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Lead Toxicosis and Salt Glands in Domestic Ducks

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The supraorbital nasal glands (salt glands), whose morphology has been described by many authors (MARPLES 1932, TECHNAU 1936, SCOTHORNE 1958 and 1959), although present in all birds, have an important functional significance in marine birds and water fowl

In these species, such organs are remarkably developed and it has been demonstrated (SCHMIDT-NIELSEN et al. 1958, McFARLAND 1959, SCHMIDT-NIELSEN 1960, FLETCHER et al. 1967, HOLMES et al. 1968, HOLMES and STEWART 1968, FLETCHER and HOLMES 1969, STEWART et al. 1969, BRADLEY and HOLMES 1972), these nasal glands provide an extra-renal pathway for the excretion of sodium chloride mostly when the environmental conditions oblige these birds to consume quantities of salt greater than their relative ability of renal clearance.

Since the birds nephron has only a limited capacity to produce hypertonic urine, the additional excretory activity of extra-renal organs such as the nasal glands, allows the maintenance of a normal electrolytic balance and, therefore, the survival of the birds in brackish and saline environment.

The activation of excretory function by salt glands is promoted by osmotic load, "via" the adrenal glands, and by the involvement of Na^+ and K^+ dependent ATP-ase at the cellular membrane level.

Apart from other possible functions of these organs (BUTLER et al. 1978), it is clear that negative interferences on the NaCl excretion process can be particularly dangerous for birds living in very saline environment.

For exemple, a report on the effects of environmental pollutants of the DDT group (FRIEND et al. 1973) on domestic ducks, has demonstrated that the interferences on Na^+ and K^+ dependent ATP-ase can alter the function of the salt glands of birds just as it is found in other marine animals (JANICKI and KINTER 1971, MERKENS et al. 1972) with serious danger for the species survival.

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In the light of these facts and knowing the interaction of lead on the ATP-ase activity, we have analysed the nasal glands from domestic ducks lead-dosed, upon various experimental conditions (RINDI et al. 1974, DEL BONO et al. 1975 a,b).

DESCRIPTION OF EXPERIMENTS

8 adult ducks (Group I) of both sexes were force fed with a standard dose of 24, size 6 (2.3 g) commercial lead shot, once a week five times.

8 adult ducks (Group II) of both sexes were treated with the same rate of lead shot plus $CaNa_2EDTA$ a dose of 1 mM/kg on the basis of body-weight/day for six weeks.

At the ninth week all ducks of both groups were sacrificed and the following data was recorded: weight, hemoglobin value, number of red blood cells and lead quantity in the blood.

All the resulting values were compared with those of a third group (Group III) of 8 adult ducks of both sexes used as control.

All the ducks treated (Groups I and II) showed various degrees of anemia during the third and fourth weeks and subsequently after the sixth week presented clinical signs of lead poisoning (prostration, anorexy, ataxy, weight loss and nervous symptomatology).

METHODS

The samples of nasal glands were wet-digested by the method of PEARCE et al. (1976). The acid digest were analysed for lead by flameless AAS on Instrumental Laboratory mod. 251 atomic absorption spectrophotometer. All reagents were analytical grade; thoroughly cleaned glassware was tested with dithizone.

RESULTS AND DISCUSSION

The mean concentration of lead in the nasal glands are reported as µg/g on wet-weight basis. The mean concentrations of lead in the blood of the same birds are reported for comparison.

Organs	Group I	Group II	Group III
Nasal Glands	10.5	4.6	1.3
Blood	3.5	4.1	1.4
Nasal Glands/Blood	3.0	1.1	1.0

It is clear from these chemical findings that the ratio nasal glands/blood lead concentration is around unity for control birds and for birds dosed with lead plus $CaNa_2EDTA$; while this ratio rises to 3 in birds heavily poisoned which have higher levels of diffusible lead in the blood stream.

As is known, diffusible lead is the principal cause of toxic effects of lead such as anemia, motor difficulty and nervous symptomatology. The high concentrations of metal found in the glands of birds heavily intoxicated could indicate the involvement of glands in the elimination of lead , or at least, the impairment of transport processes at the cellular membrane levels.

Even if a brief histopathologic examination seems to confirm the involvement of glandular structures, we will have to wait for more accurate histological research to ascertain the type of modification of salt glands of domestic ducks. Further investigations of domestic and wild water fowl should provide information on lead effects upon specific systems of environmental adaptation among water birds. We think, in fact, that the previously noted impairment of renal function due to lead poisoning can also be found at the level of the salt glands. This lesion would lead to wild water fowls' impossibility to adapt to different saline environments.

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