Turk J Intensive Care 2026;24(3):209-215
DOI: 10.63729/TJIC.2026.705

CASE REPORT

Carnitine palmitoyltransferase II deficiency: a case of post-infectious rhabdomyolysis and respiratory failure

Hicret Yeniay[1], Volkan Yarar[1], Gökhan Kılınç[2], Yakup Özgüngör[3], Mensure Çakırgöz[3]

[1]Department of Intensive Care, Balıkesir City Hospital, Balıkesir, Türkiye
[2]Department of Anesthesiology and Reanimation, University of Health Sciences, Balıkesir Atatürk City Hospital, Balıkesir, Türkiye
[3]Department of Intensive Care, İzmir City Hospital, İzmir, Türkiye

ABSTRACT

Carnitine palmitoyltransferase II (CPT-II) deficiency is an autosomal recessive inherited metabolic disorder and represents the most common genetic cause of recurrent rhabdomyolysis in adulthood. The clinical course is characterized by episodic attacks precipitated by intense physical exertion, infections, psychological stress, or other physical and emotional stressors. Although avoidance or early recognition of triggering factors plays a critical role in prognosis, many patients continue to experience recurrent episodes of rhabdomyolysis. Management primarily focuses on elimination of precipitating factors and meticulous correction of fluid and electrolyte imbalances. Prompt recognition of CPT-II deficiency and rapid identification and management of rhabdomyolysis triggers are essential for preventing life-threatening complications.

We report the clinical characteristics, therapeutic interventions, and outcome of a 31-year-old male patient with known CPT-II deficiency. The patient presented with dyspnea and generalized muscle weakness following an infectious episode. Laboratory evaluation revealed markedly elevated creatine kinase levels, and rhabdomyolysis secondary to CPT-II deficiency was diagnosed. The patient received supportive management, including intravenous fluid therapy for electrolyte stabilization, close monitoring in the intensive care unit, and treatment with triheptanoin. His symptoms improved gradually, and he was discharged in stable condition with recommendations emphasizing avoidance of known triggers and long-term disease management.

This report aims to underscore the importance of early diagnosis and timely therapeutic intervention in the management of CPT-II deficiency.

Keywords: CPT-II deficiency, rhabdomyolysis, respiratory failure, triheptanoin

Introduction

The CPT2 gene is inherited in an autosomal recessive manner. Although rare, carnitine palmitoyltransferase II (CPT-II) deficiency represents one of the most common genetic causes of rhabdomyolysis in adults (1) Approximately 300 cases have been reported in the literature; however, the true prevalence is likely underestimated (2) The enzymes CPT-I and CPT-II play pivotal roles in the transport of long-chain fatty acids into the mitochondria and, consequently, in the β-oxidation pathway. Long-chain fatty acid oxidation constitutes a major source of cellular energy production during periods of increased metabolic demand, such as prolonged or intense exercise, fasting, cold exposure, and psychological stress. Accordingly, CPT-II deficiency becomes clinically manifest under such stress conditions. In affected individuals, impaired translocation of acyl-carnitine across the mitochondrial membrane results in insufficient intramitochondrial acyl-CoA availability for β-oxidation, ultimately leading to cellular energy deficiency (3).

CPT-II deficiency is classified into three principal phenotypic forms. The neonatal and infantile forms

✉ Hicret Yeniay • hicret.yeniay@yahoo.com

Received: 25.08.2025 **Accepted:** 23.02.2026 **Published online:** 24.09.2026

present early in life, are associated with severe hypoketotic hypoglycemia and high mortality, and typically follow a critical clinical course. In contrast, the adult-onset myopathic form is generally milder and is characterized by recurrent episodes of myalgia, muscle weakness, and rhabdomyolysis triggered by prolonged exercise. The clinical spectrum of the adult form is heterogeneous; some individuals remain asymptomatic for extended periods, whereas others experience frequent and severe attacks (1,4).

Therapeutic strategies primarily focus on avoidance of precipitating factors, including fasting, strenuous exercise, and infections, as well as metabolic load reduction. Low-fat, high-carbohydrate diets are commonly recommended, and supplementation with medium-chain triglycerides (MCTs) has been reported to alleviate symptoms in certain cases (2,5) In recent years, triheptanoin—a synthetic odd-chain medium-chain triglyceride—has been approved as a promising therapeutic option for long-chain fatty acid oxidation disorders, including CPT-II deficiency. Nevertheless, long-term efficacy data remain limited (6).

Although CPT-II deficiency may present in childhood with variable organ involvement and biochemical abnormalities, the adult-onset form is most commonly characterized by exercise-induced rhabdomyolysis and myoglobinuria. The acyl-carnitine profile is widely used as a first-line diagnostic tool; however, in some late-onset cases, this profile may be normal, and definitive diagnosis may only be established through molecular genetic testing (7). Even during acute episodes, routine biochemical screening may yield normal results, thereby underscoring the importance of molecular genetic analysis. A case report published in 2024 highlighted that pathogenic CPT2 mutations may be identified despite normal biochemical screening, emphasizing the critical role of molecular testing in confirming the diagnosis (8).

These findings suggest that CPT-II deficiency should be considered in the differential diagnosis of patients presenting with recurrent rhabdomyolysis or unexplained respiratory failure, even in the presence of normal standard biochemical markers such as acyl-carnitine profiles or triglyceride levels. This consideration is particularly relevant for emergency and intensive care physicians, as reliance solely on routine metabolic screening may delay diagnosis and appropriate metabolic management (8).

From an anesthesiology perspective, perioperative complications have been reported in patients with CPT-II deficiency. Although a potential association between CPT-II deficiency and susceptibility to malignant hyperthermia has been proposed, evidence supporting the role of volatile anesthetic agents or succinylcholine in triggering malignant hyperthermia-like reactions remains limited (9). Propofol infusion has been discouraged by some experts due to concerns regarding the risk of propofol infusion syndrome (10). Furthermore, an experimental rat model of CPT-II deficiency demonstrated an association with bupivacaine-induced cardiotoxicity (11).

In this case report, we describe a 31-year-old male patient who presented to the emergency department with respiratory failure following an infectious episode. Rare metabolic disorders, including mitochondrial myopathies and CPT-II deficiency, may initially manifest as acute rhabdomyolysis and respiratory failure. This report aims to emphasize the importance of early recognition and timely therapeutic intervention in the management of CPT-II deficiency.

Case report

A 31-year-old male patient, with no history of smoking or alcohol consumption, measuring 185 cm in height and weighing 75 kg, had been previously evaluated for recurrent episodes of rhabdomyolysis and was diagnosed with CPT-II deficiency approximately five years earlier. Since the diagnosis, he has been regularly followed by specialists in endocrinology and metabolism, as well as a dietitian. He has been receiving triheptanoin therapy and adheres to a low-fat, high-carbohydrate diet while strictly avoiding prolonged fasting.

Three days after the onset of upper respiratory tract infection symptoms, the patient presented to the emergency department with acute worsening dyspnea and high-grade fever. On initial assessment, he was conscious, tachypneic, and hypoxemic. Laboratory investigations demonstrated a marked elevation in creatine kinase (CK) levels (increasing from 19,834 U/L to 50,254 U/L), a dramatic rise in liver enzymes (AST/ALT from 354/120 U/L to 1101/457 U/L), and elevated troponin I (cTnI) levels (from 5.7 ng/mL to 11.5 ng/mL). In contrast, blood urea nitrogen (BUN) and serum creatinine levels were within normal limits (Table 1). Venous blood gas (VBG) analysis revealed acidosis, hypercapnia, and hypoxemia (pH 7.29, pCO_2 59 mmHg, pO_2 20 mmHg) (Table 2).

The patient was admitted to the intensive care unit (ICU) by the critical care team. Empirical intravenous antibiotics (ceftriaxone and moxifloxacin) were initiated for the suspected underlying infection, along with fluid and electrolyte replacement and targeted metabolic management for rhabdomyolysis. Urine, blood, and respiratory tract cultures were obtained, and a respiratory PCR panel was sent. A chest radiograph was performed as part of the diagnostic evaluation. Although tachypnea improved, persistent hypoxemia continued. Due to poor tolerance of noninvasive mechanical ventilation and significant agitation in the setting of ongoing hypoxemia, elective endotracheal intubation was performed.

Given the underlying fatty acid oxidation disorder, propofol was avoided because of the potential risk of propofol infusion syndrome. Sedation was achieved with midazolam and fentanyl in a manner aimed at preserving hemodynamic stability and minimizing additional metabolic burden. Neuromuscular blockade was induced with rocuronium, followed

Table 1. Distribution of laboratory parameters throughout the clinical course.

Parameter	Value 1	Value 2	Value 3	Value 4	Value 5
White Blood Cell (WBC, ×10³/µL)	10.42	9.41	6.25		
Hemoglobin (Hb, g/dL)	16.9	16.8	14.3		
Hematocrit (HCT, %)	48.5	48.5	44.2		
Platelet (PLT, ×10³/µL)	212	186	178		
Neutrophil (NEU, ×10³/µL)	8.28	8.58	3.75		
Lymphocyte (LYM, ×10³/µL)	0.98	0.66	1.66		
Urea (mg/dL)	35	17	53	35	32
Creatinine (mg/dL)	0.96	1.26	2.5	0.99	0.82
Aspartate Aminotransferase (AST, U/L)	354	500	552	1101	962
Alanine Aminotransferase (ALT, U/L)	120	161	185	336	457
Creatine Kinase (CK, U/L)	19.834	27.539	28.234	50.254	32.593
Creatine Kinase-MB (CK-MB, U/L)	457	494	226	308	236
C-Reactive Protein (CRP, mg/L)	3.69	7.36			
Procalcitonin (ng/mL)	0.14	0.07			
Albumin (g/L)	45.2	44	31		
Potassium (K, mmol/L)	3.90	3.95	3.68	3.76	
Sodium (Na, mmol/L)	140	137	142	140	
Direct Bilirubin (mg/dL)	0.12	0.10	0.11	0.08	
Total Bilirubin (mg/dL)	0.50	0.46	0.48	0.37	
Ammonia (µmol/L)	33.4	53.6	48.6		
Troponin (ng/mL)			5.70	11.5	6

WBC: White Blood Cell, Hb: Hemoglobin, Hct: Hematocrit, PLT: Platelet, NEU: Neutrophil, LYM: Lymphocyte, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, CK: Creatine kinase, CK-MB: Creatine Kinase-MB isoenzyme, CRP: C-reactive protein.

Table 2. Changes in venous blood gas parameters during the intensive care unit (ICU) stay.

	ph	PCO_2 (mmHg)	PO_2 (mmHg)	HCO_3 (mEq/L)	Laktat (mmol/L)	O_2 Sat (%)
1	7.29	57.4	20.3	22.5	0.4	28.2
2	7.25	64.9	18.8	21.5	1.7	31.4
3	7.39	39.0	41.0	23.4	2.1	80.4
4	7.39	52.6	22.8	29.4	1.5	84.8
5	7.35	59.3	43.0	28.4	1.6	80.7
6	7.44	39.0	51.0	26.6	1.7	90.5
7	7.35	56.0	55.0	27.0	1.3	75.0
8	7.38	51.0	37.0	27.0	0.9	69.5

by endotracheal intubation and initiation of invasive mechanical ventilation (IMV).

Early in the course of rhabdomyolysis management, aggressive intravenous isotonic crystalloid therapy was administered. Fluid therapy was titrated to achieve a target urine output of ≥1–2 mL/kg/hour. Serum CK levels, renal function parameters, and electrolytes were monitored serially. When clinically indicated, urine alkalinization was performed, with a target urine pH >6.5. Electrolyte abnormalities were corrected appropriately. On the following day, the patient was successfully extubated and transitioned to high-flow nasal oxygen (HFNO) therapy in conjunction with respiratory physiotherapy. Oxygen support was gradually tapered over the subsequent days, first to nasal cannula and ultimately to room air, with maintenance of stable oxygenation.

During clinical follow-up, progressive improvement in metabolic parameters was observed. CK, AST, ALT, and cTnI levels declined steadily, while ABG parameters and oxygen saturation normalized. Under multidisciplinary care, triheptanoin dosing and dietary management were meticulously maintained. The patient's clinical condition stabilized, and he was transferred from the ICU to the general ward in good overall condition.

Discussion

Currently, no disease-specific standardized intensive care protocol exists for CPT-II deficiency. However, in patients with fatty acid oxidation disorders, prevention of metabolic stress constitutes the cornerstone of management. Avoidance of fasting, provision of adequate carbohydrate supplementation, restriction of lipid load, and prevention of catabolism are essential components of care. In cases complicated by rhabdomyolysis, early and aggressive fluid resuscitation is fundamental to preserving renal function. Furthermore, avoidance of agents that may inhibit mitochondrial fatty acid oxidation—such as propofol—is recommended. A multidisciplinary approach plays a critical role in maintaining metabolic stability (2,10,12).

At present, there is no curative therapy for carnitine palmitoyltransferase II (CPT-II) deficiency, and existing treatment strategies are primarily directed toward symptom control and prevention of metabolic crises (12). The principal therapeutic objectives during acute rhabdomyolysis episodes include prevention of acute kidney injury, correction of life-threatening electrolyte disturbances, and cessation of ongoing muscle breakdown. The literature emphasizes that early, multidisciplinary management and intensive care support are potentially life-saving, particularly during severe metabolic crises (13). In a systematic review by Ivin et al., a substantial proportion of CPT-II–associated rhabdomyolysis cases required organ support, underscoring the severity of such episodes (5).

Early and aggressive intravenous crystalloid fluid resuscitation remains the cornerstone of rhabdomyolysis management. This strategy is critical

for correcting hypovolemia, preventing acute kidney injury, and enhancing renal clearance of myoglobin. Strict bed rest and carbohydrate supplementation have also been reported to reduce the severity of muscle injury during acute attacks in CPT-II deficiency. Patients should be strongly advised to avoid strenuous physical activity (12).

From a nutritional perspective, low-fat, high-carbohydrate diets and minimization of fasting periods contribute to metabolic stability. Prevention of hypoglycemia is particularly important, as it reduces the risk of arrhythmias and rhabdomyolysis (14). In recent years, medium-chain triglycerides such as triheptanoin have emerged as promising therapeutic alternatives for long-chain fatty acid oxidation disorders. Triheptanoin supports the tricarboxylic acid (TCA) cycle through the generation of acetyl-CoA and propionyl-CoA, thereby mitigating cellular energy deficits. Clinical reports suggest a reduction in both the frequency and severity of rhabdomyolysis episodes with triheptanoin therapy; however, long-term safety and efficacy data remain limited (6). By providing anaplerotic substrates to the TCA cycle, triheptanoin may enhance cellular energy production during metabolic stress. Nevertheless, its use in the intensive care setting should be individualized and closely monitored. Although long-term efficacy data in CPT-II deficiency remain limited, current evidence suggests a potential therapeutic benefit (15). In our case, triheptanoin-supported metabolic therapy was considered to have contributed to clinical recovery.

As in other metabolic myopathies, rhabdomyolysis represents the most common cause of hospital admission in patients with CPT-II deficiency. In most cases, episodes are triggered by identifiable precipitating factors (12) Although rhabdomyolysis and respiratory failure are well-recognized entities in critical care practice, the coexistence of infection-triggered rhabdomyolysis and hypercapnic respiratory failure in adult-onset CPT-II deficiency has been rarely addressed in the literature. Respiratory failure in CPT-II deficiency is infrequently reported and remains a noteworthy clinical presentation (16).

Infection is a well-established trigger of metabolic decompensation and rhabdomyolysis in patients with CPT-II deficiency. Recent case reports and reviews emphasize that early identification of the infectious agent and timely initiation of appropriate antimicrobial therapy are essential to limit metabolic stress and prevent severe organ dysfunction (14-16). Accordingly, whenever feasible, identification of the causative microorganism and administration of targeted antimicrobial therapy may represent a critical component of management beyond empirical treatment alone.

At presentation, the patient exhibited fever and respiratory distress. Initial laboratory parameters did not demonstrate marked abnormalities beyond mild elevations consistent with a systemic inflammatory response. Imaging studies did not reveal findings suggestive of pneumonia. Despite the absence of definitive bacterial infection, empirical intravenous antibiotic therapy (ceftriaxone and moxifloxacin) was initiated due to the patient's severe metabolic stress, the risk of secondary bacterial infection, and the anticipated need for intensive care interventions. Blood and sputum cultures yielded no growth. The respiratory viral panel was positive for respiratory syncytial virus (RSV). With clinical improvement, inflammatory parameters regressed. Viral infections, particularly respiratory viruses such as RSV, constitute significant metabolic stressors capable of precipitating decompensation and rhabdomyolysis in patients with CPT-II deficiency.

In this case, infection was identified as the precipitating factor. CK levels exceeding 50,000 U/L and marked elevations in AST and ALT were interpreted as indicators of severe muscle injury. Troponin I levels increased up to 11.5 ng/mL. However, the patient did not exhibit typical anginal symptoms, dynamic ST-segment changes, or hemodynamic instability suggestive of acute coronary syndrome. Electrocardiography revealed no ischemic abnormalities, and transthoracic

echocardiography demonstrated preserved left ventricular systolic function without regional wall motion abnormalities. The troponin elevation was therefore attributed to secondary myocardial injury related to systemic inflammatory response and metabolic stress associated with rhabdomyolysis. Troponin levels declined in parallel with clinical improvement.

Arterial blood gas analysis and clinical progression were consistent with severe respiratory failure. The pathophysiology of respiratory failure in this case was likely multifactorial and could not be explained solely by infection-related hypoxemia. In CPT-II deficiency, impaired long-chain fatty acid oxidation leads to pronounced energy deficiency in skeletal and respiratory muscles during periods of increased metabolic demand. This may result in early diaphragmatic fatigue and reduced ventilatory reserve. Moreover, the systemic inflammatory response accompanying acute rhabdomyolysis may further impair respiratory muscle performance through cytokine-mediated dysfunction and mitochondrial impairment. Infection likely amplified metabolic stress and energy depletion, thereby facilitating the development of hypercapnic respiratory failure.

Reviews examining the association between rhabdomyolysis and multiorgan dysfunction suggest that the metabolic burden of extensive muscle breakdown may affect not only renal function but also other organ systems, including the respiratory system (17-19). In our patient, the observed hypercapnia and requirement for mechanical ventilation can be attributed to the combined effects of respiratory muscle fatigue, cellular energy deficiency, and infection-triggered systemic inflammation.

Systematic reviews indicate that patients with CPT-II–associated rhabdomyolysis frequently require intensive care support, further highlighting the importance of early recognition and prompt management (5). In the present case, however, a multidisciplinary approach, early intensive care intervention, rapid diagnostic assessment, and timely initiation of metabolic therapy enabled successful extubation and clinical stabilization. These findings underscore the critical role of early intervention and close monitoring in the management of severe metabolic crises associated with CPT-II deficiency.

Conclusion

In patients with CPT-II deficiency, infections may precipitate severe rhabdomyolysis and respiratory failure. In cases of abrupt clinical deterioration associated with infection, early intensive care support and prompt initiation of targeted metabolic therapy may be life-saving. Fatty acid oxidation disorders should be considered in the differential diagnosis of unexplained rhabdomyolysis accompanied by hypercapnic respiratory failure.

Acknowledgments

We thank the anesthesiology and intensive care teams for their valuable contributions to patient management.

Ethical approval

Written informed consent for publication was obtained from the patient.

Author contribution

Study conception and design: HY, GK, MÇ; data collection: HY, VY, YÖ; analysis and interpretation of results: HY, GK, MÇ; draft manuscript preparation: HY; critical review and supervision: GK, MÇ. All authors reviewed the results and approved the final version of the manuscript.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

References

1. Lehmann D, Motlagh L, Robaa D, Zierz S. Muscle carnitine palmitoyltransferase II deficiency: a review of enzymatic controversy and clinical features. Int J Mol Sci. 2017;18:82. [Crossref]
2. Avila-Smirnow D, Boutron A, Beytía-Reyes MLÁ, et al. Carnitine palmitoyltransferase type 2 deficiency: novel mutation in a Native South American family with whole-body muscle magnetic resonance imaging findings: two case reports. J Med Case Rep. 2018;12:249. [Crossref]
3. Joshi PR, Zierz S. Muscle carnitine palmitoyltransferase II (CPT II) deficiency: a conceptual approach. Molecules. 2020;25:1784. [Crossref]
4. Çakar NE, Gör Z, Yeşil G. Cause of recurrent rhabdomyolysis, carnitine palmitoyltransferase II deficiency and novel pathogenic mutation. Ideggyogy Sz. 2021;74:135-8. [Crossref]
5. Ivin N, Della Torre V, Sanders F, Youngman M. Rhabdomyolysis caused by carnitine palmitoyltransferase 2 deficiency: a case report and systematic review of the literature. J Intensive Care Soc. 2020;21:165-73. [Crossref]
6. Gillingham MB, Heitner SB, Martin J, et al. Triheptanoin versus trioctanoin for long-chain fatty acid oxidation disorders: a double blinded, randomized controlled trial. J Inherit Metab Dis. 2017;40:831-43. [Crossref]
7. Ambrose A, Sheehan M, Bahl S, et al. Outcomes of mitochondrial long chain fatty acid oxidation and carnitine defects from a single center metabolic genetics clinic. Orphanet J Rare Dis. 2022;17:360. [Crossref]
8. Lu CH, Yang CF, Chen YR, Chen YJ, Lu YH, Niu DM. Recurrent rhabdomyolysis caused by palmitoyltransferase II (CPT-2) deficiency but complete normal acylcarnitine profile: a patient presentation and review of the literature. Mol Genet Metab Rep. 2024;41:101151. [Crossref]
9. Hogan KJ, Vladutiu GD. Malignant hyperthermia-like syndrome and carnitine palmitoyltransferase II deficiency with heterozygous R503C mutation. Anesth Analg. 2009;109:1070-2. [Crossref]
10. Yu HK, Ok SH, Kim S, Sohn JT. Anesthetic management of patients with carnitine deficiency or a defect of the fatty acid β-oxidation pathway: a narrative review. Medicine (Baltimore). 2022;101:e28853. [Crossref]
11. Wong GK, Crawford MW. Carnitine deficiency increases susceptibility to bupivacaine-induced cardiotoxicity in rats. Anesthesiology. 2011;114:1417-24. [Crossref]
12. Kido J, Matsumoto S, Ito T, et al. Physical, cognitive, and social status of patients with urea cycle disorders in Japan. Mol Genet Metab Rep. 2021;27:100724. [Crossref]
13. Blah N, Sudrié-Arnaud B, Torre S, Marret S, Bekri S, Tebani A. Acute respiratory infection unveiling CPT II deficiency. Int J Mol Sci. 2018;19:2950. [Crossref]
14. Angelini C, Pennisi E, Missaglia S, Tavian D. Metabolic lipid muscle disorders: biomarkers and treatment. Ther Adv Neurol Disord. 2019;12:1756286419843359. [Crossref]
15. Mccormick BJ, Chirila RM. Carnitine palmitoyltransferase-II deficiency: case presentation and review of the literature. Rom J Intern Med. 2021;59:420-4. [Crossref]
16. Gentili A, Iannella E, Masciopinto F, Latrofa ME, Giuntoli L, Baroncini S. Rhabdomyolysis and respiratory failure: rare presentation of carnitine palmityl-transferase II deficiency. Minerva Anestesiol. 2008;74:205-8.
17. Laghi F, Tobin MJ. Disorders of the respiratory muscles. Am J Respir Crit Care Med. 2003;168:10-48. [Crossref]
18. Bosch X, Poch E, Grau JM. Rhabdomyolysis and acute kidney injury. N Engl J Med. 2009;361:62-72. [Crossref]
19. Bonnefont JP, Djouadi F, Prip-Buus C, Gobin S, Munnich A, Bastin J. Carnitine palmitoyltransferases 1 and 2: biochemical, molecular and medical aspects. Mol Aspects Med. 2004;25:495-520. [Crossref]