Intrapelvic granuloma formation six years after total hip arthroplasty in a dog

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Intrapelvic mass formation is a potential late complication in dogs undergoing total hip arthroplasty. Such masses may represent a foreign body response to particulate debris resulting from wear at the articulating surface or from particles generated at the bone-cement interface that travel into the pelvic canal via an acetabular wall defect.

A 9-year-old 33-kg (74-lb) spayed female Golden Retriever was examined at the University of Florida Veterinary Medical Teaching Hospital because of tenesmus for the preceding 10 days. According to the owner, the dog would strain to defecate and pass only small amounts of soft, occasionally bloody feces. The dog was able to urinate normally.

Six years earlier, the dog had undergone left total hip arthroplasty (THA) with a modular cemented canine hip system. The acetabulum had been prepared with a power reamer, and the medial cortex of the acetabulum had inadvertently been perforated when multiple holes were made in the acetabulum and ilium with a pneumatic high-speed drill and burr to increase surface area. Polymethyl methacrylate (PMMA) had been packed by hand into the acetabulum, and a positioning device had been used to insert an ultrahigh molecular weight polyethylene cup. A titanium femoral stem with a cobalt chrome femoral head had been cemented in the femur.

On radiographs obtained immediately following THA, a small amount (1 × 2 cm) of PMMA was evident medial to the acetabulum in the pelvic canal. The dog recovered from surgery without complications and was bearing weight on the left hind limb the day after surgery. Aerobic bacterial culture of a swab specimen obtained from the left hip joint during surgery did not yield any growth. No complications were evident when the dog was reevaluated 4 months after surgery. Signs of pain were not elicited during palpation of the left hip joint, and the left hip joint had an acceptable range of motion, although extension was slightly decreased. Hindquarter muscle mass was symmetrical, and no lameness was evident. Radiographs were not obtained during this examination.

At the time the dog was examined because of tenesmus, palpation of the caudal aspect of the abdomen elicited signs of pain. During rectal examination, a firm mass was palpated on the left side of the pelvic canal. The mass did not appear to be attached to the rectum but was compressing the rectal lumen. Results of the remainder of the physical examination were normal, as were results of a CBC, serum chemistry profile, and urinalysis.

On abdominal radiographs, a round, homogeneous, soft-tissue-opacity mass was evident in the left caudal aspect of the abdomen. The mass extended into the pelvic canal, displacing the rectum and terminal portion of the descending colon dorsally and the bladder cranially. Radiographic appearance of the PMMA seen in the pelvic canal after THA was unchanged. A radiolucent space < 1-mm wide was seen at the bone-cement interface of the acetabular component but was considered unlikely to represent aseptic loosening.

There was no periosteal reaction on the femoral shaft or lucency at the interface between the femoral implant and PMMA. No abnormalities were seen on thoracic radiographs. Abdominal ultrasonography revealed a cavitary mass in the left caudal aspect of the abdomen that was extending into the pelvic canal. The mass had a thin wall and was filled with echogenic fluid surrounding irregularly marginated, coarsely granular, homogeneous material. Hyperechoic material, presumed to be PMMA, could be seen extending into the mass. Ultrasound-guided fine needle aspiration of the mass yielded a slightly cloudy, colorless fluid containing white flocculent material. Cytologic evaluation of the fluid revealed a refractile crystalline material. There was no evidence of neoplastic or inflammatory cells or any infectious agents. Aerobic and anaerobic bacterial culture of the fluid did not yield any growth. The dog was anesthetized, and vaginourethrography was performed (Fig 1). The mass caused right lateral deviation of the vagina and urethra but did not communicate with these structures.

The dog was admitted for surgical removal of the mass. Exploratory laparotomy revealed a large fluctuant mass attached to the medial aspect of the left pelvis. A ventral approach to the pelvic canal involving a pubic flap osteotomy was performed. The base of the fluctuant mass was firmly attached to the medial surface of the left hemipelvis, and the mass appeared to originate from the PMMA in the pelvic canal. Adhesions had formed between the mass and colon and between the pelvic wall and urogenital tract. Blunt dissection was used to separate the mass from its attachments in the pelvic canal. The capsule was perforated during dissection, and a beige, caseous material exuded from the mass. Following removal of the mass, the pelvic canal was lined with moistened laparotomy sponges to protect the tissues from particulate debris, and the PMMA on the medial aspect of the left acetabular wall was extensively removed with a high-speed burr.
ulum was removed with a pneumatic burr. The surgical site was copiously lavaged with sterile saline (0.9% NaCl) solution to remove any remaining debris. The bone flap was replaced and stabilized with 18-gauge stainless steel wire.

The dog was able to walk without support and defecate 24 hours after surgery. Some straining was noticed when the dog defecated, but rectal palpation did not reveal any evidence of an obstruction. The dog was discharged, and the owner was instructed to administer 1 to 2 tablespoons of psyllium twice a day as a stool softener. Activity was limited to brief walks on a leash for 8 weeks after surgery.

On histologic examination, the mass consisted of a dense fibrous connective tissue capsule bordering lakes of pale, eosinophilic, amorphous to granular material containing punctate particulate matter and oval to round 5- to 50-mm crystalline particles (Fig 2). The particulate matter and oval crystalline structures stained positive for calcium salts with the Von Kossa stain. Rare fragments of particulate matter were birefringent when viewed with polarized light. These fragments were extracellular and had a linear to shard-like configuration. The fibrous capsule had multiple intramural granulomas and an inner layer of reactive fibroblasts, epithelial macrophages, lymphocytes, and mast cells. Results of histochemical staining for bacteria and fungi were negative. The final diagnosis was a foreign body granuloma, most likely secondary to particulate debris.

The owner declined to return to the teaching hospital for scheduled reevaluations, as the dog’s clinical signs had resolved. Telephone consultation with the owner 9 months after surgery indicated the dog was defecating and urinating normally. The dog was no longer receiving anti-inflammatory medication or stool softeners. The owner considered the function of the left hind limb to be excellent.

Reported complications associated with THA in dogs include venous embolism, femoral medullary infarction, luxation, periprosthetic fracture, sciatic neuropraxia, infection, aseptic loosening, and osteosarcoma.3-8 Complications in dogs are similar to those reported for human patients undergoing THA.9,10 Intrapelvic complications of THA in human patients are rare and include obturator neuropathy, sciatic neuropathy, fistula formation, false aneurysm, hemorrhage, and intrapelvic mass formation.11 Neuropathies and compressive masses in the pelvic inlet are typically associated with extrusion of large volumes of PMMA through a defect in the medial acetabular wall or with medial migration of the acetabular component.12,13 False aneurysms and hemorrhage are associated with acute intraoperative or chronic postoperative trauma to the vasculature, most commonly involving the external iliac artery.14 Intrapelvic mass formation is the least common of all intrapelvic complications following THA in humans, representing only 3 of 50 (6%) intrapelvic complications in a recent meta-analysis.15
and in those patients, it took years for the intrapelvic mass to form, with time from surgery to diagnosis of an intrapelvic mass ranging from 120 to 204 months.\(^\text{13}\) In the dog described in the present report, clinical signs of an intrapelvic mass were not evident until 6 years after THA.

Most intrapelvic masses in humans that have undergone THA have been synovial cysts that developed in response to an accumulation of polymer wear debris.\(^\text{14-16}\) These synovial cysts were lined with epithelium, contained synovial fluid, and were continuous with the hip joint capsule. Other isolated case reports\(^\text{17,18}\) described a granulomatous mass that formed secondary to polyethylene wear products. In 1 of these patients,\(^\text{19}\) the intrapelvic mass communicated with the acetabular wall, and the acetabular component was loose. However, accumulation of polyethylene debris may be a result of wear at the articular surface and may not always be associated with implant loosening.\(^\text{20}\)

The intrapelvic mass in the dog described in the present report was not lined by epithelium and appeared to originate from the medial aspect of the acetabulum; it did not appear to communicate with the joint capsule.

Histologic findings in the dog described in this report were most consistent with granuloma formation secondary to a foreign body response. The foreign body reaction appeared to originate from the mass of PMMA that had extruded through the defect in the medial acetabular wall during THA. Polyurethane methacrylate has been shown to be cytotoxic to macrophages, fibroblasts, and osteoblasts, and these cytotoxic actions presumably contribute to granuloma formation.\(^\text{21}\) Smaller particles stimulate a greater foreign body response and more rapid inflammatory reaction, in contrast to bulk PMMA, which induces a chronic response that develops over a period of years.\(^\text{22}\) The granuloma described in this dog could have represented a response to bulk PMMA that was extruded into the pelvic canal, although the massive foreign body response and the presence of particulate matter during light microscopy would suggest that a particulate stimulus is more likely. Particulate debris may originate from wear at the articular surface or abrasion at the bone-cement or implant-cement interface or the articulation between modular components.\(^\text{23}\)

Subsequent to our examination of the dog described in the present report, a report\(^\text{24}\) of 6 dogs with a similar long-term complication, termed extraosseous cement granulomas, was published. One dog in that series developed an intrapelvic granuloma secondary to perforation of the medial wall of the acetabulum during revision surgery. Gross and histologic changes described in association with the extraosseous cement granulomas were nearly identical to those described in the present report, including observation of birefringent particulate debris with polarized light. Scanning electron microscopy and energy-dispersive X-ray spectroscopy performed in 2 of the dogs with extraosseous cement granulomas confirmed the presence of wear products from multiple components, including PMMA, ultrahigh molecular weight polyethylene, and titanium. However, all of the dogs in the previous report\(^\text{24}\) had moderate to severe lameness and radiographic evidence of aseptic loosening of the femoral component. Thus, the granulomas were hypothesized to represent a late complication of severe aseptic loosening of the femoral stem.

Morphologic and elemental analyses of the particulate debris were not available for the dog described in the present report. Thus, the source of refractile particulate matter in the intrapelvic granuloma cannot be determined. It is possible that the particulate debris resulted from wear at the articulating surface or from particles generated at the bone-cement interface that traveled into the pelvic canal via the acetabular wall defect. The dog was not appreciably lame on the affected limb when examined because of tenesmus, and although mild osteolysis was seen at the bone-cement interface in the acetabulum, there was no evidence of aseptic loosening of the femoral stem.\(^\text{25}\)

On the contrary, the pattern of osteolysis at the acetabular bone-cement interface in this dog was comparable to that described in a human patient with a late foreign-body response to polyethylene debris produced by wear.\(^\text{14}\) In another human patient with an uncemented prosthesis, a large intrapelvic granuloma developed in association with polyethylene wear products.\(^\text{26}\) In this patient, there was no evidence of acetabular component loosening, and the cup was preserved during resection of an intrapelvic cyst.\(^\text{27}\) Thus, clinical and radiographic signs in the dog described in the present report would suggest that as in human beings, extraosseous cement granulomas may develop secondary to wear debris and may occur in the absence of aseptic loosening of the femoral stem.

Extrusion of PMMA into the pelvic inlet through a defect in the medial acetabular wall is a frequent and typically benign complication in humans undergoing cemented THA, although it has been associated with injury to intrapelvic organs and neurovascular structures.\(^\text{28,29}\) Occasionally, surgeons will purposely penetrate the medial acetabular wall to assess the thickness of the medial acetabulum during reaming.\(^\text{30}\) The acetabular defect may then be filled with cancellous bone graft harvested from the reamers used during acetabular preparation.\(^\text{31}\) Although intrapelvic complications are rare, avoiding penetration of the medial acetabular wall may further reduce the chances of complications following THA.

References

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