortality and are similar to those seen in all surgical patients admitted to ITUs.[18] One additional factor increasing the mortality of MRSA infection in vascular patients is the infection of prosthetic material.[6–10] MRSA aortic graft infection, has a reported 100% mortality.[8–10] It was not diagnosed in any patient in this study although this may reflect the difficulties of diagnosing aortic graft infection in critically ill ITU patients.[19] Almost one-quarter of patients with MRSA bacteraemia had no apparent septic focus and a higher index of suspicion for aortic graft infection in these patients may have yielded a different result.

There is little published information as to the best treatment of MRSA infected grafts, but results appear uniformly poor[7–10] and prevention of infection is, therefore, of the utmost importance. Early graft infection is attributed to graft contamination at implantation,[20] and measures to reduce graft infection should be directed to this stage. Despite considerable enthusiasm for the use of antibiotic-bonded grafts, MRSA infection occurred in two rifampicin-bonded axillobifemoral grafts in this series, albeit presumably from adjacent wound infection. Furthermore, rifampicin-bonding has not been shown to reduce the incidence of graft infection in randomised trials,[21,22] and its effectiveness in preventing colonisation with MRSA is unknown, Effective antibiotic prophylaxis is also important. Cephalosporins do not offer effective peri-operative antibiotic prophylaxis to MRSA,[23] and prolonged courses of prophylactic third generation cephalosporins increase the risk of developing MRSA infection.[24]

Vancomycin prophylaxis is, therefore, recommended for vascular procedures in hospitals with a high incidence of MRSA,[23,25] in patients colonised with MRSA,[25] or in those undergoing re-exploratory procedures in the groin.[6] To reduce the emergence of vancomycin resistant strains, postoperative administration should be limited to 24 h.[23,25]

Conservative treatment of MRSA groin wound infection complicating autogeneous vein grafts produced excellent results in this series. It is, therefore, our policy to use contralateral long saphenous vein where ipsilateral vein is inadequate rather than a PTFE graft, and to treat established groin wound infections in autogeneous vein grafts with prolonged courses of intravenous vancomycin (up to several weeks depending on the clinical picture and microbiological advice) and limited wound toilet. Conversely, for infected prosthetic grafts in the groin, the best form of treatment is complete graft excision with distal revascularisation using autogeneous vein or, if no vein is available, limb amputation.[7] The most effective strategies that have evolved to reduce MRSA infection involve minimising spread through infection control procedures.[25] Reducing MRSA carriage on the hands of staff, introducing standards of practice to reduce MRSA transmission, and treating affected patients has been shown to reduce the incidence of clinical MRSA infection.[26,27] Reduction of MRSA transmission by healthcare staff can be achieved by education of staff on the nature of MRSA infection, the need for hand washing, and the use of protective aprons and gloves when handling MRSA patients. Hand washing between patients is considered to be the single most effective infection control measure.[25,28] Isolation is another important aspect of MRSA control, and all MRSA patients should be isolated in a side room. Other attempts at reducing the incidence of MRSA carriage, particularly the introduction of community-derived MRSA, include daily Hibiscrub baths following arrival on the ward.[25] The most effective topical treatment for the eradication of MRSA carriage is mupirocin, although repeated and prolonged courses have produced resistance to this agent and high level resistance is becoming increasingly common in the UK.[29]

Conclusions

In conclusion, MRSA infection is an increasing problem with a high morbidity and mortality in vascular patients. In particular, MRSA infection in patients having aorto-iliac arterial reconstruction or insertion of prosthetic material has a poor prognosis. Diagnosis and treatment of established MRSA infections is difficult; therefore, strict adherence to infection control policies are the most effective means of reducing the scale of this problem.

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