

뇌신경재활

게시일시 및 장소 : 10 월 18 일(금) 13:15-18:00 Room G(3F)

질의응답 일시 및 장소 : 10 월 18 일(금) 15:45-16:30 Room G(3F)

P 2-94

Cardiopulmonary burden and perceived exertion of robotic-assisted gait training after stroke

Heejae Kim^{1*}, Doyoung Jeon², Min Ho Chun³, Tae-Woo KIM⁴, Jaewon Beom⁵, Hasuk Bae⁶, Joon-Ho Shin⁷, Sun Jae Won⁸, Jihoon Yang⁹, Won-Kyung Song¹⁰, Jaesoon Choi¹¹, Byung-Mo Oh^{1†}, Ju Chan Kim¹, Ji Soo Choi¹

Seoul National University Hospital, Department of Rehabilitation Medicine¹, Sogang University, Dept of Mechanical Engineering², University of Ulsan College of Medicine, Asan Medical Center, Department of Physical Medicine and Rehabilitation³, National Traffic Injury Rehabilitation Hospital, Department of Rehabilitation Medicine⁴, Chung-Ang University Hospital, Chung-Ang University College of Medicine⁵, Ewha Womans University, School of Medicine, Dept. of rehabilitation medicine⁶, National Rehabilitation Center, Department of Neurorehabilitation⁷, Yeouido St. Mary's Hospital, Department of Rehabilitation Medicine⁸, Sogang University, Department of Computer Science and Engineering⁹, National Rehabilitation Center, Department of Rehabilitative and Assistive Technology¹⁰, University of Ulsan College of Medicine, Asan Medical Center, Dept. of Biomedical Engineering¹¹

Background

Robotic-assisted gait training (RAGT) is widely used for stroke patients to improve their walking ability by providing the high-intensity repetition. However, the burden on cardiopulmonary system during RAGT has rarely been studied.

Objective

The purpose of this study was to clarify the cardiopulmonary burden of RAGT in stroke patients by assessing the change of vital signs and the rating of perceived exertion (RPE) during training and to elucidate the exercise intensity of RAGT in light of the recent physical activity guidelines.

Methods

In this multicenter prospective study, vital signs were recorded from the stroke patients during RAGT with either the end-effector or exoskeleton type robotic devices from January 2018 to April 2019. All patients received RAGT for more than 20 minutes a session, between 1 to 13 sessions for a total 3 weeks. During the training, blood pressure and RPE were measured every 5 minutes and heart rate and respiratory rate were recorded every minute using a wireless electrocardiography sensing device. Using the results, we investigated the change of vital signs and RPE and the influence of type of stroke (infarction

or hemorrhage), presence of comorbidity on cardiopulmonary system. Heart rate reserve (HRR) was calculated from measured heart rate and the Karvonen formula. The calculated exercise intensity was compared with the physical activity guideline of American College of Sports Medicine (ACSM), which recommends moderate-intensity exercise (HRR 40% - 70% or RPE 11-14) for stroke patients.

Results

A total of 87 patients, 418 sessions were included for the analysis. The median age of patients was 61.5 years (range, 24 to 89 years). Although the heart rate and respiratory rate increases over time, the changes were not significant. Other biological signals showed no significant change during training. In a repeated measure analysis of variance, there was no significant time effect by type of stroke, presence of hypertension, cardiovascular disease. None of the vital sign changes met the exercise termination criteria of ACSM. The RPE reached 11 (moderate intensity) at 15 min and remained until the end of the RAGT. However, the heart rate remained below 40% of HRR during RAGT.

Conclusion

The RAGT did not impose great cardiopulmonary burden for stroke patients regardless of the presence of hypertension, or cardiovascular disease; or the type of stroke. However, current RAGT training protocol stays below the level of recommended moderate intensity in terms of cardiopulmonary training. Further studies on the effect of RAGT with higher training intensity seems warranted.

Acknowledgment: 위 논문은 2017 년부터 3 년 6 개월간 산업통상자원부 (한국산업기술평가관리원)의 지원을 받아 수행된 연구임(No.10076752, 기계학습 기반 뇌졸중 및 파킨슨 환자 맞춤형 하지 재활치료 로봇 시스템 개발)

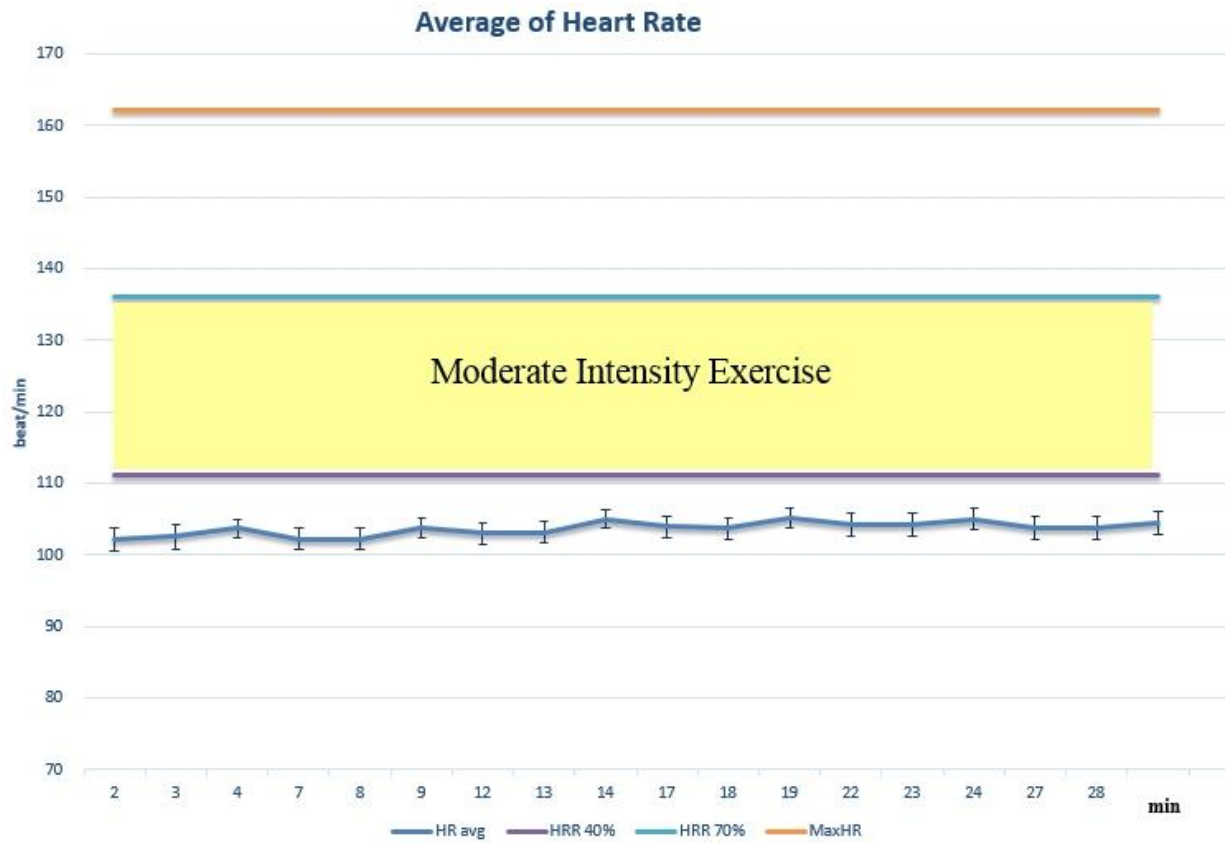


Figure 1. Average heart rate and recommended target heart rate

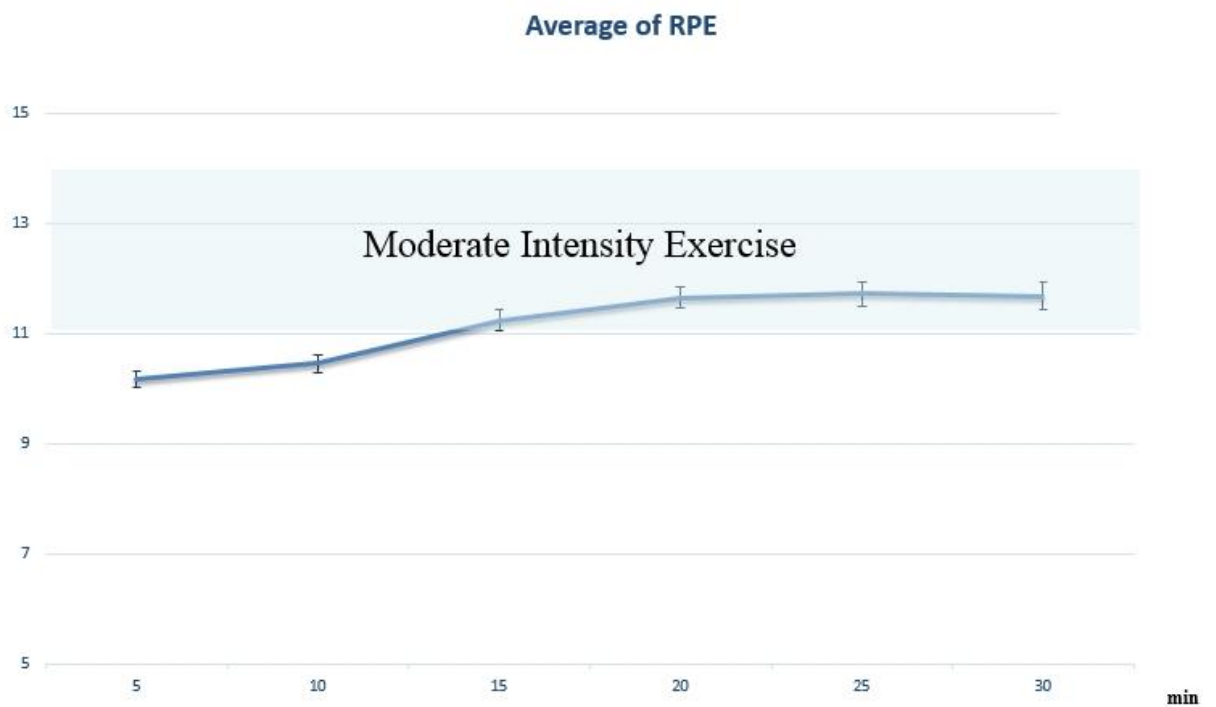


Figure 2. Average Rating of perceived exertion (RPE) and recommended intensity of RPE

Average of Respiratory Rate

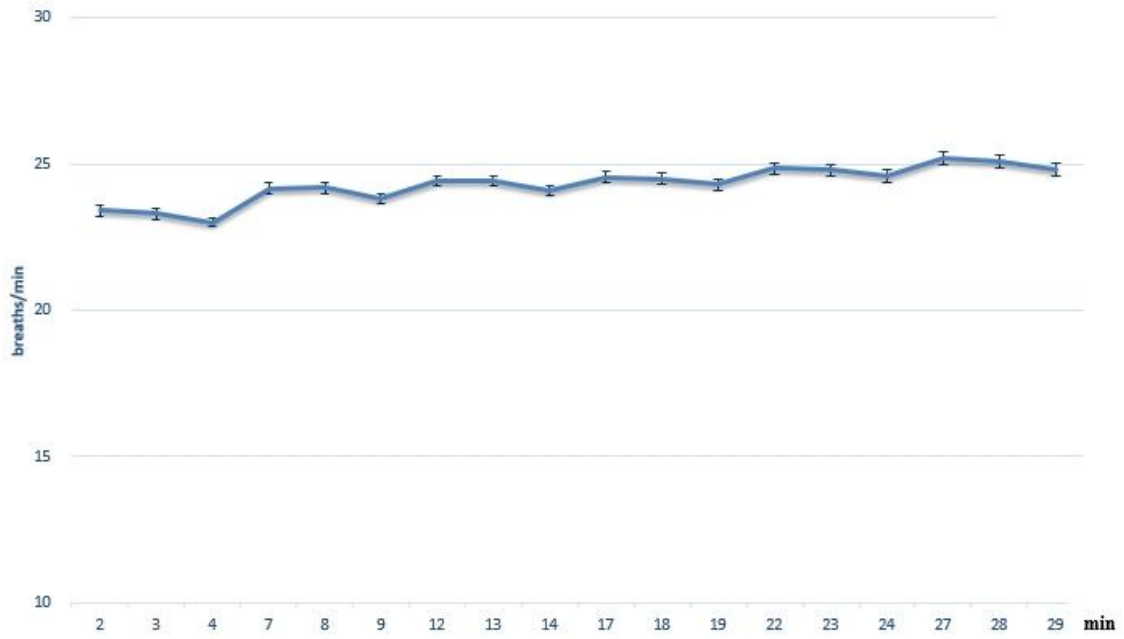


Figure 3. Average Respiratory Rate