SPORTS MEDICINE

Species Variety of Staphylococcal Microflora of the Skin in Athletes Engaged in Water Sports

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Staphylococcal flora of the skin was studied in athletes whose professional activity involved training in water. Inoculations were carried out by impressions in selective agar medium (yolk saline agar; YSA) in bacteriological signets. Drug sensitivity was studied by the disk diffusion method modified by Kerby–Bauer using standard disks with antibiotics. The study was carried out in 4 groups of athletes engaged in water sports (athletic and synchronous swimming, modern pentathlon, and water polo). Quantitative and qualitative characteristics of staphylococcal flora in water athletes are presented, MRSA strains are detected, and antibiotic sensitivity of staphylococcal microflora was evaluated.

Key Words: *staphylococci; skin microflora; athletes engaged in water sports*

Staphylococci are highly prevalent microorganisms, including representatives of normal human microbiota (*Staphylococcus epidermidis*) and opportunistic bacteria (*Staphylococcus aureus*). The most pathogenic staphylococci are methicillin resistant *Staphylococcus aureus* (MRSA) strains, which appeared in the 1960s soon after introduction of methicillin, a penicillin antibiotic, into clinical practice. Skin appendages (hair follicles, apocrine sweat and sebaceous glands) are the natural habitat of staphylococci on the skin [5].

Transformation of saprophytic cocci into pathogenic ones can lead to the development of skin diseases. The host factors promoting this transformation are physical strain, decompensated fatigue, neuroendocrine and immune disorders, unbalanced nutrition. Changes in the basic parameters of the barrier function of the skin, such as pH, hydration status, lipid content, lead to the formation of the "gate" for infection [4].

The training process implies lasting work in a limited group of athletes contacting with the same infected objects; all these factors augment the risk of out-of-hospital MRSA infection [10].

Water sports are characterized by daily work of athletes in water for a long time and hence, skin contact with chemicals added into the water for purification and disinfection. Because of these facts, professional water sports can lead to the development of skin dysbiosis of different severity in the athletes [4].

We studied staphylococcal flora of the skin in athletes whose professional work involved training in water.

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MATERIALS AND METHODS

The study was carried out in 4 groups of athletes (*N*=51) engaged in water sports: modern pentathlon, athletic and synchronous swimming, and water polo. The mean age of athletes was 20.8 years. All volunteers gave informed written consent to participation in the study.

Group 1 were pentathlon athletes (8 men and 8 women, mean age 26.9 years), group 2 were athletic swimmers (13 men and 2 women, mean age 18.6 years), group 3 were synchronous swimmers (8 girls, mean age 9.8 years), and group 4 were water polo players (11 men and 1 woman, mean age 23 years). Athletes of all groups trained every day in the same pool.

Because of the specific morphology of the microorganisms, we used an original method for identification of the species composition of staphylococci using bacteriological signets. Inoculations in selective agarized YSA (yolk saline agar) were carried out by the impression method in the media placed in bacteriological signets (Medpolymer). The species composition was evaluated as described previously [1].

The material was collected before training. A bacteriological signet (a plastic sterile container with selective media) was pressed to the chest skin for 20 sec. It was inoculated by microorganisms, after which was put into a thermostat, and the resultant colonies were evaluated after several hours.

Drug sensitivity was evaluated by the disk diffusion method modified by Kerby–Bauer using standard disks with antibiotics (Center of Pharmacotherapy).

The data were statistically processed using Microsoft Excel software. The arithmetic means, mean deviations, and coefficients of correlations were evaluated.

RESULTS

Species composition of staphylococcal microflora and its quantitative parameters were evaluated (Table 1).

Staphylococcal microflora was isolated from apparently intact skin of 50 athletes. *St. aureus* was isolated in 26 (54.7%), *St. saprophyticus* in 2 (3.2%), *St. intermedius* in 14 (25.2%), *St. epidermidis* in 6 (10.4%), and *St. haemolyticus* in 2 (4.8%). In only one athlete no staphylococcal flora was found.

Study of the species composition of staphylococcal microflora in pentathlon athletes showed the following results: *St. aureus* in 9 (56.3%), *St. intermedius* in 6 (37.5%), and *St. saprophyticus* in only one athlete. No *St. epidermidis* or *St. haemolyticus* were isolated.

All staphylococcal species were found in athletic swimmers. *St. aureus* was isolated from 5 (33.3%), *St. saprophyticus* in 1 (6.7%), *St. intermedius* in 2 (13.3%), *St. epidermidis* in 5 (33.3%), and *St. haemolyticus* in 1 (6.7%) swimmer.

Studies of staphylococcal flora in synchronous swimmers detected *St. aureus* in 7 (87.5%) and *St. haemolyticus* in only one girl. Other staphylococcal species were not detected.

The data for water polo group were as follows: *St. aureus* in 5 (41.7%), *St. intermedius* in 6 (50%), *St. epidermidis* in 1 (8.3%) athlete. No *St. saprophyticus or St. haemolyticus* were isolated.

High incidence of *St. aureus* is worthy of note. This can be due to the fact that the athletes spend much time in an enclosure with numerous objects of common use (shower rooms, furniture and floor in dressing rooms, training devices, *etc.*) A lesser incidence of *St. aureus* in athletes engaged in water sports is presumably explained by long time they spend in chlorinated water. The same fact is presumably responsible for low incidence of epidermal staphylococci, normally present on the skin. Since *St. aureus* was the most incident in all groups, we evaluated its sensitivity to antibiotics and antiseptics (Table 2).

Study of methicillin (oxacillin) sensitivity has shown the highest incidence of MRSA in synchronous swimmers (13.8%); in pentathlon athletes their level reached 10.3%. No oxacillin-resistant *St. aureus* strains were found in swimmers and water polo players.

TABLE 1. Incidence of Various Staphylococcal Species on the Skin of Athletes in Different Groups

Staphylococcus spp.	Carriers of Staphylococcus species, %			
	Group 1 (*N*=16)	Group 2 (*N*=15)	Group 3 (*N*=8)	Group 4 (*N*=12)
St.aureus	56.3	33.3	87.5	41.7
St.saprophyticus	6.2	6.7	0	0
St.intermedius	37.5	13.3	0	50
St.epidermidis	0	33.3	0	8.3
St.haemolyticus	0	6.7	12.5	0

TABLE 2. Antibiotic Sensitivity of Staphylococci Isolated from Athletes Engaged in Water Sports and Dissemination of the Bacterium (*M*±*SD*)

Antibiotics		St. *aureus*
Dissemination, CFU/dm^2		2833±2556
Sensitivity to antibacterial drugs		
Penicillins	Oxacillin	2.81±0.34
Cephalosporins	Cefuroxime (Zinacef)	2.85±0.27
	Cefoperazone (Cefobid)	2.85±0.27
	Cefotaxim (Claforan)	2.92±0.15
Aminoglycosides	Gentamicin (Garamicin)	2.19±0.87
	Neomycin	2.15±0.78
Tetracyclines	Tetracycline	2.19±0.68
	Doxycycline (Vibramycin)	2.38±0.76
Macrolides	Azithromycin (Sumamed)	1.12±0.21
	Clarithromycin (Clacide)	1.12±0.20
	Erythromycin	1.08±0.14
	Roxithromycin	1.08±0.15
Lincosamides	Klindamicin (Dalacin)	2.35±0.65
	Lincomicin	2.62±0.56
Fluoroquinolones	Ciprofloxacin (Cifrane)	2.85±0.27
	Ofloxacin (Tarivide)	2.92±0.14
Miscellaneous	Chloramphenicol (Levomycetin)	1.69±0.80
	Fusidin	2.77±0.37

According to published data, the incidence of MRSA increases every year all over the world, and hence, the hazard of staphylococcal infection also increases. In hospitals of the USA this parameter increased more than 10-fold from 1975 to 1991, reaching 29%, in Russia it reached 33.5% [3].

Out-of-hospital dissemination of MRSA also tends to increase: in 2007 more than 66% cases of MRSA infection in the USA were recorded in healthy individuals not exposed to risk factors of any kind [8]. In Japan, 3.7% healthy children were found to be MRSA carriers [11]. In Germany, one-fourth of schoolchildren were *St. aureus* carriers, but only 0.3% of the bacteria were MRSA [9].

The data of monitoring of athletes showed that MRSA carriership among the USA wrestlers increased from 2% in 2006 to 6% in 2008, among football players from 0.05 to 0.25% over the same period [7]. After detection of pyoderma of MRSA origin in a female basketball player, the entire team was examined. It was found that almost all athletes were MRSA carriers [13].

Our findings drove us to the following conclusions.

St. aureus predominates in the staphylococcal flora in athletes engaged in water sports.

Dissemination evaluated by impressions was about the same in all groups: 2833±2556 CFU/dm^2.

St. aureus strains exhibited low sensitivity to macrolides and chloramphenicol and moderate sensitivity to aminoglycosides, tetracyclines, lincosamides, and fusidin. The isolated strains were also sensitive to fluoroquinolones.

The MRSA strains were detected only in synchronous swimmers and pentathlon players, but not in swimmers and water polo players.

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