

Case report

Multiple cardiac perforations and pulmonary embolism caused by cement leakage after percutaneous vertebroplasty

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Abstract

Percutaneous vertebroplasty is a minimally invasive procedure in which polymethylmethacrylate polymer is used to treat painful diseased vertebral bodies. However, despite its minimally invasive nature and relative safety, cement leakage beyond involved vertebral bodies into the venous system can induce devastating cardiovascular complications. Here, the authors report a case of multiple cardiac perforations and pulmonary embolism caused by cement leakage after percutaneous vertebroplasty.

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1. Introduction

Since percutaneous vertebroplasty (PVP) was introduced in 1987 by Galibert et al. [1], many studies have reported on its effectiveness for relieving persistent pain and for strengthening vertebral bodies weakened by various vertebral diseases, such as osteoporotic vertebral compression fractures, osteolytic metastases, myeloma, and vertebral angioma [1–3]. However, despite the relative safety and minimal invasiveness of PVP, it may result in devastating cardiovascular complications related to acrylic cement leakage. Here, the authors report a case of multiple cardiac perforations and pulmonary embolism caused by cement leakage after PVP.

2. Case report

A 59-year-old woman suffering from chest pain radiating to both shoulders and dyspnea was admitted for further evaluation and treatment. She had a history of repeated PVP at the 12th thoracic vertebra and at the 1st lumbar vertebra 2 months and 9 days, respectively, to relieve back pain due to a compression fracture, before presentation at

our hospital. On admission, her vital signs were stable, and she had normal arterial blood gases. Her electrocardiogram was normal with a stable sinus rhythm. A routine chest radiograph revealed three linear radio-opaque opacities with cardiac shadow and a linear opacity at the right upper lung, which suggested the presence of an intracardiac foreign body and pulmonary embolism presumably caused by bone cement used during vertebroplasty (Fig. 1A). An abdominal computed tomographic scan showed cement leakage outside the involved vertebral body and in the venous system after PVP (Fig. 1B). A coronary computed tomographic angiograph disclosed fish-bone like materials that pierced three sites of the right ventricle with moderate pericardial effusion. The longest of which (9 cm long) had penetrated the right ventricular cavity obliquely from the right ventricular basal posterior wall just below the posterior cusp of the tricuspid valve to the free wall of right ventricular outflow track (Fig. 1C). In addition, 2 cm and 3 cm long pieces were stuck in the free wall of right ventricle and one had perforated the free wall of the right ventricle (Fig. 1D).

Under a diagnosis of multiple cardiac perforations and pulmonary embolism caused by acrylic cement leakage after PVP, a cardiac operation was undertaken. After median sternotomy and pericardial incision, about 400 ml of old blood was aspirated from the pericardial cavity. Routine cardiopulmonary bypass was used with moderate hypothermia, and cardiac arrest was induced by infusing cold crystalloid cardioplegic solution. After the right atrium had been obliquely incised, three fish-bone like pieces of acrylic

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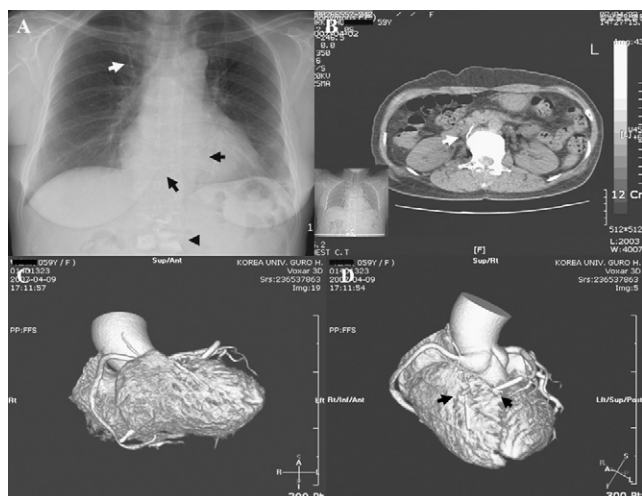


Fig. 1. (A) Chest and thoracolumbar spine X-ray showing opacification on the 12th thoracic and 1st lumbar vertebrae after percutaneous vertebroplasty (arrow head) and three fish-bone like materials in the cardiac chamber (black arrows) and a linear opacity in the right upper lung (white arrow). (B) Abdominal computed tomograph showing cement leakage outside the involved vertebral body and in the venous system after percutaneous vertebroplasty (white arrow). Coronary computed tomographic angiograph disclosing the longest fish-bone like material that pierced the right ventricular cavity obliquely (C) and multiple cardiac perforations by fish-bone like materials that pierced the right ventricular free wall (black arrows) (D).

cement that had perforated the free wall of the right ventricle were found and removed (Fig. 2A and B). The multiple perforations in the right ventricular free wall were then repaired with pledgetted 5-0 polypropylene sutures. Subsequently, the right main pulmonary artery was longitudinally incised and another piece was removed from the pulmonary artery of the right upper lobe (Fig. 2C). The patient was discharged 15 days after surgery and experienced no sequelae, except for a continuous lower back pain.

3. Discussion

Percutaneous vertebroplasty is a minimally invasive procedure that involves the use of polymethylmethacrylate (PMMA) polymer to treat painful diseased vertebral bodies [1]. This image-guided procedure has been effectively used to treat persistent pain caused by various vertebral diseases, but despite its minimally invasive nature and relative safety, cement leakage beyond the involved vertebral body into the venous system can cause devastating cardiovascular complications.

The percutaneous injection of liquid acrylic bone cement may increase intramedullary pressure, and thereby, marrow contents may be forced into the paravertebral venous circulation. Cement leakage from targeted vertebral bodies has been reported in up to 73% of cases and venous leaks in up to 24% [2–4]. Nevertheless, the majority of these remain asymptomatic, even with pulmonary emboli. In a retrospective analysis of patients with tumorous lesions managed by PVP or kyphoplasty, 4.6% of patients showed asymptomatic pulmonary emboli due to cement on chest radiographs [4]. However, penetration of cement into the right ventricle [5] and acute respiratory distress syndrome associated with

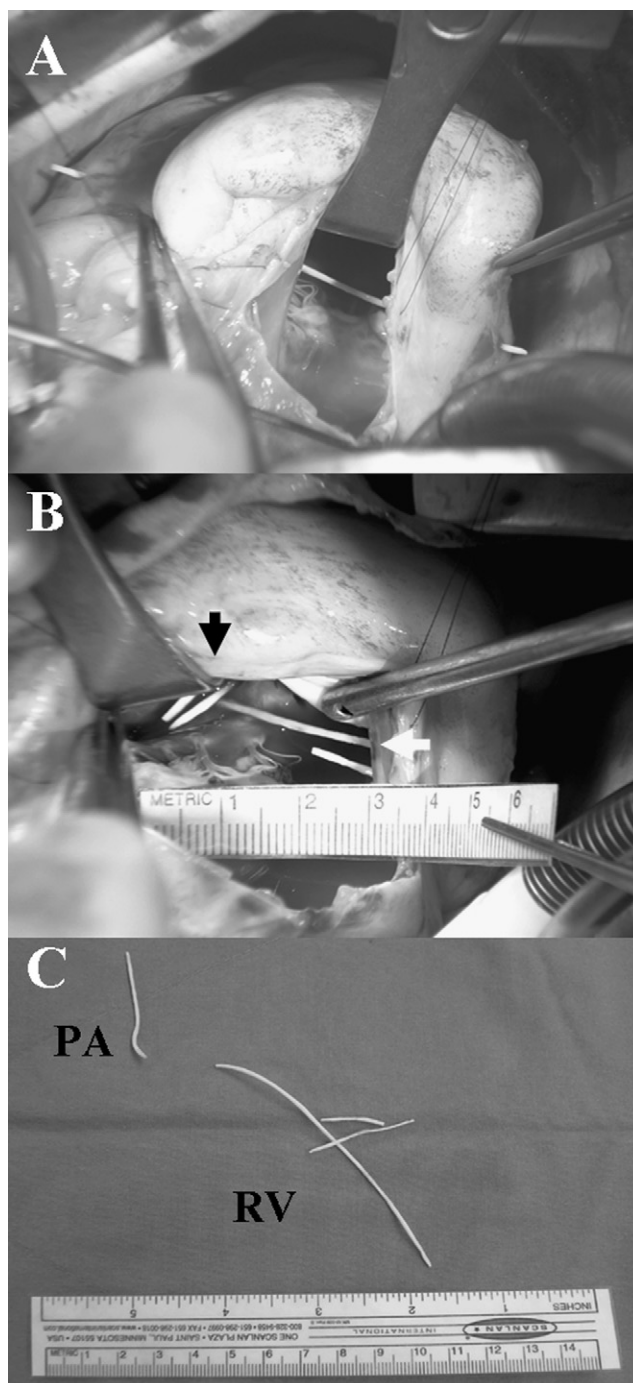


Fig. 2. (A) Operative photograph showing a 9 cm long piece of PMMA, which had penetrated the right ventricular cavity obliquely from the right ventricular basal posterior wall to the free wall of the right ventricular outflow track. (B) Operative photograph showing 2 cm and 3 cm long PMMA pieces that had stuck in the free wall of the right ventricle (black arrow) and a 9 cm long piece of PMMA that had fractured during retraction of right ventricular wall for exposure (white arrow). (C) Four PMMA pieces extracted from the right ventricle (RV) and pulmonary artery (PA).

pulmonary cement embolism [6] have been reported as rare but fatal complications.

To the best of our knowledge, this is the first case report of multiple cardiac perforations and pulmonary embolism caused by cement leakage after PVP, although cardiac

perforation and pulmonary embolism caused by cement have been previously described [5,7].

Chest pain after PVP is often attributed to the procedure, but may be caused by embolism. Accordingly, routine chest radiographs taken after the procedure may help diagnose the cause of chest pain or dyspnea [6,7]. Insufficient polymerization of the PMMA at the time of injection, a needle inadvertently placed in the basivertebral vein, or overfill of a vertebral body could all facilitate cement migration into the venous system, and have been suggested as possible mechanisms of cement embolism post-PVP [8].

Several recommendations have been made to prevent cement leakage into the circulation: (1) cement of an appropriate viscosity and volume should be injected. A paste-like consistency and smaller amounts are preferred [3,9]; (2) high-resolution fluoroscopy and mixing of the PMMA with barium or tungsten for opacification are essential for the early detection of venous PMMA migration [10]; (3) greater attention should be paid during the multilevel procedure, which has a higher associated risk of pulmonary embolism than single-level PVP [7]; (4) if vertebral venography identifies a direct shunt from the needle tip to the venous system, repositioning of the needle tip and gelfoam insertion could prevent venous drainage [7].

In conclusion, we experienced a case of multiple cardiac perforation and pulmonary embolism caused by bone cement after PVP. Although PVP is considered a safe and effective therapeutic procedure for diseased vertebral bodies, on occasion it causes serious complications as in the present case. Coronary computed tomographic angiography enabled the locations, lengths, and number of cement pieces to be clearly visualized. Sufficient knowledge of the involved anatomy and procedure, experience, a meticulous techni-

que, and early measures to detect leakage are prerequisites for the safety of patients undergoing PVP.

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