Reversible Motor Paralysis and Early Cardiac Rehabilitation in Patients With Advanced Heart Failure Receiving Left Ventricular Assist Device Therapy

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Summary

Advanced heart failure (HF) is sometimes complicated with brain impairment because of a microthrombosis caused by decreased left ventricular contraction or reduced brain circulation. Some patients may recover after left ventricular assist device (LVAD) implantation. However, little is known about the perioperative therapeutic strategy in patients suffering from such complications, particularly from a cardiac rehabilitation viewpoint. We report on a 58-year-old male patient with a previous history of poliomyelitis and a light paralysis in the left upper extremity, who suffered left hemiplegia with no evidence of stroke after hemodynamic deterioration. The combination therapy of perioperative cardiac rehabilitation and LVAD therapy improved his left hemiplegia as well as activities of daily living, and the patient was discharged on foot on postoperative day 72 after briefing the family on LVAD home management. Early initiation of cardiac rehabilitation before LVAD implantation may be a key for the smooth discharge and resocialization of patients suffering from brain impairment complicated with advanced HF. (Int Heart J 2016; 57: 766-768)

Key words: Cardiomyopathy, Stage D, Mechanical circulatory support

A s one of the end-organ dysfunctions, the complication of cognitive dysfunction is sometimes seen in patients with advanced heart failure (HF) because of a microembolism caused by decreased left ventricular contraction or reduced brain circulation. Improvement of such brain impairment is strongly expected after left ventricular assist device (LVAD) implantation because resocialization is encouraged in such LVAD patients. However, little is known about the perioperative therapeutic strategy for brain impairment, particularly from the viewpoint of cardiac rehabilitation. Here we report a patient who suffered left hemiplegia after hemodynamic deterioration despite no evidence of stroke and received early cardiac rehabilitation before LVAD implantation.

Case Report

Patient presentation: A 58-year-old male patient (height 173 cm, weight 64 kg) with stage D HF due to dilated cardiomyopathy was admitted to our hospital to consider a heart transplant (HTx) listing and LVAD treatment. His HF had progressed gradually, and he had experienced repeated admissions because of a recurrence of HF despite guideline-directed medical therapy along with implantable cardioversion therapy. On admission, his New York Heart Association class was IV, and his plasma B-type natriuretic peptide level was 630 pg/mL. Transthoracic echocardiography showed that the left ventricular diastolic diameter was 74 mm, the left ventricular ejection fraction was 18%, and there was severe mitral regurgitation and moderate tricuspid regurgitation. After hospitalization, cardiac low output syndrome progressed despite continuous intravenous inotrope infusion. He eventually underwent LVAD implantation (HeartMate II, Thoratec, Pleasanton, CA) on day 33, 9 days after preoperative intra-aortic balloon pumping (IABP) support. After the initiation of IABP support, the 35 mmHg pulmonary capillary wedge pressure remained unchanged, and his cardiac index improved from 1.5 L/minute/m$^2$ to 2.1 L/minute/m$^2$. At 5 weeks after LVAD implantation, the pulmonary capillary wedge pressure was 8 mmHg, and his cardiac index was 2.4 L/minute/m$^2$ at postoperative rotation speed adjustment to 8600 rpm.

He had a past history of poliomyelitis with marked brain damage in the right cerebral hemisphere (Figure 1). His activities of daily living were completely independent, although he had light paralysis in the left upper extremity. He had dexterity disorder and difficulty in separate movement in the left upper extremity (Brunnstrom stage 5) before the transfer. Preoperative cardiac rehabilitation: On hospitalization, he presented with motor paralysis (Brunnstrom stage 4), muscle

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weakness, and myotonia of the left upper and lower extremities despite no apparent evidence of a stroke based on image analyses, including brain computed tomography and magnetic resonance images. Soon after the initiation of IABP, which was inserted via the right femoral artery, he received an assessment of motor ability, and cardiac rehabilitation was initiated while he was in bed (Figure 2).

The grip strength of his right hand was 42.5 kg and that of the left hand was 4 kg. A dexterity disorder existed in the left upper and lower extremities, and he could not perform pinch behaviors by himself. His preoperative Barthel index was 15 points. Manual muscle testing (MMT) of the left upper extremity was 3.0. He underwent range of motion (ROM) and muscle exercises in bed during IABP support.

**Postoperative cardiac rehabilitation:** Physical therapy was restarted on postoperative day (POD) 1. He tried sitting and standing positions on POD 3 and walking rehabilitation on POD 8. His left hemiplegia had partially improved but remained at an unsatisfactory level after LVAD implantation, and we used ankle foot orthosis to support his rehabilitation.

By POD 30 he had become able to roll over and get up with a little assistance, sit on the bed by gripping the bed rail, transfer himself from the bed to a wheelchair with lateral assistance, stand with one hand support, and walk 400 m with the ankle foot orthosis and a single cane. MMT of the left upper extremity was 3.5 and the grip strength of the left hand was 4 kg.

He had relatively decreased cognitive dysfunction, which was diagnosed using the Hasegawa dementia scale (28 points, the maximum score is 30 points) and Raven’s Colored Progressive Matrices (29 points, the maximum score is 36 points) performed after the LVAD implantation. He underwent LVAD handling training by medical engineer experts and an occupational therapist.

**At the time of discharge:** He could roll over, get up, sit on the bed, and transfer himself to a wheelchair, and there were improvements in movement and myotonia of the left upper and lower extremities. Regarding walking ability, he could walk for a short distance without any support, including the ankle foot orthosis, and >1 km with the support of a T-cane and ankle foot orthosis. His Barthel index was 80 points before discharge. MMT of the left upper extremity was 4.0+ and the grip strength of the left hand was 6.3 kg. He was discharged to home on POD 72 after adequate handrails were installed at his house and his family was educated about the necessary support techniques.

**Discussion**

**End-organ dysfunction in patients with advanced HF:** End-organ dysfunction is a key to be considered for cardiac replacement therapy in patients with advanced HF. They often suffer end-organ dysfunction such as liver and renal dysfunction and pulmonary hypertension due to congestion and reduced circulation.\(^8\) We should seek optimal timing of the HTx listing and LVAD implantation based not only on the severity of the HF but also on the degree of end-organ dysfunction because patients with irreversible end-organ dysfunction are contraindicated for the bridge to transplant LVAD therapy.\(^8\) We sometimes test the reversibility of end-organ dysfunction in various procedures before LVAD implantation.\(^9,10\)

Recently, cognitive dysfunction and motor impairment have been attracting concern as one of the end-organ dysfunctions due to advanced HF.\(^11,12\) The precise mechanisms remain unclear, but microthrombosis due to decreased left ventricular contraction or reduced brain circulation may cause such an impaired brain function.\(^11,12\)

Our patient suffered left hemiplegia during hemodynamic deterioration without any imaging evidence of stroke. The timing of worsening of motor disorder was associated with that of hemodynamic deterioration. He also had relatively decreased cognitive function, even after LVAD implantation. Poliomyelitis results in muscle relaxation when the anterior horn of the spinal cord is injured. Considering that our patient suffered from hypertonia in addition to motor paralysis, reduced brain circulation due to hemodynamic deterioration may have addi-
tionally worsened the brain damage in the right cerebral hemisphere caused by poliomyelitis (Figure 1), although we cannot provide any direct evidence of changes in brain circulation such as cerebral blood flow scintigraphy or positron emission tomography. We should pay attention to a previous history of stroke beforehand because such a population may be at risk of worsening brain impairment during the advanced HF period. Furthermore, severe brain impairment may be irreversible even after an improvement in hemodynamics. In contrast, some brain impairments are reversible, if at least partially, as we reported here. The precise threshold remains undetermined, but the potential for brain impairment reversibility before LVAD implantation should be considered.

**Cardiac rehabilitation in patients with brain impairment receiving LVAD therapy:** After LVAD implantation, we sometimes need to manage fatal postoperative complications such as stroke, bleeding, and sepsis. We should strive to prevent or treat brain complications because they reduce the prospects of a patient’s resocialization.

Cardiac rehabilitation during LVAD support is different from conventional therapies because it includes LVAD-related management. We should improve patient cognitive function and teach them how to handle their device. Caregivers also should learn how to manage the device and support the patient. Furthermore, a patient’s house should be specifically renovated to support their motor paralysis or cognitive dysfunction after receiving LVAD therapy.

In this case, we suspected that improvements to the brain circulation by LVAD therapy alone may have been insufficient to normalize his hemiplegia considering the severity of his motor paralysis and partial recovery of hemodynamics by LVAD therapy. The combination of cardiac rehabilitation and LVAD therapy improved his motor paralysis and activities of daily living. Therefore, preoperative early initiation of cardiac rehabilitation may have an advantage in constructing the above-described specific post-LVAD rehabilitation program that allows the patient to be discharged to home.

**DISCLOSURES**

None.

**REFERENCES**


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