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Research Article

BACTERIAL SPECTRUM AND ANTIMICROBIAL RESISTANCE PATTERNS IN PUS ISOLATES FROM A TERTIARY CARE HOSPITAL IN NORTH INDIA

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Abstract

Background: Wound infections are a major cause of morbidity in healthcare settings, exacerbated by increasing antimicrobial resistance. Timely identification of causative organisms and their resistance patterns is essential for effective management. **Methods:** This retrospective study was conducted at a tertiary care hospital in which 665 pus samples collected between September 2022 and February 2023 and analysed. Standard microbiological techniques were used for isolation and identification, and antibiotic susceptibility was assessed using the Kirby-Bauer disc diffusion method following CLSI guidelines. **Results:** Of 665 samples, 404 (60.7%) were culture-positive. *Staphylococcus aureus* was the most common isolate (47.5%). Gram-negative isolates, including *E. coli*, *Klebsiella*, *Pseudomonas*, and non-fermenters, exhibited varying resistance patterns, with particularly low susceptibility to carbapenems among non-fermenters. **Conclusion:** The study highlights the high prevalence of multidrug-resistant organisms in wound infections, especially among non-fermenters, emphasizing the urgent need for routine surveillance and rational antibiotic use.

Keywords: Wound infection, Antimicrobial resistance, *Staphylococcus aureus*, Multidrug resistance.

INTRODUCTION

Infectious diseases continue to be a major contributor to illness and death worldwide, particularly in developing nations.[1] Numerous bacterial species naturally inhabit the skin, gastrointestinal tract, nasopharynx, and other areas of the human body, typically without causing harm due to the body's primary defense mechanisms. However, when this initial line of defense is compromised due to factors such as surgery, injuries, burns, illness, or poor nutrition, it can allow microbes to invade, leading to infections.[2] Wound infections are predominantly acquired in healthcare settings, and the microorganisms responsible for these infections can vary significantly not only between different countries but also among hospitals within the same country.[3] According to the World Health Organization (WHO), wound infections are a leading contributor to infectious diseases, causing substantial economic burden along with high rates of illness and death. It represents a leading cause of infectious illnesses, contributing notably to both morbidity and mortality rates.[4] The prolonged and extensive use of antibiotics has significantly contributed to the emergence of resistant bacteria, which in turn has escalated rates of disease and death . Research on wound infections has primarily concentrated on those occurring at surgical sites. Although significant progress has been made in managing infections, wound infections remain a challenge due to the persistent issue of antibiotic resistance. Extensive use of antibiotics over an extended period has resulted in significant challenges related to resistant microbes, which have increased both illness and death rates.[5] Understanding the microorganisms responsible for wound infections is crucial for choosing effective antimicrobial treatments and implementing proper infection control practices within healthcare settings.

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Consequently, this study was conducted to identify the key bacterial pathogens and assess their antibiotic resistance profiles, which are essential for guiding the choice of effective treatment strategies.

MATERIALS AND METHODS

This retrospective, record-based study was conducted at a tertiary care hospital in Himachal Pradesh. Pus samples submitted to the Department of Microbiology between September 2022 and February 2023 were included. All individuals who provided pus and/or wound discharge samples during the study period were considered participants. Wound swabs and discharges were aseptically collected using sterile swabs placed in test tubes and subsequently inoculated onto blood agar and MacConkey agar media. The culture plates were incubated at 37°C for 24 hours and identified using standard microbiological procedures, including culture characteristics and a series of biochemical tests. Identification involved the application of the catalase test (using 3% hydrogen peroxide), coagulase test and the oxidase test. Additional biochemical analyses included the indole test citrate utilization, urease activity and the triple sugar iron (TSI) agar test.

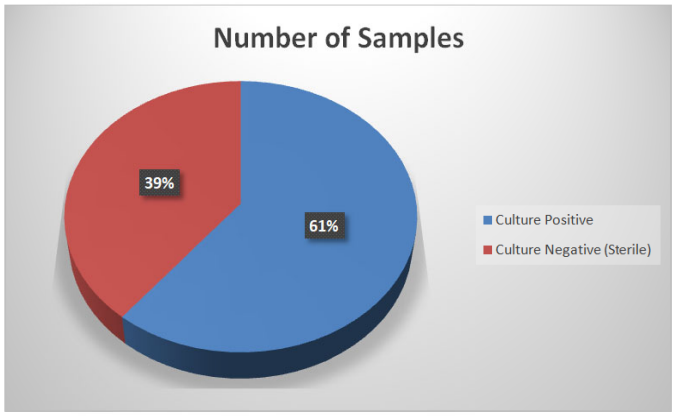
Antimicrobial susceptibility tests

Antimicrobial susceptibility testing was conducted using Mueller-Hinton agar plates, following the guidelines established by the Clinical and Laboratory Standards Institute (CLSI). The Kirby-Bauer disk diffusion method was employed to assess the antibiotic resistance patterns of all bacterial isolates.The isolates were tested against the antibioticsand the diameters of the zones of inhibition were measured and interpreted according to CLSI standards.Data were manually entered on exel and analyzed

RESULTS

Culture positivity in Pus Samples

Among 665 pus samples, bacterial pathogens were isolated from 404 samples (60.7%) whereas 261 samples (39.3 %) were sterile (Figure 1). Among the total isolates, 192 (47.5%) were Gram-positive and 212 (52.5%) were Gram-negative.



Distribution of Bacterial Isolates (n= 404)

Figure 1. Culture positivity in Pus Samples (n = 665)

Among the total 404 isolates, *Staphylococcus aureus* was the most common, accounting for 192 (47.5%). The distribution of other isolates is depicted in Figure 2.

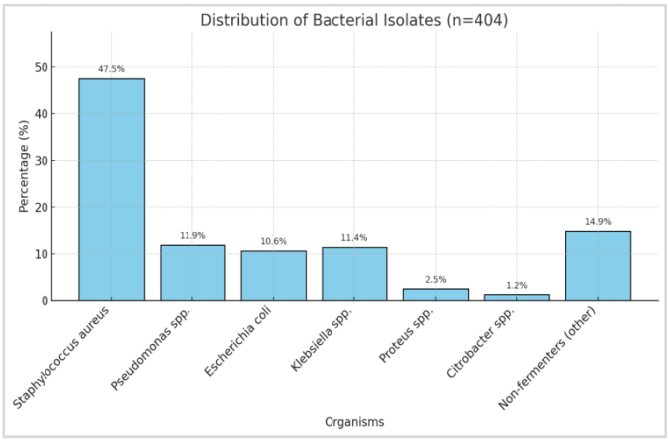


Figure 2. Distribution of Bacterial Isolates

Antibiotic susceptibilities of bacterialisolated

S. aureus showed the highest resistance to penicillin, with only 7.8% of isolates susceptible.*E.coli* is maximum resistant to ampicillin (6.9%) and cefazolin (6.9%), *Pseudomonas* is maximum resistant to ciprofloxacin (41.7%) and *Klebsiella*is maximum resistant to ampicillin (4.3%) and cefazolin (4.3%). (Table 1,2,3)

Table 1. Antibiotic susceptibilities of Gram-positive bacteria

Antibiotics	*Staphylococcus aureus (n=192)*
Penicillin	15(7.8%)
Doxycycline	134(69.8%)
Erythromycin	45(23.4%)
Clindamycin	83(43.2%)
Cotrimoxazole	148(77%)
Linezolid	100%

Table 2. Antibiotic susceptibilities of Gram-negative bacteria

Antibiotics	*E.coli n=43*	*Klebsiellaspp n=46*	*Citrobactor n=5*	*Proteus n=10*
Cotrimoxazole	11(25.6)%	13(28.3%)	3(60%)	8(80%)
Ampicillin	03(6.9%)	02(4.3%)	1(20%)	Nt
Gentamicin	36(83.7%)	21(45.7%)	4(80%)	6(60%)
Ciprofloxacin	Nt	Nt	Nt	Nt
Levofloxacin	11(25.6%)	17(37%)	2(40%)	4(40%)
Cefazolin	03(6.9%)	02(4.3%)	1(20%)	Nt
Imipenem	24(55.8%)	13(28.3%)	3(60%)	9(90%)

Table 3. Antibiotic susceptibilities of Pseudomonas species

Antibiotics	*Pseudomonasspp n=48*	*Other Non-fermentors n=60*
Gentamycin	33(68.8%)	Nt
Ciprofloxacin	20(41.7%)	26(43.3%)
Levofloxacin	Nt	30(50%)
Cefazolin	Nt	Nt
Imipenem	30(62.5%)	14(23.3%)
Cotrimaxazole	Nt	9(15%)
Ceftrixazone	Nt	Nt
Cefepime	Nt	24(48.3%)

DISCUSSION

In this study out of total of pus samples 665analyzed, 60.7% were culture positive, the remaining 39.3% did not show bacterial growth. The culture-positivity rate of 60.7 % in the present series sits squarely within the broad 57 – 85 % window reported for pus/wound swabs in recent Indian studies. A tertiary-care centre in Kashmir documented an 85 % culture yield, attributing its higher figure to a large proportion of in-patient, chronic wounds whereas a multicentre Asian survey recorded approximately seventy five percent. Such variability usually reflects case-mix (post-operative vs. community wounds), timing of specimen collection, and prior empirical antibiotic exposure.[6,7] *Staphylococcus aureus* accounted for 47.5 % of all isolates, echoing several regional reports where *S. aureus* remains the leading pathogen in skin and soft-tissue infection (SSTI) cohorts. The near-universal resistance to penicillin (only 7.8 % susceptible) mirrors the global spread of β-lactamase-producing strains. Encouragingly, susceptibility to linezolid (100 %) and doxycycline (69.8 %) is still preserved, offering effective oral and parenteral options. Comparable susceptibility figures for linezolid (>95 %) were documented in recent out-patient dermatology data from South Asia.[8,9]

In the present study, *E. coli* demonstrated a high susceptibility to gentamicin (83.7%) and moderate susceptibility to imipenem (55.8%). These findings are slightly higher than those reported in a study from Kashmir, where susceptibility to amikacin was 75% and imipenem 45%.Similarly, *Klebsiella spp.*showed 45.7% susceptibility to gentamicin and 28.3% to imipenem, which closely matches the Kashmir study where imipenem susceptibility was reported at 26%.[6]For *Citrobacter spp.*the imipenem susceptibility rate was 60%, though the small sample size limits generalizability. Nonetheless, this aligns with concerns raised in a 2023 meta-analysis about rising carbapenem resistance in Citrobacter species.[10]*Proteus spp.* showed high susceptibility to imipenem (90%) and cotrimoxazole (80%). While data on Proteus resistance patterns in India remain sparse, isolated reports have identified carbapenemase production particularly NDM among resistant strains, suggesting the importance of ongoing surveillance. The modest carbapenem susceptibility of *E. coli* and *Klebsiella* is clinically worrisome and echoes the creeping carbapenem resistance trend across India.

Pseudomonas spp. constituted 48 isolates. The ciprofloxacin susceptibility of 41.7 % is higher than the 18 % susceptibility reported for hospital isolates in 2024 surveillance data, but the imipenem susceptibility of 62.5 % contrasts sharply with several Indian ICU series now reporting figures below 30 %.[6] Such centre-to-centre variation likely reflects differences in carbapenem use density and infection-control stringency.

The antimicrobial susceptibility profile of the "other non-fermenters" group, revealed a worrying trend of multidrug resistance. Imipenem susceptibility was found in only 23.3% of isolates, consistent with recent Indian studies reporting carbapenem susceptibility rates between 20–30% in *Acinetobacter baumannii* isolates from tertiary care centers.[11,12] This reflects the growing prevalence of carbapenemase-producing strains and limited therapeutic options in nosocomial infections. Moderate susceptibility was observed to fluoroquinolones, with levofloxacin and ciprofloxacin sensitivities at 50% and 43.3%, respectively. However, previous studies have noted considerable regional variation, with ciprofloxacin resistance often exceeding 60% in hospital-acquired isolates.[13] Cefepime showed activity against 48.3% of isolates, indicating partial efficacy of fourth-generation cephalosporins, though its utility is often compromised by extended-spectrum β-lactamase (ESBL) and AmpC production .Cotrimoxazole showed poor susceptibility (15%), reaffirming its limited role in treating infections from non fermenter group of organisms. All these findings highlight the need for continuous microbiological surveillance, strict infection control, and implementation of antimicrobial stewardship protocols to mitigate the further emergence and spread of extensively drug-resistantnon fermenter group of organisms.

Conclusion

The findings of this study underscore the growing challenge of antimicrobial resistance among both gram-positive and gram-negative pathogens in wound infections. The emergence of multidrug-resistant organisms, particularly among non-fermenters, highlights the urgent need for ongoing microbiological surveillance, judicious antibiotic use, and robust infection control measures to guide effective treatment and curb resistance spread.

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