

가 : 가

가¹

가²

가³

가 : (Klatskin tumor) 가

(CT) (DSA)

가 : 1994 1 1997 12

CT DSA 25 . 2 가

가 , 가 가

가 : 가 13 가 CT 9 , DSA 3

CT 61.5%,

91.7%, 88.9%, 68.8%, 76.0% , DSA

23.1%, 100%, 100%, 54.5%, 60.0% . CT 가

DSA . CT 가 5

(n=2), (n=1), (n=1),

(n=1) 가 가 .

가 : 가 가 CT가

DSA가 .

(common hepatic duct) , (computed tomography,

(adenocarcinoma) CT) 가 가

(1), (infiltrative type), (exophytic 가 가

type), (polypoid type) (2). 가 (2, 3, 9). 가

가 5 1% raphy, DSA) 가

(3). 5 20% (digital subtraction angiog- (duplex ultra-

가 , (hepaticoje- raphy, DSA) (10, 11) .

junostomy) , CT , CT

(4-7), 가 , 가

(12, 13). 가

가 (8). CT DSA

¹ 1995 (01-1995-062-0) 1994 1 1997 '12

² 1999 9 6 1999 11 12 , CT DSA

³

25
6, 34 68 19
55.0
CT 11 Highspeed advantage scanner (GE Medical System, Milwaukee, U.S.A.), 9 Somatom Plus-S scanner (Siemens, Erlangen, Germany), 1 GE 9800 scanner (GE Medical System, Milwaukee, U.S.A.), 4
CT 17 CT 8 CT 5 mm 30 65
5mm 10mm

Ultravist 370 (Schering, Berlin, Germany) 120ml
2.5ml
DSA Angiostar (Siemens, Erlangen, Germany) Rosch
Hepatic (Cook, Bloomington, IN, U.S.A.)
50cc Ultravist 370 (Schering, Berlin, Germany) 7cc 14-16 20ug
50cc 5cc
가 CT DSA
가
1)

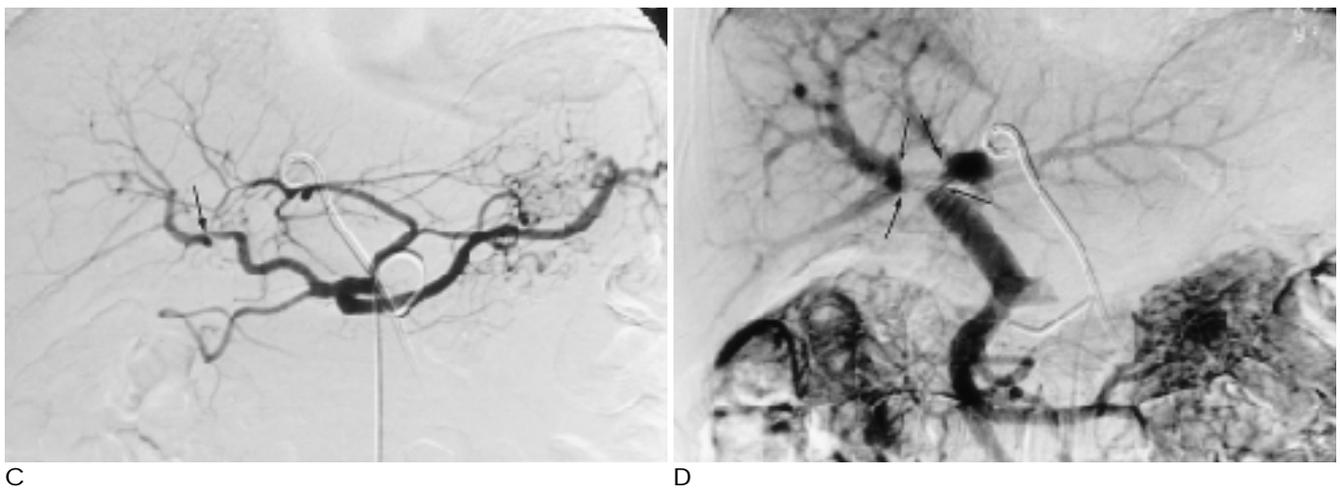
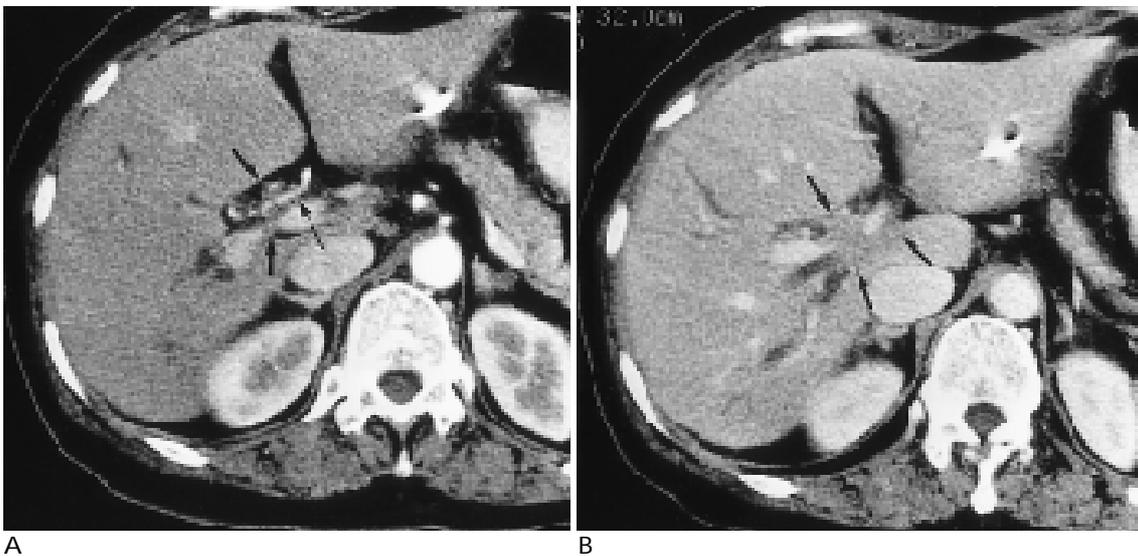


Fig. 1. Unresectable tumor correctly diagnosed on the basis of CT and DSA findings.
A. Spiral CT scan obtained during the arterial-dominant phase shows soft tissue mass (arrows) encasing right hepatic artery (long arrow).
B. CT of the portal-dominant phase also shows encasement of right and left portal veins by tumor (arrows).
C. Hepatic arteriography shows segmental narrowing of right hepatic artery (arrow).
D. Portography shows narrowing of portal vein bifurcation, right and left portal veins (arrows). Metastatic adenocarcinoma at celiac lymph node was detected at expolation, so the surgeon did not try to confirm the vascular invasion.

2) . CT
 , CT
 CT
 (hepatic parenchymal compensatory hyperperfusion)
 , DSA

가
 , CT DSA
 가
 가
 McNe-mar 's test, Matched pair test
 , p 0.05
 가

Table 1. Vascular Invasion Assessed by Computed Tomography

	Main PV	Right PV	Left PV	None	Total
Proper HA			2 ⁺		2
Right HA	2		2*		4
Left HA					
Middle HA			1		1
None	3*		3	12	18
Total	5		8	12	25

PV: Portal Vein, HA: Hepatic Artery

* Two also had simultaneous Right PV invasion.

† Two also had simultaneous Right HA and Left HA invasion.

(Colored areas represent unresectable finding)

Table 2. Vascular Invasion Assessed by Digital Subtraction Angiography

	Main PV	Bilat. PV	Right PV	Left PV	None	Total
Proper HA						
Right HA				1*	2	3
Left HA					1	1
Middle HA						
None	1	1	3	4*	12	21
Total	1	1	3	5	15	25

PV: Portal Vein, HA: Hepatic Artery

* Also had simultaneous Right PV invasion.

(Colored areas represent unresectable finding)



A B C



D

Fig. 2. Resectable tumor correctly diagnosed on the basis of CT and DSA findings.

A-C. On serial CT images, there is small soft tissue mass (arrows) in hilum, and the diameter of left portal vein (large arrows) in (B) is smaller than (A), suggesting encasement of left portal vein.

D. Portography also shows narrowed left portal vein (arrow). The tumor was resectable at surgery.

CT DSA 가 (Fig. 1)
 9, 3 가 (Fig. 2)
 16, 22 (Table 1, 2). 가

13 가
 CT 61.5%, 91.7%,
 88.9%, 68.8%, 76.0%,
 DSA 23.1%, 100%, 100%, 54.5%, 60.0%
 (Table 3, 4) 가
 (p(0.05, McNemar's test), 가

Table 3. CT in Determining Resectable or Unresectable Tumor

	Curative surgery	Palliative Surgery	Total
CT, Resectable	11	5*	16
CT, Unresectable	1	8	9
Total	12	13	25

*They had small hepatic metastasis (n= 2), paraaortic lymph node metastasis (n= 1), bile ductal variation (n= 1), extensive tumor (n= 1) as another causative findings of unresectability at surgery.

Table 4. DSA in Determining Resectable or Unresectable Tumor

	Curative surgery	Palliative Surgery	Total
DSA, Resectable	12	10*	22
DSA, Unresectable		3	3
Total	12	13	25

* They had small hepatic and lymph node metastasis (n= 6), extensive tumor (n= 2), bile ductal variation (n= 1) as another causative findings of unresectability at surgery.

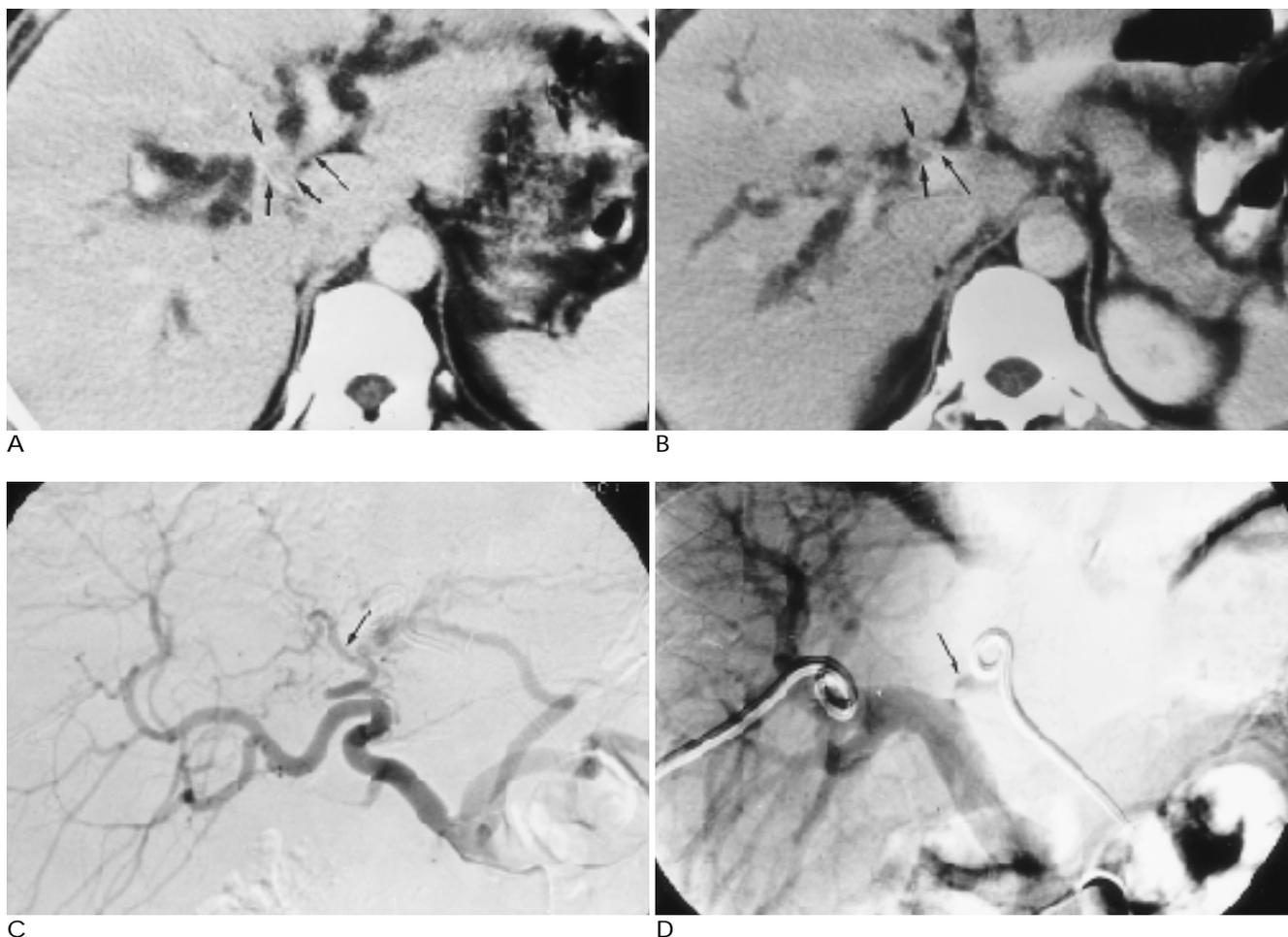


Fig. 3. Resectable tumor erroneously diagnosed as unresectable one on the basis of CT findings.
 A. Conventional CT scan shows soft tissue mass (arrows) encasing left portal vein (long arrow) at hilum.
 B. Tumor (arrows) is abutting to right hepatic artery (long arrow) and the fat plane is obliterated. But, tumor was resectable at surgery.
 C. Hepatic arteriography demonstrates that the vessel, considered as right hepatic artery on CT, is middle hepatic artery (arrow). And, right hepatic artery is free from tumor invasion.
 D. Portography shows narrowing of left portal vein (arrow).

가 10 9
 CT 가 9 8 가 (n=6), (n=2),
 가 (88.9%), 1 가 (n=1)
 (Fig. 3) (Table 3). CT 가 9 가 1 CT
 5 가 , DSA
 (n=1), (n=4) 가
 . CT 가 5
 (n=1), (n=2),
 (n=1), (n=1), 가
 (n=1) 가
 DSA 가 3
 가 (100%) (Table 4). DSA

Table 5. CT & DSA in Determining Resectability

	CT, Resectable	CT, Unresectable	Total
DSA, Resectable	16	6*	22
DSA, Unresectable		3	3
Total	16	9	25

* Five unresectable tumors, CT correctly predicted and one resectable tumor, DSA correctly predicted.

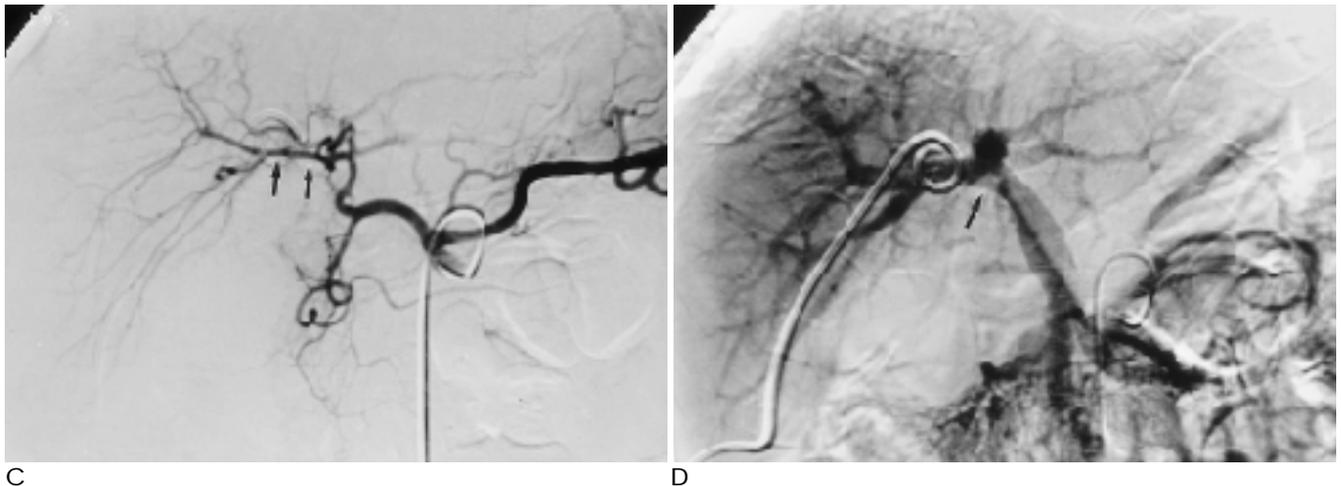
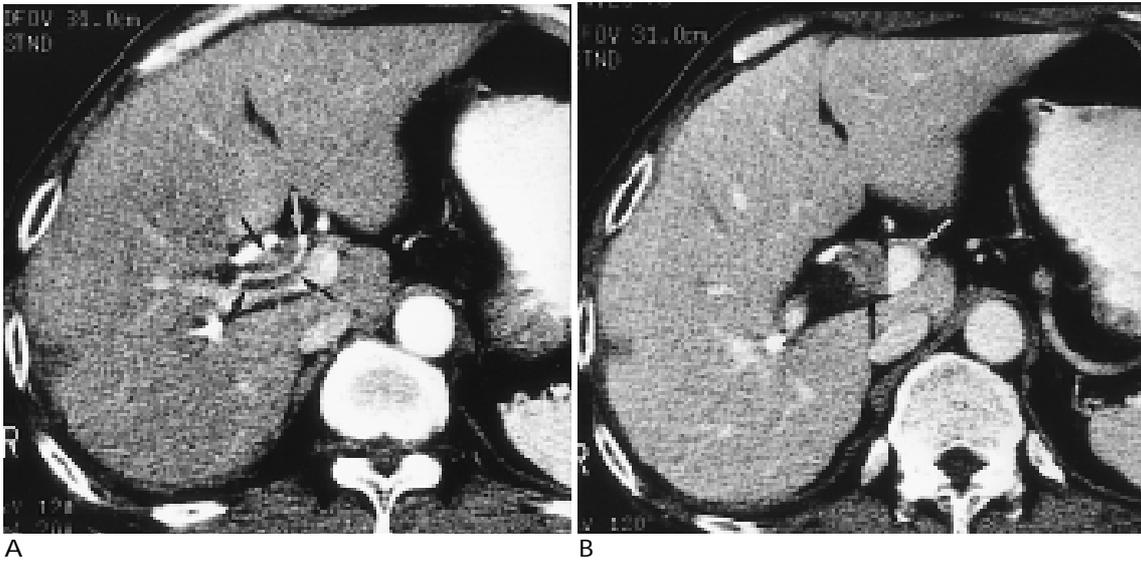


Fig. 4. Hepatic arterial invasion without luminal change, correctly diagnosed on the basis of CT findings.
 A. Spiral CT scan obtained during the arterial-dominant phase shows soft tissue mass (arrows) encasing right hepatic artery (white arrow).
 B. CT during portal dominant phase shows tumor (arrow) protruding into the right side of main portal vein lumen (white arrow).
 C. But hepatic arteriography shows right hepatic artery (arrows) as free from tumor invasion.
 D. Portography shows nodular filling defect at right side of main portal vein (arrow), correlating the spiral CT finding. The proximal ductal mass invading to portal vein, duodenum and gall bladder was found at surgery.

가 , 가 (6,8). CT (12) , 가가

CT DSA 5 (Fig. 4) , CT 가 가 6 가 가

가 , 가 1 (Fig. 3) DSA CT 가 가 88.9%

(Table 5). 가 가 68.8%

54.5% , DSA 100% CT

가 가 DSA (Fig. 4).

CT DSA (Fig. 3).

CT (n=17) CT (n=8)

CT 가 12 8

(12, 14), 가 가 5 66.7%,

가 가 100%, 100%, 55.6%,

76.5% , CT 가 1

0%, 85.7%, 7 6 85.7%,

(2, 15). , 가 가 가

가 가 가 가 CT CT

가 (Fig. 4). 가 가 CT

CT

가 가 가

(10, 11). Loosers (10) 22 가 6 5 가

86% (n=2), (n=1), 1 cm

가 가

17) 가 가 (2, 3, 17) CT (2, (n=1), 가 가

40% (2) CT (3, 11, 18). , CT

CT Nesbit (3) 가

54% CT 가 44% 가 (12).

CT 가

(12, 13).

가 가 가

가 가 가

1. 2 13 11 가 가

(secondary confluence) (Bismuth 가 가

IV), 2. , 3. 2 , 가

, 4. CT DSA ,

, CT CT
가

DSA가,

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Vascular Invasion of Klatskin Tumor : Computed Tomography vs Digital Subtraction Angiography in Determining Resectability¹

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Purpose : To compare the accuracy of computed tomography (CT) with that of digital subtraction angiography (DSA) in predicting the resectability of Klatskin tumor on the basis of vascular invasion.

Materials and Methods : Twenty-five patients with Klatskin tumor who had undergone laparotomy were included in this study. In order to assess the surgical resectability of their tumors, the preoperative CT scans and DSA of these patients were retrospectively assessed in terms of vascular invasion. The criteria of unresectability were tumoral invasion of the proper hepatic artery or main portal vein, or simultaneous invasion of the hepatic artery on one side and the other side portal vein.

Results : Tumors were unresectable in 13 cases, and resectable in 12. CT and DSA predicted nine and three tumors as unresectable ones, respectively. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of CT in determining whether a tumor was unresectable were 61.5 %, 91.7 %, 88.9 %, 68.8 % and 76.0 %, respectively. For DSA, the respective figures were 23.1 %, 100 %, 100 %, 54.5 % and 60.0 %. For the detection of vascular invasion without diameter change, CT was superior to DSA; for the evaluation of vascular anatomy, it was, however, less effective. CT failed to detect small hepatic metastasis (n= 2), lymph node metastasis (n= 1), variation of the bile duct (n= 1), and the distal extent of tumor in the bile duct (n= 1), factors which precluded surgical resection.

Conclusion : CT is a reliable method for the detection of vascular invasion and tumor unresectability. For the detection of vascular anatomic variation, the combined use of CT and DSA would be helpful.

Index words : Bile ducts, neoplasm

Bile ducts, CT

Angiography

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