Pulmonary Cement Embolism Following Percutaneous Vertebroplasty: A Case Report, Physiopathology and Literature Review

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Abstract

Objective: We report a case of pulmonary cement embolism following percutaneous vertebroplasty performed for osteoporotic vertebral compression fracture.

Summary of background data: Asymptomatic pulmonary cement embolism, more than symptomatic pulmonary cement embolism, are not so rare from 2.1% to 26%.

Methods: The fifth day after surgery, an angioscan was performed because of respiratory failure. It showed a pulmonary cement embolus in the apical segment, medium lobe and ventro-basal segment of the right lung.

Results: Symptomatic treatment with oxygen and curative anticoagulation allowed a complete respiratory function recovering.

Conclusions: So as to better diagnose this complication, a careful analysis of the post-operativ pulmonary X-ray and regular follow-up are necessary. The main interest of this case report is the knowledge of chest X-ray as a screening test for pulmonary cement embolism.

Keywords: Vertebroplasty; Pulmonary cement embolism; Leakage; Osteoporotic vertebral compression fracture

Introduction

Vertebroplasty is a percutaneous and efficient technic for treatment of painful osteoporotic vertebral compression fractures, traumatic vertebral fractures or myeloma fractures [1,2]. The first vertebroplasty was performed by Galibert in 1984 so as to treat a vertebral angioma in C2. Vertebroplasty consists in cement injection in the vertebral body of the painful vertebra [3]. Although this procedure seems to be efficient to decrease the pain and to improve the functional recovery of patients, there are complications such as same level re-fracture, radicular injuries, and cement embolism [4]. Majority of these complications are secondary to cement leakages and/or a bad filling of the vertebral body. Pulmonary cement embolism are under-estimated because many of them are asymptomatic or can become symptomatic many years after the vertebroplasty [5].

This case has three points of interest. Firstly, to be aware of this complication. Secondly, to screen quickly a symptomatic and asymptomatic cement pulmonary embolism by a systematic analysis of the post-operativ chest X-ray. And thirdly, to give to patients an appropriate information on the necessity to have a regular follow-up and a diagnosis in emergency in case of respiratory signs.

Case Report

A 81 year-old woman who had presented an osteoporotic vertebral compression fracture of the eleventh (T11) and twelfth (T12) thoracic vertebra, type A1-3 according to the Magerl classification, was admitted in our institution for a vertebroplasty (Figure 1) [6]. The Visual Analogic Scale (VAS) before surgery was 7 on 10. We had performed a vertebroplasty for this patient a few months before on the second lumbar vertebra (L2) with an excellent result. The delay between the injury and the surgery was two days. We had noticed no respiratory disease for this patient.

A vertebroplasty under general anesthesia, in ventral decubitus with thoracic and iliac support and fluoroscopic control was performed. A partial but satisfying reduction of the fracture was obtained by prone position of the patient on butress. Trans pedicular 3 mm diameter, 150 m length trocars (Vexim SA, 31130 Balma, France), was used to inject cement under fluoroscopic control. High-viscosity Poly-Methyl-Methacrylate (PMMA) cementy

Figure 1: Pre-operative X-ray showing the osteoporotic vertebral compression fracture in T11 and T12 and the vertebroplasty in L2.

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Received April 25, 2015; Accepted May 20, 2015; Published May 22, 2015


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(Vexim SA, 31130 Balma, France) was used. Cement was injected when it was pasty. Injection was stopped as soon as a venous leakage was seen on T11 on the anterior and lateral side of the vertebra. In all, 6 ml of cement was injected in each vertebra (Figure 2). There was no other indesirable event during the surgery. Post-operative neurological exam was correct. Pain relief was obtained with VAS 2/10 at first post-operative day.

The fifth day, the patient suffered of respiratory distress with desaturation (PaO₂ 80 mmHg and PaCO₂ 36 mmHg). The patient received high concentration oxygenotherapy treatment. An angioscan was performed and showed pulmonary cement embolus in the apical segment, medium lobe and ventro-basal segment of the right lung (Figures 3 and 4). Curativ anticoagulation and symptomatic oxygenotherapy allowed complete respiratory function recovering. At one year follow-up the patient has fully recovered with no respiratory symptoms and no pain-killer consumption.

Discussion

Since 25 years, vertebroplasty has become a current intervention for treatment of pain in osteoporotic vertebral compression fractures. Even if some studies do not find any statistical differences with a non-operative treatment, the majority of studies show a benefit in the decrease of pain and in an early home back [7,8].

However, the rate of pulmonary cement embolism, symptomatic or asymptomatic, varies from 2.1% to 26% according to the screening method after vertebroplasty and kyphoplasty [5]. Today, no studies show a significant bound between the surgical technique and the rate
of cement pulmonary embolism although there is a statistical bound between cement leakage and asymptomatic cement pulmonary embolism [9]. This could explain the fact that there is no difference between vertebroplasty and kyphoplasty because the rate of cement leakage seems to be similar in our practice [10]. Pulmonary cement embolism follows a cement leakage beyond the peri-vertebral veinous plexus. If the cement is too fluid, it can cross the hemiazygos vein, the azygos vein, the inferior vena cava and the pulmonary circulation [11]. Few studies give an interest to the physiopathology of cement leakage during vertebroplasty (their rate varies from 5 to 80% in the literature) but no predictive factors for cement leakage are highlighted. For some authors, the degree of vertebral kyphosis and the absence of avascular necrosis of the vertebral corpse could be bound with cement leakage [12]. For the others, the position of the trocar in the centre of the vertebral corpse could be responsible of leakage across epidual veins [13].

We have some hypothesis for the predictiv factors of cement leakage. The pressure during the injection seems to play a very important role. This pressure is correlated with the cement viscosity and not with the type of material used for the injection [14]. Krebs and al showed in an in-vivo study of measurement of intra-vertebral pressure that the pressure increases with the time of cement polymerization. A way to control this pressure is the opening or the closing of the contra-lateral trocar as it is suggested in the cadaveric study of Baroud et al. [15]. With the new low polymerization cements (high-viscosity), we think that it is necessary to consider the parameters which can modify the intra-vertebral pressure (material for injection, polymerization time and cement viscosity, opening or closing of the contra-lateral troca). Indeed, we think that the association fluidity (low polymerization cement) and high pressure injection is a risk factor of vascular cement leakage and pulmonary cement embolism.

By the way, those epidural veinous leaks are not bound with the type of fractures. Clinical symptoms can appear during the surgery but the most often they appear in the days or the weeks following the surgery. They are no specific from the chest pain, dyspnea, cyanosis, tachycardia, to the acute respiratory distress syndrom (ARDS) [5]. A systematic pulmonary X-ray after surgery could be helpful (Figures 5 and 6) especially for the diagnosis of asymptomatic pulmonary cement embolism (Choe and al found 4.6% of asymptomatic pulmonary cement embolism on systematic pulmonary X-ray in a serie of 65 patients) [9]. Angioscan, performed in emergency in case of symptomatic pulmonary cement embolism, confirm the diagnosis and the spread of the emboly.

A conservative treatment is performed in the majority of cases of symptomatic pulmonary cement embolism with oxygenotherapy and curative anticoagulation in emergency. The most often this treatment allows a complete respiratory function recovering [5]. The curative anticoagulation is necessary because of the prothrombotic effect of PMMA cement emboly and the endothelial lesions. Sometimes, the evolution is dramatic with the necessity of endovascular embolytomy, in open surgery, or lobectomy because of pulmonary infarction. In case of asymptomatic pulmonary cement embolism in the peripherique vessels a regular follow-up is necessary. To our knowledge, 6 cases of death secondary to pulmonary cement embolism are described in the literature [16,17].

To conclude, pulmonary cement embolism, symptomatic or asymptomatic, is an under-estimated complication of vertebroplasty. The awareness of this complication should allow an earlier diagnosis, which lies on a systematic chest X-ray after the surgery or an angioscan in emergency in case of clinical signs. A treatment should be performed in emergency because of the possibility of death. An appropriate information and a regular follow-up are necessary so as to avoid a delayed diagnosis in case of respiratory symptoms after the surgery [17].

References


