

CASE REPORT

Cranial internal hemipelvectomy (ileectomy) with limb sparing for a dog with ilial chondrosarcoma: A case report

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Abstract

Cranial internal hemipelvectomy can be successful for excision of ilial CSA with minimal complications. Ileectomy with adjuvant radiation therapy was well tolerated in a dog with grade II ilial CSA. The dog survived 1,271 days postoperatively and supposedly succumbed to a disease process unrelated to the CSA.

KEYWORDS

general surgery, oncology, orthopedics, veterinary

1 | INTRODUCTION

Osteosarcoma (OSA) and chondrosarcoma (CSA) are the most common primary bone tumors of the canine pelvis.^{1,2} CSA is a malignant neoplasm arising from the cartilaginous tissue, which has a predilection for the medullary cavity of flat bones. CSA accounts for about 10% of bone neoplasms and predominantly occurs in dogs.^{3,4}

Hemipelvectomy is a procedure that can be performed in companion animals to treat neoplasms involving the pelvis or surrounding soft tissue.⁵ Hemipelvectomies can be characterized by type (internal or external) and location (cranial, middle, caudal, and total), and this terminology was derived from the human literature.^{6,7} External hemipelvectomy refers to removal of a portion of the pelvis and the ipsilateral pelvic limb. Internal hemipelvectomy spares the associated limb. Lesions can be categorized as either intercompartmental or extracompartmental.^{8,9} A tumor is classified as intercompartmental if the neoplasm

is confined within a well-delineated anatomic compartment, whereas extracompartmental neoplasms extend into other tissue planes or spaces.⁹ The cortical bone and articular cartilage aid as an anatomic compartment.⁹

The current standard of care for primary proximal femoral and pelvic bone tumors in dogs has been external hemipelvectomy.^{5,10–12} External hemipelvectomy requires patients to adapt to a novel method of ambulating postoperatively and can be contraindicated in patients with severe osteoarthritis, muscular, or neurologic deficits. External hemipelvectomy may not be a consideration based on owners' perception regarding limb amputation. Decisions may be influenced by public perception, anthropomorphism, esthetic appearances, or concern for inability to adapt and phantom pain.^{13,14} A survey conducted in the Netherlands revealed owners with older dogs that had a limb amputation reported a significant increase in negative response and were accused of being cruel to their animal.¹⁴

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Limited information is published within the veterinary literature regarding internal hemipelvectomy.¹⁵ If limb function can be retained without compromising surgical margins, a limb-sparing procedure may be considered over an external hemipelvectomy.¹ Three key areas need to be spared if an internal hemipelvectomy (i.e., limb sparing) is to be considered in human patients: the femoral neurovascular bundle, the sciatic nerve, and the acetabulum.¹ Ideally, one intact fascial plane about the circumference of the tumor is preserved.⁸ Internal hemipelvectomy is considered if clean margins can be achieved, function of the limb is preserved, and the tumor does not involve major neurovascular structures.¹⁶

Additional case reports are required to document the utility of internal hemipelvectomy for pelvic neoplasia. The purpose of this report was to document the long-term outcome of cranial internal hemipelvectomy for a marginally resected ilial CSA followed by adjuvant radiation therapy in a dog.

2 | CASE HISTORY

A 6-year-old female spayed Boxer was presented to the North Carolina State University Veterinary Teaching Hospital (NCSU VTH) for the evaluation of an ilial chondrosarcoma (CSA).

A right hind limb (RHL) lameness was noticed 4 months prior to presentation. Three months later, a firm mass was appreciated over the dog's right ilium and 1 week later presented for non-weight-bearing lameness. Pelvic radiographs (PRX) revealed an osteolytic lesion of the right ilial wing. A complete blood count (CBC) and serum chemistry panel (Chem) were performed prior to bone biopsy, both of which were unremarkable. Histologic findings of the biopsy demonstrated disorganized lobules and sheets of neoplastic chondrocytes in a cartilaginous matrix. The cells exhibited moderate to prominent nuclear and cytologic pleomorphism with rare scattered mitotic figures. Histopathology was consistent with the diagnosis of CSA. The dog was referred to NCSU VTH for further staging evaluation.

On physical examination (PE), a painful, firm, irregular mass was palpated over the right ilium and measured 13.97 cm × 10.16 cm. CBC/Chem, thoracic radiographs (CRX), abdominal ultrasound (AUS), and a computed tomography (CT) of the pelvis were performed. Blood work and CRX were unremarkable. Abdominal ultrasound was unremarkable. CT of the pelvis was performed for surgical treatment planning; the dog was anesthetized with hydromorphone (0.05 mg/kg, IM) and thiopental (10 mg/kg, IV) and then maintained with isoflurane. An aggressive bone lesion and mass with lysis from the body of the right ilium

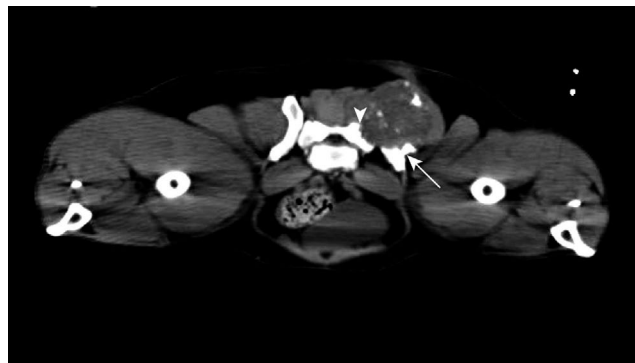


FIGURE 1 Preoperative CT examination of the pelvis revealed an aggressive mass involving the right ilium (arrow) and lateral sacrum (arrowhead)

to the lateral aspect of the sacrum with medial and lateral displacement of the epaxial muscles were appreciated (Figure 1). External or cranial internal hemipelvectomy (i.e., iliectomy) with adjuvant radiation was primarily discussed given that resection with wide margins was not possible. The owner elected iliectomy with adjuvant radiation therapy.

Two weeks later, the dog represented to NCSU VTH. A transdermal fentanyl patch (100µg/hr) was applied the evening prior to surgery. The patient was anesthetized with hydromorphone (0.05 mg/kg, IM) and thiopental (8.5 mg/kg, IV) and then maintained with isoflurane. An epidural was performed prior to surgery (morphine/bupivacaine of unknown doses). Perioperative antimicrobial prophylaxis was provided with cefazolin (22 mg/kg, IV) prior to the start of surgery and repeated every 90 min for the duration of the surgery. The surgical site was prepared in a routine aseptic fashion with the RHL prepared for free limb draping in left lateral recumbency. An 8 cm curvilinear incision was made through the skin and subcutis 3 cm ventral to the mass. The subcutaneous tissues were dissected down to the underlying musculature. The tumor was invading the middle gluteal muscle. The gluteal muscles were transected (2 cm) caudal to the tumor with electrocautery. The body of the ilium was cleared of soft tissue, and an Army Navy retractor was placed medial to the ilium to protect neurovascular structures. A sagittal saw was used to make the ilial osteotomy in a dorsoventral plane. The sacroiliac joint was disarticulated by ventrally inserting a periosteal elevator into the joint. The ilial wing and tumor were dorsolaterally reflected and removed. Remaining suspected neoplastic tissue at the disarticulation site was removed with rongeurs. A closed suction drain was placed at the resection site. A single layer of polypropylene mesh was then sutured to the fascia of the external abdominal oblique ventrally, paraspinal musculature dorsally, remaining middle gluteal muscle, and tensor fascia lata

with 3–0 Maxon using simple continuous patterns, to prevent hernia formation through weakened abdominal musculature. The subcutaneous and subcuticular layers were closed with 3–0 Maxon in a simple continuous and continuous horizontal mattress patterns, respectively. The skin was opposed to stainless steel staples. The surgical procedure lasted 184 min. The right ilial wing with exposed tumor on the ventral aspect was submitted for histopathology. Given this was a marginal excision, the tissues were not inked prior to submission. Radiographs were not postoperatively performed since CT was planned prior to adjuvant radiation therapy. Postoperatively, the dog received carprofen (2.2 mg/kg, IV once then 1.7 mg/kg, q12 h, orally), hydromorphone (0.05 mg/kg, IV, PRN), acepromazine (0.02 mg/kg, IV, PRN), and amoxicillin (14 mg/kg, q12 h, orally). Within 24 h following surgery, the dog was weight bearing and ambulating on the surgical limb. Seventy-two hours postoperatively, the drain was removed. The dog was discharged with carprofen and amoxicillin for an additional 10 days.

3 | OUTCOME/FOLLOW-UP

Histopathological evaluation was consistent with an incompletely excised grade II chondrosarcoma (Figure 2). Grade was determined based on moderate cellular pleomorphism with no undifferentiated areas and 1 mitotic figure observed per 10 high-power magnification fields.^{17–19}

The dog was scheduled for radiation therapy 27 days postoperatively. At that time, the dog had an intermittent

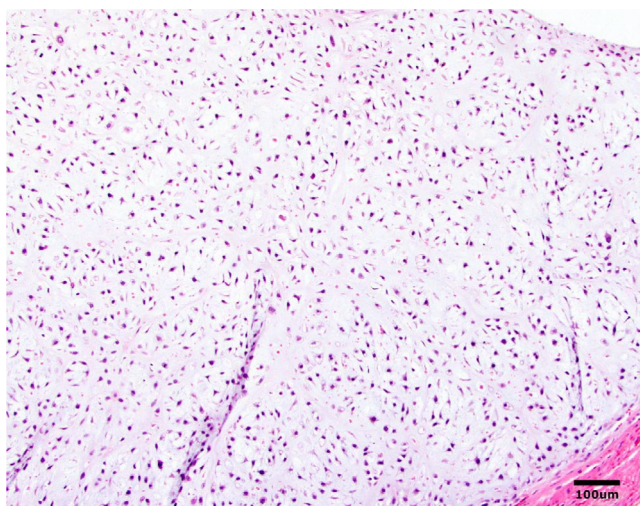


FIGURE 2 Histopathologic image (hematoxylin and eosin stain) of the tumor exhibiting moderate pleomorphism and moderate mitotic activity with no undifferentiated areas—consistent with a grade II chondrosarcoma ($\times 10$ magnification; bar = 100 μm)

non-weight-bearing lameness of the RHL and mild pain elicited with flexion of the right coxofemoral joint. Diagnostics included CRX (unremarkable) and PRX. PRX demonstrated an overlapping fracture of the left pubic bone and corresponding fracture of the left ischial arch with callus formation (Figure 3). Mild bilateral coxofemoral and stifle degenerative joint disease (DJD) was also appreciated. The radiation therapy planning CT scan had to be rescheduled due to technical issues. Carprofen (1.7 mg/kg, q12 h, orally) was prescribed, and the fractures did not appear to be causing the dog marked discomfort.

Fifty-three days after iliectomy, the dog represented for radiation therapy (19×3 Gy fractions delivered daily from Monday to Friday). PE was unremarkable. PRX and CT were performed. PXR revealed progressive coxofemoral DJD and healed pelvic fractures. The mesh overlaying the right hemipelvis region was in place. The dog was anesthetized with hydromorphone (0.05 mg/kg, IM) and thiopental (10 mg/kg, IV) and then maintained with isoflurane. CT was acquired with 5 mm slices from the cranial aspect of L5 through the entire pelvis (Figure 4). After completion of full-course radiation therapy, the plan for re-evaluation included PE and CRX to be performed at 1 month and then every 3 months for 2 years. At the 1-, 6-, and 9-month re-evaluations, PRX was performed. Chemotherapy was not recommended given the histological diagnosis. Upon serial re-evaluations, neither pulmonary metastases nor tumor recurrence was ever appreciated. Six months postradiation therapy, there was radiographic evidence of osseous proliferation within the resection site that did not appear neoplastic; a biopsy was not performed to confirm this.

Between the 15- and 18-month rechecks, the dog was noted to have some stiffness in the RHL. PRX revealed mild osteoproliferation at the iliectomy site and osteopenia of the right proximal femur (Figure 5). Osteopenia was thought to be a late side effect of radiation therapy. Carprofen as previously prescribed was recommended PRN.

An abscess had developed within the region of the mesh and, therefore, was uneventfully removed by the referring veterinarian just prior to the 18-month recheck. Forty-two months postiliectomy, the dog had a sudden collapsing episode. The dog was presented to a local emergency veterinarian; no treatments or diagnostics were performed. The dog collapsed again shortly after discharge and arrested. At the time of death, the dog had been using the affected limb with no evidence of reoccurrence on PE; however, a necropsy was not performed for confirmation. The owner was contacted for follow-up. The client was overall pleased with the outcome of the surgery and believed the dog was able to engage in normal activities with no overt pain or lameness.



FIGURE 3 Lateral and ventrodorsal pelvic radiographs 27 days following iliectomy demonstrating overlapping fracture of the left pubic bone and corresponding fracture of the left ischial arch with callus formation

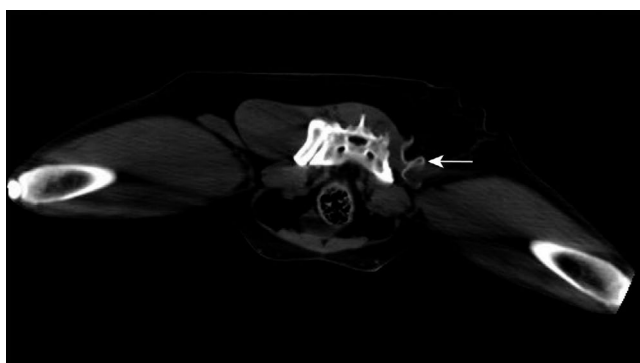


FIGURE 4 CT image of the pelvis 53 days after iliectomy for marginal excision of ilial chondrosarcoma. A portion of the prolene mesh can be seen as a linear serpiginous region of hyperattenuation (arrow)

4 | DISCUSSION

An internal pelvicotomy can be an alternative for pelvic tumor resections and result in a favorable clinical outcome.⁸ Hemipelvectomy is a complex procedure that requires extensive surgical planning, adherence to surgical oncology techniques, and thorough familiarity with regional anatomy.⁵ Internal hemipelvectomy may alter the weight-bearing axis of the contralateral hemipelvis resulting in fractures.²⁰ The decision regarding the extent of surgery should be made based on the owner's goals, surgeon's experience, comorbidities, extent of neoplasia, presence of metastasis, and ability to pursue adjuvant radiation therapy or chemotherapy (depending on histological result). Wide resection of the sacral wing was not performed as the goal was to perform a marginal resection followed by radiation therapy; however, the grossly abnormal bone associated with most lateral aspect of the sacrum was removed with rongeurs.

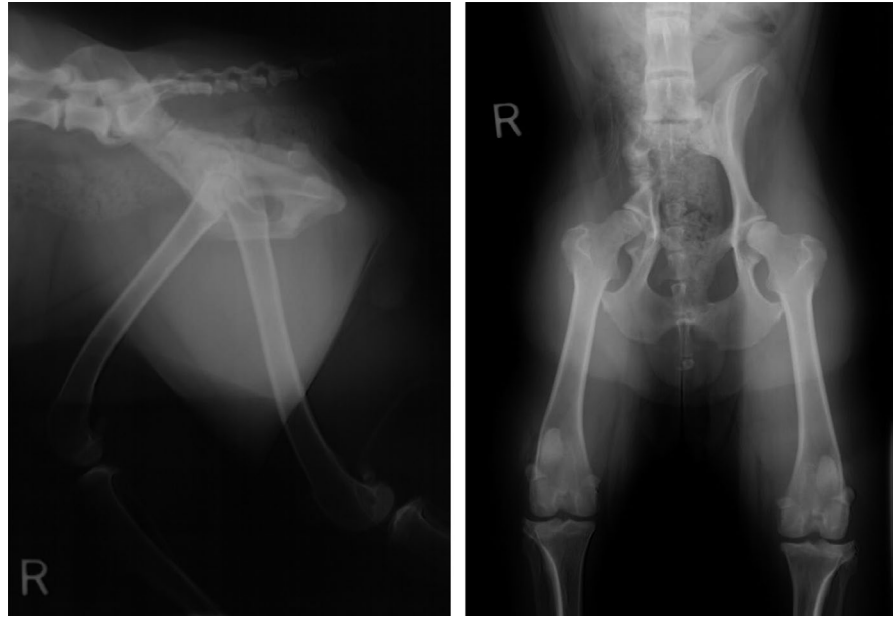
An internal hemipelvectomy is generally only considered when clean margins and a function limb can be achieved.¹ However, in this case report this dog had a good clinical outcome and MST. Clean margins are not always achievable due to involvement of, or proximity to, neurovascular structures.²¹ CSAs, due to their generally poor vascularity and low rate of mitosis, can have an inherent resistance to chemotherapy and radiation therapy.²² In some human reports, greater than 60 Gy of radiation was required for local disease control.^{22,23} The dog in this case report received nineteen three Gy fractions for a total of 57 Gy with no evidence of local recurrence. This dog's survival time (1,271 days postoperatively) was similar to the MST previously described for pelvic CSA.¹¹ Likewise, a satisfactory clinical outcome with no evidence of local recurrence or metastatic spread over a 500-day postoperative period was achieved via an ischiectomy in a dog with an ischial CSA.⁶

In a retrospective study of long-term outcomes for dogs after hemipelvectomy for surgical excision of a variety of tumor types, six out of nine dogs had CSA with incomplete margins, four (66%) of which developed metastases, and two (33%) deaths were related to the tumor. Regardless of surgical margins, one (11%) had local recurrence and five (56%) had metastatic disease.¹¹

Grading systems for skeletal CSA based on histologic features of malignancy and mitotic count have been described and correlated with prognosis in 35 dogs and 31 dogs although not routinely performed.¹⁷⁻¹⁹ Using the criteria outlined in these previous studies, the histologic features of the CSA in this case were consistent with an intermediate grade (Grade II).

Postoperative complications following hemipelvectomy include seroma, wound complications, fecal or urinary incontinence, fecal obstipation, pressure sores, fractures, and reoccurrence.^{8,11} In this case, secondary

FIGURE 5 Pelvic radiographs 488 days postilectomy revealing new bone formation within the right hemipelvis region. The right proximal femur is osteopenic in comparison to the contralateral side. The prolene mesh can also be visualized



fracture of the left pubis and ischium was appreciated ~30 days postoperatively. Fractures were presumed to have occurred due to increased weight bearing of the contralateral limb. Future research may investigate methods to reduce or eliminate postoperative fractures associated with internal hemipelvectomies. However, this patient's fractures healed without intervention and resulted in good function per the owner.

The main purpose of this study was to document the long-term outcome of an internal cranial hemipelvectomy for a pelvic CSA. The good outcome in this case study may help veterinarians considering a limb-sparing iliectomy in appropriate patients over external hemipelvectomy.¹⁶

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CONFLICTS OF INTERESTS

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AUTHOR CONTRIBUTIONS

Downey, A.C., DVM contributed to drafting the work, writing and revising the manuscript, and approval of the final version to be published. Kyle G. Mathews DVM, MS, DACVS contributed to being the primary surgeon, revising the manuscript, and approval of the final version to be published. Luke Borst, DVM, PhD, DACVP contributed to acquisition of data, histopathology analysis, preparing

histology figure included in the manuscript, revision of the manuscript, and approval of the final version to be published.

CONSENT

Written informed consent was obtained from the patient's owner to publish this report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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