Sudan University of Science and Technology

College of Graduate Studies and Scientific Research

Evaluation of Pancreatic Lipomatosis among Adult Saudi Diabetic Patients using Diagnostic Ultrasonography

تقييم داء دهون البنكرياس لدي مرضى السكري السعوديين البالغين باستخدام الموجات فوق الصوتية التشخصية

A Thesis Submitted for Partial Fulfillment for the Requirements of M.sc Degree in Medical DiagnosticUltrasound

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بسم الله الرحمن الرحيم

الآية

قال تعالي:-

﴿ وَلَمَّا بَلَغَ أَشُدَّهُ وَاسْتَوَى آتَيْنَاهُ حُكْمًا وَعِلْمًا وَكَذَلِكَ نَجْزِي الْمُحْسِنِينَ ﴾

صدق الله العظيم

[القصص : 14]

Dedication

I dedicate this study to:

My **"Dad",** who stands beside me, let me not to be stranger….

My "Mom" who races words to come out and teaching how to face difficulties….

My dear wife, "**Refqa**, I love you because you are my love & your love is a sea, supporting me in all my life conditions….

My dear son **"Mohammed**" ، I'm insightful you are my spot of light in my life darkness…

My brothers **(Nora - Asaad - Amjad)** I love you if you pass that love on a barren land, where the springs of love burst forth forever"….

My teachers being candles that burn to light up for others…

Acknowledgement

Firstly, I want to thank Allah for completion of my study and success. I would like to express my appreciation to my parents who take care of me during my stay abroad. Grateful to my Dr/ **Dr. Babiker Abdulwahab** who has cheerfully helped me by answering my questions and checking my works ,**Dr. Abdul Aliem Sobh** "internal medicine physician Zahrat Al-Amal poly clinic "1" –Riyadh-Saudi arabia ". Also deepest appreciation and sincerest gratitude for my friends & colleagues **Mohammadani Mahdi , Salah Mustafa , Mohammed Abbas , Eman Mahjoub , Nihad Ali Idris..**

Abstract

This retrospective and analytical descriptive study was Zahrat Al-Amal poly clinic (1) (Kingdom Saudi Arabia). First March to first July 2018, for adults (diabetic) patients came to ultrasound clinic for general indications of trans-abdominal ultrasound. The problem of study was increase in numbering of pancreatic Lipomatosis among Saudi population. The objectives of this study were to evaluation of pancreatic lipomatosis among Saudi population in Riyadh using medical diagnostic ultrasound, to determine the age, gender group which highest prevalence, to correlate between the family history group of DM which highest prevalence, to find the comments type of fatty replacement of pancreas.

The data were collected variables included using High resolution H60 ultrasound machine (Samsung manufacturing – koria) with 3.5 MHz convex probe, , through 50 DM patients their age was from (15-60) years old. The data were analysis by (SPSS) version 20.

The result revealed the average mean of age (3.1±0.99), the high prevalence of Lipomatosis in age (more than 45) years old and commonest in female than male. Also there was strong correlation between lipomatosis and age of patient at P value = (0.022) .There was strong correlation between lipomatosis and patient family history especially the patients whom had gastric sleeve surgery, the different significant at P value = (0.022). Lipomatosis was commonest in patients with type II of DM, but there was no significant at P value (0.212). No correlation between Lipomatosis and alcohol abuse at P value = (0.868).

Researcher recommended increase size of sample, using 3D and 4D for other accurate measuring.

ملخّص البحث

تمت هذه الدراسة الوصفية بأثر رجعي وتحليلي لعيادة زهرة الأمل عيادة رقم (1) بالمملكة العربية السعودية. في الأول من مارس إلى الأول من يوليو 2018 ، بالنسبة للبالغين (مرضى السكري) اللذين جاءوا إلى عيادة الموجات فوق الصوتية لفحوصات البطن. تمثلت مشكلة الدراسة في زيادة عدد الإصابات بالتهاب البنكرياس الشحمي بين السكان السعوديين. هدفت هذه الدراسة إلى تقييم داء البنكرياس الشحمي بين السكان السعوديين في الرياض باستخدام الموجات فوق الصوتية التشخيصية الطبية لتحديد الفئة العمرية والجنس الأكثر انتشارًا ، والربط بين مجموعة التاريخ العائلي لمرض السكري.

تم جمع البيانات المتغيرة باستخدام جهاز الموجات فوق الصوتية عالي الدقة H60 (تصنيع Samsung koria –) مع مسبار محدب 3.5 ميجا هرتز ، من خلال 50 مريضًا من مرضى السكري و كانت أعمارهم تتراوح بين (15–60) عامًا. تم تحليل البيانات بواسطة (SPSS) الإصدار 20.

أظهرت النتائج متوسط العمر (3.1 ± 0.99) ، ارتفاع معدل انتشار الدهن الشحمي في العمر (أكثر من 45) سنة والأكثر شيوعًا في الإناث عن الذكور. كما كانت هناك علاقة ارتباط قوية بين التشحم الشحمي وعمر المريض بقيمة معنوية (0.022)، وكان هناك علاقة ارتباط قوية بين الدهون والتاريخ العائلي للمريض خاصة المرضى الذين خضعوا لعملية تكميم المعدة عند قيمة المعنوية (0.022). كان الدهن الشحمي أكثر شيوعًا في المرضى الذين يعانون من النوع الثاني من DM ، ولكن لم يكن هناك معنوي بقيمة (0.212). لا توجد علاقة بين داء الشحوم وتعاطي الكحول عند قيمة(0.868) .

أوصى الباحث بزيادة حجم العينة باستخدام لمعرفة مضاعفات المرض من خلال الموجات الفوق الصوتية

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List of Abbreviations

Abbreviation	Meaning
BMI	Body Mass Index
CT	Computed Tomography
DM	Diabetes Miletus
ERCP	Endoscopic Retrograde Cholangiopancreatography
FPG	Fasting Plasma Glucose
MRI	Magnetic Resonance Imaging
NAFPD	Non-Alcoholic Fatty Pancreas Disease
PL	Pancreatic lipomatosis
PL	Pancreatic Lipomatosis
SPSS	Statistical Package for the Social Sciences
TG	Triglycerides
US	Ultrasound

Chapter one

Introduction

Chapter one

Introduction

1-1 Introduction

Pancreatic lipomatosis (PL) is also known as adipose atrophy of pancreatic parenchyma. The pancreas may appear normal or may be massively enlarged, resulting in a condition known as lipomatous pseudohypertrophy. Commonly called fat replacement – represents which is the most frequent benign pathologic condition of the adult pancreas. Most cases remain asymptomatic, and only some rare extreme degrees of lipomatosis or fat replacement may lead to exocrine pancreatic insufficiency. Many terms have been used in the literature to refer to similar conditions. Recognizing these differences, one nomenclature proposes that the general terms for pancreatic fat accumulation include pancreatic lipomatosis, fatty pancreas, and pancreatic steatosis . The most extreme variant is lipomatous pseudohypertrophy, characterized by pancreatic enlargement, but some consider this a distinct entity.

1-2 Problem

An increase in numbering of population with variable age, sex, activity and health condition with sonographic findings of pancreatic Lipomatosis among Saudi population.

1-3 Justification:

Awareness of the population will be increased about the disease & the cause, easy diagnosing by ultrasound so, our citizens will be protected.

1-4 Research Objectives

1-4-1 General objectives:

Evaluation of pancreatic lipomatosis among Saudi population in Riyadh using medical diagnostic ultrasound

1-4-2 Specific objectives:

1. To determine the age group which highest prevalence.

2. To determine the gender group which highest prevalence, to affected by pancreatic lipomatosis.
3. To determine the family history group of DM which highest prevalence.
4. To correlate the prevalence with age, gender and family history of DM.

1-5 Hypotheses

Prevalence of pancreatic lipomatosis among Saudi population in Riyadh is increase with incidence of DM.

1-6 Overviews of the Study:

This study consists of five chapters:

Chapter one contain introduction and objectives (general and specific), Chapter two shows literature review and previous studies , chapter three include the materials and methods, Chapter four contain the results presentation as well as tabulation and graphs. Lastly chapter five which include the discussion, conclusion and recommendations as well as references used in this research.

Chapter Two

Literature Reviews and Pervious Studies

Chapter Two

Literature Review and Pervious Studies

2-1 Literature Reviews:

2-1-1 Pancreatic Anatomy:

The pancreas is approximately 12–15 cm long and 2.5 cm thick. It is situated across the back of the abdomen, behind the stomach. The head of the pancreas is on the right side of the abdomen and it is connected to the duodenum (the first section of the small intestine) through a small tube called the pancreatic duct. The narrow end of the pancreas, called the tail, extends to the left side of the body (**Ian Peate ,2015)**

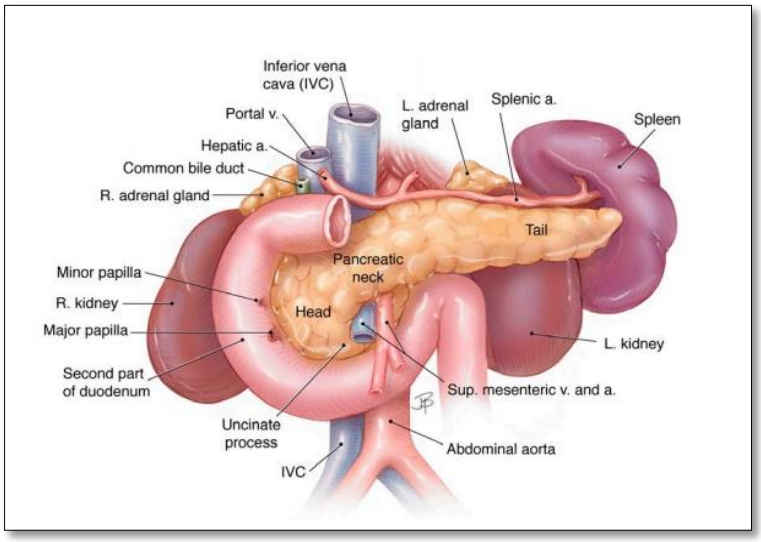

FIGURE 2-1 Anatomic relationships of the pancreas with surrounding organs Ian Peate (2015)

The pancreas is divided into a head, neck, body and tail. The head lies to the right of the spine within the "C" loop formed by the superior, descending and transverse portions of the duodenum. The uncinate process is the medial tapered projection of the head that extends posterior to the superior mesenteric vein and may be large enough to extend posterior to the superior mesenteric artery. The neck is the portion of the gland that lies anterior to the superior mesenteric vein

and the origin of the main portal vein. The body extends to the left of the neck and runs anterior to the splenic vein. The neck and body of the pancreas are often the most anteriorly located portions of the gland. No anatomic landmark separates the body from the tail. The left border of the vertebral column is an arbitrary plane for dividing the body from the tail. The tail extends across the left adrenal gland and upper pole of the left kidney to end near the hilum of the spleen. The pancreatic tail is most commonly found at or near the splenic hilum but it may lie lower and then be near the upper pole or hilum of the left kidney. The following diagram illustrates the most common position of the tail of the pancreas (#1) and other variable positions numbered according to the frequency of their occurrence. In most patients the head has the greatest anteroposterior diameter followed by the body and finally the tail with the narrowest diameter. In some patients the pancreatic tail appears bulbous and is therefore more prominent. Pancreatic Ducts performed to rule out a focal mass however, a sonographically prominent tail is most often a normal variant. In case of doubt, correlation with CT or MRI scans may be helpful (Brwein)

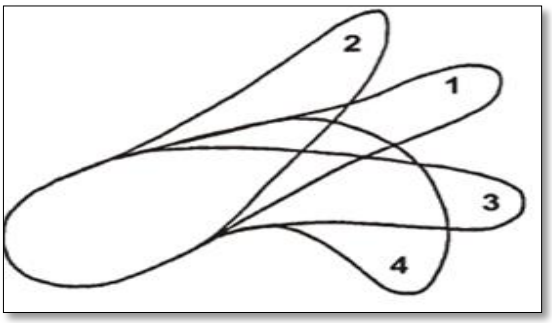

FIGURE 2-2 variable position of the tail of the pancreas (Brwein)

The normal pancreatic duct extends the length of the pancreas and is best demonstrated as parallel lines in the mid body of the gland on transverse scans. Since the duct is parallel to the skin surface and its walls are specular reflectors, the sound beam will strike these interfaces at 90 degrees, thus enabling maximum resolution. A short portion of the duct may be demonstrated in the head region where it again flows in the transverse plane. It is important to note that

parenchymal tissue completely surrounds the duct that is, the duct is centrally located within the gland. “The mean internal diameter on sonographic examination has been reported to measure 3 mm in the head, 2.1 mm in the body, and 1.6 mm in the tail.”2 Occasionally an accessory pancreatic duct (of Santorini) may be visualized in the head region of the pancreas. When present it will open into the duodenum via the lesser duodenal papilla 2 cm. more proximal than that of the main pancreatic duct. This accessory duct is usually smaller than the main pancreatic duct.

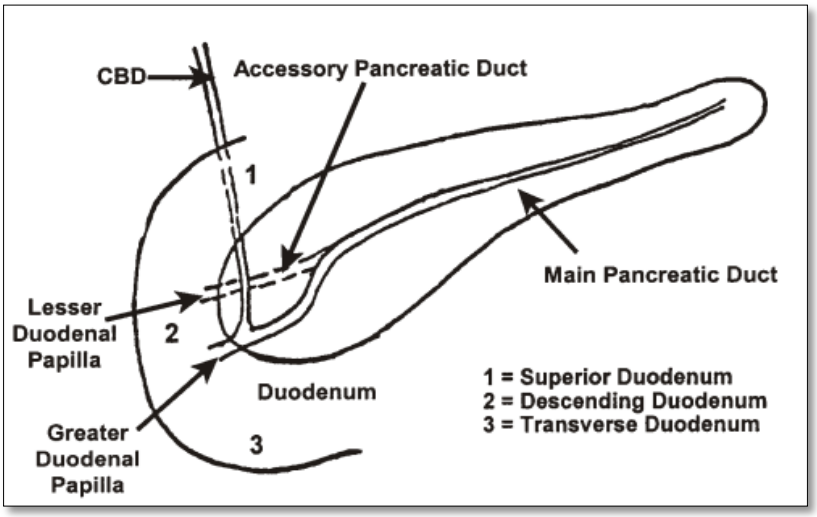

FIGURE 2-3 Pancreatic Ducts (Brwein)

2-1-2 Physiology of the pancreas:

The pancreas is a mixed gland; that is, it has both endocrine and exocrine functions. The cells that produce the exocrine secretions are grape-like in appearance. Each grape like cluster of cells is called an acinus (the pleural is acini). The cells liberate their secretions into the pancreatic duct. The volume of exocrine secretions produced in the acinar cells in man ranges from 800 to 1200 ml. per day and contains at least nine digestive enzymes, as well as water, bicarbonate and salts. In the duodenum the enzymes take part in the breakdown of proteins, carbohydrates and fats (lipids) and help to neutralize the acid chyme from the stomach. The pancreatic enzymes are very powerful digestive enzymes.

Without these enzymes food would not be broken down enough to enable adequate absorption of food by the small intestines. The person would then suffer from malnutrition. The main pancreatic enzymes are amylase which aids in the digestion of carbohydrates, lipase which can complete the digestion of fats and trypsin which aids in the digestion of proteins. The endocrine secretions are produced in isolated islands of cells called pancreatic islets or the islets of Langerhans. These islets are more numerous in the tail of the pancreas. The islet cells produce insulin and glucagon which are liberated into the bloodstream and carried throughout the body. Insulin influences the body cells to take up sugar from the bloodstream; thereby lowering the level of blood sugar. Glucagon influences the liver and causes it to liberate stored sugar into the bloodstream; thereby elevating blood sugar levels. Sugar is stored in the form of glycogen and liberated into the bloodstream as glucose. (Brewin)

TABLE 2-1: Exocrine Function of the Pancreas
1. Amylase—digests carbohydrates. **2. Lipase—digests fats.** **3. Sodium bicarbonate—neutralizes stomach acids.** **4. Trypsin, chymotrypsin, and carboxypolypeptidase— digest proteins**

TABLE 2-2: Endocrine Function of the Pancreas		
Alpha cells	Glucagon	Promotes the release of glucose by the liver (increases blood sugar level)
Beta cells	Insulin	Stimulates the body to use up glucagon to produce energy
Delta cells	Somatostatin	Restrains insulin and glucose levels

Vascular Anatomy of the Pancreas:

The arterial blood supply to the head of the pancreas is via the gastroduodenal artery. The body and tail of the pancreas receive their blood supply from the splenic and superior mesenteric arteries. Venous drainage is achieved by means of the splenic vein, superior mesenteric vein, inferior mesenteric vein, and portal veins.

2-1-3 Pathology of the Pancreas:

2-1-3-1 Sugar diabetes (diabetes mellitus):

It is a heterogeneous group of chronic disorders involving carbohydrate, fat, and protein metabolism. It is the absolute or relative lack of insulin. It is a polygenic disorder meaning it is an hereditary disorder with variable penetrance and often requires other factors to be present such as, obesity, in order for the disorder to the expressed in that individual. Sugar diabetes results in hyperglycemia (elevated levels of blood sugar). Hypoglycemia (depressed levels of blood sugar) is often due to too much insulin production or due to little or no glucagon production by the pancreas. It can also result from depletion of glycogen storage in the liver due to starvation or no carbohydrate intake in the diet. Hypoglycemia is also associated with diabetic patients; especially overnight fasting diabetic patients on regular medication who come for ultrasound examinations can become hypoglycemic during the scan session. Generally, the physician informs the ultrasound department that the patient is diabetic. The patient receives the earliest morning booking so the procedure is completed and the patient can eat as early in the day as possible. Often the diabetic patient is instructed to take his/her insulin along with a small glass of orange juice at the regular time, the morning of the ultrasound examination. Check what your department protocol is for booking and preparation for diabetic patients. **(**Brwein)

Two major types – Type 1 or “Insulin dependent DM” which more commonly arises in children and adolescents. Autoimmune disease, autoantibodies against beta cells that tends to be severe with marked insulin deficiency, and marked

hyperglycemia, if not controlled results in ketoacidosis – Type 2 or "Adult onset DM" is more common in adults, often obese normal or increased blood insulin Target tissues are insulin resistance.

Long term complications of DM can involve many organs systems with resultant high morbidity . Atherosclerosis, peripheral vascular disease, myocardial infarcts, nephrosclerosis, peripheral neuropathy, microangiopathy and cerebrovascular infarcts and hemorrhages.

2-1-3-2 pancreatic lipomatosis:

Mature fat cells with thin internal fibrous septa. It differs from pancreatic lipomatosis in that it has well-defined margins conferred by a thin collagen capsule.

- even pancreatic lipomatosis
- uneven pancreatic lipomatosis
  - type 1a: preferential fatty replacement of the head, sparing the uncinate process and peribiliary region
  - type 1b: preferential fatty replacement of head, neck, and body, sparing the uncinate process and peribiliary region
  - type 2a: preferential fatty replacement of head, including uncinate process, and sparing the peribiliary region
  - type 2b: total fatty replacement of the pancreas except the peribiliary region

2-1-3-3 Acute Pancreatitis:

Acute pancreatitis is the inflammation of the pancreas secondary to the leakage of pancreatic enzymes from the acinar cells into the parenchyma of the organ. These enzymes can destroy the pancreatic tissue and the tissues surrounding the pancreas. Acute pancreatitis may be described as mild, moderate, or severe. Causes of acute pancreatitis include alcoholism, choledocholithiasis, post endoscopic retrograde cholangiopancreatography (ERCP), and trauma.4,6 There are several specific clinical findings that suggest acute pancreatitis. The patient will complain of abdominal pain and back pain, and also have an elevation in

serum amylase and lipase. Amylase levels will rise first, and within 72 hours an accompanying rise in lipase should occur.4 Lipase appears to be more specific for diagnosing pancreatitis, as hyperamylasemia can be associated with other abnormalities. Milder cases of pancreatitis can resolve spontaneously. Higher mortality rates are associated with acute pancreatitis when the disease progresses and leads to severe necrosis and hemorrhage of the organ. In these situations, patients may suffer from shock, ileus, and have a decreased hematocrit secondary to hemorrhage. Unfortunately, sonography is not always successful at diagnosing cases of acute pancreatitis, as the pancreas may appear completely normal with mild disease.9 But it can provide useful information as to the size and echogenicity of the gland and determine if any peripancreatic fluid collections exist. This peripancreatic fluid collection may be referred to as phlegmon. The involvement of the gland can be focal or diffuse. Focal pancreatitis will lead to an enlargement of the gland in a particular segment, most often in the head. This manifestation of pancreatitis can resemble a neoplasm, and an investigation of the laboratory findings in such patients should be performed. Diffuse enlargement of the gland can also occur with pancreatitis, as the entire pancreas will become enlarged and hypoechoic. The pancreatic margins may appear ill defined with areas of fluid collections noted within and around the pancreas. Both focal and diffuse acute pancreatitis can lead to hemorrhage, peripancreatic fluid collections, and a pancreatic pseudocyst. With moderate and severe pancreatitis, the body will attempt to encapsulate the damaging pancreatic enzymes and form a pseudocyst. One of the more common sites for a pancreatic pseudocyst is the lesser sac, which is located between the pancreas and the stomach, though pseudocysts may be found as far away as the groin.4,6 A pancreatic pseudocyst will appear as an anechoic mass with posterior enhancement, although it may contain some internal echoes. Vascular complications can also arise secondary to the destructive influence of the pancreatic enzymes on adjacent vascular

structures. The more common vascular complications include thrombosis in the splenic vein and pseudoaneurysm of the splenic artery.(Steven M. Penny,2011) Clinical findings of acute pancreatitis include elevated amylase (within 24 hours) , elevated lipase (within 72 hours) , abdominal pain, back pain, fever, nausea and vomiting , Leukocytosis and severe acute pancreatitis may lead to hemorrhage and a decreased hematocrit. Sonographic appearances of acute pancreatitis include the following; the pancreas may appear normal, diffusely enlarged, hypoechoic pancreas (diffuse manifestation),focal hypoechoic area within the pancreas (focal manifestation),unencapsulated anechoic fluid collection surrounding all or part of the pancreas , pancreatic pseudocyst , abscess formation can occur and is seen as echogenic fluid containing gas bubbles, biliary obstruction may be present and vascular complications such as thrombosis (splenic vein) and pseudoaneurysm (splenic artery). (Steven M. Penny,2011)

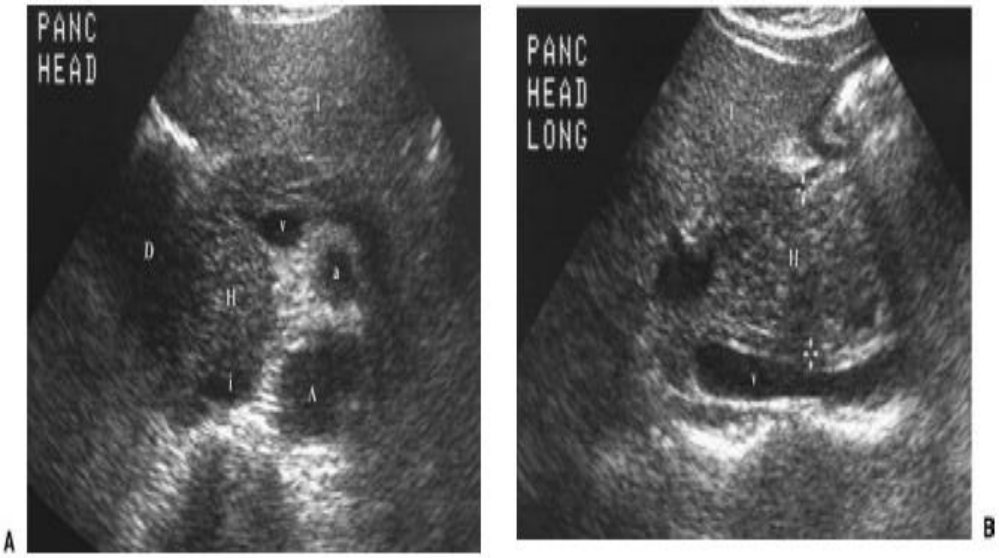

FIGURE 2-4 Focal acute pancreatitis. A. Transverse image of the pancreas reveals the duodenum (D), liver (l), inferior vena cava (i), aorta (A), superior mesenteric artery (a), superior mesenteric vein (v), and an enlarged pancreatic head (H). B. Longitudinal image of the pancreatic head (H) between calipers. (Image reprinted with permission from Brant W. The Core Curriculum: Ultrasound. Philadelphia: Lippincott Williams & Wilkins, 2001:76.)

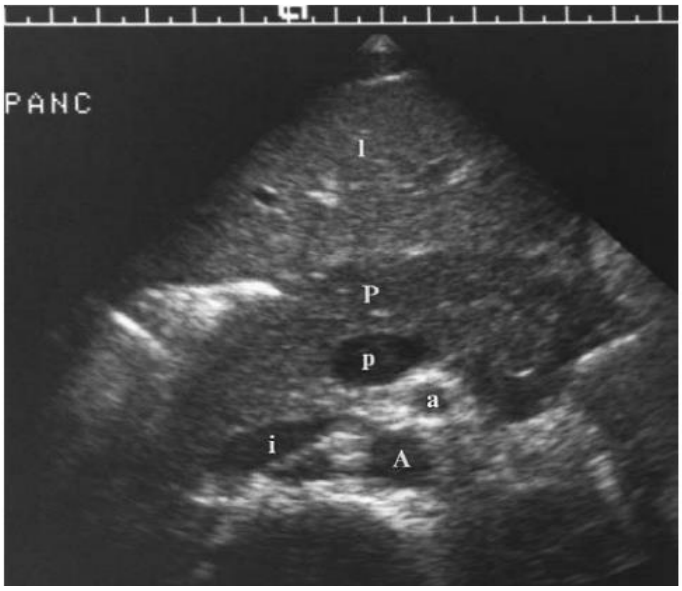

FIGURE 2-5 diffuse acute pancreatitis. This transverse image of a diffusely enlarged and hypoechoic pancreas (P) demonstrates diffuse acute pancreatitis. Also seen in this image are the portal confluence (p), superior mesenteric artery (a), aorta (A), inferior vena cava (i), and liver (l). (Image reprinted with permission from Brant W. The Core Curriculum: Ultrasound. Philadelphia: Lippincott Williams & Wilkins, 2001:76.)

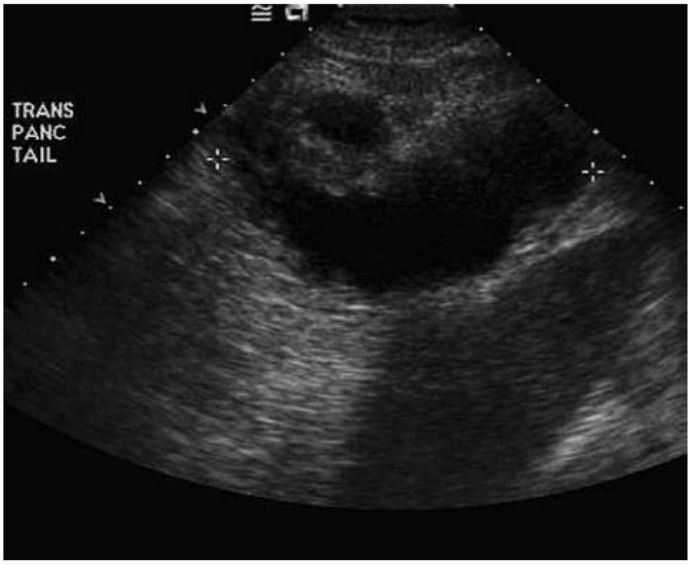

FIGURE 2-6 Pancreatic pseudocyst. This well encapsulated pancreatic pseudocyst (between calipers) was noted adjacent to the pancreatic tail in a patient with pancreatitis.

2-1-3-4 Chronic Pancreatitis

Repeated bouts of pancreatic inflammation can lead to chronic pancreatitis. This recurring destruction of the pancreatic tissue will result in atrophy, fibrosis, scarring, and the development of calcification within the gland.6 Chronic pancreatitis is, therefore, also associated with recurring attacks of acute pancreatitis, alcoholism (70%), and nonalcoholic duct-destructive pancreatitis. Although patients may be completely asymptomatic, they may present with a possible elevation in amylase and lipase, persistent epigastric and back pain, and jaundice. Sonographically, the pancreas will appear small, heterogeneous, and have poor margins. Calcifications are often noted throughout the parenchyma of the organ, although they may be confined to the pancreatic ducts. This, in turn, can lead to pancreatic duct and biliary dilatation. Like acute pancreatitis, chronic pancreatitis can lead to an enlargement of only a segment of the pancreas. Also, pseudocyst formation is common with chronic pancreatitis, and the possibility of portosplenic vein thrombosis exists. (Steven M. Penny, 2011)

Clinical findings of chronic pancreatitis include asymptomatic, persistent, epigastric pain, jaundice, back pain and possible elevation in amylase or lipase (but they may remain normal).Sonographic findings of chronic pancreatitis include heterogeneous, atrophic gland with poor margins, calcifications within the gland, pancreatic pseudocyst dilated pancreatic duct, stone(s) within the pancreatic duct that may lead to biliary obstruction and possible portosplenic vein thrombosis.(Steven M. Penny,2011)

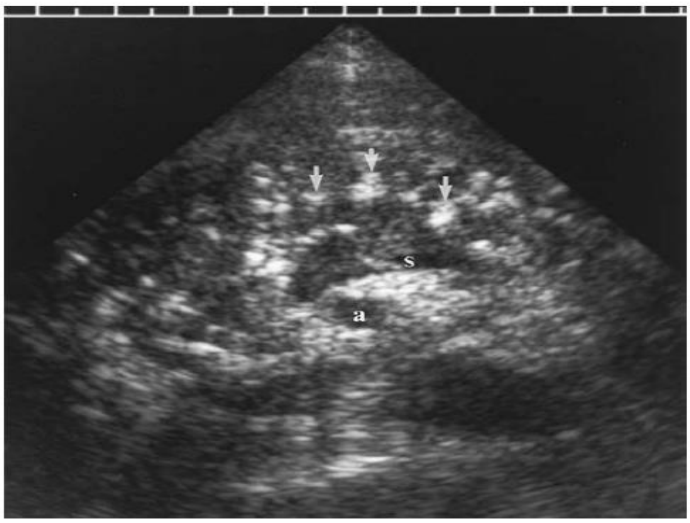

FIGURE 2-7 chronic pancreatitis. Transverse image of a pancreas demonstrates multiple parenchymal calcifications (arrows), a sonographic sign of chronic pancreatitis. The superior mesenteric artery (a) and splenic vein (s) are also seen. (Image reprinted with permission from Brant W. The Core Curriculum: Ultrasound. Philadelphia: Lippincott Williams & Wilkins, 2001:79.)

2-1-3-5 Pancreatic Adenocarcinoma:

Pancreatic adenocarcinoma, also referred to as pancreatic ductal adenocarcinoma, is the most common primary pancreatic malignancy. This disease often presents late and is too advanced to treat when it is discovered. Consequently, pancreatic cancer is the fourth most common cause of cancer-related deaths. The most common location of a pancreatic adenocarcinoma is within the pancreatic head, although they may be seen in other parts of the pancreas. This mass will lead to obstruction of the common bile duct and Courvoisier gallbladder. Courvoisier gallbladder describes the clinical detection of an enlarged, palpable gallbladder that may be caused by a malignant pancreatic head mass, or possibly some other obstructing etiology in the area of the pancreatic head. The patient frequently has jaundice secondary to the obstruction of the common bile duct by the mass. Sonographically, the most common appearance of pancreatic adenocarcinoma is a hypoechoic mass in the

head of the pancreas. Both obstruction of the common bile duct and pancreatic duct may be present, a condition known as the double duct sign. The liver and other abdominal organs should be evaluated for possible metastasis. The surgical procedure that is performed on patients with pancreatic adenocarcinoma is referred to as the Whipple procedure. The Whipple procedure may also be called a pancreaticoduodenectomy. This procedure is the removal of the head of the pancreas, the gallbladder, some of the bile ducts, and the proximal duodenum.

Clinical findings of pancreatic adenocarcinoma include elevated amylase and/or lipase, loss of appetite, weight loss, jaundice, Courvoisier gallbladder, epigastric pain and loss of appetite. Sonographic findings of pancreatic adenocarcinoma include hypoechoic mass in the head of the pancreas, dilated common bile duct and pancreatic duct (double-duct sign), liver and other abdominal organs should be evaluated for possible metastasis and enlarged gallbladder.(Steven M. Penny,2011)

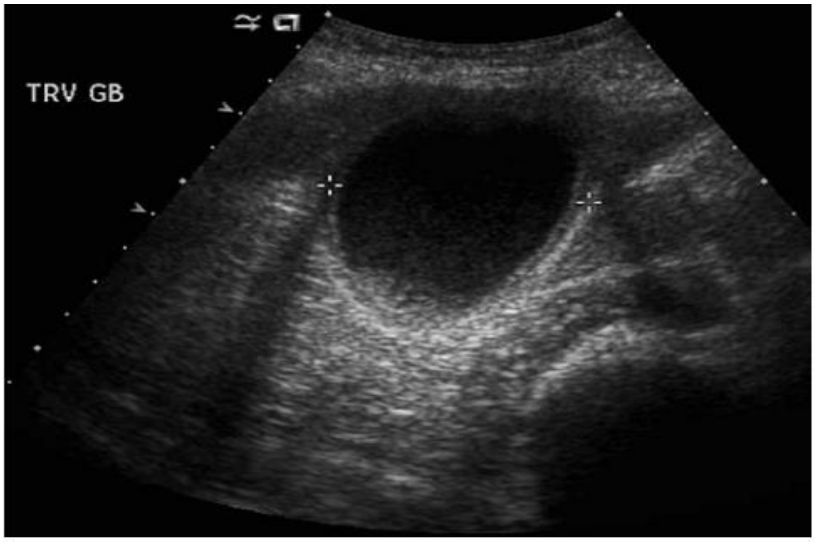

FIGURE 2-8 Courvoisier gallbladder. This gallbladder (between calipers) was enlarged, measuring greater than 5 cm in width, contained sludge, and was associated with a malignant pancreatic head mass

FIGURE 2-9 Dilated common bile duct. This dilated common bile duct (between calipers) measured more than 2 cm in diameter. It was associated with a malignant pancreatic head mass.

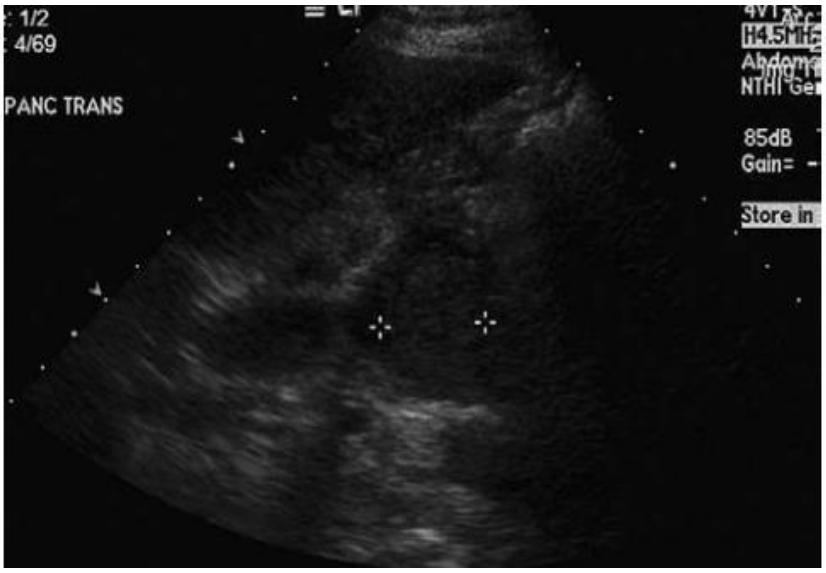

FIGURE 2-10 Pancreatic carcinoma. A solid hypoechoic mass (between calipers) representing pancreatic carcinoma is noted in the head of the pancreas.

2-1-3-6 Pancreatic Cystadenomas and Cystadenocarcinoma:

A cystadenoma within the pancreas may be either (microcystic) serous cystadenoma or (macrocystic) mucinous cystadenoma. Serous tumors are small and are always benign, while mucinous tumors are larger and have malignant potential. Malignant tumors may also be referred to as mucinous

cystadenocarcinomas. They are most often found within the body and tail of the pancreas.3 Patients with these masses present later than those with pancreatic head masses and may be asymptomatic. When symptomatic, patients often complain of epigastric pain, weight loss, palpable mass, and jaundice.4 The sonographic appearance of a serous cystadenoma is that of a cystic mass that may actually appear solid and echogenic secondary to the small size of the cysts.9 A mucinous cystadenoma or cystadenocarcinoma most often appears as a multilocular cystic masses that may contain mural nodules and calcifications.9 There may be associated dilation of the pancreatic duct.

Sonographic appearance of serous cystadenoma include cystic mass that may actually appear solid and echogenic secondary to the small size of the cysts

Sonographic appearance of mucinous cystadenoma and cystadenocarcinoma include multilocular cystic masses that may contain mural nodules and calcifications. There may be associated dilation of the pancreatic duct. (Steven M. Penny,2011)

2-1-3-7 Islet Cell Tumors:

Endocrine tumors can be found within the isles of Langerhans. There are two types of islet cell tumors: the insulinoma and the gastrinoma. These slow-growing tumors can be either functional or nonfunctional. Among the two, insulinomas are more common. Insulinomas are usually solitary, while gastrinomas are often multiple and difficult to image. The functional gastrinomas can produce Zollinger–Ellison syndrome, which is described as the excessive secretion of acid by the stomach that leads to peptic ulcers. When seen, the most common sonographic appearance of an islet cell tumor is that of a small, hypoechoic mass that may contain calcifications. Islet cell tumors can be malignant or benign, with the functioning tumors appearing hypervascular with color Doppler interrogation.

Clinical findings of islet cell tumors include insulinoma—low blood sugar symptoms and gastrinoma—Zollinger–Ellison syndrome. Sonographic findings

of islet cell tumors include hypoechoic mass that may contain calcifications. Visualization is hard because of their small size. (Steven M. Penny,2011)

2-1-3-7 True Pancreatic Cysts:

Cysts noted within the pancreas may be seen with von Hippel–Lindau disease or autosomal dominant polycystic kidney disease, which are associated with the development of cysts in many organs. Sonographic findings of true pancreatic cysts include well-defined, anechoic mass with posterior enhancement. (Steven M. Penny,2011)

2-1-4 Pancreatic Scanning Techniques:

A probe with the highest frequency possible is used and focused at the appropriate depth. The pancreas is interrogated in transverse and sagittal sections. In order to image through the long axis of the pancreas the transverse sections will have to be oblique so that the plane is lower to the right of (the patient's) midline and higher to the left of midline. The phase of respiration influences the location of the pancreas. "With maximal inspiration and expiration, the organ has been shown to shift 2 to 8 cm. In the craniocaudal axis. Air in the transverse colon and small bowel may obscure the pancreas and must be moved out of the way by graded transducer pressure. The patient is told the examiner will be pressing increasingly harder and to tell the examiner if the maneuver becomes painful. The Head - Beginning at the most superior margin of the head with the patient in the supine position, the head is interrogated in successive transverse oblique planes until the most inferior margin of the pancreatic head has been evaluated. Scanning of the pancreatic head is enhanced if the patient has a prominent left liver lobe as the liver will compress the stomach and provide an excellent acoustic window. If the left lobe of the liver is not prominent, elevation of the patient's right side 45 degrees may cause the liver to fall caudally toward the left and overlie the pancreatic head. Gas within the descending and transverse parts of the duodenum, which border the right and inferior aspect of the head, may obscure portions of the pancreatic head. The collapsed duodenum may combine

with the pancreatic head to produce a false appearance of a pancreatic mass. Visualization of the pancreatic head and body and identification of the true lateral margin of the head can be improved by angling the beam to throw the gas shadow off the region of interest, or by having the patient drink 500 ml. of degassed water at the end of the examination and then rescanning in a right-posterior-oblique position, i.e. with the patient's left side elevated so that the antrum and duodenum fill with water. Sagittal scans of the pancreatic head begin to the right of the pancreatic neck which is defined by the superior mesenteric vein and origin of the main portal vein. A longitudinal portion of the common bile duct is demonstrated as it courses posteriorly and inferiorly along or within the posterior pancreatic head. The Neck and Body - The patient is supine. Transverse scans are obtained in sequential order from the superior to the inferior border. The neck is anterior to the superior mesenteric vein and main portal vein and is interrogated along with the adjacent portion of the body. Since there is no anatomic landmark dividing the body from the tail, the left lateral margin of the lumbar vertebra is considered the arbitrary plane separating these two segments. The left lateral portion of the pancreatic body will probably have to be evaluated separately as it is unlikely to be on the same plane as the neck and the adjacent portion of body. Sagittal scans of the neck and body are taken from the superior mesenteric vein plane across to the left as far as the body can be visualized. The Tail - This is the most difficult portion of the pancreas to evaluate sonographically. Gas in the stomach often obscures the underlying pancreatic tail. The following methods have been suggested: supine or upright scanning with a fluid-filled stomach (f1.07); prone scanning through the left kidney; coronal scanning through the spleen and an angled view along the long axis of the tail with the patient supine. Transverse and sagittal scans are performed on as much of the tail that is visible. even with optimal scanning technique (graded compression or upright position with water-filled stomach and duodenum) and equipment, the entire pancreas cannot be visualized in all patients. (Brwein)

2-1-5 Sonography of the pancreas:

Rarely, the pancreas is imaged without including the complete right upper quadrant. A thorough evaluation of the bile ducts and gallbladder for associated abnormalities is generally required. The pancreas can frequently be a neglected abdominal organ because of the challenge that it presents for the sonographer. Adjacent bowel gas and body habitus are two obstacles that the sonographer encounters as one attempts to assess the pancreas using sound. To improve visualization of the pancreatic head, the sonographer can ask the patient to drink a small cup of water. The water, once in the C-loop of the duodenum, will provide a delineated view of the pancreatic head in most individuals. Additionally, left lateral decubitus position may help improve visualization of the pancreatic head. The sonographer can scan through the left kidney and spleen while the patient is in the right lateral decubitus position to better visualize the pancreatic tail area. Upright scanning can furthermore be valuable. The pancreas is identified sonographically by its neighboring vasculature (Table 2-1). The normal echogenicity of the pancreas is greater than that of the liver, and equal to, or greater than, that of the spleen in the adult. The pediatric pancreas may appear more hypoechoic because of the lack of fat surrounding the pancreas in younger patients. In the transverse plane, two round anechoic structures may be noted within the pancreatic head. The anterior structure is the gastroduodenal artery and the more posterior structure is the common bile duct. (Steven M. Penny,2011)

TABLE 2-3: Adjacent Vasculature Associated with the Pancreas	
Part of the Pancreas	Adjacent Vasculature
Pancreatic head	Right lateral to superior mesenteric vein Anterior to inferior vena cava Inferior to portal vein
Uncinate process	Posterior to superior mesenteric vein/may completely surround superior mesenteric vein Anterior to aorta
Pancreatic neck	Anterior to portal confluence
Pancreatic body	Anterior to superior mesenteric vein, splenic vein, and superior mesenteric artery
Pancreatic tail	Splenic vein marks posterior border of pancreatic tail

2.2 Previous Studies:

- Cosmas Rinaldi A. Lesmana, (etl) had studied Prevalence of Non-Alcoholic Fatty Pancreas Disease (NAFPD) and its risk factors among adult medical check-up patients in a private hospital: a large cross sectional study. The aim of this study is to evaluate the presence of NAFPD and its associated risk factors among adult medical check-up patients. A large cross-sectional study was done among adult medical check-up patients underwent abdominal ultrasound between January and December 2013 in Medistra Hospital, Jakarta. Data was obtained from the patients' medical record and include demographic data, blood pressures, fasting blood glucose level, and lipid profile. The presence of fatty pancreas was diagnosed by ultrasound. Bivariate and multivariate analyses were done to find associated risk factors for NAFPD. Statistical analysis was done using SPSS version 17. A total of 1054 cases were included in this study; pancreas cannot be visualized in 153 cases and were excluded from the analysis. Fatty pancreas was present in 315 (35.0 %) patients. Bivariate analyses found associations among fatty pancreas and several risk factors such as gender, age, systolic and diastolic blood pressures, body mass index (BMI), fasting plasma glucose (FPG), triglycerides (TG) and cholesterol levels. The study Concluate that fatty pancreas is a common finding during medical check-up with a

prevalence of 35 %. Fatty pancreas has significant association with metabolic factors and it might have an important role in risk of malignancy.

- (Miroslav Vujasinovic1, Jana Makuc2, Bojan Tepes3 2016) had studied Exocrine Pancreatic Insufficiency and Diabetes Mellitus: Gastrointestinal symptoms are common in patients with diabetes mellitus. One possible cause for these symptoms is exocrine pancreatic insufficiency, and although several hypotheses have been proposed to explain the a etiology, the precise pathophysiological mechanisms remain to be elucidated. The prevalence and the clinical importance of exocrine pancreatic insufficiency are debatable. Exocrine pancreatic insufficiency has been confirmed in insulin-dependent and non-insulin-dependent diabetes mellitus and might be related to diabetes mellitus duration. Considering the limitations of the tests, the test and patient selections in different studies have undoubtedly contributed to these conflicting results. Other likely causes are the underestimation of chronic pancreatitis and unrecognized pancreatogenic diabetes (type 3c diabetes mellitus). Because many studies have failed to relate the clinical symptoms of exocrine pancreatic insufficiency to a positive function test (e.g., faecal elastase-1 concentrations), and serum nutritional markers (as signs of malabsorption) were not been determined in all studies, the clinical importance of exocrine pancreatic insufficiency in patients with diabetes mellitus is also controversial. This review presents a critical analysis of the currently published literature on this topic, including the detailed limitations of the specific tests used to confirm exocrine pancreatic insufficiency.

- Ravinder Kumar, Abhishek Bhargava, and Gagan Jaiswal had studied Total pancreatic lipomatosis (PL) is an unusual entity of pathologic significance and speculative origin. It refers to complete replacement of pancreatic parenchyma by fat cells. Fat replacement may vary from mild fatty infiltration to massive replacement of the pancreas by adipose tissue, resulting in malabsorption syndrome due to pancreatic insufficiency. They present a case of a 60-year-old elderly woman with atypical abdominal complaints, diabetes mellitus, weight

loss, and steatorrhea. Abdominal computed tomograms were diagnostic of PL. Magnetic resonance imaging verified this impression. The patient improved clinically after the 8-week trial of high-dose oral pancreatic enzyme replacement therapy. There is a marked reduction of steatorrhea and weight gain. This case report focuses on pathophysiology, diagnosis, and treatment guidelines of PL. The study concoluate that the clinical presentation of is total PL is usually insidious due to varying signs and symptoms and should be considered in the differential diagnosis of patients with malabsorption. CT and MRI including MRCP are easy, reliable, safe, and effective imaging methods for establishing the diagnosis. The combination of low dietary modification with modern pancreatic preparation and lipase supplementation is the gold standard for treatment.

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

3.1 Materials:

3.1.1Patients:

A total of FIFTY patients (n=50) were selected to be the sample unit in this study, the inclusion criterion was any young and mid age adult diagnosed clinically with diabetic (15-60 years). Exclusion criteria are that any infant, child, elderly patients above (60 years old) and pregnancy women with dietetic.

3.1.2 Machine:

High resolution H60 ultrasound machine (Samsung manufacturing – koria) with 3.5 MHz convex probe, Ultrasound gel, and thermal Paper Printer was used. A record secondary data is used to collect the data.

3.2 Methods:

3.2.1 Technique:

Patient Preparation must be fast for 6 hours, no food or drink, no smoking. Preferably book the appointment in the morning to reduce bowel gas. Generally the pancreas can be viewed with the patient supine, erect views may be useful if colon gas is obscuring the view, If the patient has been given an oral water load, a right semi-decubitus position will displace gas away from the pancreas. The technique of pancrease begins transversely, high in the epigastrum, need to apply enough pressure to help displace bowel gas, and then adjust image depth so the aorta is at the bottom of the screen. Head of pancreas - Use both transverse & sagittal planes as the head can be quite long and continue left caudally for several centimeters.

Body of Pancreas - Transverse probe. Use the splenic vein to help identify the pancreas superficial to this. Tail of pancreas - Start with the probe transverse then angle the heel of the probe cephalad and left as the tail can be sitting up under the spleen. Thus the spleen can be used as a window and a left intercostal coronal approach can also be utilized.

3.2.2 Design of the study:

Retrospective and analytical descriptive study.

3.2.3 Area of the study:

Zahrat Al-Amal poly clinic (1) (Kingdom Saudi Arabia).

3.2.4 Method of data collection:

The data were collected during the period from first March to first July 2018, for adults (diabetic) patients came to ultrasound clinic for general indications of trans-abdominal ultrasound.

3.2.5 Method of data analysis:

The data were analysis by SPSS version 20

3.2.6 Ethical Consideration:

Permission was taken from director of Zahrat Al-Amal poly clinic (1) (Kingdom Saudi Arabia). Also from patient after explanation the procedures and purpose of research.

Chapter Four
Results

Chapter Four
Results

4-1 Results

Table (4-1) Age Distribution:

Age / Years	Frequency	Percent	Valid Percent	Cumulative Percent
(15-24) Years	5	10.0	10.0	10.0
(25-34) Years	7	14.0	14.0	24.0
(35-44) Years	16	32.0	32.0	56.0
(More than 45) Years	22	44.0	44.0	100.0
Total	50	100.0	100.0	
Mean : 3.1 SD: 0.99				

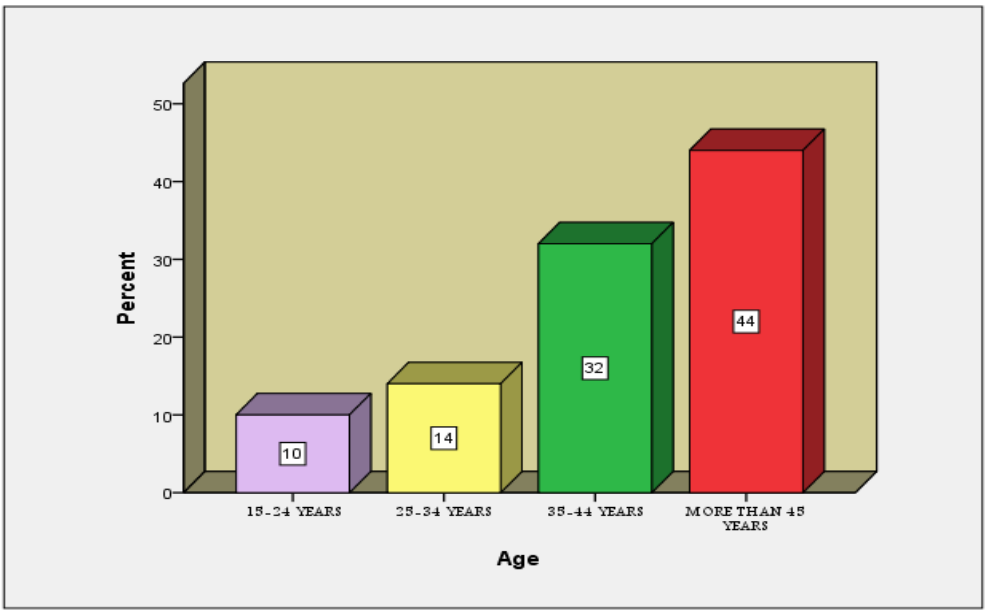

Figure 4-1 Patients Age Distribution

Table (4-2) Gender Distribution:

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	30	60.0	60.0	60.0
Male	20	40.0	40.0	100.0
Total	50	100.0	100.0	

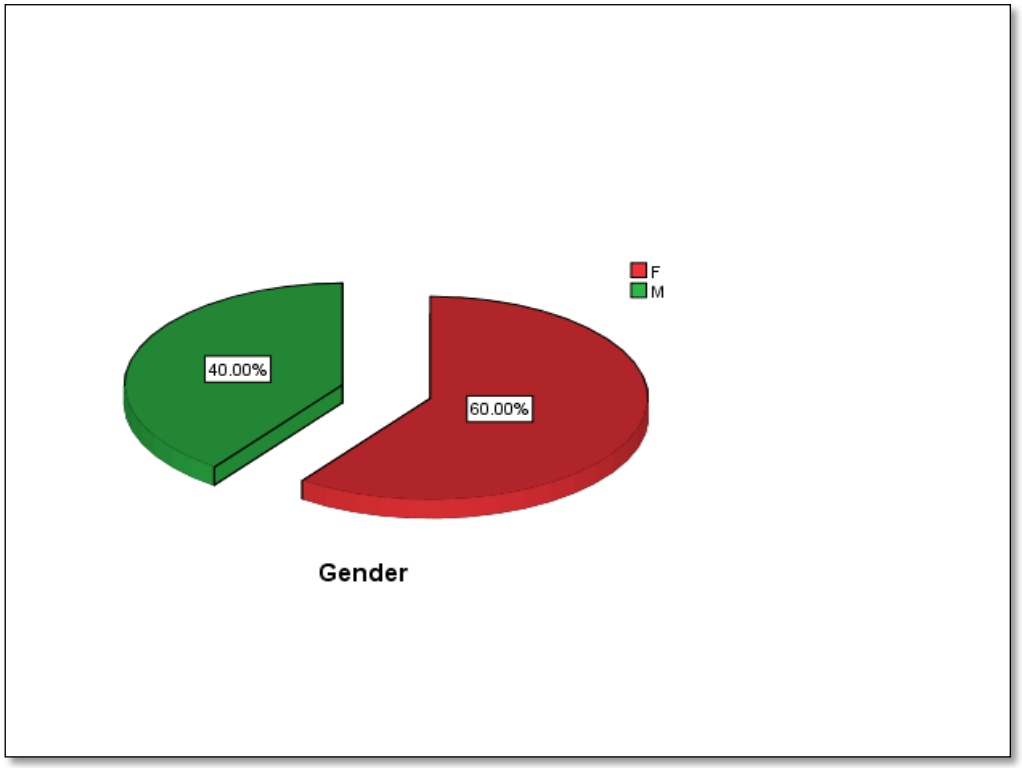

Figure 4-2 Patients Gender Distribution

Table (4-3) Weight Distribution:

Weight (Kg)	Frequency	Percent	Valid Percent	Cumulative Percent
(60-69) kg	6	12.0	12.0	12.0
(70-79) kg	14	28.0	28.0	40.0
(80-89) kg	10	20.0	20.0	60.0
(More than 90) kg	20	40.0	40.0	100.0
Total	50	100.0	100.0	
Mean : 2.88 SD: 1.08				

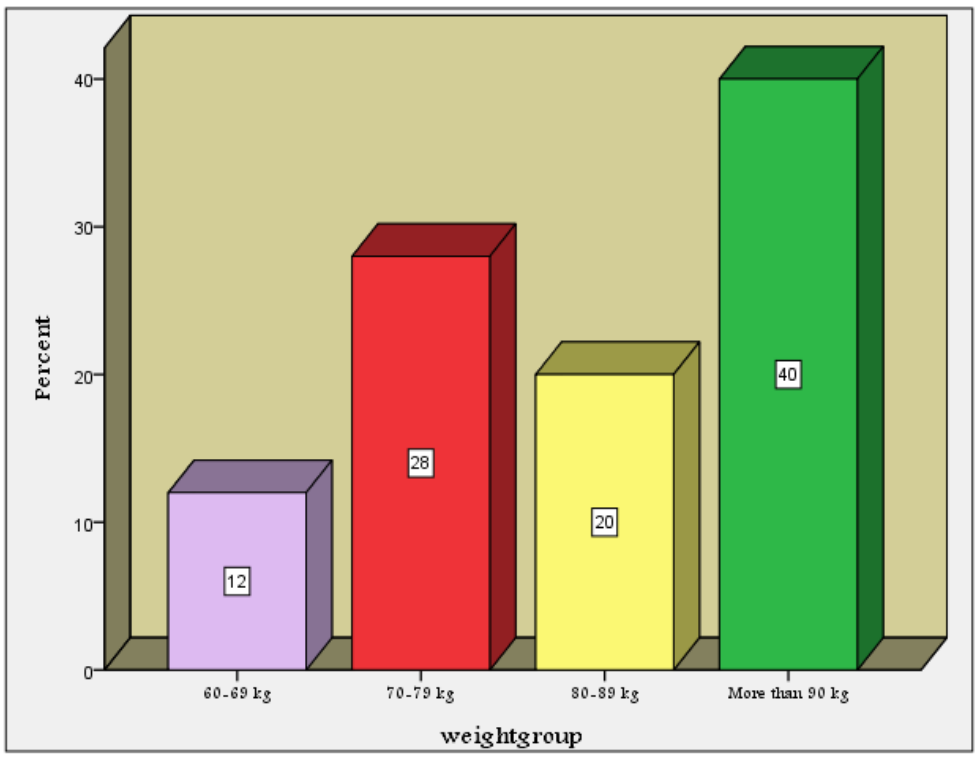

Figure (4-3) Weight Distribution

Table (4-4) Abdomen Mass Index Distribution

Abdomen Mass Index (Cm)	Frequency	Percent	Valid Percent	Cumulative Percent
(Less than 69) cm	1	2.0	2.0	2.0
(70-79) cm	10	20.0	20.0	22.0
(80-89) cm	17	34.0	34.0	56.0
(More than 90) cm	22	44.0	44.0	100.0
Total	50	100.0	100.0	
Mean : 3.2 SD: 0.832				

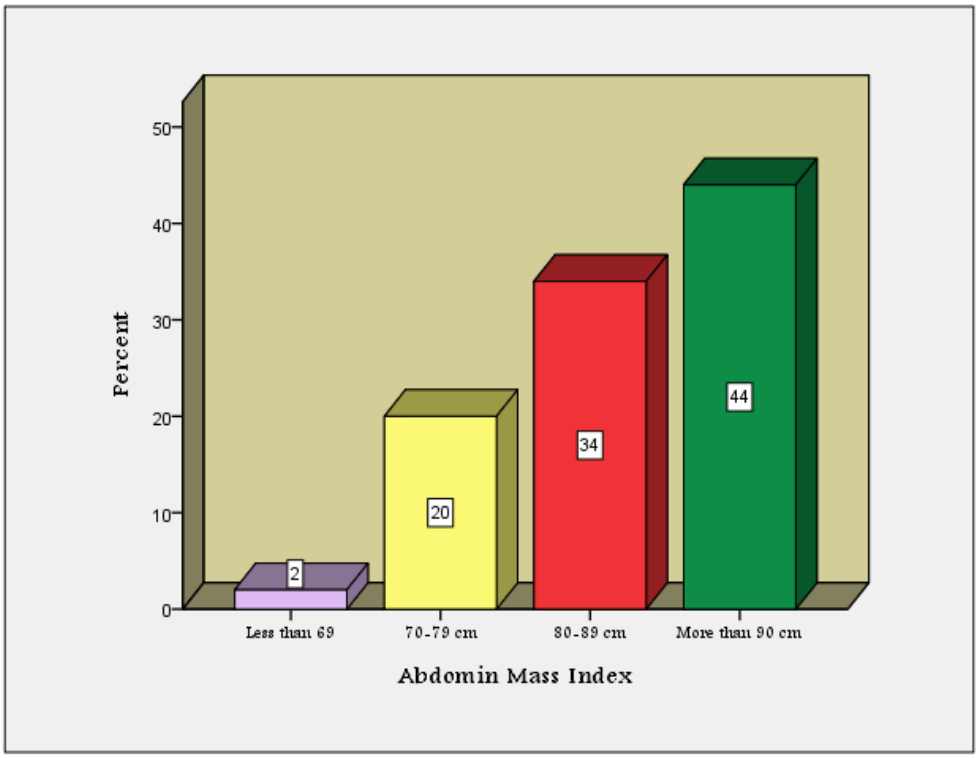

Figure (4-4) Abdomen Mass Index Distribution

Table (4-5) Alcohol Abuse Distribution

Alcohol Abuse	Frequency	Percent	Valid Percent	Cumulative Percent
NO	20	40.0	40.0	40.0
YES	30	60.0	60.0	100.0
Total	50	100.0	100.0	

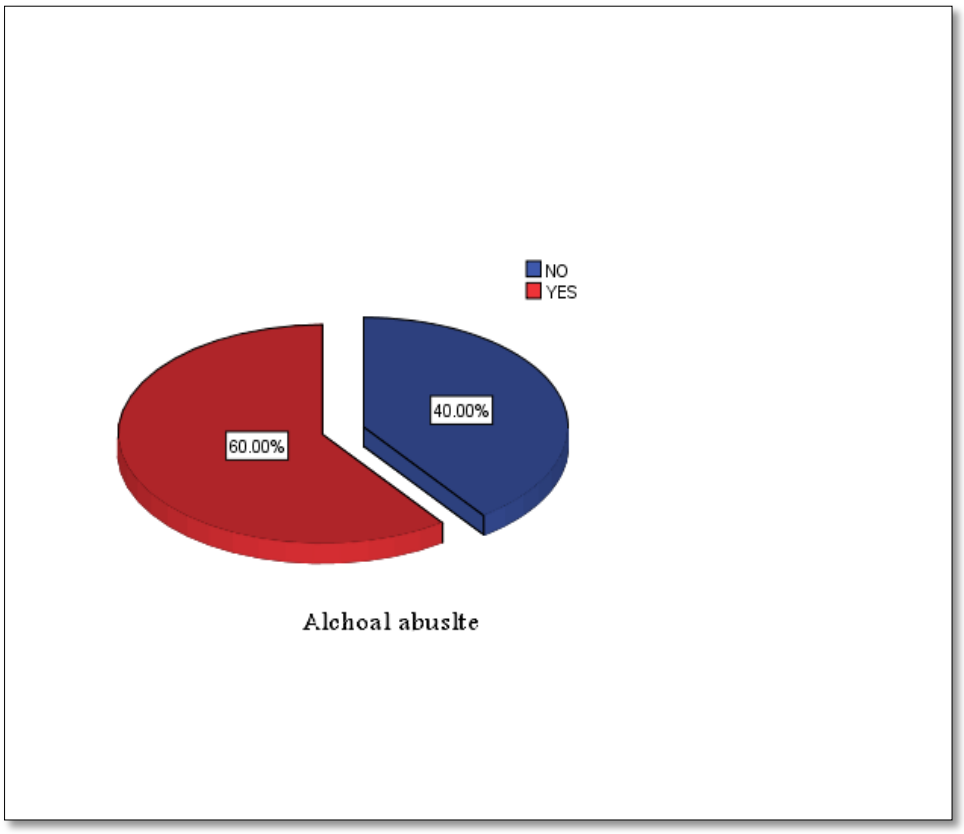

Figure (4-5) Alcohol Abuse Distribution

Table (4-6) Smoking Distribution

Smoking	Frequency	Percent	Valid Percent	Cumulative Percent
NO	22	44.0	44.0	44.0
YES	28	56.0	56.0	100.0
Total	50	100.0	100.0	

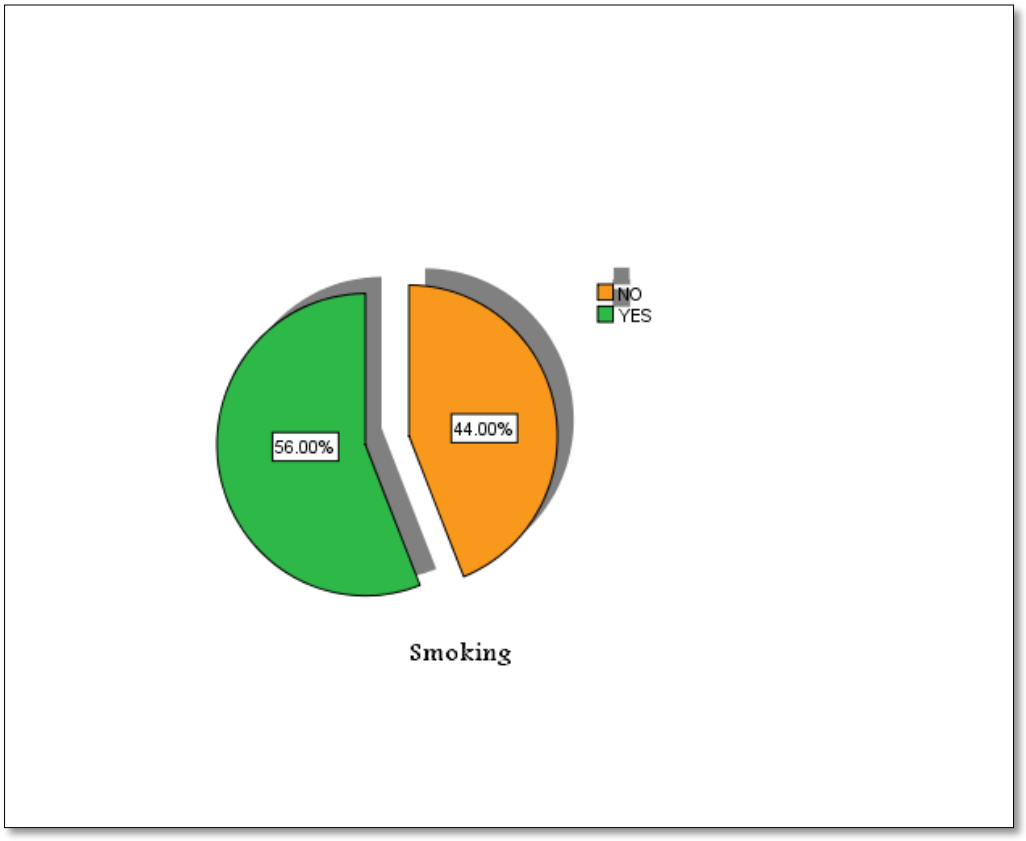

Figure (4-6) Smoking Distribution

Table (4-7) Autoimmune Disease Distribution

Autoimmune Disease	Frequency	Percent	Valid Percent	Cumulative Percent
NO	22	44.0	44.0	44.0
YES	28	56.0	56.0	100.0
Total	50	100.0	100.0	

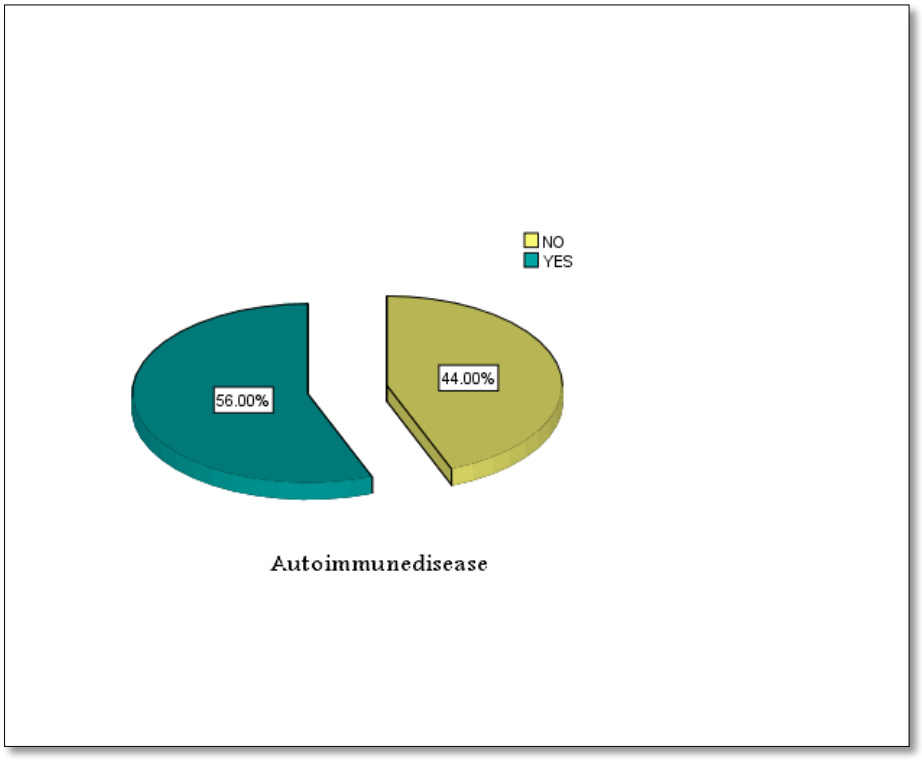

Figure (4-7) Autoimmune Disease Distribution

Table (4-8) Pervious Surgery Distribution

Pervious Surgery	Frequency	Percent	Valid Percent	Cumulative Percent
Acute appendicitis	11	22.0	22.0	22.0
Acute calcular cholecyustitis	13	26.0	26.0	48.0
gastric sleeve surgery	17	34.0	34.0	82.0
Normal	9	18.0	18.0	100.0
Total	50	100.0	100.0	

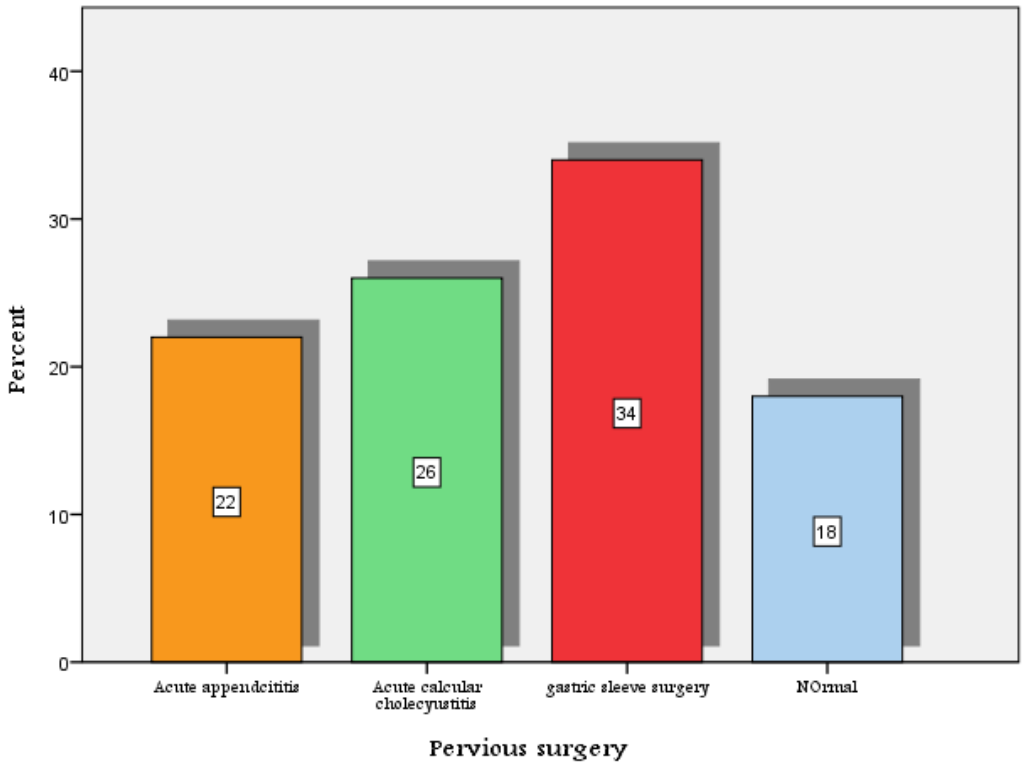

Figure (4-8) Pervious Surgery Distribution

Table (4-9) Type of DM Distribution

Type of DM	Frequency	Percent	Valid Percent	Cumulative Percent
I	17	34.0	34.0	34.0
II	33	66.0	66.0	100.0
Total	50	100.0	100.0	

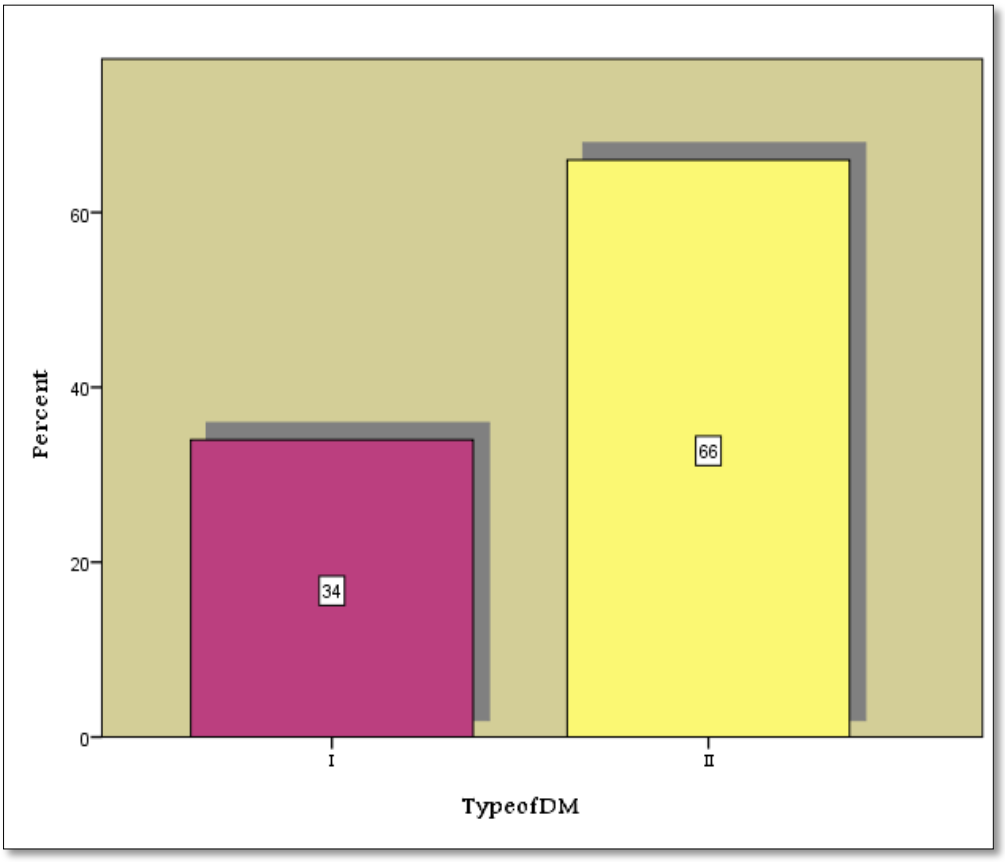

Figure (4-9) Type of DM Distribution

Table (4-10) Sonographic Finding of Pancreas Head Distribution

Sonographic Finding (Head)	Frequency	Percent	Valid Percent	Cumulative Percent
Type 1a	20	40.0	40.0	40.0
Type 1b	18	36.0	36.0	76.0
Type 2a	12	24.0	24.0	100.0
Total	50	100.0	100.0	

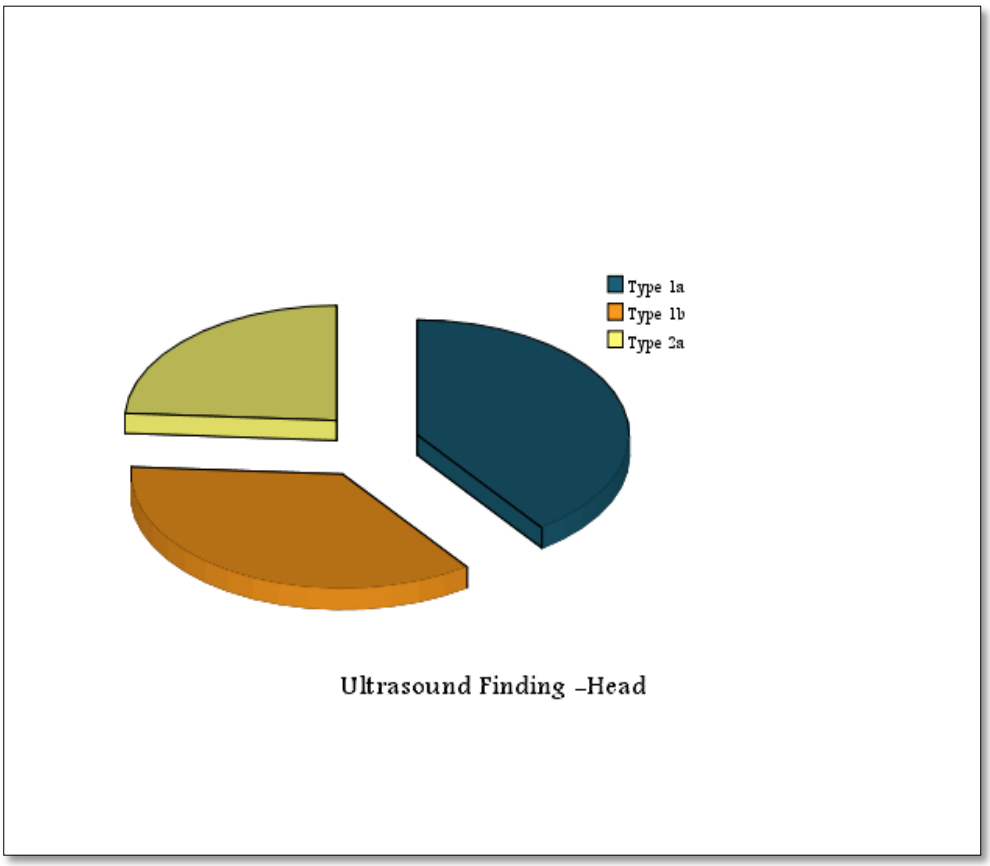

Figure (4-10) Sonographic Finding of Head Distribution

Table (4-11) Sonographic Finding of Body of Pancreas Distribution

Sonographic Finding (Neck)	Frequency	Percent	Valid Percent	Cumulative Percent
Type 1b	35	70.0	70.0	70.0
Type 2b	15	30.0	30.0	100.0
Total	50	100.0	100.0	

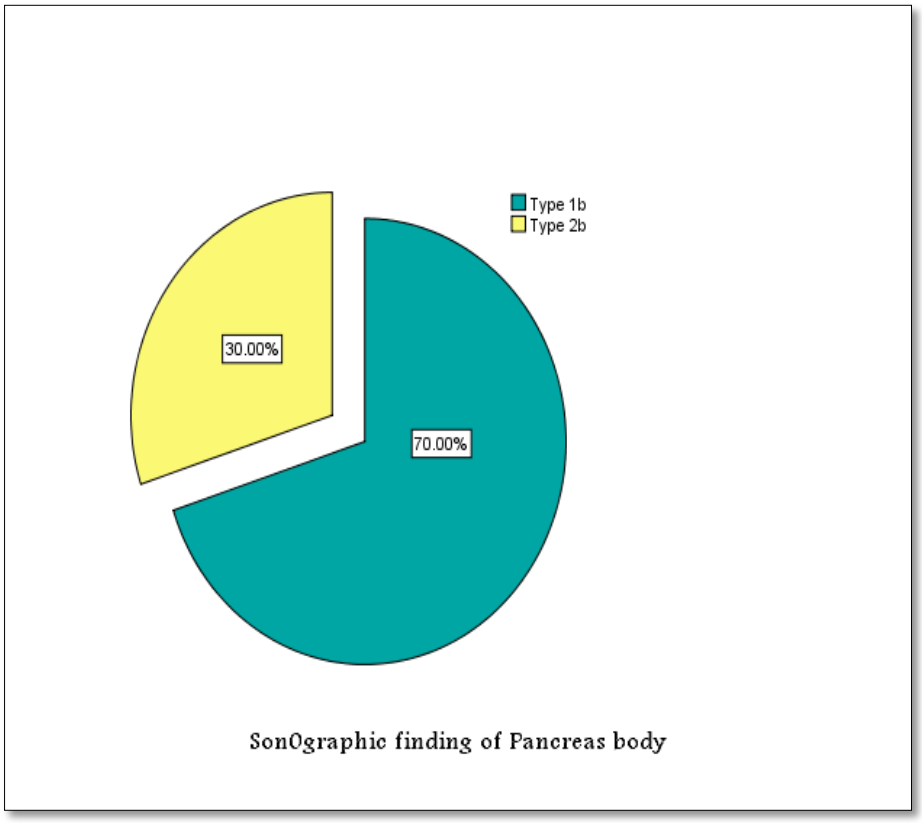

Figure (4-11) Sonographic Finding of Body of Pancreas Distribution

Table (4-12) Sonographic Finding of Tail of Pancreas Distribution

Sonographic Finding of Tail of Pancreas	Frequency	Percent	Valid Percent	Cumulative Percent
Type 1a	8	16.0	16.0	16.0
Type 2a	20	40.0	40.0	56.0
Type 2b	5	10.0	10.0	66.0
Type Ib	17	34.0	34.0	100.0
Total	50	100.0	100.0	

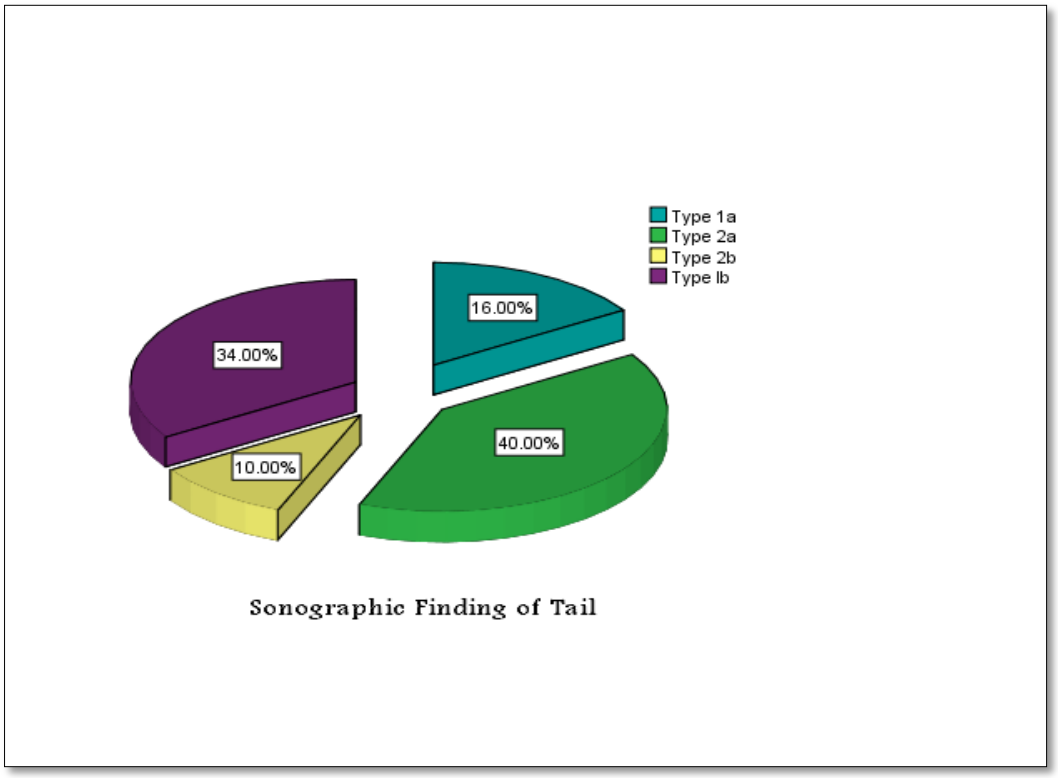

Figure (4-12) Sonographic Finding of Tail of Pancreas Distribution

Table (4-13) Sonographic Finding /Pancreatic echogenicity Distribution

Sonographic Finding Pancreatic echogenicity	Frequency	Percent	Valid Percent	Cumulative Percent
Preferential fatty replacement of head and uncinate process.	10	20.0	20.0	20.0
Fatty replacement of most of pancreas regions except per biliary region.	12	24.0	24.0	44.0
preferential fatty replacement of head	13	26.0	26.0	70.0
Preferential fatty replacement of head, neck and body.	15	30.0	30.0	100.0
Total	50	100.0	100.0	

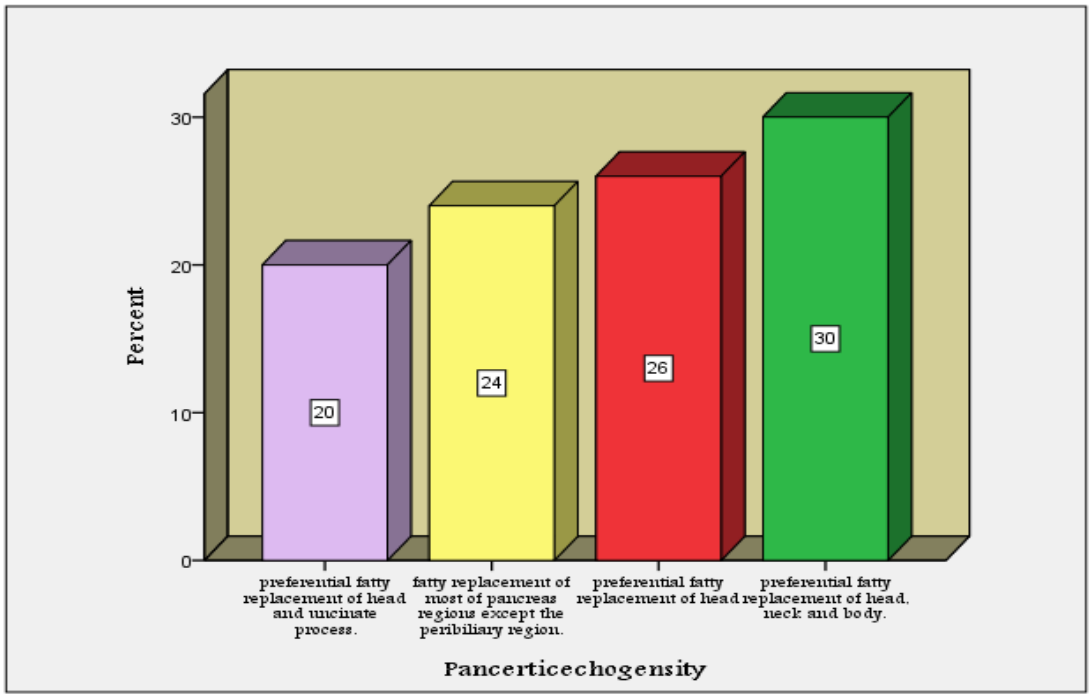

Figure (4-13) Sonographic Finding /Pancreatic echogenicity Distribution

Table (4-14) Correlations between patient variables

Patient variables		Patient age	Patient weight	Abdomen Mass Index	Duration of MD
Patient age	Pearson Correlation	1	.429**	.246	.513**
	Sig. (2-tailed)		.002	.085	.000
	N	50	50	50	50
Patient weight	Pearson Correlation	.429**	1	.662**	.278
	Sig. (2-tailed)	.002		.000	.051
	N	50	50	50	50
Abdomen Mass Index	Pearson Correlation	.246	.662**	1	.106
	Sig. (2-tailed)	.085	.000		.464
	N	50	50	50	50
Duration of MD	Pearson Correlation	.513**	.278	.106	1
	Sig. (2-tailed)	.000	.051	.464	
	N	50	50	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

Table (4-15) Calculated and Tabulated Chi-Squared Values of Measurements of Age * Pervious surgery Cross-tabulation:

Age * Pervious surgery Cross tabulation		**Pervious surgery**				**Total**
		Acute appendicitis	**Acute calcular cholecyustitis**	**gastric sleeve surgery**	**Normal**	
Age	(15-24) Years	1	1	1	2	5
	(25-34) Years	0	3	3	1	7
	(35-44) Years	4	3	7	2	16
	More than 45 years	6	6	6	4	22
Total		11	13	17	9	50

Chi-Square Tests	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.425[a]	9	.022
Likelihood Ratio	19.483	9	.021
N of Valid Cases	50		

a. 13 cells (81.2%) have expected count less than 5. The minimum expected count is 1.00.

Table (4-16) Calculated and Tabulated Chi-Squared Values of Measurements of Age * Pancreatic echogenicity Cross tabulation Cross-tabulation:

Age * Pancreatic echogenicity Cross tabulation		Pancreatic Echogenicity				Total
		Preferential fatty replacement of head and uncinate process	Fatty replacement of most of pancreas regions except the per biliary region	preferential fatty replacement of head	Preferential fatty replacement of head, neck and body	
Age	(15-24) Years	3	1	0	1	5
	(25-34) Years	0	4	2	1	7
	(35-44) Years	2	3	2	9	16
	More than 45 years	5	4	9	4	22
Total		10	12	13	15	50

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.425[a]	9	.022
Likelihood Ratio	19.483	9	.021
N of Valid Cases	50		

a. 13 cells (81.3%) have expected count less than 5. The minimum expected count is 1.00.

Table (4-17) Calculated and Tabulated Chi-Squared Values of Measurements of Alcohol Abuse * Pancreatic echogenicity Cross-tabulation:

Alcohol Abuse * Pancreatic echogenicity		**Pancreatic echogenicity**				**Total**
		Preferential fatty replacement of head and uncinate process.	**Fatty replacement of most of pancreas regions except the peribiliary region.**	**preferential fatty replacement of head**	**Preferential fatty replacement of head, neck and body.**	
Alcohol Abuse	NO	5	5	3	7	20
	YES	5	7	10	8	30
Total		10	12	13	15	50

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.260[a]	3	.520
Likelihood Ratio	2.365	3	.500
N of Valid Cases	50		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 4.00.

Table (4-18) Calculated and Tabulated Chi-Squared Values of Measurements of Type of DM * Pancreatic echogenicity Cross-tabulation:

Type of DM * Pancreatic echogenicity Cross tabulation		**Pancreatic echogenicity**				**Total**
		Preferential fatty replacement of head and uncinate process.	**Fatty replacement of most of pancreas regions except the peribiliary region.**	**preferential fatty replacement of head**	**Preferential fatty replacement of head, neck and body.**	
Type of DM	I	4	6	5	2	17
	II	6	6	8	13	33
Total		10	12	13	15	50

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.500[a]	3	.212
Likelihood Ratio	4.904	3	.179
N of Valid Cases	50		

a. 3 cells (37.5%) have expected count less than 5. The minimum expected count is 3.40.

Table (4-18) Calculated and Tabulated Chi-Squared Values of Measurements of Gender * Pancreatic echogenicity Cross-tabulation:

		Pancreatic echogenicity				**Total**
		Preferential fatty replacement of head and uncinate process.	**Fatty replacement of most of pancreas regions except the peribiliary region.**	**preferential fatty replacement of head**	**Preferential fatty replacement of head, neck and body.**	
Gender	F	5	7	8	10	30
	M	5	5	5	5	20
Total		10	12	13	15	50

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.721[a]	3	.868
Likelihood Ratio	.719	3	.869
N of Valid Cases	50		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 4.00.

Chapter Five
Discussion, Conclusion and Recommendations

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5.1 Discussion:

This study had been done in Zahrat Al-Amal poly clinic (1) Riyadh - (Kingdom Saudi Arabia), from first March to first July 2018, for adults 50 (diabetic) patients came to ultrasound clinic for general indications of trans-abdominal ultrasound.

Table (4-1) reveled age distribution, patients' age with mean value (3.1± 0.99), the most of them were aged between (more than 45) years and (35-45) years with a percentage of 44% and 32% respectively. Other age classed (25-34) years and (15-24) years were 14 % & 10 % respectively, as figure (1) illustrates.

Table (4-2) reveled gender distribution, the female (60%) and male (40%) as figure (2) illustrates.

Table (4-3) showed weight distribution, the mean value (2.8± 1.08), the commonest weight were (more than 90) kg and (70-79) kg with a percentage of 44% and 28% respectively. Other weight classed (80-89) kg and (60-69) kg were 20 %. & 12 % respectively, as figure (3) illustrates.

Table (4-4) showed abdomen mass index distribution, the mean value (3.2± 0.832), the most abdomen mass index were (more than 90) cm and (80-89) cm with a percentage of 44% and 34% respectively. Other abdomen mass index classed (70-79) cm and less than (60) cm were 20 %. & 2 % respectively, as figure (4) illustrates.

Table (4-5) reveled alcohol abuse distribution. A (60%) were in alcohol abuse, (40%) of patient didn't take alcohol as figure (5) illustrates.

Table (4-6) showed smoking distribution. A (56%) were smoking, (44%) of patient weren't smoke as figure (6) illustrates.

Table (4-7) showed autoimmune disease distribution. A (56%) were has autoimmune disease (44%) of patient were normal as figure (7) illustrates.

Table (4-8) showed pervious surgery distribution. The gastric sleeve surgery had high prevalence with percentage (34%), while acute calcular cholecystitis & acute appendicitis with percentage (26%) & (22%) respectively. A (9%) of patients were normal, as figure (8) illustrates.

Table (4-9) showed types of DM distribution. A (66%) of patients were type II of DM, while (34%) were type I as figure (9) illustrates.

Table (4-10) reveled sonographic finding of head distribution. The commonest type was type 1a & type 1b with percentage (40%) & (36%) respectively. The last category type 2a with percentage (24%) as figure (10) illustrates.

Table (4-11) reveled sonographic finding of neck distribution. The commonest type was type 1b with percentage (70%), while type 2b with percentage (30%) as figure (11) illustrates.

Table (4-12) reveled sonographic finding of tail distribution. The most common type was type 2a & type 1b with percentage (40%) & (34%) respectively, while type 1a & type 2b with percentage (16%) & (10%) respectively were less cases as figure (12) illustrates.

Table (4-13) represented sonographic finding of pancreatic echogenicity distribution, preferential fatty replacement of head, neck and body with percentage (30%) was the most common type of pancreases echogenicity. The second category was preferential fatty replacement of head with percentage (26%), otherwise fatty replacement of most pancreas regions expect biliary region and perferentional fatty replacement of head and uncinate process had less prevalence of pancreas echogenicity with percentage (24%)& (20%) respectively as figure (13) illustrates.

Table (4-14) revealed correlation between patients' variables (patient age, weight, abdomen mass index and duration of MD). There was a strong relationship significant correlate between patient age & patient weight & duration of DM at p value (0.002), (0.000), (0.000) respectively. Also there was between patient weight & abdomen mass index at p value (0.002).

Tables (4-15, 4-16,4-17,4-18,4-19) calculated and tabulated chi squared values of patients, variables.

Table (4-15) reveled age * pervious surgery cross tabulation. The gastric sleeve surgery was common in patients with age (35-44) years old, while acute calcular cholecystitits & acute appendicitis were common in patients with age more than 45 years old. Only (4) patients were normal and have no pervious surgery before.

The different significant of age and pervious surgery was ≤0.02.

Table (4-16) represented age* pancreatic echogenicity. Ninety of patients their pancreas echogenicity showed referential fatty replacement of head, neck and body was commonest in age (35-44) year's old, also ninety of patients their pancreas echogenicity showed preferential fatty replacement of head only was more common in age (more than 45) year's old. Otherwise only five patients Preferential fatty replacement of head and unicate process were in age (more than 45) years old. The last category of pancreatic echogenicity was the fat replacement of most of pancreas region except perbiliary region only four patients within age (25-34) years and (more than 45) years old. The different significant for age* pancreatic echogenicity – person Chi square- at P value (0.022).

Table (4-17) represented alcohol abuse* pancreatic echogenicity represented that the most pancreas echogenicity was preferential fatty replacement of head then perferentional fatty replacement of head, neck and body then Preferential

fatty replacement of head and unicate process, then fat replacement of most of pancreas region except perbiliary region in alcohol abuse patients.

There was no different significant for this variables (person Chi square) at value (0.52).

Table (4-18) represented Type of DM* pancreatic echogenicity represented that the most pancreas echogenicity was preferential fatty replacement of head, neck and body, then preferential fatty replacement of head then Preferential fatty replacement of head and unicate process, and fat replacement of most of pancreas region except perbiliary region in alcohol abuse patients for patients with type II of DM.

There was no different significant for this variables (person Chi square) at value (0.212).

Table (4-19) represented pancreatic echogenicity* gender cross tabulation represented that the most pancreas echogenicity was more common in female than male. The commonest pancreatic echogenicity was preferential fatty replacement of head, neck and body, then preferential fatty replacement of head then preferential fatty replacement of head and unicate process, then fat replacement of most of pancreas region except perbiliary.

There was no different significant for this variables (person Chi square) at value (0.868).

5.2 Conclusion:

The study was proved its hypothesis that; the ultrasound is a reliable and accurate in diagnosis of prevalence of pancreatic lipomatosis among Saudi population in Riyadh was increase with incidence of DM, as following:

1. There was strong correlation between lipomatosis and age (elderly) of patient at P value = (0.022) agree with (Ravinder Kumar, Abhishek Bhargava, and Gagan Jaiswal, 2016) studies.
2. Lipomatosis was commonest in female more than male especially in obese one.
3. There was strong correlation between lipomatosis and patient family history especially the diabetic patient female whom had gastric sleeve surgery, the different significant at P value = (0.022) agree with (Cosmas Rinaldi A. Lesmana,.2013) studies.
4. Lipomatosis was commonest in patients with type II of DM, but there was no significant at P value (0.212), (disagree of Miroslav Vujasinovic1, Jana Makuc2, Bojan Tepes3 2016 study that failed to correlate between DM and lipomatosis).
5. No correlation between Lipomatosis and alcohol abuse no significant at P value =(0.868)
6. There was correlation between patient weight, abdomen mass index and duration of DM , significant at P value = (0.000, 0.05, 0.000) respectively.

5.3 Recommendations:

Researcher recommended that:

1. Increasing the number of patients, to show the relation between Lipomatosis and complication.
2. The researcher recommends that sonographers must study this wonderful part of diagnostic sonography and had more skills and experiences.
3. Further studies should be carried out practically include evaluation of sonographers experiences because ultrasound is hand operator dependent.

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Appendices

Appendix (1)

Image (1) showed ultrasound machine used for data collection

Image (2) showed 3.5 MHz (convex probe)

Appendix (2)

1- Data collection sheet:

Patient no ……..... date / / 2020

Patient variable

Patient age group **a) 15 -30 yrs** **b) 30- 45 yrs** **c) 45 - 60 yrs** **d) Over 60 yrs**					
Patient gender Male Female					
Patient BMI					
Patient weight in kg					
Abdominal fat index					
Duration of DM					
Type of DM Type 1 Type 2					

2- Sonographic finding

Pancreatic size **Head (N up to) Body (N up to) Tail (N up to)**				
Pancreatic echogenicity **1-Normal** **2-Fatty infiltrated changes (lipomatosis)**				
Alcohol abuse history				
Smoking				
Autoimmune disease history				
Pervious surgery including pancreatic and pancreatic alters digestive anatomy				

Image (3) showed normal pancreas

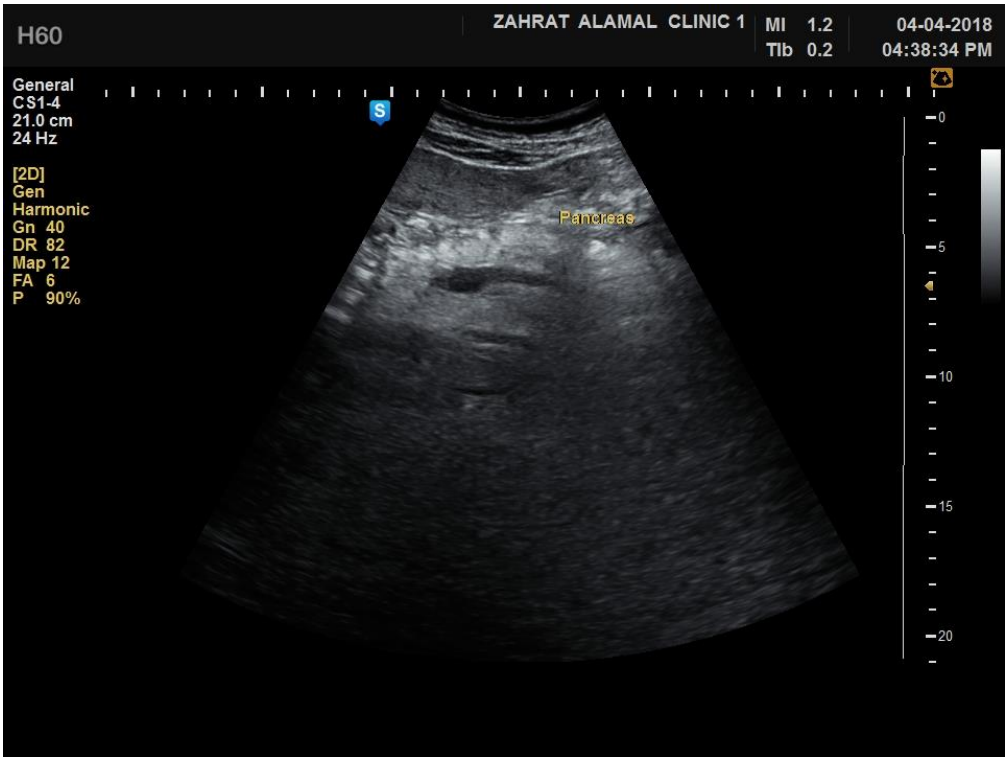

Image (4) reveals pancreatic lipomatosis

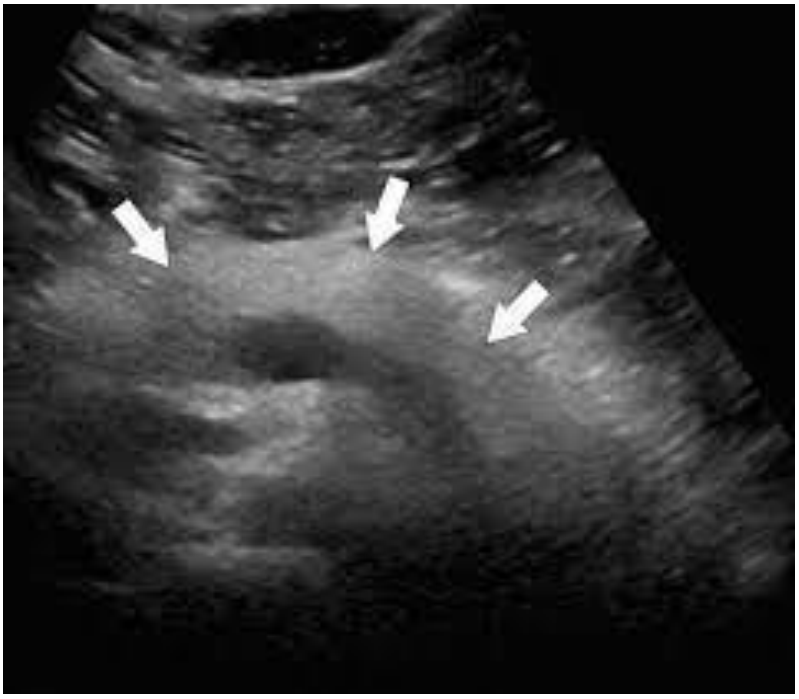

Image (5) shows total replacement pancreatic lipomatosis

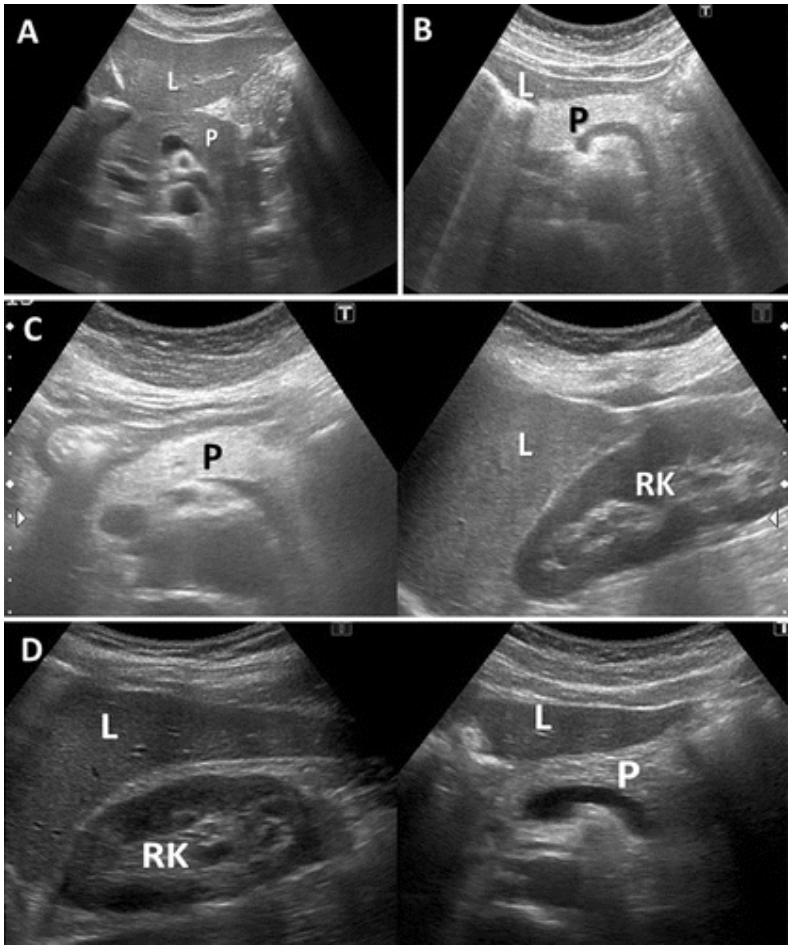

Image (6) showed compression between variable pancreatic echogenicity and adjacent organs (liver and Rt. Kidney)

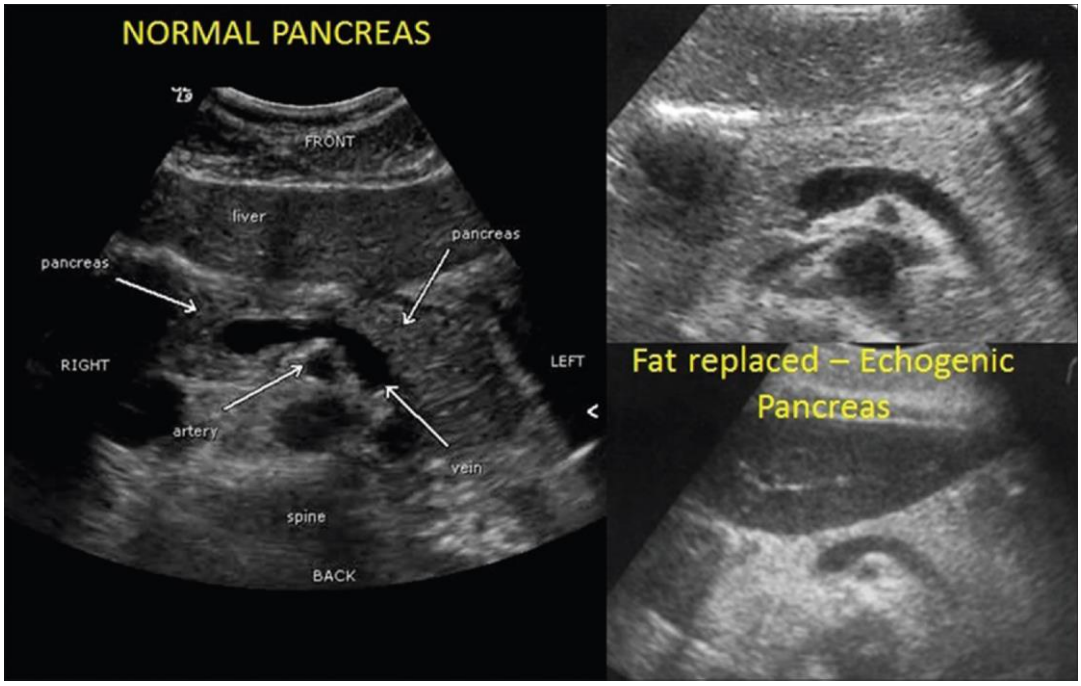

Image (7) showed normal pancreas and fat replaced echogenic pancreas

Image (8) showed postpartum pancreatic lipomatosis