6176

Permeability of Normal and Denervated Kidney to Bacteria (V).

G. MILLES AND A. J. NEDZEL. (Introduced by W. F. Petersen.)

From the Department of Pathology and Bacteriology, University of Illinois College of Medicine.

We previously reported the result as indicated by roentgenograms of the injected vascular bed in normal and denervated kidneys following the injection of adrenalin, snake venom and following single and repeated chill.[1]

We here report the results of a series of experiments to determine the permeability of the normal and the denervated kidney to bacteria. Various workers have shown that tubercle bacilli can pass through the anatomically normal human kidney leaving no trace in the organ.[2,3] Petersen and Müller[4] have demonstrated that with the onset the chill in the course of continuous injection of *B. coli* in dogs one of whose kidneys was denervated previously that the organisms can be recovered in the urine from the normal kidney but not from the urine of the denervated kidney. The technic for denervation used is that previously described. After an interval of 2 to 3 weeks following denervation the ureters were incannulated separately and urine collected from each.

In the first series of experiments a suspension of *B. prodigiosus* was injected into the femoral vein and 1 cc. of urine at 5 to 15 minute intervals was plated on plain agar, incubated and the number of colonies counted.

As indicated in Fig. 1, the excretion of organisms from the normal was cyclic reaching 250 per cc. of urine in 15 minutes, 560 per cc. in a half hour, 60 at 45 minutes, 320 at 1 hour, etc., whereas the excretion through the denervated kidney remained at 20 to 60 for the first 1½ hours, rising to 360 at 2 hours and dropping to 50, to rise again at 3½ hours, following in general the output through the normal kidney but at a distinctly lower level.

In the second experiment, Fig. 2, No. I, the same organisms were injected, the urine cultured in the same fashion and 15 minutes after

---

[1] Milles, G., Müller, E. F., and Petersen, W. F., *Arch. Path.*, 1932, **13**, 233; PROC. SOC. EXP. BIOL. AND MED., 1931, **28**, 351, 354, 561.

[2] von Rihmer, B., *Z. f. Urol.*, 1928, **22**, 939.

[3] Wyssokowitsch, W., *Z. f. Hyg.*, 1886, **1**, 1.

[4] Müller, E. F., Petersen, W. F., and Rieder, W., *Verhandl. d. Deutsch. Gesellsch. f. inn. Med.*, 1930, **42**, 580.

——— Normal Kidney, 8 dogs. - - - - - - - Denervated Kidney, 5 dogs.

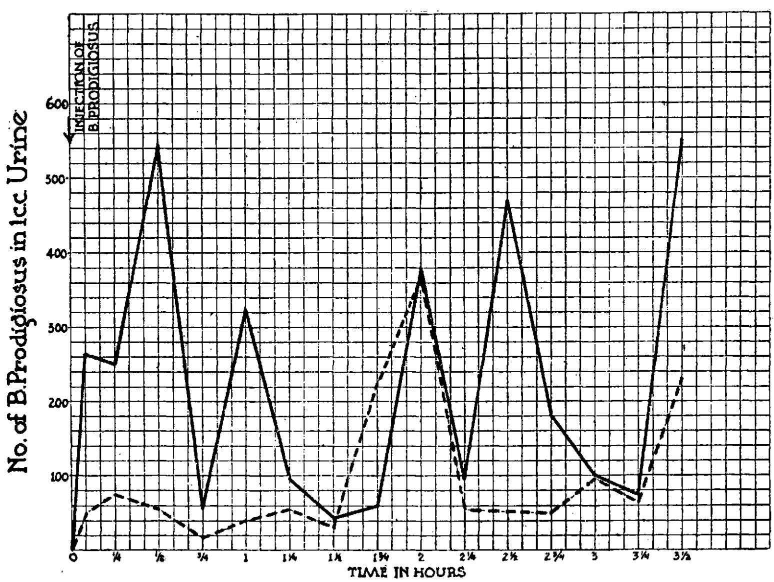

FIG. 1.

the injection of the *B. prodigiosus* 0.5 mg. snake venom per kilo body weight was injected intravenously. The organisms passed through the normal kidney in somewhat smaller numbers, the curve of excretion was prolonged and the drop at the end of 1¼ hours is

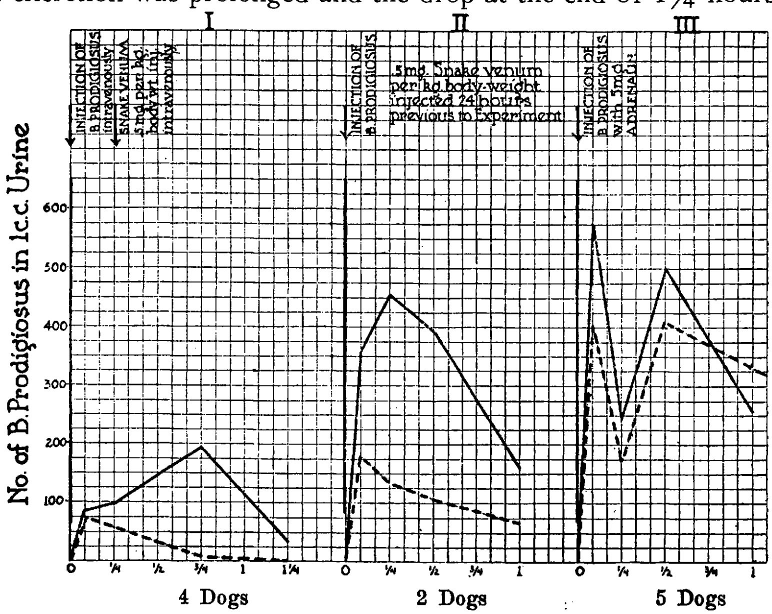

FIG. 2.

more marked than in the same experiment without snake venom. Their passage through the denervated kidney is much less than in the normal animal and again less than through the normal kidney.

In the third experiment, Fig. 2, No. II, 0.5 mg. of snake venom per kilo was injected intravenously and 24 hours later the procedures as outlined in experiment 1 were repeated. The curve of excretion of the organism was shortened as compared to that obtained in 1, the passage through the normal kidney reaching a maximum of 440 organisms per cc. in 15 minutes, dropping to 150 at the end of an hour. The denervated kidney was less permeable to the organisms, their number reaching a maximum of 180 in 5 minutes and falling to 50 at the end of an hour.

In experiment 4, Fig. 2, No. III, the organisms and 5 mg. of adrenalin were injected simultaneously. The curve of excretion was slightly lower for the denervated kidney as compared to the normal kidney, but the difference is by no means as pronounced as in the preceding experiments.

The fluctuation in the excretion curve is much sharper than in the first experiment.

The ability of bacteria to pass through the kidney into the urine indicates that excretion of particles is selective. What is of more importance, the ease with which they pass through the normal kidney as compared to the denervated kidney demonstrates that the state of dilatation or constriction of the renal vascular bed as controlled by the vasomotor nerves (or perhaps by the direct effect of the nerves on the cells) is an important factor in determining the selective excretion of materials by the kidneys.

Considering the selective excretion of bacteria as a dynamic function the effect of a capillary poison such as snake venom in reducing the excretion can be explained on the basis of functional impairment of the cells at the point of excretion, namely, the glomerular tufts, an effect that is accentuated in the denervated kidney, but also noted in the normal kidney.

The effect of adrenalin in enhancing the excretion of bacteria through the denervated kidney, affecting the normal kidney but little, would indicate that the degree of vasoconstriction resulting has little effect since only slight changes are noted in the excretion by the normal kidney but, since the nerve supply is gone, the adrenalin must have a direct effect on the cells involved in the denervated organ.

Summary. 1. Excretion of *B. prodigiosus* by the normal kidney following the intravenous injection of the organisms occurs in more

or less regular waves, a condition whose occurrence in many vital functions has been especially emphasized by Petersen. 2. After denervation the excretion of the organisms by the kidney is greatly reduced and to a large extent the wave-like curve is flattened. 3. The excretion of organisms by the kidney is reduced after the injection of snake venom but their excretion is still much less from the denervated than from the normal kidney. 4. When the organisms are injected with adrenalin their excretion through the denervated kidney is increased, through the normal kidney it remains almost unaffected.

6177

Production of Pylorospasm and Prepyloric Ulcers in Rats.

FREDERICK HOELZEL AND ESTHER DA COSTA.
(Introduced by A. J. Carlson.)
From the Department of Physiology, University of Chicago.

We reported that ulceration of the prostomach of rats following protein restriction was due to the action of the acid gastric juice.[1] An investigation was therefore undertaken to determine whether the gastric acidity was increased by protein restriction. To estimate the acidity, from 15 to 100 pieces of iron, steel or aluminum were given daily to 10 rats, by a method described elsewhere,[2] and the degree of erosion or the percentage of weight lost in passage through the digestive tract was noted. Tests were made for periods of from 47 to over 100 days during which chiefly the protein content of the diets was changed from time to time. Data thus obtained[3] were complicated by factors that tended to obscure evidence of changes in gastric acidity but the net impression was that ulceration of the prostomach occurred as a result of protein restriction without a marked increase in the gastric acidity of any of these rats.

A more definite and striking consequence of protein restriction in 7 of the 10 rats was the development of a gastric retention and a correspondingly increased erosion of test material, in some instances more than 10 times the normal. The retention was appar-

[1] Hoelzel, F., and Da Costa, Esther, PROC. SOC. EXP. BIOL. AND MED., 1932, **29**, 382.

[2] Hoelzel, F., *Am. J. Physiol.*, 1930, **92**, 466.

[3] Hoelzel, F., *Science*, 1932, **75**, 311.