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Correlation between the components of the metabolic syndrome and psoriasis

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ABSTRACT

Psoriasis (Ps) is a chronic inflammatory skin condition affecting 2% of the world's population. These people have a higher risk of developing metabolic syndrome (MS) up to one-third of patients. According to current criteria, the diagnosis of MS is made on the basis of a diagnosis of obesity and two out of three: elevated blood pressure, abnormal glucose metabolism, or atherogenic dyslipidemia. The correlation between the MS and Ps is probably due to shared genetic factors; the expression of common genes leads to the development of both diseases. Moreover, in the course of Ps, there is systemic inflammation that prompts the development of components of the MS. The psoriatic lesions negatively affect the patient's well-being leading to social withdrawal and diminishing tendency to exercise, directing to overweight and hypertension independently of the systemic inflammation. Current evidence suggests that the development of Ps is most influenced by obesity, but the risk of development is greatest when all elements of the MS are present. Appropriate prevention and lifestyle changes are important, as they significantly reduce the risk of developing MS and minimize the symptoms of Ps, while also reducing the cardiovascular risk which both diseases lead to its increment independently.

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Key words: psoriasis, metabolic syndrome, obesity, hyperglycemia, hypertension

INTRODUCTION

Psoriasis (Ps) is a chronic, inflammatory skin disease affecting approximately 2% of the world population. In its course, systemic inflammation occurs, which is conducive to the development of other non-dermatological conditions such as Crohn's disease [1] as well as disorders in the retina and macula [2], social exclusion, sleep disorders [3] or metabolic syndrome (MS). Much of the research indicates that components of MS are much more common in people suffering from Ps [3–8]. According to the literature, MS occurs in about 1/3 of patients with psoriasis, although this value varies from 28% to 45% [9]. The correlation between MS and Ps is presumably caused by genetic, environmental, and immunological factors such as activation of the Th1 and Th17 pathway along with pro-inflammatory cytokines and oxidative stress [7, 10]. Metabolic syndrome occurs more frequently in people with long-term illness [3], however high advancement of Ps, determined by the Psoriasis Area Severity Index (PASI), may not necessarily lead to the development of MS [10]. There is a contrariety, as some authors note a correlation between the higher severity of Ps and a tendency to develop MS, but they do not observe a statistical relationship between the severity of Ps and a higher cardiovascular risk [4]. The aim of this review is to analyze individual components of the MS (Fig. 1) in terms of their pathomechanism etiology, evidence of their association with Ps, and the impact of treating these components on skin conditions.

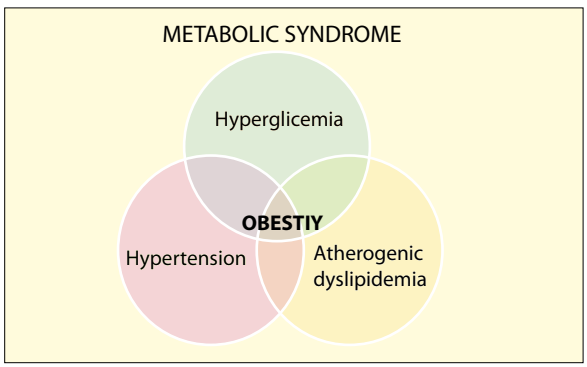

Figure 1. Components of metabolic syndrome

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OBESITY

Analysis of the individual components of MS conducted as part of the Nord-Trøndelag Health Study (HUNT) showed a positive relationship between the risk of Ps and obesity [11]. The increased body weight and the increased level of adipose tissue are associated with a greater chance of developing Ps [12], and it tends to be more severe in more overweight patients [13]. Obesity is a key element of MS that must always be present for the syndrome to be diagnosed. The diagnosis is made on the basis of an increased waist circumference of more than 88 cm in women or more than 102 cm in men or, irrespective of gender, it can be established on the basis of a body mass index (BMI) value which must be ≥ 30 kg/m^2 [14]. Some researchers suggest that overweight-related molecular disturbances lead to the development of Ps [11]. Patients suffering from obesity are featured with persistent, low-grade inflammation. This leads to disturbances in the immune regulation and metabolism of adipocytes, leading to the imbalance between adipokines and cytokines, which play a role in the initiation and development of the MS [15]. The secretion of cytokines such as C-reactive protein (CRP), IL-1, IL-6, and TNF-alpha directly links the inflammatory nature of obesity with other inflammatory diseases such as Ps [15]. An increasing number of studies confirm the common genetic basis of both of these conditions. The gene responsible for the production of adiponectin is located in the same region as susceptibility genes for MS, type 2 diabetes, and cardiovascular disease [16]. HLA-Cw6, recognized as the most important genetic susceptibility locus for the development of Ps, is also associated with the development of obesity. A South Korean longitudinal study of 8 years showed that when taking into account variables such as age, gender, smoking, alcohol consumption, physical activity, household income, and body mass index there is an associated increased risk of Ps in those who have suffered from MS [17], however, there is no data to shed light on whether the PASI index correlates with the degree of obesity. Noteworthy is that the increased waist circumference is much more frequent among women with Ps than in healthy women. There is no such correlation in men, and those with an increased waist circumference without Ps are observed more often than the ones with Ps [18]. Patients suffering from Ps experience a lower quality of life compared to the healthy population. This is strongly influenced by smoking, alcohol consumption, depression, excessive caloric intake, and lower physical activity [13, 19]. The key element of the therapy seems to be a calorie intake reduction diet, which leads to weight loss, not only reduces the PASI index but also improves the state of life assessed on the DLQI scale [20]. It has been shown that among overweight and Ps patients, physical exercise leads to an improvement in the skin condition assessed in the PASI scale, and this effect is more pronounced with longer physical activity [21]. Drugs for obesity can potentially reduce the severity of Ps and improve the quality of life of patients with Ps and MS, with pioglitazone appearing to be the most promising of these drugs [22].

ABNORMAL GLUCOSE METABOLISM

Diabetes or prediabetes is indicated by a fasting glucose level ≥ 100 mg/dL or ≥ 140 mg/dL after 120 minutes on an oral glucose load test. The diagnosis can also be made on the basis of glycated hemoglobin (HbA1c) ≥ 5.7% or the use of hypoglycaemic treatment [14]. It is the rarest component of MS [4] among psoriasis sufferers. Nevertheless, these patients are more prone to developing diabetes mellitus (DM) than the healthy population [23]. The strong correlation between psoriasis lesions and glucose metabolism disorders has led many researchers to consider Ps as a potential pre-diabetes condition. Chronic inflammation is superimposed on the pathology of DM and Ps. Pro-inflammatory cytokines such as TNF and IL-6 are involved in the development of Ps and may increase the amount of insulin-like growth factor (IGF). Increased binding of IGF with IGF receptors results in intensified proliferation of keratinocytes and fibroblasts, which leads to an exacerbation of the disease [24]. An increasing number of researchers have focused on discovering the relationship between the precedence of Ps and the promotion of DM development. Although obesity has been classified as the main predisposing factor for the development of DM and Ps, certain loci can be distinguished as leading to the development of these two diseases regardless of the BMI [25]. Wang et al. [26] differentiated the *PTPN22*, *ST6GAL1*, and *JAZF1* genes as being considered the crucial ones in the development of Ps and DM. Experiments with mice showed that at the beginning of the development of DM in people with Ps, there are no significant inflammatory or necrotic changes in the pancreatic islets nor the liver and that those changes appear later on [27]. Hence, quick diagnosis and intervention before permanent changes are essential. The assessment of insulin resistance according to the homeostatic model (HOMA-IR) and the level of HbA1c is often used to assess glucose disorders. In these studies in patients with MS, higher values of this index were obtained [3, 5–7]. The PASI index correlated in some studies with the HOMA-IR index, however, it is a subject of controversy. [3, 5]. Albeit, there is a considerably significant correlation between the PASI score and the HbA1c level. HbA1c levels were substantially higher in patients with very severe Ps. This implies that the severity of the disease correlates with glucose levels in patients with Ps [27]. Diabetes mellitus (DM) and the use of antidiabetic medications are more common in women than in men with Ps [18].

The use of blood glucose-controlling drugs is associated with a positive effect in terms of treatment of this dermatosis and a better quality of life for the patient [28]. There have been reports of a positive effect of pioglitazone at doses of 15 and 30 mg. Among patients with Ps who underwent this therapy, the PASI index increased by 75% [8].

ELEVATED BLOOD PRESSURE

Hypertension, being a component of MS, affects an increasing number of patients, including those suffering from Ps, who have an increased risk of developing this disease [29]. We consider blood pressure as elevated when it reaches ≥ 130 and/or 85 mm Hg when measured by a doctor or blood pressure ≥ 130 and/or 80 mm Hg when measured at home or whenever when there is a need of hypertension medication [14]. Even though the link between hypertension and psoriasis is a subject of discussion, it is the most common comorbidity among people suffering from Ps [3, 5]. The relationship between this MS component and chronic skin disease can be in part explained by simple factors such as the fact that Ps leads to low mood and reduced tendency to engage in sport, and an increase in alcohol consumption [19, 30]. More complex mechanisms are observed at the level of common cell pathways and both systemic endothelial dysfunction increased oxidative stress, and disorders of the renin-angiotensin system [31]. The genetic and environmental background also plays a role, as hypertension is more common in psoriasis patients in the European and Asian populations [32]. Xi Duan and associates have shown that Ps increase the risk of hypertension compared to patients without Ps. However, this mainly applies to people with advanced Ps, as no evidence of this relation has been found for patients with intermediate Ps [32]. An 11-year national cohort study conducted in Korea showed that the prevalence of Ps in the hypertensive group was higher than that of the comparative group, with no differences in age, gender, or place of residence between subjects with and without hypertension [33]. It is worth emphasizing that the increased risk of developing Ps in the course of hypertension mainly concerns young people under 65 years of age [33]. In the psoriasis population, hypertension is more common among men, although women are more likely to take antihypertensive medications [18]. Treatment of hypertension as part of the MS can exacerbate Ps, rather than improve the skin condition. There is evidence that popular antihypertensive drugs such as ß-blockers intensify psoriasis. In a study by Kim et al. [33] the use of calcium channel blockers or thiazides was associated with a higher risk of Ps in women less than 65 years of age, and the use of sartans was associated with a higher risk of Ps in men aged < 65 years.

ATHEROGENIC DYSLIPIDEMIA

Lipid disorders are an inherent component of MS and one of the major risk factors for cardiovascular disease [34, 35]. Atherogenic dyslipidemia involves the simultaneous occurrence of three types of abnormalities in blood lipid parameters: elevated triglycerides (TG), reduced HDL cholesterol levels, while LDL cholesterol levels may be elevated or normal with a predominance of the small-dense low-density lipoprotein fraction. According to current criteria, the diagnosis is made on the basis of the level of non-HDL cholesterol ≥ 130 mg/dL or the use of hypolipidemic treatment [14]. Although Ps manifests itself mainly in the form of skin eruptions, it is also marked by disturbances in the patient's lipid profile [36]. Such disturbances occur not only in Ps but also in other skin diseases, such as acne vulgaris, eczema, urticaria, or angioedema [37, 38]. Atherogenic dyslipidemia develops as a result of an inadequate diet, low physical activity, and some medications and may have a genetic basis. There are many studies demonstrating the concurrent presence of hypertriglyceridemia and individual loci [39, 40]. The study by Girisha et al. [41] aimed to determine if TG levels differ between the sick and the healthy group. Those suffering from Ps had higher TG levels compared to the control group, 34% and 20.5%, respectively. A higher incidence of MS in patients with Ps than in the control group was also noted, 28.8% *vs.* 16.7%, respectively [41]. In children, the presence of Ps is associated with a higher risk of MS and hypertriglyceridemia [42]. The ability of HDL to promote reverse cholesterol transport by its ingestion from lipid-laden macrophages is known as "cholesterol efflux capacity" (CEC). Evidence suggests that CEC is a measure of HDL quantity and quality, and highlights its importance in the prevention of cardiovascular diseases [43]. Cholesterol efflux capacity (CEC) dysfunctions have been observed in both psoriasis and psoriatic arthritis [38, 44]. Apolipoprotein A1 (apoA-1) plays an important role in the transport of cholesterol from peripheral cells to the liver (reverse cholesterol transport). Its lower levels are observed in patients with Ps, which is strongly correlated with the reduction of HDL levels [8]. HDL, in addition to transporting cholesterol in the CEC mechanism, performs several other functions important for the human organism. In the circumstances of lowered HDL concentration, its anti-inflammatory functions are impaired, which favors the development of Ps [45]. A study by Lopes et al. [43] showed that the results of patients with Ps significantly differed from the control group. It was observed that decreased concentration of apoA-1 and impaired CEC activity related to the deterioration of the anti-inflammatory and antioxidant effect of HDL, which is inevitably associated with an increased risk of developing cardiovascular disorders. Although atherogenic dyslipidemia is more strongly

reported in women with Ps, lipid-lowering drugs are used more often in men with Ps [18]. Oral administration of statins may be associated with the improvement of skin condition and a decrease in PASI scores in patients with Ps, with simvastatin being the most promising in this application, as it has shown a significant effect after eight weeks of therapy [46]. There are no thorough studies on the effects of fibrate therapy in patients with Ps, although there are reports of exacerbation of skin lesions after the use of gemfibrozil [47]. Not all patients with Ps should take statins, but a group of patients can be selected that will definitely benefit from such therapy [48]. Based on the various prevention strategies for cardiovascular diseases (e.g. ACC/AHH or ESC/ESC assessment), it is possible to determine for whom statin therapy is indicated, and the accuracy is close to 60%. It has been shown that some drugs used in the treatment of Ps lead to an increase in HDL and apoA-II levels [38]. The importance of prevention and regulating lipid disorders should also be emphasized, such as lifestyle modification in the form of diet changes, increased physical activity, and not smoking.

DISCUSSION

The relationship between MS and Ps is dose independent. Individuals affected with Ps are at higher risk of developing MS, which in some cases may be accompanied by an increase in PASI score. Furthermore, both Norwegian and Korean population studies indicate that the risk of Ps has risen with the increase in the number of MS components present in a given person [11, 17]. In regard to healthy populations, it is noticeable that MS is significantly more common in women with Ps [14]. This dependency cannot be observed in men, where MS is more common, regardless of Ps [18]. However, irrespective of gender, it is crucial to prevent the development of MS and reduce cardiovascular risk, to which both of these diseases lead [7, 49]. Multiple common risk factors put pressure on prophylaxis, early detection, and proper assessment of both conditions. All psoriatic patients should attend regular follow-up visits to assess blood screening (including blood sugar levels), blood pressure, BMI, and waist circumference measurements in order to early detection of MS. Lifestyle modification in form of diet changes, increased physical activity, and non-smoking is a primary and most important approach that influence both MS and Ps. In patients with MS and Ps, treatment of hyperglycemia and lipid disorders improves the condition of the skin, however, blood pressure medications may lead to an exacerbation. It is strongly advised to administer statins to patients with Ps suffering from very high cholesterol, diabetes, or intermediate/high cardiovascular risk. Obesity being a key element of developing MS and a main deteriorator of skin lesions can be treated successfully with antidiabetic drugs like pioglitazone [22]. However, when desired therapeutic effects are not obtained pharmacologically, bariatric surgery may be considered as one of the ways of reducing obesity which translates into improving the skin condition [50].

CONCLUSIONS

All components of MS may predispose patients to the development of Ps, however, most evidence indicates that obesity is most strongly associated with the development of psoriasis. Appropriate prophylaxis, lifestyle changes, and pharmacological interventions are essential, as they substantially reduce the risk of developing MS and lessen the symptoms of Ps, while also reducing the cardiovascular risk to which both of these diseases lead. It is of professional responsibility of the doctor to develop a treatment tailored to each psoriatic patient.

Conflict of interest

The authors declare no conflict of interest.

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