Chapter one

1.1 Introduction

Spleen is the largest haemolymph organ in the body which is closely connected with blood and with three lymphoid tissue.[Henry,G.1918] The spleen is found on the left side of your body,behaved the stomach on the level with the 9^{th} to 11^{th} ribs. The spleen varies in size and shape between people, but it is not commonly fist-shape, purple. Because the spleen is protected by the ribs cage, you cannot easily feel it unless it is abnormally enlarged.[Mathew,H1997]

The spleen plays multiple roles in the body it act as a filter for blood as part of the immune system. Old red blood cells are recycled in the spleen, and platelets and white blood cells are stored there.The spleen also helps fight certain kinds of bacteria that case pneumonia and meningitis.[Gayer,G 2001]

CT scan is used for a multitude of reasons spleen ct scan can be used Although other imaging can also reveal spleen trauma injury, to check for any injury to the spleen or determine it is not size. spleen ct scan is the radiographic modality used by most, and considered to be the best evaluation of the spleen and the surrounding tissue.Another advantage of the abdominal organs simultaneously along with the spleen.

Many different from cysts can be found and identified by using spleen CT. in fact, on some sonogram can be cofused with ulceration so CT scans are often used.[Gayer,G.2001

1.2Problem of the study

If any deviation from the normal will be consider as disease. The physician can evaluate the spleen subjectively, but also we need objective method for evaluation the spleen.

1.3Objectives

1.3.1General objective

Determination of CT Number of Normal Spleen in Sudanese Population Using CT Scan.

1.3.2Specific objectives

1) To measure the CT number of normal spleen

2) To measure liver and vertebrae to be standard for spleen

3) To correlate the spleen readings with patient age and gender

4) To correlate the spleen reading with liver CT number and vertebrae

5) To find out the normal standard value as local reference for Sudanese

6) To compare the finding with other population and literature.

Chapter Two

2.1 Anatomy Structure

2.1.1Spleen anatomy

The spleen is a brown flat oval shaped lymphatic organ that filters and stores blood to protect the body form infections and blood cells. Protected by the ribs, the spleen is located between the stomach and diaphragm in the left hypochondriachregion of the abdominal body cavity. The splenic artery branches from the aorta and celiac trunk to deliver oxygenated blood to the spleen, while the splenic vein carries deoxygenated blood away from the spleen to the hepatic portal vein.[Snell, R 2007]

A tough connective tissue capsule surrounds the soft inner tissue of the spleen ; spongy inner tissue within the spleen contains many tiny blood vessels and hollow sinuses that store blood. The spleen can release its stored blood into circulation to replace blood lost during a traumatic injury. Many platelets are also stored with the blood in the spleen to helps from blood clots to prevent further blood loss.

The red pulp region contain many net-like reticular fiber that filter worn-out red blood cells from the blood flowing through the spleen; captured red blood cells are digested to recycle the iron and protein component to hemoglobin. [Snell, R 2007]

Whitepulp of the spleen are made of lymphatic tissue containing macrophages, T lymphocytes, and B lymphocytes that destroy pathogens in the blood and produce antibodies. The spleen may enlarge during certain infection due to an increase in the number of white blood cells, captured pathogens and antibodies inside the spleen. [Lee, G. 1986]

The spleen’s ends are the posterior and anterior end.

The anterior end of the spleen is expanded forward and downward to rich midaxillary line, the posterior end is rounded and is directed upward ; it rests on the upper pole of left kidney.

The spleen's 3 border are superior, inferior and intermediate. The superior border of the spleen is notched by the anterior end. The inferior border is rounded. The intermediate border directs toward the right.

The 2 surface of spleen are diaphragmatic and visceral, the diaphragmatic surface is smooth and convex and visceral surface is irregular and concave and has impressions. The gastric impression is for the fundus of the stomach, which is largest and most concave impression on the spleen. The renal impression is for the left kidney and lies between the inferior and intermediate borders.

2.1.1.1Hilum of the spleen

The hilum can be found on the inferomedial part of the gastric impression. The hilum transmits the splenic vessels and nerves and provides attachment to the gastrosplenic and splenorenal ligaments

2.1.1.2Peritoneal relations with the spleen

The issurrounded by peritoneum and is suspended by multiple ligaments, as follows:

The gastrosplenicligament extend from the hillum of the spleen to greater curvature of the stomach; it contains short gastric vessels and associated lymphatics and sympathetic nerves.

The splenorenal ligament extends from the Hillum of the spleen to the anterior surface of the left kidney; it contain the tail of pancreas and splenic vessels.

The phrenicocolic ligament is a horizontal fold of peritoneum the extends from the spleenic flexure of the colon to diaphragm along the midaxillary line; it forms the upper end of the left paracolic gutter.

2.1.1.3Visceral relations with the spleen

The visceral surface of the spleen contacts the following organs; anterior surface of left kidney ,splenic flexure of the colon, the fundus of the stomach, tail of the pancreas

2.1.1.4Nerve supply of the spleen

Sympathetic fibers are derived from the celiac plexus.

[Lee, G1986]

2.1.1.5Blood supply of the spleen

The spleen's blood is supplied by the splenicartery.This artery is one of the three large arteries that branch out from the celiac trunk (also called the celiac artery). The celiac trunk is the frist major branch coming from the abdominal aorta.

2.1.16Venous drainage of the spleen

Thesplenic vein (formerly the lineal vein) is a blood vessel that drains blood from the spleen, the stomach fundus and part of the pancreas. It is part of the hepatic portal system. The splenic vein is subject to vein thrombosis, presenting some of the characteristics of portal vein thrombosis and portal hypertension, but localized to part of the territory drained by the splenic vein. These include varices in the stomach wall due to hypertension in the short gastric vein and abdominal pain. The most common cause for splenic vein thrombosis is both chronic and acute pancreatitis.

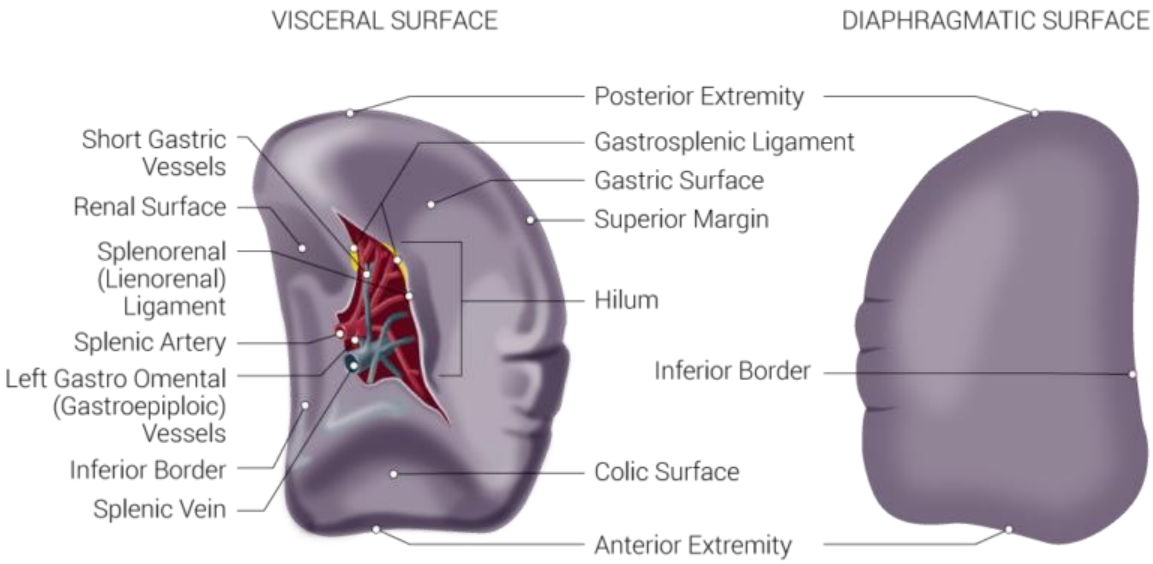


Figure 2.1 spleen anatomy and blood vesselse (Matstushita-2006)

2.1.2 Liver anatomy

The liver is the second largest organ on the human body and the largest gland {weighting an average of 1500g} .It lies under the diaphragm in the right upper abdomen. The liver has general shape of prism or wedge. The liver is divided to into right and left lobe by falciform ligament, this division is based on the right and left branches of hepatic artery and the portal vein the middle hepatic vein lies in cantlies line. Each lobe is divided into 2 sectors. The right hepatic vein divided the right lobe into anterior and posterior sector ; the left hepatic vein devided the left lobe into medial and lateral sector. The anterior sector of the right lobe contains superior and inferior segment. The posterior sector of the right lobe has superior and inverior segment. The medial sector of the left lobe is the part of the left lobe from surgical perspective but lies to right of the midline.

The falciform ligament which divides the liver into larger anatomical right and smaller left lobe has a tow layer of the peritoneum attaches the

anterosuperior surface of the liver to anterior abdominal wall and diagram. The free edge of the falciform ligament contains the ligmentumtereshepatis.

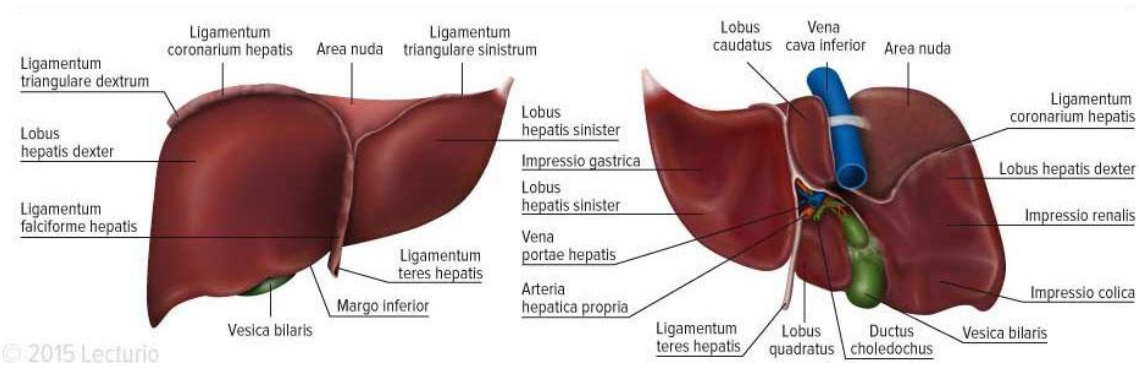


Figure2.2 shows liver anatomy and blood vessels(Reiser,2009)

2.1.3 Anatomy of vertebrae

The spine is made of 33 indvidual bones stacked one on top of the other. When viewed from the side, an adult spine has a natural S shaped curve. The nick (cervical) and low back (lumber) regions have a slight concave curve, and the thoracic and sacral regions have a gentle convex curve. The curve work like a coiled spring to absorb shock and maintain balance. The two main muscle groubs that affect the spine are extensors and flexors. The extensors muscles that enable us to stand up and lift objects. The extensors isattached to the back of the spine. The flexor muscle are in the front and include the abdominal muscles enable us to flex. The back muscle stabilize your spine. The vertebrae are numbered and divided into regions: cervical, thoracic, lumber, sacrum, coccyx are fused. Only the top 24 bones are movable ; the vertebrae sacrum and coccyx are fused. Each vertebrae in your spin is separated by intervertbral disc, keeping the bone from rubbing together. Each vertebrae has four faced joints, the faced joint of the spine

allow back motion. The spinal cord is about 18 inches long and this is thikining of your thumb.

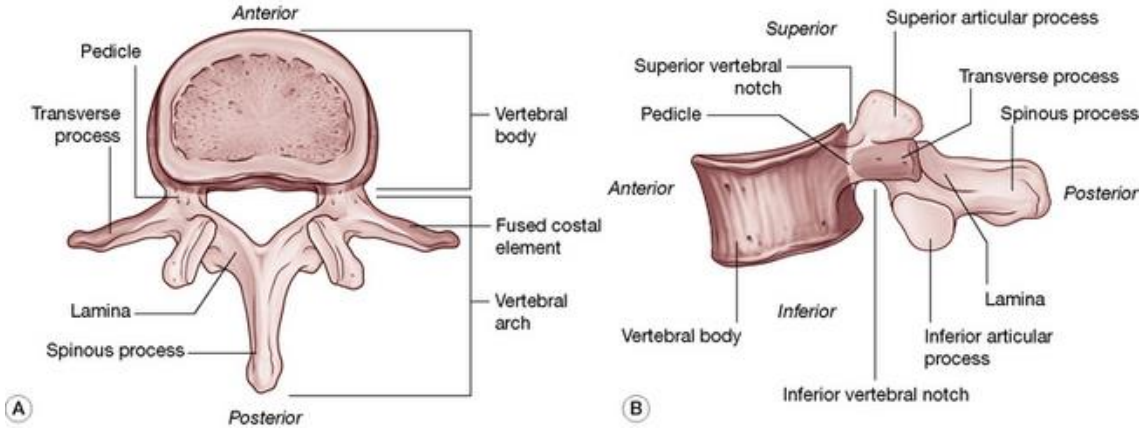


Figure2.3 lateral and superior view of the lumber vertebrae (Buzug-2008)

2.2Physiology of spleen

2.2.1 Immune responses

After antigenic stimulation, increase information of plasma cells for humoral responses and increased lymphopioesis for cellular responses occurs.

2.2.2Phagocytosis

One of the spleen's most important function is phagocytosis. The spleen is a component of reticuloendothelial system. The splinc phagocytes include reticular cells, free macrophages of the red pulp, and modified reticular cells of the ellipsoids. Phagocytes in the spleen remove debris, old and effect red blood cells (RBCs) other blood cells, and maicroorganisms, thereby filtering the blood. Phagocytosis of circulating antigens initiates the humoral and cellular immune responces.

2.2.3Hematopoiesis

The spleen is an important hematopieotic organ during fetal life; lymphopoiesis for continues throughout life.Themanufacturated lymphocytes take part in immune responses of the body. In the adult spleen, hematopoiesis can restart in certain disease such as chronic myeloid leukemia and myelosclerosis.

2.2.4 Storage of red blood cells

The RBCs are stored in the spleen. Approximately 8% of the circulating RBCs are present within the spleen; however, this function is seen well in animals than humans [Guyton,A.2005]

2.3 Pathology of spleen

2.3.1 Enlarged spleen (splenomegaly):

An enlarged spleen, usually casued by viral mononucleosis, liver desease, blood cancers (lymphoma and leukemia), or other condtions.

2.3.2Rubtered spleen:

The spleen is vulnerable to injury, and rubtured spleen can cause serious life-threatening internal bleeding and is a life-threatining emergency. An injured spleen may rupture immediately after an injuray, or in some cases, days or weeks after an injuray.

2.3.3 Sickle cell disease:

In this inherited from anemia, abnormal red blood cells block the flow of blood through vessels and can lead to organ damage, including damage to the spleen.

2.3.4Thrombocytopenia (low platelets count):

An enlarged spleen sometimes stores excessive numbers of the body’s platelets.

2.3.5Vaccinations:

After spleen removal, it's important to FET vaccinations against certain bacteria, such as H. influenza and S. pneumonia an absent spleen increases vulnerability to these infections.

Usually , treatments for spleen conditions focus not on the spleen, but on treating the underlying condition.[Gayer,G2014].

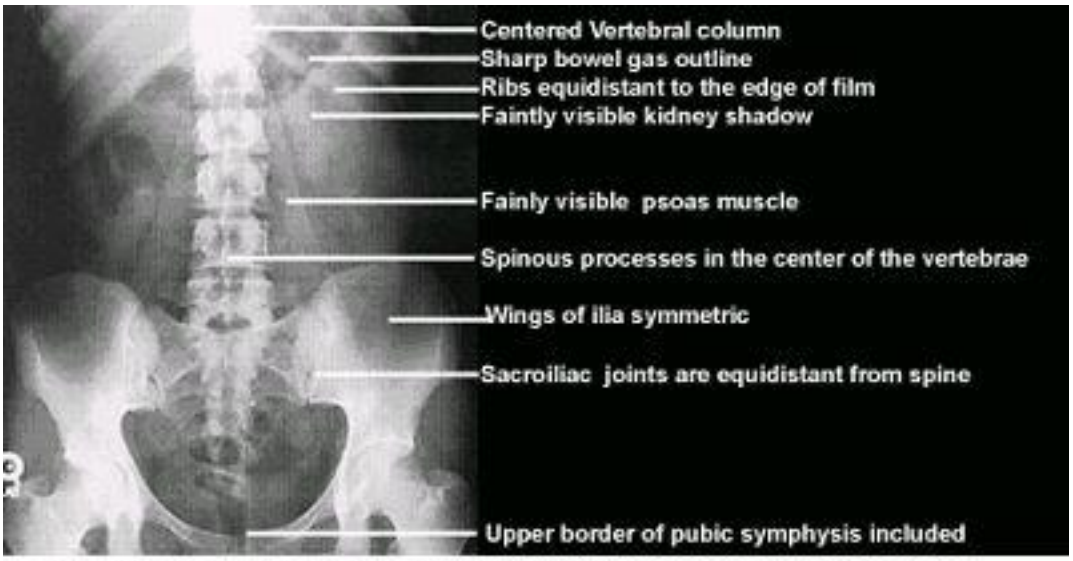
2.4Imaging of spleen

2.4.1Abdominal x-ray

The anteroposterior (AP) radiograph taken with the patient in supine position is the basis of the majority of plain-film examinations of the abdomen. The abdominal film obtained with patient in an erect position is ordered routinely, but rarely adds significant daigonistic information. However, an upright-position film may be helpful in patients with suspected bowel obstruction, as to assess the air fluid levels in the distended bowel.

This information can also be obtained on a film of the abdomen taken with patient in the lateral decubitus position. An AP supine projection is often called a flat plat or KUB (because it in- include the kidneys ,ureter and bladder) . If a supine-positions radiographed is ordered, placing a support under the knee helps to relieve the strain on the patient while the are in the supine position. For upright-position radiograph, the patient back should be against the grid device, legs slightly spread, with body weight distributed equally on both feet. In both postions, the midsagittal plane of the body should be centered to the midline of the grid device. There should be no rotation of shoulder and pelvis. Place the patient's arms at the sides and away from the body. A 14 x 17 inche (35x43-cm) film or IR should be

positened lengthwise, with its lower edge at the symphyisis pubis.crosswise cassette placement is appropriate if the patient is vary large.



AP abdominal image showing important evaluation criteria. Image courtesy of Dr. Naveed Ahmad.

Figure2.4 AP abdominal image showing important evaluation criteria [Naveed,A.2002].

2.4.2 MRI of spleen

Pulse sequences used for MR imaging of the spleen are similar to this used for the standard MR imaging. Our standard protocol comprises the following sequence: (a) coronal T2-weighted half fourier rapid acquisition with relaxation enhancement(RARE) imaging, (b) axial turbo/fast spin-echo T2-wieghted or long echo time inverstion recovery imaging performed during a breath hold, (c) axial gradient-echo (GRE) T1-wieghted chemical shift in phase and out of phase imaging performed during a breath hold, and (d) an axial three –dimensional (3D) GRE breath hold sequence such as volumetric interpolated breath- hold examination (VIBE) with pre-contrast and dynamic gadolinium-enhanced imaging.

The MR imaging characteristics of the spleen are unique with a large fractional heme content characterized by long T1 and T2 (lower in signal intensity than liver on T1-weighted images and higher on T2-weightedn (figure 2.5). Image obtained immediately after gadolinium enhancement usually demonstrate different circulation as regions of alternating high and low signal intensity, resulting in a serpentine orarciform pattern. This pattern becomes homogeneous approximately 60-90 seconds after contrast material administration.

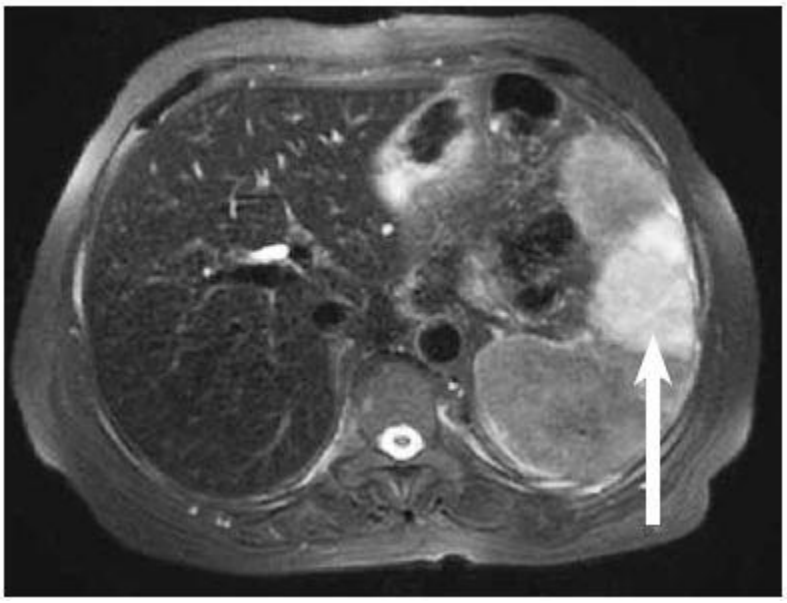


Figure2.5 shows axial T2 MRI image for the spleen(Benjamin-2012)

2.4.3 Ultrasound of spleen

Ultrasound imaging of the abdomen uses sound waves to produce pictures of the strctures within the upper abdomen. It is used to help diagnose pain or distention and evaluate the kidney, liver, gallbladder, pancreas , spleen and abdominal aorta. Ultrasound is safe, noninvasive and does not use ionizing radiation.

This procedure requires little to no special preparation .prepration including refrain from eating or drinking beforehand. Leave jewelry at home and wear loose, comfortable clothing. Patients should wear a gown.

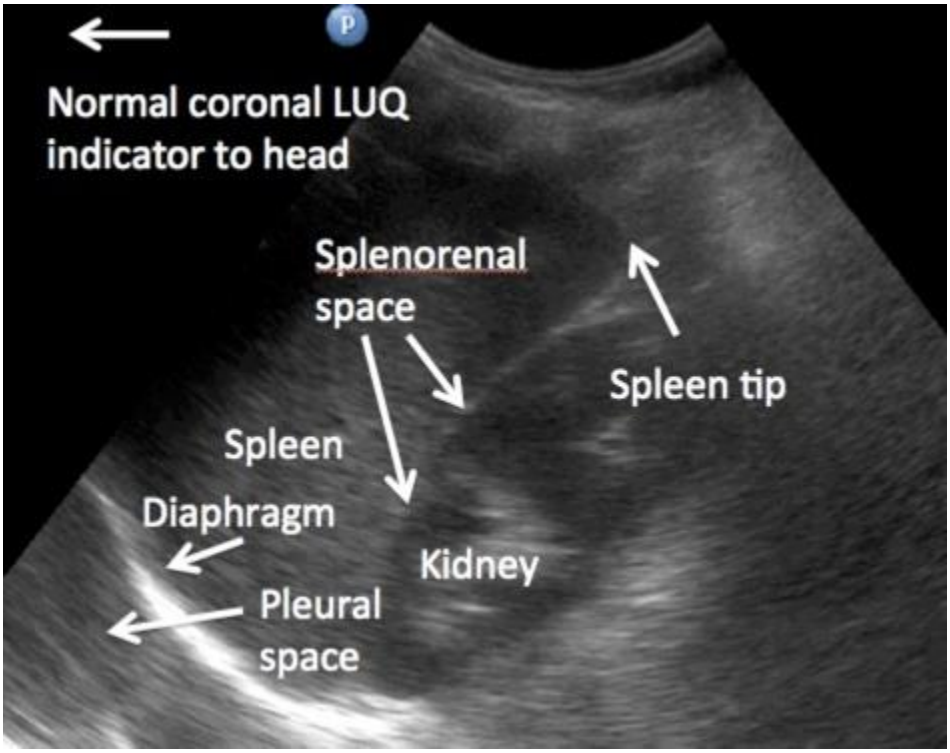


Figure2.6 shows ultrasound image of spleen(Blessmann-2003)

2.4.4 CT of spleen

Abdominal CT scans are used when a doctor suspected that something might be wrong in the abdominal area but can't find specifics through a physical examination.

2.4.4.1 Preparation

The patient should be asked to fast for two to four hours before the scan. comfortable clothing; patient should lie down on the table and wear hospital gown. Patient should remove any jewelry and other unnecessary items from your body .depending on reasons where the patient getting to do CT scan, patient may need to drink a large glass of oral contrast , a liquid that contains barium and has chalky taste and texture. Barium is chemical that helps better

seeing the lining of your organs. It's particularly helps if suspicion to have ulcers or blockage. Patient should wait between 60 and 90 minutes after drinking the contrast for it to distribute into the bowels. Before going to CT scan , if having any of the following conditions: allergy oral contrast (barium) diabetes (fasting may lower blood suger levels) pregnancy. This should be considered.Patient should wear loose,

2.2.4.2 Procedure

An abdominal CT scan is performed in a hospital's radiology department or clinic that specializes in diagnostic procedures. After dressing the hospital gown patient should lying down on procedure table.

Depending on the reasons for the patient scan, patient should be hooked up to an IV so contrast dye should be put through patient veins (it is critically important to convey any dye allergies, and to the X-ray staff). This liquid helps the machine get better imaging of the patient blood vessels and organs. Patient should ask to swallow a barium shake.

The technician asked the patient to lie in specific position during the test. They may use pillows or straps to make sure that patient stay in the right postion long enough to get a good quality image. Breath should be holded by patient during individual scans.

Using a remote control from a separate room, the technician will move the table into the CT machine, which looks like a gaint doughnut made of plastic and metal. The patient should go through the machine several times. After round of scans, the patient should be required to wait while the technician reviews the images to ensure they are clear enough to be readied correctly. A

tybical CT scan takes between 30 and 45 minutes to complete.

Figure2.7 shows CT machine(matusushita-2006)

2.4.4.4 Reconstruction

CT reconstruction is fundamentally an image de-blurring. The key principle is the central slice theorem. Of the many approaches, the convolution-back-projection method is preferred. While cone-beame reconstruction is only approximate, high quality images can nevertheless be obtained by adapting fan-beam techniques to cone-beam geometry.

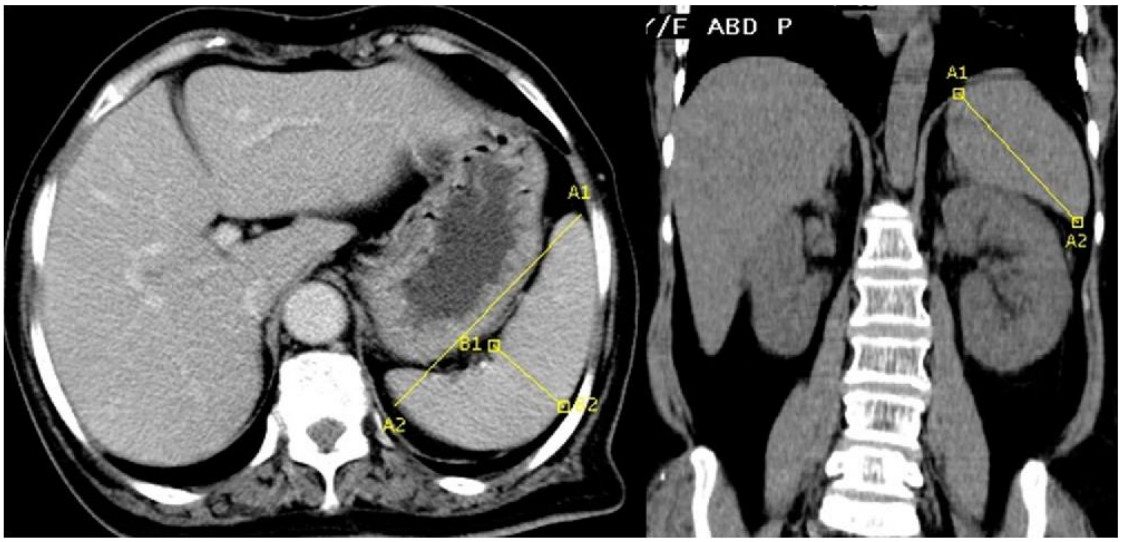
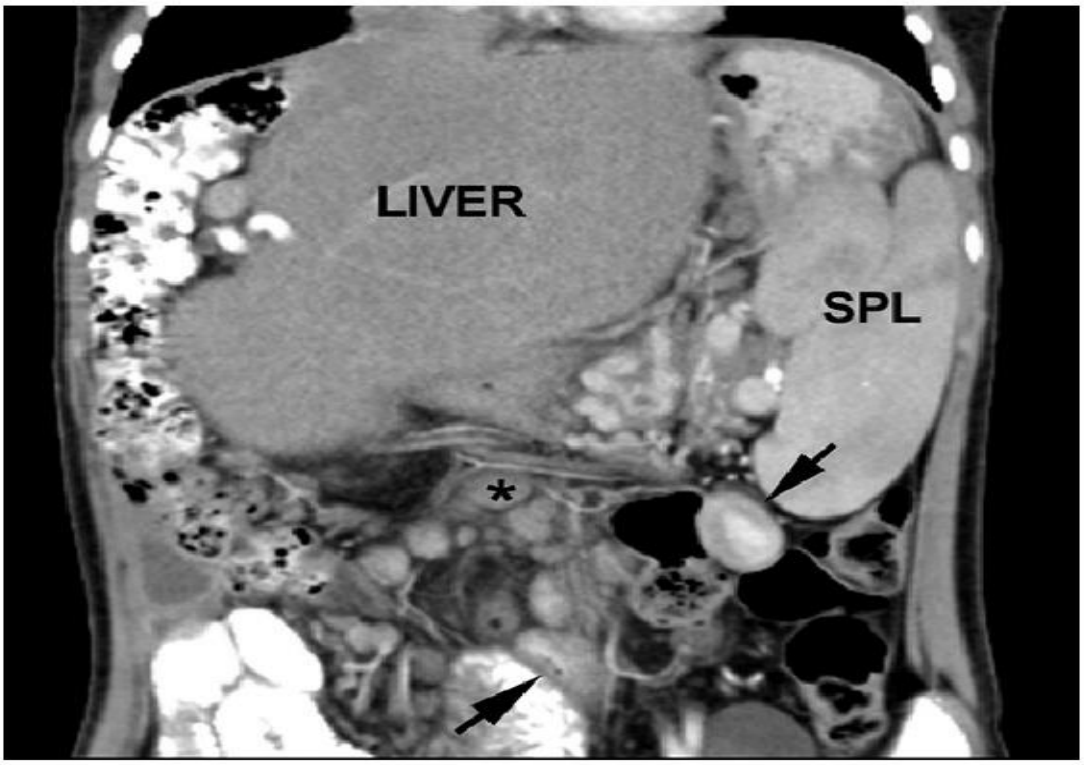


Figure2.8 axial CT for abdomen show measurement of spleen length and width(Reiser,2006)



(a)

(b)

Figure 2.9 axial CT shows spleen, liver and bowel(Matsushita-2006)

2.4.5 CThounsfield

The hounsfield scale or numbers is auantitative scale for describingradiodensity.

Table 2.1 shows Hounsfield of common substance :

Substance	H u
Air	-1000
Lung	_500
Fat	_100 to _50
Water	0
Csf	15
Kidney	30
Blood	+35 to +45
Muscle	+10 to +40
Gray matter	+37 to +45
White matter	+20 to +30
Liver	+40 to +60
Soft tissue, contrast	+100 to +300
Bone	+700(cancellous bone) to +3000(denes bone)

2.5Previous study

Piekarski, J.et al (2011) studies the difference between liver and spleen CT numbers in the normal adult and its usefulness in predicting the presence of diffuse liver disease. A constant relationship was found between the mean CT numbers of the liver and spleen in 100 normal adult. This relationship was characterized by a mean CT numbers consistently higher for the liver (24.9 +/- 4.6) than for the spleen (21.1 +/-4.1). The range for liver CT numbers was 16.7-37.2, and for the spleen it was 14.9-34.3. The mean liver-spleen CT number difference for all subjects was 3.8+/- 2.1 ($p<0.001$); in every instance , the liver exhibiting the high mean CT numbers were in subjects with high mean spleen CT numbers, with the same concordance for low mean CT numbers. This relationship between liver and spleen may be useful in the clinical setting in which a normal liver with low CT numbers must be differentiated from one in which the CT numbers is low because of fatty infiltration; the faty liver will exhibit a lower mean CT numbers than the spleen.

Kim, Y. et al (2002) studies the CT numbers of liver and spleen in normal children. To determined the mean liver CT numbers, and differences between liver and spleen , and liver and back muscle CT numbers in normal children, and to correlate the findings with sex and age. One hundred and five normal children aged 2-14 years underwent pre-contrast CT scanning. Mean CT numbers of the liver, spleen and back muscle were calculated, as well as the

differences in CT numbers between the liver and spleen (liver-spleen CT numbers), and between the liver –back muscle CT numbers were 70.22=6.51Hu, 53.28=3.57Hu, 17.13=6.57Hu, and 11.88=5.94Hu, respectively . Mean liver CT numbers and different between liver and back muscle CT numbers were not different by age. By sex, all CT numbers did not very according to age. The sex of a subjectdid not affect the CT numbers. The childern's mean liver CT numbers was 70.22=6.51Hu and the difference between liver and spleen CT numbers was 17.13=6.57Hu. Younger children had higher liver CT and liver-spleen CT numbers than older children. No CT numbers varied according to sex study about relationship between CT numbers of liver and spleen done by Goldberg, H .I. (2002) showed a constant relationship was found between the mean CT numbers of the liver and spleen in the 100 normal adults. This relationship was characterized by a mean CT numbers consistently higher for liver (24.9+/-4.6) than for the spleen (21.1+/-4.1). The range for liver CT numbers was 16.7-37.2, and for spleen it was 14.9-34.3. The mean liver-spleen CT numbers difference for all subjects was 3.8+/-2.1 ($p<0.001$); in every instance, the liver exhibiting the high mean CT numbers were in subjects with high mean spleen ct numbers, with the same concordance for low mean CT numbers. This relationship between liver and spleen may be useful in the clinical setting in which a normal liver with low CT numbers must be differentiated from one

in which the CT numbers is low because of fatty infiltration; the fatty liver will exhibit a lower mean CT number than the spleen.

Chapter three

3.1Materials

3.1.1 Study samples

Fifty sudanese patients in both genders, patient age range between [6-85] years. The procedure was explained to the patients. Patient with splenic disease or those who were scanned using intravenous contrast media were excluded.

3.1.2 Area and duration

This study took place in Khartoum states at albugaa hospital during the period from February to june 2019.

3.1.3 Machine characteristics

This study used an American CT scan machine; Brighspeed (64 slice) machine.

3.2 Methods

The patients were asked not to eat or drink any things for 4-6 hours before examination, and were asked to remove radiopaque materials and wear a hospital gown during the study.

3.2.1Methods of scanning:

CT scan were obtained with the patient in supine positions during full inspiration. The scan ranges were from 90 to 180 Kvp and 100 to 220 MAs.

3.2.2 Methods of measurement:

In each examination the CT numbers for spleen, liver and vertebra were measured in the axial cut. This was obtained by putting the curser on each organ at a section including liver and spleen in axial CT cut at the level of 2nd lumber vertebra.

3.2.3 Method of data analysis:

This is descriptive study were collected from albugga hospital using (spss) windows software. The data were presented with figure and tables as mean and standereddeviation , frequency and percentage and relation were considered significant at p=0.05

Chapter four

Results

Table (4.1) frequency distribution of gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	34	68.0	68.0	68.0
Female	16	32.0	32.0	100.0
Total	50	100.0	100.0	

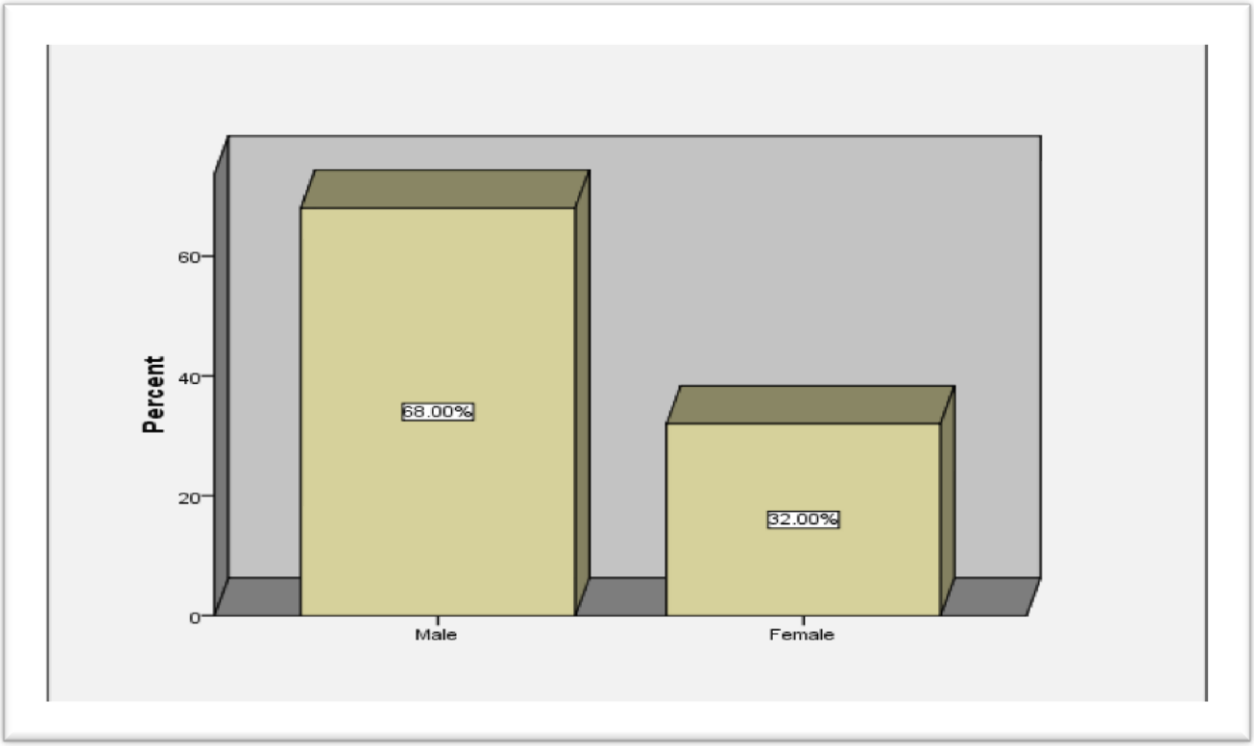


Figure (4.101) frequency distribution of gender

Table (4.2) frequency distribution of age\years

Age \years	Frequency	Percent	Valid Percent	Cumulative Percent
22-32	16	32.0	32.0	32.0
33-43	19	38.0	38.0	70.0
44-54	11	22.0	22.0	92.0
55-66	4	8.0	8.0	100.0
Total	50	100.0	100.0	

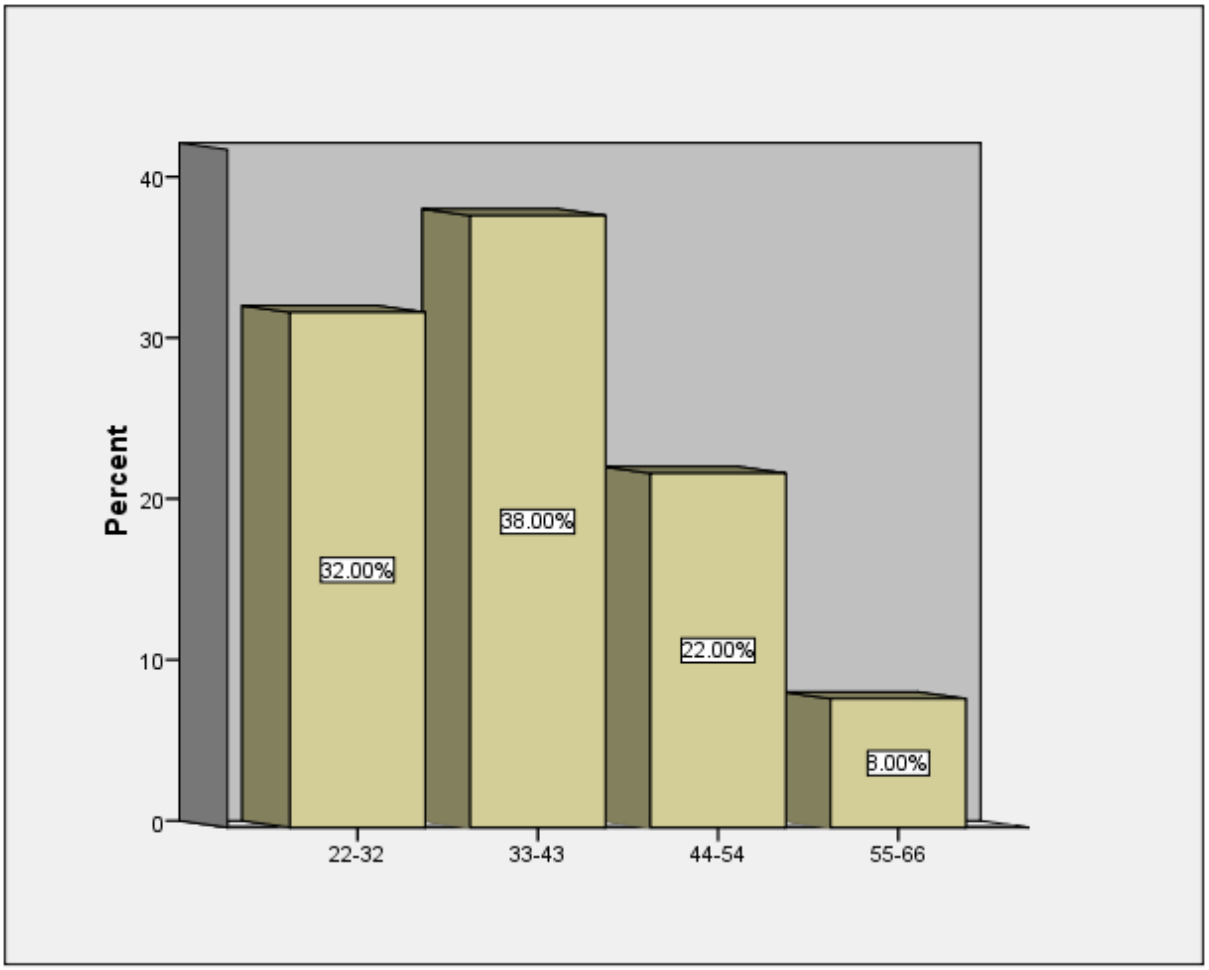


Figure (4.112) frequency distribution of age\years

Table (4.3) descriptive statistic for age, liver HU and vertebrae HU (minimum ,maximum ,mean±Std. Deviation)

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age	50	22	66	39.76	10.905
Liver HU	50	39	84	56.90	8.876
Vertebrae HU	50	203	429	290.26	57.066
Valid N (listwise)	50				

Table (4.4) compare mean liver HU and vertebrae HU in different age group

Age \ years		Vertebrae HU	Liver HU
22-32	Mean	297.44	56.06
	N	16	16
	Std. Deviation	53.511	10.382
33-43	Mean	291.53	57.42
	N	19	19
	Std. Deviation	60.985	9.305
44-54	Mean	286.82	56.45
	N	11	11
	Std. Deviation	58.254	6.283
55-66	Mean	265.00	59.00
	N	4	4
	Std. Deviation	63.770	9.201
Total	Mean	290.26	56.90
	N	50	50
	Std. Deviation	57.066	8.876
P value		0.791	0.932

liver HU

Figure (4.123) scatterplot shows relationship between age and liver HU

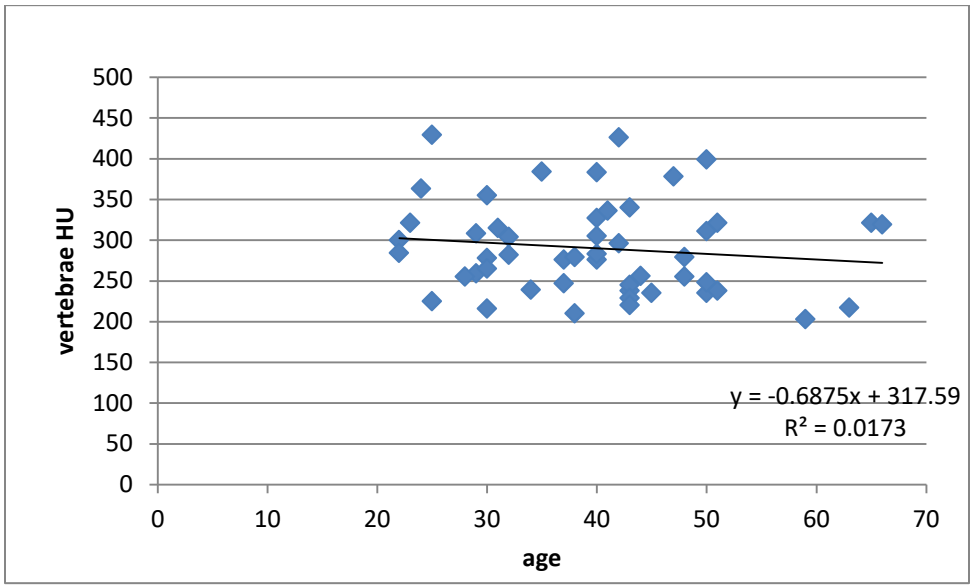


Figure (4.134) scatterplot shows relationship between age and vertebrae HU

Table (4.5) a. Compare means liver HU and vertebrae HU in different gender

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Vertebrae HU	Male	34	281.82	49.402	8.472
	Female	16	308.	69.027	17.257

			19		
Liver HU	Male	34	57.24	7.989	1.370
	Female	16	56.19	10.778	2.694

Table (4.6) b.Independent sample t-test for compare means liver HU and vertebrae HU in different gender

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Vertebrae HU	-1.545-	48	.129	-26.364-	17.061	-60.667-	7.939
	-1.371-	22.508	.184	-26.364-	19.224	-66.181-	13.453
Liver HU	.386	48	.701	1.048	2.715	-4.410-	6.506
	.347	23.059	.732	1.048	3.023	-5.204-	7.300

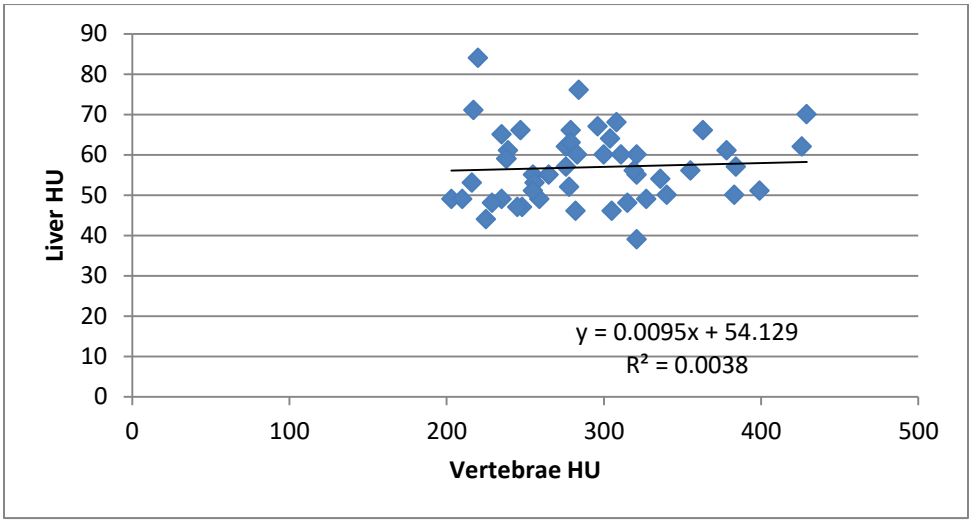


Figure (4.145) scatterplot shows relationship between vertebrae HU and liver HU

Chapter five

5.1 Discussion

Atotal of 50 patients were included, of which 34 were male (68%) and 16 were female (32%)

The mean age was found to be 39.76 ± 10.9 , with minimum 32 year and maximum 66 year. The mean spleen HU was found to be 56.90 HU ± 8.87

The P value of the total spleen HU in the age groups was found to be 0.932

The mean spleen CT number among the male was found to be 57.24 ± 7.98 HU and that amoung female was 56.19 ± 10.77 the mean different was found to be 1.05 which was staticly insignificant with a P value 0.932 this showing that gender does not affected the spleen CT number , due to the organ not being related gender .

When the patient age was correlated to the spleen CT number value, the relationship was found to be weak possitive relaationship with correlation coefficient of r=0.027 . this relationship was found to be statically significant with a P value of 0.932.

5.2 Conclusion

This study has been compared with previous studies and the first of these studies proved that the liver CT number is higher than the CT number of the spleen , while the second study conducted for children demonstrated that the CT number of the spleen and liver increases with age , and this study demonstrated that age affects the CT number of the spleen and was found to be 56.90±8.87 HU.

5.3 Recommendation

- We recommended to that :
- insert body mass index
- insert body length index
- introducing tribal affiliation.

5.4 Refrences

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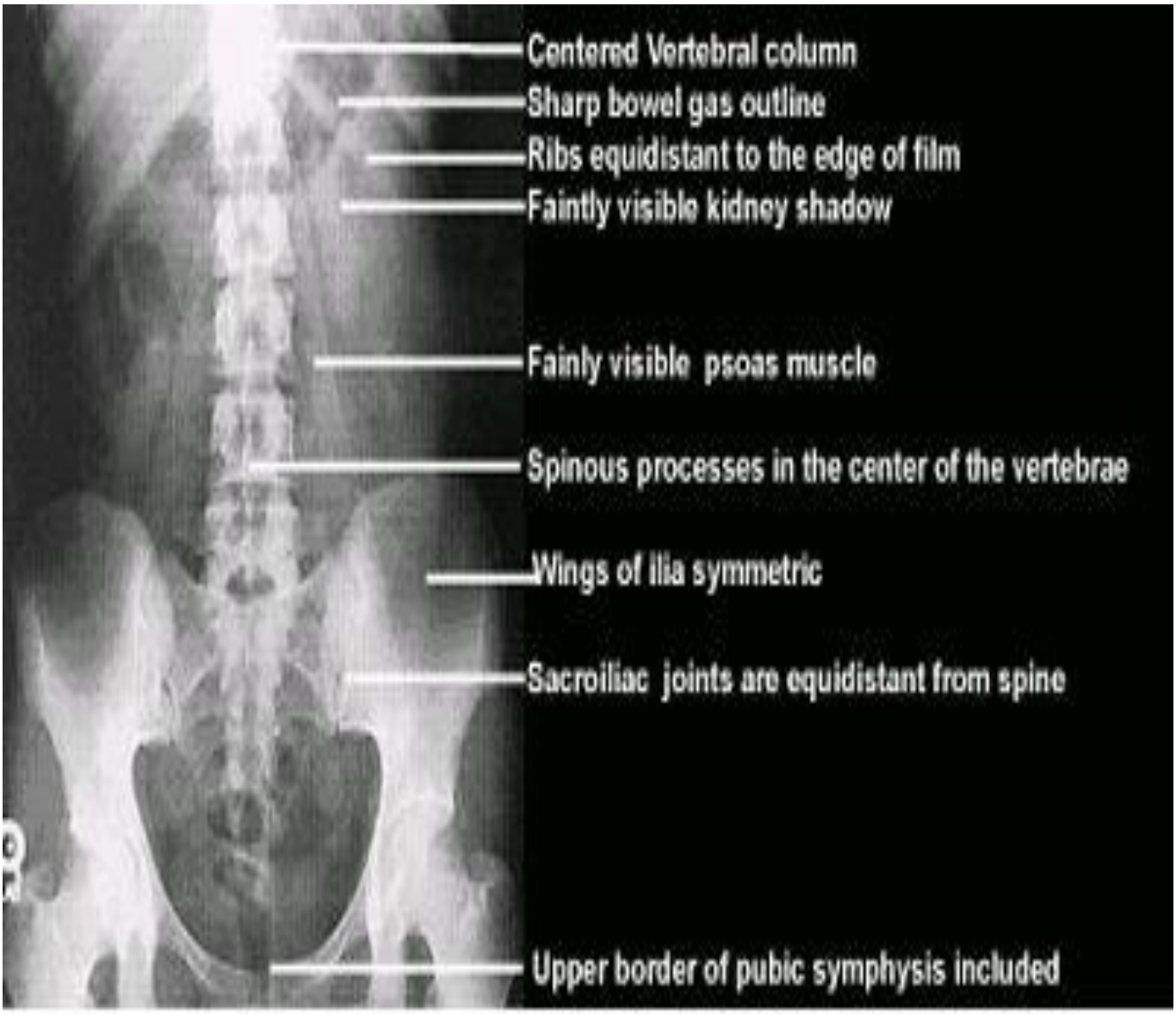
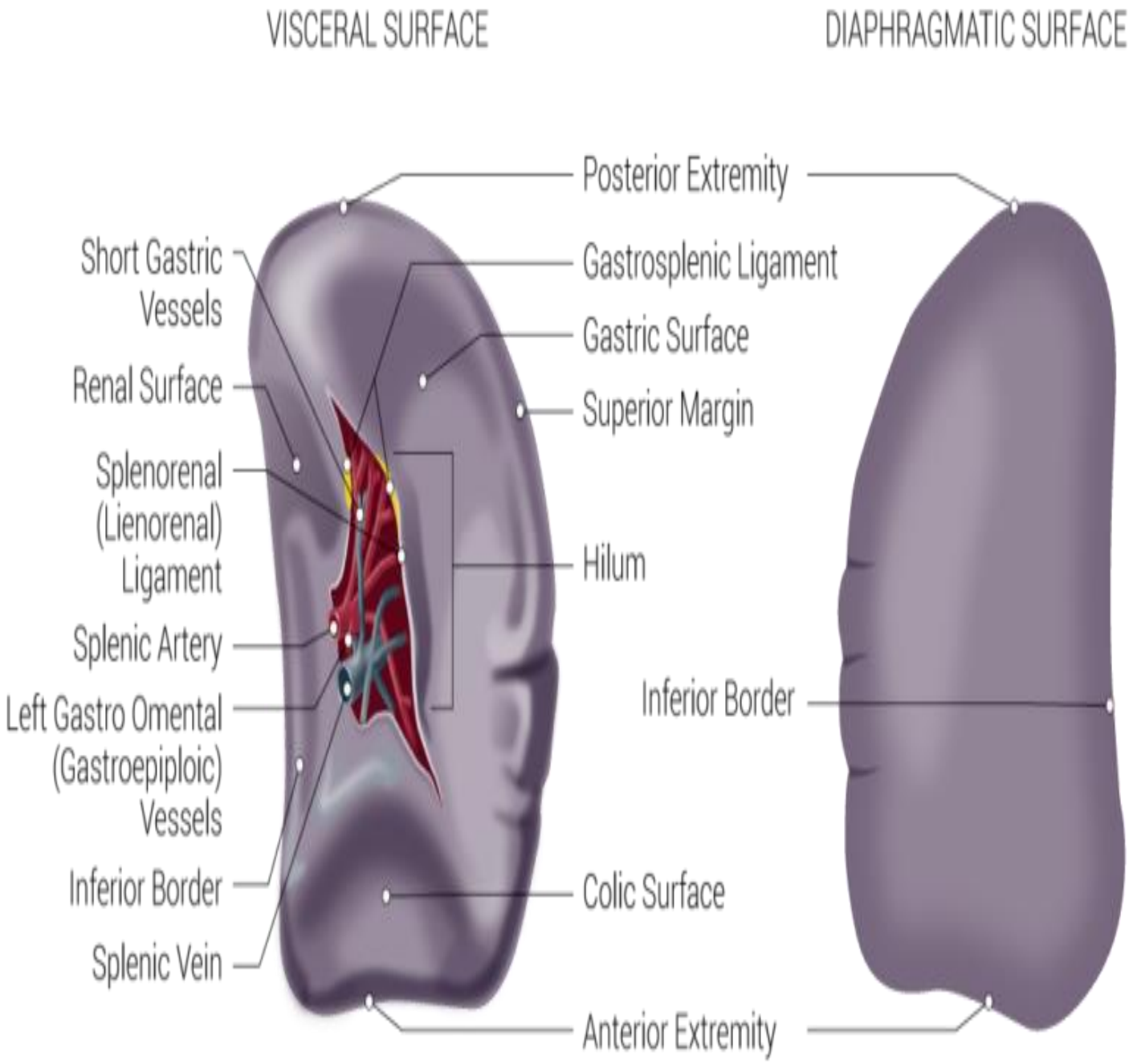
Appendix

NO	Gender	Age	Liver HU	Vertebrae HU
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
..... 50				

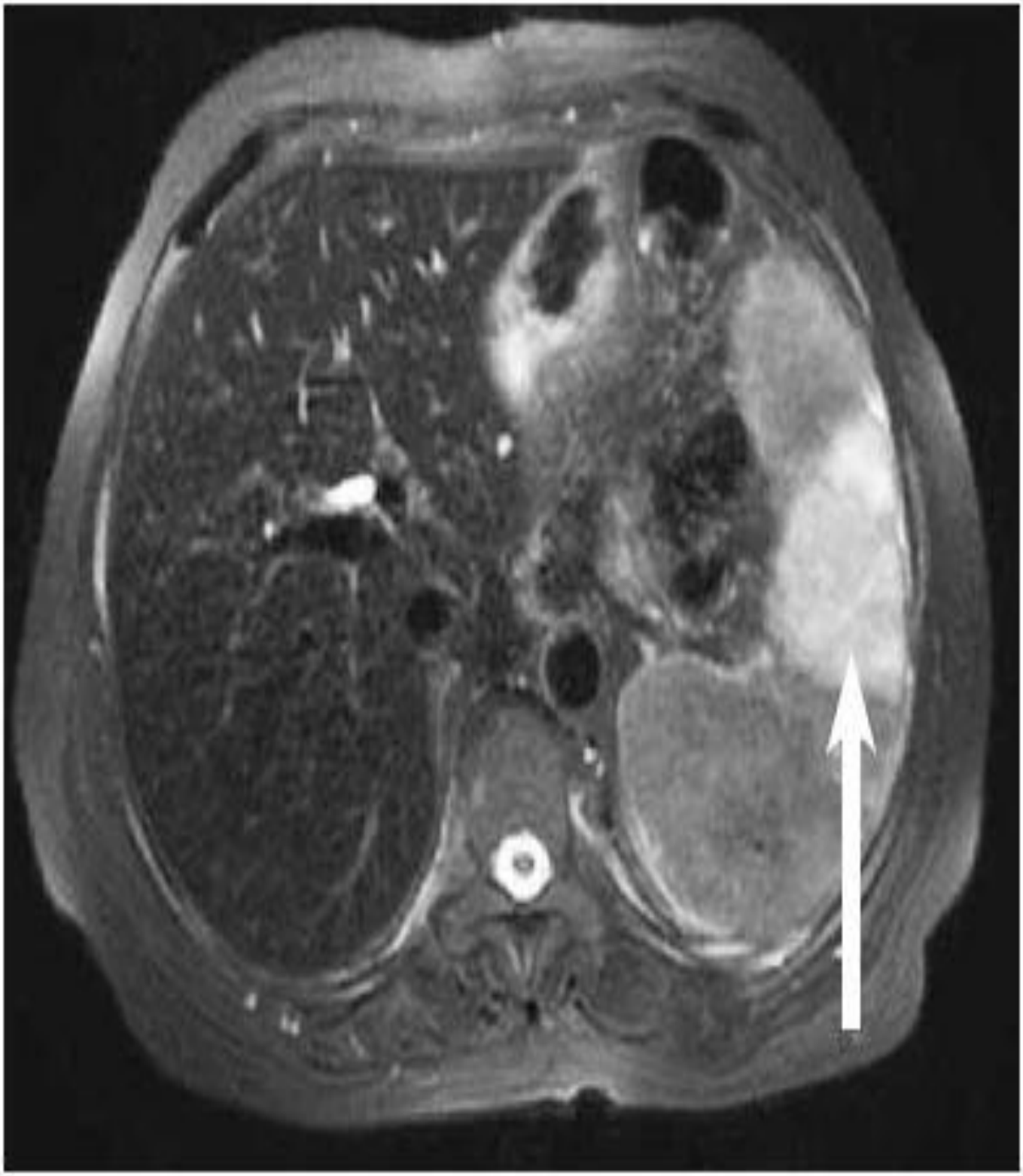


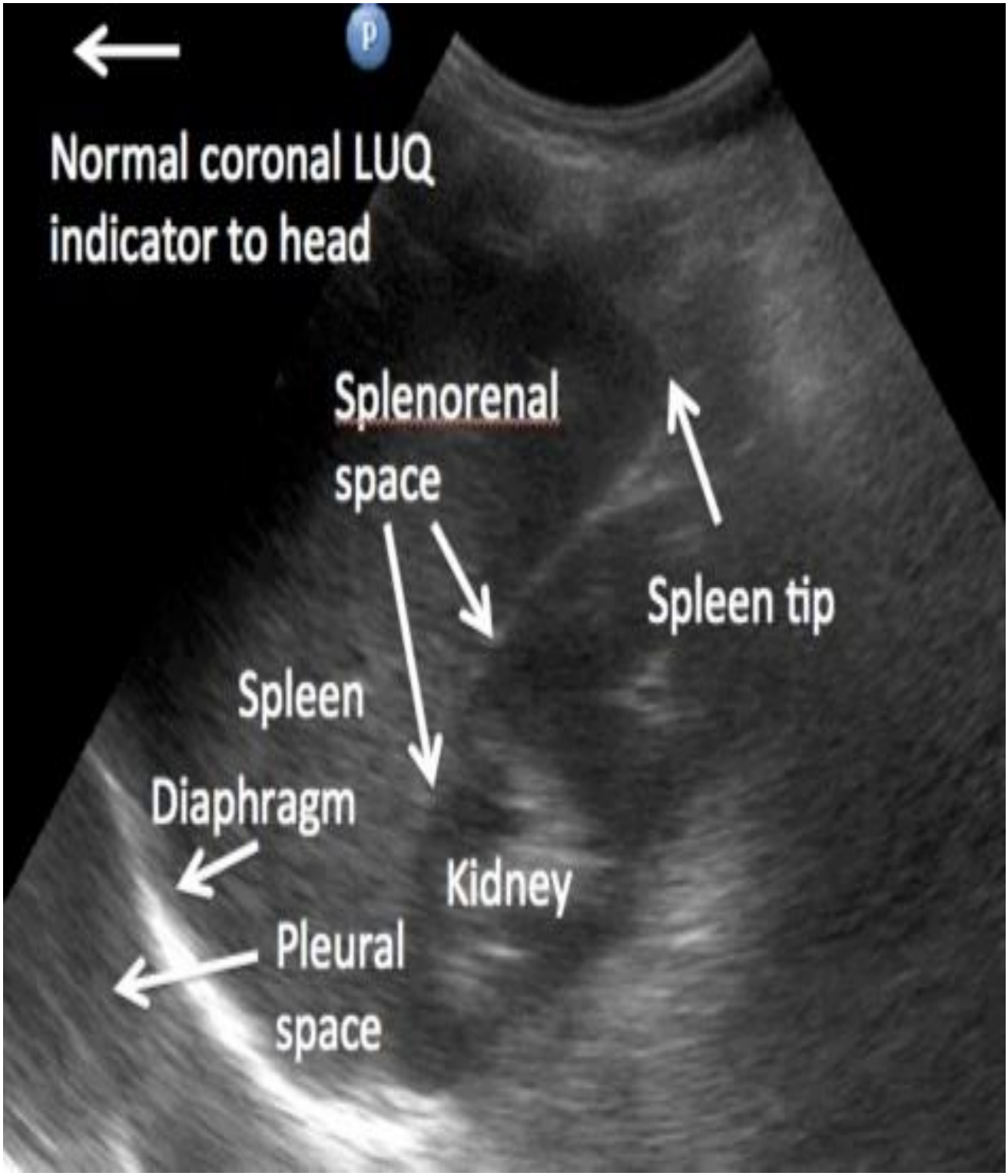
AP abdominal image showing important evaluation criteria. Image courtesy of Dr. Naveed Ahmad.


VISCERAL SURFACE
DIAPHRAGMATIC SURFACE
Posterior Extremity
Short Gastric Vessels
Gastrosplenic Ligament
Gastric Surface
Renal Surface
Superior Margin
Splenorenal (Lienorenal) Ligament
Hilum
Splenic Artery
Inferior Border
Left Gastro Omental (Gastroepiploic) Vessels
Inferior Border
Colic Surface
Splenic Vein
Anterior Extremity

(a)

(b)




Normal coronal LUQ
indicator to head
Splenorenal
space
Spleen tip
Spleen
Diaphragm
Kidney
Pleural
space