

# Management of Rhabdomyolysis and Acute Renal Failure Following Strenuous Exercise in Young Adult: A Case Report

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## Abstract

**Introduction:** Rhabdomyolysis is severe and life threatening condition in which skeletal muscles are damaged by dissolution of striped muscles. Acute kidney injury (AKI) has been widely reported (13% - 50%) as a complication of Rhabdomyolysis in which the main pathophysiological mechanisms are intra-renal vasoconstriction, intraluminal cast formation (Tamm-Horsefall) and direct myoglobin toxicity. In this report we are going to describe the management of Acute Kidney Injury due to Rhabdomyolysis that is not responding to vigorous rehydration. **Objective:** Reporting about acute renal failure induced by Rhabdomyolysis due to Excessive Exercise and dehydration in young patient. **Case Report:** A 20 years male came to the outpatient clinic complaining of sever lower limb pain, back pain and vomiting. He was anuric and hypertensive (BP = 150/90 mmHg) with serum creatinine and urea levels of 15.72 mg/dl and 235 mg/dl, respectively. The diagnosis was based on the laboratory finding of creatine kinase = 3127 IU/l. The patient, then, has been referred to the emergency department. The Management plan was based on two arms: Emergency Management with Urgent Hemodialysis for AKI and high fluid replacement therapy. Patient started to recover after three hemodialysis sessions but the peak of recovery was noted after starting manual fluid replacement therapy with a target urine output of greater than 2 ml/kg, a urine pH of greater than 6. Manual fluid replacement therapy consisted of loop diuretics, intravenous fluids and intravenous sodium bicarbonate 1.26%. Full recovery was noted after one month of hospital admission with inpatient care and regular follow-up. A follow-up after one month has been set to assess the patient progression and monitor his kidney functions. **Relevance and Impact:** Home messages and lessons are; Firstly, young adults

are vulnerable to Rhabdomyolysis, second, the diagnosis of Rhabdomyolysis can be made on the clinical bases but a confirmatory laboratory test of Creatine Kinase is mandatory, and lastly' acute kidney injury needs to be treated urgently. Also, reducing the risk of infection is one of the management objectives to achieve recovery.

## Keywords

Rhabdomyolysis, Acute Kidney Injury, Strenuous Exercise, Case Report, Manual Fluid Replacement Therapy

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## 1. Introduction

This Rhabdomyolysis is a syndrome characterized by muscle necrosis followed by release of intracellular muscle contents into the circulation. The intracellular muscle contents which are released after muscle injury include: Massive plasma myoglobin levels exceeds protein binding (of haptoglobin).

It has numerous causes: use of drugs, muscles trauma, exposure to toxins, infections, hyperthermia, seizures and electrolytes abnormalities leading to cell lysis through ischemia and acidosis [1]-[7].

Strenuous exercise may lead to disintegration of striated muscles, resulting in release of muscles constitutes into extracellular fluid and circulation. This consequently cause pigment-nephropathy and AKI [8] [9]. AKI has been reported to complicate 13% - 50% with average of 33% cases of Rhabdomyolysis [1] [10]. The pathophysiology of AKI induced by Rhabdomyolysis is: intra-renal vasoconstriction, direct tubular toxicity and tubular obstruction by Tamm-Horsfall protein containing casts all of which are precipitated by presence of myoglobin [1].

The Classic Triad of Rhabdomyolysis (Myalgia, Generalized weakness and Darkened urine) is only seen in 50% of patient and it is less common in Children [11]. Physical examination patient may have muscular pain and tenderness, decreased muscle strength, soft tissue swelling and skin changes consistent with pressure necrosis. The most commonly involved muscle groups in adults include: the calves and the lower back. Chest, back and calf pain often mimics other common conditions such as deep vein thrombosis or angina. Peripheral pulses might be intact even after evolving of compartment syndrome because it is very late sign. Even if the patient is lacking the classic history, physical examination findings or both, diagnosis of Rhabdomyolysis should not be rolled out if the suspicion is based on clinical scenario and an appropriate laboratory evaluation should be performed to diagnose muscle damaged and organ dysfunction [4].

Diagnosis of Rhabdomyolysis can be confirmed using certain laboratory studies [12]. For Muscle injury the most reliable and sensitive indicator is creatine

kinase (CK). It presents in serum immediately after muscle injury, rise within 12 hours and reach a peak in 24 - 36 hours, and decrease at a rate of 30% - 40% per day [13]. The serum half-life of CK is approximately 36 hours. CK Levels decline 3 - 5 days after resolution of Muscle injury [12]. Renal profile should be performed. Despite being a diagnostic marker for Rhabdomyolysis, initial creatine kinase levels do not predict mortality. However, creatinine initial levels are related to progression to acute renal injury and mortality at 30 days [14]. Other Routine investigations should be performed such as Complete Blood Count, urine analysis and Serum Chemistries such Glucose, Liver function tests and Potassium to detect complications.

The complications of Rhabdomyolysis beside AKI are: Electrolyte abnormalities such as hyperkalemia, hypocalcemia and hypoalbuminemia, Compartment syndrome and disseminated intravascular coagulation (DIC) [4] [12] [15].

There are few publications on exercise induced Rhabdomyolysis leading to AKI exist in the literature. After taking Clearance and patient consent, we are reporting exercise induced Rhabdomyolysis leading to AKI case of 20 years old male.

## 2. Case Report

### 2.1. Patient Information's and Clinical Findings

A 20 years male was exercising vigorously in a hot and humid weather without keeping a good hydration. 24 hours after his vigorous exercise he came to the outpatient clinic complaining of vomiting everything he eats, lower limbs pain (Myalgia), back pain and he was unable to pass urine. He was referred from the outpatient clinic with a provisional diagnosis of Rhabdomyolysis to the emergency department. The vomiting was following any oral intake. The patient vomited twice before presenting to the outpatient clinic and he was fasting because he did not want to vomit. The patient is not known to have any chronic illnesses (Diabetes Mellitus, Hypertension, Asthma etc.). The patient is not known to have any allergies. He had no history of hospital admission, surgical operations nor blood transfer. The patient is originally from Sennar a state that is around 300 km away to the north of Khartoum the capital of Sudan. There is a family history of DM and hypertension. On examination the patient looked unwell, he was febrile (38°C), His Blood pressure was 151/88 mmHg and his pulse rate was 82 b/min (**Table 1**). He had tender back and lower limbs. No other abnormalities were detected. The following investigation was requested: Creatine Phospho-kinase, Serum phosphorus, Serum Calcium, Serum Uric Acid, Renal function test, complete blood picture and blood film for malaria. The patient was admitted to the emergency ward and planned for the following: urine input/output chart, vigorous fluid replacement therapy with rate of 125 ml/hour and nephrology unit consultation. Results of investigation were available in the 2<sup>nd</sup> day of admission (**Table 2**). The diagnosis has been confirmed in the 4<sup>th</sup> day of admission with the CPK level is 3127 IU/L. The nephrology unit decided 3 urgent hemodialysis sessions for the patient in 2<sup>nd</sup> day of admission. Management

**Table 1.** Showing vital signs during hospital stay.

Days	Vitals			
	Blood pressure	Pulse rate	Respiratory rate	Temperature
1st day	151/88	82	22	38
2nd day	150/90	80	20	36.5
3rd day	130/70	70	18	
4th day	170/90	68	21	
5th day	160/90	80	24	
6th day	180/110	96	20	
7th day	160/90	88	21	
8th day	150/100	86	26	37.3
9th day	160/80	116	32	
10th day	140/90	67	19	
11th day	140/80	94	23	
12th day	170/110	97	20	
13th day	130/70	-	25	
14th day	155/80	80	22	
15th day	140/80	82	22	
16th day	130/90	88	20	
17th day	150/90	72	22	
18th day	-	-	-	
19th day	130/70	74	-	
20th day	-	76	-	
21st day	-	-	-	
22nd day	90/70	110	22	
23rd day	130/80	90	20	
24th day	-	-	-	
25th day	-	-	-	
26th day	140/80	94	22	
27th day	-	-	-	
28th day	140/80	82	21	

with 3 liters of Normal Saline continued along with Ranitidine. After the 2<sup>nd</sup> dialysis session the patient blood pressure started to rise BP = 150/90 mmHg (**Table 1**). Amlodipine 5 mg had been added to the management plan. After the 3<sup>rd</sup> dialysis session the blood pressure was recorded was really high reaching = 170/90 mmHg (**Table 1**). On the 5<sup>th</sup> day of admission the patient completed the 3 urgent dialysis sessions of 9 hours and half with 250 blood flow and ultrafiltration of 2000. The blood pressure was still high with 160/90 and the amlodipine had been increased to 10 mg. The creatine level was 9.2 mg/dl and urea was 90 mg/dl (**Table 2**). The nephrology unit decided to continue the dialysis with a 4<sup>th</sup>

**Table 2.** Showing most important the blood investigations during hospital stay.

Investigations	Days											
	2nd	3rd	4th	5th	9th	13th						
CPK	---	---	3127	---	---	166	93					
Urea	235	204	137	90	94	86	55	95	62	48	28	
Creatinine	15.7	14.8	12.09	9.20	10.67	7.62	3.2	4.1	2.61	0.8	1.1	
S. Magnesium	2.7											
S. Phosphorus	0.2											
S. Potassium	3.6	3.9	4.1	4.1	3.3	3.0	3.8	2.7	3.0	3.7	4.0	
S. Calcium	8.4											
S. Sodium	128	134	147	139	144	145	147	143	144	118	135	
WBC	7.6			7.4					9.0		6.5	
PLT	344			306					500		461	
HB	11.6			10.1					9.1		9.7	
Glucose	195	100	98		102	106	98	93				138
T. Protein	4.7											
Albumin	2.3											
AST	295											
ALT	341											
PTT												
INR												
BFFM	-ve			-ve								
Uric acid			7.39									

session. The fluid input/output chart was not established and patient started to develop puffiness of the face, the patient was still complaining of vomiting and injectable Ondansetron 8 mg once daily had been added to the management plan instead of the pantoprazole 40 mg and the ranitidine 25 mg. On the 6<sup>th</sup> day of admission the fluid input/output chart had been established indicating a positive difference in the input and output chart of 1420 ml not being cleared from the body (**Table 3**). On the 7<sup>th</sup> day of admission the patient developed generalized edema and puffiness of the face. The input/output chart indicated a positive difference of 1500 ml (**Table 3**). Furosemide had been added after several discussion with the nephrology unit. Antihistamine and Hydrocortisone trial had been initiated to guard against hypersensitivity reaction to Amlodipine. On the 8<sup>th</sup> day of admission the patient developed fever temperature was 37.3°C and shortness of breath with respiratory rate of 26 cycle/min (**Table 1**). Arterial blood gases test was obtained (**Table 4**) and the balance in the 8<sup>th</sup> day of admission was 2550 ml positive balance (**Table 3**). Ceftriaxone 1 gm intravenously twice a day and paracetamol one gram intravenously as needed had been added. The furosemide had been stopped based on the recommendation of the nephrology

**Table 3.** Table demonstrates the input and output chart during important hospital milestones.

Days	Input/Output Chart						
	Oral intake	Intravenous	Total Input	Urine output	Vomiting	Total Output	Balance
6th	350 ml	2220 ml	2570 ml	800 ml	250 ml	1150 ml	1420 ml
7th	100 ml	3000 ml	3100 ml	1500 ml	100 ml	1600 ml	1500 ml
8th	450 ml	3500 ml	3950 ml	1200 ml	200 ml	1400 ml	2550 ml
9th	1700 ml	3100 ml	4800 ml	1900 ml	200 ml	2100 ml	2700 ml
11th	1800 ml	2500 ml	4300 ml	3500 ml	0 ml	3500 ml	800 ml

**Table 4.** Arterial blood gas upon admission.

ABG	Results
pH	7.399
pCO <sub>2</sub>	27.7 mmHg
pO <sub>2</sub>	126 mmHg
HCO <sub>3</sub> <sup>-1</sup>	17.3 mmol/l
SpO <sub>2</sub>	98.9%
Na <sup>+</sup>	137 mmol/l
K <sup>+</sup>	3.5 mmol/l
Lactic acid	1.1 mmol/l
Anion gap	12.1
Hb	9.9 g/dl

unit. After thoroughly discussing the case with the nephrology unit the fluids had been shifted to fluid therapy with bicarbonate. The plan of fluids was as following: 4 liters of fluids divided; into 1 liter of Dextrose 5% with Sodium bicarbonate 75 ml, alternating with 1 liter of Normal Saline every 6 hours. On the 9<sup>th</sup> day BP was 160/80 mmHg, fever has stopped and vomiting decreased to 2 times per day RR was 32 cycle/minute (**Table 1**). Hypersensitivity drugs had been stopped and fluid balance was positive with 2700 ml and the urine output increasing to 1900 ml per day (**Table 3**). The high fluids therapy with bicarbonate showed tremendous improvement in the renal function test (**Table 2**). The patient underwent the 4<sup>th</sup> dialysis session in the 11<sup>th</sup> day of admission. After the hemodialysis session and fluid therapy, the facial swelling and puffiness has subsided slightly. The fluid and bicarbonate therapy continued and Ondansetron had been increased to be administered twice a day and promethazine hydrochloride to be administered if needed. The facial swelling and urine output improved as the balance had reach almost positive 800 ml (**Table 3**). CPK was done in the 13<sup>th</sup> day of admission and found to be 166 IU/L. The renal function test was improving with combination of fluid therapy and bicarbonate Sodium (**Table 2**). Blood pressure started to be maintained with Amlodipine 10 mg daily (**Table 1**). On the 17<sup>th</sup> day of admission CPK found to be 93 IU/L. On the 22<sup>st</sup> day of ad-

mission the patient had low potassium in his RFT as he did not establish oral feeding well due to his fear of vomiting. KCL 30 mmol had been added to his fluid therapy three times per day (Total of 1.5 L of NS) and bicarbonate sodium had been stopped. Regular Ondansetron had been shifted to be administered if there was vomiting and antihypertensive had been stopped. On the 22<sup>th</sup> day of the patient started to develop fever, chills and shivering. TWBCs was high (**Table 2**) and he vomited twice his blood pressure was 90/60 mmHg (**Table 1**). Urine catheter had been inserted for more than 21 days which led to UTI. Antibiotics had been changed to vancomycin and cefepime with renal impairment consideration. Fluids had been increased to 1 liter and 30 mmol KCL 3 times a day. Catheter had been removed. On the 26<sup>th</sup> day of admission the patient RFT has normalized and he started full oral intake (**Table 2**). Urinary Catheter had been removed 2 days previously and dialysis catheter planned to be removed after discharge. On the 28<sup>th</sup> day of admission patient discharge decision has been taken by a joint meeting between Medicine unit and nephrology unit. A follow-up after 1 month was scheduled. The follow-up will be mainly to assess the kidneys function and to measure the blood pressure. The prognosis after full recovery from the Acute Kidney injury is promising.

## 2.2. Discussion

This case needed close monitoring and multidisciplinary team approach as the internal medicine joined effort with the nephrology unit and nursing staff of the general ward. The integration of manual fluid replacement and bicarbonate usage was new to all nursing and junior doctors as it is not used regularly.

Strengths of this case included the early diagnosis of the case has led to prompt management. A strong support of the diagnosis was the CK levels that were tested very early after the presentation was which was very high with more than 3000 (**Table 2**). One of the main limitations was in spite of the early diagnosis of Rhabdomyolysis, Acute kidney failure which has responded to hemodialysis only. A major limitation was the catheter associated infection which has slowed down the recovery and increased inpatient stay. The urinary catheter has stayed for more than 14 days which indicated poor documentation and handover.

Relevant literature and case reports:

The presentation was almost typical in this case with exception of red urine. The patient was not able to pass urine in the presentation. Usually the presentation of the Rhabdomyolysis patient is muscle pain and red urine [1]. The severity of this is demonstrated by the presentation of the patient with acute kidney injury which a sign of the severity of the case [16]. There are cases that have been reported with higher CK levels but it has not reach the severity of this case with acute kidney injury [16]. The management of this case is considered the classic management of any patient presenting with acute kidney injury induced by Rhabdomyolysis [6].

Take home messages are fluid replacement should not be delayed. The invasive devices should be checked their duration should be documented in the patient chart and files. The earlier removal of invasive devices should be considered if deemed appropriate as hospital acquired infection is always expensive in terms of hospital stay and financial burden.

The patient consent has been taken from the patient himself and the case report has been discussed with him and the importance of the case report has been explained too.

### 2.3. Conclusion

Rhabdomyolysis can be expected in young adults especially after strenuous exercise. The patient should be treated promptly as multi-organ failure is a complication associated with the delay of management. The manual fluid therapy should be initiated immediately and compartment syndrome management should be avoided as it can delay the recovery, though, it should not be delayed if needed.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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