Case 11

Diagnosis of Bone Marrow Edema Associated with Metastases from SCLC using Dual Energy CT

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History

A 73-year-old male patient, with palliatively treated small cell lung cancer of the right lung, presented for an oncological re-staging CT. To date, there were no known bone metastases. The patient had a history of chronic back pain with slight aggravation during the weeks prior to the planned CT scan. The clinical examination revealed slightly diffuse pain over the middle thoracic spine with no neurological deficits.

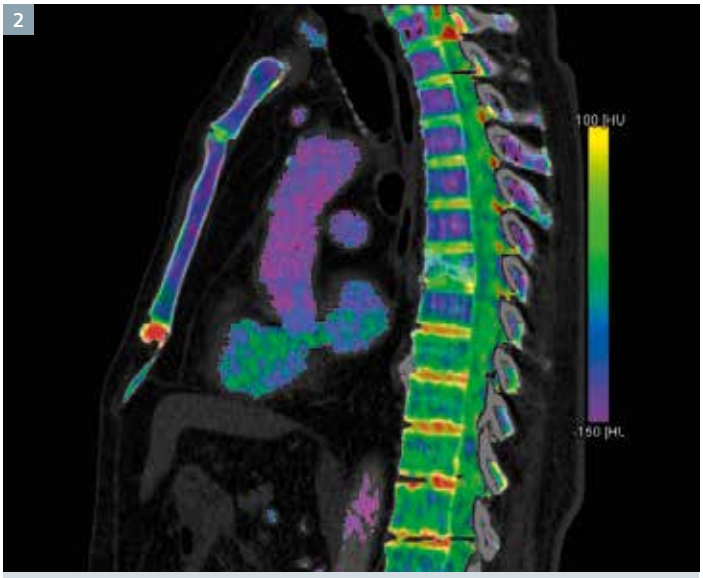
Diagnosis

A contrast-enhanced CT scan of the chest was performed on a SOMATOM Definition Flash operated in dual energy (DE) mode. Standard linear blended sagittal reformations demonstrated a diffusely hypersclerotic seventh thoracic vertebra (Th7) with deformation of the ground plate (Fig. 1). The adjacent vertebrae showed typical osteoporotic texture, with fatty replacement of the bone marrow, aggravated by prior radiation and chemotherapy. After a DE-based calcium subtraction, a diffuse signal increase of the bone marrow of Th7, consistent with edema, was visible (Fig. 2). The bone marrow edema was confirmed in MRI on TIRM (Fig. 3A) and native T1 TSE (Fig. 3B). The contrast-enhanced T1w series showed strong gadolinium uptake (Fig. 3C) indicating an active tumor process.

Comments

Standard single energy CT is primarily performed for imaging of a compression fracture of the vertebra. However, it falls short in the differentiation between an old fracture and a new one. This is due to the fact that a bone marrow edema, feature of a fresh fracture,

1 Standard line ablended sagittal CT reconstruction shows a compression fracture of the seventh thoracic vertbra with suspect osteolytic and sclerotic areas.



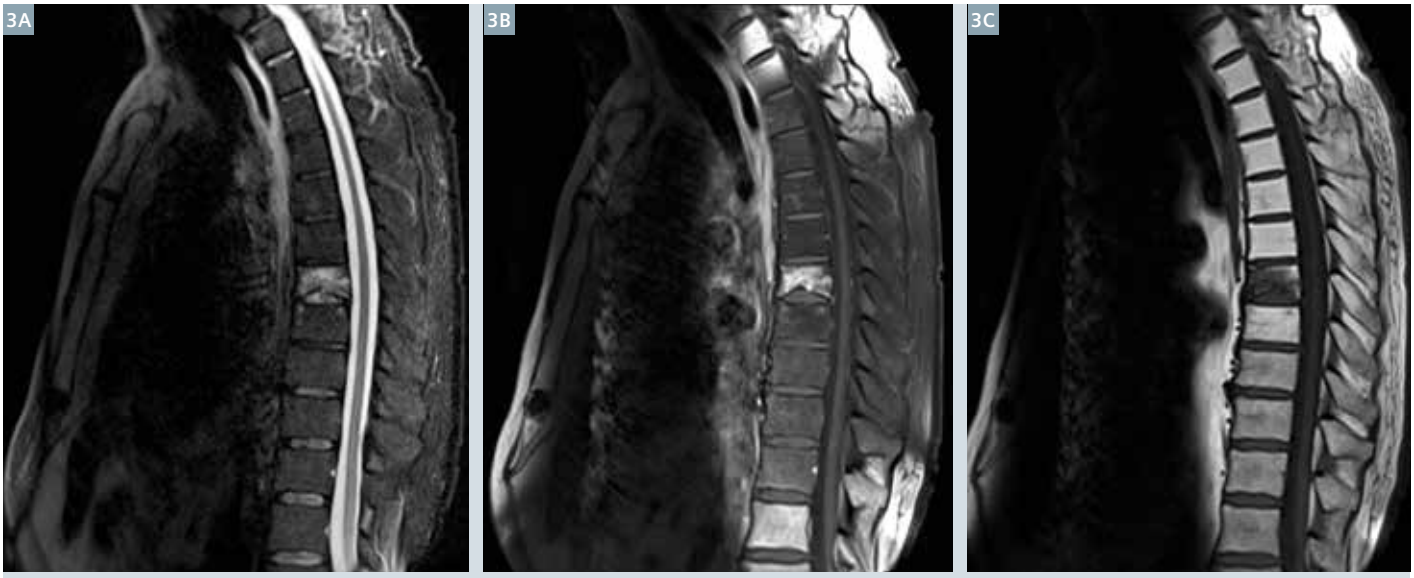
2 A sagittal bone marrow image reveals a clear visualization of the bone marrow edema of the fractured vertebra.

may be masked by underlying high-density structures such as a calcium deposit. Contrast-enhanced MRI as well as nuclear medicine (NM), with a standard bone scan or PET, are normally the suitable methods to differentiate these structures. While NM bases the diagnosis on tumor metabolism, MRI uses the features of signal alterations, in T1- and T2-weighted as well as Gd-enhanced T1-weighted sequences, hereby showing active metastases. This usually results in a low signal in native T1 and a high signal, consistent with edema, in T2 FS with markedly increased contrast uptake. DECT, with the possibility of suppressing calcium information, may provide information on water retention in tissues similar to MRI. ■

The outcomes by Siemens' customers described here in are based on results that were achieved in the customer's unique setting. Since there is no "typical" hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption), there can be no guarantee that othercustomers will achieve the same results.

Examination Protocol

Scanner	SOMATOM Definition Flash
Scan area	Thorax
Scan length	320 mm
Scan direction	Cranio-caudal
Scan time	17 s
Tube voltage	80 / Sn140 kV
Tube current	153 / 61 mAs
Dose modulation	CARE Dose4D
$CTDI_{vol}$	6.02 mGy
DLP	207 mGy cm
Effective dose	2.9 mSv
Rotation time	0.5 s
Pitch	0.6
Slice collimation	32 × 0.6 mm
Slice width	3 mm
Reconstruction increment	3 mm
Reconstruction kernel	D34f / B70f
Contrast	
Volume	60 mL
Flow rate	2 mL/s
Start delay	50 s



3 Correlating MR TIRM (Fig. 3A) and T1 TSE (Fig. 3B) sagittal images confirm the bone marrow edema. Diffuse contrast enhancement of the vertebra confirms pathologic genesis (Fig. 3C).