Haemodialysis as a practical modality of treatment in Hong Kong

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A short history of haemodialysis development

Clinical haemodialysis (HD) has a late start. William Kolff started using HD to treat his patients in Holland during the Second World War. His treatment was not very successful as all his patients died. After the War, Alwall in Sweden invented his artificial kidneys to treat renal failure patients with some degree of success. In 1970, Kolff immigrated to the United States and continued his work on artificial heart and kidneys with better results. His first HD machine was modified from a washing machine (!) and the patients on his dialysis machine survived. With the resources available in peacetime America, the number of dialysis machines increased. In the Korean War and the Vietnam War, it was shown that the mortality of soldiers suffering from acute renal failure due to massive tissue injury could be markedly reduced by rapid evacuation from the battlefield to hospitals equipped with HD facilities.

HD was introduced to Hong Kong in the 1960s and it was met with great enthusiasm. It was the first time that the function of a major organ can be replaced by artificial means. HD was life-saving in the management of hyperkalaemia and pulmonary oedema due to acute renal failure. With the development of the arterio-venous (AV) fistula, chronic maintenance HD was possible for patients with chronic end-stage renal failure.

Early obstacles in the development of HD:

1. The dialysis facilities in Hong Kong were limited in the initial period. The author had carried out a survey of the HD capacities available in Hong Kong from the year 1980 to 1984. It was noted that the capacity in 1980 was only 112 patients. The capacity later increased to 241 in 1984 but it is still very small [1].
2. For those patients declined dialysis in public hospitals, they could seek treatment in private hospitals. However, the dialysis facilities in private hospitals were limited at that time. The number of trained nurses was also insufficient and the charge expensive, taken into account of the economic parity of the time.
3. The mortality rate was high in elderly patients. It was not uncommon to see patients passing away after a few dialyses.
4. Morbidities like hypotension, vomiting during HD and mental confusion after treatment were common, especially in elderly patients. It was believed that rapid removal of the uraemic toxins in the blood by HD reduced the osmolarity in the blood. The osmolarity difference between the blood and the brain cells caused water to move into the cells by osmosis with subsequent brain swelling (the "disequilbrium syndrome").
5. Although the arterio-venous fistula was the preferred method of vascular access, the veins in Chinese are smaller and sometimes there are practical problems in the creation of the fistula.
6. The quality of life for renal patients on dialysis was not good. Many still felt weak and got tired easily even on dialysis.
7. For those patients on long-term dialysis, complications like carpal tunnel syndrome would develop after some 5–8 years. They develop painful joints and muscle weakness. The cause is due to the development of amyloidosis as a result of the accumulation of beta-2 microglobulin in patients on long-term HD. It was called dialysis-related amyloidosis (DRA).

The PD first policy

For these reasons, there was an impression that HD was a dangerous, painful and expensive mode of therapy. The outcome was poor in terms of quality of life and longevity.

In November 1979, Continuous Ambulatory Peritoneal Dialysis (CAPD) was introduced to Hong Kong and it was much more affordable because the dialysis can be performed at home, thus sparing the scarce hospital beds. It has less stress on the cardiovascular system. The advantages of CAPD was quickly realised and all patients in the public hospitals were given peritoneal dialysis (PD) first and HD were considered a second line of treatment — the "PD first

policy". This policy persists today. The author had published a review article CAPD for easy reference [2].

Advances in HD

In the past decades significant advances were made in the CAPD in Hospital Authority (HA) hospitals. Similar advances were also made in HD and nephrology, notably in the private sector.

1. It is now recognised that stroke and cardiovascular events are common causes of death in patients with chronic kidney diseases (CKD). Careful attention to co-morbid conditions like hypertension, diabetes mellitus, secondary hyperparathyroidism and coronary heart diseases helped to reduce the mortality significantly [3].
2. Dialysis can only partially replace the excretory function of the native kidneys. The secretory functions were not replaced. Hence in early days, renal anaemia (due to erythropoietin deficiency) was common. With the development of the human recombinant erythropoietin in the 1980's, replacement therapies were available. With the correction of anaemia by erythropoietin, the quality of life, including exercise toleration and sense of well being, was much improved.
3. Complications like hypotension, nausea and vomiting during HD were common in early dialysis. One of the causes was the acetate used as a buffer base in the dialysate. The acetate ions would be converted to bicarbonate in the liver, thus generating the bicarbonate base. However, in those weak or elderly patients, the acetate conversion rate might not be fast enough and some acetate accumulated in the blood. Since the acetate ion is a vasodilator, the patients would suffer from hypotension and vomiting. Modern HD machines have advanced dialysis mechanics which enable bicarbonate solution to be used directly as a buffer base and the patient discomfort was greatly reduced [4] (Figure 1).
4. For those patients with no suitable veins for creation of AV fistula, dialysis could be achieved with insertion of dialysis catheters into the central great veins like the internal jugular vein. Modern catheters are made of inert substance and can be placed percutaneously under ultrasound and X-ray control. Thus HD could become painless. However, AV fistula is still the gold standard in HD vascular access (Figure 2).
5. With the economic boom in the end of the last century in Hong Kong, the income of the people has improved. However, the cost of HD has increased very little. In fact the cost of dialysis consumables had decreased but it has decreased but there was increase in staff salary. Hence HD has become more affordable.
6. To cater for those people seeking private dialysis, many private hospitals put in resources in the development of HD, including advanced dialysis machines and water treatment systems (Figure 3). Many private centres are open in their administration and they invited guest nephrologists to their consultative committees or even in the accreditation meetings (Figure 4). Another important development was staff training. Teaming up with private dialysis institutions, the author has organised twelve renal courses to train the renal nurses. The latter two courses were in conjunction with the Open University of Hong Kong (LiPace) as well (Figure 5).

The greatest improvement in HD was not in the technical, but in the way the provision of dialysis is organised. It is now realised that,

1. HD and CAPD are complementary to each other. Many patients will failed CAPD due to peritoneal membrane failure or technical failure and had to be switched to HD.

Figure 1: Bicarbonate dialysis – modern haemodialysis machines can make bicarbonate dialysate directly from the bicarbonate powder in the cartridge (The "Bicart").

Figure 2: Insertion of HD catheter under ultrasound and X-ray control.

Figure 3: An advanced water treatment system to provide high quality, pyrogens free water for HD.

Figure 4: Hospital Accreditation meeting, an important quality control procedure.

Figure 5: Graduation dinner in a certificate renal course.

2. The HD technology is a mature mode of therapy but its cost has to be further reduced to enable its widespread use.
3. The major part of the HD cost is on staff cost.
4. It is now known that the frequency of HD is the most important factor affecting the outcome. While three times per week HD is the norm, many patients in Hong Kong opted for twice per week HD to reduce the expenses and the outcome would not be good. If one can increase the frequency of HD to 5 times per week, the result would be much better.

Satellite dialysis

Since hospital HD is expensive, nephrologists are considering the possibility of organising dialysis outside the hospital setting (the "satellite dialysis" centres). The principle is that with modern HD techniques, the risk is very small in stable renal patients and hence the dialyses can be done outside the hospital. The maintenance cost would be much reduced. Another important factor is that since patients are stable, the staff ratio can be reduced and thus a great saving can be achieved.

There are several satellite dialysis centres in Hong Kong. Many of them were run by non-government organisations and each has their own "survival advantages". The largest Satellite Centre in Hong Kong, for instance, is organised by the Lions' Kidney Education Centre. With a large patient pool, the "economy of scale" can be achieved. The Integrated Dialysis Facilities is situated right on top of the Jordan MTR station and is on the same floor as the author's nephrology clinic, thus there are much better medical supervision and support. The transport is also much more convenient than the private hospitals (Figure 6).

Home HD and nocturnal dialysis

Home HD is not new. In the early days when hospital HD facilities are limited, the author encouraged patients to buy HD machines and perform the dialyses at home. From April 1978 to 1985, the renal unit in the Princess

Figure 6: A satellite dialysis centre.

Margaret Hospital has trained 36 patients on home HD [5]. In the home setting, simple HD machines were used and sometimes, an ion-exchanger was be used to replace the expensive reverse-osmosis machine for water treatment.

With the development of CAPD and the Satellite dialysis, home dialysis was getting out of favour because the CAPD did not need a machine and satellite dialysis did not need a helper.

Home HD is having a comeback recently. This is because many patients who failed CAPD need an alternative dialysis treatment. It is also recognised that if the patients perform their dialyses at night during sleep (nocturnal HD), there will be minimal disruption of their work at day time. Since it is not expensive, it is possible to increase the frequency of dialysis to 5–6 times per week. The data from abroad show that the patients' quality of life and their physical well-being are much improved with this mode of therapy. The author has seen a patient who performed HD at night 6 times a week and she is a paddler in the National dragon boat team.

Summary

Since the establishment of HA, there is a tendency for HA centres to concentrate on CAPD and private nephrologists concentrate on HD. The HA renal centres adopted the "PD first policy" and patients were offered CAPD unless this mode of therapy is not feasible. The PD to HD ratio was 81.5 to 18.5 for patients on dialysis treatment at HA centres [6]. While this is a cost-effective method to deliver dialysis service to the community within a limited budget, the patients were effectively deprived of the choice of therapy. This is a pragmatic but not the best method, as patient choice is the core value in medicine. In recent years, The HA has embarked on the pilot scheme of "purchasing" HD from private sectors. Although the scheme is only applicable to those patients who failed CAPD, it is a good start.

HD has come of age in Hong Kong. It is now a safe and affordable procedure. Great improvement had been made in the past decades, both in the dialysis technology and the HD provision. With the development of the satellite dialysis, it is within the reach of many people. It would not be long before HD and CAPD can be incorporated into a truly integrated scheme in Hong Kong and the patients can be given a choice of therapy.

Declaration of Interest

Dr. HO Chung Ping is the Medical Director of the Integrated Dialysis Facilities (HK) Ltd.

Reference

1. Ho CP and Wong KK. Combined Report on dialysis treatment and renal transplantation in Hong Kong (1984), *Journal of the HKMA*, vol 37, No 4, 1985.
2. Ho CP and Yam KK. The development of peritoneal dialysis in Hong Kong *Journal of the HKMA*, vol 39, 2, 1987.
3. Ho CP. Chronic Kidney disease-old diseases with new global challenges, *HKMA CME Bulletin*, April, 2008.
4. Ho CP and Au YF. Haemodialysis, what have we learnt in the past three decades? *HKMA CME Bulletin*, June 2008.
5. Ho CP. Home haemodialysis, a practical mode of therapy in Hong Kong. *Hong Kong Practitioner*, 1986,8:9.
6. Kwan TH. Highlights on the Hong Kong Renal Registry (Hong Kong Society of Nephrology Annual Scientific Meeting, October 24, 2010, p.35).

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. William Kolff's first HD machine was modified from a washing machine.
2. Arterio-venous fistula was the Gold standard of vascular access.
3. Dialysis-related amyloidosis is common in patients treated with HD for a long time.
4. Hypotension during HD was a common complication in early dialysis.
5. Dialysis can effectively replace both the excretory and secretory functions of kidneys.
6. The major part of the HD cost is on equipment.
7. In the home HD, the reverse-osmosis machine is often replaced with a deionizer to save cost.
8. Currently, the percentage of patients treated with PD is lower than that with HD.
9. Many of the satellite dialysis centres in Hong Kong were run by non-government organisations.
10. After years of development, HD has become a safer and more practical procedure for CKD patients.

ANSWERS TO JANUARY 2011

Patients with uncommon causes of sciatica

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