A NEW AUTOMATIC PERITONEAL DIALYSIS SYSTEM

A. VERCELLONE, G. PICCOLI, P. L. CAVALLI, R. RAGNI and S. ALLOATTI

Clinica Medica Generale, Università di Torino, Turin, Italy

Automatic peritoneal dialysis offers the following advantages: (1) Reduction of the nurse's work, of number of checks necessary during the treatment, and thus reduction of the operating costs. Costs are further reduced by employing a Millipore filter for the sterilisation of the liquid (McDonald, 1965); our experience confirms the suitability of this filter (0.22 µ). (2) A high degree of protection against bacterial contamination. (3) Easy achievement of hourly exchanges of a large number of litres of liquid, with its rapid injection and removal; this provides improved dialytic action (Fig. 1).

![Figure 1](image)

**Fig. 1.** Influence on urea clearance of total substitution time (inflow and outflow of the dialysing fluid). Stay-in time 3–5 minutes. Use of a 2 litre solution every cycle with glucose at 15%o.

The new system develops that of Boen (Boen, 1964; Boen et al., 1964), and has been worked out in the Medical Clinic of the University of Turin*, by enlarging a previous model of ours.

The apparatus functions as follows (Fig. 2): a pump (2) draws the dialyzing solution from a reservoir (1) and sends it through a Millipore filter (0.22 µ) and through a heater (3) to an intermediate plastic bag reservoir (5).

When the desired quantity of liquid is reached, a dynamometer (6) stops the pump.

* Ing. Elio Colussi and Dr. Ennio Denti of the Biomedical Engineering Department of Sorin (Italy) carried out the technical development.
Electrovalves (V4, V5) outside the circuit control the injection and removal of the liquid from the peritoneal cavity. The liquid passes from plastic bag (5) into the peritoneal cavity (7). Its stay-in time is controlled by a timer which, at the end, starts the next stage. The removal from the peritoneal cavity is accelerated by a vacuum pressure pump (11), and is graphically checked by a visual recorder (10).

The duration of the removal period is self-regulated, and is dependent upon the removal speed in each case.

When a minimum of liquid has been removed, pre-determined according to the needs of each patient, a timer connected with the recorder comes into action, and can be arranged to allow that the extraction may continue up to 3 min., during which a further quantity of
liquid is recovered. When the pre-set period has expired, the timer opens the injection electro-valve (V4) and thus a new cycle starts.

The sterile reservoir is refilled throughout the removal period.

The liquid passes from the collecting and measuring tank to a waste tank (9) during the stay-in phase of the subsequent cycle. It is then sent to a discharge pipe or to a hand basin by the same vacuum and pressure pump during the removal stage of the following cycle.

Fig. 3. The automatic peritoneal dialysis machine. Fig. 4. The plastic bag reservoir with the dynamometer.

SAFETY DEVICES

When the system has been switched on for automatic operation, following devices guarantee its safe functioning: (1) The circulating pump cannot fill the bag: (a) if the automatic measuring balance is not in its correct position, or is imperfectly connected with the electric circuit, (b) if the sterile reservoir is already full, or (c) if the injection valve is open. (2) The injection valve will not open until pre-set period (up to 3 min.) has expired, after which the pre-determined quantity of liquid is removed from the patient. (3) The injection valve (V4) will not open if the circulating pump is still running. (4) A warning light switches on if the thermostatic bath temperature goes outside the fixed range.

The satisfactory condition of the Millipore filter is tested by air injection at 2 atm. If the filter is sound, the air will not pass. Injection takes place upstream from the filter by the vacuum and pressure pump, through a circuit controlled by an electro-valve (V3). Air pressure is checked by a pressure gauge.

This operation is manually controlled by means of the multiple switch either before or during the treatment. Before the switch is turned to the ‘manual’ or ‘automatic’ position, it is turned to an intermediate position to blow the air off from the upstream side of the filter.
REFERENCES


