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"Recent Advances in Pulmonary
Rehabilitation"

Review

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Pulmonary Rehabilitation in the Era of Multimorbidity and Multiple Disabilities (MMD)

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Japan has become the first super-aged society in the world; particularly, the life expectancy, the rate of population aged 65 and older, and the speed of aging are second to none.¹ According to the World Health Organization (WHO), in "aging society", "aged society" and "super-aged society" over 7%, 14%, and 21% of the population are aged 65 years and older, respectively. Japan had already entered an aging society in 1970, an aged society in 1994, and a super-aged society in 2007; the current rate of the population aged 65 and older in Japan is 26.7%, which is the highest in the world, and this trend is expected to continue to 2060.²

In a super-aged society, the possibility that the elderly population may have Multimorbidity and Multiple Disabilities (MMD) is increased.³ MMD is generally referred to as a state in which a patient has two or more of the following: external physical disabilities (visual impairment, hearing impairment, speech/voice impairment, mobility impairment, impairment of masticatory function), internal organ impairments (cardiac disorder, renal disorder, respiratory disorder, liver function impairment, small intestinal disorder, bladder or anorectal disorder, and AIDS), and/or mental disorders.⁴ The increasing number of patients with MMD has resulted in increased needs for rehabilitation.³ Especially, the number of persons with internal organ impairments had rapidly increased, with the majority of cases having disabilities related to cardiac function. Moreover, the number of the patients with co-occurrence of multiple internal organ impairments, including cardiac, respiratory, and renal disorders, has increased.⁵ According to a previous study using the lower-limb ergometer test, conducted in 382 patients undergoing stroke rehabilitation, 18% of subjects showed co-occurrence of cardiovascular disorders; 15% also had ischemic heart disease, 2% effort angina, and 1% old myocardial infarction.⁶ In the follow-up prognosis research conducted three years later, 51 of 285 patients who could be followed-up were deceased due to stroke, cancer, or heart disease; 33% of those older than 65 years with heart failure (HF) also had chronic obstructive pulmonary disease (COPD), and 25% of elderly patients with COPD also had HF.⁷ COPD coexisting with heart disease and/or kidney disease may have a significant impact on predicting the prognosis.

In patients with COPD, it has been demonstrated that pulmonary rehabilitation (PR) can help in easing the difficulty in breathing, increasing the exercise capacity, decreasing the period in utilization of medical resources, and improving the Health-related Quality of Life (HRQoL).^{8,9} Although, there is insufficient evidence to determine whether PR improves survival in patients with COPD,⁸ a PR program resulted in a significant and large decrease in the risk of death in rehabilitated patients, as measured using the body-mass index, airflow obstruction, dyspnea, and exercise (BODE) index.¹⁰ The timed walk distance and medical research chronic (MRC) rated dyspnea have also been shown to improve with PR, and these variables are correlated with survival in patients with COPD.¹¹

In contrast, cardiac rehabilitation (CR) improves exercise capacity; associates with improved prognosis, such as reduced cardiac death and all-cause mortality; and can increase the QoL by reducing the symptoms of impaired activities of daily living in ischemic heart failure patients.¹² Moreover, in patients undergoing hemodialysis, renal rehabilitation (RR) and an RR

exercise program have been shown to improve left ventricular function, cardiac sympathetic and parasympathetic disharmony, VO_2 max, malnutrition inflammation atherosclerosis syndrome, anxiety, anemia, sleep quality, HRQoL, and activities of daily living, and to inhibit protein catabolism and reduce mortality.^{5,13} Of note, CR or RR should be performed in COPD patients according to the current CR guidelines, as there is no evidence that CR or RR should be done differently in the presence of COPD.

Until now, medicine has aimed mainly to prolong the patients' life expectancy, that is, it has been focused on "Adding Years to life". On the other hand, rehabilitation medicine has been proactively implemented to accomplish the concept of "Adding Life to Years" by helping to overcome any disabilities through assessment and intervention of socially disadvantaged functions.¹⁴ Furthermore, it has been shown that CR and RR for internal organ impairments are useful to accomplish the concept of both "Adding Life to Years and Adding Years to Life".¹⁴ This suggests that such rehabilitation is effective for patients whose physical strength is deteriorated, and may hence also be effective for patients with MMD. According to a study on the effects of CR on patients with disabilities, the death rate of dialysis patients who experienced cardiac infarction decreased by 35% owing to the rehabilitation.¹⁵

In the era of MMD, the rehabilitation moreover needs to consider the existing principle of "Frequency, Intensity, Type, Time (FITT)" in patients with internal organ impairments.^{3,9} In addition, not only problems of each internal organ, but also the relationship between the internal organs (brain, heart, lungs, kidneys, and bone joints) should be considered simultaneously. For example, even a simple exercise like walking may place a burden on the patient's heart, because the energy consumption during the walk in patients with a history of hemiplegic stroke is higher than in healthy adults.³ Therefore, rehabilitation needs to be implemented by using a walking stick during the early stage, because the energy consumption may be reduced as a result. In the MMD of stroke and HF, the criteria for rehabilitation depend on the criteria for HF.⁹ Moreover, in the co-occurrence of respiratory and other diseases, when hypoxemia appears during exercise, oxygen inhalation should be conducted while monitoring the SpO_2 and heart rate, and while measuring the oxygen saturation; the quantity of oxygen needs to be calibrated to prevent carbon dioxide intoxication.⁹ Thus, it is important that rehabilitation programs are prepared after comprehending the risk factors and physical conditions of each disability, beginning with low-intensity exercise.

Additional studies on rehabilitation of patients with MMD need to be implemented, because the contents of rehabilitation, including the appropriate exercise intensity and hours needed to accomplish the concept of "Adding Life to Years" may be different from those needed to achieve "Adding Life to Years and Years to Life".¹⁴ As for rehabilitation medicine in the era of MMD, from now on, it is particularly important that indi-

vidualized rehabilitation programs should be prepared, comprehending the risk factors and physical conditions of each patient and their social or environmental conditions. Above all, rehabilitation medicine should be focused on "Adding Life to Years" or "Adding Life to Years and Years to Life" in the era of MMD.

SUMMARY AND CONCLUSION

In the super-aged society, it is reasonable to assume that cardiovascular diseases will increasingly occur and that the co-occurrence of MMD will become more frequent. Management of the risk factors of cardiovascular diseases should be more emphasized in the era of MMD. PR, CR, and RR have become important concepts that all rehabilitation-related professionals should be familiar with in the era of MMD. These professionals should accumulate knowledge and experience related to the rehabilitation of patients with MMD. Moreover, in the future, professionals in rehabilitation-related and other fields will need to work together. The appropriate rehabilitation intensity differs according to the contents and degrees of each patient's disabilities. It is particularly important that individualized rehabilitation programs should be prepared by comprehending the risk factors and physical conditions of the patients, and their social or environmental conditions. Above all, rehabilitation medicine should be focused on "Adding Life to Years" or "Adding Life to Years and Years to Life" in the era of MMD.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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