

96 (1843)

Further studies on ligation of the thyroid arteries in depancreatized diabetic dogs.

By G. A. FRIEDMAN and J. GOTTESMAN.

[From the Department of Clinical Pathology, College of Physicians and Surgeons, Columbia University, New York City.]

The experiments described in this and in the following paper were conducted during the year of 1921. 37 dogs were depancreatized; 9 did not develop glycosuria although in some of them repeated pancreatectomies were performed at various intervals. 3 of the animals showed a transitory glycosuria. 25 dogs became persistently glycosuric; 9 of these dogs died of various causes. Ligations of all of the thyroid arteries were done in 8 of 16 glycosuric dogs who survived the pancreatectomies, in about 4 to 7 days after complete or almost complete removal of the pancreas. In one dog the thyroid arteries were ligated in two sittings: first both arteries on the right side and seven days later the arteries on the opposite side. This dog died from tetany on the day following the second ligation. 3 of those who were completely ligated died without demonstrable causes from 1 to 2 days after ligation.

Thus in only 5 dogs could the effect of complete ligation be studied and only in one the effect of partial ligation.

The great losses in body weight which usually follow depancreatizations were not checked by the ligations.

Some interesting points, however, were brought out from the study sufficient to warrant a report. As far as we know there is no literature pertaining to ligations of thyroid vessels in depancreatized dogs.

In a previous paper¹ we referred to an experiment with dog No. 106 who was completely depancreatized. His urine on daily examinations showed from 5 per cent. to 6 per cent. sugar. On the fourth day all thyroid arteries of the animal were ligated. He became sugar-free five days after the operation, and he remained

¹ Friedman, G. A., and Gottesman, J., *PROCEED. SOC. EXP. BIOL. AND MED.*, 1921, xviii, 281.

without a trace of sugar in the urine for ten days, when he developed distemper and died from pneumonia.

Dog 120.—Male. Weight 9.6 kilos. Complete pancreatectomy June 22. Glycosuria from June 23 to June 28. Ligation of all thyroid arteries June 28. Sugar positive June 29. Sugar negative on daily examinations of passed and of catheterized specimens from June 30 to July 13. Dog was found dead July 14. Autopsy same day. No demonstrable lesions. Course: good appetite until June 12. No signs of tetany. Sections of the thyroid show many alveoli devoid of colloid (Fig. 1.)

Dog 108.—Female. Weight 8.7 kilos. Complete pancreatectomy March 16. Glycosuria from March 17 to March 24. Liga-

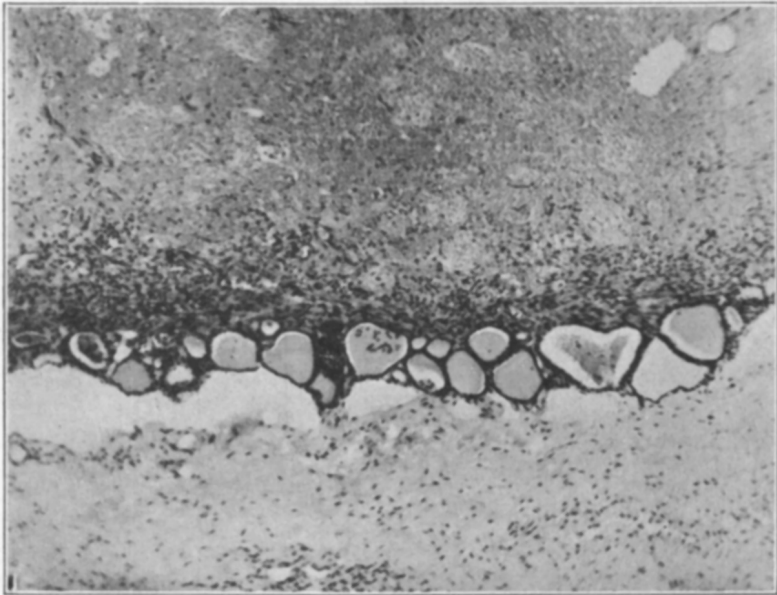


FIG. 1. From dog 123.

tion of all thyroid arteries March 24. Glycosuria persisted until April 1. Died April 2 from emaciation. Autopsy on same day. No demonstrable lesions. Course: poor appetite two days after removal of pancreas. Refused food completely from the day following ligation. No acute attack of tetany, but twitchings of the musculature of the back noted two days following ligation.

Sections of thyroid show extensive hemorrhagic infiltration, marked atrophy. Few remnants of thyroid seen underneath capsule (Fig. 2).

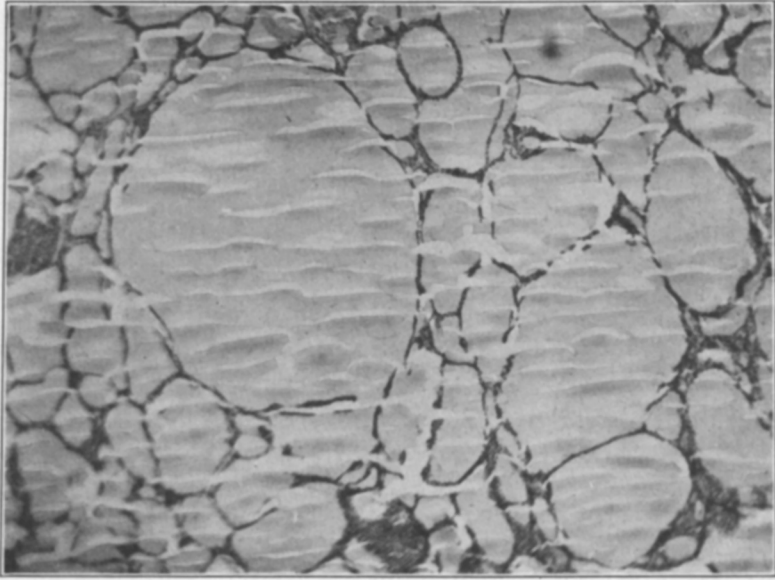


FIG. 2. From normal dog.

Dog 121.—Female. Weight 20 kilos. Complete pancreatectomy June 29. Glycosuria from June 30 to July 5. Ligation of all thyroid arteries July 5. Sugar strongly positive July 6. Sugar negative July 7. Sugar positive from July 8 to July 14. Course: slight attack of tetany from July 8 to July 10. July 11 severe attack. July 12 infection noted at neck. Mild attack of tetany. Killed July 14 with chloroform. Large pocket of pus at neck.

Dog 128.—Female. Weight 13.8 kilos. Almost complete pancreatectomy July 25. Glycosuria from July 27 to July 30. Ligation of all thyroid arteries July 30. Glycosuria persisted until August 6, when she died. No autopsy. Course: No tetany. Infection at neck noted August 3, four days after ligation.

Dog III.—Male. Weight 6.66 kilos. Almost complete pancreatectomy April 3. Glycosuria from April 4 to April 10. Ligation of superior and inferior arteries on the right side April 10.

TABLE I.

BLOODSUGAR IN NORMAL DOGS.

No.	Mgrm. Sugar per 100 c.c. Blood.	No.	Mgrm. Sugar per 100 c.c. Blood.
103.....	53	110.....	90
104.....	83	111.....	78
105.....	50	121.....	98
106.....	76	122.....	104
107.....	78	123.....	104
108.....	67	124.....	104
109.....	94	133.....	100

TABLE II.

BLOODSUGAR IN DIABETIC DOGS FOLLOWING PANCREATECTOMY.

No.	Mgrm. Sugar per 100 c.c. Blood.	No.	Mgrm. Sugar per 100 c.c. Blood.
104.....	203	121.....	238
105.....	270	123.....	127
106.....	250	124.....	100
107.....	125	128.....	228
108.....	293	136.....	250
109.....	222	137.....	200
111.....	200	138.....	290
120.....	238		

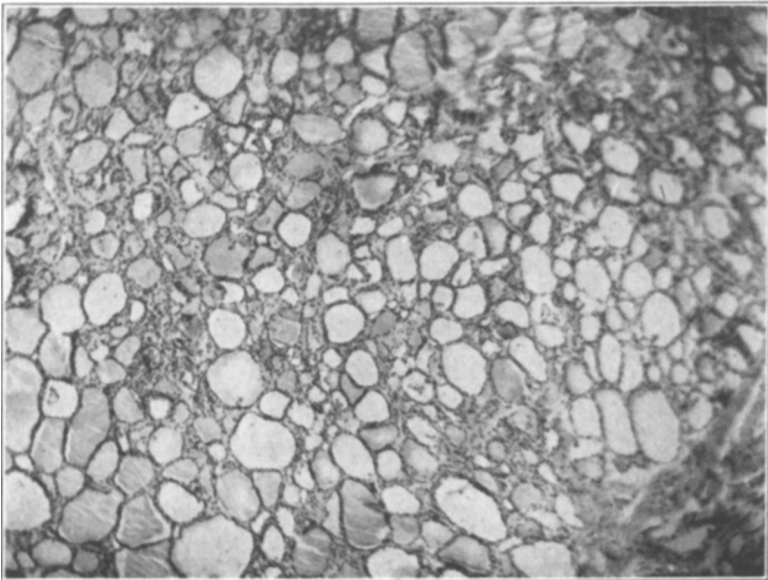


FIG. 3. From dog 120.

Glycosuria from April 11 to April 17. Ligation of superior and inferior arteries on the left side April 17. Sugar positive April 18. Dog died on the following day from a severe attack of tetany. No autopsy. Course: animal was in perfectly good condition until the day following the second ligation. There was a strong ferric-chlorid reaction in his urine on the third day after pancreatectomy. There was no diacetic-acid reaction on succeeding days.

Table I.—Bloodsugar estimations were made in these animals before the pancreatectomies. They were starved at least 24 hours preceding the operation. The highest figure obtained 104 mmgr. per 100 c.c. blood in 3 dogs in whom estimations were made during the hot summer months July and August.

Table II.—Dog 124 was glycosuric throughout after pancreatectomy, but there was no increase in the contents of bloodsugar. Dog 123 after almost complete pancreatectomy (a minute remnant of pancreas was found at autopsy) did not develop glycosuria while under observation for 26 days. His original weight was 11.2 kilos. On the last day of observation his weight was 9.7 kilos, when he was disposed of with chloroform (loss of approxi-

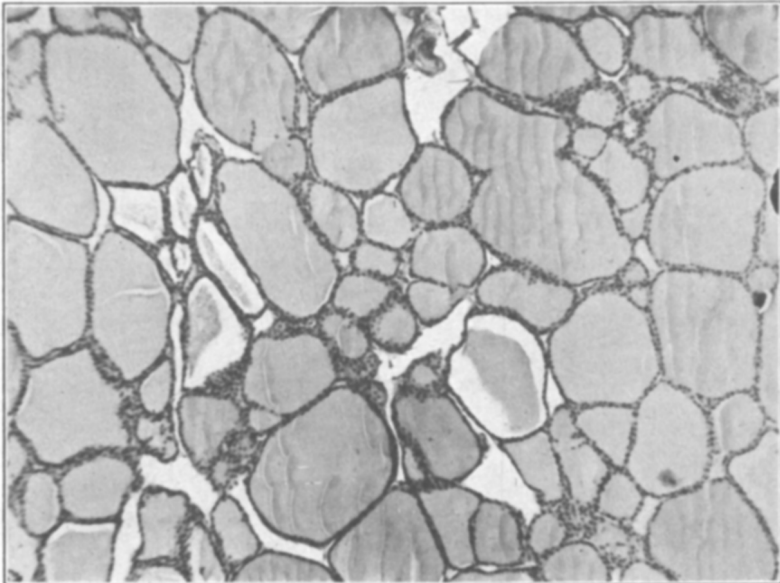


FIG. 4. From dog 108.

mately 60 grm. per day). Such a loss in dogs after almost complete pancreatectomy may be considered as a slight one. Sections of his pancreatic fragment showed very few Langerhans islands and sections from his thyroid (Fig. 3) showed unusually large alveoli rich in colloid. Compare this thyroid with one of a normal dog (Fig. 4) who weighed 13 kilos. We emphasize this point because Cohen² and Pariser reported changes in the thyroid in various organic diseases of the pancreas in man whose urine was negative for sugar.

TABLE III.

MMGR. SUGAR PER 100 C.C. BLOOD AND DATES WHEN BLOOD WAS TAKEN FOR ESTIMATION.

No.	Before Pancrea- tectomy.	After Pancrea- tectomy.	After Ligation.	Remarks.
106	76 March 2	250 March 5	192 March 7 90 " 10 50 " 14	Animal became sugar-free.
108	67 March 16	222 March 18 293 " 22	180 March 25 244 " 30	Bloodsugar diminished after ligation. Increased with tetany.
111	78 April 3	154 April 7 200 " 10	244 April 17	Glycemia increased after partial ligation.
120		238 June 28	200 July 1 172 " 5	Animal became sugar-free.
121	98 June 29	238 July 5	213 July 14	Sugar free 1 day after ligation. Reappearance of sugar with tetany.
128		228 July 30		Did not become sugar-free. Tetany absent. Infection present.

Table III.—From this table it becomes evident that partial ligation did not only diminish the diabetic glycemia, but made it more intense.

Table IV.—According to Allen³ the weight of the pancreas in dogs is approximately 2 grm. per kilogram of body weight. This table shows our figures come very close to his in completely de-pancreatized dogs.

² Cohen, Moritz, and Pariser, Hans, *Dtsch. Med. Woch.*, 1912, 38¹, 60.

³ Allen, Frederick M., "Studies Concerning Glycosuria and Diabetes," Boston, W. M. Leonard, publishers, 1913, p. 716.

TABLE IV.

No.	Body Weight in Kilos.	Weight of Removed Pancreas in Grams.	Weight of Removed Pancreas per 1 Kilo. of Body Weight in Grams.	Approximate Weight of Removed Gland According to Allen.	Remarks.
106	7.52	18.2	2.4	15.04	No pancreatic remnant at autopsy.
108	8.7	21	2.4	17.4	Complete pancreatectomy.
111	6.56	17	2.4	13.32	Remnant weight at autopsy 4 grams.
120	9.6	21	2.1	19.2	No remnant at autopsy.
121	20	44	2.2	40	Complete removal.
128	13.8	20	1.45	27.6	Almost complete removal. No autopsy.

CONCLUSIONS.

1. The mortality of completely depancreatized dogs after ligation of the thyroid arteries is high.
2. Glycosuria in depancreatized diabetic dogs was checked after complete ligation of the thyroid arteries.
3. Tetany or infection, or both, seem to interfere with the disappearance of the glycosuria.
4. Partial ligation of the thyroid arteries apparently intensifies the diabetes produced by pancreatectomy.

97 (1844)

The relation of the thyroid and parathyroids to pancreatic diabetes in dogs.

By **G. A. FRIEDMAN** and **J. GOTTESMAN**.

[From the Department of Clinical Pathology, College of Physicians and Surgeons, Columbia University, New York City.]

Lorand¹ (1904) and McCallum² (1909) performed complete thyroidectomies in depancreatized diabetic dogs. The former

¹ Lorand, A., *Compt. rend. Soc. Biol.*, 1904, lvi, 488.

² McCallum, William George, *Johns Hopkins Hosp. Bull.*, 1909, Sept.