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Sonographic measurement of pancreatic duct diameter in apparently healthy adults in Abakaliki metropolis

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Abstract
Dilatation of the pancreatic duct indicates obstruction to normal flow or a predictor to pancreatic pathology. Availability of a reference value is therefore important.
This Study is aimed at establishing a normogram in apparently healthy adults and its relationship with age, gender and anthropometry. It is a prospective cross sectional survey involving 424 subjects aged 18 to 90 years. The pancreatic duct diameter inclusive of the echogenic walls was taken at the proximal, body and tail. Anthropometric measurements were obtained using standard procedures. The mean pancreatic duct diameters from proximal to tail were: 2.44±0.59 mm, 2.12±0.48 mm and 1.86±0.52 mm. A very weak positive correlation existed with PD and anthropometry(r = 0.11)
Ductal diameters beyond these limits should prompt the need for further investigation.

Keywords: Pancreatic duct

Introduction

Abnormal dilatation of the pancreatic duct indicates obstruction of the normal flow of pancreatic secretions[1,2]. This can occur with acute pancreatitis, chronic pancreatitis or pancreatic malignancy; studies have shown that slight dilatation of the main pancreatic duct appears to be a risk factor for pancreatic cancer. Thus, in such subjects without pancreatic cancer, periodic check-ups with a non-invasive modality are advised for the early detection of pancreatic cancer[3.] Availability of a reference range is therefore very necessary. The pancreatic duct diameter is greatest at the head and neck region and is slightly narrower towards the body and tail. Its normal reported value ranges between 1-3.5 mm[1,2]. In many patients, pancreatic duct dilatation does indicate obstruction. However, such an assessment implies knowledge of the normal duct size.

Ultrasonography is an accurate, safe, non-invasive, readily available and inexpensive imaging modality, which is highly sensitive and specific for the detection of many pancreatic lesions. Though Interpretations fr om CT, MRCP and ERCP usually are more descriptive, ultrasonography is cheap, non-

invasive, readily available and the diagnostic method of choice for visualization and rational work-up of abdominal structures[4]. Although the establishment of a normal duct diameter via ultrasound is very important, but clinical symptoms and abnormal laboratory values should prompt need for further evaluation despite a normal appearance of the ducts; whereas pursuit of an isolated finding of an enlarged duct without supporting clinical data may be unwarranted[4]. Despite technological advancements, the association of anthropometric measurements with the diameter of pancreatic duct has remained controversial. Sonongraphic pancreatic duct diameter assessment may be used in every situation where its diameter affects further treatment and prognosis; hence a need to establish a reference value for our population using ultrasonography which is a useful non-invasive, readily available and cheap procedure for accurate pancreatic bed assessment.

This study was conducted to obtain data on sonographically measured diameters of the pancreatic ducts among south-eastern Nigerian population in order to determine the range of normal diameters for this population and its association with age, gender, and some anthropometric measurements.

Materials and methods

This was a prospective cross-sectional non experimental study conducted at the Department of Human Anatomy, Ebonyi state university, Presco Campus, Abakaliki, South-Eastern Nigeria. A total of 424 apparently healthy adult easterners consisting of 216 males and 208 females with essentially normal scan result, no hepatobiliary or pancreatic pathology[5], adequate visualisation of the pancreas and entire extra hepatic duct, no subjective complain of abdominal pain[6],nil physical evidence of jaundice[7], no noticeable pregnancy[7], nil splenomegaly and portal hypertension[7], nil cholecystectomy, congenital abnormalities, anatomical variations, and medications[4]

In line with Helsinki Declaration, approval for this study was obtained from the Human Research and Ethics Committee of the Federal Teaching Hospital, Abakaliki, Ebonyi State. The procedures were explained to the subjects and written informed consent was obtained from each subject before enrolling into the study.

Sonoline Prima 3.5 MHz curvilinear transducer (Siemens medical system, Germany, 1996) was used to measure the common bile duct and the pancreatic duct diameters. Other materials used were non-extensible flexible measuring tape (TR-13-60" Tailor's Tape [60 in. / 1.5 m]), for circumference acquisition, balanced beam scale with an incorporated height adjustable rule (seca Germany) for weight and height measurements, aqueous gel to dispel air at probe-skin interface and a chart prepared in advance for recording of observations.

The subjects had an overnight fast as necessary for gastro-intestinal imaging to help reduce bowel gas[8]. A total of 424 subjects were studied with Socio-demographic details related to age and gender recorded for each subject. All the physical measurements were conducted in a separate area, screened off to provide privacy. Anthropometric measurements were made based on the recommendations of Centre for Disease Control and Prevention (2008)[9]: Subjects were asked to stand with their feet together with weight evenly distributed over both feet and the arms relaxed by the sides during the measurements. To measure the weight, the volunteer was made to empty the pockets of mobile phones, bunches of keys, wallets and other objects that could add a gram or more to the weight. The weight was taken bare-foot, the volunteer stood erect on the beam balance without resting hands or body on the

table or wall. The weight, in kg was read to nearest 0.5 kg. while still standing erect and as motionless as reasonably practicable, with heels, gluteal muscles and occiput touching the upright bar of the height scale, the short, horizontal bar of the scale was adjusted to make firm contact with the vertex of the head, the height was then read off the nearest centimetre. The BMI was calculated as weight (kg) over height^2 (meter^2)[10].

As part of assessment to determine if pancreatic duct diameter vary with body build, Chest circumference was measured using a measuring tape over light clothing and while breathing normally. In the males, the measurement was made at the widest diameter of the chest; in the females, the measurement was made at the level of the nipples with the measuring tape held horizontally. The circumference at the transpyloric plane was measured at a level midway between the suprasternal notch and the symphysis pubis; 5 cm above the lower coastal margin. Circumference at the umbilicus was obtained by measuring the abdominal circumference using measuring tape at the level of the umbilicus. The waist and hip circumferences were measured at the upper border of the iliac crest and the maximum portion of the buttocks respectively[7]. The waist hip ratio was then calculated as WC/HC[11].

The longitudinal section of the pancreas was obtained and the complete pancreatic duct diameter inclusive of the echogenic wall structures was measured in the proximal corpus above the aorta (region of the head and neck), body (proximal to head and neck region) and tail (distal to the neck). A moderate amount of pressure was applied when necessary to push behind the bowel for better visualisation of the pancreas. All sonographic measurements were taken on quiet respiration. To reduce intra observer variability, two measurements were taken and the average calculated[12,13].

Figure 1: Sonogram showing the pancreatic duct. Arrow: pancreatic duct Key: S: Stomach, P: pancreas, Pc: portal confluence.

Results

A total of 424 subjects were studied consisting of 216 males (50.9%) and 208 females (49.1). The study subjects belonged to the age group 18-90 years of age; the mean age was 34.03±16.16 years. A majority of the participants belonged to the age group 18-25 years. The mean age for males was 37±18.3 years while that for females was 30.9±13 years. This difference in ages was statistically significant (p = 0.000).

The mean weight, height, BMI and BSA of t he participants was 65.3±9.61 kg, 166±7.45 cm, and 23.7±3.53 kg/m^2 and 1.5±0.25 m^2 respectively.

The mean circumference measured at levels of chest, transpyloric plane, umbilicus, waist, hip and waist-hip ratios were 89.2±10.20 cm, 78.58±8.77 cm, 80.2±10.77 cm, 83.68±9.43 cm 111±9.97cm and 1.03±2.97.

The mean pancreatic duct diameters at the proximal, middle and distal segments were: 2.44±0.59 mm, 2.12±0.48 mm and 1.86±0.52 mm respectively. The difference in mean pancreatic duct diameters at the proximal and distal segments were statistically significant (p = 0.000 and 0.001).

Table 1: Descriptive statistics of proximal PD diameters according to age group

Age group (years)	n	mean±SD	F-value	p-value
18-25	188	2.35±0.56		
26-35	92	2.42±0.59		
36-45	57	2.76±0.56	5.556	0.000
46-55	40	2.43±0.66		
> 55	45	2.44±0.57		
Total	422	2.44±0.59		

However, the post hoc test revealed that only the mean pancreatic duct diameter of subjects in the age group 36-45 years showed statistically significant difference in comparison with the other groups ($p < 0.001$)

The mean pancreatic duct at the three locations for males and females were: 2.45 mm, 2.42 mm; 2.12 mm, 2.13mm; 1.82 mm and 1.91 mm respectively. No statistically significant difference noted between genders and within each age group ($p > 0.05$).

In order to assess the association between pancreatic duct diameter with anthropometric measurements, both of which were continuous variables, correlation was used. It was observed that the pancreatic duct diameters only showed a very weak positive correlation with age ($r = 0.113$), weight, BMI, BSA, and circumference at the umbilical region for both genders.

Discussion

Ultrasonography is a cheap, non-invasive and relatively easily available means of evaluating the gastrointestinal system. In many parts of Nigeria and other resource limited countries, ultrasonography may be the only method available[8]. Very limited data is available in our environment on quantification of the pancreatic duct diameter. It is expected that in the use of these values as nomograms, the false positive rate (type 1 error) might be lower in symptomatic patients. This is because healthy subjects have a low pretest probability of having a disease, while patients clinically referred for abdominal sonography have a pretest likelihood of disease. These patients have undergone extensive work-up prior to referral to exclude other diseases[14]. The Bayes theorem indicates that in healthy subjects who have a low pretest probability of disease, a positive test result is likely to be false positive, that is, the positive predictive value is low. The result can be validated on account of the normal distribution pattern of the sample population as proved by Lyapunov central limit theorem[15].

The mean pancreatic duct diameters were: 2.44±0.59, 2.12±0.48 and 1.86±0.52 at the proximal, middle and distal segments respectively. These findings are in agreement with several studies[1,16,17.] There is a disagreement by Mortele[2] who reported the mean pancreatic duct diameter as 3.5 mm, 2.5 and 1.5 mm at the proximal, middle and tail respectively, owing to his multimodality approach. No observable statistically significant difference was noted in the overall mean pancreatic duct diameter between male and female ($p > 0.05$).

There is a weak positive correlation of pancreatic duct diameter with age ($r = 0.113$, $p = 0.100$). Similarly, the pancreatic duct showed a weak positive correlation with weight, BMI, BSA, and circumference at the umbilical region ($r = 0.11$, $p > 0.05$). These

findings are in agreement with Glaser e*t al.*[1]. There is paucity of work in our locality that has addressed the pancreatic duct diameter with anthropometric variables to the best of the researcher's knowledge.

The overall mean pancreatic duct diameters at the proximal, middle and tail were 2.44±0.59, 2.12±0.48 and 1.86±0.52 mm respectively. This reference value of the range of normality for the pancreatic duct diameter would help in defining the upper limit in assessment of patients with related pathologies. Ductal diameters beyond these limits should prompt the need for further investigations[7]. The pancreatic duct showed a very weak correlation. This proves the reliability of ultrasound in pancreatic duct assessment amongst Easterners in Abakaliki metropolis.

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