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COMPLICATIONS OF THE PERCUTANEOUS VERTEBROPLASTY

PERKÜTAN VERTEBROPLASTI KOMPLIKASYONLARI

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SUMMARY:

Percutaneous vertebroplasty (PV) has long been applied in the treatment of osteoporotic vertebral fractures, malignant vertebral fractures and hemangiomas. Low complication rates, reduced length of hospitalization, favorable results, cost effectiveness and quiet easy application compared with conventional stabilization methods make PV first choice in suitable indications. Although it is a minimally invasive interventional technique, it is not free of severe complications. Like other interventional procedures, PV must be managed carefully. Here, we reviewed mild, moderate and dreaded complications of PV.

Key words: Percutaneous vertebroplasty, Vertebroplasty complications, Vertebral Cement Complications

Level of evidence: Review article, Level V

ÖZET:

Perkutanöz vertebroplasti (PV) osteoporotik vertebra fraktürleri, malign vertebra fraktürleri ve hemanjiomların tedavisinde uzun zamandır uygulanmaktadır. Düşük komplikasyon oranları, hastanede yatış süresinde azalma, yüz güldürücü sonuçlar, maliyet etkinliği ve geleneksel stabilizasyon yöntemleri ile kıyaslandığında daha kolay uygulanabilir olması PV'yi uygun endikasyonların varlığında ilk tercih haline getirmektedir. PV her ne kadar minimal invaziv bir girişimsel işlem olsa da, ciddi komplikasyonlar da görülebilir. Diğer tüm girişimsel işlemler gibi PV de dikkatle yönetilmelidir. Bu yazıda PV'nin ılımlı, orta düzey ve en korkulan komplikasyonları gözden geçirilmiştir.

Anahtar kelimeler: Perkütan vertebroplasti, Vertebroplasti komplikasyonları, Vertebra sement komplikasyonları

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INTRODUCTION:

Percutaneous vertebroplasty (PV) has been accepted as safe and effective in the management of osteoporotic vertebral fractures, malignant vertebral fractures and hemangiomas. Low complication rates, reduced length of hospitalization, favorable results, cost effectiveness and quiet easy application compared with conventional stabilization methods make percutaneous vertebroplasty first choice in suitable indications. Although it is a minimally invasive interventional technique, it is not free of severe complications.

The aim of PV is to strengthen and stabilize the fractured vertebral body and pain reduction as a result. PV is usually applied to the thoracic and lumbar spine. Cervical and cervico-thoracic junction applications are rare[18,19]. The technique has been developed and spreaded quickly in the last 10 years. PV was first used by Galibert et al. in 1987 for a C2 hemangioma[10]. First series were reported by Cotten et al. in 1996 and Jensen et al. in 1997[7,13]. However, as for the other interventional operations, anatomy of adjacent structures need to be mastered and whole procedure should be handled carefully to avoid unexpected complications. Also, a qualified fluoroscopy that provides detailed images of the spine and an experienced technician is essential. Although most of the complications are easy to manage, occasionally troublesome results which are difficult to treat may occur.

COMPLICATIONS RELATED TO POLYMETHYLMETHACRYLATE EXTRAVASATION:

Polymethylmethacrylate (PMMA) extravasation is a frequent and usually easy to manage complication of vertebroplasty. Cement extravasation is the main cause of clinical complications. It has been reported in 38% to 72,5% of cases with malignant fractures, and in 30% to 65% of cases with osteoporotic fractures[5,7,13,26]. PMMA may leak into a large variety of anatomical compartments including the needle track, paravertebral soft tissue in 6% to 52,5% of the cases, spinal canal in up to 37,5% of the cases, into the vertebral disc in 5% to 25% of the cases, paravertebral veins in 5% to 16,6 % of the cases and epidural veins in 16,5% of the cases[4,7,8,23]. Also extravasation to metameric artery, inferior vena cava, aorta and lungs have been reported[18,26].

Cement leakage in the paravertebral soft tissue is rarely symptomatic. However, 2 cases of transitory femoral neuropathy related to PMMA leakage into the psoas muscle (Figure-1) have been reported[7,23]. Vertebral body has a round shape, thus the needle may pass anterior cortex even the tip of the needle seems to be posterior to anterior cortex on both AP and lateral images.

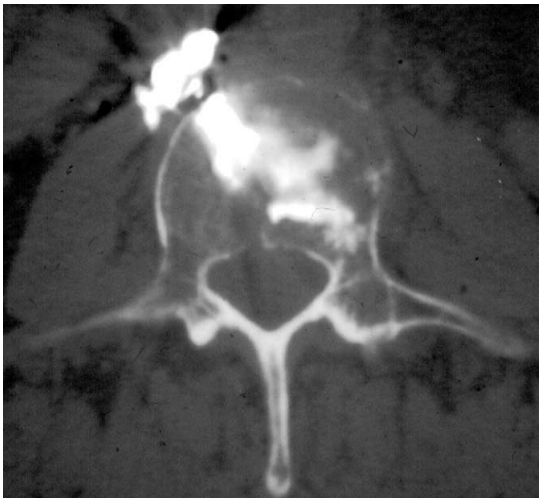

Figure-1. CT scan postvertebroplasty of a vertebral fracture of L3 due to metastatic disease: Cement extravasation in the prevertebral soft tissue.

Figure-2. A multiple myeloma vertebral fracture of T7. CT scan control after vertebroplasty showing cement leakage into the epidural space.

Cement leakage into the spinal canal in case of posterior cortical destruction is more frequent. In some cases with a mass (malignancy or aggressive hemangioma) in the posterior vertebral body or anterior spinal canal, cement may fill in the mass. Therefore a leakage into the spinal canal can be seen in postoperative CT images. Such extravasations are usually well tolerated unless significant compression on spinal cord have been occured (Figure-2).

Paraplegia is one of the most dreaded complications of PV. Fortunately it is uncommon. Chiras and Deramond reported only 1 case (0,4%) with paraplegia after PV in 274 patients[4]. This case occurred in metastatic disease and the neurologic deficit partially recovered after surgical decompression.

Since the transpedicular approach is preferred to the posterolateral approach, foraminal cement leakage is less frequent. However, an iatrogenic destruction in the medial or inferior margins of the pedicle during the PV process, foraminal and/or spinal canal cement leakage may occur (Figure-3). Nerve root compression occurs in 2% to 8% of the patients[7]. Cement leakage in the spinal canal is apparently well tolerated than in a narrow foramen. Cotten et al. reported 15 cases of spinal canal leakage and all without any clinical symptoms, whereas 2 of 8 cases of foraminal cement leakage presented radiculopathy[7]. Even if some cases of radiculopathy are managed by corticosteroids or nerve root block, surgical decompression is needed in other cases[7,26].

Intervertebral disc leakage is frequent especially in cases of severe compressions. Peh et al. reported 35% of intervertebral disc leakage in a series of severe osteoporotic fractures[18]. They also implied that the leakage was independent of the shape of the compression. Although this complication usually remains asymptomatic, long-term inconveniences may occur on adjacent vertebrae (Figure-4)[1,9].

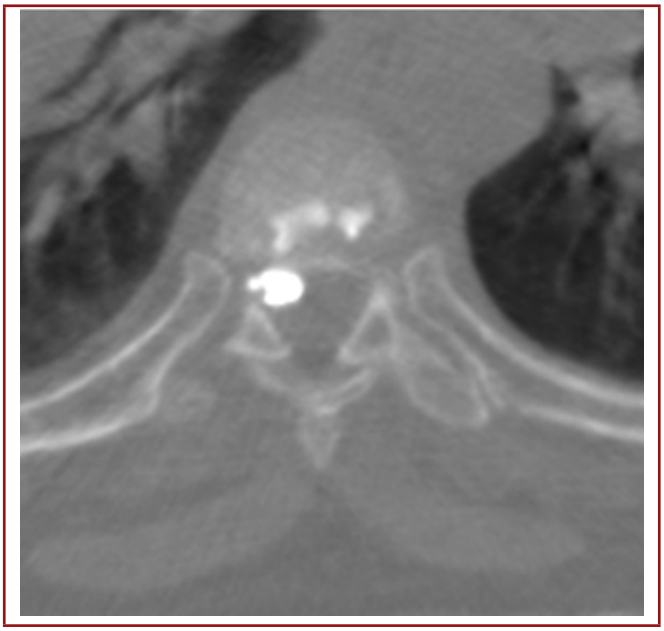

Figure-3. Axial CT scan passing through the T8-T9 disc space. The cement can be seen in the right side of the epidural space, in the right T7-T8 intervertebral foramen and in the T7-T8 disc space.

Intravenous cement leakage (Figure-5) can be seen up to 16,6% of the cases[23]. The majority of the cases with intravenous cement leakage show no clinical deterioration nevertheless catastrophic results as pulmonary embolism have been reported[24]. Cement may also leak into the inferior vena cava asymptomatically[23,26]. Wang et al. reported their large review of pulmonary cement embolism associated with percutaneous vertebroplasty or kyphoplasty in 2012[24]. They reviewed five observational studies consist of three retrospective studies and two prospective studies. Fifty-one cases in all with cement pulmonary embolism were noted in the observational studies. Among these 51 cases, 50 cases were secondary to PV and one case was following percutaneous kyphoplasty (PK). In the 32 case reports, 35 patients (34 following PV and 1 following PK) were diagnosed with pulmonary cement embolism, 30 were symptomatic and five were asymptomatic[21]. To date, 5 lethal cases of pulmonary embolism associated with PV have been reported. Scroop et al. reported a case of paradoxical cerebral arterial embolization of PMMA together with pulmonary embolism of PMMA in a 78-year-old woman after multilevel intraoperative vertebroplasty for spinal fixation surgery[20]. In that case, multiple pulmonary emboli of PMMA precipitated pulmonary hypertension and right-to-left shunting into the venous circulation through a patent foramen ovale. Intraarterial leakage is rare and may occur in highly vascularized lesions. Mozaffar et al. reported a lethal case of aorta and popliteal artery leakage following PV[16].

Pulmonary embolism rarely occurs and shows serious symptoms as already mentioned. It can be recognized if dyspnea, chest pain and tightness, respiratory distress and arrhythmia occurs. Many of the symptoms respond intensive care and medication. However, catastrophic complications as cardiac failure, multiple organ failure, severe cardiac tamponade and even death have been reported[24].

FACTORS INCREASING PMMA EXTRAVASATION RISK:

Cortical destruction, presence of an epidural soft tissue mass (Figure-6), highly vascularized lesions, and severe vertebral collapse are factors that are likely to increase the rate of complications[14]. Weill et al. found that the complications associated with cement leakage in PV is not more frequent when there is a destruction in the posterior cortex of the vertebral body or epidural tumor mass[4,26]. Still, the complication rate of PV for malignancies are much higher than osteoporotic fractures. Chiras et al. reported a complication rate of 10% in malignancies, 2,5% in hemangiomas and 1% in osteoporotic collapse[3]. Many authors have argued that severe collapse of the vertebral body (reduction of normal height more than 2/3) was a contraindication for PV[6,26]. However, Obrien et al. and Peh et al. reported in their series that the technique is not more difficult or complicated on severe collapsed vertebrae[17,18].

Needle approach and placement, cement viscosity, quality of fluoroscopy, and anatomical awareness and experience of physician as well as technician on PV are the other factors that influence the risk of PMMA extravasation.

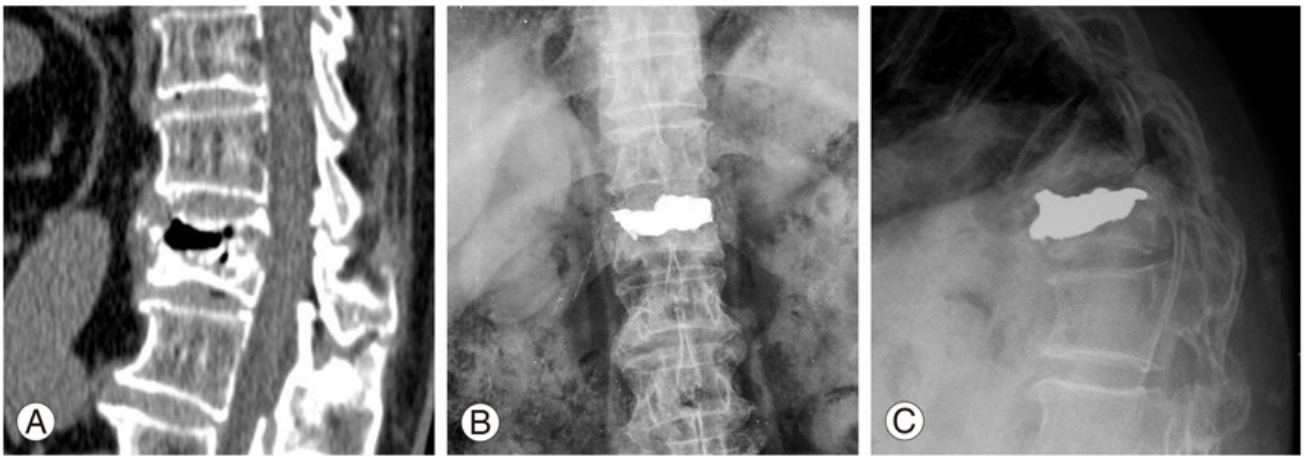

Figure-4. A patient with intravertebral vacuum cleft and upper end-plate disrupt **(A),** cement leak into intervertebral disk **(B)** and adjacent vertebral body fracture **(C)** at 3 months after the first surgery.

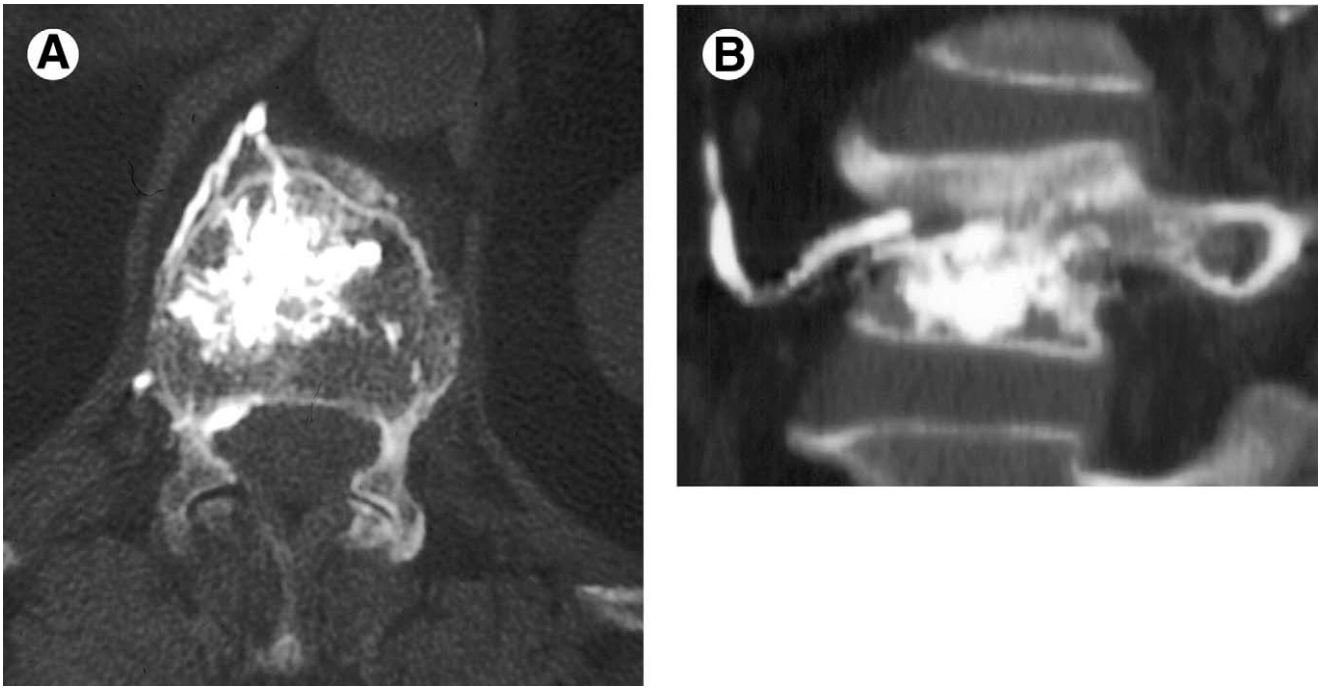

Figure-5. Postvertebroplasty CT scan with metastatic vertebral fracture. Axial scan showing prevertebral venous cement leakage **(A)**. Sagittal reformatted image showing prevertebral venous cement leakage **(B)**.

COMPLICATIONS NOT RELATED TO PMMA LEAKAGE:

Infection following PV is quite rare. Chiras et al. reported only one case (an immunocompromised patient) of secondary infection[3]. Local pain in PV area that usually lasts less than 72 hours may occur[4, 26].

It is controversial whether PV increases the risk of collapse of adjacent vertebrae. There is no prospective randomized study in the literature comparing the incidence of new vertebral fractures in patients with osteoporotic vertebral collapses either treated with PV or managed conservatively. Uppin et al. reviewed 177 osteoporotic patients treated with PV retrospectively after 2 years or more[22]. They reported a total of 36 new vertebral fractures in 22 (12,4%) patients. In another small series of 25 patients with osteoporosis, who had a total of 34 levels treated with PV, 13 (52%) developed at least one new vertebral fracture at an average follow-up of 48 months[12]. However, these results must be compared with the patients who managed conservatively. Lindsay et al. evaluated

the risk of new vertebral fractures within 1 year following a vertebral fracture in patients with osteoporosis[15]. They found an incidence of 19,2% of new fractures within the first year following the initial fracture. Grados et al. reported the relative risk of fracture adjacent to a vertebrae treated with PV as 2,27[12].

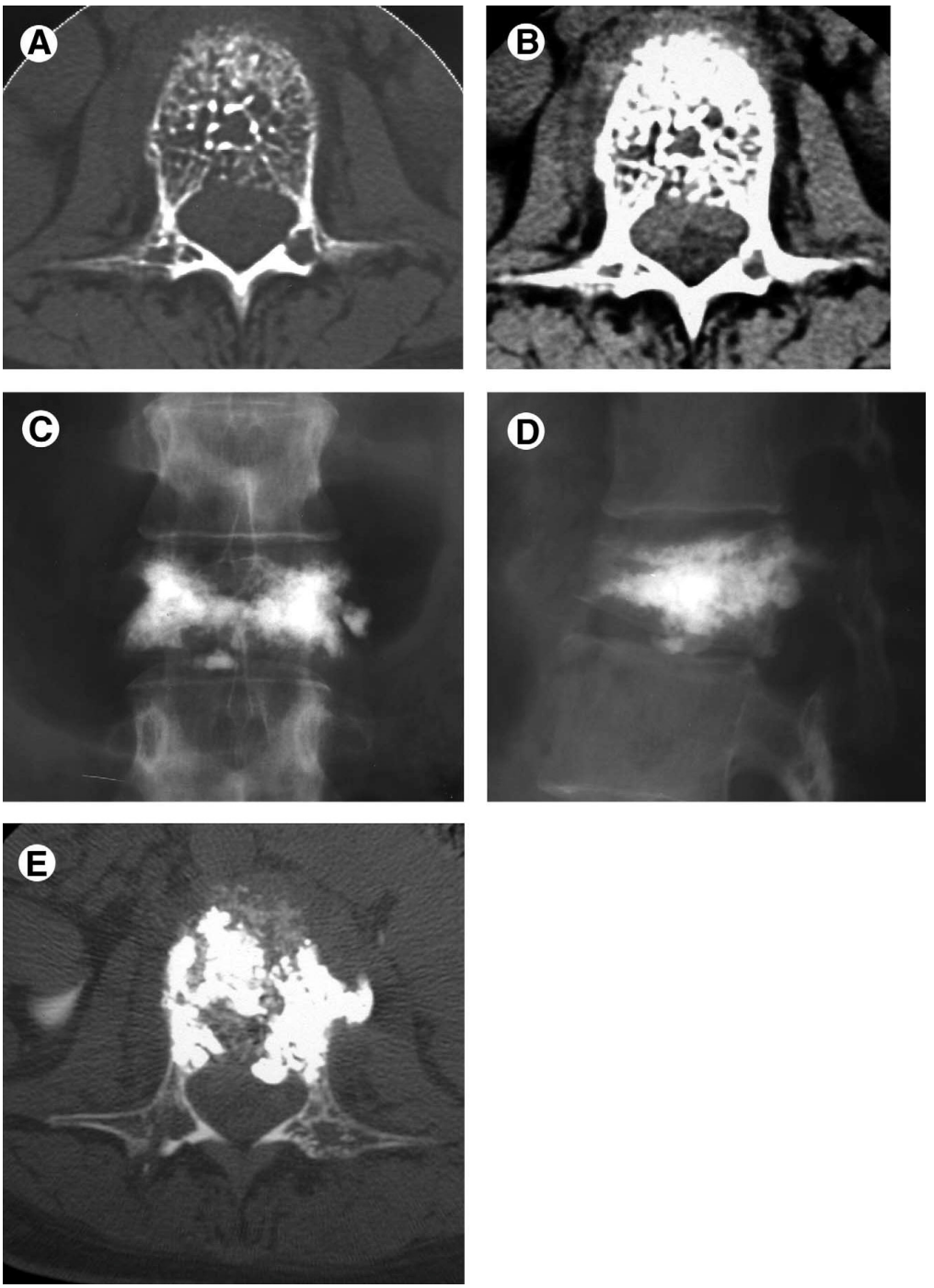

Figure-6. Aggressive hemangioma of L2, Preoperative CT scan appearance of L2 showing tumoral extension into the anterior epidural space (**A** and **B).** Anteroposterior and lateral radiographs after vertebroplasty (**C** and **D**). Postvertebroplasty CT scan **(E)**.

Uppin et al. reported a 67% incidence of new fractures adjacent to a vertebrae treated with PV, and 67% of them occurred within 30 days after treatment of the initial fracture[22]. However, these studies are not enough to conclude the effect of PV in new fractures, since bone loss may occur in vertebral bodies adjacent to a fracture[25]. Prospective randomized studies

are needed for a better conclusion about the effect of PV on new fractures in the adjacent vertebrae.

Systemic reactions during VP are quite rare, but may progress mortal. Vasconcelos et al. reported one case of sudden decrease in blood pressure after PMMA injection[23]. Weill et al. reported a case died through pulmonary embolism without an evidence of cement on the chest radiograph[26]. Although some authors have mentioned fat embolism as a potential complication of PV, there is no report of a complication that can be shown to be related to fat embolism[2,11].

There are no certain evidences to support the responsibility of PMMA injections in reported general reactions.

PV is not a procedure free of severe complications. PMMA extravasation is a frequent and usually well tolerated complication of PV. There are many factors influencing the complication rate such as needle approach and placement, cause of vertebral collapse, presence of cortical destruction, cement viscosity, quality of fluoroscopy and anatomical awareness and experience of physician as well as technician on PV. Physician must be aware of possible complications and signs of them, otherwise it may be very difficult or impossible to treat the complications.

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