Contaminated Ambu-Bag Associated Hospital-Acquired Infection with *Pseudomonas aeruginosa* in an Intensive Care Unit+

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Hospital-acquired infections due to medical devices in the ICUs pose major threat to patient safety. Here we report an outbreak of *Pseudomonas aeruginosa*, detected in an ICU, in which the source of the infection was two ambu-bags. All of the patients in the ICU of neurology department with six bed capacity were diagnosed as infected or colonized by *P. aeruginosa* between January 22 and March 22, 2007. During this period *P. aeruginosa* was isolated from 21 specimens of six patients. Environmental samples were collected to clarify the source of this outbreak. *P. aeruginosa* was isolated from both of two ambu-bags used in this unit. These strains showed the same antibiotic susceptibility pattern with the strain isolated from the index patient. Ambu-bags were considered as the source of this outbreak, and incorrect care of the ambu-bags in use was the reason of this outbreak.

Key Words: Hospital-Acquired Infections; Ambu-Bag; Intensive Care Unit, *Pseudomonas aeruginosa*

Bir Yoğun Bakım Ünitesinde Ambu Kaynaklı *Pseudomonas aeruginosa* ile Hastane İnfeksiyonu

Yoğun bakım ünitelerinde tıbbi amaçlı aletlerin kullanılmasıyla ortaya çıkan hastane kaynaklı infeksiyonlar hasta güvenliği açısında önemli bir tehdit oluşturmaktadır. Bu çalışmada, nöroloji yoğun bakım ünitesinde kullanılan iki ambunun kontaminasyonundan kaynaklandığı tespit edilen bir *Pseudomonas aeruginosa* salgını rapor edilmektedir. 22 Ocak- 22 Mart 2007 tarihleri arasında, altı yatak kapasiteli nöroloji bölümüne ait yoğun bakım ünitesindeki hastaların hepsi *P. aeruginosa* ile infekte veya kolonize olarak tanımlandı. Bu tarihler arasında 6 hastadan alınan 21 örnekden *P. aeruginosa* izole edildi. *P. aeruginosa* kaynaklı salgınının kaynağını bulmak için çevresel örnekler toplandı. Bu yoğun bakım ünitesinde kullanılan iki ambudan *P. aeruginosa* izole edildi. Bu suşlar ile hastalardan izole edilen suşların antibiyotik duyarlılık paternleri benzerlik gösterdi. Ambular *P. aeruginosa* salgınının kaynağı olarak kabul edilmiş ve ambuların, sterilizasyon ve dezenfeksiyon kurallarına uygun olmayan şekilde kullanılmasının yoğun bakım ünitesinde hastane infeksiyonu ve salgınlara yol açabileceği vurgulanmıştır.

Anahtar Kelimeler: Hastane İnfeksiyonları, Ambu, Yoğun Bakım Ünitesi, *Pseudomonas aeruginosa*

+ This manuscript has been presented as a poster at the XII. International Congress of Bacteriology and Applied Microbiology, which was held in Istanbul between August 5th and 9th, 2008.

INTRODUCTION

Although intensive care units (ICU) constitute only about 10% of hospitals' bed-capacity, approximately 25% of the hospital-acquired infections (HAI) are being reported from these units.[1] Approximately 45% of nosocomial bacteremia and pneumonia cases are being detected among ICU patients.[1-2] HAIs due to invasive medical devices in the ICUs are a major threat to patient safety. Device-associated infections (DAI), particularly ventilator-associated pneumonia, central venous catheter associated bloodstream infections, and catheter-associated urinary tract infections, pose the greatest threat to patient safety in the ICUs.[3] Especially mechanically ventilated patients with underlying disease who are hospitalized in ICUs for prolonged periods are considered as being under risk. It has been reported that HAI risk is especially high among ICUs of neurology departments since most of the patients in these departments are elderly people who have methabolic disorders.[4] When an outbreak is suspected, the source of this outbreak must be identified and isolated if possible to assist the clinicians to overcome this outbreak.

Pseudomonas aeruginosa is a notable cause of nosocomial infections of the respiratory and urinary tracts, wounds, bloodstream, and even the central nervous system. These opportunistic bacteria are widely spreaded in nature and can lead to severe hospital infections by colonizing hospital environment.[5]

METHODS

Here we report an outbreak of *P. aeruginosa,* detected in an ICU, in which the source of the infection was two ambu-bags which were used during oral tracheal intubation. All of the patients in the ICU of neurology department with six bed capacity were diagnosed as infected or colonized by *P. aeruginosa* between January 22 and March 22, 2007. During this period *P. aeruginosa* was isolated from 21 specimens (14 endotracheal aspirate, 4 urine, 3 blood) of six patients.

Blood cultures were incubated in Bactec 9120 automated blood culture system (Becton Dickinson Diagnostic Instrument Systems, Sparks,MD, USA) and other samples were inoculated on to conventional media consisting of blood and chocolate agar plates, and an Eosine Methylen Blue agar plate and incubated at 37^0C for 24-48 hours. Bacterial identification was performed using standard procedures like Gram staining, catalase and oxidase tests and by using BBL Crystal Identification Systems (Enteric/Nonfermenter ID Kit, Becton Dickinson and Company, MD, USA) Antimicrobial susceptibility of the strains was investigated by the standardized disk-diffusion method following the criteria of the CLSI,[6]

The first strain was isolated from tracheal aspirate and urine sample of the index patient on January 22, and it was susceptible to imipenem, meropenem, gentamicin, amikacin, tobramycin and netilmicin but resistant to ceftazidime, cefoperazone-sulbactam, tetracyclin and ciprofloxacin.

This patient was treated with meronem according to antibiotic susceptibility tests. On February 2007, it was recognized that *P. aeruginosa* was isolated from one or more sites of all patients in this unit. Furthermore, while the strains isolated from the index patient were susceptible to imipenem these following strains displayed multidrug resistant patterns including resistance to imipenem.

Environmental samples were collected to clarify the source of the outbreak. For this purpose, samples were taken from possible infection sources like tracheal endoscope, body fluid aspiration tubes, oxygen masks, humidified air inhalation tubes, patient beds, disinfectant solutions.

Specimens taken for bacteriological examination were inoculated on to blood agar and eosin methylene blue agar and incubated at 37^oC for 24-48 hours. *P. aeruginosa* was isolated from none of the environmental specimens cultured at the beginning of the outbreak, so the source of the infection was obscure, but persistence of *P. aeruginosa* isolation from various sites of the patients from this unit forced us to make new environmental screening.

This time we tried to make a more detailed environmental sampling and recognized that we have not taken culture specimens from the two ambu-bags which were being used in this unit during oral tracheal intubation. So the cavity of ambu-bags were washed with sterile physiological saline and lavage materials were cultured. *P. aeruginosa* was isolated on March 19, 2007 from both of two ambu-bags used in this unit. These strains isolated from the two ambu-bags showed the same antibiotic susceptibility pattern with the strain isolated from the tracheal aspirate of the index patient.

Patients were treated with meropenem-amikacin combination. None of the patients died because of infection. Conversation with the nurses revealed that ambu-bags were not being disinfected after every use. Ambu-bags were considered as the source of this outbreak and they were disinfected with chlorine-releasing tablet. After this process, repeated environmental samplings were performed from possible infection sources and no growth was observed from ambu-bags and other materials. During the follow-up for six months after the control of this outbreak 69 patients were treated in this unit, and during this period colonization or infection with *P. aeruginosa* was isolated only from 5 patients and from none of the environmental samples.

DISCUSSION

P. aeruginosa causes a threat to hospitalized patients and many outbreaks due to this bacterium have been reported in different countries. It is known that invasive diagnostic and therapeutic procedures used in hospital ICUs predispose subjects to severe infections with various organisms including *P. aeruginosa*.[7,8] Devices that come into contact with intact mucous membranes and do not ordinarily penetrate sterile tissue, including flexible endoscopes and anesthesia equipment are considered as semi-critical devices according to Spaulding Classification. Semi-critical devices require the use of either a sterilant or high-level disinfectant.

Ambu-bags are considered as semi-critical devices and if it is not possible to use disposable devices, after each use they must be decontaminated with a high-level disinfectant.[9] Unfortunately, in this case, conversation with the ICU nurses revealed that ambu-bags were not being disinfected after every use. Thus, we can suggest that incorrect care of the ambu-bag in use was the reason of this outbreak we have detected.

Procedures associated with mechanical ventilation have been the mode of *P. aeruginosa* patient-to-patient transmission for the patients in this study. In support of this hypothesis, the respiratory tract was the most frequent site of isolation.

Studies of device-associated infection in ICUs have shown a powerful association between low nurse-to-patient ratios and high proportions of inexperienced nurses and a greatly increased risk for device-associated infections.[3]

The possible explanations for the higher DAI rates in developing country ICUs, some of which have been already suggested by previous investigators are lack of administrative and financial support, shortage of trained personnel, over-crowded wards and insufficient supplies.[10] Since DAIs in the ICUs pose great threats to patient safety, priority must be given to active infection control programs which perform surveillance of HAIs and carry out guidelines for prevention from HAIs to maintain the patient safety especially in high-risk hospital settings such as ICUs. For example, there should be a standard operating procedure and schedule for the decontamination of equipment that requires frequent cleaning.

REFERENCES

1. Trilla A. Epidemiology of nosocomial infections in adult intensive care units. Intensive Care Med 1994; 20 (3): 1-4.
2. Spencer RC. Epidemiology of infection in ICUs. Intensive Care Med. 1994; 20(4):2-6.
3. Rosenthal VD, Maki DG, Salomao R, et al. Device-associated nosocomial infections in 55 intensive care units of 8 developing countries. Ann Intern Med. 2006; 145(8): 582-91.
4. Dettenkofer M, Ebner W, Els T, et al. Surveillance of nosocomial infections in a neurology intensive care unit. J Neurol. 2001; 248(11): 959-64.
5. Forbes BA, Sahm DF, Weissfeld AS. Pseudomonas, Burkholderia, and similar organisms. In: Forbes BA, Sahm DF, Weissfeld AS, eds. Bailey and Scott's Diagnostic Microbiology. 11th ed.: Mosby; Inc, St. Louis, 2002, pp. 389.
6. Clinical and Laboratory Standards Institute. 2005. Performance standards for antimicrobial susceptibility testing; M100-S15, 15th informational supplement. CLSI, Wayne, PA.
7. Jarvis WR, Martone WJ. Predominant pathogens in hospital infections. J Antimicrob Chemother. 1992;29:19-24.
8. Inan D, Saba R, Yalcin AN, et al. Device-associated nosocomial infection rates in Turkish medical-surgical intensive care units. Infect Control Hosp Epidemiol. 2006;27(4):343-8.
9. Pharmacists' Edition. Infection control for regulated professionals. Ontario Collage of pharmacists, 2005. Available at http://www.ocpinfo.com/client/ocp/OCPHome.nsf/object/Infection+Control/$file/Infect_Control.pdf Accessed September 09, 2008.
10. Leblebicioglu H, Rosenthal VD, Arıkan OA, et al. The Turkish Branch of INICC. Device-associated hospital-acquired infection rates in Turkish intensive care units. Findings of the International Nosocomial Infection Control Consortium (INICC). J Hosp Infect 2007; 65: 251-7.

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