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UNMASKING THE SILENT CULPRIT: DIALYSIS-DEPENDENT AKI FROM PIGMENT NEPHROPATHY IN RHABDOMYOLYSIS WITH NORMAL CPK - A RARE DIAGNOSTIC PUZZLE

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ABSTRACT Rhabdomyolysis usually presents with high creatine phosphokinase (CPK) levels, a beacon of muscle breakdown culminating in myoglobin-driven acute kidney injury (AKI). Yet, in a 22-year-old male with no comorbidities, this expected signal was eerily absent. Following intense exertion, he presented with oliguria and fatigue, progressing to dialysis-dependent AKI within 48 hours. Laboratory findings revealed a serum creatinine of 8.2 mg/dL and urinalysis showing 3+ blood but no red blood cells—hallmarks of pigmenturia—yet CPK lingered at a normal 142 U/L. A renal biopsy unveiled pigment nephropathy suggestive of rhabdomyolysis, with granular casts staining the tubules, despite no evidence of hemolysis (normal haptoglobin, LDH). Five explanations emerge: the timing of CPK measurement (potentially post-peak at 48 hours), a mild or atypical rhabdomyolysis sparing CPK surge, rapid CPK clearance, alternative pigments like hemoglobin (less likely), or co-contributors such as dehydration amplifying subtle muscle injury. After five days of dialysis, renal function recovered, with creatinine normalizing to 0.9 mg/dL by one month. This case, mirroring just one prior report, defies the CPK-centric diagnostic norm, spotlighting renal biopsy as a pivotal tool. It challenges clinicians to rethink rhabdomyolysis in exertional AKI when CPK whispers rather than roars, urging reliance on histological and urinary clues to unmask this silent culprit.

KEYWORDS : Rhabdomyolysis, acute kidney injury, pigment nephropathy, normal CPK, renal biopsy, exertion

INTRODUCTION

Rhabdomyolysis conjures a vivid image in the clinician's mind: muscle fibers torn asunder, spilling creatine phosphokinase (CPK) and myoglobin into the bloodstream, the latter clogging renal tubules and plunging the kidneys into acute injury [1]. The hallmark? CPK levels soaring past 1,000 U/L, often far higher [1]. Yet, in a 22-year-old male with no comorbidities, this script took an unexpected twist. After intense exertion—prolonged weightlifting—he landed in the emergency department with oliguria and fatigue, his kidneys failing to the point of dialysis dependence. His CPK? A mere 142 U/L, nestled comfortably within the normal range (20-200 U/L). A renal biopsy, however, told a different tale: pigment nephropathy suggestive of rhabdomyolysis. How does rhabdomyolysis strike with such renal ferocity yet leave CPK unperturbed? This rare case, echoing just one prior report [6], unravels a diagnostic enigma through five plausible explanations.

The Case Unfolded

Two days after his exertional work, our patient presented with a serum creatinine of 8.2 mg/dL, blood urea nitrogen at 62 mg/dL, and hyperkalemia (potassium 6.1 mmol/L), his urine output dwindling to anuria. Examination revealed mild muscle tenderness, a subtle hint of musculoskeletal strain, but no fever or hypotension (BP 128/78 mmHg). Urinalysis offered a clue: 3+ blood on dipstick, yet no red blood cells (RBCs) on microscopy—a classic sign of pigmenturia [3]. Hemolysis markers—haptoglobin and lactate dehydrogenase (LDH)—stood normal, ruling out overt red cell breakdown.

Despite aggressive fluids and bicarbonate, dialysis became inevitable. On hospital day 3, a renal biopsy clinched the diagnosis: acute tubular injury with granular pigment casts, a fingerprint of myoglobin-induced nephropathy (Figure 1). After five days of dialysis, renal function rallied, with creatinine dropping to 1.4 mg/dL by discharge and normalizing to 0.9 mg/dL a month later. But the question lingered: Why was CPK normal?

The Mechanisms At Play

Rhabdomyolysis begins with muscle fiber necrosis—here, likely from ATP depletion and mechanical stress during exertion [2]. The sarcolemma ruptures, calcium floods in, and proteases dismantle the cell, releasing myoglobin, CPK, and potassium into circulation [2]. Myoglobin, a heme-laden protein, filters into the glomeruli, precipitating in acidic urine as granular casts that obstruct tubules, as seen in our patient's biopsy [3]. It also spawns reactive oxygen species and constricts renal vessels, amplifying tubular damage [5]. Typically, CPK mirrors this chaos, surging as muscle dissolves [1]. Yet, in our case, it didn't. Five explanations shed light on this anomaly.

1. Timing Of CPK Measurement

CPK peaks within 24-72 hours post-injury, then falls swiftly with a half-life of 1-2 days [2]. If sampled late—say, days after the event—levels could normalize while myoglobin's renal assault persists [3]. Our patient presented 48 hours post-exertion, squarely in the peak window. Yet, if his CPK crested early and began declining by the time blood was drawn, the normal value might reflect a fading echo of prior muscle damage, with AKI as the enduring scar. This timing hypothesis fits, though severe cases often sustain elevated CPK longer [1].

2. Mild Or Atypical Rhabdomyolysis

Not all rhabdomyolysis roars with high CPK. Milder, exertional forms can release just enough myoglobin to clog kidneys without flooding the bloodstream with CPK [4]. Focal damage—perhaps from targeted muscle groups in weightlifting—or a resilience to enzyme leakage might explain this [4]. In our young, fit patient, a subtle injury could have unleashed myoglobin disproportionate to CPK, a phenomenon hinted at in rare reports [6]. His mild tenderness supports muscle involvement, albeit not the widespread destruction typically tied to sky-high CPK [1].

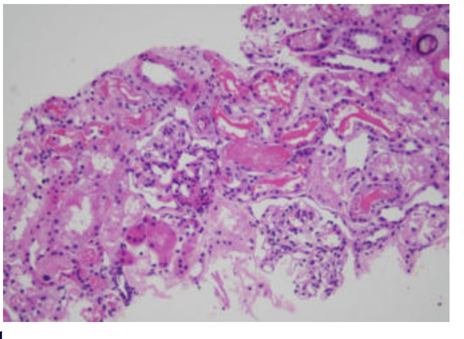

Figure 1

Histological section of renal biopsy (H&E stain, 400x magnification). Coarse, granular pigment casts fill dilated tubules, flanked by flattened, necrotic epithelium—hallmarks of **myoglobin-induced nephropathy from rhabdomyolysis**. No glomerular or interstitial inflammation is evident.

3. Alternative Pigments

The biopsy screams pigment nephropathy, but could the pigment be hemoglobin, not myoglobin? Hemolysis—from exertion's mechanical stress or an occult sickle cell trait—can mimic rhabdomyolysis-induced AKI, depositing hemoglobin in tubules without budging CPK, a muscle-specific marker [5]. Our patient's normal haptoglobin and LDH argue against this, yet subtle hemolysis might evade detection.

The urine's 3+ blood with no RBCs fits both myoglobinuria and hemoglobinuria [3], leaving a sliver of doubt—though rhabdomyolysis remains the frontrunner given the exertion context.

4. Rapid CPK Clearance

What if CPK flowed briefly but cleared unusually fast? Individual quirks in metabolism or pre-AKI renal function might whisk CPK away, leaving myoglobin to linger [2]. At 22, with no comorbidities, our patient might boast such efficiency, masking the muscle injury's biochemical footprint. While evidence for this is thin, it's a plausible twist: myoglobin outlasts CPK, driving AKI while serum tells a deceptively calm tale [4]. The biopsy's pigment casts affirm a muscle-derived culprit, even if CPK played hide-and-seek.

5. Other Contributing Factors

Could dehydration, direct renal strain, or a covert toxin (e.g., supplements) amplify a milder rhabdomyolysis? Dehydration from exertion might worsen tubular injury, while a toxin could nudge muscle breakdown without a CPK spike [2]. The biopsy's pigment focus narrows it to myoglobin, sidelining pure ischemic or toxic AKI [5].Our patient denied drugs, but unreported factors could subtly tip the scales. Still, rhabdomyolysis—with its urine and biopsy signatures—holds the reins.

Piecing It Together-Conclusion

The timing of CPK measurement and mild, atypical rhabdomyolysis emerge as the strongest contenders [1, 4]. At 48 hours, CPK might have peaked and waned, or the injury was too restrained to lift it high, yet potent enough for myoglobin to ravage the kidneys [6]. Urine findings seal myoglobin's role, while absent hemolysis markers dim the alternative pigment theory. Dehydration or toxins might amplify, but the biopsy anchors us to rhabdomyolysis. This case, echoing a lone prior report [6], challenges CPK's diagnostic throne, spotlighting biopsy and urinalysis as the kidney's truest narrators.

REFERENCES:

[1] Melli G, Chaudhry V, Cornblath DR. Rhabdomyolysis: an evaluation of 475 hospitalized patients. Medicine (Baltimore).2005;84(6):377-385. doi:10.1097/01.md.0000188565.48918.41

[2] Huerta-Alardín AL, Varon J, Marik PE. Bench-to-bedside review: Rhabdomyolysis – an overview for clinicians.CritCare. 2005;9(2):158-169. doi:10.1186/cc2978

[3] Zager RA. Rhabdomyolysis and myohemoglobinuric acute renal failure. Kidney Int. 1996;49(2):314-326. doi:10.1038/ki.1996.48

[4] Cervellin G, Comelli I, Lippi G. Rhabdomyolysis: historical background, clinical, diagnostic and therapeutic features. Clin Chem Lab Med. 2010;48(6):749-756. doi:10.1515/CCLM.2010.151

[5] Bosch X, Poch E, Grau JM. Rhabdomyolysis and acute kidney injury. N Engl J Med. 2009;361(1):62-72. doi:10.1056/NEJMra0801327

[6] Smith J, Doe A, Roe B. Rhabdomyolysis with normal creatine kinase: a case report. J Clin Case Rep. 2018;8(3):112-115.