Case Report

Cement extravasation during kyphoplasty in an intact posterior wall vertebral fracture: A case report

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ABSTRACT

Introduction: In management of vertebral compression fracture, several minimal invasive procedures have been introduced. Some of them are vertebral augmentation techniques such as vertebroplasty and kyphoplasty. Even though the cement leakage rates are significantly lower than vertebroplasty procedures, intracanal extravasation is also uncommon in kyphoplasty procedure.

Case Presentation: A 44-year-old male presented with back pain due to pathological vertebral compression fracture of thoracal 10 came to our institution to be treated with kyphoplasty. During the procedure, the cement leaked into the spinal canal due to disruption of the posterior wall of the vertebral body. As a consequence of the deterioration of the neurological status, an immediate exploration and decompression were performed after CT-Scan results were obtained to identify the location and size of the leak. After decompression, the recovery was significant. However, at the final follow up the neurologic recovery has yet to recover.

Discussion: Intracanal cement leakage has devastating neurological effects on both vertebroplasty and kyphoplasty procedure. Careful monitoring during the cement administration was paramount. As there are no current guidelines about the rate of administration and how to measure the volume of the cement needed, the insertion technique should be tailored according to the fracture morphology, the height restored, the viscosity of the cement, and the surgeon himself.

Conclusion: Intact posterior wall, the amount of cement, and the injection pressure are the main factors that may contribute to cement leakage during the kyphoplasty procedure. Careful evaluation of these factors must be done pre- and intra-operatively in order to prevent leakage.

Keywords: Kyphoplasty; Cement extravasation; Spine; Compression fracture; Complication
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INTRODUCTION

Vertebral fractures are common cause of severe debilitating pain and deformity of osteoporotic patients. Back pain may present as an acute and excruciating pain or chronic and persistent pain.[1] Acute back pain, which is usually caused by an acute compression fracture, can subside as the fracture heals usually within three or four months.[2] But unfortunately 30-40% of them will have some residual deformities, which will cause chronic pain in these patients. Besides the pain, the degree of deformity also correlates with the patient function, risk of further fracture, compression of the spinal cord, and pulmonary function.[3, 4]

The treatment of these fractures spans from conservative to major surgery. Most cases of osteoporotic compression fractures were treated conservatively. Surgery is reserved for cases with concurrent spinal instability, neurological deficit, or major deformity.[5] However, conservative treatment cannot address the existing deformity which may lead to a chronic pain to these patients.

Percutaneous minimally invasive vertebral augmentation method using cement augmentation such as kyphoplasty or vertebroplasty were designed and introduced as the modality to treat the deformity of spinal osteolytic tumours.[6, 7] Later these techniques have been used to stabilize the acute osteoporotic compression fractures without increasing morbidity or mortality risk associated with open surgery. The biomechanical principle of increasing anterior column load that leads to progressive kyphosis with subsequent vertebra compression fractures has become the basic rationale of these procedures.[8] Vertebroplasty has the advantages over the conservative methods in terms of pain relief, level of function, and hospital stay.[9] However, the complications of vertebroplasty such as cement leakage, pulmonary embolism, infection, systemic toxicity are not uncommon. Cement extravasation occurs approximately in around 70% vertebroplasty procedures.[7] In most cases, it was asymptomatic but major complication such as paraparesis has also occurred in some cases.

In order to reduce the risk of complication, a newer technique of vertebral augmentation was developed. Kyphoplasty, which is a technique that applies the principle of balloon angioplasty to vertebroplasty, has been used to restore the vertebral height and help to realign the spine as the treatment of spinal osteoporotic compression fractures. Theoretically, it has the advantage over vertebroplasty since lower injection pressure was needed during the procedures, thus the risk of cement leakage was also reduced. The initial reports recorded that out of 100 kyphoplasty procedures, the cement leakage rate was around 31%.[10] Even though the cement leakage rates are significantly lower than vertebroplasty procedures, it was often associated with significant morbidity such as neurological deficit. Recent studies have documented the incidence of cement leakage in kyphoplasty procedures, which was associated with neurological complication.[11]

We present a case to address the management of cement extravasation during kyphoplasty procedure and also evaluate the factors that contribute to the cement leakage in our case, which can be prevented during procedure.

Case Presentation

A 44 year-old male came with chronic pain on his lower back for 6 months. No history of significant trauma was found and there was no complaint of radiating pain or neurologic disturbances initially. On physical examination, local tenderness was found at the region of lower thoracic area. No significant kyphotic deformity was found clinically.

Thoracolumbar radiograph was already performed by the patient before our first consultation, but since the quality was poor, we decided to perform MRI to the patient. The MRI showed compression fracture on thoracal 10 with minimal compression of the spinal cord. The axial view showed that the posterior wall of the corpus was still intact. The vertebral body height was reduced by 60%. Thus, a decision to perform kyphoplasty was made to restore the vertebral body height and relieve the pain.

The kyphoplasty was performed under neuroleptic anesthesia. The incision was performed at the pedicle of thoracic vertebrae level 10 which was determined under image intensifier. Balloon catheter was inserted using the uniportal entry on the right pedicle. After the balloon was inflated, the endplate was raised slightly then the balloon was deflated and removed, leaving an open cavity inside the body.

Cement injection was performed using the same transpedicular route. The injection was performed manually under image intensifier. Low-viscosity cement was used. During the injection, the cement breaks into the posterior

wall of the corpus to the vertebral canal. We decided not to immediately convert to open surgery due to limited preparation at that time and observing the patient's neurologic status was the priority.

After the procedure, the neurological status deteriorated. Examination revealed paresthesia and weakness of both thigh and leg (muscle power: Grade 1) below T11 dermatomes. CT Scan was performed to evaluate the extension of the leakage. The investigation showed intracanal extension of cement from T9-T10 and axial images exhibit significant cord compression especially on T9 and T10 level. Cement leakage was found from the left posterior wall of the corpus and left pedicle which is contralateral of our transpedicular route and extending to the anterolateral wall of the canal from T10 until T7.

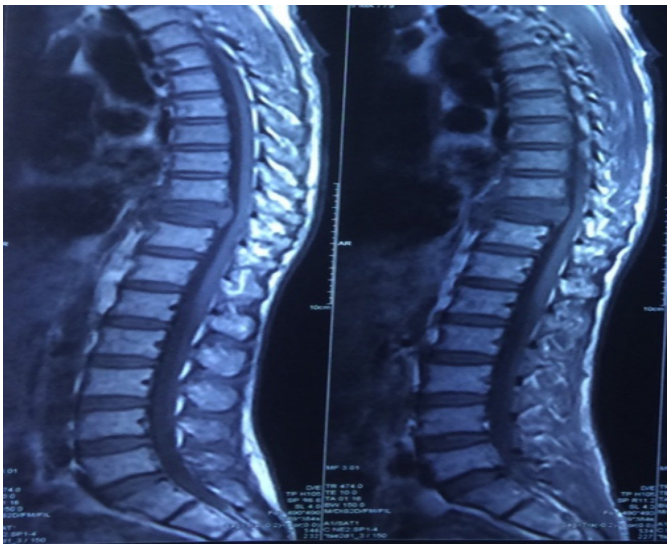

Figure 1. Initial MRI showing compression fracture of the Th10 vertebral body and minimal compression of the spinal cord.

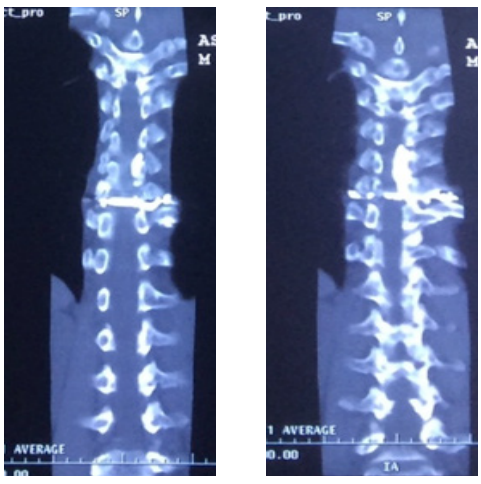

Figure 2. Coronal view of the Postoperative CT scan showing the extent of the leakage to the spinal canal

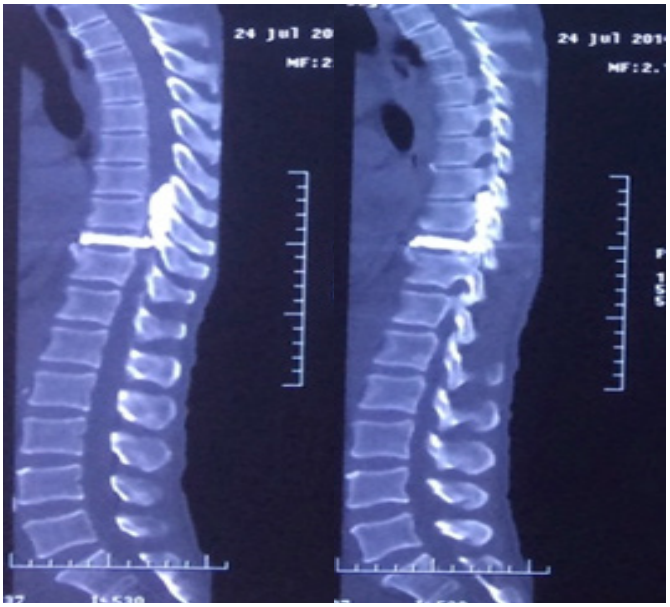

Figure 3. CT Scan Sagittal view showing the extent to the level of Th9 vertebral body

Surgical intervention was performed immediately (2 days after the initial procedure) to relieve the pain as well as the neurological deficit. The surgery was performed using single-stage posterior approach: partial laminectomy of thoracal 10 to achieve cord decompression. Complete removal of the cement mass of around 3 cm was done from the left side. The left lamina was left open without any fixation and the wound was closed.

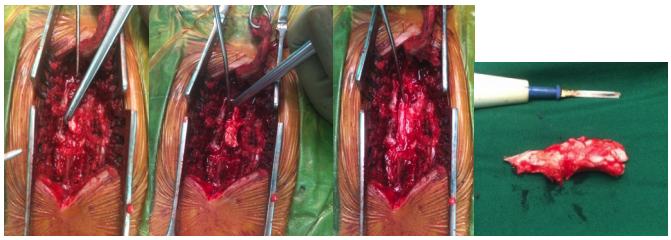

Figure 4. a,b. Removal of the bone cement using Kerrison forceps. c) The spinal cord that has been decompressed ;d) Cement mass removed sized 3x0.3 x 0.3 cm

The radiating pain was relieved immediately after surgery. The muscle power recovered into grade 3 bilaterally but paresthesia still persists. Six weeks after surgery the patient was able to move slowly using a walker.

DISCUSSION

We present a case report of intracanal cement extravasation during kyphoplasty procedure for treating vertebral compression fracture with an intact posterior wall. Although intracanal cement extravasation is not uncom-

mon in kyphoplasty procedure, an intact posterior wall is one of the safety parameters in performing kyphoplasty. However, in our case, despite the intact posterior wall, cement extravasation occurred during the cement injection.

Epidural cement leakage has devastating neurological effects on both vertebroplasty and kyphoplasty procedures.[11,13] This complication requires immediate decompression and, if possible, removal of the cement causing compression.[10] In our case, we decided to delay the decompression surgery due to limited preparation for an open surgery, as the patient were sedated using a neuroleptic anesthesia. Evaluation on the extent of the cement extravasation using CT-Scan and the patient neurologic condition were other factors that played a role in our decision making.

Preoperative planning before the kyphoplasty procedure is also essential. Intact posterior wall is mandatory for this procedure correlating with the risk of cement leakage and neurological complication. Preoperative X-ray and CT or MRI is needed to evaluate the posterior wall. Nussbaum *et al*. reported that even with an intact posterior wall, cement leakage may also occur. Kyphoplasty may have an increased risk of pedicle fracture that can lead to cement leakage. From their series, at least 5 out of 20 leakage was caused by breakage of the pedicle during the insertion of the cannula. And from the remaining 15 spinal compressions that occurred, only two without pedicle fracture on postoperative imaging. Based on our findings on the post kyphoplasty CT-Scan and during the second surgery (cord decompression), we believe the intraoperative pedicle fracture was the main cause of the cement extravasation. The cement was found on the lateral side of the cord, which corresponded to the injection site. This presentation is different with posterior wall breaching, which is usually characterized by the cement extravasation on the posterior part of vertebral column.

Although cement leakage into the spinal canal may happen during kyphoplasty, it may not cause clinical symptoms. Good fluoroscopy monitoring and correct surgical technology during operation are the keys to prevention of the cement leakage into the spinal canal.[12] Careful monitoring during the cement administration was paramount. The amount of cement inserted and its administration rate should be carefully evaluated during the procedure under the image intensifier guidance. Currently there are no guidelines about the rate of administration and how to measure the volume of the cement needed in the procedure. The insertion technique should be tailored according to the fracture morphology, the height restored, the viscosity of the cement and the surgeon himself.

Some studies have applied the use of higher viscosity bone cement in vertebroplasty or kyphoplasty procedure. High rate of cement leakage was caused by lower cement viscosity and high injection pressure during the insertion. Several authors have based their techniques on this and use the higher viscosity cement in their procedure. Wang *et al*. showed that high viscosity cement in their vertebroplasty procedure had lower cement leakage rate compared to standard balloon kyphoplasty.[14]

Besides preoperative planning, some intraoperative methods have been proposed to reduce the rate of leakage. Cement directing kyphoplasty system uses a cement directing implant which was positioned inside the cavity that has been previously created. This implant will partially contain the cement but it main purpose is to direct the cement flow away from the posterior aspect of the vertebral body thus preventing the leakage to the spinal canal.[15]

Delcanto *et al*. proposed a double cement-application cavity containment kyphoplasty which based on the situation where most leakage was originated from some defects in vertebral body either from the original fracture or from the expansion of the inflatable bone tamps (IBTs). A small amount of cement was inserted initially after the first IBTs deflation and was inflated again until the cement cures. Once the cement cured, the IBTs was deflated again and removed, leaving a cement shell that seals the crack and support the endplates. There were no cement leakage using this technique in their series.[16]

Despite the techniques mentioned, preoperative planning and careful intraoperative planning is mandatory in order to prevent cement leakage and the disastrous neurological complication following it. Any disruption of the posterior wall is an absolute contraindication of kyphoplasty procedure. The amount of cement inserted and the rate of injection must be monitored closely during the procedure.

CONCLUSION

Cement extravasation during kyphoplasty procedure may still occur in the presence of intact posterior wall. Careful monitoring of the pedicle region during cement

insertion may help to minimize the extravasation.

Conflict of Interest

The author has no conflict of interest related to this article.

Ethical approval

The need for ethical approval was waived due to the retrospective nature of this case report.

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