

# Delayed Neurologic Complications of Vertebral Bone Cement Injections

Ian B. Ross, Igor Fineman

Can. J. Neurol. Sci. 2010; 37: 125-127

Minimally invasive techniques have changed many surgical paradigms. In some instances, they have enabled surgeons to perform procedures that would otherwise be impossible. Elsewhere, they have minimized potential morbidity. In the field of neurological surgery, deep brain stimulation would fit in the former category and endovascular treatment of cerebral aneurysms the latter. Reinforcement of pathological fractures of the vertebral axis, usually with polymethyl methacrylate (PMMA) injection, provides instant fixation of unstable and painful fractures and is usually well tolerated by patients. This technique, performed either as vertebroplasty or kyphoplasty, affords both of the aforementioned advantages and has therefore been a welcome addition to the surgical armamentarium.

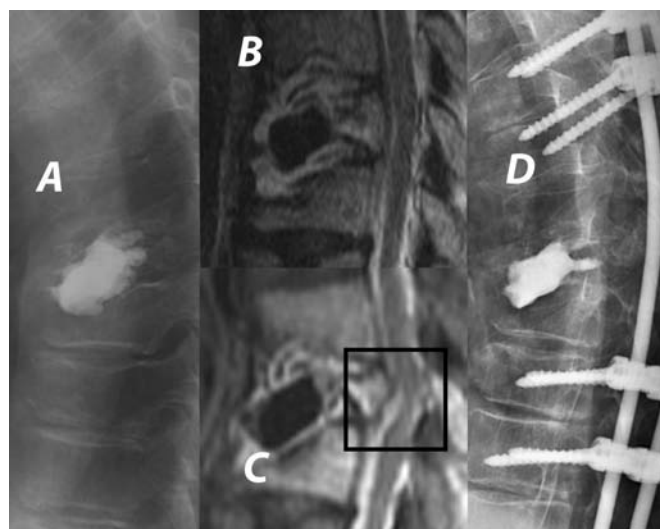
Significant improvement in pain is reported in about 90% of patients after PMMA vertebral body embolization for osteoporotic compression fractures<sup>1</sup>. Benefit appears to be durable, as evidenced by a study with a mean follow-up of 48 months<sup>2</sup>. The potential for complications, however, is not negligible. These include pulmonary venous embolism and spinal cord or nerve root compression from aberrant PMMA. The literature suggests that these complications are rare<sup>1</sup>. Symptomatic pulmonary embolism typically manifests itself rapidly and, similarly, one would expect significant PMMA in the spinal canal to cause symptoms right after the injection.

Neurological problems associated with PMMA vertebral injections may, however, manifest themselves at a later date<sup>3</sup>. It is important that practitioners of this technique recognize when a patient is having an adverse event. We report here two patients with delayed symptomatic lesions that were, eventually, treated surgically and improved clinically.

## CASE REPORTS

### Case 1

An 83-year-old woman with osteoporosis presented to a surgeon with mid-thoracic pain and kyphosis. She underwent kyphoplasty at T8. The initial films were felt by the treating physician to be satisfactory, and there was some improvement in pain control. However the patient had another fall, about a week after the kyphoplasty and immediately thereafter began complaining of back pain. Plain radiographs and an MRI done at the time looked satisfactory (Figure 1A and B), but one week later she began to develop numbness and weakness of her lower extremities, soon losing her ability to walk. A follow-up MRI demonstrated that there had been further collapse at both T8 and T9, with retropulsion of some bone into the spinal canal at T8 (Figure 1C). The patient underwent a posterior decompression



**Figure 1:** A: plain radiograph of thoracic spine, at time of refracture, demonstrating bone cement at T8; B: first MRI of thoracic spine (STIR sequence: TR 4000 ms; TE 48 ms; TI 160 ms), sagittal view, demonstrating normal spinal canal; C: repeat MRI (STIR sequence) demonstrating spinal cord compression (black box); D: plain radiograph of thoracic spine after decompression and instrumentation.

and stabilization with pedicle screw construct by one of the authors (Figure 1D). Her condition improved clinically, and she was able to walk independently at one year after the event.

### Case 2

An 81-year-old man with a history of previous compression fractures presented to a surgeon with a painful fracture at L2. The patient underwent a vertebroplasty at this level (Figure 2A). The procedure was uneventful and the patient was discharged home the next day, reporting significant improvement in his pain. He presented three days later with intermittent, severe pain radiating into his right leg, and numbness. He improved with narcotics and

From Huntington Memorial Hospital, Pasadena, California, USA.

RECEIVED MAY 21, 2009. FINAL REVISIONS SUBMITTED JULY 10, 2009.

Correspondence to: Ian B. Ross, Huntington Memorial Hospital, 630 South Raymond Avenue, #330, Pasadena, California, 91105, USA.

steroids, but a CT scan showed aberrant PMMA in the spinal canal (Figure 2B and C). One of the authors was consulted. Because of some persisting pain, and the amount of cement that appeared to be in the dural sac, he performed a laminectomy, removed the epidural and intradural PMMA, and performed an instrumented postero-lateral arthrodesis from L1 to L3 (Figure 2D). At nine months post-operatively the patient was pain free and ambulating independently without any neurologic deficit.

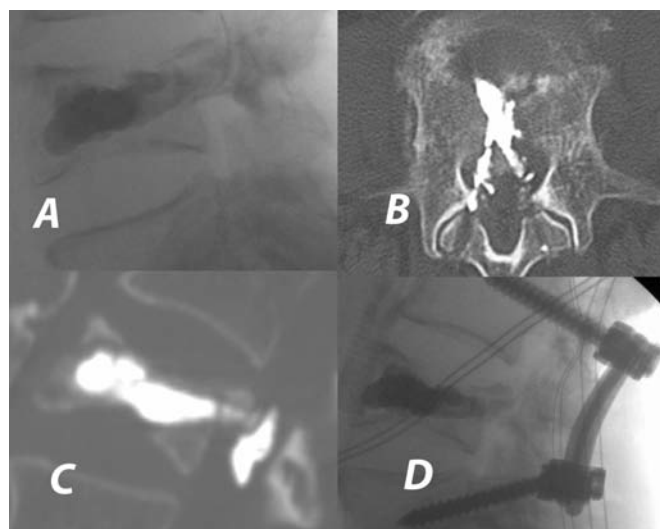
## DISCUSSION

The complications described in these two case reports were different in nature and were not initially recognized by the surgeons who had performed the PMMA injections. These surgeons felt that the injections had been successful, presumably because the initial radiographs looked good and patients did well immediately after the injections. In the second case (Figure 2B), the trajectory of the needles must have been directly through the dural sac, suggesting that poor fluoroscopic visualization and/or clinical judgement was the cause of the problem. The authors were consulted, largely because of frustration experienced by the patients and their families caused by delayed exacerbation of the patients' symptoms. These cases are presented because many practitioners are not aware that neurologic complications of vertebroplasty and kyphoplasty will not always manifest themselves immediately after the procedure.

In both of our cases there was compressive spinal pathology at treated levels: the first due to further fracturing; the second due to aberrantly injected cement. Refracture of a cemented vertebra may be a relatively common occurrence. One group has reported that this happened in 63% (62/98) of their vertebroplasties for osteoporosis<sup>4</sup>. They felt that anterior vertebral height restoration put patients at increased risk for refracture. These recurrent fractures did not cause neurologic problems. It is interesting that our patient with the refracture had a kyphoplasty at this level, a treatment aimed at restoring vertebral body height. The literature suggests that delayed neurologic deficits after vertebroplasty or kyphoplasty are usually due to retropulsion of bone or cement at treated or immediately adjacent levels<sup>3</sup>.

There are two detailed cases of delayed fractures of treated vertebral bodies with displacement of PMMA plugs that have been reported, one anteriorly that caused back pain but no neurologic deficit, the other posteriorly with some deficit<sup>5,6</sup>. In both of these cases there were biconcave fractures with relatively large volume injections (12 cc and 4.5 cc respectively), but balloon augmentation (kyphoplasty) was not used. Although the plug of bone did not, itself, retropulse into the spinal canal in our Case #1, the non-compressible "ball" of PMMA in the center of the vertebral body probably was a factor in some of the collapsed bone retropulsing into the spinal canal. If the bone had been uniformly soft, it may have collapsed without a significant portion of the fractured bone moving posteriorly. Myelopathy is not usually the result of an osteoporotic thoracic compression fracture.

There is evidence that PMMA wanders frequently outside the confines of the vertebral bodies, often through the venous complex, during vertebroplasty injections. In one series, where CT scans were done routinely after vertebroplasty, the detection rate of leakage was only 48% when both anteroposterior and lateral X-rays were compared to the gold standard of CT, though



**Figure 2:** A: plain radiograph of lumbar spine at time of vertebroplasty; B: axial CT image, demonstrating intra-dural tracks of bone cement when patient presented with leg pain; C: sagittal reconstruction of the same CT lumbar spine; D: plain radiograph of lumbar spine after removal of intradural bone cement, decompression and instrumentation.

most of these leaks were asymptomatic<sup>7</sup>. If enough cement leaks out posteriorly or postero-laterally, acute neurologic symptoms can result and urgent surgery may be required<sup>8,9</sup>. If the PMMA leaks into the intervertebral disc space, no acute symptoms will probably result, but there is evidence that the risk of fracture of an adjacent vertebral body will increase<sup>10</sup>. A close follow-up from the Mayo clinic of 1000 consecutive cases showed aberrant PMMA in 24% of cases (6% paravertebral; 12% disc space, 5% epidural veins and 1% pulmonary vasculature). Complications due to leakage, however, were only documented in 0.5% of cases in this series<sup>1</sup>. Pulmonary embolization may be more frequent, having been documented in 6.8% of patients in one series where chest X-rays were done routinely in the post-operative period<sup>11</sup>. Most are asymptomatic, but they can be fatal<sup>11,12</sup>. Intradural PMMA injections are very rare. Good fluoroscopic visualization typically allows the operator to avoid traversing the spinal canal when performing vertebroplasty.

There is no literature describing intradural PMMA injections with delayed onset of symptoms. The explanation of the delay in symptom onset in our Case #2 may be the fact that a relatively small amount of bone cement was found intradurally. The resultant symptomatology was thus more likely due to a tug on the nerve roots from the effect of gravity rather than a direct compression due to the mass-effect produced by the PMMA.

Techniques for avoiding common complications and pitfalls of vertebroplasty and kyphoplasty have been nicely described elsewhere<sup>13</sup>. It is important for practitioners of vertebroplasty or kyphoplasty to remember, however, that just because the initial radiographs look good and the patients are doing well, it is still possible for patients to end up with delayed symptomatology either directly or indirectly as a result of the PMMA injection. Indeed plain follow-up X-rays may not demonstrate a fracture or

aberrant bone cement. A CT or MRI scan may be necessary to arrive at the correct diagnosis. There is some controversy as to whether aberrant PMMA is best removed utilizing the anterior or posterior surgical approach, or both<sup>14</sup>. The optimal choice of approach will ultimately be dictated by the specific pattern of PMMA extrusion and the spinal level involved. Our experience and the literature suggest that patients symptomatic from aberrant PMMA or recurrent compression fractures occurring in the aftermath of kyphoplasty or vertebroplasty can experience good outcomes if the problem is quickly recognized and an appropriate corrective surgical plan is executed.

#### REFERENCES

1. Layton KF, Thielen KR, Koch CA, Luetmer PH, Lane JJ, Wald JT, et al. Vertebroplasty, first 1000 levels of a single center: evaluation of the outcomes and complications. *AJNR Am J Neuroradiol.* 2007;28:683-9.
2. Grados F, Depriester C, Cayrolle G, Hardy N, Deramond H, Fardellone P. Long-term observations of vertebral osteoporotic fractures treated by percutaneous vertebroplasty. *Rheumatology (Oxford).* 2000;39:1410-4.
3. Patel AA, Vaccaro AR, Martyak GG, Harrop JS, Albert TJ, Ludwig SC, et al. Neurologic deficit following percutaneous vertebral stabilization. *Spine.* 2004;29(19):2120-5.
4. Lin W-C, Lee Y-C, Lee C-H, Kuo Y-L, Cheng Y-F, Lui C-C, et al. Refractures in cemented vertebrae after percutaneous vertebroplasty: a retrospective analysis. *Eur Spine J.* 2008;17:592-9.
5. Hohegger M, Radl R, Leithner A, Windhager R. Spinal canal stenosis after vertebroplasty. *Clin Radiol.* 2005;60:397-400.
6. Tsai T-T, Chen W-J, Lai P-L, Chen L-H, Niu C-C, Fu T-S, et al. Polymethylmethacrylate cement dislodgement following percutaneous vertebroplasty: a case report. *Spine.* 2003;28:E457-60.
7. Schmidt R, Cakir B, Mattes T, Wegener M, Puhl W, Richter M. Cement leakage during vertebroplasty: an underestimated problem? *Eur Spine J.* 2005;14:466-73.
8. Sabuncuoğlu H, Dinçer D, Güçlü B, Erdoğan E, Hatipoğlu HG, Özdoğan S, et al. Intradural cement leakage: a rare complication of percutaneous vertebroplasty. *Acta Neurochir (Wein).* 2008;150:811-5.
9. Teng MMH, Chen H, Ho DM-T, Chang C-Y. Intraspinal leakage of bone cement after vertebroplasty: a report of 3 cases. *AJNR Am J Neuroradiol.* 2006;27:224-9.
10. Lin EP, Ekholm S, Hiwatashi A, Westesson P-L. Vertebroplasty: cement leakage into the disc increases the risk of new fracture of adjacent vertebral body. *AJNR Am J Neuroradiol.* 2004;25:175-80.
11. Duran C, Sirvanci M, Aydoğan M, Ozturk E, Ozturk C, Akman C. Pulmonary cement embolism: a complication of percutaneous vertebroplasty. *Acta Radiologica.* 2007;8:854-9.
12. Monticelli F, Meyer HJ, Tutsch-Bauer E. Fatal pulmonary cement embolism following percutaneous vertebroplasty (PVP). *Forensic Sci Int.* 2005;149:35-8.
13. Wong W, Mathis JM. Vertebroplasty and kyphoplasty: techniques for avoiding complications and pitfalls. *Neurosurg Focus.* 2005;18:e2.
14. Yang S-C, Chen W-J, Yu S-W, Tu Y-K, Kao Y-H, Chung K-C. Revision strategies for complications and failure of vertebroplasties. *Eur J Spine.* 2008;17:982-8.