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Vertebroplasty with Decompression for Epidural Extending Vertebral Hemangiomas: An Alternative Technique

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ABSTRACT

AIM: To document the effectiveness of an alternative surgical technique with concurrent vertebroplasty and decompression without instrumentation for patients with vertebral hemangioma presenting with neural compression symptoms.

MATERIAL and METHODS: This study is a technical note and a retrospective clinical evaluation. We analyzed the data of 8 patients operated with our alternative surgical technique for vertebral hemangiomas with epidural extension and neural compression, between 2013 and 2018. The preoperative, postoperative 1st month and postoperative 12th-month Visual Analogue Scale (VAS) scores were assessed and compared.

RESULTS: Five of the patients had lumbar and 3 had thoracic hemangiomas. The difference between preoperative and 1st and 12th-month Visual Analogue Scale scores were statistically significant. None of the patients received additional intervention, stabilization, or needed a blood transfusion.

CONCLUSION: This technique is a safe and minimally invasive approach for vertebral hemangiomas with epidural extension allowing decompression of the spinal cord without massive hemorrhage.

KEYWORDS: Decompression, Epidural extension, Vertebroplasty, Vertebral hemangioma

ABBREVIATIONS: CT: Computed tomography, **MRI:** Magnetic resonance images, **MMA:** Methyl methacrylate, **VAS:** Visual analog scale, **VH:** Vertebral hemangiomas

INTRODUCTION

Vertebral hemangiomas (VH) are common primary spinal lesions with an estimated incidence of 10-12% (2,12,16,21). The most common spinal location is in the thoracic vertebrae. Usually, only a single vertebral segment is involved and multiple vertebral involvement is rare (14,21). VHs are usually asymptomatic and only 1% present with symptoms (2,16,18). If there are symptoms, they could be due to neural compression secondary to enlargement of the lesion or pathological fractures (15,16,19,34). There are very rare reports of spontaneous epidural hematoma formation causing neural compression (8,34).

Treatment options for VH are surgical or non-surgical. Radiotherapy (7,22), percutaneous vertebroplasty (5,20,29), transarterial embolization and percutaneous ethanol injection (1,6,19,23,33) are non-surgical minimally invasive alternatives when compared to surgical excision (16,34). There are some reports in the literature suggesting that these methods can be used in cases with neural compression, however, it is widely accepted that they fail for adequate spinal canal decompression. Surgical decompression is inevitable and is the primary treatment option if the lesion adjacent to neural tissue (9,32-34).

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Although VHs are benign lesions, their extreme vascular structure increases the risk of massive hemorrhage during surgery (15-17,19,28). VH also reduces the load-carrying capacity of the vertebrae because of a lytic effect on the vertebral corpus, which may result in instability. Additionally, surgical decompression of the lesion may cause iatrogenic instability which may then require stabilization with spinal instrumentation (4,10,17).

In this report, we describe a surgical method for the treatment of VH with epidural extension and neural compression, by hemilaminectomy with a median approach for excision of the lesion occupying the epidural space, followed by vertebroplasty that also controls hemorrhage, in the same session, without stabilization.

MATERIAL and METHODS

Eight patients (5 males, 3 females) who underwent surgery with our technique between 2013 and 2018 were included in this study. The mean age at the time of surgery was 32.6 years (range, 13 to 44 years). Preoperative X-rays, spinal computed tomography (CT) scans and magnetic resonance images (MRI) were obtained for each patient. The VH diagnosis was supported radiologically. The polka-dot sign was observed in CT sections in all patients. Hypointensity on T1-weighted images and hyperintensity on T2-weighted images were seen on MRI.

A retrospective assessment of the cases with single level VH was performed. The inclusion criteria were; the expansion of the mass to the epidural space and failure to control pain with conservative treatment. Patients were initially treated with nonsteroidal anti-inflammatory drugs, bed rest and a corset for about 3 weeks. Patients without neural compression, with accompanying deformities, pathological fractures, multilevel involvement, and patients that needed stabilization for the kyphotic angulation due to depression fracture at the level of the lesion, were excluded from the study.

The preoperative, postoperative 1st and 12th-month Visual Analogue Scale (VAS) scores of all patients who underwent surgery with the described technique were evaluated and statistically compared (Table I).

Radiological (CT and MRI) examinations were also performed at the follow-up visits.

Surgical Technique

The surgery was performed in the prone position under general anesthesia. A longitudinal skin incision of 2 cm length was made at the level of the vertebra with the VH. The paravertebral muscles were then stripped laterally to reveal only the lamina of the affected vertebra. Bilateral hemilaminectomy was performed for direct visualization of the adjacent dural sac, nerve roots and epidural space for safe application of the vertebroplasty through the affected vertebra. There was no uncontrollable bleeding at this point.

Following hemostasis, one T-handle Jamshidi needle™ (14 or 16 gauge) was inserted bilaterally via percutaneous transpedicular route under fluoroscopic guidance. After removing the inner piece of the needle, significant bleeding would indicate that the needle was inside the lesion. Under fluoroscopic guidance, the guidewire was inserted into the vertebral body through the T handle Jamshidi needle™. The T handle Jamshidi needle™ was then removed and an application cannula was inserted along the guidewire (Figure 1A, B).

Methyl methacrylate (MMA) bone cement material injections were performed under fluoroscopic guidance to fill the affected vertebral body (Figure 1A, B). To maintain a homogeneous filling of the lesion, each time, the application cannula was pulled a little further towards the posterior edge of the vertebral body.

The amount of retrograde bleeding decreased after the first MMA cement filling because of the decreased blood supply. However, since the vertebroplasty was also aimed at strengthening the vertebral corpus, MMA cement injection was repeated several times to fill the vertebral body. A mean of 9.25 mL MMA cement was injected. To avoid unnecessary bleeding and prevent retrograde MMA cement leakage, we waited for MMA to solidify before pulling out the cannulae. No MMA cement leakage into the epidural space was observed in any patient.

After the vertebroplasty procedure, the dural sac and nerve root were ruled out, the epidural region was inspected via microscope. The posterior longitudinal ligament was cut and bone occupation in the epidural space was identified. Microsurgical removal of affected region of the vertebral corpus that was causing neural compression was performed through a midline incision. The fragments were excised bilaterally with disc punches and Kerrison rongeurs. Only the parts of the affected corpus intruding into the spinal canal causing neural compression were excised and sent for pathological assessment. The excision was continued until

Table I: The Evaluation of Preoperative and Postoperative VAS Scores

	Back Pain (VAS)		
Patient No.	**Preop**	**Postoperative 1st month**	**Postoperative 12th month**
1	8	2	1
2	9	3	2
3	7	2	1
4	8	1	1
5	7	1	1
6	7	2	1
7	8	3	1
8	9	3	2

Preop: *preoperative,* ***postop:*** *postoperative,* ***VAS:*** *Visual Analogue Scale.*

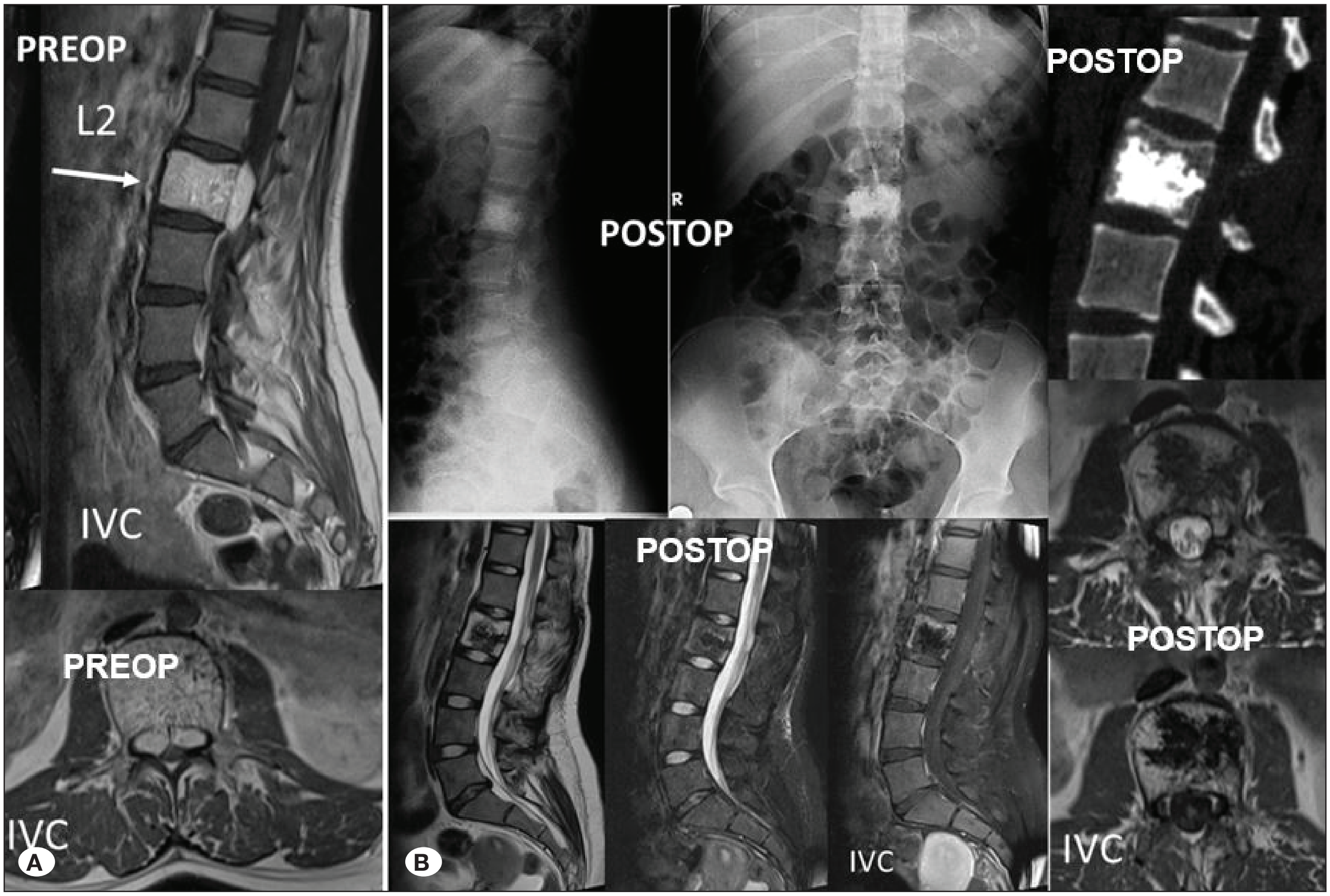


Figure 1: (Case 5) Preoperative and postoperative images of a patient whom was operated with the described technique.

normal epidural level, adjacent structures at below and above was observed and satisfactory decompression of the neural tissues was achieved. Bleeding during this procedure was usually minimal and no massive hemorrhage was seen in any patient. No iatrogenic instability was observed and there was no need for instrumentation in any patient.

This technique provides observation for cement leakage after hemilaminectomy and spinal canal decompression by excision epidural fragments of vertebral hemangioma after vertebroplasty without massive hemorrhage. For aggressive VHs, the technique is minimally invasive method that allows minimal bleeding, a shorter operation time, and smaller skin incisions.

RESULTS

There were 5 males and 3 females in this study. The average age was 32.6 years (range, 13-44 years) at the time of diagnosis. The mean follow-up time was 41 months.

The main complaint of all patients (100%) was worsening severe back pain at the level of the affected vertebra (Table I). Motor weakness was a presenting complaint in 87.5% of the patients and sensory deficits were present in 62.5%.

The average surgical duration was 172.0 minutes (range, 125-210 min) and the average blood loss was 318 mL (range 200-600 mL) (Table II). The average injected MMA cement was 9.25 mL (range 7.5 -15 mL).

Table II: Detailed Information of Patient Demographic and Clinical Characteristics

Patient	Age (y)/ Sex	Location	Surgery Time (min)	Blood loss (mL)	Follow-up (months)
1	44/M	T8	185	400	38
2	39/F	T10	210	600	36
3	40/F	T11	145	250	16
4	32/M	L2	165	200	50
5	13/F	L2	180	300	60
6	44/M	L3	125	220	48
7	40/M	L3	200	350	28
8	38/M	L3	170	220	52

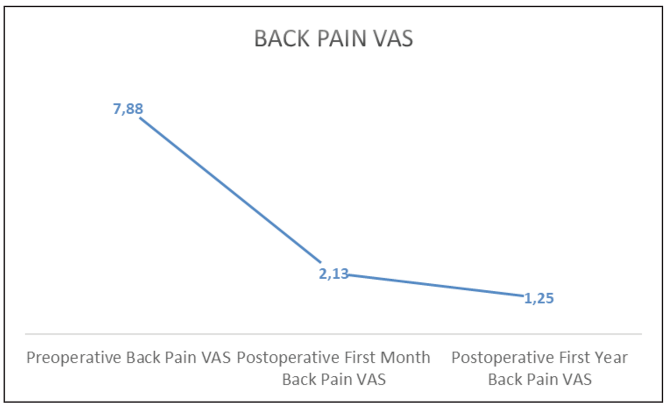
***F:** female, **M:** male, **L:** lumbar, **T:** thoracic, **y:** years, **min:** minutes.*

Table III: Preoperative and Postoperative Changes in Pain Scores

	Mean	Standard Deviation	p
Preoperative back pain VAS	7.88	0.83	
Postoperative 1^{st} month back pain VAS	2.13	0.83	**<0.0001**
Postoperative 12^{th} month back pain VAS	1.25	0.46	

**Repeated Measures ANOVA.*

Preoperative VAS values between 1^{st} and 12^{th} month repeat measurements were compared. The mean of preoperative back pain VAS was 7.88 and postoperative 1^{st} back pain VAS was 2.13 and postoperative 12^{th} month pain VAS was observed 1.25 The decrease in the trend of back pain VAS were statistically significant.



All patients were mobilized in the same day of the procedure. Overall, all patients improved significantly in terms of motor strength, sensory symptoms and pain.

There was a statistically significant improvement observed between preoperative and postoperative 1^{st} and 12^{th}-month VAS scores (Table III).

No vertebral depression or height loss with clinical or radiographic signs of recurrence of the lesion was observed during the follow-up period. No additional intervention was required.

DISCUSSION

On CT scans the typical VH appears as a lesion with small punctate areas, representing sparse thickened hyperdense vertical trabeculae surrounded by hypodense stroma that create the pathognomonic ‘polka-dot sign’ (13,31). The presence of soft tissue stroma between the osseous trabeculae on a CT scan is considered as a sign of a hypervascular and therefore aggressive lesion (11,13,24). VH appear as hyperintense lesions on T1- and T2 weighted images on MRI, due to their fat content (11,13,34). However, aggressive VH is usually formed of less fat with more hypervascular stroma and therefore may show hypointensity on T1-weighted images and hyperintensity on T2-weighted images (11,24,31). But they appear hyperintensity both in T2 and T1-weighted images with contrast enhancement. Hyperintensity in T1-weighted images with contrast enhancement and ’polka-dot sign‘ in CT and MRI can help the diagnosis for aggressive VH. All the cases in our series showed the characteristic features of aggressive VH on CT scans and MRI.

The treatment goals of VH may be summarized as local pain control, disruption of the hypervascularity of the lesion, decompression of neuronal structures, strengthening the weakened and affected vertebrae and prevention of local recurrence (2,16,17,28). The treatment options for symptomatic VH are; conservative medical therapy, vertebroplasty (5,10,29), transarterial embolization (1,19,23), direct intralesional ethanol injection (6,18,27,33), radiotherapy (7,22) and surgery (1,4,17,32).

The most important determinants of the treatment option are the existence of neural compression and spinal instability. If either is present, surgery should be considered (4,10,17,32,33). Neural compression was the priority for our patients. Patients with evident instability at lesion level were excluded from this study. For this reason and based on the literature, only surgical decompression was indicated for our patients (4,16,17,28,32). However, an additional procedure that could prevent bleeding during surgical decompression was performed. It is well-known that the challenging problem in surgical planning for VH are perioperative and postoperative hemorrhagic complications (15,17,28,33).

Despite advances in technology and surgical techniques, the morbidity and mortality rates associated with surgical management alone are still high (2,17,26,33). Therefore, to reduce these, preoperative transarterial embolization (1,16,23), direct intralesional ethanol injection (6,33), and percutaneous vertebroplasty (10,20,26) are procedures that are reported to be effective. Among these methods percutaneous vertebroplasty, apart from disruption of the highly dynamic vascular structure of VHs, unlike other non-surgical techniques, has the advantage of preventing possible pathological fractures by strengthening the spine. Percutaneous vertebroplasty is a common treatment for VH patients without neural compression (1,3,20,25). However other percutaneous treatments, such as transarterial embolization and direct intralesional ethanol injection, are not sufficient to support the vertebral column, allow spinal canal control, and eliminate the need for decompression.

Due to the discussed advantages, we preferred to perform percutaneous vertebroplasty in the same session as decompression. The criteria that informed our preference were;

1. The ability to perform vertebroplasty and surgical decompression in the same session,
2. To enable early intervention in case of MMA leakage into the epidural area, by performing hemilaminectomy prior to vertebroplasty,
3. To enable rapid decompression in one session, without having to wait for additional treatment protocols for urgent cases experiencing rapid neurological deterioration.

4. To benefit from the advantages of vertebroplasty such as;
   a. Decreasing the amount of surgical bleeding by disruption of VH hypervascularity.
   b. Eliminating the need for additional spinal stabilization by strengthening the weakened vertebrae and preventing possible pathological fractures
   c. Providing pain control by creating thermal damage
   d. Eliminating the need for radical surgery by excising the affected corpus fragments that intrude into the epidural space
5. To perform all these procedures in a minimally invasive fashion resulting in minimal bleeding, a shorter operation time, and smaller skin incisions.

One of the most common complications of percutaneous vertebroplasty is leakage of MMA material into the spinal canal and neural foramen. This can cause thermal damage or direct neural tissue compression (3,5,20,25). One of the advantages of our technique is, with bilateral hemilaminectomy at the lesion level, the ability to remove immediately if any MMA leaks into the epidural space. During hemilaminectomy, no uncontrollable hemorrhage was observed and control of the epidural space was achieved. Peroperatively, possible MMA leakage into the spinal canal was monitored with the surgical microscope at the hemilaminectomy site. No MMA leakage was experienced in any patient. It can also be concluded that performing hemilaminectomy instead of total laminectomy contributed to reducing perioperative epidural bleeding in addition to its contribution to spinal stability. Another important benefit of starting the operation with a hemilaminectomy is its advantage in cases requiring urgent decompression, such as for patients with rapid neurological deterioration that do not have adequate time for detailed preoperative preparation like embolization (1,8,9,32). Therefore we can conclude that our surgical procedure may be preferable in cases requiring urgent decompression since it does not need any preparation. However, there was no case of rapid neurological progression in our current study.

Another problem in the surgical treatment of diffuse VH is the presence of preoperative or postoperative (iatrogenic, due to extensive decompression) instability (1,17,32,34). In our series the patients with known obvious instability were excluded from the study. To prevent iatrogenic instability we performed bilateral hemilaminectomy for decompression to preserve axial load-bearing on the posterior vertebral elements (pars, facet joint, lamina). In addition, strengthening the affected vertebral corpus with MMA material not only increased the spinal load-bearing capacity, but it also allowed us to limit our excision to only the affected corpus fragments causing neural compression in the epidural space (3,5,20,30). None of the patients received additional stabilization during surgery or at follow-up.

One of the disadvantages of our technique is that vertebroplasty does not destroy the tumor, and there is a chance of tumor re-growth that may cause spinal cord re-compression (10,17,20). However, there are publications advocating that total removal is not necessary since VHs are benign lesions, and there is an increased chance of complications during total removal surgery (17,22,32). Recurrent cord compression was not detected in any of the patients during follow-up, and all patients remained asymptomatic with no recurrence, pain, instability or pathological fracture that required additional treatment. Statistically significant pain relief was observed in all patients (Table I).

Performing surgical decompression and vertebroplasty in VH cases without any additional stabilization is not new. Cotten et al. described a combined technique where each approach was performed in different sessions on consecutive days (10). They first applied transarterial embolization to the affected vertebra followed by percutaneous vertebroplasty the next day. About 3 days following vertebroplasty, laminectomy and excision of the epidural extending fragments of VH were performed. They did not use any instrumentation during or after these procedures. However, this technique lacks the advantage of simultaneous control of the spinal canal for MMA leakage during vertebroplasty as our technique does (10).

The differences and advantages of our technique can be listed as follows; the ability to perform decompression and vertebroplasty in the same session while taking precautions against MMA leakage by starting with hemilaminectomy. It does not need for additional procedures before the operation also for massive bleeding.

CONCLUSION

Our surgical technique for VHs with epidural extension provides a safe and minimally invasive method that allows spinal canal decompression and hemorrhage control by performing vertebroplasty in the same session.

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