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Research Article

Bacterial Assessment of Stethoscopes Contamination with Multidrug-Resistant Bacteria

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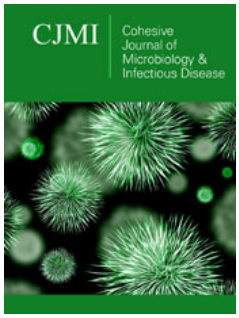

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Abstract

Background: Healthcare environments are often home to organisms that can cause infections. One example is contaminated medical equipment, such as stethoscopes, which can harbor various nosocomial pathogens, including MDR bacteria. Hospital-acquired illnesses are acknowledged as severe issues in public health.

Objectives: To assess multi-drug-resistant bacteria isolated from stethoscopes in Shendi City, Sudan.

Methodology: This prospective cross-sectional study will take place in Shendi City at the microbiology laboratory of the faculty of medical laboratory sciences at Shendi University between March 2023 and January 2024. Using moistened sterile cotton swabs, 64 specimens were obtained from stethoscopes in various hospitals. The bacteria were then cultured in Macconkey and blood agar, and the isolated specimens were identified using biochemical assays, gram stain, and colonial morphology. Sensitivity testing was then carried out. A modified Kirby-Bauer disc diffusion method was used to determine which medications were resistant to bacteria.

Results: It was discovered that bacteria from 54 (84%) of the 64 cultured stethoscopes were contaminated. These bacteria included *S. aureus* 25 (46%), *S. saprophyticus* 2 (4%), *S. epidermidis* 7 (13%), *B. cereus* 13 (24%), *Klebsiella pneumonia* 3 (6%), and *P. aeruginosa* 4 (7%). be the most effective antibiotics for Gram-negative are amoxiclav (21%) and ceftriaxone (38%), and ciprofloxacin (45%) and Gentamicin (46%) for Gram-positive bacteria.

Conclusion: Significant bacterial contamination was found in the stethoscope. The isolates were resistant to several drug classes and might have been pathogens. It is essential to disinfect the stethoscope diaphragm both before and after every patient interaction.

Keywords: Contamination; Bacteria; Stethoscope; MDR; Disinfection; HIA

Introduction

Infections linked to healthcare have been becoming more common over time [1]. One of the leading causes of the rise in the burden of infections linked to healthcare is the rising occurrence of Multidrug-Resistant (MDR) bacterial infections and cross-contamination with MDR bacteria [2]. Bacteria can cross-contaminate in several ways. The most significant method of disease transmission in a hospital setting is direct or indirect contact [3]. Recent research has demonstrated that hand hygiene is insufficient to prevent nosocomial infection [4], even though hands are recognized to be a vector of direct contact transmission during patient care. Besides hands, various medical instruments have been identified as possible means of touch transmission, such as blood pressure cuffs, doppler probes, and even marker pens [5,6]. A widespread and essential instrument for healthcare providers, the stethoscope can potentially spread nosocomial diseases. It frequently comes into contact with many people, which causes it to get infected with different harmful germs.

Stethoscopes should not be cleaned after every usage; this is not a recognized practice anywhere. All subsequent patients may be at risk for infection if the same stethoscope is used to examine another patient without being cleaned beforehand [7]. Furthermore, draping stethoscopes across the neck is a regular habit that cross-contaminates the diaphragm [8]. Moreover, the stethoscope's earpieces become contaminated by the pathogenic germs and commensal flora that live in the ears of medical practitioners. Using contaminated stethoscopes increases the danger of spreading multidrug-resistant bacteria in hospital settings [8]. The most common bacterial pathogens detected on stethoscope swabs are *Staphylococcus aureus, Clostridium difficile, Pseudomonas species, Acinetobacter species, Bacillus species, Corynebacterium species*, and *Enterobacteriales* [9-11]. In addition to these pathogens, tainted stethoscopes have the potential to spread a variety of antibiotic-resistant microorganisms, including gentamicin-resistant *Pseudomonas aeruginosa* and methicillin-resistant *staphylococci* [12].

Materials and Methods

Methodology

From March 2023 to February 2024, a cross-sectional study was carried out in the Shendi location of the River Nile state in Sudan. Several clinical facilities and hospitals may be found in the Shendi neighborhood, which is 150 kilometers northeast of Khartoum on the east bank of the Nile. Sixty-four medical staff members from various hospital departments contributed their stethoscopes for use in this study to look at bacteria. Using a sterile cotton swab, samples were aseptically taken from the bell, diaphragm, right and left earpieces, and other elements of the stethoscope. After sampling, the swab was taken to the lab for microbiological investigations and placed into the transport medium. Isolate culture and identification: Following standard methods, the obtained swabs were inoculated into plates of blood agar medium and MacConkey agar media separately for each sample and then incubated at 37 °C aerobically for 24 hours before being checked for bacterial growth [13]. Bacterial isolates were identified based on their visual and biochemical test [13].

Interpretation of cultural growth

Every time a bacterial colony grew noticeably, the plates were examined. After thoroughly isolating the bacteria, they were identified using biochemical assays, colony morphology, and Gram stain. The biochemical testing was done once the isolated organisms had been thoroughly identified using Gram stain and the relevant tests. Pure culture injected with organisms was incubated for 24 hours after the isolates were identified, and it was then stored in a refrigerator at 4 °C.

Data analysis

Data were entered, checked, and analyzed using Microsoft Excel 2007 and the SPSS (Statistical Package of Social Science) soft program version 28.0. Proportional data were presented as frequencies and percentages.

Result

Between March 2023 and February 2024, isolation and sensitivity testing methods were used to detect multi-drug-resistant bacteria. Samples were aseptically taken from the bell, diaphragm, right and left earpieces, and other elements of the stethoscope using a sterile cotton swab. Out of 64 samples collected, 84% grew, and 16% did not grow (Table 1). The most frequent bacteria isolated were *Staphylococcus aureus* 25 (46%), *B. cereus* 13 (24%), *Staphylococcus epidermidis* 7 (13%), *P. aeruginosa* 4 (7%), *Klebsiella pneumonia* 3 (6%), while the least isolated bacteria were Staphylococcus saprophyticus 2 (4%) (Table 2-4).

Table 1: The distribution of clinical specimens according to bacterial growth.

Specimen	Frequency	Percent %
Growth	54	84%
No Growth	10	16%
Total	64	100%

Table 2: The frequency and percentage of isolated organisms.

Pathogens	Frequency	Percent %
S. aureus	25	46%
S. saprophyticus	2	4%
S. epidermidis	7	13%
B. cereus	13	24%
P. aeruginosa	4	7%
Klebsiella pneumonia	3	6%
Total	54	100%

Table 3: The sensitivity of isolated bacteria to ciprofloxacin and Gentamicin.

Pathogens	CIP				GEN			
	S		R		S		R	
	No	%	No	%	No	%	No	%
S. aureus	20	44%	5	56%	19	41%	6	75%
S. saprophyticus	2	4%	0	0%	2	4%	0	0%
S. epidermidis	6	13%	1	11%	7	15%	0	0%
B. cereus	11	24%	2	22%	12	26%	1	13%
P. aeruginosa	4	9%	0	0%	3	7%	1	13%
Klebsiella pneumonia	2	4%	1	11%	3	7%	0	0%
Total	45	100%	9	100%	46	100%	8	100%

Table 4: The sensitivity of isolated bacteria to amoxiclav and ceftriaxone.

Pathogens	AMC				CTR			
	S		R		S		R	
	No	%	No	%	No	%	No	%
S. aureus	10	48%	15	45%	16	42	9	56%

S. saprophyticus	0	0%	2	6%	1	3	1	6%
S. epidermidis	4	19%	3	9%	6	16	1	6%
B. cereus	4	19%	9	27%	9	24	4	25%
P. aeruginosa	1	5%	3	9%	3	8	1	6%
Klebsiella pneumonia	2	10%	1	3%	3	8	0	0%
Total	21	100%	33	100%	38	100	16	100%

Discussion

The spread of Healthcare-Associated Infections (HCAIs) in hospital environments is a significant problem within the medical community. For example, Healthcare Workers' (HCWs') stethoscopes are likely to contain many harmful microorganisms, which could lead to the spread of Healthcare-Associated Infections (HCAIs). This study aimed to assess the bacterial contamination of stethoscopes used by Shendi Hospitals' healthcare workers. A total of 64 stethoscopes were inspected from March 2023 to February 2024. Using standard techniques created by the Clinical and Laboratory Standards Institute (CLSI), bacterial pathogens were isolated, identified, and evaluated for biochemical and Culture susceptibilities against different antibiotics. When comparing this research to numerous related studies conducted in various hospitals earlier, a high proportion of stethoscope contamination was found [14-18]. According to earlier research, healthcare workers and staff medical gadgets may be carriers of harmful organisms [19]. Variations in the rate of stethoscope contamination between institutions can be attributed to various factors, such as the frequency of sample examination, the accuracy with which the instrument is used, the user's dedication to cleanliness, and the frequency of cleaning [20]. Among Gram-positive bacteria, *Staphylococcus aureus* was the most common isolation (25¬%). *S. aureus* was identified as the primary isolate in a related study conducted in 2013 by Singh et al. [18]. According to a study by Treakle et al. [19], *S. aureus* was found to be the most common bacteria in the white coats of medical staff members at the Maryland Medical Center in Baltimore, Maryland [19]. According to these results, *S. aureus* is the most common bacteria in hospital environments and is present in various foods connected to medical professionals, including nurses and doctors. However, Micrococcus spp. has been identified in some research as the predominant isolate on stethoscopes; these bacteria were not discovered in the current investigation [12,14-19]. IPD workers may be more likely to come into contact with and evaluate hospitalized patients, which increases the possibility that their tools-including stethoscopes-will become infected [14].

Contaminated stethoscopes can harm patients' health, especially for individuals who frequently visit hospitals and have compromised immune systems [21]. Additionally, the prevalence of *Escherichia coli* and *Klebsiella* in surgical sites and *Staphylococcus aureus* in the ICU raises significant concerns regarding the hospital's standard operating procedures and degree of sanitation. When Healthcare Workers (HCWs) followed hand hygiene procedures after handling patients, their stethoscopes had less bacterial contamination than those of individuals who didn't. Hand hygiene is essential to guarantee patient safety, according to the World Health Organization (WHO), and it should be done promptly and efficiently during the treatment procedure [22]. Antimicrobial susceptibility patterns show that bacteria are becoming more resistant to routinely administered medications daily. The medication that worked best against Gram-positive bacteria was ciprofloxacin (45%). Vancomycin was the most effective drug for Gram-positive isolates, according to similar studies done by Dagnaw in Ethiopia [15]. An earlier study conducted at Chitwan Medical College in Bharatpur, Nepal, found that vancomycin was the most effective drug, with an efficacy rate of 95.7% [12]. However, studies conducted in Nigeria showed that all of the isolates that tested positive for the gram had resistance to chloramphenicol. The study found that ceftriaxone was the most effective drug (38%) for Gram-negative bacteria. In a previous study, imipenem was found to be the most effective drug for Gram-negative bacteria by Bhatta et al. [23].

Conclusion

Pathogenic germs were present in more than 25% of the stethoscopes under analysis. Significantly contaminating bacteria in a stethoscope included *S. aureus, S. saprophyticus, S. epidermidis, B. cereus, P. aeruginosa*, and *Klebsiella pneumonia*. These bacteria pose a severe risk of nosocomial infections and can be fatal for patients and medical staff. The easiest way to prevent infections is to wash your hands and stethoscope after every patient interaction. Regular stethoscope disinfection with 70% ethanol can significantly reduce this contamination and the germs' ability to spread. HCWs must strictly follow disinfection protocols to minimize cross-contamination and ensure patient safety. As a result, we must impart knowledge and motivate the HCWs to comprehend many facets of stethoscope disinfection procedures. It can be a crucial intervention step to reduce the spread of nosocomial diseases among patients and healthcare workers. More research should be done on anaerobic bacteria, fungi, and viruses to understand further the role of other contaminating organisms, such as nosocomial infections.

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