A SIMPLE PUMPLESS TRICOIL KIDNEY*

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About 2½ years ago we constructed a small artificial 3-coil kidney to perform pumpless dialysis. The arteriovenous blood pressure difference (Scribner system with teflon-silastic-cannulae) is the driving power of the blood flow, the difference in height that of the flow of dialysing fluid. With this dialyser about 150 dialyses have been performed.

Technical data

The dialysing membrane used was:

Visking seamless cellulose tubing, size 36/32, flat width 43 mm, wall thickness 0.025 mm. The tubing is wound on to a reel of stainless steel in 3 parallel coils, at the same time as a double mat of stainless steel. The winding is done with a turning apparatus, in such a way that the relative resistance per coil varies between 0.30 and 0.40.

The frame of the dialyser has a height of 245 mm and an outer diameter of 155 mm. The connections between each cellophane ending and silicon rubber tubing are of nylon, which

Fig. 1. Schema of three-coil kidney.

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is rubber-faced on the cellophane side. The 3 silicon rubber tubings (inner diameter 3 mm) are united and connected via an airchamber to the inflow and outflow lines respectively (inner diameter 5 mm) of the dialyser. On each air chamber a manometer controls the local blood pressure. The dialyser is placed in a close enveloping plastic container with a volume of 5 litres, through which the dialysing fluid flows. A stirrer, fixed to the dialyser in the axis direction of the reel, mixes this fluid, to maintain a high concentration gradient with the blood. The overflow of the container is drained off and may be analysed. The tank containing 500 litres dialysing fluid, stands more than a metre above the floor; it is kept nearly sterile by ultraviolet radiation (Philips: TUV–30 Watt). Its temperature is such that the dialyser is maintained at 37.0 ± 0.2°C.

Sterilization
The whole kidney is sterilized by boiling for half an hour in a tank with water.

Blood volume
The blood volume of the whole dialysing system is about 500 ml on a cellophane surface area of 1.2 m² and a mean hydrostatic pressure of 80 mm Hg.

Dialysing function
To attain highest efficiency in dialysis the length of the coils or surface area of the membrane may be adapted to the blood pressure and output of the arteriovenous shunt. At a flow rate of 100 ml/min and a surface area of 1.2 m², the following dialysances of the 3-coil are found for water: urea: ± 70 ml/min; creatinine: ± 45 ml/min.

Ultrafiltration
It is possible with this dialyser to attain considerable ultrafiltration. To this end the pressure gradient between blood and dialysing fluid may be increased by a difference in height between patient and dialyser. If the dialyser is placed on the floor a mean ultrafiltration of approx. 100 ml/hour per 1.2 m² is found; if it is placed approx. 80 cm lower, for instance in a small hole, a mean of approx. 200 ml/hour is found, which may even be increased to approx. 330 ml/hour with a surface area of 2.0 m².

Costs
The price of this tricoil kidney is about £ 50. The costs to prepare a sterile dialyser with new tubing is lower than £ 5 (including labour costs).

Discussion and Summary
In our opinion this kidney is simple in construction and use. If it is compared with the Kiil dialyser it is possible that the Kiil dialyser has a lower blood volume, a lower need of dialysing fluid, and a cellophane quality with a higher permeability.

The advantages of the above described 3-coil kidney are: the very low cost; the small room needed; the constancy of resistance per coil, which is easy to control; the simple sterilizing procedure; the sufficiently high capacity of ultrafiltration and the absence of pressure interference between the blood and dialysate compartment.

Moreover an important advantage, inherent in any slowly flowing dialyser, is the possibility of using a simple method of regional heparinization, without protamine sulphate.

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