Case Report

Stentoplasty (Cemented kyphoplasty with Stent) Under Biplane Digital Subtraction Angiography (Biplane DSA)

Vertebral body augmentation with cement such as vertebroplasty and kyphoplasty are well established minimally invasive treatment options for osteoporotic and pathological vertebral compression fracture with highly successful results. The original technique of injection of polymethylmethacrylate (PMMA) bone cement into the compressed vertebral body directly is called “Vertebroplasty”. This technique proved to be a useful approach that could significantly reduce back pain immediately and help the aging patient return to normal activity in a few days with less morbidity than open internal fixation. However, injecting the bone cement directly into the vertebral compression fragment “vertebroplasty” cannot well restore the height of that compressed vertebra, which can cause segmental kyphosis. Biomechanical and clinical data show that the segmental kyphosis resulting from compression fractures, leads to an increased fracture risk of the adjacent vertebral levels,1, 2 that can cause recurrent pain, deformity and disability in the future. Vertebroplasty has no intrinsic mechanical method to restore vertebral height but relies on the elasticity of the fracture itself and patient positioning to induce lordosis. Also, the directed injection of bone cement into non-homogenous space of vertebral fragments can cause a high rate of extra-vertebral leakage that can lead to tremendous complications such as cord compression, embolism, neuropathic pain, paralysis or even death. For better kyphosis correction and reducing the complication,2 Balloon kyphoplasty (BKP) was the next step in the technological evolution of cemented vertebral body augmentation. A small, temporary “Balloon” is inflated in the vertebral body before injection of the bone cement into the space that was created by the balloon.4, 5

Kyphoplasty is able to restore vertebral height better than vertebroplasty. However, clinical data shows 34% of kyphoplasty procedures do not result in an appreciable reduction in kyphotic angle or restoration of height.6 One reason for inadequate height preservation in kyphoplasty is the loss of vertebral body height after balloon tamps deflation, prior to cement injection.7, 8 The next development was a new procedure called “Vertebral body stenting” or “Stentoplasty”. Vertebral body stenting uses a specially designed catheter-mounted titanium stent which can be implanted and expanded inside the vertebral body. Biomechanical tests showed no difference in stiffness and failure load between two systems. VBS (Vertebral Body Stenting) is an innovative technique which allows for the possibly complete reduction of vertebral compression fractures and helps maintain the restored height by means of a stent. The height loss after balloon deflation is significantly decreased by using stentoplasty compared to ordinary balloon kyphoplasty, thus offering a promising new option for kyphotic correction during treatment by cement augmentation.9
In this case, we combined “Stentoplasty” technique with the special x-ray equipment that can evaluate both anterior and lateral picture in the same time. “Biplanar x-ray This special x-ray equipment is widely used in interventional treatment of brain and cardiac disease, in Bangkok Medical Center. The significant benefit of using Biplanar x-ray is to be able to evaluate the position of the trocar and the injecting cement from anterior and lateral view in same time. This reduces the possibility of pedicles being broken by instruments, malpositioning of trocar or leakage of cement that are the cause of unpleasant complications. We decided to use this technique for the patient described below.

Case study

A 72-year-old man presented with lower back pain since 7 months. His extensive history included carcinoma of testis for which he had undergone orchiectomy 30 years previously. Eleven years ago, he was also diagnosed with carcinoma of the prostate and was treated by radiation. He underwent a gastrectomy to treat cancer of the stomach 5 years later. Four years ago, he developed coronary artery occlusion and was treated by cardiac catheterization and stent insertion. Eight months ago, he had a sudden back pain after minor trauma. From x-ray evaluation at that time, compression fracture of the forth lumbar spine was detected. The patient underwent a bone biopsy which showed no malignancy. The calcium paste vertebroplasty was done, but his back pain still persisted. He came to Bangkok Spine Academy 1 month later for further evaluation and proper management.

When the patient came to the Bangkok Hospital, the PET/CT scan showed no metastatic lesion. The MRI of lumbar spine (Figure 1) showed L4 compression fracture that had still not healed, the spinal canal was not compromised and neural structure showed no compression. Physical examination revealed specific points of tenderness on the back corresponding with the fourth lumbar level. Pain evaluation was 8/10 in Visual Analogue scale, Euro-quality of life was 40/100 and Oswestry Disability Index showed 53.33/100 at that time. Because his back pain significantly disturbed his quality of life, after discussion with the patient about the treatment, he allowed us to treat his un-healed osteoporotic lumbar compression fracture by injection of bone cement by using balloon kyphoplasty with stent under biplane digital subtraction angiography (Biplane DSA).

Figure 1: The MRI of lumbar spine shows L4 compression fracture, mild central spinal stenosis, mild enhancement of bone marrow, possibly due to granulation tissue.
Technique

The patient was placed in a prone position, and x-ray pictures were monitored by Biplane DSA equipment. The fourth lumbar vertebra was located in both AP and Lateral view. After the skin area was cleaned and draped, the trocar with the working sleeve was inserted obliquely on both sides by way of the skin, entering to the fourth lumbar pedicle, under bi-planar fluoroscopy in order to make sure there was no penetration of the trocar into the spinal canal. After the instrument assembly was deep enough and in a good position, the trocar and canula were removed, leaving the working sleeve in that corrected position in vertebral body.

After determining the appropriate length, the balloons and stents were inserted each side of the pedicles. The balloons were inflated by radio-opaque solution to 5 millimeter that reached maximum stent diameter. The balloons were removed, leaving the expanded stent on both sides. After verifying the proper position of stent, the bone cement (Polymethyl methacrelate agent) was mixed and injected into stent 5 cc each side under 2-planar radiographic real-time monitoring, to make sure there was no posterior and lateral leakage. The skin was closed by layer. The patient could turn over and lie normally within 10-15 minutes, with immediate reduction of pain.10,11

Result

The patient had markedly reduced pain symptoms after this procedure. He was able to go back to his room without needing to be monitored in intensive care unit. He could move upright and walk by himself with minimal pain within a few hours. There was almost no wound pain problem because of very minimal injury at procedure site. The post-operative x-ray showed good restoration of vertebral height and that cement and stent were well placed. VAS (Visual Analogue Scale) of back pain symptom post operatively is 0/100; Euro-quality of life at sixth week showed a big improvement from 40/100 to 80/100 and ODI (Oswestry Disability Index) decreased from 53.33/100 to 2.44/100. This means that his life is now the same as normal population. At 24 weeks his Quality of life had slightly improved to 90/100 and ODI was still below at 2.44/100. No other complication occurred.
Figure 6: Antero-posterior views shows stent after cement injection.

Figure 7: Lateral views shows stent after cement injection.

Figure 8 a-d: Microscopic Sections reveal 4 irregular fragments of bone, 2 pieces show large foci of bone degeneration with amorphous areas and necrosis. A few reactive macrophages are noted. No identified or viable malignant cells. Residual tissue is congested bony trabeculae with fibrotendinous tissue.
Discussion

Vertebral Augmentation with Cement is an interventional procedure whose indications, advantages, and results have caused controversial discussions. 1,2,4-8 Vertebralplasty, Kyphoplasty, and the newest Stentoplasty are all techniques whereby cement is injected into the compressed vertebral body, thus immediately stabilizing the fracture fragment and decreasing back pain. This interventional technique has proven to be effective in elderly patients who have pathological fractures due to osteoporosis or tumorous condition. Kyphoplasty with or without Stent is proven to be more effective and safer than Vertebralplasty. Anyway, the most serious complications are cement leakage that can cause castratrophic morbidity. Cement leakage is more likely to occur due to poor visualization of needle placement in the correct position. Therefore, operators should use the highest quality fluoroscopy available to them and avoid poor-quality imaging systems such as older bedside units. Although kyphoplasty can be performed by using a single plane unit, biplane monitoring of fluoroscopic images decreases procedural time. The availability of digital subtraction angiography allows documentation of needle placement and evaluation of the trabecular space and epidural veins. Regardless of the modality used for needle placement, the injection of polymethylmethacrylate should always be performed with direct fluoroscopic control. We initially injected with biplane x-ray but did not feel confident that polymethylmethacrylate distribution was adequately and completely visualized. Cement may flow in a cranial or caudal direction, which may be difficult to monitor using CT.12

This method appears to be useful especially for monitoring the difficult steps of the procedure, such as an insertion of the osteointroducer, the balloon inflation and cemented injection. Vogl et al., have demonstrated that combined guidance improves accuracy of needle positioning in vertebroplasty. Potential cement leakages were detected earlier than with fluoroscopy alone.13

Conclusion

Vertebral Body Augmentation with Stent or “Stentoplasty” is an innovative technique for treatment of elderly patients presenting with pain from vertebral compression fracture. This technique is proven cost-effective, resulting in rapid return to normal life of the patient. The challenge of this procedure is to prevent the complication of leakage of cement. The combined use of Balloon-Stent and Bi-planar x-ray real-time in this procedure significantly increase the safety margins of this interventional treatment.

References: