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COMPARISON OF CT-ANGIOGRAPHY AND DELAYED CT SCANNING OF THE LIVER IN DETECTION OF HEPATIC METASTASIS

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ABSTRACT:

Fifteen patients with hepatic metastasis were subjected in a comparative study between CT arteriography {including injection via the hepatic artery (CTA) and injection through the superior mesenteric artery (CTAP)} and delayed scanning CT (DS-CT). We prefer to compare DS-CT with CT arteriography, because in DS-CT there was no requirement to administrate additional Iodin load as the patients had already received contrast during CT arteriography.

The detectability of these metastasis was determined with US, and or CT after injection of a bolus of contrast material. Confirmation with CT and / or US guided biopsy and histological examination was done.

CT Arterial portography (CT-AP) was performed with injection of contrast material into the superior mesenteric artery during CT in 7 patients and into hepatic artery in 8 patients. Delayed scanning (DS-CT) was performed 4 hours after intravascular administration of contrast material in the 15 patients. Both US , conventional CT, CT arteriography and delayed scan CT detected 53 metastasis in the 15 patients.

The sensitivity of (CTA) was 98 % where it detects 52 of 53 metastasis (two metastasis were detected in anatomical sites differ from that detected by (DS-CT), while DS-CT detected 51 metastasis (one metastasis was detected in site differ from that detected by CTA) with a sensitivity of 96 %.

So there was no significant difference in sensitivity between the two techniques, but both techniques were complementary to each other. Both techniques failed to detect any metastatic lesion measures less than 1.0 cm.

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We recommend DS-CT as screening modality for hepatic metastasis detection rather than hepatic angiography because DS-CT is not invasive technique and no significant difference in the sensitivity of detection of both techniques. But, we recommend to do DS-CT after injection of high dose of contrast material not less than 60 gram of Iodin. However, both techniques are complementary to each other to gain higher sensitivity of hepatic metastasis.

INTRODUCTION:

Preoperative imaging techniques for evaluation of hepatic metastasis must be as accurate as possible, and because there is relatively little difference in attenuation between metastasis and normal liver parenchyma on computed topographic scans, so a wide variety of techniques for administration of contrast material during CT have been developed in an effort to increase the difference in attenuation between metastasis and normal liver parenchyma (2).

Arterial portography relies on the difference in blood supply of hepatic metastasis (hepatic artery) and normal liver parenchyma (75 % from portal vein) to produce differential contrast enhancement during injection of the contrast material into the superior mesenteric artery or hepatic artery (7).

Delayed scanning CT depending on the increase in attenuation of normal hepatic parenchyma due to the excretion of the contrast material by normal hepatocytes (13).

We compared the results of these two methods of CT contrast enhancement with a lesion by lesion analysis in a trial to find which of these two methods will add more in the detection and localization of more hepatic metastasis than was detected by conventional CT scan or US, and also to detect which of these two methods is more sensitive than the other in detection of hepatic metastasis.

MATERIALS and METHODS:

CT arteriography performed in 15 patients who were previously evaluated by conventional CT and or US and confirmed by histologic examination to be hepatic metastasis. The age ranged from 42-75 years. The causes of metastasis included 10 from colon, 3 from the rectum, one from the kidney and one from adenocarcinoma of the gall bladder after cholecystectomy. CT arteriography (via the hepatic artery) was performed in 8 patients and CT arterioportography (via the superior mesenteric artery) was performed in 7 patients. Forty mg of papaverin was injected intraarterial to increase the portal blood flow and obtain homogenous perfusion of the parenchyma.

CTA was performed immediately after injection of contrast material through an angiographic catheter placed in the hepatic artery in 8 patients and CTAP was performed 15 seconds after injection of the contrast material via the superior mesenteric artery in 7 patients to obtain images during the beginning of portal phase of the arterial infusion. Contrast material was injected at 30 ml/ minute (0.5 ml/ sec), a total dose of 200 ml was used, the contrast injection was continuous throughout the CT examination. A bolus of 8 ml/each scan.

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Table 1: Comparison of CTA and DS-Ct in the detetion of liver metastasis.

Diameter in cm	Detection by arterioportal and hepatic angiography	Detection by delayed scanning
0.5-1.0	0	0
1.01.5	4	2
1.5-2.0	2	3
2.0-2.5	8	8
2.5-3.0	10	10
3.0-3.5	10	10
3.5-4.0	4	4
4.0-4.5	4	4
4.5-5.0	4	4
5.0-5.5	2	2
5.5-6.0	2	2
6.0-6.5	2	2
Total	52	51

Delayed CT scan obtained 4 hours after finishing the CT arteriography on the same day for all 15 patients, 14 scans were obtained with 10 mm thickness and 10 mm intervals. All CT scans were obtained on GE 9800 and sytic plus GE equipments in Al-Hussin and Bab-AlSharia University Hospitals and other private Radiology centers. The size and number of the metastatic lesions in the liver were recorded according to each technique.

RESULTS:

Fifty three metastasis were detected in 15 patients included in the lesion-by lesion analysis.

The results are shown in table 1 which demonstrates detection of metastasis with both techniques as a function of lesion diameter. The measurements were done from the scan and the greatest diameter was recorded.

All lesions larger than 2 cm were detected with CTAP and CTDS.

Both techniques failed to demonstrate any lesion less than 1,0 cm in diameter, this suggests that both methods are unreliable for the detection of metastasis much smaller than 1.0 cm in diameter.

CTAP detected 52 of 53 lesions, one lesion 1.5 cm in diameter was missed and was detected by DSCT (Fig. 1)

DS-CT detected 51 of 53 lesions, two lesions 1.0 cm diameter each were missed and detected by CTA (Fig. 2). The sensitivity of CTAP was 98 % and 96 % for DS-CT. The difference between the sensitivity of CTA and DS-CT was not statistically significant.

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The number of metastasis per patient was between 1 and 6 and the tumor diameters ranged from 1.0 to 6.5 cm. The metastasis were detected as a hypodense focal lesions on a back ground of hyperdense liver parenchyma when doing CT angioportography (Fig. 3), while on performing CTA the focal lesions were visualized as hyperdense lesions on a back ground of a relatively hypodense liver parenchyma (Fig. 4).

On performing CT hepatic arteriography two cases showed uneven distribution of the contrast through the liver parenchyma due to unfavorable arterial anatomy (Fig. 5). The same phenomenon was a problem with CT-AP as well in another two cases (Fig. 6).

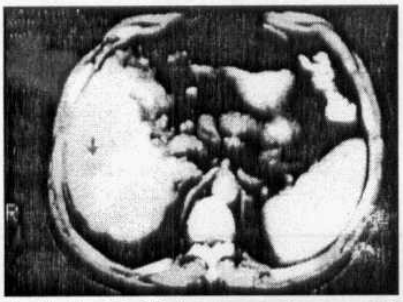

Fig. 1 (a): DS-CT demonstrated a metastatic lesion not detected by CTAP (b) of the same patient.

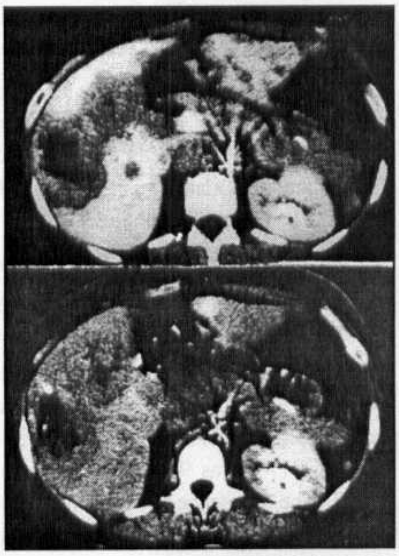

Fig. 2 (a): CTAP detected a metastatic lesion not detected by DS-CT (b) of the same patient.

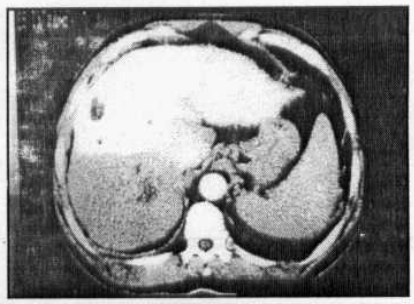

Fig. (3): CTAP demonstrates the metastatic lesion as a hypodense on a back ground of hyper dense liver parenchyma.

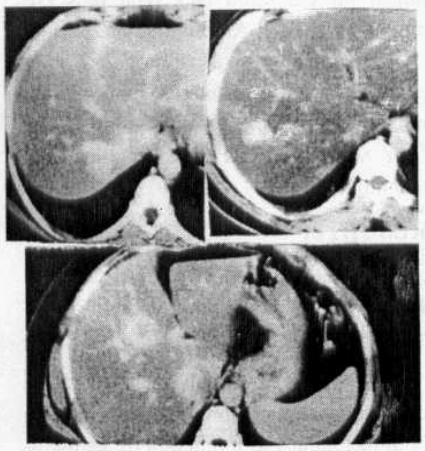

Fig. 4: CTA demonstrates the lesion as hyper dense on a back ground of relatively hypo dense liver parenchyma.

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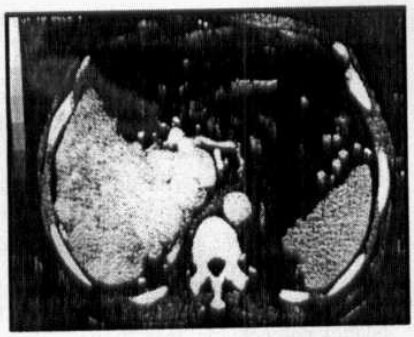

Fig. 5: CT hepatic artery angiography showed uneven distribution of the contrast through the liver parenchyma.

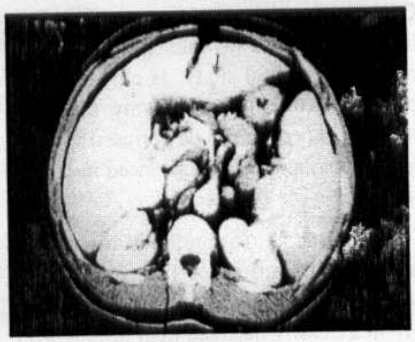

Fig. 6: (a) CTAP showed uneven distribution of the contrast through the liver parenchyma, may cause considerable difficulty in interpretation. (b) On DS-CT this metastasis was correctly identified.

DISCUSSION:

There are many ways to examine the liver for metastatic disease with CT. Clark and Matsui (2) described seven methods ranging from CT without contrast material (simple but relatively insensitive) to CT arteriography (sensitive but complicated and invasive).

In our study we selected 15 patients with known hepatic metastasis and did a comparative study between CT angiography and delayed scan CT to evaluate which method will be more sensitive as regards the size and number of metastatic lesions.

In our study we performed 8 CT-arteriography, that required placement of the angiographic catheter in the hepatic artery and 7 CT-angiography where the contrast material injected into the superior mesenteric artery.

CT angiography and CTAP are based on the dual blood supply to the liver. Primary and metastatic hepatic neoplasms receive blood supply from the hepatic artery, while the portal vein supplies about 75 % of blood to the normal hepatic parenchyma.

In our study we cannot find a significant difference between CTA and CTAP for detection of metastatic lesions, although the lesions with CTA appeared as positive contrast lesion on a back ground of hepatic parenchyma of decreased density, while the lesions with CTAP appeared of low density on a back ground of hepatic parenchyma with higher density, however in both modalities two cases showed uneven distribution of the contrast through out the liver parenchyma.

CTAP is an extremely sensitive examination for detection of both metastasis and small hepatic carcinoma (8).

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Donald et al., (3) they choose to study CTAP rather than CTA because CTAP is not dependent on favorable arterial anatomy for successful study, as only 55 % of patients have arterial anatomy that permits the entire liver to be perfused via single angiographic catheter placed in hepatic artery.

Joseph et al., (6) preferred hepatic artery CTA because they believed that lesions with positive contrast enhancement are more easily detected than lesions with negative contrast enhancement.

In a study by Philippe et al., (12) the advantage of intra operative US over CTAP is not so evident, the sensitivities of intra operative US and CTAP in detecting hepatic metastasis are 96 % and 91 % respectively and the difference between the two techniques is not statistically significant.

CTAP has sometimes been considered as unacceptable because of high false-positive rate due to uneven hepatic perfusion and uneven distribution of contrast medium in the hepatic parenchyma (9). This was due to compression of some intra hepatic portal vein branches by adjacent metastasis (4).

In our study we followed Filippe (12) where we used papaverin injected in the arterial catheter to increase the portal blood flow and provides homogenous enhancement and so minimize the false-positive rate.

DS-CT first described in 1982 (14), has been reported to be at least as good (1) or better than (10) bolus dynamic CT.

The improvement in visual contrast between tumor and normal liver is due to the increase in attenuation of normal liver (13) and is proportional to the total dose of iodine administrated (11).

In our study we noticed that the smaller number and size of the tumors the greatest was the increase attenuation of normal liver, this may be due to the equal amount of contrast that was used in all patients as we never gave more than 200 ml or less than 180 ml, so the attenuation in our patients depends upon the amount of healthy parenchymal liver tissue.

In our study we did not injecte more contrast for the DS-CT and we depended upon the amount of contrast injected during the arteriography.

In the study of Perkerson et al., (11), DS-CT of the liver was obtained 4-6 hours following intravenous administration of 60 gm of iodine (215 ml of a 60 % iodinated contrast), DS-CT has been shown to increase the contrast attenuation of normal hepatic parenchyma by approximately 20 HU.

In the series reported by Bernardino et al., (1) DS-CT improved lesion detection in 58 % of cases and detected additional lesions not seen with bolus-Dynamic CT in 27 % of patients.

In our study both types of CT examination can detect lesions 1.0 cm diameter or more and unreliable for detection of lesions smaller than this diameter. The sensitivity and size detection of both are similar, but the invasive nature of CT angiography makes it inappropriate as a screening examination.

In a comparative study done by Donald et al., (3) DS-CT and CT with an ethiodized oil emulsion (EOE-CT) injected

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slowly via intravenous infusion, he reported that DS-CT and EOE-CT are comparable in sensitivity. Because EOE-CT has been reported to be as sensitive as MR imaging (15). So we may suggest that DS-CT will be as sensitive as MR imaging.

In our study we did DS-CT following direct administration of the contrast material into the liver through the hepatic or superior mesenteric artery this may caused more opacification of the hepatocytes than intravenous administration. However Bernardino (1) administered 69 gm of iodin intravenously and have shown that increasing of the dose of iodine caused increase in attenuation of normal liver parenchyma.

Heiken et al., (5) concluded that non invasive imaging technique including delayed Scan-CT have improved the detection rate of hepatic metastasis up to 85 %.

Philippe et al., (12) concluded that intra operative US does not increase the number of detected liver metastasis when CTAP is considered as pre operative standard of reference.

Donald et al., (3) reported that false positive rate for CT-AP was significantly higher than that for DSCT and because CT-AP is an invasive technique we think that CT-AP is not more useful than DSCT.

In conclusion, on performing CT hepatic angiography we prefer to do CT angiography (CTAP Injection in the superior mesenteric artery) rather than CTA (injection in the hepatic artery) because CTAP does not depend on a favorable hepatic arterial anatomy to that degree of CTA. We advise to inject 40 mg of papaverin intra arterial to obtain homogenous perfusion of the liver parenchyma. CT-angiography and DS-CT are sensitive methods for detection of hepatic metastasis. However, because CT-AP is an invasive technique so it will not be a suitable modality for screening and further evaluation of the hepatic metastasis so we recommend DS-CT but with administration of high dose of iodine contrast medium not less than 60 gm of iodine, also CT-AP has a higher rate of false positive result. However both modalities may be complementary.

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دراسة مقارنة بين الأشعة المقطعية أثنا حقن أوردة وشرايين الكبد وبين الأشعة المقطعية المتأخرة فى بيان الأورام الثانوية فى الكبد

محمد كمال الشرقاوي - صلاح كريم - مصطفي سنبل

محمود أبو الفضل - فاتن سالم

قسم الأشعة كلية طب الأزهر - قسم الأشعة كلية طب طنطا

أجري هذا البحث علي خمسة عشر مريضًا من الذين يعانون من ثانوية سرطانية بالكبد . وكان الهدف من البحث هو مقارنة بين نتائج بيان الثانوية السرطانية من حيث عددها وحجمها باستخدام الأشعة المقطعية بعد الحقن في الشريان الكبدي والشريان المعوي حيث كلاهما يظهرا الثانوية بصورة أوضح وبين الأشعة المقطعية المؤجله والتي تعمل بعد ٤ ساعات من حقن الصبغات

وتبين أن كلا الفحصين لهما أهمية عظيمة وذو قيمة تشخيصية عالية في بيان الثانوية من نسيج الكبد الطبيعي .

وحيث أن الفحص الأول يعتبر فحص نفاذي والفحص الثاني غير نفاذي ولذلك فنحن ننصح باستخدام الفحص الثاني في عمل الفحوصات الدورية والتتابعية مع الأخذ في الاعتبار بحقن كمية كبيرة من الصبغة لا يقل محتواها من مادة الأيودين عن ٦٠ جرام .

المنارة للاستشارات

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