



CASE REPORT

**REVISED** Case Report: Exertional rhabdomyolysis in a spin class participant with sickle cell trait [version 2; peer review: 2 approved]

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**Abstract**

Exertional rhabdomyolysis is more common in sickle trait due to a predisposition to dehydration and inability to concentrate the urine. Spinning, an indoor cycling workout, has been associated with exertional rhabdomyolysis in recent reports. A consequence of rhabdomyolysis is acute kidney injury, which may be expected to be more common in patients with sickle trait. We report a case of spinning induced rhabdomyolysis in a woman with sickle trait that did not result in renal injury. “Spin rhabdo” is thought to be more severe than other causes of exertional rhabdomyolysis and is associated with higher creatine kinase levels than other causes of exertional rhabdomyolysis. Therefore, individuals with known sickle trait should consider visiting their physician prior to participation in spin classes for the first time. We might also consider voluntary screening for sickle trait in at risk populations prior to enrolling in spin classes given that many patients are unaware of their sickle trait status.

**Keywords**

Rhabdomyolysis, Spin class, Sickle cell trait

**Open Peer Review**

**Reviewer Status**

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<b>version 2</b>	report	report
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Any reports and responses or comments on the article can be found at the end of the article.

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**Author roles:** Longo T: Writing – Original Draft Preparation, Writing – Review & Editing; Shaines M: Conceptualization, Supervision

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**REVISED Amendments from Version 1**

In the revised version, we acknowledge that the etiology of rhabdomyolysis is extremely varied. We have edited the Discussion to state that the development of rhabdomyolysis in the patient is likely attributable to multiple factors including inadequate hydration and lack of regular exercise prior to participation in the spin class.

We mention that the presence of sickle cell trait (SCT) may have predisposed her to rhabdomyolysis in the setting of these other factors. Alternatively, it is possible that she had SCT by chance and developed rhabdomyolysis due to poor hydration and the fact that she was a first-time spinner.

Nevertheless, this case suggests that further investigation is warranted to assess if elevated CK values are more prevalent in patients with SCT. We recognize that more research is needed on the topic to make strong, evidence based recommendations; such research should attempt to clarify the association between SCT and exertional rhabdomyolysis.

See referee reports

**Introduction**

Rhabdomyolysis is a clinical syndrome consisting of intense muscle breakdown and necrosis. It is caused by a variety of triggers, including trauma, infection, drugs, and intense exertion. Nontraumatic exertional rhabdomyolysis is more common in patients with disorders of glucose and lipid metabolism or sickle cell disease, although it may occur in individuals with normal muscles if exertion is significant enough to impair muscle oxygenation. Spinning is a high intensity stationary cycling exercise performed in a group setting and often synchronized to music. It has recently been linked to case reports of exertional rhabdomyolysis in otherwise young, healthy individuals<sup>1</sup>.

One of the major complications of rhabdomyolysis is acute kidney injury (AKI), caused by a combination of volume depletion and accumulation of myoglobin pigment released by damaged muscle cells inside the renal tubules. Measurement of creatine kinase (CK) levels in the serum is an important indicator of muscle necrosis<sup>2</sup>; a recent study found that CK levels are higher in spinning associated rhabdomyolysis than in other causes of exertional rhabdomyolysis<sup>3</sup>. This finding implies the degree of muscle necrosis may be higher in spinning induced rhabdomyolysis, a correlation that is especially concerning for individuals predisposed to renal injury. Sickle cell trait (SCT), while usually considered benign, may predispose patients to renal problems such as hematuria and hyposthenuria. Here, we report a case of “spin class rhabdomyolysis” treated with aggressive intravenous hydration without acute kidney injury in a young woman with sickle cell trait.

**Case report**

A 28-year-old Hispanic female with no significant medical history presented to the emergency department with acute onset bilateral leg pain and dark urine 3 days after attending a spin class for the first time. She did not regularly participate in high intensity workouts, although she did frequently walk for exercise. The class consisted of 45 minutes of high intensity cycling. She did not drink much water before or during the class. Several hours after the class, her legs felt weak and gave out. She endorsed bilateral thigh pain that she described as heavy,

sore, and limiting her activity. One day prior to admission she noticed that her urine was brown in color, which prompted her to present to the emergency department.

She never experienced similar symptoms in the past. She denied sick contacts, recent travel, recent illness, fevers or feeling overheated, significant alcohol or drug use, or history of deep vein thrombosis. She took no medications and had no allergies. Although she had one episode of pyelonephritis several years prior to presentation, she reported no personal or family history of renal disorders. Family history was unremarkable for known genetic disorders, musculoskeletal disorders, or metabolic myopathies.

Vital signs were stable upon presentation. Her thighs were tender to palpation and strength of lower extremities was limited by pain. Dorsalis pedis pulses were palpable but weak. There was large blood on urine dipstick and minimal red blood cells on urine microscopic analysis. Creatine kinase (CK) was 74,978 IU/L and she was admitted with a diagnosis of rhabdomyolysis. Renal function was normal. She was treated with aggressive intravenous isotonic saline and sodium bicarbonate. Upon discharge, CK was decreasing and she was able to tolerate large intake of oral fluids. A hemoglobin electrophoresis pattern was performed at outpatient follow up to search for a potential underlying cause of her rhabdomyolysis. The result was consistent with sickle cell trait: HbA 57.8% and HbS 37.6%.

**Discussion**

Many factors can predispose to rhabdomyolysis, including trauma, metabolic disorders, sickle cell disease, dehydration, high temperature, medications, and excessive exercise<sup>4</sup>. There has been an increase in the number of admitted patients with exertional rhabdomyolysis in recent years<sup>5</sup>. While sickle cell trait is usually considered benign, a 2016 study found a significant association between sickle trait and exertional rhabdomyolysis in U.S Army soldiers<sup>6</sup>. Sickle trait may predispose to dehydration due to an inability to concentrate urine and conserve water in conditions of strenuous exercise, which leads to lactic acid buildup and erythrocyte sickling<sup>7</sup>. The etiology of rhabdomyolysis in our patient was likely multifactorial, and may be attributable to inadequate hydration and lack of regular exercise prior to participation in the spin class. The presence of sickle cell trait may have predisposed her to rhabdomyolysis in the setting of these factors. However, we must acknowledge that SCT is common, and despite its high prevalence most people with SCT do not develop rhabdomyolysis. Therefore, it possible her SCT was merely an incidental finding and she developed rhabdomyolysis due entirely to other factors, namely poor hydration in the setting of high-intensity exercise.

Spinning is a high intensity, indoor bicycle sport often synchronized to music that has been growing in popularity. It has been associated with exertional rhabdomyolysis most commonly in young, otherwise healthy females. The majority of cases occur in women under the age of 35 years<sup>8</sup>. While cases of “spin rhabdo” occur overwhelmingly in first time spin class participants with deconditioning, patients often have no other predisposing factors. Rhabdomyolysis may occur after as little as 15 minutes of spinning<sup>9</sup>. Spectrum of illness is

variable and ranges from mild to severe with potential for life threatening complications such as AKI and compartment syndrome<sup>1</sup>. One study suggested that patients with spinning induced rhabdomyolysis showed more severe disease and longer length of hospital admission than patients with rhabdomyolysis of other causes<sup>8</sup>. Additionally, a 2016 retrospective cohort study found that spinning induced rhabdomyolysis was associated with higher CK levels than other causes of exertional rhabdomyolysis<sup>3</sup>.

The risk of AKI is thought to be lower when CK values are less than 15-20,000 IU/L on admission<sup>10</sup>. Multiple studies have shown a weak correlation between serum CK value and incidence of AKI, and renal injury has occurred at CK levels as low as 5,000 IU/L<sup>10</sup>. This correlation has one major implication, namely that individuals with sickle cell trait should be especially cautious when participating in spin classes for the first time. The higher CK levels associated with spinning induced rhabdomyolysis may be particularly concerning for individuals with risk factors for kidney disease, such as those with sickle trait. Therefore, we recommend that individuals with known sickle trait visit a physician prior to participation in spin classes and discuss ways to minimize their risk of rhabdomyolysis.

In many parts of the world, newborn screening to detect both sickle cell disease and trait is widely available. In the United States, all states are now mandated to offer screening; while most parents opt to have their children tested, reporting of the result to families is variable. In a 2006 survey, only 16% of respondents were aware of their sickle trait status<sup>11</sup>. A number of sports organizations advocate for universal screening prior to participation in high intensity athletics due to rare reported instances of exercise related sudden death<sup>12</sup>. In 2010, the National Collegiate Athletic Association (NCAA) implemented a mandatory opt out sickle trait screening policy prior to athletic participation<sup>13</sup>. However, screening in adults remains controversial due to the potential for loss of employment, insurance, and other forms of discrimination based on sickle trait status. This risk must be weighed against the potential benefits from screening, which include the opportunity for providers to discuss preventative measures with patients. Given the severity of spinning-induced rhabdomyolysis and its increasing incidence in recent years, we may consider voluntary screening for sickle

trait in at risk populations prior to enrolling in spin classes for the first time. However, as evidence of an association between SCT and exertional rhabdomyolysis at the time of this article's publication is limited mainly to case reports, further studies are needed before a strong, evidence-based recommendation can be made. Nevertheless, this case warrants further investigation into whether or not extremely elevated CK values are more prevalent in patients with SCT. The point that SCT is highly prevalent and the vast majority of SCT individuals do not develop rhabdomyolysis is an important one. There is also no way of knowing how many patients with rhabdomyolysis have SCT because they are seldom screened. This case also highlights the importance that individuals seek medical care prior to starting a high intensity exercise regimen for the first time; those thought to be at increased risk for exertional rhabdomyolysis should be educated on prevention.

### Conclusion

Given the longer length of hospital admission and higher CK values associated with spinning induced rhabdomyolysis, individuals at high risk of exertional rhabdomyolysis should consider talking to their primary care physician before participating in spin classes. Prevention of exertional rhabdomyolysis may require more aggressive hydration to maintain fluid and electrolyte balance in individuals with sickle trait than in normal spin class participants, although more research is needed to clarify the association between SCT and exertional rhabdomyolysis. Organizers of spin classes should take precautions to ensure novel participants hydrate well and do not overexert themselves during the class. Voluntary screening for sickle trait in at risk populations prior to enrolling in spin classes may be considered given many individuals are unaware of their sickle trait status.

### Consent

Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient.

### Data availability

No data is associated with this article.

### Grant information

The author(s) declared that no grants were involved in supporting this work.

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# Open Peer Review

Current Peer Review Status:  

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## Version 2

Reviewer Report 24 July 2019

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 **Nyamkhisig Sambuughin** 

The Henry M. Jackson Foundation for the Advancement of Military Medicine, Bethesda, Maryland, USA

Authors revised this case report to reflect the complexity of rhabdomyolysis and its variable causes. As stated in the report, the development of rhabdomyolysis in the studied case is likely due to a combination of factors, being unaccustomed to intense exercise (i.e. spinning), dehydration and Sickle Cell Trait.

**Competing Interests:** No competing interests were disclosed.

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.**

Reviewer Report 16 July 2019

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 **Gregory Kato** 

Vascular Medicine Institute, University of Pittsburgh, Pittsburgh, PA, USA

The authors have addressed my prior comments adequately in this revised version. The points made are valid and the relevant issues are addressed in a balanced manner.

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Sickle cell disease

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

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**Version 1**

Reviewer Report 02 April 2019

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**Nyamkhishig Sambuughin**

The Henry M. Jackson Foundation for the Advancement of Military Medicine, Bethesda, Maryland, USA

Individuals with Sickle Cell Trait (SCT), generally a benign carrier state of hemoglobin mutation, are thought to be at increased risk for exertional rhabdomyolysis. This report presents an association between SCT and rhabdomyolysis triggered by spinning. The association between SCT and exertional rhabdomyolysis is mostly based on case reports. There are no well-designed case-control study that address this association except epidemiological study in US army soldiers. In many case reports, including this one, authors often highlight SCT is a main contributing risk factor. However, etiology of rhabdomyolysis is extremely variable. Although this case report describes an event of rhabdomyolysis in sufficient details, other potential contributing factors were not well discussed. The subject in the report appears to be unaccustomed to intense exercise and was not adequately hydrated before and during exercise. These are well known factors that contribute to rhabdomyolysis. Combination of those factors will certainly increase subjects' risk to muscle necrosis. Individuals should be aware of these factors before enrolling in unaccustomed strenuous exercise, regardless if they have SCT or not.

**Is the background of the case's history and progression described in sufficient detail?**

Yes

**Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?**

Yes

**Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?**

Partly

**Is the case presented with sufficient detail to be useful for other practitioners?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Inherited muscle disorders, genetic cause of rhabdomyolysis, exertional rhabdomyolysis in SCT

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Reviewer Report 25 February 2019

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**Gregory Kato** 

Vascular Medicine Institute, University of Pittsburgh, Pittsburgh, PA, USA

This is a fairly balanced presentation of a case report of a case of exertion-related rhabdomyolysis and its potential association with sickle cell trait (SCT). There is suggestive evidence for association of exertion-related rhabdomyolysis with SCT, but only with assumed prevalence of SCT in military personnel of self-identified African descent. There has never been a well-controlled analysis of this sickle cell risk, but it is strongly suspicious based on extensive circumstantial evidence. There also is an extensive history in the 1960's of stigma and discrimination involving SCT that is not well-appreciated in the current generation of biomedical personnel.

The authors do a good job of presenting the issues involved in this case report with the exception of three points:

1. At least half of the cases of exertional rhabdomyolysis do not involve SCT, and so SCT is not a complete explanation of risk. Universal precautions help to address this population outside of SCT.
2. SCT is highly prevalent and the vast majority of SCT subjects never develop rhabdomyolysis, including in spin classes, and additional risk factors must contribute to these rare cases.
3. There are inadequate data to base evidence-based recommendations and more research is needed in this area.

**Is the background of the case's history and progression described in sufficient detail?**

Yes

**Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?**

Yes

**Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?**

Yes



**Is the case presented with sufficient detail to be useful for other practitioners?**

Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Sickle cell disease

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

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