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Antibiotic susceptibility patterns of pathogenic bacteria isolated from the operating room of the Al Sader Teaching Hospital (Iraq)

Hajir B. Aljaryan[1], Ataa Khalil Al-Shamari[1,*], Ali Ahmed Nayyef[1], Taif Hussein Al-Ameedy[1], Haneen Rabeea[1], Fatimatulzahraa Ali[2]

[1]Department of Clinical Laboratory Sciences, College of Pharmacy, University of Babylon, Hillah, Iraq
[2]Babil Health Directorate, Ministry of Health, Hillah, Iraq

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ABSTRACT

In hospital settings, microbial contamination plays a major role in the transmission of healthcare-associated illnesses. This study aimed at evaluating the level of bacterial contamination in operating rooms. A cross-sectional study was carried out in the operating theatres and delivery rooms of Al Sader Teaching Hospital in Iraq, between July and November 2023. Samples were collected and sent to the laboratory for standard diagnostic analysis and the undertaking of antimicrobial sensitivity testing. The analysis revealed varying contamination rates across different operating rooms. The most frequently detected bacterial isolates belonged to *Escherichia coli* (12%), *Klebsiella pneumoniae* (17%), *Pseudomonas aeruginosa* (20%), and *Staphylococcus aureus* (25%). The antibiotic sensitivity testing showed that different bacterial strains exhibited varied responses to antibiotics, underscoring the challenges in treating infections caused by these pathogens. These findings highlight the importance of monitoring antibiotic resistance patterns in these bacterial strains in order to guide treatment decisions and enhance patient outcomes.

*** CORRESPONDING AUTHOR:**
Ataa Khalil Al-Shamari, Department of Clinical Laboratory Sciences, College of Pharmacy, University of Babylon, Hillah, Iraq; e-mail: pharm.ataa.khalil@uobabylon.edu.iq

1. Introduction

Healthcare-associated infections (HAIs) refer to nosocomial infections that are not present in the patient at the time of admission to the healthcare facility[1]. HAIs are most commonly associated with hospitalization in intensive care units (ICUs), although they can occur in various wards during treatment. Patients in ICUs are five to ten times more likely

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to acquire an HAI due to both extrinsic factors (such as the use of medical devices) and intrinsic factors (such as immunodeficiency). Furthermore, ICUs often serve as breeding grounds for multidrug-resistant microorganisms[2]. Surgical site infections (SSIs) account for 36% of nosocomial infections in surgical patients, making them the most common type of hospital-acquired infection. SSIs are associated with elevated morbidity and mortality rates, as well as increased costs[3]. The failure of antibiotic therapy may be attributed to the presence of multidrug-resistant strains, which are defined as isolates resistant to three or more classes of antimicrobials. Additionally, the polymicrobial nature of these infections and the involvement of anaerobic bacteria in SSIs further complicate treatment outcomes[4]. Thus, identifying the causative bacteria and their resistance to antimicrobial therapies is essential for achieving effective treatment outcomes for these infections. In addition to identifying and detecting bacteria from surgical sites, the current study sought to explore the isolates' antibiotic susceptibility profiles.

2. Methodology

A cross-sectional study with a laboratory investigation focus was conducted at the operating theatres of the Al Sader Teaching Hospital in Iraq, between July and November 2023. There are three operating theatres in the hospital for surgical services (general, private wings, as well as delivery and emergency wards). A total of 100 cotton swab samples were collected from the surgical instruments and surfaces in three operating theatres inside the hospital's surgical services' department. In order to enrich the samples, they were inoculated into peptone water and subsequently subjected to subculture into mannitol salt agar, MacConkey agar, and blood agar. Moreover, microorganism identification was performed by biochemical testing. The disc diffusion method was used, with one disc placed in the centre of the plate and eight discs evenly spaced, each around 15 mm from the plate's edge. A gentle press was applied to each disc in order to guarantee even contact with the media. Following an overnight incubation period at 37°C, the size of the inhibition zone was measured and was compared to the standard diameter of the inhibition zones for each antibiotic.

3. Results and Discussion

A total of 100 swab samples from various surfaces of surgical personnel and equipment within three distinct operating rooms, were collected and processed; of these, 52% were negative. Four bacterial species were isolated and identified in this study, including: *Staphylococcus aureus* (25%), *Pseudomonas aeruginosa* (20%), *Klebsiella pneumoniae* (17%), and *Escherichia coli* (12%).

Previous studies have revealed varying percentages of contaminating bacteria in Iraq (Gram-positive and -negative). *P. aeruginosa*, *E. coli*, and other bacteria have been isolated within three years at the Al-Yarmouk Teaching Hospital in Baghdad, Iraq and, of these, *P. aeruginosa* was the most prevalent (35.8%), followed by *E. coli* (25.9%)[5]. A study carried out in two surgical units at the Abu-Bakr Tafawa Balewa University Teaching Hospital, Bauchi Nigeria has reported high isolated *S. aureus* levels (28.2%), followed by those of *Bacillus* spp. *Acinetobacter* spp., *Klebsiella pneumoniae*, *Enterobacter* spp., and *Enterococcus* spp.[6]. Moreover, according to Abd-Elmonsef *et al.*[7], *P. aeruginosa* and *S. aureus* are the two most common isolates in ICUs.

Antimicrobial resistance is a rising health concern. Success in the correct treatment of patients depends on identifying the resistance pattern of these pathogens in every hospital. The most often isolated bacteria in our study included *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*, and this is why we have herein also assessed their susceptibility to antibiotics (Table 1).

In relation to the antimicrobial susceptibility pattern of the bacteria isolated in our study, numerous published studies have documented the prevalence of resistant Gram-negative bacteria among patients hospitalized in various regions of Iraq. The most common organisms isolated from trauma patients with ventilator-associated pneumonias at a Lebanese tertiary care facility, HAIs in Turkey, and ICUs in Kuwait were found to include *K. pneumoniae*,

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Table 1. Antibiotic susceptibility patterns of pathogenic bacteria isolated from the operating room of the Al Sader Teaching Hospital (Iraq). Abbreviations used: MS, moderately sensitive; R, resistant; S, sensitive.

	Sensitivity to antibiotics			
Antibiotics	*Pseudomonas aeruginosa*	*Staphylococcus aureus*	*Escherichia coli*	*Klebsiella pneumoniae*
amoxicillin and clavulanate	R	R	R	R
cefotaxime	S	R	S	R
imipenem	S	R	S	S
levofloxacin	R	S	S	S
cefixime	R	R	R	R
meropenem	R	R	S	S
tobramycin	R	S	R	S
netilmicin	S	R	S	S
ampicillin and cloxacillin	R	R	R	R
cefdinir	R	R	R	R
nitrofurantoin	R	R	R	R
nalidixic acid	R	R	R	S
norfloxacin	R	R	S	S
gentamycin	R	S	S	R
ofloxacin	R	R	R	R
ceftazidime	R	R	R	R
doxycycline	R	R	MS	R
piperacillin and tazobactam	S	R	S	S

Acinetobacter spp., *P. aeruginosa*, and *E. coli*[8,9]. The factors contributing to the elevated occurrence of these antibiotic-resistant bacteria remain undefined; however, potential associations may exist with the regional infection control protocols, the utilization of antibiotics in inpatient or community settings, or various climate and environmental factors.

4. Conclusion

Our study shows that bacterial contamination from the operating rooms can have a direct and visible impact on hospital infection rates, especially those brought on by HAIs. One of the riskiest places for patients to contract a nosocomial infection is the operation room.

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Conflicts of interest

None exist.

ORCIDs

0009-0006-0859-7747 (H.B. Aljaryan); 0000-0003-4092-1157 (A.K. Al-Shamari); 0009-0001-9768-5047 (A.A. Nayyef); 0009-0003-1170-0870 (T.H. Al-Ameedy); 0009-0008-4152-7040 (H. Rabeea); 0009-0007-6504-5938 (F. Ali)

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