

Pseudolesions around the Gallbladder Fossa: Comparison of Frequency and Radiological Characteristics in Multiphasic CT, CTAP, and CTHA¹

Hyoung Rae Kim, M.D., Yun Hwan Kim, M.D., Sung Bum Cho, M.D., Hong Won Kim, M.D., Chang Ho Kang, M.D., Kyoo Byung Chung, M.D., Won Hyuck Suh, M.D.

Purpose: The purpose of this study is to compare the frequency with which pseudolesions around the gallbladder (GB) fossa are revealed by multiphasic CT, by CT during arterial portography (CTAP), and by CT during hepatic arteriography (CTHA) and to determine their radiological characteristics.

Materials and Methods: Multiphasic CT, CTAP, and CTHA examinations of 81 patients without pathology of the GB and around the GB fossa were evaluated for pseudolesion around the GB fossa. The definition of pseudolesion was as follows: 1) hyperattenuation during the arterial phase and isoattenuation during the delayed phase of multiphasic CT, or perfusion defect on CTAP and hyperattenuation on CTHA; 2) no Lipiodol tagging on Lipiodol CT; 3) all findings observed adjacent to the gallbladder fossa; and 4) no interval change on follow-up CTAP and CTHA. We compared the frequency of pseudolesions around the GB fossa, as seen on multiphasic CT, CTAP, and CTHA, and determined their size, location, and shape, as revealed by CTHA.

Results: The frequency of pseudolesion was 2.5% (2/81) on multiphasic CT, while on CTAP or CTHA, the frequency was 53.1% (43/81), and 58 pseudolesions were identified. Of 58 pseudolesions, 56 were revealed by CTAP and 57 by CTHA. Forty-nine of 58 pseudolesions were larger and all pseudolesions showed more contrast to parenchyma on CTHA than on CTAP. The location of pseudolesions was segment V (32 of 58), IV (25 of 58), and VI (1 of 58), and their size ranged from 5 to 30 (mean, 17.5) mm. Pseudolesions were wedge-shaped (48 of 58), oval (6 of 58), bandlike (3 of 58), or round (1 of 58).

Conclusion: CTAP and CTHA frequently revealed pseudolesion around the GB fossa. The radiological characteristics of these modalities help differentiate pseudolesions from true tumoral hepatic lesions.

Index words : Liver, CT
Liver, angiography
Liver neoplasms, CT

CT during arterial portography (CTAP) and CT during hepatic arteriography (CTHA) are the most sensitive

imaging modalities for detecting hepatic masses, and the simultaneous interpretation of two studies increases the

¹Department of Diagnostic Radiology, Korea University College of Medicine
Received February 9, 1999 ; Accepted November 24, 1999
Address reprint requests to : Yun Hwan Kim, M.D., Department of Diagnostic Radiology, Korea University Anam Hospital, Korea University College of Medicine. 126-1, 5-ka, Anam-dong, Sungbuk-ku, Seoul 136-705, Korea.
Tel. 82-2-920-5573 Fax. 82-2-929-3796

probability of detecting hepatic lesion (1 - 3). But numerous false-positive lesions may, however, be well established in various regions; they may occur, for example, around the falciform ligament and in the subcapsular region.

Pseudolesions adjacent to the gallbladder fossa are also frequently demonstrated by conventional CT and CTAP (4 - 8) and one report has described the frequency of pseudolesions adjacent to the gallbladder fossa, as seen on CTHA (9).

The purpose of our study is to compare the frequency with which pseudolesions around the gallbladder fossa are revealed by multiphasic CT, CTAP, and CTHA, and to determine their radiologic characteristics.

Materials and Methods

The results of all available multiphasic CT, CTAP, and CTHA examinations performed at our institution between February 1996 and February 1998 were retrospectively reviewed. The study group consisted of 81 patients (56 men and 25 women) ranging in age from 30 to 80 (mean 56) years. Sixty patients had liver cirrhosis. All 81 underwent multiphasic CT, CTAP, and CTHA; in each case, the purpose of multiphasic CT was to evaluate the hepatic lesions revealed by ultrasonography, while that of CTAP and CTHA was to differentiate the hepatic lesions. Diagnoses of hepatocellular carcinoma, metastatic liver cancer, peripheral cholangiocarcinoma, and hypereosinophilic syndrome were confirmed pathologically ($n=37$) or radiologically ($n=44$). Patients whose gallbladder or adjacent gallbladder fossa harbored a pathologic condition, or in whom CT images revealed severe arteriportal shunt, were excluded.

For multiphasic CT, CTAP, and CTHA scanning, a spiral CT Somatom Plus S scanner 40B (Siemens, Erlangen, Germany) was used. Scanning extended from the basal lung zone to the lower pole of the right kidney. Nonionic contrast medium (Ultravist 300, Schering, Berlin, Germany) or Omnipaque (Iohexol, Nycomed, Oslo, Norway) was used. Table feed was 10 mm/sec, with 10 mm collimation, and scans were obtained at 165 or 210 mA and 120 kVp. Overlapping axial reconstructions were obtained at 10 mm intervals.

In the case of multiphasic CT, 140 ml of contrast medium was administered at a rate of 3 ml/sec by power injector (MEDRAD, Pittsburgh, Pa., U.S.A.). In the case of biphasic CT, scan delay time was 24 - 27 sec (arterial phase) or 3 min (delayed phase) after starting the

injection of contrast medium. In the case of triphasic CT, scans were also obtained 58 - 62 secs after the injection of contrast medium (portal phase). Patients were instructed to hold their breaths during spiral CT examination.

To ensure correct catheter placement and to evaluate hepatic arterial anatomy, superior mesenteric and celiac arteriography was performed prior to CT scanning. A 4-Fr Yashiro catheter (Jung Sung Corp., Seoul, Korea) was positioned in the common hepatic artery (CTHA) and superior mesenteric artery (CTAP) distal to the takeoff of any replaced or accessory hepatic arterial branches. During each angiographic sequence, patients received less than 20 ml of contrast medium at a rate of 2 - 5 ml/sec. They were then taken to the CT suite.

For CTAP, 80 ml of contrast medium was injected at a rate of 2 ml/sec through the superior mesenteric artery. Scans were obtained 40 sec after injection of contrast medium.

For CTHA, 20 - 35 ml of contrast medium was injected at a rate of 1.0 - 1.2 ml/sec through the common or proper hepatic artery. In the case of a narrow or tortuous artery, coaxial 3-Fr SP microcatheter (Terumo, Tokyo, Japan) was introduced through a 4-Fr catheter and 24 ml of contrast medium was injected at 1.0 ml/sec. Scan delay time was 6 sec after the injection of contrast medium.

The definition of pseudolesion around the gallbladder fossa was as follows: 1) hyperattenuation during the arterial phase and isoattenuation during the delayed phase of multiphasic CT, or perfusion defect on CTAP and hyperattenuation on CTHA; 2) no Lipiodol tagging on Lipiodol CT; 3) all findings observed adjacent to the gallbladder fossa; and 4) no interval change on follow-up CTAP and CTHA.

Three radiologists retrospectively analysed the findings of multiphasic CT, CTAP, and CTHA. The three modalities were reviewed Independently prior to side-by-side evaluation. The observers specifically searched for abnormal findings around the gallbladder fossa which would satisfy the above definition of pseudolesion. The location, size, and shape of abnormal findings, especially of those seen on CTHA, were recorded. For each lesion, the longest diameter, as seen on CT images, was measured, and this same diameter as seen on CTAP and CTHA was also recorded. With regard to shape, lesions were classified as wedge-like, round, oval, or band-like. All decisions were reached under the consensus of all observers.

Using Chi-square test, we determined whether there was a difference in the frequency of each pseudolesion between patients with and without liver cirrhosis. The threshold of statistical significance was <0.05 .

Pseudolesions were not pathologically confirmed, except in one case. In this patient, an ultrasonogram-guided gun biopsy was performed using a 19.5 gauge gun.

Results

A comparison of the frequency of pseudolesions, as seen on multiphasic CT, CTAP, and CTHA is shown in Table 2. Although pseudolesions were seen on multiphasic CT in only two patients, CTAP and CTHA revealed their presence around the gallbladder fossa in 43

of 81 (Fig. 1). In these 43, CTAP and CTHA demonstrated 58 pseudolesions; among this same group, CTHA failed to show the pseudolesion in one patient and CTAP in a further two. Fifty-six of 58 pseudolesions were identified on CTAP (96.6%) and 57 on CTHA (98.3%), a finding which reveals no statistical difference between CTAP and CTHA ($p=0.14$) (Fig. 2).

The size of pseudolesions ranged from 5 to 30 (average, 17.5)mm. Forty-nine of 58 pseudolesions (84.5%) appeared larger on CTHA than on CTAP ($p=0.01$) (Fig. 3).

On CTHA, 32 pseudolesions (55.2%) were located in segment V, 25 (43.1%) in segment IV, and one (1.7%) in

Table 1. The Final Diagnosis of Patients (n = 81)

Final Diagnosis	No. of Patients
Hepatocellular carcinoma	72
Metastatic tumor	7
Peripheral cholangiocarcinoma	1
Hypereosinophilic syndrome	1

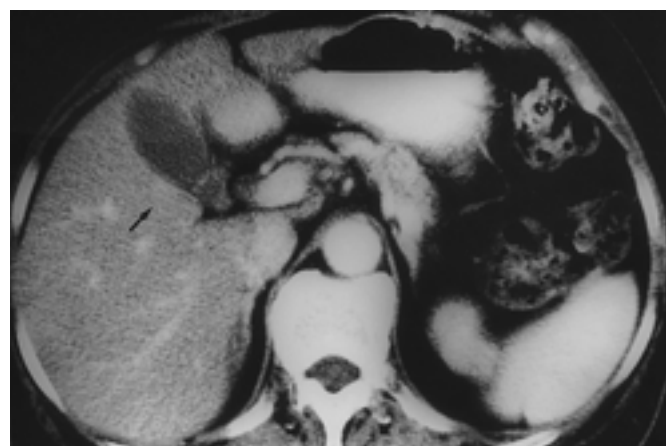
Table 2. Frequencies of Pseudolesions on Multiphase CT, CTAP, and CTHA (n = 81)

Imaging Method	Frequency
multiphasic CT	2(2.4)
CTAP	41(50.6)
CTHA	42(51.8)

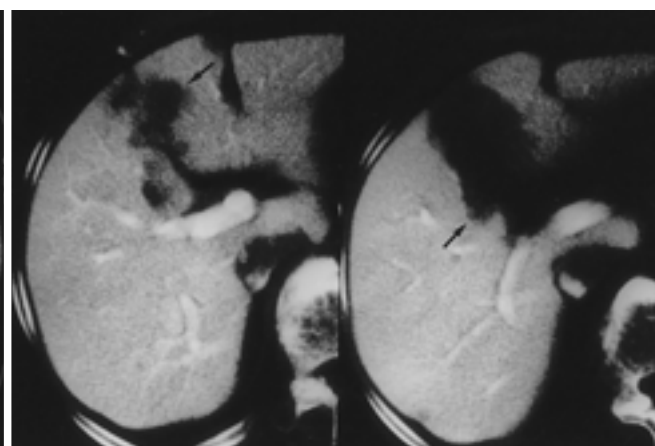
CTAP: CT during Arterial Portography

CTHA: CT during Hepatic Arteriogram

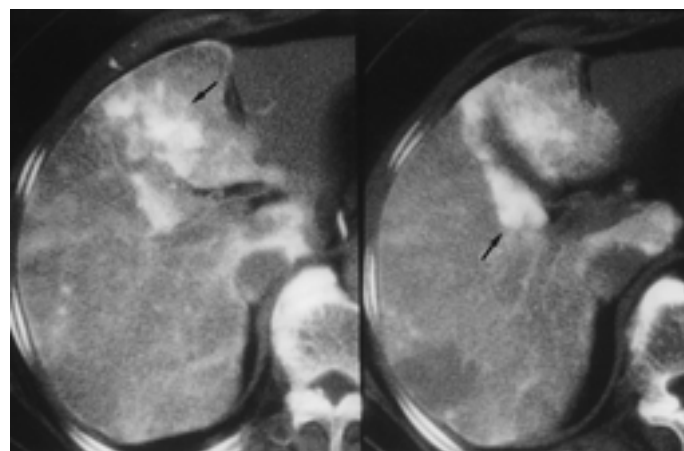
Numbers in parentheses are percentage



A



B



C

Fig. 1. Pseudolesions around the gallbladder fossa in arterial phase of triphasic CT, CTAP, and CTHA.

A. Arterial phase of triphasic CT shows wedge shaped hyperattenuation (arrow) around gallbladder fossa. But it is very subtle.

B. Multiple perfusion defects (arrows) are seen around the gallbladder fossa on multisection CTAP images. Note that hyperattenuation in CT image of arterial phase (arrow in A) becomes well defined perfusion in the same area.

C. CTHA images show hyperattenuation (arrows) in the same areas of perfusion defects on CTAP images.

segment VI adjacent to the gallbladder fossa.

Pseudolesions were most commonly wedge-shaped (48 of 58, 82.8%); the oval form was next most frequent, followed by band-like and round (Table 3).

Table 4. shows the relationship between frequency of

pseudolesions and liver cirrhosis. The prevalence of pseudolesions was not significantly different between the group without and with liver cirrhosis ($p=0.232$).

In one pseudolesion, the pathologic finding was hyperplasia of hepatocytes, without evidence of malignan-

Table 3. Frequencies of Each Shape of Pseudolesions (n = 58)

Shape	Number
Wedge	48(82.8)
Oval	6(10.3)
Band form	2(5.2)
Round	1(1.7)

Numbers in parentheses are percentage

Table 4. Correlation with Frequencies of Pseudolesion a Liver Cirrhosis ($p=0.2$)

	Pseudolesion (+)	Pseudolesion (-)	Total
LC (+)	29	31	60
LC (-)	14	7	21
Total	43	38	81

LC: Liver Cirrhosis / + : Positive / - : Negative

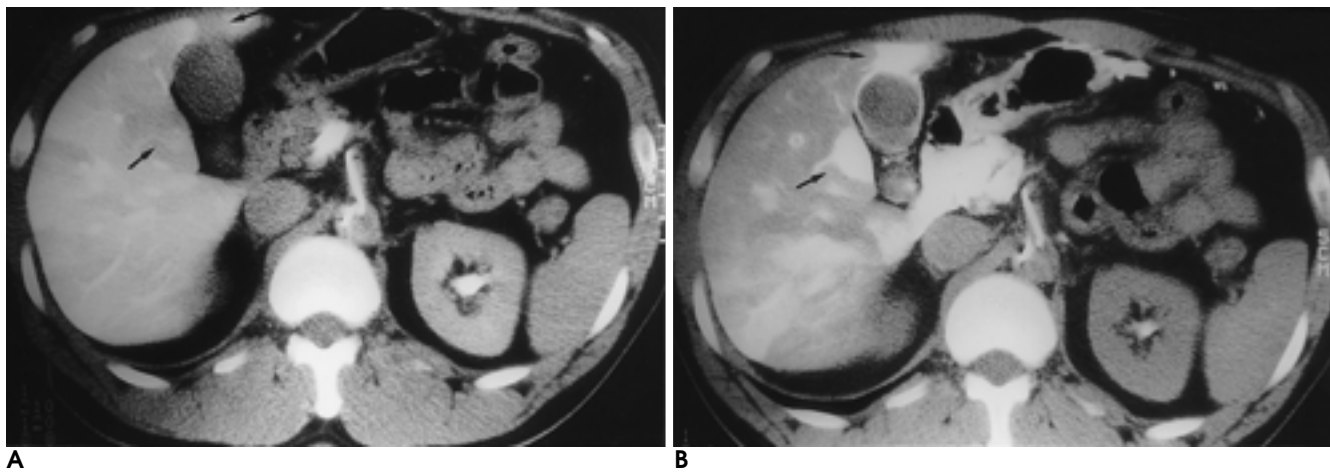


Fig. 2. Pseudolesions around gallbladder fossa in CTAP and CTHA.

A. CTAP image shows wedge shaped perfusion defects (arrows) adjacent to gallbladder fossa in segment IV and V

B. CTHA image shows wedge shaped hyperattenuation (arrows) in the same area on CTAP.

Note that CTHA shows larger size and higher contrast than CTAP.

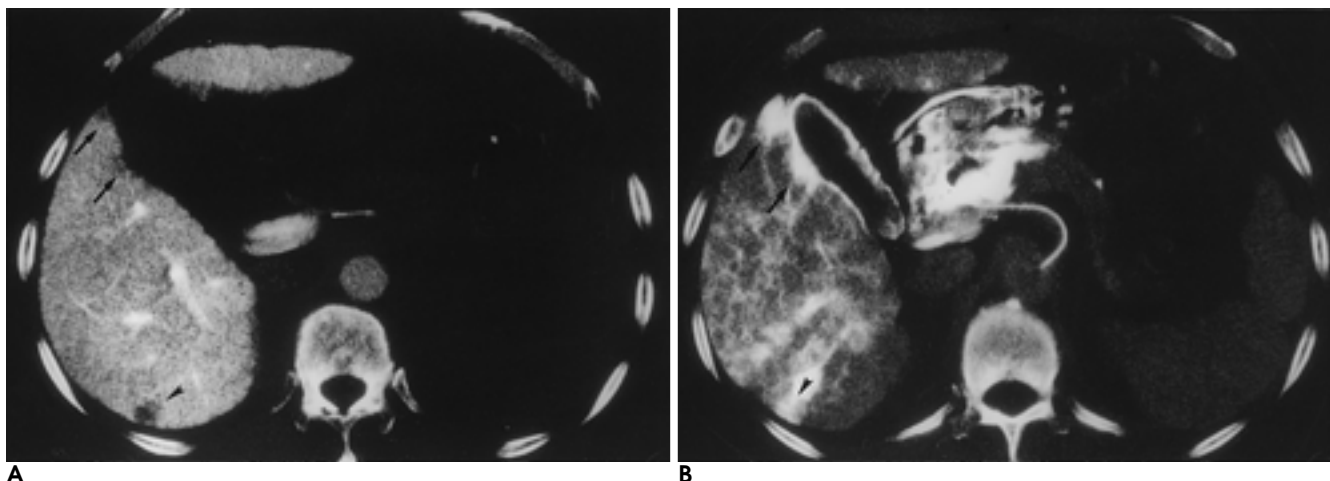


Fig. 3. A. Perfusion defects are seen in segment IV and V, adjacent to gallbladder fossa (arrows) on CTAP image.

B. CTHA image shows hyperattenuation in the same areas of CTAP. A few areas show no perfusion defect on CTAP image. Hyperattenuation has a more enlarged size and higher contrast than perfusion defect in CTAP image. The other perfusion defect (arrowhead) is seen in subcortical area of segment VI on CTAP image and this lesion shows hyperattenuation (arrowhead) on CTHA image. Pathologic result of this lesion was hepatocellular carcinoma.

cy or inflammation.

Discussion

CTAP is the most sensitive modality for detecting hepatic neoplastic lesion but its specificity is low. Non-tumoral perfusion defects in various regions have been visualized on CTAP, and pseudolesion around the gallbladder fossa is also well known (4 - 8). CTHA is also highly sensitive but its low specificity results in various false positive findings (9).

The cause of pseudolesion adjacent to the gallbladder fossa, namely increased cystic venous drainage is also well known (10 - 12). Matsui et al. concluded that increased cystic venous drainage into the intrahepatic portal vein in the gallbladder bed was the cause of the staining seen in the nondiseased gallbladder bed using CTAP and hepatic arteriography (13). Using CT during cystic arteriography, Yoshimitsu et al. demonstrated hyperattenuation around the gallbladder fossa caused by cystic venous drainage (14).

Several authors have reported pseudolesion around the gallbladder fossa (4 - 7). The highest frequency (39%, as seen on CTAP) has been demonstrated by Blumke et al (7). They noted, in addition, two morphologically distinct types with equal frequency. One type of defect was somewhat lobulated in appearance and extended approximately 15 - 22 mm along the gallbladder fossa. Other defects were focal and wedge-shaped, with a size of 8 - 10 mm. Our result showed a higher frequency of pseudolesion around the gallbladder fossa (50.6% for CTAP and 51.8% for CTHA). Examination of the findings of follow-up CTAP and CTHA explains the higher frequency of pseudolesions in our study, permitting their easy visualization. Between week 4 and week 12, pseudolesions adjacent to the gallbladder fossa showed no definite interval change in size or shape, and this allowed us to differentiate pseudolesion from true tumoral lesion. Follow-up CTAP and CTHA were available in all cases.

The use of Lipiodol CT allowed easy differentiation of pseudolesion from true tumoral lesion; in pseudolesions, Lipiodol uptake was not seen.

In our study, the fact that multiphasic CT revealed a lower frequency of pseudolesions than did CTAP is remarkable. In many cases, a retrospective review of multiphasic CT on the basis of CTAP and CTHA did not reveal the presence of pseudolesion. This was due to several factors, one of which was the influence of liver cir-

rhosis. Most hepatocellular carcinomas were found in cases of liver cirrhosis, which in our study was frequent (60/81, 74.1%). In liver cirrhosis, massive, confluent fibrosis can appear hypodense to remaining liver parenchyma on noncontrast CT, and often becomes either isodense or hypodense following contrast administration (15). This appearance may cause difficulty when locating pseudolesions on multiphasic CT images.

CTAP and CTHA revealed a similar frequency of pseudolesion around the gallbladder fossa, but on CTHA, most pseudolesions appeared to be larger, and showed better contrast to hepatic parenchyma, than on CTAP. The reason of this result is unclear. Pseudolesions present as perfusion defect or negative lesion on CTAP were seen as areas of hyperperfusion or positive lesion and on CTHA; these last-mentioned features were more easily identified after the infusion of contrast media. Arteriportal communication via the peribiliary arterial plexus has also been noted (16). Infused contrast media might diffuse to surrounding normal hepatic parenchyma, resulting in the appearance on CTHA images of pseudolesions apparently larger than their actual size.

Frequent sites of pseudolesions were segment V and IV. According to a previous study by Yoshimitsu et al., the sites of cystic venous drainage were segment V (96%), segment IV (93%), segment I (21%), and segment VI (18%) (14); their findings were similar to ours.

Pseudolesions were typically wedge-shaped, but other forms such as round, oval, or band-forms also occurred. Round pseudolesions, in particular, with a reported frequency of ten percents (7), must be differentiated from tumors. In our study, one of 58 pseudolesions (1.7%) was round, and on the basis of follow-up CTAP and CTHA was easily differentiated from tumors.

Irie et al. suggested that liver cirrhosis does not influence the frequency of pseudolesions adjacent to the gallbladder fossa (17), and our study shows the same results. The cause of pseudolesion around the gallbladder fossa is increased cystic venous drainage into the intrahepatic portal vein and even in the case of portal hypertension, frequently seen in liver cirrhosis, cystic venous blood is not distributed to the portal vein of the gallbladder bed. For this reason, there is no relation between liver cirrhosis and pseudolesions adjacent to the gallbladder fossa.

A limitation of our study is that only one case was pathologically confirmed, and correlation between the radiological and pathological results was thus not demonstrated. In one case, the result was hyperplasia of

hepatocytes. Soyer et al. demonstrated that various entities of pathologic diagnosis, including focal fatty infiltration and cirrhotic or normal liver, appeared on CTAP images as non-tumoral perfusion defect (18), while other studies have concluded that focal fatty infiltration is the cause of pseudolesion of the liver, especially in the left lobe (4 - 6, 19). Because focal fatty infiltration is seen on CTHA as an area of low attenuation, a diagnosis of focal fatty infiltration may be excluded from our study.

In conclusion, hepatic pseudolesions around the gallbladder fossa are frequently seen on CTAP and CTHA images. Pseudolesions were between 5 and 30 mm in size, most frequently wedge-shaped, and most commonly located in segments V and IV. On the basis of these characteristics, pseudolesions and true tumoral lesions may be more easily differentiated.

References

1. Miller DL, Simmons JT, Chang R, et al. Hepatic metastasis detection: comparison of three CT contrast enhancement methods. *Radiology* 1987;165:785-790
2. Nelson RC, Chezmar JL, Sugarbaker PH, Beinardino ME. Hepatic tumors: Comparison of CT during arterial portography, delayed CT, and MR imaging for preoperative evaluation. *Radiology* 1989;172:27-34
3. Matsui O, Takashima T, Kodoya M, et al. Liver metastases from colorectal cancers: detection with CT during arterial portography. *Radiology* 1987;165:65-69
4. Peterson MS, Baron RL, Dodd GD III, et al. Hepatic parenchymal perfusion defects detected with CTAP: imaging-pathologic correlation. *Radiology* 1992;185:149-155
5. Paulson EK, Baker ME, Hilleren DJ, et al. CT arterial portography: causes of technical failure and variable liver enhancement. *AJR Am J Roentgenol* 1992;159:745-749
6. Nelson RC, Thompson GH, Chezmar JL, Hamed RK II, Fernandez MP. CT during arterial portography: diagnostic pitfalls. *Radiographics* 1992;12:705-718
7. Bluemke DA, Soyer P, Fishman EK. Nontumorous low-attenuation defects in the liver on helical CT during arterial portography: frequency, location, and appearance. *AJR Am J Roentgenol* 1995;164:1141-1145
8. , , . CT CT 1994;31:1113-1120
9. , , . CT 1996;35:373-380
10. Sprayr gen S, Messinger NH. Carcinoma of the gallbladder: diagnosis and evaluation of regional spread by angiography. *AJR Am J Roentgenol* 1972;116: 382-392
11. R sch J, Croliman JH, Steekel RJ. Arteriography in the diagnosis of gallbladder disease. *Radiology* 1969;92:1485-1491
12. Gothin J, Potterson H. Angiography in malignancy and chronic inflammatory lesions of the gallbladder. *Acta Radiol Diagn* 1976;17:343-352
13. Matsui O, Takashima T, Kodoya M, et al. Staining in the liver surrounding gallbladder fossa on hepatic arteriography caused by increased cystic venous drainage. *Gastrointest Radiol* 1987;12:307-312
14. Yoshimitsu K, Honda H, Kaneko K, et al. Anatomy and clinical importance of cholecystic venous drainage: helical CT observation during injection of contrast medium into the cholecystic artery. *AJR Am J Roentgenol* 1997;169:505-510
15. Haaga JR, Lanzieri CF, Sartoris DJ, Zerhouni EA. *Computed tomography and magnetic resonance imaging of the whole body*. 3rd ed. Missouri: Mosby, 1997:967
16. Takayasu K, Okuda K. *Imaging in liver disease*. New York: Oxford, 1997:21-23
17. Irie T, Tsushima Y, Terahata S, Hatsuse K, Kusano S. Influence of liver cirrhosis on pseudolesions in liver at CT during arterial portography. *J Comput Assist Tomogr* 1996;20:914-918
18. Soyer P, Lacheheb D, Levesque D. False-positive CT portography: correlation with pathologic findings. *AJR Am J Roentgenol* 1993;160:285-289
19. Paulson EK, Baker ME, Spritzer CE, Leder RA, Gulliver DJ, Meyers WC. Focal fatty infiltration: a cause of nontumorous defects in the left hepatic lobe during CT arterial portography. *J Comput Assist Tomogr* 1993;17:5

CT, CTAP CTHA

1

1

CT, CT arterial portography(CTAP) CT hepatic arteriography(CTHA)

: 1996 3 1997 12 CT, CTAP CTHA

81 CT Lipiodol CT Lipiodol CT, CTAP CTHA

CT, CTAP CTHA

CT 2.4%(2/81) CTAP CTHA 53.1%(43/81)

, 58 58 CTAP 96.5%(56/58), CTHA 98.3%(57/58)

84.5%(49/58) 가 CTHA 10.4%(3/58) 가 CTAP CTHA V 55.2% (32/58), IV 43.1%(25/58), VI 1.7%(1/58) 1.75 1.25 cm (0.5 cm - 3 cm) 82.8%(48/58), 10.3%(6/58), 5.2%(3/58) 1.7%(1/58)

CTAP CTHA

-《

>>

가

1 /

2

3

4

5

6

[: _____]

1 , 1 .

1 (double space) 21 x 30cm (A4)

(Index Words)

가