

Complications in Vertebroplasty

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Background: Vertebroplasty is one of the minimally invasive surgery that benefit in pain relief from the osteoporotic or malignancy related vertebral compression fractures. However, many literatures reported both asymptomatic and serious complications. The aim of the present study was to summarize, collect data and report the complication of vertebroplasty from our experience at a single institute.

Material and Method: Three hundred and twenty five vertebroplasty procedures from 236 patients performed in our institute were retrospectively reviewed. Data of diagnosis, age at the time of procedure were collected. All complications found were reviewed in detail.

Results: Commonly performed procedures were at thoracolumbar junction (51.4%). Osteoporosis was the most common cause of fracture. The present study found 88 (27%) complications with 26 (8%) symptomatic patients. Most common complication was cement leakage, which intervertebral disc was the most common site (42.9). Spinal canal leakage was found in 14 cases (20%). Four out of 14 cases had neurological complications and need further managements. Two cases had neurologic complications from needle injury. Adjacent level collapse found in 13 patients (4%) and remote segment collapse occurred in 5 patients (1.5%). Three had progressive kyphosis required later surgical treatment. One asymptomatic cement pulmonary embolism was found in the present study.

Conclusion: The complications of vertebroplasty were mostly asymptomatic, but serious complication such as neurologic injury could occur. Vertebroplasty could be considered a quite safe treatment for osteoporotic vertebral fracture. Meticulous technique should be executed during the procedure to avoid the leakage complication.

Keywords: Vertebroplasty, Osteoporotic compression fracture, Cement leakage

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Vertebroplasty is one of the minimally invasive surgery that benefits in pain relief from the osteoporotic vertebral compression fracture⁽¹⁻⁵⁾, also in some of benign and malignant tumors such as hemangioma, multiple myeloma or metastatic lesions⁽⁶⁻⁸⁾. In this procedure polymethylmethacrylate (PMMA) was injected into the vertebral body through the pedicle under fluoroscopic guidance. Current literature reviews have shown successful treatment in pain control, improving the quality of life, and functional outcomes. Especially, pain relief has been reported a success rate of 70-95% regardless of the spinal pathology, as well as in long term studies⁽⁹⁻¹¹⁾.

However many studies have reported the complications of vertebroplasty. Lee MJ et al⁽¹²⁾ in a meta-analysis of vertebral compression fracture

revealed asymptomatic cement leakage 75%, symptomatic leakage 1.48%, new fracture 18% (adjacent level 51.6% and remote level 48.2%). Layton KF et al⁽⁵⁾ reviewed 1,000 vertebroplasty levels and founded cement leakage 25%, most common in disc space (12%), with symptomatic patients in 1.8% and 1 case of cement pulmonary embolism. Barragan-Campos et al⁽¹³⁾ reported higher complication rate in vertebral metastatic disease than in vertebral compression fracture. Other reported complications were epidural hematoma, rib fracture, pulmonary embolism, systemic cement toxicity, cement extravasations, spinal cord compression and adjacent vertebral fracture. Common complications were cement extravasations and vertebral fracture which usually were asymptomatic⁽¹²⁻¹⁷⁾ and required no further treatment. But less common complication such as neurologic complication that resulted in radicular pain, spinal canal stenosis, spinal cord or cauda equina injuries⁽¹⁸⁻²¹⁾ usually leaded to further surgical management after vertebroplasty⁽²²⁾.

At Siriraj Hospital, vertebroplasty for the treatment of back pain has been performed for 10 years.

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The aim of the present study was to summarize, collect data and report the complication of vertebroplasty from our experience at a single institute.

Material and Method

A retrospective review of medical records and x-ray films were carried out in 255 patients who underwent vertebroplasty between February 2000 and September 2011. There were 40 male and 215 female. Twenty two patients were excluded because of the incomplete data. Therefore 236 patients were included in the present study. Data of diagnosis, age at the time of procedure were collected. All complications were reviewed in detail.

Results

In the present study 325 procedures of 236 patients (36 men and 200 women) were treated. Mean age at the index procedure was 73.4 years (range 39-97). Two hundred and twenty-four patients were diagnosed as osteoporotic fracture. Other 12 patients were related to neoplastic involvement (2 lymphoma, 3 multiple myeloma, 4 metastatic disease and 3 hemangioma).

The procedure was commonly performed at thoracolumbar junction (T12-L1) which accounted for 51.4% (167 out of 325). L1 was the most common level, with 98 procedures performed (30%) (Fig. 1). Complications found in the present study were cement leakage, further vertebral collapse, persistent pain or new onset radicular pain. Total complications were 88 from 325 procedures (27%). Sixty-two were asymptomatic and need no further management, therefore symptomatic complications were in 26 of 325 procedures (8%).

Cement leakage

The most common complication was leakage

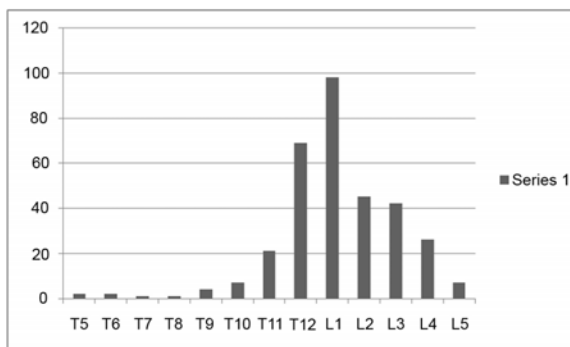


Fig. 1 Number of patients in each level of vertebroplasty

of cement found in 70 of 325 procedures (21.5%). Nine were symptomatic. The leakages were 30 in the intervertebral disc (42.8%), 22 soft tissues (31.4%), 4 paravertebral veins (5.7%) and 14 spinal canal (20%) (Table 2). Five out of 30 disc leakages were symptomatic (16.7%). Of these 5 leakages, 3 patients required subsequent additional vertebroplasty at the same level (1 month, 8 months and 20 months after the first vertebroplasty). Other 2 patients developed adjacent endplate fractures due to cement leakage, requiring vertebroplasty (at 3 months and 8 months). Four out of 14 spinal canal leakages were symptomatic (28.6%). Two cases had radicular pain which improved by a laminectomy and cement removal (Fig. 2). One case developed a post-vertebroplasty urinary retention associated with ossifying ligamentum flavum at T10 which was treated with decompressive laminectomy. And one case had delayed radicular pain, which improved after a selective nerve root block with steroid injection. This patient also had another level vertebral compression fracture above, underwent the vertebroplasty 2 months later.

Needle penetration injury

This were neurologic complications occurred without radiographic evidence of cement leakage. One patient with lymphoma and L4 collapsed fracture after a fall post radiation therapy. He developed radicular pain to the anterior thigh with quadriceps weakness of grade 4/5 in his right leg after the vertebroplasty at L4

Table 1. Complication

Complication	Total number of 325 (%)
Cement leakage	70 (21.5)
Needle Penetration injury	2 (0.6)
Adjacent Fracture	13 (4.0)
Remote Fracture	5 (1.5)
Progressive Deformity	3 (0.9)

Table 2. Anatomical location and number of cement leakage

Anatomic Location	Total number of 70%
Intervetebral disc	30 (42.9%)
Soft tissue	22 (31.4%)
Vein	4 (5.7%)
Spinal canal	14 (20%)
(surgical intervention 4 from 325 = 1.23%)	

as a result of needle penetration out of the right pedicle. He did not respond to 3 episodes of selective nerve root block with steroid injection. Subsequently the patient underwent a microdecompression at level L3-4 on the right side. One case developed severe progressively worsening of neurological deficit in her right lower extremity after the vertebroplasty at L1. This was a result of accidental venous injury by a needle causing an intradural and subarachnoid hematoma. The patient underwent surgical removal of clot (Fig. 3).

New vertebral fracture

Adjacent level collapsed found in 13 from 325 procedures (4%). Subsequent vertebroplasty were performed in 12 cases (Table 3). There were 5 remote fractures required vertebroplasty (one at 5 months, three at 2 years and one at 8 years).

Progressive deformity

There were three patients developed symptomatically progressive deformity. One vertebra

had further collapsed at the same vertebroplasty level at 4 months causing progressive kyphosis requiring spinal fusion. One patient had a vertebroplasty done at level T12. Seven months later, there was progressive kyphosis at the level of fracture. Instrumentation with pedicular screw and rod one level above and one level below were performed to stabilize the segment. One patient had an adjacent fracture treated with vertebroplasty, subsequently developed coronal and sagittal sub-luxation 2 years later, requiring posterior spinal fusion with pedicle screws and rods (Fig. 4).

Pulmonary Embolism

One asymptomatic pulmonary embolism was found in the present study. The cement was found traversing into the venous system at the time of injection. The chest x-ray was done immediately after the procedure (Fig. 5).

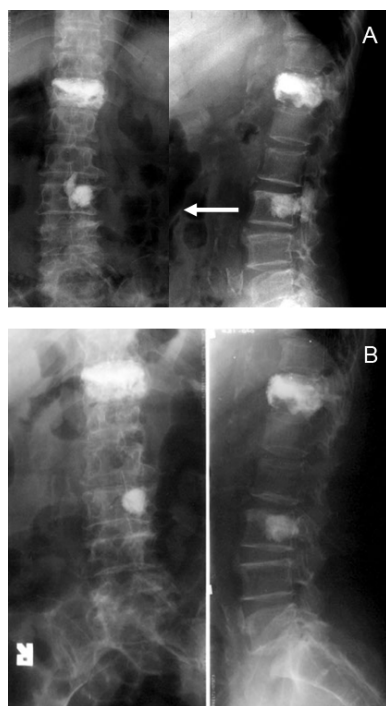


Fig. 2 A 61-year-old woman with osteoporotic vertebral compression fracture T12 and L3. She underwent vertebroplasty on both levels. She developed leg pain after the operation. (A) X-ray shows spinal canal leakage of cement (white arrow). (B) After surgical removal of cement



Fig. 3 83-year-old woman with osteoporotic compression fracture L1 vertebra, after vertebroplasty, she developed right lower extremity weakness. (A) Post-vertebroplasty x-ray showed no abnormality. (B) MRI revealed acute extradural hematoma and subarachnoid hemorrhage occupying T12-L2 causing cord compression at anterior aspect

Table 3. Timing of adjacent fracture vertebroplasty

Time	Number of Procedures
< 6 months	3
6months- 1 year	2
2 years	4
3 years	1
5 years	1
7 years	1

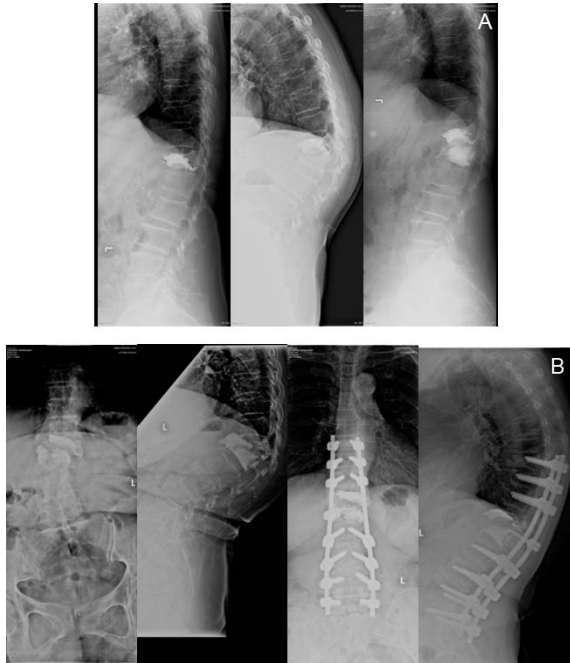


Fig. 4 A 75-year-old women with osteoporotic vertebral compression fracture treated with vertebroplasty. (A) She developed adjacent fracture treated with vertebroplasty 3 months later. (B) Subsequently she developed coronal and sagittal subluxation 2 year after, required posterior spinal fusion with pedicle screws and rods. She also had spondylolisthesis and stenosis at L4-5. This was address at the same surgery

Discussion

Vertebral compression fracture is one of the most common problems in elderly, results in pain, physical, functional and psychological impairment. Surgical stabilization is facing with severe osteoporosis because the bone cannot hold the pedicle screw. Vertebroplasty can be helpful as an alternative treatment.

Overall complication in the present study was

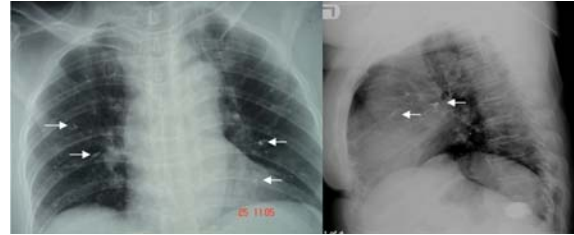


Fig. 5 Asymptomatic pulmonary emboli from cement (Arrow)

27%. It seems to be higher than in the meta-analysis of complication⁽¹²⁾ that reported 3.8%. This probably caused by including all the cases whether symptomatic or asymptomatic patients with abnormal radiographic findings.

Cement extravasations had been the most commonly found in vertebroplasty. Adjacent intervertebral disc leakage has been reported to occur in 35%⁽¹⁾ to 67%⁽¹⁹⁾ and not correlate to the shape of vertebral collapse. Legroux-Gerot et al⁽¹⁰⁾ reported 31% leakage into disc space. From meta-analysis Lee⁽¹²⁾ reported 75% of asymptomatic leakage. In the present study, cement leakage found in 70 of 325 (21.5%). The disc space leakage was the most common one (42.9%) which was lower than in the literatures. It is possible that the cement can leak through the disrupted endplate. Five out of 30 needed additional vertebroplasty. This may results from mechanical consequence on adjacent vertebrae⁽¹⁴⁾. There were 31.4% of paravertebral soft tissue leakages, similar to other studies. All were asymptomatic. Four procedures had paravertebral venous leakage, which were also asymptomatic. However, once the venous leakage was detected from the real time monitor, the injection was stopped. So no further cement can flush into the venous system. Nevertheless one patient showed pulmonary emboli as described.

Cement leakage into spinal canal can cause serious effect on neural structure and result in neurological complication. But some patients can tolerate if the residual space is enough. The present study showed 14 cases of radiographic cement leakage into spinal canal. Four patients had neurologic consequence (28.6%) while the other 10 had not. Patel⁽¹⁹⁾ reported 14 patients with neurologic complication after vertebroplasty, 12 of 14 patients required surgical treatment with decompression with or without, short or long, instrumented fusion. Layton⁽⁵⁾ reported 5 of 552 patients had new onset radiculopathy, however, 3 of these were transient. Some cases of

radiculopathy can manage by systemic corticosteroid and nerve root block⁽¹⁴⁾. Unfortunately radiculopathy in our 4 patients did not response to nerve root block and need surgical treatment (1.23% rom all 325 procedures). Two of these four patients, the leakage occurred because of the penetration of pedicle wall during the attempt of needle insertion. Therefore it has been our protocol in case of pedicle wall penetration, the other side of pedicle is then attempted. If the injection of dye demonstrates no leakage into the penetrated pedicle, the cement is then injected. But if any doubt, then the procedure is aborted immediately and reattempted 2 week afterward.

New vertebral fracture was reported in 2.5% to 18% of patients after vertebroplasty and 51-67% occurred at adjacent level^(9,12,23). Some authors advised to perform prophylactic vertebroplasty in segment between two collapsed vertebrae⁽⁹⁾. The present study revealed the similar result as the literatures. Most of these patients (12 out of 13, 92.3%) required vertebroplasty for pain relief.

Conclusion

The complications of vertebroplasty were mostly asymptomatic, but serious complication such as neurologic injury still could occur. Vertebroplasty could be considered a quite safe treatment for vertebral fracture in osteoporotic fracture. Meticulous technique should be executed during the procedure to avoid the leakage complication.

Potential conflicts of interest

None.

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ภาวะแทรกซ้อนจากการฉีดซีเมนต์เข้าในกระดูกสันหลัง

อารีศักดิ์ โชติวิจิตร, เอกพจน์ กอวุฒิกุลรังษี, อัญชลี ชูโรจน์, ทิตพงษ์ สังแสง

ภูมิหลัง: การฉีดซีเมนต์เข้ากระดูกสันหลัง (vertebroplasty) เป็น *minimally invasive surgery* ที่มีประโยชน์ในการบรรเทาอาการปวดหลังที่เกิดจากกระดูกสันหลังหักยุบตัวจากโรคกระดูกพรุนหรือพยาธิสภาพของกระดูกสันหลังจากเนื้องอก อย่างไรก็ตามมีรายงานในต่างประเทศถึงภาวะแทรกซ้อนทั้งที่ผู้ป่วยไม่มีอาการไปจนถึงมีอาการรุนแรง การศึกษานี้มุ่งศึกษาเพื่อรวบรวม สรุป และรายงานภาวะแทรกซ้อนที่เกิดจากการฉีดซีเมนต์เข้าในกระดูกสันหลัง

วัตถุประสงค์และวิธีการ: ผู้นิพนธ์รวบรวมข้อมูลจากผู้ป่วย 236 คน ที่ได้รับการฉีดซีเมนต์เข้าในกระดูกสันหลัง จำนวน 325 ครั้ง เก็บข้อมูลการวินิจฉัย อายุที่ทำให้เกิดการ ทบพจนภาวะแทรกซ้อน ได้แก่ ซีเมนต์รั่วออกนอกกระดูกสันหลัง กระดูกสันหลังระดับข้างเคียงยุบตัวมากขึ้น ที่ต้องได้รับการฉีดซีเมนต์ซ้ำ หรือได้รับการผ่าตัดเพิ่มเติม ทั้งจากภาพรังสีและจากเวชระเบียน

ผลการศึกษา: การฉีดซีเมนต์เข้ากระดูกสันหลังพบรอยต่อระหว่างกระดูกสันหลังช่วงอกและเอว (Thoracolumbar junction) 51.4%. โดยโรคกระดูกพรุนเป็นสาเหตุของกระดูกสันหลังยุบตัวที่พบบ่อยที่สุด จากการศึกษา พบว่ามีภาวะแทรกซ้อน 88 ครั้ง (27%) ซึ่งทำให้เกิดอาการ 26 ครั้ง (8%) ภาวะแทรกซ้อนที่พบบ่อยที่สุดได้แก่ ซีเมนต์รั่วจากกระดูกสันหลัง โดยพบรั่วไปที่หมอนรองกระดูกมากที่สุด พบว่ามีกรร่วของซีเมนต์เข้าไปในช่องไขสันหลังในผู้ป่วย 14 ราย และมีผู้ป่วย 4 ราย ที่มีอาการทางระบบประสาท ที่ต้องได้รับการรักษาอื่นเพิ่มเติม นอกจากนี้ยังมีผู้ป่วยอีก 2 ราย ที่มีภาวะแทรกซ้อนทางระบบประสาทโดยที่ไม่พบความผิดปกติจากภาพถ่ายรังสี ภาวะกระดูกสันหลังระดับข้างเคียงยุบตัว (Adjacent level collapse) พบ 13 ราย (3.6%) และปล้องที่ไม่ได้อยู่ติดกันยุบตัว (Remote segment collapse) 5 ราย มีผู้ป่วย 1 ราย ที่ซีเมนต์รั่วเข้าไปในหลอดเลือดไปที่ปอด แต่ผู้ป่วยไม่มีอาการผิดปกติ

สรุป: ภาวะแทรกซ้อนจากการฉีดซีเมนต์เข้ากระดูกสันหลังส่วนใหญ่ไม่ทำให้เกิดอาการในผู้ป่วย แต่ก็ยังพบผู้ป่วยที่มีภาวะแทรกซ้อนที่รุนแรงได้แก่ทางระบบประสาท การฉีดซีเมนต์เข้ากระดูกสันหลังเป็นหัตถการที่ค่อนข้างปลอดภัยสำหรับการรักษาผู้ป่วยที่มีกระดูกสันหลังยุบจากกระดูกพรุน แต่ต้องให้ความสนใจระวังขณะทำหัตถการเพื่อหลีกเลี่ยงการเกิดภาวะแทรกซ้อนจากซีเมนต์รั่วออกนอกกระดูก
