



Case Report

# Symptomatic pulmonary cement embolism after pedicle screw polymethylmethacrylate cement augmentation: A case report and review

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## ABSTRACT

**Background:** In osteoporotic patients, a useful technique for significantly enhancing the strength of a pedicle screw is augmentation with polymethylmethacrylate cement. However, a rare complication of this procedure is a symptomatic pulmonary cement embolism.

**Case Description:** A pedicle screw cement augmentation was performed in a middle-aged female for the failed back syndrome. When she developed symptomatic pulmonary cement emboli, she was successfully managed with conservative measures, including anticoagulation.

**Conclusion:** Despite the increased use of cement augmentation for pedicle screw placement and the relatively high incidence of cement leakage into the prevertebral venous system, symptomatic cement pulmonary embolism remains rare. The management of such symptomatic CPE should be evaluated and treated based on both the size and location of the embolism. Here, we presented this case while reviewing three symptomatic and four asymptomatic cases from the literature.

**Keywords:** Cement augmentation, Cement pulmonary emboli, Complication, Failed back syndrome, Pedicle screw, Polymethylmethacrylate

## INTRODUCTION

For nearly two decades, polymethylmethacrylate (PMMA) augmentation of pedicle screws in osteoporotic patients has been performed to improve pullout strength. One of the very rare but serious complications is symptomatic pulmonary cement embolism (PCE).<sup>[6,13]</sup> Interestingly, the medical literature only cites three cases of symptomatic PCE when used for pedicle screw PMMA augmentation.<sup>[8,10,12]</sup> Here, we present the fourth case.

## CASE REPORT

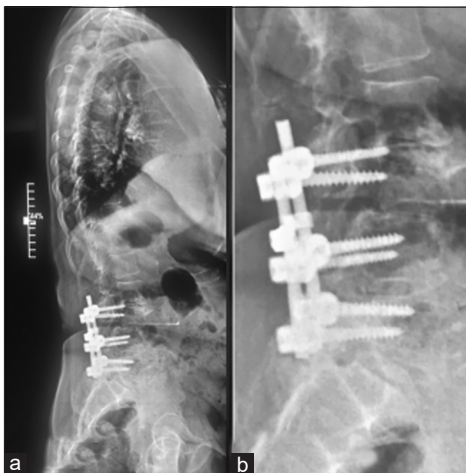
A middle-aged female underwent surgery for failed back syndrome requiring additional decompression and instrumentation [Figure 1]. Due to her underlying osteoporosis, pedicle screw placement was augmented with PMMA cement. However, cement emanating from the L3

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vertebral body subsequently leaked into the perivertebral veins and eventually settled on the inner layer of the inferior vena cava [Figure 2]. One day postoperatively, on attempting to ambulate, she sustained a cardiopulmonary arrest, originally attributed to a pulmonary embolism (PE). She was stabilized within 3 h, regained consciousness 6 h following intubation, and was successfully extubated 24 h later. The portable chest X-ray, chest computerized tomography (CT), and pulmonary angiogram demonstrated multiple, relatively large cement emboli in the segmental arteries of the left lung; she was appropriately heparinized [Figures 3 and 4]. Six days later, intravenous heparin was gradually discontinued and replaced by rivaroxaban (15 mg daily). Postoperative full spinal radiographs showed both the integrity of the cemented construct and the left PCE and confirmed the disappearance of the cement lump which had been attached to the inner

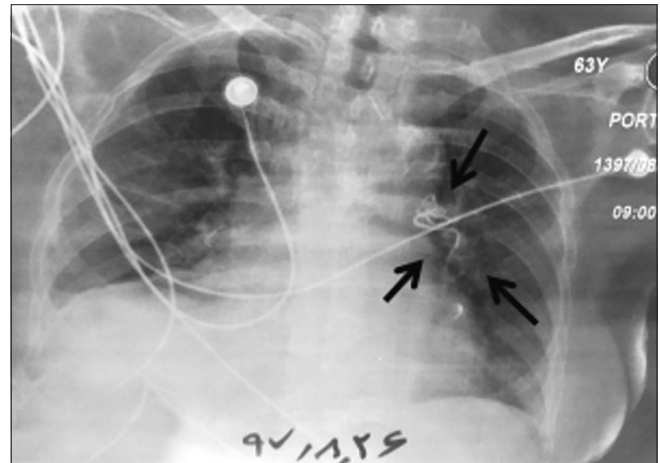
layer of the inferior vena cava [Figure 5]. The patient was discharged on the 11<sup>th</sup> postoperative day. Rivaroxaban was discontinued after 3 months. One year later, she is doing well without further sequelae.



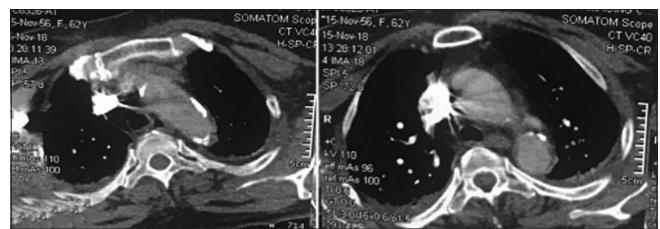
**Figure 1:** (a) Lateral full view X-ray of the patient with failed back, (b) note that L3 screws are pulled out.



**Figure 2:** Intraoperative fluoroscopy demonstrates cement embolism on the inner wall of inferior vena cava (black arrowheads).



**Figure 3:** Portable chest radiograph shows a serpentine-like cement embolism in a pulmonary artery branch (black arrows).



**Figure 4:** Chest computerized tomography angiogram showing the pulmonary embolism.



**Figure 5:** Postoperative full view lateral and anteroposterior radiographs at 1 year follow-up showed cemented iliac to L2 screw rod construct, note that the cement in inferior vena cava has disappeared; in addition, PCE is visible in both views (white arrows).

## DISCUSSION

One of the most serious complications of pedicle screw PMMA augmentation is cement leakage into the inferior vena cava or azygos vein with subsequent migration through the pulmonary arteries into the lungs (e.g., PCE).<sup>[6,13]</sup> Intraoperative leakage into the inferior vena cava/azygos venous system significantly contributes to PCE, which is symptomatic from 1.2% to 1.4% versus asymptomatic from 4.2% to 16.3% of the time.<sup>[6,7,13]</sup> Rarely, PCE may lead to death (0.6%). Here, we presented our case along with reviewing three symptomatic and four asymptomatic cases in the literature [Table 1].<sup>[1,4,5,8,10-12]</sup>

### Risk factors and prevention

The occurrence of PCE during pedicle screw PMMA augmentation depends on the viscosity of cement at the time of its delivery. The increased force attributed to the rapid injection of low viscous cement (dough-like) likely contributes to a higher incidence of PCE, while the reduced delivery rate of toothpaste-like cement results in a smaller incidence of leakage.<sup>[2]</sup> The additional use of the shielding technique also acts as a barrier for cement leakage. In this method, 0.3 cc of pasty cement is initially injected in each hole followed by an injection of the additional 1 cc of the cement 1 min later. El Saman *et al.* further believed that the application of positive end-expiratory pressure during cement augmentation decreased the rate of leakage by decreasing overall venous return.<sup>[3]</sup>

### Clinical picture of PCE

The clinical picture of a symptomatic PCE is similar to that of a thrombotic PE; the cardinal features include tachycardia, dyspnea, hypotension, and loss of consciousness that may result in cardiorespiratory arrest and death.<sup>[6-8,10,12,13]</sup>

## Diagnostic imaging

With PCE, echocardiography may demonstrate changes in pulmonary artery pressure and right ventricular dilatation. The chest X-ray and CT for both symptomatic and asymptomatic PCE may be visualized as large tubular, branching (serpentine), or multiple small densities/opacities.<sup>[6-8,10,12,13]</sup>

## Management

Asymptomatic subjects with small cement particles in the lung fields require no treatment, while those with symptomatic thrombotic pulmonary emboli require emergent anticoagulation, for example, 5000 units of heparin and IV push followed by 1000 units/h.<sup>[1,4,5,7,8,11,12]</sup> Once the clinical status of the patient stabilizes, heparin can be switched to Coumadin (Warfarin) or factor Xa inhibitor drugs (rivaroxaban).<sup>[9]</sup> Large cement emboli trapped within the pulmonary artery can also be retrieved utilizing endovascular procedures performed under fluoroscopic guidance. However, those trapped in the atrium may require emergent cardiovascular surgery.<sup>[10]</sup>

## CONCLUSION

Symptomatic PCE is a rare, potentially catastrophic complication of augmenting pedicle screw instrumentation with PMMA. Rapidly injected low-viscous cement significantly contributes to cement leakage. If studies (X-ray, chest CT, and CT angiography) demonstrate cement in the inferior vena cava, one should be aware of its potential for embolization into the lungs (e.g., PCE).

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms.

**Table 1:** The patients with pulmonary cement embolism and detailed information

Author	Year	Sex	Age	Clinical picture	Location	Site of embolism	Management	Outcome
Rasch <i>et al.</i> <sup>[10]</sup>	2010	M	55	Symptomatic	Lumbar	Right pulmonary artery and upper lobe of the left lung	Surgical	Good
Rollnghoff <i>et al.</i> <sup>[11]</sup>	2010	F	69	Asymptomatic	Thoracolumbar	Multiple both lungs	None	Good
Akinola <i>et al.</i> <sup>[11]</sup>	2010	M	78	Asymptomatic	Lumbar	Both pulmonary arteries	Conservative	Good
Tonolini <i>et al.</i> <sup>[12]</sup>	2011	F	71	Symptomatic	Thoracolumbar	Right pulmonary artery and upper lobe right lung	Conservative	Good
Ozalay and Ozkoc <sup>[8]</sup>	2012	F	75	Symptomatic	Thoracolumbar	Right pulmonary artery, middle lobe of the right lung	Conservative	Good
Ignacio and Ignacio <sup>[5]</sup>	2013	M	31	Asymptomatic	Thoracolumbar	Central pulmonary artery	None	Good
Hemmer <sup>[4]</sup>	2015	M	64	Asymptomatic	Lumbar	Left pulmonary artery, upper lobe of the left lung	None	Good
Current case	2019			Symptomatic	Lumbar	Left pulmonary artery middle lobe of the left lung	Conservative	Good

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## Conflicts of interest

There are no conflicts of interest.

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