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Case Report

Two cases of vertebral perfusion disturbances in computer tomography imitating metastatic lesions in the course of superior vena cava thrombosis ☆,☆☆

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ABSTRACT

Skeletal metastases are frequently observed in various malignancies. In some cases, they are asymptomatic and can be found incidentally in various imaging methods in patients without known malignant tumors. In this case study 2 cases of vertebral perfusion disturbances are presented that imitate vertebral metastatic lesions in computer tomography in the course of superior vena cava thrombosis. The first patient was referred to our clinic for chest and abdominal computer tomography (CT) for staging due to a known tumor in the anterior mediastinum. The second patient was referred for chest CT due to swelling in the upper extremity and neck, with the suspected diagnosis of a tumor or pulmonary embolism. In both cases, CT scans showed metastases suspected lesions in the upper thoracic vertebral bodies. In both cases, additionally, the thrombosis of superior vena cava (SVC) and vena brachiocephalica was confirmed (in the first case due to tumor compression in the upper mediastinum, in the second case due to the presence of pacemaker leads). In control CT scans after anticoagulation treatment, there were no suspected lesions in the vertebral bodies, which confirmed the diagnosis of vertebral perfusion disturbances in the course of SVC thrombosis in both patients. In conclusion, in rare cases of metastases suspected lesions of thoracic vertebral bodies in contrast-enhanced computer tomography among patients with a diagnosis of superior vena cava thrombosis vertebral perfusion disturbances should be included in differential diagnosis protocol.

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Introduction

Skeletal metastases are frequently observed in many malignancies and are the third most frequent behind lung and liver metastases [1]. In some cases metastatic vertebral lesions can be asymptomatic and can be frequently found incidentally as a first tumor manifestation in various imaging methods including computer tomography (CT). These patients without known malignant tumor need obviously further diagnostics steps to determine the primary cancer location.

A deep vein thrombosis (DVT) can affect the upper circulation, with thrombosis in the upper extremity deep veins and/or in the superior vena cava (SVC); or the lower circulation, in which the inferior vena cava, iliac veins or lower extremity deep veins can be affected [2,3]. The upper extremity deep vein thrombosis (UEDVT) is relative rare and accounts for up to 6% of all patients presenting with DVT [2,3]. However its incidence is reported to increase due to the escalating use of central venous catheters [4]. The thrombosis of SVC is thought to appear even rarer and most often results from extension of thrombus from the upper extremity [5]. The isolated SVC thrombosis is thought to be a consequence of malignancy in the chest [5]. The vast majority of DVT in the upper circulation are secondary, resulting from pacemaker leads or intravenous catheter placement as well as underlying malignancy or malignant compression. Primary UEDVT is mostly associated with the presence of Paget-Schroetter syndrome (venous thoracic outlet syndrome), in which thrombosis occurs secondary to anatomical abnormalities which principally compress thoracic outlet and accounts for about 20% of all UEDVT cases [6]. Co-occurrence of deep vein thrombosis of various origins, as well as malignancy with skeletal metastases may be possible, both completely independently, as well as in the case of the above-mentioned compression of the malignant lesion on the venous vessels.

In the differential diagnosis of lesions suspected of bone metastasis, it is recommended to take into account: bone islands, spondylosclerosis hemispherica, primary bone tumors like osteoblastoma or osteoid osteoma and therapy effects like radiation, chemotherapy, and vertebroplasty [1,7]. To the best of our knowledge only few cases of perfusion disturbances in vertebral bones imitating vertebral metastases in the course of superior vena cava thrombosis were described [8–10]. Therefore, the study aimed to present 2 cases of vertebral perfusion disturbances imitating metastatic lesions in computer tomography in the course of superior vena cava thrombosis.

Case presentation

Case report 1

A 43-year-old woman was referred to our clinic for chest and abdominal computer tomography (CT) for staging due to a known tumor of the anterior mediastinum. CT (Toshiba Aquilion One, with 70 mL Iomeron 350 intravenous, staging program) revealed evidence of a dense soft-tissue mass of about 4 × 6 × 12 cm in size, located in the upper mediastinum ventrally to the heart with filling of the entire retrosternal space and extending to the neck through the thoracic aperture. The tumor presented a broad contact with the anterior pericardium, the ascending aorta, and the pulmonary trunk. The superior vena cava was surrounded and compressed by the tumor with a short section of contrasting disruption. Also contrasting disruption was present in the left brachiocephalic vein. Additionally, an engorgement of venous collaterals paravertebral was observed. In the bone window except for multi-segmental spondyloosteochondrosis intervertebralis, diffuse hyperdense vertebral body lesions especially in posterior regions of Th2-Th6 were evaluated as highly suspected of metastases (Fig. 1A). The diagnosis of thrombosis of the superior vena cava as a result of compression was made. Anticoagulation therapy was introduced as recommended [11].

The next day a CT-guided biopsy of the tumor in the anterior mediastinum was performed. In the non-contrast-enhanced CT scans there were no suspected lesions in the vertebral bodies (Fig. 1B). Thymic carcinoma was diagnosed. After 5 days magnetic resonance imaging (MRI) (Philips, 1.5 Tesla) of the vertebral column was performed to clarify suspicious changes in the thoracic spine. In the T2-STIR there were a slight signal increase from Th1 to Th6 with a slight signal reduction in the native T1. These images were interpreted as vertebral bodies' hypervascularization with congestion in paravertebral venous circulation (Fig. 1C). Two weeks after the initial CT, control CT scans with and without iodine contrast were performed. The non-contrast-enhanced examination showed no hyperdensity in the vertebral bodies (Fig. 1D). The series with contrast showed hyperdensity in the upper thoracic vertebrae, predominantly dorsally localized, which confirmed the diagnosis of hypervascularization of the upper thoracic vertebral bodies as a result of existing collateralization due to occlusion of the SVC and left brachiocephalic vein (Fig. 1E) like the first CT. Six months after the initial diagnosis, a control chest and abdomen CT was performed. There were also no suspected lesions in the vertebral bodies. As a result of treatment additionally, the regression of thymic carcinoma mass was observed.

Case report 2

A 68-year-old man was referred to our clinic for chest CT due to upper extremity, neck, and face swelling as well dyspnea with suspicion of tumor or pulmonary embolism. The patient has had these symptoms for about 2-3 weeks, especially in the morning. Additionally, obstructive sleep apnea syndrome, coronary heart disease, hypothyroidism and hypercholesterolemia were known. In 2016 patient survived sudden cardiac death by ventricular fibrillation, a cardiac defibrillator was implanted.

CT (Toshiba Aquilion One, with 45 mL Accupaque 350 intravenous, pulmonary embolism program) revealed relatively wide veins, especially subclavial on the right side with strong venous collaterals dorsal and paravertebral. The SVC was locally filled with low-density material. The diagnosis of thrombosis of SVC following the presence of pacemaker leads was made. Pulmonary embolism and tumor were excluded. Additionally there were diffuse hyperdense lesions ventral in Th2

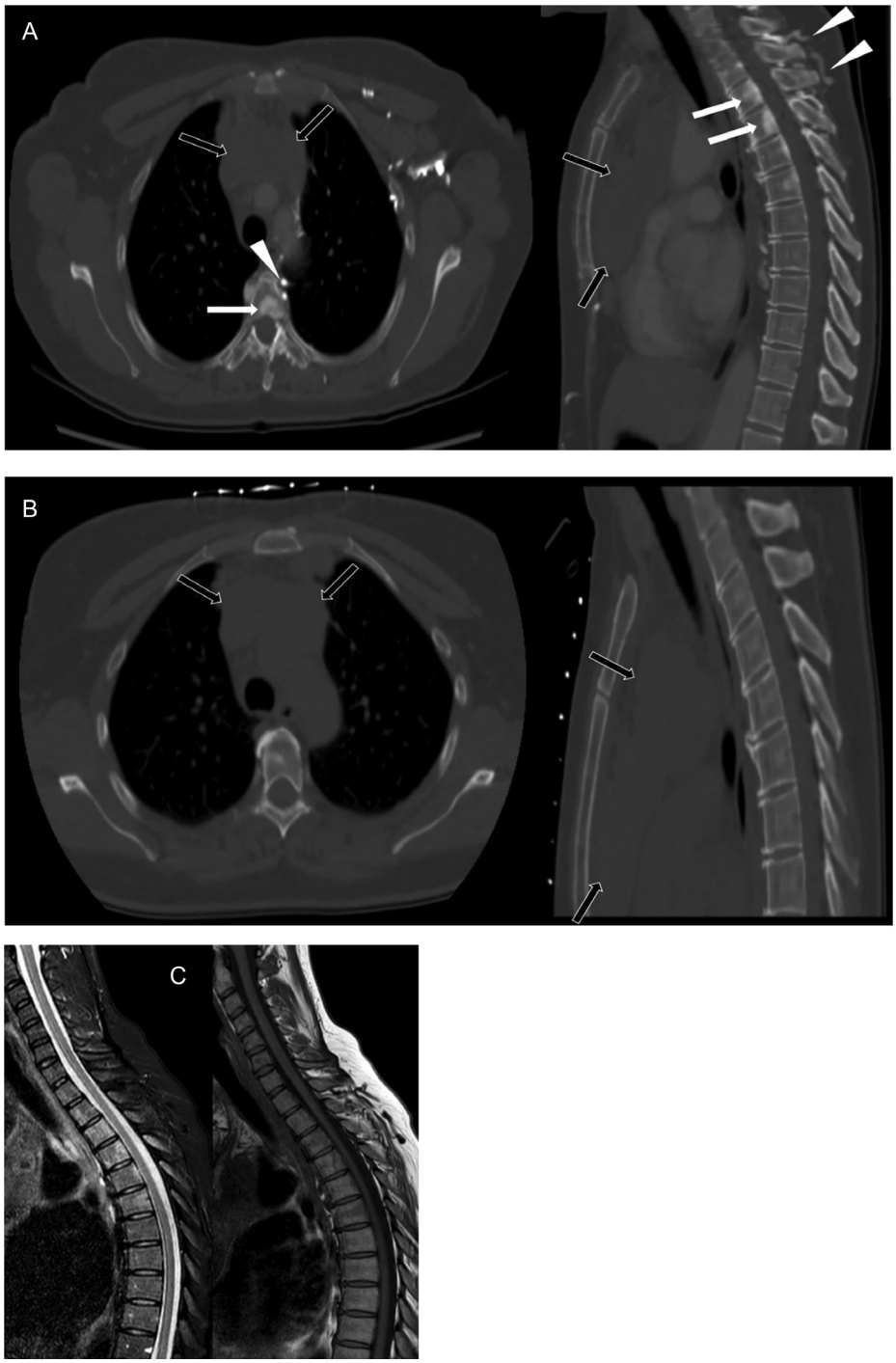

Fig. 1 – (A) CT images of thoracic vertebral bones (axial and sagittal) – diffuse hyperdense lesions in Th2-Th6 (arrows) initially evaluated as highly suspected of metastases. Congestion in the paravertebral veins (arrowheads). Additional dense soft-tissue mass of about 4 x 6 x 12 cm in size, located in the upper mediastinum ventrally to the heart with filling of the entire retrosternal space and extending to the neck through the thoracic aperture (black arrows with white contours). (B) CT images of upper thoracic vertebral bones obtained during the biopsy of tumor in the anterior mediastinum (axial and sagittal). Black arrows with white contours show soft-tissue mass located in the upper mediastinum. No suspected lesions in the vertebral bodies. (C) MRI images of thoracic vertebral column, T2-STIR sagittal (left) and T1 sagittal (right) – T2-STIR slightly signal increases and T1 slightly signal reduction in Th1-Th6. (D) Control CT 2 weeks after initial CT. Non-contrast enhanced images of thoracic vertebral bones (axial and sagittal). There were no hyperdensity in the vertebral bodies.) Control CT 2 weeks after initial CT. Contrast enhanced images of thoracic vertebral bones (axial and sagittal). Images revealed diffuse hyperdense lesions in the upper thoracic vertebral bodies (arrows) as well as congestion in the paravertebral veins (arrowheads).

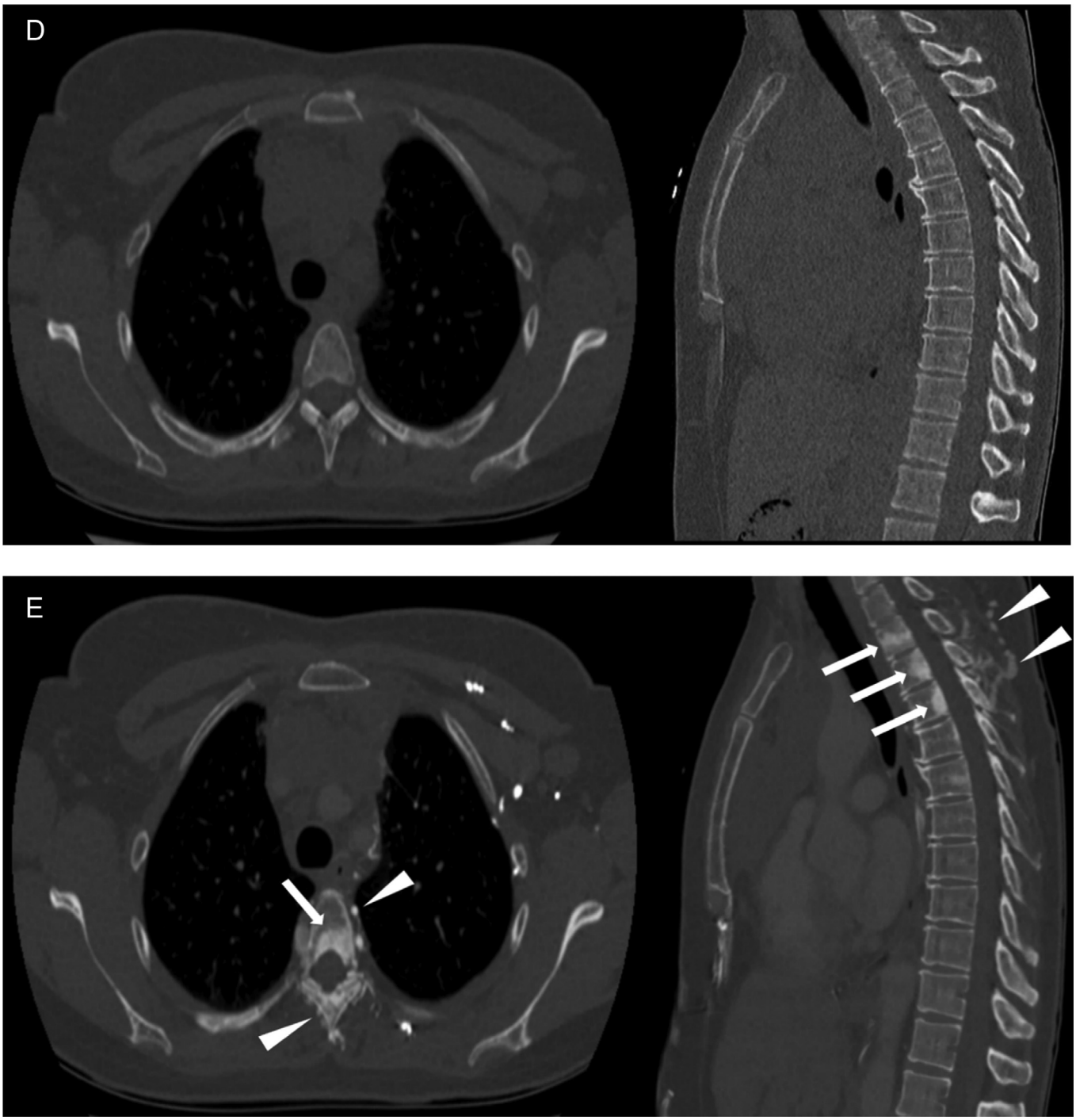

Fig. 1 – Continued

(Fig. 2A). Anticoagulation therapy was introduced as recommended for patients with catheter-related thrombosis [12]. After 4 months from initial diagnosis control CT of the chest was performed. Complete occlusion of the left brachiocephalic vein was revealed. Congestion of the paravertebral veins as well as the hemiazygos vein and the azygos vein was observed. Distally to its inflow, the SVC was normally perfused. Proximally to the inflow, there was thrombosis. Additionally, there was evidence of diffuse hyperdense vertebral body lesions predominantly in posterior regions of Th1-Th7, which were evaluated as highly suspected metastases (Fig. 2B). Two months later a control CT of chest and abdomen was performed. There were no suspected lesions in the vertebral bodies. Initial diagnosis of perfusion disturbances in the thoracic vertebral bodies in course of the thrombosis in SVC and vena brachiocephalica was confirmed.

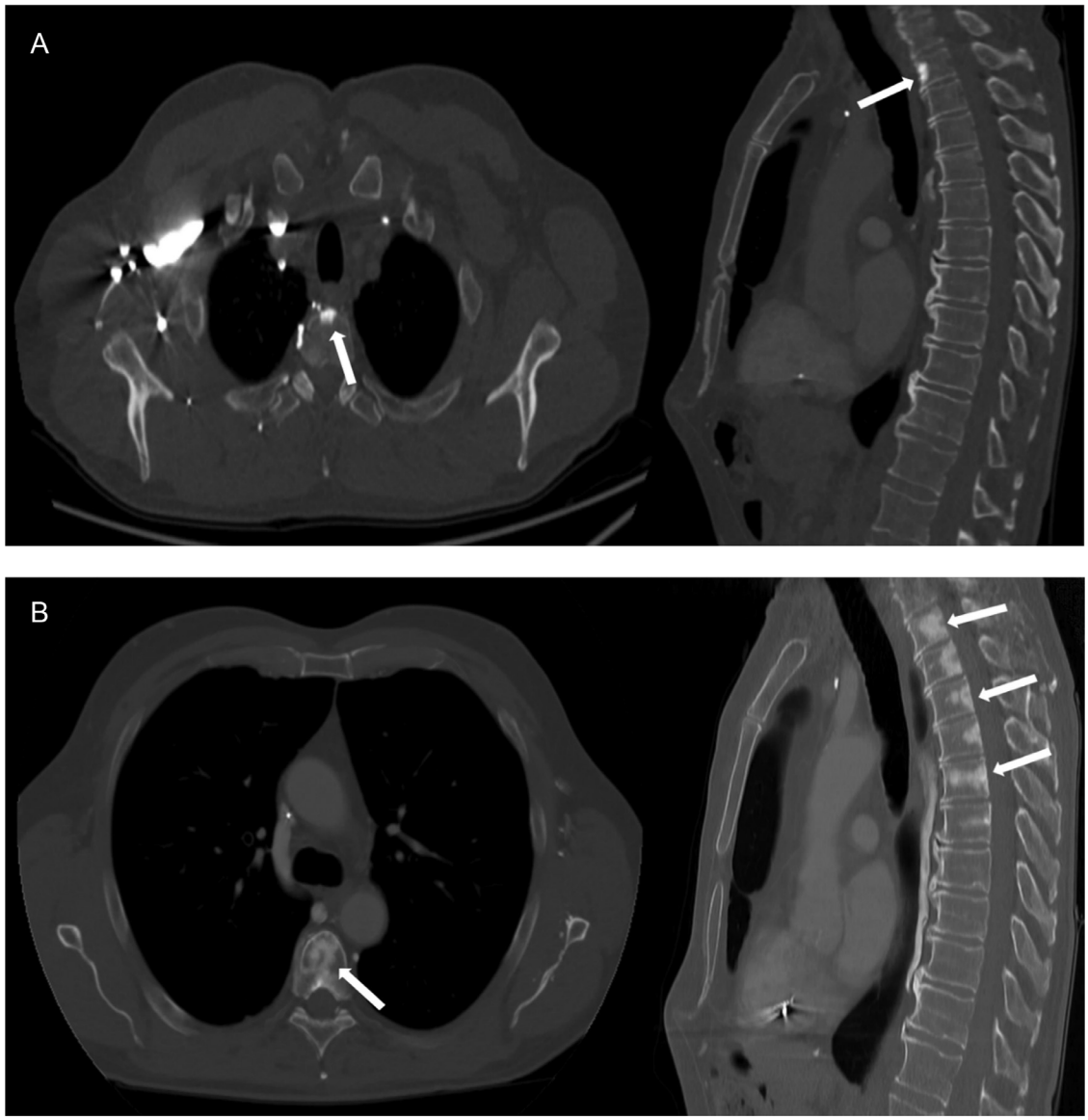

Fig. 2 – (A) CT images of thoracic vertebral bones (axial and sagittal) – hyperdense lesions in Th2 (arrows) initially evaluated as highly suspected of metastases. (B) CT images of thoracic vertebral bones (axial and sagittal) 4 months later – diffuse hyperdense lesions in Th2-Th6 (arrows) evaluated as highly suspected of metastases.

Discussion

We presented 2 patients, in which CT scans showed lesions in the upper thoracic vertebral column. In both cases, there was a suspicion of metastatic lesions. In both cases, additionally thrombosis of the SVC and left brachiocephalic vein was confirmed (in the first case due to tumor compression in the upper mediastinum, in the second case due to the presence of pacemaker leads). In control CT scans after anticoagulation treatment, there were no suspected lesions in the thoracic vertebral bodies, which confirmed the presence of perfusion disturbances in vertebral bodies in the course of superior vena cava thrombosis in both patients.

As mentioned above, co-occurrence of DVT of various origins, as well as cancer with skeletal metastases theoretically may be possible, both completely independently, as well as in the case of the malignant lesion which compresses the venous vessels. Furthermore, recent studies indicated that different malignancies have strong associations with DVT. Poh et al. in the study based on California Cancer Registry indicated that the cancer with the highest risk of UEDVT was leukemia (1.7%), stomach (1.4%), lymphoma (1.3%), and pancreas (1.1%) [13]. On the other hand, DVT seems to also be a risk factor for malignancy in future as well. As observed by Adelborg et al. amongst patients diagnosed with UEDVT, there was a 5% risk of developing any cancer in the 6 months after initial diagnosis [14].

In both presented cases we observed paravertebral venous engorgement. Presumably, there were intraosseous bypass circuits as a result of observed thrombosis in the SVC and brachiocephalic vein. We believe that these intraosseous circuits are responsible for the described image in upper thoracic vertebral bodies in contrast-enhanced CT scans. The intra- and extraosseous vertebral venous system seems to be complex and up to date not fully described [15]. Besides, there are some reports of unusual pathways and enhancement patterns related to SVC obstruction, including brain or liver parenchymal enhancement as well as breast vein engorgement [16,17]. Similar to our observations, Paksoy et al. reported epidural engorged veins due to inferior vena cava obstruction or occlusion in group of 13 patients [15]. However, to the best of our knowledge, up to date only a few cases of perfusion disturbances imitating vertebral metastases in CT images were reported [8–10]. In the study by Thomas et al. metastatic suspected lesions were observed in several upper thoracic vertebrae in the contrast-enhanced CT. A clue to final diagnosis was subsequent non-contrast-enhanced CT-positron emission tomography (PET), in which vertebral density was normal [8]. Kim et al. reported similar vertebral body enhancement not only in thoracic but also in cervical and lumbar vertebrae. Small area of enhancement was also observed in sternum [9]. Similar to our observation, in the case described by Rager et al. perfusion disturbances were presented mostly in posterior regions of thoracic vertebral body [10].

The first described patient was diagnosed with thymic carcinoma. Skeletal metastases are not commonly seen in this carcinoma [18]. It is assessed that about 80% of all bone metastases occur in case of lung cancer, breast cancer, renal cell carcinoma, and prostate cancer [19]. In the differential diagnosis of sclerotic lesions suspected of bone metastasis, it is recommended to take into account: bone islands, spondylosclerosis hemispherica, primary bone tumors like osteoblastoma or osteoid osteoma and therapy effects like radiation, chemotherapy, and vertebroplasty. In the differential diagnosis of mixed sclerotic and lytic lesions - primary bone tumors like osteoblastoma or osteoid osteoma as well as therapy effects like above [6,7]. However, mentioned lesions are mostly solitary. What is more, usually bone metastases either sklerotic or litic can be seen in non-enhanced CT examination [6,7]. Observed perfusion disturbances were presented mostly in posterior parts of vertebral body. Recent study by Guo et al. indicates that regardless of primary cancer histology, metastatic lesions localize more often in the posterior aspects of thoracic and lumbar vertebral bodies [20]. Following the described history of our 2 patients, we concluded that in rare cases of metastases suspected lesions of vertebral bones observed in CT among patients with diagnosis of SVC thrombosis vertebral perfusion disturbances should be included in differential diagnosis protocol. Many protocols of CT imaging today do not include not-contrast-enhanced scanning, primarily due to radiation dose protection [21]. If not performed initially, as in the cases described, complementary not-contrast-enhanced CT scanning should be implemented to improve the radiological assessment.

As the limitations of this case study, it should be pointed out that the techniques of performing CT in both cases were different, which resulted from the indications for the imaging. Furthermore, we decided to use the global term 'superior vena cava thrombosis' although in both patients not only superior vena cava thrombosis but also vena brachiocephalica thrombosis was observed.

In conclusion, in rare cases of metastases suspected lesions of thoracic vertebral bodies observed in contrast enhanced computer tomography among patients with diagnosis of superior vena cava thrombosis vertebral perfusion disturbances should be included in differential diagnosis protocol. If not performed initially, complementary non-contrast-enhanced computer tomography scanning should be implemented to improve the radiological assessment.

Patient consent

Necessary informed consents were obtained from the patients.

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