Acne vulgaris: An overview of epidemiology pathophysiology, classification, contributing factor and protective agent

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Abstract:

Acne vulgaris is a common long-term skin condition that involves the oil glands and hair follicles, mainly found on the face, chest, shoulders, and back. It often appears during teenage years but can also happen or continue into adulthood. The main reasons it happens include more oil being produced, a blockage in the hair follicles, the presence of a bacteria called Cuti bacterium acnes, and inflammation. Things like changes in hormones, especially increased male hormones, family history, stress, some medicines, and environmental factors can all play a role in causing acne. Acne can show up as non-inflammatory spots, like blackheads and whiteheads, or as inflammatory ones, such as red bumps, pus-filled spots, deep lumps, and large, painful cysts. Based on how bad it is, acne is usually categorized into mild, moderate, or severe. While it's not dangerous, acne can have a big impact on how people feel about themselves, their mental health, and their overall life quality. If left severe or not treated properly, it can lead to lasting scars and dark patches on the skin. Doctors usually diagnose acne by looking at the type of skin blemishes, where they're located, and how severe they are. The goal of treatment is to get rid of current breakouts, stop new ones from forming, reduce scarring, and help people feel better about their skin. Treatments can include creams with retinoids, benzoyl peroxide, azelaic acid, and antibiotics. For more serious cases, doctors might use oral antibiotics, hormonal treatments, or a strong medicine called isotretinoin, but only under their care. Early recognition, right treatment, proper skin care, and learning about the condition are all important for managing acne over the long term. In short, acne vulgaris is a skin issue that comes from many different factors and needs personalized care to manage redness, prevent problems, and boost both appearance and mental health.

Keywords:

Inflammation, Hormonal Treatments, Antibiotics, Skin Blemishes, Benzoyl Peroxide.

1. Introduction:

Acne Vulgaris:

Acne vulgaris is one of the most common chronic inflammatory disorders of the pilosebaceous unit, affecting a substantial proportion of the global population. Approximately 80–95% of adolescents experience acne at some stage of their lives, and the condition may persist into adulthood in many individuals (Williams HC et al., 2012). Genetic predisposition plays an important role in the development of acne, resulting in a familial tendency. Although acne affects both males and females, more severe forms are generally observed in males.

The development of acne is multifactorial and is influenced by several factors, including hormonal fluctuations, alterations in follicular keratinization, colonization by Cutibacterium acnes, certain medications, exposure to specific chemicals, mechanical irritation, and psychological stress (Cong TX et al., 2019).

Although acne may not always be permanently eliminated, appropriate treatment can effectively control its clinical manifestations and reduce the risk of complications (Kolli SS et al., 2019, Reynolds RV et al., 2024, Sanjay K Rathi, 2011). The primary objectives of acne management are to reduce lesion formation, control inflammation, prevent the development of new lesions, minimize permanent scarring, and improve the patient's quality of life.

2. Epidemiology of acne vulgaries:

Acne vulgaris is most prevalent during adolescence, although it can affect individuals of all ages and both sexes. Its increased occurrence during puberty is primarily associated with hormonal changes that stimulate sebaceous gland activity and influence keratinocyte proliferation and differentiation within the pilosebaceous follicles (Kristen M Whitney et al., 2011, Arora MK et al., 2011, Trifu V et al., 2011).

Approximately three-quarters of adolescents experience some degree of acne, although prevalence estimates vary according to the population studied and the diagnostic criteria used. Hormonal fluctuations associated with the menstrual cycle, pregnancy, and the use or discontinuation of hormonal contraceptives may influence the severity of acne in susceptible individuals (Weinstein M et al., 2013). Genetic susceptibility is another important determinant, as individuals with a family history of acne have an increased likelihood of developing the condition (Williams HC et al., 2012).

Psychological stress may also contribute to the exacerbation of acne through neuroendocrine and inflammatory mechanisms. Patients frequently report worsening symptoms during periods of increased stress, although the relationship between stress and acne is complex (Zaenglein Al et al., 2013).

Dietary factors have also been investigated in relation to acne development. Although certain foods, including chocolate and high-fat or high-sugar foods, have traditionally been considered potential triggers, the available evidence does not establish a consistent association between all such foods and acne (Zaenglein AL et al., 2016, Babaeinejad S et al., 2011, Barbaric J et al., 2016). Some studies suggest that high-glycemic-load diets and the consumption of certain dairy products may be associated with acne in susceptible individuals (Choi JS et al., 2011, Di Landro A et al., 2012, Dreno B et al., 2015). However, further research is required to establish the nature and clinical significance of these associations.

3. Pathophysiology of acne vulgaries:

The pathogenesis of acne vulgaris involves the interaction of four major factors: increased sebum production, abnormal follicular keratinization, alteration of the follicular microbiome involving Cutibacterium acnes, and inflammation (Fabbrocini G et al., 2011, Fouladi RF et al., 2012, Fox L et al., 2016).

3.1. Increased sebum production:

Sebum production increases under the influence of androgens during puberty and may remain elevated in susceptible individuals during adulthood. Androgens stimulate sebaceous gland growth and activity, resulting in increased secretion of sebum into the pilosebaceous follicles (Garner SE et al., 2012).Excess sebum contributes to the development of a favorable microenvironment for acne-associated inflammation.

3.2. Abnormal follicular keratinization:

Abnormal keratinization within the pilosebaceous follicle results in the excessive accumulation of keratinocytes and their increased adhesion to one another. This process leads to follicular obstruction and the formation of microcomedones, which are the precursors of visible acne lesions (Gold LS et al.,). Depending on the degree of follicular obstruction and subsequent inflammatory changes, these lesions may develop into open or closed comedones and inflammatory lesions.

3.3. Role of cuti bacterium acnes:

Cuti bacterium acnes, formerly known as Propionibacterium acnes, is a Gram-positive, anaerobic or aerotolerant bacterium that normally inhabits the pilosebaceous follicles (Gupta A et al., 2015)·Changes in the follicular environment and microbial community can promote inflammatory responses associated with acne. The bacterium produces enzymes, including lipases that hydrolyse sebum triglycerides into free fatty acids. These products may contribute to follicular irritation and inflammation (Hammer KA et al., 2015, Holzmann R et al., 2014, Ismail NH et al., 2012).

3.4. Inflammatory response:

Inflammation is a central component of acne pathogenesis. The interaction between sebum, follicular keratinocytes, C. acnes, and the host immune system promotes the release of pro-inflammatory mediators

(Muhammad Rajar UD et al., 2023). These responses may result in disruption of the follicular wall and the release of follicular contents, including sebum, keratin, and microorganisms, into the surrounding dermis(Poulin Y et al., 2011, Qin M et al., 2015, Sakamoto FH et al., 2010).

This process can lead to the development of inflammatory lesions, including papules, pustules, and, in more severe cases, nodules and cyst-like lesions. The inflammatory response is not simply a consequence of bacterial infection; rather, acne is a multifactorial inflammatory disease involving interactions between the follicular microbiome and the host immune system (limonart T et al., 2012, Tan J et al., 2012).

4. Stages of acne development:

Acne lesions develop through a sequence of changes within the pilosebaceous unit. Initially, abnormal keratinization and the accumulation of sebum lead to the formation of microcomedones. These may subsequently develop into open or closed comedones. When inflammation develops, the lesions may progress to papules and pustules, while more severe inflammation may result in nodules and scarring (Tan JK et al., 2013).

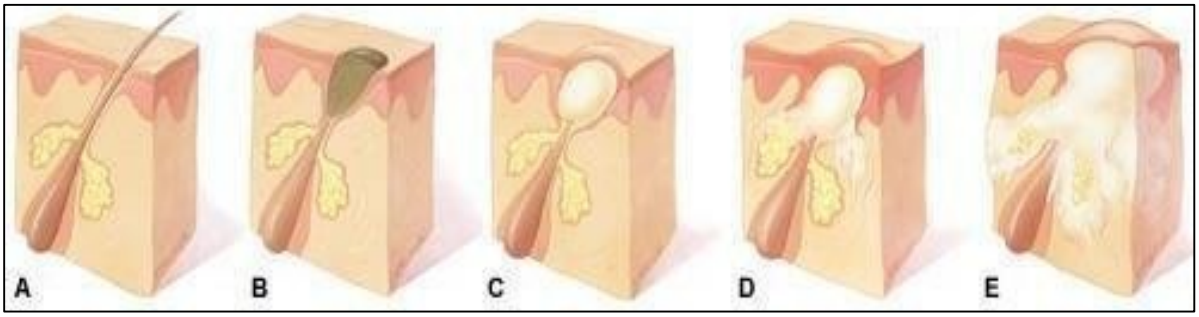


Figure. 1.4.1: Stages of acne A. Normal follicle, B. Open come done (blackhead), C. Closed Come done (whitehead), D. Papule, E. Pustule

5. Classification of acne:

Correct classification of the types of lesions is essential for choosing the most effective therapy. This can be confusion, because there are a number of different classification systems for acne. Acne can be classified by severity, morphology and the presence or absence of inflammation. Table 1.1 is shown the severity grading of Acne.

5.1. Classification Based on Severity:

Acne severity is commonly assessed according to the number, type, distribution, and inflammatory characteristics of the lesions. The following table presents a simplified clinical classification (Torok HM et al., 2011).

Table. 1.1: Acne Classification by Severity Grading

Severity	Papules/pustules	Nodules
Mild	Few to several	None
Moderate	Several to may	Few to several
Severe	Numerous or extensive	Many

5.2. Classification Based on Lesion Morphology:

Non-inflammatory acne:

Non-inflammatory acne is characterized primarily by comedones and includes the following lesions:

- Open comedones (blackheads): These develop when a follicular opening remains open despite the accumulation of sebum and keratin. The dark appearance results primarily from changes in the exposed follicular contents and melanin, rather than from dirt.
- Closed comedones (whiteheads): These occur when the follicular opening remains closed or narrowly obstructed. They generally appear as small, skin-coloured or whitish elevations on the skin.

Inflammatory acne:

Inflammatory acne is characterized by redness, swelling, and varying degrees of tenderness. Its principal lesions include:

1. **Papules:** Small, raised, erythematous inflammatory lesions without visible pus.
2. **Pustules:** Inflamed lesions containing purulent material.
3. **Nodules:** Large, deep, firm, and often painful inflammatory lesions that may result in scarring (Trifu V et al., 2011).

6. Causes and contributing factors of acne:

Acne vulgaris develops through the combined effects of several biological and environmental factors. The principal mechanisms include abnormal follicular keratinization, increased sebum production, alterations in the follicular microbiome, and inflammation (Trivedi MK et al., 2017).

6.1. Follicular obstruction:

Abnormal shedding and accumulation of keratinocytes within the hair follicle may result in the formation of a keratinous plug. This obstruction prevents the normal discharge of sebum and contributes to the development of comedones. In some cases, progressive distension and inflammation may lead to disruption of the follicular wall and the release of its contents into the surrounding tissue.

6.2. Role of bacteria:

Cutibacterium acnes is a normal inhabitant of the skin and contributes to the microbial ecosystem of the pilosebaceous unit. Under acne-associated conditions, changes in its abundance, strain composition, and interaction with the host immune system may promote inflammation. Bacterial lipases and other biologically active products can contribute to the inflammatory process.

6.3. Hormonal influence:

Androgens are important regulators of sebaceous gland activity in both males and females. During puberty, increased androgen activity stimulates sebaceous gland enlargement and sebum secretion. Excessive sebum production, combined with follicular obstruction and inflammation, contributes to acne development.

Hormonal changes associated with the menstrual cycle may also influence acne severity in some women. Estrogen-containing contraceptives may improve acne in selected patients by reducing androgen-mediated sebaceous activity. However, treatment selection requires consideration of individual contraindications and clinical circumstances.

6.4. Genetic predisposition:

Genetic factors contribute to individual susceptibility to acne. A positive family history is associated with an increased likelihood of developing acne and may influence the age of onset, severity, and persistence of the condition (Weinstein M et al., 2013, Williams HC et al., 2012).

6.5. Anatomy of the hair follicle:

Hair follicles are present across most areas of the skin, with the notable exception of the palms and soles. Each follicle extends from the skin surface into the deeper layers of the skin, and the hair shaft emerges through a follicular opening.

Sebaceous glands are associated with many hair follicles and release sebum into the follicular canal. Sebum lubricates the skin and hair and contributes to the maintenance of the skin barrier. The face, chest, and back contain relatively high concentrations of sebaceous glands and are therefore common sites of acne development (Zaenglein AL et al., 2013, Zaenglein AL et al., 2016).

7. Protective agent:

Protective Agents: Protective agents form a barrier over the skin surface and help reduce exposure to irritants, moisture, and other external factors. They may be useful in supporting the skin barrier and protecting damaged or sensitive skin.

Absorbents: Absorbent agents take up excess moisture from the skin surface or localized wounds. They may help maintain a suitable local environment, depending on the formulation and intended application.

Demulcents: Demulcents soothe and protect irritated or abraded tissues by forming a protective coating. Their primary purpose is to reduce discomfort and minimize further irritation.

Emollients: Emollients soften and smooth the skin by improving surface lubrication and supporting the skin barrier. They may reduce dryness, improve flexibility, and enhance the cosmetic ac ceptability of topical formulations.

Astringents: Astringents cause localized protein precipitation or tissue contraction and may reduce minor superficial secretions. Their effects depend on the substance used and its concentration.

Counterirritants: Counterirritants produce a mild local sensory or inflammatory response that may temporarily reduce the perception of discomfort arising from an underlying condition. Their use depends on the specific agent and clinical indication.

Rubefacients: Rubefacients produce localized redness through superficial vasodilation or irritation. They have traditionally been used in selected preparations intended to provide temporary relief from localized discomfort (Lakshmi et al., 2011).

8. Conclusion:

Acne vulgaris is a common, chronic inflammatory skin disorder that affects individuals of different age groups, particularly adolescents and young adults. It develops due to multiple factors, including excessive sebum production, follicular hyperkeratinization, *Cutibacterium acnes* activity, hormonal changes, and inflammation. Although acne is not a life-threatening condition, it can significantly affect physical appearance, self-esteem, psychological health, and quality of life. Early diagnosis and appropriate treatment are essential to control acne lesions, prevent recurrence, and minimize complications such as permanent scarring and post-inflammatory hyperpigmentation. Treatment should be individualized according to the severity of the condition and may include topical agents, oral medications, hormonal therapy, and proper skincare practices. Patient education, treatment adherence, and regular follow-up play important roles in achieving satisfactory outcomes. In conclusion, effective and timely management of acne vulgaris can improve skin health, prevent long-term complications, and enhance the overall well-being and confidence of affected individuals.

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