

INVESTIGATION OF BACTERIAL COUNTS IN AIR AT INTENSIVE CARE UNITS AND OPERATING ROOMS

YOĞUN BAKIM ÜNİTELERİ VE AMELİYATHANELERDE HAVADAKİ BAKTERİYEL PARTİKÜL SAYILARININ ARAŞTIRILMASI

Mehmet ÖZDEMİR, Nadire Seval GÜNDEM, Bülent BAYSAL

Selcuk university Meram Medical Faculty, Medical Microbiology Department Konya.

Özet

Nozokomiyal enfeksiyon, modern hastanelerin tümünde önemli bir problemdir. Ameliyathaneler ve yoğun bakım üniteleri, en yüksek düzeyde hijyen standartlarının olması gereken çalışma alanlarıdır. Bu çalışma, Selcuk Üniversitesi Meram Tıp fakültesinin yoğun bakım üniteleri, ameliyathaneleri ve yenidoğan yoğun bakım ünitesinde yürütülmüştür. Air Ideal cihazı havadan örnek alımı için kullanılmıştır. Cihazın filtresi, cihaza yerleştirilen besiyerinin yüzeyine ekim yapacak şekilde havayı aspire etmektedir. Farklı kliniklerde Air Ideal (bioMe'rieux) aracılığıyla aspire edilen örneklerin kanlı agar ve Sabouroud Dexrose Agara ekimi yapılmış, aerobik atmosferde 37°C'de 24 saat inkübe edilmiştir. İzole edilen mikroorganizmalar, koagülaz negatif stafilokok, non-fermentatif gram negatif bakteriler ve sporlu basillerdir. Ortalama partikül sayısı, yenidoğan yoğun bakım ünitesinde 8160 cfu/m³ bakteri, reanimasyon yoğun bakım ünitesinde 610 cfu/m³ bakteri, genel cerrahi yoğun bakım ünitesinde 2308 cfu/m³ bakteri ve ameliyathanede 2491 cfu/m³ bakteri olarak belirlenmiştir. Bu sonuçlara göre hastane enfeksiyonlarını önleme prosedürlerine ek olarak riskli bölgelerde partikül sayımının yapılması faydalı bir yöntemdir. (Anatol J Clin Investig 2010;4(1):1-4).

Abstract

Nosocomial infection is an important problem in all modern hospitals. Hospital operating rooms (OR) and intensive care units (ICU) are the workplaces that need the highest hygiene standards. This study was conducted in intensive care units, operating rooms and neonatal intensive care units of Meram Medical Faculty Hospital of Selcuk University. Air Ideal machine was used for sampling the air and aspirates air through a perforated plate, which results in impaction of particles from an air stream onto the surface of agar medium. Thus, all of samples from different clinics were inoculated into blood agar and incubated aerobically 24 hours at 37°C. The isolated microorganisms were coagulase negative staphylococci, non-fermentative gram negatives and spore forming rods. On average counts of particle were 8160 cfu/m³ bacteria in neonatal intensive care units, 610 cfu/m³ bacteria in reanimation intensive care units, 2308 cfu/m³ bacteria in general surgery intensive care units, 2491 cfu/m³ bacteria in operating rooms. It is useful to determine the particle number in critical area in hospital in addition other infection prevention procedure. (Anatol J Clin Investig 2010;4(1):1-4).

Introduction

Nosocomial infections represent an important cause of morbidity and mortality in population [1]. It is associated with a considerable increase in morbidity and mortality of patients at a hospital as well as to significant increases in costs. Nosocomial infections occur in 5% to 17% of hospitalized patients [2]. The prevalence of bacterial infections in humans is increasing and has been shown to result in part from transmission of pathogens from the hospital setting to the community and vice versa[3]. Microorganisms were transmitted to the patients by the contaminated hands of healthcare workers. Hospital operating rooms (OR) and intensive care units (ICU) are the workplaces that need the highest hygiene standards, also the same requirements for the personnel working

there and the equipment used by them [4]. Intensive care units are places where the most severely ill patients are treated and where the highest mortality rates occur. Nosocomial infection and mortality in intensive care units are more prevalent than in other wards of the hospital. In these units, where the frequent use of invasive procedures and multiple therapies expose patients to an increased risk, prevalence rates are even higher. It is crucial to know the prevalence rates and nature of nosocomial infections to achieve satisfactory results in controlling this important phenomenon [2]. Also air-control measures are crucial for reducing dissemination of airborne biological particles in hospitals. Monitoring is strongly recommended for epidemiological investigation in epidemic

situations, as nosocomial outbreaks have been linked to airborne transmission of pathogens. Since air-control measures (ie, use of high-efficiency particulate air filtration, laminar air-flow systems, high rates of room-air exchange, positive pressure rooms, and well-sealed rooms) are strongly recommended in hospital units housing high-risk patients, we consider that regular monitoring is essential to assess air control efficiency and also to detect any irregular introduction of airborne particles via clothing of visitors and medical staff or carriage by personal and medical materials [5].

The aim of this field study is to determine the particle number in critical area in addition the training of healthcare personnel about strict infection control procedure, hand hygiene, environmental disinfection, and optimum disinfection methods.

Materials and Methods

The study was conducted in intensive care units, operating rooms and neonatal intensive care units of Meram Medical Faculty of Selcuk University during six months period of time. *Air IDEAL* (bioMérieux) is the biocollector selected to set up this protocol. Its operating principle is based on the impaction method: a volume of air, known and determined using the device keypad, is taken up and impacted onto an agar medium inside the device (Figure 1).

Air IDEAL (bioMérieux) was used for sampling the air and aspirates 200 L air through a perforated plate, which results in impaction of particles from an air stream onto the surface of agar medium. The sampler was calibrated before use as recommended by the manufacturers. At the end of each sampling period and at each sampling site, the sampler's filter was changed. After each series of samples, the sampling head is disinfected with bactericidal wipes. However, it was autoclaved at 121°C for 20 minutes. Measurements were thus made in intensive care units, operating rooms and neonatal intensive care units during 6 months period in every month. At each sampling site, all of samples from different clinics were inoculated into blood agar and incubated aerobically 24 hours at 37°C. Isolated microorganisms were identified using gram stain, colony morphology, coagulase test, catalase and oxidase reaction. All isolates were allocated to the appropriate genera.

Results

On average counts of particle were 8160 cfu/m³ bacteria in neonatal intensive care units, 610 cfu/m³ bacteria in reanimation intensive care units, 2308 cfu/m³ bacteria in general surgery

intensive care units, 2491 cfu/m³ bacteria in operating rooms.

These data shows that while the air of neonatal intensive care units have higher colony counts, the air of reanimation intensive care units have the least colony counts. Bacterial counts in different parts of hospital are demonstrated at Table 1.

Discussion

During epidemics monitoring is generally based on counts of particles and counts of colony-forming units on solid media after capture by air samplers in hospital units [5]. Gangneux et al [5] compared the yields of 4 recently developed sieve impactor air samplers that meet international standard ISO 14698-1, using 2 growth media (tryptic soy agar and malt extract agar) in real conditions of use. Several hospital sites expected to have different densities of airborne microflora were selected in 2 hospitals. The Samplair MK2, Air Ideal, and Mas-100 samplers yielded higher bacterial counts than did the SAS Super-100 device. No significant differences in fungal counts were noted between the 4 devices. In our study, *Air IDEAL* (bioMérieux) was used for sampling the air. All of samples from different clinics were inoculated into blood agar. The isolated microorganisms from clinics were similar. They were coagulase negative staphylococci, non-fermentative gram negatives and spore forming rods. The results were expressed as colony-forming units per cubic meter. As a result the air of neonatal intensive care units have higher colony counts, the air of reanimation intensive care units have the least colony counts.

Pediatric intensive care units differ from adult intensive care units in a number of ways, apart from the age of their patients. First, they are usually multidisciplinary, because there are too few patients to justify separate medical and surgical units. Second, they frequently lack the physical barriers between patients now commonly present in adult intensive care units. Third, fewer children than adults in intensive care units have chronic or degenerative organ system disorders and probably the majority of children in pediatric intensive care units will, if successfully treated, return to a normal productive life. Nosocomial infections represent an important cause of morbidity and mortality in this population. The overall mortality attributable to pediatric nosocomial infections has been estimated at 11% [1]. In our study neonatal intensive care units have the highest colony counts. According to these results it is obvious that, the training of healthcare personnel about

strict infection control procedure, hand hygiene, environmental disinfection and eventually, optimum disinfection methods are very important.

Microbiological control of surfaces in a hospital is the key to guarantee the quality of the environment. The objective of these controls is to verify the relevance and efficiency of the biocleaning procedures, and check critical control points. Ulger et al, [4] showed that healthcare worker's hands and their mobile phones were contaminated with various types of microorganisms. Mobile phones used by healthcare workers in daily practice may be a source of nosocomial infections in hospitals. In a study conducted in Germany, two operating rooms (OP K I, OP K II) with conventional air-conditioning and one operating room with horizontal laminar-flow-ventilation (TAVS) were compared by measurements of airborne microorganisms, settling microorganisms and wound contamination. In OP K I and OP K II the number of airborne colony forming units (cfu) was about 8 cfu/m³ when the rooms were empty and between 70 cfu/m³ (OP K I) and 140 cfu/m³ (OP K II) during operations [6]. In our study, we found 2491 cfu/m³ bacteria in operating rooms during operations.

In French, a comparative study of two air-bacteria counting machines, MK II (Casella,

London) and R.B. (Joubert, Lyon) was carried out. Pre-operation air samples from operating rooms were drawn by the two machines working simultaneously. The results from the two machines are similar; however the RB machine is the more sensitive of the two machines. Moreover, an old operating room without filtrated air had a significantly higher air bacteria contamination than a new one with filtrated air. Samples from laminar air flow were examined as test studies. Working methods and results of air bacteria counts are studied [7]. In this study we set up periodical testing of the microbiological air quality in protected sectors and more specifically, in operating theatres and intensive care units to control any airborne nosocomial infections.

Monitoring airborne particles can at least assess air control efficiency in units equipped with high-efficiency particulate air filters by reference to the clean-room classification established by the European Union and in US guidelines. Prevention of contamination risk of nosocomial pathogens and infections stands out as problem that must be weighed in mind. It is obvious that, the training of healthcare personnel about strict infection control procedure, hand hygiene, environmental disinfection and eventually, optimum disinfection methods are of great importance.

Figure 1. Air-ideal

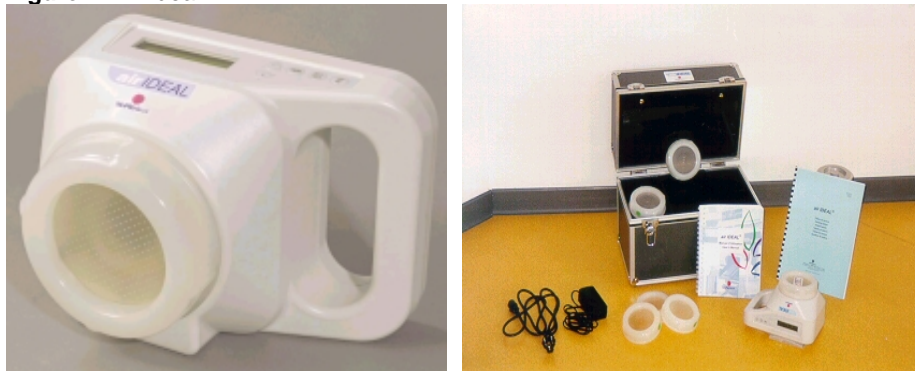


Table 1. Bacterial counts in different parts of Hospital

	Bacteria (cfu/m ³)*
Neonatal intensive care units	8160
Reanimation intensive care units	610
General surgery intensive care units	2308
Operating rooms	2491

*The results given are expressed in CFU/m³ (Colony Forming Units)

References

1. Richards MJ, Edwards JR, Culver DH, Gaynes RP: Nosocomial Infections in Pediatric Intensive Care Units in the United States, Pediatrics 1999;103:39
2. Çelik İ, İnci N, Denk A, Sevim E, Yaşar D, Yaşar MA: Prevalence of Hospital Acquired Infections in Anesthesiology Intensive Care Unit, Fırat Tıp Dergisi 2005;10:132-5
3. Kassem II, Sigler Von and Esseili MA: Public computer surfaces are reservoirs for methicillin-resistant staphylococci. The ISME Journal 2007;1:265-8
4. Ulger F, Esen S, Dilek A: Are we aware how contaminated our mobile phones with nosocomial pathogens? Annals of Clinical Microbiology and Antimicrobials 2009;8:7
5. Gangneux JP, Gangneux FR, Tanquerel JJ: Bacterial and Fungal Counts in Hospital Air: Comparative Yields for 4 Sieve Impactor Air Samplers With 2 Culture Media, Infect Control Hosp Epidemiol 2006; 27:1405-8
6. Botzenhart K, Hoppenkamps G: Wound contamination in conventionally air-conditioned operating rooms as compared to laminar-flow-operating-rooms, Zentralbl Bakteriol 1978;167:29-37.
7. Berche P, Ghnassia JC, Avril JL, Fauchere JL et al: Quantitative study of the bacterial flora air in operating theatres, Pathol Biol (Paris). 1978;26:89-93.