

Full Length Research Paper

The role of stethoscopes in the transmission of hospital infections

Ibrahim Halil Kilic^{1*}, Mehmet Ozaslan¹, Isik Didem Karagoz¹, Yasemin Zer², Eda Savaş² and Vedat Davutoğlu³

¹Biyoloji Bolumu , Gaziantep Universitesi, 27310 Gaziantep, Turkey.

²Mikrobiyoloji ve Klinik Mikrobiyoloji ABD. Gaziantep Universitesi, 27310 Gaziantep, Turkey.

³Kardiyoloji Klinigi Gaziantep Universitesi, Gaziantep Universitesi, 27310 Gaziantep, Turkey.

Accepted 19 May, 2011

Stethoscopes are one of the most commonly used medical devices and have been reported to be potential sources of hospital acquired infections. In this study, we aimed to find out the bacterial contamination of stethoscopes used by health-care staff. Swab samples were taken from the surface of the diaphragm of the stethoscopes used by health personnel in four hospitals including three second-line and one third-line health care institution in Turkey. The samples were inoculated onto bacteriological and mycological media. For identification of the microorganisms, conventional methods and Vitek2 (Biomérieux) were performed. Swab samples were taken from 121 stethoscopes. We found bacterial and fungal contamination on 92 (76%) of the stethoscopes. 15 out 90 (16.3%) had potential pathogens including methicillin susceptible *Staphylococcus aureus* (5), methicillin resistance *Staphylococcus aureus* (4), *Escherichia coli* (3), *Acinetobacter baumannii*, *Acinetobacter haemolyticus* and *Enterococcus* spp. Of the 121 health-care persons, only 61 regularly cleaned their stethoscopes by various disinfectants. The statistical difference between the two groups in terms of pathogen and microorganism isolation was not determined ($p>0.05$). Although stethoscopes are uncritical medical devices, they could contain pathogen microorganisms and they might be a potential source of hospital acquired infections.

Key words: Stethoscopes, hospital infections, *Staphylococcus aureus*.

INTRODUCTION

Hospital infections are important since they cause high mortality and in addition they are preventable. In Turkey, nearly 5% ratios were detected in a limited number of hospitals where total surveillance was conducted. It was observed that hospital infections prolong the duration of hospital stay, directly caused 60000 deaths and resulted in spending over 10 billion dollars per year. An important part of nosocomial infections are seen in the form of life-threatening infections (especially *Bacteriemia*) in intensive care units (Topcu et al., 2002). 1/3 of hospital infections are caused by the microorganisms that are found around the hospital. Infections caused by hospital equipments markedly threaten the security of patients,

especially patients in intensive care units. With surveillance studies, it was shown that contaminated surveys and medical devices can act as the source of hospital infections (Guinto et al., 2002). In addition to devices used in invasive interventions, such as ventilator and catheter, the equipments commonly used in the hospital, such as sphygmomanometers, thermometer and stethoscope bear a high risk of transmitting infection from patient to patient (Zachary et al., 2001; Maluf et al., 2002; Nyström, 2004). Sterilization of invasive equipments and the disinfection of such kind of devices before the interventions are usually ignored. Among those equipments, stethoscopes are the most frequently used medical devices. Researches showed that stethoscopes might have a role in the infestation of microorganisms from patient to patient (Jones et al., 1995; Bernard et al., 1999).

The goal of this study was to check the cleaning habits

*Corresponding author. E-mail: kilic@gantep.edu.tr. Tel: +903423171918.

Table 1. Microorganisms isolated from stethoscopes used in hospitals.

Hospital	Isolated microorganism	No growth	Total
A	33	19	52
B	20	1	21
C	23	0	23
D	16	9	25
Total	92	29	121

Table 2. Microorganisms isolated from stethoscopes of health care staff.

Microorganism	Number	%
<i>S. epidermidis</i>	77	83.7
<i>Bacillus</i> spp.	11	12
<i>Corynebacterium</i> spp.	8	8.7
MSSA	5	5.4
MRSA	4	4.3
<i>Sarcinia</i> spp	3	3.2
<i>E. coli</i>	3	3.2
<i>A. haemolyticus</i>	1	1.1
<i>Enterococcus</i> spp	1	1.1
<i>A. baumannii</i>	1	1.1
<i>Candida</i> spp.	2	2.1
<i>Aspergillus</i> spp.	1	1.1
<i>Penicillium</i> spp.	2	2.1

MRSA, Methicillin-resistant *S. aureus*; MSSA, methicillin-sensitive *S. aureus*.

of healthcare personals of their stethoscopes and also its effect on microorganism colonization.

MATERIALS AND METHODS

Samples were collected from 121 stethoscopes used by health-care personnel working in four distinct hospitals in Gaziantep province. The stethoscopes shared by all personnel in the departments were not included. Swab samples were taken from the surface of the diaphragm of the stethoscopes via Carry Blair carriage medium. All collected samples were inoculated onto Sabouraud dextrose agar (SDA), Eosin methylene blue agar (EMB) and 5% sheep blood agar base media and incubated at 37°C for 24 to 48 h. The identification of bacteria was performed with conventional methods and Vitek2 (Biomérieux). The methicillin resistance of *Staphylococcus aureus* was investigated by using 30 µg cefoxitin (Oxoid) disc according to CLSI standardization (Wayne, 2007). The cleaning habits of the stethoscopes of healthcare personnel collected samples were investigated.

RESULTS AND DISCUSSION

Samples were taken from the diaphragm of a total of 121 stethoscopes from four different hospitals found in Gaziantep province. 90 of them were from doctors and

the others from nurses. The included health care personnel in this study were 67 male and 54 female. 90 out of the one 121 stethoscopes, were contaminated with microorganisms (76%). However, microorganisms were isolated from 33 of the 52 stethoscopes collected from Hospital A, 20 of the 21 from Hospital B, all the stethoscopes from Hospital C and 16 of the 25 from Hospital D (Table 1). The isolated microorganisms are shown in Table 2. We found bacterial and fungal contamination in 92 (76%) of the stethoscopes. 15 out of 92 (16.3%) had potential pathogens including methicillin sensitive *S. aureus* (5), methicillin resistance *S. aureus* (4), *Escherichia coli* (3), *Acinetobacter baumannii*, *Acinetobacter haemolyticus* and *Enterococcus* spp. Of the 121 health-care persons, only 61 regularly cleaned their stethoscopes by using alcohol, batticon and various disinfectant substances. The statistical difference between the two groups in terms of pathogen and microorganism isolation was not determined ($p > 0.05$).

Hospital acquired infections are associated with high mortality and morbidity rate and excess health care cost. Survey studies conducted, reported that these rates decreased by taking hospital infections under control (Rosenthal et al., 2006). Infections transmitted by medical devices form an important part of hospital-based infections and such studies correlated with this study. Particularly, venous catheter-mediated blood diseases, ventilator-mediated pneumonia and catheter-mediated urinary system infections are infections with increased incidence due to medical devices used in invasive interventions. Although, the importance of hospital infections of such devices was emphasized in terms of contamination by many studies (Guinto et al., 2002), the relationship between medical devices, such as stethoscope, is in direct contact with the patient, and hospital acquired infections are unnoticed. However, stethoscopes have more direct contact with patient than medical devices used in invasive interventions. Moreover, they can play a role in spreading infections not only among hospitalized patients, but also outside. In addition, taking into consideration the hospital acquired infections that are vital in intensive care and new born units, the possibility of infection transmission of the stethoscopes which is used intensively should also be considered.

In fact, stethoscopes directly touching the body of all patients were detected not to be free of infections as a result of the observations. Transmission of bacteria from

Table 3. Features of isolated microorganisms.

Parameter	Total	Isolated microorganisms		Potential pathogen	
		Number	%	Number	%
Male	67	50	75	10	66.7
Female	54	40	74	5	33.3
Total	121	90		15	100
Doctor	90	66	72	11	73.3
Nurse	29	24	83	4	26.7
Total	121	90		15	100
Male Doctor	67	50	75	10	91
Female Doctor	25	16	64	1	9
Total	90	66		11	100
Cleaned stethoscope	61	44	72	6	40
Non-cleaned stethoscope	60	46	78	9	60
Total	121	90		15	100

patient to patient and transmission through hospital personnel to outside, via stethoscopes, forms an important threat risk for people. In particular, the presence of pathogenic bacteria on stethoscope diaphragms is more worrisome (Jones et al., 1995; Bernard et al., 1999; Parmar et al., 2004; Rosenthal et al., 2006).

In this study, microorganisms on stethoscope diaphragm used by hospital personnel were detected. These were non-pathogen or slightly pathogen bacteria: *Staphylococcus epidermidis*, *Bacillus* spp., *Sarcinia* spp. and *Corynebacteria* spp., and pathogen bacteria: *E. coli*, *A. baumannii*, *A. hemolyticus*, *S. aureus* (four of them were MRSA) and *Enterococcus* spp. Apart from these, fungi: *Candida* spp., *Aspergillus* spp. and *Penicillium* spp. were also detected. It is not surprising that Gram positive bacteria were isolated more than Gram negative bacteria through normal skin flora which contains mostly Gram positive bacteria. Although, the life span of Gram negative is maximally 6 h *in vitro*, the half life span is less than an hour; Gram positive bacteria remain alive for a longer period of time. This situation cannot explain bacterial transmission from patient to patient via stethoscopes. However, excessive bacterial colonization on stethoscope diaphragm enables them to remain alive for a period exceeding 8 h (Bernard et al., 1999). Besides, isolation of pathogen and microorganisms from stethoscope diaphragms has importance because of the threat to hospitalized patients. *Acinetobacter* species are important hospital acquired infection agents that can remain alive on various inanimate surfaces and are frequently observed, especially in intensive care units. In this study, although we detected only two *Acinetobacter* species, from the intensive care units, they are both vital. The fact that four of the detected nine *S. aureus* were

MRSA, implies that they are important as a result of the difficulty of treatment and presence of resistance. MRSA infection and colonization is generally seen in hospitals and in hospitalized patients and it is known as the agent of meningitis and pneumonia. In particular, the isolation of this microorganism from pediatrics clinics may be based on the fact that it was carried by hospital personnel. Generally, vancomycin is used for the treatment of MRSA infection and this antibiotic is potentially toxic and can be taken by parenteral. The fact that 10 of the 14 pathogen bacteria were isolated from male personnel and the rest of them from female personnel indicated that female personnel behave more sensitively in stethoscope cleaning than male personnel. 11 of the 14 stethoscopes, on which the pathogen bacteria were detected, belonged to doctors, whereas only 3 of them belonged to nurses (Table 3). This situation was based on the fact that the doctor's stethoscopes contacted more patients.

When investigation was made about the cleaning of the 121 samples, it was observed that 61 of them performed cleaning with various disinfectants at certain intervals. In five of the 61 samples, pathogen microorganisms were found (8%), while in nine of the samples taken from 60 people without stethoscope cleaning habits (15%), pathogen microorganism was detected. Cleaning of stethoscopes with alcohol, soap, batticon and disinfectants prevents mainly the bacterial colonization. The work of Cohen et al. (1997), Rosenthal et al. (2006) and Schroeder et al. (2009) correlates with the results of this study. It is suggested that the disinfection of stethoscopes with 70% alcohol or liquid soap, or the use of disposable sheaths can minimize stethoscope-mediated infectious spread among hospitalized patients. In another

study, it was reported that stethoscope contamination, which was at a level of 90% decreased to a level of 25 to 28%, following its disinfection with 66% ethyl alcohol (Cohen et al., 2003). Many studies reported that stethoscopes were contaminated with microorganisms, which were caused by agents of many hospital infections (Bernard et al., 1999). In another study, 85% of 355 stethoscopes were contaminated with non-pathogenic or weakly pathogenic bacteria, while 9% of them were contaminated with potentially pathogenic bacteria such as *S. aureus*, methicillin resistant *S. aureus* (MRSA), *Acinetobacter* spp., *Enterobacter* spp., *Escherichia coli*, *Klebsiella* spp. and *Stenotrophomonas maltophilia* (Jones et al., 1995).

Jones et al. (1995) collected a sample from 150 stethoscopes and found that 89% of them were contaminated with staphylococci and 19% of them were contaminated with *S. aureus* (Cohen et al., 1997). In a similar study, coagulase negative staphylococci (CoNS), *S. aureus*, *Candida albicans*, *Acinetobacter* spp., *S.s maltophilia*, *Aspergillus* spp., *Bacillus* sp., *Corynebacteria* spp., *E. coli* and non-fermenting Gram (-) Basil were detected on samples (Bernard et al., 1999). In another study, seven MRSA, seven *Enterobacter cloacae*, 12 *Acinetobacter baumannii* and 22 *S. maltophilia* were isolated from stethoscopes in the intensive care unit (Whittington et al., 2009). Younster et al. (2008) isolated one MRSA, nine Gram-negative organisms and one *A. baumannii* in nine different stethoscopes in the neonatal intensive care unit.

As a result, stethoscopes with contamination at a high rate, act as potential vectors in the spread of hospital acquired infections, although there is no direct evidence between the contaminations of stethoscopes (the most important means of physical examination commonly used among health personnel) and hospital acquired infections. Based on this, it is considered that daily cleaning of stethoscopes with disinfectant substances is vital for public health.

REFERENCES

Bernard L, Kereveur A, Durand D, Gonat J, Goldstein F, Mainardi JL, Acar J, Carlet J (1999). Bacterial contamination of hospital physicians' stethoscopes. *Infect. Control Hospital Epidemiol.* 20(9): 626-628.

Cohen HA, Amir J, Matalon A, Mayan R (1997). Stethoscopes and otoscopes-a potential vector of infection?. *Family Practice*, 14: 446-449.

Cohen S, McCorwack D, Youkhana A, Wall R (2003). Bacterial colonization of stethoscopes and the effect of cleaning. *J. Hospital Infect.* 55(3): 236-237.

Guinto CH, Bottone EJ, Raffalli JT, Montecalvo MA, Wormser GP (2002). Evaluation of dedicated stethoscopes as a potential source of nosocomial pathogens. *AJIC Brief Rep.* 30(8): 499-502.

Jones JS, Hoerle D, Riekse R (1995). Stethoscopes: A potential vector of infection? *Ann. Emergency Med.* 6(3): 296-299.

Maluf ME, Maldonado AF, Bercial ME (2002). Stethoscope: a friend or an enemy? *Sao Paulo Med J.* 120: 13-15.

Nyström B (2004). The disinfection of thermometers in hospitals. *J. Hospital Infect.* 1(4): 345-348.

Parmar RC, Valvi CC, Sira P and Kamat JR (2004). A Prospective, randomised, double-blind study of comparative efficacy of immediate versus daily cleaning of stethoscope using 66% Ethyl Alcohol. *Indian J. Med Sci.* 58(10): 423-430.

Rosenthal VD, Maki DG, Salomao R, Alvarez-Moreno C, Mehta Y, Higuera F, Cuellar LE, Arkan ÖA, Abouqal R and Leblebicioğlu H (2006). Device-associated nosocomial infections in 55 intensive care units of 8 developing countries. *Ann. Internal Med.* 145(8):583-591.

Schroeder A, Schroeder MA, D'Amico F (2009). What's growing on your stethoscope?(And What you can do about it). *J. Family Practice*, 58(8): 404-409.

Topcu AW, Soyletir G and Doganay M (2002). Hospital infections and infection control IV.section, infection diseases and microbiology (Infeksiyon hastalıkları ve infeksiyon kontrolu, infeksiyon hastalıkları ve mikrobiyolojisi). *Nobel Tıp Kitabevleri.* İzmir, 1: 401-409.

Wayne PA (2007). *Clinical Laboratory Standarts Institute.Performance standarts for antimicrobial disk susceptibility tests. Approved Standard M2-A7,11th edition.*USA.

Whittington AM, Whitlow G, Hewson D, Thomas C, Brett S J (2009). Bacterial contamination of stethoscopes on intensive care unit. *Anaesthesia.* 64: 620-624.

Younster I, Berkovitch M, Heyman E, Lazarovitch Z, Goldman M (2008). The stethoscope as a vector of infectious diseases in the pediatric division. *Acta Pediatr. Sep;* 97(9): 1253-1255.

Zachary KC, Bayne PS, Morrison VJ (2001). Contamination of gowns, gloves, and stethoscopes with vancomycin-resistant enterococci. *Infect Control Hospital Epidemiol.* 22: 560-564.