بسم الله الرحمن الرحيم

Sudan University for Science and Technology

College of Graduate Studies

Prediction of Weight by Measuring Anterior Abdominal Wall Fats Using Computer Tomography

التنبؤ بالوزن من خلال قياس دهون جدار البطن الامامية باستخدام الاشعة المقطعية المحوسبة

A thesis Submitted for Partial Fulfillment of Requirement of M.SC. Degree in Diagnostic Radiology Imaging Technology

Prepared by

Ashwag Abdelfatah Salih Mohammed

Supervisor:

Dr. Caroline Edward Ayad Kihilla

2019

الاية

بسم الله الرحمن الرحيم

(اقرا باسم ربك الذي خلق)

صدق الله العظيم

Dedication

To my parents, teachers, sisters, brothers, and all those who contributed to my learning, development and success in one way or another.

Acknowledgement

I would like to thank my supervisor Dr. Caroline Edward Ayad Kihilla for all her help, guidance and unlimited support throughout the different phases of this project. Furthermore, I want to extend my appreciation and thanks to my university, hospital, x-ray department and all those who supported me to complete this dissertation.

Abstract

The objective of this study is to predict the body weight by measuring Anterior Abdominal Fats Using CT Scans and providing the true weight for patients. This research also aims to evaluate the Component of Anterior Abdominal Wall Fat and correlating the findings With the Age and Gender. The Statistical Package for Social Sciences (SPSS, version24) program was used in order to analyze the primary data of the study. Both descriptive and inferential stats, e.g. regression and t tests, are employed in the study to examine the data and hypotheses. The data was collected in the period between December 2016 To April 2017. The study subjects were randomly drawn from patients referred to Ct Medical Centers in the State of Khartoum, namely: Almoalem Medical City- using Toshiba 160 Slices Device Type, Antalya Medical Center- using Ge 16 Slices Device Type, Modern Medical Center- using Ge 16 Slices Device Type, and Alzaytouna Specialist Hospital- using Toshiba 64 Slices Device Type. The study sample composed of 50 patients (28 Males, 22 Females), their age ranged between 10 and 85 years, body weights ranged between 30 and 130 Kg and had CT examination for abdomen done with or without contrast media used. The assessment of the clinical problems & medical history included: the indications of the study, contrast media allergies, renal impairment &who undergo CT abdomen for fasting 6 to 8 hours. The body weight of these patients was taken after the completion of the CT examination, measurements were made on the pancreatic level which was approximately 12-15cm long and is located deeply on the posterior abdominal wall. It lies approximately on the Trans pyloric plane (l1 vertebral level) and slopes upwards from right to left. Assuming that all CT devices/types are supported by the Arti Rad Dicom viewers programs, the measurements was taken from skin in right side of anterior abdominal wall to external oblique muscle, from skin in central to

linea alba and from skin in left side to external oblique muscle for anterior abdominal fat wall thickness. And was also taken the measure from skin to anterior abdominal wall to posterior back skin and measured from right side skin of abdomen to left side skin of abdomen (circumference), with abdomen dimensions from CT image and correlate the findings with the age and gender of the subjects.

This study concluded that the most affected ages were between 41 and 55 Years. The study found a significant link (p = 0.042) between Anteroposterior measurements and the age, i.e. the older the Age not relies to more the fat accumulation The R^2 value (the "R Square" column) indicates how much of the total variation in the weight can be explained by age. In this case, only (0.1%) of variations in weight participated by age. Moreover, a significant relationship (p = 0.007) was also reported between the right & left measurements subcutaneous of Anterior Abdominal fat wall thickness. They were found to be equal because the fat distribution is equal by side of abdomen. Furthermore, a highly significant relationship (p = 0.00) between RT, Cen & LT Anterior Abdominal Subcutaneous Fat Thickness, it was equal for each. This result was justified based on the fact that Females have more fat compared to their males' counterparts because physiologically they store more fat. That direct linear association between weight and anterior abdominal wall fat (right, center and left) in this relation the weight increase by 1.4, 0.91 and 1.1 respectively, the study also showed that, there a direct linear association between weight and RT/LT, and A/P ,and age in this relation the weight increase by 0.28, 0.187 and 0.037 respectively .

الخلاصة

تهدف هذه الدراسة للتنبؤ بالوزن بقياس دهون البطن الامامية باستخدام الاشعة المقطعية لاعطاء الوزن الصحيح للمرضى. تقييم محتوى دهون حائط البطن الامامي. ربط النتائج مع العمر و الجنس. هذه الدراسة تحليلية والتي استخدم فيها البرنامج الاحصائي للعلوم الاجتماعية واصدار 24. البيانات اجريت في الفترة من ديسمبر 2016 الى ابريل 2017. تمت الدراسة في ولاية الخرطوم على المرضى الذين حضروا للمستشفى وتم تحويلهم الى مراكزطبية بها اشعة مقطعية كمدينة المعلم الطبية بنوع جهاز توشيبا 160 شريحة ومركز انطاليا الطبي بنوع جهاز جي إي 16 شريحة والمركز الطبي الحديث بنوع جهاز جي إي 16 شريحة ومستشفى الزيتونة التخصصي بنوع جهاز توشيبا 64 شريحة. جمعت البيانات من 50 مريض (28 رجل و 22 إمرأة) بمدى اعمار من 10- 85 سنة و مدى اوزان من 30- 130 كيلوجرام كان عنده فحص اشعة مقطعية اجري مع او بدون استخدام وسط تباين. تقيم المشاكل السريرية و التاريخ المرضي، يتضمن دلائل الدراسة، الحساسية من وسط التباين،ضعف الكلى،وان يصوم حوالي 6-8 ساعات قبل المرور بالاشعة المقطعية للبطن.تم اخذ وزن الجسم من هؤلاء المرضى. بعد اكتمال الفحص بالاشعة المقطعية، تمت القياسات على مستوى البنكرياس الذي يقع تقريبا بطول 12- 15 سنتميتر واقع بعمق على حائط البطن الخلفي. يرقد تقريبا على الطائرة عبر البوابة (مستوى الفقرة الاولى) و انحدرات بالتفافات علوية من اليمين للشمال. على افتراض انو اي نوع جهاز اشعة مقطعية مدعوم بارتي راد دايكوم فيورز تاخذ القياسات لسمك دهون حائط البطن الامامية من الجانب الايمن لجدارالبطن الامامي الى العضلة المائلة للخارج، ومن الجلد في المنتصف لللينيا البا، ومن الجلد في الجانب الايسر الى العضلة المائلة للخارج ، واخذ القياس من الجلد في جدار البطن الامامي الى الجلد في الخلف على الظهر، واخذ القياس ايضا من الجلد في الجانب الايمن للبطن

الـــى الجلــد فـــي الجانـــب الايســـر للـــبطن (المحيط)،ومـــع ابعـــاد الـــبطن مـــن صـــورة الاشعة المقطعية ، ومع مقارنة النتايج بالعمر والجنس

هذه الدراسة استنتجت بان اكثر الاعمار المؤثرة كان بين 41 – 55 سنة الاشداء من الشباب البالغين. وجدت ان هنالك دلالة احصائية 0,042 مع القياسات الامامية الخلفية كلما زاد العمر لايعتمد زيادة تراكم الدهون لان معادلة الارتداد توضح اختلاف مابين الوزن والعمر بنسبة ضئيلة جدا وهي بنسبة (0.1%) فقط. وجدت دلالة احصائية 0,007 مع القياسات في اليمين والشمال لسمك دهون تحت الجلد للبطن على التوالي متساوي لان توزيع الدهون متساوي في جانبي البطن. ووجدت دلالة احصائية 0,000 مع القياسات في اليمين والوسط والشمال لسمك دهون البطن تحت الجلد متساوي لكل واحد وبرر بوضوح ان محتوى الدهون في النساء اكبر من الرجال لان النساء لديهم قابلية لتخزين الدهون اكثر من الرجال فسولجيا.وان الترابط الخطي المباشر بين الوزن ودهون حائط البطن الامامية في كل من (اليمين والوسط والشمال) في هذه العلاقة الوزن يزيد ب 0.91 ,1.4 و 1.1 على التوالي واظهرت ايضا الترابط الخطي المباشر بين الوزن والقياسات من الايمن للايسر و من الامام للخلف والعمرفي هذه العلاقة يزيد الوزن ب 0.187 ,0.28 و 0.037 على التوالي

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List of abbreviations

3D	Three dimension
AFOV	Axial field of view
AT	Adipose tissue
BMI	Body mass index
CAT	Computerized axial Tomography
CEN	Center
CSF	Cerebrospinal fluid
CT	Computer tomography
DXA	Dual energy x-ray absorptiometry
FBP	Filtered back projection
GIT	Gastrointestinal tract
GPU	Graphical processing unit
HU	Hounsfield unit
IVCM	Inter venous contrast media
IVHOCM	Inter venous high osmoler contrast media
Kg	Kilogram
KVP	Kilovolt
LAGB	Laproscopic adjutable gastric band
LOCM	Low osmoler contrast media
LT	Left
LV	Liver volume
MA	Mali amber
MRI	Magmatic resonance imaging
NAFLD	nonalcohlic fatty liver disease
NO	Number
PC	Processing card

RT	Right
SAT	Subcutaneous adipose tissue
SEC	Second
SPSS	Statistical package for social sciences
STP	Standard pressure and temperature
US	Ultrasound
VA	Visceral adipose
VAT	Visceral adipose tissue
VLED	Avery low energy diet

Chapter one

Introduction

Chapter one

Introduction

1.1 Introduction

Computed tomography (CT) offers the possibility of combining site specific and whole body methods of measuring fatness. CT scans are thin cross-sectional, radiographic images that can be obtained at anybody level. CT is much more sensitive to slight differences in attenuation than standard radiography and therefore depicts the soft tissues with great clarity. As in standard radiography, fat has lower attenuation than other tissues and has a distinct appearance on the CT image. Because CT scans are computer reconstructions of thousands of separate determinations of attenuation, the data can be analyzed statistically using CT software. A number of heretofore impossible measurements can be made, including total fat area of a single section, and the combination of areas from successive sections to compute fat volumes (Gary, A. and jeremihia, E.1982).

The computer software enables the user to encircle any portion of the anatomy and obtain the area of fat and lean tissue within by specifying the appropriate attenuation ranges. In the abdomen, this feature permits the differentiation of subcutaneous fat area from intraabdominal fat area. Measurements of fat between muscles in the extremities can also be made

Several studies have documented the value of CT scans in assessing lean tissue, but none has evaluated its potential for measuring adiposity (Gary, A. and jeremihia, E.1982).

1.2The problem of study:

Prediction of Weight by Measuring Anterior Abdominal Fats Using CT Scan is giving the true weight for patient.

1.3Objectives of the study:

1.3.1General objective:

Prediction of weight by measuring anterior abdominal fats using CT scan.

1.3.2 Specific objectives:

- To evaluate the component of anterior abdominal wall fat measurements in all of the Right from skin to external oblique muscle. Central from skin to linea alba. And Left from skin to external oblique muscle anterior abdominal wall fat thickness. And from Right to Left (circumference). And from anterior to posterior contents of abdomen in pancreatic level (L1).
- To correlate the finding with age and gender.

1.4 Overview of the study:

This study was be fall into five chapters:-

Chapter one is an introduction that about what is CT abdominal as well as statement of the problem, objectives of study and overview of the study. Chapter two the anatomy physiology pathology and literature review of the study. Chapter three which deal with material and method. Chapter four which presented the results of the study. Charter five which involves discussion, conclusion and recommendations, and the study end with the references and appendices.

Chapter Two

Literature Review

Chapter two

Literature review

2.1Anatomy of anterior abdominal wall:

The anterior abdominal wall forms the anterior limit of the abdominal viscera. It runs, superiorly from the xiphoid process and costal cartilages of the 7th, 8th, 9th and 10th ribs to the iliac crest, inguinal ligament, anterior superior iliac spine, pubic tubercle, pubic crest and pubic symphysis inferiorly. Generally, from superficial to deep, it is comprised of the skin, superficial fascia (adipose and membranous tissues), deep fascia, layers of muscles, extra-peritoneal tissue and the peritoneum. Most of these structures, especially the muscles, span the anterolateral abdominal wall and there is no definite boundary between the anterior and lateral abdominal walls, thus the anterior abdominal wall is sometimes referred to as the anterolateral abdominal wall. (Onome okpe; et.al, 2018).

2.2 Structure of the anterior abdominal wall:

Is made up of skin, superficial fascia, deep fascia, muscles, extra peritoneal fascia, and parietal peritoneum.

2.2.1Skin: Is loosely attached to the underlying structures except at the umbilicus, where it is tethered to the scar tissue. The natural lines of cleavage in the skin are constant and run downward and forward almost horizontally around the trunk. The umbilicus is a scar representing the site of attachment of the umbilical cord in the fetus; it is situated in the linea alba (Richard S. Snell; 2012).

2.2.2 Lying just below the skin are two layers of superficial fascia called Camper's fascia and Scarpa's fascia. The Camper's fascia is a subcutaneous tissue containing variable amounts of fatty tissue. This fatty tissue is generally more in females and also in the right and left lower quadrants.

Next to the Camper's fascia is the Scarpa's fascia. The Scarpa's fascia is a membranous fatty layer containing fibrous tissue and very little fat. It runs inferiorly into the lower limbs where it changes its name to the fascia lata of the thigh. It is also continuous with the superficial perineal fascia called Colles' fascia and also with the fascia which invests the scrotum and penis in males.

2.2.3Deep to the two superficial fascia are layers of deep fascia. The deep fascia of the anterior abdominal wall directly invests the muscular layers of the anterior abdominal wall. They are made up of elastin fibres, dense fibrous connective tissue and divide the groups of muscles of the anterior abdominal wall into fascial components. Because this layer of fascia contains elastin fibres, it helps the anterior abdominal wall in playing a role in increasing the intra-abdominal pressure to support defecation, parturition and micturition (Richard S. Snell; 2012).

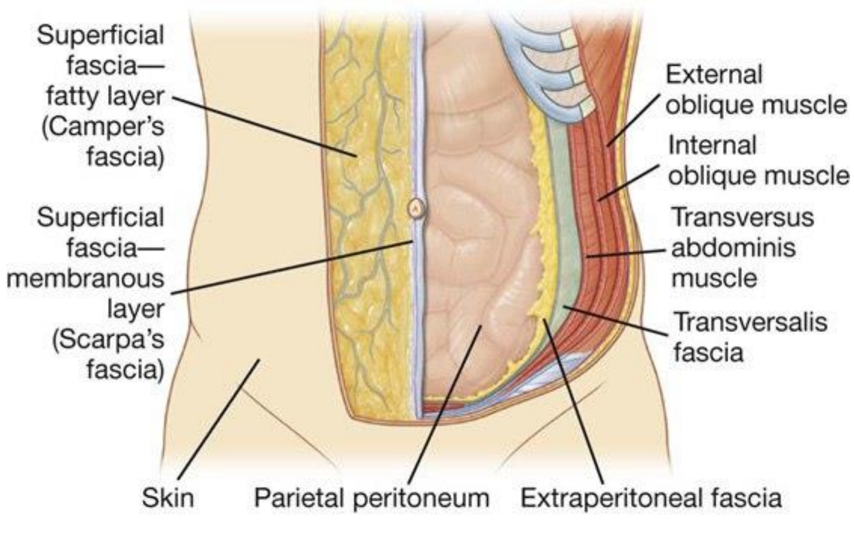

Fig: (2.1) CLINICAGATE (2015) Anterior ABD Wall Layer https://clinicagate.com [Accessed 05/02/018]

2.3Nerve Supply:

The cutaneous nerve supply to the anterior abdominal wall is derived from the anterior rami of the lower six thoracic and the 1st lumber nerves. The thoracic nerves are the lower five intercostal and the subcostal nerves; the 1st lumber nerve is represented by the lliohypogastric and the llioinguinal nerves.The dermatome of T7 is located in the epigastrium over the xiphoid process. The dermatome of T10 includes the umbilicus and that of L1 lies just above the inguinal ligament and the symphysis pubis (Richard S. Snell; 2012).

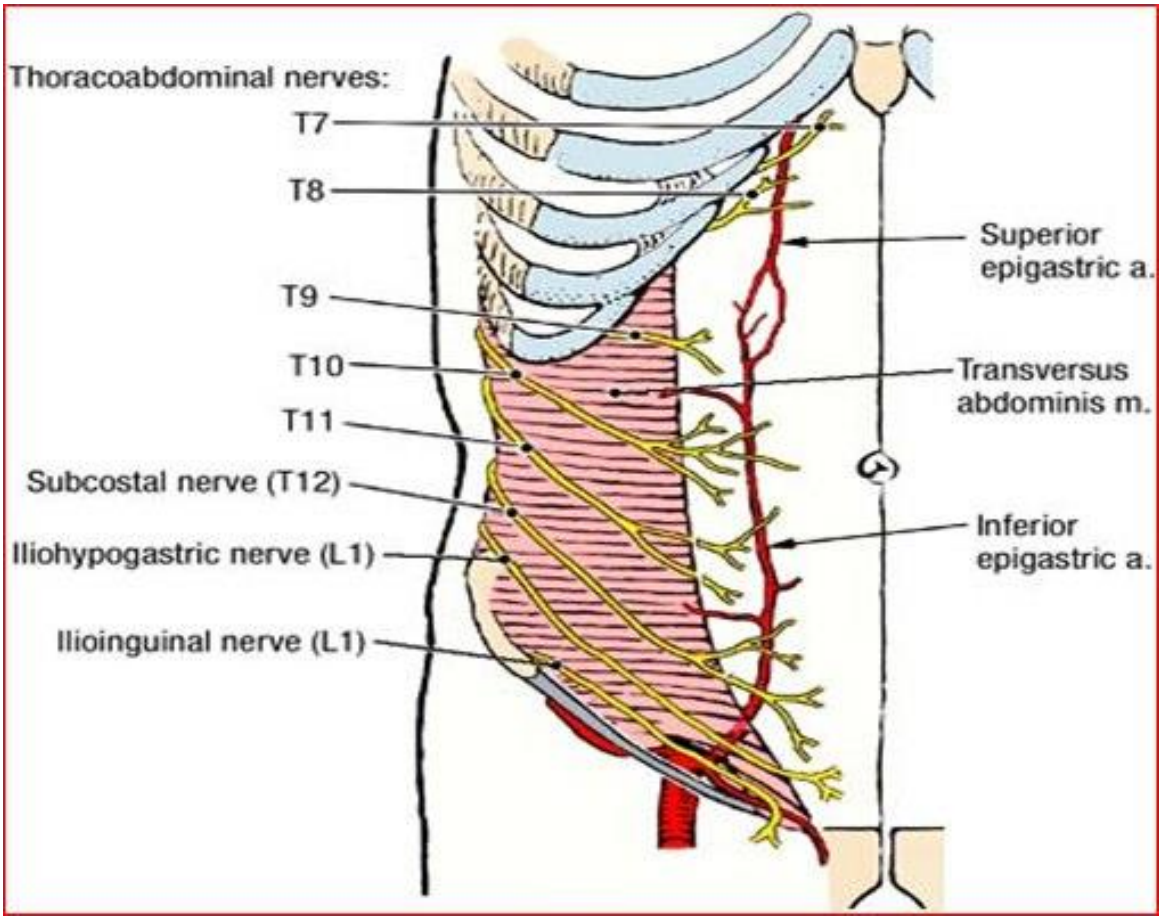

Fig: (2.2) CLODFRONT (2015) Nerve Supply of Anterior ABD Wall http://d1yboe6750e2cu.cloudfront.net [Accessed 04/02/018]

2.4 Blood supply:

2.4.1 **Arteries**: The skin near the midline is supplied by branches of the superior and inferior epigastric arteries. The skin of the flanks is supplied by branches of the intercostal, lumbar, and deep circumflex iliac arteries. In addition, the skin in the inguinal region is supplied by the superficial epigastric, the superficial circumflex iliac, and the superficial external pudendal arteries, branches of the femoral artery (Richard S. Snell; 2012)

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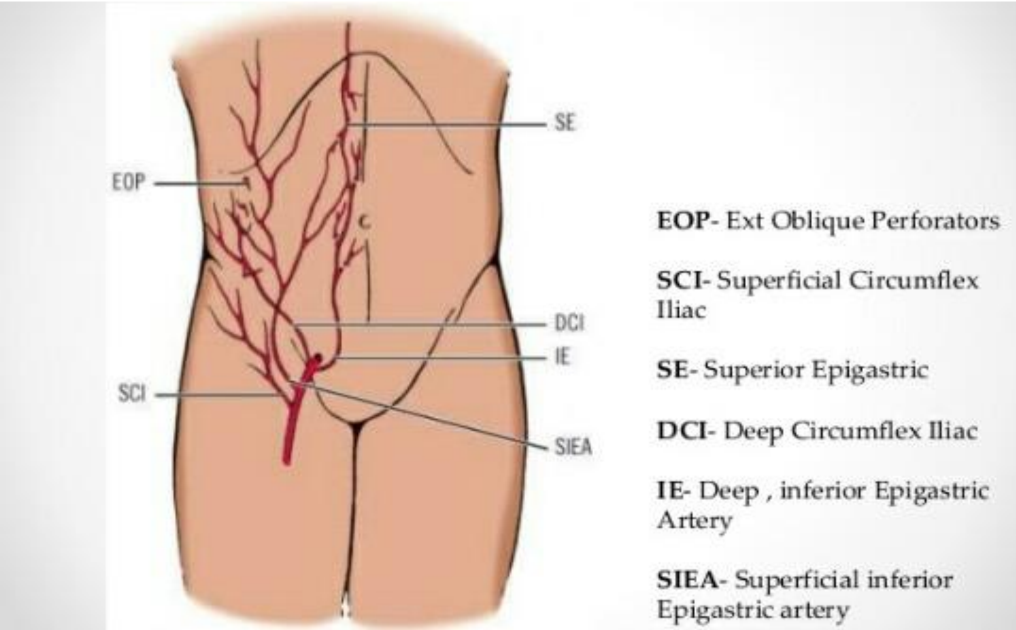

Fig: (2.3) SLIDESHERECDN (2006) Artery of Anterior ABD Wall https://image.slidesherecdn.com [Accessed 04/02/018]

2.4.2 **Veins**: The venous drainage passes above mainly into the axillary vein via the lateral thoracic vein and below into the femoral vein via the superficial epigastric and the great saphenous veins (Richard S. Snell; 2012).

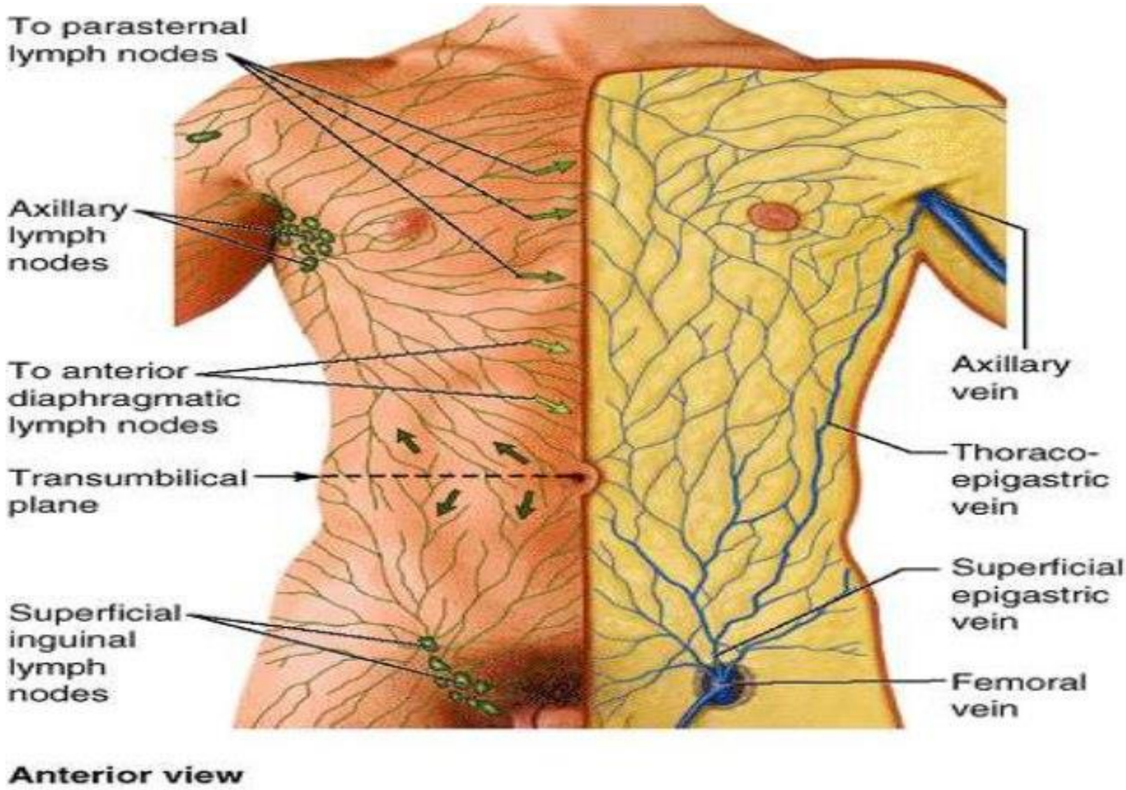

Fig: (2.4) SLIDESHERECDN (95) Vein & Lymph Node of Anterior ABD Wall https://image.slidsharecdn.com [Accessed 04/02/018]

2.5**Muscles of the anterior abdominal wall**: consist of three broad thin sheets that are aponeurotic in front; from exterior to interior they are the external oblique, internal oblique, and Trans versus. On either side of the mind line anteriorly is, in addition, a wide vertical muscle, the rectus abdominis. Asthe aponeuroses of the three sheets pass forward, they enclose the rectusabdominis to form the rectus sheath. The lower part of the rectus sheath might contian a small muscle called the pyramidalis (Richard S. Snell; 2012).

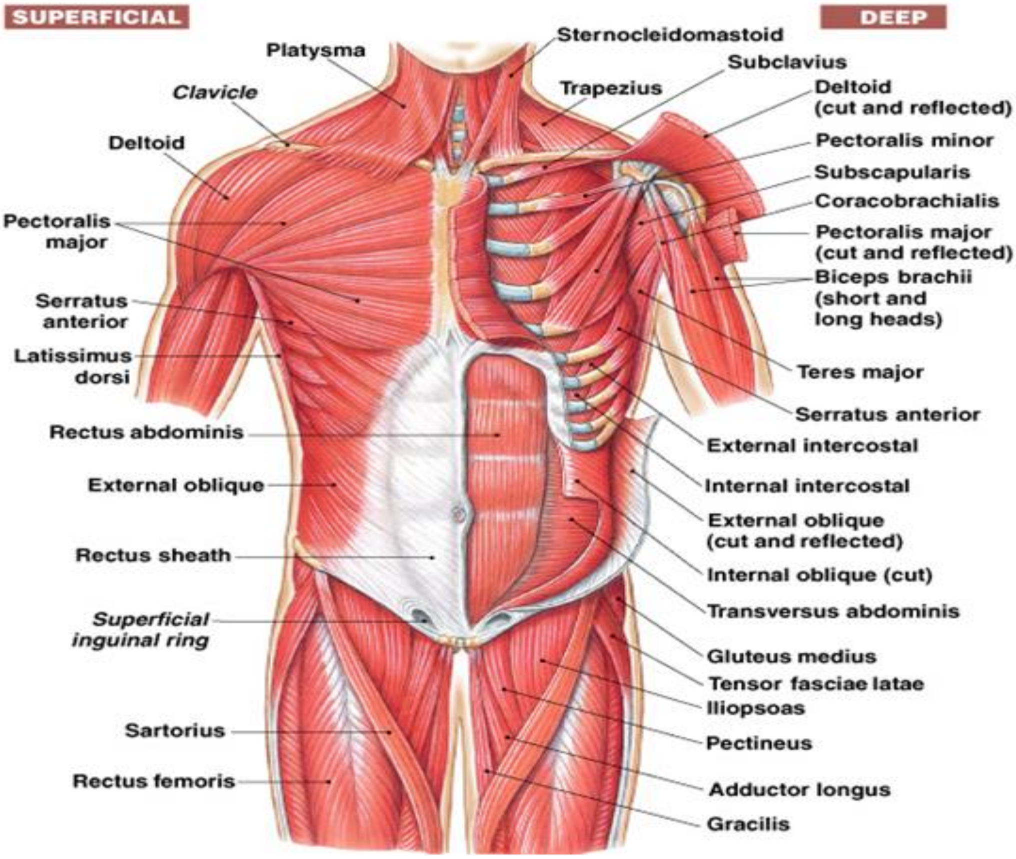

Fig: (2.5) UOCODAC (2016) the Superficial & Deep Anterior ABD Muscles http://images.google.com [Accessed 21/02/018]

2.5.1 **The following is a short description of these five muscles**:

The external oblique muscles are a pair of broad, thin, superficial muscles that lie on the lateral sides of the anterior abdominal wall. The location and structure of the external abdominal obliques gives them many different possible actions. The external obliques get their name from their position in the abdomen external to the internal abdominal obliques and from the direction of their fibers, which run diagonally across the sides of the abdomen. The external abdominal obliques have their origins along the lateral ribs 5 through 12 and insert into the xiphoid process, linea alba of the abdomen, the pubis, and the iliac crest of the pelvic bones. Their shape is roughly rectangular with the long axis running anterior to posterior along the linea alba. The posterior most fibres form the free posterior border. Above and medial to the pubic tubercle, a small triangular defect in its aponeurosis is termed as superficial inguinalring. (Onome okpe; et.al, 2018).

The inferior border of the aponeurosis between the anterior superior iliac spine and pubic tubercle folds backward and forms the inguinal ligament. The lacunar ligament extends backward and upwards towards pectineal line from the medial end of the inguinal ligament. Muscle fibers in the external obliques run medially and inferiorly from the origins to the insertions across the lateral sides of the abdomen and end just lateral to the rectus abdominis muscles (Onome okpe; et.al, 2018).

The internal oblique muscles lie deep to the external oblique muscles, and they are of the anterior and lateral parts of the abdomen. They originate in the lumbar fascia, anterior two-thirds of the iliac crest, and the lateral two-thirds of the inguinal ligament and insert into the inferior borders of the lower three ribs and their costal cartilages, xiphoid process, and aponeurosis of the rectus sheath as well as the conjoined tendon to the pubic crest and pectineal line. Most of its fibres run at a right angle to those of external oblique (Onome okpe; et.al, 2018).

The transverse abdominal muscle lies deep to the internal oblique muscle. It is the deepest of the flat muscles, and originates from the lateral third of the inguinal ligament, the anterior three-fourths of the inner lip of the iliac crest of the pelvic bone, the inner surfaces of the cartilages of the 7th to 12th ribs, and interdigitates with the diaphragm and the lumbodorsal fascia. It attaches to the xiphoid process, linea alba and pubic symphysis. A conjoint tendon is formed by the joining of the lowest tendinousfibres of the internal oblique and transverse abdominal muscle (Onome okpe; et.al, 2018).

The rectus abdominis muscles are a pair of long straight muscles which run vertically on each side of the anterior abdominal wall. The term rectus abdominis is the Latin meaning “straight abdominal”, and indicates that the muscle fibers run in a straight vertical line through the abdominal region of the body. They are contained in the rectus sheath. The rectus abdominis muscles are separated at the midline by the linea alba. They extend along the entire length of the abdomen adjacent to the umbilicus. Each muscle consists of a string of four fleshy muscular bodies connected by narrow bands of tendon known as tendinous intersections. These intersections are present usually at three levels: at the level of xiphoid process, the level of umbilicus and midway between them. The muscle originates and extends from the xiphoid process of the sternum and costal cartilages of the 5th to 7th ribs to insert into the pubic bone, particularly from the pubic symphysis, pubic crest, and tubercle (Onome okpe; et.al, 2018).

The pyramidalis muscle is a small triangular muscle lying anterior to the rectus abdominis muscle. It is contained in the rectus sheath and originates from the bony pelvis, where it is attached to the pubic symphysis and pubic crest through tendinous fibers. The fibres run superiorly and medially to insert into the linea alba at a point midway between umbilicus and pubis through the anterior pubic ligament. Superiorly, the fleshy portion of the muscle passes upward, diminishing in size as it ascends, and ends by a pointed extremity which is inserted into the linea alba, therefore when it contracts, it tenses the linea alba (Onome okpe; et.al, 2018).

2.5.2 Rectus Sheath

The rectus sheath is a strong fibrous sheath around the rectus abdominis and pyramidalis muscle. It is formed by the decussation of the aponeurotic fibres of the flat abdominal muscles. The linea alba is present between the sheaths of both sides. Along with the muscles, it contains superior and inferior epigastric vessels, anterior rami of the lower six thoracic nerves and lymph vessels (Onome okpe; et.al, 2018).

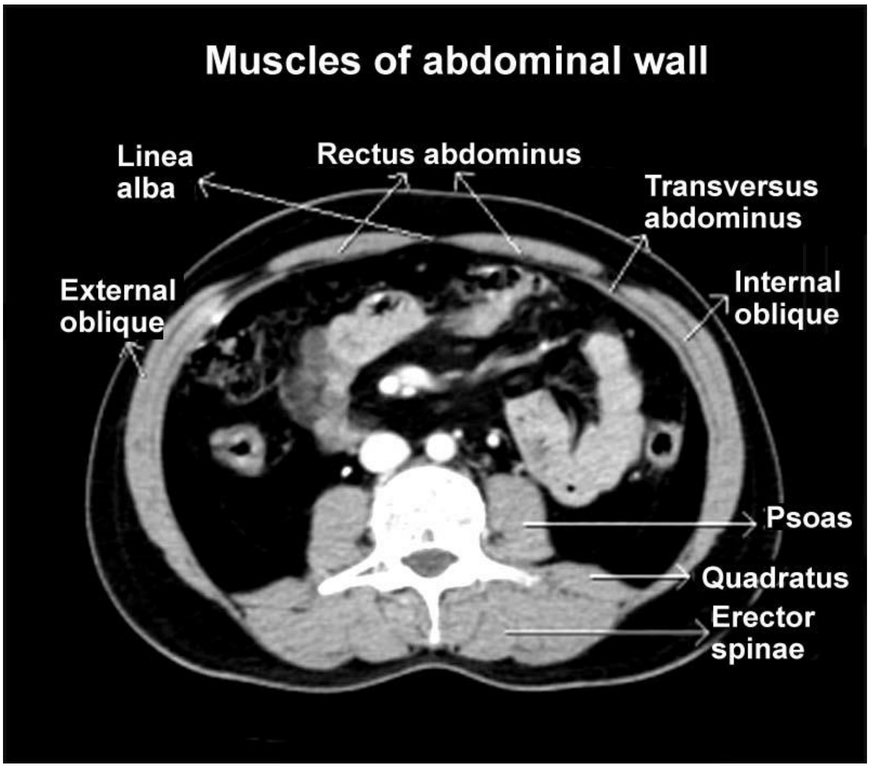

Fig: (2.6) Jaypee Brothers Medical Axial CT showing the anterior abdominal wall muscles surrounded by subcutaneous fat and skin (2011), Available from: Step by Step Cross-sectional Anatomy, Jaypee Brothers Medical Publishers.

2.6Functions of Anterior Abdominal Wall Muscles

2.6.1**The anterior abdominal wall** is also important because it is used in clinical surface anatomy for the localization of abdominal viscera. For these purposes, the abdominal wall is divisible into four quadrants by two imaginary lines; a midline (vertical) and a horizontal line which passes through the umbilicus. The quadrants are named as follows; the right upper quadrant, left upper quadrant, right lower quadrant and left lower quadrant. This form of dividing the abdomen into four quadrants is known as the four region scheme (Onome okpe; et.al, 2018).

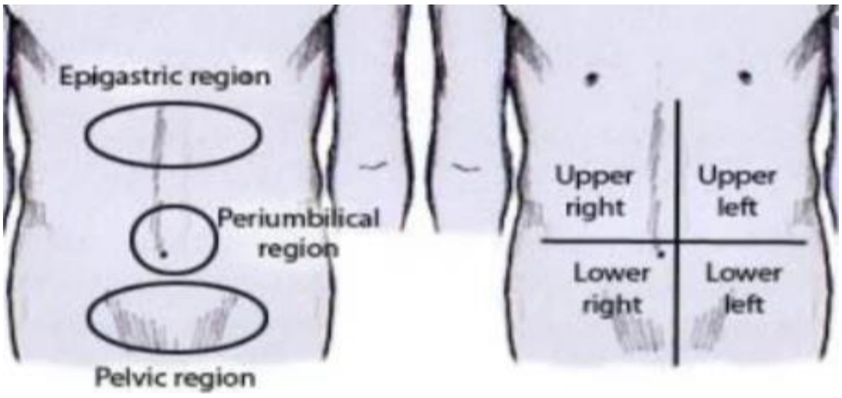

Fig: (2.7) MEDSCAPESTATIC (31) Four Quadrants & Three Region of-Anterior-abdominal-wall.https://img.medscapestatic.com [Accessed 05/02/018]

2.6.2 **Similarly**, the anterior abdominal wall can also be divided into nine regions by two imaginary vertical lines called mid-clavicular lines (two vertical lines passing through the midpoint of the clavicle on the left and right side), and two imaginary horizontal lines. These regions are of clinical importance. The mid-clavicular lines extend downwards to reach the mid inguinal point. The superior horizontal line is known as a transpyloric line (or transpyloric plane). This line is so named because of its relation to the pylorus of the stomach. It runs horizontally at the halfway point between the jugular notch and top of the pubic symphysis, passing through the pylorus of the stomach. The lower horizontal line can be drawn to join the tubercles of the right and left iliac crests of the hip bones. It is called the transtubercular plane or intertubercular line (intertubercular plane). Therefore, these four lines divide the anterior abdominal wall and the abdominopelvic cavity into a middle epigastric, umbilical, suprapubic or hypogastric, right hypochondrium, left hypochondrium, right flank (right lumbar), left flank (left lumbar), right groin (right iliac, inguinal) and left groin (left iliac, inguinal) regions. This division of the abdomen into nine regions is aptly known as the nine region scheme (Onome okpe; et.al, 2018).

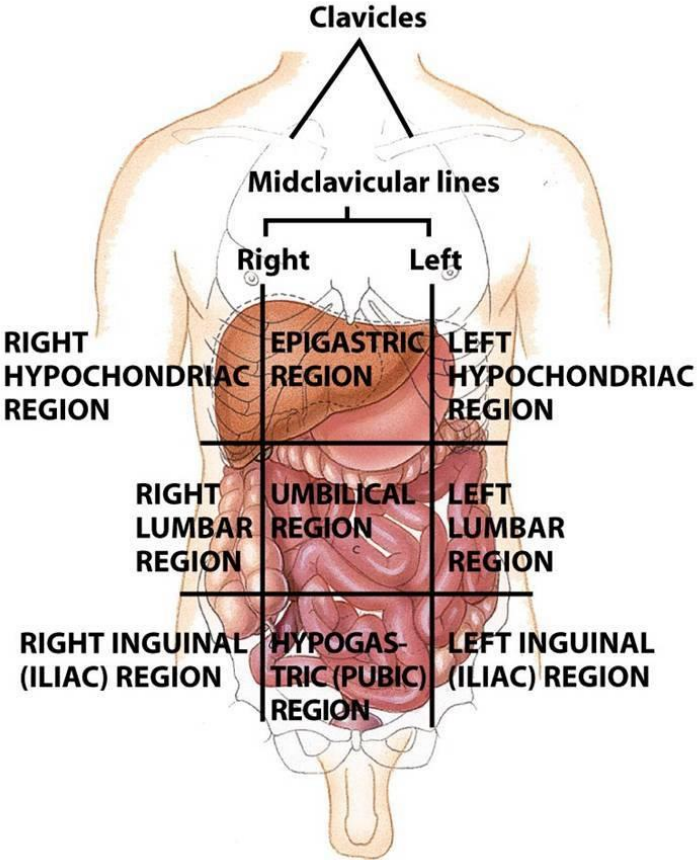

Fig: (2.8) WORDPRESS (2010) Nine Regions of the Anterior ABD Wall https://paulinebms191.files.wordpress.com [Accessed 04/02/018]

2.6.3 **The external abdominal oblique muscles** both sides acting together, flex the vertebral column by drawing the pubis towards the xiphoid process. Acting unilaterally it results in ipsilateral side flexion and contralateral rotation of the trunk. (Anne Millar, Evan Thomas; et al, 2015).

2.6.4 **The internal abdominal obligue muscles** acting unilaterally, contraction results in ipilateral side flexion and rotation of the trunk. It acts with the external oblique muscle of the opposite side to achieve this torsional movement of the trunk. It also acts to compress the abdominal viscera, pushing them up into the diaphragm, resulting in a forced expiration. (Anne Millar, Evan Thomas; et al, 2015).

2.6.5 **The transversus abdominis muscles** contraction has a corset like effect, narrowing and flattening the abdomen. Its primary function is to stabilize the lumbar spine and pelvis before movement of the lower and / or upper limbs occur. (Anne Millar, Evan Thomas; et al, 2015).

2.6.6 **The rectus abdominis** is an important postural muscle. With a fixed pelvis, contraction results in flexion of the lumbar spine. When the ribcage is fixed contraction results in a posterior pelvic tilt. It also plays an important role in forced expiration and in increasing intra-abdominal pressure. (Anne Millar, Evan Thomas; et al, 2015).

2.6.7 **The anterior abdominal wall** is highly distensible and is involved in various functions ranging from support of movements of the abdominal viscera to protection of the abdominal cavity. It is more flexible than the posterior abdominal wall, and supports lateral bending, flexion, extension or protrusion and twisting. It plays a role in the maintenance of posture, and increases in intra-abdominal pressure to support defecation, parturition and micturition (Onome okpe; et.al, 2018).

2.7Abdominal Wall Pathology:

The anterior abdominal wall (AAW) forms flexible sheet of tissue across the anterior and lateral abdomen, has an important role in maintaining the form of the abdomen, and provides a barrier between the peritoneal cavity and the exterior. It forms the inguinal canal, umbilicus, both of which are of considerable clinical importance. Pathological processes affecting the anterior abdominal wall can be grouped into hernias, Infections & abscesses, inflammatory lesions including endometriomas & fistulas, traumatic or spontaneous haematomas and tumours both benign and malignant (S.P.Ramachandra, N. Gurjar; et.al, 2010).

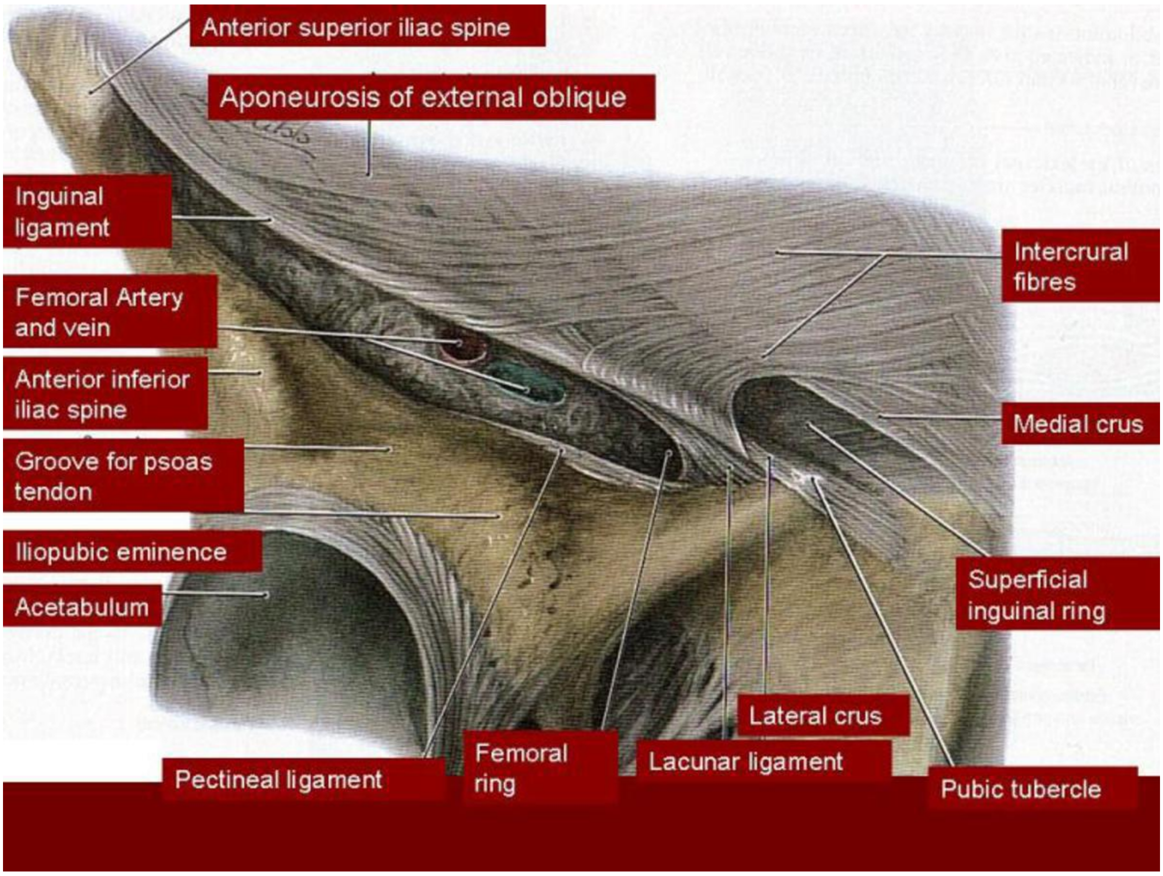

Fig: (2.9) this image depicts the anatomy of the inguinal region and the hernia sites (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Multimodality imaging is often required to assess these pathologies. Ultrasound is a useful simple first line investigation but is limited by its inability to visualise the full extent of pathology and its relation to adjacent structures. CT is commonly used, but MRI has superior soft tissue resolution, multi-planar capability and lack of radiation and is a particularly useful modality especially in younger patients and in cases of suspected primary neoplasm's (S.P.Ramachandra, N. Gurjar; et.al, 2010).

2.7.1Tumours:

- Benign tumours: desmoids, lipomas, leiomyomas
- Malignant tumours: direct tumours spread, heamatogenous metastasis, sarcomas lymphomas (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Sarcoma

The most common primary malignant neoplasm involving the abdominal wall is a sarcoma. These sarcomas, depending on what layers and cell types of the abdominal wall soft tissue are involved, can be of several subtypes: liposarcoma, fibrosarcoma, leiomyosarcoma, rhabdomyosarcoma, and malignant fibrous histiocytoma. The clinical progression of these tumors is reflective of their histology, size, and location.

These abdominal wall sarcomas can present as painless abdominal wall masses. Suspicion for malignancy arises with masses that are solid, large, fixated, and fast growing. On ultrasound, a sarcomatous lesion will be a hypoechoic solid lesion that may have localized areas of necrosis or fluid. MRI can also be used to further delineate extent of disease. These lesions require guided biopsies, either incisional or percutaneous, to confirm their pathological diagnosis (Nguyen phat JSC, 2017).

Metastatic Neoplasm

Transperitoneal, hematogenous, lymphatic seeding of intra-abdominal carcinomas or melanomas may result in metastatic lesions in the abdominal wall. Cases of port-site seeding after laparoscopic surgery have also been reported in the literature, particularly following laparoscopic cholecystectomy where the cancer diagnosis was unknown at the time of operation. A metastatic deposit at the umbilicus is known as a Sister Mary Joseph’s nodule. These lesions may be characterized and biopsied with sonographic guidance and are typically treated with surgical resection and radiation as needed. Ultrasound has also been reported to be of use in guiding insertion of applicator needles that can administer brachytherapy to abdominal wall metastases from colorectal cancer (Nguyen phat JSC, 2017).

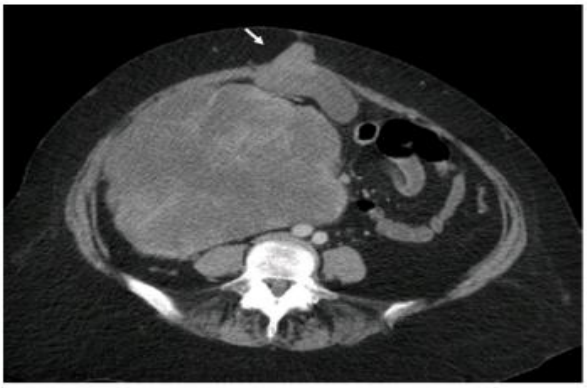

Fig: (2.10) Post contrast Axial CT abdomen demonstrating large metastasis from ovarian carcinoma to abdominal wall. The smaller mass is infiltrating into the umbilicus – "Sister Mary Jopsephs Nodule" (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.11) metastatic melanoma – Enhancing soft tissue nodules along the external oblique muscle on the left (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Other Abdominal Wall Masses / Urachal Cyst

An urachal cyst is a sinus remnant that persists between the umbilicus and bladder. It is usually present in the lower third of the urachus but may lie inferior to the umbilicus as well. These cysts can be depicted on ultrasound, where there will be well-circumscribed fluid collections that are anechoic, along the lower midline. When infected, they have varying internal echoes and may be associated with adjacent soft-tissue inflammatory changes and urinary bladder wall thickening on ultrasound. If symptomatic or associated with recurrent urinary tracts infections, these cysts should be surgically excised (Nguyen phat JSC, 2017).

Scar-Related Masses

Common masses that present in relation to prior surgical scars include stitch granulomas, heterotropic calcifications, and endometrial implants. A stitch granuloma will occur near a retained non absorbable suture and will demonstrate irregular borders and heterogenicity on ultrasound. Heterotrophic calcifications are benign lesions, which on US examination have posterior acoustic. The lesion may present as a painful solid mass near a previous scar. On ultrasonography, it appears as a hypoechoic solid lesion, with scattered internal echoes and internal vascularity that can be demonstrated with color Doppler (Nguyen phat JSC, 2017).

The benign tumours of the abdominal wall are more common than the malignant neoplasms. Metastasis (fig 2.10) and (fig 2.11) account for most of the malignant lesions found in the abdominal wall, although primary sarcomas or lymphomas may also develop. Pancreatic and lung tumours are the most common neoplasms that metastasis to the abdominal wall. Sister mary josephs nodule (fig 2.10) is referred to as the metastasis of visceral malignancy to umbilicus, commonly from the gastrointestinal or genitourinary tract (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Desmoids are now included in deep fibromatosis and are histologically benign but locally aggressive tumours. Although they are rare, they are a common manifestation of Gardner syndrome. They are common in 3rd and

4th decade and female are affected more commonly (S.P.Ramachandra, N. Gurjar; et.al, 2010).

They are locally aggressive tumours with invasion of contiguous structures with high incidence of local recurrence despite apparent complete surgical removal (S.P.Ramachandra, N. Gurjar; et.al, 2010).

lipomas are most common soft tissue neoplasm and are much more frequent than liposarcomas. These can be categorized as superficial or deep. In the abdomen and trunk, superficial lipomas are more common and are generally less than 5cms. The deep lipomas are usually large at presentation and imaging is often required. On ultrasound the lipomas appear as hyperechoic mass and the capsule is usually difficult to see (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.12) Axial reconstructions showing lipoma between the transversus abdominis and internal oblique muscles (S.P.Ramachandra, N. Gurjar; et.al, 2010).

CT and MRI are superior in providing a confident diagnosis. CT and MRI reveal a mass of homogenouns adipose tissue similar to the surrounding normal fat. They can have thin internal septa and do not enhance after intravenous contrast administration. In many cases MRI can be used to make a confident diagnosis (S.P.Ramachandra, N. Gurjar; et.al, 2010).

2.7.2 Infections:

Inflammatory lesions: Endometriomas, fistula / sinuses, Others – AVMs / portosystemic shunts, vascular grafts, heamatomas, hernias, implants (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Abdominal wall fluid collections include cysts, hematomas, seromas, and abscesses. Ultrasonography is a useful modality in identifying a fluid collection and its characteristics. Hematomas may be spontaneous, postsurgical, or related to anticoagulation therapy or traumatic injury. If warranted, hematomas may be drained with image guidance. Abscesses have a variable appearance on ultrasound. They are typically irregular fluid collections containing septations and fluid debris and may have air-fluid levels. They may also exhibit peripheral hyperemia with Doppler evaluation. If gas bubbles are present with the abscess, they will be echogenic and demonstrate acoustic shadowing. Seromas are usually more homogenous anechoic or hypoechoic fluid collections on ultrasound. They are usually encountered following an abdominal operation, particularly following ventral hernia repairs. The development of postoperative seromas may be prevented with the use of pressure dressings and abdominal binders. If there is no evidence of superinfection, it is acceptable to observe a seroma without intervention, as there is a risk of introducing infection with needle aspiration. If a seroma or hematoma appears infected or an abdominal wall abscess is identified, operative drainage or needle drainage with image guidance is warranted in addition to antibiotic therapy. For larger fluid collections that are percutaneously drained, a drain may be left in place to facilitate additional drainage (Nguyen phat JSC, 2017).

The infections of the abdominal wall are uncommon and can be divided into cellulitis, necrotizing fasciitis, absses, pyomyositis, the latter involving the muscles. Thay can occur spontaneously or in association with diabetes mellitus, immunosuppression, sepsis, surgery, and trauma. These can be difficult diagnose clinically because of poor localising signs. The extent of underlying tissue involvement is frequently underestimated at physical examination and is often far more extensive than visualised cutaneous abnormality at surgery or imaging. While ultrasound can be used as an initial imaging modality, CT and MRI are far more superior in providing information on the nature and extent of the lesion. CT is particularly useful when percutaneous drainage is required and to assess if there is communication with bowel/ peritoneal cavity (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.13) Cellutitis: sagittal reconstruction demonstrating subcutan-eous inflammatory stranding and skin thickening (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.14) Axial CT reformat showing necrotising in the lower right lateral abdominal wall with extensive kin and subcutaneous tissue loss (arrows). Also note the ascites (star) from other pathology (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Endometriosis is relatively common gynaecological problem in women of reproductive age group. It is the most common site of extraovarian or extrauterine endometriosis following a cesarean section operation. There are two main theories for the pathogensis of endometriosis. The characteristic clinical symptom is cyclic pain associated with menses. The imaging appearance can be heterogeneous with cystic change but can vary from purely cystic change to solid deposits or fibrosis. CT and MRI help to assess the extent of the disease. Frequently histology by either image guided puncture or excision biopsy is required for diagnosis. On ultrasonography, it appears as a hypoechoic solid lesion, with scattered internal echoes and internal vascularity that can be demonstrated with color Doppler (Nguyen phat JSC, 2017) & (S.P.Ramachandra, N. Gurjar; et.al, 2010).

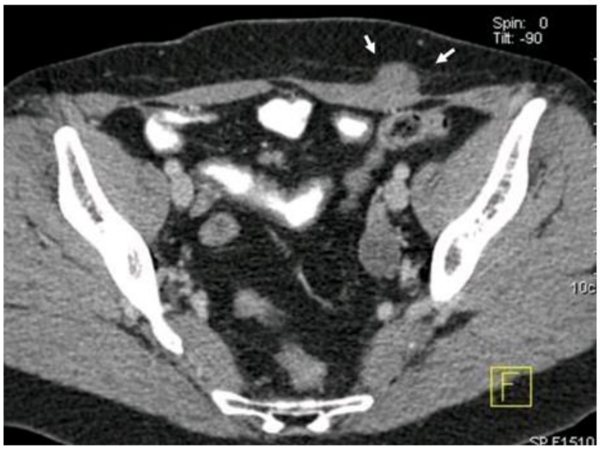

Fig: (2.15) Axial reconstructions showing small mass inrelation to the left rectus abdominis muscle which proved to be endometrioma (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fistula formation is a hallmark of crohns disease and occurs in up to 40% of the cases. Sinus and fistula tracts often involve the distal small bowel and may be associated with peritoneal abscess and phlegmon formation (S.P.Ramachandra, N. Gurjar; et.al, 2010).

The underlying causes of acquired GI fistulas are diverse and include virtually any process resulting in bowel perforation from within or bowel penetration from extraintestinal process. The majority of cutaneous fistulas represent a complication of recent abdominal surgery.

The leading causes for enterocutaneous fistula / sinus in the developed countries include crohns disease, diverticulitis, malignancy or a complication of treatment of these entities (S.P.Ramachandra, N. Gurjar; et.al, 2010).

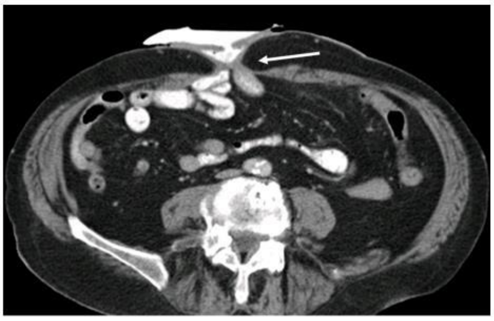

Fig: (2.16) Post-operative enterocutaneous fistula: Note the oral contrast leak from the midline post-operative fistula with a loop of small bowel tethered to the anterior abdominal wall (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.17) Fistula with peritoneal cavity in a patient with renal failure undergoing peritoneal dialysis. Contrast has been injected into the peritoneal cavity via peritoneal dialysis catheter (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Diverticulitis is a common cause of colonic fistula formation and can be seen up to 20% of v cthe surgically treated patients (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Abdominal wall hernias are a frequent imaging finding and prompt diagnosis is desirable because delay is associated with greater morbidity. The complications include incarceration, bowel obstruction, volvulus, and strangulation. To prevent acute complications, external hernias are usually repaired elective. MDCT with multiplanar reformations provides an excellent perspective on abdominal anatomy, shows wall defects to beset advantage, and adds important information in the interpretation and planning of treatment. Advantages of CT include more accurate identification of abdominal wall hernias and their contents, differentiation of hernias from other abdominal masses and detection of complications (S.P.Ramachandra, N. Gurjar; et.al, 2010).

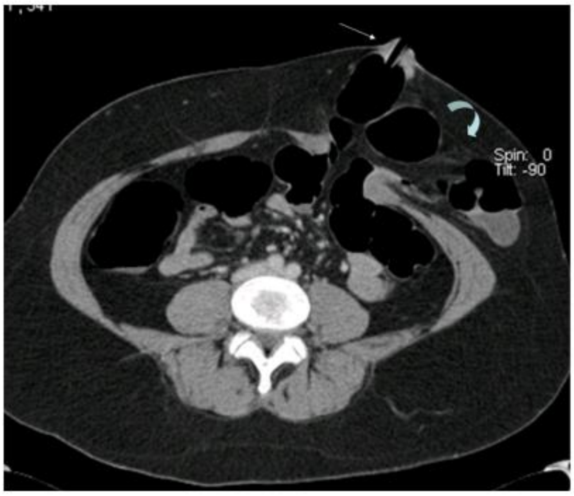

Fig: (2.18) Parastomal hernia: Arrow depicts the cuffed rectal catheter through the stoma. Large parastomal hernia is seen (curved arrow). These can be difficult to diagnose on clinical examination (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Indirect inguinal hernias are the most common abdominal wall hernias. They result from herniation through a patent processus vaginalis and hence are located lateral to the inferior epigastric vessels. They are responsible for almost all inguinal hernias in children and are more common in men, because the peritoneal extension accompanying the testis often fails to obliterate. In adults, they are caused by acquired weakness and dilation of the internal inguinal ring (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Rectus diastasis is characterized by a thinning of the linea alba so that the distance between the rectus muscles is increased. There is no defect in the underlying aponeurosis and transversalis fascia; thus, there is no actual hernia. The patient may have a midline bulge as a result of this diastasis that is often mistaken as a hernia. Management usually entails reassurance to the patient.

If surgical correction is desired by the patient, abdominoplasty techniques are utilized. Ultrasound has been shown to be an accurate method of measuring the supraumbilical and periumbilical diastasis for the purposes of operative planning (Nguyen phat JSC, 2017).

The Direct inguinal hernia is caused by the weakness of transversalis fascia and is located medial to the inferior epigastric vessels (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Ventral hernias include all the hernias occurring in the anterior and lateral abdominal wall. Umbilical hernias are the most common type. The other midline ventral hernias are epigastric, hypogastric and paraumbilical hernias. Strangulation and incarceration are more common in midline hernias (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Rectus sheath heamatomas may occur as a result of trauma to the abdominal wall or secondary to disorders of coagulation, blood dyscrasia, or degenerative vascular diseases. CT demonstrates that the heamatoma is confined to the abdominal wall. Although hematomas are usually treated nonsurgically, a residual mass may persist for several weeks.

Rectus sheath hematomas are usually easy to differentiate from hernias at multi-detector row CT. High attenuation on uenhanced images, lack of enhancement, and resolution on follow-up studies help confirm the diagnosis (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.19) Rectus sheath Heamatoma (arrow) in the right rectus muscles, iso attaenuating to muscle. (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.20) Axial CT demonstrate the large anterior abdominal wall heamatoma in a patient with cirrhosis at the site of drain insersion. (S.P.Ramachandra, N. Gurjar; et.al, 2010).

The other/ miscellaneous abdominal wall lesions – AVMs / portosystemic shunts, vascular grafts, haematomas, implants (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Vascular Anomalies Patients with portal hypertension often recannulate their umbilical vein as a means to shunt blood flow to the systemic veins (caput medusae). Ultrasound with color Doppler can be utilized as a means to avoid these varices when performing abdominal wall procedures such as a paracentesis or placement of a percutaneous endoscopic gastrotomy tube in patients with portal hypertension (e.g., cirrhotic patients) (Nguyen phat JSC, 2017).

In cirrhotic patients with portal hypertension, some blood in the portal venous system may reverse direction and pass through the portosystemic anastomoses in the systemic venous system. As a result, a variety of major hepatofugal collateral pathways can develop in patients with portal hypertension (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.21) Portosystemic Shunt between the paraumbilical veins, inferior and superior epigastric vessels in a patient with cirrhosis (S.P.Ramachandra, N. Gurjar; et.al, 2010).

Fig: (2.22) Parastomal variceal bleeding – CT angiogram demonstrates parastomal varicies with bleeding (S.P.Ramachandra, N. Gurjar; et.al, 2010).

In neurosurgical patients with considerable cerebral oedema, decompressive craniectomy is done to avoid the damage from increased intracranial pressure. The calvarial flap will be placed wtihn the abdominal wall and will be replaced back once the patient improves (S.P.Ramachandra, N. Gurjar; et.al, 2010).

The oblique rectus abdominal myocutaneous flap is sometimes used based on perforating vessels exiting the rectus near the umbilicus. Compared to other flaps, the oblique rectus abdominal myocutaneous flap provides increased soft tissue to fill pelvic dead space, with the further advantage of intact skin to close perineal defects (S.P.Ramachandra, N. Gurjar; et.al, 2010).

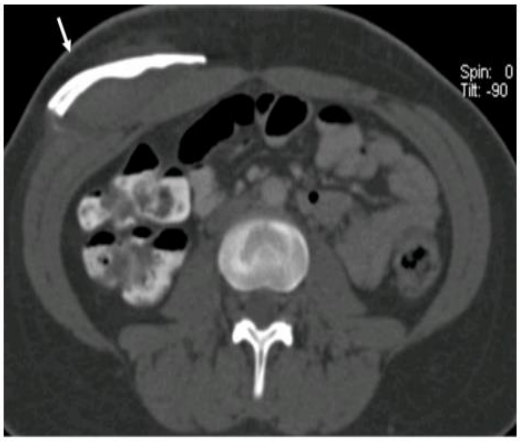

Fig: (2.23) Craniectomy flap in in the anterior abdominal wall (S.P.Ramachandra, N. Gurjar; et.al, 2010).

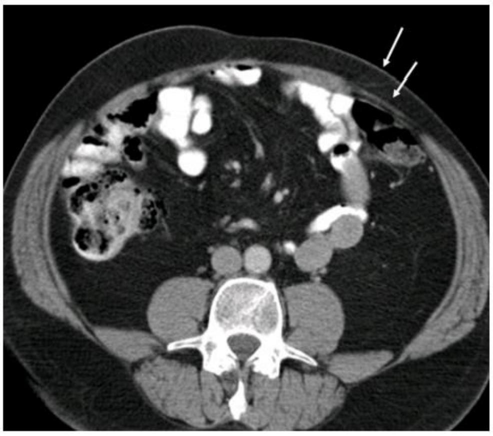

Fig: (2.24) Rectus abdominis flap: note the difference in the size of the right and left abdominal wall thickenss (arrows). Left sided rectus abdominis flap used to fill the pelvic dead space at surgery. The flap has undergone lipomatous change (S.P.Ramachandra, N. Gurjar; et.al, 2010).

In cases of muscular dystrophy there is extreme wasting of musculature sometimes with fatty replacement. Focal Muslce wasting and thinning resulting in eventration can be secondary to trauma / surgery (S.P.Ramachandra, N. Gurjar; et.al, 2010).

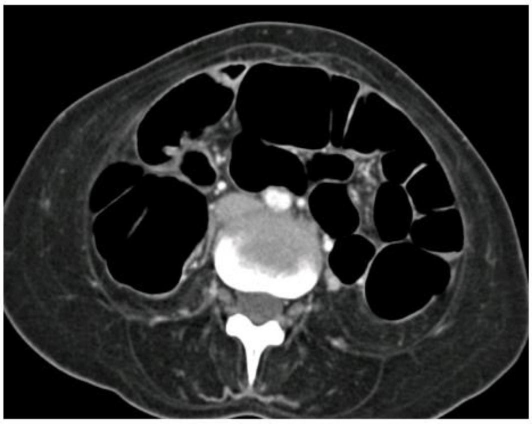

Fig: (2.25) Muscular dystrophy: CT colonography examination in a patient with muscular dystrophy showing extreme wasting and fatty replacement of all the muscles (S.P.Ramachandra, N. Gurjar; et.al, 2010).

2.8 The body mass index (BMI):

BMI is calculated as the persons weight in kilograms divided by the square of his or her height in meters (Kg / m^2) for example, an adult weighting 70 kg with a height of 1.75 metres has a BMI of 70 /1.75^2 = 22.9. This adjusts crudely for differences in body habitus, and provides the usual definition of severity of obesity (table). A simple measure which reflects the degree of abdominal obesity is the waist circumference, measured at the level of umbilicus. A waist circumference of > 102 cm in men or > 88 in cm in women indicates that the risk of metabolic and cardiovascular complications of obesity is high. (NICKIR . Colledge, Davidson; et.al, 2008).

Table (2.1) Quantifying obesity with body mass index (weigh / $height^2$)

BMI (kg /m^2)	Classification*	Risk of obesity comorbidity
18.5 – 24.9	Normal range	Negligible
25.0 – 29.9	Overweight	Mildly increased
>30.0	Obese	
30.0 – 34.9	Class I	Moderate
35.0 – 39.9	Class II	Severe
> 40.0	Class III	Very severe

*classification of the world health organization (WHO) and international obesity task force.

(NICKIR. Colledge, Davidson; et.al, 2008).

2.9 Previous studies:

Grauer, W. O., et.al. (1984) had studied a computed tomographic method was used to assess the pattern of abdominal fat distribution in normal males and females at different abdominal levels. The method permitted site specific calculations of total body volume (TA), total fat volume (TF), subcutaneous fat volume (SF), and intra-abdominal fat volume (IF) in each computed tomography scan. The ratio of TF/TA, SF/TF and IF/TF were calculated for the LI, L3, and L5 vertebral levels. Regression analysis of IF versus SF, SF versus TF, TF versus TA, and TF versus body mass index and age were calculated. A significant linear correlation between the measured variables TA, SF, IF, and TF and between TF and body mass index was found for virtually all correlations attempted at all scanned levels. Female had a higher total fat volume and greater percentage of subcutaneous fat at all levels. Males accumulated more fat intra-abdominally than subcutaneously at the L1 and L3 levels. The male–female differences were greatest at L1 and the ratio SF/IF statistically significant at the L1 and L5 levels. Our results demonstrate that computed tomography can noninvasively quantify abdominal fat distribution at various sites. There is an inherent difference in abdominal fat distribution between males and females that is not related to weight. The distribution of body fat in males and females varies markedly from level to level.

SoJung Lee1, et.al; (2008) had studied the Race and Gender Differences in the Relationships Between Anthropometrics and Abdominal Fat in Youth they examined the influence of race and gender on abdominal adipose tissue (AT) distribution for a given anthropometric measure including waist circumference (WC)], waist-to-hip ratio (WHR) and waist-to-height (W/Ht) in youth in Subjects included healthy 62 black and 98 white youth. A single transverse image of the abdomen (L4–L5) was obtained using computed tomography. Our fined for a given BMI, there was a significant ($P < 0.05$) main effect of race and sex on the relationship between BMI and WC, such that boys and whites had a higher WC than girls and blacks. For a given WC, black boys and girls had higher abdominal subcutaneous AT (SAT) than white peers, wherein the magnitude of the difference is increased with increasing WC. Black boys and girls had higher SAT than white peers, wherein the magnitude of the difference is increased with increasing W/Ht.

Borkan, G.A., et.al; (1983) had studied the Relationships between computed tomography tissue areas, thicknesses and total body composition. Three cross-sections (upper leg, abdomen, chest including upper arms) were scanned in 41 healthy men (mean age 57·6 years). Subcutaneous fat thicknesses measured at specific sites on the CT scans were correlated with the total area of fat from the same scans. For the chest and leg cross-sections, correlations were highly significant. Subcutaneous fat thicknesses at the abdomen were relatively poorer correlates of total abdomen fat area, because they were unrelated to intra-abdominal fat. Correlation analyses were performed between fat areas of each cross-section and total fat weight. And the abdomen yielded the highest correlations. Multiple regression was used to predict abdomen fat area from external anthropometry, and abdomen circumference plus one skinfold provided excellent prediction of total abdomen fat area (R^2 = 0·79). Subcutaneous or intra-abdominal fat areas separately were not predicted as well by external measurements.

Seidell, et.al; (1987) had studied the relation between anthropometry and computed tomography in assessment of intra-abdominal and subcutaneous abdominal fat. In this study anthropometric measurements were taken from 71 men and 34 women presenting for routine computed tomography (CT). Areas of abdominal fat were calculated from CT scans made at the level of the L4 vertebra. The amounts of intra-abdominal and subcutaneous abdominal fat could be accurately predicted from several circumferences, skinfold measurements, body mass index, and age (R2 ranged from 0.79 to 0.84). In addition, it was found that the area of intra-abdominal fat on the CT scan was related to the waist:hip circumference ratio (r = 0.75 in men, r = 0.55 in women) and to the waist:thigh circumference ratio (r = 0.55 in men, r = 0.70 in women). The correlations of the circumference ratios with the areas of subcutaneous fat were invariably lower.

The purpose of Kekes-Szabo, T et.al; (1994) their study was to develop multiple regression equations for predicting computed tomography (CT) derived intra-abdominal (IAF), subcutaneous (SCF), and total (TOTF= IAF+SCF) abdominal adipose tissue areas from anthropometric measures in adult white males with a large range of age (18–71 years) and percent body fat (2.0–40.6). One hundred fifty-one white male subjects had IAF, SCF, and TOTF determined by a single CT scan, skinfold and circumference measures taken and body density determined. IAF was estimated from age, waist circumference. SCF was estimated from age, umbilicus circumference, and chest and suprailiac skinfolds. TOTF was estimated from age, body mass index (BMI), chest skinfold, and umbilicus circumference. R^2 for IAF, SCF, and TOTF was .73, .77, and .86 respectively. All three new equations met validation criteria with R^2 validations of .75, .79, and .85 for IAF, SCF, and TOTF respectively. It is concluded that the new equations might be used as an inexpensive estimation of IAF, SCF, and TOTF in adult white males varying greatly in age and percent body fat.

Gary, A., et.al; (1982) had studied the Computed tomography (CT) produces thin cross-sectional radiographs that may prove very useful in body composition research]. CT images of the abdomen allow computerized measurement of total fat area, and also enable the differentiation of subcutaneous fat from intraabdominal fat. The preset investigation examines whether a single CT scan of the abdomen provides an accurate indication of overall abdominal adiposity. Graphs of measurements from seven sequential scans of the abdomen in eight patients showed that rankings of total abdominal area, total fat area, subcutaneous and intraabdominal fat area are relatively consistent no matter which abdominal level is chosen. Correlations of 0.89 to 0.99 between single scans and the average values for all scans show that a single CT image contains the same information on adiposity as a series of scans. These results suggest that future CT studies of body composition can limit radiation exposure by using single scans at different anatomical sites. If only a single scan at one site can be obtained, the level of the umbilicus may be the most useful, because it contains the largest percentage of fat in the body, and best allows differentiation of intraabdominal from subcutaneous fat.

Chapter Three

Materials and Methods

Chapter three

Material and Method

3.1Materials:

Fig: (3.1) CT scanner machine

Equipment (CT machine) and control console, accessories (head rest and head caddis), automatic injector show in Almoalem medical city by Toshiba 160 slices device type.

Fig: (3.2) CT control console

Fig: (3.3) Automatic injector

3.1Contrast media:

IVCM used to improve contrast resolution (to aid ease of differentiation between tissues).

3.1.1 IV HOCM or LOCM:

3.3.2 Total amount of: 85-80 cc 20-25 minutes independent of age and body weight

3.1.2 Injection rate:

5cc/sec through an 18-gauge and 3-4cc/sec through a 20 gauge

In these study were been supervened department role.

Figure (3.4) IV OMNIPAQUE (CM)

3.1.3 Oral CM:

Contrast material to opacity the gastrointestinal tract (GIT) {mannitol 50 ml diluted by water in department role} 400 ml – 45 minutes before scan,200 ml just before scan in Almoalem Medical city , {omnipaque 20 cc with diluted by water in department role} 600 ml - 45 minutes befor scan , 200ml just before scan in Modern Medical center.

Figure (3.5) Mannitol (CM)

3.2 Technique and protocol:

All patients under went CT Scan for abdomen with patient lies supine, feet first, the arm are a raised and placed behind the patient head (out of the scan plane), positioning is add by alignment light "the median sagittal plane is perpendicular and the coronal plane is parallel to the scanner table top" the scanner table light is adjusted to ensure that's the coronal plan alignment is at the level of axillary line. The patient was moved in to the scanner until the scan reference point is at the level of the xiphoid process. The scout view was obtained to include the diaphragm and pubis "with slice thickness 5-8 mm". Contrast scans can be classified as single-phase, multiphase, or special Single-phase scans are typically used to evaluate acute abdomen or suspected abdominal problems. With imaging usually in the portal venous phase. It is usually combined with administration of oral contrast. Oral or intraluminal contrast enhances the evaluation of the bowel. Multiphase scans consist of pre contrast and combinations of arterial phase, portal venous phase, and delayed imaging, depending on the organ of interest, with measurements was taken from any abdominal image in level of pancreas in all of right from skin to external oblique muscle, central from skin to leania alba and left from skin to external oblique muscle of anterior abdominal fat wall, in anterior abdominal wall skin to posterior back wall skin, and in right abdominal wall skin to left abdominal wall skin.

3.2.1 Methods:

In this study the samples were collected from fifty patients of different age and gender, the body weight of these patients was taken. After the completion of the CT examination, measurements were made on the pancreatic level it is approximately 12-15cm long and is located deeply on the posterior abdominal wall. It lies approximately on the transpyloric plane (L1 vertebral level) and slopes upwards from right to left. for anterior abdominal fat content by CT supposedly the device type by Arti Rad Dicom viewers programs in device, the measurements was taken from skin in right side of anterior abdominal wall to external oblique muscle, and from skin in central to linea alba, and from skin in left side to external oblique muscle for anterior abdominal fat wall thickness, and was taken the measure from skin to anterior abdominal wall to posterior back skin, and also was taken measure from right side skin of abdomen to left side skin of abdomen, with abdomen dimension from CT image.

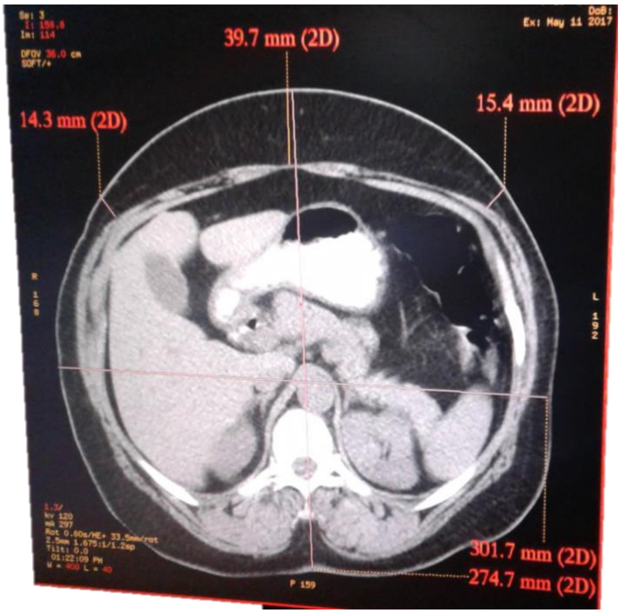

Figure (3.6) Method of measurements of abdomen diemention of patients from CT image.

3.2.2 Study design:

This is analytical study.

3.2.3 Duration of study:

The data was conducted in the period from December2016 to April 2017.

3.2.4 Place of study:

This study has been conducted in Khartoum state on patient came to hospital and refereed to CT medical center in Almoalem medical city by toshiba 160 slices device type BY (120Kv/ 50mAs/WL40/WW400), Antalya medical center by GE 16 slices device type BY (120Kv/222Ma/WL40/WW400), Modern medical center by GE 16 slices device type BY (120Kv/222Ma/WL40/WW400), Alzaytouna specialist hospital by Toshiba 64 slices device type (120Kv/210Ma/WL46/WW428) supposedly the device type by Arti Rad Dicom viewers programs in device.

3.2.5 Sampling and sample size:

50 patients (28 male, 22 female) were at age ranged from 10 - 85 years and body weight ranged from 30 - 130 kg, had CT examination for abdomen with or without contrast media used.

3.2.6 Data analysis:

Analyses of data were done by using statistical package for social sciences (SPSS) and version24.

3.2.7 Patient preparation:

Asses the clinical problems & medical history, includes the indication of the study, contrast allergies, renal impairment &who undergo CT abdomen for fasting 6 - 8 hours.

Chapter four

Results

Chapter four
Results

Table (4.1) Distribution of sample according age

Age/years	Frequency	Percent
10-25	7	14.00%
26-40	9	18.00%
41-55	14	28.00%
56-70	13	26.00%
71-85	7	14.00%
Mean±SD	49.98±18.26	
Total	50	100.00%

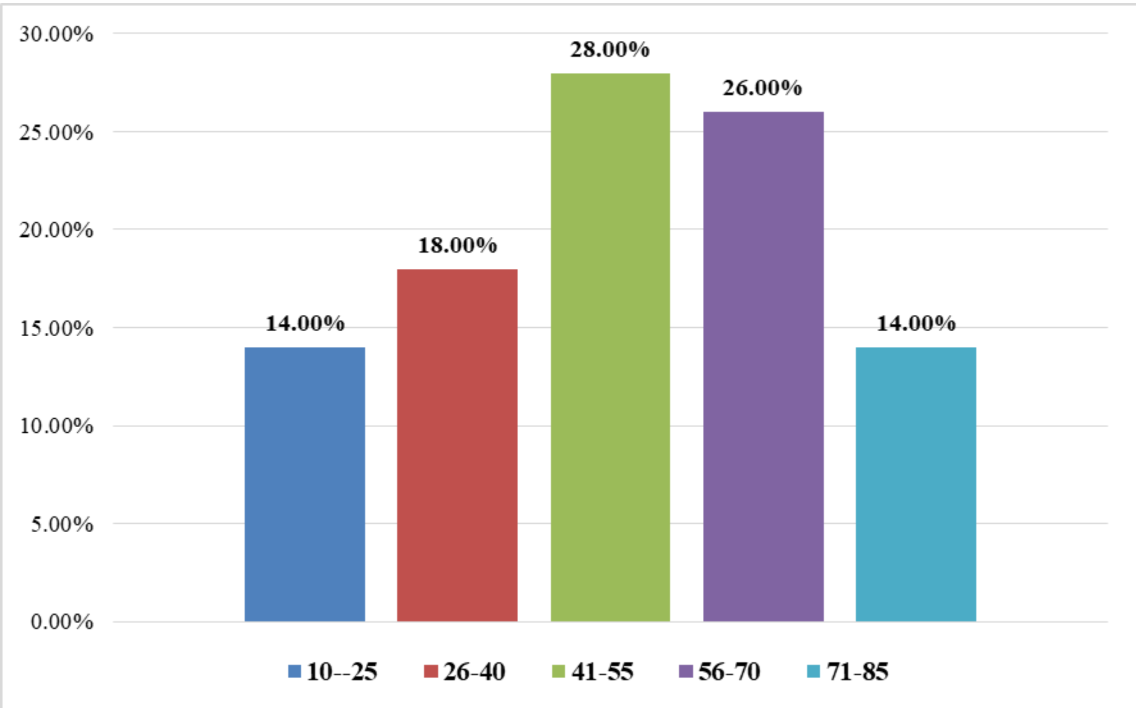

Figure (4.1) Distribution of sample according age

Table (4.2) Distribution of sample according gender

Sex	Frequency	Percent
Male	28	56.00%
Female	22	44.00%
Total	50	100.00%

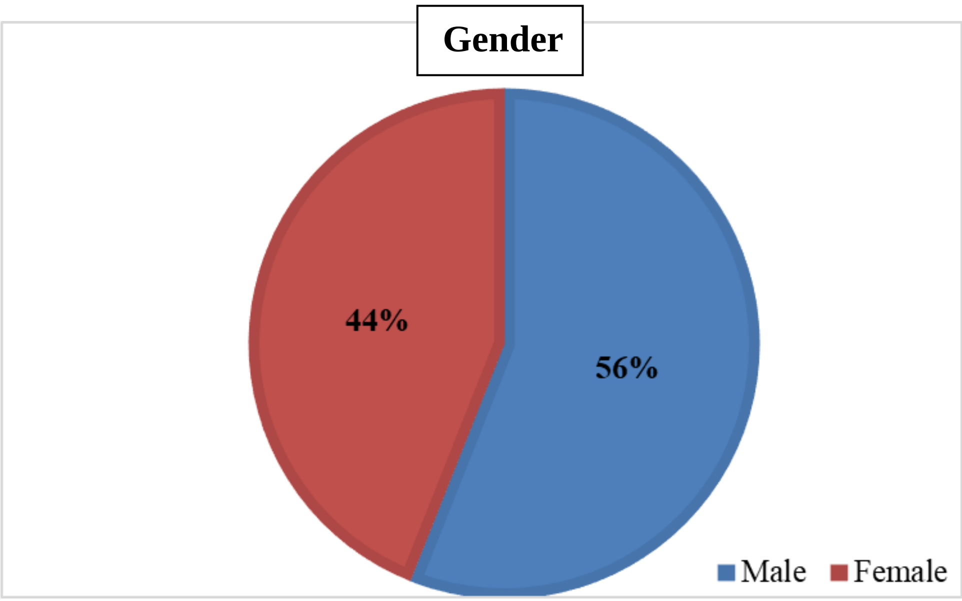

Figure (4.2) Distribution of sample according gender

Table (4.3) Distribution of sample according body weight

Body Weight/kg	Frequency	Percent
30-50	4	8.00%
51-70	22	44.00%
71-90	23	46.00%
111-130	1	2.00%
Mean±SD	69.12±14.71	
Minimum	30	
Maximum	130	
Total	50	100.00%

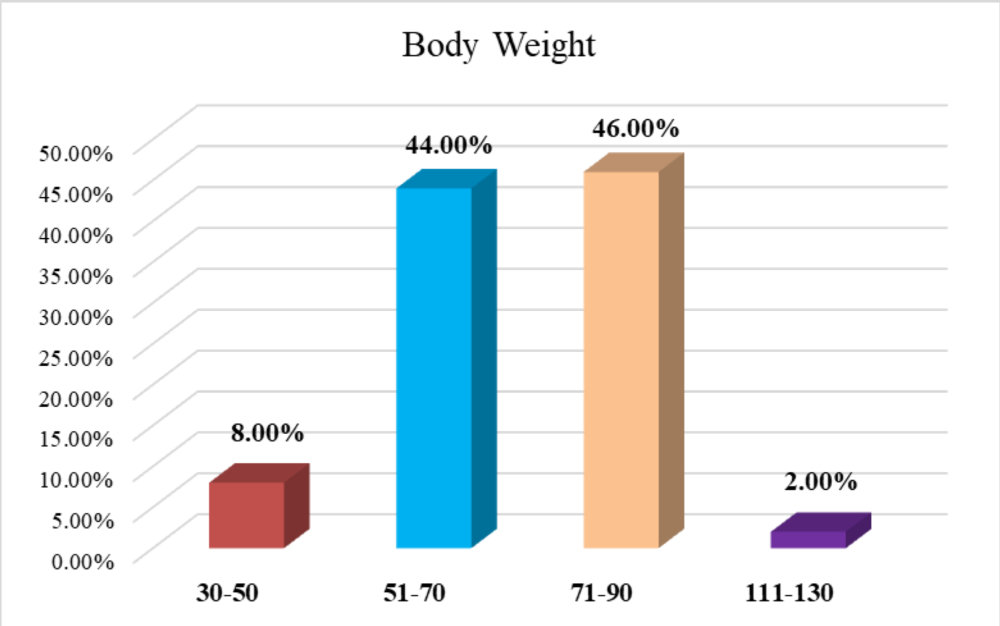

Figure (4.3) Distribution of sample according body weight

Table (4.4) Distribution of sample according to abdominal measurement

Abdominal Measurements/mm	Mean±SD	Min	Max
Right	10.81±7.26	0	31.3
Central	15.68±10.88	1.4	39.7
Left	10.80±7.20	0	30.00
A/p	228.53±32.99	139.3	312
circumference RT /LT	292.27±37.62	121.4	361.8

Table (4.5) Distribution between body weights with gender

Body Weight/kg	**Male n(28)**	**Female n(22)**
30-50	3	1
51-70	7	15
71-90	18	5
111-130	0	1

Table (4.6) Relation between abdominal measurement and age

Abdominal		Age/years				
Measurements		10-25	26-40	41-55	56-70	71-85
		n(7)	n(9)	n(14)	n(13)	n(7)
Right	Mean± SD	6.19±5.02	12.18±10.49	13.79±4.89	11.43±7.91	6.60±3.44
	Min	1	0	8	0.8	1.7
	Max	15	31.3	23.9	28.6	11
Significant Test		F 2.181 P0.086				
Central	Mean± SD	7.99±7.08	16.64±13.44	17.34±8.67	19.24±11.88	12.19±10.58
	Min	2.1	1.4	2.3	1.6	3
	Max	21	39.1	35.7	39.7	31
Significant Test		F 1.572 P0.198				
Left	Mean± SD	7.56±6.15	12.99±10.73	11.69±5.26	11.74±7.26	7.71±5.73
	Min	2.2	0	0.8	0.8	3
	Max	17	30	21	26.4	17.6
Significant Test		F 0.991 P0.422				
A/p	Mean± SD	229.13±15.29	233.92±37.81	229.25±28.12	209.10±35.26	255.64±28.79
	Min	206	157.6	184.6	139.3	220
	Max	250.2	274.7	263.7	260.2	312
Significant Test		F 2.700 P0.042*				
circumference RT /LT	Mean± SD	276.13±43.99	300.68±21.83	295.51±55.12	297.79±25.89	280.90±20.31
	Min	214.6	260.6	121.4	264.3	254.1
	Max	331.3	330.1	358.2	361.8	305.4
Significant Test		F 0.672 P0.615				

*= Significant at P<0.05

Table (4.7) Relation between abdominal measurement and body weight

Abdominal		Body Weight/kg			
Measurements/mm		30-50	51-70	71-90	111-130
		n(4)	n(22)	n(23)	n(1)
Right	Mean±SD	14.55±7.93	11.49±5.73	8.63±7.09	31.00±0.0
	Min	7.2	1	0	31.3
	Max	23.9	21.7	28.6	31.3
Significant Test		F 4.595 P0.007*			
Central	Mean±SD	19.95±7.37	15.51±10.23	14.07±11.19	39.10±0.0
	Min	9.4	2.1	1.4	39.1
	Max	26.6	39.7	38.3	39.1
Significant Test		F 2.042 P 0.121			
Left	Mean±SD	12.08±4.07	11.05±5.85	9.57±8.03	28.50±0.0
	Min	6.70	0.80	0	28.50
	Max	16.30	21.00	30	28.50
Significant Test		F 4.595 P0.007*			
A/p	Mean±SD	229.85±34.09	233.15±26.23	223.82±39.55	230.00±0.0
	Min	196	162.7	139.3	230
	Max	260.2	274.7	312	230
Significant Test		F.289 P 0.833			
Circum ference RT /LT	Mean±SD	329.85±26.61	288.45±41.14	287.76±32.89	330.10±0.0
	Min	305.4	358.2	214.6	330.1
	Max	121.4	331.3	361.8	330.1
Significant Test		F 1.963 P 0.133			

*= Significant at P<0.05

Table (4.8) Relation between abdominal measurement and gender

Abdominal		Male	Female	Significant Test
Measurements/mm		n(28)	n(22)	
Right	Mean±SD	6.78±4.35	15.95±7.03	t 5.670
	Min	0	Jan-00	P 0.000*
	Max	15.2	31.3	
Central	Mean±SD	9.56±6.83	23.46±10.14	t 5.782
	Min	1.4	2.4	P 0.000*
	Max	25.1	39.7	
Left	Mean±SD	7.75±6.44	14.69±6.28	t 3.822
	Min	0	2.2	P 0.000*
	Max	30	28.5	
A/p	Mean±SD	226.71±38.31	230.85±25.36	t 0.437
	Min	139.3	184.6	P 0.664
	Max	312	266.1	
Circumference RT /LT	Mean±SD	285.68±42.55	300.65±29.04	t 1.410
	Min	121.4	218.3	P 0.165
	Max	346.8	361.8	

*= Significant at P<0.05

Table (4.9) Measure of weight effect to measures of anterior abdominal wall fat:

Measure	R	R Square
Right	0.693	0.480
Center	0.678	0.459
Left	0.553	0.305
A/p	0.641	0.411
circumference RT /LT	0.479	0.229

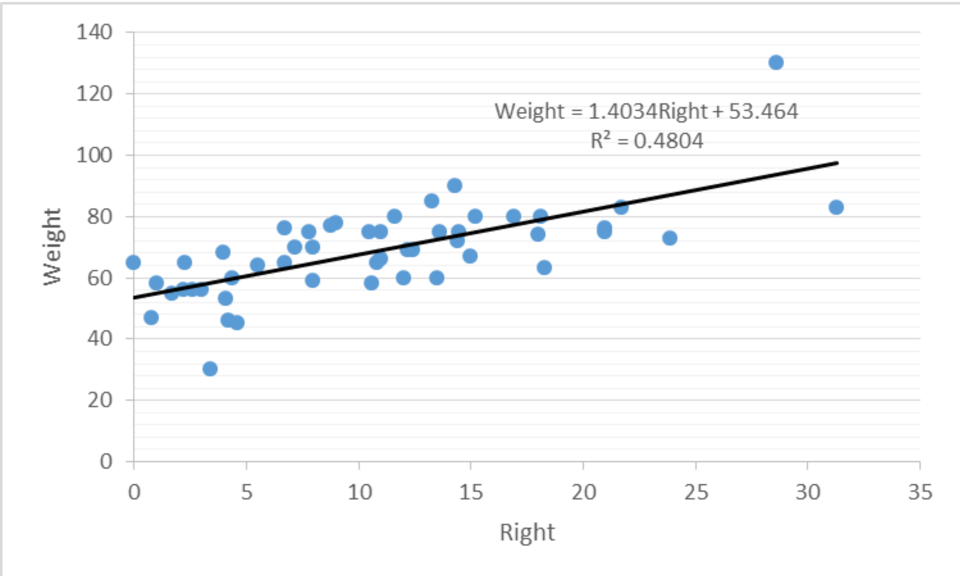

Figure (4.9.a) the linear relationship between weight and right anterior abdominal wall fat

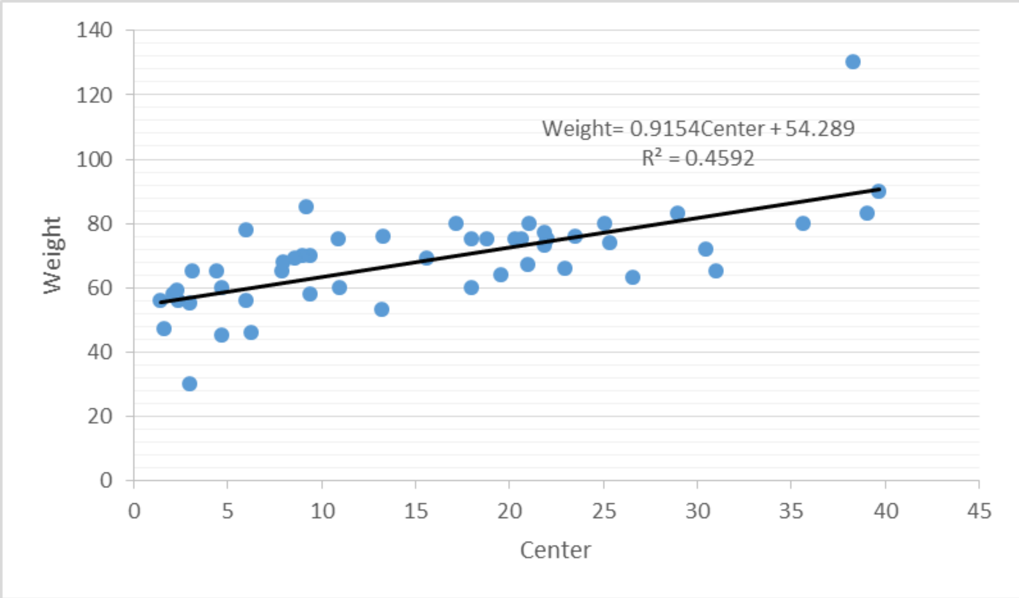

Figure (4.9.b) the linear relationship between weight and center anterior abdominal wall fat

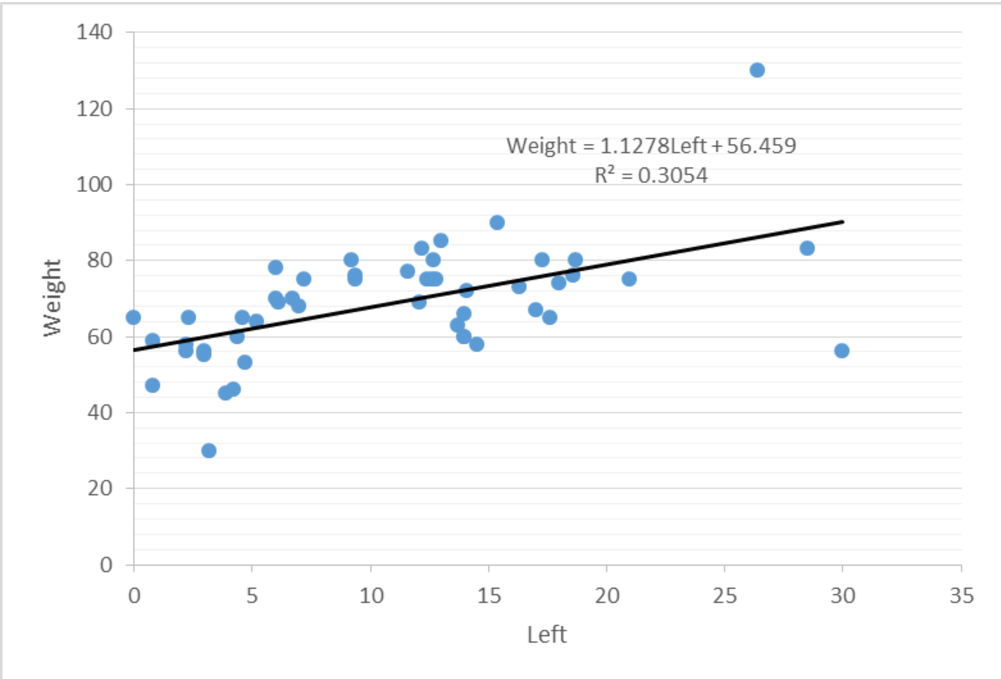

Figure (4.9.c) the linear relationship between left and right anterior abdominal wall fat

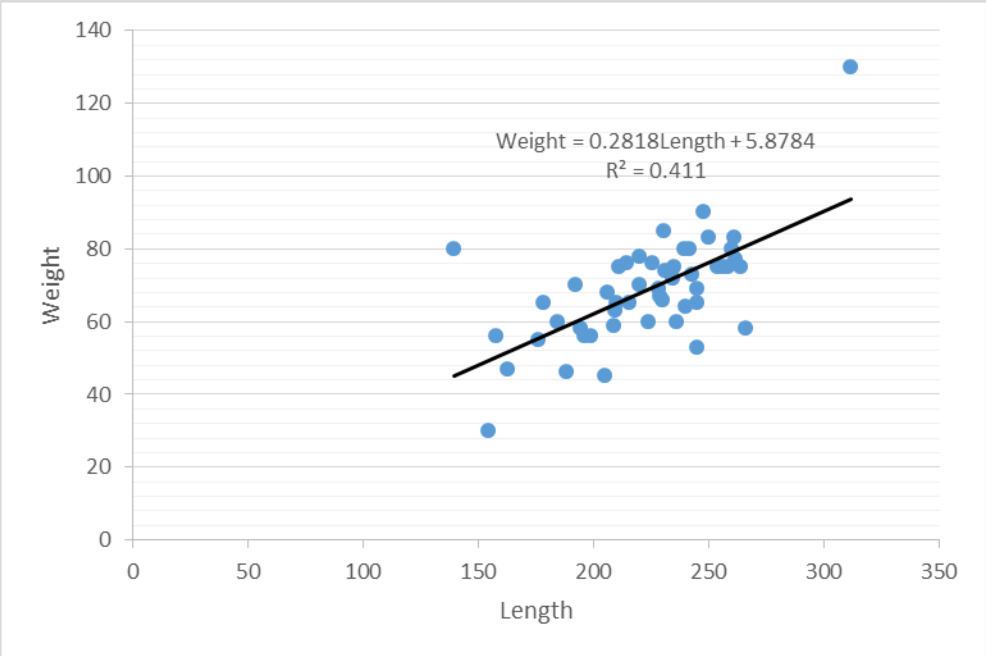

Figure (4.9.d) the linear relationship between weight and A/p

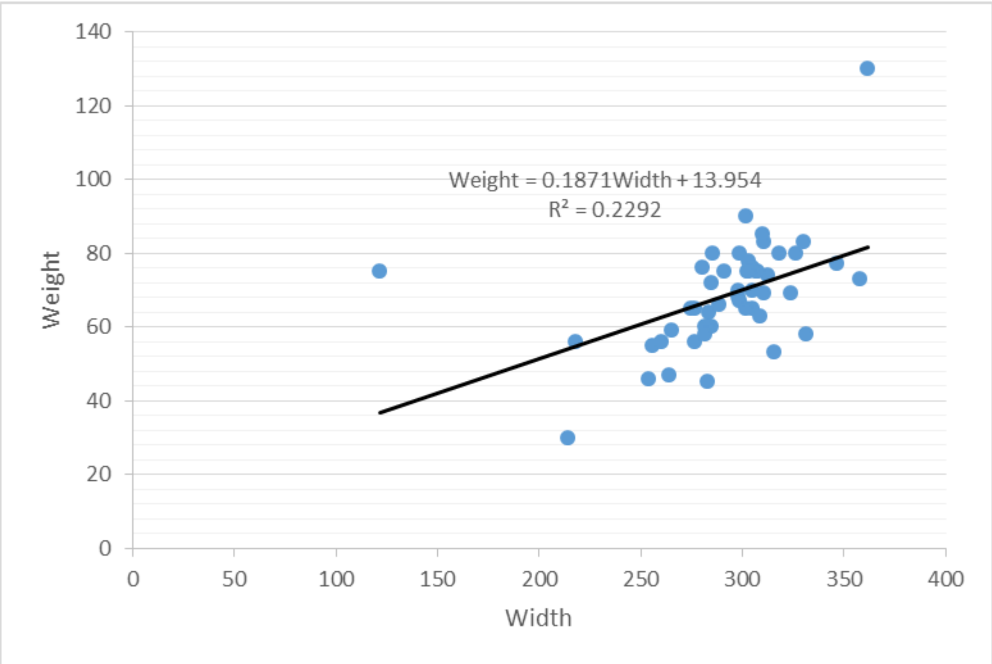

Figure (4.9.e) the linear relationship between weight and circumference
RT /LT

Table (4.10): regression model of anterior abdominal wall fat measures on weight:

Measure		Coefficients		T	Sig.
		B	Std. Error		
Right	(Constant)	53.464	2.735	19.545	0.000
	Weight	1.403	0.211	6.662	0.000
Center	(Constant)	54.289	2.728	19.902	0.000
	Weight	0.915	0.143	6.384	0.000
Left	(Constant)	56.459	3.177	17.771	0.000
	Weight	1.128	0.245	4.594	0.000
A/p	(Constant)	55.878	10.964	0.536	0.594
	Weight	0.282	.049	5.787	0.000
circumference RT /LT	(Constant)	53.954	14.590	0.956	0.344
	Weight	0.187	0.050	3.778	0.000
Dependent Variable: Weight					

Table (4.11) Measure of age's effect to weight:

R	R Square
0.030	0.001

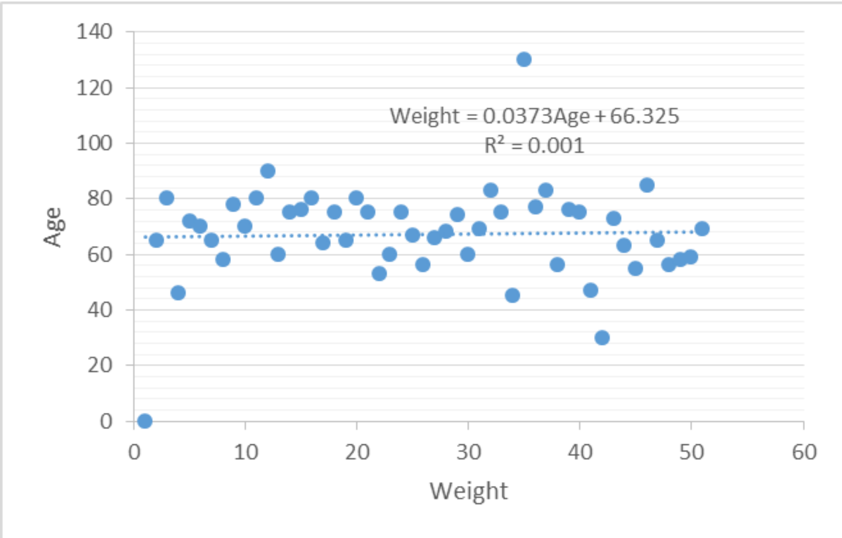

Figure (4.11) the linear relationship between weight and age

Table (4.12): regression mode of weight on age:

	Coefficients		t	Sig.
	B	Std. Error		
(Constant)	69.843	6.174	11.312	0.000
Weight	-0.024	0.116	-0.207	0.837

Table (4.13) Mean measures with respect to gender:

Measure	**Gender**	**Mean**	**Std. Deviation**
Right	Male	6.779	4.3469
	Female	15.950	7.0271
Center	Male	9.557	6.8343
	Female	23.465	10.1395
Left	Male	7.746	6.4437
	Female	14.686	6.2823
A/p	Male	217.446	31.9630
	Female	229.500	34.8189
circumference RT /LT	Male	285.689	42.5493
	Female	300.655	29.0431

Table (4.14) t-test for equality of mean measures for males and females:

	t-test for Equality of Means				
Measure	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Right	-5.670	48	0.000	-9.1714	1.6175
Center	-5.783	48	0.000	-13.9078	2.4049
Left	-3.822	48	0.000	-6.9399	1.8158
A/p	-1.273	48	0.209	-12.0536	9.4709
circumference RT /LT	-1.410	48	0.165	-14.9653	10.6120

Chapter Five

Discussion, Conclusion and

Recommendation

Chapter five

Discussion, Conclusion and Recommendation

5.1 Discussion:

This study is to prediction of the weight by measuring anterior abdominal fats using computer tomography (CT) scan and the results were presented in tables and figures with frequency and percentage & Mean ± SD.

From table and figure (4.1) the distribution of sample according to age was predicted. The most affected age was the ages between 41- 55 counting 14 F (28 %).

The gender distribution was presented in table and figure (4.2) the males were 28F (56 %) & the females were 22 F (44 %).

The body weight per kilogram distribution in table and figure (4.3) the patient group with 71- 90 kg was prepared with high frequency 23 (46 %).

The abdominal measurement per millimeters was showed in table (4.4) were the mean of the Right & Left abdominal thickness with few difference this may be due to problem in position, were 10.81±7.26 in right, and 10.80±7.20 in left respectively.

The correlation between body weights and gender in table (4-5) the highest weights group with (71-90kg) by more men frequency than women (18 males and 5 females).

The correlation of abdominal measurement and age showed in Table (4.6) we were founded significant test: P 0,042 with anterioposterior measurements because the greater the age not relies to more fat accumulation and comparison with The purpose of Kekes-Szabo, T et.al; (1994).

The relation between abdominal measurement and body weight in Table (4.7) we were founded significant test: P 0,007 with right & left measurements subcutaneous of anterior abdominal fat wall thickness respectively they were equal because the fat distribution is equal by side of abdomen.

The correlation between abdominal measurement and gender in Table (4.8) we were founded significant test: P 0,000 with RT & CEN & LT anterior abdominal subcutaneous fat thickness as equal was for each when the justify clear of that the female have greater than male these is because females were store fat more than male physiologically and comparison with Grauer, W. O., et.al. (1984) and with sojung lee1, (2008) there is also significant relations.

provides the R and R^2 values in table (4.9) The R-value represents the simple correlations between weight and measures (Right, center, left, A/p and circumference RT /LT) are (0.693, 0.678, 0.553, 0.641 and 0.479) respectively, (the "R" Column), which indicates a medium degree of positive correlations between weight and measures. The R^2 value (the "R Square" column) indicates how much of the total variation in measures (Right, center, left, A/p and circumference RT /LT) can be explained by weight. In this case, respectively (48%, 45.9%, 30.5%, 41.1% and 22.9%) of variations in (Right, center, left, A/p and circumference RT /LT) participated by weight.

The Coefficients in table (4.10) provide us the necessary information to predict weight from anterior abdominal wall fat measures (Right, center, left, A/P and circumference RT /LT) and determine whether measures contributes significantly to weight, since ("Sig.") for coefficients of all measures are less than the test significance value (0.05) which indicates that statistically a significant correlation between weight and measures (Right, center, left, A/P and circumference RT /LT). Furthermore, we can use the values in the "B" column for measures to estimate weight (Right, center, left, A/p and circumference RT /LT) from weight, then (Weight is 53.464±2.735 kg, while it increases 1.403±0.211 kg per (mm) in right), (Weight is 54.289±2.728 kg, while it increases 0.915±0.143 kg per (mm) in center), (Weight is 56.459±3.177 kg, while it increases 1.128±0.245 kg per (mm) in left), (Weight is 55.878±10.964 kg, while it increases 0.282±0.049 kg per (mm) in A/p) and (Weight is 53.954±14.59 kg, while it increases 0.187±0.05 kg per (mm) in circumference RT /LT).

Table (4-11), provides the R and R2 values. The R value represents the simple correlation is (0.030) (the "R" Column), which indicates an extremely weak degree of correlation between weight and age. The R^2 value (the "R Square" column) indicates how much of the total variation in the weight can be explained by age. In this case, only (0.1%) of variations in weight participated by age.

Table (4-12), The Coefficients provide us the necessary information to predict weight from age and determine whether age contributes significantly to the weight ("Sig." = 0.837 > 0.05) which indicates that statistically an insignificant correlation between weight and age. Furthermore, we cannot use the values in the "B" column for age to estimate the weight.

Table (4-13), provides useful descriptive statistics for the two groups that we compared, including the mean and standard deviation.

Table (4-14), T-test results will tell us if the mean measures (right, center, left, length and width) for the two groups were statistically different (significantly different) or they were relatively the same We can see that the male and female means for (Right, center and left) are statistically, significantly different because the all values of P-values in "Sig. (2-tailed) are less than 0.05. Looking at the Distributions of two groups

Table (4-13) Looking at the Distributions of two groups table, we can conclude that there were statistically significant differences in (Right, center and left)mean between males and females, there for females are over (Right, center and left) males and comparison with Grauer, W. O., et.al. (1984) and with sojung lee1, (2008) there is also significant relations.

Table (4-9), This study showed that direct linear association between weight and anterior abdominal wall fat (right, center and left) in this relation the weight increase by 1.4, 0.91 and 1.1 respectively (figure 4-9-a to 4-9-c), the study also showed that, there a direct linear association between weight and A/P , RT/LT and age in this relation the weight increase by 0.28, 0.187 and 0.037 respectively (figure 4-9-d to 4-11).

5.2 Conclusion:

This study concluded by the most affected age was the ages between 41- 55 counting 14 F (28 %).

We were founded significant test: P 0,042 with anterioposterior measurements because the greater the age not relies the more fat accumulation and comparison with The purpose of Kekes-Szabo, T et.al; (1994).

We were founded significant test: P 0,007 with right & left measurements subcutaneous of anterior abdominal fat wall thickness respectively they were equal because the fat distribution is equal by side of abdomen.

We were founded significant test: P 0,000 with RT & CEN & LT anterior abdominal subcutaneous fat thickness as equal was for each when the justify clear of that the female have greater than male these is because females were store fat more than male physiologically

We were founded The R^2 value (the "R Square" column) indicates how much of the total variation in the weight can be explained by age. In this case, only (0.1%) of variations in weight participated by age.

We were founded that direct linear association between weight and anterior abdominal wall fat (right, center and left) in this relation the weight increase by 1.4, 0.91 and 1.1 respectively, the study also showed that, there a direct linear association between weight and length, width and age in this relation the weight increase by 0.28, 0.187 and 0.037 respectively

5.3 Recommendation:

More studies in this area with take the height of patient for to collect body mass index (BMI) as variables to help in result of study.

Increase the patient sample to get more significant result.

Make sure in position of patients stay to avoid measurement error.

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Appendices

Appendix 1

Table (1) data collected sheet from CT scans of patients

NO	AGE	WEAIGHT	GENDER	MEASUREMENTS				
				RT	CEN	LT	LENGTH	WIDTH

Appendix 2

Computed Tomography Images

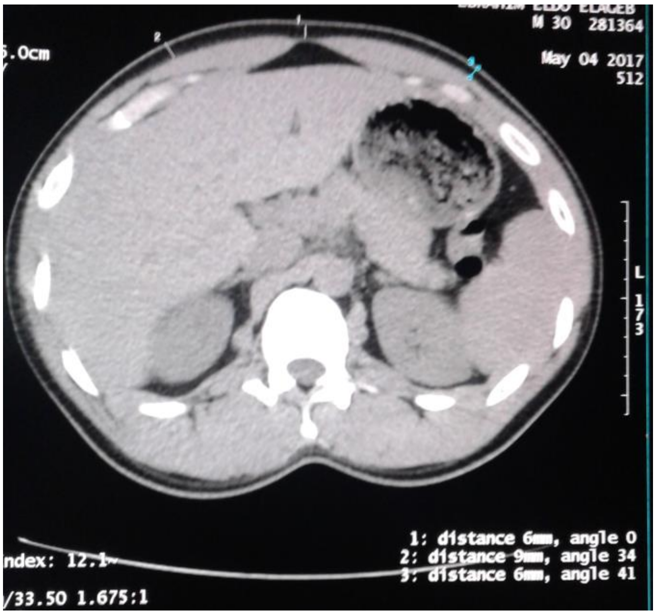

Fig: (1a) KUB CT for male had 30 years old,78 kg, with measurmentes in RT 6 mm,Cen 9 mm, LT 6 mm.

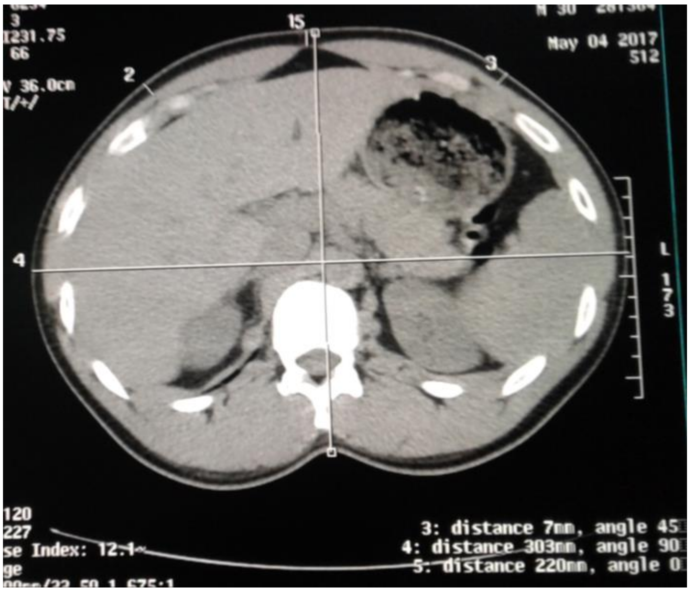

Image: (1b) KUB CT for male had 30 years old,78 kg, with measurmentes in LT 7 mm, AP 303 mm, Cirecumferance (RT/LT) 220 mm.

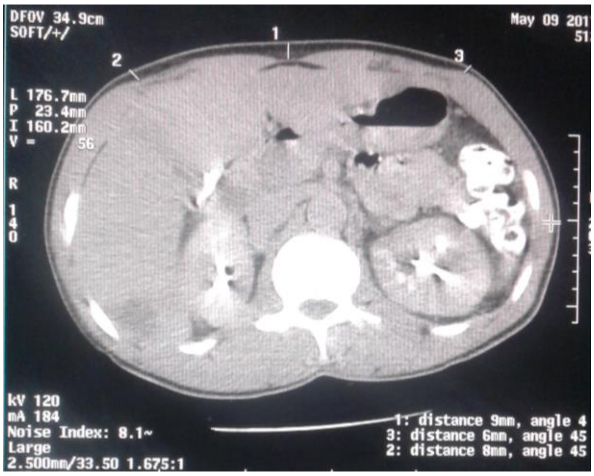

Image: (2a) ABD CT for male had 52 years old,70 Kg, with measurmentes in RT 8 mm, Cen 9mm, LT 6 mm.

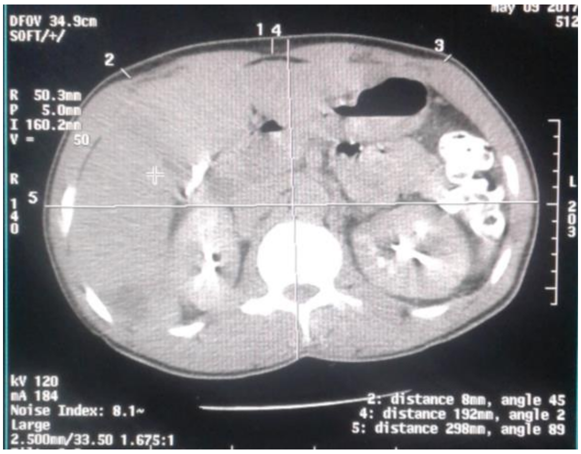

Image: (2b) ABD CT for male had 52 years old,70 Kg, with measurmentes in RT 8mm, AP192 mm, Cirecumferance (RT/LT) 298 mm.

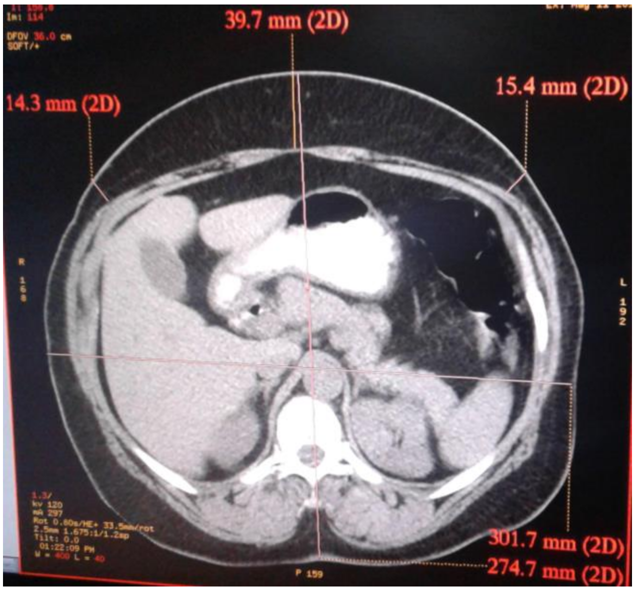

Image: (3) ABD CT for female had 60 years old, 90 Kg, with measurmentes in RT 14.3 mm, Cen 39.7 mm, LT 15.4 mm, AP 274.7 mm, Cirecumferance (RT/LT) 301.7 mm.

Image: (4a) ABD CT for male had 65 years old, 60 Kg, with measurmentes in RT 12 mm, Cen 11 mm, LT 14 mm.

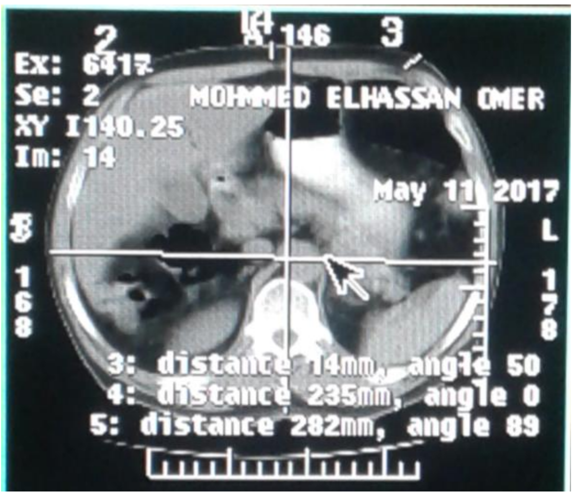

Image: (4b) ABD CT for male had 65 years old, 60 Kg, with measurmentes in LT 14 mm, AP 235 mm, Cirecumferance (RT/LT) 282 mm.

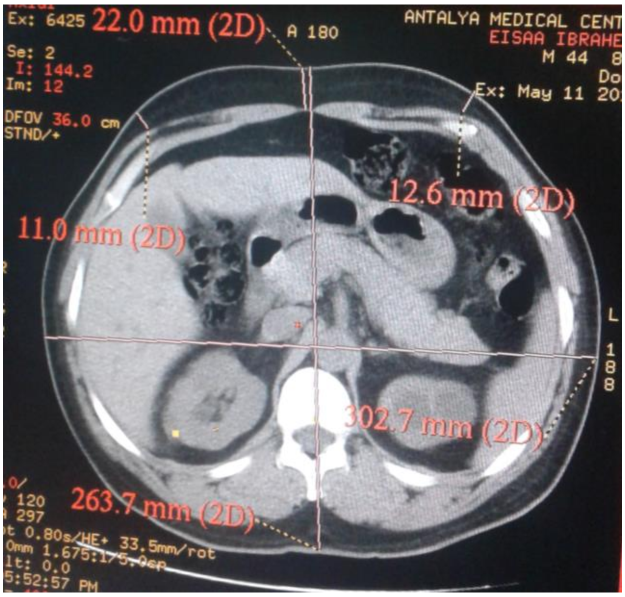

Image: (5) KUB CT for male had 44 years old,75 kg, with measurmentes in RT 11 mm, Cen 22 mm, LT 12.6 mm AP 263.7 mm, Cirecumferance (RT/LT) 302.7 mm.

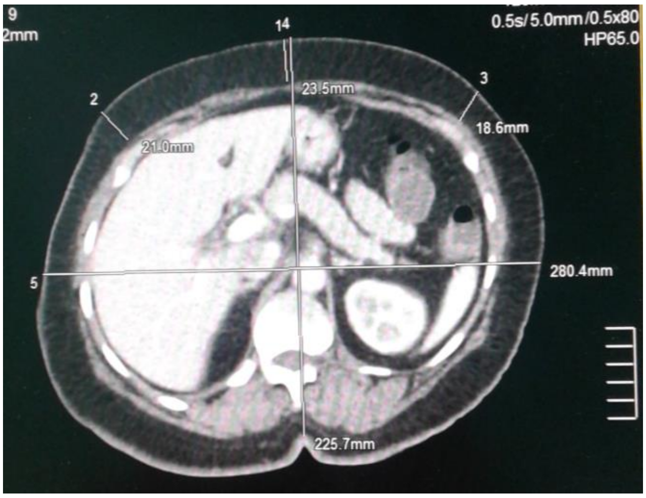

Image: (6) ABD CT for female had 67 years old, 76 Kg, with measurmentes in RT 21 mm, Cen 23.5 mm, LT 18.6 mm, AP 225.7 mm, Cirecumferance (RT/LT) 280.4 mm.

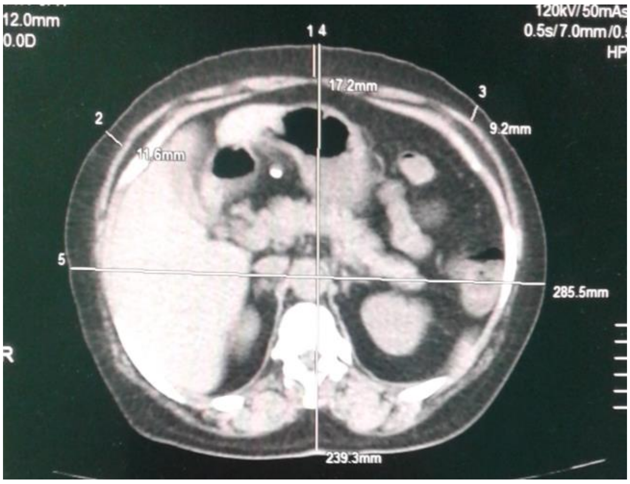

Image: (7) ABD CT for female had 55 years old, 80 Kg, with measurmentes in RT 11.6 mm, Cen 17.2 mm, LT 9.2 mm, AP 239.3 mm, Cirecumferance (RT/LT) 285.5 mm.

Image: (8) ABD CT for male had 69 years old, 64 Kg, with measurmentes in RT 5.5 mm, Cen 19.6 mm, LT 5.2 mm, AP 240.2 mm, Cirecumferance (RT/LT) 283.9 mm.

Image: (9) ABD CT for female had 37 years old, 75 Kg, with measurmentes in RT 7.8 mm, Cen 20.3 mm, LT 7.2 mm, AP 211.2 mm, Cirecumferance (RT/LT) 290.9 mm.

Image: (10) KUB CT for male had 70 years old, 65 Kg, with measurmentes in RT 6.7 mm, Cen 7.9 mm, LT 4.6 mm, AP 245.3 mm, Cirecumferance (RT/LT) 301.9 mm.

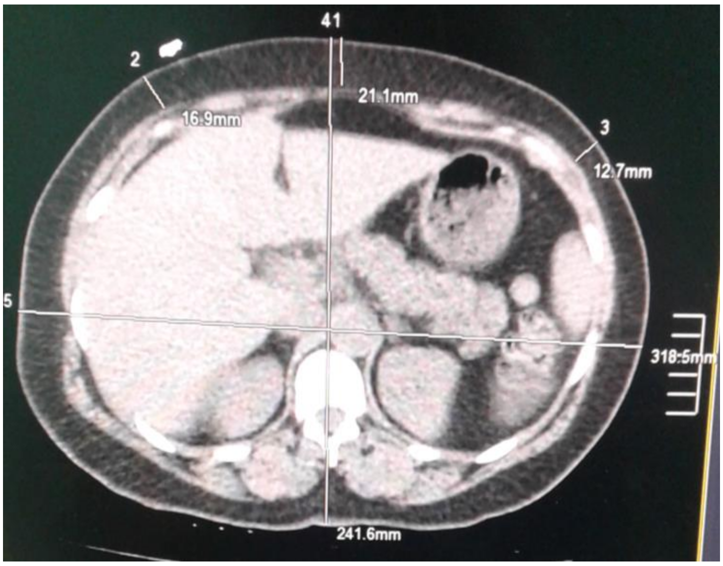

Image: (11) KUB CT for female had 40 years old, 80 Kg, with measurmentes in RT 16.9 mm, Cen 21.1 mm, LT 12.7 mm, AP 241.6 mm, Cirecumferance (RT/LT) 318.5 mm.

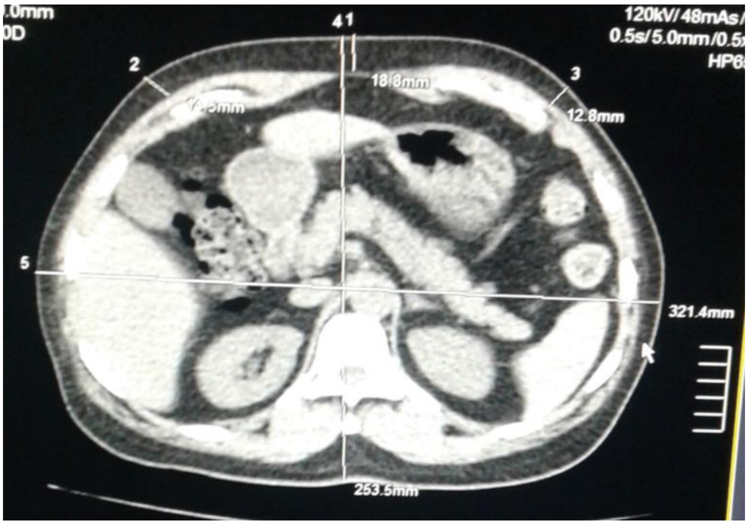

Image: (12) KUB CT for male had 55 years old, 75 Kg, with measurmentes in RT 14.5 mm, Cen 18.8 mm, LT 12.8 mm, AP 253.5 mm, Cirecumferance (RT/LT) 321.4 mm.

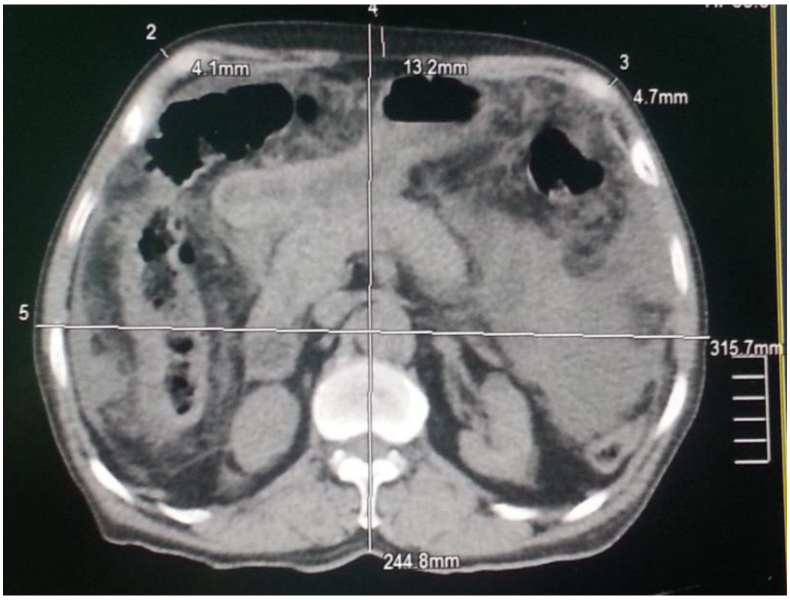

Image: (13) ABD CT for male had 67 years old, 53 Kg, with measurmentes in RT 4.1 mm, Cen 13.2 mm, LT 4.7 mm, AP 244.8 mm, Cirecumferance (RT/LT) 315.7 mm.

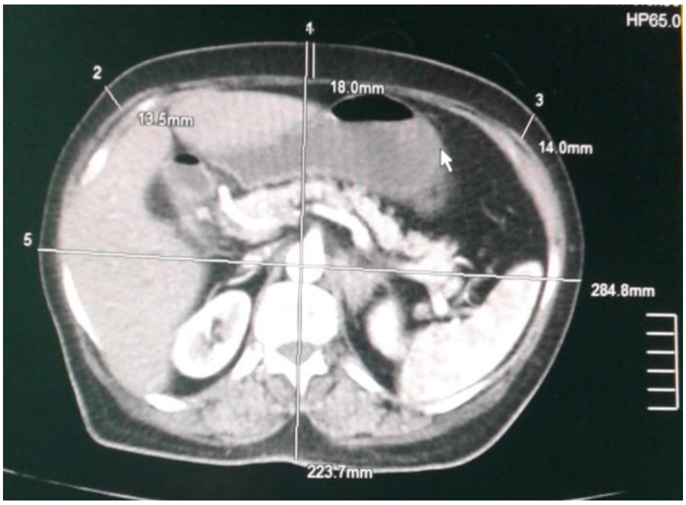

Image: (14) ABD CT for female had 60 years old, 56 Kg, with measurmentes in RT 13.5 mm, Cen 18 mm, LT 14 mm, AP 223.7 mm, Cirecumferance (RT/LT) 284.8 mm.

Image: (15a) ABD CT for female had 45 years old, 75 Kg, with measurmentes in RT 21 mm, Cen 18 mm, LT 21 mm.

Image: (15b) ABD CT for female had 45 years old, 75 Kg, with measurmentes in LT 21 mm, AP 256 mm, Cirecumferance (RT/LT) 307 mm.

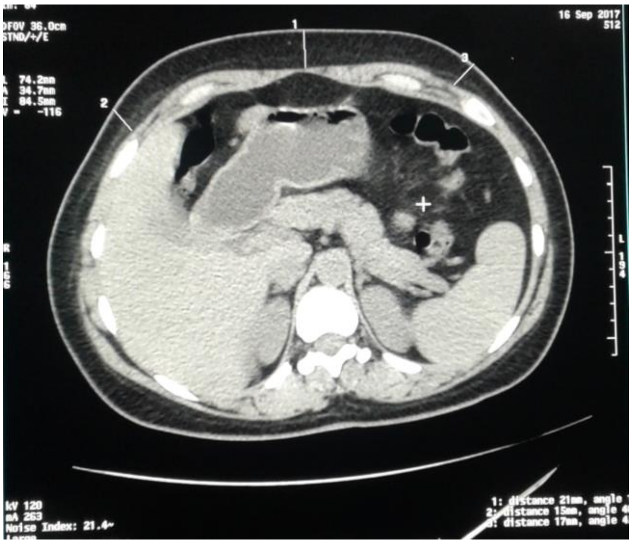

Image: (16a) KUB CT for female had 21 years old, 67 Kg, with measurmentes in RT 15 mm, Cen 21 mm, LT 17 mm.

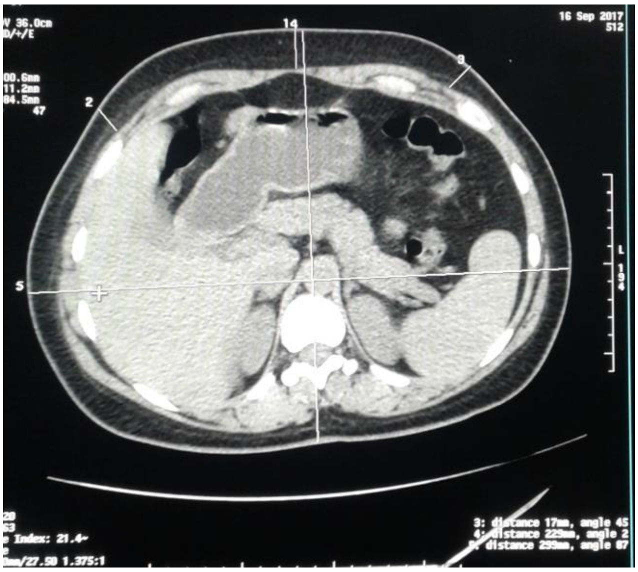

Image: (16b) KUB CT for female had 21 years old, 67 Kg, with measurmentes in LT 17 mm, AP 229 mm, Cirecumferance (RT/LT) 299 mm.

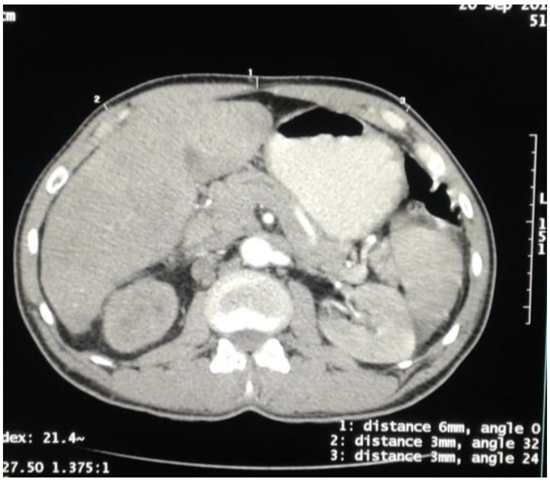

Image: (17a) ABD CT for male had 62 years old, 56 Kg, with measurmentes in RT 3 mm, Cen 6 mm, LT 3 mm.

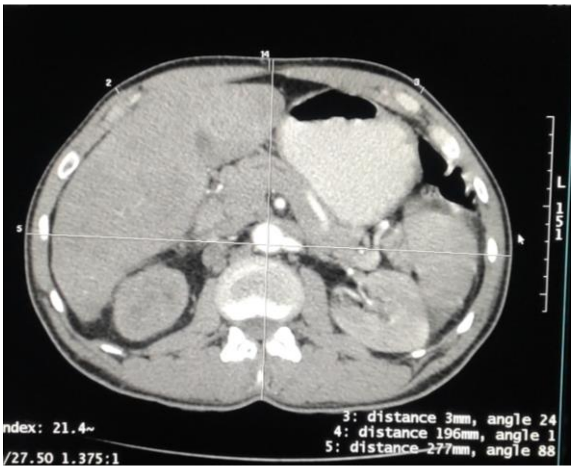

Image: (17b) ABD CT for male had 62 years old, 56 Kg, with measurmentes in in LT 3 mm, AP 196 mm, Cirecumferance (RT/LT) 277 mm.

Image: (18a) ABD CT for female had 75 years old, 66 Kg, with measurmentes in RT11 mm, Cen 23 mm, LT 14 mm.

Image: (18b) ABD CT for female had 75 years old, 66 Kg, with measurmentes in LT 14 mm, AP 230 mm, Cirecumferance (RT/LT) 289 mm.

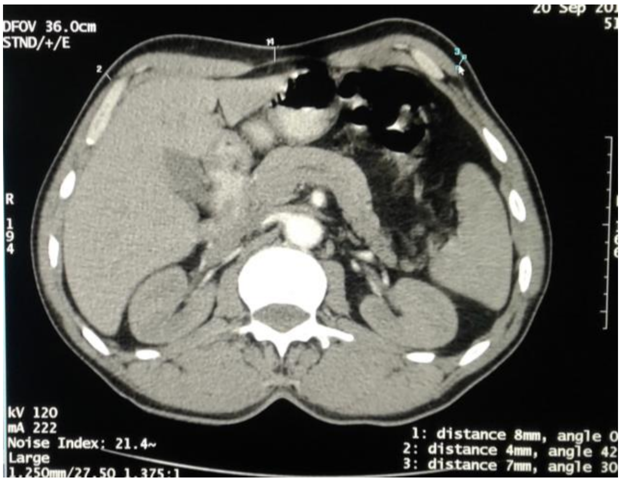

Image: (19a) ABD CT for male had 58 years old, 68 Kg, with measurmentes in RT 4 mm, Cen 8 mm, LT 7 mm.

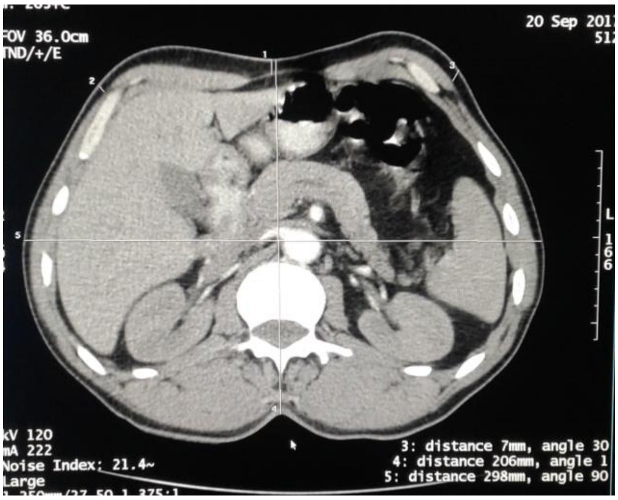

Image: (19b) ABD CT for male had 58 years old, 68 Kg, with measurmentes in LT 7 mm, AP 206 mm, Cirecumferance (RT/LT) 298 mm.

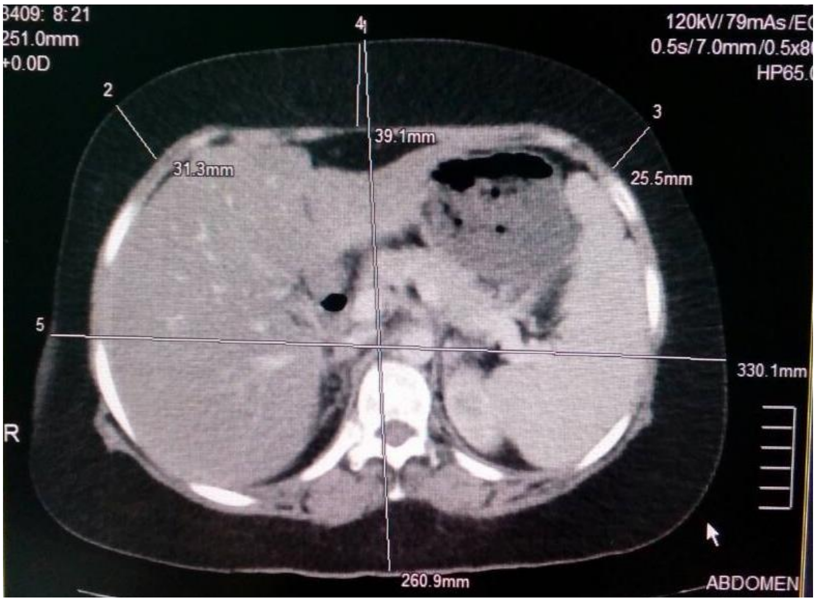

Image: (20) ABD CT for female had 32 years old, 83 Kg, with measurmentes in RT 13.3 mm, Cen 39.1 mm, LT 25.5 mm, AP 330.1 mm, Cirecumferance (RT/LT) 260.9 mm.

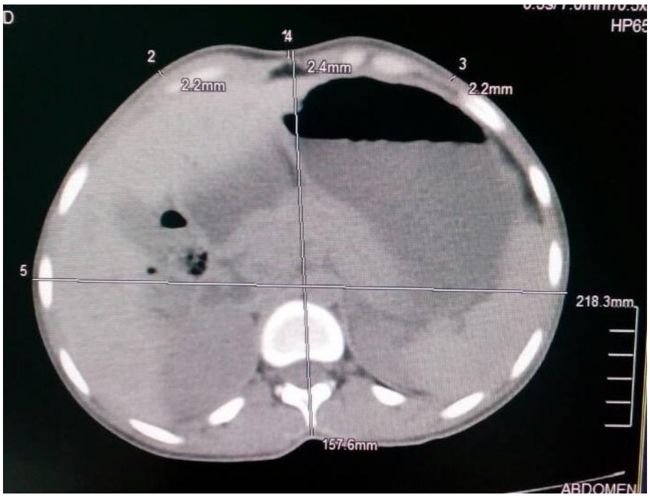

Image: (21) ABD CT for female had 22 years old, 56 Kg, with measurmentes in RT 2.2 mm, Cen 2.4 mm, LT 2.2 mm, AP 157.6 mm, Cirecumferance (RT/LT) 218.3 mm.

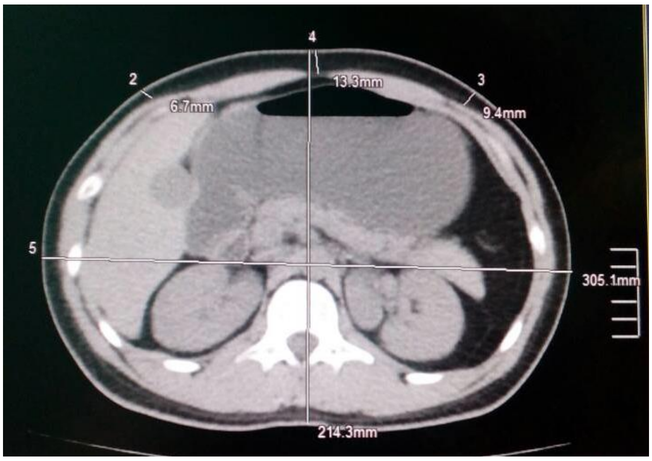

Image: (22) ABD CT for male had 21 years old, 76 Kg, with measurmentes in RT 6.7 mm, Cen 13.3 mm, LT 9.4 mm, AP 214.3 mm, Cirecumferance (RT/LT) 305.1 mm.

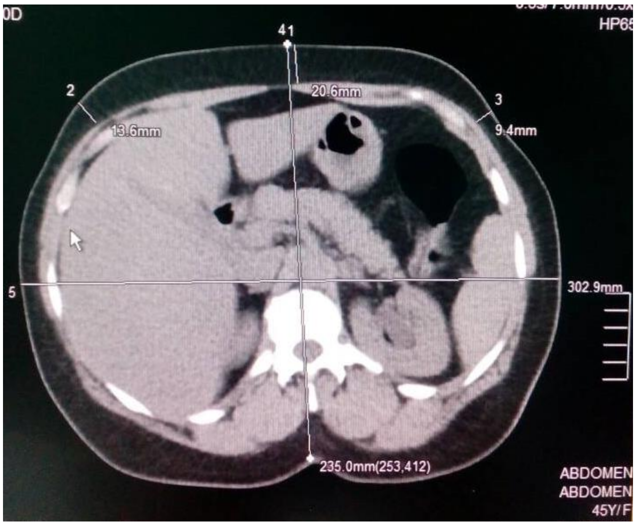

Image: (23) ABD CT for female had 45 years old, 75 Kg, with measurmentes in RT 13.6 mm, Cen 20.6 mm, LT 9.4 mm, AP 235 mm, Cirecumferance (RT/LT) 302.9 mm.

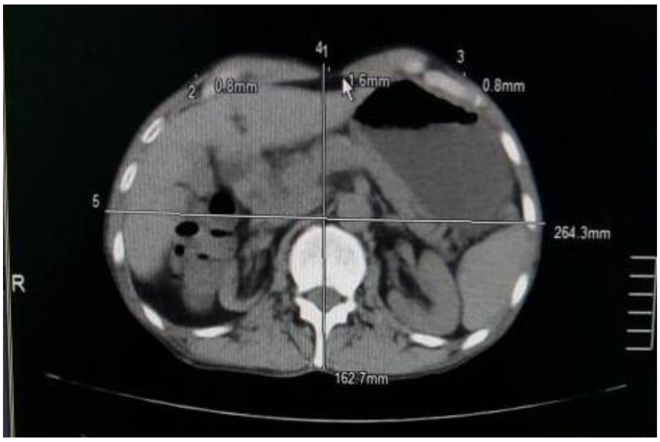

Image: (24) ABD CT for male had 67 years old, 47 Kg, with measurmentes in RT 0.8 mm, Cen 1.5 mm, LT 0.8 mm, AP 162.7 mm, Cirecumferance (RT/LT) 264.3 mm.

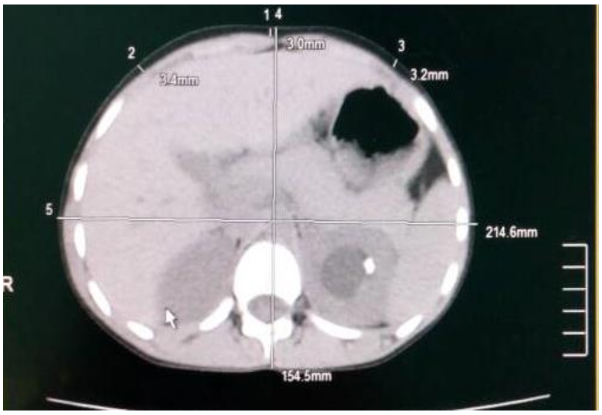

Image: (25) KUB CT for male had 13 years old, 30 Kg, with measurmentes in RT 3.4 mm, Cen 3 mm, LT 3.2 mm, AP 154.5 mm, Cirecumferance (RT/LT) 214.6 mm.

Image: (26) CTU for female had 54 years old, 73 Kg, with measurmentes in RT 23.9 mm, Cen 21.9 mm, LT 16.3 mm, AP 358.2 mm, Cirecumferance (RT/LT) 242.7 mm.

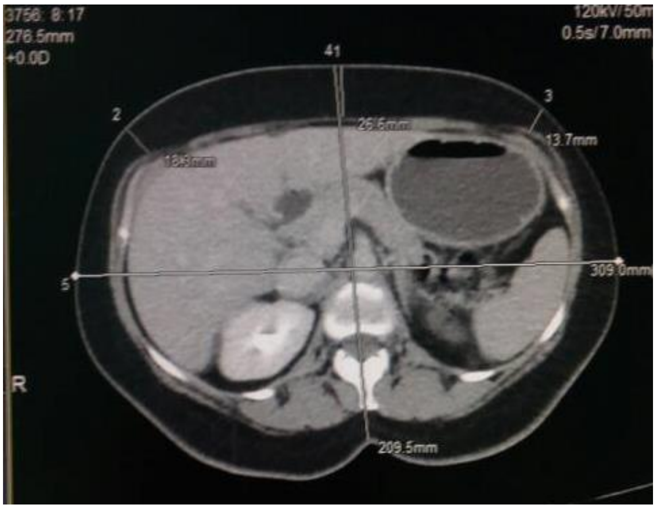

Image: (27) ABD CT for female had 45 years old, 63 Kg, with measurmentes in RT 18.3 mm, Cen 26.6 mm, LT 13.7 mm, AP 209.5 mm, Cirecumferance (RT/LT) 309 mm.

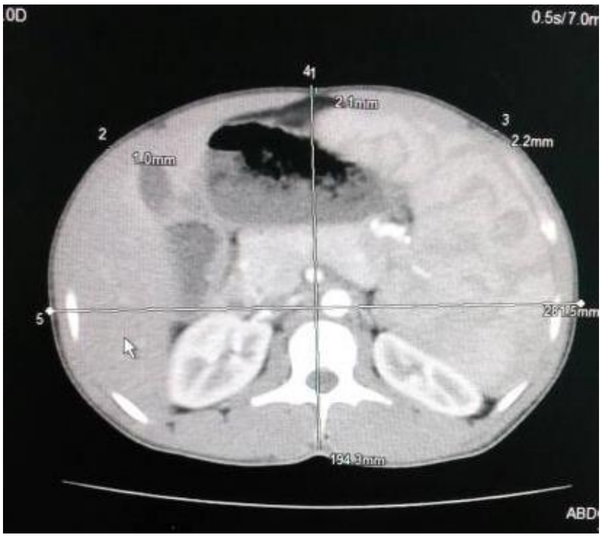

Image: (28) ABD CT for male had 25 years old, 58 Kg, with measurmentes in RT 1 mm, Cen 2.1 mm, LT 2.2 mm, AP 194.3 mm, Cirecumferance (RT/LT) 281.5 mm.

Image: (29) ABD CT for male had 50 years old, 59 Kg, with measurmentes in RT 0.8 mm, Cen 2.3 mm, LT 0.8 mm, AP 209 mm, Cirecumferance (RT/LT) 265.1 mm.

Image: (30) CTU for male had 65 years old, 69 Kg, with measurmentes in RT 12.2 mm, Cen 15.6 mm, LT 12.1 mm, AP 215.1 mm, Cirecumferance (RT/LT) 310.5 mm.

Image: (31) ABD CT for female had 59 years old, 130 Kg, with measurmente in RT 28.6 mm, Cen 38.3 mm, LT 26.4 mm, AP 312 mm, Cirecumferance (RT/LT) 361.8 mm.

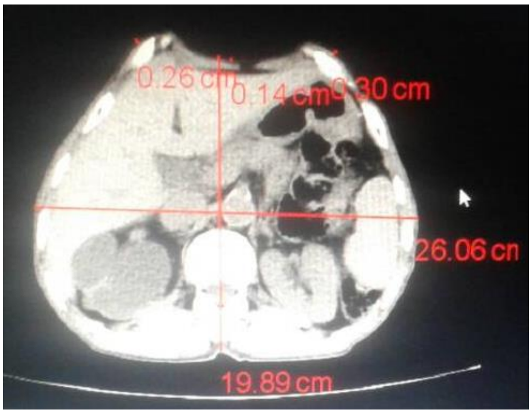

Image: (32) KUB CT for male had 38 years old, 56 Kg, with measurmente in RT 0.26 cm, Cen 0.14 cm, LT 0.30 cm, AP 19.89 cm, Cirecumferance (RT/LT) 26.06 cm.

Image: (33) ABD CT for female had 85 years old, 65 Kg, with measurmente in RT 1.08 cm, Cen 3.10 cm, LT 1.76 cm, AP 21.56 cm, Cirecumferance (RT/LT) 27.7 cm.

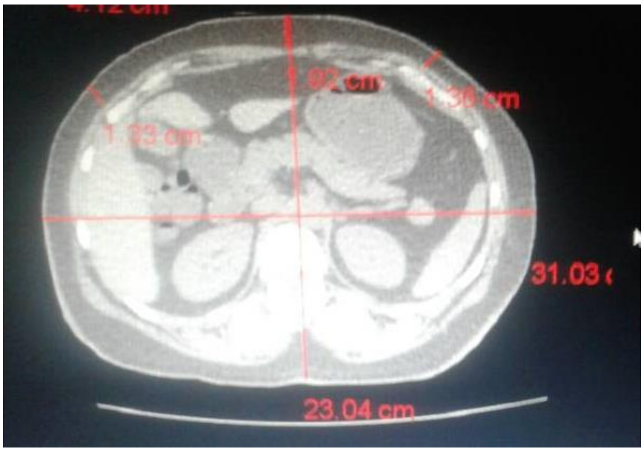

Image: (34) ABD CT for female had 42 years old, 85 Kg, with measurmente in RT 1.33 cm, Cen 1.92 cm, LT 1.30 cm, AP 23.04 cm, Cirecumferance (RT/LT) 31.03 cm.

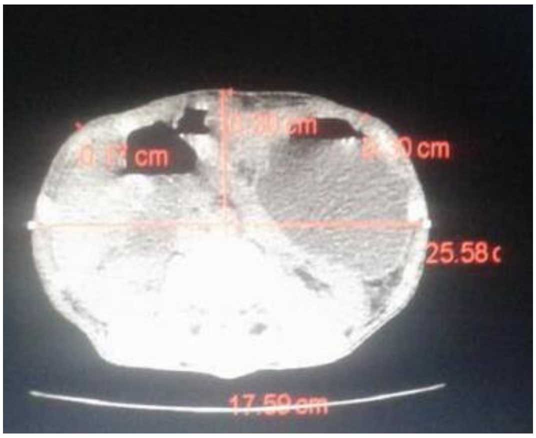

Image: (35) ABD CT for male had 73 years old, 55 Kg, with measurmente in RT 0.17 cm, Cen 0.30 cm, LT 0.30 cm, AP 17.59 cm, Cirecumferance (RT/LT) 25.58 cm.

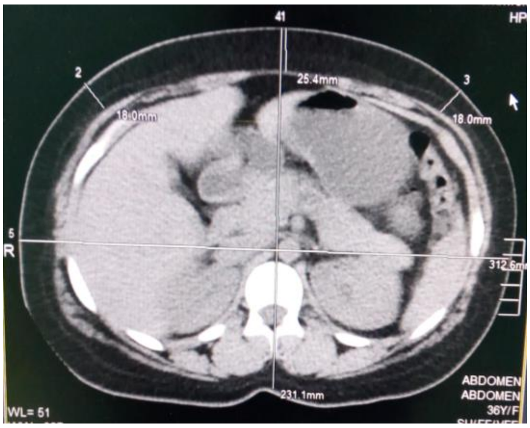

Image: (36) ABD CT for female had 36 years old, 74 Kg, with measurmente in RT 18 mm, Cen 25.4 mm, LT 18 mm, AP 231.1 mm, Cirecumferance (RT/LT) 312.6 mm.

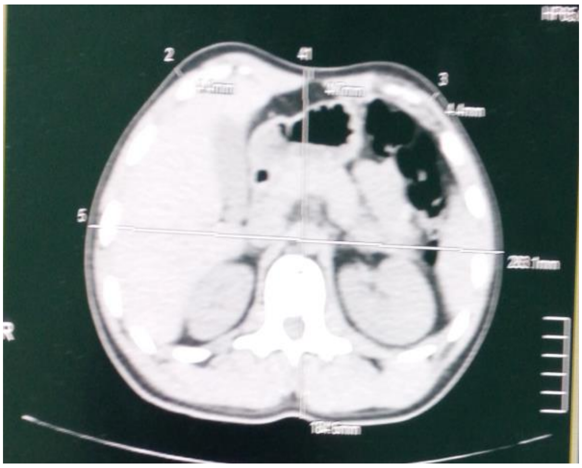

Image: (37) KUB CT for male had 25 years old, 60 Kg, with measurmente in RT 4.4 mm, Cen 4.7 mm, LT 4.4 mm, AP 184.6 mm, Cirecumferance (RT/LT) 283.1 mm.

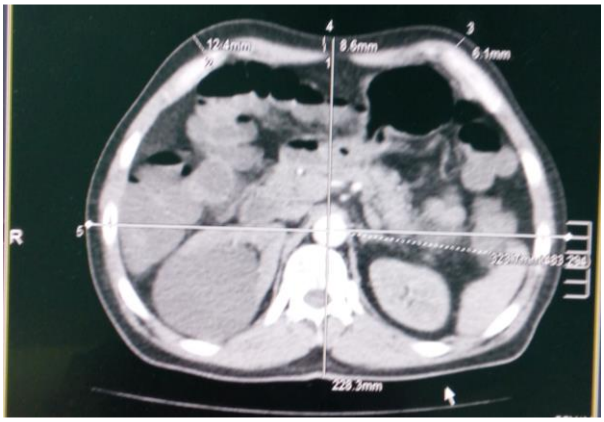

Image: (38) ABD CT for male had 55 years old, 69 Kg, with measurmente in RT 12.4 mm, Cen 8.6 mm, LT 6.1 mm, AP 228.3 mm, Cirecumferance (RT/LT) 323.7 mm.

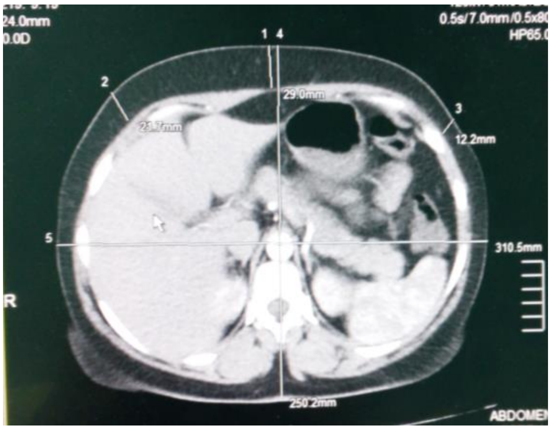

Image: (39) ABD CT for female had 35 years old, 83 Kg, with measurmente in RT 71.7 mm, Cen 29 mm, LT 12.2 mm, AP 250.2 mm, Cirecumferance (RT/LT) 310.5 mm.

Image: (40) KUB CT for male had 46 years old, 75 Kg, with measurmente in RT 10.5 mm, Cen 10.9 mm, LT 12.4 mm, AP 248.2 mm, Cirecumferance (RT/LT) 307.5 mm.

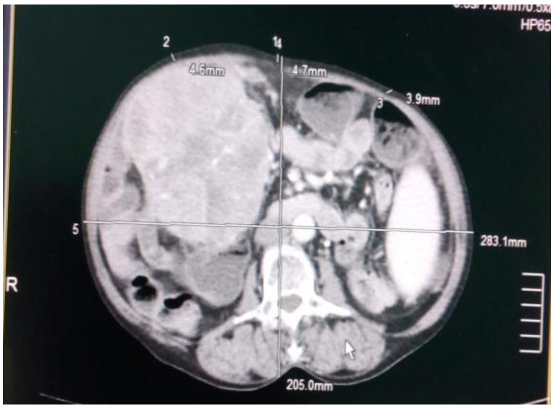

Image: (41) ABD CT for female had 85 years old, 45 Kg, with measurmente in RT 4.6 mm, Cen 4.7 mm, LT 3.9 mm, AP 205 mm, Cirecumferance (RT/LT) 283.1 mm.

Image: (42) KUB CT for male had 30 years old, 65 Kg, with measurmente in RT 2.3 mm, Cen 4.4 mm, LT 2.3 mm, AP 210.2 mm, Cirecumferance (RT/LT) 304 mm.

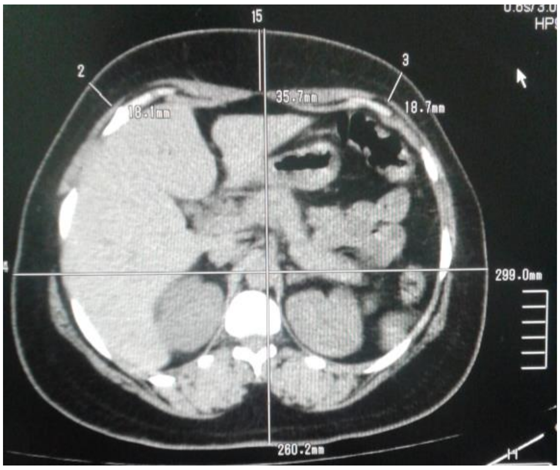

Image: (43) KUB CT for female had 45 years old, 80 Kg, with measurmente in RT 18.1 mm, Cen 35.7 mm, LT 18.7 mm, AP 260.2 mm, Cirecumferance (RT/LT) 299 mm.

Image: (44) ABD CT for male had 73 years old, 73 Kg, with measurmente in RT 4.2 mm, Cen 6.3 mm, LT 4.2 mm, AP 188.5 mm, Cirecumferance (RT/LT) 254.1 mm.

Image: (45) ABD CT for female had 67 years old, 72 Kg, with measurmente in RT 14.4 mm, Cen 30.5 mm, LT 14.1 mm, AP 234.6 mm, Cirecumferance (RT/LT) 284.6 mm.

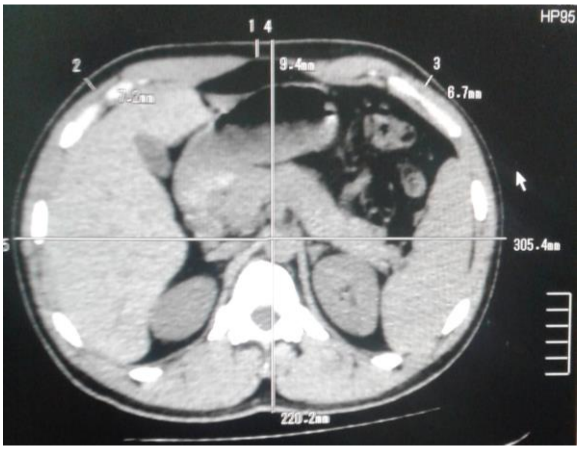

Image: (46) KUB CT for male had 77 years old, 70 Kg, with measurmente in RT 7.2 mm, Cen 9.4 mm, LT 6.7 mm, AP 220.2 mm, Cirecumferance (RT/LT) 305.4 mm.

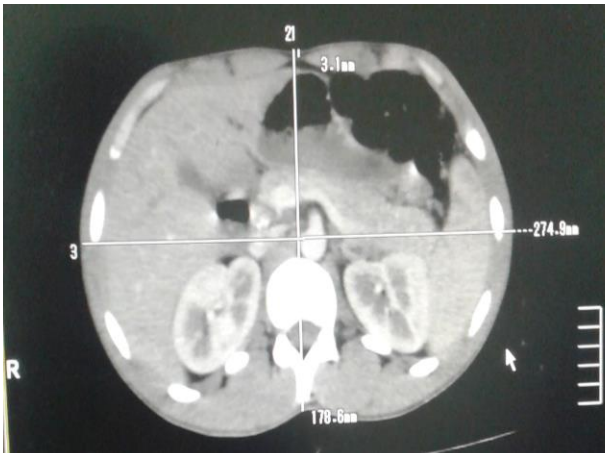

Image: (47) ABD CT for male had 30 years old, 65 Kg, with measurmente in RT 0 mm, Cen 3.1 mm, LT 0 mm, AP 178.6 mm, Cirecumferance (RT/LT) 274.9 mm.

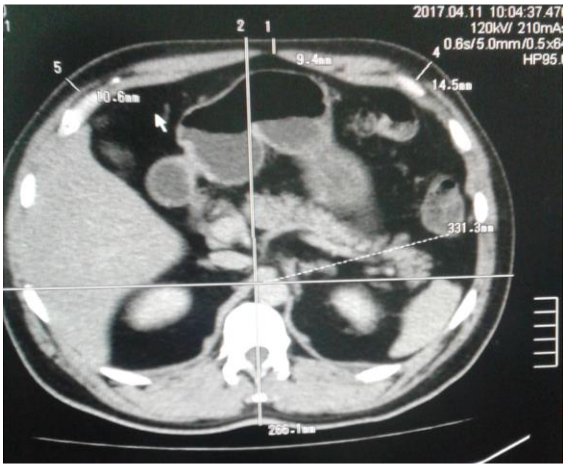

Image: (48) ABD CT for female had 23 years old, 58 Kg, with measurmente in RT 10.6 mm, Cen 9.4 mm, LT 14.5 mm, AP 266.1 mm, Cirecumferance (RT/LT) 331.1 mm.