

## Differentiation of Malignant Vertebral Collapse from Osteoporotic and Other Benign Causes Using Magnetic Resonance Imaging

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### Abstract

**Introduction:** Elderly patients presenting with backache and vertebral collapse are a diagnostic challenge. Plain X-rays, computed tomography and radionuclide bone scans have not always reliably distinguished between benign and malignant causes. Magnetic resonance imaging (MRI) may be able to do so. **Materials and Methods:** Patients who underwent MRI evaluation for vertebral collapse were retrospectively studied. Over a 21-month period from January 1995 to September 1996, 47 patients with 58 vertebral collapses were studied. Benign and malignant aetiologies were established by serial imaging, clinical outcome and histology. Imaging was performed with T1 and T2-weighted sequences, with contrast enhancement in some patients. Collapsed vertebrae were examined for appearance of marrow on T1 and T2-weighted sequences and after contrast administration, signal intensity of adjacent discs, degree of marrow involvement, involvement of posterior elements, presence or absence of paraspinal mass and end-plate integrity. Agreement between the final and radiological diagnosis was evaluated. **Results:** There were 36 benign vertebral collapses (20 osteoporotic, 7 post-traumatic, 9 infective) and 22 malignant ones (20 metastatic carcinoma, 2 multiple myeloma). Features which pointed to malignant cause were hypointense marrow on T1-weighted images, marrow enhancement after intravenous contrast, greater than 50% marrow involvement and involvement of posterior elements. Of the vertebral collapses due to infection, 78% showed end-plate disruption. **Conclusions:** This study shows that MRI can be used to accurately differentiate between benign and malignant causes of vertebral collapse. Further differentiation between an osteoporotic, traumatic or infective cause can be done with the help of clinical history and evaluation of end-plate integrity.

*Ann Acad Med Singapore 2002; 31:8-14*

**Key words:** Compression fracture, Magnetic resonance imaging, Metastasis, Osteoporosis, Spine

### Introduction

An elderly patient presenting with backache and vertebral collapse on plain X-ray is a common clinical scenario and a diagnostic challenge. It is difficult to differentiate between benign and malignant causes for the vertebral collapse. Clinical history is often inconclusive. A patient with a proven primary malignancy may have a vertebral collapse from a benign cause. It is estimated that up to one third of vertebral compression fractures in patients with known malignancies are benign.<sup>1</sup> Plain X-rays, computed tomography (CT) and radionuclide bone scans have not always reliably made the distinction. It appears that magnetic resonance imaging (MRI) may be able to accurately differentiate between benign and malignant vertebral collapse, based on certain imaging features and patterns. It is important to make this differentiation as the benign causes are self-limiting or treatable, while malignant disease in the spine often indicates extensive metastatic disease with poor prognosis. The common benign causes of vertebral collapse include osteoporosis, trauma and infection. Further

differentiation between osteoporotic, traumatic and infective aetiology is also possible in conjunction with the clinical history.

The aims of this study were to characterise some MRI features of benign and malignant vertebral collapses and to further differentiate between osteoporotic, traumatic and infective causes.

### Materials and Methods

A retrospective study of patients who underwent MRI for evaluation of vertebral collapse was performed.

Over a 21-month period from January 1995 to September 1996, there were 52 patients with 66 vertebral collapses. Of these, 5 patients with 8 vertebral collapses were excluded from the study, as they either had a history of high energy trauma (such as road traffic accidents and falls from a height) or had old vertebral collapses, making the diagnosis obvious. Our study population thus comprised 47 patients with 58 vertebral collapses. There were 31 male and 16 female patients

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with an age range of between 21 and 92 years (mean age 62 years).

The location of the vertebral collapses were as follows: 8 cervical, 25 thoracic and 25 lumbar. Six patients had multiple level involvement. Seven patients gave a history of minor trauma.

MRI was performed with a 1.5 Tesla GE Medical Systems (Milwaukee, WI, USA) Signa machine. Spin-echo T1-weighted (TR 450-600 msec/TE 10-14 msec) and fast spin-echo T2-weighted (TR 3000-4000 msec/TE 80-100 msec) sequences were obtained. Gadolinium-diethylene triamine pentaacetic acid (Gd-DTPA) was injected intravenously, at a dose of 0.2 mmol/kg, in 22 patients (28 vertebral collapses) followed by acquisition of T1-weighted sequence. Sagittal images of the cervical spine were of 3 mm thickness with a 1-mm gap. Sagittal images of the thoracic and lumbar spine were of 4 mm thickness with a 1-mm gap. Axial images were of 5 mm thickness with a 0.8-mm gap.

Collapsed vertebrae were evaluated for the following factors:

1. Signal intensity of bone marrow on T1-weighted images as compared to other normal uninvolved vertebrae in the same scan;
2. Signal intensity of bone marrow on T2-weighted images as compared to other normal uninvolved vertebrae in the same scan;
3. Signal intensity of bone marrow after intravenous Gd-DTPA administration;
4. Signal intensity of adjacent discs on T1 and T2-weighted images;
5. Degree of involvement of bone marrow; this was subdivided into no involvement, less than 50% involvement, greater than 50% but less than 100% involvement and complete marrow replacement;
6. Involvement of other parts of the vertebra, especially the posterior elements;
7. Presence or absence of a paraspinal mass;
8. Appearance of end-plates; this was subdivided into intact, broken and distorted.

Fisher's exact test was used to test for statistical significance.

Final diagnosis was established on serial imaging, clinical outcome and histology. Agreement between the final and the radiological diagnosis was evaluated.

## Results

There were 47 patients with 58 vertebral collapses. Of these, 36 were benign and 22 were malignant in aetiology. Of the 36 benign vertebral collapses, 20 were osteoporotic,

7 were post-traumatic and 9 were due to infection. In the 22 malignant vertebral collapses, 20 were due to metastatic carcinoma (lung, breast, colon, prostate, renal cell, nasopharyngeal, unknown primary) and 2 were due to multiple myeloma.

### *Appearance of Bone Marrow on T1-weighted Images*

These results are shown in Table I. In malignant vertebral collapses, the bone marrow was hypointense in 21 of 22 (95.4%) cases, only 1 of 22 (4.5%) malignant lesions was isointense and none were hyperintense. In benign vertebral collapses, 25 of 36 (69.4%) lesions showed hypointense marrow (Fig. 1a), 5 of 36 (13.9%) were isointense and 6 of 36 (16.7%) were hyperintense. There was a significant difference in the appearance of the bone marrow between benign and malignant vertebral collapse ( $P = 0.050$ ).

### *Appearance of Bone Marrow on T2-weighted Images*

As shown in Table I, there were almost equal proportions of hypointense, isointense and hyperintense marrow in benign cases (Fig. 1b). In malignant lesions, 10 of 22 (45.5%) were hypointense, 10 of 22 (45.5%) were hyperintense and 2 of 22 (9%) were isointense. There was no significant difference in the appearance of the bone marrow between benign and malignant vertebral collapse ( $P = 0.453$ ).

### *Signal Intensity of Bone Marrow after Intravenous Contrast Administration*

In this study, intravenous Gd-DTPA was administered in only 22 patients. There were 28 vertebral collapses in this cohort, with 13 benign and 15 malignant lesions. As shown in Table I, 7 of 13 (53.8%) benign lesions showed enhancement and 6 of 13 (46.2%) were isointense. In malignant lesions, 14 of 15 (93.3%) showed enhancement and 1 of 15 (6.7%) was hypointense. There was a significant difference in marrow enhancement between benign and malignant vertebral collapse ( $P = 0.005$ ).

### *Signal Intensity of Adjacent Discs on T1 and T2-weighted Images (Table I)*

There was no significant difference in the appearance of the discs on T1 and T2-weighted images, between benign and malignant vertebral collapse ( $P = 0.613$  and  $P = 0.461$ , respectively).

### *Degree of Involvement of Bone Marrow*

Greater than 50% or complete marrow involvement was seen in 18 of 22 (81.8%) malignant vertebral collapses (Figs. 2a & 2b). Less than 50% or no marrow involvement was noted in 21 of 36 (58.3%) benign cases. Detailed results are shown in Table I. There was a significant difference in the degree of marrow involvement between benign and malignant vertebral collapse ( $P = 0.022$ ).

TABLE I: MRI FINDINGS IN 36 BENIGN AND 22 MALIGNANT VERTEBRAL COLLAPSES

|                                                          |                | Benign | Malignant | Total | Fisher's exact test |
|----------------------------------------------------------|----------------|--------|-----------|-------|---------------------|
| Appearance of bone marrow on T1-weighted images          | Hypointense    | 25     | 21        | 46    | $P = 0.050$         |
|                                                          | Isointense     | 5      | 1         | 6     |                     |
|                                                          | Hyperintense   | 6      | 0         | 6     |                     |
|                                                          | Total          | 36     | 22        | 58    |                     |
| Appearance of bone marrow on T2-weighted images          | Hypointense    | 16     | 10        | 26    | $P = 0.453$         |
|                                                          | Isointense     | 8      | 2         | 10    |                     |
|                                                          | Hyperintense   | 12     | 10        | 22    |                     |
|                                                          | Total          | 36     | 22        | 58    |                     |
| Appearance of bone marrow after intravenous Gd-DTPA*     | Hypointense    | 0      | 1         | 1     | $P = 0.005$         |
|                                                          | Isointense     | 6      | 0         | 6     |                     |
|                                                          | Hyperintense   | 7      | 14        | 21    |                     |
|                                                          | Total          | 13     | 15        | 28    |                     |
| Signal intensity of adjacent discs on T1-weighted images | Hypointense    | 1      | 1         | 2     | $P = 0.613$         |
|                                                          | Isointense     | 28     | 14        | 42    |                     |
|                                                          | Hyperintense   | 4      | 5         | 9     |                     |
|                                                          | Destroyed      | 3      | 2         | 5     |                     |
|                                                          | Total          | 36     | 22        | 58    |                     |
| Signal intensity of adjacent discs on T2-weighted images | Hypointense    | 2      | 2         | 4     | $P = 0.461$         |
|                                                          | Isointense     | 23     | 10        | 33    |                     |
|                                                          | Hyperintense   | 7      | 8         | 15    |                     |
|                                                          | Destroyed      | 4      | 2         | 6     |                     |
|                                                          | Total          | 36     | 22        | 58    |                     |
| Degree of involvement of bone marrow                     | None           | 4      | 1         | 5     | $P = 0.022$         |
|                                                          | <50%           | 17     | 3         | 20    |                     |
|                                                          | >50% and <100% | 9      | 9         | 18    |                     |
|                                                          | Complete       | 6      | 9         | 15    |                     |
|                                                          | Total          | 36     | 22        | 58    |                     |
| Paraspinal mass                                          | Absent         | 29     | 19        | 48    | $P = 0.727$         |
|                                                          | Present        | 7      | 3         | 10    |                     |
|                                                          | Total          | 36     | 22        | 58    |                     |
| Appearance of end-plates                                 | Intact         | 18     | 9         | 27    | $P = 0.123$         |
|                                                          | Broken         | 9      | 11        | 20    |                     |
|                                                          | Distorted      | 9      | 2         | 11    |                     |
|                                                          | Total          | 36     | 22        | 58    |                     |

\* Gd-DTPA: gadolinium-diethylene triamine pentaacetic acid

### Involvement of Posterior Elements of Vertebra

In 5 of 22 (22.7%) malignant vertebral collapses, there was involvement of the posterior elements, namely the pedicles or laminae. None of the benign vertebral collapses showed posterior element involvement.

### Presence or Absence of Paraspinal Mass (Table I)

Only 3 of 22 (13.6%) malignant vertebral collapses and 7 of 36 (19.4%) benign vertebral collapses were associated with a paraspinal mass. There was no significant difference between benign and malignant vertebral collapse ( $P = 0.727$ ).

### Appearance of End-plates

As shown in Table I, 18 of 36 (50%) benign and 13 of 22 (59.1%) malignant vertebral collapses had broken or distorted end-plates. There was no significant difference in the appearance of the end-plates between benign and

malignant vertebral collapse ( $P = 0.123$ ). However, of 9 benign cases due to infection, 7 of 9 (77.8%) had associated disruption of end-plates.

In the large majority of cases, the final diagnosis was in agreement with the radiological diagnosis. However, 3 benign lesions were incorrectly reported as malignant. Of these, 1 vertebral collapse was due to osteoporosis and 2 were tuberculous infections.

### Discussion

The evaluation of vertebral compression fractures has long been a diagnostic dilemma, with the distinction of benign causes such as osteoporosis from metastatic causes being critical in the further management of the patient. The spine is frequently involved in metastatic disease and accounts for up to 39% of bone metastases.<sup>2</sup> This is also complicated by the high incidence of both osteoporosis and malignant tumours in the elderly. Osteoporosis may be

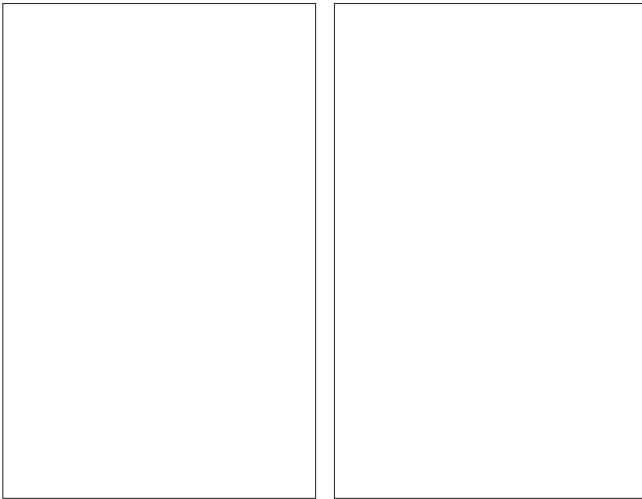


Fig. 1a.

Fig. 1b.

Fig. 1a. Sagittal T1-weighted images of the thoracolumbar spine showing abnormal low signal intensity and loss of height of the T11 vertebral body, due to a benign osteoporotic compression fracture.

Fig. 1b. Sagittal T2-weighted images of the thoracolumbar spine of the same patient showing abnormal low signal intensity and loss of height of the T11 vertebral body, due to a benign osteoporotic compression fracture.

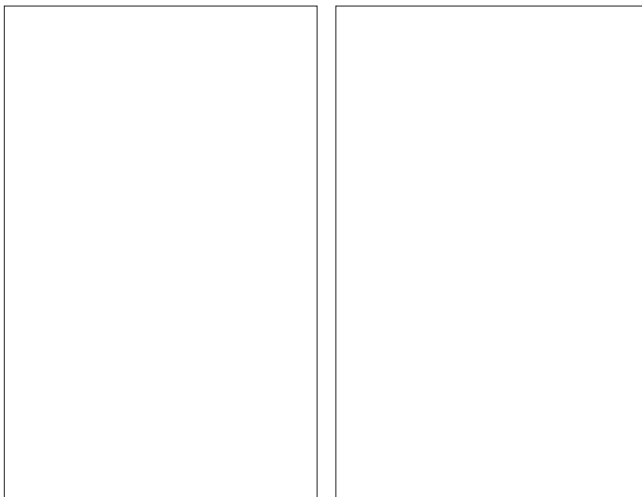


Fig. 3a.

Fig. 3b.

Fig. 3a. Lateral X-ray of the lumbar spine showing a compression fracture of L4 with buckling of the superior end plate.

Fig. 3b. Sagittal T1-weighted images of the thoracolumbar spine of the same patient showing extensive metastases involving multiple thoracic and lumbar vertebrae, which were not evident in the plain X-ray.

present to such a degree that even minor trauma which may not be recalled can result in vertebral collapse, and a compression fracture may also herald a yet-undiagnosed tumour elsewhere in the body.

Both causes would show increased focal activity on a radionuclide bone scan, and it has been reported that even acute osteoporotic compression fractures can have a positive bone scan for up to 1 year or more.<sup>3</sup> The finding of a solitary focus of radionuclide uptake is also equivocal.<sup>4</sup> Other imaging modalities may not be able to distinguish between

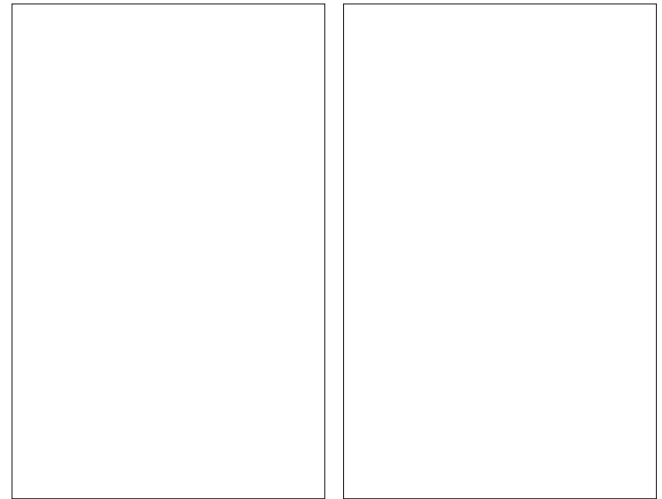


Fig. 2a.

Fig. 2b.

Fig. 2a. Lateral X-ray of the cervical spine showing almost complete loss of height of the C4 vertebral body.

Fig. 2b. Sagittal T2-weighted images of the cervical spine of the same patient showing complete marrow replacement and bulging of the posterior cortex in a malignant compression fracture of C4, due to metastasis from carcinoma of the prostate.

the two causes with certainty. Although histological biopsy remains the gold standard, many patients would either be unfit or unwilling to go through an invasive procedure. MRI, with its superior soft tissue characterisation, has a distinct advantage in this respect.

The analysis of vertebral compression fractures on MRI falls into two main areas: changes in signal intensity and morphological changes. Our criteria for assessment encompass both these areas. With regard to signal intensity, the appearance of the marrow of the vertebral body on T1 and T2-weighted sequences, the enhancement after intravenous Gd-DTPA, and signal intensity of the adjacent intervertebral discs were assessed. Morphologic factors include degree of marrow involvement, posterior element involvement, the presence of a paraspinal mass and end-plate integrity. These factors for analysis have also been used in other studies,<sup>5-8</sup> and we attempt to apply them to our local population.

#### Signal Intensity on T1-weighted Images

The marrow of the normal vertebral column in adults is mainly haemopoietic bone marrow with a significant amount of fat within. The degree of fat increases with age, and will generally be of high signal intensity on T1 and intermediate on T2-weighted images.<sup>9</sup> Our patients showed a large proportion (95%) with low signal intensity of the vertebral marrow involved by malignancy, as compared to a more even distribution in the benign group. In osteoporotic fractures, the low signal intensity in an acute vertebral collapse regresses slowly and becomes isointense over 1 to 3 months.<sup>10</sup>

### *Signal Intensity on T2-weighted Images*

The large number of patients with high signal intensity is related to the presence of oedema from 2 different mechanisms. In acute and benign compression fractures, the oedema from the fracture will cause an increased signal, as will malignant compression fractures where tumour tissues may invade and cause reactive changes as well.<sup>11</sup> Metastatic lesions of similar pathology have been shown to produce lesions with varying signal intensity, where prominent lesions on T1-weighted scans were isointense on T2-weighted scans.<sup>12</sup>

### *Signal Intensity after Contrast Administration*

The difference in the degree of enhancement of the vertebral body in benign and malignant compression fractures in our cohort corresponds well with other reported series, in which a high proportion (94% to 100%) of malignant lesions enhance.<sup>6,7</sup> The pattern of contrast enhancement in these studies was also notable, where heterogeneous enhancement was seen more frequently in malignant fractures, and homogeneous enhancement in benign fractures.<sup>6</sup> The homogeneous enhancement is usually linear or band-like in configuration, and represents areas of vascular repair process reactive to the fracture, at the margins of the compacted bone.<sup>5</sup>

### *Signal Intensity of Adjacent Discs*

The signal change, if any, in the intervertebral discs adjacent to the fractured vertebrae did not show any correlation with the nature of the collapse. This is expected, as the disc is generally not affected by both osteoporosis and malignancy, but rather by desiccation due to degenerative change.

### *Degree of Marrow Involvement*

In our series, total or near-total involvement of the marrow was a strong indicator that the cause of the compression fracture was malignant. 81.8% of malignant cases had this pattern of involvement, and this is in good agreement with other published literature. Mouloupoulos et al<sup>7</sup> quoted 86% of greater than 50% replacement of the vertebral marrow in malignant cases, while similar figures of 92% and 100% were seen in studies done by Yuh et al<sup>8</sup> and Baker et al, respectively.<sup>10</sup>

Cuenod et al<sup>5</sup> described patterns characteristic of osteoporotic vertebral collapse on T1-weighted images. A band-like area of low signal intensity beneath the fractured end-plate with areas of preserved signal intensity opposite the fractured end-plate and at the posterior part of the vertebral body were considered typical of osteoporotic vertebral collapse.

### *Posterior Element Involvement*

This included both destruction or expansion of the pedicles

or laminae, with or without signal change. None of the osteoporotic and benign fractures in our study showed any abnormality in the posterior elements. In the study by Cuenod et al,<sup>5</sup> only 6% of the osteoporotic vertebral collapses showed involvement of at least 1 pedicle. This is probably due to sparing of the pedicles in reactive bone marrow oedema following vertebral collapse. In contrast to previous reports, the high figures of 69% to 88%<sup>6,8</sup> of pedicle involvement in metastatic disease were not reproduced in our study. Tumour might have sufficiently weakened the vertebral body enough to undergo pathological fracture before spread to the pedicles and laminae.

### *Presence or Absence of Paraspinal Mass*

Although there are other published reports of the presence of a paraspinal or epidural mass being more indicative of malignancy,<sup>5,6</sup> the small numbers of such a finding in both the benign and malignant categories in our cohort make it difficult to assess. However, the presence of a paraspinal mass could be due to tumour extension or an abscess cavity extending out of the vertebral body.

### *Integrity of End-plates*

The lack of significant difference in this factor is not unexpected as end-plate fracture will occur if the underlying bone is adequately weakened by either osteoporosis or tumour. The high proportion of end-plate fractures in cases of infection is most likely related to the discitis.

Other factors which have been previously reported include disruption of the posterior cortex of the vertebral body,<sup>13</sup> and appearance of the margins of the area of signal abnormality.<sup>6</sup> The demonstration of other sites of unsuspected metastases in the rest of the imaged spine was also useful in indicating that a malignant cause was more likely the cause of the fracture<sup>14,15</sup> (Figs. 3a & 3b).

Reviewing all these above-mentioned factors, it reveals that there is no consensus of definite or fixed guidelines in distinguishing between benign and malignant vertebral compression fractures. Certain articles also have conflicting viewpoints, such as the appearance of signal abnormality on T1-weighted scans. Porter et al<sup>16</sup> reported that metastatic disease is most easily detected with T1-weighted scans, which is supported by Norman et al,<sup>17</sup> who stated that osteoporotic compression fractures will retain normal signal intensity while it would be decreased in malignant fractures. However, Sugimura et al<sup>18</sup> concluded that T1-weighted images alone were not useful in differentiating benign from malignant fractures. Their cases showed that 50% of benign lesions had low signal intensity on T1-weighted scans, similar to the proportion of malignant lesions.

TABLE II: MRI FINDINGS IN 36 BENIGN VERTEBRAL COLLAPSES

|                                                          |                | Infective cause | Non-infective cause | Total |
|----------------------------------------------------------|----------------|-----------------|---------------------|-------|
| Appearance of bone marrow on T1-weighted images          | Hypointense    | 7               | 18                  | 25    |
|                                                          | Isointense     | 0               | 5                   | 5     |
|                                                          | Hyperintense   | 2               | 4                   | 6     |
|                                                          | Total          | 9               | 27                  | 36    |
| Appearance of bone marrow on T2-weighted images          | Hypointense    | 3               | 13                  | 16    |
|                                                          | Isointense     | 0               | 8                   | 8     |
|                                                          | Hyperintense   | 6               | 6                   | 12    |
|                                                          | Total          | 9               | 27                  | 36    |
| Appearance of bone marrow after intravenous Gd-DTPA*     | Hypointense    | 0               | 0                   | 0     |
|                                                          | Isointense     | 1               | 5                   | 6     |
|                                                          | Hyperintense   | 6**             | 1                   | 7     |
|                                                          | Total          | 7               | 6                   | 13    |
| Signal intensity of adjacent discs on T1-weighted images | Hypointense    | 1               | 0                   | 1     |
|                                                          | Isointense     | 3               | 25                  | 28    |
|                                                          | Hyperintense   | 2               | 2                   | 4     |
|                                                          | Destroyed      | 3               | 0                   | 3     |
|                                                          | Total          | 9               | 27                  | 36    |
| Signal intensity of adjacent discs on T2-weighted images | Hypointense    | 0               | 2                   | 2     |
|                                                          | Isointense     | 3               | 20                  | 23    |
|                                                          | Hyperintense   | 2               | 5                   | 7     |
|                                                          | Destroyed      | 4               | 0                   | 4     |
|                                                          | Total          | 9               | 27                  | 36    |
| Degree of involvement of bone marrow                     | None           | 0               | 4                   | 4     |
|                                                          | <50%           | 0               | 17                  | 17    |
|                                                          | >50% and <100% | 4               | 5                   | 9     |
|                                                          | Complete       | 5               | 1                   | 6     |
|                                                          | Total          | 9               | 27                  | 36    |
| Paraspinal mass                                          | Absent         | 3               | 26                  | 29    |
|                                                          | Present        | 6               | 1                   | 7     |
|                                                          | Total          | 9               | 27                  | 36    |
| Appearance of end-plates                                 | Intact         | 2               | 16                  | 18    |
|                                                          | Broken         | 7               | 2                   | 9     |
|                                                          | Distorted      | 0               | 9                   | 9     |
|                                                          | Total          | 9               | 27                  | 36    |

\* Gd-DTPA: gadolinium-diethylene triamine pentaacetic acid

\*\* One patient with 2 vertebral collapses did not receive intravenous Gd-DTPA

The distinction between infective and malignant causes of vertebral collapse poses some difficulty. In our study, 2 cases of infection were incorrectly reported as malignant. Details of the imaging features of the 9 vertebral collapses due to infection in our cohort are shown in Table II. Although benign, vertebral collapses due to infection had some features which pointed to a malignant cause. 85.7% of cases showed enhancement after intravenous Gd-DTPA and 100% had greater than 50% or complete marrow involvement. None of the vertebral collapses due to infection had involvement of the posterior elements. There were a few features which helped to point to an infective cause. These were end-plate disruptions and signal changes or destruction of the adjacent discs. In our cohort, 77.8% of vertebral collapses due to infection had associated disruption of the end-plates, 66.7% had disc signal change or destruction on both T1 and T2-weighted images.

In patients with benign vertebral collapse with minimal or no trauma, and without clinical and radiological features of infection, osteoporosis was considered the most likely cause.

With further development of newer sequences in MRI, we expect that these will continue to increase the precision in distinguishing between benign and malignant compression fractures. Short-tau inversion recovery (STIR) sequences have been shown to provide a high marrow contrast for lesions by suppressing signal from fatty marrow, as well as combining T1 and T2 relaxation times.<sup>10</sup> STIR is also very sensitive to the presence of water or fluid in bone marrow oedema. One of the more promising sequences in recent practice is diffusion-weighted MRI.<sup>19,20</sup> This utilises the free mobility of water molecules in tissue. In benign compression fractures, the increase in interstitial fluid from oedema results in an increase in the extracellular volume

fraction, leading to an increase in the mobility of water molecules. In contrast, tumour replacement of the vertebra in malignant disease reduces the extracellular volume, and the limitation of mobility of the water molecules is seen as increased signal intensity on diffusion-weighted images. However, just as in the other factors used in evaluation of benign and malignant fractures, there are conflicting reports on the usefulness of diffusion-weighted imaging,<sup>21</sup> and further studies with larger cohorts are needed in this area.

## Conclusion

We have looked at imaging features commonly used in the analysis of vertebral compression fractures to determine their aetiology. In summary, low or reduced signal intensity of the vertebral marrow on T1-weighted images, significant contrast enhancement after intravenous Gd-DTPA, total or near-total degree of marrow involvement and the involvement of posterior elements were features that were indicators of malignancy. Signal intensity of the marrow on T2-weighted images, signal intensity of the adjacent discs, presence of a paraspinal mass and end-plate integrity did not contribute to establishing a diagnosis.

The differentiation between infective and malignant causes of vertebral collapse was occasionally difficult as there was some overlap of features. End-plate disruption and disc signal change or destruction were suggestive of infection.

In cases with minimal or no trauma, and without clinical and radiological features of malignancy or infection, osteoporosis was the most likely diagnosis.

MRI is thus helpful in differentiating benign from malignant causes of vertebral collapse, and provides additional information with other imaging modalities. In the minority of cases where the differentiation cannot be made, clinical correlation with either a biopsy or short-term MRI follow-up is recommended.

## Acknowledgements

The authors would like to thank Ms Genedine Lim, Dr Thng Choon Hua and Dr Gervais Wansaicheong for their invaluable assistance in the preparation of this manuscript.

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