ORIGINAL RESEARCH

Evaluation of morphology, anatomical variation and volume of pancreas in North Indian population using MDCT

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ABSTRACT
Aim: The purpose of this study is to demonstrate the normal anatomy of the pancreas and its variations on CT as to aid to correct diagnosis of various pancreatic pathologies. **Materials and Method**: All the patient coming to the department of radiodiagnosis aged 21 to 70 years with the possibility of correct identification and exact isolation of the pancreas from the adjacent structures were included in the study.Patients with CT evidence of pancreatitis or clinical history of pancreatitis,pancreatic cancer, history of pancreatic surgery or trauma, poor image quality due to motion artifacts, patients with splenomegaly or lesions of the left adrenal or left kidney exerting mass effect in the pancreatic body or tail region were excluded.Convenient sampling was used and the sample size of497 was achieved. **Results**: The normal range of AP diameter of head was 20 - 29 mm, AP diameter of body 14- 25mm, and AP diameter of tail 13-20mm The normal range of volume of pancreas was 43 cm-- 86cm^3. The normal range of A-P diameters of head, body and tail was from (20-29) mm, (14-25) mm, and (13-20) mm respectively. With age, an increasing reduction in the anterior posterior diameters of pancreatic head, body and tail could be seen (table 3). The normal range of pancreatic volume was (43-86cc). The average pancreatic volume was slightly higher in males than in females for a particular age group. The volume of pancreas also showed correlation with anatomical variants with a p value of (0.013).**Conclusion**: Normograms from this data can be used for north indian ethnic population to allow radiologists to estimate more accurately the degree of atrophy or hypertrophy of organs in certain disorders thus , avoid false positive and false negative diagnosis of pathological enlargement or reduction of pancreas in clinical practice.
Keywords: Normograms, pancreatic volume. Splenomegaly.

INTRODUCTION
The pancreas is a retroperitoneal organ located at the anterior pararenal space of retroperitonium. Pancreatic pathologies have a variety of presentations, which make their diagnosis challenging to physicians. Imaging plays a critical role in the evaluation of pancreatic diseases and provides valuable information to clinicians, thereby dictating crucial management decisions.[1]
Detailed visualisation and definition of deeper and smaller structures and of subtle changes in density of the normal and abnormal pancreas are possible with images generated by multidetector computed tomography scanners (MDCT). Computed tomography diagnosis depends not only changes in size and shape of organs but also on x-ray attenuation of various tissues. However ,variation of contour and configuration of an organ remain the main problem in the inter pretaion of CT.
A knowledge of normal anatomy and its variation is therefore a pre requistie for successful diagnosis. The new factor is, of course, the sections are in the axial plane viewed from cranio-caudal direction henceforth a detailed knowledge of the axial anatomy now becomes essential to radiological practice[2].
The purpose of this study is to demonstrate the normal anatomy of the pancreas and its variations on CT as to aid to correct diagnosis of various pancreatic pathologies.

MATERIAL AND METHODS

An observational cross sectional study was conducted in GSVM Medical College, Kanpur with the approval of institutional ethical committee from January 2021 to October 2022. All the patient coming to the department of radiodiagnosis aged 21 to 70 years with the possibility of correct identification and exact isolation of the pancreas from the adjacent structures were included in the study.Patients with CT evidence of pancreatitis or clinical history of pancreatitis,pancreatic cancer, history of pancreatic surgery or trauma, poor image quality due to motion artifacts, patients with splenomegaly or lesions of the left adrenal or left kidney exerting mass effect in the pancreatic body or tail region were excluded.Convenient sampling was used and the sample size of497 was achieved. Data was analysed using the SPSS version 20 software. Descriptive statistics were reported as mean (SD) for continuous variables and frequency (percentage) for categorical variables. Pearson's Chi-square test was used to find association between two categorical variables. A p value< 0.05 was considered as statistically significant.

ASSESSMENT OF PANCREATIC VOLUME

In axial image of the venous phase, the pancreas was segmented manually on each section to define the region of interest (ROI) using GE healthcare workstation software .Peripheral fat and blood vessels were avoided as much as possible. The pancreatic volume was determined by joining all ROI.
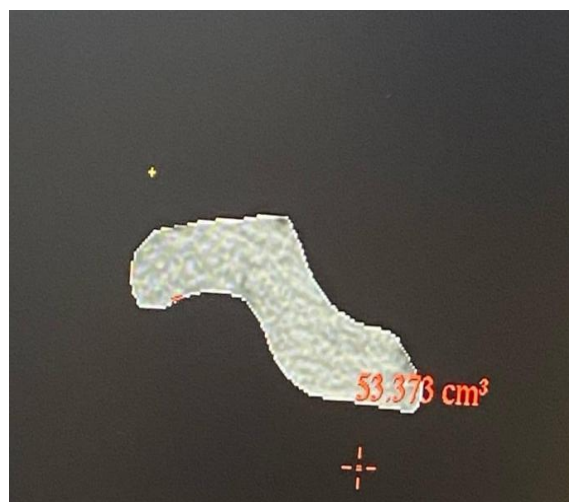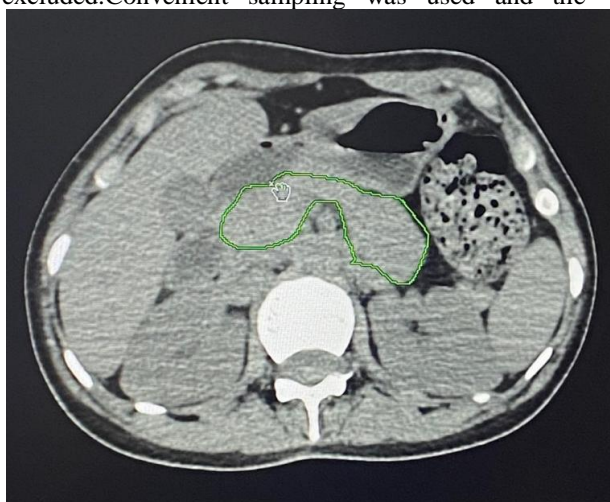
ASSESSMENT OF OTHER PARAMETERS

The diameters of anterior - posterior (AP) tail and (AP) body were measured from the lienal vein to the anterior contour of the pancreas ; and the diameter of (AP) head was measured at the level at which both the superior mesentry vein and artery were observed Image .

CONTOUR VARIATIONS OF PANCREAS
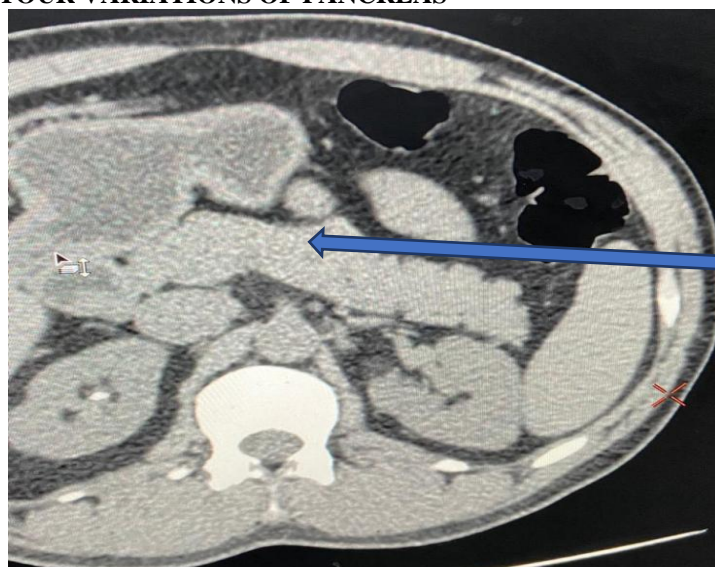
Anterior protrusion from the body of pancreas

The tail of the pancreas shows contour variation of bifid variety.

Globular pancreatic tail
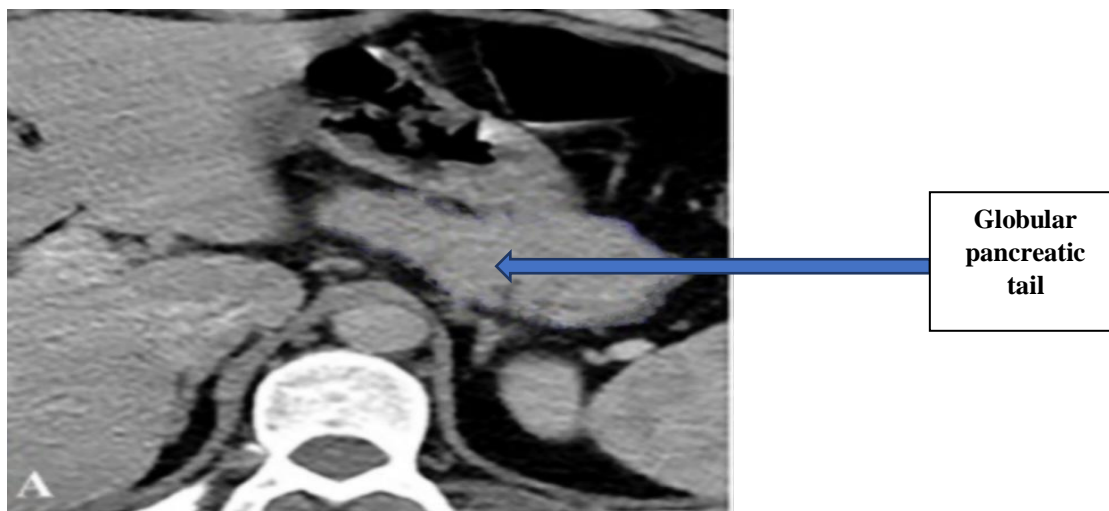
RESULTS

Table 1: Distribution of cases according to age of the patient (N = 497)

Age of the patient	Number of cases
21 – 30	93 (18.71%)
31 – 40	156 (31.38%)
41 – 50	118 (23.74%)
51 – 60	92 (18.51%)
61 – 70	41 (8.24%)
Mean age of the patient in years (SD)	42.03 (12.17)

Mean age of the study participants was 42.03±12.17 years. 31.3% of the study participants were 31-40 year old , 118(23%)were 41-50 year old,92(18%)were 51-60 year old , 93(18%) patients were 21 -30 years old 41(8.2%)were 61-70 year old (Table 1).

Figure 1: Distribution of cases according to sex of the patient. (N = 497)

Distribution of cases according to sex of the patient
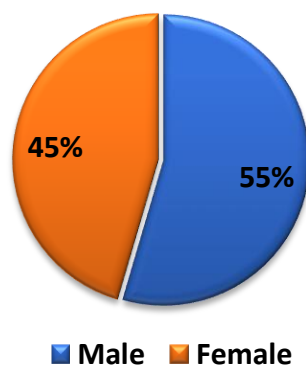
In our study 271 (54%) patients were male and 226 (45%) were female (Figure1)

Table 2: Mean parameters of pancreas as visualised on MDCT (N = 497)

	Mean(mm)(SD)	Range(mm)
AP diameter of Head of pancreas	24.05 (1.73)	20.0 – 29.0
AP diameter of Body of pancreas	18.80 (2.01)	14.0 – 25.0
AP diameter of Tail of pancreas	16.33 (1.57)	13.0 – 20.0
Volume of pancreas	66.24 (7.65)	43.00 – 86.00(cc)

The normal range of AP diameter of head was 20 - 29 mm, AP diameter of body 14- 25mm, and AP diameter of tail 13-20mm The normal range of volume of pancreas was 43 cm-- 86cm3 (Table 2).

Table 3: Range of values according to age

Age of the patient	AP diameter of Head of pancreas(mm)	AP diameter of Body of pancreas(mm)	AP diameter of Tail of pancreas(mm)	Volume of pancreas(cc)
21 – 30 years	23 - 29	18 - 25	15 - 20	63 - 86
31 – 40 years	21 - 29	16 - 24	14 - 20	43 - 80
41 – 50 years	21 - 26.8	15 - 22	13 - 19.8	52 - 77
51 – 60 years	20 - 26	15 - 23	13 - 17	49 - 74
61 – 70 years	20 - 25.7	14 - 22.7	13 - 17	49 - 74

The normal range of A-P diameters of head, body and tail was from (20-29) mm, (14-25) mm, and (13-20) mm respectively. With age, an increasing reduction in the anterior posterior diameters of pancreatic head, body and tail could be seen (table 3). The normal range of pancreatic volume was (43-86cc). The average pancreatic volume was slightly higher in males than in females for a particular age group. The volume of pancreas also showed correlation with anatomical variants with a p value of (0.013).

Table 4: Distribution of cases according to anatomical variation (N = 497)

Anatomical variation	Number of cases
Normal anatomy	495 (99.59%)
Pancreatic divisum	1 (0.2%)
Partial agenesis of tail	1 (0.2%)

Out of 497 patients, only two cases of anatomical variations was found. One of pancreatic divisum and other partial agenesis of tail. (Table 4) These anatomical variations did not showed any significant correlation with pancreatic Anterior – posterior diameters (p value 0.645), however a significant correlation with volume of pancreas was found (p value 0.013).

DISCUSSION

In this study we found that the mean pancreatic Volume range was(67 +-19cm3). While Goda et al.[3] reported 71.5 ± 18.7 cm3 for (mean age of 46 years), Geraghty et al.[4] 64.4 ± 18.1 cm3 for female individuals and 87.4 ± 21.3 cm3 for 57 male individuals (mean ages of 49 and 48 years, respectively).

We found that the mean Pancreatic Volume based on CT was 43-78 cm3 for females and 50-86 cm3 for males. The mean Pancreatic Volume was larger for males than for females, which is consistent with the findings of previous anatomical and radiological studies[5,6]. However, the Pancreatic Volume obtained in this study is smaller than those of other studies. This could be attributed to differences in the number of subjects enrolled, and differences in the anthropometric characteristics.

There was a correlation between the Pancreatic Volume and Anterior – Posterior diametetrs ($p < 0.001$), and these results were consistent with previous reports[7,8].

Djuric et al[9] in his study concluded that considerable individual variations in the volume of normal pancreas in the adult population are observed. Pancreatic volume strongly correlates with the diameters of the pancreas that are commonly measured by the cross-sectional imaging. Their study found that applying the following formula:

Vp an creas = (AP tail +AP body) /2×L body & tail ×C body C C 2+(AP head /2) ×3.14×CChead

Pancreatic volume could be estimated using a few simple linear measurements, which could be useful in regular practice.

In our study we found that A-P diameters for head, body and tail were in the following range 20- 29mm , 14-25mm and 13-25 mm respectively .Just like pancreatic volume the A-P diameters too showed declining trend with age . There was slight variation in pancreatic A-P diameters between male and female. It was slightly towards higher end in males as compared with females. L kreel et al[10] in his study concluded that the size of the normal pancreas was upto 3cm for the head, 2.5cm for the neck and body, and 2.0cm for the tail.

In our study The contour of body was found to be normal in 486 patients. There was an anterior protrusion in 11 (2.21%) patients. The configuration of pancreatic tail was fairly normal in 481 patients. it was globular in 7 (1.4%) patients, lobular in 4(0.8%) patients, tapered in 3(0.6%) patients and showed bifid configuration in 2(0.4%) patients.

In the study of Okan dilek[11] et al , anterior protrusion was detected in 8.5% of the cases and posterior protrusion was found in 1.2% of the cases. In their study of 449 patients in a Japanese population. Our study detected two cases of pancreatic anatomical variants, one pancreatic divisum and other partial agenesis of tail . Since these anomalies are very rare the smaller sample size can be the reason for detection of fewer cases .

CONCLUSION

Normograms from this data can be used for north indian ethnic population to allow radiologists to estimate more accurately the degree of atrophy or hypertrophy of organs in certain disorders thus , avoid false positive and false negative diagnosis of

pathological enlargement or reduction of pancreas in clinical practice.

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