The Risk of New Osteoporotic Vertebral Compression Fractures in the Year after Percutaneous Vertebroplasty

Maurits H.J. Voormolen, MD, Paul N.M. Lohle, MD, PhD, Job R. Juttmann, MD, PhD, Yolanda van der Graaf, MD, PhD, Hendrik Fransen, MD, and Leo E.H. Lampmann, MD, PhD

PURPOSE: To prospectively assess the incidence, location, and possible causative mechanisms of new vertebral compression fractures (VCFs) in 66 symptomatic patients with osteoporotic VCFs treated with percutaneous vertebroplasty (PV) and to study the relation between new VCFs and back pain symptoms.

MATERIALS AND METHODS: Sixty-six patients with 102 painful symptomatic VCFs were treated with PV. All patients had baseline total spinal magnetic resonance (MR) imaging. Follow-up MR imaging was performed at 3, 6, and 12 months to locate new VCFs. Visual analog scales for pain and pain medication consumption were used to assess clinical outcomes. The following characteristics were compared in patients with new VCFs after PV versus patients without new VCFs: patient age, sex, presence of secondary osteoporosis, bone mineral density, number of preexisting VCFs, shape and grade of VCFs, type of bone cement used for PV, volume of injected cement, and cement leakage in intervertebral disc spaces.

RESULTS: Sixteen of 66 patients had 26 new VCFs during 1 year of follow-up after PV. Most new VCFs occurred within 3 months of PV, half of new VCFs appeared in levels adjacent to treated levels, and half of the new VCFs were symptomatic. The presence of more than two preexisting VCFs was the only independent risk factor for the development of a new VCF.

CONCLUSIONS: New VCFs occurred after PV in 24% of patients. Half of new VCFs occurred in levels adjacent to treated levels and half were symptomatic. The presence of more than two preexisting VCFs was the only independent risk factor for the development of a new VCF.

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Abbreviations: PV = percutaneous vertebroplasty, VAS = visual analog scale, VCF = vertebral compression fracture

PERCUTANEOUS vertebroplasty (PV) is the percutaneous stabilization of a compressed vertebral fracture with the injection of polymethylmethacrylate. The main goal of PV is to reduce or eliminate pain caused by vertebral compression fractures (VCFs). Although patients with primary or secondary osteolytic vertebral tumors were initially treated with this procedure, the main target population for PV is patients with painful, therapy-resistant VCFs caused by osteoporosis. A major concern after PV in patients with osteoporosis is the occurrence of new VCFs in the nontreated vertebral bodies at other levels. Some authors believe new VCFs after PV are caused by the augmented stiffness of the treated vertebrae related to the amount of injected cement or by cement leakage in the adjacent vertebral disc space (1–7). Others have stated that the ongoing osteoporosis induces new VCFs (8–11).

In this study, we prospectively assessed the incidence, location, and possible causative mechanisms of new VCFs in 66 patients treated with PV after osteoporotic VCF by magnetic resonance (MR) imaging follow-up. We also studied the relation between new VCFs and back pain symptoms.

PATIENTS AND METHODS

Patients

Between March 2002 and March 2004, 77 consecutive patients under-

From the Departments of Radiology (M.H.J.V., P.N.M.L., L.E.H.L.) and Medicine (J.R.J.), St. Elisabeth Ziekenhuis, Tilburg; Department of Clinical Epidemiology (Y.v.d.G.), Julius Center for Health Sciences and Primary Care, Utrecht, The Netherlands; and Department of Radiology (H.F.), Algemeen Ziekenhuis St Lucas, Gent, Belgium. Received June 20, 2005; accepted September 19. **Address correspondence to** M.H.J.V., Department of Radiology, St. Elisabeth Ziekenhuis, PO Box 90151, 5000 LC Tilburg, The Netherlands; E-mail: mhjvoorm@elisabeth.nl

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went PV of painful osteoporotic VCFs in our hospital. Eleven patients were excluded from the study. One patient died of unrelated disease within 2 months. Ten patients refused 3-month and/or 6-month follow-up MR imaging and were excluded from the study. The remaining 66 patients had 6-month follow-up MR imaging after PV and constitute the current study population. PV was performed only if conservative treatment had failed and back pain still existed after at least 6 weeks. Other causes of back pain were excluded by means of anamnesis, physical examination, and MR imaging.

All patients had total spine MR imaging before PV. Preprocedural MR imaging sequences consisted of sagittal T1-weighted, T2 turbo spin-echo weighted, and short τ inversion recovery sequences and additional transverse T2 turbo spin-echo weighted images at the level of the VCF. Only patients with VCF with a minimum of 15% height loss compared with the dorsal wall height of the vertebral body and presence of bone marrow edema of the collapsed vertebral body were included for treatment. Before treatment, all patients underwent bone mineral densitometry. Before the procedure, institutional review board approval and patient informed consent were obtained.

Procedure

PV was performed under local anesthesia in a biplane angiography suite (Integris BN 3000 Neuro; Philips Medical Systems, Best, The Netherlands). Polymethylmethacrylate bone cement was injected under continuous fluoroscopic imaging guidance. Various bone cements were used: Simplex-P (Howmedica, Limerick, Ireland), Palacos LV-40 (Schering-Plough Europe, Brussels, Belgium), Osteopal V (Biomet Merck, Ried b. Kerzers, Switzerland), and Osteo-Firm (William Cook Europe, Bjaeverskov, Denmark). In each treated VCF, the amount of injected cement per vertebral body was noted. Immediately after the procedure, computed tomography with multiplanar reconstructions of treated levels was performed to identify possible extra cement leakage or other local complications that might not have been noted on fluoroscopy. Intervertebral disc leakage into upper or lower disk space in relation to the treated level was assessed.

Imaging Follow-up

After PV, total spine MR imaging scans were scheduled at 3, 6, and 12 months. Follow-up MR imaging consisted of sagittal T1-weighted and short τ inversion recovery sequence images and additional transverse T2 turbo spin-echo weighted images of treated vertebrae and new VCFs if present.

Preprocedural and postprocedural total spinal MR images were compared to identify new VCFs. Regardless of the presence of clinical symptoms, we considered new VCFs to be present when postprocedural MR images showed more than 15% compression of the vertebral body and bone marrow edema at a level other than the treated vertebra. The presence, number, and level of new VCFs were recorded. Development of new VCFs between two directly adjacent treated VCFs was noted separately.

Clinical Follow-up

Before PV treatment and at every MR imaging follow-up visit, patients were asked to fill out a visual analog score (VAS) for pain and pain medication use. The VAS consisted of a 10-point scale ranging from 0 indicating no pain to 10 indicating the most severe pain ever in the patient's life (12). Treatment was considered successful if the follow-up VAS score was at least 50% lower than the initial VAS score. The follow-up pain questionnaire was also used to distinguish symptomatic from asymptomatic new VCFs. A new VCF was considered asymptomatic if the patient had no or minor back pain, a follow-up VAS score less than 50% of the initial VAS score, and no need for extra pain medication.

Statistical Analysis

The decrease in VAS score of patients with osteoporotic VCFs before and after PV was tested with the Wilcoxon paired-sample test.

The following patient characteristics were compared in patients with new VCFs versus patients without VCFs: age, sex, presence of secondary osteoporosis, and bone mineral density. In secondary osteoporosis, bone loss is associated with an identifiable medical condition in which treatment with steroid drugs is required. The following imaging characteristics were compared between groups: the number of preexisting VCFs, vertebral shape (wedge, biconcave, or crush), and grade of VCF (mild, moderate, and severe). The shape and grade of every treated VCF was scored according to the semiquantitative visual grading of vertebral deformities (13). The shape of VCF was classified on the basis of reduction in anterior height (ie, wedged), middle height (ie, biconcave), or posterior height (ie, crush). The grade of VCF was classified on the basis of the percentage of reduction: 15%–25% (mild), 26%–40% (moderate), and more than 40% (severe). Shape and grade of treated VCFs were determined by two radiologists on a consensus basis.

The following technical characteristics were compared between groups: type of bone cement used, volume of injected cement, and occurrence of cement leakage into adjacent intervertebral disc space(s). Corresponding 95% confidence limits were calculated with confidence interval estimation (14).

Differences in baseline characteristics between patients with and without new VCFs were compared with the χ^2 test for categoric variables and an unpaired t test for continuous variables. The independent effect of baseline characteristics on the occurrence of new VCFs was estimated with logistic regression analysis by calculating odds ratios and corresponding 95% CIs.

RESULTS

The 66 patients treated with PV had a total of 228 preexisting VCFs with a median of three VCFs per patient (range, 1–10). Of these 228 VCFs, 102 showed bone marrow edema on MR imaging and were subsequently treated with PV in 68 sessions. Two patients were treated in two PV sessions.

There were no technical failures and there was no procedural morbidity. Injected bone cements included Simplex-P, Palacos LV-40, Osteopal V, and Osteo-Firm in 15, 28, 29, and 30 VCFs, respectively. All 66 patients had 3-month and 6-month MR imaging