Severe Heat Cramps in a High School Football Player: A Case Report

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Abstract: We present a case study of an adolescent football player who suffered from severe full body muscle cramping after supplementing with creatine for two months. A paucity of data exists regarding the safety of creatine supplementation and its side effects on dehydration, body fluid/electrolyte balance, and other heat illnesses.

Fluid replacement and the prevention of heat illness in American football players have been current topics in the athletic training literature. Incidences of fatal collapses or heat illnesses in athletes have caused a growing concern in athletic trainers and other medical professionals about the safety of ergogenic aids and other over the counter supplements. Although skeletal muscle cramps are not always associated with dehydration or heat illness (Schwellnus, 1999), those incurred during or after exercise are usually caused by excessive water and electrolyte loss during exercise (Anderson, Hall, & Martin, 2000). Other predisposing factors to heat cramps include sodium depletion in the normal diet, use of diuretics or laxatives, and a lack of acclimatization (Anderson et al., 2000). However, recent trends in the use of creatine supplementation as an ergogenic aid have led to studies on the possible relationship between creatine supplements and dehydration or heat cramps (Armsey & Green, 1997; Bailes, Cantu, & Day, 2002; Juhn, 1999; Juhn, O'Kane, & Vinci, 1999; Terjung, Clarkson, & Eichner, 2000). The purpose of this study is to present the case of an adolescent male who had been supplementing with creatine when he suffered from severe heat cramps after a spring football practice.

Background and Case Report

Our clinical case report involved a 16-year-old football player who suffered severe full body muscle cramps following a spring football practice at a high school in South Florida. The primary investigator was the certified athletic trainer employed by the school district to provide medical coverage for the high school athletic teams. The athlete in question had practiced for three hours in full football equipment (helmet and full pads) on a warm sunny day (average temperature 78.8 ^{o}C, range 71.9 – 85.7 ^{o}C, National Weather Service, Miami WSCMO Airport, FL) between the hours of 3:00 and 6:00 p.m. The athlete began to feel extremely weak at the end of practice, he removed his helmet and shoulder pads, and as he entered the locker room, he began experiencing a painful muscle cramp in his low back. The painful muscle cramps continued throughout the athlete's mid and low back muscles and spread to his bilateral quadriceps, hamstrings, and gastrocnemius muscles. His teammates attempted to passively stretch the cramped muscles and began to rehydrate him with water. The certified athletic trainer was called into the locker room, where she found the athlete in excruciating pain and unable to move. The athletic trainer then attempted to alleviate the heat cramps with stretching. After several minutes, the athlete was carried into the athletic training room where he was placed in a full body whirlpool with ice water. The certified athletic trainer and several student athletic trainers gently massaged the athlete's muscles and continued to attempt to stretch the cramped muscles to no avail. The athlete was also given an electrolyte drink by mouth. After approximately 5-10 minutes in the whirlpool, the athlete was removed from the whirlpool and

transferred to a treatment table in the athletic training room, where he was wrapped in a blanket to prevent hypothermia. At this time, the emergency medical system was activated and the athlete's parent was contacted. After about 30 minutes, while still in the athletic training room, the heat cramps eventually began to subside. By the time the paramedics arrived, the athlete's condition had markedly improved and the athlete was sent home with his parent. Although he was not transported to the hospital, the paramedics instructed the parent to monitor the athlete and to continue to orally rehydrate him throughout the night.

Methods

The participant involved in this case study was a 16 year old high school student-athlete who suffered from severe full body muscle cramps while under the medial care of a certified athletic trainer, the primary investigator. A signed medical information release and informed consent form was obtained from the participant and his parent in accordance with Florida International University Institutional Review Board policies. The participant's medical records were obtained from the athletic training room files and personal accounts of the incident were recorded. All information was synthesized and integrated into the case report. Relevant literature was reviewed and incorporated when appropriate.

Results

A thorough medical history revealed that our athlete had no previous health problems or occurrences of heat related illnesses. The athlete reported that he had rehydrated sufficiently with water throughout the football practice that day, but he admitted he had not properly hydrated throughout the day. He also stated he had been ingesting oral creatine supplements in the amount of a 1000 mg dose twice daily for approximately two months.

Discussion

Creatine is a nitrogenous amino acid derivative found naturally in skeletal muscle, heart muscle, brain, and other organs (Juhn, et al., 1999). Creatine is also abundantly found in meat and fish (Anderson et al., 2000; Baechle & Earle, 2000; Bailes et al., 2002; Juhn, 1999; Juhn et al., 1999; Eichner, 1997). At various levels of athletic participation, creatine is being used by many athletes as an ergogenic aid for increasing athletic performance in the form of increased energy, muscle mass, and muscle power (Armsey & Green, 1997; Bailes et al., 2002; Juhn, 1999; Terjung et al., 2000; Eichner, 1997). Creatine intake may increase creatine levels of blood, creatine transport in cells, and the amount of creatine phosphate levels in skeletal muscle by 5-10% (Baechle & Earle, 2000; Benzi & Ceci, 2001). Theoretically, oral creatine supplementation would then increase energy substrate availability (Baechle & Earle, 2000). Thus, the presence of creatine phosphate in skeletal muscle would lead to an accelerated rate of adenosine triphosphate synthesis (Baechle & Earle, 2000; Benzi & Ceci, 2001; Rosenbloom, 2000) which is critical at the start of any high intensity exercise (Baechle & Earle, 2000), such as an explosive lift or a sprint.

The average American diet contains approximately 1 g of creatine a day and if this amount is not obtained through diet, it is synthesized by the body (Baechle & Earle, 2000; Terjung et al., 2000). Several studies have shown improved athletic performance with the recommended creatine dose of a loading phase of 20 g/day for 5 days, followed by a maintenance dose of 2 – 5 g/day (Baechle & Earle, 2000; Eichner, 1997; Juhn, 1999; Juhn et al., 1999; Rosenbloom, 2000). A slower, alternative dose of 3 g/day without the loading phase was

shown to have the same 20% increase in skeletal muscle creatine levels as the rapid loading dose (Eichner, 1997). However, in a survey of 39 of 52 National Collegiate Athletics' Association baseball and football players reported exceeding the manufacturers' recommended dosage (Juhn et al., 1999). In this study, 52 male collegiate athletes supplementing with creatine were surveyed to determine overall satisfaction with creatine supplementation. Most of the athletes surveyed were ingesting 6 – 8 g/day, while others ingested a range of 9 – 20 g/day for maintenance. Research has shown, however, that not all individuals retain creatine in skeletal muscle after creatine ingestion and often do not benefit from the supplementation because creatine levels are already at optimum levels (Baechel & Earle, 2000).

Despite the growing number of studies on creatine supplementation, many questions remain unanswered in terms of the supplement's ergogenic effects and possible adverse side effects. One main concern in relation to our current case report is whether the creatine supplementation may have caused or exacerbated the severe heat cramps suffered by the high school athlete. Several studies (Bailes et al., 2002; Benzi & Ceci, 2001; Juhn, 1999) have shown that weight gain associated with creatine supplementation is a result of water retention. A study by Ziegenfuss, Lowery, & Lemon (1998) revealed that only 3 days of creatine supplementation may result in an osmotic increase of fluid into the intracellular compartment, therefore increasing total body weight and intracellular fluid volume. Water retention may cause a fluid imbalance which may be linked to impaired thermoregulation in athletes who engage in strenuous exercise in hot environments (Bailes et al., 2002; Terjung et al., 2000), such as our athlete. Although there are different causes for heat cramps, many anecdotal incidents of muscle cramps in athletes supplementing with creatine have been reported in the medical literature (Anderson et al., 2000; Bailes et al., 2002; Juhn, 1999; Juhn et al., 1999; Terjung et al.). Whether or not our football player suffered heat cramps because of the creatine supplementation cannot be completely elucidated. However, in our case, the athlete did not have a history of muscle cramping or dehydration until he began the creatine supplementation. The athlete stopped ingesting the supplements after this incident and has not had recurrences of heat cramps since. Other contributing factors for this athlete may have included a diet low in sodium, insufficient fluid intake, excessive fluid loss, electrolyte imbalance, and premature muscle fatigue (Schwellnus, 1999; Anderson et al., 2000).

Conclusions and Implications

It is imperative that the athletic trainer, strength and conditioning specialist, or any other professional involved in consulting athletes remains up-to-date on the latest information regarding nutritional supplements and their effects. Claims that creatine supplementation is both safe and effective are unwarranted given the fact that there is no published long-term safety data (Rosenbloom, 2000). More information is needed on the effects of creatine supplementation on dehydration, heat cramps, and other heat illnesses. Furthermore, other possible negative side effects of creatine need to be investigated. It is crucial that everyone involved with athletes and their health be aware of the potential detrimental effects of nutritional supplements and ergogenic aids. Therefore, we recommend that athletes, coaches, and athletic trainers are educated about the potential danger of ergogenic aids and that sufficient data be provided regarding the efficacy or side effects of these supplements. Fortunately, our athlete recovered fully with no long-term effects; however, prevention is paramount. Proper hydration, fluid replacement, protocols limiting strenuous exercise in hot weather, proper conditioning, proper

nutrition, and education on the use of dietary supplements are the keys to preventing heat illnesses and other preventable catastrophic heat incidents in athletics.

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