Ectopic thyroid carcinoma infiltrating the right atrium of the heart in a dog

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Abstract — A 12-year-old intact female shih tzu dog was diagnosed with an ectopic thyroid carcinoma infiltrating the right atrium of the heart. Echocardiography and computed tomography were helpful in diagnosis; a definitive diagnosis was made based on postmortem histopathology and immunohistochemistry. The patient lived 428 days beyond diagnosis with only medical management.

Résumé — Carcinome thyroïdien ectopique infiltrant l’oreillette droite du cœur chez un chien. Une chienne Shih Tzu intacte âgée de 12 ans a été diagnostiquée avec un carcinome thyroïdien ectopique infiltrant l’oreillette droite du cœur. Une échocardiographie et une tomodensitométrie ont été utiles pour le diagnostic; un diagnostic définitif a été posé en se fondant sur l’histopathologie et l’immunohistochimie postmortem. La patiente a vécu 428 jours après le diagnostic avec seulement une gestion médicale.


Primary heart tumors are infrequent in all species (1,2). In dogs, hemangiosarcoma is the most common primary cardiac tumor, and it usually involves the right atrium (2–4). Other tumors, such as aortic body tumors, arise more frequently at the base of the heart (5–7). Most cardiac tumors occur in dogs over 7 y old and cause clinical signs such as coughing, dyspnea, pericardial effusion, and ascites that are related to their anatomic location (2,7,8). Two-dimensional echocardiography is a helpful method for diagnosis of heart tumors; however, for definitive diagnosis, postmortem histopathology and immunohistochemistry are needed (1,2).

This report describes echocardiographic, computed tomography (CT), clinicopathologic, and immunohistochemical findings of an ectopic thyroid carcinoma infiltrating the right atrium of the heart in a dog.

A 12-year-old intact female shih tzu dog was referred to the Veterinary Medical Teaching Hospital of Konkuk University due to coughing, exercise intolerance, and abdominal distention. On admission, the dog was quiet, had pale mucous membranes and delayed capillary refill time (> 1.5 s). Physical examination revealed tachycardia (180 beats per min), a grade III/VI left systolic heart murmur, and right side muffled heart sounds. Systolic blood pressure was normal (133 mmHg, Cardell Model 9401; Sharn Veterinary, Tampa, Florida, USA). A hemogram revealed mild non-regenerative, normocytic-normochromic anemia [hematocrit (Hct) 31%; reference range (RR): 37% to 55%], and mild thrombocytosis (603 \times 10^9 cells/L; RR: 150 to 500 \times 10^9 cells/L). Serum chemistry profiles showed elevated blood urea nitrogen (BUN) concentration (16 mmol/L; RR: 2.8 to 9.3 mmol/L), and alanine transaminase (ALT) activity (77 U/L; RR: 19 to 70 U/L). Hypoproteinemia [total protein (TP), 44 g/L; RR: 54 to 74 g/L] and hypoalbuminemia (albumin, 26 g/L; RR: 29 to 42 g/L) were detected.

Thoracic radiographs showed dorsal tracheal displacement, generalized cardiomegaly, and pleural effusion. Abdominal radiographs showed decreased serosal margin detail. On electrocardiography, sinus tachycardia and low QRS voltage were identified. An electrocardiogram revealed the presence of pericardial effusion, a thickened anterior mitral valve with regurgitation, and a cardiac mass located between the aorta and pulmonary artery and protruding into the right atrium (Figure 1). Pericardiocentesis was performed and 60 mL of serosanguineous fluid were removed. The fluid had a low cell count (550 cells/μL), with a Hct of 3%, a specific gravity of 1.018, and a protein concentration of 21 g/L. Red blood cells and a few reactive mesothelial cells were observed on cytology. The specific gravity was higher than that of a pure transudate but, cellularity and protein concentration were low, thus the pericardial fluid was characterized as a transudate. Abdominocentesis yielded 600 mL of pink-tinged clear fluid, which was a transudate (cell count: 380 cells/μL; specific gravity: 1.022; protein: 16 g/L). An electrocardiogram conducted post-pericardiocentesis showed normal QRS amplitude. Clinical signs improved after removal of the fluid. Computed tomography with a non-ECG-gated 4-slice CT scanner (Asteion 4; Toshiba, Japan), 0.75-second rotation time,
2.0 mm slice thickness, 150 kVp, and 120 mAs was performed to evaluate the anatomic location, the extension of the mass, and invasion of adjacent organs. An oval mass, within the right cardiac chamber was apparent on the post-contrast image. Dorsal reconstructed CT [post-contrast, with non-ionic contrast medium (Omnipaque; GE Healthcare, Milwaukee, Wisconsin, USA)], 850 mg/kg body weight (BW) was used to define the margins of the mass. A heterogeneously enhanced mass in the right atrium was detected without metastasis to the other organs including the lung.

Given the poor prognosis for long-term survival, the owner refused further treatment, such as surgical resection, or chemotherapy. The dog was initially treated with oxygen supplementation, furosemide (Handok, Seoul, Korea), 1 mg/kg BW, PO, q12h, and angiotensin converting enzyme inhibitor, ramipril (Sandoz Korea, Seoul, Korea), 0.125 mg/kg BW, PO, q24h. There was marked improvement in activity and appetite after the treatment. The extension of the cardiac mass was re-evaluated using thoracic radiographs (Figure 2) and CT scan 14 mo after the first presentation. A collapsed left cranial lung lobe, calcified intra-cardiac mass, and extension of the mass to the caudal part of the heart were observed (Figure 3). Intermittent cough recurred and the dog died 428 d after initial presentation. A necropsy was performed.

On gross examination, a firm, multilobulated, irregular mass (8 × 2.5 × 0.5 cm) was observed at the base of the heart (Figure 4A). One small mass (1.5 × 1 cm) around the aorta and 2 circular protruding masses (3 × 4 cm and 2 × 3 cm) inside the right atrium were also observed (Figures 4B and 4C). The mitral valve was thickened with several nodules along the free

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**Figure 1.** Echocardiography showed a protruding mass inside the right atrium. (A) Pericardial effusion was observed and a protruding oval mass inside the right atrium was apparent. (B) 14 months later, a mass was also detected on the left side. LA – Left atrium, LV – Left ventricle, RV – Right ventricle, M – mass, PCE – pericardial effusion.

**Figure 2.** Thoracic radiographs of a dog with ectopic thyroid carcinoma. (A) 14 months after the first presentation, enlarged cardiac size with apparent calcified intra-cardiac mass was observed. (B) The cardiac axis was deviated to the left side.
There were no distant metastases or abnormalities in the visceral organs. Impression smears for cytological analysis were taken from the masses. Round naked nuclei or free nuclei within a background of lightly basophilic cytoplasm without distinct cell borders were consistent with features of neuroendocrine tumors (Figure 5A). Nucleoli and anisokaryosis were also prominent. On histopathologic examination, the mass had cuboidal to polygonal cells with round nuclei, granular cytoplasm, and indistinct cell outline. A poorly demarcated, infiltrative, multilobulated tumor composed of cuboidal to polygonal cells in solid cellular sheets was detected. The lobules were subdivided by multiple small packets, each surrounded by a fine fibrous stroma and capillaries. The mass had infiltrated to the endocardium (Figures 5B and 5C). Mitotic figures were rarely seen. Immunohistochemistry using polyclonal rabbit anti-human thyroglobulin antibody (Dako, Carpinteria, California, USA) showed strong cytoplasmic immunoreactivity in most neoplastic cells (Figure 5D). The thyroid gland was normal in its gross appearance and by histopathology. Based on histopathology and immunohistochemistry, this case was diagnosed as an ectopic thyroid carcinoma.

In humans, ectopic thyroid tissue is rare and in 90% of cases it is found in the base of the tongue (9,10). However, in dogs, it is detected in the thorax in 23% to 80% of cases (2,11). Ectopic...
thyroid carcinoma represents 1% of all cardiac tumors (5), and various nonspecific clinical signs may occur depending on the anatomic site (5,11–13).

On presentation, the dog showed coughing, exercise intolerance, and abdominal distention; laboratory examination revealed non-regenerative anemia with hypoproteinemia. Diagnostic testing revealed mitral valve insufficiency and a tumor in the right atrium with pericardial effusion and ascites. Fluid from the pericardium and abdomen was a transudate due to right-sided heart failure. The non-regenerative anemia could be anemia of inflammatory disease. Radiography showed enlargement of the cardiac silhouette and ECG findings included sinus tachycardia.

Figure 4. Postmortem appearance of the heart. (A) Multilobulated, irregular mass (8 × 2.5 × 0.5 cm) from the right atrium and right auricle, which surrounded the heart to the left ventricle. There was no invasion into the left side of the heart (B & C). Two circular protruding masses (3 × 4 cm and 2 × 3 cm) inside the right atrium were also observed. Inset: cut surface of the protruding mass.

Figure 5. Impression cytology and histopathological appearance of the cardiac mass. (A) A mass located inside the right atrium was sampled. Moderate anisokaryosis with prominent nucleoli was observed (Diff-Quik stain; ×125). (B) A poorly-demarcated, infiltrative, multilobulated tumor composed of cuboidal to polygonal cells was detected (H & E; ×50). (C) The lobules were subdivided by multiple small packets which were surrounded by a fine fibrous stroma and capillaries. Round nuclei, granular cytoplasm, and indistinct cell outline were prominent features (H & E; ×400). (D) The immunohistochemistry results obtained using anti-thyroglobulin antibody showed strong cytoplasmic immunoreactivity.
and low QRS amplitude. There was no electrical alternans or ST segment elevation. Echocardiography shows that there is pericardial effusion with tumors in the right atrium. Almost all cardiac tumors involve the right side of the heart, and hemangiosarcoma is particularly common in the right atrium (2–4).

Previous reports described ectopic thyroid carcinoma at the heart base and right ventricle, which usually obstructs the right ventricular outflow tract due to its anatomic location (2,3,5,11,12–14). The ventricular outflow tracts arise from the bulbus cordis and it has been suggested that migration of thyroid tissue to this site may be due to abnormal persistence of contact between the thyroid primordium and bulbus cordis of the heart during embryologic development (1,12,15).

In this case, we used CT concurrent with 2-D echocardiography to evaluate the cardiac mass. In humans, CT has certain advantages over magnetic resonance (MR) imaging for angiographic evaluation of the cardiovascular system (16,17). Magnetic resonance imaging requires longer scanning time and a slower heart rate and therefore has limited application in pediatric patients. Computed tomography provides improvements in scanning speed and coverage area which have led to expanded applications in pediatric patients (17) and may provide similar benefits to companion animals. Computed tomography is useful for identification of the anatomic location of the tumors, the extension of the mass and adjacent organ invasion (7,18); it provided the exact anatomic location of the intra- and extracardiac mass and detailed images of pulmonary parenchyma and blood vessels.

This report describes an ectopic thyroid carcinoma detected in the right atrium and heart base. Cardiac diagnostic examination and CT scan initially revealed a cardiac tumor at the right atrium and later, the tumor around the heart base became larger. The interventricular septum, right ventricle, and right ventricular outflow tract were normal on postmortem examination, and definitive diagnosis was made based on postmortem histopathology and immunohistochemistry results.

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References