Case 13

Differentiation of Liver Metastases from Benign Cysts

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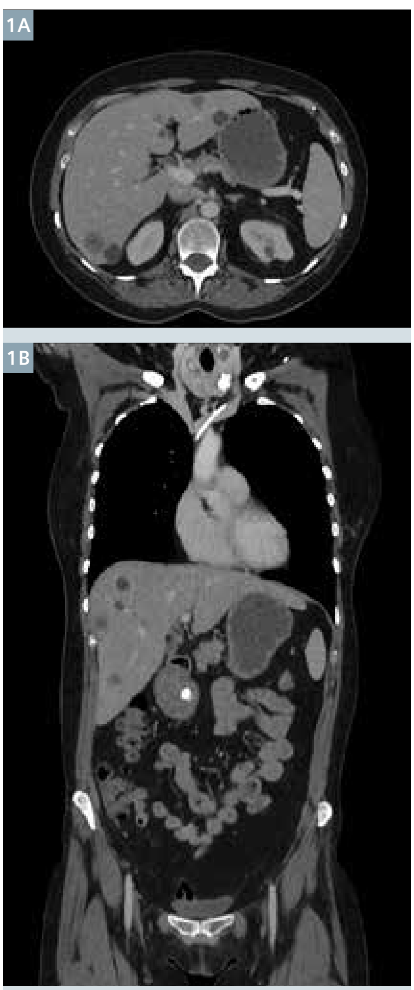
History

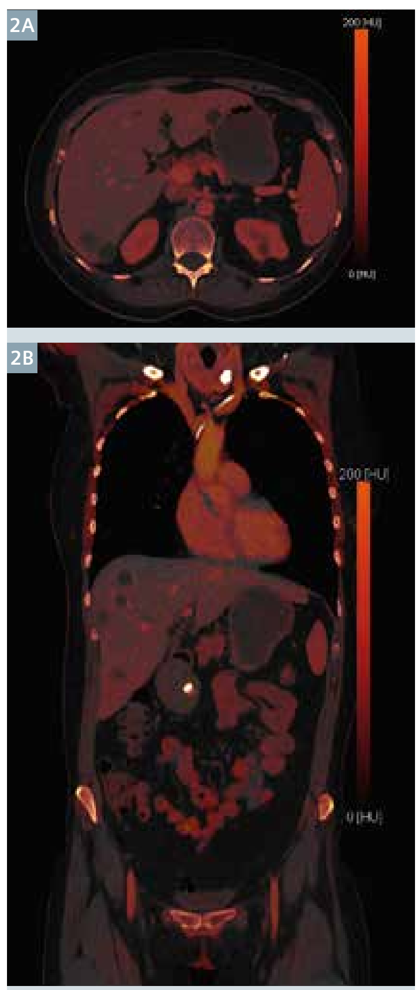
A 54-year-old female patient with breast cancer, post-lumpectomy status, underwent thoracoabdominal CT for the assessment of metastatic disease. A contrast-enhanced TwinBeam Dual Energy CT (TBCT) was performed.



1 Axial (Fig. 1A) and coronal (Fig. 1B) views of the mixed AuSn 120 kV dataset (blending of 0.8) show multiple lesions in both liver lobes.

Diagnosis

Composed TBCT images (Figs. 1A and 1B) revealed multiple liver lesions in both lobes. Some of these lesions could be clearly diagnosed as simple hepatic cysts, as the measured values were below 10 HU. However, some lesions showed higher CT values of up to 32 HU. The radiologists were unable to definitely classify these lesions as hepatic metastases since hepatic cysts can sometimes rupture resulting in higher CT attenuation values. Since the examination was acquired using dual energy, the iodine maps (Fig. 2 and Fig. 3) were calculated, enabling iodine uptake evaluation in the hepatic lesions. The significant differences in the iodine concentration evaluated in the lesions helped to differentiate between the simple benign hepatic cysts and the metastatic lesions (Fig. 3). Figure 4 demonstrates the virtual unenhanced images (VNC) generated from the contrast-enhanced TBCT data-set, which can be used for analyzing CT attenuation values of organs (e.g. liver, adrenal gland) in the absence of a true unenhanced image.

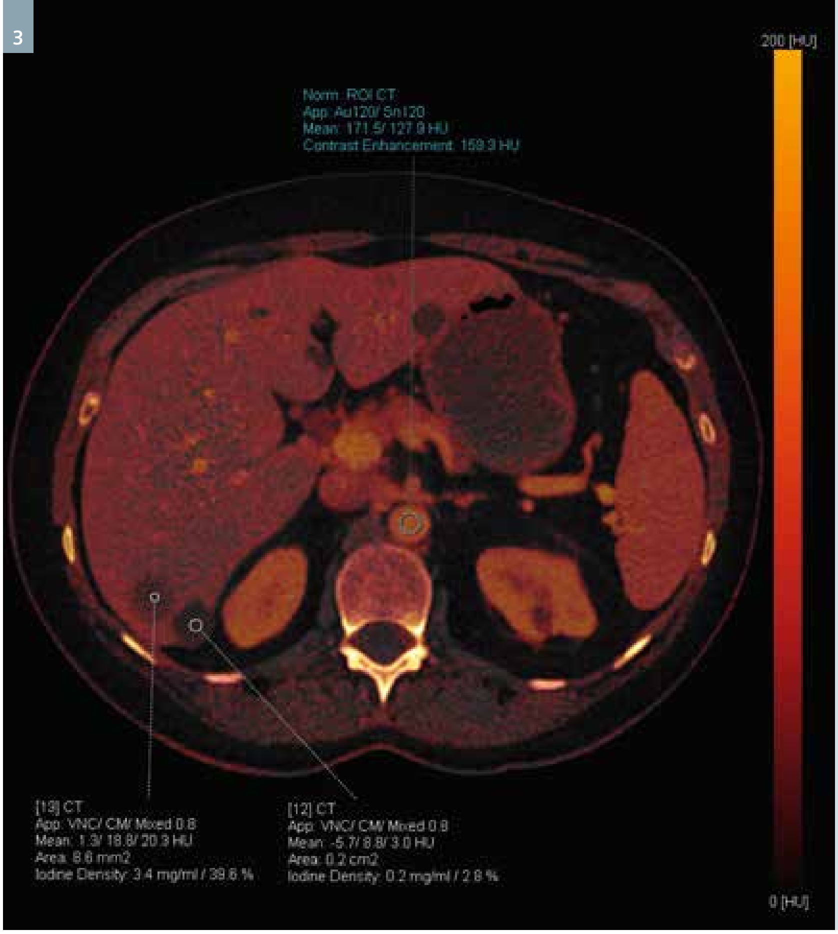


2 Fused VNC/iodine maps demonstrate the increased conspicuity of liver lesions in axial (Fig. 2A) and coronal (Fig. 2B) sections.

Comments

Dual Energy CT plays a pertinent role in oncological imaging by virtue of its ability to assess the amount of iodine uptake in suspicious lesions. This could be associated with tumor vascularity and could become useful in therapy monitoring.[1] Because of a series of virtual unenhanced images, can be extracted from the contrast-enhanced images, there is an opportunity to reduce radiation dose by avoiding hav-ing to perform a second CT study.[2]

TwinBeam Dual Energy is a new tech-nology that creates two X-ray spectra simultaneously from a single X-ray tube. The X-ray beam is pre-filtered using two different materials: gold (Au) and tin (Sn). As a result, the 120 kV X-ray beam is split into a high- (Sn) and low-energy (Au) X-ray spectrum before reaching the patient. The full number of projections is available for both



3 The evaluated iodine concentration in suspicious liver lesions shows a significant difference in the liver metastasis (ROI#13) and in the benign simple cyst (ROI#12). ROIs were also placed in the aorta (blue) for normalization.

4 VNC images generated from the post-contrast dual energy dataset show the same axial (Fig. 4A) and coronal (Fig. 4B) section.

spectra. The simultaneously acquired low- and high-energy data can be reconstructed separately to provide a high- and low-energy image series or composed to give a single energy image dataset. The full field-of-view of 50 cm as well as advanced dose reduction techniques, such as advanced modeled iterative reconstruction (ADMIRE) and real-time anatomic exposure control (CARE Dose4D), are all available.

TwinBeam CT is capable of providing morphological and functional information in oncological examinations and has tremendous potential in replacing the routine use of single-energy scans in the future. This is accompanied by the advantage of providing a dose-neutral dual energy imaging approach compared with a standard 120 kV single-energy study. ■

In clinical practice, the use of ADMIRE may reduce CT patient dose depending on the clinical task, patient size, anatomical location, and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.

References
[1] De Cecco CN, Darnell A, Rengo M, et al. Dual-energy CT: oncologic applications. AJR Am J Roentgenol 2012; 199:S98-S105
[2] Agrawal MD, Pinho DF, Kulkarni NM, Hahn PF, Guimaraes AR, Sahani DV. Oncologic applications of dual-energy CT in the abdomen. Radiographics 2014; 34:589-612

Examination Protocol

Scanner	SOMATOM Definition Edge		
Scan area	TAP	Rotation time	0.33 s
Scan length	650 mm	Pitch	0.3
Scan direction	Cranio-caudal	Slice collimation	64 × 0.6 mm
Scan time	18 s	Slice width	1.5 mm
Tube voltage	AuSn 120 kV	Reconstruction increment	1.2 mm
Tube current	355 mAs	Reconstruction kernel	Q30f (ADMIRE 3)
Dose modulation	CARE Dose4D	**Contrast**	370 mg/mL
$CTDI_{vol}$	7.6 mGy	Volume	90 mL
DLP	508 mGy cm	Flow rate	2 mL/s
Effective dose	7.6 mSv	Start delay	70 s