



PULMONARY CEMENT EMBOLISM AFTER SEGMENTAL POLYMETHYL METHACRYLATE-AUGMENTED PEDICLE SCREW FIXATION

SEGMENTAL POLİMETİLMETAKRİLAT İLE GÜÇLENDİRİLMİŞ PEDİKÜL VİDASI KULLANIMI SONRASI GELİŞEN PULMONER SEMENT EMBOLİSİ

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SUMMARY:

A 75-year-old female patient was admitted to hospital with complaints of lower back pain that began after a fall two months previously, an inability to stand and walk, bilateral leg pain, and urinary incontinence. An L1 vertebral osteoporotic compression fracture, epidural compression and lumbar spinal stenosis at the L3–4 level were diagnosed. T12–L2 posterior stabilization with a polymethyl methacrylate-augmented pedicle screw system and fusion, L1 and L3 total laminectomy and bilateral foraminotomy were carried out. On the first day after surgery she had a slight fever, chest pain and breathing difficulty. Thorax computerized tomography and angiography revealed cement emboli at the truncus pulmonalis, right pulmonary artery and middle lobe pulmonary artery segments, and azygos vein. Heparin treatment was started immediately, the patient received coumadin, and the symptoms regressed after three months. One year postoperatively, she was symptom-free. As a result, as with vertebroplasty, pulmonary cement emboli should be considered after a PMMA-augmented pedicle screw augmentation.

Key Words: Osteoporosis, pedicle screw augmentation, polymethyl methacrylate, pulmonary emboli

Level of evidence: Case report, Level IV

ÖZET:

75 yaşında bayan hastada 2 ay önce düşme sonucu sırt-bel ağrısı, ayakta duramama, yürüyememe, her iki bacak ağrısı ve idrar kaçırma gelişmiştir. Hastada L1 omurgada osteoporotik vertebra kompresyon kırığı, epidural bası ve L3-4 seviyesinde dar kanal saptanmıştır. Hastaya T12-L2 seviyelerine posterior stabilizasyon (pedikül vidaları osteoporoz nedeniyle polimetilmetakrilat ile güçlendirildi) ve füzyon, L1 ve L3 total laminektomi ve bilateral foraminotomi uygulanmıştır. Ameliyat sonrası 1.gün hafif ateş, göğüs ağrısı ve nefes darlığı şikayeti gelişen hastanın torakal bilgisayarlı tomografisi ve pulmoner bilgisayarlı tomografi anjiyografisinde trunkus pulmonalis, sağ pulmoner arter ve orta lob pulmoner arter dallarında ve azigos vende sement embolisi tespit edilmiş ve heparin başlanmış ve hasta daha sonra kumadinize edilmiştir. 3 ay kumadin kullanan hastanın semptomları gerilemiştir. 1 yıl kontrolünde sorun olmadığı görülmüştür. Sonuç olarak, sement embolisi vertebroplasti uygulanan vakalara görüleceği gibi, polimetilmetakrilat ile güçlendirilmiş pedikül vidası uygulamalarında da gelişebileceği akılda tutulması fikri elde edilmiştir.

Anahtar Kelimeler: Osteoporoz, pedikül vida güçlendirilmesi, polimetilmetakrilat, Pulmoner emboli

Kant düzeyi: Olgu sunumu. Düzey IV

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Received: 12th December, 2011.
Accepted: 1st April, 2012

INTRODUCTION:

When using pedicular screws in an osteoporotic or metastatic spine, augmentation methods such as polymethyl methacrylate (PMMA) have been defined^{12,20}. Cardiopulmonary side effects of PMMA after arthroplasty and vertebroplasty are well-documented^{6,11,13}. There have been many publications describing the development of clinical or subclinical pulmonary thromboembolic cases at high rates after vertebroplasty and kyphoplasty with PMMA. However, there have been limited case reports describing the occurrence of pulmonary cement emboli after the use of augmented pedicular screws. Here, we present a case study with the aim of drawing the attention of readers to pulmonary problems after the application of augmented pedicular screws.

CASE PRESENTATION:

A 75-year-old female patient was admitted to hospital with complaints of lower back pain that began after a fall two months previously, an inability to stand and walk, bilateral leg pain and urinary incontinence. In the patient's anamnesis, it was learned that she had undergone appendectomy 40 years previously, and abscess drainage in the left hip seven years previously.

On local examination of the patient, tenderness at the L1 spine level and weakness of the left leg were observed, and ankle dorsiflexion and toe extensors were found to be at 4/5 strength. No bilateral Achilles reflex could be found, and the quadriceps tendon reflex was normoactive on the right and hypoactive on the left.

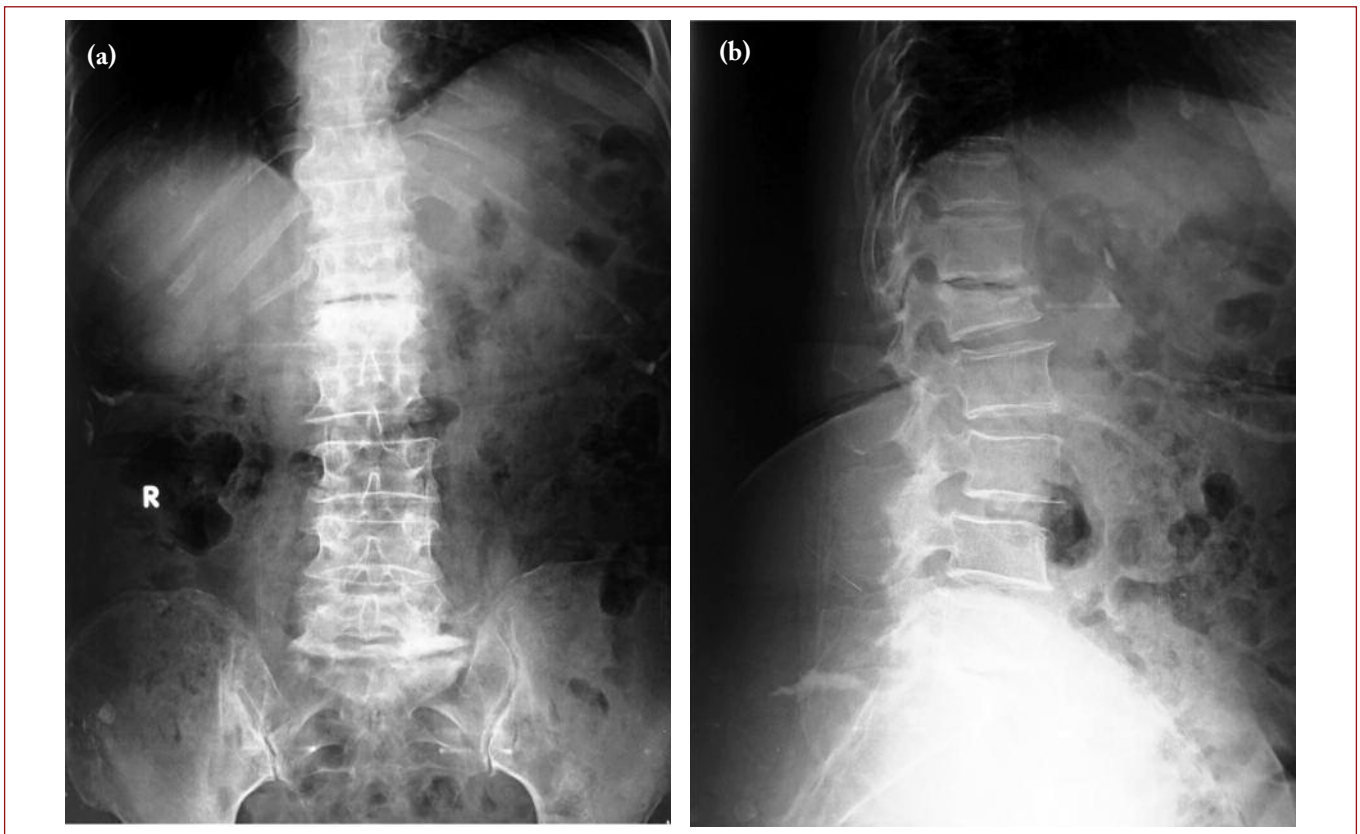


Figure-1. a and b. Direct X-rays showing L1 osteoporotic vertebral compression fracture and degenerative spondylolisthesis.

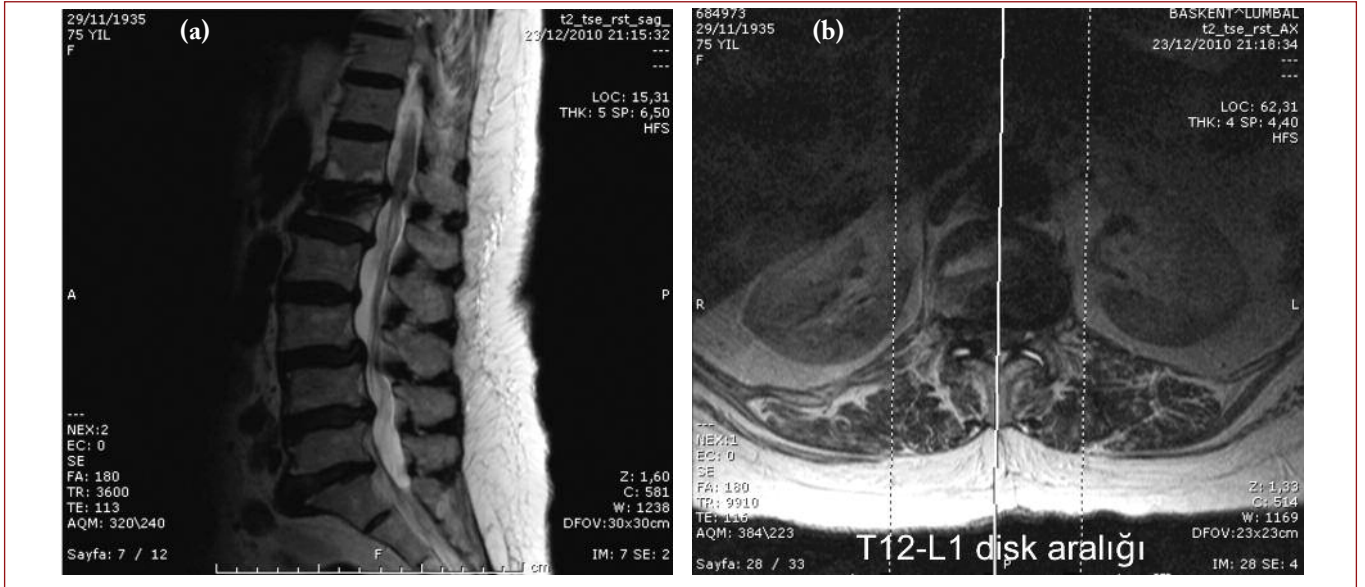


Figure-2. a,b Fracture and epidural compression at the L1 level and lumbar spinal stenosis at the L3–4 level in T2 sagittal and axial MRI.

There were no abnormalities in laboratory findings. There was a fracture in the L1 vertebra (Figure- 1.a,b) in a direct X-ray, an L1 vertebral osteoporotic compression fracture (OVCF) in lumbar Magnetic Resonance Imaging (Figure-2.a,b), epidural compression, and lumbar spinal stenosis at the L3–4 level.

On diagnosis of an L1 OVCF-conus medullaris lesion and lumbar spinal stenosis, the patient was given posterior stabilization and fusion at the T12–L2 levels (in which the pedicular screws were augmented with cement due to osteoporosis), and laminectomy and bilateral foraminotomy at the L1 and L3 levels. During surgery, cement leakage to the paravertebral area was detected, and the cement sending process was ended (Figure-3.a,b).

On the first day after surgery, the patient had a slight fever, chest pain and breathing difficulties, and cardiology was consulted. No cardiological pathology was detected. Opacity was detected in the right main pulmonary artery area in a

lung X-ray (Figure-4). In thorax computerized tomography and a pulmonary computerized tomography angiograph, there were cement emboli at the truncus pulmonalis, right pulmonary artery and middle lobe pulmonary artery segments, and azygos vein (Figure-5.a,b). The bilateral lower extremity colored venous Doppler was evaluated as normal, and the D-Dimer value was 2000 µg/L.

Heparin treatment was begun and the patient received coumadin. After three months, the symptoms were in regression, and she was symptom-free at a follow-up after one year.

DISCUSSION:

Treatments of fractures due to osteoporosis or metastasis and spinal instability can be complex. Minimally invasive approaches can be applied during treatment, but the treatment can be changed for cases where these augmentation methods are not sufficient, especially for patients with mechanical and/or neurological instability.

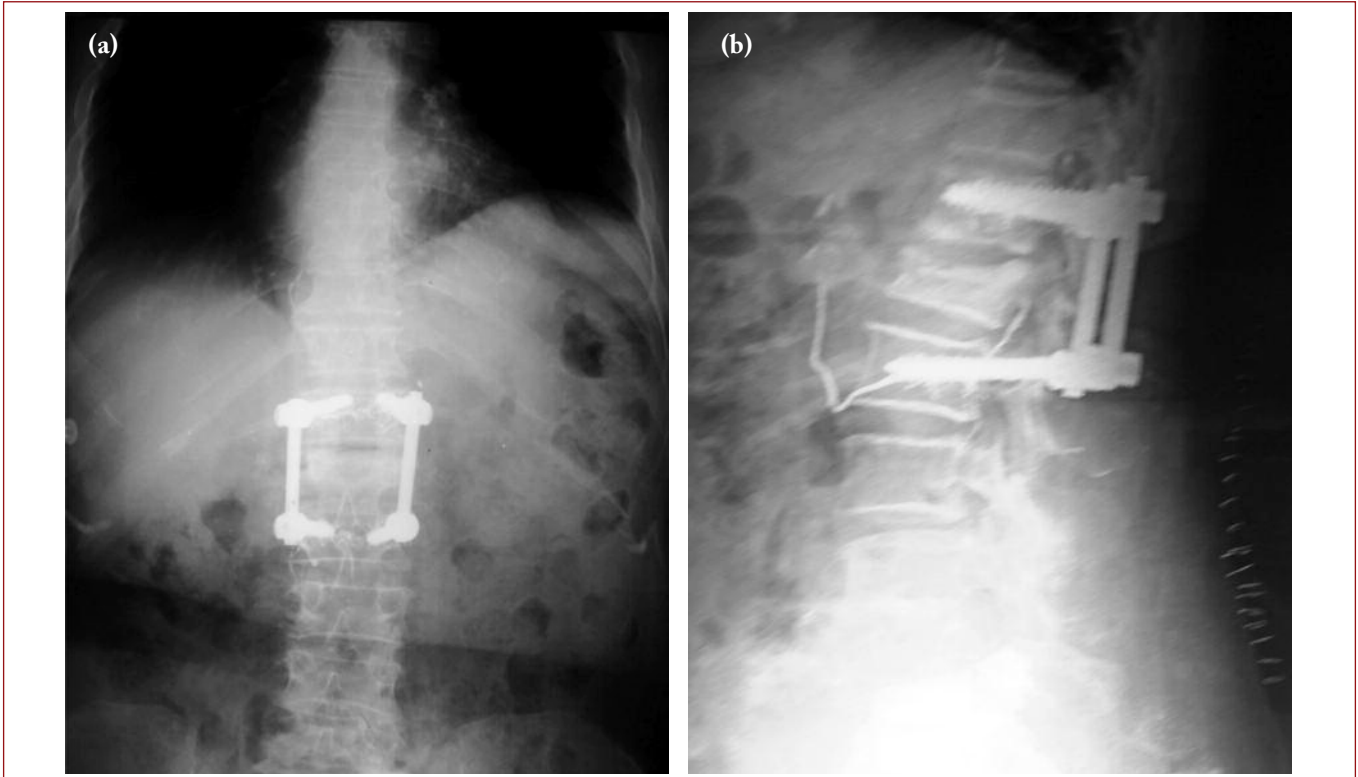


Figure-3. a,b Radiological images after surgery

For these patients, surgical decompression of the neural elements with rigid spinal fixation is required. Problems have been reported with osteoporotic spine instrumentation during surgery, or complications such as implant failure after surgery^{9,14,20}. Materials such as polymethyl methacrylate have been used to prevent these complications and to increase mechanical strength. In cadaver studies, it has been observed that PMMA increases the pull-out force and transverse bending stiffness^{12,19}.

Undesired side effects may occur due to the use of PMMA. Systemic complications can result, such as fever, infection, pulmonary embolism (PE), fat embolism, hypoxia, hypotension, myocardial infarction and sudden death, as seen on the use of PMMA for joint replacement, vertebroplasty and kyphoplasty. Depending on the extravasation in the spine, participation of PMMA in the peripheral venous system can occur. A high level of extravasation was reported

after vertebroplasty. The extravasation rate of PMMA has been given as 27–74% in various studies, and the rates of radiculopathy and cord compression have been given as 3.7% and 0.5%, respectively^{6,11,13-14}. Symptomatic PE has been reported at a rate of 1.1% after vertebroplasty⁹. The rate of escape to the paravertebral venous system has been shown to be 16.6%^{10,22}.

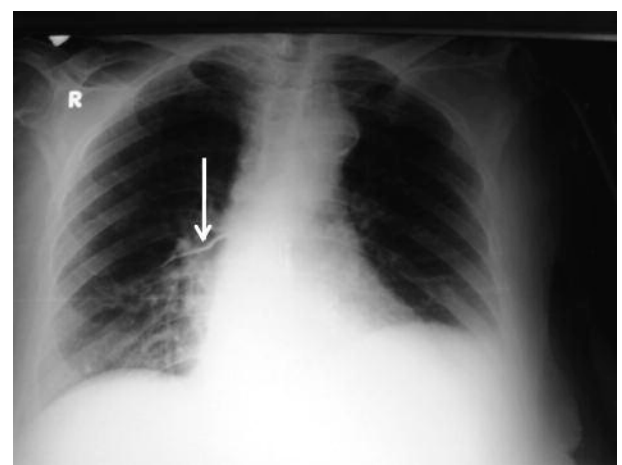


Figure-4. PA lung X-ray showing cement emboli in the right pulmonary artery

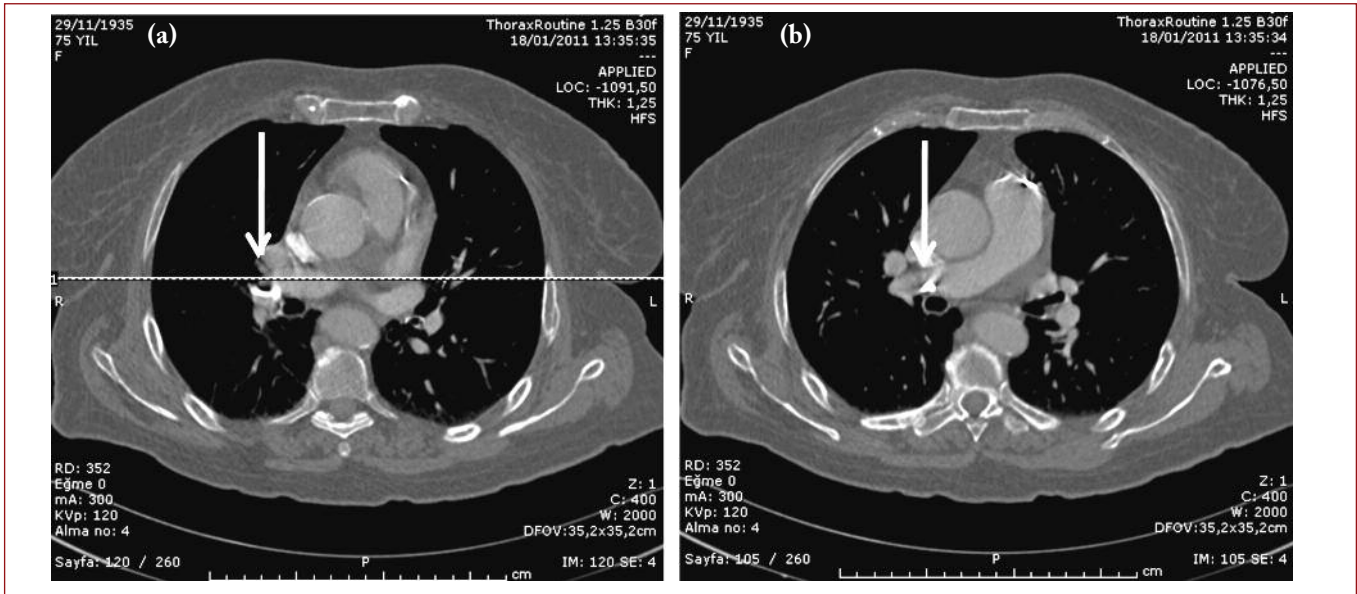


Figure-5. a,b Pulmonary cement emboli in thorax CT and angiography

For the pathophysiology of cement emboli, PMMA exits the basivertebral vein inside the spine corpus, passes to the anterior external vertebral venous plexus and then progresses to the pulmonary veins through the segmental vein, vena radicularis magna, azygos vein and accessory hemiazygos vein.

PMMA migrates easily due to the absence of valves in the vertebral venous system. This extravasation is commonly seen in malignancies due to neo-angiogenesis⁵.

A symptomatic pulmonary embolism can occur due to the use of acrylic after vertebroplasty or fat and bone marrow cell migration. Most PMMA that migrates to the lung and can be detected radiologically is asymptomatic. Fat embolism is seen more commonly than PMMA¹⁶. Three patients that developed a cement or fat embolism after augmentation using pedicular screws with PMMA have been reported in the literature^{2,18,21}. Initially in this case, symptomatic cement emboli were detected in the truncus pulmonalis, right pulmonary artery and middle

lobe pulmonary artery branches and azygos vein. Long-term coumadin treatment was used, and the patient responded to medical treatment.

Pedicular screw augmentation can be performed by injection of the cement into a previously-prepared pedicle with subsequent screw delivery, or by cement augmentation using cannulated screws. The first method was used in our case. Leakage to the outside of the corpus during the process was observed, and the cement-sending process was ended. Various methods have been suggested to prevent PMMA extravasation during vertebroplasty^{7,11,13,23}. PMMA should be applied when it reaches the desired viscosity, which is similar to that of toothpaste. A high resolution scan is required during this process. The cement should include contrast in order to provide an image. The issue of vertebral angiography should be discussed before the cement is applied. The needle can be directed to a different site if leakage to the epidural or paravertebral veins is estimated to be likely to occur.

However, this method may prevent imaging during the cement setting process, particularly if radiopaque cement is used.

The risk of PE increases as the number of vertebrae receiving cement increases. The amount of cement injected into a vertebra should not exceed 4–6 cc. This amount is sufficient for biomechanical durability^{4,7}.

Pulmonary embolism symptoms can develop during the process, immediately after the process, or after a few days^{15,17}. It has been shown that the toxicity of PMMA is formed by residual monomer and other components *in vivo*. The methyl methacrylate monomer causes activation of thrombocytes, pro-coagulant phospholipids to leave the cells, and endothelial cells to form a thrombogenic layer^{3,8}. Sometimes the presence of a late clinical finding can be due to a late start of the cytotoxic effects¹. In our case, the symptoms were formed early and medical treatment was begun as a result of early diagnosis. The treatment plan can change according to the clinical status of the patient. Bed rest, analgesics and oxygen therapy are initiated. In cases with cement in a pulmonary artery in which hemodynamic instability occurs, a pulmonary embolectomy can be considered. The presence of acrylic in the vascular system triggers the coagulation system, and so anti-coagulation should be initiated in these patients.

In summary, as for vertebroplasty cases, the formation of cement emboli should be kept in mind on application of pedicular screws augmented with PMMA.

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