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Exertional Rhabdomyolysis and the Law: A Brief Review

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ABSTRACT

Ciccolella ME, Moore B, VanNess JM, Wyant J. Exertional Rhabdomyolysis and the Law: A Brief Review. **JEP**online 2014;17 (1):19-27. In rare cases, excessive and/or exuberant exercise can result in exertional rhabdomyolysis where muscular damage results in potential long-term disability. The purpose of this review is to identify what can lead to exertional rhabdomyolysis, provide several legal cases where the duty of care of an exercise specialist is examined, and question the assumption of risk for exercise participants. Exercise specialists should understand the importance of carefully applying the principles of progressive overload and eccentric training to avoid putting the participant at risk for exertional rhabdomyolysis. It is also important that the exercise specialist and the exercise participant understand the legal implications of reasonable foreseeability when it comes to the potential for complications from exercise-induced rhabdomyolysis.

Key Words: Excessive Exercise, Long-Term Disability, Exertional Rhabdomyolysis, Creatine Kinase, Legal Issues, Exercise Specialists

INTRODUCTION

Exertional rhabdomyolysis occurs during extreme exercise overload and results in such profound muscle damage that myocyte membranes leak protein into the blood. Large globular proteins such as myoglobin (an iron-containing protein in skeletal muscle that stores oxygen for aerobic mitochondrial metabolism) and enzymes like creatine kinase (CK) produce a toxic overload at the kidneys resulting in reddish-brown (tea colored) urine and potential renal failure (23). While exercise specialists may be aware of the difference between delayed onset muscle soreness and exertional rhabdomyolysis, they should also be aware of the legal implications when a person under their supervision experiences extended convalescence, long-term loss of muscle function, and acute kidney injury (AKI) from exertional rhabdomyolysis.

Reasonableness and foreseeability are central to a legal analysis of exertional rhabdomyolysis. The concern is whether rhabdomyolysis is a reasonably foreseeable consequence of strenuous or prolonged exertion during exercise and sports events. This concern is applicable both to those who direct others in exercise and to those who participate in exercise. Do exercise specialists have a legal duty to protect those under their supervision from the risk of exertional rhabdomyolysis as a consequence of overload during exercise? Also, do exercise participants voluntarily assume this risk thereby relieving exercise specialists of any liability for excessive overload?

The purpose of this brief review is two-fold. First, it presents the causes and consequences of exertional rhabdomyolysis including the factors that may predispose and trigger it as well as drugs or conditions that may increase the likelihood of suffering rhabdomyolysis. Second, it examines the legal aspects associated with exertional rhabdomyolysis. In particular, the review covers relevant law from selected cases that examines foreseeability and duty of care for exercise professionals and the voluntary assumption of risk for exertional rhabdomyolysis for exercise participants.

THE PHYSIOLOGY OF RHABDOMYOLYSIS

Exertional rhabdomyolysis is a rare, but serious condition that has been widely described in different settings. It may result from extreme muscular exercise in untrained subjects or during exercise in extremely hot or humid conditions. The pathogenesis of rhabdomyolysis (9) includes the depletion of ATP and the breakdown of striated muscle. Both of these factors allow skeletal muscle proteins to enter the extracellular fluid and circulatory system. This may cause an overload of the filtration of the kidneys resulting in acute renal failure (ARF).

The depletion of ATP during excessive muscle contraction impairs the normal movement of sodium, potassium, and calcium ion across the cell membrane by robbing the Na^+/K^+ ATPase and the Ca^{2+} ATPase of substrate. Leaking of ions across the membrane may be due to the failure of ion pumps, damage to the myocyte membranous structure, and/or reactive oxygen species (7). Excess intracellular calcium causes tonic sustained muscle contraction, activates proteolytic enzymes that degrade myocytes (8,10), and further impairs mitochondrial function (19). The leaking of potassium from the skeletal muscles may also negatively influence cardiac function (9).

Physical damage to the skeletal muscles from microtrauma associated with ischemia/reperfusion and/or eccentric muscle contraction causes materials from the muscle to be released into the blood. Creatinine, uric acid, myoglobin, calcium, CK, and phosphates can leak into the blood from damaged skeletal muscles. As myoglobin levels increase, there is a threshold for renal filtration

that is crossed whereby myoglobin appears in the urine (5). This large MW protein is the main concern that produces acute renal failure (7).

Although the dissolution of skeletal muscle can result from exercise in excessive heat while severely dehydrated and/or taking non-steroidal anti-inflammatory drugs (7,9), the primary factor seems to be extreme physical exertion. That is why it is necessary to engage in a progression of exercise intensity. Gradually increasing the intensity of any new exercise program allows the body to safely adapt to the training. It also provides a resistance to the development of exertional rhabdomyolysis, which can be sometimes catastrophic.

EXERTIONAL RHABDOMYOLYSIS AND THE LAW

The Professional: Duty of Care and Foreseeability of Risk?

Duty of care obligates each person to a standard of conduct that requires protection from unreasonable risk of harm. This cornerstone legal concept does not require flawless conduct. Rather, it requires each person to be reasonable in his or her conduct. (6). The mere possibility that harm may occur is an insufficient basis on which to impose a duty of care. Reasonable foreseeability of harm is a central issue (6, p. 201). This is important to the exercise specialist who cannot protect the client from harm under all circumstances. No one can be expected to guard against harm from events that are not reasonable to anticipate, or are so unlikely to occur that the risk, although recognizable, would commonly be disregarded. Additionally, this is a prospective analysis. Reasonable foreseeability must be judged as to what the reasonably prudent person would have foreseen as likely to happen at the time of defendant's conduct, not what may appear with hindsight (22).

There are numerous examples of exertional rhabdomyolysis offered from the position of hindsight. The critical question is whether, on the basis of these numerous and long standing published events, that exertional rhabdomyolysis under extreme overload is now reasonably foreseeable, thereby raising the possibility of liability for a breach of duty of care. Still, the courts are loath to impose liability on professionals whose clients or students suffer exertional rhabdomyolysis as a consequence of following exercise directed by those professionals. The following cases illustrate this reluctance on the part of the courts.

Case #1. Turner vs. Rush Medical College (1989). Rhabdomyolysis Following a Mile Run in an Apparently Healthy but Sedentary Young Adult Male. Turner (22) is a case that considers a medical doctor's duty of care and reasonable foreseeability in protecting against post-exercise kidney failure. In this case, a 23-yr-old second year medical student alleged that the duty to exercise reasonable care for his safety was breached when he was required by his professor, a medical doctor, to run one mile within 8 min as a "laboratory experiment" for a clinical pathology class. Prior to the experiment, the plaintiff had not been involved in regular physical exercise since he was in high school, had never run a timed-mile run, and was not in physical condition to participate in a timed-mile run. The plaintiff complained that during the run, the defendant did not conduct a physical examination of him to check respiration and blood pressure, did not have medical personnel present during and after the run, did not have oxygen and water available during and after the run, and did not properly supervise him during the run.

Following the run, the plaintiff suffered a "total collapse in his body mechanisms" which included "extreme exertional rhabdomyolysis" among other medical problems, that required hospitalization for 2 ½ months at a cost of over \$250,000.

The court considered what would have been apparent to a reasonably prudent person at the time the defendant required the plaintiff to run a mile. From the allegations of the plaintiff's complaint, there was nothing to indicate that the defendant saw the plaintiff as anything other than a healthy 23-yr-old man. Additionally, there were no allegations that the surrounding conditions, such as heat or humidity of the day, would suggest a need for caution. The court concluded that at the time of the defendant's conduct, a reasonably prudent person would not have foreseen plaintiff's injury.

The court stated that imposition of a duty under these circumstances would lead to countless applicable situations and violate public policy.

If we were to hold that a duty exists under the facts alleged in plaintiff's complaint, we can foresee countless situations where our holding could potentially be applicable. Almost any physical activity that a school or teacher required could trigger a duty to provide medical precautions. The imposition of a duty in such cases would impose an expensive financial burden on schools which we believe would violate public policy (Id. at p. 892).

This case was dismissed and no liability imposed.

Case #2. Moore vs. Willis Independent School District (2000). Rhabdomyolysis Following 100 Squat Thrusts Imposed for School Discipline. In Moore (14), a "gym" teacher punished a 14-yr-old 8th grade student, Aaron Moore, for talking during roll call. For violating the rules against talking, the teacher told Aaron to do 100 squat thrusts. In the following days, Aaron was diagnosed with rhabdomyolysis and renal failure, among other problems. He was hospitalized, missed 3 wks of school, and was unable to participate in school sports or physical education due to continued fatigue. Aaron's parents sued alleging that Aaron's harm was a result of excessive exercise. The teacher's explanation for the punishment explicitly acknowledged the value of inflicting pain:

With high school kids you can have them do ups and downs and they remember the next time. With junior high kids, you have to inflict pain or they don't remember (Id. at p. 873).

The court recognized that "every teacher and coach must know that inflicting pain on a student through, *inter alia*, unreasonable excessive exercise, violates that student's constitutional right to bodily integrity by posing a risk of significant injury" (Id. at p. 875). However, the court's analysis of this case focused upon the issue of excessive discipline imposed as punishment to maintain discipline. The court concluded that discipline must be maintained in classrooms and gymnasiums to create an atmosphere in which students can learn (Ibid.).

No liability was imposed upon the teacher or school.

Case #3. Makimba Mimms vs. Ruthless Training Concepts (2008). Rhabdomyolysis Following CrossFit Military Training. In Mimms (11,12), a lawsuit filed by a former sailor raised concerns about the dangers of exertional rhabdomyolysis from CrossFit workout regimens that were rapidly growing in popularity across the military (see 13 for specific reference to CrossFit). The suit claims Mimms suffered from exertional rhabdomyolysis as a result of performing a CrossFit workout under the direction of a trainer, who worked at Ruthless Training Concepts. Several physicians concluded that Mimms suffered rhabdomyolysis, among other injuries, following his intense CrossFit workout. In the lawsuit, Dr. Clarkson of the University of Massachusetts

contended that the trainer encouraged Mimms to perform CrossFit exercises known to produce rhabdomyolysis. "Adequate precautions to prevent such a condition from occurring were not taken." Evidence of foreseeability was further established with statistics noting an increase in cases of rhabdomyolysis in the military from 114 cases in 2004 to 159 cases in 2007 (Id. at pp. 1-3, Letter from Dr. Priscilla Clarkson).

THE PARTICIPANT

Voluntary Assumption of a Known Risk?

The doctrine of ***primary assumption of risk*** is an exception to the general rule that all persons have a duty to use due care to avoid injury to others. When applied, the doctrine acts as a complete defense to negligence. The doctrine provides that a voluntary participant in a sporting or recreational activity "consents to those commonly appreciated risks which are inherent in and arise out of the nature of the sport [or recreational activity] generally and flow from such participation" (17). The overriding consideration is to avoid imposing a duty that might chill vigorous participation in the implicated activity and thereby alter its fundamental nature (18, pp. 331-333).

In *Rostai* (18), for example, working out in a gym with a personal trainer was an activity subject to primary assumption of risk and was the specific basis from which the court relieved a personal trainer of any duty to his client. In this case, an overweight, sedentary, and middle-aged man suffered a heart attack during his first workout with his "certified" personal trainer. During the workout, the man repeatedly asked to stop because he was experiencing fatigue, heat, thirst, breathlessness, and chest pain. The trainer responded to requests to stop and complaints of fatigue by questioning his client's masculinity and by continuing the workout. In the end, the court held that under this doctrine, the trainer owed no duty to protect a client from the risks inherent with exercise or to avoid challenging him beyond his current capacity during an initial training session. Simply put, the client assumed the risks associated with exercise, including a risk as serious as a heart attack (3).

Case #4. Pineda vs. Town Sports International, Inc. (2009). Rhabdomyolysis Following a Workout with a Personal Trainer. In *Pineda* (17), plaintiff, a 21-yr-old man who was overweight and out of shape began a fitness program at a fitness club with a personal trainer certified by the National Academy of Sports Medicine (NASM). Prior to the workout, plaintiff disclaimed any prior medical conditions that would prevent him from working out. His 50-min workout consisted of a 10-min warm-up on the treadmill and stationary bike and a 15 to 20 min cool down doing crunches, sit-ups, and work on a rowing machine. The mid-workout consisted of weight lifting for upper and lower body exercises using weights varying from 20 to 80 lbs. The following day the plaintiff complained of flulike symptoms, blood in his urine, and pain in his lower back. Two days later, the plaintiff was hospitalized for 9 days for rhabdomyolysis.

The plaintiff sued alleging that he sustained massive muscle damage resulting in exertional rhabdomyolysis as a consequence of the personal trainer's negligence. The plaintiff further alleged that he did not understand the risks inherent in weight training after having just begun a club membership. The plaintiff also stated that he felt a little tired and sore midway through the workout, but gladly followed the trainer's advice because he wanted a similar physique. Plaintiff submitted the affirmation of Frederick C. Hatfield, PhD, the President and Co-Founder of the International Sports Sciences Association (ISSA), which is an accredited organization for educating and certifying personal fitness trainers. Dr. Hatfield contended that exertional rhabdomyolysis was a probable and foreseeable injury in situations such as the one involving the plaintiff.

The club defended using the doctrine of primary assumption of risk. It stated that the plaintiff's injuries were not due to negligence on the club's part, but rather were caused from an inherent, usual, and ordinary risk associated with weight training. The court determined the doctrine to be applicable in this case because the plaintiff was engaged in a recreational activity when he sustained his injury. It further found Hatfield's comments to be conclusory and unsubstantiated without any corroborating documentation, testimony, or exhibits to support his contentions.

Accordingly, the court dismissed the plaintiff's complaint.

IMPLICATIONS FOR EXERCISE PROFESSIONALS

Issues relevant to exertional rhabdomyolysis have been examined in case law involving a myriad of professionals including personal trainers, physical education teachers, military and law enforcement physical trainers, and medical professors.

Maximal exertion exercise produces potential risks that are of interest to physical education teachers. Physical educators continue to increase the emphasis on embedding health-related fitness concepts into school programming (15,16). That said, it is important to remember that it is the physical educator's responsibility to avoid overexertion by recognizing the common muscular signs and symptoms of overexertion. For certain, the particularly risky combination of strength training with explosive plyometrics and jump training "high-intensity" exercises should be avoided (21). When physical education teachers incorporate maximal exertional exercises into their teaching, they must be keenly aware of the risks associated with repeated and exhaustive repetitions that may result in muscle damage. This is especially the case since recent evidence indicates that many physical education teachers are not as knowledgeable as they should be when it comes to health-related fitness concepts (20). These findings highlight that teacher preparation programs and public schools must adopt more prudent measures to ensure that physical education teachers have the necessary competencies to safely incorporate health-related fitness exercises into their teaching.

Similarly, exercise specialists should be aware that moderate to severe exercise, particularly in hot humid climates, in untrained subjects can produce a dangerous outcome like rhabdomyolysis. This is a very important point, especially when prescribing and monitoring exercise for the novice exerciser where the exercise type is a new modality and the exercise intensity is too high. Exercise specialists must also consider each subject's state of conditioning, training age, experience, and any confounding medical conditions when assigning exercise volumes and intensities. Baseline assessment of a client, athlete, and student is critical to determine appropriate relative workloads and rest intervals, and to develop a proper progression plan as he or she adapts to the training load.

Factors that increase the risk for rhabdomyolysis include: (a) exercising in a hot and/or humid environment; (b) dehydration or lack of hydration; (c) limited exposure to exercise and/or detrained; (d) competition that increases work load and work intensity; (e) taking statins (cholesterol-lowering drugs), salicylates or neuroactive medications; (f) large consumption of alcohol; and (g) chronic electrolyte imbalances.

CONCLUSIONS

Exercise specialists should recognize that the more common culprit that may lead to exertional

rhabdomyolysis is excessive exercise. It is always smart to follow the scientifically acknowledged thinking of gradually increasing exercise intensity and/or duration, particularly with regards to exercising in a physiologically safe temperature and humidity while adequately hydrated. However, having said that, from a legal point of view, reasonable foreseeability is the crux of this discussion for both the exercise specialist and the participant.

It is hard to imagine the courts' continued determination to relieve exercise specialists, fitness instructors, and personal trainers of a duty of care after directing extreme overload during exercise on the basis that the condition is not reasonably foreseeable under the circumstances or that the assumption of risk is an applicable defense. For example, CrossFit explicitly acknowledged in 2005 the potentially lethal risk of exertional rhabdomyolysis in two articles appropriately named "CrossFit Induced Rhabdo" and "Killer Workouts" (1,4). CrossFit marginalized the condition with a cartoon of its mascot, "Uncle Rhabdo," a male with a clown face urinating blood with his internal viscera on the floor as he stands at a dip station with electrocardiographic leads on his chest (4). The cartoon begs the question of whether "Uncle Rhabdo" is warning about his risk or is just simply having good fun clowning about his outcome. In either case, both articles and "Uncle Rhabdo" are explicit evidence of foreseeability by CrossFit. Thus, the larger question is this: "Does this knowledge apply to exercise specialists, fitness instructors, personal trainers, (and exercise physiologists as healthcare professionals) in general?" Reasonable foreseeability for participants on the basis of assumption of risk is equally confounding. The dissent in Turner (22) states:

It is logically unimaginable that where a 23-yr-old medical student is required by his medical school professors to run an eight minute mile as a part of a class experiment in clinical pathology, that reasonable minds could not differ on whether an injury from such a run could be reasonably foreseen, thus requiring a duty by the professors to exercise reasonable care for the safety of the student in running the eight minute mile. The trial court erred in dismissing plaintiff's complaint on the ground that it did not allege a duty owed plaintiff by defendants (Id. at p. 896).

The importance of standards in business and education should continue to be emphatically addressed. Holding professionals who direct exercise to a higher standard of delivery is explicitly supported by the American Society of Exercise Physiologists (ASEP) (2). For now, caveat emptor prevails for those under the direction of fitness specialists without proper training and/or motivation. The voice of qualified experts in a legal forum may lead to the enforcement of a defined duty of care that is not so readily trumped by defenses relevant to foreseeability or assumption of risk. A disciplined focus on this issue may result in the legal dissents of today becoming the majority opinions of tomorrow.

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