Tackling the rhabdomyolysis outbreak before it spins out of control

A recent article on rhabdomyolysis secondary to spin classes, published in the Singapore Medical Journal, is a timely reminder that in an era where high-intensity workouts and fitness classes are becoming increasingly popular resolutions to get fit may actually be harmful if not done correctly.

THE ISSUE

Rhabdomyolysis results from the breakdown of damaged muscle with subsequent release of intracellular muscle contents, which can result in acute kidney injury (AKI). Non-exertional aetiologies include trauma, vascular compromise, drugs, toxins and infections. Exertional rhabdomyolysis occurs after strenuous exercise, and spinning-induced exertional rhabdomyolysis (SER) has been increasingly reported in the literature since the first reported case in 2004. A similar trend has also been observed in Singapore.

Spin classes are indoor bicycle-based workouts in a class setting. The class environment and loud music played in spin classes encourage participants to push on with the high-intensity workout. While this can provide encouragement to push harder and burn more calories, it can also result in severe muscle injury and the resultant rhabdomyolysis. Similar to previous reports, the majority of patients who presented with SER in this current study tend to be younger women attending their first spin class. This does not mean that young women are more predisposed to SER than men or older women, but that spin classes are more in vogue in this population group than other forms of high-intensity exercise. The patients with SER in these studies were all under the age of 35 years. It is also not uncommon for young men attending their first spin-class to develop SER.

Similar to the findings of other studies, the current study showed that patients with SER tend to have higher serum creatine kinase (CK) levels on presentation to the emergency department than patients with other forms of rhabdomyolysis. This was associated with higher admission rates compared to other forms of rhabdomyolysis. With a mean length of stay of 4.3 days, these cases can put an unnecessary strain on tight hospital resources.

CLINICAL CONSIDERATIONS

Is this SER or compartment syndrome?

Muscle pain (>80%) and muscle weakness (70%) are the most common symptoms of SER, and the triad of muscle pain, muscle weakness and dark-coloured urine only occurs in 10% of patients. Most patients, however, do not present with dark-coloured urine, although this is a suggestive symptom. The signs and symptoms of SER and compartment syndrome are similar, with pain and tenderness in specific muscle groups/compartments predominating, as well as aggravation of pain on passive stretching of the affected muscles.

It is important to remember that while compartment syndrome is a differential diagnosis, it can also occur as a secondary complication to rhabdomyolysis. The expedient diagnosis of compartment syndrome is imperative in instituting timely treatment in the form of surgical fasciotomy to avoid muscle ischaemia and necrosis. However, misdiagnosis and injudicious fasciotomies can lead to unnecessary surgery and significant post-surgical morbidity in a fit, young and image-conscious individual. When in doubt, physicians should seek an orthopaedic specialist’s opinion and perform compartment pressure measurement.

Do I have to admit or can I discharge this patient?

Exertional rhabdomyolysis is often undiagnosed and rarely results in long-term sequelae. The main aim of inpatient management is to avoid complications such as AKI. A recent systematic review and meta-analysis found that serum CK level on its own is not a good screening tool for predicting AKI, but it may be used alongside other clinical markers. Likewise, urine myoglobin has not been found to be useful in predicting AKI.

Separately, several studies have shown that patients with rhabdomyolysis with normal admission creatinine levels who were treated with inpatient hydration did not develop AKI. To date, no studies have evaluated the safety and complications of outpatient management of exertional rhabdomyolysis. To aid in decision-making, various risk stratification tools have been suggested to help predict renal failure or mortality in rhabdomyolysis, with one such tool comprising age, gender, underlying aetiology, and initial laboratory values of calcium, CK, phosphate and bicarbonate.

Hence, low-risk patients with exertional rhabdomyolysis and SER, who may possibly be discharged home with follow-up, include those with mild symptoms, normal vital signs, normal renal function and electrolytes, and the ability to take fluids orally at home. Certainly, high-risk patients with abnormal vital signs, abnormal laboratory findings such as elevated serum creatinine (above their baseline), previous rhabdomyolysis and significant underlying comorbidities would benefit from further inpatient evaluation and management.
What is the best treatment protocol for SER?
Sharman et al.'s systematic review suggests that early institution of intravenous fluid therapy may reduce the incidence of AKI in patients with rhabdomyolysis. Crystalloid infusions of normal saline and lactated Ringer’s solution are commonly used fluids, with the former being associated with iatrogenic hyperchloremic metabolic acidosis and acidification of the urine. Most systematic reviews also recommend titrated infusion rates to achieve 300 mL/hr of urine output. The infusion of bicarbonate, mannitol and loop diuretics, as well as urine alkalinisation have shown mixed results, with some studies even suggesting their detrimental effects. These should be used only if deemed necessary. Renal replacement therapy is not commonly required unless there are significant metabolic derangements such as hyperkalaemia.

When can this patient return to physical activities?
Most patients can safely return to sports once the pain and weakness have resolved. Cleary et al. suggested a simplified guideline for return to supervised training, which includes the absence of fever, flu-like symptoms, muscle pain and myoglobinuria, as well as adequate hydration and a normal blood CK level.

The Consortium for Health and Military Performance (CHAMP) have also established a conservative guideline for return to physical activity. It recommends that patients should be stratified into high-risk and low-risk groups. High-risk patients should be evaluated for genetic or myopathic disorders before being allowed to return to sports. This group includes patients who have delayed recovery of more than one week; persistently elevated CK despite rest for two weeks; any degree of AKI; personal or family history of exertional rhabdomyolysis/recurrent muscle cramps/severe muscle pain/malignant hyperthermia/sickle cell disease or trait/heat stroke; muscle injury after low to moderate activity; or serum CK peak > 100,000 U/L. Low-risk individuals can attempt to return to physical activities according to a phased ‘low-risk’ athlete return to sport guideline. This group includes patients who have rapid clinical recovery, CK normalisation and no high-risk factors; are sufficiently fit or well-trained athletes with a history of intense training/exercise bouts; have other group or team-related cases of exertional rhabdomyolysis during the same exercise sessions; have suspected or documented concomitant viral illness or infectious disease; or have taken a drug or dietary supplement that could contribute to rhabdomyolysis. The phased return to sports starts with a 72-hour period of rest and oral hydration with eight hours of nightly sleep, followed by urinalysis and check for normalisation of CK. The second phase allows for light activities for a week while monitoring for return of clinical symptoms. If there are no further symptoms, the athlete may resume regular training in the third phase.

FINAL RECOMMENDATIONS
Cases of SER are being seen more frequently in our hospital emergency departments. Hospitals should have sound admission and treatment protocols for these patients, with the aim of preventing AKI while managing hospital resources and beds. Based on the increasing popularity of spin classes, which seem to attract young women, centres and gyms offering such spin classes should be on the lookout for high-risk first-timers or individuals who rarely exercise. In the interest of preventing SER, these participants should be started on a beginner’s class, with their cadence and resistance optimised to aim for a less rigorous workout, as well as reduced training session time. A routine with less time spent in a half-rising position may also reduce the degree of muscle activation as compared to a fully standing or seated position on the bike. The relevant authorities and sports safety committees can also play an active role in looking into and enforcing the safety aspects of spin classes.

REFERENCES
1. Shroff K, Gunasegaren M, Norbu K, Omar E. Clinical characteristics of spinning-induced rhabdomyolysis and other causes of rhabdomyolysis: A comparative study. Singapore Med J 2021. doi.org/10.11622/smedj.2021116.
2. Brogan M, Ledesma R, Coffino A, Chander P. Freebie rhabdomyolysis: A public health concern. Spine class-induced rhabdomyolysis. Am J Med 2017;130:484-7.
3. Ramme AJ, Vira S, Alaia MJ, Van De Leuv J, Rothberg RC. Exertional rhabdomyolysis after spinning: Case series and review of the literature. J Sports Med Phys Fitness 2016;56:789-93.
4. Young IM, Thomson K. Spinning-induced rhabdomyolysis: A case report. Eur J Emerg Med 2004;11:358-9.
5. DeFilippis EM, Kleiman DA, Derman PB, DiFelice GS, Echempati SR. Spinning-induced rhabdomyolysis and the risk of compartment syndrome and acute kidney injury: Two cases and a review of the literature. Sports Health 2014;6:333-5.
6. Kim YH, Ham YR, Na KR, Lee KW, Choi DE. Spinning: An arising cause of rhabdomyolysis in young females. Intern Med J 2016;46:1062-8.
7. Shim DW, Hyun SY, Woo JH, Jang JH, Choi JY. Comparative analysis between spinning and other causes in exercise-induced rhabdomyolysis. J Trauma Inj 2018;31:159-65.
8. Mong R, Thng SY, Lee SW. Rhabdomyolysis following an intensive indoor cycling exercise: A series of 5 cases. Ann Acad Med Singap 2021;50:431-3.
9. Long B, Koyfman A, Gottlieb M. An evidence-based narrative review of the emergency department evaluation and management of rhabdomyolysis. Am J Emerg Med 2019;37:518-23.
10. Safari S, Yousefifard M, Hashemi B, Baratloo A, Forouzanfar MM, Rahmati F, et al. The value of serum creatine kinase in predicting the risk of rhabdomyolysis-induced acute kidney injury: A systematic review and meta-analysis. Clin Exp Nephrol 2016;20:153-61.

11. Rodríguez-Capote K, Balion CM, Hill SA, Cleve R, Yang L, El Sharif A. Utility of urine myoglobin for the prediction of acute renal failure in patients with suspected rhabdomyolysis: A systematic review. Clin Chem 2009;55:2190-7.

12. Delaney K, Vohra R. Prediction of safe discharge of emergency department patients with acute rhabdomyolysis. Crit Care 2004;8(Suppl 1):P154.

13. Sinert R, Kohl L, Rainone T, Scalea T. Exercise-induced rhabdomyolysis. Ann Emerg Med 1994;23:1301-6.

14. Manis T, George-Varghese B, Kashani J. Rhabdomyolysis – go big or go home. Am J Emerg Med 2019;37:2194-6.

15. McMahon GM, Zeng X, Waikar SS. A risk prediction score for kidney failure or mortality in rhabdomyolysis. JAMA Intern Med 2013;173:1821-8.

16. Lee GX, Duong DK. Rhabdomyolysis: Evidence-based management in the emergency department. Emerg Med Pract 2020;22:1-20.

17. Sharman EJ, Troutman WG. Prevention of kidney injury following rhabdomyolysis: A systematic review. Ann Pharmacother 2013;47:90-105.

18. Cho YS, Lim H, Kim SH. Comparison of lactated Ringer’s solution and 0.9% saline in the treatment of rhabdomyolysis induced by doxylamine intoxication. Emerg Med J 2007;24:276-80.

19. Manspeaker S, Henderson K, Riddle D. Treatment of exertional rhabdomyolysis in athletes: A systematic review. JBI Database System Rev Implement Rep 2016;14:117-47.

20. Cleary MA, Ruiz D, Eberman L, Mitchell I, Binkley H. Dehydration, cramping, and exertional rhabdomyolysis: A case report with suggestions for recovery. J Sport Rehabil 2007;16:244-59.

21. O’Connor FG, Brennan FH Jr, Campbell W, Heled Y, Deuster P. Return to physical activity after exertional rhabdomyolysis. Curr Sports Med Rep 2008;7:328-31.

22. Okada M. An Electromyographic estimation of the relative muscular load in different human postures. J Hum Ergol (Tokyo) 1973;1:75-93.