

NUMBER OF GLOMERULI IN KIDNEY OF ADULT WHITE
RAT UNILATERALLY NEPHRECTOMIZED IN
EARLY LIFE

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Despite many investigations, the total number of glomeruli in the hypertrophic kidney remains a question. The problem may be approached in two ways; first, experimental production of a hypertrophic kidney by unilateral nephrectomy, and second, observations of the lesion in congenital anomalies of the urinary tract. The present paper reports the results of experimental investigations in the white rat. In a future paper, observations on congenitally asymmetrical kidneys will be presented.

Two methods have been used by other investigators in the enumeration of the glomeruli in the hypertrophic kidney, a relative and an absolute method. The relative method compares the total glomeruli in equal areas of standard sections. The absolute method consists in a complete enumeration of the glomeruli. Three types of the absolute method have been developed. Kittleson (1) counted the glomeruli in serial sections and by the ingenious use of carbon paper avoided duplication. This method is applicable to small kidneys, such as the rat and mouse, but is too laborious for larger kidneys. Two students of Bensley have evolved injection methods which are quite accurate, yet are not time consuming. Nelson (2) used Janus Green B as a vital dye and counted the whole glomerulus in teased preparations. Vimtrup (3) modified Traut's (4) Prussian blue injection method and enumerated the glomeruli in the kidneys of man, dog, cat, and white rat with a high degree of accuracy.

The general trend of previous investigation separates the problem into two classes, the response of young and of adult animals. There is general agreement that unilateral nephrectomy in the adult animal has no effect on the total glomeruli in the opposite kidney. The reported results in young animals are at variance.

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Tizzoni and Pisenti (5), Lorenz (6), Galeotti and Villa-Santa (7) and Zanetti (8) found an increase, while von Gudden (9), Ribbert (10), Debenedetti (11) and Peruzzi (12) were unable to find histologic or quantitative evidence of the formation of new glomeruli. More recently Arataki (13) has demonstrated by the accurate method of Kittleson (1) that there is no increase of total glomeruli in the white rat after unilateral nephrectomy at 20 to 50 days of age. Jackson & Shiels (14) in one animal found no increase after operation at 7 days of age.

In the rat, there is an active formation of new glomeruli for some days after birth and it seemed desirable to extend these accurate studies to include animals operated at a time when the kidney exhibits definite nephrogenesis.

Method

Litters from thoroughly tame females were selected. In all cases one-half were operated and one half saved as controls. The right kidney was removed through a lumbar incision under ether anaesthesia. The pedicle was tied by one ligature and the wound closed by catgut and celloidin.

The mortality of animals operated at 1 day of age was high, only 1 of 10 surviving to adult life, while the mortality at 3 days of age was about 50 per cent.

At about 165 days of age, the animals were killed by a blow on the head and the kidneys injected with Janus Green B and counted according to the technique of Nelson (2). In all instances the counts represent a complete enumeration of the glomeruli in the left kidney.

RESULTS

Inspection of the accompanying table reveals that, aside from biological variation, the experimental animals do not differ in any marked respect from the controls.

When the results are submitted to statistical analysis, the results leave much to be desired.

	<i>Control</i>	<i>Experimental</i>
Arithmetical mean.....	20,162	20,371
Difference.....		209
Standard deviation.....	1,184	1,480
Probable error.....	326	446
Probable error of difference.....		552

The finding of a probable error of the difference twice as great as the actual difference makes the results ambiguous and points to insufficient number of observations. Assuming that the difference of the arith-

metrical mean from the individual observations remains the same, a study of 50 animals in each group would be necessary in order to bring the probable error of the difference to about the same figure as the actual difference. It is clearly impossible to undertake such a study in one laboratory even if the mortality of unilateral nephrectomy in young animals were low.

Despite the failure of mathematical proof, we believe that the results here reported demonstrate that unilateral nephrectomy in the

TABLE I

Rat No.	Type	Sex	Body wt.	Kidney No.	Total count
Nephrectomy—1 Day of Age—Sacrificed—165 Days of Age					
1	Control	Male	370	144	18,562
2	Experimental	Male	390	111	18,389
Nephrectomy—3 Days of Age—Sacrificed—166 Days of Age					
3	Control	Male	310	113	21,411
4	Experimental	Male	285	112	18,887
5	Experimental	Male	300	115	21,540
Nephrectomy—3 Days of Age—Sacrificed—168 Days of Age					
6	Control	Male	290	127	21,899
7	Control	Male	280	130	20,384
8	Control	Male	325	132	19,188
9	Control	Male	320	134	19,526
10	Experimental	Male	360	128	20,881
11	Experimental	Male	265	129	22,159

The animals in each group are litter mates.

young white rat has no effect on the total number of glomeruli which will be formed in the opposite kidney. Certainly, the hypertrophic kidney does not contain double the number of glomeruli observed in the normal kidney.

The counts here reported for the white rat differ appreciably from those of Kittleson (1), Arataki (13) and Vimtrup (3). The latter counts were made on the Wistar rat and average 28,000 to 30,000. We have been able to duplicate these counts on the standard rat, but in our colony of black and white animals have never secured a count

higher than 22,200. We are at present attempting to explain this difference on a sub-species difference and will report the results of counts on hybrids at a future date.

CONCLUSION

Unilateral nephrectomy during the period of active nephrogenesis in the white rat has no effect on the total number of glomeruli which will be formed in the opposite kidney.

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