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Foreign body granuloma after bone cement augmentation of pedicle screws for osteoporotic spinal surgery: A case report

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Abstract

Osteoporosis causes a decrease in bone mineral density. To overcome the decrease in fixation strength, a variety of techniques and devices have been developed, including cement augmentation of pedicle screws. Polymethyl methacrylate (PMMA), is commonly known as bone cement, and is widely used for implant fixation in various orthopaedic and spine surgery. In general, PMMA augmentation of pedicle screws is simple and safe if performed with technical precautions. PMMA is a safe agent, but it may rarely lead to significant foreign body reactions. In this report, we present a patient who developed bone cement-related epidural space foreign body granuloma.

INTRODUCTION

Osteoporosis causes a decrease in bone mineral density. As bone mineral density decreases, the force required for pedicle screw pullout decreases.[1,2] To overcome the decrease in fixation strength, a variety of techniques and devices have been developed, including cement augmentation of pedicle screws.[3] In general, polymethylmethacrylate (PMMA) cement augmentation of pedicle screws is simple and safe if performed with precautions. However, serious complications such as pulmonary emboli and paraplegia may occur if bone cement leaks into the pulmonary artery or spinal canal.[4,5] In this report, we present a case with reactive changes and foreign body granuloma, in intraspinal cement leakage area after cement augmentation.

CASE REPORT

A 72-year-old woman was admitted to our institution for progressive low back pain and sciatica with progressive neurological deficits for three months. Two years earlier, she had had a history of lumbar surgery for spinal stenosis at L2-L3 level, including posterior lumbar interbody fusion at other hospital. During this procedure, the pedicle screws were augmented with PMMA (Simplex P, Stryker Orthopaedics, Mahwah, NJ). Postoperatively, the patient reported that her leg weakness and numbness had improved, but her leg pain had gradually increased. The patient had been initially treated with nonsteroidal anti-inflammatory drugs and physiotherapy. However, her symptoms became worse and the incapacity more severe. She was referred to our hospital for evaluation of persistent leg pain and difficult with ambulation.

The neurologic examination revealed weakness of the hip flexion and the knee extension. The patient complained abnormal sensations in the both buttocks and thighs, but bladder and bowel function were normal, and there was no reduction in deep tendon reflex. Conventional radiography of the spine showed the leakage of bone cement along the screw tract into the epidural space. Lumbar magnetic resonance imaging (MRI) scans showed two cystic lesions at L2-3 epidural space with contrast enhancing margins representing probably an abscess (Figure 1). Laboratory investigation was as follows: Hemoglobin 15.0g/dl, WBC 14.800/mm 3 with differential count. The erythrocyte sedimentation rate (ESR) was 7mm/h and C reactive protein (CRP) 1.5mg/L. A surgery was performed. During the operation, a 10-millimeter lesion with yellow-beige color and a smooth surface that could be separated easily from the surrounding tissues was encountered. When the lesion was taken out, we noticed that there was residual bone cements fragment, several millimeters in length. This residual bone cement fragment, located in the ventral epidural space was also removed. The lesion was sent to microbiology for culture. Culture of the lesion

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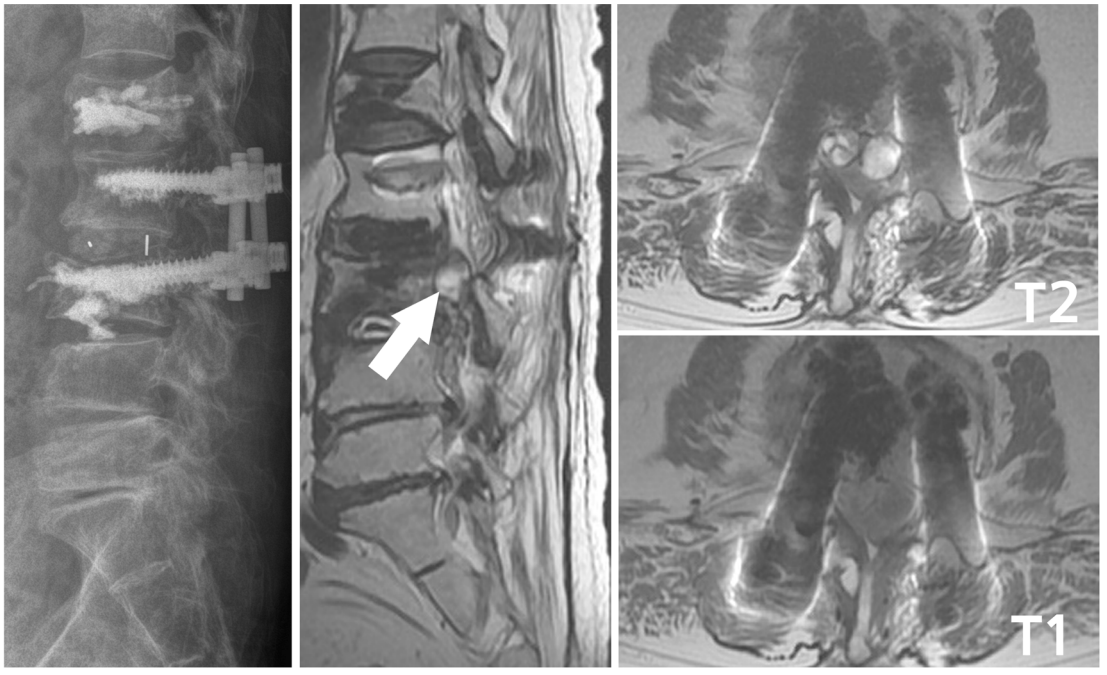

Figure 1. Initial imaging showing reactive changes of epidural space after spinal surgery. T2 weighted sagittal MRI scan showed a cystic lesion at the site of L2-3 epidural space (white arrows). Axial MRI scans showed low signal intensity on T1-weighted image and hyperintensity on T2-weighted image.

yielded no pathogens. The histopathological examination revealed foreign body granuloma (Figure 2).

The postoperative course was uneventful. She had complete relief from her persistent lower back pain and sciatica. The patient was discharged on the fourteenth postoperative day. A postoperative MRI was performed two months later which revealed no lesions in both L2-L3 epidural space and laminectomy area.

DISCUSSION

Since the introduction of pedicle screw fixation in spine surgery, loosening and pull-out of pedicle screws have become well-known problems. In many patients, especially those with osteoporosis, pedicle screw anchoring may be problematic, and several efforts to cope with this challenge have failed. Augmentation of pedicle screws with bone cement was described as early as 1975 and increases the pedicle screw interface and pullout strength in osteoporotic vertebrae.[6,7]

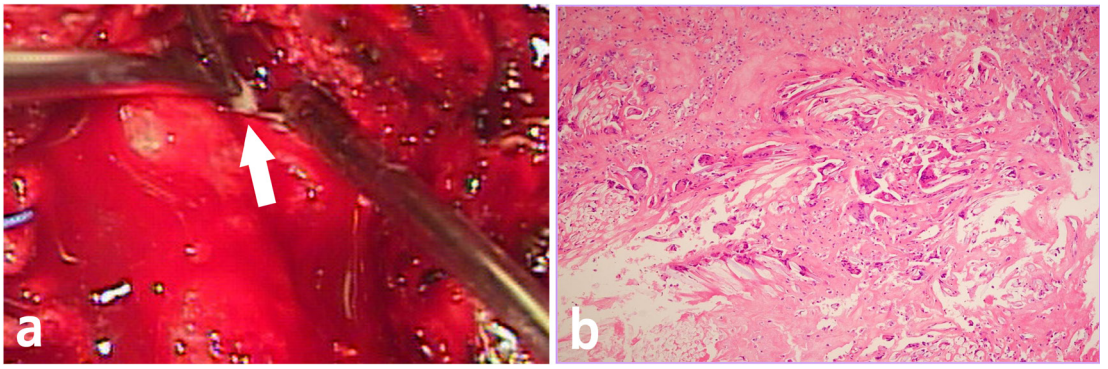

Figure 2. (A) Intraoperative photograph. A 10-millimeter lesion with yellowish color and a smooth surface was noted at the laminectomy area (white arrows). (B) Photographs of histological examination in our case. H and E, capillary vascular proliferation, multinuclear benign giant cell infiltration and fibroblasts in fibrous tissue (x200)

It allows pedicle screw fixation in patients with preoperatively known risk for screw loosening. However, bone cement may pass to several unwanted locations, including the lumbar venous plexus, pulmonary artery, disc space, epidural space in the spinal canal, intervertebral foramina, and paravertebral region. A paravertebral leak or leakage into the intervertebral foramen may lead to nerve compression, aggravation of back pain, generation of new back pain, or radiculopathy. Cement leakage rates are reported in the literature at 13% to 17%.[4,5,8]

PMMA is commonly known as bone cement, and is widely used for implant fixation in various Orthopaedic and spine surgery. PMMA is an acrylic polymer that is formed by mixing two sterile components: a liquid MMA monomer and a powered MMA-styrene co-polymer[9]. When the two components are mixed, the liquid monomer polymerizes around the pre polymerized powder particles to form hardened PMMA.

Although PMMA are inert, they are still able to stimulate a more or less pronounced granulomatous reaction with multinucleated giant cell reaction.[10,11] In animal study, Daisuke *et al*. reported that exposing vertebral cancellous bone to PMMA causes minimal foreign body reaction at the bone-cement interface and it occurs by 26 weeks after surgery.[12] There are also cases of complications associated with the use of PMMA as a synthetic permanent filler for soft tissue augmentation, such as chronic inflammatory reaction, and formation of granuloma.[13] But, reactive changes of epidural space and foreign body granuloma due to remnant bone cement after lumbar spinal surgery has never been reported in the literature. In our patient, the preoperative MRI diagnosis for the cystic lesion located at the site of epidural space was abscess. However, in the operation we found a granuloma and bone cement remnants, rather than an abscess. The histopathological examination revealed chronic inflammation and foreign body granuloma. The follow-up MRI at two months after surgery showed that both the granuloma and the reactive changes at L2-L3 epidural space had disappeared. If these disc space changes had been septic caused by an infectious agent, they would not have disappeared in the follow-up MRI without antibiotic therapy. We proposed that cystic changes of L2-3 epidural space might be reactive inflammatory response due to remnant bone cement. It is known that enzymes in tissue do not break down PMMA microspheres because of the methyl group in the alpha position that stabilizes the molecule.[14] This PMMA sphere, not degraded in tissue, could be integrated into collagen fibrils. It is possible that these patients produce antibodies against PMMA-binding proteins.

However, it is not known if the reaction is in response to actual PMMA particles or to the barium sulfate contained in the PMMA. Barium sulfate is added to the PMMA during preparation in order to make it radiopaque so that it can be visualized by fluoroscopy during the imaging procedures. It is uncertain whether our patient had a foreign body granuloma in reaction to the particular packet of the particular brand of bone cement. Nevertheless, care should be taken regarding the origin of the product, and the PMMA should be refined and all phagocytosable particles removed in the future.

In conclusion, to our knowledge, this represents the first report of the adverse effects of bone cement in spinal surgery. Although bone cement is a safe agent, it may rarely lead to foreign body granuloma and reactive changes in the disc space due to a foreign body reaction in the spine. Therefore, bone cement should be used carefully, avoiding its leakage to epidural space because of the risk of causing a foreign body reaction.

DISCLOSURE

Conflict of interest: None

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