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Case Report

Effectiveness of gait training for a severe Guillain-Barré syndrome patient requiring a mechanical ventilator: Case report

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ABSTRACT

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Introduction: We report the case of a patient with Guillain-Barré syndrome (GBS) who required mechanical ventilation (MV) during hospitalization for Kaifukuki rehabilitation to focus mainly on gait training, ultimately resulting in successful weaning from MV.

Case: The patient, a 49-year-old woman, was admitted to an acute hospital with the chief complaint of dyspnea and gait disturbance following diarrhea for 7 days. She was diagnosed with suspected GBS based on respiratory paralysis, quadriplegia, abducens paralysis, and facial paralysis. On the same day, invasive MV was initiated, and she was transferred to another acute hospital. She was diagnosed with an axonal type of GBS and was treated. She was transferred to our hospital for Kaifukuki rehabilitation on day 54. Rehabilitation mainly focusing on gait training using a trunk-hip-bilateral knee-ankle-foot orthosis with inside hip joint for patients with paraplegia allowed our patient to withdraw from MV on day 125.

Discussion: It was highly possible that increased ventilation volume resulting from an adequate exercise load allowed the patient to wean from MV. All patients who require MV and whose condition is stable should receive rehabilitation exercise.

Key words: Guillain-Barré syndrome, Kaifukuki rehabilitation, mechanical ventilator, gait training, a trunk-hip-bilateral knee-ankle-foot orthosis with inside hip joint for patients with paraplegia

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Introduction

Guillain-Barré syndrome (GBS) is a serious autoimmune disorder affecting the peripheral nervous system [1]. Patients with GBS have different degrees of severity, and 14.3% of these patients develop respiratory failure, requiring mechanical ventilation (MV) [2, 3]. Although there are published reports of rehabilitation in patients with GBS [4−6], there are no currently available reports on rehabilitation for patients with GBS who require MV. We report the case of a patient with GBS who required MV, was hospitalized for Kaifukuki rehabilitation, and underwent rehabilitation to focus mainly on gait training, which ultimately resulted in successful weaning from MV.

Case

The patient was a 49-year-old woman with a history of ovarian surgery. She was admitted to an acute hospital with the chief complaint of dyspnea and gait disturbance following a 7-day episode of diarrhea. She was diagnosed with suspected GBS based on respiratory paralysis, quadriplegia, abducens paralysis, and facial paralysis. On the same day, invasive MV was initiated, and she was transferred to another acute hospital. She suffered from complete paralysis of the upper and lower limbs on day 2. She was diagnosed with GBS based on prolonged distal latency and prolonged F wave latency on nerve conduction study, and she was administered immunoglobulin therapy and plasmapheresis. She underwent tracheostomy on day 5. She was diagnosed with an axonal type of GBS based on significantly low compound muscle action potential and sensory nerve action potential, absence of F waves on nerve conduction study, and anti-GM1 antibodies on blood analysis. Enteral feeding was initiated using a nasogastric tube, and a urethral catheter was inserted because of urinary retention. She was transferred to our hospital for Kaifukuki rehabilitation on day 54.

On admission, the patient's height and weight were 161.0 cm and 47.2 kg, respectively. Her blood pressure

was 135/73 mmHg; heart rate, 105 beats/min, regular; body temperature, 37.0°C; respiratory rate, 17 breaths/min; and percutaneous arterial oxygen saturation (SpO_2), 97%. MV mode (Trilogy O_2 plus®, Royal Philips) consisted of synchronized intermittent mandatory ventilation, fraction of inspired oxygen at 21%, tidal volume at 420 mL, positive end-expiratory pressure at 5 cmH_2O, pressure support (PS) at 10 cmH_2O, and respiratory rate at 10 breaths/min. Hughes Disability Scale (HDS) was Grade 5. Although she was unable to close her eyes, she was able to indicate yes or no with an ocular movement. Gross muscle testing (GMT) was 0 for the neck, the upper limbs, the lower limbs, and the trunk. The Medical Research Council (MRC) sum-score was 0 (Table 1). Range of motion in the upper and lower limbs was not restricted. Deep tendon reflex of the upper and lower limbs was not observed. Mild sensory disturbance was present in the whole body. We were unable to conduct an intelligence test using the Hasegawa Dementia Rating Scale-Revised score. The Functional Independence Measure (FIM) score was 40 (13 for motor items and 27 for cognitive items). Rehabilitation was aimed at extubation, inhibiting contracture, stabilizing sitting position, reducing the amount of assistance, achieving communication tools, vocalization, and enabling the oral consumption of meals. The patient received three 20-min sessions of physical therapy (PT), occupational therapy (OT), and speech language therapy (ST) daily (i.e., nine sessions daily for approximately 150 days). The strategy for PT was to focus mainly on gait training using a trunk-hip-bilateral knee-ankle-foot orthosis (THbKAFO) with inside hip joint for patients with paraplegia (Prime walk R®, Tomei Brace Co., Ltd.) (Figure 1), cervical orthosis (Vista®TX, Aspen Medical Products), and bilateral arm sling (New Arm Suspender®, ALCARE Co., Ltd.) 3 or 4 days a week, except on bathing day and on holidays

Table 1. A comparison of Medical Research Council (MRC) scale between day 1 and day 150.

	MRC Scale	
	Day 1 (right/left)	Day 150 (right/left)
Shoulder abduction	0/0	1/1
Elbow flexion	0/0	1/1
Wrist extension	0/0	1/1
Hip flexion	0/0	1/1
Knee extension	0/0	1/1
Ankle dorsiflexion	0/0	1/1
MRC sum-score	0	12

Figure 1. A trunk-hip-bilateral knee-ankle-foot orthosis with inside hip joint for patients with paraplegia and gait training used for the patient requiring mechanical ventilation.

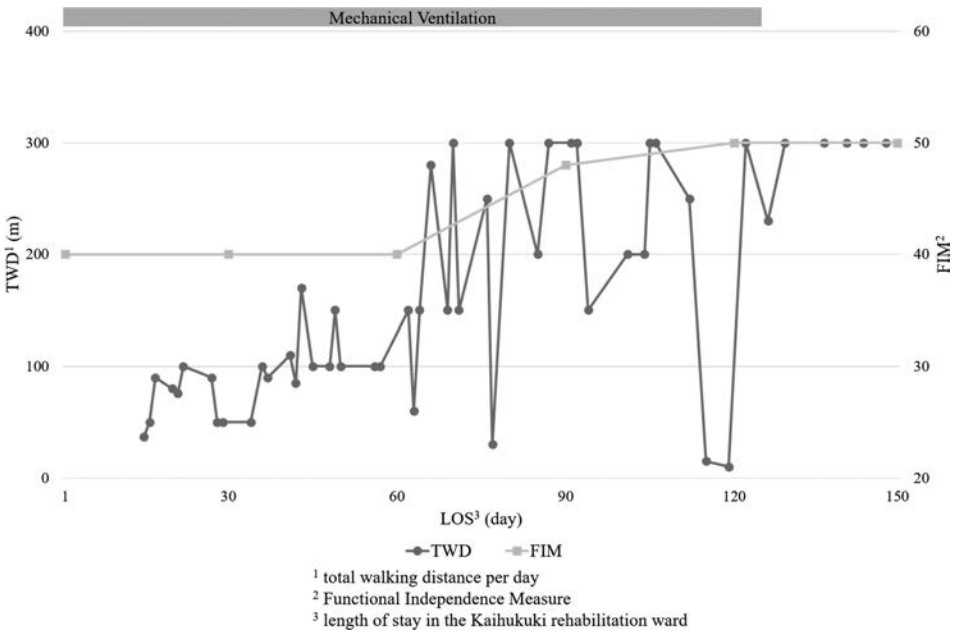

Figure 2. Clinical course of total walking distance per day and Functional Independent Measure.

when the attending physician was absent. Additionally, respiratory rehabilitation, range-of-motion exercises (ROMEs), sitting training, and standing training using a tilt table were planned. For OT, ROMEs and upper-limb training were planned. Oral care, oral and facial function training, and achieving communication tools were planned for ST. The Japanese Association of Rehabilitation Medicine standards were used for discontinuing rehabilitation [7]. The exercise load was adjusted using vital signs, and the Borg scale was used as indices during rehabilitation. We established a strategy of regularly checking creatine kinase (CK) and aldolase (ALD) to evaluate overwork.

For PT, respiratory rehabilitation and ROMEs on a bed, sitting training on a wheelchair with a reclining backrest, and standing training using a tilt table were initiated on day 1. On day 6, blood gas analyses indicated that pH was 7.605, PCO_2 and PO_2 were 25.6 and 114.4 mmHg, respectively, and HCO_3^- and BE were 25.4 and 4.0 mEq/L, respectively. She was able to stick out her tongue a little. Gait training using a THbKAFO with Prime walk R® was initiated at a distance of 40 m on day 15 (when it was delivered to our hospital) (Figure 1). Walking distance per day was gradually increased to 100 m on day 22. A videofluorographic examination for swallowing was implemented on day 35. Although making a bolus and delivering to the pharynx was poor, no aspiration was observed. On day 37, blood gas analyses revealed that pH was 7.478, PCO_2 and PO_2 were 33.5 and 102.8 mmHg, respectively, and HCO_3^- and BE were 24.8 and 1.3 mEq/L, respectively. A muscle contraction of her face was observed on day 38. The urethral catheter was removed on day 44; subsequently, urine left the body. As the patient's respiratory state was stable, PS was decreased to 5 cmH_2O in the daytime from day 46. Movements of lips, tongue, and eyelids were observed on day 51. For ST, we had her perform vocalization training using a tracheal cannula speech type (KOKEN TRACHEAL CANNULA PP Speech Type®, KOKEN CO., LTD.) on the condition that she was intermittently weaned from MV for a few minutes from day 69. Gait training was increased to 300 m on day 70. She was able to utter up to 12 sounds on day 78. She was weaned from MV for 2 h and was able to converse from day 89. She was able to eat rice and chopped food on day 105, and she was served these items for lunch from day 107. As the patient's respiratory state was stable, PS was decreased to 3 cmH_2O on gait training from day 113. She was weaned from MV and had KOKEN TRACHEAL CANNULA PP Speech Type® in the daytime, and MV was used at night from day 121. She was allowed to wean from MV all day on day 125. Subsequently, gait training was performed safely. Endotracheal extubation was performed on day 140. She was transferred to a bed for long-term care for the purpose of continuing rehabilitation on day 150. Kaifukuki rehabilitation improved the patient's HDS to Grade 4, MRC sum-score to 12, and FIM score to 50 (15 for motor items and 35 for cognitive items) (Figure 2 and Tables 1 and 2). Gait training occasionally could not be performed, and walking distance was short because of leg pain, general fatigue, and trouble with the orthosis. Gait training was implemented for 50 days, and there was no problem in the patient's cardiopulmonary state (Figure 2 and Table 3). CK and ALD levels were within normal ranges during hospitalization.

Informed consent was obtained from the patient and her family prior to preparing this report.

Discussion

Rehabilitation focusing mainly on gait training allowed the patient to wean from MV. In patients with GBS, lower MRC sum-score, presence of facial and/or bulbar weakness, and days between onset of weakness and admission (≤ 7 days) were the main predictors of MV [3, 8]. Patients who are unable to lift their arms from the bed (bilateral MRC of deltoid muscles of 0–2, its common C5 innervation with the phrenic nerve) with axonal degeneration have a 90% chance of requiring prolonged MV [9]. The lack of foot flexion ability at the end of immune therapy predicts a prolonged duration of MV [10]. The patient satisfied all of these conditions so that it may have been difficult to wean from MV. Gait training significantly contributed to weaning from MV under such a bad condition.

Table 2. A comparison of Functional Independence Measure (FIM) between day 1 and day 150.

	FIM	
	Day 1	Day 150
Eating	1	1
Grooming	1	1
Bathing	1	1
Dressing, upper body	1	1
Dressing, lower body	1	1
Toileting	1	1
Bladder management	1	2
Bowel management	1	2
Transfers—bed/chair/wheelchair	1	1
Transfers—toilet	1	1
Transfers—bath/shower	1	1
Walk/wheelchair	1	1
Stairs	1	1
Comprehension	6	7
Expression	2	7
Social interaction	7	7
Problem solving	6	7
Memory	6	7
Total score	40	50

In the first place, exercise loading is not contraindicated for patients requiring MV [11]. Standing training and gait training are effective for patients requiring MV [12, 13]. After a positional change from supine to standing, the increase in minute ventilation is achieved by significant increases in tidal volume and respiratory rate in patients requiring MV [12, 14]. Progression to gait training may require the use of a tilt table given the prolonged bed rest and dysautonomia that are associated with GBS [15]. Additionally, gait training for patients requiring MV for more than 30 m or 6 min decreases the duration of MV [12, 13]. Therefore, it is possible that gait training for up to 300 m decreased the patient's duration of MV. Elevations in respiratory rate and heart rate of the patient receiving gait training suggested an adequate exercise load for cardiopulmonary function. Although GMT of the patient's lower limbs was not much improved, respiratory function was improved by active gait training. In a similar case, Muraki et al. reported the effect of passive leg cycle exercise (PLE) on respiratory responses in people with paralysis due to spinal cord injuries with complete lesion, in which mean time since injury was more than 14 years [16]. Pulmonary ventilation was significantly greater during PLE at exercise than at rest [16]. It is suggested that a chemical signal (carbon dioxide) within the arterial blood controls the pulmonary ventilation response [16]. Ozasa et al. reported the effect of machine-assisted cycling on exercise capacity in elderly patients with heart failure [17]. Machine-assisted cycling has the potential to improve endothelial function in these patients [17]. It is possible that passive gait training using a THbKAFO with Prime walk R® improved the patient's respiratory function by means of the same mechanism.

THbKAFO with Prime walk R® was used for the patient's gait training. Prime walk R® has an imaginary axis close to a location of physiological hip joints and a linear guide unit, which make legs swing smoothly, hence improving the efficiency of gait [18]. THbKAFO is useful in patients who have low-bearing capacity of the trunk and both low limbs [19]. THbKAFO demonstrated more extended walking distance than a combination of other orthoses [19]. Therefore,

Table 3. Respiratory rate, heart rate, tidal volume, and saturation of percutaneous oxygen of patient requiring mechanical ventilation.

	Before gait training		On gait training	After gait training supine
	Supine	Standing		
Respiratory rate (breaths/min)	19 (11–27)	23 (22–24)	28 (23–33)	14 (10–22)
Heart rate (beats/min)	96 (84–110)	114 (109–120)	102 (85–135)	104 (88–114)
Tidal volume (mL)	416 (140–532)	375 (340–410)	436 (162–703)	568 (395–752)
SpO_2 (%)	96 (93–99)	98 (98–99)	96 (93–99)	95 (92–98)

Mean (minimum–maximum).
SpO_2, saturation of percutaneous oxygen.

THbKAFO with Prime walk R® was useful in implementing gait training for up to 300 m for the patient who required full assistance.

In a strengthening program for patients with GBS, care should be taken not to overwork muscle groups [15]. Overworking muscles in patients with peripheral nerve involvement can lead to paradoxical weakening [15]. The exercise load for the patient was adequate because there were no muscle weakness and elevation of muscle enzymes.

In conclusion, it was highly possible that rehabilitation aimed mainly on gait training allowed the patient to wean from MV. The benefits of early rehabilitation include decreased duration of MV and hospital stay [12, 13]. If patients can be successfully weaned from MV, they will have an advantage for conversation and oral feeding. Therefore, exercise should be conducted for all patients who require MV and whose conditions are stable [11, 12]. Successful implementation requires a multifaceted approach that includes engaging key hospital administrators and rehabilitation leaders [11, 12].

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