131. The Influences of Kidney Irritants on the Gaseous Metabolism of Kidney.

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Recent works of Tamura and his co-workers\(^1\)\(^2\) reveal the oxygen consumption in the kidney to be practically constant (0.05—0.06 c. c. per gram per minute) under normal conditions, and to remain experimentally unchanged during diuresis caused by such kidney stimulants as caffeine and other purine derivatives. In connection with these investigations, the changes in the gaseous metabolism of kidney after the injection of such kidney irritants as sandalwood oil and turpentine oil were thoroughly investigated.

These experiments were carried out on rabbits weighing ca. 3 kilog. under urethane anaesthesia. The animals were prepared after Barcroft and Brodie's\(^3\) method to measure the rate of renal blood flow and to collect the blood samples. For the blood-gas analysis to compare the oxygen content of blood of the renal vein with that of the arterial blood, Plesch's apparatus, modified by Tamura and Miwa\(^4\) to keep the temperature constant, was used, and by the intravenous injection of various doses of sandalwood oil or turpentine oil, emulsified by gum, the following results were obtained.

Small doses of sandalwood oil (0.002-0.003 c. c. per kilo), even though a slight fall of the general blood pressure sometimes occurred, could induce diuresis without any noticeable change in the oxygen consumption of kidney. With larger doses (0.005-0.01 c.c. per kilo), marked diuresis occurred, but it was accompanied by an increase in the oxygen absorption in the kidney (for example: it increased from 0.048 to 0.072 c.c. per gram per minute), showing a slight irritation of the kidney cells. Still larger doses (0.02 c.c. or more per kilo) considerably

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\(^3\) Barcroft and Brodie, Journ. Physiol., 32 (1905), 18.

augmented the absorption of oxygen in the kidney, indicating some irritation of the kidney cells (for example: up to 0.096 c.c. per gram per minute), often with rather decreased urine outflow.

In brief, the kidney cells, when irritated by sandalwood oil, mostly consume more oxygen than normal, and usually produce an increased flow of urine.

Unlike sandalwood oil, small doses of pinene, the chief constituent of the turpentine oil, (0.002-0.02 c.c. per kilo), caused no change in the general blood pressure and no increase in urine, while very often the oxygen consumption of kidney increased (for example: from 0.060 to 0.084 c.c. per gram per minute). An injection of larger doses of pinene (0.03 or more per kilo) induced a marked increase in the oxygen consumption in the kidney (for example: up to 0.140 c.c. per gram per minute) and often it was accompanied by diuresis. With still larger doses (0.06 or more per kilo) an increased oxygen absorption always followed, though less markedly (for example: up to 0.07 c.c. per gram per minute), and frequently the excretion of urine rather diminished.

These facts indicate that the irritation of kidney cells by pinene generally increases the absorption of oxygen in the kidney, but is rarely accompanied by diuresis.

Furthermore, the following interesting results were obtained concerning the relation between the cloudy swelling and the gaseous metabolism of kidney cells by the observation during the course of the continued intravenous injections of pinene. At an early stage, where a cloudy swelling had not yet or only faintly developed, the oxygen consumption of kidney increased distinctly (for example: up to 0.08-0.12 c.c. per gram per minute), and at a later stage where a heavy cloudy swelling became perceptible, oxygen consumption never showed an increase, but often a tendency to decrease, probably due to an impairment in the vitality of the kidney cells.

These experimental results show that such kidney irritants as sandalwood oil and turpentine oil augment the oxygen consumption by affecting the kidney cells, but this irritation does not necessarily accompany diuresis and consequently such kidney irritants differ essentially in their diuretic action from such kidney stimulants as caffeine and its allies which induce marked diuresis without showing any sign of irritation of the kidney cells.