

The diagnostic pathway in acute vertebral fragility fractures

Il percorso diagnostico delle fratture vertebrali da fragilità in acuto

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KEY WORDS

VCFs • Imaging • Laboratory

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Summary

Vertebral compression fractures (VCFs) are a common and frequent clinical manifestation of pathological conditions of bone fragility. The clinical VCF starts with a localized pain, initially also small, that tends to worsen rapidly and to become constant and then decrease slowly. It is usually in relation to a minimal trauma and a simple x-ray of the spine is often sufficient to confirm the clinical suspicion. But, if the radiological diagnosis of a fracture is simple and immediate, we cannot say the same for the identification of the causes. A structural collapse of a vertebral body in acute can hide many diagnostic dangers and the inappropriate use of the different imaging methods sometimes complicates rather than simplifies the diagnosis.

Riassunto

Le fratture vertebrali da compressione (VCFs) sono una manifestazione clinica comune e frequente delle osteopatie da fragilità. La VCF clinica esordisce con un dolore localizzato, che inizialmente può essere anche di modesta entità, e tende ad aggravarsi rapidamente e a diventare continuo per poi ridursi lentamente. Esso è di solito in relazione ad un trauma minimo ed una semplice RX del rachide spesso è sufficiente per confermare il sospetto clinico. Ma se la diagnosi radiologica di una VCF è semplice ed immediata, non altrettanto si può dire lo sia l'individuazione delle cause. Un cedimento strutturale di un corpo vertebrale in acuto può nascondere numerose insidie diagnostiche ed il ricorso inappropriato alle varie metodiche di imaging talvolta complica anziché facilitare la diagnosi.

Introduction

Vertebral compression fractures (VCFs) are a common and very frequent clinical manifestation of pathological bone conditions that reduce the resistance. They can start with an acute and worsening pain in the spine, mainly localized to the middle thoracic part or to thoracolumbar transition, or with a small pain that increases in orthostasis and decreases in clinostasis, and then they are slowly resolved over the next few months. Anamnestically, the onset of pain is often related to a minimal trauma, such as lifting a small weight, for example the shopping bag, and the simple x-ray of the spine is sufficient to establish the presence of a VCF. But, if the radiological diagnosis of a vertebral fracture is simple and immediate, we cannot say the same for the identification of the causes. In fact, the structural collapse of a vertebral body in acute can hide many diagnostic dangers and the use of the different available imaging methods for the skeleton, if not appropriate and properly interpreted, may sometimes be a confounding factor for a correct clinical diagnosis¹. The VCF could be defined as a deformity of the vertebral body that is established in conditions of reduced

bone strength. It is known that a VCF increases the risk of new VCFs, significantly alters the quality of life and increases the risk of mortality in the medium term. In the presence of VCFs, all pathological conditions which can affect bone strength should be considered in the differential diagnosis (Tab. I). The use of laboratory and imaging diagnostic is necessary to identify the causes and for the differential diagnosis.

Tab. I. Causes of Vertebral Fragility Fractures.

metabolic osteopathies
osteoporosis
primary (postmenopausal, senile)
secondary (endocrine, myeloproliferative, drugs, etc.)
osteomalacia
Paget's disease
osteogenesis imperfecta
renal osteodystrophy
inflammatory osteopathies
infectious spondylitis
rheumatic spondylitis
neoplastic osteopathies
primary and secondary malignant (metastasis)
benign (angiomas, cysts, etc.)

Tab. II. Clinical approach to the patient with VCFs (1).

Clinical history and evaluation	
a)	assessment of pain symptoms <ul style="list-style-type: none"> • characteristics <ul style="list-style-type: none"> - acute (macrofracture) - subacute (microfracture) • mode of onset of pain <ul style="list-style-type: none"> - low energy trauma - high energy trauma • type <ul style="list-style-type: none"> - at load - at rest • amount (VAS) • duration • location <ul style="list-style-type: none"> - middle-thoracic - thoraco-lumbar
b)	objectivity <ul style="list-style-type: none"> • height decrease • alteration of the physiological curves • pressure pain spinous apophysis and musculature
c)	search for risk factors for fragility fractures

The correct approach to the patient with VCF in acute starts with the evaluation of pain symptoms, the identification of clinical signs referable to postural imbalances caused by the VCFs and the search for risk factors for fractures (Tab. II).

The correct approach continues with the request for laboratory investigations (Tab. III). In the VCFs, the recourse to the laboratory provides a valuable aid in the differential diagnosis and directs towards targeted imaging studies. A lot of information related to the turnover and bone mineralization, as well as to the presence of organ diseases which cause skeletal injuries, can be obtained from laboratory tests (Tab. IV). The information obtained from the medical history and physical examination must be taken into account in the request for laboratory tests². Even the use of diagnostic imaging, complementary to the laboratory, must be based on the same information.

The imaging in the VCFs^{3,4}, in addition to the traditional x-ray, includes bone scan, MRI and CT; each of these methods provides different information whose interpre-

Tab. III. Clinical approach to the patient with VCFs (2).

Laboratory tests and clinical significance	
CBC	Hematologic diseases, malabsorption
Creatinine	Renal function
Protein profile	Hypoalbuminemia, monoclonal gammopathy
ESR	Inflammations, infections, vasculitis, connective tissue, neoplasms (nonspecific)
Calcaemia	Alterations in mineral metabolism
Phosphorus	Alterations in mineral metabolism
ALP (BALP)	Osteogenic activities osteopathies
Hypercalciuria 24h	Intestinal calcium absorption, renal reabsorption of calcium
PTH	Hypercalcemic and hypocalcemic syndromes
25(OH)D	Intestinal malabsorption
BGP, BALP, PINP	High turnover osteopathies
CTX, NTX, DPD	High turnover osteopathies
TSH	Hyperthyroidism
Cortisol	Hypercorticism
PRL, LH, FSH, Testosterone, 17βE	Hypogonadism
Anti-transglutaminase ab	Celiac disease
Tumor markers	Metastatic osteopathy

Tab. IV. Clinical approach to the patient with VCFs (3).

Disorders of bone mineral metabolism and clinical significance							
Pathology	Ca s	P s	BALP	PTH	25(OH)D	Ca u/24h	P u/24h
Osteoporosis	[=]	[=]	[=]	[=]	[=]	[=]	[=]
Osteomalacia	[-]	[-]	[++]	[+]	[--]	[-]	[-]
Hyperparathyroidism	[+]	[-]	[+]	[++]	[=]	[+]	[+]
Paget's disease	[=]	[=]	[+++]	[=]	[=]	[=]	[=]
Renal osteodystrophy	[-]	[+]	[+]	[++]	[=]		
Neoplastic osteopathy	[++]	[=/-]	[++]	[--]	[=/-]	[++]	[+]

Ca s = calcaemia; P s = phosphorus; BALP = bone alkaline phosphatase; PTH = parathormone; 25(OH)D = vitamin D; Ca u/24h = calciuria 24 hours; P u/24h = phosphaturia 24 hours; [=] = normal values; [-] = values decreased; [+] = values increased

Fig. 1. X-ray of the spine. T12 vertebral deformity in fragility fracture in acute. The repetition of the X-ray examination after a month.



Fig. 2. Bone scintigraphy. Bone metastases from cancer of the breast.



tation is not possible without a comprehensive assessment. In the presence of VCFs, the reliable information obtainable from the traditional x-ray concern the number, degree, and characteristics of the vertebral deformities as well as the monitoring over time. In the VCF in acute, the repetition of the x-ray examination after a short time allows to follow its evolution⁵ (Fig. 1). Moreover, the traditional x-ray can suggest the use of more specific surveys in case of difficulty in the interpretation of the imaging⁶⁻¹⁰ (Tab. V).

In the presence of VCFs, the use of bone scintigraphy, panoramic and extremely sensitive, although nonspecific, survey, is indicated in the suspect of systemic osteopathy in order to identify a multifocality of the locations; its performance is strongly recommended in case of high ERS values. However, it must be taken into account that this test is able to provide precise information on

the spread of the disease (Fig. 2) but not on the type of disease, which must be investigated in some other way, even if it is sometimes possible to envisage the diagnosis thanks to some peculiar characteristics, such as the location, intensity of hypercaptation, and asymmetry of the lesions^{11 12} (Tab. V).

MRI of the spine in VCFs is very useful because it allows to distinguish the altered signal due to bone marrow edema in T2 and STIR, old from recent fractures and to identify not yet deformed vertebrae in which the structural collapse is imminent (Figs. 3, 4). However, the verification of a widespread alteration in the signal is possible even in infectious, or only inflammatory, spondylitis in which the differential diagnosis can, sometimes, be difficult, especially in the presence of nonspecific biochemical alterations¹³ (Tab. V).

The spine CT should always be performed on completion of what emerges by scintigraphy or MRI when there are doubts about the nature of the bone lesion. In fact, with the CT, it is possible to study in detail the spinal injury, obtaining information about the possible dis-

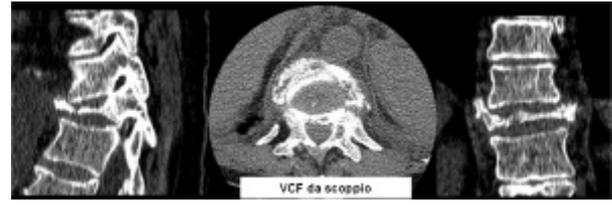
Tab. V. Clinical approach to the patient with VCF (4).

Imaging and clinical significance	
X-ray	Diagnosis of fracture Morphometric evaluation (<i>number, degree, characteristics</i>) and monitoring
Scintigraphy	Presence and distribution of areas of altered bone remodeling (<i>Paget's disease, pseudofractures, occult fractures, osteitis, metastases, primary bone tumors</i>) Dating of radiologically detected fractures
MRI	Occult fractures Completion of X-ray information (<i>distinction of fresh and old VCFs</i>) Completion of information about areas of scintigraphic hypercaptation
CT	Completion of X-ray information (<i>osteolysis, bone fragments in the medullary canal</i>) Completion of information about areas of scintigraphic hypercaptation

Fig. 3. MRI of the spine. Altered signal for fragility fracture in L2 and for imminent structural collapse in L1.



Fig. 4. CT of the spine. Structural collapse in L1.



osteosclerotic lesions, and, finally, to correctly interpret the causes of an altered signal on MRI or of an area of scintigraphic hypercaptation (Tab. V).

Conclusions

The spine x-ray is sufficient to identify a VCF; however, in order to diagnose any underlying osteopathy, no laboratory or instrumental examination is able to solve the diagnostic problem by itself. Only the integration of clinical evaluation and laboratory and imaging investigation allows to make a diagnosis.

It must be considered that, even in the presence of a correct diagnostic approach to the VCFs in acute, sometimes the use of bone biopsy is necessary in order to arrive at a diagnosis of certainty.

placement of bone fragments within the medullary canal (Fig. 4), the mode of distribution of the fracture lines of force in the vertebral body, the presence of osteolytic or

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