Pakistan Veterinary Journal

ISSN: 0253-8318 (PRINT), 2074-7764 (ONLINE)
DOI: 10.29261/pakvetj/2025.162

CASE REPORT

Primary Renal Hemangiosarcoma with a Hematoma Adhering to the Caudal Vena Cava in a Dog

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ARTICLE HISTORY (25-139)

Received: February 15, 2025
Revised: April 17, 2025
Accepted: April 18, 2025
Published online: May 05, 2025

Key words:
Adhesions
Chemotherapy
Computed tomography
Immunohistochemistry
Nephrectomy

A B S T R A C T

Hemangiosarcoma is a highly malignant tumor of vascular endothelium or bone marrow origin, often metastasizing to the lungs, liver, and omentum. The purpose of this report was to provide insight into the diagnosis and management of primary renal hemangiosarcoma in a dog, a rare neoplasm with limited documentation. A 10-year-old, spayed female Pomeranian dog, referred for evaluation of a right renal mass incidentally detected without any clinical symptoms, was examined. Ultrasonography and computed tomography revealed a right renal mass compressing the caudal vena cava, with pulmonary metastases, but no other metastatic sites were noted. Due to severe vascular adhesions, nephrectomy was performed with ligation, leaving a small remnant near the vena cava. Histopathology and immunohistochemistry of the mass confirmed renal hemangiosarcoma. Postoperatively, adjuvant chemotherapy with doxorubicin was administered, and the dog survived for 232 days following surgery. This case highlights the importance of a careful surgical approach to manage renal hemangiosarcoma with extensive vascular adhesions and the potential benefit of combining surgery with chemotherapy in achieving extended survival, even in the presence of metastasis.

To Cite This Article: Jung YW, Lee EH, Hyun JE and Yoon HY, 2025. Primary Renal Hemangiosarcoma with a Hematoma Adhering to the Caudal Vena Cava in a Dog. Pak Vet J. http://dx.doi.org/10.29261/pakvetj/2025.162

INTRODUCTION

Hemangiosarcoma is a highly malignant tumor of vascular endothelium or bone marrow origin. Hemangiosarcomas are characterized by early hematogenous metastasis, with tumor cells entering the bloodstream and traveling to distant sites. At the time of diagnosis, metastasis is frequently identified in the lungs, liver, and omentum (Kim *et al.*, 2015; De Nardi *et al.*, 2023; dos Reys *et al.*, 2023). Common primary sites for this tumor include the spleen, right atrium, skin, and liver (Locke and Baber, 2006; De Nardi *et al.*, 2023). Visceral hemangiosarcomas disseminates rapidly due to their rapid growth and high risk of rupture and haemorrhage, frequently leading to hemoperitoneum and haemorrhagic shock (Locke and Baber, 2006).

Renal hemangiosarcoma is extremely rare, comprising only 12 cases (1%) in a study of 1,200 canine hemangiosarcomas, and primary forms are infrequently reported as individual case studies (Locke and Baber, 2006; dos Reys *et al.*, 2023). Treatment of renal hemangiosarcoma typically involves surgery, chemotherapy, or their combination (Locke and Baber, 2006; De Nardi *et al.*, 2023). However, due to the rare occurrence of renal hemangiosarcoma, the efficacy of different treatments remains unclear. Therefore, this report aimed to contribute clinical insight into diagnosis, surgical and chemotherapeutical management, and outcome of a primary renal hemangiosarcoma in an adult female dog.

Case history: A 10-year-old spayed female Pomeranian dog, weighing about 2.0kg, was referred to the Konkuk University Veterinary Medical Teaching Hospital, Seoul, South Korea, on January 25, 2024, for evaluation of an incidentally detected right renal mass. The dog was asymptomatic, and physical examination was unremarkable.

Clinical examination: Urinalysis revealed values within normal range. Haematological analysis revealed a mildly elevated symmetric dimethylarginine (SDMA) level (16µg/dL; reference range, 0–14µg/dL). Other renal function parameters, including creatinine (1.2mg/dL;

reference, 0.82±0.12mg/dL), blood urea nitrogen (BUN; 12mg/dL; reference, 16.9±2.08mg/dL), phosphorus (2.9mg/dL; reference, 4.39±1.27mg/dL), and calcium (9.2mg/dL; reference, 9.48±0.18mg/dL), were within the normal limits reported in healthy dogs (Kim *et al.*, 2020). Coagulation test showed elevated D-dimer levels (3410ng/dL; ref. 50-250ng/dL).

B-mode, real time ultrasonographic examination of the right kidney revealed a mass compressing the caudal vena cava (CVC), with no evidence of vascular invasion or thrombosis; although severe hydronephrosis and minimal residual renal parenchyma were observed. The mass exhibited poor vascularity and was assumed to represent a hematoma (Fig. 1A). No vascular invasion or thrombosis was observed. Computed tomography (CT) identified a right renal mass measuring 4.4×3.0×3.1cm, consisting of two distinct components: an enhanced portion (102HU) and a non-enhancing portion (20HU), as shown in Fig. 1B.

Pulmonary CT image identified one 5mm nodule and two micronodules, suggestive of metastasis of the tumor to lungs (Fig. 1C). The largest nodule in the accessory lobe showed enhancement (Pre- 27HU, AP 23HU, PP 90HU, DP 3MIN 109HU) similar to those of the renal mass (Pre 47HU, AP 49HU, PP 102HU, DP 3MIN 92HU) reported previously (Tanaka *et al.*, 2019; Mattolini *et al.* 2024). Computed tomographic angiography showed loss of excretory function in the right kidney, while contrast excretion from the left kidney was confirmed. Echocardiography showed no evidence of hemangiosarcoma, but ACVIM (American College of Veterinary Internal Medicine) stage B1 heart disease with chordae tendineae rupture and secondary pulmonary hypertension was diagnosed.

Surgical treatment: The surgical area was prepared using standard aseptic technique. General anaesthesia was induced with propofol (4mg/kg IV) following premedication with butorphanol (0.2mg/kg IV) and midazolam (0.2mg/kg IV), and maintained with isoflurane (2%) in oxygen. Exploratory laparotomy revealed adhesion of the right renal mass to the pancreas, which was separated by electrocautery. The right ureter was ligated using 2-0 absorbable sutures and transected near the urinary bladder, while the renal vessels were ligated and transected using hemoclips and 2-0 absorbable sutures. The hematoma on the caudal aspect of the kidney was severely adherent to the CVC (Fig. 2A). Due to the risk of rupture of haematoma, only limited dissection was performed to

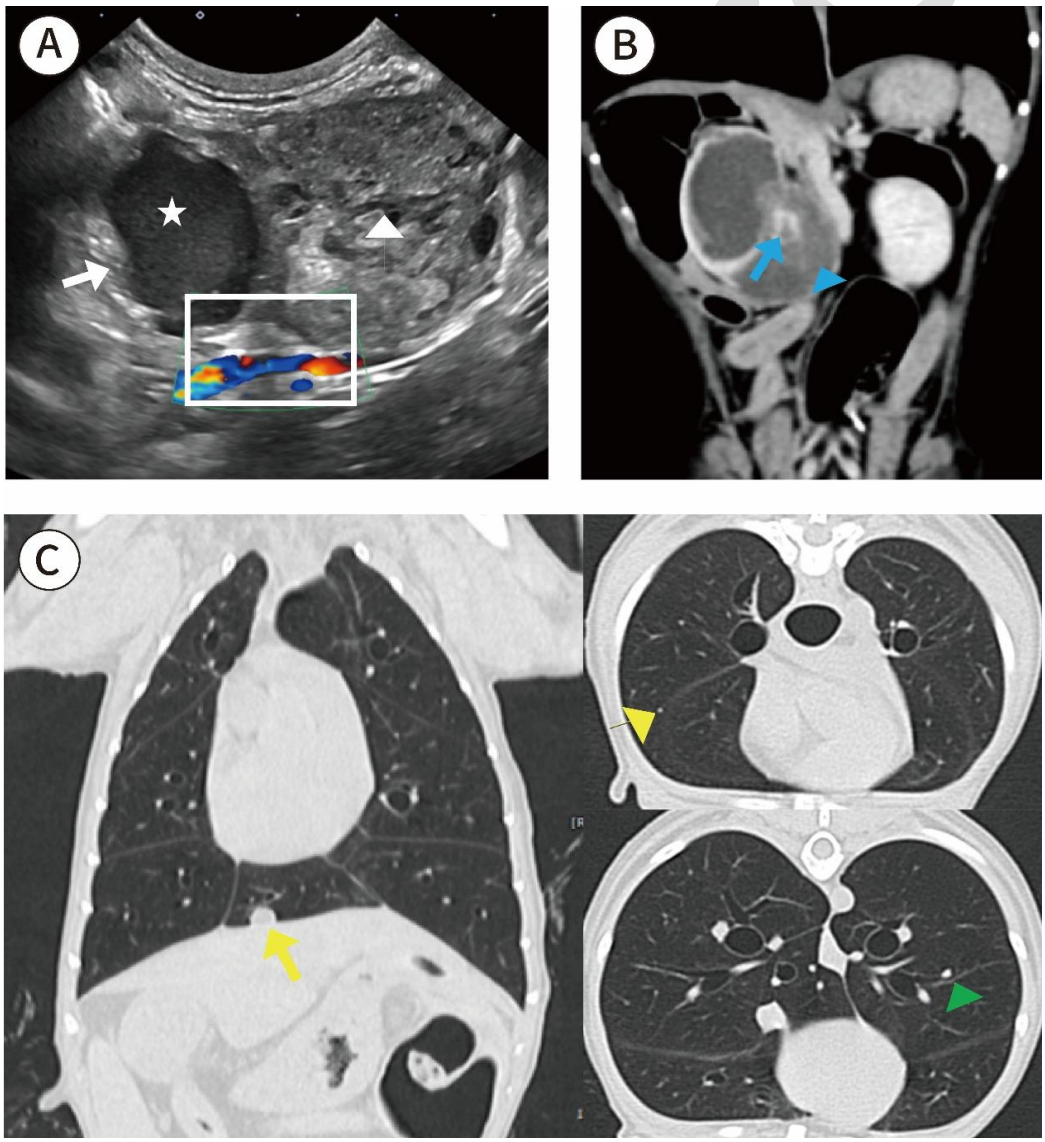

Fig. 1: A). B-mode ultrasonography image showing a right renal mass with heterogeneous parenchymal echogenicity and irregular margins, accompanied by severe hydronephrosis (white star) and minimal residual renal parenchyma (white arrow). The mass exhibits poor vascularity and is presumed to represent a hematoma (white arrowhead). The large mass compresses the caudal vena cava (white rectangle), with no evidence of vascular invasion or thrombosis. B). Computed tomography (CT) image showing a right renal mass composed of two distinct components: an enhancing portion (102 Hounsfield units [HU]; blue arrow) and a non-enhancing portion (20HU; blue arrowhead). C). CT images of the lung showing a 5mm nodule in the accessory lobe (yellow arrow) and micronodules (yellow arrowhead and green arrowhead).

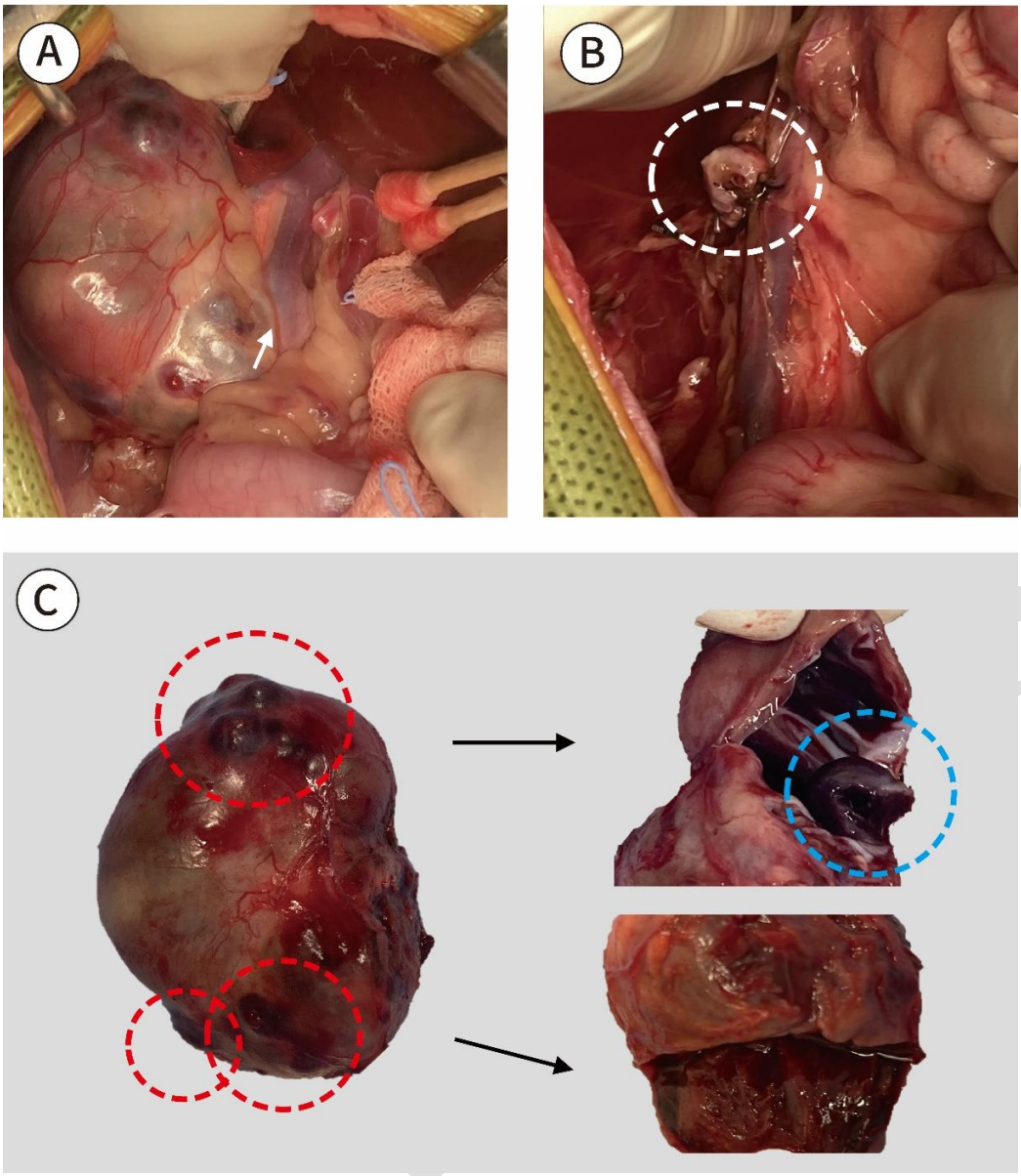

Fig. 2: A). Intraoperative findings showing severe adhesion (white arrow) between the renal mass and the caudal vena cava. B). The mass was removed following ligation, leaving a small stump (dotted white circle). C). Gross appearance of the kidney showing multiple 3-5mm nodules (dotted red circles) scattered throughout the parenchyma. Hydronephrosis with marked loss of renal parenchyma and a large 8mm nodule (dotted blue circle) are observed on the cut section. The suspected hematoma is also visible.

expose its base. The area was packed with laparotomy sponges, the hematoma was ligated close to the CVC using 2-0 absorbable suture material and transected with a scalpel blade, leaving a 5mm stump (Fig. 2B). No bleeding was observed at this site. The abdomen was flushed with warm saline and closed routinely. Postoperatively, the dog received IV amoxicillin/clavulanate (13.75mg/kg, BID), famotidine (1mg/kg, BID) and fentanyl CRI (4µg/kg/hr). Dalteparin (150 units/kg, SC, TID) was administered for 7 days to prevent thromboembolic complications. Pancreatitis was diagnosed on postoperative day 3 and managed with maropitant, fresh frozen plasma transfusions, and fluid therapy. The dog was discharged on postoperative day 7.

Diagnosis: The right kidney and mass were removed via nephrectomy and submitted for histopathological examination. Grossly, 3-5mm nodules scattered throughout the renal parenchyma, as well as a haematoma located on the caudal aspect of the kidney, were seen. Hydronephrosis with marked loss of renal parenchyma and a large 8mm nodule were observed on the cut section (Fig. 2C).

Histopathological examination confirmed the diagnosis of hemangiosarcoma, with spindle to rounded neoplastic cells forming blood filled channels, accompanied by moderate anisocytosis and extensive necrosis (Fig. 3A). Neoplastic cells were infiltrated into the renal parenchyma and extended to the renal surface. Immunohistochemical staining further confirmed the diagnosis due to strong CD31 positivity, supporting the vascular origin of the neoplasm (Fig. 3B). Based on histopathology and immunohistochemistry findings, a final diagnosis of grade III renal hemangiosarcoma (T3N0M1, TNM classification) was made. Chemosensitivity testing revealed sensitivity to vincristine, epirubicin, doxorubicin, and imatinib (Fig. 3C).

Chemotherapeutic treatment: On postoperative day 19, doxorubicin 0.2% (25mg/m^2) was administered in four cycles at three weeks intervals. Pre-medications included maropitant (1.0mg/kg), ondansetron (0.5mg/kg), dexamethasone (0.2mg/kg), and chlorpheniramine (0.2mg/kg). Abdominal ultrasound and thoracic radiographs performed after each cycle showed no evidence of recurrence of the tumor. Pimobendan (0.3mg/kg, BID orally) was given for cardiac support.

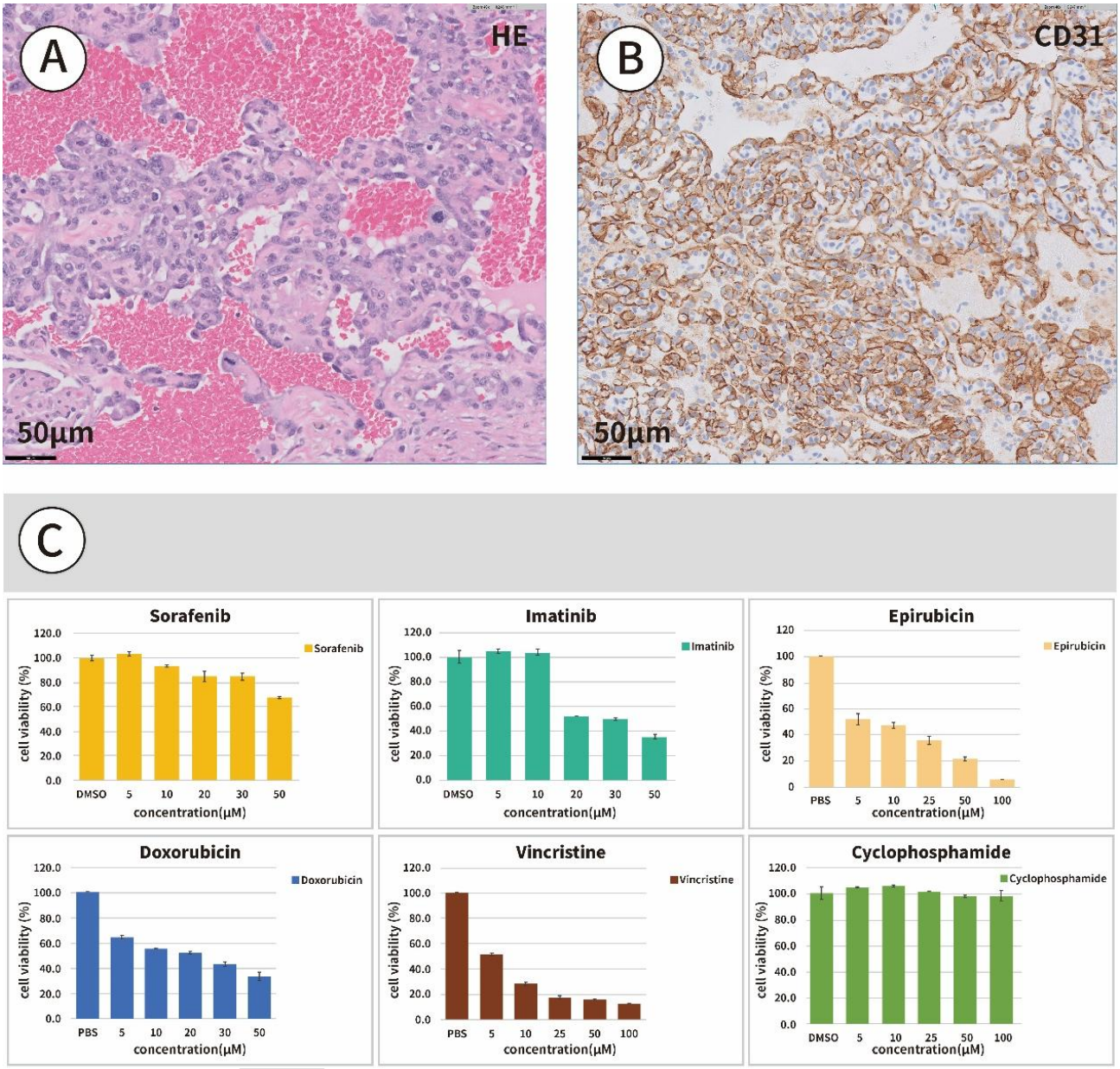

Fig. 3: A). Histopathological examination (H&E staining) confirms the diagnosis of hemangiosarcoma, characterized by marked necrosis, hydronephrosis, corticomedullary tubular loss, and fibrosis. The infiltrative mesenchymal neoplasm is composed of plump spindle to rounded cells arranged in dense clusters and lining blood-filled channels. Neoplastic cells exhibit variably distinct borders, amphophilic to eosinophilic cytoplasm, and oval to elongate nuclei with finely stippled chromatin. Anisocytosis and anisokaryosis are moderate to occasionally marked, with rare binucleation observed. B). Immunohistochemical staining further supports the diagnosis. Neoplastic cells within the renal parenchyma show diffuse, strong membranous immunoreactivity, consistent with an endothelial origin. C). Chemosensitivity testing demonstrates sensitivity to vincristine, epirubicin, doxorubicin, and imatinib in this patient.

After three cycles, doxorubicin-associated cardiotoxicity developed. To mitigate further cardiotoxic effects, dexrazoxane (Cardioxane; 10mg/kg, IV over 10 minutes) was administered before the fourth cycle. Following the fourth administration of doxorubicin, progressive azotemia and syncope occurred, and chemotherapy was discontinued per the owner's request. On day 70 after discontinuation of chemotherapy, the dog was hospitalized for 10 days due to acute kidney injury and pancreatitis. Treatment included IV fluid therapy and transfusion of fresh frozen plasma. The patient also received famotidine (1.0mg/kg, IV, BID) and maropitant (1.0mg/kg, IV, SID) for gastrointestinal support. Renamesin (2 tablets, BID orally), lanthanum carbonate (30mg/kg, BID orally), and sevelamer (30mg/kg, BID orally) were administered to manage hyperphosphatemia. Cardiovascular and respiratory support included pimobendan (0.3mg/kg, BID orally), codeine (1.0mg/kg, BID orally), and theophylline (10mg/kg, BID orally). To address potential infections, the dog was treated with amoxicillin-clavulanate (12.5mg/kg, IV, BID) and metronidazole (15mg/kg, IV, BID).

Following discharge, hospice care was provided at the owner's request. Haematuria was noted during the final days, and the dog passed away 232 days following surgery (255 days after initial diagnosis).

DISCUSSION

Renal masses in dogs are commonly metastatic in nature, whereas primary renal tumors are quite rare.

Among these, renal hemangiosarcoma is exceptionally uncommon (De Nardi *et al.*, 2023; dos Reys *et al.*, 2023). In this case, CT and echocardiography were performed to confirm the primary renal origin of the mass. No other lesions were identified, except for several small pulmonary nodules. Computed tomography revealed subtle pulmonary metastases undetectable on radiographs, providing early evidence suggestive of hemangiosarcoma prior to histopathological confirmation. These findings are characterized by vessel enhancement with non-enhanced areas in post-contrast images and expanded enhancement around the vessels (Tanaka *et al.*, 2019). Immunohistochemistry demonstrated CK negativity and Vimentin positivity, confirming the mesenchymal origin of the mass. Additionally, CD31 positivity, a marker commonly expressed in endothelial cells and vascular-origin tumors, further supported the histopathological diagnosis (Jung *et al.*, 2013).

The renal mass consisted of both hemangiosarcoma and a hematoma, likely resulting from tumor-associated haemorrhage, consistent with the known tendency of hemangiosarcoma to rupture (Kim *et al.*, 2015). Histopathological findings showed that the hematoma was encapsulated within the renal capsule, potentially serving as a physical barrier to prevent peritoneal seeding and haemoabdomen. However, rupture remains a possibility in cases of severe or persistent bleeding, highlighting the importance of timely surgical intervention.

Surgery revealed strong adhesion of the mass to the CVC, and complete resection would have required venectomy. However, the owner did not agree for a more aggressive surgical approach. Given this risk and the presence of metastasis, a ligation technique was selected to achieve maximal resection while minimizing surgical risk. The mass was successfully removed without haemorrhage. While complete tumor removal could not be confirmed, the remaining tissue appeared to consist primarily of hematoma and renal capsule.

The patient showed hypercoagulability (D-dimer 3410ng/dL). Hemangiosarcoma is known to induce heterogeneous changes in endothelial cells and express procoagulant tissue factor, increasing risk of disseminated intravascular coagulation and thromboembolism (Witter *et al.*, 2017). Although no thrombi were indentified on imaging, prolonged compression of the CVC may have impaired blood flow. As a preventive measure, dalteparin, a low-molecular-weight heparin, was administered during hospitalization to manage the risk of venous thromboembolism. By postoperative day 6, D-dimer levels were decreased to 261ng/dL.

Although information on chemotherapy for renal hemangiosarcoma is limited, common chemotherapy options for hemangiosarcoma include doxorubicin monotherapy, combination protocols with cyclophosphamide and vincristine, or carboplatin-based treatments (Finotello *et al.*, 2017; Faulhaber *et al.*, 2021). Doxorubicin was selected for this dog based on the chemosensitivity test results and its proven efficacy (Locke and Baber, 2006; De Nardi *et al.*, 2023). During the 5-month monitoring period after surgery, no progression of pulmonary metastases or spread to other abdominal organs was observed. However, haematuria in the final days suggested metastasis to the contralateral kidney.

The patient survived for 255 days from initial diagnosis and 232 days postoperatively, which exceeds the median survival times reported for hemangiosarcoma originating in the heart (42–175 days; Weisse *et al.*, 2005), spleen (48–86 days; Wendelburg *et al.*, 2015), and retroperitoneal space (129.5–241.5 days; Ichimata *et al.*, 2023). Compared with other two cases with a similar diagnosis of grade III renal hemangiosarcoma, staged as T3N0M1, treated with surgery and chemotherapy and showed survival times of 154 and 160 days, respectively; Locke and Baber, 2006; Itoh *et al.*, 2015), this case demonstrated longer survival time.

Conclusions: This clinical report describes a case of renal hemangiosarcoma associated with hydronephrosis and a large hematoma, highlighting the importance of prompt surgical resection to prevent rupture. Despite the presence of tumor adhesion and metastasis, the patient achieved prolonged survival with the aid of anticoagulant and chemotherapeutic treatment. This case adds valuable clinical insight to the limited literature on primary renal hemangiosarcoma and suggests the potential for long-term survival through a multimodal therapeutic approach.

Authors contribution: All authors made the diagnosis and had direct patient contact. HY Yoon and YW Jung carried out the diagnosis and performed the surgery. JE Hyun and EH Lee administered chemotherapy. YW Jung interpreted the data and wrote the manuscript. EH Lee contributed to the manuscript by writing about chemotherapy. JE Hyun revised the manuscript. HY Yoon supervised and reviewed the final version.

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