Opportunistic Diagnosis of Vertebral Fractures Using Routine CT Scans: The Portuguese Experience

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BACKGROUND AND AIMS

Vertebral fractures are among the most common fragility fractures in patients with osteoporosis, accounting for nearly 50% of all osteoporotic fractures, as described in the WHO report on osteoporosis prevention and management[1] and in the epidemiological analysis by Johnell and Kanis.[2,3] Their clinical relevance extends far beyond the initial event, as patients who sustain a vertebral fracture are approximately five times more likely to develop subsequent vertebral fractures and have a twofold increased risk of hip fracture, according to Lindsay et al.[4] These fractures are associated with substantial morbidity, mortality, reduced quality of life, and increased healthcare costs.[2] Furthermore, many vertebral fractures remain clinically silent and therefore undiagnosed, contributing to the progression of osteoporosis without adequate treatment, a problem highlighted in the IMPACT study by Delmas et al.[5]

The mid-thoracic spine and the thoracolumbar junction are the regions that are most frequently affected, likely due to the biomechanical stresses concentrated in these transition zones. Progressive vertebral collapse often results in kyphotic spinal deformities, which may significantly impair posture and physical function. These deformities predispose patients to chronic pain, loss of balance, increased risk of falls, muscle fatigue, and accelerated degenerative changes of the intervertebral joints. In more advanced cases, thoracic kyphosis may also contribute to restrictive pulmonary disease, decreased exercise tolerance, and progressive sedentarism or immobilisation, further worsening frailty and overall functional decline.[6]

Despite their importance, vertebral fractures are frequently underdiagnosed in routine clinical practice. Some authors demonstrated that radiologists often overlook or fail to report those fractures when imaging studies are performed for unrelated clinical indications, such as chest or abdominal evaluation.[5] This underreporting represents a missed opportunity for early diagnosis and intervention, particularly because identification of a vertebral fracture should prompt investigation and treatment of underlying osteoporosis in order to reduce the burden of future fragility fractures, as recommended in the European guidance by Kanis et al.[3]

Several imaging modalities can be used to identify those fractures. Conventional radiography, including anteroposterior and lateral spine projections, remains the first-line imaging technique and is widely used for fracture detection and morphologic assessment. Genant et al.[7] described the semiquantitative technique that remains one of the most widely accepted methods for vertebral fracture assessment. Conventional radiography can be used particularly if vertebral fracture assessment (on dual X-ray absorptiometry) is not available.[3] CT provides excellent bony detail and can detect fractures incidentally on studies performed for other indications. MRI, particularly with short tau inversion recovery sequences, is especially valuable in differentiating acute from chronic fractures by demonstrating bone marrow

oedema. Bone scintigraphy may also aid in identifying metabolically active fractures, particularly in cases with multiple lesions or unclear symptom localisation.[6]

MATERIALS AND METHODS

More recently, during 1 year, in a tertiary hospital with an already implemented Fracture Liaison Service programme, two imagiologists prospectively analysed 430 thoracic, abdominal, and pelvic CT scans performed for other diagnostic purposes, in order to identify vertebral fractures.[8]

RESULTS

Two hundred and six patients (48%) were identified with vertebral fractures, 74 patients (36%) were eligible for osteoporosis management, and 68 patients (33%) died during the data collection; these patients were significantly older (84 versus 75 years; p<0.01) and more frequently had ≥2 vertebral fractures (47% versus 28%; p=0.02). Twelve patients (16%) had a previously known fragility fracture and had never been on anti-osteoporotic drugs. Furthermore, 28% were active smokers, 22% were receiving oral anticoagulants, 32% were taking antidepressants and/or antipsychotics, and 20% were using oral or inhaled corticosteroids.

CONCLUSION

This Portuguese work has shown that within 1 year of opportunistic CT scan evaluation, a vulnerable population could be identified for osteoporosis management and fracture risk reduction intervention measures. It also helped with the understanding that untreated and undiagnosed vertebral fractures can significantly impact a patient's quality of life and life expectancy.

Inappropriate or ambiguous terminology in CT reports may create confusion for referring clinicians and contribute to underdiagnosis of vertebral fractures. Descriptions such as "vertebral height loss," "wedging," "endplate deformity," or "degenerative change" are often used without explicitly identifying the presence of a vertebral fracture, thereby reducing the likelihood of appropriate clinical follow-up.[9] Since many of these fractures are detected incidentally on CT examinations performed for unrelated indications, failure to use clear and standardised terminology may result in missed opportunities for osteoporosis assessment and secondary fracture prevention.[10]

Educational initiatives directed at radiologists have been shown to improve awareness and reporting of osteoporotic vertebral fractures. Other authors emphasised the importance of adequate training in vertebral fracture assessment and standardised interpretation methods. Basic training programmes emphasising the radiological appearance of those fractures, the importance of standardised reporting, and the clinical implications of these findings could significantly enhance diagnostic accuracy and communication with referring physicians.[11]

The adoption of structured reporting systems and internationally recognised classification criteria may further reduce variability in interpretation and facilitate earlier diagnosis, timely referral, and initiation of anti-osteoporotic treatment, in line with the recommendations of the International Osteoporosis Foundation (IOF) through the 'Capture the Fracture' Best Practice Framework.[12]

More recently, AI-based vertebral fracture detection algorithms have been developed to operate in real-world clinical settings. Burns et al.[13] demonstrated that automated CT-based systems are capable of detecting vertebral compression fractures and assessing bone density with promising accuracy. Similarly, others showed that deep learning models can automatically identify osteoporotic vertebral fractures on CT scans with high sensitivity and specificity.[14] According to a systematic review, AI-assisted tools may be particularly valuable in high-volume radiology workflows, where subtle fractures are more likely to be overlooked due to time constraints or competing diagnostic priorities.[15]

In addition to improving fracture detection rates, AI technologies have the potential to optimise the efficiency of Fracture Liaison Services by facilitating automated patient identification and referral pathways. The IOF highlighted the importance of coordinated secondary fracture prevention programmes,[12] and AI-supported imaging analysis may further strengthen these initiatives. More recently, Behanova et al.[16] demonstrated the clinical relevance of opportunistic AI-supported detection of vertebral fractures on routine CT scans, showing that early recognition of incidental vertebral fractures may enable prompt osteoporosis evaluation and treatment, ultimately reducing the risk of subsequent fragility fractures and their associated healthcare burden.

As these technologies continue to evolve, their integration into routine radiological practice may become an important component of comprehensive osteoporosis care and secondary fracture prevention strategies.

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