Exercise-induced rhabdomyolysis

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ABSTRACT

We report the case of a 34 year-old man who developed exercise-induced rhabdomyolysis after unaccustomed high-intensity exercise. Subclinical rhabdomyolysis is common after heavy exercise, yet it is uncommon for patients to seek medical advice. The presentation is variable and despite potentially life-threatening complications the diagnosis may be easily missed by patients and healthcare professionals. A high-index of suspicion is critical to avoid missing the diagnosis. We summarise the current knowledge, clinical course, complications and management of exercise-induced rhabdomyolysis.

Case Report

A 34 year-old man with unremarkable past medical and family histories was referred by his GP with a one-day history of pain and weakness affecting the lower back and thighs, and "tea-coloured" urine. Earlier that day, he had performed a strenuous weight training session to which he was unaccustomed. He denied use of steroids, supplements, or statins.

Examination was unremarkable aside from marked palpation tenderness in the quadriceps and lumbar para-spinal muscles, with 4+/5 weakness of hip flexion and knee extension bilaterally (limited by pain). There was no evidence of compartment syndrome.

The full blood count, coagulation screen, routine biochemistry and thyroid function were normal except for elevated creatine kinase (CK) of >14,000 U/L (60–220 U/L) and mildly elevated serum lactate of 1.6mmol/L (0.3–1.3mmol/L). His urine was tea coloured (Figure 1) and was strongly positive for blood on dipstick testing. However, urinary creatinine and protein was normal and the urine was acellular upon microscopy. These changes are suggestive of myoglobinuria due to the cross-reactivity of urine dipstick testing with myoglobin/haemoglobin.

The findings were consistent with exercise-induced rhabdomyolysis. Aggressive intravenous fluids were given and he was monitored daily for electrolyte disturbances and other sequelae. Electrolytes remained normal aside from transient asymptomatic hypocalcaemia 2.05 mmol/L (2.10–2.55mmol/L). CK remained >14,000 U/L for five days before falling. Symptoms improved over the same time-frame and he was discharged with GP follow-up.

Figure 1: Tea-coloured urine specimen from patient with exercise-induced rhabdomyolysis.

Table 1: The major categories of rhabdomyolysis and common causes for each category.

Type of Rhabdomyolysis	Common causes
Trauma	Crush syndrome, major trauma
Exertional	Strenuous or unaccustomed exercise, seizures (epilepsy, alcohol withdrawal)
Muscle hypoxia	Acute limb ischaemia/major artery occlusion, prolonged compression of limb during immobilisation or unconsciousness
Genetic	Disorders of glycolysis or glycogenolysis, disorders of lipid metabolism
Infection-related	Influenza A and B, Cocksackievirus, EBV, HIV, staph aureus pyomyositis, clostridium
Temperature-related	Heat stroke, malignant hyperthermia, malignant neuroleptic syndrome, hypothermia
Metabolic and electrolyte disorders	Hypokalaemia, hypophosphataemia, hypocalcaemia, DKA, hyperosmolar hyperketotic state
Drugs/toxins	Fibrate, statins, alcohol, heroin, cocaine
Idiopathic	Unknown

Discussion

Rhabdomyolysis may be triggered by numerous insults (Table 1). Complications are less frequent in exercise-induced rhabdomyolysis than in other forms of rhabdomyolysis. Resolution is expected within one–two weeks. Severe exercise-induced rhabdomyolysis can cause acute kidney injury, electrolyte disturbances, disseminated intravascular coagulopathy, compartment syndrome and death.[2,4]

Excessive muscle activity induces rhabdomyolysis when myocyte energy demand exceeds production. Intracellular glycogen stores are exhausted and myocellular membranes become disrupted. The resulting release of intracellular skeletal muscle constituents into the circulation is responsible for complications observed.[13] Exercise-induced rhabdomyolysis is most commonly seen following strenuous physical activity but can sometimes occur after low-intensity exercise, especially in dehydrated individuals.[4] Risk factors include: male sex, being physically untrained, coexistent heat stroke, impaired sweating, sickle-cell trait, hypokalaemia and inherited muscle enzyme defects.[1,3–4]

Clinically, exercise-induced rhabdomyolysis is characterised by:[1]

- muscle tenderness, stiffness, cramping
- weakness in affected muscle groups
- "tea-coloured" urine
- other urinary symptoms: oliguria, anuria
- non-specific symptoms: malaise, fever, nausea, vomiting.

Baseline investigations include: urine dipstick, serum CK, electrolytes (including calcium), full blood count, coagulation screen, lactate, blood gas, TFTs and ECG.[1] The urine dipstick may be false-positive for blood due to cross-reactivity of myoglobin and haemoglobin (as in this case).[1–2] In recurrent cases, or if there is a family history of exercise-induced rhabdomyolysis, investigation for a predisposing genetic cause is suggested.[6] The conditions that predispose or cause rhabdomyolysis are varied and include disorders of lipid and carbohydrate metabolism, mitochondrial disease and myopathies.[1,3] Investigations should be targeted to the specific conditions of concern and may include skin and/or muscle biopsy, tissue histochemistry, muscle-exercise testing, biochemical tests and formal genetic testing.

The initial treatment of rhabdomyolysis is aggressive intravenous fluid resuscitation.[1–2,4] Normal saline is most commonly used. Care should be taken with fluid resuscitation, particularly in the context of prolonged anuria where patients are at greater risk of iatrogenic overload. Electrolyte disturbances should be corrected promptly, aside from hypocalcaemia which should only be treated if symptomatic or if concurrent severe hyperkalaemia is present due to risk of arrhythmia.[2] Sodium bicarbonate or mannitol may be considered under specialist guidance only.[2] Renal-replacement therapy may be used

for refractory complications, although this does not facilitate myoglobin elimination.[2] Plasmapheresis or haemofiltration with super-high-flux dialysers may have a role in severe cases.[7,8]

Conclusion

Exercise-induced rhabdomyolysis is an under-recognised phenomenon with potentially serious complications. The presentation, complications, investigations and management of exercise-induced rhabdomyolysis are summarised (Table 2). The most critical facet of making a diagnosis remains retaining a high-index of suspicion due to the uncommon nature of the presentation and its significant potential complications.

Table 2: Exercise-induced rhabdomyolysis: key points.

Summary of Exercise-induced Rhabdomyolysis	
Clinical features	• Muscle stiffness, tenderness, cramping • Weakness in affected muscles • Dark "tea-coloured" urine • Non-specific: malaise, fever, nausea, vomiting, fever
Risk factors	Male sex, unaccustomed exercise, heat stroke/hot weather, impaired sweating, hypokalaemia, inherited muscle enzyme defects, sickle cell trait
Investigations	• Urine dipstick and microscopy • Bloods: FBC, UEs, creatine kinase, lactate, calcium, phosphate, TFTs, clotting • Blood gas • ECG • May require specialist genetic testing if concerns about underlying cause
Management	• Early IV fluids (0.9% saline), large volumes may be required • Monitor: - Fluid input/output: may require catheter - Close electrolytes monitoring - Signs of compartment syndrome/coagulopathy • Correct hypocalcaemia only if symptomatic or concurrent severe hyperkalaemia • Treat other electrolyte disturbances especially hyperkalaemia • Consider: - Early involvement of intensive care/renal-services - Consider use of Mannitol or Sodium Bicarbonate under specialist guideance - Renal replacement therapy if resistant hyperkalaemia or other sequaelae of renal failure
Complications	• Acute kidney injury • Electrolyte disturbance: hyperkalaemia, hypocalcaemia, hyper/hypophosphataemia • Disseminated intravascular coagulopathy • Compartment syndrome • Death
Prognosis	Generally very good

Competing interests:
Nil.

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URL:
https://www.nzma.org.nz/journal/read-the-journal/all-issues/2010-2019/2016/vol-129-no-1442-23-september-2016/7023

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