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Original article

Severe pathological fractures caused by vertebral hemangiomas with posterior decompression, bone cement augmentation and internal fixation

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ABSTRACT

Aim: To evaluate the treatment strategy for pathological fractures caused by vertebral hemangiomas (VHs) using large case series.
Methods: From January 2008 to January 2014, 28 patients suffering from severe pathological fractures (more than 2/3 loss of original vertebral height) due to thoracic or lumbar VHs were randomized to an experimental (the posterior decompression, bone cement augmentation and internal fixation, $n = 14$) or control (only the posterior decompression combined with internal fixation, $n = 14$) group. The anterior, middle vertebral body height, kyphosis angle and the cement leakage were measured on radiography. Visual analogue scale (VAS), 36-item short form (SF-36) and Oswestry disability index (ODI) were recorded to assess the pain relief, life quality and function improvement.
Results: Compared with the preoperation, the anterior, middle vertebral body height and kyphosis angle were significantly improved after two procedures, but the improvement efficacy seemed to be more significant in the experimental group, with no significant loss of correction effect at final follow-up. The VAS, SF-36 and ODI scores were all significantly improved postoperatively, especially at final follow-up in two groups. The neurological situation was improved in patients at least 1 grade in Frankel scale. After mean follow-up of 24 months, no operative complications (internal fixation loosening, breakage, spinal nerve damage or pneumothorax) were observed, except bone cement leakage occurred in two cases in experimental group.
Conclusion: Posterior decompression, bone cement augmentation and internal fixation seems to be effective and safe for pathological fractures caused by VHs, with better outcomes and few complications.

1. Introduction

Vertebral hemangiomas (VHs) are frequently encountered tumors of the spine, with the incidence of 10%–12% of the general population and predominant involvement of the thoracic and lumbar segments. Most of VHs lesions are clinically silent, but rare cases (0.9%–1.2%) manifest relevant symptoms, from simple back pain to neurological deficit (spinal cord compression) due to epidural extension, expanded vertebra to cause spinal canal stenosis [1], hematoma or pathological fracture. Among them, a compression fracture of the vertebra by VHs is rare, with less than 20 cases reported by the literature search [2–8].

There are several options for treatment of patients with symptomatic VHs including analgesics [9], alcohol ablation [10], endovascular embolization [11], radiotherapy [12], vertebroplasty [7,13–16], kyphoplasty [8], surgical decompression [4] or a combination of these modalities [4,17–19], but no consensus has been achieved because current evidence comes from case reports or small case series by retrospective analysis. The aim of this present study was to further evaluate the efficacy of posterior

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decompression, internal fixation and/or bone cement augmentation in the treatment of pathological fractures caused by VHs on basis of our larger case series (28) by a single-blind, randomized controlled trial and comprehensive evaluation index, including improvement of vertebral height, kyphosis angle, pain, function and quality of life.

2. Materials and methods

2.1. Patients

From January 2008 to January 2014, 28 patients suffering pathologic fractures (AO type A3.1 [20], with about 2/3 loss of original vertebral height) due to thoracic or lumbar VHs (Murphy type IV [21]) were surgically treated in our hospital. Each patient was diagnosed with single-level VHs based on clinical symptoms and magnetic resonance imaging (MRI) (Fig. 1A and B). All patients in our cohort were symptomatic manifesting back pain, degeneration or loss of muscular strength. Five of them had a history of radiotherapy, but failed.

All the patients were pre-paired according to hospital admission order and then randomly scheduled to receive the posterior decompression, bone cement augmentation and internal fixation (experimental group, $n = 14$) or only the posterior decompression combined with internal fixation (control group, $n = 14$) intervention in each pair using a computer-generated list of random numbers. Patients were blinded to the group to which they belonged. This study was approved by ethics committee of the Affiliated Hospital of Xuzhou Medical College and all patients agreed to participate in this clinical trial by signing an informed consent form.

2.2. Surgical procedures

All patients underwent general anesthesia and placed in a prone position on a surgical table. A posterior midline incision was made to expose the fractured vertebra and its upper, lower vertebra, left and right articular process. After four pedicle screws were inserted into the adjacent upper and lower vertebra, routine posterior approach was performed to remove the vertebral laminae of the fractured vertebra, then the spinal cord and nerve root were thoroughly decompressed. Rod was used for distraction reduction. If the excellent reduction of the bone protruded into the vertebral canal was not achieved, a curved nerve detacher was further applied for reduction by pushing. By referring to the vertebroplasty, the 13-gauge core needle (Cook Medical, Limerick, Ireland) was advanced to the anteromedial third of the vertebral body along the bilateral vertebral pedicles of the fractured vertebra. The inner core was then retracted and high-viscosity polymethylmethacrylate (PMMA) bone cement (OsteoPal-V, Heraeus Medical, Germany) formed by combining powder cement polymer and liquid monomer, was gradually injected into the lesion under the C-arm X-ray monitoring to prevent bone cement leakage. The amount of cement used depended on the hemangioma's size. The needle was withdrawn before the bone cement was completely coagulated. Subsequently, the pedicle screws were introduced and the inter-transverse bone grafting was performed to increase the stability (Fig. 1C). Compared with the experimental group, only the posterior decompression and inter-transverse internal fixation were carried out in the control group.

2.3. Postoperative management and follow-up

After surgery, a negative drainage tube was placed for 24 to 48 hours and antibiotics were routinely given for 2 days to prevent wound infection. One week after the surgery, the patients were allowed to exercise with their thoracic and lumbar brace. Two months after the surgery, only common support was used to exercise. Follow-up visits were scheduled at every 3 months within 1 year as well as every 6 months one year later.

2.4. Evaluation of therapeutic efficiency

The intraoperative data between 2 groups were recorded and analyzed, including operation time (min, from the first skin incision to the last suture) and blood loss (mL, estimated according to both the swab blood loss and suction volumes). The radiological measurements were performed in a lateral view to assess the reduction, which were taken preoperatively, one week postoperatively and at follow-up time. According to the method of Lee and Chen [22], the anterior and middle vertebral body height for the injured vertebra was estimated to be $(a1 + a2)/2$ and $(m1 + m2)/2$, in which the a1 and m1 are the anterior and middle vertebral body height immediately above the injured level, but the a2 and m2 are the anterior and middle vertebral body height for the intact inferior adjacent vertebra (Fig. 1D–F). Kyphosis angle was determined by the angle formed between a line drawn parallel to the superior endplate of the vertebrae above the fractured body and a line drawn parallel to the inferior endplate of the vertebrae below the fractured body, using Cobb's method [23] (Fig. 1G–I).

Clinical outcomes were determined by the comparison of data obtained preoperatively, one week postoperatively and at follow-up time between the two groups from the following indices: Huskisson visual analogue scale (VAS) score used for pain evaluation (a score of 0 indicated no pain and a score of 10 suggested the most pain imaginable) [24]; the Short Form 36-item Health Status Questionnaire (SF-36) used for the assessment of health-related quality of life (HRQOL, a score of 0–100 for each of eight domains, with a higher score indicating better HRQOL) [25]; the Oswestry disability index (ODI) used for the functional capacity estimation (0% = minimal to 100% = maximal disability) [26]. In addition, the outcomes of treatment were defined as pain remission proposed by the World Health Organization:

- complete remission (CR), where the pain disappeared completely after therapy;
- partial remission (PR), where the pain was significantly reduced. Although occasional pain was observed, but the oral common analgesics were not needed;
- mild remission (MR), where the pain was slightly alleviated and oral analgesics were needed;
- no remission (NR), the pain was not mitigated by oral common analgesics and strong analgesics were necessary. Effectiveness rate was defined as the CR + PR/total.

2.5. Statistical analysis

Statistical comparisons were carried out using SPSS version 19.0 software (SPSS Inc., Chicago, IL, USA). The radiographic and clinical data were evaluated with the paired t-test within each group (between preoperative and postoperative or follow-up) and between the two groups preoperatively, postoperatively and at follow-up. A P-value of < 0.05 was considered to be statistically significant.

3. Results

Demographic data including age, gender, lesion site, Frankel grade, the time from injury to surgery, follow-up time, the preoperative radiographic results and scoring index were shown in Tables 1 and 2, which were demonstrated to be not statistically significant, indicating the comparability between these two groups.