Management of Vertebral Re-Fractures after Vertebroplasty in Osteoporotic Patients

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Summary

This study illustrates the usefulness of vertebral biopsy in osteoporotic patients previously treated with vertebroplasty (VP) who present at follow-up with a new fracture in a vertebral soma adjacent or distant from the collapsed vertebral body.

Five hundred and fifty patients with osteoporotic vertebral collapse underwent a minimally invasive treatment with vertebroplasty (VP) for a total of 980 vertebral bodies. The approach was unipedicular in 520 patients and bipedicular in 30. Only cases with unclear findings at MR or CT (23 patients) were scheduled for a vertebral biopsy before VP treatment. The biopsy results were positive for haematological disease in only eight patients. A vertebral biopsy was carried out during re-treatment with VP in all patients who presented a vertebral refracture in the three month follow-up at a site adjacent to or distant from the previously treated vertebra (21 patients). We have found new fractures of adjacent vertebrae in 15 patients and new fractures of distant vertebrae in 16 patients at three month follow-up examination. Five of the 31 cases (16%) of spinal refracture, where during vertebroplasty treatment a bone biopsy and a sternal medullary aspiration had been carried out, an anatomopathological response to multiple myeloma was responsible for the refracture.

It is useful to perform a spinal bone biopsy during re-treatment of the vertebroplasty proce-

dure to rule out multiple myeloma or other disease as the cause of the new collapse in patients with osteoporotic disease presenting a new vertebral fracture in an adjacent or distant site from the previously collapsed vertebral body.

Introduction

Vertebroplasty (VP) is a percutaneous minimally invasive technique introduced in clinical practice by Galimbert and Deramond in 1987. It consists of introducing acrylic material, polymethylmethacrylate (PMMA), into the pathological vertebral body¹.

The aim of the VP procedure is to stabilize the fractured vertebra, thereby alleviating pain. Initially reported as a treatment for vertebral angiomas, VP application has been extended to vertebral fractures caused by osteoporosis, trauma, primary or secondary neoplastic lesions and aggressive vertebral angiomas¹⁻².

Osteoporosis is certainly the most treated disease with this method, both for the natural history of the disease and its high epidemiological incidence. Current estimates in Europe envisage around 438,750 vertebral collapses per year, i.e. 117 out of 100,000 people, while in the United States it is around 700,000 per year³. Women over 50 years have a 26% estimated incidence of vertebral collapse of osteoporotic nature with a tendency to increase with age, reaching 40% in women over 80 years³⁻⁴. More-

over, there is evidence that women previously affected by a first osteoporotic vertebral collapse present a 19.2% risk of developing new fractures in the following year⁵⁻⁷. Patients with a porotic collapse treated with VP are demonstrated to have a risk of vertebral refracture adjacent to or distant from the site of the treatment that varies from 10 to 30%⁸⁻¹³.

The purpose of this study is to illustrate the usefulness of vertebral bone biopsy in the clinical management of patients with clear or suspected osteoporosis already treated with VP, and who present a new vertebral fracture in the short-term follow-up (three months) in a vertebral body distant from or adjacent to the first collapse.

Materials and Methods

From January 2004 to December 2007, 550 patients (415 women and 135 men, average age 61 years) underwent VP for a total of 980 metamers divided as follows: 80 D12; 630 L1 100 L2; 170 L4.

A unipedicular approach was carried out in 520 patients, and a bipedicular approach in 30 patients. The procedure was performed at different levels up to a maximum of six metamers in eight patients and it was always conducted under fluoroscopic guidance. All procedures were performed under local anaesthesia or neuroleptoanalgesia; general anaesthesia was never required.

Before the first treatment with VP, a spinal bone biopsy was performed only in 23 cases of vertebral collapse of uncertain porotic nature at MRI or CT, reporting a positive result for another disease in eight patients (multiple myeloma or metastasis).

We considered eligible for treatment with VP all patients with no history of recent trauma presenting severe spinal pain, without characteristics of radicular pain, located along the midline, strongly evoked by digital pressure on the spinous apophysis of the collapsed vertebral body, and resistant to conventional medical therapies.

Exclusion criteria were:

- asymptomatic vertebral fractures;
- diffuse, not circumscribed, pain;
- MRI examination that failed to disclose signal alteration of the spongiosa;
- systemic or local infectious disease;
- non-correctable coagulation disorders.

Required preliminary examinations included all routine haematological blood tests.

All patients were initially studied with X-ray examination of lumbar and sacral spine to identify a morpho-structural alteration of the vertebral body, and later with MRI examination of the pathological spinal tract to localize the affected vertebral body (revealed by hyperintense signal in T2W and STIR sequences corresponding to intra-spongious oedema) and to establish a correct diagnosis of the collapse. The MRI protocol comprised T1W, T2W and STIR, T2*W sequences on sagittal level, and T1W post contrast sequences on both sagittal and axial levels. We also performed an MDCT study with multiplanar reconstructions for a proper evaluation of the posterior wall integrity of the pathological vertebral body.

All collapses were assumed to have an osteoporotic etiology on the basis of the following parameters:

- absence of haematological alterations in laboratory tests;
- age > 60 years;
- absence of recent trauma history;
- type and onset modalities of back pain;
- vertebral collapse > 20%;
- no epidural masses and / or paravertebral or neoplastic lesions already known;
- alteration of MRI signal intensity of the vertebral body.

Patients were evaluated before treatment and three, six and 12 months after using the “Visual Analogue Scale” (VAS) and “Oswestry Disability Scale” (ODS).

We performed a vertebral biopsy during re-treatment with VP in all patients who had shown a new fracture of a vertebral body in the short-term follow-up (three months) adjacent to or distant from the treated one.

Results

The results were analyzed according to VAS and ODS methods after three, six and 12 months.

We had a successful outcome in 90% of cases with a reduction of pain in the following 24-72 hours. We observed extravertebral vascular or discal cement leakages in 25 patients but only one patient had onset of clinical radicular iatrogenic symptoms caused by root compression due to epidural diffusion, resolved with medical treatment within a month. We had two

Figure 1 A) Sagittal T1W MRI post-VP at 3 month follow-up shows a new compression vertebral fracture with hypointensity signal of soma of T8. Hypointensity signal of L3 after VP. B AP X-ray control after first VP treatment with good degree of filling of the vertebral body T12, L1, L2. C, D) AP and LL X-ray control after VP of T8 and T9 with a good degree of filling.

cases of asymptomatic thromboembolic pulmonary complications.

Among the 550 patients assumed to have osteoporosis, three month follow-up examination disclosed new fractures of a vertebral body adjacent to the treated one in 15 patients and fractures of a vertebral body distant from the previously treated one in 16 patients. We therefore reconsidered the nature of the vertebral collapse initially defined as osteoporotic. Analysing the previous and the new MR examinations, we performed a focused vertebral bone biopsy during VP treatment. The sample was evaluated immediately and then stained with haematoxylin-eosin (Figure 1A-D). These patients subsequently underwent haematological evaluation, sternal puncture and laboratory blood tests to rule out or confirm a secondary nature of the vertebral collapse. The anatomicopathological analysis revealed a vertebral collapse from multiple myeloma, probably unidentified in five cases out of 31 (16%) of vertebral refracture. This finding changed the therapeutic management after the VP procedure, and these patients were directed to a specialized haematological setting.

Discussion

The main therapeutic indications of VP are:

- 1) vertebral collapse of osteoporotic and non-osteoporotic nature;
- 2) primary and metastatic vertebral neoplasms;
- 3) vertebral angiomas.

The action mechanism of VP is based on the principle that injection of PMMA into the collapsed vertebral body stabilizes the movements of the trabecular and spongiosal microfractures responsible for the pain, making the vertebral body more compact and resistant, thereby alleviating pain. The intention is to use a technique that will act on pain symptoms in the first 24-72 hours avoiding a prolonged medical treatment. Considering their epidemiological relevance, we found that vertebral collapses of porotic origin are the most common vertebral lesions treated with VP, with a variable reduction of pain from 90 to 95% of cases¹⁴.

Osteoporotic patients have a risk of occurrence of a new fracture of a vertebral body, adjacent to or distant from the damaged one treated with VP, varying from 10 to 30%^{6,12,15-20}. This occurrence is due both to the natural evo-

lution of the original disease and to the VP procedure itself. Indeed, the procedure alleviates pain, making the vertebral body compact and stable but it also impairs biomechanical vertebral mechanisms with a modification of spinal force discharge, thus increasing the risk of a new fracture²¹.

Clinical evidence demonstrates that a vertebral fracture in an osteoporotic patient is highly predictive of the occurrence of further fractures and the risk of developing new fractures in the following year is proved to be approximately 19.2%, particularly in women presenting a first vertebral collapse of osteoporotic nature⁵⁻⁷. Recently, these percentages have been further reassessed because some vertebral collapses previously defined as osteoporotic are actually the result of the asymptomatic evolution of an unidentified haematological disease. In such cases, a possible refracture could be determined by the evolution of the initially unknown neoplastic disease rather than by the progression of osteoporosis. On the other hand, both diseases may arise in the same patient making it objectively difficult to identify the true cause of the refracture²²⁻²³.

We know that the vertebral column is the most common site for skeletal metastases and that, among the various patterns of injury, the collapse of a vertebral body- typically of a benign/porotic nature- may be found in patients with osteomalacia as well as in patients with haematopoietic disease²⁴⁻²⁶.

Osteoporosis is the most common cause of vertebral collapse, especially in subjects older than 60 years. Malignant lesions (primary and metastatic malignancies) may distribute or even coexist in these patients and are potentially responsible for a vertebral collapse that may appear very similar to a porotic fracture²². This makes the differential diagnosis between a malignant and a benign aetiology of a vertebral collapse based on imaging features difficult and almost uncertain, especially in patients who have no other symptoms or impairments that may lead to the suspicion of a malignant neoplastic lesion. In addition, 38% of patients with multiple myeloma and vertebral fracture present a vertebral collapse classified as benign at MR examination due to its morphological characteristics and metameric distribution totally compatible with a porotic fracture²⁷.

Togawa et Al²⁸, in a series of 178 vertebral biopsies performed in patients with presum-

ably porotic collapses, reported an incidence of fractures due to unrevealed myelodysplastic nature of about 2.8%, so that they found it necessary to perform a vertebral biopsy in all types of non-traumatic vertebral fractures to obtain a clear etiological diagnosis. Schoenfeld et Al²⁹, in a retrospective review of 80 vertebral biopsies performed during vertebroplasty or kyphoplasty, found that 8% of patients with vertebral fracture, initially classified as of porotic nature, actually had a neoplastic location caused by lymphoma or by metastatic lung, breast or colon cancer or by multiple myeloma. They emphasized the need to perform a vertebral biopsy during percutaneous treatment to obtain a certain diagnosis of benign nature of the collapse. Shindle et Al³⁰ reported an incidence of unrevealed lymphoma of 1.3% in a series of 523 collapsed vertebrae subjected to biopsy during kyphoplastic treatment.

Our study included only 31 patients presenting a new vertebral fracture at three month follow-up in a vertebral body adjacent to or distant from the one already treated with VP. We performed a biopsy in this group during the percutaneous treatment of the new spinal lesion and the samples were analyzed immediately and later after staining with haematoxylin-eosin. Patients then underwent a sternal medullary biopsy disclosing a previously unknown multiple myeloma in five patients out of 31 (16%). A subsequent review of MRI / CT examinations in those patients before the percutaneous treatment never disclosed radiological criteria suggesting a diagnosis of malignant vertebral collapse.

Conclusions

Vertebral biopsy is the most accurate method to define the nature of a vertebral collapse. The procedure cannot be easily performed in all patients for obvious organizational reasons, but we believe it must be taken into consideration for those patients treated with VP for osteoporotic vertebral disease who present a new vertebral collapse at short-term follow-up.

We believe a vertebral biopsy should be performed in these patients during the VP procedure for the treatment of the new collapse and the histological sample must undergo an extemporary evaluation and fixation with haematoxylin-eosin. A complete haematological as-

assessment with laboratory blood tests and sternal puncture must be scheduled to rule out a haematological disease as the effective cause of the vertebral fracture.

Any hypothesis of vertebral collapse, different from what previous assumptions based on

clinical data and diagnostic imaging features (MRI-CT) does not compromise the indication of treatment with VP for pain relief, but it clearly suggests the patient requires a different management in a specialist haematological setting.

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