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Received December 28, 1955. P.S.E.B.M., 1956, v91.

Abnormalities of Urogenital System in Strain A x C Line 9935 Rats. (22247)

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At autopsy congenital absence of one kidney was observed in a rat of the strain A x C line 9935 colony maintained at the National Cancer Institute. Subsequently, a number of rats of this strain were observed to have one kidney missing, and a number were observed to have other urogenital abnormalities. Observations on the extent and incidence of these abnormal conditions are presented herein.

Materials and methods. The strain A x C line 9935 (black agouti irish) rats were obtained from Dr. W. F. Dunning* of the College of Medicine, Wayne University in October 1945. At that time the strain had been inbred by brother x sister matings for 30 generations. The strain A x C line 9935 was started in 1926 by Doctors Dunning and M. R. Curtis from a cross between the August line 1561 and the Copenhagen line 2331. Neither of these 2 strains has ever been observed to have any urogenital abnormality. Dr. Dunning indicated that an abnormality was first observed in March 1937 in animals of the 16th brother by sister generation of the subline (which is the one on which the present observations were made). The right testicle was absent in 5 of a group of 50 males in which methylcholanthrene was being injected. She has observed urogenital abnormalities in the hybrid progeny of a male of the 12th generation of this same subline outcrossed to an August line female. In 1946, she briefly described the urogenital anomaly as occurring with about equal frequency in the 2 sexes and varying in extent in them. Either the right or the left side might be involved. In affected females, an adrenal and an ovary were absent occasionally and in affected males, the testis was absent or atrophic more frequently(1). Following the initial observation in this laboratory a routine search for similar abnormalities was made in young animals (one to 18 days of age) and in adult animals (2 to 17 months of age) of inbred generations 30 through 34. The majority of the adult animals were breeding females and for them data on the size and number of litters produced were available for comparison in the normal and abnormal animals. When the strain A x C line 9935 rats, in which the abnormalities had been observed, were outcrossed to strain M-520, the abnormalities were observed in the F_1 progeny(2).

Results. The incidence of urogenital abnormalities in young and adult rats in shown in Table I. It will be observed that the incidence of urogenital abnormalities in older animals was slightly higher than that in younger animals. However, when the data were analyzed statistically this difference was not found to be significant in either the females or the males (for the females, $\chi^2 = 3.39$; $P = 0.07$, and for the males, $\chi^2 = 0.26$; P is between 0.5 and 0.7).

Animals with urogenital abnormalities always showed either the absence of one kidney or the presence of one cystic kidney. Each of the two manifestations was often associated with various other abnormal conditions. There was no significant difference in the frequency

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TABLE I. Incidence of Urogenital Abnormalities in Strain A × C Line 9935 Rats.

				No. of animals with specific organs abnormal							
Age	Sex	Total	% abnormal	Kidney	Ureter	Oviduct & horn of uterus	Ovary	Ovarian capsule	Testis	Epididymis & vas deferens	Vesicular gland
1-18 days	♀	748	17.9	134	110	99	5				
"	♂	813	16.9	137	95				20		
2-17 mo	♀	189	23.8	45	40	38		18			
"	♂	62	19.4	12	12				5	12	6

of the abnormalities of the kidneys between females and males ($\chi^2 = 1.3$; P is between 0.20 and 0.30). However, they occurred more often on the right side than on the left (182 right and 142 left).† The absence of a kidney was seen more frequently on the right side, (150 right and 67 left) and the cystic kidney was seen more frequently on the left (32 right and 75 left).

Among the 45 abnormal adult females there were 33 which lacked one kidney, the right one in 21 and the left in 12. There was no ureter in 26 cases, no uterine horn in 28, no ovarian capsule in 17, and no oviduct in 2. There was hypertrophy of the remaining kidney‡ in 10, an incomplete ureter in 3, and a cystic and incomplete uterine horn in 4. Twelve of the 45 females had a cystic kidney (3 right and 9 left). The ureter was cystic in 9 cases, the uterine horn incomplete in 3, the ovarian capsule cystic in one, and the opposite kidney hypertrophied in one. The ureter was missing in 2 cases and the uterine horn in one.

In the group of 134 abnormal young females, 91 lacked one kidney, the right one in 65 and the left in 26. The ureter was missing in 84 cases, the uterine horn in 81, and the ovary in 5. The remaining kidney and ureter were cystic in 2 cases, the remaining kidney was hypertrophied in one and cystic in one, and the uterine horn was incomplete in one. There was one animal in which both kidneys, ureters, and uterine horns were lacking. One kidney was cystic in 41 (11 right and 30 left) of the 134 females and both were cystic in one. The ureter was cystic in 25 and the uterine horn in one. The uterine horn was incomplete in 16 cases.

Among the 12 abnormal adult males, there were 8 which lacked one kidney (5 right and 3 left). The ureter was missing in 8, the epididymis in 5, the vas deferens in 6, and the vesicular gland in 4. Atrophy of the testis was observed in 5 cases (the testis of one of these was undescended), of the vesicular gland in 2, and of the epididymis in one. The opposite kidney was hypertrophied in 2 cases. One kidney of 4 (one right and 3 left) of the 12 abnormal males was cystic. The ureter was cystic in 3 cases and ended blindly in one.

Among the 137 abnormal young males, 85 lacked a kidney (59 right and 26 left) and one lacked both kidneys. The ureter was missing in 61 and the testis was undescended in 6. The remaining kidney was hypertrophied in 4 and cystic in 5, and the remaining ureter was cystic in 2. Fifty of the 137 abnormal young males had one cystic kidney (17 right and 33 left). The ureter was cystic in 33 and incomplete in one, and the testis was undescended in 14. There was one animal in which one kidney was atrophied and the testis undescended.

As previously mentioned, a large number of the adult animals used in this experiment were breeding females. Therefore, data on the sizes of the litters of normal and abnormal rats were available. A reduction in the average litter size of successive litters in animals, in which abnormalities were present, as compared with the average litter size of normal animals has been observed (Table II).

† These figures do not include 3 cases where either both kidneys were missing or were cystic, and 1 case where the kidney was atrophic.

‡ Kidneys of small groups of normal animals and of animals lacking one kidney were weighed on spiral spring balance of the Roller Smith Type. Weights (average weight of both kidneys in normal females was 0.87 g and in normal males was 1.1 g while that of one kidney in abnormal females was 1.4 g and in abnormal males was 2 g) confirmed the gross observation of hypertrophy of the remaining kidney.

TABLE II. Average Litter Size for Normal and Abnormal Strain A × C Line 9935 Female Rats.

Group	No. of animals	Avg litter size for successive litters									
		1	2	3	4	5	6	7	8	9	10
Normal	127	6.9	7.9	7.2	7.0	6.4	6.3	5.8	6.4	4.9	7.0
Abnormal	39	4.6	4.6	4.4	3.7	4.5	4.0	3.8	4.0	1.0	

Discussion. Urogenital abnormalities have been observed in animals by various workers. Hain and Robertson(3,4) observed anomalies, similar to those just described, in Wistar rats and in hybrids between the Wistar strain and a hooded variety. The anomalies were manifested in various ways similar to those described for the strain A x C line 9935 rats, but differed from them in that the abnormalities occurred only on the left side. In contrast to this observation, Faulconer(5) reported a case of hydronephrosis with accompanying abnormalities on the right side in a young female rat of the McCollum hooded strain.

Following small doses of X-rays in mice, Bagg(6-9) observed abnormalities of the viscera, principally of the kidney. These ranged from partial to more pronounced atrophy of one kidney, to absence of one or both kidneys. Hydronephrotic or polycystic kidneys were also observed. The abnormalities occurred as often on the right side as on the left and in females as often as in males. In the present study the findings agreed with this sex distribution, however, the abnormalities occurred more frequently on the right side than on the left.

Summary. The occurrence of congenital abnormalities of the urogenital system of strain A x C line 9935 rats has been described. The principal manifestations were the absence of one kidney or the presence of one cystic kidney. These were accompanied generally by other abnormal conditions. In females, they included a missing ureter, uterine horn, oviduct, ovarian capsule, or ovary; an incomplete ureter or uterine horn; a cystic ureter, uterine horn, or ovarian capsule; or hypertrophy of the remaining kidney, with variation in degree of abnormality. In males, they included a missing ureter, epididymis, vas deferens, or vesicular gland; atrophy of the testis, vesicular gland, or epididymis; cystic ureter; undescended testis; and hypertrophy of the remaining kidney, all also varying in degree.

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Received December 28, 1955. P.S.E.B.M., 1956, v91.