ORIGINAL RESEARCH

Comparative Study of Pancreatic Size in Diabetic and Non-Diabetic Individuals (Age 35-65 Years)by Ultrasound Sonography

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ABSTRACT
Background &Objectives: Diabetes mellitus is the collective term for disorders affecting glucose homeostasis. The pancreas is situated in the retroperitoneum within the anterior pararenal fascial space, positioned anteriorly to the aorta and inferior vena cava. Specifically, the pancreas is commonly located just below the origin of the superior mesenteric artery (SMA). Ultrasound imaging serves as a valuable tool for acquiring detailed information about the pancreas, encompassing factors such as pancreatic size, echotexture, ductal anatomy, and the surrounding structures. This imaging modality not only facilitates diagnostic evaluations but also allows for interventional procedures, all accomplished efficiently within a brief timeframe and at a minimal cost.**Methods:**150 healthy adults as controls and 150 diabetic patients of age group 35-65 years were evaluated by ultrasound sonography. **Results:**The mean pancreatic head, body and tail size is 2.01±0.38cm, 1.26±0.18cm and 2.26±0.32 cm respectively in diabetic participants while in controls it is 2.40±0.13 cm, 1.59±0.17 cm and 2.50±0.32. This showed a significant decrease in pancreatic head size in diabetic individuals.**Conclusions:**Diabetic individuals exhibit smaller pancreases compared to normal controls.
Key words: Diabetic Mellitus, Echotexture, Pancreas, Retroperitoneum, Superior Mesenteric Artery, Ultrasound Sonography.

INTRODUCTION

In ancient times, the pancreas received little attention, both as an organ and as a potential source of diseases.[1] Situated in the upper abdomen, behind the stomach, the pancreas lies transversely, slightly obliquely, on the posterior abdominal wall across the lumbar (L1-2) spine. It is enveloped by neighbouring organs such as the small intestine, liver, and spleen. With a spongy texture, it spans about six to ten inches and takes on the shape of a flat pear or a horizontally extended fish.[2]

Based on its anatomical relationships, the pancreas is divided into the head, neck, body, tail, and uncinate process.[3]

The antero-posterior dimensions in orientation for the pancreas are as follows: the head measures 2.5 cm, the body 1.5 cm, the tail 3.5 cm, and the pancreatic duct is less than 2.5 mm.[4]

Diabetes mellitus is the collective term for disorders affecting glucose homeostasis.[5]The underlying mechanisms of diabetes are closely linked to insulin levels in the body and the body's capacity to utilize insulin. Type 1 diabetes is characterized by a complete absence of insulin, whereas in type 2 diabetes, peripheral tissues resist the effects of insulin.[6]The development of type 1 diabetes, involving the loss of beta cells, is a consequence of autoimmune-mediated destruction of islet beta cells, influenced by intricate interactions between genetic predispositions and environmental factors. Unlike the distinct alterations in islet morphology and immune infiltration observed in type 1 diabetes, there is no standardized pancreatic histology associated with type 2 diabetes.[7]

Ultrasound imaging serves as a valuable tool for acquiring detailed information about the pancreas, encompassing factors such as pancreatic size, echotexture, ductal anatomy, and the surrounding structures. This imaging modality not only facilitates diagnostic evaluations but also allows for

interventional procedures, all accomplished efficiently within a brief timeframe and at a minimal cost.[8]

The advantages of ultrasound are notable, as it is readily accessible, cost-effective, portable, and does not involve ionizing radiation. Its widespread availability makes it a convenient choice for various medical settings, contributing to its popularity. Additionally, the portability of ultrasound equipment enhances its versatility and utility in different clinical scenarios.[9]

MATERIALS AND METHODS

This is Retrospective study which spanned over a period of fourteen months from September 2022 to November 2023.

This study was conducted at the Department of Radiology, Jawahar Lal Nehru Medical College and Associated Group of Hospitals, Ajmer, Rajasthan.

Computing Sample Size

Sample Size:Minimum 100

$n = z^2 \times p(1 - p)/E^2$

z = z score = 1.96

p = prevalence = 6% (Rajasthan)

E = Margin of error = 5%

N = 87 ~ 100

The current sample size used in the study is 150 to increase the accuracy of the study and decrease errors. The study was conducted on 150 healthy adults as normal population volunteers who were in the hospital for reasons other than health such as patient relatives, hospital staffs etc., and 150 diabetic patients from medicine OPD and wards.

Inclusion Criteria

- Healthy adult males and females aged 35-65 years.
- Diabetic patient males and females aged 35-65 years.

Exclusion Criteria:

- Subjects below 35 years of age and above 65.
- Clinical history suggestive of pancreatic or liver disease e.g jaundice, pancreatitis and epigastric pain.
- Presence of systemic or metabolic disease.
- Major anatomic variation of the pancreas.
- Pregnant women.
- Individuals having history of intake of drugs for long period of time.
- Subject that cannot withstand 6-8 hours fasting for whatever reason.
- History of recent barium meal study.

Approval to carryout the study was obtained from the institutional ethical committee of Jawahar Lal Nehru Medical College and associated group of hospitals, Ajmer, Rajasthan. Informed consent was obtained from all the subjects after the procedure was thoroughly explained to them.

A high-resolution real-time ultrasound scanner (SAMSUNG HS70A) equipped with a 2.5MHz to 5MHz frequency probe was used for the examination. Subjects underwent examination in various positions—supine, right anterior oblique (RAO), left anterior oblique (LAO), or upright—based on the optimal visualization of the organ. The examination involved transverse upper epigastric sections for detailed visualization of the pancreas, especially its head and tail.

To obtain the best ultrasound windows, different approaches were employed, such as using high epigastric sections to avoid the colon, employing transgastric sections, and utilizing sections that utilized the left liver lobe as an acoustic window. For transgastric sections, it was crucial to ensure that the stomach did not contain air or, alternatively, was filled with fluid to serve as an "acoustic ultrasound window" for the pancreas.

Data management and statistical analysis was performed using SPSS 27.0packages. Subject characteristic and result were reported as mean$\pm$standard deviation. Normal distribution values for the pancreatic head, body and tail were expressed as mean$\pm$standard deviation.

OBSERVATIONS AND RESULTS

The data collected from these were subjected to statistical analysis. 33% of the participants are in the age range of 31-40 years, while 44% fall into the 41-50 age group, and 23% are in the 51-60 age bracket.

59% of the participants were male, while 41% were female, resulting in a male-to-female ratio of 1.43:1.

Participants aged 31-40 years exhibited a mean pancreatic head size of 2.32 cm, followed by those aged 41-50 years with a mean of 2.18 cm, 51-60 years with 2.09 cm, and 61-70 years with 2.48 cm. The overall mean pancreatic head size among 300 participants was 2.21 cm. Consequently, there is a noticeable decrease in pancreatic head size as age increases, and this trend is statistically highly significant.

Participants aged 31-40 years demonstrated a mean pancreatic body size of 1.50 cm, followed by those aged 41-50 years with a mean of 1.43 cm, 51-60 years with 1.32 cm, and 61-70 years with 1.78 cm. The overall mean pancreatic body size among 300 participants was 1.43 cm. Thus, indicating a decrease in pancreatic body size with advancing age, which is statistically highly significant.

Participants aged 31-40 years showed a mean pancreatic tail size of 2.50cm, followed by those aged 41-50 years with a mean of 2.39cm, 51-60 years with 2.19cm, and 61-70 years with 2.28cm. The overall mean pancreatic tail size among 300 participants was 2.38cm. Thus, indicating a decrease in pancreatic tail size with advancing age, which is statistically highly significant.

Hence, pancreatic size diminishes as age progresses.

The average pancreatic head size among male participants is 2.20 cm, while for female participants,

it is 2.21 cm. Thus, there appears to be no notable correlation between participants' gender and pancreatic head size.

The average pancreatic body size among male participants is 1.43 cm, while for female participants, it is also 1.43 cm. Thus, there is no discernible correlation between participants' gender and pancreatic body size.

The average pancreatic tail size among male participants is 2.39 cm, while for female participants, it is 2.37 cm. Therefore, there is no apparent correlation between participants' gender and pancreatic tail size.

Pancreatic size is not associated with the gender of the individual.

The average pancreatic head size among diabetic participants is 2.01 cm, while for normal participants, it is 2.40 cm. This suggests a statistically highly significant decrease in pancreatic head size among diabetic individuals (table 2).

The average pancreatic body size among diabetic participants is 1.26cm, whereas for normal participants, it is 1.59cm. This indicates a statistically highly significant decrease in pancreatic body size among diabetic individuals (table 3).

The average pancreatic tail size among diabetic participants is 2.26cm, while for normal participants, it is 2.5cm. This indicates a statistically highly significant decrease in pancreatic tail size among diabetic individuals (table 4).

Notably, diabetic individuals exhibit smaller pancreas compared to normal controls.

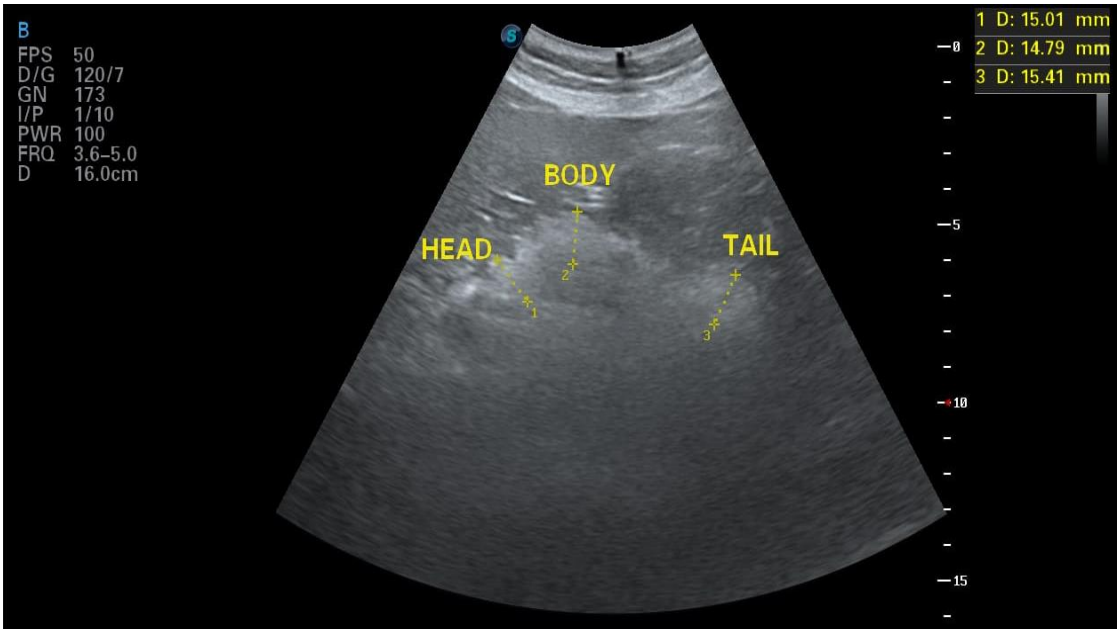

Fig 1: Ultrasound Measurement of Pancreas Head, Body and Tail of Control Participant

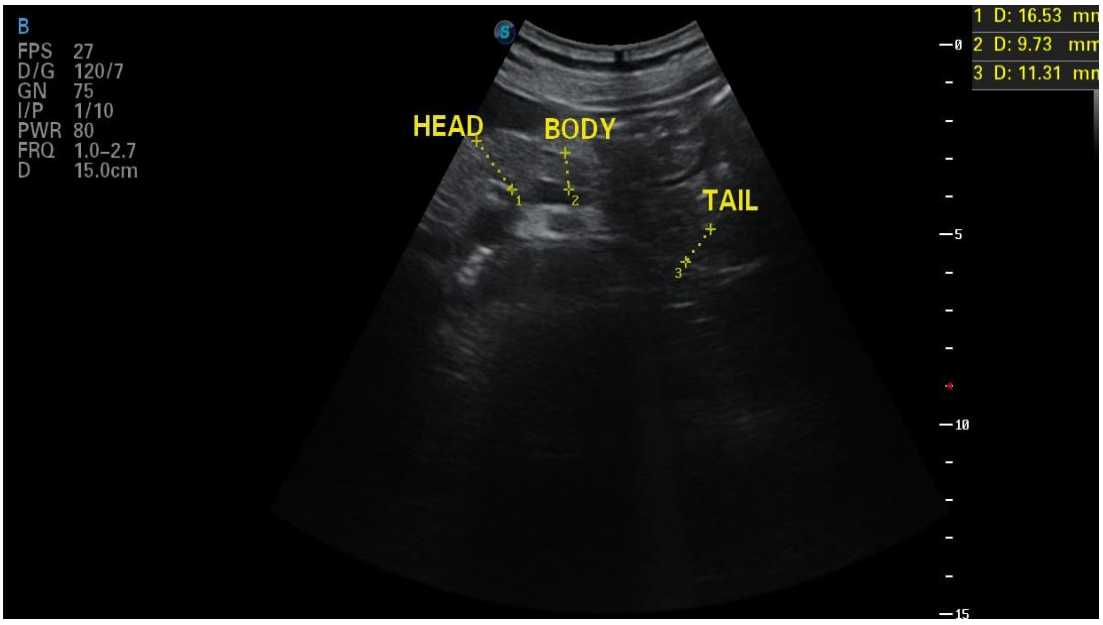

Fig 2: Ultrasound Measurement of Pancreas Head, Body and Tail of Diabetic Participant

Table 1: Comparison of Age with Pancreatic Size

Pancreatic Size	Age Group (years)	Number	Mean (cm)	S.D	P value	Significance
Head	**31-40**	98	2.32	0.27	<0.001	HS
	41-50	133	2.18	0.37		
	51-60	68	2.09	0.35		
	61-70	1	2.48	0.0		
	Total	300	2.21	0.34		
Body	**31-40**	98	1.50	0.28	<0.001	HS
	41-50	133	1.43	0.23		
	51-60	68	1.32	0.14		
	61-70	1	1.78	0.0		
	Total	300	1.43	0.24		
Tail	**31-40**	98	2.50	0.29	<0.001	HS
	41-50	133	2.39	0.34		
	51-60	68	2.19	0.25		
	61-70	1	2.28	0.0		
	Total	300	2.38	0.32		

Table 2: Comparison of Pancreatic Head Size in Diabetic and Normal Participants

Pancreatic Size	Variable	Number	Mean (cm)	S.D	P value	Significance
Head	**Normal**	150	2.40	0.13	<0.001	HS
	Diabetic	150	2.01	0.38		

Table 3: Comparison of Pancreatic Body Size In Diabetic And Normal Participants

Pancreatic Size	Variable	Number	Mean (cm)	S.D	P value	Significance
Body	**Normal**	150	1.59	0.17	<0.001	HS
	Diabetic	150	1.26	0.18		

Table 4: Comparison of Pancreatic Tail Size In Diabetic And Normal Participants

Pancreatic Size	Variable	Number	Mean (cm)	S.D	P value	Significance
Tail	**Normal**	150	2.50	0.29	<0.001	HS
	Diabetic	150	2.26	0.32		

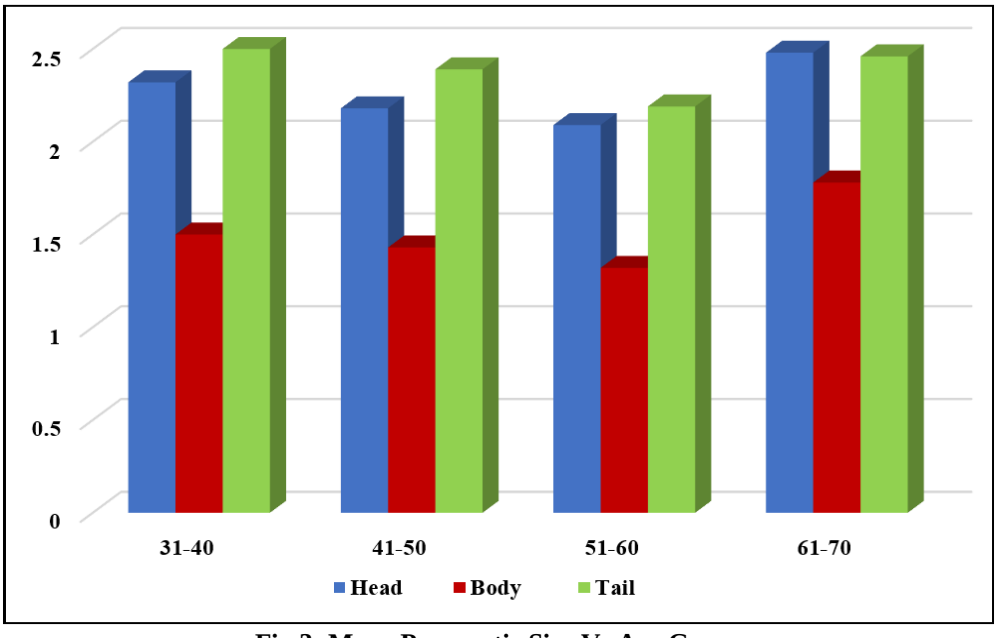

Fig 3: Mean Pancreatic Size Vs Age Group

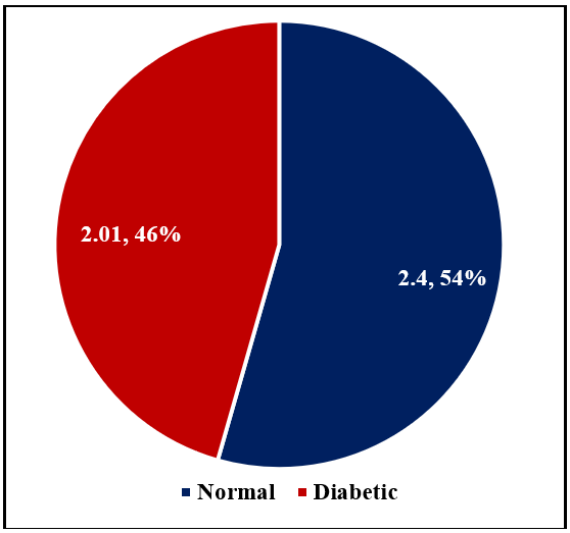

Fig 4: Comparison of Mean Pancreatic Head Size in Diabetic and Normal Participants

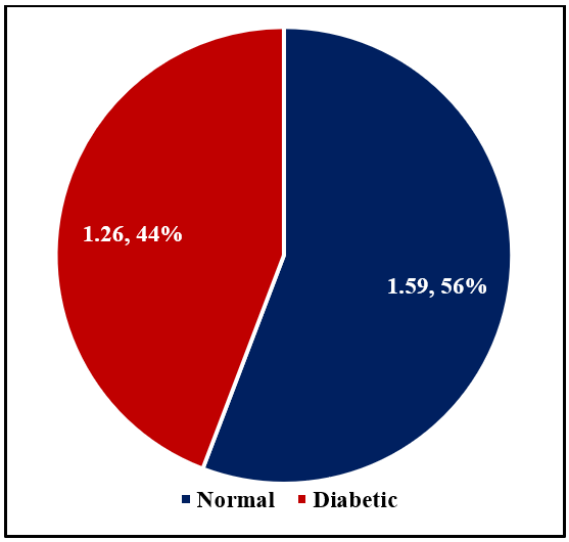

Fig 5: Comparison of Mean Pancreatic Body Size In Diabetic And Normal Participants

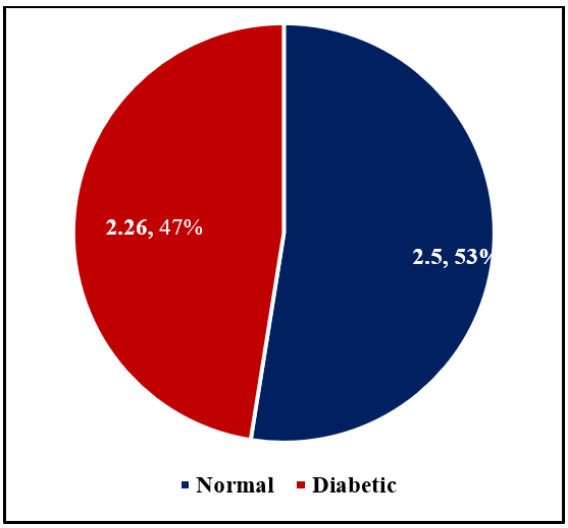

Fig 6: Comparison of Mean Pancreatic Tail Size In Diabetic And Normal Participants

DISCUSSION

A notable discussion point is the potential link between pancreatic atrophy and diabetes. Research suggests individuals with diabetes may have smaller pancreases compared to non-diabetics, indicating a potential role of pancreatic morphology in diabetes

development and progression. This observation raises questions about pancreatic atrophy as a biomarker for disease progression.

Like other investigations in this area, anterior-posterior diameter of head, body and tail of the pancreas had significantly diminished in the diabetic group compared with healthy controls.

This study highlights significant alterations in pancreatic head, body, and tail sizes among diabetic individuals compared to controls. Specifically, diabetic participants exhibited a notable decrease in mean pancreatic head, body, and tail sizes when compared to non-diabetic individuals. These changes were observed to correlate with factors such as age. However, no significant correlations were found between pancreatic size and gender.

The findings of this study are consistent with previous research by Izhar Ud Din et al. and Azza S. Khalaf et al., further supporting the notion of pancreatic size reduction in diabetic individuals.[10, 11]

Such insights may contribute to a better understanding of the pancreatic changes associated with diabetes, potentially aiding in early detection and management strategies for this condition.

Further research is warranted to explore the underlying mechanisms and clinical implications of these associations.

LIMITATIONS

1. Gaseous distention of the stomach, duodenum and colon provides difficulty in visualization of the pancreas. This was overcomed by asking the subjects to take water to eliminate air in the stomach and duodenum.
2. In obese participants the pancreas is difficult to visualize

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