Zagazig University Medical Journal
www.zumj.journals.ekb.eg

ORIGINAL ARTICLE

The Role of Multi-Detector Computed Tomography in The Evaluation of Pancreatic Lesions

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Submit Date 2019-04-06
Revise Date 2019-05-10
Accept Date 2019-05-31

ABSTRACT

Aim of work: To determine the role of Multi-detector Computed Tomography in the evaluation of various pancreatic lesions.

Background:MDCT with its thin collimation allows three-dimensional reformatting and multiplanar reconstruction of pancreatic anatomy which permits good depictions of many pancreatic lesions.

Patients and Methods:30 patients with pancreatic lesions suspected on the basis of clinical symptoms, laboratory investigations and USS findings were enrolled in this study. Majority of patients (2 patients were fellow-up patients) were subjected to full clinical history, general and abdominal examination, Laboratory investigations, Ultrasonography examinations with (Siemens, Acuson.X300), and CT examinations; Triphasic contrast-enhanced and monophasic MDCT (with delay of 40-50s) performed on (Philips, Ingenuity core128-multislice CT) in the Zagazig university hospital.

Results:This study included 30 patients with suspected pancreatic lesions. They were 19 males (63.4%) and 11 females (34.6%). The most studied patients were above 50 years. 11 patients were diagnosed with acute pancreatitis, one patient with acute on chronic pancreatitis, and 18 patients with pancreatic neoplasms. Hence, pancreatic neoplasms were found to be the most common pancreatic lesions in our study.

Conclusion:MDCT with contrast proved to be the imaging modality of choice in identification of various pancreatic lesions. The faster scanning time (with single breath hold) and thin slice thickness, allowed for better resolution and superior scan quality. The ability of MDCT to scan in both arterial and venous phases with its post processing techniques (MIP, MinP, CRP, and VR) allowed for excellent visualization of the pancreas, biliary anatomy and peripancreatic vasculature.

Keywords: MDCT, pancreatic cancer, pancreatitis, tumor resectability.

INTRODUCTION

The pancreas is a glandular organ, with both endocrine and exocrine function; it has no capsule and covered with fine connective tissue. [(1)] The pancreas lies at the posterior abdominal wall, as a retroperitoneal organ with the exception of the tail which lies in splenorenal ligament (the tail is an intraperitoneal part). [(2)(3)]

In 1990, The MDCT (with its high spatial resolution and speed) was introduced into the world and became superior to other imaging modalities in the evaluation of pancreatic lesions. [(4)]

In acute pancreatitis, the peripancreatic collection of fluid and necrosis can be evaluated by MDCT, (With accuracy of 87% and sensitivity and specificity of 100% in the detection of pancreatic necrosis) [(5) (6)]

The MDCT considered as the modality of choice for the characterization of pancreatic cystic lesions [(6)]

The CT severity index, obtained from Balthazar et al at 1990, has become a widely used tool in the evaluation of acute pancreatitis and determines its severity. [(7)] The CTSI depends on assessment of the size, density of the pancreases, the presence of

peripancreatic abnormalities, and presence or absence of pancreatic tissue necrosis. [5]

The pancreatic cancer has less than 5% five years survival rate [8], and the "surgical resection offers the best chance of cure"[9].

When the pancreatic cancer is suspected, the contrast-enhanced CT scan in multi- phases should be done to assess the vascular involvement and metastatic disease [10], as well as differentiation between PDA and pancreatic neuroendocrine tumors. [11]

PATIENTS AND METHODS

Patients:

30 patients with pancreatic lesions suspected on the basis of clinical symptoms, laboratory investigations and USS findings, or as follow-up patients, were enrolled in this study, 19 were males and 11 were females. They were referred to the Zagazig Radiodiagnosis department from private clinics as well as from the hospital units.

Our study was a prospective study, between April/2017 & October/2017.

Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Patient exclusion criteria

1. Pregnant patient, unless highly recommended (e.g. acute pancreatitis)
2. Patient with history of allergy to contrast
3. Patient unwilling to complete the study
4. Patients with severe renal impairment (N. creatinine 0.4-1.4mg/dl) and not on dialysis.

Methods:

28 patients were subjected to (2 patients were fellow-up patients):

1). full clinical history:

2) General and abdominal examination

3) Laboratory investigations:

LFT, Bilirubin level, RFT, CBC, Serum amylase and lipase and Tumors markers

4) Ultrasonography examinations with (Siemens, Acuson.X300)

4) CT examinations: Triphasic contrast-enhanced and monophasic MDCT (with delay of 40-50s) were performed on Philips, Ingenuity core128-multislice CT in the Zagazig university hospital.

Preparations:

Low residue diet was prescribed 24 hours before the procedure, and the patient was instructed to come to CT unit after completing fasting for about 4–6 h.

Prior to examinations patients drank 1500 mL of mixed water and contrast (20ml of urografin/1 liter of water) to demarcate the duodenum and delineate the pancreatic head region. Reassurance and brief explanation of the procedure to the patient were given. Each patient was instructed to remain stable during examination and suspend breathing during scanning time. Patients were canulated using 18-20 gauge needle.

Technique: all patients were examined in the supine position, they were asked not to move and to put their hands above their heads during the examination, all scans were acquired in craniocaudal direction. The unenhanced MDCT series were programmed to include the entire pancreas, from the level of diaphragmatic copula to the level of symphysis pubis for scanning of the whole abdomen.

The precontrast scan was performed to asses any abnormal calcification, stones or soft tissue mass, and identifying the scan range for contrast enhanced images. After the end of precontrast CT examination, post contrast scan was done after automatic power injector of 100 ml of high osmolar iodinated ionic contrast media (Telebrix 350mg/ml) at a rate of 4 ml/s into the antecubital vein, the volume of contrast medium was based on the patient's weight. The volume of contrast medium delivered was 1.5-2 ml per kg of body weight with an average of 100–150 ml. The arterial phase starts 20–35 s after the start of injection of contrast medium. The porto-venous and the delayed phase began 50-70s and 180 s after initiation of the contrast injection, respectively then image data were reconstructed and sent to a workstation. MIP (maximum intensity projection) was created using the raw data in 4 cases.

The scan parameters

The scan parameters are: tube voltage 120 kV, effective current 400

mA
slice thickness 3 mm/ pitch 0.89-1.015s / gantry rotation time 0.75s
FOV: 512X512
Table speed of 7.5–10 mm per rotation during a single breath-hold acquisition.

CT images interpretations:

CT scans were reviewed and evaluated for:

1. Pancreatic enlargement and pattern of enhancement.
2. Peripancreatic fluid collection.
3. Pancreatic mass (location, CT attenuation and pattern of enhancement).
4. Intrahepatic and extrahepatic biliary ducts and Pancreatic duct.
5. Local tumors extension (splenic hilum, porta hepatis and adjacent organs).
6. Assessment of tumor resectability: the lesion was considered unresectable if there is a distance metastasis, arterial invasions; encasing the adjacent arteries {celiac artery (CA), superior mesenteric artery (SMA), and common hepatic artery (CHA)}, or venous invasion; occluding the superior mesenteric vein (SMV), portal vein (PV), or superior mesenteric vein-portal vein (SMV-PV) confluence.

Standard for references

For pancreatic inflammation, the Laboratory investigations and clinical manifestations were the standards for references. For patients with neoplastic lesions, the pathological specimen was the standard for reference; the final histopathological results were achieved by surgical biopsy or resected tumor and fine needle aspiration or core biopsy.

Statistical analysis

All data were analyzed using (IBM SPSS Statistics for Windows, version 19 (IBM Corp., Armonk, N.Y., USA). Validity for MDCT in diagnosis was analyzed using nominal methods for determination of sensitivity, specificity, PPV, and NPV

RESULTS

According to the clinical data and MDCT findings, the pancreatic lesions of studied patients were classified into; inflammatory lesions and neoplastic lesions. Among the thirty studied patients, twelve were believed to have inflammatory lesions, and the rest (eighteen patients) believed to have neoplastic lesions. **(Table.1)**

According to Balthazar CTSI score, the studied cases with acute pancreatitis were categorized into: mild pancreatitis (6 cases), moderate pancreatitis (4 cases) and severe pancreatitis were reported only in 2 cases. (**Table.2 and Figure.1**)

Regarding the pancreatic neoplasm, table (3) shows site of pancreatic lesion detected in the studied patients, majority of lesions detected were at the area of the head of pancreas (61.2%). The tail lesions were detected in 4 patients, while the body lesions were detected in 2 patients. Only one patient showed a diffuse type of pancreatic neoplastic lesion. (**Table.3, Figure.2 and Figure.3)**

The Accuracy of MDCT in prediction of resectability (in comparing to surgical and histopathological resectability) is 94.4%, with a sensitivity of 100% and specificity of 92.3 %.**(Table.4)**

Table.1 types of pancreatic lesions among the studied patients

Type of pancreatic lesions	Studied patients (n=30)	
	No	**%**
Inflammatory lesions		
• Interstitial edematous pancreatitis (IEP)	8	26.67%
• Necrotizing pancreatitis (NP)	3	10%
• Acute on chronic	1	3.33%
Neoplastic lesions		
• Solid neoplastic lesions	17	56.67%
• Cystic neoplastic lesions	1	3.33%

Table.2: Grading severity of acute pancreatitis using Balthazar CTSI score.

Severity	*Score*	*No. of patients (n=12)*	*%*
Mild	0-3	6	50%
Moderate	4-6	4	33.4%
Severe	7-1	2	16.6%

Table.3: Site of pancreatic lesion detected in the studied patients with suspected neoplastic pancreatic lesions. (n=18)

Site of pancreatic lesion	*No. of patients(n=18)*	*%*
Head	11	61.2
Body	2	11.1
Tail	4	22.2
Diffuse	1	5.5

Table.4: Accuracy of MDCT prediction of the resectability in the studied patients with suspected neoplastic pancreatic lesions

		Surgical & histopathological resectability		
		Resectable	**No resectable**	**Total**
MDCT prediction	**Resectable**	5(27.78)	1(5.56)	6
	Non resectable	0(0.0)	12(66.67)	12
Total		5(27.78)	13(72.22)	18
Sensitivity: 100.0%			*Specificity :92.3%*	
Predictive value positive:83.33%			*Predictive value negative:100.0%*	
Accuracy:94.44%				

Figure.1 Multislice Triphasic CT of Abdomen & pelvis axial view with contrast for a 48 years old male patient.)

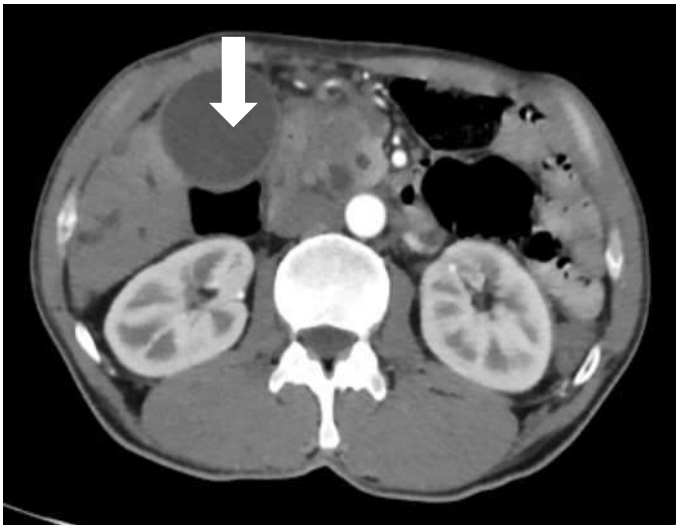

Figure.2: Multislice Triphasic CT of Abdomen & pelvis axial view, with contrast for a 50years old male patient)

Captions of patient's cases:

(Figure .1): Multislice Triphasic CT of Abdomen & pelvis with contrast for a 48 years old male patient, presented with history of acute epigastric abdominal pain show: diffusely enlarged homogenous enhanced pancreas, with peripancreatic fluid collections and fat stranding. No definitive solid or cystic pancreatic lesions. Normal GB wall thickness with two GB stone inside (black arrow) … (IEP with GB stone, CTSI=3)

(**Figure.2**): Multislice Triphasic CT of Abdomen & pelvis with contrast (axial view) show: mixed density lesion in pancreatic head (white arrow), heterogeneously less enhanced than the pancreatic tissue with dilated CBD, pancreatic duct and IHBRD … (Pancreatic head adenocarcinoma)

DISCUSSION

A total of 30 patients referred to our institution for pancreatic diseases were studied using MDCT, of which, 11 patients were diagnosed with acute pancreatitis, 1 with acute on chronic pancreatitis and 18 patients with pancreatic neoplasms. Males were 19 in number (63.4%) and females were 11 in number (36.6%). The age group mostly affected in this study was in between (50-59) years.

Acute Pancreatitis

Acute pancreatitis (AP) is one of the commonest reasons for hospitalized cases due to gastrointestinal disease. Its incidence increased dramatically in the past 2 decades,

from 4-8% before 1998, to reach 14.9% at 2013[12]. In this study peak age of incidence was noted in the 40-50 years age group constituting. Hence, it was shown in this study that males were predominantly affected in acute pancreatitis, in agreement with Parida K et al who studied 62 patients of acute pancreatitis and found that out of 62 cases, 47 (76%) were males and 15 (24%) were females with a male: female ratio of 3.1[13], and Paul Georg Lankisch et al (who found in their study (63%) were men, and (37%) were women). [14] Abdominal pain was the commonest symptom as seen in 12 cases (100%) and both Amylase and Lipase level were raised in all cases (100%).

Peripancreatic inflammatory changes were the most common CT findings seen in 88% of the cases of acute pancreatitis in our study {fat changes (100%) and Peripancreatic fluid collection (83.3%)}, in agreement with Sameer Raghuwanshi et al (out of 50 cases with acute pancreatitis, Peripancreatic inflammatory changes were about 88%)[15]

In our study, ascites was found in 3 patients (25%) and inflammation of GIT (thickness of gastric wall) in 4 patients (33.4%), a nearer results were obtained from Salvi B et al (2015) (50 patients involved), who found ascites to be the second most common complication, representing (36%) of all complications, and the GIT involvements were found in 13 patients (26%) [16]

In 1990, Balthazar et al designed a radiologic prognostic scoring system, or what we know as CT severity index (CTSI), based upon pancreatic inflammation and necrosis detected on CECT. In our study we depended on this scoring system to determine the severity of acute pancreatitis. (50%) of studied patients with acute pancreatitis had mild pancreatitis. (33%) had a moderate pancreatitis, and only 2 patients (16.6%) had a severe form of acute pancreatitis, in agreement with Sameer Raghuwanshi et al 2016, who have a similar result with majority (42%) of the cases were categorized as mild pancreatitis [15]. K J. Mortele et al 2004 found mild pancreatitis represent (63%) of cases in their study (44 out of 66 patients), (29%) with moderate, and only (7.5%) of cases were categorized as severe pancreatitis. [17]

Pancreatic Neoplasms

The poor prognosis of pancreatic cancer may be explained by the location of pancreas deeply in the abdomen, in close related to vital vascular structures that are early involved in the course of this disease. The median time between onset of usually nonspecific symptoms and presentation is 6 months. although the surgical resection offers the best chance of cure, few patients at presentation have resectable disease because of either already present metastases or locally advanced disease [8][9][18]

In our study, there were a total of 18 patients with pancreatic neoplastic lesions. With M: F ratio ~2:1. Hence in our study, males were affected more than females. Age group was above 50s with a mean age of (55.6), in agreement with Enass M.Khattab et al (2012). In their study on 39 patients, they found that males were affected more than females, and mean age of 58.3 years [19]. A recent study (2016) by Mohammad S Hossain et al,(50 patients involved), found that males is more affected than females and commonest age group amongst the patients was in between 56-65 years [20].

In current study MDCT could identify 17 (94.4%) solid lesions, 1 (5.5%) cystic lesion (serous cystadenoma). Haney Heneidy et al (2017) stated that cystic lesions of the pancreas has been estimated to range from 2.4% to 24% in imaging and autopsy studies [21] , Charles Galanis et al stated that serous cystadenoma accounts for only 1-2% of all pancreatic neoplasm. [22]

A recent study by Mary Y. Tadros and, Remon Zaher Elia (2016), found that11 patients showed hypodense lesions, 57% of tumors occupied the head of the pancreas, (29%) the body, and (14%)the tail. And, Compared to our study, 15 patients showed hypodense lesions, (61.2%) of tumors occupied the head of the pancreas, that may explains why (77%) of patients had a clinical history of jaundice because (61%) of the masses occupied pancreatic head. [23]

In the study of Vargas et al (2004), 25 patients involved in the study, 20 tumors

masses (80%) were hypodense, one (4%) was mixed density, and 4 (16%) were considered isodense in comparing to normal pancreatic parenchyma, in our study 15 lesions(83.3%) were hypodense, 1 (5.5%) was mixed and 2 (11.1%) were isodense.[24]

In our study (more than one criterion was detected in same patient) Liver metastasis was detected by MDCT in 8 patients (44.5%). Peritoneal deposits and ascites detected in 3patients (16.6%) which represent a highly suspicious peritoneal metastasis, and Osteolytic bony lesion seen in one patient (5.5%). Murfit had stated that metastasis to the liver occurred in approximately (17–55%) of the patients [25]. Tadros and, Remon Zaher Elia (2016) showed Liver metastases were detected by 7 patients (50%),ascites in 2 patients (14%) and Osteolytic bony lesions were found in (7%).[23]

Assessment of vascular invasion is an important parameter for determining resectability of pancreatic cancer [26]In their study, Vyacheslav I Egorov et al found vascular involvement of patients with pancreatic carcinoma ranges between (21%-64%), most often with involvement of SMA, due to its location [27]. In our study, 8 patients (44.4%) showed a vascular involvements, among them SMA and splenic artery were the most involved arteries, while SMV and splenic vein were the most involved veins. Omar Hassanen et al (2014), in their study (112 patients involved) found SMA to be the most invaded artery and SMV was the most invaded vein. [28]

According to predicting resectability by using the MDCT on the studied 18 patients, 6 patients (33.3%%) were considered suitable for tumor resection and 12 patients (66.7%) were considered inoperable with unresectable tumor, and the causes of unresectability were hepatic metastasis, distant lymph nodes involvement, vascular invasion and ascites. Li et al. stated that about (15-20%) of patients have resectable disease at the time of presentation [29] Enass M.Khattab et al (2012) in their study (39 patients), found 21 patients (53.8%) were considered inoperable with unresected tumor; the remaining 18 patients (46.2%) were considered suitable for tumor resection. [19]

The sensitivity and specificity of MDCT in prediction of resectability in our study were (100%) and (92.3%) respectively, with accuracy of (94.4%), and A nearer results was obtained from Desiree E. Morgan et al in their study (173 patients involved) with a sensitivity and specificity of (81%) and (86%) respectively. [30] Amr Mostafa Aziz et al (69 patients involved), found the accuracy of MDCT resectability in between 91%-97%, which comes with agreement of our results. [31]

RECOMMENDATION

A better evaluation of each of pancreatic lesions requires larger sample, longer duration and/ or studying each entity individually. Furthermore, it is better to evaluate any suspicious cases that are not definitely diagnosed by MDCT, by using other imaging techniques like Magnetic Resonance Imaging, to decrease the hazards of unnecessary operative procedures.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Funding information

None declared

Tables s1 : shown in the online supplement

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To Cite This Article: TantawyHI, Elfiki IM , Bayoumi SS, Sargewa EA., The Role Of Multi-Detector Computed Tomography In The Evaluation Of Pancreatic Lesions.ZUMJ 2019;25(5);639-647, Doi: 10.21608/zumj.2019.11028.11900