PERCUTANEOUS VERTEBROPLASTY TREATMENT OF
STERROID-INDUCED OSTEOPOOROTIC COMPRESSION FRACTURES

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This report describes the case of a woman in whom multiple compression fractures of the lower thoracic and lumbar spine occurred in association with long-term corticosteroid therapy for systemic lupus erythematosus. Pain markedly limited the patient's mobility and daily activities, and conservative therapy with bracing and narcotic analgesics gave little improvement. Affected vertebrae were treated with polymethylmethacrylate, introduced percutaneously under fluoroscopic guidance. The resulting reinforcement of the fractured vertebral bodies eliminated the pain and the need for narcotic analgesics. The utilization of percutaneous vertebroplasty as a therapeutic alternative for the treatment of pain resulting from osteoporotic compression fractures is described.

Age-related osteoporotic compression fractures occur in more than 500,000 patients per year in the US and are more frequent than fractures of the hip (1). Osteoporosis is also a major problem in women with systemic lupus erythematosus (SLE). In one study of women with SLE, most of whom were premenopausal, only 36% had normal bone mineral density by dual x-ray absorptiometry. Predictors of low bone mineral density included age, race (white), lower weight, lower serum C4 level, and highest daily prednisone dosage (2). The cumulative prednisone dose was also associated with later osteoporosis. Fracture was not infrequent, and only 25% of the fractures were associated with any trauma. Vertebral fractures were second in frequency to fractures of the hip and femur (2).

Although efforts to prevent corticosteroid-induced osteoporosis, including calcium and vitamin D supplementation, exercise, smoking cessation, and bisphosphonates and calcitonin treatment, have been emphasized, patients may still present with compression fractures, requiring pain control and management. Acetaminophen, nonsteroidal antiinflammatory drugs (NSAIDs), narcotic analgesics, and bracing are helpful for initial pain management. Protracted immobilization has the potential of causing secondary complications such as atelectasis, pneumonia, and/or pulmonary embolus.

Percutaneous vertebroplasty has recently been introduced as a therapeutic alternative for the treatment of pain associated with compression fractures (3-5). Herein we describe a patient who developed multiple debilitating compression fractures associated with high-dose corticosteroid therapy for SLE. Ultimately, 7 lower thoracic and lumbar vertebrae were injected percutaneously with polymethylmethacrylate (PMMA), resulting in a marked reduction in pain and improvement in mobility. This case is unique because of the number of involved vertebrae that were treated by percutaneous vertebroplasty. The clinical features and technique of percutaneous vertebroplasty are described.

CASE REPORT

The patient was a 36-year-old white woman with SLE of 10 years duration. She had previously had 3 pregnancies, of which 2 had resulted in live births and 1 in spontaneous abortion. Initial manifestations of SLE included polyarthritis, fever, lymphadenopathy, malar rash, photosensitivity, mouth ulcers, Raynaud’s phenomenon, headache, and leukopenia. She had had multiple bouts of meningitis (culture-negative with cerebrospinal fluid protein >100 mg/dl) and scleritis. Her serologic symptoms had included antinuclear antibodies at a titer of 1:2,560 (fine speckled and homogeneous pattern), anti-double-stranded DNA, anti-Sm, anti-RNP, low C3, low C4, and high erythrocyte sedimentation rate. Serum calcium, phosphorus, and alkaline phosphatase levels had been normal. The patient was a nonsmoker. Past
treatment included prednisone since diagnosis, with the highest dosage of 250 mg/day intravenously for 7 days during hospitalization and the highest oral dosage of 60 mg/day for >1 month. Additional therapy included hydroxychloroquine and NSAIDs. At the time of presentation with her first vertebral compression fracture, she was taking prednisone 12.5 mg daily. The compression fractures were first noted 3 months after her last pregnancy, when she presented with acute pain. Initial conservative treatment included morphine, transcutaneous electronic nerve stimulation, and calcitonin, initially given subcutaneously and then intranasally. These were largely unsuccessful at controlling pain, and the patient experienced increasing debilitation during the ensuing 3 months. She became progressively less mobile and required assistance in getting out of bed.

Alternatives to vertebroplasty, ranging from conservative analgesic therapy to orthopedic reconstructive surgery, were discussed with the patient and her family. Conservative therapy was providing no recognizable improvement, and percutaneous vertebroplasty was selected as the treatment modality. The procedure and materials are approved by our institutional review board. Three outpatient percutaneous vertebroplasty procedures were performed, beginning with the most symptomatic spinal region.

The vertebroplasty was performed after the patient was sedated with intravenous fentanyl (Sublimase, Abbott Labs; Chicago, IL) and midazolam (Versed, Roche; Manati, Puerto Rico). Blood pressure, electrocardiographic readings, and oxygen saturation were monitored continuously. The patient was given 1 gm of cefazolin intravenously immediately prior to the procedure. She was placed in a prone position on a high-resolution angiographic table capable of biplane imaging. The involved vertebrae were identified and the overlying skin prepared and draped in a sterile manner. Local anesthesia was applied to the skin and deep structures, including the periosteum of the bone at the intended site of entry by the bone needle. Biplane fluoroscopic guidance allowed the placement of an 11-gauge Jamshidi bone biopsy needle (Manan Medical; Northbrook, IL) via a transpedicular approach to approximately the junction of the anterior and middle thirds of the vertebral body (Figures 1A and B). Intravascular venography was performed through the 11-gauge needle, using ~5 cc of non-ionic x-ray contrast medium (Omnipaque 300, Nycomed; Princeton, NJ) to assess the flow characteristics within the vertebral body and to determine if there were abnormally large or dangerous communications with the epidural space or inferior vena cava (Figures 2A and B). Polymethylmethacrylate (Codman cranioplastic, CMN Laboratories; Blackpool, England) was prepared by adding the sterile opacification agent barium sulfate (E-Z-EM; Westbury, NY), which allowed visualization during fluoroscopy. The useful working time of the PMMA is 5–10 minutes. Careful monitoring of the PMMA during in-
A

Figure 2. Lateral (A) and anteroposterior (B) digital subtraction images from an intraosseous venogram, revealing typical intratrabecular fillings (arrows). There is subsequent outflow of contrast to paravertebral veins (arrowheads).

jection is required in order to recognize any flow into an undesirable location such as the epidural space or inferior vena cava. Approximately 2.5–5 cc of PMMA was injected into each half of the vertebral body via separate, bihemispheric injections (Figures 3A and B). For each vertebral level treated, the procedure time was \( \sim 1 \) hour. A total of 7 vertebral levels were ultimately treated in the 3 outpatient settings (Figures 4A and B).

At the termination of each procedure, the patient was transferred to a holding area and monitored for 2–3 hours before discharge. She experienced soreness over the puncture site for several days after the procedure; this was managed with oral analgesics. Relief of the pain associated with the compression fracture itself is usually noted within the first 24 hours following the procedure. This improvement occurred in our patient, with each treatment resulting in a progressive reduction in local pain and an increase in mobility. Her functional ability improved from being unable to get out of bed without assistance to resumption of routine activities in the home, as well as part-time profes-

B

Figure 3. Lateral (A) and anteroposterior (B) radiographs, showing the L4 vertebra after bi-hemisphere injections of polymethylmethacrylate. (A needle is seen in L5 prior to injection at that level.)
markedly impact quality of life. Conservative therapy with external bracing, bed rest, and analgesics may be all that is necessary for pain control in some patients. However, severely osteoporotic patients may experience protracted or ongoing pain even with these measures. Additionally, they may have multiple vertebral compressions as were found in our patient. Percutaneous vertebroplasty offers a unique method for pain management, which has not previously been widely described or utilized in this patient population.

PMMA has been used in spine stabilization for metastatic disease in prior series (6–8) and for the treatment of primary bone lesions such as hemangiomas and giant cell tumors (9,10). The percutaneous injection of PMMA into a collapsed or partially destroyed vertebra is a relatively new procedure first described in the French literature (3,4,11–14). The PMMA used for this procedure is FDA approved for cranial defect reconstruction, but is used “off label” for intracavitary injection into a collapsed vertebra.

Reports of small series of patients have noted a high degree of pain relief and few associated complications (3,13,14). Infection is an obvious potential concern but has not been reported as an actual complication. Treatment of infection would require intravenous antibiotics at a minimum, and possibly surgery and drainage. Compression of adjacent neural structures by PMMA has not been a problem in osteoporotic fractures. In cases of metastatic destruction of portions of the vertebral wall, confinement of the PMMA within the vertebral body is more difficult, but still the number of symptomatic complications remains low (13,14). Extravasation of PMMA may result in nerve root or cord compression, according to the site of deposition. Radicular symptoms may be transient, but surgical removal of unwanted cement has been reported in cases of persistence of symptoms (13,14). No report of breakdown or chronic extrusion of PMMA has been reported. Additionally, PMMA has been used for more than 2 decades for bone augmentation and prosthesis implantation. It is well tolerated by bone but is not thought to be osteoconductive or remodeled by bone. A more physiologic agent that could be converted or incorporated into bone would obviously be preferred in a young patient such as the one described herein. This may be less of a practical concern in elderly patients in whom percutaneous vertebroplasty is deemed appropriate.

The need for appropriate opacification of the PMMA and high-resolution fluoroscopic monitoring during injection for the avoidance of complications cannot be overemphasized. There have been prior re-

Figure 4. A and B, Lateral radiographs obtained immediately after the final percutaneous vertebroplasty procedure, showing polymethylmethacrylate in 7 vertebrae from T11 through L5.

DISCUSSION

Osteoporotic compression fractures may result in persistent, severe pain. This can limit mobility and marked responsibilities outside the home. This improvement was further documented by the elimination of the need for narcotic analgesics. The patient has been followed up for 9 months after vertebroplasty and continues to have good pain control and mobility without narcotic analgesic treatment.
Percutaneous vertebroplasty is a minimally invasive procedure for the treatment of vertebral compression fractures. The technique involves the injection of polymethylmethacrylate (PMMA) into the vertebral body through a needle inserted percutaneously. This injection is guided by a combination of CT and fluoroscopy, allowing for precise placement of the acrylic cement into the fractured vertebra.

The procedure is typically performed under general anesthesia, and the patient is placed in a prone position. A small incision is made in the skin over the vertebral body, and a needle is inserted under fluoroscopic guidance. The PMMA is then injected into the vertebra, and the needle is removed. The goal is to fill the void created by the fracture with the acrylic cement, which hardens rapidly and provides immediate pain relief and stabilization of the vertebral body.

In conclusion, percutaneous vertebroplasty was successfully applied at multiple spinal levels in our patient to alleviate severe pain associated with corticosteroid-induced osteoporotic compression fractures. This technique offers a new therapeutic option for pain relief in appropriately selected cases when conservative or more conventional therapy has failed.

REFERENCES