



Isolation of Bacterial Contaminants from Operating Theatres in EnNahud City, West Kordofan State – Sudan

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Authors' contributions

This work was carried out in collaboration among all authors. Authors EANA, MAA, EAYM and AHAE designed the study, collected data, performed the statistical analysis, and wrote the manuscript. Authors MBMB, GMM and BMTG designed the study and were major contributors to writing the manuscript. All authors reviewed the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: The prevalence of nosocomial infections has continued to rise due to microbial contamination of the hospital environment. Operating room contamination, on the other hand, is one of the most common and life-threatening sources of nosocomial infections.

Objective: The goal of this research is to isolate and identify bacterial contaminants in operating rooms and equipment in EnNahud, West Kordofan.

Methods: A total of 45 samples (from three hospitals) were collected from various operating theatre sites between September and December 2020. Using the accepted bacteriological methods

(ISO/TC 147/SC 4 Microbiological techniques), all isolated bacteria were identified. *S. Escherichia coli* ATCC 25922 and *Staphylococcus aureus* ATCC 25923 were employed as control bacterial strains to track the entire bacteriological process.

Results: Five kinds of bacteria were recovered from the 45 (100%) positive specimens in three hospitals in this study. The number of polluted hospitals is on the rise (100%). The most prevalent bacterial pollutants identified from operation theaters were *Staphylococcus aureus* 24 (53.3%), *Pseudomonas aeruginosa* 13 (28.8%), *Bacillus spp* 6 (13.3%), *Proteus spp* 1 (2.2%), and *Salmonella spp* 1 (2.2%), according to the findings (2.2%). All of the places where samples were taken were found to be completely contaminated.

Conclusion: The relatively high degree of bacterial contamination in hospital operating rooms highlights the need for ongoing microbiological surveillance aimed at detecting bacterial contamination levels and their impact on nosocomial infection early.

Keywords: *Bacterial contamination; operating theaters; equipment; West Kordofan State; EnNahud City; Sudan.*

LIST OF ABBREVIATIONS

HAI : Hospital-Acquired Infections.

SSIs: Surgical Site Infections.

1. INTRODUCTION

Theatre contamination is one of the most common sources of nosocomial diseases that can be fatal [1]. The prevalence of nosocomial infections has continued to rise due to microbial contamination of the hospital environment, particularly in operating rooms and other specialty units [2]. The operating room is only for the anesthetic and surgical teams and should not be utilized for anything else; nonetheless, it is one of the most dangerous locations in the health-care system. As a result, microbial contamination in the operating theatre poses a significant risk of surgical site infections (SSIs) during clean surgery [3].

SSIs, which are one of the most common causes of nosocomial infections, are a common surgical consequence [4]. Surgical site infection after caesarean delivery is a common complication that affects 2.5% to 16% of women and is linked to a considerable increase in maternal morbidity, hospital stay, expenses, and psychological stress for new parents [5]. Microbial contamination in the operating room can come from a variety of sources, including frequent movement of the surgical and medical teams, movement within the theatre, a large human population, particularly theatre staff and medical students, theatre gowns, foot wares, wound drainage, and patient transportation. All of these factors contribute to polluting the operating room and, as a result, causing post-operative infection [6].

Hospitals serve as a reservoir for germs, many of which are antibiotic-resistant. Antimicrobial

resistance is a global public health disaster, particularly among bacteria that cause nosocomial infections, which has resulted in increased morbidity, death, rising health-care costs as a result of treatment failure, and longer hospital stays [7]. The rate of nosocomial infections among patients in an institution is a measure of the care's quality and safety. The creation of a surveillance system to track this rate is a critical initial step in identifying local issues and priorities, as well as assessing the efficacy of infection control efforts. Surveillance is an efficient way to reduce the number of hospital-acquired illnesses on its own [8].

The lack of a microbiologically safe environment in the operating room causes a delay in recovery and is linked to SSIs [9]. Regular cleaning in accordance with institutionalized infection control measures can reduce the risk of contamination and prevent hospital-acquired infections (HAI), lowering the morbidity and mortality associated with HAI [10].

In Sudan, only few data are available about the subject under study. Therefore, the goal of this research is to isolate and identify bacterial contaminants in operating rooms and equipment in EnNahud, West Kordofan. Result obtained from this study may help the Sudanese infection control agency to place plan in order to reduce and control distribution of such bacterial contaminants in operating rooms.

2. MATERIALS AND METHODS

2.1 Design of Study

This is a descriptive cross-sectional study carried out to isolate bacterial contaminants in theatres in West Kordofan in EnNuhud City. The study

was carried out during the period from September to December 2020.

2.2 Specimen Collection

After the sterilization process was completed, samples were taken from the target operating theatre. The choice of culture sites is based on the epidemiology and long-term survival of organisms' features. Different samples were collected from various locations in the operating theatre (operation room bed, trolley, floor, focusing lamp, wall, monitor, ventilator, air-conditioning, Dressing drums, cupboard, door, refrigerator, water wash, and the air) by dipping sterile cotton swabs in normal saline and gently swabbing the equipment of interest. The samples were then transferred to the laboratory for bacteriological examination.

2.3 Cultivation of the Specimens and Interpretation of Culture Growth

Under aseptic circumstances, all collected specimens were inoculated on blood agar and incubated aerobically for 24 hours at 37°C. (near Bunsen burner). On the plates, any bacterial colonies that expanded were counted. At first, microscopic analysis and bacterial colony morphology was used to identify bacteria. According to the Gram reaction, the growth was subcultured onto the proper medium, i.e., Gram-positive Staphylococci was grown on Oxoid's 5% Sheep's Blood Agar and Mannitol Salt Agar, and Gram-negative rods were cultured on MacConkey Agar (Oxoid, UK). Biochemical tests were used to do additional identification using the accepted bacteriological procedures (ISO/TC 147/SC 4 Microbiological methods). *S. Escherichia coli* ATCC 25922 and *Staphylococcus aureus* ATCC 25923 were employed as control bacterial strains to track the entire bacteriological process.

2.4 Data Collection and Analysis

Data was collected using a checklist. Then data were entered, checked, and analyzed using

Microsoft Excel 2007 and SPSS (Statistical Package of Social Science) software program version 11.5. Proportional data were presented as frequencies and percentages.

3. RESULTS

The research was carried out in West Kordofan, EnNuhud City, from September to December 2020. A total of 45 swab samples from three hospitals were used in this study. The practical processes were carried out in the West Kordofan University's medical laboratory college's laboratories. The operation room bed, trolley, floor, focusing lamp, wall, monitor, ventilator, air-conditioning, cabinet, door, operation room table, refrigerator, water wash, and the Air were all sample collection sites in the operating theatre. The sites were chosen based on the organisms' known epidemiology and survival properties. Five species of bacteria were recovered and identified from 45 (100%) positive specimens in three operating rooms during this study. *Staphylococcus aureus* was the most commonly isolated bacteria, with 24 (53.3%), *Pseudomonas* 13 (28.8%), *Bacillus* 6 (13.3%), *Proteus spp* 1 (2.2%), and *Salmonella* 1 (2.2%). (Table 1). All of the sites where we were collected were 100% contaminated, including the operating room bed 3(100%), trolley 3(100%), floor 3(100%), focusing lamp 3(100%), wall 3(100%), monitor 3(100%), ventilator 3(100%), air condition 3(100%), dressing drums 3(100%), cupboard 3(100%), door 3(100%), operation room table 3(100%), refrigerator 3(100%), water wash 3(100%), and water wash 3 (Table 2).

4. DISCUSSION

Any hospital's operating rooms should be in a completely sanitary environment. As a result, and obviously, bacterial infection in these operating rooms is extremely harmful to patients and poses a significant risk to healthcare providers. Various microorganisms, primarily bacteria, viruses, fungi, and parasites, are uniquely susceptible

Table 1. Frequency and percentage of isolated organisms

Isolate	Frequency	Percentage
<i>S. aureus</i>	24	53.3%
<i>P. aeruginosa</i>	13	28.8%
<i>Bacillus Spp</i>	6	13.3%
<i>Proteus spp</i>	1	2.2%
<i>Salmonella spp</i>	1	2.2%
Total	45	100%

Table 2. Frequency of isolated bacteria according to the site of collection

Site of sample collection	No	Isolated bacteria
Operation room bed	3(6.6%)	<i>S. aureus</i> 2 (8.3%) <i>P. aeruginosa</i> 1(7.6%)
Trolley	3(6.6%)	<i>S. aureus</i> 2(8.3%) <i>P. aeruginosa</i> 1(7.6%)
Floor	3(6.6%)	<i>S. aureus</i> 2(8.3%) <i>P. aeruginosa</i> 1(7.6%)
Focusing lamp	3(6.6%)	<i>S. aureus</i> 2(8.3%) <i>Bacillus spp</i> 1(16.6%)
Wall	3(6.6%)	<i>S. aureus</i> 2(8.3%) <i>P. aeruginosa</i> 1(7.6%)
Monitor	3(6.6%)	<i>S. aureus</i> 2(8.3%) <i>Salmonella spp</i> 1(100%)
Ventilator	3(6.6%)	<i>S. aureus</i> 1(4.2%) <i>P. aeruginosa</i> 1(7.6%) <i>Bacillus spp</i> 1(16.6%)
Air condition	3(6.6%)	<i>S. aureus</i> 1(4.2%) <i>P. aeruginosa</i> 1(7.6%) <i>Bacillus spp</i> 1(16.6%)
Cupboard	3(6.6%)	<i>S. aureus</i> 1(4.2%) <i>P. aeruginosa</i> 2(15.3%)
Door	3(6.6%)	<i>S. aureus</i> 3(12.5%)
Operation room table	3(6.6%)	<i>S. aureus</i> 1(4.2%) <i>P. aeruginosa</i> 2(15.3%)
Refrigerator	3(6.6%)	<i>S. aureus</i> 2(8.3%) <i>Bacillus spp</i> 1(16.6%)
Water wash	3(6.6%)	<i>S. aureus</i> 1(4.2%) <i>P. aeruginosa</i> 2(15.3%)
Air	3(6.6%)	<i>S. aureus</i> (4.2%) <i>Bacillus spp</i> 2(33.3%)
Dressing drums	3(6.6%)	<i>S. aureus</i> 2(8.3%) <i>Proteus spp</i> 1(100%)
Total	45(100%)	

to contamination in the accompanying structures of operation theatres. We attempted to isolate bacterial pollutants from the operation room in our research. In this study, the rate of contaminated specimens with bacteria was collected from the operating room bed 3(100%), trolley 3(100%), floor 3(100%), focusing lamp 3(100%), wall 3(100%), monitor 3(100%), ventilator 3(100%), air condition 3(100%), cupboard 3(100%), door 3(100%), operation room table 3(100%), refrigerator 3(100%), water wash 3(100%), and air 3(100%). All these locations have more patient contact as well as employees that work in the operating room and deal with patients. However other studies found that the floor was the most common contaminated area in the operating room [11,12]. In this study the bacterial contaminant of the operating room was *Staphylococcus aureus* 24 (53.3%), *Pseudomonas* 13 (28.8%), *Bacillus* 6 (13.3%), *Proteus spp*1 (2.2%), and *Salmonella* 1

were the most commonly isolated bacteria (2.2%). Our findings matched those of Ali SA [11], who found that *Staphylococcus aureus* (30.8%) was the most often isolated bacteria in Sudan [11]. This was in line with a study conducted in India by Kaur and Hans (2007), who found that the most common bacterial contamination in the operating room was *Staphylococcus aureus* (16%), *Coagulase Negative Staphylococcus* is a normal skin flora of the patients and the staff working in the theatres. Droplet and nuclei contaminated with *Staphylococcus* can infect not only the wounds but also the ground, shelves, and lamps of the operating rooms. Furthermore, the findings contradicted those of an Altom RB, 2013 study conducted in Sudan, which found that *Pseudomonas aeruginosa* (32.5%) was the most commonly isolated bacteria [12]. Antiseptic solutions were a likely source of contamination for *Pseudomonas aeruginosa*, which is an

opportunistic pathogen that may be found in most damp situations. It also possesses a number of characteristics, including the ability to live and propagate in hospital settings, the acquisition of several virulence determinants, and inherent resistance to routinely used antibiotics and disinfectants. This makes *Pseudomonas aeruginosa* a prominent nosocomial infection responsible for numerous outbreaks in operating rooms, and the second most common bacteria in our study [13]. In this study *Bacillus subtilis* was isolated (13.3%) which is considered a contaminant. A recent study carried out by Kiranmani and Madhavi, 2016 in operating theatres and intensive care units of a teaching hospital in Telangana in India reported that *Bacillus subtilis* 45% (contaminants) were the most common isolates followed by *Proteus spp* (2.2%) and salmonella (2.2%) were commonly isolated from operating theatre but by low percent [2]. The high prevalence of nosocomial infections had been greatly influenced by bacterial contamination of operating rooms [14]. The after-operative or open wound that may arise while dressing or contaminated air atmosphere in the operating room and other specialized units, the consequent effect of bacterial contamination is considerably more prominent. In clean surgery, microbiological contamination of the air in the operating theater is typically thought to be a risk factor for surgical site infections. The microbiological quality of the air may be viewed as a reflection of the operating rooms' sanitary state. Indoor air quality is influenced by both internal and external factors, including ventilation, cleaning practices, the surgical team, and their activities [15,16]. The requirements for environmental infection control in healthcare facilities should always be followed since unnecessary staff movement during surgery can result in air stream surrounding the open wound. Laminar air flow ventilated operating rooms provide high-quality air during surgery [16].

5. CONCLUSION

The rate of bacterial contamination of the target operating theatre in this study was 100%. The most common contaminant species found in the different operating theatres (*S. aureus* and *P. aeruginosa*) had some relation to the kind of operation. This may indicate that sterilization methods are not efficient in our operating theatres and are putting patients at risk of postoperative infections. Implementation of comprehensive infection control programs and

surveillance of infections, in hospitals by the infection control committee. Health education of hospital staff, to protect themselves and the patients from the contaminating bacteria, as well as from spreading pathogenic bacteria themselves.

6. LIMITATION

This study was used only conventional culture technique to detect presence or absence of bacterial contamination, in addition the detection of antibiogram may also be valuable which was not done in this study.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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ETHICAL APPROVAL

Permission to carry out this study was obtained from the College of Medical Laboratory Science, West Kordofan University and Public Health hospital the Administration.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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