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Research Paper

Bacterial Contamination of Stethoscopes

Microbiology

KEYWORDS : Stethoscope, Disinfection, Contamination

R. Srikanth Aswin — Final MBBS Student, Kasturba Medical College, Mangalore, Manipal University

*** Dr Ashwini Hegde** — Associate Professor, Kasturba Medical College, Mangalore, Manipal University.
* Corresponding author

ABSTRACT

Background and Objectives: The stethoscope, which comes into contact with multiple patients, can transmit infections from one patient to another. We intended to determine the level of contamination of stethoscopes and analyse the disinfection methods used by interns and postgraduates of a teaching hospital in South India.

Materials & Methods: A non-randomized trial with self-reporting of disinfection practices was conducted among 105 interns and postgraduates in three teaching hospitals. Swabs were taken from each stethoscope and sent for analysis within one hour of collection. Antibiotic sensitivity of isolates was performed as per CLSI guidelines.

Results: Among the 105 participants, 93(88.6%) stethoscopes showed evidence of contamination. The bacteria isolated include Coagulase-Negative Staphylococcus (56.1%), Staphylococcus aureus (18.1%), Methicillin Resistant Staphylococcus aureus(4.7%), Pseudomonas aeruginosa (6.6%) and Escherichia coli (2.8%). The frequency of disinfection determined the level of contamination.

Conclusion: The high rate of contamination of stethoscopes and presence of dangerous pathogens like MRSA indicates that they could play a major role in the transmission of nosocomial infections. This is further supported by the observation that stethoscope cleaning procedures are not routinely employed by a large number of health care professionals.

Introduction

Nosocomial infections are a significant hazard for hospitalized patients and a potential source of nosocomial infections in health care workers[1].They also result in increased health care costs. Health-care workers can transmit many pathogens through their hands and contaminated medical devices. Medical devices such as thermometers, blood pressure cuffs, stethoscopes, latex gloves, masks, neckties, pens, and white coats have been associated with outbreaks of hospital acquired infections[1]. It is essential to identify the reservoirs of microorganisms that cause nosocomial infections for planning preventive actions.

Stethoscope is an important instrument of medical professionals and is often used on multiple patients. A single stethoscope is often used for all patients i.e. inpatients and outpatients.Stethoscopes used by medical practitioners, students and health workers have been shown to be potential vectors in the transmission of nosocomial infection in various parts of the world.Disinfection of stethoscopes is not done as a routine.Contamination of stethoscopes with pathogens, particularly the diaphragms can occur following contact with infected skin. The pathogens can subsequently be transferred to other patients if the stethoscope is not disinfected[2,3].Studies on the exact mode and frequency of cleaning of stethoscope are lacking.

Antibiotic resistant microorganisms may be transmitted from one patient to another on stethoscopes. These antibiotic-resistant organisms are capable of initiating severe infections in hospitals and infections caused by these organisms could require contact isolation and aggressive treatment to prevent their spread[4].Examples of such antibiotic-resistant organisms are ESBL producingKlebsiella pneumoniae, vancomycin-resistant enterococci, methicillin-resistant Staphylococci, ciprofloxin-resistant Pseudomonas aeruginosa, gentamicin-resistant P. aeruginosa, and penicillin-resistant Pneumococci[4,5].

There are no previous studies relating to the bacteriological contamination of stethoscopes used by interns and postgraduates of teaching hospitals in Mangalore. Therefore we intended to determine the level of contamination of stethoscopes used by interns and postgraduates and analyse the effectiveness of different stethoscope disinfecting methods currently being employed by the interns and postgraduates of three teaching hospitals in Mangalore.

Material and Methods

The study was a non-randomised trial conducted between April 2012 to June 2012 in a population consisting of interns and postgraduates associated with two government and one private teaching hospital in Mangalore. The study population was chosen because interns and postgraduates come in contact with a large number of patients in a teaching hospital and hence there is a high risk of bacterial contamination of stethoscopes used by them and subsequently a greater implication for transmission of nosocomial infections. The sample size (n) was fixed at 105 participants by taking into account a confidence interval of 95%, power of 90% with reference proportion as 80.1. n=105(10% default). Ethical clearance was obtained from the institutional ethics committee(IEC). Informed consent was obtained from every participant and a questionnaire was administered to obtain information of gender, age, hand washing techniques, stethoscope maintenance and handling techniques used by the participants. Complete confidentiality of the response of the participants was ensured.

A sterile cotton swab moistened with normal saline was used to swab the entire surface of the diaphragm of the stethoscope of each participant and the same was numbered correspondingly and transferred to the microbiology laboratory of Kasturba Medical College, Mangalore for analysis. Laboratory analysis was carried out within one hour of collection of samples. The swabs were directly inoculated on blood agar and MacConkey agar. The inoculated media were incubated aerobically at 37°C for 24 hours and then examined for bacterial growth according to standard protocol[6]. Bacteria were identified by assessing colony characteristics, Gram reaction, motility and biochemical tests. The biochemical tests performed included catalase, coagulase and oxidase tests, hemolysis, sugar fermentation, indole production, citrate utilization, urease activity; triple sugar iron (TSI) agar test, hydrogen sulphide and decarboxylase production tests. The biochemical tests were done according to protocols described previously[6].Three or more colony forming units (CFU) were considered before assigning a species as a contaminant[1].

Bacterial isolates were subjected to antibiotic sensitivity test by the Kirby-Bauer disk diffusion method as per the Clinical and Laboratory Standards Institute (CLSI) guidelines[6]. Gram positive organisms were tested using discs containing penicillin, gentamicin, netilimicin, chloramphenicol, erythromycin, tetracycline, cephalothin and cefoxitin. Discs containing ampicillin,

gentamicin, ceftazidime, ciprofloxacin, co-trimoxazole, cephalothin and netilimicin were used for testing gram negative organisms. Cefoxitin disc was used to detect MRSA.

Data was entered and analysed using spss version 17. For testing the association between variables Chi square test was used and $p<0.05$ was taken as statistically significant.

Results

A total of 105 individuals participated in this study, of whom 47 were interns and 58 were postgraduates. The stethoscopes of all the participants were examined. Of these stethoscopes, 93(88.6%) were contaminated. 42(89.3%) stethoscopes used by the interns and 51(87.9%) stethoscopes used by the postgraduates were found to be contaminated. A few stethoscopes had more than one bacterial isolate. The bacteria isolated include Coagulase-Negative Staphylococcus(56.1%), Staphylococcus aureus(18.1%), Methicillin Resistant Staphylococcus aureus(4.7%), Pseudomonas aeruginosa(6.6%), Escherichia coli(2.8%), Klebsiella spp (1.9%), Bacillus spp (8.5%) and Micrococcusspp (1.9%).

The results showed a higher proportion of contamination among the stethoscopes from males. 80.3% of stethoscopes used by female participants showed contamination as compared to 96.2% in males. This difference was statistically significant(Chi-square=6.554, p=0.013).

Stethoscope maintenance practices followed by the participants were related to the level of contamination of the stethoscopes (Table II). The level of contamination was related to the last time the stethoscopes were cleaned. It was found that stethoscopes cleaned at least one week prior to the survey were the least contaminated (47%). The stethoscopes that were never cleaned showed the highest contamination (100%).The level of contamination was related to the frequency of cleaning of the stethoscopes. It was found that stethoscopes cleaned at least once daily had no contamination (0%), whereas stethoscopes that were never cleaned showed 100% contamination. This difference was also statistically significant (p=0.0). The level of contamination was 75% for those that were cleaned with methylated spirit and was 100% with those cleaned with other agents or those that were never cleaned.Lower contamination observed on stethoscopes cleaned with methylated spirit was statistically significant(Chi-square=10.161 p=0.038).

Participants who washed their hand after seeing every patient had lower colonization on their stethoscopes. However this difference was not statistically significant.75 participants (71.4%) were of the opinion that stethoscopes could serve as potential vectors for the transmission of nosocomial infections. 76 participants (72.4%) reported that adequate emphasis was not laid during their course of study, on the importance of proper maintenance of stethoscopes.

The antibiotic sensitivity test indicated that CONS, S aureus and MRSA were the most resistant organisms. Isolates of Staphylococcus aureus and MRSA showed the highest resistance to penicillin, ciprofloxacin and cotrimoxazole. Among the gram negative bacteria the isolates of P aeruginosa were most resistant to ampicillin and co-trimoxazole. In E.coli resistance to ampicillin and ceftazidime was more common. Isolates of Klebsiella were most resistant to ceftriaxone and ceftazidime.

Discussion

Health care associated infections or infections acquired in the hospital cause an increase in the morbidity, mortality, and economic costs. Colonisation of the patients' skin, gut or other systems with hospital flora are usually responsible for most of these infections[8].Impairment of the normal body defenses through underlying diseases, immunosuppressive therapy or use of invasive devices may lead to infection by colonised flora. Identification of pathogens that colonise the patientsis necessary to develop rational control methods for hospital infections. Earlier studies have reported stethoscopes as a potential source for transmitting infections in the hospital environment in various parts of the world[9,10].Routine disinfection of stethoscopes to prevent contamination are not followed by most of the health care workers[11,12].Health care workersoften usestethoscopes on multiple patients. Direct contact of stethoscopes with multiple patients can result in the dissemination of microorganisms from one patient to another. Contaminated stethoscopes expose an already susceptible host in the hospital to a higher microbial overload and they may pose a serious risk to immunocompromised hosts.

Our study showed bacterial contamination of a large number of stethoscopes(88.6%).The high rate of stethoscope contamination observed in our study indicates that stethoscopes could be vectors playing a major role in transmitting microorganisms in the hospital environment. This confirms the finding that stethoscope-cleaning procedures are not followed by health care workers. It has been shown that the level of contamination is related to the regular maintenance practices adopted by the participants. Stethoscopes that were cleaned at least once daily with methylated spirit showed no contamination while those that had never been cleaned showed 100% contamination. Stethoscopes which were reported to be cleaned at least a week prior to the survey showed significantly lesser colonization. In our study we found that methylated spirit was more commonly used and was more effective as a cleaning agent. The level of contamination was 75% for stethoscopes that were cleaned with methylated spirit and was 100% for those cleaned with other agents or those that were never cleaned. Lower contamination observed on stethoscopes cleaned with methylated spirit was statistically significant. Earlier studies have shown the efficiency of methylated spirit in the form of hand sanitizer or alcohol rub in eliminating bacterial contaminants from the diaphragms of the stethoscopes[1,24].

Nearly 30% of the students did not follow any stethoscope-cleaning practices. Lack of emphasis on stethoscope cleanliness in their training may be the reason for this. Earlier studies have also indicated that insufficient emphasis on consistent stethoscope disinfection practices in the medical curriculum are responsible for the high rate of bacterial contamination on stethoscopes of medical students, physicians and other health workers[9,13].Stethoscopes used by female participants were found to have lesser colonization and this is probably due to better maintenance practices by the female participants.

Consistent with observation of others we found frequent contamination of stethoscopes [11,12,14,15].The most common contaminating organism of the stethoscope in the present study was CONS. Infections due to CONS were regarded as endogenous in origin until recently. However, there are now increasing reports on the endemic occurrence of distinct strains of CONS. Several outbreaks due to CONS have been reported in neonates and patients undergoing cardiac surgery. The second most common organism isolated in this study was Staphylococcus aureus (19%). Previous investigations have found it on 15.8 to 89% of stethoscopes surveyed[16-18]. We also isolated many potential pathogens such as Gram-negative bacilli, Bacillus spp., and MRSA. Gram negative bacilli are important cause of nosocomial infections[19,20]. Bacillus spp has been implicated in septicaemia[21]. MRSA is a nosocomial pathogen associated with prolonged carriage and serious infections that are difficult to treat[22,23]. There are no studies linking the presence of microorganisms on the stethoscope directly to hospital-acquired infection. However, strategies to reduce the occurrence of hospital-acquired infections should take this possibility into account. It is

a well-known fact that disinfection or removal of contaminated equipment can play a significant role in preventing outbreaks[24].

This study helped in understanding the role of stethoscopes,used by interns and postgraduates, as potential vectors in the transmission of nosocomial infections. Several strains of bacteria, showing multiple antibiotic resistance, including the highly pathogenic MRSA were isolated from the stethoscopes and their presence highlights the importance of regular cleaning of stethoscopes.

The chances of contamination are significantly reduced if the stethoscopes are cleaned regularly with a suitable agent.The data obtained from this study could help in the control of nosocomial infections by creating more awareness and also enable health care providers to adopt better strategies to minimize the risk of transmission of infections by stethoscopes.

Table I: Bacterial Isolates from stethoscopes of Interns & Postgraduates

Bacterial Isolates	Interns	Postgraduates	Total
Coagulase Negative Staphylococcus	24	35	59(56.1%)
Staphylococcus aureus	9	10	19(18.1%)
MRSA	2	3	5(4.7)
Pseudomonas aeruginosa	4	3	7(6.6%)
Escherichia coli	2	1	3(2.8%)
Klebsiella spp	0	2	2(1.9%)
Bacillus spp	6	3	9(8.5%)
Micrococcus spp	1	1	2(1.9%)

Table II: Relationship between frequency of cleaning of stethoscopes and level of contamination

Frequency of cleaning	No. of stethoscopes examined	Contaminated stethoscopes
Once Daily	4	0 (0%)
Weekly	17	12 (70.5%)
Monthly	35	32 (91.4%)
Annually	17	17 (100%)
Never	32	32 (100%)
Total	105	93

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