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Exoskeletal Robot Gait Training in Patient with Post-Cardiac Arrest ICU Weakness: A Case Report

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Introduction

- ICU-acquired weakness (ICU-AW) represents a complicated and multifaceted syndrome that plays a major role in prolonged morbidity and diminished quality of life for ICU survivors and their caregivers.
- Elderly patients, even after recovering from acute illness, may develop P-ICUAW, necessitating rehabilitation interventions such as RAGT with wearable exoskeletons.
- This study assesses the efficacy of robot-assisted gait training (RAGT) with wearable exoskeletons in an elderly patient with post-ICU weakness, highlighting its potential to enhance recovery.

Patient presentation (83/M)

Chief complaint	Generalized weakness and inability to stand or ambulate.
Onset	1-months before transfer to department of rehabilitation medicine.
Vector	Cardiac arrest due to acute decompensated heart failure.
Past history	Diabetes Mellitus, 28 years ago. Hypertension (HTN) and Angina Pectoris, 15 years ago. Unstable angina s/p percutaneous coronary intervention (PCI), 5 years ago. Prostate cancer s/p robotic radical prostatectomy, 2 years ago
Physical examination	Manual muscle test (MMT): Grade 4/4 Range of motion (ROM): Passively full ROM
Diagnosis	Post-Cardiac Arrest ICU Weakness DM with neuropathy Prostate cancer, s/p RALP (2021.05.27)

Treatment & Progression

- The patient remained incapable of standing or ambulating independently despite the preserved muscle grades. Thus, he received conventional rehabilitation treatment for 6 weeks until he could stand and ambulate using a walker.
- We proceeded with exoskeletal robot assisted gait training using Angel Legs robots (ANGELROBOTICS Co., Seoul, Korea), consisting of 60 sessions, 5 sessions per week for 12 weeks in total duration.
- Evaluations were conducted before treatment, one month after treatment, and two months after treatment using the 10-Meter Walk Test, the 6-Minute Walk Test, Cadence, Gait Profile Score Abnormality Level(GPS AL) the Timed Up and Go test, as well as spatiotemporal and kinematic gait analyses.

Figure 1.

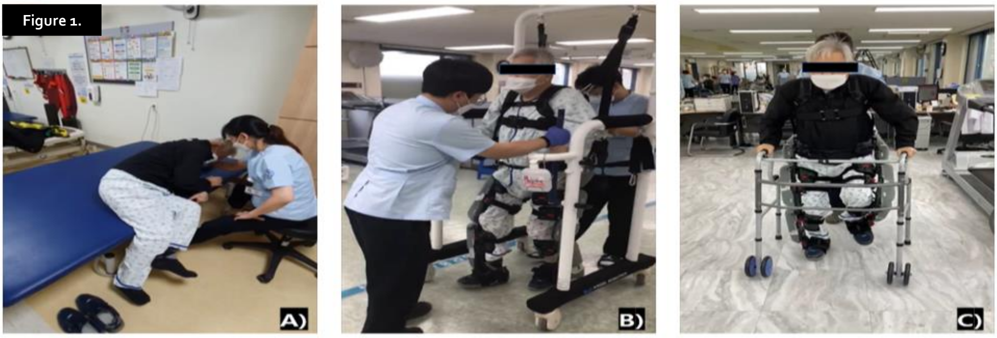

Figure 1. A) For the initial six weeks, the patient underwent conventional rehabilitation treatment focusing on bilateral lower extremities strengthening and sit-to-stand exercises. B) Between weeks 6 and 8, due to difficulty standing independently, the patient used a weight-supported gait training device with a harness for assistance and received weight support from two therapists during robotic-assisted gait training (RAGT). C) Starting from week 8, the patient continued with RAGT, using a standard rolling walker and receiving weight support from one therapist.

Table 1.	Before treatment	1 month after treatment	2 months after treatment
10MWT (Average speed, m/s)	0.28	0.42	0.42
6MWT (Average endurance, m/s)	0.22	0.44	0.42
Cadence (Rt/Lt)	62.9/66.7	73.5/76.1	71.4/77.3
GPS AL (Rt/Lt)	20.3/19.4	21.6/22.3	15.9/16.4

Table 1. Gait parameters
10MWT: 10-meter walk test; 6MWT: 6-minute walk test; m: meter; m/s: meter/second, Rt: Right, Lt: Left, GPS AL: gait profile score abnormality level; The larger the GPS AL is the greater difference of leg's gait kinematics from the reference

Table 2.	Before treatment	1 month after treatment	2 months after treatment
BBS	28	31	31
TUG	56	44	43
FTSST	310	160	141

Table 2. Balance and physical performance test
BBS: berg balance scale; TUG: timed up and go; FTSST: five times sit to stand test

Conclusion

- Exoskeletal robot-assisted gait training may be an effective intervention for improving gait and balance in elderly ICUAW patients Further randomized controlled trials with larger study should be needed to validate the efficacy of this treatment.