Section: Radiodiagnosis

Original Research Article

ULTRA-SONOGRAPHIC EVALUATION OF PANCREAS AMONG TYPE 2 DIABETICS IN INDIA: A CASE-CONTROL STUDY

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Abstract

Background: Diabetes mellitus is a chronic metabolic disease with huge burden globally. The biggest challenge among physician in management of type 2 diabetes is the decision of switching over to insulin. The study aims to compare the pancreatic dimension and hyper-echogenicity of type 2 diabetic patients with normal individuals. The study also evaluated the correlation between dimensions of pancreas and duration of diabetes. Ultrasound measurements of the pancreatic head, body, and tail of both study groups were performed. Data analysis was done using Statistical Package for Social Sciences version 21. Statistical test was done with $p \leq 0.05$ considered statistically significant. **Materials and Methods:** A case-control study was done with 33 diabetics matched with 33 normoglycemic healthy controls for age and sex. **Result:** Pancreatic length of head, body and tail were lesser among diabetes patients than control group which was statistically significant. The mean anteroposterior diameter of the head, body and tail of pancreas of type 2 diabetes was 2.86 ± 0.39 cm, 1.73 ± 0.26 cm and 0.94 ± 0.23 cm respectively. There was negative correlation between pancreatic dimension and duration of diabetes. The proportion of patients with hyper-echogenicity of pancreas was more (39.3%) among diabetics than the control group (12.1%) which was also statistically significant. **Conclusion:** Ultrasound can be used as a screening test to identify patients with type 2 diabetes needing shift to insulin therapy.

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disorder which has emerged as a global health problem.[1] The total disease burden being 422 million people across the globe still raising and with 1.5 million deaths every year. The World Health Organization of Global Diabetes Compact launched amidst 100th anniversary of discovery of Insulin has commitment towards prevention of Type II Diabetes from obesity, unhealthy diet, physical inactivity and reduce premature mortality due to it by one third by 2030.[2] This major non-communicable disease is primarily due to pancreatic dysfunction, predominantly the islet cell dysfunction which is distributed more than 2-fold higher in the tail region, compared to head and body region.[3]

Loss of pancreatic parenchyma in due course results in diabetes mellitus, the pathophysiology of which is similar to well established pancreatogenic diabetes mellitus. [4] Moreover, loss of pancreatic tissue for both endocrine and exocrine function among diabetics in due course of over 10 years duration has also been well documented.[5] Patients with lesser pancreatic dimensions as well as those with fatty infiltration of pancreas are more likely to develop Diabetes Mellitus. It is cumbersome to do histopathological examination to assess the proportion of islet cells in living specimen or in cadaveric specimens. A simple, easy availability and affordable investigation of choice in living subjects being ultrasound of the abdomen. It also helps ruling out other structural or major space occupying causes for DM. Another added advantage being indication for the need of insulin for patients with significant decrease in pancreatic parenchyma.

Several studies have compared the volume and dimensions of pancreas to be smaller in DM than control groups, mostly focusing on type 1 DM. The present study aims to compare the pancreatic lengths (head, body and tail) and hyper-echogenicity of type 2 DM with non-diabetics. We also evaluated these

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pancreatic finding among type 2 DM with the duration of disease.

MATERIALS AND METHODS

The present analytical case-control study was done in the Department of Radiology of a tertiary care teaching hospital, Trichy during the period January to March 2020. Based on a previous study, the pancreatic tail diameter among the diabetes and control group was 1.12 ± 0.25 cm and 1.46 ± 0.54 cm respectively. Using this difference in diameter with power of 90% and confidence interval of 95% the sample size was calculated to be 66 using OpenEpi software. A case-control ratio of 1:1 was taken with 33 cases of type 2 diabetes and 33 matched controls.

The pancreatic measurements were taken using GE Logiq P9 Ultrasound system (C1-5-RS) using convex transducer of 3.5 MHz. Cases were patients aged more than 18 years and diagnosed with type 2 diabetes for more than 1 year who were included in the study. Those patients with any pancreatic abnormality such as pancreatitis, pancreatic tumors, thalassemia, liver cirrhosis or any metabolic abnormality were excluded. Pancreatic echogenicity was compared with that of liver to identify hyper-echogenicity, which was taken as a proxy for fat deposition. Controls were patients who had no known history of pancreatic or metabolic disorder, recent random blood sugar within normal limits and no history of any antidiabetic drug intake. Cases and controls were matched for age and sex. The study was undertaken only after obtaining institutional ethical committee certificate.

Data collection and analysis was done using Statistical Package for Social Sciences (SPSS) software (version 21, SPSS, Inc, Chicago, IL, USA). Independent sample t-test was used to assess any significant difference in the mean pancreatic lengths of head, body and tail between the cases and control. Pearson correlation analysis was used to assess the correlation between the pancreatic dimensions of cases with the duration of diabetes. A p value of <0.05 was considered to be statistically significant.

RESULTS

The baseline characteristic of both the control and type 2 DM group was similar in term of age, sex and BMI with no statistically significant difference (p>0.05), thus making them comparable. The mean HbA1c of type 2 DM was 7.07± 0.82 while that of controls was 5.22 ± 0.28 which was statistically significant. Mean duration of diabetes among the cases was 7.57 ± 4.8. [Table 1]

Mean anteroposterior values of pancreatic head, body and tail of controls was 3.03 ± 0.33 cm, 1.82 ± 0.23 and 1.18 ± 0.15 respectively while that of type 2 diabetes was 2.86 ± 0.39 cm, 1.73 ± 0.26 cm and 0.94 ± 0.23 cm. All mean values of pancreas were lesser among type 2 diabetes than controls, but only the anterior-posterior length of the tail was found to be statistically significant (p=0.00) using independent sample t- test. Hyper-echogenic pancreas was seen among 13 (39.3%) patients of type 2 diabetes and 4 (12.1) among the control group. This difference in proportion was statistically significant on chi-square test (p=0.04). [Table 2]

A negative correlation was found between all the pancreatic measurements and duration of diabetes which was statistically significant. [Table 3]

Table 1: Demographic profile of study participants

Variables	Controls	Type 2 DM	p value
Age (years), mean ± SD	49.41 ± 8.45	49.18 ± 9.33	1.36
Sex			
Female (n, %)	10 (47.6)	11 (52.4)	1.00
Male (n, %)	23 (51.1)	22 (48.9)	
BMI (kg/m2), mean ± SD	25.46 ± 4.6	26.09 ± 3.7	0.14
HbA1c (%), mean ± SD	5.22 ± 0.28	7.07 ± 0.82	0.00*
Duration of DM (years), mean ± SD	-	7.57 ± 4.8	-

SD- Standard Deviation, DM- Diabetes, n-Frequency, BMI- Body Mass Index, *-Statistically significant

Table 2: Comparison of pancreatic findings using Ultrasound between type 2 DM and control group

Variable	Controls (mean ± SD)	Type 2 DM (mean ± SD)	p value
AP length of pancreatic head (cm)	3.03 ± 0.33	2.86 ± 0.39	0.07
AP length of pancreatic body (cm)	1.82 ± 0.23	1.73 ± 0.26	0.30
AP length of pancreatic tail (cm)	1.18 ± 0.15	0.94 ± 0.23	0.00*
	n (%)	n (%)	
Hyper-echogenicity pancreas (n, %)	4 (12.1)	13 (39.3)	0.04*

*-Statistically significant, AP-Anteroposterior, n-frequency

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Table 3: Correlation between duration of type 2 DM with pancreatic measurements

Variable	Correlation coefficient (r)	p value
Pancreatic head	-0.541	0.001*
Pancreatic body	-0.498	0.003*
Pancreatic tail	-0.675	0.000*

*-Statistically significant

DISCUSSION

Diabetes management has multiple components including diet, physical activity, oral hypoglycaemic drugs and insulin. The most challenging part for a physician in treating type 2 diabetes is to decide on adding insulin in the routine medication. ADA guidelines recommends insulin only after failure of triple combination drugs in type 2 DM patients with uncontrolled HbA1c level.[5] Research states that any individual with decreased pancreatic islet proportion has decreased insulin production. [6,7,8] Thereby identifying insulin dependent / deficient individuals becomes essential for early initiation of insulin therapy. The role of ultrasound in detecting such insulin deficient individual by measuring their pancreatic size has been emphasized.

The mean age of type 2 diabetes patients in our study was 49.18 ± 9.33 years with a mean BMI of 26.09 ± 3.7. Agabi et al and Azza et al had also done their study among similar patients.[9,10,11] The mean AP diameter of head, body and tail among the control group was 3.03cm, 1.82 cm and 1.18 cm respectively. Previous studies have also documented similar results. All the pancreatic measurements of type 2 DM were lesser than that of control group, but only the dimensions of AP length of the tail was found to be statistically significant ($p<0.05$) similar to other studies.[10,11] But a study by Safa et. al. found only AP diameter of tail among diabetes to be statistically significantly lesser than the controls. But this study had compared type 1 DM among the adolescent age group. Maria et al,[12] in their study had compared the pancreatic dimension among insulin dependent DM (IDDM), non-insulin dependent DM (NIDDM) and normal individuals. This study reported that the pancreatic diameters of head, body and tail of IDDM were lesser than NIDDM and controls. It was also highlighted that the decrease in dimensions of IDDM was more prominent after 10 years of disease. Alzaid et al,[13] demonstrated that the size of pancreas of type 2 DM was related to their basal insulin secretion level. Those with lower or undetectable C-peptide had smaller pancreas than those having normal insulin secretion. This provides evidence that decrease in the pancreatic dimensions could be an indicator to start on insulin therapy.

Fatty infiltration of the pancreas along with the liver has been implicated in type 2 DM due to insulin resistance. This is accompanied by visceral adiposity and inflammatory changes. Though MRI can easily detect the increased fat deposition and the irregular border of pancreas among type 2 diabetic individuals, ultrasound is a cost-effective alternative with no radiation exposure in identifying these changes. Hence qualitative evaluation of the pancreas is equally important than the mere size estimation.[14,15] In our study 39.3% of patients belonging to type 2 DM had hyper-echogenicity of pancreas while only 12.1% had among the control. This difference was also statistically significant. A meta-analysis of pancreatic size and fat content in diabetes found increased fat content with reduced pancreatic size among type 2 diabetics.[16] Maria et al,[12] found a much higher percentage of hyper-echogenicity i.e 83.3% of NIDDM. The mean duration of diabetes among this study group was 13.0 ± 9.3 years which could be reason for increased echogenicity.

A negative correlation was documented between the dimension of head, body and tail of pancreas with duration of diabetes in the present study. Chavva et. Al,[17] and Azza et al,[11] also documented similar findings. Safa et al,[9] in their study found a weak negative correlation between pancreatic head and tail but not the body. Agabi et al,[10] found no significant correlation between pancreatic head length of diabetics and duration of illness, but found negative correlation for body and tail of pancreas with duration of illness. Varied results have been obtained across different studies, except for tail dimension of pancreas which has shown consistent decrease with increase in duration of diabetes. Thus consistent with results of previous studies that the islet cell density is maximum at the tail region than head and neck which is affected in diabetes patients.[4,18]

CONCLUSION

Based on findings of this study we can conclude that the pancreatic lengths of head, body and tail of type 2 diabetics are lesser than normal individuals which is negatively correlated with the duration of diabetes. The fat content of pancreas among types 2 diabetics is also more when compared to normal individuals. Hence, we may use ultrasonography of pancreas as a screening tool to detect individuals on need of insulin therapy for better control of type 2 DM.

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