

An indigenous, life-saving device

The development of an indigenous equipment for continuous renal replacement therapy gives new hope for patients with acute renal failure.

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PATIENTS suffering from acute renal failure but are unable to tolerate conventional techniques such as haemodialysis or peritoneal dialysis for survival, now have an effective and relatively inexpensive option — an indigenous equipment for continuous renal replacement therapy (CRRT). Engineers A.N. Rajan and B. Shiva designed it under the guidance of nephrologist Dr. R. Ravichandran, who heads the Madras Institute of Nephrology at the Vijaya Health Centre, Chennai. Known as Vira 99, the equipment can perform the functions of a kidney in critically ill patients. According to Dr. Ravichandran, more than 60 per cent of patients with kidney failure in intensive care units die not because of their primary ailment but because they are unable to tolerate haemodialysis.

Kidneys perform the vital bodily functions of removing toxic substances, waste products and excess water from the blood and maintaining the balance of various salts and acids in the blood. When kidneys fail, haemodialysis will have to be undertaken in order to prevent the accumulation of impurities in the blood. In haemodialysis, blood is purified by the exchange (diffusion) of blood solutes with the dialysis solution (dialysate has a salt composition similar to that of blood but without any waste products) in the dialyser (a semi-permeable membrane which filters water and waste products from the blood). Purified blood is then introduced back into the body through a vein. While one haemodialysis procedure (in which blood is transported to the dialyser through plastic tubings) takes around five hours, a round of peritoneal dialysis (in which the dialysis solution is introduced into the peritoneal or abdominal cavity through a catheter) takes between 12 and 24 hours. In both these processes,

between 200 and 300 ml of blood is drawn from the body every minute.

Critically ill patients cannot tolerate such rapid drawal of blood and they could even collapse during the procedure. According to Dr. Ravichandran, such patients constitute nearly 10 per cent of in-patients with kidney failure in any hospital at a given time and around 80 per cent of the ICU patients, several of whom suffer multi-organ failure. To save such patients, equipment that could continuously filter unwanted substances from the blood at a slow rate of, say, 50 ml a minute, and pump back the purified blood into the patient, was needed. And that is what the new equipment seeks to do.

The basic model of the CRRT machine incorporates a simple continuous venovenous haemofilter (CVVH) circuit that consists of a main pump which draws blood at a slow rate continuously for several days at a stretch; a haemo-filter that purifies blood; an anti-coagulant pump with heparin that prevents blood-clotting; and a tube that takes the purified blood back to the body. The machine has a power backup facility. The machine makes it possible to control the metabolism of critically ill patients and maintain their vital functions for a couple of weeks, until their kidneys can be revived.

The digitally controlled machine is essentially a life-saving device that acts as a short-time replacement for kidneys. In that sense it is different from a regular

dialysis machine, which is a sophisticated piece of multi-function equipment that has a number of integrated safety alarms, fluid-balancing controls and connected blood modules.

Dr. Ravichandran tried Vira 99 on a couple of his patients and found it to be efficacious. The prototype has been calibrated to international standards on a computer-aided design (CAD) model with the help of a software package, IDEAS, developed by the Structural Dynamics Research Centre, Chennai. This software package was adapted by experts at the Indian Institute of Technology (IIT), Chennai.

Vira 99 is compact and simple to operate. It can be taken to the bedside and does not require training to operate it. Also, as the machine does not require water or fluids, there is no danger of contamination, which is a major problem in haemodialysis. Even small hospitals in remote areas can utilise this equipment. It is relatively inexpensive and spare parts are inexpensive and easily accessed. Apart from the low initial cost, which may be less than one-tenth the cost of an imported machine for haemodialysis, the running costs of Vira 99 are relatively low. In principle, the machine can be used for any procedure that requires to draw blood or any other fluid from the body. According to Dr. Ravichandran, cardiologists will find it useful to treat cardiothoracic cases, particularly patients with pulmonary edema.

Why did Dr. Ravichandran opt for CRRT and not work towards an indigenous dialysis machine? He says that he thought the critically ill should be given priority over chronic renal failure patients, who could be sustained for longer periods through haemodialysis. Moreover, he says this machine would be useful for people in remote rural areas and in small hospitals without adequate skilled staff. ■



Vira 99 in operation.