Balloon kyphoplasty as a single or as an adjunct procedure for the management of symptomatic vertebral haemangiomas

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Vertebral haemangiomas are usually asymptomatic and discovered fortuitously during imaging. A small proportion may develop variable degrees of pain and neurological deficit. We prospectively studied six patients who underwent eight surgical procedures on 11 vertebral bodies. There were 11 balloon kyphoplasties, six lumbar and five thoracic. The mean follow-up was 22.3 months (12 to 36). The indications for operation were pain in four patients, severe back pain with Frankel grade C paraplegia from cord compression caused by soft-tissue extension from a thoracic vertebral haemangioma in one patient, and acute bleeding causing Frankel grade B paraplegia from an asymptomatic vascular haemangioma in one patient. In four patients the exhibited aggressive vascular features, and two showed lipomatous, non-aggressive, characteristics. One patient who underwent a unilateral balloon kyphoplasty developed a recurrence of symptoms from the non-treated side of the vertebral body which was managed by a further similar procedure.

Balloon kyphoplasty was carried out successfully and safely in all patients; four became asymptomatic and two showed considerable improvement. Neurological recovery occurred in all cases but bleeding was greater than normal. To avoid recurrence, complete obliteration of the lesion with bone cement is indicated. For acute bleeding balloon kyphoplasty should be combined with emergency decompressive laminectomy. For intraspinal extension with serious neurological deficit, a combination of balloon kyphoplasty with intraslesional alcohol injection is effective.

Haemangiomas constitute 7% of all benign soft-tissue tumours and may also involve bone, in particular, the spine and calvaria. The long bones are less frequently involved. Vertebral haemangiomas are usually asymptomatic and are discovered fortuitously during imaging. They are discovered in the spine in between 10% and 12% of cadavers, whereas spinal imaging demonstrates their presence in up to 27% of cases. About 1% may develop symptoms, with variable degrees of pain, a neurological deficit or a combination of both. In one study, symptomatic vertebral haemangiomas were associated with pain in 54% of cases and there was variable neurological involvement in 45%. In another series acute pain from a pathological compression fracture occurred in 19%, disabling chronic pain in 61.9%, epidural extension and cord compression in 4.7%, and 14.2% were asymptomatic.

Several options are available for the management of symptomatic lesions, including resection and spinal stabilisation, transarterial embolisation, intraslesional alcohol injection, radiotherapy, vertebroplasty, and kyphoplasty. Each has its advantages and disadvantages. An open surgical approach is a major procedure. The hypervascularity of the lesions may provoke serious complications, with profuse bleeding or a consumptive coagulopathy (Kasabach-Merritt syndrome). Embolisation of the feeding artery is not always useful, as it may not reduce intraoperative bleeding. In the mid-thoracic spine such a procedure may well be dangerous and angiography may fail to demonstrate feeding vessels that could be embolised.

Radiation therapy has been advocated as the treatment of choice, particularly for multiple spinal lesions. However, the recommended dose of 2 Gy per day for several weeks, with a total of 30 Gy to 40 Gy, precludes the immediate effectiveness of radiation therapy and such management is not recommended in acute situations. Radiation has also the potential risk of radionecrosis and may also induce sarcomatous change.

Translesional embolisation, although beneficial in the presence of a neurological deficit,
Table I. Summary of the pathology, management and outcomes in the six patients with symptomatic vertebral haemangiomas

<table>
<thead>
<tr>
<th>Case</th>
<th>Gender</th>
<th>Age (yrs)</th>
<th>Clinical onset</th>
<th>Symptoms</th>
<th>Level and type</th>
<th>Degree of involvement</th>
<th>Other problems</th>
<th>Treatment</th>
<th>Bleeding</th>
<th>Result</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 M</td>
<td>26</td>
<td>Gradual deterioration over a period of one month</td>
<td>Severe back pain. Paraplegia (Frankel C)</td>
<td>T11 cavernous vascular haemangioma</td>
<td>Whole VB. Extension: soft tissue &amp; the spinal canal, lamina, facets, transverse and spinal processes</td>
<td>None</td>
<td>T11 Intravertebral EA followed by T11 BK. After two weeks: intralesional EA into lamina, facets, transverse and spinal processes</td>
<td>Constant; healed immediately after EA injection</td>
<td>Immediate relief of pain. Complete restoration of function: three months</td>
<td>CT: No recurrence (+)</td>
<td>24 months: asymptomatic. MRI: resolution of soft tissue haemangioma. CT: No recurrence (+)</td>
</tr>
<tr>
<td>2 F</td>
<td>14</td>
<td>Acute onset. No trauma</td>
<td>Paraplegia (Frankel B, partial sensory deficit)</td>
<td>T7 Cavernous vascular haemangioma</td>
<td>Whole VB. Extension: lamina, spinal canal, facets, transverse and spinal processes Complication: epidural bleeding</td>
<td>None</td>
<td>Laminctomy: T6, T7. Instrumentation: T5-T8. BK: T7</td>
<td>Excessive Sphincteric restoration after one week. Leg function restoration after four weeks. CT: No recurrence (+)</td>
<td>36 months asymptomatic. MRI: resolution of soft tissue haemangioma. Radiographs: unchanged (+)</td>
<td></td>
<td></td>
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<tr>
<td>3b F</td>
<td>72 (same patient as 3a)</td>
<td>Gradual deterioration over a period of three months</td>
<td>Mid thoracic back pain.</td>
<td>T6 cavernous vascular haemangioma. T3, T7, T8 capillary lipomatous hemangioma</td>
<td>Partial VB: T6 with extension to left pedicle and lamina</td>
<td>Mitral valve prolapse</td>
<td>T6 vertebra EA alcohol injection into lamina, pedicle, transverse and spinal processes followed by BK-VB</td>
<td>No bleeding</td>
<td>Immediate and sustained relief of pain. CT: No recurrence (+)</td>
<td>12 months asymptomatic. Radiographs: unchanged (+)</td>
<td></td>
</tr>
<tr>
<td>4 F</td>
<td>75</td>
<td>Acute and persistent back pain. Duration: four months</td>
<td>Severe back pain.</td>
<td>Whole VB</td>
<td>L1 subchondral fracture, rheumatoid arthritis, hypothyroidism</td>
<td>L1 &amp; L2 BK.</td>
<td>Constant</td>
<td>Immediate and sustained relief of pain. CT: No recurrence (+)</td>
<td>12 months asymptomatic. Radiographs: unchanged (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 F</td>
<td>21</td>
<td>Spontaneous. Duration: six months. Getting worse</td>
<td>Severe back pain.</td>
<td>Whole VB</td>
<td>T5 &amp; T8 cavernous vascular haemangioma</td>
<td>Whole VB and soft tissue with ballooning of anterior and posterior VB walls, lamina and pedicles</td>
<td>None</td>
<td>T5 &amp; T8 BK</td>
<td>Excessive</td>
<td>Immediate and sustained relief of pain. CT: No recurrence (+)</td>
<td>12 months asymptomatic. Radiographs: unchanged (+)</td>
</tr>
<tr>
<td>6a F</td>
<td>69 (same patient as 6a)</td>
<td>Chronic back pain</td>
<td>Severe back pain.</td>
<td>Whole VB</td>
<td>Failed surgery for spinal stenosis (laminectomy)</td>
<td>Repeat L4, L5 decompression. BK: right side. L4 VB</td>
<td>Constant</td>
<td>Relief of back pain for six months. CT: no recurrence (++)</td>
<td>6 months asymptomatic. Radiographs: unchanged (+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6b F</td>
<td>21 (same patient as 6a)</td>
<td>Onset of back pain six months after successful Rt side BK</td>
<td>Naging back pain.</td>
<td>Whole VB</td>
<td>Lt side: L4 Haemangioma. Previous BK Rt side</td>
<td>As above</td>
<td>BK: Lt side. L4 VB</td>
<td>Excessive</td>
<td>Immediate relief of back pain. CT: No recurrence (+)</td>
<td>24 months asymptomatic. Radiographs: unchanged (+)</td>
<td></td>
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</table>

* VAS, visual analogue scale; ODQ, Oswestry Disability Index questionnaire; LT, local tenderness
† VB, vertebral body
‡ EA, ethanol alcohol; BK, balloon kyphoplasty
¶ (+), unchanged since post-operative imaging
§ (++), unchanged since post-operative imaging
by devascularising the tumour, is not as effective in controlling vertebral pain as other procedures. The overall success rate of intralesional injection of pure alcohol is reported to range from 75%\(^29\) to 85%,\(^30\) with 72% in the presence of paraplegia.\(^31\)

The technique of vertebroplasty was first described in 1987 by Galibert et al.\(^32\) in the treatment of an aggressive haemangioma of the cervical spine. The success rate for the management of vertebral haemangioma with vertebroplasty has ranged from 71.4% to 91.6%.\(^30,33-37\) There are only two case reports describing the use of balloon kyphoplasty; one for a painful sacral haemangioma\(^17\) and the other for a lesion at T12.\(^18\) Leakage of cement is less likely to occur during balloon kyphoplasty than vertebroplasty,\(^38\) and we have therefore used the former with polymethylmethacrylate bone cement (PMMA) for the management of symptomatic vertebral haemangioma in six patients.

**Patients and Methods**

There were five women and one man, with a mean age of 45.6 years (14 to 75) and mean follow-up of 24 months (12 to 36). Pre-operative investigation included a detailed history, a thorough clinical examination, plain radiographs and CT and MRI scanning. During clinical examination, the affected site was localised by tenderness elicited by point pressure\(^59\) and subsequently verified by fluoroscopic examination. This test was not performed in one patient who presented with Frankel B paraplegia.\(^40\) A CT scan was performed in order to depict cavernous haemangiomas and the integrity of the vertebral walls. T\(_1\), T\(_3\) and gadolinium-enhanced T1-weighted MR images were undertaken routinely to distinguish lipomatous from vascular haemangiomas.

The six patients underwent eight surgical procedures at different times for different reasons on 11 vertebral bodies, six lumbar and five thoracic, for the treatment of symptomatic vertebral haemangiomas. One additional kyphoplasty was performed for an acute osteoporotic subchondral fracture adjacent to a vertebra affected by a haemangioma. This procedure is not included in the analysis of data. Balloon kyphoplasty was carried out according to the technique published previously.\(^39\) Five patients had the procedure under general, and one under local anaesthesia. During the procedure the arterial blood pressure and oxygen saturation were monitored and remained normal. Biopsies were obtained in five patients.

One patient had four symptomatic vertebral haemangiomas in the lumbar spine, each requiring a balloon kyphoplasty. These procedures relieved her pain, but 24 months later she developed pain in the mid-thoracic spine from a haemangioma at T6 with extension into the pedicle, lamina, transverse and spinal processes. This was managed by balloon kyphoplasty with intralesional injection of alcohol into the extensions of the haemangioma into the spinal and transverse processes, the pedicle and lamina. This patient was followed for 36 months for the lumbar spine and 12 months for the thoracic spine (Table I; patient 3).

Another patient had a right-sided unilateral balloon kyphoplasty for a haemangioma at L4 with decompression of L4 and L5 for spinal stenosis. She experienced relief from back pain for six months and then had further symptoms which were attributed to residual haemangioma on the left side. A further balloon kyphoplasty was carried out on this side, after which she was followed up for a period of 24 months (Table I; patient 6).
Each patient was assessed by means of subjective perception of pain and functional status using a visual analogue scale (VAS)\textsuperscript{31} and the Oswestry Disability Index Questionnaire,\textsuperscript{42} clinical examination, and plain radiographs at three, six and 12 months after operation. The final follow-up was at 12 months for two patients, 24 months for two and 36 months for the remaining two.

A CT scan was performed within a week after surgery and was repeated after six months in all six patients (eight surgical procedures). An MRI was also performed at 12 and 24 months in patient 1, who had a haemangioma with an epidural soft-tissue extension.

Results

The epidemiological summary, pathology, management and outcomes are presented in Table I. There were no intra-operative or post-operative complications. Local anaesthesia used in patient 1 gave excellent analgesia and was well tolerated. All patients experienced immediate relief from pain, and five were discharged on the following day. One patient who had a decompressive laminectomy for complete motor paraplegia was discharged within a week of the procedure and returned to school after four weeks. All patients recovered sufficiently to return to their pre-illness activities. At final follow-up four patients were free from pain and two had a significant improvement in terms of functional status and subjective perception of pain. At the final follow-up one patient scored 2 on the VAS and 10% on the Oswestry Disability Index, whereas the other scored 3 on the VAS and 20% on the Oswestry Disability Index (Table I).

In one patient, emergency decompressive laminectomy was considered necessary because of the acute onset of paraplegia (Frankel B) and it was deemed proper to proceed with cement augmentation of the vertebral body by balloon kyphoplasty because of the aggressive nature of the haemangioma. This resulted in complete resolution of the soft-tissue haemangioma from the spinal canal (Fig. 1). The bleeding was spontaneous in this otherwise asymptomatic vertebral haemangioma, and was not secondary to trauma. One patient developed paraparesis (Frankel grade C) by extension of soft tissue from a haemangioma affecting the 11th thoracic vertebra. This was an aggressive vascular lesion that extended into the pedicles and spinal process. Despite the aggressive nature of the haemangioma, the combination of direct intralesional injection of alcohol into the vertebral body with balloon kyphoplasty proved to be highly effective and safe, eliminating the need for open decompression. Two weeks later, the patient was re-injected with ethanol into areas of persisting haemangioma in the neural arch, and expansion of the cortex of the vertebral body, an irregular honeycomb pattern, extension of the vertebral lesion into the neural arch, and expansion of the cortex of the vertebral body with indistinct margins.

Another predictive feature is the vascularity of the lesion as demonstrated by soft-tissue density on CT, a low signal on a T\textsubscript{1}-weighted MRI, and high signal intensity on gadolinium contrast enhancement.\textsuperscript{45} Although it has been claimed that haemangiomas with predominantly fatty tissue are almost always non-aggressive and asymptomatic, symptoms of pain\textsuperscript{46} and neurological complications\textsuperscript{47} can originate in non-aggressive haemangiomas\textsuperscript{48} which may require vertebral enhancement with cement to relieve pain. In our series, one patient presented with MRI findings suggestive of a non-aggressive lipomatous haemangioma that was associated with debilitating pain, relieved only by balloon kyphoplasty. In this patient the lesion involved the entire vertebral body, as did the symptomatic lipid-filled haemangioma in another.
Axial CT views demonstrating a) the polka dot appearance of thickened trabeculae, b) sagittal reformating images demonstrating a cavernous haemangioma with thickened trabeculae simulating a 'corduroy cloth' pattern. c) Sagittal $T_1$-weighted MRI demonstrating mottled low signal intensity of the vertebral body of T11 and soft-tissue extension into the spinal canal, d) axial view of gadolinium-enhanced $T_1$-weighted MRI scan, demonstrating a soft-tissue haemangioma occupying the lateral half of the spinal canal and displacing the spinal cord to the right, e) post-operative mid-sagittal CT scan showing successful enhancement with bone cement after balloon kyphoplasty and f) at 12 months after operation a $T_2$-weighted MRI sequence demonstrates complete resolution of the soft-tissue haemangioma in the spinal canal.
Since the diagnosis is fairly accurate when using MRI and CT we do not recommend biopsy because of the potential for profuse bleeding.

Vertebral haemangiomas can compromise the neural tissue and cause neurological deficit by concentric narrowing of the spinal canal, bony intrusion into the canal after fracture, vertebral enlargement with ballooning of the posterior vertebral wall into the spinal canal, soft-tissue extension of the lesion and spontaneous or traumatic haemorrhage of the tumour into the epidural space. Two of our cases were associated with a serious neurological deficit. The reported rates of neurological deficit in symptomatic haemangiomas varies from 6.25% to 92.8%,

Epidural bleeding from vertebral lesions can be either precipitated by trauma or occur spontaneously. With spinal cord compression there is strong evidence to recommend combining surgical decompression with either vertebroplasty, arterial embolisation or intralesional injection of alcohol. Decompression is usually effective, but may not always provide the expected results. Not all patients who develop a neurological deficit and are treated by combining laminectomy and vertebroplasty will regain complete neurological function. Purkayatha et al observed only mild to moderate regression of epidural extension of haemangiomata after embolisation or intralesional injection with alcohol. Surgical decompression should be considered for severe paraparesis (Frankel B or C) or after failure of other procedures.

Our data confirm that an aggressive haemangiomata may remain asymptomatic until it develops serious complications. Castel et al found that laminectomy and instrumentation as a sole procedure may fail to relieve back pain, and can be more effective when combined with vertebroplasty.

Relief of spinal cord compression has been recorded after intralesional injection of ethanol. However, serious complications have also been encountered after treatment by alcohol injection, including a case report of Brown-Séquard syndrome and pathological fractures caused by osteonecrosis, which have been noted in 21% to 29% of patients. We have combined the use of injections of alcohol with PMMA cement to prevent these potential complications. Transient deterioration of the neurological status after intralesional injection of alcohol has also been noted and may be considered one of the side effects of this treatment. We injected 15 ml of absolute alcohol at a rate of 2 ml every five minutes, as suggested in the literature, to prevent neurological complications, and did not encounter such problems. The intralesional injection of alcohol promptly controls bleeding from vascular haemangiomas.

Brunot et al reported the need for further vertebroplasty for recurrent symptoms in 19% of their patients. We encountered this problem in one patient, who developed partial recurrence of symptoms necessitating balloon kyphoplasty on the opposite side. This suggests that complete obliteration of a vertebral haemangioma through a biportal balloon kyphoplasty may be appropriate.

As haemangiomas can be associated with other problems at adjacent levels, such as degenerative disc disease, spinal stenosis or osteoporotic compression fractures, before attributing the origin of pain to a vertebral haemangioma, care must be taken to exclude other concomitant pathologies.

In one patient in our series the pain was attributed equally to a haemangioma and concomitant spinal stenosis, and in another the pain was partly due to a compression fracture of the inferior subchondral bone of T12. In the latter case, although investigation revealed that the haemangioma was not of an aggressive nature, it was decided to proceed with balloon kyphoplasty because of the local tenderness and the involvement of the entire vertebral body by the lesion. Previous studies have indicated that vertebrae adjacent to those enhanced with bone cement might be at risk of sustaining compression fractures. Haemangiomas that involve the whole of the vertebral body may become symptomatic, and in this patient, although the MRI was suggestive of a non-aggressive, lipid-filled haemangioma, there was localised tenderness over the spinous process of L4 and during balloon kyphoplasty there was an excessive amount of bleeding. When imaging suggests that a vertebral haemangioma has the potential for more aggressive progression, or identifies asymptomatic haemangiomas with potential complications in patients predisposed to occupational hazards, augmentation of the vertebral body with cement may be justifiable. Haemangiomas may progress spontaneously, and can also be complicated by consumptive coagulopathy.

We have found balloon kyphoplasty, either as the sole procedure or as an adjunct to open surgery or transliesional alcohol ablation, to be a safe and effective procedure, and an effective option for the treatment of vertebral haemangioma in the short term. From our experience and a review of the literature we conclude that aggressive vascular haemangiomas usually present with pain, whereas non-aggressive lipomatous lesions are asymptomatic. Aggressive vascular haemangiomas may remain asymptomatic until the occurrence of serious complications, such as paraplegia. Lipid-filled lesions, particularly if large, may occasionally become symptomatic. As intralesional injection of alcohol is frequently associated with avascular necrosis and pathological fractures, it is reasonable to stabilise the vertebral column by augmentation with cement. An extensive review of the literature has shown that balloon kyphoplasty is associated with less cement leakage than vertebroplasty. If a...
unilateral approach does not obliterate the haemangioma-
tous lesion then a bilateral approach is recommended to
prevent a recurrence of symptoms.

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References
3. Topfer D. Über ein infiltrierend wachsendes hamangiom der haut und multiple kapil-

5. Mirra JM, Picci P, Gold RH. Bone tumours: clinical, radiologic and pathologic con-
6. Motamedi K, Ilaslan H, Seeger LL. Radiotherapy in the treatment of symp-
9. Tang XJ, Wu ZX, Zhao JF, et al. Treatment of vertebral hemangioma with percu-
19. Castel E, Lazenec JJ, Chiras J, Enkaoua E, Saillant G. Acute spinal cord com-
pression due to intraspinal bleeding from a vertebral haemangioma: two case-reports. Eur Spine J 1999;8:244-8.
pression: the place of preoperative percutaneous vertebroplasty with methyl meth-

tebreal hemangioma following repetitive irradiation and extraction. Pathol Int 1996;46:71-8.
33. Tang XJ, Wu ZX, Zhao JF, et al. Treatment of vertebral hemangioma with percu-
34. Gangi A, Guth S, Imbert JP, Marini H, Dietemann JL. Percutaneous vertebro-

37. Murugan L, Samson RS, Chandy MJ. Vertebral haemangiomas with spinal cord com-
pression: the place of preoperative percutaneous vertebroplasty with methyl meth-


