Journal of Pharmaceutical Research International

31(5): 1-5, 2019; Article no.JPRI.52712
ISSN: 2456-9119
(Past name: British Journal of Pharmaceutical Research, Past ISSN: 2231-2919, NLM ID: 101631759)

Antibiotic Resistance Patterns in a University Hospital in Al-Kharj City

Nehad J. Ahmed[1*] and Mohd F. Khan[1]

[1]Department of Clinical Pharmacy, College of Pharmacy, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia.

Authors' contributions

This work was carried out in collaboration between all authors. Author NJA designed the study, performed the statistical analysis, wrote the protocol, managed the literature searches and wrote the first draft of the manuscript. Author MFK managed the analyses of the study.

Article Information

DOI: 10.9734/JPRI/2019/v31i530310
Editor(s):
(1) Dr. Syed A. A. Rizvi, Department of Pharmaceutical Sciences, Nova Southeastern University, USA.
Reviewers:
(1) Rd Mavunda, University of Johannesburg, South Africa.
(2) Syed Umer Jan, University of Balochistan, Pakistan.
(3) Bagiu Radu-Vasile, Victor Babeş University of Medicine and Pharmacy, Romania.
Complete Peer review History: http://www.sdiarticle4.com/review-history/52712

Original Research Article

Received 01 September 2019
Accepted 08 November 2019
Published 14 November 2019

ABSTRACT

Introduction: Antibiotics are medications that are used to kill a bacterium which causes different infections. The misuse of these medications has contributed to the development of bacterial resistance. In order to predict the efficacy of the antimicrobial drugs and to guide antimicrobial therapy, antibiogram should be used.
Objective: This study aims to explore the Antibiotic resistance patterns in a university hospital in AL-kharj city.
Methods: Data from a university hospital in Al-Kharj city were used to assess the *in vitro* antimicrobial susceptibility rates for different types of bacteria. We included all bacterial and fungal cultures in the last 2 years.
Results: The most common bacterium was *E. coli* and the most common fungus pathogen was *Candida albicans*. There was a low resistance rate to gentamicin, imipenem, meropenem and amikacin for the studied bacteria pathogens and high resistance rate for some antibiotics such as erythromycin, tetracycline and ampicillin.
Conclusion: The physicians should follow the treatment guidelines and they should know the susceptibility rate of different bacteria to prescribe antibiotics appropriately.

**Corresponding author: E-mail: n.ahmed@psau.edu.sa, pharmdnehadjaser@yahoo.com;*

Keywords: Antibiotic; resistance patterns; hospital; Al-Kharj.

1. INTRODUCTION

Antibiotics are medications that are used to kill a bacterium which causes different infections and they have saved the life of several patients. However, the misuse of these medications has contributed to the development of bacterial resistance and leads to the reduction or the elimination of the effectiveness of antibiotics [1].

Historically, bacterial pathogens have been a main reason of diseases and death. The development of antimicrobial drugs provided an effective management for bacterial infections [2-5]. Nowadays, many bacteria have evolved resistance to different antibiotics, and multidrug-resistant bacteria have resulted in untreatable infections. Therefore, this problem becomes a major threat to the human beings [6-11].

Centers for Disease Control and Prevention reported that antibiotic resistance causes around two million infections, more than twenty thousand deaths and, costs about 55 billion $ each year in the United States [12]. In Europe, about twenty five thousand people pass away yearly due to antibiotic-resistant infections [13].

Antimicrobial susceptibility testing is a key activity in diagnostic microbiology [14]. It is based on testing the capability of antibiotics to inhibit the growth of clinical isolates under standardized experimental conditions [14]. The results of antibiogram are used to predict the efficacy of the tested antimicrobial drugs and to guide antimicrobial therapy, when taken either on a cumulative basis or on an individual basis [14].

The antibiogram is a summary of antimicrobial susceptibilities of bacterial isolates that are submitted to the microbiology laboratory [15,16]. Antibiograms are frequently used by physicians to measure the local susceptibility rates to help in selecting empirical antibiotic therapy, to predict the causal resistance mechanisms, and also help in observing resistance trends over time [15,16].

This study aims to explore the Antibiotic resistance patterns in a university hospital in Al-kharj city.

2. METHODS

To provide further insights on the Antibiotic resistance patterns we used data from a university hospital in Al-Kharj city to assess *in vitro* antimicrobial susceptibility rates for different types of bacteria. The results of bacterial cultures in the last 2 years (2017 and 2018) were included in the study. We included all bacterial and fungal cultures in this period and excluded the cultures before 2017.

The bacterial cultures were collected from the microbiology laboratory in the university hospital separately and we collect these results and prepare antibiogram table for antibiotics and antibiogram table for antifungals.

The antibiogram is prepared by using excel sheet to calculate the number of bacteria that were resistant and the number of bacteria that were susceptible to the antibiotics after that we calculate the percentage of susceptibility and prepared the antibiogram.

The study is approved by the institutional review board PSAU/COM/RC/IRB/A/20.

3. RESULTS AND DISCUSSION

During the last two years there were only 92 cultures, 79 bacterial cultures and 13 fungal

Table 1. The numbers and percentages of different bacterial cultures

Bacterial isolates	Number	Percentage
Acinetobacter baumannii	1	1.266%
E. coli	21	26.58%
Morganella morganii	1	1.266%
Enterococcus faecalis	11	13.92%
Enterobacter cloacae	1	1.266%
Klebsiella pneumoniae	13	16.455%
Sphingomonas paucimobilis	2	2.53%
Streptococcus agalactiae	5	6.33%
Staphylococcus epidermidis	1	1.266%
Streptococcus pyogenes	3	3.797%
Pseudomonas aeruginosa	10	12.66%
Staphylococcus aureus	10	12.66%
Total	**79**	

Table 2. The numbers and percentages of different fungal cultures

	Number	Percentage
Candida albicans	10	76.92%
Candida glabrata	1	7.69%
Candida parapsilosis	1	7.69%
Candida rugosa	1	7.69%
Total	**13**	

Table 3. The susceptibility of different bacteria to antibiotics

	Acinetobacter baumannii	*E. coli*	*Morganella morganii*	*Enterococcus faecalis*	*Enterobacter cloacae*	*Klebsiella pneumoniae*	*Sphingomonas paucimobilis*	*Streptococcuse agalacticae*	*Staphylococcus epidermidis*	*Strepto pyogens*	*Pseudomonas aerginosa*	*Staphylococcus aureus*
Ampicillin	100	38.88	0	-	-	0	0	100	-	100	0	-
Pipracillin/tazobactam	100	90.47	100	-	100	100	100	-	-	-	40	-
Ceftazidime	100	66.66	0	-	100	92.3	0	-	-	-	90	-
Cefepim	100	70	0	-	-	100	100	-	-	-	90	-
Aztreonam	0	0(2)	0	-	-	-	0	-	-	-	-	-
Imipenem	100	95	100	-	100	100	100	-	-	-	90	-
Meropenem	100	95.23	100	-	100	100	100	-	-	-	80	-
Trimethoprim/sulfamethoxazole	100	55	100	0	100	100	0	100	100	100	14.28	83.33
Gentamycin	100	95.23	100	-	100	100	100	-	100	-	100	91.66
Tobramycin	100	-	100	-	-	-	100	-	0	-	100	83.33
Ciprofloxacin	100	85	100	-	100	100	0	-	-	-	100	-
Levofloxacin	100	-	100	100	-	-	0	100	100	100	100	58.33
Minocycline	100	100(2)	0	-	-	-	100	-	-	-	14.28	-
Tigecycline	100	66.66(6)	-	100	-	100(4)	-	100	-	-	16.66	100(1)
Colistin	100	100(2)	0	-	-	-	0	-	-	-	100	-
Ceftriaxone	-	72.22	-	-	100	100	-	100	-	100	-	-
Amikacin	-	95.23	100	-	100	100	100	-	-	-	100	-
Nitrofurantoin	-	88.88	-	80	100	50	-	-	100	-	-	100
Moxifloxacin	-	-	-	75	-	-	-	100	100	-	-	66.66
Erythromycin	-	-	-	18.18	-	-	-	25	0	66.66	-	66.66
Clindamycin	-	-	-	25	-	-	-	20	100	100	-	75
Linezolid	-	-	-	100	-	-	-	100	100	100	-	100
Teicoplanin	-	-	-	100	-	-	-	-	100	-	-	100
Vancomycin	-	-	-	90.9	-	-	-	100	100	100	-	100
Tetracycline	-	-	-	0	-	-	-	20	0	66.66	-	91.66
Benzylepenecillin	-	-	-	-	-	-	-	100	0	100	-	8.33

cultures. The most common bacteria pathogenswere E. coli (26.58%) followed by *Klebsiella pneumoniae* (16.45%), *Enterococcus faecalis* (13.92%), *Pseudomonas aeruginosa* (12.65%) and *Staphylococcus aureus* (12.65%). The most common fungi pathogen was Candida albicans (76.92%). The numbers of different bacterial cultures is shown in Table 1 and the numbers of different fungal cultures is shown in Table 2.

Different bacteria pathogens showed different resistance rate for different antibiotics. Thesusceptibility rate of different bacteria to antibiotics is shown in Table 3.

The results showed that the majority of the studied antibiotics are appropriate for the treatment of infections caused by *acinetobacter baumannii* due to the low resistance rate for antibiotics except for aztreonam. For the

Table 4. The susceptibility of different fungi to antifungals

	Candida albicans	*Candida glabrata*	*Candida parapsilosis*	*Candida rugosa*
fluconazole	100	100	100	100
voriconazole	100	100	100	100
caspofungin	100	100	100	100
micafungin	100	100	100	100
amphotericin B	90	100	100	100
flucytosine	100	100	100	100

treatment of E.coli infections, many antibiotics can be used except ampicillin and aztreonam due to the high resistance rate for these antibiotics. Morganella morganii showed high resistance rate to ampicillin, ceftazidime, cefepim, aztreonam, minocycline and colistin. Additionally, *enterococcus faecalis* showed high resistance rate to trimethoprim/sulfamethoxazole, clindamycin and to tetracycline and *klebsiella pneumoniae* is highly resistant to ampicillin and to nitrofurantoin.

The result also showed that *sphingomonas paucimobilis* is highly resistance to ampicillin, ceftazidime, aztreonam, trimethoprim/ sulfamethoxazole, ciprofloxacin, levofloxacin and colistin. Moreover, it is inappropriate to treat infections caused by *streptococcuse agalacticae* with erythromycin, clindamycin and tetracycline due to the highly resistance rate to these antibiotics.

The susceptibility of *staphylococcus epidermidis* is low to tobramycin, erythromycin, tetracycline and benzylepenecillin and the susceptibility of *pseudomonas aeruginosa* is low to ampicillin, pipracillin/tazobactam, trimethoprim/ sulfamethoxazole, minocycline and tigecycline.*Streptococcus pyogenes* and *enterobacter cloacae* showed low resistant rate for the studied antibiotics. Moreover, *staphylococcus aureus* is susceptible to the majority of antibiotics except to benzylepenecillin and moderately susceptible to levofloxacin.

Generally, there were low resistance rate for gentamicin, imipenem, meropenem and amikacin for the studied bacteria pathogens and high resistance rate for some antibiotics such as erythromycin, tetracycline and ampicillin.

Different fungi showed low resistance rate for different Antifungals. The susceptibility of different fungi to antifungals is shown in Table 4.

Generally, the susceptibility is very high and the resistance rate is low for the studied fungi to different antifungals.

The main limitation in this study is the availability of few bacterial and fungal cultures in the hospital, there were only 79 bacterial cultures and 13 fungal cultures in the last 2 years. So the results can give insight about the resistance pattern but these results are not conclusive and to give accurate results more cultures should be collected to prepare the antibiogram.

4. CONCLUSION

The misuse of antibiotics increases the development of antibiotic resistance that leads to the reduction or effectiveness of antibiotics. Therefore, to prescribe the appropriate antibiotics, the physicians should follow the treatment guidelines and additionally they should know the susceptibility rate of different bacteria to antibiotics by preparing the antibiogram which will help in selecting the appropriate antibiotics that should be used.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. U.S. Food and Drug Administration. Combating Antibiotic Resistance. [Online]; 2019.
Available:https://www.fda.gov/consumers/consumer-updates/combating-antibiotic-resistance
[Accessed 31 Oct. 2019]

2. MacLean R, San Millan A. The evolution of antibiotic resistance. Science. 2019; 365(6458):1082-1083.
3. Rattan A. Multidrug-resistant Mycobacterium tuberculosis: Molecular Perspectives. Emerging Infectious Diseases. 1998;4(2):195-209.
4. Boucher H, Talbot G, Bradley J, Edwards J, Gilbert D, Rice L, Scheld M, Spellberg B, Bartlett J. Bad Bugs, No Drugs: No ESKAPE! An Update from the Infectious Diseases Society of America. Clinical Infectious Diseases. 2009;48(1):1-12.
5. Saravanan M, Niguse S, Abdulkader M, Tsegay E, Hailekiros H, Gebrekidan A, Araya T, Pugazhendhi A. Review on emergence of drug-resistant tuberculosis (MDR & XDR-TB) and its molecular diagnosis in Ethiopia. Microbial Pathogenesis. 2018;117:237-242.
6. Gillespie S. Evolution of Drug Resistance in Mycobacterium tuberculosis: Clinical and Molecular Perspective. Antimicrobial Agents and Chemotherapy. 2002;46(2): 267-274.
7. Otto M. Staphylococcus epidermidis — the 'accidental' pathogen. Nature Reviews Microbiology. 2009;7(8):555-567.
8. Schaefler S. Staphylococcus epidermidis BV: Antibiotic resistance patterns, physiological characteristics, and bacteriophage susceptibility. Appl Microbiol. 1971;22(4):693-699.
9. Saravanan M, Ramachandran B, Barabadi H. The prevalence and drug resistance pattern of extended spectrum β–lactamases (ESBLs) producing Enterobacteriaceae in Africa. Microbial Pathogenesis. 2018;114:180-192.
10. Leopold S, van Leth F, Tarekegn H, Schultsz C. Antimicrobial drug resistance among clinically relevant bacterial isolates in sub-Saharan Africa: A systematic review. Journal of Antimicrobial Chemo-therapy. 2014;69(9):2337-2353.
11. Eady EA, Gloor M, Leyden JJ. Propionibacterium acnes resistance: A worldwide problem. Dermatology. 2003; 206(1):54-56.
DOI: 10.1159/000067822
12. Centers for Disease Control and Prevention. The biggest antibiotic-resistant threats in the U.S. [online]; 2019.
Available:https://www.cdc.gov/drugresistance/biggest-threats.html
[Accessed 31 Oct. 2019]
13. Lorig KR, Sobel DS, Ritter PL, et al. Effect of a self-management program for patients with chronic disease. Effective Clinical Practice. 2001;4:256–62.
14. Courvalin P, Leclercq R, Rice L. Antibiogram. Portland, Or: ESKA Pub; 2010.
15. Joshi S. Hospital antibiogram: A necessity. Indian Journal of Medical Microbiology. 2010;28(4):277.
16. Tascini C, Sozio E, Viaggi B, Meini S. Reading and understanding an anti-biogram. Italian Journal of Medicine. 2016; 10(4):289-300.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/52712