

THE NUMBER OF OPEN GLOMERULI IN ACUTE MERCURIC CHLORIDE NEPHROSIS¹

BY ROBERT A. MOORE,² M.D., AND LOUIS M. HELLMAN, Ph.B.

(From the Institute of Pathology, Western Reserve University, Cleveland)

(Received for publication, November 6, 1930)

The hypothesis that the oliguria and anuria associated with acute nephroses are due to a decreased cortical circulation, has been accepted for many years and figures in many text books. Experimental investigations to test the hypothesis have been of four types: first, measurement of renal blood flow; second, determination of the vasomotor response of the renal vessels; third, supravital measurement of the perfusion rate; and fourth, direct observation of the formation of glomerular urine. Support of the hypothesis from the clinical side is largely derived from the results of decapsulation. The literature of these observations has been recently reviewed by Hayman (1). The elaboration of an intravital method for the determination of open glomeruli by Hayman and Starr (2) offers another mode of investigation of this problem. The results of an investigation with this procedure are reported herewith.

Method

The method employed is essentially that used by Hayman and Starr (2) and Moore and Lukianoff (3). It consists of the determination of the total number of glomeruli in the right kidney by the method of Nelson (4) and the enumeration of the open glomeruli in the left kidney after intravital staining with Janus green B. On the assumption that the two kidneys contain an equal number of glomeruli, division of the latter by the former gives the per cent of open glomeruli.

Twenty-one rabbits were used, 13 experimental and 8 control. Few controls have been employed because the controls of Moore and Lukianoff (3) are appli-

¹ A part of this investigation was carried on in the Osborn Zoological Laboratory, Yale University, through the courtesy of Professor R. G. Harrison and Dr. J. S. Nichols.

² Hanna Research Fellow in Pathology.

TABLE I
Experimental Animals

Animal No.	Weight of animal kg.	Functional studies before intoxication			Dose of mercuric chloride mg. per kg.	Functional studies after intoxication			Left kidney—intravital					Right kidney—supravital				
		P.S.P. per cent	Average 24 hr urine output	Blood urea mg./100 cc.		P.S.P. per cent	Urine output 24 hrs. before death	Blood urea mg./100 cc.	Weight cortex gm.	Cortex counted gm.	Glomeruli counted	Glomeruli per gm.	Stained glo- meruli in gm.	Weight cortex gm.	Cortex counted gm.	Glomeruli counted	Glomeruli per gm.	Total glomeruli in kidney
51-52	1.5	—	—	—	10	0	4.06	0.52	7,379	14,190	57,611	4.25	0.53	16,027	30,239	128,516	44.8	
55-56	1.8	—	—	—	10	0	3.56	0.53	10,683	20,157	71,759	3.96	0.59	15,363	26,039	103,114	69.5	
57-58	2.1	—	—	—	20	0	2.54	0.29	5,994	20,669	52,499	2.22	0.45	16,333	36,293	80,570	65.1	
113-114	2.1	70	60	20.3	20	0	170.8	4.31	0.50	3,119	6,238	26,886	4.89	0.52	14,255	27,413	134,049	20.0
115-116	2.0	60	130	19.3	20	0	135.2	4.64	0.53	9,208	17,373	80,611	4.98	0.53	13,953	26,326	131,103	61.5
117-118	2.0	80	110	17.5	20	0	147.4	4.35	0.52	4,119	7,921	34,456	4.81	0.50	12,009	24,003	115,454	29.8
67-68	1.8	80	140	—	20	0	4.08	0.49	10,056	20,522	83,852	3.43	0.42	18,529	44,117	151,321	55.4	
111-112	2.0	75	94	23.2	20	0	67.4	3.99	0.50	7,500	15,000	59,850	4.62	0.53	14,104	26,611	122,943	48.7
109-110	2.2	75	120	12.9	20	15	64.0	5.45	0.53	8,197	15,446	84,181	5.18	0.54	13,042	24,152	125,107	67.3
69-70	1.9	80	100	—	10-48 hrs.	24	—	1.55	0.28	6,516	23,271	36,070	2.74	0.31	7,536	24,310	66,609	54.1
107-108	2.0	50	115	26.9	7	20	53.5	6.11	0.52	6,778	13,145	80,316	5.23	0.52	10,488	20,269	106,007	75.8
85-86	2.0	80	88	—	7-48 hrs.	109	—	3.86	0.41	7,482	18,249	70,441	3.61	0.44	9,352	21,246	76,698	91.8
105-106	2.1	80	90	16.5	7-72 hrs.	110	47.2	4.61	0.51	7,102	13,925	64,319	4.27	0.62	15,088	24,335	103,910	61.8

cable to this experiment. All animals were kept in metabolism cages and given 37.5 cc. of water per kilogram by stomach tube morning and evening throughout the experimental period. The normal urinary output was an average of two 24 hour periods previous to injection of the mercuric chloride. The phenolsulfonphthalein tests were for a 2 hour period after intravenous injection. The blood urea was determined by the urease aeration method given by Myers (5). The mercuric chloride was given hypodermatically into the tissues of the back. In three instances the injection was repeated 48 and 72 hours after the first injection. The animals were injected with Janus green B from 48 to 96 hours after intoxication, selected so that anuric, oliguric and kaluric³ animals were observed. A

TABLE II
Control Animals

Animal No.	Weight		Left kidney—intravital					Right kidney—supravital					Open glomeruli per cent
	kg.	gm.	Cortex counted gm.	Glomeruli counted	Glomeruli per gm.	Stained glomeruli in kidney	Weight cortex gm.	Cortex counted gm.	Glomeruli counted	Glomeruli per gm.	Total glomeruli in kidney		
41-42	2.1	4.83	0.64	10,976	17,103	82,607	5.29	0.73	12,809	17,546	91,941	89.8	
43-44	2.5	4.23	0.55	12,463	22,660	95,852	5.89	0.64	12,307	19,233	113,282	84.6	
47-48	2.1	4.38	0.58	8,243	14,212	62,248	4.24	0.56	11,960	21,357	90,553	68.7	
49-50	1.8	4.40	0.54	8,984	16,637	73,203	4.40	0.62	19,394	31,280	137,632	53.2	
99-100	2.0	5.59	0.68	5,622	8,268	46,218	4.74	0.67	9,003	13,437	66,379	69.6	
101-102	2.1	4.13	0.55	7,281	13,238	54,673	4.18	0.53	14,175	26,745	111,794	48.9	
M-1	2.2	4.38	0.52	7,194	13,835	60,597	4.56	0.51	15,281	29,933	136,494	44.3	
M-2	2.0	3.96	0.48	8,126	16,929	67,039	3.84	0.53	17,834	33,659	129,251	51.8	

complete autopsy was performed on all. Animals with non-experimental disease of the kidneys or other organs were discarded. Gross examination of the kidneys established the existence of a severe nephrosis in all the experimental animals.

The intravital injections were performed after section of the lumbar spine, as described by Ecker (6). The glomerular counts were made in the manner described by Moore and Lukianoff (3).

RESULTS

The results are given in Tables I and II. The open glomeruli in the control animals vary from 49 per cent to 89 per cent, with an average

³ The term, kaluric, has been devised to signify, as its derivation would indicate, normal urinary output.

of 63.8 per cent, which agrees well with the results of Hayman and Starr (2) and Moore and Lukianoff (3). In the experimental animals, the variation is from 20 per cent to 91 per cent, with an average of 57.3 per cent. Noting the spread of variability, the general conclusion must be, that an acute nephrosis, induced by mercuric chloride, does not influence the number of open glomeruli in the kidney. It is of interest to note that the fewest open glomeruli were observed in two oliguric animals and the most in a kaluric or polyuric animal. Since normal animals occasionally give figures within this range and since other experimental animals of this series with similar urinary output gave figures well within the normal range, it is impossible to attach significance to these three observations.

These observations make it doubtful that any success attendant upon surgical decapsulation directly depends upon alterations of cortical circulation. It is possible that other factors than the mechanical are responsible for the beneficial effects of this procedure. An investigation of this problem by the procedure used in the present study has been undertaken in this laboratory.

The results lend support to the theory of Richards (7), that the anuria of mercurial nephrosis is due to an inability of swollen and necrotic tubular epithelium to prevent a resorption of tubular urine.

SUMMARY

Acute mercurial nephrosis in the rabbit is not associated with a decrease of glomerular circulation.

BIBLIOGRAPHY

1. Hayman, J. M., Jr., *J. Clin. Inv.*, 1929, **8**, 89.
2. Hayman, J. M., Jr., and Starr, I., *J. Exp. Med.*, 1925, **42**, 641.
3. Moore, R. A., and Lukianoff, G., *J. Exp. Med.*, 1929, **50**, 227.
4. Nelson, B. T., *Anat. Rec.*, 1922, **23**, 355.
5. Myers, V. C., *Practical chemical analysis of blood*, C. V. Mosby Company, St. Louis, 2nd edition, 1924.
6. Ecker, E. E., and Biskind, M. S., *Arch. Path.*, 1929, **7**, 204.
7. Richards, A. N., *Methods and results of direct investigation of the function of the kidney*, 8th Beaumont lectures of Wayne County Medical Society, The Williams and Wilkins Company, Baltimore, 1929.