UREA TOLERANCE AFTER UNILATERAL NEPHRECTOMY IN RABBITS

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It is well established that following the removal of one kidney its remaining fellow increases in size and weight and the glomeruli undergo enlargement (1) without augmentation of their number (2). Usually the remaining kidney exhibits some functional inadequacy for a short time after the operation. The work quoted by and reported by Addis, Myers and Oliver (3) shows that after full recovery the one kidney excretes urea in practically normal amounts. The remaining, usually enlarged, kidney is spoken of as hypertrophic, but the term hypertrophy, if critically employed, implies a connotation of increased functional capacity. The question arises as to whether the remaining kidney exercises only the reserve power of one of paired organs or whether it is capable of an increased functional activity in the presence of demands in excess of those imposed by ordinary body processes. The problem is thus related to the general pathology of hypertrophy rather than to a test for determination of amount of renal tissue. It was decided that the simplest and most precise method of administration of excess of urea is by the intravenous route. For the purposes of this series of experiments it was thought that the curve of urea level in the blood, the urea tolerance curve, drawn as the result of hourly readings over a period of 8 or 9 hours would provide the necessary information.

Method

Rabbits which weighed from 1.7 to 2.5 kilos were employed. After a fast of 48 hours, urea was injected in a dose of 500 mg. per kilo of body weight. 1 hour thereafter and at hourly intervals for 6 to 9 hours, the blood urea was determined

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by the aeration method of Myers (4), and simple graphs plotted. In normal animals the blood urea level returns essentially to normal in about 8 hours. Without urea injections, hourly withdrawal of blood over a period of 8 hours shows a maximum variation of only 5 mg.

One group of fourteen animals was subjected to right nephrectomy by the lumbar route under ether anesthesia. Another group of nine animals was subjected to deep incision through the right lumbar muscles under ether anesthesia. The third group of four animals served as controls, in addition to the preliminary

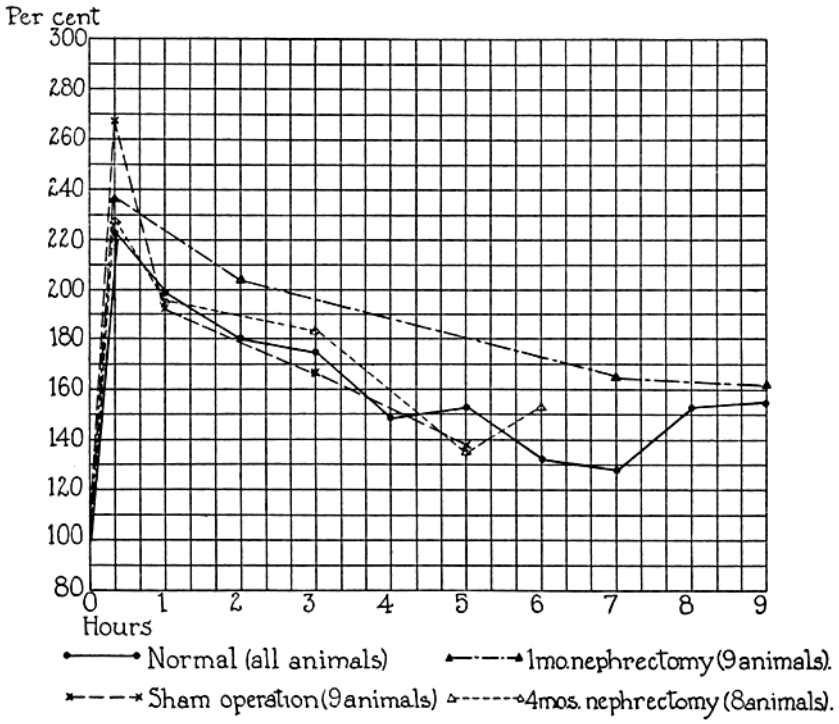

CHART 1

control observations on the other twenty-three animals. The animals were studied before operation and at periods of approximately 1 and 4 months after nephrectomy or sham operation.

The fasting level of urea in the rabbit varies considerably, but in the normal and experimental groups the curve after the urea injections shows respectively the same general course. For comparison, the fasting level is regarded as representing 100 per cent. In the control series 100 per cent represents an average of 43.7 mg. per 100 cc. blood. In the sham operation series it represents 45.5 mg. In the

animals studied 1 month after nephrectomy it represents 63.7 mg., and in those 4 months after nephrectomy 47.4 mg. All values for each animal were based upon at least two curves before operation and one, two or three curves at the specified periods after operation.

RESULTS

The essentials are shown in Chart 1. Immediately following the intravenous injection of 500 mg. urea per kilo of body weight there is in all groups of animals an elevation of blood urea level of from 223 to 267 per cent of the fasting level. In normal animals this falls progressively to 129 per cent in 7 hours with a subsequent elevation. This late elevation is unexplained save as the result of inadequate number of observations, despite the use of twenty-seven normal animals. In the animals subjected to sham operations the initial rise is to a figure higher than in any of the other groups, but the figure falls to within the normal range in 5 hours. For the period of 2 to 4 weeks after unilateral nephrectomy, the curve is decreased, is less sharp, and presumably the rate of decrease slower, than is true of the normal controls and at 7 hours is still significantly higher than the control figures.

SUMMARY

The method of study has an objective somewhat different from, and lacking the precision of, the ratio of Addis and the urea clearance of Van Slyke. It serves, however, to demonstrate that although for a month after unilateral nephrectomy the remaining kidney shows diminished capacity to hold blood urea within the normal range, nevertheless after 4 months this function is maintained in essentially the same degree as if both kidneys were present. This does not imply that all activities of the kidney remaining after unilateral nephrectomy are potentially augmented, but the data offered justify the conclusion that as the remaining kidney undergoes enlargement its functional capacity increases and the process represents a genuine hypertrophy in the critical sense.

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