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Ultrasonographic and computed tomographic examination in diagnostics of jaundice

Jaundice occurs in many ailments, may be parenchymatous or mechanical, with partial or complete obstruction of the bile ducts, may produce pain of different severity or it may go painlessly. US is a screening technique used to diagnose patients with jaundice and to detect dilatation of the intra- and extra-hepatic bile ducts. It is essential to define operability in the patients with bile ducts obstructed due to cancer (3, 10). Obstructive jaundice increases mortality in the patients who underwent surgery for its negative effects on numerous abdominal organs (9).

The purpose of the study was to validate the role of imaging techniques (US and CT) in establishing the etiology of jaundice which is essential for further management.

MATERIAL AND METHODS

The study included 81 patients with jaundice hospitalized in Teaching Hospital No 1 (manager: Adam Borowicz, Ph.D.) in Lublin in 1998–2005: 17 patients had cholecystolithiasis, 11 – cholelithiasis, 21 patients had pancreatic carcinoma, 16 patients – chronic pancreatitis, 3 patients had gall bladder carcinoma, 4 patients – duodenal papilla carcinoma, 3 had bile ducts carcinoma and 6 – cholangitis sclerosans.

CT of the abdomen was performed on SOMATOM AR.T or SOMATOM EMOTION (Siemens) prior to and after IV administration of iodine non-ionic contrast dye. Axial cuts were done, 5 and 10 mm thick and MPR reconstructions made in randomly selected planes. If peripheral obstruction to the common bile duct was suspected high-definition slices were cut, 3 or 5 mm thick. Technical parameters of dynamic scanning included 120 kV, 160–280 mAs. Dye was injected by automatic syringe 120 ml (3 ml/sec). An hour prior to the examination contrasting agent was administered orally, 250 ml of 3% gastrographine solution and 50 ml just before the examination.

RESULTS

In 16 patients with pancreatic head carcinoma, the dilatation of pancreatic duct and common bile duct was diagnosed. The contours were smooth.

In 14 patients the ultrasonographic examination revealed double duct symptom. The level of obstruction was visualized on thin CT cuts after contrast strengthening. In those patients jaundice was an early symptom, hardly painful.

Fig. 1. Ultrasonographic examination of the liver. Significantly dilatated intra-hepatic bile ducts within parahilus region of the liver in patient suffering from carcinoma of the pancreas head

Fig. 2. Ultrasonographic examination of the liver. The presence of gas within dilatated intra-hepatic common bile duct fitted with stent in patient suffering from carcinoma of the pancreas head

The presence of gas within intra-hepatic bile ducts was stated in 6 patients suffering from carcinoma of the pancreas head and fitted with the stent in the common bile duct.

In 3 cases of gall bladder carcinoma obstruction was located in the middle region of the common bile duct whose walls were irregularly contoured. Distended bladder demonstrated thickened walls, in 3 cases it was infiltrated by the surrounding tissues.

In 7 patients with cholelithiasis and in 3 cases with pancreatic head tumors the common bile duct terminated suddenly with total occlusion, which was an indication to perform endoscopic papillotomy, ERCP.

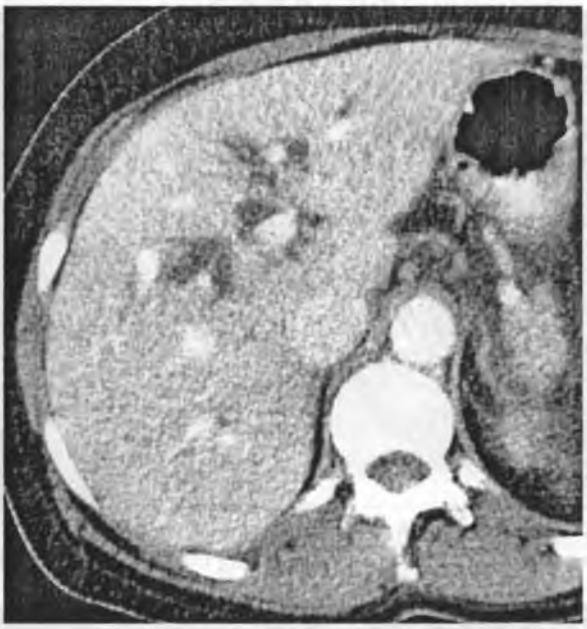

Fig. 3. Computed tomographic examination of the liver. Significantly dilatated intra-hepatic bile ducts within parahilus region of the liver in patient suffering from carcinoma of the pancreas head

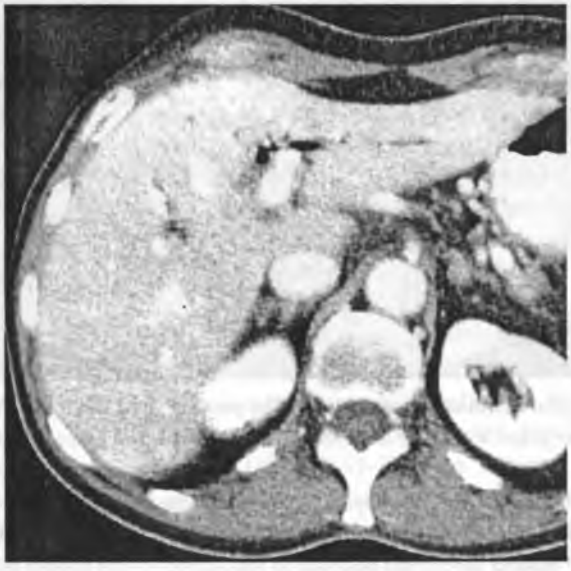

Fig. 4. Computed tomographic examination of the liver. The presence of gas within dilatated intra-hepatic common bile duct fitted with stent in patient suffering from carcinoma of the pancreas head

In 3 cases of bile duct carcinoma the narrowings were irregular, regionally thickened walls corresponded to their infiltration.

In 16 cases of chronic pancreatitis dilatations of common bile ducts and pancreatic ducts were irregularly contoured with circular narrowings. Ducts diameters and parenchyma density varied.

Hypodense pseudocysts existed aside hyperdense zones corresponding to fibrosis. The pancreas contours were irregular, in 4 cases the narrowing of the terminal part of the common bile duct was thread-like.

In the group of 17 patients with cholecystolithiasis there were 11 cases of thickened walls and pericystic oedema which suggested concomitant inflammation.

In 12 cases of hyperplasia delayed CT slices made 8–10 min after dynamic option had been injected revealed differentiated structure of the parenchyma and opacities in the ducts invisible in the earlier slices.

DISCUSSION

Jaundice is often an early symptom of pancreas carcinoma, especially within its head, creating stenosis of the peripheral part of the common bile duct. Common bile duct widenings cause carcinoma of the pancreatic head and body, never affect the top of its tail. Pancreas carcinoma constitutes 50% obstructions of the common bile duct. Double duct symptom with the widening of the pancreatic duct suggests cancer of the pancreas head, although it also occurs in other benign and malignant carcinomas of the pancreas. The tumor is resectible in 30% patients and gives 5-year survival < 1% (12). It is most frequent in the elderly with increased risk of morbidity and gives metastases (2).

Even small nodules may obliterate common bile duct producing little interstitial foci of lower density of little contrast strengthening located at the terminus of the dilatation duct. Narrowed common bile duct may discontinue suddenly, may take a distal thread-like narrowing or bead-like configuration.

The cause of obstructive jaundice may also be explained by ERCP, transcutaneous intrahepatic cholangiography, cholangioscopy, choledoscopy, magnetic resonance cholangiopancreatograpy (MRCP), cholangio comuted tomography (CCT) (1, 7, 18).

Nodular metastases into the pancreatic head may mimic primary pancreas carcinoma. Obstruction to the intra-pancreatic part of the common bile duct may cause cancer of the pancreas, cholangiocarcinoma, chronic pancreatitis or lithiasis. Since pancreas head carcinoma creates obstruction for the bile, often metastasizing to the lymph nodes and liver, CT may not only establish the level and causes responsible for the obstruction but also define the stage of tumor progress.

Chronic pancreatitis may mimic pancreas carcinoma as it forms concentrated masses forming the widening of the bile and pancreatic ducts. Thin slices cutting through the obstruction in the dynamic phase of the bolus and contrast strengthening are indispensable.

Characteristics of modern CT emphasize 3 parameters – the quality of the picture, slices after dynamic contrast strengthening and thin slices of high definition.

Jaundice more frequently occurs in pancreas carcinoma (56.3%) than in chronic pancreatitis (23.9%) (13).Tumors of the pancreatic head give early symptoms due to close location of the common bile duct and pancreatic duct. In 70% cases adenocarcinomas are located in the pancreas head producing jaundice (11). Painless jaundice as a result of pressure on the ducts suggests the presence of tumor in the pancreas head or Vater's papilla. (7).

Chronic partial obstruction leads to pathological changes in the bile ducts and liver (16). Duct widening may spread onto the entire bile tree or may be limited to intra-hepatic ducts. It does not occur when the obstruction formes within a short time, when secondary cirrhosis developed due to prolonged obstruction with inflammatory complications, which is a specific symptom of cholangitis

sclerosans. If there are no widenings in the US scans transcutaneous biopsy of the liver should be performed.

Transcutaneous bile drainage ensures outflow of the bile thus decreasing the level of bilirubin, causes remission of mechanical jaundice. It is a paliative procedure in inoperative tumors infiltrating bile ducts. The pressure > 250–300 mHg in the bile system stops bile release by the liver cells which may also cause jaundice and colic attacks.

Cholangiocarcinoma or adenocarcinoma make 95% of tumors (6). In peripheral cholangiocarcinomas CT can detect hypo- and iso-dense masses with minimal contrast strengthening in the dynamic phase too. In more than 25% patients the regional widening of the ducts cause problems in differentiating it from cholangitis sclerosans.

Tumors of the liver hilus were detected in 40–50% patients in whom the extent of the infiltration was diagnosed by CT scans. Mechanical jaundice occurs in liver cirrhosis and portal vein thrombosis. Obstructive jaundice is one of the basic 4 clinical symptoms of the carcinoma of the gall bladder with 15–20% incidence in the patients with malignant obstruction. Metastases to the liver and lymph nodes affect 75% of those patients (19). In tumors of the liver hilus CT scans can reveal enhanced strengthening with contrast accumulated, visible in the late slices cut 8–10 min after the initial dynamic sequence (5).

Jaundice is the most common clinical problem diagnosed in the children with biliary atresia and recurrent hepatitis, responsible for 70–80% cases of recurrent jaundice (8). Cysts of the bile ducts, metabolic imbalance and cystic fibrosis are less frequent in children. In elder children jaundice is most often triggered by damaged cells of the liver taking the form of hepatitis.

Regional narrowing of the intra-hepatic ducts and widening are typical of cholangitis sclerosans. Biliary ducts dilatation is often filled with deposits of so-called bile slime, pus, calcium bilirubinate and minerals (15).

Cholelithiasis, chronic inflammations obliterating or causing fibrosis of the bile ducts result in cholestasis and secondary inflammation. Thin slices of high definition facilitate identification of the stones. The precision of US in detecting chlelithiasis is low (11–50%) (10), sensitivity 75%. CT detected cholelithiasis in 19 out of 21 patients (16). In CT scans cholesterol stones have density close to surrounding jaundice. Cholelithiasis and cholangitis are difficult to differentiate. Contrast in the duodenal lumen or its diverticulum may overshaddow stones stuck in the ducts. Missing fragments in the inferior part of the common bile duct may require choledochoscopy. Sudden narrowing of the duct, even with total obstruction, suggests cholelithiasis. Concrement interrupted closing or delicate narrowing of the intra-hepatic ducts may not cause the widening of the proximal part. Biliary ducts dilatation being the only criterion to detect the obstruction is doubtful. The ducts that have normal diameter may occur in jaundice confirmed by function tests. Nevertheless, the dilatation of common bile duct can define the level of obstruction in the pancreatic region or Vater's papilla.

Defining the character of obstruction is essential. The sudden widening or narrowing of the ducts are typical of carcinoma while the gradual narrowing of the common bile duct is more characteristic of chronic pancreatitis. It is necessary to precisely evaluate the pancreatic field and detect additional symptoms of the inflammation (14).

The isolated widening of the extra-hepatic ducts when the intra-hepatic ducts are normal occurs in cholestasis, cirrhosis and disseminated metastases. Considerably enlarged gall bladder – Courvoisier's symptom suggests malignancy. Jaundice is not an early symptom in case of liver carcinoma. It is caused by the tumor exerting pressure most often at the place where hepatic ducts unite to form the common bile duct. The slices without contrast can visualize hypodense mass or masses of density close to the surrounding parenchyma. Hyperdense border corresponds to the cyst. The tumors on the liver surface protrude from its outline. The tumors of non-homogenous structure suggesting cirrhosis or fibrosis may

have lesser density than the surrounding cancerous tissue. The infiltration of the surrounding adipose tissue increases its density. Past hemorrhages may increase the density of the damaged part of the tumor. Gall bladder carcinoma and cholangiocarcinoma usually obstruct the middle part of the common bile duct in 15–20% patients with malignant obstruction (4). Jaundice due to the tumor invasion on the bile ducts is a late complication to the gall bladder carcinoma. Metastases to the liver and hiliary nodes occur in 75% patients (18). Carcinoma of the gall bladder accounts for the widening of the intra-hepatic ducts and the narrowing of the lumen by the irregular mass of the bladder formed. Metastases to the hiliary nodes obstruct the extra-hepatic ducts in the proximal region. Direct infiltration of the bile tree causes jaundice (17). In 95% patients thickened walls > 5 mm were detected with considerable contrast strengthening. In 85% of cases CT scans detected direct invasion of the liver, lymphadenopathy, periductal, peripancreatic or periaortal (17).

The widening of the bile ducts occurs in ca. 50% patients. Obstruction is detected at the level of the common bile duct below the bifurcation resulting in secondary infiltration of the biliary duct, common duct and pressure from the enlarged lymph nodes.

Intra-hepatic obstructions may be formed by the congenital cystic widening of the intra-hepatic ducts (Caroli's disease). CT and US demonstrate characteristic numerous cystic branched structures and dilatation of ducts communicating with the cysts of low density, especially in the area of the porta hepatis and in the portal circulation. Usually asymptomatic the ducts cause numerous narrowings. Jaundice is a classic symptom of choledochus cyst and palpable abdominal masses, although the triad is detected in less than 1/3 patients (8). Three types of widening have been described: cystic or spindle-like common bile duct, unilaterally dilatation of the common bile duct defined as diverticulum, regionally dilatation of the duodenal part of the common bile duct defined as choledochocele. Cysts located nearby the liver hilus occur in various types of cirrhosis, portal vein thrombosis and portal hypertension.

Cholangiocarcinoma forms a considerable widening of the intra-hepatic ducts and common bile duct with abruptly terminated end, even by a small mass at the porta hepatis. In 70% cases of cholangiocarcinoma the narrowing is blunt cut, CT symptoms are nonspecific, often revealing hypo- and iso-dense masses with little contrast strengthening also in the dynamic option. Thickened walls of the bile ducts and sometimes polyp-like masses in the dilatation of the bile duct are rare symptoms seen on the US examination. The most frequent tumor of the extra-hepatic bile ducts is the carcinoma of the common bile duct (30–40%), common hepatic duct (30%), bifurcation of the bile duct (20%), gall bladder duct (< 5%). In the USA > 60% carcinomas of the bile ducts occur in the proximal 1/3 bile duct, affect the bifurcation of the hepatic duct. Jaundice associated with small pain in the function tests reflects the process of destruction. Initial practice with MRI in the case of cholangiocarcinoma suggests advantages in the evaluation of the tumors affecting the portal vein and intra-hepatic blood vessels.

It is essential to locate the obstruction in the communicating, supra-pancreatic, intra-pancreatic and ampullar areas. Dilatation of the intra-hepatic ducts may take linear, branch or circular forms. Width of the ducts cannot be the only criterion to diagnose cholestasis. ERCP is indicated to perform biopsy of the tumor and define the width of the ducts (5).

CONCLUSIONS

US and CT are essential to define the character of jaundice. US is preferable due to easy technique. Contrast, spiral CT defines the level and character of narrowing and widening of the bile ducts, assesses resectibility in case of malignant obstruction of the bile ducts.

CT is indicated when US picture is normal, results doubtful or normal, however diversive from the clinical picture. Generalized or regional widening of the ducts, symmetrically or asymmetrically thickened walls of the bile ducts are more precisely visualized by CT.

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SUMMARY

Obstructive jaundice is characterized by partial or total narrowing of the lumen of bile ducts and dilatated intra- and extra-hepatic bile ducts. The purpose of the study was to validate the role of imaging techniques (US and CT) in establishing the etiology of jaundice which is essential for further management. The study included 81 patients with jaundice hospitalized in Teaching Hospital No 1 in Lublin in 1998–2005. US and CT are essential to define the character of jaundice. US is preferable due to easy technique. Contrast, spiral CT defines the level and character of narrowing and dilatation of the bile ducts.

Znaczenie ultrasonografii i tomografii komputerowej w diagnostyce żółtaczki

Żółtaczka mechaniczna przebiega z częściową lub całkowitą obstrukcją przewodów żółciowych oraz ich poszerzeniem w odcinkach poza- i wewnątrzwątrobowych. Celem pracy jest ocena roli badań obrazowych, ultrasonografii i tomografii komputerowej w rozpoznawaniu i ustaleniu etiologii żółtaczki. Materiał obejmuje 82 chorych z żółtaczką, leczonych w latach 1998–2005 w Klinikach SPSK Nr 1 w Lublinie. Stwierdzono, że USG i KT mają istotne znaczenie w określaniu charakteru żółtaczki. USG jest techniką preferowaną ze względu na łatwość wykonania. Kontrastowe, spiralne KT określa poziom i charakter zwężeń oraz rozszerzeń przewodów żółciowych.