INSENSITIVITY OF FOWL TESTES TO CADMIUM

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Summary. A single subcutaneous dose of cadmium chloride (1 mg/100 g body-weight) was administered over the breast muscle of male chicks ranging in age from 4 to 180 days. Necrosis of seminiferous tubules had not occurred by the time of autopsy 21 days after treatment. The only consistent finding was a post-injection lethargy and, frequently, tissue damage at the site of injection. Organ/body-weight ratios of comb-wattles and combined testes did not differ significantly between experimental and control animals.

INTRODUCTION

Pařízek & Zahor's report (1956) of the destructive effect of administration of cadmium chloride on the testis of the rat has been followed by reports of similar effects of the compound on mice (Meek, 1959), goats, rhesus monkey, and following direct injection into the testis of rabbits (Kar, Dasgupta & Das, 1961). Cadmium is not considered an essential element. When administered to rats it apparently interferes with normal uptake of zinc by the testis and dorso-lateral prostate, but not with its uptake by other tissues studied (Gunn, Gould & Anderson, 1961). Although many tissues contain zinc, turnover of the radioactive ion in the testis of the rat is slower than that observed in any other tissue tested (Gilbert & Taylor, 1956). We have studied the effect of administration of cadmium to male chicks of varying ages to determine if necrosis of seminiferous tubules or interference with Leydig function would result.

MATERIAL AND METHODS

Groups of nine or more male sex-linked chicks (Merryknoll chicks supplied by Merryknoll Farms, East Freetown, Massachusetts) were given a single subcutaneous injection of cadmium chloride at the rate of 1 mg/100 g body weight at the ages of 4, 33, 60, 90, 120, 150 or 180 days. Controls were injected with 0.5 ml of saline, equivalent to that used as carrier for the cadmium. Twenty-one days after injection, the animals were weighed and killed. Testes, comb and wattles were excised and weighed; and the stage of development of the vas deferens was noted. Portions of each testis were fixed and examined for evidence of necrosis.

RESULTS

Although the amount of cadmium administered was approximately ten times that required for destruction of the seminiferous tubules in the rat, there was no gross or histological evidence of disruption of the testis architecture or function. The age range of chicks used was selected to cover the entire period from shortly after hatching through maturity. The only age at which there was a marked (but insignificant) difference in testis weight of controls compared to treated birds was 90 days (Table 1). It is at this age, however, that the testis may begin to undergo rapid growth toward maturity, so that cadmium treatment was not the only variable. Comb and wattle weights of controls were also correspondingly greater than those of the test birds at this age. Well-developed, convoluted vasa deferentia were observed in increasing numbers of both control and test birds of 90 or more days of age.

TABLE 1

ORGAN/BODY-WEIGHT RATIOS (MG/KG) OF SELECTED TISSUES FROM CADMIUM CHLORIDE TREATED BIRDS AND CONTROLS AT 21 DAYS FOLLOWING INJECTION

Age at time of injection (days)	No. animals		Comb + wattles/body wt (Mean + S.E.)		Left + right testis/body wt (Mean + S.E.)	
	Test	Control	Test animals	Controls	Test animals	Controls
4	9	10	4.3 ± 0.4	5.7 ± 0.7	2.3 ± 0.2	2.8 ± 0.2
33	10	10	2.5 ± 0.4	2.2 ± 0.2	0.41 ± 0.07	0.45 ± 0.08
60	10	10	2.4 ± 0.4	2.1 ± 0.2	0.33 ± 0.14	0.28 ± 0.06
90	10	10	2.2 ± 0.1	3.1 ± 0.5	2.2 ± 0.7	4.0 ± 0.5
120	10	10	4.5 ± 0.6	3.8 ± 0.5	6.5 ± 1.0	5.3 ± 1.6
150	10	9	5.7 ± 0.9	5.6 ± 0.9	6.9 ± 0.9	7.3 ± 1.2
180	10	9	7.2 ± 0.6	7.2 ± 0.4	7.6 ± 0.9	7.2 ± 0.5

The only consistent effect noted in the treated birds was a lethargy which developed shortly after administration of the compound and lasted overnight. In many birds from the older groups, there was marked sloughing of tissue from the area of injection. In all but the 4-day group, final body weights were lower in test birds than in controls. This may have been related to the poor condition of the skin at the injection site and to attendant infection rather than to a systemic effect of cadmium *per se*.

DISCUSSION

Perhaps some degree of confusion regarding the mechanism of cadmium-induced testicular necrosis in certain experimental mammals has existed because of the knowledge that the normal uptake of zinc by the testis and dorsolateral prostate depends on the isch testosterone axis and that certain limited portions of the body are apparently unable to detect the difference between zinc and cadmium when they are presented in approximately equivalent proportions. The lack of knowledge concerning the specific role of zinc

in spermatogenesis (Vallee, 1959) has been a further impediment to solution of the cadmium problem. It has been shown that zinc-deficient diets fed to breeding hens will lower the hatchability and vigour of chicks (Roberson & Schiabe, 1958), and zinc-deficient diets result in poor growth and skin condition in young chicks (Blamberg, Blackwood, Supplee & Combs, 1960); but no report on the effect of such a regime on spermatogenesis or on the reproductive performance of the rooster has been found. Zinc-deficient diets in rats result in slow growth of the testes of immature males and eventual atrophy of the seminiferous tubules which cannot be reversed by subsequent feeding of zinc (Millar, Fischer, Elcoate & Mawson, 1958).

Gunn, Gould & Anderson (1963) and Chiquoine (1963) have pursued studies concerning the mechanism of cadmium damage to the seminiferous tubules. Gunn proposes that vascular factors are of greater significance in the regional destruction of testes than specific sensitivity of the seminiferous tubules *per se*. That endothelial changes precede tubular changes has been confirmed by Chiquoine and has led to the suggestion by Gunn *et al.* (1963) that there may be an enzyme system peculiar to the pampiniform plexus and testicular vessels, sensitive to cadmium and possibly dependent on zinc. They consider the possibility that the enzyme system affected may normally be involved in active regulation of the thermal environment of the testes in scrotal animals. Chiquoine's work with a variety of scrotal and non-scrotal animals supports the hypothesis, for an examination of the grass frog, pigeon, rooster and armadillo 3 days after cadmium administration failed to uncover testicular damage. The opossum, however, also failed to show signs of testicular necrosis.

This report extends the findings of Chiquoine with regard to roosters. Although Pařízek (1960) found rats responded to cadmium only after 9 to 15 days of age, we have found that regardless of the degree of maturity, Merryknoll roosters fail to be affected by subcutaneous injections of cadmium chloride in doses considerably greater than those which destroy the seminiferous tubules of mammals. A preliminary study with intraperitoneal injection of young chicks also failed to show morphological evidence of testicular damage.

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