Automatically Controlled Ultrafiltration during Haemodialysis using the Kiil Haemodialyser

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A method of removing fluid by ultrafiltration is essential in any haemodialysis system. Using the Kiil haemodialyser this is achieved by applying a negative pressure to the dialysate compartment; during a given dialysis the efficiency of ultrafiltration can only be checked indirectly by measuring the weight lost by the patient and adjusting the negative pressure by hand in an empirical manner.

We have applied a 'control systems' approach to this problem and have developed a servo loop which can be used to maintain automatically a predetermined ultrafiltration rate. The system incorporates a differential flow meter of entirely new design based on the electromagnetic principle. Dialysis fluid flows through the meter before entering the haemodialyser and is directed back through a parallel channel of the same meter after leaving the haemodialyser. The meter measures continuously the rate of ultrafiltration in the range of 0.5 to 10 ml per minute in a common flow of 500 ml per minute. The error in measurement is less than ±10%.

It seems likely that this system can be developed so as to eliminate the need for weighing the patient's bed during haemodialysis.
$W_d$, water loss rate due to dialysis

$W_p$, " " perspiration

$W_b$, " " breathing

$W_i$, water intake rate due to drinking

$W_e$, " " eating

$W_o$, " " oxidation of solids

$\frac{dH}{dt}$, rate of change of hydration

Figure 1. The proposed ultrafiltration control scheme

The output is proportional to the differential flowrate

Figure 2. The differential flowmeter