

Common Sports-Related Infections: A Review on Clinical Pictures, Management and Time to Return to Sports

Zahra Ahmadinejad^{*1,2AEG}, MD; Neda Alijani^{1BDG}, MD; Sedigeh Mansori^{1BDG}, MD; Vahid Ziaee^{2AEG}, MD

Authors' Affiliation:

1. Department of Infectious Diseases, Imam Khomeini Hospital, Tehran University of Medical Sciences, Tehran, Iran
2. Sports Medicine Research Center, Tehran University of Medical Sciences, Tehran, Iran

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* Corresponding Author;

Address: Sports Medicine Research Center, No 7, Al-e-Ahmad Highway, Tehran, Iran

E-mail: ahmadiz@tums.ac.ir

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Abstract

There is a relationship between exercise and changes in immunity. So athletes are prone to different medical problems such as injuries and infections. Infection is an important medical problem which could be a reason for athletes' absence from training. The relationship between physical activity and immune system, characteristics of different types of infections in athletes with emphasis on special clinical presentations or complications, time to return to physical activity and training and strategies to prevent development and transmission of infections in athletes or physically active people are the main topics of this review.

Key Words: Sports Medicine; Infectious Diseases; Respiratory Tract Infections; Blood Borne Pathogens; Viral Hepatitis; Skin Infections; Immunity

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INTRODUCTION

Athletes are prone to different medical problems which are directly or indirectly related to their physical activities and may result in training abstinence. Injuries are one of the most common of these problems. Another medical problem which could be a reason for athletes' training abstinence is infection. Certain circumstances in sport may increase the susceptibility of athletes to infectious diseases. On the other hand, athletes with infectious diseases may be at risk for severe complications if they continue their physical activity. Finally they may have transmittable diseases, so other people including sports competitors, trainers and even audiences could be at risk. Transmission of infectious diseases in sports usually occurs via direct contacts, fecal oral routes, common source exposure and airborne or droplets^[1,2].

Despite high prevalence of infectious diseases in athletes and the important role of this medical problem in training and competition abstinence, there is little

evidence and guidelines for physician in the literature^[2,3,4].

By presentation of 3 real scenarios, we review the main aspects of infections and sport in this paper.

FIRST SCENARIO

M. Akbari is a 16 year student who presented with a severe sore throat, fever, myalgia and abdominal pain. His tonsils are enlarged with dirty exudates. He has several enlarged and tender lymph nodes on his neck and a palpable spleen. He is a member of his School's wrestling team and has had hard training during the last weeks. His parents have concerns about his physical activity in the school; they also want to know if there is any relationship between his training and severity of the disease which he has got; finally, can he participate in a national wrestling tournament next week or not?

Exercise and Immune System

Exercise and changes in immunity have a proven relationship [5]. Very heavy sports may increase risk of infections, such as respiratory tract infections. These risks are high especially during 1-2 weeks after heavy training [6]. In a marathon, 33.3% of athletes who ended the marathon got an upper respiratory tract infection (URI) during the first two weeks [7]. There are two theories regarding sports and the immune system. Some experts hypothesized a J-shaped relationship between physical activity and respiratory tract infection. According to this theory, regular, moderate activity strengthens the immune system and decreases rate of viral infection. While severe, prolonged activity (including marathon) has a transient inhibitory effect on immune system which may predispose athletes to URI and malignancy [8]. According to the second theory, immune system function is suppressed for at least several hours after intensive exercise, this time is an “open window” and the risk of infections may be increased in this period [5]. However, despite these attractive theories, there are a few studies which evaluate the effect of exercise on different parts of immune system [5,6,9].

Exercise may influence quality and quantity of different types of white blood cells including natural killer (NK) cells, neutrophils and lymphocytes. After heavy exercise, NK cells increase immediately, and fall below pre-exercise level after 30 min which probably is not clinically important. Heavy exercise does accompany a decreased cytotoxic effect of NK cells while moderate, regular activity increases number of NK cells [8,10].

Neutrophil counts increase after exercise but high-intensity activities impair neutrophil function. Lymphocyte counts and B-cell function are decreased

after heavy exercise but moderate exercise increases them [4].

Salivary IgA decreases with heavy and prolonged activities but IgG level has a small decrease. While low-intensity short term exercise increases the secretory IgA transiently [11]. A ratio of CD4 to CD8 decrease to <1.5 following exercise. In acute exercise, proinflammatory cytokines such as tumor necrosis factor (TNF) α , interleukin (IL) 1 and IL6 and anti-inflammatory cytokines such as IL10, IL1 receptor antagonist increased [9]. Physical activity may also influence the filtering system of respiratory tract. High flow air and change of breathing from nose to mouth breathing induces progressive cooling and drying of the respiratory tract mucous. Decreasing movement of ciliated cells and increasing mucosal viscosity, finally impairing filtering of microorganisms from the upper respiratory tract system [10].

In summary athletes have brief immunosuppression after acute, heavy exercise in the open window period, when there is reduced ciliary activity, lymphocyte count, CD4 to CD8 ratio and mucosal IgA level. Indeed, intensive activity is associated with increased risk of infection. According to J curve, regular moderate exercise can reduce respiratory tract infections.

Upper Respiratory Infections in Athletes

Upper respiratory tract infection is one of the most common diseases in humans, with a high prevalence in athletes. It is the reason of 30-40% of referrals to sports medicine clinics [12]. Healthy adult get URI up to six times annually. Higher incidence (>four times annually) of URI in athletes is not a fact but it is observed in a lot of studies [13-16]. It is more prevalent in

Clinical points for strengthening the immune system during physical activity

Athlete Should Avoid

- Prolonged heavy exercise
- Severe progressive weight loss
- Exposure to sick people

Athlete Should Have

- Proper nutrition
- Proper and frequent hand hygiene
- Regular sleep
- Yearly influenza vaccination

athletes with heavy exercise comparing with those with moderate to low activity ^[12,16]. Different families of viruses cause URI including rhinoviruses, coronaviruses, respiratory syncytial, Para influenza and Influenza. Close contact with infected patients is the main way of transmission. Transmission through aerosols has been approved for rhinoviruses and influenza ^[17]. Higher prevalence of common cold in high contact sports including wrestling is predictable. Water sports such as swimming, predispose athletes to sinusitis, otitis and conjunctivitis. Due to different etiologies, clinical syndrome is different and could be presented as rino-sinusitis, bronchitis, flu-like or croup. Upper respiratory infection is self limited and most patients recover within 3 to 5 days with or without symptomatic treatment. Basic hygiene practices and limiting exposure to infected persons are important in the prevention of URI ^[2].

As we mentioned before, the relationship between physical activity and URI has been described in the form of a J curve. This model suggests that although moderate exercise training may reduce URI symptomatology, heavy chronic exertion may increase it.

When Should Athletes Return to Training and Competition After Respiratory Tract Infections?

Effect of physical activity on the symptomatology of URI is different and depends on the severity of physical activity and disease. In athletes with mild to moderate URI with rinorrhea, sore throat and cough (upper the neck syndrome) there is no evidence of more severity, complication or duration of disease following physical activity. However in athletes who have fever, myalgia, arthralgia and tachycardia (lower the neck syndrome), physical activity may increase the severity and duration of the respiratory tract infection. On the other hand, isometric and dynamic contractions may decrease in patients with fever. In this case, bed rest until complete recovery (normal heart rate and body temperature) is recommended ^[18].

If sore throat is due to infection with Epstein bar virus (EBV), light physical activity could be started

three weeks from symptoms onset. Although return to contact activities is more controversial because of the risk of splenic rupture following minor abdominal trauma even in patients with no splenomegaly ^[19]. In patients with sinusitis and otitis media, diving is forbidden until complete recovery of signs and symptoms and a normal tympanogram in the latter group. Diving is also contraindicated in swimmers with chronic otitis media with tympanostomy tube (Grommets). Athletes with conjunctivitis may transmit infection to the competitors during contact sports (including wrestling) and should not return to sports until complete recovery. Swimmers with adenovirus conjunctivitis are also prohibited from sport. Heavy exercise in athletes with acute bronchitis is forbidden due to increased risk of bronco-spasm and secondary bacterial infection. Athletes with acute bacterial pneumonia need at least two weeks rest before full return to physical activity. However it makes 4- 6 weeks in patients with pneumococcal pneumonia. Chest X ray has no role in determining the time to return to sport. Return to sport should be gradually and in response to signs and symptoms. Athletes should perform 10-14 days of mild exercise then start up training. In general, athletes should do two days of light exercise for every day of rest.

Treatment and prevention

Although, most patients with URI recover gradually without specific treatment, symptomatic treatment with nonsteroidal anti-inflammatory drugs (NSAIDs) decreases duration and severity of disease. Anti-histamines alone or in combination with NSAIDs, decrease duration of sinusitis by early opening of Eustachian tube. It also results in decrease of fluid collection in patients with otitis media. Sedative antihistamines are forbidden by International Olympic committee (IOC) in shooters. In swimmers with Grommets, polymixin B plus neomycin and hydrocortisone (PBNH) two drops after swimming, may decrease rate of otorrhea. This agent has approval of both IOC and national collegiate athletic association (NCAA). Amoxicillin with or without clavulanate for seven to ten days are the drugs of choice for acute otitis

media. Athletes with external otitis need local treatment with PBNH or ciprofloxacin. New quinolones (gattyfloxacin, levofloxacin or moxifloxacin) are drugs of choice for conjunctivitis and duration of treatment is seven to ten days. Acute bronchitis should be treated with NSAIDs and bronchodilators. Antibiotics have no effect on acute bronchitis and are not recommended. Although, in patients with persistent signs and symptoms for more than seven days and/or in final weeks of a preparation for a major competition, empiric therapy with antibiotics could be useful. Athletes with acute pneumonia need emergent empiric antibiotic therapy. Macrolides (Azithromycin or Clarithromycin) are drugs of choice in young adults with no morbidity. Doxycycline is an alternative agent, but photosensitivity in athletes with outdoor sports is a considerable side effect.

SECOND SCENARIO

A 21 year old wrestler refers to a dermatologist due to pruritic hyperpigmented skin lesions on his toes. He has noticed these lesions 1 month ago. On physical examination there are scaly plaques on the soles and toes, especially between the first and second toe. He needs a certification to attend in a wrestling match one week later. He also is worried about complete recovery of the skin lesions after treatment.

What is your diagnosis for his skin lesion?

What is your diagnostic plan and management?

Is he allowed to participate in the wrestling match next week if his skin lesion has not improved?

Skin Infections in Athletes

Skin infections are common in athletes. They may be viral (herpes simplex infection, molluscum contagiosum, warts), bacterial (impetigo, folliculitis) or fungal (tinea). Contact is a risk factor for this infection^[9]. Skin infections are common among wrestlers, football, rugby and judo players^[20,21]. This is due to

high skin contacts, sweating, skin abrasions and tight clothing among these athletes.

Viral Skin Infections

Important viral infections in athletes are: herpes simplex virus (HSV) infection, molluscum contagiosum, and warts. Abrasion, sweating, occlusive clothing are risk factors for these infections. Other factors including, weights, weight benches, pool decks and communal showers can also be effective in transmission. The most common skin infection in athletes is HSV infection, especially in wrestlers (herpes gladiatorum) and rugby players (herpes rugbiorum)^[9]. This virus is transmitted through contact, and it is common in contact sports such as Wrestling, rugby, basketball and Football^[2]. Twenty to forty percent of wrestlers and rugby players are infected with HSV. Skiers who are exposed to low temperatures and ultraviolet solar radiation also are at risk of recurrent herpes labial infection^[9].

The incubation period of HSV infection is 5-10 days. The main symptoms in primary HSV infection are fever, malaise, and painful oral or genital lesions. The lesions are common on the head and face because of frequent contact in sports. Extremities and trunk are affected less commonly^[3]. The vesicles rupture quickly and crust within a few days; however, this may take two to three weeks. During primary infection, virus is transported via sensory ganglia most commonly in the trigeminal, cervical, or lumbosacral ganglia. Retrograde transport of HSV along nerves is not dependent on viral replication in the skin or neurons^[22]. In recurrent HSV infection, local lesions are more limited without systemic signs and symptoms. Self induction of infection may result in felon and keratoconjunctivitis in athletes, and later infection may lead to blindness^[23].

Treatment and prevention:

Disease is self-limited and skin lesions improve in 2 - 21 days. However, early treatment with acyclovir reduces duration and severity of disease, and transmission rate to other athletes. It should begin immediately after prodromal symptoms. Drug of

choice is oral acyclovir (400mg three times a day or 200mg five times a day for seven to ten days). Topical acyclovir is not helpful. In stressful conditions recurrences may occur. It is milder and usually lasting five days. Duration of treatment in recurrent infection is five days^[9]. Benzoyl peroxide and warm wind flow cause faster drying of the lesions. Periodic screening of athletes for skin lesions is recommended for prevention of disease. Valacyclovir in athletes with a past history of herpes gladiatorum could decrease risk of recurrence in sports tournaments. Sanitation of environment and equipment has a limited role in prevention, due to low transmission rate of infection through environment^[4].

Time to return to sport:

Patients who have active skin lesions should avoid sports that require skin contact or using a mat, such as wrestling, gymnastics, karate, or judo. In sports that involve less contact or more protective clothing, avoidance may be unnecessary. The athlete may return to activity when the lesions are healed or a physician confirms that they are not contagious^[24]. The national collegiate athletic association (NCCA) rules^[4] for athletes with herpetic skin infection include:

1. No evidence of systemic symptoms such as fever and malaise
2. No new lesions for at least 72 hours before examination
3. No evidence of moist lesion (All lesions must be dried and crusted)
4. Using appropriate dosage of antiviral drug for at least 120 hours before and during competitions
5. Covering active lesions is not enough to allow participation

Fungal Skin Infections

Fungal skin infections termed also as dermatophytosis or ringworms are one of the most common infections in athletes especially those with contact sports. Twenty to 77% of wrestlers are infected with dermatophytes. In a previous study by authors, 34.2% of the wrestlers with skin lesions had fungal infection. *Malassezia furfur* (50%), *trichophyton tonsurans* (30%), and

epidermophyton floccosum (7.5%), were the most common fungal organisms^[21]. Skin to skin contact is the main way of transmission. Role of the environment and equipment (including mats) in transmission is not clear and prevalence of contamination in the environment is variable in different studies. Dermatophytosis presents as circular, scaly, red, itchy skin lesions, usually with an active border, in different parts of the body including head and neck, trunk and extremities^[3,25].

Athlete's foot or tinea pedis is common in athletes because it grows in dark, moist and warm environments. Sweaty feet, tight shoes, not drying one's feet after swimming or bathing are predisposing factors^[26]. Organisms causing tinea pedis include *Trichophyton rubrum* and *Trichophyton mentagrophytes*^[27]. The lesions are peels, cracks and scales and involve the skin between the toes. It may cause itching and burning of the feet.

Fungal infections can affect the nails. These lesions can cause scaling, crumbling, thickening and partial loss of the nails. The diagnosis is made with scraping the scaly area^[26]. Tinea corporis is common among wrestlers and athletes who have close contact with each other, so it's called tinea corporis gladiatorum. The most common organisms are *trichophyton tonsurans*, *trichophyton rubrum* and *microsporum canis*. The lesions are annular scaling, erythematous plaques with swollen margins. Topical corticosteroids may change the clinical picture of tinea corporis and lesions present without raised margins^[28]. Because wrestlers with dermatophytosis are prohibited from participating in contact sports, surveillance and rapid initiation of therapy can reduce the absence rate of athletes from competition^[29].

Treatment and prevention:

Localized antifungals such as clotrimazole or ketoconazole are the drug of choice for limited skin lesions. In widespread or chronic infection and in tinea capitis, systemic drugs such as griseofulvin or terbinafine or itraconazole are also recommended. In wet and macerated lesions, Burow's solution can be used for drying the lesions^[9]. An astringent soak and 30% aluminum chloride may keep the skin dry, remove crusts and macerated tissue, and kill bacteria

responsible for superinfection. Topical antibiotic is recommended with evidence of severe inflammation and early cellulitis in athletes with tinea pedis [28]. Prevention of dermatophytosis in athletes can be achieved by frequent changing of socks, drying feet and trunk by using powder, and wearing ventilated shoes and moisture wicking synthetic socks. Athletes should also wear sandals in the locker room and showers [27].

Time to return to sport:

After 72 hours of treatment, athletes are allowed to participate in sport. In localized or clustered lesions, cleaning surface of the lesions with ketoconazol or selenium sulfate and dressing with terbinafine cream is recommended before competitions [4,9]. Although in extensive and severe infection, it is better to refrain from competitions until complete recovery of the lesions.

THIRD SCENARIO

A 21 year football player is referred to an infectious diseases clinic due to a positive HBS Ag test. He was asymptomatic and had no history of gastrointestinal bleeding, abdominal swelling, and leg edema or sleep disorders. His physical examinations did not reveal any significant findings. In the laboratory tests all things were normal except for abnormal liver enzyme tests (AST= 90, ALT= 110).

1. What are the rules of sports participation for patients infected with a blood borne pathogen like HBV?
2. What is the effect of physical activity on the prognosis and severity of viral hepatitis and HIV infection?

Blood-Borne Infectious Diseases in Athletes

Body contact during sports activity is a way through which several blood-borne infectious diseases, the most serious of which are viral hepatitis B and C and human immunodeficiency virus (HIV) infection, are transmitted [30].

Sexual contact, parenteral exposure to blood and blood components, contamination of open wounds or mucous membranes by infected blood, and prenatal hazards are some of the ways that human immunodeficiency virus is transmitted. Furthermore, no consolidated report has been submitted on the involvement of sports in the transmission of HIV. On the other hand, similar to contact sports, savage street fights are asserted to result in transmission of HIV. It is believed that typical socialization and utility of others' properties such as sports equipment or facilities like locker rooms or bathrooms and restrooms as well as contact with contaminated surfaces such as wrestling mats or toilet seats are highly improbable to be ways of HIV transmission.

Excluding contact during sports activities, all athletes suffering from HIV infection are infected with at least one more risk factor rather than unprotected sex. Primary HIV infection is asymptomatic or may be presented as Flu like illness which is followed by AIDS defining syndromes during the next 8-12 years [31].

Physical activity has variable impact on HIV/AIDS patients. Seemingly, a light workout is not only harmless to HIV patients, but also is fruitful to them both psychologically and immunologically. With reference to the American Academy of Pediatrics (AAP), athletes do not have to undergo typical HIV tests, and they should not be deprived of continuing sports just because of their HIV infection. Athletes with HIV/ AIDS who are involved in sports with a high body contact should be promoted to change their field of interest with sports that enjoy less body contact such as doing gymnastics or playing tennis, however [32].

At a highly competitive level, regarding whether to decide to take part in the sport or not, numerous factors such as the general health of the athletes, the HIV progression, the risk of transmission, and the level of psychological and physical stress of the sport should be taken into consideration [30].

Viral Hepatitis in Athletes

Infectious hepatitis, which may end in morbidity and mortality, is of prevalent causes leading to a disease of the liver. There are at least six viruses (A, B, C, D, E,

F, and G) developing infectious hepatitis cases, all of which are highly widespread amongst young adults. Globally speaking, in case the infected person is asymptomatic and unaware of his/ her condition, hepatitis A and E are usually carried from person-to-person. The outbreak of enteric viral hepatitis has been mostly witnessed in off-the-field activities. Hepatitis B, C and G viruses are blood borne pathogens. Of the various circumstances required for the spread of blood-borne viral hepatitis, bleeding lacerations or oxidative skin lesions in the infected athlete can be mentioned. Additionally, suffering from a skin lesion or exposed mucous membrane as a portal of entry, there must be a vulnerable athlete who is in a sustained contact with the source individual. Athletes involved in sports in which there is close body contact with others, namely wrestlers and boxers are more susceptible to get infected than those who are at moderate risk of blood borne pathogen transmission such as, players of soccer, basketball and judo. Two major ways through which these blood borne pathogens are transmitted to athletes are utilization of common contaminated syringes for drug injection as well as bleeding wounds during sports enjoying close contact [30]. People who are sexually active and are keen on getting tattoos as well as those sharing personal belongings of one another are also at the high risk of getting infected [33]. Horizontal transmission of hepatitis B in contact sports is an issue to which health care professionals should also pay careful attention [34].

Physiological and Biochemical Considerations of Exercise and Liver Function

In the maintenance of blood glucose, the liver plays a crucial role, the injury of which might result in hypoglycemia and altered lipid metabolism and protein synthesis.

The serum transaminases of healthy individuals suffering from sustained physical stress might elevate, and exercise can alter the hemodynamics of their liver. Exercise is beneficial to chronic persistent hepatitis, and patients suffering from compensated cirrhosis should consider a graduated exercise program such as

vigorous walking, swimming and cycling.

Generally speaking, starting training at low workloads and then enhancing the amount at a slow gradual pace might be effective [34]. On the other hand, as in patients with decompensated cirrhosis physical activity may increase the risk of variceal hemorrhage, hepatic encephalopathy and renal dysfunction, it should be recommended cautiously [35].

When Should Athletes Return to Training and Competition After Acute Viral Hepatitis?

Physical activity can be permitted in the healthy persons with acute viral hepatitis if tolerated. Moderate physical activity during acute phase is safe and it can be gradually increased once bilirubin level decreases to 1.5 mg/dl without any increase in relapse rate, convalescence period or complications [35]. American college of sports medicine recommends refraining from competitive level sports and training until complete recovery of systemic signs and symptoms and liver tests are normal. In addition, any patient with palpable hepatomegaly or splenomegaly should completely stay away from contact and semicontact sports until complete resolution of organomegaly [33,35]. Abdominal ultrasonography is recommended to determine organomegaly in athletes with acute viral hepatitis before returning to sport.

Should Athletes with Chronic Hepatitis Participate in Competitive Sports?

Patients suffering from chronic persistent hepatitis are tolerant enough to get involved in numerous activities with different levels of intensity, yet with no unfavorable or adverse impact. To monitor the progression of their disease, these patients are highly advised to be in regular contact with a physician. In addition, those Patients with progressive chronic active hepatitis or cirrhosis are encouraged not to take part in competitive sports which are both high and sustained in intensity [33].

Prevention of Blood-Born Infections and Viral Hepatitis in Athletes

As mentioned before, sports pose a low risk- yet not zero- of carrying blood borne pathogens. As a result multiple sources as well as various guidelines are provided to prevent an outbreak of such among athletes.

The most prevalent recommendations suggested by a high number of experts as well as published guidelines are as followed:

1. It is vital to dress skin injuries such as lacerations, cuts, or oozing wounds during sports up to the time that they are totally healed.
2. Strong attention must be drawn to all types of wounds and injuries by athletes.

3. Protective instruments are suggested to be used by athletes in contact sports.
4. All high-risk athletes might undergo tests voluntarily.
5. HBV vaccine is recommended to be taken by athletes.
6. Those athletes who travel to high endemic regions are better to be vaccinated against HAV.
7. In epidemic situations, athletes having contaminated food are advised to take Intramuscular immunoglobulin to prevent HAV.
8. Razor, toothbrush and other private and personal things are forbidden from being shared.

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