International Journal of Pathogen Research

Volume 12, Issue 2, Page 16-21, 2023; Article no.IJPR.97531
ISSN: 2582-3876

Detection of Common Bacterial Pathogen in Hospital and Lab Settings and Their Anti-microbial Susceptibility Pattern in Various Medical Laboratories in Shendi Town, Sudan

Leila Mohamed A. Abdelgade [a], Mohamed Alrsheed Ahmed [a], Ghanem Mohammed Mahjaf [a] and Babbiker Mohammed Taher Gorish [b*]

[a] *Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Shendi University, Sudan.*
[b] *Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Omdurman Islamic University, Sudan.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPR/2023/v12i2222

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/97531

Original Research Article

Received: 11/01/2023
Accepted: 15/03/2023
Published: 28/03/2023

ABSTRACT

Background: Laboratory infections can be classified as occupational and nosocomial infections. Laboratory-related infections are generally recognized as a potential risk for clinical laboratory workers. Some bacteria can survive longer on dry surfaces and more on wet surfaces that can infect others and also environments.

**Corresponding author: Email: qorish456@gmail.com;*

Objective: To detect common bacterial pathogens in various medical laboratories in Shendi City.
Materials and Methods: A cross-sectional analytical study was conducted in Shendi City (Sudan) from August to December 2021. This study included 17 laboratories and 50 samples collected by wet exchange from various locations including laboratory surfaces, microscopes, centrifuges, CBC devices, staining racks, and CBC devices.
Results: This study included *Staphylococcus aureus* (No=11) (22%), *Staphylococcus epidermidis* (No=10) (20%), *Escherichia coli* (No=1) (2%), *Klebsiella pneumonia* (No=9) (18%), and *Pseudomonas aeruginosa* (No=2) (4%). Significant growth of pathogenic bacteria was recoded. Among all the organisms isolated, there was moderate resistance to antibiotics, some bacteria were very resistant, others were resistant, and some organisms were resistant to some antibiotic they were highly sensitive to the substance and resistant to other antibacterial agents. Bacterial isolates (39.4%) were resistant to Amoclane, (No=12) (36.4%) were resistant to gentamicin, and (No=11) (33.3%) were resistant to Ciprofloxacin and Imipenem.
Conclusions: Contamination with pathogens was found on laboratory surfaces and equipment's (approximately 66% of exchanged items contained pathogens), and dry surfaces may use these organisms as a source of laboratory infection.

Keywords: Laboratory infections; nosocomial infections; Staphylococcus aureus; Shendi; Sudan.

1. INTRODUCTION

Working with pathogenic microorganisms requires good laboratory practices, risk assessments, and bio safety/bio security measures to ensure the safety of personnel, communities, and the environment from accidental or intentional infection. Occupational infections of laboratory personnel, called laboratory infections (LAI). Accidental or exposure events leading to LAI may include inhalation of infectious aerosols or contact with mucous membranes, droplets, contacts, spills, or transmission via per cutaneous routes (bites, cuts, accidental self-inoculation). However, in many of LAI cases, the actual cause often remains unknown or uncertain [1]. Nosocomial infections can be defined as infections that occur in patients in hospitals or other healthcare facilities where the infection was absent or latent at the time of admission. These include nosocomial but post-discharge infections and occupational infections among facility staff [2]. Nosocomial infections are known worldwide and, despite scientific and technological health advances, and the are represent a major concern, especially in developing countries, due to limited resources [3]. Healthcare-associated infections (HAIs) are an important cause of inpatient morbidity and mortality. The severity of infection depends on the characteristics of the microorganisms involved and the frequency of resistant pathogens in hospital settings [2]. Several recent studies suggest that environmental contamination plays an important role in nosocomial infections with multidrug-resistant bacteria (MDROs), viruses, mycobacteria, and fungi [4]. Cross-infection of these pathogens can occur through the hands of healthcare workers, directly by contact with patients, or indirectly by touching environmental surfaces. Less commonly, direct contact with contaminated environmental surfaces can lead to patient colonization [4]. The role played by medical devices and work surfaces in transmitting these organisms inevitably contributes to increased mortality, morbidity, and antibiotic resistance [3]. The emergence of multidrug-resistant bacteria has exacerbated this problem, especially in resource-poor countries, as a result of overuse, abuse, and inadequate antimicrobial management policies in healthcare systems. Broad-spectrum and first-line antibiotics are widely used and resistance is exacerbated due to the lack of hospital antimicrobial teams and strict adherence to treatment guidelines [5,6]. This resistance results in longer hospital stays and a total economic burden due to treatment with correspondingly higher morbidity and mortality [3]. The implementation of surface microbiological controls in healthcare facilities is part of the policy to prevent nosocomial infections. Preventive and corrective actions can be implemented with a better understanding of microbial ecology, demonstrating that monitoring the hospital environment is an essential component in controlling nosocomial infections [7].

This study was aimed to detect common bacterial pathogens in various medical laboratories in Shendi City.

2. MATERIALS AND METHODS

2.1 Study Design

This is an analytical cross-sectional study aimed at determining the types of pathogenic bacteria found in the laboratory setting and their susceptibility to antibiotics.

2.2 Study Area

A medical research institute in Shendi, Nile State, Sudan.

2.3 Study Population

Medical laboratories at the Shendi Local Market.

2.4 Inclusion Criteria

All surfaces and equipment.

2.5 Sampling

All surfaces and equipment are included in the sampling.

2.6 Data Collection Tools

Data were collected from the results of actual bacterial cultures of the collected samples.

2.7 Collection of Samples

Samples were collected from surfaces and equipment with saline-soaked swabs and transferred to the Shendi University Microbiology Laboratory in approximately 30 min.

2.8 Culturing of Samples

All samples were cultured on MacConkey agar and blood agar and subculture to obtain pure bacteria.

2.9 Antimicrobial Susceptibility Testing

Isolated bacteria were tested for antimicrobial susceptibility using the standard Kirby-Bauer disc diffusion method. Gram-positive bacteria were tested for susceptibility to Co-amoxiclav, ceftriaxone, ciprofloxacin, and gentamicin.

2.10 Data Analysis

Data were manually analyzed and presented in tables.

3. RESULTS

In this study, 50 swabs samples have been amassed from different sites in the laboratories inclusive of surfaces, microscopes, centrifuges, staining racks, and CBC devices, The percentage of a pathogenic microorganism was as follows: the table surfaces confirmed a relatively infected location at 11 (92%) swabbed surfaces, approximately 9 (89%) of centrifuges incorporate pathogenic microorganism, 4 (67%) of CBC gadgets incorporate pathogenic microorganism, 10 (56%) of microscopes were infected with the aid of using a pathogenic microorganism, the racks which can be used for staining display the decrease wide variety of pathogens 14% only. Eight samples of the amassed 50 samples confirmed no increase in microorganisms. From the isolated microorganism, 9 cultures confirmed the natural increase of gram-high-quality bacilli (18% of all cultures incorporate increase), in keeping with gram stain and colonial morphology, it changed into *Bacillus* species, additionally. *Bacillus* species changed into determined blended with the different pathogenic microorganism in lots of cultures, the Gram-positive cocci have been 21 microorganisms (42% of all isolated microorganism), 12 microorganisms have been Gram-negative bacilli (24%) (Table 1). The species of these bacteria according to the site of sample collection were showed in the (Table 2). The isolated Gram-positive cocci encompass *Staphylococcus aureus* 11 (22% of all isolated microorganisms), *Staphylococcus epidermidis* 10 (20%), the Gram-negative bacilli encompass *Klebsiella pneumonia* 9 (18%), *Escherichia coli* 1 (2%), *Pseudomonas aeuroginosa* 2 (4%) (Table 3). The result of antimicrobial susceptibility changed into proven in Tables 4,5.

Table 1. The percentage of gram-positive and gram-negative among isolated bacteria

Age group	*Frequency*	*Percent %*
Gram positive cocci	21	42%
Gram negative bacilli	12	24%
Gram positive bacilli	09	18%
Gram positive bacilli mixed with other species	20	40%
No growth	08	16%
Total	62	100.0

Table 2. The isolated bacteria according to site of sample collection

Type	MIC	STR	CEN	DS	CBC
No growth	5	1	0	0	2
S. aureus	3	0	3	3	2
S. epidermidis	2	1	3	3	1
E. coli	1	0	0	0	0
K. pneumoniae	3	0	2	3	1
P. aeuroginosa	0	0	0	2	0
Bacillus spp	10	4	8	4	3

Table 3. The percentage of isolated bacterial species

Type	No	Percent %
S. aureus	11	22%
S. epidermidis	10	20%
E. coli	01	02%
K. pneumoniae	00	18%
P. aeruginosa	02	04%
Total	33	100%

Table 4. The number of resistant bacteria among all isolatedorganisms of to antibiotics

Antibiotics	Resistant
Co-amoxiclav	13 (39.4%)
Ceftriaxone	15 (45.4%)
Ciprofloxacin	11 (33.3%)
Gentamycin	12 (36.4%)
Imipenem (Gram negative)	4 (33.3%)

Table 5. Sensitivity of the *isolated bacteria* to the antibiotics

Antibiotics	Sensitive	Resistant
Sensitivity of *Staphylococcus aureus*		
Co-amoxiclav	7 (63.6%)	4 (36.4%)
Ceftriaxone	3 (27.3%)	8 (72.2%)
Ciprofloxacin	4 (36.4%)	7(63.6%)
Gentamycin	9 (81.8%)	2 (18.2%)
Sensitivity of S. epidermidis		
Co-amoxiclav	5 (50%)	5 (50%)
Ceftriaxone	2 (20%)	8 (80%)
Ciprofloxacin	3 (30%)	7 (70%)
Gentamycin	4 (40%)	6 (60%)
Sensitivity of *E. coli*		
Co-amoxiclav	0	1(100%)
Ceftriaxone	0	1(100%)
Ciprofloxacin	0	1(100%)
Gentamycin	0	1(100%)
Sensitivity of *K. pneumoniae*		
Co-amoxiclav	5 (55.6%)	4 (44.4%)
Ceftriaxone	1 (11.1%)	8 (88.9%)
Ciprofloxacin	5 (55.6%)	4 (44.4%)
Gentamycin	4 (44.4%)	5 (55.6%)
Imipenem	6 (66.7%)	3 (33.3%)
Sensitivity of *P. aeruginosa*		
Co-amoxiclav	1 (50%)	1 (50%)
Ceftriaxone	0	2 (100%)
Ciprofloxacin	0	2 (100%)
Gentamycin	1 (50%)	1 (50%)
Imipenem	0	2 (100%)

4. DISCUSSION

This study was conducted from August to December 2021 to detect bacterial contamination found in laboratories. It was conducted in Shendi City. This study included 17 laboratories and the number of samples collected was 50 samples collected from different locations, including laboratory surfaces, microscopes, centrifuges, staining racks, and CBC machines. This study showed that there was significant growth of pathogenic bacteria other bacteria accounted for (40%) of all isolated pathogenic bacteria; included. 10 *Staphylococcus epidermidis* (20%), 1 *Escherichia coli* (2%), 9 *Klebsiella pneumoniae* (18%), 2 *Pseudomonas aeruginosa* (4%). Antimicrobial susceptibility did not affect the *Bacillus spp*, so it was not pathogenic. *Staphylococcus aureus* showed the highest percentage. This is consistent with study conducted in 2018 they found that: 75.4% of contaminant bacteria in post-operative wards are *Staphylococcus aureus* [3]. Also, agreed with another study that done in 2019 [2]. Other prevalent bacteria include coagulase-negative *staphylococci* and *Klebsiella pneumonia*. This finding is agreement with previous study done in 2018 [3]. Considering antimicrobial susceptibility and antibiotic resistance, the antibiotics tested in this study were imipenem for Gram-negative bacteria only and co-amoxiclav, ceftriaxone, and ciprofloxacin for both Gram-negative and Gram-positive bacteria, and gentamicin. Among all organisms isolated, there was moderate resistance to antibiotics, some bacteria are highly resistant, others are susceptible, and some organisms are highly susceptible to certain types of antibiotics and resistant to other antibacterial agents. Ceftriaxone has a high rate of resistance, with approximately 15 (45.4%) of the isolates resistant to this antibiotic indicated by Amoclane and 13 (39.4%) of the isolates resistant to Amoclane, 12 (36.4%) bacteria are resistant. are resistant to gentamicin and 11 (33.3%) bacteria are resistant to ciprofloxacin and imipenem. The high resistance to ceftriaxone and amoclane indicates that these antibiotics are frequently prescribed by doctors in our country without testing the antimicrobial susceptibility to these antibiotics, or without shedding the prescribed dose. It has been suggested that this is due to patients using unreasonably large amounts. I oppose the use of these antibiotics. Among the isolated bacteria, only one sample showed growth of *Escherichia coli (*100%) resistant to all antibiotics, and two samples had *Pseudomonas aeruginosa* with high antibiotic resistance and susceptibility to Amoclane. *K. pneumoniae* showed the highest resistant to Ceftriaxone, about 8 (88.9%) of isolated bacteria and highly susceptible to Imipenem, while *staphylococcus epidermis* showed the highest resistant to Ciprofloxacin, about 7 bacteria (70%) followed by *S. aureus*, about 7 bacteria (63.6%) and 9 bacteria (82%) of *S. aureus* susceptible to Gentamycin, *Staphylococcus epidermidis* show proportionally high resistant to almost all antibiotics, than other isolated bacteria and have proportionally low sensitivity.

5. CONCLUSION

At the end of this study, contaminating pathogenic bacteria were found on laboratory surfaces and equipment, and the bacterial species isolated were *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli, Klebsiella pneumoniae,* and *Pseudomonas aeruginosa*. Some of these bacteria are multi-drug resistant and most of them can survive on dry surfaces for long periods. Due to poor personal hygiene, laboratory workers can become infected with these organisms and pass them on to patients, colleagues, the community, and others. Laboratory workers and other healthcare workers may also hand-infect these organisms in other areas of the healthcare center, such as patient wards and intensive care units, where susceptible populations are found, which can lead to the spread of these microbes. Lack of infection control programs and regular surveillance of laboratory infections may also act as pathways to the spread of nosocomial infections. Improper cleaning and disinfection of laboratory surfaces and equipment can lead to high levels of laboratory contamination.

ETHICAL APPROVAL

Ethical approval for the study was obtained from the Board of the Faculty of Graduates Studies at Shendi University.

ACKNOWLEDGEMENTS

The authors are thankful to the Department of Microbiology, Faculty of Medical Laboratory Sciences, Shendi University, Shendi, Sudan, for their support during the study period.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Siengsanan-Lamont J, Blacksell SD. A Review of Laboratory-Acquired Infections in the Asia-Pacific: Understanding Risk and the Need for Improved Biosafety for Veterinary and Zoonotic Diseases. Trop Med Infect Dis. 2018;3(2):36.
DOI: 10.3390/tropicalmed3020036
PMID: 30274433; PMCID: PMC6073996
2. Chaoui L, Mhand R, Mellouki F, Rhallabi N. Contamination of the surfaces of a health care environment by multidrug-resistant (MDR) bacteria. Int J Microbiol. 2019; 2019:3236526.
DOI: 10.1155/2019/3236526
PMID: 31871459; PMCID: PMC6906863
3. Sserwadda I, Lukenge M, Mwambi B, Mboowa G, Walusimbi A, Segujja F. Microbial contaminants isolated from items and work surfaces in the post- operative ward at Kawolo General Hospital, Uganda. BMC Infect Dis. 2018;18(1):68.
DOI: 10.1186/s12879-018-2980-5
PMID: 29409447; PMCID: PMC5801902
4. Suleyman G, Alangaden G, Bardossy AC. The role of environmental contamination in the transmission of nosocomial pathogens and healthcare-associated infections. Curr Infect Dis Rep. 2018;20(6):12.
DOI: 10.1007/s11908-018-0620-2
PMID: 29704133
5. Menon RU, George AP, Menon UK. Etiology and anti-microbial sensitivity of organisms causing community acquired pneumonia: a single hospital study. Journal of family medicine and primary care. 2013 Jul;2(3):244.
6. Pondei K, Oladapo O, Kunle-Olowu OE. Anti-microbial susceptibility pattern of micro-organisms associated with urinary tract infections in a tertiary health institution in the Niger Delta Region of Nigeria. African Journal of Microbiology Research. 2012 Jun 21;6(23):4976-82.
7. Lalami A, El Ouali, et al. Microbiological monitoring of environment surfaces in a hospital in Fez city, Morocco surveillance microbiologique des surfaces de l'environnement d'un hôpital dans la ville de Fès, au Maroc. Journal of Materials and Environmental Science. 2016;7(1):123-130.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/97531