

Common CT findings of cholangiocarcinoma at King Chulalongkorn Memorial Hospital (KCMH)

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Background : *We evaluated CT findings of 45 patients with cholangiocarcinomas.*

Objective : *To evaluate CT findings and pattern enhancement of cholangiocarcinoma at King Chulalongkorn Memorial Hospital (KCMH).*

Methods : *The contrast-enhanced CT images of the abdomen of 45 patients (29 males, 16 females) were retrospectively reviewed. The mean age of the subject was 56 years. Their age range was 26-81 years old. The subjects were pathologically proven cases of cholangiocarcinoma diagnosed from 2004-2006. The CT findings were analyzed as follows: (1) location and macroscopic appearance (mass-forming, periductal infiltrating, intraductal and extrahepatic cholangiocarcinoma); (2) tumor size; (3) pattern of enhancement; (4) other associated findings, such as bile duct dilatation, vascular involvement, satellite nodules, capsular retraction, lymphadenopathy, distant metastasis, etc.*

Result : *In 45 patients, the tumors were classified as follows; 31 patients (68.9%) had mass-forming; 11 patients (24.4%) had periductal infiltration at the hilar region, and 3 patients (6.7%) had extrahepatic type. However, intraductal type was not identified in our study. Most of cholangiocarcinoma tumors of each type showed enhancement in the portovenous phase (77.8%) and the delayed phase (95%).*

Bile ducts dilatation was present in 37 of 45 patients (82.2%). Satellite nodules were found in 16 of the 45 patients (35.6%). Capsular retraction was present in 19 of 45 patients (42.2%). Regional lymph node enlargement was observed in 20 of 45 patients (44.4%). In mass-forming type and periductal type at the hilar region, vascular involvement was found in 38 of 45 patients (84.4%). Other associated findings in our study included ascites, marginal disruption with adjacent subcapsular collection, gallstones, peritoneal nodules, adrenal metastasis, pleural effusion, lung and bone metastases.

Conclusion : *The most common type of cholangiocarcinomas in our study was mass-forming type. The pattern enhancement in the portovenous phase and the delayed phase with associated findings were suggestive of cholangiocarcinomas. Vascular involvement was common.*

Keywords : *Bile duct, cholangiocarcinoma, CT (computed tomography), liver.*

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เหตุผลของการทำวิจัย : เพื่อศึกษาลักษณะที่พบจากภาพเอกซเรย์คอมพิวเตอร์ของโรคมะเร็งท่อน้ำดีในโรงพยาบาลจุฬาลงกรณ์

รูปแบบการวิจัย : การศึกษาเชิงพรรณนา

สถานที่ทำการวิจัย : ภาควิชารังสีวิทยา คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

วิธีการศึกษา : ภาพเอกซเรย์คอมพิวเตอร์ของผู้ป่วยที่ได้รับการวินิจฉัยว่าเป็นมะเร็งท่อน้ำดี ในช่วงเวลาระหว่างเดือนมกราคม 2547 - เดือน ธันวาคม 2549 ได้รับการศึกษาย้อนหลังเพื่อดูชนิด, ตำแหน่ง, ลักษณะการ enhancement รวมถึงลักษณะอื่น ๆ ที่สามารถพบร่วมในโรคนี้ได้

ผลการศึกษา : ชนิดของมะเร็งท่อน้ำดีในตับที่พบในโรงพยาบาลจุฬาลงกรณ์ แบ่งได้ดังนี้ คือ แบบก้อน (mass-forming type) พบ 66.9%, แบบกระจายรอบท่อน้ำดีบริเวณขั้วตับ (periductal infiltrating at hilar region) พบ 24.4% และมะเร็งท่อน้ำดีนอกตับ (extrahepatic type) พบ 6.7% ลักษณะการ enhancement ของมะเร็งส่วนมากจะ enhance ใน portovenous phase (77.8%) และ delayed phase (95%) ส่วนลักษณะที่สามารถพบร่วมได้ เช่น ท่อน้ำดีในตับขยาย (bile duct dilatation) พบ 82.2%, ต่อมน้ำเหลืองโต พบ 44.4%, การดึงรั้งของแคปซูลของตับ (capsular retraction) พบ 42.2%, การโอบล้อมหลอดเลือดจากมะเร็ง (vascular involvement) นอกจากนี้ยังพบบำเหนี่ยวในช่องท้อง, นิ่วในถุงน้ำดี, น้ำในช่องเยื่อหุ้มปอด รวมถึงการแพร่กระจายของมะเร็งในช่องท้อง, ปอดและกระดูก

สรุป : มะเร็งท่อน้ำดีในตับที่พบมากที่สุดที่พบมากที่สุดในโรงพยาบาลจุฬาลงกรณ์ คือ แบบก้อน (mass-forming type) และการที่พบลักษณะการ enhancement ของมะเร็งใน portovenous phase และ delayed phase จากภาพเอกซเรย์คอมพิวเตอร์ร่วมกับลักษณะอื่น ๆ ดังกล่าวข้างต้น ก็เป็นลักษณะที่บ่งว่าน่าจะเป็นโรคนี้

คำสำคัญ : ท่อน้ำดี, มะเร็งท่อน้ำดี, เอกซเรย์คอมพิวเตอร์.

Cholangiocarcinoma is a malignant neoplasm, which arising from the bile duct epithelium. It is the second most common primary intrahepatic malignancy after hepatocellular carcinoma.

As for the risk factors associated with cholangiocarcinoma, it has been suggested they included long standing inflammation, i.e., primary sclerosing cholangitis or chronic parasitic infestation, choledochal cyst, hapatolithiasis and ulcerative colitis. Other risk factors included liver flukes, chemical carcinogen exposure such as nitrosamine, Thorotrast, and dioxin.^(1,2)

Cholangiocarcinoma is a common cancer in Southeast Asia, with the highest prevalence in the northeastern region of Thailand.⁽³⁻⁶⁾ One of the risk factors in this cancer in Thailand is ingestion of uncooked fish products or insufficiently cooked traditional food.⁽⁷⁾

Cholangiocarcinoma is usually classified as intrahepatic and extrahepatic types. In this study, we classified cholangiocarcinomas according to the classification scheme propose by the Liver Cancer Study Group of Japan. There are three types of intrahepatic cholangiocarcinoma based on their macroscopic appearance as follows:

1. Mass-forming intrahepatic cholangiocarcinoma characterized by a well-marginated mass in the liver parenchyma.⁽¹⁾
2. Periductal infiltrating intrahepatic cholangiocarcinoma characterized by infiltration of the tumor along the bile duct.⁽¹⁾
3. Intraductal intrahepatic cholangiocarcinoma characterized by papillary or granular growth within the bile duct lumen.⁽¹⁾

CT scan is one of non-invasive modalities which aid to identify this tumor. Therefore, if the CT features of cholangiocarcioma can be recognized with accuracy, they will aid the clinicians to diagnose the disease, plan for its treatment and give early treatment.

Materials and Methods

There are 177 patients who were diagnosed with cholangiocarcinoma from January 2004-December 2006. Our study group consisted those of 45 patients who underwent contrast-enhanced CT scan of the abdomen at King Chulalongkorn Memorial Hospital before liver resection and had final histopathologic results were retrospectively reviewed. The patients were 29 males and 16 females; their mean age was 56 years that ranged 26-81 years old. The medical records of these patients were also reviewed. The information about their gender, age and presented symptoms were collected. One hundred and thirty-two patients were excluded.

Exclusion criteria:

- Patient who had no histopathologic result (n = 96).
- Patient who did not receive contrast-enhanced CT scan of the abdomen at King Chulalongkorn Memorial Hospital or CT was not available on the picture archiving and communicating system (PACS) (n = 15).
- Patient who underwent surgical resection before CT imaging (n = 10)
- Contrast-enhanced CT of the abdomen was performed in single phase (n = 6).
- CT of the abdomen had artifact from post procedure such as portal vein embolization, which

interfere the attenuation of the lesions (n = 1).

- Patient who had underlying malignancy (n = 4).

Imaging technique: The contrast-enhanced CT scan of the abdomen were performed with Somatom Sensation plus-4 or Somatom Sensation plus-16, Siemens Medical Systems, Germany. The CT study was performed with the following parameters: 0.75 - 2.5 mm collimation, effective section thickness 5 mm. reconstruction interval 5 mm, pitch 1.0. The CT images of all patients were obtained in pre-contrast, arterial phase and portovenous phase. Additional delayed phases in these studies were obtained in 40 cases. The arterial phase was determined by using bolus tracking and measuring the time-to-peak of enhancement of the abdominal aorta at the level of the celiac axis, about 100 HU. The arterial phase was obtained at 30-35 seconds after contrast material injection, portovenous phase was obtained at 65-70 seconds and delayed phase was obtained from 5-15 minutes after injection. The rate of contrast injection by using power injector are about 3-4 ml/sec of 100 ml of non-ionic contrast medium.

Image analysis: CT findings were analyzed retrospectively and reviewed independently by two experienced radiologists on PACS with blind clinical history. In case of opinion disagreement, the image would be interpreted by consensus. The radiologists evaluated the classification of tumors based on the location of involvement (intrahepatic or extrahepatic). In this study, intrahepatic cholangiocarcinoma was classified into three types which had been proposed by the Liver Cancer Study Group of Japan based on the macroscopic appearance: mass-forming,

periductal infiltrating and intraductal type.

The following findings were evaluated: size of tumor, location of hepatic segment involvement, intra/extrahepatic bile duct dilatation, vascular invasion, satellite nodules, capsular retraction, regional lymph node enlargement, ascites, distant metastasis, and incidental findings.

The pattern of contrast enhancement was assessed during the arterial, portovenous and delayed phases, by comparing with the surrounding liver parenchyma. To ensure the accuracy of the enhancement of the lesion, CT number was obtained with region-of-interest (ROI) about 0.2 mm². A different 10 HU or more between the tumor and liver attenuation was considered enhancement.⁽⁸⁾

As for the assessment of lymph node enlargement, a significant enlargement was defined as follows: retrocrural and portahepatis > 6mm, retroperitoneal, celiac and mesenteric nodes > 10mm and pelvic node > 15 mm.⁽⁹⁾

Result

Patient demographic data: The mean age of the patients who were diagnosed cholangiocarcinoma was 56 years and ranged from 26-81 years old. There were 39 patients whose age ranged from 41-80 years old (Table 1). In this study, patients from the northeastern region of Thailand were recorded in 18 of 45 patients (40%), 9 patients (20%) from Bangkok, 10 patients (22.2%) from the middle and northern regions, 6 patients (13.3%) from the eastern region and 2 patients (4.5%) from the western region.

Clinical presentations: The clinical presentations of these patients were jaundice, abdominal distension and abdominal mass with weight

loss.

Morphologic CT features: In 45 patients, tumors were of the following types: 31 mass-forming cholangiocarcinomas (68.9%), 11 periductal infiltrating at the hilar region (24.4%) and 3 extrahepatic type (6.7%) (Table 2). Intraductal type was not found in this study. The mean size of mass-forming type, measured on axial CT scan in maximum transverse diameter, was 8.8 cm (range = 2.1- 22.1 cm).

The presence of some calcifications in the tumors was noted in 6 of 45 patients (13.3%). All of which were mass-forming type. Calcifications were not found in the periductal infiltrating type at the hilar region and the extrahepatic type.

Pattern of enhancement: Most of cholangiocarcinomas in each type showed enhancement in portovenous phase and delayed phase. On precontrast studies, nearly all lesions were hypoattenuation relative to liver parenchyma. Overall tumors showed arterial enhancement in 20 of 45 patients (44.4%), 35 of 45 patients (77.8%) enhanced in portovenous phase and 38 of 40 patients (95%) enhanced in delayed phase (Table 3).

Mass-forming type: The tumors showed arterial enhancement in 16 of 31 patients (51.6%), enhanced in portovenous phase in 23 of 31 patients (74.2%) and enhanced in delayed phase in 26 of 27 patients (96.3%). The delayed phase was not obtained in 4 patients. Regarding the arterial enhancement, most of the tumors were enhanced at periphery of the masses and increased heterogeneous enhancement in the portovenous phase and delayed phase (Figure 1).

The tumors did not enhanced the arterial and

portovenous phases in 2 patients with liver cirrhosis.

Periductal infiltrating type: Presence of arterial enhancement were observed in 4 of 11 patients (36.4%) and enhanced in portovenous phase in 10 of 11 patients (90.9%). All of cases in this type were enhanced in delayed phase in 10 of 10 patients (100%) (Figure 2), except only 1 patient was not obtained delayed phase.

Extrahepatic type: In 2 of 3 patients (66.7%) showed thickened enhancing wall of common bile duct in portovenous and delayed phases (Figure 3).

Tumor extension: Local extension of cholangiocarcinoma may infiltrated into adjacent soft tissue, involving hepatoduodenal ligament, falciform ligament (Figure 3B), peripancreatic region, gallbladder wall and hemidiaphragm.

Associated findings: Bile ducts dilatation was presented in 37 of 45 patients (82.2%) as following; mass-forming type in 23 of 31 patients (74.2%), periductal infiltrating at hilar region in 11 of 11 patients (100%) and extrahepatic periductal infiltrating in 3 of 3 patients (100%).

Satellite nodules were found in 16 of 45 patients (35.6%) as follows: mass-forming type in 13 of 31 patients (41.9%) and periductal infiltrating at hilar region in 3 of 11 patients (27.3%). No satellite nodule was present in the extrahepatic type. Pattern enhancement of satellite nodules was similar to the primary tumor (Figure 4).

Capsular retraction was present in 19 of 45 cases (42.2%), except the extrahepatic type, as follows: mass-forming in 18 of 31 patients (58.1%) and periductal infiltrating at the hilar region in 1 of 11 patients (9.1%) (Figure 5).

Lobar atrophy was identified in 4 of 31

patients (12.9%) of the mass-forming intrahepatic type and in 1 of 11 patients (9.1%) of the periductal infiltrating type at the hilar region (Figure 6). There was no demonstrable lobar atrophy in the extrahepatic type.

Regional lymph node involvement were observed in 20 of 45 patients (44.4%) as follows: mass-forming in 15 of 31 patients (48.4%), periductal infiltrating at the hilar region in 3 of 11 patients (27.3%) and the extrahepatic type in 2 of 3 patients (66.7%). There were multiple regional lymph node involvement included hepatoduodenal nodes, aortocaval nodes, celiac nodes, retrocaval nodes, para-aortic node, peripancreatic nodes, gastrohepatic nodes, retrocrural nodes, cardiophrenic nodes and mesenteric nodes. Some of these lymph nodes showed areas of low attenuation, representing necrosis.

No vascular invasion or encasement was seen in the extrahepatic type. Nearly all of the mass-forming type and periductal type at the hilar region had vascular involvement in 30 of 31 patients (96.8%) and in 8 of 11 patients (72.7%), respectively. There were portal vein, hepatic vein and IVC encasement or thrombosis.

We found 4 patients of marginal disruption in mass-forming intrahepatic type with adjacent subcapsular collection. All of the ruptured tumors were located in the peripheral, subcapsular location of the liver (Figure 7).

Tumor with secondary infection was depicted on CT in 1 patient, showing air-fluid level in the lesions (Figure 8).

Other associated findings were observed in this study include ascites, gallstones, peritoneal nodules, adrenal metastasis, pleural effusion, lung and bone metastases.

Table 1. Demographic data.

Age	Male	Female	Total
21 - 30	2	0	2
31 - 40	0	0	0
41 - 50	8	4	12
51 - 60	7	6	13
61 - 70	9	5	14
71 - 80	2	1	3
>80	1	0	1
Total	29	16	45

Table 2. Classification.

Type	Number (cases)
Mass-forming	31(68.9%)
Periductal infiltrating at hila	11 (24.4%)
Extrahepatic	3 (6.7%)
Total	45

Table 3. Pattern enhancement.

	Mass-forming	Periductal infiltrating	Extrahepatic	Total
Arterial phase	16/31 (51.6%)	4/11 (36.4%)	0	20/45(44.4%)
Portovenous phase	23/31 (74.2%)	10/11 (90.9%)	2/3 (66.7%)	35/45 (77.8%)
Delayed phase	26/27 (96.3%)	10/10 (100%)	2/3 (66.7%)	38/40 (95%)
Total	31	11	3	45

Table 4. Associated findings.

	Mass-forming	Periductal infiltrating	Extrahepatic	Total
Bile duct dilatation	23/31 (74.2%)	11/11 (100%)	3/3 (100%)	82.2%
Satellite nodules	13/31 (41.9%)	3/11 (27.3%)	0	35.6%
Capsular retraction	18/31 (58.1%)	1 /11 (9.1%)	0	42.2%
Lobar atrophy	4/31 (12.9%)	1/11 (9.1%)	0	11.1%
Lymph nodes	15/31 (48.4%)	3/11 (27.3%)	2/3 (66.7%)	44.4%
Venous involvement	30/31 (96.8%)	8/11 (72.7%)	0	84.4%



Figure 1. Mass-forming type: A 51-year-old male, presented with jaundice. CT scan obtained during A. non-contrast CT; B. arterial phase; C. portovenous phase; D. delayed phase show a large irregular peripheral, heterogeneous arterial enhancing mass relative to liver parenchyma in left hepatic lobe (arrowed in B) and gradually increased enhancement in the portovenous phase (arrowed in C) and the delayed phase (white-arrowed in D). Intrahepatic bile duct dilatation was observed.

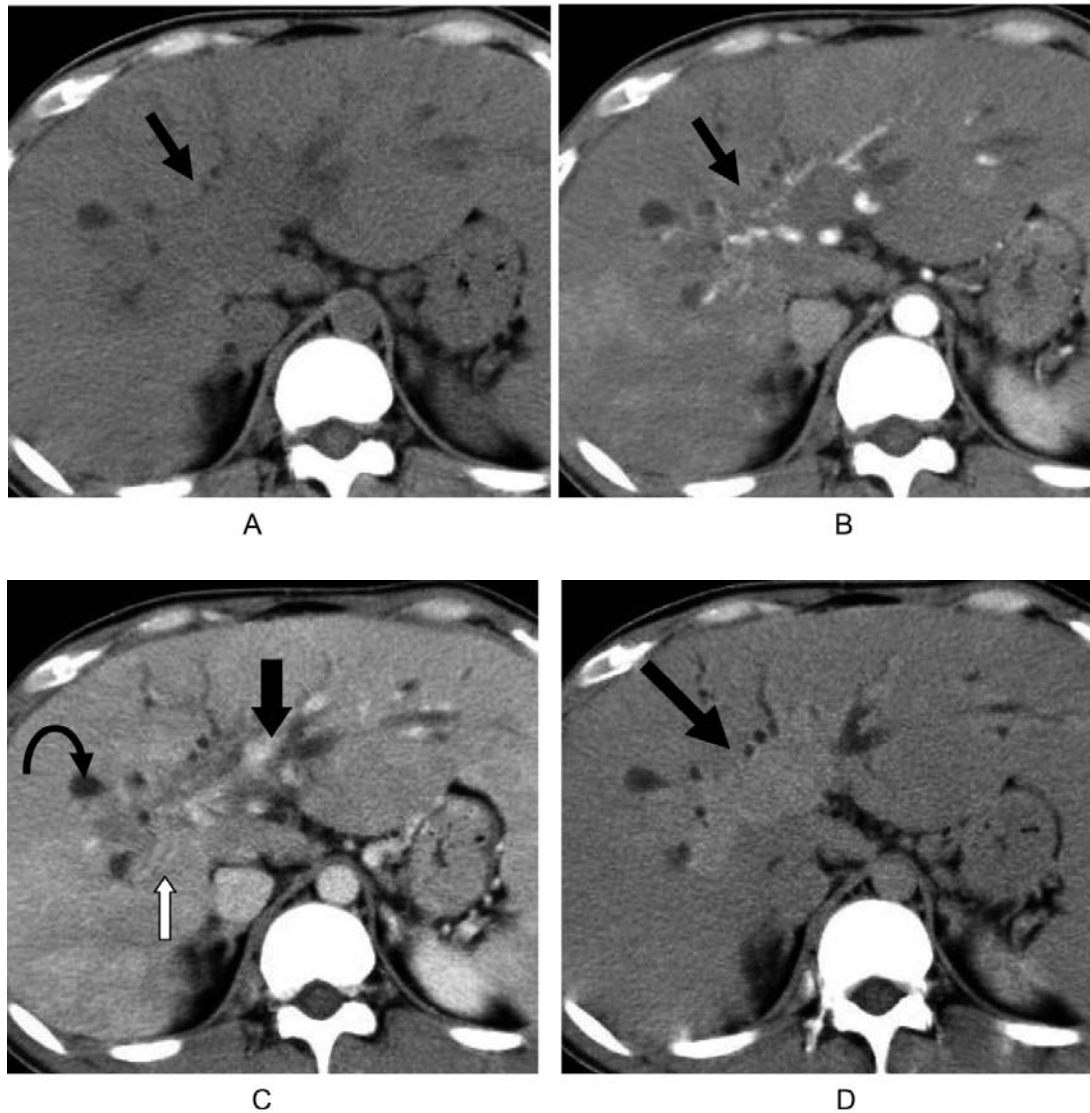


Figure 2. Periductal infiltrating at the hilar region: A 28-year-old male, presented with jaundice. CT scan obtained during; A. noncontrast CT; B. arterial phase; C. portovenous phase; D. delayed phase show non-union of right and left hepatic ducts. There is a hypodensity lesion in non-contrast study at the hilar region (arrowed in A), isodensity to liver in arterial phase (arrowed in B) and mild enhancement in the portovenous phase. Associated dilatation of the intrahepatic ducts (curve arrowed in C) in both hepatic lobes together with encasement of right and left main portal veins (white- and-black arrowed in C.) were noted. An obvious enhanced tumor on the delayed phase (long-black arrowed in D.) is depicted.

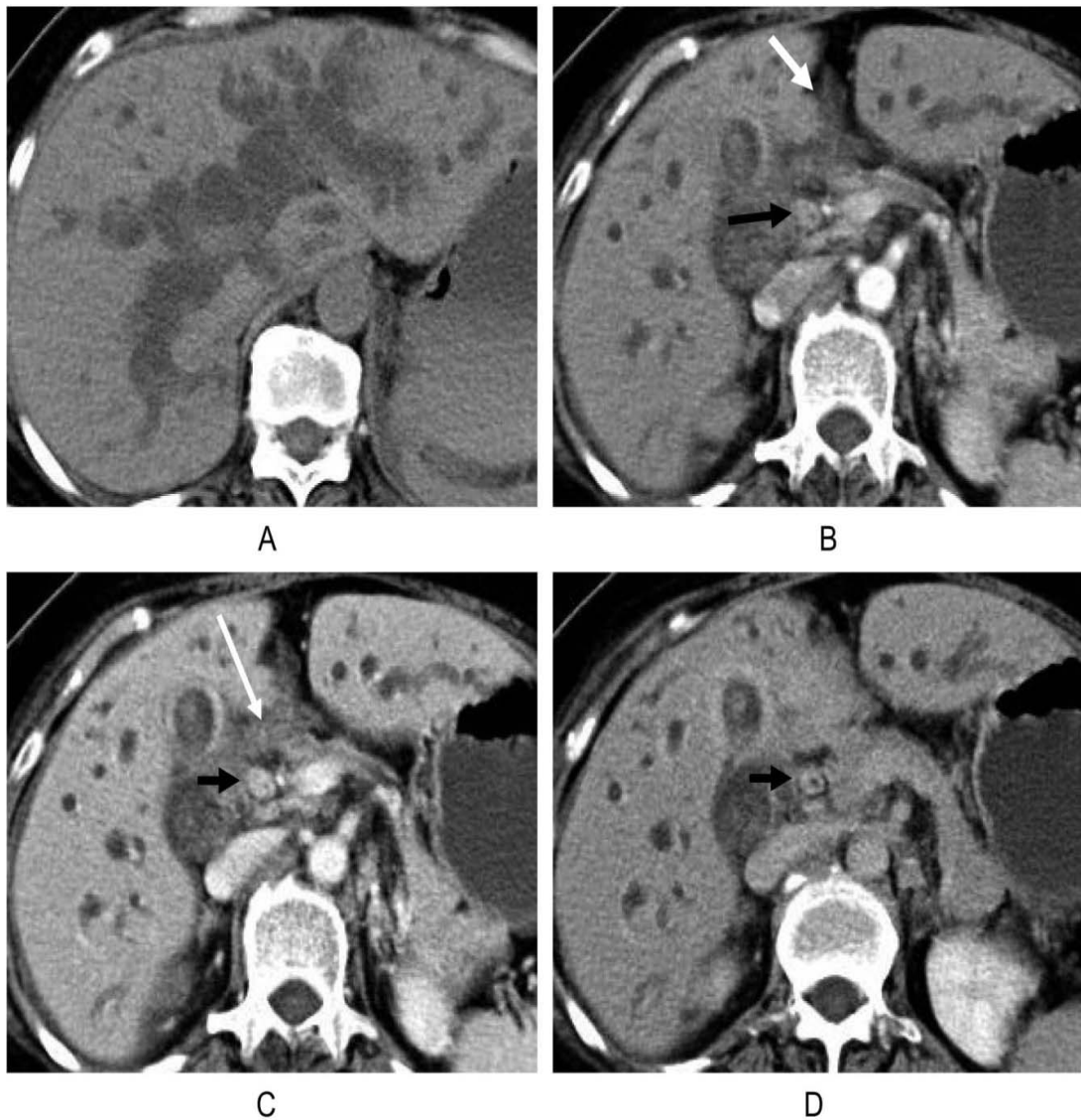


Figure 3. Extrahepatic, periductal infiltrating type: A 67-year-old female, presented with jaundice and weight loss. CT scan obtained during: A. noncontrast CT shows diffuse dilatation of the intrahepatic ducts; B. arterial phase, caudal to the view shown in A; C. portovenous phase; D. delayed phase, caudal to the view shown in C. show thickened enhancing wall of CBD (black-arrowed in B, C and D). The lesion extends along CBD and also involves hilar region, falciform ligament (white-arrowed in B) and hepatoduodenal ligament (long white-arrowed in C).

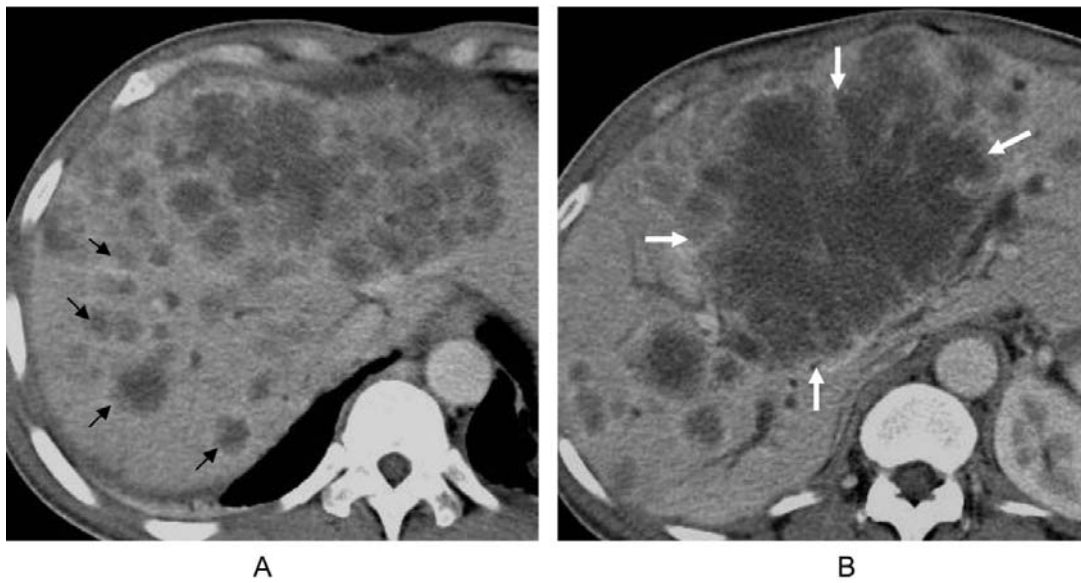


Figure 4. Satellite nodules: A. CT scan obtained during the portovenous phase and B. caudal to the view shown in A. show multiple small central low density nodules with peripheral enhancement scattered throughout the liver (arrowed in A). B. The primary mass lesion (arrowed in B) also shows central low density with peripheral enhancement, similar pattern enhancement of primary mass & small satellite nodules.



Figure 5. Capsular retraction Capsular retraction adjacent to the mass in left hepatic lobe is shown (arrowed).



Figure 6. Lobar atrophy: A. CT scan obtained during portovenous phase and B. caudal to the view shown in A. shows a well-defined hypodensity mass in right hepatic lobe (black-arrowed in B) with adjacent mild dilatation of intrahepatic bile ducts (white-arrowed in A). There is relative small size of right hepatic lobe which containing cholangiocarcinoma. Obliteration of right portal vein is noted (not shown).

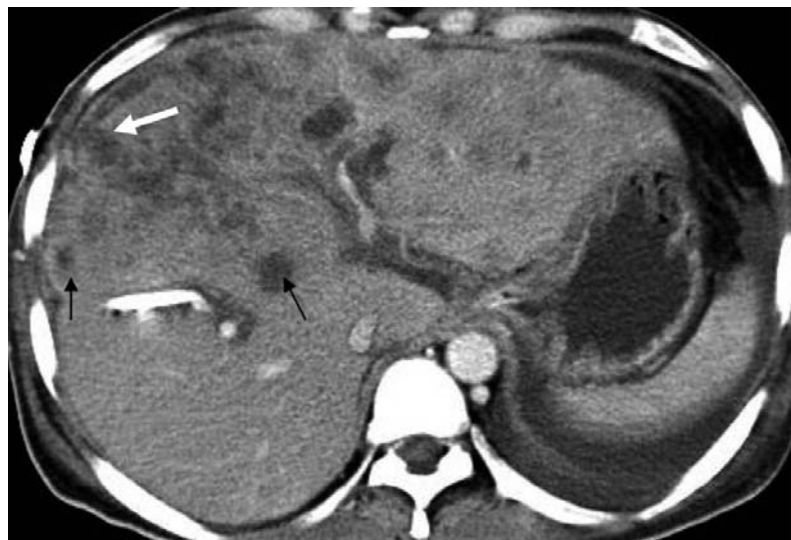


Figure 7. Marginal disruption: A. A 43-year-old man diagnosed as cholangiocarcinoma post right and left percutaneous biliary drainage (PTBD). The CT image demonstrates marginal disruption of the liver capsule (white-arrowed) at segment IV with minimal adjacent subcapsular collection and intraperitoneal free fluid. Heterogeneous enhancement of the mass and scattered satellite nodules (black- arrowed) are seen.

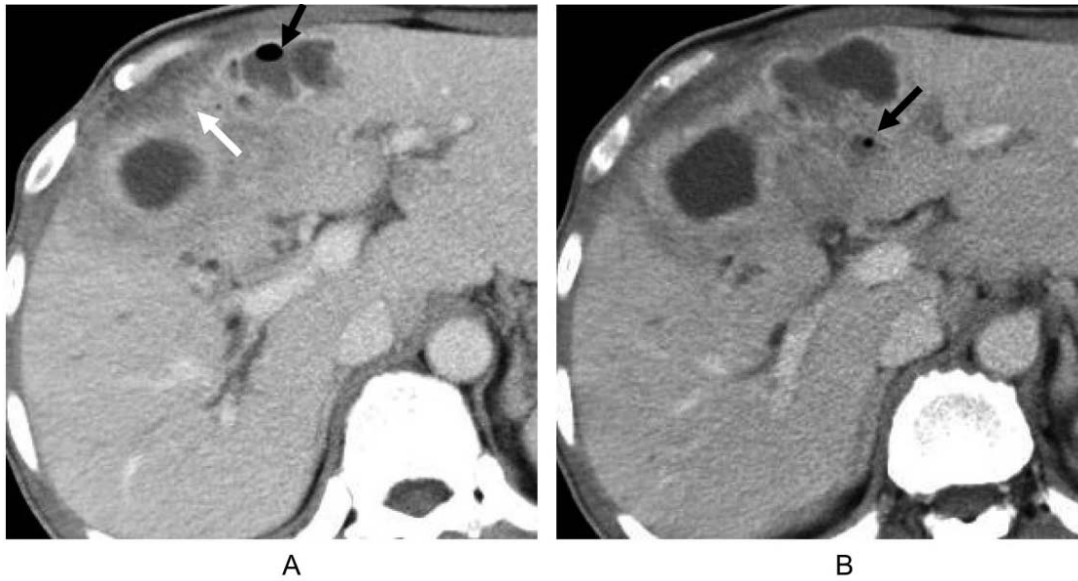


Figure 8. Tumor with secondary infection: A 50-year-old man with cholangiocarcinoma, presented with abdominal pain. The CT scan A. and B. caudal to the view shown in A. shows several well-defined, central low density lesions with peripheral enhancement and containing air-fluid level (black-arrowed in A and B) in some nodules. Subcapsular retraction and subcapsular fluid are also seen (white-arrowed in A).

Discussion

The most common type of cholangiocarcinomas found at King Chulalongkorn Memorial Hospital from 2004 - 2006 was of mass-forming intrahepatic type in about 31 of 45 patients (68.9%). Periductal intrahepatic cholangiocarcinoma and extrahepatic type were accounted for 11 patients (24.4%) and 3 patients (6.7%), respectively. No intraductal type cholangiocarcinoma was found. Han *et al.*⁽¹⁾ reported mass-forming intrahepatic cholangiocarcinoma (peripheral) was the most common type of intrahepatic cholangiocarcinoma, same as in our study.

In our study, cholangiocarcinomas were found more in men than in women. The common age range was 41 - 70 years old.

The most common pattern of enhancement of mass-forming type cholangiocarcinomas in

our study showed irregular peripheral arterial enhancement (51.6%) and increased enhance in the portovenous phase (74.2%) and the delayed phase (96.3%). According to Kim *et al.*⁽¹⁰⁾ and Valls *et al.*⁽¹¹⁾, reported that rimlike enhancement on both the arterial and portovenous phases were observed in about 68% and 60% of the patients, respectively. Progressive enhanced in the central portion in the delayed phase should be due to dense fibrous stranding in the central part and slow diffusion of contrast into the interstitium of the tumor.⁽¹²⁾

Periductal infiltrating hilar cholangiocarcinomas showed relatively low attenuation than liver parenchyma, increased enhancement in portovenous phase and delayed phase.

Extrahepatic type cholangiocarcinomas are also enhanced in the portovenous phase and delayed phase. Therefore, the delayed phase is useful for

characterize and detect cholangiocarcinomas. The pattern enhancement of cholangiocarcinoma and associated findings are the clue for diagnosis.

In a large lesion, there is overlapping between mass-forming lesion and periductal infiltrating tumor at the hilar region and sometime combined type. Extrahepatic type cholangiocarcinomas usually grow along the bile duct, causing the thickening of the wall, narrowed lumen and bile duct obstruction.

The most commonly associated findings in our study were bile duct dilatation (82.2%). All cases of the periductal infiltrating hilar cholangiocarcinoma and the extrahepatic type caused bile duct obstruction and dilatation. Mass-forming type caused bile ducts dilatation about 74.2% of patients. Valls *et al.*⁽¹¹⁾ demonstrated bile duct dilatation in 52% and Kim *et al.*⁽¹⁰⁾ recorded 62% of patients with peripheral cholangiocarcinomas. Hans *et al.*⁽¹⁾ also recorded that biliary dilatation is frequently found.

Satellite nodules are commonly found in cholangiocarcinomas (35.6%) as in intrahepatic metastases. Valls *et al.*⁽¹¹⁾ reported that 32% of satellite nodules were observed in advanced stage intrahepatic peripheral cholangiocarcinomas. Choi *et al.*⁽¹²⁾ found that satellite nodules were frequent and varied in size. No satellite nodule was found in the extrahepatic type in our study.

Soyer *et al.*⁽³⁾ reported retraction of the liver capsule with a prevalence of 2% of hepatic tumors and can be found in several malignant hepatic tumors such as cholangiocarcinoma, hepatocellular carcinoma, hepatic metastasis from carcinoid tumor, gallbladder carcinoma and colorectal metastases. The hepatic tumors resulting in biliary obstruction, especially cholangiocarcinoma can result in localized

hepatic atrophy, which may simulate capsular retraction. Kim *et al.*⁽¹⁰⁾ and Valls *et al.*⁽¹¹⁾ found capsular retraction in peripheral cholangiocarcinomas in 21% and 36% of patients, respectively. In the series of Choi *et al.*⁽¹²⁾ and Hans *et al.*⁽¹⁾ capsular retraction in peripheral or mass-forming type was found. In our study, capsular retraction was present in 42.2%, more pronounce in the mass-forming type (58.1%).

The presence of some intratumoral calcifications was observed in about 13.3% of the mass-forming type. Soyer *et al.*⁽³⁾ and Choi *et al.*⁽¹²⁾ also found calcifications in cholangiocarcinomas.

Lobar atrophy was identified in 4 of 31 patients (12.9%) of the mass-forming intrahepatic type and 1 of 11 patients (9.1%) of the periductal infiltrating type at the hilar region. In our study, we found affected lobar atrophy associated with ipsilateral portal vein encasement or invasion. According to Kim *et al.*⁽¹³⁾, lobar atrophy was depicted in 1 of 9 patients with extrahepatic cholangiocarcinomas. Feydy *et al.*⁽¹⁴⁾ showed lobar atrophy and ipsilateral portal vein invasion in 5 of 11 patients with hilar cholangiocarcinomas. There was no demonstrable lobar atrophy in extrahepatic type in our study.

Lymph node involvement was observed in 20 of 45 patients (44.4%). There were multiple location regional lymph node. Hepatoduodenal nodes were frequently found in 22.6% of patients, followed by celiac nodes, aortocaval nodes and para-aortic nodes. Kim TK *et al.*⁽¹⁰⁾ reported that lymph node enlargement in peripheral cholangiocarcinomas included celiac nodes in 38%, hepatoduodenal nodes in 29% and common hepatic nodes in 26%, left gastric nodes and para-aortic nodes.

Involvement of portal veins was found in peripheral cholangiocarcinoma from several reports. Valls *et al.*⁽¹¹⁾ found portal vein encasement in 40%. Feydy *et al.*⁽¹⁴⁾ detected portal vein invasion with CT scan or angiography in 5 of 7 patients. Kim *et al.*⁽⁸⁾ showed that portal vein invasion was seen in 7 of 28 patients with peripheral mass-forming cholangiocarcinoma. In our study, nearly all mass-forming type and periductal type at the hilar region had portal vein encasement in 30 of 31 patients (96.8%) and 8 of 11 patients (72.7%), respectively. The smallest size of tumor, which had portal vein encasement was 2.1 cm in maximum transverse diameter. Vascular involvement was seen such as thrombosis, invasion, narrowed lumen and nonvisualized contrast opacify the lumen. Hepatic artery and IVC encasement were observed. No vascular invasion or encasement in extrahepatic type was seen. From these findings, we thought that vascular involvement was not dependent on the tumor size.

There are few case reports of ruptured mass-forming type peripheral cholangiocarcinoma. Akatsu *et al.*⁽¹⁵⁾ reported rupture of a 10 cm mass with mild peripheral enhancement and uniquely showed a papillary pattern of tumor growth with little fibrous stroma. In generally, peripheral cholangiocarcinoma is a hard tumor with abundant fibrous stroma; these tumors hardly have spontaneous rupture. Peripheral location and subdiaphragmatic location of the tumors tend to ruptured due to the bulging of the liver and diaphragm irritated by respiratory motion. Chong *et al.*⁽¹⁶⁾ reported rupture of a 4.8 cm cholangiocarcinoma, abutting liver capsule with area of necrosis at the point of rupture and adjacent perihepatic fluid.

In our study, we found 4 patients of with marginal disruption at subcapsular region in mass-forming intrahepatic type with adjacent subcapsular collection. All of four tumors also had some areas of necrosis that should be predisposing factor to rupture.

Limitation: The number of the recruited patients in this study was relatively small, possibly limited by retrospective study and incomplete information.

Conclusion

The most common type of cholangiocarcinoma in our study was mass-forming intrahepatic type. Delayed enhancement pattern is associated with bile ducts dilatation are the clue for diagnosis. Vascular involvement is not uncommon. Necrotic subcapsular lesion is one of the predisposing factors for marginal disruption.

References

1. Han JK, Choi BI, Kim AY, An SK, Lee JW, Kim TK, Kim SW. Cholangiocarcinoma: Pictorial Essay of CT and cholangiographic Findings. *Radiographic* 2002 Jan; 22(1): 173-87
2. Khan SA, Thomas HC, Davison BR, Taylor-Robinson SD. Cholangiocarcinoma. *Lancet* 2005 Oct; 366(9493): 1303-14
3. Soyer P, Bluemke DA, Vissuaziane C, Beers BV, Barge J, Levesque M. CT of hepatic tumors: Prevalence and Specificity of Retraction of the adjacent Liver Capsule. *AJR* 1994 May; 162(5):1119-22
4. Sripa B, Pairojkul C. Cholangiocarcinoma: lessons from Thailand. *Curr Opin Gastroenterol* [online] 2008[cited 2008 Dec 27] May; 24(3):

- 349-56 Available from: <http://www.ncbi.nlm.nih.gov/>
5. Srivatanakul P, Sriplung H, Deerasamee S. Epidemiology of liver cancer: an overview. *Asian Pac J Cancer Prev* [online] 2004 Apr [cited 2008 Dec 27];5 (2):118-25. Available from: <http://www.ncbi.nlm.nih.gov/>
 6. Srivatanakul P. Epidemiology of Liver Cancer in Thailand. *Asian Pac J Cancer Prev* [online] 2001 [cited 2008 Dec 27]; 2 (2): 117- 21. Available from: <http://www.ncbi.nlm.nih.gov/>
 7. Wiwanitkit V. Clinical findings among 62 Thais with cholangiocarcinoma. *Trop Med Int Health* 2003 Mar; 8(3): 228-30
 8. Kim SJ, Lee JM, Han JK, Kim KH, Lee JY, Choi BI. Peripheral mass- forming cholangiocarcinoma in cirrhotic liver. *AJR* 2007 Dec; 189(6): 1428-34
 9. Einstein DM, Singer AA, Chilcote WA, Desai RK. Abdomnal Lymphadenopathy: Spectrum of CT Findings. *Radiographic* 1991 May; 11(3): 457-72
 10. Kim TK, Choi BI, Han JK, Jang HJ, Cho SC, Han MC. Peripheral Cholangiocarcinoma of the Liver: Two-phase Spiral CT Findings. *Radiology* 1997 Aug; 204(2): 539-43
 11. Valls C, Guma A, Puig I, Sanchez A, Andia E, Serrano T, Figueras J. Intrahepatic peripheral cholangiocarcinoma: CT evaluation. *Abdom Imaging* 2000 Sep; 25(5): 490-6
 12. Choi BI, Lee JM, Han JK. Imaging of intrahepatic and hilar cholangiocarcinoma. *Abdominal imaging* 2004 Sep; 29(5): 548-57
 13. Kim YH. Extrahepatic cholangiocarcinoma associated with clonochiasis: CT evaluation. *Abdominal imaging* 2003 Jan; 28(1): 68-71
 14. Feydy A, Vilgrain V, Denys A, Sibert A, Belghiti J, Vullierme MP, Menu Y. Helical CT Assessment in hilar cholangiocarcinoma: correlation with surgical and pathologic findings. *AJR Am J Roentgenol* 1999 Jan; 172(1): 73-7
 15. Akatsu T, Ueda M, Shimazu M, Kawachi S, Tanabe M, Aiura K, Wakabayashi G, Sakamoto M, Matsuo R, Kitajima M. Spontaneous rupture of a mass-forming type peripheral cholangiocarcinoma. *Journal of Gastroenterology and Hepatology* 2005 Jan; 20(1):162-3
 16. Chong RW, Chung AY, Chew IW, Lee VK. Ruptured peripheral cholangiocarcinoma with hemoperitoneum: *Dig Dis Sci* 2006 May; 51(5): 874-6
 17. Kim JH, Kim TK, Eun HW,Byun JY, Lee MG, Ha HK, Auh YH. CT findings of cholangiocarcinoma associated with recurrent pyogenic cholangitis. *AJR Am J Roentgenol* 2006 Dec; 187(6):1571-7
 18. Lee JW, Han JK, Kim TK, Kim YH, Choi BI, Han MC, Suh KS, Kim SW. CT features of intraductal intrahepatic cholangiocarcinoma. *AJR Am J Roentgenol* 2000 Sep; 175(3): 721-5
 19. Oddsdottir M, Hunter J. Gallbladder and the extrahepatic biliary system. In: Brunicaardi FC, Andersen DK, Billiar TR, Dunn DL, Hunter JG, Pollock RE, eds. *Schwartz's Principles of Surgery*. 8th ed. New York: McGraw-Hill, 2005: 1187-1220
 20. Lim JH. Review: Cholangiocarcinoma: morphologic classification according to growth pattern and imaging findings. *AJR Am J Roentgenol* 2003 Sep; 181(3): 819- 27