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MULTIDRUG-RESISTANT PATHOGENS IN WOUND INFECTIONS: FINDINGS FROM A TERTIARY CARE HOSPITAL IN PESHAWAR, PAKISTAN

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Abstract

Introduction: The emergence and spread of multidrug-resistant pathogens in wound infections represent a growing public health concern, threatening to undermine the efficacy of conventional antimicrobial therapies. **Objectives:** The main objective of the study is to find the multidrug-resistant (MDR) pathogens in wound infections and these findings are from a tertiary care hospital in Peshawar, Pakistan. **Methodology of the study:** This retrospective observational study was conducted at Lady Reading Hospital Peshawar from January 2023 till December 2023. A total of 350 patients with clinically diagnosed wound infections were included in the study. Patients of all ages and genders who presented with wound infections during were included in the study. Patient data were retrieved from electronic medical records, including demographic information, clinical history, wound characteristics, microbiological culture results, and antibiotic susceptibility profiles. **Results:** Data were collected from 350 patients according to inclusion criteria. Out of the 350 patients included in the study, multidrug-resistant pathogens were identified in 45% of cases. The most commonly isolated multidrug-resistant organisms were Methicillin-resistant *Staphylococcus aureus* (MRSA) (20%), Extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli* (15%), and Vancomycin-resistant *Enterococcus* (VRE) (10%). It revealed that patients with MDR infections had a significantly higher rate of prolonged hospital stays, with 70% requiring extended medical care compared to 40% in the susceptible group. **Conclusion:** It is concluded that wound infections caused by multidrug-resistant pathogens pose significant challenges in clinical practice, emphasizing the critical need for effective management strategies.

Introduction

The emergence and spread of multidrug-resistant pathogens in wound infections represent a growing public health concern, threatening to undermine the efficacy of conventional antimicrobial therapies. Wound infections are common complications in healthcare settings, occurring in various clinical contexts such as surgical wounds, traumatic injuries, and chronic wounds like diabetic foot ulcers [1]. Multidrug-resistant organisms, including bacteria like methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), and extended-spectrum beta-lactamase (ESBL)-producing *Enterobacteriaceae*, have become increasingly prevalent in these infections [2].

Several factors contribute to the development and dissemination of multidrug resistance, including the overuse and misuse of antibiotics, inadequate infection control practices, and the inherent adaptability of microbial pathogens [3]. The consequences of multidrug resistance are far-reaching, leading to prolonged hospital stays, increased morbidity and mortality, and higher healthcare costs [4]. Moreover, the limited availability of effective antimicrobial agents against these resistant pathogens complicates treatment decisions, necessitating the use of alternative therapeutic modalities and antimicrobial stewardship strategies [5].

The term multidrug-resistant (MDR) refers to a bacterium that exhibits resistance to multiple antimicrobial drugs from different chemical classes or subclasses, employing various mechanisms [6]. Many authors and authorities use *in vitro* antimicrobial susceptibility testing results as one method to classify organisms as MDR. Resistance to antimicrobial drugs can

arise from mutation, acquisition of resistance genes via horizontal gene transfer, or may be an inherent characteristic encoded chromosomally [7]. MDR is a significant concern in both hospital and community settings for clinicians, patients, and pharmaceutical industries. Prolonged and widespread use of antibiotics has contributed to the emergence of resistant organisms [8]. Factors such as overuse, incorrect dosing, prescription without proper susceptibility testing, self-medication, and extended hospital stays exacerbate the issue of MDR, particularly in developing nations [9]. The Centers for Disease Control and Prevention (CDC) has highlighted antimicrobial-resistant gram-negative bacilli as an emerging threat in healthcare settings, according to their report on healthcare-associated infections. The emergence of antimicrobial resistance, particularly in life-threatening bacterial infections, presents significant global public health concerns. This resistance diminishes the effectiveness of antibacterial treatments, increases morbidity and mortality rates, raises treatment costs, and places a heavy burden on healthcare systems. The unethical and indiscriminate use of synthetic antibiotics for both prophylaxis and treatment of bacterial illnesses has contributed to the development of multidrug resistance (MDR), a phenomenon criticized for spawning bacterial strains resistant to multiple antibiotics commonly used against various bacterial diseases [10]. Infections caused by MDR bacteria profoundly impact clinical outcomes, as these strains often resist available antibiotic treatments, leading to increased mortality rates. Consequently, alongside the quest for more effective and novel antibiotics to combat MDR bacterial strains, researchers and medical practitioners worldwide are exploring alternative therapeutic approaches to mitigate the adverse effects of bacterial pathogens, particularly in tackling the rapid proliferation of MDR strains [11].

Objectives

The main objective of the study is to find the multidrug-resistant (MDR) pathogens in wound infections and these findings are from a tertiary care hospital in Peshawar, Pakistan.

Methodology of the study

This retrospective observational study was conducted at Lady Reading Hospital Peshawar from January 2023 till December 2023. A total of 350 patients with clinically diagnosed wound infections were included in the study. Patients of all ages and genders who presented with wound infections during were included in the study. Patient data were retrieved from electronic medical records, including demographic information, clinical history, wound characteristics, microbiological culture results, and antibiotic susceptibility profiles. Information on the presence of multidrug-resistant pathogens, defined as microorganisms resistant to at least three classes of antibiotics, was specifically documented. Wound swabs or tissue specimens obtained from each patient were processed for microbial culture and identification using standard microbiological techniques. Antimicrobial susceptibility testing was performed according to Clinical and Laboratory Standards Institute (CLSI) guidelines. Data were analyzed using SPSS v29. The prevalence of multidrug-resistant pathogens in wound infections was calculated, along with the distribution of specific bacterial species and their resistance profiles. Statistical analysis was conducted, and results were interpreted to identify trends and associations.

Results

Data were collected from 350 patients according to inclusion criteria. Out of the 350 patients included in the study, multidrug-resistant pathogens were identified in 45% of cases. The most commonly isolated multidrug-resistant organisms were Methicillin-resistant *Staphylococcus aureus* (MRSA) (20%), Extended-spectrum beta-lactamase (ESBL)-producing *Escherichia coli* (15%), and Vancomycin-resistant *Enterococcus* (VRE) (10%).

Table 01: Prevalence and distribution of MDR pathogens

| Pathogen | Prevalence (%) |
|------------------------------------------------|----------------|
| Methicillin-resistant <i>S. aureus</i> (MRSA) | 20 |
| ESBL-producing <i>E. coli</i> | 15 |
| Vancomycin-resistant <i>Enterococcus</i> (VRE) | 10 |

It revealed that patients with MDR infections had a significantly higher rate of prolonged hospital stays, with 70% requiring extended medical care compared to 40% in the susceptible group. Moreover, treatment failure was more prevalent among patients infected with MDR pathogens, with 25% experiencing inadequate response to therapy compared to 10% in the susceptible group.

Table 02: Association of MDR pathogens with clinical outcomes

| Clinical Outcome | Multidrug-Resistant (%) | Susceptible (%) |
|-------------------------|-------------------------|-----------------|
| Prolonged Hospital Stay | 70 | 40 |
| Treatment Failure | 25 | 10 |
| Mortality | 5 | 5 |

Results revealed that surgical incisions had a higher proportion of MDR infections, with 30% affected, compared to 15% in susceptible cases. Pressure ulcers also exhibited a similar pattern, with 25% MDR infections versus 10% susceptible ones. Traumatic wounds showed an intermediate level of MDR prevalence, with 20% affected, while diabetic foot ulcers had the lowest MDR prevalence at 15%.

Table 03: Distribution of wound

| Wound Type | Multidrug-Resistant (%) | Susceptible (%) |
|----------------------|-------------------------|-----------------|
| Surgical Incisions | 30 | 15 |
| Pressure Ulcers | 25 | 10 |
| Traumatic Wounds | 20 | 5 |
| Diabetic Foot Ulcers | 15 | 8 |

Results indicated that antibiotic treatment alone achieved a success rate of 60%, albeit with a relatively higher complication rate of 20%. Combining antibiotics with debridement led to a higher success rate of 80% and a lower complication rate of 15%. Surgical intervention demonstrated the highest success rate of 90%, accompanied by a minimal complication rate of 10%. However, the amputation approach had a lower success rate of 50% and the highest complication rate of 30%.

Table 04: Clinical management of wound infection

| Treatment Regimen | Success Rate (%) | Complications (%) |
|---------------------------|------------------|-------------------|
| Antibiotics only | 60 | 20 |
| Antibiotics + Debridement | 80 | 15 |
| Surgical Intervention | 90 | 10 |
| Amputation | 50 | 30 |

Table 05: Significance of treatment outcomes

| Outcome | p-value |
|------------------------------------------|---------|
| Antibiotics only vs. Surgery | <0.001 |
| Antibiotics + Debridement vs. Surgery | 0.002 |
| Antibiotics only vs. Amputation | 0.005 |
| Antibiotics + Debridement vs. Amputation | 0.01 |
| Surgery vs. Amputation | 0.003 |

Discussion

The high prevalence of multidrug-resistant pathogens underscores the pressing need for effective strategies to combat these infections. The efficacy of various treatment modalities, including antibiotics, surgical intervention, and debridement, is evident from the favorable response rates observed in our patient cohort [12]. However, it is essential to note that certain interventions, such as surgery, demonstrated significantly better outcomes compared to antibiotic therapy alone or in combination with debridement, as evidenced by the p-values. Wound infections face a significant challenge in healthcare settings. Specifically, multidrug-resistant organisms (MDROs) are involved [13]. Therefore, wound infections remain a persistent public health concern. Moreover, wound infection leads to prolonged patient debility and increased healthcare costs [14]. Hence, MDROs, such as methicillin-resistant *Staphylococcus aureus* (MRSA), have emerged and spread. In addition, it contains *Pseudomonas aeruginosa* and *Acinetobacter baumannii*, which have exacerbated this problem. Therefore, it is a major threat to patient healthcare systems globally. Moreover, the relatively high rate of hospitalization required underscores the severity and complexity of wound infections associated with multidrug-resistant pathogens [15]. This emphasizes the importance of prompt diagnosis, appropriate antimicrobial therapy, and close clinical monitoring to prevent complications and improve patient outcomes. Additionally, our study highlights the need for continued research and innovation in antimicrobial stewardship and infection control practices to mitigate the emergence and spread of multidrug-resistant pathogens in wound care settings [16]. Overall, our findings underscore the multifaceted challenges posed by wound infections involving multidrug-resistant pathogens and emphasize the importance of a comprehensive and multidisciplinary approach to their management. Effective strategies should integrate antimicrobial stewardship, infection prevention and control measures, and evidence-based treatment protocols to optimize patient care and mitigate the impact of multidrug resistance on wound healing and patient outcomes.

Conclusion

It is concluded that wound infections caused by multidrug-resistant pathogens pose significant challenges in clinical practice, emphasizing the critical need for effective management

strategies. Our findings also highlight the importance of diagnosis, appropriate antimicrobial therapy, and surgical intervention in optimizing treatment outcomes.

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