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Use of intraoperative impression smear cytology to guide successful treatment of a large renal cyst in a dog: a case report

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ABSTRACT

A 13-yr-old Shih tzu was referred for surgical management of right-sided cranial abdominal mass, which corresponded to large, cavitated renal mass on ultrasonography, and was suspected to represent neoplasia. Intraoperative impression smear cytology (ISC) of the renal mass wall was consistent with benign renal cyst (RC), without evidence of neoplasia or infection. Deroofing and omentalisation were performed and histopathology was consistent with benign RC. Chronic kidney disease was diagnosed 4 mon postoperatively, however, the dog was asymptomatic, without cyst reoccurrence. Intraoperative ISC is an expedient and inexpensive diagnostic technique that can guide most appropriate treatment in dogs with large RCs.

Keywords: Renal cyst; renal cystic lesion; dog; partial nephrectomy; impression smear cytology

INTRODUCTION

Canine renal cysts (RCs) are benign, fluid-filled, epithelial-lined structures within the renal cortex or medulla and can achieve a very large size. RCs are rarely reported in veterinary literature [1-6]. Clinical signs associated with canine RCs are nonspecific [2-7], and oftentimes, they can be an incidental finding [1,2]. They are most commonly reported in middle-aged to older dogs [1-5], affecting both male [1,2,4,7] and female [2,3,5,8] dogs, as well as a variety of breeds [1-5,7,8]. Common examination findings in dogs with RCs include pyrexia, abdominal distension and pain, and systemic hypertension [5,6]. Abdominal radiographic findings include a mass effect in the mid abdomen in the region of the kidney [5,7]. Ultrasonographic findings include a well-delineated, round to ovoid, anechoic to hypoechoic structure within the cortex or medulla creating acoustic enhancement, with smooth borders, a hyperechoic and thin wall, and disruption of normal renal parenchyma [1-5,7,8].

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Conflict of Interest

The authors declare no conflicts of interest.

Principal treatment options for RCs in dogs include percutaneous drainage [3,7], sclerotherapy [1,3,4,6,7], partial nephrectomy (deroofing/fenestration) combined with omentalisation [2,7], and ureteronephrectomy [5,8]. In cases with RCs in the contralateral kidney or chronic kidney disease, performing ureteronephrectomy could be associated with morbidity if such RCs were to increase in size and cause progressive renal insufficiency. In such cases, performing renal-sparing techniques such as sclerotherapy and partial nephrectomy may be more appropriate. However, a concern with performing such renal-sparing techniques is potential for diagnosis of neoplasia on definitive histopathology [7]. While ureteronephrectomy would be more suitable for malignant renal cystic lesions (RCLs), obtaining a preoperative diagnosis of neoplasia can be challenging [7].

The purpose of this report is to describe the use of intraoperative impression smear cytology (ISC) as a method of differentiating benign and malignant RCLs, informing prognosis and guiding the most appropriate treatment.

CASE PRESENTATION

A 13-yr-old, 5.6 kg, spayed female Shih tzu was referred for further investigation of a right-sided cranial abdominal mass. Clinical signs included weight loss and abdominal distension of several months' duration. A right cranial abdominal mass was palpated by the primary veterinarian. Abdominal radiographs identified a large well-defined soft tissue mass in the right cranial abdomen (**Fig. 1**). Abdominal ultrasound identified a 7×7 cm mass, with a cavitated centre, arising from the right kidney. The dog was subsequently referred.

On examination at our institution, the dog was bright and alert. Abdominal palpation identified a palpable large right cranial abdominal mass. Biochemistry identified mildly increased alkaline phosphatase (106 U/L; reference intervals [RI], 0–82), total protein (74.4 g/L; RI, 54–71), and urea (12.8 mmol/L; RI, 3.6–8.6). Urinalysis (free catch) identified specific gravity of 1.026, pH 6.0, 1+ leucocytes and epithelial cells, occasional erythrocytes, 2+ protein, and hyaline casts. Systolic blood pressure was mildly increased (175 mmHg; RI, 110–160). Informed owner consent was obtained prior to any intervention being performed.

Contrast computed tomography (CT) of the abdomen and thorax identified a large, soft tissue/fluid-attenuating, poorly contrast enhancing, cystic mass arising from the caudal

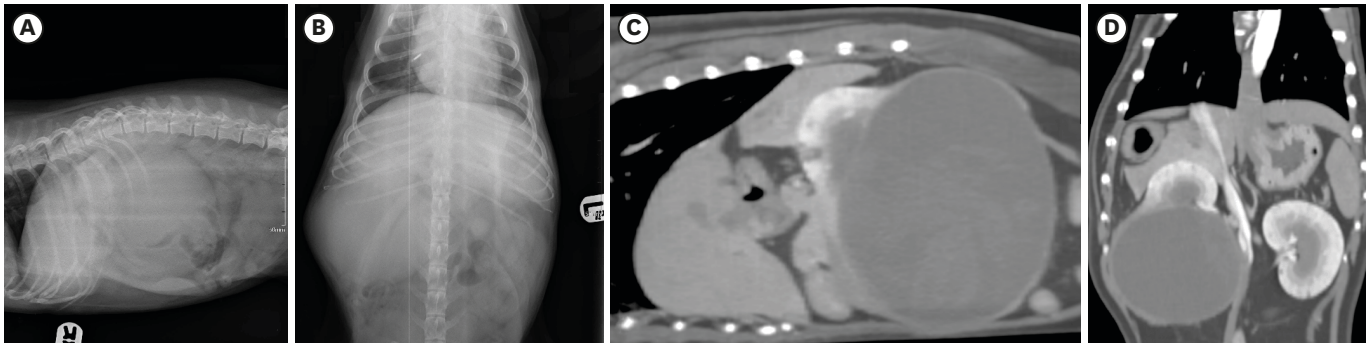

Fig. 1. Lateral (A) and ventrodorsal (B) radiographs and dorsal (C) and sagittal plane (D) multiplanar reconstruction contrast computed tomographic images of a 13-yr-old, 5.6 kg (12.3-lb), spayed female Shih tzu that was referred for further investigation and treatment of a right-sided cranial abdominal mass demonstrating a large soft tissue/fluid attenuating poorly contrast enhancing, cystic mass arising from the caudal aspect of the right kidney.

right kidney, invading renal parenchyma and distorting normal architecture, with peripheral contrast enhancement (**Fig. 1**). The mass caused significant mass effect, without evidence of caval invasion. Multiple variably sized (largest 4.4 mm), round, soft tissue/fluid-attenuating, cystic lesions were present in the cranial cortex of the right kidney, with preservation of normal architecture. There were multiple, round-to-ovoid, soft tissue/fluid-attenuating, cystic lesions throughout the left renal cortex, the largest 9.2 mm and extending to the medulla. CT of the thorax was unremarkable. Differential diagnoses considered for the right renal mass included renal carcinoma, sarcoma, or lymphoma. Given its cystic appearance, other possible differentials included intraparenchymal RC, adenoma and cystoadenocarcinoma.

The dog was premedicated with acepromazine (ACP injection 2 mg/mL; Elanco UK AH Ltd., USA) and pethidine hydrochloride (Pethidine; B. Braun Melsungen AG, Germany) and anaesthesia was induced with propofol (Propofol-Lipuro, B. Braun Melsungen AG) and maintained after endotracheal intubation with isoflurane (Isothesia; Henry Schein Animal Health, Ireland) in oxygen. Midline celiotomy identified a large, firm, pale pink mass, with areas of purple discoloration in the region of the right kidney (**Fig. 2**). More normal renal parenchyma was identified cranially, contiguous with the mass. Multiple, small (3–4 mm), round, black-purple and slightly raised lesions were present subcapsularly in the cranial pole of the right kidney. Similar lesions were identified subcapsularly throughout the left kidney (**Fig. 2**). The mass was aspirated and yielded dark brown non-viscous fluid, which was submitted intraoperatively for cytology, culture, and measurement of fluid creatinine and potassium concentrations. Comparison of fluid and peripheral blood creatinine and potassium concentrations excluded presence of urine. Cytology of fluid identified low cellularity in a densely eosinophilic proteinaceous background, numerous protein crescents and small numbers of erythrocytes. There were 5–10 nucleated cells per 40×-objective field of view, with 75% of nucleated cells neutrophils, typically degenerate, karyorrhexis and pyknotic. Remaining cells were medium-to-large mononuclear cells. No bacteria were identified (**Fig. 3**). Culture yielded no growth. A full thickness biopsy of the wall of the mass was obtained and submitted for intraoperative ISC. Cytology identified high cellularity in a dense background of fresh blood, large numbers of mononuclear cells consistent

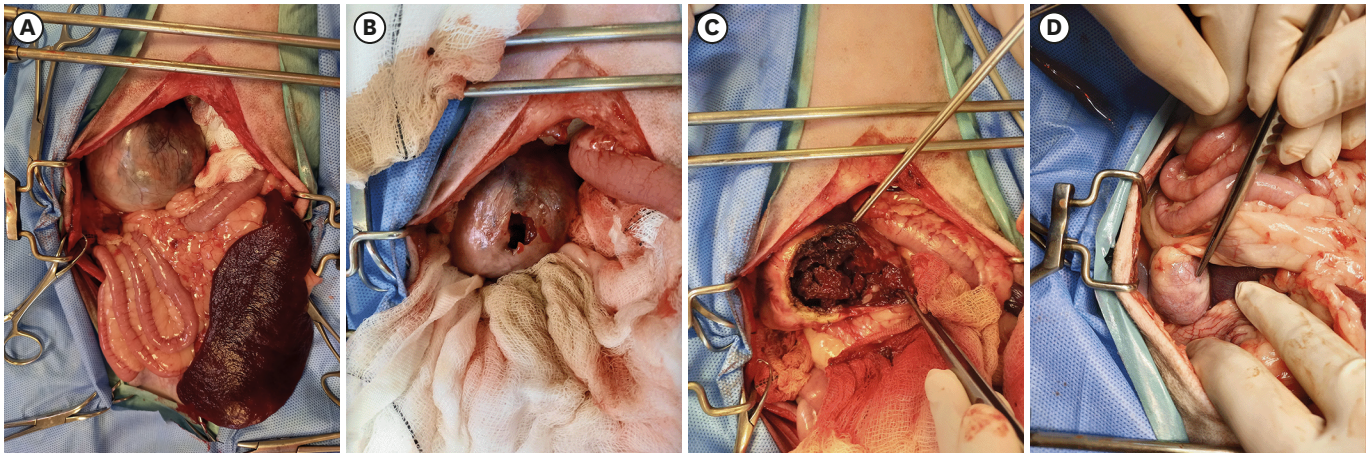

Fig. 2. Intraoperative image of the same dog in **Fig. 1** demonstrating the presence of a large firm pale pink mass, with areas of purple discoloration in the region of the right kidney (A), the same mass in "A" following full thickness incisional biopsy of the wall of the mass for intraoperative impression smears (B), the presence of abundant red-brown, soft friable material within the mass following deroofing (C), and the presence of multiple, small (3–4 mm), round, black-purple and slightly raised lesions located subcapsularly and multifocally throughout the left kidney (D). The right side of the dog is to the left of the image. Cranial is to the top of the image.

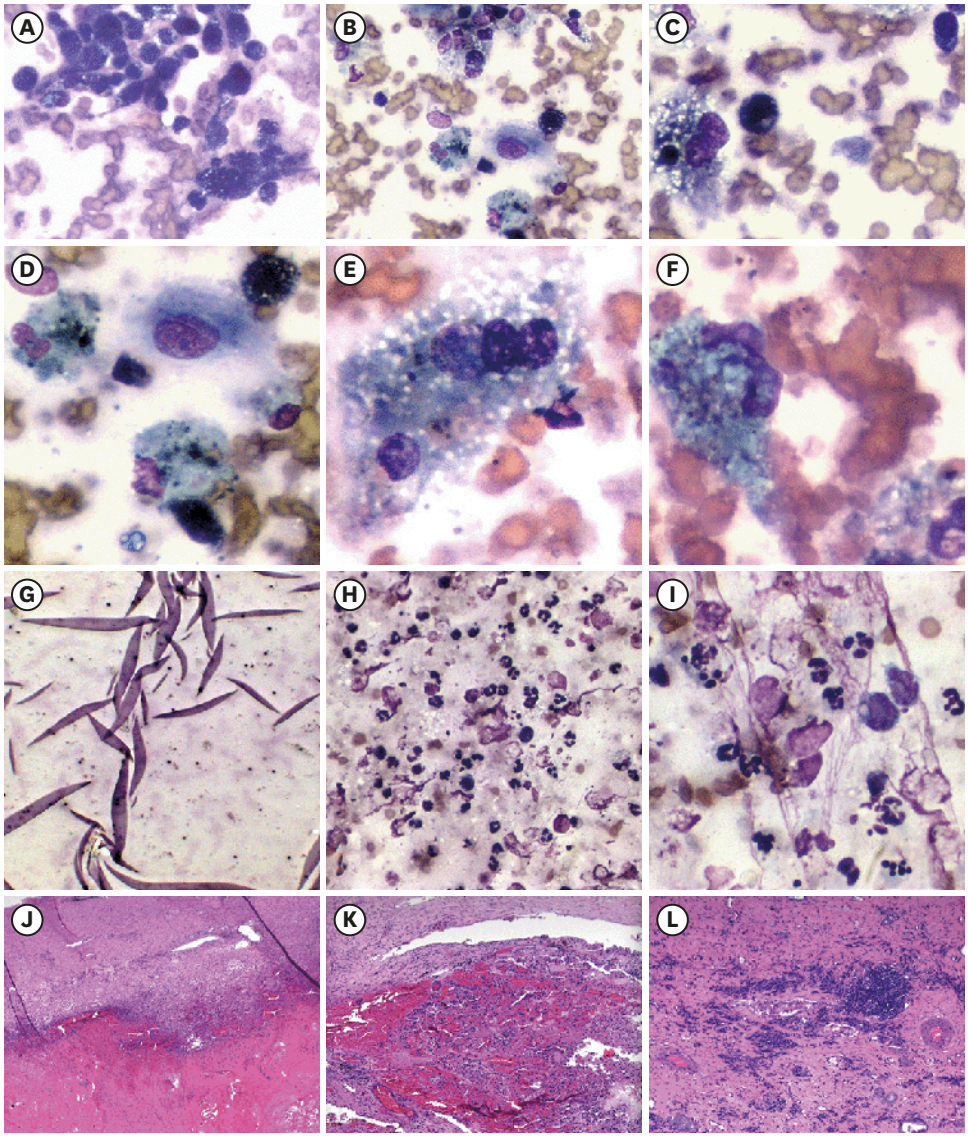

Fig. 3. Cytological examination of the wall of the mass of the same dog in **Fig. 1** reveals numerous, relatively-monomorphic, plump spindloid cells (A, B) and large numbers of macrophages (C, D) that were occasionally multinucleated (E) and frequently filled with light-to-dark, blue-green and black, granular material consistent with haemosiderin (B F). Fluid within the mass was densely eosinophilic with frequent, protein crescents (G) and large numbers of neutrophils (5 to 10 per 50×-objective field-of-view) with small numbers of mononuclear cells and macrophages (H). No bacteria were identified (I). Histopathologic examination reveals a thick fibrous capsule encapsulating dense fibrinous/proteinaceous content containing aggregations of erythrocytes and admixed both intact and degenerate neutrophils. Multifocally, there are irregular collagenous projections covered by single to multiple-cell layers of well regimented monomorphic cuboidal epithelium extending from the inner surface of the capsule. Multiple small diameter ducts lined by cuboidal/columnar epithelium and lymphoid aggregations were identified within the fibrous capsule (J-L).

with macrophages containing with abundant, cytoplasmic, haemosiderin. No evidence of neoplasia or infection was identified (**Fig. 3**). Based on this information, renal-sparing partial nephrectomy (deroofing) and omentalisation were performed using a bipolar vessel sealing device [2]. The mass contained abundant, red-brown, soft friable material (**Fig. 2**). Histopathologic examination of the wall of the mass identified a collagenous/fibrous capsule variously featuring inward irregular projections covered by well regimented monomorphic cuboidal epithelium, possessing eosinophilic cytoplasm and basally located round vesicular nuclei. The capsule also contained fibrinocellular (neutrophilic) exudate and haemorrhage. There were multiple small diameter ducts lined by cuboidal epithelium entrapped

within the fibrous wall along with multifocal lymphoid aggregations and more scattered hemosiderophages. In other areas, there was more immature inflamed fibrovascular tissue on the inner aspect of a thick collagenous capsule (**Fig. 3**). The contents of the mass consisted of abundant fibrinous exudate entrapping erythrocytes and multifocally small loose clusters of neutrophils (intact and degenerate) and haemosiderophages. The histologic diagnosis was consistent with a RC, with a significant inflammatory component.

The dog was hospitalised for 4 d and received fluid therapy, amoxicillin-clavulanate (Augmentin; GlaxoSmithKline Ireland Ltd., Ireland) (20 mg/kg intravenously every 8 h [q8hrs]), paracetamol (Paracetamol Kabi; Fresenius Kabi, Ireland) (10 mg/kg intravenously q12hrs), methadone (Synthadon; Animalcare Ltd., UK) (0.2 mg/kg intravenously q6hrs) and gabapentin (Neurosil; Teva UK Ltd., UK) (10 mg/kg orally q8hrs). Abdominal ultrasonography 3 d postoperatively identified absence of hydronephrosis, cyst reoccurrence or significant free peritoneal fluid. The dog was discharged with instructions for short leash walks until suture removal, paracetamol (Calpol; Johnson & Johnson Ltd., Ireland) (10 mg/kg q12hrs) for 5 d and gabapentin (Gabapentin Rosemount; Jenson R+ Ltd., Ireland) (15 mg/kg q12hrs) for 10 d.

At 6 wk postoperatively, the dog was doing well without clinical signs. Physical examination was unremarkable. Systolic blood pressure was normal (152 mmHg). Haematology was unremarkable. Biochemistry identified mildly increased urea (11.4 mmol/L; RI, 3.6–8.6), normal creatinine concentration (94 umol/L; RI, 20–120), and mildly increased ALT (81 U/L; RI, 0–36), ALP (99 U/L; RI, 0–82) and cholesterol (8.27 mmol/L; RI, 3.2–6.5 mmol/L). Urinalysis (cystocentesis) identified specific gravity of 1.018, 2+ proteinuria, 1+ epithelial cells, pH 6.0, occasional erythrocytes and leucocytes, and non-hyaline casts. Urine culture yielded no growth. Abdominal ultrasound identified no cyst reoccurrence. The dog was discharged with a protein-restricted renal diet (Royal Canin Renal; Mars Inc., USA).

At 4 mon, the dog was doing well with normal activity levels. Physical examination was unremarkable. Systolic blood pressure was normal. Biochemistry identified further mild increases in urea (16.9 mmol/L; RI, 3.6–8.6) and creatinine (139 umol/L; RI, 20–120). Haematology was normal. Urinalysis (cystocentesis) identified specific gravity of 1.016, 3+ proteinuria, and 1+ epithelial cells. Urine protein:creatinine ratio was increased at 11.4 (RI, 0–2). Urine culture yielded no growth. Abdominal ultrasound identified no cyst reoccurrence. The dog was diagnosed with IRIS stage II chronic kidney disease. Continuation with protein-restricted renal diet and provision of free access to fresh water was prescribed.

DISCUSSION

To our knowledge, this is the first report of use of intraoperative ISC to guide treatment of a large RC in a dog. This simple and cost-effective technique can help differentiate benign and malignant RCLs intraoperatively and help guide prognosis and most appropriate treatment. Similar use of intraoperative ISC or squash cytology has been described as a diagnostic tool in people as part of the surgical management of renal and central nervous system tumours [9-13]. The technique has also been used to guide treatment of central nervous system tumours in dogs and cats [14,15]. Microscopic examination of intraoperative frozen tissue sections would have been an alternative but is not available at our institution.

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No studies have compared outcomes of dogs with RCs treated with different techniques. Percutaneous cyst drainage can be performed alone or in combination with sclerotherapy [3,4], and provides a sample of the cyst contents for cytologic analysis, bacterial culture, and biochemical testing [3,4,7]. Sclerotherapy is targeted at inactivating fluid secreting epithelium lining the cyst. In our case, preoperative intravenous urography and intraoperative biochemical testing of renal cystic fluid excluded the presence of urine. Intraoperative cytologic analysis of fluid obtained from the mass did not identify neoplastic cells, however, cytology has been shown to be unreliable in a case of renal cystic adenoma [7]. Partial nephrectomy/deroofing can be performed open [2] or laparoscopically [2,7], and involves puncturing the RC with scissors, aspiration of its contents, and removal of the wall of the lesion as close as possible to normal renal parenchyma using a vessel sealing device or ultrasonic scalpel [2,7]. Omentum is secured to the exposed renal surface or remaining cuff of cyst wall using suture or haemostatic clips [2,7]. In our case, partial nephrectomy was performed by open celiotomy and allowed careful isolation of the mass from other abdominal organs and prevention of intraoperative spillage and potential tumour seeding had the lesion been neoplastic, in which case, conversion to ureteronephrectomy would have been indicated.

In dogs presenting with large RCLs, determination of the histologic nature of the lesion is not always straightforward. Cytologic analysis of fluid obtained by percutaneous drainage from a RCL in a dog subsequently diagnosed with renal cystic adenoma histologically failed to identify neoplastic cells [7]. Similarly, preoperative imaging in that case identified a large, thin-walled, hypoechoic, cystic lesion, typical of a RC [7]. Thus, without histopathology, performing a renal-sparing technique such as partial nephrectomy and omentalisation risks seeding of neoplastic cells into the peritoneal cavity, especially if performed laparoscopically, and direct lymphatic invasion via the omentum. Conversely, in cases with small RCLs in the contralateral kidney or chronic kidney disease, both of which were present in our case, performing ureteronephrectomy may be associated with morbidity if such RCLs were to increase in size and cause progressive renal insufficiency. In our case, while we cannot confirm how much (if any) renal function the right kidney had pre- or postoperatively, partial nephrectomy was favoured over total nephrectomy on the basis of the preoperative diagnosis of azotaemia and the concern that if the other smaller RCLs in the contralateral kidney were to progress in size after total nephrectomy this could result in further loss of renal tissue and function.

Although based on only a single case, we propose that use of intraoperative ISC can help discriminate benign from malignant lesions, and guide prognosis and the most appropriate treatment in dogs presenting with large RCLs. Deroofing and omentalisation should be preferred over ureteronephrectomy in benign cases without communication with the urine collecting system and in cases with bilateral lesions to preserve renal function and reduce risk of postoperative renal insufficiency. Further research is warranted to determine the diagnostic accuracy of this technique for diagnosing RCs in a larger group of dogs.

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