Case Report

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Exercise-induced rhabdomyolysis manifestations and complications: a case report

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Introduction: Rhabdomyolysis is a medical condition that results from damage to striated muscles that causes the release of their components into the bloodstream. Laboratory indications include high levels of creatinine kinase and myoglobin in the serum.
Importance: This case report emphasizes the importance of having professional trainers in gyms and training centers who respect trainees' limitations and physical capabilities and ensure that physical exercise programs are being conducted safely and effectively.
Case presentation: A 39-year-old female healthcare provider presented to the emergency department at a tertiary/quaternary hospital in Saudi Arabia, with progressive right arm pain, swelling, weakness, and dark urine 2 days after an unaccustomed heavy physical exercise session with her personal trainer following a long pause from physical training.
Clinical discussion: Levels of serum creatinine kinase, aspartate aminotransferase, and alanine transaminase were moderately elevated. There was no evidence of renal impairment, electrolyte disturbance, or coagulopathy. The patient was treated with analgesics, received hydration, and was discharged home under close observation and with a follow-up clinic visit scheduled to check for complications. Data were collected from the hospital's electronic medical records, including clinical notes and laboratory investigations.
Conclusion: Awareness campaigns need to be conducted to educate the public about healthy ways to exercise, such as gradually increasing the intensity of physical activity, warming up before exercising, cooling down after each workout, and staying hydrated. It is important that healthcare providers, trainees and trainers are able to recognize the signs of muscular injury following vigorous exercise in order to reduce the incidences of complications that could be deadly if they are not caught and managed early.

Keywords: exercise-induced rhabdomyolysis, gym-induced rhabdomyolysis, personal training

Introduction

Rhabdomyolysis is a medical condition characterized by damage to striated muscles that causes the release of muscle cell components into the bloodstream[1,2]. Resulting in the elevation of myoglobin, creatinine kinase (CK), alanine transaminase (ALT), and aspartate aminotransferase (AST) levels in the serum[1]. Causes of rhabdomyolysis include but are not limited to surgery, trauma, electrical injury, severe burns and seizures, infections such as influenza, HIV, and COVID-19, as well as alcohol, cocaine, and opiate use. Medications causing rhabdomyolysis include statins, diphenhydramine, and corticosteroids[1,2]. A hot environment, low dietary protein intake, and sickle cell trait are linked to exertional rhabdomyolysis[1–4].

Exercise or exertion-induced rhabdomyolysis (exRML) is uncommon; however, pressure from social media platforms for young adults to try to get the perfect body shape might have contributed to its increased prevalence[5]. Primary factors linked to exRML include the trainee's exercise experience, level of physical fitness, and the duration, type, and intensity of exercise[3]. Less experienced participants who have done little or infrequent previous training are more prone to muscle injury and high serum CK levels[3]. Unaccustomed, sudden, heavy, and prolonged physical exercise can induce rhabdomyolysis[6]. Myalgia/pain, muscle weakness, local swelling, myoglobinuria (tea-colored dark urine), and fatigue within 24–48 h postphysical activity are typical presentations of exRML[1,6,7]. Elevation of CK to more than 1000 IU/l, which is about five times the upper limit of the normal level, combined with a history of recent vigorous or prolonged physical activity, should raise suspicion of ExRML[1,4,7]. CK levels of more than 5000 IU/l indicate severe muscle injury and an increased risk of complications[1,4,6].

ExRML could impose serious life-threatening risks such as acute kidney injury (AKI), liver injury, compartment syndrome, cardiac arrhythmia, electrolyte imbalance, and disseminated intravascular coagulation[1,8]. Early recognition of the signs and symptoms of ExRML and early management with fluid, ideally less than 6 h from the onset of clinical presentation, is essential to prevent complications[9]. Treatment mainly includes adequate hydration via the intravenous infusion of normal saline to maintain adequate urine output, correcting electrolyte disturbance or acid-base derangement, and the management of complications.

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ExRML may lead to AKI in about 10–50% of affected patients[1–4,6]. The mortality rate from rhabdomyolysis increases from 20 percent in patients without AKI to 50–59% in patients with AKI. Acute compartment syndrome is another serious complication that can cause permanent disability[1,2]. The prevalence of compartment syndrome and disseminated intravascular coagulation among patients with severe rhabdomyolysis was found to be 4 and 8.3%, respectively[4].

Effective approaches to safe physical activity include conducting preworkout warm-ups and postworkout cool-downs, adequate hydration, a balanced diet intake, and wearing clothing that provides a cooling mechanism[3]. Educating athletes and coaches about the signs and symptoms of ExRML for early recognition and management is crucial to prevent complications[3].

This report aims to highlight the contributing factors that increase the risk of exRML and to emphasize the need to educate people about the importance of the early recognition of symptoms of muscle injury and their early management to prevent mortality and morbidity among athletes and people who engage in physical activity.

Case presentation

A 39-year-old female healthcare provider who was previously healthy and not on any regular medications presented to the emergency department (ED) at a tertiary/quaternary hospital in Makkah, Saudi Arabia, in March 2023 after experiencing progressive arm pain, swelling, weakness, and dark urine for 2 days. There was no history of fever, chills, chest pain, nausea, vomiting, or diarrhea. Her symptoms started during a personal training session in which she did three sets of 24 push-up cycles each (12 wide and 12 narrow) with her personal trainer at the gym after returning to the gym following a long pause. The patient had been used to doing regular physical activity without any significant encounters but took a break from exercise for 6–8 weeks. Once she returned to the gym, her personal trainer immediately engaged her in vigorous physical workouts without recognizing the need to resume physical activities gradually.

At the training session, the patient experienced pain, weakness, and a sudden drop of both arms while rising from the ground at the last set of push-ups. She informed her personal trainer, who insisted that she should complete the workout, which she struggled to do. On the second day after the personal training session, the patient noticed swelling with worsening pain in her upper arm muscles (over the biceps and triceps muscles) and she had difficulties putting on her clothes and combing her hair. She experienced sudden on-and-off right-sided flank pain, which lasted for a few seconds. She also noticed she had dark urine. Drawing on her experience as a healthcare provider, she increased her water intake to 2–3 l per day, took oral ibuprofen to control the pain, and did yoga and stretching exercises, which improved her pain slightly. However, the swelling progressed to the forearm, and the pain increased, preventing her from doing her daily tasks. When the patient could not tolerate the pain and muscle soreness any further, she went to the ED.

On presentation to the ED, the patient was alert and oriented with no signs of dehydration. Her vital signs were stable: blood pressure 112/64 mmHg, heart rate 73 bpm, temperature 36.6°C, and oxygen saturation 96% on room air. A physical examination of the limbs showed right arm edema. The skin over the right arm was tight, warm, and shiny, with no visible redness. She felt tenderness to the touch, and the edema was pitting. The patient reported moderate pain, stiffness, and weakness during movement. The pain was rated 5 out of 6 on the Likert scale, where 0 indicates no pain, and 6 indicates severe pain with restricted movement[5]. Peripheral pulses and neurologic exam were intact and cardiovascular, chest, and abdominal examinations were normal. Because the swelling was more recognizable on the right arm than on the left, a right upper limb venous Doppler ultrasound was requested to exclude deep vein thrombosis, which was found to be negative, and deep vein thrombosis was excluded. Laboratory investigations, shown in Table 1, showed mild elevation in serum CK, AST, and ALT. There was no laboratory evidence of renal impairment, electrolyte disturbance, or coagulopathy.

The patient was diagnosed with exercise-induced rhabdomyolysis and received 2 l of intravenous (IV) normal saline and one gram of acetaminophen IV. The patient was discharged home with analgesics for pain control and advice on ensuring adequate oral hydration, cold compression, arm elevation, and resting for 5 days, with a clinic follow-up scheduled for the fifth day following discharge. Red flags related to the risk of complications were explained to the patient and she was asked to come to the ED if she encountered any.

On the fifth day after discharge from the ED, the patient was seen at the outpatient clinic (OPD), and the pain and swelling had improved substantially on the right side. However, the left arm swelling was noticeable, following the same course as the right arm (starting from the upper arm and progressing to the forearm). The patient took ibuprofen thrice daily to control her pain and practiced regular arm elevation and cold compression while also restricting physical activities. All these measures contributed to the CK dropping from 3000 to 243 U/l, ALT from 148 to 81 U/l, and AST from 118 to 48 U/l. Laboratory markers were still higher

Table 1

Laboratory investigations in the ED on the first day of presentation to the ED

Test	Result	Reference range
CK, serum	3000 U/l	26–192 U/l
BUN level	9 mg/dl	8–24 mg/dl
Creatinine, serum	0.60 mg/dl	0.59–1.04 mg/dl
AST	118 U/l	8–43 U/l
ALT, serum	148 U/l	14–59 U/l
Total bilirubin	0.20 mg/dl	< 1.2 mg/dl
Hemoglobin	11.8 g/dl	12–15 g/dl
WBC count	8.58 10^9/l	3.9–11 10^9/l
Platelet count	312 10^9/l	150–400 10^9/l
INR	0.97	0.9–1.2
PTT	32 s	28–44 s
Sodium, serum	139 mmol/l	136–145 mmol/l
Potassium, serum	4.10 mmol/l	3.5–5.1 mmol/l
Bicarbonate, serum	32 mmol/l	21–32 mmol/l
Blood in urine	Trace	Negative
RBC in urine	0–2	0–2
Protein in urine	Negative	Negative

ALT, alanine transaminase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; CK, creatinine kinase; g/dl, gram per deciliter; INR, the international normalized ratio; mg/dl, milligram per deciliter; mmol/l, millimoles per liter; PTT, partial thromboplastin time; RBC, red blood cell; U/l, unit per liter; WBC, white blood cell.

Table 2

Laboratory investigations in the OPD on the fifth day of presentation to the ED

Test	Result	Reference range
CK, serum	243 U/l	26–192 U/l
BUN level	7 mg/dl	8–24 mg/dl
Creatinine, serum	0.61 mg/dl	0.59–1.04 mg/dl
AST	48 U/l	8–43 U/l
ALT, serum	81 U/l	14–59 U/l
Total bilirubin	0.30 mg/dl	< 1.2 mg/dl

ALT, alanine transaminase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; CK, creatinine kinase; mg/dl, milligram per deciliter; U/l, unit per liter.

than the normal range but showed significant improvement (Table 2). The laboratory tests took about 3 months to return to normal levels.

During the same visit to the OPD and despite the improvement in laboratory investigation, the patient complained of constant hand numbness involving the little fingers on both the left and right hands, but had no weakness, headache, or other focal neurologic symptoms. The neurological exam was normal. Recent patient labs showed vitamin B_{12} and hemoglobin A1c levels were normal. Thus, a nerve conduction study of ulnar nerves was conducted and showed normal study with no evidence of ulnar motor or sensory neuropathy in either of the upper limbs up to the midarm level.

In traumatic causes of rhabdomyolysis, distal pulses and peripheral nerves should be examined to rule out limb ischemia and peripheral neuropathy[1]. The sickle cell trait has been linked to an increased risk of exRML in young, healthy adults[2]. Thus, hemoglobin electrophoresis was conducted for this patient. However, it did not show any evidence of hemoglobinopathies (Table 3).

Discussion

The increasing influence of social media to get into shape has contributed to younger people engaging in regular exercise programs in gyms and training centers[6]. Although regular physical activity improves physical, mental, and spiritual health, it can lead to exercise-related injury, especially if trainees lack proper knowledge about exercise, such as the importance of warming up before exercise, staying hydrated, and practicing with professional trainers[6]. ExRML, also called gym-induced rhabdomyolysis, can result when personal trainers do not anticipate trainees' needs or respect their physical limitations and push them to a level beyond their physical capacity and personal expectations (6, p.1).

Our patient experienced exRML, most likely due to vigorous exercise in the form of 72 push-ups divided into three sets, which exceeded her physical ability after ~2 months of absence from the gym. Despite the patient's desire to stop, the trainer pressured her to continue. The presentation was typical; she developed progressive muscle pain, weakness, tenderness, fatigue, and dark urine.

Most reported cases of exercise-induced rhabdomyolysis showed higher levels of serum CK (above 100 000 U/L) compared to our patient (3000 U/L)[2,10]. This might be because the patient was a healthcare provider who recognized the signs of muscle injury and took precautionary measures to manage her symptoms early and prevent complications through increasing fluid intake, taking analgesics, practicing arm elevation, and seeking medical advice when her symptoms started to exacerbate.

This patient developed self-limited rhabdomyolysis; there was a moderate elevation in CK (about 14 times the upper limit of normal) and no evidence of renal impairment, acid-base disturbance, electrolyte abnormalities, or compartment syndrome, which made her a candidate for outpatient management. Evidence shows that the risk of AKI is low with a CK level of less than 5000 IU/l; thus, in such patients, excessive fluid replacement is not recommended as in those who have a CK elevation of more than 5000 IU/l[1].

Peripheral neuropathy is a rare complication of rhabdomyolysis[11]. It may occur if the rhabdomyolysis is complicated by acute compartment syndrome, an orthopedic emergency in which the edematous muscle compression leads to nerve damage and vascular compromise if not treated urgently[1,11]. Peripheral neuropathy can also occur in severe rhabdomyolysis in the absence of compartment syndrome due to muscle injury and the spread of local inflammation[11]. Our patient did not have acute compartment syndrome but experienced numbness in the ulnar nerve distribution bilaterally. However, the nerve conduction study was normal. The patient was referred to receive physical therapy and rehabilitation to regain her previous status of normal functioning.

Table 3

Hemoglobin electrophoresis results

Test	Result	Reference range
HBA	96.2	95.8–98.0
HBA2	3.0	2.0–3.3
HBF	0.8	0.0–0.9

HBA, adult hemoglobin; HBA2, hemoglobin A2; HBF, fetal hemoglobin.

Conclusion

This study emphasizes the need to conduct awareness campaigns to educate the public about the risk of developing rhabdomyolysis following unaccustomed exercise, as well as increasing recognition of common presentations and emphasizing the importance of the early management of symptoms and taking precautionary measures to reduce the risk of life-threatening complications.

Ethical approval and consent to participate

The study protocol was reviewed and approved by King Abdullah Medical City's Institutional Review Board (study reference number #23-1141).

Consent for publications

Written informed consent was obtained from the patient for publication . A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Not applicable.

Data availability statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

Provenance and peer review

Not applicable.

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