

# A primer in haemodialysis for primary care physicians and nurses

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## Summary

*Haemodialysis is getting increasingly popular in the treatment of end-stage renal failure. Dialysis is a major undertaking on the part of the patient, and family physicians have an important supporting role. This article covers the questions commonly asked by patients such as when to start dialysis and the choice between haemodialysis and peritoneal dialysis. Vascular access is a patient's lifeline, and so it would be most helpful if the family physician knows how to check the patency of arterio-venous fistulae with simple bedside techniques. Dietary advice is also covered.*

## 摘要

以血液透析治療末期腎衰竭愈見盛行，進行透析療程對病人和家人是重大承擔，而家庭醫生亦負上重要的支援角色。本文闡述病人常見的問題，例如何時開始透析療程，和在血液透析與腹膜透析之間的選擇。透析導管是病人的「生命線」。如家庭醫生懂得以簡單臨床方法檢視導管的暢通性，肯定對病人有莫大幫助。本文亦包括飲食方面的囑咐。

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## Introduction

Haemodialysis (HD) and peritoneal dialysis (PD) are the two modes of dialysis therapy for the treatment of end-stage renal failure (ESRD). According to the Hong Kong Renal Registry, the point prevalence of

ESRD in Hong Kong was 1078/million population/year. In 2009, 7580 patients in Hong Kong developed ESRD. About 930 of them were admitted to the dialysis programme in Hospital Authority (HA) hospitals. In accordance with the HA 'PD first' policy, the majority of these patients were offered Continuous Ambulatory Peritoneal Dialysis (CAPD) treatment. Recently, haemodialysis is gaining increasing popularity because of technological advances as well as the development of satellite haemodialysis centres.<sup>1</sup>

Although dialysis is within the realm of nephrologists, patients still need the care and support of primary care physicians. There are certain aspects on dialysis which are not well covered in the general literature. This article may be useful for physicians and nurses taking care of their patients.

## Commonly asked questions

The technique of HD has been described elsewhere.<sup>2</sup> Commonly asked questions from patients include:

1. When do I need to start dialysis?
2. Which should I have, HD or PD?
3. Which type of HD should I choose?
4. What measure do I need to take to care for my AVF or dialysis catheter?
5. What particular diet precautions should I take?
6. What other measures should I undertake?

## When should dialysis be instituted?

When this question was thrown to medical students, the common answer was 'when the blood urea was greater than 35 mmol/l, creatinine greater than 1000 umol/l or potassium greater than 6.5 mmol/l. In fact such criteria are used in acute renal failure management only.

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**Figure 1: Calculation of MDRD eGFR by an application mounted on a smart phone by the bedside**



For patients with chronic renal failure, dialysis is indicated when conservative treatment failed to maintain a good quality of life. The usual criteria of urea 35 mmol/l and creatinine of 1000  $\mu\text{mol/l}$  might not be applicable. A patient with advanced renal failure may not have a high blood urea because his protein intake may be poor and hence the nitrogenous load is low. A patient with advanced chronic renal failure may develop muscle wasting with marked reduced muscle mass. Because of its relationship with muscle mass, serum creatinine may not be elevated much despite advanced renal failure.

Glomerular filtration rate, a measure of renal function, can be calculated from the Cockcroft-Gault formula (using patient's age, gender, weight and serum creatinine) or the MDRD equation (termed the estimated GFR [eGFR]).<sup>1</sup> eGFR can be calculated at the bedside and is a very convenient clinical tool (**Figure 1**). Qx-calculate is another alternative tool that is available as a freeware mobile application on both the Android and iOS platforms (<http://www.qxmd.com/apps/calculate-by-qxmd>).

Dialysis should be considered if the creatinine clearance or the eGFR falls below 10 ml/minute. However, in many instances the decision for dialysis is a clinical one. If patient's symptoms like anorexia, weakness, muscle wasting is deteriorating despite conservative management, dialysis should be considered. Since diabetic patients tolerate uraemic symptoms poorly, dialysis should be started much earlier in those patients.

**Figure 2: An infected catheter exit wound**



### The role of family physicians

Many patients in Hong Kong would prefer to delay dialysis 'until the last minute'. This attitude is due to the fear of the unknown, compounded with the wish to save medical expenses.

The primary care physician is the best person to support patients by giving them the necessary information and encouragement. It is important to explain to them that *delaying dialysis would allow advanced uraemic complications such as peripheral neuropathy and muscle wasting to advance*. Such complications take a very long time to reverse and money will not be saved by delaying dialysis.

### Should I choose haemodialysis or peritoneal dialysis?

In fact these two modalities of treatment are not exclusive but complementary to each other. Most patients can be put on either treatment. Patients with a colostomy or after repeated abdominal operations may not be suitable for PD, and HD would be the only option.

PD may be a safer procedure for elderly patients with severe heart diseases. HD requires an arterio-venous fistula (AVF) for vascular access. For patients with poor peripheral blood vessels there may be difficulties in creating an AVF, and so PD would be preferred. Various improvements in HD make it a remarkably safe therapy. With the development of chronic dialysis catheters, it is possible to put patients with poor peripheral blood vessels on long-term dialysis with a central venous catheter.

The main advantage of PD is that it is a simple procedure so much so that the patient can perform his/her own dialysis at home. Its main complications include peritonitis, catheter infection and dialysis failure. If CAPD fails, the patient has to revert to HD. The main cost for PD is the peritoneal dialysis fluid which amounts to a few thousand dollars a month. Moreover, there are *hidden costs* including admissions for peritonitis and other complications.

### Care of dialysis catheters

For patients needing dialysis immediately, temporary HD can be performed using catheters inserted into central veins. Such catheters have limited life span of only a few weeks. Tunnelled catheters have a subcutaneous tunnel and can last a few months or even years.

The care of catheters is important. The commonest site of infection is at the 'exit wound' where the catheter exits from the skin. Good hygiene is essential. If there is significant infection, antibiotic prescription would be needed (**Figure 2**: an infected catheter exit wound). Patients and their carers should be taught how to clean the catheter wound and to change the dressing should the catheter become contaminated.

### Care of the AVF

The AVF is the patient's lifeline. Chinese patients tend to have smaller veins, thus reducing the success rate of AVF surgery. In recent years, pre-operative ultrasound mapping are increasingly used, enabling surgeons to choose the suitable vessels and plan the operation accordingly.

The regeneration power of our veins allow AVF to last for many years despite repeated venipuncture. Complications such as thrombosis or stenosis do occur. Early detection of fistula malformation and intervention are instrumental to the longevity of AVF. Specialized equipments like the Transonic machine are available for monitoring blood flow and other parameters of AVF. All renal nurses should be trained in the 5-steps fistula examination, which allows preliminary AVF assessment without complex equipments. Primary care physicians can familiarize themselves with this technique, as he/she can refer the patient to renal centres if abnormalities are detected.

### Examination of the AVF

The 5 steps consist of inspection, palpation, occlusion, elevation and auscultation.

1. **Inspection.** Stenotic lesions can be easily identified through careful examination (**Figure 5 and 6**; simple inspection of the fistula can yield valuable information)
2. **Palpation.** A working fistula has a palpable thrill due to vascular flow from a high-pressure artery directly to the vein without intervening capillaries. Absence of a palpable thrill may indicate early complications and may warrant further clinical intervention.
3. **Occlusion.** Occlusion of the proximal end of the fistula would cause the fistula to 'swell up', allowing assessment of fistula size. Good distension of the AVF on occlusion indicates a good arterial supply inflow. (**Figure 7**: occlusion of the fistula by hand to check venous engorgement)
4. **Elevation.** Gravitational pull when the arm is elevated will cause the fistula to collapse. The absence of collapse of the fistula on arm elevation indicates stenosis at the proximal end of the fistula (or a graft). (**Figure 8 and 9**: elevation of the arm to check the venous outflow of the fistula)
5. **Auscultation.** Normally auscultation is not as useful as palpation. However, immediately after the creation of an AVF, the thrill may not be easily palpable due to oedema and auscultation for a bruit instead would be a good reassuring sign. (**Figure 10**: auscultation for the bruit of the fistula)

With these simple clinical procedures, many problems of the AVF can be detected. Patients should be referred for further nephrologist assessment if necessary. In some cases, a fistulogram may be needed for confirmation.

### Role of phosphate binders

Patients with end-stage renal failure (ESRF) have diminished ability to excrete the phosphate absorbed from their food intake. High serum phosphate will predispose to the development of secondary hyperparathyroidism and vascular calcification. It has

**Figure 3:** Evaluating the status of the veins by ultrasound increases the chance of AVF success



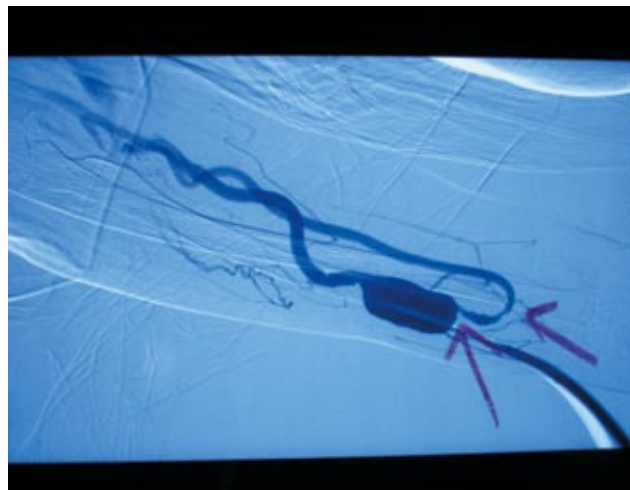
**Figure 4:** Using the Transonic equipment to monitor the function of the fistula



**Figure 5:** The figure pointed to the site of stenosis. The fistula on the left was much narrower after the stenosis



**Figure 6:** A fistulogram showing the site of the stenosis - arrowed



**Figure 7:** occlusion of the fistula by hand to check venous engorgement



**Figure 8 and 9:** Elevation of the arm to check the venous outflow of the fistula





Figure 10: Auscultation for the bruit of the fistula



Figure 11: Commonly used phosphate binders



been repeatedly shown that high serum phosphate is associated with a higher mortality rate secondary to cardiovascular events.<sup>3</sup>

Dietary phosphate restriction is important, especially avoiding those high phosphate foods such as internal organs, nuts and beans. However, phosphate is present in many types of food and hence the use of phosphate binders is usually required. In the past, phosphate binders are mainly prescribed in the form of aluminum or calcium salts, which bind to dietary phosphate in the gut as non-absorbable complexes and excreted in the faeces.

Although aluminum based phosphate binders are potent, long term use may be associated with aluminum accumulation, resulting in osteomalacia or even encephalopathy in ESRF. Calcium based phosphate binders are considered safe in this aspect and will also correct co-existing hypocalcaemia. However,

Figure 12: Models of high phosphate foods on exhibition in the renal unit



constipation, which is common among renal failure patients because of water restriction, may be further worsened.

Over the recent years, resins such as sevelamer have been used as phosphate binders. They do not cause constipation and are very effective, the main limitation being their high cost. (Figure 11: different phosphate binders available)

### Dietary advice

Since protein breakdown would lead to accumulation of nitrogenous waste, pre-dialysis patients would need to reduce protein intake in order to reduce the production of nitrogenous waste. The downside of this practice is the risk of malnutrition due to protein deficiency.

Contrary to popular belief, patients on regular dialysis should be encouraged to take MORE protein, especially those high biological proteins like meat or egg in order to promote positive anabolism. Dialysis

### Key messages

1. Dialysis should be considered if the eGFR falls below 10 ml/minute or the patients conditions deteriorated despite conservative treatment.
2. Haemodialysis and peritoneal dialysis are complementary to each other unless there are specific contraindications.
3. Delay in starting dialysis would cause muscle wasting and other complications.
4. A high protein diet is recommended for patients on dialysis for muscle building.
5. Water, phosphate and potassium restriction are usually needed in dialysis patients.
6. Star fruit is highly toxic to end-stage renal failure patients and should be avoided altogether.

also provides a mechanism for the removal of nitrogenous waste. Under such circumstances, protein and caloric intake should and can be encouraged.

Most patients on dialysis will develop hyperphosphataemia or hyperkalaemia subsequent to dietary intake. Since haemodialysis is performed two to three times a week, the amount removed may not be sufficient to meet the intake amount. For this reason, the majority of patients would need to restrict phosphate or potassium in the diet and to keep the phosphate and potassium level to below 1.6 mmol/l and 5.5 mmol/l respectively.

It is of interest to note that for patients undergoing daily haemodialysis at home, the weekly amount of phosphate removed may be high. For this reason, the patient may sometime need to take phosphate supplement.

### Water restriction

It is noteworthy to remember that HD is an intermittent process, and is carried out two to three times a week. During dialysis, the amount of fluid accumulated since the last dialysis would need to be removed. For a patient on thrice weekly dialysis, the

fluid gain is usually between 2 to 3 kg. For a patient on twice weekly dialysis, the fluid gain may be up to 5 kg.

Since HD removed the fluid from the blood compartment, the reduced circulatory volume will need to be replenished by the movement of fluid from the interstitial compartment. If the fluid removal rate is too high, the refilling rate may not be sufficient to replace the intravascular volume loss and the patient may develop hypotension.

For this reason, fluid restriction is necessary for HD patients, especially for those patients on twice weekly HD with little urine output. The amount of water the patient can drink depends on the amount of urine output of the patient and also the frequency of dialysis. In general, the weight gain of a patient should be less than 0.7 kg/day in between dialyses. For a patient on a twice weekly dialysis, his weight gain in between dialysis should not be greater than  $0.7 \times 3 = 2.1$  kg.

### The star fruit story

20 years ago, workers in Brazil and Taiwan reported that the ingestion of star fruits (star apple, 楊桃) among ESRF patients is associated with the development of hiccup, dizziness, convulsions, coma or even death. The causative agent is a potent neurotoxin present in the star fruit whose renal excretion among patients with ESRF is impaired. This toxin is readily removed by HD. However, ESRF patients are strongly advised not to take even a very small piece of star fruit.

### Conclusion

Haemodialysis has earned its place in the renal field in Hong Kong. It is gaining popularity and the primary care providers would need to be familiar with this treatment modality. ■

### References

- 1 Ho CP, Au YF, Haemodialysis as a practical mode of therapy in Hong Kong HKMA CME Bulletin, February 2011
- 2 Ho CP, Haemodialysis- what have we learnt in the past three decades HKMA CME Bulletin, June, 2008
- 3 Ho CP, Au YF, Secondary hyperparathyroidism in chronic kidney diseases – recent paradigm shift in clinical management HKMA CME Bulletin, March 2009