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ACNE: PATHOGENESIS, TREATMENT METHODS, AND SKIN CARE PRINCIPLES

Abstract: The article examines the etiology, pathogenesis, and approaches to treating acne – a chronic skin condition that significantly impacts patients' self-esteem and quality of life. The primary causes of acne include sebaceous gland hypersecretion, pore blockage, inflammation, and *Propionibacterium acnes* activity. Particular attention is given to topical therapy, which involves the use of retinoids, benzoyl peroxide, and salicylic acid to reduce inflammation, normalize keratinization processes, and improve skin texture. The importance of proper skincare, including cleansing, moisturizing, and sun protection, is emphasized. The article highlights the value of early treatment, an individualized approach, and a healthy lifestyle in preventing complications.

Key words: acne, topical therapy, skincare, post-acne, acne treatment.

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Introduction

Acne is the maximum common skin ailment affecting all age corporations. The maximum prevalence is amongst teenagers due to hormonal modifications for the duration of this era. However, acne can persist into or maybe expand in maturity, adding extra problems to social life.

The main mechanisms of development include hyperactivity of the sebaceous glands, blockage of the pores, inflammatory responses, and the activity of *Cutibacterium acnes*. Such complex pathogenesis requires a multilevel approach to treatment. Nowadays, dermatology already means a number of various methods, among which topical therapy leads in its effectiveness and handiness. In addition, proper care and prevention can help in avoiding aggravations and maintaining good skin health.

The aim of the item is to research current methods to topical acne therapy, its efficacy, and application in different medical situations. Special attention is paid to pores and skin care as an integral a part of remedy and prevention, and tips on the way to reduce the outcomes of the sickness, together with scarring and hyperpigmentation.

Main part. Etiology and pathogenesis of acne

Acne is a chronic inflammatory skin disorder of the pilosebaceous units, characterized by the formation of comedones, papules, pustules, nodules, and cysts [1]. The development of acne is primarily driven by increased sebum production, hyperkeratinization, pore blockage, and inflammatory processes caused by the activity of *Cutibacterium acnes* (fig. 1).

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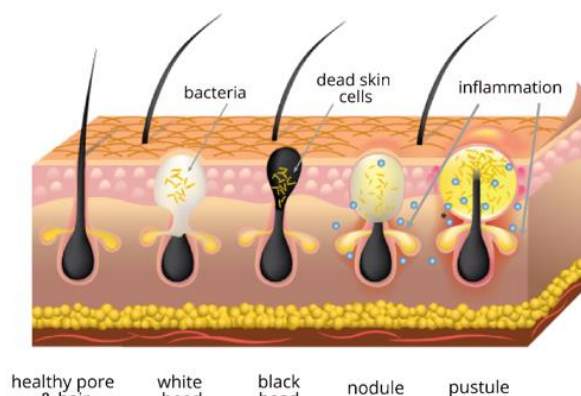


Figure 1. Acne development.

Acne is a multifactorial condition rooted in complex interactions between internal and external factors. Understanding the mechanisms behind acne formation requires analyzing the primary factors involved in its pathogenesis.

Increased sebum production is an important trigger in the development of acne [2]. Sebocytes are the cells of sebaceous glands and produce sebum under the influence of androgens, which are the sex hormones specially increased during puberty. Too much production of sebum causes hyperlipidemia and disrupts the balance of the skin microbiome. The resulting oily skin creates an ideal setting for bacterial growth and the start of inflammatory processes.

Pore blockage and formation of comedones represent decisive steps in early pathogenesis. Hyperkeratinization of the epithelial lining of sebaceous ducts gives way to the accumulation of dead cells with subsequent blocking of pores, where either closed-type microcomedones or open-type comedones will then arise. These formations present some sort of a container with stored sebum inside it, where inflammation and further enhancement of conditions for pathogenic microorganisms will take place.

The role of *Propionibacterium acnes*, nowadays called *Cutibacterium acnes*, in acne development is a fact. Although this microorganism forms part of the normal skin microbiota, upon activation, it becomes a crucial inflammatory factor. *P. acnes* synthesizes lipases that hydrolyze sebum triglycerides by releasing free irritant fatty acids, therefore stimulating an immune response.

Hormonal modifications appreciably have an effect on pimples improvement, particularly all through intervals of hormonal fluctuations, such as puberty, the menstrual cycle, pregnancy, and polycystic ovary syndrome (PCOS) [3]. Androgens stimulate sebaceous gland hypertrophy and boom sebum production. In women, hormonal imbalances

because of hyperandrogenism can be a main cause of severe pimples.

Diet and its relation to acne have been discussed in most scientific literatures. High glycemic index foods increase insulin levels, thereby increasing androgen synthesis and stimulating IGF-1. These, in turn, enhance sebum production and hyperkeratinization [4]. Dairy merchandise, specially people with growth hormones, are also connected to a heightened risk of developing acne. However, the exact mechanisms via which food plan impacts acne are nevertheless debated.

Stress affects pimples development by using exacerbating inflammatory tactics via activation of the hypothalamic-pituitary-adrenal axis. Elevated cortisol levels stimulate sebum manufacturing, impair the pores and skin barrier feature, and accentuate inflammation. Furthermore, stress can also negatively effect skincare habits, in addition stressful the condition.

In summary, the etiology and pathogenesis of pimples are multifactorial in nature, involving a complicated interplay of biological and outside factors. Understanding these procedures is of paramount importance for the improvement of individualized treatment and prevention strategies geared toward minimizing inflammation, normalizing sebum manufacturing, and restoring skin fitness.

Main approaches to acne treatment

Acne treatment must be complete, addressing all of the crucial pathogenetic factors of the disease. Both topical and systemic methods are used within the healing application, the choice being conditioned by the degree of severity of the pimples, the age of the affected person, and related factors. Topical therapy is the vital location within the treatment, in particular for mild-to-mild forms, at the same time as systemic therapy is reserved for severe bureaucracy. The most appropriate healing routine for a given ailment often calls for a combination of various retailers to maximize efficacy and save you relapses (table 1).

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Table 1. Medications for acne treatment and their characteristics [5]

Medication	Mechanism of action	Indications	Side effects and limitations
Topical retinoids	Normalizes keratinization, reduces comedones, decreases inflammation.	Mild and moderate forms of acne.	Dryness, skin irritation, photosensitivity.
Benzoyl peroxide	Antiseptic action, eliminates C. acnes, reduces inflammation.	Inflammatory lesions, comedones.	Dryness, peeling, potential allergic reactions.
Salicylic acid	Reduces hyperkeratosis, cleanses pores, anti-inflammatory effect.	Mild forms of acne, recurrence prevention.	Skin irritation with frequent use.
Combination products	Combines retinoids, antibiotics, benzoyl peroxide for maximum effect.	Moderate to severe forms of acne.	Combined side effects (e.g., dryness, photosensitivity).
Systemic retinoids	Reduces sebum production, regulates keratinization, anti-inflammatory action.	Severe nodular acne, recurrences.	Teratogenicity, dryness of skin and mucosa, elevated lipid levels.
Systemic antibiotics	Eliminates C. acnes, reduces inflammation.	Severe inflammatory forms of acne.	Resistance development, microbiome disruption.

Treatment can be successful in the individual approach: depending on the degree of severity, skin type, and accompanying factors of acne. Early stages are most safely and effectively treated using topical therapy. The following medicines treated the most important pathogenetic mechanisms of the disease and were very effective in this way: topical retinoids, benzoyl peroxide, and salicylic acid.

For extra serious kinds of acne, systemic remedy concerning the use of retinoids and antibiotics is utilized, even though it has to be saved underneath very close tracking in order to decrease possible aspect consequences. Maximum therapeutic effect is carried out through the blended use of topical and systemic marketers. Observation of remedy period and accurate skincare are crucial capabilities of remedy to prevent recurrence and keep the fitness of the pores and skin.

Skincare as an essential component of acne therapy

Indeed, the effective treatment of acne can never be complete without thorough skincare, which helps in restoring barrier functions of the skin, minimizes the risk of inflammation, and reduces possible side effects of medical therapy [6]. Properly chosen merchandise and workouts assist to reduce inflammation, save you flare-ups, and provide extra safety towards the have an effect on of environmental factors.

The **cleansing procedure** is aimed at doing away with excess sebum, impurities, and lifeless pores and skin cells that block pores and reason comedones. The frequency of cleansing should not exceed instances an afternoon-in the morning and evening-and after intensive bodily paintings. The more

frequent use of cleansers can lead to damage to the epidermal barrier, which may be accompanied by increased sebum production and sensitivity.

Mild cleansers with low pH are endorsed; they keep the pores and skin's herbal acidity. Products containing active soothing and anti inflammatory components, such as niacinamide, aloe vera, or panthenol, help reduce infection. The use of alcohol-based merchandise or soap is contraindicated due to the fact that it could cause immoderate dryness, worsen infection, and bring about pain.

On the other hand, **moisturizing of the skin**, though very generally misjudged as forbidden for oily skin, actually promotes the restoration of the barrier and reduces the irritant side effects of the therapeutic agents applied. The treatment should preferably be supported by the application of non-comedogenic moisturizers without oils and comedogenic ingredients.

Extra attention to moisturization is always paid when the treatment includes retinoids, benzoyl peroxide, or acids, which usually cause dryness and peeling. Regular application of moisturizers after cleansing will help to retain moisture, reduce feelings of tightness, and make active treatments more tolerable. This reduces the risk of discontinuing therapy due to pronounced side effects.

Ultraviolet (UV) exposure promotes hyperkeratinization, inflammation processes, and post-inflammatory hyperpigmentation; thus, this is the most important issue to be resolved by the acne sufferer. In addition, most treatment agents, including topical retinoids and various types of acids, promote skin photosensitivity, making sunscreens indispensable.

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Sunscreen products for acne patients should be lightweight, non-comedogenic, and hypoallergenic. Physical filter-based formulations containing zinc oxide and titanium dioxide are optimally protective without irritation. Sunscreens with SPF 30 or higher are recommended, especially during periods of significant UV exposure. Regular reapplication every 2-3 hours ensures prolonged efficacy.

Evidence-based treatment of acne improves skin condition and augments the effect of medical intervention. The basis for preventing relapses and minimizing the long-term outcomes of the disease is a combination of gentle cleansing, adequate moisturization, and reliable UV protection.

Prevention and management of complications

Acne, especially in its moderate and more severe stages, is very often associated with complications such as post-inflammatory scarring and hyperpigmentation. These outcomes significantly impair the skin's appearance and can persist long after the resolution of active lesions. Prevention and management of complications are important steps in the treatment process for improving the aesthetic and functional characteristics of the skin.

Post-inflammatory skin changes develop according to the depth of the damage, the intensity of inflammation, and treatment mistakes. It is necessary to start treatment on time and limit the time of inflammation to avoid cicatrices and hyperpigmentation. Topical retinoids activate skin turnover, preventing scar tissue development. Products with azelaic acid or hydroquinone are quite effective in hyperpigmentation by evening out the skin tone and not allowing dark spots to appear.

Professional processes consist of treatments like chemical peels with glycolic or salicylic acid, microdermabrasion, and laser therapy. These techniques sell the elimination of superficial pores and skin layers, stimulate regeneration, and improve pores and skin texture. However, those strategies must be completed handiest after consulting a dermatologist to keep away from similarly deterioration within the situation of the pores and skin.

One of the main causes of complications is mechanical damage to the skin, which includes squeezing acne lesions and overuse of abrasive products. Skin damage may enable bacterial

penetration, increase the degree of inflammation, and result in deep scarring. Patients should be strongly counseled against the manual removal of acne lesions to avoid infection and deterioration in the cosmetic appearance of the skin.

Gentle cleansers should be selected to avoid mechanical damage, and the use of harsh scrubs or sponges should be avoided. Professional cosmetic procedures for comedone extraction, performed under sterile conditions, are safer and more effective.

Timely consultation with a dermatologist or cosmetologist will allow avoiding complications. Early onset of therapy allows one to better control inflammation, limit tissue destruction, and not apply aggressive methods of treatment. Besides, a doctor will give recommendations on the care of skin individually and prevent its complications, which will significantly increase the effectiveness of treatment.

Consultation with a physician is especially important in cases of nodular or cystic acne, which have a high likelihood of resulting in scarring. Such conditions may require systemic retinoids or injectable correction methods, such as injections of corticosteroids into deep inflammatory lesions. Regular follow-ups with a specialist allow for timely adjustments to the treatment and minimize the risk of complications.

In summary, the prevention and management of acne complications involve the use of appropriate treatment, avoidance of mechanical damage, and regular observation by specialists. These measures will not handiest prevent the formation of scars and hyperpigmentation however will even make the therapeutic revel in of the sufferers more comfortable and safe.

The role of lifestyle in acne treatment and prevention

Lifestyle can be regarded as one of the main factors in acne pathogenesis, which influences the development of the disease and the success of therapy. Indeed, food, stress condition, and general lifestyle impact the skin, sebaceous glands, and inflammatory response. By making changes to lifestyles, acne symptom severity can be lessened, recurrences averted, and the quality of life enhanced in the suffering patient (table 2).

Table 2. Influence of lifestyle factors on skin condition in acne [7, 8]

Factor	Mechanism of influence	Recommendations
Low-glycemic index diet	Stabilizes insulin levels, reduces insulin-like growth factor-1 (IGF-1) activity, and decreases sebum production.	Avoid foods with high sugar content, refined flour, and fast-digesting carbohydrates.
Healthy fats and antioxidants	Omega-3 fatty acids reduce inflammation; antioxidants neutralize free radicals.	Increase intake of fish, nuts, olive oil, vegetables, and fruits rich in vitamins A, C, and E.

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Stress reduction	Lowers cortisol levels, reducing sebum hypersecretion and inflammatory responses.	Regular physical activity, meditation, relaxation techniques, and adherence to a consistent sleep schedule.
Healthy habits	Improves overall skin condition by strengthening immunity and supporting normal metabolism.	Regular physical activity, avoiding smoking, and limiting alcohol consumption.

Lifestyle modification forms a very crucial part of the therapy for acne and enhances its effectiveness in skin improvement. A diet balanced with foods of a low glycemic index, healthy fats, and antioxidants helps to reduce inflammation and normalize sebum production. Stress management and avoidance of vices give more chances to the body to recover from the disease. An individualistic approach toward a patient's lifestyle, based on scientific evidence, helps to minimize the recurrence of acne and enhances quality of life.

Conclusion

Acne is a chronic skin disease that seriously diminishes the somatic and psychosomatic well-being of a patient, lowering self-esteem and quality of life. The treatment of acne, taking into consideration such

key pathogenetic elements as sebaceous hypersecretion, inflammation, and hyperkeratinization, requires a complex approach with the help of both topical and systemic therapy. Along with therapeutic approaches, proper care-which involves gentle cleansing, moisturizing, and UV protection-plays a crucial role in maintaining skin health and preventing complications.

The most important aspect of management is lifestyle, including a healthy diet, stress management, and avoidance of unhealthy behaviors that can worsen the disease. Because of the psychological impact of acne on patients, considering all aspects of treatment, from medical therapy to daily skin care, represents a basic aim of modern dermatology, focused on both skin health and quality of life.

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