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Occlusion of the Posterior Vena Cava in Two Dogs by Pheochromocytoma


SUMMARY

Two cases of a pheochromocytoma occluding the posterior vena cava are presented. One, in a 14-year-old wire-haired terrier, caused no clinical signs and was an incidental finding at necropsy. In addition to partial occlusion of the vena cava, this neoplasm had metastasized to the spleen. The other, in a 10-year-old male cocker spaniel, had a clinical syndrome resembling congestive heart failure and was characterized by ascites, edema of the posterior extremities, and weakness. Histologic evidence of hypertension was inconclusive in both cases.

INTRODUCTION

Although infrequently observed in dogs, effects of pheochromocytoma have been well described. The clinical signs and changes, which resemble paroxysmal hypertension in man, are attributed to the increase in catechol amines secreted by the neoplastic adrenal medulla. Other vascular damage may occur mechanically as a result of the tendency for the neoplasm to invade adjacent blood vessels. This report describes the gross, histologic, and histochemical characteristics of pheochromocytomas that invaded the vena cavae of two dogs. One, a 14-year-old female wire-haired terrier, had been treated for a chronic keratitis for several months. Euthanasia was performed when there was no improvement. There were no clinical signs of the neoplasm. The second, a 10-year-old male cocker spaniel, had been obese and ascitic for more than a year. A diagnosis of congestive heart failure had been made clinically. The dog was euthanatized after continued failure to alleviate the condition.

Necropsy findings.—Case 1: 14-year-old female wire-haired terrier.

There were pedunculated growths at the junction of the pyloric and fundic portions of the stomach. The tumors were each about 1 cm. in diameter. The liver was congested, mottled red and yellow, had a rough, uneven surface, and was friable. Moderate valvular endocardiosis of the mitral valve was noticed. There was a cloudy film over the cornea of both eyes. The cornea of the right eye contained a white, opaque area approximately 3 mm. in diameter. The spleen contained many small white foci throughout.

The left adrenal gland was neoplastic, measuring 3 by 1.5 cm. The neoplasm had extended into the posterior vena cava almost to the liver. The intravascular portion measured 2.5 by 6 cm. The mass was unattached except at its point of entry at the adrenal vein (Fig. 1). The neoplasm...
was mottled red-yellow, multilobular, and soft in consistency. The cortex of the right adrenal gland contained multiple nodules throughout, 2 mm. or less in diameter.

Case 2: 10-year-old male cocker spaniel.

The peritoneal cavity contained nearly 2 liters of clear, yellow-tinged, serous fluid.

Figure 1. Left kidney and neoplastic adrenal gland in case 1.

Figure 2. Pheochromocytoma (case 2) in the posterior vena cava. The vessel is being held open by forceps. Multiple hyperplastic nodules are present throughout the liver.
Subcutaneous edema was extensive throughout the rear limbs. Moderate valvular endocardiosis and dilation of both ventricles of the heart were noticed. The liver contained multiple yellowish nodules varying in size from 1 mm. to 3 cm.

The left adrenal gland was neoplastic, with a major portion of the neoplasm invading and partially occluding the lumen of the posterior vena cava (Fig. 2). The portion inside the vessel measured 12 by 4 cm.; the extravascular segment measured approximately 4 by 6 cm. The neoplasm was yellow-brown and multilobular. Dissection revealed that the neoplastic tissue had gained entrance into the lumen of the posterior vena cava by extension into the adrenal vein.

**Histologic Findings.**—In both cases the histologic appearance of the neoplasms was similar. The tumor cells were round to polygonal in shape with foamy to granular cytoplasm. The cell boundaries were generally indistinct. The round to ovoid, hyperchromatic nuclei varied considerably in size. Mitotic figures were not seen. The cells were arranged in a multilobular pattern by strands of connective tissue stroma and numerous vascular channels (Fig. 3). There was a tendency for the tumor cells to palisade around blood vessels or blood sinuses. In many areas these cells actually formed the lining of the sinuses, with the nuclei near the pole opposite the sinus (Fig. 4). The neoplasm in case 1 contained much hemorrhage and necrosis throughout. In case 2, a thick capsule enclosed the neoplasm in some areas, with only a sparse amount of atrophied cortical tissue remaining under the capsule. In other areas residual cortical cells were interspersed among the neoplastic medullary cells.

Histologic examination of the spleen from case 1 revealed the small, white foci to be metastatic adenocarcinoma from the primary pheochromocytoma. The foci of metastasis were discrete and displayed the same cellular type and arrangement seen in the primary neoplasm. The spleen had been fixed in formalin, thus eliminating confirmation by chromaffin stains. Considerable hemosiderosis and moderate lymphoid hyperplasia were also observed in the spleen. Fibrous thickening of the glomerular capsule was present in the kidneys of both animals (Fig. 5). In case 1, medial arteriolar sclerosis was prominent throughout the kidney. This lesion was not noticed in case 2. Nodular hyperplasia of the hepatic cord cells was evident throughout the livers of both dogs.

**Histochemical Techniques.**—To confirm the diagnosis of pheochromocytoma,
a modified Nocht's technique was used to demonstrate the chromaffin granules in the cytoplasm of the neoplastic cells. The tissues were chromated in 2% potassium dichromate for three days prior to staining.*

Formalin fixation was used following chromation, as fixation in formalin prior to potassium dichromate even for as short a period as an hour reduces significantly the amount of chromaffin reaction. Potassium dichromate oxidizes the epinephrine and norepinephrine in the medullary cells to adrenochrome and noradrenochrome respectively. The adrenochrome and noradrenochrome (red in color) are rapidly transformed into brown to yellow pigments which stain the cytoplasm of the cells in which they are found. Although some differentiation can be made between the color of oxidized epinephrine and norepinephrine, it was not attempted in this

* We have since used 5% potassium dichromate buffered to pH 5 to 6 with 5% potassium chromate.

Figure 4. Tumor cells arranged around a vascular sinus. Notice that the nuclei are at the pole of the cells away from the vascular channel. H & E stain. × 1,000.

Figure 5. Fibrous thickening of the glomerular capsule in the kidney. H & E stain. × 400.
case because of poor cellular resolution in the potassium dichromate-fixed tissues. After fixation in potassium dichromate, paraffin sections were stained with a buffered azure-eosin solution (modified Nocht's technique). The pH of the buffered solution was kept above 4.1 to bring out more of the blue-staining characteristics. A more acidic pH gives reddish effects in the finished sections, and the chromaffin cells are not a clearly visible. Using the above technique, the chromaffin cells appear yellow-green in color. Other cells, including the cortical cells and stroma of the adrenal medulla, stain blue.\(^1\)

In sections stained with modified Nocht's technique, green granules (noradrenochrome and adrenochrome) were variably concentrated in the cytoplasm of neoplastic cells, being dense in some and sparse in others. In those tumor cells directly adjacent to vascular channels, the granules were concentrated in the pole of the cells near the sinus.

**DISCUSSION**

Because of its extensive occlusion of the posterior vena cava, the pheochromocytoma in case 2 resulted in clinical signs suggestive of congestive heart failure. The neoplasm in case 1, being much smaller, presented no clinical signs. In neither animal were there clinical signs associated with hypertension.\(^4\)

The auditory changes produced by the unassociated valvular endocardiosis in both cases interfered with auscultation of any other abnormalities in cardiac sounds. Since hormonal assays had not been made in either case, it cannot be determined whether the sclerosed glomerular capsules or the extensive medial hyperplasia of the arterioles were a result of excessive catechol amines. These lesions, although frequently seen in cases of pheochromocytoma, are commonly encountered in dogs of advanced age and therefore may not be attributable to any hypertension produced by the secretions of the neoplasms. Since the neoplasms in both animals invaded the posterior vena cava and partially occluded it, the effects on vascular dynamics were due in part to the mechanical presence of the neoplasm. Since the vascular lesions were seen only in the kidneys and may be associated with advancing age in the canine, both of these neoplasms may have been non-secreting or minimally secreting.

**REFERENCES**