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Editorial

Development of Newer Therapies in Haemodialysis

K T Woo, H K Tan

In recent years, many new technological advances have been made in the field of haemodialysis. We have moved from the Travenol (Kolff) twincoil artificial kidney and the Quinton-Scribner Shunt of the 1960s, and the use of acetate-based dialysis to modern dialysis using bicarbonate-based dialysate with capability for volumetric fluid removal and sodium modelling[1,2].

Haemodialysis in Singapore started in 1961 when a patient with acute renal failure was dialysed using the twin coil artificial kidney. In 1968, a chronic haemodialysis programme was established in the Singapore General Hospital (SGH). It was housed in an attic above the Surgery A unit of the old SGH: an eight-bedded dialysis centre. Dialysis was performed using cuprophane membranes in a standard Kiil dialyser and patients were dialysed for six to eight hours, thrice weekly[2].

The home haemodialysis programme was introduced in 1970 and patients were trained for two months at SGH, together with their helpers, before going home to perform their own dialysis. In 1975, the first self-dependency dialysis unit (SDDU) was set up in Alexandra Hospital and, in 1983, the second SDDU was established in Tan Tock Seng Hospital. These are subsidised state-supported haemodialysis programmes where the patients are dialysed with the help of their spouses or relatives. One nursing officer can supervise up to 20 such patients and the cost of staff salary is very much reduced[1].

In 1981, with the opening of the new SGH, a new dialysis centre was set up there. This remains today as the main dialysis centre and copes with those patients requiring temporary dialysis, training of patients for the satellite centres and those with problems from the National Kidney Foundation Centres and other centres. Here, too, patients requiring renal transplant work-up and those who have failed or are awaiting CAPD are dialysed.

In the past, after years on dialysis, a patient would develop slurring of speech, facial grimacing, fits with severe wasting and osteomalacia – the "monkey syndrome". Today, we know this syndrome as dialysis dementia. This is due to aluminium toxicity of the brain and bones. The dialysate or solution used for dialysis is mixed with tap water. After years of dialysis, the aluminium present in tap water induces dementia. In 1979, the SDDU in Alexandra Hospital installed a deioniser followed by the installation of reverse osmosis facilities in 1981 in the centre in SGH. These water treatment facilities have since solved the problem of dialysis dementia[3].

In the early phase, dialysis dementia was the commonest cause of death whereas nowadays, more patients die from cardiovascular causes. Anaemia used to be a problem but, with the use of erythropoietin injections, most of our patients nowadays maintain Hb of about 10 gm/dl or more. The incidence of hypertension is high and this problem of poor compliance

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with salt and water restriction in these patients is solved by using the newer dialysers with larger sieving coefficients and surface areas to draw more fluid from these patients. All patients are now vaccinated against hepatitis B prior to entry in the dialysis programme, but about one-third of those patients were admitted into the programme before vaccination became available[3].

Over the past decade, various new techniques have been introduced, viz., Rapid High Efficiency Dialysis (RHED), High Flux Dialysis (HFD), Haemodiafiltration (HDF) and Rapid High Flux HDF (RHFHDF). All these techniques for improved methods of haemodialysis have resulted in shortening the hours of dialysis from the conventional four to five hours to three hours. Most of our patients are on three-and-a-half-hour dialysis using better membranes and more efficient dialysis prescribed to their individual needs which include sodium modelling and other facilities.

In this issue of the journal, H-K Goh et al[4] from Singapore study the Profile of Admissions to an Acute Dialysis Care Unit over a three-month period comprising 124 patients who had 157 admissions. In most centres there are two groups of renal patients requiring dialysis. Those with acute renal failure and those with chronic renal failure. The acute renal failure patients are often dialysed in ICU and high dependency areas using Continuous Renal Replacement Therapy (CRRT) and other modalities. These are patients with ARF due to sepsis, post trauma, obstetric cases, etc in a hospital setting.

In addition, there is the other group who are those with ESRF on regular haemodialysis presenting with fluid overload, vascular access problems, infections and other problems which cause them to be admitted to hospital and therefore require in-hospital dialysis using conventional haemodialysis.

Since the paper is about an Acute Dialysis Care Unit, we should expect patients to have the profile of those with Acute Renal Failure. But in this paper we are presented with data on patients with chronic renal failure (ESRF) – 96%, of which 40% had vascular access problems.

There is a mismatch between the type of patients being dialysed here and the type of care that an "Acute" centre should deliver. It is in fact a dialysis centre offering in-hospital dialysis to chronic dialysis patients who are admitted for intermittent dialysis problems or intercurrent illness requiring hospitalisation.

In the acute ICU setting, in terms of acute haemodialysis for the patient with Acute Renal Failure requiring haemodialysis, intermittent haemodialysis is no longer considered the ideal form of renal replacement therapy[5]. This is so because conventional haemodialysis is often associated with episodes of hypotension and this especially in a patient with acute renal failure due to acute tubular necrosis (ATN) would mean that such episodes of hypotension during haemodialysis would result in worsening of the existing acute tubular necrosis and contribute to a longer duration for recovery of the renal tubular cells from ATN.

In recent years, patients with acute renal failure, no longer receive conventional intermittent haemodialysis. They are now treated with Continuous Renal Replacement Therapy (CRRT) which is a technical variant of conventional intermittent haemodialysis[6].

CRRT as we know it today had its early beginnings in a technique known as hemofiltration. Hemofiltration, pioneered by L W Henderson in 1967[7] is employed alone or as an adjunct to haemodialysis for the purpose of fluid removal. It can also be used for the removal of uraemic or other toxic solutes.

In most centres there are two groups of renal patients requiring dialysis. Those with acute renal failure and those with chronic renal failure.

Hemofiltration effects removal of water and its contained solutes by means of convective transfer along a pressure gradient whereas in haemodialysis, solute transfer occurs as a result of diffusion down a concentration gradient. In contrast to haemodialysis, a dialysis machine is not required for hemofiltration. The equipment for hemofiltration consists of an extra-corporeal blood circulation where blood is usually let out by means of femoral catheters, a hemofilter containing the filtration membrane, a system for infusing replacement solution and a receptacle for the filtrate. Heparin is given to prevent clotting in the hemofilter.

There are two ways of using hemofiltration. Firstly, Intermittent Hemofiltration, where 40% to 50% of body weight is exchanged in each thrice weekly hemofiltration session in patients who have end stage renal failure. This will rid the body of small molecular weight uraemic metabolites like urea, inorganic phosphates and potassium as well as middle molecules. Fluid removal can also be effected with fewer symptoms and less hypotension than with haemodialysis[8]. This treatment is therefore useful for patients with unstable cardiovascular system or hypotension.

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Secondly, hemofiltration can also be employed as continuous venous-venous hemofiltration (CVVH)[9]. Patients with acute renal failure with fluid overload, an unstable cardiovascular system or hypotension can be treated by CVVH for days. Filtration rates of 5 to 10 ml/min are commonly employed. CVVH is usually performed on patients in intensive care units. It provides continuous correction of both volume and composition of extracellular fluid. CVVH is employed for patients with acute renal failure who have unstable circulation or severe hypotension, the commonest group of patients being post cardiac surgery patients. CVVH is useful in the critically ill patient with acute renal failure with unstable haemodynamics.

In today's context, CRRT consists of three subtypes, depending on the mode of solute elimination[10]. They are Continuous Veno-Venous Haemofiltration (CVVH) which effects convective solute removal; Continuous Veno-Venous Hemofiltration with dialysis (CVVHD) for diffusive solute elimination and Continuous Veno-Venous Haemodiafiltration (CVVHDF) which effects convective plus diffusive solute removal. V refers to central venous access usually secured by means of a double-lumen dialysis catheter. CVVH is the most widely performed form of CRRT and is best suited for critically ill, haemodynamically unstable, acute renal failure (ARF) patients. Critically ill end-stage renal disease (ESRD) patients can also be treated with CRRT.

In contrast to intermittent haemodialysis, CVVH provides a more physiological regulation of the internal milieu in ICU patients, although it has not been shown to confer a survival benefit[11]. However, available data support the early initiation of CVVH[12] and at an adequate intensity to make a difference to patient survival based on the work by Ronco and Bellomo et al[13]. Further work is being done to exploit high-volume haemofiltration (HVHF) as a potential immunomodulatory tool in sepsis[14]. Finally, basic CRRT technology is being further developed to exploit blood purification in sepsis[15]. Examples of such innovations include super high-flux haemofiltration[16] and coupled plasma filtration-adsorption (CPFA)[17]. SMJ

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WELCOME ABOARD, Dr. Linda Clever, MD, MACP

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Biographical Sketch

Linda Hawes Clever, MD, MACP, President of RENEW, founding Chair of the Department of Occupational Health at California Pacific Medical Center and former Editor of the Western Journal of Medicine, received undergraduate and medical degrees from Stanford University. After interning at Stanford, she had several years of medical residency and followships at Stanford and the University of California, San Francisco. Dr Clever is Board Certified in Internal Medicine and Occupational Medicine. In 1970, Dr Clever became the first Medical Director of the teaching clinic at St. Mary's Hospital in San Francisco where she started patient education and nurse practitioner training and research programmes. In 1977, she started the Department of Occupational Health at the then-Pacific Medical Center and began her activities in the American College of Physicians in which she served as Governor, Chair of the Board of Governors, and Regent. She is a member of the Institute of Medicine of the National Academy of Sciences and the Western Association of Physicians, and is Clinical Professor of Medicine at UCSF. She has written numerous papers, chapters, articles and editorials. Her areas of special interest include personal and organisational renewal; current issues in health care, including managed care and ethics; the interactions of life, work and health; the occupational health of women and health care workers; leadership; and ways to build community. She has chaired the Boards of KQED and University High School and has served on numerous other boards including the Stanford University Board of Trustees. She is now president-elect of the Western Association of Physicians and serves on the Boards of the Buck Institute for Research in Aging and the Northern California Presbyterian Homes and Services. Her husband is also an internist; their daughter is a Fellow in General Internal Medicine at Johns Hopkins School of Medicine. Dr Clever is a dedicated walker and enjoys good company and good conversation.

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