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Case Report

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Spinning-Induced Exertional Rhabdomyolysis an Increasing Problem in Developed Nation - Can this be Prevented

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1. Introduction

Spinning-induced Exertional Rhabdomyolysis is an increasing problem in developed nation. Spin class can predispose to exertional rhabdomyolysis. We describe a young patient with Spinning-induced Exertional Rhabdomyolysis (SER).

2. Case

A 26-year-old woman with no significant medical history presented to the Emergency Department with bilateral thigh, back and knee pain following spin class. This was her third spin class, the first two of which were 1 month and 10 months ago. After her first and second class, she experienced minor thigh pain that resolved spontaneously. She did not seek medical attention and no bloods were done. She recovered in both previous episodes in 3 days. On this instance, her pain lasted 2-3 days, and worsened subsequently before she came to emergency department.

3. Investigations

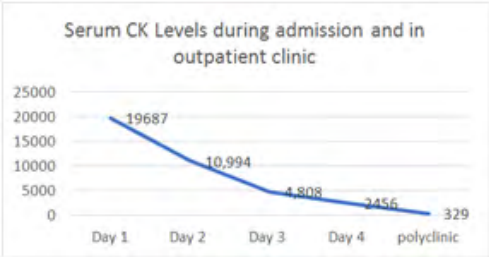
Investigations on admission revealed a Creatinine Kinase (CK) level of 19687 U/L (normal range 30-250 U/L), Aspartate Transaminase (AST) level of 710 U/L (normal range 15-40 U/L), Alanine Transferase (ALT) level of 227 U/L (normal range 5-40 U/L), red blood cell level of 5.69 x1012L (normal range 3.7- 4.8 x1012L), mean corpuscular volume (MCV) of 68 fL (normal range 83-98 fL), mean cell haemoglobin (MCH) of 21 pg (normal range 28-34 pg) and a MCH concentration (MCHC) of 31 g/dL (normal range 33-35g/dL). Other investigations including urinalysis, renal panel, liver panel, inflammatory markers (C-reactive protein), and full blood count were within normal parameters (Table 1). A thyroid panel was performed in 2021, which was normal (Free T4 16.2, TSH 1.640), and a diabetes screen done in 2020 revealed negative urine glucose and ketones.

Table 1: Investigations done on admission

Investigation	Values on admission	Reference Range
White blood cells	8.6	4.0 – 9.6 x 10^9/L
Haemoglobin	11.8	11.8 – 14.6 g/dL
Haematocrit	38.6	34.3 – 43.0 %
Red blood cells	5.69*	3.7 – 4.8 x 10^{12}/L
MCV	68*	83 – 98 fL
MCH	21*	28 – 34 pg
MCHC	31*	33- 35 g/dL
RDW	14.3	12.0 – 15.0 %
Platelet	325	150 – 360 x 10^9/L
MPV	9.1	7.0 – 10.0 fL
Neutrophils %	68.2	%
Neutrophils	5.84	1.90 – 6.60 x 10^9/L
C-reactive protein	0.4	<0.9 mg/dL
Liver function test		
Total protein, serum	74	63-83 g/L
Albumin, serum	46	35-50 g/L
Globulin-C	28	23-39 g/L
Bilirubin	5	2-21 µmol/L
AST	710*	10-35 U/L
ALT	227*	10-35 U/L
ALP	44	22-104 U/L
GGT	28	7-32 U/L
Renal function test		
Urea, serum	2	2.0-6.5 mmol/L
Creatinine, plasma	44	40-75 µmol/L
Creatinine, serum	63	44 – 79 µmol/L
eGFR (CKD-EPI)	117	>60 ml/min
Sodium, serum	140	135-145 mmol/L
Potassium, serum	4.9	3.5 – 5.1 mmol/L
pH, Urine	8	5.0 – 8.0

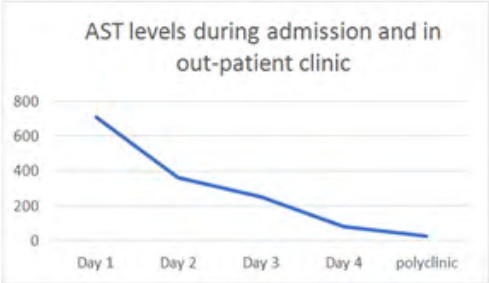
4. Progress

Management plans included intravenous hydration, avoidance of nephrotoxic and hepatotoxic drugs, and daily CK level monitoring and regular monitoring of liver enzymes. Intravenous hydration of 1.5L a day was commenced for 4 days (and oral intake of 1.5L/day, total intake 3L/day). An ultrasound of the hepatobiliary system was performed on day 3, which revealed hepatic steatosis with no suspicious hepatic lesion. Her gallbladder and biliary tree otherwise appeared normal with negative sonographer's murphy's sign. Over the course of her admission, her CK, ALT and AST levels progressively declined and she was subsequently discharged with a CK level of 2456 U/L, ALT level of 119 U/L, AST level of 78 U/L and resolution of her symptoms, with plans for outpatient review and advise given to return if symptoms recur. Her CK level at outpatient clinic one week later was 329 U/L, ALT was 42 U/L and AST level was 23 U/L (Graph 1-3).



Graph 1: Showing progression of serum CK levels

Graph 2: Showing progression of serum ALT levels



Graph 3: Showing progression of serum AST levels

5. Discussion

Spinning, a high-intensity indoor stationary cycling programme, is increasingly being known to cause exertional rhabdomyolysis. This is most often seen in young healthy women, often presenting with exceptionally high CK levels. Rhabdomyolysis occurs due to skeletal muscle necrosis, resulting in leakage of intramuscular contents such as CK and myoglobin. The depletion of Adenosine Triphosphate (ATP) during exercise leads to dysfunction of sodium-potassium ATPase and an increased level of sodium in cells, causing a reverse activation of the sodium-calcium exchanger. Resultantly, intracellular hypercalcaemia occurs, leading to the activation of proteases, skeletal muscle cell contraction, mitochondrial and sarcolemma damage and the production of reactive oxygen species ultimately causing skeletal muscle cell death [1,2]. Eccentric contractions and high-force lengthening contractions causing damage to muscle protein occurs to the thigh with spin exercises, tends to cause greatest injury [3]. Rhabdomyolysis can be complicated by compartment syndrome, Acute Kidney Injury (AKI) and disseminated intravascular coagulopathy [4]. While spinning programmes allow the tailoring of intensity, cadence and resistance based on individual preferences, overexertion due to peer pressure easily occurs. As a result, those unaccustomed to intense exercise become most prone to experiencing exertional rhabdomyolysis.

A number of predisposing factors for Spinning-Induced Exertional Rhabdomyolysis (SER) have been identified by several studies [5,6]. These include modifiable factors include lack of warm-up prior to and lack of hydration during exercise, lack of identification of unwell participants by instructors due to the ambience (dark rooms with strobe lights), the use of statins and antihistamines, hyperthermal environments and alcohol consumption [7]. Non-modifiable factors including genetic predispositions are coming to light, including inherited metabolic myopathies resulting from glycogenolytic disorders, fatty acid metabolism disorders, mitochondrial disorders and structural myopathies [5,8,9]. Type 1 Ryanodine Receptor mutations have also been recently recognised as a contributing factor to rhabdomyolysis, with further investigation required. Evaluation of an underlying myopathy should be encouraged in cases of recurrent SER precipitated by mild exercise or strong family history. We have previously reported similar cases after spin class which could have been prevented [10].

Studies have differentiated SER from other forms of exertional rhabdomyolysis and non-exertional rhabdomyolysis in its clinical presentation [4,11,12]. Of note, SER patients experience higher CK levels at presentation and longer length of admission [11]. This suggests greater muscle breakdown and subsequently puts them at a higher risk of incurring an AKI. Hence, treatment involves early heavy hydration to prevent renal hypoperfusion and urinary acidosis which can occur with raised CK levels >40,000 U/L. While the prognosis of SER is good and the rate of complications post treatment is low, the knowledge of SER is important in its prevention from a public health standpoint, and in reducing healthcare costs5. While literature has focussed on identifying cause and mechanisms of SER, fewer studies focus on the post-SER state and advise on suitable exercises for individuals post-SER, highlighting a knowledge gap for further research. Spinning studios should warn participants of the potential risks involved with spinning, advise against overexertion and be prudent in ensuring only gradual increases in intensity and exercise volume especially

among first-timers.

6. Conclusion

Exercise programs and classes such as spin carry the risk of causing exertional rhabdomyolysis, especially in the unaccustomed individual. This can lead to adverse complications if untreated and recognised late. Spin classes should advertise the risks individuals are posed to, especially to newcomers. Instructors should encourage proper hydration, warm-up exercises and should be trained to be able to identify participants who are overexerting themselves to minimise the modifiable risk factors of SER among participants. This will aid in the early detection and prevention of SER, ultimately reducing the incidence of SER.

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