Research Article

Handgrip Endurance of Elderly with Heart Failure

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Abstract

There are many reports that strength and endurance are related to life prognosis, and it is attracting attention. A previous study reported 20 seconds of grip strength and endurance in healthy elderly people. However, there is no comparison that evaluates the sustained strength of the subject with or without heart failure. In this experiment, we investigated the relationship between the presence or absence of heart failure and endurance. The subjects were 17 people living in Hiroshima City, Hiroshima Prefecture (78.1 ± 4.0 years old, 3 males). Grouping was performed according to the presence or absence of mild heart failure. There were 10 people in the heart failure group. (78.3 ± 3.5 years old, 2 males). For the endurance of grip strength, the maximum force of the dominant hand was measured for 20 seconds, and the average value per second was calculated from the obtained results. Grip strength was not different between the two groups with or without heart failure (p=0.25) In both groups, the change in grip strength for 20 seconds did not decrease with respect to the maximum value. Comparing the transition of the rate of decrease in grip strength per second with respect to the maximum value, the group with heart failure decreased only after 20 seconds with respect to the maximum value. However, in the group without heart failure, there was a decrease after 16 seconds from the maximum value (interaction effect p=<0.01)

Conclusion: In the elderly with heart failure, the hand grip endurance for 20 seconds did not decrease, and the exertion of power was almost constant. The evaluation of exercise tolerance in patients with heart failure is limited in situations, but there is a possibility that screening such as exercise tolerance can be performed by evaluation using the endurance of grip strength.

Keywords: Handgrip Endurance; Heart failure

Abbreviations: ED: Handgrip Endurance; HF: Heart failure; HS: Healthy

Introduction

The evaluation of muscle strength can be measured in a short time such as the evaluation of sarcopenia and frailty, and there are many standard values and reports. In addition, these results are of great interest, as they are related to the prognosis of life and the prevention of diseases in the elderly, and there are many theoretical backgrounds related to the experimental results. Especially for the evaluation of sarcopenia and frail, the criteria have been created based on the characteristics of each region in the world, and the responsiveness and credibility are very high

[1-4]. Therefore, these muscle strength evaluations are easily used in various situations as one of the measures for prevention and disease. There are also many reports on endurance and longevity, and it is used with interest in daily rehabilitation and training [5,6]. In actual, endurance assessments (especially cardiopulmonary exercise testing) can only be measured at a facility with measurable conditions. However, there are reports that endurance differs depending on the presence or absence of disease, and it is widely used for indications for surgery [7,8]. Previously, we reported on

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20-second grip strength and endurance in healthy elderly people, but there is no comparison that evaluated sustained strength with or without heart failure [9]. In this experiment, we measured handgrip endurance (HE) in healthy people of the same age as elderly people with mild heart failure and focused on the difference in maximum value and the transition of time. The purpose of the study is to examine the difference in results depending on the disease, and to examine the possibility of screening for evaluation of time and disease selection such as exercise tolerance.

Materials and Methods

17 elderly people aged 65 and over (78.1 ± 4.0 years old, 3 males, 14 females) who live in Hiroshima City, Hiroshima Prefecture and perform light intensity exercises once a week. The subjects were divided into a heart failure group (HF group) and a healthy group (HS group) according to the presence or absence of mild heart failure (Stage A/B) according to the AHA/ACC classification [10]. For the endurance of grip strength, the maximum force of the dominant hand was measured for 20 seconds, and the average value per second was calculated from the obtained results. The measurement was performed in November 2021 while wearing a mask, paying attention to prevent the spread of infectious diseases caused by COVID-19. Subjects suffering from diseases that may affect HE measurement were excluded (patients with severe heart failure (Stage C/D), end-stage renal disease, malignant tumors, dementia, severe chronic lung disease, inability to walk 20 m or more. This study was approved by the Institutional Review Board of Hiroshima cosmopolitan University (2019004). When acquiring the data, the data was anonymized based on the protection of personal information.

For HE measurement, as in the previous measurement, a digital grip meter (T.K.K.5401 manufactured by Takei Kikai Kogyo Co., Ltd.) was used with a strain amplifier (T.K.K.1268 Takei Kikai Kogyo Co., Ltd.) and an A / D converter (T.K.K.5721 Takei Kikai Kogyo Co., Ltd.). Digitally output, measured and analyzed. The subjects did not use the backrest of the chair, bent their knees at right angles, placed their soles on the ground, and bent their elbows on the measuring side at right angles, and measured their dominant hand with maximum force for 20 seconds [11]. The maximum grip strength value and the average value per second were calculated. The maximum value of grip strength is shown in kg, and the average value is the value (v) measured in 1/100 second as the average value in every second up to 20 seconds. Commercially available software (SPSS ver.28 IBM) was used for the analysis. In the data, the table is shown as mean ± SD and the figure is shown as mean ± SE. Continuous variables are displayed as mean values. P-values below 0.05 were considered statistically significant.

Result and Discussion

As a result of grouping according to the presence or absence of heart failure, there were 10 patients (2 males) in the HF group and 7 patients (1 male) in the HS group (78.3 ± 3.5 years vs. 77.7 ± 5.0 years, p = 0.79). The maximum grip strength was not different between the HF and HS groups (23.2 ± 6.2 kg vs. 19.9 ± 4.2 kg, p = 0.25). As a result of comparing the transition of each time with respect to the maximum value in all the subjects, it did not decrease within 20 seconds (figure 1). The rate of decrease to the maximum value decreased after 16 seconds (figure 2). There was no difference in sustained grip strength for 20 seconds between the two groups (interaction effect p=1.00). In both groups, there was no decrease from the maximum value. When the rate of decrease from the maximum value of both groups was calculated, it decreased only after 20 seconds in the HF group, while it decreased after 15 seconds in the HS group (82.4% Vs. ≤ 84.0%, interaction effect p=<0.01) (Figure 1&2).
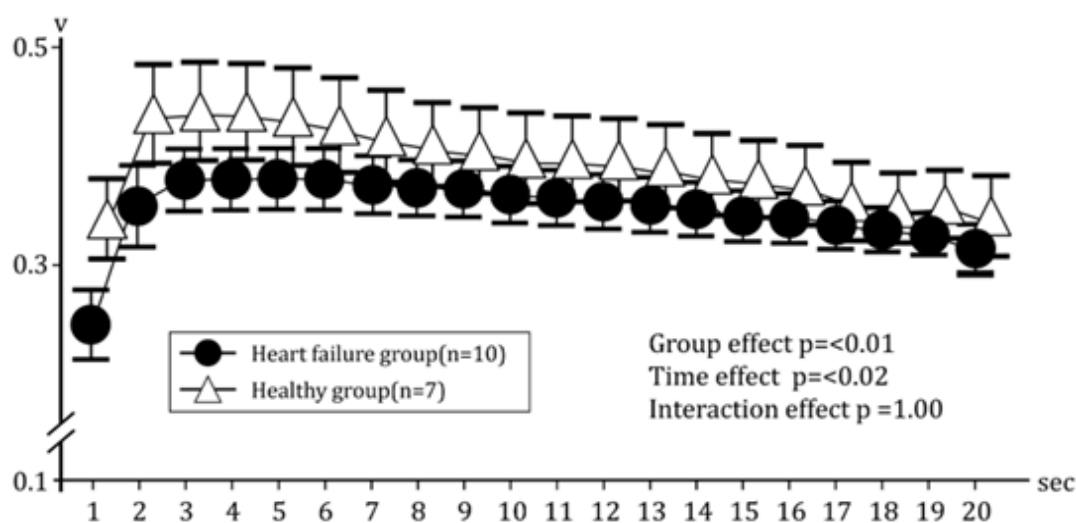

Figure 1: Changes in handgrip strength per second.
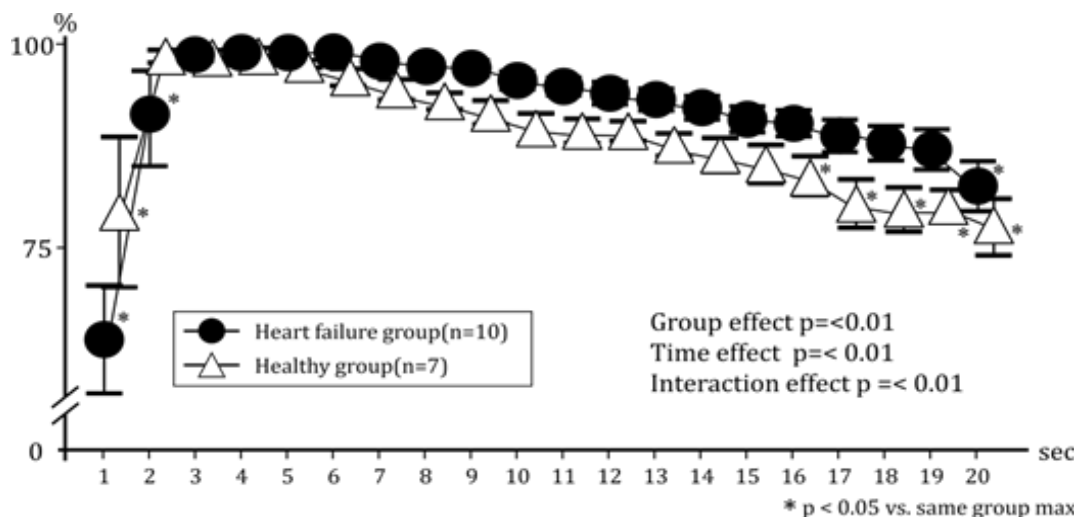
Figure 2: Rate of decrease per second relative to peak grip strength.

In discussion, this study divided the elderly into heart failure and non-heart failure groups, measured the handgrip endurance of the dominant hand with the maximum force for 20 seconds, and examined the difference in the maximum value and the change with time.

Handgrip endurance within elderly people

We compared the changes per second with respect to the maximum value of HE in Elderly, but it did not decrease. However, the rate of decrease per second from the maximum value decreased after 16 seconds. In the measurement of healthy elderly people reported earlier by Miyahara et al., there was no difference in the time transition when compared in the mean value, but a decrease was observed after 17 seconds when compared in terms of the rate of decrease. In young people, there was a difference in the rate of decrease 12 seconds after the start [9]. Similar results were seen in this elderly subject group.

Grouping due to heart failure

As a result of comparing 10 participants corresponding to Stage A/B according to AHA/ACC classification with the heart failure group [10] and 7 healthy elderly groups, the healthy elderly group had the rate of decrease per second decreased after 16 seconds from the start of measurement. But there was no difference in the heart failure group. Izawa et al. state that grip strength may help predict prognosis in patients with congestive heart failure [12]. Hamada et al. reported that the grip strength was lower in heart failure cases in which the ejection fraction was not maintained than in heart failure in which the ejection fraction was maintained [13]. In the subject group this time, there was no difference in the maximum value between the heart failure group and the healthy subjects,

but the rate of decrease by HE measurement for 20 seconds in the healthy subjects was 15 seconds after the start of the elderly and 12 seconds after the start of the young. It was lower than the maximum value. On the other hand, cases of heart failure did not show any decrease for 20 seconds. In similar cases, GU Ogbutor et al. reported that 24-day rhythmic seizure exercises reduced systolic, diastolic, and heart rate [14]. In this case as well, it is necessary to pay attention to excessive increase in blood pressure and symptoms, but continuous administration may influence blood pressure and heart rate. There are many reports of differences in the maximum grip strength depending on the presence or absence of heart failure [15,16]. Since the maximum grip strength is low in HF cases, it may be difficult to see a decrease in the rate over time, so care must be taken when making a judgment as a screening.

Conclusion

As a result of measuring the endurance of grip strength in the elderly, in the case of mild heart failure, no decrease was observed for 20 seconds, and the exertion of force was constant. In healthy elderly people, a decrease was observed after 16 seconds. It may be one of the means to check physical fitness in rehabilitation. In the future, it is necessary to examine the relationship between the decrease in physical strength and muscle strength, oxygen intake, and the relationship with MACE.

Acknowledgement

None.

Conflict of Interest

None.

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