As cancer therapy continues to evolve, many patients are living longer with metastatic lesions of the skeleton. Typically arising from lung, breast, prostate, or renal cancer, these lesions can be a debilitating source of pain, as well as a risk for fracture and life-altering mobility issues. Among the common sites of disease, acetabular metastases can be particularly challenging, given the importance of this weight-bearing region for ambulation and the complexity of restoring a structurally strong joint surface. Osteolytic destruction from metastasis weakens the acetabulum, which in turn can lead to significant pain and risk of pathologic fracture. A variety of nonsurgical management options including chemotherapy, osteoclastic inhibition, and radiation therapy typically are used, but these may fail to contain the disease and its symptoms. Many osseous lesions have variable responses to chemotherapy alone, and although symptoms can sometimes be controlled by medications such as bisphosphonates, lesions often will progress and cause significant disability.

Percutaneous Acetabuloplasty for Metastatic Lesions to the Pelvis

RYAN A. DURFee, MD; SCOTT A. SABO, MD; G. DOUGLAS LETSON, MD; ODION BINITIE, MD; DAVID CHEoNG, MD

abstract

Metastatic lesions of the acetabulum can be painful and debilitating. First-line treatment is multimodal and consists of disease-specific chemotherapy, osteoclastic inhibitors, analgesics, and radiation therapy. When these therapies fail, surgical intervention usually is indicated and varies from regional defect stabilization to large periacetabular reconstructions that are demanding procedures with high rates of complications. Percutaneous cement augmentation (acetabuloplasty) of lesions in selected patients has been explored as a less invasive method of lesional control. This retrospective review included 11 patients with painful periacetabular lesions who underwent percutaneous acetabuloplasty using fluoroscopic guidance from 2007 to 2012, in addition to standard treatment with either radiation or chemotherapy, or a combination of both radiation and chemotherapy. Primary tumors included 4 multiple myeloma, 4 renal cell, and 3 breast malignancies. Mean procedure length was 58.4 minutes, and mean hospital stay was 1.4 days (range, 1-2 days). Mean blood loss was 33.4 mL, and there were no complications due to infection or cementation. Mean follow-up was 26.4 months (range, 3-36 months), with 2 patients dying from complications of underlying disease. All of the patients experienced pain relief following the procedure, with mean visual analog scale scores improving from 7.7 to 2.1 (P=.002). Postoperative Musculoskeletal Tumor Society and Oxford hip scores were obtained for 7 of 11 patients and demonstrated improvement. One patient underwent conversion to an acetabular reconstruction due to disease progression. This report demonstrates the effective use of a minimally invasive procedure to provide acute stability, pain relief, and good functional outcomes in patients with periacetabular metastatic lesions without pathologic fracture. [Orthopedics. 2017; 40(1):e170-e175.]
Adjuvant radiation is useful to slow or halt lesion expansion and decrease tumor-related pain but lacks the ability to restore mechanical support and has significant soft-tissue effects. Lesions that progress despite these treatments can lead to pathologic fracture, precluding safe weight bearing and decreasing both quality of life and life expectancy in patients who may already be in poor health. In many cases of conservative management, the expected return to full weight bearing may exceed a patient’s life expectancy, and in cases of radiotherapy treatment, structurally significant osseous recovery may never occur.

For these reasons, some patients with significant acetabular destruction will be candidates for reconstructive surgery. In 1981, Harrington reported on the reconstruction of metastatic acetabular fractures in 56 patients using cemented acetabular components combined with Steinmann pins and acrylic cement reinforcement. This method has been modified by different authors but still remains the gold standard for acetabular reconstruction in the setting of significant metastatic disease. Although reported outcomes are generally successful at restoring function, the surgery requires a complex reconstructive effort on patients who typically are very ill. For this reason, some patients who have significant disease of the acetabulum may not be suitable candidates for the procedure or they may desire a less invasive stabilization method.

Similar to the acetabulum, metastatic disease of the spinal skeleton frequently is painful and debilitating. Although excision and reconstruction may be an option for some patients, many undergo vertebroplasty and balloon kyphoplasty of the affected area for pain relief. Several studies in the literature have reported pain reduction and return to function using such techniques and a few authors have published results using similar cementoplasty techniques in extraspinal osseous sites for relief of pain from metastasis. The current authors have used percutaneous cement augmentation (acetabuloplasty) as a minimally invasive alternative to acetabular reconstruction for patients who have metastatic involvement of the peri-acetabular area, without fracture or loss of the integrity of the acetabular surface.

**MATERIALS AND METHODS**

After receiving institutional review board approval, data were collected retrospectively on patients treated between 2007 and 2012 at a single institution for metastatic disease of the acetabulum. Patients were included if they had 1 or more metastatic lesions involving or in close proximity to the acetabulum and underwent percutaneous cement augmentation (acetabuloplasty) of these lesions. Diagnosis was obtained with biopsy either before or at the time of procedure. All procedures were performed by one of the senior authors (D.C.) after a full discussion of the risks, benefits, and alternatives of the procedure. In addition, all of the patients continued to undergo either radiation or chemotherapy, or both radiation and chemotherapy as recommended for treatment for their underlying disease. Patients were excluded if they had a fracture of the ilium or acetabulum at the time of diagnosis, lesional involvement of the femoral head, or a diagnosis other than metastatic cancer.

A total of 11 patients who underwent the procedure and had mean follow-up of 20 months (range, 3-36 months) from the time of the index procedure met the inclusion criteria and comprised the study population. Postoperatively, patients were assessed for a number of outcome factors including postoperative complications, pain reduction using a visual analog scale, ambulatory status, need for additional procedures, and overall survival. In addition, several of the patients had completed Oxford and Musculoskeletal Tumor Society (MSTS) assessments at their most recent follow-up visits.

All of the procedures were performed with the patient either supine or lateral on a radiolucent table, with positioning determined by lesion location. For lesions of the superior or anterior dome, an anterior percutaneous incision was made over the anteroinferior iliac spine. A trocar then was introduced into the lesion under fluoroscopic guidance. If not already performed, biopsy of the lesion was performed at this time as well. Next, using Kyphon balloon kyphoplasty equipment (Medtronic Inc, Minneapolis, Minnesota), the balloon was inflated, and the cavity lesion was filled with Kyphon bone aug-
feature article

mentation cement (Medtronic Inc). The filling process was visualized under fluoroscopy to confirm completeness of defect ablation and to ensure there was no cement extravasation into the joint. For lesions of the posterior or inferior acetabulum, a similar procedure was used from a minimally invasive ischial incision. Near complete filling of the defect was visualized radiographically for all patients (Figure 3).

Patients were admitted for observation following the procedure, and weight bearing was allowed as tolerated.

RESULTS

Ten patients underwent the procedure, and 1 patient underwent the procedure with the addition of an intramedullary nail for prophylactic fixation of the ipsilateral femur. Mean patient age was 50 years (range, 25-69 years). Mean follow-up was 26.4 months (range, 3-36 months), and 2 patients died before last follow-up. Pathology of the patients included multiple myeloma, breast, and renal cell primary cancers. Demographic and surgical data are listed in Table 1.

All of the patients underwent adjuvant chemotherapy, and 7 patients received adjuvant radiation. In 2 cases, radiation was performed both pre- and postoperatively. Mean duration of surgery was 58.4 minutes, with the exception of the patient who also received intramedullary nailing. Mean blood loss was 33.4 mL (range, 0-150 mL). Mean length of hospital stay was 1.4 days (range, 1-2 days), and all of the patients were allowed to bear weight as tolerated using a variety of ambulatory aids.

At study completion, 2 patients had died from underlying disease, and 2 patients required additional surgery for their acetabular disease. One procedure was performed for disease progression and required a Harrington-type acetabular reconstruction with a cage construct; although the procedure was regarded as successful, the patient died of underlying disease (Figure 4). The second patient elected to undergo an additional acetabuloplasty procedure at the same site due to persistent pain with successful pain relief.

Table 1: Patient Demographics

<table>
<thead>
<tr>
<th>Patient No./Sex/Age, y</th>
<th>Diagnosis</th>
<th>Length of Surgery, min</th>
<th>Blood Loss, mL</th>
<th>Length of Stay, d</th>
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<td>20</td>
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<tr>
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<td>Myeloma</td>
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<td>150</td>
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<td>25</td>
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</tr>
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<td>1</td>
</tr>
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<td>1</td>
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<tr>
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<td>54</td>
<td>25</td>
<td>2</td>
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<tr>
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Figure 2: Clinical photograph of the procedure showing the trocar inserted into the superior acetabulum (A). Fluoroscopic image showing trocar placement inside the defect (B). Fluoroscopic image showing the use of an inflated balloon to create space and help define the empty volume of the defect (C). Fluoroscopic image showing the defect after cement has been injected and the trocar removed (D).

Figure 3: Postoperative anteroposterior radiograph showing the defect in Figure 2. Although the cement does not appear to fill the entire defect, the patient experienced durable pain relief.
The remaining 9 patients (82%) did not undergo any subsequent procedures for their acetabular disease; however, 1 patient continued to have significant pain, and reconstruction was proposed.

All of the patients reported decreased pain scores compared with preoperative levels; mean visual analog scale scores improved from 7.7 to 2.1 ($P=0.002$) (Table 2). Six patients (55%) reported postoperative pain levels of zero or 1 (Table 2). No complications related to either the cement placement or infection occurred. Oxford Hip Scores and MSTS scores were obtained during postoperative office visits for 7 patients. The average Oxford Hip Score was 29, and the average MSTS score was 20.57. Six of these 7 patients reported Oxford Hip Scores above 44 and MSTS scores above 28, with 1 patient reporting very low scores due to persistent pain. Most patients also were able to decrease their reliance on ambulatory aids following the procedure.

**DISCUSSION**

Acetabular metastases are common, painful, and debilitating lesions that are challenging to treat. Although many will respond initially to medical therapy, most eventually progress without further treatment. Radiation therapy has become a mainstay for the treatment of these lesions, but 12% to 30% of patients ultimately will not experience pain relief from radiotherapy and medication alone. Surgery is indicated when nonoperative measures fail but remains a large and invasive undertaking in patients who often have complex medical issues and a shortened life expectancy. For this reason, many patients with significant pain are not candidates for reconstruction, and percutaneous acetabuloplasty may represent another treatment option for lesions that are contained and a significant source of pain.

The use of polymethylmethacrylate (PMMA) cement to fill painful and lytic lesions in bone has been well studied in the spinal literature and has an established history of reducing the pain attributable to bone lesions in these patients. Use of PMMA outside of the spine was reported by Cotton et al in 1995 and subsequently has been shown to reduce pain from metastases throughout the axial and appendicular skeleton. The current results corroborate these findings, with the majority of patients experiencing significant pain reduction and only 1 patient requiring eventual reconstruction. This is consistent with previous reports of acetabuloplasty.

In the current study, all of the patients maintained their level of pain reduction for an average of 20 months, which is longer than previous reports. The primary limitations of this study are its retrospective nature and small size. Diagnosis, surgical data, and visual analog scale scores were collected from patient records after procedures were performed. Patients then were approached at follow-up visit or contacted by phone and asked to come in for further assessment scores (Oxford Hip Score and MSTS scores). However, some patients were unable or unwilling to undergo further assessment with these tools, and scores were not obtained for these patients.

The small size of the study population is another limitation and is reflective of the initial scarcity of this procedure in the first several years of the review, as this was still an investigative technique. To qualify as a candidate for this procedure, patients had to have an acetabular lesion in an early stage or a significant health risk that contraindicated a full reconstruction.

**Figure 4:** Preoperative anteroposterior radiograph (A), intraoperative fluoroscopic image (B), and immediate postoperative anteroposterior radiograph (C) showing a large defect of the superior and posterior acetabulum treated with percutaneous acetabuloplasty. Postoperative anteroposterior radiograph showing progression of the lesion (D). Unfortunately, anteroposterior radiographs 3 months postoperatively showed progression of disease (D) and the patient was converted to acetabular reconstruction with a cage and cement construct (E).
Finally, there was no control group; however, patients experienced significant pain relief compared with pre-procedure levels, and most did not require further procedures during the study period. Despite these limitations, this report shows a clinically significant pain reduction in patients undergoing percutaneous acetabuloplasty. As more procedures are performed, the authors plan to continue evaluating and improving this technique, offering patients with painful metastases an alternative to surgery when conservative efforts fail to alleviate pain.

For the past 30 years, surgical reconstruction of the acetabulum has been the standard procedure to treat symptomatic lesions that fail medical treatment and radiotherapy. Although its efficacy in reducing acetabular pain from metastases is well established, the procedure is time consuming and technically demanding, and requires extended hospitalization. It routinely requires extensive dissection and necessitates use of a total hip arthroplasty, with or without acetabular modifications and cement augmentation (Harrington technique). There are significant risks such as major bleeding, wound infection, and early or late dislocation. In their report of the modified Harrington technique at a large-volume cancer institution, Marco et al reported an average estimated blood loss of 2200 mL and an average hospitalization length of stay of 24 days.

Comparatively, the minimally invasive acetabuloplasty used in this study demonstrated no increased risk of dislocation and a negligible infection rate, as there was no sizable incision. The procedure often resulted in less than 50 mL of blood loss and less than 1 hour of operative time. Patients were allowed weight bearing as tolerated and often were discharged from the hospital on the first postoperative day. Pain scores were decreased after the procedure, and many patients were able to recover or maintain ambulation with assistive devices. Marco et al reported a 34% mortality of their patients within 6 months due to underlying disease. In patients with shortened life expectancy, a quick recovery can be important. The results of the current study show that acetabuloplasty can be undertaken in a safe manner and result in significant pain relief and a short hospital stay for patients undergoing the procedure.

Acetabuloplasty remains a minimally invasive procedure that is designed for a specific patient and level of disease. Lesions of the acetabulum must be contained to properly benefit from percutaneous cement treatment. The single patient in this series who required acetabular reconstructive surgery had a lesion that was identified as an uncontained acetabular lesion after careful study. Cortical destruction of the acetabular columns did not allow for sufficient support of the remaining bone by the addition of cement. This case highlights the importance of proper patient selection for the procedure.

In addition to their lesional stabilization, all of the patients underwent disease-specific chemotherapy and radiation treatment dependent on their underlying prima-

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**Table 2**

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Preoperative</th>
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*Abbreviation: MSTS, Musculoskeletal Tumor Society.*

*MSTS and Oxford Hip scores were not able to be obtained for all patients (marked as -).*
ry tumor. Because the procedure involves only a small incision and minimal soft-tissue dissection, adjuvant therapy could be started quickly postoperatively without increased concern for wound problems. In the current series, all of the patients underwent chemotherapy and 6 patients underwent radiation; there were no cases of wound breakdown or infection. The procedure allows for timely administration of chemotherapy and radiation that is critical for controlling metastatic disease, without the concern for wound problems that would be present with full reconstruction.

**CONCLUSION**

Metastasis to the acetabulum remains a challenging problem in patients who often are struggling with a larger disease process. A minimally invasive option, when available, presents an opportunity to address the disease with only slight disruption of the patient’s routine and ongoing treatment. Percutaneous acetabuloplasty is a safe and minimally invasive procedure that offers significant pain relief and also avoids some of the risks of open reconstruction. It can be combined with current regimens for chemotherapy and radiation, without a gap in treatment, and may have a role in preventing further procedures.

**REFERENCES**


