Rhabdomyolysis in a Civil Aviation Pilot

Xincheng Liu; Xingxing Meng; Chuanyin Zhang; Jian Chen; Pengxiang Li; Xuan Wu; Hongbin Fan

BACKGROUND: Rhabdomyolysis is a potentially fatal disease caused by trauma, infections, and toxins. Rhabdomyolysis has not been reported in Chinese civil aircrew, but in our case report a male civil copilot contracted rhabdomyolysis after excessive exercise, showing potential for morbidity in pilots.

CASE REPORT: After excessive exercise, a 29-yr-old male civil aviation copilot complained of serious myalgia and weakness in lower limb muscles and gross hematuria, whose values of alanine transaminase (ALT), aspartate transaminase (AST), myohemoglobin (Mb), creatine kinase (CK), CK-MB, lactate dehydrogenase (LDH), and α-hydroxybutyrate dehydrogenase (α-HBDH) were conspicuously increased. Magnetic resonance imaging showed abnormal signal intensities in the lower limbs. The patient was diagnosed with rhabdomyolysis. He was treated with hydration and urine alkalinization. When his condition was stabilized, the patient was discharged. After remaining asymptomatic for 3 mo and getting documentation of normalized lab results, he was granted a first-class medical certificate and returned to work.

DISCUSSION: This was the first case of rhabdomyolysis reported in Chinese civil aircrew. Excessive exercise in an overweight pilot may induce rhabdomyolysis. This condition can be controlled and cured by early and effective treatment. Rhabdomyolysis could occur in a population suffering from overweight, obesity, or hyperlipidemia. This case fits in with several other cases of military pilots exercising excessively. The progression could lead to acute kidney injury without prompt and effective intervention. And common symptoms like muscular weakness or myalgia may induce sudden in-flight incapacitation, so early medical intervention should be adopted. Moreover, recurrence of rhabdomyolysis should be considered when resuming flying duties.

KEYWORDS: rhabdomyolysis, pilot, excessive exercise.

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Rhabdomyolysis is a potentially life-threatening condition of myocyte injury leading to release of intracellular contents into the blood, such as myohemoglobin (Mb), creatine kinase (CK), lactate dehydrogenase, and potassium.[9] Every year, approximately 26,000 cases are hospitalized in the United States.[1] The causes of rhabdomyolysis are complex and the most common acquired etiologies are considered to be trauma, exertion, extreme body temperature, illicit drugs, drugs, infections, and toxins.[2,6] Main manifestations of rhabdomyolysis include profound muscular weakness and pain, swelling, and coffee-colored urine.[5] In addition, approximately 30–50% of patients with rhabdomyolysis will develop acute kidney injury (AKI).[14] The diagnosis of this disease relies on etiology and characteristics of blood biochemical indices. An elevated CK higher than five times the upper limit of normal and increased Mb values are key indicators for diagnosis of this disease.[7] The goal of the treatment is to protect kidney function through eliminating the causes of rhabdomyolysis, avoid risk factors that exacerbate rhabdomyolysis, blood volume resuscitation, alkalinize the urine, even hemodialysis or hemofiltration, and other complicated treatments with the goal of diluting Mb and other substances that are potentially threatening to the kidneys.[8]

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CASE REPORT

A 29-yr-old male civil aviation copilot, with a weight of 90 kg and height of 180 cm [body mass index (BMI) = 27.77], complained of serious myalgia and weakness in lower limb muscles for 3 d. He had a medical history of bilateral renal calculus treated with ultrasonic lithotripsy in 2016. On August 16 and 17 of 2017, with the purpose of losing weight, he walked on the treadmill for 4 h in the fitness room one time with the room temperature at 18–22°C with air conditioners. Then he did sit-ups, push-ups, high-knees, cross-body crunch, elliptical training, and the leg press (50 kg) in the gym. He did full relaxation of his muscles at the end of the gym exercise and after that he immediately felt pain and weakness in his lower limbs. The pain became more serious the next day after he relaxed his muscles. He complained about the pain to the captain during a flight mission. His urine volume was normal; however, gross hematuria occurred on the third day and, therefore, he requested hospitalization.

Physical examination showed slight tenderness in the lateral muscles of both thighs. Laboratory tests showed substantially increased serum concentrations of alanine transaminase (ALT), aspartate transaminase (AST), myohemoglobin (Mb) and creatine kinase (CK), CK-MB, lactate dehydrogenase (LDH), and α-hydroxybutyrate dehydrogenase (HBDH). Protein and occult blood were positive in the urine routine test. MRI showed abnormal signal intensities in the bilateral iliopsoas, tensor fascia, rectus femoris, obturator externus, pectineus, iliacus, and the perimuscular space (**Fig. 1**). The concentration of serum creatinine (Cr) was normal (**Table I**). The electrocardiograph and color Doppler ultrasonography of the liver, gallbladder, pancreas, spleen, urinary system, and blood vessels in the lower limbs were all normal. The patient was diagnosed with rhabdomyolysis. Since there was no history of drugs, toxins, traumatic events, infectious diseases, or alcohol consumption, excessive physical effort-induced rhabdomyolysis was assumed to be the cause of his symptoms. Applications of reduced glutathione, sodium lactate Ringer's injection, $NaHCO_3$, and magnesium isoglycyrrhizinate were used for treatment. Within 7 d, muscle pain gradually disappeared and the serum enzyme values gradually decreased to the normal level. The patient was then discharged in good physical and mental condition. With normal values of ALT, AST, Cr, Mb, CK, CK-MB, LDH, and α-HBDH after three repeated examinations and 3 mo of complete rest, he passed the physical examination and was granted a Chinese first-class medical certificate on November 3, 2017. This copilot was also granted a certificate in November of 2018 and 2019. He was instructed to avoid strenuous exercise, maintain adequate hydration, and ensure proper caloric intake during exercise. He was also recommended to stop exercise when feeling unwell.

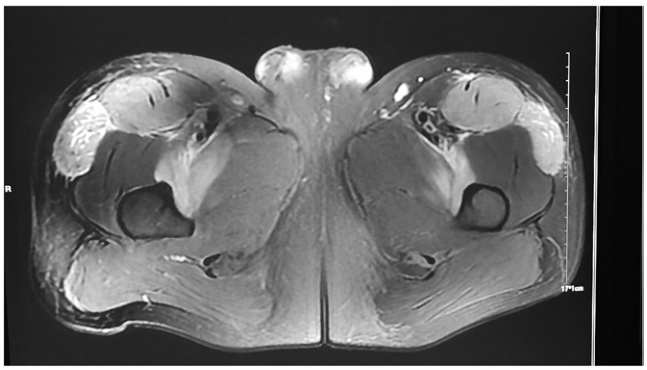

Fig. 1. Magnetic resonance imaging (MRI) of hip, T2, and diffusion weighted image, transverse section.

DISCUSSION

In China, pilots normally get a 36-h break after a 4-d consecutive flight mission. However, the valuable days off are often occupied by internal conferences, training, and other activities, leaving limited time for exercise. Before 1990s, the military training standard was used in the cultivation of Chinese student pilots in civil aviation. Without enough formal physical training and demand in the army, the morbidity of overweight or obesity has reached 49.64% in Chinese civil aviation pilots.[10]

This patient is overweight, which is associated with increased risk for AKI with the morbidly obese. Moreover, BMI $\geq 35\ kg \cdot m^{-2}$ was found to be associated with increased risk of rhabdomyolysis.[4] Meanwhile, excessive exercise triggered the patient's sudden rhabdomyolysis. Luckily, he was hospitalized and got the correct treatment in time without further renal injury. His Cr was always in the normal range, indicating no distinct renal injury, which is a significant reason why he could be granted a first-class medical certificate 3 mo later.

The case reported by Watson[13] was similar to ours, but with some different points. In that case, the student pilot collapsed during running after upper and lower body exercise, with ambient temperature of 25°C, while in our case, the patient experienced pain after excessive exercise, mostly in his lower limbs. In our view, excessive exercise and ambient temperature may be important inducing factors. This disease would be effectively prevented by scientific training methods.

In Gray's case report,[3] the patient was formally hospitalized after a complaint of decreased energy level and fatigue over 2 mo. Renal injury occurred with higher levels of blood urea nitrogen and plasma sodium. However, the most important indicators, Cr and urine volume, were missing. The patient finally recovered and was granted first-class medical certification after remaining asymptomatic for 6 mo, rather than 3 mo as in our case. This indicates that early detection and treatment are very beneficial for pilots to recover and return to their work positions. Rhabdomyolysis is a rare disease that is not recorded in medical standards for physical examination of aircrew and air traffic controllers in China (AC-67FS-001, 2017). Renal injury is commonly found in patients suffering this disease, but that did not happen in our case, which shortened the ground observation period. The keys to the prognosis are early discovery, early diagnosis, and early treatment.

Furthermore, hypercholesterolemia and hypertriglyceridemia are common diseases in pilots because of ageing,

Table I. Main Biochemical Index of the Patient.

ITEMS	RANGE OF NORMAL VALUES	TEST DATA			
		2017.8.18	2017.8.19	2017.8.22	2017.8.27
ALT	5–40 $U \cdot L^{-1}$	351	/	520	174
AST	8–40 $U \cdot L^{-1}$	1211	/	1062	65
Cr	59–104 $\mu mol \cdot L^{-1}$	Normal*	/	76	Normal*
CK	26–196 $U \cdot L^{-1}$	/	91,880	31,400	1075
Mb	28–72 $ng \cdot ml^{-1}$	>3000	/	276.6	103.6
CK-MB	0–25 $U \cdot L^{-1}$	/	595 $U \cdot L^{-1}$	218 $U \cdot L^{-1}$	/
	<4.94 $ng \cdot ml^{-1}$†	110.8 $ng \cdot ml^{-1}$		11.44 $ng \cdot ml^{-1}$	7.83 $ng \cdot ml^{-1}$
LDH	109–245 $U \cdot L^{-1}$	/	1500	1080	402
α-HBDH	72–182 $U \cdot L^{-1}$	/	906	104	372

ALT: Alanine transaminase; AST: aspartate transaminase; Cr: creatinine; Mb: myohemoglobin; CK: creatine kinase; LDH: lactate dehydrogenase; and HBDH: α-hydroxybutyrate dehydrogenase.

* The Cr value on 2017.8.18 and 2017.8.27 could not be seen on the copy of the patient's record because they were normal values.

† There were two CK-MB tests in two different test groups, so CK-MB was tested twice and the units were different.

imbalanced and irregular diet, lack of exercise, sleep disorders, and work stress. Statins and fibrates are often applied in the treatment of these diseases. However, rhabdomyolysis is one of the most commonly reported adverse effects of statins and fibrates.[11,15] In addition, pilots suffering hyperlipidemia and hypertension are usually treated with statin and fibrate coadministration. Their liver and renal functions should be tested because the incidence of rhabdomyolysis is more than 10 times higher than separate therapy.[12]

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