Case Reports

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Gallbladder gangrene after percutaneous vertebroplasty, an uncommon presentation of vascular complication: a case report and analysis of the causes

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Abstract

We present a case of an 81-year-old man with gallbladder gangrene after percutaneous vertebroplasty (PV) that was successfully treated via laparoscopic cholecystectomy (LC). The patient underwent multilevel, thoracic PV for painful osteoporotic compression fractures. PV performed at the T6 level was complicated by severe abdominal pain owing to direct embolization of the right T6 segmental artery with penetration of bone cement into the radicular artery beneath the pedicle. Cement leakage, especially arterial embolization of cement into the general circulation, is a known potential complication following PV. Serious complications related to PV augmentation procedures, such as vertebroplasty and kyphoplasty, are rare and most often result from local cement leakage or venous embolization. Combined with this case report, we reviewed the literature regarding the unusual occurrence of direct arterial cement embolization during PV and analyzed the causes to alert clinicians to this potentially rare vascular complication.

Keywords

Vertebroplasty, vascular complication, cement embolization, artery of Adamkiewicz, laparoscopic cholecystectomy, gallbladder gangrene

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Introduction

Percutaneous vertebroplasty (PV) is a treatment modality for painful vertebral compression fractures caused by osteoporosis. The technique was first used in the treatment of cervical hemangioma by Galibert and Deramond as early as 1984.[1] Currently, injecting polymethylmethacrylate (PMMA, bone cement) into the affected vertebral body is used to strengthen and stabilize the vertebral body to relieve pain and avoid the many complications of open surgery. This is a simple procedure with low trauma, high safety, good pain relief, and rapid postoperative recovery. PV has become a minimally invasive treatment for osteoporotic vertebral compression fractures. However, it is worth noting that cement leakage occurs easily during bone cement injection into the diseased vertebral body during PV. Although most patients have no obvious clinical symptoms, the possibility of catastrophic complications cannot be ignored. According to the literature, the rate of bone cement leakage caused by PV is as high as 25%.[2] Complications caused by cement leakage are spinal nerve root compression (0.8% to 2.6%), adjacent vertebral fracture (3% to 29%), and pulmonary cement embolization (0.4% to 4.6%).[2] Direct arterial embolization of cement is exceptionally rare, with only a handful of isolated case reports related to PV. There have been no reports worldwide of gallbladder gangrene caused by cement leakage, which is rare in clinical practice.

Case report

History and examination

The patient was an 81-year-old man who presented with a history of severe bilateral chest pain for 2 months. He denied a history of breathlessness, cough, fever, or hemoptysis, and there was no history of chest trauma. Subsequent investigations, including spine magnetic resonance imaging (MRI), demonstrated chronic vertebral compression fractures at T6 and T8 (Figure 1). The findings in the patient's other preoperative investigations were normal.

General examination revealed a pulse rate of 86 beats per minute, respiratory rate of 22 breaths per minute, room air blood oxygen saturation (SaO_2) of 98%, and right upper limb blood pressure of 118/77 mmHg. Respiratory system examination revealed decreased breath sounds in both lung fields. Other system examination findings were normal.

Figure 1. Magnetic resonance image (MRI) showing compression fractures of the T6 and T8 thoracic vertebrae.

Operation

The patient underwent left transpedicular PV at the T6 and T8 levels. The PV procedure was terminated when vascular extracorporeal cement leakage was documented during injection via the left T6 pedicle (3 mL PMMA was injected). The cement obviously penetrated the left intercostal vessels on the chest X-ray (Figure 2). Kyphoplasty was performed using an AND kyphoplasty kit ZT-I (the name of the company from China was not recorded in the previous hospital's records) according to the manufacturer's instructions. Percutaneous spine procedures were performed while the patient was under conscious sedation, and the patient benefitted from immediate and significant pain relief, post-procedure.

Postoperative course

The first day after PV, the patient complained of severe and persistent right upper abdominal pain that was not relieved after symptomatic treatment. Abdominal computed tomography (CT) indicated acute gangrenous cholecystitis, and multistripe high-density shadows were observed in the liver, spleen, and gallbladder (Figure 3, 4). CT also demonstrated cement embolization of the patient's right T6 intercostal segmental artery (Figure 5). Laparoscopic cholecystectomy (LC) was then performed in the emergency department. Gallbladder enlargement was apparent, and there was gangrene of the gallbladder wall. The liver surface was grayish white, an ischemic area was obvious, and yellowish-green ascites was seen in the abdominal cavity intraoperatively (Figure 6). The cholecystectomy procedure was uneventful; postoperative pathological findings are shown in Figure 7. The patient's general condition after surgery was good, with intermittent abdominal distention. Three days after the operation, his bowel sounds, exhaust, and defecation gradually recovered. He was treated with anti-infective medications and drugs for liver support, postoperatively. Three days after surgery, his aminotransferase and D-dimer concentrations peaked, and then gradually decreased to normal concentrations (Figure 8). On the 10th day after LC, abdominal CT showed that the high-density stripes in the liver had narrowed (Figure 9). The patient was hospitalized

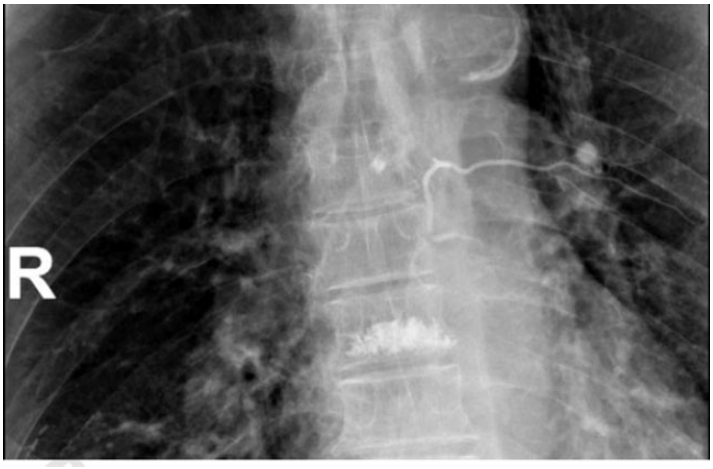

Figure 2. Cement penetration into the left intercostal artery during percutaneous vertebroplasty (PV).

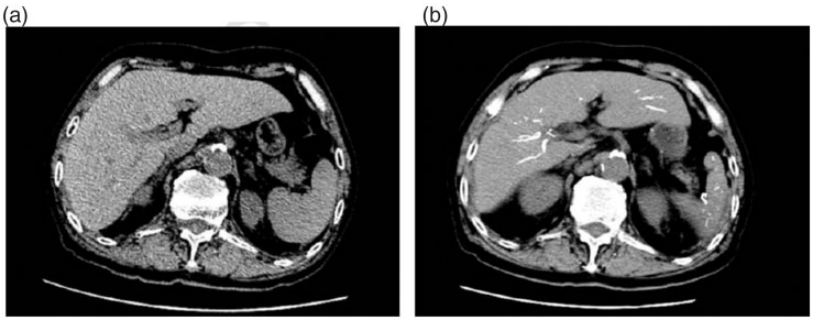

Figure 3. (a) Preoperative abdominal plain computed tomography (CT) before the percutaneous vertebroplasty (PV) showing no abnormalities in the liver and spleen. (b) Abdominal plan CT image after PV showing multiple splenic high-density shadows in the liver and spleen.

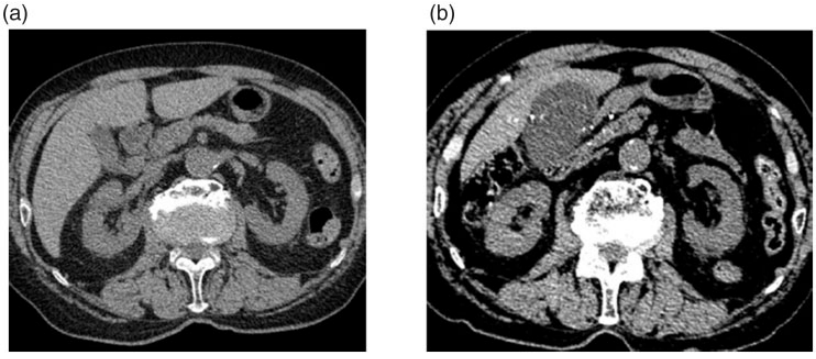

Figure 4. (a) Preoperative abdominal plan computed tomography (CT) before the percutaneous vertebroplasty (PV) showing no abnormalities in the gallbladder. (b) Abdominal plain CT after PV showing multiple high-density shadows in the gallbladder wall and spleen.

for 30 days. Two months after LC, the patient was followed-up and was well, with no significant discomfort.

Discussion

PV is an important tool in the treatment of painful vertebral fractures secondary to osteoporosis and malignancy. The often immediate pain relief and low complication rates have increased the procedure's popularity.[3] However, leakage of PMMA cement is a known and often self-limiting complication. PMMA may leak into the perivertebral soft tissues or epidural space; extravasate into the foraminal space, intervertebral disc space, or spinal canal; or migrate to the perivertebral veins, often with no clinical consequences. The frequency of cement leakage in the literature ranges from 41% to 88% in PV.[4–6] Many studies have shown that cement leakage is closely related to vascular distribution;[7,8] however, serious adverse events are uncommon and are generally related to inadvertent extracorporeal leakage. In the recent VERTOS II trial, 72% of injected vertebrae demonstrated cement leakage, most commonly into the disc space or segmental veins.[9] All of the studied patients remained asymptomatic.

Direct arterial migration of cement is infrequent but potentially catastrophic.

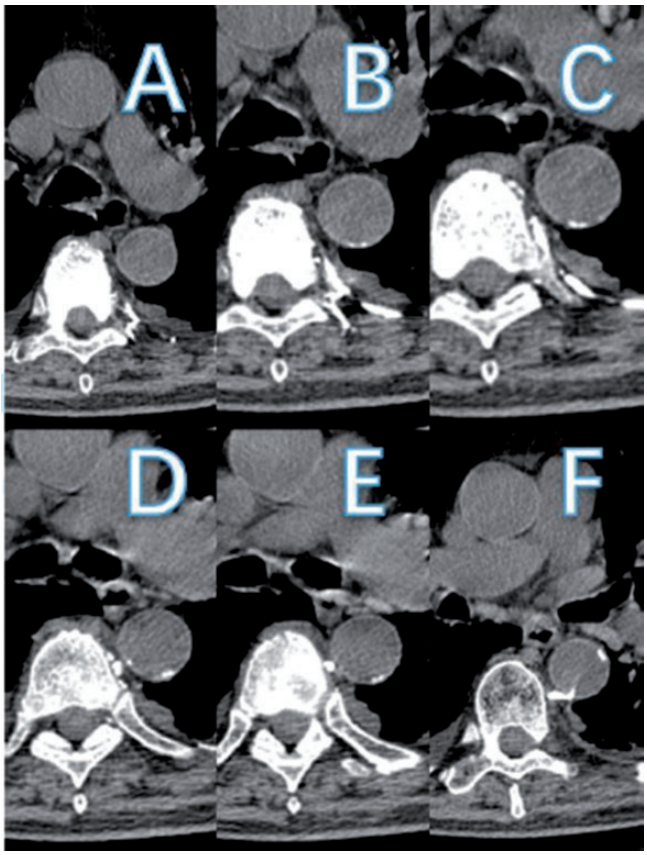

Figure 5. Non-contrast chest computed tomography (CT) image showing arterial cement embolization of the right T6 segmental artery. Note the direct communication of the pedicle and vertebral body with the segmental artery via multiple small somatic branches. Also note retrograde cement migration toward the posterior wall of the thoracic aorta.

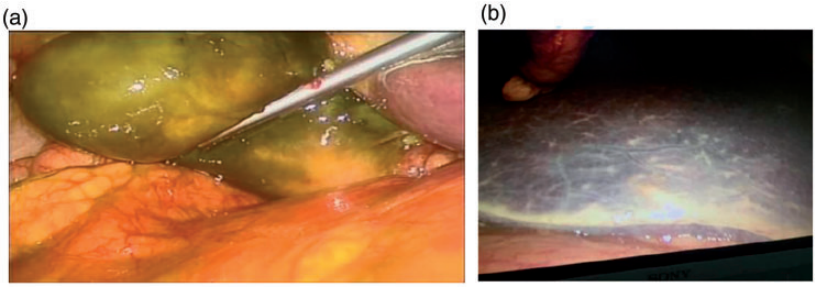

Figure 6. (a) The gallbladder as seen during laparoscopic cholecystectomy (LC) showing gangrene in the wall of the gallbladder, which has become enlarged. (b) The liver surface is grayish white, and the ischemic area is obvious.

However, the mechanism of arterial cement embolization remains poorly understood.[3] In our case, the patient had no abdominal symptoms before PV, and preoperative abdominal plain CT to evaluate the PV showed no abnormalities in the gallbladder. On the first day after PV, severe abdominal pain and hyperthermia were seen, and postoperative CT images showed high-density shadows around the gallbladder wall, which were similar to the high-density shadows on the liver and spleen. The gallbladder was dissected after LC, and no stones were found. Therefore, after a comprehensive analysis, we believe that the main leakage path leading to gallbladder gangrene was cement flowing through the thoracic aorta to the abdominal aorta (via the celiac artery), leading to cystic artery embolism. Regarding how the cement entered the thoracic aorta, we suggest the following: Bilaterally, the segmental artery on both

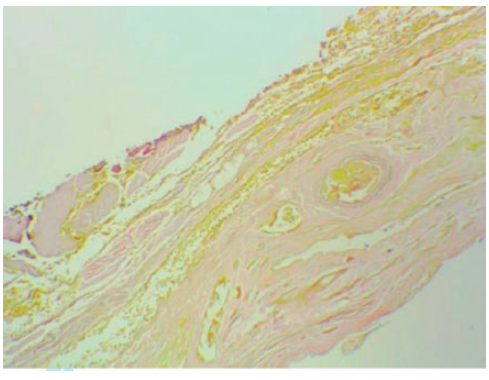

Figure 7. Postoperative pathological findings showing gallbladder gangrene, the damaged structure of the gallbladder wall, and bile components immersed in the gallbladder wall.

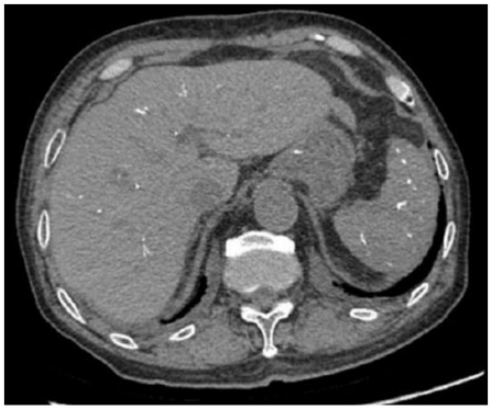

Figure 9. Abdominal computed tomography (CT) before discharge (10th day after laparoscopic cholecystectomy (LC)) showing that the range of high-density shadows in the liver and spleen has obviously narrowed.

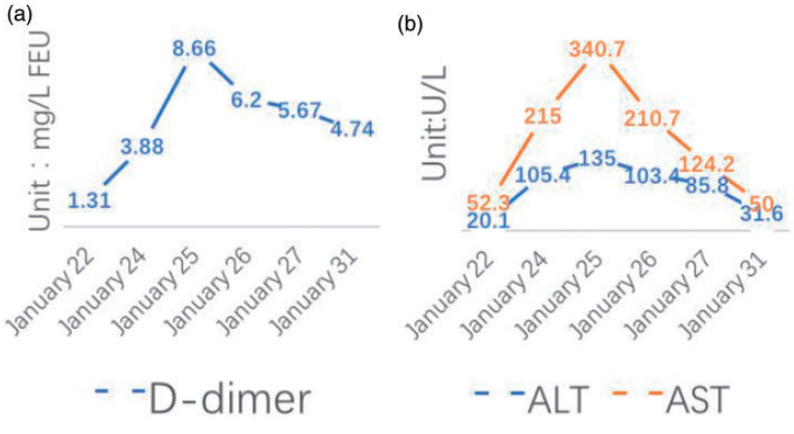

Figure 8. (a) Trend map of D-dimer concentrations after percutaneous vertebroplasty (PV). (b) Trend map of aminotransferase concentrations after PV.

sides of the spine enters through the intervertebral foramen into the spinal canal and divides not only into the branches of the nutrient arteries to the vertebral body and vertebral arch, but also into the thicker branches of the nutrient arteries to the spinal ganglion and the anterior and posterior roots of the spinal nerve. The vessel then branches into the endorachis, through the endorachis and arachnoid along the anterior and posterior roots into the spinal cord. According to the position of entry, the radicular arteries are divided into the anterior and posterior radicular arteries, which are of great significance to the spinal cord's blood supply. In the thoracic spinal cord, the radicular artery arises mainly from the intercostal arteries. However, the intercostal arteries are an important branch of the thoracic aorta. According to the imaging findings in our patient, we noted that the cement was distributed through the celiac artery, distal to the right and left hepatic artery, as well as to the body of the stomach via the right and left gastric arteries. Cement leakage to the pancreas through the gastroduodenal artery was also observed. After a comprehensive analysis, we postulate that during the puncture process, deviation between the upper and lower angles of the puncture needle resulted in injecting the cement into the radicular artery. Under the influence of injection pressure, the cement migrated retrograde toward the thoracic aorta along the abdominal aorta. Meanwhile, the patient was in the prone position, for PV. Cement has high density, and in the prone position, it flowed along the anterior wall of the thoracic aorta with the blood, to the abdominal aorta; the celiac artery was the first major branch the cement encountered. It then entered the cystic artery through the celiac artery, causing embolism. Because the cystic artery is the terminal artery, this very likely led to gangrene. Although cement traveling retrograde against the strong aortic pulsation from an intercostal artery is unusual, similar reports have been published.[3] The direct communications of the pedicle and vertebral body with the segmental artery via multiple, small somatic branches is worth noting. It is important to note that retrograde cement migration toward the posterior wall of the thoracic aorta has also been reported.[3]

In summary, we described a patient with osteoporotic compression fractures whose T6-level PV was complicated by clinically symptomatic, direct arterial cement embolization of a segmental artery. We alert clinicians to this potentially catastrophic vascular complication and suggest technical considerations to prevent its occurrence.

Ethics statement

Because of the retrospective nature of this report and because all data were based on routine testing performed during hospitalization, which was approved by the patient, we did not seek ethical approval for this study. The patient provided written informed consent for publication.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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