Clinical Microbiology and Infection 24 (2018) 548.e1–548.e3

Contents lists available at ScienceDirect

Clinical Microbiology and Infection

journal homepage: www.clinicalmicrobiologyandinfection.com

Research note

Low incidence of subsequent bacteraemia or fungaemia after removal of a colonized intravascular catheter tip

N. Buetti [1,*], E. Lo Priore [1], A. Atkinson [1], A. Kronenberg [2], J. Marschall [1] on behalf of the Swiss Centre for Antibiotic Resistance (ANRESIS)

[1] Department of Infectious Diseases, University Hospital Bern, Bern, Switzerland
[2] Institute for Infectious Diseases, University of Bern, Bern, Switzerland

ARTICLE INFO

Article history:
Received 6 July 2017
Received in revised form
15 September 2017
Accepted 16 September 2017
Available online 28 September 2017

Editor: M. Paul

Keywords:
Catheter tip
Subsequent bloodstream infection
Central venous catheter
Subsequent bacteraemia
Delayed bacteraemia

ABSTRACT

Objectives: We determined the frequency of subsequent bloodstream infection more than 2 days after removal of a catheter with positive tip cultures.
Methods: We conducted a nationwide, observational study on intravascular catheter (IVC) tip cultures in Switzerland from 2008 to 2015 using data from the Swiss Antibiotic Resistance Surveillance System (ANRESIS). An IVC tip culture was included in the analysis if at least one microorganism could be cultivated from it. We excluded all data from patients with concurrent bacteraemia with the same microorganism identified 7 days before to 2 days after IVC removal. Subsequent bloodstream infection was defined as isolating (from blood cultures performed more than 2 days up to 7 days after catheter removal) the same microorganism as the one recovered from the IVC. Data on antibiotic therapy were not available in this surveillance study.
Results: Over the 8-year period, 15 033 positive IVC tip cultures were identified. Our study population comprised 12 513 episodes of positive IVC tip cultures without concurrent bacteraemia. The frequency of sBSI was 1.8% ($n = 219$). Subsequent bloodstream infections were more frequently detected after identification of *C. albicans* (10/113, 8.8%), *S. marcescens* (9/169, 5.3%), and *S. aureus* (30/623, 4.8%) on a catheter tip.
Conclusions: A very low incidence of subsequent bloodstream infection was observed if a microorganism was identified on a removed IVC tip without concurrent bacteraemia. The risk of subsequent bloodstream infection increased if *C. albicans*, *S. aureus*, or *S. marcescens* were identified in this context. **N. Buetti, Clin Microbiol Infect 2018;24:548.e1–548.e3**

Introduction

There is little information regarding the significance of positive intravascular catheter (IVC) tip cultures without concurrent bacteraemia [1–4]. Some studies have shown that the incidence of bacteraemia was low after removal of IVCs in patients where that tip culture became positive [2,5]. Other authors have postulated that positive tip cultures, in particular those with *S. aureus* [1,6,7], *Candida* spp [4], and Gram-negative bacteria [8] with negative concurrent blood cultures, could reflect a recent bloodstream infection, and therefore require a short course of antimicrobial therapy, or point to the potential risk of developing delayed bacteraemia (or fungaemia).

The studies investigating this topic, however, reported data from individual hospitals only [1,2,4–9]. Use of national surveillance data could help to better understand the epidemiology of device-associated infections. Here, we used the Swiss Antibiotic Resistance Surveillance System (ANRESIS) to describe the current epidemiology of patients with culture-positive IVC tips without concurrent bacteraemia and aimed to characterize bacteraemia or fungaemia occurring after catheter removal.

* Corresponding author. N. Buetti, University Hospital of Bern, Freiburgstrasse, 3010 Bern, Switzerland.
E-mail address: niccolo.buetti@gmail.com (N. Buetti).

https://doi.org/10.1016/j.cmi.2017.09.009
1198-743X/

Methods

We conducted a nationwide, observational study on IVC tip cultures in Switzerland from 2008 to 2015. We analysed data from 36 hospitals distributed across Switzerland that sent information to ANRESIS for at least five positive catheter tip cultures per year.

An IVC tip culture was included in the analysis if at least one microorganism could be cultivated from it. If at least one pathogen was isolated from the same tip, each individual pathogen was considered to be a separate episode of catheter colonization. Eighty-three per cent of participating laboratories (15/18) used the semiquantitive roll-plate culture method.

New episodes of catheter colonization from other removed catheters in the same patient within a 7-day period were excluded. Episodes of catheter colonization with concurrent bacteraemia or fungaemia with the same microorganism identified 7 days before to 2 days after IVC removal were also excluded. Subsequent bloodstream infection (sBSI) was defined as isolating (from blood cultures performed more than 2 days up to 7 days after IVC removal) the same microorganism (and antibiogram) as that recovered from the IVC tip. To ease readability we use the term 'sBSI' instead of 'subsequent bacteraemia and fungaemia' throughout the text.

As the analysis was performed on anonymized non-genetic surveillance data, ethical consent was not required according to the Swiss law for research on humans.

Results

Over the 8-year period, 15 033 episodes of catheter colonization were identified. Of these, 2520 episodes (16.7%) presented with concurrent bacteraemia or fungaemia and were excluded from the following analysis (Fig. S1, Supporting information). Our study population thus comprised 12 513 episodes of catheter colonization without concurrent bacteraemia.

In 219 (1.8%) of the 12 513 episodes an sBSI was observed (Table 1). Subsequent bacteraemia (without fungaemia) developed in 207 of the 12 341 (1.7%) catheter tips demonstrating bacterial growth. Among Gram-positive bacteria, *Staphylococcus aureus* was the most frequently identified agent causing sBSI (i.e., 30/623, 4.8%), followed by enterococci (12/733, 1.6%) and coagulase-negative staphylococci (116/8518, 1.4%). Among Gram-negative bacteria, Enterobacteriaceae and Gram-negative nonfermenters were the cause for sBSI in 2.6% (40/1552) and 1.9% (8/431) of the cases, respectively. *Serratia marcescens* was the most frequently identified Gram-negative to present with sBSI (9/169, 5.3%). Subsequent fungaemia (100% of them candidaemias) developed in 12 (7.0%) of the 172 catheter tips positive for fungi; *Candida albicans* (10/113, 8.8%) was the most frequent yeast causing sBSI.

Among episodes of catheter colonization with sBSI, 42.4% of cases were from intensive care (vs. 23.9% in those without sBSI, $p < 0.001$, Table S1, Supporting information).

Discussion

Only limited epidemiological data are available regarding the significance of positive catheter tip cultures without concurrent bacteraemia or fungaemia. All the studies published in recent years restricted their reporting to selected hospitals [1,2,4–9]. To our knowledge, ours is the largest study to describe the epidemiology of sBSI, incorporating data from a total of 36 hospitals.

In Switzerland, most hospitals follow U.S. guidelines in only recommending tip cultures if a catheter is removed because of suspected catheter-related bloodstream infection, and thus advising against routine tip processing [3]. On the other hand, the clinical possibility of catheter-related bloodstream infection (e.g., in the setting of fever in an inpatient with an IVC) may prompt the treating physician to cultivate a catheter tip anyway.

The major finding of this analysis is that sBSI is rare in patients with colonized catheter tips. A comparison with other studies is difficult because of the lack of a generally accepted definition of sBSI. Some authors excluded only those bloodstream infections as concomitant that had occurred within ±48 hours of the removal of the IVC [9], and therefore included patients with bloodstream infection immediately prior to that time window. Furthermore, certain authors did not exclude bacteraemic episodes in the 48 hours after catheter removal [4–8]. Munoz et al. took yet another approach and studied *S. aureus* bacteraemia that occurred >7 days after catheter removal [5], showing a low risk of bacteraemia after this 7-day window. In our study, we considered a bacteraemia or fungaemia episode as being 'subsequent' if a positive blood culture was found more than 2 days after catheter removal. This time frame was chosen to eliminate cases where a bacteraemia was pre-existing, while assuming that early episodes of positive blood cultures post-catheter removal could still be catheter-related [10]. According to this definition, only 1.7% of patients with a positive catheter tip developed subsequent bacteraemia, which is comparable with another study which relied on a similar definition [2]. Unfortunately, clinical data and, more specifically, data about antibiotic therapy were not included in this surveillance study, which should be taken into account when interpreting our results. Consequently, we cannot make a statement on a possible impact of antibiotic treatment. Interestingly, other studies failed to demonstrate an association between

Table 1
Microorganism distribution of positive catheter tip culture and subsequent bloodstream infection (sBSI)

	Total[a] *N* (%)	sBSI *N* (%)	sBSI/pathogen isolated from catheter tip (95% CI)
Enterobacteriaceae	1552 (12.4)	40 (18.3)	2.6% (1.8–3.4)
S. marcescens	169 (1.4)	9 (4.1)	5.3% (1.9–8.7)
Gram-negative non-fermenters	431 (3.4)	8 (3.7)	1.9% (0.6–3.1)
P. aeruginosa	297 (2.4)	7 (3.2)	2.4% (0.7–4.1)
S. aureus	623 (5.0)	30 (13.7)	4.8% (3.1–6.5)
CoNS	8518 (68.1)	116 (53.0)	1.4% (1.1–1.6)
Streptococcus spp	51 (0.4)	0 (0)	0%
Enterococcus spp	733 (5.9)	12 (5.5)	1.6% (0.7–2.5)
Anaerobes	12 (0.1)	0 (0)	0%
Fungi	172 (1.4)	12 (5.5)	7.0% (3.2–10.8)
Candida albicans	113 (0.9)	10 (4.6)	8.8% (3.5–14.0)
Other	421 (3.4)	1 (0.5)	0.2% (-0.2–0.6)
Total	12513 (100.0)	219 (100.0)	1.8% (1.6–2.0)

CoNS, coagulase-negative staphylococci spp species; sBSI, subsequent bacteraemia or fungaemia; CI, confidence interval.
[a] Without episodes of bacteraemia 7 days before and 2 days after catheter removal.

appropriate antimicrobial therapy around the time of catheter removal and reduced frequency of sBSI [2,8,9].

In this study, we observed an increased likelihood of sBSI among patients with catheter tips colonized with *C. albicans* and *S. aureus*, with an sBSI frequency of 8.8% and 4.8%, respectively. This observation is consistent with the findings of a single-centre study in a large tertiary care centre in South Korea [2]. Interestingly, *S. marcescens* was the second most frequent agent causing sBSI. In the last few years, only a single case of *Serratia* spp sBSI has been reported [8]. Our data suggest the need for additional studies to shed light on the epidemiology and clinical outcomes of sBSI with *S. marcescens*.

Our study has several limitations. First, the study is based on the assumption that each hospital sent information on all of the IVC tips (and not other catheter types, e.g., neurosurgical shunts) to the central database. Second, we had no access to clinical data and therefore information on the indication of catheter removal (e.g., catheter type) as well as clinical outcome was unavailable. This could have led to an underestimation of the burden of sBSI in certain patient populations (e.g., patients with septic metastasis, blood cultures drawn while on antibiotic therapy, and regarding patients with few symptoms). Third, no reliable information regarding the total number of drawn blood cultures is available in the ANRESIS database; this is because not all hospitals send negative blood culture results to their microbiology laboratories. It is conceivable that more blood cultures were taken if 'difficult pathogens' such as *C. albicans* and *S. aureus* appeared on a catheter tip, thus leading to an under/overestimation of the burden of disease for these selected microorganisms.

This large surveillance study shows a very low incidence of sBSI if a microorganism was identified on a removed IVC tip. However, the risk of sBSI increased if *C. albicans*, *S. aureus*, or *S. marcescens* were identified in this context.

Transparency declaration

The ANRESIS database is funded by the Federal office of Public Health, the Conference of cantonal health ministers, and the University of Bern, Switzerland. The authors declare that they have no conflict of interest.

Acknowledgements

We thank Antoine Buetti and Paolo Mombelli for their editorial support. We thank all microbiology laboratories participating in the ANRESIS network: Institute for Laboratory Medicine, Cantonal Hospital Aarau; Central Laboratory, Microbiology Section, Cantonal Hospital Baden; Clinical Microbiology, University Hospital Basel; Viollier AG, Basel; Laboratory Medicine EOLAB, Department of Microbiology, Bellinzona; Institute for Infectious Diseases, University Bern; Microbiology Laboratory, Unilabs, Coppet; Central Laboratory, Cantonal Hospital Graubünden; Microbiology Laboratory, Hospital Thurgau; Microbiology Laboratory Hôpital Fribourgeois, Fribourg; Bacteriology Laboratory, Geneva University Hospitals, Geneva; ADMED Microbiology, La Chaux-de-Fonds; Institute for Microbiology, Université de Lausanne; Centre for Laboratory Medicine, Cantonal Hospital Luzern; Centre for Laboratory Medicine, Cantonal Hospital Schaffhausen; Centre for Laboratory Medicine Dr. Risch, Schaan; Central Institute, Hôpitaux Valaisans (ICHV), Sitten; Centre of Laboratory Medicine St. Gallen; Institute for Medical Microbiology, University Hospital Zürich; Laboratory for Infectious Diseases, University Children's Hospital Zürich. In addition, we appreciate the steering committee of ANRESIS for supporting this analysis.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.cmi.2017.09.009.

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