Accuracy of Multidetector Computed Tomographic Cholangiography In Evaluation of Causes of Biliary Tract Obstruction

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Abstract

Introduction: Using MDCT cholangiography with MinIP and MPR is a quick noninvasive imaging modality that gives high diagnostic accuracy in detection of biliary stones and characterization of nature of biliary strictures. It would be mostly valuable in pre-operative cases when biopsy or therapeutic intervention is not required, or if ERCP failed.

Aim of the Work: The purpose of this study is to evaluate the accuracy of MDCT cholangiography utilizing minimum intensity projection (MinIP) reconstruction in diagnosis of causes of obstructive jaundice.

Patients and Methods: The current study was performed between September 2012 and October 2014 on 30 patients with clinical, biochemical and imaging evidences of biliary tract obstruction referred to the Radiology Department in Kasr Al-Aini University Hospital from the Departments of Tropical Medicine, Internal Medicine and Surgical Units.

Results: The results of this study showed high diagnostic accuracy of MDCT cholangiography in the group of malignant obstructive jaundice causes with a sensitivity of 100%, specificity of 92.9%, PPV of 94.1%, NPV of 100% and accuracy of 96.7%. High diagnostic accuracy in benign stricture group and fair diagnostic accuracy in calculus group with a sensitivity of 75%, specificity of 100%, PPV of 100%, NPV of 75% and accuracy of 85.7%.

Conclusion: In our study, we concluded that reconstruction of MDCT cholangiography by MinIP and MPR is a good noninvasive imaging modality that offers fair diagnostic accuracy in detection of biliary stones and high diagnostic accuracy in differentiation between benign and malignant biliary strictures, which allows single-step evaluation of the biliary system and the surrounding structures with ideal assessment of the lesion site and extension. It cannot be expected to challenge the optimum results of ERCP as it does not allow direct access to biopsy or therapeutic actions.

Key Words: Biliary obstruction – Minimum intensity projection – Multidetector computed tomography – Cholangiography – Jaundice.

Introduction

IN suspicion of biliary obstruction, the diagnosis is essential for treatment design. Ultrasonography has been considered as the first imaging tool in assessment of cause of obstructive jaundice, as a widely available and relatively inexpensive modality. However, considerable disadvantages of ultrasonography are the limited diagnostic efficiency and operator dependency [1].

Although the invasiveness, ERCP and Percutaneous Transhepatic Cholangiography (PTC) are used to detect the presence, degree, level and the possible cause of biliary obstruction [2]. Furthermore, the wall and the surrounding structures cannot be evaluated with these techniques [1].

Recent advances in imaging technology have allowed CT and MRCP to offer minimally invasive substitutes to endoscopic retrograde cholangiopancreatography for evaluate biliary obstruction [3]. Recently MRCP has been considered as a good, noninvasive diagnostic modality for evaluating the biliary system and the surrounding organs; however, it is expensive and has limited availability [4].

Multidetector CT is widely available and useful. It shows the cause and the level of biliary obstruction and also helps imaging the entire abdomen [5]. Recent studies have revealed that the minimum intensity projection (MinIP) of MDCT data that depends on low density of the bile as a negative contrast for imagining of the biliary system provided a higher accuracy in assessment the degree of bile duct dilatation and better correlation with MRCP than conventional MDCT [6]. By utilizing advanced post-processing techniques, malignant and benign strictures, choledocholithiasis and hepatolithiasis, can be evaluated. Variable types
of post-processing techniques, such as minimum intensity projection (MinIP), MPR, Maximum Intensity Projection (MIP), and Curved Planar Reformation (CPR) have been described [7].

Aim of the work:

The aim of this study is to evaluate the accuracy of MDCT cholangiography utilizing MPR and MinIP reconstruction in diagnosis of causes of biliary obstruction.

**Patients and Methods**

This current study was performed between September 2012 and October 2014 on 30 patients, eighteen males and twelve females, their ages ranged between 30 to 81 years (mean ± SD 58.73 ± 14.61).

**Inclusion criteria:**

All patients with clinical, biochemical and imaging evidences of biliary tract obstruction referred to our Radiology Department from the Departments of Tropical Medicine, Internal Medicine and Surgical Units.

**Exclusion criteria:**

- Patients were excluded from this study if they had submitted to any intervention of the biliary system before MDCT, those with no medical records and those with no reference test.
- Patients with high creatinine level and those with history of allergy to contrast media were also excluded from this study.

**Patients were subjected to the following:**

1. Clinical assessment including; recording of age, sex and clinical presentation.
2. Laboratory investigation (CBC, total and direct bilirubin, ALT, AST, ALP, urea and creatinine).
3. Abdominal ultrasonography.
4. MDCT cholangiography.
5. ERCP (with endoscopic biopsy when possible).
6. The final diagnosis is reached based on reference examinations histopathological diagnosis, clinical follow-up and operative details.

**Multidetector computed tomography technique:**

- MDCT cholangiography was done for patients with clinically evident biliary tract obstruction. The causes of biliary obstruction recognized by MDCT were divided into two groups: Benign obstruction (including calcular and benign stricture) and malignant obstruction. The MDCT findings were compared with the final diagnosis, based reference examinations mentioned above.
- All MDCT examinations were performed with a 64-channel MDCT scanner (Aquilion 64 system; Toshiba Medical Systems Corporation, JAPAN) using the following parameters: Detector configuration (64 X 0.5mm), slice thickness (0.5-1mm), collimation (0.5mm), pitch factor (0.828), reconstruction interval (1mm), rotation time (0.5sec), 300mAs; 120kVp. Patient preparation a low-residue diet was prescribed twenty four hours before the examination, and the patient was instructed to come to the CT unit completely fasting for at least 4h. Reassurance and a brief explanation of the procedure to the patient were carried out.

Patient position—all patients were examined in the supine position. Suspended breathing during the scanning duration was also important; each patient was instructed to remain stable and not to move during examination. Scanning in the antero-posterior scout view with scanning area from the dome of the liver to the level of L3 vertebra was carried out.

**MDCT cholangiography protocol:**

**Precontrast scan:**

- Precontrast scanning of the upper abdomen in the craniocaudal direction during breath hold was first done to screen for bile duct or gall bladder stones.

**Postcontrast scan:**

- Each patient received 800-1000ml of water or water-soluble contrast medium orally, 10-15 minutes before scanning.
- Because of the high contrast between the hepatic parenchyma and the biliary tree, the portovenous phase was used for the reconstruction of MinIP images.
- Thus, portovenous phase were obtained 60-70 seconds after initiation of intravenous injection of 100-150ml of nonionic contrast medium at a flow rate of 2 to 4ml/sec into the antecubital vein.
- No biliary contrast agent was given.

**Image evaluation:**

- Image dataset was transferred to a workstation (Vitrea®, Version 6.0) to be reconstructed by using MinIP and MPR techniques to create MDCT cholangiography. Variable slab thicknesses were used for reconstruction according to the degree of biliary dilatation and coronal oblique planes were oriented throughout the biliary tract.
- The final images were reported by an experienced radiologist.
- The radiologists were asked to evaluate the images for degree and pattern of biliary tract dilatation, level of obstruction, presence of biliary stones or stricture, and to suggest whether the stricture was due to benign or malignant etiology.

As compared to diameter of adjacent portal veins, the biliary tract dilatation were classified into four degrees:
- Non dilated: CBD diameter is lesser than 6mm with imperceptible intrahepatic biliary radicles.
- Mild dilatation: CBD is greater than 6mm and the dilated intrahepatic bile ducts diameter is smaller than adjacent portal veins.
- Moderate dilatation: Bile duct diameter is equal to adjacent portal veins.
- Severe dilatation: Bile duct diameter is larger than adjacent portal veins.

The pattern of biliary dilatation was identified as extrahepatic, intrahepatic or both (either equal or one exceeding the other).

The causes of biliary obstruction were categorized into two groups including:
- Benign obstruction (including calcular and benign stricture).
- Malignant obstruction.

Biliary stones existed as relatively hyperdense material within the bile duct as compared to surrounding hypodense bile.

Benign stricture short segment stricture (<1cm) with a smooth margin and symmetric narrowing.

Malignant stricture was suggested if any of the following were seen:
- A long segment stricture (>1.5cm) with abrupt obstruction of bile duct.
- Irregular margin and asymmetric narrowing.
- Enhancement of the stricture wall more than 10 HU as compared to the noninvolved common bile duct wall in portovenous phase.
- More than 1.5mm increased thickness of the involved wall of bile duct.
- Tumor visualization.
- Distant metastasis.

Reference examination:
ERCP was done in all patients within a month after MDCT.

**Statistical analysis:** Results were expressed as number and percentage. Comparison between categorical data was undergone using Chi square test. Measurement of agreement between MDCT Cholangiography and ERCP (and other reference standards) was performed using Kappa test.

By comparing the diagnosis obtained from MDCT with that obtained from reference examinations, the accuracy of MDCT cholangiography in assessment of cause of obstructive jaundice was evaluated in terms of specificity, sensitivity, Negative Predictive Value (NPV), Positive Predictive Value (PPV) and diagnostic efficacy as described by Galen (1980). SPSS computer program (Version 16 windows) was used for data analysis. p-value less than or equal to 0.05 was considered significant and less than 0.01 was considered highly significant.

**Results**

The study group consisted of 30 patients. The patients' age ranged between 30 to 81 years (mean ± SD 58.73±14.61). Patients' sex: Eighteen (60%) patients were males and twelve (40%) were females.

Causes of biliary obstruction as suggested by MDCT cholangiography: Malignant biliary stricture was diagnosed in seventeen patients (56.7%), diagnosis of calcular obstructive jaundice in six patients (20%), diagnosis of passed stones in six patients (20%) and one case of benign biliary stricture (3.3%) (Table 1).

Distribution of benign causes of obstructive jaundice by MDCT cholangiography (total number 13):

Benign causes were distributed as follows: Six patients as stones (46.2%), six patients as passed stones (46.2%) and one patient as an inflammatory cause (7.6%) (Table 2).

Distribution of malignant causes of obstructive jaundice by MDCT cholangiography (total number 17): Malignant causes were distributed as follows: Fourteen patients with pancreatic masses (82.3%), two patients with ampullary masses (11.8%) and one patient with cholangiocarcinoma (5.9%) (Table 3).

**ERCP features of the studied group:**

ERCP was done for all patients after MDCT and revealed the following: Two patients with ampullary mass that ended the examination by biopsy taking (6.6%), one patient with benign
looking stricture (3.3%), five patients showing variable patterns and degrees of biliary dilatation with no detectable stones or strictures (16.7%), fourteen patients with malignant looking stricture (46.7%) and eight patients with detectable stones (26.7%). Table (4).

- Final diagnosis of causes of biliary obstruction by reference examinations: Summarized in (Table 5).

Analysis of diagnostic indices of MDCT cholangiography:

With grouping of the studied sample into benign and malignant groups, the overall diagnostic indices were obtained.

Upon correlating the MDCT findings to the final diagnoses, zero case was found to be false negative (0%), one case was false positive (7.1%), 13 were true negative (92.9%) and 16 were true positive (100%), as shown in (Table 6).

Based on the previous findings, MDCT had a sensitivity of 100%, a specificity of 92.9%, a positive predictive value of 94.1%, a negative predictive value of 100% and efficacy of 96.7%.

Regarding the false positive case by MDCT, faint content of the stone associated with prominent pancreatic head (may be reactive to impacted stone) was misleading. So, it was considered as a pancreatic mass. Yet, on ERCP a small distal filling defect corresponding to a stone was found and was extracted later on.

The other case had proximal stone with the same density as liver tissue. It was considered as benign biliary obstruction (? passed stone) and was only discovered by ERCP that ended by stent placement to the patient who was not medically fit for further intervention.

- The inflammatory subgroup:

Upon correlating the MDCT findings to the final diagnosis in the benign group according to presence or absence of benign stricture, none of the cases was found to be false negative (0%), none of the cases was false positive (0%), 13 cases were true negative (100%) and a single case was true positive (100%).

- The paucity of benign stricture group (only one positive case) has biased the late result.

- The overall diagnostic indices of MDCT was considered the same as the diagnostic indices for malignant causes of biliary obstruction as the whole study population was described as malignant versus benign.

Table (1): Causes of biliary obstruction as suggested by MDCT cholangiography of the studied group.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant stricture (mass)</td>
<td>17</td>
<td>56.7</td>
</tr>
<tr>
<td>Benign stricture</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Stone</td>
<td>1</td>
<td>20.0</td>
</tr>
<tr>
<td>? Passed stone</td>
<td>6</td>
<td>20.0</td>
</tr>
</tbody>
</table>

Table (2): Distribution of benign causes of obstructive jaundice by MDCT cholangiography (total number 13).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stone</td>
<td>6</td>
<td>46.2</td>
</tr>
<tr>
<td>Passed stone</td>
<td>6</td>
<td>46.2</td>
</tr>
<tr>
<td>Inflammatory</td>
<td>1</td>
<td>7.6</td>
</tr>
</tbody>
</table>

Table (3): Distribution of malignant causes of obstructive jaundice by MDCT cholangiography (total number 17).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreatic mass</td>
<td>14</td>
<td>82.3</td>
</tr>
<tr>
<td>Ampullary mass</td>
<td>2</td>
<td>11.8</td>
</tr>
<tr>
<td>Cholangiocarcinoma</td>
<td>1</td>
<td>5.9</td>
</tr>
</tbody>
</table>
Table (4): ERCP findings of the studied group.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant stricture</td>
<td>14</td>
<td>46.7</td>
</tr>
<tr>
<td>Ampullary mass</td>
<td>2</td>
<td>6.6</td>
</tr>
<tr>
<td>Benign stricture</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Stone</td>
<td>8</td>
<td>26.7</td>
</tr>
<tr>
<td>Dilatation, no stone or stricture</td>
<td>5</td>
<td>16.7</td>
</tr>
</tbody>
</table>

Table (5): Final diagnosis of causes of biliary obstruction by reference examinations of the studied group.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pancreatic carcinoma</td>
<td>13</td>
<td>43.3</td>
</tr>
<tr>
<td>Ampullary carcinoma</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>Cholangiocarcinoma</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Inflammatory stricture</td>
<td>1</td>
<td>3.3</td>
</tr>
<tr>
<td>Stone</td>
<td>8</td>
<td>26.7</td>
</tr>
<tr>
<td>Passed stone</td>
<td>4</td>
<td>13.3</td>
</tr>
<tr>
<td>Iatrogenic</td>
<td>1</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Table (6): Association between MDCT and final diagnoses in the studied group.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>ERCP</th>
<th>Kappa value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benign (n=13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(TN)</td>
<td>13</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>(FN)</td>
<td>0</td>
<td>0 (0.0%)</td>
</tr>
<tr>
<td>Malignant (n=17)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(FP)</td>
<td>1</td>
<td>16 (100.0%)</td>
</tr>
</tbody>
</table>

Table (7): Association between ERCP and MDCT in the benign group of obstructive jaundice according to the presence of calculi (total number 14).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>ERCP</th>
<th>Kappa value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non calcular (n=8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(TN)</td>
<td>6/6</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>(FN)</td>
<td>2/8</td>
<td>25%</td>
</tr>
<tr>
<td>Calcular (n=6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(FP)</td>
<td>0/6</td>
<td>0%</td>
</tr>
<tr>
<td>(TP)</td>
<td>6/8</td>
<td>75%</td>
</tr>
</tbody>
</table>

Fig. (1): Male patient 35 years old presented with jaundice and weight loss. (A) ERCP demonstrated distal third irregular stricture of the CBD (white arrow). (B,C) Coronal oblique minimum intensity projection images (7-mm thick slab) demonstrated moderate dilatation of CBD more than IHBR with asymmetric narrowing and irregular margins of the obstructed lower third of CBD (black arrow), features of malignant stricture with visualization of soft tissue mass (black arrow heads) at the level of pancreatic head.

Fig. (2): Male patient 73 years old presented with jaundice and right hypochondrial pain. Coronal (A,B) Sagittal (C) Oblique and axial (D) Minimum intensity projection images (3.5-mm thick slab) at different phases demonstrated moderate intrahepatic biliary radicles dilatation (more obvious in image c; 5-mm thick slab) with a hepatic hilar mass of heterogenous density showing gradual increased portal and delayed enhanceement. Cirrhotic liver.
Fig. (3): Male patient 73 years old presented with jaundice and epigastric pain. (A) ERCP demonstrated a large stone in distal CBD (white arrow) (B,C) Coronal oblique minimum intensity projection images (5-mm thick slab) demonstrated distal CBD stone with moderate proximal dilatation of CBD and IHBR. Crescent sign (white arrow) and central stone nidus (black arrow) was demonstrated.

Fig. (4): Male patient 59 years old presented with jaundice. Coronal oblique (A) and axial (B, C, D & E) minimum intensity projection images (5 & 7-mm thick slab) demonstrated moderate CBD dilatation with gradual tapering (black arrows), symmetrical narrowing and smooth margin of its distal third.
Discussion

Many imaging modalities as US, MRCP, CT scan, and ERCP can be used to assess the cause of obstructive jaundice; each modality still has some limitations [1].

According to Hakansson et al., [8], the sensitivity of US for detection of bile duct stones ranged from 20-80%. In the present study, abdominal US was done for all patients and biliary stones were diagnosed as a cause of obstructive jaundice in (10%) of the cases.

MRCP is a non-invasive examination with the absence of ionizing radiation and contrast medium administration [9]. It has a high diagnostic accuracy in assessment of biliary pathology; however, high cost, limited availability, and long examination time still limit its use [4].

Tongdee et al., [1] stated that ERCP provides both diagnosis and therapeutic intervention in the same setting as compared to other noninvasive modalities. However, it does not offer extraluminal information with failure rate of 3-10% and 0.5-5% rate of complications.

In the present study, ERCP was done for all patients after MDCT and revealed the following:

Two patients with ampullary mass that ended the examination by biopsy taking (6.6%), one patient with benign looking stricture (3.3%), five patients showing variable patterns and degrees of biliary dilatation with no detectable stones or strictures (16.7%), fourteen patients with malignant looking stricture (46.7%) and eight patients with detectable stones (26.7%).

In the present study, although ERCP was the standard reference test and was satisfactory in grouping causes of biliary obstruction into benign and malignant groups and was considered as a final diagnostic tool in seven patients (23.3%). Final diagnosis also was obtained from other reference examinations as follows: Biopsies (either endoscopic or US guided) taken in seven patients (23.3%), CA19-9 obtained in three patients (10%), clinical follow-up of patient status in eight patients (26.7%) and surgical approach in five patients (16.7%).

A better imaging of the biliary system and pancreatic duct has been facilitated by recent techniques of MDCT reconstruction as MPR and MinIP that offers the single-step evaluation of the biliary tract and the surrounding organs [1].

The present study showed that MDCT cholangiography was accurate in detecting the presence and level of biliary obstruction in 100% of the cases. This coordinates with the studies performed by Zhang et al., [10] and Darwish et al., [11] who stated that MDCT cholangiography was accurate in detecting the presence and location of the obstruction in 100% of their studied cases.

In the present study, biliary tract dilatation was demonstrated in all cases: Mild degree in (16.7%), moderate in (56.6%) and severe in (26.7%) of the cases, and the malignant cases showed more severe dilatation than those of benign obstruction. This matches with the study of Tongdee et al., [1] who found that malignant causes of biliary obstruction result in dilatation more severe than that of benign causes with an exception of biliary stones that result to variable degree of biliary dilatation according to the stone size.

In the present study, variable slab thickness was utilized to MPR and MinIP reconstruction in coronal oblique planes considering the degree of duct dilatation, and it improved the sensitivity to detect the degree of biliary dilatation. This agrees with Kim et al., [12], and Denecke et al., [13] who concluded that MinIP and MPR images combined with conventional MDCT improve the assessment of mild degree of bile duct dilatation and vascular invasion.

The present study has reported the high accuracy of MDCT cholangiography using MinIP technique in detection of causes of biliary obstruction. This agrees with the studies by Kim et al., [12] and Zandrino et al., [14].

In our study MinIP and MPR images were considered satisfactory for diagnosis of causes of biliary obstruction in (90%) of the cases with no need for axial images. Further need of axial source images was essential in (10%) of the cases with malignant obstruction for more evaluation of mass extension and staging. This is in agreement with the studies performed by Ryoo et al., [6], Park et al., [2] and Lee et al., [15] who concluded that MDCT with MinIP and MPR images was able to provide an accuracy comparable to that of axial MDCT only.

Although the biliary stone disease is the commonest cause of obstructive jaundice, the present study demonstrated that MDCT diagnosed 57% of the cases as malignant obstruction in contrast to 43% of benign cause. That was suggested to be due to early intervention of most of calculous group with ERCP and stone extraction after US screening,
clinical and laboratory assessment without referral for MDCT examination. In the present study one case of obstructive jaundice was suggested to be a pancreatic mass by US which was not proved by MDCT, and hence diagnosed as a passed stone. Finally, a history of previous endoscopic stone extraction was proved with complications (perforation and infection).

In the present study, causes of obstructive jaundice by MDCT were grouped into: Benign group in (43.3%) and malignant group in (56.7%) of cases. In the classification by ERCP and other reference examinations the benign group included (46.7%) and malignant group (53.3%) of the cases. In the present study, malignant causes were distributed as follows: (81.3%) pancreatic masses, (12.5%) ampullary masses and (6.2%) of the cases were cholangiocarcinomas.

In this study, unfortunately we could not encounter other causes of malignant biliary obstruction as lymphoma, metastases or hepatocellular carcinoma which may have been presented by obstructive jaundice as late manifestation of the disease process.

Our study demonstrated sensitivity of 100%, a specificity of 92.9%, a positive predictive value of 94.1%, a negative predictive value of 100% and accuracy of 96.7% in detection of malignant causes of biliary obstruction. The association between MDCT and reference examinations was highly significant (p-value 0.001) and with high interobserver agreement (Kappa value 0.933). This agrees with the study by Tongdee et al., [1] who found that MDCT has a sensitivity, specificity, accuracy, PPV, and NPV of MDCT cholangiography in diagnosis of malignant biliary stricture of 95%, 93.3%, 94%, 90.5%, and 96.6%, respectively.

In the present study, MDCT could detect the pancreatic head mass (Fig. 1) in all thirteen cases studied with one false positive case that was a calcular obstruction misdiagnosed as a pancreatic mass. This coincides with the studies by Heller et al., [16] and Darwish et al., [11] who stated that the sensitivity of MDCT in the detection of pancreatic head mass approached 100%.

Darwish et al., [11] and Salles et al., (2008) [17] stated that MinIP shows well dilated ducts as well as ductal adenocarcinoma against the background of more enhancing normal pancreatic tissue.

Ryoo et al., [6] concluded that MDCT with MinIP and MPR images was able to offer an accuracy comparable to that of axial MDCT only for classification of cholangiocarcinoma.

In the present study, MDCT cholangiography diagnosed one case of intrahepatic mass forming cholangiocarcinoma. In the studies performed by Kim et al., [18] and Darwish et al., [11] MDCT cholangiography diagnosed all studied cases of hilar cholangiocarcinoma (Fig. 2) (100%) correctly.

Kim et al., [19] stated that the intrahepatic cholangiocarcinomas can be classified into three types: The mass-forming type (the most common), the infiltrative periductal type, and the intraductal growing type.

In our study, with MDCT cholangiography we diagnosed two cases of ampullary masses. Chang et al., [20] showed a sensitivity of 91.7% with MDCT in the detection of ampullary mass compared to 20-39% by single slice CT. Darwish et al., [11] stated that the use of water as a negative oral contrast medium increased the conspicuity of the enhancing ampullary mass within the distended duodenum.

Regarding benign causes of biliary obstruction in the present study, they were distributed as follows: (57.1%) diagnosed as stones (Fig. 3), (28.5%) as passed stones, (7.2%) as an inflammatory benign stricture and (7.2%) as iatrogenic cause. Unfortunately, no other causes of benign biliary obstruction were encountered in this study as they are less common than the previously mentioned causes.

Although, up to 20% of bile duct calculi have isodense to bile according to Baron et al., [21], our study achieved a sensitivity of 75%, a specificity of 100%, a positive predictive value of 100%, a negative predictive value of 75% and accuracy of 85.7% in the diagnosis of choledocholithiasis. The association between MDCT and reference examinations was highly significant (p-value 0.005) with good interobserver agreement (Kappa value 0.720). This coincides with the results of Zandrino et al., [22] and Anderson et al., (2008) [23] who reported a sensitivity of MDCT of 82 and 77.8%, respectively.

Tongdee et al., [1] achieved a sensitivity, specificity, accuracy, PPV, and NPV in diagnosis of bile duct calculi by MDCT as 91.7%, 100%, 96%, 100%, and 92.9%, respectively, which in turn achieved considerable improvement compared to the prior studies by Soto et al., [24] and Neitlich et al., [25] using single-slice CT with a sensitivity and specificity of 65-88% and 84-97%, respectively.
Retrospectively, the calculi missed in the present study were of small size, distal position and isoattenuation to the bile in one case and proximal position and isoattenuation to the bile in the other case which made the stones difficult to be detected.

Regarding the detection and classification of bile duct strictures, MDCT with multiplanar capabilities increased the ease of visualization and characterization of the biliary stricture. Anderson et al., [23] and Kim et al., [18] reported the CT criteria of benign strictures as smooth and gradual narrowing of the CBD in a short segment less than 1 cm without mass.

In the present study, the criteria of benign stricture were seen only in one studied case (Fig. 4). The diagnosis was confirmed by ERCP. Togndee et al., [1] achieved a sensitivity of 66.7% and a specificity of 95.5% in cases of benign stricture with overall accuracy of 88.5% compared to the prior study by Choi et al., [26] which reported an accuracy of 90% in classification of biliary strictures.

In our study, MDCT had overall sensitivity of 100%, specificity of 92.9%, positive predictive value of 94.1%, negative predictive value of 100% and accuracy of 96.7% in evaluation of causes of biliary obstruction. The overall performance of MPR and MinIP reconstruction in addition to conventional MDCT images showed a synergic effect to conventional axial CT, coinciding with the results of Denecke et al., [13], Togndee et al., [1] and Darwish et al., [11] in evaluation of causes of biliary tract obstruction.

The present study had some limitations including:
- The initial screening of jaundiced patients was followed by ERCP before the MDCT in most instances which led to exclude a large number of cases with previous intervention that altered the sample pool of the study.
- Awareness of radiologists by the clinical presentation the patients led to more careful evaluation for evidence of strictures or calculi that could have influenced the accuracy by focusing on a limited aspect of the study.
- Unavailability of pathological diagnosis in all cases.
- The small number of cases, mainly in the benign stricture group.

Conclusion:
In our study, we concluded that reconstruction of MDCT cholangiography by MinIP and MPR is a good noninvasive imaging modality that offers fair diagnostic accuracy in detection of biliary stones and high diagnostic accuracy in differentiation between benign and malignant biliary strictures, which allows single-step evaluation of the biliary system and the surrounding structures with ideal assessment of the lesion site and extension. It cannot be expected to challenge the optimum results of ERCP as it does not allow direct access to biopsy or therapeutic actions.

References


دقة الأشعة المقطعية بالحاسب الآلي متعددة المجسات للقنوات المرارية
في تقييم آسباب إنسداد القنوات المرارية

مقدمة: يتكون التصور المراري أهمية كبيرة في حالات الإنسداد المراري لليورة الإحتلالات التشريخية، والساعدة في الخطة العلاجية. إن العديد من التقنيات المفيدة لحزم المعلومات المكتسبة خلال التصور تم إستعراضها مثل إعادة تشكيل الصور متعددة المستوى، واستخدام الكثافة الكبرى، أو الكثافة الصغرى، والمعالجة متعددة المستويات التحليلية. والدراسات الحديثة أوضحت استخدم الكثافة الصغرى في حالات الإنسداد المراري مستخدمة الكثافة القليلة للعصرية المرارية بديل عن المواد التقليدية أو كمادة تألي كان سلبيا لمعالجة القنوات المرارية، وتقييم آسباب إنسدادها بكفاءة أفضل من التصور المقطعي العتيدي إذا ما قررت بكافحة الأطراف المرارية وذلك باستخدام وحدة التحكم الملائمة.

الهدف وأسباب البحث: في هذه الدراسة، قمنا بتقييم دقة التصور المراري بالأشعة المقطعية بالحاسب الآلي متعددة المجسات في تقييم آسباب إنسداد القنوات المرارية للثلاثين مريضا تم تشخيص إصابتهم باليرقان الإنسادي سريريا. وتم استخدام تقنيات المعالجة المذكورة أعلاه، ومن ثم دراسة النتائج وتبسيطها.

النتائج: خلت الدراسة إلى النتيجة الإلمانية للتصور المراري بالأشعة المقطعية بالحاسب الآلي متعددة المجسات في تشخيص آسباب الإنسداد المراري الخبيثة حيث كانت حساسية التشخيص بـ 99.9/%. والخصوصية 99.9/، والقيمة التنبؤية الإيجابية 96.1/، والقيمة التنبؤية السلبية 100/.
وتوقع العام 96.7/ في المجموعة التي نسبت بها وجود آسباب خبيثة لإنسداد القنوات المرارية.
وتوصيات الدراسة إلى تفكيك قوة في تشخيص الإنسداد المراري الناتج عن الإصابة المرارية حيث كانت له حساسية 96/، وخصوصية 100/، وقيمة التنبؤية الإيجابية 96/، وقيمة التنبؤية السلبية 96/، والتوقع العام 96/ في المجموعة التي نسبت بها وجود آسباب إنسداد القنوات المرارية.

الخلاصة: تستخلص من هذه الدراسة أن التصور المراري بالأشعة المقطعية بالحاسب الآلي متعددة المجسات مع استخدام تقنية إعادة تشكيل الصور متعددة المستوى، وإسقاط الكثافة شيء يوفر ديدا سريعا وغير نافذ للتخصص ويبطئ نتائج مقدمة في تشخيص الحصوات كسبب لإنسداد المراري، وتنتهي علاجها في تشخيص آسباب الخبيثة، وتشخيص الحصوات المتعددة للقنوات المرارية للتقرير بينهما، مما يتيح تقييمها مباشرةً، خطة واحدة للقنوات المرارية والأعضاء المحيطة بها.