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CASE SERIES
Other

Massive cardiopulmonary cement embolism with cardiac perforation after vertebroplasty: a case series

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Background The prevalence of cement embolism after percutaneous vertebroplasty ranges from 2.1 to 26%, in literature. Even if most cases remain asymptomatic, intracardiac cement embolism becomes symptomatic in up to 8.3% of the cases.

Case summary We report a case series of two cases with massive cardiopulmonary cement embolism, which lead to perforation of the right ventricle and needed cardiothoracic surgery.

Discussion As this entity affects different fields of medical specialties and may lead to fatal outcome, we believe that the efforts of better understanding its development, avoidance, detection, and treatment need to be intensified. For this purpose, systematic and interdisciplinary studies to follow up patients after vertebroplasty are needed.

Keywords Cardiac Embolism • Vertebroplasty • Cement • Case series

ESC Curriculum 2.1 Imaging modalities • 2.2 Echocardiography • 2.4 Cardiac computed tomography • 9.2 Trauma to the aorta or the heart • 9.4 Thromboembolic venous disease

Learning point

- Acute thoracic pain in patients that underwent vetrebroplasty are at risk for cardiopulmonary embolism and treating physicians should seek actively for this complication.

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Introduction

We report a case series of two patients, who underwent percutaneous vertebroplasty and developed the complication of cardiopulmonary cement embolisms. Both patients suffered from cardiac perforation and underwent cardiothoracic surgery.

Percutaneous vertebroplasty is a technique to treat fractured vertebrae by injecting medical cement into the fracture bone by a minimal-invasive surgery. The entity of cardiopulmonary cement embolisms is in most cases asymptomatic and occurs in up to 26% after vertebroplasty.[1] Cardiac perforation is a known complication, but—in our opinion—still underestimated, as none of our experienced cardiologists and cardiothoracic surgeons was affected during their career with this complication.

Timeline

DAY	CLINICAL EVENT
Case 1	
0	Percutaneous vertebroplasty
14	Hospital admission due to thoracic pain
14	Echocardiography
15	CT scan
22	Surgery
Case 2	
0	Percutaneous vertebroplasty
27	Hospital admission due to thoracic pain
27	Echocardiography
29	CT scan
34	Surgery

Case1

A 79-year-old patient presented to our centre 14 days after percutaneous vertebroplasty with a history of chest and upper abdominal pain. His blood pressure was 158/73 mm Hg, and he had a heart rate of 86 beats/min (sinus rhythm) and a respiration rate of 16–20 breaths/min. The heart sounds were regular. The lungs were clear to auscultation. The abdomen was slightly tender with mild epigastric pain on palpation but no signs of peritonism. Permanent medication was pantoprazole, torasemide and metamizole. External x-rays revealed a dense intracardiac structure, which could also be seen in echocardiography (see Supplementary material online, *Videos*). Computed tomography angiography (CTA) confirmed the intracardiac structure with an imminent perforation of the right ventricular wall and revealed additional foreign body structures of the same density in the peripheral pulmonary arteries (*Figure 1A*). CTA scan of the vertebra L2, which underwent vertebroplasty with polymethylmethacrylate (PMMA) medical cement, revealed a completely cemented lumbar vein, draining into the left renal vein, where the cemented structure was discontinued abruptly (*Figure 1B*).

The first attempt to remove the intracardiac foreign body with a percutaneous snare technique (6 French, 12–20 mm Merit Medical) failed (*Figure 1C*), and the patient underwent emergency cardiothoracic surgery. During the procedure, the foreign body was angulated between the right apex while the other end already perforated the right atrium and the surrounding pericardium, establishing a connection to the peritoneal cavity (*Figure 2*, see Supplementary material online, *intraoperative video*). The needle-like cement embolism with a length of ~10 cm could be removed successfully, without affecting the integrity of the tricuspid valve. The pericardium and the atrium could be successfully closed and the patient recovered completely.

Case 2

The second case is an 84-year-old patient. He presented to our department for a coronary angiography because of a suspected progression of his known three-vessel coronary artery disease due to a novel, mildly impaired left ventricular systolic function that was observed by the referring cardiologist. His blood pressure was 108/68 mm Hg, and he had a heart rate of 82 beats/min (sinus rhythm) and a respiration rate of 14–16 breaths/min. The heart sounds were regular. The lungs were clear to auscultation. The abdomen was soft. Permanent medication was aspirin, ramiprile and atorvastatin. The patient had undergone vertebroplasty of the vertebrae L2 and L3 in the weeks before presentation to our ward. During the coronary angiography, and the consecutive percutaneous coronary intervention, a needle-like intracardiac structure was noticed in the fluoroscopy.

Echocardiography confirmed a right ventricular intracardiac foreign body penetrating the right ventricular apex (*Figure 3A*). Consecutively, a thoraco-abdominal computed tomography was conducted revealing filiform cementeous material in the V. cava inferior (VCI) with linkage to the vertrebrae that were treated with cement injection (*Figure 3B*). The maximal length of this filiform foreign body was about 4 cm. Filiform foreign bodies were also present in the right ventricle, perforating the right ventricular wall, and in the right lower pulmonary lobe artery (*Figure 3C and D*). Possibly, the filiform foreign bodies constitute fragmentations of the lesion in the lower V. cava.

The foreign body in the heart was surgically removed. The foreign bodies in the V. cava and the pulmonary arteries remained *in situ*. The patient was discharged into a rehabilitation centre 1 week after surgery.

Discussion

In literature, the prevalence of cement embolism after percutaneous vertebroplasty ranges from 2.1 to 26%.[1–3] Even if in most cases remain asymptomatic, intracardiac cement embolism is reported to be symptomatic in up to 8.3% of the cases.[4] There is at least one successful removal with snare technique described in literature.[5] We here report two cases of massive cardiopulmonary cement embolisms, that perforated the right ventricle and needed cardiothoracic surgery.

Known mechanisms that increase the risk for cement embolisms are high injection pressure of PMMA, high amount of PMMA used during a procedure, conduction of multiple vertebroplasties, thoracal vertebroplasties, and an insufficient fluidity management of PMMA.[6] An insufficient fluidity management during procedure leads to injection of PMMA, which is not yet crystalized and still too fluid. A too liquid texture is able to drain into the vertebral vein system, where the final crystallization finally takes place and is able to lead to the here described complications. Therefore, it is necessary for the orthopaedic surgeons to follow the guidance recommendations of the PMMA manufacturers in respect to preparation time, injection volume, PMMA temperature, and injection pressure. In our cases, we had no information of PMMA being inadvertently during procedure —so we have to postulate that the PMMA is being transported directly into the blood stream through the fractured vertebrae, similar to fat embolisms.

As we report a small case series, both solved with a surgical approach, there are still questions that need to be answered: What efforts can be done to minimize the occurrence of PMMA

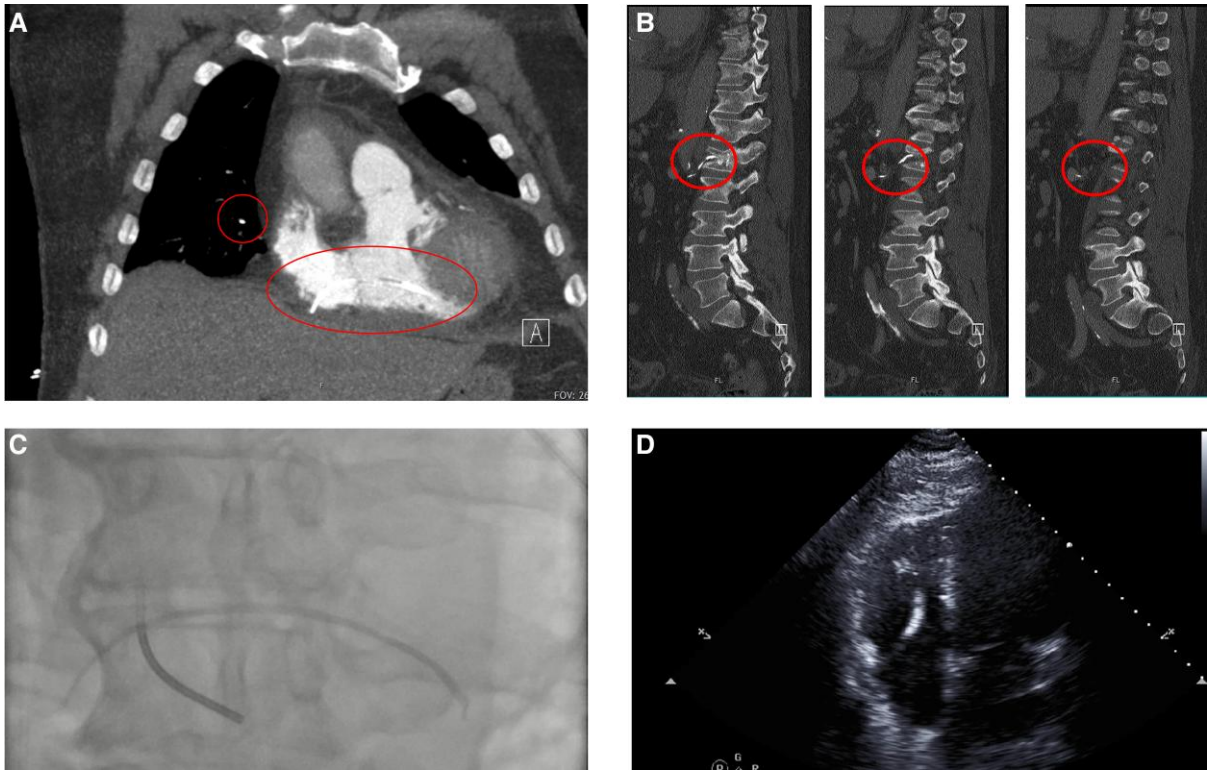

Figure 1 CTA (*A*, *B*), angiography (*C*) and echocardiography (*D*) of the intrathoracal foreign body (*A*, *C*, *D*) and the cemented lumbal vein (*B*) of Case 1.

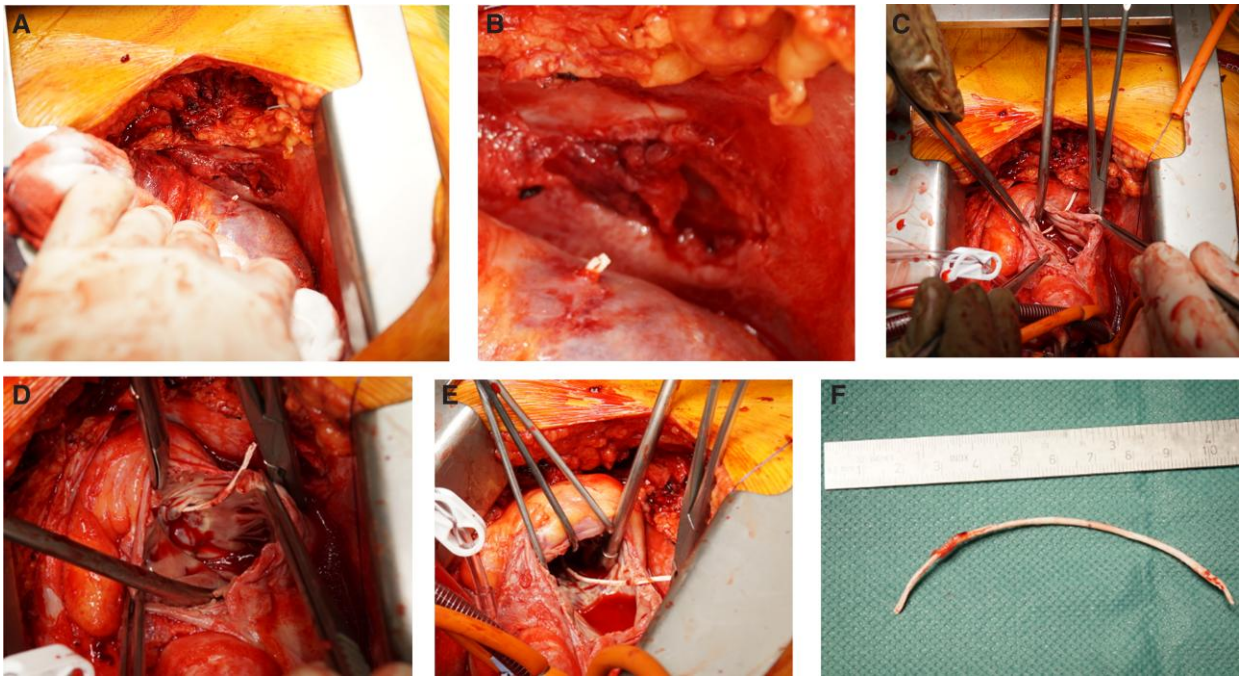

Figure 2 Intraoperative photography of the cement embolism perforating the right atrium and pericardium (*A*, *B*), its anatomical localization through the tricuspid valve and angulation in the right ventricular apex (*C*–*E*) and the removed foreign body (*F*) of Case 1.

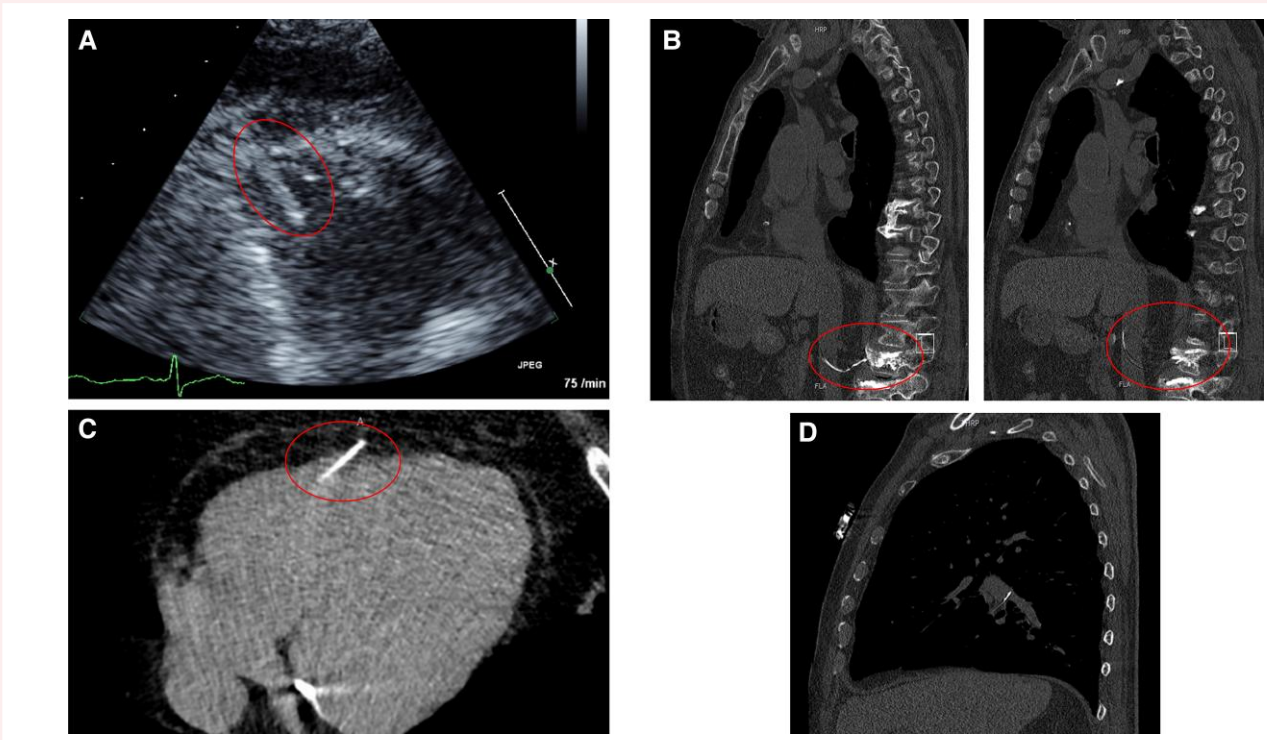

Figure 3 Echocardiography (*A*) and CTA (*B–D*) of the intracardiac cement embolism with cardiac perforation and cement (*A*, *C*, *D*) and the filiform cementous material in the VCI of Case 2.

cementation in the blood stream, in detail: how can the fluid management be optimized? As foreign body material remained *in situ* in the vena cava, we do not know, if patients would profit from complete removal or if not, if anticoagulation is necessary in such a setting. The in literature described case of successful removal by snare technique seems promising—if possible. In our cases, where patients already suffered from cardiac perforation, the initial approach of removal by snare technique was performed in surgical standby. We think that this technique still remains a potentially successful therapy, but surgical standby should be maintained as treatment of the potential fatal complication like of cardiac tamponade might need thoracotomy after successful removal but also for the potentially necessary surgical removal through the percutaneous access in the groin. Therefore, this complication needs to be discussed by different medical specialties and systematic interdisciplinary studies are needed. Its diagnosis and treatment as a multi-disciplinary approach is challenging but very positive not only for the patients' outcome but also for the medicating teams.

Lead author biography

Dr. Simon Schoechlin is working at the University Heart Center Freiburg Bad Krozingen. After specializing in the field of cardiac intensive care medicine, he is apparently working in the field of electrophysiology.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports*.

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None.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The authors confirm that written consent for submission and publication of this case report including the images and associated text have been obtained from the patient in line with COPE guidance.

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