Cement Pulmonary Embolus Complicating Percutaneous Vertebroplasty

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Abbreviations: CT, computed tomography

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Abstract

We present the case of a 63-year-old woman who suffered a cement pulmonary embolus that resulted from methylmethacrylate extravasation into the paravertebral venous plexus during percutaneous vertebroplasty. We discuss the radiographic diagnosis and strategies for prevention and treatment.

Introduction

Percutaneous vertebroplasty, which was first established in 1987 by Galiber et al [1], has become the standard of care for the treatment of vertebral body disease, including painful osteoporotic collapse and osteolytic metastasis. Under fluoroscopic guidance, methylmethacrylate cement, a rapidly setting bone cement, is injected via a transpedicular or paravertebral approach. Its efficacy has been widely demonstrated [2, 3]. The incidence of complications after percutaneous vertebroplasty has been shown to range from 1 to 10% [4]. Complications are rare and local, and usually include infection, radicular pain, and hemorrhage. However cement leaks into the paravertebral venous system can lead to more significant consequences, including cement pulmonary embolus. As vertebroplasty becomes more common, radiologists are more likely to encounter these complications on routine imaging. For these reasons, we discuss radiographic presentations of cement pulmonary emboli and possible prevention and therapeutic measures. We present a case of cement pulmonary embolus that resulted from methylmethacrylate extravasation into the paravertebral venous plexus during percutaneous vertebroplasty. We discuss the radiographic diagnosis and strategies for prevention and treatment.

Case Report

A 63-year-old woman underwent multi-level spinal fusion with vertebroplasty of T12 and L1 on February 15, 2008. She had presented with pain and immobility from lumbar stenosis, degenerative disc disease, and flat back syndrome. The plan was to augment vertebral bodies T12 and L1, and to strengthen the previously placed pedicle screws in these vertebral bodies. These procedures were particularly challenging secondary to patient's distorted spinal anatomy resulting from history of multiple spine procedures.

Under C-arm fluoroscopic guidance, methylmethacrylate cement was attempted to be injected via prior pedicle screw pathway of vertebral body T12, however there was no initial flow likely due to lack of suction from the syringe plunger. After more force was applied, there was a relatively sudden plunge of the cement with instantaneous visualization of cement outlining the paravertebral venous plexus. The syringe was immediately withdrawn, and then a Kyphone cement applicator was used for injection, allowing better control for cement placement. Only a minimal amount of cement was administered. Patient was stable upon completion of procedure.

On post procedure day 4, the patient returned to the hospital due to persistent tachycardia. A pulmonary embolus protocol CT was performed. Findings demonstrated high density material within multiple bilateral subsegmental pulmonary arteries consistent with multiple methylmethacrylate cement pulmonary emboli (Fig. 1). Upon further review of post operative chest radiographs, multiple dense linear opacities were seen bilaterally (Fig. 2).

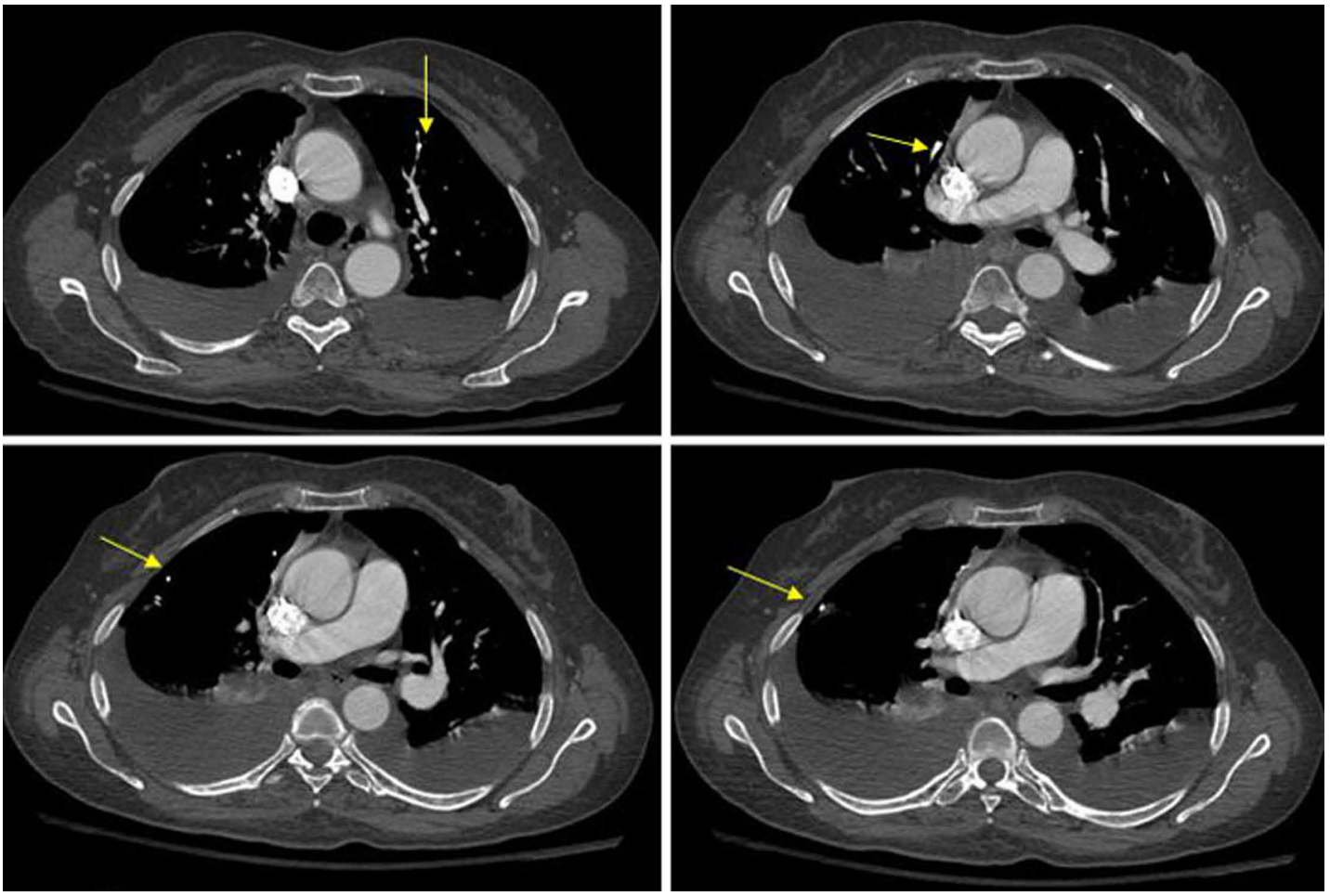

Figure 1. 63-year-old woman with cement pulmonary embolus. Contrast-enhanced chest CT reveals high density structures (arrows) within subsegmental pulmonary arteries, representing cement pulmonary emboli

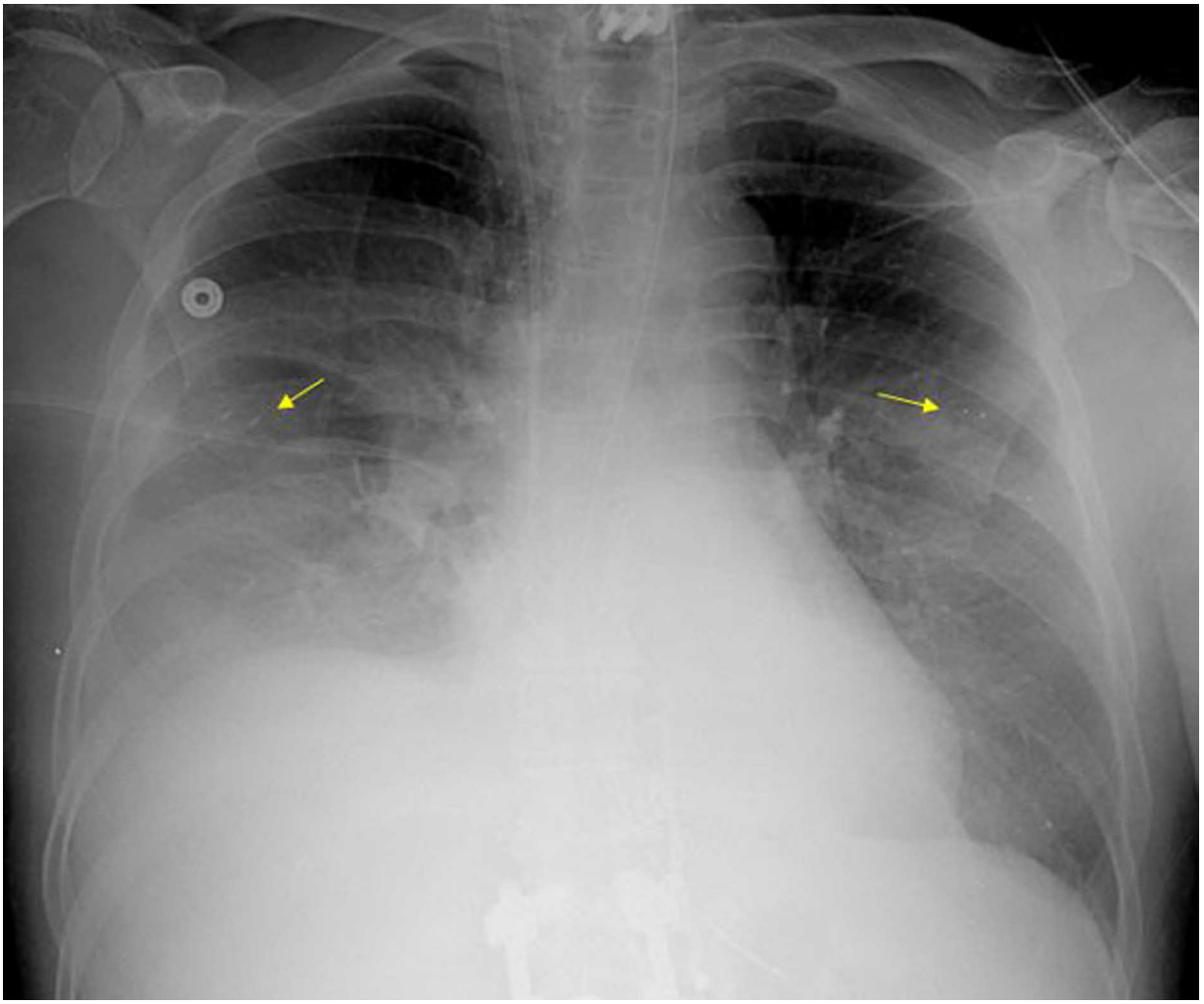

Figure 2. 63-year-old woman with cement pulmonary embolus. Frontal view of the chest shows cement emboli (arrows) at subsegmental levels.

On the same day, follow-up frontal and lateral views of the lumbar spine were obtained and demonstrated linear density projecting over the T10, T11, and T12 vertebral bodies, coursing superiorly (Fig. 3). These findings confirmed methylmethacrylate extravasation into the paravertebral venous plexus.

Patient's cardiopulmonary symptoms shortly resolved without significant intervention. As her symptoms were transient, it was believed her symptoms were not due to the cement pulmonary emboli, and for this reason, anticoagulation was not initiated. At both 1- and 4- month follow-ups, patient has responded favorably to spinal surgical intervention.

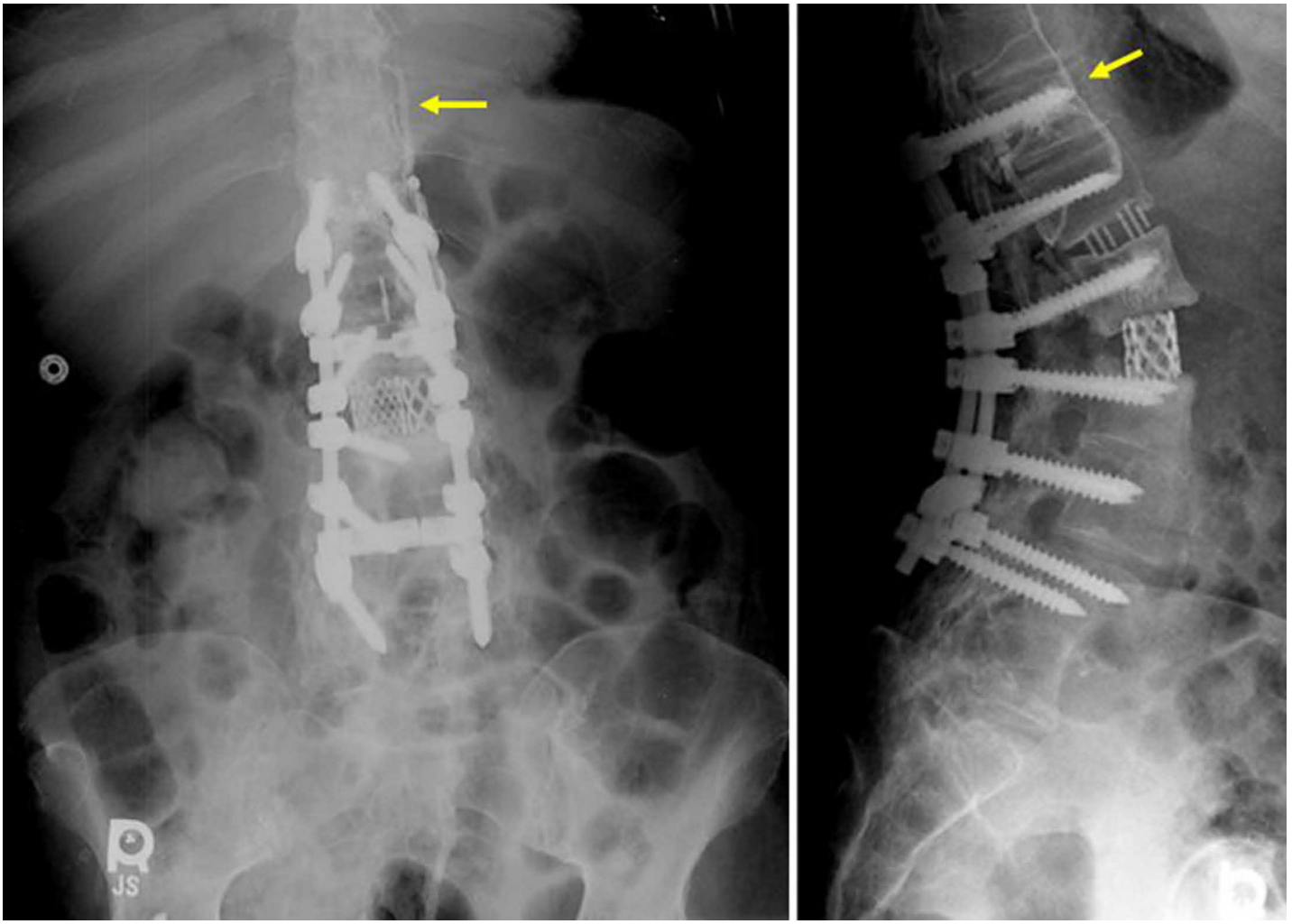

Figure 3. 63-year-old woman with cement pulmonary embolus. Frontal and lateral views of the lumbar spine demonstrate linear density (arrows) coursing superiorly, lateral to vertebral bodies T10, T11, and T12, consistent with methacrylate extravasation into the paravertebral spinous plexus

Discussion

Percutaneous vertebroplasty and kyphoplasty have become routine procedures in medical practice to relieve pain from collapsed, weakened, or otherwise diseased vertebral bodies. These procedures involve the use of methylmethacrylate cement, which is injected using a transpedicular or paravertebral approach usually with fluoroscopic guidance. Complications are usually rare and temporary; however, cement leaks into the paravertebral venous system may lead to the serious complication of pulmonary embolism.

The rate of cement leaks is high, approaching 75%, with venous leaks reported in up to 25% of vertebral bodies treated, with the vast majority of cases asymptomatic [5, 6]. Due to the lack of routine screening after vertebroplasty and kyphoplasty, the literature is limited regarding the frequency of asymptomatic pulmonary embolus. However, Choe Du et al verified a frequency of 4.6% for asymptomatic pulmonary embolus [7], while Duran et al reported a 6.8% rate of symptomatic methylmethacrylate embolus following vertebroplasty [8]. Balloon kyphoplasty, which involves injecting contrast into an inflated balloon within the vertebral body, has shown some success in limiting paravertebral extravasation [9], but this technique did not significantly reduce rate of cement emboli [7].

Studies have shown an increased risk of cement pulmonary embolus following venous cement leaks. A pathway for the migration of cement to the lungs involves flow through the basivertebral vein and anterior external vertebral venous plexus, to the pulmonary arteries via the segmental spinal veins, vena radicularis magna, azygos vein, and accessory hemiazygos vein [10]. The lack of valves in the venous system facilitates this migration.

Recent descriptions of methylmethacrylate extravasation into the pulmonary vasculature have been limited to a few case reports and retrospective studies [7, 8, 10]. Conventional radiographs typically demonstrate

high density tubular structures within a pulmonary arterial distribution, as does computed tomography. Due to the high density of cement, emboli demonstrate higher density than lung parenchyma. Emboli can range from minimal, small emboli to large and numerous. Our patient had multiple small emboli that were not appreciated on preliminary review. Due to the increased number of spine procedures performed today, radiologists are more likely to encounter complications of vertebroplasty and kyphoplasty on routine imaging.

Most patients with methylmethacrylate pulmonary emboli are asymptomatic [7], however, they can also present with significant symptoms of pulmonary vascular occlusion. Symptoms can begin immediately being mistaken for pain related to the procedure, but also may occur several days after discharge. One particular patient presented with a large saddle embolus that caused right heart failure and renal failure, requiring emergent pulmonary embolectomy [11]. A delayed presentation of symptoms has also been demonstrated [10]; Abdul-Jalil, et al have discussed the progressive occlusion of pulmonary vessels secondary to platelet activation, release of procoagulant substances, and additional thrombogenic occlusion.

The risk of methylmethacrylate extravasation is increased with acute fractures (within 3-4 weeks of fracture incident) as fracture lines are not yet sealed by hematoma and callus formation. For this reason, some authors recommend kyphoplasty for acute fractures since the balloon tamp produces an intravertebral cavity that potentially limits methylmethacrylate extravasation [12]. A cadaveric study using experimentally-created compression fractures demonstrated extravertebral cement leakage in five of eight vertebral bodies treated with vertebroplasty whereas zero of eight vertebral bodies leaked in the kyphoplasty group [13]. In a more recent study, Eck, et al et al conducted a meta-analysis of 168 studies to assess the risk of complications between vertebroplasty versus kyphoplasty. They found that the risk of extravertebral cement leak was 19.7% with vertebroplasty versus 7.0% with kyphoplasty [14].

Several authors have recommended precautionary measures to reduce the risk of methylmethacrylate extravasation, such as using biplanar radiography or CT [10]. Jensen et al proposed intraoperative venography/vertebrography to avoid venous puncture, however, this may disturb the evaluation of methylmethacrylate detection with pooling of additional contrast material [5]. Other recommendations include using larger caliber needles to reduce the injection pressure and using more barium in the mixture for better detection [7]. In addition, if there is extravasation of methylmethacrylate into the venous system, injection should be stopped, and then it is possible to proceed after a delay of 20 seconds after involved veins have become occluded [15].

Treatment involves a combination of anticoagulation therapy [16] to avoid additional thrombus along with bed rest, analgesics, and oxygen. No controlled studies have evaluated the extent of the benefit of this regimen. Additionally, some authors do not favor anticoagulation therapy for asymptomatic patients as it may produce more harm than benefit [7]. In severe cases, pulmonary embolectomy may be necessary.

We present this case to highlight the uncommon, yet potentially serious complication of pulmonary embolus resulting from vertebroplasty and kyphoplasty. Cautionary measures need to be taken during these procedures to reduce the risk of methylmethacrylate extravasation. In patients whom venous extravasation is seen, one should have a low threshold for further imaging to prevent this serious complication.

References

1. Galibert P, Deramond H, Rosat P, Le Gars D. Preliminary note on the treatment of vertebral angioma by percutaneous acrylic vertebroplasty. Neurochirurgie 1987; 33: 166-8. [PubMed]

2. Gangi A, Kastler B, Dietemann JL. Percutaneous vertebroplasty guided by a combination of CT and fluoroscopy. Am J Neuroradiol 1994; 15: 83-6. [PubMed]

3. Peh WC, Gilula LA, Peck DD. Percutaneous vertebroplasty for severe osteoporotic vertebral body compression fractures. Radiology 2002; 223: 121-6. [PubMed]

4. Cotton A, Boutry N, Cortet B, et al. Percutaneous vertebroplasty: state of the art. Radiographics 1998; 18: 311-322. [PubMed]

5. Jensen ME, Evans AJ, Mathis JM, Kallmes DF, Cloft HJ, Dion JE. Percutaneous polymethylmethacrylate vertebroplasty in the treatment of osteoporotic vertebral body compression fractures: technical aspects. Am J Neuroradiol 1997; 18: 1897-1904. [PubMed]

6. Cotten A, Dewatre F, Corte B, et al. Percutaneous vertebroplasty for osteolytic metastases and myeloma: effects of the percentage of lesion filling and the leakage of methyl methacrylate at clinical follow-up. Radiology 1996; 200: 525-530. [PubMed]

7. Choe DH, Marom EM, Ahrar K, Truong MT, Madewell JE. Pulmonary embolism of polymethyl methacrylate during percutaneous vertebroplasty and kyphoplasty. Am J Roentgenol 2004; 183; 1097-102. [PubMed]

8. Duran C, Sirvanci M, Aydogan M, Ozturk E, Ozturk C, Akman C. Pulmonary cement embolism. A complication of percutaneous vertebroplasty. Acta Radiol 2007; Oct; 48(8): 854-9. [PubMed]

9. Fourney DR, Schomer DF, Nader R, et al. Percutaneous vertebroplasty and kyphoplasty for painful vertebral body fractures in cancer patients. J Neurosurgery 2003; 98: 21-30. [PubMed]

10. Abdul-Jalil Y, Bartels J, Alberti O, Becker R. Delayed presentation of pulmonary polymethylmethacrylate emboli after percutaneous vertebroplasty. Spine 2007; Sep; 32(20): E589-93. [PubMed]

11. Tozzi P, Abdelmoumene Y, Corno AF, Gersbach PA, Hoogewoud HM, von Segesser LK. Management of pulmonary embolism during acrylic vertebroplasty. Ann Thorac Surg 2002; 74: 1706-1708. [PubMed]

12. Resnick DM, Garfin SR. Vertebroplasty and kyphoplasty. 1st ed. New York, NY: Thieme Medical Publishers; 1005:84-88.

13. Belkoff S, Mathis J, Fenton D, Scribner R, Reiley M, Talmadge K. An ex vivo biochemical evaluation of an inflatable bone tamp used in the treatment of compression fractures. Spine 2001; 26: 1631-8. [PubMed]

14. Eck J, Nachtigall D, Humphreys C, Hodges SD. Comparison of vertebroplasty and balloon kyphoplasty for treatment of vertebral compression fractures: a meta-analysis of the literature. Spine J 2008; May-June;8(3):488-97. [PubMed]

15. Vasconcelos C, Gailloud P, Beauchamp NJ, et al. Is vertebroplasty without pretreatment venography safe? Evaluation of 205 consecutive procedures. Am J Neuroradiol 2002; 23: 913-7. [PubMed]

16. Zaccheo M, Rowane J, Costello E. Acute respiratory failure associated with polymethyl methacrylate pulmonary emboli after percutaneous vertebroplasty. Am J Emerg Med 2008; Jun; 26(5): 636.e5-7. [PubMed]
