



# Distinguishing Acute Motor Axonal Neuropathy from Hypokalemia Induced Paralysis: Add 15 Minutes for an Exercise Test

## *Hipokalemik Periyodik Paralizinin Akut Motor Aksonal Nöropatiden Ayrımı: 15 Dakikalık Egzersiz Testi Ekle*

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### Abstract

We evaluated the reversible electrophysiologic abnormalities of two cases of hypokalemia paralysis (HypoPP) because of its similar findings in acute motor axonal neuropathy (AMAN). Nerve conduction studies (NCS), repetitive nerve stimulation, and exercise tests were performed in both patients. Adding a 15 minute-exercise test to routine NCS may help distinguish AMAN from HypoPP.

**Keywords:** Acute motor axonal neuropathy, hypokalemic periodic paralysis, hypokalemia, exercise test, nerve conduction studies

### Öz

Hipokalemik periyodik paralizi (HPP) olan iki hastanın elektrofizyolojik bulgularını akut aksonal motor nöropati (AMAN) elektrofizyolojik bulgu benzerliği nedeniyle değerlendirdik. Sinir iletim çalışmaları (NCS), ardıışık sinir uyarım testi ve egzersiz testi iki hastaya da uygulandı. On beş dakikalık egzersiz testini rutin NCS'ye eklemek AMAN ve HPP hastalıklarını ayırmada yardımcı olabilir.

**Anahtar Kelimeler:** Akut motor aksonal nöropati, hipokalemik periyodik paralizi, hipokalemi, egzersiz testi, sinir iletim çalışmaları

## Introduction

Reversible electrophysiologic abnormalities can be encountered during hypokalemia or attacks of hypokalemic periodic paralysis (HypoPP) (1). These abnormalities, especially reduced motor amplitudes that usually recover with normalization of serum potassium levels and muscle strength, can be confusing at the initial stage of the attack, and may lead to misdiagnoses such as acute motor axonal neuropathy (AMAN). Here, we would like to address two individual cases of hypokalemia and the exercise test for distinguishing these two situations.

## Case Reports

### Case 1

A woman aged 22 years presented with a two-day history of progressive limb weakness. She described having a respiratory tract infection approximately one month before the clinical presentation. Her neurologic exam revealed prominent quadriparesis with absent deep tendon reflexes without sensory loss. There were no abnormalities in the emergency administration blood samples; thyroid-stimulating hormone (TSH): 2.31 uIU/mL, free triiodothyronine (fT3): 5.14 pmol/L, free thyroxine (fT4): 20.12 pmol/L apart from mild hypokalemia (3.2 mEq/L). There was

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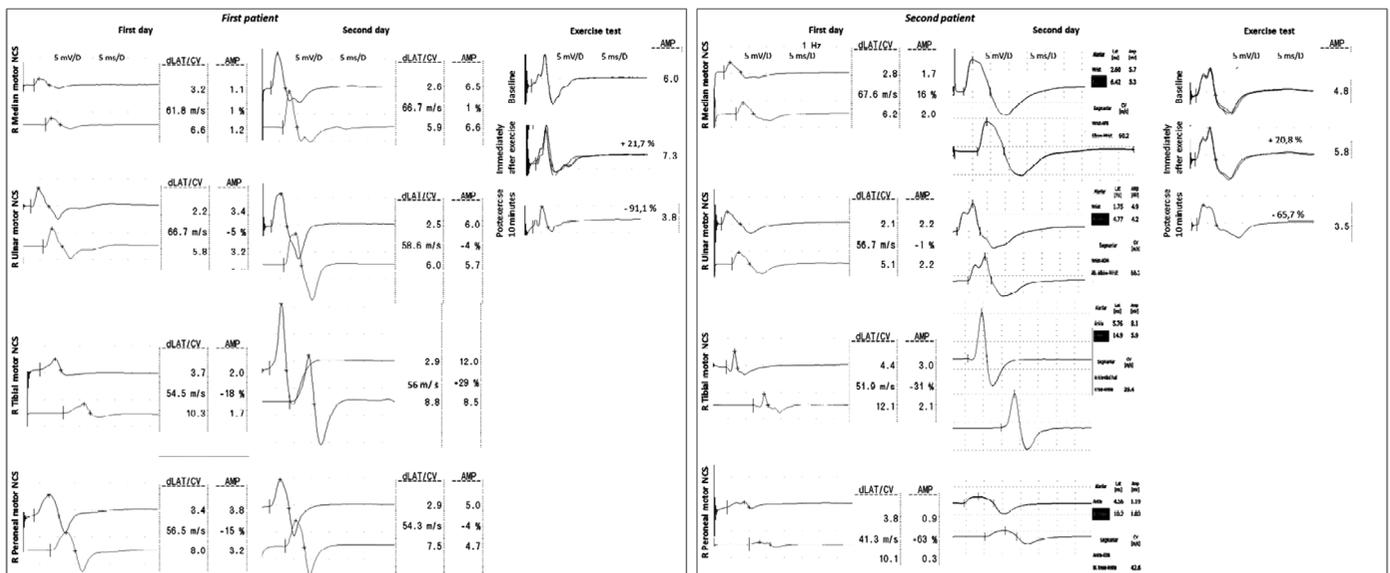
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no family history of hypertension or hypermineralocorticoidism. Nerve conduction studies (NCS) and needle electromyography (EMG) were performed. NCS included motor conduction studies in median, ulnar, posterior tibial and peroneal nerves along with sensory NCS in the median, ulnar and sural nerves. Compound muscle action potential (CMAP) amplitudes in all extremity nerves were reduced with normal conduction velocities and distal latencies (Figure 1). Sensory NCS were normal. A repetitive nerve stimulation (RNS) test that was performed to exclude botulism was normal. AMAN was suspected owing to the electrophysiologic findings and acute onset of symptoms, and she was started on intravenous immunoglobulin (IVIG) therapy. On the second day of her admission, near-total recovery of motor function was detected. The follow-up potassium level that day was 3.7 mEq/L. Considering the rapid recovery of symptoms and mild hypokalemia on admission, HypoPP was considered in the differential diagnosis and electrophysiologic tests were repeated the following day. This time, all CMAP amplitudes were within the normal ranges. Additionally, a 5-minute exercise test was performed. CMAPs in the abductor digiti minimi (ADM) muscle were recorded by stimulating the ulnar nerve every minutes for 5 minutes during, and 10 minutes after the voluntary contraction of the ADM muscle. The change in CMAP amplitude was calculated according to McManis et al. (2,3). The percentage changes all supported the findings of hypokalemia; +21.7% increment immediately after the exercise and -92.1% decrement at 10 minutes post-exercise. Finally, she was discharged three days later without residual deficits. A detailed evaluation revealed no underlying disease for the initial hypokalemia. She had another attack 6 months later following a period of a few days with a diet rich in carbohydrates and her symptoms again totally disappeared within two days.

**Case 2**

A woman aged 27 years had had gastroenteritis with severe diarrhea and vomiting for a week. In her evaluation in

the emergency department, severe hypokalemia of 1.8 mEq/L was detected along with hypophosphatemia (0.8 mg/dL). No other biochemical abnormality was present except for mild thyroid dysfunction (TSH: 6.94 uIU/mL, fT3: 3.5 pmol/L, fT4: 12.1 pmol/L). There was no family history of hypertension or hypermineralocorticoidism. Electrolyte replacement was initiated intravenously. While she was being followed up in the emergency department, she had sudden-onset cardiac arrhythmia and circulatory arrest, which was attributed to hypokalemia. Resuscitation was successful and normal cardiac rhythm was established in less than 5 minutes. Afterwards, she quickly regained consciousness and was admitted to the intensive care unit, where generalized weakness was detected. Her neurologic examination was consistent with moderate to severe quadriparesis with hypoactive but retained deep tendon reflexes. With an initial diagnosis of Guillain-Barre syndrome, NCS, with the same protocol as the first case, were performed on the third day of admission while her quadriparesis was persisting and serum potassium level was normal (3.6 mEq/L). These tests showed prominently reduced CMAP amplitudes in all extremity nerves with normal conduction velocities and distal latencies. Sensory NCS and RNS tests were normal. After being diagnosed as having AMAN, she was started on IVIG. Surprisingly, on the second day, her motor examination was found to be totally normal. We then ceased IVIG treatment and performed additional electrophysiologic tests the following day with a possible diagnosis of hypokalemia-induced paralysis. CMAP amplitudes were normal and the exercise test supported hypokalemia; +20.8% increment immediately after 5 minutes' exercise and -65.7% decrement 10 minutes post-exercise. She denied having had similar attacks previously and she had no family history of periodic paralysis. She was discharged with no remaining deficit.



**Figure 1.** Repeated motor nerve conduction studies of patients  
*dlat:* Distal latency (ms), *CV:* Conduction velocity (m/s), *AMP:* Amplitude (mV)

## Discussion

Our first patient developed another similar weakness attack, which was consistent with HypoPP. Involvement of K channels and membrane depolarization has already been suggested in HypoPP (4,5). Therefore, the membrane becomes hyperpolarized, which results in difficulty to provoke CMAP (6). Neither patient had a family history of hypertension or hypermineralocorticoidism. On the other hand, it is not clear whether the second patient's attack was due to HypoPP or secondary to severe hypokalemia, the exact etiology is unknown. Our two cases demonstrate how it can be difficult to differentiate AMAN from hypokalemia-induced paralysis during the onset of the first attack on clinical and electrophysiologic bases. Both patients had histories of respiratory infection and gastroenteritis within the previous weeks of generalized weakness and diminished reflexes, which could be a typical form of presentation for AMAN. NCS findings in these two patients were indistinguishable from acute-onset AMAN, which is characterized by normal NCS but with decreased CMAP amplitudes. This difficulty in the electrophysiologic differentiation between AMAN and HypoPP has been previously discussed (1). Serum potassium levels may not always be helpful for diagnosis because attacks can occur even without prominent hypokalemia (7). Considering our patients, the serum potassium level in case 1 was only mildly decreased and in case 2, potassium levels had been normalized at the time of the electrophysiologic examination, yet the patient was still quadriparetic, despite her severe and symptomatic hypokalemia on admission. In fact, hypokalemia may also be incidentally detected in AMAN, especially if other confounding factors such as poor oral intake or diarrhea are present. Although a family history of HypoPP may be very helpful for diagnosis, it is not always present.

Duration of HypoPP episodes can extend from hours to a few days (7). In both of our patients, motor symptoms lasted for at least three days. Therefore, it may take time to make a proper diagnosis of periodic paralysis, possibly after a few sessions of IVIG or plasmapheresis if patients are unnecessarily started for AMAN. In our cases, the very rapid normalization of muscle strength within days of the attack cannot be explained by action of IVIG.

Although CMAP amplitudes were normal in the follow up EMG examination, and the NCS of both patients were also normal, the exercise test reliably showed increasing amplitudes in CMAPs. Had it been performed during the first study, the increase in amplitudes possibly might even be demonstrated with already decreased amplitudes of basal CMAPs. On the other hand, at the exercise test, immediately after exercise, a progressive decrease occurs in the CMAP amplitude over 30-40-minutes (2). We did

not examine this whole period and only considered the first 10 minutes of the post-exercise period.

Considering the extreme difficulty in differentiating HypoPP from AMAN within the first days of attack, depending on clinical findings and routine investigations, we suggest applying this simple exercise test to all patients who fulfill the clinical and electrophysiologic criteria for AMAN. This is important for preventing unnecessary administration of expensive treatments, which also have potential adverse effects, and for assuring and informing the patients about the benign and preventable nature of the weakness episodes.

### Ethics

**Informed Consent:** Consent form was filled out by all participants.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: Ş.E.E., F.G.Y., E.Y.A., Ç.M.T., Concept: Ç.M.T., Design: F.G.Y., Ç.M.T., Data Collection or Processing: Ş.E.E., Analysis or Interpretation: Ş.E.E., Literature Search: Ş.E.E., F.G.Y., Ç.M.T., Writing: Ş.E.E., F.G.Y.

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