Acta Neurochir (Wien) (2008) 150: 811–815
DOI 10.1007/s00701-008-1503-3
Printed in The Netherlands

Acta Neurochirurgica

Short Illustrated Review

Intradural cement leakage: a rare complication of percutaneous vertebroplasty

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Received 25 October 2007; Accepted 20 December 2007; Published online 29 May 2008

Summary

Percutaneous vertebroplasty (PV) is one of the alternative treatments for vertebral fractures. Reported significant complications include pain, radiculopathy, spinal cord compression, pulmonary embolism, infection and rib fractures. In this report, we highlight intradural cement leakage which is a rare complication of the procedure.

A 49 year old man with a T12 compression fracture due to multiple myeloma was referred to the neurosurgery department from the orthopaedics and traumatology clinic after developing a right lower limb weakness following percutaneous vertebroplasty with polymethylmethacrylate. An urgent thoraco-lumbar magnetic resonance imaging was performed. The T1 and T2-weighted images demonstrated intradural extramedullary and epidural cement leakages which were hypointense on both sequences. Total laminectomy was performed at T12 and L1 and two epidural cement collections were excised on the right. Then, a dural incision from T12 to the body of L1 was done and cement material seen in front of the rootlets excised without any nerve injury. The patient was discharged after a week and referred to the haematology clinic for additional therapy of multiple myeloma. Although the cement leakage was extensive, the right leg weakness improved significantly and he began to walk with assistance 3 months later.

Good quality image monitoring and clear visualisation of cement are essential requirements for PV using polymethylmethacrylate to prevent this complication from the treatment.

Keywords: Percutaneous vertebroplasty; intradural; cement leakage; complication.

Introduction

Vertebral fractures are a common cause of morbidity. They are often caused by osteoporosis, trauma or metastases. Metastatic tumour is the most frequent type of neoplasm of the spinal column, regardless of the primary origin [8]. Approximately 85% of metastases causing spinal instability and neurological compromise arise anteriorly from the vertebral body [4, 7, 9]. Percutaneous vertebroplasty (PV) is a relatively safe technique but should still be performed with great care to prevent disabling complications.

The initial success of PV with polymethylmethacrylate used to treat aggressive vertebral haemangiomas and painful osteolytic vertebral tumours led to an extension of the indications to compression fractures secondary to osteoporosis [14]. The first PV was performed in 1984 by French radiologists for the treatment of a pain-

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ful haemangioma in the cervical spine of a young female patient. Radiologists have been successfully treating pathological vertebral fractures secondary to osteoporosis, painful vertebral metastases and multiple myeloma since the mid-1980s in France and the mid-1990s in the United States [17]. The procedure using polymethylmethacrylate reportedly showed a pain relief rate of 80–100% for the treatment of vertebral tumours and osteoporotic vertebral fractures [14]. PV is indicated for any pathology that weakens the vertebral body [1]. A pathologic fracture may cause acute severe local or radicular pain. The two main objectives of PV are analgesia and stabilisation. The method is minimally invasive and also relieves pain. With this type of treatment, it is possible to prevent further vertebral collapse, increase the patient's functional ability, and help achieve the previous level of activity [11].

Fig. 1. Sagittal T2-weighted image demonstrates the intradural extramedullary (*long arrow*) and epidural (*short arrow*) components of cement leakage. There is minimal cord oedema (*arrowhead*). Note the acute compression fracture of T12 vertebrate at the superior end plate level

Illustrative clinical example

A 49 year old man with a T12 compression fracture due to multiple myeloma was referred to the neurosurgery department from the orthopaedics and traumatology clinic after developing a right lower limb weakness (Grade 1/5) while undergoing percutaneous vertebroplasty with polymethylmethacrylate. The neurosurgery team examined the patient in the operating room and realised that the right leg pain and weakness occurred only after the PV. The plain radiograph with the C-arm, showed that there was cement material in the spinal canal. He was immediately transferred to the MRI center. Thoraco-lumbar MRI was performed and in the T1 and T2-weighted images, a hypointense intradural extramedullary and three epidural cement collections were revealed. There was displacement of the spinal cord to the left side with minimal oedema secondary to the mass effect (Figs. 1 and 2). The patient and his family were advised about decompressive surgery. A T12 and L1 total laminectomy was performed. During the operation, a needle hole was discovered on the right T12 hemi-lamina and another needle hole injury was seen on the posterior dural area with cerebrospinal fluid leakage. Two ($0.5 \times 0.5 \times 0.5$ cm size) epidural cement collections were excised from right side and one was left in its place on the left. After dural incision intradural cement material was seen on the right in front of the rootlets. Irregularly shaped, 0.7 cm long epidural and 6.5 cm long intradural cement material were excised without any rootlet injury (Fig. 3). After watertight closure of the dura, fibrin glue was placed over it. The patient was discharged after a week and referred to the haematology clinic for additional therapy of multiple myeloma. Although the cement leakage was extensive and preop-

Fig. 2. Axial T1–T2-weighted images show the intradural extramedullary component (*long arrow*) with displacement of the spinal cord to the left and epidural components (*short arrows*) of cement leakage

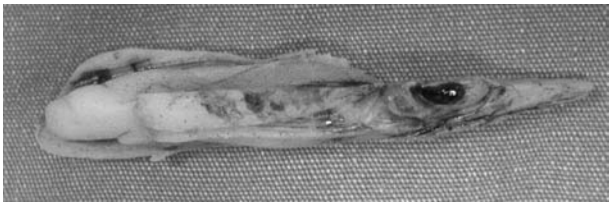

Fig. 3. The excised 6.5 cm long and irregular shaped intradural polymethyl methacrylate (PMMA) cement material

erative muscle power on the right leg was Grade 1/5, the healing continued and 3 months later, the right leg weakness was improved to Grade 4/5 power, there was no urinary and stool incontinence and he began to walk with assistance.

Discussion

Malignant lesions with metastases usually cause systemic and local symptoms. Spinal metastases are expected to develop in 27% of cancer patients [12]. Treatment of metastases to the spine is complex and requires systemic and local therapy. The latter includes radiation therapy, surgical stabilisation or vertebrectomy, and palliative therapy. Since its introduction, the last 20 years has seen PV progressively developing and being used to treat spinal metastases. In fact, PV has grown in acceptance and is becoming the standard care for pain associated with compression fractures of the spine [15]. This is because it has been proven effective for this purpose and is generally safe when used by well-trained and prudent physicians.

The patient who may benefit most from PV has severe, localised mechanical back pain related to vertebral collapse without epidural compression [6]. Percutaneous vertebroplasty is also useful in patients with limited anticipated survival, in poor surgical candidates, in those who have received maximum radiation doses and those with significant asymptomatic vertebral body collapse secondary to lytic lesions [2, 6]. Although it may be used in the cervical region when surgery is contraindicated, the success of PV in metastatic disease has best been examined in the thoraco-lumbar region. It should be noted that PV should not be performed in patients with spinal instability or in those with spinal cord compression or epidural tumour extension [16].

As with any invasive procedure, PV can be associated with complications. Reported significant complications include pain, radiculopathy, spinal cord compression, pulmonary embolism, infection and rib fractures [3, 10]. Some papers have reported that leakages are relatively common and generally of no clinical significance, but these complications can occur with variable frequency, which depends on the causation and the surgeons' experience [4]. Epidural, foraminal, intradiscal, paravertebral and venous areas are the most affected regions [16]. Polymethylmethacrylate leakage is the main source of clinical complications after PV and frequently occurs during this particular procedure. Leakage has been reported to occur in 30–65% of patients with osteoporosis and in 38–72.5% of patients with malignant vertebral collapse [5, 20].

Based on the Workers' Compensation Board of British Columbia Evidence Based Group's review manuscript, many cement leakage cases were reported near to the spinal cord, in locations such as epidural and foraminal spaces, paradiscal, paravertebral tissues and the perivertebral veins. However, no intradural cement leakage was reported during percutaneous vertebroplasty in osteoporosis or cancer related compression fractures until May 2003. The number and ratios of cement leakages in the treatment of osteoporotic and metastatic vertebral fractures in recent reports are summarised in Tables 1, 2 and 3. They searched the Pubmed database by employing the keywords ‘‘vertebroplasty’’ or ‘‘percutaneous vertebroplasty’’. Aside from limiting the search to human subjects and English only, there was no specific inclusion or exclusion criteria employed in the search. Only the latest up-date of repeated published

Table 1. *Complication rates for cement leakage in percutaneous vertebroplasty performed on osteoporotic patients*

Osteoporosis patients	First author												
	Jensen	Wenger	Cyteval	Cortet	Grados	Barr	Lee	Kallines	Yeom	Peters	Maynar	Lin	Ryu
No. of patients	29	13	20	16	25	47	8	41	118	42	27	75	159
No. of procedures	47	21	23	20	34	84	24	63	118	56	35	112	347
Cement leakage *n* (%) (epidural, foraminal, intradiscal, paravertebral tissues, perivertebral vein)	10 (21)	10 (48)	8 (35)	13 (65)	7 (21)	0 (0)	10 (42)	0 (0)	49 (42)	11 (20)	0 (0)	0 (0)	92 (27)

Table 2. *Complication rates for cement leakage in percutaneous vertebroplasty performed on cancer related patients*

Cancer related patients	First author				
	Jang	Cotton	Weill	Kaemmerlen	Fourney
No. of patients	27	37	37	20	34
No. of procedures	72	40	40	27	65
Cement leakage *n* (%) (epidural, foraminal, intradiscal, paravertebral tissues, perivertebral vein)	0 (0)	25 (63)	5 (13)	0 (0)	6 (9)

Table 3. *Complication rates for cement leakage in percutaneous vertebroplasty performed mixed cancer and osteoporosis patients*

Mixed cancer and osteoporosis patients	First author									
	McGraw	Evans	Vasconselos	Cotton	Munk	Gangi	Martin	Zoarski	Amar	Heini
No. of patients	100	245	137	258	11	570	40	30	97	17
No. of procedures	156	937	205	258	11	868	67	54	258	45
Cement leakage *n* (%) (epidural, foraminal, intradiscal, paravertebral tissues, perivertebral vein)	0 (0)	0 (0)	53 (26)	0 (0)	0 (0)	15 (6)	4 (6)	1 (2)	7 (3)	8 (18)

Table 4. *Intradural cement leakage with percutaneous vertebroplasty reported in the literature*

	First author			
	Shapiro	Teng*	Chen	Sabuncuoğlu
Compression fracture level	L2	L2	T12, L1	T12
Type of disease	osteoporosis	osteoporosis	osteoporosis	multiple myeloma

* Teng *et al*. reported 3 intraspinal examples but only one was intradural.

studies by the same authors/group was included in this review. In a pooled series of 4087 procedures (among 2280 patients), the overall complication rate was about 10%. In general, complications occur in 23.9% among osteoporotic patients, 18% among cancer patients and about 4.6% among the others [21]. The search on the Pubmed database done by ourselves using the keywords ''vertebroplasty'', ''intradural'', ''cement'', ''leakage'' between 2003 up till the present time, revealed that only three incidents of intradural leakage were reported in the literature by Chen, Shapiro and Theng *et al*. and our example is the fourth [3, 18, 19] (Table 4). Although Teng *et al*. reported 3 intraspinal events, only one was intradural [3].

Immediate neuroradiological evaluation of the spine with CT or MRI is essential when cement leakage is suspected outside of the treated vertebral body. Spinal canal and neural foramina involvement should be ruled out before decompressive surgery. Direct mass effect and thermal injury to the spinal cord or nerve root may cause neurological deficit. In our patient, for a detailed evaluation of neurological tissues, a non-enhanced MRI of the thoraco-lumbar spine was favoured because serious cement leakage was suspected during percutaneous vertebroplasty.

The two possible ways to explain this rare complication are posterior wall perforation and dural penetration during needle insertion through the pedicle. Cement leaks into the intradural space via this defect can continue to run inferiorly during cement injection. Intradural cement leakage is an important complication of PV with polymethylmethacrylate and therefore should be performed with caution and safeguards. Needle position should be carefully monitored during insertion. The needle tip should not cross the medial border of the pedicle in the antero-posterior view before it has reached the posterior cortex of the vertebral body in the lateral view [3, 13]. A screw type cement injection syringe is a useful device to control the volume to avoid forceful injection of cement. Since there is no way to eliminate the thermal effect of cement on the spinal cord or rootlets, urgent decompressive surgery should be performed for prevention of neurological deficits.

In summary, although percutaneous vertebroplasty has grown in acceptance and is becoming the standard care for pain associated with compression fractures of the spine, complications may still occur, especially with neural structures. However, morbidity and patient satisfaction are affected adversely. The purpose of this case report is not to criticise the technique but to warn the surgeons of such major neurological complications. If PV is not performed with good quality image monitoring and clear visualisation of cement during injection.

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