

Various roles of renal rehabilitation including prevention and improvement of renal function, cardiovascular disease, frail and life prognosis

Abstract

Historically speaking, there was two supreme physicians in the rehabilitation medicine, which were Dr. George Morris Piersol and Dr. Howard Archibald Rusk. Thanks to their efforts, rehabilitation medicine has been developed for long years. There has been a paradigm shift in the rehabilitation, and several kinds of rehabilitation are found, including cardiac, pulmonary and renal rehabilitation. For patients with chronic kidney disease (CKD) and hemodialysis (HD), exercise was restricted in the past. However, the need for exercise therapy has been recently advocated with various evidence and a drastic change. Exercise therapy in the renal rehabilitation has various roles such as prevention and improvement of frail, Activities of Daily Living (ADL), Quality of Life (QOL), renal function, life prognosis by prevention of cardiovascular disease.

Keywords: renal rehabilitation, cardiac rehabilitation, george morris piersol, howard archibald rusk, chronic kidney disease

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Introduction

Rehabilitation medicine is an important field, and has a very wide range of management. When looking back the history of rehabilitation, there was a great doctor. Dr. George Morris Piersol became a doctor at the University of Pennsylvania in 1905 and became the first Professor of Physical Medicine and Rehabilitation in 1947. After that, he made a prominent role in the Secretary-General for 20 years at the American College of Physicians (ACP). As a historian, he wrote the fascinating story of its developments and accomplishments, which was published (1962) as the "Gateway of Honor".¹ One of his impressive words was "Not only to add years to life, but also to add life to years".²

The disciple taught by Piersol was Howard Archibald Rusk. He has been generally recognized as "The father of comprehensive rehabilitation." Rusk had founded the World Rehabilitation Fund (1955), where there were developed programs for professionals in 110 countries and more than 2000 trained physicians. Rusk had ended his autobiography with the word, "To believe in rehabilitation is to believe in humanity".³

In relation to these two phrases, there has been a paradigm shift in the rehabilitation. Conventionally, target organs have spread from the physical region of the entire body. Cardiac rehabilitation for chronic heart failure (CHF) and post-acute myocardial infarction (AMI) has begun.⁴ Pulmonary rehabilitation for chronic obstructive pulmonary disease (COPD) has also started,⁵ and combined guideline of rehabilitation for cardiac and pulmonary were presented.⁶

Recently, renal rehabilitation has been prevalent and in focus.⁷ Authors and colleagues have conducted clinical studies on patients with diabetes.⁸ Furthermore, we have presented reports on chronic renal disease and hemodialysis.^{9,10} Renal rehabilitation is characterized by its mutually connected rehabilitation, including pathophysiology of cardiovascular, respiratory, neurology, immunology, metabolism and so on. As regard to renal rehabilitation, the guideline has been proposed.¹¹ The discussion of both of cardio- and renal rehabilitation has been in important.¹²

As to chronic kidney disease (CKD), it was common that exercise was restricted in the past. However, the need for exercise therapy has been advocated, and then a drastic change has been observed.^{11,12} Exercise therapy, which is the core of renal rehabilitation, has various roles such as prevention and improvement of frail, ADL, QOL, renal function, life prognosis by prevention of cardiovascular disease and exacerbation to dialysis.¹¹ The benefits and risks of renal dysfunction by exercise therapy would be understood for all patients and staffs who are related to CKD and renal rehabilitation.

Epidemiologically, Japan has a population of 120 million, 13 million for CKD patients and 10 million for DM patients. Estimated glomerular filtration rate (eGFR) shows that 1 in 4 over 70 years old and 1 in 2 over 80 years old have CKD.¹¹ There are more patients with CKD present diagnosed by proteinuria and hematuria. As mentioned above, the management for CKD has been very important.¹²

Studies of experimental animal rats have been reported. Renal insufficiency models include hypertensive renal insufficiency,¹³ 5/6 nephrectomy chronic renal insufficiency,^{14,15} nephrotic syndrome, diabetic nephropathy¹⁶ and so on. These models had the experiments for receiving light intensity to moderate intensity exercise for a long period of time. The results showed that renal function was not deteriorated but rather improved.¹⁷ The mechanism of renal protection by exercise is considered to include improvement of glomerular hypertension, suppression of urinary protein increase, suppression of macrophage invasion into renal glomerulus, and suppression of fibroblast proliferation.

Appropriate exercise therapy is necessary and justified for patients with stable CKD. The basic evidence has been present on the guidelines for rehabilitation in cardiovascular disease.¹⁸ CKD patients carry possible various risks, then to conduct the risk assessment would be needed. Consequently, several screening examinations such as urinary protein, electrocardiogram, and cardiovascular disease are required.¹⁹ After evaluation in detail, the exercise content can be adjusted according to the symptoms associated with renal impairment and other complications.

In addition, resistance training is important for maintaining the overall health of stable CKD patients. Based on the exercise recommendations of the American College of Sports Medicine (ACSM),²⁰ center-based supervised exercise therapy and home-based exercise non-supervised exercise therapy have been prepared.

For center-based exercise, the exercise prescription has been ordered as FITT, which is Frequency, Intensity, Time and Type. One example of the order will be described in the following: i) Frequency: aerobics exercise 3 times/week, resistance exercise 2 times/week, ii) Intensity: % heart rate max is 50%, subjective exercise intensity is Borg 11, iii) Time: aerobics 30 min/day, 10 times 3 set, iv) Type: walking or pedaling, squat or training tube.²⁰

For home-based exercise, the activity of the exercise cannot be usually measured. On the other hand, the use of a pedometer is useful as a method for quantifying aerobic exercise under home-based non-monitoring.²¹ It is a cheap and simple tool because it is easy to get the motivation of the exercise by showing the exercise amount by the objective value.²¹

From the evidence point of view, CKD patient in the preservation period shows the level 2c that exercise would be performed to the extent possible while considering age and physical function. For HD patient, exercise therapy is recommended because of suggesting effects of improving exercise capacity, gait function, and physical QOL (level 1b).¹⁸

When patients with acute myocardial infarction (AMI) have renal dysfunction, subsequent mortality and cardiovascular-related mortality increase. Therefore, maintenance of renal function in AMI patients is an important issue. If patients with post-AMI can keep higher activity of exercise, they can suppress the decline in renal function.²² Even in patients with cardiac and renal dysfunction, exercise therapy would be effective for improving renal and cardiac function.²²

Frail prevalence is high in CKD patients. The development of frailty also involves insufficient nutritional intake, uremia, systemic inflammation, diabetes and cardiovascular comorbidities, insulin resistance, metabolic acidosis, and others. Life prognosis of CKD patients is related to physical function.²³ The mortality rate is higher in patients that slow walking speed is slow, walking distance is short for 6 minutes, and grip strength is weak.²³ The same tendency is observed in dialysis patients, and patients who do not exercise or have poor exercise tolerance have a poor life prognosis.²⁴ Among dialysis patients, those with regular exercise habits have a better life prognosis. Furthermore, the more they exercise per week, the better the prognosis.

In summary, recent topic concerning renal rehabilitation has been described. We recognize the contribution of Dr. Piersol and Dr. Rusk and the historical development of rehabilitation medicine. This article will be hopefully useful for clinical practice and research.

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Conflicts of interest

The authors declare have no conflict of interest about the publication of this paper.

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