EFFECT OF PINEALECTOMY ON BONE GROWTH IN LAYER CHICKS

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ABSTRACT

Pinealectomy was perfomred at one-day Euribrid layer chicks. The effect of pinealectomy on bone growth in chicks were studied after six months. In pinealectomized birds, femur, humerus and radius showed slight inhibition in growth. No abnormalities were observed in these bones by radiology. Inhibition in growth may be due to high plasma calcium level and /or hypertophy of the adrenal cortex.

INTRODUCTION

The only source of melatonin in chicken is the pineal gland (Pehlam, 1975). Removal of the pineal gland results into an increase in thyroid gland weight (Houssay and Pazo, 1968) and thyroxine secretion rate (Ishibashi *et al.*, 1966). The pineal gland exerts an anti-growth influence (Reiter and Fraschini, 1969; Sorrentino *et al.*, 1971). However, constent light has been found to decrease pineal weight and live body weight in rats (Fiske *et al.*, 1960). Pinealectomy increases food intake (Injidi and Forbes, 1983) but on the other hand, studies reported no long term effects on weight gain, oxygen consumption and food intake in white leghorn cockrels (Darre *et al.*, 1978). Therefore, this project was undertaken to investigate the effect of pinealectomy on bone growth in layers chicks under normal lighting periods.

MATERIALS AND METHODS

Twelve chicks (6 males, 6 females) of Euribrid laying strain were used out of fourteen (two died during surgery). Birds were divided into two groups, first group (3 males, 3 females) were pinealectomized at one day of age. The surgical technique used was as described by Foss *et al.* (1972) and developed by Injidi and Forbes (1983). The second group was sham operated by opening the scalp only. In both cases, birds were anaesthetized with ether during the operation. The two groups were kept separately for three weeks for recovery, then transfered into separte individual wire-meshed cages. Birds were offered ration and water *ad libitum* and were subjected to 16 hours lighting period daily.

At six months of age, birds were killed and right femur, humerus and radius were collected. Bones were scrapped to remove the muscles then boiled for five minutes to remove remaining flesh completely. The longest distance between the two ends of the bone was considered the length (vernier was used). The width was recorded as the mean of the minimum and maximum diameters of the bone shaft. The volume was calculated by water displacement after coating the bones with thin film of paraffin to seal. The right wing and leg were radiographed to observe abnormalities (if any). Statistical analysis of the data was checked by using t-test (Steel and Torrie, (1982).

RESULTS

Body weights of pinealectomized birds of both sexes showed increase in comparison to intact birds (Table 1). The growth of femur, humerus and radius of pinealectomized birds showed slight inhibition in mathematical values but were statistically non-significant. The inhibition was noticed when comparing lengths and widths of bones of pinealectomized and sham operated males and female birds; however, the only exception was the humerus where the width showed similarity in both cases (Table 1).

The retardation of growth was also reflected on all bones of pinealectomized birds irrespective to volume with the exception of male humerus (Table 1). Radiography of all bones showed normal configurations.

DISCUSSION

Pineal gland in poultry is considered as an intermediate stage between the pineal apparatus of lower vertebrate (work as a sensory organ) and the pineal gland in mammals (Hanna, 1994). Berry and Payne (1961) stated the the pineal gland plays an opposite rule at the same time according to the stages of age of the bird. It was noticed that pinealectomized

Table 1: Measurements of body weight (kg), length, wideth (cm) and volume (cc) of bones of pinealectomized and sham operated birds of both sexes.

		Sham Operated		Pinealectomized	
		Male	Female	Male	Female
Body weight		1.99 ± 0.07	1.55 ± 0.10	2.2 ± 0.6*	1.61 ± 0.2
Femur	Length	9.92 ± 0.25	8.85 ± 0.07	9.57 ± 0.32	8.65 ± 0.05
	Width	0.99 ± 0.02	0.88 ± 0.06	0.95 ± 0.01	0.83 ± 0.01
	Volume	11.53 ± 1.46	8.60 ± 1.20	9.30 ± 0.29	7.00 ± 0.55*
Humerus	Length	8.92 ± 0.17	7.95 ± 0.05	8.60 ± 0.33	7.74 ± 0.05*
	Width	0.75 ± 0.02	0.65 ± 0.05	0.75 ± 0.03	0.67 ± 0.02
	Volume	7.11 ± 0.87	6.30 ± 1.00	7.10 ± 0.37	5.03 ± 0.42
Radius	Length	9.00 ± 0.19	8.05 ± 0.05	8.60 ± 0.36	7.75 ± 0.01
	Width	0.60 ± 0.02	0.52 ± 0.03	0.57 ± 0.01	0.52 ± 0.01
	Volume	3.60 ± 0.56	2.40 ± 0.40	3.23 ± 0.21	2.30 ± 0.16

* Significant ($P < 0.01$)

birds (male and female) had slight increase in body weights due to the removal of the inhibitory effect of the pineal gland. This finding is in agreement with Injidi and Forbes (1983) who studied pinealectomyized chicken, treated with melatonin and tri-iodothyronin. However, in rats Rowe *et al.* (1970) recorded no change in body weight or tail length after pinealectomy.

Previous studies showed increase in thyroid weight (Houssay and Pazo, 1968) and increase in thyroxine secretion rate (Ishibashi *et al.*, 1966). Excess thyroid hormones secretion causes high bone turnover, which could have been the cause of epiphyseal plate closure and cessation of growth (Wasserman, 1977). Bone growth inhibition in pinealectomized birds could have been resulted as an indirect effect. The removal of the inhibitory effect of the pineal gland on the thyroid gland activity which usually result into hypertrophy and lead to increase metabolic rate all over the body including the bones. The other possibility of bone growth inhibition in this study could be explained on the light of the findings of Vaughan *et al.* (1972) who described a hypertrophy of the adrenal cortex due to the removal of the pineal gland in mice. Rowe *et al.* (1970) have demonstrated that chronic administration of cortical steroids in rats depresses the uptake of calcium by bone and increase calcium fecal secretion. Further, Spanos *et al.* (1976) and Injidi (1981) have demonstrated high level of calcium ions concentration in the plasma of pinealectomized chicken.

There is evidence of the involvement of the pineal gland in the growth and function of several systems in the fowl but, to date, it has been difficult to provide absolute experimental proof of this functional relationship (Berry and Payne, 1961). Therefore, further study is needed to proof the link between pinealectomy and bone growth.

REFERENCES

Berry, J.E. and D.D. Payne, 1961. The effect of the chicken pineal body and thymus gland upon growth rate and egg production. Poultry Sci., 400: 1378.

Darre, M.J., H.C. Hanson and L.A. Cogburn, 1978. The effect of pinealectomy on feed and oxygen consumption in immature cockerels. Poultry Sci., 57: 1132.

Fiske, V.M., G.K. Bryant and J. Putman, 1960. Effect of light on the weight of the pineal gland in the rat. Endocrinol. 66: 489-491.

Foss, D.C., R.H. Machemer and L.B. Carew, 1972. Surgical removal of the pineal galnd in 3-5 day old chicks. Proc: Soc. Exp. Biol. Med., 139: 1451-1453.

Hanna, I.S., 1994. Physiology of the domestic fowl. Faculty of Agriculture, University of Aleppo, Syria.

Houssay, A.B. and J.H. Pazo, 1968. Role of the pituitary in the thyroid hypertrophy of pinealectomized rats. Expereintia, 24: 813-814.

Injidi, M.H., 1981. The involvement of melatonin, thyroid hormones and glucose in the control of food intake and growth of chickens. Ph.D. Thesis, Leeds University, U.K.

Injidi, M.H. and J.M. Forbes, 1983. Growth and food intake of intact and pinealectomized chickens treated with melatonin and triiodothyronin. Br. Poult. Sci., 24: 463-469.

Ishibashi, T., D.W. Hahn, L. Srivastava, P. Kumuresan and C.W. Turner, 1966. Effect of pinealectomy and melatonin on feed consumption and thyroid hormones secretion rate. Proc. Soc. Exp. Biol. Med., 122: 644-647.

Pehlam, R.W., 1975. A serum melatonin rythm in chickens and its abolition by pinealectomy. Endocrinol., 96 (2): 543-546.

Reiter, R.J. and F. Fraschini, 1969. Endocrine aspects of the mammalian pineal gland: A review. Neuroendorinol, 5: 219-255.

Rowe, J.W., J.R. Richert, D.C. Klein and S. Reichlin, 1970. Relation of the pineal gland and environmental lighting to thyroid function in the rat. Neuroendocrinol, 6: 247-254.

Sorrentino, S., R.J. Reiter and D.S. Schalch, 1971. Pineal regulation of growth hormone synthesis and release in blinded and blinded-anosmic male rats. Neuroendocrinol, 7: 210-218.

Spanos, E., K.W. Colston, I.M.A. Evans, L.S. Galante, S.J. McAuly and I. Mclntyre, 1976. Effect of prolactin om vitamine D metabolism. Mol. Cell Endocrinol, 5: 163-167.

Steel, R.G.D. and J.H. Torrie, 1982. Principles and procedures of statistics. A biometrical approach. McGraw Hill, Koyakusha, Japan.

Vaughan, M.K., G.M. Vaughan, R.J. Reiter and B. Benson, 1972. Effect of melatonin and other pineal indoles on adrenal enlargement produced in male and female mice by pinealectomy, castration and cold stress. Neuroendocrinol, 8: 139-154.

Wasserman, R.H., 1977. In: Duke's Physiology of Domestic Animals. 9th Ed., Edited by Melvin, J.Swenson. Comstock Publishing Association, Itheca, New York.