Medical Laboratory Journal
Online ISSN: 2538-4449
Golestan University of Medical Sciences

Bacteriological profile of pyogenic infections and their antimicrobial susceptibility in a tertiary care hospital in central India

Bhawana Bajare [1]*, Akanksha Dhangar [1], Supriya Tankhiwale [1], Sunanda Shrikhande [1]

1. Government medical college and hospital, Nagpur, Maharashtra, India
* Correspondence: Bhawana Bajare. Government Medical College & Hospital, Nagpur (M.S). Tel: +919595529982; Email: bhavnabajare@gmail.com

Abstract

Background: Pyogenic infection is a significant cause of morbidity. Infection with multidrug-resistant strains poses a major difficulty in the treatment. The study was conducted to know the bacteriological profile of pyogenic infections and their antibiotic susceptibility.

Methods: A cross-sectional study was conducted in a tertiary care hospital from October 2021 to March 2022. Isolates from pus specimens were subjected to an antibiotic sensitivity test using the Kirby-Bauer method as per CLSI 2021.

Results: Out of 752 samples, etiology could be revealed in 510 (68.4%) specimens. *Enterobacterales* dominated the profile, with K pneumoniae isolated in the maximum number of specimens. Staphylococcus aureus was the culprit in 14% of the cases. Non-fermenters were isolated in 17% of the cases. Methicillin resistance in S aureus was 67%. Gram-positive cocci showed high sensitivity to linezolid. For both Piptaz and carbapenem, *Enterobacterales* and non-fermenters showed around 50% and 60% susceptibility, respectively.

Conclusion: Continuous surveillance of the aetiologic agents of pyogenic infections and their antibiotic sensitivity pattern needs to be done to design and implement the antibiotic policy for the infection in our set-up.

Article History

Received: 4 March 2023
Received in revised form: 12 July 2023
Accepted: 6 March 2024
Published online: 29 April 2024
DOI: 10.29252/mlj.18.2.16

Keywords

Pyogenic infections
MRSA
Carbapenem-resistant *Enterobacteriaceae*

Article Type: Original Article

Introduction

Globally, infectious diseases have become the major and important causes of morbidity and mortality, whether in the community or hospital settings. Each year, nearly 25% of estimated deaths are due to infectious diseases out of a total of 60 million deaths worldwide (1). The crude mortality rate due to infectious diseases in India is approximately 417 per one lakh population (2).

Pyogenic infections are infections involving the production of pus at the site of local inflammation of the skin, soft tissue, and other body parts caused by the invasion and multiplication of pathogenic microorganisms (3). During infection, macrophages release cytokines, triggering neutrophils to reach the site of infection by chemotaxis. There, neutrophils release granules, which destroy the bacteria. The bacteria resist the immune response by releasing toxins called leucocidins. As the neutrophils die off from toxins and old age, they are destroyed by macrophages, forming the viscous pus (4).

If proper care is not initiated promptly, pyogenic infection leads to sepsis. In developing countries, reports of suppurative wound infections are as high as 40%, compared to developed countries, which are around 3% to 11% (5). Hence appropriate antimicrobial treatment should be started at the right time. Over the years, poor antimicrobial stewardship in India has led to an increase in multidrug-resistant (MDR) superbugs in both community and hospital settings.

This study aims to determine the bacterial isolates in such pyogenic infections followed by their antimicrobial susceptibility pattern to aid in formulating empirical therapy and implementing hospital infection control strategies to prevent multidrug resistance.

Methods

Study design

This cross-sectional study was conducted in the Department of Microbiology at a tertiary care hospital in Nagpur city from the central region of India from October 2021 to March 2022. All pus and wound swab samples from outpatient departments, inpatient departments, and intensive care units (Department of Medicine, Orthopedics, Surgery, Obstetrics and Gynecology, and various other departments) for routine microscopy, culture, and sensitivity received at the Microbiology Laboratory during the study period were included.

Isolation and identification

The specimens received were subjected to culture on Blood Agar and MacConkey Agar plates and incubated aerobically for 18-24 hours at 37 °C. Direct smears of specimens were subjected to Gram stain and observed microscopically. Inoculated plates were observed for bacterial growth. Species identification was done on the basis of morphological appearance of colonies on media, Gram stains and various biochemical tests as per standard laboratory protocol.

Antimicrobial susceptibility testing

Isolates from pus specimens were subjected to antimicrobial sensitivity test by Kirby-Bauer method as per Clinical and Laboratory Standards Institute (CLSI) 2021.

For GNB following antimicrobial discs were used:
ampicillin (10µg), amoxicillin – clavulinate (20/10µg), ceftazidime (30µg), ceftriaxone (30µg), cefepime (30µg), cefoxitin (30µg), piperacillin-tazobactam (100/10µg), aztreonam (30µg), imipenem (10µg), meropenem (10µg), gentamycin (10µg), amikacin (30µg), ciprofloxacin (5µg), levofloxacin (5µg), trimethoprim-sulphamethoxazole/co-trimoxazole (25µg), from HiMedia Laboratories, India.

The antibiotics used for Gram-positive bacteria were as follows:
Penicillin (10U), Cefoxitin (30µg), High-Level Gentamicin (HLG) (120µg), Levofloxacin Trimethoprim/Sulfamethoxazole (1.25/23.75 µg), Clindamycin (2µg), Erythromycin (15 µg), Linezolid (30 µg), Vancomycin (30 µg discs), Teicoplanin (30 µg). (5)

Detection of MRSA Strains of Staphylococcus aureus

Methicillin resistance among *Staphylococcus aureus* isolates was tested by using cefoxitin disc (30µg) as per standard detection guidelines mentioned as per CLSI (5).

Quality Control

For quality control following were used
S. aureus (ATCC 25923)
Escherichia coli (ATCC 25922)
Pseudomonas aeruginosa (ATCC 27853)

Data Analysis

Data regarding all the isolated were entered into WHONET software and analyzed using the same. WHONET is a Windows-based database software package for managing Microbiology laboratory data and the analysis of antimicrobial susceptibility test results (6). Categorical variables have been mentioned in numerical and percentages.

Results

A total 752 pus and wound samples were received in Microbiology laboratory for culture and sensitivity during the study period. 510(68%) samples yielded positive culture and there was no growth in 242(32%) samples.

Among 510 bacterial isolates, 394(77%) Gram negative bacteria were isolated and 116 (23%) were gram positive bacteria. Among Gram negative bacteria, 261(51%) were fermenters and 133(26%) were non-fermenters. *Klebsiella pneumoniae ss. pneumoniae* dominated the profile and became the most common isolated organism, followed by *Escherichia coli*. Among gram positive bacteria *Staphylococcus aureus* were major isolated organism, becoming the 2nd most common isolate. (Table 1)

Staphylococcus aureus showed maximum sensitivity towards Linezolide (99.1%) followed by Doxycycline (81.1%) and least sensitivity towards penicillin. Among *S.aureus*, 33.1% isolates were methicillin sensitive, showing methicillin resistant *S.aureus* (MRSA) to be 67%.(Figure 1)

Enterococcus species showed maximum sensitivity to Linezolide (92.85%) followed by vancomycin (81.25%). Among *Enterococcus spp.* 18.75% were vancomycin resistant. (Figure 2)

Table 1. Biological profile data of isolated organism

Group	Organism	No. of Isolates(n=510)	Total
Gram positive cocci	*Staphylococcus aureus ss. aureus*	107 (21%)	116 (23%)
	Enterococcus species	9 (1.7%)	
Gram negative bacilli - fermenters	*Escherichia coli*	103 (20.2%)	261 (51%)
	Klebsiella pneumoniae ss. pneumoniae	137 (27%)	
	Others	21 (4.1%)	
Gram negative bacilli—non-fermenters	*Pseudomonas aeruginosa*	75 (15%)	133 (26%)
	Acinetobacter spp.	58 (11%)	

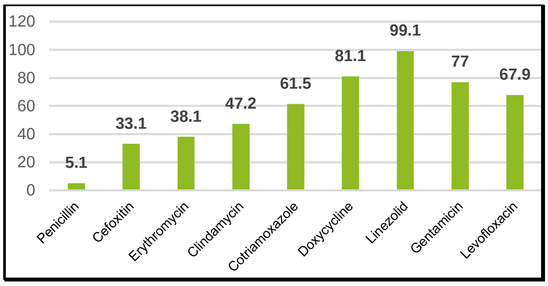

Figure 1. Antimicrobial sensitivity pattern of *Staphylococcus aureus*

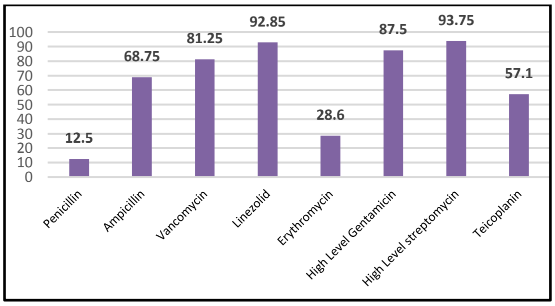

Figure 2. Antimicrobial sensitivity pattern of *Enterococcus spp.*

Antimicrobial susceptibility pattern of Gram-negative isolates is shown in Figure 3 and Figure 4.

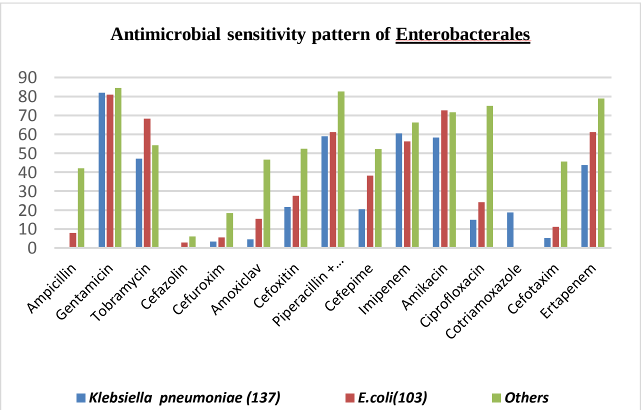

Figure 3. Antimicrobial sensitivity pattern of Enterobacterales

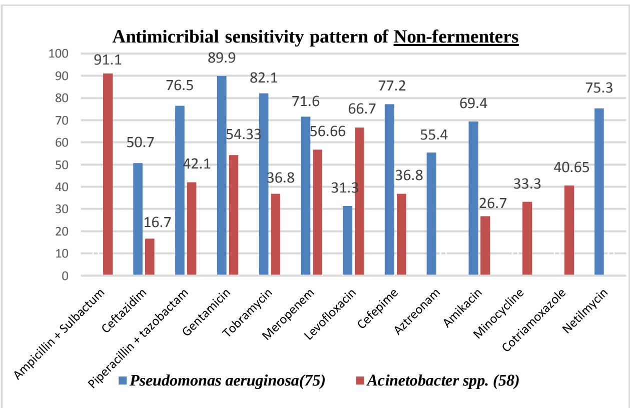

Figure 4. Antimicrobial sensitivity pattern of non-fermenters

Gram negative organism were mostly sensitive to gentamicin (80%) followed by piptaz and carbapenem, and least sensitive to amoxiclav. *Pseudomonas aeruginosa* had maximum sensitivity to Gentamicin (89.9%) followed by tobramycin, cefepime, meropenem, and least sensitivity to Amoxiclav. *Acinetobacter* showed the highest sensitivity to Ampicillin-sulbactam (91.1%) followed by levofloxacin and meropenem (56.66%), and least sensitivity to ceftazidime.

Discussion

In present study Gram negative bacteria (GNB) were more compared to Gram positive bacteria (GPB) which is similar to study conducted by Gomatheswari *et al*, at Tamilnadu in 2016 (7).

Among GNB Klebsiella pneumoniae was the predominant organism isolated in present study (27%) with similar findings shown in studies by Sharma V et al, Krisnamurthi et al, (2020) and Gomatheswari et al. (2016) (7-9). Among GPB *S. aureus* was isolated in higher abundance followed by *Enterococcus spp.* in studies Biradar *et al*. (2015) and Mukherjee *et al*. (2019*)* similar to the present study. (10,11)

In a study conducted by Mukherjee *et al*, in HTMC, Rourkela, Odissa in 2019 *Staphylococcus aureus* showed high sensitivity to linezolid (92%), aminoglycoside (84%), clindamycin (88%) and cotrimoxazole (72%) but lower sensitivity to erythromycin (25%), amoxiclav (40%) and fluoroquinolones (44%) similar to the present study (10). However, in another study by Duggal *et al*. (2014) and Ramesh Kannan et al. (2014), *Pseudomonas spp*. was the most abundant organism (12,13).

The percentage of MRSA in the present study was 67%, whereas in a study conducted by Mohansundari et al. in 2020 in Rasipuran, Tamilnadu it was 50% (14). *Enterococcus* showed maximum sensitivity to Linezolide (92.85%) followed by Vancomycin (81.25%) similar to Batra *et all,* (2021) (15). Percentage of Vancomycin-resistant *Enterococcus* is 18.75% whereas in was 6.70% in Batra *et all* study (15). In a study conducted by Mukherjee *et al*, in HTMC, Rourkela, Odissa in 2019, most of the gram-negative bacilli showed high sensitivity towards imipenem (53-93%), meropenem (80-100%), piperacillin tazobactam (67-100%) and amikacin (67- 88%) but lower sensitivity to 3rd generation cephalosporins (36-73%), cotrimoxazole (60-80%), amoxiclav (20-75%) and fluoroquinolones (10).

As seen in Gomatheswari et al (2017), Mukherjee et al., (2020), and Gupta M et al, (2019), Trojan R et al (2016) it is stated that S. aureus and Gram- negative bacterial pathogens can produce highly potent virulence factors, which is responsible for maintaining the infection and delaying the process of recovery (7,10,16,17).The present study identified the most commonly isolated organisms causing pyogenic infection, also the existence of superbugs like MRSA and VRE.

Conclusion

This study provided us insight about prevalence and common etiology of pyogenic infections, with their antibiotic susceptibility in central region of India, which will help in formulating antibiotic stewardship for hospitals. In this study, the rate of pyogenic infections was 68%. *Klebsiella pneumonia* is the most predominant isolated bacteria followed by *E. coli, Staphylococcus aureus* and *Pseudomonas spp.* Among Gram positive bacteria isolated, MRSA was 67% and vancomycin resistant *Enterococcus* was 18.75%. Strict implementation of antimicrobial stewardship with a routinely updated antibiogram and proper infection control measures may help decrease the burden of infections with various resistant organisms in the era of challenges faced due to the globally increasing antimicrobial resistance.

Acknowledgement

NIL

Funding sources

NIL

Ethical statement

Approval from institutional ethical committee has been taken.

Conflicts of interest

NIL

Author contributions

Bhawana Bajare - Contributed in preparation of research plan, research work, data collection & analysis and manuscript preparation.
Akanksha Dhangar - Contributed in Research work, data analysis and done manuscript writing.
Supriya Tankhiwale - Contributed in manuscript preparation.
Sunanda Shrikhande - Contributed in manuscript preparation.

References

1. Kalita JM, Nag VL, Kombade S, Yedale K. Multidrug resistant superbugs in pyogenic infections: a study from Western Rajasthan, India. Pan Afr Med J. 2021;38:409. [View at Publisher] [PMID] [Google Scholar]
2. Laxminarayan R, Chaudhury RR. Antibiotic resistance in India: drivers and opportunities for action. PLoS medicine. 2016;13(3):e1001974. [View at Publisher] [DOI] [PMID] [Google Scholar]
3. Gulati BK, Sharma S, Rao MV. Analyzing the changes in certain infectious and parasitic diseases in urban population of India by using medical certification of cause of death data. Indian Journal of Community Medicine: Official Publication of Indian Association of Preventive & Social Medicine. 2021;46(1): 20. [View at Publisher] [DOI] [PMID] [Google Scholar]
4. Madigan MT, Martinko JM, Parker J. Brock biology of microorganisms. Upper Saddle River, NJ: Prentice Hall; 1997. [View at Publisher] [Google Scholar]
5. Wajid M, Naaz S, Hashmiya SS. Evaluation of bacteriological profile of pyogenic infections and their susceptibility profiles at a tertiary care hospital. International Journal of Medical Reviews and Case Reports. 2022;6(3):5237-46. [View at Publisher] [DOI] [Google Scholar]
6. Patil SP, Nagamoti SM, Nagamoti MB. Application of Whonet for the Surveillance of Antimicrobial Resistance in Teaching Hospital. [Google Scholar]
7. Gomatheswari SN, Jeyamurugan T. Bacteriological profile and the antibiotic susceptibility pattern of microorganisms isolated from pus/wound swab isolates in patients attending a tertiary care hospital in South India. Int J Curr Microbiol App Sci. 2017;6(10):1405-13. [View at Publisher] [DOI] [Google Scholar]
8. Sharma V, Parihar G, Sharma V, Sharma H. A study of various isolates from pus sample with their antibiogram from Jln hospital, Ajmer. IOSR Journal of Dental and Medical Sciences. 2015;14(10):64-8. [Google Scholar]
9. Krishnamurthy S, Sajjan AC, Swetha G, Shalini S. Characterization and resistance pattern of bacterial isolates from pus samples in a tertiary care hospital, Karimnagar. Trop J Pathol Microbiol. 2016;2:49-54. [View at Publisher] [DOI]
10. Mukherjee S, Mishra S, Tiwary S. Microbial Profile and Antibiogram of Pus Isolate in a Tertiary Care Hospital of Western Odisha. Journal of Evolution of Medical and Dental Sciences. 2020;9(16):1325-31. [View at Publisher] [DOI] [Google Scholar]
11. Biradar A, Farooqui F, Prakash R, Khaqri S Y, Itagi I, Aerobic bacteriological profile with antibiogram of pus isolates. Indian J Microbiol Res 2016;3(3):245-9. [View at Publisher] [DOI] [Google Scholar]
12. Duggal S, Khatri PK, Parihar RS, Arora R. Antibiogram of various bacterial isolates from pus samples in a tertiary care centre in Rajasthan. Int J Sci Res. 2015;4(5):1580-4. [View at Publisher] [Google Scholar]
13. Rameshkannan S, Nileshraj G, Rameshprabu S, Mangaiarkkarasi A,Meher Ali R. Pattern of pathogens and their sensitivity isolated from pus culture reports in a tertiary care hospital, puducherry. Indian J Basic Appl Med Res. 2014 Dec;4(1):243-8. [View at Publisher] [Google Scholar]
14. Mohanasundari C, Anbalagan S, Srinivasan K, Sankareswaran M. Bacteriological profile and antibiogram of the bacteria isolated from pus samples in a secondary care unit. Journal of Information and Computational Science. 2020;10(11):62-9. [View at Publisher] [DOI]
15. Batra S, Balothia V, Agarwal S, Sharma R. Bacteriological Profile and Antimicrobial Susceptibility Pattern of Pus Culture Isolates from a Tertiary Care Hospital, SMS Medical College Jaipur. European Journal of Molecular & Clinical Medicine (EJMCM). 2020;7(11):2020. [View at Publisher]
16. Gupta M, Naik AK, Singh SK. Bacteriological profile and antimicrobial resistance patterns of burn wound infections in a tertiary care hospital. Heliyon. 2019;5(12):e02956. [View at Publisher] [DOI] [PMID] [Google Scholar]
17. Trojan R, Razdan L, Singh N. Antibiotic susceptibility patterns of bacterial isolates from pus samples in a tertiary care hospital of Punjab, India. International journal of microbiology. 2016;2016. [View at Publisher] [DOI] [PMID] [Google Scholar]

How to Cite:

Bajare B, Dhangar A, Tankhiwale S, Shrikhande S. Bacteriological profile of pyogenic infections and their antimicrobial susceptibility in a tertiary care hospital in central India. *Med Lab J.* 2024;18(2):16-8.