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Cement-associated thrombotic embolism in the inferior vena cava and bilateral iliac veins after percutaneous vertebroplasty: a case report

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Abstract

Percutaneous vertebroplasty (PVP) was first reported in 1987 for treating vertebral hemangiomas. PVP is also an effective treatment for osteoporotic vertebral compression fracture that mainly involves a percutaneous injection of polymethylmethacrylate. Severe complications of PVP have been reported in recent years. However, to the best of our knowledge, cement-associated thrombotic embolism in the inferior vena cava and bilateral iliac veins after PVP has rarely been reported. We experienced a patient with cement-associated thrombotic embolism in the inferior vena cava and bilateral iliac veins after PVP. Fortunately, after conservative therapy, we achieved a satisfactory result. Unfortunately, we could not explain the cause of the cement leakage and formation of the thrombotic embolism. We believe that surgeons should have a better understanding of the fracture pattern and anatomy of the vertebral venous net system. They should also perform meticulous imaging monitoring with slower pushing of the cement to minimize the risks during the PVP. This case report highlights a rare, but potentially life-threatening, complication of PVP. Surgeons need to be aware of the possibility of cement leakage and the formation of cement-associated thrombotic embolism so that they are much more vigilant when performing PVP.

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Introduction

Percutaneous vertebroplasty PVP was first reported in 1987 for treating vertebral hemangiomas.[1] PVP is an effective treatment for osteoporotic vertebral compression fracture (OVCF) that mainly involves percutaneous injection of polymethylmethacrylate (PMMA). A large, high-quality, randomized, clinical trial showed that PVP was advantageous over conservative treatment.[2] Although PVP is considered to be minimally invasive, severe complications can still occur during the procedure, and the most frequently reported complication is cement leakage. The rate of cement leakage in osteoporotic compression fractures ranges from 30% to 65%.[3,4] Cement can be leaked into epidural, intradiscal, foraminal, paravertebral, and venous systems. Fortunately, this leakage is well tolerated in the majority of patients. However, life-threatening complications have sporadically been reported. Audat et al.[5] reported intracardiac leakage of cement during kyphoplasty and vertebroplasty, and the patient recovered with life-saving open heart surgery. Chen et al.[6] reported combined extraforaminal and intradiscal cement leakage following PVP, and the patient's discomfort was relieved after decompression surgery. Naud et al.[7] reported a pulmonary cement embolism complicating percutaneous kyphoplasty in a patient, and symptoms resolved after 6 months of anti-coagulation therapy with rivaroxaban. However, to the best of our knowledge, cement-associated thrombotic embolism has rarely been reported. We report a rare, but potentially life-threatening, complication with cement-associated thrombotic embolism in the inferior vena cava and bilateral iliac veins after PVP.

Case presentation

A 63-year-old woman complained of a slightly swollen left leg and low lumbosacral pain (visual analog scale score: 4), and was admitted to our department. She had a history of diabetes mellitus and hyperlipidemia for more than 20 years, and these were treated by medications prescribed by her endocrinologist and cardiologist. She had an L3 OVCF, with a visual analog scale score of 8 2 months previously, and was successfully treated with PVP. She was discharged on postoperative day 2, with no cement-associated complications and a visual analog scale score of 2 (Figure 1). Accordingly, a newly fractured vertebra was suspected at admission to our department. A physical examination showed a slightly swollen left leg with no other major complaints. The intensity of the low lumbosacral pain did not increase when she slightly twisted her spine. No major abnormalities of a regular laboratory test were observed.

The patient suddenly fainted when she was taking a shower on admission night 2. After general resuscitation of moving her back to the bed and resting with electrolyte fluid supplementation, she gradually

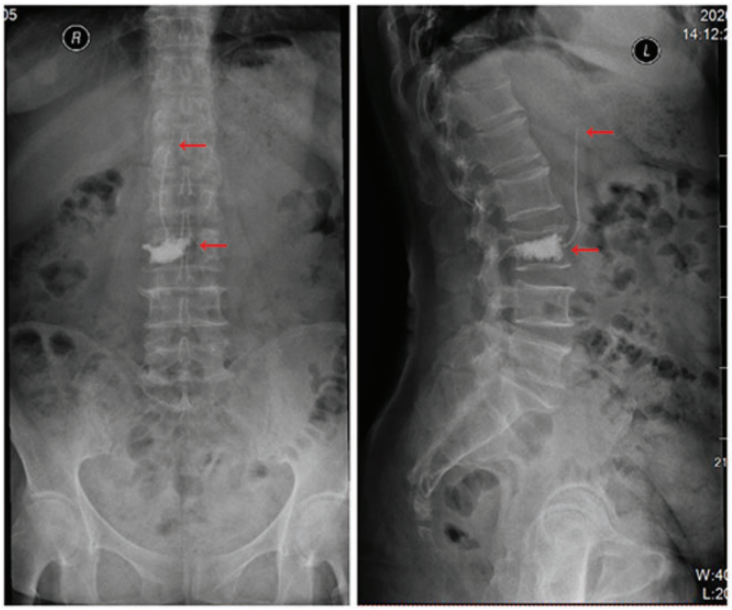

Figure 1. X-ray in the anterio-posterior and lateral views on postoperative day 1 shows that cement is firmly distributed in L3. There is cement leakage extending from the L3 to L1 levels (red arrows).

became conscious and returned to a normal status. The next day, magnetic resonance imaging of the spine, computed tomography angiography, and ultrasonography were performed. No newly fractured spinal vertebra was detected. No major abnormality in the arteries or deep veins in both lower extremities was detected on ultrasound. A cement leakage that started from the L3 level and migrated to the L1 level, and was suspended in the inferior vena cava was detected (Figure 2). Another cement leakage was detected in the right pulmonary artery (Figure 3). After 4 days of general conservative therapy, the patient became agitated and her left leg started swelling (Figure 4). Her condition became severe. General anti-coagulation therapy with 3000 units of low molecular weight heparin daily was empirically implemented. Relevant blood tests were performed again and showed the following: D-dimer concentration, 9.45 mg/L (normal range: 0–0.55 mg/L); hemoglobin concentration, 69 g/L (normal range: 115–150 g/L); red blood cell count, $2.43 \times 10\hat{}12$/L (normal range: 2.8–$5.1 \times 10\hat{}12$/L), and hematocrit, 29.1% (normal range: 35%–45%). The patient later complained of slight left low abdominal pain, with no rebound, and an acute abdominal hemorrhage was suspected. Thereafter, enhanced computed tomographic scanning of the abdomen was performed. Thrombotic embolism in the inferior vena cava and bilateral iliac veins was detected, and a lower abdominal hematoma around the left iliopsoas muscle was also detected (Figure 5).

After consultation of our vascular interventionist, anti-coagulation therapy was temporarily stopped. Digital subtraction angiography was performed, which further confirmed our diagnosis. However, owing to the wide range of thrombotic embolism formation, no further interventional

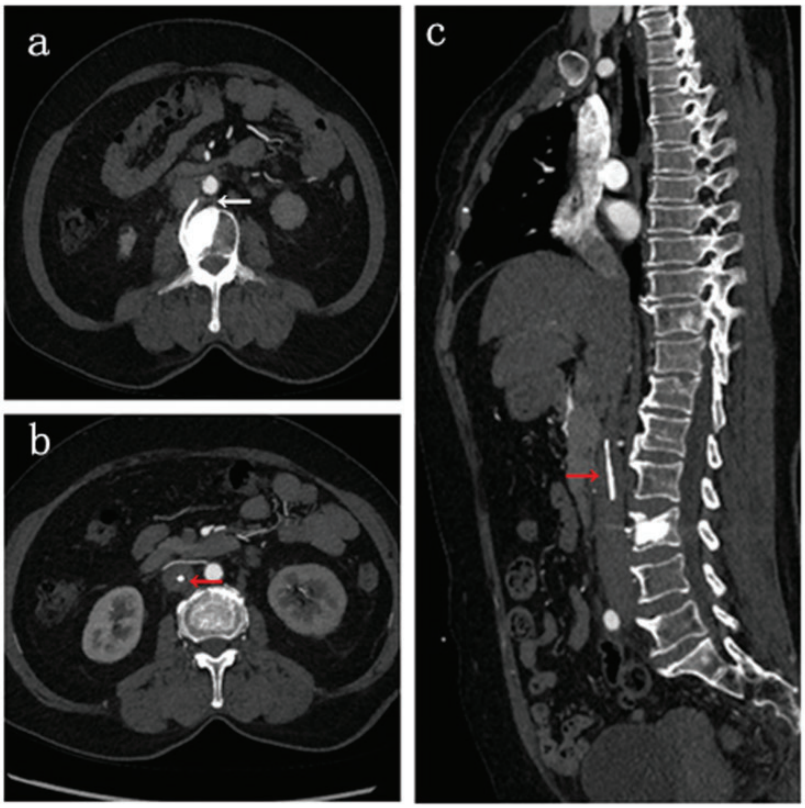

Figure 2. Computed tomography shows that cement leakage started from L3 (a) (white arrow), migrated to L1 (b) (red arrow), and then became suspended in the inferior vena cava (c) (red arrow).

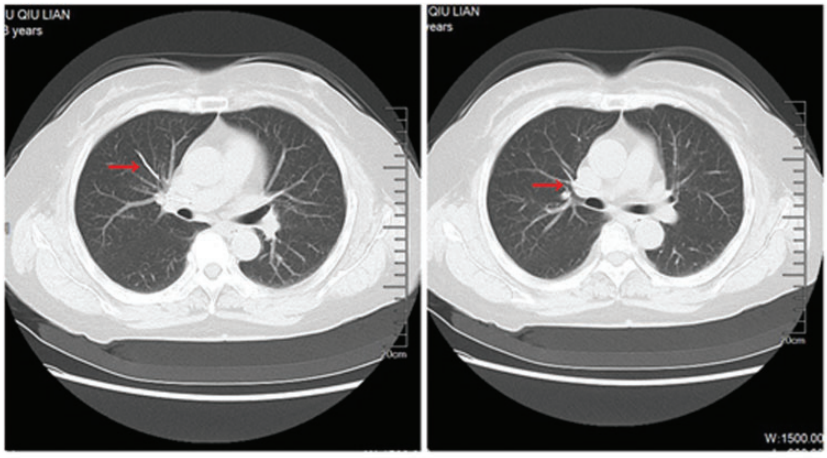

Figure 3. Computed tomography shows another cement leakage that was detected in the right pulmonary artery (red arrows).

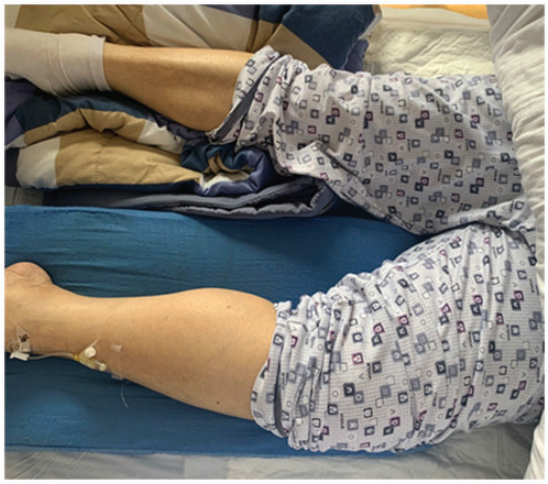

Figure 4. Photograph showing the patient's swollen left leg.

therapy, such as embolism extraction and filter insertion, was performed during the surgery. We then arranged for a multiple disciplinary team for assistance and also asked for help from prestigious vascular specialists in our province. Specialists empirically advised that a wide venous collateral network would eventually form. Therefore, conservative anti-coagulation therapy was recommended. The patient was then transferred to the Vascular Department for further anti-coagulation therapy, with 3 days of conservative therapy of blood transfusion and nutritional supplementation. The patient's condition stabilized. A dissolved and stabilized left lower abdominal hematoma was detected on a computed tomography scan (Figure 6). Therefore, anti-coagulation therapy with 5000 units of low molecular weight heparin daily was uneventfully administered. Fortunately, the patient's condition became stable and the swelling in her left leg started to improve (Figure 7). She was discharged home on day 21 with a prescription for 10 mg oral rivaroxaban daily. Long-term follow-up of this patient is on-going.

The reporting of this study conforms to the CARE guidelines.[8]

Discussion

PVP in OVCF, which mainly involves percutaneous injection of cement directly into the fractured vertebra, is an effective way of alleviating OVCF-associated pain.[9] A limitation of this procedure is the potential risk of extravertebral cement leakage after high-pressure cement injection, causing severe clinical complications, including spinal cord compression,[10] radicular nerve pain,[11] and systemic embolism.[12] Yeom et al.[13] generally classified cement leakage into the following three types: type B is through the basivertebral vein, type S is through the segmental vein, and type C is through a cortical defect. Wang et al.[14] recommended that the patterns of cement leakage could be categorized into the following five types: through a cortical defect into the paraspinal soft tissues (type A); through the basivertebral foramen (type B); via a needle channel (type C); through a cortical defect into the disc space (type D); and via the paravertebral vein (type

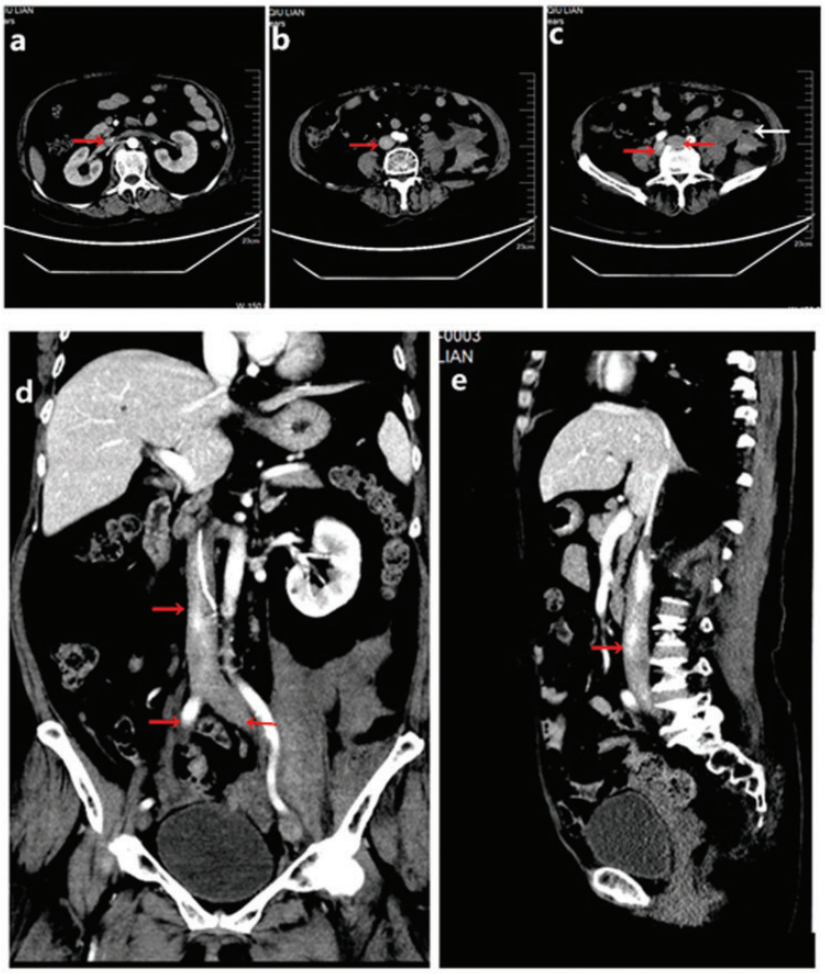

Figure 5. Enhanced computed tomography shows thrombotic embolism in the inferior vena cava (a, b, d, e) and bilateral iliac veins (c) (red arrows). A lower abdominal hematoma around the left iliopsoas muscle was detected (c) (white arrow).

E). In our case, the PMMA leaked outside of the left anterior cortical fracture site of the L3 vertebral body, migrated, and then became suspended in the inferior vena cava via the anterior external vertebral venous plexus. This leakage was a mixed pattern. Anatomically, the vertebral venous system is a large, valveless, collateral venous network within and around the vertebral column. This system extends from the sacral hiatus along the entire length of the vertebral column up to the foramen magnum.[15] Based on the findings in our case, we speculate that the thrombotic embolism was related to the suspended cement in the inferior vena cava. Our patient had several risk factors as follows: (1) She suffered from obesity with hyperlipidemia; (2) She had been suffering from diabetes mellitus for longer than 20 years; (3) Cement in vessels is a foreign object, and it theoretically increases the risk of forming a

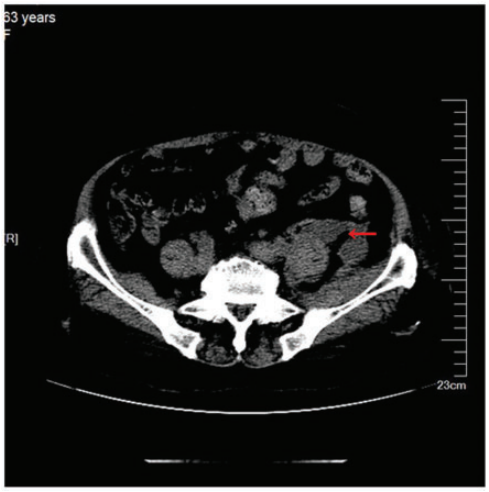

Figure 6. Computed tomography shows a dissolved and stabilized lower abdominal hematoma around the left iliopsoas muscle(red arrow).

thrombotic embolism; And (4) when our patient suddenly fell when she was taking a shower, this might have increased the formation of the thrombotic embolism.[16] However, we are not sure about the exact time when the embolism started forming. Formation of the embolism could have been a chronic process starting from the moment of performing the last surgery, it could have formed at another time after the last surgery, or it could have occurred because of the sudden fall. We also cannot fully explain the left low abdominal hematoma, which might simply have been due to the sudden fall or an adverse effect of the anti-coagulation treatment.

Vascular leakage of PMMA, although rare, might have catastrophic consequences. There are various methods of decreasing the risks of this leakage. Martin et al.[17] reported that complications were mainly related to an excessive PMMA injection. Chung et al.[18] concluded that there are several important elements that prevent the possibility of vascular cement leakage as follows. (1) Controlling the viscosity of

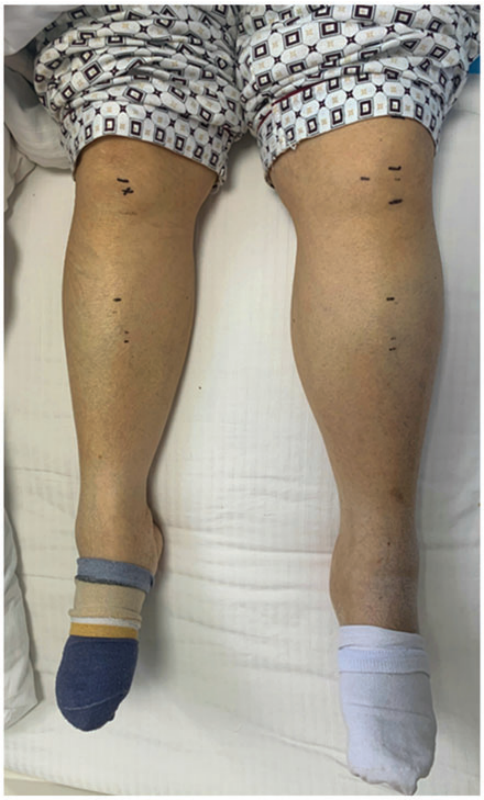

Figure 7. Photograph shows that the swelling in the patient's left leg is reduced.

the PMMA cement is a crucial aspect during the procedure. (2) Using good-quality fluoroscopy is essential for the early detection of minimal cement leakage into the perivertebral vein. (3) Vertebral venography is recommended before PMMA injection. (4) The patient's position is also clinically important. Asymptomatic patients with a small amount of cement leakage require no treatment, while those with symptomatic thrombotic venous, pulmonary emboli or other serious complications require prompt anti-coagulation or even surgical interventions.[19] Some authors have suggested that preventive anti-coagulation therapy, insertion of a vena cava filter in asymptomatic patients with early imaging showing cement leakage,

and embolization after PVP or percutaneous kyphoplasty are recommended.[20] A further, larger scaled study is required to demonstrate the clinical benefits of preventative therapies for patients with asymptomatic cement-associated thrombotic embolism.

There is a limitation of this report in that our conclusions are only based on one case. Therefore, a large-scale, prospective, randomized, controlled trial is required to further compare the effects between surgical and conservative treatments in patients with asymptomatic cement-associated thrombotic embolism.

Conclusion

If intraoperative imaging shows cement leakage in the inferior vena cava, physicians should promptly be aware of its potential for embolization into the lungs and the occurrence of thrombotic embolism. Early treatment, such as anti-coagulation and precautionary filter insertion, might also be helpful for asymptomatic patients in preventing cement-associated thrombotic embolism and other further complications.

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Ethics statement

Ethics approval was not required because this manuscript only reports our experience of one case. Informed consent was obtained from the patient for publication of this case report and the associated images.

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References

1. Galibert P, Deramond H, Rosat P, et al. [Preliminary note on the treatment of vertebral angioma by percutaneous acrylic vertebroplasty]. *Neurochirurgie* 1987; 33: 166–168.
2. Klazen CA, Lohle PN, Vries JD, et al. Vertebroplasty versus conservative treatment in acute osteoporotic vertebral compression fractures (Vertos II): an open-label randomised trial. *Lancet* 2010; 376: 1085–1092.
3. Cortet B, Cotten A, Boutry N, et al. Percutaneous vertebroplasty in the treatment of osteoporotic vertebral compression fractures: an open prospective study. *J Rheumatol* 1999; 26: 2222–2228.
4. Jensen ME, Evans AJ, Mathis JM, et al. Percutaneous polymethylmethacrylate vertebroplasty in the treatment of osteoporotic vertebral body compression fractures: technical aspects. *AJNR Am J Neuroradiol* 1997; 18: 1897–1904.
5. Audat ZA, Alfawareh MD, Darwish FT, et al. Intracardiac Leakage of Cement During Kyphoplasty and Vertebroplasty: A Case Report. *Am J Case Rep* 2016; 17: 326–330.
6. Chen JK, Lee HM, Shih JT, et al. Combined extraforaminal and intradiscal cement leakage following percutaneous vertebroplasty. *Spine (Phila Pa 1976)* 2007; 32: E358–E362.
7. Naud R, Guinde J and Astoul P. Pulmonary cement embolism complicating percutaneous kyphoplasty: A case report. *Respir Med Case Rep* 2020; 31: 101188.
8. Gagnier JJ, Kienle G, Altman DG, et al. The CARE guidelines: consensus-based clinical

case reporting guideline development. *Headache* 2013; 53: 1541–1547.
9. Silverman SL. The clinical consequences of vertebral compression fracture. *Bone* 1992; 13: S27–S31.
10. Sidhu GS, Kepler CK, Savage KE, et al. Neurological deficit due to cement extravasation following a vertebral augmentation procedure. *J Neurosurg Spine* 2013; 19: 61–70.
11. Kulkarni AG, Shah SP and Deopujari C. Epidural and intradural cement leakage following percutaneous vertebroplasty: a case report. *J Orthop Surg (Hong Kong)* 2013; 21: 365–368.
12. Kao FC, Tu YK, Lai PL, et al. Inferior vena cava syndrome following percutaneous vertebroplasty with polymethylmethacrylate. *Spine (Phila Pa 1976)* 2008; 33: E329–E333.
13. Yeom JS, Kim WJ, Choy WS, et al. Leakage of cement in percutaneous transpedicular vertebroplasty for painful osteoporotic compression fractures. *J Bone Joint Surg Br* 2003; 85: 83–89.
14. Wang C, Fan S, Liu J, et al. Basivertebral foramen could be connected with intravertebral cleft: a potential risk factor of cement leakage in percutaneous kyphoplasty. *Spine J* 2014; 14: 1551–1558.
15. Groen RJM, Du Toit DF, Phillips FM, et al. Anatomical and pathological considerations in percutaneous vertebroplasty and kyphoplasty: a reappraisal of the vertebral venous system. *Spine (Phila Pa 1976)* 2004; 29: 1465–1471.
16. Heit JA, Spencer FA, White RH. The epidemiology of venous thromboembolism. *J Thromb Thrombolysis* 2016; 41: 3–14.
17. Martin JB, Jean B, Sugiu K, et al. Vertebroplasty: clinical experience and follow-up results. *Bone* 1999; 25: 11S–15S.
18. Chung SE, Lee SH, Kim TH, et al. Renal cement embolism during percutaneous vertebroplasty. *Eur Spine J* 2006; 15: 590–594.
19. Krueger A, Bliemel C, Zettl R, et al. Management of pulmonary cement embolism after percutaneous vertebroplasty and kyphoplasty: a systematic review of the literature. *Eur Spine J* 2009; 18: 1257–1265.
20. Franco E, Frea S, Solaro C, et al. Fatal pulmonary embolism: when the cause is not a thrombus. *Spine (Phila Pa 1976)* 2012; 37: E411–E413.