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CASE REPORT
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# Hematoma Mimicking Liver Mass in a Dog Developed by Spontaneously Ruptured Adrenocortical Adenoma

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## ABSTRACT

***Background*:** Adrenal tumors can be divided into functional and nonfunctional tumors. Some adrenal tumors can induce hyperadrenocorticism, e.g., adrenocortical carcinoma or adenoma and pheochromocytoma. Patients with nonfunctional adrenal tumors may present without any symptoms associated with excessive catecholamines or corticosteroids, including polyuria, polydipsia, panting, potbelly, polydipsia, and hypertension. Adrenal tumors that present no clinical signs and are detected incidentally on diagnostic imaging are called incidentalomas. Incidentalomas sometimes rupture spontaneously without trauma, resulting in a hemoabdomen and hematoma. Herein, a ruptured benign adrenal gland tumor created a large hematoma that mimicked a liver mass on computed tomography (CT) scans. These findings can support surgeons managing a ruptured adrenal gland tumor or 2 or more masses suspected on CT scans.

***Case*:** A 13-year-old neutered male poodle, weighing 6.98 kg, was presented with abdominal distension and lethargy. Physical examination revealed prolonged capillary refill time (CRT), pale mucous membranes, decreased blood pressure, and elevated portable lactate values. In blood analysis, aPTT and PT were mildly prolonged, and the D-dimer value was elevated. Abdominal mass and fluid were defined on ultrasonography, and abdominocentesis was performed. Sanguineous fluid was collected. The patient had no history of any traumatic events to indicate the likelihood of an abdominal mass rupture. Subsequent CT scans revealed 2 masses in the right adrenal gland and the caudate lobe of the liver. High attenuation in the adjacent parts between the masses suggested mass adhesion or invasion of the adrenal mass into the liver. After blood transfusion, hemodynamic values did not improve; therefore, an exploratory laparotomy was performed. During surgery, the suspected liver mass was found to be a large hematoma distributed throughout the abdomen. The liver exhibited no gross pathological findings. After the removal of the suspected hematoma, right adrenalectomy was performed, and part of the hematoma was separated without intentional modification. On histopathological examination, the right adrenal tumor was defined as an adrenocortical adenoma and the hematoma was defined as an adrenocortical adenoma with marked hematoma formation. Adrenocorticotropic hormone (ACTH) levels were within the normal range, ruling out hypoadrenocorticism. After 9 months of the surgery, the patient showed no clinical signs of any adrenal gland dysfunction or hemodynamic problems.

***Discussion*:** An adrenocortical adenoma rupture is rare. This is the 1st veterinary case of a hematoma-mimicking liver mass originating from a ruptured benign adrenal tumor. The mass, thought to be a liver mass, showed a CT scan pattern similar to that of the primary liver mass reported in a previous canine study. This hematoma showed the pattern of a ruptured adrenal gland that could be indistinguishable from the adrenal tumor in a human study, which could suggest it as being the sole tumor, not a hematoma. Moreover, its characteristic histopathological findings indicated that it was a hematoma mixed with adrenocortical neoplastic tissue. This condition might generate CT patterns similar to those of other masses. The location of hematoma formation defined on CT scans may suggest to surgeons that the hematoma is a liver mass. Surgeons who encounter this complication should consider the likelihood of hematoma formation.

**Keywords:** hematoma, computed tomography, adrenal gland tumor, incidentaloma, adrenalectomy, spontaneous rupture.

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## INTRODUCTION

Adrenal tumors in dogs are rare, and their reported prevalence varies [6]. The primary adrenal tumor can be divided into functional (secreting hormones) or non-functional (not secreting hormones) tumor type. Functional tumors tend to cause symptoms that a patient may present with, including adrenal gland-dependent hyperadrenocorticism, which can result from adrenocortical adenoma, adrenocortical carcinoma, or pheochromocytoma [3,13]. However, most patients with primary adrenal tumors do not present the clinical signs that are associated with steroidal hormones and catecholamines. In these patients, any adrenal mass tends to be found incidentally (incidentaloma) during an abdominal ultrasound or computed tomography (CT) scans ordered for other indications [6,10].

Older dogs present with incidentalomas, and evaluations include hormone level tests and thoracic or abdominal imaging to evaluate metastasis [6]. However, tumors can rupture and generate a hemoabdomen, which requires an emergency surgery [5,7,13,17].

Herein, the incidentally detected adrenocortical adenoma ruptured and formed a hematoma at the site of the caudate liver lobe region, as defined by CT scans. The presentation misled surgeons into believing it to be a liver mass. During surgery, the mass was defined as a huge hematoma originating from the rupture of the right adrenal gland tumor. This huge hematoma, which could not be distinguished from the liver mass on the CT scans, was a complication not previously reported in veterinary surgery. Surgeons managing similar cases of incidentalomas should anticipate and plan for this type of complication.

## CASE

A 13-year-old neutered male poodle, weighing 6.98 kg, was presented with abdominal distention and lethargy. Physical examination revealed prolonged capillary refill time (CRT) (< 2 s), pale mucous membranes, decreased blood pressure (Systolic blood pressure (SBP) 97 mmHg), and elevated portable lactate level (6.0). No other abnormalities were observed on physical evaluation. Blood tests revealed mildly prolonged aPTT and PT (111.3 s [Ref.: 75-105 s] and 19.4 sec [Ref.: 14-19 s], respectively) and elevated D-dimer levels (813.90 ng/mL [Ref.: 0-250 ng/mL]). Ultrasonography revealed a large amount of abdominal fluid near the right kidney and spleen, along with an abdominal mass that might have been derived from the liver or right adrenal gland. Abdominocentesis was performed. The fluid was sanguineous, and the patient had no history of trauma; therefore, the mass could have ruptured in the abdomen. CT scans performed the following day revealed 2 masses in the abdomen (Figure 1C). One was derived from the right adrenal gland, and the other one was suspected to have derived from the caudate lobe of the liver. A hyper-attenuated pattern between the masses (Figure 1D) and central part of the liver mass was observed on the CT scans (Figure 1B), suggesting adhesions between the masses or invasion of the adrenal tumor into the liver. Therefore, a right adrenalectomy and caudate lobectomy of the liver should be performed. Preoperatively, the dog's PCV mildly decreased compared to that at admission. The platelet count was 0, and a fresh whole blood transfusion was performed. However, there was no significant improvement in blood parameters. Therefore, exploratory laparotomy was performed.

The ventral midline approach was used. Sanguineous ascites in the abdominal cavity were removed. The paracostal approach was used to retract the abdominal wall. A large mass of unknown origin was identified. The mass was distributed throughout

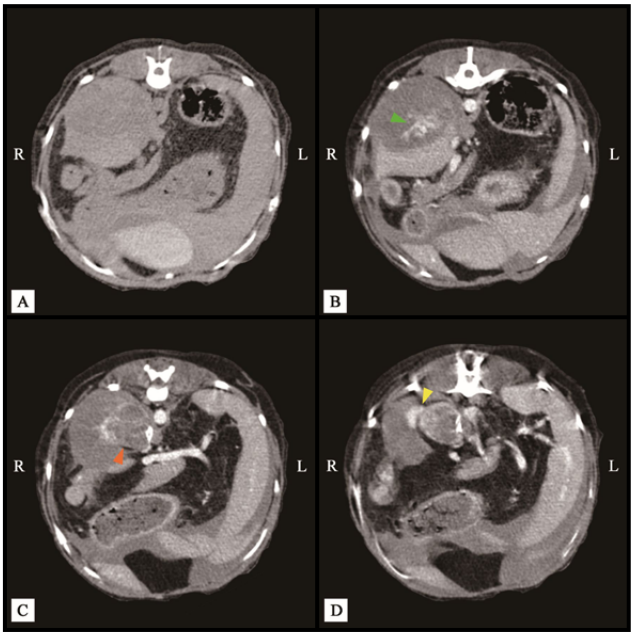


**Figure 1.** Computed tomography (CT) images showing: A- A mass in caudate lobe of liver with a homogenous pattern and soft tissue opacity. B- Central enhancement in artery phase of CT scan (green arrow) with a mean Hounsfield unit (HU) value of 108.19 in the region of interest (ROI). C- Orange arrow showing the mass observed in right adrenal gland. D- Yellow arrow indicates high attenuation between 2 masses. This could be interpreted as adhesion between masses or invasion of adrenal mass to caudate lobe of liver.

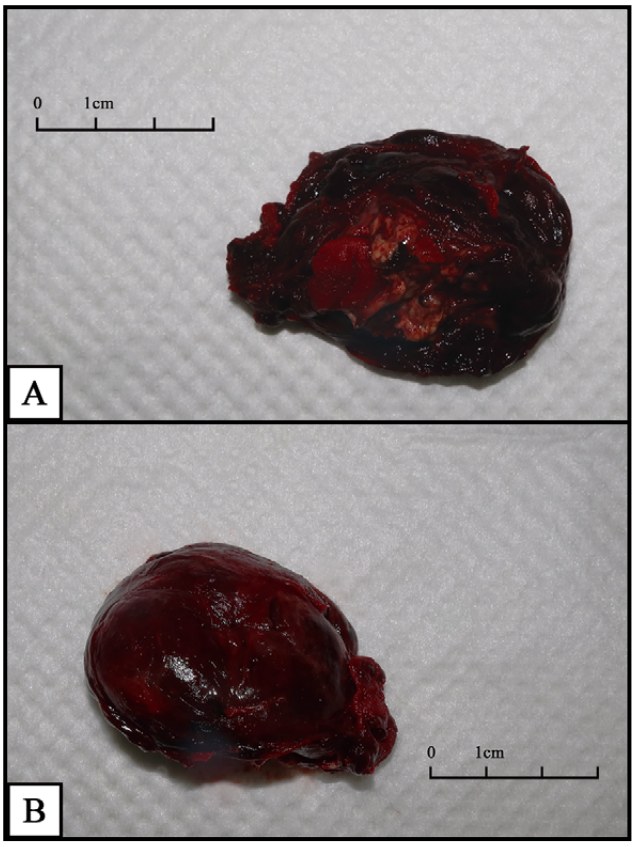


**Figure 2.** Spontaneously detached hematoma from a larger hematoma from the abdominal cavity, allowing for easy removal. The detached hematoma was approximately 6 cm. A- Front side of the hematoma. B- Back side of the hematoma.

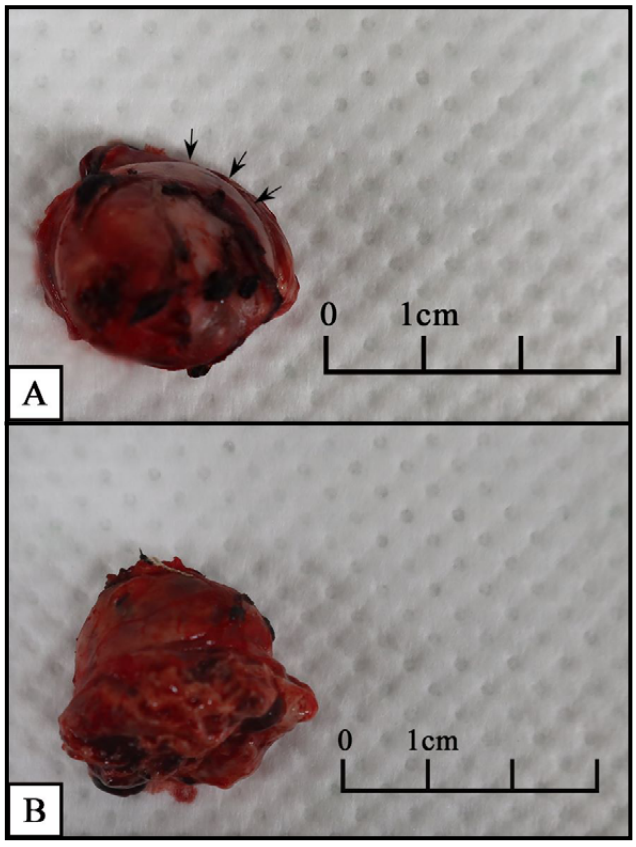


**Figure 3.** The right adrenal gland tumor mass which was resected during surgery. A- Phrenicoabdominal vein (black arrows). B- Ruptured part of the adrenal tumor.

the abdomen and did not seem to be connected to the liver or other organs. Therefore, a large hematoma was expected (Figure 2). The liver appeared normal and was not associated with a hematoma or other masses. A careful blunt dissection was performed. After the excision of the hematoma-suspected mass, the ruptured region of the 2nd mass was detected (Figure 3). The Spongostan[1] was used to control lesion hemorrhage. To dissect the right adrenal mass, the phrenicoabdominal vein was ligated using polydioxanone[2] and a hemoclip[3]. After the ipsilateral phrenicoabdominal vein was ligated, right adrenalectomy was performed, and an additional hematoma was identified and removed. Surgicel[4] and Spongostan[1] were applied to the region of the suspected origin of the hemorrhage. During surgery, because of the large blood loss volume, systolic blood pressure decreased to 60 mmHg, and heart rate increased to 200 bpm. To maintain the blood pressure level, crystalloid fluid volume was increased, and dobutamine[5] CRI [5–10 µg/kg/min] and norepinephrine[6] CRI [1–2 µg/kg/min] were administered. The blood pressure stabilized, and the heart rate was stable and within the normal range. Before closure, abdominal pressure was very high because of hyperhydration. Furosemide[7] was administered intravenously to prevent compartment syndrome. After replacing the organs in the abdomen, an active suction drain was applied. The abdominal wall, subcutaneous tissues, and skin were sutured.

After surgery, fentanyl[8] CRI [1 µg/kg/h] was administered to control the abdominal pain. Blood test results indicated that the patient had hypoalbuminemia and hypoglobulinemia; therefore, a fresh frozen plasma transfusion was performed. Thrombocytopenia was observed; romiplostim[9] was administered to promote platelet regeneration. The patient recovered and was discharged 5 days after surgery.

Histopathological examination demonstrated that the adrenal gland tumor was an adrenocortical adenoma, and a part of the unknown large mass was an adrenocortical adenoma with marked hematoma formation (Figure 4).

An ACTH test was performed to assess residual adrenal gland function. The patient showed no evidence

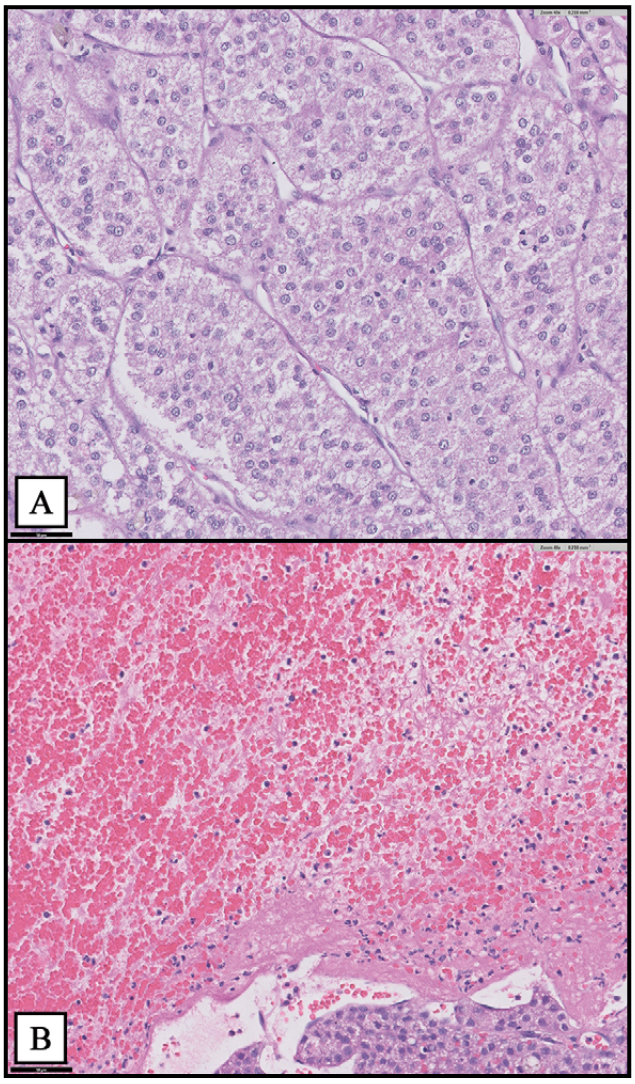


**Figure 4.** Histopathological images of excised masses showing. A- Adrenocortical adenoma of the right adrenal gland. Neoplastic cells observed were polygonal with distinct cell borders and moderate eosinophilic cytoplasm, mild anisocytosis and anisokaryosis, and round nuclei with lightly stippled chromatin and prominent nucleoli. Mitotic figures were rare. B- Histopathology findings revealed the suspected-hematoma as adrenocortical adenoma with marked hematoma formation. The sections consist largely of peripheral blood, fibrin, and leukocytes. Well-differentiated neoplastic epithelial cells similar to right adrenal gland tumor were also observed. [Scale bar= 50 µm].

of hypoadrenocorticism, and the left adrenal gland seemed to act normally. Nine months after the surgery, the patient remained free of any symptoms associated with adrenal gland functions, coagulopathy, or bleeding.

## DISCUSSION

Adrenal gland tumors are rare in dogs. Cases of adrenal gland tumor rupture are also rare and seldom reported [16]. Malignant tumors are eight times larger, and more likely to rupture, than benign tumors [16]. A study of ruptured adrenal tumor glands has shown that in all cases the tumors were malignant [17]. Nevertheless, herein, we describe a rare case of non-traumatic and spontaneous rupture of an adrenocortical adenoma.

In humans, CT scan features of ruptured adrenocortical carcinoma, pheochromocytoma, myelolipoma, and adrenocortical adenoma have been described [1,2,9,11,15]. However, the CT scan features of ruptured adrenal gland tumors in veterinary medicine remain unclear [18]. In human CT scans, adrenal neoplasia and hematoma can be indistinguishable. A study analyzing the patterns of adrenal hematomas in humans divided them into 6 types, namely solid round or oval mass, solid peripheral components with central fluid density, infiltrative, adreniform enlargement, amorphus solid mass, and active bleeding [12]. According to this classification, the present case is an amorphous solid mass, with hematomas in this category with potential to mimic neoplasm. Furthermore, CT scans of this hematoma seemed homogenous and soft-tissue density pattern in pre-contrast scan (Figure 1A). In contrast, high density pre-contrast scan images in a previous study were indicative of a hematoma [12]. Another case in humans also reported a tumor-mimicking hematoma, which was chronic expanding hematoma with soft-tissue tumor features. Diagnostic magnetic resonance imaging (MRI) and CT revealed the presence of hemorrhagic foci, which could not be differentiated as either a hematoma or neoplasm [8]. Therefore, CT scans in this case also could make surgeons think the hematoma as unknown neoplasm.

Clinically, the mass site, anatomical structure, and proximal organs are important characteristics for surgeons. The site of the mass was defined as the caudate lobe of the liver, which was attached to the adrenal gland tumor on the CT scans. Consequently, hemorrhage at this attachment site between individual masses or invasion of the adrenal gland tumor into the liver was 1$^{st}$ considered. Moreover, the mass pattern was suspected to be a primary liver mass. Although the attachment site was highly attenuated, the central part of the liver mass was also highly attenuated; therefore, it could be interpreted as a primary liver mass. A study that analyzed the relationship between CT features and histopathological findings in primary canine hepatic masses demonstrated that malignant hepatic masses, especially hepatocellular carcinomas, showed central or marginal enhancement, whereas hepatic adenomas showed diffuse enhancement in the arterial phase [4].

This enhancement pattern, also observed in this case, can lead surgeons to suspect that the mass is an individual liver mass and not a hematoma.

The histopathological findings revealed mild anisokaryosis and anisocytosis, rare mitoses, and well-differentiated neoplastic cells in the adrenal gland (Figure 4A). Erythrocytes, leukocytes, fibrin, and well-differentiated neoplastic cells, similar to those in the adrenal gland tissue samples, were observed in Hematoma (Figure 4B). These histopathological findings, especially in hematoma samples, generate greater Hounsfield unit (HU) values on CT scans compared to those of common hematomas. Clotted blood usually exhibits attenuation ranging from 45 to 70 HU [14]. In this case, the hematoma showed a mean attenuation value of 108.19 HU in the region of interest (ROI) at the T13-L2 level, presenting an unusual value for a hematoma.

There is a case report of a ruptured adrenal cortical adenoma mimicking splenic rupture in humans [2]. In Veterinary Surgery, similar complications of misleading cavitary lesions or masses made from ruptured adrenal gland tumors have not been reported previously. In this case, tumors that seemed to be in other organs could be hematomas, potentially misleading surgeons while planning or approaching the mass resection. In conclusion, when surgeons encounter such unusual presentations, tumor-mimicking hematomas should be considered and anticipated as potential complications, and the surgical approach should be planned accordingly.

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