Transmission of Extended-Spectrum β-Lactamase *Klebsiella oxytoca* via the Breathing Circuit of a Transport Ventilator: Root Cause Analysis and Infection Control Recommendations

To the Editor—We would like to report our root cause analysis and infection control recommendations after a case of extended-spectrum β-lactamase (ESBL) *Klebsiella oxytoca* colonization transmitted via the breathing circuit of a transport ventilator. The index patient was treated in our intensive care unit (ICU) for multiorgan failure. The screening performed at admission to the ICU (which included analysis of nasal, pharyngeal, and rectal swab samples and of a tracheal aspirate) revealed gram-negative rods and fungi in the tracheal aspirate. The gram-negative rods were identified as *K. oxytoca* with ESBL characteristics on day 3 of ICU hospitalization, and contact precautions were implemented.

The second patient had been treated for subarachnoid hemorrhage for 8 days when the index patient was admitted to the ICU. On day 14 of the second patient's ICU stay, gram-negative rods were cultured from a surveillance nasal swab specimen for the first time and were subsequently identified as *K. oxytoca*. The antibiotic resistance profile of this strain was identical to that of the strain isolated from the index patient.

This triggered a red flag alert for a possible transmission and a root cause analysis. The epidemiological time course was analyzed (Table 1). Both patients had undergone bronchoscopy but on 2 different days and with different bronchoscopes and different operators. The analysis of the reprocessing of the bronchoscopes and testing of the disinfection machine did not reveal any problems. Observation of nursing practice revealed good hand hygiene compliance. When it became obvious that both patients had been transported to the computed tomography scanner on the same day (before contact precautions were initiated) with the same transport ventilator, the focus of the investigation shifted to the transport ventilator.

Swab samples were obtained from different parts of the transport ventilator (Oxylog 3000), and samples obtained at the distal end of the breathing circuit close to the patient grew *K. oxytoca*. Genetic testing (with random amplified polymorphic DNA analysis) confirmed that the strain isolated from the transport ventilator was identical to the strains isolated from both patients.

Surface contamination of anesthesia machines,[1,2] mobile telephones,[3] keyboards,[4] stethoscopes,[5] and manual ventilation bags[6] has been described. Medical equipment is classified according to the degree of contact with patients into uncritical, semicritical, and critical, and each classification requires a different level of disinfection or sterilization.[7] During long-term ventilation, breathing circuits of our ICU ventilators are replaced every 7 days according to national guidelines,[8] whereas the Society for Healthcare Epidemiology of America/Infectious Diseases Society of America Practice Recommendations published in 2008 made no recommendation for a routine changing interval, especially when heat- and moisture-exchange filters are in use.[9]

This raises the question of how to proceed with transport ventilators, whose usage patterns are more comparable to those of anesthesia machines and involve frequent patient changes and frequent hand contact by personnel. The recent joint recommendation of the German Society of Anesthesia and Critical Care and the German Society of Hospital Infection Control recommended a changing interval of up to 7 days for anesthesia machine breathing circuits if air-filtering systems are used.[10]

On the basis of our observations, we would recommend a surface disinfection of the breathing circuit of transport ventilators and anesthesia machines with suitable disinfection wipes after every use (independent of the known colonization or infection status) to prevent patient-to-patient transmission of bacteria and other pathogens if the breathing circuit is not changed.

ACKNOWLEDGMENTS

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article.

TABLE 1. Time Course of Screening and Surveillance Culture Results Positive for Extended-Spectrum β-Lactamase *Klebsiella oxytoca*

	ICU hospitalization, days																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Index patient	...	...	...	...	...	...	...	A	+	+	+	X	X	X	X	X	X
Patient 2	A	−	−	−	−	−	−	−	−	−	−	−	−	+	+	X	X
Event	...	...	...	...	...	...	...	...	B1	B2	CT	CP1	...	...	...	CP2	...

NOTE. A, admission; BI, bronchoscopy index patient; B2, bronchoscopy patient 2; CT, computed tomography examination for both patients using the same transport ventilator; CP1, contact precautions index patient; CP2, contact precautions patient 2; ICU, intensive care unit; X, culture results positive for extended-spectrum β-lactamase *Klebsiella oxytoca*; +, culture results positive for gram-negative rods; −, negative culture results.

https://doi.org/10.1086/661225 Published online by Cambridge University Press

S. Schulz-Stübner, MD;[1] E. Kniehl, MD[2]

Affiliations: 1. Deutsches Beratungszentrum für Hygiene am Universitätsklinikum Freiburg, Freiburg, Germany; 2. Zentralinstitut für Laboratoriumsmedizin, Mikrobiologie und Transfusionsmedizin (ZLMT), Abteilung für Mikrobiologie und Krankenhaushygiene Städtisches Klinikum Karlsruhe, Karlsruhe, Germany.

Address correspondence to Sebastian Schulz-Stübner, MD, Deutsches Beratungszentrum für Hygiene am Universitätsklinikum Freiburg, Schnewlinstr. 10, 79098 Freiburg im Breisgau, Germany (schulz-stuebner@bzh-freiburg.de).

Presented in part: Berliner Workshop Krankenhaushygiene; Berlin, Germany; January 2011.

Infect Control Hosp Epidemiol 2011;32(8):828-829

 0899-823X/2011/3208-0018$15.00. DOI: 10.1086/661225

REFERENCES

1. Hall JR. Blood contamination of anesthesia equipment and monitoring equipment. *Anesth Analg* 1994;78:1136–1139.
2. Loftus RW, Koff MD, Burchman CC, et al. Transmission of pathogenic bacterial organisms in the anesthesia work area. *Anesthesiology* 2008;109:399–407.
3. Jeske HC, Tiefenthaler W, Hohlrieder M, Hinterberger G, Benzer A. Bacterial contamination of anaesthetists' hands by personal mobile phone and fixed phone use in the operating theatre. *Anaesthesia* 2007;62:904–906.
4. Fukada T, Iwakiri H, Ozaki M. Anaesthetists' role in computer keyboard contamination in an operating room. *J Hosp Infect* 2008;70:148–153.
5. Whittington AM, Whitlow G, Hewson D, Thomas C, Brett SJ. Bacterial contamination of stethoscopes in the intensive care unit. *Anaesthesia* 2009;64:620–624.
6. Weber DJ, Wilson MB, Rutala WA, Thomann CA. Manual ventilation bags as a source of bacterial colonization of intubated patients. *Am Rev Respir Dis* 1990;142:892–894.
7. Schulz-Stübner S, Hauer T, Dettenkofer M. Aufbereitung von Medizinprodukten in der Anästhesie und in der Intensivmedizin: Sinnvolle Integration in ein Qualitätsmanagementsystem. *Anästhesiol Intensivmed* 2003;44:442–446.
8. Mitteilung der Kommission für Krankenhaushygiene und Infektionsprävention am Robert Koch-Institut. Prävention der nosokomialen Pneumonie. *Bundesgesundheitsbl* 2000;43:302–309.
9. Coffin SE, Klompas M, Classen D, et al. Strategies to prevent ventilator-associated pneumonia in acute care hospitals. *Infect Control Hosp Epidemiol* 2008;29(suppl):S31–S40.
10. Kramer A. Infektionsprävention bei der Narkosebeatmung durch Einsatz von Atemfiltern. *Anästh Intensivmed* 2010;51: S831–S838.