The use of vertebroplasty in traumatic fractures of the thoracolumbar spine

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Percutan vertebroplasty (VP) is a well known minimally invasive method. VP has gained popularity in the treatment of vertebral body instability caused by trauma too. Using a case report, the authors present the technique of VP. Three weeks after the operative treatment (VP) of LII. Fracture of a policeman fellow compatriot, the patient became pain-free, without symptoms, and returned to his previous work. The authors concluded that VP is a feasible method for treating anterior column traumatic vertebral fractures. The pain reduces shortly after the operations, there is no need for spinal stabilization, the time of healing, load ability, as well as return to work is faster. The costs of treatment are also lower. VP can be done as a one-day surgery in ROLE 3 military hospitals, in selected cases the injured soldier may be fit for transport to a ROLE 4 hospital.

Introduction

In Western countries, the annual incidence of spinal fractures is of 60 out of 100,000 inhabitants. Indications for surgery basically depend on 3 criteria: the existence neural compression, the level of angulation, and the stable or unstable nature of the fracture. The regular treatment of unstable vertebral fractures was arthrodesis with the application of screw and plate instrumentations: that means great operative stress and postoperative pain, with complete recovery within 3 to 4 months. The application of brace, as an alternative treatment, debilitates the patient in everyday life for 2–3 months.

In the last few years VP has become a widespread therapeutic approach in the treatment of vertebral compression fractures with different aetiologies. It is used to treat when a fracture touches the anterior column of the spine and it doesn’t cause tightening of the spinal canal. VP is a vertebral augmentation procedure: bone cement is injected into the vertebral body through a filling tube, and as the bone cement gets rigid,
it results in stability of the vertebral body. The percutaneous, minimally invasive vertebroplasty is technically easy to do in a short operative time.

In the last few years the technique was applied in the treatment of traumatic vertebral fractures by many authors. Our purpose was to evaluate the method of VP in the treatment of traumatic anterior column vertebral fractures in our series, by presenting a case report of a fellow police officer.

**Methods**

In our opinion, surgery is indicated at the presence of these three criteria: 1. vertebral body compression fracture, with intact posterior column, and without consequent spinal canal stenosis, 2. the fracture is not healed: MRI shows oedema of the fractured vertebral body, 3. the presence of local pain due to fracture. Contra-indications are: 1. healed fracture; 2. active infection; 3. coagulopathy; 4. spinal canal stenosis due to trauma (bone fragment in the spinal canal).

Physical examination, lateral and antero-posterior osteography, MRI and CT scans are needed before surgery. MRI (T2 and STIR sequences) shows oedema of the vertebral body, CT – in questionable cases – enables us to examine the posterior wall of the vertebral body.

The intensity of pain is investigated by visual analogue scale preoperatively, on the postoperative second day, and on every check-up.

During the procedure, general anaesthesia is used. As a first step, the patients are positioned in a lordotising way, and in selected cases, ligamentotaxis is made. The next step is using a percutaneous, parapedicular method, bone cement (either acrylic based PMMA, or resorbable cement containing calcium-phosphate) is injected into the fractured vertebral body under continuous fluoroscopic guidance. The resorbable bone cement containing calcium phosphate is much more expensive, and is used for young patients. After control osteography is performed, patients are mobilised on the first postoperative day.

**Case report**

A 32 year old man – police officer – sustained an accident by falling off a horse during his service, injured his bottom and waist. The patient sustained no other injuries. The patient was brought to our hospital by auto-mobile by his colleague. He didn’t lose consciousness.
Physical status: on general examination, the injured patient was well-built, well-nourished white male. Skin: dry, warm, slightly pale. Chest: well proportioned, tenderness on right side, and on the back on palpation. Heart: regular rate and rhythm. Abdomen: soft, nondistended, nontender. Back: pronounced tenderness at the level of LII. Pelvis: pronounced sacral pain was detected by applying pressure to the symphysis pubis. No pelvic instability. The patient was alert, awake and oriented, there were no neurological findings.

Vital signs: Blood pressure: 150/90, pulse: 80/min, spO2 94%. Pain on VAS 80%.

Routine laboratory findings were normal. Abdominal ultrasound and chest X-ray showed no alterations. Cervical, thoracic and lumbar X-rays showed compression fracture on the second lumbar vertebra. The second column of the vertebral body had a height loss of 20%.

CT of the lumbar spine showed an anterior two-third L2 vertebral body fracture, with an incomplete burst fracture and minimal dislocation of the anterior edge. There was an approximately 20% height loss of the anterior column (Fig. 1).

MRI of the lumbar spine showed slight kyphotic angulation at the L 2 level. There was an impression on the upper end-plate of the L2 vertebra. Oedema appeared, and was shown on the upper half of the L2 vertebra. Summarising the data, we concluded, that the patient sustained acute L2 compression fracture. The middle and posterior column was intact.
VP was proposed to the patient, which was performed the next day without complication. On the first postoperative day the patient was mobilised after performing control lumbar X-ray (Fig. 2). There was no change in the neurological status, VAS was 30%. The patient was pain-free one week, and returned to work 3 weeks after surgery.

![X-ray pictures after operation (The bone cement fills well the fractured L 2 vertebra.)](image)

**Figure 2.** X-ray pictures after operation (The bone cement fills well the fractured L 2 vertebra.)

**Discussion**

For patients with neurological disorders or spinal canal stenosis exceeding 50% due to vertebral fractures, surgery is required (decompress and recalibrate the spinal canal and neuroforamina).

At the dorsolumbar junction, surgery is also necessary if the kyphosis is above 20 degrees to prevent corporeal collapse and prevent neurological disorders or subsequent chronic low back pain. The stable or unstable nature of the lesions is sometimes difficult to decide: it is assessed by checking for the occurrence of interpedicular listhesis, involvement of the posterior wall or disruption of the spinal arch. In case of instability, surgery is required, which can be basically dorsal, or combined (dorsal and ventral) fixation.
In cases, in which usual, open surgical technique is not indicated, or not possible for other reasons, conservative treatment is recommended (external brace for three months). The kyphosis must be between 10 and 15 degrees and the retropulsion of the bone fragment within the canal must be under 50%. However, obese patients and/or patients with multiple traumas are commonly candidates for open surgery because of the difficulty such patients have in wearing a brace. Until the last few years, there was no therapeutic alternative between open surgery and conservative treatment.

WOOD et al. (2003) have shown that there was no difference in subsequent kyphosis after stable burst fractures between patients treated surgically or conservatively. It must also be noted that 25% of treated patients experience debilitating residual pain. RESCH et al. (2000) also found, that in case of stable dorso lumbar fractures without significant deformity, and for patients in bad general condition, conservative therapy is an alternative to surgery.

VP, i.e. filling of the vertebral body with bone cement, is now a common treatment of painful pathological vertebral conditions and osteoporotic vertebral fractures for many decades. VP can be performed percutaneously, through pedicules on the lumbar (transpedicular VP), or through extrapedicularly on the thoracal spine. Percuteneous VP is performed in a short operative time, patients can be mobilized immediately – as the bone cement consolidates, and the pain also relieves immediately after the procedure.

Compared to the past, VP today has significantly wider indications. In the past few years, VP became a widespread therapeutic approach not only for treatment of osteoporotic compression fractures, pathological debilitating conditions (haemangiomas, myelomas, metastases) of the spine, but for traumatic vertebral fractures – without neurological deficit – as well.

For many years, the treatment of toracolumbar fractures consisted of dorsal stabilization, later however, dorsoventral stabilization became a standard procedure. BRIEM et al. (2004) showed that dorsoventral stabilization results in a better postoperative X-ray picture, but there are no correlation between the picture and the life’s quality. According to CHRISODOULOU et al. (2005), together with dorsal transpedicular instrumentation, VP has a role in the treatment of unstable toracolumbar fractures.

The guidelines of optimal treatment for spine fractures are still not clear, and prospective studies are still investigating the issue.

HUET et al. (2005) used the method of VP (without dorsal stabilization) for treating traumatic vertebral fractures first in patients with further compression fractures after osteosdesis or conservative treatment. VP was also used in patients displaying various, traumatic or medical, associated pathologies for which the interdisciplinary debate that
included the anesthetist, the surgeon and the neuroradiologist had led to recommend a treatment that minimized the period of confinement to bed and hospitalization.\textsuperscript{8}

In our series, the selected criteria were traumatic fractures of the anterior column, minimal degree of angulation, with a relatively intact spinal canal.

During VP, the precise percutaneous placement of the needle into the vertebral body is important. Kasó et al. (2006) found, that regarding the process of injection, proper positioning of the end of the needle is crucial. When the needle end is near to the vertebral body’s center, bone cement can easily get into the basivertebral system, and then to the epidural space, causing cauda – or myelon compression.\textsuperscript{9} In our series, however, such complication was not found. Through azygos and hemiazygos venous system bone cement particles can get into the superior caval vein, right atrium and then to the pulmonary arteries, resulting in pulmonary embolism. Injection made into the lateral third of the vertebral body significantly reduces the risk of ventral epidural extravertebral bone cement accumulation.\textsuperscript{9} If VP is performed due to traumatic vertebral fractures, the end of the needle should not reach the fracture line. In our series, the needle-end in sagital plane was positioned near to the ventral cortex of the vertebral body.

Using axial MR images, the ideal route for percutaneous transpedicular trepanation can be planned preoperatively. On an axial MR image showing the widest pedicle, the ideal route – through which the (beveled) needle will reach the vertebral body – can be drawn. The point, where this line crosses the skin, will be the entry point (the distance from the mediansagittal plane is determined). On sagital images the same route can be determined preoperatively, which will show the ideal angle of the needle.\textsuperscript{10} The method was also found useful in our series.

Regarding osteoporotic vertebral fractures, VP can be performed through unilateral percutaneous punction, if the needle can be easily directed to the center of the vertebral body (ventral third on sagital plane) at preoperative planning.\textsuperscript{10} We found, that in case of traumatic vertebral fractures, unilateral injection of bone cement is not always sufficient, because the compound fracture lines limit the positioning of the needle. Considering this condition, we prefer bilateral VP.

Kasó et al. (2002) found, that VP can be performed even if metastatic pathology affects ventral epidural structures (i.e., dorsal cortex of the vertebral body), but only, when signs of myelon or cauda compression are missing.\textsuperscript{11} In our opinion, this role can be adopted to traumatic vertebral fractures. As well as other authors,\textsuperscript{8} in our series we did not experience bone cement leakage despite a ruptured posterior cortex either.

From a technical point of view, Huet et al. (2005) recommend to stop the (bone cement) injection after two anterior third (of the vertebral body) were filled, in order to prevent intracanal displacement of the posterior cortex fragment.\textsuperscript{8} The authors also
found, that it is necessary to change the position of the needle, or wait for a hardening, if cement begins to leak through a crack. Discal leaking was also found to be frequent. In our series there was only one example of this condition.

In our opinion – in concordance with the literature – VP after traumatic vertebral fracture was more difficult, then VP after vertebral fractures of pathologic origin, or vertebral haemangiomas. Our patient’s example justifies, that VP is an effective method for the reconstruction of the anterior column after traumatic vertebral fractures. There was no need for using a brace after the procedure, and the load ability of the spine was recovered within 3 weeks. The surgery can be performed quickly in the field as well (in accordance to ROLE 3).

References