THE COIL KIDNEY IN RECIRCULATION AND IN SINGLE PASS.
COMPARATIVE EFFICIENCY STUDIES

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The following studies deal with the qualitative and quantitative analysis of the two different systems by which a circuit of dialysate between the supply tank and the dialyser can be established:

1. The single (or mingle) pass system,
2. The recirculation system.

The dialyser used in the study was the Travenol Chron-A-Coil. The mingle pass system consisted in a hospital-made inexpensive apparatus with a small recirculating deadspace of 3 litres (Kopp and Grossmann, 1966). The recirculation system consisted in a 100 litre tank type kidney with 4 consecutive dialysate changes in equal time intervals. The total dialysate volume was 400 litres and the total dialysis time was equal in both studies.

Results

From Figure 1 it can be seen that there is no advantage of having bath changes with fresh dialysate when the time and the total recirculating dialysate volume are identical with the time and volume supplied in single pass. The quantities of creatinine extracted in both cases were 2.4 g ± 0.1 g per 8 hours.

Fig. 1. Comparison between single (mingle) pass system and the recirculation system (with 4 bath changes) under identical conditions concerning serum level, blood flow and total dialysate volume. The total quantity of creatinine extracted in both cases is identical: 2.4 g ± 0.1 g/8 hours.
Fig. 2. Relationship between the dialysate flow rates and the extraction of urea (full lines) and the extraction of creatinine (dotted lines) at different blood flows valid for the Chron-A-Coil in single (mingle) pass in steady state (Kerr and Elliott, 1966). Reasonable working points for dialysis fluid supply rates are given with reference to the extraction of urea.

The optimal changing times and optimal fractional volumes in recirculation however can only be determined by chemical analysis of blood and dialysate. Moreover they are of course different for substances of differential dialysances. There are further drawbacks to the recirculating system such as increased servicing requirements and bacterial growth.

Fig. 3. Nomogram which gives a direct reading of the quantities of urea (g/h) extracted with the Chron-A-Coil depending on serum level and blood flow. Point of intersection on the curve with the straight line connecting serum level and blood flow.
Fig. 4. Nomogram which gives a direct reading of the quantities of creatinine (mg/h) extracted with the Chron-A-Coil, depending on serum level and blood flow. Point of intersection on the curve with the straight line connecting serum level and blood flow.

On the other hand the single (or mingle) pass system has the advantage that the extraction is automatically optimized. In steady state the concentration gradient between blood and dialysate is proportional to the arterial blood concentration. Compared with the recirculation technique the extraction is therefore always optimum for a given dialysate volume and for a given dialysis time. In Figure 2 the relationship between the extraction of creatinine and urea and the dialysate flow rates is shown for different blood flows. Reasonable dialysis fluid supply rates are indicated with reference to the extraction of urea. These flow rates are beyond those to allow the maximal extraction of creatinine which is obtainable with the given dialyser surface. No increase in extraction or dialysance is therefore possible for any other substance which diffuses more slowly than urea when the dialysate flow rate is increased.

From the nomograms below, Figure 3 and 4, the quantities per hour of urea and creatinine which are extracted with the Chron-A-Coil can be read directly when the corresponding serum levels and the blood flows are known.

As there is usually a rapid decrease of the serum urea concentrations during the first 2 to 3 hours of dialysis the quantities which then will be extracted per unit of time will markedly diminish. Therefore the initial serum urea level before dialysis should not be taken as the parameter for the total quantity of urea extracted during the whole dialysis. This may be done with the aid of the mean serum urea concentration. As a rough approximation for practical purposes the mean serum urea level may be calculated as:

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\text{Conc. urea} = \frac{\text{Conc. urea (begin)} + 2 \times \text{Conc. urea (end)}}{3}
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REFERENCES
