

reaction between cysteine and glutathione (but not thioglycolic acid) and thymonucleic acid; can be made about 10 times more sensitive if it is performed in the following way:

To 1 cc of a solution containing cysteine (glutathione) are added, with cooling, 1.7 cc of concentrated  $H_2SO_4$ . The well-cooled mixture is then treated with 0.03 cc of a 1% solution of Na thymonucleinate and held at  $40^\circ$  for 3 minutes. The red-brown color with the same absorption maximum appears and can easily be recognized when the concentra-

tion of cysteine is only 0.0002%, or that of glutathione is 0.0005%.

Both color reactions of the thymonucleic acid with cysteine are probably due to the formation of some furfuryl compound from the desoxyribose. In fact, furfuraldehyde reacts with cysteine under the same conditions as thymonucleic acid forming a violet red product in presence of an excess of cysteine, and a brown color when the aldehyde is in excess. The latter reaction is much less sensitive than the reaction with thymonucleic acid.

## 14526

### Experimental Production of Diabetic Cataract in the Rat.

VIRGILIO G. FOGLIA AND FREDERICO K. CRAMER.

*From the Institute de Fisiologia, Facultad de Ciencias Medicas, Buenos Aires.*

Two groups of workers describe the appearance of cataracts in animals with experimental diabetes. Dohan, Fish, and Lukens<sup>1</sup> observed this phenomenon after 5 months in a dog with permanent diabetes produced by injection of anterior pituitary lobe extract. Chaikoff and Lachman<sup>2,3</sup> observed it after a year in 8 dogs without pancreas, which were kept alive with insulin and an adequate diet. The spontaneous appearance of cataracts in pancreatectomized rats, with progressive evolution to complete opacity of the lens, led us to investigate factors that might be involved.<sup>4</sup>

**Technic and Methods.** Male white rats were almost completely pancreatectomized when they weighed 60-80 g. A portion of pancreas was left which varied between 5% to 20% of the weight of the organ. The diet was the same as that given to all the other rats of the Institute, in which no evidence of cataract was detected.

After 7 hours fasting, blood sugar was determined with blood from the tail, following Hagedorn and Jensen's method. The lens was examined through an electric ophthalmoscope after dilatation of the pupil by atropin. A Gullstrand's lamp was used for more minute studies. We classified the lens lesions in 4 degrees of increasing severity, as follows: Type A, alteration of the anterior capsule of the lens (rugosity); Type B, opacity of the lens sutures; Type C, partial opacity of the lens parenchyma, and Type D, total opacity of the lens parenchyma.

The lens and blood sugar in rats were observed under 3 different experimental groups: (1) with 5% of pancreas; (2) with 20% of pancreas; (3) normal, without operation. A fourth group was specially formed with some animals in order to follow the evolution of blood sugar and lens lesions in them.

**Results.** (1) Rats with only 5% of pancreas: 41 rats were observed. The lesions of the lens appear 50 days after the operation and, generally speaking, get worse as time goes on (Table I). Lesions of Types C and D are rarer because the most seriously affected animals die soon, thus giving no time for the formation of the cataract. The frequency and severity of the lens lesions increase in direct

<sup>1</sup> Dohan, F., Fish, C., and Lukens, F., *Endocr.*, 1941, **28**, 341.

<sup>2</sup> Chaikoff, I. L., *Proc. Soc. Exp. Biol. and Med.*, 1935, **33**, 211.

<sup>3</sup> Chaikoff, I. L., and Lachman, G. S., *Proc. Soc. Exp. Biol. and Med.*, 1933, **31**, 237.

<sup>4</sup> Cramer, F. K., and Foglia, V. G., *Rev. Soc. Argent. Biol.*, 1943, **19**.

TABLE I.  
Frequency and Types of Cataracts in 47 Pancreatectomized Rats from the Date of Operation.

| Days of operation |  | 0.50                  | 50-125 | 125-200 | 200-275 | 275-325 | 325-400 |
|-------------------|--|-----------------------|--------|---------|---------|---------|---------|
|                   |  | With 5% of pancreas.  |        |         |         |         |         |
| Without lesions   |  | 10                    | —      | —       | —       | —       | —       |
| Lesion Type A     |  | —                     | 4      | 5       | 2       | —       | —       |
| " " B             |  | —                     | 3      | 4       | 2       | 2       | —       |
| " " C             |  | —                     | —      | 1       | 2       | 1       | —       |
| " " D             |  | —                     | —      | 2       | 1       | 1       | 1       |
| Total             |  | 10                    | 7      | 12      | 7       | 4       | 1       |
|                   |  | With 20% of pancreas. |        |         |         |         |         |
| Without lesions   |  | —                     | —      | —       | —       | —       | 2       |
| Lesion Type A     |  | —                     | —      | —       | 1       | —       | 1       |
| " " B             |  | —                     | —      | —       | —       | 1       | 1       |
| Total             |  | —                     | —      | —       | 1       | 1       | 4       |

relation with the level of blood sugar (Table II). Thus very few rats with a normal level of blood sugar have lesions, while all rats with a level greater than 220 mg % have lesions of the most serious types, C or D. The evolutionary character of the cataract is well marked. We have been able to follow the development of each type of lesion in the same rat. Lesion A takes 50 days to arise, but lesion D takes over 4 months and with very high levels of blood sugar (greater than 220 mg per 100 cc). Histological study of cataracts of Type D showed deep alterations in the cortical zone of the lens and very few if any in the capsular and nuclear zone.

TABLE II.  
Frequency and Severity of Cataracts in 41 Pancreatectomized Rats According to the Blood Sugar Level.

| Blood sugar mg %      | 80-120 | 120-220 | More than 220 |
|-----------------------|--------|---------|---------------|
| With 5% of pancreas.  |        |         |               |
| Without lesions       | 9      | 1       | —             |
| Lesion Type A         | 1      | 7       | 3             |
| " " B                 | 1      | 7       | 3             |
| " " C                 | —      | 1       | 3             |
| " " D                 | —      | —       | 5             |
| Total                 | 11     | 16      | 14            |
| With 20% of pancreas. |        |         |               |
| Without lesions       | 2      | —       | —             |
| Lesion Type A         | 1      | 1       | 1             |
| " " B                 | —      | 1       | —             |
| Total                 | 3      | 2       | 1             |

(2) Rats with 20% of pancreas: These show less incidence of diabetes than rats with 5% of pancreas. They also show less frequency and severity of lesions of the lens than those of the previous group (Tables I and II). The onset of the lesions took place after 200 days. Lesions were never more serious than those of Type B and could be observed only in rats with increased blood sugar.

(3) Normal rats: 100 rats were observed. None showed lesions of any type (B, C, or D). A few had lesions resembling Type A though not exactly like it. We did not find any lesions, either, in 80 rats with experimental arterial hypertension due to a renal cause.

*Summary and Conclusions.* In all rats with 5% of pancreas remaining after partial pancreatectomy, cataracts appear after a period of time which in the cases we observed was from 50 days onward. This cataract is progressive and its degree is in direct relation to the level of fasting blood sugar. Microscopic examination shows well marked lesions in the lens.

In rats with 20% of pancreas, the lens lesions take over 200 days to appear and are less serious in direct relation to the less serious character of the diabetes.

We have not observed any cataracts like these in normal rats.