

Bone cement embolism into the right heart



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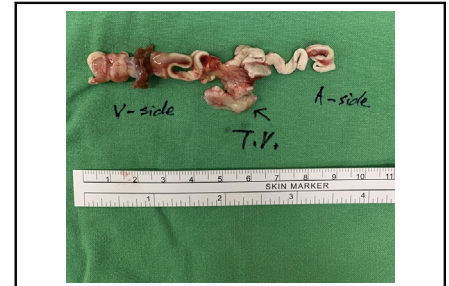
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Intracardiac embolization of bone cement into the right heart.

CENTRAL MESSAGE

Bone cement embolization is a well-documented complication of percutaneous vertebroplasty. Cardiac embolization is not an infrequent condition that may sometimes require surgical intervention.

▶ Video clip is available online.

Percutaneous vertebroplasty with the use of bone cement is a widely performed minimally invasive orthopedic procedure for treating osteolytic vertebral metastases and osteoporotic vertebral fractures. One of the main complications associated with percutaneous bone cement injection is cement leakage, either into the paravertebral tissue or, less frequently, into the perivertebral venous plexus, which may result in embolization into the right heart or pulmonary vasculature. In this report, we present a case of intracardiac bone cement embolism after percutaneous vertebroplasty.

CASE REPORT

This is a 76-year-old female patient with a history of osteoporotic vertebral compression fracture, for which she had received percutaneous vertebroplasty of the L3–L5 vertebra with methyl methacrylate 2 months before presentation (Figure E1). The patient had been experiencing intermittent chest tightness and dyspnea since the procedure, so she presented to the cardiology clinic for evaluation. An echocardiogram showed an echogenic mass within the right atrium/ventricle (Figure 1, A), as well as the presence of moderate tricuspid insufficiency. Radiograph of the chest (Figure 1, B) and computed tomography (Figure 1, C) also revealed a linear-shaped hyperattenuated lesion extending from the right atrium into the right ventricle.

Fragments of hyperattenuated lesions were also seen in the branches of the right pulmonary artery (Figure E2). In light of her recent surgical history, bone cement cardiac embolism was suspected.

Upon admission, physical examination was unremarkable except for a grade II systolic murmur at the right lower sternal border. Subsequent surgical extraction of the cement was successfully performed through a median sternotomy under cardiopulmonary bypass. Upon right atriotomy, it was noted that the bone cement was densely adhered to the tricuspid valve leaflet (Video 1), and tricuspid valve replacement was required due to irreparable leaflet damage (Figure 2). The patient was admitted to the intensive care unit for postoperative monitoring and was subsequently transferred to the general ward the next day. In accordance with the institutional policy of the institutional review board (IRB) or equivalent ethics committee of the National Taiwan University Hospital, the IRB committee of the National Taiwan University waives the need for IRB approval and patient informed consent for case report of a single patient, as long as the article does not contain any patient identifiable information.

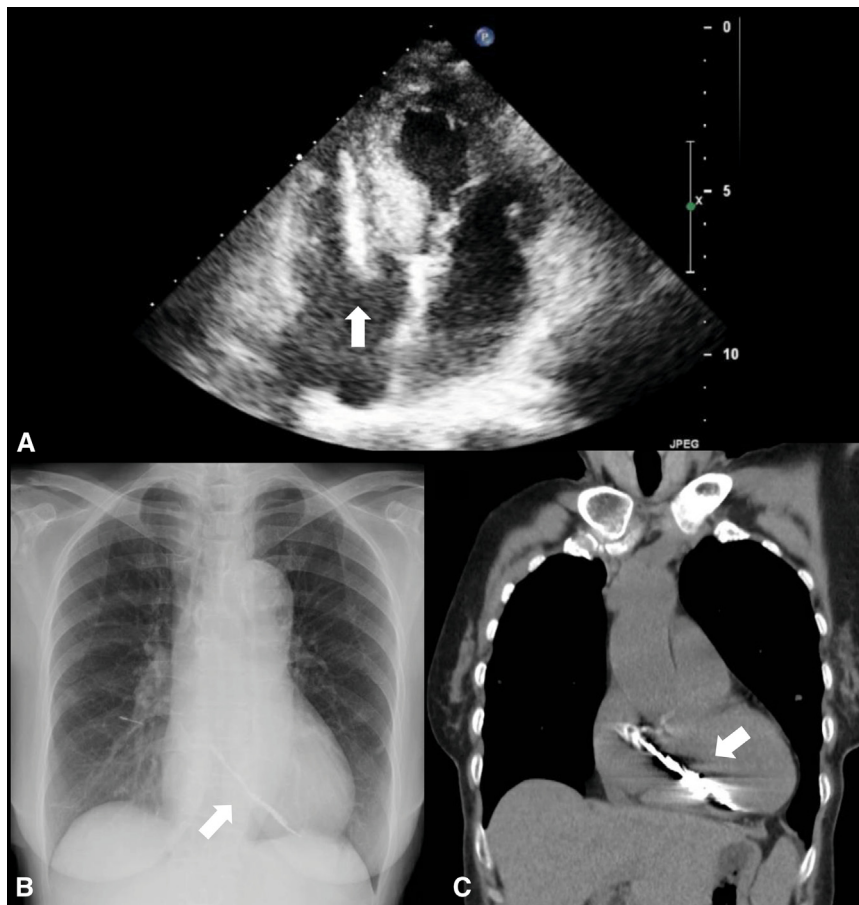


FIGURE 1. A, Echocardiography showed the presence of an echogenic linear mass within the right atrium and ventricle of the heart (*white arrow*). B, A linear hyperattenuated lesion was found on the radiograph of the chest (*white arrow*). C, Computed tomography also clearly demonstrated that there was a radio-opaque mass extending from the right atrium into the right ventricle (*white arrow*).

DISCUSSION

Bone cement leakage and embolization is a well-documented complication of percutaneous vertebroplasty, with a reported incidence of 4.6%.^{1,2} Potential risk factors for cement embolisms include osteoporotic or osteolytic fracture, injection of cement in large amounts, and under high injection pressure, etc.³ Although greater injection pressure has generally been considered as a risk factor,^{4,5} there is currently lack of evidence to suggest what injection pressure increases risk of cement embolization. The injection pressure is affected by multiple factors, including the technique and equipment used for injection, viscosity of the cement before injection, site of injection, severity and etiology of the fracture, etc.⁶ In our case, the amount of injected cement was unknown. However, in a retrospective study by Hsieh and colleagues,⁷ the authors reported an increased risk of pulmonary embolism with >7 cc of injected cement compared with <3.5 cc (0.9% vs 0%, $P < .01$). However, there have been reports of cement embolism with injected volume as little as 1.5 cc.⁸ This can again be explained by

the fact that the occurrence of cement leakage and subsequent embolization is multifactorial, and risk assessment should be individualized.

Surgical Approach

- ✓ Median sternotomy
- ✓ Cardiopulmonary bypass setting: SVC/IVC venous cannulation (bicaval snare) → Ascending aorta, normothermia, beating heart
- ✓ Right atriotomy
- ✓ Extraction of bone cement with DeBakey forceps
- ✓ Excised destructed tricuspid valve, followed by implantation of a 27mm Mosaic bioprosthetic valve
- ✓ Closed the RA atriotomy & de-air

VIDEO 1. The bone cement was retrieved under partial cardiopulmonary bypass. Upon right atriotomy, a string-shaped piece of cement was seen adhered to the tricuspid valve, and was subsequently removed carefully with DeBakey forceps. Video available at: [https://www.jtcvs.org/article/S2666-2507\(22\)00519-3/fulltext](https://www.jtcvs.org/article/S2666-2507(22)00519-3/fulltext).

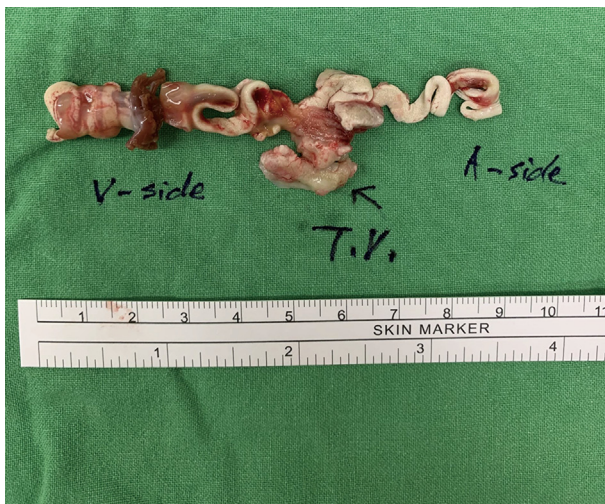


FIGURE 2. The embolized bone cement was successfully extracted. The cement was densely adhered to the tricuspid valve leaflet. TV, Tricuspid valve.

Our patient's symptoms developed insidiously over the course of weeks, but for the majority of patients with cement embolization, they remain asymptomatic. For those with symptoms, the onset is highly variable. Whereas some patients develop dyspnea and chest pain immediately after cement injection, there were cases in which patients develop symptoms months or even years after the procedure.⁹

For cases with no symptoms as well as small and peripherally located cement emboli, they can be managed conservatively with anticoagulants, whereas some patients may require surgery, including those with tricuspid valve dysfunction, right ventricular perforation, and large pulmonary embolism causing hemodynamic instability.¹⁰ Previous literature has reported the retrieval of right atrial cement fragments through percutaneous approach; however, there is a potential risk of causing further fragmentation and distal embolization, as well as causing valvular injury.¹¹ Therefore, the optimal interventional should be individualized based on the size/location of the bone cement, presence of valvular or ventricular injury, and extent of the

embolization, as well as the risk of the procedure and its associated complications.

CONCLUSIONS

Bone cement embolization is a well-documented complication of percutaneous vertebroplasty with methyl methacrylate, and disease manifestation may vary considerably depending on the size/location/associated valvular dysfunction, etc. Postoperative surveillance with a radiograph of the chest has been proposed by some experts, although its sensitivity may be limited when compared with computed tomography or echocardiography. Most important of all, clinicians should keep in mind that cardiac embolization is not an infrequent condition that may sometimes require surgical intervention.

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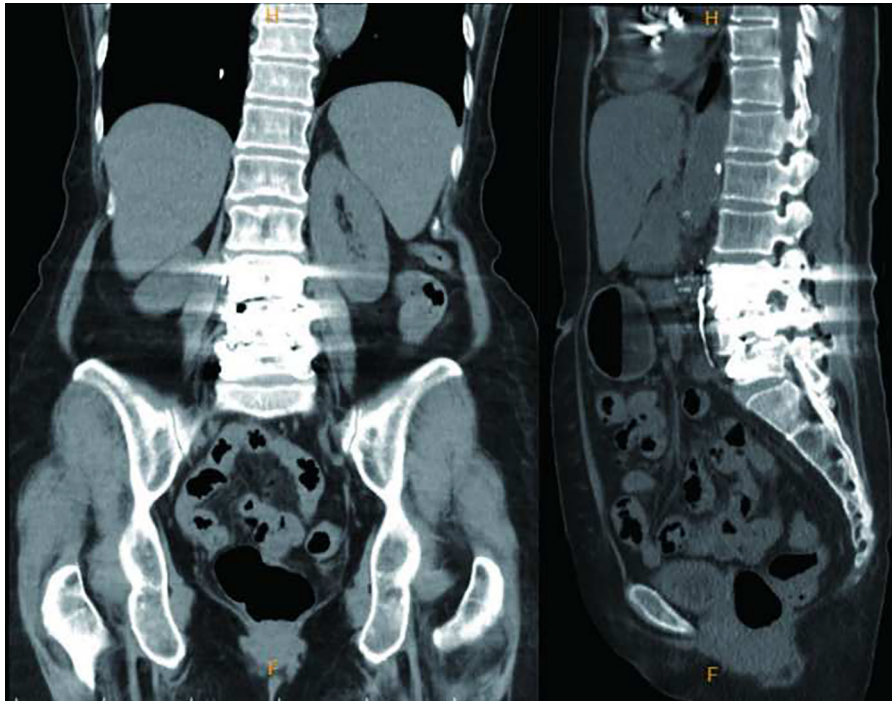


FIGURE E1. Computed tomography image showing bone cement in the lumbar vertebra (L3-L5).



FIGURE E2. Computed tomography image showing small fragment of bone cement within branch of the right pulmonary artery (*white arrow*).