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Morphometric changes in the renal tissue of offspring rats born under experimental diabetes mellitus conditions on days 3, 60, and 90

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In connection with the widespread prevalence of this condition, the number of people with diabetes mellitus (DM) continues to increase steadily. According to the latest data from the International Diabetes Federation (IDF), by the year 2030 the number of adults aged 20 to 79 with diabetes worldwide is expected to reach 439 million.

Materials and Methods: For the study, 60 white laboratory rat pups were used: 3-day-old ($68.4 \text{ g} \pm 2.31$), 10-day-old ($79.74 \text{ g} \pm 2.61$), 30-day-old ($106.5 \text{ g} \pm 2.7$), 60-day-old ($122.5 \text{ g} \pm 2.7$), and 90-day-old ($153.6 \text{ g} \pm 3.7$). The animals were kept under standard vivarium conditions at the Tashkent Medical Academy, in plastic cages with wood shavings, no more than 10 rats per cage. The diet and drinking regimen in the vivarium were standard.

The experiments were carried out in accordance with the “Rules for the use of experimental animals” and the European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes (1986, Directive 86/609/EEC, March 18). Euthanasia was performed under ether anesthesia, and the internal organs (kidneys) were collected for subsequent histological and morphometric examinations.

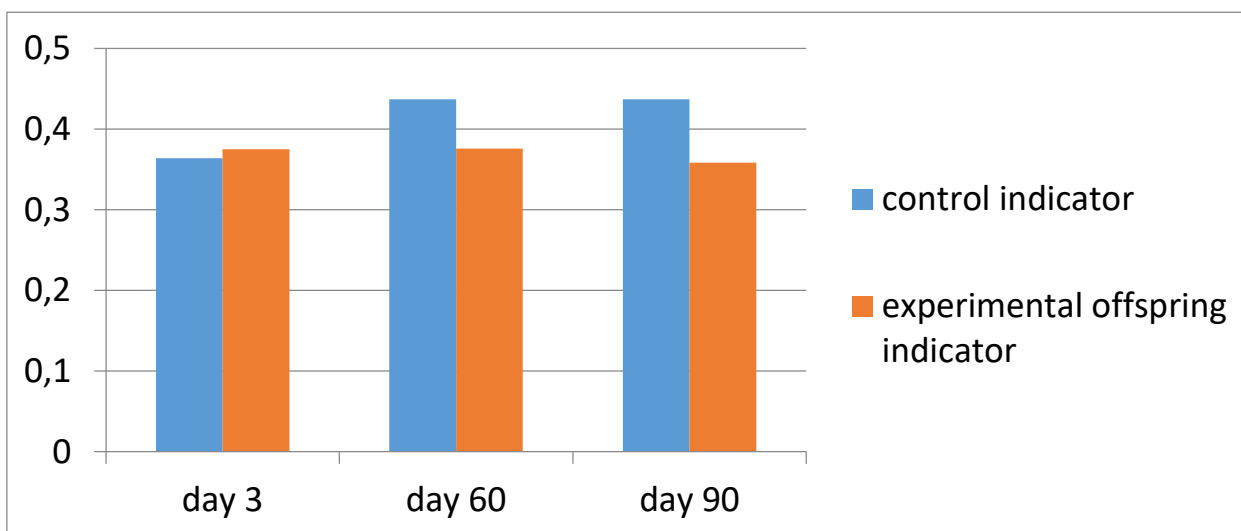
The material was fixed in 10% neutral formalin, dehydrated in ascending concentrations of ethanol, and embedded in paraffin. Serial histological sections 2–3 μm thick were obtained using a rotary microtome. The specimens were prepared using standard histological techniques and stained with hematoxylin and eosin, Van Gieson's picrofuchsin, and silver nitrate according to Foote. The rats were euthanized by decapitation at different stages of postnatal ontogenesis. The study was conducted at the following postnatal periods: on days 3, 60, and 90 of ontogenetic development.

Renal corpuscle of 3-day-old white rat	Value (M $\pm$ m)		
		$\pm$	0,364167
Thickness of the parietal layer of the Shumlyansky–Bowman capsule, μm	0,375092	0,075533	
Area of the glomerulus with the Shumlyansky–Bowman capsule, μm^2	4630,537	720,3992	4495,667
Area of the urinary (Bowman's) space in the renal corpuscle, μm^2	1343,807	295,3525	1304,667
Area of glomerular capillary loops, μm^2	3323,553	501,2667	3226,75

Renal corpuscle of 60-day-old white rat	Value (M $\pm$ m)		
Thickness of the parietal layer of the Shumlyansky–Bowman capsule, μm		$\pm$	
	0,37582	0,07568	0,437
Area of the glomerulus with the Shumlyansky–Bowman capsule, μm^2	4639,528	721,798	5394,8
Area of the urinary space in the renal corpuscle, μm^2	1346,416	295,926	1565,6
Area of glomerular capillary loops, μm^2	3330,006	502,24	3872,1

90-day-old white rat renal corpuscle	Value (M $\pm$ m)		
Thickness of the parietal layer of the Shumlyansky–Bowman capsule, μm			
	0,35834	0,07216	0,437
Area of the glomerulus with the Shumlyansky–Bowman capsule, μm^2	4423,736	688,226	5394,8
Area of the urinary space in the renal corpuscle, μm^2	1283,792	282,162	1565,6
Area of glomerular capillary loops, μm^2	3175,122	478,88	3872,1

Comparison of the thickness of the parietal layer of the capsule under normal and pathological conditions on days 3, 60, and 90



Conclusion: By day 10 of the experiment, epithelial cells showed light cytoplasmic staining and mild protein dystrophic changes. Increased cellularity was observed in the glomeruli and medullary regions, along with hypertrophy of the glomeruli and proximal tubular epithelium. In the distal tubular epithelium, hyaline droplet dystrophy was noted, and tubular lumens contained mesh-like homogeneous protein structures. These structures differed from the normal pattern, appearing in most glomerular capillaries as “capped glomeruli” (diabetic glomerulosclerosis). In other glomeruli, crescent-shaped lumens were formed, with connective tissue developing within these spaces.

By day 30 of the experiment, changes in the cortex and medulla of the kidneys from the offspring of laboratory rats had intensified. Distinct mesangioproliferative foci formed in the glomeruli, accompanied by hyalinosis of afferent and efferent arterioles and sclerotic alterations in the vascular intima. Notably, in the “glomerular mesh” structures, podocytes accumulated at the capillary periphery, and limited proliferation of mesangial cells was observed, indicating a clear manifestation of typical nephropathic glomerulosclerosis.

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