

Basic Science

Pseudopathologic vertebral body enhancement in the presence of superior vena cava obstruction on computed tomography

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Abstract

BACKGROUND CONTEXT: Superior vena cava (SVC) obstruction can cause the development of collateral vessels. During contrast-enhanced thoracic computed tomography (CT), contrast material may reflux into the collaterals such as paravertebral venous plexus. However, an unusual pseudopathologic vertebral body enhancement on CT in the presence of SVC obstruction has not been studied previously.

PURPOSE: To demonstrate clinical presentation and imaging findings of pseudopathologic vertebral body enhancement in patients with SVC obstruction.

STUDY DESIGN: Retrospective study of diagnostic CT images examined at our clinic.

PATIENT SAMPLE: From March, 2009 to September, 2012, a retrospective radiologic database review was performed to identify patients with obstruction of SVC causing contrast reflux into collateral vessels and presented with an unusual vertebral body enhancement on thoracic CT. Thirteen patients (11 men, mean age 51.4 years) with vertebral body enhancement were enrolled.

OUTCOME MEASURES: Enhancement patterns of vertebral bodies were classified as nodular enhancement with round shape occupying less than one-third of vertebral body or polygonal enhancement occupying greater than or equal to one-third of vertebral body on axial image. The locations of enhanced areas within vertebral bodies were described using right lateral/central/left lateral, anterior/posterior, and upper/middle/lower in the x-, y-, or z-axis directions, respectively.

MATERIALS AND METHODS: Enhancement patterns, locations, and the presence of a connection between vertebral body enhancement and the paravertebral venous plexus were evaluated.

RESULTS: A total of 39 vertebral body enhancements were found in the 13 patients, involving cervical (n=12), thoracic (n=25), or lumbar (n=2) vertebrae. Vertebral body enhancements showed a nodular (n=19) or a polygonal (n=20) pattern. The central portions of vertebral bodies were more frequently involved. The connection to the paravertebral venous plexus was observed in 34 lesions (87.2%).

CONCLUSIONS: Patients with SVC obstruction with extensive collateral vessels might exhibit a pseudopathologic vertebral enhancement. They tended to involve the central portion of the vertebral body, and most of them showed connection to the paravertebral venous plexus. © 2015 Elsevier Inc. All rights reserved.

Keywords: Superior vena cava; Collateral circulation; Computed tomography; Thorax; Vertebra

FDA device/drug status: Not applicable.

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Introduction

Superior vena cava (SVC) obstruction is a complication of both malignant and benign diseases that occlude the SVC and subsequently direct blood flow into collateral veins. Collaterals related to SVC obstruction are well documented in the literature and may include lateral thoracic, internal thoracic, azygos, and vertebral veins [1–3]. Unusual pathways and enhancement patterns have also been reported including breast vein engorgement, brain parenchymal enhancement, and liver parenchymal enhancement [4–6]. However, no study to our knowledge has previously demonstrated a retrograde vertebral body enhancement. The present report describes our recent observations of an unusual vertebral body enhancement in patients with SVC obstruction on thoracic computed tomography (CT).

Materials and methods

Our institutional review board approved this retrospective research study. Patient informed consent was not required, but written informed consent was obtained from patients who underwent the enhanced CT study. A retrospective review of our radiologic database was performed to identify all patients with the obstruction of SVC or brachiocephalic vein causing reflux of contrast agent into collateral vessels and presented with an unusual vertebral body enhancement on thoracic CT. From March, 2009 to September, 2012, 13 patients with vertebral body enhancement were enrolled in the present study. The cohort comprised 11 men and 2 women of mean age 51.4 years (range 21–77 years). The underlying diseases that caused SVC obstruction were adenocarcinoma of the lung in four, non–small-cell lung cancer in two, large cell neuroendocrine carcinoma, small-cell lung cancer, thymic carcinoma, sarcomatoid carcinoma, diffuse large B-cell lymphoma, Hodgkin lymphoma, and metastatic

lymphadenopathy from pancreatic cancer in one patient each. Baseline and demographic data of all patients are summarized in Table 1.

All patients underwent contrast-enhanced CT of the chest with (n=6) or without (n=7) unenhanced scan on a 64-channel multidetector CT scanner (Sensation 64; Siemens Medical Solutions, Forchheim, Germany). The parameters of the CT examinations were 120 kVp, 100 mAs, rotation time 0.5 s, and pitch 1.2. The postenhancement images were obtained within 30 to 40 s of injecting 90 mL nonionic iodinated contrast agent through an antecubital vein at a rate of 3 to 4 mL/s. All CT scans were retrospectively reviewed by two authors (YMS and YKK), and decisions were reached by consensus. All axial images were reviewed at a mediastinal window setting (window level 45, window width 440) to evaluate collateral vessel development, level of venous obstruction by the mass, and contrast agent injection site. Axial images at a bone window setting (window level 500, window width 4,000) were used to evaluate an unusual enhancement within vertebral bodies. Coronal and sagittal reformation images were compared with corresponding axial images. We recorded vertebral body level of enhancement and analyzed the pattern and location of the enhancement. Enhancement patterns of vertebral bodies were classified as nodular with round shape occupying less than one-third of vertebral body (Fig. 1B) or polygonal occupying greater than or equal to one-third of vertebral body (Fig. 2, Bottom) on axial image. The locations of enhanced areas within vertebral bodies were described using right lateral/central/left lateral, anterior/posterior, and upper/middle/lower in the x-, y-, or z-axis directions, respectively. Other bony site involvements were recorded when present.

The differentiation of this unusual vertebral body enhancement from other pathologic condition such as bone metastasis was confirmed by reviewing the available data,

Table 1
Patient baseline and demographic data

No.	Age (y)	Sex	Level of venous obstruction	Site of contrast injection	Underlying disease causing SVC obstruction	Unenhanced CT	Confirmation studies
1	26	F	LBV, SVC	Left arm	DLBL	Obtained	PET-CT, F/U
2	45	M	LBV	Left arm	SCLC	Obtained	PET-CT, F/U
3	39	M	SVC	Right arm	Metastatic LN from pancreatic cancer	Obtained	F/U
4	77	M	SVC	Left arm	Adenocarcinoma	Obtained	PET-CT, bone scan, F/U
5	71	M	SVC	Right arm	Adenocarcinoma	Obtained	F/U
6	50	M	SVC	Right arm	NSCLC	Obtained	PET-CT, bone scan, F/U
7	74	M	SVC	Right arm	Thymic carcinoma	Not obtained	PET-CT, bone scan, F/U
8	51	M	SVC	Left arm	Adenocarcinoma	Not obtained	F/U
9	66	M	LBV, SVC	Left arm	Adenocarcinoma	Not obtained	F/U
10	42	M	LBV, SVC	Left arm	Sarcomatoid carcinoma	Not obtained	F/U
11	44	M	SVC	Right arm	LCNC	Not obtained	PET-CT, F/U
12	21	F	LBV	Left arm	Hodgkin lymphoma	Not obtained	MRI, F/U
13	62	M	LBV	Left arm	NSCLC	Not obtained	F/U

F, female; M, male; LBV, left brachiocephalic vein; SVC, superior vena cava; DLBL, diffuse large B-cell lymphoma; SCLC, small-cell lung cancer; LN, lymph node; NSCLC, non–small-cell lung cancer; LCNC, large-cell neuroendocrine carcinoma; PET, positron emission tomography; CT, computed tomography; F/U, follow-up; MRI, magnetic resonance imaging.

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