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Pheochromocytoma In the Adrenal Gland of a Horse

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A pheochromocytoma which elevated the dorsal surface of the left adrenal gland was encountered in a 22 year old female horse (Quarter Horse-Standardbred) used as an anatomy cadaver in the gross dissection laboratory at Iowa State University.

Gross Examination

The lesion produced two rounded elevations of the capsule on the dorsal surface of the gland. The larger of the two lesions was black in color and measured 2 x 1 x 1 centimeters (Figure 1). The smaller lesion, also on the dorsal surface of the gland, was light gray in color and measured 0.5 x 0.5 x 0.5 centimeters.

The right adrenal gland appeared normal with no outward manifestation of lesions. The left adrenal gland presented a loosely arranged mass of medullary tissue which was black throughout the cut surface. Slit-like openings in the medullary tissue appeared to be areas of excessive vascularization (Figures 1 and 2).

Microscopic Examination

Tissue from the previously embalmed horse was sectioned and stained with H & E for microscopic examination. A compression of the cortex and a sharply demarcated corticomedullary junction of the left adrenal gland were noted (Figure 3). Open tissue spaces suggestive of areas of excessive vascularization were prominent (Figure 4).

Cells in the medulla were pleomorphic, had abundant granular cytoplasm, and elongated nuclei. Mitotic figures were sparse and the cell outlines were not clearly defined (Figure 5). This tissue was stained with H & E after removal from the previously embalmed animal. The nuclei revealed dense granules (Figure 5). Fine cellular detail was obscured. Expanding and crowding hypertrophic medullary cells extended into the larger vascular channels of the medulla.

Incidental Findings

Enlargements suggestive of osteomas were found ventrally on the bodies of the thoracic vertebrae 14, 15, 16, and 18 and on the dorsal surface of lumbar vertebrae 1 and 2 (Figures 6 and 7). Intestinal con-
cretions were found in the diaphragmatic flexure of the large colon. Their cut surface revealed concentric laminations. Eight of the concretions ranged from 4 to 8 centimeters in diameter; the largest weighed 300 grams. Numerous small concretions were found.

**Review of Literature**

Head and West\(^1\) reported a paraganglioma which measured 5 x 4 x 4 centimeters in a 2 to 3 year old grade bovine bull. This tumor was located in the left adrenal medulla at the posterior end of the gland. The same authors\(^2\) also reported a pheochromocytoma in a 14 year old English Sheepdog which had been castrated at twelve years of age because of enlarged testicles due to a seminoma in a testis. The adrenal medullary tumor was found in the posterior part of the right adrenal gland. Another pheochromocytoma was reported by the same authors in a 10 year old Great Dane dog which occurred in the right adrenal gland and had metastasized to the right adrenal lymph node.

Moulton\(^5\) noted that pheochromocytomas may somewhat resemble normal adrenal medullary tissue. The neoplastic tissue appears as lobules of round, ovoid, or polygonal cells separated by connective tissue and vascular channels. Blood channels may be lined with neoplastic cells. Cell boundaries are usually indistinct and cells may be multinucleated. Cells with vacuolated cytoplasm are commonly encountered. Mitotic figures are not numerous. The neoplasms may invade blood vessels including the aorta and vena cava. Metastases to the regional lymph nodes, liver, and lungs have been reported.

Jubb and Kennedy\(^3\) state that the neoplasms are friable and pink to red-brown in color depending upon the amount of blood present and may be marked by areas of hemorrhage and necrosis. They also state that these neoplasms histologically tend to reproduce tissue similar to that of the medulla. Cellular pleomorphism is common. The nuclei are large, spherical and vesicular.

Figure 1. The normal adrenal gland is shown on the right and the neoplastic adrenal gland sectioned through the pheochromocytoma is shown on the left. Panatomic x film; ISU Anatomy Dept. Negative.
Moulton\textsuperscript{5} reported the occurrence of the pheochromocytoma in the ox, horse, dog, and sheep. The neoplasm usually occurs unilaterally, but bilateral occurrences have been reported. Tumors in animals may exceed 10 centimeters in diameter. The lesions are usually multilobular and thinly encapsulated. The tissue is firm and may vary from yellow to brown to gray in color in the unfixed state. Moulton suggests that these lesions be treated, prior to fixation, with 3 per cent (potassium) dichromate for 3 days prior to paraffin sectioning in order to demonstrate the brown color of granules in the cytoplasm of the chromaffin cells for a more accurate diagnosis. Without special staining it may be difficult to differentiate the anaplastic lesion from a carcinoma of the cortex. Unfortunately, most adrenal glands are fixed in formalin, because the pheochromocytoma is unsuspected at the time the tissue is harvested. The Orth’s solution, recommended for fixation, is usually not available at the time.

Jubb and Kennedy\textsuperscript{3} further state that the majority of lesions are clinically benign with no established manifestations of hormonal excesses in domestic animals. Moulton\textsuperscript{5}, however, reports that the dog and horse with adrenal tumors have displayed tachycardia, edema, and cardiac hypertrophy. Head and West\textsuperscript{2} reported a pharmacological analysis of a pheochromocytoma from a right adrenal gland which showed an elevation of noradrenaline (norepinephrine), in the dog.

Jubb and Kennedy\textsuperscript{3} reported that pheochromocytomas of the adrenal medulla and neoplasms of the cardioaortic and carotid bodies are rather commonly encountered in animals. They state that tumors which originate in chromaffin paraganglia and sympathicoblastomas and ganglioneuromas of the adrenal medulla are rare.
Figure 4. A higher magnification of Figure 3 at the junction of the cortex and medulla shows open vascular spaces in the area below the blood vessel. H & E stain; x100. Panatomic X film; green filter. ISU Anatomy Dept. Negative.

Karsner lists a number of terms applied to lesions of the adrenal gland in man: Pheochromocytoma (Lat.); chromaffin cell tumor; chromaffinoma; chromophile tumor; medullary adenoma of the adrenal gland; and paraganglioma. He reports that neoplasms of pheochrome tissue are often accompanied by paroxysmal or spasmodic hypertension. The cells implicated in the pheochromocytoma in the medulla of the adrenal gland are of ectodermal origin from the neural crest cells.

Karsner continues that the most frequent incidence in man occurs between the 20th and 50th years of life. Pheochromocytomas appear to be rarely accompanied by paragangliomas in other sites. He noted that the existence of malignancy in man approximates 8 per cent.

In man the clinical phenomenon is referred to as the adrenal-sympathetic or adrenal-medullary syndrome. Spasmodic hypertension and persistent hypertension may vary with the size of the tumor. Three types of tumors are recognized in man: (1) Malignant pheochromocytoma with metastasis; (2) benign neoplasm with hypertension; (3) benign neoplasm without hypertension. Regarding the last type of tumor it is reported that a man with the benign tumor without evidence of hypertension may die suddenly as a result of slight trauma or minor surgery. Spasmodic hypertension may be precipitated by over eating, over exertion, surgical manipulations, and unknown causes. Blood pressures may be as high as 300/200 mm Hg. with lower pressures in the extremities and cold skin temperatures. It is reported in man that clinical signs of glycosuria, albuminuria, hematuria, and occasionally diabetes may be seen. The latter disappears with the removal of the adrenal tumor. The tumor may weigh as much as 2000 grams in man.

History

A history of the animal revealed that it was nervous from the time it was acquired (by Iowa State University, from whom it was obtained for dissection) and that at times it became unmanageable when suddenly startled by a passing train,
Figure 7. The arrow points to the cut section of the bony enlargement on the ventral surface of the body of the 14th thoracic vertebra shown in Figure 6. Panatomic X film; ISU Anatomy Dept. Negative.

Figure 6. The arrow points to a bony enlargement on the left ventral surface of the body of the 14th thoracic vertebra. Panatomic X film; ISU Anatomy Dept. Negative.

truck, or automobile. While these actions cannot be directly implicated with this lesion, it would seem to suggest that an excessive secretion of epinephrine attributed to the pheochromocytoma may have accounted for the nervous reactions shown by this animal.

Discussion

A definitive diagnosis of pheochromocytoma was impaired by the lack of cellular detail in the sections made from the previously embalmed animal. The diagnosis was based upon the crowding and the proliferation exhibited by the chromaffin cells of the medulla which compressed but did not invade the cortex. It is realized that vascular spaces which are characteristic of pheochromocytomas may not have been excessive in this tissue.

REFERENCES


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