Treatment of uremia by dialysis and other methods with special regard to the principles and scope of intestinal dialysis
Twiss, Erik Ernst

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SUMMARY

Treatment of uremia has received, in recent years, increased attention as progress in conservative treatment (forced high-caloric protein-poor regime, control of water and electrolyte balance) as well as the introduction of clinical dialysis opened new and interesting perspectives which widely stimulated research in this field of therapy.

In the clinic in Kampen KOLFF devised an artificial kidney, suitable for human use and treated many uremic patients with this apparatus.

KOP, in cooperation with KOLFF, studied peritoneal dialysis in the same clinic.

The main purpose of this study, also made in the Kampen clinic, is to offer a contribution to the experimental and clinical evaluation of various forms of intestinal dialysis.

In the first chapter an attempt is made to define uremia. Some recent knowledge concerning the pathogenesis of uremia is discussed; special emphasis is placed upon the importance of the potassium ion and upon the possible role of retention of hormones and other biological substances in the uremic pathogenesis.

In the second chapter a survey is presented of those renal diseases which mostly cause clinical uremia, including the lower nephron syndrome; the recent investigations and concept of TRUETA et al., concerning the genesis of some forms of anuria are shortly discussed.

Some important problems in general treatment of uremia are discussed with special emphasis on the forced high-caloric regime, the correction of electrolyte disturbances, and the role of dialysis treatment in uremia. Some types of artificial kidney are described, and attention is drawn to the possibilities of the resin artificial kidney.

The value of exsanguination-transfusion is briefly considered.

In the third chapter a survey of the literature is presented concerning the possibility of eliminating nitrogenous waste substances in uremia by way of the intestinal mucosa.

Difficulties encountered in the application of intestinal perfusion are discussed. Study of the literature demonstrates that gastric and colonic lavage are much less effective in eliminating urea than perfusion of the small intestine. By forced intestinal perfusion considerable quantities of urea can be removed.

The most serious complication encountered in intestinal perfusion was edema (general, pulmonary and cerebral), due to absorption of rinsing solution by the intestinal mucosa.

The rinsing solutions employed often contained high concentrations of sodium chloride. Some investigators pointed out that no sodium chloride should be added to the rinsing solution in order to prevent fluid and salt absorption.
Some features of the intestinal physiology are discussed in chapter IV. The mucosa of the small intestine has an enormous surface area, due to the projecting villi and the plicae circulares. The intestinal capillary network is very extensive; total capillary surface approximately equals total mucosal surface. A rapid exchange of substances between intestinal lumen and blood may be expected as a result of this rich capillary network. Intestinal blood-flow is relatively large and may be influenced by various factors, which are shortly discussed.

It may be assumed that intestinal bloodflow is stimulated during intestinal perfusion. The mucosa, the separating membrane between the intestinal lumen and the blood, has special properties, which should be considered in order to find a suitable composition for the rinsing solution.

The work of VISSCHER et al. has made it clear that the intestinal mucosa is able to transfer monovalent electrolytes against great concentration gradients in the direction gut lumen to blood. This explains the absorption of sodium chloride, even when its concentration in the rinsing solution is lower than in the blood (in contrast to peritoneal dialysis!). Sodium chloride, therefore, should be left out from the rinsing solution or its concentration should be very low.

In order to find a suitable rinsing solution for intestinal perfusion, experiments were carried out on two dogs, which are described in chapter V. By intestinal loop perfusions it could be demonstrated that the sodium chloride concentration in the rinsing solution should be very low, unless sodium chloride absorption is desired.

The rinsing solution had to be made moderately hypertonic in order to prevent fluid absorption. Sucrose, sodium- and magnesium-sulfate were suitable as these substances are little absorbed if an adequate flow rate is maintained. Electrolyte balance could usually be maintained during the perfusions by the addition of calcium chloride (25 mg/100 ml), potassium chloride (40 mg/100 ml) and sodium bicarbonate (100-200 mg/100 ml) to the rinsing solution.

Addition of sodium-carboxymethylcellulose, in the concentrations tested, did not appear to promote fluid retention in the gut lumen.

In chapter VI the technique employed in Kampen for intestinal perfusion is discussed. Distinction should be made between perfusions through an isolated loop (of small intestine) which can be applied daily for long periods and perfusion of the small and large intestine by means of an intubation technique; the latter method is only applicable for a relatively short time.

Daily intestinal loop perfusions have their indication in long term treatment of irreparable renal insufficiency; “intubation perfusion” in temporary treatment of acute renal insufficiency,
leading to severe uremia and acute exacerbations of chronic renal
insufficiency.

Technique, complications and preparation of suitable rinsing
solutions are discussed. For rapid jejunal intubation a special tube
was devised.

In chapter VII the case histories of 11 patients treated by in-
testinal perfusion are described; a summary of the results is
presented in chapter VIII. Patient X and XI were treated by per-
fusions of an isolated intestinal loop, the other patients by “in-
tubation perfusions”.

Most patients died within a few weeks after the perfusions,
death being due to severe irreversible renal insufficiency in all
these cases. In one case 33.5 gm of urea were removed by “in-
tubation perfusion”. Improvement of clinical condition was
marked in some cases. Using the technique employed in Kampen,
the duration of the perfusion appeared to be limited by exhaustion
of intestinal motor activity. In this respect the efficiency of in-
testinal perfusion is inferior to that of peritoneal dialysis, which
can be continued for 2-3 days (KOP), in which time much higher
quantities of urea can be eliminated.

Vomiting and convulsions were the main complications of “in-
tubation perfusion”. Serum potassium could be lowered, and
edema and vomiting were lessened effectively by the perfusions.

By daily loop perfusion in two patients more than 100 gm of
urea were eliminated in 10 and 16 perfusions respectively. Survival
for 46 days of practically complete anuria was obtained in patient
XI; death finally occurred not on account of the uremic in-
toxication (as blood urea was kept down at a constant level of
200 mg/100 ml) but from embolism, shock and forward failure.

Daily intestinal loop perfusions, therefore, seem to offer the
possibility of prolonging life considerably in patients who suffer
from virtually complete irreversible renal insufficiency.