A New Pumpless Compact Unit for Haemodialysis with Flatbed or Coil Dialysers

R FLANDOLI, G GIACOMINI, E PETRELLA, G D'AMICO

Dasco Research Laboratory, Mirandola and S Carlo Borromeo Hospital, Milan, Italy

Our experience derives from more than 1500 hours of dialysis, carried out by means of a new type of single dialysis unit, particularly studied for home use. The equipment, illustrated in Figure 1, can be used with both flatbed and coil dialysers.

In our department, the latest version has been employed, which is 84.5cm high, 55cm wide and 55cm deep; its weight is 75kg. It is fed by normal domestic electric current and uses demineralised or softened water at a minimum pressure (0.4kg/cm²) and with a mean consumption of 32 l/hr.

The original working principle eliminates the need for proportioning pumps. It consists of blending concentrate and water by a system of isopressures. When the same pressure has been obtained in the two fluids, their proportion will only depend on the gauges of the tubes leading to the mixing chamber. The variation of such proportion can be obtained by an adjustable resistance placed on one of these tubes. Figure 2 shows a diagram of the hydraulic circuit forming the equipment.

Water flows through a filter (fi) and a pressure reducer (rp), runs inside the circuit (represented by a dotted line) and, after the electrovalve (2), divides into two branches. One of these passes through the electrovalve (4) and reaches a rigid
and perfectly sealed tank. Entering this tank, it moves an equal volume of air which, at the same pressure, will pass to the other perfectly sealed tank (tc) where the concentrate is kept. This will be displaced out through passage (bl) at the same pressure as the entering air (equal to water pressure) and go on through the duct towards the mixing chamber (mi) where the other branch of the water circuit (dotted line) comes through electrovalve 11. Therefore, water and concentrate will reach the mixing chamber at the same pressure and the mutual proportion will depend on the gauge ratio between the two nozzles through which the two fluids enter the mixing chamber; modifications to such a ratio can be got by a stopcock (rc) inserted in the last section of the water circuit.

The other elements of the drawing represent the dialysate reservoir (bm), the sterilisation circuit (hypochlorite or formalin) and the rinsing circuit, which operate automatically.

The equipment is supplied with a probe for conductivity measurement giving a continuous evaluation of the exactness of the prepared liquid, while a meter indicates the variation of bath sodium concentration. There are also minimum and maximum alarms which, if mistakes occur, stop the dialysate supply and emit acoustic and visual signals.

Testing the equipment led us to the following conclusions:

1. Dialysate concentration, after the desired value is reached, keeps steady during the whole dialysis, with variations lower than 1%. The system alarmed only once because of too high a dialysate concentration. This arose because of a rapid fall of pressure in the
2. Pyrogenic reactions never occurred in the patients during treatment, where the prescribed sterilisation (by 10% formalin) and rinsing procedure was properly followed.

3. Even without dialysis experience, one can handle the equipment with the utmost safety after a theoretical and practical training lasting only 10 hours, over 20 dialyses.

4. To start dialysis (using the equipment from the end of the sterilisation phase), about 1 hour is necessary (filter assembly included) and employs only one person.
   At the end of dialysis, the equipment can be left in the sterilisation phase for about 20 minutes.

5. The equipment's overall dimensions are moderate and its working is quite noiseless.

   Being easy to handle and safe in practice, it is particularly suitable for home dialysis as well as for hospital dialysis. It can be used to supply both flatbed and coil dialysers.