

Stress and skin diseases. Overview using acne vulgaris as an example

Stres a choroby skóry. Omówienie na przykładzie trądziku pospolitego

ABSTRACT

Stress is defined as the activation of complex physiological and psychological response mechanisms in situations that threaten physical as well as mental human homeostasis. Skin diseases and associated skin lesions can become a source of stress and psychological burden.

Acne vulgaris affects appearance, which plays an important role in self-esteem, a person's functioning in society, his or her psychological state, and quality of life. Stress is one of many factors considered in the etiopathogenesis of this dermatosis. Chronic stress hurts the condition of the skin because cortisol levels are increased, which inhibits the synthesis of collagen and proteins the skin's building blocks.

This study aimed to review the literature on the significance of stress in the onset and course of skin diseases, using acne vulgaris as an example.

Due to the recurrent and chronic course of acne, treatment should be interdisciplinary, complemented by appropriate psychological care and effective methods of stress management, to increase the efficiency of dermatological therapy.

Keywords: stress, cortisol, skin diseases, acne vulgaris

STRESZCZENIE

Stres to proces, w którym zostają aktywowane złożone mechanizmy reagowania fizjologicznego oraz psychologicznego, w sytuacjach stanowiących zagrożenie dla równowagi zarówno fizycznej, jak i psychicznej człowieka. Choroby skóry i związane z nimi zmiany na jej powierzchni mogą stać się źródłem stresu i obciążenia psychicznego.

Trądzik pospolity wpływa na wygląd, który odgrywa ważną rolę w kształtowaniu samooceny, a także funkcjonowaniu człowieka w społeczeństwie, na jego stan psychiczny i jakość życia. Stres to jeden z wielu czynników rozpatrywanych w etiopatogenezie tej dermatozy. Chroniczny stres negatywnie wpływa na kondycję skóry – dochodzi do podwyższenia poziomu kortyzolu, który hamuje syntezę kolagenu i białek stanowiących budulec skóry.

Celem pracy było dokonanie przeglądu literatury na temat znaczenia stresu w powstawaniu i przebiegu chorób skóry, na przykładzie trądziku pospolitego.

Ze względu na nawrotowy i przewlekły przebieg trądziku, leczenie powinno mieć charakter interdyscyplinarny, uzupełniony o odpowiednią opiekę psychologiczną oraz o skuteczne metody radzenia sobie ze stresem, w celu zwiększenia efektywności terapii dermatologicznej.

Słowa kluczowe: stres, kortyzol, choroby skóry, trądzik pospolity

INTRODUCTION

Stress is an unavoidable phenomenon that accompanies humans in everyday, usually in difficult situations. It is a state in which internal body reactions occur in response to external stimuli in the environment [1-3].

Multiple stressors exist in the human living environment, which are variables that induce stress. There are three main categories that stress factors can be divided into: environmental stressors (e.g. disasters), psychological stressors (e.g. fear) and social stressors (e.g. death of a family member). Based on duration, a distinction is made between short-term stressors, which occur unexpectedly, and long-term stressors, which occur over an extended period of time and cause chronic stress [1].

TYPES OF STRESS

Humans exhibit different abilities to manage and adapt to stress. The way in which stress is perceived determines whether it has a positive or negative dimension. Short-term stress (eustress) is necessary for human beings, as it increases the body's mobilisation and makes it possible to cope with problems. Long-term, chronic stress (distress), on the other hand, leads to negative effects in the body in the form of somatic complaints or mental disorders. It does not allow the body to return to equilibrium and can disrupt its functioning. The hypothalamic-pituitary-adrenal axis (HPA) and the sympathetic nervous system are involved in the stress response, which is activated after a stressor, causing the adrenal glands to be stimulated to produce adrenaline and noradrenaline. The HPA axis is involved in the regulatory mechanism and plays an important role in the normal course of the stress response. A disruption in the activity of the HPA axis triggers excessive secretion of steroid hormones, resulting in impaired physiological processes. An optimal level of stress is needed for effective human performance, as too low a level of stress causes a decrease in motivation, while too high a level of stress contributes to tension and anxiety. The research carried out repeatedly highlights the negative consequences of chronic stress, which can contribute to health disorders and impair the efficiency of the body's functioning. Adverse consequences of psychological stress include anxiety, social withdrawal, depression and reduced quality of life [1-5].

STRESS AND SKIN DISEASES

The skin contains a myriad of micro-organisms, known as the microbiome (bacteria, viruses, fungi), which play a protective role against pathogens. Depending on the location of the skin (i.e. oily, moist or dry), its composition varies on the body surface and depends on the pH of the skin. The species and quantity composition of the microflora is influenced by the thickness of the epidermis, the distribution of appendages, temperature and humidity on the skin surface. In order to

elucidate the aetiology of skin diseases, it is crucial to study the composition of the microflora at different sites. An important metabolic and immunological role is played by the intestinal flora, which is responsible for maintaining homeostasis in the body, including the skin. The association of bacteria with acne is due to the increasing resistance of bacteria to acne antibiotics. The effect of a high-fat diet on altering the gut microbiota, contributing to acne, is also significant. An imbalance of the gut microbiome makes it easier for bacteria with their metabolites to enter the skin downstream, disrupting the balance of the microflora. The microbiome is influenced by many factors including, for example: age, gender, lifestyle (diet, medication, cosmetics, hygiene products, stimulants), climate, environmental factors, occupation and stress. The secreted stress hormone alters the pH level of the skin, causes an overproduction of sebum, i.e. skin sebum, disrupting the balance of beneficial microorganisms that make up the skin barrier balance. Dysbiosis, or an imbalance of the microbiome, exposes the skin to inflammation or skin diseases such as atopic dermatitis, psoriasis, dandruff or acne [6].

People struggling with dermatological diseases often suffer from psychological or behavioural disorders, or show difficulties in everyday social or occupational functioning. Reduced mood levels, poor self-esteem, neurotic symptoms or depression are not uncommon in patients with skin diseases. Among people with dermatoses, these disorders are observed much more frequently than among the general population [7-10]. The relationship between the nervous system and the skin is due to the fact that both structures originate from the same primordial embryonic structure, namely the ectoderm. Chronic stress exacerbates skin lesions and can become a triggering or sustaining factor in many dermatological conditions. It is the skin that becomes the target of the stress response, as it is among the organs that are the direct recipients of stress [8]. Participating in this mechanism, skin is responsible for the receptor transmission of external signals to the spinal cord and, in turn, to the brain, which responds to stress. This mechanism affects the manifestation of stress reactions by causing alterations on the surface of the skin [7-11].

The science that considers the relationship between stressors, emotional factors and dermatological diseases is psychodermatology. Studies have repeatedly highlighted the importance of psychological factors, including stressors, in the manifestation of skin diseases such as acne vulgaris, atopic dermatitis and psoriasis [7-9, 12-14].

Acne vulgaris is a chronic disease that significantly affects quality of life. Many studies have confirmed a decrease in quality of life in patients struggling with acne [7, 15-19]. The disease often causes embarrassment and loss of self-esteem, which translates into lowered mood and difficulties in establishing interpersonal relationships or avoiding social contacts. It has been shown that in people with acne,

depression was 2-3 times more common compared to the rest of the population [20]. In a study by M.A. Gupta and A.K. Gupta on depression and suicidal thoughts among patients with selected dermatoses confirmed that the occurrence and severity of depression is determined by the type of dermatological condition. The highest prevalence of depression has been shown among patients with mild to moderate acne and inpatients with psoriasis [21]. Furthermore, it was noted that approximately 5-7% of patients with acne and psoriasis had suicidal thoughts [21]. The results obtained suggest and emphasise the importance of early recognition of psychiatric comorbidities, especially depression, among dermatological patients and indicate that, in some cases, skin diseases of even clinically mild or moderate severity may be associated with the occurrence of depression and even suicidal thoughts [21].

Acne symptoms, such as itching, pain or persistent aesthetic consequences, e.g. acne lesions, scars and hyperpigmentation, cause discomfort, increased stress and negative psychological consequences [7-9, 13, 20]. Long-term stress has many negative consequences, among which are adverse effects on the skin condition. The first worrying symptoms include itching, burning, dryness and hypersensitivity, which lead to an overproduction of sebum. The effect of stress is a weakening of the protective function of the hydrolipid mantle made up of sebaceous gland secretions, which consequently leads to increased susceptibility of the skin to inflammation as well as injury. The skin becomes dry and less firm. This process also leads to the appearance of wrinkles. There is an increased production of sebum to replenish lipid deficiencies, which in turn results in an increased risk of acne lesions. Increased sebaceous gland activity also occurs as a result of adrenal androgen production increased by chronic stress. In addition, cortisol, the main stress hormone, which is secreted as a result of stress, is primarily involved in the body's stress response, influences the rate of cell metabolism, affects the function of the sebaceous glands and inhibits the synthesis of collagen as well as other proteins, which are the basic building material of the skin. The stress hormone is a determinant of the functioning of the normal circadian rhythm, which also plays an important role in maintaining homeostasis. The circadian rhythm is defined by the stages of wakefulness and sleep, which are ordered by a 24-hour cycle. The presence of morning and evening light are among the co-occurring factors regulating hormone secretion. It is also a factor that significantly exacerbates the appearance of skin lesions by increasing cortisol levels. As a result of its anti-inflammatory and anti-allergic properties, this hormone has a debilitating effect on the immune system and promotes skin susceptibility to infection. Increased concentrations of cortisol, and with it sex hormones, lead to increased sebum secretion and persistence of lesions (Figure 1) [7-9, 22, 23].

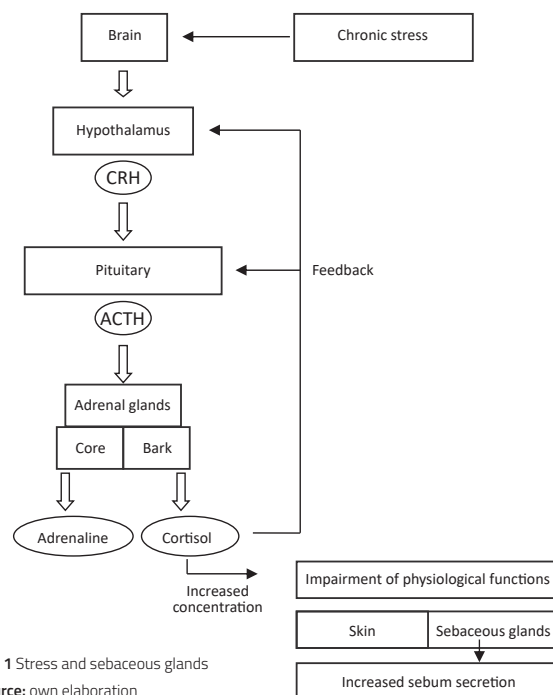


Fig. 1 Stress and sebaceous glands

Source: own elaboration

ACNE VULGARIS

Acne vulgaris is one of the most common dermatological conditions, increasing mainly among adolescents during puberty, with approx. 85% between the ages of 16 and 19. However, acne lesions also increasingly affect people even after the age of 50, in which case they are called late acne. The incidence of the disease is similar in both men and women, but more severe forms of acne occur in men. Among women, the peak incidence of acne vulgaris is between 14 and 17 years of age, while among men it peaks slightly later, between 16 and 19 years of age [19, 22, 24-26].

Etiology

The essence of this chronic disease is primarily related to the overproduction of sebum and inflammation of the hair follicle, which is why the parts of the body with the most sebaceous glands, i.e. primarily the face (T-zone), back and chest, are most prone to acne. Another cause of this disease is a disorder of keratinisation, consequently leading to the accumulation of keratinised cells in the exit ducts and to the formation of blackheads. An increased colonisation of the anaerobic bacteria *Cutibacterium acnes* is also a pathogenic factor in acne. The characteristic symptoms of this disease are the occurrence of papules, comedones, pustules, inflammatory infiltrates, nodules, cysts and seborrhoea. An oily complexion is also an indicated substrate of this dermatosis [27]. The main factor that influences the type of pimple, papule or inflammatory nodule lesion that appears is the depth of localisation of the inflammation. Sebum secretion and the occurrence of acne lesions are also related to genetic predisposition [28]. It has been observed that approximately

60-70% of premenstrual women experience an increase in acne lesions [8, 19, 24, 25, 27].

External factors that are important in the development of acne include poor skin hygiene, stress, smoking, the use of certain medications (e.g. hormonal, neurological drugs, B vitamins), environmental factors, obesity and poor diet [7, 8, 29-32].

The analysis of the incidence of acne and identified demographic characteristics, clinical features and exacerbating factors showed that stress was one of the factors that exacerbated acne and caused disease symptoms in approximately 80% of the subjects [33].

A cohort study by Yosipovitch et al. found a statistically significant positive correlation between stress and the severity of papulopustular acne [34].

Clinical forms of acne vulgaris

Among the forms of acne, a distinction is made between mild, severe and other forms, of which mild is the most common, accounting for 85% of cases [7, 24, 25].

The mild forms of acne include papulopustular (inflammatory), papular and comedonal (non-inflammatory). The papulopustular form is the most common form of the disease and appears in particular on the face, chest, arms and back. Blackheads and inflammatory lesions in the form of papules and pustules are observed in the disease picture. The papular form appears on the face with a predominance of papules, usually co-occurring with pustules and comedones. Once the papules have ceased, they do not result in any scarring on the skin. In contrast, the comedonal form (juvenile acne) is located in the face, forehead, chin and cheeks, initiated by the presence of bacteria and excessive sebum secretion. The lesion presents with numerous closed and/or open comedones. This form of acne usually resolves without scarring [24, 25, 27].

The severe forms of acne are purulent (nodular, nodular-cystic), scarring, clustered and fulminant. The suppurative form is characterised by multiple comedones, nodules and nodules present in the clinical picture, which have the ability to soften and pierce outwards, leading to the formation of ducts and fistulae. It is associated with the discharge of a bloody, purulent or purulent-bloody secretion. Characteristic of this form are atrophic scars and keloids, which appear after the tumour has subsided. The scarring form is characterised by the ability to form hypertrophic scars. In the clustered form of acne, on the other hand, there are deep abscesses and cysts that lead to hypertrophic and atrophic scars remaining. The most common form of this type of acne is the fulminant form, which is characterised by a sudden onset and acute course. In fulminant acne there is the possibility of haemorrhagic necrosis, abscesses and scarring. This form often resembles clustered acne and is accompanied by general symptoms such as fever, malaise, arthralgia and weight loss [24, 25, 27].

Other clinical forms include drug-induced acne, cosmetic acne, occupational acne, infantile acne and self-induced acne.

Drug acne is most commonly associated with topical and systemic use of corticosteroids, less commonly with drugs such as phenytoin, lithium, bromine, and androgen hormones. This leads to the appearance of a papulopustular lesion, which is localised at the mouth of the hair follicles. Cosmetic acne is caused by the use of cosmetics containing comedogenic substances that promote the formation of blackheads, or by the use of cosmetics that clog the sebaceous glands (usually foundations, powders). The cosmetic in question accumulates in the sebaceous gland, which blocks the sebaceous gland outlets, resulting in acne lesions. To get rid of the lesions, it is usually sufficient to stop using cosmetics. Occupational acne, on the other hand, is caused by constant exposure to chemicals in the workplace, such as volatile chlorine compounds or oil lubricants. Acne lesions appear in the orbital region and in areas where soiled work clothes adhere to the skin, i.e. mainly on the lower limbs, thighs. Infantile acne is caused by hormones from the mother, but also by the use of mineral oils for daily skin care. Changes in the form of cysts and inflammatory nodules are only visible on the face of infants. Self-inflammatory acne is caused by chronic scratching or squeezing of minimal acne lesions present on the face, resulting in inflammation or ulceration. This form of acne results in pruritus, or abrasions of the epidermis, scarring and discolouration that are difficult to remove [24, 25, 27].

Therapy

Due to the recurrent nature of acne vulgaris, treatment is challenging. Depending on the severity of the disease and the desired results, a cosmetologist can help to control acne vulgaris in its mild forms, who is able to eradicate the lesions formed in the early stages of the disease and inhibit its recurrence. In the case of severe clinical forms of acne, treatment by a dermatologist becomes necessary. Topical therapy may include over-the-counter benzoyl peroxide (concentrations of 4%, 5%, 10%) in the form of a gel, with mainly exfoliating and disinfecting properties, and azelaic acid (concentration of 20%) in the form of a gel or cream, reducing discolouration and showing anti-seborrhoea, keratolytic (exfoliating keratinised layers of the epidermis) anti-inflammatory and antibacterial properties. Retinoids, derivatives of vitamin A, are also used in topical treatment. These contribute to the proper functioning of the follicular duct and to facilitate sebum secretion. Antibiotics are also available, applied externally in the form of gels, creams and liquids, directly to acne lesions. For oral treatment, vitamin B6 (pyridoxine), which reduces skin seborrhoea, and vitamin B2 (riboflavin), which regulates the sebaceous glands and contributes to maintaining good skin condition and healthy skin colour, are recommended. On the other hand, hormone therapy is used as a general treatment for women in their 20s with symptoms of hirsutism and excessive seborrhoea.

Vitamin B3, with anti-inflammatory and anti-ageing effects, is also used, as well as antibiotics, which, in addition to their anti-inflammatory properties, reduce the *C. acnes* bacteria. For severe forms of acne vulgaris that do not respond to antibiotic therapy, isotretinoin, which exhibits anti-epidermal, anti-inflammatory and anti-seborrhoeic effects, is used [24, 25, 29]. For the treatment of hyperpigmentation and scarring, chemical peeling, laser therapy and even plastic surgery are increasingly used [35–37].

Psychotherapy should be considered for people with psychological illnesses and severe emotional issues whose dermatoses have a notable effect on their appearance. Seeing a dermatologist and complementing the therapy with a psychologist will enable the patient's full range of psychodermatological conditions to be recognised and may contribute to more effective treatment. The relationship between dermatoses and psychological dysfunction is the result of common mediators for the skin, nervous system and immune system, which requires a multidisciplinary approach to the patient. The skin, being an externally visible organ, plays a role in the emotional development of an individual. A depressed mood, exhaustion, stress and inadequate mental attitude can affect the appearance of the skin. Increased skin changes and thus stress reactions and consequent mood changes lead to a vicious circle. Although dermatoses are often not life-threatening for dermatological patients, they consequently significantly affect quality of life, cause dysfunction in fulfilling social roles, and increasingly cause dramatic consequences in the form of depressive disorders and suicide attempts, so early recognition and implementation of psychiatric treatment are important for the therapeutic process [38].

It is worth emphasising that treatment should be undertaken as early as possible to prevent the dermatosis from developing to an advanced stage and to reduce the chances of permanent skin changes in the form of hyperpigmentation and scarring, which can become a source of psychological and social burden. Given the involvement of stress in the pathogenesis of the disease, it is worthwhile to include psychological or psychiatric care, dietary recommendations and appropriate stress management methods in therapy [7, 24, 25, 27, 29–31, 35, 39].

SUMMARY

Among the many negative consequences of chronic stress is an increased risk of skin diseases. Acne vulgaris is one of the most common chronic dermatological diseases, which is a psychological, social and therapeutic problem. An increase in the stress hormone leads to an increase in sebum secretion and the severity of acne lesions. The effects of acne symptoms on exposed parts of the body contribute to chronic stress. Depression, social withdrawal, fear, anxiety, depression and reduced quality of life are increasingly observed among people struggling with this dermatosis. It is

important to take comprehensive care of the skin and to start treating dermatosis at the earliest possible stage. In addition, it is advisable to complement dermatological therapy with psychological treatment, recommendations from a dietician and effective methods of stress management.

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