Retrospective Study

Single Level Percutaneous Vertebroplasty for Vertebral Hemangiomata — A Review of Outcomes

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Disclaimer: There was no external funding in the preparation of this manuscript.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted manuscript.

Manuscript received: 12-04-2019
Revised manuscript received: 03-20-2020
Accepted for publication: 05-06-2020

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Background: Percutaneous vertebroplasty is a minimally invasive technique to treat patients with symptomatic vertebral hermangiomata.

Objectives: We present a single-operator series of cases to demonstrate the clinical outcomes and complication profiles for this technique.

Study Design: This is a retrospective multi-center cohort study.

Setting: Procedures were performed across multiple hospitals in Italy by a single proceduralist.

Methods: All patients with symptomatic vertebral hermangiomata that had percutaneous vertebroplasty over a 14-year period (March 1999 to April 2013) by a single proceduralist were included in this study. Information collected included demographic data, vertebral level of intervention, cement volume used, and the Visual Analogue Score for pain that was assessed pre- and post-intervention. Patients were followed up for a minimum of one year.

Results: Percutaneous vertebroplasty was performed for 50 patients. All patients had an improvement in pain, with 39 patients (78%) reporting complete pain relief. A unipedicular approach was undertaken in 41 cases (82%), and bipedicular approach in 8 patients (16%), while a transoral approach was used in one patient. The mean cement volume per vertebral level was 6.8 mL (1 – 18 mL). Recurrent symptoms occurred in 2 patients (4%) requiring repeat vertebroplasty. There were no cases of symptomatic cement leak, and no cases of procedural morbidity or mortality.

Limitations: As a multicenter study conducted over a 14-year time period, there may be heterogeneity in procedural technique and rehabilitation protocols. There were no cases of cement leakage in our study, which could be an underreporting of cases. This is could be due to none of our patients receiving a post procedural computerized tomography scan, which is more sensitive in detecting cement leakage when compared to procedural fluoroscopy.

Conclusion: Percutaneous vertebroplasty is associated with good post-procedural outcomes in patients with vertebral hermangiomata. Complications such as neurological injury and cement leakages are rare.

Key words: Hemangioma, interventional, radiology, spine, vertebroplasty

Pain Physician 2020: 23:E637-E642

Vertebral hermangiomata (VH) are a venous cavernous malformation, and were first described in 1933 by Barnard and Van Nuys (1). It is the most common type of benign vertebral tumor, commonly occurring in the thoracic spine, with an estimated incidence of 10% – 12% (2,3), of which only approximately 0.9% – 1.2% of cases are symptomatic (4-6).

Symptomatic hermangiomata with neurological involvement can be managed surgically — with decompression of the lesion and transpedicular injection of cement, or via removal of vertebral body with bone grafting (7).

The use of percutaneous vertebroplasty, which involves injection of polymethylmethacrylate (PMMA) cement into a compressed vertebral body, was first described in 1987 for symptomatic VH (8). It has since been more commonly used in osteoporotic compression fractures of the vertebral body, and also for spinal metastases and myeloma. The procedure provides pain relief as well as structural support for a compressed vertebral body (9). We aim to present the results of a multicenter experience of treating VH via percutaneous vertebroplasty.

Methods

All procedures were performed by a single proceduralist (GCA) and were performed at multiple sites over a 14-year period (March 1999 to April 2013). Only patients that had single-level vertebroplasty for an hermangiomata were included in this study.

Patients who underwent vertebroplasty were those that had first tried and failed non-operative management. All patients had a preoperative magnetic resonance image (MRI). Percutaneous vertebroplasty was performed under conscious moderate sedation, with hybrid digital fluoroscopic and/or computed tomography (CT) guidance (Allura X-per CT, Philips, The Netherlands).

All procedures involved injection of 1% lidocaine to the periosteum of the target vertebral body. A coaxial technique was utilized and all procedures involved a core biopsy to confirm the diagnosis of hemangioma. A 13-gauge bevel tip needle (Optimed, Germany) was advanced via the target pedicle and placed within the lesion of question. Both unipedicular and bi-pedicular approaches were taken PMMA cement was used to fill the cavity of the hemangioma via a cannula. All patients received prophylactic intravenous antibiotics post-operatively and all patients were discharged from the hospital the following day after observation. Post-operatively, patients were assessed for complications related to vertebroplasty. All patients were routinely followed up until one-year post-intervention, and visual analog scale (VAS) scores were gathered pre-operatively as well as at the one-year post-treatment follow-up.

Results

Demographics

Our series includes 50 patients (29 women and 21 men). The mean patient age at the time of the procedure was 55 years (SD = 15, range 21 – 79 years).

Vertebroplasty was performed for a total of 4 cervical, 20 thoracic, 24 lumbar, and 2 sacral vertebral levels. The most common vertebral levels being treated were L1 (7 cases – 14%), L4 (6 cases – 12%), and T11 (4 cases – 8%) as outlined in Table 1.

Intervention

A unipedicular approach was undertaken in 41 cases (82%), and bipedicular approach in 8 cases (16%), while a transoral approach was utilized in one patient with a C2 level lesion (Fig. 1). Figures 2-4 demonstrate unipedicular PMMA injection into a T12 vertebral body. Fluoroscopy guidance was used in all cases, while one

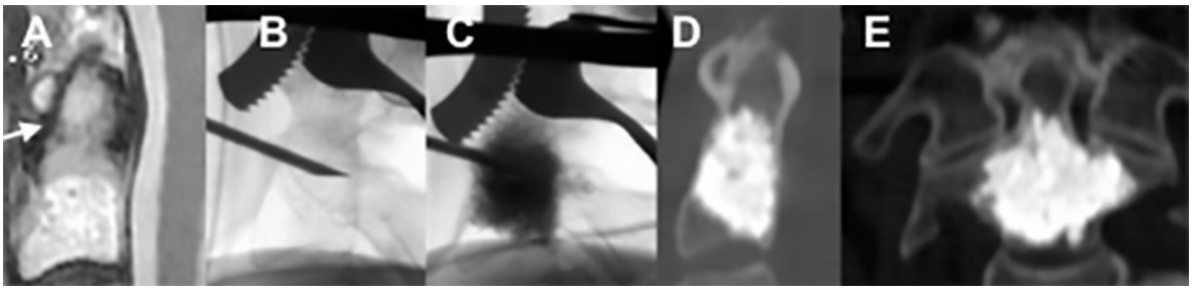

Fig. 1. *C2 symptomatic vertebral hemangioma. (A) T2 weighted MRI demonstrates a C2 hemangioma, (B) 13 gauge needle inserted into vertebral body through transoral approach, (C) cement injected, (D, E) post-procedural CT images demonstrates lesion being filled with cement.*

case also included CT guidance. The mean injected PMMA cement volume was 6.8 mL (range 1 – 18 mL). None of the patients had adjuvant treatment with polyvinyl alcohol (PVA) or pre-interventional embolization.

Outcomes

The mean pre-intervention VAS score was 7.0 (3 – 10) and mean post-intervention VAS at the one-year mark was 0.3 (0 – 3). The mean reduction in VAS score was 6.8 points (2 –9). All patients had an improvement in pain symptoms, with 39 cases (74%) reporting complete pain relief (VAS 0).

Complications

There were no cases of cement leakage noted. There were no cases of PMMA cement embolism or infection postoperatively. There were no instances of procedural morbidity or mortality. Two patients (4%) had further percutaneous vertebroplasty at the same level for recurrence of symptoms, leading to a limitation of their physical functional status. Both were due to incomplete filling of the initial VH and no complications were noted post revision surgery.

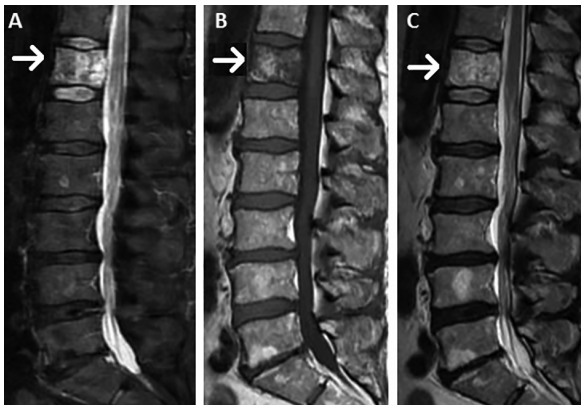

Fig. 2. *Pre-interventional MRI of T12 symptomatic hemangioma on (A) fat suppressed T2 weighted, (B) T1 weighted, (C) T2 weighted images.*

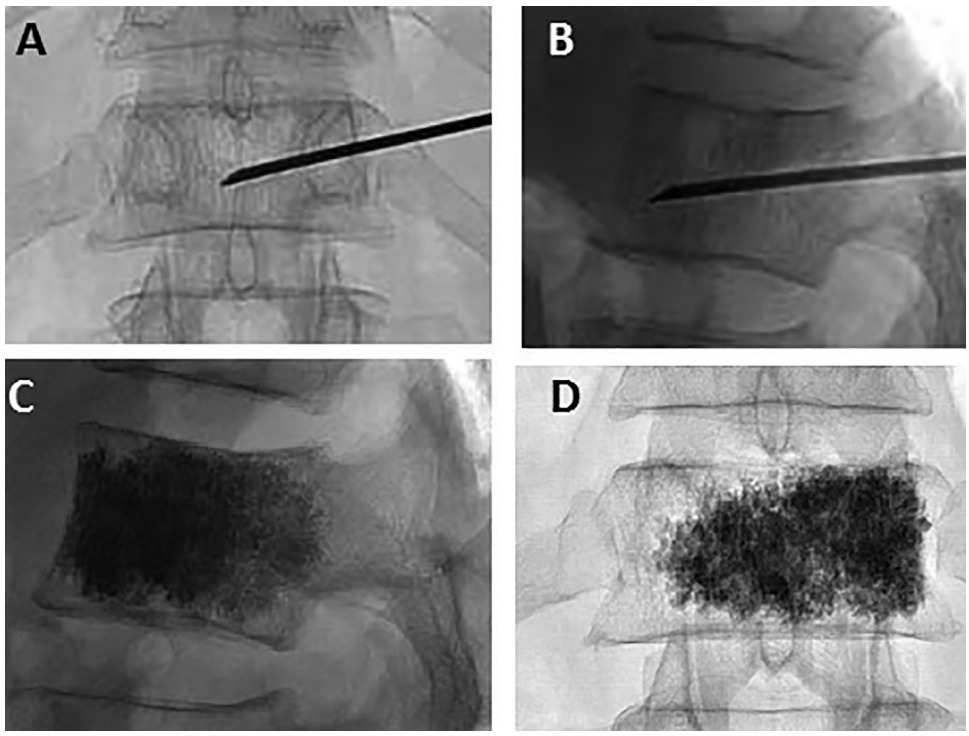

Fig. 3. *T12 hemangioma (A, B) Insertion of 13 gauge needle into T12 vertebral body hemangioma via a unipedicular approach, (C, D) Intra-procedural fluoroscopy demonstrating cement within the hemangioma. Note the spoke wheel appearance of the trabeculae in keeping with a vertebral hemangioma.*

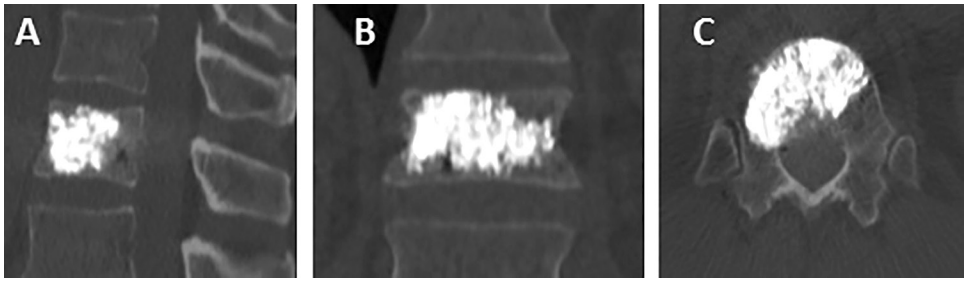

Fig. 4. *(A-C). Post-procedural CT scan showing adequate filling of the vertebral lesion.*

Table 1. *Vertebral regions and levels that underwent percutaneous vertebroplasty.*

Region	n (%)
Cervical	4 (8)
C2	1 (2)
C4	1 (2)
C5	1 (2)
C6	1 (2)
Thoracic	20 (40)
T3	3 (6)
T4	2 (4)
T5	2 (4)
T6	1 (2)
T8	2 (4)
T9	2 (4)
T10	1 (2)
T11	4 (8)
T12	3 (6)
Lumbar	24 (48)
L1	7 (14)
L2	4 (8)
L3	4 (8)
L4	6 (12)
L5	3 (6)
Sacrum	2 (4)
S1	1 (2)
S2	1 (2)

Discussion

We present the largest single-operator series of percutaneous vertebroplasty for VH. VH are the most common benign vertebral body lesion, and the vast majority are asymptomatic presenting as incidental findings on radiological imaging. Occasionally they may be symptomatic, and they are often managed conservatively with lifestyle modification and analgesia. In more severe cases where pain, quality of life, and mobility are impaired, intervention via percutaneous vertebroplasty may be warranted. Vertebroplasty involves the injection of PMMA cement percutaneously into the target lesion. In cases of pathological fracture, the PMMA cement fills the osseous defect and acts as a platform to stabilize vertebral body. Peak PMMA cement temperatures ranging from 44 to 113 degrees have been noted in cadaveric models which have been hypothesized to contribute to pain relief through the exothermic reaction of polymerization (10). This can cause thrombosis of the VH through the process of thermal necrosis (11) and may also result in ablation of perivertebral nerve endings. PMMA cement setting can also cause a compression effect, resulting in ischemia and tumor necrosis (12,13). Progressive thrombosis and destruction of tumor distant to the area of initial cement injection have been hypothesized to be secondary to this effect (14,15).

Indication

Guarnieri et al (16) classified VH into 4 main groups based on MRI findings. This includes (a) asymptomatic patients with no sign of aggressiveness, (b) symptomatic patients with no signs of aggressiveness, (c) asymptomatic patients with signs of aggressiveness, (d) symptomatic patients with signs of aggressiveness. Features of aggressiveness have been described as hypointensity on T1 and hyperintensity on T2-weighted MRI sequences with enhancement after contrast administration, involvement of epidural and perivertebral soft tissue, extension into the pedicles, irregular trabeculae, and cortical erosion (16,17). There is no indication for vertebroplasty in the first group. Vertebroplasty may be indicated in the second and fourth

groups if symptoms of lower back pain are present, while the third group should be monitored for progression of the lesion with serial MRI(s).

Vertebroplasty is more appropriate in the treatment of VH than kyphoplasty due to maintenance of vertebral architecture (14). Surgical management of VH is an option if neurological symptoms are present, due to nerve root or cord compression, requiring decompression (18); or if the vertebral structural integrity has been compromised, and cannot be safely stabilized via vertebroplasty, necessitating surgical stabilization. In these circumstances, pre-fusion vertebroplasty can be performed as an adjuvant procedure. A series of aggressive VH managed with surgical decompression noted that preoperative vertebroplasty can decrease bleeding (mean 1093 mL versus 1900 mL for patients that did not have vertebroplasty) due to the thrombotic effects of the injected PMMA. Vertebroplasty can also be used as a method of augmenting the vertebral body before undergoing subtotal surgical resection or stabilization, and can act as a load-sharing construct for spine stabilization (19).

Adjuvant treatment

Various adjuvant treatment options with vertebroplasty have been described. The monomer of PMMA can rarely result in anaphylaxis and hemodynamic instability. As a result, some techniques describe the injection of glucocorticosteroid before PMMA cement injection (20).

Ethanol ablation of vasculature with PVA, first described in 1994, is a recognized adjuvant option (21). As a sclerosing agent, ethanol can help to decrease the size of the VH as well as reducing blood loss during operative intervention (11,22,23). There is a potential for VH recurrence with post percutaneous vertebroplasty revascularization (22,23). Furthermore, spinal cord ischemia has been reported after percutaneous alcohol embolization for VH secondary to thrombosis of epidural veins and spinal cord vasculature (24). Hermangiomata are radiosensitive and radiotherapy can be an adjuvant treatment option (7,25,26). However, there is a risk of radionecrosis of the spinal cord and vertebral body, as well as a higher incidence of subsequent fractures (22). No patients in our series required PVA or preoperative radiotherapy.

Clinical outcome

All patients in our cohort had improvement of pain after vertebroplasty. Two patients in our cohort had a recurrence of symptoms during the follow-up period requiring re-do vertebroplasty. Similar excellent outcomes have been noted in the literature (11,14,16,20, 27,28). Similar to Guarnieri et al (16), patients in our cohort experienced symptomatic relief within 24 – 72 hours.

Complications

Risks of general surgical complications such as venous thromboembolism, bleeding, and infection remain rare in the vertebroplasty patient population (11,14,20). This is likely due to the minimally invasive technique and early mobilization of patients. The main complication of vertebroplasty is PMMA cement leakage as the cement is injected under pressure into the vertebral body hemangioma. The incidence of PMMA cement leakage reported in the literature is variable, with some studies describing detection of cement leakage in 14 out of 24 patients (29). Most PMMA cement leakage is minor and asymptomatic (9,14,27,29,30). Neurological complications from PMMA cement use in vertebroplasty are rare, but when they occur, necessitate surgical intervention (16,31,32). Hao and Hu (20) described one patient with PMMA cement leakage resulting in nerve root compression causing numbness, which required surgical intervention to decompress the nerve. Higher reported PMMA cement leak rates may be due to use of cement with increased density, but detection of leakage is also greater with the use of post procedural CT, which is more sensitive for small leaks when compared with fluoroscopy. Furthermore higher PMMA cement leak rates are noted in patients with epidural extension of the VH and with lesions requiring a higher volume of PMMA cement (11). A unipedicular approach is thought to result in increased PMMA cement leakage, due to increased local pressure in the area of intervention (32). Accurate transpedicular needle placement, avoiding low viscosity cement injection as well as controlling the pressure and rate of injection have been described as important techniques in preventing PMMA cement leakage (13,16,33).

Conclusion

Percutaneous vertebroplasty is safe and effective in the treatment of symptomatic vertebral hermangiomata with low risk of complications.

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