Original Research Article

SONOGRAPHIC ASSESSMENT OF PANCREATIC ECHOGENICITY IN NORMAL ADULTSIN SOUTH-SOUTH NIGERIA

ABSTRACT

Background: The pancreas has a normal echogenicity that is comparable to or slightly higher than that of the liver. Fat accumulated around the pancreas determines pancreatic echogenicity, and ultrasound scan is a crucial diagnostic and screening tool for its assessment.

Objective: To determine the pancreatic echogenicity in normal adults, and their relationship with age, sex, height, weight and body mass index (BMI).

Subjects and Methods: This descriptive, cross-sectional study was conducted in four health institutions in Bayelsa State, Nigeria from July, 2022 to February, 2023. Statistical Product and Service Solutions for Windows® version 25, SPSS Inc.; Chicago, USA was used for data analysis. Descriptive statistics (mean, standard deviation, frequency, and percentages) and analysis of variance were done.Chi-square statistics was used to examine the association between sex and echogenicity of the pancreas. The statistical significance was set at $P<0.05$.

Results: Most (303, 75.3%) of the participants had Grade I pancreatic echogenicity. There was positive correlation between pancreatic echogenicity and age, height, weight and body mass index. There was no significant relationship between pancreatic echogenicity and sex ($X^2 = 0.085$; $p = 0.771$).

Conclusion: This study has established that pancreatic hyperechogenicity does not always suggest a pathology. Healthy males and females can have pancreatic hyperechogenicity without the presence of a medical condition.

Keywords: Pancreas,Ultrasound, Pancreatic echogenicity, Age, Sex, Height, Weight, BMI.

INTRODUCTION

The pancreas is a retroperitoneal organ, which is located at the level of the first and second lumbar vertebrae on the posterior abdominal wall.[1] It is an accessory digestive gland, with a head, neck, body and tail.[1] Ultrasound imaging of the pancreas can reveal information on its echogenicity, size, ductal structure, and surrounding tissues.[2] It is affordable and simple to execute diagnostic and interventional procedures quickly. The low cost, portability, and absence of ionizing radiation of ultrasonography are advantages. However, its retroperitoneal position, obesity, substantial amount of bowel gas, and the operator's skills are limitations of ultrasound scan.[2]

The pancreas has variable echogenicity.[3] The echogenicity of the pancreas can be less than that of the liver; same as the liver; slightly higher than the liver, but less than subcutaneous fat; and as echogenic as subcutaneous fat. The pancreas is usually less fatty and hypoechoic in younger individuals.[3] With

increasing age, the pancreas may become fatty, which may cause echogenicity similar to the mesenteric fat in the area. The uncinate process is usually spared of fat deposition.[3] Hyperechogenicity of the pancreas is associated with age, male gender,obesity, diabetes mellitus, smoking, hypertension, fatty liver, hypertriglyceridemia, pancreatitis, pancreatic pseudocyst, pancreatic abscess, pancreatic cystadenoma and pancreatic cancer.[4–6]

Computed tomographic scan, magnetic resonance imaging, magnetic resonance cholangiopancreatography, and endoscopic retrograde cholangiopancreatography are other imaging methods for assessing the pancreas. Nevertheless, the need for specialist equipment and the resulting radiation exposure limits the use of computed tomography and endoscopic retrograde cholangiopancreatography. Furthermore, in our low-resource setting, they are expensive and challenging to apply to a larger population of people.Therefore, the objective of this study was to determine the normal pancreatic echogenicity among normal adults, and their relationship with age, sex, height, weight and body mass index.

MATERIALS AND METHOD

Study setting and design: The Federal Medical Centre, Yenagoa, Niger Delta University Teaching Hospital, Okolobiri, Diete Koki Memorial Hospital, Yenagoa, and Silhouette Radiodiagnostic Consultants, Yenagoa, all in Bayelsa State, Nigeria, were the locations of this descriptive, cross-sectional study. The research was carried out from July 2022 to February 2023. These facilities provide specialized care services to the residents of Bayelsa State and the neighboring States of Rivers and Delta, which are all in Nigeria's South-South geopolitical zone.

Sample size calculation: The formula below was used to calculate the sample size for this study:

$n = z^2pq/d^2$ [7]

Where:

n = minimum sample size

z = normal standard deviation set at 95% confidence limit = 1.96

p = proportion in the target population which was 50% (0.5) from a previous study.[8]

q = 1 – p (complementary probability).

d = margin of error = 5% = 0.05

Calculation:

$n = (1.96)^2 \times 0.5 \times 0.5 / (0.05)^2$

$n = 3.8416 \times 0.5 \times 0.5 / 0.0025$

$n = 0.9604 / 0.0025$

$n = 384.16$

After considering attrition of 5%, ‘n’ was adjusted to 403

Study population: Four hundred and three healthy males and females (patient relatives, students and hospital staff) who were in the various health facilities for purposes other than health wererecruited and enrolled.

Inclusion criteria: Healthy males and females without any medical condition.

Exclusion criteria: Males and females with pancreatic or liver disease and other medical conditions, previous liver or pancreatic surgery, chronic alcoholism, pregnant women, those on opioids, individuals who cannot fast for up to 6 – 8 hours or have recently undergone a barium meal study.

The participants in this study gave their consent to be included. To rule out the presence of any medical diseases or anything else that could have an impact on pancreatic size, the sociodemographic data and a brief history of the participants were gathered and documented.

The participants were asked to fast for at least 6 to 8 hours prior to the ultrasound scan, to reduce interference from overlying bowel gas, which may make visualisation of the pancreas difficult. The participants were counselled on the examination and research. The height (in meters) and weight (in kilograms) were recorded, and the body mass index (BMI) was determined as the weight in kilograms (kg) divided by height in meters (m) squared. The participants had urinalysis, fasting blood sugar, liver function tests, and serum electrolytes, urea and creatinine done prior to commencement of the investigative modality. Following normal investigation results, they were referred to the Radiology Units of the study centers for ultrasound scan.

Procedure: Four consultant radiologists performed transabdominal ultrasound examinations on each patient using a 2012 Philips HD11 device with a 3.5 MHz curvilinear probe. Before data collection began, the consultant radiologists discussed the standard operating procedure for ultrasonography, assessed its reliability and interobserver variability, and came to a consensus.To further reduce interference from overlying bowel gas, which may make visualisation of the pancreas difficult, the participant drinks 500 – 700 ml of water 10 – 15 minutes before ultrasound scan. Using a combination of axial, sagittal and oblique planes, the pancreas was scannedalong themidline at the upper abdomen. With some transducer pressure, the initial scan was transverse in the epigastric area. The pancreas was seen behind the left lobe of the liver or the gastric antrum.

The echogenicity of the pancreas was noted and graded as follows (Figure 1): Grade 0 – echogenicity less than that of the liver.Grade I –echogenicity same as the liver. Grade II – echogenicity slightly higher than the liver, but less than subcutaneous fat.Grade III – as echogenic as subcutaneous fat.

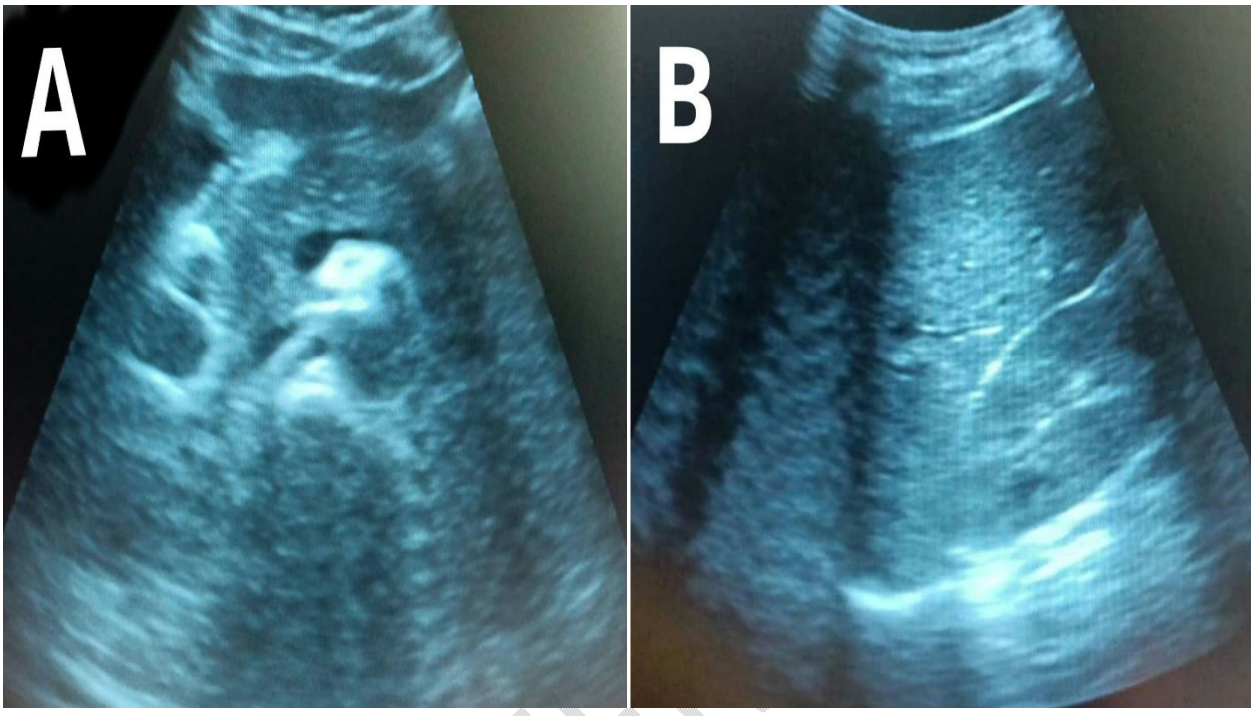

Figure 1: Classification of pancreatic echogenicity on ultrasound scan.

A: Echogenicity same as the liver. **B:** Echogenicity slightly higher than the liver, but less than subcutaneous fat*(from our study)*.

Data analysis: The measurements were documented using a pre-designed proforma. Statistical Product and Service Solutions for Windows® version 25, developed by SPSS Inc. in Chicago, USA, was used for data analysis. Descriptive statistics (mean, standard deviation, frequency, and percentages) was done.Chi-square statistics was used to examine the association between sex and echogenicity of the pancreas. The relationship between the dimension of the pancreas and age, height, weight, and body mass index was established using analysis of variance (ANOVA), which was subsequently confirmed using a separate student t-test.The interobserver and intraobserver agreements between the four radiologists were analysed using intraclass correlation coefficient (ICC) and interpreted as poor:<0.20; fair: 0.20 – 0.39; moderate: 0.40 – 0.59; substantial: 0.60 – 0.79; almost perfect: ≥0.80. The cutoff for statistical significance was set at P<0.05.

RESULTS

The total number of participants in this research was 403. There were 141 (35%) males and 262 (65%) females. The mean age was 34.66 ± 13.97 years, with a range of 17 to 68 years. Participants in the age

group of 17 – 25 years made up 141 (35%), while those over 65 years made up 19 (4.7%) of the study population (Table 1). Table 1 also shows the anthropometric measurements of the participants.Most (303, 75.3%) of the participants had Grade I pancreatic echogenicity (Table 2). While there was positive correlation between pancreatic echogenicity and age, height, weight and body mass index, there was no significant relationship between pancreatic echogenicity and sex(X^2 =0.085; p = 0.771) (Table 3).There was a significant relationship between the two variables X^2 = 24.86; p = 0.000.Table 4 shows the results for the interobserver and intraobserver correlation coefficients.

Table 1: Baseline characteristics of the participants

Characteristics	Frequency, n = 403	Percent
Age group (years)		
17 – 25	141	35.0
26 – 35	120	29.8
36 – 45	80	19.9
46 – 55	20	5.0
56 – 65	23	5.7
> 65	19	4.7
Age in years – mean ± SD	34.66 ± 13.97	
Anthropometric measurements		
Height in metres – mean ± SD	1.66 ± 0.09	
Weight in kg – mean ± SD	61.35 ± 9.57	
Body mass index in kg/m^2 – mean ± SD	22.25 ± 3.07	
Body mass index		
Underweight	60	14.9
Normal weight	263	65.3
Overweight	80	19.9

Table 2: Echogenicity of pancreas

Characteristics	Frequency, n = 403	Percent
Echogenicity of pancreas compared to the liver		
Grade 0	40	9.9
Grade I	303	75.2
Grade II	60	14.9

Table 3: Correlation between pancreatic echogenicity and age, height, weight and body mass index

Characteristics	Correlation	p-value
Age	0.324[a]	0.000
Sex	0.085[b]	0.771
Height	0.451[a]	0.000
Weight	0.329[a]	0.000
Body mass index	0.152[a]	0.002

[a]**Spearman's rho;**[b]Pearson Chi-square

Table 4: Interobserver and intraobserver intraclass correlation coefficient results

Ultrasound parameter	Intraclass correlation coefficient	
	Interobserver	Intraobserver
Pancreatic echogenicity	0.98 (95% CI 0.53–0.99)	0.99 (95% CI 0.55–0.99)

DISCUSSION

This study was conducted to assess the echogenicity of the pancreas in healthy males and females, and correlate it with age, sex, height, weight and body mass index. Most (75.5%) of the participants in this study had Grade I pancreatic echogenicity. This may explain the fact that pancreatic hyperechogenicity does not always suggest a pathology. In this research, there was positive correlation between pancreatic echogenicity and age. As the age of the participants increased, the more echogenic their pancreas was. This observation is in tandem with the findings of Choi et al.[6] and Glaser and Stienecker.[9] Choi et al., observed that pancreatic echogenicity was marked after the age of 60 years, while Glaser and Stienecker observed that the pancreas became more echogenic as people aged, starting in the fourth decade of life. Most patients over the age of 50 years and all patients over the age of 80 years had significant echogenicity.[6,9] Fat accumulation in the pancreas is more marked as age increases.

In our research, there was no significant relationship between sex and pancreatic echogenicity. There was no gender predilection. This is not in consonance with the findings of Choi et al.,[6]Oh et al.,[10] and Ford et al.[11]Choi et al.,[6]revealed that male gender was significantly associated with pancreatic echogenicity. They observed that up until the age of 60 years, men were more likely than women to experience metabolic syndrome, which is closely associated with visceral fat deposition. Oh et al.,[10] and Ford et al.,[11] observed similar findings as Choi et al.

Our study revealed a positive correlation between height and weight and pancreatic echogenicity.The reason for this is not readily understood, as there is a paucity of published information on the subject in the literature. What abounds in the literature is the relationship between body mass index and pancreatic echogenicity. However, weight gain is usually associated with accumulation of both subcutaneous and visceral fat, which will in turn predispose to increased echogenicity of the pancreas.

Our study revealed a positive correlation between pancreatic echogenicity and obesity. Pancreatic echogenicity increased as body mass index increased. This finding is in agreement with the observation of Choi et al.,[6] who reported that obesity was a risk factor on a univariate analysis for pancreatic echogenicity, and visceral adipose tissue was found to be a statistically significant risk factor on a sub-group analysis. Lee et al.,[12] observed that increased BMI was a significant risk factors for pancreatic echogenicity, while Al-haddad et al.,[13]reported that increased visceral fat was significantly associated with pancreatic echogenicity.The regional distribution of adipose tissue is an important risk factor for

many metabolic and cardiovascular conditions. Fatty deposition on the pancreas increases pancreatic echogenicity. Pancreatic fat is known to increase with ageing and obesity.[14]

For evaluating pancreatic echogenicity in this study, the ICC was employed to lower intraobserver and interobserver variability.The consistency of measurements for the same parameter are assessed[15], and both interobserver variability and the variance of all measurements are taken into account.[15,16] With the normal range being 0 to 1, a value above 0.8 indicates nearly perfect agreement.[17,18] Our study's inter- and intraobserver variance results, which showed nearly perfect agreement, were 0.98 and 0.99, respectively.

This study's strength comes from its multicenter design, which only enrolled healthy male and female participants. Hence, confounding factors (such as liver and pancreatic diseases and other health issues) that may have altered the assessment of pancreatic echogenicity were eliminated. Gas in the stomach, duodenum and colon makes it difficult to visualize the pancreas. The participants were encouraged to drink water about 15 minutes prior to ultrasound scan to help reduce the gas. It can be difficult to visualise the pancreas in obese people. With the aid of our high-resolution ultrasound scan device, this was overcome. Another limitation is that since this study was hospital-based, it might not exactly reflect what is obtainable in the general population of people.

CONCLUSION

This study has established that pancreatic hyperechogenicity does not always suggest a pathology. Healthy males and females can have pancreatic hyperechogenicity without the presence of a medical condition. Our study also revealed positive correlation between pancreatic echogenicity and age, height, weight and body mass index. More researches are recommended as there a paucity of recently published information on the subject matter.

Consent

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

Ethical Approval

The protocol for this study was examined and approved by the Research and Ethics Committee of the Federal Medical Centre, Yenagoa, Bayelsa State, Nigeria (FMCY/REC/ECC/2023/697/0280).

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