# Effects of L-Carnitine Supplementation, Botulinum Neurotoxin Injection, and Rehabilitation for a Chronic Stroke Patient

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Botulinum neurotoxin injection therapy and rehabilitation have been conducted for stroke patients to reduce the spasticity of their affected limbs and improve their walking ability and daily living. Furthermore, their disability was reported to be related to muscle wasting. Supplementation of L-carnitine was reported to improve physical endurance and was used to treat sarcopenia in, for example, patients with cancer. Here, we report a case of chronic stroke with muscle wasting in a patient with improved walking endurance by L-carnitine supplementation, botulinum neurotoxin injection, and rehabilitation. A 58-year-old woman had a left putamen hemorrhage 9 years before, and right spastic hemiplegia and walking disability. She could walk no more than 20 m. Botulinum neurotoxin injection and rehabilitation were performed 6 times every 3 months. The first time, walking speed and continuous walking distance increased as her spasticity decreased. However, the improvement declined after the second and third treatments. She had right leg pain during walking, accompanied by muscle wasting. The L-carnitine prescription contributed to the attenuation of her leg pain during walking and rapid improvement of her continuous walking distance. Walking speed and endurance further improved. In addition, the withdrawal of L-carnitine did not decrease her walking ability or induce a recurrence of her leg pain. Interestingly, creatine phosphokinase increased after L-carnitine was stopped, indicating that L-carnitine had helped to reduce muscle damage during rehabilitation. This case suggests that chronic stroke patients with muscle wasting have an abnormality in the mitochondrial energy metabolism of their muscles.

Key Words: L-carnitine—Botulinum neurotoxin injection—rehabilitation continuous walking distance—spastic hemiplegia

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# Introduction

Recently, botulinum neurotoxin (BoNT) injection therapy and rehabilitation have been conducted for stroke patients to reduce the spasticity of their affected limbs

Grant support: None.

and improve their walking ability and daily living.<sup>1</sup> Furthermore, their disability was reported to be related to muscle wasting.<sup>2</sup> L-carnitine, which is essential for free fat acid metabolism in mitochondria, was reported to reduce fatigue and improve endurance in patients with muscle wasting due to various conditions such as cancer.<sup>3</sup> Here, we report a case of chronic stroke in a patient whose walking endurance was improved with L-carnitine prescription, BoNT injection, and rehabilitation.

# **Case Presentation**

A 58-year-old woman had left putamen hemorrhage 9 years before, and right hemiplegia and a walking disability. Her hemiplegia was Brunnstrom recovery stages 3, 2, and 3 for the arm, hand, and leg, respectively. The spasticity of her right limbs had a modified Ashworth scale score of 2 for most muscles. At baseline, she could

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Received April 12, 2018; revision received July 4, 2018; accepted July 22, 2018.

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<sup>1052-3057/\$ -</sup> see front matter

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https://doi.org/10.1016/j.jstrokecerebrovasdis.2018.07.033

walk no more than 20 m. The speed on the first 10-m walking test at the first visit to our hospital was .17 m/s, and was reportedly unchanged. Laboratory data were within normal range, including a creatine phosphokinase level of 54 U/L, aspartate aminotransferase level (AST) of 29 U/L, creatinine level of .75 mg/dL, white blood cell count of 5000/µL, and C-reactive protein level of .02 mg/dL. BoNT injection, physical therapy, and occupational therapy for 1 month in our hospital were performed 6 times every 3 months. In the first time, walking speed, muscle strength, and continuous walking distance increased as her spasticity decreased (Fig 1). However, the improvement declined after the second and third treatments. She had right leg pain and fatigue during walking. The ankle brachial index of blood pressure was normal and incompatible with peripheral arterial disease. Furthermore, she showed muscle wasting with a skeletal muscle mass index of 4.7. Under the suspicion of carnitine deficiency, L-carnitine was prescribed with informed consent at 1.5 g/day, which was increased to 3 g/day. After prescription, her leg pain and fatigue during walking disappeared and her continuous walking distance increased rapidly (Fig 1). In the subsequent hospitalization, walking speed, and endurance further improved. Eventually, she could walk 1200 m. Her walking ability was maintained, but she sustained a fall, and thereafter limited walking distance to 650 m because of anxiety about falling again. As her carnitine deficiency was thought to be ameliorated, L-carnitine was withdrawn. Her leg pain did not recur during walking, and her walking speed and continuous walking distance were maintained. Laboratory

examination indicated an elevation of creatine phosphokinase to 151 U/L at hospitalization after withdrawal of L-carnitine, with levels of 84-98 U/L at other hospitalizations. This suggested that L-carnitine had prevented muscle damage during daily activities and rehabilitation. Other blood test results at every hospitalization were within normal range and unchanged, including a lactate dehydrogenase level of 150-170 U/L, aspartate aminotransferase level of 23-30 U/L, creatinine level of .75-.87 mg/dL, white blood cell count of 4200-6000/ $\mu$ L, and C-reactive protein level of .02-.03 mg/dL.

### Discussion

This is the first report to show that supplementation of Lcarnitine in a chronic stroke patient improved walking ability, especially walking endurance. In peripheral arterial disease patients, one of the causes of intermittent claudication was metabolic abnormality in peripheral skeletal muscles, and Lcarnitine reduced leg pain and increased walking distance.<sup>4</sup> Similarly, L-carnitine contributed to the reduction of leg pain and extended the continuous walking distance in this case. This suggests that stroke patients with muscle wasting may have metabolism abnormalities in their muscles.

In this case, withdrawal of L-carnitine did not induce a setback in walking ability. This was thought to be because adequate carnitine was stored in her muscles and because the turnover of carnitine between serum and muscle was too small to cause recurrent deficiency, as suggested in a previous report.<sup>5</sup> Additionally, improvement in walking



**Figure 1.** The course of walking abilities and L-carnitine prescription, botulinum neurotoxin injection, and rehabilitation. BoNT, botulinum neurotoxin; 10MWT, 10-m walking test.

#### EFFECTS OF L-CARNITINE AND REHABILITATION

ability and daily activity seemed to contribute to stability. Temporary supplementation with L-carnitine may be an option for chronic stroke patients with muscle wasting and walking disturbance to support rehabilitation. Further studies of L-carnitine metabolism and long-term effects in stroke patients are required.

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