Ultra Endurance Athletes At-Risk

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In recent years, participation in ultra endurance events such as running, cycling, and triathlon has increased.[1] Ultra endurance competitions are defined as events that exceed 6 hr, including events of 50 km and beyond.[2,3] Ultra endurance athletes incur an increased risk of cardiovascular events and sudden cardiac death (SCD).[4] Causes of SCD, in individuals younger than 30 years of age competing in ultra endurance events, include hypertrophic cardiomyopathy, anomalous coronary arties, dilated cardiomyopathy, and long QT syndrome.[4] In individuals older than 30 years of age, coronary heart disease, acute myocardial infarction, and ischemia are the common causes of SCD associated with exercise.[4] The negative side effects associated with extreme, chronic endurance training include, cardiac damage, structural remodeling, and developing abnormal arrhythmias.[4] Blood tests suggest that serologic markers of cardiac damage include cardiac troponin, creatine kinase MB, and B-type natriuretic peptide. However, the evidence is unclear whether these are natural, healthy adaptations to long-term endurance training or a cause for long-term health concerns[4] as some individuals may develop structural changes and myocardial scarring due to the constant load on the heart.[4] Many times these changes/abnormalities are asymptomatic and develop over years of training, but they may predispose the individual to serious arrhythmias. Cardiac remodeling caused by endurance training may increase the likelihood for developing an arrhythmia.[4]

Two types of ultra-marathon events exist, either described by distance or time (greatest distance over time).[2] Ultra-triathlon events begin with the distances of Ironman competitions (swim 2.4 mi, bike 110 mi, run 26.2 mi) and increase to events lasting multiple days that have distance requirements for each day. Our purpose is to describe the considerations of extreme, chronic endurance training including potential pathologies, training modifications, and nutritional issues.

Key Points

- Ultra endurance athletes, those participating in events that exceed 6 hr, including events exceeding 50 km, may incur an increased risk of sudden cardiac death (SCD).
- After repeated bouts of endurance exercise, blood testing should be performed to ensure markers of cardiac damage have returned to baseline levels.
- Ultra endurance training requires greater attention to proper nutrition, hydration, maintenance of essential body fat, rest, and incremental increases to training (no more than 10%).
- To ensure proper training and recovery, individuals should complete no more than two ultra endurance events per year.

Common Injuries and Illnesses

The intense and physically demanding nature of ultra endurance events necessitates participants to be well trained to avoid risk of injury. The long-term effects of extreme exercise involved with ultra events and training are unknown. Researchers examined injury rates in three multiday ultra-marathon events from 2005 to 2006.[5] The research yielded

http://dx.doi.org/10.1123/ijatt.2014-0034

an average of 3.87 injuries/participant, including hyperthermia, hypothermia, bursitis, tendonitis, and blisters.[5] Illnesses/injuries were placed in two categories—major and minor—depending on whether the participant could continue the race or not. Hyperthermia and hypothermia accounted for 56.5% of all major illnesses, while 95% or all injuries were minor in nature. Minor injuries included skin abrasions and blisters (74.3%), musculoskeletal injuries (18.2%), and medical illnesses (7.5%).[5]

Cardiac Testing

Long-term endurance training places an increased demand on the heart, causing physiological changes to occur.[4] Common cardiac adaptations that lead to SCD include enlarged left ventricle (LV) and right ventricle (RV) volumes, increased LV wall thickness and myocardiac mass, and increased left atrial size.[4] Cardiac remodeling occurs from repeated strenuous endurance training due to stretching of the right atria and ventricle as a result of increased cardiac output.[4] The constant stretching of the right atria and ventricle leads to myocardial tissue scarring.[4]

Researchers have not identified a gold standard screening method for detecting cardiovascular changes associated with ultra endurance activity. Post-competition screening for biomarkers are suggested, such as, echocardiography, and/or advanced imaging such as a cardiac magnetic resonance image (MRI).[4] However, imaging is cost-prohibitive as a prevention tool. In contrast, blood testing for biomarkers and echocardiography are more reasonable.[4] According to Consumer Reports Health a comprehensive metabolic panel costs from $15–$135, the national average price is $30.[6] A standard echocardiogram ranges from $1,000–$2,000, and patients without health insurance may have to pay the whole cost themselves.[7]

Training

A successful training regimen for ultra endurance athletes to minimize health deficits requires periodization, rest, and proper nutrition. Successful performance can be achieved through a periodized training plan by following key principles of training: all-around development, overload, specificity, individualization, and consistent training.[2] When an appropriate training plan is implemented, athletes can achieve peak performance in time for their competition. Adherence to a periodized plan can help athletes avoid overtraining. The selection of an individualized training plan requires specific development for each athlete. Once athletes begin an aerobic endurance exercise program, they need to be consistent to either maintain or advance aerobic fitness.[8] Progression of the program involves an increase in the frequency, intensity, and duration of exercise. General recommendations suggest individuals always include at least one recovery or active rest day in each week of training.[8] Mileage should not increase by more than 10% per week to avoid overtraining.[8]

Overtraining is defined as excessive frequency, volume, or intensity of training that results in extreme fatigue, illness, or injury.[8] Overtraining may be due to insufficient rest, recovery, and nutrient intake.[8] Obtaining sufficient rest, rehydrating, and restoring fuel sources should be the main focus for the athlete during recovery.[8] Recovery after individual training sessions is imperative for the athlete to avoid overtraining and to gain the maximum benefits from subsequent training sessions.

Nutrition and Supplements

Nutrition is important for ultra endurance athletes to promote proper recovery, prepare for daily training sessions, and decrease chance of injury and illness.[2] Whether the primary goal of an athlete's diet is to enhance performance or prevent disease, two fundamental components must be present: appropriate caloric intake and appropriate nutrient levels to prevent deficiency or toxicity (Table 1).[8] One tool designed to provide guidance for evaluating nutrient adequacy is MyPlate, an interactive website developed by the U.S. Department of Agriculture in 2011.[9] To ensure proper pre-exercise hydration, the athlete should consume approximately 500–600 mL (17–20 fl oz) of water or sports drink 10–20 min before exercise.10 Fluid replacement should approximate sweat and urine losses and maintain hydration at less than 2% body weight reduction. This generally requires 200–300 mL (7–10 fl oz) every 10–20 min.[10] Fluid requirements will vary based on the environment of the event and should be monitored by body weight changes.

Endurance athletes typically have deficiencies associated with iron and white blood cell count, therefore, supplementation may be necessary. Iron deficiency leads to abnormal hemoglobinization of erythrocytes, causing a reduction in oxygen transport capacity, which