Staphylococcus aureus Bacteraemia Associated with Furosemide Infusion for the Treatment of Decompensated Heart Failure

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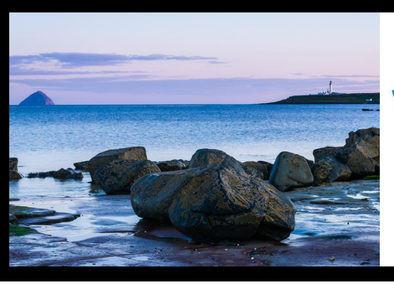


Introduction

The annual incidence of *Staphylococcus aureus* bacteraemia (SAB) in the United Kingdom is static. New approaches are needed to bring about reduction. We describe a novel association between SAB and treatment of decompensated heart failure with intravenous furosemide infusion.

Context

NHS Ayrshire and Arran (A&A) serves around 400,000 people in south west Scotland and has two acute hospitals. University Hospital Crosshouse (UHC) has a 30-bed cardiology ward and 12-bed Coronary Care Unit (CCU) and University Hospital Ayr (UHA) has a 24-bed cardiology ward and 6-bed CCU. The incidence of SAB in A&A is around 100 cases per year (0.27/100,000 acute occupied bed days). All cases of SAB are discussed at fortnightly meetings of the infection control team (ICT) and microbiology consultants. Since March 2017, there has been a microbiology-led weekly ward review of all SAB cases. NHS A&A uses an electronic prescribing system. PVC insertion and maintenance documentation is mandatory for all clinical areas in A&A.

Identifying a problem

Eleven episodes of hospital-acquired SAB were noted (10 MSSA, 1 MRSA), occurring over ten months across two cardiology wards on separate hospital sites between May 2017 and January 2018. No SABs were identified from either CCU. The previous baseline mean for these two wards had been 3.5 episodes/year (Table 1). There had been no increase in blood culture sampling. These 11 cases accounted for one quarter of our hospital-acquired SABs in 2017.

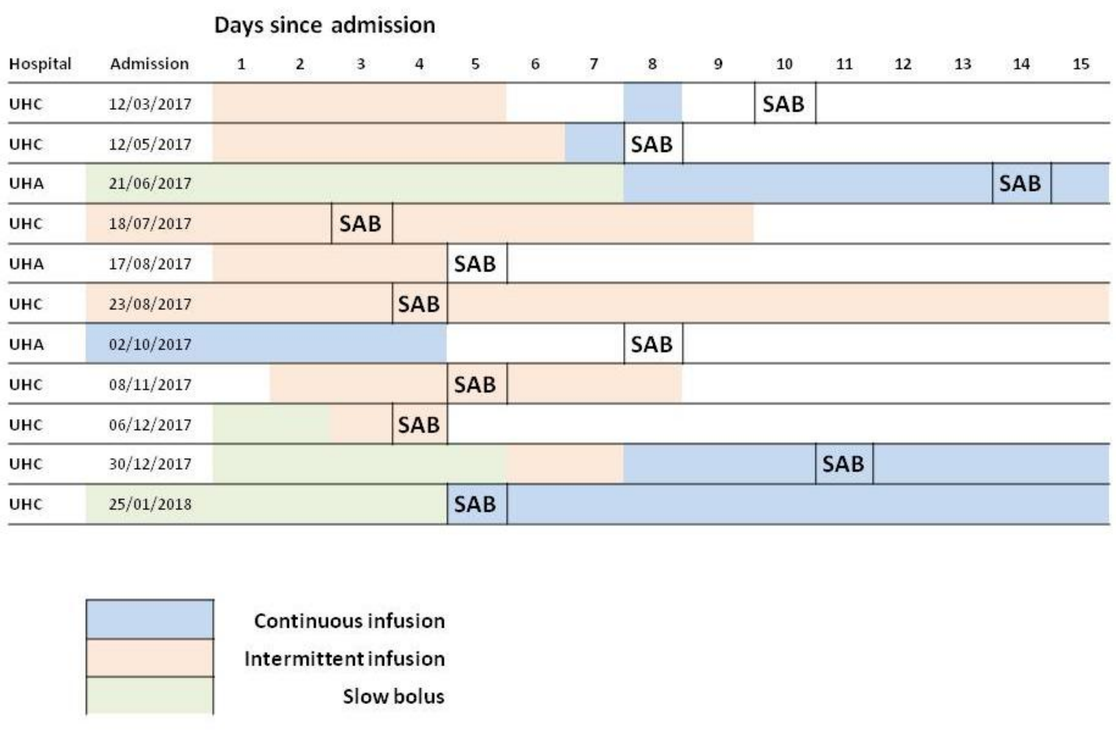
Table 1: *S. aureus* bacteraemia in cardiology wards over five years

		2013	2014	2015	2016	2017	2018*
UHC	**BC taken**	91	170	225	188	167	136
	SAB	2	3	4	3	6	3
UHA	**BC taken**	108	122	132	91	152	115
	SAB	1	0	1	0	4	0
Total	**BC taken**	199	292	357	279	319	249
	SAB	3	3	5	3	10	3

* Data up to 31st Oct 2018

All episodes occurred between three and fourteen days into admission for the management of decompensated heart failure (Figure 1). All patients had received furosemide infusions, with six having received continuous infusions. All infusions were given using Alaris Asena syringe drivers through BD Venlon Pro Safety peripheral venous cannulae (PVC). Evidence of PVC site infection was present in only seven of eleven episodes. There were nine different *spa* types identified from the eleven isolates, suggesting that a point source was not responsible.

Figure 1 : Timeline of hospital admission, furosemide infusion and SAB



Generating a hypothesis

No SAB had occurred among patients receiving continuous furosemide infusion before 2017 or in any of the CCUs (Table 2), suggesting a change in practice specific to the cardiology wards. Data obtained from the electronic prescribing system showed a progressive increase in the use of continuous furosemide infusion (Table 2). The rise in furosemide infusion use was due to an intentionally more aggressive approach in treating decompensated heart failure, but was likely also a consequence of an earlier organisational change limiting the dose of furosemide that could be administered by bolus. We hypothesized that the rise in SAB cases was due to deficiencies in PVC maintenance and infusion management precipitated by the increasing burden of infusions on the cardiology wards. This was supported by anecdotal evidence of staff, in an effort to help their patients mobilise or dress, disconnecting infusions without proper hand or hub decontamination.

Table 2: SAB per episode of continuous furosemide infusion

		2015	2016	2017	2018*
UHC	**CCU**	0/16	0/22	0/24	0/16
	Ward	0/14	0/30	2/40 (5%)	2/39 (5%)
UHA	**CCU**	0/4	0/6	0/2	0/9
	Ward	0/9	0/19	2/23 (9%)	0/25

* Data up to 31st Oct 2018

What we did

In November 2017, at which time eight cases had occurred, a meeting was held between the ICT, microbiology, cardiology and nursing staff to discuss possible causes and the importance of standard infection control precautions was emphasised. No concerns over staffing levels were raised. In light of a further three cases occurring after this meeting, PVC insertion and maintenance documentation was audited in UHC and UHA showing compliance rates between 78% and 87%. A quarter of staff did not know the correct skin preparation for PVC insertion and 1 in ten did not know the correct means of decontaminating a needle free device prior to use. Education of the ward nursing staff was undertaken by the ICT.

What happened next

Only one further case of SAB has occurred in either cardiology ward in the nine months following the intervention. It was unrelated to heart failure management or furosemide infusion. Of the 11 cases, four had prosthetic material (pacemaker [2], mitral valve replacement, shoulder hemi-arthroplasty). All survived to hospital discharge and the 30 day mortality rate was zero. One developed deep-seated infection (shoulder septic arthritis). There have been no recurrences.

Discussion

We identified and addressed a cluster of eleven SAB cases associated with intravenous furosemide infusion. Two organisational systems made this possible:

- regular multidisciplinary review of all SAB allowed for early pattern recognition
- electronic prescribing allowed for easy retrospective medication review

We believe the cause to have been the coalescence of several factors:

- greater use of furosemide infusion due to change in departmental therapeutic strategy and prior organisational change in the dosing of furosemide
- rising use of infusions placing greater burden on clinical staff
- an ‘at risk’ group of patients, all with significant peripheral oedema and many with additional risks for deep-seated infection

This is the first description of the association of SAB and treatment of heart failure. Four of eleven cases (36%) did not have evidence of PVC site infection, a finding that has previously been described in PVC-associated bloodstream infection[1]. This suggests that infection spread directly down the internal PVC lumen (presumably from hub contamination) was responsible for at least some of the cases. This has implications for how PVC-related SAB should be defined.

Feedback, multi-disciplinary discussion and ward-based staff education were key interventions in preventing further episodes.

Local, contextual, hypothesis-driven prevention strategies can be effective at reducing hospital-acquired SAB.

Reference

1) Guembe M, *et al* Journal of Hospital Infection 97:260-6 (2017)