

# Radiographic Appearance of Benign Versus Malignant-Associated Bone Infarcts in Dogs

Stephen C. Jones, MVB, MS, DACVS-SA

*The Ohio State University*

## In the literature

Jones SA, Gilmour LJ, Ruoff CM, Pool RR. Radiographic features of histologically benign bone infarcts and bone infarcts associated with neoplasia in dogs. *J Am Vet Med Assoc.* 2020;256(12):1352-1358.

## FROM THE PAGE ...

A bone infarct is an area of osteonecrosis that develops following an ischemic event. Bone infarcts can be of benign or malignant origins and have been reported to occur secondary to previous surgery (eg, total hip replacement) or bone neoplasia (eg, osteosarcoma).<sup>1-7</sup> The radiographic appearance of malignant-associated bone infarcts has been described but benign infarcts have not.

This retrospective study aimed to assess radiography in discerning benign versus malignant-associated bone infarcts. Two board-certified radiologists were blinded to case signalment and ultimate histologic diagnosis and asked to assess radiographs of bone infarctions, classifying them as likely benign, likely malignant associated, or undistinguishable in nature.

Of the 49 included cases, 33 had a histologic diagnosis of benign infarct and 16 had a malignant-associated infarct. Only 48% of the benign infarcts and 38% of the malignant-associated infarcts were correctly identified by both radiologists. Patterns of both the periosteal response and the medullary lysis were the only radiographic features significantly associated with the histologic diagnosis. Despite this finding, there was substantial crossover, with a high percentage of dogs in both histologic groups having an aggressive periosteal response and an aggressive medullary lysis pattern.

Overall, significant overlap was observed in the radiographic appearance of benign and malignant-associated infarcts, suggesting that radiographic assessment is not very useful in distinguishing the histologic nature of bone infarcts. These results underpin the need for additional diagnostics for bony lesions detected on radiology, even those with a radiographic pattern typical of an aggressive process.

Continues ►

## ... TO YOUR PATIENTS

Key pearls to put into practice:

**1** Bone infarcts in dogs can be either benign or malignant in nature and can have considerable variability in radiographic features. Furthermore, the radiographic features of benign and malignant-associated infarcts have many similarities, making radiography an unreliable diagnostic modality for identifying the nature of the infarct.

**2** Given the overlap in radiographic signs, benign bone infarcts in dogs could easily be misclassified as a malignant process, for which limb amputation is often the recommended surgical intervention. This finding underscores the importance of performing additional diagnostic evaluations (eg, bone biopsy) in dogs with an aggressive radiographic appearance.

## References

- Dubielzig RR, Biery DN, Brodey RS. Bone sarcomas associated with multifocal medullary bone infarction in dogs. *J Am Vet Med Assoc.* 1981;179:64-68.
- Marcellin-Little DJ, DeYoung DJ, Thrall DE, Merrill CL. Osteosarcoma at the site of bone infarction associated with total hip arthroplasty in a dog. *Vet Surg.* 1999;28(1):54-60.
- Riser WH, Brodey RS, Biery DN. Bone infarctions associated with malignant bone tumors in dogs. *J Am Vet Med Assoc.* 1972;160(4):414-421.
- Newman ME, Johnson KA. Suspected intramedullary bone infarct subsequent to tibial plateau levelling osteotomy in a dog. *Aust Vet J.* 2015;93(7):255-258.
- Haney DR, Peck JN. Influence of canal preparation depth on the incidence of femoral medullary infarction with Zurich cementless canine total hip arthroplasty. *Vet Surg.* 2009;38(6):673-676.
- Marsolais GS, Peck JN, Berry C, Johnson A. Femoral medullary infarction prevalence with the Zurich cementless canine total hip arthroplasty. *Vet Surg.* 2009;38(6):677-680.
- Sebestyen P, Marcellin-Little DJ, DeYoung BA. Femoral medullary infarction secondary to canine total hip arthroplasty. *Vet Surg.* 2000;29(3):227-236.

## Suggested Reading

Thrall DE. *Textbook of Veterinary Diagnostic Radiology.* 6th ed. W.B. Saunders; 2013.

# Elura™

(capromorelin oral solution)

20 mg/mL  
For oral use in cats only

**CAUTION:**

Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian. Before using Elura, please consult the product insert, a summary of which follows:

**INDICATION:**

For management of weight loss in cats with chronic kidney disease.

**DOSAGE AND ADMINISTRATION:**

Administer ELURA orally at a dose of 2 mg/kg (0.9 mg/lb) or 0.1 mL/kg (0.045 mL/lb) body weight once daily.

**CONTRAINDICATIONS:**

ELURA should not be used in cats that have a hypersensitivity to capromorelin.

**WARNINGS:**

Not for use in humans. Keep this and all medications out of reach of children and pets. Consult a physician in case of accidental ingestion by humans.

**For oral use in cats only.**

Do not use in cats with hypersomatotropism (acromegaly). ELURA may increase serum glucose for several hours after dosing. Use in cats with current or historical diabetes mellitus has not been evaluated and use may not be appropriate.

**PRECAUTIONS:**

Use with caution in cats that may have cardiac disease or severe dehydration. ELURA causes transient decreases in heart rate and blood pressure up to 4 hours following dose administration. Some cats may exhibit clinical signs of bradycardia or hypotension following administration of ELURA. Use with caution in cats with hepatic dysfunction. Capromorelin is metabolized in the liver in humans and dogs and similar metabolism is expected in the cat.

The safe use of ELURA has not been evaluated in cats younger than 5 months old. The safe use of ELURA has not been evaluated in cats that are pregnant, lactating, or intended for breeding.

**ADVERSE REACTIONS:**

Safety was evaluated in a 56-day field effectiveness study in 176 client-owned cats (118 administered ELURA, 58 administered vehicle control) that received at least one dose. Cats enrolled had  $\geq 5\%$  unintended weight loss and a history of chronic kidney disease (CKD). Cats had a mean age of 15 years and at enrollment 11.4% of the cats were in Stage 1 CKD, 66.5% were in Stage 2, 21.0% were in Stage 3, and 1.1% were in Stage 4. Cats enrolled in the study had a variety of comorbid conditions: dental disease (88.1%), moderate or severe muscle loss (43.2%), heart murmur (28.4%), history of vomiting or underlying gastrointestinal disease (28.4%), hyperthyroidism (13.6%) and hypertension (9.7%).

**Table 1: Adverse Reactions in the Field Effectiveness Study**

Adverse Reaction	ELURA (n=118)	Vehicle Control (n=58)
Vomiting	35 (29.6%)	13 (22.4%)
Hypersalivation	25 (21.2%)	0 (0.0%)
Inappetence	22 (18.6%)	7 (12.0%)
Behavior Change <sup>a</sup>	17 (14.4%)	3 (5.2%)
Lethargy	16 (13.6%)	6 (10.3%)
Anemia	11 (9.3%)	1 (1.7%)
Dehydration	11 (9.3%)	2 (3.4%)
Stage of CKD Increased <sup>b</sup>	10 (8.5%)	3 (5.2%)
Diarrhea	9 (7.6%)	2 (3.4%)
Urinary Tract Infection	8 (6.8%)	2 (3.4%)
Hyperglycemia	8 (6.8%)	2 (3.4%)
Upper Respiratory Infection	7 (5.9%)	1 (1.7%)
Hypercalcemia	7 (5.9%)	0 (0.0%)
Facial Skin Lesion	6 (5.1%)	3 (5.2%)
Hyperkalemia	5 (4.2%)	0 (0.0%)
Ataxia	4 (3.4%)	0 (0.0%)
Diabetes Mellitus	1 (0.8%)	0 (0.0%)
Congestive Heart Failure	1 (0.8%)	0 (0.0%)

Note: If an animal experienced the same event more than once, only the first occurrence was tabulated.

<sup>a</sup> Behavior change included hiding from the owner (8 ELURA, 1 vehicle control); owner reported difficulty administering medication (7 ELURA, 1 vehicle control); and redirected aggression to another household cat (2 ELURA, 1 vehicle control).

<sup>b</sup> Two ELURA and 1 vehicle control cat increased by two CKD stages; 8 ELURA and 2 vehicle control cats increased one CKD stage. It could not be determined if the progressive renal disease was the natural course of the pre-existing disease or treatment related.

Hypersalivation was generally associated with dosing and resolved within a few minutes.

Nine cats (8 ELURA and 1 vehicle control) either died or were euthanized during or shortly after the study. Six ELURA cats were euthanized or died from decompensated CKD. One ELURA cat was euthanized after study withdrawal on Day 33 for declining quality of life and recent identification of a new mass. One ELURA cat acutely declined and was euthanized for findings of nodules in both kidneys and diagnosis of sarcoma. The vehicle control cat was euthanized for acute onset of right hindlimb paresis and suspected embolic event. Two additional cats were diagnosed with neoplasia during the study (one ELURA cat with unspecified soft tissue sarcoma and one control cat with mammary adenocarcinoma) but completed the study. In voluntary post-approval reporting for extra-label use of a capromorelin product for dogs, the following adverse events have been reported in cats (listed in decreasing order of reporting frequency): bradycardia, lethargy, hypersalivation, hypotension, behavior change, and vomiting.

To report suspected adverse events, for technical assistance or to obtain a copy of the Safety Data Sheet (SDS), contact Elanco US, Inc. at 1-888-545-5973.

For additional information about adverse drug experience reporting for animal drugs, contact FDA at 1-888-FDA-VETS or <http://www.fda.gov/reportanimalae>.

**EFFECTIVENESS:**

Effectiveness was demonstrated in a multicenter, prospective, masked, randomized, vehicle-controlled field study. The study enrolled 176 client-owned cats with  $\geq 5\%$  unintended weight loss and a history of chronic kidney disease. The cats enrolled included 96 females and 80 males of various breeds, 4.4 - 22.1 years old with a mean age of 15 years and weighing 1.81 - 6.76 kg. CKD stage was determined based on creatinine at screening according to the International Renal Interest Society (IRIS) 2015 guidelines. All stages were enrolled. Cats were administered ELURA at 2 mg/kg or a matched volume of control once daily by mouth for 56 days. The control was the solution without capromorelin (vehicle control). The primary effectiveness variable was the percent change in body weight from Day 0 to Day 55. Effectiveness was evaluated in 112 cats: 71 cats administered ELURA and 41 cats administered vehicle control. There was a statistically significant difference between the percent change in weight for the ELURA group (+5.2%) compared to the vehicle control group (-1.6%) at Day 55 ( $p < 0.0001$ ). Secondary analysis for percent change in weight at Day 15 and Day 27 demonstrated cats in the ELURA group gained weight throughout the study.

**STORAGE CONDITIONS:**

Store at or below 86°F (30°C)

**HOW SUPPLIED:**

20 mg/mL flavored oral solution in a 15 mL bottle with an oral dosing syringe.

Approved by FDA under NADA # 141-536.

Manufactured for: Elanco US Inc, Greenfield, IN 46140 USA

REV. DATE-10/2020

ELURA, Elanco and the diagonal bar logo are trademarks of Elanco or its affiliates.

PA402828X

