The Effects of Pinealectomy on Young White Leghorn Cockerels[1]

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Introduction

The possibility that the pineal body is an endocrine gland has been a perplexing problem for many years. Pinealectomy has proved to be difficult, and previous investgators have been hampered by not obtaining enough operated animals to draw valid conclusions. Moreover, these investigators have reported results that are in conflict. Jullien (4) reported for example, that guinea pigs implanted with pineal substance have smaller gonads while Borrel and Ostrom (2) reported similar results when rats were pinealectomized.

Material and Methods

White Leghorn cockerels were used because they have a relatively fast growth and the maturation of the gonads occurs at relatively early age. The chicks were raised in battery brooders on the same food, and under the same light, heat, and space conditions. Each cage utilized contained equal numbers of the three groups of animals used in this study, i.e. control, sham operated, and operated.

Operations were performed at four days post-hatching in the following manner. The chicks were anesthetized with ether, placed under a binocular microscope, and a median incision 2 cm. long was made through the skin at the apex of the head. The fascia was removed by scraping with a sharp scapel and a incision was made at the fusion of the frontal and parietal bones, followed by a + incision through the dura. The last incision ruptured the dural sinus, and exposed the pineal body, which was then removed by means of fine jewelers forceps after which the edges of the skin were sewed together and gentian violet applied to prevent cannibalism. In addition to unoperated-controls sham operated-control animals were used and were handled in the same manner as those which were pinealectomized, with the exception that the pineal body was not removed.

The bodies, combs, and the endocrine glands were weighed at autopsy, and special care was taken with operated chicks to determine if the pineal body was completely removed. Chicks with a partial removal of the pineal body were discarded.

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Observations

No significant difference was found in the body weights, or in the weights of adrenals, thyroids, or the pituitaries. The comb weights of the pinealectomized chicks were found to be significantly larger than the comb weights of the two control groups, only at the age of 70 days.

The pinealectomized chicks, however, were found to have signficantly smaller testis weights than the controls at the age of 19 days. The testis weight, however, returned to normal at the age of 28 days and remained so until about 40 days. Shortly after the age of 40 days, the operated chicks were found to have significantly larger testis weights, but this increase was no longer evident at 94 days.

The operative mortality is summarized in table I and the testis weights are summarized in table II.

TABLE I. Operative Mortality

Series 1	totals	female	died from operation*	gland not removed	discarded	died	autopsied
Operated	55	3	10	8	2	2	30
Sham operated-controls	22	0	3	0	0	0	19
Control	18	1	0	0	1	1	15
Totals	95	4	13	8	3	3	64
Percentage	100.0	4.2	13.6	8.4	3.2	3.2	67.4
Series 2							
Operated	78	5	15	9	0	2	47
Sham operated-controls	60	1	11	0	2	3	43
Control	47	3	0	0	1	3	40
Totals	185	9	26	9	3	8	130
Percentage	100.0	5.0	14.0	5.0	1.6	4.4	70.0

* Chicks that died within 72 hours after operation were placed in this classification.

Discussion

When a significant statistical difference was found between the testis weights of the pinealectomized chicks and the controls, a signficant statistical difference could usually be demonstrated between the pinealectomized chicks and the sham controls. Also, the testis weights of the control chicks were never found to differ from the testis weights of the sham controls. Thus it is suggested that the effects on testis weights were due to the removal of the pineal body rather than the effects of the operation.

TABLE II. Testis Weights

Age in days	operated	sham operated-control	control	t-value
19	N 15	15	15	2.329*
	mean 28 mg	43	36	
28	N 11	9	9	
	mean 54 mg	51	52	
40	N 10	8	9	
	mean 88 mg	95	92	
42	N 15	9	5	2.104*
	mean 160 mg	133	115	
50	N 11	11	11	2.544*
	mean 155 mg	133	122	
70	N 10	5	5	2.177*
	mean 597 mg	288	382	
94	N 5	5	5	
	mean 5.8 gm	6.0	6.5	

* t-value computed on operated chicks compared to control chicks.

The weights of the testes of the operated chicks seemed to vary in two directions. First, the testis weights of the operated chicks were decreased at an early age (19 days). At the next age group autopsied (28 days) the weights of the testis of the pinealectomized chicks has returned to normal and remained normal until 42 days. Then an increase in testis weights of the operated chicks was noted, and increased testis weights remained above the weights of the testis of the control chicks until somewhere between 70 and 94 days. A corresponding increase in comb weights was noted at 70 days. These data might suggest that possible effects of pinealectomy should be looked for during the early part of the chick's life cycle.

It was mentioned earlier that a paradox seems to exist between the results of implantation and pinealectomy and these reports may be examined in the light of our observations on age differences in response to pinealectomy. Jullien implanted pineal substance into guinea pigs and stated that the gonads were smaller in the experimental animals, and on the other hand, Borell and Ostrom reported smaller gonads following pinealectomy of rats. Einhorn and Rowntree (3) reported that injection of pineal substance resulted in earlier breeding of successive generations of rats, but Martin and Davis (6) obtained earlier breeding in cats following pinealectomy.

Badertscher (1) reported the gonad weights of pinealectomized chicks to be unchanged. It is suggested by my data that somewhere

after 70 days, in the chick, the pineal body has no effect on the testis, and Badertscher did not autopsy any chicks until the 228th day and thus his samples were autopsied at an age that would have been too old to detect any differences in testis weights.

Likewise, Kolzelka (5) reported that the implantation of pineal substances into cocks resulted in unchanged testis weights of the experimental animals. This might also be the result of the lateness of the implantation, as the chicks were half-grown, which would be beyond the 90 day limit suggested by my data.

Now, in an attempt to bring a small amount of order out of this seeming chaos, two assumptions must be made. Assumption one—the removal of the pineal body results in a dual effect on gonad weights. Assumption two—it would seem reasonable to expect that the removal of the pineal body would produce the opposite effect as the addition of pineal substance by injection or implantation. Since the time factor is important, if the pineal body were removed at an early age, a decrease of testis weights might be expected if the experimental animals were autopsied at an early age. If the pineal body substance were added by injection or implant at an early age, and the experimental animals were autopsied at a much later age, a decrease of testis weights might also be expected.

Thus it seems that both the technique of pinealectomy and the technique of implantation and injection should be re-explored during early growth periods, while maintaining a constant time factor. The conflict in reported results might eliminated in such a manner.

Summary

It is suggested that pinealectomy of four day old White Leghorn Cockerels has the dual effect of first decreasing the weights of the testes and later causing an increase in the weights of the testes.

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