



## Case Report

# Pulmonary cement embolism following transpedicular screws placement for thoracolumbar fractures

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## ABSTRACT

**Background:** Symptomatic pulmonary cement embolism in patients undergoing thoracic transpedicular fenestrated screw placement is rare. Here, we have added a 64-year-old female undergoing transpedicular screw placement for a T11 fracture who developed a pulmonary cement embolism intraoperatively and add this case to 13 others identified in the literature.

**Case Description:** A 64-year-old female presented with a type “C”, ASIA “E” T11 fracture. The thoracolumbar pedicle screw fixation was supplemented with bone cement due to her underlying severe osteoporosis. During the fluoroscopy-guided supplementation with bone cement, a leak through the paravertebral venous system was noted. Thirty minutes later, the patient acutely developed extreme respiratory failure and required mechanical ventilation for the next 2 days. The diagnosis of pulmonary embolism due to bone cement was confirmed on a contrast computed tomography study of the chest.

**Conclusion:** Symptomatic pulmonary cement embolization supplementing transpedicular screws placement for osteoporotic bone is rare. Here, we present a 64-year-old female who during transpedicular fixation of a T11 fracture developed an acute pulmonary embolism from the bone cement resulting in the need for 2 days of postoperative artificial ventilation.

**Keywords:** Fenestrated transpedicular screws, Polymethylmethacrylate, Pulmonary embolism, Thoracolumbar fracture

## INTRODUCTION

Polymethylmethacrylate (PMMA) bone cement improves immediate stability and increases pullout resistance from 173% to 244% for patients with osteoporosis undergoing thoracic fracture transpedicular fixation.<sup>[4,14,19]</sup>

Potential locations of bone cement leakage include perivertebral, disc intracanalicular, foraminal, local perivertebral venous system cement leakage, and critically, as in this case, leakage to the central vascular system with migration to the cardiac or pulmonary system with risk of pulmonary embolism (2.1–26%).<sup>[2,3,8,17,18]</sup>

The presence of pulmonary embolism correlates with instrumentation of >7 levels.<sup>[16]</sup> Notably, patients with anterior or posterior wall fractures or burst fractures and accompanying cortical

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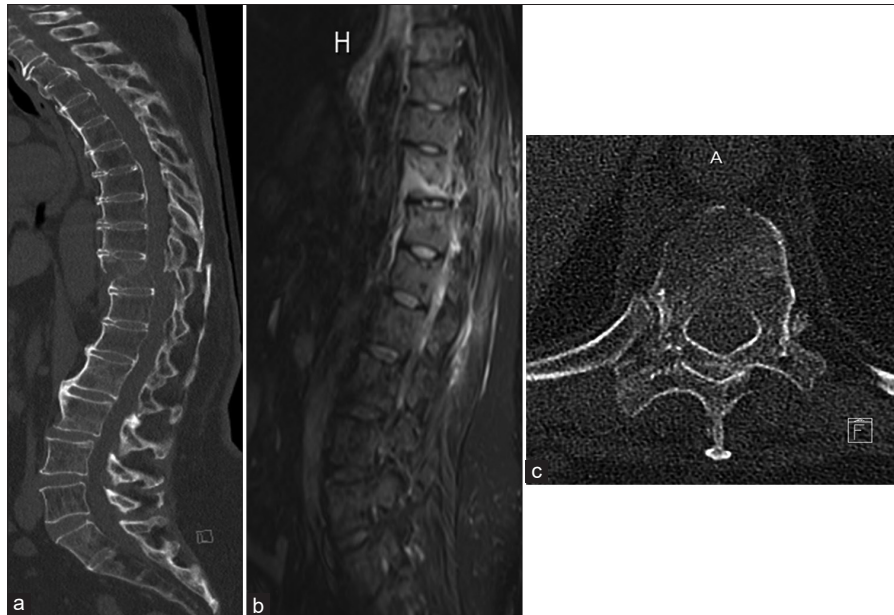
destruction are at increased risk of pulmonary cement embolization.<sup>[8]</sup>

### CASE REPORT

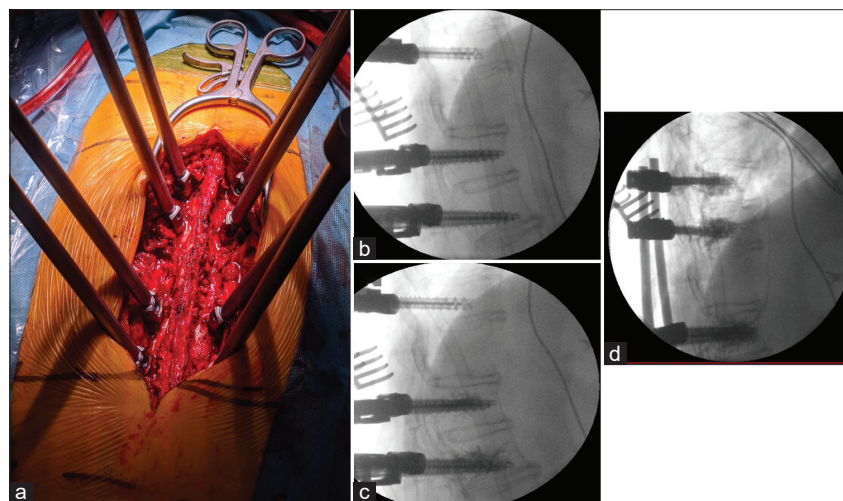
A 64-year-old female with osteoporosis, presented with a non-penetrating T11 traumatic spinal injury as a result of falling backwards downstairs. The computed tomography (CT) scan showed a T11, AO spine C classification, without a neurological deficit, ASIA – E [Figure 1].

### Surgery

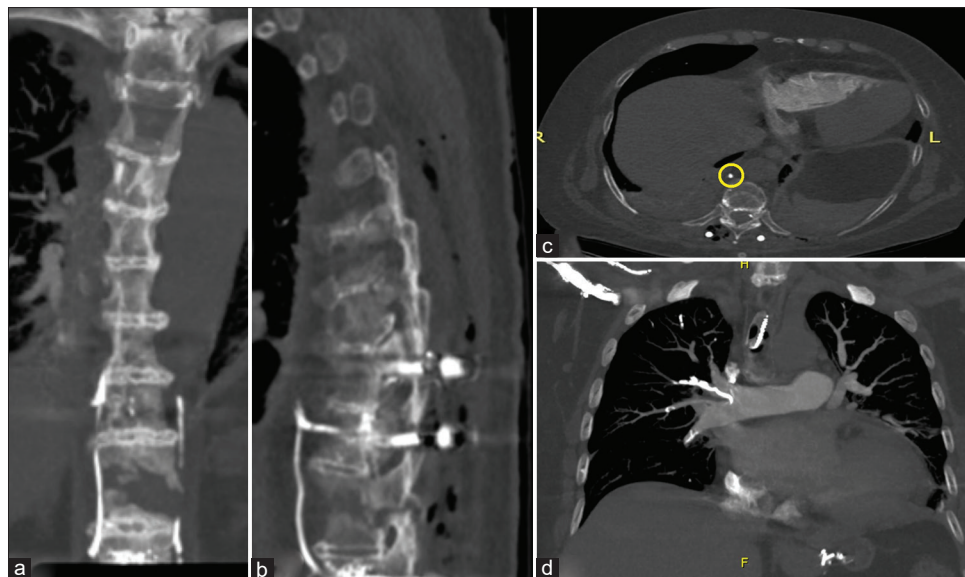
Three days later, she underwent a T11 hemilaminectomy to remove an epidural hematoma with T9 - T10 (5.5 mm × 40 mm screws) to T12 - L1 (6.5 mm × 45 mm screws) transpedicular instrumented fusion. Vertebral body augmentation with 1.5 mL of PMMA bone cement per transpedicular screw (distally fenestrated) was performed due to her underlying osteoporosis. When the fourth screw was placed, fluoroscopy showed leakage of PMMA cement into the paravertebral system [Figure 2]. We



**Figure 1:** (a) Computed tomography, sagittal view, transverse fracture of T11, subluxation of the vertebral body. (b) T2-weighted magnetic resonance imaging, sagittal view, injury of the posterior ligament complex. (c) Computed axial tomography, axial view, double image of vertebral laminae due to subluxation.



**Figure 2:** (a) Intraoperative, instrumental placement for cement application. (b) Fluoroscopy, sagittal view, transpedicular screw placement. (c) Augmentation begins, bone cement at the level of the vertebral body. (d) Suspected bone cement leakage through the paravertebral venous system.



**Figure 3:** Computed axial tomography Angiography, (a-c) Coronal, sagittal, and axial view (yellow circle), respectively where high density material is observed in the paravertebral venous system, is suggestive of cement embolus. (d) Presence of the high density material occupying the lumen of the subsegmental arterial vessels, in the apicoposterior segment of both upper lobes, anterior segment of the right upper lobe, lingula lobe, middle lobe, posterior and medial basal, segment of the right lower lobe.

briefly stopped applying bone cement, but then resumed its application when we observed no intraoperative cardiorespiratory compromise. Fracture reduction was then performed with bilateral 5.5 mm × 36 cm rod placement. The intraoperative arterial blood gas showed respiratory acidosis with a moderate “oxygenation disorder” (pH, 7.31; pO<sub>2</sub>, 100 mmHg; pCO<sub>2</sub>, 48 mmHg; HCO<sub>3</sub>, 24 mEq/L; O<sub>2</sub> saturation, 96%; PaO<sub>2</sub>/FiO<sub>2</sub>, 178 mmHg; lactate, 1 mmol/L, hemoglobin 11.5 g/dL). Thirty minutes after transfer to the recovery room, however, she suddenly developed hypoxemia with oxygen saturation of 45%, requiring ventilatory support.

The CT angiogram of the chest documented a cement pulmonary embolism [Figure 3]. She remained intubated for the next 2 days and was started on low molecular weight heparin 4 days postoperatively. Nine days later, she had a postoperative Chest X-ray that showed a radiopaque image in the right lung associated with cement emboli [Figure 4]. She was then discharged without supplemental oxygen or on anticoagulation.

## DISCUSSION

Symptomatic pulmonary embolism due to bone cement utilized to perform transpedicular screw fixation is rare, occurring in 1.4% of isolated cases.<sup>[6,7,9,11,13,20]</sup> Currently, ten publications have reported 13 cases of patients with symptomatic pulmonary embolism due to bone cement.<sup>[1,5,9-12,14-16,20]</sup> Most of the patients reported were over 64 years of age and had instrumentation of the lumbar



**Figure 4:** Follow-up at 1 week after surgery. Instrumentation with transpedicular screws at T9, T10, T12 and L1 with polymethylmethacrylate augmentation. (a) Anteroposterior view, radiopaque image in right lung associated with cement emboli. (b) sagittal view radiopaque image which is correlated with cement leakage through the paravertebral venous system.

spine [Table 1]. Of the 13 cases, one had a fatal outcome, and two required open embolectomy; Where pulmonary cement embolisms involve main arterial trunks or are located in cardiac cavities but the patient is asymptomatic, anticoagulation is recommended for 6 months.<sup>[1,5,10,12,15]</sup> In

**Table 1:** Case Reports of Symptomatic Pulmonary Embolism After Transpedicular Cemented Screw Instrumentation.

Author/Year	Sex/Age	Diagnosis/ Spinal Surgery Levels	Medical Background	Embolus Location	Signs and Symptoms	Treatment	Outcomes
Rasch <i>et al.</i> 2010 <sup>[12]</sup>	M/55 years old	L3 and L4 fracture/No data available on instrumented levels	Osteoporosis	Right and left pulmonary arteries of the upper lobe	3 <sup>rd</sup> postoperative day Tachycardia Dyspnoea Oxygen desaturation down to 65%	Anticoagulation, pulmonary arteriotomy under extracorporeal circulation, cement embolus was removed from the right pulmonary artery with Fogarty catheter. Intermittent use of CPAP. Ilomedin administration	Improvement of respiratory symptoms. Adequate left and right ventricular function. On the 9 <sup>th</sup> day, transferred from the intensive care unit to regular ward and discharged a few days later
Tonolini and Bianco 2012 <sup>[15]</sup>	F/75 years old	L2 fracture/L1 - L3	Not applicable	Distal right pulmonary artery, subsegmental branches in the right upper lobe	Immediate postoperative period Progressive dyspnoea Tachypnoea Bilateral hypoventilation	Anticoagulation with low- molecular- weight heparin followed by warfarin	Symptoms improved. No sequelae
Özalay and Özkoç 2012 <sup>[10]</sup>	F/75 years old	L1 fracture, lumbar spine stenosis at L3-L4, epidural compression/ T12 - L2	Osteoporosis	Pulmonary trunk, right pulmonary artery, middle lobe segmental arteries	1 <sup>st</sup> day after surgery Low-grade fever Chest pain Breathing difficulty D-Dimer 2000 ug/L	Anticoagulation with low- molecular weight heparin followed by warfarin	Symptoms improved after 3 months. No symptoms after one year
Zheng <i>et al.</i> 2013 <sup>[20]</sup>	F/47 years old	Thoracic spinal stenosis/T1, T2, T3, T4 and T9	No data	Pulmonary arterioles and capillaries of both lungs	1 h post anaesthetic recovery Low blood pressure Dyspnea Sudden loss of consciousness	Not applicable	Death
Hemmer 2015 <sup>[5]</sup>	M/64 years old	L3 fracture/No data	Lumbar fusion in 1985 at L4-5 and L3-4 64-pack-year smoking history Type 2 diabetes	Proximal left pulmonary artery	Occasionally felt “a little winded”	Surgical removal of the cement embolus	Symptoms improved
Andrä <i>et al.</i> 2017 <sup>[1]</sup>	F/62 years old	L1 fracture/T11 - L3	Osteoporosis Arterial hypertension Obesity	Peripheral pulmonary arteries and right atrial perforation	During surgery Hemodynamic instability Severe tachycardia Hypotonia, Hemorrhagic hypovolemic shock Pneumothorax	Sternotomy and embolus removal	Extubated on postoperative day 2 and transferred to intermediate care unit on postoperative day 8

(Contd...)

**Table 1:** (Continued)

Author/Year	Sex/Age	Diagnosis/ Spinal Surgery Levels	Medical Background	Embolus Location	Signs and Symptoms	Treatment	Outcomes
Ulusoy et al. 2018 <sup>[16]</sup>	4 patients, average age 72,8 years old	Adult spinal deformity or degenerative disease/Thoracic or thoracolumbar instrumentation without any further specification	Osteoporosis Case one: no comorbidities. Case two: chronic steroid use for polymyalgia rheumatica and history of myocardial infarction Case three: chronic hypertension, diabetes mellitus and heavy smoker Case four: severe COPD	Main pulmonary artery, lobar artery, and segmentary-sub segmentary arteries	During surgery Haemodynamic instability	Case one and three: low-molecular-weight heparin followed by warfarin for 6 months Case two: low-molecular-weight heparin after surgery, then suspended due to gastrointestinal bleeding Case four: intraoperative resuscitation. Low-molecular-weight heparin followed by warfarin for 6 months	No deaths
Rahimizadeh et al. 2020 <sup>[11]</sup>	F/No data	Failed back syndrome/L2 - Sacroiliac	Osteoporosis	Segmental arteries of the left lung	First day after surgery Cardiopulmonary arrest	Anticoagulation with heparin which was gradually discontinued 6 days later and replaced by Rivaroxaban for 3 months	1-year follow-up with no sequelae
Tang et al. 2020 <sup>[14]</sup>	F/73 years old	Lumbar degenerative disease/L2 - L5	No data	Right pulmonary arteries	After surgery Dyspnoea Oxygen desaturation	Unspecified anticoagulation Oxygen	2-year follow-up with no symptom
Liang et al. 2021 <sup>[9]</sup>	F/67 years old	L4 and L5 spondylolisthesis, spinal stenosis/L4 - S1	Osteoporosis, Arterial hypertension	Intracardiac, multiple segments of right pulmonary arteries, anteromedial basal segment and basal lateral segment of left lower lobe	3 <sup>rd</sup> day after surgery Sudden decrease in oxygen saturation to 70% D-dimer increased at 7669 ng/mL Elevated pH 7.47 Reduced oxygen partial pressure at 58.6 mmHg Fever	Low-flow oxygen Low-molecular-weight heparin for 1 month, then switch to Warfarin for 2 months Levofloxacin	Asymptomatic for 30 months

M: Male, F: Female, COPD: Chronic obstructive pulmonary disease

this case, due to clinical improvement and lack of level A evidence, the cardiology department did not recommend

continuing anticoagulation. Follow-up was performed 15 days, 1 month, and 6 months after discharge.

## CONCLUSION

PMMA cementation continues to be used in osteoporotic patients to increase pull-out resistance when placing transpedicular screws for thoracolumbar fractures/fusions. Although cement leakage resulting in symptomatic pulmonary embolization following cemented PMMA transpedicular screw fixation is rare, it should be aggressively diagnosed and medically managed in every patient individually by an interdisciplinary team.

## Declaration of patient consent

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

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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