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One-year molecular surveillance of carbapenem-susceptible *A. baumannii* on a German intensive care unit: from diversity to clonality

Andreas F. Wendel[1], Monika Malecki[1], Robin Otchwemah[1], Carlos Tellez-Castillo[3], Samir G. Sakka[2], Frauke Mattner[1]

[1]Institute of Hygiene, [2]Department of Anesthesiology and Operative Intensive Care Medicine, University of Witten/Herdecke, Cologne Merheim Medical Center, Cologne, Germany. [3]Department of Clinical Microbiology, MVZ synlab Leverkusen GmbH, Köln-Merheim, Germany

Kliniken Köln
Beste Medizin für alle.
Institut für Hygiene

universität Witten/Herdecke

wendela@kliniken-koeln.de

Introduction

A. baumannii is a common nosocomial pathogen known for its high transmission potential within the hospital. Observation of a high rate of carbapenem-susceptible *Acinetobacter calcoaceticus-Acinetobacter baumannii* (ACB)-complex in clinical specimens on a 32-bed surgical intensive care unit (SICU) of a German tertiary care centre led to the installation of a pathogen-based surveillance.

Materials | Methods

Setting: The study was conducted at a 724-bed tertiary care hospital. The SICU has 32 beds (14 single, 9 double rooms). Only four single rooms are equipped with washbasins.

Study period: From 04/2017 to 03/2018 we analyzed all ACB-complex isolates.

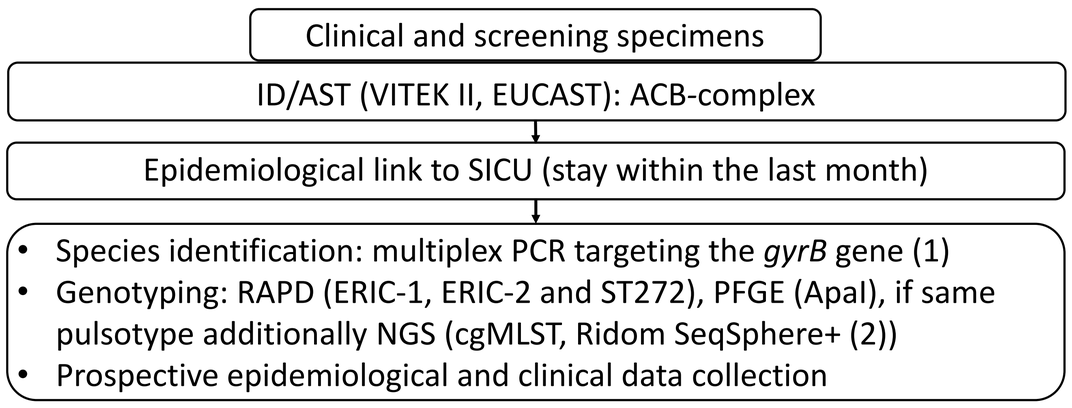

Figure 1. Diagnostic algorithm for *Acinetobacter calcoaceticus-Acinetobacter baumannii* (ACB)-complex

Infection control measures:

- Rectal and nose/throat screening on MDR-ACB-complex at admission and weekly; from Sep. 2017 also on carbapenem-susceptible ACB-complex
- Standard precautions; contact precautions (barrier nursing or single room) only if ciprofloxacin-non-susceptible and/or carbapenem-non-susceptible
- Hand hygiene training and compliance observations
- Additional cleaning and disinfection: 2x Glucoprotamin 0.5%, UV-light (Verilux CleanWave Sanitizing Wand) for complex surfaces, Aug./Sep. 2017
- Environmental sampling (total of 206 specimens)

Results

44 patients were found to be colonized/infected with one or two (different) carbapenem-susceptible ACB-complex isolates of which 43 out of 48 were classified as hospital-acquired (detection on or after 3rd day of admission). All ACB-complex isolates, except four, were available for further identification and genotyping. Nearly all were identified as *A. baumannii*, only four as *A. pittii*. Twelve patients developed infections with *A. baumannii* (**Table 1**).

Table 1. Epidemiologic characteristics of 36 patients with nosocomially-acquired *A. baumannii* (*A. pittii* or non-available ACB-complex excluded)

Characteristics		Value
Age (years)	median (range)	62 (21; 80)
Gender	female	13 (36%)
Hospital stay at first isolation (days)	median (range)	19 (5; 62)
Source of first positive specimen[1]	respiratory tract	14 (38.8%)
	screening (nose/throat)	12 (33.3%)
	screening (rectum)	7 (19.4%)
	wound	4 (11,1%)
	urine	2 (5.6%)
	blood culture	1 (2.8%)
Infection[#]	pneumonia	7 (19.4%)
	wound	2 (5.6%)
	urinary tract	1 (2.8%)
	CLABSI	2 (5.6%)
Prior antibiotic treatment*		30 (83.3%)
Prior surgery*		20 (55.5%)
Mechanical ventilation*		24 (66.7%)
Prior non-surgical intervention*		14 (38.8%)
Dialysis*		5 (13.8%)

[1]exceeds 100% as first identification was done in two different specimens in four patients; *within a maximal interval of seven days before first isolation; #hospital-acquired infections were classified according to the CDC definitions; CLABSI, central line associated blood stream infections

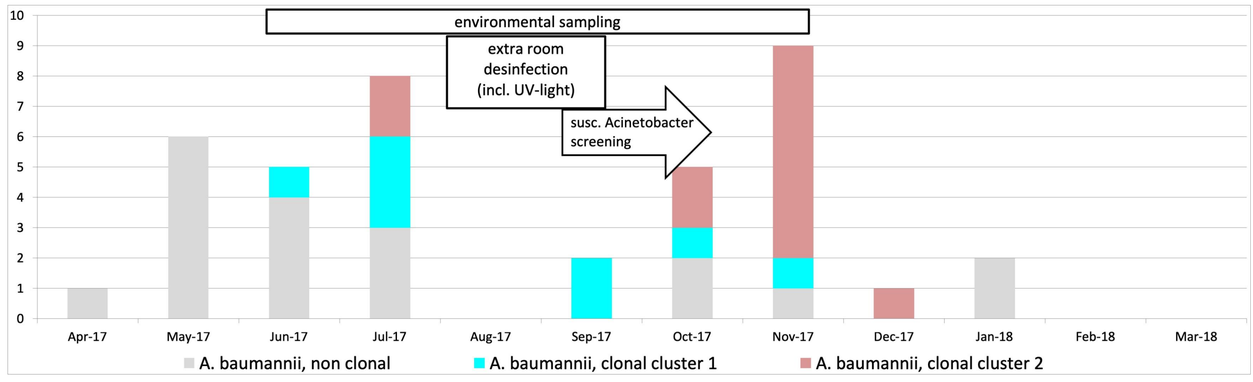

Figure 2. Overview of new cases with a hospital-acquired carbapenem-suscepible *A. baumannii* with an epidemiological link to the SICU (39 isolates from 36 patients). Boxes and arrow indicate infections control measures.

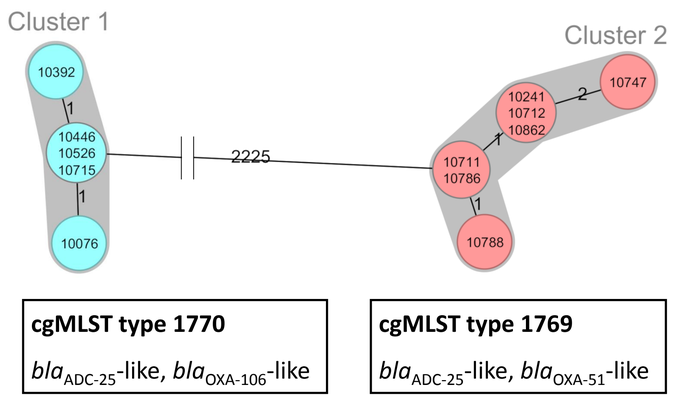

Figure 3. Minimum-spanning tree of the representative 12 *A. baumannii* isolates showing the genetic relationship based on the cgMLST scheme (Ridom SeqSphere+, 2359 targets). Each circle displays a single genotype and numbers on the connecting lines in between the allele difference. Clonally related genetic clusters (< 10 alleles difference) containing more than one patient are encircled in grey. Resistance genes from ResFinder (version 2.1).

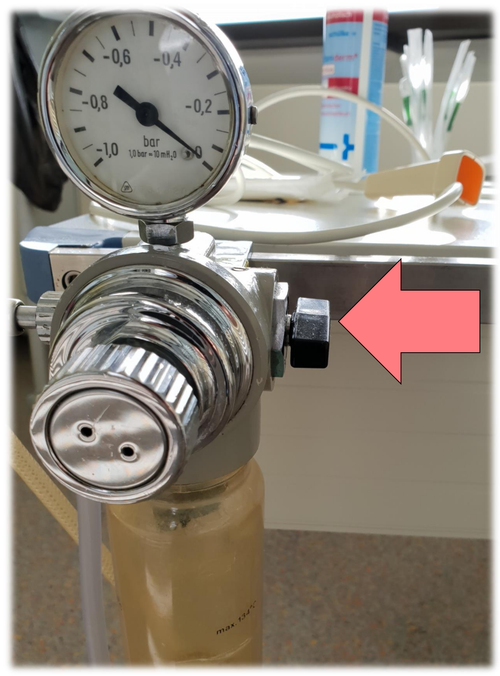

Figure 4. Buttons of the endotracheal suction system

Genotyping revealed two prominent polsotypes confirmed to be cgMLST clonal clusters: type 1770 (n = 8 patients) and type 1769 (n = 12 patients, three environmental isolates) (**Figure 2 and 3**). All other isolates were distinct to each other. Based on conventional epidemiology nearly all transmission events of the two clonal clusters were confirmed and traced back to the SICU. Nevertheless, we were also able to confirm spread to and within other wards. Transmission of the clonal cluster strains stopped after a period of several months.

Environmental sampling revealed a relevant dissemination of *A. baumannii* (mobile x-ray system cassette, washbasin, fixation tape and buttons of the endotracheal suction system). The isolates from the buttons corresponded to clinical strains (cluster type 2, **Figure 3 and 4**). Introduction of the enhanced screening revealed a significant earlier detection of susceptible *A. baumannii* during hospitalization (median: 19 days before vs. 12 days after; $p = 0.04$).

Only two carbapenem-resistant *A. baumannii* isolates were detected during the study period (genetically not linked to each other or the other carbapenem-susceptible isolates).

Conclusion

A pathogen-based surveillance of ACB-complex based on identification on the species level, classic epidemiology and genotyping revealed simultaneously occurring independent transmission events and clusters in mostly nosocomially-acquired *A. baumannii*. This underlines the importance of such methodology for surveillance purposes in an apparent highly endemic setting for a targeted approach within the hospital.

References:

1. Higgins PG, Lehmann M, Wisplinghoff H, Seifert H: gyrB multiplex PCR to differentiate between *Acinetobacter calcoaceticus* and *Acinetobacter* genomic species 3. *J Clin Microbiol* 2010, 48:4592-4.
2. Higgins PG, Prior K, Harmsen D, Seifert H: Development and evaluation of a core genome multilocus typing scheme for whole-genome sequence-based typing of *Acinetobacter baumannii*. *PLoS One* 2017, 12:e0179228.

Sequence reads: ENA accession number PRJEB27660.

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