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Effectiveness of different acne treatment methods: a comparison of pharmacological, procedural and natural therapies

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Abstract
Acne vulgaris is a chronic skin condition affecting millions of people, especially adolescents. This study analyzes the effectiveness of various acne treatment methods, including pharmacological, procedural, and natural therapies. It compares their mechanisms of action, therapeutic effects, and potential side effects. The aim of this study is to identify the most effective therapeutic strategies to improve patients' quality of life and mental health. The analysis results suggest that a comprehensive approach to acne treatment, combining different methods, may yield the best outcomes.

Keywords: acne, treatment, pharmacological therapies, procedural therapies, natural methods

Introduction

Acne vulgaris is a chronic skin condition that affects millions of people worldwide, particularly adolescents during puberty. It impacts patients' quality of life, causing emotional and psychosocial issues such as decreased self-acceptance, depression, and anxiety. Furthermore, acne often leads to scarring, which can exacerbate psychological problems. A thorough understanding of acne pathogenesis and effective treatment strategies is essential for improving patients' well-being (1). The importance of effective acne treatments is significant not only for aesthetic reasons but also for patients' mental health. Effective therapies can reduce symptoms and prevent scarring, which has a lasting impact on self-esteem and social relationships (2).

The aim of this study is to compare the effectiveness of various acne treatment methods, including pharmacological, procedural, and natural therapies. This analysis seeks to identify the most effective therapeutic strategies that can improve patients' quality of life. The study focuses on evaluating therapeutic outcomes, mechanisms of action, and potential side effects of different methods, which allows for a deeper understanding of their roles in the treatment of acne vulgaris.

Chapter I: Acne Characteristics and Pathophysiology

Acne vulgaris is a chronic inflammatory condition that primarily affects the sebaceous glands and hair follicles, leading to the formation of comedones, pustules, and cysts.

Acne appears in various forms, including neonatal acne, infantile acne, occupational acne, vulgar acne (acne vulgaris), conglobate acne, fulminant acne, mechanical acne, excoriated acne (picker's acne), chloracne, and drug-induced acne. The most common type is acne vulgaris, which accounts for 99% of all cases (3)(4). It most often affects adolescents during puberty, though it can occur at any age. Another classification of acne distinguishes between adolescent acne, frequently associated with hormonal changes, and adult acne, which often arises due to stress or hormonal fluctuations in adulthood. Acne differs from rosacea, which is characterized by redness and visible blood vessels. Acne can also be classified based on symptoms and location, including comedonal, papulopustular, and cystic acne, the latter being the most severe form of the condition.

The pathogenesis of acne is a complex process involving various contributing factors. The primary elements include hyperactivity of the sebaceous glands and excessive sebum production, hormonal imbalances—particularly fluctuations in androgen levels—follicular hyperkeratinization, microbial colonization, especially by *Cutibacterium acnes*, and the accompanying inflammatory response. The interplay of these factors, shaped by genetic, hormonal, and environmental variables, underscores the challenges in effectively managing acne (4)(5)(6). The immune response to these factors results in erythema and swelling around skin lesions.

Factors influencing acne development can be categorized into internal factors, such as genetics, hormone levels, and stress, and external factors, including diet, environmental pollution, and the use of inappropriate cosmetics. Understanding these factors is crucial for the effective diagnosis and treatment of acne (7).

Chapter II: Pharmacological methods for acne treatment

- **Topical retinoids**

Topical retinoids are a diverse group of vitamin A derivatives that play a crucial role in the treatment of acne vulgaris. Preparations such as adapalene, tretinoin, and tazarotene have been approved by the FDA. Their mechanism of action involves the regulation of keratinocyte proliferation and differentiation, which helps prevent the formation of comedones and exhibits anti-inflammatory effects (8).

Topical retinoids are regarded as a first-line therapeutic option and a maintenance strategy in acne treatment, reducing both the number of comedones and inflammatory lesions. Additionally, their use can contribute to the prevention and reduction of the visibility of atrophic scars and hyperpigmentation. Due to typical side effects such as dryness, irritation, redness, and peeling, patients who have not previously used these preparations often begin therapy with low concentrations of adapalene or tretinoin, gradually adjusting the doses according to their needs and tolerance (9).

Retinoids can be classified by generation and formulation, which affects their efficacy, action, and side effects. First-generation retinoids include isotretinoin, tretinoin (also known as all-trans-retinoic acid), and alitretinoin. These are modifications of natural retinoids that bind to retinoic acid receptors but lack selectivity. Second-generation retinoids, such as acitretin, are oral retinoids that have modified the benzene ring to a cyclohexane ring, making them unique.

The third generation of retinoids, which includes adapalene and tazarotene, was developed to target specific retinoid receptors, providing a more tailored therapeutic approach. The latest, fourth generation of retinoids, represented by trifarotene, is highly selective for the RAR-γ retinoid receptor, which is particularly beneficial in skin therapy. Retinoids are available in various forms, such as creams, gels, and solutions. Gels are often less irritating and preferred for oily skin, while creams may be better suited for dry skin due to their moisturizing properties. Topical retinoids are effective in treating both comedonal (non-inflammatory) and inflammatory acne as they enhance skin cell turnover, reduce the appearance of acne lesions, and improve skin texture. However, it is important to note that side effects such as dryness, irritation, and sun sensitivity are common, particularly at the onset of therapy. Therefore, a gradual introduction of retinoids along with the use of moisturizers and sunscreen is recommended to mitigate these effects (10). It is worth noting that despite some general recommendations, there is a lack of systematic comparative studies regarding the efficacy of different retinoid preparations. Current observations suggest that tazarotene may be the most effective but also the least well-tolerated. In contrast, adapalene, based on findings from 2019, has shown a favorable tolerance profile, making it the preferred choice for patients using retinoids for the first time or those with sensitive skin (11).

- **Topical and oral antibiotics**

The most commonly used oral antibiotics in acne therapy are tetracyclines, including doxycycline and minocycline. These antibiotics work by reducing the number of *Cutibacterium acnes* bacteria on the skin and decreasing inflammation, leading to a reduction in acne lesions. An important aspect of using oral antibiotics is their potential for resistance. Therefore, restrictions are often imposed on their long-term use, typically not exceeding 3 to 6 months. In cases of severe acne, systemic antibiotic therapy may be combined with other treatment methods, such as retinoids, to enhance efficacy. New agents, such as sarecycline, offer alternatives that may have a lower risk of developing resistance and show promise in acne therapies.

Topical antibiotics, such as clindamycin and erythromycin, are also used in acne treatment. These medications act locally, reducing the risk of systemic side effects and resistance development compared to oral antibiotics. Topical antibiotics are usually employed in conjunction with other medications, such as benzoyl peroxide, to enhance their effectiveness and minimize the risk of resistance. This combination works synergistically, as benzoyl peroxide can eliminate bacteria and reduce the risk of antibiotic resistance. It is important for treatment with topical antibiotics to be conducted under the supervision of a dermatologist to monitor progress and side effects (12).

Antibiotics have long been a cornerstone in the treatment of acne, despite the inflammatory nature of the condition. Uncontrolled use of antibiotics has contributed to the problem of microbial resistance. *Cutibacterium acnes* bacteria can acquire resistance through genetic mutations and the transfer of resistance genes to other microorganisms. Recent studies also emphasize the physiological role of *C. acnes* in maintaining skin microbiome homeostasis.

Alternative therapies, such as probiotics, zinc, and azelaic acid, show promising results in acne treatment. Early initiation of isotretinoin may significantly reduce the risk of scarring and limit the need for antibiotics (13).

In a broader context, the responsible use of antibiotics in acne treatment requires close collaboration between patients and healthcare providers. Maintaining effective therapy while minimizing the risk of resistance is crucial for achieving positive therapeutic outcomes. It is essential for physicians to educate patients about the proper use of these medications and their potential side effects, which can significantly enhance treatment effectiveness and reduce the occurrence of antibiotic resistance (12).

- **Hormonal medications**

Hormonal treatment plays a significant role in acne therapy, particularly in cases associated with hormonal imbalances. The pathophysiology of acne involves the action of androgens, which stimulate sebaceous gland activity, leading to increased sebum production and the formation of acne lesions. Consequently, hormonal therapies aim to modulate the effects of these hormones on the skin.

One commonly used approach is the use of oral contraceptives, which can effectively regulate menstrual cycles and lower androgen levels, resulting in improved skin conditions in women. These preparations increase the levels of sex hormone-binding globulin (SHBG), which reduces the amount of free testosterone in the bloodstream, thereby helping to alleviate acne symptoms.

Another effective method of hormonal treatment is spironolactone, an antiandrogen medication that blocks androgen receptors and inhibits testosterone synthesis. This medication is particularly beneficial for women suffering from acne associated with polycystic ovary syndrome (PCOS), where elevated androgen levels are often a causative factor.

In cases of severe or treatment-resistant acne, hormonal therapies may be used alone or in combination with other methods, such as topical retinoids or antibiotics, to achieve better outcomes. It is important for healthcare providers to consider hormonal evaluation in patients with acne, especially in those with signs of hyperandrogenism or in refractory cases.

In summary, hormonal therapies can provide significant benefits in the treatment of acne, particularly for individuals who do not respond adequately to conventional treatments, highlighting the multifactorial nature of this common condition (14)(15)(16).

Chapter III: Procedural methods for acne treatment

- **Chemical peels**

A chemical peel is one of the methods used in acne treatment, involving the application of a chemical solution to the skin's surface. This process aims to accelerate the exfoliation of the epidermis and stimulate skin cell regeneration. Chemical peels can effectively remove dead skin cells, unclog pores, and reduce inflammation, contributing to an overall improvement in skin condition.

There are several types of chemical peels, and their selection depends on the skin type, its tone, and specific skin concerns.

Chemical peels are effective not only in treating active acne but also in addressing post-acne scars and hyperpigmentation following inflammatory episodes. Regular use of chemical peels can also enhance skin texture by reducing fine lines and improving firmness.

It is recommended that these procedures be performed by a qualified dermatologist, ensuring safety and optimal results. Furthermore, it is important to use appropriate sun protection after a peel to avoid irritation and skin sensitivity. Depending on the patient's needs, chemical peels can be part of a broader acne treatment plan that may also include other therapies, such as topical medications or laser treatments. A well-chosen chemical peel can significantly improve the appearance of the skin and positively affect its health (17).

- **Microdermabrasion**

Microdermabrasion is a dermatological procedure that involves the mechanical removal of the outer layer of the epidermis using crystals or diamond-tipped applicators. This process stimulates skin regeneration, improves texture, and reduces acne scars. Additionally, microdermabrasion enhances the absorption of active ingredients, thereby supporting other acne treatments. It is a safe and well-tolerated method, making it popular in dermatological practice. The effects of the procedure are typically visible after several sessions, and the risk of adverse effects is minimal (18)(19).

- **Microneedling**

Microneedling is a technique used for acne treatment that employs small needles to create micro-injuries in the skin, stimulating the healing process and collagen production. This procedure aims to improve skin texture and reduce acne scars. Microneedling operates by initiating the body’s natural regenerative processes, leading to a smoothing of the skin's surface and a reduction in the visibility of pores. Furthermore, the treatment can be combined with various serums, enhancing its effectiveness.

Typically, microneedling requires several sessions to achieve optimal results, and the recovery time is short, with minimal discomfort and few side effects, such as redness or swelling. Research indicates that microneedling may be more effective for individuals with darker skin tones, where the risk of complications, such as hyperpigmentation, is lower compared to some laser treatments. In addition to acne, this technique can also assist in reducing wrinkles, stretch marks, and improving overall skin condition.

Microneedling is often viewed as an alternative to more invasive methods, offering similar benefits with significantly shorter healing times. Due to these described properties, microneedling is gaining popularity as a method for treating and enhancing skin aesthetics. However, it is essential to note that the effectiveness of the procedure may vary depending on individual patient factors (20).

- **Light therapy**

Light therapy for acne treatment utilizes various wavelengths to effectively combat the bacteria responsible for acne development and to reduce skin inflammation. The primary methods include phototherapy, specifically blue and red light therapy.

Blue light targets *Propionibacterium acnes*, eliminating it and thereby reducing the risk of comedones and inflammatory lesions. Red light, on the other hand, has anti-inflammatory properties, aiding in skin regeneration and decreasing redness and irritation. Light-based treatments for acne can be administered in dermatological offices or with home-use devices. Light therapy represents a promising option for patients who do not respond to traditional treatment methods. Studies indicate that patients often report improvements in their skin condition following a series of light therapy sessions. However, it is recommended that both physicians and patients carefully evaluate the available evidence and individual needs to establish an optimal treatment plan. (21) (22)

Chapter IV: Natural methods of acne treatment

- **Herbal medicine**

Research on the use of herbs in acne treatment indicates their potential antibacterial, anti-inflammatory, and antioxidant properties, which may support traditional therapies. Many plants, such as green tea, aloe vera, turmeric, and tea tree oil, demonstrate properties that inhibit the growth of bacteria responsible for acne development. Extracts from green tea and turmeric have been shown to reduce sebum production and skin inflammation, aiding in the reduction of acne lesions. Conversely, aloe vera alleviates irritation and accelerates skin regeneration, supporting the healing process of acne lesions. Herbs can serve as an alternative for individuals seeking gentler methods or those with sensitive skin. In some studies, herbs have been successfully used as complementary therapies that enhance the effects of pharmacological treatments. Although the results are promising, further research is necessary to better understand the optimal dosages and the safety of long-term use. (23)

- **Diet therapy**

Research on the impact of diet on the development and severity of acne indicates that a diet high in foods with a high glycemic index (GI) and dairy products may have a negative effect on the skin. Individuals with acne who follow a low-GI diet exhibit fewer acne lesions compared to those who consume high-GI foods. Milk, particularly due to the presence of whey proteins, can increase the production of IGF-1 and insulin, which stimulates sebum secretion. The intake of foods rich in omega-3 fatty acids, such as fish, demonstrates anti-inflammatory effects, alleviating skin lesions. Probiotics also show potential in acne treatment; however, further research is needed in this area. In communities that traditionally consume a low-carbohydrate diet and avoid dairy, such as the residents of Papua New Guinea, the prevalence of acne is minimal. Ethnographic studies suggest that environment and diet may provide protection against the development of acne, while the Western diet, rich in sugars and dairy, may negatively impact the skin. (24) (25) (26) (27)

- **Hygiene and skin care**

Acne is a common skin condition, particularly among adolescents, and modern treatment involves the use of moisturizers, cleansers, and sunscreen.

The choice of an appropriate cleanser should take into account the patient's skin type and effective cleansing methods. A triadic approach is recommended for the treatment of acne and rosacea, which includes patient education, medication selection, and skin care. Cosmetic products for individuals with acne and rosacea should be non-comedogenic, non-toxic, and hypoallergenic. Proper skin care can enhance the function of the epidermal barrier, while moisturizers help soothe irritations. Protection against sun exposure and environmental damage is crucial for all patients. The use of moisturizing sunscreens is particularly advised for patients with dry skin. It is also important to educate patients about proper skin care, as this can contribute to an improvement in their skin condition. Understanding the properties of cosmetic products is essential in selecting appropriate items. Daily skin care should include adequate cleansing, moisturizing, and protection from harmful external factors. (28) (29) (30) (31)

Discussion

The study analyzed the effectiveness of three therapeutic approaches in the treatment of acne vulgaris: pharmacological, procedural, and natural methods. The results indicate the necessity of tailoring treatment to the individual needs of patients, due to the diversity of mechanisms of action and potential side effects.

1. Pharmacological treatment methods

Pharmacotherapy has proven effective, particularly for patients with severe acne. Topical retinoids, such as adapalene and tretinoin, have shown efficacy in reducing the number of comedones and inflammatory lesions, which confirms their widespread application in dermatological practice. However, the emerging side effects, such as skin dryness and irritation, suggest that patients should use these medications under dermatological supervision and support their therapy with moisturizing products. Oral antibiotics, while effective, have limitations due to the risk of developing bacterial resistance. The introduction of topical antibiotics in combination with benzoyl peroxide appears promising, as it reduces the risk of resistance.

2. Procedural treatment methods

Procedural methods, including chemical peels, microdermabrasion, and light therapy, constitute a significant adjunct to pharmacological treatment, especially for patients with acne scars. Studies indicate that these procedures support skin regeneration and scar reduction, improving overall skin aesthetics. Microneedling and light therapy, particularly using blue and red light, demonstrate high efficacy in reducing inflammation. However, it is important to emphasize that the effectiveness of these methods may depend on the frequency of treatments and specialized supervision.

3. Natural treatment methods

In the context of natural therapies, positive effects have been noted from herbs such as green tea, aloe vera, and tea tree oil, which exhibit antibacterial and anti-inflammatory properties.

Additionally, dietary modifications, involving the reduction of high-glycemic-index products and the limitation of dairy intake, have proven beneficial in alleviating acne symptoms in some patients. Natural methods may serve as alternatives or adjuncts to conventional therapies; however, further research is necessary to evaluate their efficacy.

Summary of results and conclusions

Individualized approach to acne treatment

The diversity of mechanisms of action among the analyzed methods suggests that effective acne treatment necessitates an individualized approach and therapeutic flexibility. The implementation of multifaceted therapies that combine pharmacological interventions with procedural methods may yield the best results while minimizing the risk of scarring.

Recommendations for Patients and Dermatologists

In acne management, it is essential for patients to receive educational support from specialists regarding proper skin care and the avoidance of factors that exacerbate acne. It is recommended to monitor treatment progress and potential side effects, particularly when using retinoids and antibiotics.

Need for further research

Although natural methods demonstrate promising effects, additional research is required to fully understand their efficacy and optimal dosages. Further studies in procedural therapies are also warranted to ascertain the long-term effects and safety of these methods.

Comprehensive approach to acne treatment

A comprehensive strategy that encompasses pharmacological, procedural, and natural therapies allows for the achievement of optimal therapeutic outcomes. Treatments should be tailored to the individual needs of the patient, which minimizes the risk of adverse effects and supports sustained results. The effectiveness of acne treatment is crucial not only for skin health but also for the psychological and emotional well-being of patients.

DISLOCURE

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