Transient hepatic attenuation difference (THAD) - A case report

Article *in* The Indian journal of radiology and imaging · November 2006

DOI: 10.4103/0971-3026.32240

3 authors:

Ravikumar Hanumaiah
State University of New York Upstate Medical University
43 PUBLICATIONS **66** CITATIONS
SEE PROFILE

J.Singh Singh
Maharana Pratap University of Agriculture and Technology
356 PUBLICATIONS **6,752** CITATIONS
SEE PROFILE

Arjun Kalyanpur
63 PUBLICATIONS **636** CITATIONS
SEE PROFILE

Transient Hepatic Attenuation Difference (Thad) - A Case Report

H RAVIKUMAR, J SINGH, A KALYANPUR

Ind J Radiol Imag 2006 16:4:441-444

Key words : THAD, portal vein thrombosis, Straight border sign

THADs are areas of increased parenchymal enhancement visible during the hepatic arterial phase on hepatic CT (1,2).

THADs are associated with a large variety of liver disorders-Portal or hepatic vein thrombosis, cirrhosis, Budd- Chiari syndrome, biliary obstruction, trauma ,focal hepatic lesions and aberrant blood supply. THADs that are associated with hepatic tumors are generally characteristic of malignant tumors. However, benign focal lesions, such as hemangiomas, focal nodular hyperplasia, pyogenic abscess and focal eosinophilic necrosis, may accompany THADs.

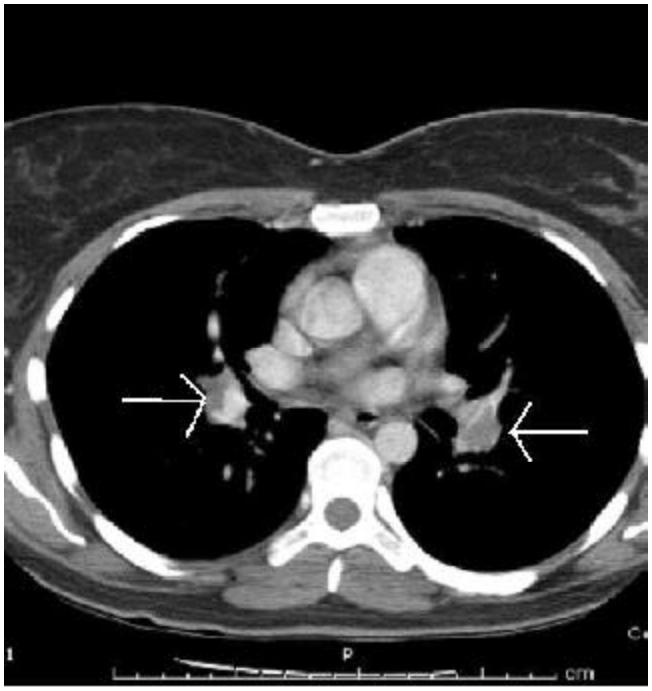
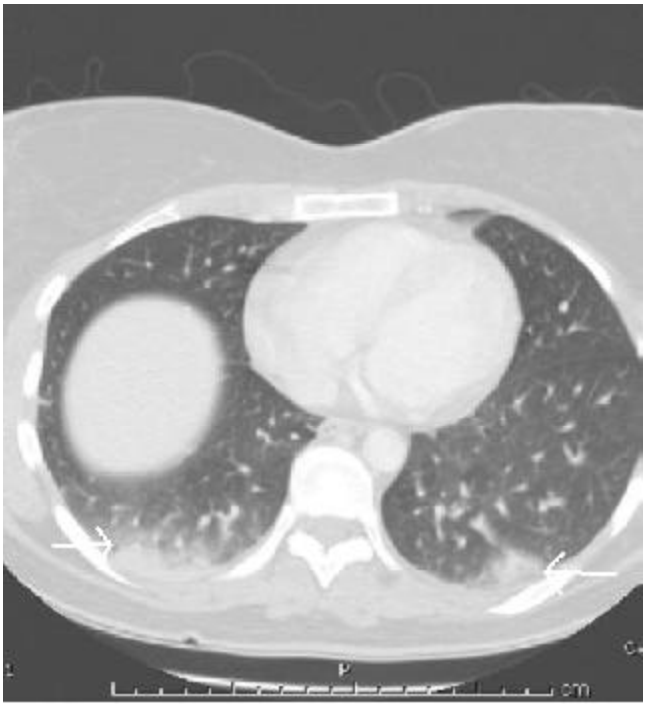


FIG 1
a) CT angiogram of the chest demonstrates filling defects within the lower lobe pulmonary artery divisions (arrows) consistent with pulmonary embolism.



b) Wedge shaped pleural based opacities (arrows) in the bilateral lower lobes suggestive of pulmonary infarcts

Case report:

A 45 year old woman presented with shortness of breath & chest pain.

A CT angiogram of the chest was performed, which showed filling defects within the lower lobe pulmonary artery divisions consistent with pulmonary embolism (fig 1a).

CT scan also demonstrated wedge shaped pleural based opacities suggestive of pulmonary infarcts (fig1b).

In addition THAD was demonstrated in the left lobe of the liver due to thrombosis of the left branch of portal vein,

From the Teleradiology Solutions, Bangalore

Request for Reprints: Dr Ravikumar H. Teleradiology Solutions, Villa 2, Regent Place, Whitefield Main Road, Bangalore - 560066

Received 20 July 2005; Accepted 10 July 2006

with a well defined straight margin medially (fig 2a,b).

FIG 2
a) Sectorial THAD: Wedge shaped hyper-enhancement in the left lobe of liver(arrow) with straight border sign on hepatic arterial phase CT scan is due to increased arterial flow as compensation for compromised portal vein flow.
b) The left branch of portal vein is thrombosed (arrow).

Discussion :

The liver has a dual blood supply (70% portal vein, 30% hepatic artery) with compensatory relationships: arterial flow increases when portal flow decreases.

Transient hepatic attenuation difference (THAD) is an attenuation difference of the liver appearing during contrast enhanced dynamic CT and not corresponding to mass (3). THAD is generally seen as an area of high attenuation on the hepatic arterial phase that returns to normal attenuation on the portal venous phase images. Persistent THAD up to portal venous phases may be due to concurrent obstruction of a hepatic vein branch.

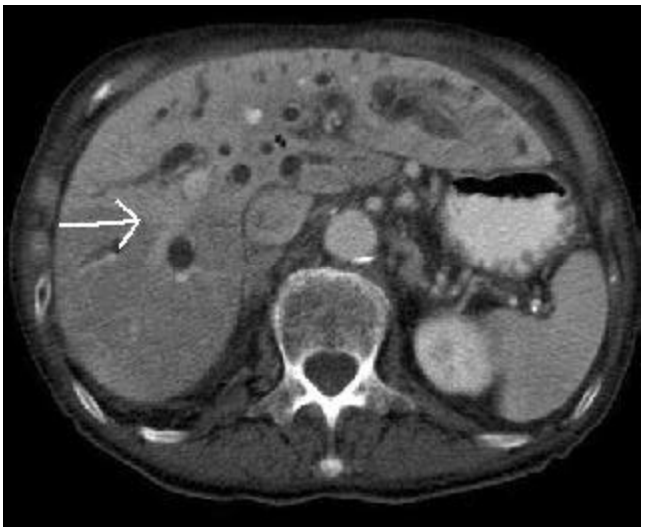


FIG 3. Peribiliary THAD: CT scan of a different patient with pancreatic carcinoma demonstrating a linear, branching pattern of increased enhancement (arrow), along the dilated biliary tree.

THAD on hepatic arterial phase CT scan is due to increased arterial flow as compensation for compromised portal vein flow (fig 4,5).

THADs can be classified according to morphology, etiology, pathogenesis and association with focal lesions (4).

According to morphology, they can be divided into four groups (5).

a) Lobar multisegmental
b) Sectorial
c) Polymorphous
d) Diffuse

Lobar multisegmental

They involve all or almost all segments of one hepatic lobe and are usually caused by an increase in arterial inflow and therefore follow arterial distribution (5). They usually occur when a hypervascular focal lesion (Hepatocellular carcinoma, hemangioma, focal nodular hyperplasia, hypervascular metastses) leads to hyper-perfusion of the surrounding parenchyma ("siphoning effect") in the absence of portal hypoperfusion. They do not show a triangular shape or a straight border sign. Mediators most likely work on the right or the left hepatic artery and produce THAD in the hepatic lobe containing the lesion (1, 2). The tumor may also act on the right or the left hepatic artery and steal blood flow from the

contralateral segment (1).

Sectorial.

They follow portal vein branches, are either wedge or fan-shaped (1,6) with at least one straight border sign (a clear separation line from the normally attenuating parenchyma) when not associated with focal lesions. They can be caused by portal (as in our case) or hepatic vein thrombosis, long-standing biliary obstruction, or an arterioportal shunt (congenital, caused by liver cirrhosis or trauma). In such cases, THADs are always wedge-shaped with a straight border sign.

When associated with a focal lesion it could be malignant and induce portal hypoperfusion by compression or infiltration of a portal branch. HCC is the most common primary hepatic tumor associated with the THAD (7). Okuda et al reported that arterioportal shunts occurred in 63% cases of Hepatocellular carcinoma (8).

This may also be seen in case of liver abscesses where the THAD is likely due to compression of the adjacent portal radicals.

When the focal lesion is benign, it is usually small and located near the hepatic capsule.

Sectorial THAD may sometimes be the only warning sign of hidden nodular lesion (eg: a nodule not detectable for size or contrast reasons). This possibility must be considered when sectorial THAD has no other explanation (9).

Polymorphous

Usually do not follow the portal vein branches and show various shapes and sizes without a straight border sign. They may be caused by an aberrant blood supply, inflammation or parenchymal injuries from physical or chemical agents (including contusion, extrinsic compression, percutaneous biopsy or treatment of a liver neoplasm by ethanol injection or radio frequency ablation).

Diffuse

Differences involve the entire hepatic parenchyma and may assume a patchy, central peripheral or peribiliary pattern on the basis of location of the portal blockade.

Right heart failure and Budd-Chiari syndrome results in a generalized central lobular enhancement during the arterial phase. The hepatic parenchyma assumes a marbled aspect called a "patchy" pattern (5).

When obstruction takes place at the level of portal trunk, as in portal vein thrombosis. Portal flow remains adequate for central zones of liver but not for the peripheral ones.

The arterial response produces enhancement of the peripheral subcapsular hepatic parenchyma with relative hypodensity of the central perihilar area. This CT pattern is called a "central-peripheral" phenomenon (5).

In biliary obstruction (as in pancreatic cancer or choledocholithiasis) the peribiliary plexus become obstructed with decrease in portal blood flow and arterial compensation. This results in peribiliary THAD, characterized by a linear,branching pattern along the dilated biliary tree(fig 3) .

Differentiation of Tumorous and nontumorous THAD

Portal venous phase images have an important role because most hypervascular tumors are seen as low attenuations. Where as THADs are seen as normal attenuations on portal venous images (8).

On arterial phase images, a straight border, wedge shape, and the presence of normal vessels coursing through the lesion makes the diagnosis of THAD more likely.

If there is any doubt about the diagnosis of THAD on dynamic CT, MRI may solve the problem. Normal signal intensity on T1 and T2 weighted images exludes hypervascular tumor.

Conclusion:

With the widespread utilization of dual phase helical CT for the evaluation of various vascular pathologies, THADs may be encountered as incidental findings. Radiologists should be familiar with the dual phase CT appearances of THADs to arrive at the etiology and pathogenesis.

THADs are important signs of an underlying liver disorder and they are useful to detect and characterize a large variety of liver diseases. Therefore the hepatic arterial phase must always be performed, even if no focal lesion is expected.

References :

1. Itai Y, Matsui O .Blood flow and liver imaging. Radiology 1997; 202: 306-314.
2. Oliver J H 3rd, Baron RL. Helical biphasic contrast-enhanced CT of the liver:Technique, indications, interpretation and pit falls. Radiology 1996; 201:1-14.
3. Itai Y, Hachiya J, Makita K, Ohtomok, Kokubo T, Yamauchi T. Transient hepatic attenuation differences on dynamic computed tomography. J Comput Assist Tomogr 1987; 11: 461-645.
4. Colagrande S, Carmignani L, Pagliari A, Capacioli L, Villari N. Transient hepatic attenuation differences not connected to focal lesions. Radiol Med 2002; 104:25-

43.
5. Stefano Colagrande, Nicoletta Centi, Giorgio La Villa, Natale Villari. Transient hepatic attenuation differences AJR 2004;183;459-464.
6. Quiroga S, Sebastia C, Pallisa E, Castella E, Perez-Lafuente M, Alvarez-Castells A. Improved diagnosis of hepatic perfusion disorders: value of hepatic arterial phase imaging during helical CT. Radiographics 2001; 21:65-81.
7. Okuda K. Musha H. Yamasaki T. et al. Angiographic demonstration of intrahepatic arterioportal anastomoses in Hepatocellular carcinoma. Radiology 1977; 122: 53-58.
8. Hyoung Jung Kim, Ah Young Kim, Tae kyoung Kim, Jae Ho Byun et al . Transient hepatic attenuation differences in focal hepatic lesions:Dynamic CT features. AJR 2005;184 : 83-90.
9. Brink JA. Increased CT contrast enhancement of "normal" hepatic parenchyma may herald occult "metastasis" .Radiology 1997;205 : 37-38.