

Increase in Community Acquired *S. aureus* Bloodstream Infection Associated with the Sars-Cov-2 Public Health Emergency

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Abstract

Aim

In March 2020, a public health emergency related to COVID-19 was declared in Ireland, resulting in certain healthcare restrictions. We hypothesised, in the microbiology laboratory in Galway University Hospital (GUH), that the national lockdown would impact results from our blood culture service.

Methods

A surveillance review of all blood cultures received in the microbiology laboratory in GUH for the six-month period March-August 2020 was performed and compared to the same time-period for the preceding four years. Patient demographics and blood culture isolates were collected and reviewed.

Results

From March to August 2020, 5,753 blood culture sets were tested, of which 6.1% (n=351) were positive; a lower positivity rate than in previous years. In 2020, 46 *S. aureus* isolates were detected in blood cultures (representing 13.1% of all 351 positive blood cultures), which was significantly higher than 2016-2019.

Conclusion

The higher number of reported *S. aureus* bloodstream infections in the SARS-CoV-2-era was unexpected.

Introduction

In March 2020, a public health emergency related to SARS-CoV-2 was declared in Ireland. This was associated, in the initial period, with significant limitations to accessing certain healthcare services including access to non-emergency hospital care. Other respiratory virus infections, such as influenza, are associated with secondary bacterial infections that carry a high rate of morbidity and mortality¹.

Therefore, it was of interest to assess changes in laboratory-confirmed bacterial bloodstream infections associated with the pandemic.

In this context, we performed a review of the blood culture service delivered by the microbiology laboratory in Galway University Hospital (GUH) for the six-month period March-August 2020 (corresponding to the first six months of the public health emergency), and compared this to the same time-period for the preceding four years. We hypothesised that significant positive cultures (for example *Staphylococcus aureus*, gram-negative organisms) would represent a higher proportion of all cultures because of reduced presentations with less severe febrile illnesses, and delayed presentations with serious infections related to patient reluctance to attend.

A retrospective study conducted in a network of New York City Hospitals reported an increase in blood culture utilisation of 34.8% between January and March 2020, and also reported a lower rate of bacteraemia in SARS-CoV-2 positive patients(3.8%) when compared to patients without a diagnosis of SARS-CoV-2 infection(8%)². Additionally, an observational case series across two New York City Hospitals reported 42 cases of *S. aureus* bacteraemia in patients admitted with SARS-CoV-2 infection from March to May 2020³. This publication reported a 14-day mortality rate of 54.8% and a 30-day mortality rate of 66.7% in patients with *S. aureus* bloodstream infection with SARS-CoV-2.

Methods

Data was collected on the blood culture numbers and isolates (significant vs non-significant) and patient demographics.

For this survey, a blood culture set was considered as an individual blood sample. This is typically two bottles from an adult (aerobic and anaerobic) and one from a child. The blood culture system in use is the Bactec FX Blood Culture System. To avoid bias from duplicate isolates, only one culture per patient, pathogen and clinical episode was recorded. To test the significance of differences between groups, we performed a chi-square test.

Results

From March to August, 5,753 blood culture sets were tested, of which 6.1% (n=351) were positive. This was low compared to 2016 to 2019 respectively; 7.8% (n=520/6696), 7.2% (n=468/6495), 7.2% (n=482/6708), 6.7% (n=432/6488). The difference was statistically significant (chi square, $p < 0.05$) for all years except 2019, and significant when compared to the mean of the previous years($p = 0.02$). The results are demonstrated in table 1.

From March to August 2020, 46 *S. aureus* isolates were detected in blood cultures (representing 13.1% of all 351 positive blood cultures). This was significantly higher compared to 6.9% (n=36/520), 5.8% (n=27/468), 7.9% (n=38/482), 6.9% (n=30/432) from 2016 to 2019 respectively (chi square, $p < 0.05$). This increase was accounted for by an increased number of community-acquired *S. aureus* bloodstream infections (BSI) (n=22 compared with 11, 10, 12, 5; 2016-2019). The number of hospital-acquired *S. aureus* BSI (n=24) remained unchanged.

A significant male preponderance for *S. aureus* BSI was observed in all years (77.8%, 59.3%, 81.6%, 70% and 65.2%; 2016-2020). There was no statistically significant increase in the percentage of hospital-acquired/healthcare-associated *S. aureus* bacteraemia secondary to line infections (peripheral/central venous cannulae) between years.

Gram-negative organisms were isolated in 40.2% of positive blood cultures (n=141), and coagulase-negative staphylococci in 26.2% of positive blood cultures (n=92). This was similar to previous years (when compared to the mean of the previous years; p not significant, p=0.3 and p=0.16 respectively).

	2016	2017	2018	2019	2020
Total number of blood cultures (BC) sent to lab	6696	6495	6708	6488	5753
Total number of positive blood cultures	520	468	482	432	351
%positive BCs of all BCs sent	7.8%	7.2%	7.2%	6.7%	6.1%
p-value compared to 2020	<u>0.0003</u>	<u>0.0159</u>	<u>0.0143</u>	0.2063	
Total <i>Staphylococcus aureus</i>	36	27	38	30	46
% <i>S. aureus</i> of all positive BCs	6.9%	5.8%	7.9%	6.9%	13.1%
p-value compared to 2020 (Chi-square)	<u>0.0022</u>	<u>0.0002</u>	<u>0.0176</u>	<u>0.000037</u>	
Gram-negative bacteria	165	175	176	163	141
%gram-negative of all positive BCs	31.73%	37.39%	36.51%	37.73%	40.17%
Yeasts	8	9	8	6	6
Coagulase-negative staph	181	163	147	132	92
%coagulase-negative staph of all positive BCs	34.81%	34.83%	30.50%	30.56%	26.21%
Streptococci species	83	67	86	69	52
Other organisms (e.g. other gram-positive organisms)	47	27	27	32	14
Total <i>Staphylococcus aureus</i> in blood cultures	36	27	38	30	46
MSSA (Methicillin-susceptible <i>S. aureus</i>)	29	18	35	24	38
MRSA (Methicillin-resistant <i>S. aureus</i>)	7	9	3	6	8
%of <i>S. aureus</i> in BCs from male patients	77.8%	59.3%	81.6%	70%	65.2%
Average age of <i>S. aureus</i> in BCs	59.94	64.07	58.63	68.93	63.47
Number of <i>S. aureus</i> BCs <18 years of age (males)	2 (2)	1 (0)	3 (2)	0 (0)	3 (3)
Contaminant or unknown	2	2	6	1	2
Community acquired <i>S. aureus</i>	10	10	12	5	22
Hospital-acquired(HAI)/Healthcare-associated infection(HCAI) <i>S. aureus</i>	24	15	20	24	22
%of HAI/HCAI SA secondary to line (PIVC + CVC)	(n=9) 37.5%	(n=6) 40%	(n=8) 40%	(n=12) 50%	(n=15) 68.18%
p-value compared to 2020 (Chi-square)	<u>0.0396</u>	0.0938	0.0702	0.2160	

Table 1: Total results of blood cultures tested in the laboratory, and details on *Staphylococcus aureus* bloodstream infections

Discussion

The higher reported number of *S. aureus* bloodstream infections in the SARS-CoV-2 era was unexpected. The reason for this is unclear, but it may be because of delayed presentations of *S. aureus* infections to healthcare facilities resulting in progression of infections leading to bacteraemia.

The 30-day all-cause mortality of *S. aureus* bacteraemia⁴ has been reported at 20.6%, so the increase of *S. aureus* bacteraemia may represent a clinically important finding. A male preponderance for *S. aureus* infections has previously been described. A number of hypotheses have been advanced to account for this, including that oestrogen-production in females is protective, and that males are less compliant with healthcare advice^{5, 6}. Despite *S. aureus* BSI being more common in males, the 30-day mortality is reportedly higher in females⁷. We suggest it would be of interest to look at the experience in other Irish and international centres to determine if this is a local phenomenon, and to seek a better understanding of the reasons if this is a generalised finding.

With the results of the New York City centres retrospective studies^{2, 3} in mind, we found that thirty-three (72%) patients with *S. aureus* bacteraemia had been tested for SARS-CoV-2 via nasopharyngeal swab PCR (polymerase chain reaction). All were reported as *SARS-CoV-2 not detected*. This does not suggest that *S. aureus* bacteraemia secondary to COVID-19 accounts for the observed change.

Declaration of Conflicts of Interest:

The authors declare that they have no conflicts of interest.

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