Illness and injury can significantly limit a swimmer's participation in training and competition. Catastrophic injuries to the neck and risk of drowning are life threatening. Infectious illness can cause significant time out of the water and an even longer convalescence. When injuries to the shoulder, back, and knee become chronic, these overuse injuries can affect performance despite continued cross-training. By identifying the risks for swimming injury and illness, and implementing prevention strategies, the physician can help keep swimmers in the water.

Introduction

Competitive swimming at the highest levels requires 20 to 30 hours of training each week. Even at the masters level and age-group level, a minimum of 5 to 10 hours are spent each week swimming laps. Up to 1 million shoulder revolutions per year are possible; thus, shoulder injury is the most common cause of missed training and has been well documented in the medical literature [1,2,3,4,5]. Other causes of missed training that have not been explored in as much depth range from devastating neck injuries and drowning to less serious illness, such as upper respiratory infections (URIs). Acute and overuse musculoskeletal injuries can also result from dry-land training that includes weight lifting, plyometrics, running, and various calisthenics. The culture of competitive swimming is such that coaches and teammates do not tolerate missed training due to the mix of myth and fact about how quickly swimmers decondition. Furthermore, swimmers can usually perform some kind of dry-land cross-training or kick in the water if they have an upper extremity injury, and can usually continue to do modified swimming while rehabilitating a lower extremity injury. So, total restriction from training is unusual, and thus is not well-tolerated within the swimming world. The physician must be aware of the common risks in a competitive swimming environment and be able to help prevent and treat the associated injuries or illness. The focus of this review is the injuries and illness that are the most significant in limiting a swimmer’s ability to participate in training and competition.

Catastrophic Injuries

The two most catastrophic injuries in competitive swimming are neck injury resulting in paralysis and drowning, and sudden death. Neck injury can result from too deep a dive into a shallow pool or colliding head first into the wall while swimming backstroke. Safety precautions in the sport include minimum depth requirements of 5 feet for competitive starting block dives, which is mandated by USA Swimming (Colorado Springs, CO). For backstroke, overhead flags are placed 5 meters from a wall to help prevent head-first collisions. All coaches are required to be trained by the American Red Cross in first aid, cardiopulmonary resuscitation, and a special coaches’ safety training, which teaches back-boarding. Coaches must renew those certifications every 1 to 2 years [6]. Coaches should also teach low-entry angle dives and steering-up techniques to minimize high-risk dives [7]; steering-up techniques involve angling the hands toward the surface after reaching a safe depth.

Drowning has resulted from breath-holding and underwater swimming. One recent case of a collegiate swimmer drowning resulted from a breath-holding attempt of 75 meters while swimming unsupervised in an uncoached setting [8]. Hypoxia results when the PaO₂ drops rapidly before the rising PaCO₂ stimulates the drive to breathe, thus leading to unconsciousness and drowning. A case of sudden death occurred during practice in a collegiate swimmer and was later revealed to be hypertrophic cardiomyopathy on autopsy [9]. A recent case of fatal arrhythmia was reported in a swimmer with prolonged QT syndrome after diving into cold water resulted in an irregular rhythm that further prolonged the QT interval [10]. All governing bodies of competitive swimming now highly discourage breath-holding training techniques and encourage preparticipation cardiac screening [6].
Fatigue Illness
A second group of illnesses that are not as devastating but can have long-term detrimental effects are associated with the training demands placed on competitive swimmers. Chronic fatigue-type illnesses related to overtraining can affect the mood and performance of high-level swimmers. Costill et al. [11] found that not ingesting sufficient carbohydrate may cause chronic muscle fatigue. Mackinnon et al. [12] showed that neuroendocrine changes marked by decreased urinary excretion of norepinephrine preceded overtraining by 2 to 4 weeks. Increased training volume can also lead to a depressed mood [13].

Mononucleosis also can cause a chronic fatigue state that can be debilitating for a swimmer because of the difficulty in returning to training after a prolonged convalescence [14]. The physician must work very closely with the athlete and coach in devising a gradual progression of return to training. Unfortunately, no protocol seems to work in these cases, as each individual responds differently. In general, however, increasing volume by 5% to 10% per week over a 10- to 12-week period, followed by a more gradual reintroduction to higher-quality (faster) training may prove effective. The dry-land portions of training need to be reintegrated in a stepwise manner as well [15]. Educating coaches and athletes on the important concepts of periodization, progression, adaptation and recovery, and the signs and symptoms of overtraining, may help prevent future recurrences [16].

Upper Respiratory Illness and Infection
Upper respiratory illness and infection is also a common cause of missed training. Although URI is no more common in swimmers than in the general population, it can be very limiting for the swimmer because of the necessity of controlled breathing while training in water. Another added problem is that chlorine is a strong upper respiratory irritant. An Australian study has shown that competitive swimmers are no more at risk of developing URIs than a group of untrained controls; however, URIs do result in poorer performance [17†]. Other studies also show no relationship of plasma glutamine levels to the risk of URI, although levels of glutamine have been shown to be depressed in athletes during long bouts of intense training [18]. But some data have shown that low preseason levels of salivary IgA may predict risk of URI in swimmers [19]. More recent theories have proposed that low levels of plasma glutamine, immunoglobulins, and cytokines combined with decreased function of neutrophils and natural killer cells may decrease resistance to minor infection during intense training periods [20]. Prevention of illness thus becomes of paramount importance to both coaches and athletes. Other important illness prevention strategies include vaccination, especially meningococcus, for those living in a herd-type environment (dorm or frequent team travel trips), and instructing athletes on the universal precautions of close contact avoidance and hand washing. Many teams employ the use of a sick room to prevent spread of illness.

An interesting phenomenon of herd illness that I have observed is mononucleosis with an unusual number of recurrences. In a single swim season, I diagnosed 10 cases of mononucleosis confirmed by Epstein-Barr virus serologies from one team of 24 athletes. All but two of those cases were freshman athletes, and there were four recurrences among the group of 10. Interestingly, a recent study from Gleeson et al. [21] has shown that the reactivation and viral shedding may be a reflection of the altered immune control mechanisms that occur in response to intensive exercise. My approach to those illnesses and their recurrences was to communicate contact precautions and hand washing instructions to those athletes who spent 6 hours each day in close contact, and then to devise a much more gradual return to training. Subsequently, there was no more spread of illness and no more recurrence, and the following season the group of incoming athletes remained illness-free. The six swimmers who undertook a more gradual 6-month progression to return to training performed much better than the early returnees (3 months or less).

Asthma
Upper respiratory illness causes even more significant limitations of training in asthmatic swimmers. Asthmatics tend to migrate toward swimming, as the humid environment is thought to be more asthma friendly, due to the anecdotal evidence of Olympic swimmers having succeeded with asthma [22]. Yet conversely, the chlorine in indoor pools irritates the respiratory tract and can cause asthma [22,23]. A recent report by Bernard et al. [24] concluded that exposure of children to chlorinated pools increases lung epithelial permeability and thus increases the risk of developing asthma, especially in indoor pools. But in support of the assumption that swimming helps asthmatics, a 2000 Australian study demonstrated that the 1964 Australian Asthma Children’s Swimming Program has achieved its intended purpose of improving quality of life and asthma management by reducing medications, doctor visits, and hospitalizations in swimming participants [25]. Thus, swimming in indoor chlorinated pools may be a risk factor for developing asthma, and some data suggest eosinophilic inflammation in elite swimmers in the exercise-induced bronchial hyper-responsiveness [26]. However, swimming may still benefit known asthmatics by reducing their frequency of exacerbations and increasing their aerobic capacity [27].

Musculoskeletal Injuries
With the potential for missed training from illness, preventing musculoskeletal injuries that may lead to significant time out