Bacteriological Profile and Antibiotic Sensitivity Pattern of Pus Samples in a Tertiary Care Hospital

Ahsan Tameez-ud-Din1, Abdullah Sadiq2, Noman Ahmed Chaudhary3, Awais Ahmed Bhatti4, Raja Saeed Lehrasab5, Muhammad Talha Khan6

1,2,3,4 Final year MBBS Student, Rawalpindi Medical University, Rawalpindi.
5 Senior Demonstrator, Department of Pathology & Microbiology, Rawalpindi Medical University, Rawalpindi.

Abstract

Background: Wound infection is one of the most common causes of mortality and prolonged hospital stay worldwide. The emergence of resistant strains of bacteria poses a serious threat in the eradication of hospital-acquired infections. The objective of this study is to find the most common bacterial isolates in the pus samples and to assess their antibiotic sensitivity patterns.

Material and Methods: This descriptive cross-sectional study was conducted in the Department of Pathology and Microbiology, Holy Family Hospital, Rawalpindi from August 2017 to December 2017 by using convenient sampling. The pus samples of all the patients, tested in the department, were included in the study. Sampling was done using blood and MacConkey agar and antibiotic sensitivity was done on Muller Hinton agar. Data was analyzed using SPSS v.23.0.

Results: The most common bacterial isolate was Staphylococcus aureus (29.6%) followed by Escherichia coli (23.8%) and Pseudomonas aeruginosa (14.7%). S. aureus was most sensitive to vancomycin (100%) whereas E. coli and P. aeruginosa showed the highest sensitivity to imipenem (90.7%) and tazocin (80%), respectively.

Conclusion: The most common bacterial isolate in pus cultures is S. aureus. Vancomycin is highly effective against S. aureus.

Keywords: Bacteria, Pus, Antibiotic, Sensitivity.
Introduction

Wound infection is one of the most common causes of morbidity, mortality and prolonged hospital stay worldwide.\(^1\) Wound infection can be caused by a variety of organisms like bacteria, virus, fungi, and protozoa. These organisms may co-exist as polymicrobial communities. Even though the bacterial profile of pus samples in many studies remain the same, the antibiotic resistance pattern of these isolates has shown a lot of variations.\(^2\) The skin and soft tissue infections caused by bacteria during or after trauma, burn injuries, and surgical procedures result in the production of pus.\(^3,4\) This is resulting in increased hospital stay duration and cost of treatment hence contributing to increased economic burden on the health sector of developing countries.\(^5\)

The common bacterial pathogens implicated in wound infections are Staphylococcus aureus (S. aureus), Pseudomonas aeruginosa (P. aeruginosa), and bacteria belonging to family Enterobacteriaceae.\(^6\) Due to increased prescription of antibiotics, resistance against these drugs is increasing day by day.\(^7\) Resistant strains of S. aureus, Acinetobacter, Escherichia coli (E. coli), Klebsiella pneumonia (K. pneumoniae) and P. aeruginosa are found to be the culprit in many hospital-acquired infections.\(^8,9,10\) Prudent monitoring of resistance patterns is of utmost significance in order to overcome these difficulties and to reduce the risk of serious infections.\(^11\)

The rationale of our study is to assess the antibiotic sensitivity trends which may help to formulate empirical therapy guidelines in this setup. The objective of this is to find the most common bacterial isolates in the pus samples and to assess their antibiotic sensitivity patterns.

Materials and Methods

This descriptive cross-sectional study was conducted in the Department of Pathology and Microbiology, Holy Family Hospital, Rawalpindi from August 2017 to December 2017. The pus samples of all the patients that were tested in the department were included in the study. Repeated samples from the same patient and improperly handled samples were excluded. 342 samples were selected by using a convenient sampling technique. Pus samples were received from patients in the outpatient and inpatient department. Samples were inoculated on agar plates. Wound culture was done on blood and McConkey agar. Cultures were incubated at 37°C for 24 to 48 hours. Microbes were identified under a microscope by observing morphological characteristics after gram staining and applying biochemical tests. Antibiotic sensitivity pattern was done on Muller Hinton agar by Kirby Bauer disk diffusion method. Antibiotics discs containing amikacin (aminoglycosides), amoxicillin-clavulanic acid, piperacillin (penicillins), ceftriaxone, cefotaxime, cefepime (cephalosporins), ciprofloxacin, levofloxacin (fluoroquinolones), erythromycin, azithromycin (macrolides), imipenem, meropenem (carbapenems), linezolid, clindamycin, tetracycline, and vancomycin were obtained. The potencies of antibiotics were used in accordance with the Clinical Laboratory Standards Institute guidelines.\(^12\)

Data was entered and analyzed using the Statistical Package for Social Sciences (SPSS) v-23.0. Descriptive statistics were applied to find the frequencies and percentages of qualitative variables. Pie charts, bar graphs and tables were constructed. Chi-square tests were applied for comparing qualitative variables (gender and proportion of positive growth). A p-value of ≤0.05 was considered significant.

Results

Out of 346 samples, 59% (n= 204) were from males, 37.32% (n= 129) from females and gender was missing for 3.8% (n= 13) patients (Figure 1). Samples from males showed a greater proportion of positive growth (64.21%) than females (50.4%) (p=0.012).

Figure 1: Distribution of Gender (N=346)
A total of 59.5% (n=206) samples showed positive growth. In 206 bacterial isolates, 31.6% (n=65) were gram-positive cocci whereas 68.4% (n=141) were gram-negative bacilli. Out of the bacteria isolated from positive growth cultures, S. aureus (29.6%, n=61) which included 9.8% (n=6) Methicillin Resistant Staphylococcus aureus (MRSA) was the most common, followed by E. coli (23.78%, n=49) and P. aeruginosa (17.47%, n=36). Least common isolate was Streptococci (0.48%, n=1) (Figure 2).

**Table 1: Antibiotic sensitivity pattern of S. aureus in pus samples**

| Antibiotics                  | S. aureus (%) |
|------------------------------|---------------|
| Chloramphenicol              | 90.6          |
| Moxifloxacin                 | 51.4          |
| Erythromycin                 | 38.5          |
| Trimethoprim-sulfamethoxazole| 39.4          |
| Teicoplanin                  | 100           |
| Vancomycin                   | 100           |
| Linezolid                    | --            |

S. aureus was sensitive to vancomycin (100%) and teicoplanin (100%) (Table 1). MRSA was sensitive to chloramphenicol (100%) and vancomycin (83.3%). Sensitivities of E. coli, P. aeruginosa, Acinetobacter, K. pneumoniae and coliforms to cefepime were 25.6%, 29%, 0%, 22.2% and 31.6% respectively (Table 2). Pus samples of males were significantly more sensitive to moxifloxacin (p=0.027) than of females and samples from males were more resistant to aztreonam than samples from females (p= 0.015).
Discussion

When infected wounds do not heal, they result in prolonged morbidity and hospital stay. This causes an increased burden on hospital resources. So, more and more efforts are being directed towards understanding the role of hospital environment in the spread of infections.13 In our study, 59.5% samples showed positive growth. It is consistent with a study by Khanam et al. where 61.8% of the cultures were positive.13 This can be attributed to increased nosocomial infection rate among surgical patients. Staphylococcus aureus was the most common bacterial isolate (29.6%). This finding is consistent with multiple studies conducted by Khanam et al., Mantravadi et al., Rao et al., Tiwari et al. and Mehmood et al.13 Staphylococcus aureus is the most common organism involved in pyogenic infections. However, Gosh et al. and Zubair et al. have shown E. coli and Pseudomonas species to be the most common isolates.18,19 The second most common organism in our study was Escherichia coli (23.78%). This has also been demonstrated by Khanam et al.13 However, Raza et al. have shown that E. coli was their most common isolate.20 MRSA in our study was isolated in 9.8% of the samples as compared to 19% reported by Rai et al.21 Pseudomonas (17.47%) was the third most common isolate in our study, which is in accordance with the study conducted by Khanam et al.13 S. aureus showed very high resistance to penicillin G (95.5%). This is in accordance with the study by Khanam et al. where 84.5% of the samples were resistant to penicillin.13 Penicillin is one of the oldest known antibiotics and extensive use of penicillin over the span of many decades has resulted in high resistance against this antibiotic. Macrolides like erythromycin showed 38.5% sensitivity and 61.5% resistance. Khanam et al. demonstrated 58.3% sensitivity to macrolides.13 This shows that resistance of Staphylococcus aureus against macrolides has also increased over the years. S. aureus showed 100% sensitivity to vancomycin and teicoplanin in our study similar to Khanam et al.13 The clock is ticking and the time might be near when we find resistance against these antibiotics as well. Rao et al. revealed that Staphylococcus aureus was resistant to penicillin (84.62%), erythromycin (84.62%), and sensitive to clindamycin (65.38%) and vancomycin (100%).15 E. coli in our study showed high resistance to amoxicillin-clavulanic acid (89.1%) and ceftriaxone (85.1%) which was close to the findings reported by Trojan et al. which also showed high resistance to amoxicillin-clavulanic acid (95%) and 70% resistance was reported for ceftriaxone.22 E. coli was found to be highly sensitive towards imipenem (90.7%) and amikacin (77.6%) as compared to the findings shown by Trojan et al. which reported 75% bacterial sensitivity towards both of these drugs.22 The difference in the sensitivity towards imipenem might be attributed to different demographic factors and steps should be taken to avoid the percentage of imipenem resistant bacteria from rising. P. aeruginosa was found to be 100% resistant towards ceftriaxone in our study. Sensitivity for ciprofloxacin and amikacin was found to be 35.3% and 55.9% respectively. These alarming findings are in contrast with the findings reported by Trojan et al. with 80% bacterial resistance towards ceftriaxone, on the other hand 60% bacteria were found to be sensitive to ciprofloxacin and 80% sensitive to amikacin.22 These findings raise some serious questions about antibiotic prescription practices still prevailing in the medical settings.

Antibiotic resistance patterns of Acinetobacter species were staggeringly high. Our study shows that Acinetobacter was 100% resistant against amikacin, ciprofloxacin and ceftriaxone while 92.9% were resistant against imipenem. This is consistent with the findings by Trojan et al. which reported 100% bacterial resistance for amikacin, ciprofloxacin, ceftriaxone and imipenem.22 This demonstrates that resistance of bacteria against antibiotics has spread over a vast geographical area. Klebsiella was found to be 83.3% sensitive towards amikacin and 90% sensitivity was shown towards imipenem. This was found to differ from findings of Trojan et al. (50% sensitivity towards both).22 The resistance against cefepime (77.8%) and ceftriaxone (75%) was high. This is corroborated by Trojan et al., reporting 90% resistance towards these two drugs.22

Conclusion

Most common bacterial isolate is Staphylococcus aureus followed by E. coli. Vancomycin and teicoplanin against S. aureus while imipenem against E. coli are highly effective and can be given as empirical therapies.
References

1. Neelima DP, Nandeeshwar PS. Bacteriological profile of wound infection in rural hospital in R.R District. Int J Med Res Health Sci. 2013;2(3):469.
2. Banker N, Wankhade A, Bramhane RB, Hathiwala R, Chandi DH. Bacteriological Profile of Pus/Wound Swab and Antimicrobial Susceptibility of Staphylococcus Aureus Isolated from Pus & Wound Swab of Indoor Patients of Tertiary Care Hospital in Durg, Chhattisgarh India. Int J Res Med Sci. 2018;3(4):1976–80.
3. Cogen AL, Nizet V, Gallo RL. Skin microbiota: a source of disease or defense? Br J Dermatol. 2008;158(3):442–455.
4. Dryden MS. Complicated skin and soft tissue infection. Journal Antimicrobial Chemotherapy. 2010;65(3):35–44
5. Scalise A, Bianchi A, Tartaglione C. Microenvironment and microbiology of skin wounds: the role of bacterial biofilms and related factors. Semin Vasc Surg. 2015;28(3–4):151–59
6. Mordi RM, Momoh MI. Incidence of Proteus species in wound infections and their sensitivity pattern in the University of Benin Teaching Hospital. Afr J Microbiol Res. 2009;8(5):725–30.
7. Courvalin P. Antimicrobial Drug Resistance: Prediction Is Very Difficult, especially about the Future. Emerg Infect Dis. 2005;11(10):1503–06
8. Rice LB. Antimicrobial resistance in gram-positive bacteria. American Journal Medicine. 2006;119(6, supplement 1):S11–S19
9. Misic AM, Gardner SE, Grice EA. The Wound Microbiome: modern approaches to examining the role of microorganisms in impaired chronic wound healing. Adv Wound Care. 2014;3(7):502–10
10. Iredell J, Brown J, Tagg K. Antibiotic resistance in Enterobacteriaceae: mechanisms and clinical implications. BMJ. 2016;352:h6420.
11. Azizi EM, Mushtaq A, Drake C, Lawhorn J, Barenfanger J, Verhulst S, et al. Evaluating antibiograms to monitor drug resistance. Emerg Infect Dis. 2005
12. CLSI Microbiology: 2018 AST Packages [Internet]. Clinical & Laboratory Standards Institute. 2019 [cited 1 July 2019]. Available from: https://clsi.org/global-training-old/2018-ast-packages/
13. Khanam R, Islam M, Sharif A, Parveen R, Sharmin I, Yusuf M, et al. Bacteriological Profiles of Pus with Antimicrobial Sensitivity Pattern at a Teaching Hospital in Dhaka City. Bangladesh J Infect Dis. 2018;51(1):10–14.
14. Mantravadi HB, Chinthaparthi MR, Shravani V. Aerobic isolates in pus and their antibiotic sensitivity pattern: a study conducted in a teaching hospital in Andhra Pradesh Int J Med Sci Public Health. 2015;4(8):1076–80
15. Rao DR, Basu R, Biswas DB. Aerobic bacterial profiles and antimicrobial susceptibility pattern of pus isolates in a south Indian tertiary care hospital. IOSR J Dent Med Sci. 2014;13(3):59–62
16. Tiwari P, Kaur S. Profile and sensitivity pattern of bacteria isolated from various cultures in a tertiary care hospital in Delhi. Indian J Public Health. 2010;54(4):213–15
17. Mahmood A. Bacteriology of surgical site infections and antibiotic susceptibility pattern of the isolates at a tertiary care hospital in Karachi. J Pak Med Assoc. 2000;50:256–9
18. Ghosh A, Karanakar PS, Pal J, Chakraborty N, Deb Nath NB, Mukherjee JD, et al. Bacterial incidence and antibiotic sensitivity pattern in moderate and severe infections in hospitalized patients. J Indian Med Assoc. 2009;107(1):21–2
19. Zubair M, Malik A, Ahmad J. Clinico-microbiological study and antimicrobial drug resistance profile of diabetic foot infections in north India. Foot (Edinb). 2011;21(1):6–14
20. Raza MS, Chander A, Ranabhat A. Antimicrobial susceptibility patterns of bacterial isolates in postoperative wound infections in a tertiary care hospital, Kathmandu, Nepal. Open J Med Microbiol. 2013;3(3):159–63
21. Rai S, Yadav U, Pant N, Yakha J, Tripathi P, Poudel A, et al. Bacteriological Profile and Antimicrobial Susceptibility Patterns of Bacteria Isolated from Pus/Wound Swab Samples from Children Attending a Tertiary Care Hospital in Kathmandu, Nepal. Int J Microbiol. 2017;2017:1–5.
22. 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.