CHARACTERISTICS OF THE FUNCTION OF THE AUTOTRANSPLANTED CONSERVED KIDNEY

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The object of this investigation was to determine the functional state of conserved and fresh transplanted kidneys.

EXPERIMENTAL METHOD

Twelve dogs, on which A. G. Lapchinskii's operation had been performed, were investigated. One kidney was taken from the animals and kept in sterile conditions at 2-4° for between 6 and 27 h, after which it was transplanted subcutaneously into the neck by means of a mechanical vascular suture. Later the intact kidney was removed. After the grafted kidney had been taken and diuresis was restored, at various times after the operation estimations were made of the volume of the diuresis, and the concentration of ascorbic acid (AA), urea, and creatinine in the urine in a fasting state and after a water-milk load (WML). The water-milk mixture was given in a volume of 50 ml/kg body weight. Urine from the intact kidney was obtained by catheterization of the bladder. The results were compared with the indices of excretion of these substances by the kidney transplanted without having been conserved. As a first step, in 65 experiments, the character of the excretion of AA was studied after WML in a dog with ureters exteriorized by Orbeli's method.

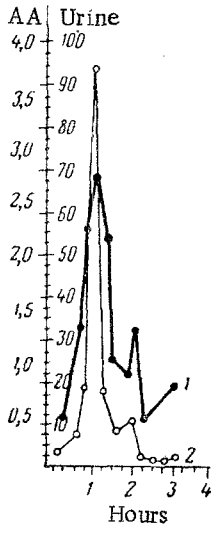

Fig. 1.

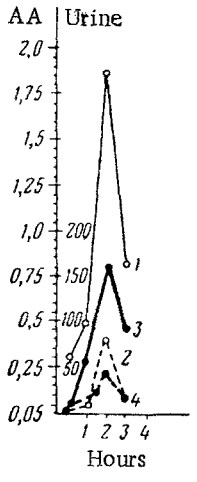

Fig. 2.

Fig. 1. Excretion of ascorbic acid (AA) after a water-milk load (WML) by a dog with ureters exteriorized by Orbeli's method. 1) AA (in mg); 2) urine (in ml).

Fig. 2. Excretion of ascorbic acid (AA) by an autotransplanted, conserved kidney and by an intact kidney after water-milk load (WML). 1) Urine (in ml) of intact kidney; 2) urine (in ml) of autotransplanted, conserved kidney; 3) AA (in mg) of intact kidney; 4) AA (in mg) of autotransplanted, conserved kidney.

EXPERIMENTAL RESULTS

The data for the excretion of AA after WML by a dog with exteriorized ureters are given in Fig. 1. The increase in diuresis was accompanied by an increase in the excretion of AA. Usually in the intact kidney, the maximal hourly volume of urine and excretion of AA were observed in the first and second hours after WML. After transplantation into the neck, the excretion of AA by the kidney fell sharply, to correspond with the decrease in diuresis (Fig. 2). Comparison of the excretion of AA by intact, autotransplanted, fresh kidneys and kidneys transplanted after conservation for different periods showed that the excretion of AA by the fresh, transplanted kidney did not exceed 17.4% of the total quantity of AA excreted by the two kidneys during the experiment. The kidney conserved for 6 h was not appreciably different from that transplanted without conservation in its excretion of AA. A difference was observed only for the kidney conserved for a longer time—for 27 h (14.4% compared with 17.4% for the fresh, transplanted kidney, Table 1).

The dynamics of the increase in diuresis and excretion of AA after the WML may be seen in Table 2.

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TABLE 1. Excretion of Ascorbic Acid (AA) by Intact and Autotransplanted Kidneys after a Water-Milk Load (WML) (comparative data in % of total amount during an experiment lasting 5 h)

Experimental conditions	Time elapsing between transplantation and investigation (in months)	Intact kidney		Autotransplanted kidney	
		AA	urine	AA	urine
Autotransplantation of kidney without conservation	13	82.6	75.3	17.4	24.7
Autotransplantation of kidney conserved for 6 h	18	82.8	76.6	17.2	23.4
Autotransplantation of kidney conserved for 27 h	6	85.6	88.8	14.4	11.2

TABLE 2. Maximal Excretion of Ascorbic Acid (AA) and Urine after Water-Milk Load (WML) by Hours (mean data of 54 experiments on 12 dogs, in %)

Experimental conditions	AA				Urine			
	hours after WML							
	1	2	3	4	1	2	3	4
Intact kidney	10	90	—	—	10	90	—	—
Unconserved autotransplanted kidney	25	75	—	—	25	75	—	—
Conserved autotransplanted kidney	25	50	—	25	—	75	25	—
Conserved autotransplanted kidney after removal of intact kidney	6.9	37.9	44.8	10.4	—	65.5	31	3.5

For the intact kidney, in 90% of the experiments, the maximum of diuresis and of AA excretion occurred after 2 h. Similar results were obtained for the transplanted unconserved kidney, but for the conserved transplanted kidney in 25% of the experiments, the maximal indices of diuresis were found after 3 h, and the maximum of AA excretion 4 h after the WML.

After removal of the intact kidney, when the transplanted conserved kidney had to perform the whole excretory function of the organism, the curve of the reaction to WML was more drawn out (see Table 2).

The results of the study of the excretion of urea and creatinine (89 experiments), revealed considerable changes in this process resulting from transplantation, from conservation and, in particular, after removal of the intact kidney. The intact dog's kidney, after the second kidney had been transplanted in a fresh state, in 100% of the experiment gave maximal indices of diuresis in the second hour after the WML, and the excretion of creatinine and urea was maximal in the first hour after the WML. In most experiments the transplanted, unconserved kidneys excreted a maximal amount of urine, urea, and creatinine in the second hour after the WML; by comparison with the intact kidneys of these dogs, the transplanted unconserved kidneys excreted urea and creatinine in the urine with some delay. After transplantation of the second, conserved kidney, in most experiments the intact kidney reacted to the WML somewhat differently from the intact kidney after transplantation of the second, unconserved kidney. The maximal increase in diuresis and excretion of urea and creatinine by these kidneys in most experiments took place in the second hour, and in some experiments (13.4%) in the third hour. After removal of the intact kidney the reaction of the transplanted, conserved kidneys became more protracted in character: in 34.4% of cases the maximum for diuresis was observed in the third hour, and in a high proportion of experiments, the peak for the excretion of urea and creatinine was found at the same time (in 28.8 and 25% respectively). In some experiments the maximum for diuresis and excretion of urea and creatinine took place in the fourth hour after the WML.

It is noteworthy that the intact kidney in the dogs with a conserved transplanted second kidney reacted to the WML differently from the intact kidney in the dogs with the transplanted unconserved second kidney. For the latter, the maximum of excretion of urea and creatinine occurred in the first hour, and for the former—in the second hour after the WML.

The results of this investigation demonstrate a considerable increase in the functional inertia of the transplanted kidney. This was clearly apparent in the transplanted, unconserved kidneys, it was intensified in the

transplanted, conserved kidneys, and it was seen particularly clearly after removal of the intact kidneys. The depression of the function of the transplanted kidneys by comparison with the intact, and also their insufficient lability, has been demonstrated by several different types of investigation [7, etc.]. Most authors consider that the functional insufficiency of the transplanted kidneys depends on their denervation. A. A. Lebedev [3, 4] showed that reinnervation of the transplanted kidneys considerably increases their functional capacity. On this basis, G. M. Shpuga [10] rejected the views put forward by some authors [11] that the irreversible changes in the parenchyma of the kidneys are produced not by denervation, but by anoxia of the kidneys. Taking into account the results of some investigations [6, 12-14], this factor of operation anoxia cannot be excluded, more especially because in the present experiment the increased functional insufficiency of the transplanted conserved kidneys and, in particular, their increased functional inertia, corresponded to the period of their conservation, i.e., to the period of anoxia. After removal of the intact kidneys the function of the transplanted conserved kidneys was considerably stimulated during the first days after this operation [8, 9]. However, as the result of the present experiment with a WML showed, the functional inertia of these kidneys are increased. The influence of many different organs on renal function, including the influence of one kidney on the other [5], has now been adequately investigated [5].

It is possible that removal of the intact kidney increases the functional inertia of the transplanted kidney by means of a reflex with a humoral link [1].

The possibility of restoration of the innervation in transplanted kidneys cannot be ruled out, for the present experiments were carried out a long time after transplantation of the kidneys into the neck.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of the first issue of this year.
