PERITONEAL DIALYSIS FISTULA USED IN EXPERIMENTAL PHYSIOLOGY

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The repeated taking of blood, especially from small animals, not only is technically difficult but may also have a considerable influence both on the state of the organism as a whole and on the indices studied.

In this paper a method enabling the quantitative analysis of low molecular weight components of the internal milieu to be carried out in chronic experiments without the need for taking blood is described.

The composition of the low molecular weight substances contained in the peritoneal fluid is known to be closely similar to that of the blood plasma, with which an intensive interchange takes place. On this basis it has been suggested that if a fistula tube with a small bag for dialysis were introduced into the peritoneal cavity a dialysate close in composition to the peritoneal fluid and, consequently, to blood would be obtained*.

Construction of the fistula tube. As the figure shows, the fistula tube consists of an organic glass tube 2.5-3 cm long and 2 mm in diameter. The inner end of the fistula is connected to a cellophane bag for dialysis, which can be filled with any liquid (usually physiological saline)†. To prevent it from flowing out, the outer end of the tube is plugged with sponge rubber (through which a puncture needle used for withdrawing the contents of the dialysis bag and for injecting a desired solution into it may be passed freely) and covered with a metal screw cap.

Course of the operation. The rat was anesthetized with ether and fixed on its side. At a distance of 1.5-2 cm below the right costal margin in the mid-axillary line, an incision was made in the skin, subcutaneous fascia, muscles, and peritoneum. The fistula tube with the dialysis bag was inserted into the peritoneal cavity and the tissues were sutured in layers. The position of the fistula tube was varied, depending on the purpose of the investigation.

Control experiments. On the day of the operation, 2 ml physiological saline with antibiotics was introduced into the dialysis bag of 4 rats. Next day, the contents of the bag were completely withdrawn, the rats were decapitated, and the blood was centrifuged. The sodium and potassium concentrations in the dialysate and plasma were determined by flame photometry. Their concentrations in the dialysate and plasma of 3 of the 4 rats were practically identical; in the 4th rat the sodium concentration was the same in both but the plasma potassium concentration was slightly higher than its concentration in the dialysate, possibly because of the hemolysis which took place in this case. In a rabbit the concentrations of electrolytes in the dialysate and plasma were determined on 3 successive days. On the day of operation, as in the case of the rats, 2 ml physiological saline with antibiotics was injected into the cellophane bag. Next

*Paul [2] has described methods of tissue culture for short periods in diffusion chambers with Millipore membranes inserted into the peritoneal cavity of small laboratory animals.

†A detailed description of the properties of dialyzing membranes and of their experimental possibilities has been given in a survey by Glick [1].

TABLE 1. Sodium and Potassium Concentrations in Dialysate and Plasma of a Rabbit

Day of investigation	Sodium (in meq/liter)		Potassium (in meq/liter)	
	dialysate	plasma	dialysate	plasma
1	152,1	150,0	5,7	5,9
2	150,4	149,2	5,8	5,6
3	151,0	152,4	5,9	5,7

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TABLE 2. Concentrations of Sodium and Potassium in Dialysate and Plasma of a Rabbit during Injection of Various Solutions

Liquid injected	Sodium (in meq/l)		Potassium (in meq/l)	
	dialysate	plasma	dialysate	plasma
Distilled water	157,2	155,8	6,1	6,3
	156,0	157,0	6,0	6,1
Physiological saline	155,8	156,2	6,4	6,0
	156,4	154,8	6,2	5,9
Hypertonic solution (10 %)	154,8	154,0	5,8	6,1
	155,6	154,7	6,3	5,9
Distilled water	157,0	156,1	6,4	6,1
	156,2	157,4	6,2	5,9

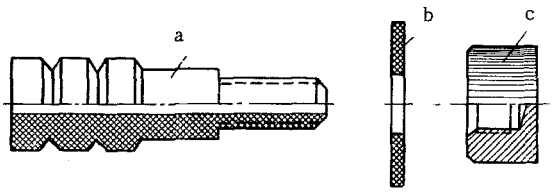

Fig. 1. Diagram representing the fistula tube for dialysis. a) Fistula tube; b) stop disk; c) cap.

day, the contents of the bag were completely withdrawn and the concentrations of sodium and potassium were determined, after which a further 2 ml physiological saline with antibiotics was injected into the bag. In parallel tests, blood was taken from the auricular vein and centrifuged, and the concentration of electrolytes in the phasma was determined. The procedure was repeated daily. The concentrations of sodium and potassium in the rabbit were practically identical for 3 days (Table 1).

To determine to what extent the concentrations of sodium and potassium in the dialysate are dependent on the salt concentration in the solution injected, the concentrations of these electrolytes was investigated in the dialysate and plasma of a rabbit when distilled water (first 2 days), physiological saline (next 2 days), a hypertonic sodium chloride solution (next 2 days, 10%), and distilled water again (last 2 days) were injected over a period of 8 days. No essential difference in the concentrations of sodium and potassium in the dialysate could be found when the various solutions were injected (Table 2).

The experiments were repeated on rats. In these animals likewise, no essential differences in the sodium and potassium concentrations in the dialysate could be detected in the course of the 8 days.

The method described makes it possible to use dialysate as the equivalent of plasma for determination of its sodium and potassium concentrations, and it is convenient for prolonged and frequent observations on the indices of water and salt metabolism in healthy animals and in various degrees of mineral imbalance. In addition, the peritoneal dialysis fistula tube is convenient for the parenteral administration of various low molecular weight compounds, the rate of whose entry into the animal organism may be changed within wide limits and regulated by the experimenter.

LITERATURE CITED

1. D. Glick, Meth. Biochem. Anal., 10, 175 (1962).
2. J. Paul, Cell and Tissue Culture [Russian translation], 262, Moscow (1963).