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ORIGINAL ARTICLE

The antibiogram of pus cultures in federal tertiary care hospital, Islamabad and its utility in antimicrobial stewardship

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ABSTRACT

Background and Objectives: Antimicrobial resistance has emerged as a significant global health threat. Infections caused by Multi Drug-Resistant (MDR) bacteria pose formidable challenges in terms of treatment options and patient outcomes. Pus cultures serve as crucial diagnostic tools in identifying the agents responsible for various infections, and their antimicrobial susceptibility patterns which help in establishment of empirical therapy guidelines. This study was conducted to determine the pathogen and its susceptibility pattern from pus cultures and to generate antibiogram in our tertiary care setting.

Materials and Methods: It was a cross-sectional study, conducted for a period of six months, from July 2022 to December 2022, in the Pathology Department of Pakistan Institute of Medical Sciences (PIMS).

Results: Out of total 2507 samples received, 1242 (49.5%) showed positive culture. Among the 1242 positive samples, 364 were Gram positive cocci (GPCs) and 878 were Gram negative rods (GNRs). Methicillin resistant *Staphylococcus aureus* (MRSA) was the most common isolate (23%) followed by *Klebsiella pneumoniae* (22.6%), *Pseudomonas aeruginosa* (16.9%), *Enterobacter* spp. (15.5%) and *Escherichia coli* (14.2%). Vancomycin was found to be highly effective (100%) against MRSA. GPCs were highly susceptible to linezolid (98%) while GNRs showed high level of sensitivity to colistin (96%) and tigecycline (92%).

Conclusion: The generation of a local antibiogram specific to the hospital setting is essential to effectively manage infections empirically and preserve the efficacy of existing antibiotics. By implementing antimicrobial stewardship practices based on a better understanding of antibiotic susceptibility patterns, we can contribute to the mitigation of antibiotic resistance and improve patient outcomes.

Keywords: Antimicrobial drug resistance; Antimicrobial stewardship; Antibiotic resistance; Antibiotic susceptibility testing; Bacterial sensitivity test

INTRODUCTION

Bacterial skin infections pose a noteworthy threat to public health globally. Suppurative infections are relatively common and can arise from various sources including wounds, abscesses, and other localized infections. Various bacterial pathogens, both Gram positives and Gram negatives, are often responsible for such infections.

One of the major concerns in bacterial infection management is the evolution of antibiotic resistant strains. The rise and spread of antibiotic resistant

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bacteria have drastically limited treatment options for infectious diseases, leading to increased morbidity, mortality, and healthcare expenses worldwide. It is estimated that antimicrobial resistance kills at least 1.27 million people every year (1) and it could increase up-to 10 million people per year by 2050 (2). The misuse and overuse of antibiotics have accelerated the progress of antibiotic resistance, requiring urgent action to preserve the effectiveness of available antimicrobial agents (3).

Understanding the antibiotic sensitivity patterns of prevalent pathogenic bacteria found in pus samples can provide valuable insights into appropriate antibiotic selection, dosage optimization, and effective treatment strategies.

Pus/pus swab is a common clinical specimen collected from individuals with several types of infections, including skin, surgical site infections, soft tissue infections, diabetic wound, and abscesses. These infections are frequently caused by a diverse range of bacteria, including primarily methicillin resistant *Staphylococcus aureus* (MRSA), *E. coli, K. pneumoniae, P. aeruginosa* and many others (4).

Antibiotic susceptibility testing plays a vital role in guiding the clinicians to select the most appropriate and effective antibiotics for the treatment of a bacterial infections. It involves determining the antibiotic susceptibility patterns of bacterial pathogens against several types of antibiotics. This is crucial for tailoring empirical therapy and preventing the emergence of multi drug-resistant (MDR) strains (5). There is a lack of data in Pakistan Institute of Medical Sciences (PIMS) and most of the existing studies provide very limited information or are focused on some specific pathogens (6) making it difficult for the clinicians to make a decision regarding the choice of appropriate antibiotics for empirical treatment.

The objective of this study was to determine the pyogenic bacteria from pus culture and to determine their antibiotic susceptibility to various groups of antibiotics so that we could generate antibiogram in our tertiary care setting. This would help clinician in making decision and developing empirical antibiotic therapy guidelines.

MATERIALS AND METHODS

This was a descriptive cross-sectional study, performed over a period of six months from July 2022 to December 2022 at Microbiology Laboratory, Pathology Department of PIMS. Sample technique was consecutive, nonprobability. During this period, 2507 samples were received for culture and antimicrobial sensitivity. Demographic details of patients were collected on pre-defined Performa.

We included all patients from 12 to 80 years of age including both genders. Samples were collected from Surgical wards, Orthopaedics, Medical ICU, Neurosurgery and Medical wards. We excluded all the duplicate samples and samples from patients who were taking antibiotics.

The pus samples received were processed according to the standard aerobic culture methods of bacteria. Inoculation was done on both Blood agar and MacConkey agar (Oxoid). Then, samples were incubated aerobically at 37°C for 24 hours. Biochemical tests were performed including Gram staining, oxidase, catalase, DNASE / coagulase and API 20 E (Biomerieux) for Gram negative rods (GNRs). A number of antibiotics were applied using Kirby-Baur Disk Diffusion Method (7) and incubated at 37°C for 16-18 hours. The results were inferred according to CLSI guidelines (8).

SPSS 28 was used to analyze the data. The frequency and percentages were calculated for qualitative variables like gender. The percentage of various isolates against different antibiotics were calculated. Mean and standard deviation were calculated for quantitative variables such as age and different wards. P value of <0.05 was taken significant.

All ethical considerations were duly addressed. The study was conducted after approval of ethical committee of the Hospital.

RESULTS

Out of 2507 samples received for culture and sensitivity testing, 1242 (49.5%) showed positive culture while 1265 (50.5%) samples had no growth. Among these 1242 positive cultures, 801 samples (64.4%) were collected from male while 441 samples (35.5%) were collected from females yielding a ratio 1.8:1.

Most of the positive samples were from age group 41-60 years (45%) (Table 1). Mean age in the study was 52.4 + 16.72. P-value was insignificant. The major contributors of samples were from Surgical ICU with 37% of samples followed by Surgical ward (I, II, OPD) with 22% samples, Orthopedics with 18%,

Medical ICU with 9%, Neurosurgery with 9%, Medical Wards (I,II) with 5% (Fig. 1).

Among the 1242 positive samples, 364 were Gram positive cocci (GPCs) and 878 were GNRs. MRSA was the most common isolate (23%) followed by *K. pneumoniae* (22.6%), *P. aeruginosa* (16.9%), *Enterobacter* spp. (15.5%), *E. coli* (14.2%), methicillin sensitive *S. aureus* (MSSA) (4%), *Streptococcus pyogenes* (2%), *Proteus* spp. (1%) and *Enterococcus* spp. (0.8%).

The susceptibility pattern of Gram-Positive bacteria is presented in Table 2.

Table 1. Age group wise distribution of Aerobic culture positive Pus/pus swab samples (n = 1242)

Patient's Age	Positive Samples n (%)
12-20	99 (8%)
21-40	149 (12%)
41-60	559 (45%)
61-80	435 (35%)

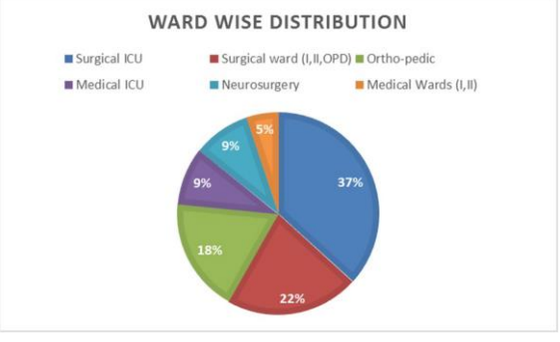

Fig. 1. Ward wise distribution of Aerobic culture positive Pus/pus swab samples (n = 1242)

The antimicrobial susceptibility pattern of Gram-negative bacteria is shown in Table 3.

DISCUSSION

This study provides valuable insight about the most common pathogens found in pus and their antibiotic sensitivity pattern against various antibiotics. These results can give better understanding regarding effective antibiotics for particular bacterial infection.

Most of the samples in our study, belonged to the age group of 41-60 years (45%). The findings are comparable with the study performed by Biradar et al. who found the age group 41-60 years to be 38.28% (9). In our study, ward wise distribution of samples show that Surgical ICU and Surgical wards were major contributors of samples (59%) followed by Orthopedics ward (18%). Comparable results were also shown in a study done by Biradar who found surgical wards to be 55% (9).

In our study, it was revealed that infection rate is higher in male than females in a ratio of 1.8:1 which was in agreement to study done by Mudassar et al. (4) and slightly higher than the study performed by Waheed et al. who found this ratio to be 1.39:1 (10).

Several studies have been conducted in this area providing valuable information about the prevalence of antimicrobial resistance patterns of most common bacteria found in pus. A study by Garoy, E.Y., et al. examined the antibiotic susceptibility profiles of *S. aureus* from pus samples and found high prevalence of MRSA (72%), emphasizing the need for empirical antibiotics in the management of such infections (11). Furthermore, a study conducted by Khan MI. focused on *P. aeruginosa* from pus and examined their antibiotic susceptibility patterns. The findings highlighted the emergence of MDR strains, emphasizing the importance of appropriate antibiotic selection and the need for constant surveillance (12).

These studies collectively highlight the significance of monitoring antibiotic susceptibility patterns and understanding the occurrence of MDR bacteria in pus. By analyzing the findings from these relevant studies, the purpose of this study was to contribute to the existing knowledge base, ultimately helping in the development of effective strategies for the management of bacterial infections associated with pus especially in tertiary care setting where no antibiogram is available and to implement antimicrobial stewardship with full spirit.

In our study, MRSA was the most abundant bacterial pathogen i.e: 23% in pus culture which was in correspondence with a study performed by Syed et al. who found this to be 22% (13). Another study by Ullah et al. stated MRSA to be 36% (14). This abundance of MRSA is also proven by other studies performed by Mudassar et al. who found MRSA to be 42%,(4) and Khan et al. who found 65% of MRSA (15). It is worth mentioning that the spread of MRSA may vary from city to city and even from hospital to hospital. Hence, more studies would be required to address the alarming situation of MRSA.

In our study, MRSA was followed by *K. pneumo-*

Table 2. Antimicrobial susceptibility of Gram-positive bacteria

Antibiotic drugs	*S. aureus* Sensitive%	MRSA Sensitive%	*Streptococcus Pyogenes* Sensitive %	*Enterococcus* spp. Sensitive %
Penicillin	1 %	--	100%	35%
Ampicillin	1%	--	100%	36%
Cefoxitin	100%	0%	NT	NT
Erythromycin	40%	32%	95%	30%
Clindamycin	82%	80%	98%	IR
Co-trimoxazole	88%	64%	NT	IR
Doxycycline	88%	50%	NT	78%
Minocycline	98%	92%	NT	90%
Linezolid	100%	98%	100%	94%
Ciprofloxacin	34%	24%	95%	43%
Levofloxacin	45%	35%	99%	65%
Chloramphenicol	90%	84%	98%	96%
Vancomycin	100%	100%	100%	86%

NT: Not Tested
IR: Intrinsically Resistant

Table 3. Antimicrobial susceptibility of Gram-negative bacteria

Antibiotic drugs	*K. pneumonia* Sensitive%	*Enterobacter* spp. Sensitive%	*E. coli* Sensitive%	*Proteus* spp. Sensitive%	*Pseudomonas* spp. Sensitive%
Ampicillin	IR	IR	5%	IR	IR
Amox-clavulanate	12%	IR	14%	50%	IR
Pipra-tazobactam	41.5%	60%	50%	78%	78%
Cefoperazone-sulbactam	54.5%	61%	62%	80%	73.5%
Cefipime	20%	7%	25%	65%	60%
Ceftriaxone	20%	23%	29%	60%	IR
Ceftazidime	NT	NT	NT	NT	68%
Ciprofloxacin	26%	25%	20%	25%	60%
Levofloxacin	27%	27%	22%	26%	67%
Co-trimoxazole	29.5%	27.5%	22%	25%	IR
Gentamicin	57%	50%	71%	67%	70%
Amikacin	80%	82%	93%	80%	80%
Imipenem	60%	75%	79%	95%	66.5%
Meropenem	62%	77%	83%	95%	67%
Doxycycline	35%	47.5%	40%	IR	IR
Tigecycline	89%	90%	97%	IR	IR
Chloramphenicol	71.5%	80.5%	80%	90%	IR
Aztreonam	NT	NT	NT	NT	75%
Colistin*	95%	98%	99%	IR	92%

*Colistin sensitivity was determined by Disk diffusion method.

niae (22.6%) which was contrary to study of Mudassar et al. who found *P. aeruginosa* to be the second most commonly found pathogen (19%). (4) The study performed by Sudhaharan et al. who found *E. coli* to be the most abundant bacterial pathogen in the pus (38.6%) was also contrary to our study (16).

In our study, vancomycin (100%) was the most effective drug against MRSA which was comparable to the findings of study executed by Rao et al. However, they found levofloxacin to be 80% susceptible which was more than our finding (54%) indicating the increase in resistance (17). GNRs were mostly MDR. *E. coli, K. pneumoniae* and *Enterobacter* spp. showed remarkable resistance against cefipime (82.6%), ciprofloxacin (76.4%) and ceftriaxone (76%). The findings are parallel to the study performed by Trojan et al. (18). These MDR were found to be susceptible to tigecycline (92%) which has also been shown by the study done by Gill and Sharma (19).

In our study, *P. aeruginosa* was found to be most susceptible to colistin (92%) which is not comparable with the study by Farooq et al. who found colistin to be 100% effective against MDR *Pseudomonas.* This may be due to the increase in resistance because of extensive use of colistin over the years (20).

There are multiple factors that can affect the antibiotic susceptibility of a bacteria which include the geographical location, lifestyle, infection, and disease control practices. Antibiotic stewardship plays a vital role in combating the growing threat of antibiotic resistance. Our study emphasizes the urgent need to adopt and implement effective antibiotic stewardship programs including appropriate prescribing practices, awareness campaigns and surveillance systems.

Limitations. In our study, antibiotic susceptibility of *P. aeruginosa* against colistin was done by Disk diffusion method and not by micro broth dilution which is the recommended method. Also, anaerobic bacteria could not be explored due to lack of resources. Hence, research should be done on a larger scale including both aerobic and anaerobic bacterial pathogens.

CONCLUSION

This study highlights the significance of monitoring antimicrobial susceptibility patterns and understanding the prevalence of MDRs bacteria in pus samples, which is alarming. Therefore, every hospital should generate its local antibiogram to implement the empirical guideline and antimicrobial stewardship. By having a better understanding of antibiotic susceptibility patterns of pathogens, we can preserve the efficacy of existing antibiotics and mitigate emergence of antibiotic resistance.

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REFERENCES

1. Antimicrobial Resistance Collaborators. Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *Lancet* 2022; 399: 629-655.
2. O'Neill J. Tackling drug-resistant infections globally: final report and recommendations. 2016. https://apo.org.au/node/63983
3. English BK, Gaur AH. The use and abuse of antibiotics and the development of antibiotic resistance. *Adv Exp Med Biol* 2010; 659: 73-82.
4. Mudassar S, Khan SW, Ali M, Mahmood F. Aerobic bacteriological profile and antimicrobial susceptibility pattern of pus isolates in a teaching hospital, Lahore, Pakistan. *Int J Contemp Med Res* 2018; 5: D1-D3.
5. Jorgensen JH, Ferraro MJ. Antimicrobial susceptibility testing: a review of general principles and contemporary practices. *Clin Infect Dis* 2009; 49: 1749-1755.
6. Ghazal L, Qureshi AH, Iqbal N. Antibiotic susceptibility pattern of Gram-negative Bacilli isolated from different clinical specimens in a tertiary care Hospital. *JIMDC* 2018; 7: 112-117.
7. Garcia LS. Clinical microbiology procedures handbook: American Society for Microbiology Press; 2010.
8. Hutchings MI, Truman AW, Wilkinson B. Antibiotics: past, present and future. *Curr Opin Microbiol* 2019; 51: 72-80.
9. Biradar A, Farooqui F, Prakash R, Khaqri SY, Itagi I. Aerobic bacteriological profile with antibiogram of pus isolates. *Indian J Microbiol Res* 2016; 3: 245-249.
10. Waheed A, Amar A, Afridi I, Rauf S, Mehran. Bacteriological profile and antibiotics susceptibility patterns of complicated skin and skin structure infections in tertiary care hospitals, Peshawar. *J Pak Assoc Dermatol* 2020; 30: 580-586.

11. Garoy EY, Gebreab YB, Achila OO, Tekeste DG, Kesete R, Ghirmay R, et al. Methicillin-resistant *Staphylococcus aureus* (MRSA): prevalence and antimicrobial sensitivity pattern among patients-a multicenter study in Asmara, Eritrea. *Can J Infect Dis Med Microbiol* 2019; 2019: 8321834.
12. Ali MM, Mansoor R, Zahra QA, Liangliang L, Gangguo W, Ali R, et al. Frequency and antimicrobial susceptibility pattern of *Pseudomonas aeruginosa* in human pus samples at holy family hospital Rawalpindi. *J Microbiol Biotechnol* 2021; 6: 000189.
13. Syed MA, Jamil B, Ramadan H, Rukan M, Ali S, Abbasi SA, et al. Genetic diversity of *Staphylococcus aureus* atrains from a tertiary care Hospital in Rawalpindi, Pakistan. *Microorganisms* 2021; 9: 2301.
14. Ullah A, Qasim M, Rahman H, Khan J, Haroon M, Muhammad N, et al. High frequency of methicillin-resistant *Staphylococcus aureus* in Peshawar Region of Pakistan. *Springerplus* 2016; 5: 600.
15. Khan AA, Ali A, Tharmalingam N, Mylonakis E, Zahra R. First report of mecC gene in clinical methicillin resistant S. aureus (MRSA) from tertiary care hospital Islamabad, Pakistan. *J Infect Public Health* 2020; 13: 1501-1507.
16. Sudhaharan S, Kanne P, Chavali P, Vemu L. Aerobic bacteriological profile and antimicrobial susceptibility pattern of pus isolates from tertiary care hospital in India. *J Infect Dev Ctries* 2018; 12: 842-848.
17. Rao DR, Basu R, Biswas DR. Aerobic bacterial profile and antimicrobial susceptibility pattern of pus isolates in a South Indian Tertiary Care Hospital. *Surgery* 2014; 36: 35-29.
18. Trojan R, Razdan L, Singh N. Antibiotic susceptibility patterns of bacterial isolates from pus samples in a tertiary care hospital of Punjab, India. *Int J Microbiol* 2016; 2016: 9302692.
19. Gill MK, Sharma S. Bacteriological profile and antibiotic sensitivity patterns of aerobic pus isolates: A study conducted in tertiary care hospital of North India. *Int J Med Microbiol Trop Dis* 2019; 5: 99-102.
20. Farooq L, Memon Z, Ismail MO, Sadiq S. Frequency and antibiogram of multi-drug resistant pseudomonas aeruginosa in a Tertiary Care Hospital of Pakistan. *Pak J Med Sci* 2019; 35: 1622-1626.