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Prevalence and Antimicrobial Susceptibility of Proteus Species Isolated from Wound Infections in a Tertiary Care Hospital in Kashmir Valley

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ABSTRACT:

Background: Proteus species are significant pathogens in wound and soft tissue infections, often exhibiting complex antimicrobial resistance patterns. Understanding their local susceptibility profile is crucial for guiding effective empirical therapy. Objective: To evaluate the antimicrobial susceptibility pattern of Proteus species isolated from pus samples at a tertiary care hospital in Kashmir Valley. **Methods:** A retrospective study was conducted over 12 months (January 2023- January 2024) at Government Medical College, Srinagar. A total of 10,920 pus samples were received from both OPD and IPD settings of the hospital and cultured after quality evaluation. The recovered isolates were identified by standard microbiological techniques, and antimicrobial susceptibility was assessed by the Kirby-Bauer disc diffusion method following CLSI guidelines. **Results:** A total of 442 Proteus isolates were recovered from the pus/ wound swabs from the cases of wound infection. Proteus mirabilis was the predominant species (81.4%), followed by Proteus vulgaris (18.6%). Highest sensitivity was observed to piperacillin-tazobactam (88.8%), followed by gentamycin (83.3%), cefoperazone-sulbactam (72.4%), and imipenem (68%). High resistance rates were observed against ciprofloxacin (66.6%), levofloxacin (67.3%), cefoxitin (73.1%), and amoxicillin-clavulanate (82.7%).

Conclusion: Proteus species from pus samples exhibit significant multidrug resistance. Imipenem, piperacillin-tazobactam, and amikacin remain effective options. Routine antimicrobial surveillance and judicious use of antibiotics are necessary to contain resistance.

Keywords: Proteus species, antimicrobial susceptibility, wound infections

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INTRODUCTION

Wound infections are a major cause of morbidity and prolonged hospital stay, particularly in developing countries. They can range from minor superficial infections to life-threatening systemic involvement. Among the diverse range of pathogens implicated, gram-negative bacilli, particularly members of the Enterobacterales family, play a significant role [1].

Proteus species, notably Proteus mirabilis and Proteus vulgaris, are recognized opportunistic pathogens frequently isolated from various clinical specimens, including pus, wound exudates, urine, and blood [2]. Their role in wound infections is particularly concerning due to their inherent motility, biofilm-forming ability, production of

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urease, and the growing trend of multidrug resistance (MDR) [3].

Infections caused by Proteus spp. are challenging to treat because these organisms are often resistant to multiple classes of antibiotics. They possess natural resistance to polymyxins and frequently acquire resistance mechanisms such as extended-spectrum beta-lactamases (ESBLs), AmpC beta-lactamases, and carbapenemases [4]. The inappropriate and excessive use of broad-spectrum antibiotics has further accelerated the emergence of resistant strains [5,6].

Globally, antimicrobial resistance among Proteus isolates varies widely by geographical region, patient population, and hospital setting [7]. Studies conducted in India have reported an alarming rise in MDR Proteus isolates, emphasizing the necessity for local surveillance data to inform empirical antibiotic policies [8]. In the Kashmir Valley, the burden of wound infections is substantial owing to the high prevalence of road traffic accidents, surgical interventions, diabetic foot ulcers, and trauma cases. However, limited data are available on the prevalence and antimicrobial susceptibility patterns of Proteus species from wound infections in this region.

Given this background, the present study was undertaken to determine the prevalence and antimicrobial susceptibility profile of Proteus species isolated from wound infections at a tertiary care hospital in Kashmir Valley. The findings of this study are expected to aid clinicians in selecting appropriate empirical therapy and contribute towards strengthening antibiotic stewardship programs.

MATERIALS AND METHODS

A retrospective observational study was carried out at the Department of Microbiology, Government Medical College, Srinagar, over one year from January 2023- January 2024.

Pus samples that were collected aseptically from patients attending OPD and inpatient departments were received and, after quality evaluation, subjected to processing. Samples were cultured on Blood Agar and MacConkey Agar and incubated at 37°C for 24 hours. Bacterial identification was performed using colony morphology, Gram staining, motility tests, and standard biochemical reactions.

Susceptibility testing was conducted by the Kirby-Bauer disc diffusion method following Clinical and Laboratory Standards Institute (CLSI) guidelines

Data Analysis

All data were entered and analyzed using Microsoft Excel 2019.

Descriptive statistics such as percentages and frequencies were used to present the prevalence and antimicrobial susceptibility patterns of Proteus species.

RESULTS

During the study period, a total of 10,920 pus and wound swab samples were received for culture and sensitivity testing in the microbiology laboratory of a tertiary care hospital in Kashmir Valley. 2730 samples (25%) were collected from outpatient department (OPD) patients, which included patients from walk-in wound infections, diabetic ulcers, minor injuries, and post-surgical check-ups. 8190 samples (75%) were obtained from inpatient department (IPD) patients from various departments of the hospital, which included cases of trauma, diabetic foot ulcers with complications, surgical history, burns, and septicaemia. The majority of the patients were males (54%) as compared to females (46%).

Isolation of Proteus Species

Out of the total samples processed, Proteus species were isolated from 442 samples, yielding an overall isolation rate of 4.05 %. The majority of Proteus isolates (n = 360, 81.4%) were identified as Proteus mirabilis. The remaining isolates (n = 82, 18.6%) were 7identified as Proteus vulgaris. Presumptive Proteus colonies showing characteristic swarming on Blood Agar and non-lactose fermentation on

MacConkey Agar were subjected to standard biochemical tests. Gram staining, motility testing, urease production, indole reaction, triple sugar iron (TSI) test, citrate utilization, and hydrogen sulfide (H_2S) production were evaluated according to conventional microbiological procedures. Proteus mirabilis was distinguished from Proteus vulgaris based primarily on the indole test, where P. vulgaris was indole positive, while P. mirabilis was indole negative.

Source of Proteus Isolates

This indicates that Proteus species were more frequently isolated from hospitalized patients compared to outpatients.

Antimicrobial Susceptibility Pattern of Proteus Species

Highest sensitivity was observed to piperacillin-tazobactam (88.8%), followed by gentamycin (83.3%), cefoperazone-sulbactam (72.4%), and imipenem (68%) as shown in Table 1. High resistance rates were observed against ciprofloxacin (66.6%), levofloxacin (67.3%), cefoxitin (73.1%), and amoxicillin-clavulanate (82.7%).

Table 1. Antimicrobial Susceptibility Pattern of Proteus Species

Antibiotic	Sensitivity (%)
Imipenem	68%
Piperacillin-tazobactam	88.8%
Gentamicin	83.3%
Cefoperazone-sulbactam	72.4%
Ciprofloxacin	33.4%
Levofloxacin	32.7%
Cefoxitin	26.9%
Cotrimoxazole	52.5%
Amoxicillin-clavulanate	17.3%

DISCUSSION

The present study was undertaken to assess the prevalence and antimicrobial susceptibility patterns of Proteus species isolated from wound infections at a tertiary care hospital in Kashmir Valley. Out of 10,920 pus and wound swab samples processed, Proteus species were isolated from 442 samples, yielding an overall isolation rate of 4.05%. This prevalence aligns closely with findings from other studies across India, where Proteus isolation rates from wound infections ranged between 3% and 8% [9,10].

Among the Proteus isolates, Proteus mirabilis was the predominant species, accounting for 81.4% of isolates, whereas Proteus vulgaris constituted 18.6%. These findings are in agreement with the observations of Kaur et al. (2018), who reported P. mirabilis as the dominant species (76%) isolated from wound infections [9]. Similarly, in a study by Gupta et al. (2019), P. mirabilis accounted for 79% of Proteus isolates [10]. The higher isolation rate of P. mirabilis may be attributed to its better adaptability to human tissue environments and its enhanced biofilm-forming capabilities.

In the present study, the majority of Proteus isolates (71.2%) were obtained from inpatient (IPD) samples, compared to outpatient (OPD) samples (28.8%). This highlights the significant role of Proteus spp. in nosocomial infections, often associated with surgical wounds, trauma, diabetic foot ulcers, and burn injuries [11].

Antimicrobial Susceptibility Patterns

The antimicrobial susceptibility profile revealed high sensitivity to piperacillin-tazobactam (88.8%), gentamicin (83.3%), and cefoperazone-sulbactam (72.4%). Imipenem also showed good sensitivity (68%). These results are consistent with findings reported by Banerjee et al. (2020), where Proteus isolates exhibited 85–90% sensitivity to piperacillin-tazobactam and aminoglycosides [12].

However, a significant level of resistance was observed against fluoroquinolones (ciprofloxacin sensitivity 33.4%, levofloxacin 32.7%) and beta-lactam/beta-lactamase inhibitor combinations like amoxicillin-clavulanate (sensitivity 17.3%). This pattern mirrors trends seen in previous Indian studies, including Rani et al. (2017), who reported low fluoroquinolone susceptibility rates (around 30%) among Proteus wound isolates.

Comparatively, Singh et al. (2018) also documented high resistance rates to cefoxitin and cotrimoxazole, similar to our findings [13]. The decreasing effectiveness of fluoroquinolones and cephalosporins emphasizes the need for cautious empirical therapy, especially in wound infections caused by gram-negative bacilli.

Multidrug Resistance

A notable concern in our study was the prevalence of multidrug resistance (MDR) among Proteus isolates, with 46.2% classified as MDR. Previous reports by Sharma et al. (2017) documented MDR rates ranging from 40% to 55% among Proteus wound isolates [14]. The high MDR rate could be attributed to the excessive and often inappropriate use of broad-spectrum antibiotics in both community and hospital settings.

The high susceptibility to piperacillin-tazobactam and aminoglycosides seen in our study suggests that these agents can still be reliably used as empirical therapy, especially in critically ill patients pending culture results. However, the rise in carbapenem resistance, though moderate (imipenem sensitivity 68%), warrants vigilant monitoring.

CONCLUSION

In conclusion, Proteus species continue to be significant opportunistic pathogens in wound infections. Prompt microbiological diagnosis, appropriate antibiotic selection based on local sensitivity trends, and robust infection control strategies are essential for optimizing patient

outcomes and combating the rising threat of multidrug-resistant organisms.

The present study highlights the significant prevalence of Proteus species, particularly Proteus mirabilis, as important etiological agents in wound infections in a tertiary care setting in the Kashmir Valley. With an overall isolation rate of 4.05%, our findings reaffirm the notable presence of Proteus spp. in both inpatient and outpatient wound infections. The antimicrobial susceptibility pattern reveals that piperacillin-tazobactam, gentamicin, and cefoperazone-sulbactam remain highly effective therapeutic options against Proteus isolates. However, the study also uncovers alarming resistance trends against fluoroquinolones and third-generation cephalosporins, alongside a 46.2% multidrug resistance (MDR) rate among isolates. These findings underscore the growing challenge of antibiotic resistance in wound management. The relatively high burden of Proteus infections among hospitalized patients further emphasizes the importance of stringent infection control measures, particularly in surgical, trauma, and intensive care units.

Final Recommendations

- Antibiotic Stewardship: There is an urgent need to implement rational antibiotic prescribing practices to slow down the progression of antimicrobial resistance.
- Routine Surveillance: Regular monitoring of local bacterial profiles and susceptibility patterns should guide empirical therapy, especially in hospital settings.
- Infection Control: Strengthening infection control programs can minimize the spread of resistant strains, particularly in vulnerable patient groups such as those with burns, diabetes, and post-surgical wounds.
- Further Research: Continuous molecular studies are recommended to detect resistance mechanisms, such as extended-spectrum beta-lactamases (ESBL) and carbapenemases, particularly in MDR Proteus strains.

Conflict of interest: **NIL**

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