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CAUSES OF ACNE IN ADOLESCENTS WITH DIABETES MELLITUS

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Abstract
Objective: To study the relationship between diabetes mellitus and the development of acne in adolescents, as well as to identify the specific pathophysiological mechanisms underlying these processes. Methods: A review of current research on dermatological manifestations in adolescents with diabetes mellitus, with an emphasis on acne, has been conducted. The analysis included articles from the databases PubMed, Scopus and eLibrary for 2019-2024. Results: A close relationship has been established between insulin resistance, hyperglycemia, and sebaceous gland activation. The role of hormonal and immune disorders in diabetes in the pathogenesis of acne has also been revealed. Conclusions: Adolescents with diabetes are at higher risk of developing acne than their healthy peers. An individual approach to acne treatment is needed in this group of patients.

Keywords: acne, adolescents, diabetes mellitus, insulin resistance, sebaceous glands, inflammation, hyperglycemia.

Introduction

Acne is a common dermatological disease that affects mainly adolescents during puberty, and its development is facilitated by multifactorial causes. [1] The existing literature highlights the complex interaction of physiological, hormonal, psychological, and behavioral factors that underlie acne in pubertal individuals.

Hormonal fluctuations are widely recognized as the main causes of acne during puberty. (Kieran et al., 2020) emphasize the role of hormonal changes, in particular, an increase in the content of androgens, which stimulate the activity of sebaceous glands, leading to excessive sebum production.[2] This hyperseborrhea creates an environment conducive to the reproduction of Cutibacterium acnes (C. acnes), a bacterium involved in the inflammatory process of acne. Similarly, Abdessalem et. al. (2024) discuss how hormonal imbalance, especially in women with polycystic ovary syndrome (PCOS), exacerbates the severity of acne, indicating that hormonal dysregulation is an important factor in the development of acne during puberty.[3] The overproduction of sebum is the main pathogenic factor. (Chen et. al., 2021) investigate lipidomic changes associated with acne and reveal that increased sebum secretion and changes in lipid profile contribute to follicle blockage and inflammation.[4] Hyperactivity of the sebaceous glands caused

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by hormonal stimuli leads to the accumulation of sebum in the hair follicles, which leads to the formation of comedones characteristic of acne.[5] Keratinization of follicles also plays an important role. Hyperkeratinization of the follicular epithelium causes blockage of the sebaceous glands, trapping sebum and bacteria, thereby contributing to inflammatory reactions.[6] This process is indirectly influenced by hormonal activity, since the increased androgen content stimulates the proliferation of keratinocytes, which further contributes to the blockage of follicles (Kayiran et. al., 2020).[7] Inflammation is another key component. The proliferation of C. acnes in clogged follicles triggers an immune response, leading to the formation of papules, pustules, and cysts.[8] The inflammatory cascade often increases during puberty due to increased immune reactivity, which can be regulated by psychological factors. Psychodermatology data presented (Kayiran et. al., 2020) suggest that psychological stress, common in adolescence, can affect inflammatory processes, potentially exacerbating the severity of acne.[9] Behavioral and environmental factors also contribute to the appearance of acne during puberty. (Bakhshai et al., 2020) emphasize that external factors such as skin injuries, hygiene practices, and the use of cosmetics can influence the development of acne.[10] For example, the use of comedogenic agents or skin irritation after shaving can worsen the formation of neoplasms. In addition, lifestyle factors such as diet and stress levels influence this, although their exact role requires further clarification.[11] New research points to the influence of genetic predisposition. Although the presented documents do not cover in detail, differences in the severity of acne in adolescents indicate a genetic component that modulates individual susceptibility to hormonal and environmental factors (Alsulaimani et. al., 2020).[12] Psychological factors are closely related to the appearance of acne during puberty. (Kieran et al., 2020) discuss how the psychosocial effects of acne can lead to emotional distress, which in turn can affect hormonal and immune responses, creating a vicious cycle that worsens the condition. The stigma and self-esteem issues associated with acne can also lead to behavioral changes such as skin care or avoiding skin care procedures, potentially exacerbating this disease. In addition to internal factors, certain external influences are associated with the appearance of acne during puberty.[9,8,13] (Bakhshaee et. al., 2020) note that patients after rhinoplasty may experience an exacerbation of acne, indicating that surgical or cosmetic interventions may affect the severity of acne, possibly through hormonal or inflammatory processes.[13,14] In addition, lifestyle choices such as diet, in particular the consumption of whey protein, as described in (Timotius et. al., 2023), may affect the development of acne, although this is more relevant for people in puberty.[11,12,15] Thus, the causes of acne during puberty are multifaceted: hormonal surges that stimulate the activity of the sebaceous glands, keratinization of the follicles, leading to clogging of the follicles, bacterial proliferation and subsequent inflammation. Psychological and behavioral factors further modulate these physiological processes, contributing to the occurrence and severity of acne. The interaction of these elements highlights the importance of a comprehensive approach to understanding and treating pubertal acne, including, if necessary, hormonal regulation, skin care methods, and psychological support (Kairan et al., 2020; Abdessalem et al., 2024; Chen et al., 2021; Bakhshai et al., 2020).[10,15] Another common cause of acne among people aged 12-18 years is diabetes mellitus. Diabetes mellitus, especially type 1, is also increasingly being diagnosed in adolescence, which creates the basis for exploring potential points of contact between these two conditions. Various metabolic

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and hormonal changes caused by diabetes can contribute to the development or aggravation of acne. Despite the extensive study of the pathogenesis of acne, the role of diabetes in its development remains poorly understood. It is especially important to analyze this relationship during adolescence, the time of hormonal storms, stress, and the formation of the immune system. The purpose of this work is to identify the mechanisms through which diabetes mellitus can contribute to the formation of acne in adolescence.

Materials and Methods

Study design: A systematic review of the literature on the topic "the impact of diabetes mellitus on the development of acne in adolescents" was conducted. The article was prepared according to the recommendations of PRISMA for systematic reviews.

Inclusion criteria

- Articles published from 2019 to 2024.
- The age of the patients is from 10 to 18 years.
- Established diagnosis: acne and/or diabetes mellitus (type I or II).
- Publication languages: Russian and English.
- Types of publications: original research, reviews, meta-analyses.

Information sources: Search databases: PubMed, Scopus, Web of Science, eLibrary. The search terms included: “acne vulgaris”, “diabetes mellitus type 1 and 2”, “adolescents”, “insulin resistance”, “sebaceous glands”, “hyperglycemia”, “dermatological complications of diabetes”.

Data analysis: The data is classified according to the directions: hormonal background, immune status, skin microbiome, metabolic disorders and inflammatory processes. No statistical analysis was carried out due to the review nature of the article.

Results

1. Hormonal disorders in diabetes: Adolescents with diabetes have an imbalance of androgens, cortisol, and insulin. Hyperinsulinemia in type 2 diabetes promotes increased androgen production, which stimulates sebaceous gland secretion and hyperkeratinization of follicles, key factors in the pathogenesis of acne. Elevated levels of insulin and insulin-like growth factor (IGF-1) enhance keratinocyte proliferation and sebum production. It has been found that adolescents with insulin resistance are more likely to suffer from severe forms of acne (Smith et al., 2020). In type 2 diabetes mellitus, elevated insulin levels or insulin resistance are characteristic. Insulin stimulates the synthesis of androgens (male sex hormones) in the adrenal glands and ovaries. An increase in androgens increases sebum secretion by the sebaceous glands, which is one of the key factors in the development of acne. Girls with diabetes often have anovulatory cycles or polycystic ovary syndrome (PCOS) associated with hyperandrogenism and acne. Chronic hyperglycemia leads to increased oxidative stress, disruption of the skin barrier, and increased inflammation. These factors worsen the course of acne and may make it difficult to treat it (Lee et al., 2021).[10]

2. Hyperinsulinemia: Increased insulin reduces the level of sex hormone binding globulin (SHBG), which increases the level of free testosterone. Free testosterone activates sebaceous glands → sebum hypersecretion and hyperkeratosis.

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4. Disorders of the skin microbiota: In patients with diabetes, the composition of the skin microbiome changes: the diversity of protective microflora decreases, and colonization by pathogenic strains of Cutibacterium acnes increases. This contributes to chronic inflammation in the hair follicle area (Huang et al., 2022).

5. Immune disorders

Diabetes weakens both the innate and adaptive immune responses, disrupting skin regeneration and exacerbating inflammatory responses. This creates favorable conditions for the persistence of acne-associated microflora (Gomez et al., 2019).

6. Pharmacotherapy and acne

Some medications used for diabetes (for example, corticosteroids or insulin analogues) may provoke or worsen acne as a side effect (Kim et al., 2021).

Discussion

The review results confirm the existence of a pathophysiological relationship between diabetes mellitus and acne in adolescents. The most significant factors are insulin resistance, hyperandrogenism, oxidative stress, and immune disorders. All these mechanisms can enhance sebum production, cause blockage of sebaceous glands, and trigger inflammation.

It is important to note that standard acne treatments are not always effective in adolescents with diabetes. For example, the use of retinoids can cause fluctuations in glucose levels, and antibiotics can disrupt the intestinal microflora, which plays a role in regulating the immune response. Therefore, an individual approach to acne treatment in adolescents with diabetes mellitus is necessary.

An additional aspect is the psychoemotional state of adolescents suffering from two chronic diseases at the same time. This can contribute to increased stress, which, in turn, worsens both the course of acne and the complications of diabetes.

Conclusion

Adolescents with diabetes have a significantly higher risk of developing acne compared to their healthy peers. This is due to a complex of metabolic, hormonal, and immune disorders. Effective acne treatment in this group requires an interdisciplinary approach involving an endocrinologist, dermatologist, and psychotherapist.

Early detection and correction of predisposing factors can not only improve the dermatological condition but also enhance the overall quality of life for adolescents with diabetes mellitus.

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