

## RENAL CYST IN DOGS – AN IMAGING APPROACH

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**Abstract.** The aim of this paper is to provide a comprehensive imaging-based approach to the diagnosis and evaluation of renal cysts. The study focuses on the case of a Yorkshire Terrier dog, which underwent a detailed imaging examination, including ultrasonography, radiographs and computed tomography (CT) scanning, to assess the renal condition. A comprehensive abdominal ultrasound was done, which revealed significant anechoic fluid-filled distension at the level of the right kidney. Radiographs demonstrated soft tissue opacity in the mid-abdominal region, and computed tomography (CT) imaging confirmed a distension of the right renal pelvis with clear demarcation from renal parenchyma. Differential diagnoses such as hydronephrosis and renal neoplasms were considered; however, renal cysts should also be prioritized when ultrasonography features reveal a round structure with hyperechoic wall, anechoic content and well demarcation from renal pelvis.

**Keywords:** renal cyst, us, x-ray, ct

### Abbreviations

CT – computed tomography

HU – Hounsfield units

KG - kilogram

HU - miligrame

WL – window level

WW – window width

## INTRODUCTION

Renal cysts are spherical fluid-filled structures of varying sizes having a thin wall that can arise from renal tubules and less commonly from collecting ducts. The pathogenesis of primary renal cysts is not fully understood, and genetic mechanisms can be involved, but is not a requirement. Congenital renal cysts can occur as a primary condition or secondary to tubular obstruction in dysplastic kidneys, while acquired renal cysts typically develop secondary to tubular obstruction, leading to increased tubular pressure (Zachary, 2022).

Morphologically, renal cysts are typically oval to round, and they can appear either as single or multiple cysts. Although solitary renal cysts are generally benign, asymptomatic, and do not require treatment in most of the cases, intervention may be necessary if complications such as abdominal pain, discomfort, hypertension, infection, or obstruction of renal outflow arise. The relationship between renal cysts and hypertension remains unclear, it is hypothesized that cyst expansion is leading to renal ischemia and increased renin release may cause early hypertension (Agut et. al, 2008; Chang et. al, 2007).

The diagnosis of a renal cyst can be achieved through ultrasound, a non-invasive imaging technique that is more cost-effective compared to computed tomography (CT)

or X-ray imaging. On ultrasound imaging, renal cysts are characterized by anechoic fluid-filled structures with well-defined, smooth borders and enhanced posterior acoustic transmission. In contrast, computed tomography (CT), which is considered the gold standard for diagnosing renal cysts, reveals these cysts as having clearly delineated, sharp, and smooth outlines with homogenous water attenuation (Timev et. al, 2009).

## MATERIALS AND METHODS

A 13-year-old female Yorkshire Terrier was referred to our service with a history of apathy, vomiting, and inappetence. Following the completion of blood tests, the patient was referred to the radiology department for a detailed imaging approach.

An abdominal ultrasound examination to assess the underlying causes of the clinical signs, including potential abnormalities in the gastrointestinal tract, liver, spleen, kidneys, and other abdominal organs was performed. The ultrasound was performed with a Siemens Acuson Juniper system using a curved transducer (1.4-5.0 MHz bandwidth).

Patient was placed in dorsal recumbency in a special support. Following the completion of the ultrasound examination, a series of two abdominal radiographs were obtained with the patient positioned in both right and left lateral recumbency. The radiological was done to further evaluate any underlying structural abnormalities not visible on ultrasound, providing additional diagnostic insight into the patient's condition. A Synthesis Opera G800 DR x-ray system was used.

Helical CT scanning of the head and spine were obtained using a Siemens CT Somatom Scope machine with 16 channels. The scan was made with patient in dorsal recumbency. In order to perform the CT scan the patient was fully sedated to ensure optimal imaging acquirement and minimize movement. Premedication was administered using butorphanol at a dosage of 0.2 mg/kg intravenously, followed by induction with midazolam at a dosage of 0.25 mg/kg. After achieving adequate sedation, endotracheal intubation was performed using a 5 mm diameter endotracheal tube to secure the airway and facilitate proper ventilation throughout the procedure. Abdominal images were obtained in axial plane using a 512x512 matrix, narrow windows (WW: 120, WL: 40), 3mm slice thickness, pitch of 1.5. Multiplanar image reconstruction of the abdomen were obtained using soft tissue and bone window algorithm at a slice thickness of 0.75 mm.

## RESULTS AND DISCUSSIONS

On the ultrasound examination the left kidney (Fig. 1 B) was visualized and found to be without remarkable changes. The renal cortex appeared hypoechoic relative to the liver and spleen, with a distinct hypoechoic medulla, creating a well-defined corticomedullary junction. No significant abnormalities were noted in the left kidney. In contrast, the right kidney demonstrated a marked anechoic fluid-filled distension (Fig. 1 A), measuring approximately 4.98 cm by 3.71 cm. This distension was accompanied by a thin rim of residual cortical tissue, suggesting significant compression of the renal parenchyma. Despite this, the surrounding renal architecture of the right kidney was preserved. Slightly enlargement of the liver lobes was also seen.

The remainder of the abdominal ultrasound examination, including spleen, gastrointestinal tract, and bladder, did not reveal any remarkable abnormalities.

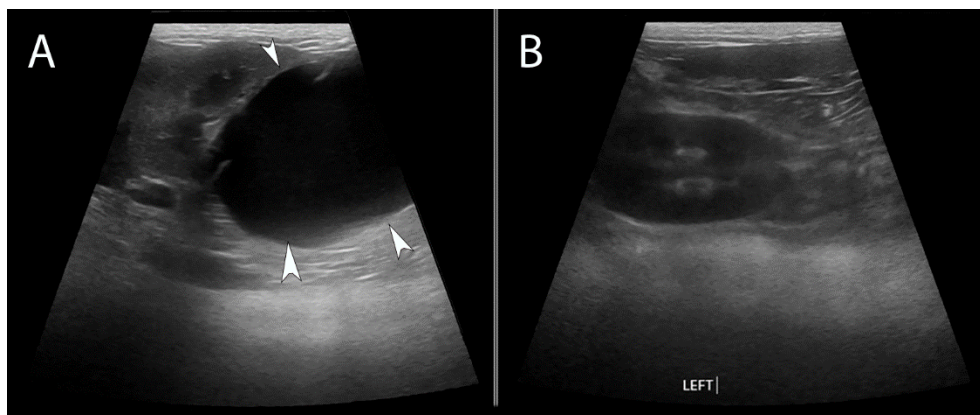


Fig. 1. Ultrasound examination of the kidneys. A - Significant anechoic fluid-filled distension of the renal pelvis and compression of the renal parenchyma (white arrowheads) B – Left kidney with no remarkable changes

Radiographs revealed that serosal detail of the abdomen was within normal limits. Ventral to the first lumbar vertebrae and caudal to the stomach, an oval soft tissue opacity structure was seen (Fig. 2), with regular margins causing ventral displacement of the adjacent organs. Stomach was mildly distended with mixt opacity, most likely ingesta, small bowel was predominantly fluid distended, and the colon contained feces, normal distension. The liver lobes were rounded and beyond the costal arch. Musculoskeletal system was without remarkable changes.

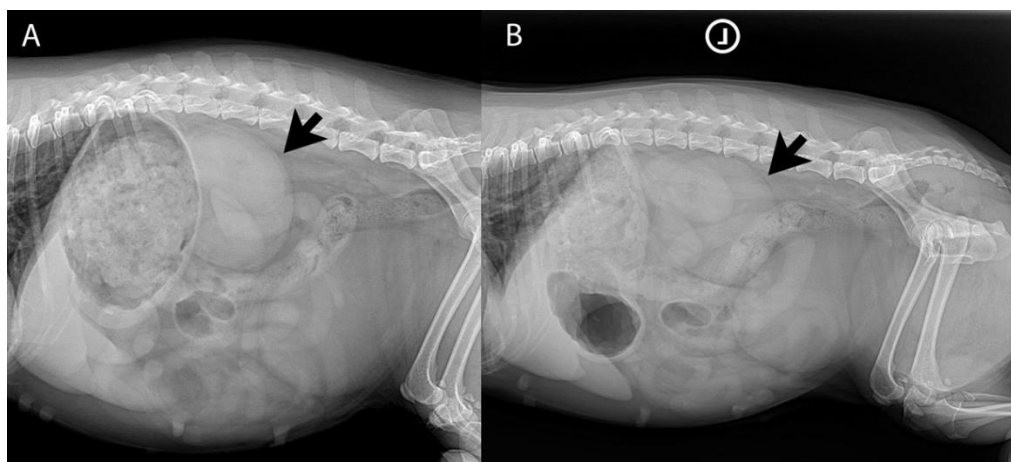


Fig. 2. Lateral radiographs of the abdomen A – B Right and left lateral of the abdomen showing a soft tissue opacity structure (black arrows) beyond the stomach and causing displacement of the small bowels and descending colon.

On the CT images a well-defined intrarenal spherical mass (Fig. 3) was seen within the caudal pole of the right kidney, clearly demarcated from the surrounding renal parenchyma. The lesion exhibits a uniform attenuation value of approximately

12 Hounsfield units (HU) on both pre-contrast and post-contrast imaging, with a measured diameter of around 5 centimeters.



Fig. 3. Transverse and coronal postcontrast CT images with soft-tissue algorithm of the abdomen. A – Significant round structure with fluid attenuation and without contrast enhancement occupying the right retroperitoneal space (white arrows) B – Round structure with fluid attenuation compressing over the right renal parenchyma (white arrowheads)

Renal cysts have a prevalence of 5% from human population with no significant correlation to sex or age and are typically diagnosed incidentally during imaging studies performed for unrelated reasons. In contrast, the occurrence of renal cysts in dogs is considered exceedingly rare, with only a few documented cases, making their detection in veterinary practice an incidental finding (Dekerle et. al, 2022; Agarwal and Hemal, 2011). The term "renal cyst" is broad and non-specific applied to describe any primarily cystic lesion occurring within the renal parenchyma. Most of these cystic lesions are benign, with the most common type being simple epithelial cysts (radiopaedia.org).

The ultrasound characteristics of a simple renal cyst are highly distinctive, typically presenting as an oval or round structure. These cysts exhibit a sharply defined margin, with an anechoic content and a thin, hyperechoic wall. In our case, these classic sonographic features were clearly observed, further supporting the diagnosis of a simple renal cyst (Van Dyck et. al, 2018).

This case represents only the second documented occurrence of a renal cyst in a Yorkshire Terrier. While the previously reported case involved a patient that had been cytologically diagnosed with mammary adenocarcinomas, our patient presented without any known tumoral pathologies (Park et. al, 2019). Renal cysts, though uncommon, have been identified in other breeds according to existing literature, most notably in Shih Tzu, Cocker Spaniel, German Shepherd, Miniature Pinscher and crossbred dogs (Otero Balda et. al, 2022; Dekerle et. al, 2022; Park et. al, 2019; Agut et. al, 2008; Paskalev et. al, 2012).

In the differential diagnosis for renal cyst, it is important to consider both malignant neoplasms and hydronephrosis. Among the primary renal neoplasms in dogs, renal carcinoma, renal sarcoma, and nephroblastoma should be considered. While these conditions are less common, involving 0,6 to 1,7% from all reported neoplasm, their potential presence must be evaluated due to their aggressive nature and

the significant implications for the patient's prognosis (Bryan et. al, 2006; Tanaka et. al, 2019). Renal cell carcinoma has a slightly different ultrasound appearance compared to renal cysts, revealing the same large oval-shaped mass at the level of the renal architecture but with cavitated content, while on CT it shows heterogenous contrast enhancement and most likely unilateral involvement (Bennett, 2004; Tanaka et. al, 2019).

Hydronephrosis is characterized by the pathological dilation of the renal urinary collecting system, typically resulting from an obstruction or impaired drainage of urine. This condition can affect one or both kidneys and may lead to significant renal impairment if left untreated (radiopaedia.org). In severe cases, the renal parenchyma can become completely obliterated, leading to significant loss of kidney function. The primary concern in such situations often centers on ureteral obstruction, which can further complicate the outcome. Renal pelvis will present an anechoic fluid distension on ultrasound, a soft tissue opacity on the mid abdomen on radiographs and a distended pelvis with loss of the renal architecture and peripheral contrast enhancement on CT (Thrall, 2018).

Like findings from human medicine, there is no definitive evidence suggesting a sex predisposition to the development of renal cysts, although a slightly higher incidence of cases in males were seen that can be attributed to genetic, hormonal, environmental factors or to the low number of patients (Vagias et. al, 2022).

Similar to the other cases described, our patient also presented with abdominal discomfort accompanied by clinical symptoms such as vomiting, loss of appetite, and apathy. A detailed internal medicine evaluation revealed the presence of pulmonary hypertension of unknown etiology. According to data from human medicine, patients with renal cysts have an increased likelihood of being hypertensive (Vagias et. al, 2022).

In human medicine, the evaluation and classification of renal cysts are conducted using a well-established system known as the Bosniak classification, which includes five distinct categories. These categories are designed to correlate the imaging appearance of the cysts with histopathological findings, to perform the most appropriate and individualized treatment strategy. In contrast, veterinary medicine lacks a similarly standardized classification system for renal cysts, and the optimal surgical approach is generally determined by the experience of the surgeon and their preferred method of choice (Vagias et. al, 2022).

Treatment for a simple renal cyst is generally recommended only when clinical symptoms occur, which is infrequently. In such cases, minimally invasive surgical techniques, such as laparoscopic deroofing combined with omentization, offer an effective therapeutic approach. This method minimizes patient recovery time and surgical complications, making it a preferred option for managing symptomatic renal cysts (Patel et. al, 2020).

## CONCLUSIONS

In conclusion, although renal cysts are often asymptomatic and may remain clinically silent for long periods, it is important to establish an accurate diagnosis to prevent potential complications that may arise unexpectedly. The first step in the diagnostic approach for simple renal cysts should begin with ultrasonography, a non-

invasive and widely accessible imaging technique. During the ultrasound examination, a well-defined, round to oval-shaped lesion is typically observed, characterized by a thin, hyperechoic wall surrounding a fluid-filled, anechoic content from varying sizes (Zatelli et. al, 2005). The gold standard method for the diagnosis of such lesions is computed tomography (CT) examination, where these lesions typically appear as well-circumscribed, round structures that exhibit fluid attenuation, generally within the range of 0 to 20 Hounsfield units. This indicates the presence of simple fluid within the cyst, differentiating it from more complex masses. The cyst wall is smooth, thin, and often barely perceptible on imaging, with no signs of irregularity or thickening. Additionally, there is an absence of contrast enhancement, a key feature that further distinguishes simple cysts from more concerning pathologies, such as malignant or complex cystic lesions (Agochukwu et. al, 2017).

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