CLINICAL AND LABORATORY ASPECTS OF SKIN DISEASES IN ATHLETES

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ABSTRACT

Professional athletes represent a unique group of dermatological patients since almost all of them face skin diseases during their sports career. With the increase in the number of people involved in sports, the number of skin diseases associated with sports is also constantly increasing. Sports activity can lead to the development of new or exacerbation of chronic dermatological diseases.

To determine the frequency of detection of dermatoses and comparative analysis, routine medical examinations were conducted on the basis of the Republican Center for Sports Medicine at the National Olympic Committee of the Republic of Uzbekistan. 395 athletes of different specializations were examined, including 150 football players, 67 swimmers, 78 wrestlers, and 100 athletes. The work used a modern classification of sports according to different criteria (intensity of load, team or individual character, level of injury, etc.)

63 strains of microorganisms were isolated in the control group. The normal microflora of the skin is represented by various combinations of microorganisms. Among the representatives of gram-positive flora, Staph. spp. - 33 strains (52.4%) were identified as the most common group. Of the conditionally pathogenic flora, there were 24 strains of Staph.epidermidis, which accounted for 38.09% of all isolated strains in the control.

Indicators of skin microbiocenosis in athletes can serve as a marker of the functional state of the skin, which must be taken into account when developing methods of hygiene and skin care. Normal microflora of the skin is an important factor of bactericidal activity, preventing the penetration of pathogenic microorganisms and the development of dermatoses.

Keywords: normal skin microflora, skin microbiota in dermatoses, athletes.

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Introduction

Professional athletes represent a unique group of dermatological patients, since almost all of them face skin diseases during their sports career. With the increase in the number of people involved in sports, the number of skin diseases associated with sports is also constantly increasing. Sports activity can lead to the development of new or exacerbation of chronic dermatological diseases [1],

which can negatively affect the results of an athlete [2]. There are so-called transitional states, which can be both specific and general, weakening the body and thereby predisposing to diseases. These are the consequences of stress, physical overstrain, overwork, unfavorable and sharply changing environmental conditions, prolonged under-recovery after exertion, hard work, etc. It is shown that the first signs of the disease are manifested primarily when the body is presented with increased demands. Transitional states are important for the prevention and detection of the disease. Athletes whose activities are associated with daily training in swimming pools are subject to constant skin contact with disinfectants that damage the skin, contribute to dehydration and degreasing of the upper layers of the epidermis, reducing the barrier function of the skin and leading to its dryness [3]. The microbiocenosis of the skin is directly dependent on the action of endo – and exogenous factors. Endogenous factors include gender, age, past illnesses and reactivity of the body. The range of exogenous factors is quite wide and includes medicines and biologically active additives, climatic and geographical living conditions and professional working conditions. Therefore, during life, the composition of microorganisms living on the skin undergoes significant changes. Resident microorganisms have means of protection and aggression, which allows them, on the one hand, to overcome the barriers of the skin and mucous membranes, and on the other to suppress the growth and reproduction of pathogenic microorganisms. Some microorganisms use secreted water– and fat-soluble substances, keratin breakdown products and microbes themselves as food sources. They are permanent inhabitants of the skin, do not affect its functional state and do not cause diseases. Other microorganisms produce toxins and enzymes that can alter the development of dermatoses. A significant number of microorganisms colonizing the skin is conditional. One of the most important functions of normal microflora is its participation in colonization resistance, which means a set of mechanisms that give stability to microbiocenosis and ensure the prevention of colonization of the host by extraneous microorganisms. With a decrease in colonization resistance, there is an increase in the number and species spectrum of potentially pathogenic microorganisms, translocation through the barriers of the body, the occurrence of endogenous infection or superinfection of various localization. In humans, barrier function is restored by sixty percent after 12 hours, and full recovery takes seventy-two hours [4]. Violations of the integrity of the skin barrier are a significant factor in the development of chronic skin diseases. Violation of the restoration of the epidermal barrier leads to dehydration of the epidermis and the development of pronounced dryness of the skin [5]. Dry skin is caused by a decrease in the barrier function of the skin, which leads to an increase in transepidermal moisture loss and is manifested by itching, burning and peeling. Dry skin is often susceptible to infection with bacterial flora. Microorganisms are in symbiosis with a

macroorganism, forming a stable ecosystem. The quantitative and qualitative composition of individual types of microorganisms is constantly changing, which is the state of the microbiocenosis of the skin. The leading role among bacterial dermatoses belongs to staphylococci, which is due to their wide spread in the external environment, among sick and healthy people. Among staphylococci, there are precursors of the normal human microbiota - epidermal staphylococcus, and conditionally pathogenic – Staphylococcus aureus. Staphylococcus aureus is considered the most dangerous due to the existence of resistant strains. The appearance of strains of microorganisms with signs of pathogenicity during heavy physical exertion. Pustular skin diseases can have a significant impact on the athlete's well-being and the level of athletic performance. According to modern concepts, normal microflora activates the immune system, and in the absence or defects of the automicroflora, the maturation of the immune system is suppressed and its activity decreases. At the same time, the presence and level of potentially pathogenic pathogens deserve attention.

In the pathogenesis of various dermatoses, the ability of the skin to resist microbial invasion is of decisive importance [9,12,20,37]. The protective function of the skin is carried out due to the ability to bactericidal activity due to a combination of factors - the impermeability of the epidermal barrier to bacteria, low pH values of the epidermis [4,16,19], the state of the body's immune system and factors of nonspecific resistance, antimicrobial activity of keratinocytes, as well as the antagonism of normal and pathogenic microflora [5,6,14,20,30]. The microflora of the skin is important in maintaining the homeostasis of the body, prevents the penetration of pathogenic microorganisms, and activates the immune system; the balanced state of the microbiocenosis of the skin provides colonization resistance of this biotope [17,33,38,43]. Violation of certain components of homeostasis changes the constancy of the microsystem and leads to dysbiosis of the skin [17,21,22,32].

On the skin of an adult healthy person, 19 taxonomic ranks (fili) of microorganisms usually are determined, most of which belong to four of them: Actinobacteria, Firmicutes, Bacteroidetes and Proteobacteria, also present on the oral mucosa and gastrointestinal tract (gastrointestinal tract), but their proportions differ from those on the skin [16,19,26]. The resident microflora of the skin and mucous membranes contains: Staphylococcus epidermidis; Staphylococcus aureus; Micrococcus spp.; Sarcina spp.; corineform bacteria; Propionibacterium spp. As part of the transient: Streptococcus spp; Peptococcus spp; Bacillus subtilis; Escherichia coli; Enterobacter spp.; Acinetobacter spp.; Lactobacillus spp.; Candida albicans and many others [5,17,22]. A significant number of microorganisms belong to conditionally pathogenic – Staphylococcus aureus,

Staphylococcus saprophyticus, and Malassezia species and are in symbiosis with a macroorganism, forming a single ecosystem [3,6,24,25,44,45]. Some microorganisms use secreted water- and fat-soluble substances, keratin breakdown products, and microbes themselves as a food source. They are permanent inhabitants of the skin, do not affect its functions, and do not cause diseases. Others produce toxins and enzymes that can change the permeability of tissues, the chemical composition of sebum and contribute to the development of dermatoses [3,24,27,43].

The colonization of the skin by microorganisms (bacteria, fungi, viruses, mites) is caused by the ecology of the skin surface and varies depending on endogenous and exogenous factors, is subject to changes under the influence of increased physical and sports loads, stress, seasonal and climatic features [4,5,17,18,22,24,35,50], as well as topographic position [36]. The physico-chemical properties of the skin areas determine the presence on its surface of a unique set of microorganisms adapted to a specific physiological niche [5,16,17,19,50]. In general, the skin is characterized by an acidic pH value, so the most comfortable places for microorganisms are areas of thin skin, folds, mouths of hair follicles and glands [26,36].

On dry areas of the skin (for example, forearms, hands), the greatest variety of microorganisms is determined: Actinobacteria, Proteobacteria, Firmicutes and Bacteriodetes [17,26]. An amazing feature of the microbiota of these sites is the abundance of gram-negative microorganisms, although previously it was believed that they rarely colonize the skin, getting from the gastrointestinal tract [17].

Sebaceous areas of the skin are characterized by a small variety of phylotypes of microorganisms, facultative anaerobes dominate here, such as Propionibacterium acnes (P.acnes) [8,22], which hydrolyze triglycerides of sebum, releasing free fatty acids (FFA) that maintain an acidic pH value on the skin surface [5,17,18,20]. Low skin pH inhibits the growth of such common pathogens as Staphylococcus aureus and Streptococcus pyogenes, and at the same time is favorable for the growth of coagulase-negative staphylococci and corynebacteria [17]. Metagenomic analysis has shown that wet areas, such as the navel area, armpits, inguinal and intervertebral folds, sole of the foot, popliteal fossa, elbow fold area, are most abundantly colonized by Staphylococcus and Corynebacterium spp. [17,26]. Staphylococci occupy an aerobic niche on the skin and probably use urea present in sweat as a nitrogen source [17,24,27]. Microorganisms not related to bacteria were also identified on healthy skin: fungi (the genus Malassezia accounts for 53-80% of the total population of fungi), mites Demodex folliculorum and Demodex brevis (colonization by these microorganisms is especially increasing in areas rich in sebaceous glands) and commensal viruses [7,24,46,49).

Material and methods of research

To determine the frequency of detection of dermatoses and comparative analysis, routine medical examinations were conducted on the basis of the Republican Center for Sports Medicine at the National Olympic Committee of the Republic of Uzbekistan. 395 athletes of different specializations were examined, including 150 football players, 67 swimmers, 78 wrestlers, and 100 athletes. The work used a modern classification of sports according to different criteria (intensity of load, team or individual character, level of injury, etc.), according to which comprehensive laboratory studies were conducted in various categories of athletes by sports: cyclic, game, complex coordination, summer and winter sports, team and individual, etc. during the examination, various skin diseases were identified in all sports subgroups. A total of 287 episodes of skin lesions were diagnosed in 247 athletes (62.5% of the examined athletes). In many cases, combinations of various nosologies were noted, for example, patients with mycoses often had allergies, microbial eczema, pyoderma, etc. swimmers more often developed allergic dermatitis from antiseptics used to treat water in swimming pools, wrestlers more often had viral diseases – herpes, warts (Fig.1)

Dermatoses	Football players n=150	Swimmers n=67	Wrestlers n=78	Athletes n=100
Fungal infection of major skin folds (groin dermatophytosis, candidiasis)	18	-	15	16
Foot mycosis, onychomycosis	38	21	6	22
Malassezia infection (pityriasis versicolor, seborrheic dermatitis)	18	18	-	8
Erythrasma	8	-	7	-

Staphylococcal dermatitis	12	-	-	12
Acne	8	-	-	-
Allergic contact dermatitis	9	11	-	-
Microbial eczema	6			3
Atopic dermatitis	-	4	-	-
Xerosis (dry skin)	-	14	-	-
Ringworm (tinea)	4			
"Herpes gladiatorum"	-	-	6	-
Warts	3			
Total: 287	124 (43,2%)	68 (23,69%)	34 (11,84%)	61 (21,3%)

Fig. 1 Distribution of skin diseases in athletes

The analysis of the detection of dermatoses in accordance with the training season showed a significant preponderance of the frequency of diseases in the spring-summer period of the year than in the autumn-winter time of training (Fig. 2).

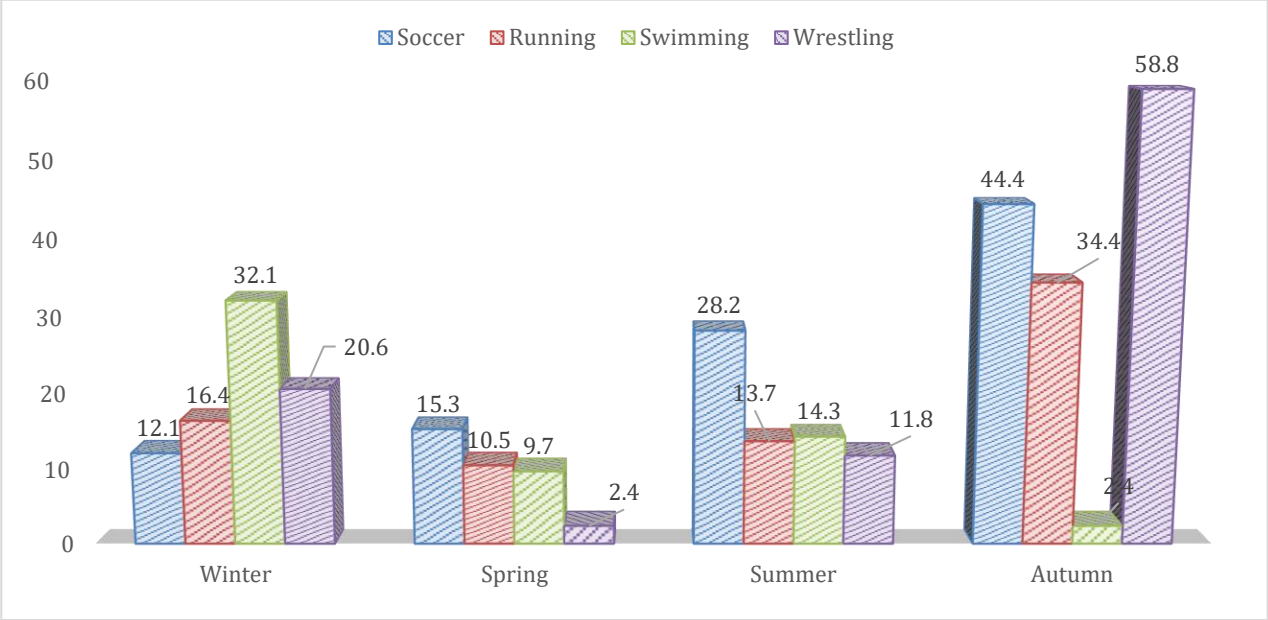

Fig. 2 Frequency of recurrence of skin diseases in athletes depending on the training season

In the conditions of the hot climate of Uzbekistan, the majority of recurrent dermatoses are observed in the summer-autumn season, especially among wrestlers, football players and athletes, while swimmers have the highest incidence in winter.

Thus, athletes of different specialties have a variety of skin lesions during periods of pre-competitive training. At the same time, along with the features characteristic of each type of sport, there are similar trends – a significant proportion of mycotic and bacterial skin infections, as well as allergic dermatitis with transformation into eczema. The frequency of detection of dermatoses increases significantly with an increase in the length of professional activity, which may be due to the sensitization of the body, the strain of adaptive capabilities, the presence of concomitant diseases. The dependence of the debut, the frequency of skin diseases and relapses on the training season is noted. In general, intensive training throughout the year, stress of physiological processes (sweating, thermoregulation, adaptation processes in the skin and in the body as a whole), psychological stress, traumatization, as well as hygienic conditions of the training process contribute to a change in the functional state of the skin, its protective properties, which can lead to the development of dermatoses. In this regard, it is relevant to study the balance of indicators of the functional state of the skin in athletes examined in accordance with the requirements of sports medicine. Along with special tests and samples, general clinical studies were carried out: a general analysis of blood, urine, a study of biochemical parameters - blood glucose, protein content, ALT, AST, bilirubin, cholesterol. Before the start of the study, the permission of the ethics committee and the written informed consent of the athletes were obtained.

Both microbiological and modern non-invasive methods of studying the epidermal barrier were carried out before the start of training.The most common way to determine the state of the microflora of the skin is bacteriological sowing of flora from the surface of the skin by different methods. Microbiological studies were carried out in the bacteriological laboratory of the Tashkent Regional Skin and Venereological Dispensary (KVD). For qualitative and quantitative analysis of the microflora of the skin, the methods of flushing according to Willamson et Kligman (2001) were used. Highly selective nutrient media were used for sowing: blood agar, yolk-salt agar, Saburo, Endo, etc. Washes were made from 1 cm2 of the skin surface. A cotton swab with a diameter of 0.5 cm, soaked in 0.6 ml of a pH 7.9 phosphate buffer solution, intensively rub the skin area of the middle of the chest with an area of 9 cm2. After that, the tampon is again placed in a test tube with a buffer, intensively suspended and removed. 0.1 ml (in case of sowing on staphylococcal microflora) or 0.05 ml (when sowing on Malassezia spp) is taken from the contents of the test tube with an automatic pipette, sown on a Petri dish with an appropriate selective medium, the cup is incubated in a thermostat at +37 ° C during the day in case of staphylococcus or at +32 ° C for 2-5 days in the case of Malassezia spp. The grown colonies are placed in a loop in a drop of the same buffer solution and microscopized at x1750 magnification to visualize Malassezia spp cells (round or oval cells with kidneys on a wide base having a typical "collar") [14; pp.69-82,16; pp.55-58]. The number of yeast populations is read by the formula (CFU-1 x 0.6 ml): 0.05 ml: 9 cm2 = CFU-2, where CFU-1 is the number of colonies grown on the cup, CFU-2 is the number of colony-forming units per cm2 of skin. The population of staphylococci is calculated according to the formula (CFU-1 x 0.6 ml): 0.1 ml: 9 cm2 = CFU-2, where CFU-1 is the number of colonies grown on the cup, CFU-2 is the number of colony-forming units per square centimeter of skin.

Statistical processing was carried out by the method of variational statistics with the calculation of arithmetic averages (M), their standard errors (m), confidence interval () and significant differences (p) according to the Student's t-criterion.

Results and discussion

63 strains of microorganisms were isolated in the control group. The normal microflora of the skin is represented by various combinations of microorganisms. Among the representatives of gram-positive flora, Staph. spp. - 33 strains (52.4%) were identified as the most common group. Of the conditionally pathogenic flora, there were 24 strains of Staph.epidermidis, which accounted for 38.09% of all isolated strains in the control. Staph.spp accounted for 4.76% (3 strains), Staph.haemoliticus and Staph.aureus were present in the same proportion, Enterococcus faeceam

- 4 strains (6.35%) (Table 1). Along with staphylococci, Corynebacter– 15 strains (23.8%) were often isolated. Of the gram–positive microflora, Streptococcus spp.- 2 strains were also present in healthy individuals (3.17%). High colonization density was observed in Staph.aureus (42.4±1.42 KOE/cm2), Staph.epidermidis(36.3±1.39 KOE/cm2), Enterococcus (42.85±1.66KOE/cm2) and Corynebacter(40.81±1.28).

Table 1.

Characteristics of the skin microbiota in athletes

(abs, %, CFU, cm2, M ±m)

	Healthy n=35		Athletes with dermatoses , n=78			
			Intact skin areas, n=66		Affected skin areas, n=78	
	Abs and % of strains	КОЕ, $см^2$,М±м	Abs and % of strains	КОЕ, $см^2$, М±м	Abs and % of strains	КОЕ, $см^2$, М±м
Staph.aureus	3(4,76%)	42,4±1,42	35(19,02%)	420,3±21,07*	42(22,7%)	425±25,0*
Staph.epider	24(38,09%)	36,3±1,39	23 (12,5%)	178,5±6,84*	27(14,59%)	182,3±7,73*
Staph.spp	3(4,76%)	11,96±0,74	8(4,34%)	68,2±3,5*	8(4,32%)	68,13±3,5*
Staph.haemo	3 (4,76%)	7,4±0,26	16 (8,68%)	91,8±6,35*	16(8,64%)	91,8±6,35*
Staph.hominі	-	-	7(3,80%)	101,0±0,5	2 (1,08%)	119,5±12,39
Micrococcus	-	-	20(10,87%)	89,9±12,01	9(4,86%)	119,7±8,75
Candida alb	-	-	27(14,67%)	19,0±0,66	39(21,08%)	20,4±0,79
Strept.spp	2 (3,17%)	47,7±1,1	3(1,63%)	619,0±31,66*	3(1,62%)	619±31,66*
Enterobacter faeceam	4(6,34%)	42,85±1,66	4(2,17%)	617,5±62,23*	4(2,16%)	617,5±62,23*
Enterobacter faecalis	-	-	2(1,09%)	519±21,00	2(1,08%)	519±21
Corynebacter	15(23,8%)	40,8±1,28	22(11,95%)	124,6±5,64	16(8,64%)*	125,9±5,9*
Klebsiela	-	-	4(2,17%)	37,3±0,95	4(2,16%)	37,4±0,95
Psevdomon. auriginosa	-	-	4(2,17%)	3887±157,7	4(2,16%)	3887,5±157,7
Proteus	-	-	3(1,63%)	112,7±7,51	3(1,62%)	112,7±7,51

Total	63(100%)		184(100%)		185(100%)	

Note: * marked values significantly different from the control, P<0.01

CONCLUSION

Indicators of skin microbiocenosis in athletes can serve as a marker of the functional state of the skin, which must be taken into account when developing methods of hygiene and skin care. Normal microflora of the skin is an important factor of bactericidal activity, preventing the penetration of pathogenic microorganisms and the development of dermatoses. The constancy of the microbiocenosis of this biotope depends on the functional state of the skin (features of the hydrolipidic mantle, factors of nonspecific resistance, antimicrobial activity of keratinocytes, etc.), which in turn is ensured by the homeostasis of the body as a whole. Violations of the components of homeostasis due to the action of various exogenous and endogenous factors leads to a change in the constancy of the microbiota (dysbiosis) of the skin. Colonization resistance of the skin is maintained by low pH values of the epidermis and can change both in practically healthy individuals (for example, in athletes with hyperhidrosis against the background of stress and inadequate physical activity) and in patients with immune-dependent, neuro-endocrine, infectious diseases accompanied by fever or metabolic disorders.

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