SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF GRADUATE STUDIES

Characterization of Normal Pancreas Among Sudanese Population by Using MRI

توصيف البنكرياس الطبيعي لدي السودانيين باستخدام الرنين المغنطيسي

partial Fulfillment for Requirement of M.Sc Degree in Diagnostic Radiologic technology

Presented By:
Hanona Hassab ALrasol Mohamed

Supervised By:
Dr. Caroline Edward Ayad

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الأيـــــــــه

قال تعالي:

(وعنده مفاتيح الغيب لا يعلمها إلا هو ويعلم ما في البر والبحر وما تسقط من ورقة إلا يعلمها ولا حبة في ظلمات الأرض ولا رطب ولا يابس إلا في كتاب مبين)

صدق الله العظيم

سورة الأنعام الأيه (59)

Dedication

This research dedicated to soul of my father

To my mother

To my children and their husband

To my sons and sister

To my friends

To all person help me

Acknowledgement

My great thanks to alla to let me reaching this place.

My gratitude thanks to Dr. Caroline Edward for her support.

My thanks extend to everyone who help ,supported ,and provided me any type of help throughout this study.

Abstract

This study was conducted to define the normal pancreatic size and for Sudanese in order to establish a local reference of values using MRI. Magnetic Resonance Image was performed in the Radiology Unit of the ALzytona Specialized Hospital period from August to December 2016.

The data was collected from 50 normal subjects and were considered patients age, weight, height, , body mass index (BMI), pancreas head size, pancreas body size, pancreas tail size.

Measurement were made and Data were presented as mean and standard deviation (SD) for all of the variables .

The study revealed that the Sudanese pancreas size was 26.81 ± 1.71 mm for head, 20.02 ± 1.57mm for body,17.99 ± 1.27mm for tail.

The study showed negative linear relation[reversal relation] between the pancreas size and subject's age, As the head, body and tail of pancreases were decrease with age increase.

The study showed There was no relation between BMI and pancreases measurements.

ملخص البحث

الهدف من هذه الدراسة هو قياس أبعاد البنكرياس للسودانيين تعتبر الدراسة دراسة وصفيه تحليليه أجريت في مستشفى الزيتونة التخصصي في الفترة من أغسطس إلى ديسمبر 2016

خضعت هذه المجموعة لإجراء فحص باستخدام جهاز الرنين المغناطيسي تم تسجيل العمر والنوع والطول والوزن و مؤشر كتلة الجسم

تم قياس أبعاد البنكرياس أمامي خلفي عند منطقة الرأس والجسم والذيل

وأوضحت الدراسة النتائج الآتية : الأبعاد المرجعية للبنكرياس لعينة السودانيين كقياس

17.99 ± 1.27 ملم للجسم و 20.02 ± 1.57 ملم للرأس و 26.81 ± 1.71 ملم للذيل

أمامي خلفي

أظهرت النتائج إن هناك علاقة عكسية بين حجم البنكرياس وعمر المريض بينما العلاقة بين مؤشر كتلة الجسم وحجم البنكرياس كانت علاقة ضعيفة

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List of abbreviation

AP	Antero posterior
BMI	Body Mass Index
CCK	Cholecystokinin
CT	Computed Tomography
FOV	Field Of View
GD DTPA	Gadolinium diethylene-triamine-penta-acetic acid
GRE	Gradient Echo
HASTE	Half acquisition single shot turbo SE
LR	Left To Right
MRI	Magnetic Resonance Image
PP	Poly Peptide
SPIR	Spectrally selective inversion recovery
STIR	Short TAU inversion recovery
TE	Time to Echo
TR	Time to Repeat
TSE	Turbo Spin echo
US	Ultra Sound

Contents

Chapter one

Introduction

Chapter one:

1.1 Introduction:

The pancreas is situated on the posterior abdominal wall at approximately L1 level .It is described as having a head, neck, body and tail.

The pancreas is prismoid in shape and appears triangular in cut section with superior, inferior, and anterior borders as well as anterosuperior, anteroinferior, and posterior surfaces. (Stephen 2004)

The head of the pancreas lies in the duodenal C loop in front of the inferior vena cava (IVC) and the left renal vein (see the following images). The uncinate process is an extension of the lower (inferior) half of the head toward the left; it is of varying size and is wedged between the superior mesenteric vessels (vein on right, and artery on left) in front and the aorta behind it.

The size of the normal pancreas was found to be up to 3.0 cm fore the head , 2.5 cm for the neck and body, and 2.0 cm for the tail. In assessing these values , it is important to be sure that adjacent structures such as the portal vein , splenic vein , and duodenum are not included in the measurement that the measurement are taken on scans of maximum resolution with no movement and that the measurement are strictly related to the anteroposterior diameter. (www.pancreapedia.org /reviews/anatomy-and-histology-of pancreas.)

The pancreas contains tissue with an endocrine and exocrine role, and this division is also visible when the pancreas is viewed under a microscope.

The tissues with an endocrine role can be seen under staining as lightly-stained clusters of cells, called pancreatic islets (also called islets of Langerhans).

Darker-staining cells form clusters called acini, which are arranged in lobes separated by a thin fibrous barrier. The secretary cells of each acinus surround a small *intercalated duct*. Because of their secretary function, these cells have many small granules of zymogens that are visible. The intercalated ducts drain into larger ducts within the lobule, and finally *interlobular ducts*. The ducts are lined by a single layer of columnar epithelium. With increasing diameter, several layers of columnar cells may be seen.

The pancreas is best evaluated with a triphasic (arterial, portal venous, and systemic venous phases), contrast-enhanced (after intravenous injection of contrast medium), computed tomography (CT) scan with 3-dimensional (3-D), tri planar (axial, coronal, and sagittal planes) reconstruction.

CT scan of the pancreas may be performed to assess the pancreas for tumors and other lesions, injuries, bleeding, infections, abscesses, unexplained abdominal pain, obstructions, or other conditions, particularly when another type of examination, such as X-rays or physical examination, is not conclusive. CT scans of the pancreas may be used to distinguish between disorders of the pancreas and disorders of the retro peritoneum (the back portion of the abdomen behind the peritoneal membrane (Yale, 2012).

Computed Tomography scan can identify complication of pancreatic diseases such as fluid around the pancreas or collection of tissue fluid and pancreatic enzymes.

Ultrasound A probe is placed on the belly, and harmless sound waves create images by reflecting off the pancreas and other organs (Webmed ,2011)

Can be used to assess for pancreatic malignancy, pancreatitis and it is complication as well as for other pancreatic pathology.

Magnetic resonance imaging (MRI): Magnetic waves create highly detailed images of the abdomen. Magnetic resonance cholangiopancreatography (MRCP) is an MRI that focuses on the pancreas, liver, and bile system

Endoscopic retrograde cholangiopancreatography (ERCP): Using a camera on a flexible tube advanced from the mouth to the intestine, a doctor can access the area of the pancreas head. Tiny surgical tools can be used to diagnose and treat some pancreas conditions (Web med, 2011).

1.2.The problem:

The organ measurement usually affected by the body characteristic, this might lead to wrong diagnosis therefore is need compare this measurement to the body characteristic and hence we can have our own index.

1.3.The objective:

1.3.1General objective:

General objective of this study is to evaluate normal pancreas measurement in different Sudanese using MRI (in order to find new index in Sudanese).

1.3.2.Specific objective:

To measure the pancreas head, body and tail size,

To correlate pancreas measurement (age, weight, height and body mass index {BMI})

To compare pancreas measurement in different Sudanese people.

1.4.Significance of study:

This study provides good information about Sudanese pancreatic measurement and hence it can be used as guide line to proper Sudanese index.

1.5.Over view:

This study will consist of five chapters, chapter one deal with the introduction. Chapter two include literatures review. Chapter three detailed the material and method. Then chapter four presents the results and chapter five presents the discussion conclusion and recommendation.

Chapter Two

Literature Review

Chapter Two

Literature Review

Anatomy, Physiology and Pathology

2.1.Development of pancreas :

The pancreas is developed in two parts, a dorsal and a ventral. The former arises as a diverticulum from the dorsal aspect of the duodenum a short distance above the hepatic diverticulum, and, growing upward and backward into the dorsal mesogastrium, forms a part of the head and uncinate process and the whole of the body and tail of the pancreas. The ventral part appears in the form of a diverticulum from the primitive bile-duct and forms the remainder of the head and uncinate process of the pancreas. The duct of the dorsal part (**accessory pancreatic duct**) therefore opens independently into the duodenum, while that of the ventral part (**pancreatic duct**) opens with the common bile-duct. About the sixth week the two parts of the pancreas meet and fuse and a communication is established between their ducts. After this has occurred the terminal part of the accessory duct, *i. e.*, the part between the duodenum and the point of meeting of the two ducts, undergoes little or no enlargement, while the pancreatic duct increases in size and forms the main duct of the gland. The opening of the accessory duct into the duodenum is sometimes obliterated, and even when it remains patent it is probable that the whole of the pancreatic secretion is conveyed through the pancreatic duct. (Slack, 1995).

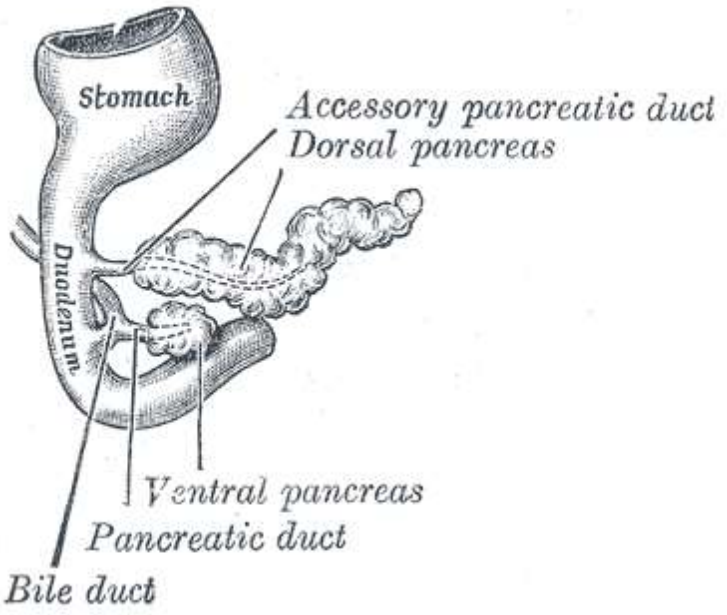

Figure 2.1 Pancreas of a human embryo of five weeks. (Williams PL,1998)

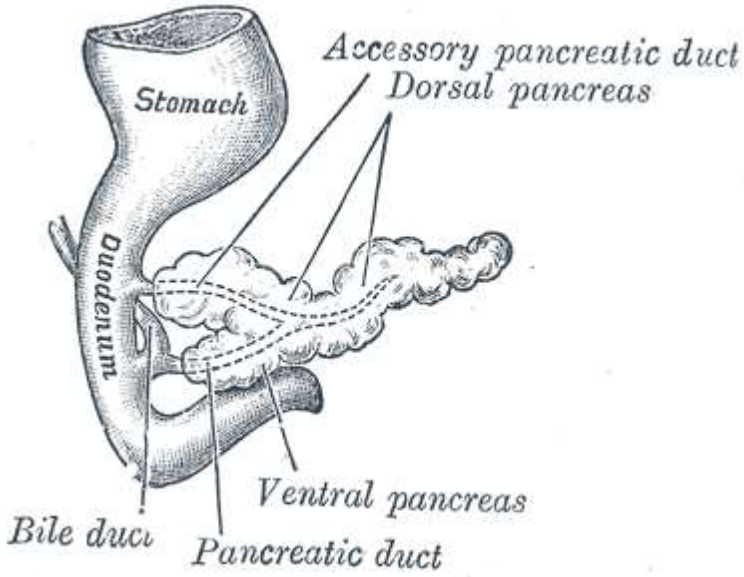

Figure 2.2:Pancreas of a human embryo at end of sixth week. *(*Williams PL,1998*)*

2.2.Anatomy of the pancreas:-

The pancreas is a soft, lobulated organ that stretches obliquely across the posterior abdominal wall in the epigastric region. It is situated behind the stomach and extends from the duodenum to the spleen. flattened organ that measures about 12.5–15 cm in length, the pancreas is located in the curve of the duodenum, the first part of the small intestine, and consists of a head, a body, and a tail.

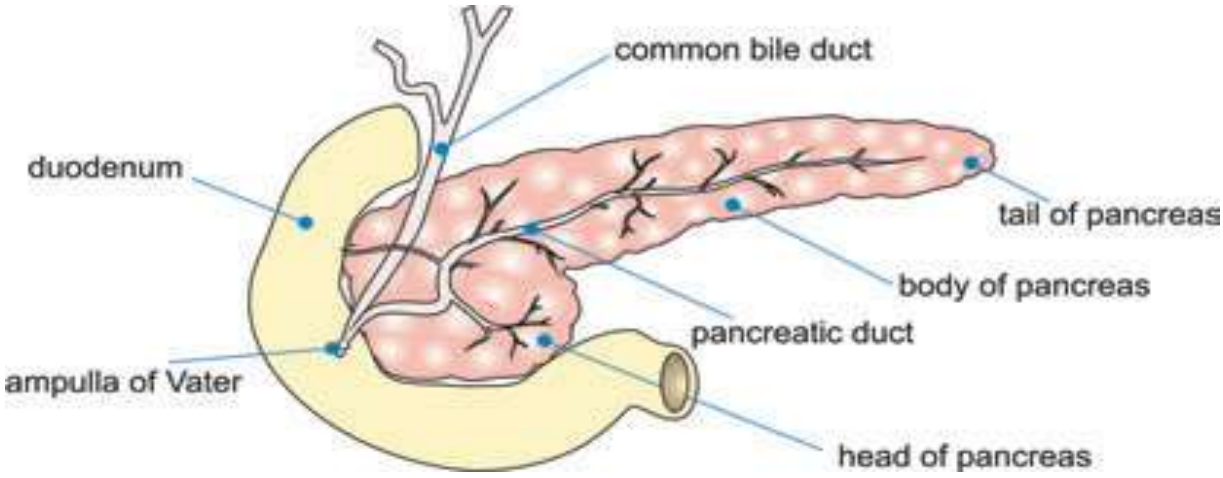

Figure 2.3: The pancreas

2.2.1.The head of the pancreas:

is the biggest part of the pancreas. located on the right side and lies within the curvature of the duodenum. The neck, body, and tail of the pancreas lie obliquely in the posterior abdomen, with the tail extending as far as the gastric surface of the spleen The common bile duct enters this area of the pancreas. The head is attached to the main part of the pancreas, the body. The head is tucked into the bend of the duodenum. The duodenum's superior part overlaps the top border of the head and the horizontal part overlaps the lower border. There is an overlap in front by the left and right

borders.(http://www.mdconsult.com/das/book/body/1077054624/0/1389/383.html).

2.2.2The uncinate:

process is a prolongation of pancreatic tissue of variable size and shape. It projects off the lower part of the head of the pancreas, extending upward and to the left. The uncinate process lies anterior to the aorta and inferior vena cava and is covered superiorly by the superior mesenteric vessels that emerge below the neck of the pancreas. (http://www.mdconsult.com/das/book/body/107705462-4/0/1389/383.html).

2.2.3.The neck of the pancreas:

supports the pylorus of the stomach. It starts from the top right part of the front of the head of the pancreas. The neck is around 2.5 cm in length. In the beginning it moves up and forward and then to the left to join the body of the pancreas. It's a bit flat on top. The stomach's pylorus is supported by the antero-superior surface. The end of the portal vein is connected with the neck's postero-inferior surface. The neck extends to the right as far as the anterosuperior pancreaticoduodenal artery from the gastroduodenal artery. (http://www.mdconsult.com/das/book/body/107705462-4/0/1389/383.html).

2.2.4.**The body of the pancreas**:

is prismatic in shape, lies posterior to the distal portion of the stomach between the tail and the neck, The anterior surface of the body is covered by peritoneum of the omental bursa that separates the stomach from the pancreas .The antrum and body of the stomach and the transverse mesocolon contact the body anteriorly. Posterior to the body of the pancreas are the aorta, the origin of the superior mesenteric artery, the left crus of the diaphragm, the left kidney, the left adrenal gland, and the splenic vein. The midline part of the body overlies the lumbar spine, which makes this area of

The pancreas most vulnerable to abdominal trauma. The body passes laterally and merges with the tail. (http://www.mdconsult.com/das/book/body/107705462-4/0/1389/383.html).

2.2.5The tail of the pancreas :

is narrow; it extends to the left as far as the lower part of the gastric surface of the spleen, lying in the phrenicolienal ligament, and it is in contact with the left colic flexure.

Birmingham described the body of the pancreas as projecting forward as a prominent ridge into the abdominal cavity and forming part of a shelf on which the stomach lies. "The portion of the pancreas to the left of the middle line has a very considerable antero-posterior thickness; as a result the anterior surface is of considerable extent; it looks strongly upward, and forms a large and important part of the shelf. As the pancreas extends to the left toward the spleen it crosses the upper part of the kidney, and is so moulded on to it that the top of the kidney forms an extension inward and backward of the upper surface of the pancreas and extends the bed in this direction.(http://www.mdconsult.com/das/book/body/1077054624/0/1389/383.html).

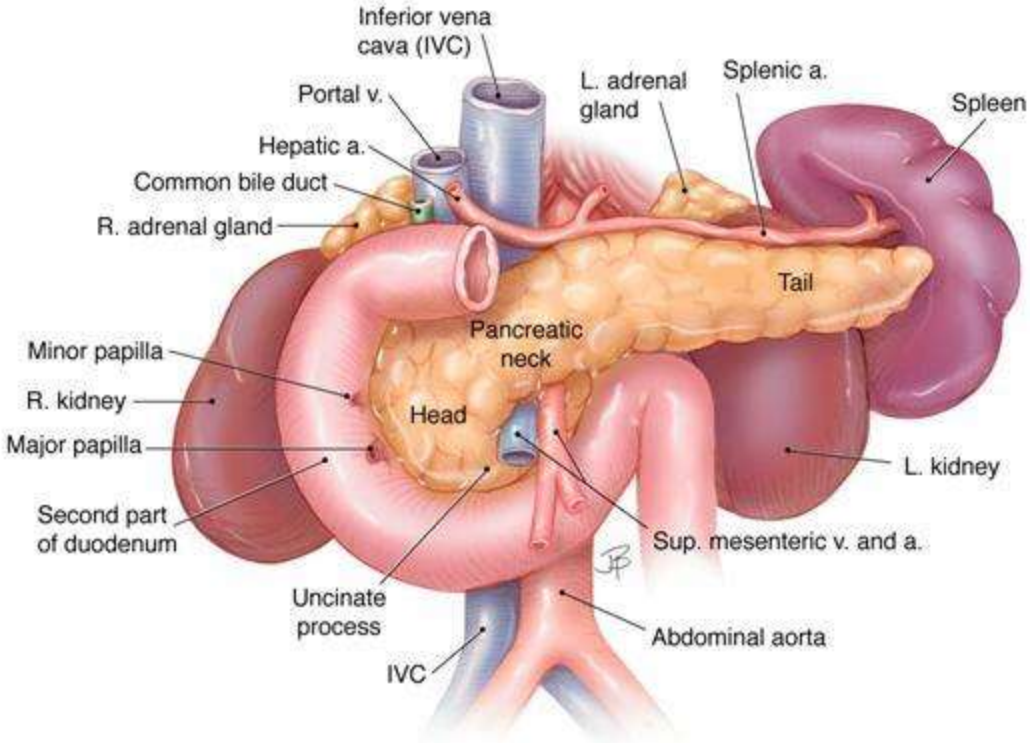

Figure2.4: Anatomic relationship of the pancreas with surrounding organs and structures

Figure2.5: Normal anatomic relation of the pancreas with other intra-abdominal
structures as shown by Magnetic Resonance Imaging.(Catherine Westbrook 2008)

2.2.6.Pancreatic Duct (duct of Wirsung):

extends transversely from left to right through the substance of the pancreas It commences by the junction of the small ducts of the lobules situated in the tail of the pancreas, and, running from left to right through the body, it receives the ducts of the various lobules composing the gland. Considerably augmented in size, it reaches the neck, and turning downward, backward, and to the right, it comes into relation with the common bile duct, which lies to its right side; leaving the head of the gland, it passes very

obliquely through the mucous and muscular coats of the duodenum, and ends by an orifice common to it and the common bile duct upon the summit of the duodenal papilla, situated at the medial side of the descending portion of the duodenum, 7.5 to 10 cm. below the pylorus. The pancreatic duct, near the duodenum, is about the size of an ordinary quill. Sometimes the pancreatic duct and the common bile duct open separately into the duodenum. Frequently there is an additional duct, which is given off from the pancreatic duct in the neck of the pancreas and opens into the duodenum about 2.5 cm. above the duodenal papilla. It receives the ducts from the lower part of the head, and is known as the **accessory pancreatic duct** (*duct of Santorini*).

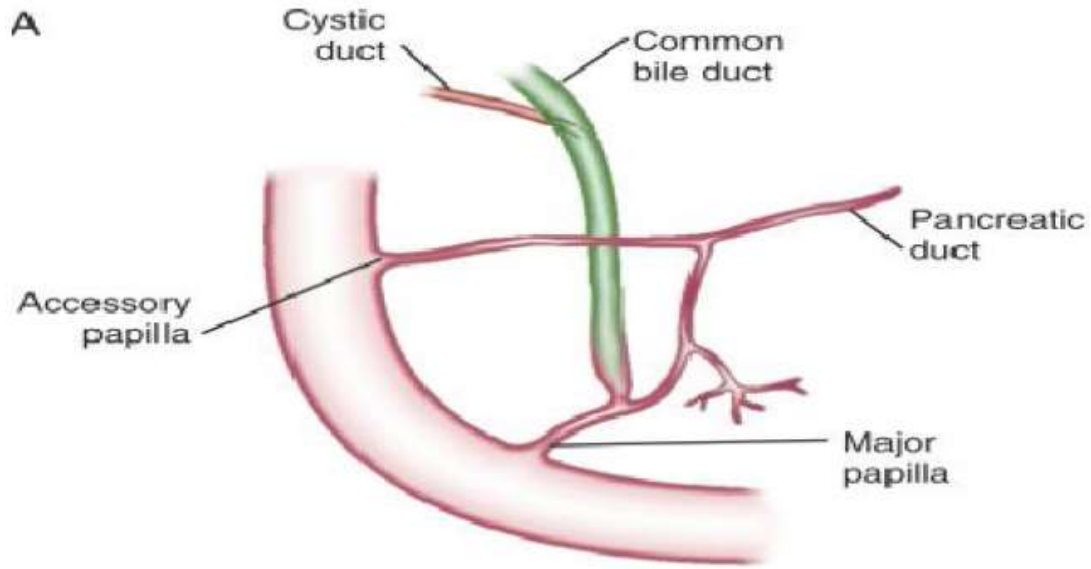

Figure2.6:Anatomic arrangement of the pancreatic duct system *(http://www.mdconsult.com/das/book/body/107705462-4/0/1389/383.html).*

2.2.7.Blood supply:

The pancreas receives blood from branches of both the coeliac artery and superior mesenteric artery. The splenic artery runs along the top margin of the pancreas, and supplies the neck, body and tail of the pancreas through its pancreatic branches, the largest of which is called the greater pancreatic artery. The superior and inferior pancreaticoduodenal arteries run along the anterior and posterior surfaces of the head of the pancreas at its border with the duodenum. These supply the head of the pancreas.

The body and neck of the pancreas drain into the splenic vein; the head drains into the superior mesenteric and portal veins. (Drake et al, 2005).

2.2.8.The lymphatic drainage of Pancreas

The lymphatic drain into nodes which lie along its upper border, in the groove between its head and the duodenum, and along the root of the superior mesenteric vessels. (Harold Ellis, 2006).

2.3.Physiology of pancreas :

The pancreas is involved in blood sugar control and metabolism within the body, and also in the secretion of substances which help digestion. Classically, these are divided into an "endocrine" role, relating to the secretion of insulin and other substances within pancreatic islets and helping control blood sugar levels and metabolism within the body, and an "exocrine" role, relating to the secretion of enzymes involved in digesting substances from outside of the body.

Approximately 3 million cell clusters called pancreatic islets are present in the pancreas. Within these islets are four types of cells which are involved

in the regulation of blood glucose levels. Each type of cell secretes a different type of hormone: α alpha cells secrete glucagon increase glucose in blood, β beta cells secrete insulin decrease glucose in blood,

δ delta cells secrete somatostatin regulates/stops α and β cells and PP cells, or γ (gamma) cells, secrete pancreatic polypeptide. These act to control blood glucose through secreting glucagon to increase the levels of glucose, and insulin to decrease it.

The islets are crisscrossed by a dense network of capillaries. The capillaries of the islets are lined by layers of islet cells, and most endocrine cells are in direct contact with blood vessels, either by cytoplasmic processes or by direct apposition. The islets function independently from the digestive role played by the majority of pancreatic cells.

Activity of the cells in the islets is affected by the autonomic nervous system:

Sympathetic : decreases secretion from beta cells, increases secretion from alpha cells,: increases secretion from beta cells

Parasympathetic : increases stimulation of alpha cells and beta cells.

Cells in the lining of the duodenum produce secretin in response to acidic chyme emerging from the stomach. Secretin stimulates the pancreas to produce and secrete pancreatic juice containing a high concentration of bicarbonate ions. Bicarbonate reacts with and neutralizes hydrochloric acid present in chyme to return the chyme to a neutral pH of around 7.

CCK is a hormone produced by cells in the lining of the duodenum in response to the presence of proteins and fats in chyme. CCK travels through the bloodstream and binds to receptor cells in the acini of the pancreas. CCK

stimulates these cells to produce and secrete pancreatic juice that has a high concentration of digestive enzymes. The high levels of enzymes in pancreatic juice help to digest large protein and lipid molecules that are more difficult to break down.(Gerard J. Tortora 2009)

2.4.Pathology of the pancreas:

2.4.1**Congenital anomalies:-**

Pancreatic development is a complex process involving fusion of dorsal and ventral primordia; subtle deviations in this process frequently give rise to congenital variations in pancreatic anatomy.

2.4.2Pancreas Divisum:

Is the most common clinically significant congenital pancreatic anomaly, with an incidence of 3% to 10% in autopsy series.

2.4.3Annular Pancreas :

Is a relatively uncommon variant of pancreatic fusion in which a ring of pancreatic tissue completely encircles the duodenum.

2.4.4. Ectopic Pancreas:

Aberrantly situated, or ectopic, pancreatic tissue occurs in about 2% of the population; favored sites are the stomach and duodenum, followed by the jejunum, Meckel diverticulum, and ileum.

2.4.5. Pancreatitis :

Inflammatory disorders of the pancreas range in severity from mild, self-limited disease to life-threatening, widely destructive process, and are accordingly associated with deficits that may be trivial and transient or serious and permanent.

2.4.6. Pancreatic Carcinoma:

Infiltrating ductal adenocarcinoma of the pancreas (more commonly referred to as "pancreatic cancer") is the fourth
leading cause of cancer death in the United States, preceded only by lung, colon, and breast cancers. Although it is substantially less common than the other three malignancies, pancreatic carcinoma is near the top of the list of killers because it carries one of the highest mortality rates.

2.4.7. Pancreatic pseudo cyst:

After a bout of pancreatitis, a fluid-filled cavity called a pseudocyst can form. Pseudo cysts may resolve spontaneously, or they may need surgical drainage (Robbins 2013)

2.5. Previous studies:

Basnet, et al 2011 Had done a morphometric study of pancreas among Nepalese population . Their study was carried out to establish a normal dimension of pancreas Thus, a descriptive type of study was done within a period of eight years of time (2004 -2011) on 40 pancreases of both sexes and different age groups, collected from embalmed cadavers from four medical colleges of Kathmandu, Nepal. The obtained specimens of pancreas were classified according to the age and sex. Simultaneously, the weight and length were measured. The data was statistically analyzed and compared, which revealed that the mean size of pancreas was significantly larger in below forty years of age group. Although, there was no significant
difference in the size of pancreas between male and female, the pancreas of male subjects was found larger. Thus, the result of the present study not only provides that the pancreas is larger in younger people and males Basnet, et al 2011).

Association between body mass index (BMI: kg/m2) and pancreatic cancer risk in Asian populations also had done by Kristin E. Anderson, 2014 ,they examined this relationship in 51,251 Chinese men and women aged 45–74 who enrolled between 1993 and 1998 in the population based, prospective Singapore Chinese Health Study. Data were collected through in-person interviews. 194 cohort participants had developed pancreatic cancer. A Cox proportional hazards model was used to estimate hazard ratios (HR) and their 95% confidence intervals (95% CI). They hypothesized the association between BMI and pancreatic cancer risk may vary by smoking status (ever v. never) and there was evidence for this as the interaction between BMI and smoking status was significant ($p = 0.018$). Among ever smokers, being classified as underweight (BMI <18.5 kg/m2), was associated with a significantly elevated risk of pancreatic cancer relative to smokers with a BMI of 21.5–24.4 kg/m2 (HR = 1.99, 95% CI = 1.03–3.84). This association was strengthened after exclusion of the first three years of 36 follow-up time. Among never smokers, there was no association between BMI and pancreatic cancer risk. However, after excluding pancreatic cancer cases and person-years in the first three years of follow-up, never smokers with a BMI ≥ 27.5 kg/m2 showed a suggestive increased risk of pancreatic cancer relative to never smokers with a BMI of 21.5–24.4 kg/m2 (HR = 1.75, 95% CI = 0.93–3.3). In conclusion, Singaporean Chinese who were underweight with a history of smoking had an increased risk of developing pancreatic cancer, whereas there was no significant association between BMI and pancreatic cancer in never smokers (Kristin E. Anderson, 2014).

Heuck et al, 1987 performed abdominal computed tomographic scans

on a group of 360 patients between the ages of 20 and 80 years. The anteroposterior diameter of the pancreatic head, body, and tail, the agerelated ratio of vertebral body-pancreas diameter, and the external and internal contours of the organ were analyzed. The age-related changes in the pancreas were compared with known anatomical findings. External contour of the pancreas show that pancreatic lobulation increase not only in frequently with age but also in degree ;and with advance age a lobular outer contour is common ,Internal structure of the pancreas also changes with age .a homogeneous structure is almost exclusively to one 3rd decade ,by 4th decade patchy structure to one third of pancreas and increase with age. Anteroposterior pancreas diameter affected with age ,an increasing reduction of anteroposterior diameter of pancreatic head ,body, and tail (Heuck et al, 1987).

Afraa et al, 2015 : The data was collected from 252 normal subjects The study revealed that the Sudanese pancreas size was 28.16 ± 3.37 mm for head, 23.19 ± 3.74mm for body, 19.05 ± 3.05mm for tail and pancreas texture which was evaluated as Hounsfield was 59.02 ± 14.17for head, 57.22 ± 12.59 for pancreases body and 55.44 ± 13.12 for pancreases tail. The study showed a significant relation between the pancreas size and subject's age, height, abdomen circumference and vertebral body size, where the pancreas texture has significant relation with age ,height, abdominal circumference body width and texture vertebral and spleen texture. (Afraa et al, 2015).

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

3.1 Study Design

This was descriptive analytical study. It was achieved at radiology department Al-zytouna specialist hospital during the period from August to December 2016.

3.2 Material:

MRI machine –,Toshiba MRI system magnetic felid strength 1.5 Tesla.

Metric scale for patient's heights,

Weight scale, in (KG) s.

3.3 Sample:

3.3.1 Inclusion Criteria:

A total of 50 patients were included in this study 28 female /22 male their ages were between 20 –50years who had undergone axial T1,T2 abdominal MRI weighted images.detailed demographic information of the population including age, gender, weight, height, body mass index (BMI), pancreas head size, pancreas body size and pancreas tail size.

3.3.2 Exclusion criteria:

Patients having pathological changes such as; ascetics, Retro peritoneal mass, Ca head of pancreas, Pancreatitis or any pathology affecting the measurement of the pancreas were excluded.

3.4 Methods

3.4. 1 MRI technique:

All patients underwent combined MRI of the upper abdomen and MRCP. MRI was performed with a 1.5T MR scanner Toshiba Medical Systems. with the use of four-element quadrature phased-array surface coil. The patient lies supine on the examination couch .The patient is positioned so that the longitudinal alignment light lies in the midline, and the horizontal alignment light passes through the level of the third lumbar vertebra, or the lower costal margin Contrast is often necessary in conjunction with dynamic imaging to visualize small pancreatic lesions. Positive and negative oral contrast agents to delineate bowel, and therefore the pancreas, can be useful. Recently studies have been performed using secretin as an enhancement agent. This stimulates the release of fluid into the pancreatic duct, thereby improving visualization on T2 weighted images. used Gd-DTPA was injected at a dose of 0.1 mmol/kg of body weight as a bolus injection at 2 mL/sec using a power injector.

3.4. 2 MRI Protocol:

The standard upper abdomen MRI protocol consisted of the following imaging sequences and parameters:

Coronal breath-hold fast incoherent (spoiled) GRE/SE T1.

Axial FSE/SE/breath-hold fast incoherent (spoiled) GRE T1.

Axial FSE/SS-FSE T2.

Axial breath-hold fast incoherent (spoiled) GRE T1.

MRI m chine 1.5 Tesla was used at alzytona specialist hospital, the selected sequences were Scout: axial sagittal, and coronal. Sequence 1 and 2 were

coronal and axial T2 weighted: TSE, breath hold: TR=3000-4000, TE=90-140, respiratory triggering TR=1900-2300, TE=100, Flip angle 90oSTIR: TR= 2200, TE =60, TI=100 HASTE, breath hold; TR =11.9, TE= 95, Slice thickness 4-6 mm. Slice gap : (0.8- 1.2mm),phase encoding gradient: LR,FOV : 380-400mm, sequence 3 was axial T1-weighted, GRE (FFE), breath hold: TR = 120-140,TE= 4 Flip angle 60oGRE (FFE), respiratory compensation : TR=500-600, TE=10 or as SPIR : TR =500-600, TE=15, or TSE, breath hold: TR = 320, TE=14, Matrix = 140×256.

3.4.3 Method of Pancreas Measurement:

The measurements were taken from the operator council of the MRI machine, the axial images were obtained through the middle of the pancreatic portion (head, body and tail) being studied, anter-posterior (AP) measurements of the body and tail thickness perpendicular to the long axis of the organ were made in (mm). Measurements of AP thickness of the pancreatic head were typically performed in the true AP dimensions. The transverse diameter of the adjacent vertebral body .

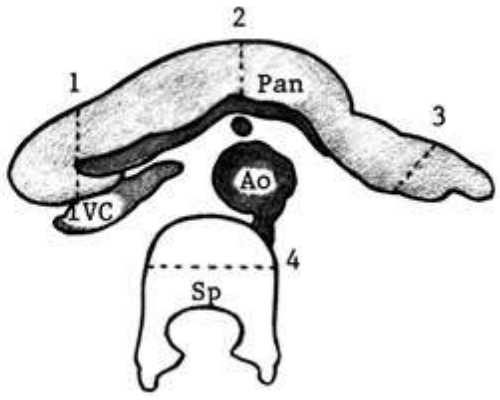

Figure 3.1 shows the method of pancreas measurements

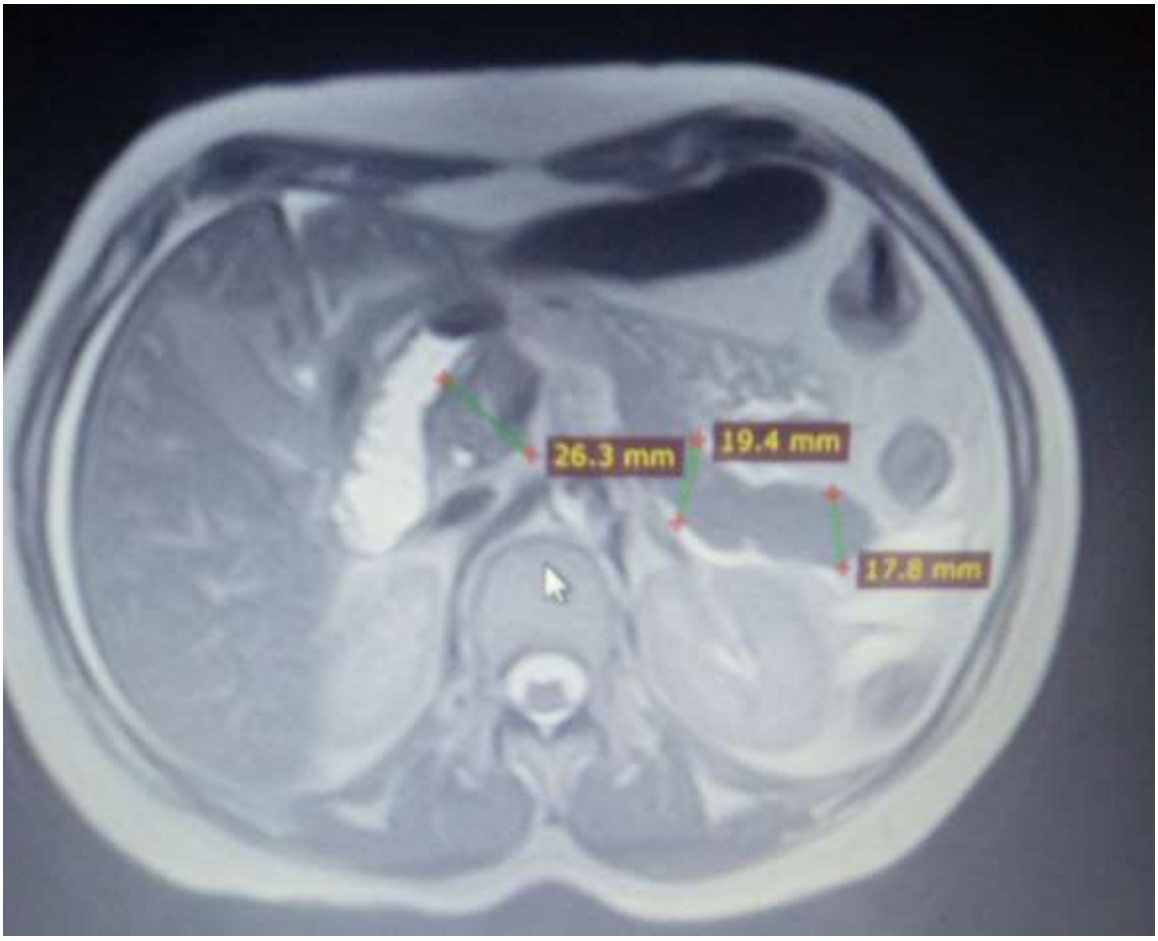

Figure 3.2: Measurement of pancreas for normal patient .

3.5. Statistical Analyses

The data were collected in master data sheet and were analyzed using SPSS program version 16. Data were presented as mean and standard deviation (SD) for all of the variables.

Chapter Four

Results

Chapter Four

Results

The data was achieved at radiology department Al-zaytouna specialist hospital. The data was collected from 50 normal subjects (28 female, 22 male).Patients age, weight, height body mass index (BMI), pancreas head size, pancreas body size, pancreas tail size, Measurement were made ,
Data were presented as mean and standard deviation (SD) for all of the variables.

Table1:Descriptive statistics of the Normal Sudanese Body Characteristics (Total Sample):

	Patient Demographic data			
	Age	**Weight**	**Height**	**BMI**
Mean	35.28	66.81	1.65	24.36
STDV	±10.32	±12.68	±0.089	±3.42

Table 4.2. Descriptive Statistics Mean, Standard deviation of Pancreatic Measurements for the total sample

	Pancreas Parameters /measured in mm		
	Head	**Body**	**Tail**
Mean	26.81	20.02	17.99
STDV	±1.71	±1.57	±1.27

Table 4.3 Descriptive Statistics Mean, Standard deviation of the variables for Males and females:

	Pancreas Parameters /measured in mm		
Gender	**Head/mm**	**Body/mm**	**Tail/mm**
Female	26.52	19.75	17.97
	±1.51	±1.42	±1.06
Male	27.17	20.35	18.00
	±1.71	±1.56	±1.27

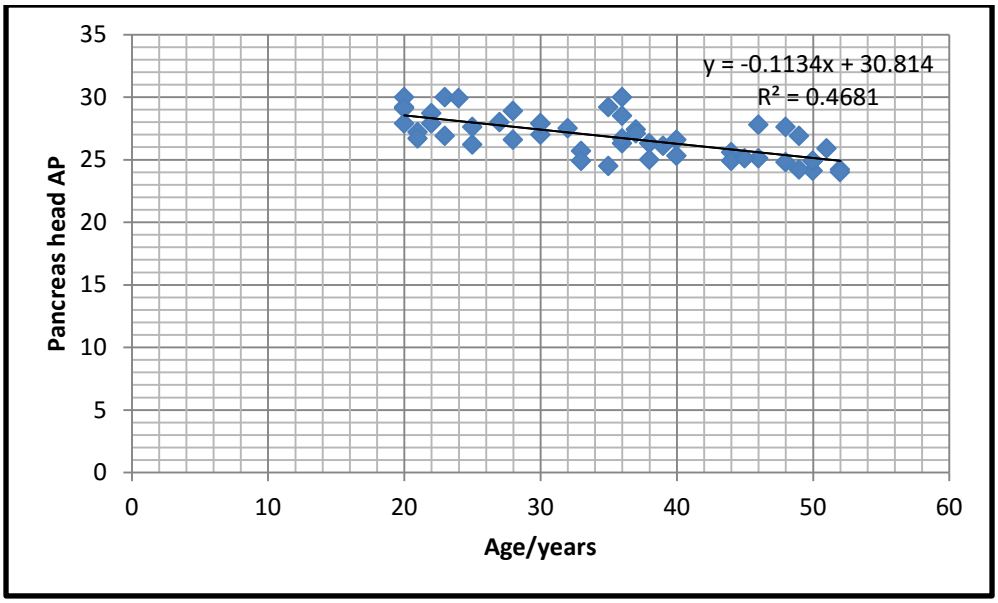

Figure 4.1: Scatter plot diagram shows the relationship between the subjects age and the pancreatic head AP the relation show a linear relation between the age and the pancreatic head R2=0.468, as the age increase the pancreatic head is decreased by o.113 staring from 30.8

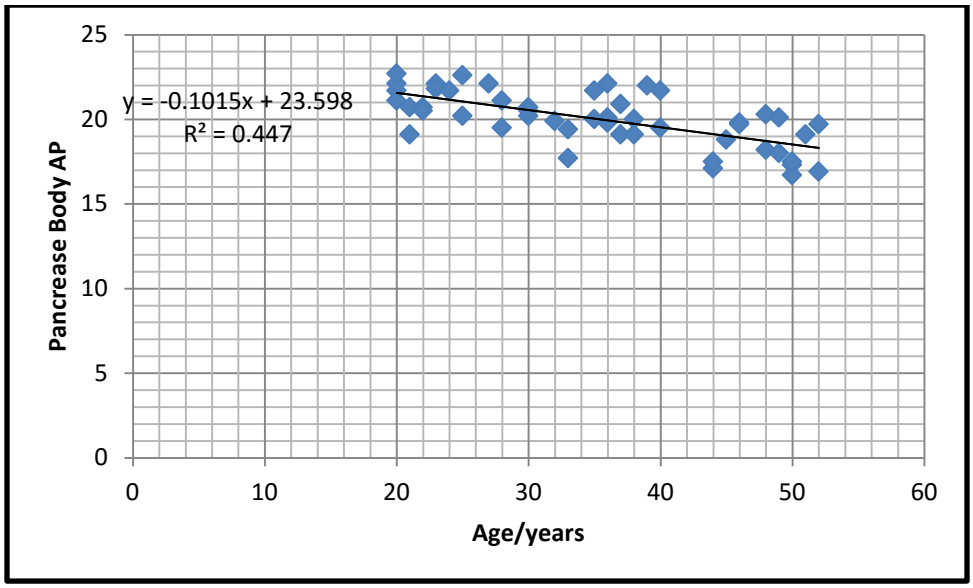

Figure 4.2: Scatter plot diagram shows the relationship between the subjects age and the pancreatic body AP the relation show a linear relation between the age and the pancreatic body, R2=0.447, as the age increase the pancreatic body is decreased by 0.101 starting from 23.6

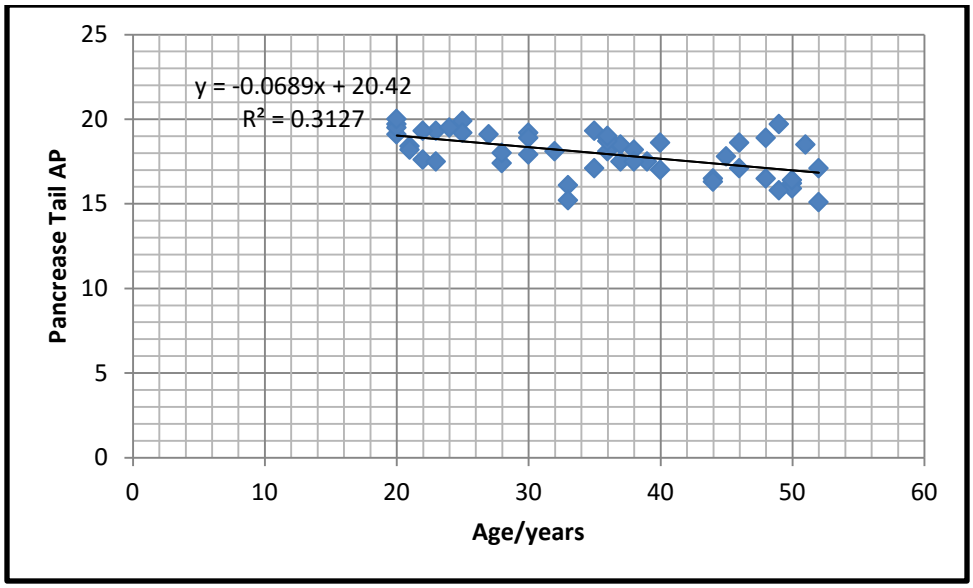

Figure 4.3: Scatter plot diagram shows the relationship between the subjects age and the pancreatic tail AP the relation show a linear relation between the age and the pancreatic tail R2=0. 312, as the age increase the pancreatic tail are decreased by 0.068 starting from 20.4

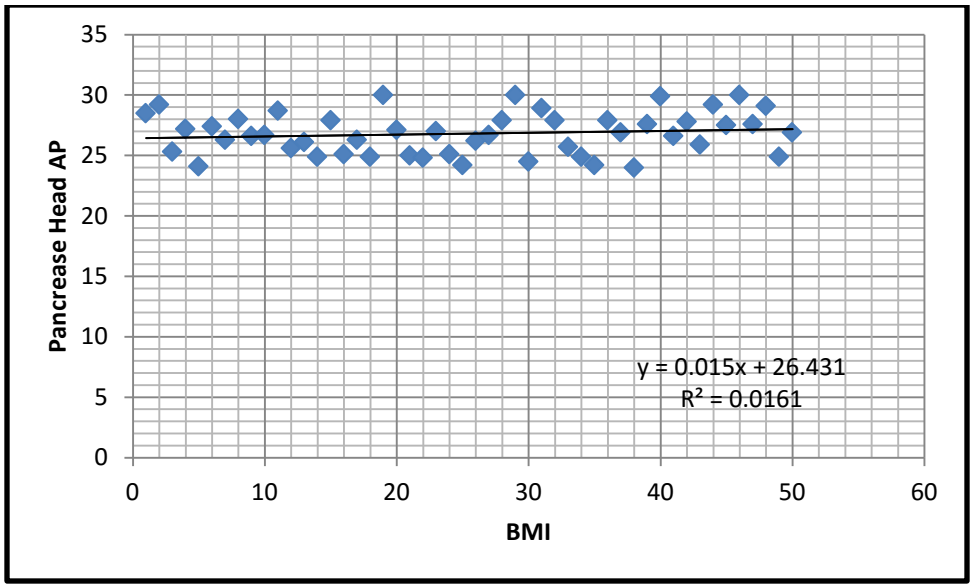

Figure 4.4: Scatter plot diagram shows the relationship between the BMI and the pancreatic head AP the relation show linear relation between the BMI and the pancreatic head R2=0.016 .

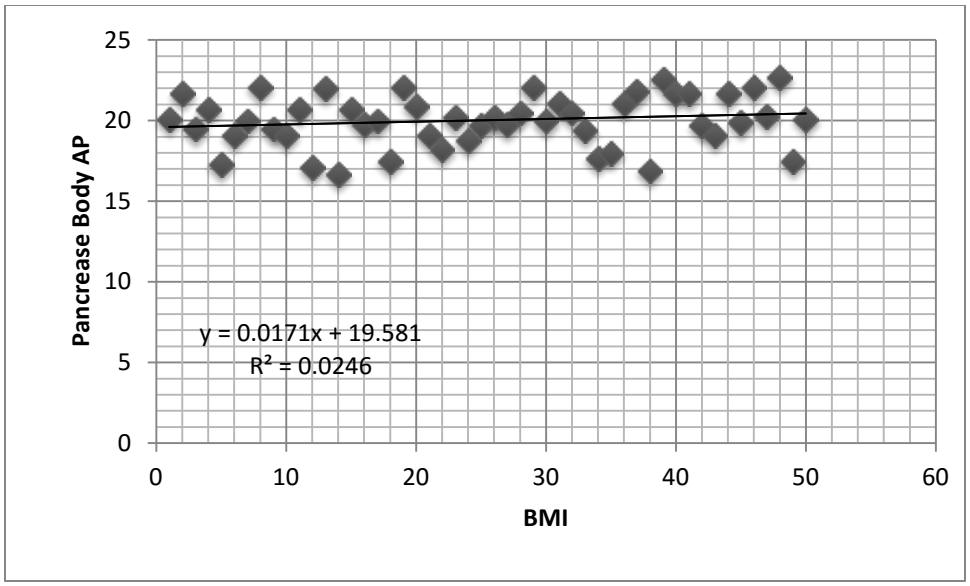

Figure 4.5: Scatter plot diagram shows the relationship between the BMI and the pancreatic body AP the relation show linear relation between the BMI and the pancreatic body R2=0.024.

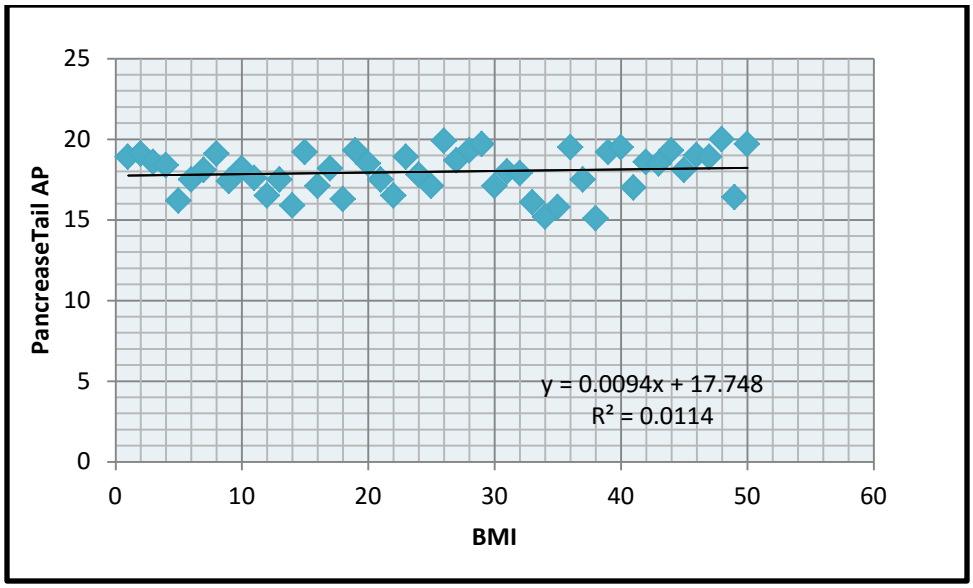

Figure 4.6: Scatter plot diagram shows the relationship between the BMI and the pancreatic tail AP the relation shows linear relation between the BMI and the pancreatic tail R2=0.011.

Chapter five

Discussion

Chapter five

5.1Discussion:

The objectives of this descriptive study were to characterize the pancreas in Sudanese population by using MRI scan in order to alleviate the discrepancy that arise in the pancreas measurement which attributed to body characteristic .The sample of this study consisted of 50 subjects with different genders, 28 were Female and 22 were male.

Descriptive Statistics mean and SD of the variables which includes age, height, weight, BMI, pancreas characteristic of head, body, tail size.

The study showed mean and STD of total samples of the body characteristics for age weight height and BMI were 35.28±10.32, 66.81±12.68, 1.65±0.089, 24.36±3.42 respectively, as table{4.1}.

The Mean, Standard deviation of Pancreatic Measurements for the total sample head, body and tail were 26.81±1.71, 20.02±1.57, 17.99±1.27 respectively, as table {4.2}these measurement is smaller compared to study done by[afraa et al,2015]

The study showed Mean, Standard deviation of the variables for Females pancreas head, body and tail were 26.52 ±1.51

,19.75±1.42, 17.97±1.06 and males were 27.17±1.71, 20.35±1.56, 18.00±1.27 respectively, as table {4.3.}.

The relation between the age and the head of pancreases, the study showed that there was negative linear relation .The head of pancreases

decreased with age increase by o.113 staring from 30.8 as in figure[4.1].these measurement compared to study done by[heuck et al,1987]

The relation between the age and the body of pancreases, the study showed that there was negative linear relation .The body of pancreases decreased with age increase by 0.101 starting from 23.6 as in figure[4.2] these measurement compared to study done by[heuck et al,1987]

The relation between the age and the tail of pancreases, the study showed that there was negative linear relation .and the tail of pancreases decreased with age increase by 0.068 starting from 20.4 as in figure [4.3]. these measurement compared to study done by(heuck et al,1987)

The relation between the BMI and the pancreatic head ,body and tail AP the study showed that there was no linear relation between the BMI and the pancreatic head ,body and tail as table{4.4,4.5,4.6}.

5.2 Conclusion:

The study showed negative linear relation[reversal relation] between the pancreas size and
subject's age, As the head, body and tail of pancreases with age.

The study showed There was no linear relation between BMI and pancreases measurements.

The study showed There were differences between males and females measurements.

5.3 Recommendations:

- Its recommened to studies texture of pancreas by MRI.

- The pancreatic duct diameter in Sudanese population must be studies
- Because MRI scan plays a big rule in imaging of pancreas there for it is recommended to be used as a diagnostic method in pancreatic diseases.

- As the morphology differs regarding the race and ethnicity factor a Similar local research is recommend in different Sudanese tribes
- The researcher notes that the size of the pancreas is different in normal Sudanese people so suggest study of that theory.

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Appendix

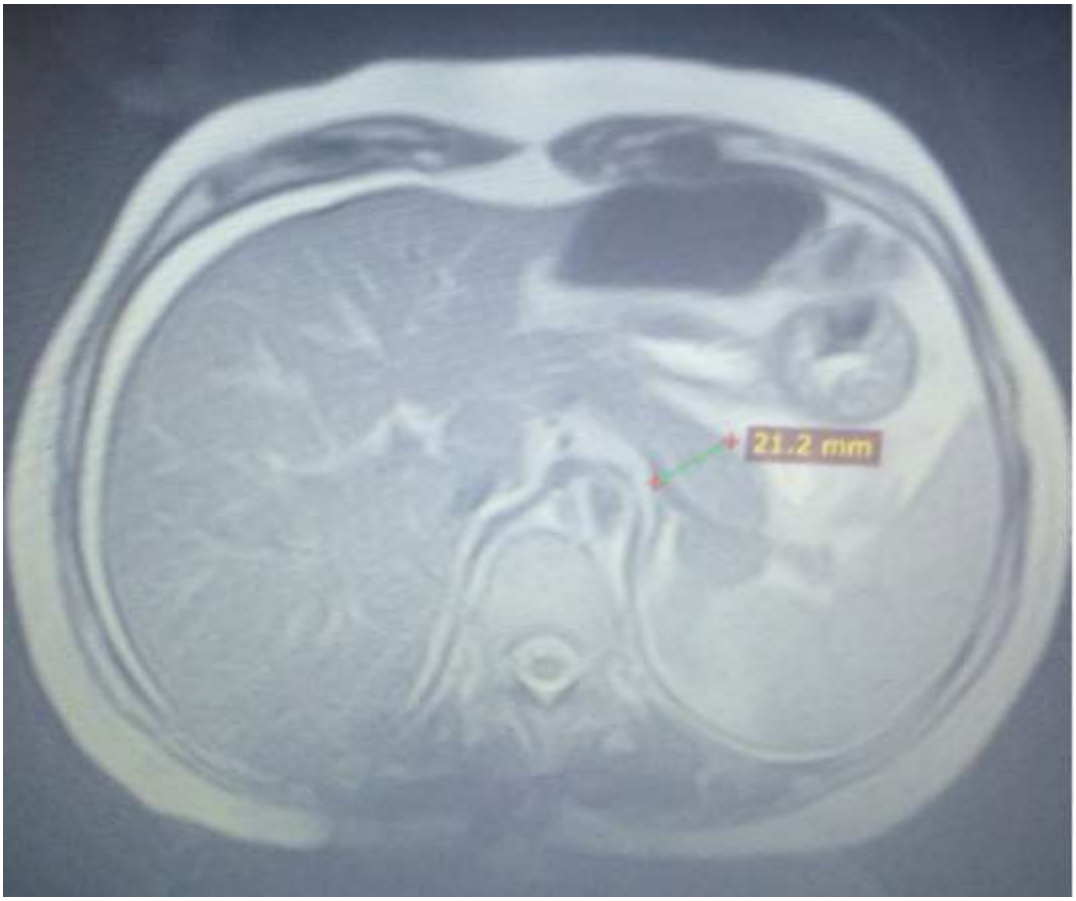
Sudan University of Science and Technology

Collage of Graduate Studies

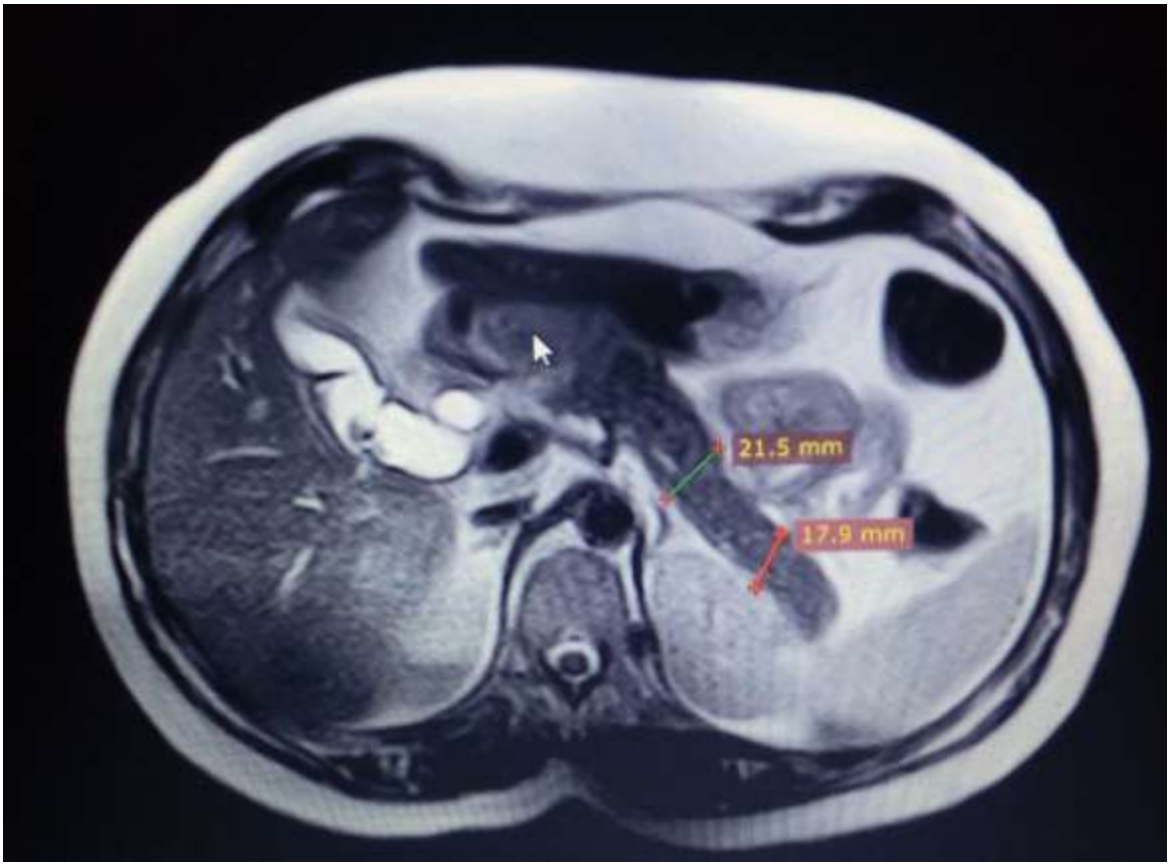
Measurement of normal pancreas in Sudanese people

Data collection sheet

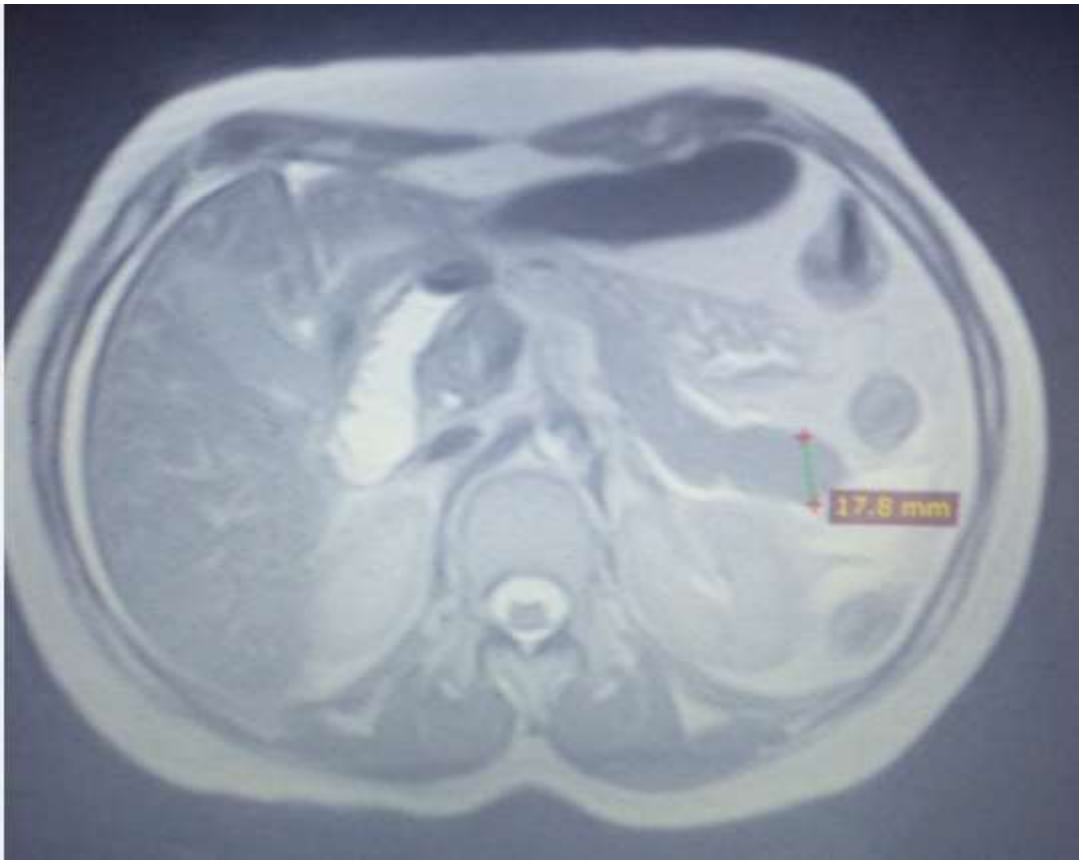
NO	Age	Gender	Weight	Height	BMI	Head	Body	Tail



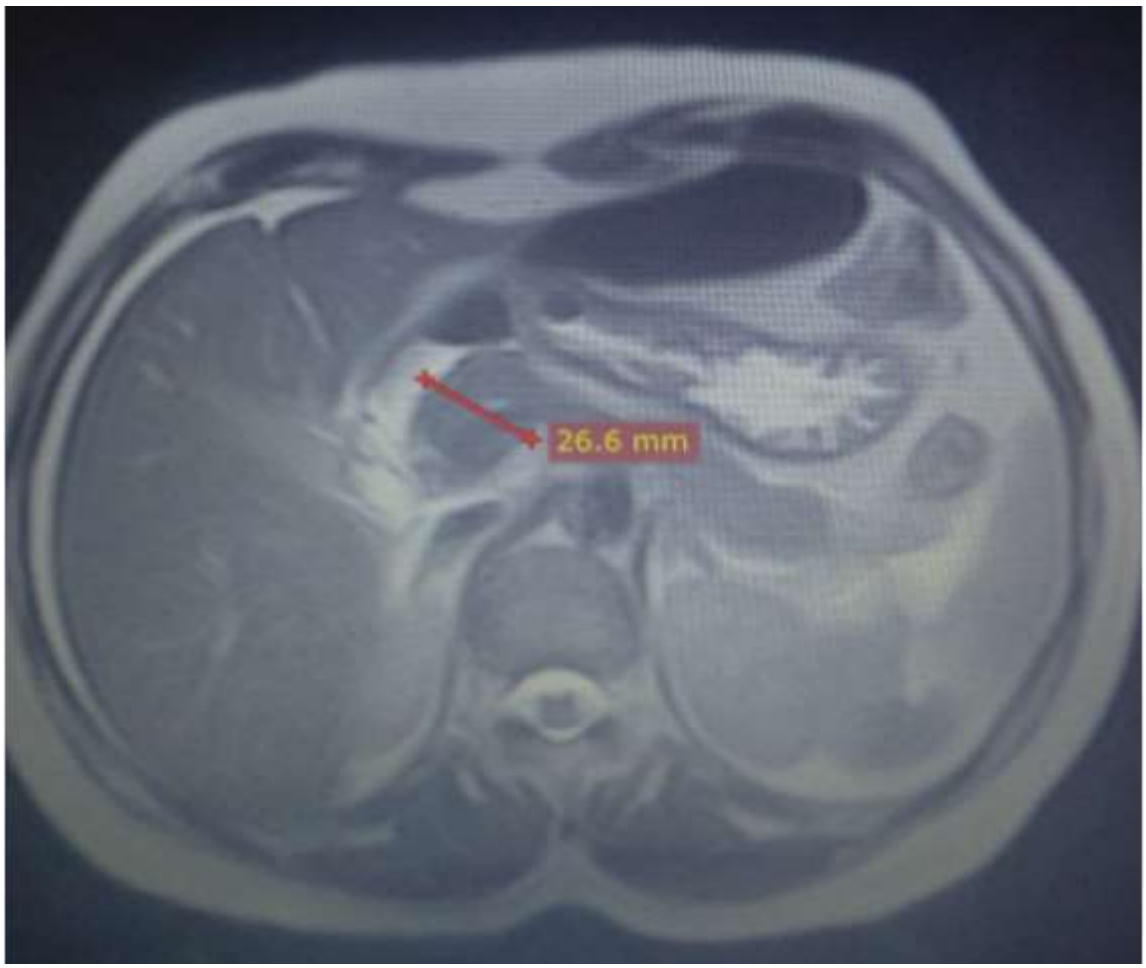
Measurement of pancreas body for normal female patient with age 33 years.



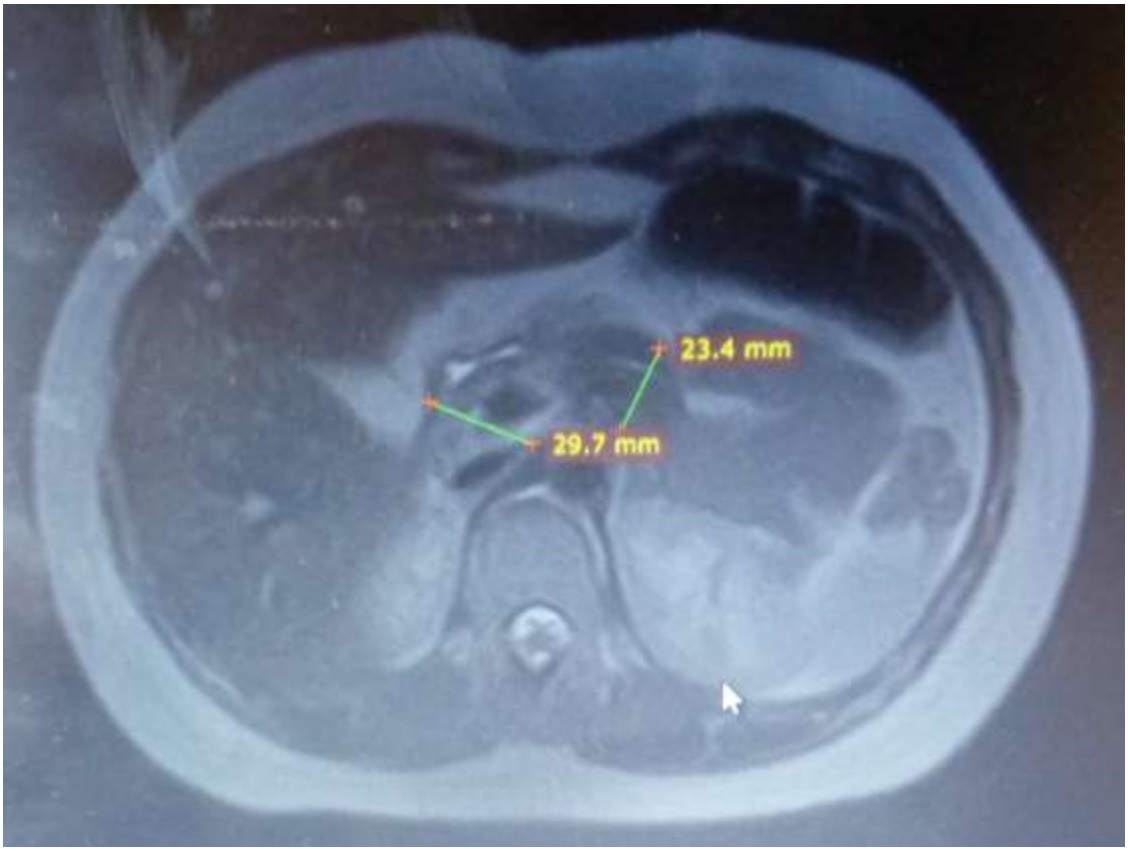
Measurement of pancreas body and tail for normal male patient with age 35 years



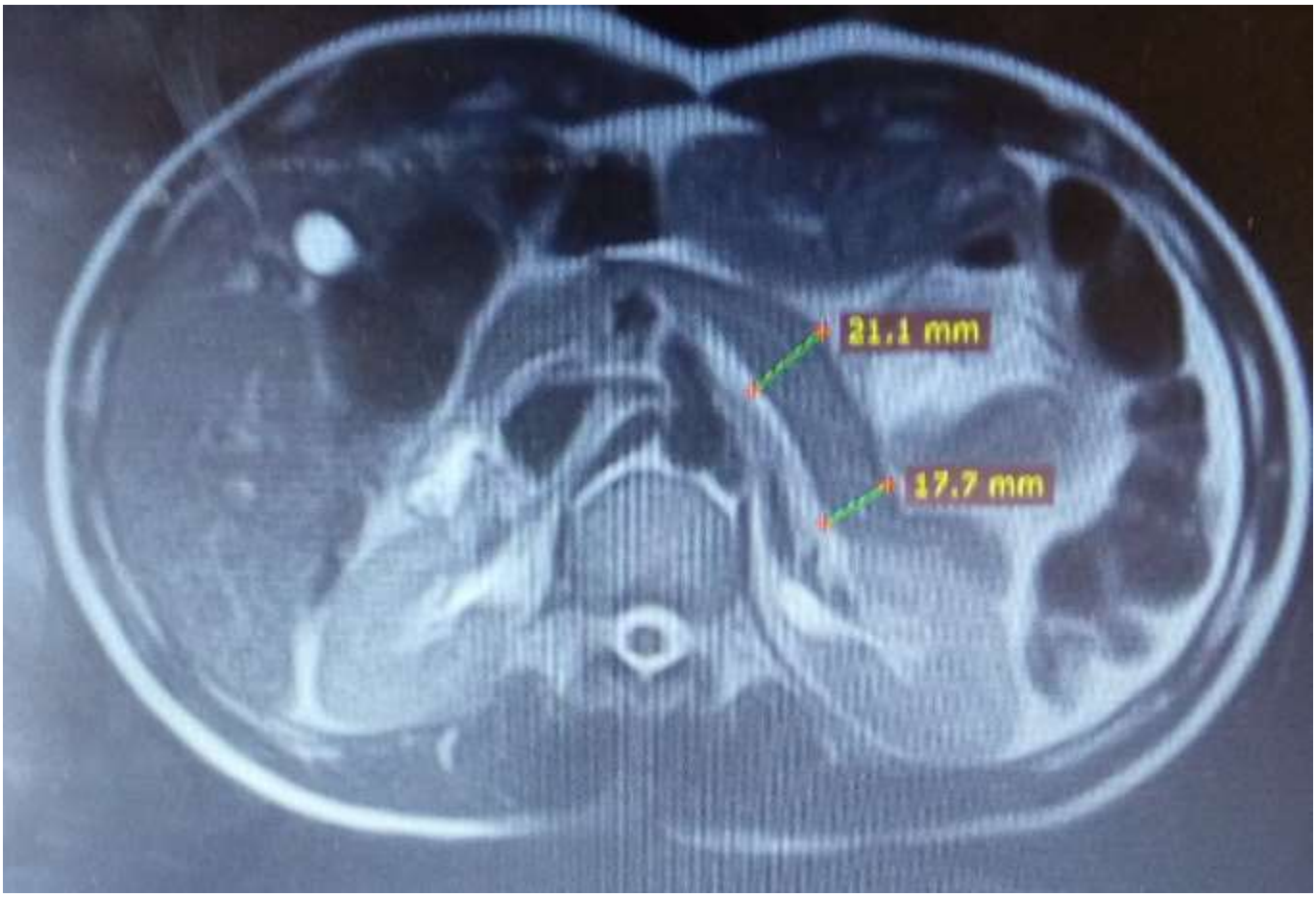
Measurement of pancreas tail for normal female patient with age 38 years.



Measurement of pancreas head for normal female patient with age 45 years.



Measurement of pancreas head and body for normal male patient with age 23 years.



Measurement of pancreas body and tail for normal male patient with age 28 years.