NEW MODIFICATION OF THE METAL-COIL-KIDNEY

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Many years ago, the effective treatment of the renal insufficiency of man by means of the artificial kidney was started. It has been in existence since the first clinical trials of Dr. Kolff. Different types of haemodialysers have appeared in the literature. The first model of the coil-kidney was used by Von Garrelts (1948). Von Garrelts prepared the coil-kidney by rolling up the cellophane tubing together with metal net belt around the central nucleus of the coil-kidney.

Assembly of the artificial kidney

Essentially our model is a modification of the Von Garrelts coil-kidney. A perpendicular constant spiral s'lot (Fig. 1, No. 1) is formed by means of firmly and constantly reeling wire net belt (Fig. 1, No. 2) around a central core 16 cm in diameter. This wire net belt is reeled together with the metal belt fitting (Fig. 1, No. 4), reaching only one half of the belt so that a constant spiral slot (Fig. 1, No. 1) remains in the other half only. Thus it is possible to put in single threads of dry cellophane tubing (Fig. 1, No. 5) easily. Neither the cellophane tubing nor the whole metal-coil-kidney can be dipped in water during the preparation of the apparatus for haemodialysis. The whole coil is firmly packed in a metal case on the outside (Fig. 1, No. 6). The inside cylinder-nucleus (Fig. 1, No. 3) is connected with the outside metal case (Fig. 1, No. 6) from below by means of a system of radial ribs (Fig. 1, No. 7). The outside metal case is connected in a waterproof manner with the vessel (Fig. 1, No. 9) regulating the bath fluid flow through the neck (Fig. 1, No. 10) into the slot around the outside wall of the cellophane tubing. In Figure 2 can also be seen the inlet (Fig. 2, No. 11) and the outlet (Fig. 2, No. 12) for the cellophane tubing entering and emerging from the firm constant slot (Fig. 1 or 2, No. 1). The bath fluid is pumped by means of a water-pump.
through the coil-kidney and returns upward into the bath fluid reservoir. A special pump is required to propell blood through the tubing but it is possible to dialyse without the pump because of a very low resistance inside the cellophane tubing (30-50 mm Hg). Every dialysis has been conducted with a special flowmeter connected with a bubble catcher and clot catcher and with facilities for sampling of blood and application of injections. Figure 3 shows our metal-coil-kidney lying beside a sphygmomanometer for comparison.

**Efficacy**

1. Technical data. The dialysing surface is 1.05 sq.m. when using cellophane tubing of 15 m length and 3.5 cm width. Broader cellophane tubing may be used because the constant spiral slot between single threads of the wire net belt has dimensions of 0.4 mm, 4.5 cm, 15 m. The maximum blood volume of the cellophane tubing in our metal-coil-kidney is 500 ml.

2. The dialysance evaluated experimentally by dialysis of a water solution containing urea in a concentration of 233 mg%, NPN 200 mg%, creatinine 21.3 mg% and potassium 6.2 mEq per litre, is seen in the table below. This blood solution passed only once through the coil-kidney and was examined at the entrance and the exit of the cellophane tubing. The blood flow was 200 ml per minute and the bath fluid output 10 litres per minute. The bath fluid was pure water:

<table>
<thead>
<tr>
<th>Dialysance</th>
<th>Amount per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>59 ml</td>
</tr>
<tr>
<td>Urea</td>
<td>95 ml</td>
</tr>
<tr>
<td>Potassium</td>
<td>106 ml</td>
</tr>
</tbody>
</table>

3. The ultrafiltration rate of the fluid from the blood using aqueous solution was 4.4-5.2 ml per minute as the intraluminal pressure was increased to 200 mm Hg, and 9.1 ml per minute with further increase to 480 mm Hg.

4. Our experience with 120 further dialyses shows 50-70% decrease in plasma creatinine. All dialyses were carried out on patients with acute renal failure.

**Comment**

Our coil-kidney manufactured completely from wire and metal can be applied permanently
with only the cellophane tubing being replaced after each dialysis. The metal-coil-kidney thus reduces operating costs substantially. The main advantage is the perpendicular constant slot between single threads, permitting firm uniform interwinding of the wire net belt with single threads of the dry cellophane tubing without any difficulties. Therefore the inside resistance to the blood flow is very low. Also, the blood volume of the cellophane tubing remains constant even when pressure in the tubing rises excessively. On the other hand the cellophane tubing in fixed metal slot resists very high pressure.

Operation of this metal-coil-kidney is easy because of its low weight (8 kg). Putting in the cellophane tubing requires 30 minutes but the whole metal-coil-kidney must be dry. Cleaning is easy after unfastening the inferior vessel and superior coil and after removal only of the used cellophane tubing. The very small dead surface of the dialysing cellophane area is the important cause of high efficiency of dialysis and ultrafiltration, in spite of the relatively small overall surface area. Our experience with 120 further dialyses has given evidence that the blood volume of the metal-coil-kidney makes it suitable for the therapy of patients with acute and chronic renal insufficiency.

Summary

A new modification of the coil-kidney manufactured completely from metal with a perpendicularly fixed slot of 0.4 mm for putting in the dry cellophane tubing is described. This model provides the following advantages: Blood volume of the cellophane tubing is constant. The resistance to blood flow in the cellophane tubing is minimal. The effectiveness of this metal-coil-kidney is considerable. The preparation of the dialyser is simple. Operational costs with this kidney are low.

REFERENCE