

# Methicillin resistant *Staphylococcus aureus* infection in vascular surgery patients

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Received: August 31, 2020; Reviewed: December 19, 2021; Accepted: February 27, 2022

Presented at: SPACV Online Event 2020

## ABSTRACT

**INTRODUCTION:** Surgical site infections are associated with devastating consequences in vascular surgery patients but the data on Methicillin Resistant *Staphylococcus aureus* (MRSA) infection among those remains scant and conflicting. Most vascular surgery antibiotic prophylaxis assume that all patients submitted to surgery are tested prior to the intervention or that all patients with risk factors for MRSA are presumed to be colonized. However, the costs associated with testing all patients are not negligible, and most of the vascular surgery patients have risk factors for MRSA colonization. The purpose of this study was to evaluate the burden of MRSA clinical infection and its outcome and to adjust clinical practice accordingly.

**METHODS:** A retrospective analysis of clinical data from all patients with MRSA isolations that were submitted to vascular surgery in the year 2019 was conducted. The primary endpoint was in-hospital mortality. Secondary endpoints were timing of infection (pre-existent infection or post-surgical infection), need for ICU and length of hospital stay.

**RESULTS:** Out of 1681 patients admitted for surgery in the year 2019 in the vascular surgery ward, only 21 had clinical infection with positive MRSA isolates. All the patients had risk factors for MRSA colonization. Seventeen were admitted for PAD (Rutherford grade 5 or 6). Eight patients had post-operative infections, whilst the remaining presented with MRSA infection prior to the intervention. Post-operative infections ranged from superficial incisional in three patients, deep incisional in one patient, and organ/space/prosthesis infection in four patients (of the last group, two had prosthesis infection). There were five deaths, of which two were unrelated to the infection. Of the three deaths probably infection-related, all were post-operative surgical site infections, and all were organ/space/prosthesis infections (one with prosthesis infection). There was no patient admitted to the ICU that survived. The mean hospital stay was increased by 26 days (31 days, 95% CI, 19-43).

**CONCLUSION:** Infection by MRSA was less frequent than expected in our population, which may mean that colonization might be smaller than expected. Pre-operative infection was almost always related to chronic wounds and did not increase the risk of post-operative wound infection or death, contrary to post-operative infection, which seems to significantly increase mortality.

**Keywords:** Vascular Surgery; Surgical Site Infection; Methicillin Resistant *Staphylococcus aureus*; Prosthesis infection.



## INTRODUCTION

Patients with arterial diseases are at high risk for post-operative surgical site infection (SSI), both because of the nature of the underlying pathology process and frequent use of synthetic material, and because of multiple and serious comorbidities which are present in most cases.

There has been an uprising in the number of multiresistant pathogens present in nosocomial environments, and patients with chronic wounds and under multiple and/or prolonged antibiotic therapy are especially susceptible. Most vascular surgery antibiotic prophylaxis schemes assume that all patients submitted to surgery are tested for Methicillin Resistant Staphylococcus aureus (MRSA) colonization prior to the intervention or that all patients with risk factors for MRSA are presumed to be colonized.<sup>[1]</sup> The risk factors for colonization are well known, and include previous MRSA colonization, haemodialysis, antibiotic regimen in the last 6 months, use of invasive devices, chronic wounds, hospitalization in the last 6 months, hospitalization for more than 48 hours before transfer, or stay in a nursing home.<sup>[2]</sup> Given the nature of arterial vascular disease, which represent most admissions in a vascular surgery ward, most patients present at least one risk factor for colonization. Colonization in turn is a risk factor for MRSA SSI and for device related MRSA systemic infection.

Studies report a 9% incidence of MRSA infection in vascular surgery patients after arterial reconstruction representing the most prevalent organism responsible for post-operative infections.<sup>[3,4]</sup> In Cardiac Surgery patients, that present most of the same risk factors for colonization, up to 20% of patients are colonized by MRSA, and up to 65% of post-surgical mediastinitis after coronary bypass are caused by MRSA.<sup>[5]</sup>

Protocols for MRSA screening imply a nasal swab and a wound swab for a Polymerase Chain Reaction (PCR) test at admission. Patients are placed in isolation until the definitive result is available and appropriate treatment can be started.<sup>[6]</sup> The logistics and economic burden associated with screening all patients, makes implementation difficult if not sufficiently substantiated.<sup>[6]</sup>

The purpose of this study was to evaluate the toll of MRSA infection and respective prognosis in a vascular surgery ward, to decide the need for MRSA screening and adjustment of antibiotic surgical prophylaxis.

## METHODS

The authors declare that they have followed the protocols of their center on the publication of patient data and comply with the Helsinki declaration on research ethics. A retrospective analysis of all microbiologic laboratory results was performed for all patients admitted in the vascular surgery ward in a tertiary university hospital from the 1st of January of 2019 to the 31st of December of 2019. All patients with a positive MRSA isolate (hemoculture, surgical biopsy, prosthesis, surgical site swab or wound swab) were then selected for patient chart analysis. Data collected were age, gender, pathology classification, Rutherford grade of ischemia for peripheral arterial disease (PAD) patients, timing of infection (pre-existing infection or post-surgical infection), type of infection<sup>[4]</sup> (superficial incisional SSI, deep incisional SSI, organ/space/prosthesis

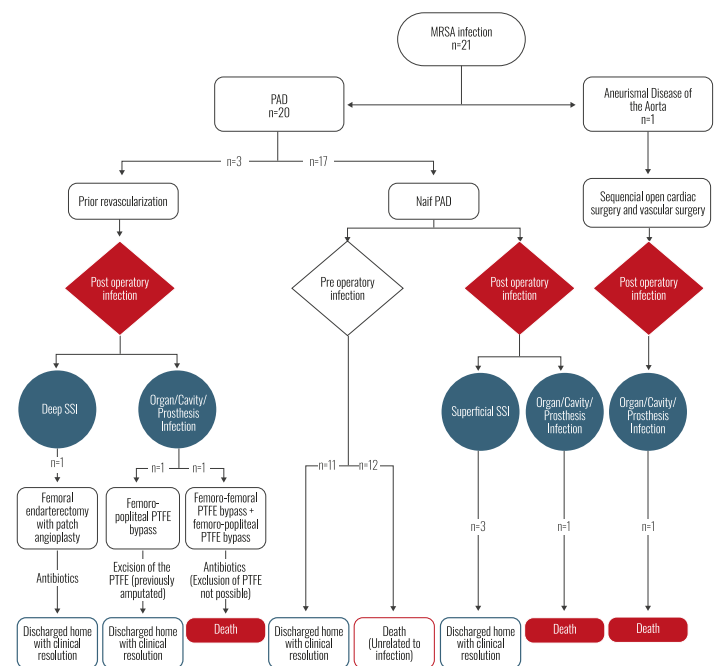
SSI, non-surgical infection), clinical criteria of systemic infection (either leukocytosis and elevated reactive protein C and/or fever), MRSA risk factors (as previously mentioned), treatment (directed antibiotics), need for ICU, length of hospital stay and outcome (death, discharge with clinical resolution). Given the small number of patients eligible for the study, complex statistical analysis was not possible, and a descriptive analysis of the data was performed. When the data had a normal distribution mean value was calculated.

The primary endpoint was in-hospital mortality. Secondary endpoints were timing of infection, need for ICU and length of hospital stay.

## RESULTS

There were 1681 patients admitted in the year 2019 in the vascular surgery ward. MRSA infection was identified in only 21 patients (1,25%) and all of them had at least one risk factor for MRSA colonization.

**Figure:** Stratification of patients according to pre or post-operative infection, and to type of infection and respective outcomes



**MRSA** – meticilin resistant staphylococcus aureus; **PAD** – peripheral arterial disease; **SSI** – surgical site infection; **PTFE** – polytetrafluoroethylene.

Of the 21 patients with confirmed MRSA infection, mean age was 70 years old (+/- 8 years) and there were only three female patients. 20 patients were admitted for PAD, but three had been previously submitted to vascular reconstructions, and admission motive was pos-operative infection (two with vascular prosthetic graft infection – one patient with a femoral-femoral bypass with a femoral-popliteal bypass, and another with a femoral-popliteal bypass – and one with deep incisional SSI from a femoral endarterectomy with patch angioplasty). The other 17 patients had never been submitted to any surgical revascularization (naïf PAD) and all were Rutherford grades 5 and 6. One patient was admitted

for aneurysmal disease of the aorta.

Among the *naif* PAD population (n=17), 13 patients presented with pre-operative infection by MRSA, manifested by non-surgical site infections detected by wound swabs or surgical biopsies. Eleven of these patients were discharged with clinical improvement after resolution of the underlying pathology. Two patients died of complications unrelated to the infection.

Of the four *naif* PAD patients that had post-operative MRSA infections, three with superficial SSI, and one with cavity/organ/prosthesis infection, the last patient died from sepsis, and the others were discharged with clinical improvement.

Among the PAD patients admitted for SSI, one had deep SSI (previous femoral endarterectomy with patch angioplasty) and was discharged with clinical improvement after antibiotic therapy. Two patients had cavity/organ/prosthesis SSI. The patient that had an infected femoral-popliteal bypass had previously been amputated and so surgical resolution of the infection was managed by excision of the infected prosthetic material and the patient was discharged home without further complications. The other patient presented with a femoral-femoral bypass infection that extended to a previous femoral-popliteal bypass and had no surgical options available for the excision of the prosthetic material and was as such managed with broad spectrum antibiotics. This patient later died of sepsis.

The patient admitted for aneurysmal disease of the aorta was submitted to open repair of the infra-renal aorta. He had been submitted two weeks earlier to cardiac surgery. In the post-operative period of the vascular intervention, a mediastinitis by MRSA was identified and the patient was submitted to cardiac revision and broad-spectrum antibiotic therapy but ultimately died of sepsis.

Among all groups, eighteen patients had systemic clinical manifestations of infection, either leukocytosis and elevated reactive protein C and/or fever and were managed with appropriate antibiotics. Those without such clinical or laboratory parameters of infection were not medicated with antibiotics, and that did not worsen their prognosis.

There were five patients admitted to the ICU, of which two admissions were not related to infection (both cases of spontaneous cerebral hemorrhage in the context of systemic anticoagulation). The other three patients admitted to the ICU had post-operative SSI, and all were organ/space/prosthesis infections (one with prosthesis infection). None of the patients admitted to the ICU survived. The mean hospital stay was increased by 26 days (31 days, 95% CI, 19-43).

## DISCUSSION

Arterial vascular surgery patients are known to be elderly and have multiple co-morbidities, many of which are known risk factors for MRSA infections. As such it would be expected that a large proportion of patients be colonized and especially prone to SSI by MRSA. This is particularly true for open surgical interventions, that in many cases carry the additional burden of needing prosthetic material. Even in strictly endovascular approaches, which by its less invasive nature might carry a lower risk of infection, risk from additional procedures such as the need for invasive monitoring or central catheters, should not be overlooked.

Given the number of patients admitted, having only 21 (1.25%) infections by MRSA is much lower than expected. This may mean that either the colonization is much lower than that predicted by risk factors, in which case, better clinical stratification of risk factors might be in order, or that despite a high colonization, as predicted by risk factors, there isn't a high infection rate, in which case, specific criteria for infection risk should be developed. In either case determining local colonization prevalence might help us develop a better strategy in determining which patients are at higher risk of complications and death.

Rutherford grades 5 and 6 represented a group of patients with higher pre-operative infection rates of MRSA, but that did not seem to increase the risk of SSI, possibly because of earlier institution of broad-spectrum antibiotics, and because of adjuvant amputations, that eliminate the infection reservoir.

Post-operative infection with MRSA, specifically when it extends to deep tissues and to prosthetic material seems to worsen prognosis, carrying an additional risk of mortality. This may reflect the need for surgical challenging options to replace the infected prosthetic material, and upon exhaustion of such procedures, the need for long-term, frequently intravenous, antibiotic schemes, with prolonged hospital stays, often culminating in a septic state difficult if not impossible to treat. Consequently, admission to ICU carries a dismal prognosis.

## CONCLUSION

Pre-operative MRSA infection was almost always related to chronic wounds and did not increase the risk of post-operative wound infection or death, contrary to post-operative infection which seems to significantly increase mortality, particularly when manifested by deep tissue and prosthetic infection.

The criteria for MRSA colonization are not effective in stratifying risk of infection in vascular surgery patients in our setting, and more specific surgical/wound/clinical status variables might be helpful in evaluating prognosis in this group of patients.

Knowledge of local colonization prevalence and identification of specific risk factors for serious infection may allow for a narrower screening protocol, and eventually, identification of a specific population in which decolonization should always be attempted prior to surgical intervention.

**Acknowledgements** None

**Conflicts of interest** None

**Funding** None

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