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Occurrence of Cataract in Experimental Pancreatic Diabetes.*

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Despite the fact that the existence of "diabetic cataract" as a distinct clinical entity has been questioned by some investigators,[1, 2, 3, 4] cataractous changes in the eyes of diabetic patients are not uncommon. Spalding and Curtis[2] reported the presence of cataract in 10% of Joslin's diabetic subjects while Von Noorden[5] found such lens changes in 13% of his diabetic cases. The age at which cataracts appeared in these patients is obviously of importance in determining the significance of these percentages, for cataractous changes of some degree occur frequently in normal subjects during late-middle and old age. In none of the cases reported by Spalding and Curtis[2] did cataracts occur earlier than 53 years of age. Twenty-eight of Von Noorden's 62 diabetic patients with cataracts, however, were under the age of 50. The presence of cataracts in young adults and in children suffering from diabetes is of more significance in establishing a relation between these 2 conditions, for lenticular changes other than congenital cataract are rare in normal individuals of these age periods. Although cataracts have been reported in diabetic children[6-11] their occurrence in juvenile diabetes is not common. In a careful survey of the diabetic patients studied in Joslin's clinic from 1898 to 1931 White[10] reported 15

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[1] Gallus, E., *Deutsch. Med. Wchnschr.*, 1919, **45**, 658.

[2] Spalding, F. M., and Curtis, W. S., *Boston Med. and Surg. J.*, 1927, **197**, 165.

[3] Gradle, H. S., *Indiana State Med. Assn. J.*, 1929, **22**, 2.

[4] Jess, A., *Kurzes Handbuch der Ophthalmologie, bearbeitet von W. Gilbert, A. Jess, H. Ronne, F. Schieck.* 1930, Julius Springer, Berlin, 253.

[5] Von Noorden, C., *Die Zuckerkrankheit und ihre Behandlung.* 1917, Julius Springer, Berlin, 305.

[6] Sherrill, J. W., *J. Metab. Res.*, 1922, **1**, 667.

[7] Strouse, S., and Gradle, H., *J. Am. Med. Assn.*, 1924, **82**, 546.

[8] Major, R. H., and Curran, E. J., *J. Am. Med. Assn.*, 1925, **84**, 674.

[9] Joslin, E. P., Treatment of Diabetes Mellitus, 1928, Lea and Febiger, Philadelphia, 833.

[10] White, Priscilla, Diabetes in Childhood and Adolescence, 1932, Lea & Febiger, Philadelphia.

[11] Joslin, E. P., *Southern Med. J.*, 1933, **26**, 1.

TABLE I.

Dog	Date of Birth	Date Depancreatized	Duration pancreatectomy to eye examination		Condition of Lens	
					Right	Left
			Yr.	Mo.		
1 Whte-Chrms Male diabetic		Dec. 25, 1930	2	8½	Peripheral striations.	Peripheral striations.
2 Airdle Female diabetic	Nov. 20, 1930 *	Sept. 1, 1931	2	½	Faint opacity at posterior pole and beneath posterior capsule.	Faint opacity at posterior pole and beneath posterior capsule
3 Airdle Female Normal	Nov. 20, 1930 *				Normal	Normal
4 Brn-c-Wht-Col Female diabetic		June 29,1932	1	2½	Diffuse striated opacification involving anterior and posterior cortex; moderate sclerosis of nucleus.	Striations in spoke formation.
5 Red-a-Wht Female diabetic	Nov. 29, 1931 **	Sept. 5, 1932	1	½	Normal	Normal
6 Blk-a-Wht Male diabetic	Nov. 29, 1931 **	Sept. 1, 1932	1	½	Small triangular opacity beneath anterior capsule.	Small triangular opacity beneath anterior capsule.
7 Brownie Female diabetic		March 11, 1931	2	6	Faint peripheral striations; generalized spotting; numerous vacuoles scattered throughout whole lens.	Changes similar to that found in right eye but less marked.

8 Wht-c-Brn-Hd Female diabetic	Sept. 16, 1931 ***	July 27, 1932	1	1⅔	Diffuse striations irregularly distributed throughout whole lens.	Peripheral striations.
9 Brn-a-Blk Female diabetic	Sept. 16, 1931 ***	Aug. 1, 1932	1	1½	Normal	Normal
10 Blk Female normal	Sept. 16, 1931 ***				,,	,,
11 Hyn Female diabetic		March 2, 1931	2	6½	Irregular opacity of posterior cortex.	Similar to right eye.
12 Bty Female diabetic		April 2, 1931	2	5½	Peripheral striations.	Several long dense striations extending from periphery to center; several vacuoles.

Three groups of litter mates are included in this table: Dogs 2 and 3; Dogs 5 and 6; Dogs 8, 9, 10—indicated by *, **, ***, respectively.

cases with cataractous lenses among 750 subjects who developed diabetes in childhood, and 4 cases showing similar lens pathology among 251 patients in whom the onset of the disease occurred in adolescence.

In the present investigation a study was made of the eyes of completely depancreatized dogs kept alive with insulin. This animal is particularly well adapted for studies of this nature, for in addition to providing an animal with pancreatic diabetes in which the diagnosis is never in question, such animals can be kept under well-controlled conditions.

The animals recorded as diabetic are completely depancreatized dogs that have been maintained in this laboratory in good nutritional condition for long periods of time by means of a suitable diet and insulin. Each dog received twice daily, at 8:00 a. m. and at 4:00 p. m., a diet consisting of 225 gm. of lean meat, 70 gm. of sucrose, and 5 gm. of bone ash. Vitamin B concentrate[12] was added to the diet at least 3 times per week. Vitamins A and D were supplied as the unsaponifiable portion of cod liver oil or as raw cod liver oil. The animals were injected with 8 units of insulin at each time of feeding. The 24-hour sample of urine of the animals always contained glucose, in varying amounts from day to day.

The results are shown in tabular form. They indicate quite definitely that a high incidence of cataract is present in completely depancreatized dogs maintained for long periods of time in apparently good nutritional condition by means of diet and insulin. Eight out of the 10 diabetic dogs showed lens changes varying in degree from peripheral striations to diffuse irregular opacification. All cataracts found in these animals were either incipient or immature. As judged by ophthalmoscopic examination, the lens changes were similar to those found in early senile cataract of human subjects.

The results suggest that the duration of diabetes is a factor in the development of cataract by depancreatized dogs. Five of these animals were diabetic for 2 years or more. All showed marked lens changes. Five other animals were diabetic for 14.5 months or less and it is interesting to note that the 2 depancreatized dogs which had normal lenses were diabetic for approximately one year only, the shortest period of any of the animals studied. The duration of the diabetes, however, does not determine the extent of the cataractous process for dog 4 that had been diabetic for 14 months at the time of its eye examination had marked lens pathology, where-

[12] Evans, H. M., and Lepkovsky, S., *J. Nutrit.*, 1931, **3**, 353.

as dog 2 that had been depancreatized 2 years prior to its eye examination revealed only peripheral striations in both lenses.

Old age as a factor in the production of the cataractous changes in the depancreatized dogs studied can be ruled out for lens opacities were discovered in animals 2 years old or younger (dogs 6 and 8). As will be pointed out below, cataracts were not found in young normal dogs.

A large number of normal dogs of various ages were examined with respect to lens pathology. Two normal dogs, litter mates of dogs that had been depancreatized, are included in the table. Dog 3, a normal dog, was placed on the diet recorded above on September 1, 1931, the day when its litter mate, dog 2, had been depancreatized. Thus both normal and depancreatized dogs have been kept under the same environmental and dietary conditions for the same length of time. Dogs 8, 9, and 10 are also litter mates, the first 2 being diabetic and dog 10, normal. The normal control of this group has also been maintained under the same dietary and environmental conditions as its 2 diabetic litter mates. The lenses in dogs 3 and 10 were found normal. Seventy normal dogs in various laboratories of the Medical School were also examined. Only 4 of these animals showed cataractous involvement. It is significant, moreover, that the latter were advanced in years, all showing signs of old age.

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Ovogenesis in the Ewe and Cow.

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The evidence presented by Allen[1] did much to establish the concept that ovogenesis extends into the postpubertal period in mammals. He found that the germinal epithelium contributed new ova in the adult mouse and, further, that the rate of ovogenesis varied according to the stage of the oestrous cycle. The greatest number of mitotic figures was found in the germinal epithelium during oestrus. Allen and coworkers[2] found in the sow that there was an elimination of most of the larger follicles in the ovaries coincident

[1] Allen, E., *Am. J. Anat.*, 1923, **31**, 439.

[2] Allen, E., Kountz, W. B., and Francis, B. F., *Am. J. Anat.*, 1925, **34**, 445.