

Reporting of Osteoporotic Vertebral Fracture Detected Opportunistically on Thoraco-abdominal Computed Tomography

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ABSTRACT

Introduction: The aim of the present study was to investigate the reporting of opportunistic vertebral fracture detected on sagittal spinal reconstructions during thoraco-abdominal computed tomography (CT) examinations.

Methods: CT examinations and radiological reports of 500 patients aged >50 years, with no known malignancy or recent trauma history, who underwent thoraco-abdominal CT examinations from March to June 2017 at our hospital were reviewed. The study group included 290 men and 210 women, mean age 65 ± 9 years. A standardised semi-quantitative approach was used to identify and grade vertebral fracture. All cases were reviewed by a single experienced musculoskeletal radiologist. Patients with clear metastatic fracture (n = 31) were excluded. CT reports of all patients with osteoporotic vertebral fracture were reviewed.

Results: Of 469 patients, 69 (15%) had one or more fractures. Of these fractures, only 29 (42%) were reported in the CT reports. The terminology used for fracture description was ambiguous in 25 (86%) of the 29 reports including terms such as 'collapse' (n = 20, 80%), 'wedging' (n = 4, 16%), and 'loss of height' (n = 1, 4%). In no case was the severity of the fracture accurately recorded in the radiological report.

Conclusion: Opportunistic osteoporotic vertebral fractures were mostly unreported. For fractures that were reported, descriptions were ambiguous and severities were under-reported. Radiologists are encouraged to routinely report clinically relevant osteoporotic vertebral fractures on thoraco-abdominal CT accurately and non-ambiguously.

Key Words: Osteoporosis; Spinal fractures; Tomography

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中文摘要

在檢查目的非為脊柱時胸腹電腦斷層掃描報告骨質疏鬆性椎體骨折的情況

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引言：本研究旨在檢視胸腹電腦斷層掃描（胸腹CT）檢查期間於矢狀脊柱重建術中有機會性發現椎體骨折的情況。

方法：回顧2017年3月至2017年6月在本院接受胸腹CT檢查的500例50歲以上，無惡性腫瘤或近期外傷史患者的CT檢查及影像學報告。研究組包括290名男性和210名女性，平均年齡 65 ± 9 歲。使用標準半定量方法來識別和分級椎體骨折。由轉移性腫瘤引發的椎體骨折患者（ $n = 31$ ）被排除在外。本文回顧了所有CT報告中提到有骨質疏鬆性椎體骨折的病人圖像。

結果：在469例患者中，有69例（15%）有一個或多個骨折。在這些骨折報告中，CT報告佔29例（42%），當中25個（86%）用於描述骨折的術語不明確，包括「塌陷」（ $n = 20$ ，80%）、「楔形」（ $n = 4$ ，16%）和「高度下降」（ $n = 1$ ，4%）。放射學報告中均沒有準確記錄骨折的嚴重程度。

結論：在檢查目的非為脊柱時，骨質疏鬆性椎體骨折多數未被報告。有報告的骨折其描述多不明確，也未報告其嚴重程度。應鼓勵放射科醫生在日常報告書寫中準確地報告經胸腹電腦斷層掃描檢測到的骨質疏鬆性椎體骨折。

INTRODUCTION

Osteoporosis affects one in four women and one in 12 men over the age of 50 years.^{1,2} Osteoporosis is characterised by weakened bone predisposing to fracture. The hallmark of osteoporosis is an insufficiency fracture.³ An insufficiency fracture is a fracture occurring either spontaneously or during minimal trauma (defined as falling from a standing height or less). Bone fracture is the overriding negative effect of osteoporosis. All health warnings, preventative measures, and screening procedures for osteoporosis have but one goal in mind and that is to prevent osteoporotic fracture. Once an osteoporotic fracture is present, the likelihood of a further osteoporotic fracture is markedly increased.⁴ Osteoporotic fractures mainly occur in the vertebral body, the proximal femur, and the distal radius.⁵ These bones areas are affected as they depend relatively more on trabecular bone for their strength. Although osteoporosis is characterised by compromised cortical as well as trabecular bone strength, trabecular bone is preferentially affected initially. Vertebral body fractures are the earliest and most common osteoporotic fracture to occur.⁶ A vertebral insufficiency fracture provides indisputable evidence of reduced bone strength and therefore osteoporosis irrespective of bone density results.⁶ Most patients with osteoporotic fracture will have normal or reduced dual X-ray absorptiometry

rather than osteoporotic range T-scores.⁷ Recognition and treatment of vertebral body fractures at an early stage can prevent subsequent vertebral body, proximal femoral, or other osteoporotic fractures.^{4,8}

One of the best things that the radiologist can do to prevent osteoporotic fracture is to routinely report the presence of vertebral fractures seen opportunistically on sagittal reconstructed images of the spine on thoraco-abdominal computed tomography (CT) investigations. Reporting of these fractures in a clear, unambiguous manner will allow more patients with osteoporosis to be identified. If appropriate treatment is started, this should reduce the risk of subsequent fracture. The present study investigated the reporting of opportunistically detected fractures of the thoracolumbar spine seen on routine CT examinations performed in a general hospital setting.

METHODS

Thoraco-abdominal CT examinations of 500 consecutive patients that had been performed between March and June 2017 in the Prince of Wales Hospital, Hong Kong were reviewed. Patients had to be aged >50 years, with no known recent trauma history or known metastatic bone disease. Sagittal images of the thoracolumbar spine were reconstructed. These sagittal images were reviewed by a single experienced musculoskeletal

radiologist for identification of vertebral fracture. Patients with clear or suspicious metastatic fracture were further excluded. If there was any doubt as to the presence or the nature of a vertebral fracture, the patient was not included. Fractures were diagnosed based on loss of vertebral body height \pm unambiguous contour deformity such as endplate fracture.

Fracture location and fracture severity were noted. Fracture severity was graded using an established semi-quantitative approach with a mild fracture defined as 20% to 25% reduction in vertebral body height compared to what one would normally expect this height to be based on experience. A moderate fracture is defined as being 25% to 40% reduction in vertebral body height and a severe fracture being $>40\%$ reduction in vertebral body height.⁹

All radiology reports were reviewed to determine (i) whether a vertebral fracture was reported; (ii) the terminology used to describe this fracture, and (iii) whether the severity of fracture was noted.

RESULTS

Of the 500 patients (290 men, 210 women; mean age 65 ± 9 years), 31 were excluded owing to metastatic fracture. Of the remaining 469 patients, 69 (15%) patients had one or more fracture comprising a total of 106 fractures, 54 (51%) of which were located in the thoracic spine and 52 (49%) in the lumbar spine. No fracture was located proximal to T5. Fifty-three (50%) of the 106 fractures were mild (Figure 1), 27 (25%) were moderate (Figure 2), and 26 (25%) were severe (Figure 3).

Of the 69 patients with one or more vertebral fracture, 29 (42%) had a vertebral fracture reported in the radiology report. This patient group had 54 (51%) of the overall 106 vertebral fractures. Of these 54 vertebral fractures, eight were reported unambiguously and the remaining 46 fractures were reported ambiguously using terms such as ‘collapse’ ($n = 20$), ‘wedging’ ($n = 4$) or ‘loss of height’ ($n = 1$) rather than vertebral fracture (Figures 1 and 2). Of the 54 reported vertebral fractures, 16 (30%) were mild, 17 (31%) were moderate, and 21 (39%) were severe. Fracture severity was not reported in any patient’s CT report.

Of the 69 patients with one or more vertebral fracture, 40 (58%) patients had no vertebral fracture reported in the radiology report (Figure 3). This patient group had 52 (49%) of the overall 106 vertebral fractures. Of these 52



Figure 1. Sagittal reconstruction of thoracolumbar spine junction from abdominal computed tomography examination. Mild fracture L1 vertebral body (arrow). This was ambiguously reported as “wedging of the L1 vertebral body”.



Figure 2. Sagittal reconstruction of lumbar spine from abdominal computed tomography examination. Severe fracture of the L1 with moderate fracture of the L2 vertebral body (arrows). These were ambiguously reported as “collapse of the L1 and L2 vertebral bodies”.



Figure 3. Sagittal reconstruction of thoracolumbar spine junction from abdominal computed tomography examination. Severe fractures of the L1 and L2 vertebral bodies with a moderate fracture of the L4 vertebral body (arrows). These fractures were not reported.

vertebral fractures, 37 (71%) were mild, 10 (19%) were moderate, and five (10%) were severe.

Of the 69 patients with vertebral fracture, four (6%) were taking anti-osteoporotic medication (calcium carbonate in all) at the time of CT. After CT, one patient with a vertebral fracture reported was prescribed calcium carbonate and one patient had a follow-up bone density absorptiometry arranged by the attending physician. No other patients with a vertebral fracture had any change in medication or management as a result of the CT showing a vertebral fracture.

DISCUSSION

The prevalence of vertebral fractures in the present study was 15%, which is similar to previous studies with a vertebral fracture prevalence ranging from 9.5% to 24%.¹⁰⁻¹³ Only 42% of vertebral fractures visible on sagittal spine reconstructions in patients undergoing CT for unrelated disorders were reported. The terminology used to describe these vertebral fractures was ambiguous in 86% of cases. Fracture severity was not reported in any case. Only one patient had new treatment initiated as a result of a vertebral fracture being present. Although not ideal, the findings of the present study are similar to those reported recently in several similar studies conducted mainly in Europe and America. Only about 30% to 40% of the fractures present on thoraco-abdominal CT examination were reported in these studies with only a fraction of these cases receiving treatment.¹⁰⁻¹⁴

As shown in the present study, insufficiency fractures of the vertebral bodies are not uncommon in older patients. Less than half of these fractures were reported. This under-reporting most likely reflects under-recognition of the clinical importance of such fracture rather than any particular difficulty in vertebral fracture identification for most clinical radiologists. As seen from previous studies, this is a worldwide phenomenon.¹⁰⁻¹⁴ The vertebral fracture initiative programme was started over 10 years ago by the International Osteoporosis Foundation specifically to encourage a greater recognition and reporting of vertebral fractures detected opportunistically on imaging studies.¹⁵

Fracture severity was not reported in any case. Vertebral body fractures are unlike fractures in the appendicular skeleton in that they are often incremental in nature, progressing over time from mild to moderate to severe degrees of severity. Most of the fractures present were mild, in keeping with a known greater prevalence of

mild over moderate or severe fractures in screening populations studies of older patients. The fracture spectrum seen in the present study is comparable to that seen in similar studies. Fracture severity is an important feature to report as it is related to the degree of deterioration in bone quality. Patients with moderate or severe fracture have greater deterioration in bone quality than patients with mild fracture.¹⁶ That withstanding, all patients with an insufficiency fracture nevertheless have osteoporosis and are at a greater risk of the subsequent fracture than the general population.

Of those fractures which were reported, ambiguous terminology was used in most cases. Use of ambiguous terminology does not help clearly convey the message that there is an osteoporotic fracture present. If a vertebral fracture is visible, this should be reported in a clear unambiguous manner, i.e., clearly stating that there is a vertebral fracture present that is either mild, moderate, or severe in degree. It is reasonable to use a combination of terms such as 'moderate-severity anterior wedge fracture', or 'mild fracture collapse' as such description so include the term "fracture". A fracture in any other part of the skeleton is always called a fracture so the same terminology should be used to describe vertebral body fractures.

The presence of an insufficiency fracture, in the absence of other causes of bone weakening such as osteomalacia, renal osteodystrophy, is diagnostic of osteoporosis. An insufficiency fracture provides direct indisputable evidence of bone weakening and far outweighs any bone density result in this respect. In fact, most patients presenting with an osteoporotic fracture will have a normal (>-1.0) or low bone mass (>-2.5) T-score bone density result range rather than it being in the osteoporotic (<2.5) range. The clinical benefit of reporting these fractures is real.

Less than 10% of the patients with prevalent fracture received anti-osteoporotic medication. This too, is in line, with reported findings where about 28% of patients were shown to receive specific anti-osteoporotic treatment. This relative under-treatment can reflect under-recognition as to the clinical importance of vertebral fracture, the cost of treatment, the feasibility of treatment and co-occurrence of other overriding medical concerns. Although patients with prevalent vertebral fractures detected in population screening programmes have a clear reduction in subsequent incident fractures if started on treatment, no study has addressed whether

patients with opportunistically detected fractures would achieve a similar benefit from anti-osteoporotic medication, though circumstances would suggest that this would most likely be the case.

The primary aim of the present study was to investigate whether obvious non-malignant vertebral fractures were being reported. It was assumed that all the vertebral fractures included were osteoporotic in nature. This may not be the case. A small percentage of those included may have been malignant or traumatic in nature. In clinical practice, it would be necessary to fully exclude a malignant or traumatic aetiology before commencing anti-osteoporotic medication. Most malignant fractures can be readily distinguished on CT imaging though magnetic resonance imaging many very occasionally be required to firm up this distinction. In the current study, if any suspicion existed regarding the nature of a vertebral fracture on initial CT, the patient was excluded. Traumatic vertebral fractures occur only during severe spinal trauma or during a grand mal seizure, both of which can be excluded in the clinical history. Traumatic vertebral body fractures are uncommon and infrequently encountered in patients <50 years. The possible inclusion of some malignant or traumatic fractures as osteoporotic fractures would not have significantly skewed the present results.

In summary, radiologists can benefit patient care by routinely reporting vertebral fractures in a clear, unambiguous manner. Currently, such opportunistically detected fractures are likely to be both unreported and ambiguously reported. Such insufficiency fractures provide clear evidence of reduced bone strength, i.e., the existence of osteoporosis irrespective of subsequent bone density measurement. Timely intervention with anti-osteoporotic medication in patients with such opportunistically detected insufficiency fractures may prevent further osteoporotic fracture.

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