

## Case Report



# Cardiac Perforation Caused by Bone Cements as a Complication of Cement Augmented Pedicle Screw Fixation Using the Fenestrated Pedicle Screw: A Case Report



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### Conflict of Interest

The authors have no financial conflicts of interest.

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## ABSTRACT

Cement-augmented fenestrated pedicle screw fixation is becoming more popular for osteoporotic patients. Although several reports have been published on leakage-related problems with bone cement, no cases of cardiac perforation after cement-augmented pedicle screw fixation have been reported. We present a case of cardiac perforation after cement-augmented fenestrated pedicle screw fixation. A 67-year-old female was admitted to our hospital with complaints of dyspnea and chest pain after lumbar surgery. She had been treated with L4–5 lumbar interbody fusion and percutaneous pedicle screw fixation with bone cement augmentation seven days earlier for degenerative spondylolisthesis. The right chest pain was observed a day after the surgery; she was treated conservatively but it did not improve for 7 days after surgery. Chest computed tomography (CT) revealed a hemothorax and a large sharp bone cement fragment that perforated the right atrium. Bone cement can be removed with thoracotomy surgery. We have to be aware of cement leakage through the normal venous drain system around the vertebral body. We also have to consider a detailed cardiac workup, which may include chest CT or echocardiography, if a patient complains of chest pain or dyspnea after cement augmentation.

**Keywords:** Bone cement augmentation; Fenestrated pedicle screw; Cement leakage; Hemothorax; Cardiac perforation

## INTRODUCTION

Pedicle screw fixation has been the gold standard for the treatment of an unstable spine caused by trauma, degeneration, or tumorous conditions.<sup>12)</sup> However, an increasing number of patients worldwide who suffer from osteoporosis have poor bone quality that does

not provide sufficient bone strength for common pedicle screws during fusion surgery. Polymethylmethacrylate augmentation is regarded as an efficient way to enhance screw strength in osteoporotic patients.<sup>4,8)</sup> Generally, cement is injected before screw insertion and the pedicle screw is then inserted into the cement to enhance its strength.<sup>8,9,12)</sup> This procedure is almost the same method as conventional vertebroplasty. Cardiac perforation after vertebroplasty is a very rare complication<sup>10,11,15)</sup> and it would be caused by a sharp and large fragment of bone cement. The cause of cardiac perforation after vertebroplasty is not yet known, but several case reports assumed that cardiac perforation was caused by direct cement injection to the vena cava.<sup>11,15)</sup>

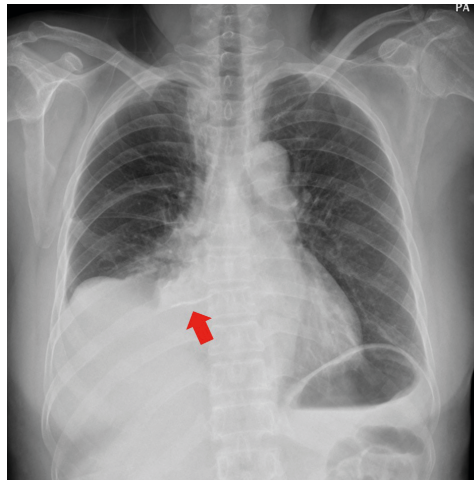
Recently, fenestrated pedicle screws are also becoming more popular in screw augmentation.<sup>1,4,5)</sup> The fenestrated pedicle screw has cement exiting holes on the side of the screw. Also, cement injection was done after pedicle screw insertion, so direct cement leakage to the great vessels is theoretically impossible. To our best knowledge, there are no papers that have been published thus far on cardiac perforation due to cement augmented pedicle screw fixation using the fenestrated pedicle screw. In this report, we describe a case of needle-shaped bone cement accidentally penetrated the right atrium and the pericardium after cement-augmented pedicle screw fixation using the fenestrated pedicle screw.

## CASE REPORT

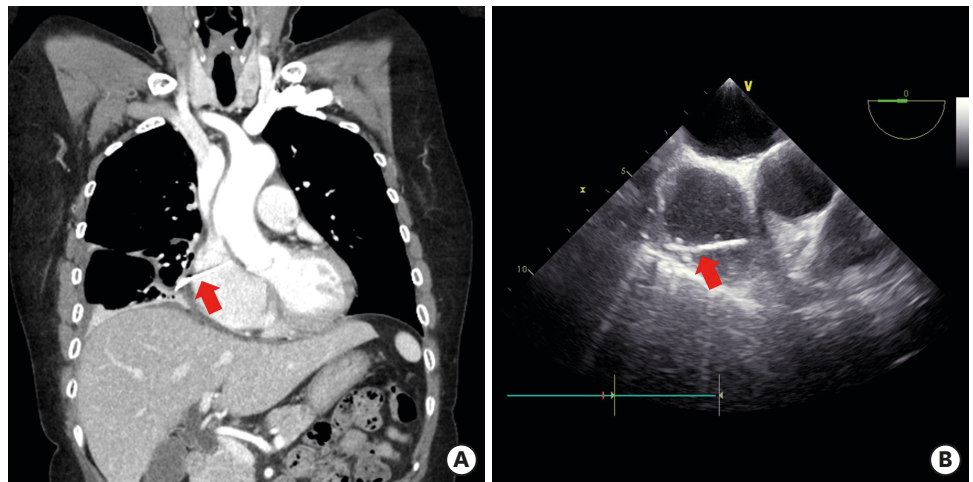
A 67-year-old female visited our hospital with a history of ongoing dyspnea with right chest pain for 7 days. She had spinal surgery (L4–5 lumbar interbody fusion and percutaneous pedicle screw fixation with bone cement augmentation) 7 days ago for degenerative spondylolisthesis (**FIGURE 1**). Right chest pain was observed from the day after surgery. The foreign body was shown in right atrium on X-ray (**FIGURE 2**), but the clinician didn't find it. She was treated with diuretics at the hospital for 5 days, but her symptoms did not improve. She was transferred to our hospital 7 days after the spine surgery. When she arrived at our hospital, her vital signs were normal. The chest computed tomography (CT) was performed, and a linear material that perforated the right atrium and the right middle lobe of the lung was detected (**FIGURE 3A**). It also showed that there was a linear high-density material in the right atrium on echocardiography (**FIGURE 3B**). We decided to remove them by emergency surgery.



**FIGURE 1.** Simple X-ray showing the spinal instability on L4–5 (A). Magnetic resonance imaging showing the degenerative spondylolisthesis with spinal stenosis (B, C).



**FIGURE 2.** Chest X-ray showing the foreign body on right atrium.



**FIGURE 3.** The bone cement fragment (red arrow) penetrating the right atrium is shown in a chest computed tomography scan (A) and an echocardiogram (B).

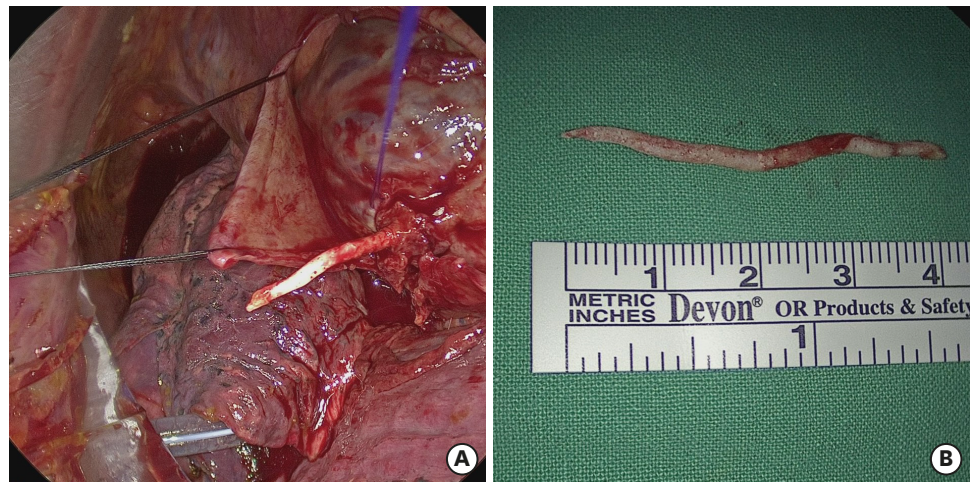
Anterolateral thoracotomy was performed at the fifth intercostal space under one-lung ventilation. We found 4.5-cm-sized needle-shaped bone cement that perforating the right atrium (**FIGURE 4**). After removal of the bone cement, we confirmed there is no remnant material in the right atrium or other abnormalities in the heart by using transesophageal echocardiography. The patient was discharged from the hospital 9 days after the cardiac surgery.

We obtained informed consent from the patient and approval from the Institutional Review Board of Hospital.

## DISCUSSION

Bone cement-augmented pedicle screw fixation is an efficient technique to enhance screw strength in osteoporotic bones.<sup>4,8)</sup> Cement leakage can occur as a complication of cement augmentation and cause local complications and systemic complications such as cerebral embolism, cardiac embolism, pulmonary embolism, renal artery embolism, and acute

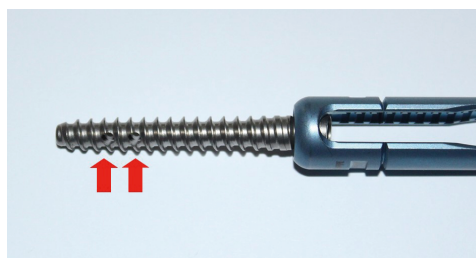




**FIGURE 4.** Intraoperative image showing linear polymethylmethacrylate cement in the right atrium (A) and a gross cement fragment that has a linear and sharp shape (B).

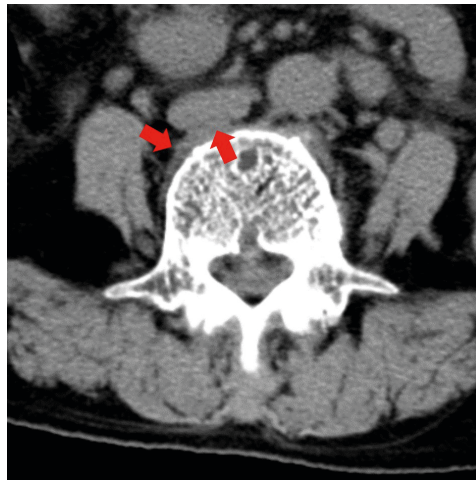
respiratory distress syndrome.<sup>2,6,7,10,11,13,15</sup> The mechanisms of cement leakage have not been analyzed yet, but it could be estimated. First, the intravertebral cleft would be a tract of cement leakage. Second, the drainage vein would be the tract of cement leakage. Third, direct injection of bone cement might be possible. Most cement leakage can result from the first reason. However, cardiac perforation caused by a large bone cement fragment may have a different mechanism from other embolic complications.<sup>10,11,15</sup>

To our best knowledge, all cardiac perforation after bone cement injection has happened in vertebroplasty,<sup>10,11,15</sup> and it could be caused by a sharp and large fragment of bone cement. The mechanism of cement leakage causing cardiac perforation has not been confirmed. Only 2 case reports have assumed that cardiac perforation was caused by direct cement injection to the vena cava.<sup>11,15</sup> The injection point of bone cement in vertebroplasty was the tip of needle, so it is very close to the anterior portion of vertebral body which contains the aorta and inferior vena cava. However, cement augmentation was done using a fenestrated pedicle screw, which had exiting holes of the penetrated screw on the side of the screw (**FIGURE 5**). Cement injection was done after pedicle screw insertion, so direct cement leakage to the great vessel is theoretically impossible. Also, preoperative CT showed venous drain to the vena cava (**FIGURE 6**), and postoperative CT showed remnant bone cement in the vein (**FIGURE 7**). The shape of the cement fragment is very long and thin (**FIGURE 4B**). Beyond these facts, we could speculate that the bone cement leaks to the vena cava through the lumbar drain vein.

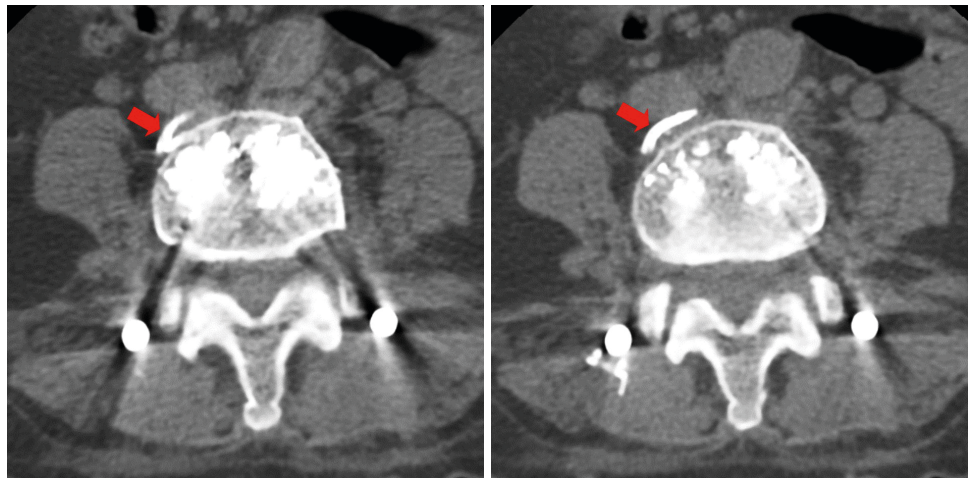


**FIGURE 5.** The fenestrated pedicle screw has exiting holes (red arrow) of bone cement on the side of the screw.





**FIGURE 6.** Preoperative computed tomography showing venous drain (red arrow) to the vena cava around the L4 vertebral body.



**FIGURE 7.** Postoperative computed tomography showing a remnant cement fragment (red arrow) in the vein.

The viscosity of bone cement is an essential parameter regarding extra-vertebral bone cement leakage.<sup>3,16)</sup> High viscosity is difficult to inject the bone properly, and low viscosity has a high risk of cement leakage. In this case, we could guess 2 problems, one which is the low viscosity of bone cement and the other which is a fast injecting time. As a result, we have to be aware of cement leakage through the normal venous drain system around the vertebral body. Preoperative CT might be helpful, and we have to detect bone cement leakage through the venous drain system as soon as possible under fluorescence. Also, we need to take a close look at the simple X-ray first and we may consider the need for a detailed cardiac workup, such as chest CT or echocardiography, if the patient complains of chest pain or dyspnea after cement augmentation.

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