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Study of Pancreatic Steatosis in Diabetics Patients Using Multi detectors Computed Tomography

Alaa Ibrahim[1], Caroline Edward[2], Ahlam Asiri[1], Hamid Osman[1], K. Sherrif[1], Yasen[1]
[1]Taif University College of applied medical science, Taif, P O box 2425 Post code-2194, KSA
[2]Sudan University of Science and Technology College of medical radiological Science, Khartoum, Sudan.

***Corresponding author**
Alaa Ibrahim

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Abstract: The accumulation of fat in the pancreas has been referred to as fatty infiltration, fatty pancreas, fat non-alcoholic pancreatic disease and pancreatic steatosis. Pancreatic steatosis is the best description of fat accumulation in the pancreatic gland without fat replacement, and this term also describes the possibility that the fat accumulation is a reversible process. Pancreatic steatosis is an increasing problem due to the increasing incidence of obesity, aging, diabetes and metabolic syndrome. We aim to evaluate the diagnostic capacity of abdominal computed tomography in the assessment of pancreatic steatosis in diabetic patients. High-resolution MDCT scans of 44 patients (26 diabetic patients) that underwent CT examinations of the abdomen CT was performed with conventional sequences of unenhanced examination. Attenuation in CT of the pancreas and spleen were measured in Hounsfield units and scored by two blinded radiologist. The study shows the age group distribution in the diabetic patients with significant different in the age group between (60 years and more) with p value (.054). The percentage between the male and female were no significant differences in respect to gender in the presence of diabetes. the main findings of this study for the diabetic patients images comparing to the control group were found that, highly significant CT number (p=0.000)and hypodense signal compared to spleen with significant value (p=.054) distribution of the pancreas head CT number with highest percentage in the diabetic patient in (25 HU) compared to highest percentage of non-diabetic patient in (35 HU).and no significant different in the other part of the pancreas. Pancreatic steatosis is a common, benign pancreatic condition observed in clinical practice. The study concluded that axial CT scan is considered as an appreciable radiological method for characterizing the pancreas structure using CT number (Hounsfield). Pancreatic steatosis is not due to the presence of diabetes but is highly associated with the metabolic syndrome.
Keywords: MDCT, diabetes, obesity, pancreatic Steatosis

INTRODUCTION

Pancreatic steatosis referred to the accumulation of fat in the pancreatic gland has been referred to using various synonyms, such as pancreatic lipomatosis, fatty replacement, fatty infiltration, fatty pancreas, lipomatous pseudohypertrophy, non-alcoholicfattyand pancreaticdisease [1]. Pancreatic steatosis and fat replacement of the pancreas are the most frequent benign pathologic conditions of the adult pancreas [2-4]. Classically, the phenomenon causes an increasing hypodensity of the pancreas on CT and a typical hyperechogenicity on ultrasound (US) examination**.**

Accumulation of fat in the pancreas is increasingly recognized as a cause of pancreatic dysfunction and of the death of nonadipocytes through lipoapoptosis, ultimately leading to diabetes [5-10]. Fatty infiltration of an organ, which occurs in patients with nonalcoholic fatty liver disease, is known to trigger inflammatory cascades [11,12].

Fatty infiltration of the pancreas is generally a diffuse process occurring uniformly throughout the gland and occurs most frequently in the elderly and obese populations[13,14]. However, fatty infiltration may be unevenly distributed in the pancreas and can be confined to 1 region of the pancreas (focal fatty infiltration)[15-20]. Similarly, fatty infiltration may spare regions of the pancreas (focal fatty sparing)that is analogous to focal fatty spearing in the liver[21,22].

Focal fatty infiltration can mimic a hypoattenuating mass on CT examinations [17], and

fatty sparing of the pancreatic head can appear as a "pseudomass [22]. These are both normal variants and should not be confused with a neoplasm or other pathological processes. Alternatively, hypoattenuating neoplasms in the pancreatic head should not be mistaken as focal fatty infiltration. Computed tomography (CT) may be a more practical, noninvasive imaging modality for the pancreas because it is widely available and is performed with a short acquisition time [23].

CT shows fatty infiltration in an organ as a decrease in attenuation. However, because the CT attenuation can be affected by other components such as manganese [24], an abundance of manganese in the pancreas could mask a change in CT attenuation caused by fatty infiltration [25]. Similar concerns were raised for the quantification of hepatic fat because iron deposition may prevent an accurate assessment of the fat content [26].

Focal fatty infiltration is often most prominent in the anterior aspect of the head of the pancreas, whereas the posterior aspect of the head of the pancreas and the area around the common bile duct tend to be spare [15,20,21]. Focal fatty infiltration is often stable on follow-up CT examination [15]; however, the extent of involvement may progresson serial scans [21]. Focal fatty infiltration in the pancreas is seen as a region of decreased attenuation in the pancreas on noncontrastor postcontrast CT [17].

Computed tomographic attenuation within the focal fatty infiltration may be negative and show apparent fat attenuation [20]. In these cases, diagnosis of focal fatty infiltration can be supported by measuring CT attenuation. However, when focal fatty infiltration is mild, the region may not show apparent fat attenuation and may simulate a hypoattenuating mass on CT [18]. In such cases, differentiation of tumor and focal fatty infiltration can be difficult.

Ct findings to help differentiate focal fatty infiltration from pancreatic neoplasm

On CT, the area of hypoattenuation by focal fatty infiltration preserves the normal pancreatic contour and lobular appearance of the parenchyma [20]. There are no associated features of malignancy; for example, the pancreatic and bile ducts are not dilated, the adjacent vessels are not displaced orinvaded, and there is no associated adenopathy in patients with focal fatty infiltration [17, 18, 21]. The sharp interface from the embryological ventral pancreas that extends in the craniocaudal direction, well visualized on sagittal-reformatted CT images, also helps to distinguish focal fatty infiltration from apathologic process [15].

The uncinate process maintains its normal configuration in patients with focal fatty sparing. However, in some cases, it is difficult or impossible to differentiate focal fatty infiltration from a non-border-deforming neoplasm of the pancreas on CT [21]. Comparison of fatty pancreas by sonography and abdominal CT**.**

To determine correlations between metabolic parameters and fatty pancreas appearing on CT finding pancreas and those found by sonography, the difference between the averages Hounsfield Units (HU) from mean pancreas HU to mean spleen HU was calculated. If the difference was -5 or lower the subjects were classified into the fatty pancreas group on CT finding, and others were classified into the non-fatty pancreas group. A comparison of metabolic syndrome factors and body measurement factors found no difference in visceral fat, lipid profile, and liver chemistry between the two groups, based on CT findings [27]. Pancreatic fat density assessed by HU values based on unenhanced MDCT images also decreased according to the duration of diabetes [28].

The pancreatic HU values were significantly different between groups: They were lowest in the T2D≥5Y group, intermediate in the T2D<5Y, and T2D-new groups and highest in the Normal group, indicating greater fat accumulation in patients with a longer duration of T2D compared with those with a shorter duration of T2D or with the Normal group[28].There was significant difference of HUp–s between the Normal and the T2D<5Y or T2D≥5Y groups. When the pancreatic-to-splenic HU ratio (HUp–s) was used, similar difference was found between the groups [28].

More than 90% of population would have less than 5% of fat infiltration in pancreas [29]. The etiology of pancreatic steatosis varies from congenital related to acquired conditions. However, it can be classified into 4 groups :obesity and metabolic syndrome; there are some clinical studies [30-34] regarded the patients who were diagnosed as fatty pancreas from endoscopic ultrasound, MRI or CT scan which demonstrated that high body mass index(BMI) and metabolic syndrome were associated with fatty pancreas (Odd Ratio(OR) 1.05-3.13 while nonalcoholic fatty liver showed a 14-fold correlation with pancreatic steatosis [35]. congenital syndromes such as cystic fibrosis, Shwachman–Diamond syndrome(which was a rare autosomal recessive disorders characterized by association of pancreatic exocrine insufficiency ,due to fat infiltration and atrophy, bone marrow dysfunction and skeleton abnormalities)[36-40], and Johanson–Blizzard syndrome(a rare genetic disorder characterized by short stature, mental retardation, pancreatic insufficiency, sensorineural hearing lost, hypoplatic nasal alae, scalp defect and dental abnormalies) [41,42].

toxic agents and medications such as steroid therapy and gemcitabine chemotherapy which all of these medication related cases were reported case only [43,45,4] other rare causes such as reoviral infection [46], human immunodeficiency virus infection that could cause pancreatic steatosis through a combination of malnutrition-related and viralrelated effects, and chronic hepatitis B infection[47].

Clinical Impact of Fatty Pancreas the prevalence of NAFP was reported to be around 16% in Hong Kong Chinese population [32]. There was a statistically significant correlation between NAFP and non-alcoholic fatty liver disease (NAFLD) (odds ratio [OR]=2.22; 95%confidence interval [CI], 1.88–2.57; P<0.001), central obesity (OR = 2.16; 95% CI, 1.85–2.52; P<0.001), age (OR = 1.05; 95% CI, 1.04–1.05; P<0.001), hypertriglyceridemia (OR = 1.32; 95% CI, 1.13–1.55; P=0.01), aspartate aminotransferase and alanine transaminase level elevation.

(OR = 1.29; 95% CI, 1.13–1.70; P=0.02), and diabetes mellitus (DM) (OR = 1.59; 95% CI, 1.30–1.95; P<0.001).Data suggest that fat accumulation in the pancreas may lead to similar processes as in non-alcoholic steatohepatitis (NASH). Patel *et al*. demonstrated in 2013 [48] that higher pancreatic fat content correlated with a higher grade of hepatic steatosis in patients with biopsy-proven NAFLD, but did not correlate with body mass index (BMI) or DM. This study also demonstrated no difference in the distribution of fatty content among the pancreatic portions (head, body, and tail). Although pancreatic steatosis was reported as a clinical manifestation of metabolic syndrome, other research indicates that this condition might lead to beta-cell dysfunction, causing DM.

Importance of study

This study is important to have a reliable, noninvasive method for quantification of pancreatic fat by using unenhanced multidetectors computed tomography for abdomen.

The objectives

The objectives of this manuscript were to evaluate the diagnostic capacity of abdominal computed tomography in the assessment of pancreatic steatosis in diabetic patients.

MATERIALS AND METHODS

Samples

This study included 44 patients (26 diabetic Pt) that underwent CT examinations of the abdomen CT was performed with conventional sequences of unenhanced examination.

CT Positioning

All the patients lie supine on the examination couch. The body is adjusted so that the midsagittal line is perpendicular to the couch and the horizontal alignment light passes through the xiphoid. Straps and foam pads areused for immobilization.

CT Protocols and Techniques

CT was performed by using a (General electric GE Medical system, 128 detectors row scanner). The scanning and reconstruction parameters included tube voltage, 120 kVp; effective tube current-time product, 200 mAs; collimation, 16 × 1.5 mm; rotation speed, 0.5 second; pitch, 1.25; section thickness, 5 mm; and reconstruction interval, 4 mm.The conventional CT abdomen Protocols are selected to produce the scout images in the two planes (Lateral , AP “anterior-posterior”)Transverse images of the abdomen were obtained during the unenhanced phase and no oral or intravenous contrast was used .

A Spiral Scan Mode are used to avoid the Motion Artifacts from the involuntary movement of the abdominal organs The scan is performed with breath hold (suspended expiration) and cover the abdominal region (from bases of lungs to iliac crest).

METHOD OF EVALUATION

The data were collected from CT images using PACS (Picture archiving and communication system) from radiology measured the CT number of the pancreas and spleen.

CT analysis

All CT imaging was evaluated in the non-contrast phase by two blinded radiologists. Fatty infiltration (i.e. steatosis) of the pancreas, and spleen was assessed by attenuation, which was measured in Hounsfield units (HU). Pancreatic attenuation was measured in three ROIs with areas of 1.0 cm^2 in three different sections head, body and tail of the pancreas; CT attenuation in the spleen was measured The data were collected on the check lists analyzed using the crosstabs frequency tables of statistical computer program (SPSS).

CT images were acquired from normal and diabetic patient with standard clinical abdominal CT protocols utilizing a multi slice ct scanner. For diagnosis of the steatosis pancreas , it will appear hypodense compared with the spleen on CT scan (less than normal in CT number) .The difference between pancreatic and splenic attenuation and the pancreas-to-spleen attenuation ratio were calculated Samples are evaluated according to the age group and the percentage of the diabetes in the male and female .

RESULTS

Table-1: Distribution of Age groups by diabetic patient Status

		Patient status		Total	p
		Diabetic N0. %	non diabetic N0. %	N0. %	
Age groups	< 50 years	6 23.1%	10 55.6%	16 36.4%	.054
	50 - <60 years	8 30.8%	5 27.8%	13 29.5%	
	60 years and more	12 46.2%	3 16.7%	15 34.1%	
Total		26 100.0%	18 100.0%	44 100.0%	

Table 1: shows the age group distribution in the diabetic patients with significant different in the age group between (60 years and more) compared to non-diabetic patients with significant different in the age group between (<50 years).

Table-2: Distribution of gender by diabetic patient status

		patient state		Total	p
		Diabetic N0. %	non diabetic N0. %	N0. %	
sex	female	13 50.0%	4 22.2%	17 38.6%	.063
	Male	13 50.0%	14 77.8%	27 61.4%	
Total		26 100.0%	18 100.0%	44 100.0%	

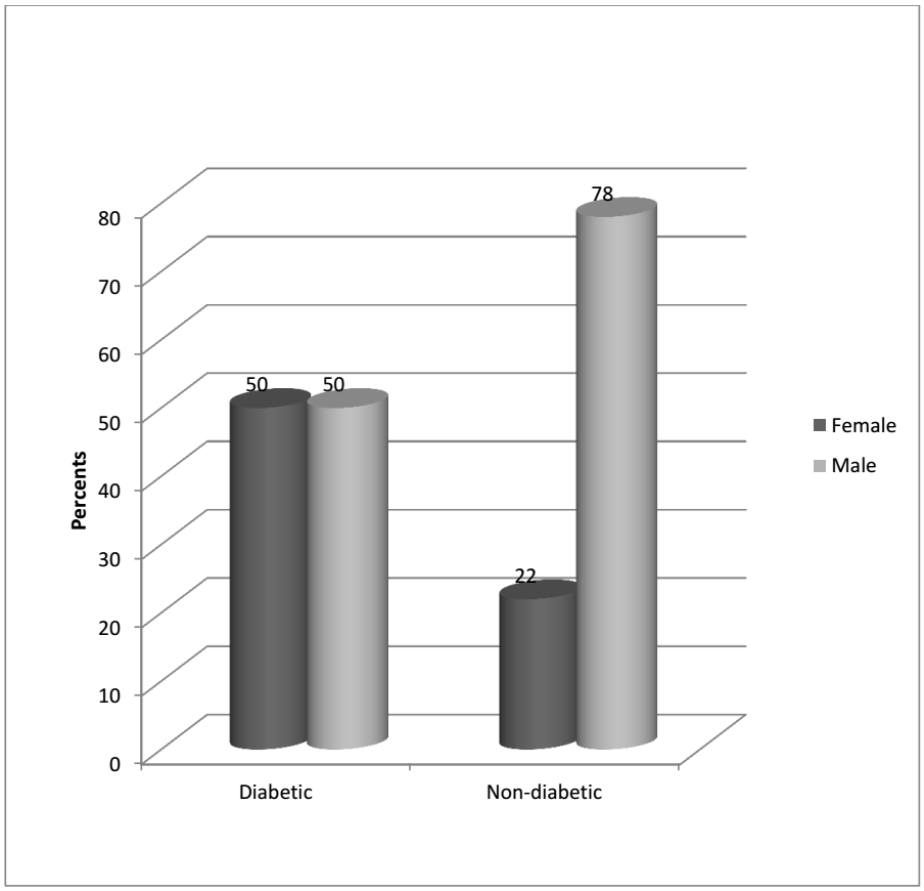

Fig-2: shows the distribution of gender in the diabetic patients

Table 2 and Fig.2 shows the distribution of gender in the diabetic patients compared to non-diabetic patients and there is no significant different between the male and female.

Table-3: Distribution of pancreas head CT number by measurement the density (HU) for diabetic patient status

		patient state		p
		Diabetic N0. %	non diabetic N0. %	
pancreas head CT number	25 HU	12 46.2%	1 5.6%	0.000
	30 HU	3 11.5%	5 27.8%	0.000
	35 HU	11 42.3%	12 66.7%	0.000
Total		26 100.0%	18 100.0%	.

Table3: shows the distribution of the pancreas head CT number with highest percentage in the diabetic patient in (25 HU) compared to highest percentage of non-diabetic patient in (35 HU).

Table-4: Distribution of pancreas body CT number by measurement the density (HU) for diabetic patient status

		patient state		**p**
		Diabetic N0. %	non diabetic N0. %	
pancreas body CT number	30 HU	11 42.3%	7 38.9%	.476
	33 HU	9 34.6%	9 50.0%	.466
	35 HU	6 23.1%	2 11.1%	.707
Total		26 100.0%	18 100.0%	

Table 4: shows the distribution of the pancreas body CT number (density) with no significant different in the diabetic patients and non-diabetic patients.

Table-5: Distribution of pancreas tail CT number by measurement the density (HU) for diabetic patient status

		patient state		p
		Diabetic N0. %	non diabetic N0. %	
pancreas tail CT number	30 HU	10 38.5%	7 38.9%	.998
	33 HU	10 38.5%	738.9%	.998
	35 HU	6 23.1%	422.2%	.957
Total		26 100.0%	18100.0%	

Table 5: shows the distribution of the pancreas tail ct number (density) with no significant different in the diabetic patients and non-diabetic patients.

Table-6: Distribution of spleen CT number by measurement the density (HU) for diabetic patient status

		patient status		p
		Diabetic Count %	non diabetic Count %	
spleen CT number	40 HU	1 3.8%	3 16.7%	.346
	45 HU	8 30.8%	5 27.8%	.347
	50 HU	17 65.4%	10 55.6%	.266
Total		26 100.0%	18 100.0%	

Table 6: and Fig3 show the distribution of the spleen CT number by measurement the density and there is no significant different between the diabetic patients and non-diabetic patients.

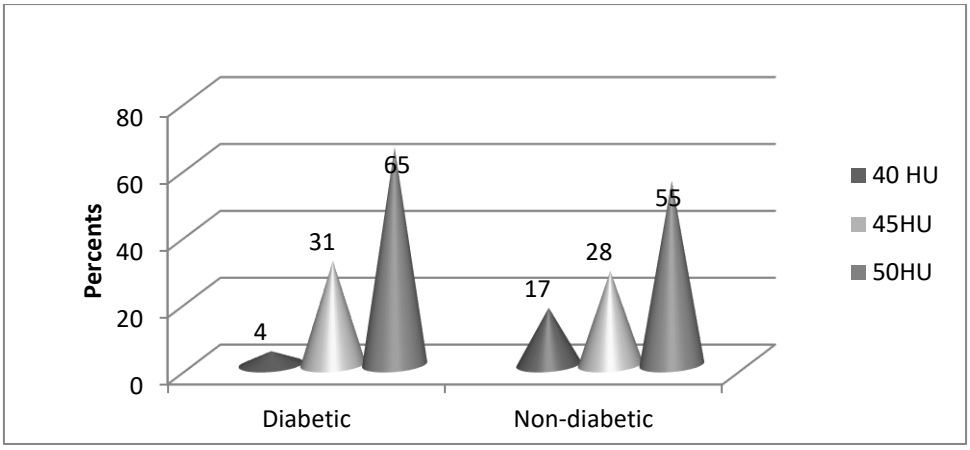

Fig-6: Distribution of spleen CT number by measurement the density (HU) for diabetic patient status

Table-7: Relation between pancreas head CT number (density) and spleen CT number (density) in the diabetic patients

		Spleen CT number			p
		40 HU Count %	45 HU Count %	50 HU Count %	
Pancreas head CT number	25 HU	1 100.0%	00.0%	2 11.8%	.054
	30 HU	00.0%	5 62.5%	7 41.2%	
	35 HU	00.0%	3 37.5%	8 47.1%	
Total		1 100.0%	8 100.0%	17 100.0%	

Table 7: shows the relation between the pancreas head ct number and spleen CT number with significant different among the diabetic patients

Table-8: Relation between pancreas body CT number and spleen CT number in the diabetic patients

		Spleen CT number			P
		40 HU Count %	45 HU Count %	50 HU Count %	
Pancreas body CT number	30 HU	0 0.0%	4 50.0%	7 41.2%	.392
	33 HU	0 0.0%	2 25.0%	7 41.2%	
	35 HU	1 100.0%	2 25.0%	3 17.6%	
Total		1 100.0%	8 100.0%	17 100.0%	

Table 8: shows the relation between the pancreas body ct number and spleen CT number with non-significant different among the diabetic patients.

Table-9: Relation between pancreas tail CT number and spleen CT number in the diabetic

		Spleen CT number			Total	P
		40 HU Count %	45 HU Count %	50 HU Count %	Count %	
Pancreas tail CT number	30 HU	00.0%	337.5%	741.2%	1038.5%	.792
	33 HU	1100.0%	337.5%	635.3%	1038.5%	
	35 HU	00.0%	225.0%	423.5%	623.1%	
Total		1100.0%	8100.0%	17100.0%	26100.0%	

Table 9: shows the relation between the pancreas tail ct number and spleen CT number with non-significant different among the diabetic patients.

CONCLUSION

Pancreatic steatosis is a common, benign pancreatic condition observed in clinical practice. Clinical knowledge of this condition is essential for gastroenterologists to be able to care for their patients. The study concluded that axial CT scan is considered as an appreciable radiological method for characterizing the pancreas structure using CT number (Hounsfield). Pancreatic steatosis is not due to the presence of diabetes but is highly associated with the metabolic syndrome.

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