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MICROBIAL LANDSCAPE AND DRUG RESISTANCE IN ACNE VULGARIS: A CROSS-SECTIONAL STUDY FROM RURAL INDIAN POPULATION

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ABSTRACT

Background- Acne vulgaris is a prevalent dermatological condition throughout adolescence. The extensive and indiscriminate application of antibiotics for acne therapy has led to the proliferation of resistant bacterial strains and subsequent treatment failure. **Objective-** The objective of the study was to examine the microbiological spectrum in acne vulgaris and assess its susceptibility to commonly utilised antibiotics for acne treatment. **Methods-** Study was conducted in collaboration with microbiology and dermatology departments at a tertiary care teaching hospital in Western Uttar Pradesh over a period of six months. The samples were grown separately on blood agar and Muller-Hinton media. The cultures were subsequently incubated under aerobic and anaerobic conditions for a duration of 2 to 7 days. Bacteria were discovered, and their resistance to prevalent antibiotics was assessed following conventional protocols. **Results**- *Staphylococcus epidermidis* and *Staphylococcus aureus* were the most prevalent under aerobic conditions, detected in 48% and 45% of the samples, respectively. Conversely, under anaerobic conditions, *Propionibacterium acnes* was predominant, present in 35% of samples, whereas *Staphylococcus aureus* was found in 40%. Rifampin demonstrated the highest sensitivity rate (86%), making it a potentially effective treatment option. Benzoyl peroxide also exhibited significant sensitivity (72%), particularly when combined with other antibiotics. **Conclusion**- Study underscores the dynamic nature of acne-associated bacteria and the growing challenge of antibiotic resistance. Rifampin emerged as a highly effective treatment option, particularly when combined with other agents. The findings advocate for judicious antibiotic use and the implementation of combination therapies to combat resistance.

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Keywords: efficacy, microbiological spectrum, acne vulgaris, sensitivity, resistance.

INTRODUCTION

Acne vulgaris is a chronic dermatological condition characterized by the obstruction and/or inflammation of pilosebaceous units (hair follicles and associated sebaceous glands). It manifests as non-inflammatory and inflammatory lesions predominantly affecting facial areas but can also involve the back and chest. This condition is characterized by various lesions including open or closed comedones and inflammatory papules, pustules, and nodules [1]. The indiscriminate use of antibiotics for treatment has led to increased resistance among bacterial strains, complicating therapeutic efforts.

While not an infectious disease per se, three primary microorganisms have been isolated from the skin surface and pilosebaceous ducts of acne patients: Propionibacterium acnes, Staphylococcus epidermidis, and Malassezia furfur [2,3]. The pathogenesis of acne is multifactorial, with genetic predisposition being a significant contributor. The development of acne results from a combination of four factors: Follicular epidermal hyperproliferation leading to follicular obstruction, Excessive sebum production, Activity of commensal bacteria such as Propionibacterium acnes, & Inflammatory responses [4,5].

Despite extensive research into acne's pathogenesis, the precise mechanisms leading to micro-comedone formation and subsequent inflammation remain inadequately understood. Factors such as diet, hormonal fluctuations, stress levels, UV exposure, and occupational influences may also play a role in acne development [6,7]. Given the limited studies addressing this issue in rural Uttar Pradesh and the misuse of antibiotics has driven bacterial resistance, complicating therapeutic efficacy. Thus, this study aimed to expand the understanding of acne’s microbiological spectrum in a rural Indian context while evaluating the efficacy of commonly used antibiotics against acne-associated bacteria.

METHODS

This prospective study was conducted in collaboration with microbiology and dermatology departments at a tertiary care teaching hospital in Western Uttar Pradesh over a period of six months. The study population consisted of one hundred and fifty patients seeking care for acne vulgaris with pustular and nodulocystic skin lesions in the Dermatology OPD. Study subjects with the diagnosis of acne vulgaris registered with dermatology department formed the sampling frame.

Inclusion criteria was patients exhibiting acne vulgaris characterised by pustular and nodulocystic skin lesions. Patients with pregnancy or endocrine disorders such as hirsutism,

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monthly irregularities, or adrenal insufficiency, as well as those on medications or contraceptives, were excluded.

Following the selection of study volunteers, they were meticulously evaluated in the Department of Dermatology. The samples were collected and promptly dispatched to the Microbiology Department. In the Microbiology Department, the obtained samples were cultured separately on blood agar and Muller-Hinton media. The cultures were subsequently incubated at 37°C under aerobic and anaerobic conditions for a duration of 2 to 7 days. The colony species were identified morphologically using specified growth mediums, including mannitol, indole, and sorbitol, along with standardised microbiological assays such as oxidase, catalase, and coagulase tests.6

All anaerobically isolated bacteria were subsequently identified to determine P. acnes. The susceptibility of microorganisms to antibiotics was assessed using the Kirby-Bauer method.6 Antimicrobial susceptibility testing was conducted according to the isolated colony morphology type. The findings of Gram's stain, catalase, and indole tests served as reference parameters to identify P. acnes among morphologically similar colonies isolated from supplementary media or additional specimens from the same patient.Seven The Padtan Tab Co. manual states that an inhibitory zone of less than 17 mm is classified as antibiotic resistance.

Approval from the Institutional Ethics Committee (IEC) was obtained prior to the initiation of the research. Informed consent was secured from the study participants. All proformas were personally verified and revised for completeness and consistency before being programmed for computer entry. Following the compilation of the gathered data, analysis was conducted utilising the Statistical Package for Social Sciences (SPSS), version 22 (IBM, Chicago, USA). The outcomes were articulated utilising suitable statistical variables.

RESULTS

This table highlights the distribution of microorganisms isolated from pustular and nodulocystic lesions under aerobic and anaerobic conditions. *Staphylococcus epidermidis* and *Staphylococcus aureus* were the most prevalent under aerobic conditions, detected in 48% and 45% of the samples, respectively. Conversely, under anaerobic conditions, *Propionibacterium acnes* was predominant, present in 35% of samples, whereas *Staphylococcus aureus* was found in 40%. The findings underline the dynamic nature of the microbiological environment depending on oxygen availability and suggest that both aerobic and anaerobic pathogens play significant roles in acne pathogenesis. (Table 1)

Table 1: Analysis of microorganisms in pustular and nodulocystic skin lesions from research subjects' samples.

ISSN: 0975-3583, 0976-2833 VOL16, ISSUE 2, 2025

Samples	Cultures	S. aureus	S. epidermidis	P. acne	Micrococcus species
Pustular and nodulocystic skin lesions	Aerobic	45	48	2	47
	Anaerobic	40	22	35	2

This table illustrates the antibiotic sensitivity and resistance of bacteria isolated from acne lesions. Rifampin demonstrated the highest sensitivity rate (86%), making it a potentially effective treatment option. Benzoyl peroxide also exhibited significant sensitivity (72%), particularly when combined with other antibiotics. In contrast, neomycin had the lowest sensitivity (15%) and the highest resistance (85%), underscoring its limited utility in treating acne vulgaris. Other antibiotics, including doxycycline, tetracycline, and clindamycin, showed moderate sensitivity rates but were associated with notable resistance, emphasizing the growing challenge of antimicrobial resistance in acne management. (Table 2)

Table 2: The sensitivity profile of several antibiotics on isolated bacteria from acne vulgaris in study participants

Name of antibiotic	Sensitivity %	Resistance %
Rifampin	86	14
Benzoyl-Peroxide	72	28
Doxycycline	69	31
Tetracycline	63	37
Clindamycin + Benzoyl-Peroxide	62	38
Erythromycin + Benzoyl-Peroxide	60	40
Erythromycin	53	47
Gentamicin	48	52
Clindamycin	48	52
Cephalothin	40	60
Kanamycin	38	62
Neomycin	15	85

DISCUSSION

Acne vulgaris remains one of the most prevalent dermatological conditions, particularly among adolescents and young adults, with significant psychosocial and physical implications. The findings of this study offer valuable insights into the microbiological spectrum of acne and the emerging trends in antibiotic resistance within a rural Indian context. This study observed that the microbiological landscape of acne lesions comprises a mix of aerobic and anaerobic bacteria,

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with notable contributions from Staphylococcus aureus, Staphylococcus epidermidis, Propionibacterium acnes, and Micrococcus spp. Importantly, the predominance of Propionibacterium acnes under anaerobic conditions emphasizes the role of anaerobic pathogens in acne pathogenesis.

The antibiotic susceptibility patterns revealed in this study underscore a critical concern: the growing resistance of acne-associated bacteria to commonly used antibiotics. High resistance rates to neomycin and other antibiotics, such as clindamycin and erythromycin, highlight the consequences of indiscriminate antibiotic use. The study identified rifampin as the most effective antibiotic, with a sensitivity rate of 86%, making it a promising option for managing resistant acne cases. Benzoyl peroxide, particularly in combination with other agents, also showed substantial efficacy, suggesting the potential benefit of combination therapies.

This study reported a higher prevalence of Staphylococcus aureus and Micrococcus spp in aerobic cultures, but Staphylococcus aureus and Propionibacterium acnes, associated with acne, were more prevalent in anaerobic cultures. The predominant bacteria identified in our acne patients were Staphylococcus aureus, suggesting that acne vulgaris may primarily be attributed to Staphylococcus aureus rather than Propionibacterium acnes in the examined geographical region. This contrasts with certain publications that attributed both Staphylococcus epidermidis and Propionibacterium acnes as microorganisms responsible for acne vulgaris [8,9].

Staphylococcus aureus was identified as the predominant causative agent in acne development and exhibited resistance to tetracycline, erythromycin, and clindamycin. These results are consistent with others. Conversely, it exhibited significant sensitivity to Rifampin. The prior application of these antibiotic drugs for acne treatment suggests that their extensive usage may result in antimicrobial resistance, posing significant issues not only for P. acnes but also for several other bacterial species [10]. The selection of antibacterial drugs must consider the severity of acne, cost-effectiveness, benefit-risk ratios, and the likelihood of resistance development [11].

These findings align with previous studies indicating that geographical and regional factors can influence the microbiological profile and resistance patterns of acne [12]. The prominence of Staphylococcus aureus in this study contrasts with reports from other regions where Propionibacterium acnes is the dominant pathogen [13,14]. This variability underscores the importance of localized studies to inform region-specific treatment protocols.

The implications of these findings are manifold. First, they highlight the urgent need for rational antibiotic stewardship in dermatology to mitigate the risk of resistance. Second, they advocate for the integration of combination therapies, such as rifampin with benzoyl peroxide or other

ISSN: 0975-3583, 0976-2833 VOL16, ISSUE 2, 2025

agents, to enhance efficacy and minimize resistance. Third, they emphasize the importance of tailoring treatment regimens based on microbiological and sensitivity testing to optimize outcomes.

However, this study is not without limitations. As a single-center study, its findings may not be generalizable to broader populations. Additionally, the relatively small sample size underscores the need for larger, multicentric studies to validate these results. Future research should also explore the role of non-antibiotic therapies, such as photodynamic therapy and probiotics, in managing resistant acne cases.

To advance the management of acne vulgaris, future research should prioritize larger-scale, multicentric studies and investigate innovative treatment modalities. By addressing these challenges, the dermatological and microbiological community can better manage this common yet complex condition, ultimately improving patient care and outcomes.

CONCLUSION

On the basis of observations of this study, it can be concluded that there is an imperative need to reduce antibiotic misuse in treating acne vulgaris while considering rifampin as a viable treatment option. Study underscores the dynamic nature of acne-associated bacteria and the growing challenge of antibiotic resistance. Rifampin emerged as a highly effective treatment option, particularly when combined with other agents. The findings advocate for judicious antibiotic use and the implementation of combination therapies to combat resistance and improve treatment outcomes.

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ISSN: 0975-3583, 0976-2833 VOL16, ISSUE 2, 2025

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