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McArdle Disease Confirmed by Nonischemic Forearm Exercise Test and Muscle Biopsy: A Case Report

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Backgrounds

- **Glycogen storage disease type V** (**McArdle's disease**) is characterized by **impaired glycogenolysis** resulting in **intramuscular glycogen accumulation** and **reduced lactate production** during anaerobic exercise, leading to **exercise intolerance, muscle cramps, recurrent myoglobinuria,** and the characteristic **second-wind phenomenon.**
- Here, we report a patient with long-standing exercise intolerance who exhibited classical clinical and diagnostic features of McArdle's disease with genetic confirmation.

Case Presentation

- **A 20-year-old male** presented with **long-standing exercise intolerance since childhood**. He experienced his first episode of **dark-colored urine** following exertion in 2012 and reported **recurrent severe myalgia** after strengthening exercises. During aerobic activity, he reported marked fatigue within 5–10 minutes followed by symptomatic improvement, consistent with **the second-wind phenomenon**. **Family history was suggestive of similar symptoms in his father.**
- On admission, the serum **creatine kinase level was 2,702 IU/L**, whereas the **C-reactive protein level was 0.06 mg/dL** and within the normal range. **Lower extremity MRI showed minimal fatty infiltration** in bilateral vastus lateralis and biceps femoris muscles. **Routine nerve conduction studies were normal.**
- Two **nonischemic forearm exercise tests** were performed using 30-second isometric contractions at 70% of maximal voluntary contraction, as measured by a dynamometer, and demonstrated **marked post-exercise ammonia elevation**, whereas **the increase in lactate did not exceed 0.8 mmol/L** (Figure 1, 2).
- **Muscle biopsy** of the left vastus lateralis revealed **subsarcolemmal glycogen accumulation**, which was **abolished after diastase digestion** on periodic acid–Schiff staining, confirming glycogen deposition.
- **Genetic analysis** identified a likely **pathogenic PYGM gene variant**.

Conclusions

- This case demonstrates the characteristic clinical and diagnostic features of McArdle disease.
- **The absence of lactate elevation with concomitant ammonia increase** on **nonischemic forearm exercise testing** reflects **impaired glycogenolysis**, resulting in reduced lactate production and compensatory purine nucleotide degradation.
- **The muscle biopsy** confirms **glycogen accumulation** due to **myophosphorylase deficiency**.
- Recognition of these findings on **the nonischemic forearm exercise test** and **muscle biopsy** is essential for accurate diagnosis and prevention of exercise-related complications in patients with unexplained exercise intolerance.

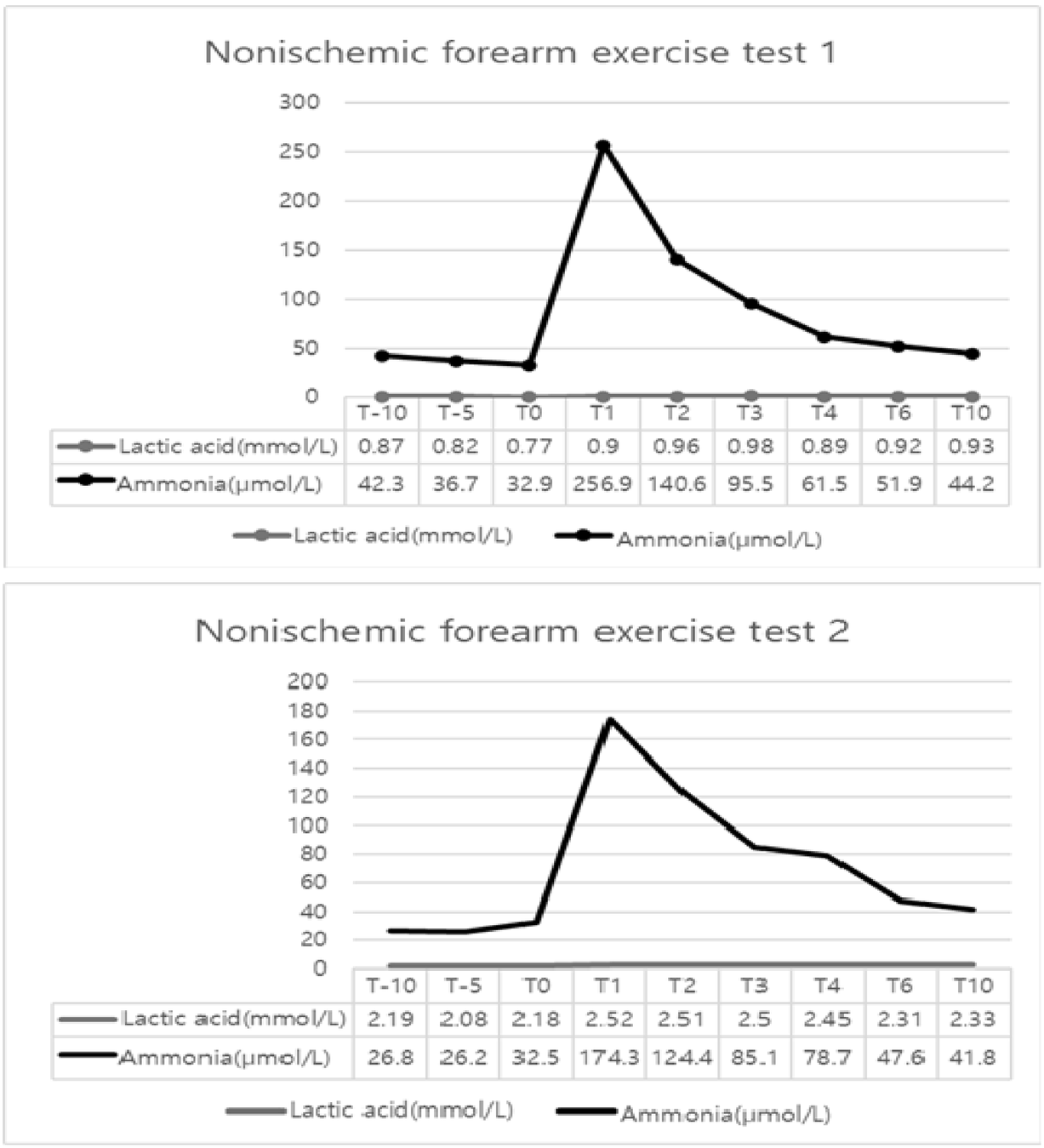

Figure 1. Post-Exercise Lactate and Ammonia Responses in the Nonischemic Forearm Exercise Test
Nonischemic forearm exercise tests were performed using 30-second isometric contractions at 70% of maximum voluntary contraction, as measured with a dynamometer. Both tests demonstrated marked post-exercise ammonia elevation, whereas the increase in lactate levels was minimal.

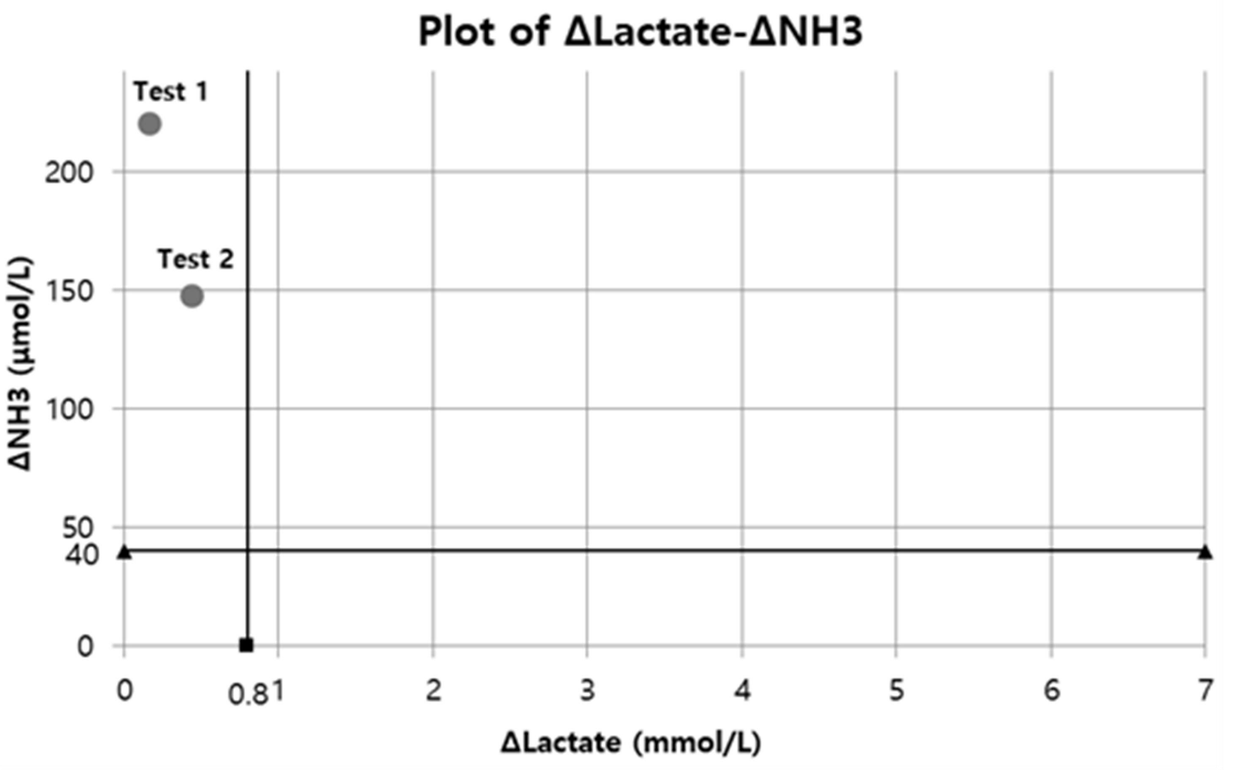

Figure 2. Diagnostic Performance of the Nonischemic Forearm Exercise Test in McArdle's Disease
The nonischemic forearm exercise test fulfilled the diagnostic criteria of Δlactate < 0.8 mmol/L and ΔNH_3 > 40 μmol/L, which have been reported to demonstrate a sensitivity of 100% and a specificity of 99.7% for the diagnosis of McArdle's disease.

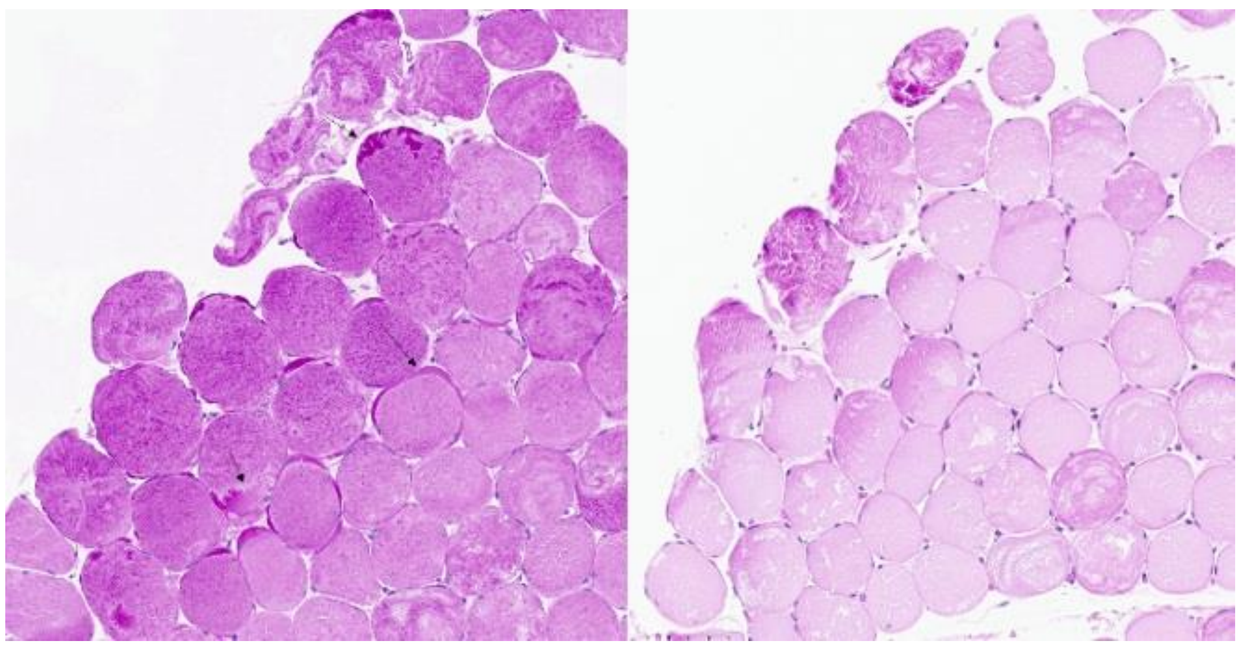

Figure 3. Characteristic Glycogen Accumulation in Muscle Biopsy of McArdle's Disease
Muscle biopsy of the left vastus lateralis revealed increased intracytoplasmic glycogen with focal subsarcolemmal accumulation. The deposits were abolished following diastase digestion on periodic acid–Schiff (PAS) staining, thereby confirming that the accumulated material was glycogen.