Incidental vertebral fractures on computed tomography

Pui Ling Chan, Taryn Reddy, David Milne, Mark J Bolland

Abstract

Vertebral fractures are the most common osteoporotic fracture and predict subsequent fracture and mortality. We undertook an audit (Auckland City Hospital, Auckland, New Zealand) to determine whether targeted assessment for incidental vertebral fractures on computed tomography (CT) examinations of the chest or abdomen in older people would detect previously unidentified vertebral fractures. In 175 consecutive patients aged >65 years, sagittal images of the spine were obtained by reformatting data from CT examinations of the chest or abdomen. Vertebral fractures were assessed using a semi-quantitative technique.

The prevalence of vertebral fractures was 13%, with 41 vertebral fractures identified in 22 patients; 12/22 (55%) had vertebral fracture mentioned in the formal CT report, and 2/12 patients with contemporaneous plain films had vertebral fracture mentioned in the X-ray report. The vertebral fracture was newly identified in 17 (77%) patients, but vertebral fracture and osteoporosis were each listed in the relevant discharge summary or clinic letter for only 14% of patients, and only 31% of patients with fracture subsequently received osteoporosis treatment.

In summary, assessing sagittal spine images reformatted from CT examinations of the chest or abdomen detects previously unidentified vertebral fractures, offering an undervalued opportunity to assess fracture risk and intervene with treatments that prevent fractures and reduce mortality.

Vertebral fractures are the most common osteoporotic fracture and frequently occur in older men and women. The incidence of radiological vertebral fractures is approximately 1% per year in older women and 0.5% per year in older men, with a prevalence of 10–20% at age 65 years. Radiological vertebral fractures are strong predictors of subsequent vertebral, hip and other osteoporotic fractures and mortality.

Vertebral fractures are usually diagnosed using lateral spine radiographs, although they are also commonly detected incidentally on chest radiographs. More recently, incidental vertebral fractures have been detected on multislice computed tomography (CT) examinations of the chest or abdomen. Reformating of the axially acquired dataset can be used to generate sagittal images of the spine, allowing ready detection of vertebral fractures.

We undertook a simple audit to determine whether routine assessment for incidental vertebral fractures on CT examinations of the chest or abdomen in older people would detect previously unidentified vertebral fractures.
Methods

Sagittal reformatting was carried out on consecutive scans of patients aged >65 years who underwent CT examination of the chest and/or abdomen in Auckland City Hospital (Auckland, New Zealand) over 4 weeks in November 2009. All the CT scans were requested as part of routine clinical care, but we did not record the indications for each scan. All CT examinations were reported routinely by the duty radiologist.

For this audit, all images were subsequently assessed by one radiologist (TR) for vertebral fractures, using the semi-quantitative technique developed by Genant. In brief, each vertebra is graded from 0 to 3: Grade 0 = normal, no fracture; Grade 1 = mildly deformed, approximately 20–25% reduction in anterior, middle, and/or posterior height and a reduction in vertebral area of 10–20%; Grade 2 = moderately deformed, approximately 25–40% reduction in any height and a reduction in area of 20–40%; Grade 3 = severely deformed, approximately >40% reduction in any height and area. It was also recorded whether any fractures identified on CT were noted in the formal CT report, and whether vertebral fractures were reported on plain films taken at the same visit or previously.

Finally, the relevant discharge summary or clinic letter was reviewed to determine whether the patient had pre-existing osteoporosis, whether the vertebral fracture was noted, and whether the patient was treated with osteoporosis medications.

Results

CT examinations from 175 patients were reviewed: 77 (44%) included the thoracic spine, 144 (82%) the lumbar spine, and 48 (27%) both the thoracic and lumbar spine. Eighty-two (47%) of the patients were male and 93 (53%) female; 80 (46%) were aged 65–74 years, and 95 (54%) were aged ≥75 years.

The prevalence of radiological vertebral fracture was 13%: 41 vertebral fractures were identified in 22 patients (Table 1).

Twenty-two fractures occurred in 14 women, and 19 fractures in 8 men; 11 (50%) individuals with a vertebral fracture were aged 65–74 years, and 11 were aged ≥75 years.

Eighty-five percent of fractures were in the lower thoracic or lumbar region, and 15/22 (68%) patients had at least 1 fracture with severe deformity; 12/22 (55%) patients had vertebral fracture mentioned in the formal CT report.

In patients with vertebral fracture, 2 of 12 patients (17%) with contemporaneous plain films had vertebral fractures mentioned in the X-ray report. 4 of 12 patients (33%) with previous plain films had a previous report of a vertebral fracture: in all cases, this fracture was in the same location as the fracture identified on the current CT examination.

Of the 22 patients with vertebral fracture, 2 had pathological fractures, 8 (36%) had pre-existing osteoporosis, and 5 (23%) had a history of previous vertebral fracture. In the problem list or medication summary of the relevant discharge summary or clinic letter, 3 (14%) had vertebral fracture listed, 3 (14%) had osteoporosis listed, and 7 (31%) had treatment for osteoporosis listed.
Table 1. Characteristics of 22 patients with vertebral fractures identified on CT

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
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<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
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<tr>
<td>Male</td>
<td>8 (36)</td>
</tr>
<tr>
<td>Female</td>
<td>14 (64)</td>
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<tr>
<td><strong>Age (years)</strong></td>
<td></td>
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<tr>
<td>65–74</td>
<td>11 (50)</td>
</tr>
<tr>
<td>75+</td>
<td>11 (50)</td>
</tr>
<tr>
<td><strong>Site of fractures</strong></td>
<td></td>
</tr>
<tr>
<td>Total fractures</td>
<td>41 (100)</td>
</tr>
<tr>
<td>Upper thoracic (T1–T6)</td>
<td>6 (15)</td>
</tr>
<tr>
<td>Lower thoracic (T7–T12)</td>
<td>14 (35)</td>
</tr>
<tr>
<td>Lumbar</td>
<td>21 (50)</td>
</tr>
<tr>
<td><strong>Grade of fractures</strong></td>
<td></td>
</tr>
<tr>
<td>Grade 1</td>
<td>11 (27)</td>
</tr>
<tr>
<td>Grade 2</td>
<td>9 (22)</td>
</tr>
<tr>
<td>Grade 3</td>
<td>21 (51)</td>
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</tbody>
</table>

**Discussion**

The prevalence of incidental radiological vertebral fracture on sagittal spinal images reformatted from CT examination of the chest or abdomen was 13% in this audit of examinations performed on patients aged over 65 years. 77% of patients with a vertebral fracture identified had no previous history of vertebral fracture (thus a newly identified fracture), and in 83% of patients with contemporaneous plain films, no vertebral fracture was mentioned in the X-ray report. Thus, assessing sagittal spinal images from CT examinations of the chest or abdomen commonly detected otherwise unidentified vertebral fractures. Eight examinations were required to detect 1 patient with vertebral fracture, and 10 examinations to detect 1 patient with a newly identified vertebral fracture.

Vertebral fractures are the most common osteoporotic fracture with a prevalence of 10–20% at age 65 years, although they are often asymptomatic. Studies have shown that vertebral fractures are under-reported on plain films and CT. This may occur because the fracture was not seen on the radiology imaging. For example, many vertebral fractures cannot be diagnosed on chest films, or on spine axial or coronal CT images.

Another possibility is that the reporting radiologists see the fractures but choose not to report them because they are perceived as common, unimportant, or perhaps not relevant to the patient because of co-existing pathology. Regardless of the reason, this represents a lost opportunity to initiate a clinical review which may lead to intervention with osteoporosis treatments.

It is important to diagnose vertebral fractures because they are associated with increased risk of future fractures and mortality, whether diagnosed clinically or radiologically.

The Study of Osteoporotic Fractures Group found that women >65 years with prevalent vertebral fracture had a 5.4, 2.3, and 1.8 fold increased risk of subsequent
vertebral, hip, and non-vertebral fracture respectively over 3.7 years, and a 1.2-fold increased risk of mortality over 8.3 years.

In the Dubbo Osteoporosis Study, men and women >60 years with an incident vertebral fracture had a 1.8–2.1-fold increased risk of subsequent mortality. Treatment of patients with vertebral fractures effectively reduces further vertebral fractures by >50% and total non-vertebral fractures by 20–30%.

Effective treatment of patients with osteoporosis, of which vertebral fracture is often a hallmark, reduces mortality by approximately 10% over 3–4 years, particularly in the frail elderly. Thus, identification of a vertebral fracture should prompt a clinical review of fracture risk, and in many cases, will lead to osteoporosis treatment.

There was evidence of underreporting of vertebral fractures in our current audit: vertebral fractures identified in our audit were not mentioned in 45% of CT reports and in 83% of plain film reports. Further, osteoporosis and vertebral fracture were each mentioned in only 14% of the relevant discharge summaries or clinic letters, and only 31% of patients with vertebral fracture were treated for osteoporosis. Thus, the significance of the vertebral fractures appears to have been overlooked by radiologists and clinicians, important information regarding fracture risk was not entered in the medical record, and osteoporosis treatment was underused.

It is possible that although the information regarding vertebral fracture and osteoporosis treatment did not appear in the medical record, nevertheless the fracture was recognised and appropriate treatment instigated but not recorded, but this seems unlikely.

There are several advantages to assessing vertebral fractures on sagittal spine images from CT examinations of the chest and abdomen. The sagittal reformatting is quick (<1 min) and does not require additional radiation exposure. CT overcomes some of the technical limitations for imaging the spine in chest and spine radiography, such as superposition of other structures. Finally, the image quality is high, allowing better interobserver agreement than for other methods (Figure 1).
Figure 1. Reformatted sagittal image of the spine showing Grade 3 fractures of T12 and L1 vertebrae (arrows)

Taken together, the ability to accurately detect vertebral fractures, the high prevalence of vertebral fractures, and the changes in clinical management that should result from identification of a vertebral fracture strongly suggest that consideration should be given to routinely assessing reformatted sagittal spinal images for vertebral fractures in patients aged >65 years or at high risk of vertebral fractures undergoing CT examinations of the chest or abdomen.
Competing interests: None declared.

Author information: Pui Ling Chan, Endocrinology Registrar, Greenlane Clinical Centre, Auckland; Taryn Reddy, Radiologist, Vancouver General Hospital, Vancouver, BC, Canada; David G Milne, Radiologist, Auckland District Health Board, Auckland; Mark J Bolland, Senior Research Fellow, Department of Medicine, University of Auckland

Correspondence/reprints: Pui Ling Chan, Department of Endocrinology, Greenlane Clinical Centre, Private Bag 92 024, Auckland, New Zealand. Email: PuiLingC@adhb.govt.nz

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