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Assessment of Dimension and Density of Pancreas in Diabetic and Non diabetic patients in Computed Tomography

Rakesh Kumar Karna[1], Prakash Kayastha[2], Sharma Paudel[2], Sundar Suwal[2], Mukunda Prasad Humagain[2], Mukhtar Alam Ansari[2]

[1]Department of Radiology, Grande International Hospital, Dhapasi, Kathmandu

[2]Department of Radiology and Imaging, Tribhuvan University Teaching Hospital, Maharajgunj, Kathmandu

ABSTRACT

Introduction: Pancreatic fat content is negatively associated with insulin secretion. Thus, pancreatic size may vary in diabetics as compared to non-diabetics. Computed tomography (CT) can accurately measure pancreatic size and density. This study was aimed to measure density and thickness of pancreas in diabetic and non-diabetic individuals.

Methods: A prospective cross-sectional study was done in 226 individuals, 108 diabetics and 118 non-diabetics, who were sent for contrast enhanced CT. Weight and BMI of the individuals were recorded. Thickness and density of the pancreas of all the individuals were measured at head, body and tail regions. Density was measured in both non-contrast and contrast images. Mean, standard deviation and range of the pancreatic thickness and density were derived. Thus, derived data were compared in different gender and in diabetic and non-diabetic individuals.

Result: Among 226 individuals, 50% were male and 50% were female. Mean age of the subjects was 54.8 years with range of 21-78 years. Weight and BMI were significantly higher in diabetic individuals as compared to non-diabetics (p=0.008 and p =0.001 respectively). Thickness of the pancreas at all levels were significantly more in non-diabetics as compared to the diabetic individuals (p=0.0001). However, density of the pancreas at all levels was not significantly different in diabetic and non-diabetics.

Conclusion: We found smaller pancreatic size in diabetics as compared to non-diabetic individuals. Although increased pancreatic fat deposition was presumed in diabetics, no significant pancreatic density differences between diabetics and non-diabetics was observed in our study.

Keywords: Computed Tomography, Density, Diabetic,Non-diabetics, Pancreas Size

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Correspondence:
Prakash Kayastha.
Assistant Professor, Department of Radiology and Imaging, Tribhuvan University Teaching Hospital, Maharajgunj, Kathmandu
E-mail: rrjkuprakash@gmail.com.
Phone No: 9841223758, ORCID No 000-0002-8597-8344.
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INTRODUCTION

Type 2 diabetes mellitus (DM2) is caused by a combination of insulin resistance and decreased beta cell function.[1]Blood glucose levels do not rise unless pancreatic insulin secretory function has declined by approximately 50%, and the subsequent gradual deterioration of blood glucose control is related solely to declining beta cell competence.[2]Substantial amount of ectopic fat storage has been linked to insulin resistance and pancreatic fat content has been negatively associated with insulin secretion.[3,4]

Computed Tomography (CT) permits accurate non-invasive measurement of pancreas as it shows all parts of pancreas including the tail.[5]Nowadays imaging protocols have produced exact non-invasive measurements of pancreatic fat content in humans.[6]

The purpose of this study was to calculate the density and thickness of the pancreas in diabetic patients and non-diabetic patients.

METHODS

A prospective cross-sectional study was carried out in 226 subjects (108 diabetics and 118 non-diabetics) who were referred for contrast enhanced CT of abdomen for various clinical indications in the Department of Radiology and Imaging, Tribhuvan University Teaching Hospital, Kathmandu from July 2017 to October 2017. Diabetic group comprised of patients who were on regular treatment for diabetes for more than seven year period. Seven year period was chosen considering the long time required for morphologic changes to occur in the pancreas. Non-probability purposive sampling method was used.

The study was approved by the Institutional Review Board (IRB) of Institute of Medicine. All the subjects were explained about the study and written informed consent was obtained from each patient. The privacy and confidentiality of the subjects enrolled in this study were strictly maintained. All the subjects underwent CT on 128 slice Siemens Somatom definition AS+ machine with the standard protocol of the department. The subjects enrolled in the study were free of pancreatic pathology. Those subjects without precise delineation of pancreas from adjacent structures and with previous pancreatic surgery were excluded.

Anthropometric measurements (Weight and height)of all the subjects were recorded and Body Mass Indies (BMI) was derived. The thickness of the pancreas was measured at head, body and tail on the slice that demonstrated their thickest part. Density of pancreas was also measured in head, body and tail. Thickness was measured in contrast images and density was measured in both non-contrast and contrast images (portal venous phase).

Data was collected on an Excel spreadsheet (Microsoft Corp., Redmond, WA, USA) and analysis was done with Statistical Package for Social Studies (SPSS 23) (IBM Corp., New York, USA). The mean, standard deviation and range of pancreatic thickness and density were calculated. The independent-sample t-test was used to compare data obtained from male and female subjects; as well as data obtained in diabetic and non-diabetic subjects to check statistical significance at the p=0.05 level.

RESULTS

Among 226 subjects, 108 were diabetic [62 male (57.41%) and 46 females (42.59%)] and 118 were non-diabetic [61 male (51.69%) and 57 females (48.31%)].

Mean age of the subjects was 54.8 years (59.3 years in diabetic and 50.3 years in non-diabetic) with range of 37-78 years in diabetics and 21-78 years in non-diabetics. Mean values and the ranges of the age ,weight, height, BMI, thickness of pancreas and density of pancreas in diabetic and non-diabetic

subjects are given in the Table 1 and Table 2 respectively.

Table 1. Measurements of the variables in diabetic subjects. (n=108)

Parameters	Range	Min	Max	Mean	Std. Deviation
Age (Years)	41	37	78	59.305	10.447
Weight (Kg.)	40	50	90	67.451	8.531
Height(meter)	0.55	1.25	1.80	1.618	0.092
BMI(kg/m2)	20.70	20.90	41.60	25.817	3.107
APH (cm)	2.02	1.52	3.54	2.700	0.343
APB (cm)	1.60	1.50	3.10	2.362	0.370
APT (cm)	1.78	1.19	2.97	1.925	0.351
HDP (HU)	71	20	91	43.861	7.863
BDP (HU)	52.60	15.40	68	43.818	7.671
TDP (HU)	55	6	61	44.123	7.479
HDC (HU)	75	30	105	83.504	10.755
BDC (HU)	47	63	110	86.463	8.366
TDC (HU)	110	8	118	87.924	10.775

(APH- Anteroposterior diameter of head, APB - Anteroposterior diameter of body, APT - Anteroposterior diameter of tail, HDP - Head density in plain, BDP - Body density plain, TDP - Tail density plain, HDC - Head density contrast, BDC - Body density contrast, TDC - Tail density contrast)

Table 2. Measurements of the variables in non-diabetic subjects. (n=118)

Parameters	Range	Min	Max	Mean	Std. Deviation
Age (Years)	57	21	78	50.339	14.555
Weight (kg)	55	40	95	64.756	10.726
Height (meter)	0.39	1.46	1.85	1.618	0.088
BMI (kg/m2)	15.48	17.36	32.84	24.631	2.944
APH (cm)	2.54	1.56	4.10	3.128	0.392
APB (cm)	1.73	1.60	3.33	2.779	0.379
APT (cm)	2.10	1.13	3.23	2.259	0.317
HDP (HU)	29	26	55	42.637	5.469
BDP (HU)	38	22	60	44.494	5.744
TDP (HU)	33	23	56	46.129	5.650
HDC(HU)	69	62	131	84.079	9.312
BDC (HU)	64	62	126	86.350	8.984
TDC (HU)	66	61	127	87.912	8.605

(APH - Anteroposterior diameter of head, APB - Anteroposterior diameter of body, APT - Anteroposterior diameter of tail, HDP - Head density in plain, BDP - Body density plain, TDP - Tail density plain, HDC - Head density contrast, BDC - Body density contrast, TDC - Tail density contrast)

Weight and BMI in diabetic subjects were significantly higher than in non-diabetics (p=0.008 and p =0.001 respectively). Thickness of the pancreas at all levels (head, body and tail) were significantly more in non-diabetics than in diabetics (p=0.0001). However, density of the pancreas at all levels (head, body and tail) were not significantly different in diabetics and non-diabetics, both in non-contrast and contrast images (p>0.05).

DISCUSSION

Increased body fat is associated with increased risk of metabolic diseases, including type 2 diabetes mellitus, thus many patients with type 2 diabetes mellitus are overweight or obese.7Weight and BMI were significantly higher in diabetics in our study as well.However, there was no significant difference in height of diabetics and non-diabetics as in the study done byVeliCaglar et al.[8]

Pancreas is smaller in diabetic patients than in the non-diabetic and obese patients, whether or not the patients are diabetic.9Pancreas atrophy is particularly seen in type 1 diabetic patients. However, pancreas size may be variable in type 2 diabetics, although study done by Al-Mrabeh et al10 found significant reduction of pancreatic size in type 2 diabetics as well. Pancreas volume may play important role in clinical management of type 1 diabetics and may predict the prognosis as well. Pancreatic imaging with CT or magnetic resonance imaging (MRI) has availed precise measurement of the pancreas size and volume.11 Our study alsoshowedsignificantly smaller all parts of pancreas in diabetics compared to the non-diabetics. The decrease in the thickness of pancreatic body was greater compared to the pancreatic head and tail in our study.Similar findings were also seen in study done by Gilbeau et al.[9]

Pancreatic fat content affects insulin secretion; thus, diabetics may show increased lipid deposition in pancreas as compared to the non-diabetics. Recently available imaging protocols can accurately measure pancreatic fat content as well. Measurement of pancreatic density is an indirect form of pancreatic fat content measurement as fat rich structures are of low density in CT.6Tiago Severo Garcia et al6and Mavin Macauley et al12found significant decrease in pancreatic density due to increased fat content in the diabetic patients. However, there was no significant difference in pancreatic density between the diabetic and non-diabetic subjects in both plain and portal venous phase in our study. Similar findings was also seen in the study done by Gilbeau et al.9 It may be speculated to the fact that fat infiltration or increased fibrotic tissue may be observed in diabetic patients. On CT scans fat has a low attenuation while fibrosis has a high one, which might have been the reason for no difference in the pancreatic density between the diabetic and non-diabetic patients. The second reason behind our observation might be we didn't consider the duration of the diabetes, which is one of the limitations of this study. Another limitation of our study is non-separation of type 1 DM and type 2 DM subjects.

CONCLUSION

Our study showed smaller pancreas in diabetic subjects compared to the non-diabetic. The body of the pancreas appeared to be the most affected part of this organ. Smaller pancreatic size in diabetics may affect the treatment plan and prognosis. Although increased pancreatic fat deposition is observed in diabetics, our study didn't show significant difference of pancreatic density in diabetics and non-diabetics. This could be due to non-homogenous sample in our study.

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