

## CASE REPORTS

# Successful treatment of periodic paralysis with coenzyme Q10: two case reports

YUWEI DA<sup>1</sup>, LIN LEI<sup>1</sup>, KARIN JURKAT-ROTT<sup>2</sup> AND FRANK LEHMANN-HORN<sup>3</sup>

<sup>1</sup> Department of Neurology, Xuan Wu Hospital, Capital Medical University, Beijing, China;

<sup>2</sup> Department of Neurosurgery, Ulm University, Germany; <sup>3</sup> Division of Neurophysiology, Ulm University, Germany

Primary periodic paralyses (PPs) are autosomal dominant ion channel disorders characterized by episodic flaccid weakness associated with variations in serum potassium level. The main prophylactic therapy of choice for PPs is carbonic anhydrase inhibitors that are not always effective. In this report, we described two PP patients who were successfully treated with coenzyme Q10. They remained asymptomatic since initiation of treatment, which may be associated with promotion of energy synthesis, anti-oxidant activity, influence of the fiber type composition and regulation of the expression of gene. To our knowledge, this is the first report of primary periodic paralyses which have been successfully treated with CoQ10. More observations need to substantiate this clinical finding in PPs.

**Key words:** Periodic paralyses, Therapy, Coenzyme Q10

## Introduction

Primary periodic paralyses (PPs) are rare, autosomal-dominant disorders caused by ion channel dysfunction and characterized by recurrent episodes of muscle weakness secondary to abnormal sarcolemmal excitability. Generally, PPs are classified into hyperkalaemic (HyperPP) and hypokalaemic (HypoPP) forms, based on ictal serum potassium level. Current treatment strategies encompass acute treatments to terminate ongoing episodes of paralysis, and prophylactic therapies attempting to reduce ictal frequency or severity. Acute episodes are treated with oral potassium supplement in HypoPP and either inhaled salbutamol or intravenous glucose/insulin therapy in HyperPP. Prophylactic therapy usually involves a combination of avoiding weakness triggers and diuretic medications. The latter include potassium-sparing diuretics in HypoPP, hydrochlorothiazide in HyperPP and carbonic anhydrase in-

hibitors in both disorders. However, there are patients who fail to benefit from these drugs, even worsened particularly for Arg-to-Gly substitutions (1). Here, we report two patients with primary periodic paralyses who were successfully treated with coenzyme Q10 (CoQ10).

## Case report

### Case 1

A 29-year-old male had a history of several recurrent attacks of limb weakness since the age of 19. The frequency of episodes was at least once a month in the past year and increased to once a week in the last half a year. Severity of weakness varied ranging from mild weakness of lower limbs to tetraplegia. Predisposing factors included poor sleep and exposure to cold conditions. Ictal serum potassium blood level during an attack was normal and potassium supplementation was ineffective. Results of routine hematological and biochemical tests including thyroid function were all normal. Molecular genetic analysis revealed the R675Q mutation in the sodium channel encoded by the SCN4A gene associated with PPs (2). Since prophylactic medicine was unavailable in our hospital, he was only treated *ex adjuvantibus* with CoQ10 – 10 mg three times a day – to improve the energy metabolism of muscle. Surprisingly, the patient did not develop any episodes of paralysis during three months of treatment, even when exposed to the previously known triggers.

### Case 2

The second case is a man of 50 years old who complained of paroxysmal generalized muscle weakness accompanied by myalgia and stiffness since he was 37. Epi-

Address for correspondence: Yuwei Da, Department of Neurology, Xuan Wu Hospital, Capital Medical University, Chang Chun Street, Beijing 100053, China. Tel. +86 10 83198493. Fax +86 10 83171070. E-mail: dayuwei1000@163.com; Frank Lehmann-Horn, Division of Neurophysiology, Ulm University, Germany. E-mail: frank.lehmann-horn@uni-ulm.de

sodes occurred once or twice a month averagely during the past one year and worsened in the latest weeks, up to nearly twice a week. The blood potassium level during episodes was as low as 2.8 mmol/L and potassium intake could alleviate paralysis. There was a positive family history whereby his father and two of his siblings had similar but less severe attacks. Clinical examination between episodes and thyroid function were normal. The result of a long exercise test was positive. He was diagnosed with HypoPP despite gene tests for CACNA1S and SCN4A were negative, which account for approximately 10% of HypoPP cases (3). In light of the possible therapeutic effectiveness of CoQ10 with little side effect, he was administered tentatively idebenone 30mg three times a day, which is a synthetic quinone similar to CoQ10. Similarly, the patient responded well without any episodes during a one-month treatment.

## Discussion

Periodic paralysis is a channelopathy related to abnormal sarcolemmal excitability with limited drugs. We incidentally observed that CoQ10 significantly reduced frequency of episodes in two PP patients without knowing its exact mechanism of action. However a variety of physiological functions of CoQ10 may explain its effect: 1) CoQ10 serves as an electron carrier between respiratory chain enzymes, facilitating cellular energy production and activating the Na<sup>+</sup>-K<sup>+</sup> exchange pump, which is a central target for regulation of cell membrane excitability (4, 5); 2) acting as an antioxidant, CoQ10 may protect muscle from a Na<sup>+</sup> overload in muscle fibers, observed in muscle biopsies from PPs patients, and also increase the mitochondrial production of reactive oxygen species (6, 7); 3) CoQ10 can affect the muscle fibers for a long-term by increasing the percentage of type 2 fibers in vastus lateralis muscle (8). Type 2 fibers contain more Na<sup>+</sup>-K<sup>+</sup> exchange pump and atrophy of type 2 fibers predominated over type 1 in muscles of PPs patients (9, 10). Therefore, CoQ10 may play a protective role from episodes by expanding overall content of Na<sup>+</sup>-K<sup>+</sup> exchange pump in skeletal muscle. Furthermore, CoQ10 functions as a major skeletal muscle gene regulator, affecting the

expression of a large number of genes (8). This is the first report of primary periodic paralyses which have been successfully treated with CoQ10. More observations need to substantiate this clinical finding in PPs.

## Compliance with ethical standards

### *Ethic standards*

Patients gave informed consent prior to making the case report. Details that might disclose the identity of the patients have been omitted.

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