

## What Is Your Diagnosis?

In collaboration with the American College of Veterinary Radiology

### History

A 10-year-old 26.5-kg castrated male mixed-breed dog was presented to a veterinary teaching hospital for staging of its urinary bladder transitional cell carcinoma (TCC), which had been diagnosed via cystoscopy and biopsy 16 months prior to presentation. Since diagnosis, the patient had been treated with piroxicam (0.3 mg/kg, PO, q 12 h, discontinued 6 weeks prior to presentation due to azotemia), mitoxantrone (5 mg/m<sup>2</sup>, IV, q 3 wk for 6 doses), palliative radiation therapy (5 Gy/treatment for 5 treatments), and, at the time of presentation, chlorambucil (4 mg/m<sup>2</sup>, q 24 h for 6 weeks). Approximately 2 weeks prior to presentation, the patient was reported to have had signs of generalized pain when touched by the owner. Treatment was initiated with carprofen (2.2 mg/kg, PO, q 12 h), which resolved signs of pain; therefore, a complete orthopedic examination was not performed to localize the pain. The patient was eating, drinking, and urinating clinically normally. Thoracic radiography was performed as part of routine tumor restaging (**Figure 1**).

**Formulate differential diagnoses, then continue reading.**

### Diagnostic Imaging Findings and Interpretation

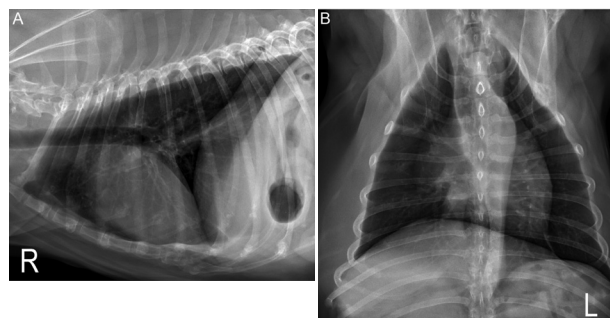
Thoracic radiography revealed expansile lysis of the ventral third of the left third rib with irregular periosteal proliferation. This lesion was not visible on thoracic radiographs generated 12 weeks earlier. The pulmonary parenchyma was unremarkable with no evidence of pulmonary metastatic disease. A previously diagnosed right thoracic subcutaneous lipoma and hypoplastic right 13th rib remained present (**Figure 2**). Primary differential diagnoses for the aggressive lesion of the left third rib included metasta-

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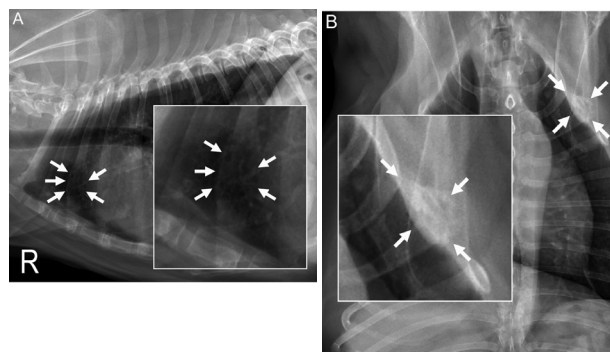
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**Figure 1**—Right lateral (A) and ventrodorsal (B) radiographic images of a 10-year-old 26.5-kg castrated male mixed-breed dog evaluated for restaging of its urinary bladder transitional cell carcinoma diagnosed via cystoscopy and biopsy 16 months earlier.

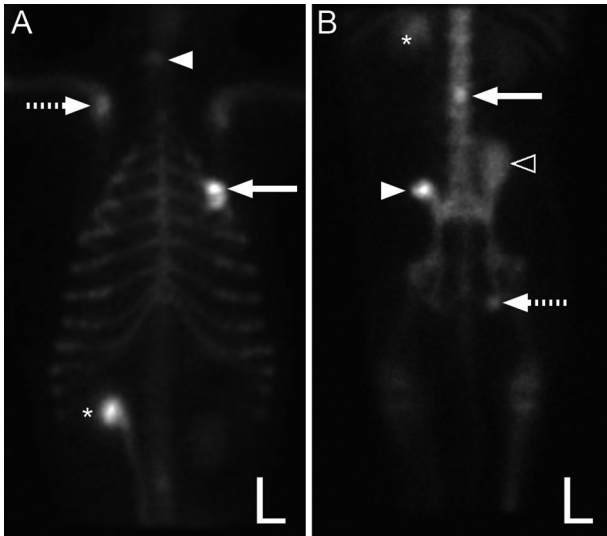


**Figure 2**—Same images as in Figure 1 with additional inset close-up images showing expansile lysis and irregular periosteal proliferation of the distal portion of the left third rib (arrows).

sis from the TCC or primary osseous neoplasia, such as osteosarcoma, chondrosarcoma, fibrosarcoma, or hemangiosarcoma.<sup>1</sup>

### Treatment and Outcome

An ultrasound-guided fine-needle aspirate of the rib lesion was performed, and cytologic results were consistent with metastasis of the patient's TCC. To assess for additional skeletal metastases, 25 mCi technetium-99m-methylene diphosphonate was administered and bone scintigraphy was performed. Increased radiopharmaceutical uptake was noted in the left third rib, right ilium, left ischium, right humeral head, and C3 and L3 vertebral bodies, consistent with multifocal metastatic disease (**Figure 3**).



**Figure 3**—Dorsal plane scintigraphic images of cranial (A) and caudal (B) aspects of the dog described in Figure 1. A—There is increased radiopharmaceutical uptake in the left third rib (solid arrow), right humeral head (dashed arrow), and C3 (solid arrowhead). Dilation of the right renal pelvis and ureter is seen (asterisk), likely secondary to a progression of local disease within the urinary bladder; the left kidney is normal. B—There is increased radiopharmaceutical uptake in the right ilium (solid arrowhead), left ischial tuberosity (dashed arrow), and L3 (solid arrow). Increased radioactivity within the urinary bladder is superimposed over the left ilium (outlined arrowhead).

Due to the widespread metastatic disease, the owners opted for palliative treatment and the dog received a single treatment with zoledronate (0.1 mg/kg, IV) for alleviation of bone pain. The patient was euthanized 1 week later due to declining quality of life. A necropsy was not performed.

## Comments

Transitional cell carcinoma of the urinary bladder is the most common bladder tumor in dogs.<sup>2</sup> Transitional cell carcinoma is typically seen in older dogs, and patients are commonly presented with hematuria, stranguria, and pollakiuria.<sup>2</sup> Although TCC often arises in the trigone of the bladder, involvement of the urethra and prostate is also observed in 56% (57/102) of all dogs and 29% (11/38) of male dogs, respectively.<sup>3</sup> Most dogs with this disease die as a result of local effects of the tumor, which can cause partial or complete urinary obstruction. Approximately 50% (69/137) have distant metastasis at death, with the lungs being the most common site.<sup>3</sup> Although less common, skeletal metastasis has been reported up to 11% (15/137) of dogs with TCC at the time of death.<sup>3,4</sup>

For patients undergoing treatment for TCC, restaging with abdominal and thoracic imaging is important for assessing disease progression and evaluating whether prescribed treatments are ef-

fective. In this patient, abdominal ultrasonography was performed 6 weeks prior and revealed stable disease in the urinary bladder. Thus, during the staging evaluation of the present report, only thoracic radiography was performed. This diagnostic test is most frequently used to evaluate for pulmonary metastatic disease; however, thoracic radiography also offers an opportunity to evaluate other systems as well, particularly parts of the skeleton. For this dog, thoracic radiography revealed an aggressive bone lesion of the left third rib, with differential diagnoses including metastatic or primary osseous neoplasia. As these differential diagnoses cannot be distinguished on the basis of radiographic appearance, an ultrasound-guided fine-needle aspirate sample was obtained for cytologic evaluation, which was critical in making the diagnosis of metastatic TCC.

As most patients with tumors metastatic to bone have multiple skeletal lesions, additional evaluation of the skeleton via scintigraphy or CT may be considered to determine the extent of disease and develop an appropriate treatment plan.<sup>5</sup> A bone scan was performed in this patient to determine the extent of skeletal metastasis and showed multiple bony lesions. Incidentally, scintigraphy also identified hydronephrosis of the right kidney, suggesting progression of local disease. On the basis of this information, the owners elected palliative care with a bisphosphonate for the management of bone pain. However, the patient continued to decline and was euthanized 1 week later.

In summary, thoracic radiography is an incredibly important tool in staging neoplasia in dogs and is frequently performed to evaluate for pulmonary metastasis; however, radiography can also provide an opportunity to assess for skeletal metastasis, such as in this patient with urogenital neoplasia. As such, a systematic approach to the interpretation of radiographic images is crucial, and evaluation for multifocal bone involvement should be considered in patients with suspected or confirmed skeletal metastasis.

## References

1. Pirkey-Ehrhart N, Withrow SJ, Straw RC, et al. Primary rib tumors in 54 dogs. *J Am Anim Hosp Assoc*. 1995;31(1):65-69. doi:10.5326/15473317-31-1-65
2. Mutsaers AJ, Widmer WR, Knapp DW. Canine transitional cell carcinoma. *J Vet Intern Med*. 2003;17(2):136-144. doi:10.1892/0891-6640(2003)017<0136:ctcc>2.3.co;2
3. Fulkerson CM, Knapp DW. Management of transitional cell carcinoma of the urinary bladder in dogs: a review. *Vet J*. 2015;205(2):217-225. doi:10.1016/j.tvjl.2015.01.017
4. Charney VA, Miller MA, Heng HG, Weng HY, Knapp DW. Skeletal metastasis of canine urothelial carcinoma: pathologic and computed tomographic features. *Vet Pathol*. 2017;54(3):380-386. doi:10.1177/0300985816677152
5. Trost ME, Inkelmann MA, Galiza GJN, Silva TM, Kommers GD. Occurrence of tumours metastatic to bones and multicentric tumours with skeletal involvement in dogs. *J Comp Pathol*. 2014;150(1):8-17. doi:10.1016/j.jcpa.2013.07.002