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CASE REPORT
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Primary Adrenal Tumors in Bitches

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ABSTRACT

***Background*:** Adrenal tumors are rare in dogs, accounting for less than 2% of diagnosed neoplasms. They can be primary or metastatic, and are classified as adrenocortical or medullary based on their histological origin. Functional tumors secrete hormones, leading to clinical signs, such as polyuria, polydipsia, and abdominal distension. Adrenalectomy is the primary treatment but carries perioperative risks. This study reports 3 cases of adrenal tumors, highlighting their clinical presentation, diagnostic approaches, surgical outcomes, and histopathological findings.
***Cases*: *Case 1*.** A 11-year-old bitch Shih Tzu presented with polyuria, polydipsia, polyphagia, and mammary lump. Ultrasonography and CT revealed a nodular mass in the left adrenal gland. A low-dose dexamethasone suppression test suggested cortisol-secreting adrenal-dependent hyperadrenocorticism. The dog underwent adrenalectomy without complications, and histological examination confirmed adrenocortical adenoma. The patient remained disease-free for two years postoperatively. ***Case 2*.** A 7-year-old neutered bitch Dalmatian underwent routine imaging, which revealed an incidental adrenal mass. Ultrasound and CT showed a left adrenal nodule without vascular invasion or thrombus formation. Hormonal tests were used to exclude functional diseases. The bitch underwent an adrenalectomy without complications. The histopathological findings confirmed nodular adrenocortical hyperplasia. No tumor recurrence was observed over the 3-years follow-up period. ***Case 3*.** A 15-year-old neutered bitch mixed-breed dog presented with vomiting, hyporexia, and diarrhea. Imaging revealed a large right adrenal mass in close contact with major vessels, causing vena cava displacement. Dexamethasone suppression test ruled out cortisol overproduction. The bitch underwent adrenalectomy, and histological examination confirmed the diagnosis of adrenocortical carcinoma. The patient was followed-up for 3 months without evidence of recurrence.
***Discussion*:** All 3 bitches underwent adrenalectomy without perioperative complications, supporting studies linking surgery to prolonged survival. No recurrence was observed during the long-term follow-up, suggesting favorable outcomes in selected cases. All patients were females, which is consistent with reports of higher adrenal tumor incidence in spayed bitches. Their ages ranged from 7 to 15 years, which is consistent with the literature. A slight left adrenal predilection was noted, although the prognosis depended more on factors such as vascular invasion, particularly of the caudal vena cava, which complicates surgery. In *Case 3*, tumor proximity to the pancreas raised concerns about pancreatitis, reinforcing the need for thorough preoperative evaluation. Ultrasound and CT are essential for diagnosis and surgical planning. While ultrasound has moderate sensitivity, CT provides better details, especially for assessing vascular invasion and tumor extent. Large irregular lesions are often indicative of malignancy. Two cases involved incidental adrenal masses ("incidentalomas"), highlighting the need for hormonal assessment as some tumors may be functional despite no clinical signs. In *Case 1*, hormonal testing confirmed hypercortisolism, justifying adrenalectomy. Histopathology confirmed adenoma in *Case 1* and carcinoma in *Case 3*. Carcinomas typically exceed 2 cm, with capsular invasion, necrosis, and hemorrhage, while adenomas show cytoplasmic vacuolization. Nodular adrenocortical hyperplasia, observed in *Case 2*, is common in older dogs without a clear cause, although its link to adenohypophyseal proliferation was not observed here. These cases emphasize the importance of imaging, hormonal testing, and histopathology in the diagnosis of adrenal tumors. Despite these risks, adrenalectomy remains a viable treatment, with favorable long-term outcomes in well-selected cases.

Keywords: adrenal tumor, adrenalectomy, canine neoplasia, imaging diagnosis, histopathology.

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INTRODUCTION

Adrenal tumors are uncommon, accounting for < 2% of all neoplasms diagnosed in dogs, and may be primary or metastatic [8]. The most common lesions are adenomas and adenocarcinomas, which account for 75% of primary adrenal tumors, followed by pheochromocytomas [5]. Adrenal tumors can arise in different regions and are classified as adrenocortical or medullary depending on their histological origin [3]. They are also divided into functional and non-functional groups [18], which produce glucocorticoids and, less frequently, sex hormones or mineralocorticoids [5].

The clinical signs of functional adrenal tumors are directly related to hormone secretion [19]. Neoplasms associated with adrenal-dependent hyperadrenocorticism (ADH) account for 13-25% of ADH cases [6]. Clinical signs include polyuria, polydipsia, polyphagia, abdominal distension, and dermatological changes [1].

Adrenalectomy is often indicated for the treatment of adrenal tumors but is associated with high perioperative mortality in dogs [10,15]. Treatment decisions depend on the extent of local invasion and presence of metastases. If the primary tumor is not considered to be resectable, medical treatment is preferred [9]. In this context, this study reports 3 cases of adrenal tumors and highlights their clinical presentation, diagnostic approaches, surgical outcomes, and histopathological findings.

CASES

Case 1. A 11-year-old bitch Shih-tzu presented with polyuria, polydipsia, polyphagia, and a lump in the left inguinal mammary region measuring 1.0 x 0.8 x 0.5 cm. On physical examination, vital signs were as follows: heart rate (HR) 90 bpm, respiratory rate (RR) 32 rpm, capillary refill time (CRT) less than 2 s, temperature 38.4°C, pulse firm and regular, mucous membranes normal in color, lymph nodes nonreactive, blood glucose 115 mg/dL, systolic blood pressure (SBP) 140 mmHg, and body score 3 (scale 1-5).

Hematological tests were unremarkable, whereas biochemical tests revealed increases in alkaline phosphatase (AP), alanine aminotransferase (AAT), and triglycerides.

Ultrasound showed an enlarged left adrenal gland (3.85 x 3.58 x 0.66 cm) with a nodule in the cranial pole measuring 2.42 x 2.89 cm. The right adrenal gland was unremarkable. Computed tomography (CT) confirmed a nodular neoformation in the left adrenal gland, which was displaced and in close contact with the renal vein, phrenic veins, and caudal vena cava, but without evidence of vascular infiltration or thrombi. Chest radiography revealed no evidence of pulmonary metastases.

The suppression test with low-dose dexamethasone indicated cortisol values of 2.80 µg/dL at time 0 h, 2.69 µg/dL at time 4 h and 2.41 µg/dL at time 8 h, suggesting CAH independent of pituitary stimulation.

The patient was referred for adrenalectomies. The surgery was uneventful, and postoperative recovery was normal. After intensive 24-h monitoring, the patient was discharged.

Histological examination of the adrenal gland revealed proliferation of polygonal cells arranged in trabeculae, similar to the cells in the glomerular and reticular zones of the adrenal gland. The cells had clear vacuolized eosinophilic cytoplasm, round to oval nuclei with coarse chromatin, and were separated by a thin fibrovascular stroma (Figure 1). The histological findings were compatible with adrenocortical adenoma.

After 60 days of clinical follow-up, remission and complete improvement of clinical signs were observed. The patient was monitored for 2 years, during which time there was no disease recurrence.

Case 2. A 7-year-old neutered bitch Dalmatian presented for routine examination, with no clinical signs. On physical examination, vital signs were within normal limits: HR, 128 bpm; RR, 40 rpm; TPC, less than 2 s; temperature, 38.1°C, firm and regular pulse, normal-colored mucous membranes; and nonreactive

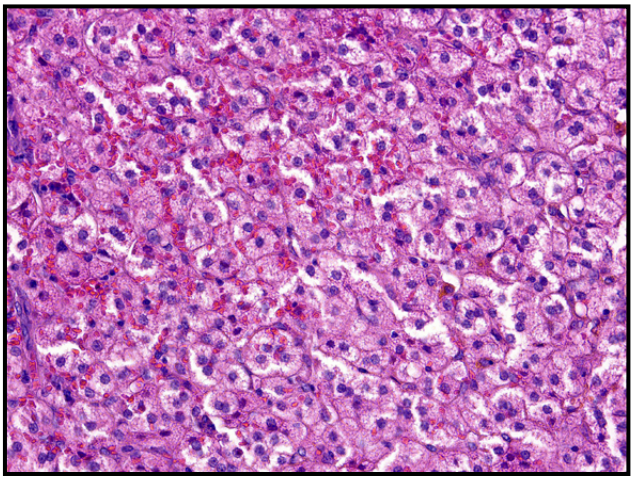

Figure 1. Primary adrenal tumors in dogs. Adrenal Cortical Adenoma: Proliferation of polygonal cells with clear, vacuolated eosinophilic cytoplasm and round to oval nuclei with coarse chromatin. The cells were arranged in nests and were separated by a thin fibrovascular stroma [HE; 40x].

lymph nodes. blood glucose level was 98 mg/dL, systolic blood pressure varied between 160 and 260 mmHg, and body score was 3 (scale 1-5).

Hematological and biochemical test results were unremarkable.

Abdominal ultrasound showed an enlarged left adrenal gland (2.94 x 1.35 cm) with a nodule at the caudal pole measuring 2.05 x 1.21 cm. No changes were observed in the right adrenal gland. Computed tomography (CT) confirmed that the abdominal aorta, caudal vena cava, portal vein, and their tributaries did not show signs of tumor invasion or thrombus formation. No foci of pulmonary metastases were identified on the chest radiograph.

Suppression testing with low-dose dexamethasone revealed cortisol levels of 1.16 µg/dL at time 0, 0.45 µg/dL at time 4, and 0.9 µg/dL at time 8 h, excluding the hypothesis of independent CAH.

The patient underwent adrenalectomy without any intraoperative or postoperative complications. The patient was discharged 24 h after intensive monitoring.

Histological analysis of the adrenal gland revealed unencapsulated nodules composed of polygonal cells arranged in nests and packets. These cells resembled those of the zona glomerulosa and zona reticularis, and were separated by a fine fibrovascular stroma, confirming the diagnosis of nodular adrenocortical hyperplasia.

The patient has been followed-up for 3 years since surgery, with no new tumors or recurrences.

Case 3. A 15-year-old neutered bitch of an unspecified breed presented with a history of vomiting, hyporexia, and diarrhea for several months. On physical examination, vital signs were as follows: HR, 136 bpm; RR, 40 rpm; TPC, less than 2 s; temperature, 38.4°C, firm and regular pulse, normal color of mucous membranes, nonreactive lymph nodes, glycemia of 132 mg/dL, systolic blood pressure between 160 and 260 mmHg, and body score of 3 (scale 1-5). Blood count showed no significant changes, but biochemistry revealed elevated ALT (174.00 U/L) and FA (693.80 U/L) enzyme levels, and high triglycerides (178.0 mg/dL).

Abdominal ultrasound showed an enlarged right adrenal gland (4.12 x 0.80 x 1.81 cm) with a nodule in the cranial pole measuring 4.3 x 2.1 x 2.3 cm. The left adrenal gland was also enlarged (2.1 x 1.1 cm), but with regular contours and homogeneous parenchyma. Computed tomography (CT) showed that the adrenal nodule was in close contact, without a plane of separation, with the caudate process of the caudate lobe of the liver, the dorsal wall of the abdomen, the psoas muscle, and the ipsilateral caudal vena cava. This formation caused marked ventral displacement and narrowing of the vena cava diameter from the hepatic hilum to the caudal pole of the left kidney (Figure 2). No pulmonary metastases were observed on the chest radiograph.

The suppression test with low dose dexamethasone showed the following results: T0 h - 0.91 µg/dL, T4 h - 0.51 µg/dL and T8h - 3.61 µg/dL, excluding the possibility of independent CAH.

The patient underwent adrenalectomy without any intraoperative or postoperative complications. The patient was discharged 24 h after intensive monitoring.

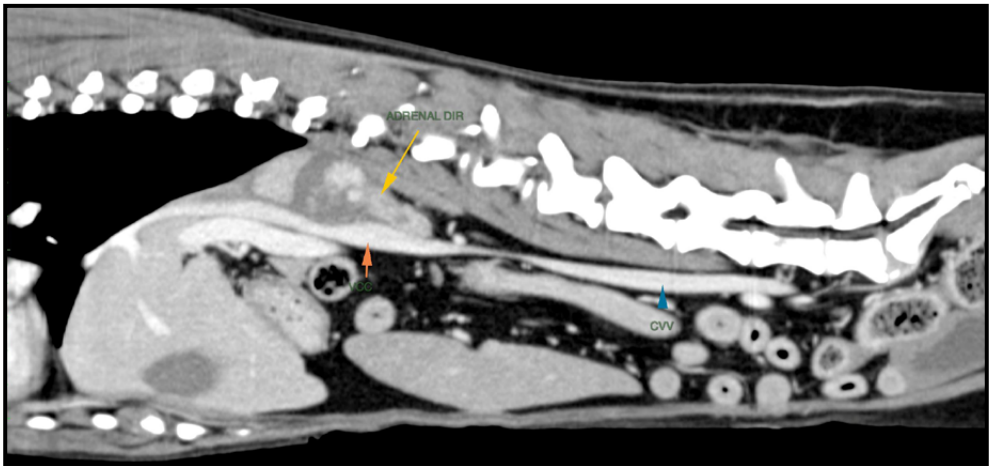

Figure 2. Primary adrenal tumors in dogs. Adrenocortical Carcinomas. Computed tomography reveals an amorphous mass with irregular borders at the cranial pole of the right adrenal gland (arrow). The lesion was in close contact with the caudate lobe of the liver, dorsal abdominal wall, psoas minor muscle, and ipsilateral caudal vena cava without a clear separation plane. Marked ventral displacement and reduced diameter of the vena cava were observed.

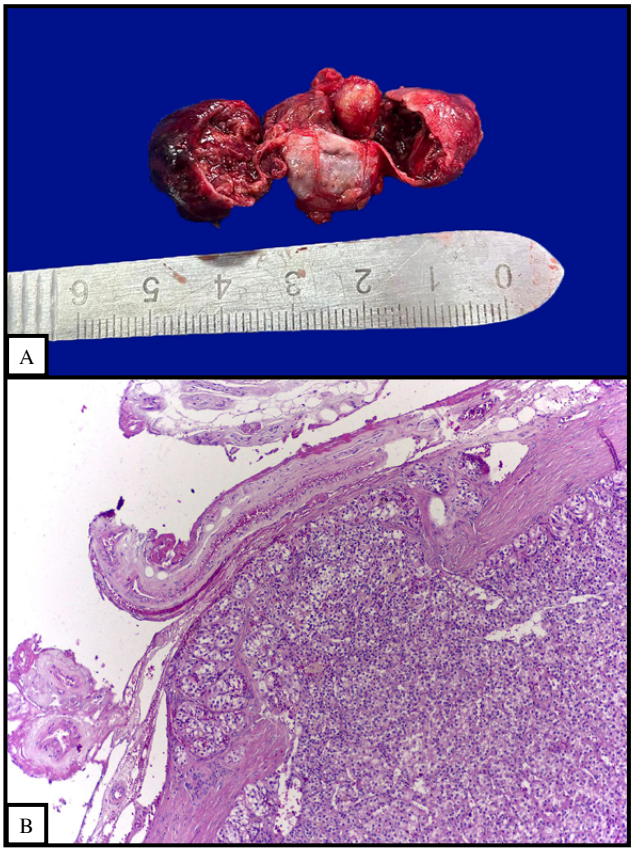

Figure 3. Primary adrenal tumors in dogs. Adrenocortical Carcinomas. A- The adrenal gland exhibited an irregular surface, measured 5.0 cm, and appeared friable and hemorrhagic. B- Loss of normal adrenal architecture was evident, with replacement by irregular and invasive proliferation of polygonal cells arranged in nests or interconnected trabeculae. Capsular invasion of the adrenal glands has also been observed [HE; 10x].

Macroscopically, the adrenal gland exhibited an irregular surface, appeared hemorrhagic and friable, and measured approximately 5 cm in length (Figure 3A). Histological analysis revealed a loss of normal architecture, replaced by irregular and invasive proliferation of polygonal cells with large, microvacuolated cytoplasm and round, moderately prominent vesicular nuclei. These cells were arranged in nests or anastomosing trabeculae surrounded by fibrovascular connective tissue, consistent with the diagnosis of adrenocortical carcinoma (Figure 3B).

The patient was followed up clinically for 3 months after surgery, with no evidence of tumor recurrence or recurrence of clinical signs.

DISCUSSION

In this study, all 3 bitches underwent adrenalectomy without complications in the postoperative period, with a survival time of more than 90 days. Similarly, in a study evaluating prognostic factors in the surgical management of canine adrenal tumors, animals that survived the postoperative period had prolonged survival [16].

In the 3 cases presented, all patients were spayed bitches, which is consistent with the literature, indicating a higher incidence of adrenal neoplasia in sterilized females, followed by spayed and intact males [11]. It was also observed that dogs of an unspecified breed (UB) were more affected, confirming other studies that highlighted a higher incidence of adrenal tumors in UB dogs, followed by Labradors, Golden Retrievers, and German Shepherds [17]. In addition, the bitches in this report were between 7 and 15 years of age, a range consistent with that described in other studies, which ranged from 4 to 16 years [12].

In the cases reviewed, adrenal tumors showed a slight predilection for the left adrenal gland, which is consistent with previous studies in which approximately 63% of neoplasms were in this gland. However, the literature also highlights that tumor location alone does not significantly influence patient survival. Factors such as vascular invasion, especially in the caudal vena cava, are more relevant to the prognosis. Tumors in the right adrenal gland, due to their proximity to the pancreas, may be associated with a higher risk of postoperative complications such as pancreatitis, as observed in *case 3*. These findings emphasize the importance of detailed preoperative evaluation, regardless of the side involved, to improve surgical planning and reduce complications.

In this study, the combination of ultrasound and computed tomography significantly contributed to improving diagnosis and guiding clinical and surgical decisions. Ultrasound is a widely used tool in the diagnosis of adrenal tumors because of its accessibility, speed, and high specificity (100%), although it has moderate sensitivity (63.7%), especially for lesions smaller than 10 mm, which often go unnoticed [14]. In contrast, CT offers a more detailed assessment and is more effective in detecting small lesions, vascular invasion, and tumor extension, making it indispensable in surgical planning. Large, irregular lesions associated with malignancy are better characterized by CT, which is also superior in identifying tumor thrombi in vessels such as the caudal vena cava.

In *cases 2* and *3*, adrenal masses were discovered incidentally during imaging studies, characterizing "incidentalomas," defined as adrenal lesions larger than 1 cm with no direct relationship to clinical signs [4]

Functional assessment of adrenal tumors is critical because these neoplasms can be either non-functional or functional, with the latter being capable of secreting hormones, such as cortisol. Excessive cortisol is associated with the development of characteristic clinical signs of CAH, including polydipsia, polyuria, polyphagia, abdominal distension, alopecia, and muscle weakness [2,14]. In *case 1*, the suppression test with low-dose dexamethasone was crucial to confirm the diagnosis of independent CAH, indicating the presence of a functional cortisol-secreting tumor.

Histopathological examination revealed adenoma in *case 1* and adrenocortical carcinoma in *case 3*. According to the criteria established by Labelle [7], adrenocortical carcinomas are often associated with tumor size greater than 2 cm, peripheral fibrosis, capsular invasion, trabecular growth pattern, necrosis, and hemorrhage, whereas adenomas are associated with fibrin thrombi, cytoplasmic vacuolization, and hematopoiesis. In addition, the Ki-67 proliferation index is an important indicator of malignancy, and is significantly elevated in carcinomas. A value greater than 2.4% correlated with malignancy in 96% of the cases analyzed. These findings emphasize the importance of detailed histopathological evaluation combined with immunohistochemical analysis for a more accurate classification of canine adrenal tumors. However, immunohistochemical analysis was not performed.

Nodular adrenocortical hyperplasia was observed in *case 1*. This condition is commonly observed in older dogs, without a clearly defined cause. However, a recent study suggested that the prevalence of adrenocortical hyperplasia increases with the progression of adenohypophyseal proliferation from hyperplasia to microadenoma, and ultimately to macroadenoma [13]. However, this association was not observed in the present case.

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