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Research Article

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

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Abstract

As super-aged society has come, the number of persons with Multimorbidity and Multiple Disabilities (MMD) and their needs of rehabilitation have increased rapidly more than we had expected. The purpose of the state of the art is to demonstrate a paradigm shift in rehabilitation in the era of MMD, mainly introducing the data and situation of Japan, which is a most aged country in the world. Until a recent date, medicine has aimed to prolong the life expectancy; that is, "Adding Years to Life" (improvement of vital prognosis). Rehabilitation aims to "Adding Life to Years" (improvement of activities of daily livings and quality of life). However, rehabilitation process of visceral impairments including cardiac and pulmonary rehabilitation is effective for the concept of "Adding Years to Life" and the excellent way to accomplish the concept of "Adding Life to Years and Years to Life". The more studies on the rehabilitation of persons with MMD need to be implemented, because the contents of rehabilitation including the exercise intensity and hours to accomplish "Adding Life to Years" may be different from those to do "Adding Life to Years and Years to Life". It is important that individualized programs should be prepared considering the condition of entire body or risk factors of the patients, their social or environmental conditions comprehensively and, most of all, which to choose "Adding Life to Years" or "Adding Life to Years and Years to Life".

Keywords: Multimorbidity; Multiple Disabilities; Super-Aged Society; Visceral Impairment

Introduction

The Advent of Rapid Super-aged Society

Japan has become the first super-aged society in the world; especially the life expectancy, the rate of 65 and older population and the speed of aging are the second to none in the world [1].

The rate of 65 and older population of Japan was in the lower level until 1980's and in the middle level until 1990's among the advanced countries in the world, but it has remarkably increased by the lowered fertility rate and the prolonged life expectancy [2]. Japan had become an aging society in 1970, an aged society in 1994 and a super-aged society in 2007; aging society has over 7% of 65 and older population, aged society over 14% and super-aged society over 21 %. The rate of 65 and older population of Japan became 25.0% in 2013, which is in the highest level of the world, and this situation is expected to continue to 2060.

In 2060 in Japan, the rate of 65 and older population is expected to be about 40% and the proportion of care receivers (65 years and older) to care givers (20 to 64 years old) may have decreased from 2.6 care givers per one care receiver to 1.3 care givers per one receiver [2].

The Current State of Persons with Multimorbidity and Multiple Disabilities (MMD)

As super-aged society has come, the number of persons with Multimorbidity and Multiple Disabilities (MMD) and their needs of rehabilitation have increased rapidly more than we have expected. In Japan, the number of persons with visceral impairments had rapidly increased and in result, became to hold the 30 percentage of persons with physical disabilities [3]. In particular, for the last five years, the increase of the population with visceral impairments has been extraordinary and the number of persons with visceral impairments became to account for 93% of the increased number of persons with physical disabilities. Furthermore, the number of persons with visceral impairments holds 60% of persons with mobility impairments [3].

The majority of persons with visceral impairments have the disabilities in cardiac functions. The number of the patients with both Cardiovascular Diseases (CVD) and mobility impairments and the co-occurrence of multiple visceral impairments have increased; in particular, the number of the patients who show the co-occurrence of cardiac disorder, respiratory disorder and renal disorder has increased [3].

The probability that people who suffered acute Myocardial Infarction (MI) have a stroke within 30 days after its occurrence goes up to 44 times of people without the experience of acute MI [4]. Stroke patients are more likely to have Ischemic Heart Disease (IHD), too. In the USA, 32~62% of stroke patients also have IHD and the first cause of death is not the reoccurrence of stroke, but CVD including IHD [5].

According to the research on the lower-extremity (or upper-extremity) ergo meter test that was conducted for 382 patients who have been rehabilitated from a stroke [6], 18% of the subjects showed the co-occurrence of CVD; 15% had asymptomatic myocardial ischemia, 2% effort angina and 1% old MI. In the prognosis after three

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years, 18% of the patients who could be followed up were deceased due to cancer (18%), stroke (18%) and cardiac disorders (12%) [7,8], 33% of elderly patients with heart failure also had COPD (Chronic Obstructive Pulmonary Disease) and 25% of elderly patients with COPD also had heart failure [9] and moreover, osteoarthritis is the independent risk factor of cardiovascular diseases. In the results of analyzing statistics after adjusting the statistics of age and sex in the prospective study, the co-occurrence of IHD and osteoarthritis has increased to 33% among the male elderly and 45% among the female elderly and the co-occurrence of heart failure and osteoarthritis has increased to 25% among the male elderly and 20% among the female elderly [10].

Diverse Effects of Rehabilitation

Rehabilitation is the part of medicine that the diverse effects are obtained by acting up to the principle of FITT (frequency, intensity, time and type). For example, the cardiac rehabilitation that had been conducted for the Chronic Heart Failure (CHF) patients in the latter part of the recovery phase comprehensively affected not only the pivotal roles of heart, but also entire body due to the peripheral effects in skeletal muscles, respiratory muscles and vascular endothelial cells and neurohumoral factors in autonomic nerve function, ventilator response and inflammatory markers; as to effects on the roles of heart, cardiac rehabilitation helped in extending the vital prognosis, in decreasing the period in hospital due to heart failure, in increasing the expression of endothelial nitric oxide syntheses (eNOS) and in improving Health-Related Quality of Life (HR-QL), endothelium-dependent vasodilatation, ejection fraction of the left ventricle at rest and left ventricular early diastolic function [11].

As to the rehabilitation of COPD, it has been proven that the exercise therapy for gait muscle help in increasing the exercise ability, in easing the difficulty in breathing, in improving vital prognosis and HR-QL, and in decreasing the period in hospital and the utilization of medical resources [12]. COPD and CHF, two major causes of morbidity and mortality have important systemic components, affecting additional tissues, other than the lung or the heart, such as the skeletal muscle. Muscle dysfunction may not only influence the symptoms that limit exercise, but may contribute directly to the poor exercise performance, health status. The muscular abnormalities in COPD and CHF and the mechanisms underlying these alterations, which are strikingly similar, despite the obvious differences concerning the primary impairment in these two chronic diseases [13]. Only one practical therapeutic intervention currently exists that can reverse some of the muscle abnormalities observed in COPD and CHF, namely exercise training, which becomes nowadays the "cornerstone" of the whole rehabilitation [13].

It has been shown that the exercise therapy for dialysis patients led to improve the exercise ability, HR-QL and MIA (malnutrition, inflammation and arteriosclerosis) syndrome and to inhibit protein catabolism [14].

The rehabilitation for the patients with stroke, orthopedic diseases or the experience of amputation has been proven to be effective, too. As to the stroke rehabilitation, as stroke patients also have disorders in heart, lung and bone joints, the effectiveness of stroke rehabilitation may be doubled by thoroughly performing rehabilitation treatment for those organs as well as stroke.

An increasing number of Post Intensive Care Syndrome (PICS) patients survive and develop MMD such as mental, cognitive, or physical impairments [15]. Identifying effective recovery and rehabilitation strategies is very important. New studies, although at this stage often presented as pilot work, provide important beginning messages for improving recovery from a critical illness [16]. Innovative rehabilitation and recovery strategies during the post intensive care and post hospital periods are now being published [16].

Persons with MMD Need Rehabilitation

Long-term bed rest often causes disuse syndrome in the patients with MMD; those restrictions may deteriorate the functions and functional capability of all the body organs, psychological stability or the quality of life and also cause disuse syndrome; and they may also cause the CVD and shorten the lifetime when combining with obesity, insulin resistant diabetes, dyslipidemia or artery hardening. To break out of or prevent this vicious circle, active exercise is required to maintain and improve health [17].

According to our study, 24% of stroke patients in the recovery phase also had diabetes and 76% showed abnormal glucose tolerance. In particular, stroke patients who have difficulty in walking showed the high rate of abnormal glucose tolerance; as the patients already had had abnormal glucose tolerance that was caused by diabetes before the stroke occurred and physical disabilities that were added by the stroke lowered the exercise ability, the stroke may contribute insulin resistance to increase [6]. It is reasonable to assume that the active performance of activities of daily living is important for persons with multiple disabilities in the aspects of maintaining the ability to perform activities of daily living, preventing relapse and prohibiting the co-occurrence of other arteriosclerotic diseases.

Generally the rehabilitation is effective for people whose physical strength is deteriorated and it may be so for persons with MMD. While stroke rehabilitation tends to aim to live at home or to return to work, cardiac rehabilitation mostly aims to prevent the relapse of CVD and the extension of vital prognosis as well as to live at home or to return to work. Therefore, in the rehabilitation of stroke accompanied by CVD, vital prognosis can be prolonged by implementing cardiac rehabilitation.

Precautions in the Rehabilitation of Persons with MMD

Visceral impairments including CVD have seriously affected the stroke or rehabilitation as the risk factor of stroke or the impediment of rehabilitation [17]. In the era of MMD, the rehabilitation needs to consider the existing principle of FITT in the rehabilitation of visceral impairments. The unique problems of each organ and the relationship among them such as brain, heart, lung and bone joints should be considered simultaneously.

For example, even a simple walk may lay a burden on the patient's heart, because the energy consumption during the walk of the patients with hemiplegic stroke is higher than that of healthy people with same speed. Therefore, exercise therapy needs to be implemented with using walking stick in the early stage of rehabilitation, because the energy consumption during the walk may be reduced by using walking stick. In the case of the co-occurrence of stroke and chronic heart failure, the criteria of exercise therapy depends on the criteria of heart failure; it is important that individualized programs need to be

prepared after understanding the conditions of entire body and the risk factors by beginning with the low intensity of exercise.

The accidents during the rehabilitation treatment of patients with MMD include consciousness disorder (seizure due to hypoglycemia, etc.), chest pain, difficulty in breathing, arrhythmia, falling accident, bone fracture, etc. Not only objective indicators including exercise electrocardiogram, heart rate, blood pressure, SpO_2, etc. should be checked, but also the opinions of doctors from the observation of patients' conditions, the indicators to show the effectiveness of exercise therapy and the risk management should be monitored, because the stroke patients often have difficulty in expressing self-reported symptoms due to aphasia or cognitive impairment; in the case of the co-occurrence of respiratory diseases, when hypoxemia during exercise appears, oxygen inhalation has to be conducted while monitoring heart rate and SpO_2 by using measuring instrument of oxygen saturation and the quantity of oxygen needs to be calibrated to prevent SpO_2 from being below 90% while being careful for carbon dioxide intoxication. The inhalation of oxygen does not only prevent the hypoxemia during exercise, but also mitigate the shortness of breath due to exercise, which, in result, increase the ability of exercise.

In the case of the co-occurrence of orthopedic diseases in lumbar vertebrae or lower limb joints, while exercise therapy to strengthen the muscular strength through progressive resistive exercise is conducted, water walking, exercises sitting in chair and exercise for lower back pain may be considered.

Because the proportion of the elder among persons with MMD is high, symptoms and signs are atypical and self-reported symptoms are not enough to understand the physical conditions, exercise test has to be conducted (Table 1). Beginning with the exercise of low to moderate intensity rather than high intensity, exercise hours and frequency may be increased while implementing exercise test and managing risk factors. Comprehensive rehabilitation treatment needs to be performed based on the individualized treatment goals by sufficiently considering the mental and psychological conditions, social background and the needs of patients, because the prognoses of disease often differ depending on the social environments [1].

Furthermore, the elderly with MMD often have cognitive disorders often leads not to participate in rehabilitation treatment; many of the elderly with MMD have hearing and visual impairments, too. Therefore, the rehabilitation that does not follow the standardized way, but can be conducted based on the consideration of the characteristics of the patient should be conducted. It may be the advisable way to educate patient and his or her family by introducing the books about rehabilitation or materials or providing explanation about the rehabilitation process via easy ways to understand [18].

In the past the informed consent has been considered as important and patients generally just followed the directions if medical staff made a unilateral decision. It means that "compliance" to medical staff's direction was almost absolute, but in recent the "adherence" of patients to the recommendations of medical staff has been considered as much more important: patients adhere to the recommendations of medical staff voluntarily, because they listen to and accept the recommendations and put them in action with their own will. To increase the "adherence" of the elderly, the explanations that can be in sympathy with them and support their hope should be given by medical staff. Lastly, the rehabilitation has to go on by patients themselves or patients and family independently; to do so, the rehabilitation process needs to be explained by the way easy to understand, what they need should be clearly delivered to patients or their family and the contents of the rehabilitation process to make patients willing to participate in need to be prepared [1].

Which Do You Choose "Adding Life to Years" or"Adding Life to Years and Years to Life"?

Until a recent date, medicine has aimed to prolong the life expectancy; that is, "Adding Years to Life" (improvement of vital prognosis) has been the focus of the medicine. In addition, the extension of disability-free life expectancy has become the major target of medicine by trying to prevent the diseases that may cause disabilities.

The rehabilitation aims to overcome or mitigate the disabled conditions by assessing functional disorders, the deterioration of ability and the disadvantages in society that were caused by diseases and intervening in the treatment process; that is "Adding Life to Years" [19]. The rehabilitation process of visceral impairments including cardiac rehabilitation is effective for the concept of "Adding Years to Life" and the excellent way to accomplish the concept of "Adding Life to Years and Years to Life" [18,19]. Among the fields of the rehabilitation, cardiac rehabilitation has been emphasized in the era of multiple disabilities; the cardiac rehabilitation of which the clinical evidence is robust and the risk factors has been thoroughly managed has been considered as huge advances among other fields of rehabilitation medicine.

The more studies on the rehabilitation of persons with MMD need to be implemented, because the contents of rehabilitation including the exercise intensity and hours to accomplish "Adding Life to Years" may be different from those to do "Adding Life to Years and Years to Life". As to the rehabilitation medicine from now on, it is important that individualized programs should be prepared considering the condition of entire body or risk factors of the patients, their social or environmental conditions comprehensively and, most of all, which to choose "Adding Life to Years" or "Adding Life to Years and Years to Life".

Conclusion

As human beings age, their blood vessels do, too. In the super-aged society, it is reasonable to assume that the cardiovascular diseases increasingly occur. The co-occurrence of CVD and multiple disabilities that were caused by other diseases appears more frequently. The management of risk factors of CVD should be more emphasized in the era of multiple disabilities. The rehabilitation of visceral impairments including cardiac rehabilitation has become the part that all the rehabilitation-related professionals should be familiar with in the era of multiple disabilities. Rehabilitation professionals should accumulate the knowledge and experiences of rehabilitation of persons with MMD and link up with professionals in rehabilitation and other fields in the future. The appropriate exercise intensity differs from the contents and degrees of disabilities. The principle of FITT should be also sufficiently examined to improve functional or vital prognosis. Further research with larger sample sizes is required

Table 1: The Characteristics of Persons with Multimorbidity and Multiple Disabilities (MMD) and the Noteworthy Points regarding Rehabilitation.

1)	**One medical condition may easily affect the others.**
	• The knowledge of visceral impairments should be sufficiently accumulated.
	• Holistic medicine should be always performed by considering the conditions of each organ and entire body.
	• The careful attention has to be paid to the change of regimen, the nutritive conditions, dehydration, etc.
2)	**The conditions of diseases are diverse and there are big differences among individuals.**
	• Responses need to be customized according to the goals of each individual.
	• Self-reported symptoms should not be trusted too much, for clinical signs may not be observed, even though the diseases are in a critical situation.
	• Body weight, blood pressure, pulse frequency, oxygen saturation, the results of electrocardiogram, biochemical examination and urine examination need to be consulted.
	• Exercise tolerance test needs to be conducted thoroughly.
	• Beginning with the exercise of low to moderate intensity rather than high intensity, exercise hours and frequency may be increased.
	• Loud, clear, slow and polite responses should be given to the patients with the impairment of cognitive function, hearing or vision and the books or material about rehabilitation treatment that can be easily read need to be published.
	• The training should be given to not only patients, but also their families.
3)	**Complications that are not directly related to the orginal diseases may often occur.**
	• The periods of warming up and cooling down should be given sufficiently.
	• Sufficient time should be given to each intensity of exercise.
4)	**Disuse Syndrome may be often co-ocurred.**
	• To deal with the deterioration of basic physical strength due to aging, rehabilitation should be conducted in early stage and be sustained.
5)	**Returning to home or society may often become the goals of rehabilitation, because it is difficult for the diseases to be completely cured.**
	• Rather than encouraging the long-term hospitalization for the perfection of the ability of ADL, the rehabilitation at home needs to be recommended when the ability of ADL are recovered to a certain degree.
6)	**The occurrence and prognosis of disease are often related to psychological and social (environmental) factors as well as medical factors.**
	• The countermeauseres should be prepared, considering the psychological and physical conditions, functional disorders, health condition, personal factors, environmental factors, the deterioration of strength and the disadvantages to social participation.
7)	**Quality of life needs to be considered in the process of treatment.**
	• When obtaining the informed consent from patients, the discussion should be taken place with a patient and his or her family, after sufficiently listening to the current life habits and life values of patients and considering the point of agreement between what should be done and what they could do.
	• After choosing the concept of goals between "Adding Life to Years" and "Adding Life to Years and Years to Life", the individualized programs need to be prepared and conducted.

to demonstrate the optimal approaches for implementation, outcome assessment and follow-up periods for rehabilitation interventions in the patients with MMD.

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