Rehabilitation in patients with chronic kidney disease

Complete this course and earn 1 CME POINT

Dr. HO Chung Ping, MH, JP
MBBS (HK), MRCP (UK), FRCP (Edin, Glas), FHKAM (Medicine), Specialist in Nephrology

Ms. YUEN Hing Wah
Senior Registered Nurse

Ms. WAH Sai Ling, Louise
Registered Nurse

End stage renal failure (ESRD) is a dreaded disease. Without renal replacement therapy, the outcome is uniformly fatal. As haemodialysis became available after the Second World War, the ESRD patients were given an extra lease of life with dialysis treatment. However, it was not uncommon for those early patients to suffer from malnutrition, peripheral neuropathy and infections. As medicine is growing holistic, the aim of the ESRD treatment has extended beyond keeping patients alive. The patients' quality of life is now a major concern. As we learn more about the pathophysiology of renal failure, it was realized that rehabilitation beginning at early stages of renal diseases produces much better quality of life for patients. The era of **renal rehabilitation** has come.

Important developments in renal rehabilitation

1. **Stratification of chronic kidney disease (CKD)**
   Renal rehabilitation involves a multi-disciplinary approach and hence the communication between different healthcare providers is very important. The management of patients with early renal impairment, including exercise prescription, is different from those with advanced renal impairment.

   For this reason, **CKD is divided into 5 stages, irrespective of the cause of the renal impairment** [1]. The stratification was based on the renal function as shown by the glomerular filtration rate (GFR), which is the best index of renal function. The actual measurement of GFR involves sophisticated tests and in clinical practice, the estimated GFR (eGFR), calculated from the age, gender, and race and serum creatinine of the patient with an empirical formula, was used. The MDRD (Modification of Diet in Renal Disease) formula is a complicated one, even with the "abbreviated" version, but portable applications mounted on iPads or iPhones are available to enable the healthcare providers to calculate the eGFR at patient's bedside (Figure 1).

   The stratification of CKD into 5 stages greatly facilitates the communication between patients and healthcare providers and it facilitates rehabilitation planning.

2. **Association between CKD and cardiovascular disease established**
   It is well known that diabetes mellitus is an important risk factor for cardiovascular disease. A diabetic patient is as likely to develop a heart attack as those with previous cardiac events. Diabetes mellitus is regarded a "cardiovascular risk equivalent" in terms of risk. It is now known that patients with CKD are also predisposed to cardiovascular events and CKD is considered another cardiovascular risk equivalent. In fact, many CKD patients died of heart attack before they went into ESRD [2].

   This has an important implication in renal rehabilitation – CKD patients need to have cardiovascular risk factors assessed and treated. **Like patients with heart disease, CKD patients should be advised on adequate warm up before and cool down after exercise.**

3. **Role of dietary protein**
   Without dialysis therapy, protein restriction with an increased caloric intake was the mainstay of treatment for renal patients. Protein restriction reduces the nitrogenous

Figure 1. The MDRD equation ported to a smartphone.

Figure 2. The daily protein allowance, the right hand showed 40 g pork and the left hand showed 40 g beef.

load which had to be excreted by the kidneys and partially alleviates the uraemic symptoms. On the other hand, protein restriction leads to protein malnutrition with muscle wasting, thus making rehabilitation difficult.

It is now generally accepted that for patients with moderate renal impairment, moderate protein restriction to about 40 g protein per day is advisable. This reduces the nitrogenous load on the kidneys while preventing muscle wasting. The daily protein allowance would be able to cover the palm of a hand (Figure 2).

The actual daily protein intake of a patient can be done by a "diet recall", i.e., to ask the patient to record the type and amount of food taken per day and then calculate the protein content of the food. It is difficult and inaccurate, and requires the expertise of a dietician.

A much simpler and more reliable method to assess protein intake is to calculate from the amount of urea nitrogen in the urine. Most of the urinary nitrogen comes from the protein ingested. One gram of urine nitrogen comes from 6.25 g of dietary protein. In a renal clinic, the physician asks the patient to collect 24-hour urine and the **urine urea nitrogen** is determined. To this value, the amount of "non-urea nitrogen" (body weight in kg × 0.031) is added. The protein intake is calculated from the formula below:

Protein Intake = [urine nitrogen excreted in grams/day + (body weight in kilograms × 0.031 g)] × 6.25 g

To automate the workflow, the principal author has developed a simple programme using Microsoft Excel. The programme can calculate the protein intake based on the patient's body weight and urine urea. Interested readers are welcomed to contact the author for a copy of the programme.

For patients on dialysis, they are encouraged to take in more protein because the nitrogenous waste so produced can be removed by dialysis. A high protein intake encourages protein anabolism and muscle build-up. Since all protein food sources contain phosphates as well, the serum phosphates need to be monitored carefully. **High protein intake in dialysis patients has become the corner stone of renal rehabilitation**.

4. **Exercise prescription**

The medical professional is the person best suited to advise the patient on the benefits of exercise and the ways to implement it. It is known as "exercise prescription". Since 2005, the Hong Kong Medical Association (HKMA) has organized five to eight module certification courses for healthcare professionals. The Centre for Health Protection (CHP) has published a handbook on exercise prescription. It is available in hardcopy and the softcopy can be downloaded on the CHP website (Figure 3).

For the renal patient, the following points on exercise prescription are worth noting:

- In CKD patients, regular exercise is needed to maintain the power of muscles, improve blood pressure and increase the quality of sleep. Unfortunately, the majority of renal patients in Hong Kong do not do enough exercise. Recommended exercise include swimming, cycling (indoors or outdoors), aerobic dancing or any other activities in which large muscle groups are involved

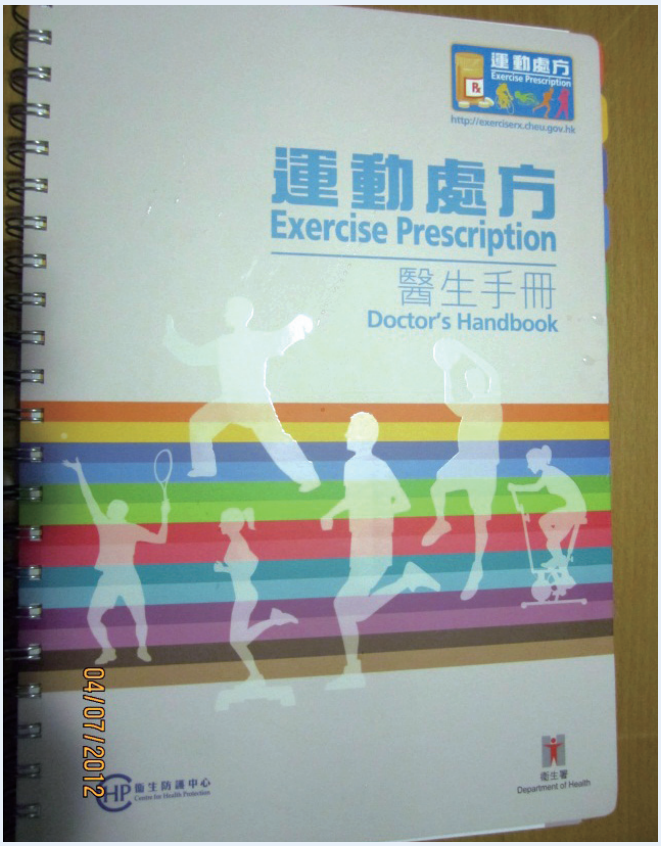

Figure 3. *The Exercise Prescription – Doctor's Handbook*.

continuously. Even 30-minute walking daily is useful. Some renal centres offer tai-chi and other exercise programmes to patients.

- Since CKD patients are predisposed to cardiovascular events, it is important to remind patients when to **stop** during exercise. The National Kidney Foundation in the US gave the following advice:

  You should stop exercising if you feel any of the following:

  a. Very tired
  b. Shortness of breath
  c. Chest pain
  d. Irregular or rapid heart beating
  e. Sick to your stomach
  f. Leg cramps
  g. Dizzy or light-headed

- To help cultivating the habit of exercise, many renal centres organize patient outings each year. This gives patients a chance to go out with their family and their healthcare providers, usually doctors and renal nurses. Such activities are greatly appreciated by the patients. Many relatives said they wished to bring the patients out but they fear about medical events. Having the healthcare providers with them helps booster their confidence and improve their relationships.

Special problems with CKD stage 4 and 5 patients

In addition to the general considerations mentioned above, there are special measures which can help those pre-dialysis and ESRD patients.

1. **Correction of anaemia**

   The majority of ESRD patients are anaemic with haemoglobin of around 8 g/dL if left untreated. This causes symptoms of tiredness, weakness and decreased exercise tolerance, thus hampering rehabilitation. Before the advent of erythropoietin, repeated packed cell transfusions were necessary but this could cause iron overload in the long term. The white cells in the packed cells cause sensitization with the formation of antibodies that might cause "hyper-acute graft rejection" in future transplants operations.

   The situation is changed drastically by the availability of human recombinant erythropoietin. It can be given intravenously or subcutaneously and the haemoglobin can be raised to around 11 g/dL. It is, however, not advisable to raise the haemoglobin to more than 12 g/dL. After treatment, exercise tolerance and subjective sense of well-being of the patients are much improved, enabling them to benefit from more vigorous exercise.

   Blood transfusion is still useful in a situation in which the haemoglobin needs to be increased quickly. One example is that a patient with continuous oozing from a dialysis catheter wound as clotting is impaired when the haemoglobin was low. The bleeding stopped after a packed cell transfusion. **If the patient plans to undergo renal transplant in the future, one may request leucocyte depleted packed cells in which the white cells were first removed by filtration**. Leucocyte depleted blood is available at the Hong Kong Red Cross upon request (Figure 4).

2. **Maintaining adequate dialysis**

   In the early days of haemodialysis era, many patients developed peripheral neuropathy with muscle wasting and many patients became wheelchair-bound as a result. This complication was mainly due to underdialysis. With the improvement in dialysis technology, dialysis efficiency is much increased and such complication is getting uncommon.

   In Hong Kong, many patients prefer delaying the initiation of dialysis "until the last moment" due to the fear of the unknown. One of the author's patients repeatedly refused dialysis and he developed severe muscle wasting (Figure 5).

   He became wheelchair-bound when he finally agreed to dialysis treatment. His conditions improved after

Figure 4. Preparing leucocyte depleted blood by filtration.

Figure 5. Muscle wasting due to delayed dialysis.

dialysis and he went back to his home town in the Mainland for continued treatment. His daughter later reported to me that the patient could walk by himself with the treatment.

My father is receiving the dialysis well and he has been gradually restoring his mobility as expected. He was still on a wheelchair when we arrived in Hefei on Jan 9, but now he can walk by himself. The other side issues such as anaemia and low blood pressure (which cause him to faint) are still there, so the doctors are monitoring these conditions and trying out different approaches.

In Hong Kong, many patients have to pay for their haemodialysis as private patients. For financial reasons, many of them elected to reduce the frequency of dialysis from three times per week to twice per week. This is unfortunate because the reduced dialysis frequency would predispose them to under-dialysis complications [3].

3. **Ensuring an adequate protein and caloric intake**
   Dialysis provides a means by which nitrogenous waste from protein breakdown is removed from the body. The main aim is to encourage muscle building to facilitate rehabilitation. For this reason, ESRD patients are asked to increase their protein and caloric intake to promote anabolism. The recommended amount of protein intake is around 1.2 g/kg/day. Since the protein loss in the peritoneal fluid in CAPD patients is substantial, a more protein intake is encouraged.

   Unfortunately, the phosphate content in all protein-rich food is high and hence phosphate binders are necessary to prevent phosphate retention. Specially-trained renal nurses can offer very good diet advices to the patients as they have spent long periods of time with the patients resulting good rapport (Figure 6).

4. **Intradialytic exercise programme**
   Patients on haemodialysis need to attend renal centres three times a week. Since each dialysis lasts around 4 hours, there is a window of opportunity for the renal staff to provide exercise for these "captive audience". One such exercise is a stationary exercise bicycle for the patient to paddle while lying in bed during haemodialysis treatment (Figure 7).

   To assess the utility and the safety of the exercise machine, the nursing staff elected to test the machine themselves before subjecting the patients on the machine (Figure 8).

Figure 6. High phosphate foods to avoid being exhibited in the renal unit.

Figure 7. A patient on a MOTOmed exercise bike during treatment.

Figure 8. A renal nurse evaluating the machine herself.

Yuen and Wah [3] reported an intradialytic exercise programme used a stationary cycling machine during haemodialysis in a local renal unit. The machine was MOTOmed Letto 2 with three function modes – "passive", "motor-assisted" and "active movement". Cycling can be conducted with patients lying on the bed during haemodialysis. It allowed the patients' muscles to be moved and loosened up by using the "passive" mode. "Motor-assisted" mode helped patients with minimal residual muscle strength. Some patients used their own strength against resistance with "active" mode. The user can start or stop the movement therapy at any time. The resistance level of the cycling was self-adjustable to achieve 0 to 14 gears. Renal nurses and technicians were trained to operate the cycling bike. The cycling exercise starts at the second or third hour of haemodialysis treatment and was closely monitored by renal nurses. The time was set at 15 minutes by default and the speed at 20 paddles per minutes in one session. The cycling exercise can be extended according to the endurance or tolerance of the patients with the maximum duration of 30 minutes. There was a built-in analysis programme for each patient after exercise. It recorded the data including the speed (rpm), duration of training (min), muscle tone (NM), distance covered. The exercise programme was established to patients under nurses' supervision.

Conclusions

Rehabilitation in renal patient is now an established discipline. It is a multi-disciplinary task with medical teams to carry out the cardiac assessment, correction of the oedema and anaemia, control of bone and mineral metabolism. Dietary advices from the dietician, reinforced by the nurses, are important so that the proper amount of protein is taken to avoid muscle wasting while preventing excessive loads on the kidneys. A physiotherapy team is vital for setting up an exercise programme for patients. The support from families and a caring team of renal nurses are of paramount importance. All parties have important roles to play and an integrated team approach can achieve very effective rehabilitation.

Sponsorship and conflict of interest: none

Correspondence should be addressed to Dr C P Ho at cpho@hkma.org

This paper was based on the lecture by the principal author to the Hong Kong Physiotherapy Association Ltd on 12 May, 2012.

References

1. Ho CP. Chronic Kidney Disease – old diseases with new global challenges. *HKMA Bulletin*. April, 2008.
2. Ho CP. Secondary hyperparathyroidism in CKD – recent paradigm shift in clinical management, *HKMA Bulletin*. March, 2009.
3. Ho CP. Haemodialysis, what have we learnt in the past three decades. *HKMA Bulletin*. June, 2008.
4. Yuen HW, Wah SL. An intradialytic exercise program for haemodialysis in the Renal Unit, *Clinical Audit Report* 2012.

Q&A

Answer these on page 17 or make an online submission at: www.hkmacme.org

Please indicate whether the following statements are true or false

1. It was uncommon for end stage renal failure (ESRD) patients to suffer from malnutrition.
2. Chronic kidney disease (CKD) is divided into 5 stages, according to the cause of the renal impairment.
3. Diabetes mellitus is an important risk factor for cardiovascular disease.
4. Without dialysis therapy, protein restriction of patients leads to muscle wasting.
5. "Diet recall" is a more reliable method than urine test in accessing protein intake.
6. Chest pain and tiredness are two of the signs that a patient should stop the exercising.
7. Human recombinant erythropoietin can only be given intravenously.
8. ESRD patients are recommended to increase their protein and caloric intake to avoid music wasting and favour rehabilitation.
9. The cycling machine in an intradialytic exercise programme allows only the healthcare professionals to adjust the resistance.
10. Rehabilitation in renal patient is now the main treatment objective.

ANSWERS TO DECEMBER 2012

Developing a mobile clinical decision support tool for the management of diabetic nephropathy

1. False	2. True	3. False	4. False	5. False
6. True	7. True	8. True	9. True	10. False