Treatment of vertebral fractures with vesselplasty

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Learning objectives

Vesselplasty is an intervention designed to treat pain vertebral fractures by means of percutaneous introduction of deflated balloons within the vertebral body, and fill them with cement to expand the vertebra and produce a mechanical stabilization.

This technique is an evolution from vertebroplasty and kyphoplasty, designed to avoid cement leakage outside the vertebral body.

We describe technical details of this intervention, and clinical and radiological criteria that we use in our Hospital to select adequate candidates for this treatment.
Background

Vertebral compression fractures (VCF) are a major health care burden. Osteoporosis is the most common cause, and tumour infiltration, primarily by metastasis or myeloma, is another important cause. Furthermore, because the treatment of oncologic patients requires the use of corticosteroids, secondary osteoporosis may develop and result in additional vertebral fractures.

The conventional management of symptomatic VCF is medical therapy. Surgery is generally limited to cases of spinal instability or neurologic deficit.

Vertebroplasty and kyphoplasty are two minimally invasive percutaneous interventions developed for the treatment of symptomatic VCF which do not respond to medical therapy.

Vertebroplasty is a procedure introduced in the 80s, in which polymethylmethacrylate (PMMA) is percutaneously injected into the vertebral body with the fracture. The mechanism for pain relief appears to be mechanical stabilization of the vertebral body. The main risk of this technique is leakage of PMMA out of the vertebra (into the venous system, with the possibility of pulmonary embolism, or into the spinal canal or neural foramina, with the risk of neurologic disorders).

Kyphoplasty is a modification of vertebroplasty, and it was introduced in the late 90s. It involves inflation of a high-pressure balloon within the collapsed vertebral body, followed by percutaneous injection of bone cement into the cavity created by the balloon. The risk of cement extravasation is reduced because of the lower-pressure injection of cement into the previously formed cavity.

Vesselplasty is a new alternative to vertebroplasty and kyphoplasty. Instead of using a balloon to create a cavity, vesselplasty uses a polyethylene erephthalate balloon container (Vessel-X), which serves as both a vertebral body expander and a bone cement container. It is introduced into the vertebra in its reduced configuration and after positioned expanded by the injection of PMMA. The porous structure of the balloons, allows a small amount of bone cement permeates through its wall and interdigitates within the vertebral body to increase its stability.

This technique improves the problem of leakage of cement from the vertebral body because most of the cement is contained by the expandable artificial vessel.
Imaging findings OR Procedure details

The action protocol approved in our centre to make an adequate patient selection is as follows:

- The patient is always studied by a rheumatologist in a specific consulting of "bone metabolism".

- A vertebral compression fracture proved by X-ray needs further analysis with MR (with T1, T2 and Fat Sat sequences), in order to demonstrate acute oedema of the vertebra.

- Once the vertebral oedema is seen and the patient refers pain rebel to adequate medical treatment (scheduled by the own rheumatologist), vertebral cementation is offered to the patient, and they give informed consent.

- We include patients with the following causes of vertebral fractures: osteoporosis (primary or secondary), multiple myeloma, metastatic disease, and high-impact trauma.

- The exclusion criteria are: pain due to a herniated disk, spinal stenosis, or other spine abnormality not associated with the fracture, fractures with a retropulsed bone fragment resulting in myelopathy, uncorrectable coagulopathy, and the presence of any systemic or spinal infection.

- In our Hospital this intervention is performed by Interventional Neuroradiologists, with an anaesthetist who is responsible for superficial sedation or spinal anaesthesia.

The steps that we follow at our Centre to perform the procedure are the following:

- Vesselplasty procedure is performed at our institution under fluoroscopic control (Allura Xper FD20 Philips Healthcare).

- The patient is placed in the prone position on the angiography table. Antibiotic coverage with cefazolin 2gr is administered 30 minutes after intervention, and 1gr 6 hours and 12 hours after procedure.

- The fractured vertebral body is localized under fluoroscopic control in both the anteroposterior and lateral planes. Local anaesthetic in the skin over the pedicle is administered.
- A small skin incision is made, and the bone access needle (10-gauge) is advanced into the fractured vertebral body creating a path through the pedicle. We always attempt a bipedicular approach.

- The stylet of the bone access needle is removed, leaving the cannula tube in the vertebral body. Then, a precision drill is introduced into the vertebral body through the cannula tube until the tip of the drill is closest to anterior wall of the vertebra.

- The Vessel-X bone filling container (20 or 25 mm) is next inserted into the cannula tube and placed within the vertebral body. The cement delivery system is connected, and the bone cement is progressively filled in the Vessel-X balloons under fluoroscopy control.

- The injection of cement ends when the balloon acquires adequate morphology according to vertebral size, extravasation is observed, or more cement cannot be injected due to high pressure.

- We recommend absolute rest in bed 12-24 hours, and progressive ambulation later. Usually discharge from hospital is 24 hour after intervention.

The final morphology of Vessel balloon is independent to the analgesic effect. Even more, the porous structure of the balloons, allows diffusion of cement its wall and interdigitates within the vertebral body to increase its stability. However a slow and controlled injection of cement is mandatory, in order to avoid a ruptured of balloon and uncontrolled leakage inside or outside of the vertebra.
Images for this section:

![Patient placed in the prone position on an angiography table (Allura Xper, Philips Healthcare) for the procedure.](Image)

**Fig. 1**: Patient placed in the prone position on an angiography table (Allura Xper, Philips Healthcare) for the procedure.

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Fig. 2: Transpedicular access with 10 gauge needle.

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**Fig. 3:** Precision drill introduced into the vertebral body through the cannula tube (making the working channel) until a few millimeters posterior to the anterior wall of the vertebra.

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**Fig. 4:** Positioning of Vessel-X ballon within the vertebral body.

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Fig. 5: Vessel-X balloons filled of cement.

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**Fig. 6:** Access, positioning, filling with cement and release of Vessel-X balloons.

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Fig. 7: Different morphologies of the Vessel-X balloons with cement.

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Fig. 8: Mild diffusion of cement through the porous wall of the balloon.

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**Fig. 9:** Mild diffusion of cement through the porous wall of the balloon and extension within the vertebral body.

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Conclusion

Vesselplasty is a feasible and safe technique to treat vertebral compression fractures without response to analgesic medical treatment. It is superior to vertebroplasty and kyphoplasty minimising the risk of cement leakage, but it needs an adequate learning curve to perform the intervention properly.

Patients often improve their symptomatology at 24 hours, but sometimes they refer to some other milder symptoms due to compensatory phenomena (muscular, tendinous or facet joint pain) secondary to the painful vertebral fracture.

In our experience, vesselplasty is an optimal modality of intervention which provides a safe alternative to vertebroplasty or kyphoplasty in the treatment of vertebral compression fractures.
Images for this section:

**Fig. 10:** Hospital Universitario Virgen de la Arrixaca.

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