

مقدمة



علم الأشعة

- علم يدرس تأثير الاشعاع على المادة الحية

علم الأشعة



العلاج الشعاعي

- العلاج الشعاعي هو الاستعمال الطبي للأشعة المؤينة كجزء من علاج الخلايا السرطانية.
- يستخدم العلاج الإشعاعي لوحده كشفاء أو مع طرق علاجية أخرى كمساعد على شفاء السرطان.

الإشعاع RADIATION

طاقة تنتقل عبر الفراغ أو المادة (انبعاث و انتقال و امتصاص) وتكون على شكل أمواج أو جسيمات عالية السرعة



أنواع (تصنيف) الإشعاع

- Non-Ionizing Radiation الأشعة غير المؤينة

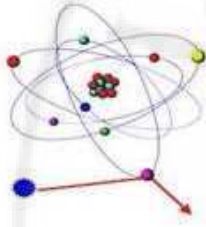


- Ionizing Radiation الأشعة المؤينة



Ionization التشرد (التأين)

إزالة الإلكترون من مدار الذرة ومغادرتها.



Excitation الإستثارة

تحرك الإلكترون من مدار إلى آخر وعودته دون مغادرة الذرة.

الاشعاع المؤين

- الاشعاع المؤين (عالي الطاقة) لديه القدرة على نزع الالكترونات من الذرات، لتأيين الذرة.
- الاشعاع المؤين مثل : الاشعاع الكهرومغناطيسي ، و اشعاع جسيمات.
- سريريا : تستخدم فوتونات، الكترونات، بروتونات، نوترونات.

أنواع الإشعاع الأساسية (الجدول):

أشعة غير مؤينة (غير مشرّدة)

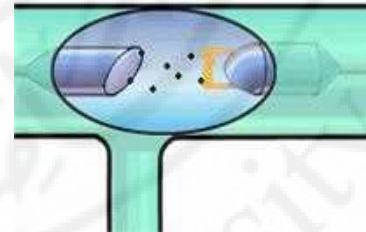
- موجات الراديو - الميكروويف
- الأشعة تحت الحمراء
- الضوء
- معظم الأشعة فوق البنفسجية

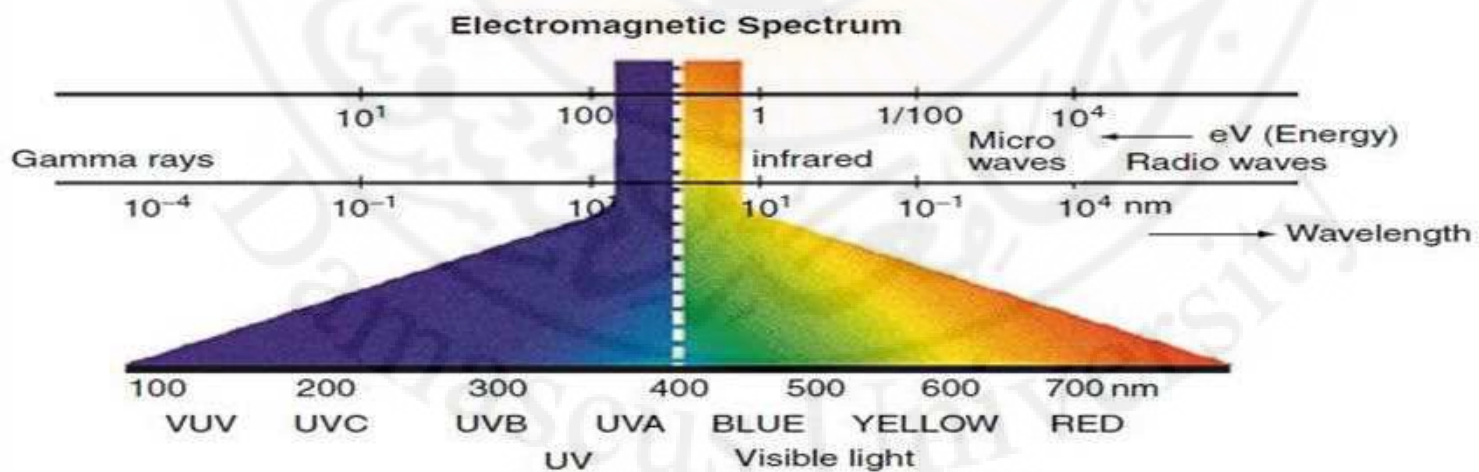
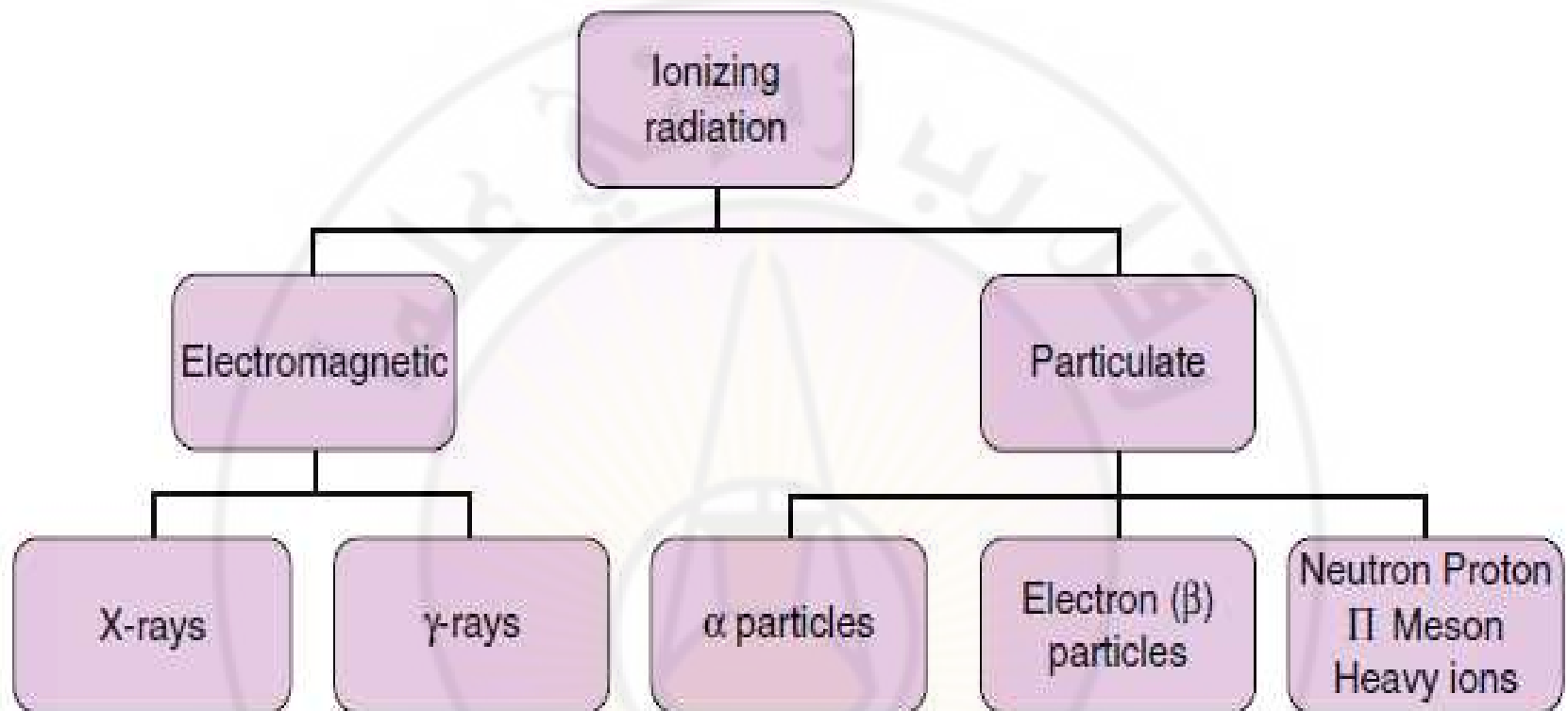
أشعة جسيمية (مؤينة)

- أشعة ألفا
- أشعة بيتا السالبة والموجبة
- البروتونات
- النيوترونات

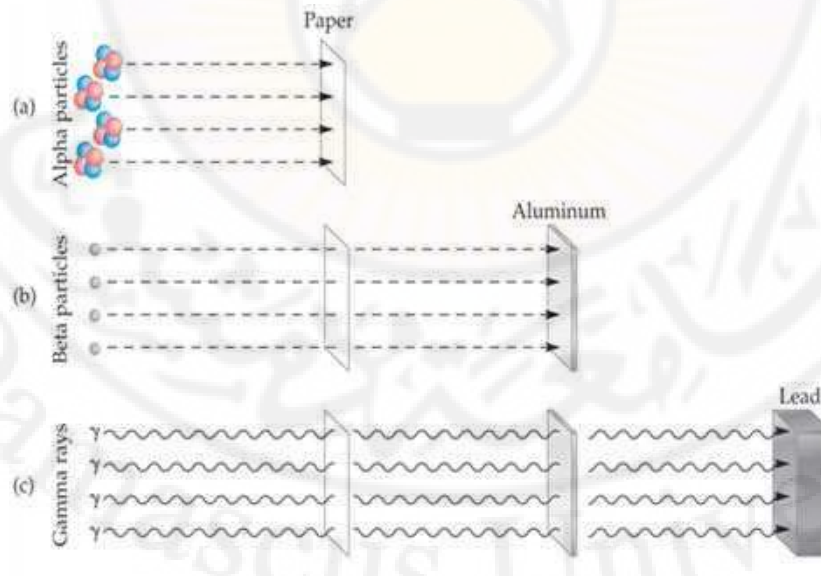
أشعة مؤينة (مشرّدة)

- جزء بسيط من الأشعة فوق البنفسجية
- الأشعة السينية
- أشعة غاما





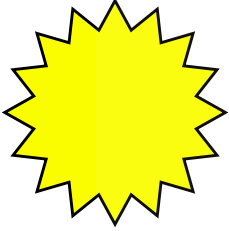
الإشعاع	المدى في الهواء	المدى في الأنسجة
ألفا	٣ سم	٠,٠٤ سم
بيتا	٣٠٠ سم	٥ ملم
السينية و غاما	كبير جداً	تعبّر الجسم



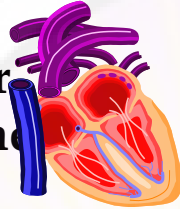
مصادر الإشعاع:

أ) الطبيعي
ب) من صنع الإنسان

Solar Radiation



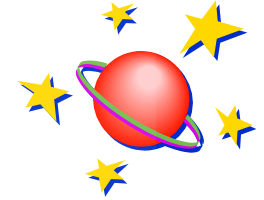
Nuclear
Medicine



X-Rays



Cosmic Rays



Consumer
Products



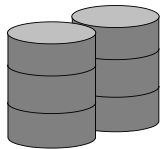
Radon ${}^4_2\alpha^{++}$



Each
Other



Radioactive
Waste



Terrestrial
Radiation



Food &
Drink



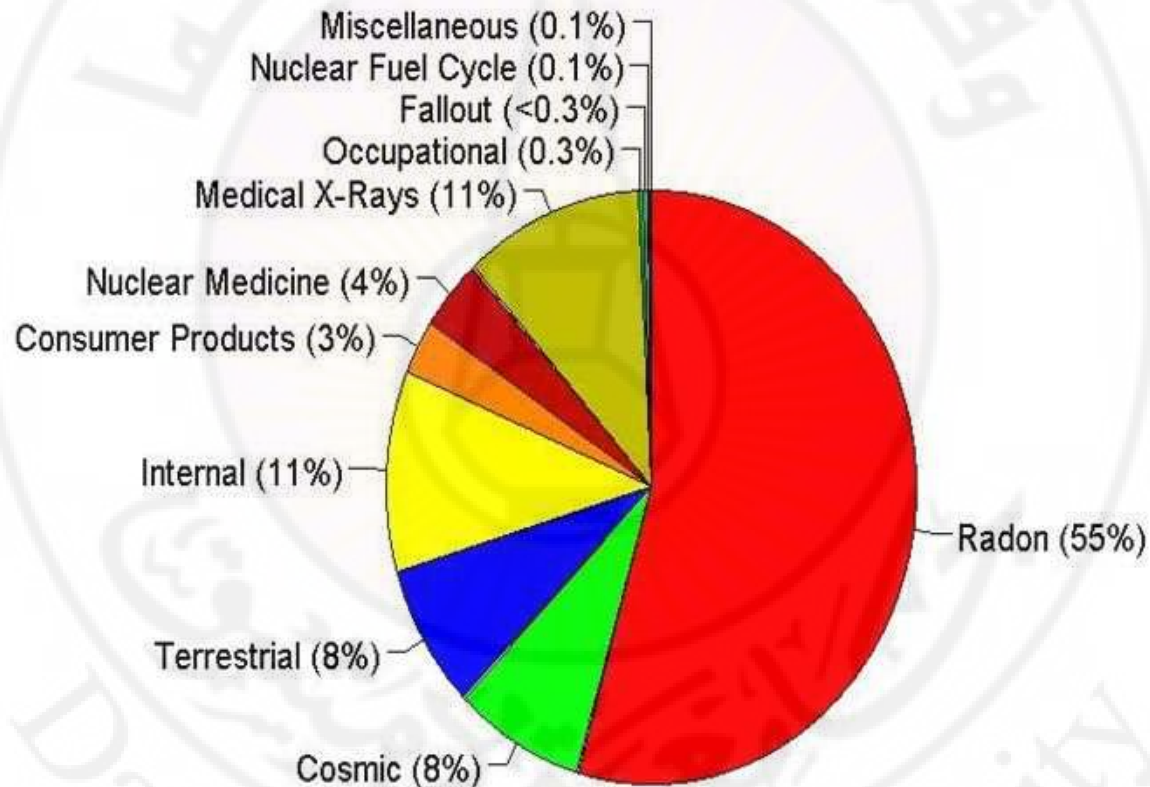
Nuclear
Power



التعرض الشعاعي في الحياة

Percentage of Contributions

Sources of Background Radiation



أنواع الإشعاع الأساسية (الجدول):

أشعة غير مؤينة (غير مشرّدة)

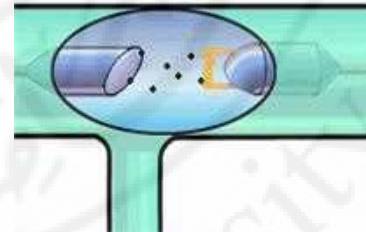
- موجات الراديو - الميكروويف
- الأشعة تحت الحمراء
- الضوء
- معظم الأشعة فوق البنفسجية

أشعة جسيمية (مؤينة)

- أشعة ألفا
- أشعة بيتا السالبة والموجبة
- البروتونات
- النيوترونات

أشعة مؤينة (مشرّدة)

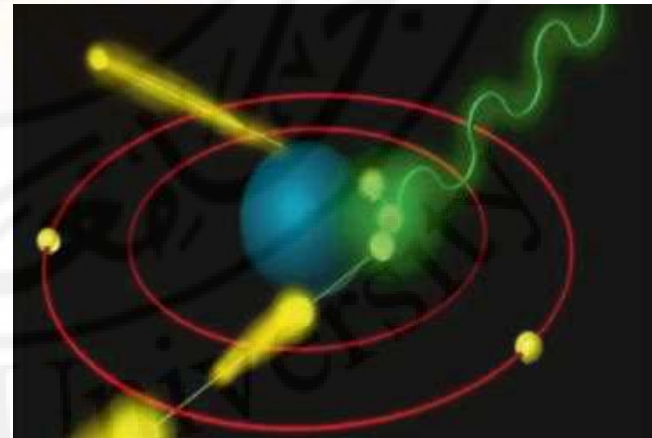
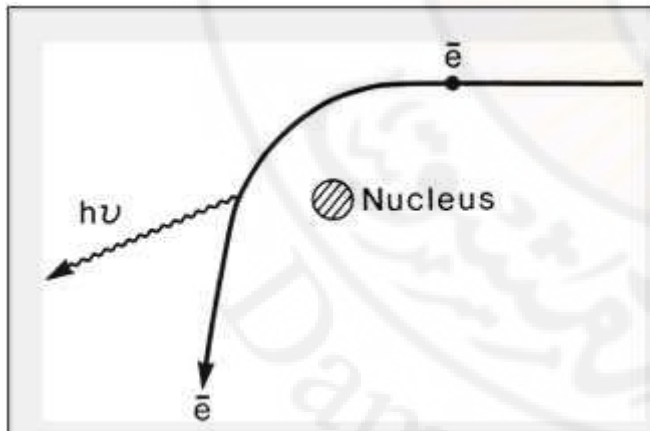
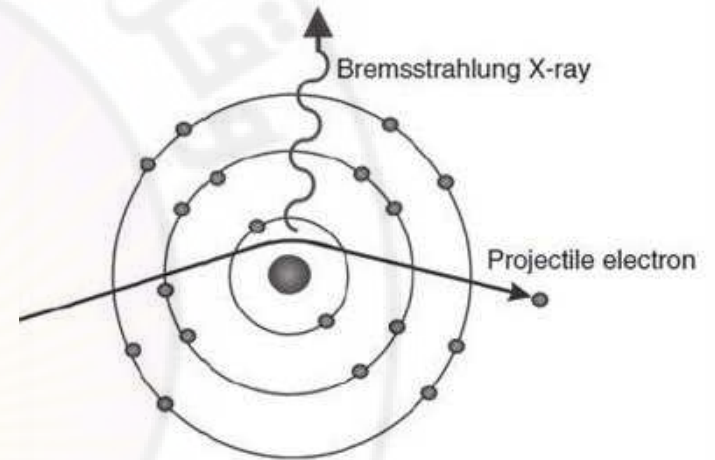
- جزء بسيط من الأشعة فوق البنفسجية
- الأشعة السينية
- أشعة غاما

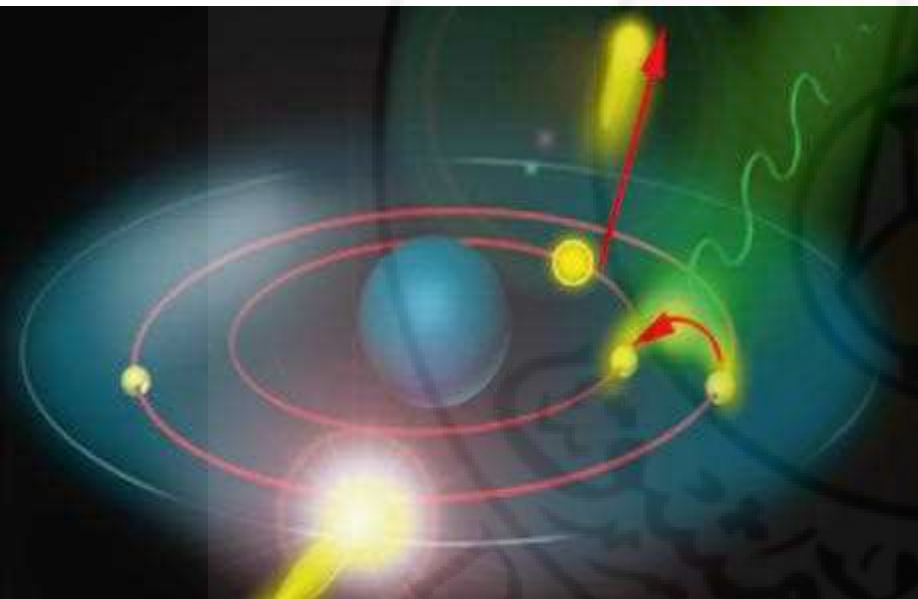


X-Rays

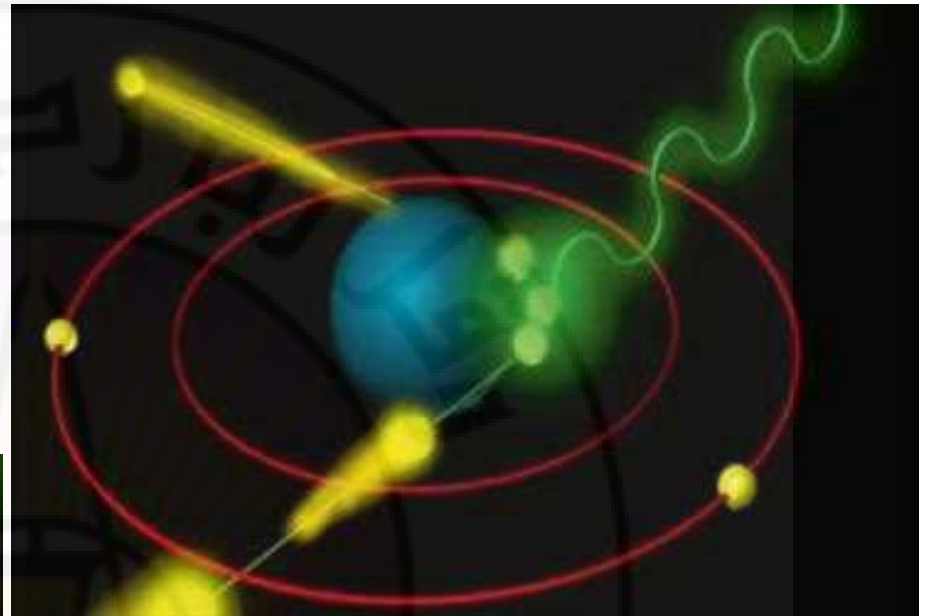
- X-rays اكتشفها الفيزيائي رونتجين في عام ١٨٩٥ .
- هذا الاشعاع يمكن توليده من أنبوب الاشعاع من خلال (الفرملة) أو من خلال هبوط الكترونات الى مدار أقرب للنواة (الاشعاع المميز) و تعتمد على نوعية المادة.
- الاشعاع الصادر من خلال الفرملة (bremsstrahlung) ، لديها طيف من طاقة الاشعاع، في حين النوع الآخر (الاشعاع المميز) لديه طاقة وحيدة.

الفرملة Bremsstrahlung





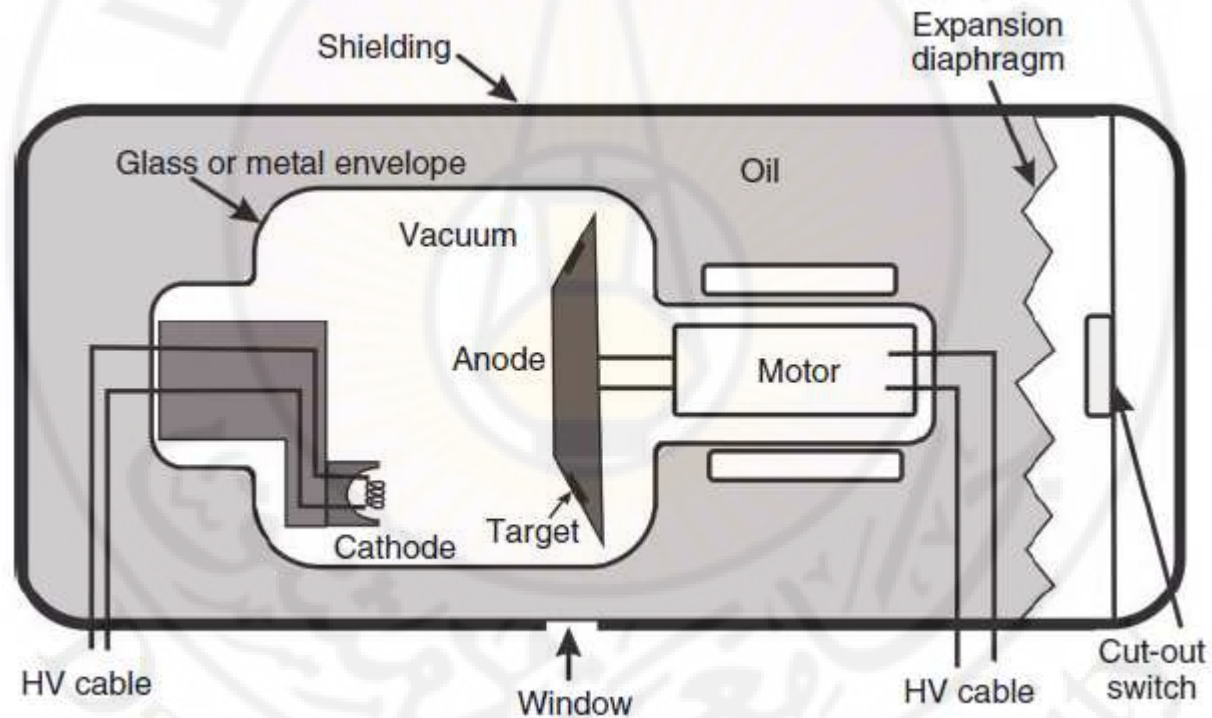
الاشعاع المميز



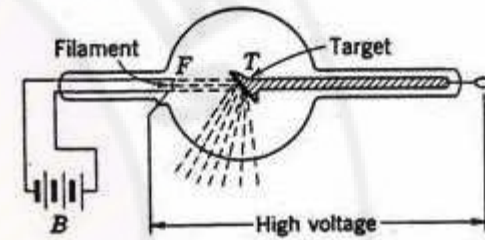
الفرملة

أنبوب الأشعة

The X – ray tube



A diagram of an X-ray tube.



خصائص الاشعاع الكهرومغناطيسي

- تنتشر بخط مستقيم.
- تسير بسرعة الضوء (300000 كم/ثا).
- تنقل الطاقة الى المادة التي تعبرها ، و هذه الطاقة المنتقلة تتناسب طردا مع تردد الاشعاع و عكسا مع طول الموجة.
- طاقة الاشعاع المنتشر ضمن المادة تتناقص، بسبب الامتصاص و التناثر، و هذا التناقص بالطاقة يتناسب عكسا مع مربع بعد مسار الاشعاع ضمن المادة.



Radiation Dosimetry

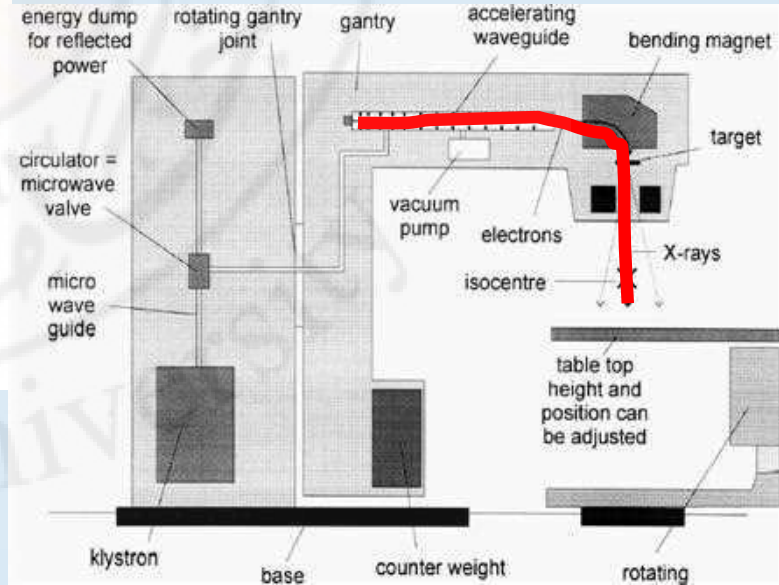
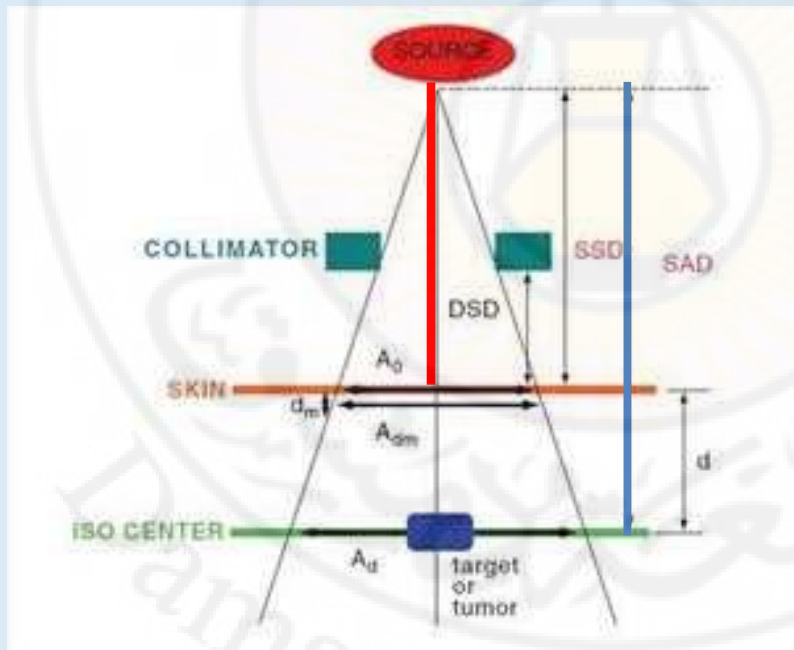
قياس الجرعة الشعاعية

مقدمة

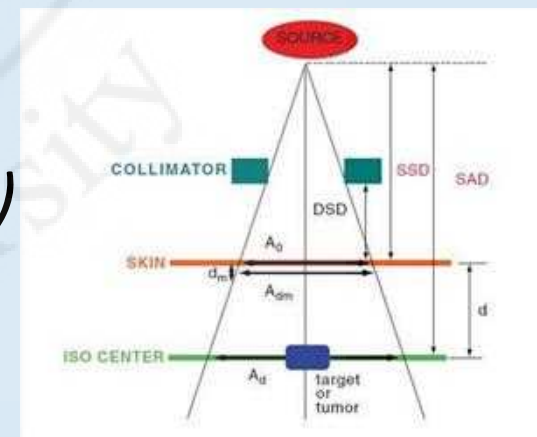
Damascus University

تعريف

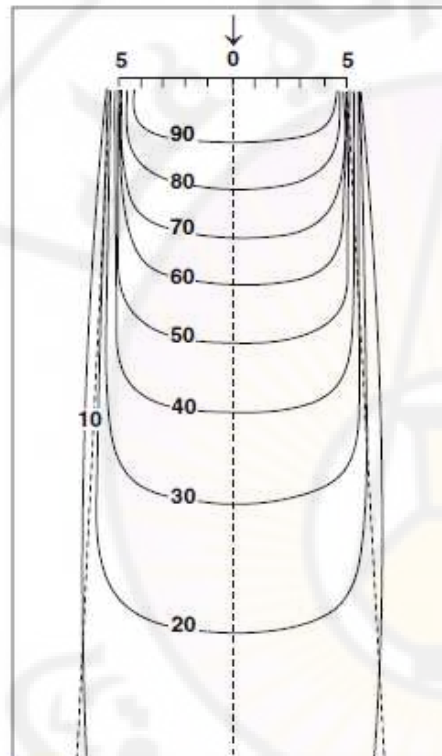
- الجرعة الشعاعية للمريض تتعلق بوضعية المريض و مصدر الاشعاع.



- SSD: skin to source distance
- SAD: skin to axis distance
- DSD: diaphragm to skin distance
- A_0 : field on skin
- A_d : field at D_0 depth (field at the location of the tumor)
- $d_m A$: field size at the point of dose maximum (field at build-up point)
- d : depth (tumor depth)
- d_m : depth at dose maximum (D_{max})

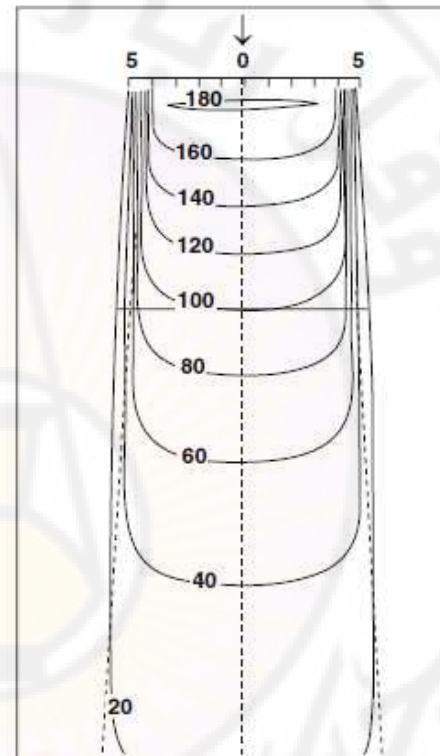


- SAD+SSD هي قيم فيزيائية يمكن أن تتغير .
- تبعاً لذلك هناك خطتين لحساب الجرعة :
- تكنيك *SSD* الثابت ، هنا المركز المحور (نقطة تلاقي كل الحزم) لجهاز المعالجة يكون على جلد المريض (nonisocentric technique) و بالتالي يتحدد الحقل و الجرعة تبعاً للحقل على جلد المريض.
- التكنيك الآخر هو يكون *SAD* هو الثابت ، و هنا مركز المحور يكون ضمن المريض (isocentric technique) أي ضمن الورم ، و الحقل و الجرعة يتحدد حسب الحقل في عمق الورم.



SSD type

60Co beam,
SSD = 80 cm,
field size = 10x10 cm



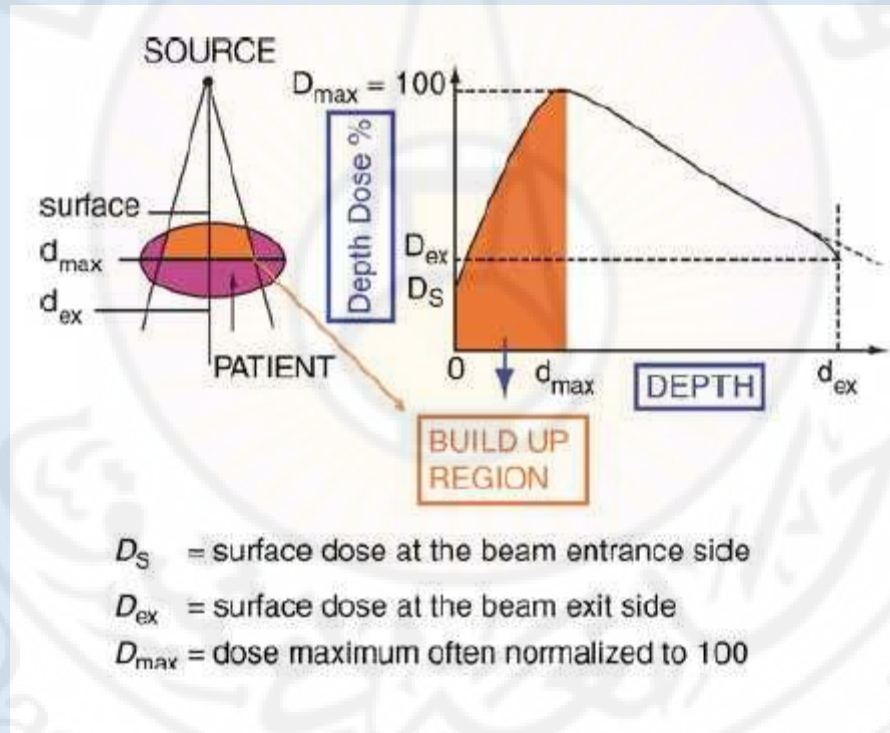
SAD type

60Co beam,
SAD = 100 cm,
depth of isocenter = 10 cm,
field size of isocenter = 10x10 cm

Isodose curves in SSD and SAD techniques

Build-Up Region

منطقة بناء الجرعة



Build-up region

أمثلة

Build-up points (depth of $D_{\max}$) for various photon energies

	Superficial	Orthovoltage	Co-60	4 MV	6 MV	10 MV	18 MV	25 MV
Depth of $D_{\max}$ (cm)	0	0	0.5	1	1.5	2.5	3.5	5

Field size = 5×5 cm

Build-up points (depth of $D_{\max}$) for various electron energies

	6 MeV	9 MeV	12 MeV	15 MeV	18 MeV	22 MeV
Depth of $D_{\max}$ (cm)	1.2	1.56	2.1	1.7	1.5	1.49

Percentage Depth Dose (PDD)

الجرعة الممتصة على العمق

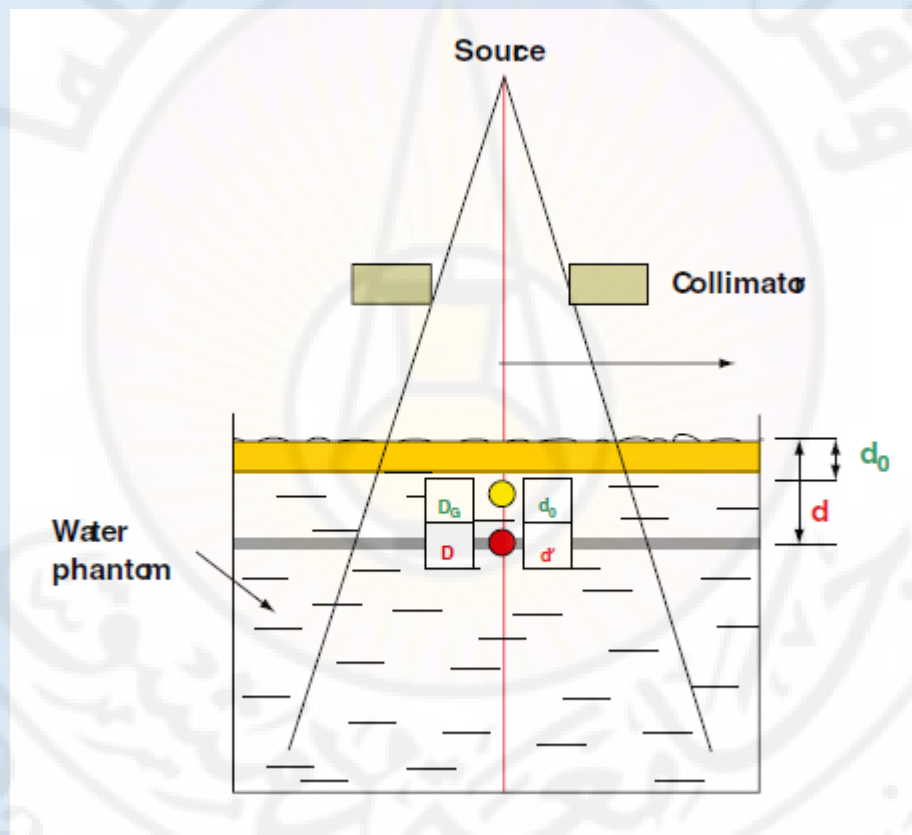
- معدل جرعة ممتصة عند عمق معين الى الجرعة الممتصة العظمى ، و يحسب كما يلي :

$$DD_x \% = 100 \times \frac{D_x}{D_{max}}$$

PDD

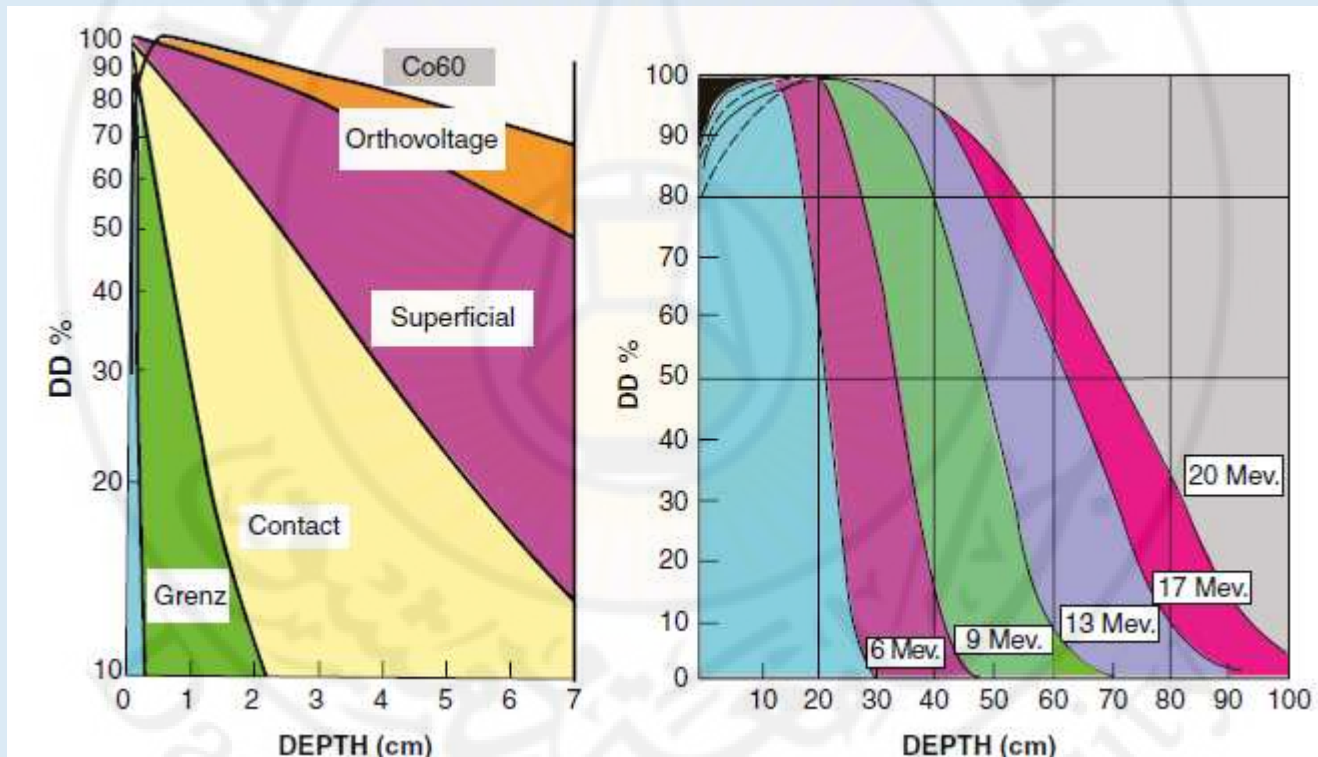
- الجرعة الممتصة بالعمق تتعلق بالعمق ، و الحقل و طاقة الاشعة.
- و منحني الجرعة يعطي معلومات عن نوعية الاشعة.
- و العمق عند الجرعة العظمى يمكن حسابه
- الجرعة: الطاقة المنتقلة في وحدة كتلة النسيج الهدف، و الواحدة هي الغري.

طريقة القياس



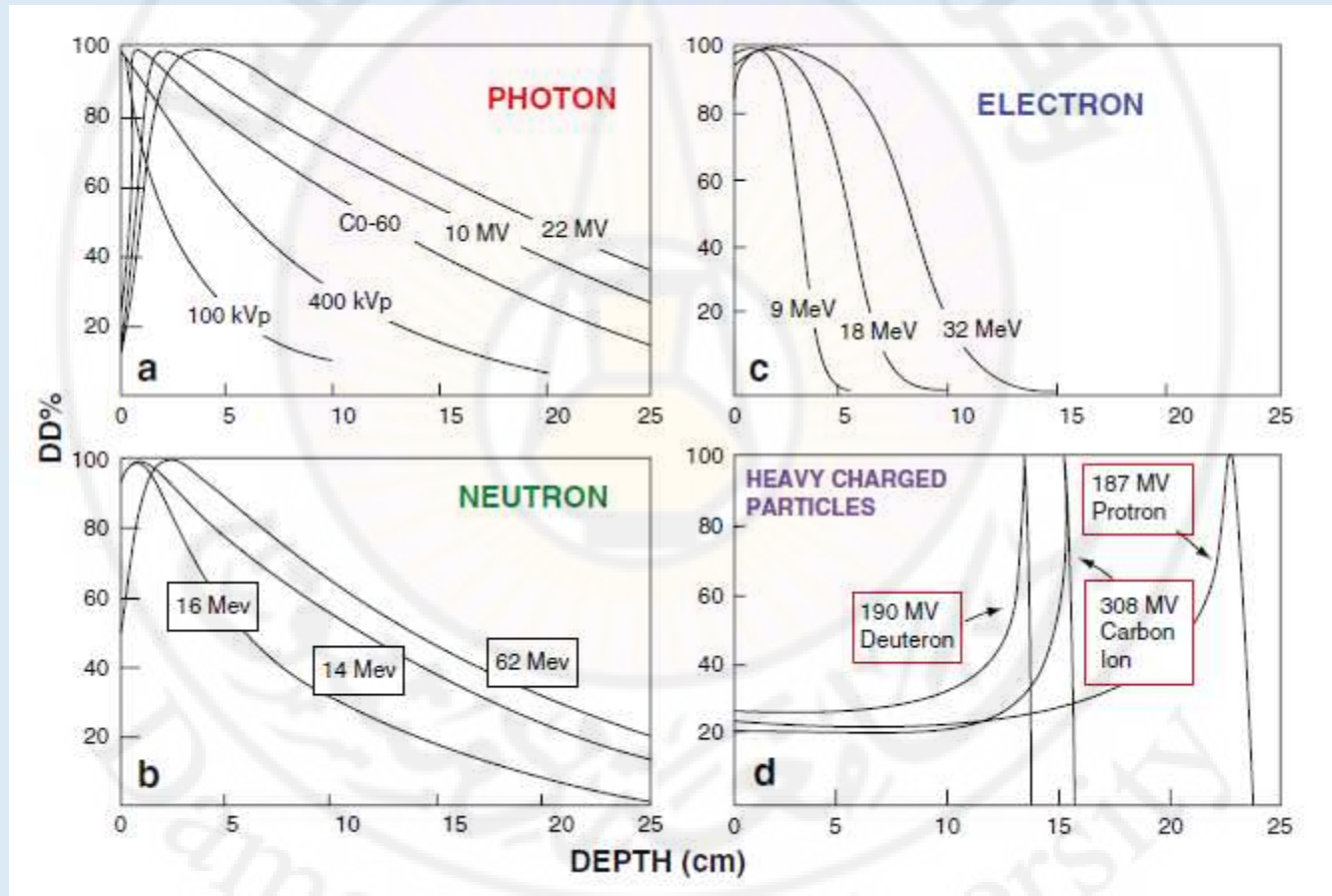
Percentage depth dose (PDD) in a water phantom

أمثلة



PDDs for various X-ray and electron energies

أمثلة



PDD curves for photon, electron, neutron and heavy charged particles

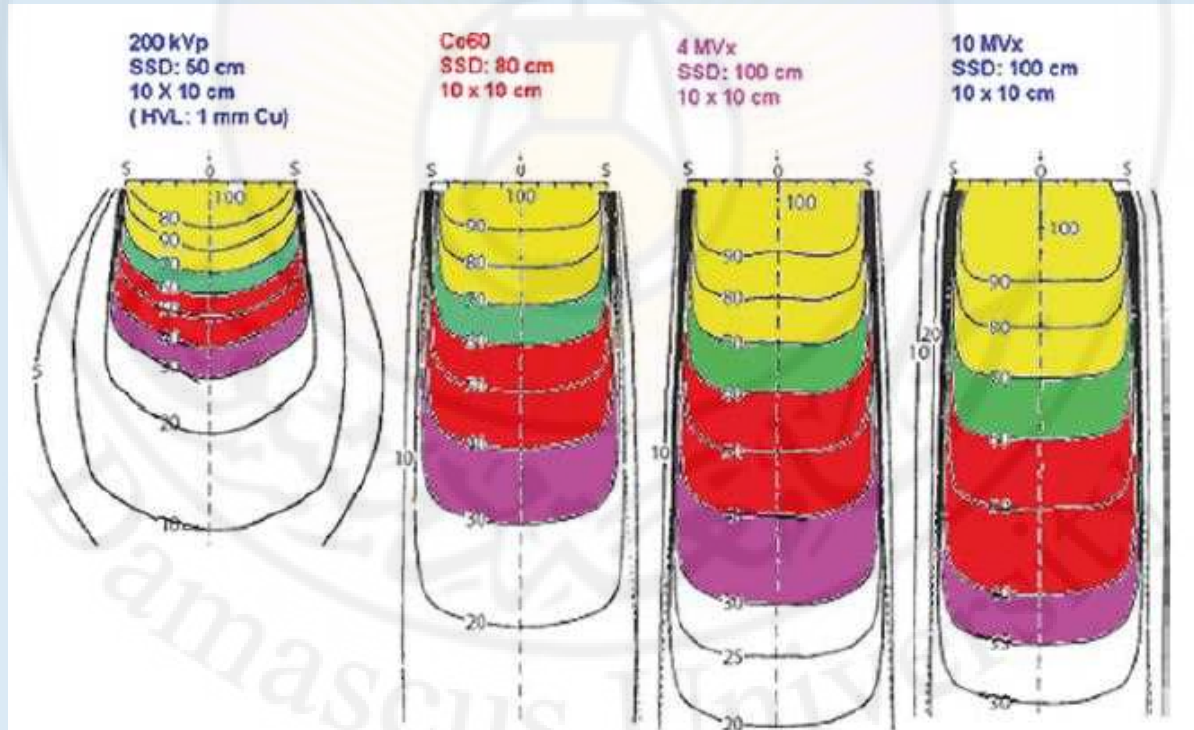
Isodose Curves

منحنيات الطاقة المتماثلة

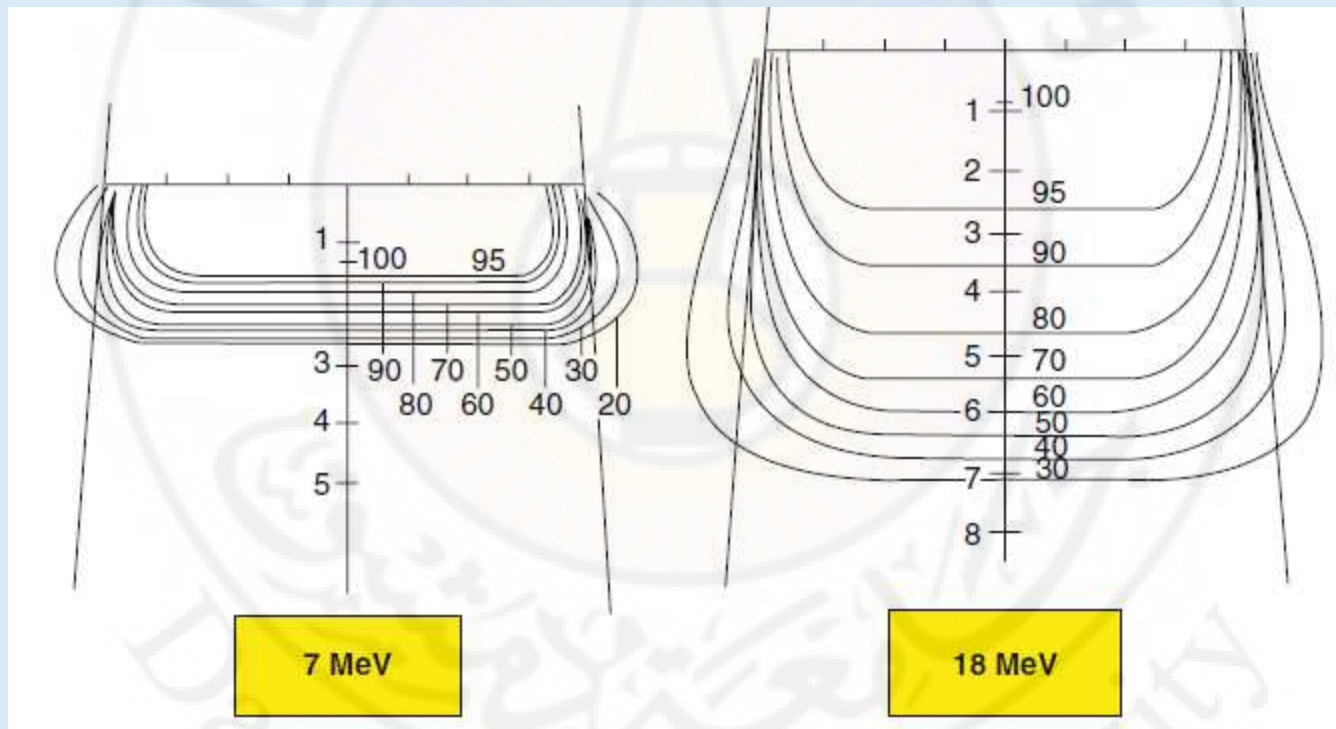
- هذه المنحنيات تحضر من خلال جمع النقاط ضمن الفانتوم التي تتلقى نفس الجرعة.
- هذه المنحنيات تقاس بمقياس للدوزيمتر، الجرعة الأعلى تعتبر ١٠٠% و المنحنيات الأخرى لها قيم مئوية، و تستخدم في مخططات توزيع الجرعة في النسيج الهدف تبعاً للطاقة.
- تفيد باستخدام هذه المنحنيات أثناء تخطيط المعالجة في حساب توزيع الأشعاع التي يتلقاها النسيج الهدف و النسيج المجاورة ، ويمكن مشاهدته من عدة زوايا مختلفة.

فوتونات

- في الرسم البياني لمنحنيات الجرعة : المحور y يمثل العمق أسفل سطح الجلد، و المحور x يمثل قياس الحقل المشع.



الكترونات

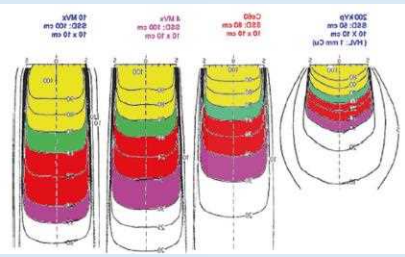


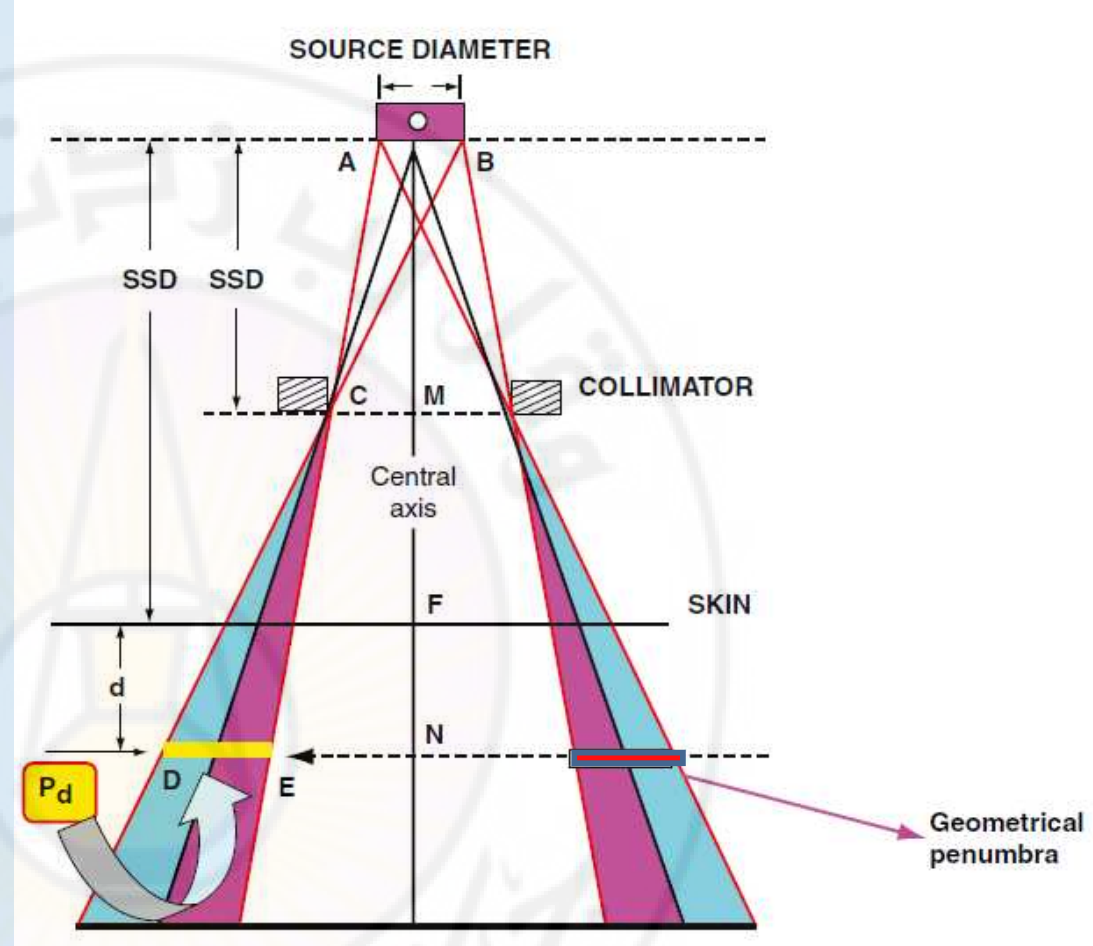
Isodose curves for various electron energies

Penumbra

شبه الظل

- شبه الظل تعرف بمنطقة انحدار حاد للجرعة على أطراف الحزمة الشعاعية ، مع ملاحظة أن هذا الانحدار بمعدل الجرعة يحدث بالابتعاد عن المحور المركزي.
- أنواع شبه الظل:
- ١- الفيزيائي: و يحسب بقياس المسافة بين منحنى ٢٠% و ٨٠% على مستوى محور x عند الجرعة العظمى على العمق.
- ٢- شعب الظل الهندسي: يحدث بسبب أبعاد المنبع (منبع كبير = شبه ظل كبير).
- ٣- شبه ظل النقلى: يحدث بسبب تنافر الحزمة عند أطراف المحدد و الحماية. يمكن التقليل منها من خلال تصميم شكل للمحدد و الحماية بحيث تتوافق مع تباعد الحزمة (موازي لها).





Penumbral parameters and the calculation of the penumbra

P : penumbra

S : source diameter

$SCD = SSD$: source-collimator distance (= source-diaphragm distance)

d : depth

Field size does not affect penumbra.

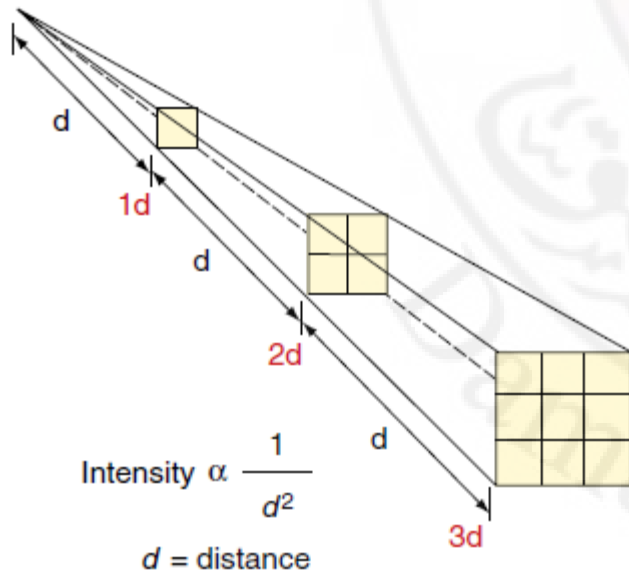
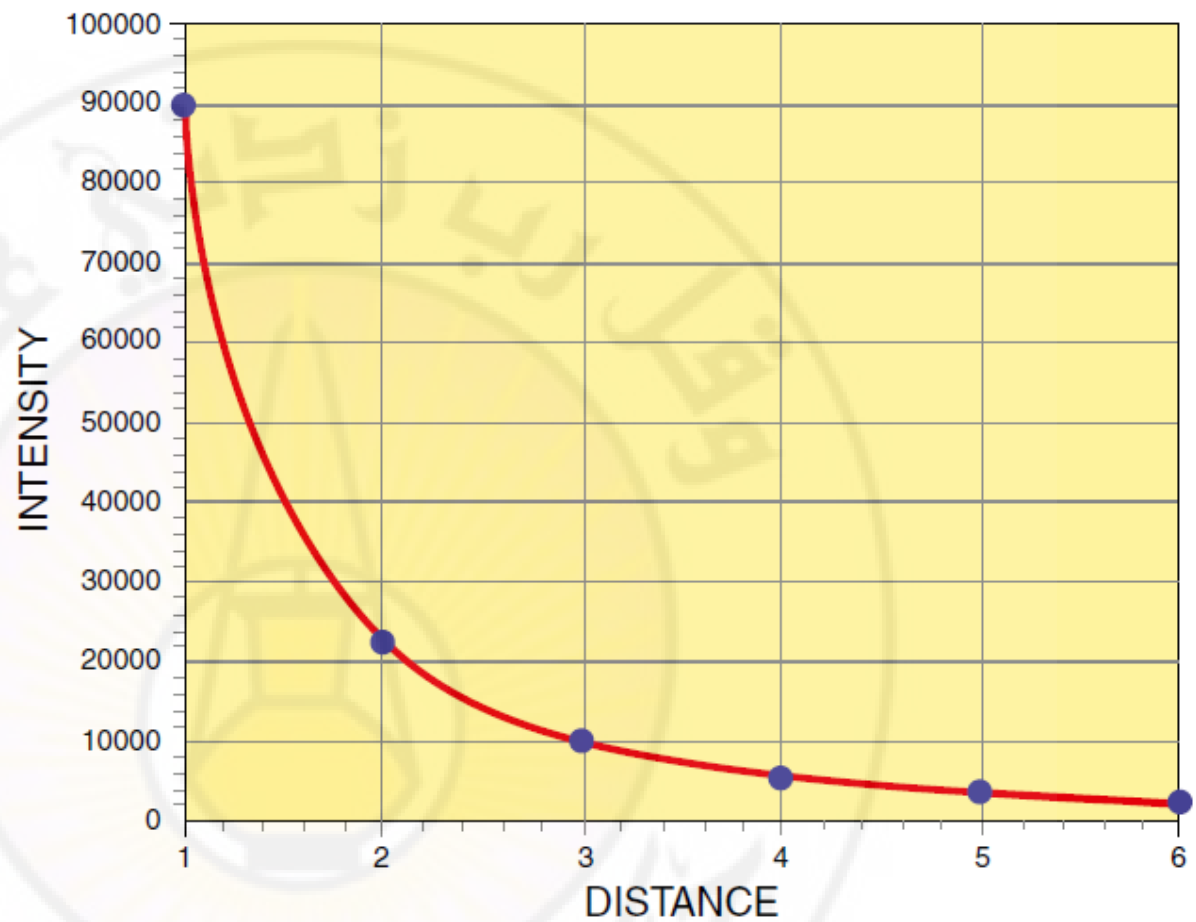
$$P = \frac{s(SSD + d - SCD)}{SCD}$$

- العوامل التي تزيد: ازدياد SSD ، از ياد أبعاد المنبع، و ازدياد SDD .
- العوامل التي تنقصه: نقصان السابق.

Inverse Square Law

قانون التربيع العكسي

- This is the decrease in radiation intensity with the square of distance from the source
- For instance, when the distance from the source **triples**, the **surface dose** decreases **ninefold** .



The relationship between intensity and distance from the source

أهميته

- The inverse square law is very important in both **radiotherapy and protection** from radiation.



Introduction to Cancer

مقدمة عن السرطان

د. مضر بكور

احصائيات



- >9.7 million cases are detected each year
- 6.7 million people will die from cancer
- Every day, around 1700 Americans die of the disease
- 20.4 million people living with cancer in the world today
- 1 in 3 people will be diagnosed with cancer in the UK and 1 in 4 will die from their disease

WHO Statistics

احصائيات منظمة الصحة العالمية

- 2023 **15** million people die from cancer

- Causes

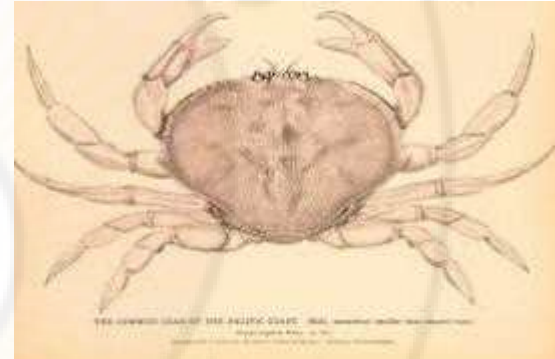
- ☐ Ageing population
- ☐ Obesity
- ☐ Smoking

المناطق الأعلى وقوعا



■ كلمة السرطان أتت من كلمة
يونانية karkios و ترجمت
الى الاتينية cancer .

■ الخلية السرطانية تشبه سرطان
البحر.

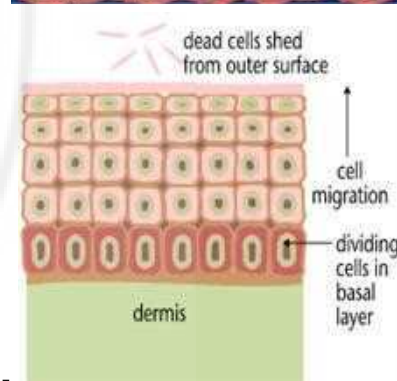
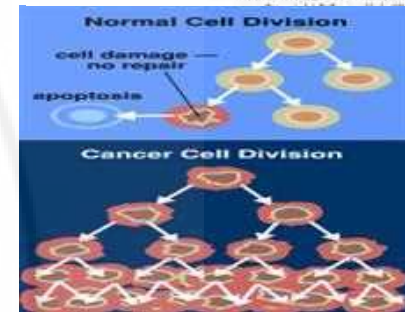
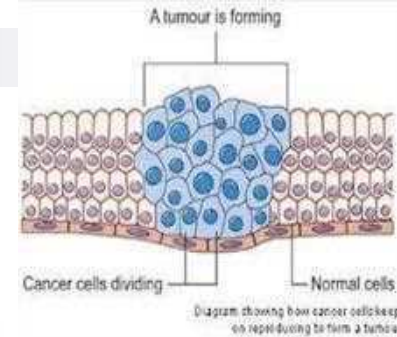


What is Cancer?

ما هو السرطان



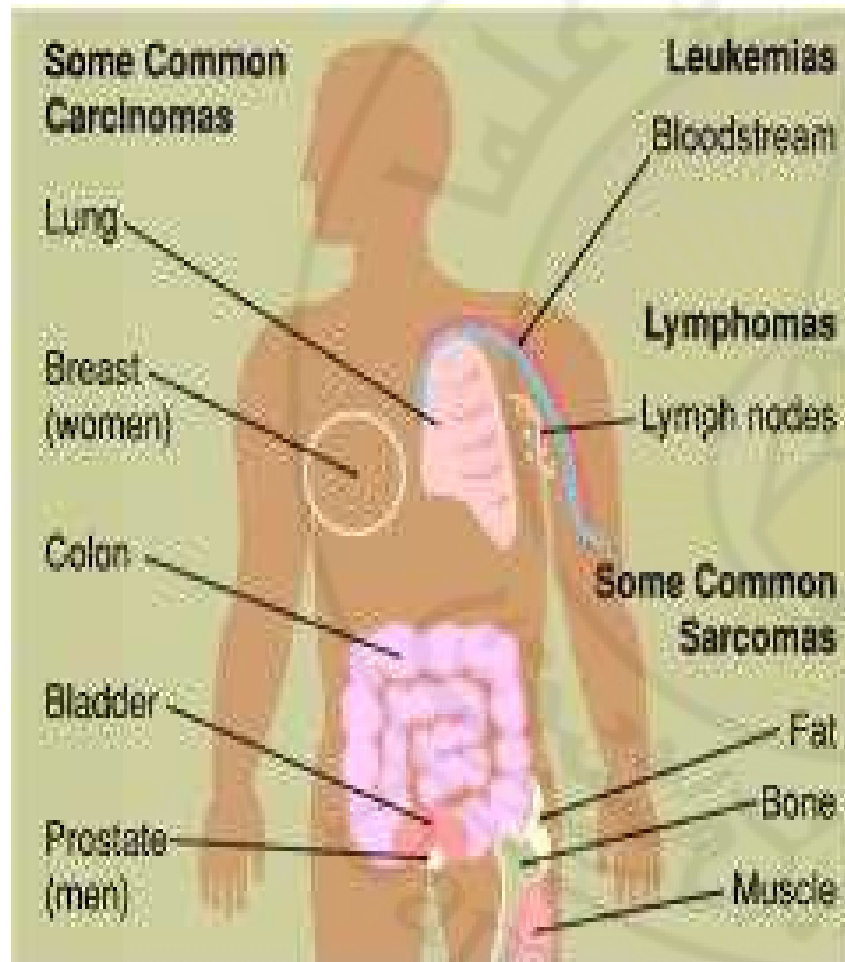
- انقسام/Division – uncontrolled cell division
- نمو/Growth
- طفرة/Mutation
- انتشار/Spread – ability to move within the body and survive in another part



Types of Cancer

أنواع السرطان

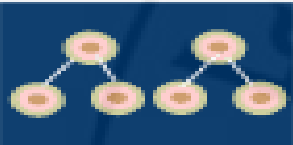
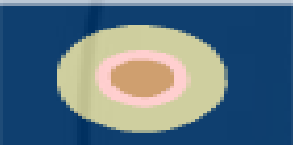
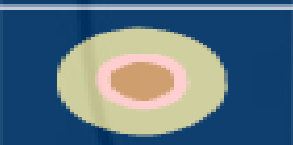
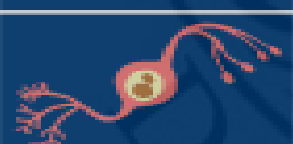
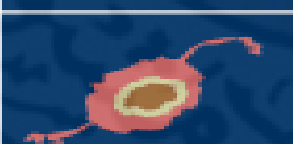
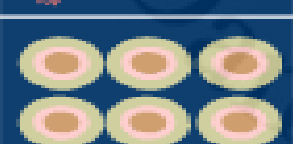
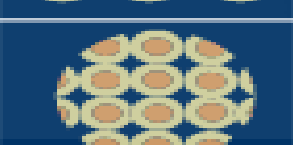
- Carcinomas/كارسينوما
- Sarcomas/ساركوما
- Lymphomas/لمفوما
- Leukaemias/ابيضاض



Some Prefixes Used in Naming Cancers

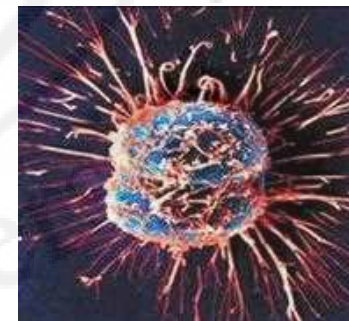
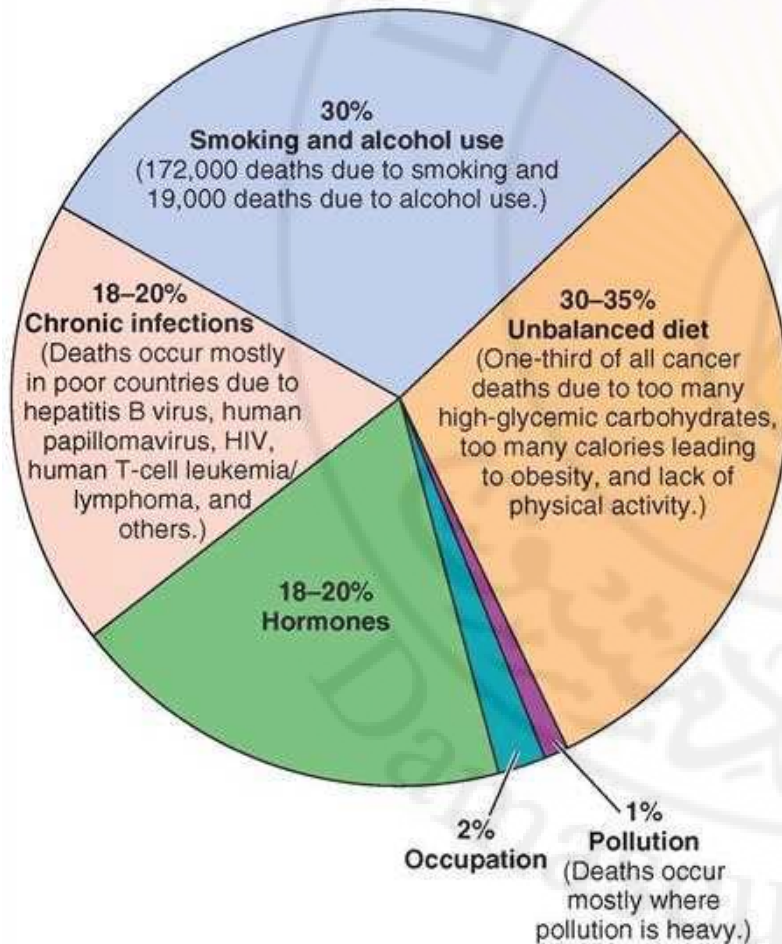
PREFIX	MEANING
adeno-	gland
chondro-	cartilage
erythro-	red blood cell
hemangio-	blood vessels
hepato-	liver
lipo-	fat
lympho-	lymphocyte
melano-	pigment cell
myelo-	bone marrow
myo-	muscle
osteo-	bone

ما هي الفروق بين الخلايا الطبيعية و الورمية؟

NORMAL	CANCER	
		Large number of dividing cells
		Large, variable shaped nuclei
		Small cytoplasmic volume relative to nuclei
		Variation in cell size and shape
		Loss of normal specialized cell features
		Disorganized arrangement of cells
		Poorly defined tumor boundary

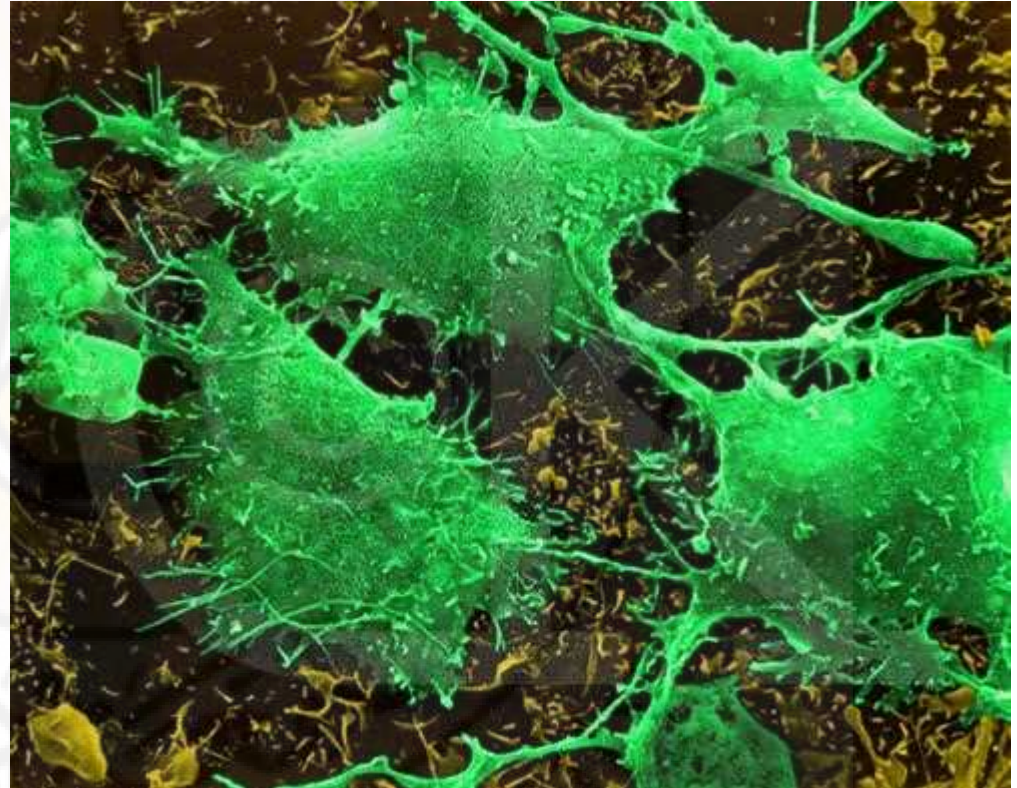
What causes cancer?

أسباب السرطان



المسرطنات/Carcinogenesis

- Heredity(٥-١٠%)
- Immunity
- Chemical
- Physical
- Viral
- Bacterial
- Lifestyle



الوراثة/Heredity

- 5-10% of Cancers



- Molecular biology
and Human
Genome Project

الوراثة/Heredity



- Genes isolated for several classic familial cancer syndromes:
 - RB1 (retinoblastoma)
 - APC (familial polyposis)
 - Human Non Polyposis Colon Cancer (HNPCC)
 - BRCA 1&2 (breast cancer)
 - p53 (many cancers)



المناعة/Immunity

- HIV / AIDS
- Immunosuppression

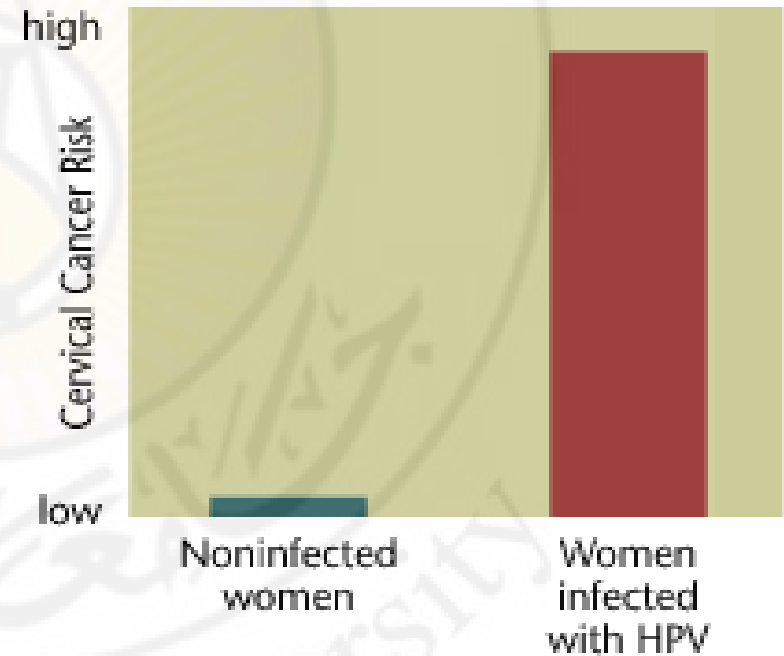




فيروسات/Virus's

- Hepatitis B
- Human T-cell
Leukaemia virus
- Epstein Barr Virus
- Human Papilloma
Virus (HPV)

HPV Infection Increases Risk
for Cervical Cancer



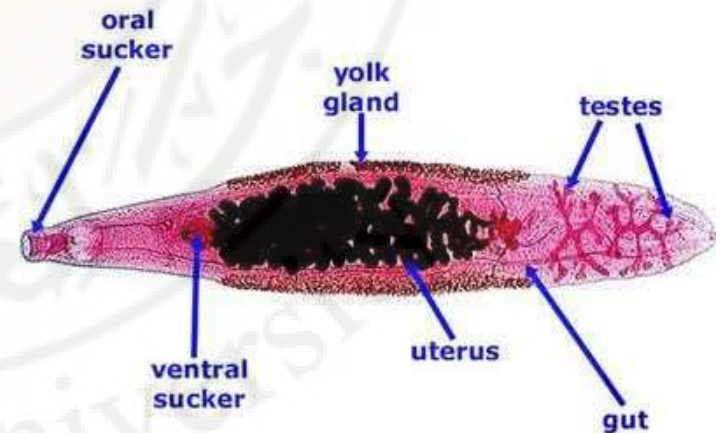
جراثيم/Bacterial

- H. pylori



- Other Parasites:

□ Schistosoma (البلهارسيا)



Chemical/مواد كيمياوية



- Alcohol
- Asbestos
- Wood dust
- Rubber, plastics, dyes
- Tar
- Aflatoxin
- Tobacco



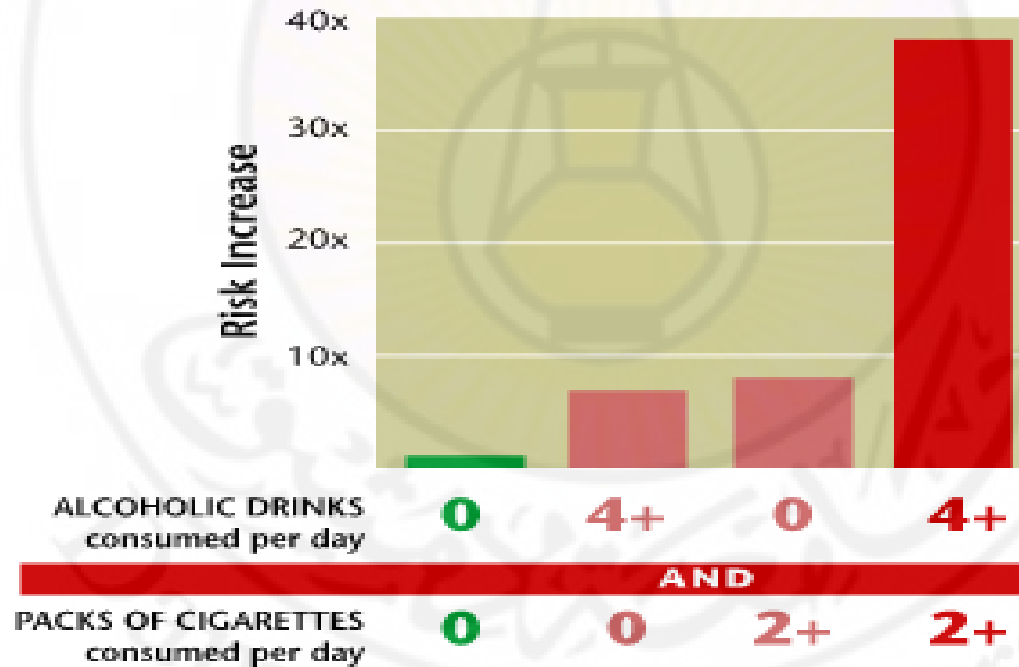
التدخين/Smoking

- Single biggest cause of cancer
- 25-40% smokers die in middle age
- 9 in 10 lung cancers
- Known to cause cancer in 1950

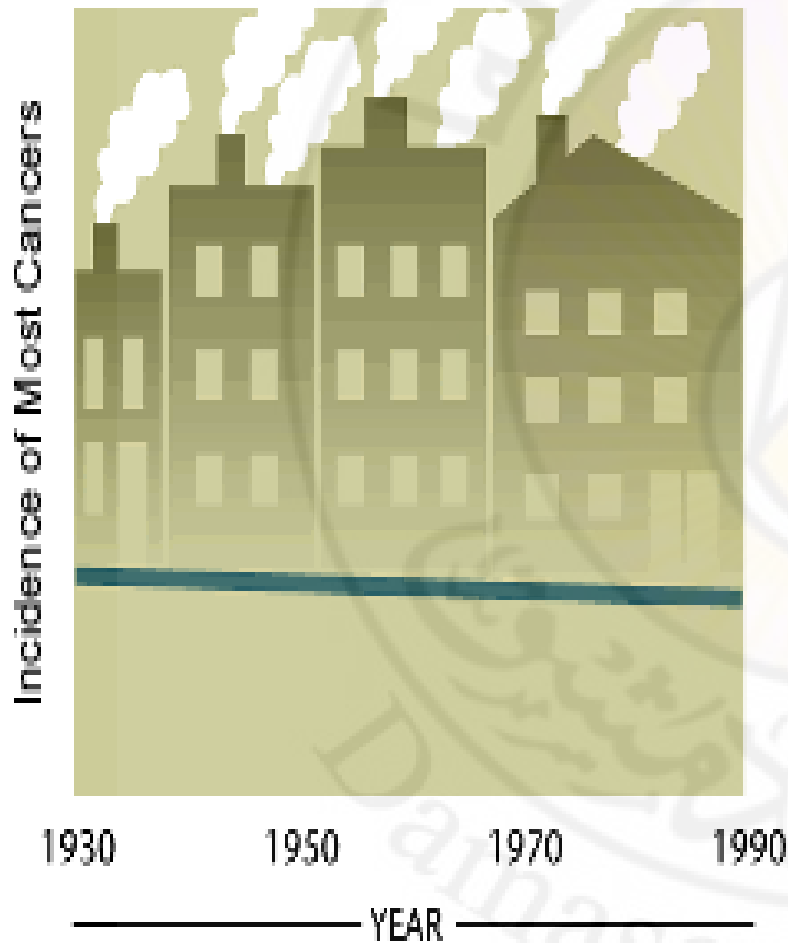


Smoking and alcohol /التدخين و الكحول

Combination of Alcohol and Cigarettes
Increases Risk for Cancer of the Esophagus



التلوث البيئي/Industrial pollution



أسباب فيزيائية/Physical causes

■ أشعة فوق بنفسجية/Ultraviolet radiation

- Sunlight
- Certain industrial sources



■ الأشعة المؤينة/Radiation

- Radon
- Cancer treatment



البدانة/Obesity



Lifestyle:

- Highly caloric diet, rich in fat, carbohydrates and animal protein
- Low physical activity

Consequences:

- **Cancer**
- Diabetes
- Cardiovascular disease
- Hypertension

نمط الحياة/Lifestyle

- العمر/Age
- المهنة/Occupation
- العرق/Ethnicity



Summary

- السرطان هو مرض منقسم نامي منتشر.
- هناك العديد من أسباب حدوث السرطان، و يمكن تجنب حدوثه.
- توقع معدل شفاء المرض بحسب المرحلة السريرية للورم .
- قابلية الشفاء عالية اذا كان الورم صغير غير منتشر.



10 Rules to Avoid Cancer

1. Don't smoke
2. Don't smoke.
3. Don't smoke.
4. Avoid exposure to other known carcinogens, including aflatoxin, asbestos and UV light.
5. Enjoy a healthy diet, moderate in calories, salt and fat, and low in alcohol.
6. Eat fresh fruit and vegetables several times a day.
7. Be physically active and avoid obesity.
8. Have vaccination against, or early detection/treatment of, cancer causing chronic infections.
9. Have the right genes.
10. Have good luck !

شكرا لكم

□ □□□□□□□□□ □ □ □□□□□□ □ □

- □ □□□□□□□ □□□□□□□□□□□□□□□□ □□□□
□□□□□□□□ □ □ □□□□□ □ □
- □ □ □ □- □ □□□□□□□□□□□□□□□□
- □ □ □ □- □ □□□□□□□□□□□□□□
- □ □□□□ □□□□□□□□□□□□□□ □ □ □□□□□□□□□□□□
□□□□□□□□□□□□□□□□□□

DNA and RNA are polynucleotides

- [Diagram showing a single strand of a polynucleotide with 10 nucleotides connected by phosphodiester bonds.]
- [Diagram showing a double-stranded polynucleotide with 10 base pairs connected by hydrogen bonds.]
- [Diagram showing a single strand of a polynucleotide with 10 nucleotides connected by phosphodiester bonds.]



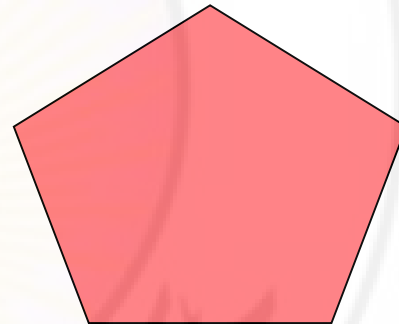
- [Diagram showing a single strand of a polynucleotide with 10 nucleotides connected by phosphodiester bonds.]



Structure of a nucleotide

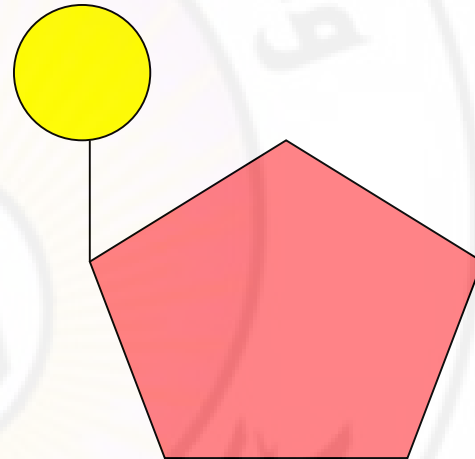
A nucleotide is made of 3 components:

- A **Pentose sugar**
- This is a 5 carbon sugar
- The sugar in DNA is **deoxyribose**.
- The sugar in RNA is **ribose**.



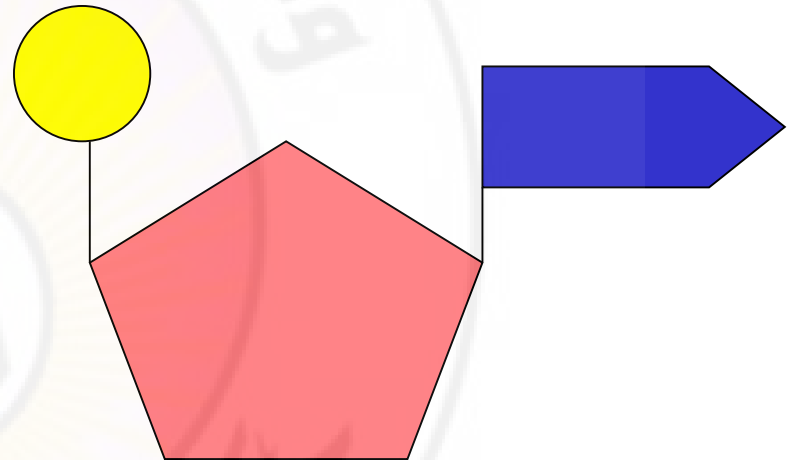
Structure of a nucleotide

- A **Phosphate group**
- **Phosphate groups are important because they link the sugar on one nucleotide onto the phosphate of the next nucleotide to make a polynucleotide.**



Structure of a nucleotide

- A Nitogenous base
- In DNA the four bases are:
 - Thymine
 - Adenine
 - Cytosine
 - Guanine
- In RNA the four bases are:
 - Uracil
 - Adenine
 - Cytosine
 - Guanine



Nitrogenous bases – Two types

Pyrimidines

Thymine - T

Cytosine - C

Uracil - U

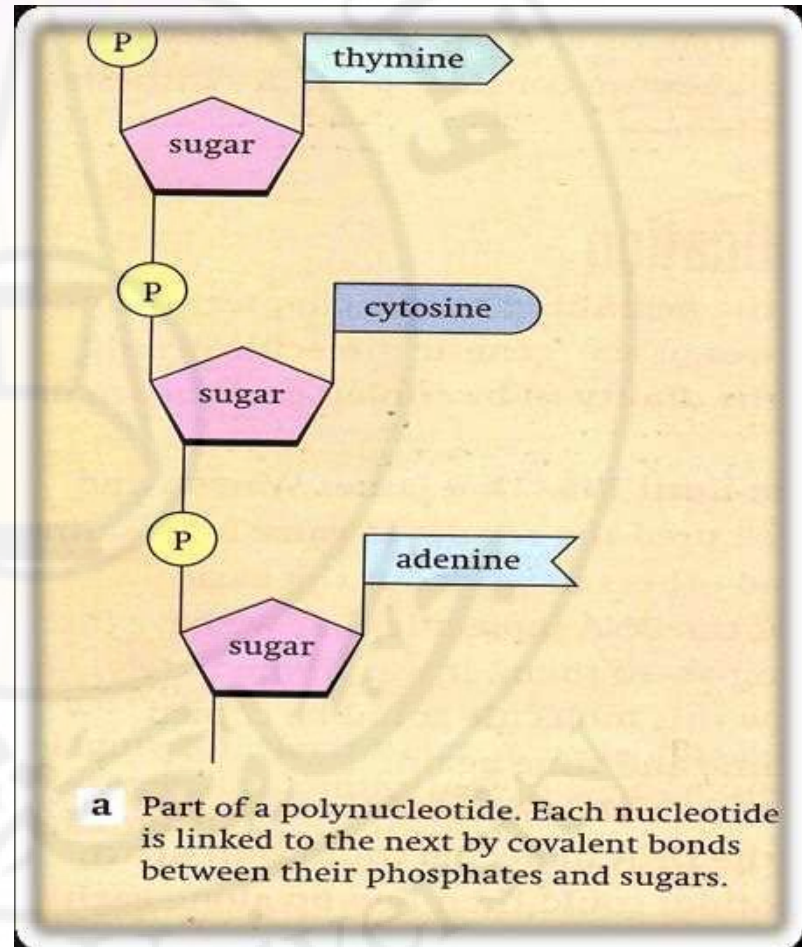
Purines

Adenine - A

Guanine - G

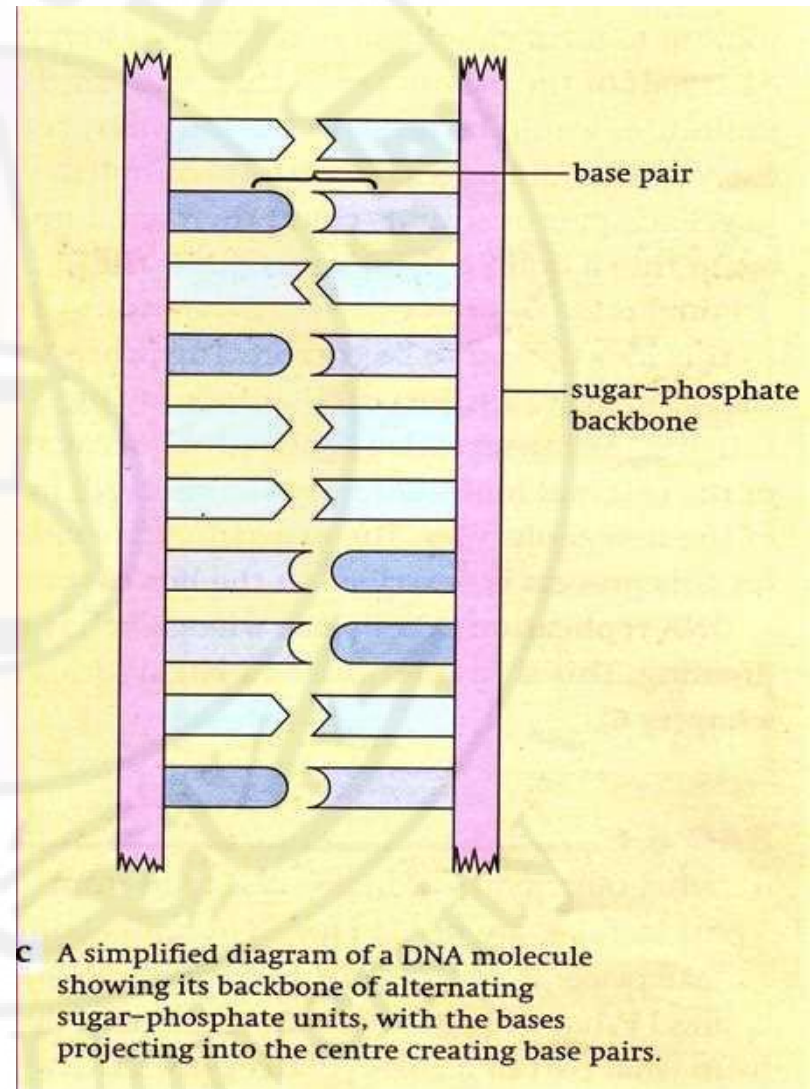
Sugar phosphate bonds (backbone of DNA)

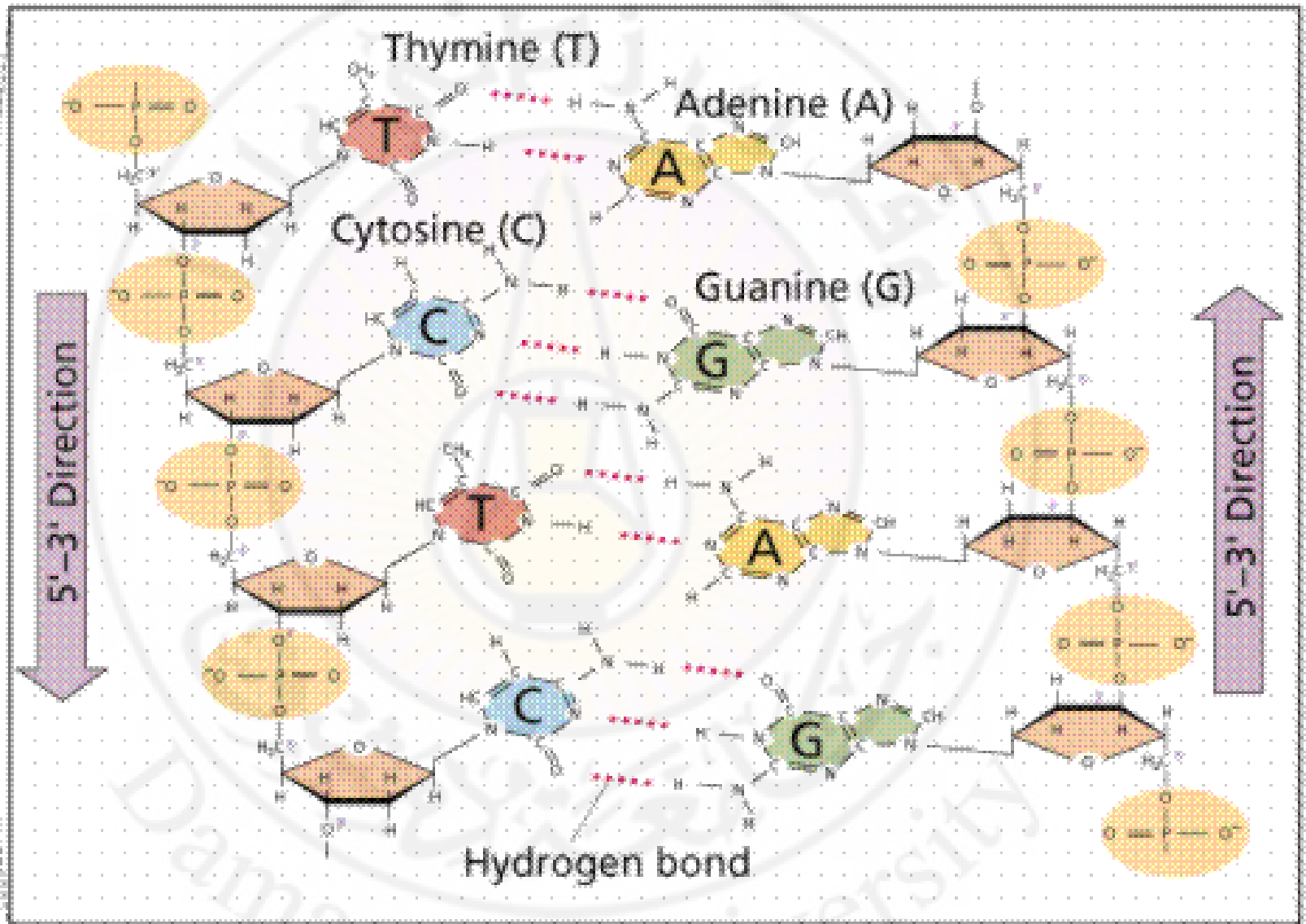
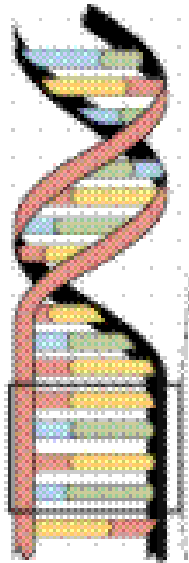
- Nucleotides are connected to each other via the phosphate on one nucleotide and the sugar on the next nucleotide
- *A Polynucleotide*

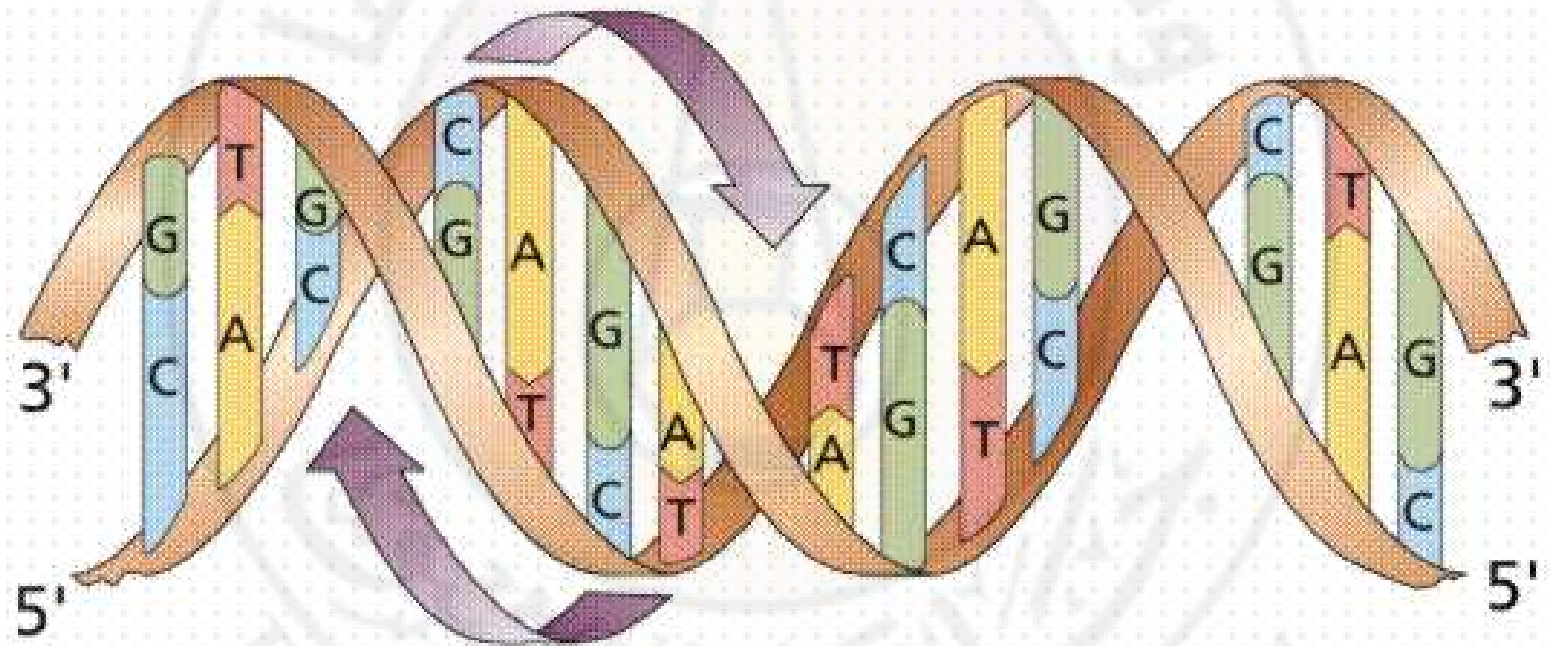


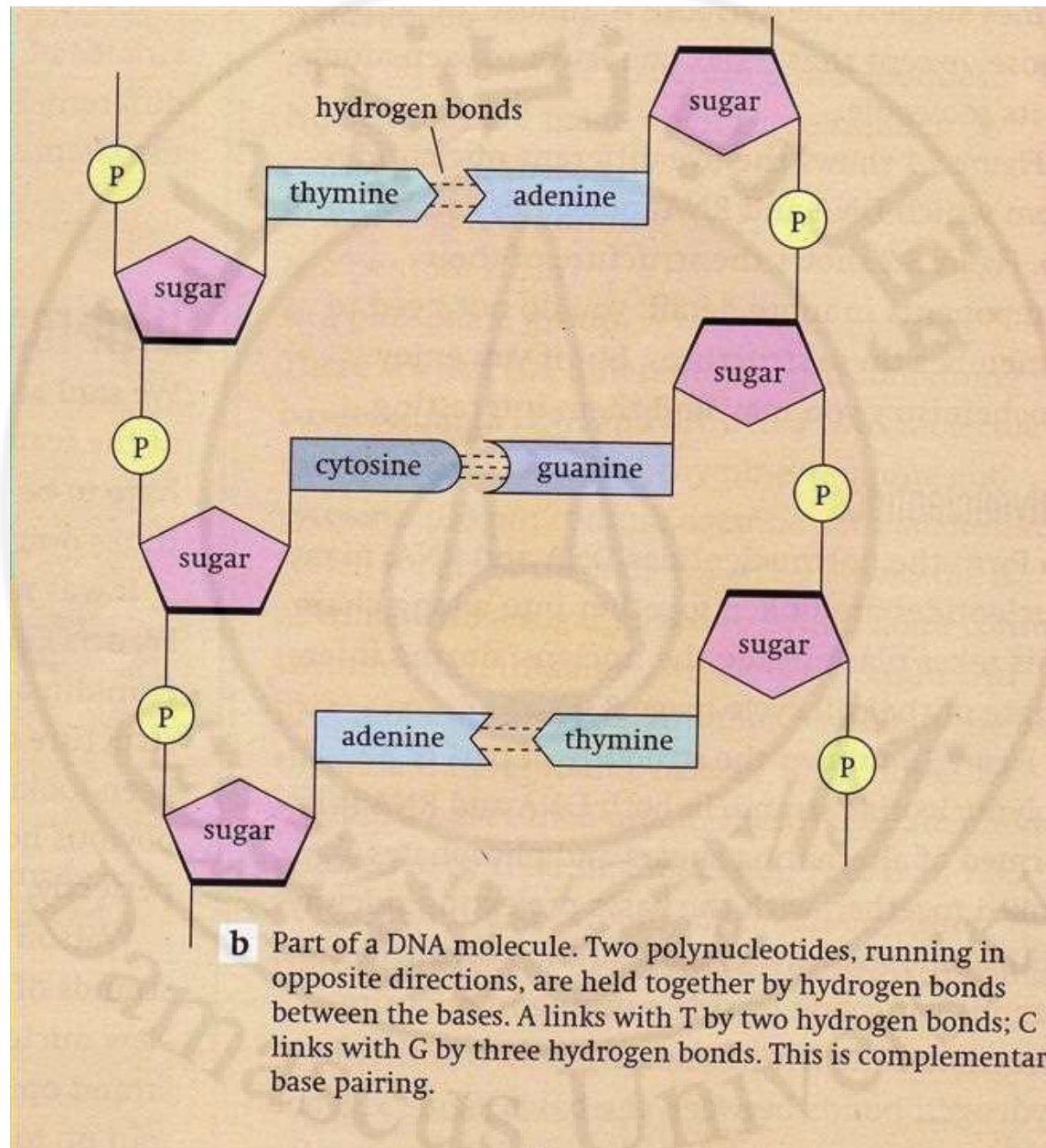
Base pairing

- The Nitrogenous Bases pair up with other bases. For example the bases of one strand of DNA base pair with the bases on the opposite strand of the DNA.









The Rule:

- Adenine always base pairs with Thymine (or Uracil if RNA)
- Cytosine always base pairs with Guanine.
- This is because there is exactly enough room for one purine and one pyrimidine base between the two polynucleotide strands of DNA.

Purines

Pyrimidines

Adenine $\longleftrightarrow$ Thymine

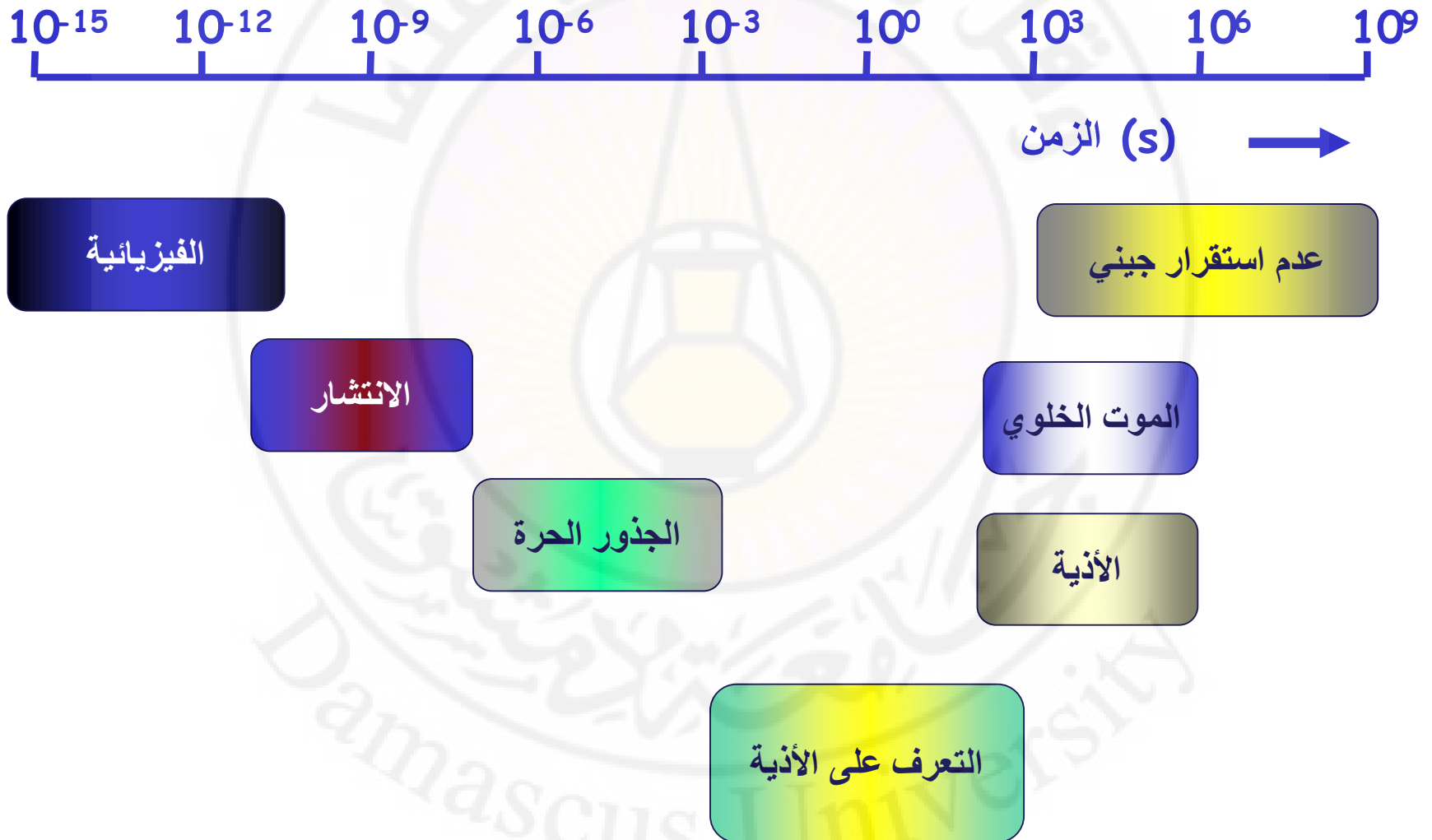
Adenine $\longleftrightarrow$ Uracil

Guanine $\longleftrightarrow$ Cytosine

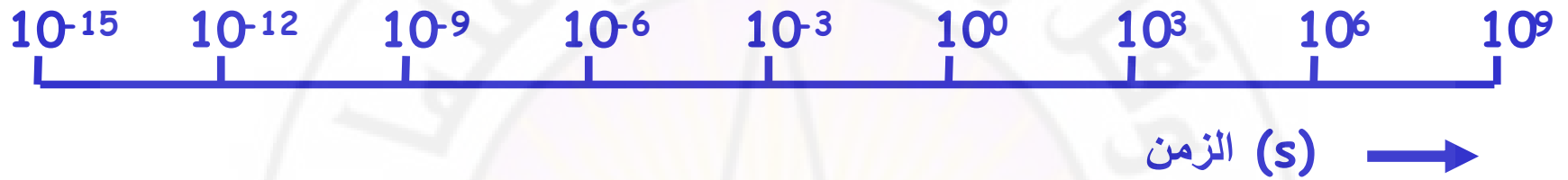
The background of the slide features a large, faint watermark of the Damascus University logo. The logo is circular, with the Arabic text "وقل رب زدني علما" (O Lord, increase my knowledge) at the top and "جامعة دمشق" (Damascus University) at the bottom. In the center is a stylized lamp with rays emanating from it.

مبادئ في البيولوجيا الشعاعية

مراحل التأثير للأشعة المؤينة



مراحل التأثير للأشعة المؤينة



المرحلة الفيزيائية

المرحلة الفيزيائية

تحريض / تشريد

مباشر
e

غير مباشر
ph

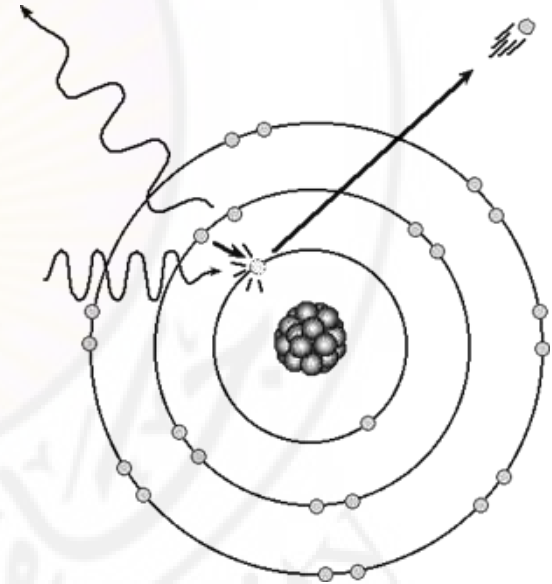
Damascus University

المرحلة الفيزيائية

التفاعل بين الفوتون و المادة



كومبتون



الفعل الكهروضوئي

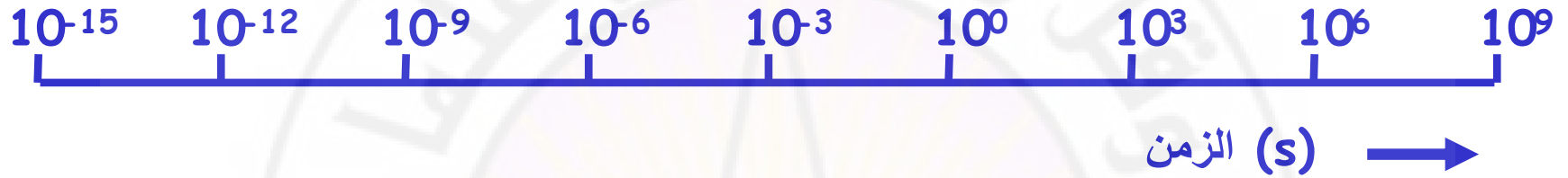
المرحلة الفيزيائية

التفاعل بين الالكترون و المادة

-تفاعل بين الكترون / الكترون : تصادم.

- تفاعل بين الكترون / نواة : الفرملة(الكبح)

مراحل التأثير للأشعة المؤينة



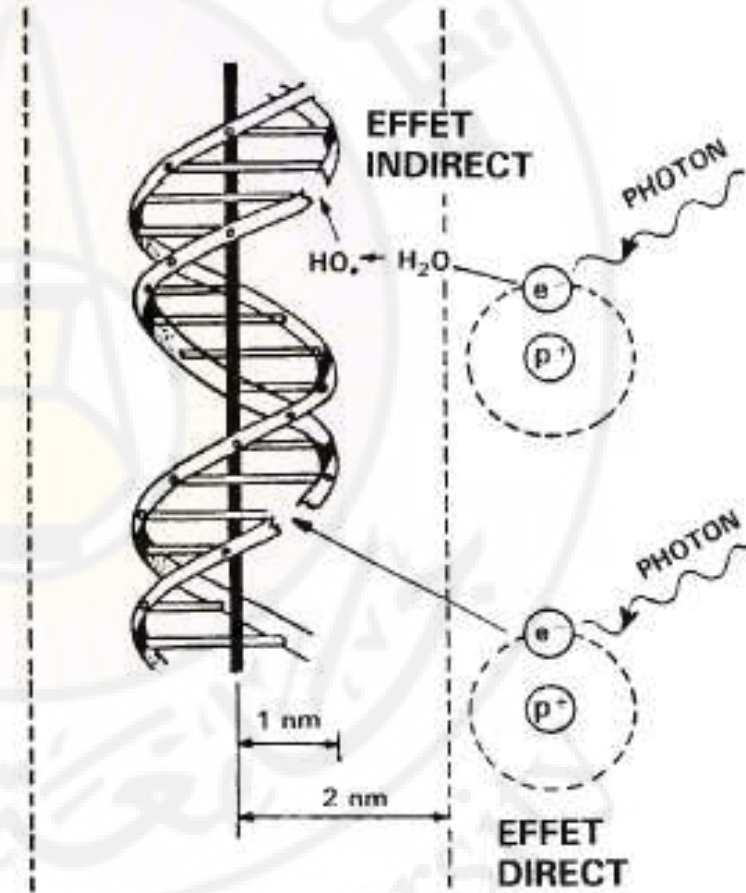
الفيزيائية

الانتشار

الجنور الحرة

Damascus University

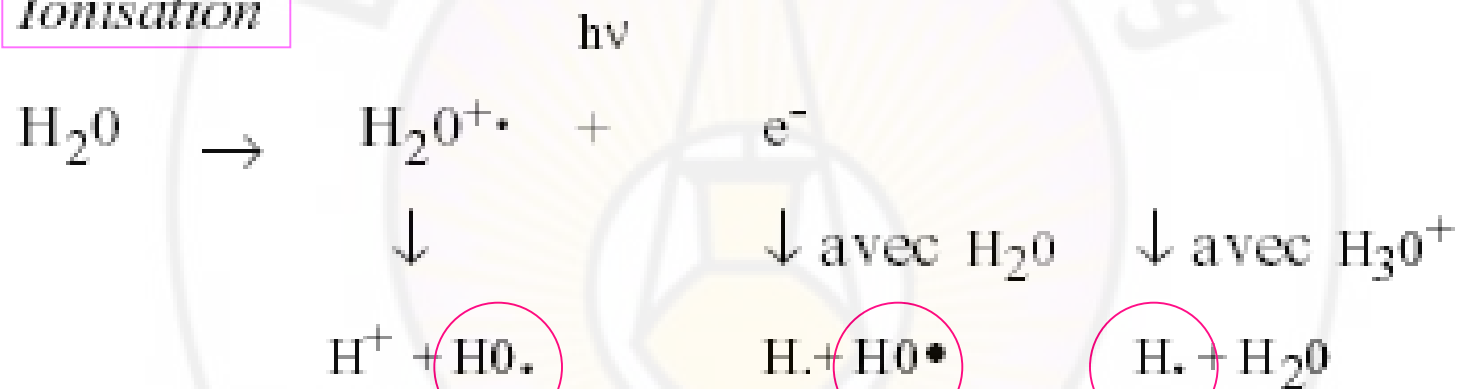
المرحلة الفيزيوكيماوية



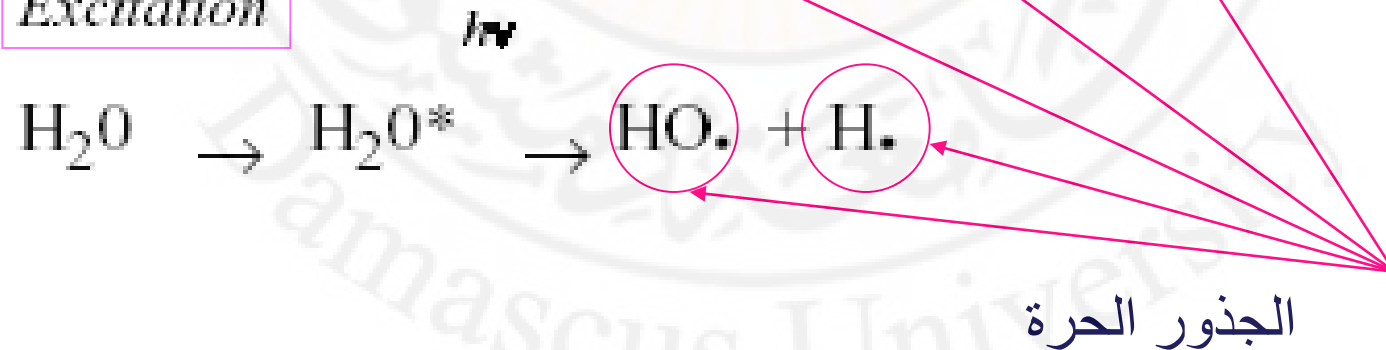
المرحلة الفيزيوكيماوية

التقك الشعاعي للماء

Ionisation

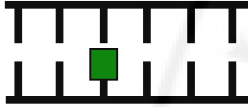


Excitation



المرحلة الفيزيوكيماية

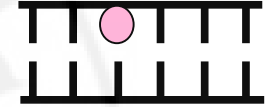
الضرر الشعاعي المحدث على المادة الصبغية



تغير الأساس



فقدان الأساس



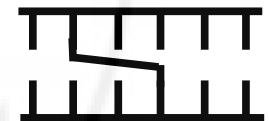
ضرر في الأساس



كسر وحيد



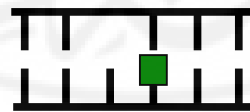
جسور



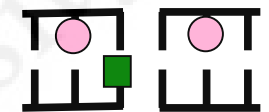
جسور



كسر مزدوج



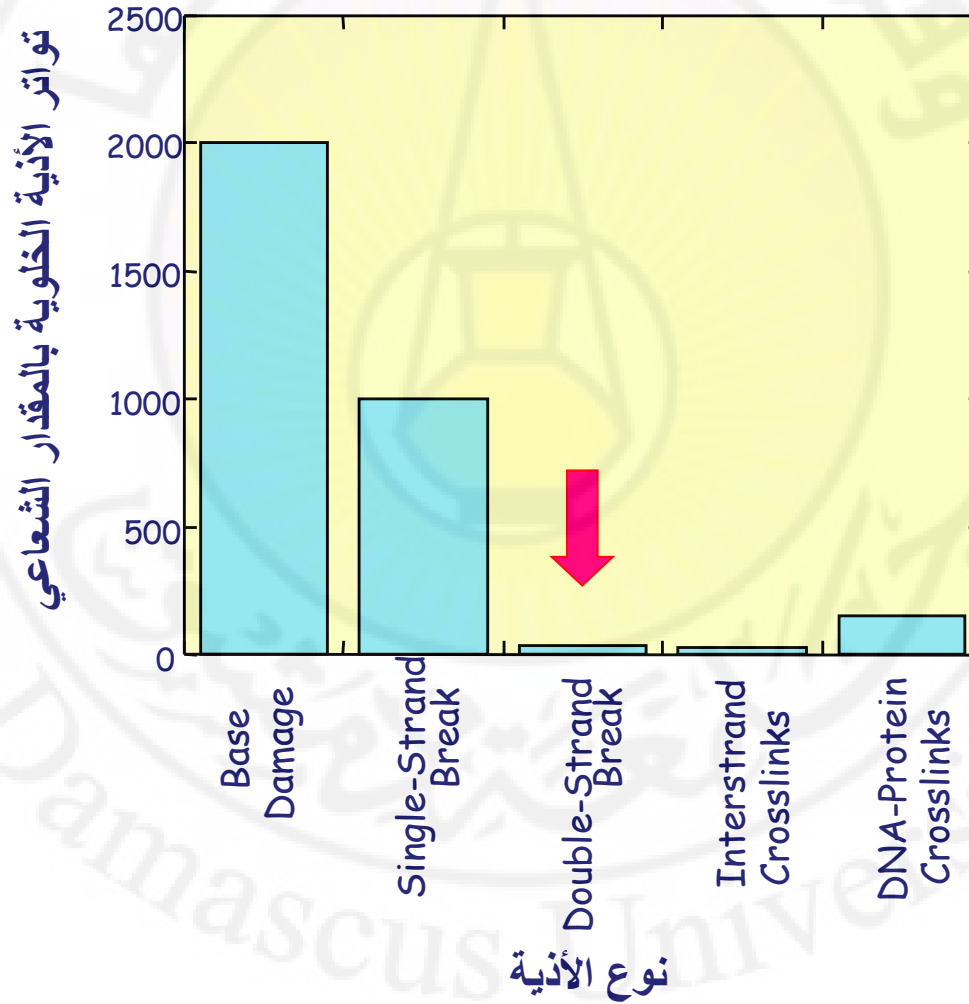
أذية مركبة



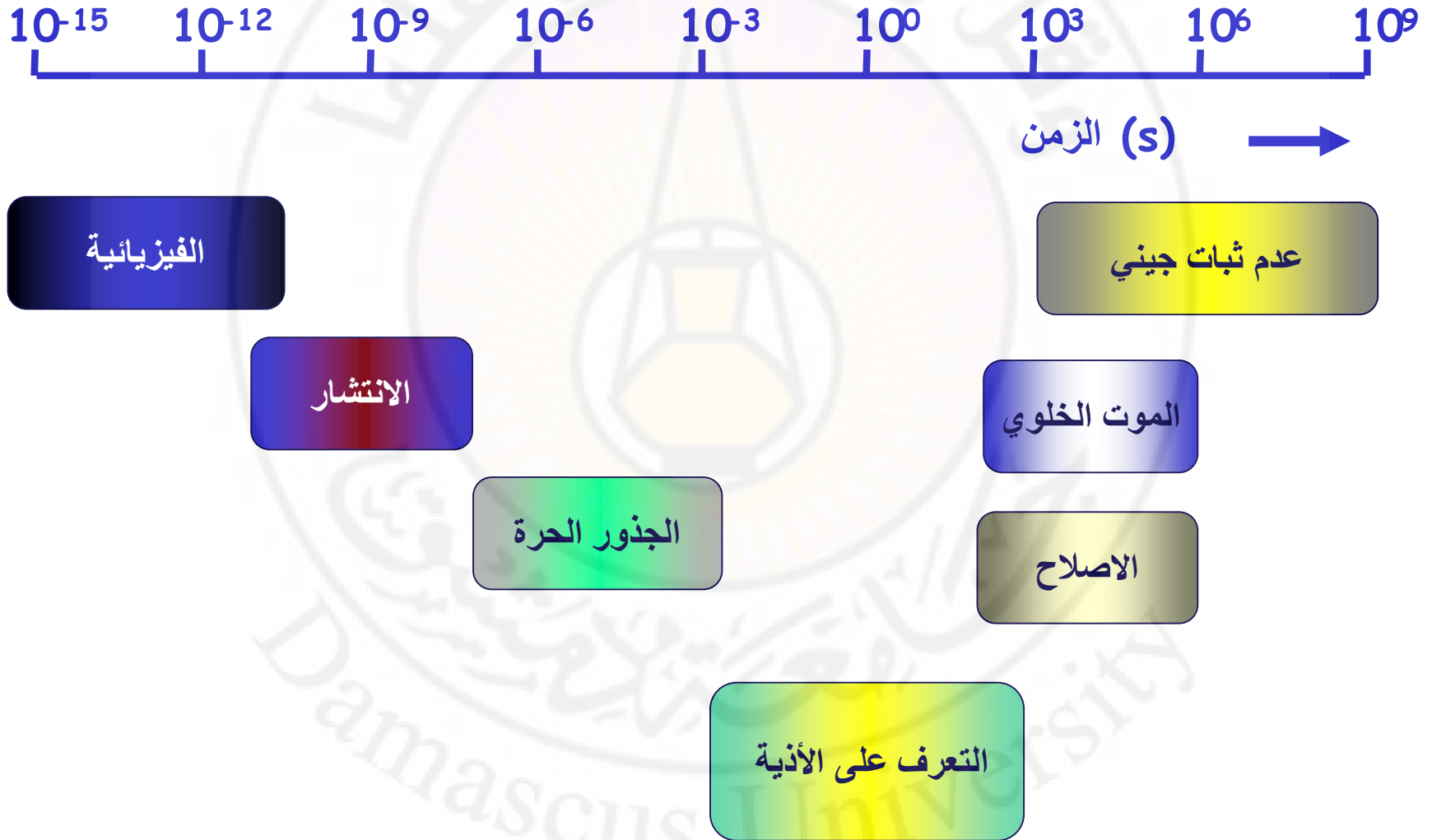
أذية مركبة

المرحلة الفيزيوكيماوية

الأذية على مستوى الدنا



مراحل التأثير للأشعة المؤينة



الأثر على الخلية

نتائج ضرر على الدنا :

اعادة برمجة الانقسام الخلوي بسبب وجود نقطة تفتيش في المرحلة G2-M :

طفرات

فقدان كروموزومات

موت خلوي

الأثر في الخلية

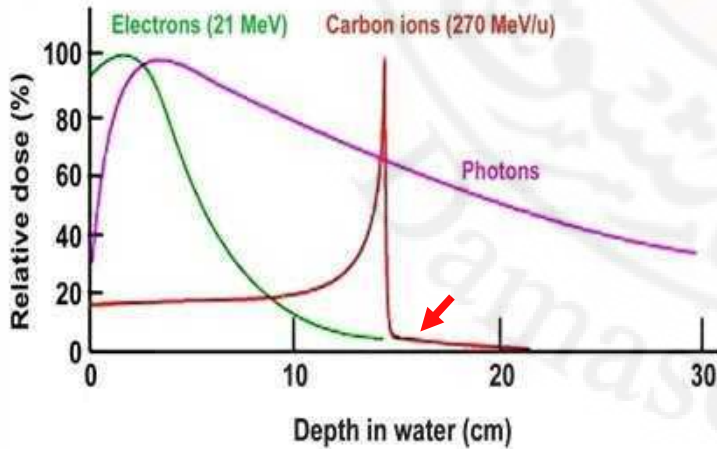
اذية قاتلة غير قابلة للإصلاح : موت الخلية
اذية تحت قاتلة غير قابلة للإصلاح : تراكم الاذيات يؤدي الى موت الخلية
اذية تحت قاتلة قابلة للإصلاح : تورث أو تسبب سرطان
اذية غير قاتلة كامنة مع إمكانية الإصلاح مع انقسام الخلية

•

سؤال : هل الضرر الشعاعي يمكن أن يتعدل

العوامل المؤثرة في الفعل البيولوجي للأشعة

- الحساسية الداخلية للأشعة
- عوامل الزمن : التجزأ (عدد الجلسات)، الزمن (مدة العلاج الكلي)، و الجرعة الكلية.
- تأثير الاوكسجين.
- نوعية الاشعاع.
- الدورة الخلوية
- معدل الجرعة
- الحرارة
- العلاج الكيميائي

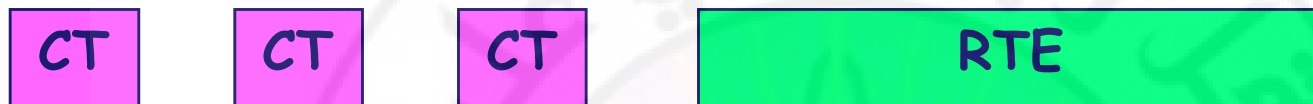


هدف المشاركة الشعاعية الكيماوية

- تحسين السيطرة الموضعية للورم.
- تحسين البقيا.
- انقاص السمية على النسيج الطبيعية.
- امكانية العلاج مع الحفاظ على العضو.

تعريف

- متلاحق



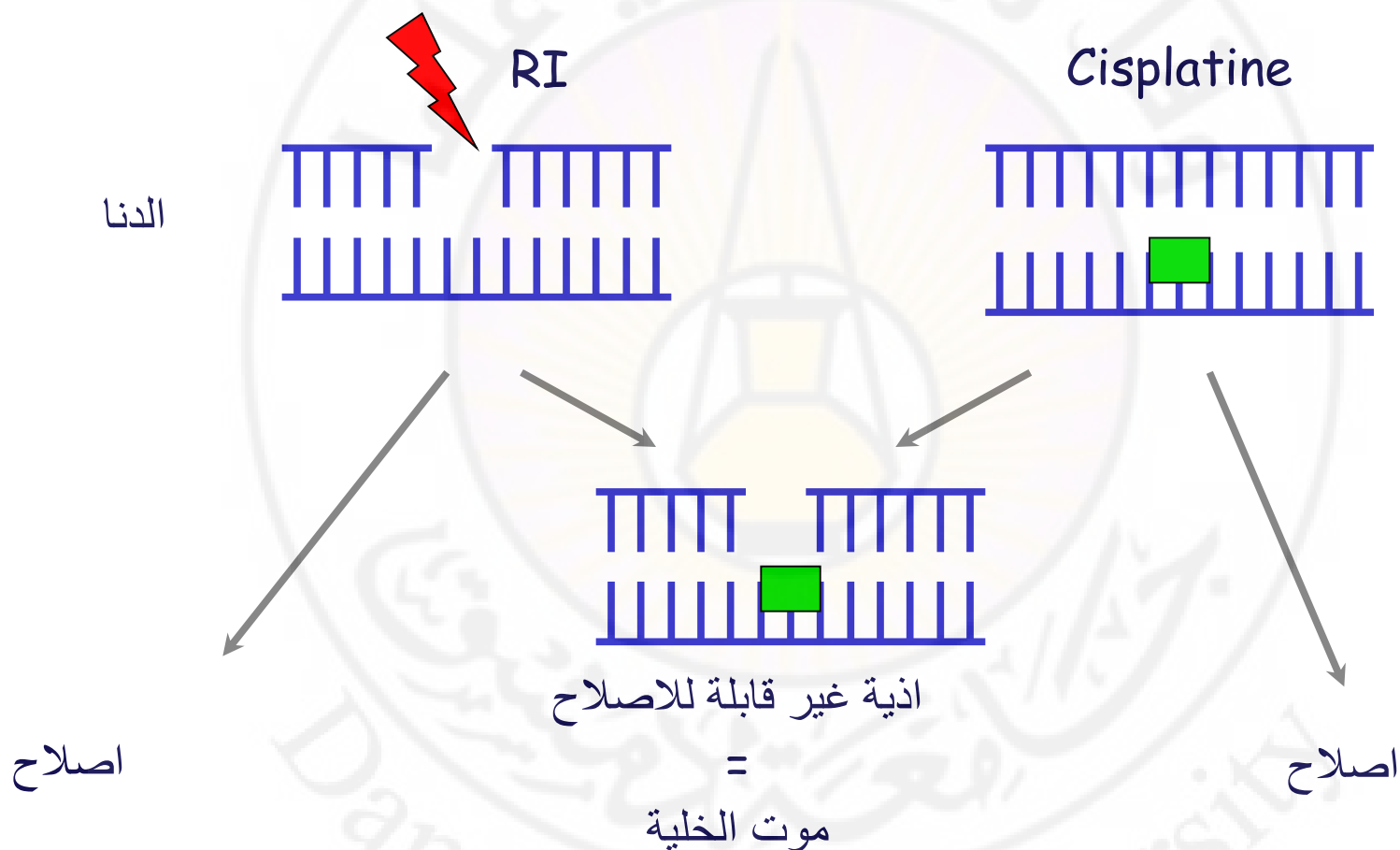
- متداخل

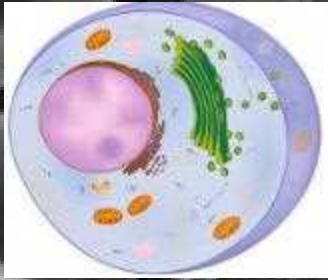


- متزامن



مشاركة مركبات البلاتين مع العلاج الشعاعي





الخلية

د. مضر بكور

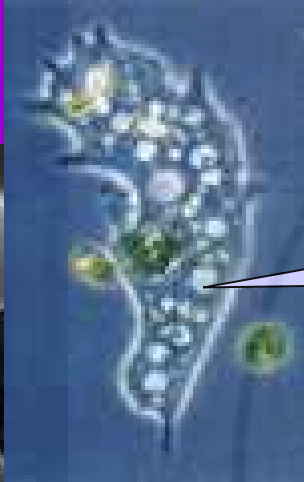
ما هي الخلية ؟

الخلية هي أصغر وحدة قادرة على انجاز وظائف الحياة.
تعتبر الوحدة الأساسية للأشياء الحية.

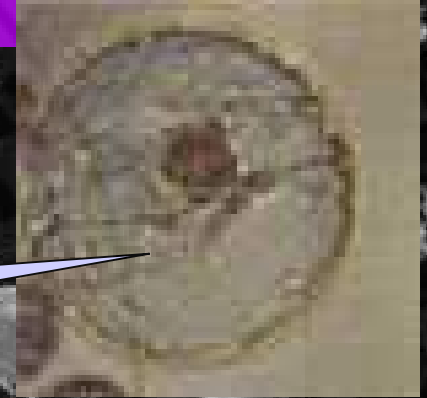
الخلية

- كل الأحياء تتألف من خلايا.
- الخلية هي أصغر وحدة في كل الأحياء.
- كل الخلايا تأتي من خلايا أخرى منقسمة.

أمثلة



أميبيا



الخلية الجذعية النباتية

جراثيم



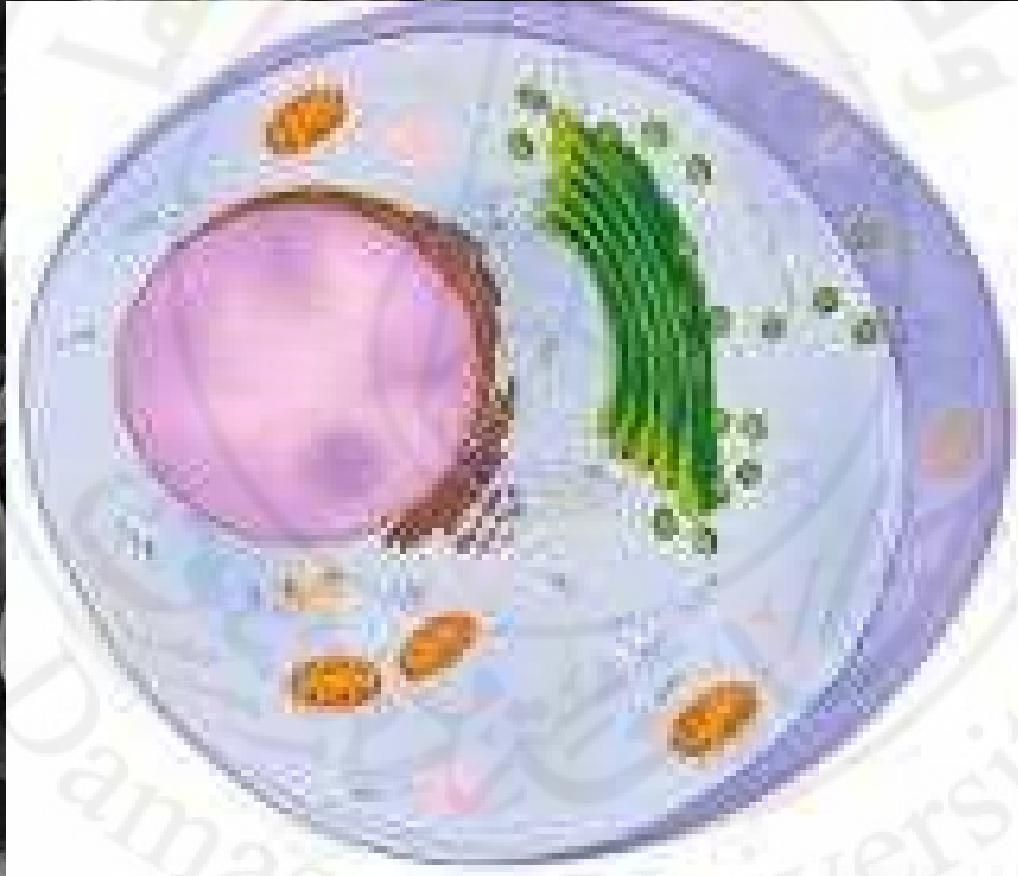
خلية الدم الحمراء



الخلية العصبية



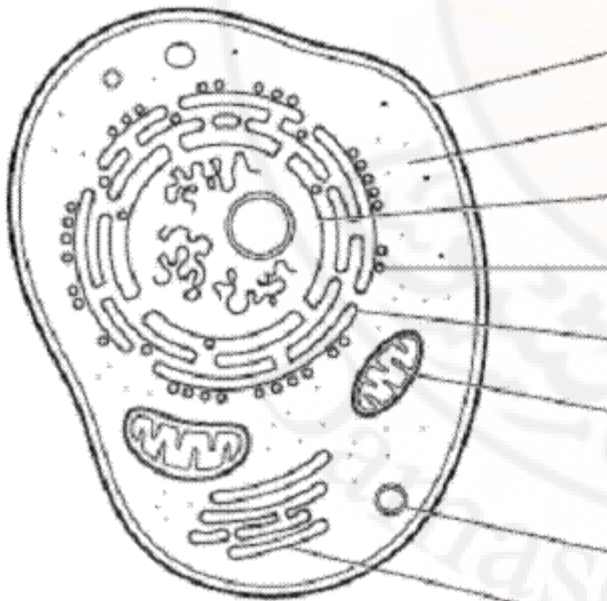
أجزاء الخلية



جدار الخلية

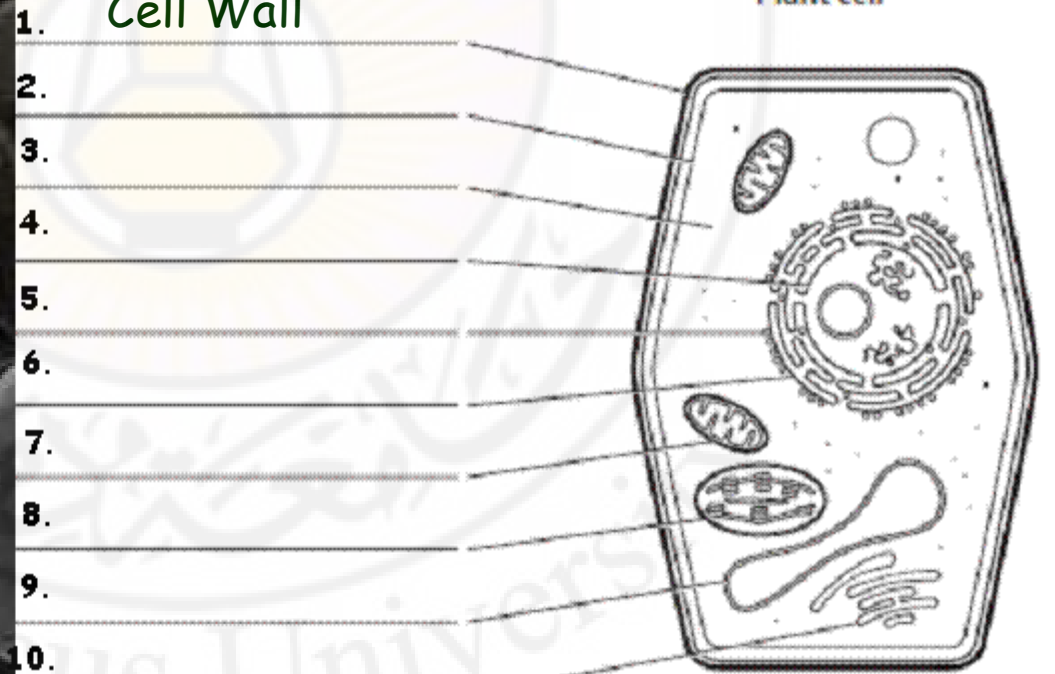
دعم و حماية الخلية
موجودة فقط بالنبات

Animal cell



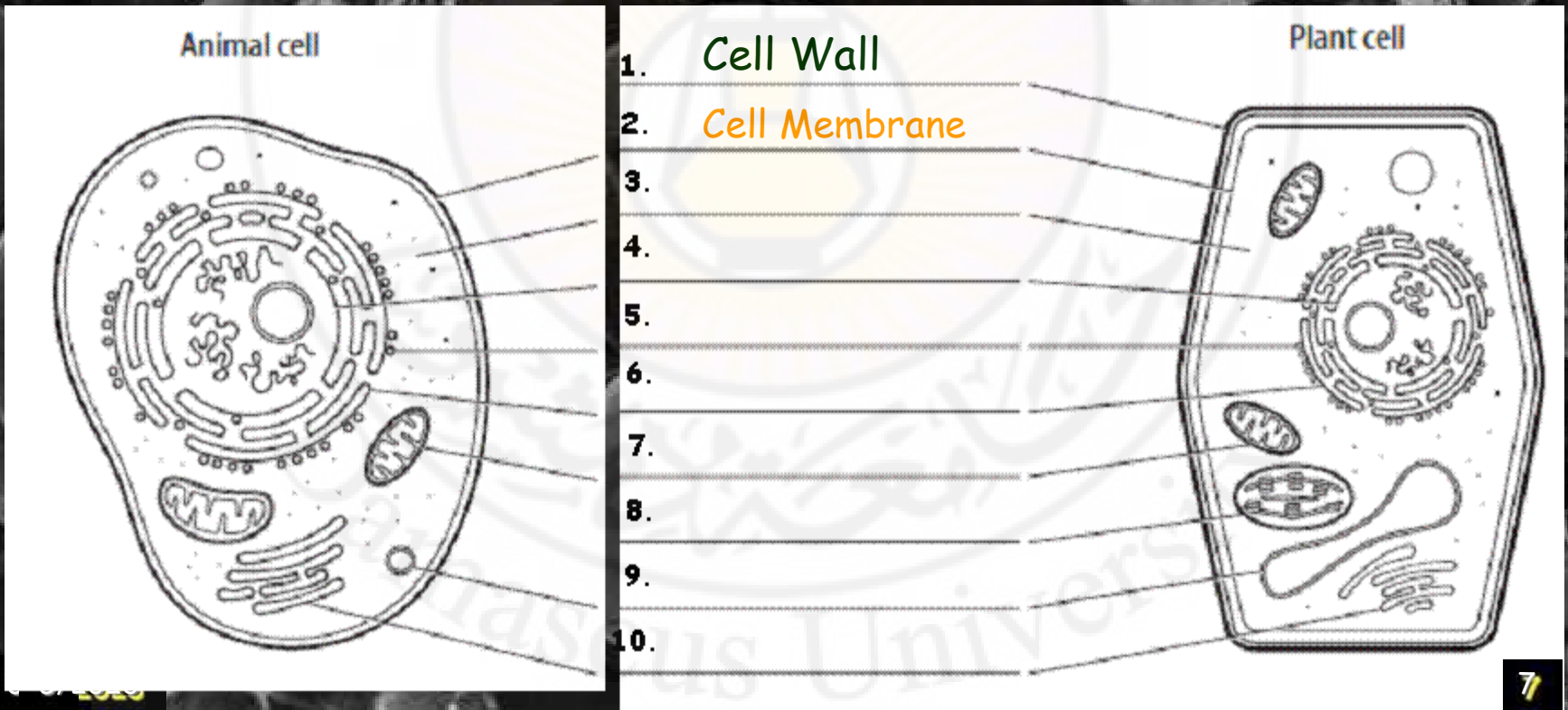
Cell Wall

Plant cell



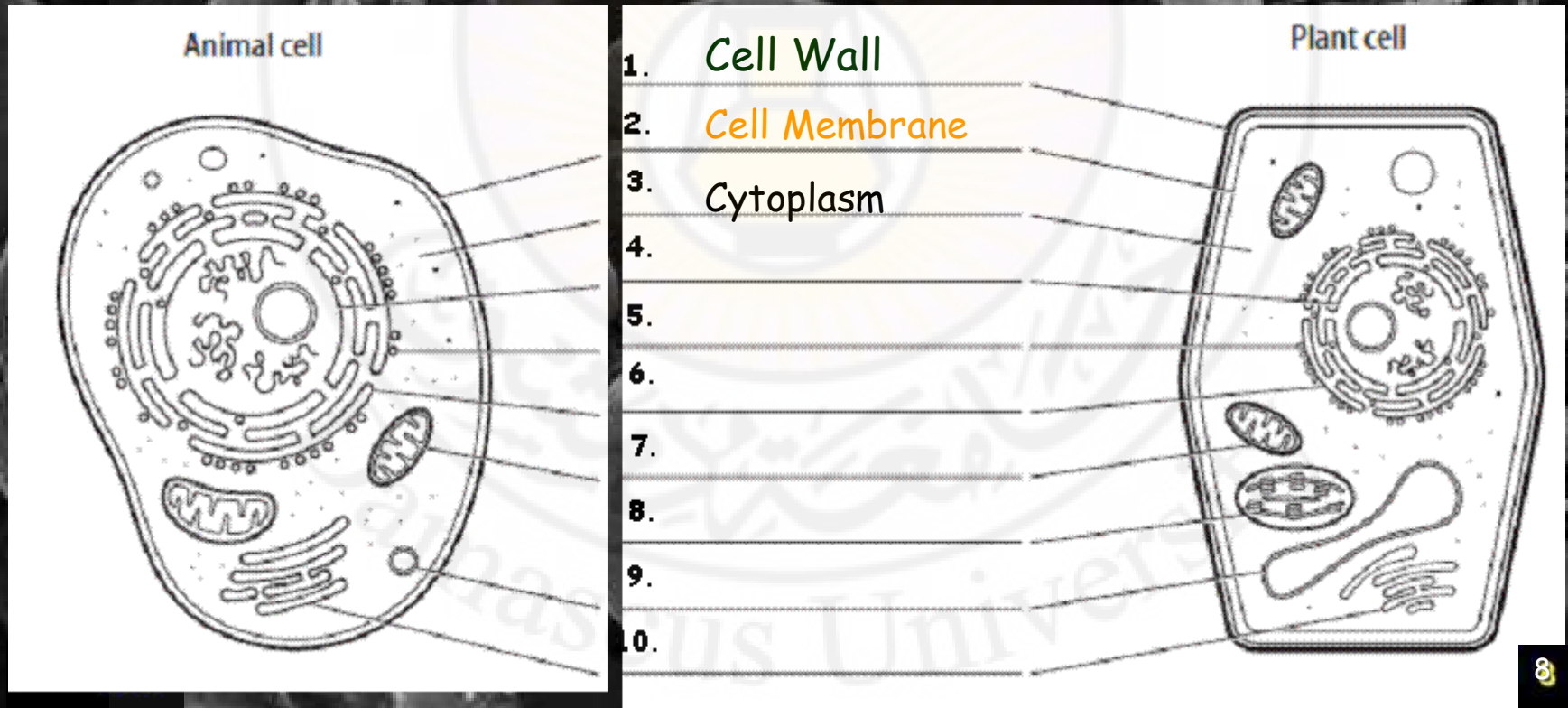
الغشاء الخلوي

- حماية الخلية
- دخول الطعام و خروج الفضلات ، بالإضافة للتنفس..



سيتوبلاسم

- مادة شبيهه بالجيل
- قوام مائي



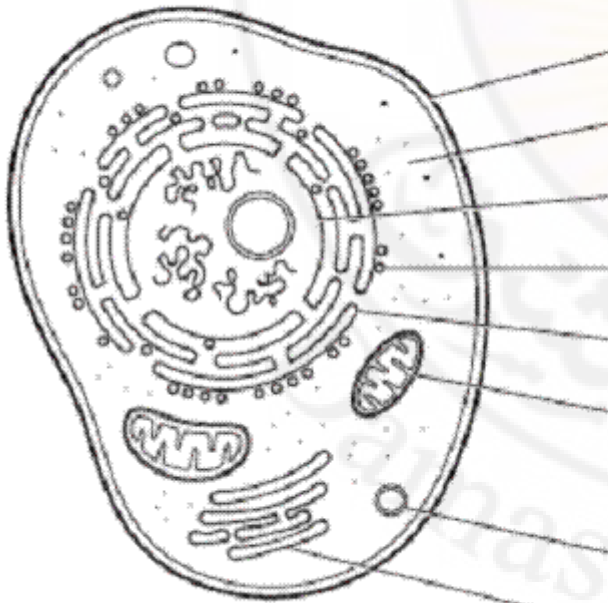
النواة

• تحوي المادة الوراثية الموجودة بالدنا DNA

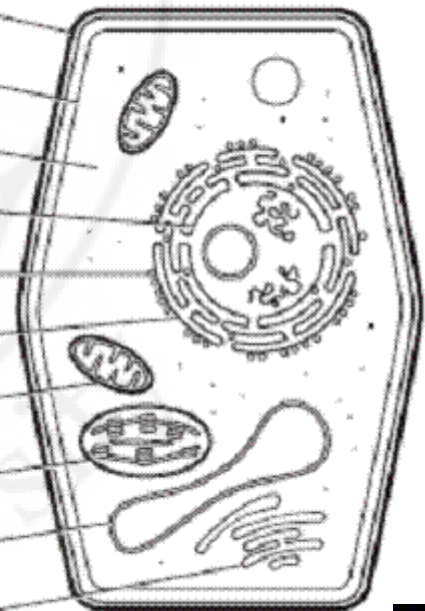
Structure of DNA and RNA

- Genetic material of living organisms is either DNA or RNA.
- DNA - Deoxyribonucleic acid
- RNA - Ribonucleic acid
- Genes are lengths of DNA that code for particular proteins.

Animal cell



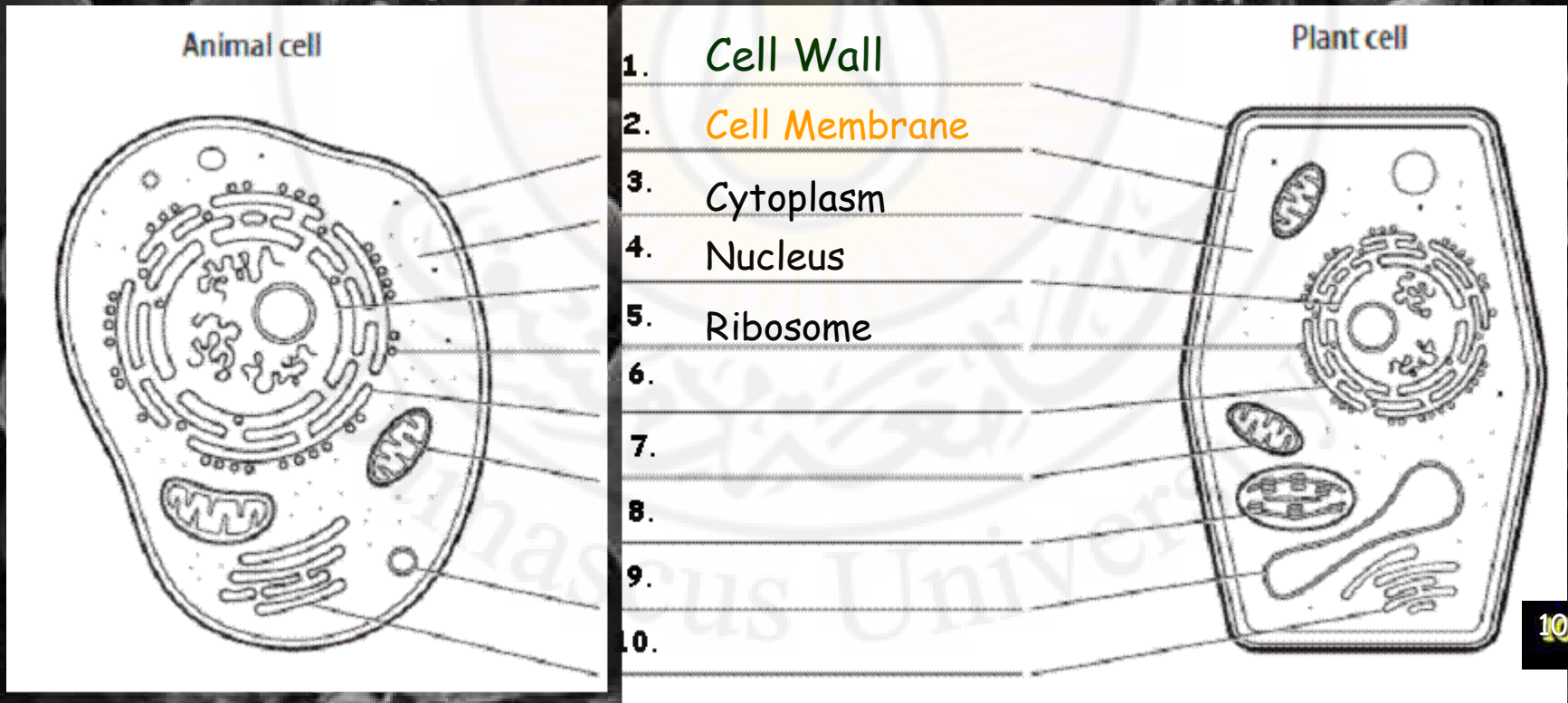
Plant cell



1. Cell Wall
2. Cell Membrane
3. Cytoplasm
4. Nucleus
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

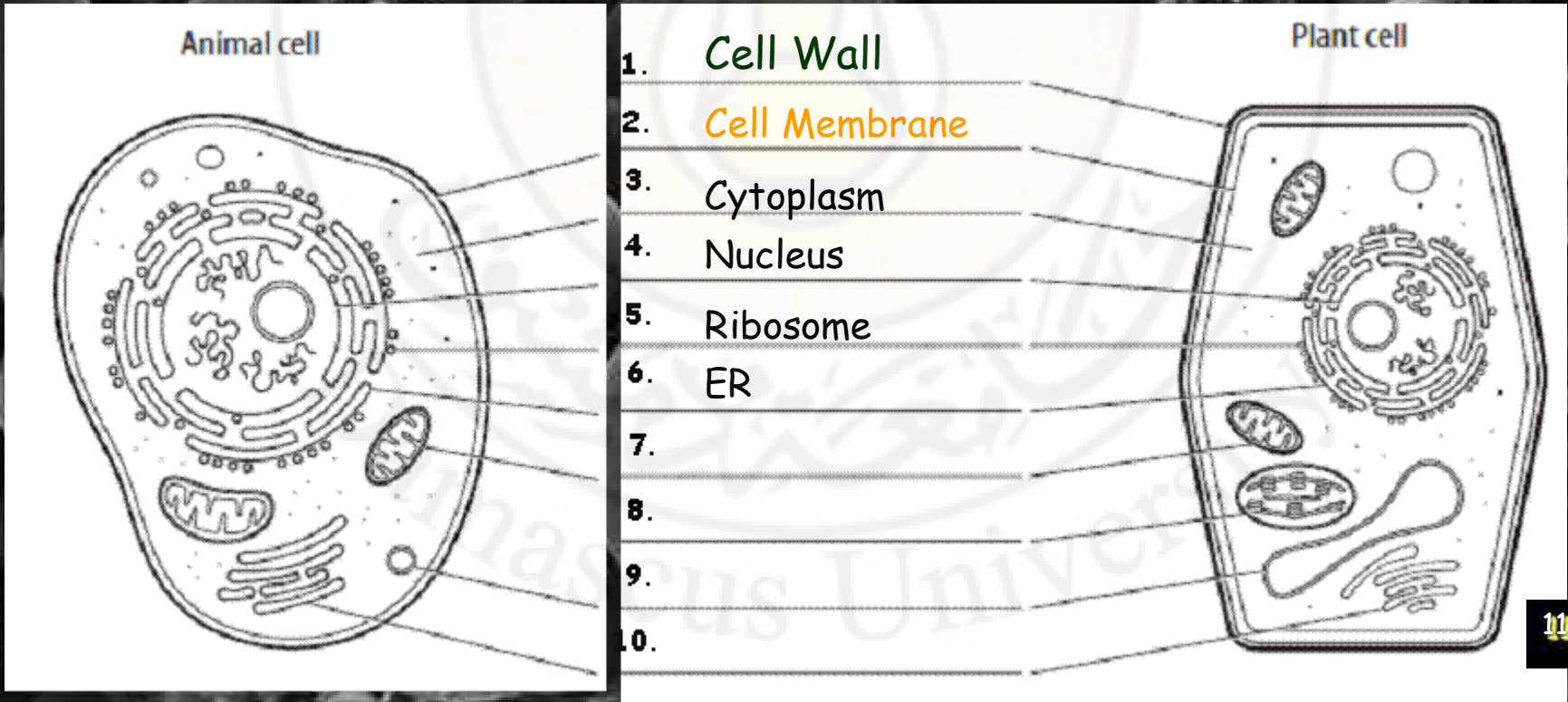
الجسيم الريبي

• مصنع البروتين



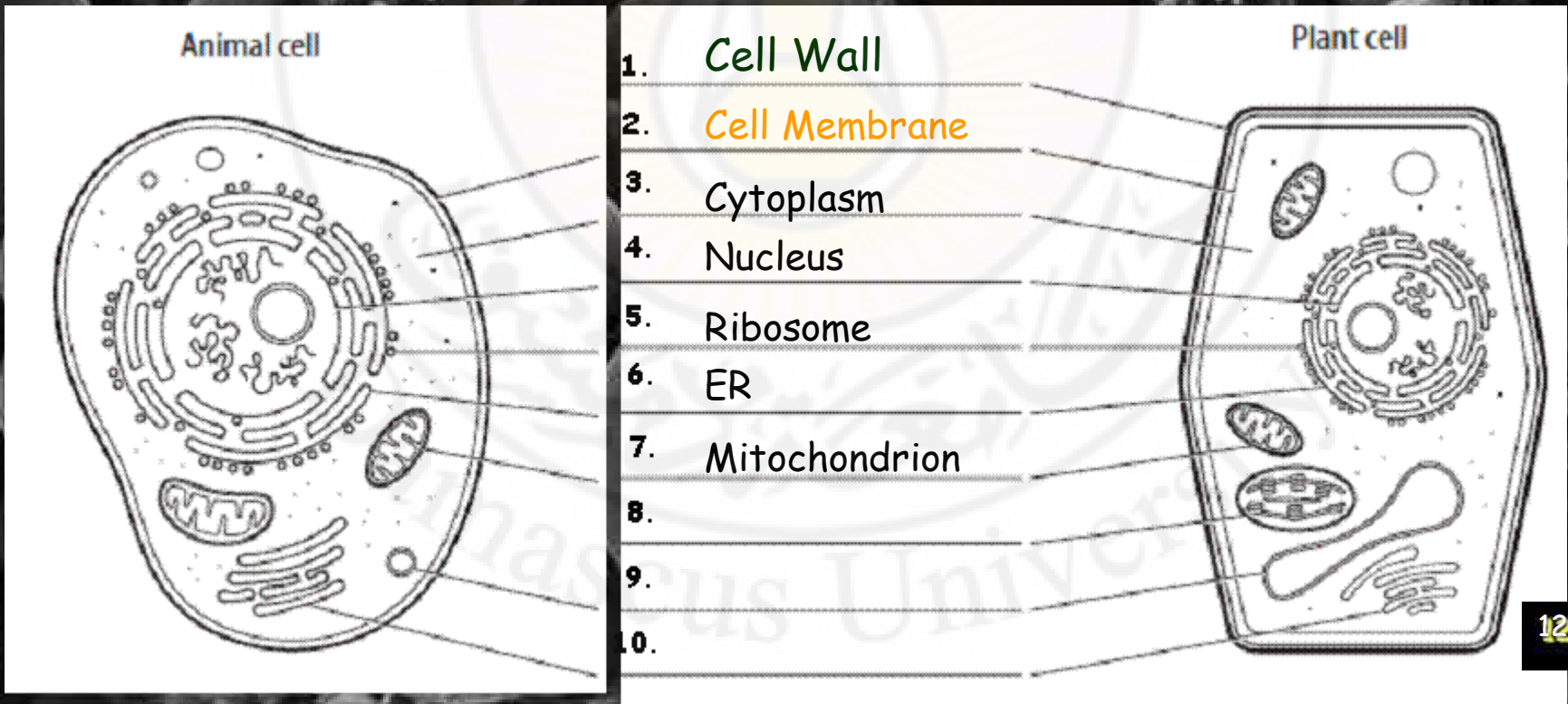
الشبكة البلاسمية الداخلية

- تحوي على الجسيمات الريبية
- توجه المواد ضمن الخلية



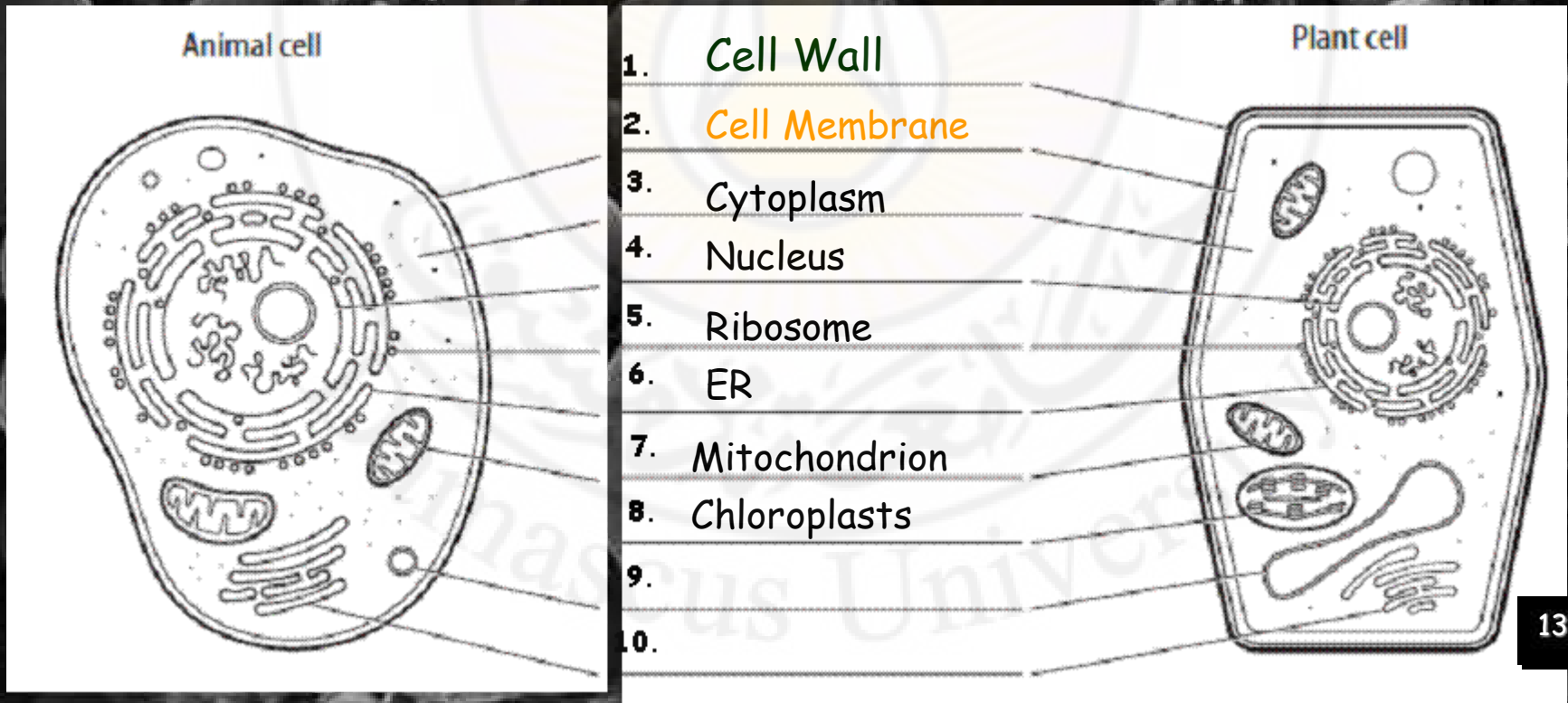
الميتوكوندريا

- انتاج الطاقة من الطعام
- التحكم بمستوى الماء و مواد أخرى ضمن الخلية



الجسيمات الملونة

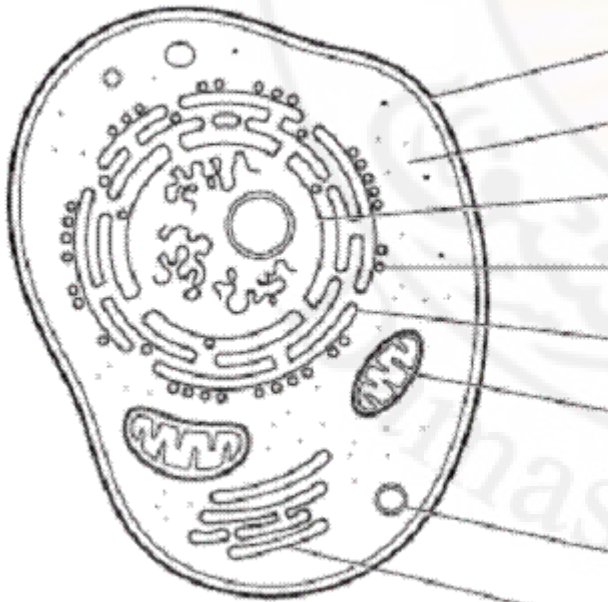
- موجودة فقط بالنبات
- تصنع الطعام



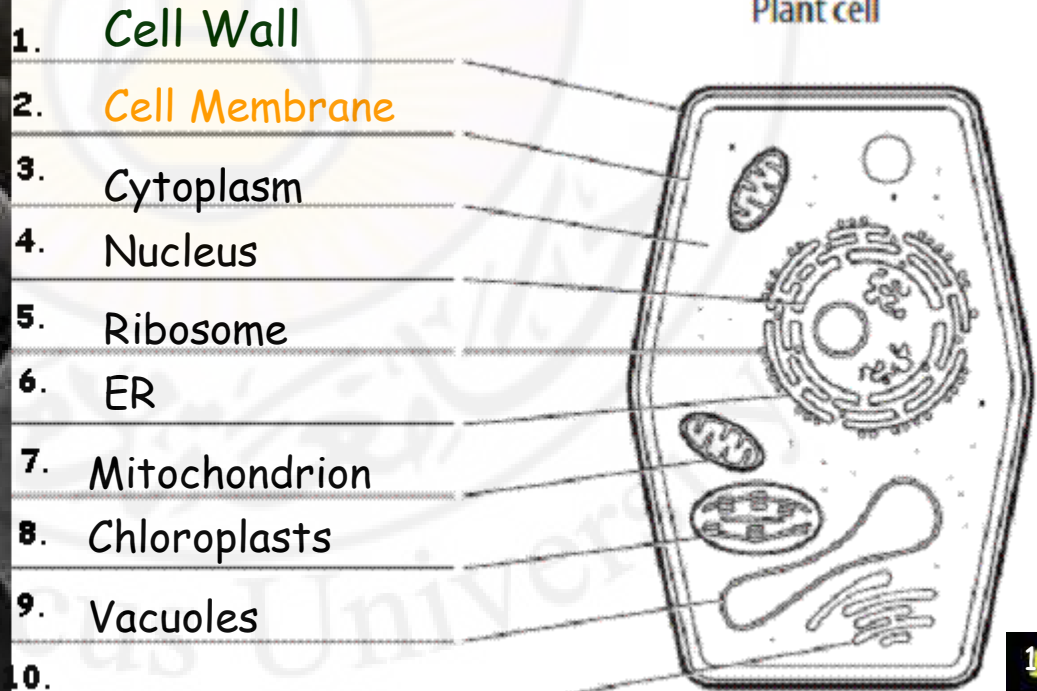
الفجوات

- حيز ل-خزن المواد مؤقتا محاط بغشاء
- يحوي على مواد منحلة بالماء
- بالنبات تساعد على الحفاظ على شكل الخلية.

Animal cell

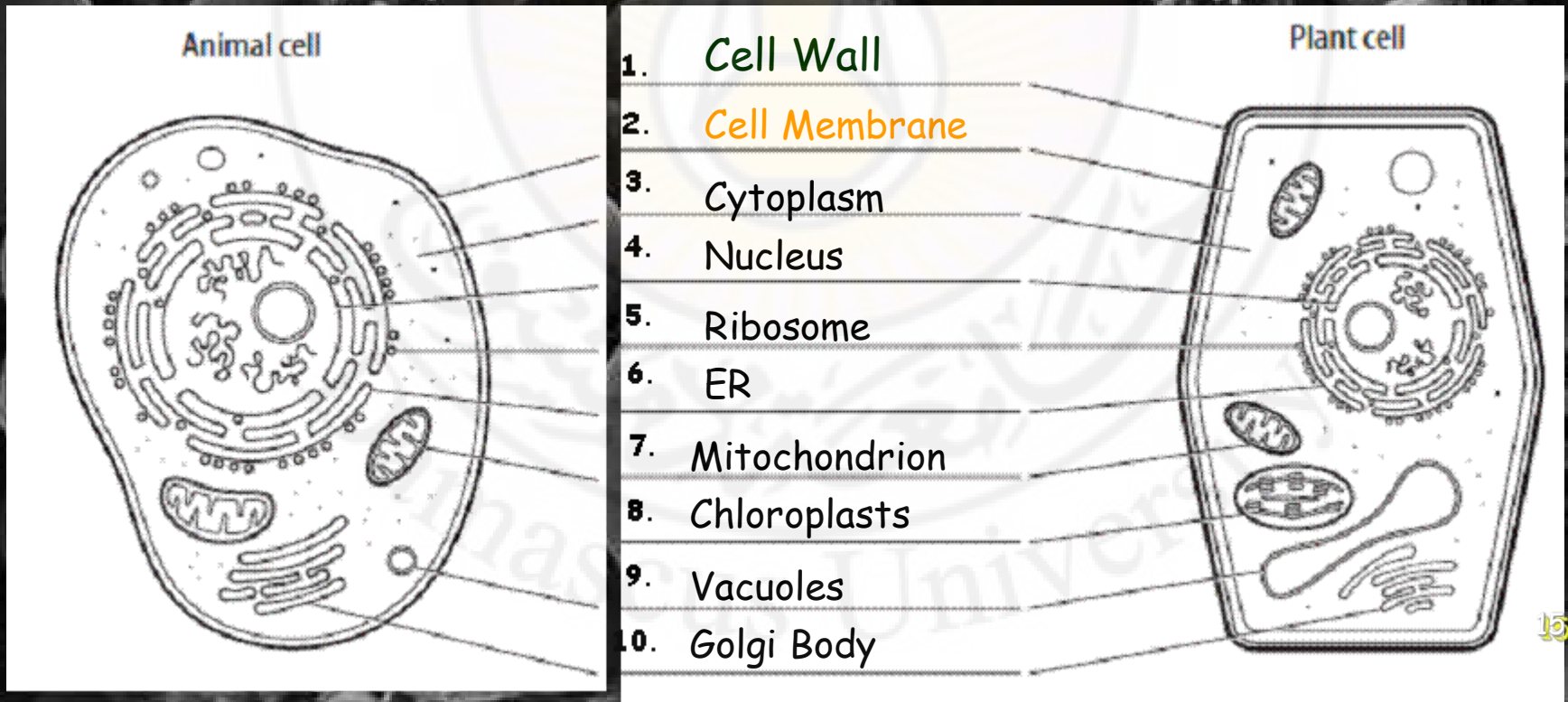


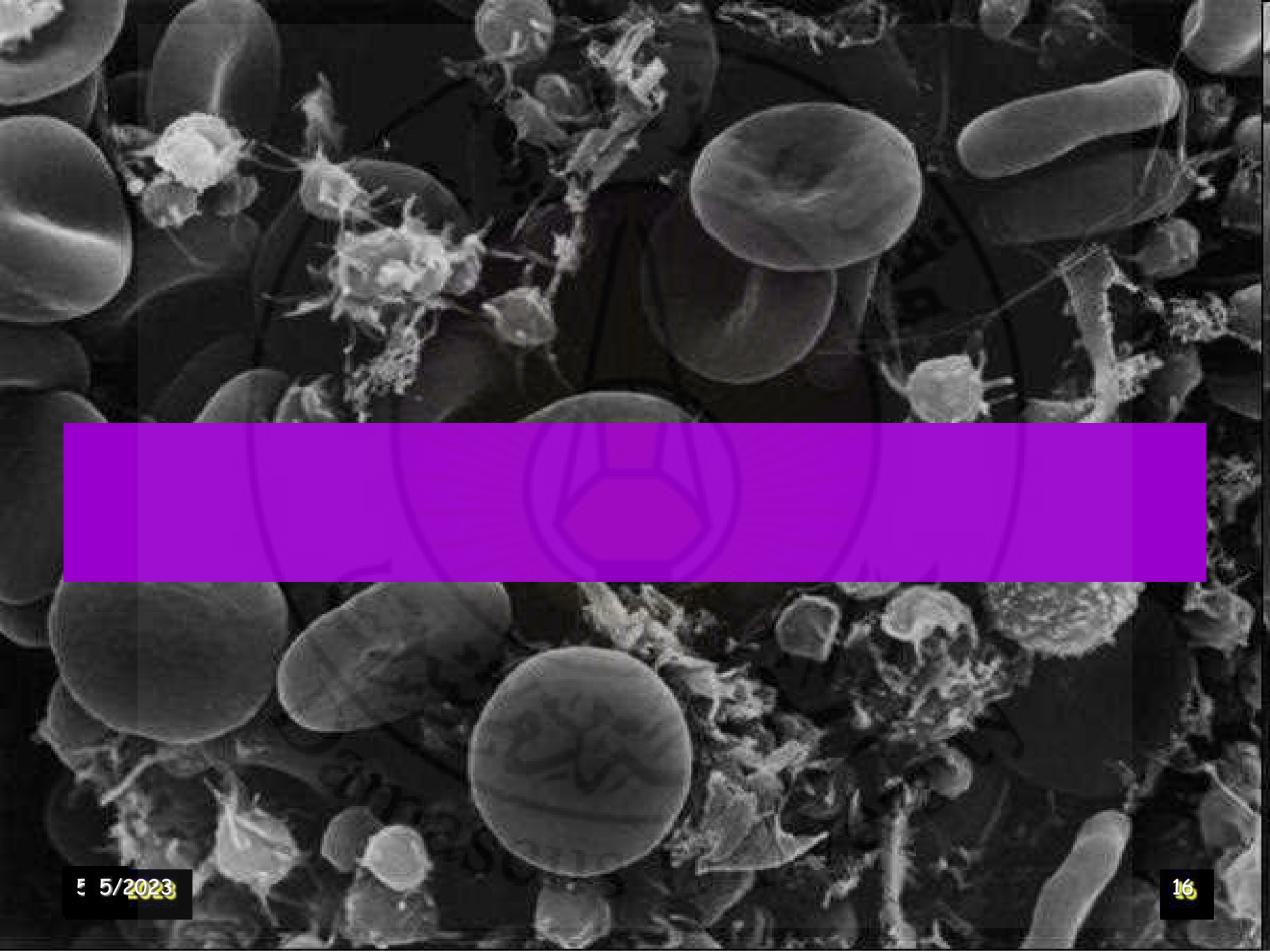
Plant cell

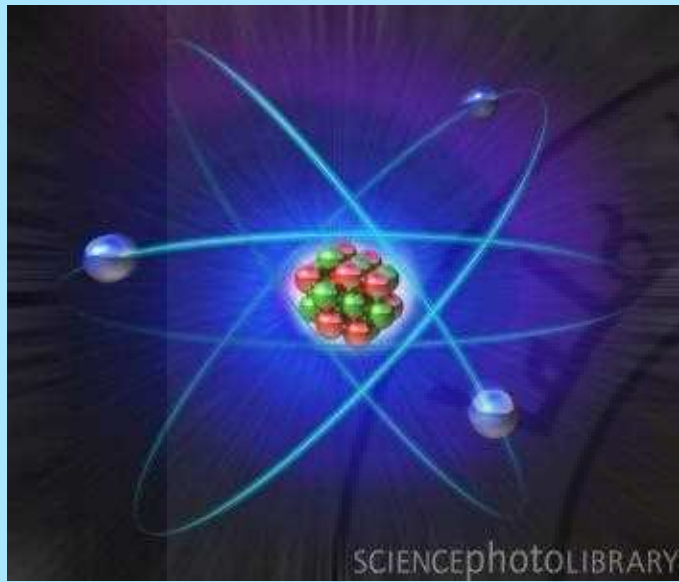


جهاز كولجي

- افراز مواد لخارج الخلية
- توجيه المواد الداخلة و الخارجة للخلية







ATOMIC STRUCTURE

البنية الذرية

Atomic Structure

المادة مكوّنة من ذرّات

الذرة تاريخياً

1808

John Dalton



اقترح دالتون أن المادّة مكوّنة من كرات صغيرة جداً بإمكانها الحركة في جميع الاتجاهات بمرونة كبيرة وأطلق على هذه الكرات اسم:

ATOMS

Subatomic Particles

الجسيمات تحت الذرية: مكونات الذرة

Particle	Mass (kg)	Charge (Coulombs)	Charge (units)
Electron (e^-)	9.1×10^{-31}	-1.6×10^{-19}	-1
Proton (p)	1.67×10^{-27}	$+1.6 \times 10^{-19}$	+1
Neutron (n)	1.67×10^{-27}	0	0

$$\text{mass p} = \text{mass n} = 1840 \times \text{mass } e^-$$

Atomic Structure

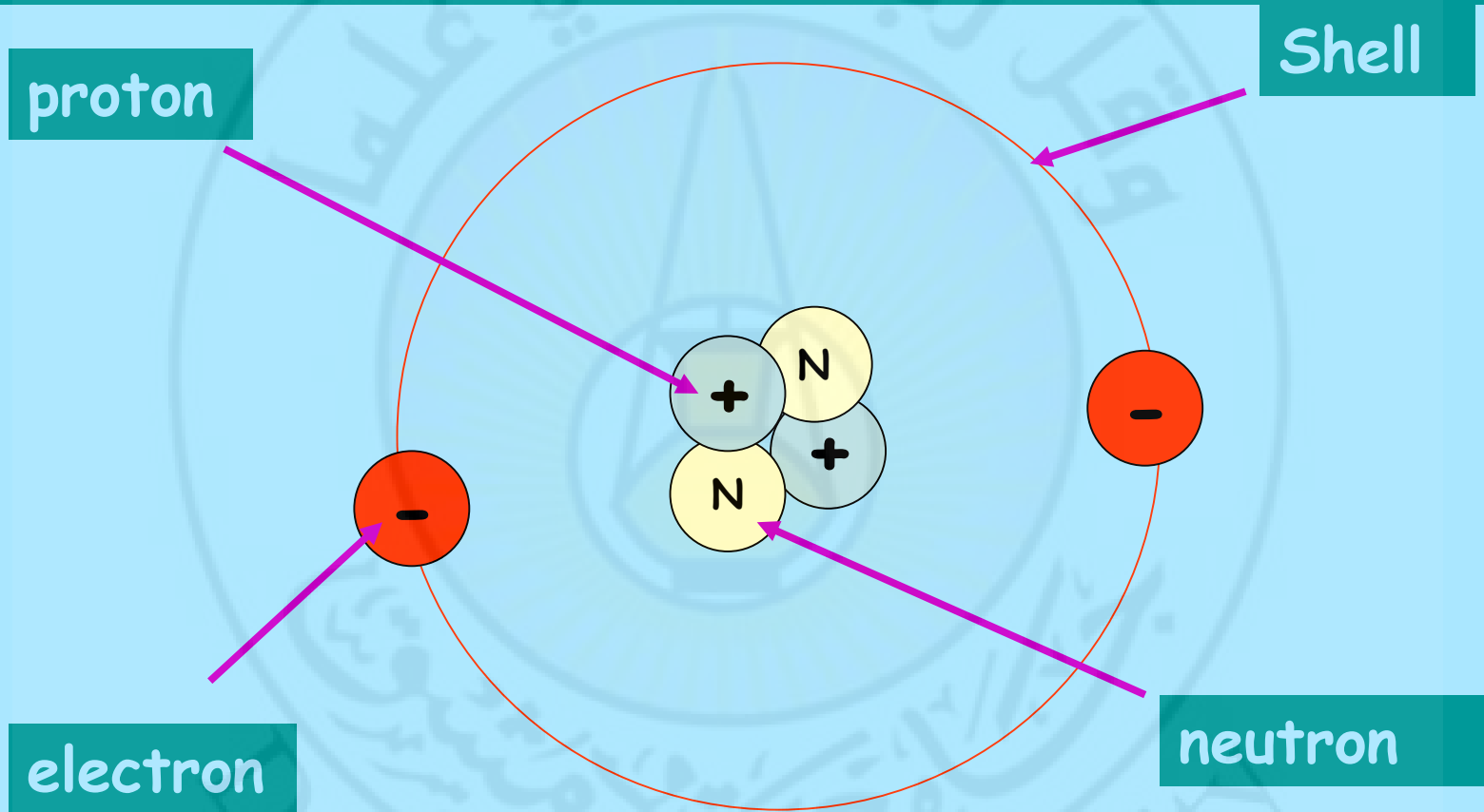
Atoms are composed of

- **Protons** – positively charged **(+)** particles
- **Neutrons** – neutral particles (معتدلة الشحنة)
- **Electrons** – negatively charged **(-)** particles

Protons and Neutrons are located **in** the **nucleus**.

Electrons are found in **orbitals** surrounding the nucleus. (مدارات حول النواة الذرية)

HELIUM ATOM



Atomic Structure

تمتلك ذرة **محددًا** من البروتونات في نواتها وهو يساوي عدد الإلكترونات المدارية. هذا العدد يسمى العدد الذري وهو يحدّد الخواص الكيميائية للعنصر (**Element**) المقصود.

Atomic number = number of
protons = **Z**

Atomic Structure

تمتلك البروتونات والنيوترونات (مكونات النواة الذرية) كتلاً متقاربة ومجموع كتلهما يشكل معظم كتلة الذرة:

Atomic Mass

عدد النيوترونات N + عدد البروتونات Z = عدد الكتلة A

النظائر - **Isotopes**: نفس العدد الذري Z ، أي نفس العنصر، والاختلاف بعدد النيوترونات N وبالتالي بعدد الكتلة A .

ATOMIC STRUCTURE

Mass number

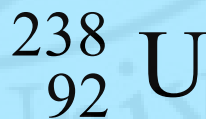
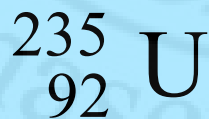
the number of protons and neutrons in an atom

Atomic number

the number of protons in an atom



number of electrons = number of protons



- عندما تكتسب الذرة طاقة، يمكن للإلكترون أن ينتقل إلى مدار ذي طاقة أعلى. وتكون هذه الذرة في حالة مُثارة **Excited State**.

- الذرة **أقلّ** استقراراً في حالتها **المُثارة**، وتتخلّص عادةً من طاقتها الزائدة دفعةً واحدة أو على مراحل، وتعود إلى حالتها **الأساسيّة المستقرّة**.



The Human Body introduction

جسم الإنسان // مقدمة

Dr. M bakkour

Damascus University

An Overview of Anatomy

■ التشریح : دراسة تركيب جسم الإنسان.

■ مقطعي (Gross anatomy)

مجهری (Microscopic anatomy (histology))

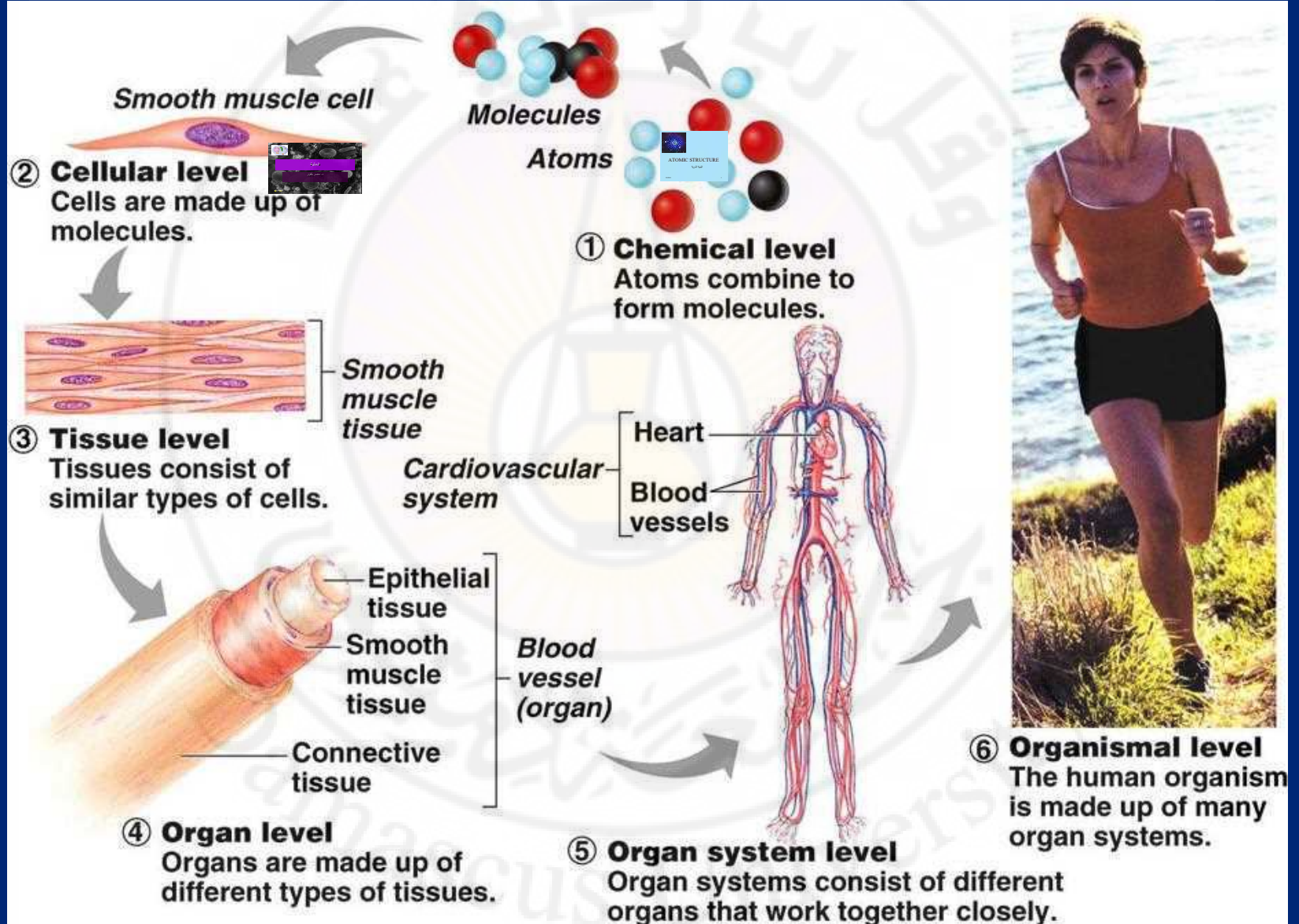
سطحي (Surface anatomy)

Damascus University

The Hierarchy of human body

التسلسل الهرمي للجسم البشري

- **Chemical level** – atoms form molecules
- **Cellular level** – cells and their functional subunits
- **Tissue level** – a group of cells performing a common function
- **Organ level** – a discrete structure made up of more than one tissue
- **Organ system** – organs working together for a common purpose
- **Organismal level** – the result of all simpler levels working in unison



Systemic v. Regional Anatomy

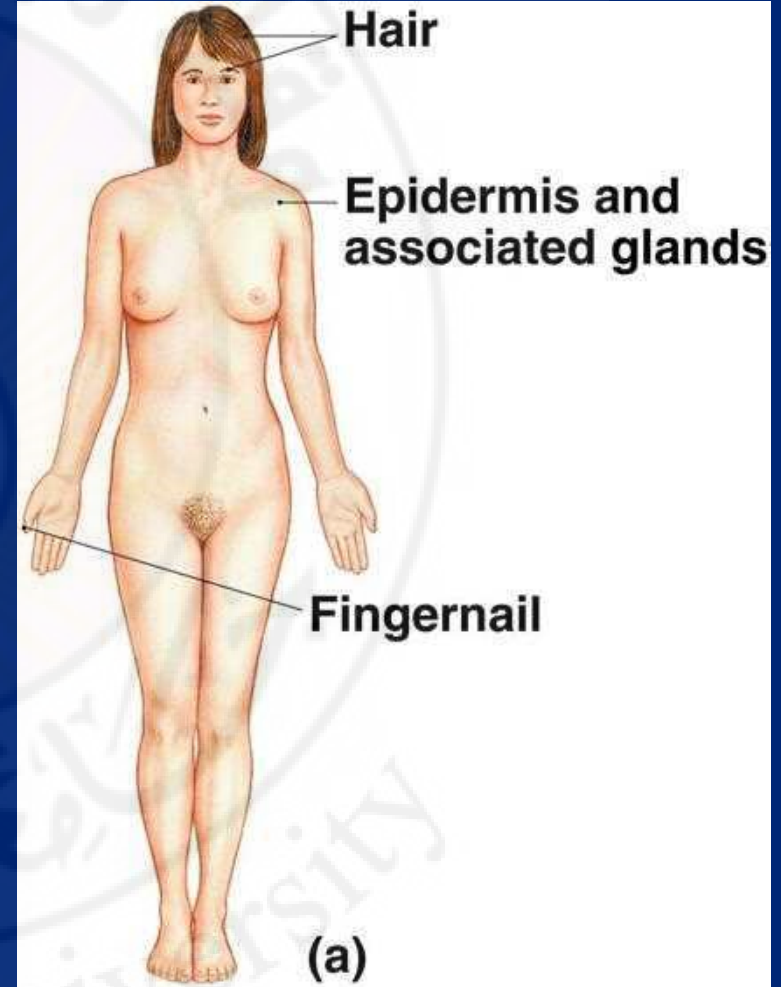
التشريح الناحي // الجهاز

- **Systemic** – study of anatomy by system
- **Regional** – study of anatomy by region
- Most students use a combination of regional and systemic study

The Integumentary System

الجهاز الغلافي الخارجي

- يغطي محيط الجسم الخارجي.
- يحمي النسيج العميقة من الأذى.
- إنتاج فيتامين د .
- يحوي مستقبلات حسية و غدد ملحقه.
- ينظم الحرارة.
- يعطي لون للجسم.
- يحوي الأشعار.

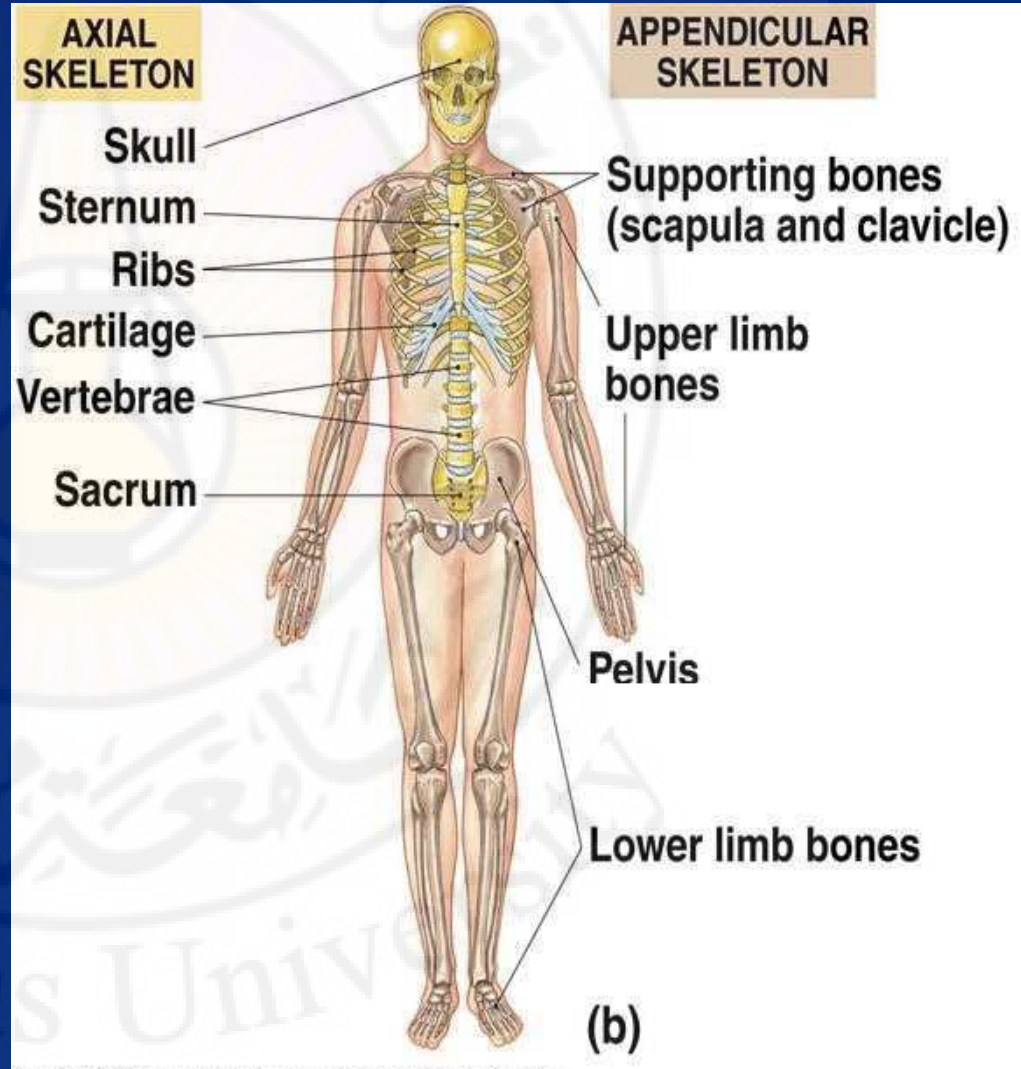


Copyright © 2007 Pearson Education, Inc., publishing as Benjamin Cummings

The Skeletal System

الجهاز الهيكلي العظمي

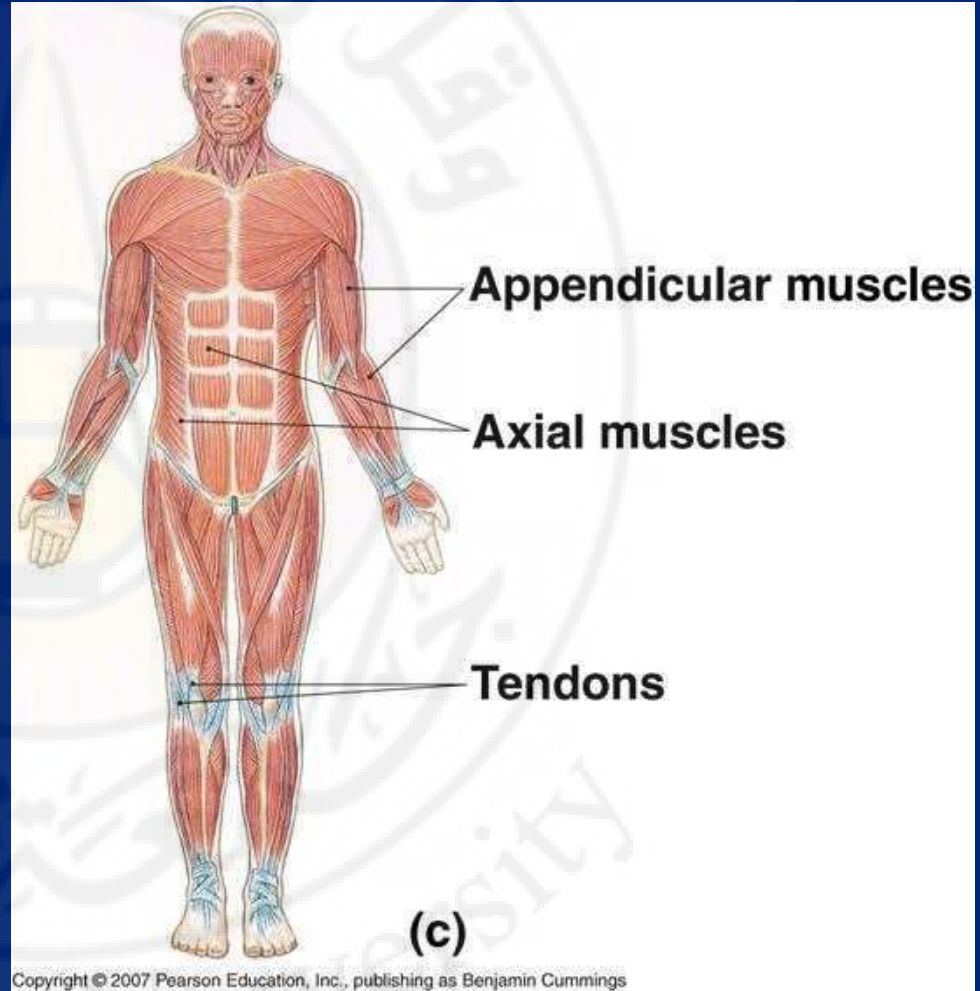
- يدعم و يحمي الجسم.
- مرتكز للعضلات.
- انتاج كريات الدم ضمن النقي.
- خزان للشوارد.



The Muscular System

الجهاز العضلي

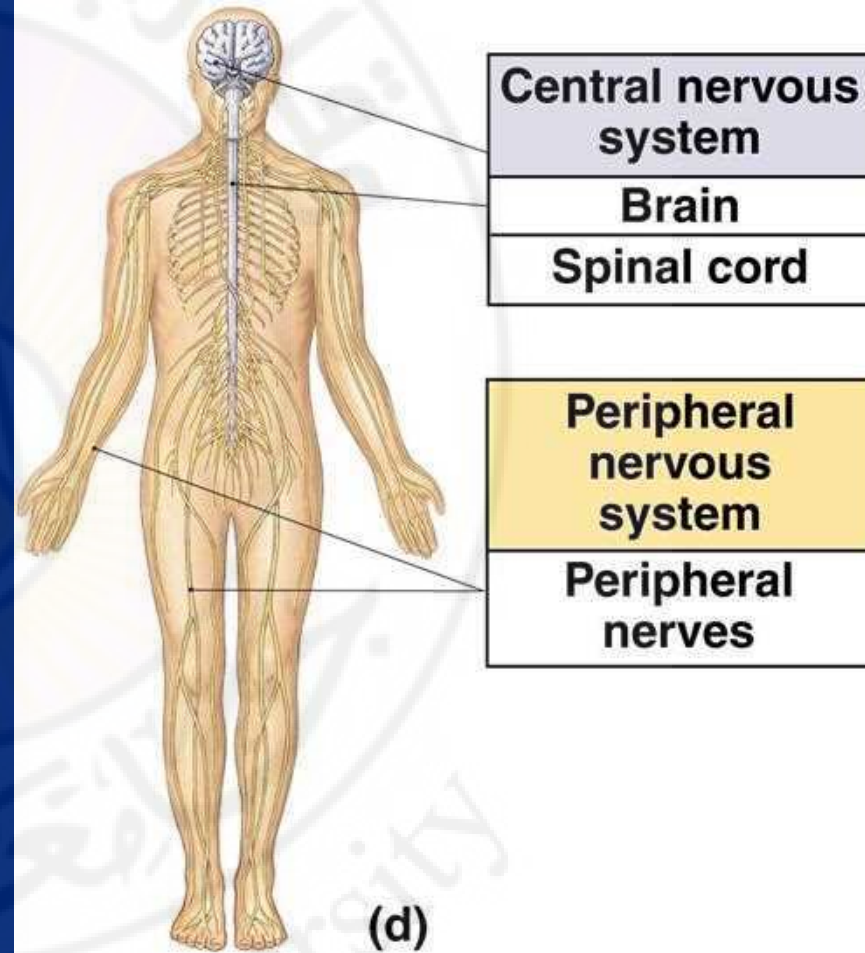
- يسمح بالتنقل و الحركة.
- تعبير الوجه.
- انتاج حرارة.



The Nervous System

الجهاز العصبي

- يتألف من جملة عصبية مركزية و محيطية.
- المركزية : دماغ و نخاع شوكي .
- محيطية : أعصاب و جملة ودية و نظيرة ودية.

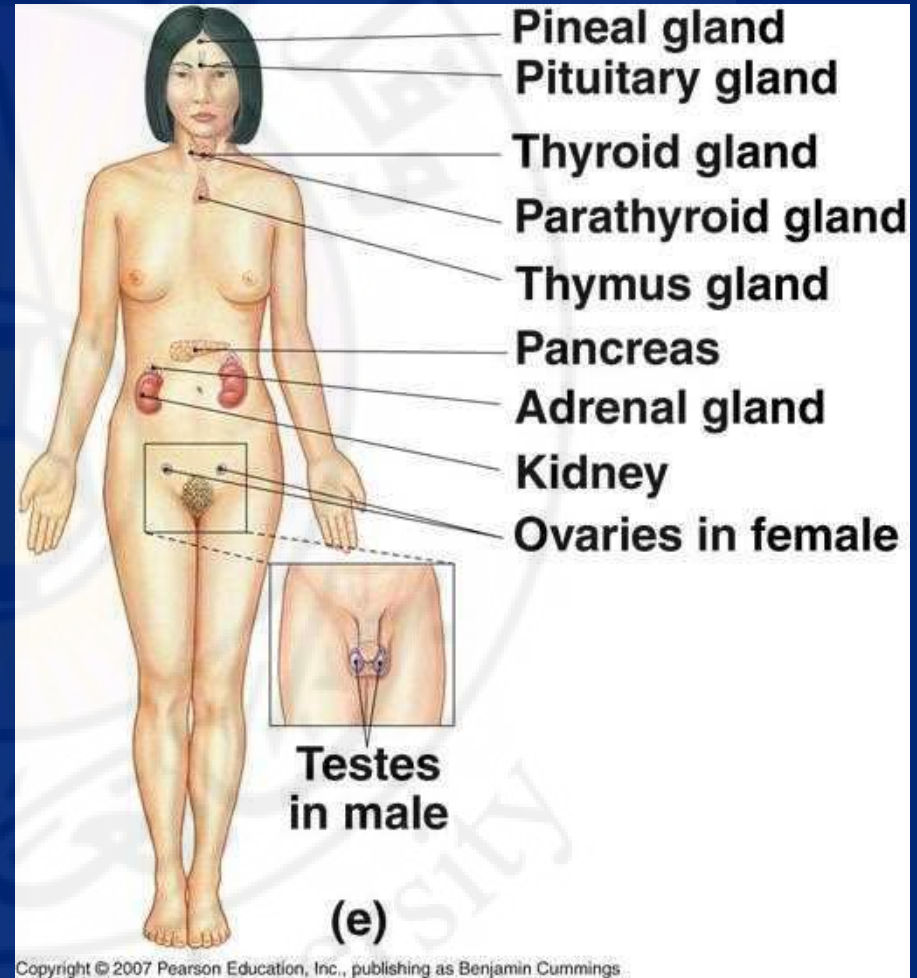


Copyright © 2007 Pearson Education, Inc., publishing as Benjamin Cummings

The Endocrine System

الجهاز الغدي

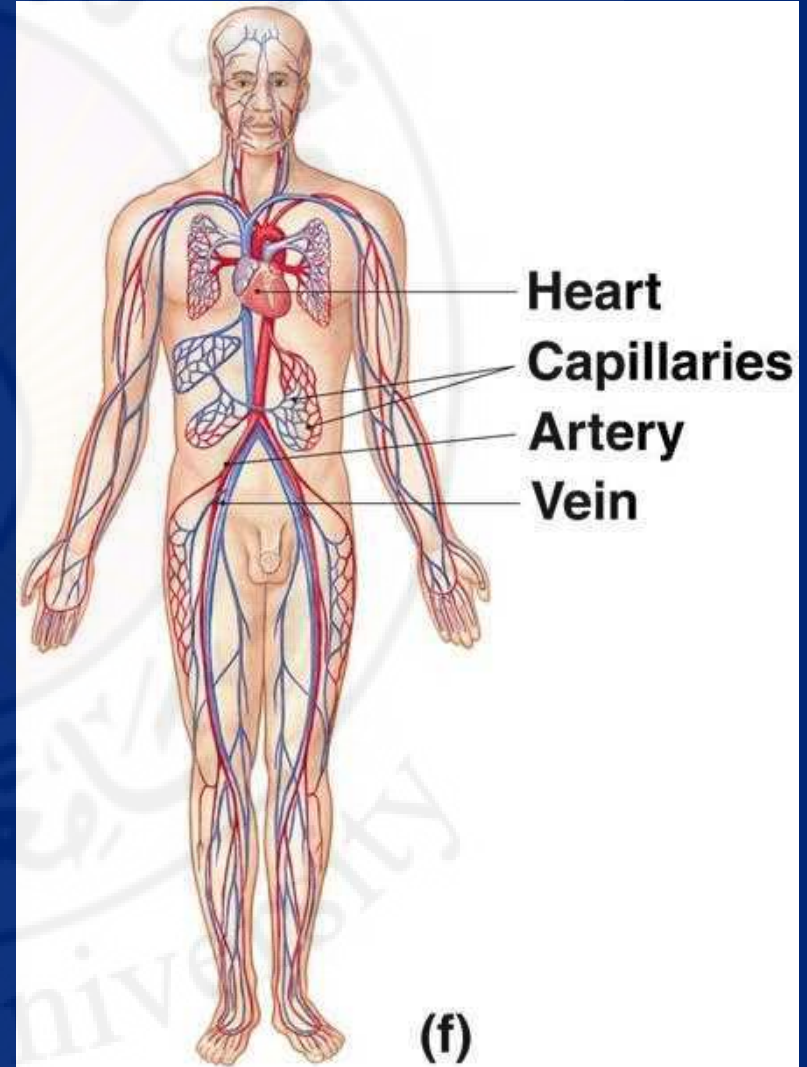
- الغدد التي تفرز هرمونات لتنظيم:
 - النمو
 - التغذية
 - الجنس



The Cardiovascular System

الجهاز القلبي الوعائي

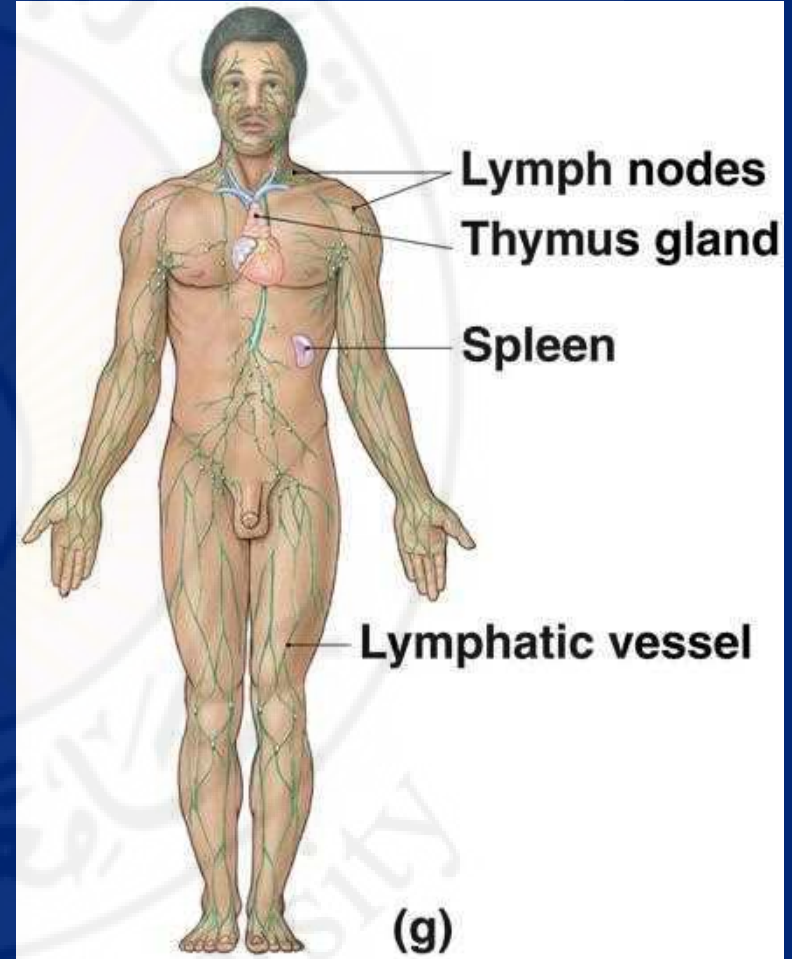
- عضلة القلب التي تضخ الدم عبر الأوعية الدموية.
- الأوعية الدموية تنقل الدم ، و الذي يحمل بدوره O_2/CO_2 ، و أيضا الطعام و الفضلات.



The Lymphatic System

الجهاز اللمفاوي

- يلتقط السوائل المتسربة من الأوعية الدموية.
- يحوي على الكريات البيضاء.
- مكان لتوليد الأضاد

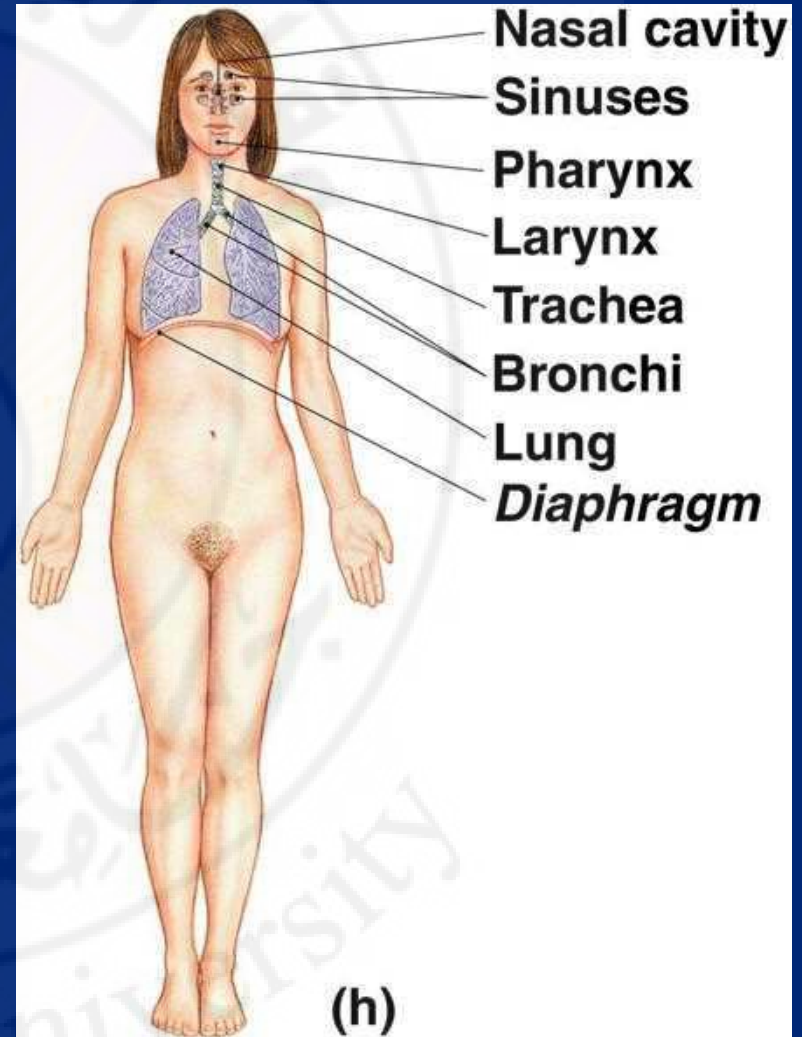


Copyright © 2007 Pearson Education, Inc., publishing as Benjamin Cummings

The Respiratory System

الجهاز التنفسي

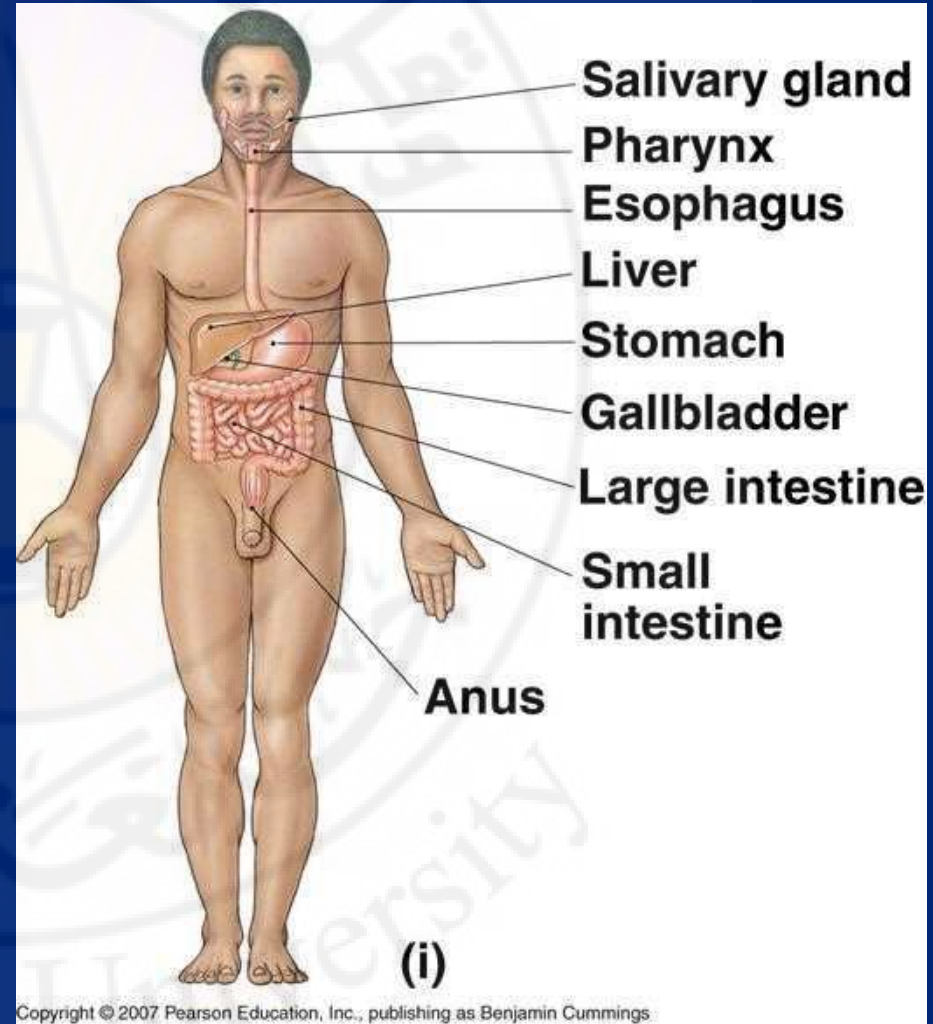
- يزود الدم بالأكسجين.
- ينزع CO_2 .
- هذا التبادل يحصل ضمن جدار الأسناخ الهوائية.



The Digestive System

الجهاز الهضمي

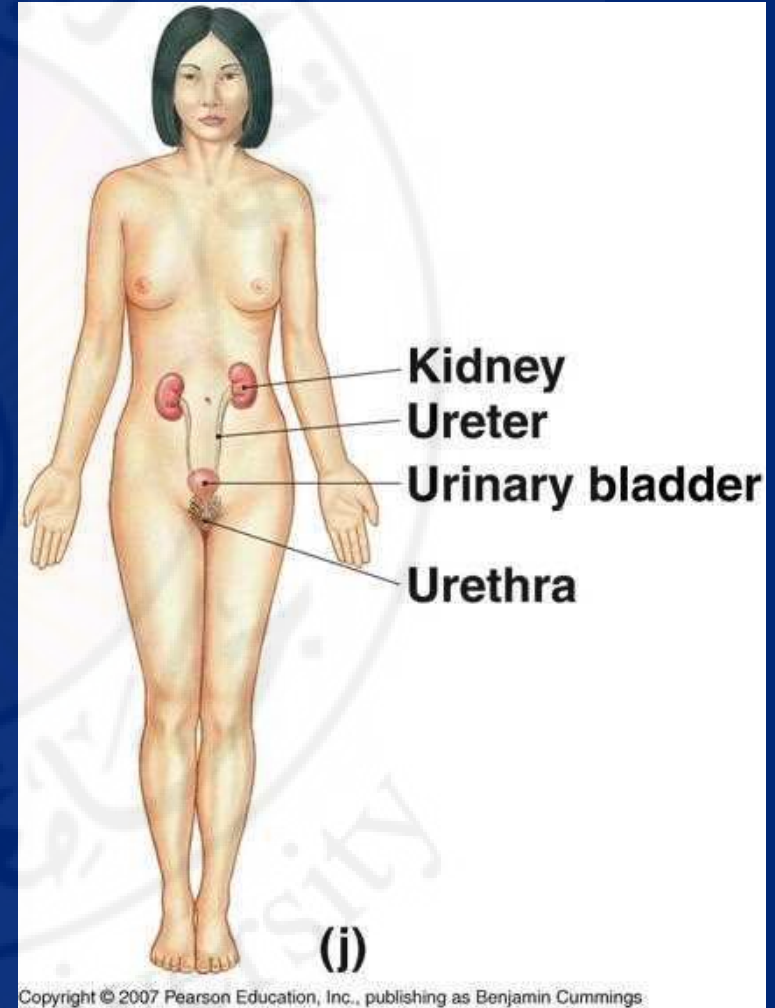
- تفكيك الطعام الى وحدات قابلة للامتصاص.
- طرح المتبقي بشكل براز.



The Urinary System

الجهاز البولي

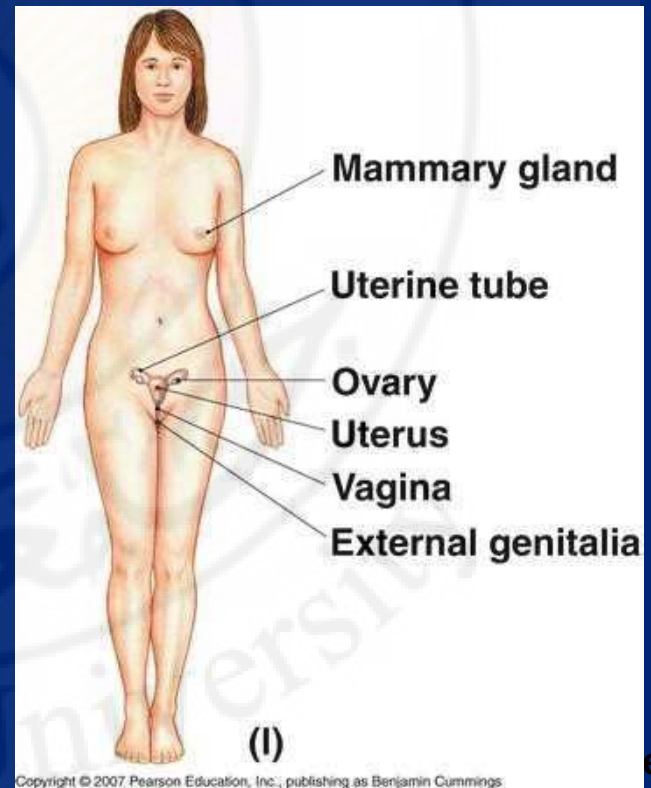
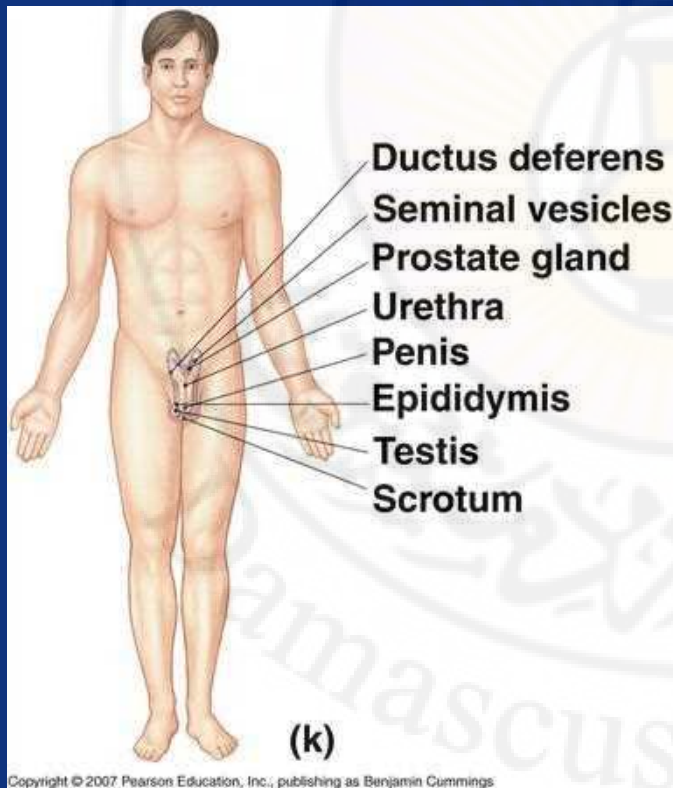
- التخلص من فضلات النتروجينات.
- تنظيم الماء و الشوارد بالدم و الحفاظ
- التوازن الحامضي الاساسي بالدم (PH).



Reproductive System

الجهاز التناسلي

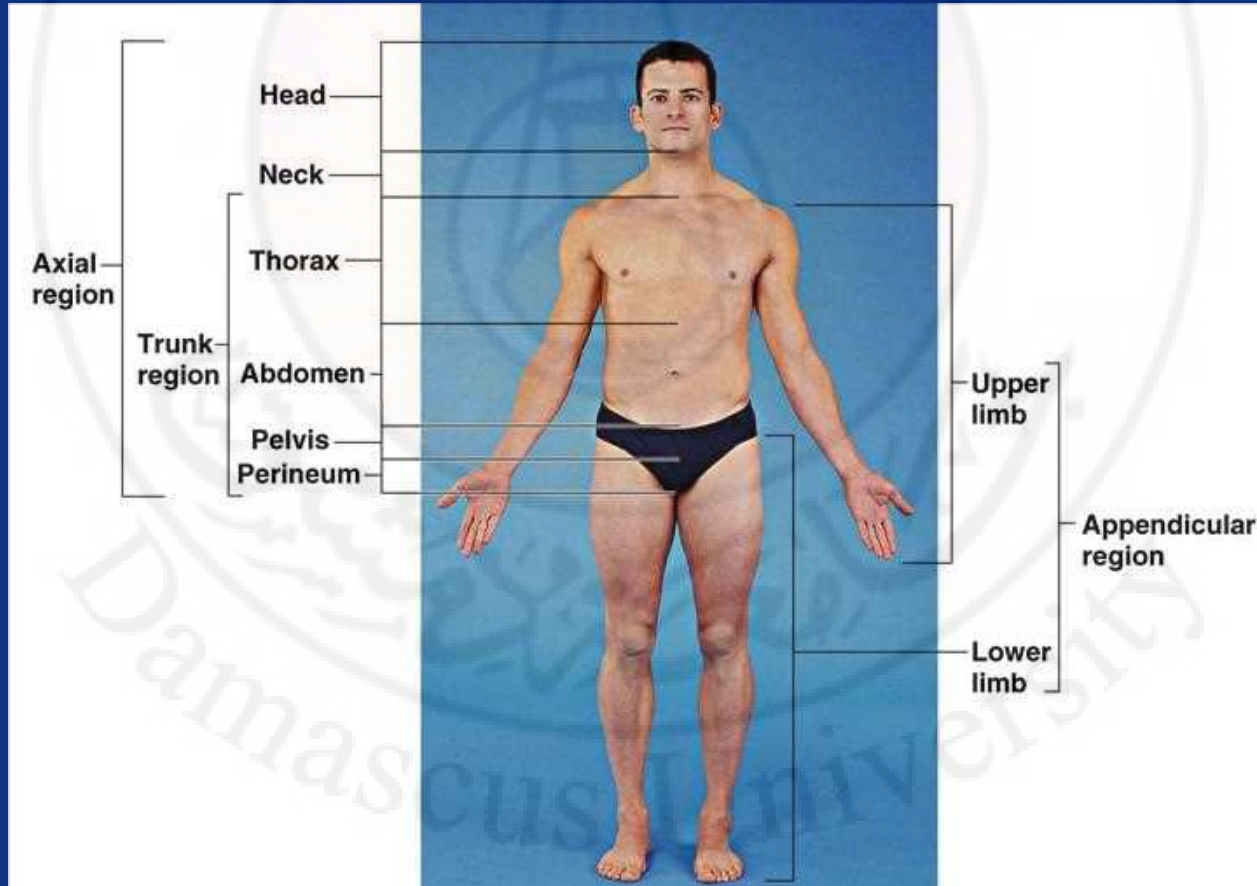
- إنتاج الأعراس الذكرية و الانثوية.
- إنتاج الهرمونات الجنسية.
- إنتاج الحليب عند النساء.



Gross Anatomy

التشريح المقطعي

- الوضعية التشريحية.
- شخص واقف على قدميه القدمية و العينان للأمام.
- راحة اليدين للأمام مع الابهام بعيد عن الجسم.



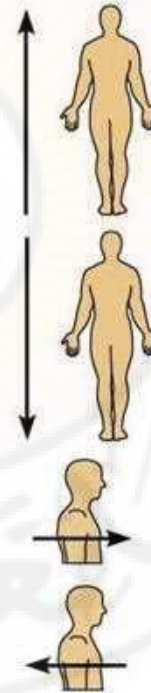
Orientation and Directional Terms

مصطلحات التوجه و الاتجاه

TABLE

1.1 Orientation and Directional Terms

Term	Definition	Example
Superior (cranial)	Toward the head end or upper part of a structure or the body; above	The head is superior to the abdomen.
Inferior (caudal)	Away from the head end or toward the lower part of a structure or the body; below	The navel is inferior to the chin.
Anterior (ventral)*	Toward or at the front of the body; in front of	The breastbone is anterior to the spine.
Posterior (dorsal)*	Toward or at the back of the body; behind	The heart is posterior to the breastbone.



*Whereas the terms *ventral* and *anterior* are synonymous in humans, this is not the case in four-legged animals. *Ventral* specifically refers to the "belly" of a vertebrate animal and thus is the inferior surface of four-legged animals. Likewise,

although the dorsal and posterior surfaces are the same in humans, the term *dorsal* specifically refers to an animal's back. Thus, the dorsal surface of four-legged animals is their superior surface.

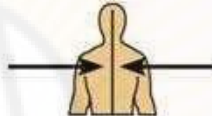
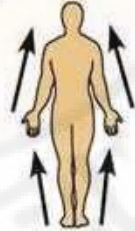
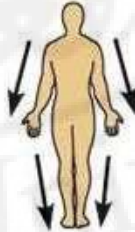
Orientation and Directional Terms

مصطلحات التوجه و الاتجاه

TABLE

1.1

Orientation and Directional Terms

Term	Definition		Example
Medial	Toward or at the midline of the body; on the inner side of		The heart is medial to the arm.
Lateral	Away from the midline of the body; on the outer side of		The arms are lateral to the chest.
Proximal	Closer to the origin of the body part or the point of attachment of a limb to the body trunk		The elbow is proximal to the wrist.
Distal	Farther from the origin of a body part or the point of attachment of a limb to the body trunk		The knee is distal to the thigh.

Orientation and Directional Terms

مصطلحات التوجه و الاتجاه

TABLE

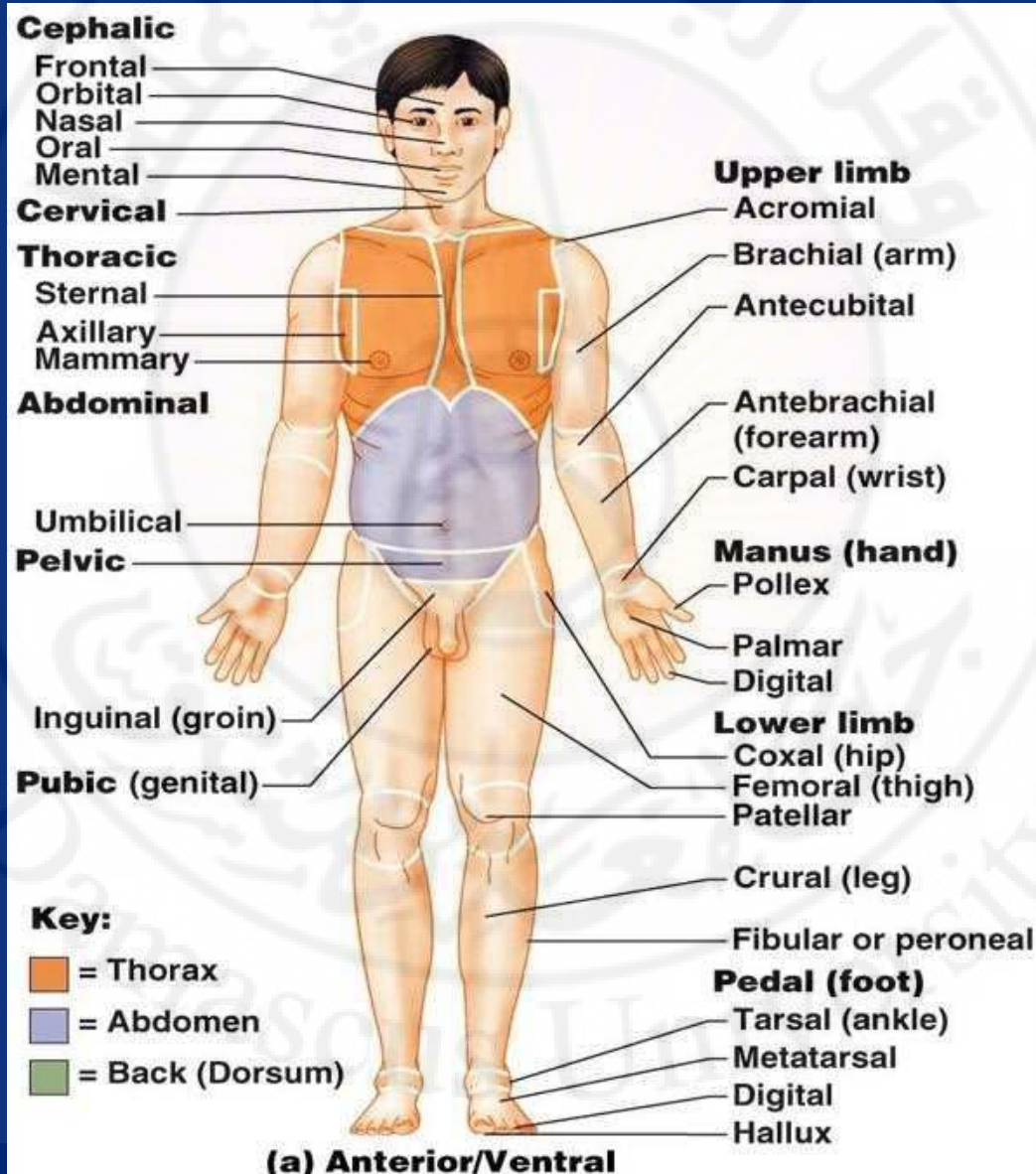
1.1

Orientation and Directional Terms

Term	Definition	Example
Superficial (external)	Toward or at the body surface	 The skin is superficial to the skeletal muscles.
Deep (internal)	Away from the body surface; more internal	 The lungs are deep to the skin.
Ipsilateral	On the same side	 The right hand and right foot are ipsilateral.
Contralateral	On opposite sides	 The right hand and left foot are contralateral.

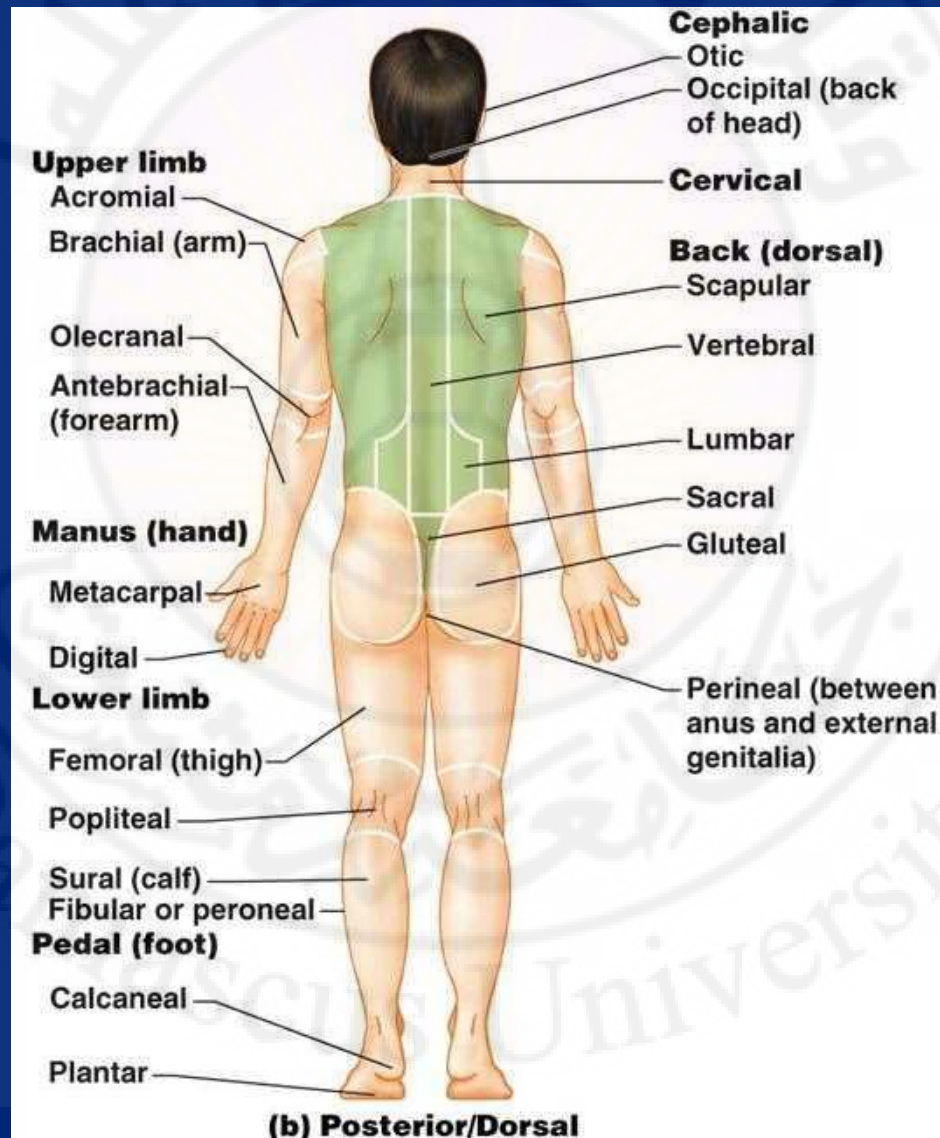
Regional Terms

مصطلحات النواحي التشريحية



Regional Terms

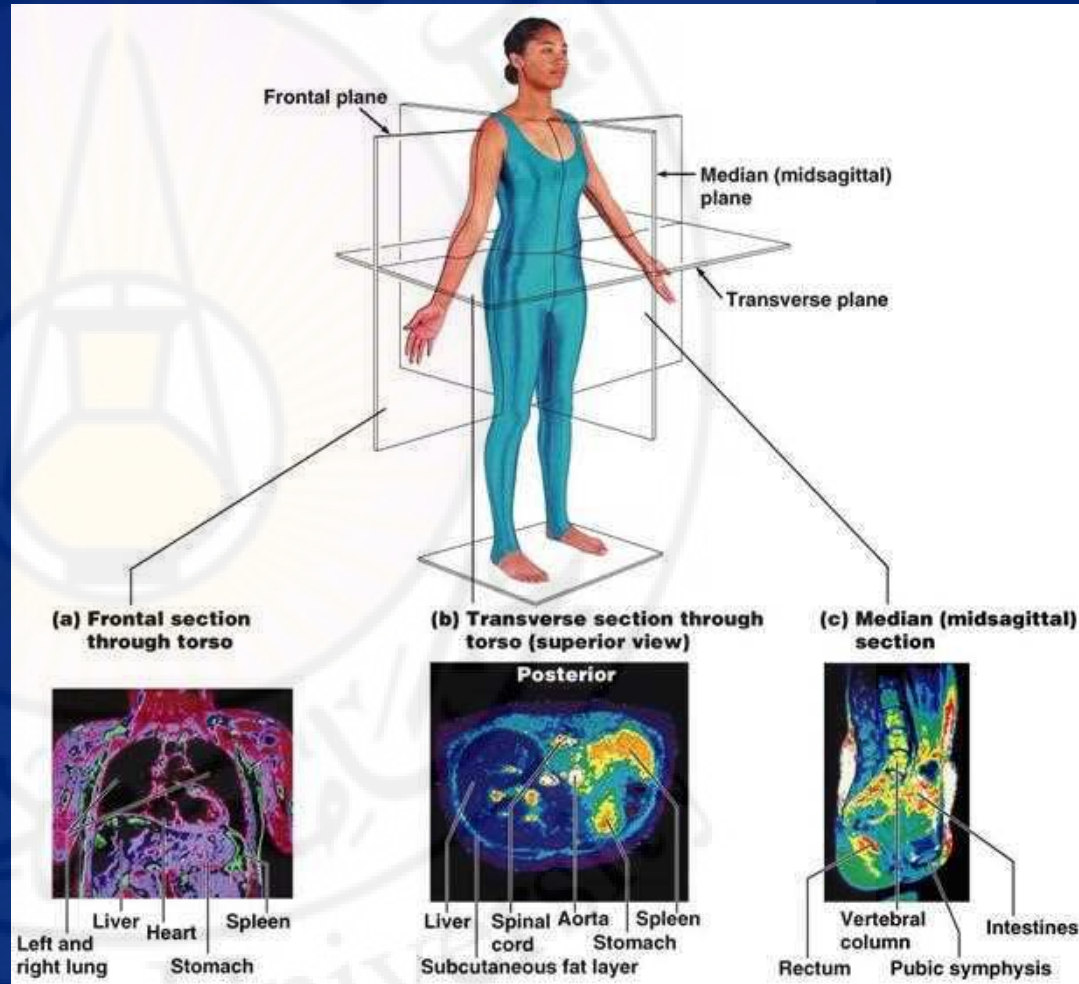
مصطلحات النواحي التشريحية



Body Planes and Sections

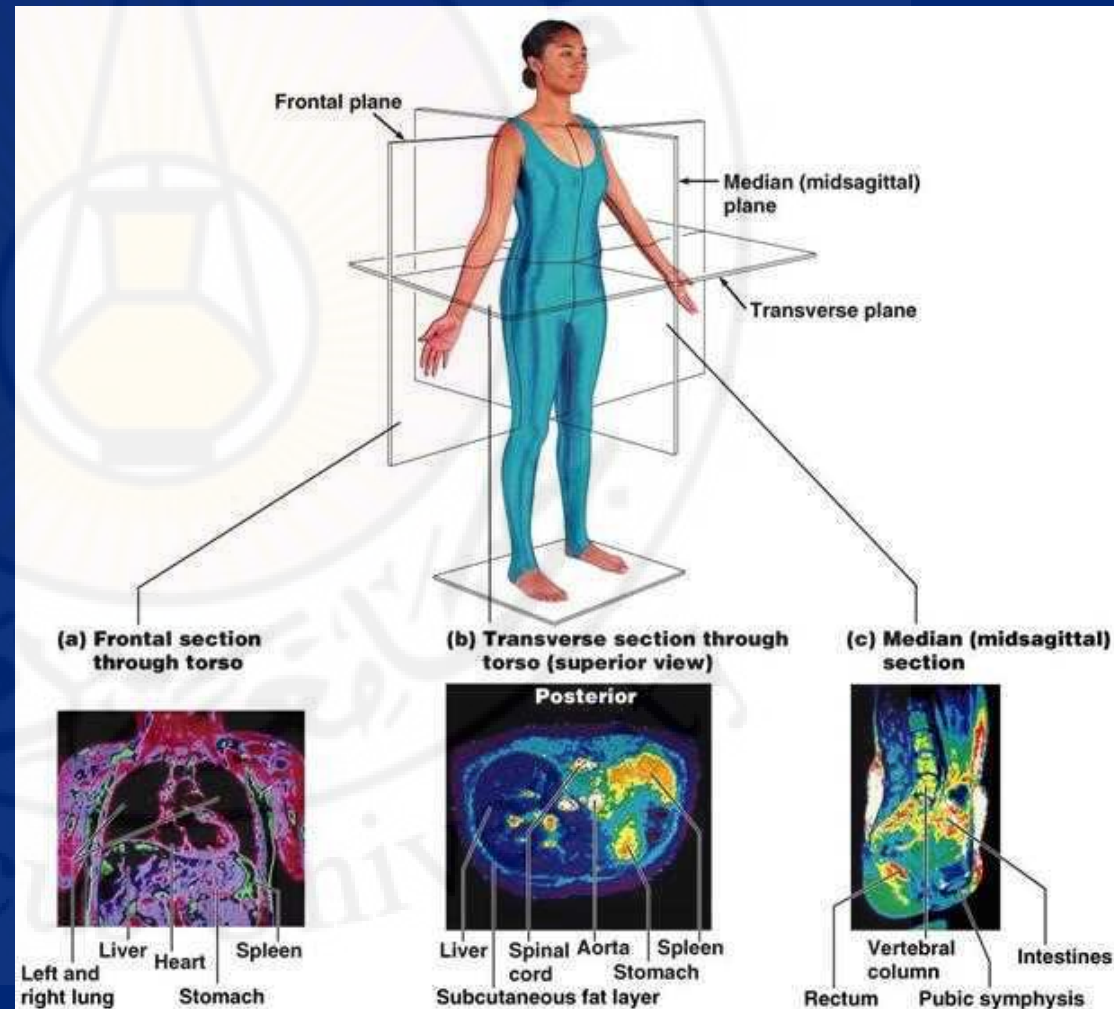
مصطلحات مقاطع الجسم

- Coronal (frontal) plane / مقطع جبهوي - Lies vertically and divides body into anterior and posterior parts
- Median (midsagittal) plane / مقطع ناصف - Specific sagittal plane that lies vertically in the midline



Body Planes and Sections

- Transverse plane / معترض - runs horizontally and divides body into superior and inferior parts



Body Planes and Sections

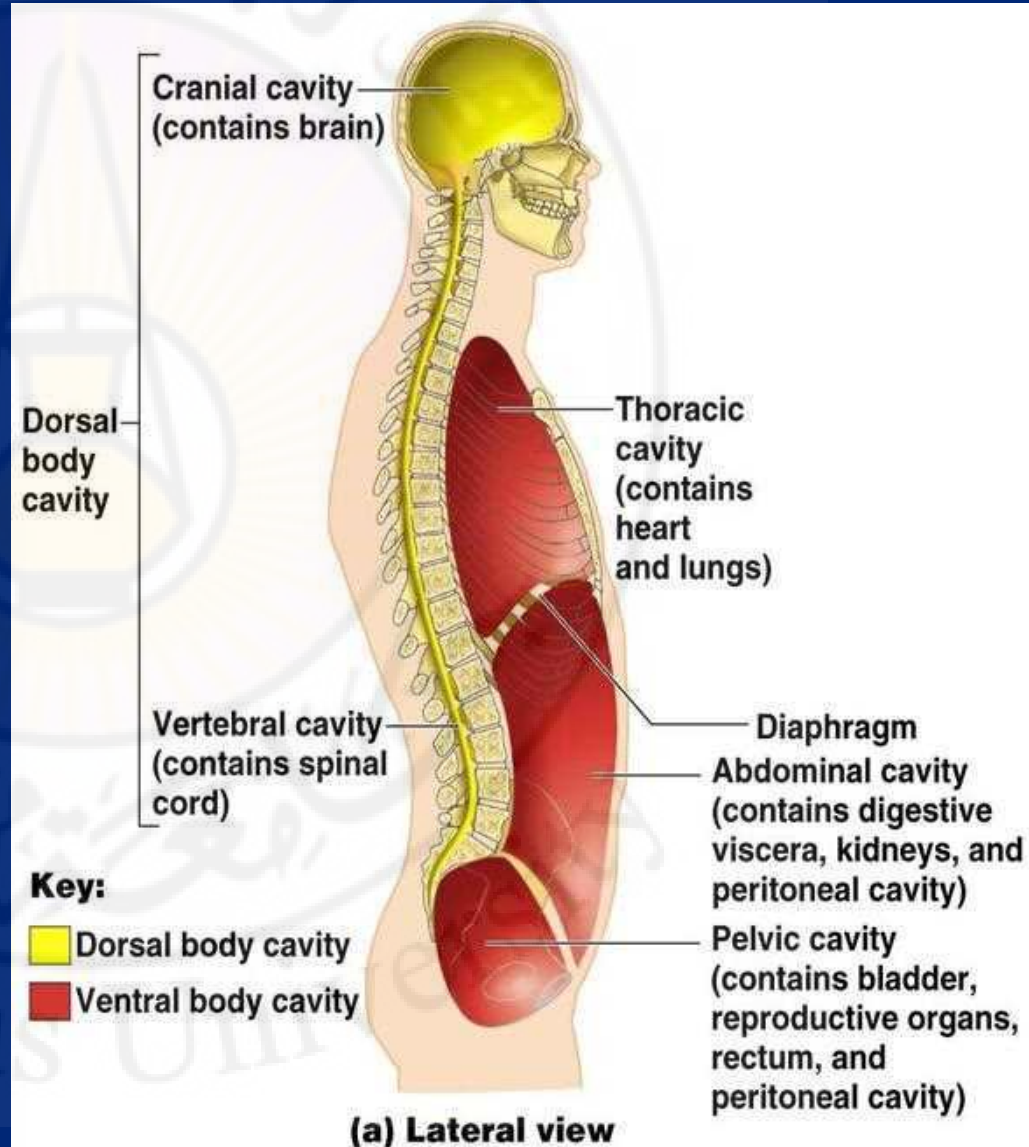
- منحرف/Oblique section through the trunk



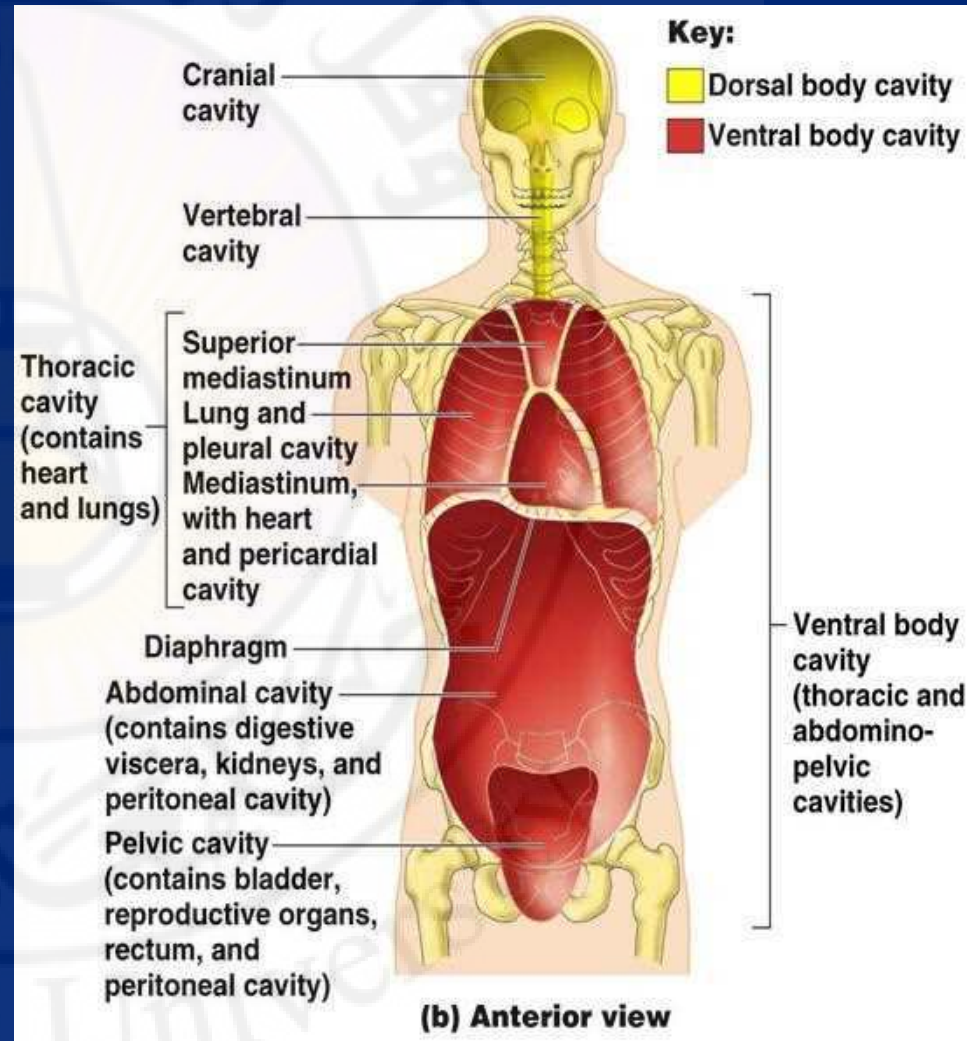
Body Cavities and Membranes

تجاويف الجسم و الأغشية

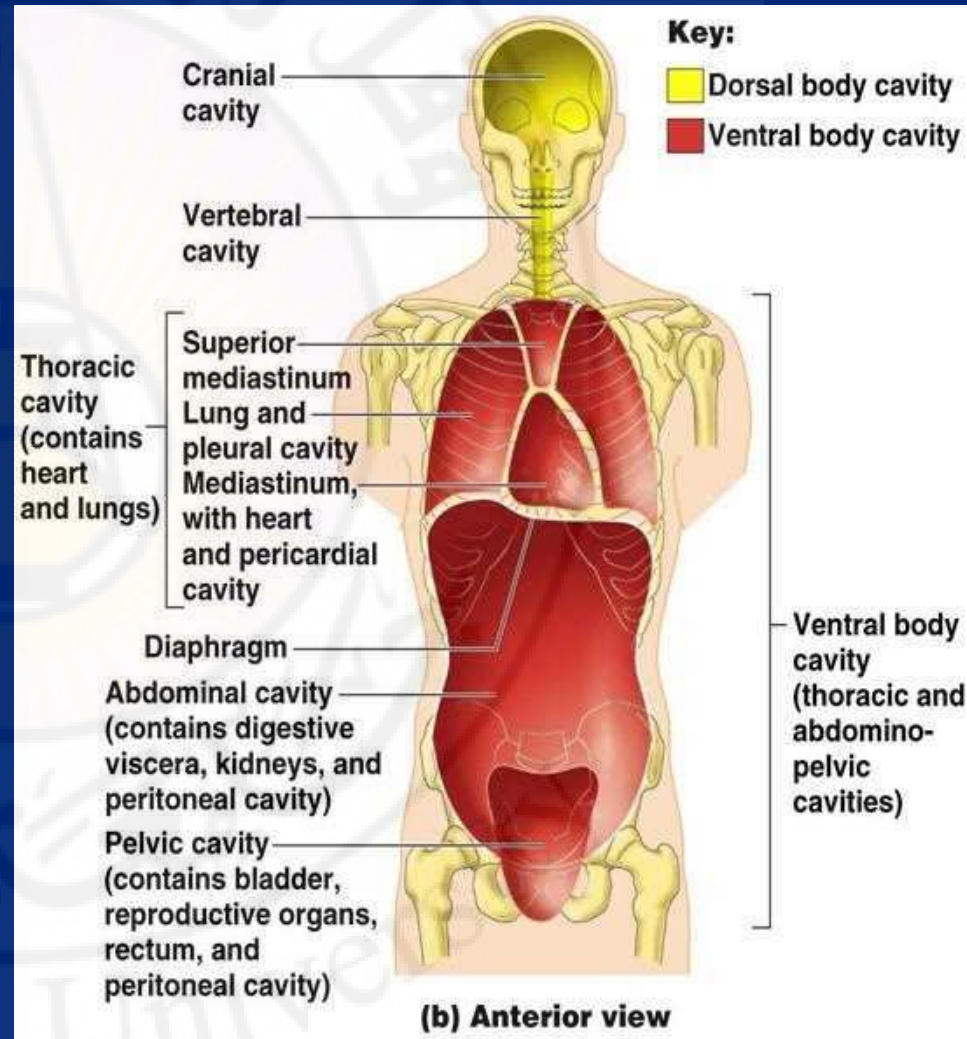
- ظهري/Dorsal body cavity
- Cavity subdivided into the cranial cavity and the vertebral cavity.
 - قحفي/Cranial cavity houses the brain.
 - فقري/Vertebral cavity runs through the vertebral column and encloses the spinal cord



- **بطني/Ventral body cavity** – subdivided into:
 - **صدري/Thoracic cavity** – divided into three parts
 - Two lateral parts each containing a lung surrounded by a pleural cavity
 - **Mediastinum** – contains the heart surrounded by the pericardial sac

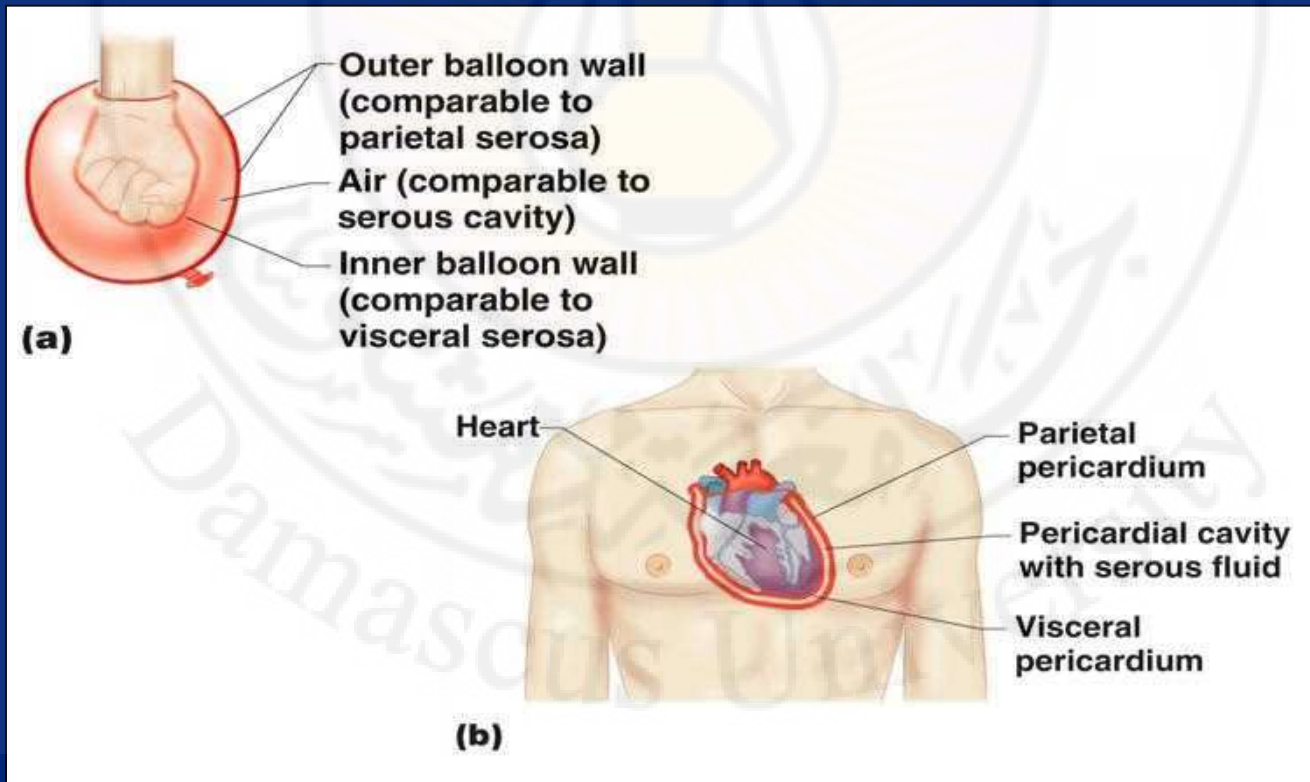


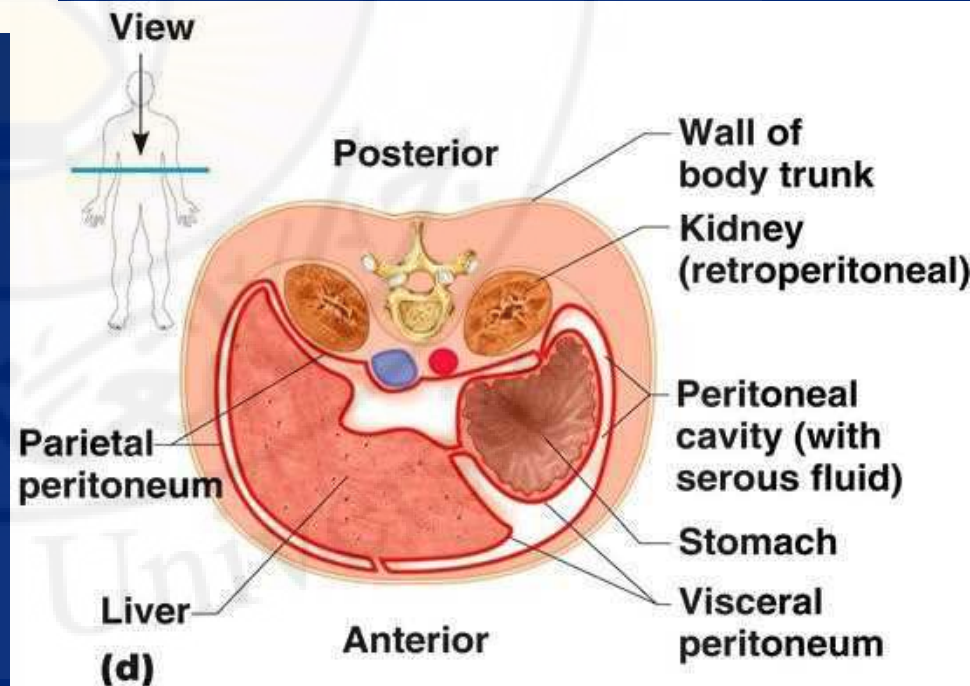
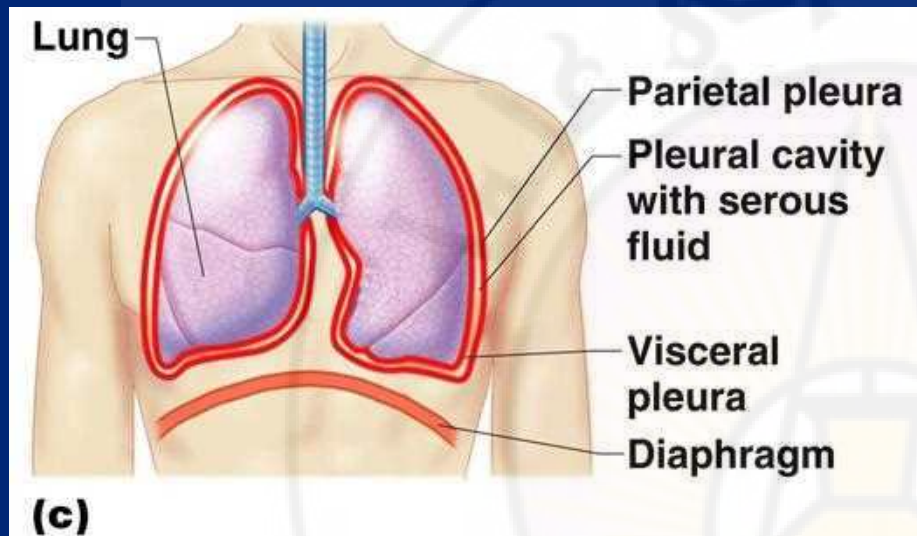
- **بطني/Ventral body cavity**
 - **Abdominopelvic cavity** – divided into two parts
 - **Abdominal cavity** – contains the liver, stomach, kidneys, and other organs
 - **حوضي/Pelvic cavity** – contains the bladder, some reproductive organs, and rectum



- **المصليّة/Serous cavities**

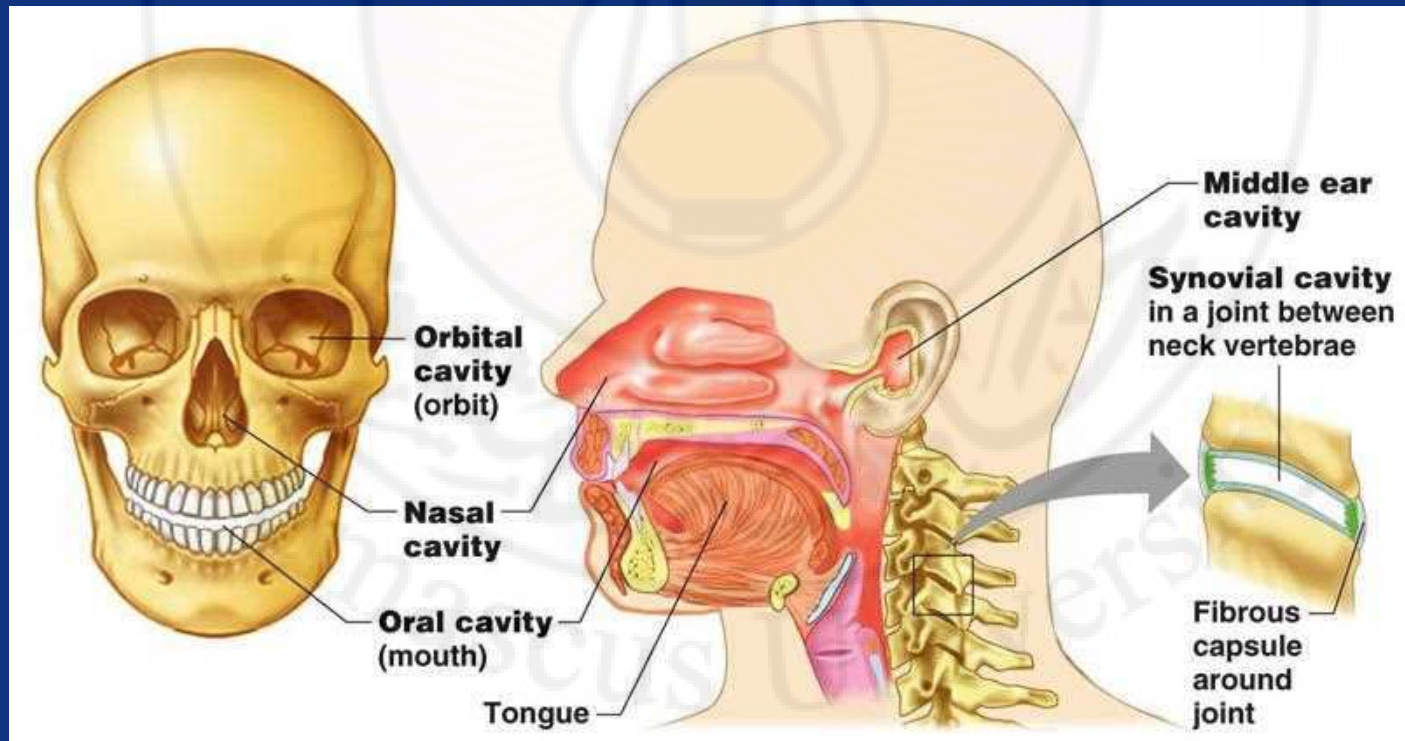
- Pleura, pericardium, and peritoneum
 - جدارية/Parietal serosa – outer wall of the cavity
 - حشوية/Visceral serosa covers the visceral organs

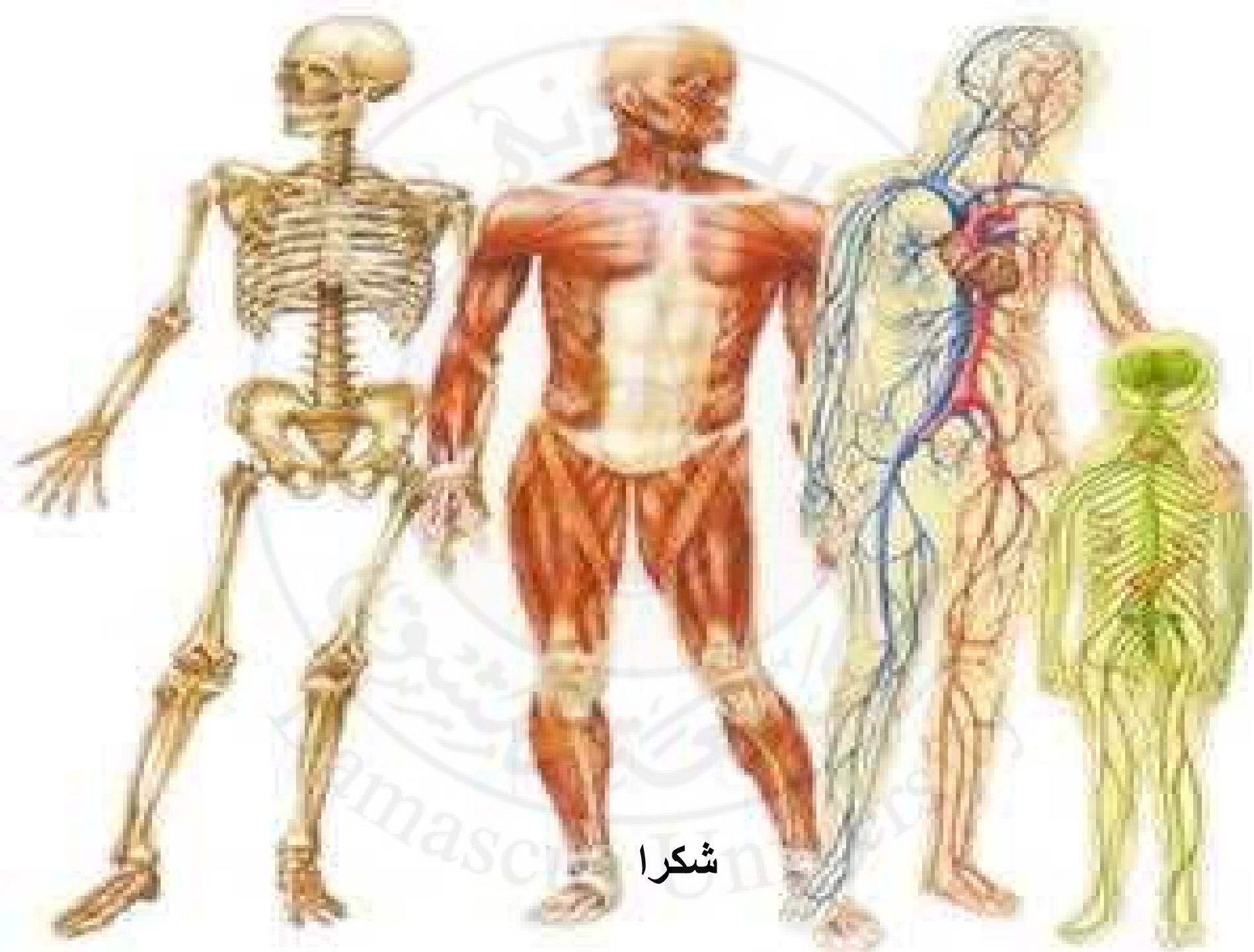




Other Body Cavities

- فموي/Oral cavity
- أنفي/Nasal cavity
- حجاجي/Orbital cavities
- أذن وسطي/Middle ear cavities
- المفصلي/Synovial cavities





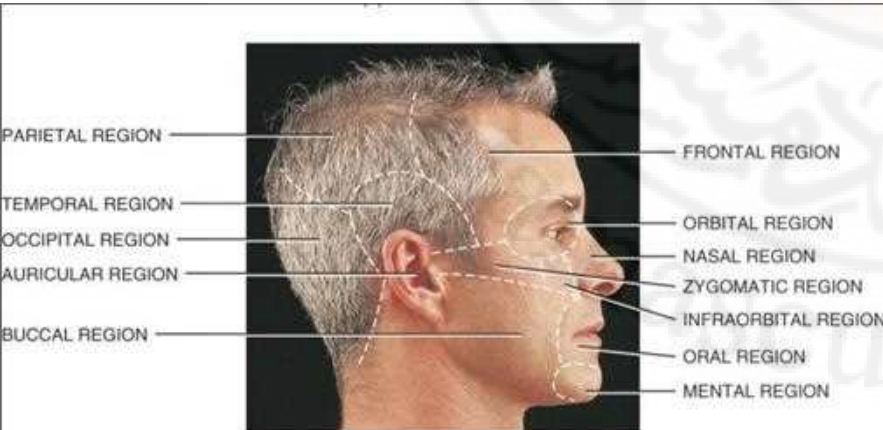
شكرا

علامات تشريحية شعاعية للرأس و العنق

د. مضر بكور

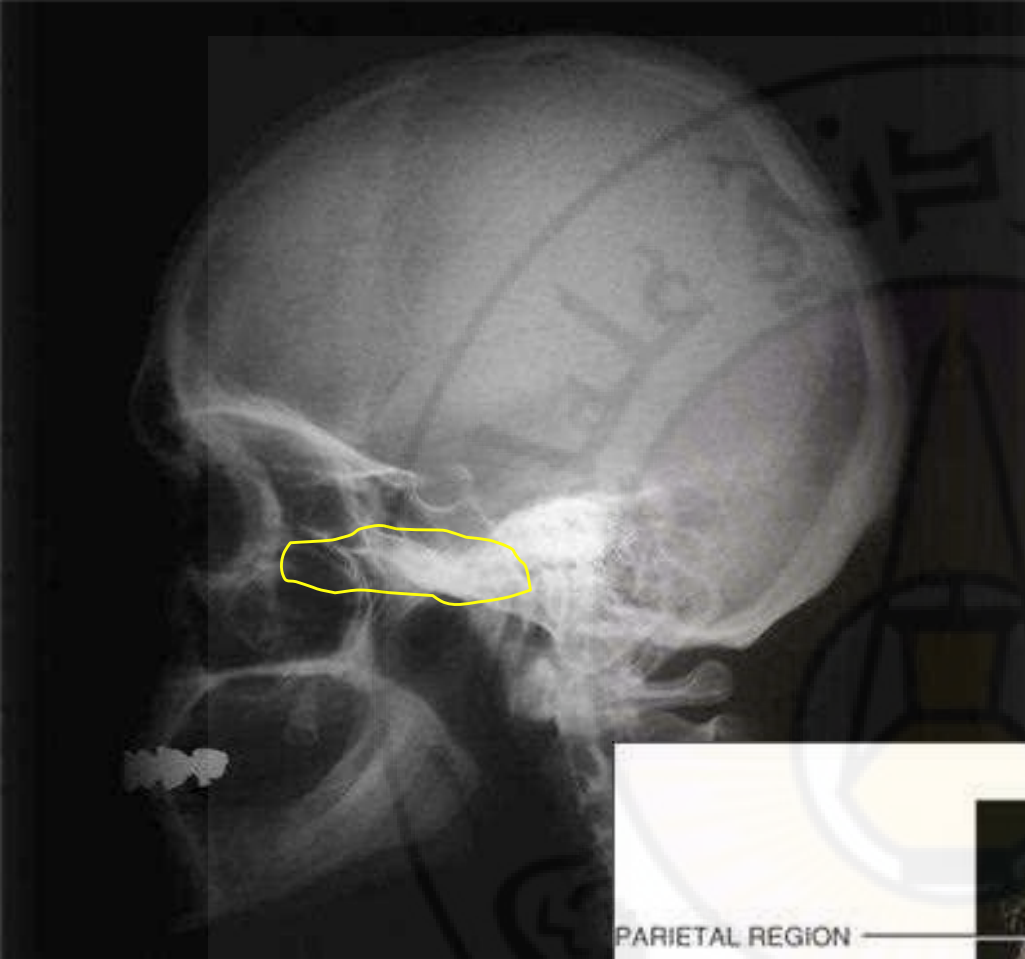
العلامات السطحية التشريحية :

- - القحف :
- يتألف من ٢٩ من العظام .
- الجبهي + الجداري + القذالي يشكل الجانب الوحشي من القحف .
- عظام الوجه تتألف من ١٤ من العظام :
- عظام الجيب الفكي + الوجنة + الأنف + الدمعي + الحنك + الفك السفلي .
- الجيوب جانب أنفية :
- جبهي + فكي + وتدي + غربالي .
- جسم العظم الوتدي في مستوى القوس الوجنية .
- الغدة النخامية : أعلى الجيب الوتدي ، ٢ سم أمام و ٢ سم أعلى الصماخ السمع الظاهر



(b) Right lateral view





PARIETAL REGION

TEMPORAL REGION

OCCIPITAL REGION

AURICULAR REGION

BUCCAL REGION



FRONTAL REGION

ORBITAL REGION

NASAL REGION

ZYGOMATIC REGION

INFRAORBITAL REGION

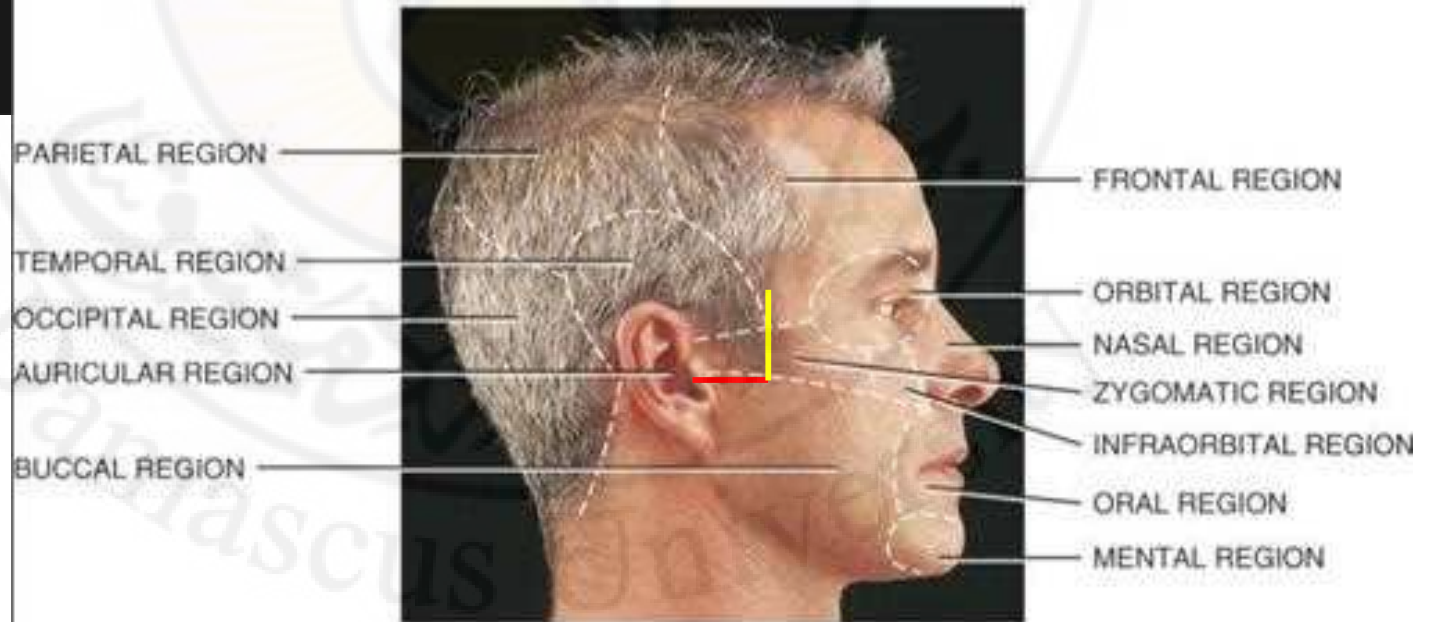
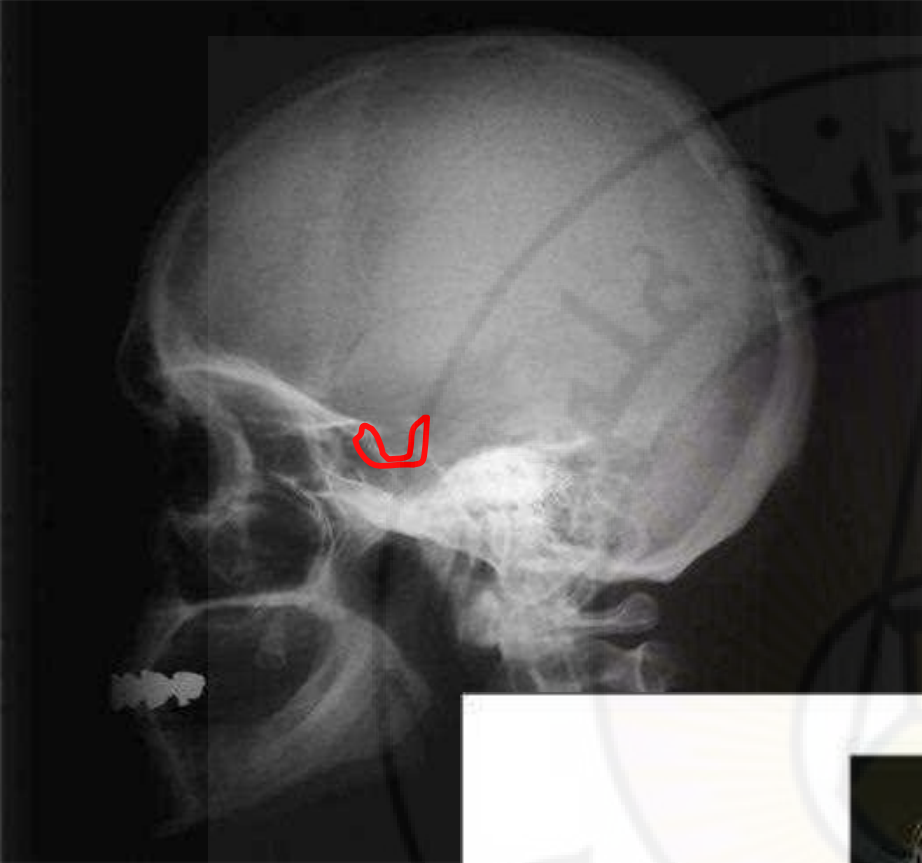
ORAL REGION

MENTAL REGION

(b) Right lateral view

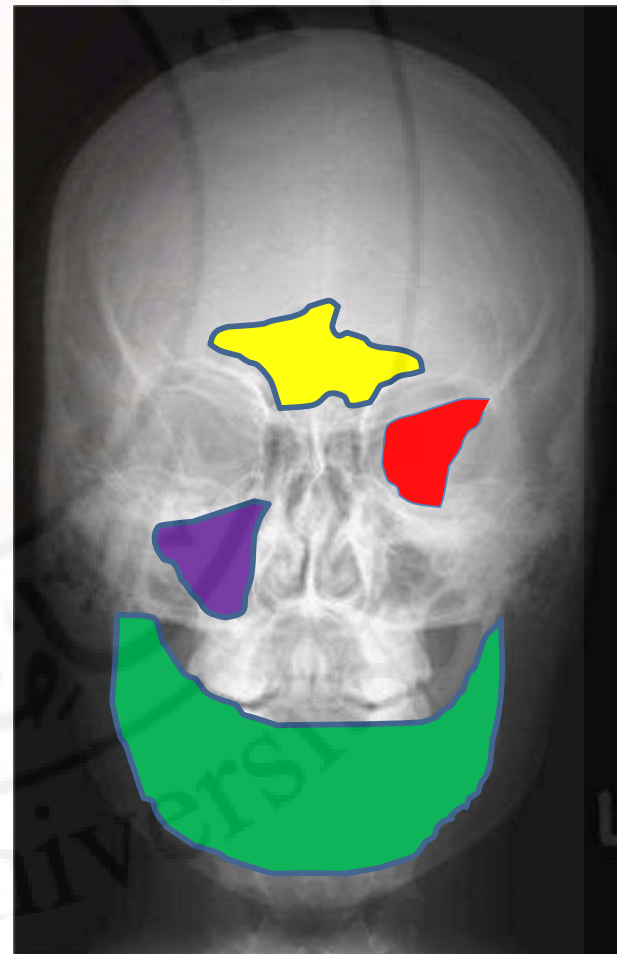
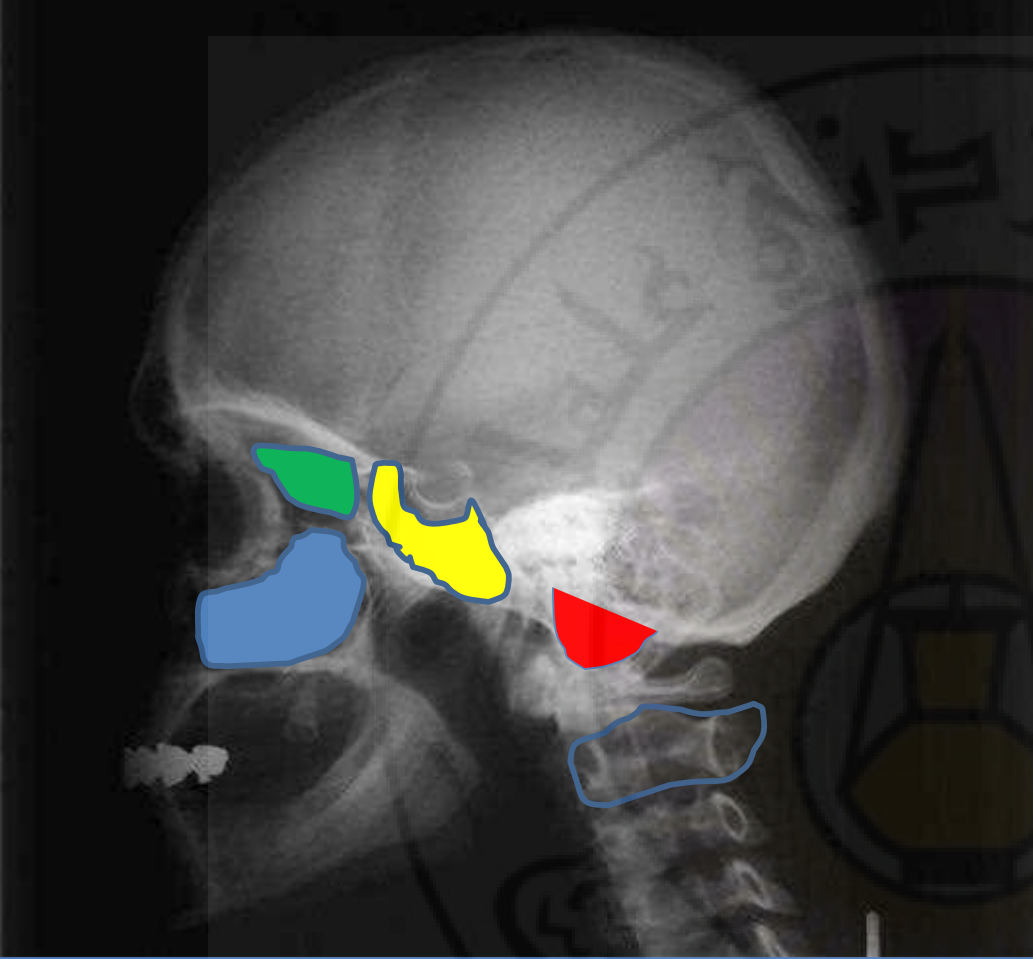
الغدة النخامية :

أعلى الجيب الوتدي ٢
سم أمام و ٢ سم أعلى
الصماخ السمع الظاهر



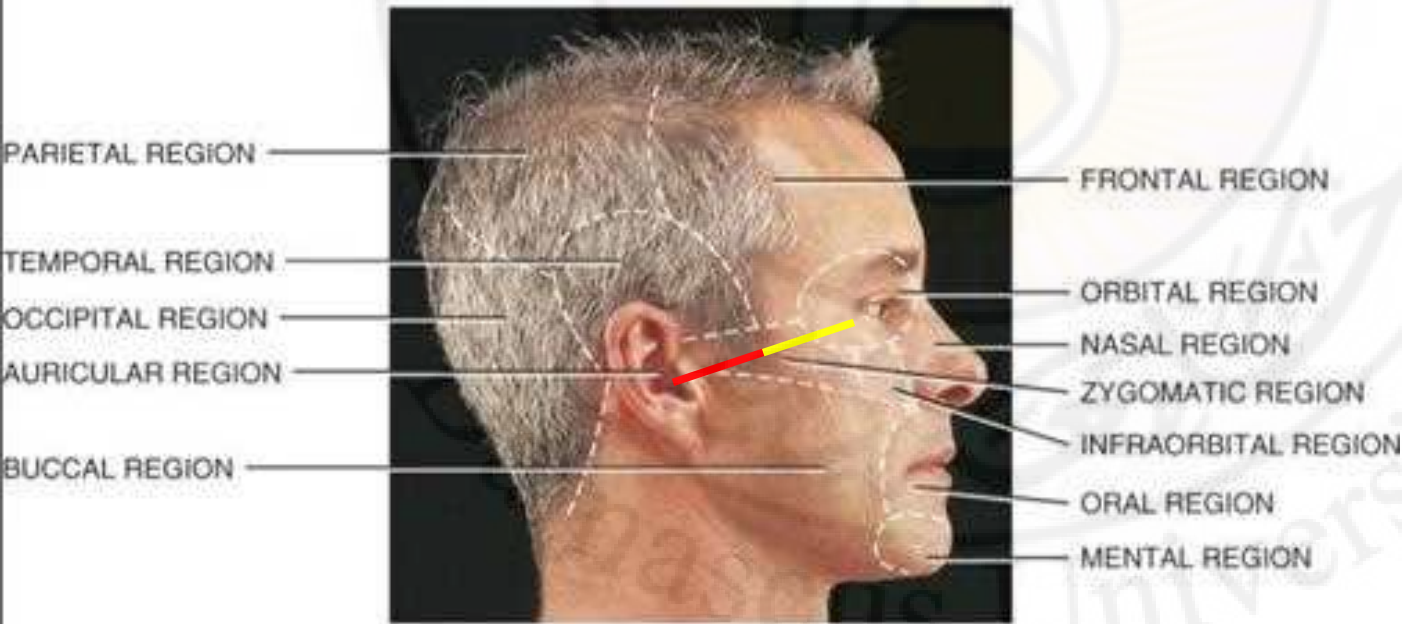
(b) Right lateral view

- – الرأس و العنق :
- العلامات بالسطح الأمامي و الجانبي :
- Frontal bone
- Superior orbital : يشكل سقف الحجاج و هو مهم لتحديد الحد السفلي لحقل كامل القحف (على طول الزنمة و حتى ذروة الخشاء) ، لشم الفص الجبهي .
- Maxilla
- Zygomatic bone
- Mastoid process : مهم لتحديد الحد السفلي لحقل كامل القحف .
- External occipital protuberance
- Angle of the mandible : يوجد عقد أسفل و أنسي هذه المنطقة ، علامة الى موضع اللوزة .



منتصف المسافة بين مجرى السمع الخارجي و اللحاظ الوحشي ،
هي تقريبا بمستوى أرض الجيب الوتدي و سقف البلعوم
الأنفي

١ سم فوق هذه النقطة يوجد أرض السرج التركي ، ١,٥ سم
فوقها توجد الغدة النخامية



(b) Right lateral view

PARIETAL REGION

TEMPORAL REGION

OCCIPITAL REGION

AURICULAR REGION

BUCCAL REGION

FRONTAL REGION

ORBITAL REGION

NASAL REGION

ZYGOMATIC REGION

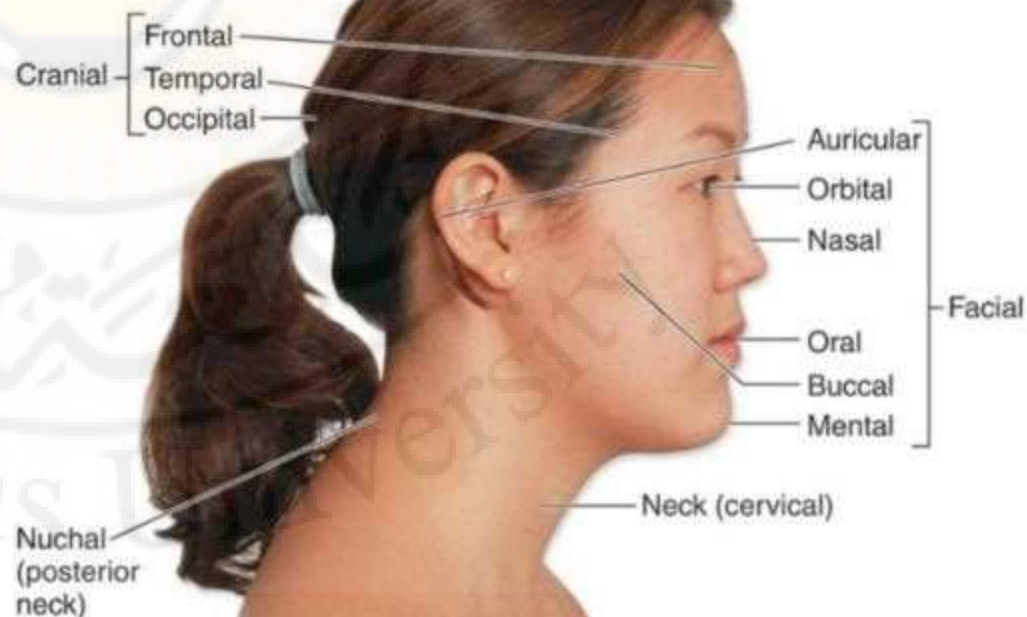
INFRAORBITAL REGION

ORAL REGION

MENTAL REGION

(b) Right lateral view

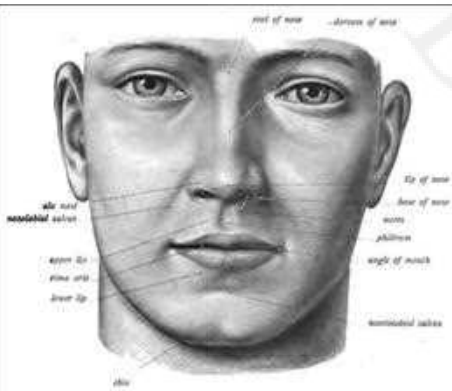
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

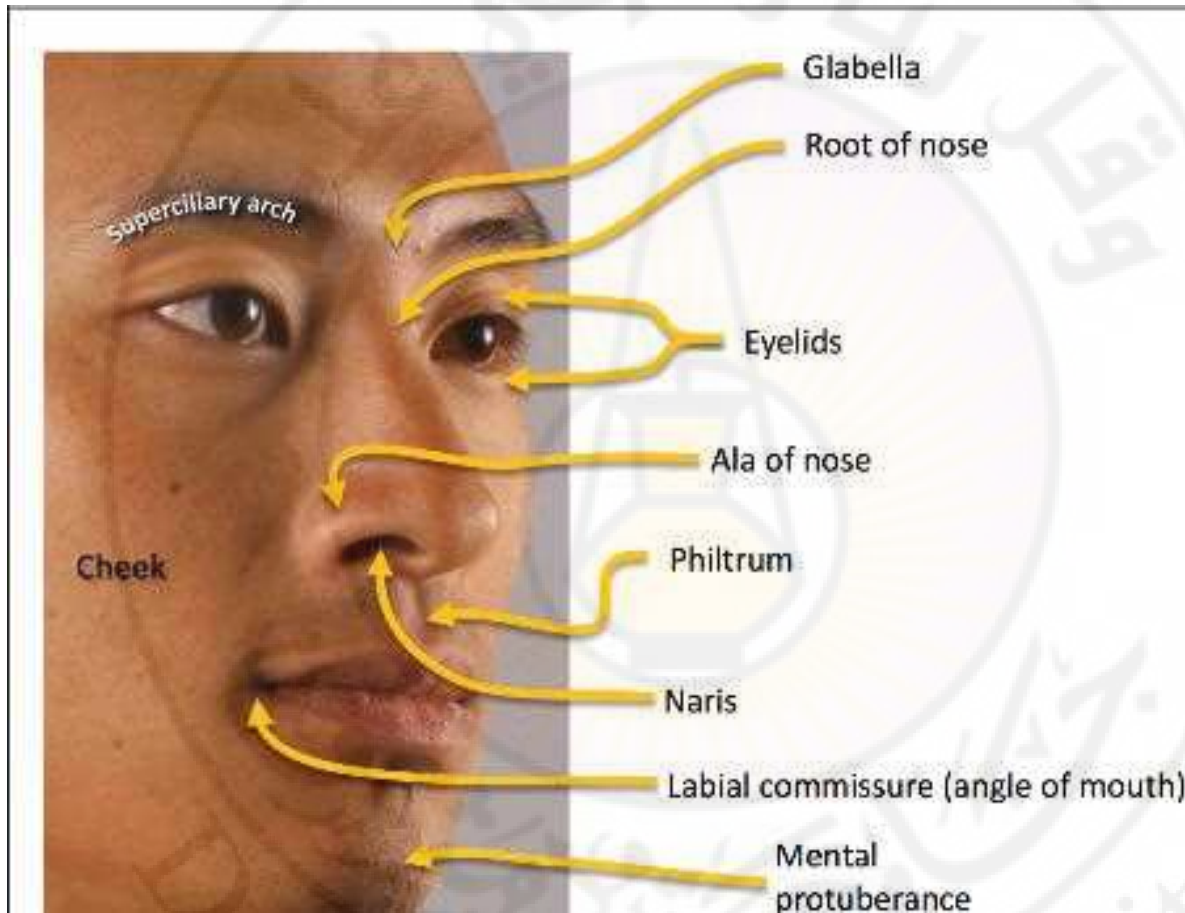


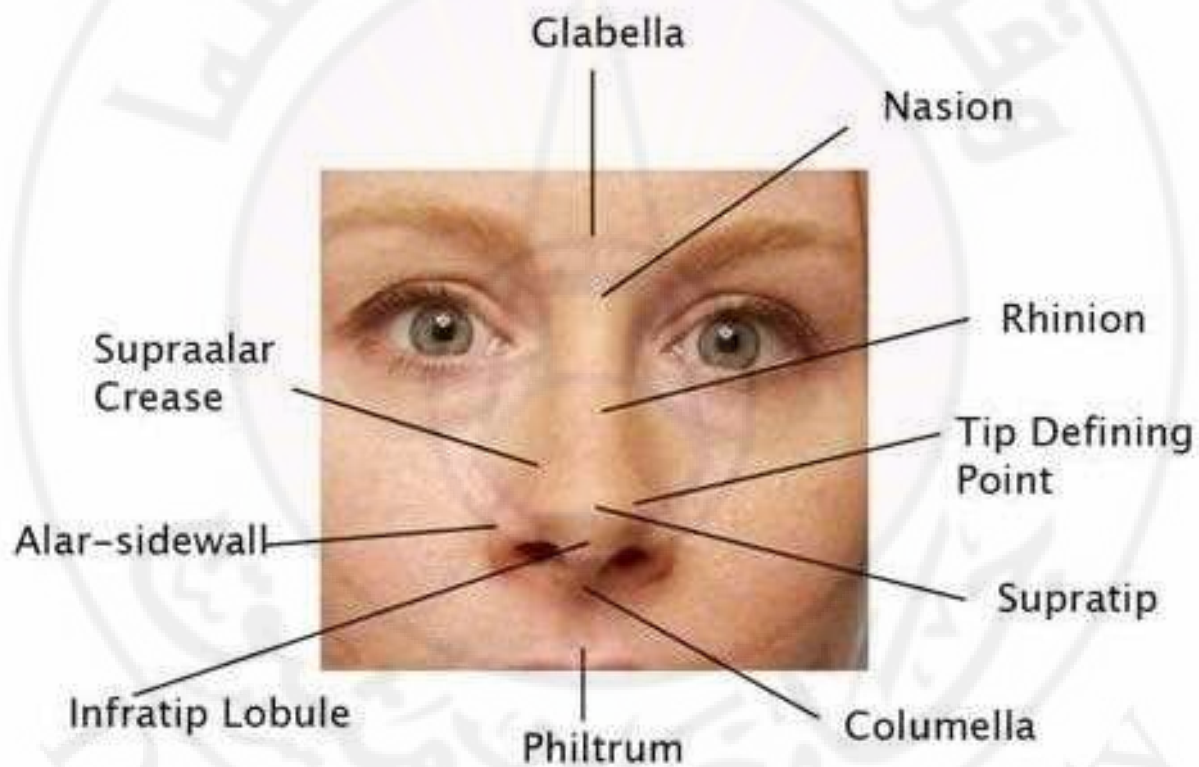
- العلامات حول الحجاج :
- هي علامات عظمية :

- (العلامات النسيجية تتغير بالعمر و الوزن و الجراحة و متحركة تحت الجلد)
 - Inferior orbital margin
 - superior orbital margin
 - lateral orbital margin
 - medial orbital margin
 - inner canthus
 - outer canthus
- **punctum lacrimae** : يجب تجنبها أثناء العلاج الشعاعي (الحد الأنسي لحقل الجيب الفكي الأمامي) حتى لا يحدث تليف ثم دماغ .

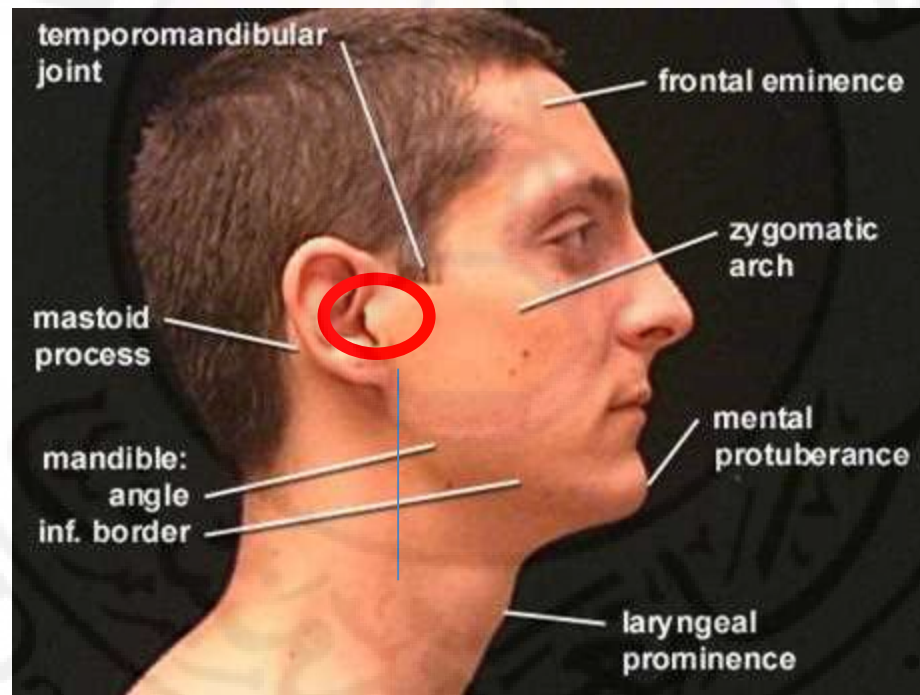
- العلامات حول الأنف :
- ظهر الأنف ، جناح الأنف الوحشي و السفلي مفيد في تحديد الحقول و اجراء قياسات في جميع الاتجاهات .
- العلامات حول الفم :
- يجب الانتباه الى وضعية الفم (فلين ، قالب) :
- صوار الفم (متحرك) ، الخط الجلدي المخاطي .

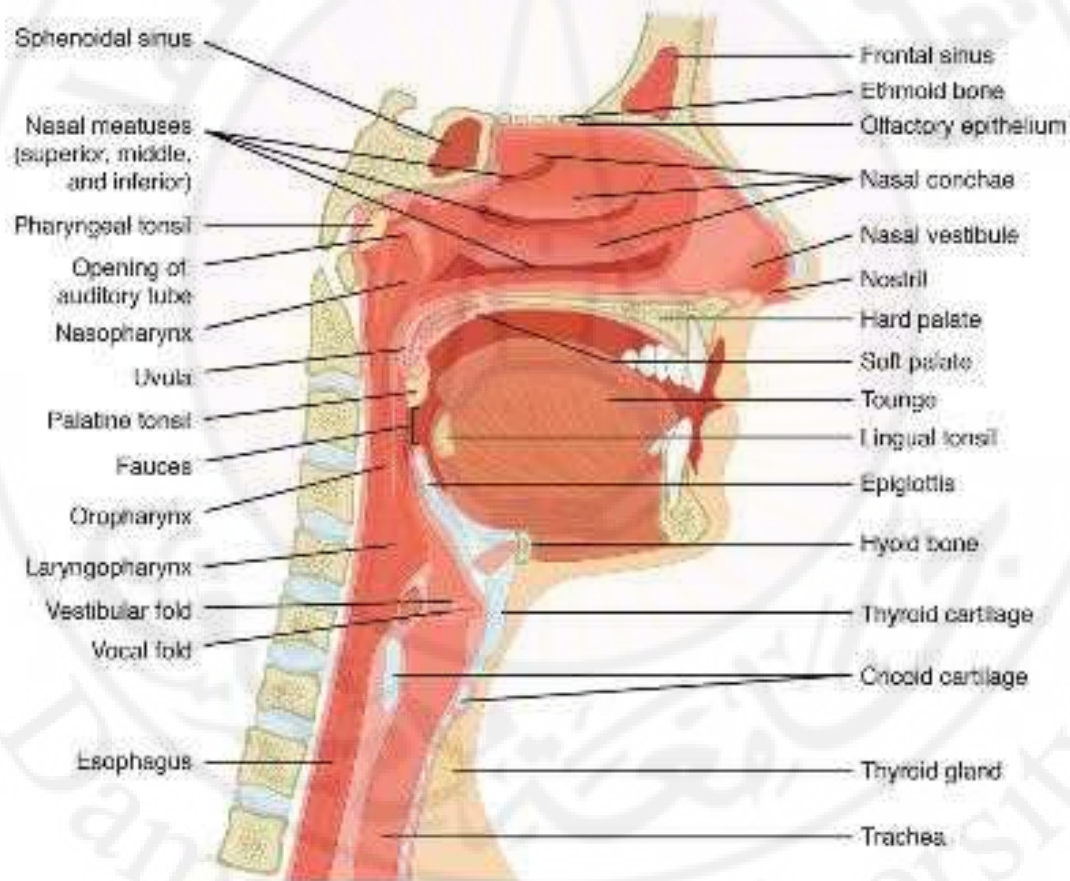


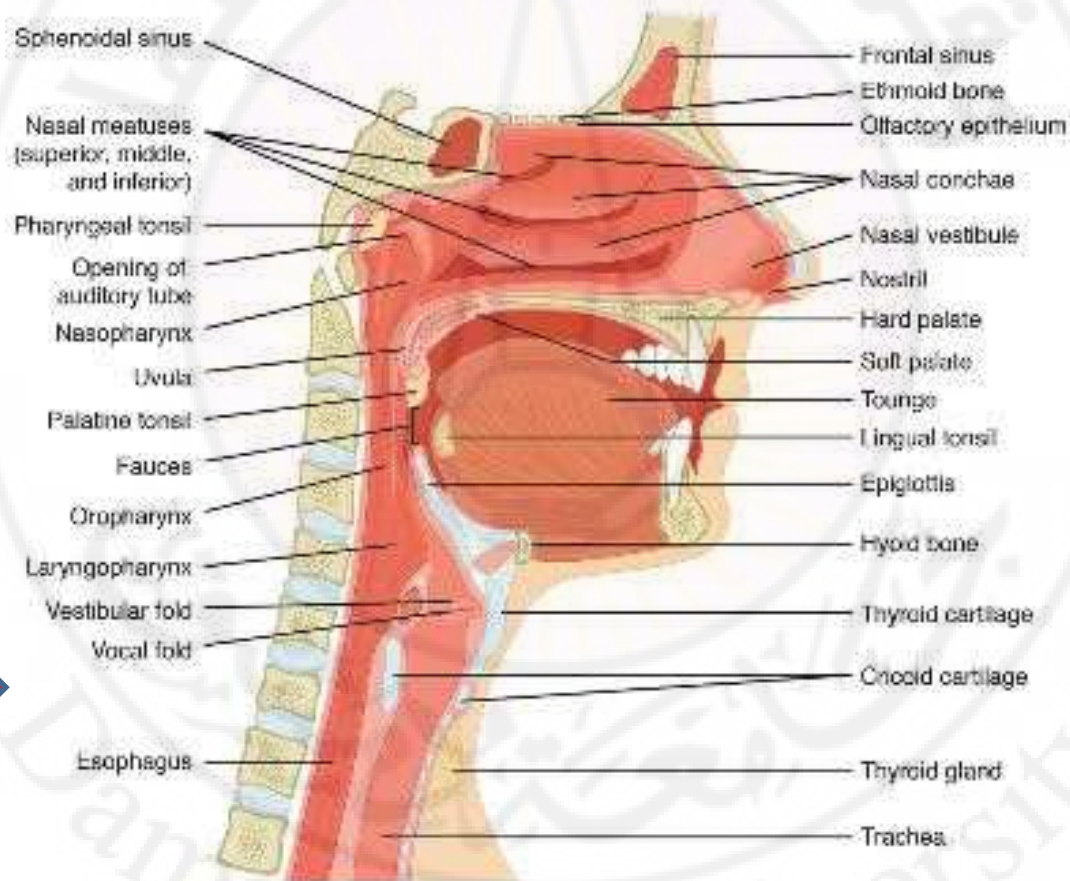




- العلامات حول الأذن :
- Tragus : الوتدة (الزنمة) مهمة في ضبط الوضعية بحيث يكون الليزر بالجانبين يكونان متناظرين فيهما .
- أمام الزنمة يتوضع الجدار الخلفي للبلعوم الأنفي ، و عند هذه النقطة يكون الحد الخلفي من الحقول تتجنب النخاع
- العلامات في العنق :
- العظم اللامي مقابل الحد العلوي للرقبية ٤
- ١ سم أسفل من زاوية الفك السفلي (الفاصل ٢,٣) .
- الرقبية ١ : الناتئ المعترض للرقبية ١ يتوضع تماما أسفل الناتئ الخشائي .
- الفاصل ٢,٣ : مستوى زاوية الفك السفلي ، أسفل ٥ ، الى ٧ سم من الناتئ القذالي الخارجي .
- الفاصل ٣,٤ : أعلى العظم اللامي .
- ر ٤ : مستوى الجزء العلوي من الغضروف الدرقي و تعتبر بداية الحنجرة .
- ر ٦ : مستوى الغضروف الحلقي ، اتصال الحنجرة و الرغامى ، و البلعوم و المري .
- ر ٧ : الناتئ الشوكي الذي يجس في العنق الخلفي .





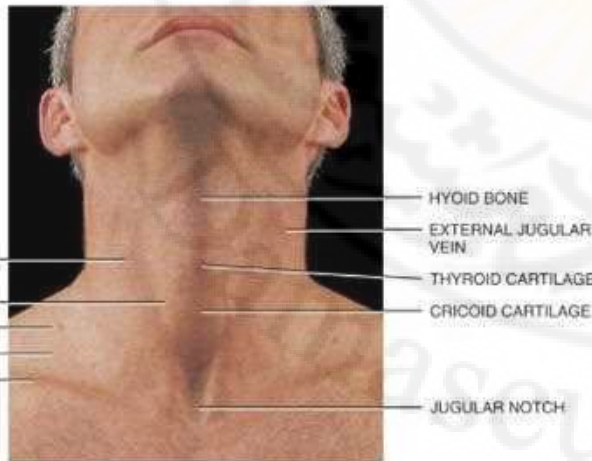


Cervical Spine

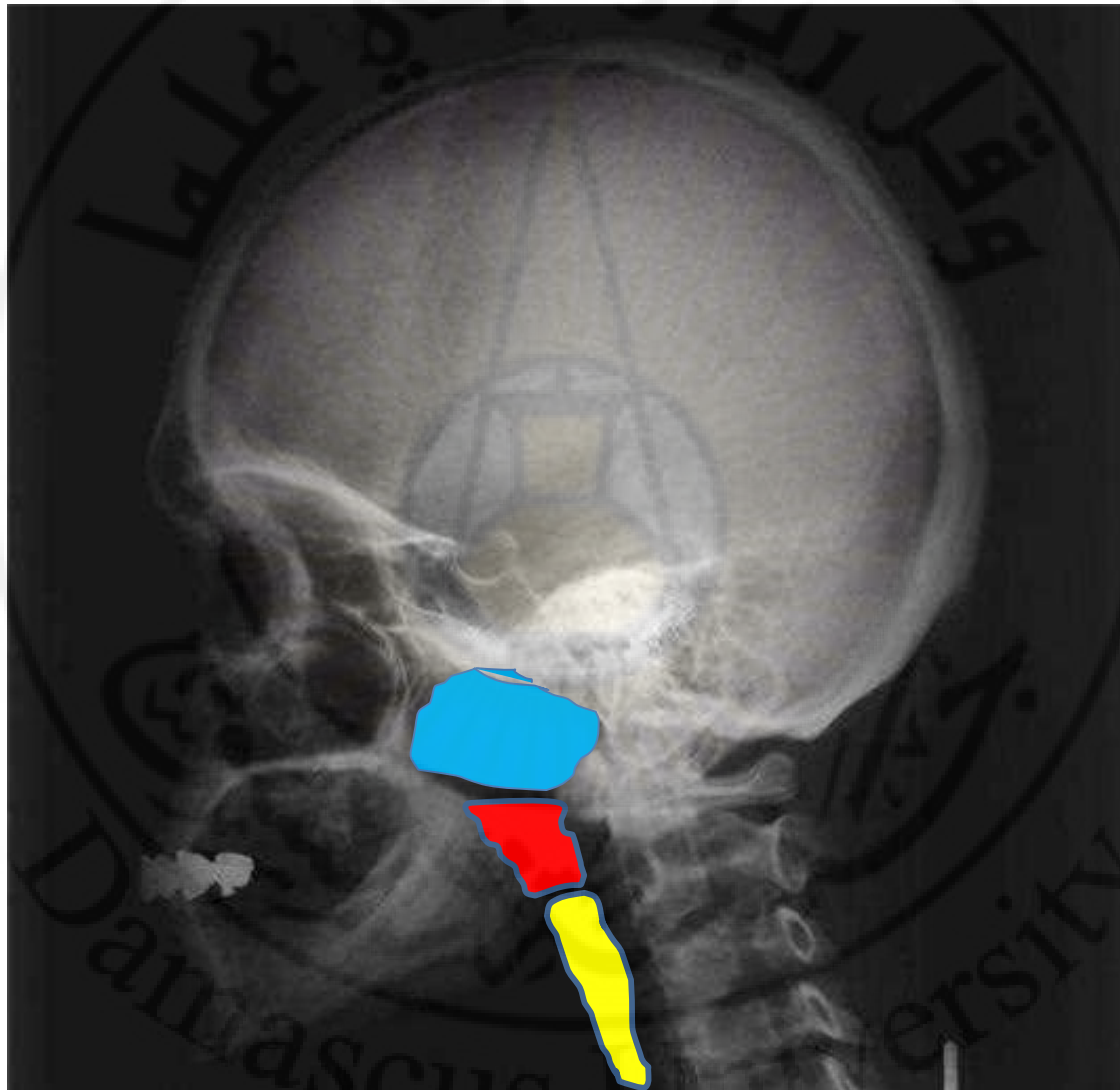


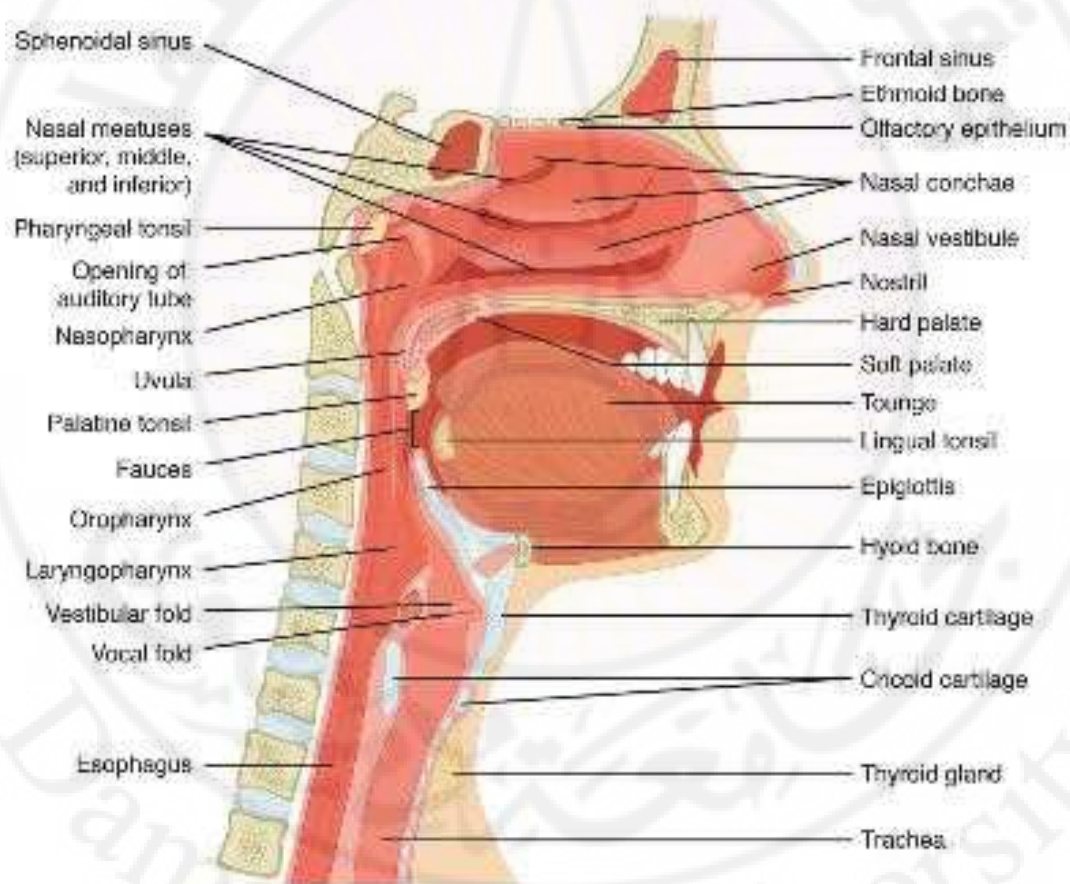
VERITAS health

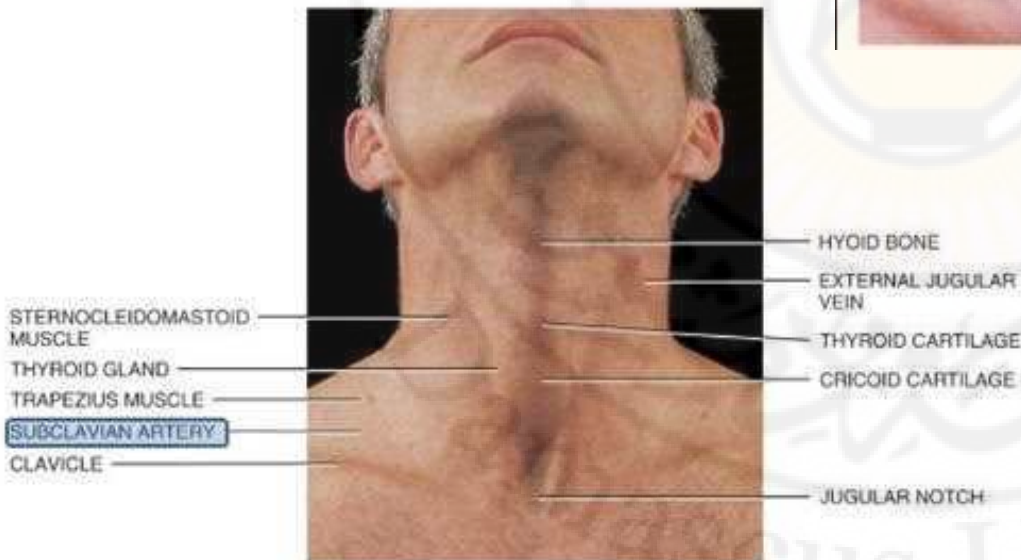
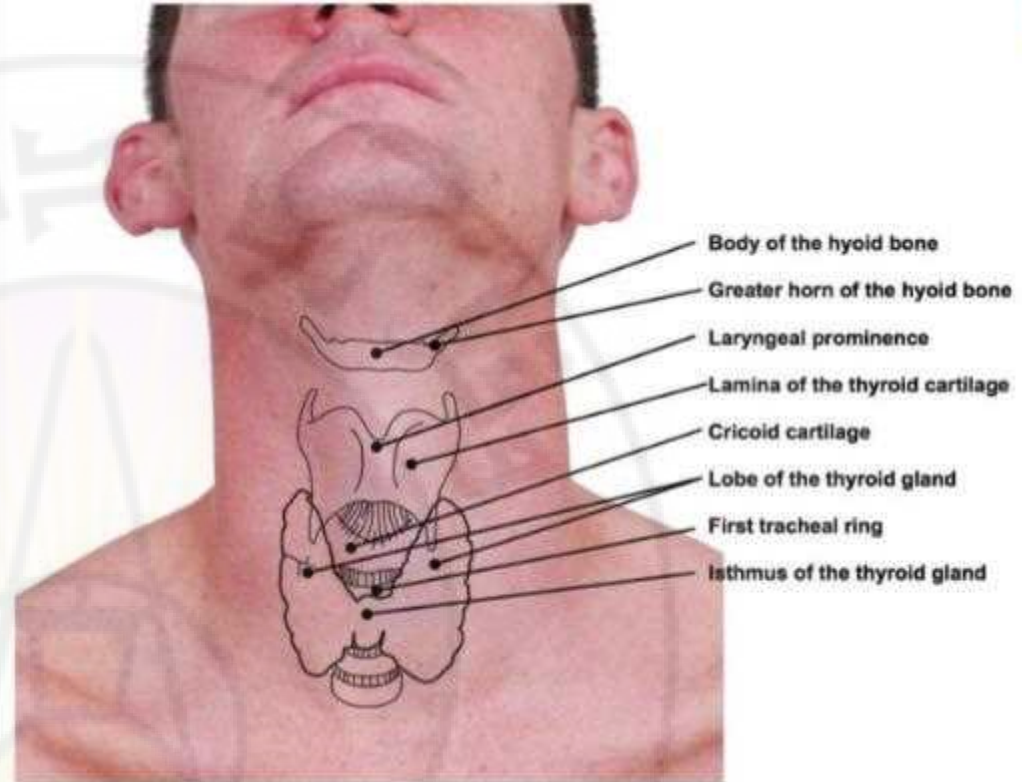
- البلعوم :
- أنبوب يمتد من قاعدة القحف الى المري.
- و يصل مع التجويف الأنفي و الفم و الحنجرة و المري .
- الحنجرة :
- تمتد من البلعوم بالأعلى الى الرغامى بالأسفل ، من ذروة لسان المزمار بمستوى الفاصل ر (٣ - ٤) الى الحافة السفلية للغضروف الحلقي مستوى ر ٦ .
- يقسم الى : فوق و تحت المزمار و المزمار .
- العلامات السطحية بالعنق :
- العضلة القترائية .
- الترقوة .
- الغضروف الدرقي .
- الناتئ الخشائي .
- النواتئ الفقرية .



(a) Anterior view of surface anatomy features







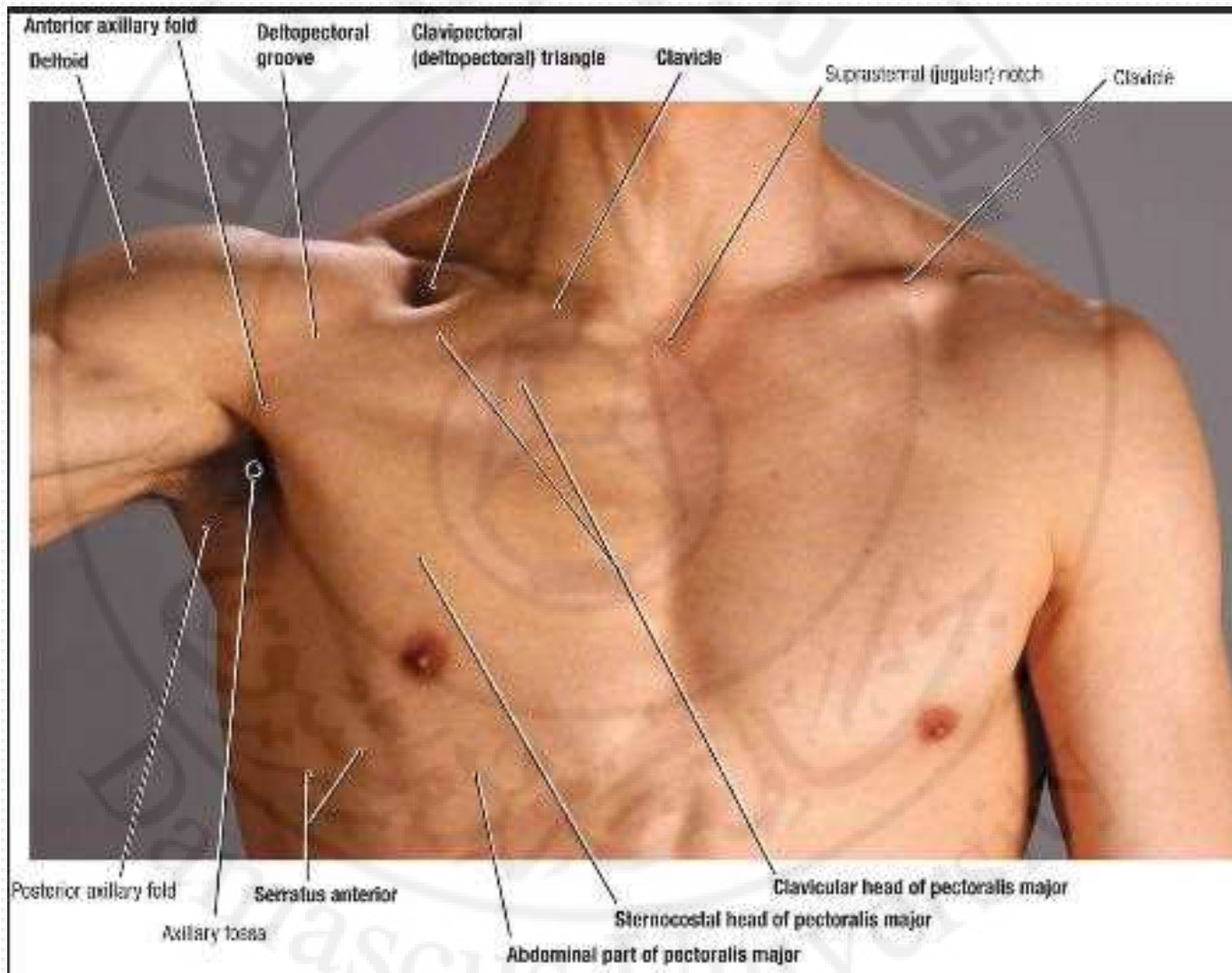
(a) Anterior view of surface anatomy features



التشريح الشعاعي السطحي الصدر-البطن-الحوض

Surface and sectional anatomy and landmarks of
the thorax abdomen and pelvis

Damascus University



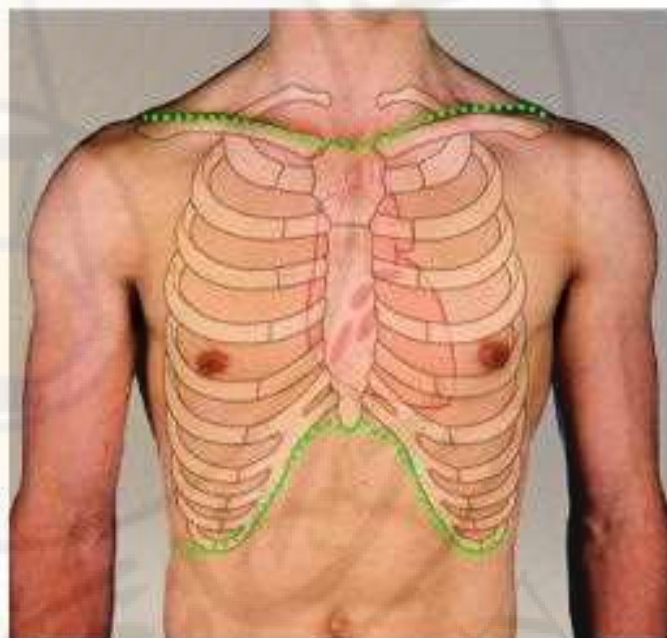
Parts and regions of the thorax

Boundaries

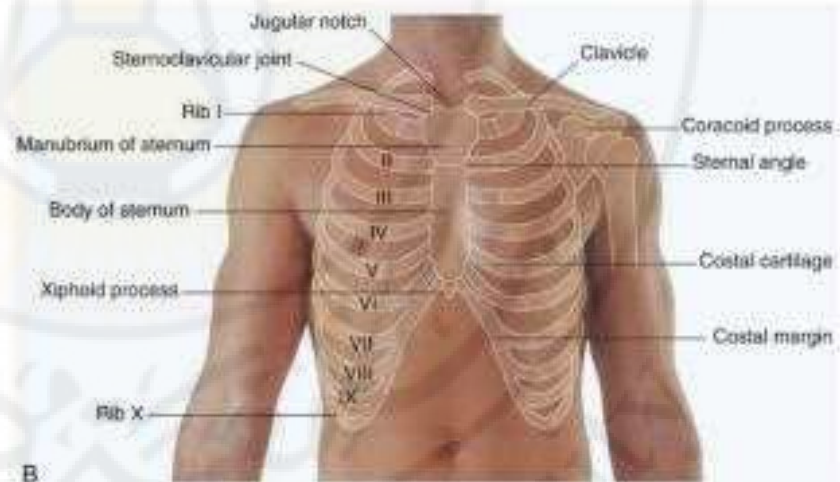
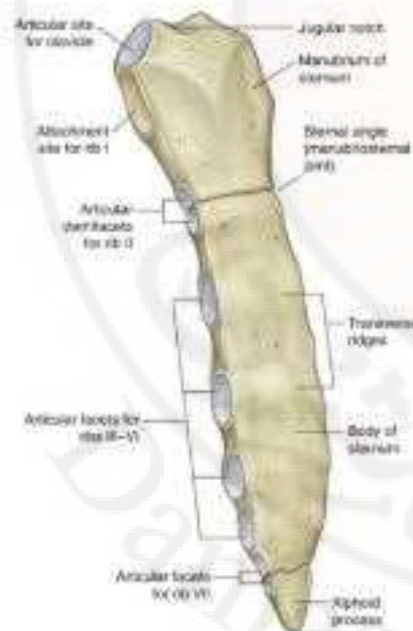
- Superiorly - jugular notch, sternoclavicular joint, superior border of clavicle, acromion, spinous processes of C7
- Inferiorly - xiphoid process, costal arch, 12th and 11th ribs, vertebra T12

Regions

- Thoracic wall
- Thoracic cavity



Surface Markings



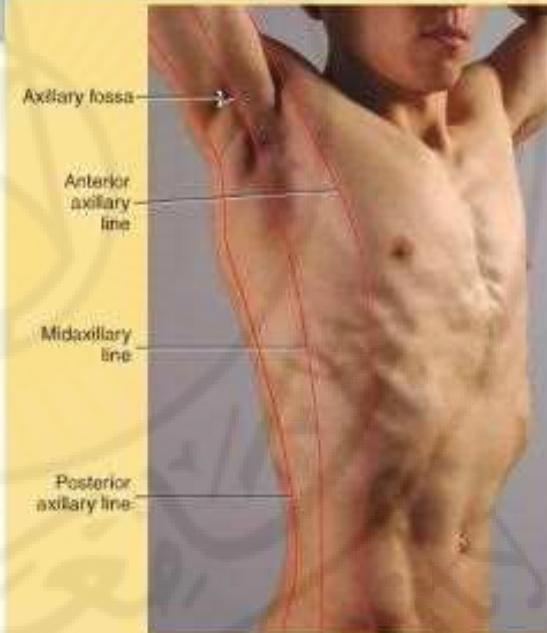
Anterior Planes

* 3 Anterior Planes

- Median Plane
- 2x Midclavicular Plane

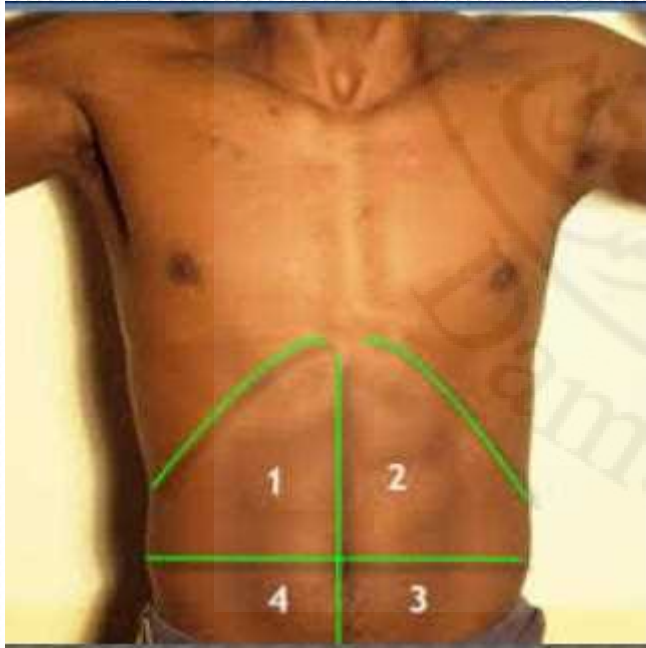
* 3 Anterolateral Planes

- Anterior Axillary Plane
- Midaxillary Plane
- Posterior Axillary Plane



العلامات التشريحية السطحية \ بطن و حوض

- جدار البطن الأمامي:
- يتحدد من :
- بالأعلى / حافة الأضلاع السفلية
- بالأسفل / ارتفاع العانة ، الرباط الاربي، الشوك الحرقفي العلوي الأمامي
- عضلات البطن الأمامية:
- المستقيمة البطنية
- المعترضة البطنية
- المعترضة الداخلية
- المعترضة الخارجية



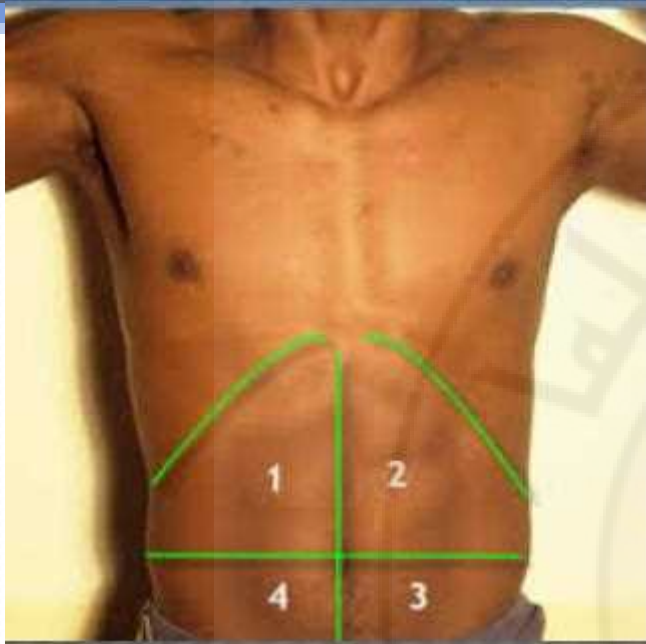


- جدار البطن الخلفي:
- الأضلاع السفلية
- النواتئ الشوكية
- العرف الحرقفي
- الناتئ الحرقفي العلوي الخلفي

الجدار الخلفي للحوض

- العرف الحرقفي
- العصص : اسم من الشرج
- الناتئ الحرقفي السفلي الخلفي : ٥-٦ سم عن الخط المتوسط

التراكيب و النواحي المجسوسة



الجدار الأمامي

- الحافة الضلعية (غضاريف ٧-١٠)
- الناتئ الشوكي الحرقفي العلوي الأمامي
- العانة

- الناتئ الرهابي xiphoid process (علامة ثابتة) (T9) بالشرسوف
- السرة : علامة جلدية متحركة (وضعية الاستلقاء: L4)

الجدار الخلفي

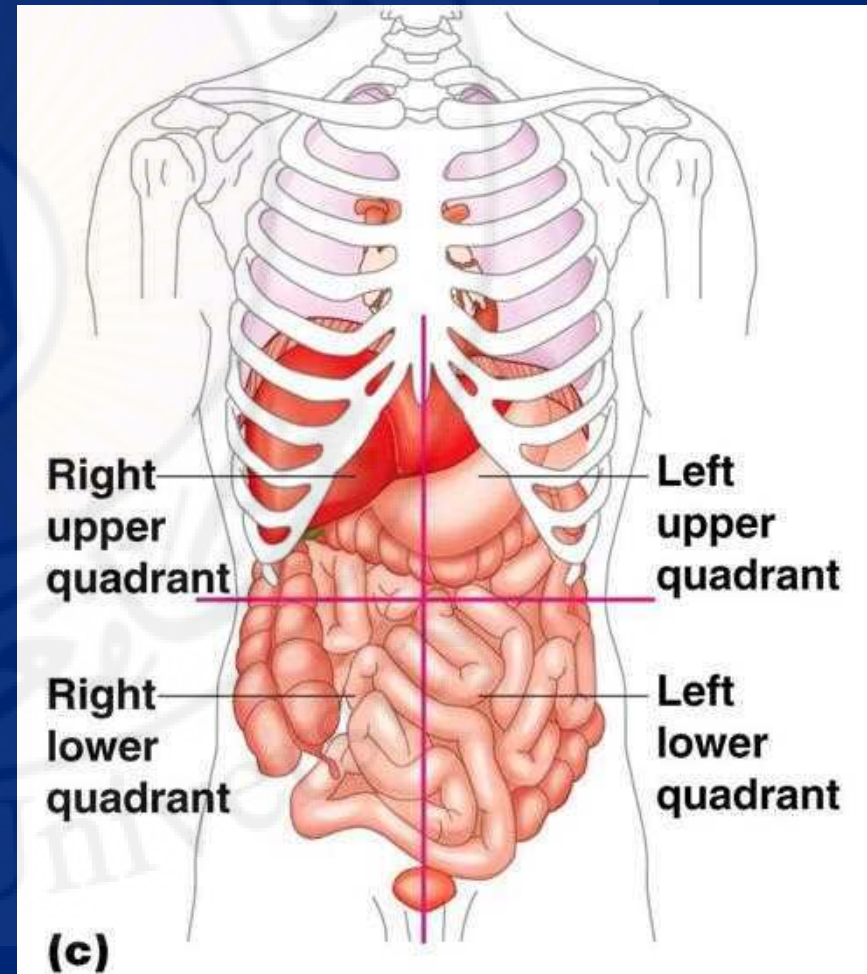
- العرف الحرقفي
- الناتئ الشوكي الحرقفي الخلفي
- نقطة البزل (L3-L4)



Abdominal Quadrants

أرباع البطن

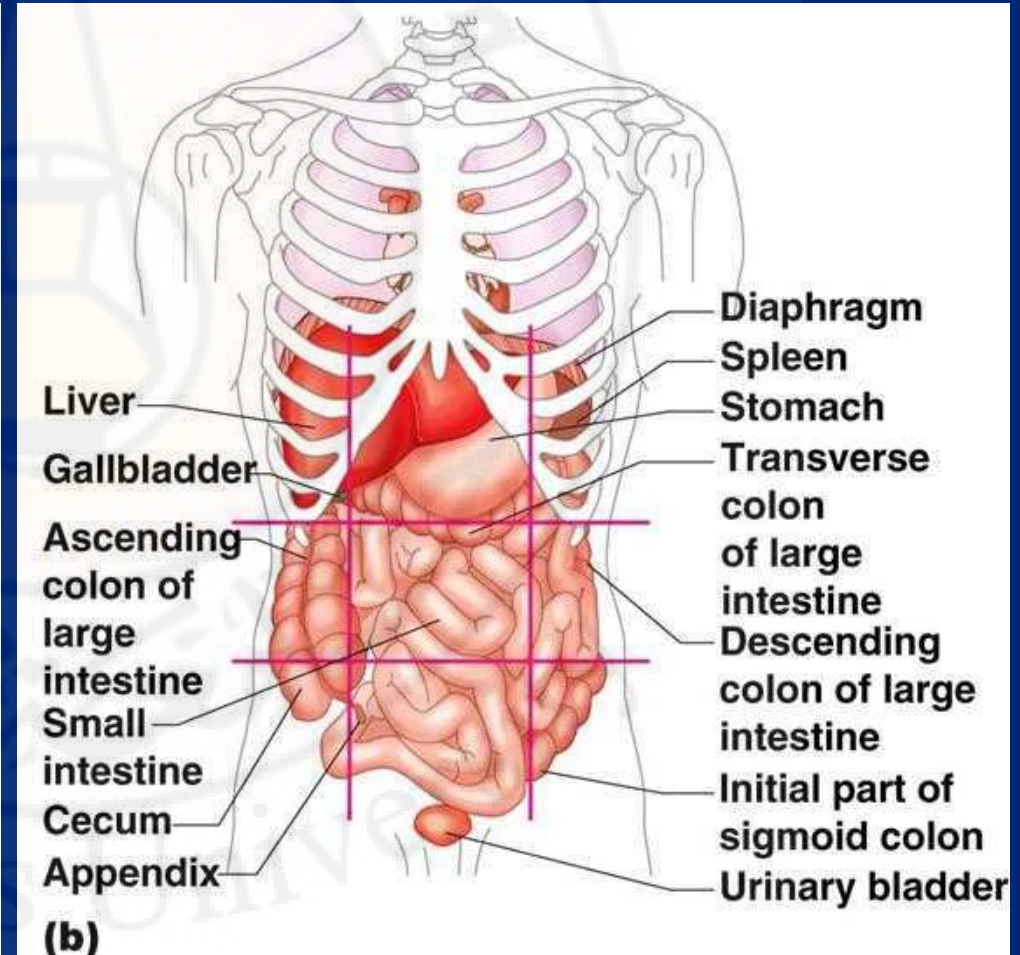
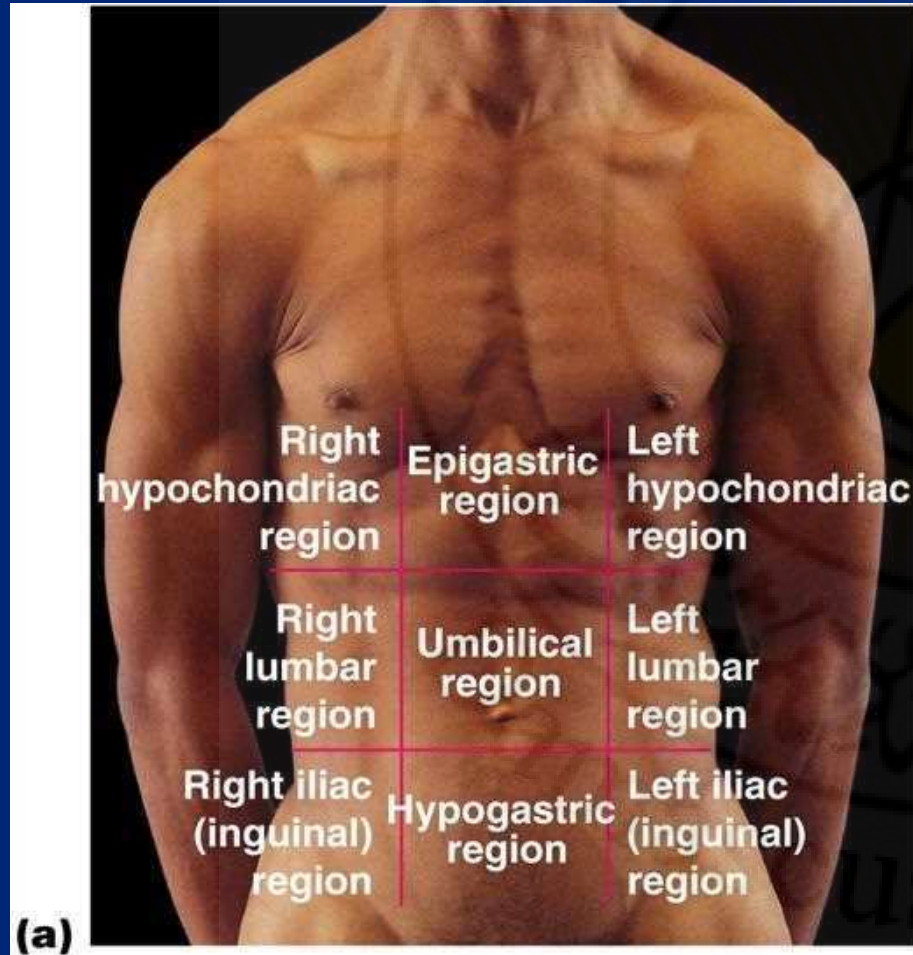
- **Abdominal quadrants** divide the abdomen into four quadrants
 - Right upper and left upper quadrants
 - Right lower and left lower quadrants



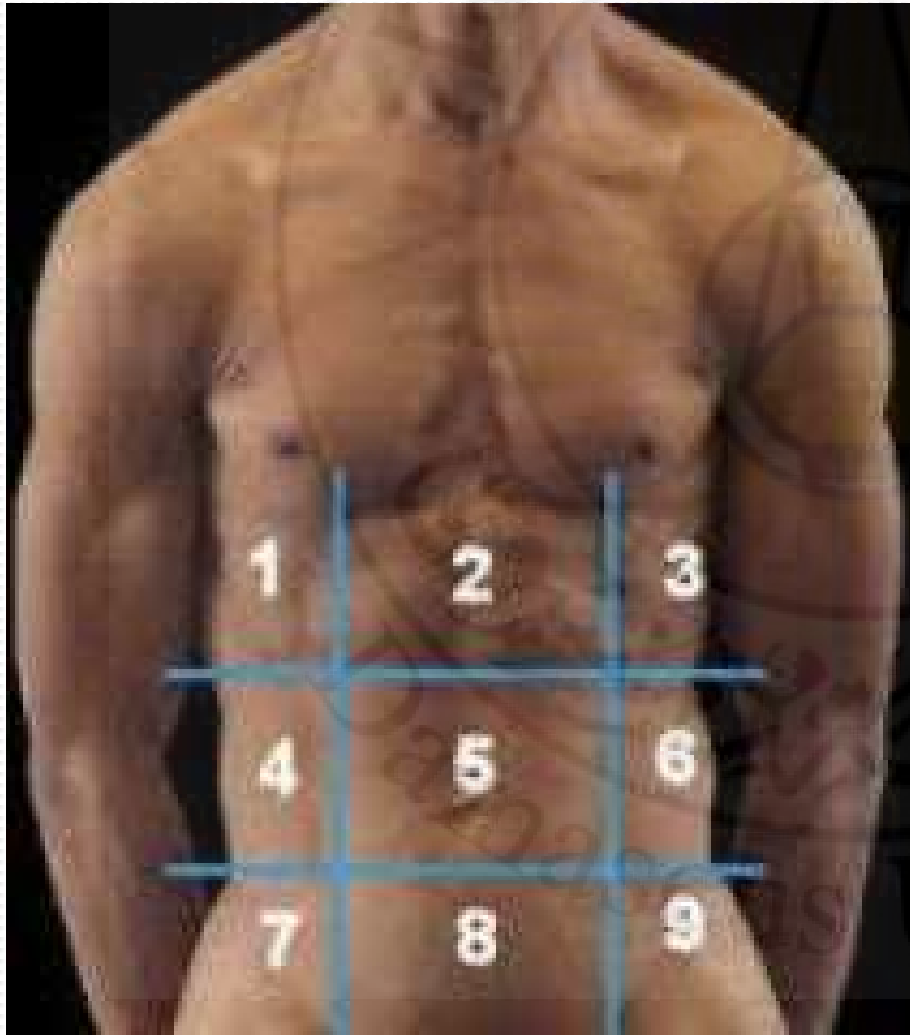
Abdominal Regions and Quadrants

نواحي البطن و أرباعه

- **Abdominal regions** divide the abdomen into nine regions



التراكيب الحشوية



أعضاء متحركة
تختلف باختلاف :
الوضعية،
التنفس،
وزن الإنسان

توضع أحشاء البطن

- أعضاء متحركة
- المري : يدخل تجويف البطن أيسر الخط المتوسط (٢-٣سم) بمستوى T10
- العفج : شكل حرف C ، ٢٥ سم ، يبدأ أيمن الخط المتوسط، عضو ثابت.
- الطحال : ٥ سم أيسر الخط المتوسط عند T10-T11 (ضلع ٩-١١)
- الكبد: الحد العلوي عند T7-8.
- المرارة : عند الحافة السفلية للكبد، نقطة تقاطع غضروف الضلع ٩ مع العضلة المستقيمة الأمامية
- البنكرياس :الجسم بمستوى L1 ، الذيل ضمن سرة الطحال

- الأمعاء الدقيقة : الصائم و اللفائفي
- الأمعاء الغليظة : تبدأ من الأعور بالأيمن
- الأعور بمستوى L4
- الكولون الصاعد: ١٥ سم
- الكولون النازل: ٢٥ سم
- المستقيم يبدأ S3 وحتى ٤ سم من الشرج، بطول ١٢-١٥ سم من فوهة الشرج

أعضاء الجهاز البولي

- الكلية : عضو خلف البريتوان ، سرة اليمنى L2 ، و اليسرى L1
- الكظر : القطب العلوي الانسي للكلية
- الحالب : أمام البسواس و يدخل الحوض بمستوى المفصل العجزي الحرقفي (S1)
- المثانة : عضو حوضي
- عنق المثانة : خلف ارتفاع العانة و أمام المستقيم ، عند الرجل يتوضع تماما فوق البروستات

العجان

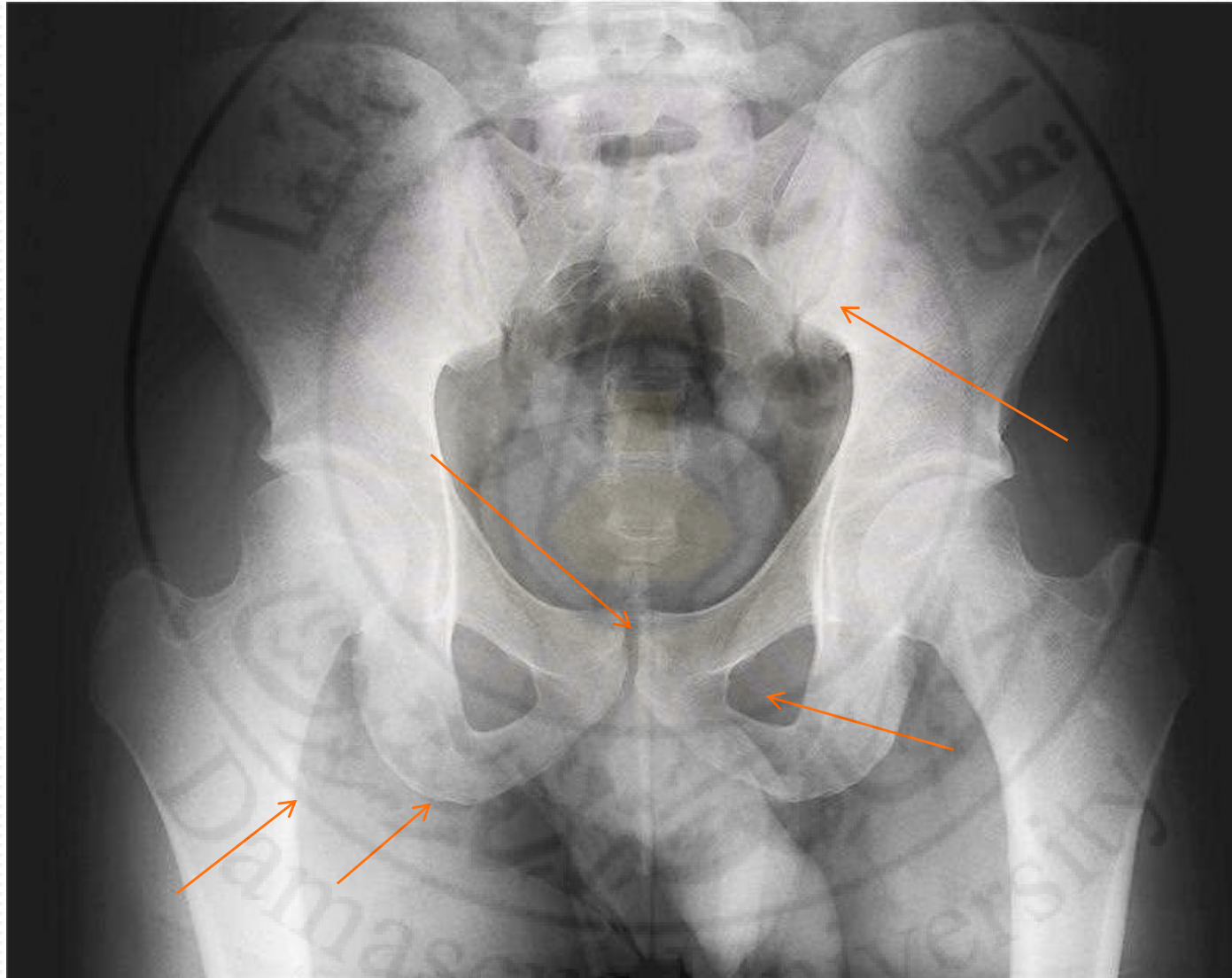
- شكل معين ، تمتد من الحبة الوركية بالجانبين و ارتفاع العانة و العصص
- منطقة ضعيفة
- الملتقى الأمامي للشفرين الكبيرين
- قاعدة القضيب



العلامات الشعاعية \ الحوض

- العرف الحرقفي
- رأس الفخذ (تليف ، الم ، تحدد بالحركة)
- المدور الكبير و الصغير
- سقف الحق
- ارتفاع العانة
- الحدة الوركية
- العصص (أسفل ١ سم منه توجد فوهة الشرج)

05/05/2023



05/05/2023



النزح اللمفاوي للبطن و الحوض

- قرب أبهرية:
- الزلاقية
- مساريقي علوي و سفلي.
- جانب أبهرية:
- خلف البريتوان: T12- L4
- الحوضية:
- الحرقفي الأصلي
- الظاهر
- الباطن
- الاربية

العقد الحوضية

- العقد الحرقفية الأصلية : (مثانة ، موثة، عنق رحم، مهبل)
- الظاهرة: مثانة، موثة، عنق الرحم، الخصية، المهبل، المبيض.
- الباطنة: المهبل، عنق رحم، موثة، الشرج، المثانة.
- الاربية : الفرج، قناة الشرج ، العجان، الصفن، المبيض ، الرحم ، المهبل.
- العجزية : عنق الرحم ، المثانة، الموثة.



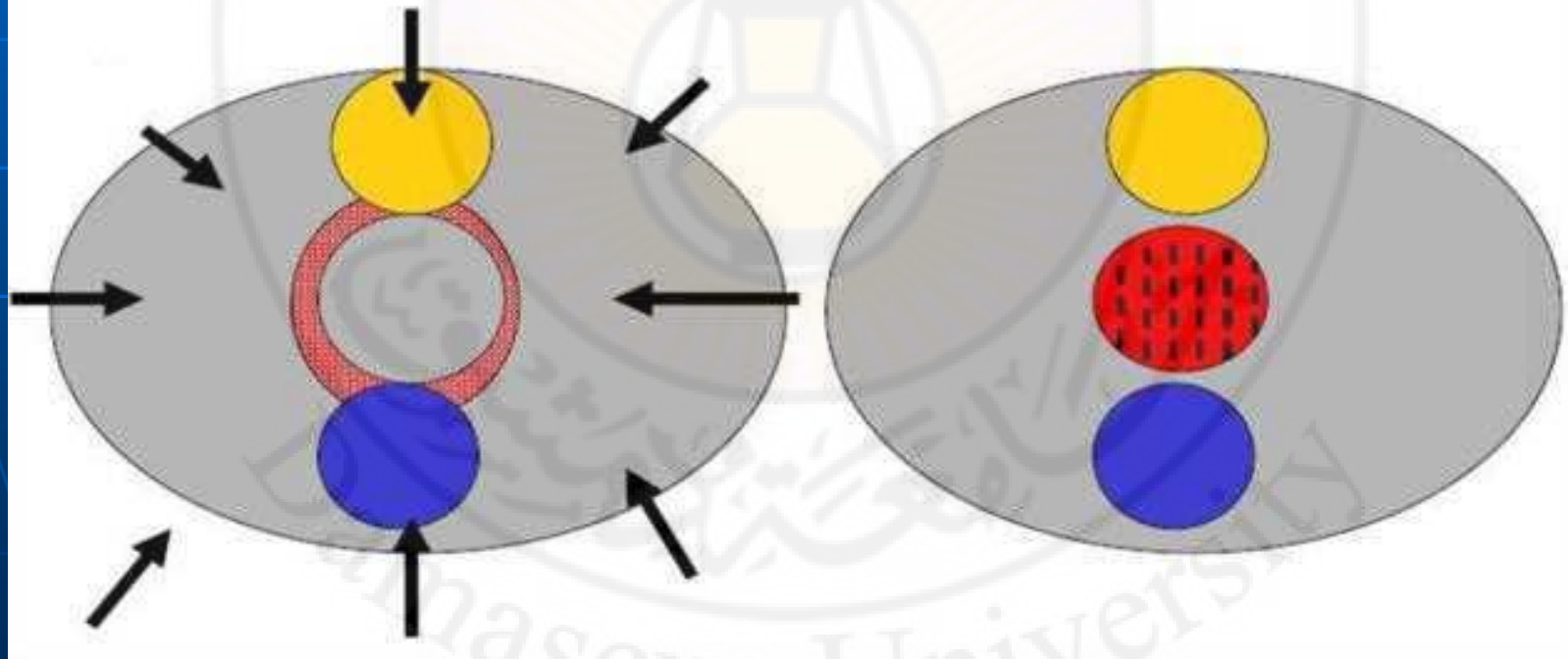


أجهزة المعالجة الشعاعية الخارجية

المعالجة الشعاعية عن قرب

أجهزة المعالجة الشعاعية الخارجية

المعالجة الشعاعية الخارجية المعالجة عن قرب



• الكوبالت 60

• المسرع الخطي

• أجهزة الأشعة السينية عالية الطاقة

أجهزة أشعة-غاما Gamma-ray equipment

- يوجد في الوقت الحاضر العديد من نماذج أجهزة الكوبالت-٦٠ الحديثة





Cobalt-60 Teletherapy Unit

- الكوبالت هو معدن طبيعي سهل التحطم , لونه رمادي
- ضمن النواة تحوي 27 بروتون , و 32 نوترون , و حول النواة 27 الكترون.
- الكوبالت الغير المشع يمكن أن يكون ضمن خلائط معدنية موجودة بالطبيعة , على سبيل المثال يسبب اللون الأزرق للزجاج و السيراميك منذ آلاف السنين.

- الكوبالت المشع هو نظير الكوبالت الطبيعي.
- يتحطم الكوبالت المشع في البدء مصدرا أشعة بيتا , ثم يصدر فوتونين طاقة كل واحد منهما (1.173 , 1.33 ميف).

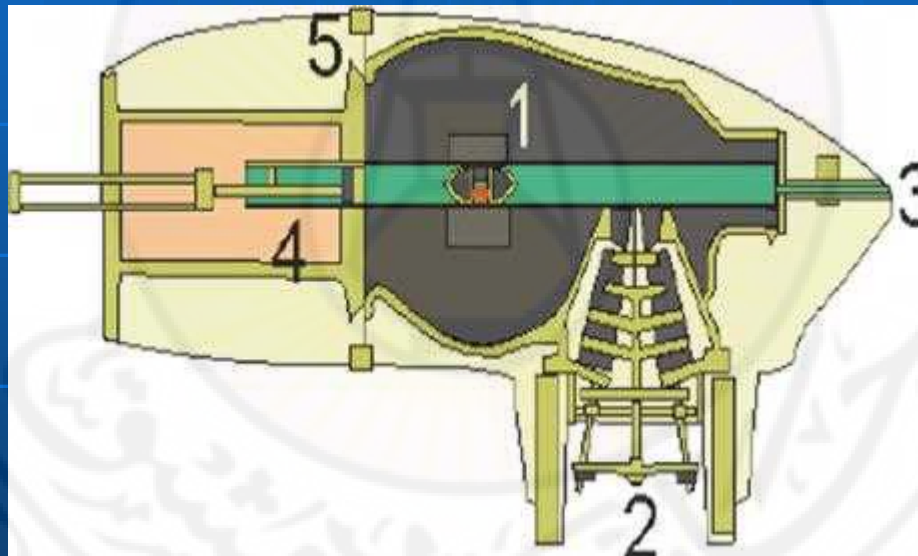
The half-life

- نصف عمر العنصر المشع : هو الزمن اللازم حتى يصبح الفعالية الشعاعية الى النصف.
- بالنسبة للكوبالت هو : 5.27 سنة.
- عمليا يصبح غير ضار و غير فعال بعد 53 سنة.

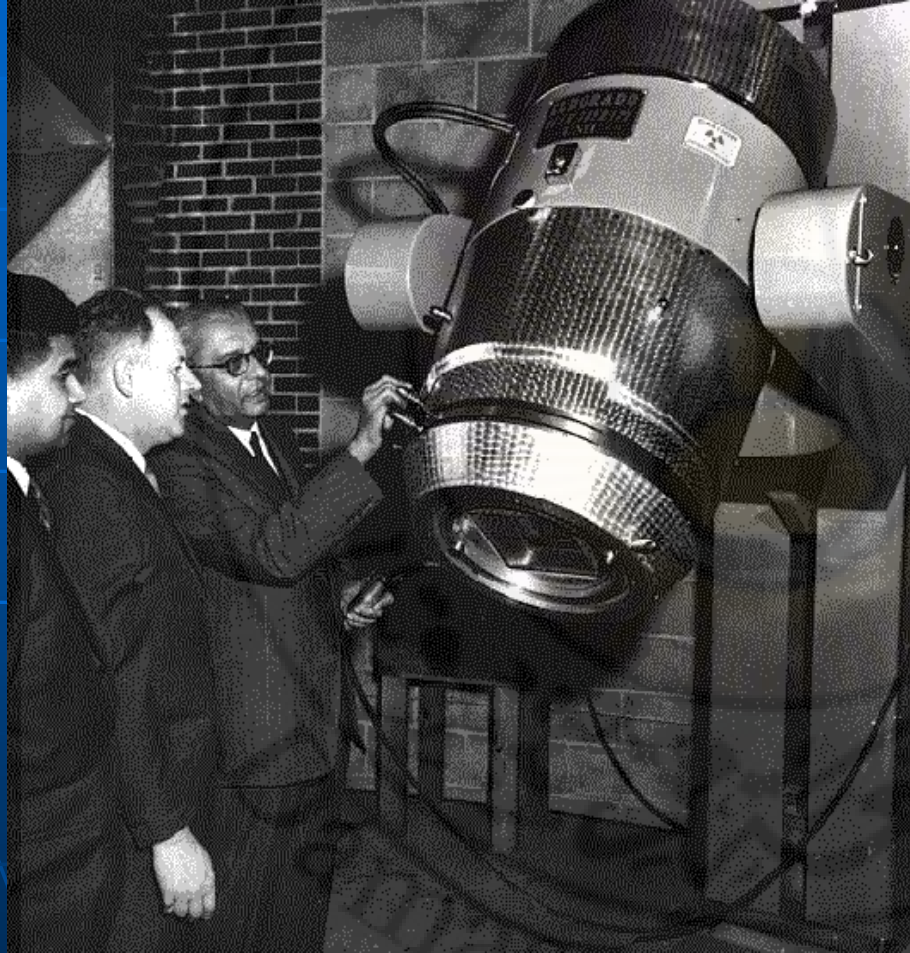
- وحدة العلاج الشعاعي بالكوبالت المشع تحوي على منبع اسطواناني الشكل (2 سم) .
- الفعالية الشعاعية : هي بين 5000 , 15000 كوري.
- المنبع الذي فعاليته أقل من 3000 كوري يجب استبداله بآخر جديد (بعد 5-7 سنوات).
- يمكن أن يستخدم في حال الأورام أقل من 10 سم , أكثر من ذلك يفضل المسرع .

Treatment Head and Collimator

- محرك المنبع في رأس الجهاز هو محرك بسيط
- البعد منبع جلد (80-100 سم).
- محدد شكل الحزمة يمكنه الدوران 360 درجة
- هناك منبع ضوئي في رأس الجهاز لتحديد و ضبط حقول المعالجة.
- ذراع الجهاز يدور 360 درجة حول محوره.



أول جهاز معالجة بالكوبالت-60



1951

Gantry

- ذراع الجهاز يدور 360 درجة.
- يدور بواسطة جهاز بسيط كهربائي



الكوبالت 60

يصدر الكوبالت 60 أشعة غاما بطاقة 1.25 MeV
عمر النصف للكوبالت 60 5,27 سنة، يبدل كل 5-8 سنوات
آلية عمله غير معقدة

المزايا: قدرته، بساطة الاستخدام، صيانة بسيطة، سعر معقول ...
العيوب: الطاقة وحيدة، مقداره ضعيف بالمقارنة مع المسرع
الخطي، شبه الظل، تبديل المنبع،

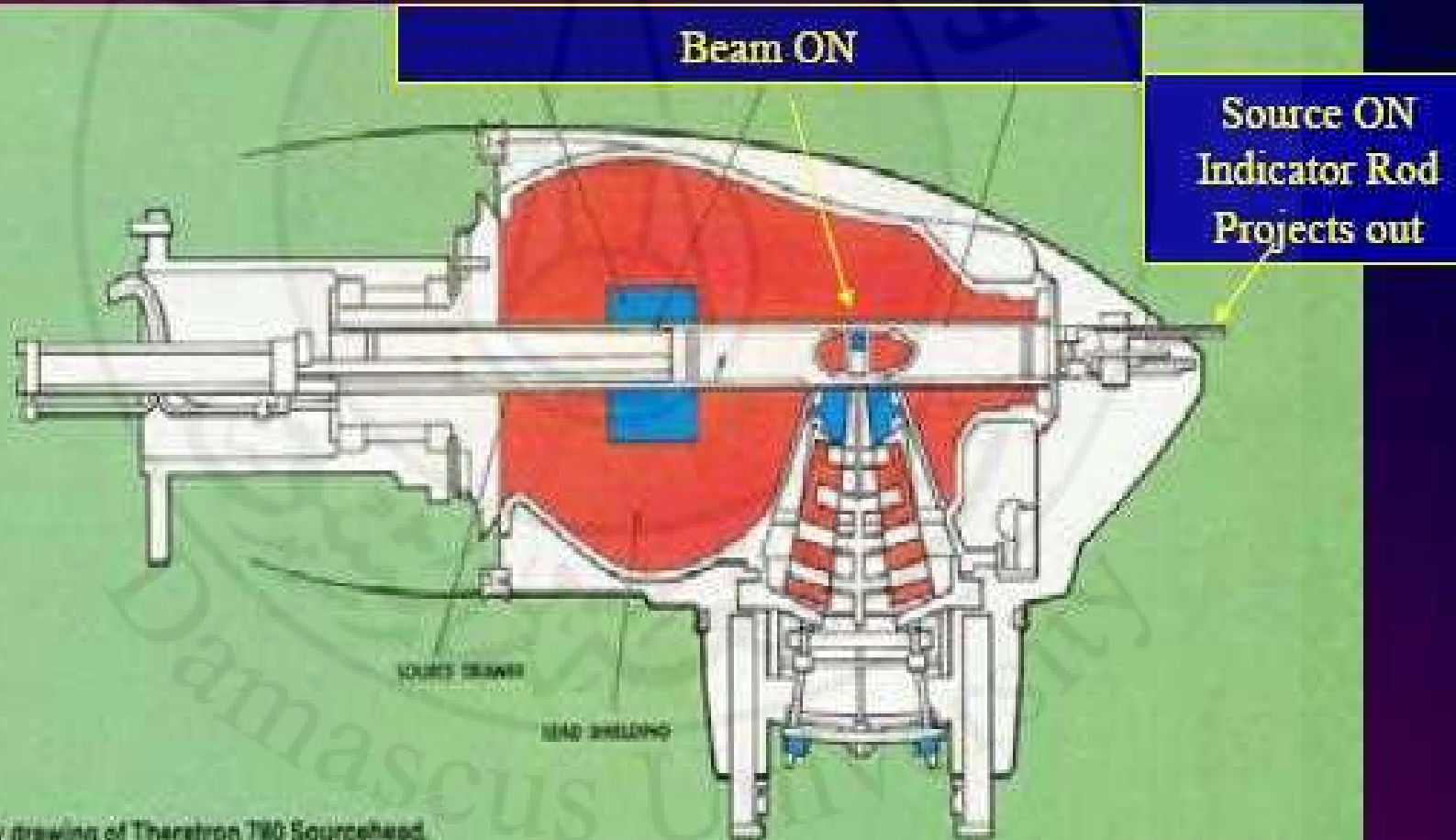
الحركات الميكانيكية لجهاز الكوبالت-60



□جهاز المعالجة بالكوبالت-60



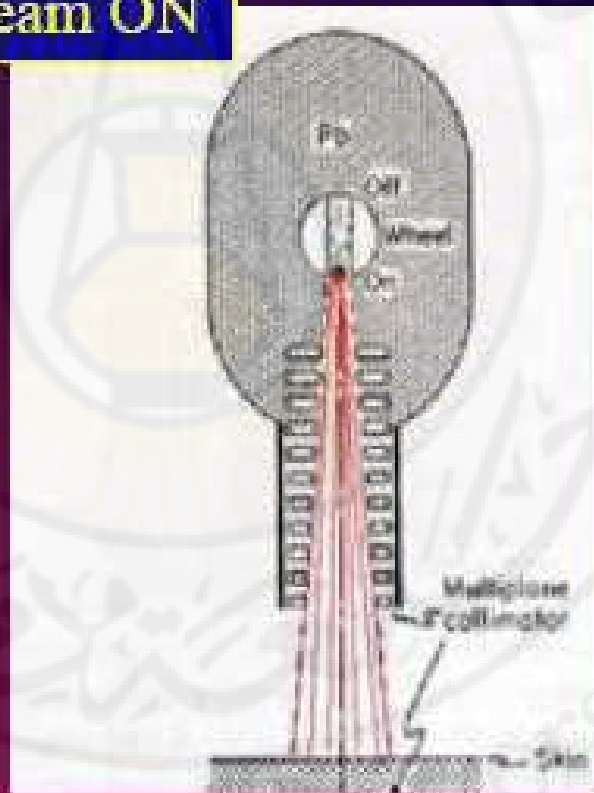
الحركة الآلية للمنبع المشع - حركة انسحابية



Cutaway drawing of Theratron 780 Sourcehead.

الحركة الآلية للمنبع المشع-حركة دائرية

Beam ON



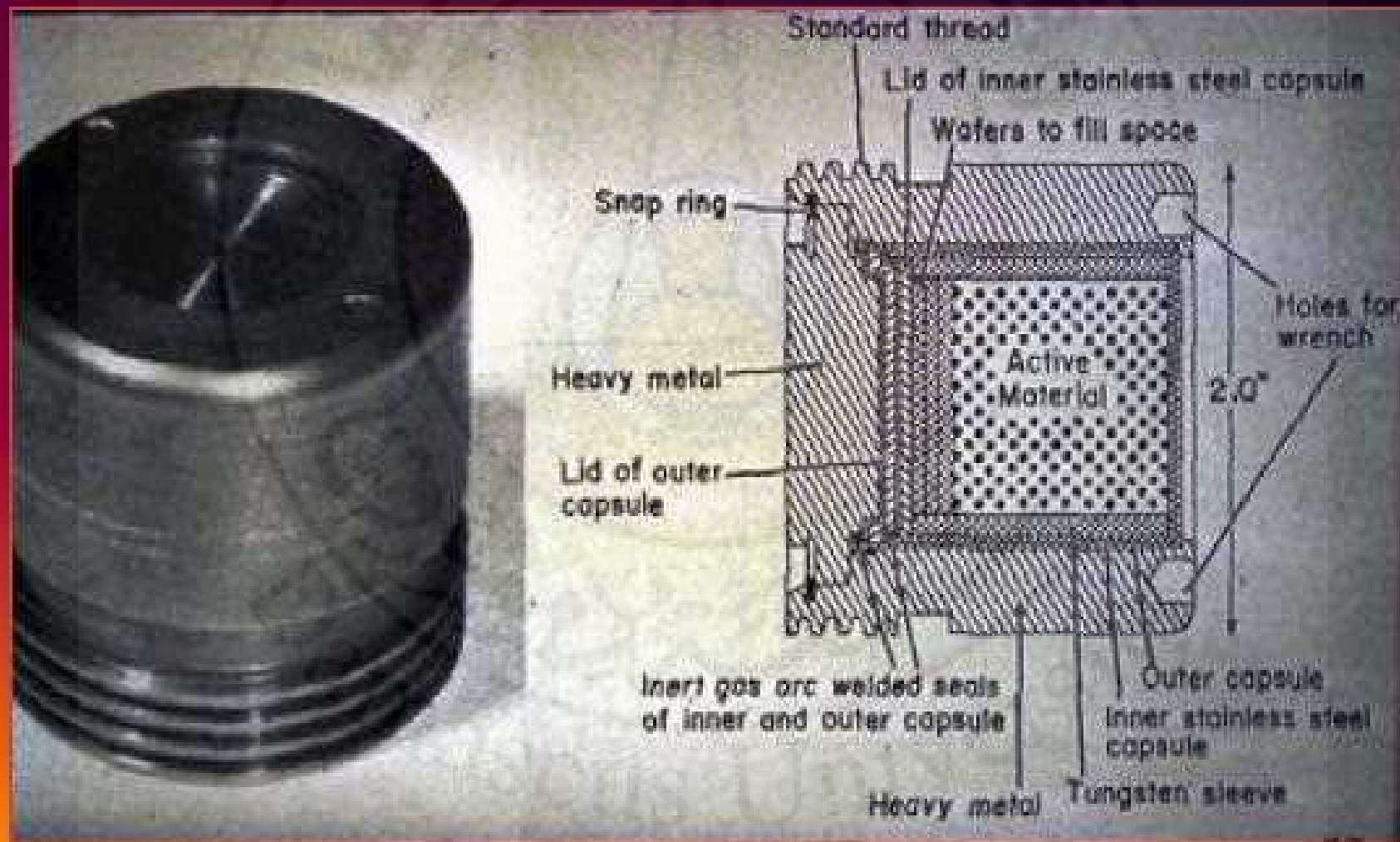
أجهزة أشعة-غاما Gamma-ray equipment

- تركيبة المنبع المشع.
- يجب أن يبقى المنبع مغلقاً بحيث يبقى كذلك حتى في درجات الحرارة التي تحدث في حالة الحريق،
- يوصى بالتغليف المضاعف لتجنب أي تسرب leakage للمادة المشعة



Co-60
material

تصميم منبع الكوبالت

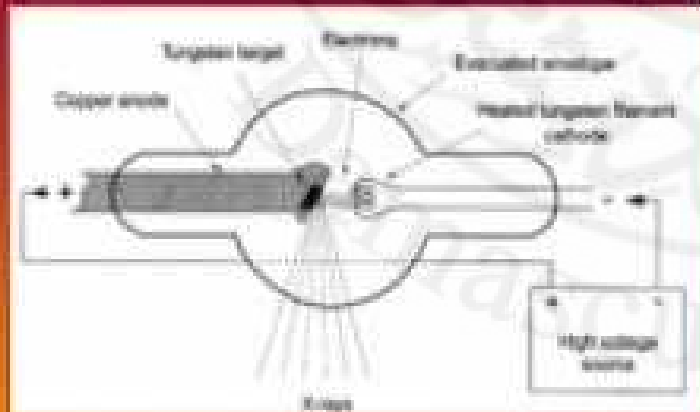


المزايا	العيوب
سهولة الاستخدام	قليل الدقة
قليل الأعطال	شبه الظل
قليل التكلفة	قلة الفعالية مع الزمن
قدرة استيعاب كبيرة	
أخطاؤه ظاهرة	

الأشعة السطحية والعميقة

Superficial and Orthovoltage

- نحصل على هذا النمط من الإشعاع باستخدام أنبوب أشعة-X التقليدي حيث تسرع الإلكترونات بواسطة الحقل الكهربائي.
- المصعد anode ثابت (بالمقابل في أنابيب التشخيص يكون المصعد دوار كي يسمح بتصغير حجم البؤرة المحرقة).
- في هذه الحالة الترشيح filtration هام جداً.



أنبوب الأشعة السطحية

Superficial X-ray tube

أنبوب أشعة-X

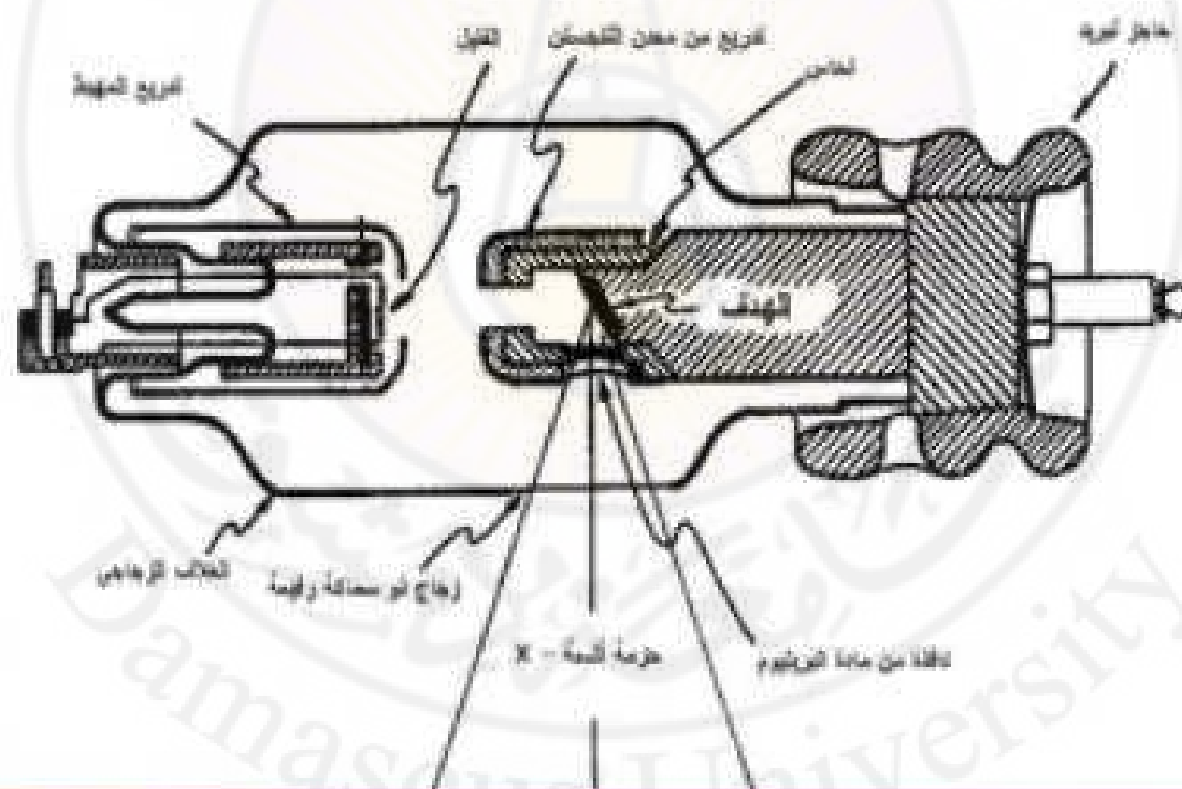


الهدف Target

ماء التبريد

المحدد

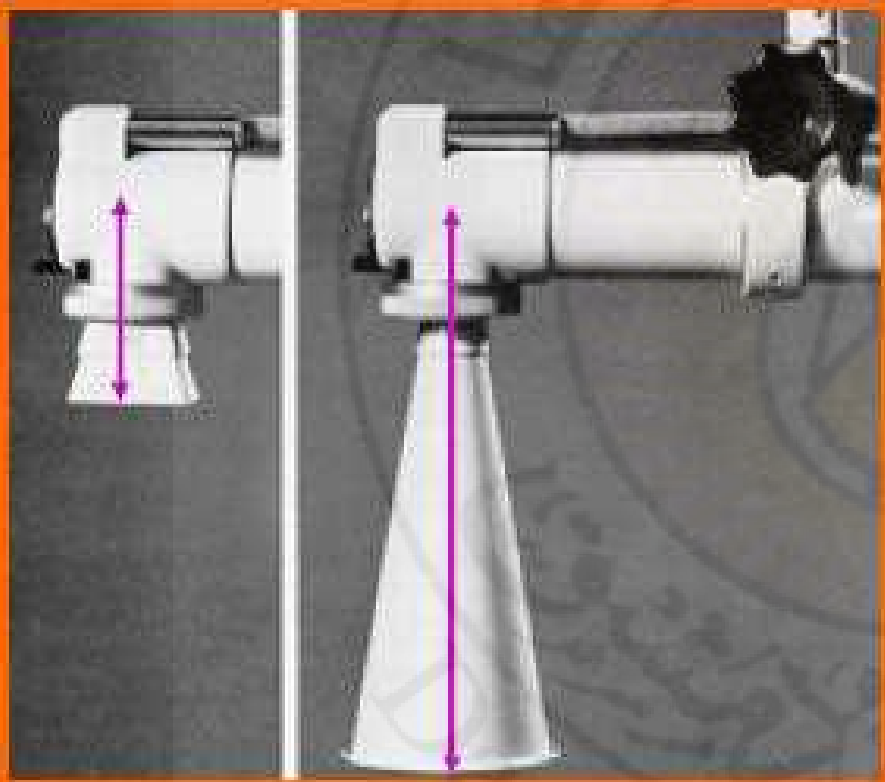
أنبوب الأشعة السطحية
Superficial X-ray tube



يفيد استعمال المخاريط Cones فيما يلي:

- استعمال بؤرة محرقية كبيرة، مسافة المعالجة صغيرة (المسافة بين البؤرة المحرقية والجلد غالباً تساوي ١٠ سم أو أقل) وهذا يعني أن الحزمة يجب أن تكون محددة على الجلد.
- تفيد مخاريط المعالجة لإجراء ذلك، كما يمكن استعمال تدريع اضافي باستعمال قطع من الرصاص على شكل صفائح توضع على الجلد

يعتمد الخرج الإشعاعي في أجهزة المعالجة السطحية على ما يلي:



قانون التربيع
العكسي

- تأثير التشغيل/التوقف On/off effect
- المسافة FSD حيث يؤثر طول المخروط بشكل ملموس على معدل الخرج الإشعاعي.
- التلوث بالالكترونات الصادرة عن المحددات (مما يزيد من جرعة الجلد وخاصة في عند الجهد 100kVp).

تجهيزات الكليوفولت (10 - 150 kVp)

- تستعمل المرشحات لحذف أشعة-X منخفضة الطاقة (التي تساهم فقط زيادة جرعة الجلد).



يجب أن يزود للتأكد
من صحة المرشح
المستخدم

وحدة التحكم والتشغيل



طبقة القيمة النصفية للحزمة (HVL)

Beam Half Value Layer

- من الهام جداً اختبار ميزات نوعية (جودة) الحزمة

characterize beam quality

- اختبار كفاءة المرشحات الموضوعة في مسار الحزمة في

حذف التخریب الحاصل بفعل الأشعة ذات الطاقة المنخفضة.

- هذا الاختبار لا يتطلب فقط استعمال كاف إشعاعي فقط بل

يجب استعمال رقائق عالية النقاوة من الألمنيوم **Al** أو

النحاس **Cu**.

Orthovoltage units تجهيزات الأشعة العميقة

- الجهد 120 to 400 kVp

- يستخدم أنبوب أشعة-X التقليدي.

- التطبيقات:

- الآفات الجلدية العميقة.

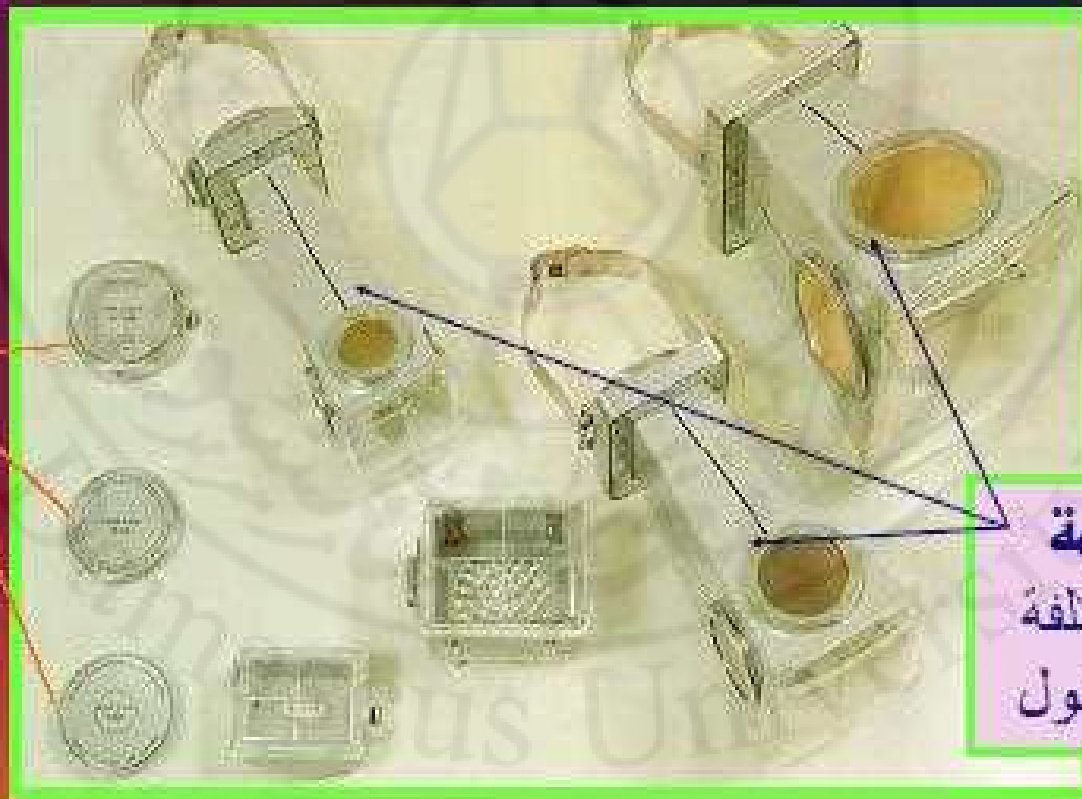
- الانتقالات العظمية



Damascus University

تجهيزات الكيلوفولت (150 - 400 kVp)

● محددات الحزمة والمرشحات.

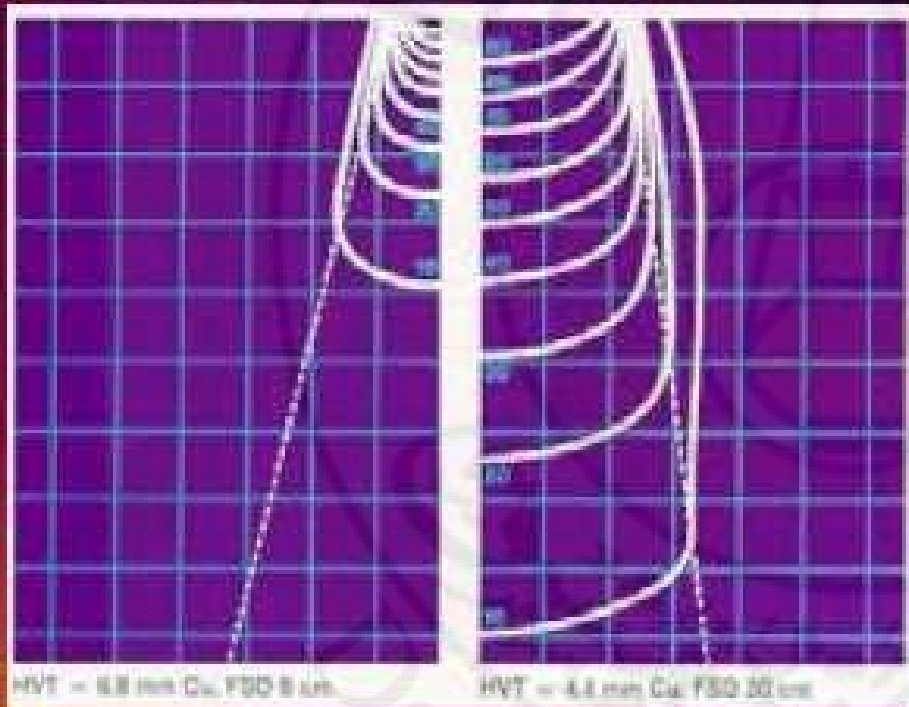


مرشحات

محددات الحزمة

أبعاد مساحة مختلفة
ومختلفة في الطول

تجهيزات الكيلوفولت (150 - 400 kVp)



- يعتبر قانون التربيع العكسي هاما في هذه الحالة.

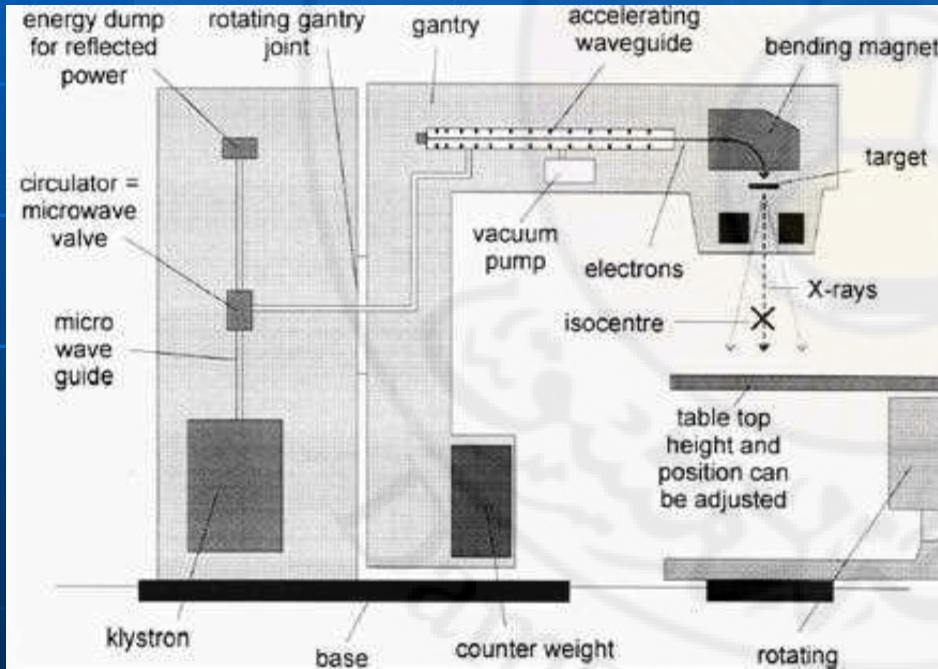
- معدل الجرعة بالعمق يتأثر بشدة مع تغير المسافة FSD

FSD 6cm,
HVL 6.8mm Cu

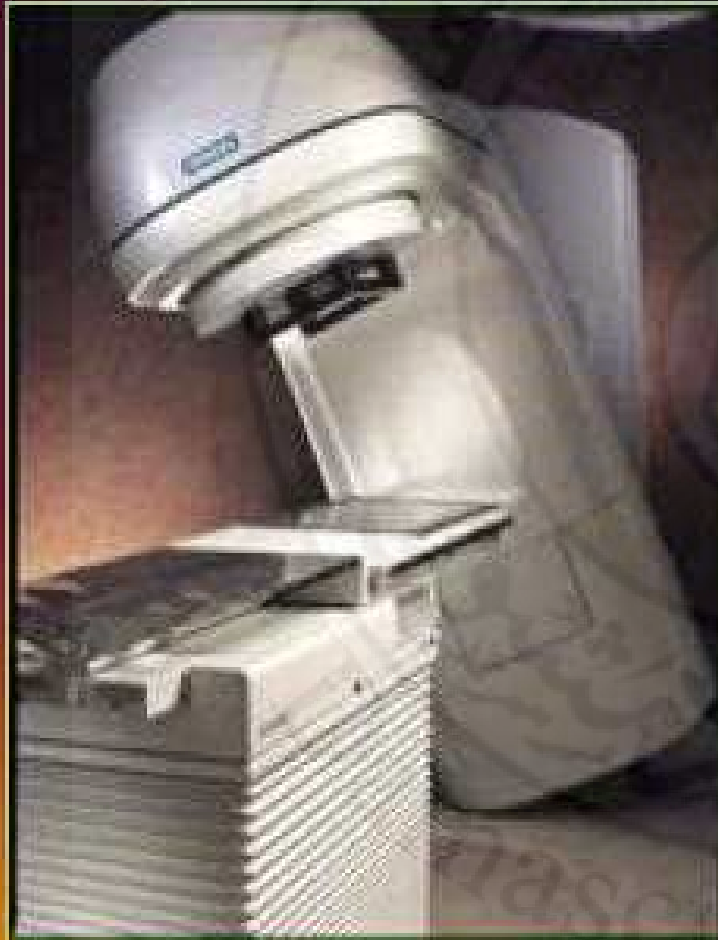
FSD 30cm,
HVL 4.4mm Cu

المسرّع الخطي

- الأكثر إستخداما
- يعطي فوتونات والكترونات مما يساعد في خيار المعالجة
- له حسنات(مزايا) و عيوب



٣. المسرعات الخطية Medical Linear Accelerators



- باختصار "linac"

- في الوقت الحالي معظم المرضى تعالج بالمسرعات الخطية

- يوجد عدد من الشركات الصانعة:

- Varian

- Siemens

- Elekta

مقارنة بين النسبة المئوية للجرعة بالعمق لحزم الفوتونات وأشعة غاما وأشعة X

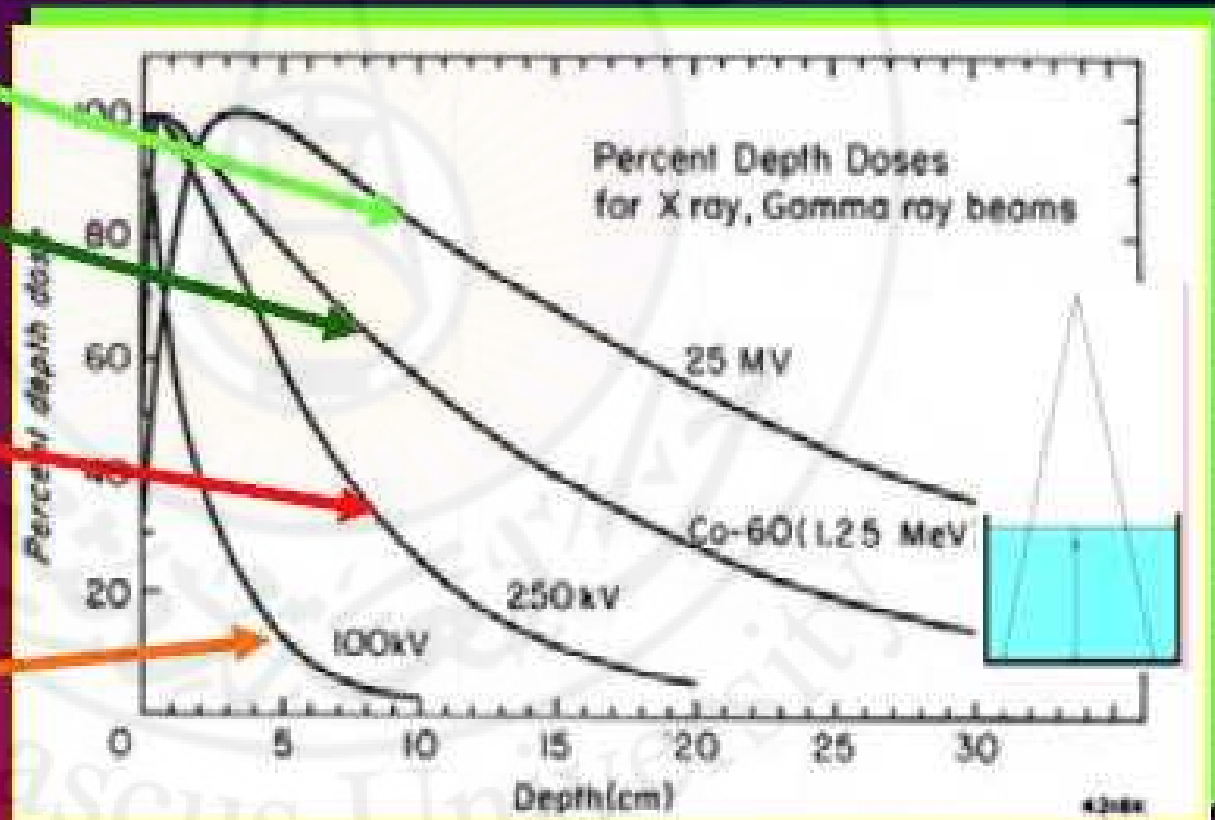
● الفوتونات

حزم فوتونات صادرة عن
مسرّع بطاقة 25 MV

حزم فوتونات صادرة عن
الكوبالت-60

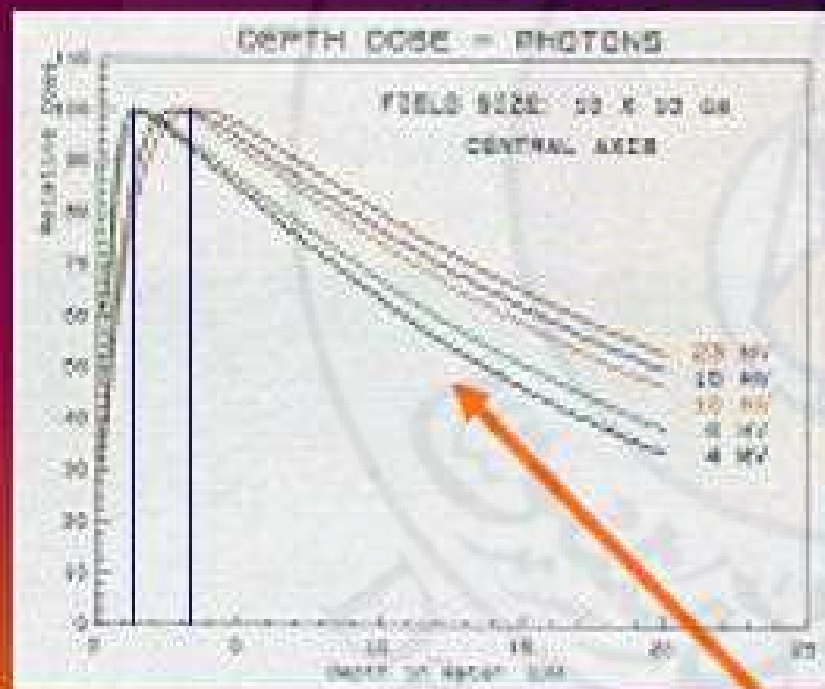
حزم فوتونات صادرة عن
مسرّع بطاقة 25 MV

حزم فوتونات صادرة عن
الكوبالت-60

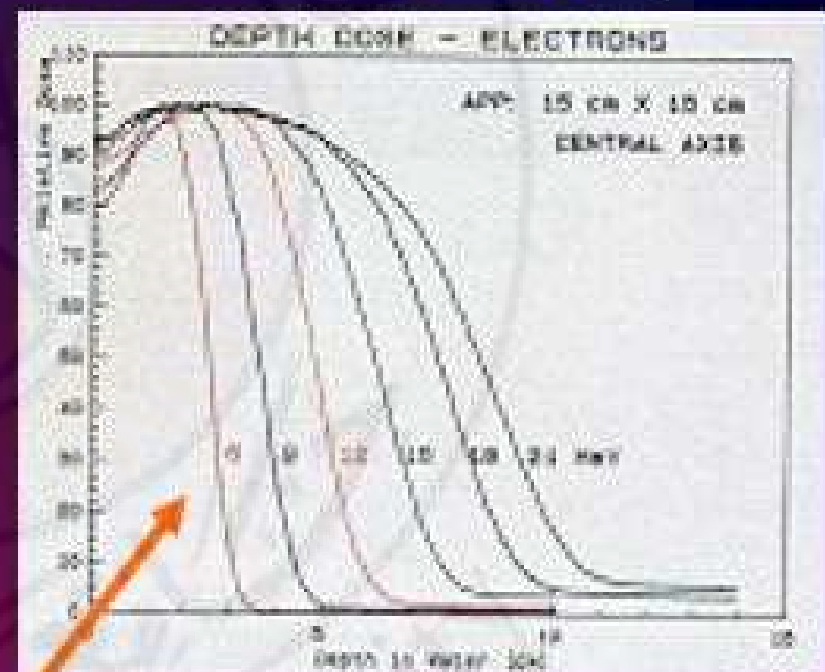


مقارنة بين النسبة المئوية للجرعة بالعمق لحزم الفوتونات والإلكترونات

● الفوتونات

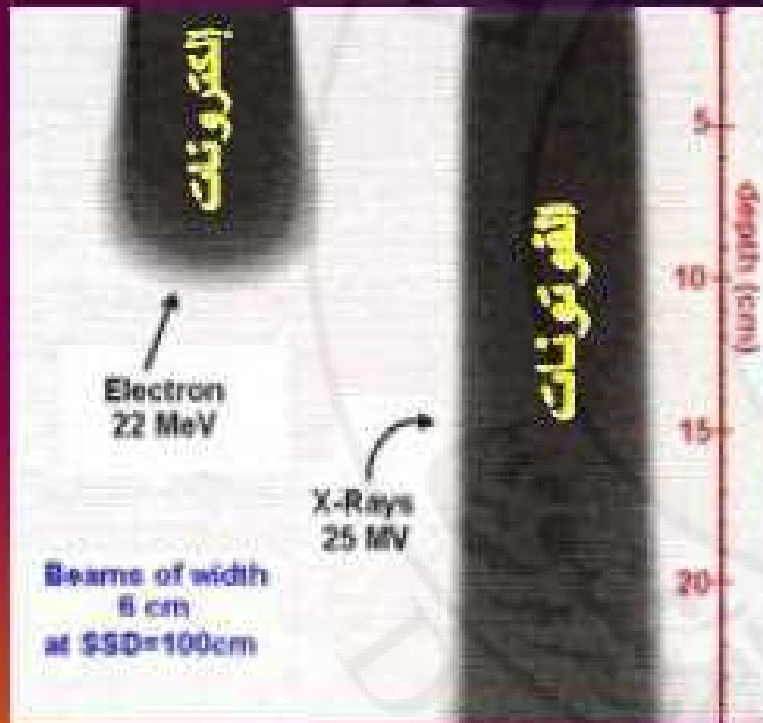


● الإلكترونات

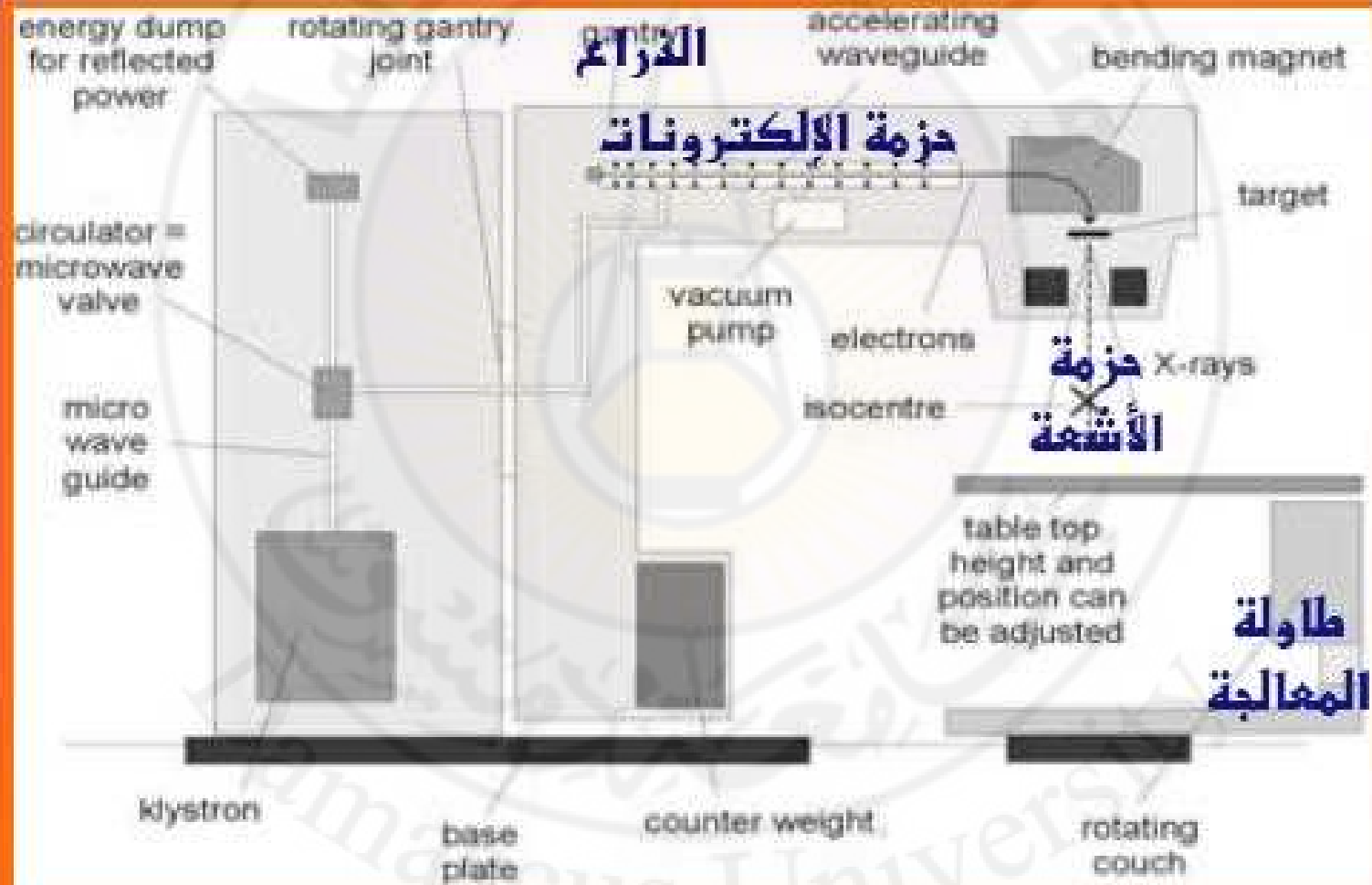


الحزم الإشعاعية التي تصدر عن المسرعات

• توزع جرعة الفوتونات والإلكترونات بالعمق:



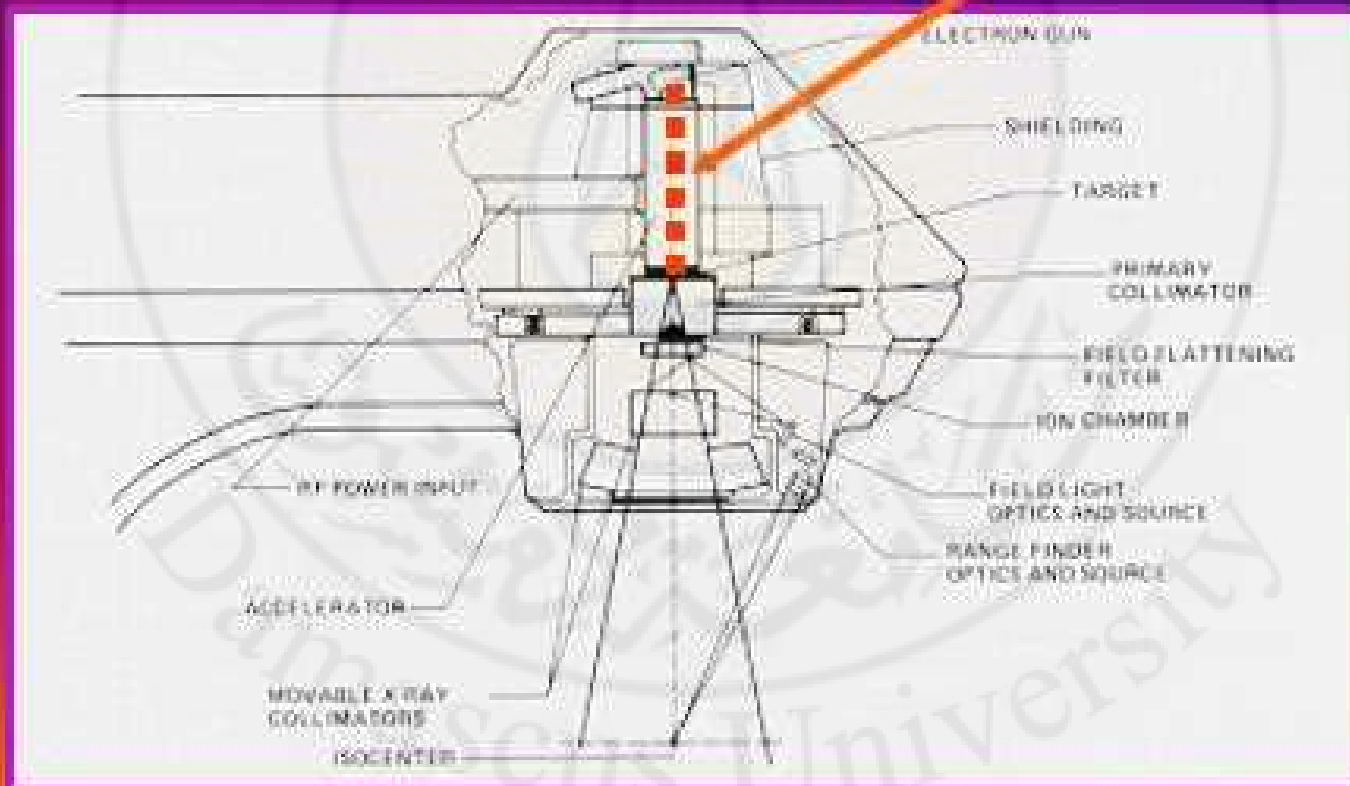
المسرور الخطي



Electron Accelerators مسرعات الإلكترون

- **6 MV** short waveguide

No bending magnet



Electron Accelerators مسرعات الإلكترون

- **18 MV** long waveguide



Bending
magnet

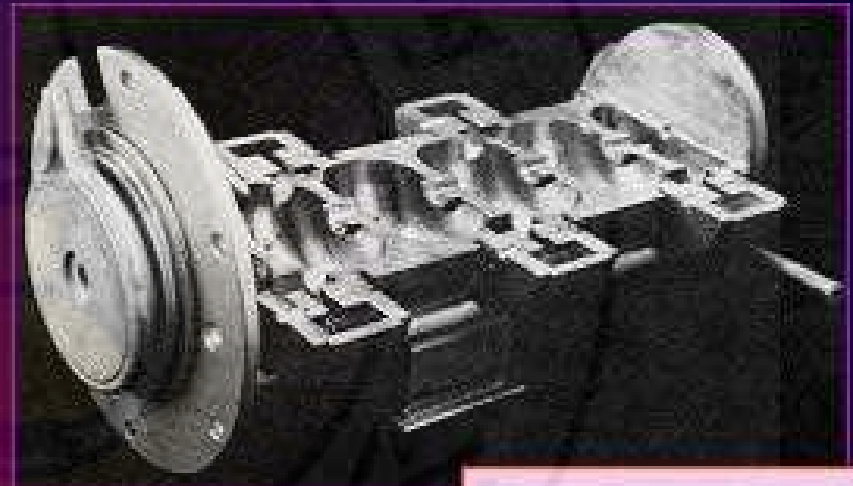
Electron
Beam

Electron
Gun

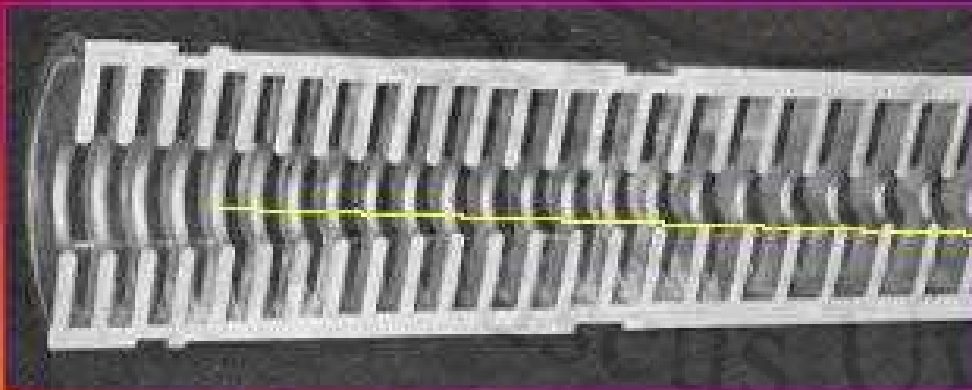
Useful
Beam

Electron Accelerators مسرعات الإلكترون

- Waveguides for acceleration of electrons using microwaves



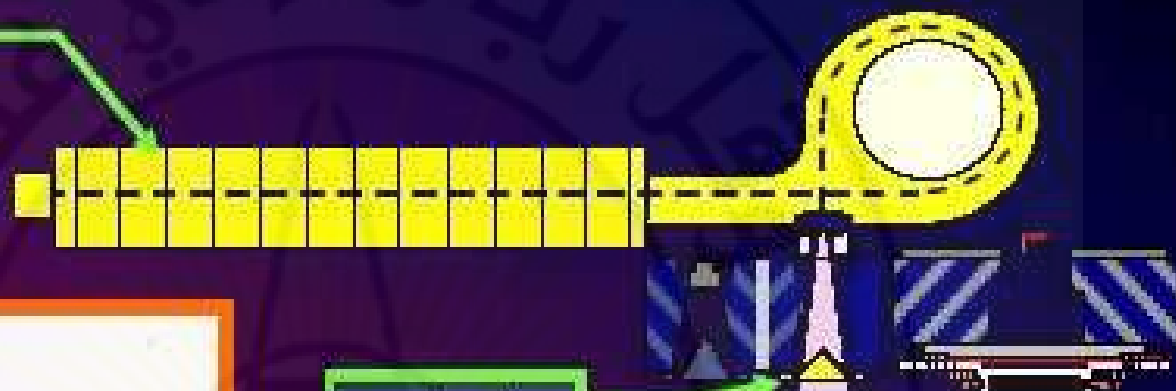
Short standing wave guide



Buncher for initial acceleration of electrons

آلية إصدار الفوتونات

المسرّع

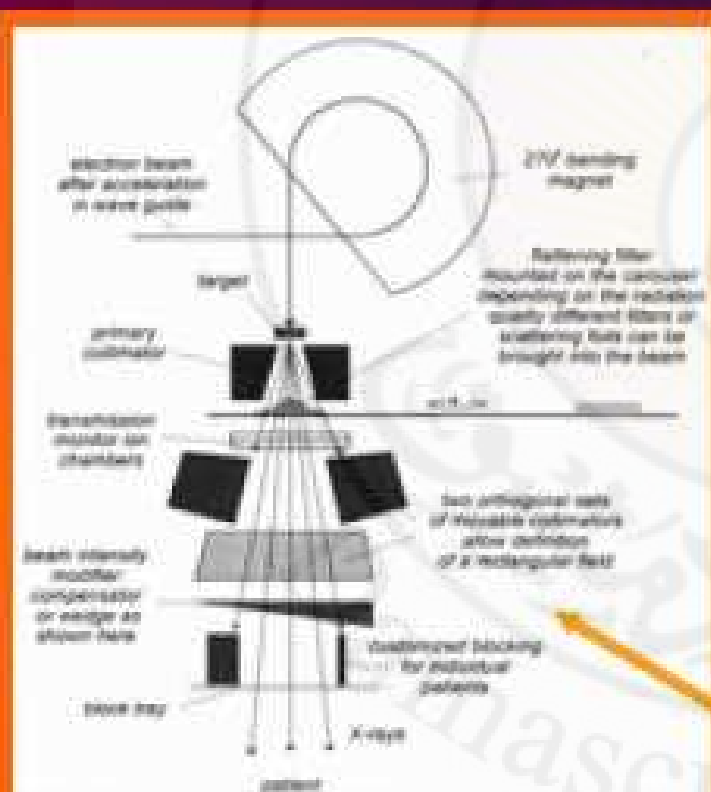


الهدف

حجيرة التأين

المحددات

حزمة الفوتونات



رأس المعالجة للمسرّع الخطي

Treatment head

● آلية إصدار الإلكترونات

المسرّع

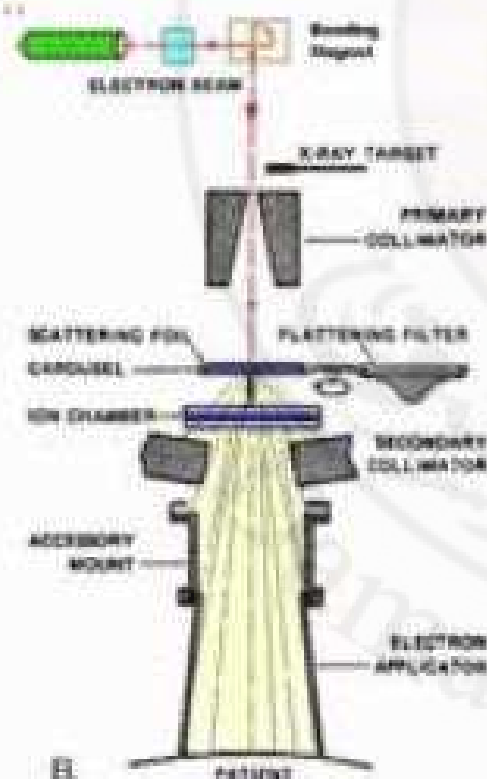
الهدف

حجرة التأين

المحددات

المحددات
الإلكترونات

حزمة
الإلكترونات



محددات حزمة الإلكترونات Electron Applicators



Electron Applicator System 95 cm



Rotational Electron
Applicator

مسرعات الإلكترونات Electron Accelerators



- المسرعات الحديثة لها الكثير من خيارات المعالجة، على سبيل المثال:

- ☞ أشعة سينية (فوتونات) و

- ☞ إلكترونات (نمط ثنائي)

- عدد من الطاقات:

- ☞ طاقتا اشعة سينية

- ☞ طاقات إلكترونات أو أكثر

الملحقات الهامة Important Accessories

- المرشح الاسفيني **Wedges**
- المرشح الاسفيني الديناميكي **Dynamic wedges**
- قوالب الحماية **Blocks**
- المحدد المتعدد الوريقات **Multileaf Collimator (MLC)**
- نظام التصوير المباشر **Electronic Portal Imaging (EPID)**

المحدد المتعدد الوريقات (MLC) Multileaf Collimator

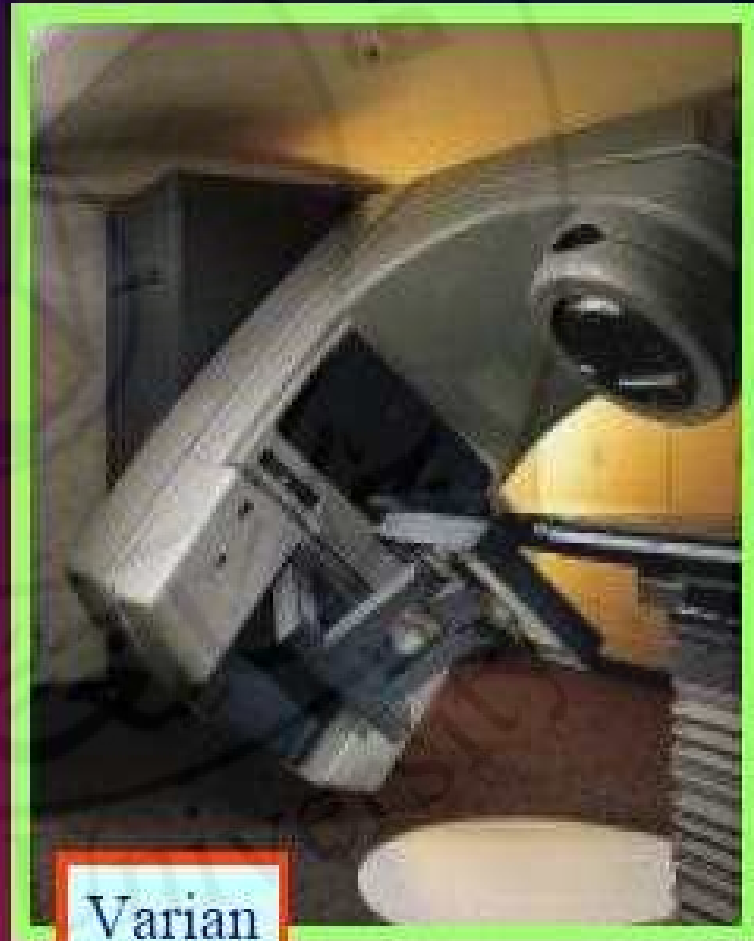
- يستعمل لتحديد أي شكل للحرمة الإشعاعية
- يوجد عدة نماذج:

■ اختلاف في عرض الوريقة
(1cm to 0.4cm).

■ منها استبدل المحدد الأساسي أو
أضيف مع المحافظة على
المحددات الأساسية.



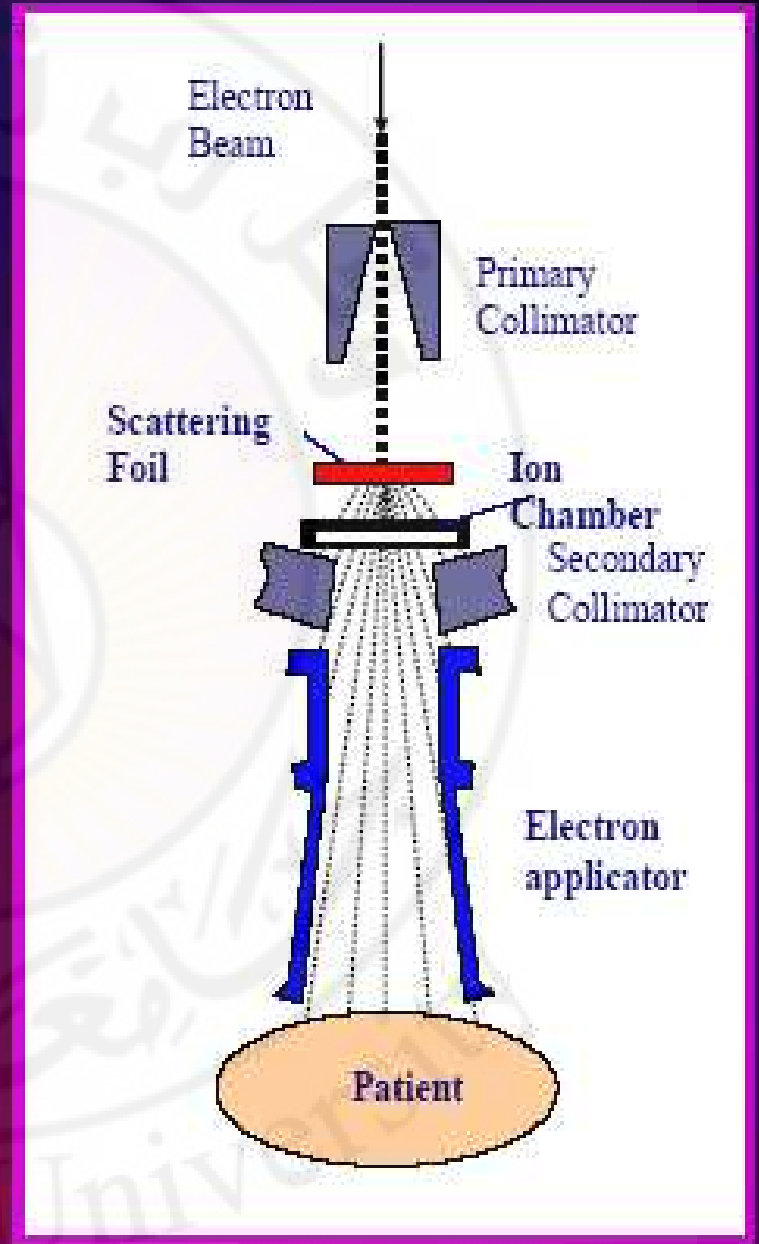
Electronic portal imaging devices in practice



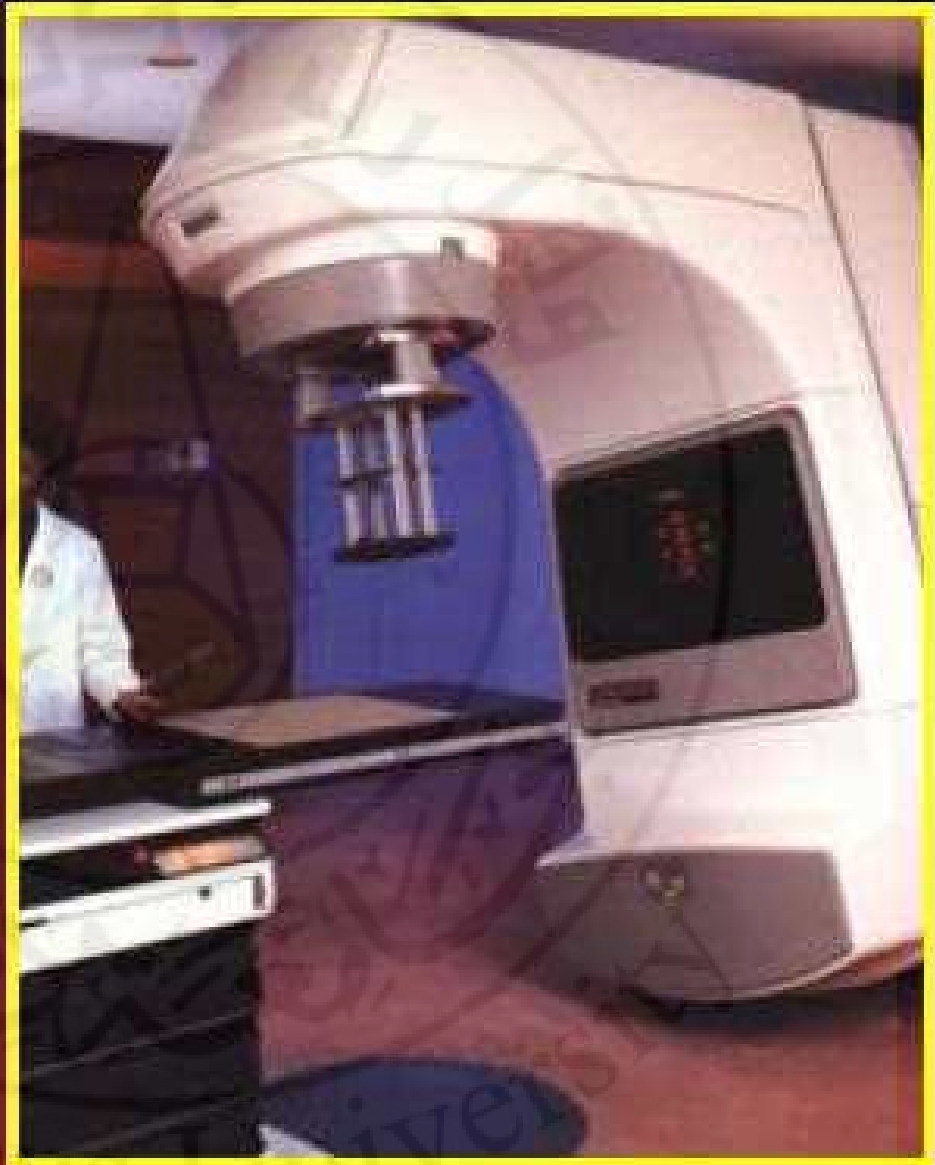
حزم الإلكترونات

Electron beams

- لا نحتاج إلى هدف Target
- تستعمل وريقات التبعثر Scattering foil للتوليد حزمة واسعة نسبياً من خلال مسح الحزمة الضيقة pencil beam باستعمال الحقول الكهربائية.
- نحتاج على محددات خاصة Applicator لتحديد الحزمة بشكل جيد على المريض.



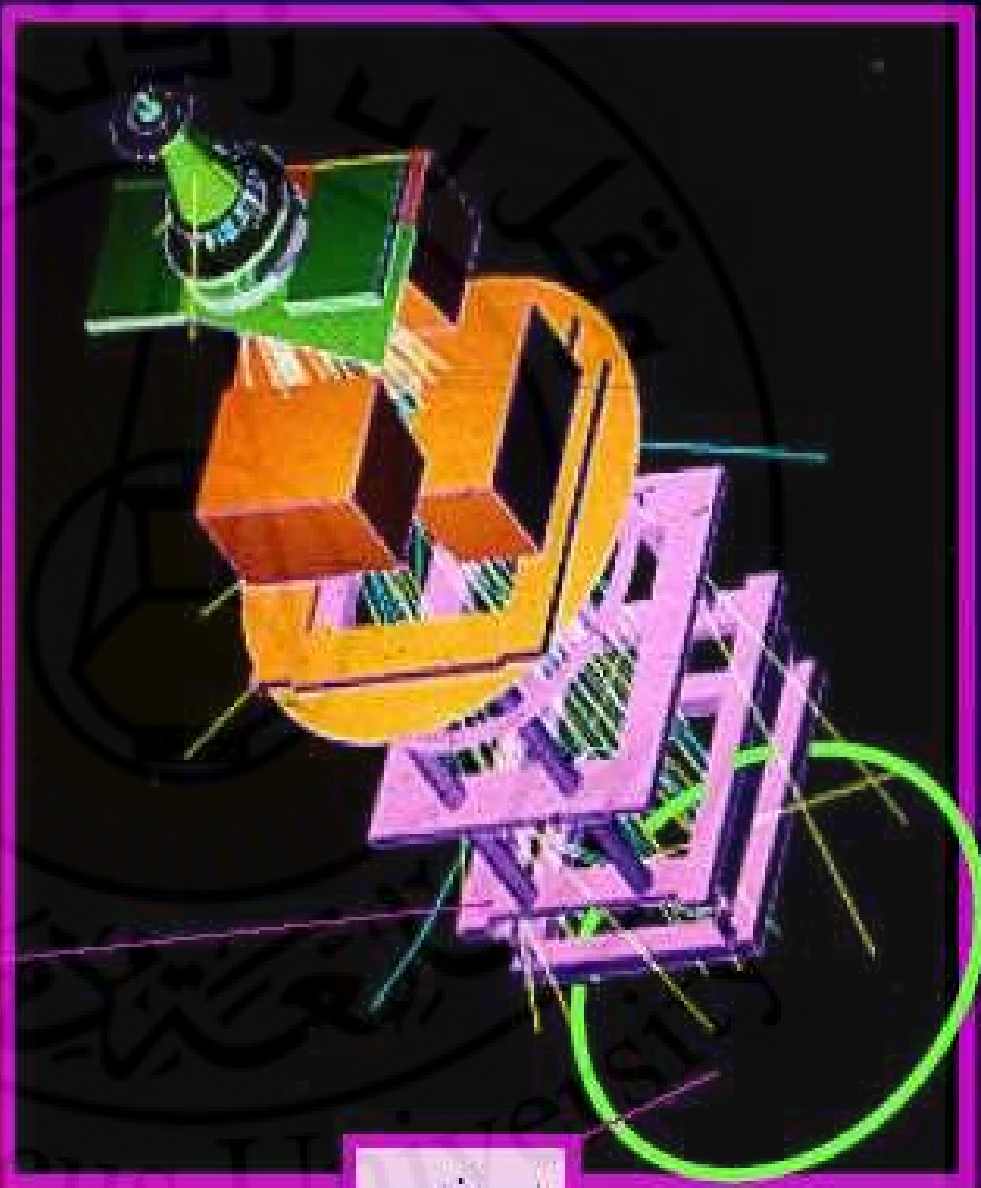
**Electron
applicator on
a modern
Varian linear
accelerator**



Model of an electron applicator for Monte Carlo Calculations

Electron
applicator

patient



Electron Accelerators

- Complex control system
- Reliance on computers

MLC control

EPID
control

Linac control

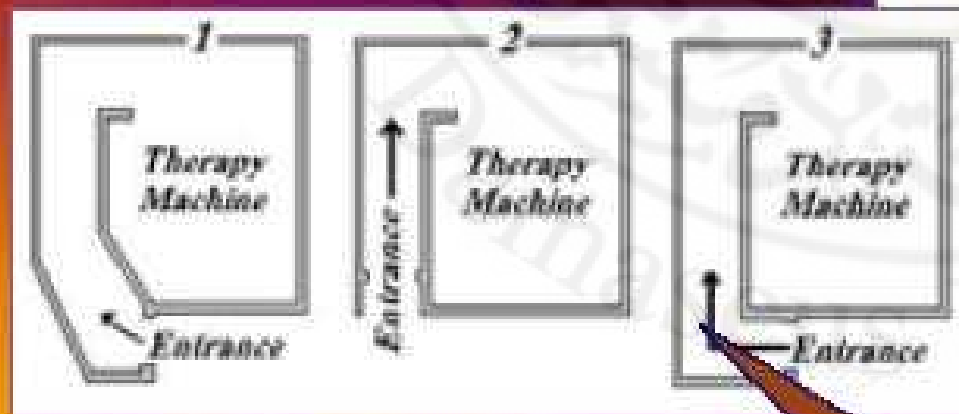


تصميم غرفة المعالجة

حاجز
لؤلؤ

حاجز
ثانوي

الحزمة الرئيسية



المسرّع	الكوبالت
يعطي نوعين من الأشعة – عدة طاقات – زمن معالجة محدود وثابت – لا يوجد مخلفات شعاعية – شبه ظل ضيق	قدرته – بساطته – صيانة قليلة – سعر معقول
صيانة صعبة – مكلفة – سعر عالي – نسبة أعطال	وحيد الأشعة – وحيد الطاقة – منسوب متناقص – شبه ظل كبير – كلفة تبديل المنبع – مخلفات شعاعية

٤. تجهيزات أخرى للمعالجة الإشعاعية الخارجية

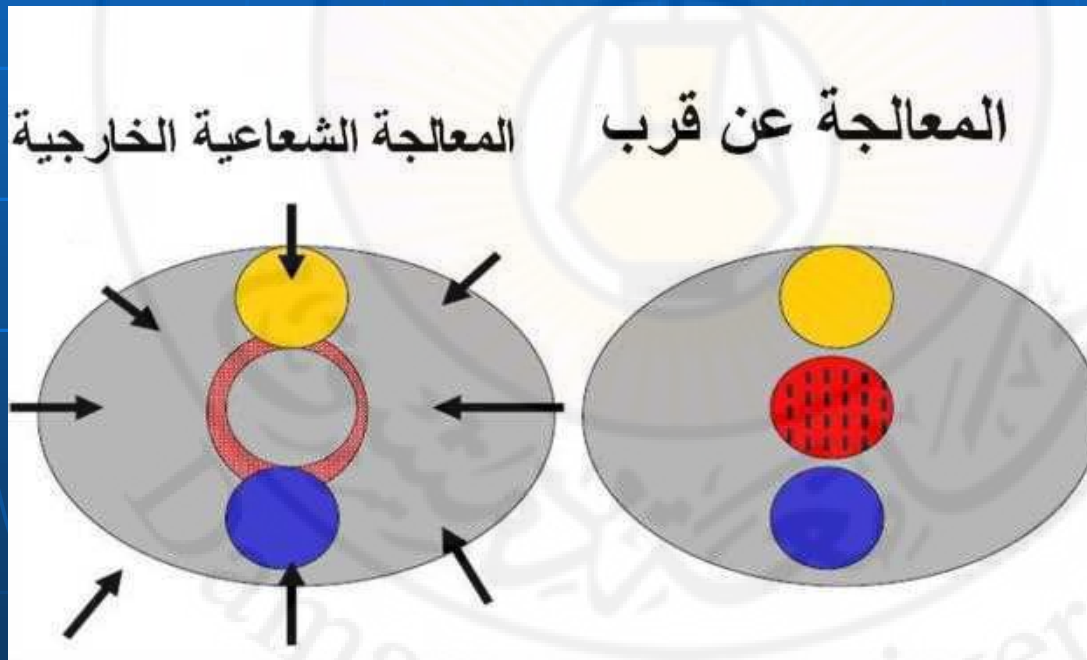
- الغاما نايف Gamma knife
- المعالجة بالنيوترونات Neutrons - خارج مجال هذه الدورة - ما تزال ضمن الأبحاث
- المعالجة بالبروتونات Protons

الغاما نايف *Gamma knife*



المعالجة الشعاعية عن قرب – الكورية

- استخدام المصادر المشعة المغلقة في منطقة الورم (ضمنه) أو بتماسه
- إيصال جرعة إشعاعية لمنطقة الهدف.
- تعريض النسيج السليمة (الأعضاء الحساسة) المجاورة للورم إلى أقل جرعة ممكنة.



تطبيقات المعالجة عن قرب:



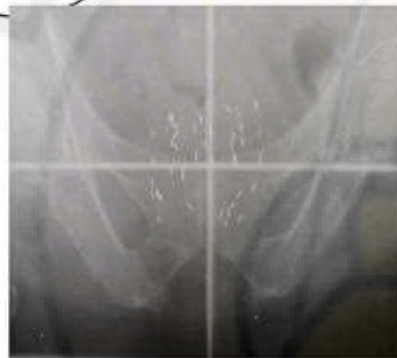
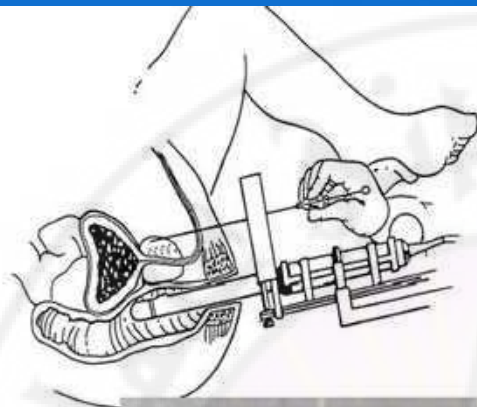
- * الثدي
- * المريء
- * القصبات

- * البروستات
- * العنق
- * عنق الرحم

□ المصادر المشعة المستخدمة

السيزيوم - 137 : العمر النصفى 30 سنة
الإيريديوم - 192 : العمر النصفى 74 يوماً
الأيودين - 125 : العمر النصفى 60 يوماً

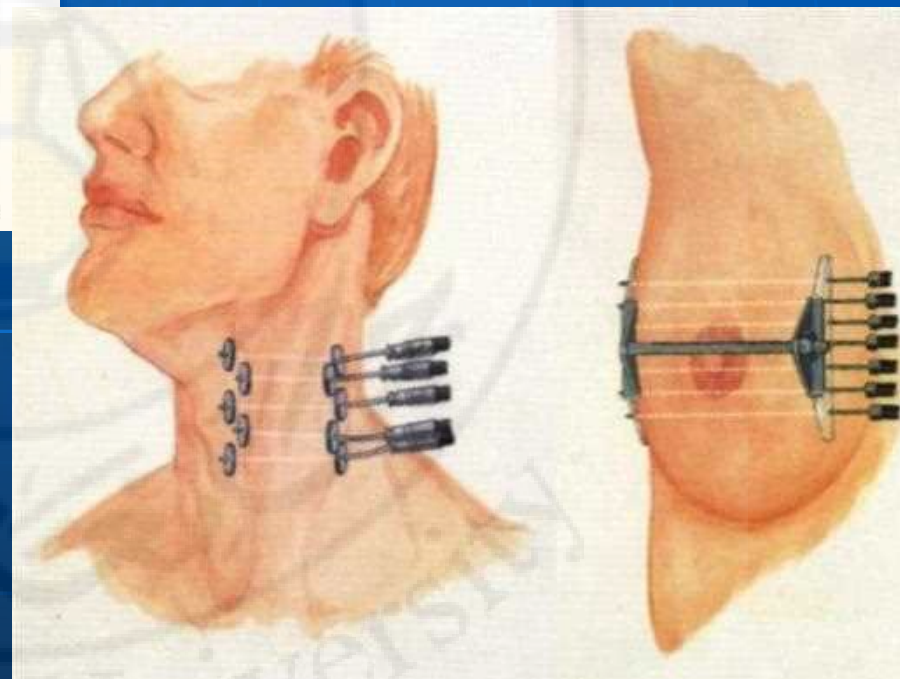
المعالجة عن قرب
(ضمن الورم)



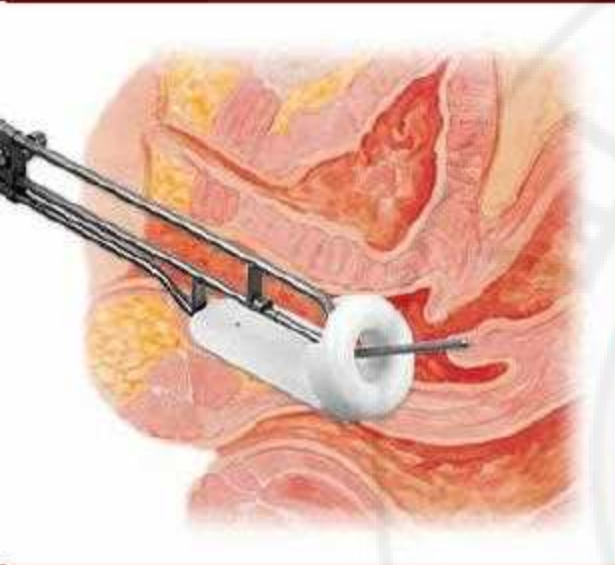
أشكال المنابع المشعة بذور

□ إبر

□ أسلاك

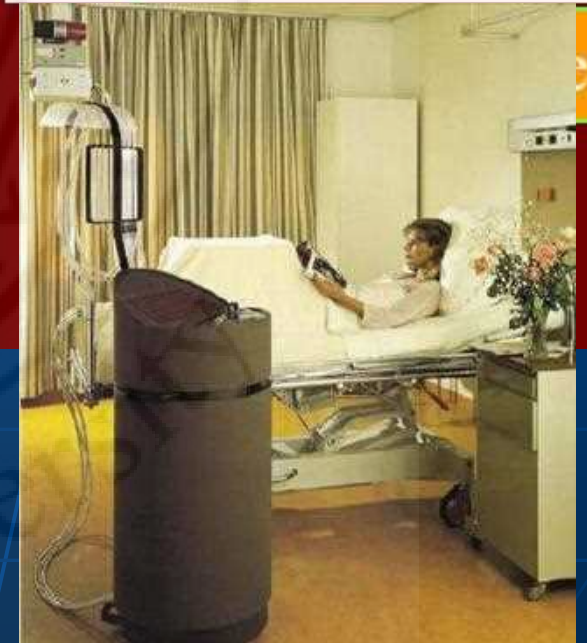


Gynaecological applicators



Ring type

Fletcher Suit





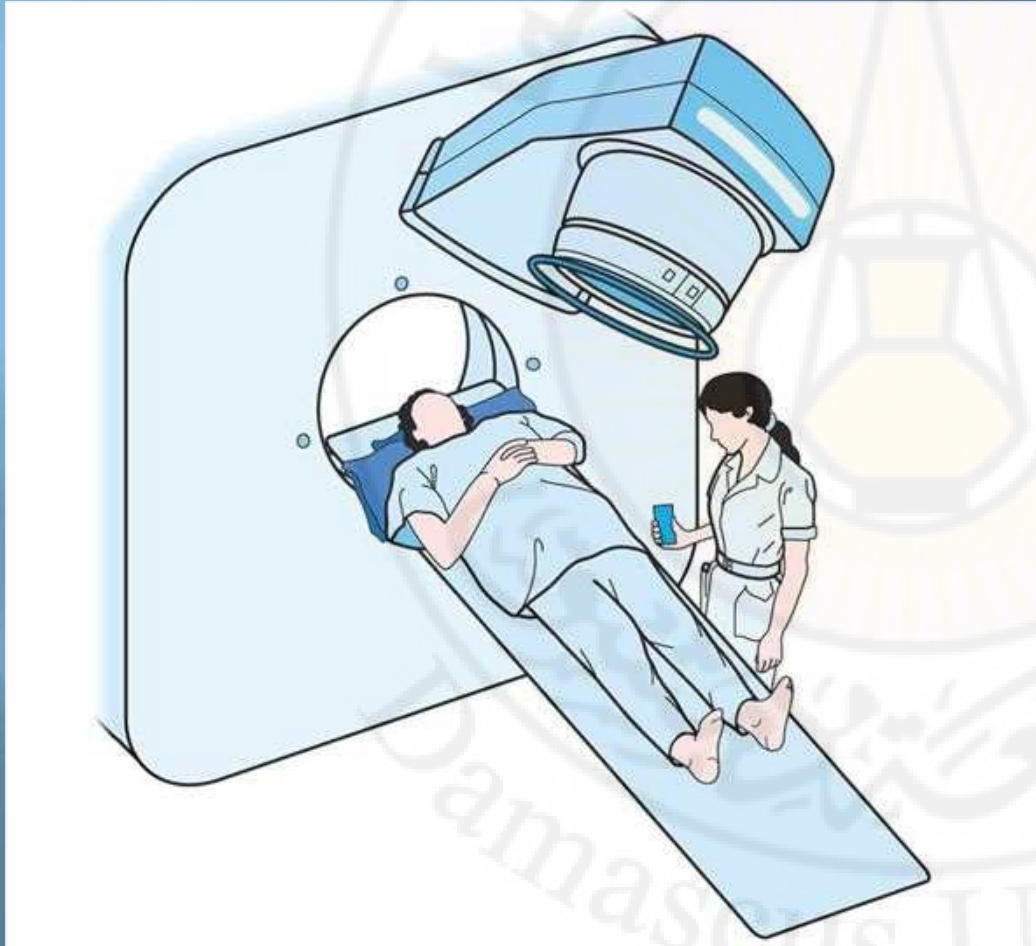
عن بعد

يدوياً

- المنابع يتم شحنها آلياً من مكان التخزين الآمن إلى المطبقات.
- تعود المنابع آلياً إلى المخزن الآمن في كل مرة يتم بها الدخول إلى غرفة المريض.

- يتم إدخال المنابع يدوياً غالباً من قبل الفيزيائي.
- المنابع يتم نزعها عند انتهاء فترة المعالجة.

مقدمة في التكنيك الشعاعي



الهدف من العلاج الشعاعي

- اعطاء جرعة كافية على الحجم الورمي الهدفي مع احترام جرعة تحمل الأعضاء الحساسة المجاورة لأجل ازالة كل الخلايا الورمية للحصول على تحكم موضعي و بالتالي امكانية الشفاء.
- يمكن أن بهدف شفائي أو ملطف

الجرعة الشعاعية:

- كمية الطاقة المنتشرة في وحدة الكتلة المشعة.
- الواحدة : غري.
- ١ غري : تمثل ١ جول في ١ كغ من المادة.

الجرعة الشعاعية:

مفهوم الجرعة

التجزأ : عدد الجلسات لاعطاء جرعة شعاعية كلية

جلسة واحدة = جرعة واحدة

مدة المعالجة : عدد الأيام بين أول و آخر جلسة.

- بشكل عام الجرعة الكلية مجزأة مقسمة على عدد من الجلسات بفاصل ٢٤ سا.
- الهدف منه لفعل مختلف بين النسيج الطبيعي و الورمي.

فائدة التجزأ

- الاصلاح الخلوي يكون أكبر في النسيج الطبيعي منه في الورمي.
- التكاثر الخلوي بين الجلسات الشعاعية مفيد للخلايا الطبيعية و بالتالي يقلل من السمية.

أنواع التجزأ

- التقليدي: ٨، ١-٢ غري بالجلسة.
- قليل التجزأ: زيادة جرعة التجزأ و انقاص عدد الجلسات ، عادة في العلاج الملطف.
- عديد التجزأ: عدد التجزأ باليوم الواحد أكثر من واحد مع نقصان جرعة التجزأ الواحد بدون نقصان المدة.



- اذا كانت قصيرة : خطوة السمية.
- اذا كانت طويلة : تكاثر ورمي بين الجلسات .
- التقليدي : ٤-٥ جلسات بالأسبوع ، بدون توقف قدر الامكان.



مبادئ المعالجة

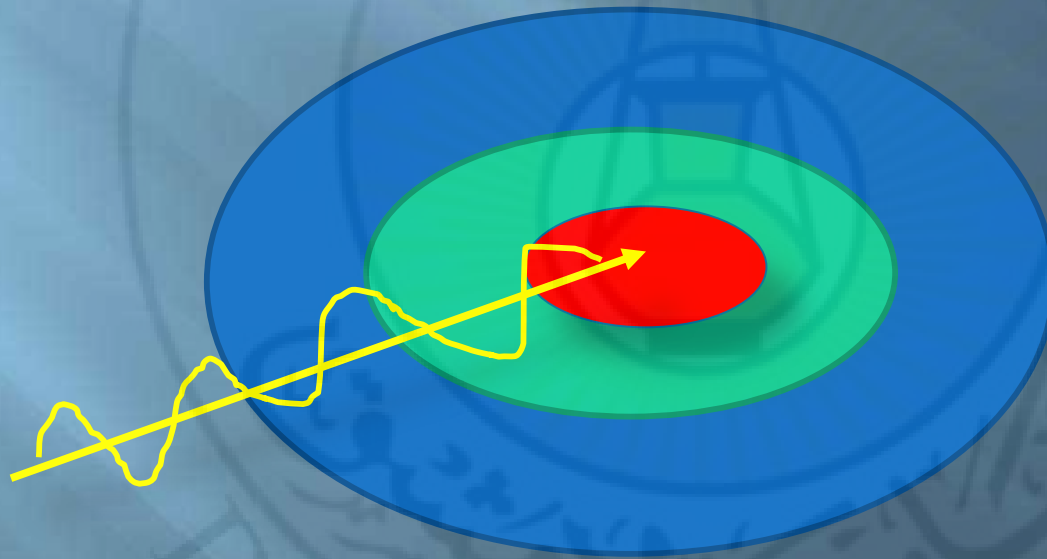
ازالة الخلايا الورمية تتم من خلال ايجاد جرعة قاتلة للورم بدون ضرر للنسج السليمة من خلال الاعتماد على ثلاث عناصر:

الجرعة الكلية

الزمن

التجزا

الخلايا الورمية



تحديد الحجم الهدف

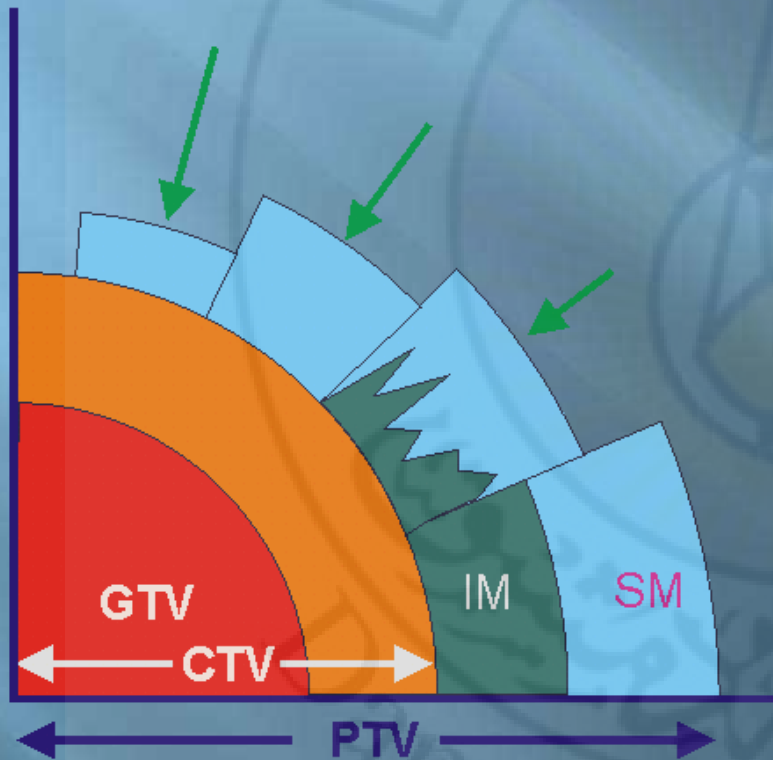
□ يتعلق :

- تقرير الجراحة
- تقرير التشريح المرضي
- تقرير التصوير الشعاعي

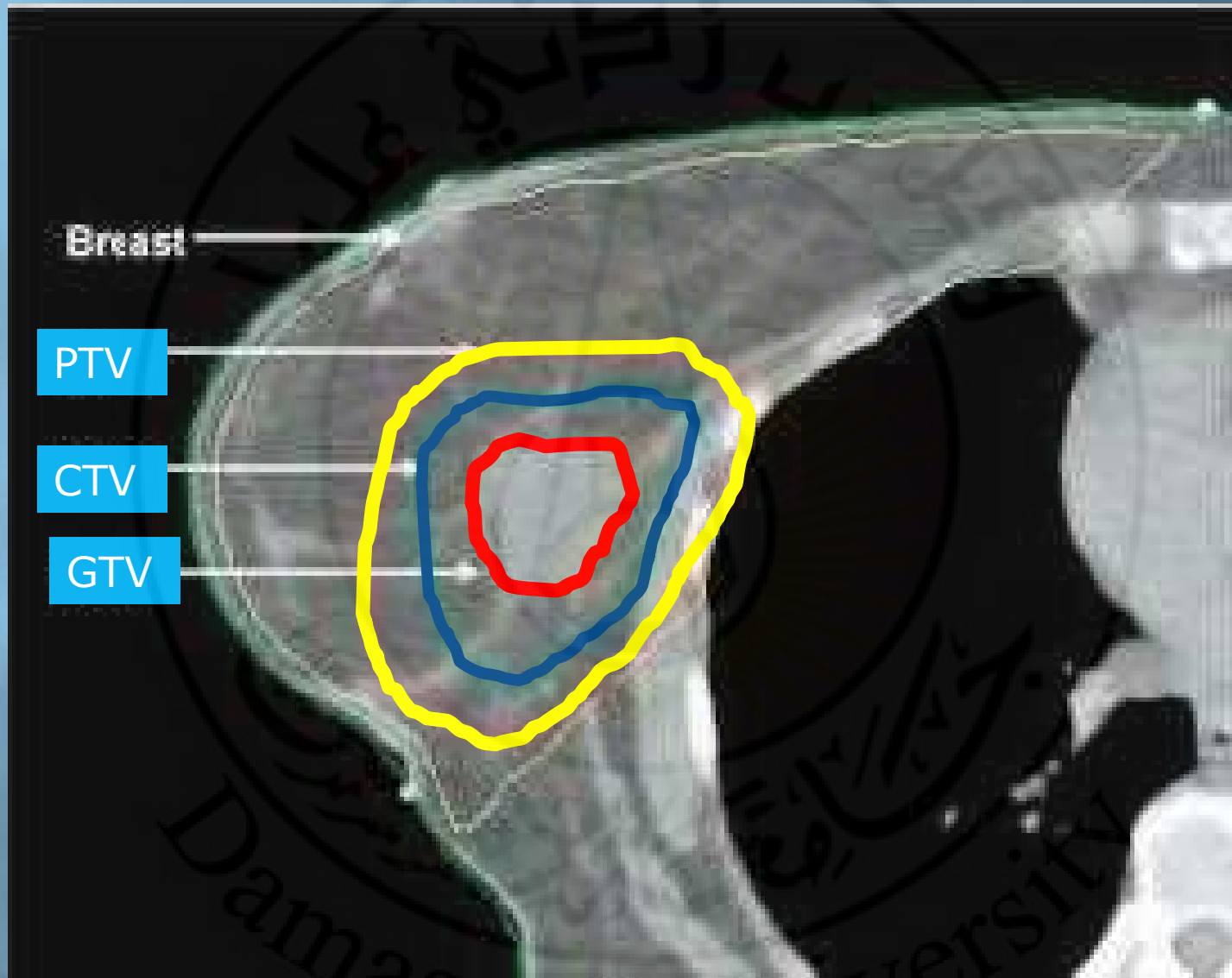
تحديد الحجم الهدف

- الحجم الورمي النامي (GTV): الحجم الورمي المجسوس أو المشاهد شعاعيا.
- الحجم الورمي السريري (CTV): يشمل الحجم السابق مع هامش لشمّل الامتداد المجهرى للورم ، أو مسكن الجراحة.
- الحجم الورمي المخطط (PTV): يشمل الحجم السابق مع اضافة هامش آخر تبعا لحركة الأعضاء الداخلية و حركة المريض اثناء الجلسة و أيضا فروق وضعية المريض اليومية.

الحجوم الورمية المشعة



- GTV □
- CTV □
- SM □
- IM □
- PTV**



اختيار الجرعة

- يتم من قبل الطبيب من خلال دراسات سريرية ، أو من خلال بروتوكول متبع في المركز الشعاعي.
- يعتمد على حجم الورم و موقعه، الأعضاء المجاورة ، و على هدف المعالجة.

أمثلة عن بروتوكولات العلاج الشعاعي

- أورام الرأس و العنق الغير جراحية : ٧٠ غري / ٣٥ جلسة / ٧ أسابيع.
- أورام الرئة : ٦٠ غري / ٣٠ جلسة / ٦ أسابيع
- أورام الخصية : ٢٥-٣٠ غري / ١٥ جلسة / ٣ أسابيع
- داء هودجكن : ٣٥-٤٠ غري / ٢٠ جلسة / ٤ أسابيع

اختيار التجزأ

يعتمد على خيار العلاج

-شفائي : تقليدي

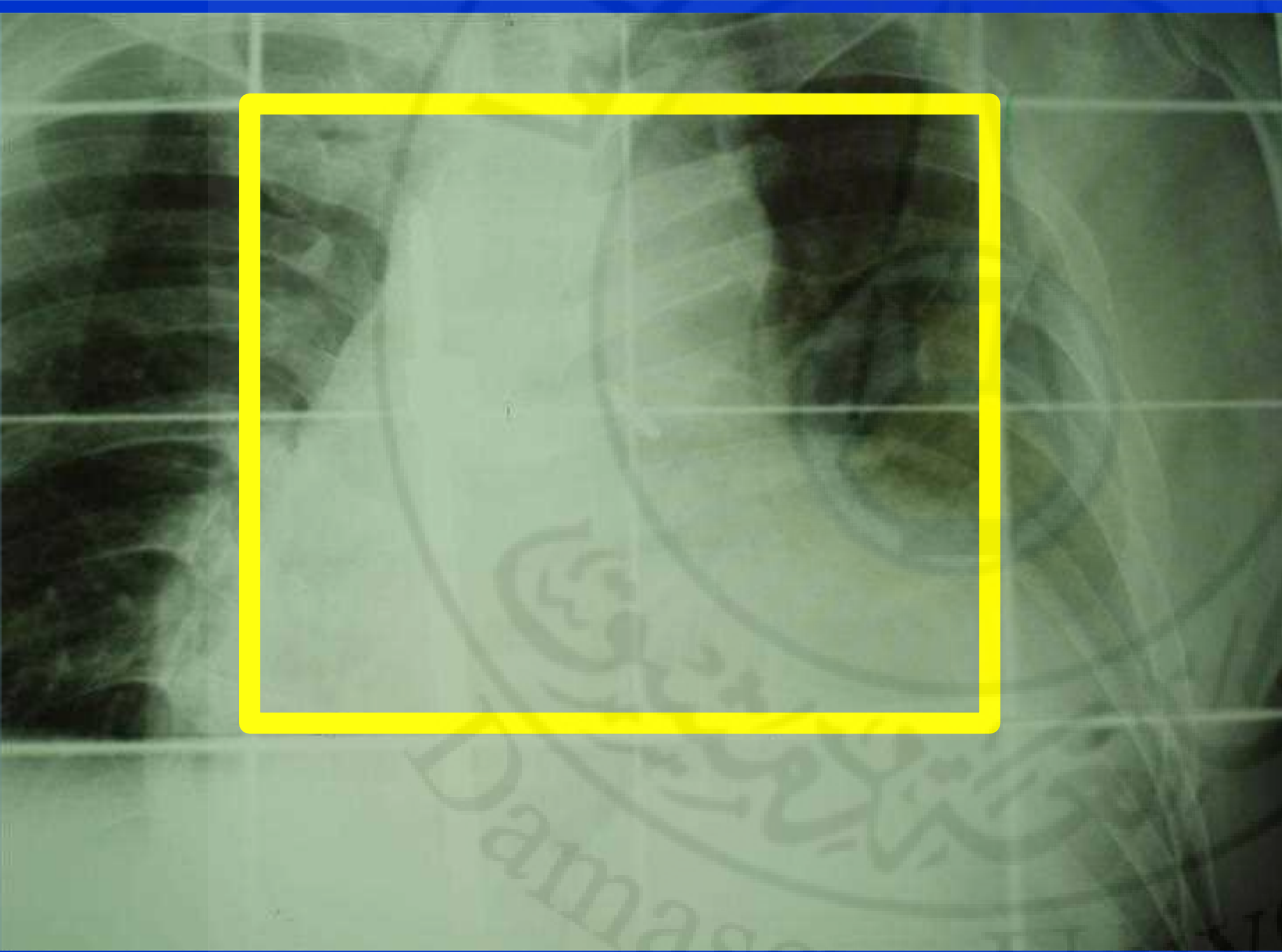
-ملطف : قليل التجزأ

Damascus University

اختبار الحقل

- يتم من خلال تحديد عدد ، أبعاد ، و تزوي الحقول الضرورية لشمّل الحجم الهدف.
- الأعضاء السليمة يجب تجنبها قدر الامكان بالحمايات مع احترام تحملها للأشعة.

حقل المعالجة



الحمايات

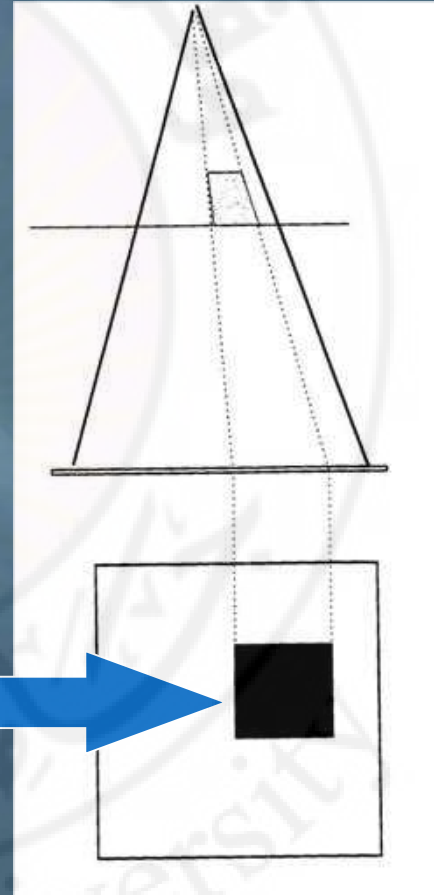
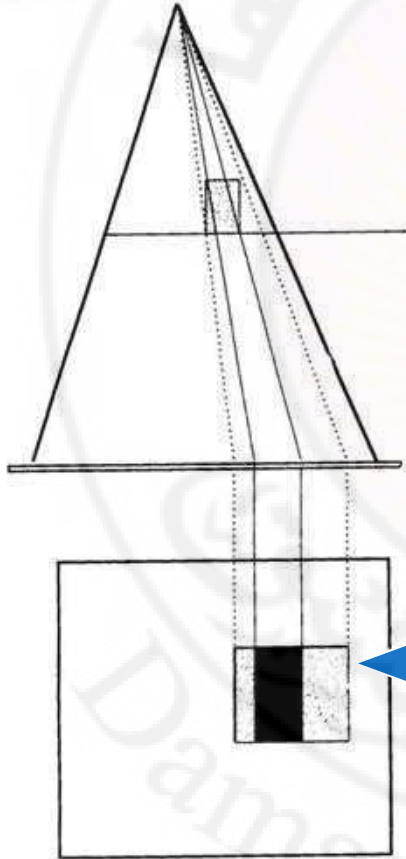
- في حال المحدد في رأس جهاز المعالجة يعطي حقول مربعة أو مستطيلة.
- حماية النسيج السايمة القريبة من الحجم الورمي.
- مصنوعة من خلائط خاصة (cerrobend) (رصاص ، بيسموث، كادميوم) (70°C)
- رصاص (327°C)

الحماية

- حماية بسيطة، يوضع على حامل خاص في راس الجهاز.
- حماية شخصية مركبة مع الانتباه الى اتجاه تباعد الحزمة الشعاعية.
- حاليا المحدد عديد الشرائح.

حماية

cache non focalisé



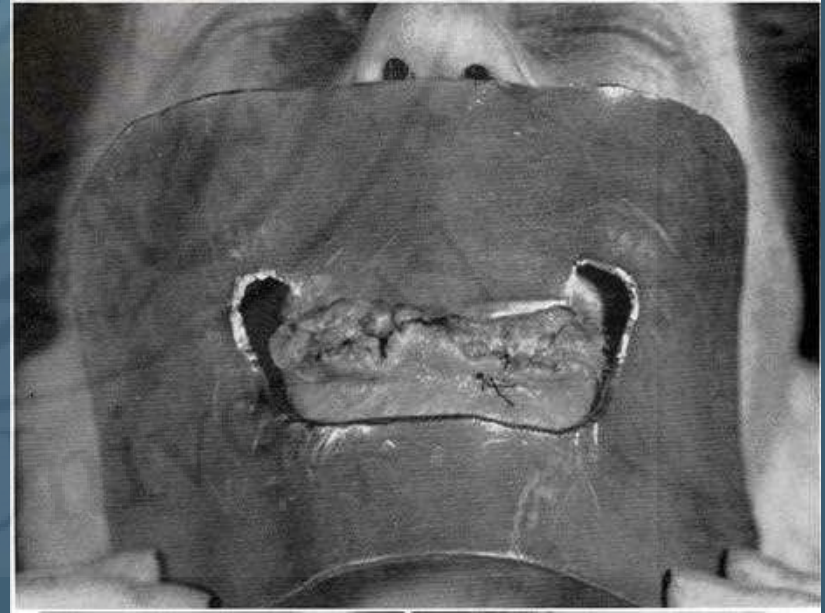
حماية

وضع الحماية



□ حامل الحماية

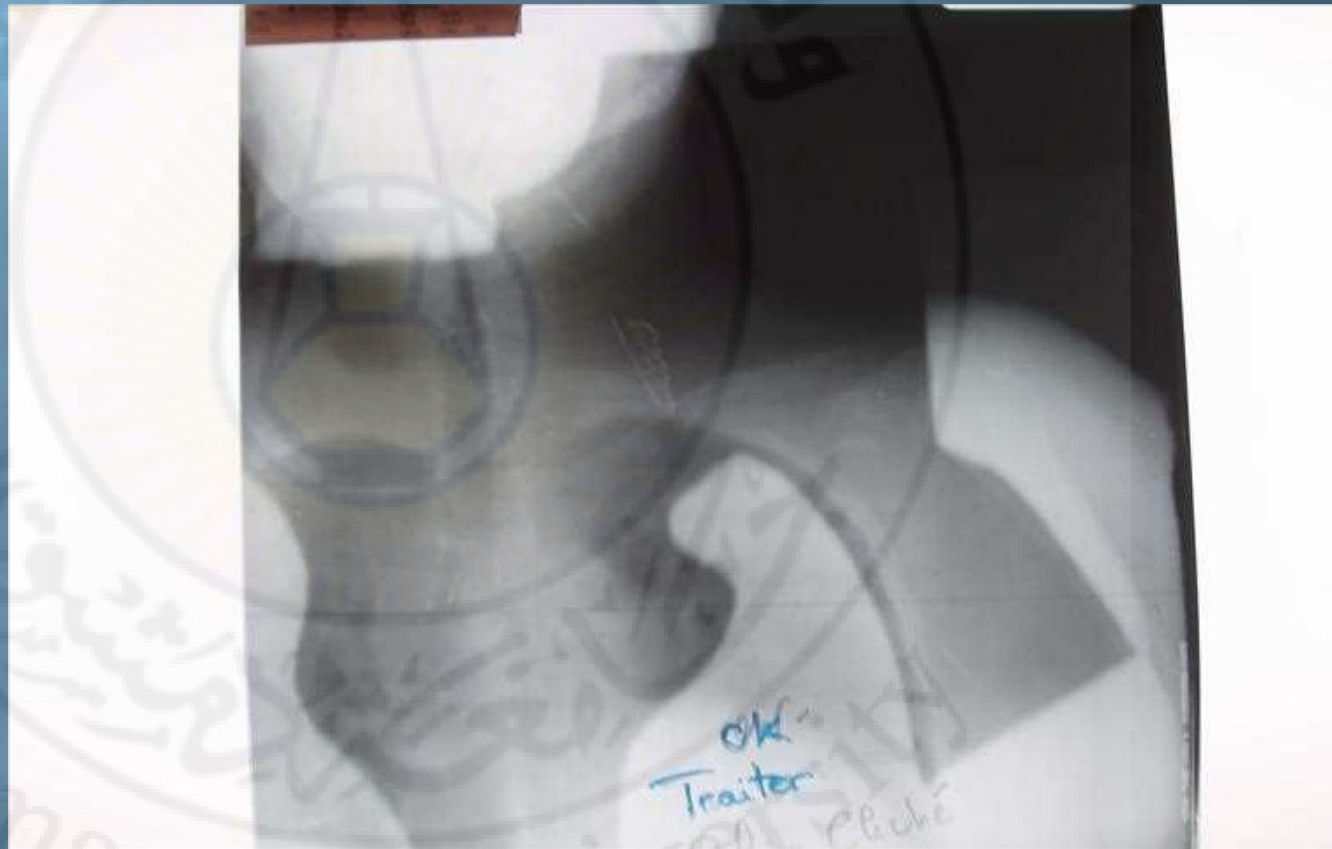
الحمايات الشخصية



الحماية المركزة



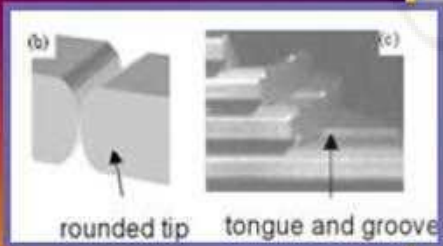
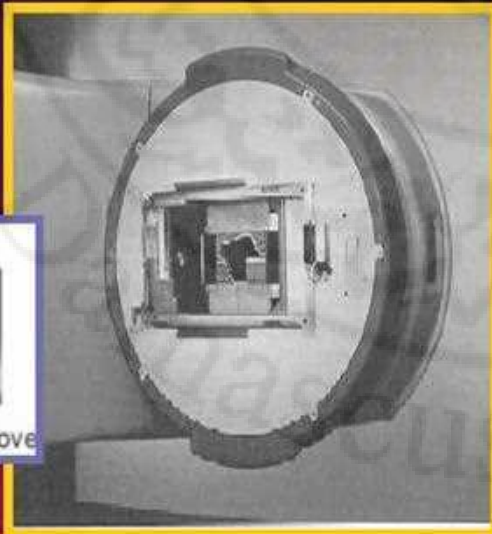
الحماية المبركرة الشخصية



المحدد عديد الشرائح

- في الأجهزة الحديثة.
- بدل الحمايةات الثقيلة.
- موجودة في رأس الجهاز
- لكل منها محرك خاص
- تشكيل حمايات معقدة و بسهولة

Linac mounted MLC

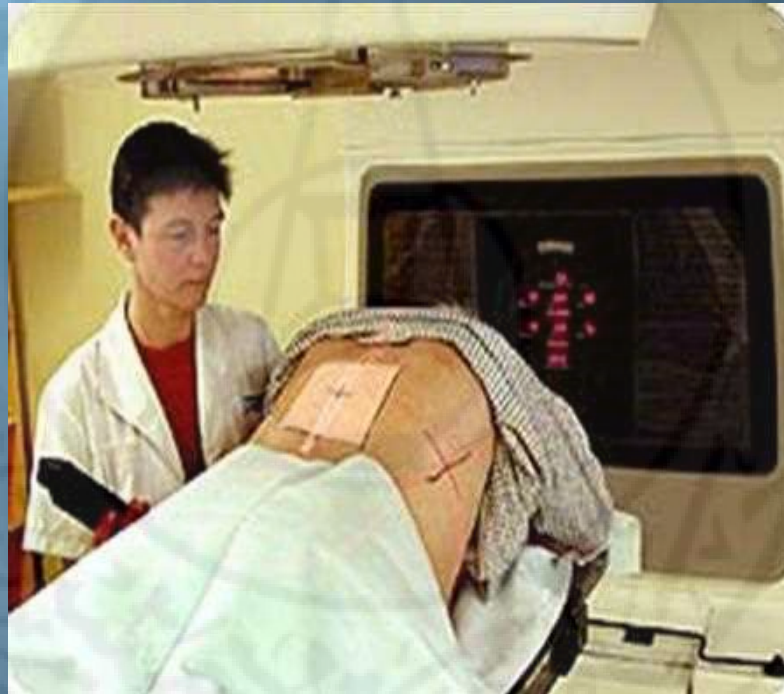


المحدد العديد الشرائح



الشريحة

وضعية المريض



اختيار وسائل التثبيت

- وضعية خاصة
- مثبتات في كل جلسة

اختيار وسائل التثبيت

- يتم في يوم التخطيط
- يجب شرحه للمريض
- كتابة هذه الوسائل بشكل واضح في الاضبارة الشعاعية
- كتابة اسم المريض عليها

علاج على الحوض



وسائل التثبيت

□ القناع



وسائل التثبيت

□ وسائل الراس



□ وسائل القدم



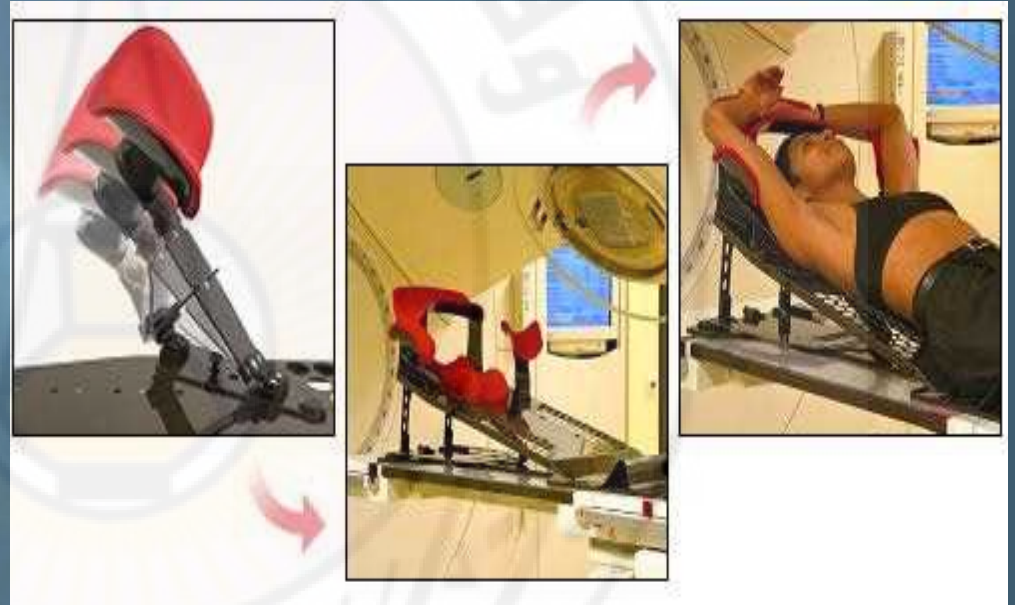
وسائل التثبيت

□ وسائل



وسائل التثبيت

□ سطوح مائلة



اختيار التكنيك

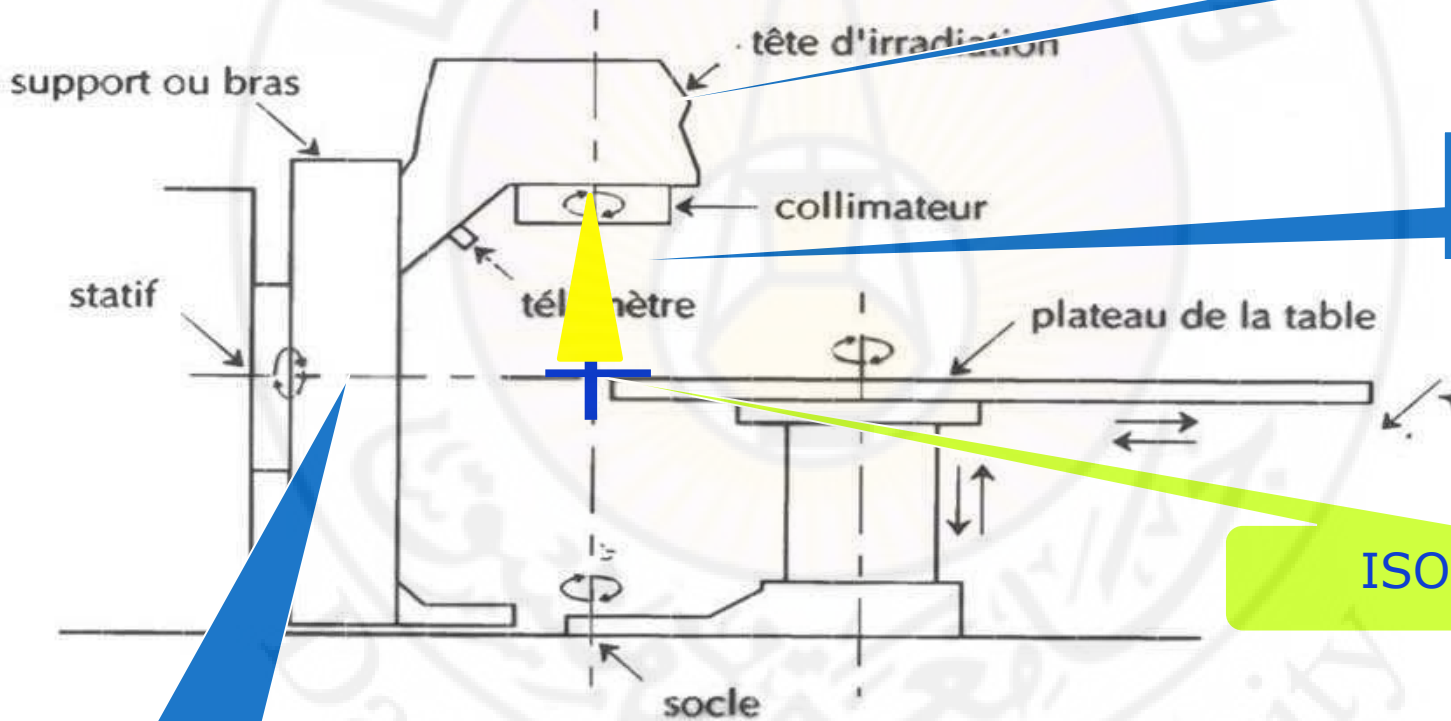
- التكنيك يعتمد على:
 - على جغرافية الحجم الهدف (سطحي/عميق)
 - عدد الحقول(وحد/متعدد)
 - التكنيك اما منبع جلد، أو منبع النقطة المركزية

- النقطة المركزية (ISOCENTRE): نقطة تقاطع محور الحقل مع محور دوران الجهاز.
- SID : المسافة بين المنبع و النقطة السابقة

المنبع

محور الحقل

ISOCENTRE



محور الدوران





البعد المربع جلد

- وضع النقطة المركزية بمستوى الجلد.
- رفع الطاولة حتى قراءة البعد على الجلد و الخاص بالجهاز.
- تستخدم في حقل وحيد بشكل عام.

تكميلك منبع ورم

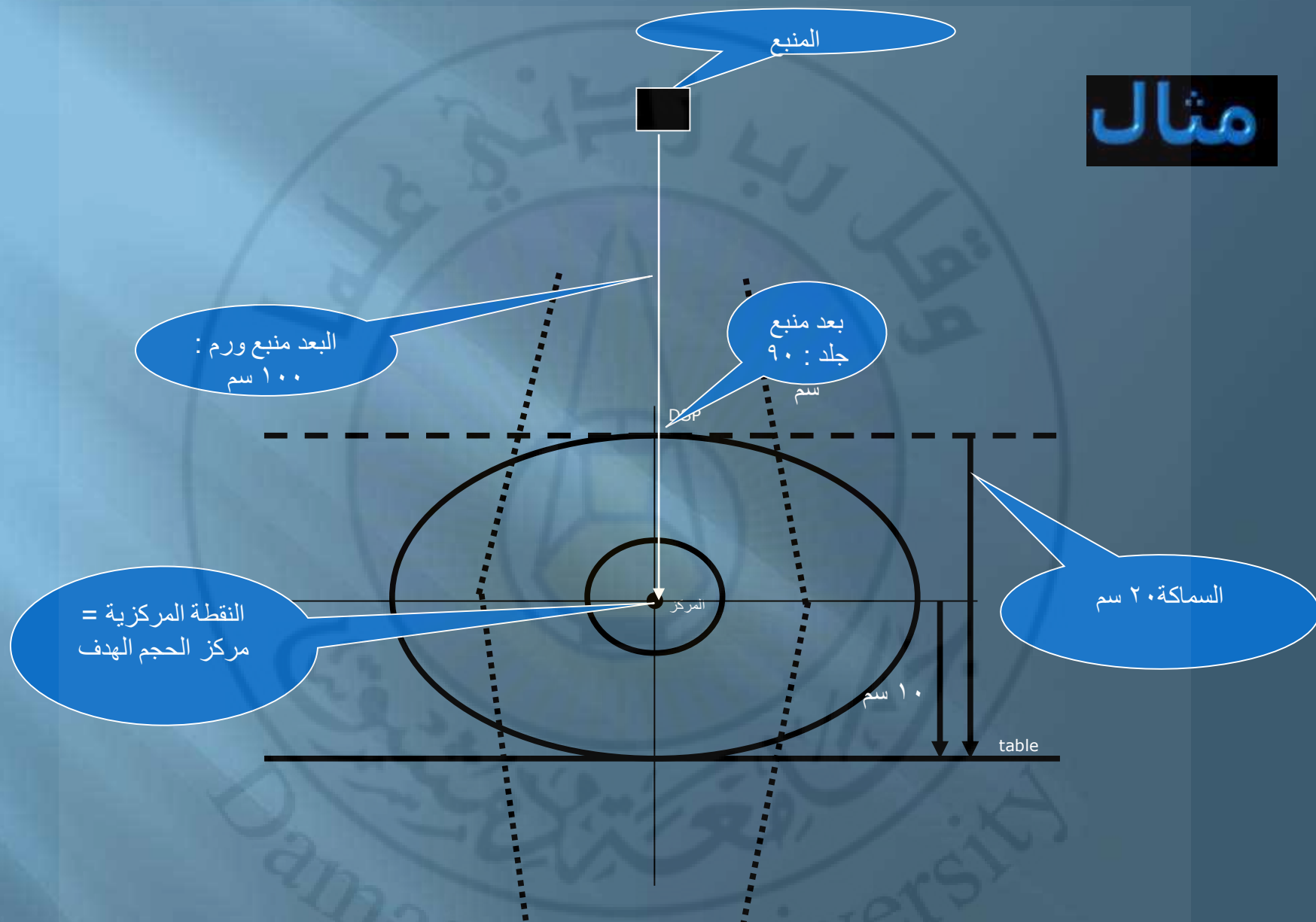
- عدة حقول
- النقطة المركزية في مركز الحجم الهدف
- بعد منبع ورم = بعد منبع نقطة مركزية

- الجهاز يدور حول مركز الورم في كل حقل و المريض ثابت
- مركز الورم يتحدد عبر السماكة عند منتصف الحقل ، و ارتفاع الطاولة

أمثلة

ورم رئة يعالج بحقلين أمام/ خلف.
النقطة المركزية توضع في منتصف السماكة في مركز الحقل
بعد منبع ورم = بعد منبع نقطة مركزية
بعد منبع جلد = بعد منبع نقطة مركزية - نصف السماكة.

مثال



استخدام الليزر



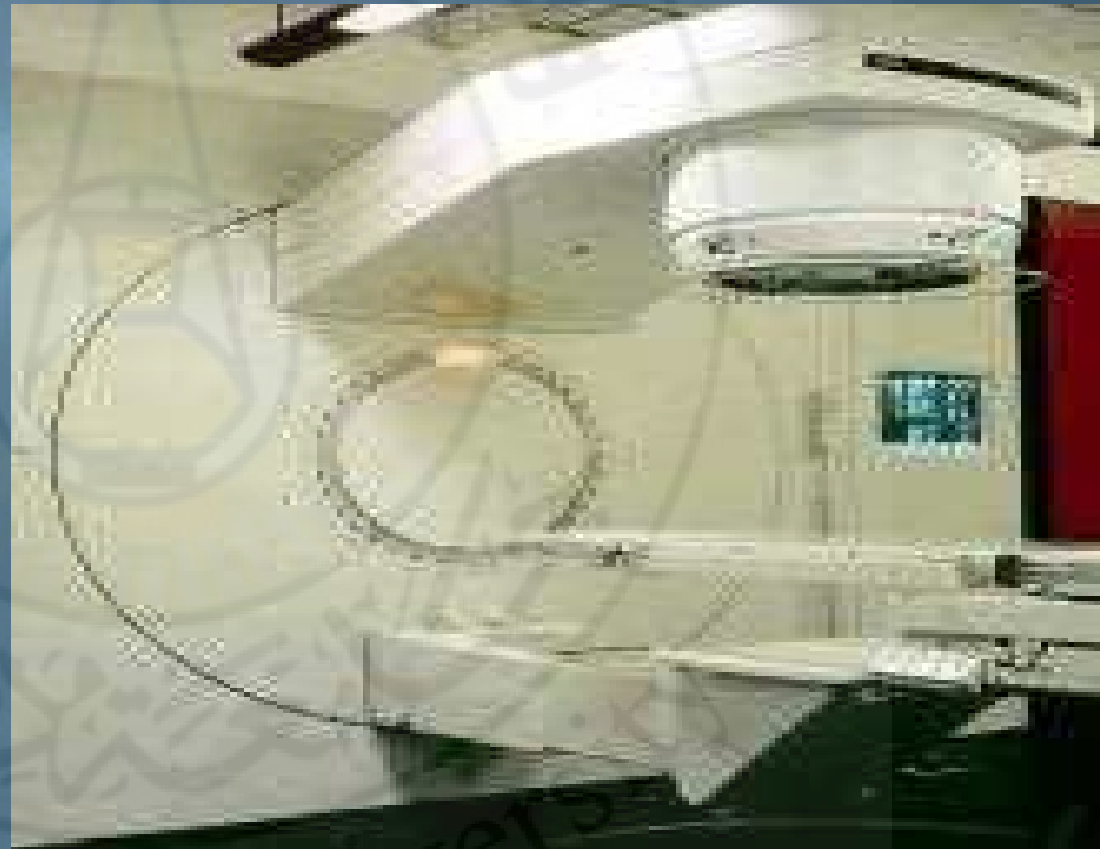
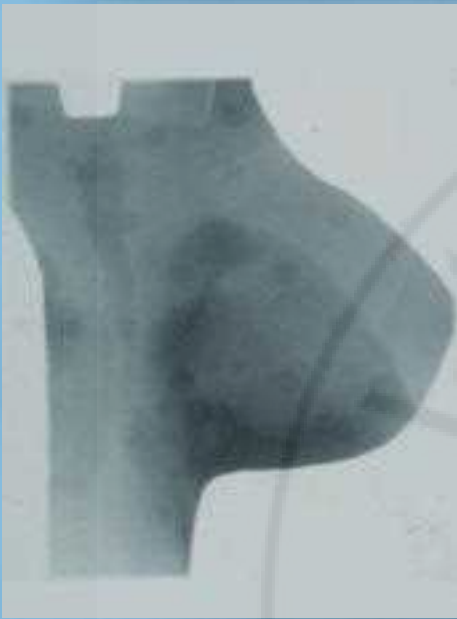
ضبط الحقل من خلال الصور

- أخذ صور شعاعية تحت جهاز المعالجة بوضعية و وسائل التثبيت المعالجة (صور رقمية)
- تعديل الحقل من خلال مقارنة الصور أثناء العلاج بشكل دوري

الحراء صورة الضبط

- وضعية العلاج
- تطبيق الحقل على المريض
- وضع الفيلم
- أول جلسة

التصوير الرقعي



صورة ضبط المعالجة



صورة
رقمية

صورة
التخطيط

وظيفة الفني الشعاعي

- ▣ ضبط وضعية المريض + وسائل التثبيت.
- ▣ تحميل حقول المعالجة.
- ▣ مراقبة المريض اليومي.
- ▣ اخبار الطبيب أو الفيزيائي بأي طارئ.

المراقبة السريرية

□ في العيادة الشعاعية الورمية

- دعم نفسي
- التحمل الشعاعي
- الاستجابة الورمية

شكرا



X-RAY

Dr. Muhannad Ibrahim

Damascus University



Radiology: The Eye of Medicine

Normal Chest X-Ray

X-ray

PA ERECT L

Anatomy – Cardiac Silhouette and Mediastinum

Ascending aorta

Right pulmonary artery

Right atrium

Aortic arch

Aortopulmonary window

Left pulmonary artery

Left atrium

Left ventricle

Descending aorta

How to interpret the chest X-rays ?!

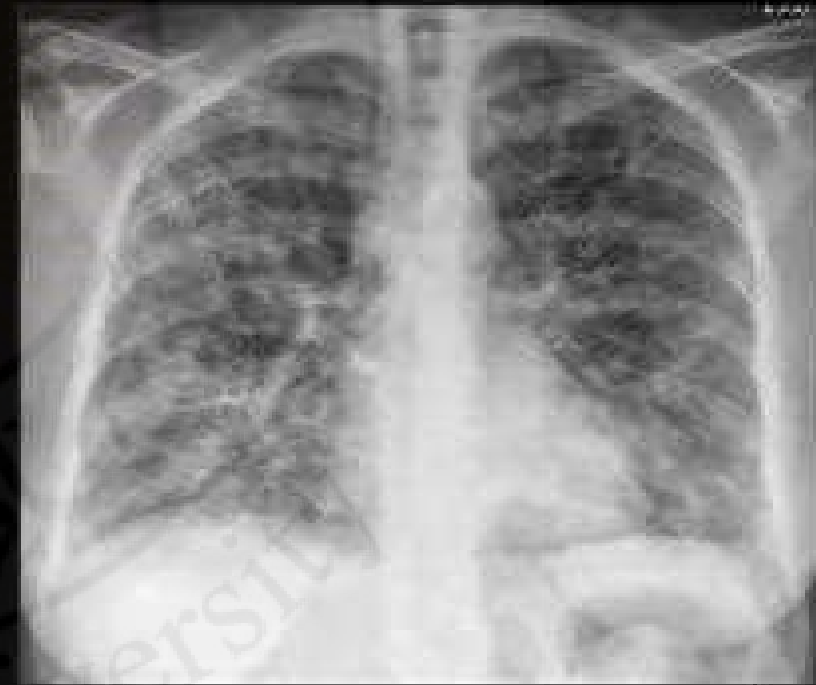
- Optimal quality radiograph
- Patient Data and previous films
- CT support



Focal pathology



Discriminate
between



Diffuse pathology

Focal lesions

- ◆ Nodules
- ◆ Masses
- ◆ Patches
- ◆ Cavities



Nodules

6

common

Well defined lesion measuring 3cm or less

- ♦ Tuberculoma
- ♦ Hamartoma
- ♦ Bronchogenic ca.
- ♦ Metastases
- ♦ AVM
- ♦ Hydatid cyst



How to discriminate between the lesions ?!!

Smooth edge with matrix calcification = **benign lesion**

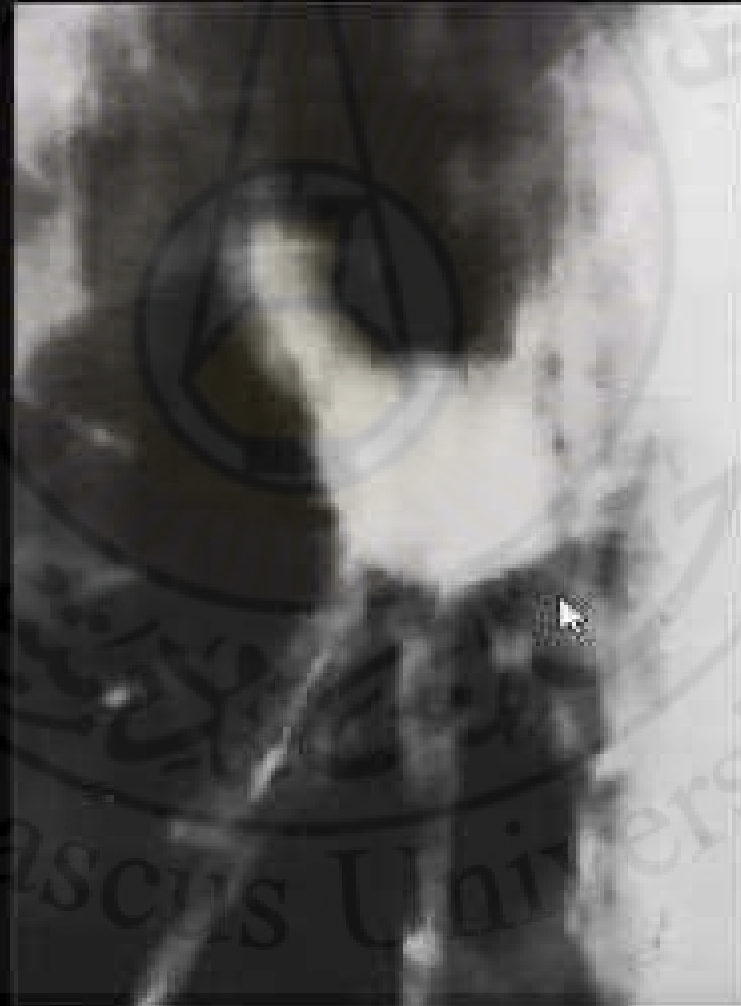
- ◆ Tuberculoma
- ◆ Hamartoma
- ◆ Bronchogenic ca.
- ◆ Metastases
- ◆ AVM
- ◆ Hydatid cyst



- ◆ Number
- ◆ Edge
- ◆ Calcium
- ◆ Density
- ◆ Vascular pedicle

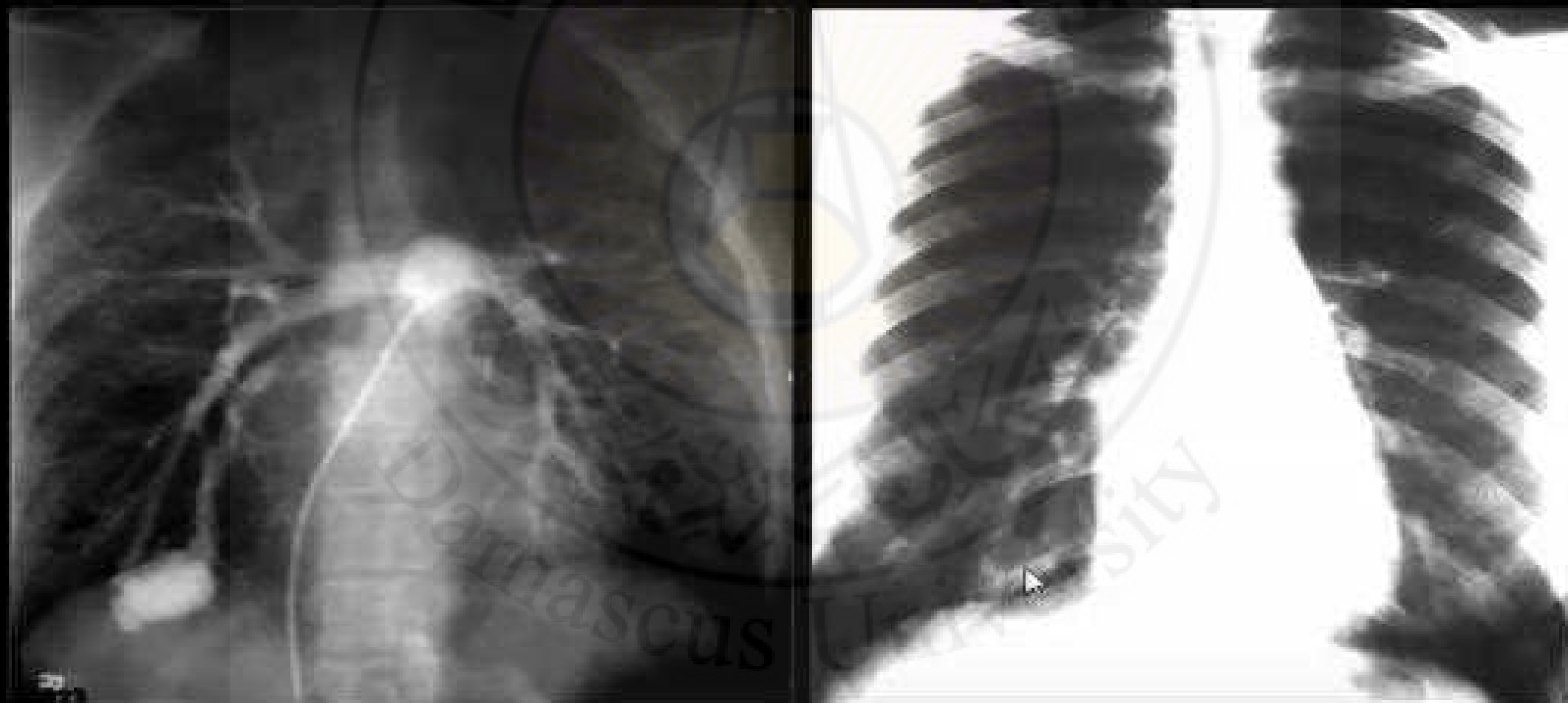
Speculated margin = malignant lesion

- Tuberculoma
- Hamartoma
- Bronchogenic carcinoma
- Metastases
- AVM
- Hydatid cyst



- Number
- Edge
- Calcium
- Density
- Vascular pedicle

Pulmonary vascular malformation



Masses

Well defined lesion measuring more than 3cm

3

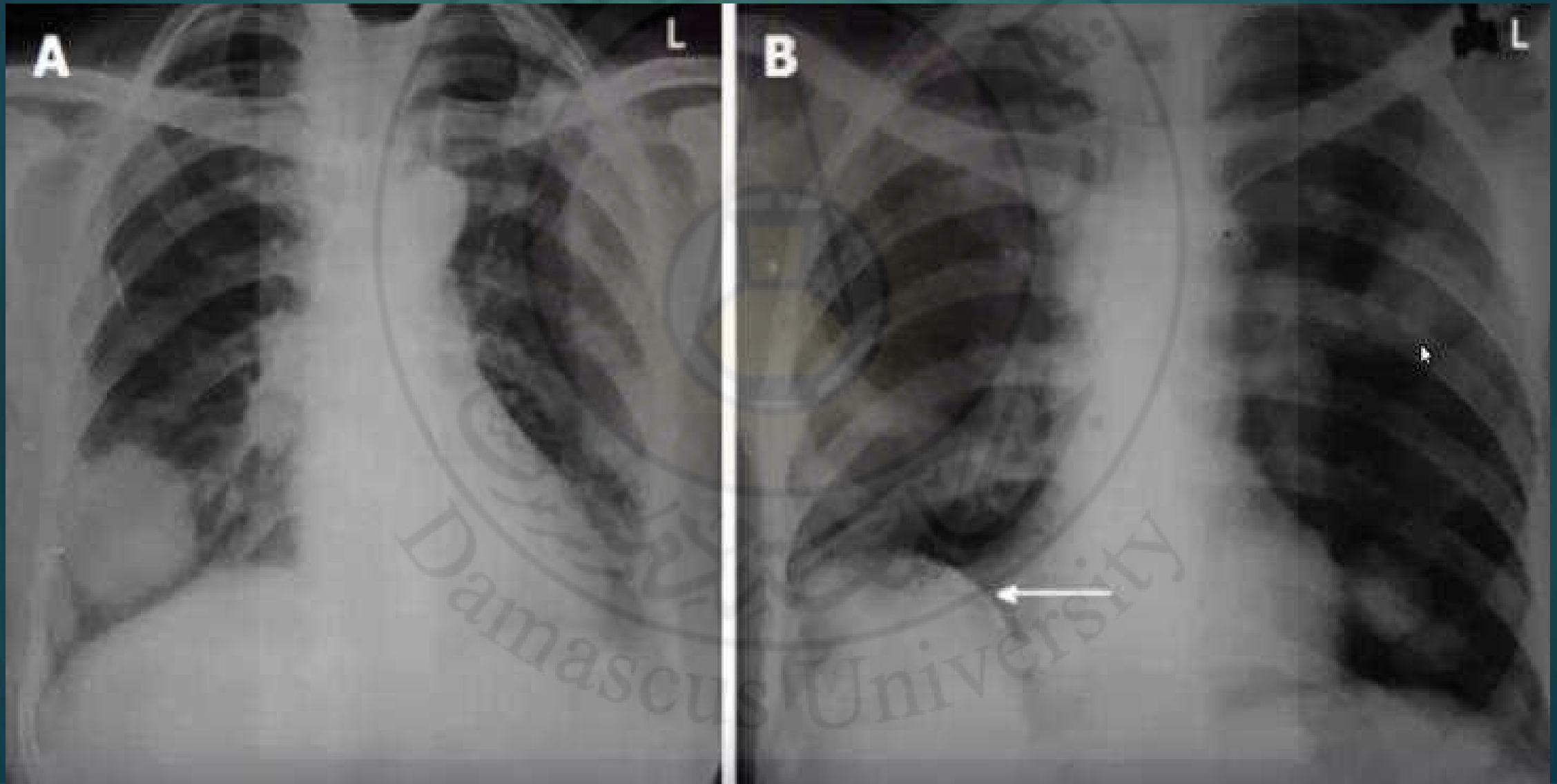
common

- Bronchogenic Carcinoma
- Hydatid Cyst
- Metastatic deposit



CT is needed to show if the lesion is cystic or solid ?!!

Hydatid Cyst



Solid with no known primary malignancy = Br. Ca.
Solid with known primary malignancy = deposit

- ◆ Bronchogenic Carcinoma
- ◆ Hydatid Cyst
- ◆ Metastatic deposit



Cannon ball deposits



M 50Y

Cancer
colon

Patch

An ill defined lesion with air bronchogram

Air bronchogram = Air filled bronchi passing through opaque lung parenchyma

2

common

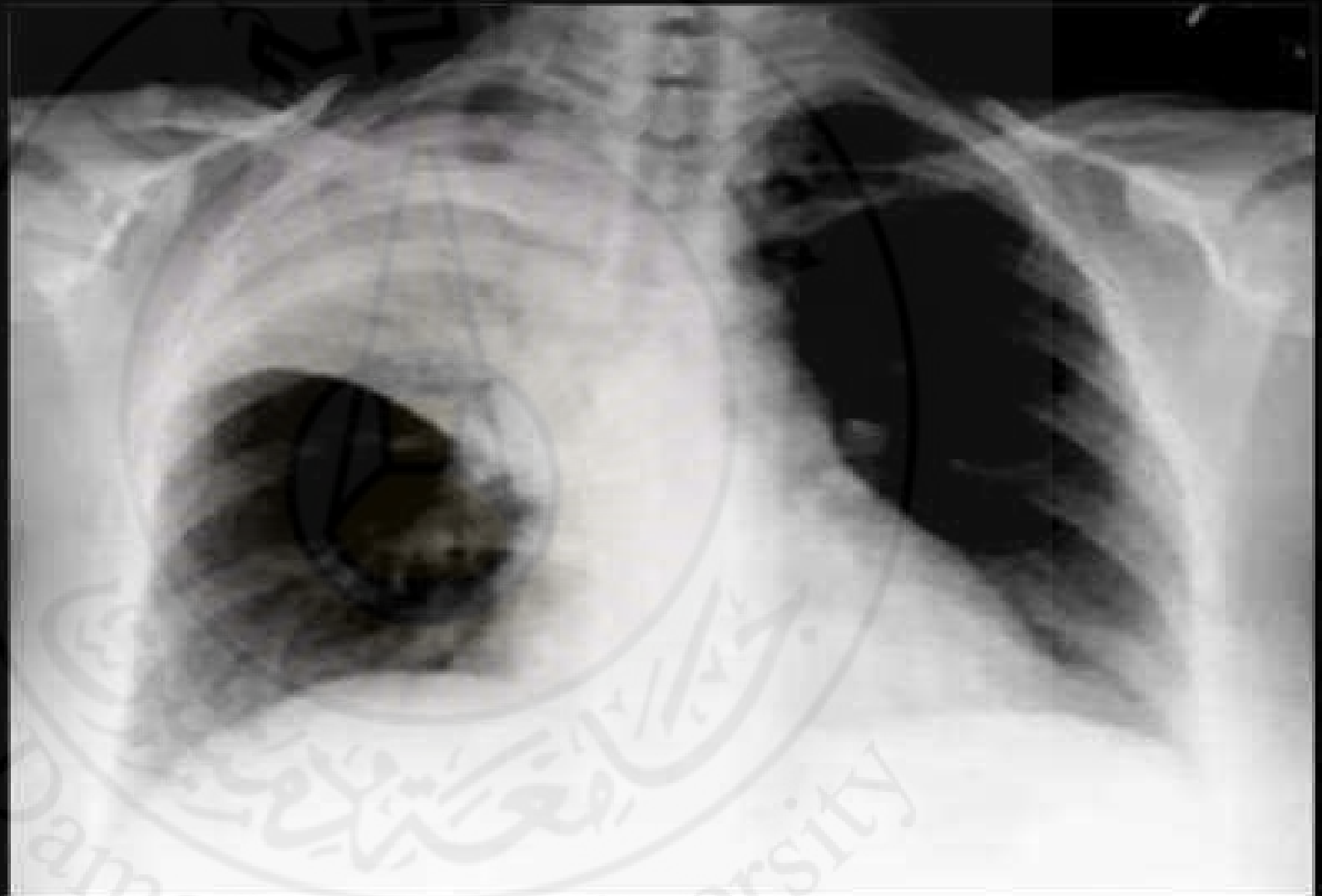
Pneumonia
Infarction



- ♦ Pulmonary lesion
- ♦ Alveolar pathology
- ♦ Consolidation

Pneumonia

Air
bronchogram



Pneumonic consolidation

Consolidation within the superior segment of the left lower lobe. *Chlamydophila pneumoniae* was isolated as the causative organism for this pneumonia. Consolidation has resolved on the follow-up CXR performed **one month later**.

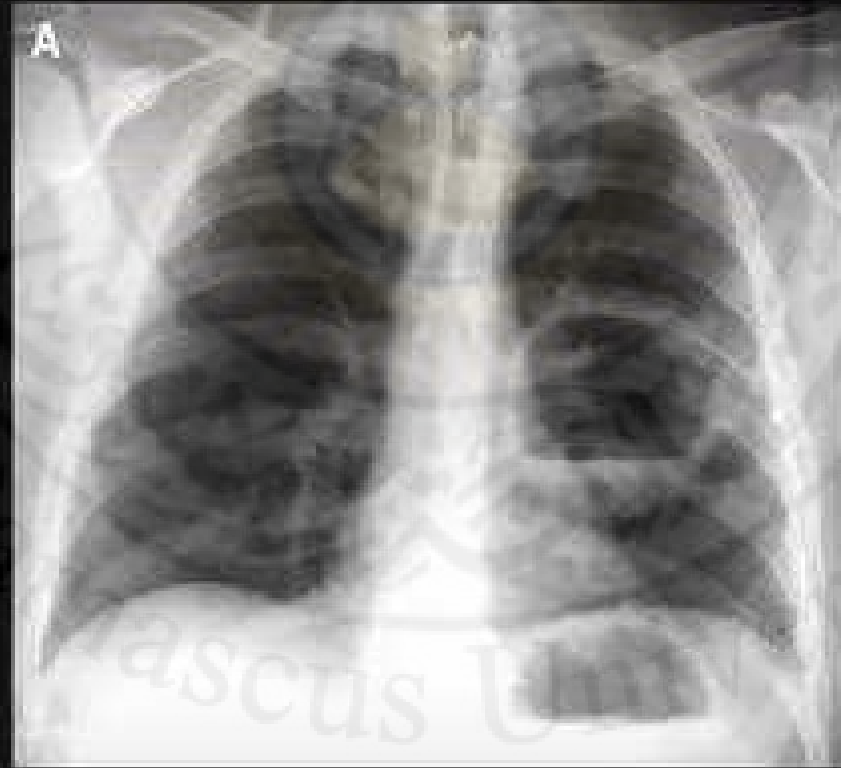


Cavities

A cavity is a lesion that is partially or totally contains **air**

8

common



Thick Wall

Air only



Inner margin smooth = Chronic abscess



Thin Wall

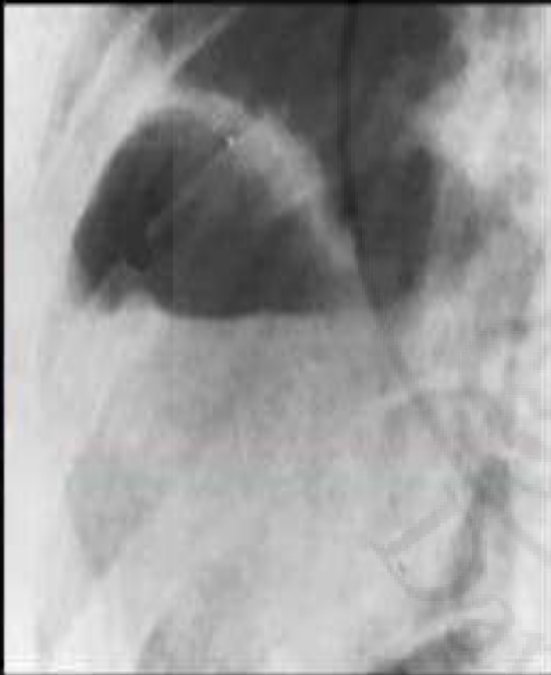
Pneumatocoele



Air & Fluid

Look to the surface of the fluid

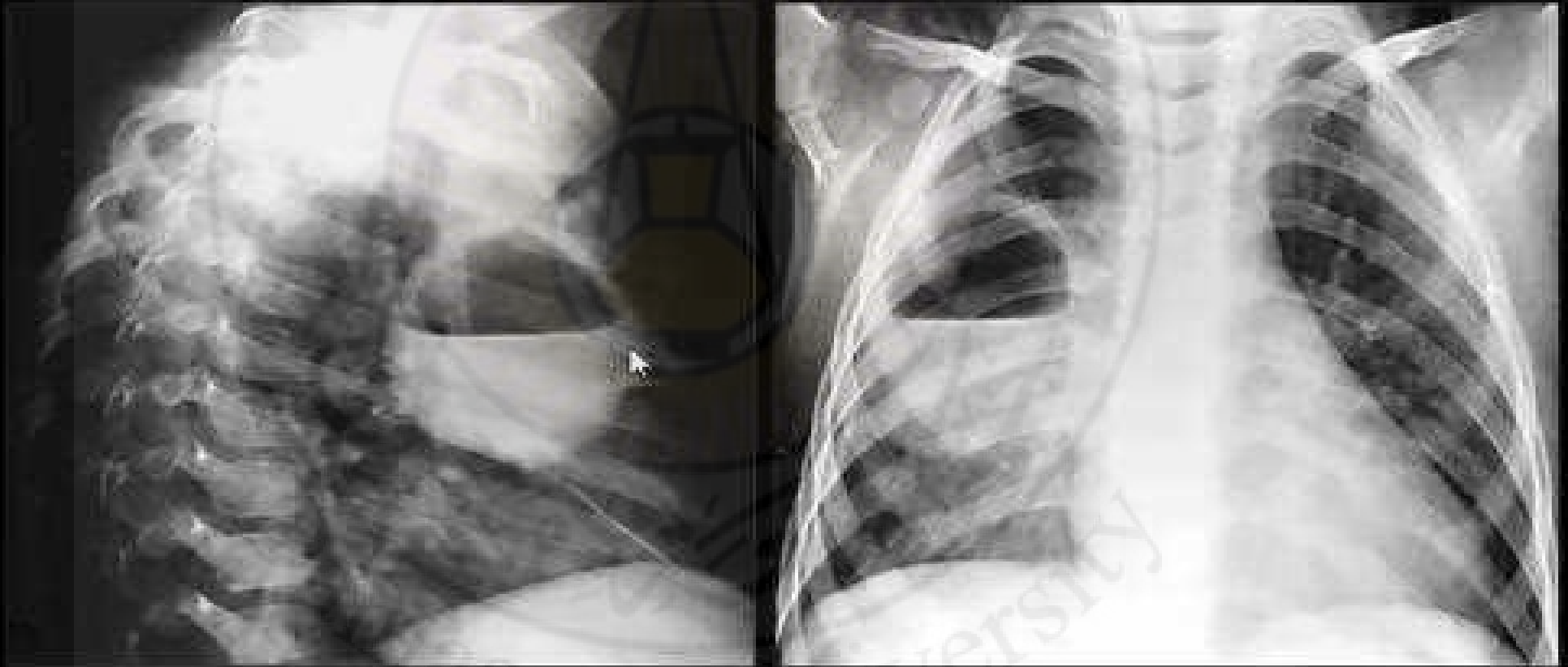
Lung abscess



- ♦ Straight surface = Abscess
- ♦ Wavy surface = Ruptured hydatid cyst



Lung abscess



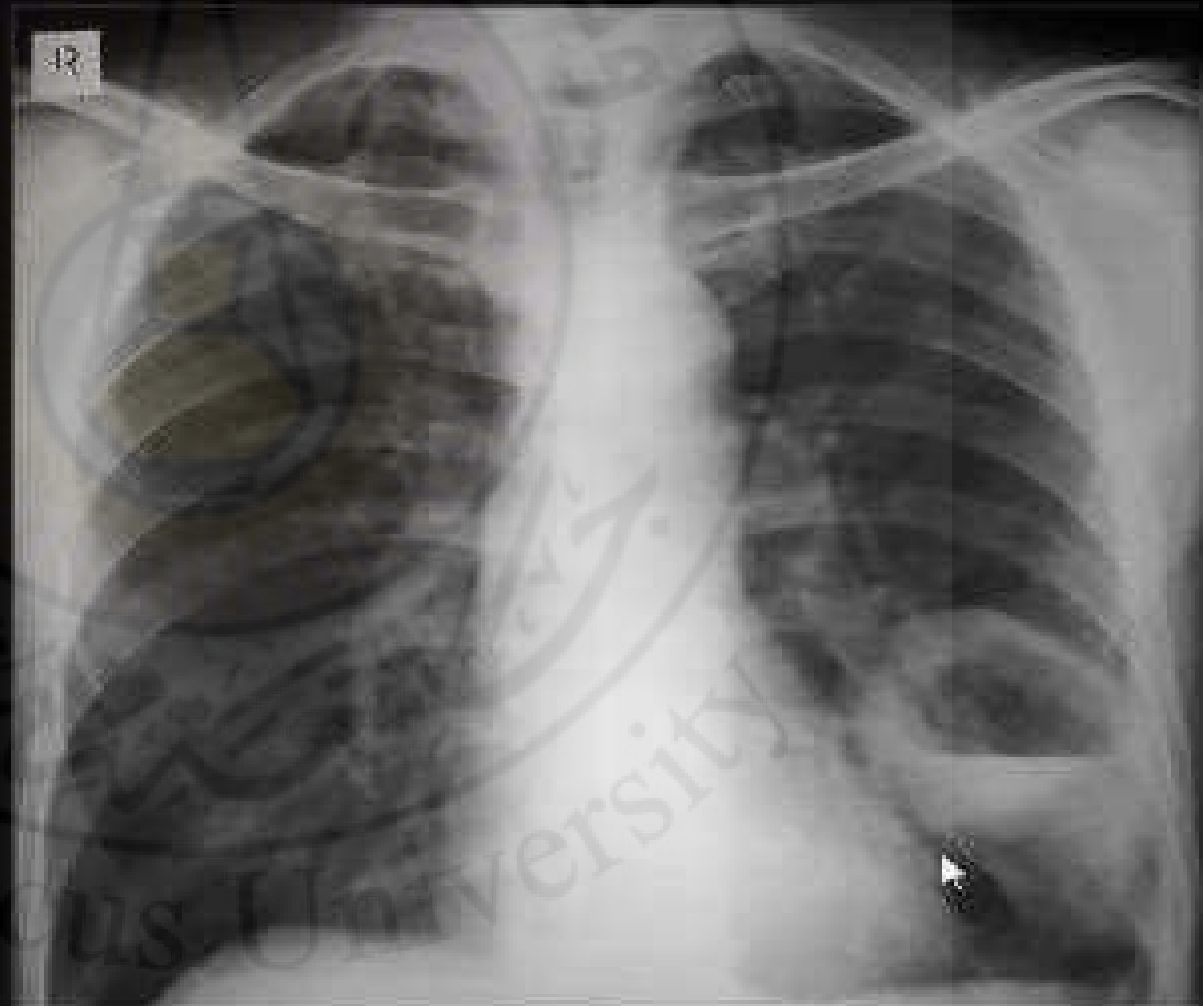
Air & mass

- Fungal ball
- Necrotic tumor



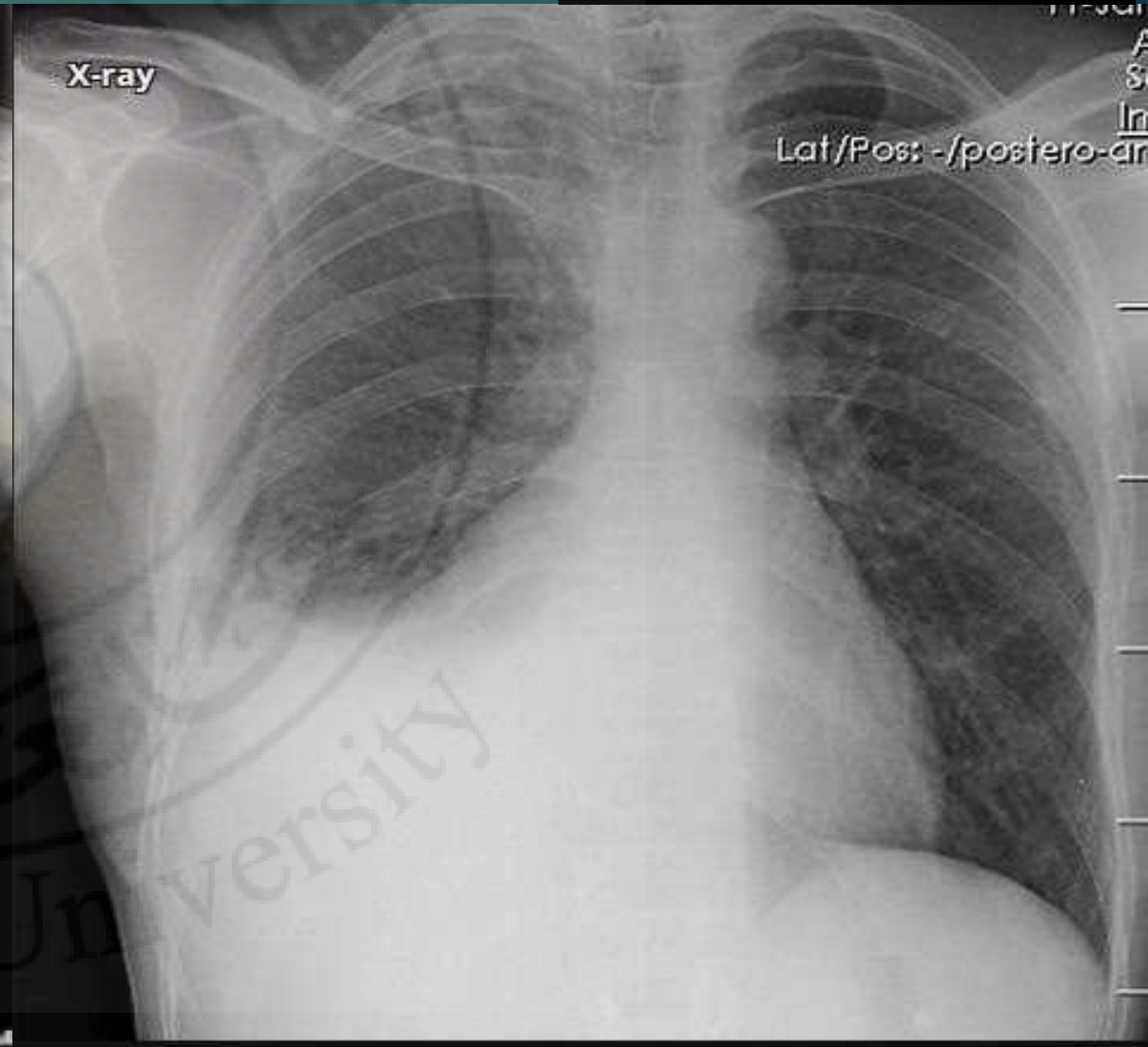
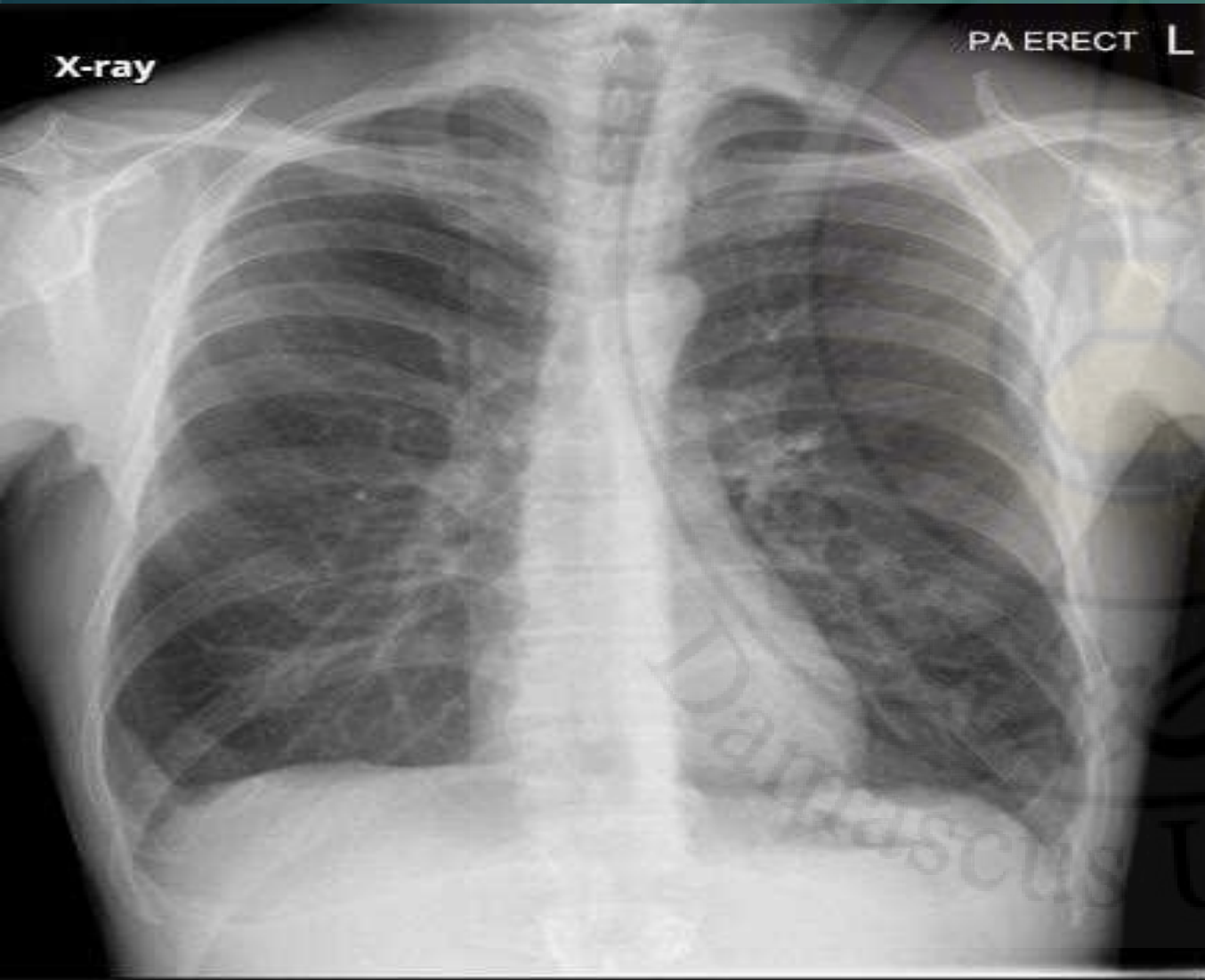
Cavitating squamous cell carcinoma

Cavitation implies communication with an airway . Radiologically, it allows some characterization of the wall, with a thickened, irregular, nodular implying cancer . A thin-walled cavity may still be an abscess or may indicate a post-infective pneumatocoele, an infected bulla, a resolving haematoma or contusion, or a pulmonary infarct (rare).



Plural Effusion

- ♦ CHF
- ♦ Para pneumonic
- ♦ Trauma
- ♦ Pulmonary embolism
- ♦ Tumors of the lung and pleura
- ♦ Autoimmune disease
- ♦ Renal failure

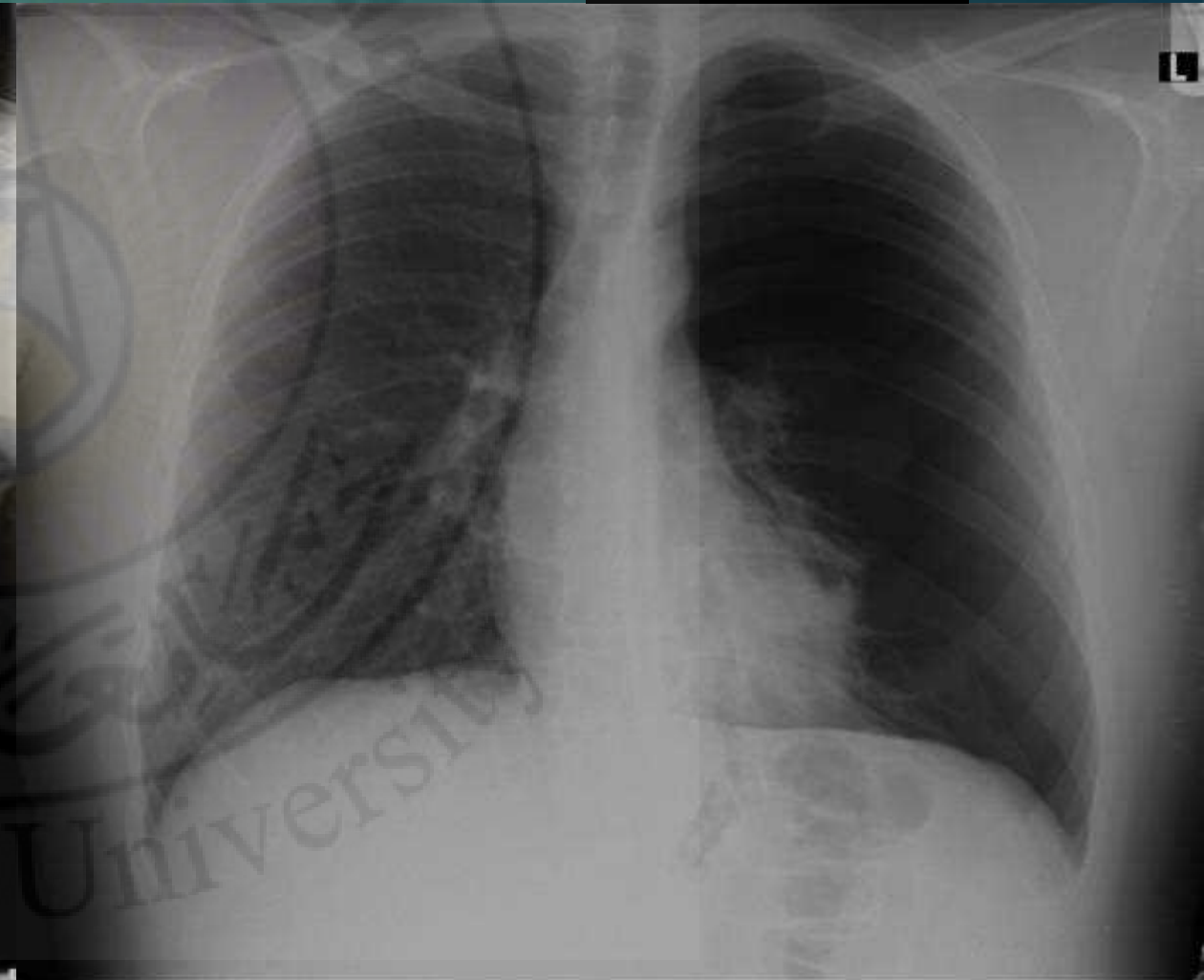
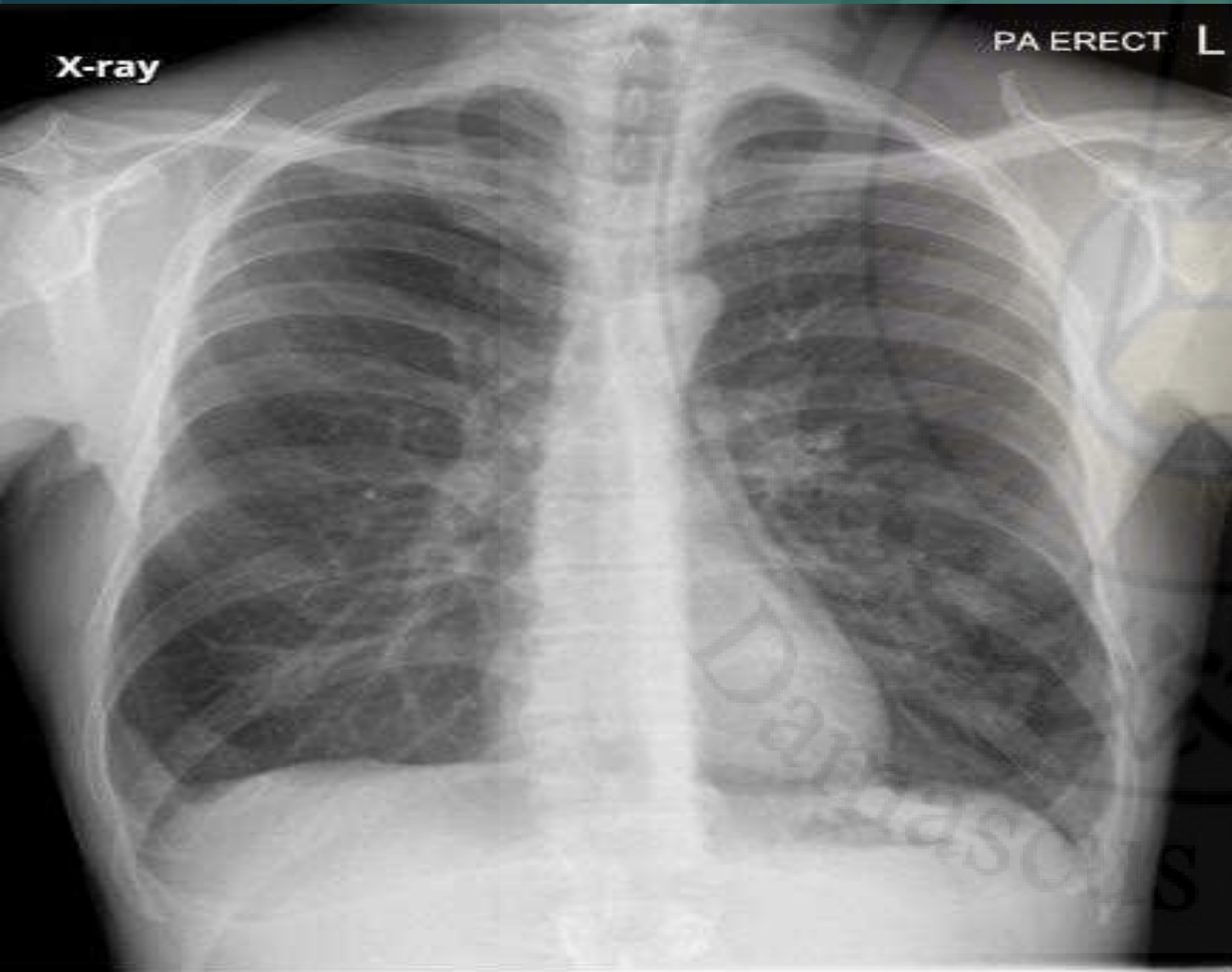


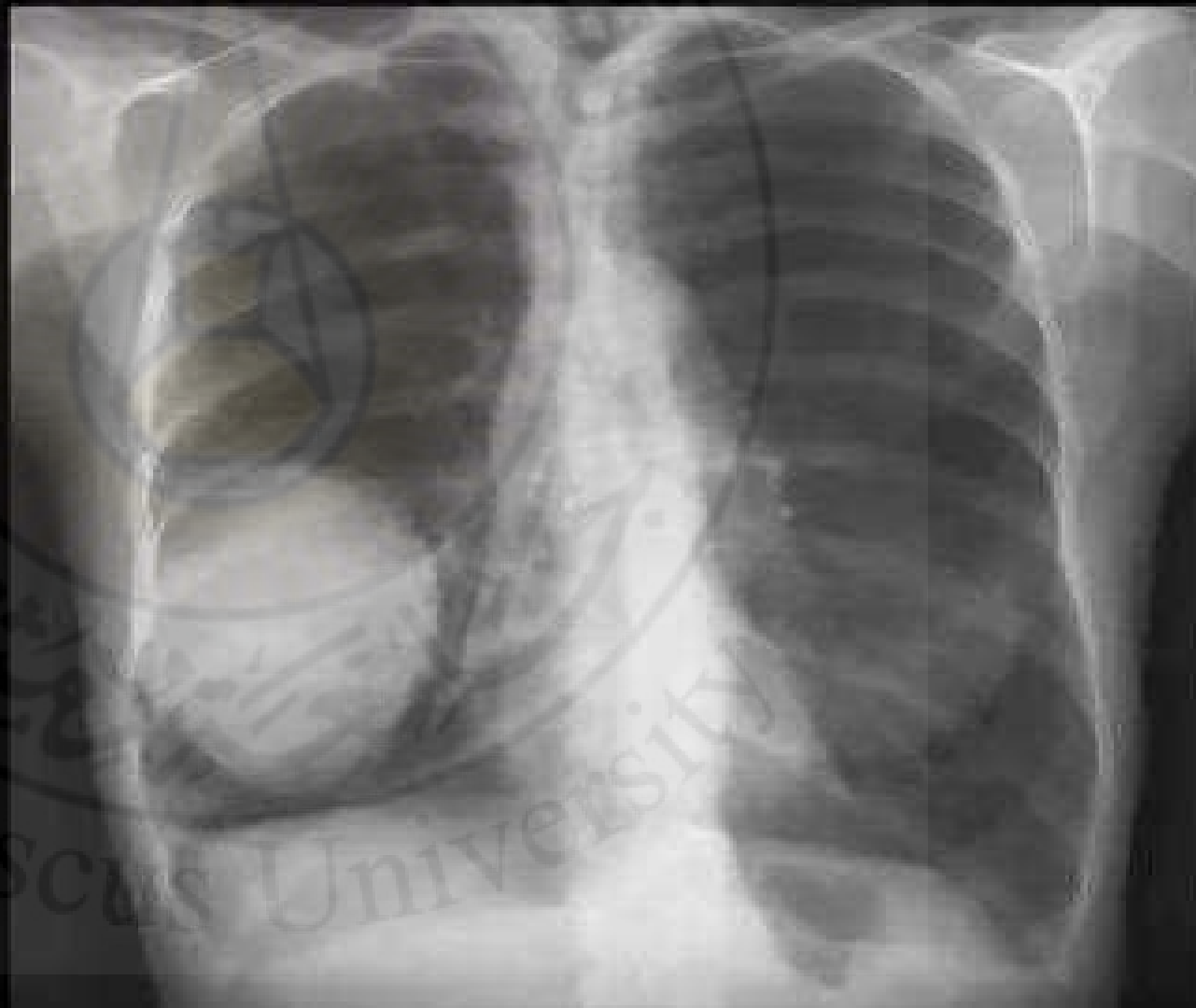
Neumothorax

Spontaneous Pneumothorax occurs without an obvious inciting incident.

Other causes

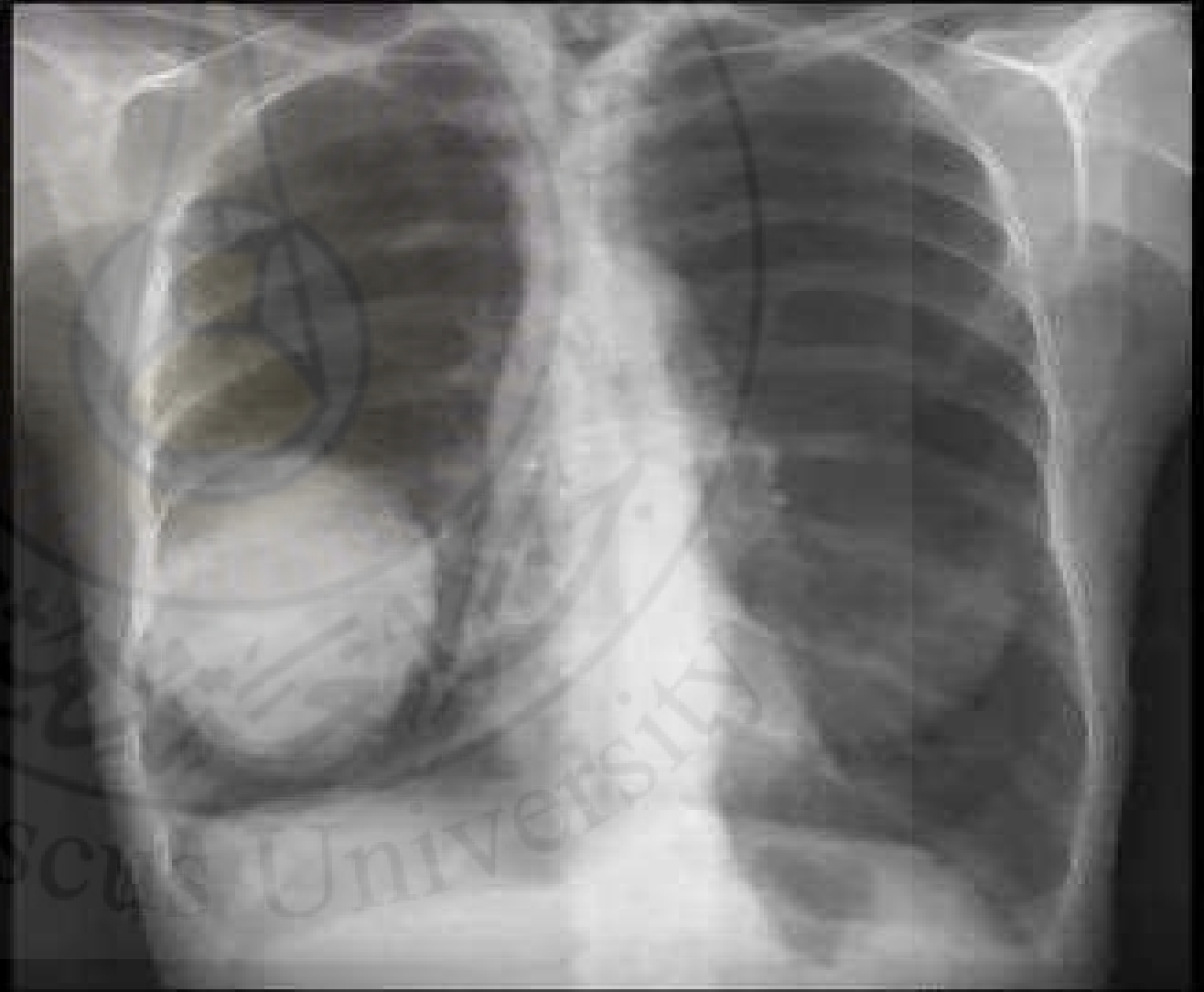
- ◆ Asthma
- ◆ COPD
- ◆ Pulmonary infection
- ◆ Neoplasm
- ◆ Marfan's syndrome
- ◆ Smoking cocaine

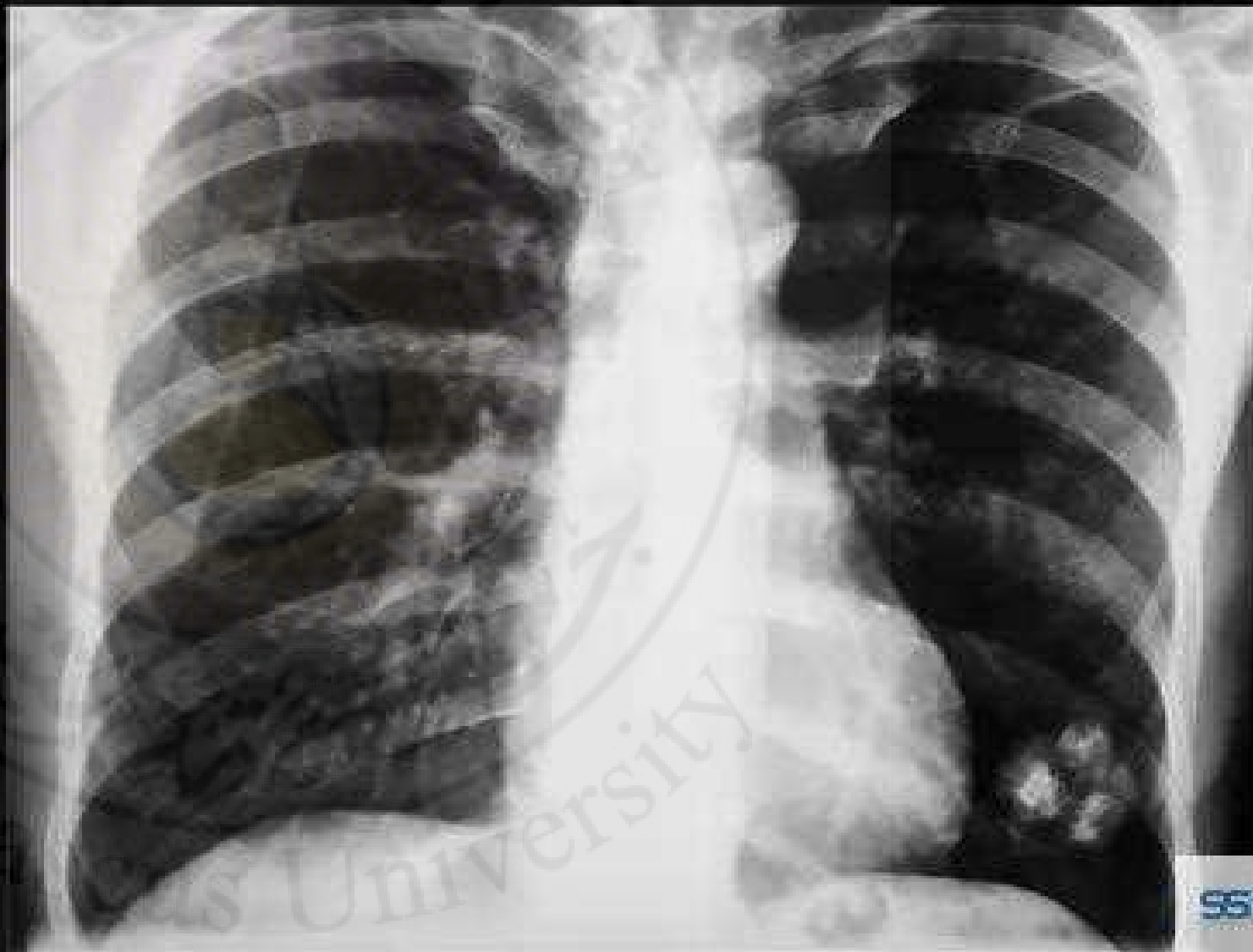






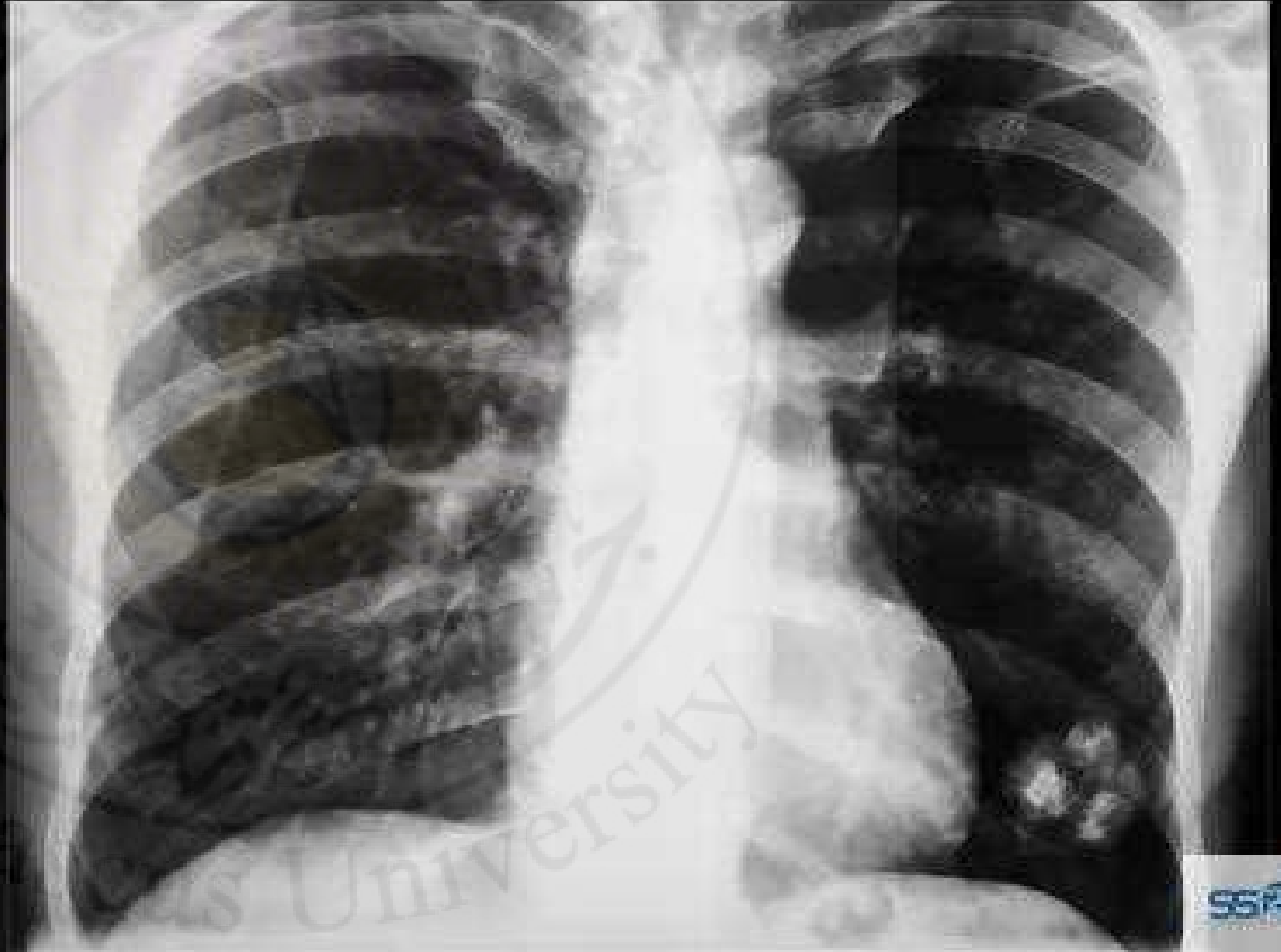
Bronchogenic carcinoma

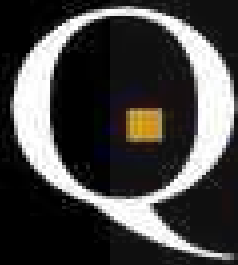


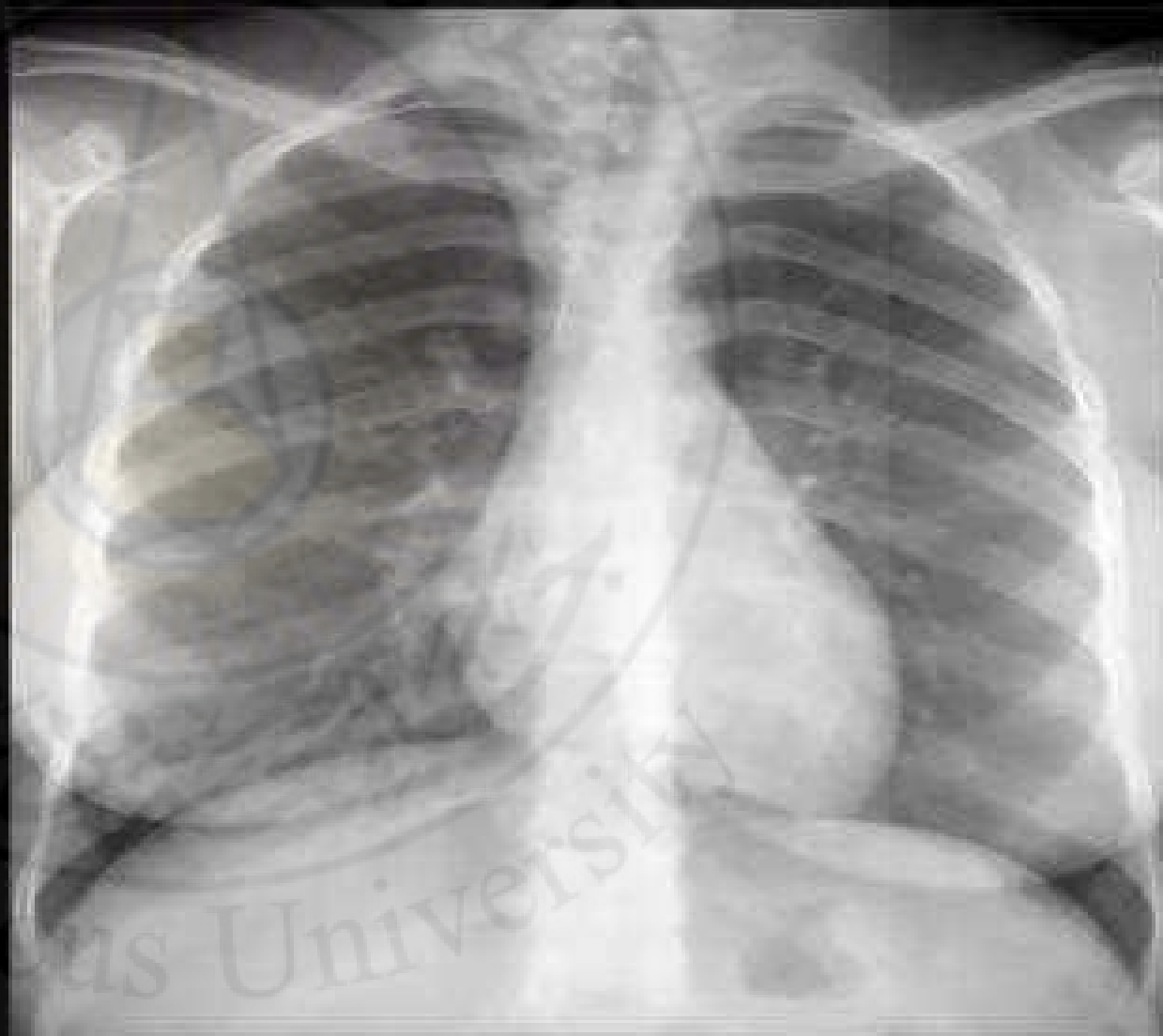




Hamartoma

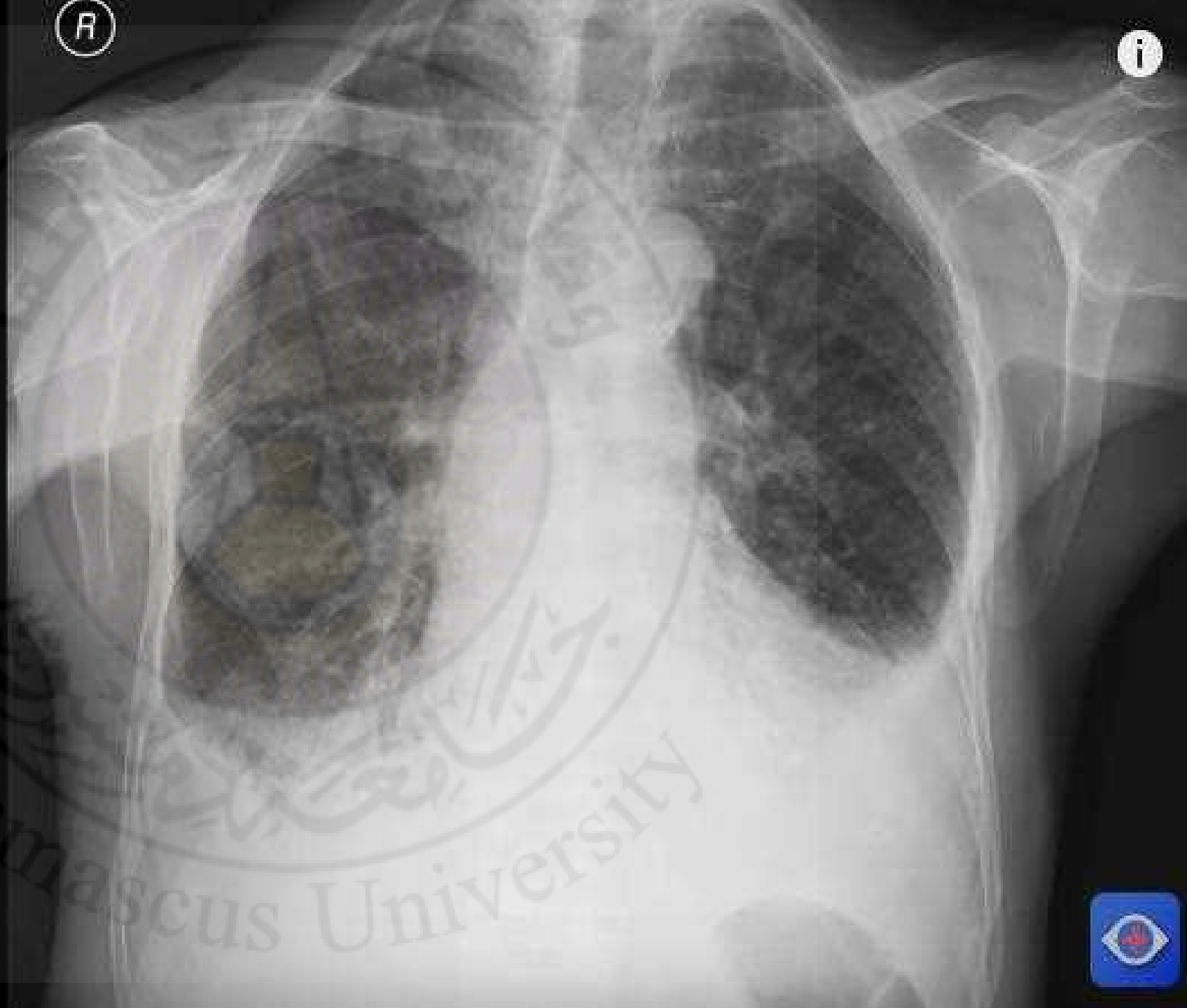






What is the
diagnosis?

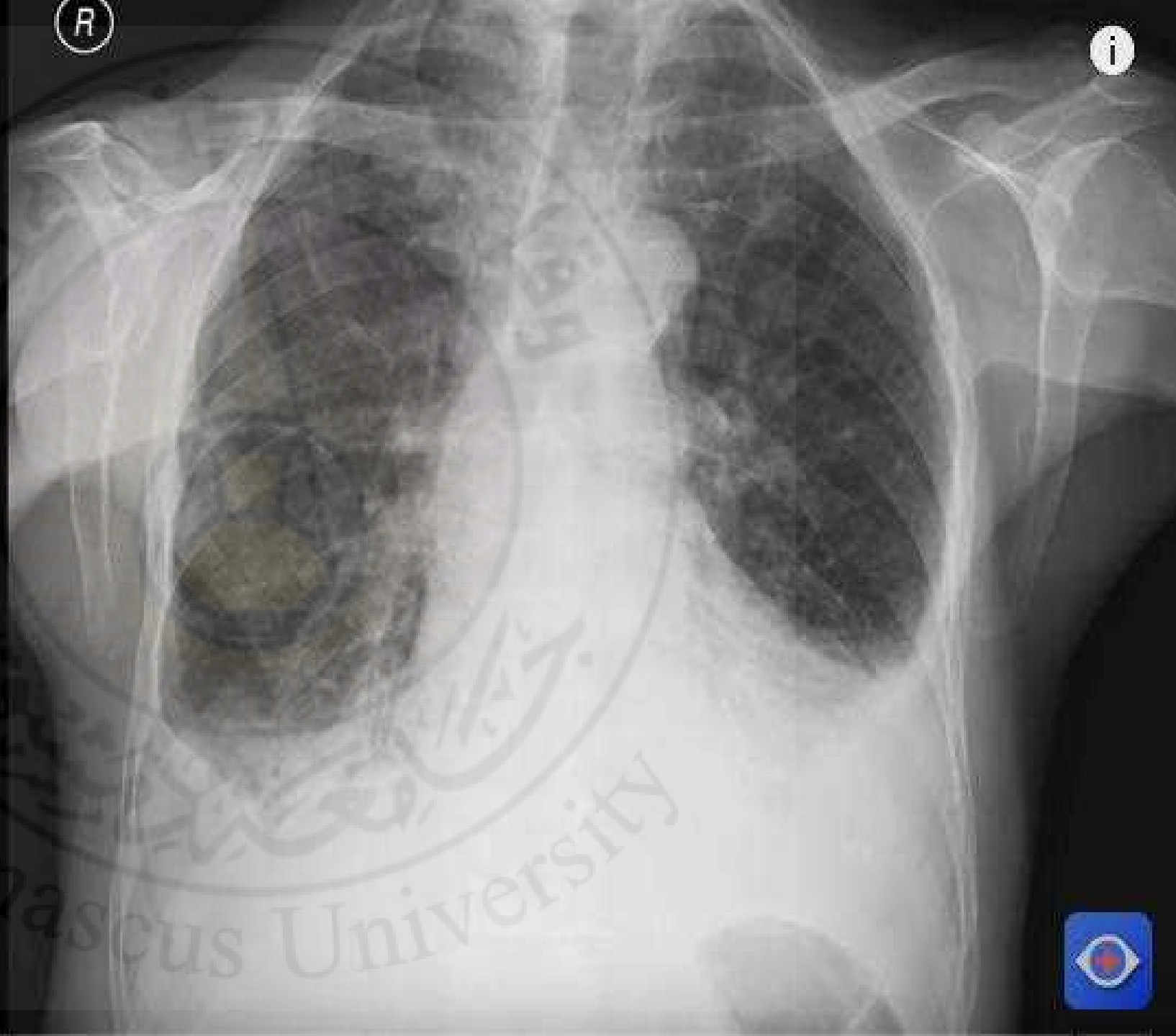
03



Pleural Effusion

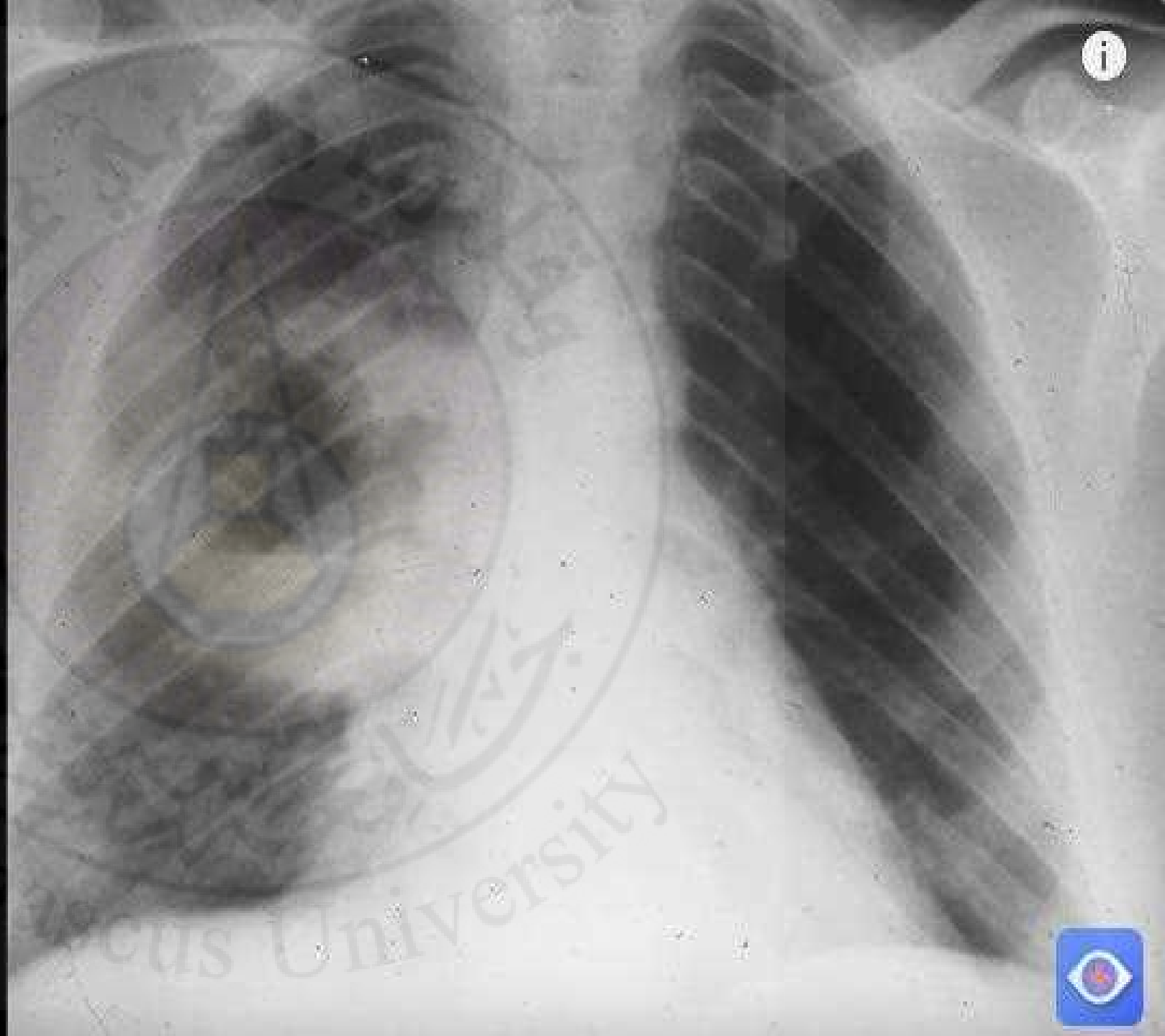
(*Bilateral*)

04



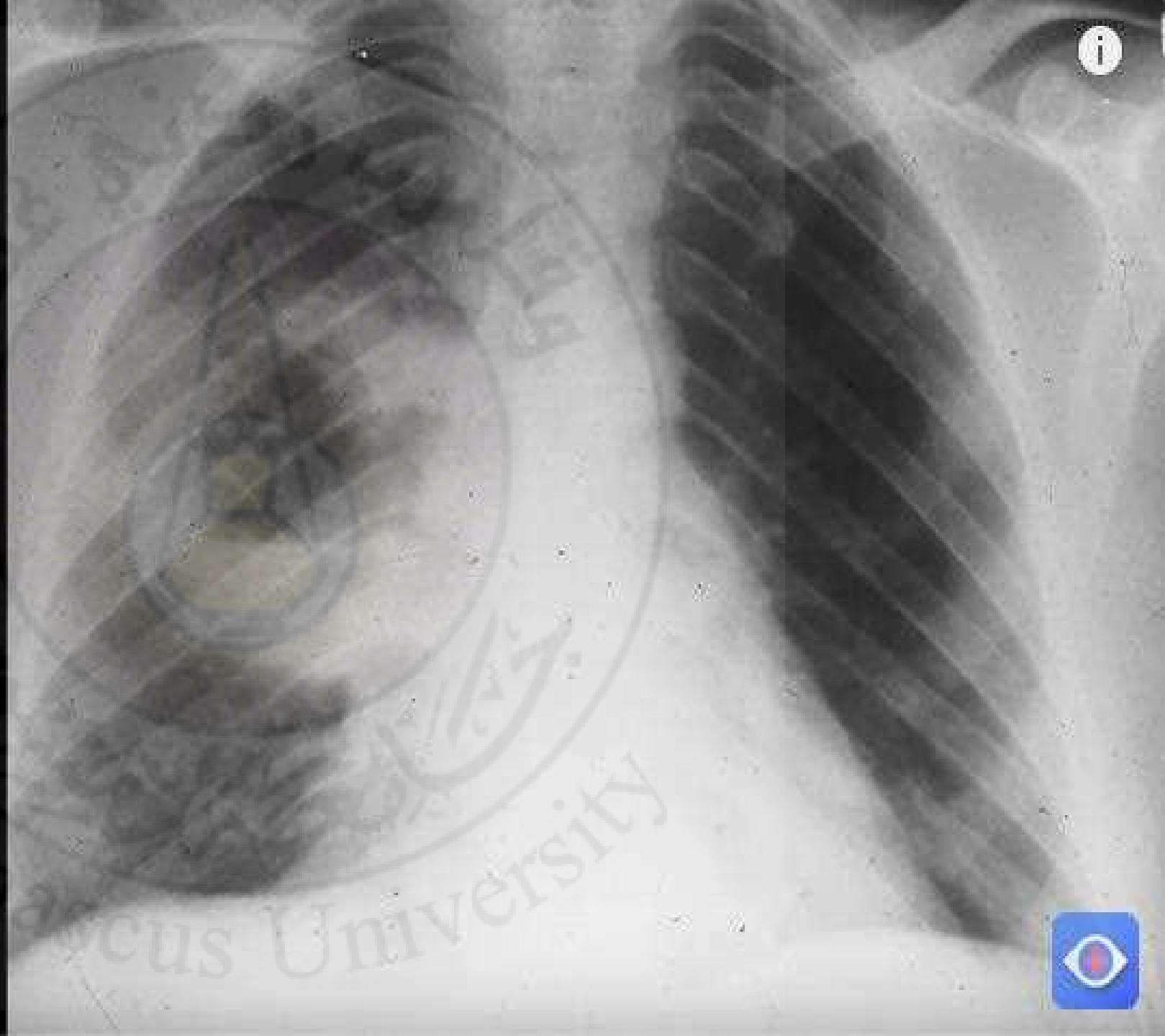
What is the
diagnosis?

01



Lung Abscess

02



What is the
diagnosis?

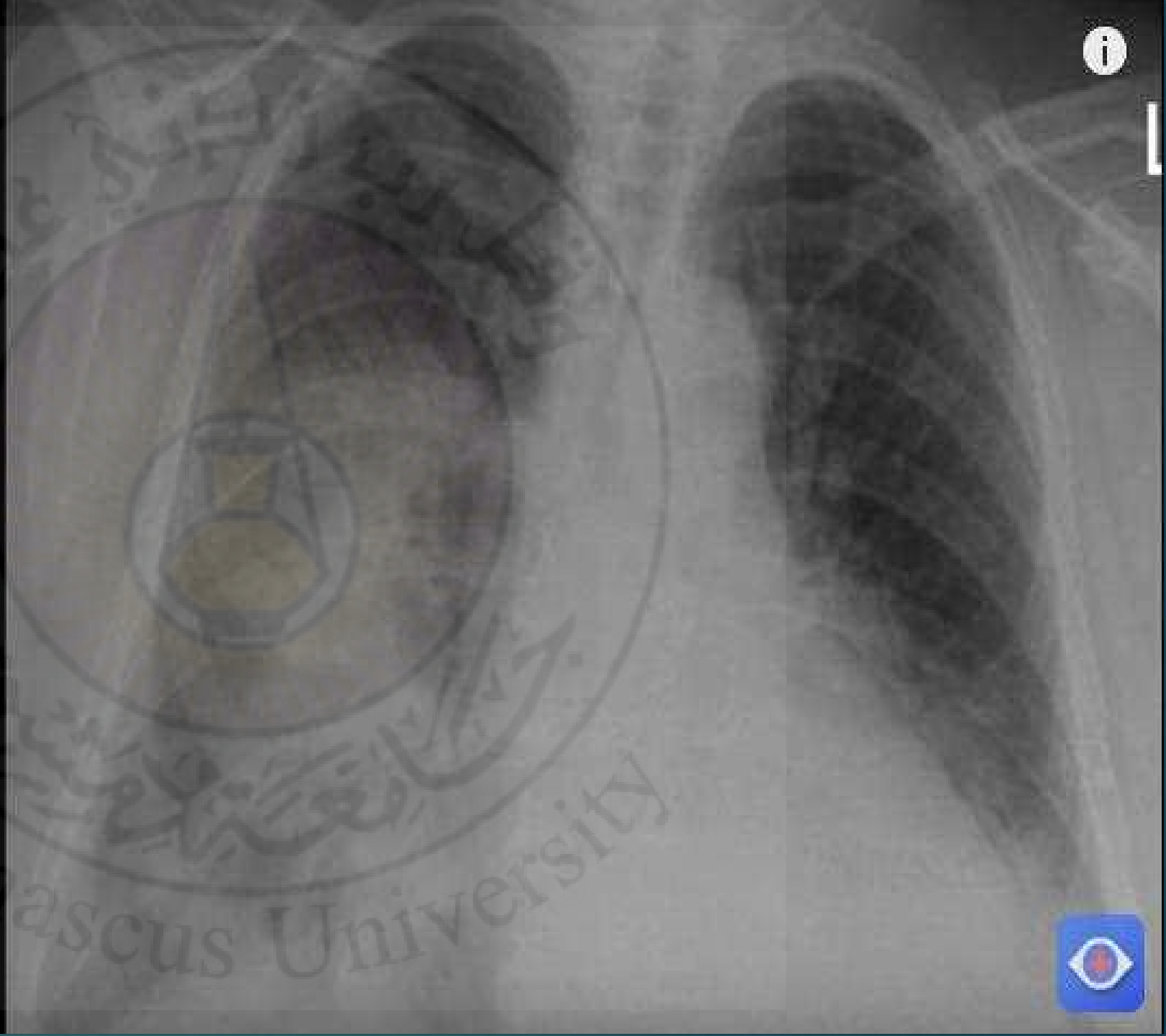
06



Pneumonia

*(Right Middle and
both Lower Lobes)*

02





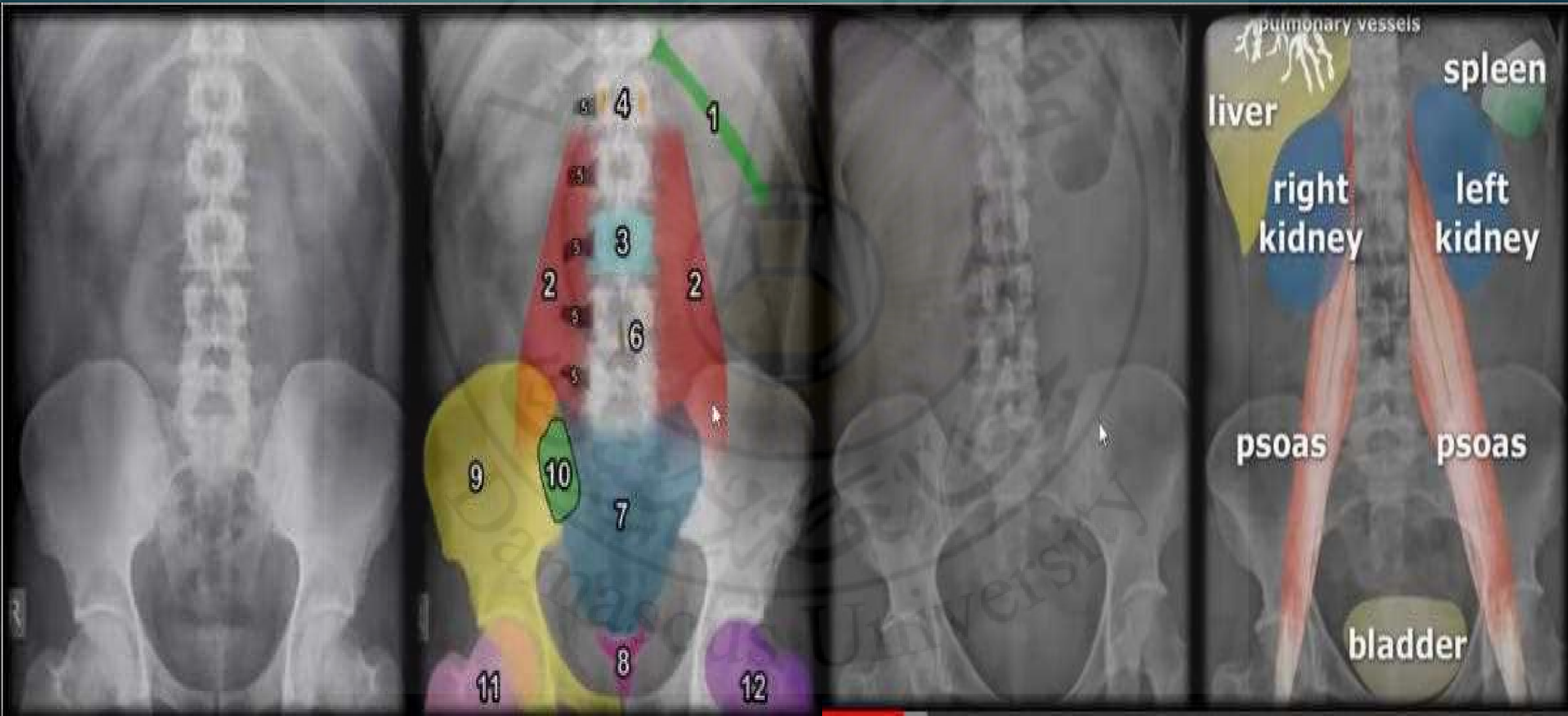
Thank you

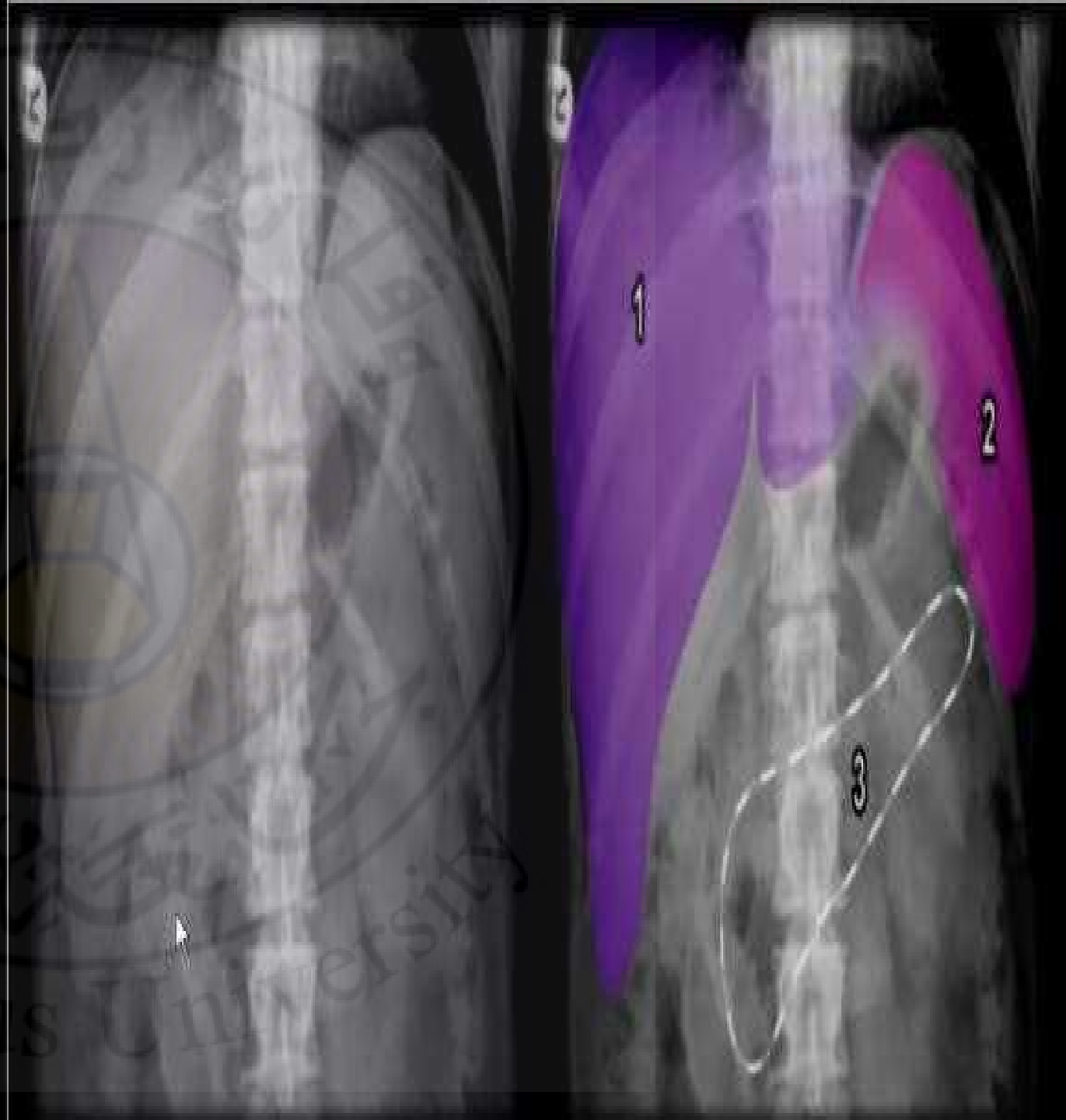
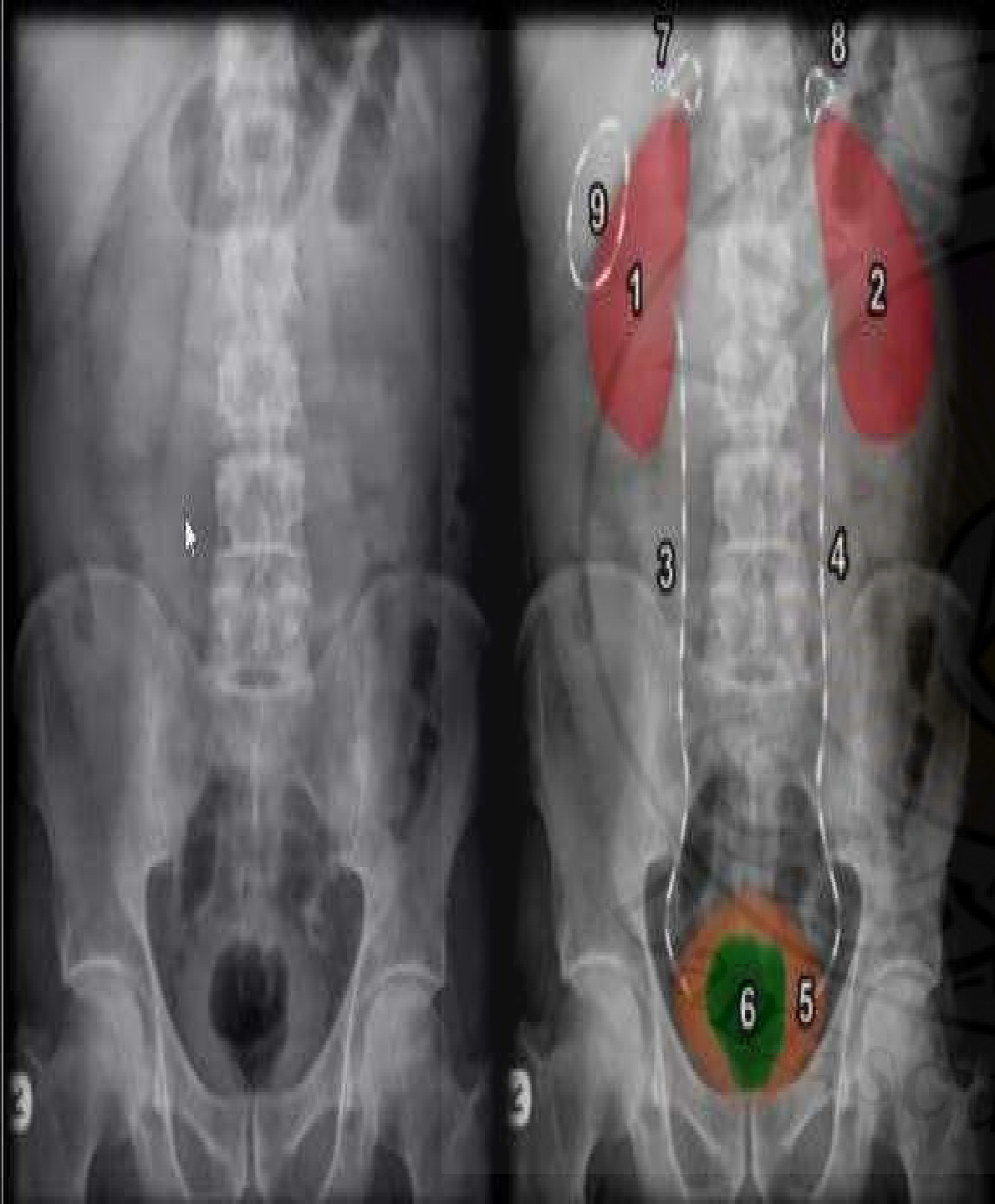
Abdominal X.ray

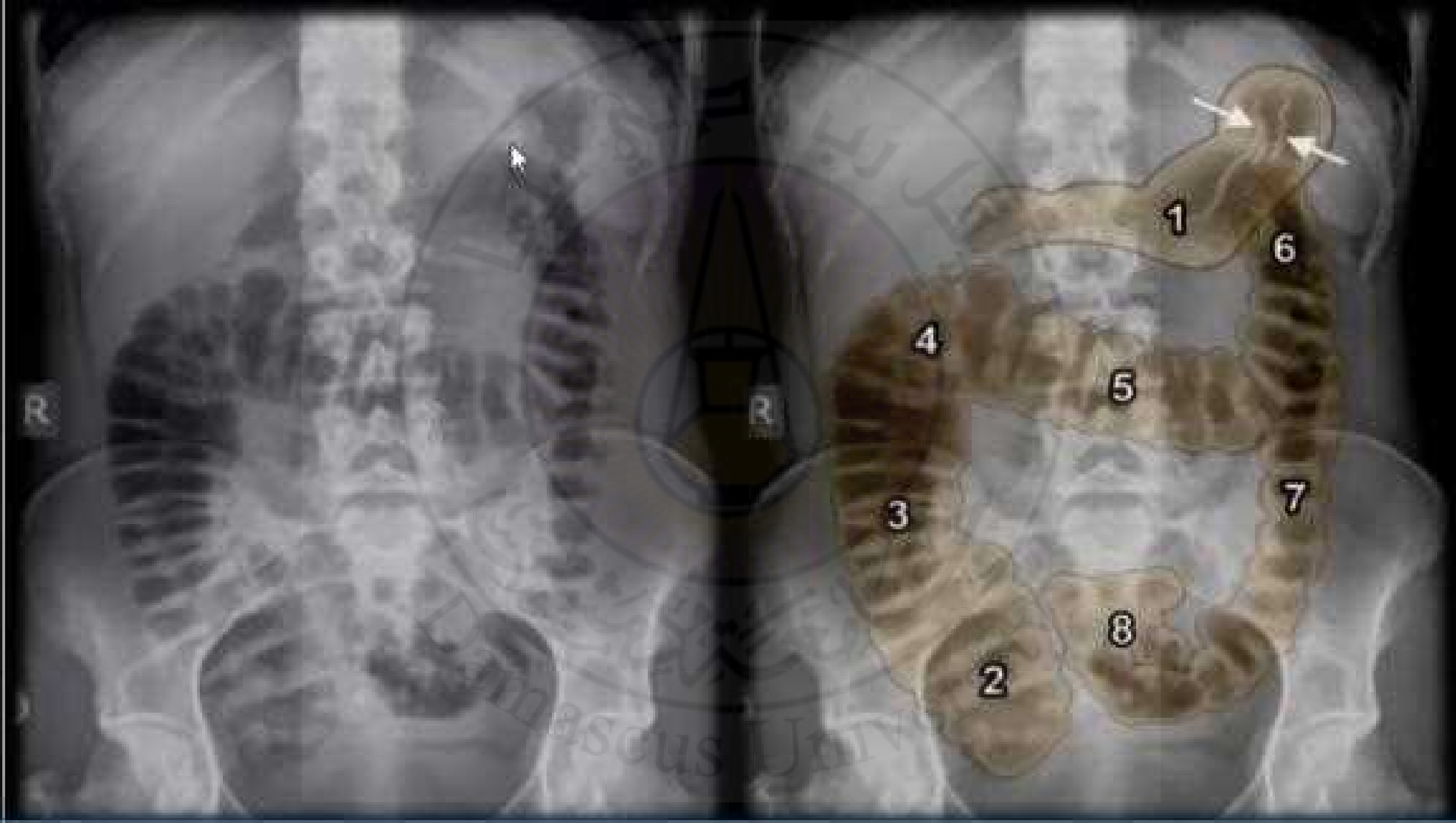
DR.MUHANNAD IBRAHIM

Damascus University

Normal Anatomy







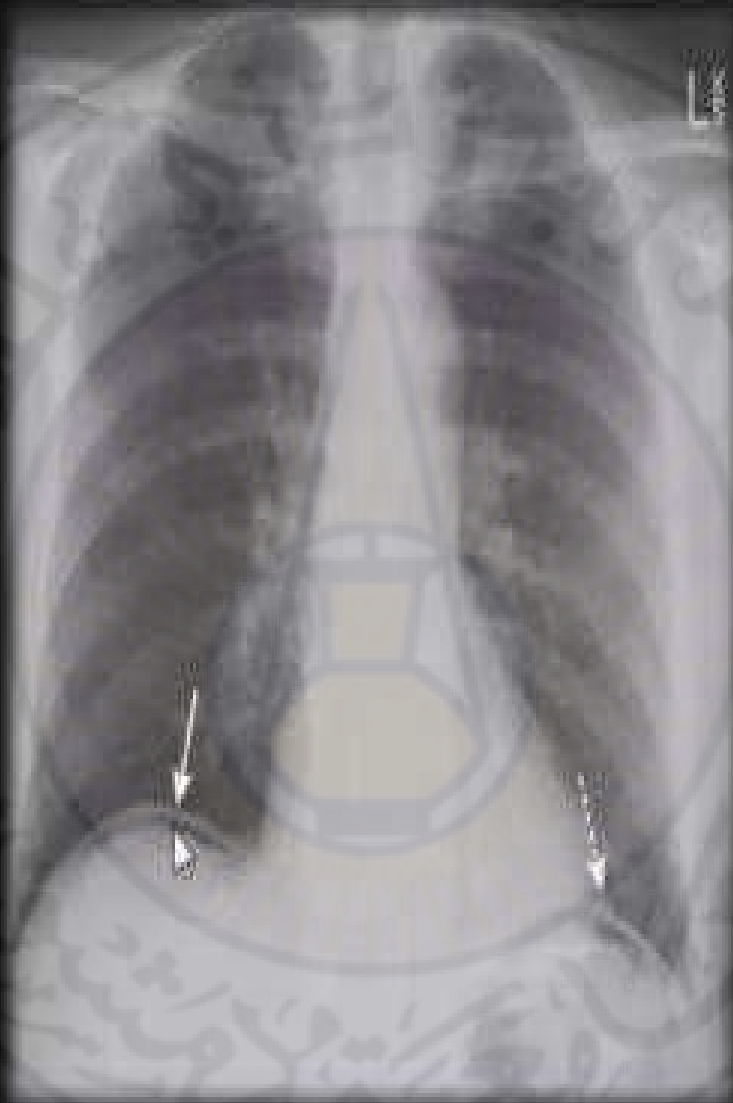
Be Systematic

Data of patient
Data of exam



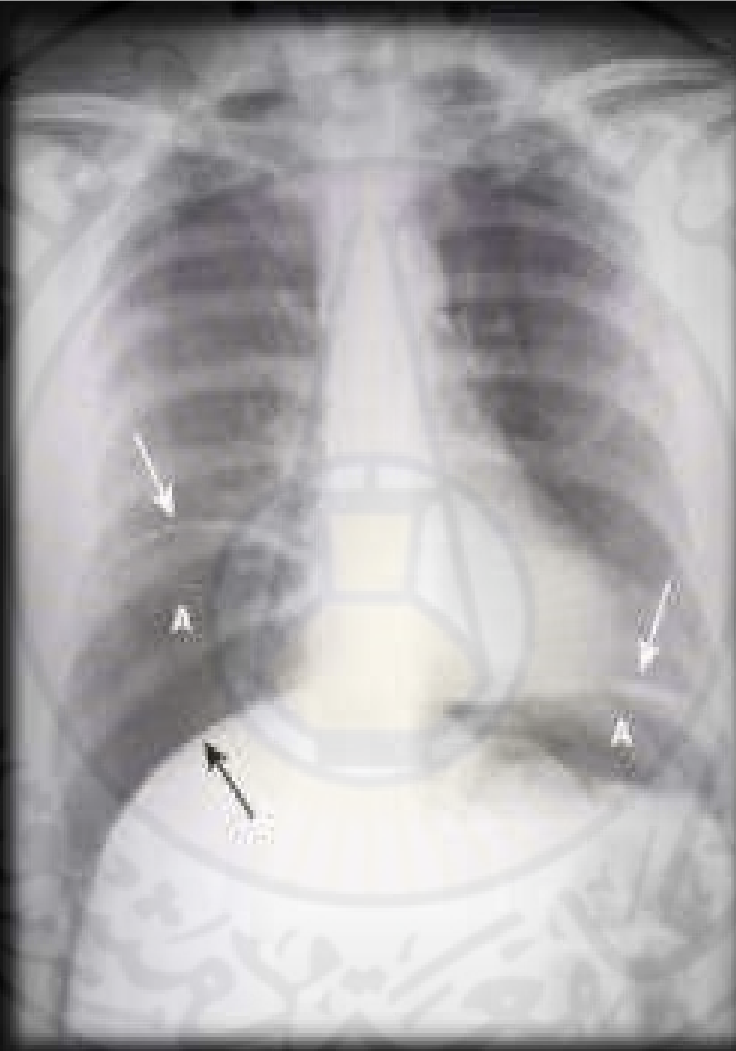
ABC approach

-
- A - Air in a wrong place.
 - B - Bowel.
 - C - Calcifications.
 - D - Dense structures as bones & soft tissues.
 - E - Everything else as foreign bodies,....



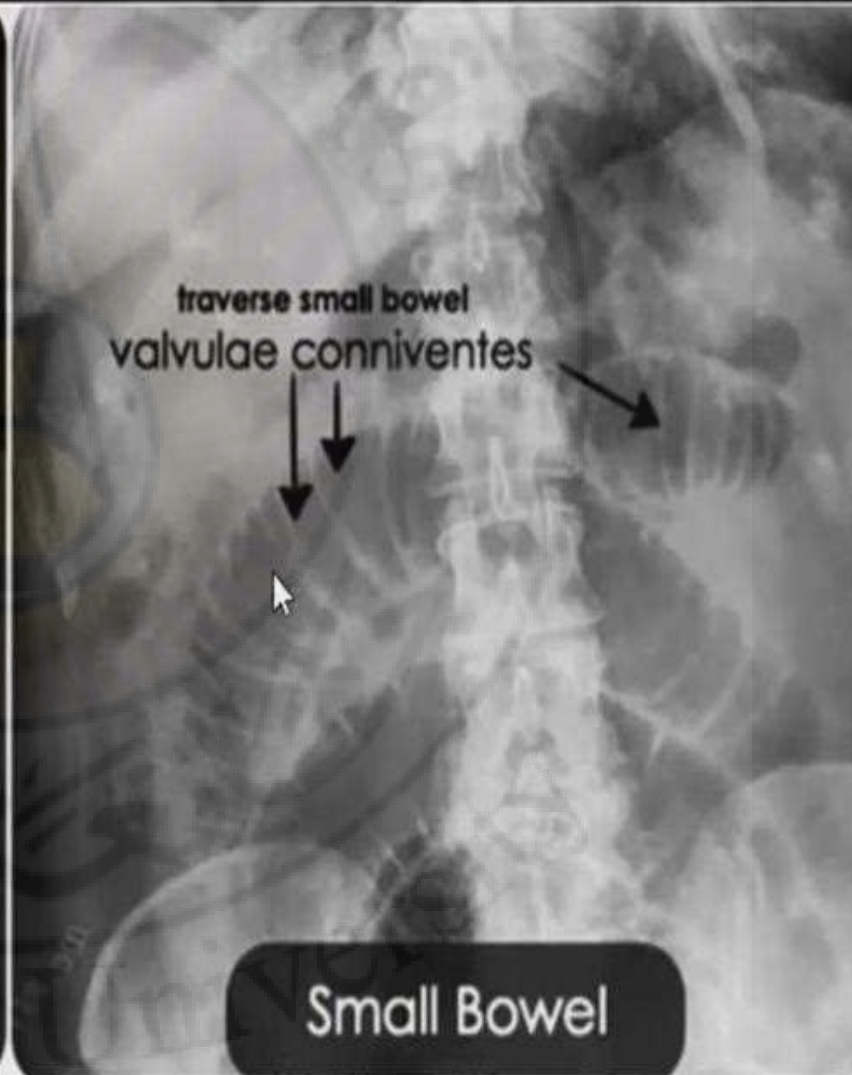
- **Free air beneath the diaphragm.**

The patient had undergone abdominal surgery 3 days earlier.



- **Free air beneath the diaphragm.**
The patient had perforated gastric ulcer.

1 - Small vs large bowel ?



3 – Cause of small bowel dilatation ?

❑ 1. Mechanical obstruction:

- _ Congenital , ...
- _ Acquired :
 - Adhesions (post-operative, look for surgical clips, history,...).
 - Obstructed hernia containing bowel.
 - Intussusception.
 - Volvulus of midgut.
 - Gallstone ileus.

❑ 2. Ileus:

- _ Generalized : post-operative.
- _ Localized : inflammatory.

- Distended small bowel.
- No large bowel gas.

Diagnosis: **small bowel obstruction.**



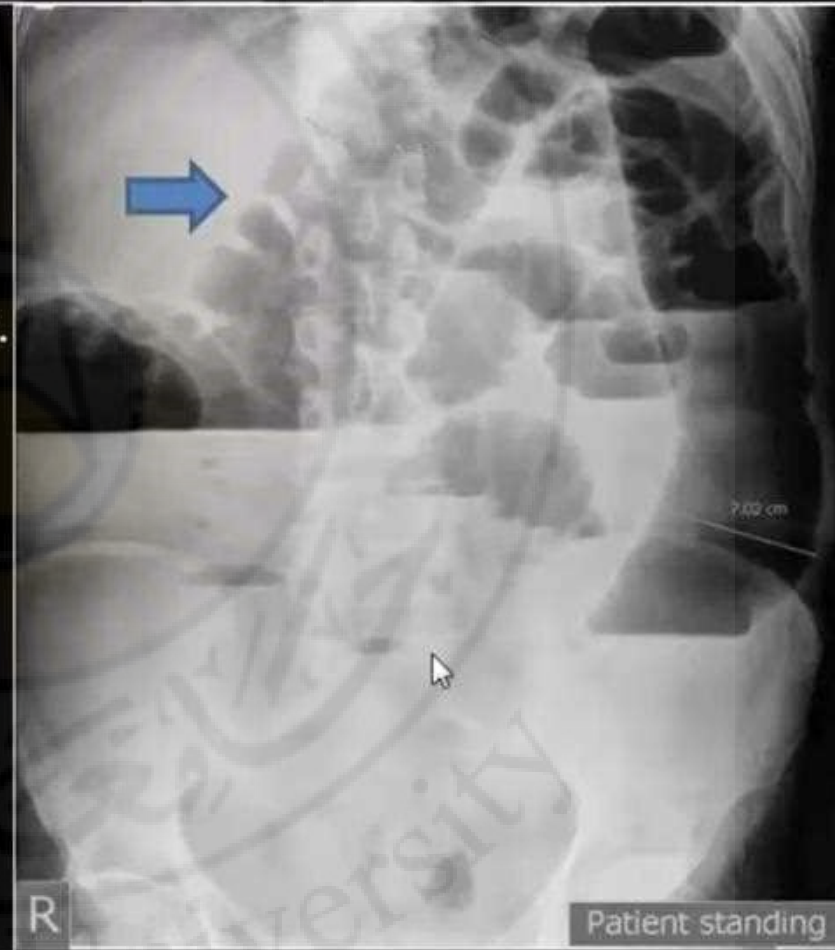
- Centrally located dilated bowel loops.
- Multiple air-fluid levels.
- Bowel folds are thin and complete.

Diagnosis: small bowel obstruction.



- Distended gas-filled colon, present centrally and peripherally in the abdomen.
- Multiple air-fluid levels.
- Bowel folds are thick and incomplete.

Diagnosis: large bowel obstruction.

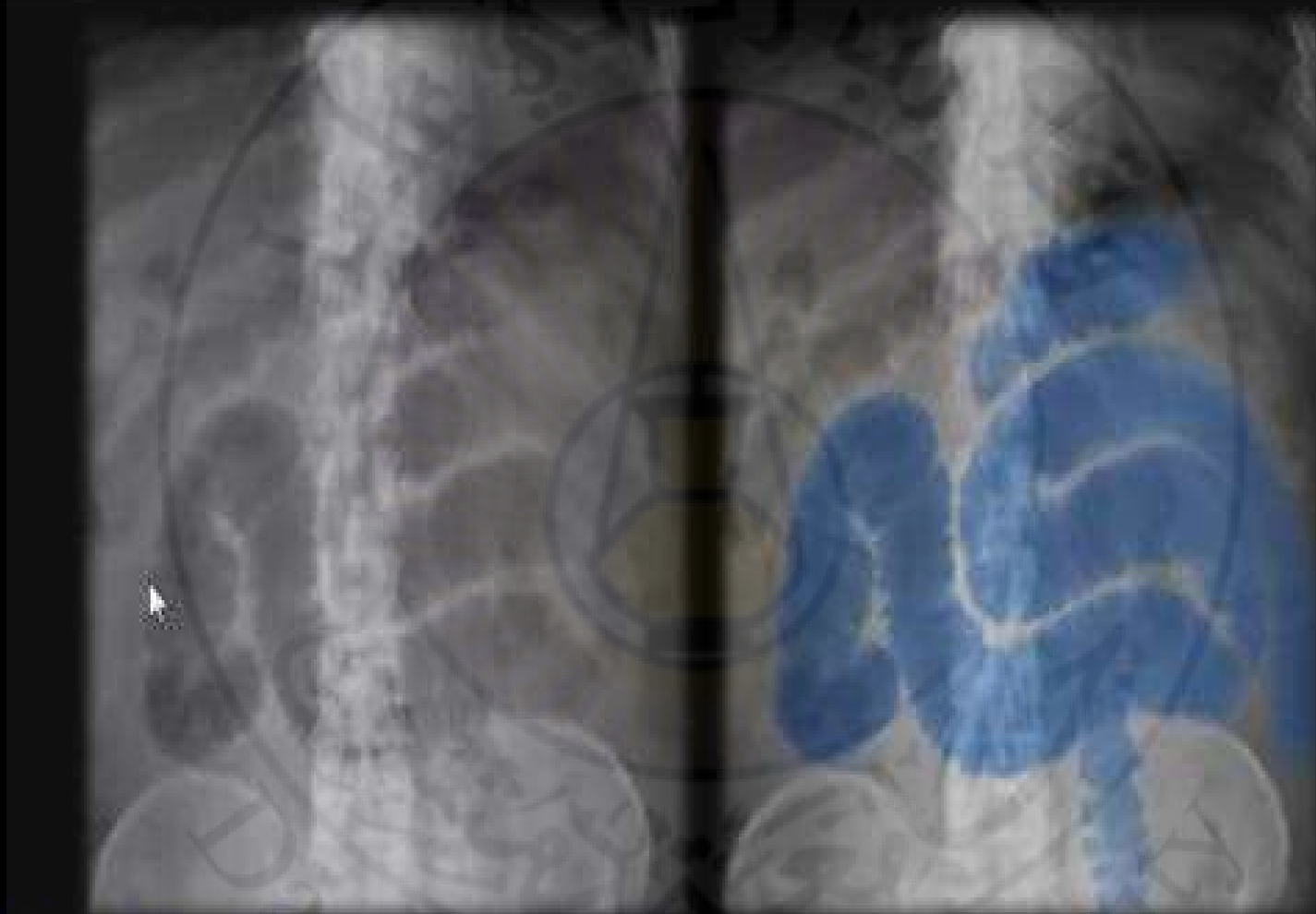


Dilated large bowel

- Large bowel obstructions are far less common than small bowel obstructions, accounting for only 20% of all bowel obstructions.
- The classic presentation is with abdominal pain, distension, and failure of passage of flatus and stool.
As dilatation of the colon increases, the risk of perforation also increases.

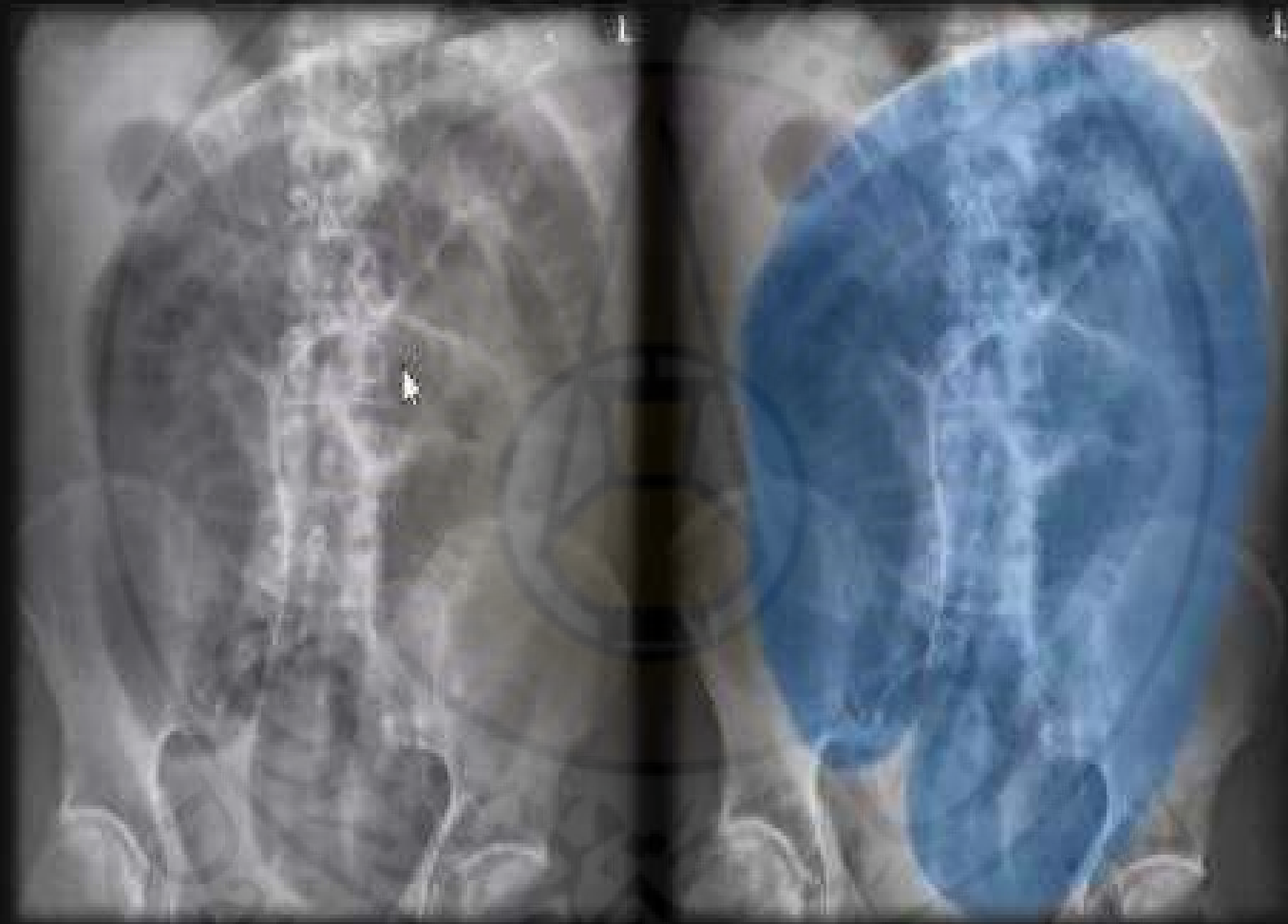
Causes of large bowel obstruction:

- ❑ **Malignancy** (colorectal carcinoma is the most common cause of large bowel obstruction in adults). (50-60%)
- ❑ **Diverticular stricture.** The second most common cause in adults
Together, obstructing tumors and acute diverticulitis account for 90%
- ❑ **Volvulus.**
- ❑ **Faecal impaction** (most common cause in immobile elderly persons)



➤ **Dilated Small bowel.**

Multiple dilated (> 3 cm) gas-filled bowel loops are seen having central location with valvulae conniventes seen throughout.



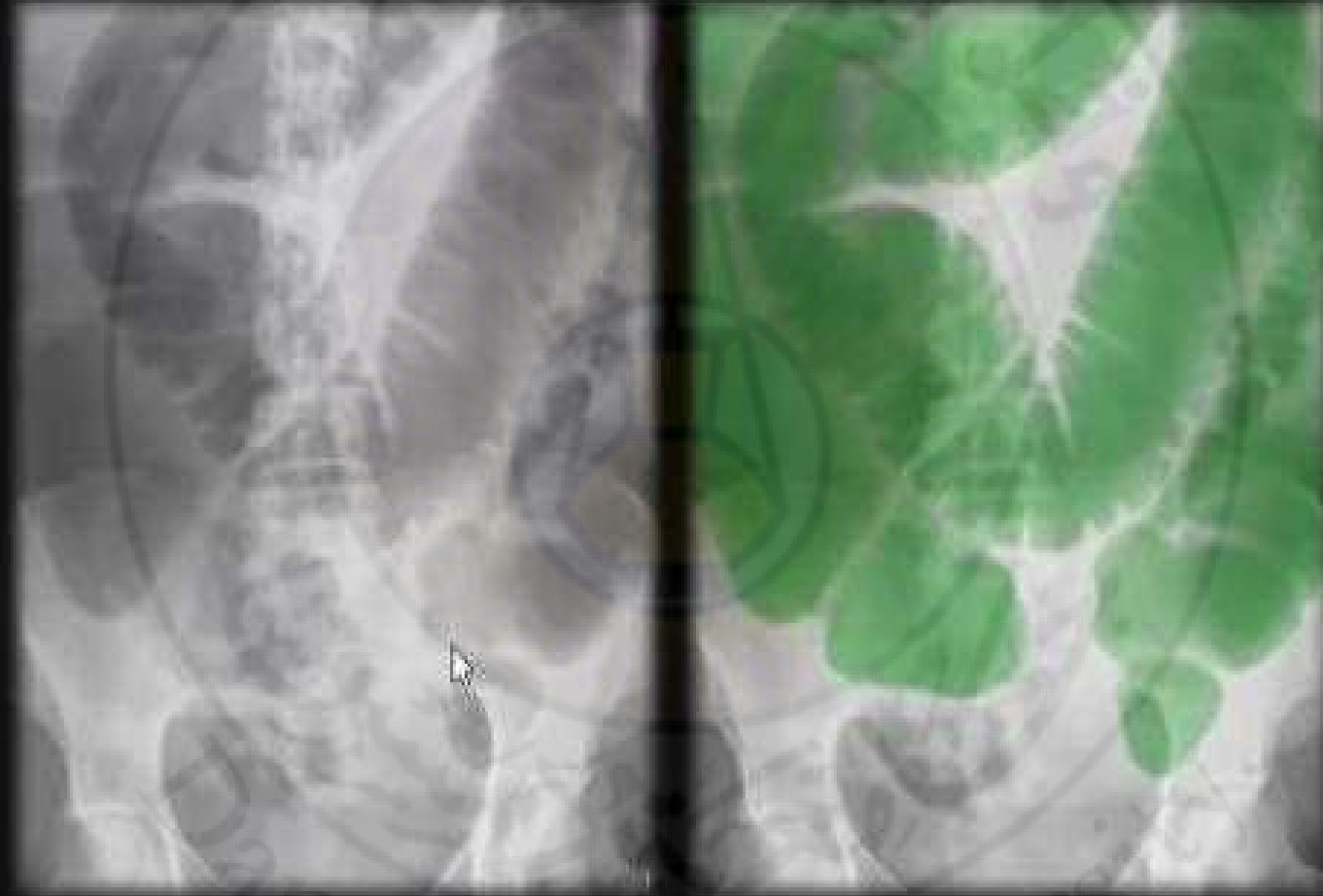
➤ **Dilated Small bowel.**

Multiple dilated (> 3 cm) gas-filled bowel loops are seen having central location with valvulae conniventes seen throughout.



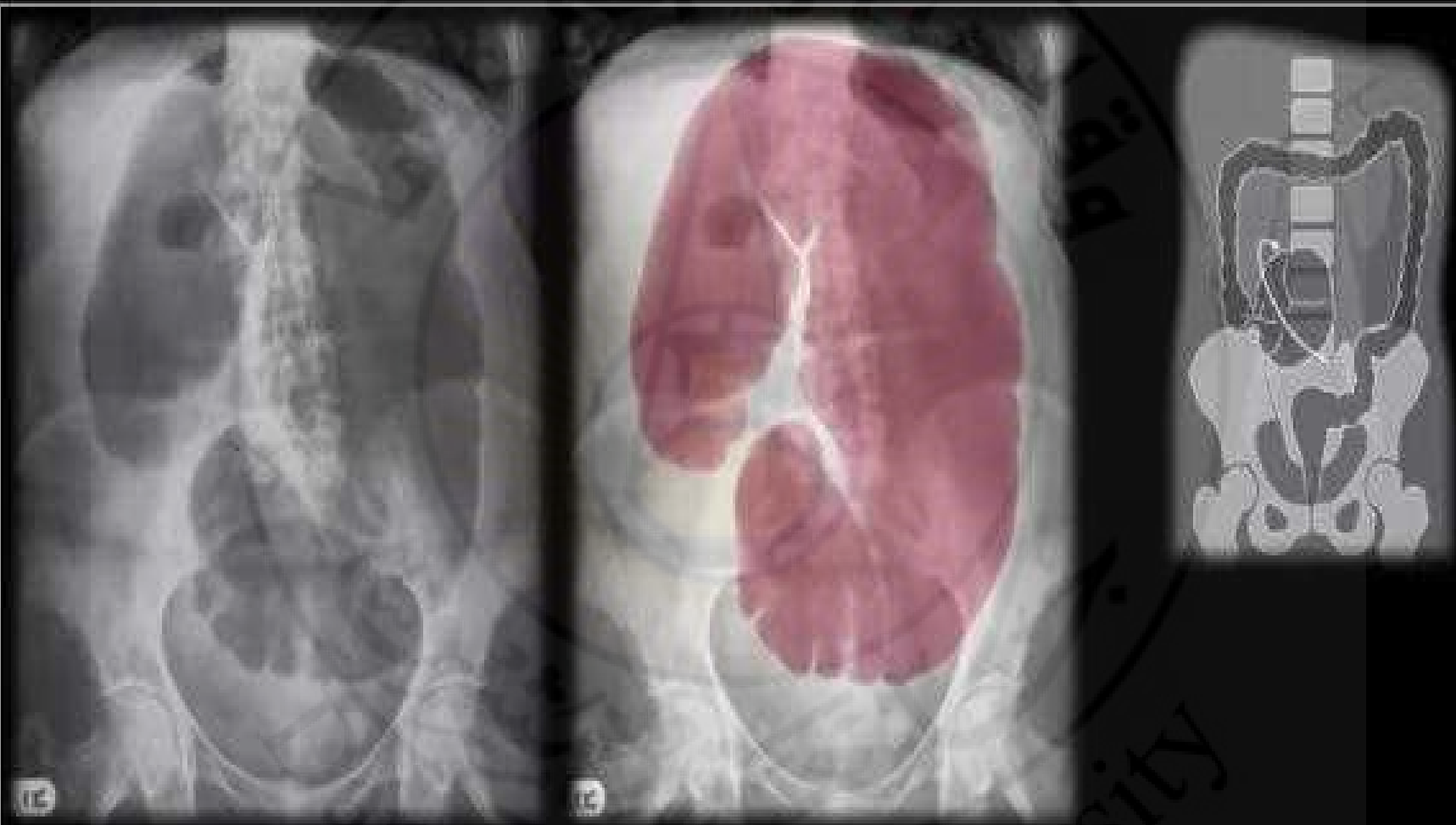
➤ **Dilated Large bowel.**

Multiple dilated (> 5.5 cm) gas-filled bowel loops are seen having circumferential location with haustra seen throughout.



➤ **Dilated Large bowel.**

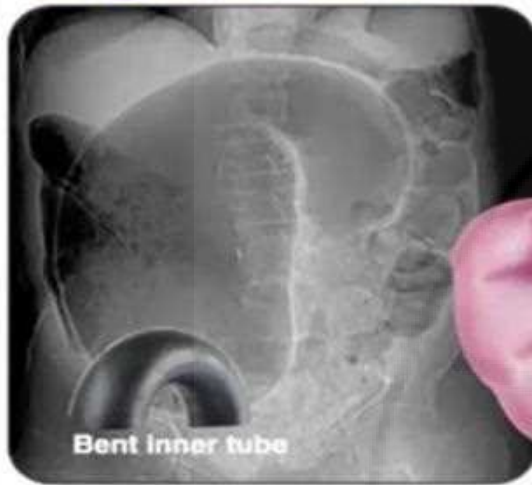
Multiple dilated (> 5.5 cm) gas-filled bowel loops are seen having circumferential location with haustra seen throughout.



➤ **Cecal volvulus.**

Rounded comma-shaped dilated bowel loop crossing midline & extending to left upper quadrant, showing haustral pattern. Collapsed distal colon.

Sigmoid Volvulus



Diagnosis

- Plain film (Low specificity) [U-shaped, bent inner tube]
- Abdominal CT scan
- Contrast enema

Risk factors

- Nursing home patients
- Elderly
- Bed bound
- Chronic constipation

Clinical

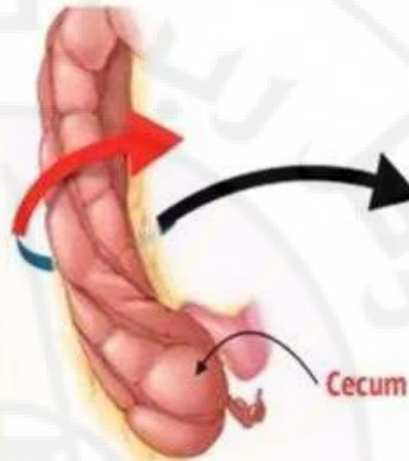
- Insidious onset of slowly progressive abdominal pain
- Abdominal distension
- Nausea, constipation
- Vomiting (several days after pain onset)

Management

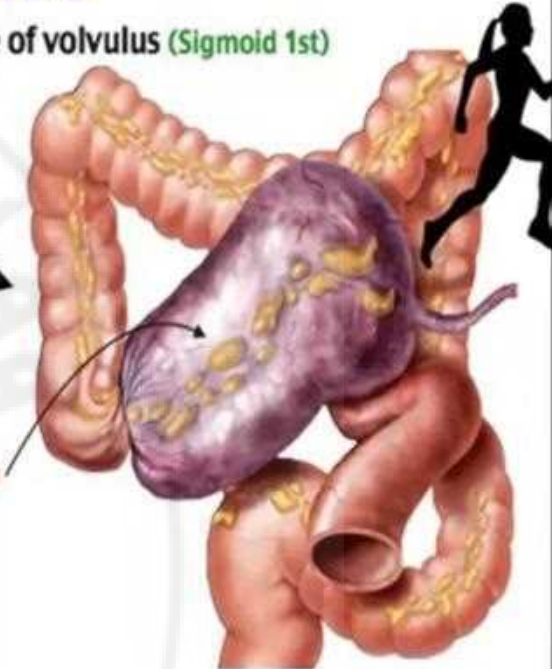
- Flexible sigmoidoscopy (to reduce volvulus)
- Surgery (to prevent recurrence)

Cecal Volvulus

→ 2nd most common site of volvulus (Sigmoid 1st)



Congenital defect in peritoneum resulting in the **twisting** of the mobile segment of the **cecum**



Risk factors

- Relatively **younger** than sigmoid volvulus (30s-50s)
- Associated with **marathon runners**
- Increased in GI malignancy

Diagnosis

- Plain film (coffee-bean or comma cecum) [Low specificity]
- Abdominal CT (90% of patients) [Whirl sign]
- Surgical exploration (10% of patients)

Management

- Surgical



Coffee bean appearance



Comma appearance

Sigmoid volvulus

- A **sigmoid volvulus** is caused when the sigmoid colon twists on its mesentery.
- It is usually seen in the **elderly** or **hospitalized** patients.

Radiological signs of a sigmoid volvulus:

- ❑ **1. Coffee bean sign:**

The shape of the distended gas filled 'closed loop' of colon looks like a **large coffee bean**.



- ❑ **2. General lack of haustra:**

Often the bowel is so distended that haustra flatten out and are no longer seen.

- ❑ **3. Distension of the proximal colon:**

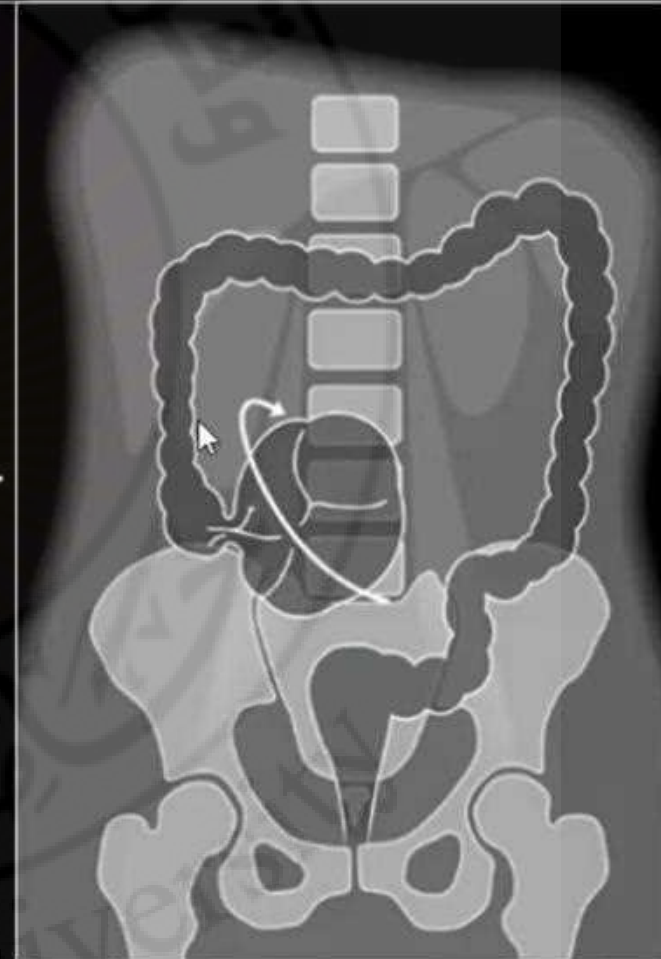


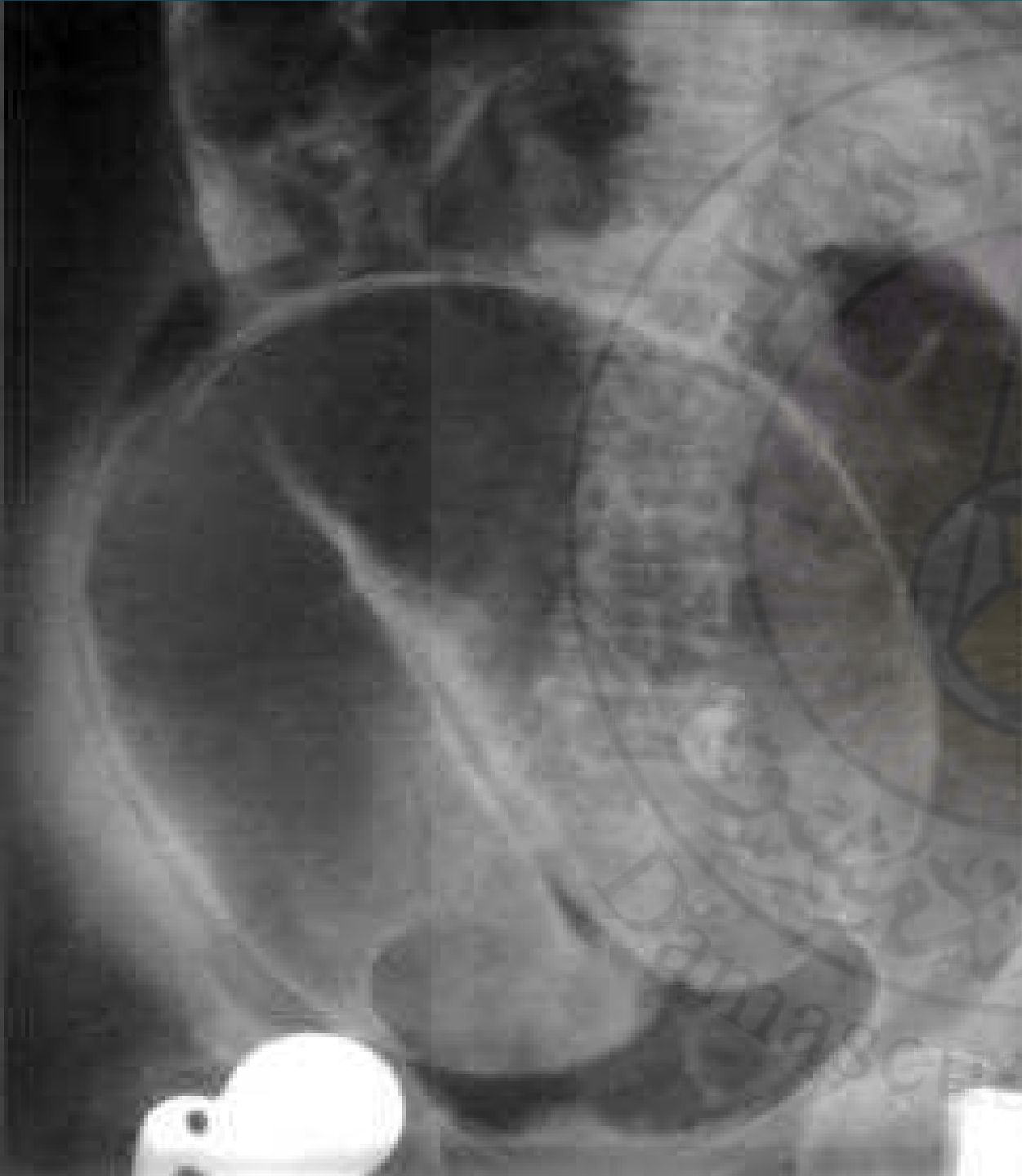
Caecal volvulus

- **A caecal volvulus** is caused when the caecal colon twists on its mesentery.
- Usually seen in younger patients.

Radiological signs of a caecal volvulus:

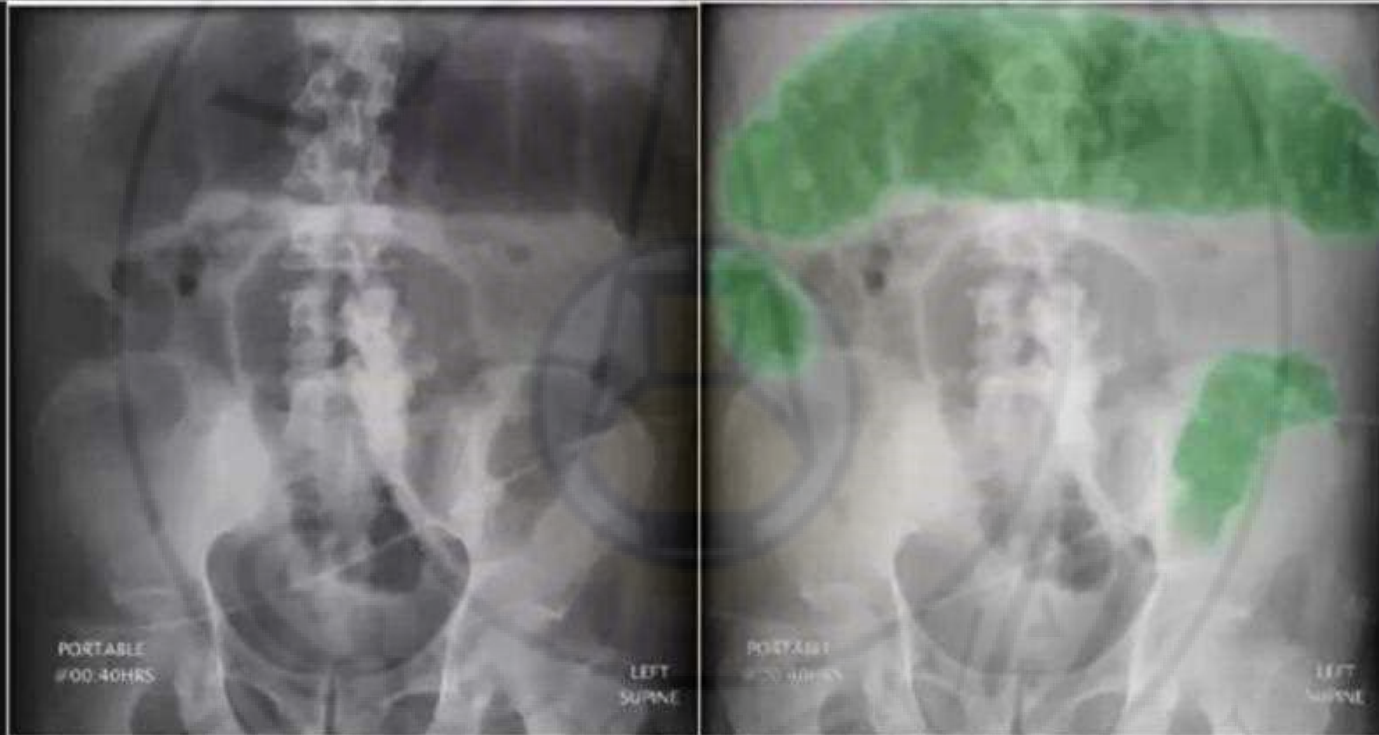
- ❑ **1. Comma shaped:**
The shape of the distended gas filled 'closed loop' of colon often looks like a large comma. (more rounded than a sigmoid volvulus).
- ❑ **2. Haustra often visible:**
The haustral folds are often still clearly visualized, even when it is very distended.
- ❑ **3. Collapse of the distal colon:**
The colon distal to the obstruction (volvulus) is often collapsed.





Toxic Megacolon

- **Toxic megacolon** is an **acute** form of **bowel dilatation** occurring as a complication of **inflammatory bowel disease** (ulcerative colitis or Crohn's) or **infection** (e.g. pseudomembranous colitis from *C. difficile*).
- The patient develops **rapid dilation** of the colon and may show signs of **septic shock**. If the condition does not improve, it can be **life threatening** and require an **emergency colectomy** (resection of the diseased colon).
- **What to look for?**
 - ❑ 1. **Large bowel dilatation to >6 cm diameter.**
 - ❑ 2. **Inflammatory pseudopolyps** (mucosal islands):
Lobulated opacities in the bowel wall from areas of raised mucosal tissue surrounded by areas of ulceration
 - ❑ 3. **Thumbprinting and mucosal oedema** may be present.
 - ❑ 4. Usually **transverse colon** affected.



➤ **Toxic megacolon.**

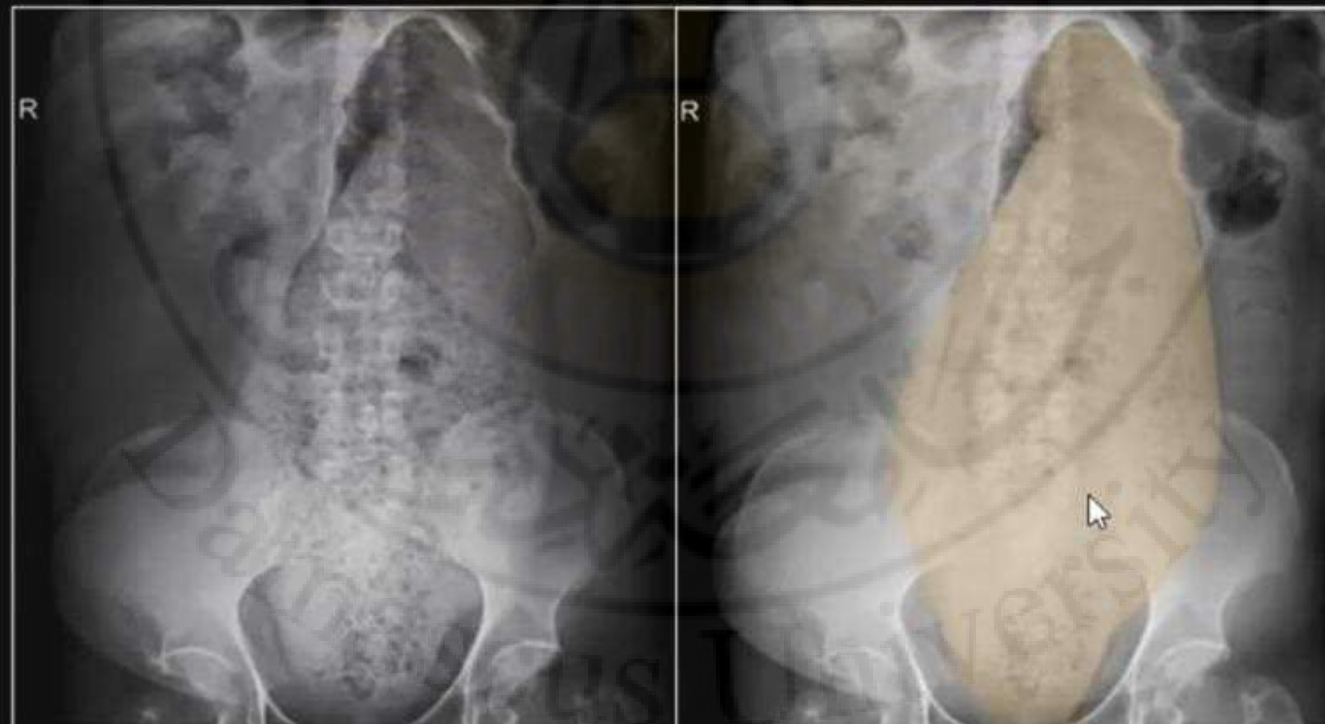
Transverse colon is dilated (> 6 cm) showing multiple small lobulated masses (pseudopolyps). Loss of normal fecal matter in large bowel.

Faecal impaction

- It is **more severe** than faecal loading and refers to a solid, immobile bulk of faeces that can develop in the rectum, resulting from **chronic constipation**.
- Patients most at risk are the **elderly** and those who are **immobile**.

It has a characteristic appearance:

- ❑ **A large (sometimes massive) bulk of faeces in the rectum.**



Advanced achalasia of the cardia

Achalasia with **sigmoid deformity** of esophageal dilatation, tapering at the gastroesophageal junction and an air-fluid level within the esophagus.



Esophageal carcinoma

Histological types

Squamous cell carcinoma : 81 - 95%

Adenocarcinoma : 4 - 19%

arising from mucosal / sub mucosal glands, ectopic gastric mucosa or columnar-lined epithelium

70% related to Barrett's esophagus

occur at the gastro- esophageal junction

Other types :

- Mucoepidermoid carcinoma
- Adenoid cystic carcinoma
- Spindle-cell squamous carcinoma
- Leiomyosarcoma
- Rhabdomyosarcoma
- Fibro sarcoma



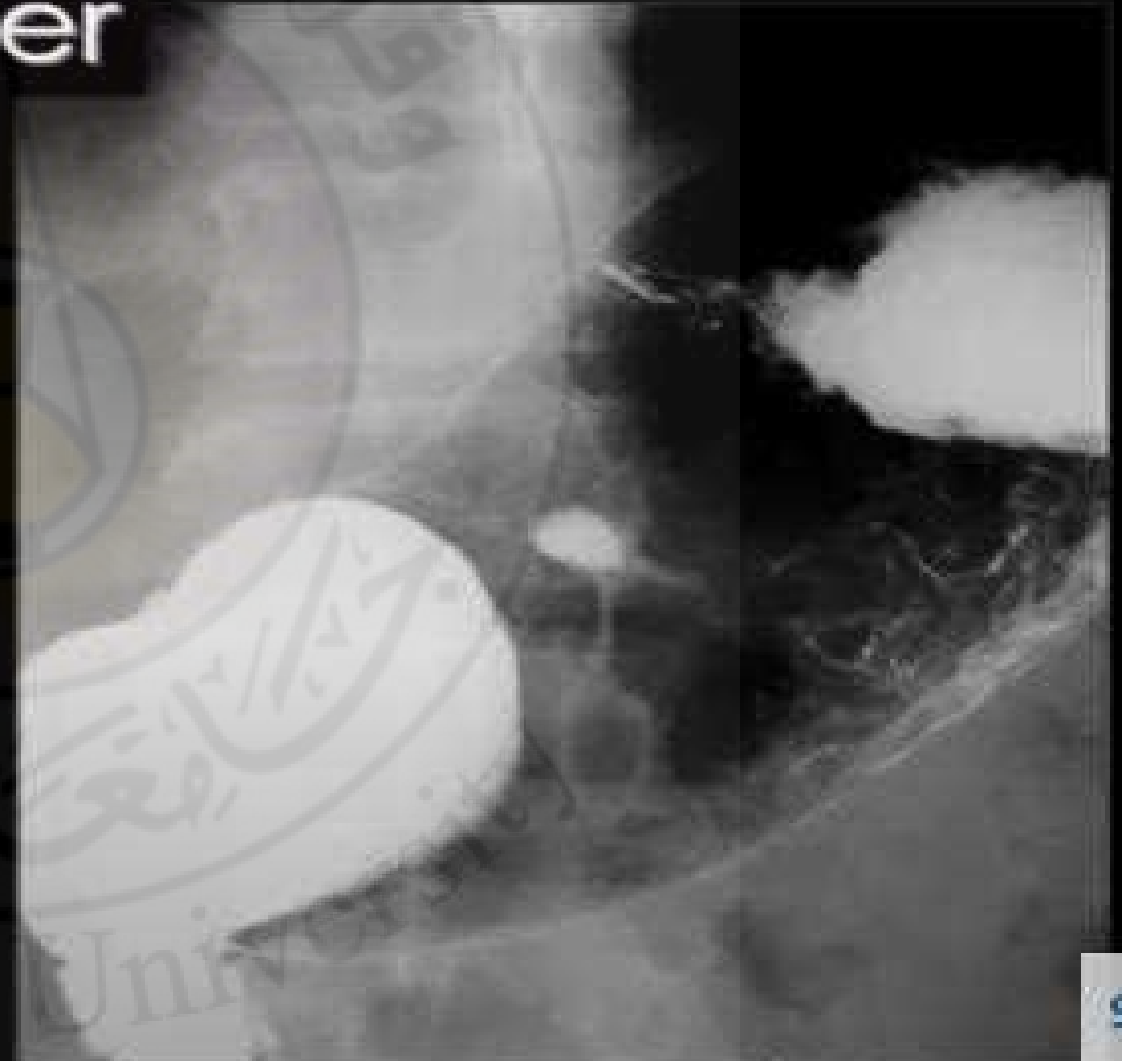
Gastric ulcerations

- ♦ Common gastric lesions
- ♦ About 30% of peptic ulcers occur in the stomach
- ♦ About 5% of gastric ulcers are malignant
- ♦ 5mm ulcers may not be seen on barium studies
- ♦ Giant ulcers > 3 cm have a higher risk of complications
- ♦ Complications include bleeding and perforation



Benign gastric ulcer

Barium meal showing an ulcer in the body of the stomach. Deciding whether a gastric ulcer is benign or malignant may be possible by examining it from different angles. An ulcer crater set well apart from the stomach wall with mucus fold extending to the crater's edge is more likely to be benign.

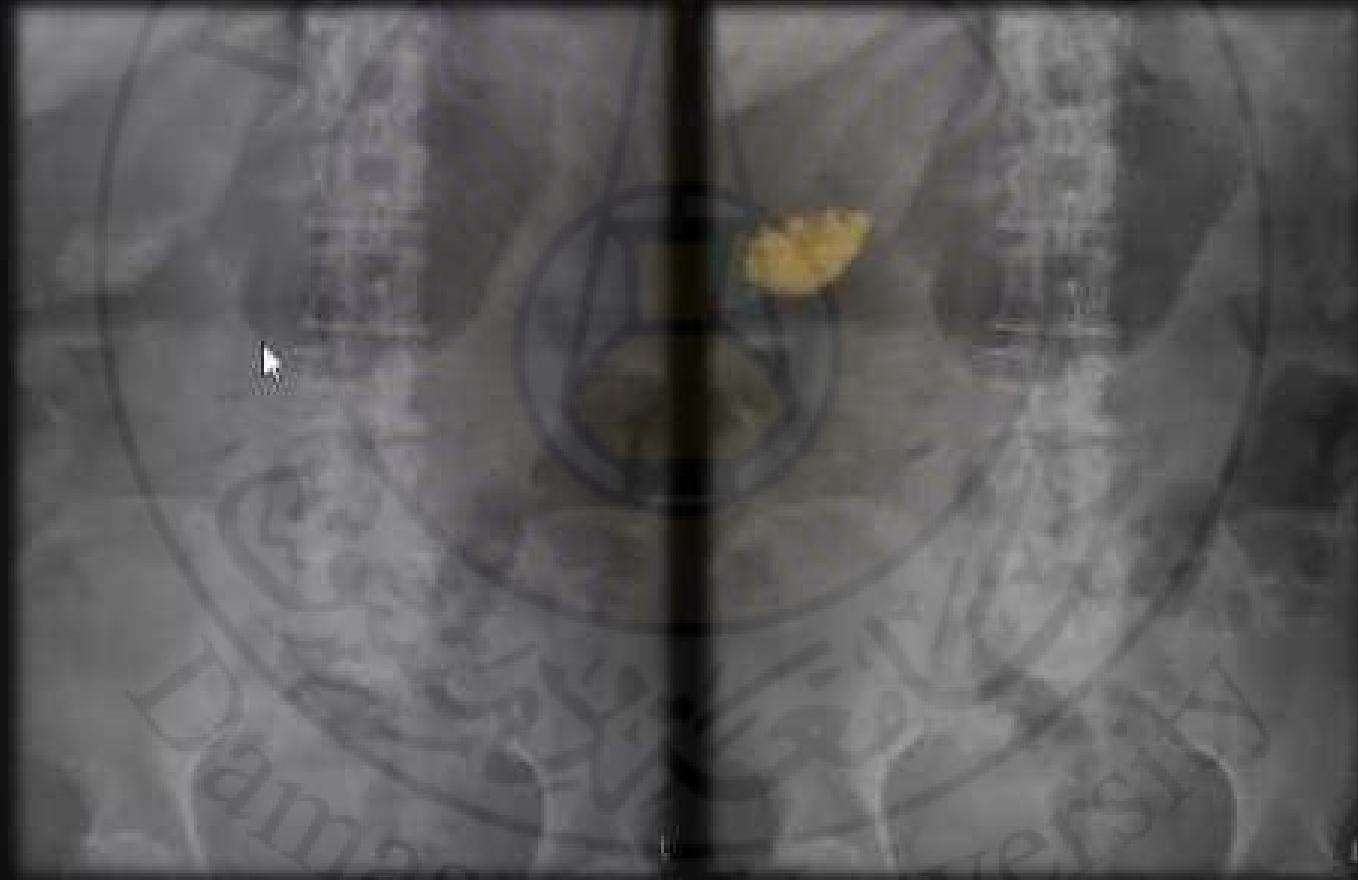


Malignant gastric ulcer

Double Contrast barium study showing a large deep penetrating malignant ulcer on the lesser curve of the body of the stomach. Note the prominent tumor collar around the margin of the ulcer

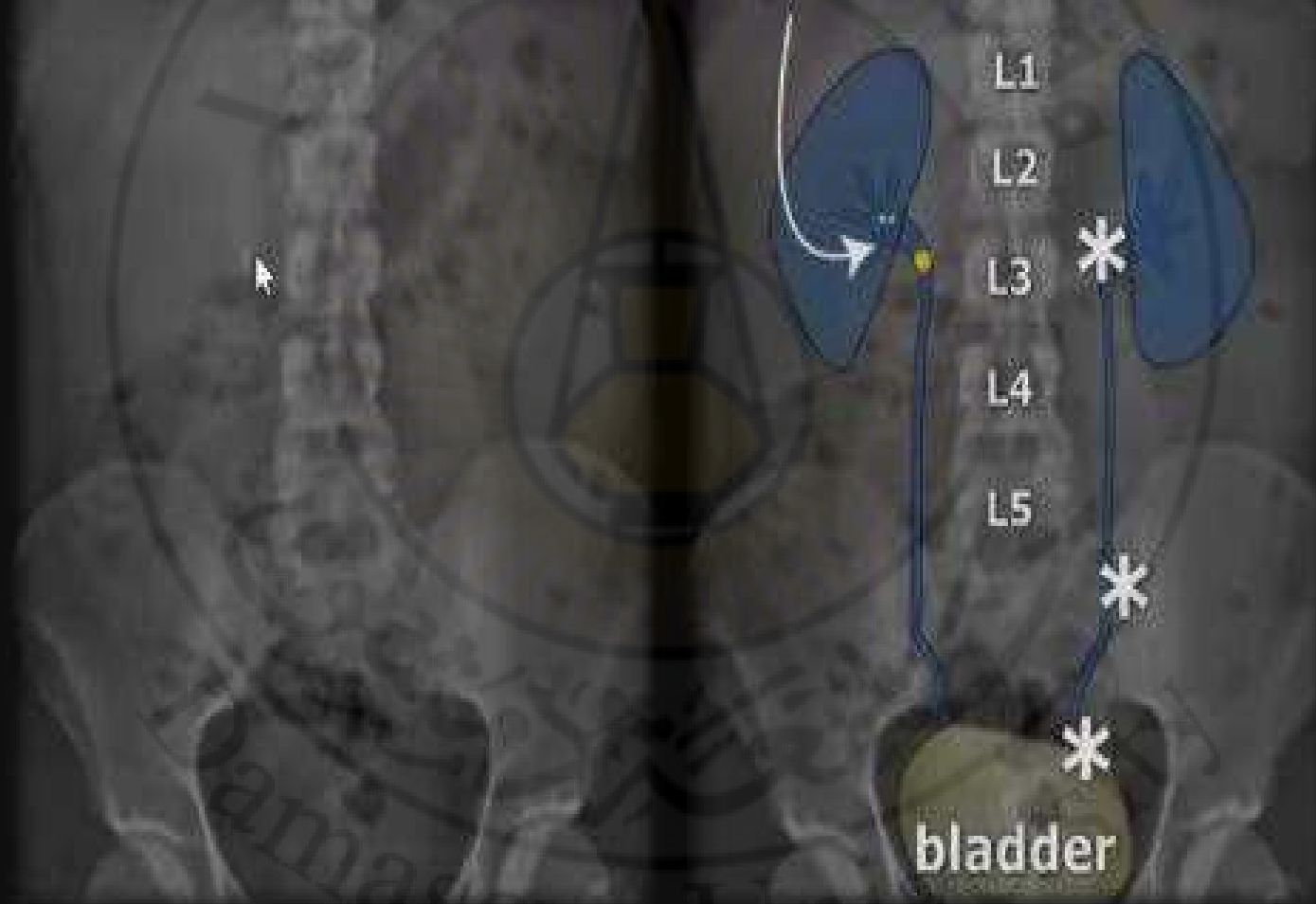


Gallbladder Stones



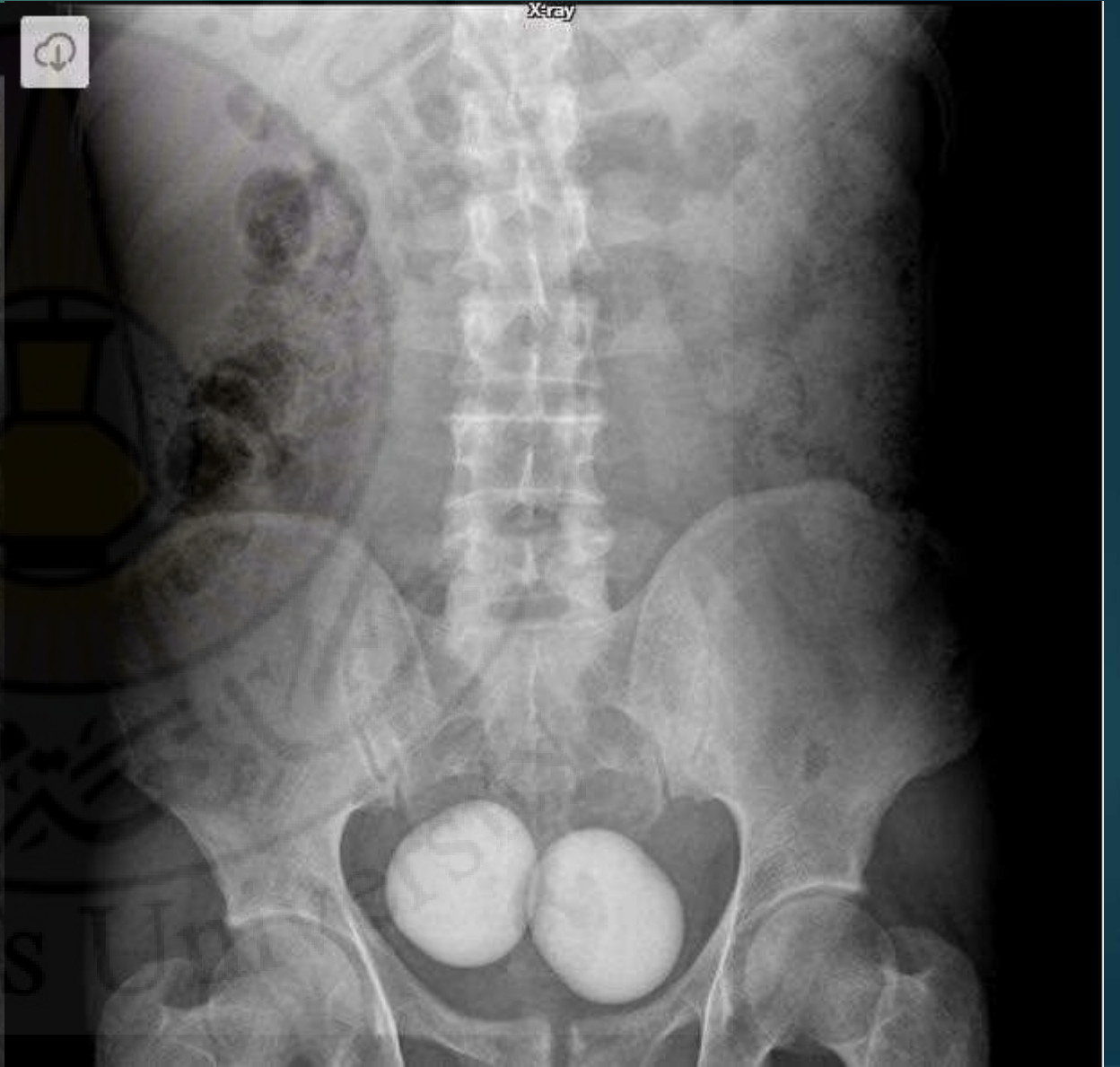
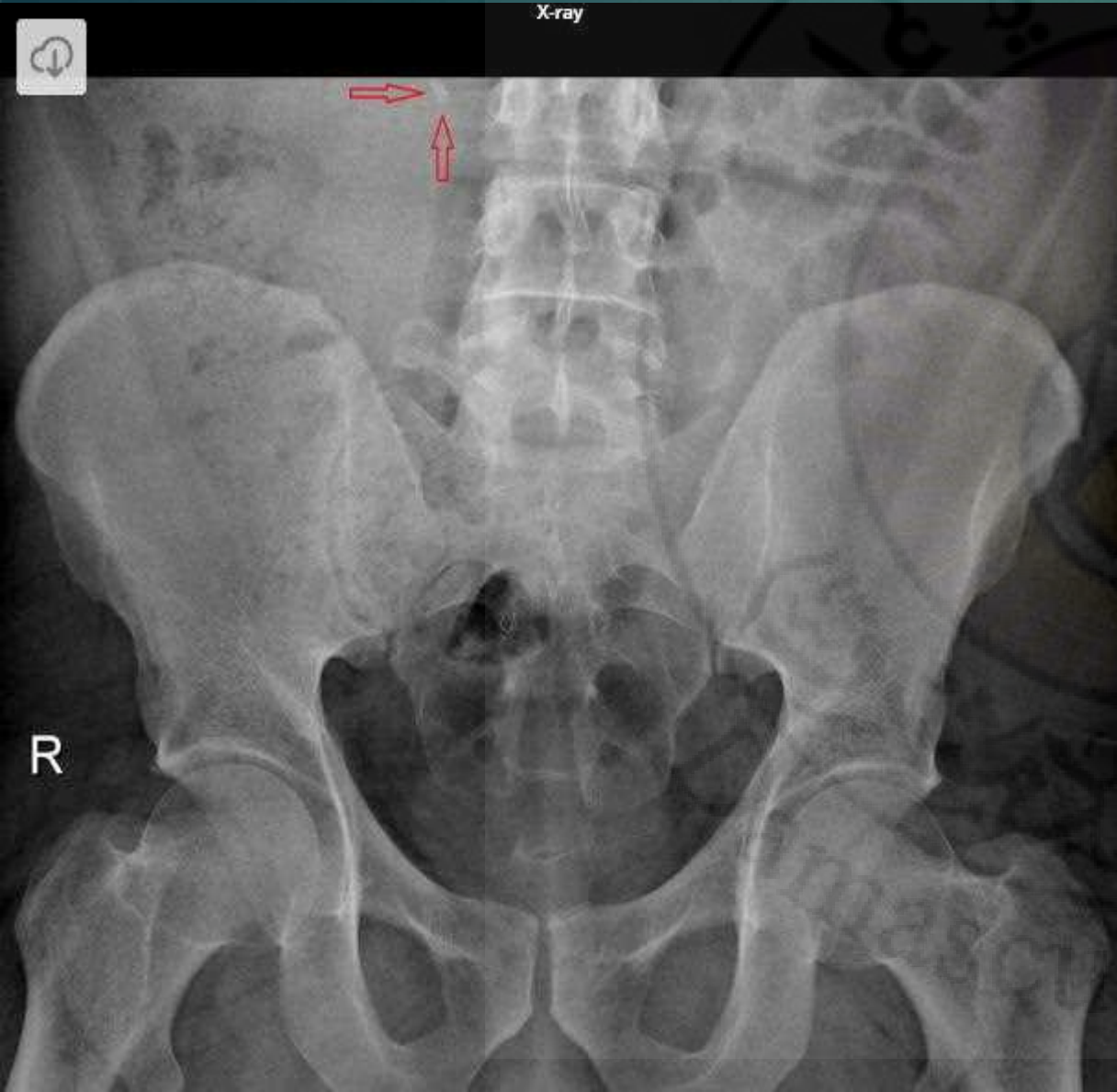
- Lamellated / faceted gall stones.

nephrolithiasis / urolithiasis



Ureteric stone

Urinary bladder stones



- Medullary nephrocalcinosis (Patient has 1ry hyperpara,).



BONES X.RAY



< 30 years

> 30 years



Chondroblastoma



GCT

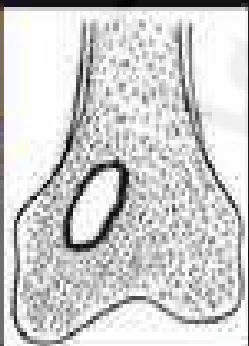


Geode

Geographic

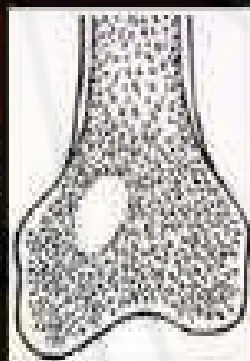
Margin 1A

Well-defined
sclerotic
margin



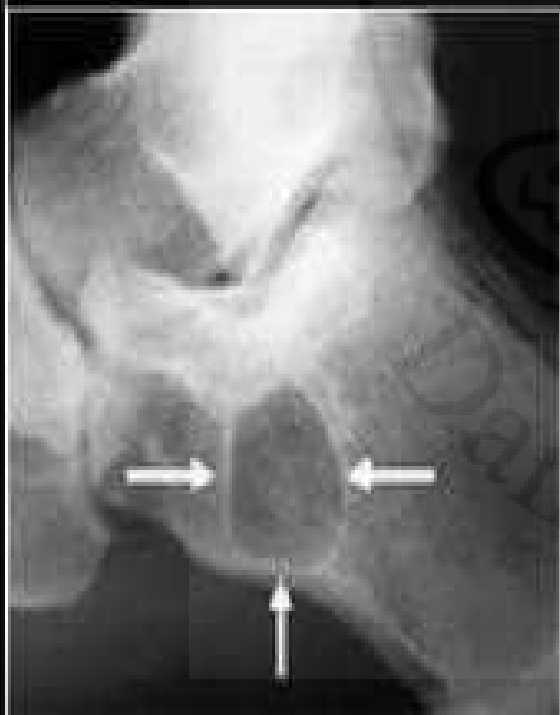
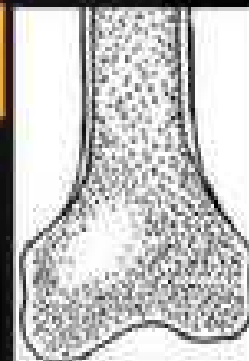
Margin 1B

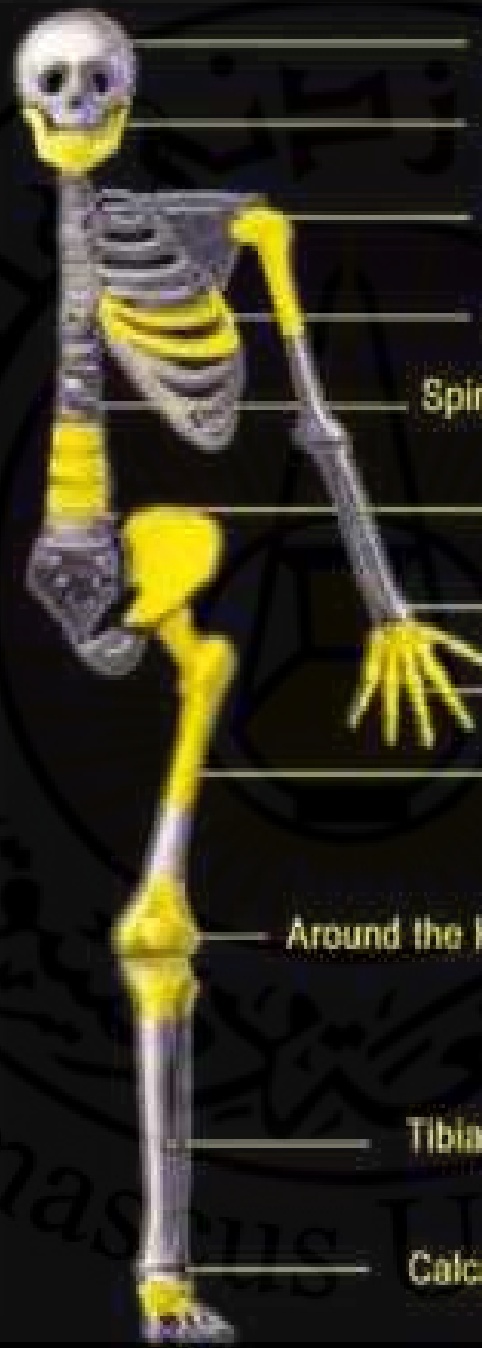
Well-defined
non-sclerotic
margin



Margin 1C

ill-defined
margin





Skull: EG, mets, myeloma

Mandible: Adamantinoma, dentogenic cyst

Humerus: All, SBC

Ribs: Mets, Enchondr, Chondrosarc, Ewing

Spine: Mets, Myeloma, Osteoblastoma, Chordoma
Hemangioma, ABC, Osteoid osteoma,

Pelvis: Osteosarcoma, Chondrosarc, SBC
Lymphoma, Ewing, EG, Chordoma

Distal radius: GCT, EG

Hands: Enchondroma,

Prox Femur: SBC, FD, Enchondroma
Ewing, EG

Around the Knee: All, Osteosarc, Ewing,

Tibia shaft: NOF, FD, Adamantinoma
Osteoid osteoma

Calcaneus: SBC, Ewing, Osteoblastoma
Chondroblastoma



- **Simple bone cyst** : a well-defined lytic lesion in the calcaneus.
- **Enchondroma** : a well-defined expansile lytic lesion in the hand +_ calc.
- **Chordoma** : an aggressive lytic lesion in sacrum in an adult.



- **Chondroblastoma** : a well-defined lytic lesion in the epiphysis of a child.
- **Exostosis / osteochondroma** : a well-defined exophytic / pedunculated lesion extends from the metaphysis, and directed ...
- **Simple bone cyst** : a well-defined lytic lesion in diaphysis with ... sign.



Metaphysis / diaphysis.

- Eccentric in long bone :

FCD / NOF, osteosarcoma, chondroblastoma, GCT, chondromyxoid fibroma and osteoblastoma are located eccentrically in long bones.



Metaphysis / diaphysis.

Juxtacortical



Cortical

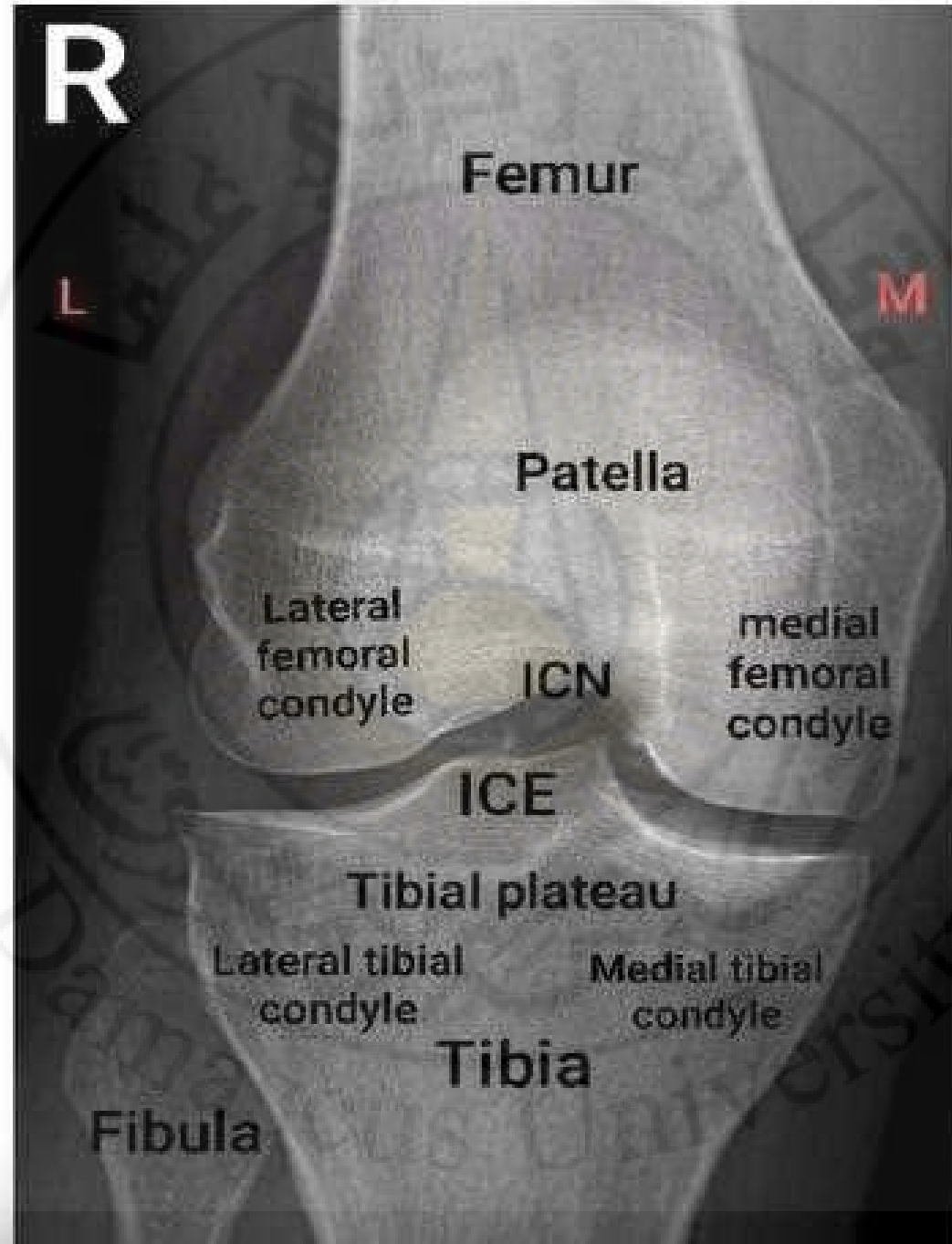


Eccentric



Centric





ICN – Intercondylar notch

ICE – Intercondylar eminence

Radiological signs of OA of knee

- **Join space narrowing**
- **Presence of osteophytes**
- **Subchondral sclerosis**
- **Subchondral cyst formation**

Joint space narrowing and osteophytes



**Osteophyte
formation**

**Loss of joint
space**

Subchondral

**Subchondral
cysts (geodes)**



Grading of the knee osteoarthritis

• Kellgren lawrence grading system

- **grade 0 (none):** definite absence of x-ray changes of osteoarthritis
- **grade 1 (doubtful):** doubtful joint space narrowing and possible osteophytic lipping
- **grade 2 (minimal):** definite osteophytes and possible joint space narrowing
- **grade 3 (moderate):** moderate multiple osteophytes, definite narrowing of joint space and some sclerosis and possible deformity of bone ends
- **grade 4 (severe):** large osteophytes, marked narrowing of joint space, severe

Grade 0

**No joint space
narrowing or
reactive changes.**



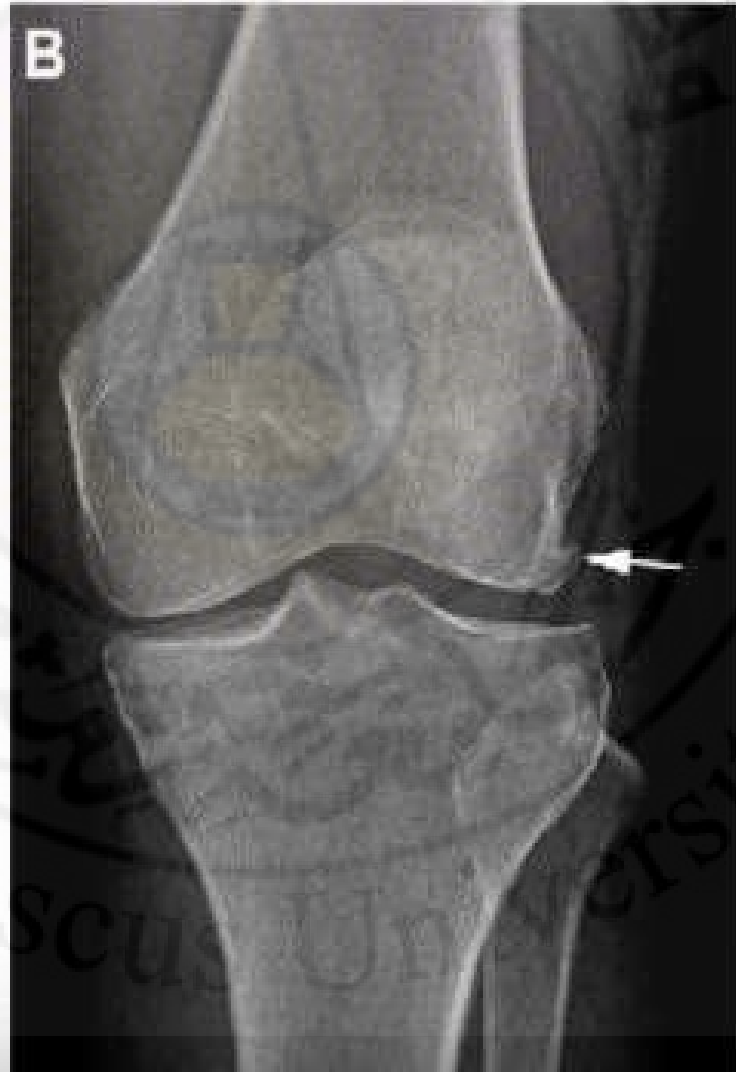
Grade 1 (Doubtful OA)

Doubtful joint space narrowing with possible osteophyte lipping.



Grade 2 (Mild OA)

**Definite osteophytes,
definite narrowing of
the joint space.**



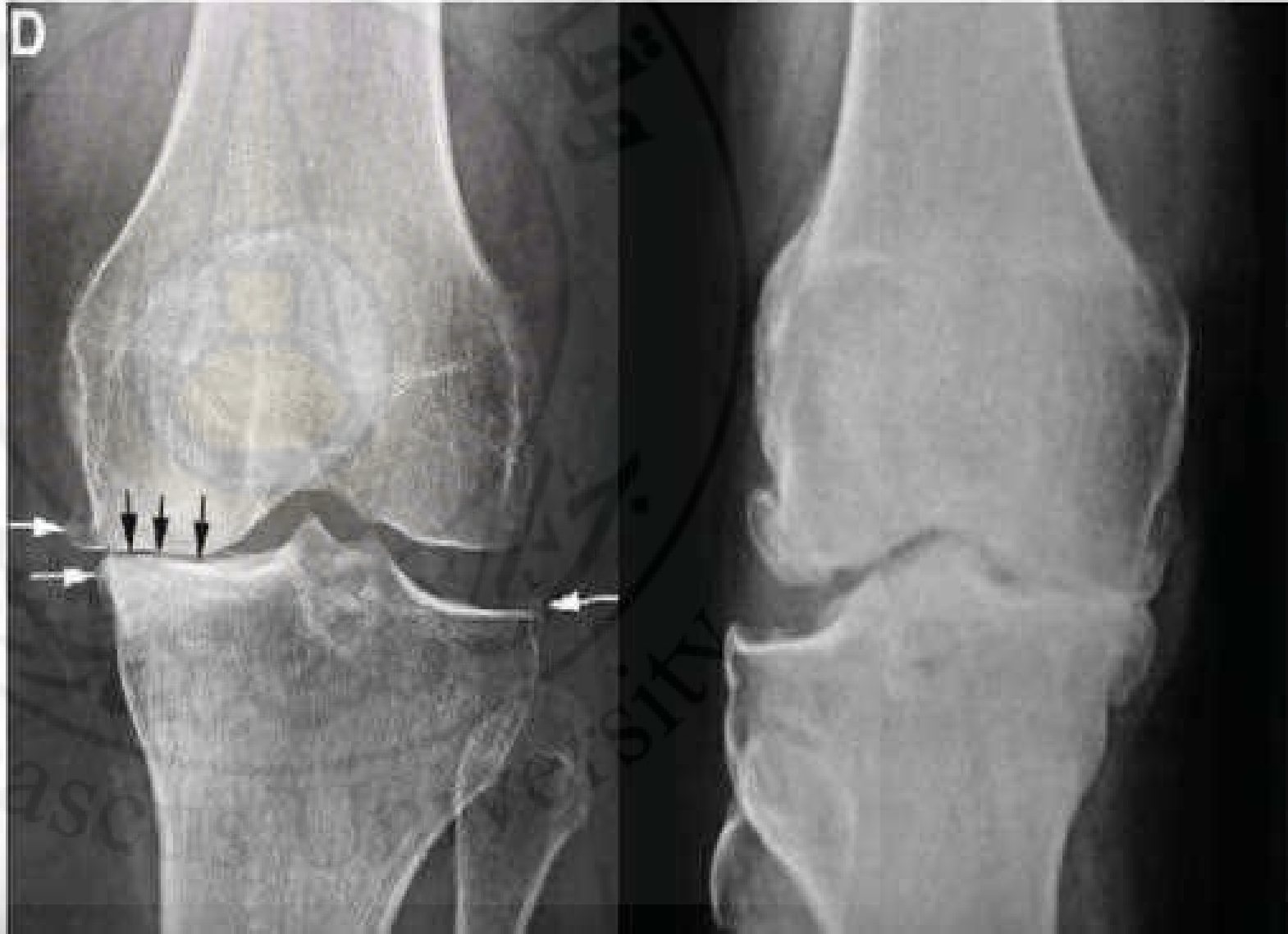
Grade 3 (Moderate OA)

Multiple osteophytes, definite narrowing of the joint space, some sclerosis, possible deformities of bone ends.



Grade 4 (Severe OA)

Large osteophytes, marked joint space narrowing, severe sclerosis and definite bone end deformity.



Fracture :-

interruption of the continuity of part of the skeletal system (= broken bone).

A fracture is either **complete** break in the continuity of a bone OR **incomplete** break.

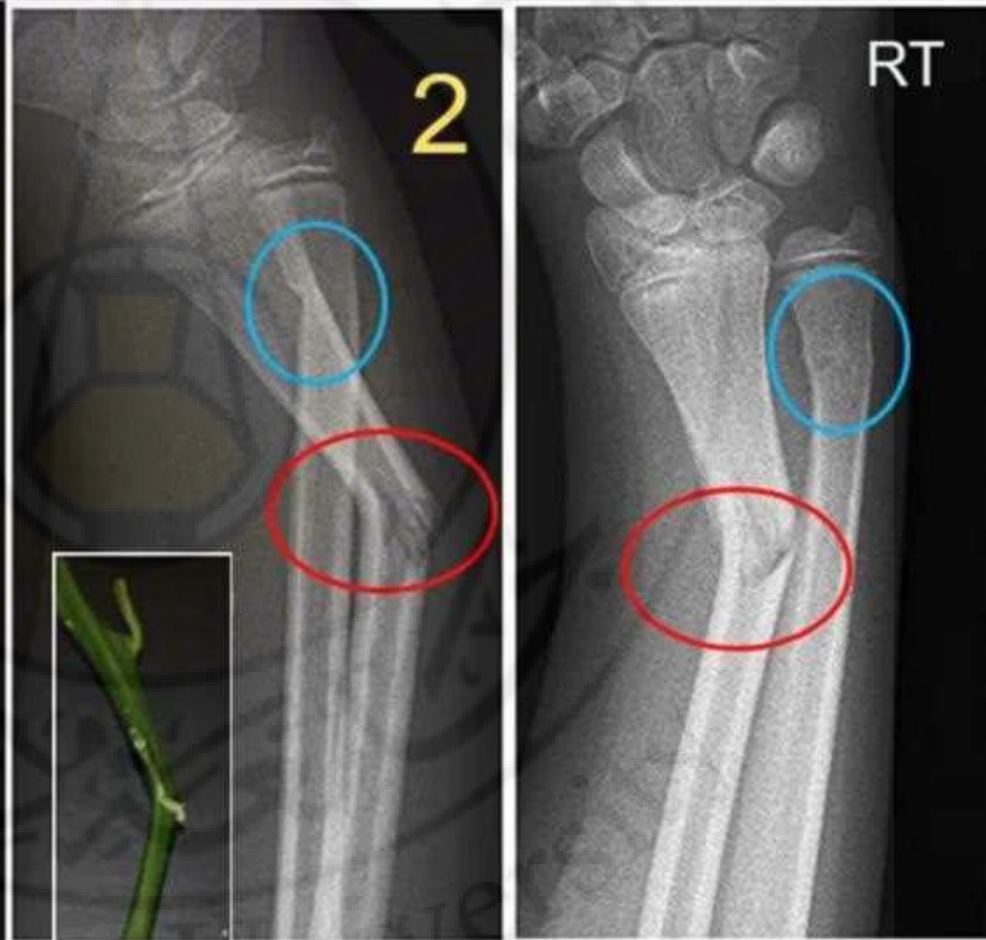


Incomplete fracture.

- _ Greenstick # (in **Red** circle)
- _ Torus # (in **Blue** circle)
- _ Others.

It occurs mainly in children due to soft bones.

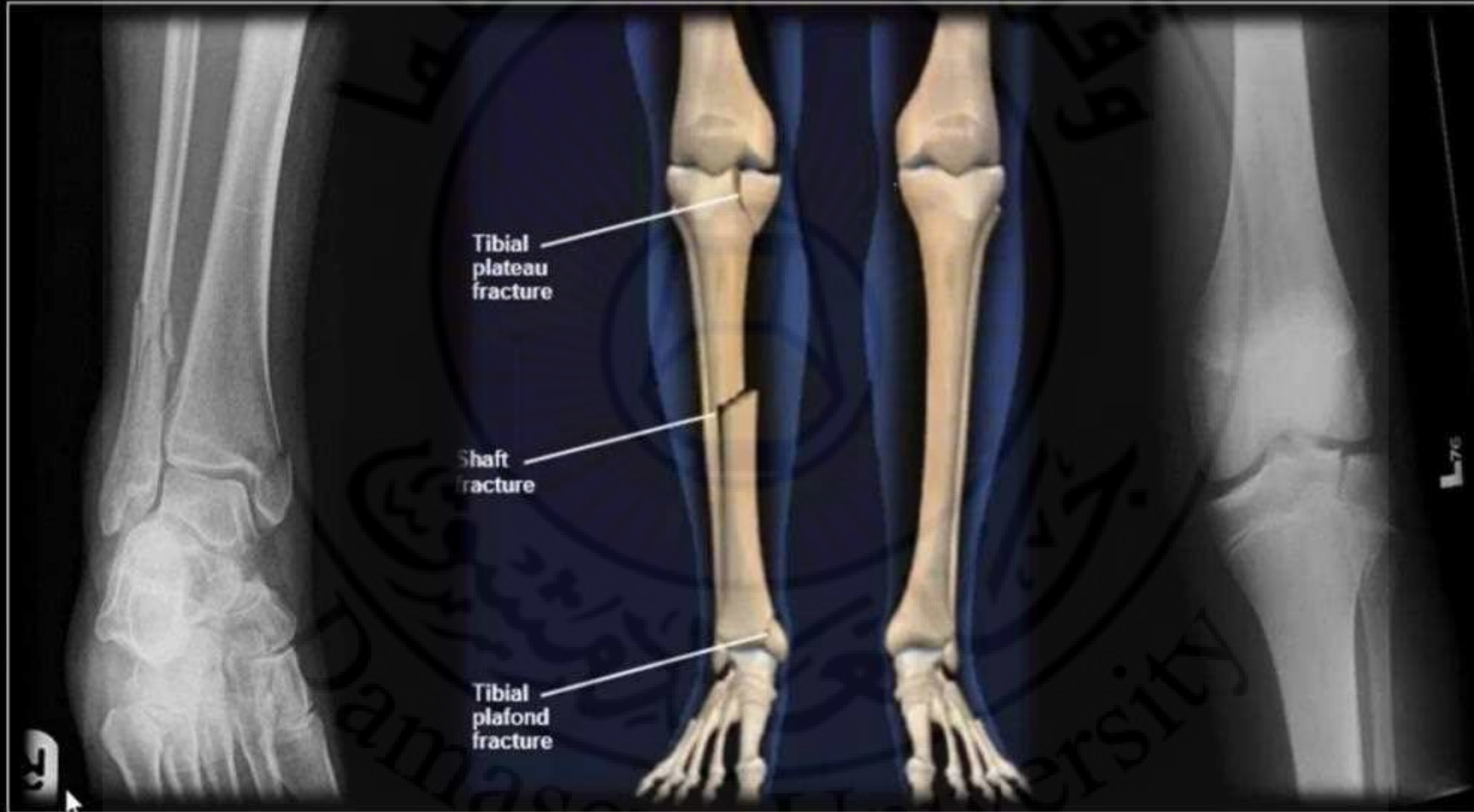
In adults incomplete # may be seen in Non-traumatic conditions, like looser zone of ...



Complete fracture.

It occurs in both age groups,
_ adults (Mature skeleton) and
_ children (Immature skeleton).





➤ In acute traumatic fractures, comment on :

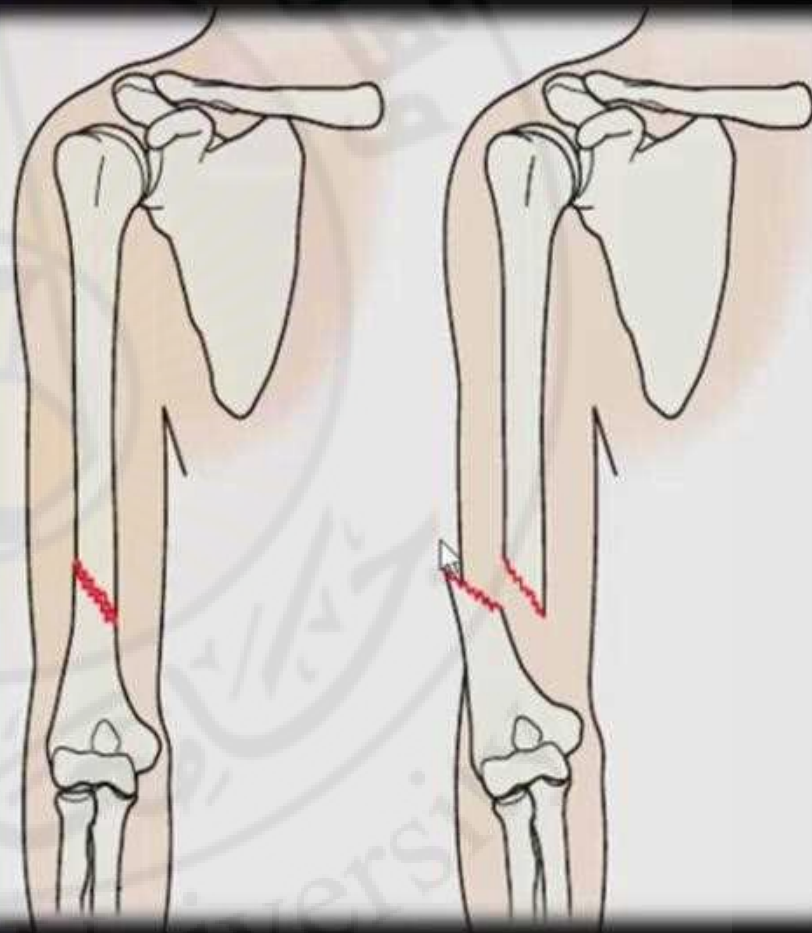
❑ Site / Location of #

❑ Closed OR open #

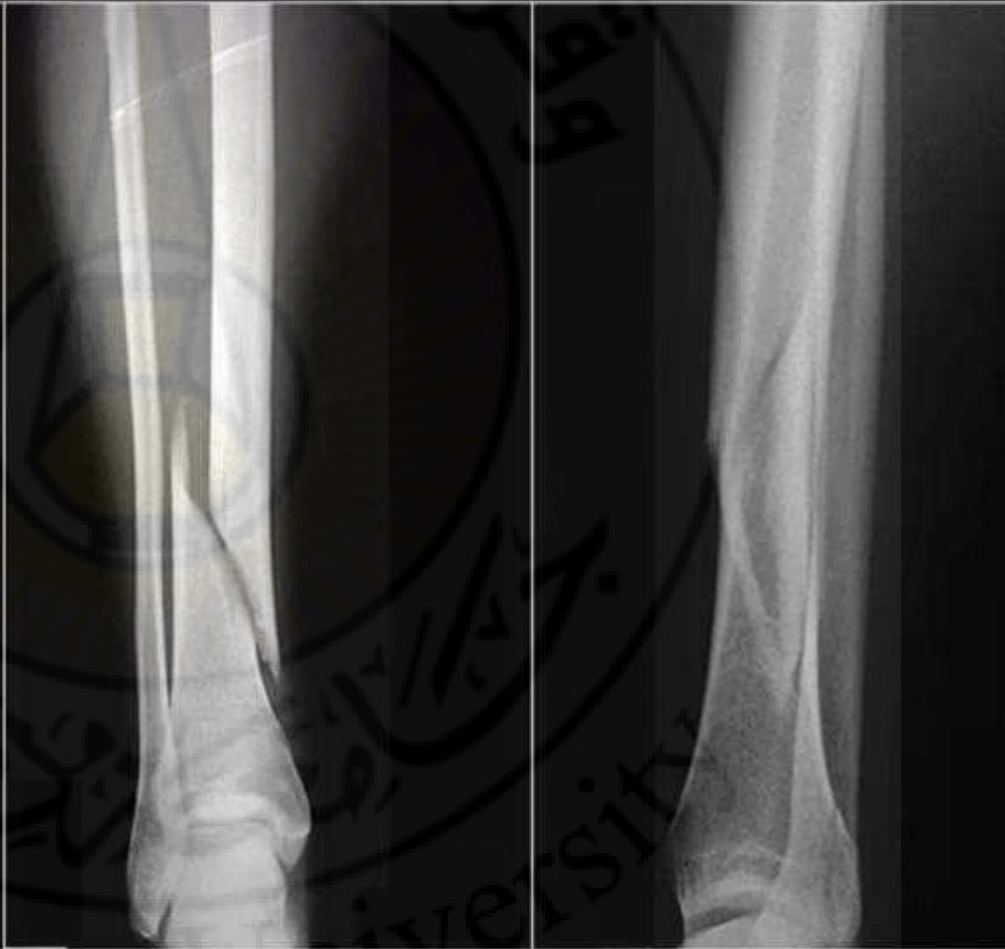
- Closed # : no communication between fracture and skin surface, OR
- Open/Compound # : wound extends from skin surface to fracture.

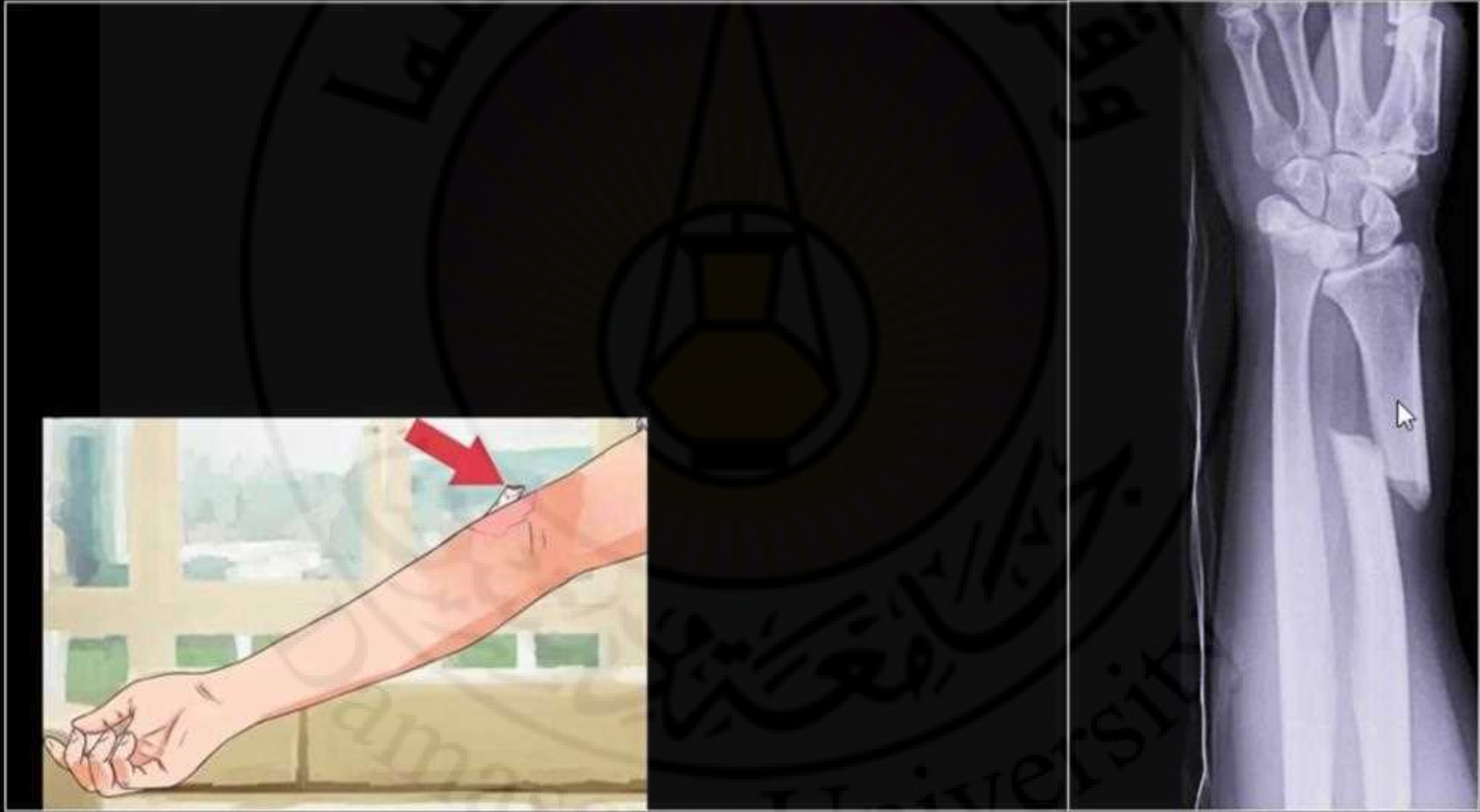
Closed or open.

- Closed: the fracture has not punctured the skin; no open wound (left).
- Open: the bone has pierced the skin (right). Also referred to as a compound fracture.



- Closed fracture,
not reaching overlying skin.







Thank you

Liver imaging

DR. MUHANNAD IBRAHIM

DIAGNOSTIC RADIOLOGIST

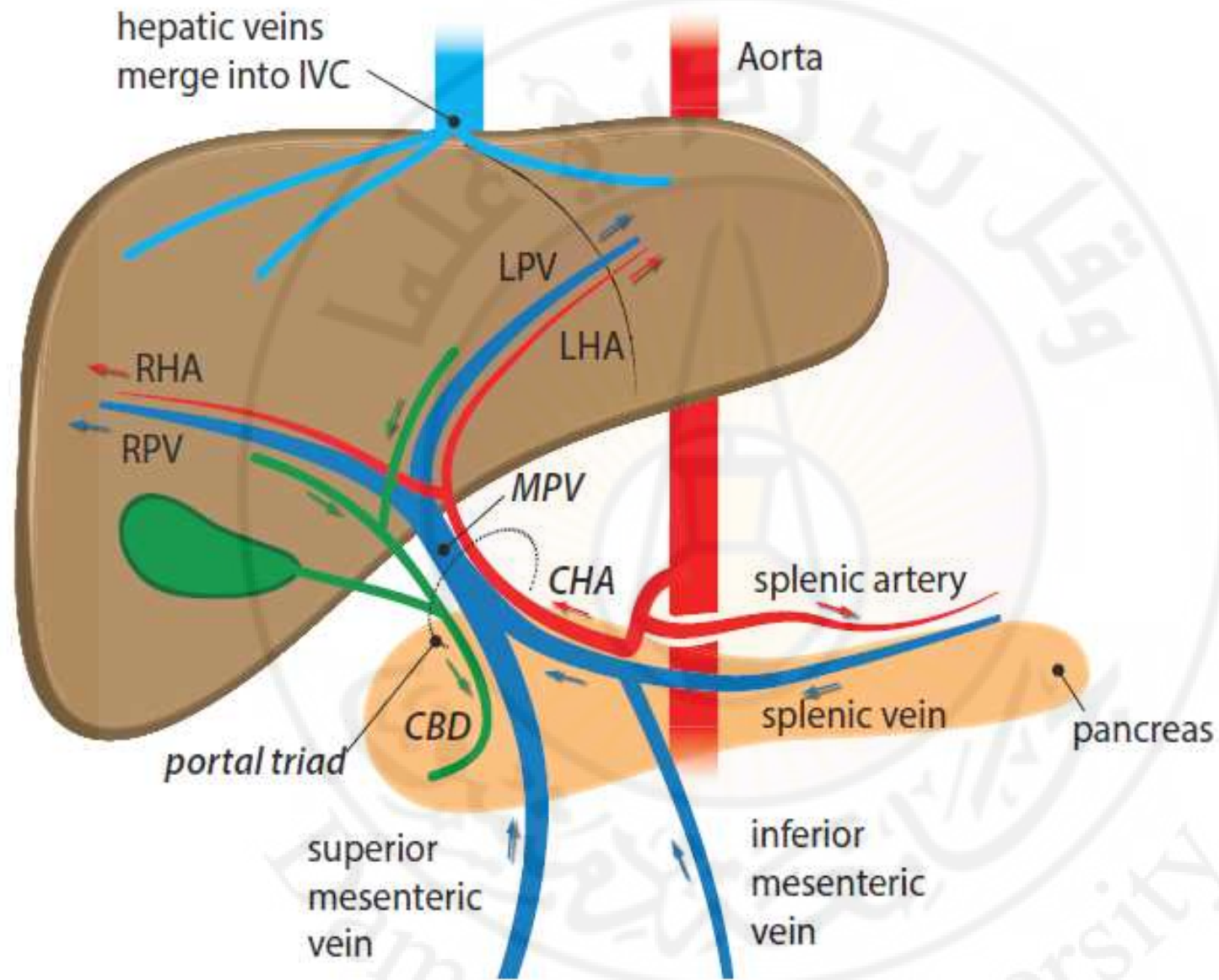
HEAD DEPARTMENT OF INTERVENTIONAL
RADIOLOGY,

TISHREEN MILITARY HOSPITAL



Indications for hepatic ct

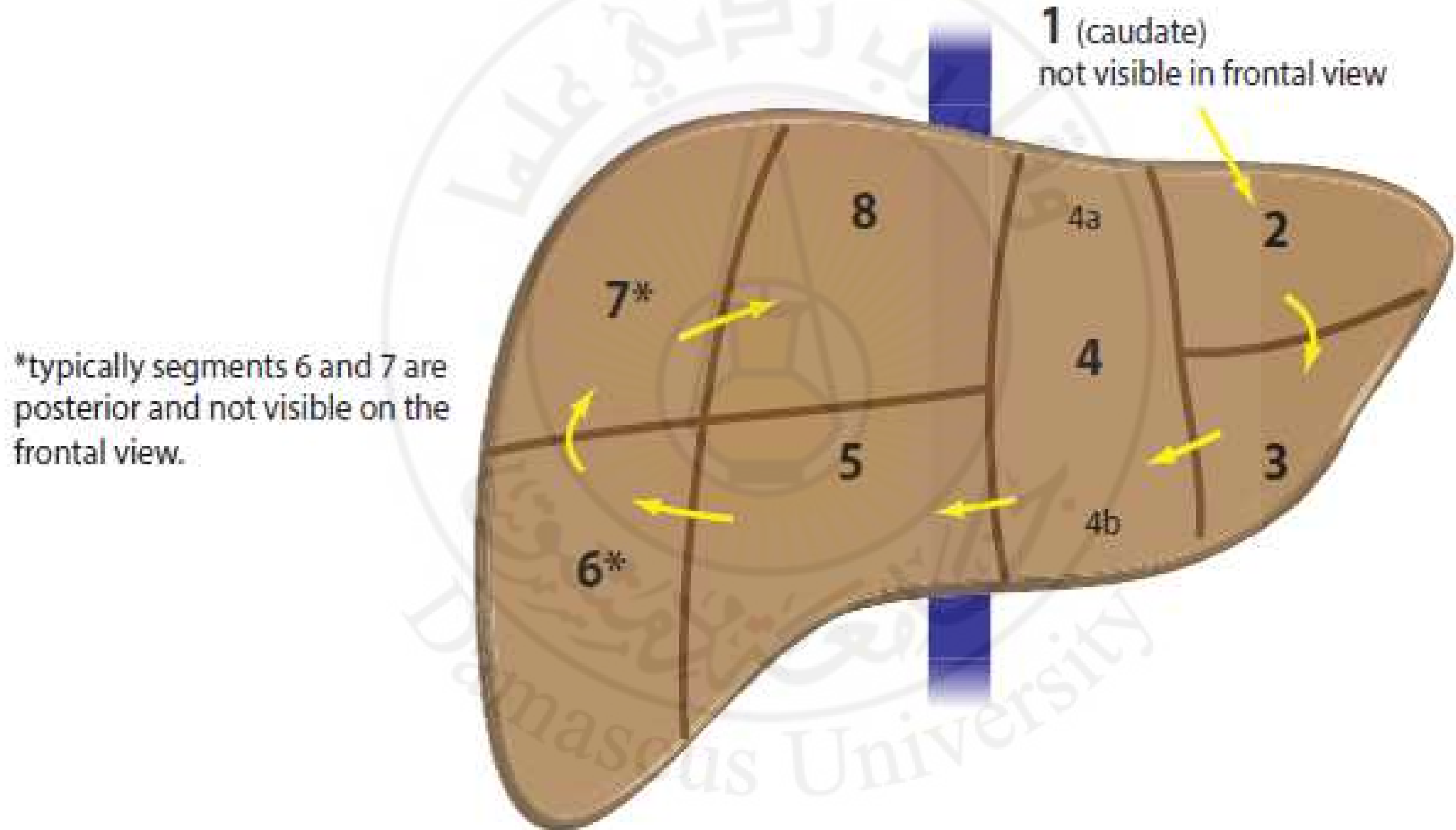
- ❖ To assess equivocal imaging findings .
- ❖ Staging of hepatic neoplasms .
- ❖ Metastatic workup of primary malignancies .
- ❖ Diagnosis of diffuse hepatic diseases .
- ❖ Assessment of biliary disease and tumor .
- ❖ Congenital anomalies
- ❖ Assessment of suspected post traumatic injury .

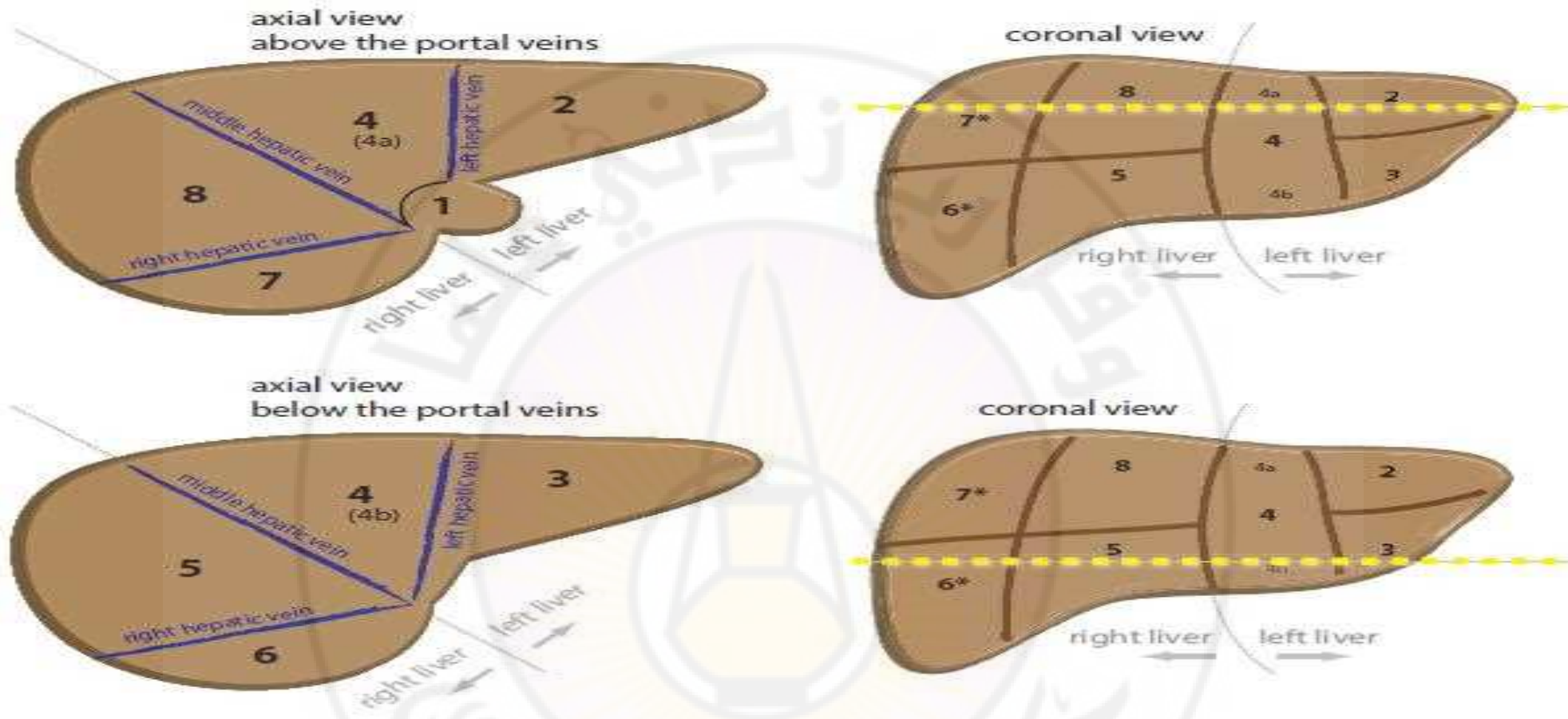


*RHA = right hepatic artery
LHA = left hepatic artery
CHA = common hepatic artery
RPV = right portal vein
LPV = left portal vein
MPV = main portal vein*

Anatomy

Numbering of hepatic segments is clockwise when looking at a frontal/coronal view.

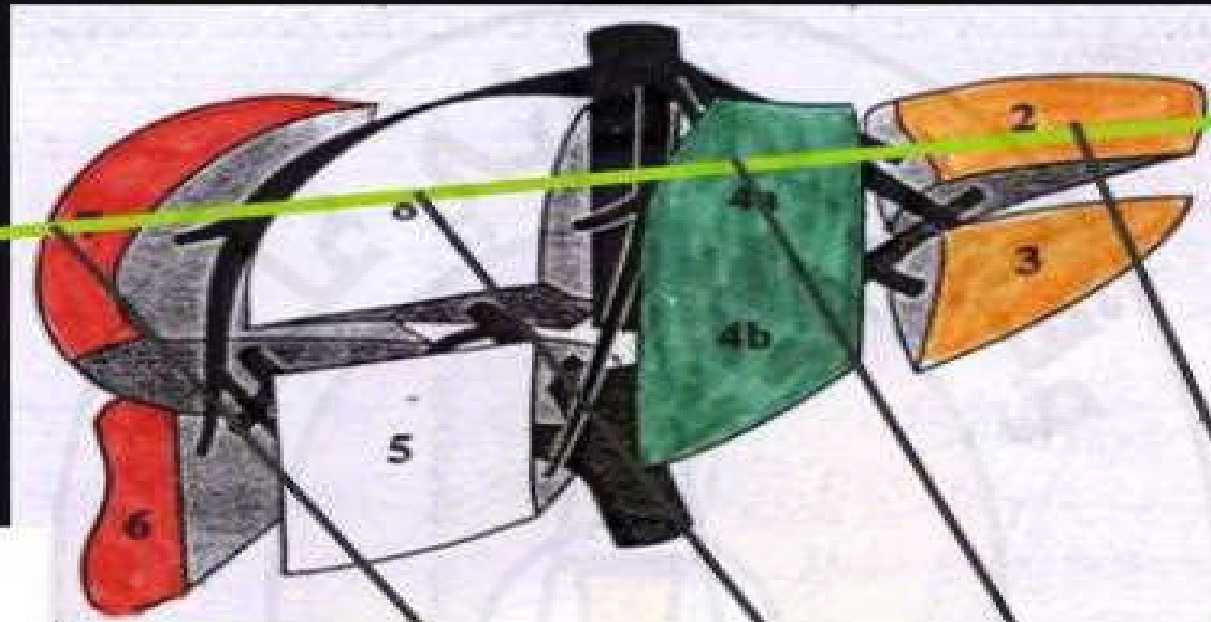
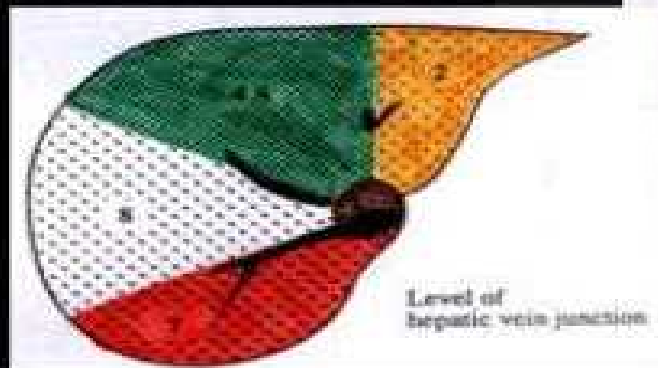




The portal veins divide the superior from inferior segments, while the hepatic veins form the segmental borders in the axial plane. The middle hepatic vein divides the left (segments 2–4) from right (segments 5–8) lobes of the liver.

Each hepatic segment features its own:

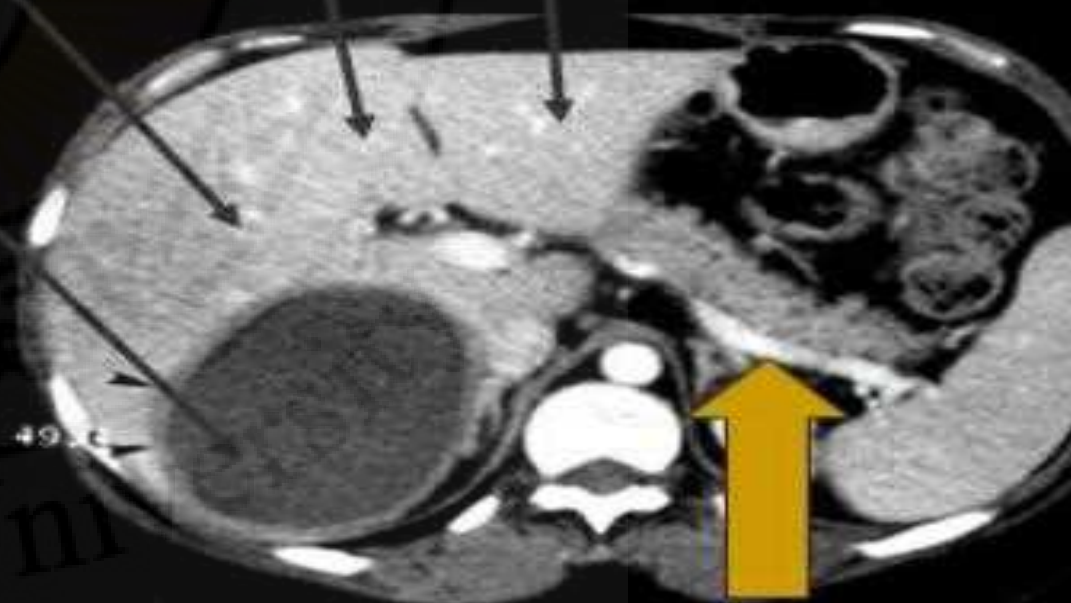
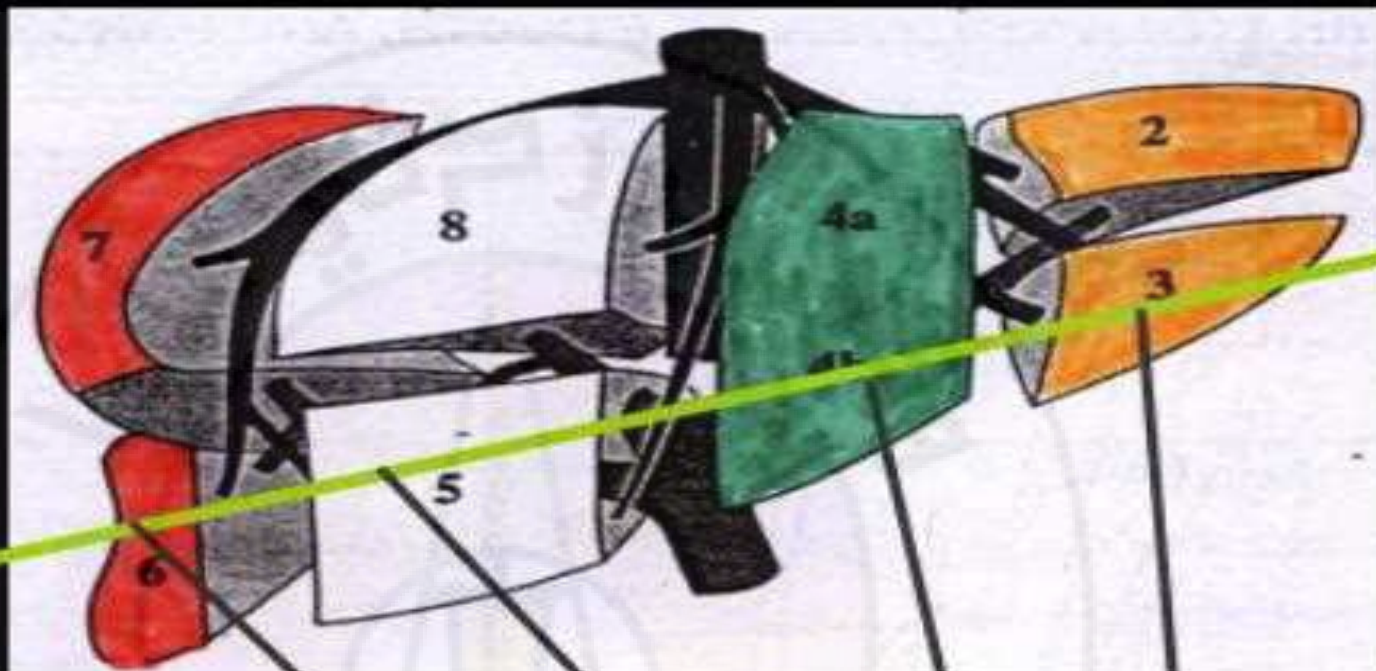
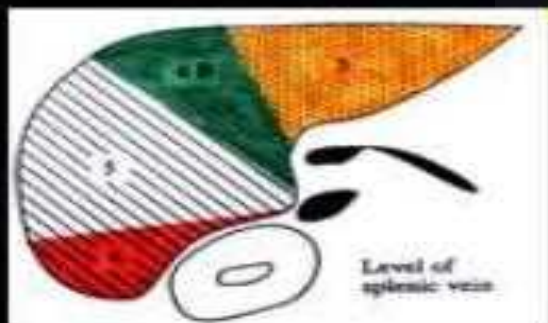
Central portal triad made up of a portal vein, hepatic artery, and bile duct, with peripheral venous drainage to the hepatic veins and ultimately the IVC.



**Superior
segments**



Inferior segments



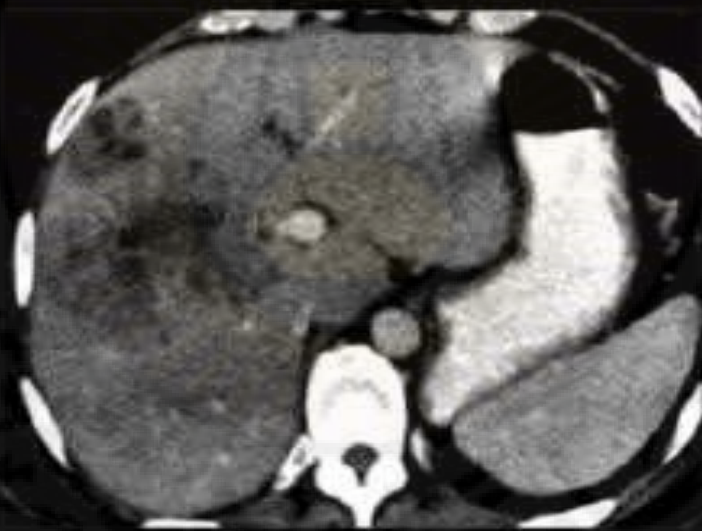
Hepatic pathology

Benign lesions



- ♦ Liver cysts.
- ♦ Hemangioma.
- ♦ Adenoma.
- ♦ Focal nodular hyperplasia.

Malignant lesions



- ♦ Hepatocellular carcinoma.
- ♦ Fibrolamellar carcinoma.
- ♦ Hepatoblastoma.
- ♦ Metastasis.

Diffuse lesions



- ♦ Fatty liver
- ♦ Cirrhosis
- ♦ Storage diseases

Hepatic pathology

Focal lesions



Cystic

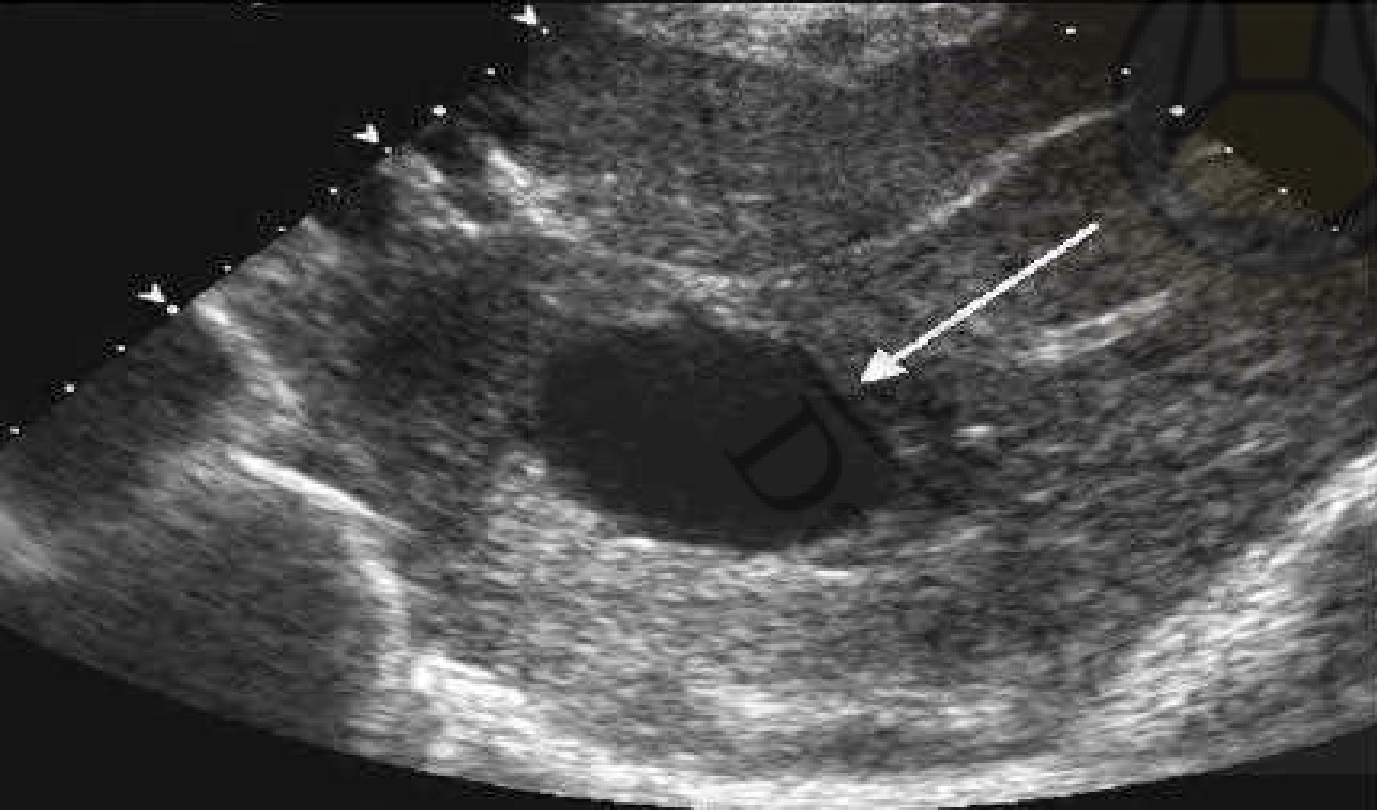
- ◆ Simple cyst
- ◆ Abscess
- ◆ Hydatid cyst
- ◆ Hemangioma

Rare

Biliary
cystadenoma

Hepatic cysts

- ◆ Congenital lesions but detected late
- ◆ Isolated or associated with congenital cystic disease
- ◆ Usually asymptomatic
- ◆ Complications [rupture or haemorrhage] lead to symptoms
- ◆ Few mms to several cms in size



Typical cyst criteria

- Sharply defined margin
- Has no measurable wall.
- Clear water contents 0-15 HU

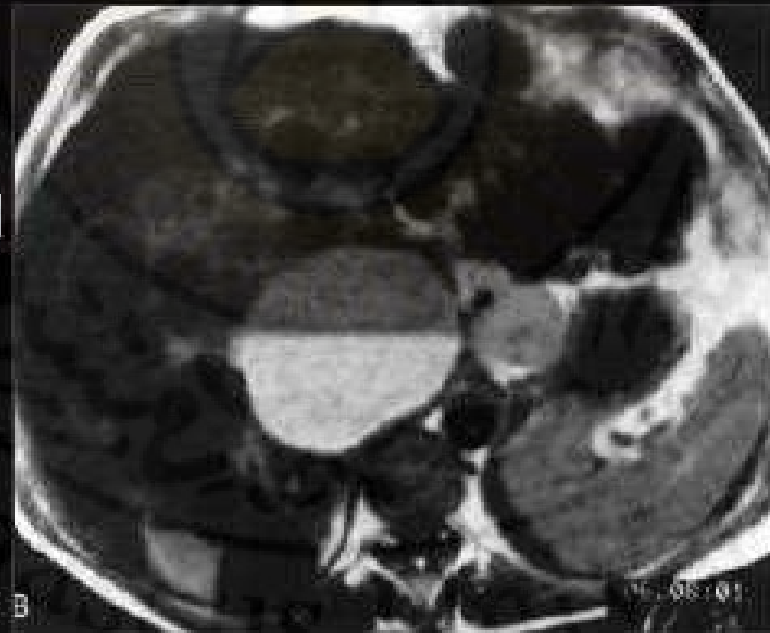
■ **NO**

Septations
Calcification
Enhancement
Mural nodules



Atypical cyst criteria

- ◆ Thick enhancing margin [abscess]
- ◆ Abnormal contents [hemorrhage]
- ◆ Presence of
 - Septations
 - Calcification [hydatid]
 - Enhancement
 - Mural nodules [neoplasm]



Hepatic abscess [Pyogenic]

- ◆ Frequently indolent with no signs of infection
- ◆ May present with profound septicemia
- ◆ Micro abscesses (>2cm) cluster or scattered
- ◆ Macro abscesses :Unilocular or multilocular
- ◆ Marginal enhancement 6% ?!
- ◆ Gas containing abscesses uncommon





Pyogenic hepatic abscess associated with basal pneumonia and abscess

Hepatic abscess [Amebic] *Entamoeba Histolytica* 10% world wide

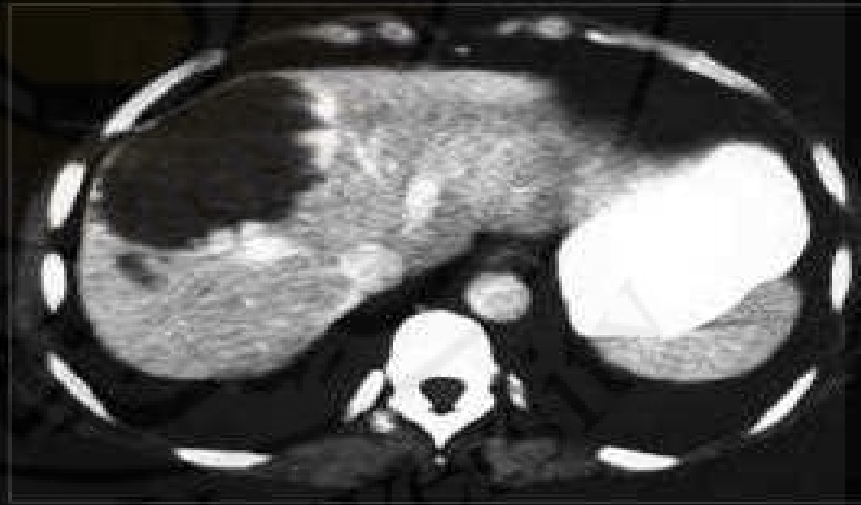
- ♦ Patients are more often acutely ill
- ♦ Single or multiple near the liver capsule
- ♦ Enhancing wall is evident with peripheral zone of edema [Common in amebic abscess]

Amebic hepatic abscess



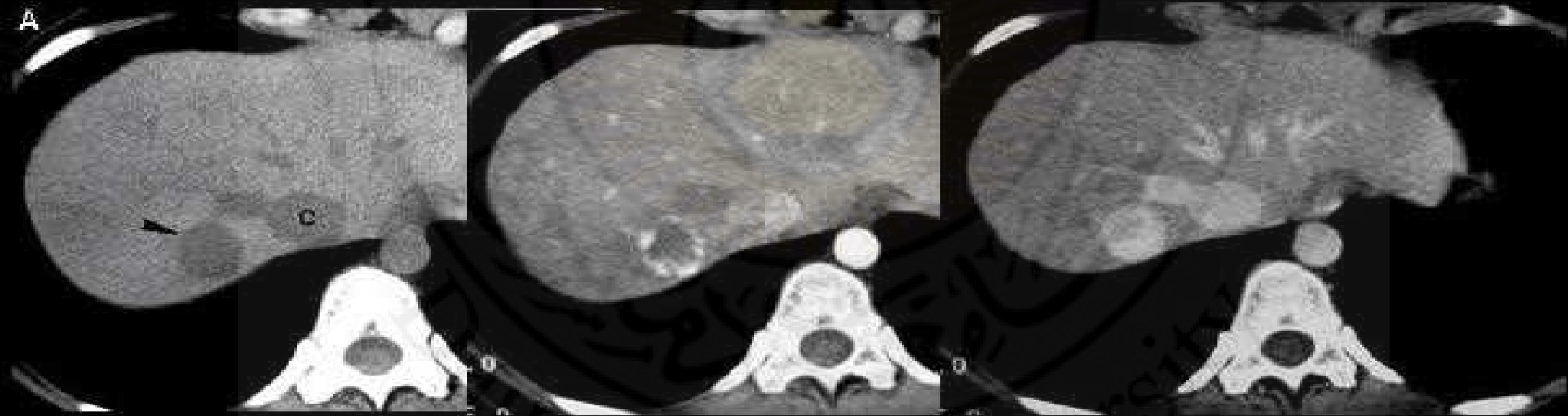
Hemangioma

- ◆ The most common benign liver tumour.
- ◆ 20% of hepatic tumors Female: male = 5:1
- ◆ 85% are asymptomatic 50% are multiple
- ◆ Giant hemangioma More than 5 cm in diameter

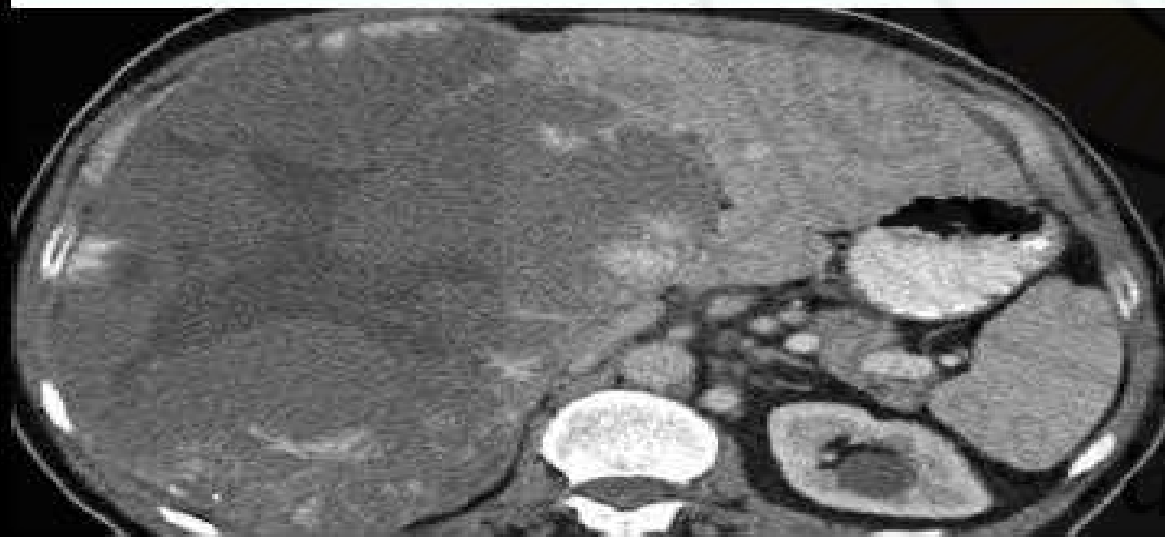


Hemangioma

- ◆ **Non contrast** well defined hypo dense lesion ,10% of cases shows calcification
- ◆ **Contrast enhancement** peripheral nodular enhancement on late imaging

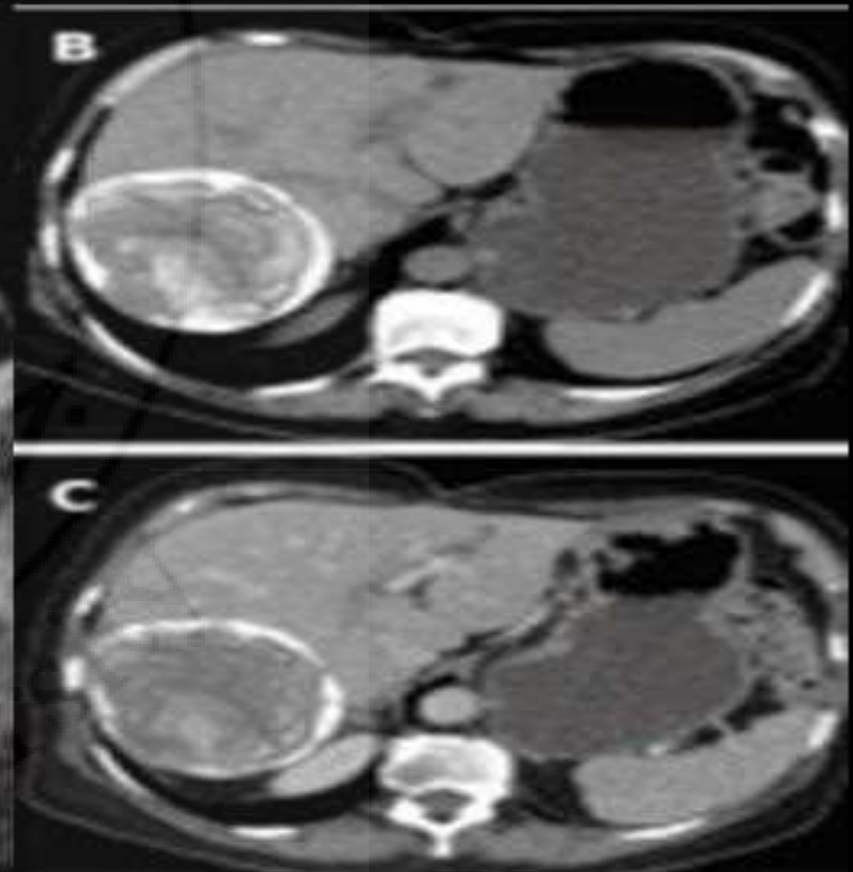
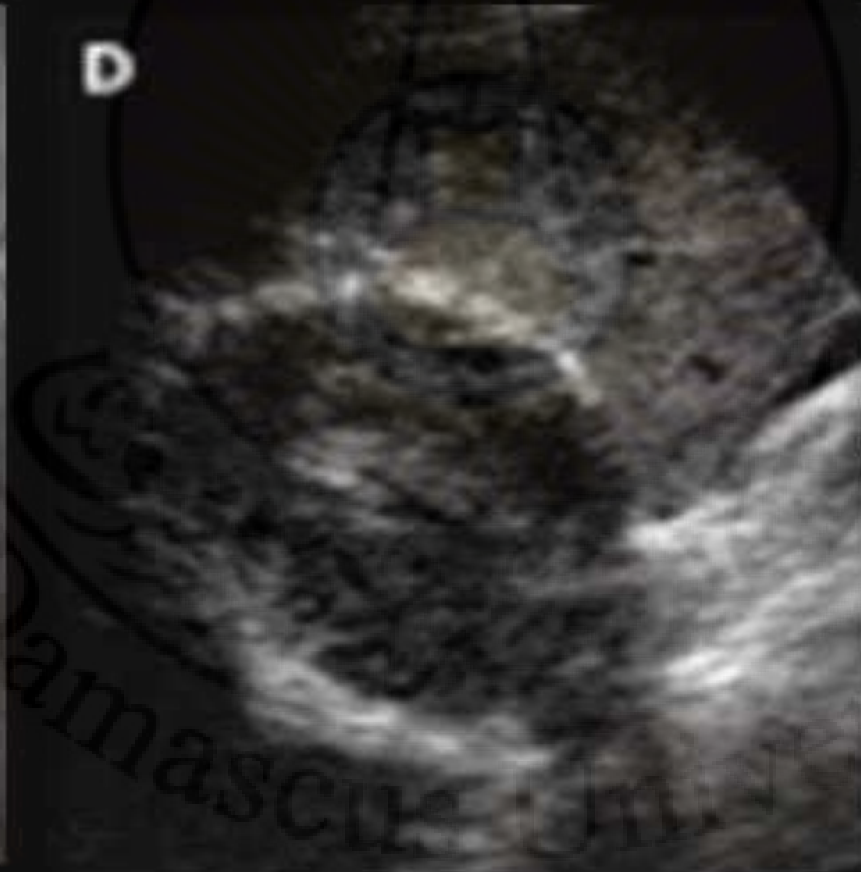


Giant Hemangioma (more than 5 cm)



Echinococcal disease [Hydatid cyst]

- ♦ Larval stage of *E. granulosus*
- ♦ Well defined unilocular or multilocular cyst
- ♦ Central and peripheral **calcification**
- ♦ Daughter cysts can be inside the large cyst

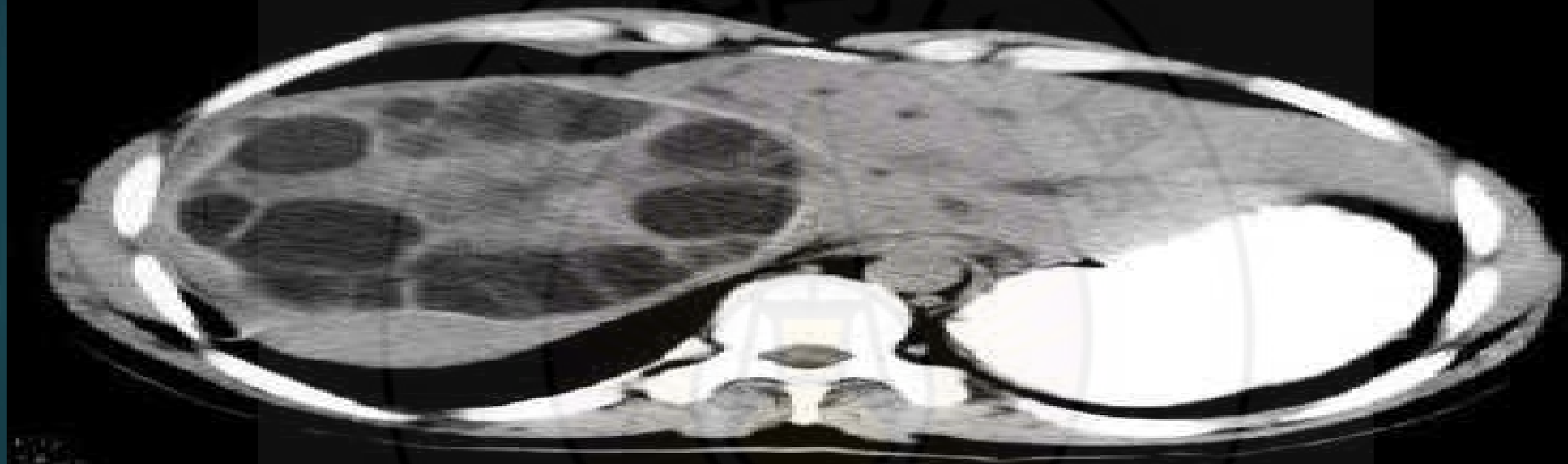


Hydatid cyst after treatment with rupture and floating shadows





Hydatid cyst



Imaging features for hydatid cyst diagnosis

- ◆ Other cysts specially in the lung
- ◆ Unilocular or multilocular cyst with marginal calcification
- ◆ Internal floating shadows
- ◆ Daughter cysts within the large cyst

Malignant cystic lesions

- ♦ Biliary cyst adenoma / carcinoma
- ♦ Cystic deposits



Biliary cystadenoma

90% occur intrahepatic

With ovarian stroma [seen in females with **good** prognosis]

Without ovarian stroma [males and females with **bad** prognosis]

Biliary cystadenoma , carcinoma

- ♦ Large [3 – 40 cm] cystic **multilocular** tumor with mural nodule [seen better by US]
- ♦ Distinction between cystadenoma and cystadenocarcinoma may not be possible by imaging and is **not clinically critical**, both will be excised



Multilocular cyst in porta hepatis

Enhancing septae



Irregular cystic mass with thick septations

Useful cystic fluid analysis for CA 19-9 & CEA

Excision to prevent recurrence & **malignant transformation (25%)**



Multilocular cyst in porta hepatis

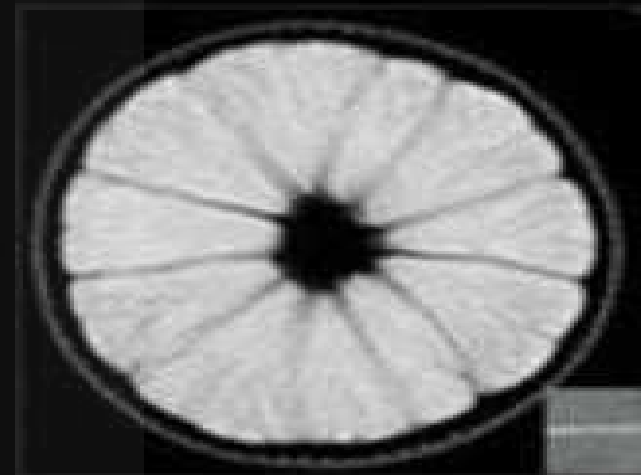
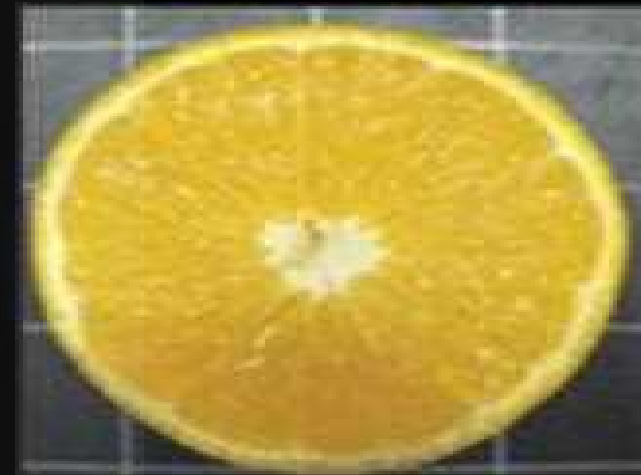
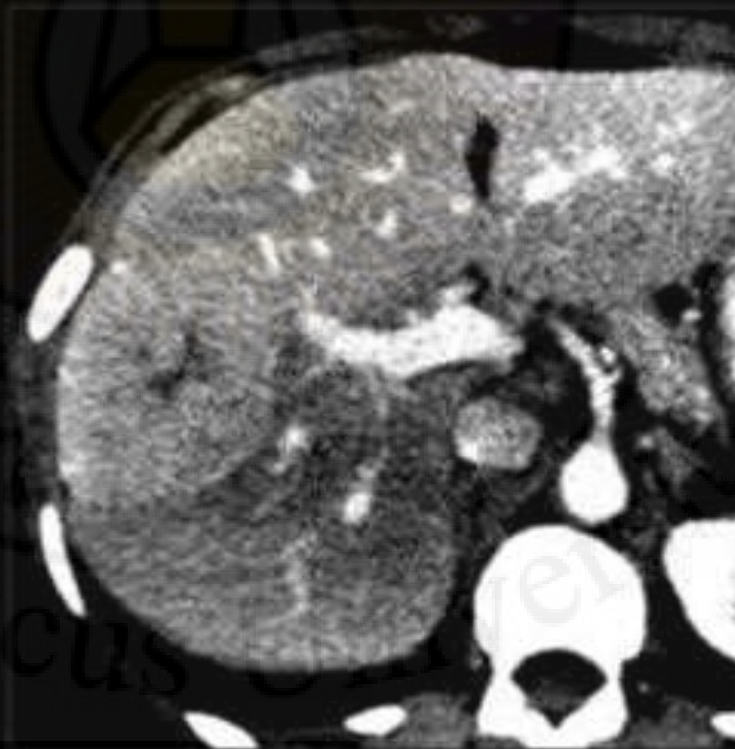
Enhancing septae

Multilocular cyst in porta hepatis

Mural calcification

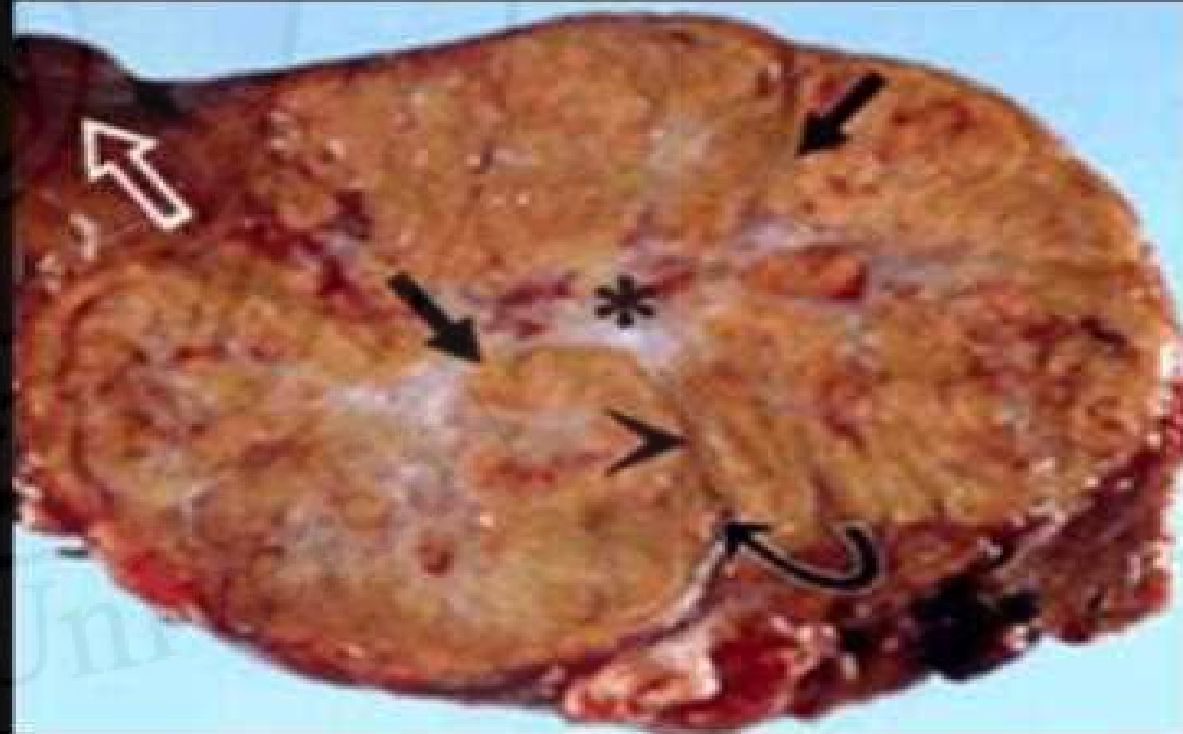
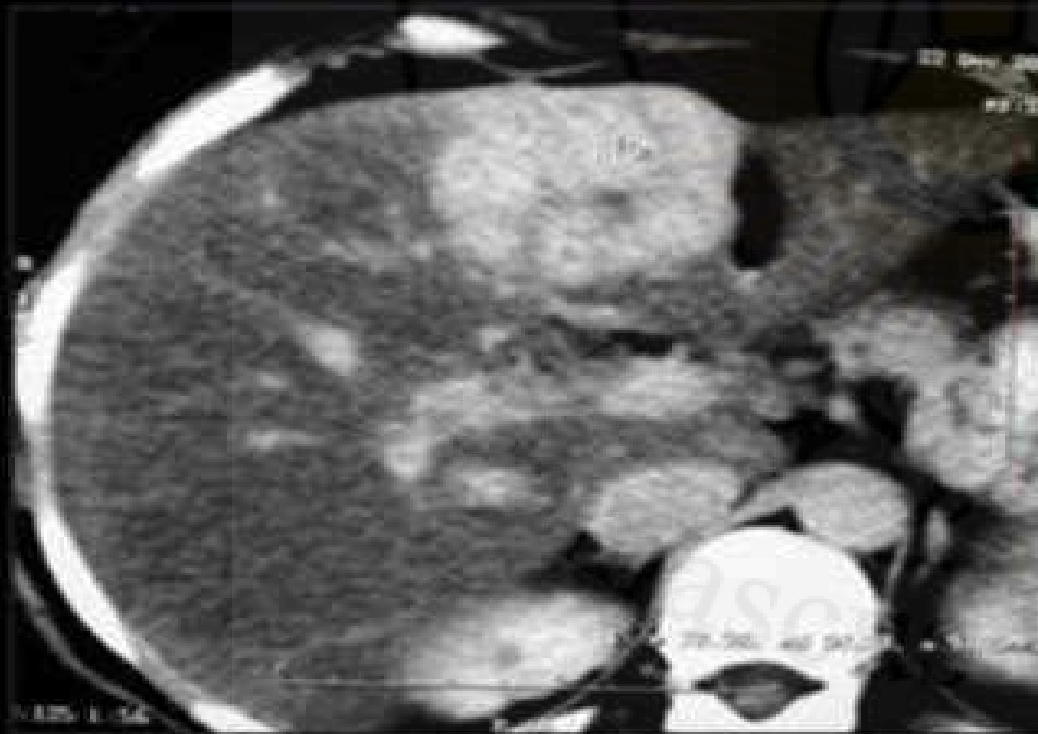
Benign solid lesions

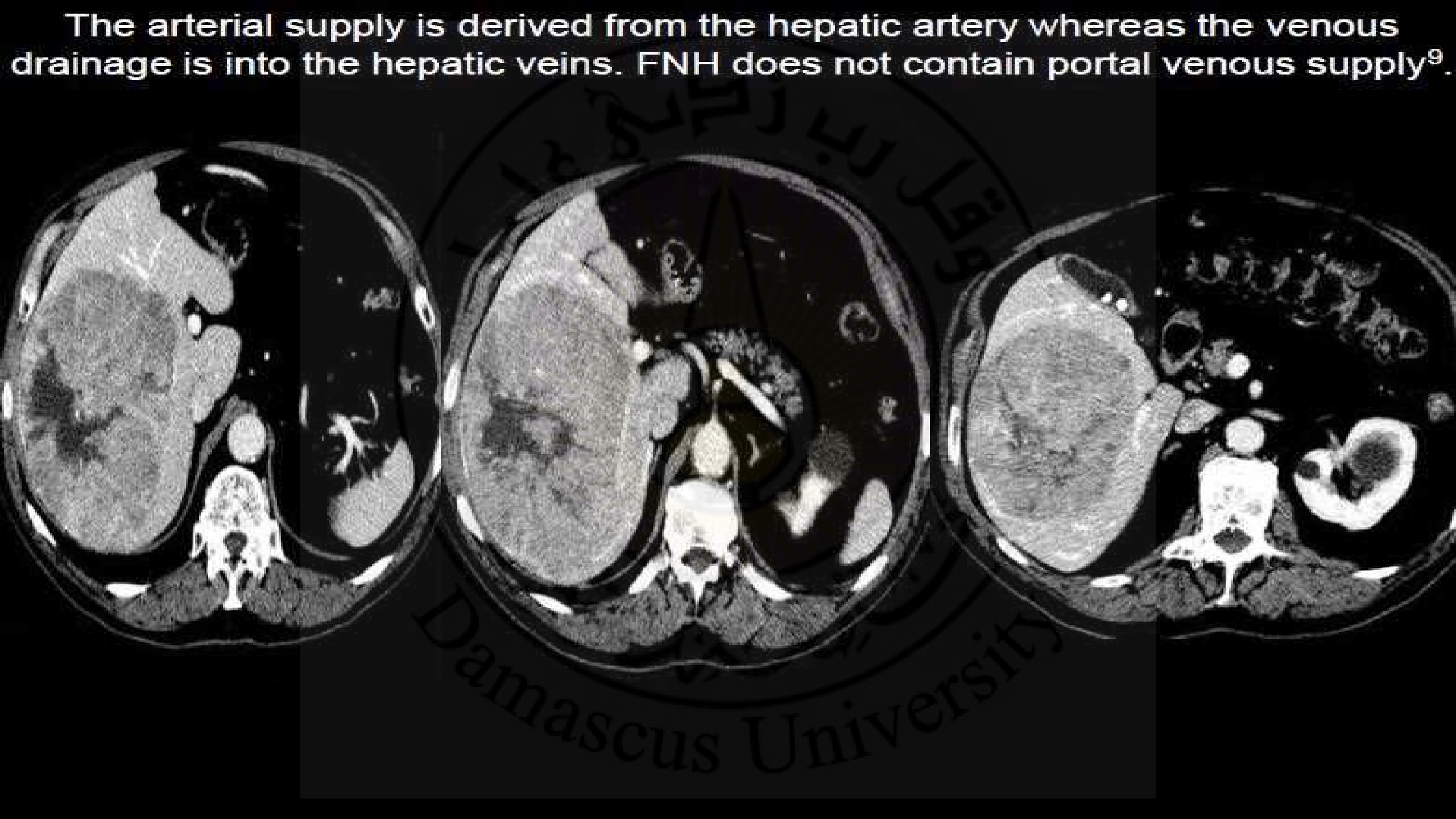
- ◆ Hepatic adenoma
- ◆ Focal nodular hyperplasia [FNH]
- ◆ Angiomyolipoma Fat containing lesion



FNH

- ◆ 8% of all hepatic tumours
- ◆ 2nd most common benign hepatic tumor after hemangioma
- ◆ 80%- 90% in women 3rd – 5th decades
- ◆ 80%- 90% are solitary lesions <5cm in diameter
- ◆ Central **fibrous scar** is a characteristic feature

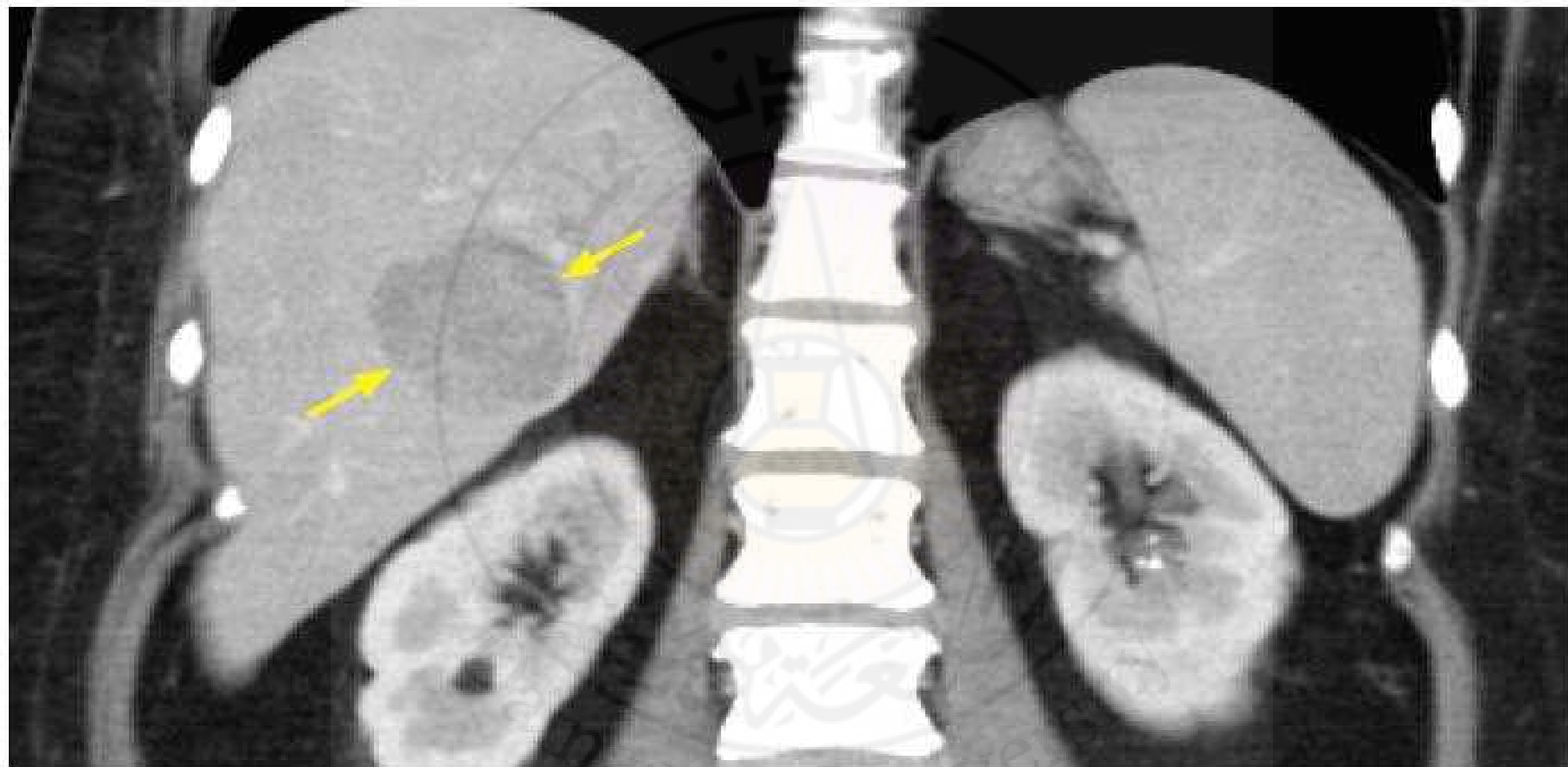




Hepatic Adenoma

Clinical features

- Benign neoplasm composed of normal hepatocytes no portal tract, central veins, or bile ducts
- More common in women
- Associated with contraceptive hormones
- Usually asymptomatic but may have RUQ pain
- May presents with rupture, hemorrhage, or malignant transformation (very rare)



Coronal portal venous phase contrast-enhanced CT demonstrates a heterogeneously enhancing hypoattenuating mass (arrows) in the liver, which is a nonspecific appearance.

Malignant Liver Tumors

1. Hepatocellular carcinoma (HCC)
2. Fibro-lamellar carcinoma of the liver
3. Hepatoblastoma
4. Intrahepatic cholangiocarcinoma
5. Others like lymphoma and metastasis

Hepatocellular carcinoma

- ◆ The most common primary malignant hepatic neoplasms
- ◆ 3rd – 4th decades Male: female 8:1
- ◆ 80% of HCC occur in cirrhotic liver
- ◆ Serum AFP and ultrasound [screening]



Hepatocellular carcinoma

- Single or multiple masses that are hypo dense to normal liver
- Calcification may be seen
- After contrast injection [**should be Triphasic study**]
 - ♦ **Arterial phase** : Very early arterial perfusion.
 - ♦ **Portal phase** : contrast washout

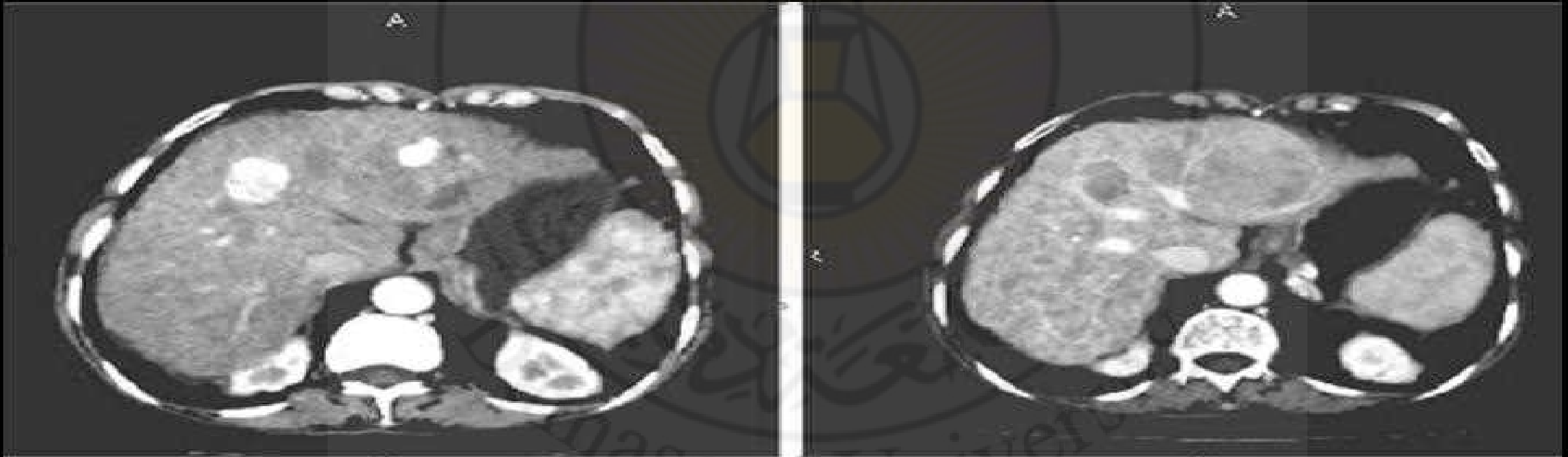
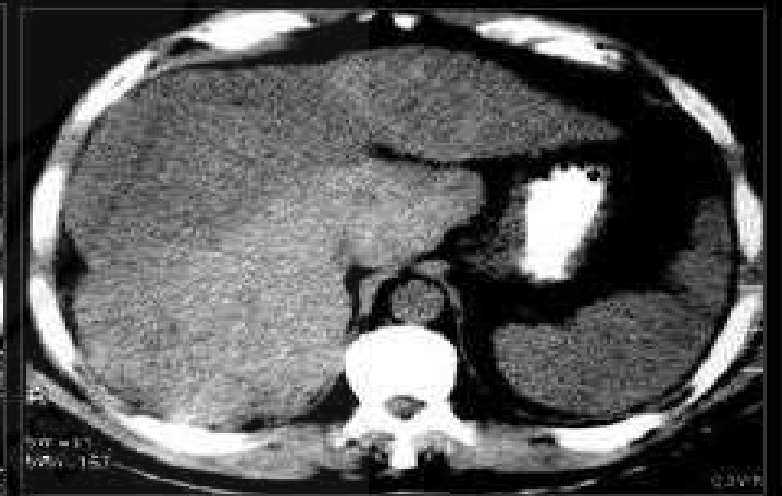


Figure-2: Hepatoma: Enhancing lesions in arterial phase with washout in portovenous phase.

Arterial phase

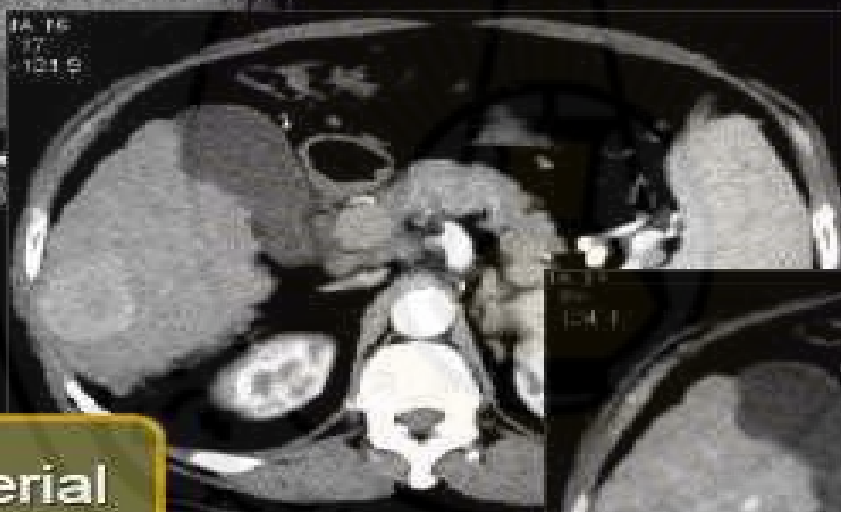
- ◆ Detects a greater number of HCC than usual scanning
- ◆ Detects intravascular thrombosis [portal vein]
- ◆ Better delineation of tumour capsule in capsulated lesions
- ◆ Detects early arteriovenous shunting [sign of malignancy]

CT





Delayed

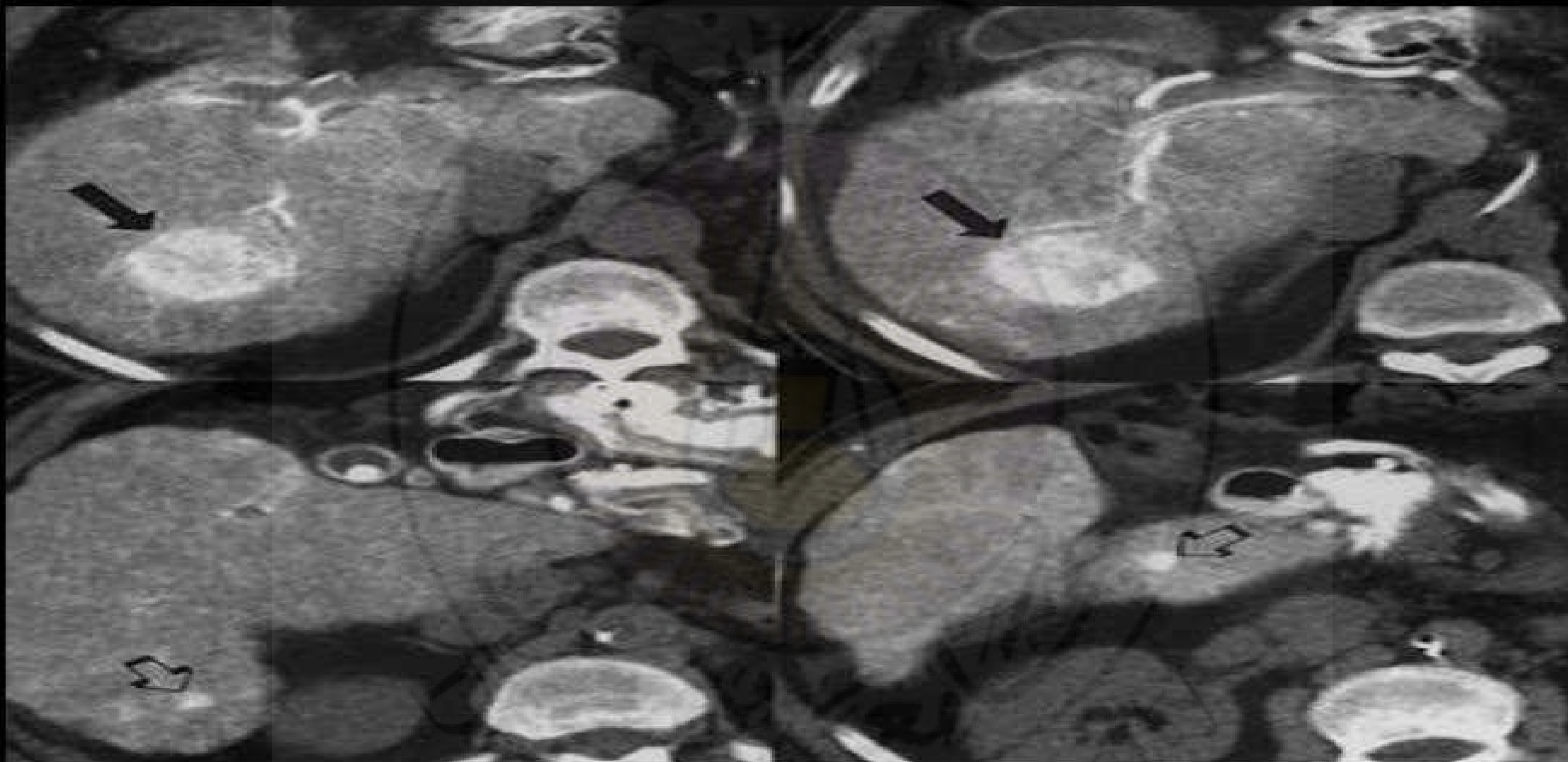


Arterial



Portal

M 59 Y with liver cirrhosis , splenomegaly and suspected focal lesion on US



Hepatocellular carcinoma

Hepatoblastoma

- ◆ The most common 1ry hepatic neoplasm in children below 5 years
- ◆ Usually presents with abdominal mass with elevated AFP
- ◆ Large diffuse or multifocal hypodense lesion is seen on CT
- ◆ Matrix calcification and septations may be seen



Cholangiocarcinoma

- ◆ The 2nd most common primary malignant tumor
- ◆ Arise from bile duct epithelium [3 TYPES]
 - ◆ Intrahepatic arises from **small ducts**
 - ◆ Or the **major ducts** near the helium
 - ◆ Or at the bifurcation of the **CHD** [Klatkin tumor



Cholangiocarcinoma

- ◆ Hypo dense lesion that shows heterogeneous enhancement
- ◆ Portal vein invasion is rarely seen
- ◆ Small dilated ducts around the lesion may be seen



Contrast-enhanced CT

Fibrolamellar carcinoma is a hepatocellular malignancy with clinical and pathologic features that are distinct from HCC. Tumors typically present as a large liver mass in an adolescent or young adult (mean age, 23 years) with none of the risk factors for HCC, and without elevation of AFP levels. Cords of tumor are surrounded by prominent fibrous bands that emanate from a central fibrotic scar. The surrounding liver is usually normal without features of cirrhosis or chronic liver disease. The characteristic appearance is a large, lobulated hepatic mass with central scar and calcifications. The central scar with radiating septa mimics the appearance of FNH.

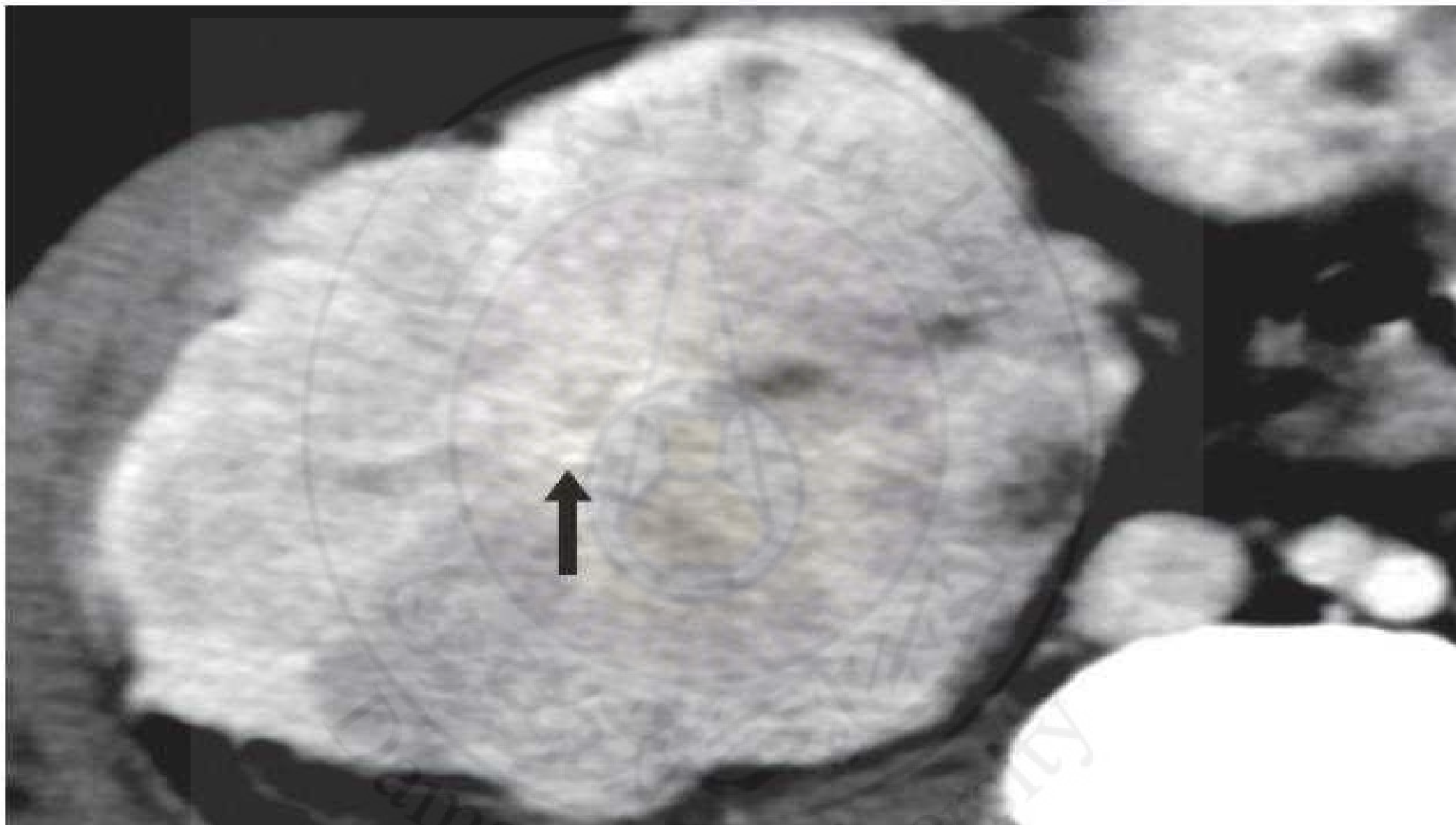
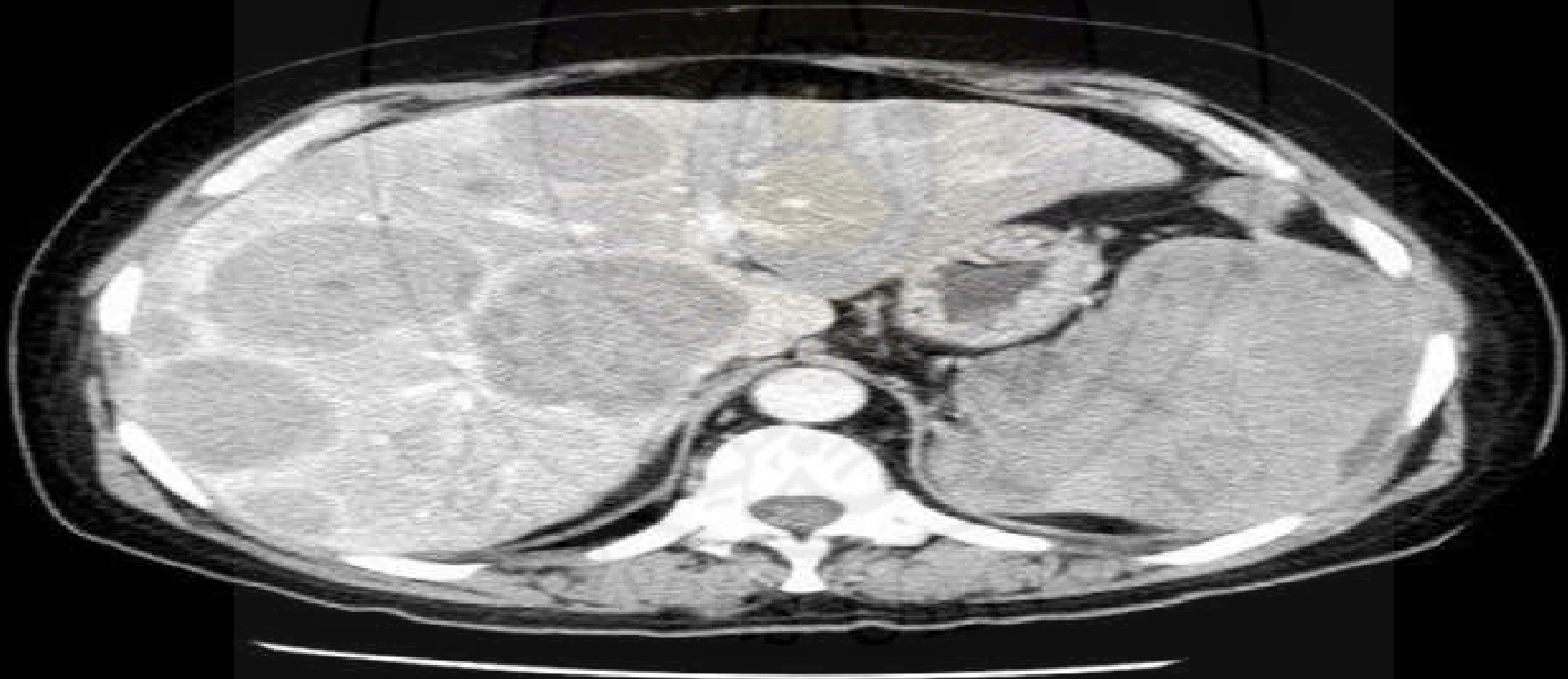


FIGURE 41.23. Fibrolamellar Hepatocellular Carcinoma—CT. Delayed postcontrast image demonstrates a large enhancing tumor extending caudally from the right lobe of the liver. A characteristic enhancing stellate central scar (arrow) is present.

Lymphoma

- ◆ Primary hepatic lymphoma is rare compared to the 2ry type
- ◆ AIDS and organ transplant patients have an increased risk
- ◆ Non specific **CT** and **MR** appearance
- ◆ Diffuse hepatic lymphoma → hypo dense liver similar to fatty infiltration

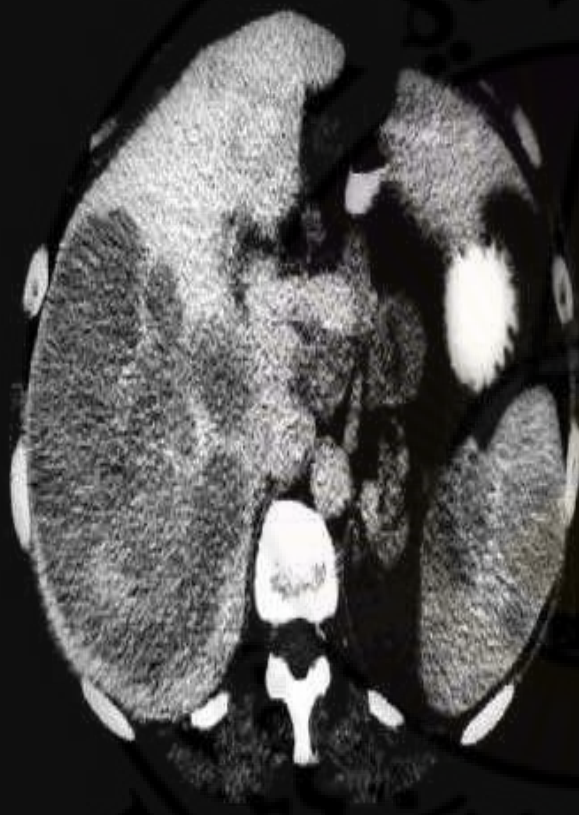


Lymphoma

Lymphoma

52Y/M

ANTERIOR



Hepatic deposits

- ◆ Liver is the 2nd most common site for deposits after nodes
- ◆ 30% - 70% of patients who die of cancer have liver deposits
- **NCCT** hypodense lesions ,calcification in mucin producing metastases
- **CECT** Dynamic bolus contrast injection with helical scanning



Hypovascular metastasis



Hypervascular metastasis

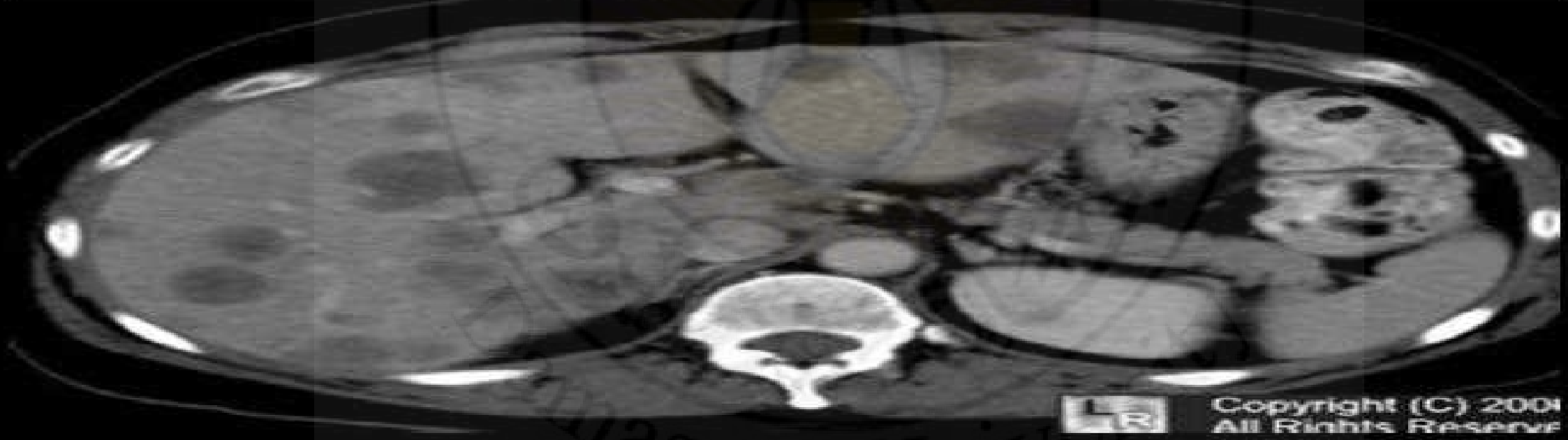
Hepatic deposits

- ◆ Most of hepatic deposits are hypo vascular
- ◆ Hepatic neoplasms receive most of their blood supply via hepatic artery
- ◆ Hyper vascular deposits should be assessed by dual phase CT or dynamic MRI
- ◆ CTAP and intra operative US are the most sensitive methods for detection of deposits

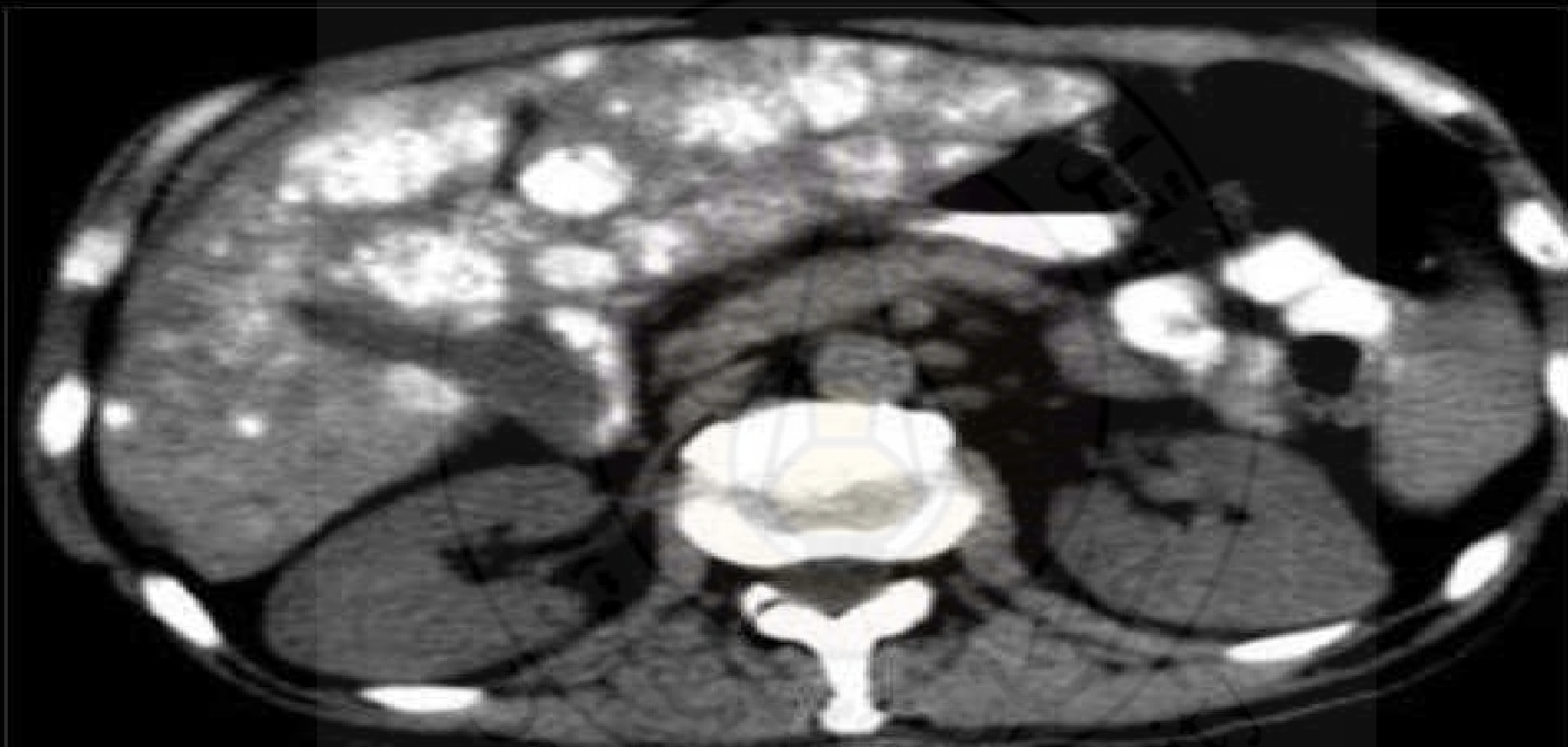


Hyper vascular deposits





Colorectal carcinoma with multiple hepatic metastasis.



Calcified hepatic metastases in a patient with mucinous adenocarcinoma of the colon

Cystic metastases from breast cancer

Portal phase CECT scan



Arterial phase CECT scan



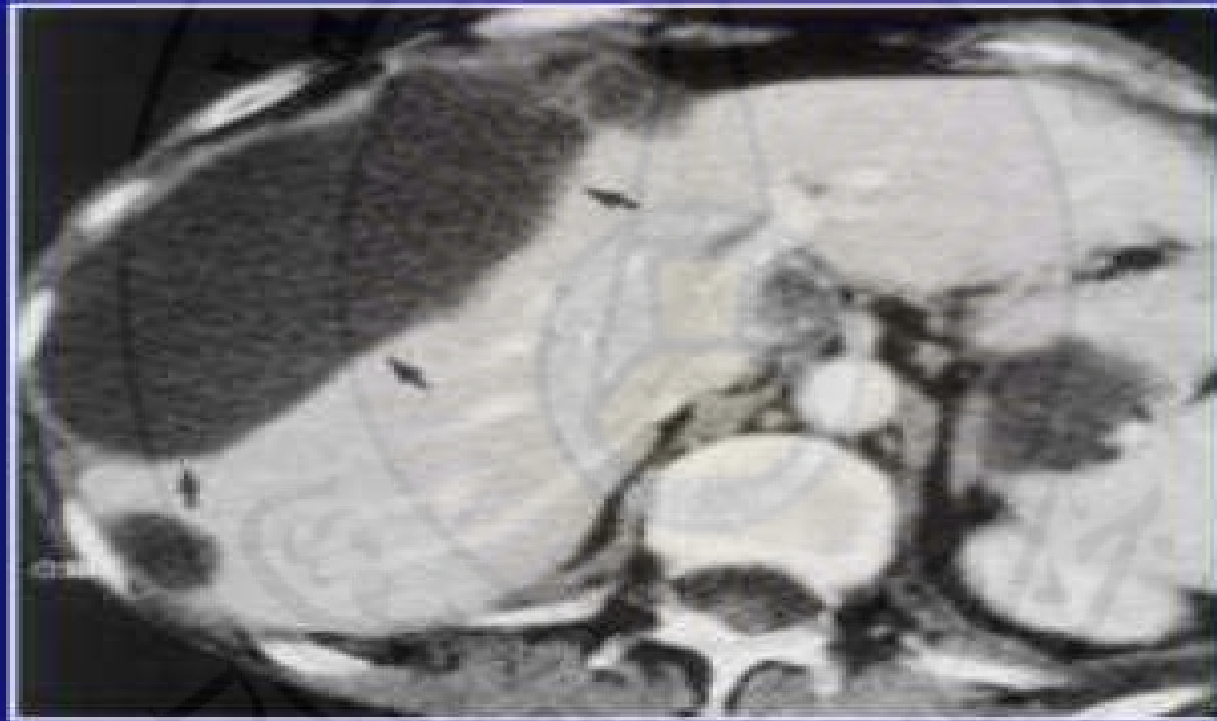
Cyst-like hypoattenuating lesion
without peripheral enhancement

Peripheral rim-enhancement
Typical of metastatic lesion

Known primary tumor, multiple lesions, rim enhancement

Cystic metastasis from ovarian cancer

Portal venous phase CECT scan



Ovarian metastases spread by peritoneal seeding
Elliptical cystic lesion on surface of liver

ENHANCEMENT PATTERNS OF COMMON HEPATIC MASSES

	Arterial phase	Portal venous phase	Delayed phase
HCC	↑	↓	↓
FNH	↑	iso	iso
Hepatic adenoma	↑	↓	↓
Hypervascular metastasis	↑ or iso	↓ or iso	↓ or iso
Non-hypervascular metastasis	↓	↓	↓

- **Hypovascular** hepatic metastases include:

Breast.	Lung.
Pancreas.	Lymphoma.

- **Hypervascular** hepatic metastases include (mnemonic = MRCT):

Melanoma.	Carcinoid / Choriocarcinoma.
Renal cell carcinoma.	Thyroid.

- **Calcified** hepatic metastases include:

Mucinous cancers (including colon, gastric, ovarian).
Osteosarcoma.
Treated lymphoma.

- **Cystic** hepatic metastases include:

Ovarian cystadenocarcinoma.
Gastrointestinal sarcoma.

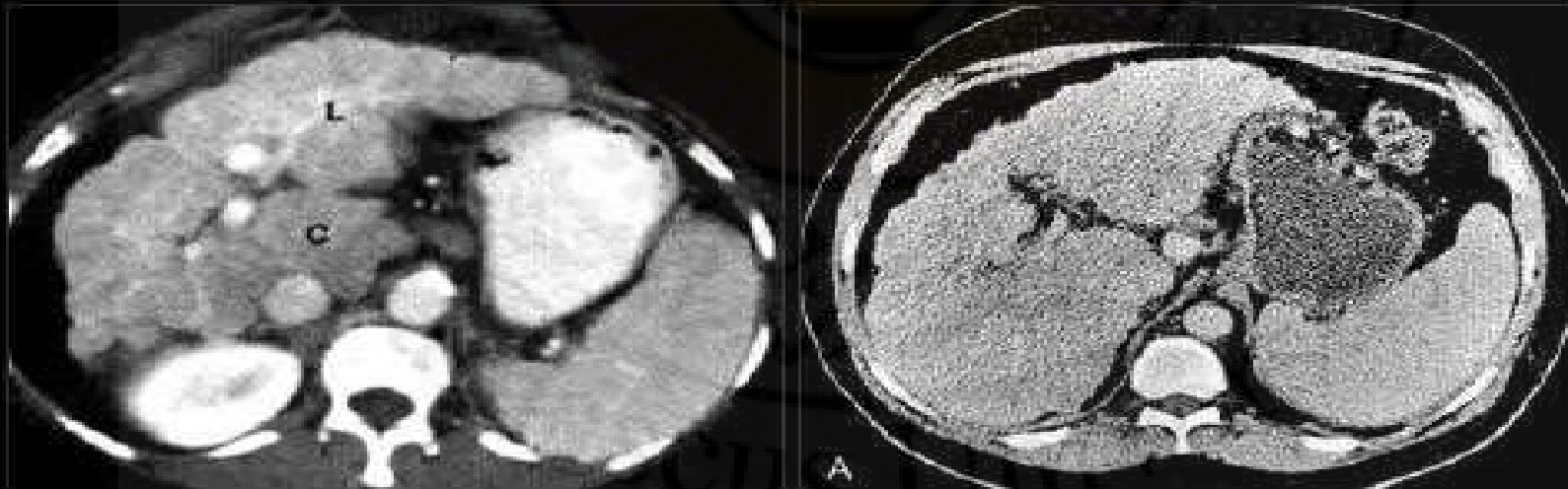
Diffuse Hepatic Disease

- ◆ Cirrhosis
- ◆ Fatty Changes
- ◆ Storage diseases(hemochromatosis & hemosidrosis)
- ◆ Neoplastic diseases [HCC , Deposits , Lymphoma]



Cirrhosis

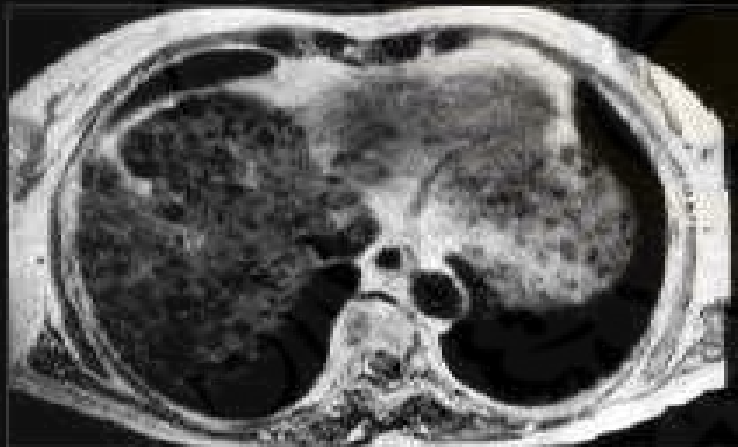
- Repeated episodes of hepatic injury → fibrosis + regeneration
 - Small fibrotic right lobe with regenerative enlargement of the caudate and left lobe
 - Caudate/ right lobe ratio = 0.65 or more
 - Portal vein diameter more than 1.3 cm
 - Splenomegaly, ascites
 - Dilated perisplenic collateral venous channels



Liver cirrhosis

Regeneration nodules

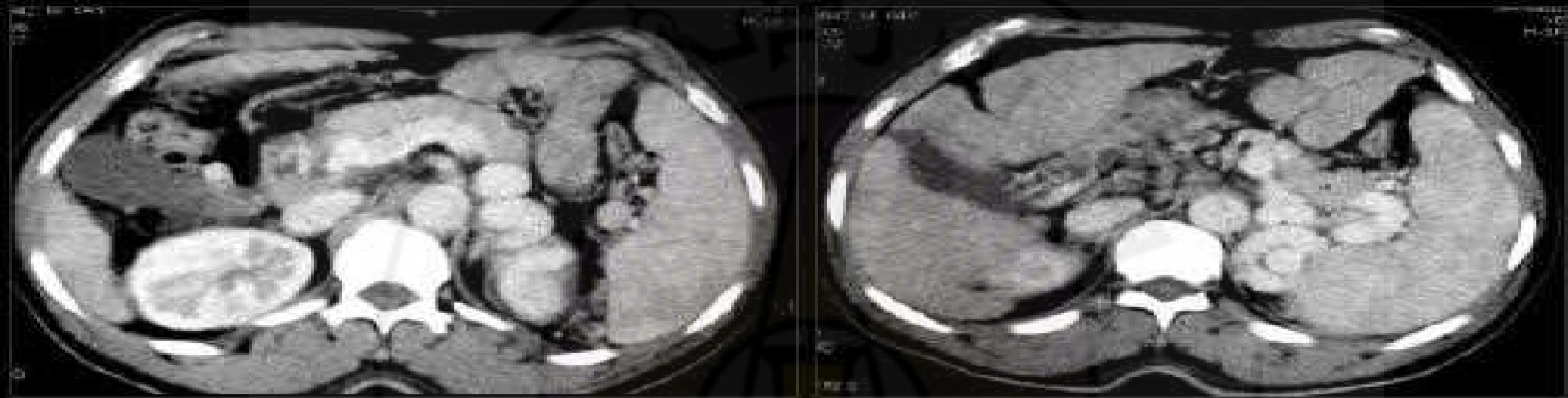
- Without hemosiderin mild hyper intense in T1/ mild **hypo intense in T2**
- With hemosiderin mild hyper intense in T1/ more **hypo intense in T2**



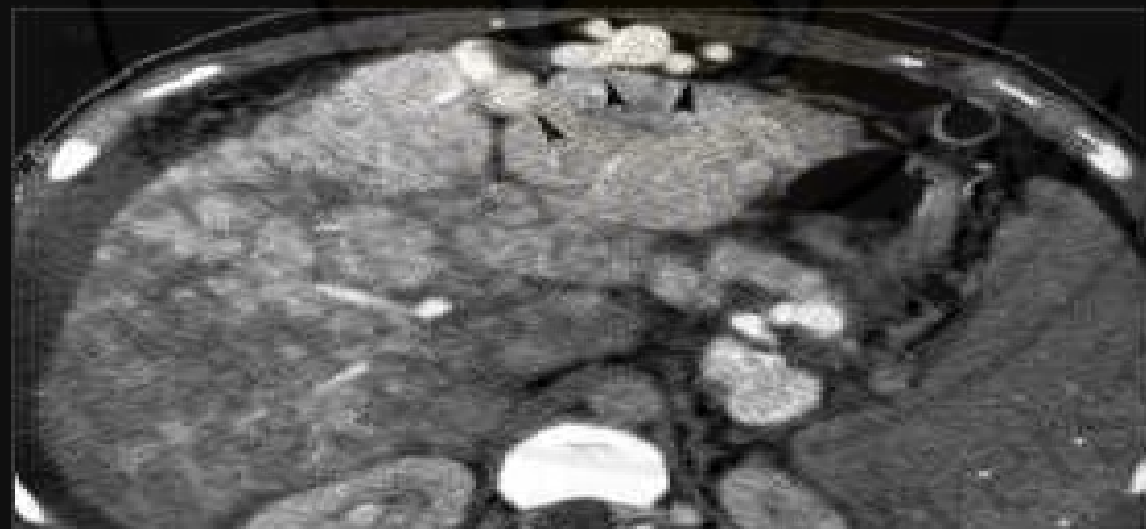
- ◆ Gradient echo images are more sensitive for hemosiderin
- ◆ MR angiography : Portosystemic shunts and portal vein thrombosis



Liver cirrhosis with multiple regeneration nodules



MDCT in a patient with cirrhosis and portal hypertension



CT arterial portography (CTAP) in a patient with cirrhosis

Liver cirrhosis

Other imaging findings

- ♦ Widening of hepatic fissures
- ♦ Gall bladder and small bowel wall thickening (edema)
- ♦ Signs of portal hypertension



Fatty infiltration

- ♦ Alcohol, obesity, diabetes , hepatitis, drugs
- ♦ Focal, multifocal, diffuse fatty infiltration
- ♦ Normal hepatic density is 8HU greater than spleen
- ♦ Fatty liver is 10 HU below the spleen without contrast and 25 HU after contrast
- ♦ Vessels course in the focal areas undisturbed

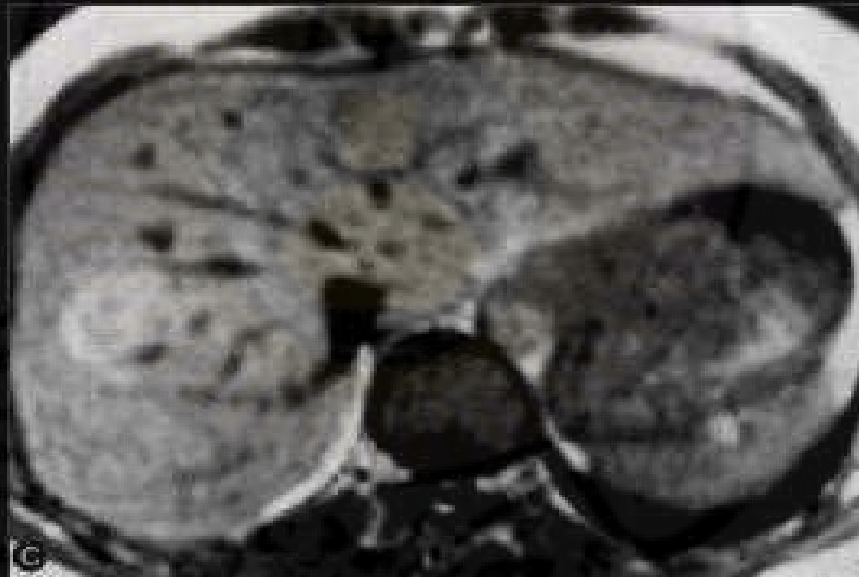
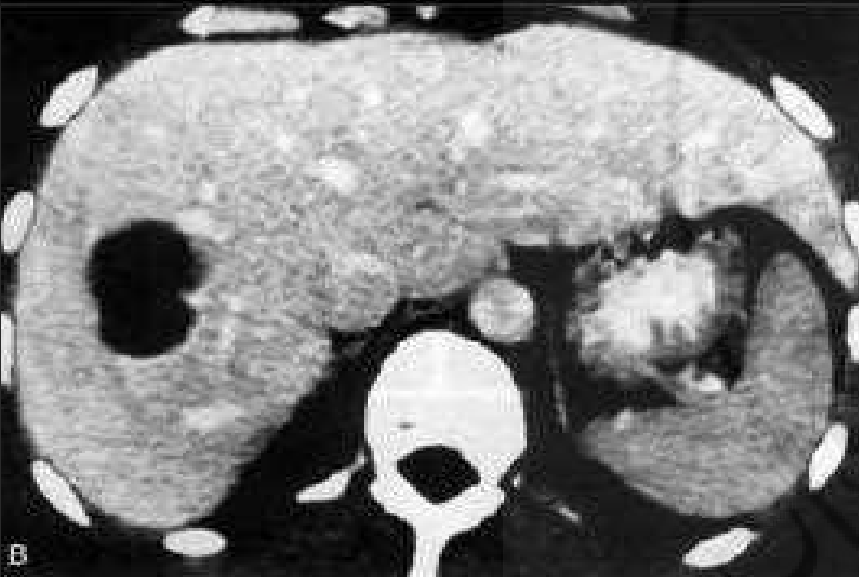
- ♦ MR is helpful using the fat suppressed technique



LONG RK



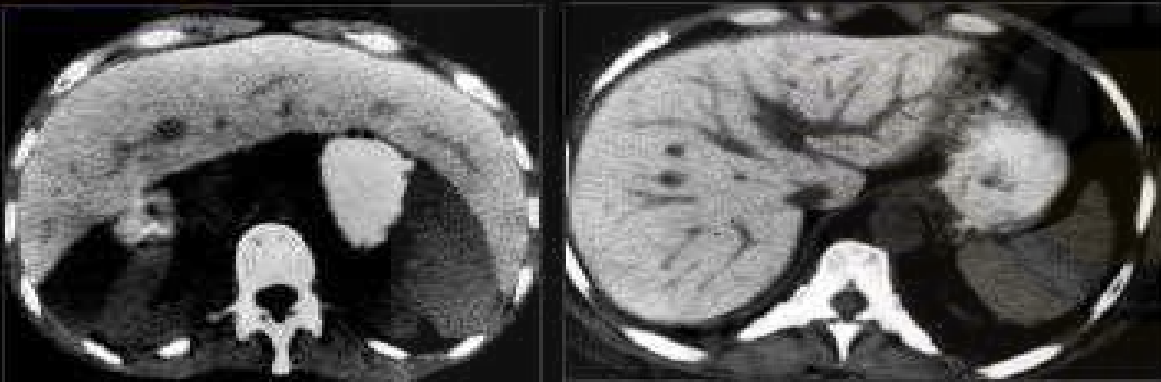
Lipoma



Iron overload

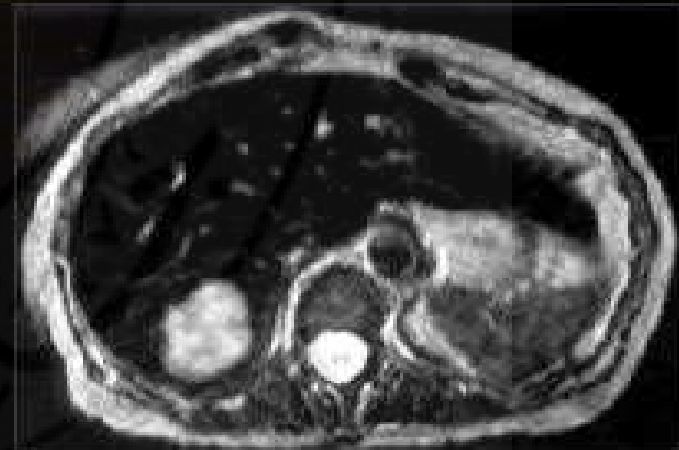
- ♦ Liver cells or reticuloendothelial iron deposition
- ♦ Hereditary hemochromatosis, cirrhosis, hemolysis,.....

CT



Generalized increase attenuation value of liver parenchyma [seen also in other conditions Wilson's disease, glycogen storage disease]

Liver signal below that of the muscles is diagnostic, iron is not deposited in the muscles



MRI

More specific → diffuse decrease signal intensity of liver parenchyma in T2 and gradient echo images

Diffuse Neoplastic disease

Multiple small tumour foci scattered throughout the liver parenchyma

- Vascular invasion is common
- Increased T2 signal on MR images



Diffusely infiltrating Hepatocellular carcinoma with portal vein invasion

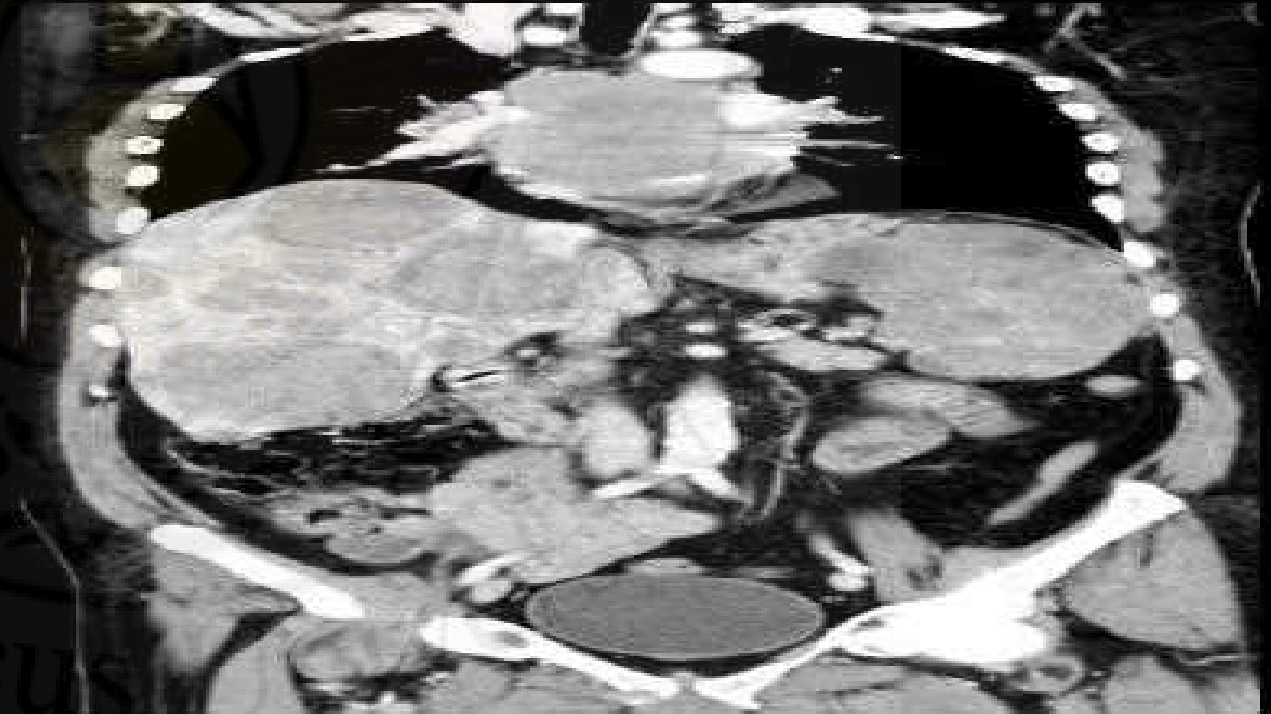


Diffusely metastasis of the liver

Diffuse Neoplastic disease

Lymphoma 35% of patients with secondary hepatic lymphoma show either diffuse or mixed pattern (focal+ diffuse)

Imaging findings are non specific



Variations in CT attenuation

- **Hypoattenuating liver:** The liver is generally considered hypoattenuating if it attenuates less than the spleen on an unenhanced CT.

Fatty liver (hepatic steatosis) is by far the most common cause of a diffusely hypoattenuating liver.

Hepatic amyloid is rare and may cause either focal or diffuse hepatic hypoattenuation.

- **Hyperattenuating liver:** The normal unenhanced attenuation of the liver is 30 to 60 HU. An absolute attenuation greater than 75 HU is considered hyperattenuating.

Iron overload is by far the most common cause of a hyperattenuating liver.

Medications (e.g., amiodarone, gold, and methotrexate).

Wilson disease (Copper overload).

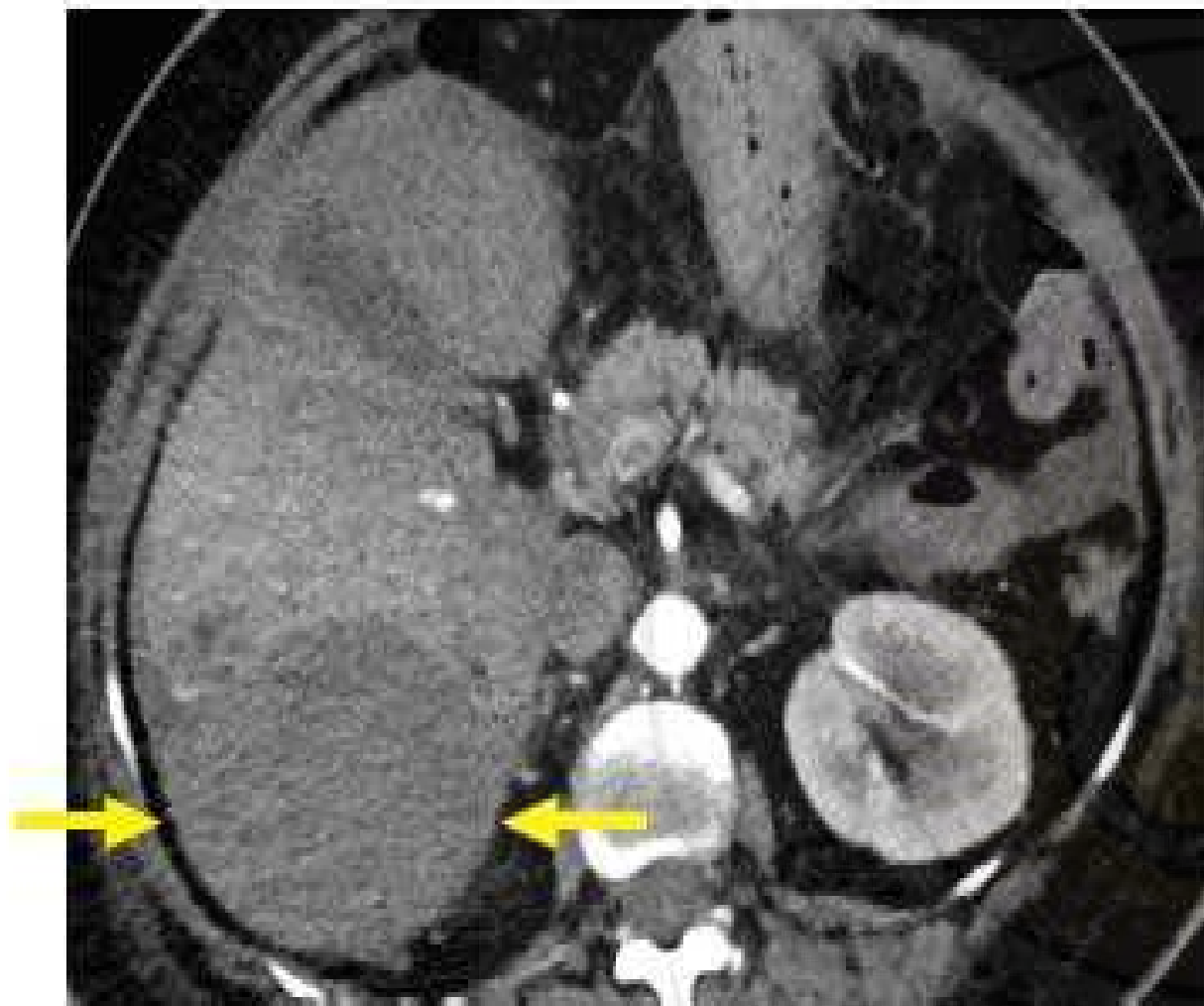
Glycogen excess.

LIVER TRAUMA

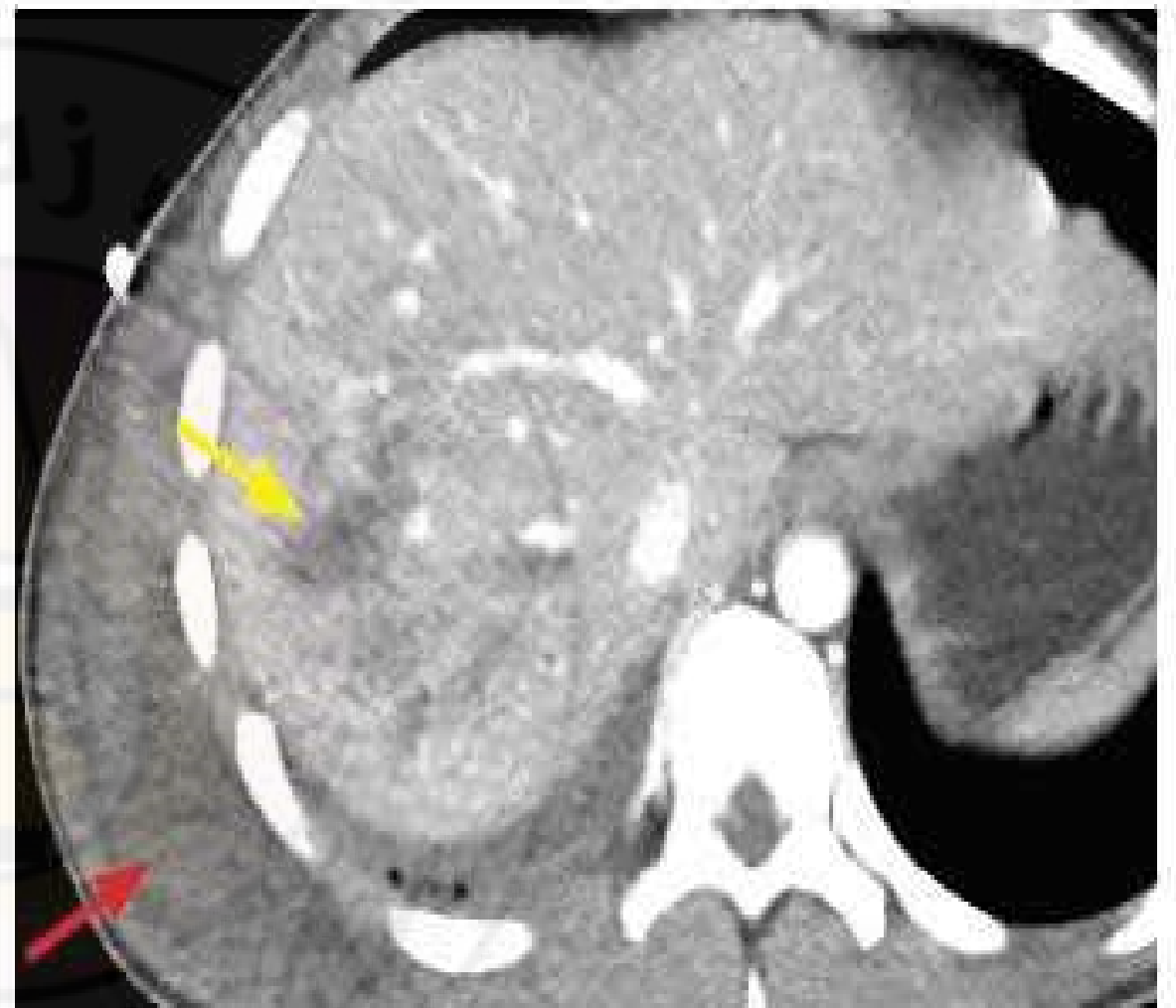
Overview of liver trauma

- The liver is the second most commonly injured solid organ due to blunt trauma, second to the spleen.
- The 2018 revised organ injury scale (OIS) for liver published by the American Association for the Surgery of Trauma (AAST) includes imaging, operative, and pathologic criteria for grading injury. The final AAST grade assigned is based on the highest of the three criteria.
- The imaging criteria is based on CT findings and is more commonly used by radiologists. It is similar to the organ injury scale for splenic trauma.

- Grade I:
 - Subcapsular hematoma <10% liver surface.
 - Superficial laceration <1 cm deep.
- Grade II:
 - Subcapsular hematoma 10–50% liver surface.
 - Intraparenchymal hematoma <10 cm in size.
 - Laceration 1–3 cm deep.
- Grade III:
 - Subcapsular hematoma >50% liver surface.
 - Ruptured subcapsular/intraparenchymal hematoma.
 - Laceration >3 cm deep.
 - Any intraparenchymal vascular injury (i.e., pseudoaneurysm or AV fistula) or contained active bleeding.
- Grade IV:
 - Laceration involving 25–75% of one hepatic lobe.
 - Extraparenchymal extension of active bleeding into the peritoneum.
- Grade V:
 - Laceration or destruction >75% of one hepatic lobe.
 - Injury to retrohepatic IVC or central hepatic veins.



Left image: CT angiogram axial image demonstrates a large subcapsular hematoma (yellow arrows) along the right hepatic lobe with no evidence of active extravasation.



Right image: Portal venous phase CT axial image shows hypodense geographic/linear regions (yellow arrow) in the right hepatic lobe, indicating hepatic lacerations. Note the large right chest wall hematoma (red arrow).

Thank You



Practical Introduction To CT

DR.MUHANNAD IBRAHIM

DIAGNOSTIC RADIOLOGIST

HEAD DEPARTMENT OF INTERVENTIONAL RADIOLOGY,
TISHREEN MILITARY HOSPITAL

Damascus University

Incremental CT

[Conventional CT, Standard CT]

Scanning technique



Spiral CT 1986

[Helical CT - Volumetric CT]

Continuous table advancement during tube rotation



Spiral CT 1986

Continuous table advancement during tube rotation



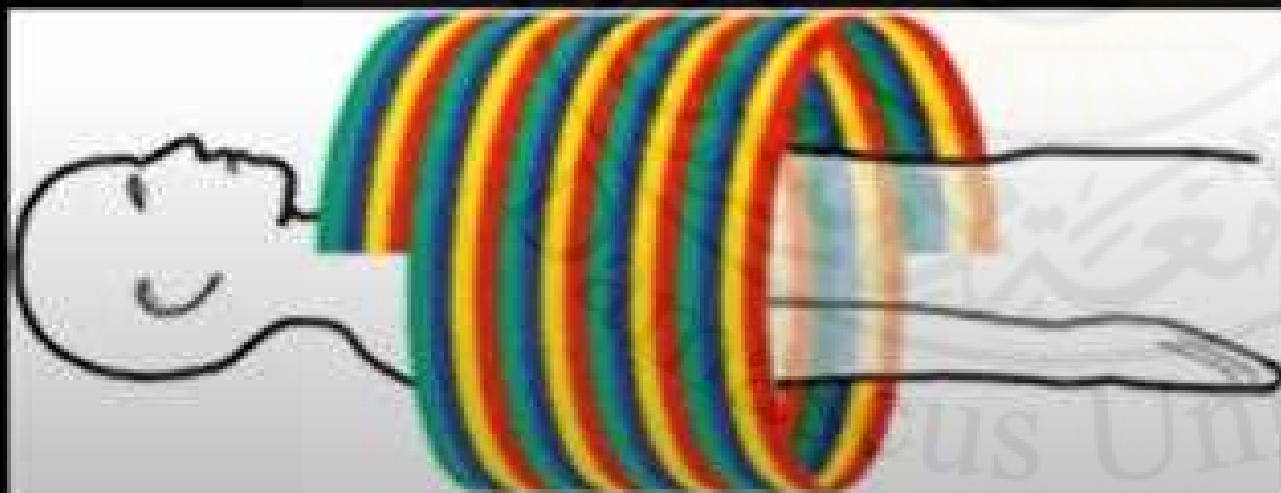
Advantages

- ♦ Short examination time
- ♦ Reduce the slice thickness

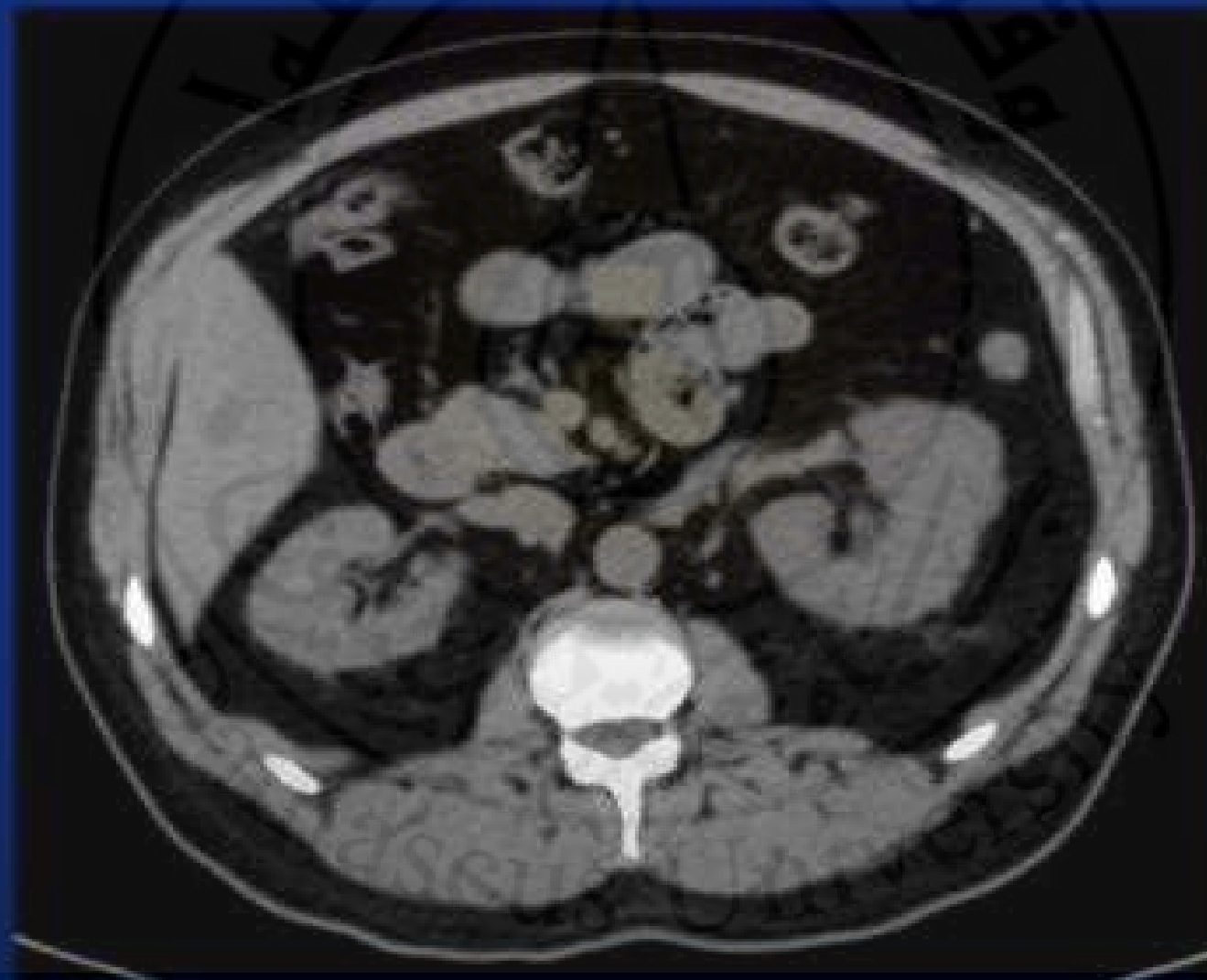


Multislice CT 1999 [Multidetector row CT] [MDCT]

- Very rapid scanning
- Vascular imaging
- Virtual endoscopy
- Vertical reconstruction



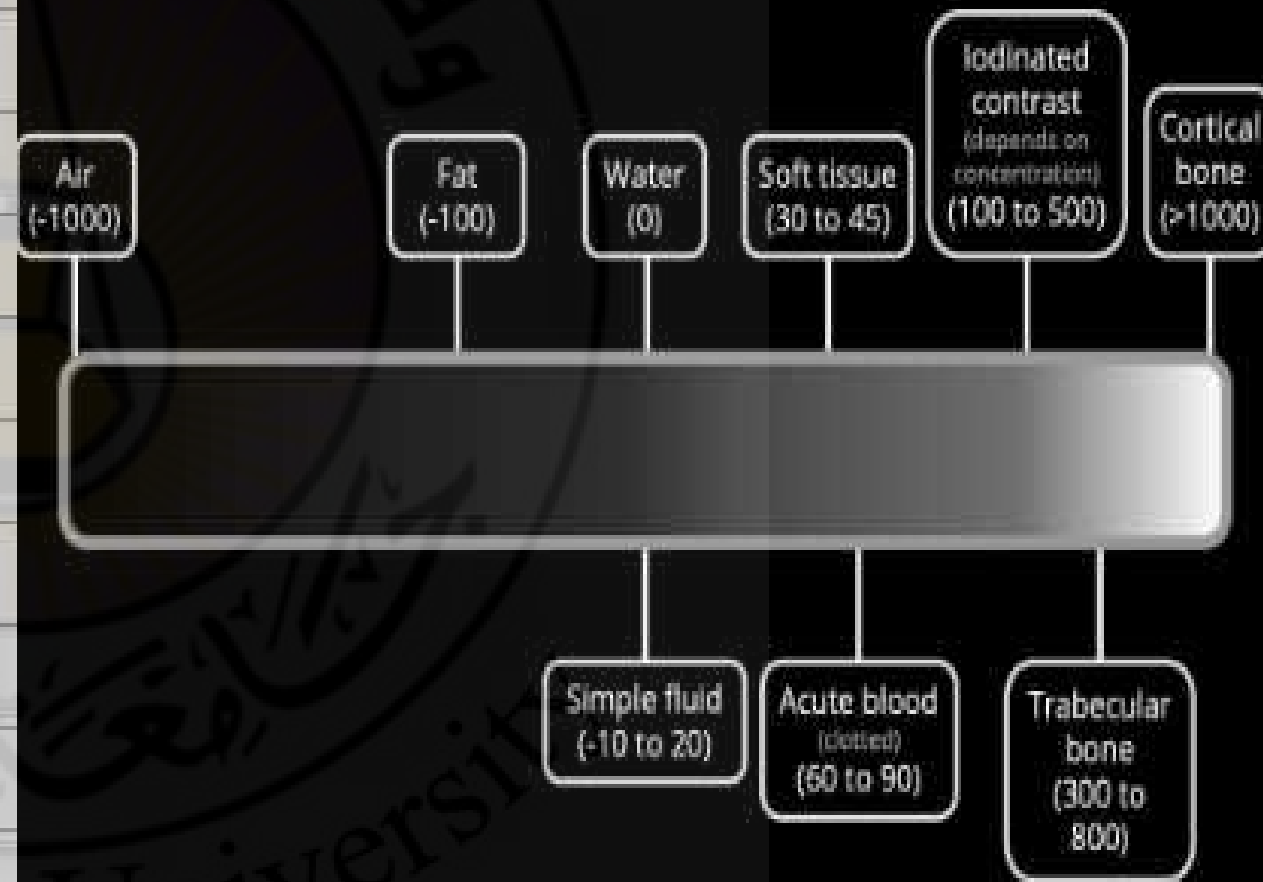
****Hounsfield Units****



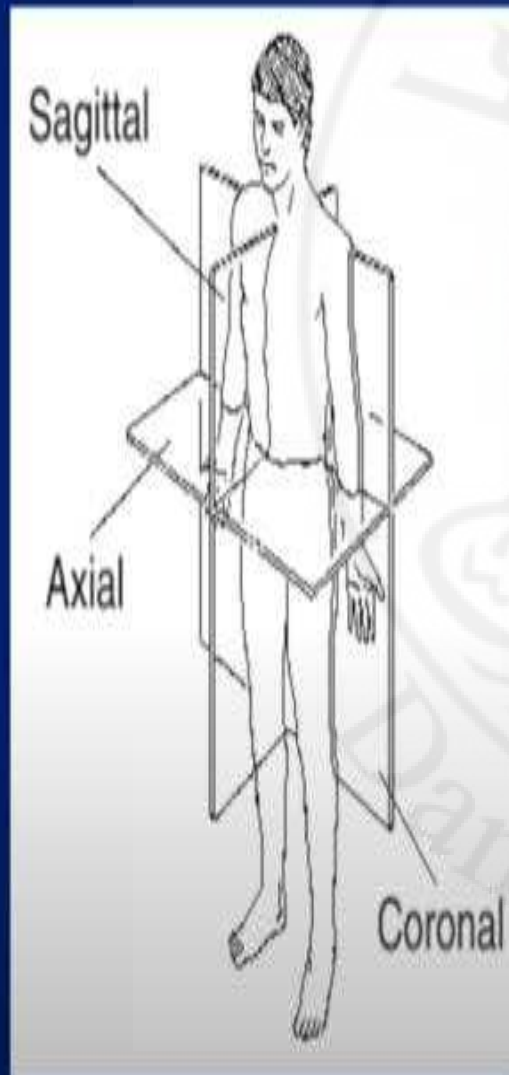
Substance	HU
Air	-1000
Lung	-500
Fat	-100 to -50
Water	0
CSF	15
Kidney	30
Blood	+30 to +45
Muscle	+10 to +40
Grey matter	+37 to +45
White matter	+20 to +30
Liver	+40 to +60
Soft Tissue, Contrast	+100 to +300
Bone	+700 (cancellous bone) to +3000 (dense bone)

Hounsfield Scale (HU)

(Simplified)



Conventions



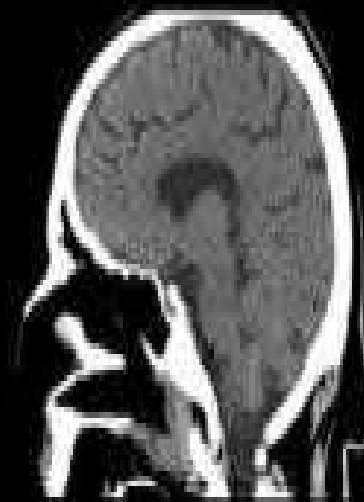
Plane examples



Axial plane

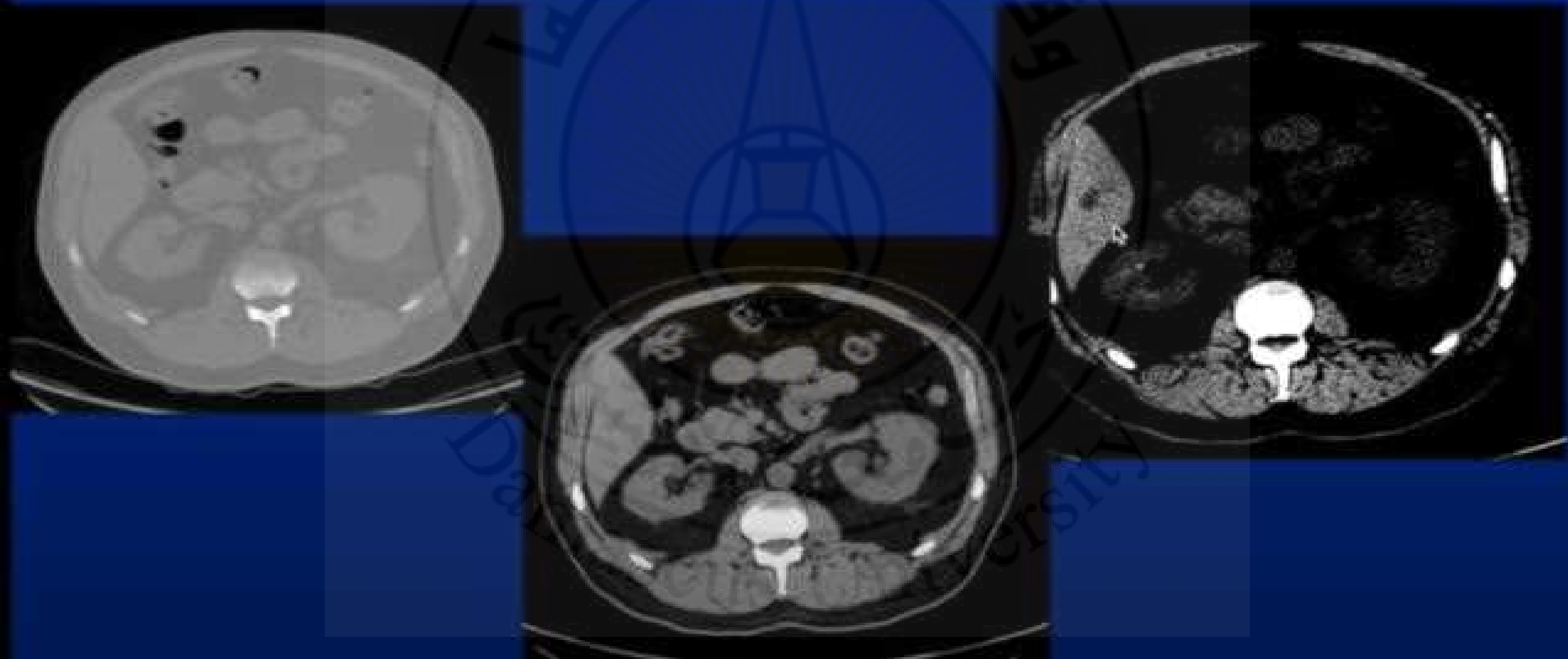


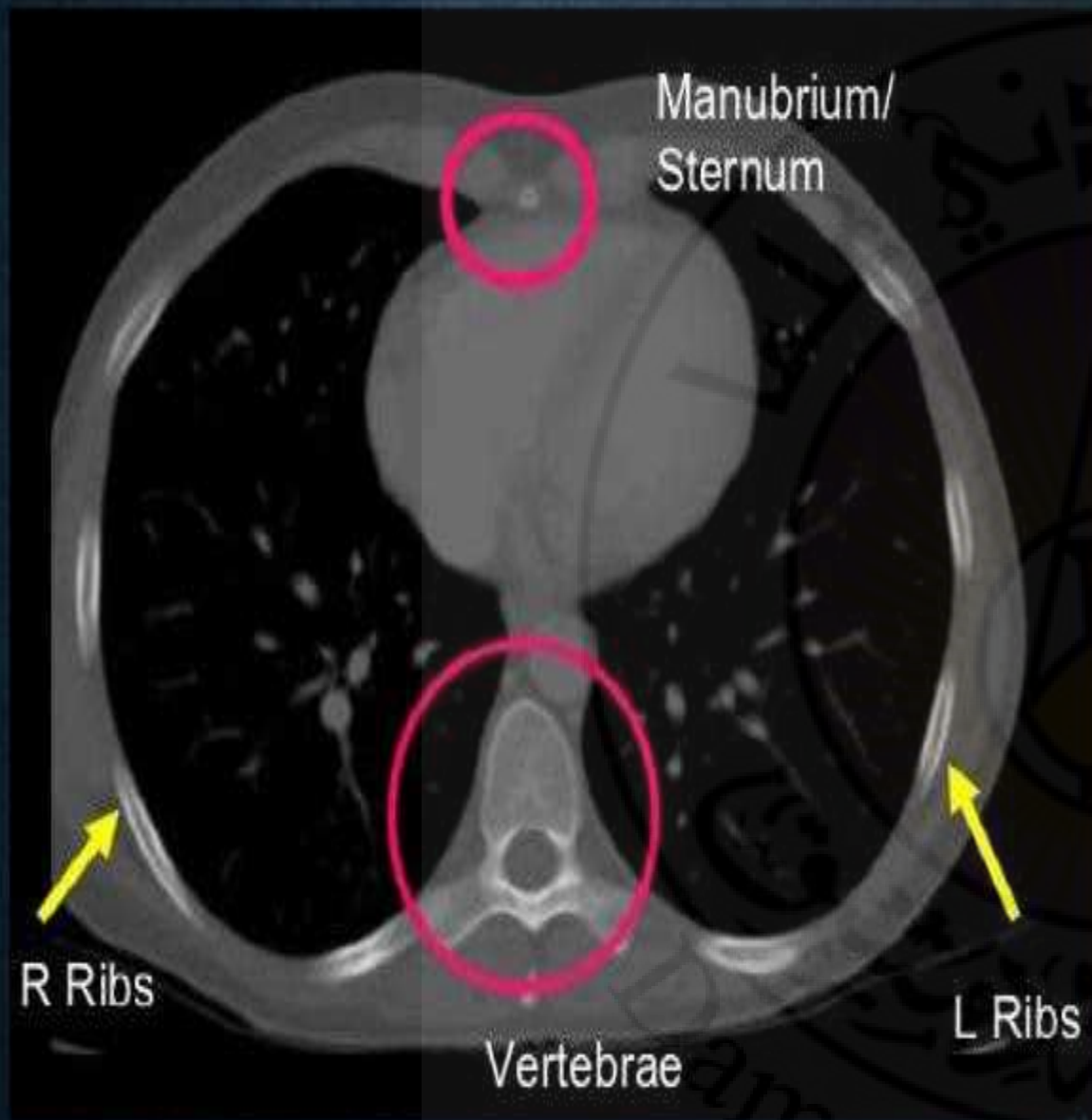
Coronal plane



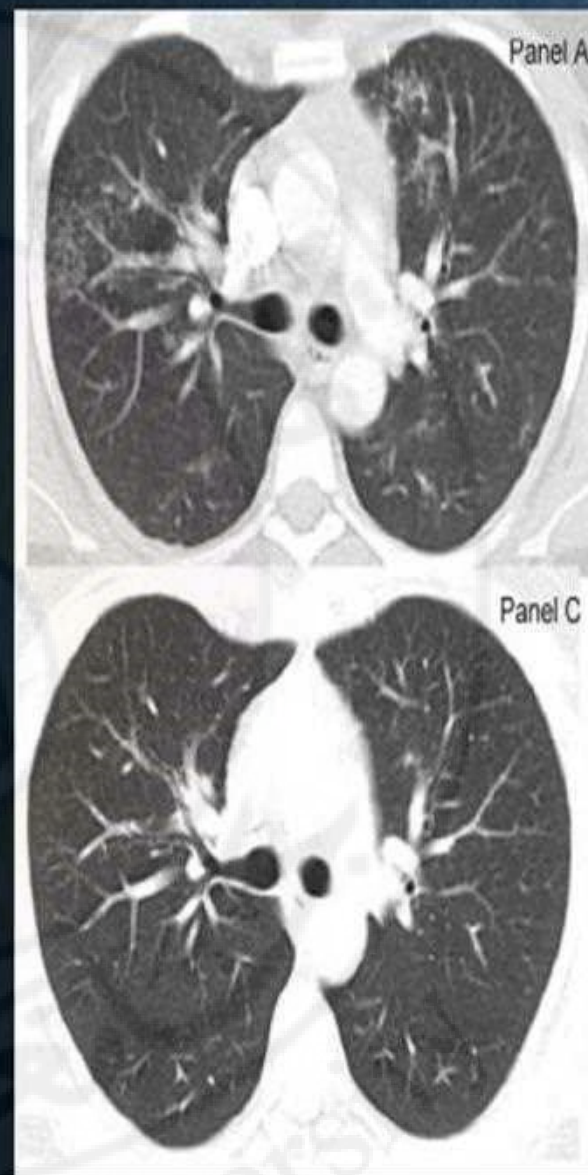
Sagittal plane

Windowing

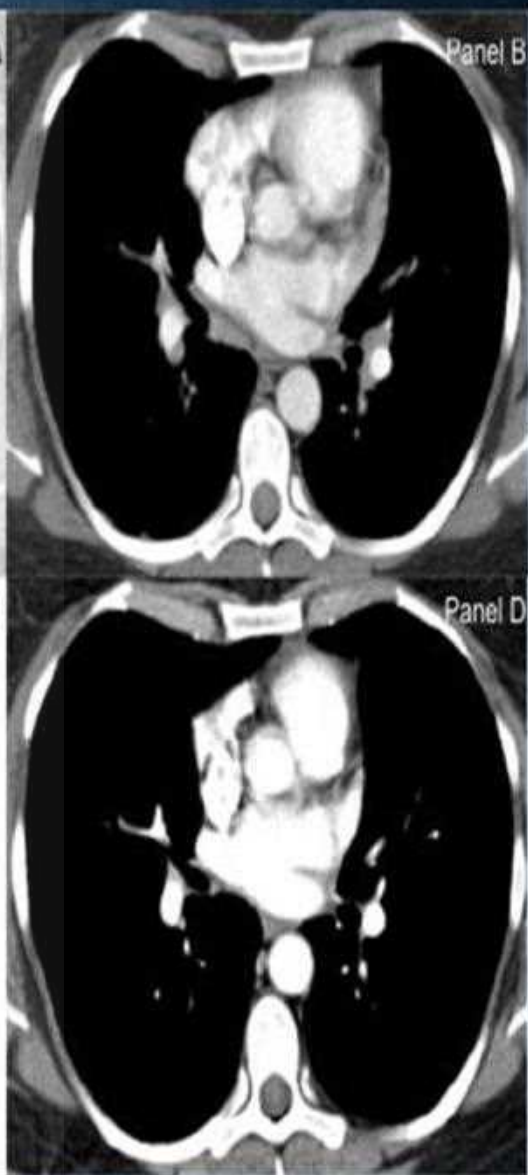




BONE WINDOW



LUNG WINDOW

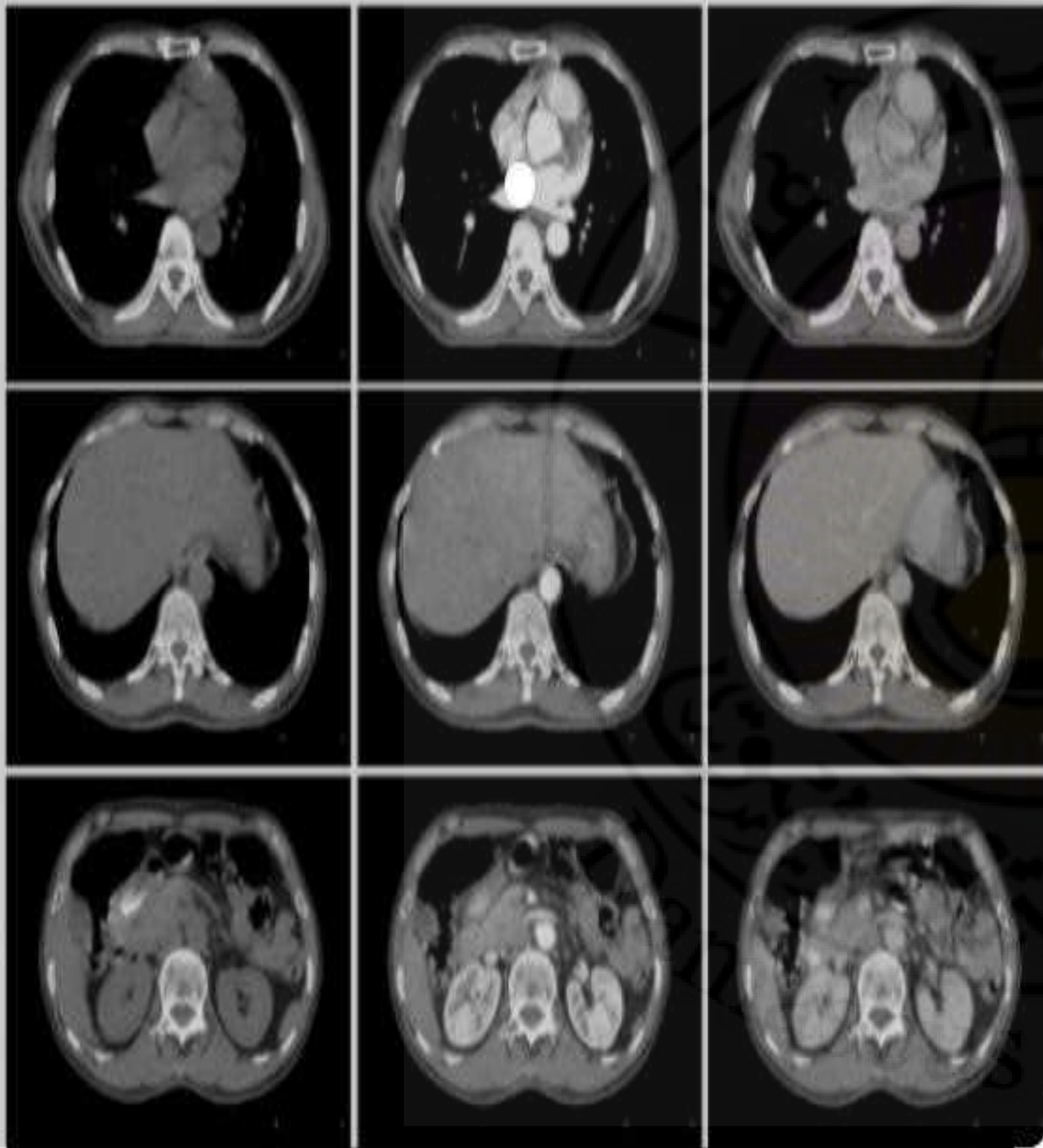


MEDIASTINAL WINDOW

Non-Contrast Phase

Arterial Phase

Venous Phase



Phases of IV Contrast

Depending on the timing, different structures are enhanced by IV contrast.

- **Pre-contrast Phase** = Non-contrast – no enhancement.
- **Arterial Phase** (15-25 seconds)
- **Angionephric or Venous Phase** (30-60 seconds) The Renal cortex appears enhanced.
- **Nephrographic Phase** (75-100 seconds) Cortex and Medulla appear enhanced.
- **Excretory/Urographic Phase** (after 3 minutes -- routinely taken at 10 minutes) The collecting system is enhanced.



CT CHEST

INDICATIONS

To assess equivocal plain X-ray findings

Staging of lung neoplasms

Metastatic workup of extrathoracic malignancies

Diagnosis of diffuse lung disease with HRCT

Assessment of bronchiectasis

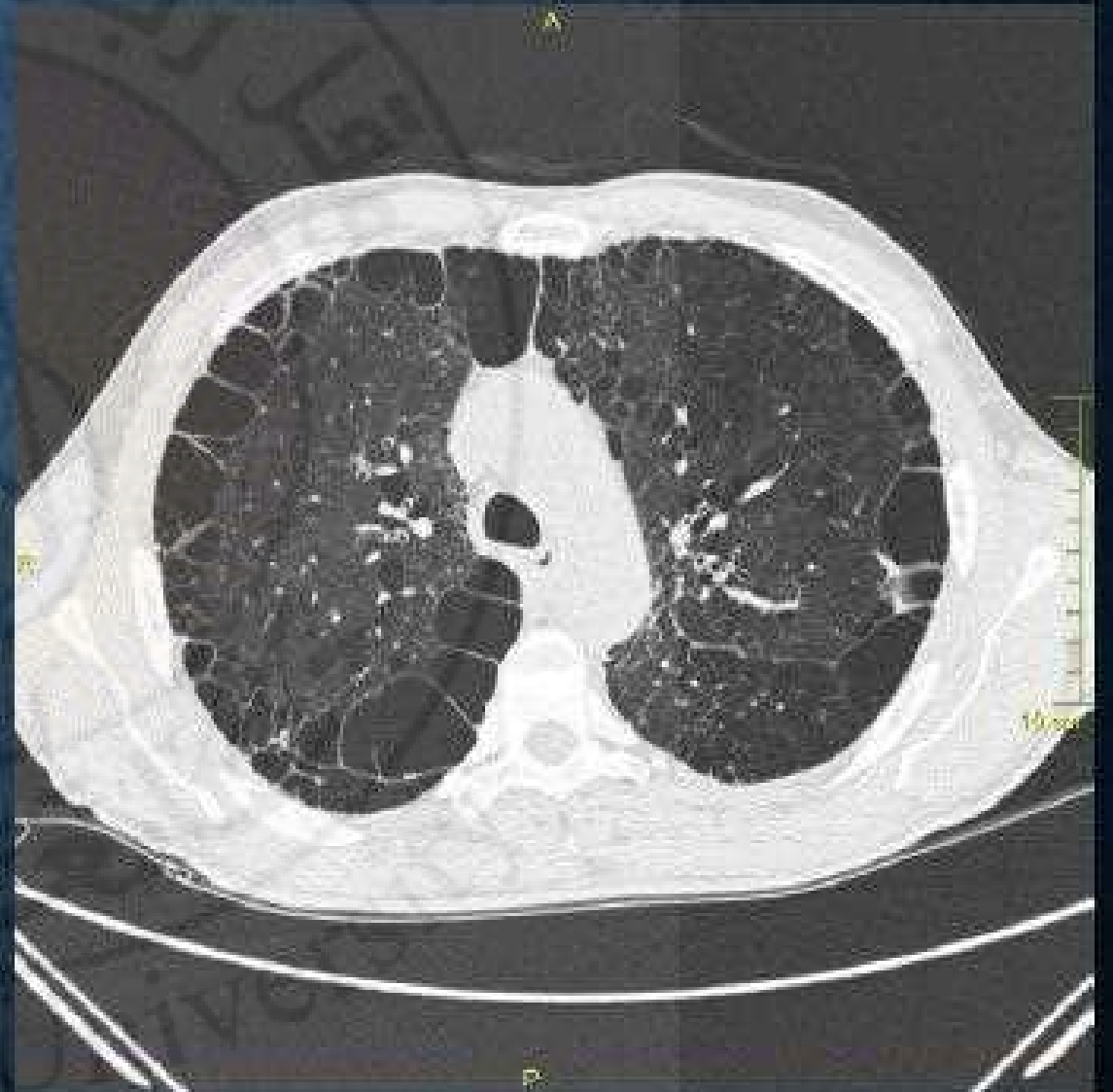
Assessment of suspected post-traumatic complications

Diagnosis of mediastinal and chest wall lesions

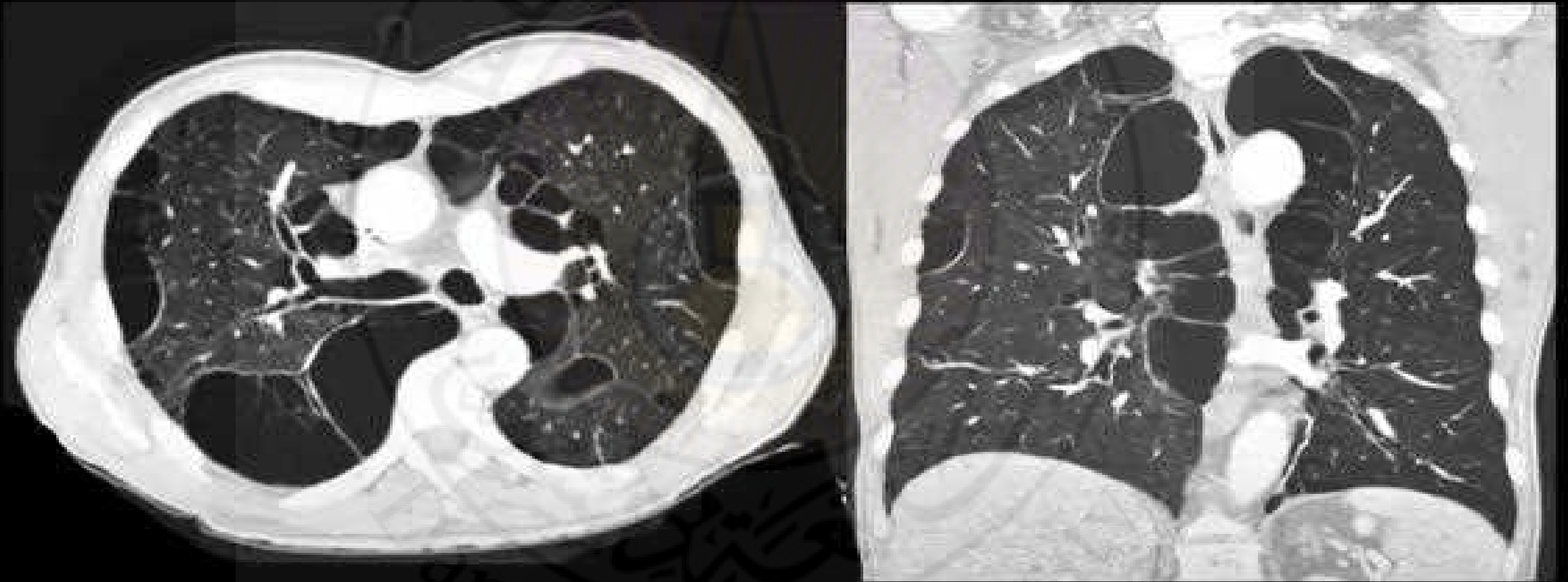
Diagnosis of suspected pulmonary embolism

AIRWAY DISEASES

**EMPHYSEMA/
EMPHYSAMATOUS
BULLAE**

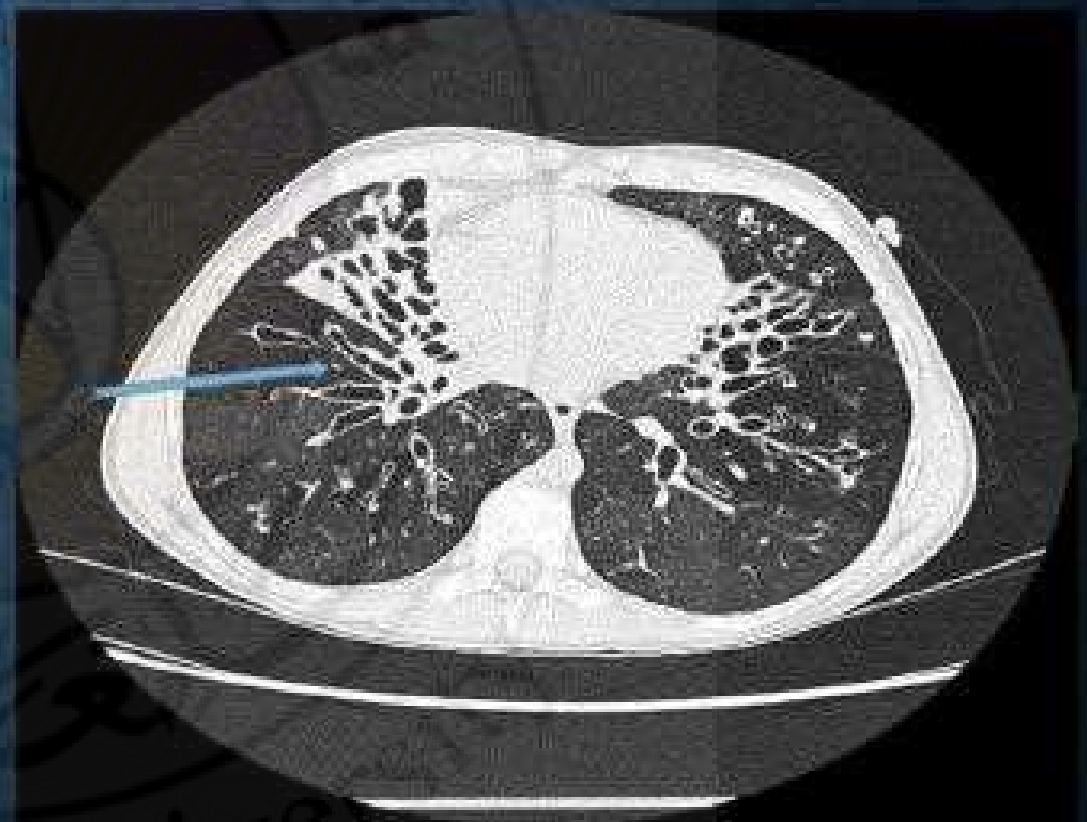


Bullous emphysema



Several large air-containing areas with a diameter larger than 1 cm are seen in both lungs. Note the subpleural location and the upper lobe predominance

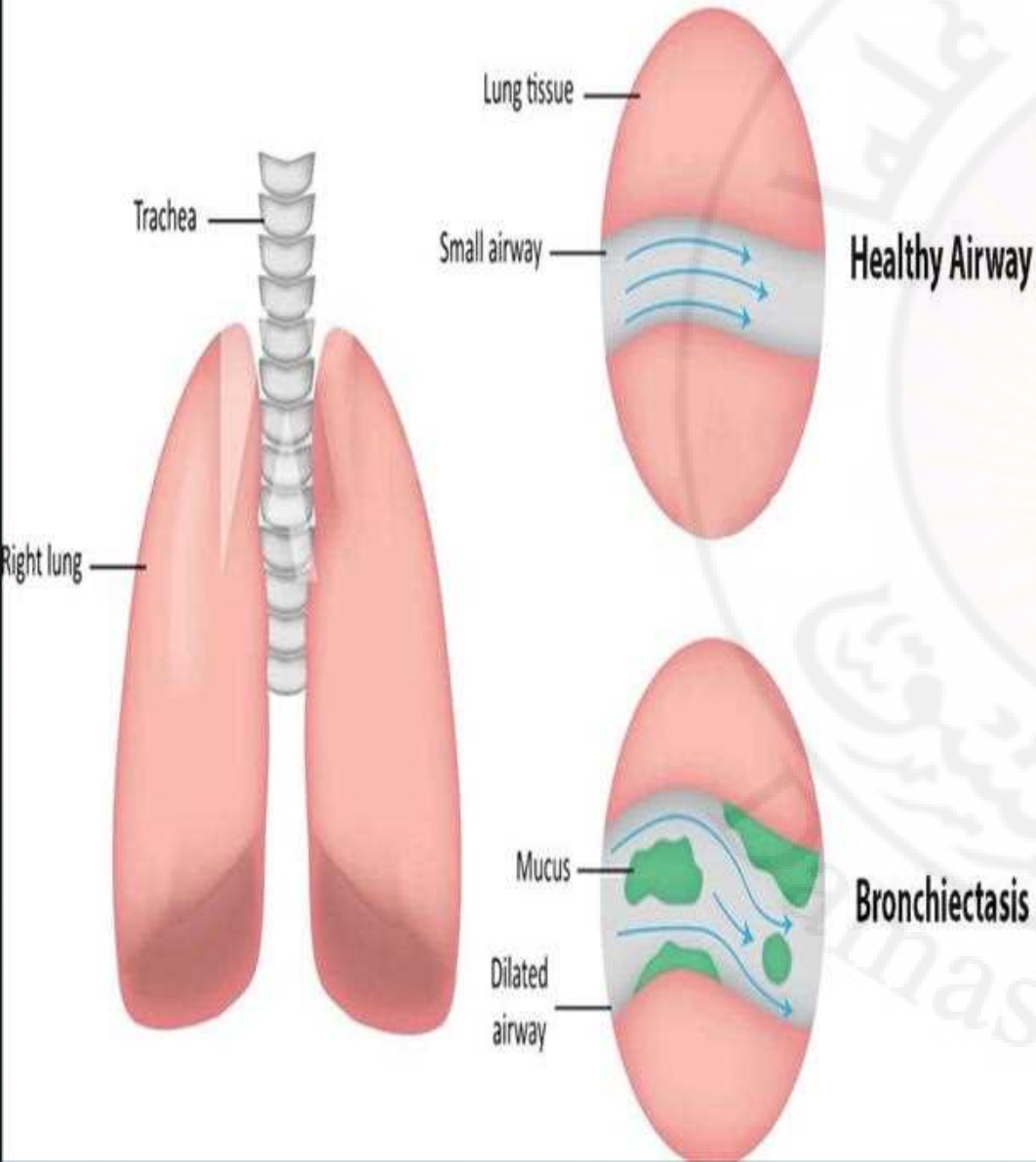
BRONCHEICTASIS



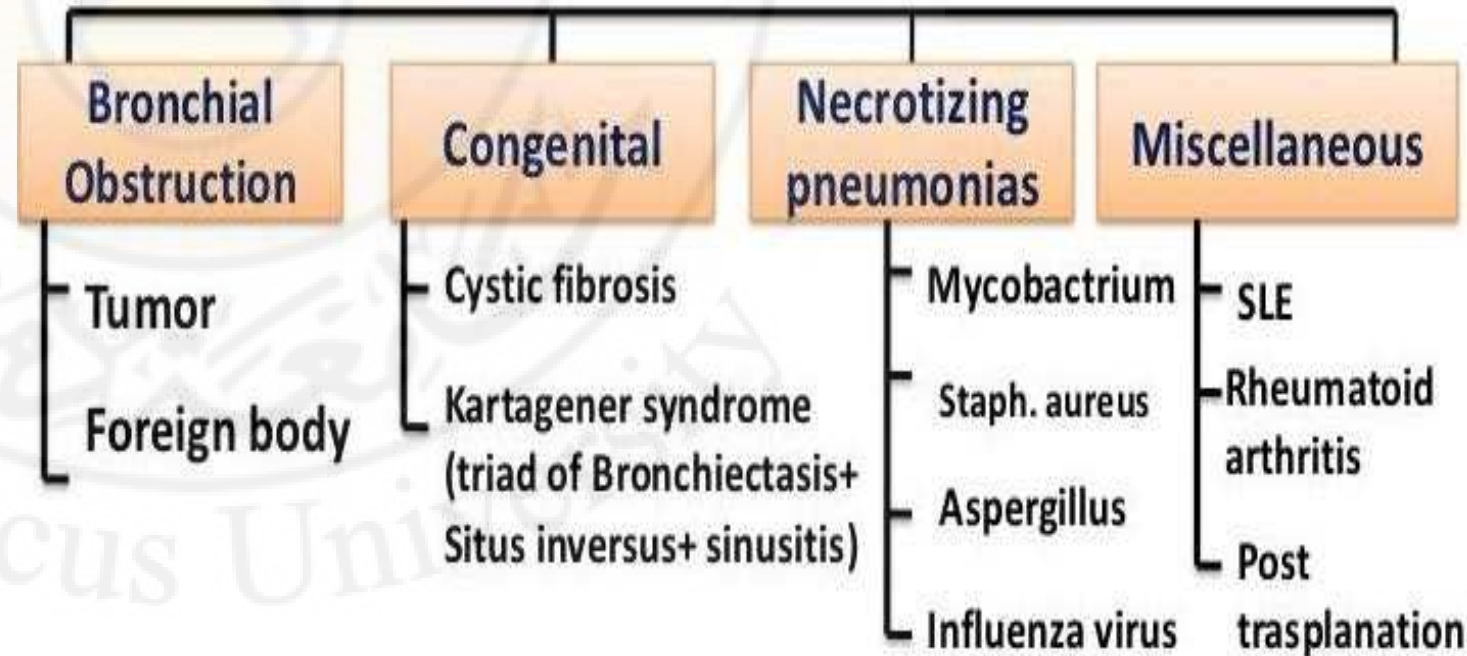
Bronchiectasis

4. Bronchiectasis

- Abnormal permanent airways dilation resulting from chronic necrotizing infection is called bronchiectasis.



Cause

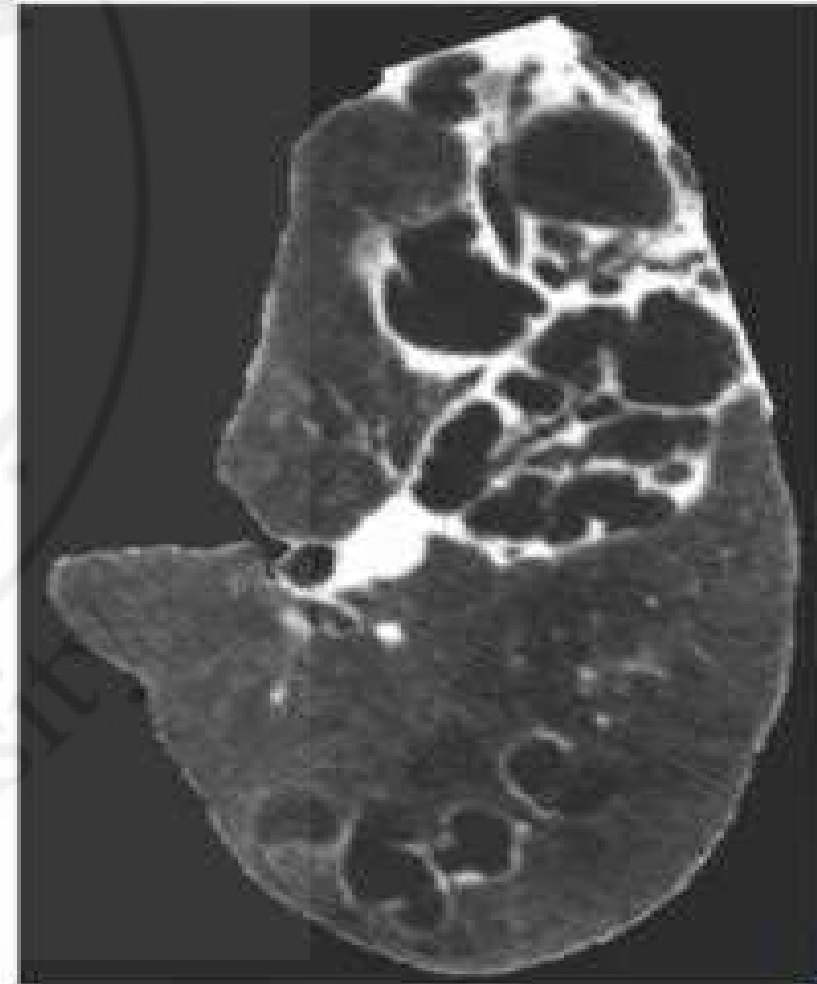
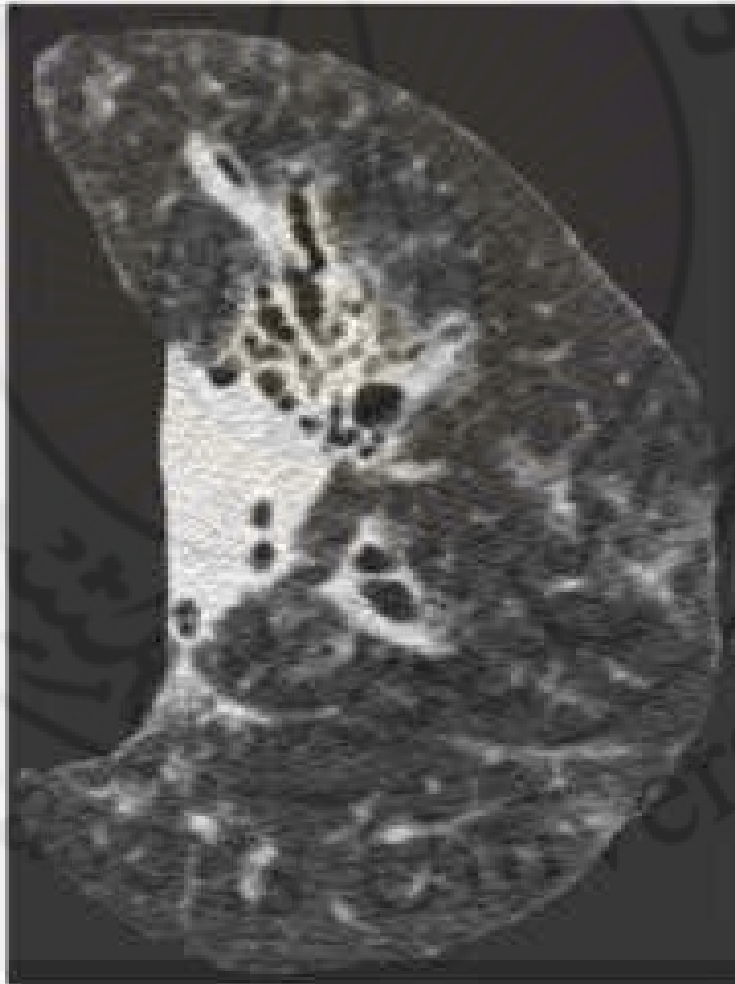


Types

Cylindrical

Varicose

Cystic

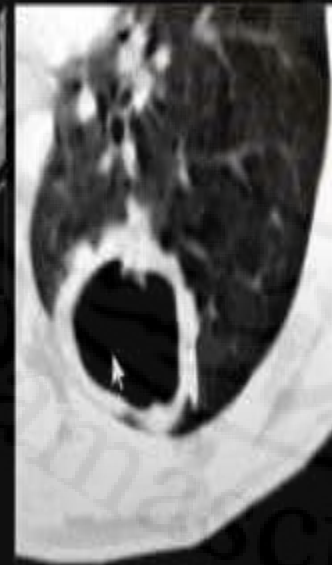




Acute



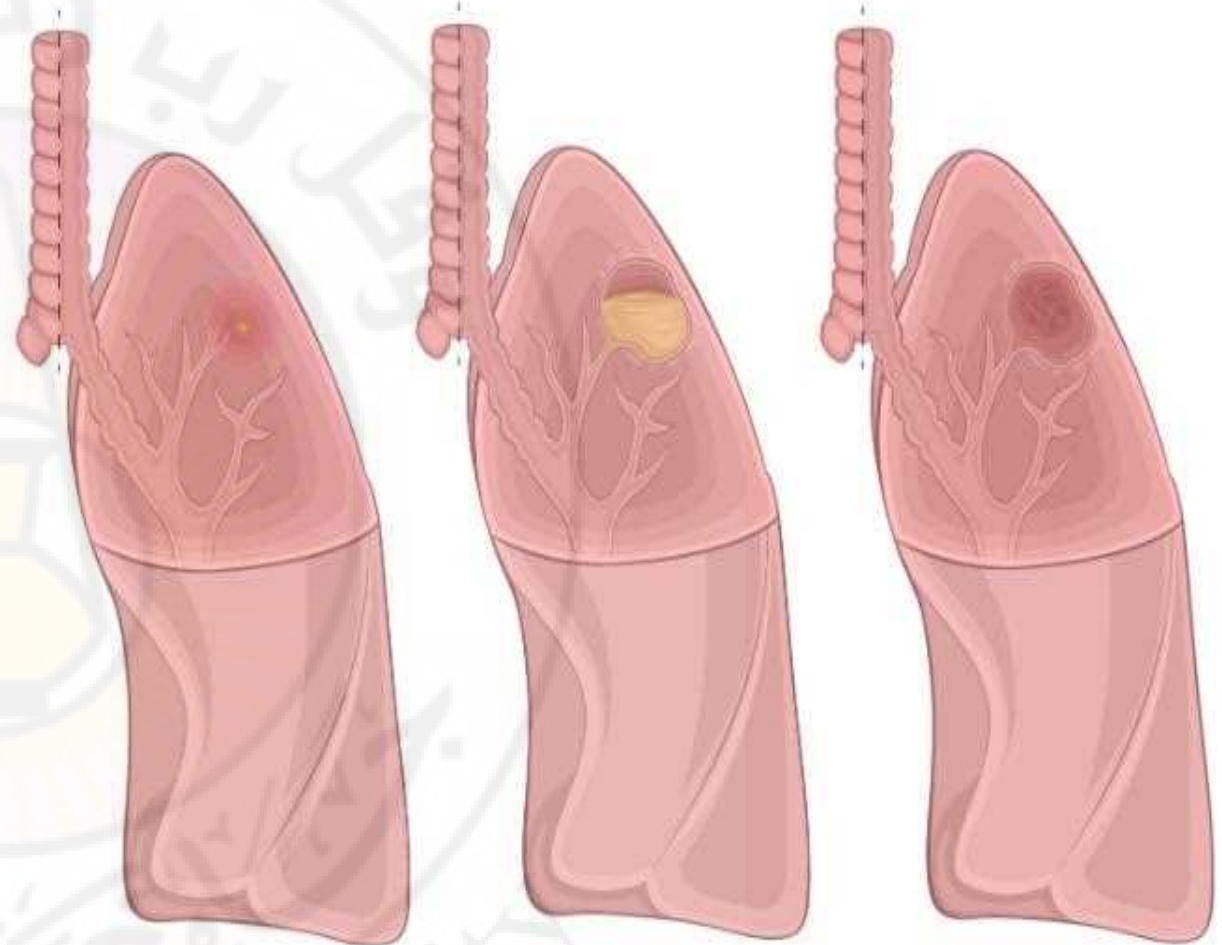
Sub-acute



Chronic

Lung
abscess

Stages of Lung Abscess



I stage

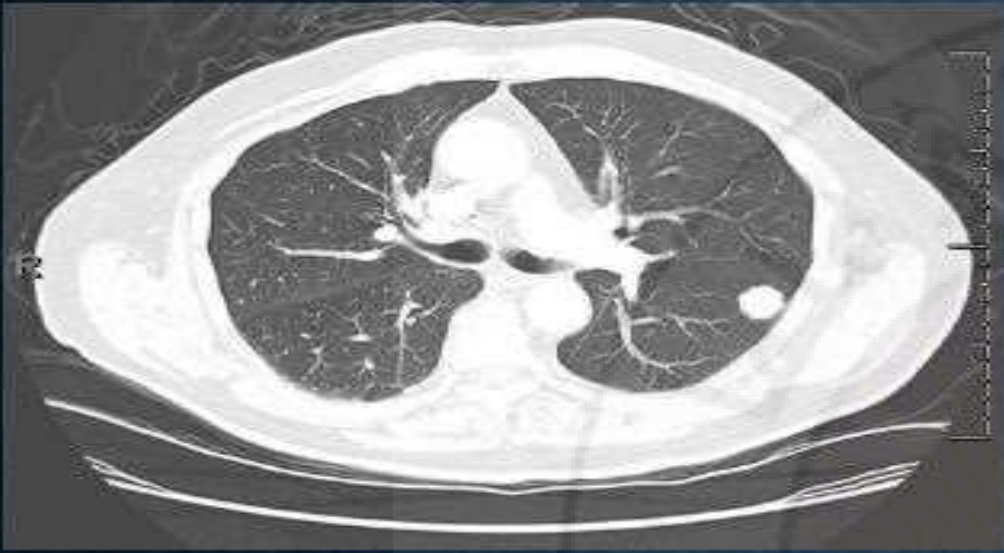
Inflammatory infiltration
of lung tissue

II stage

Formation of a cavity
filled with pus

III stage

Occurs obliteration
of the cavity with the
formation of the area
of pneumosclerosis



NODULE
< 3 CM



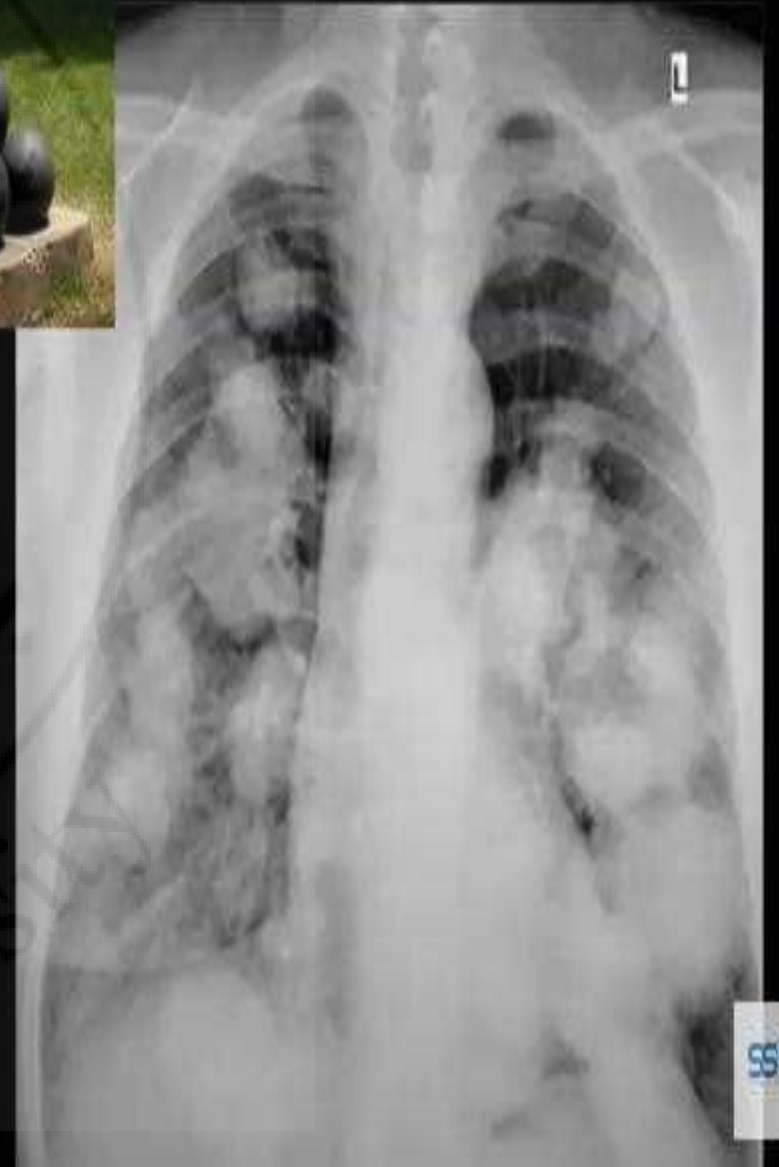
MASS
> 3 CM

- ▶ **Nodule** : well defined lung lesion **< 3 cm**
- ▶ **Mass** : Well defined lung lesion **> 3 cm.**

PULMONARY METASTASIS



Cannon
ball
deposits



MEDIASTINAL ANATOMY

Anterior Mediastinum

Borders

- Anterior: Sternum
- Posterior: Middle mediastinum

Contents

- Thymus
- Lymph Nodes
- Internal Thoracic Vessels
- Thyroid tissue

Middle Mediastinum

Contents

- Pericardium and Heart
- Ascending Aorta
- SVC/IVC
- Brachiocephalic Vessels
- Pulmonary Vessels
- Trachea and Main Bronchi
- Phrenic, Vagus, Left Recurrent Laryngeal Nerves

Superior Mediastinum

Borders

- Manubriosternal joint
- Inferior edge of T4 body

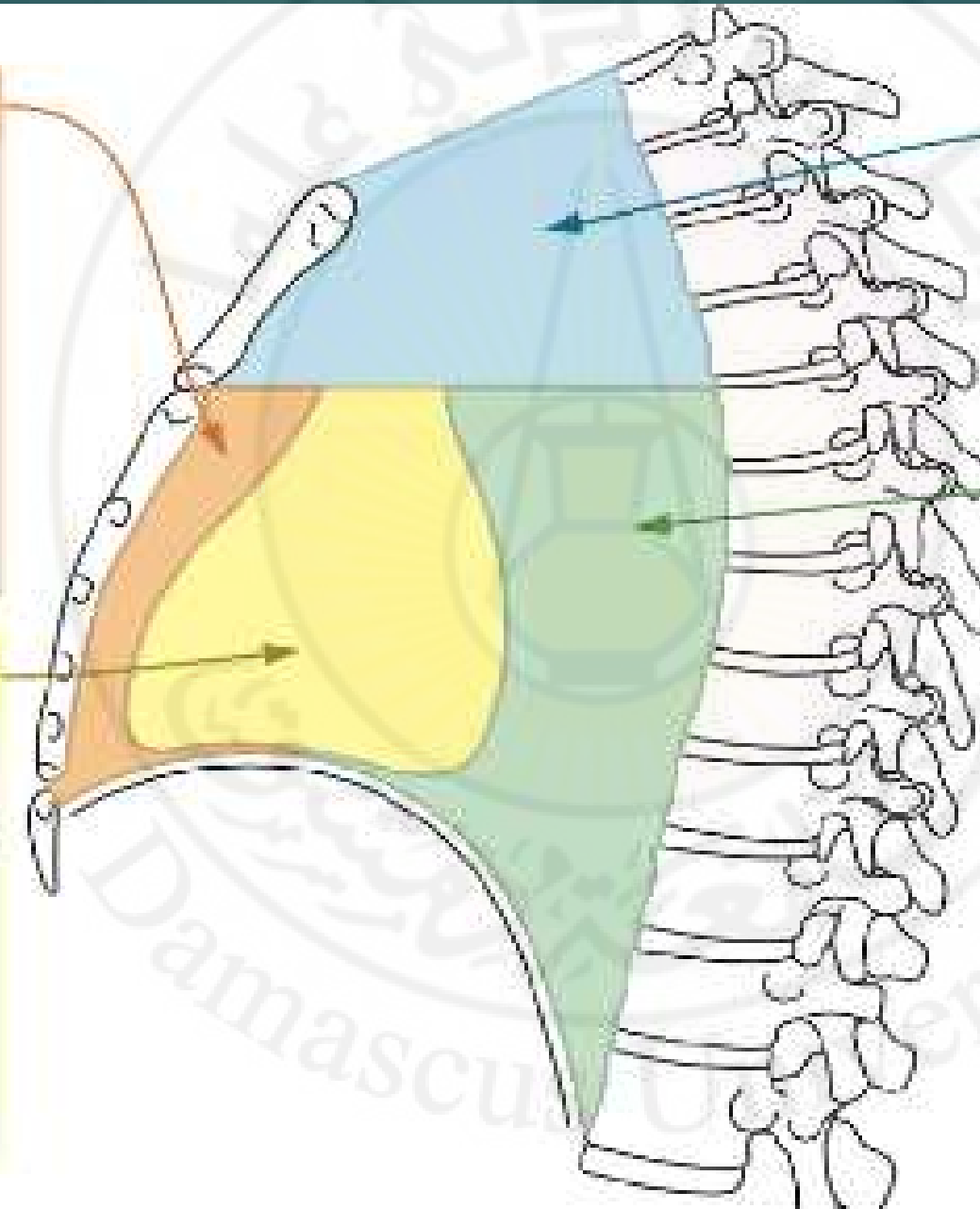
Posterior Mediastinum

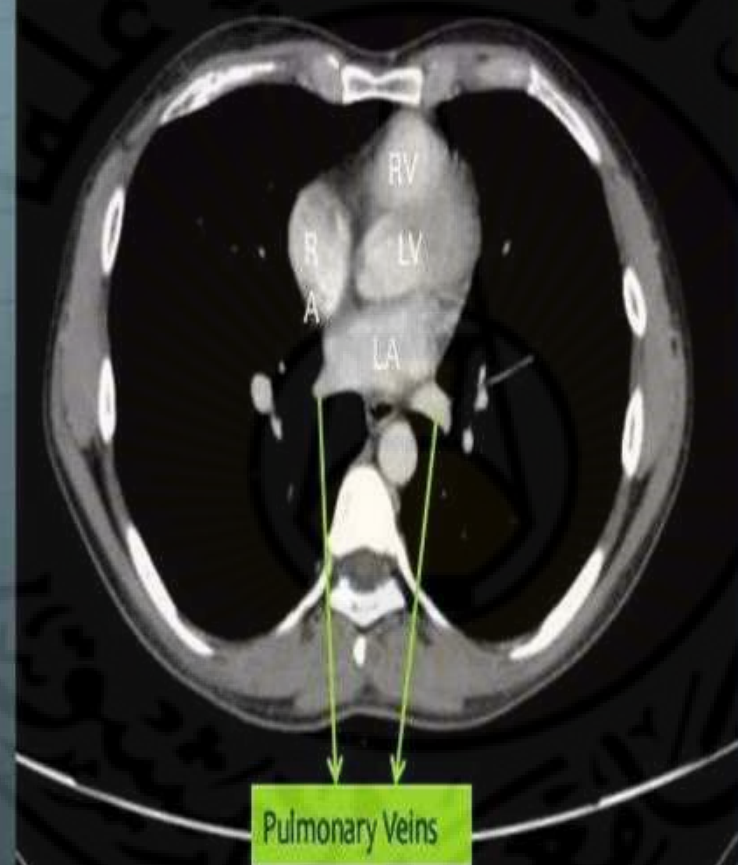
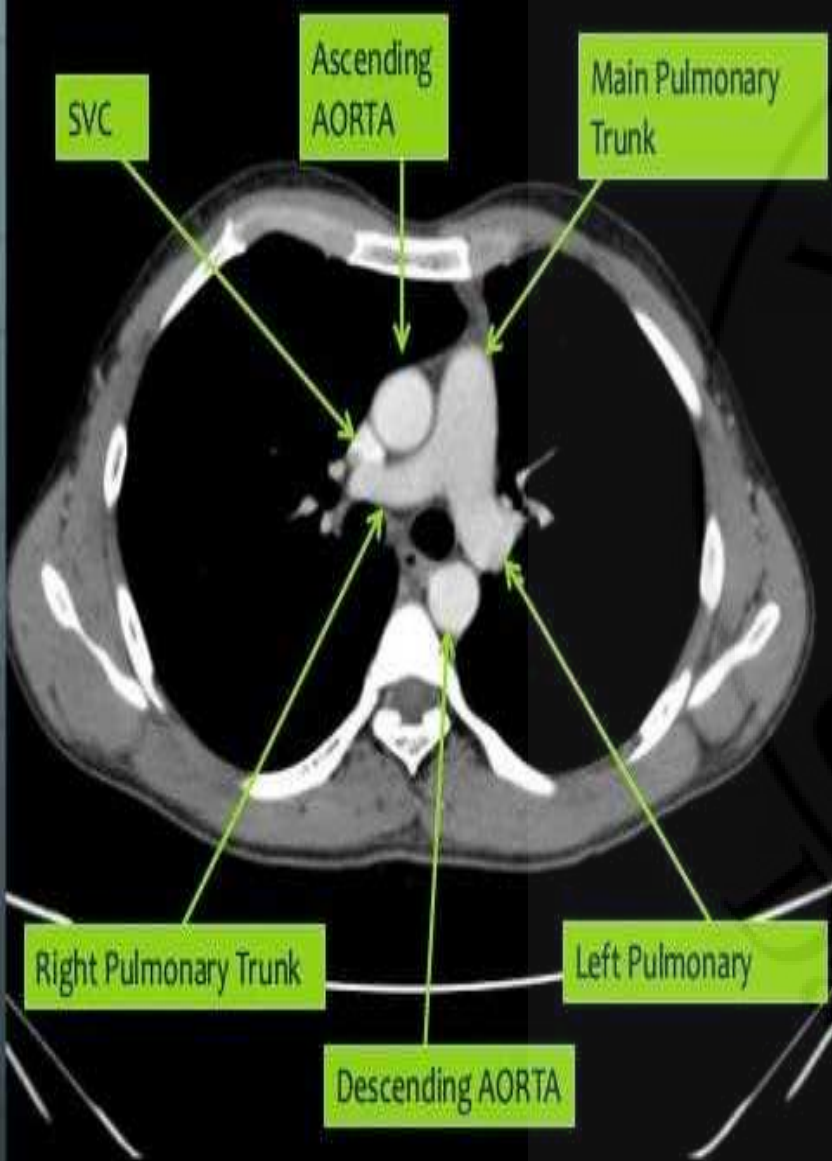
Borders

- Anterior: Middle mediastinum
- Posterior: Anterior thoracic vertebral column

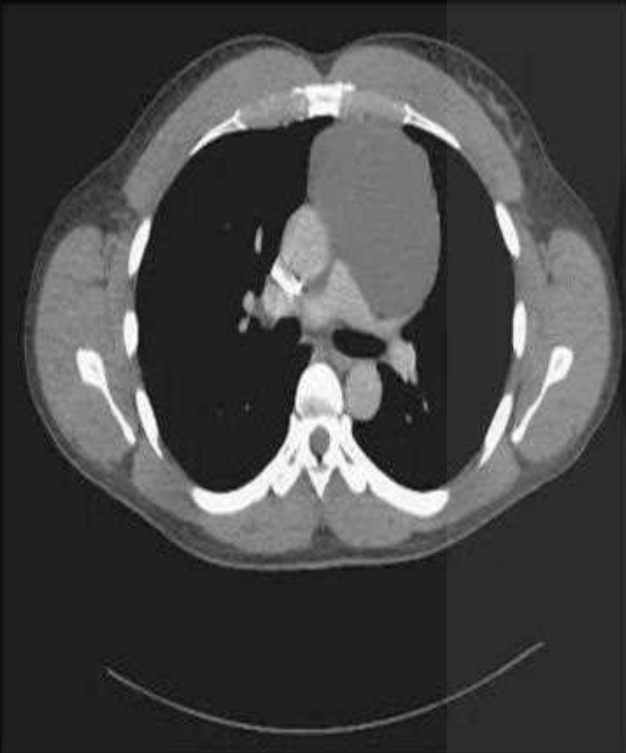
Contents

- Esophagus
- Azygous and Hemiazygous
- Descending Aorta





MEDISTINAL MASSES



ANTERIOR



MIDDLE



POSTERIOR

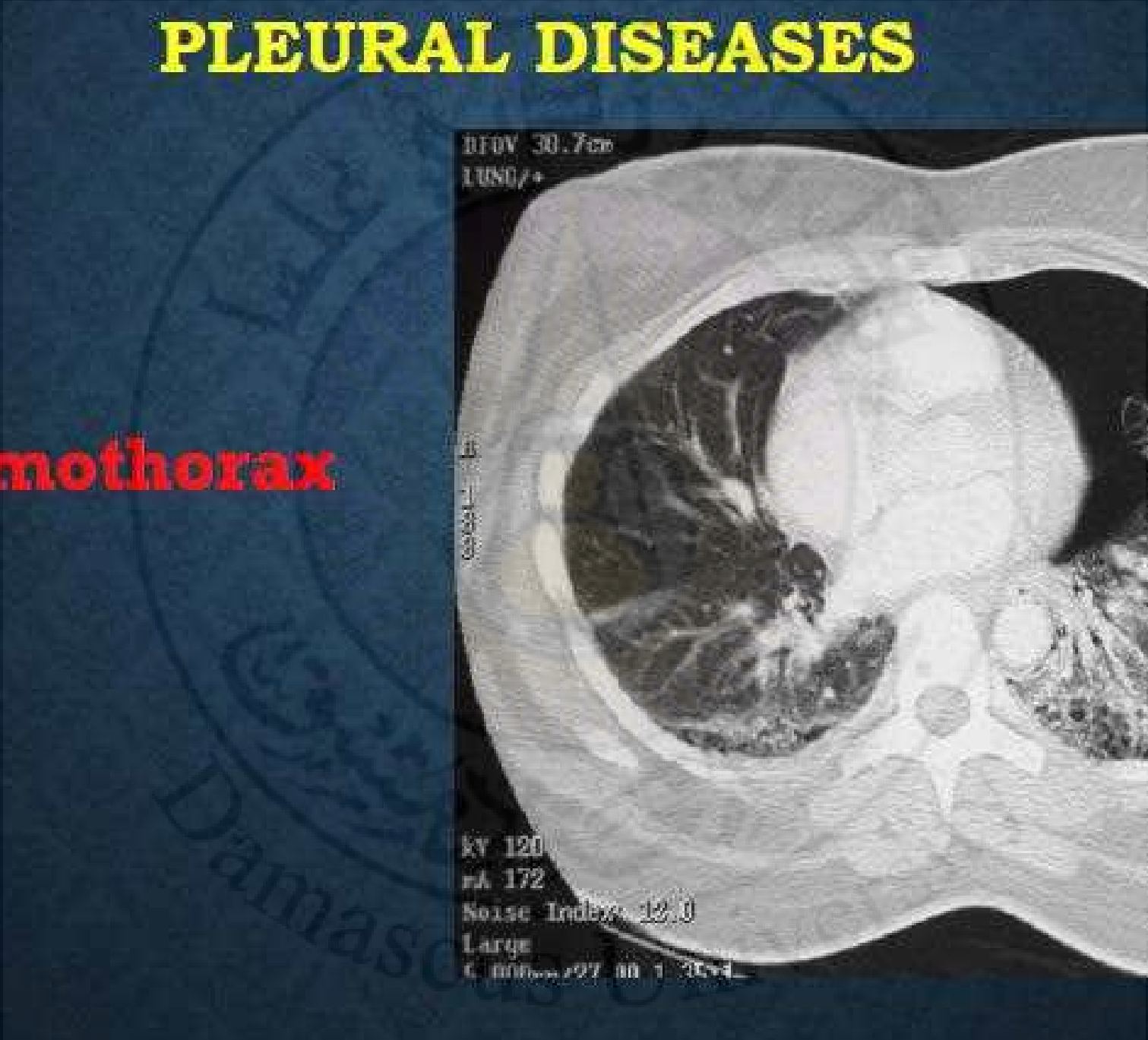
[illegible]

PLEURAL DISEASES

emothorax



DFOV 30.7cm
LUNG/+
kV 120
mA 172
Noise Index 12.0
Large
C. 000000121 on 1 Rev4



Causes of pleural effusion

Transudate	Exudate
Congestive heart failure	Infections
Liver cirrhosis	Tumours (lung, breast, lymphoma)
Nephrotic syndrome	Pulmonary embolism
Peritoneal dialysis	Vasculitis – autoimmune disorders
Myxoedema	Empyema thoracis

Pneumonia



consolidation with air bronchogram

CT ABDOMEN

INDICATIONS

To assess equivocal imaging findings

Staging of hepatic neoplasms

Metastatic workup of primary malignancies

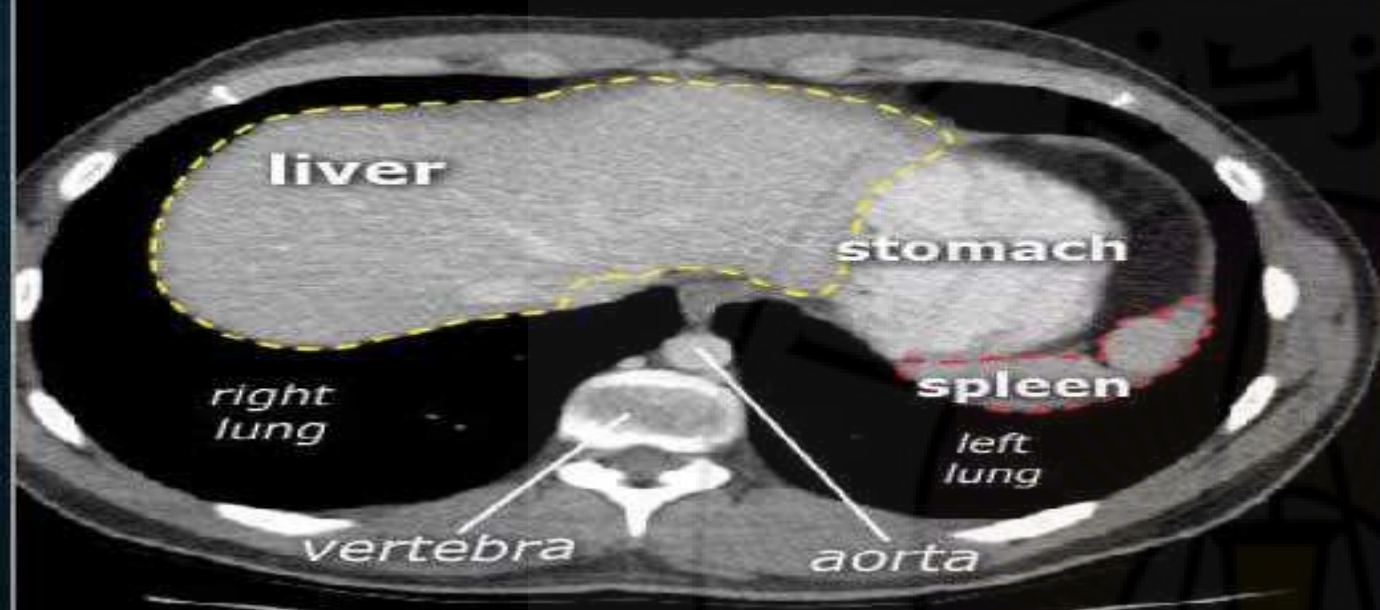
Diagnosis of abdominal masses

Assessment of biliary problems

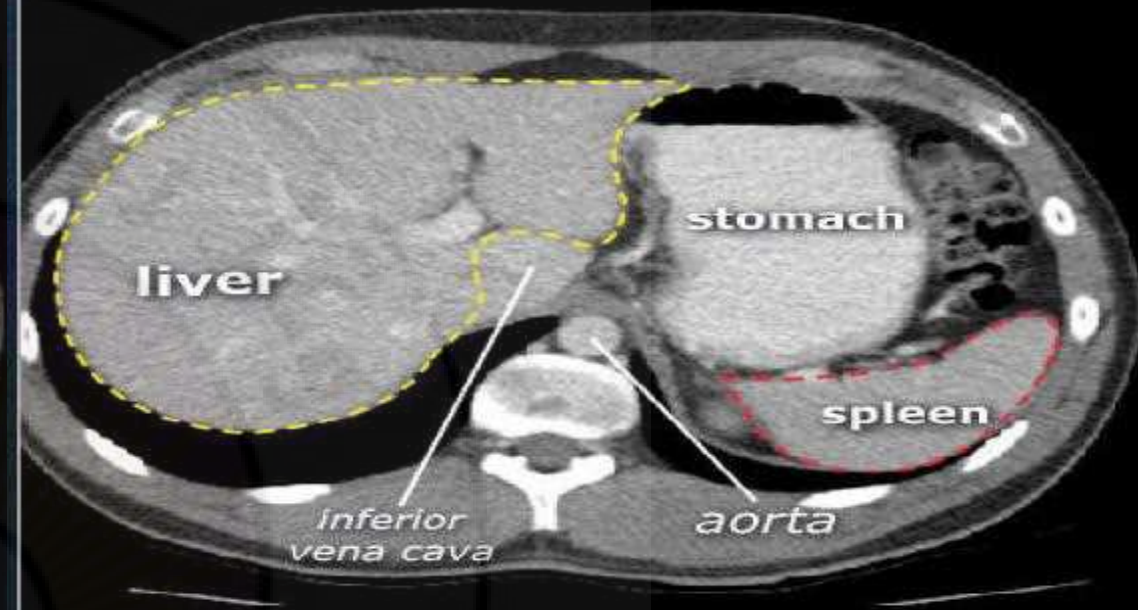
Diagnosis of vascular lesions

Assessment of suspected post-traumatic complications

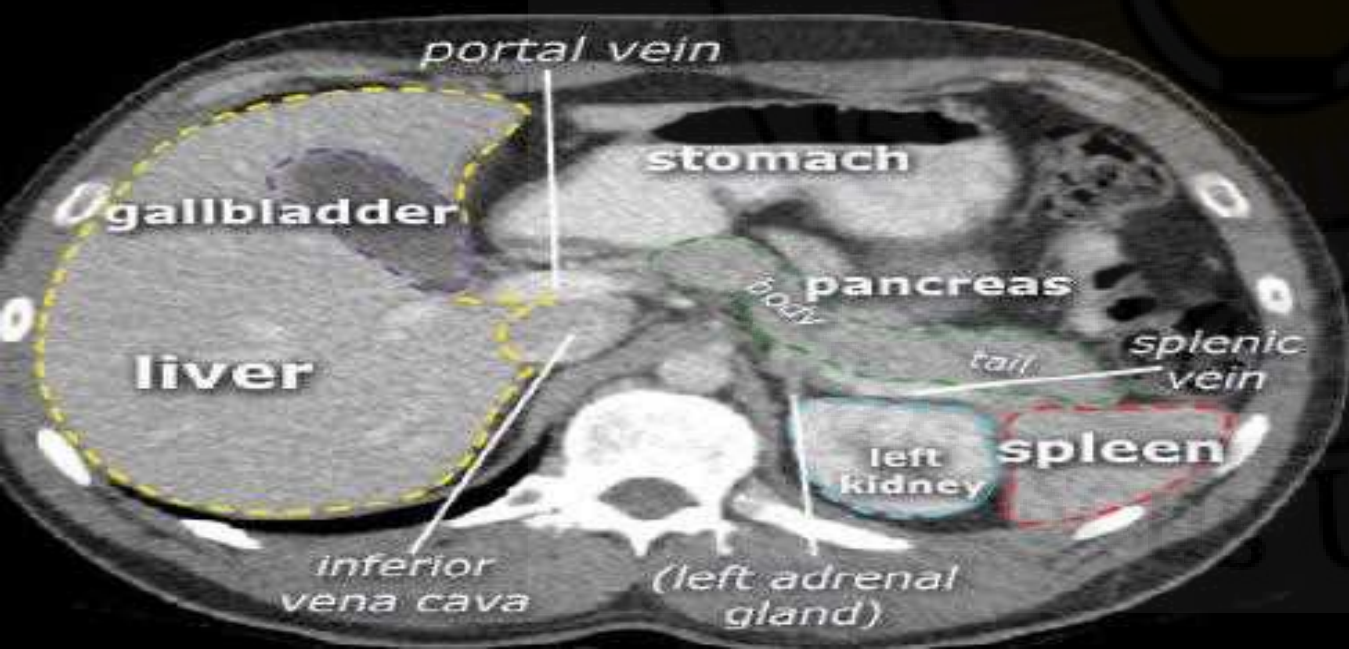
Normal abdominal CT



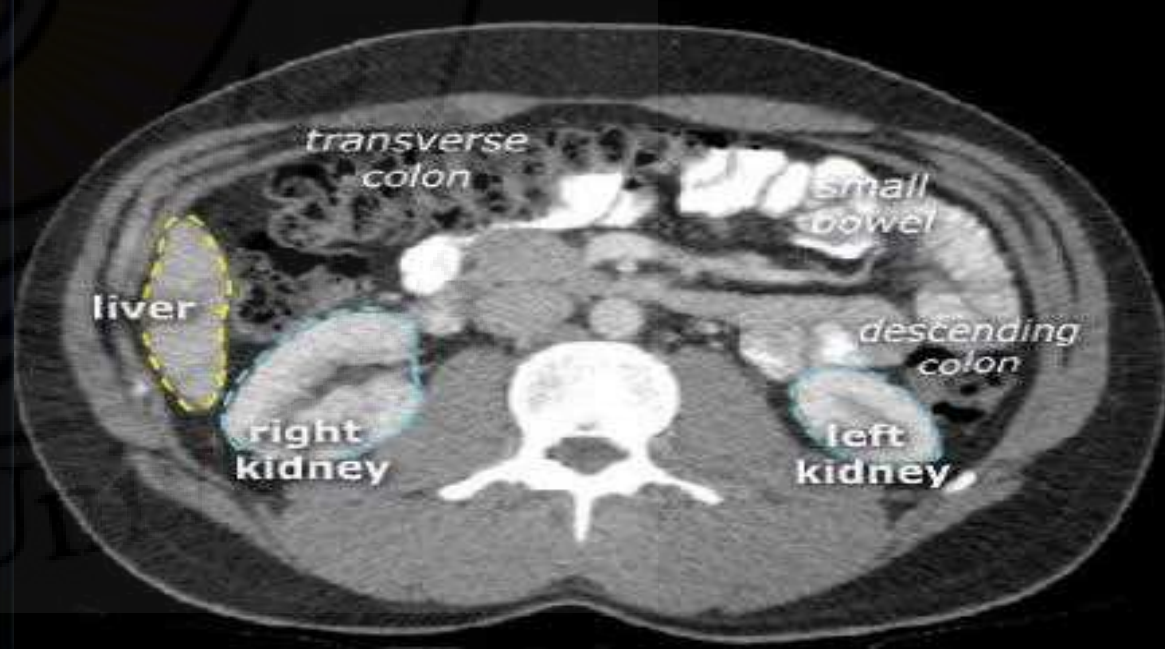
Normal abdominal CT



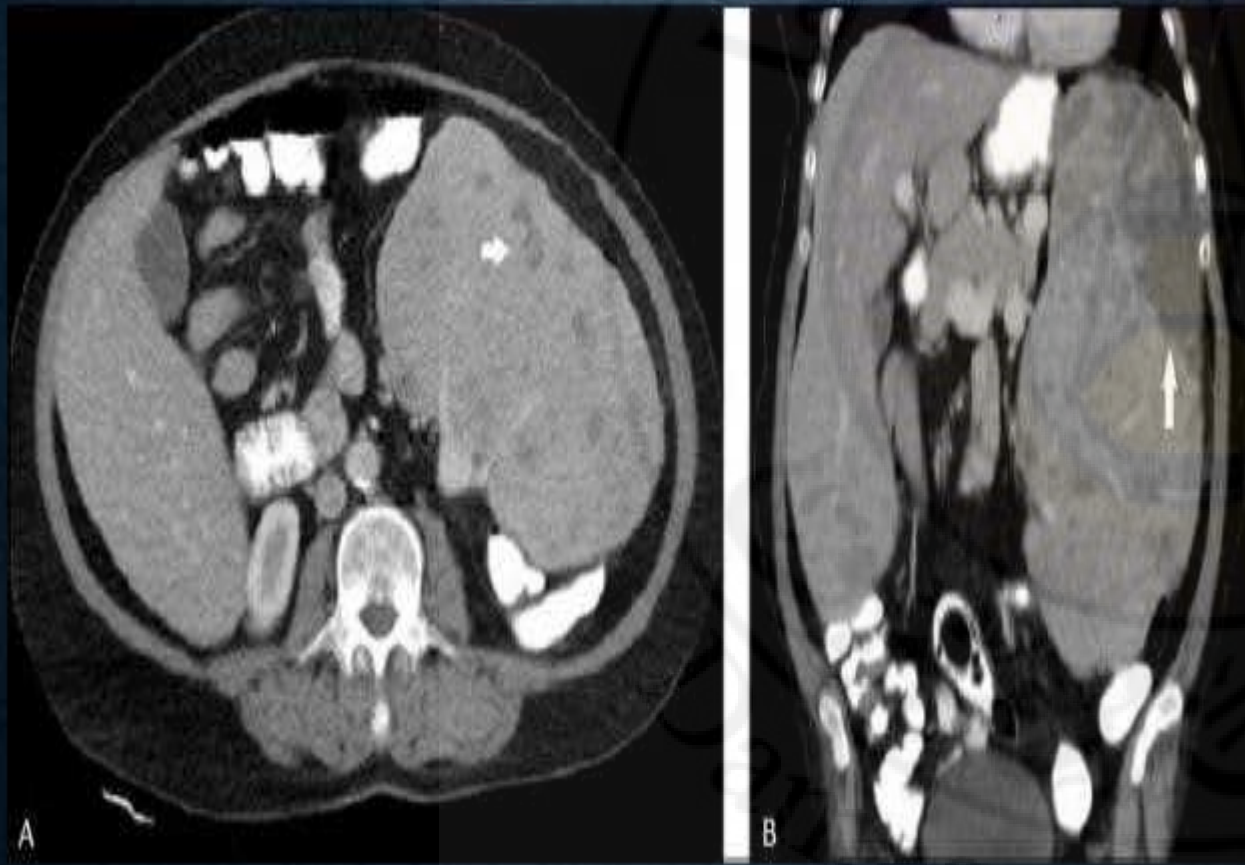
Normal abdominal CT



Normal abdominal CT



HEPATOSPLENOMEGALY



Hepatosplenomegaly: Causes

■ Infective:

- Viral: Hepatotrophic (A,B,C,D,E) and other viruses (herpes, cytomegalo, Epstein-Barr, varicella, HIV, rubella, adeno, entero, arbo.)
- Protozoal: malaria, kala-azar, amoebic, toxoplasma
- Bacterial: sepsis; tuberculosis, brucellosis, syphilis,
- Helminths: hydatid, visceral leishmaniasis
- Fungal: histoplasmosis

■ Malignancies:

- Leukemia, histiocytic syndromes, myeloproliferative syndromes, lymphomas,

■ Immunological:

- Chronic granulomatous, hereditary neutrophilia, Ornstein-Ehrlich syndrome.

■ Developmental:

- Congenital hepatic fibrosis

■ Congestive:

- Hepatic vein obstruction, constrictive pericarditis

■ Haemopoietic:

- Haemolytic: haemolytic disease of newborn, thalassaemia;
- Anaemia

■ Metabolic:

- Niemann-Pick, gangliosidosis, Gaucher, fucosidosis, Wolman, glycogen storage, sialidosis, galactosialidosis, α -mannosidosis.



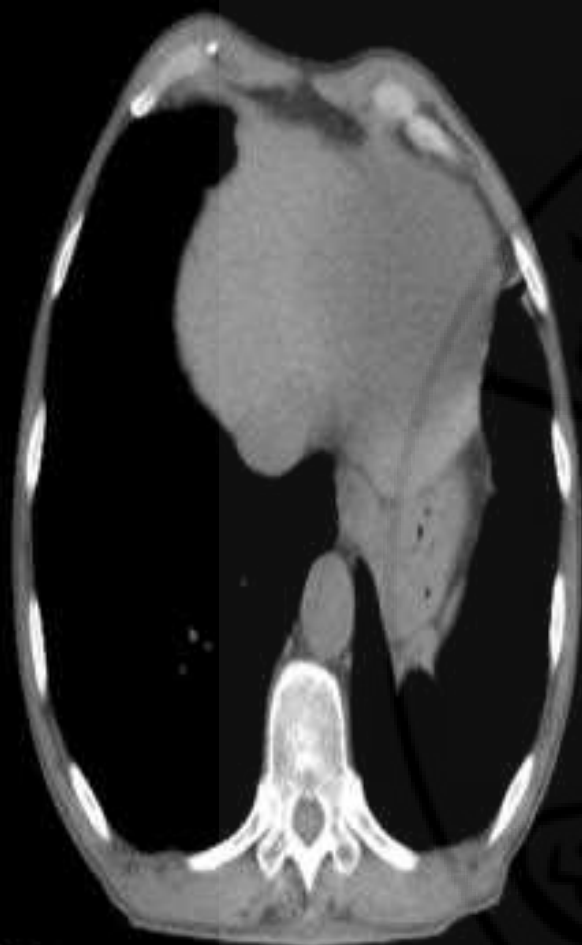
Measure Spleen CT

01/01/1972
ID: 10778733
Male
51 Years

Chest - Abdomen - Pelvis 01/01/1972
Study ID: 10617 ID: 10778733
Ac. No: 244165 Male
Acq: 15/05/2023 51 Years
Acq: 01:53:19

Chest - Abdomen - Pelvis
Study ID: 10617
Ac. No: 244165
Acq: 15/05/2023
Acq: 01:53:21

10 cm
R



Frame: [40] 40 / 98
Zoom: 164.35%
WindowLevel: 400/30
Pixel No value - Outside image
CT (512x512) - AXIAL

10 cm
R



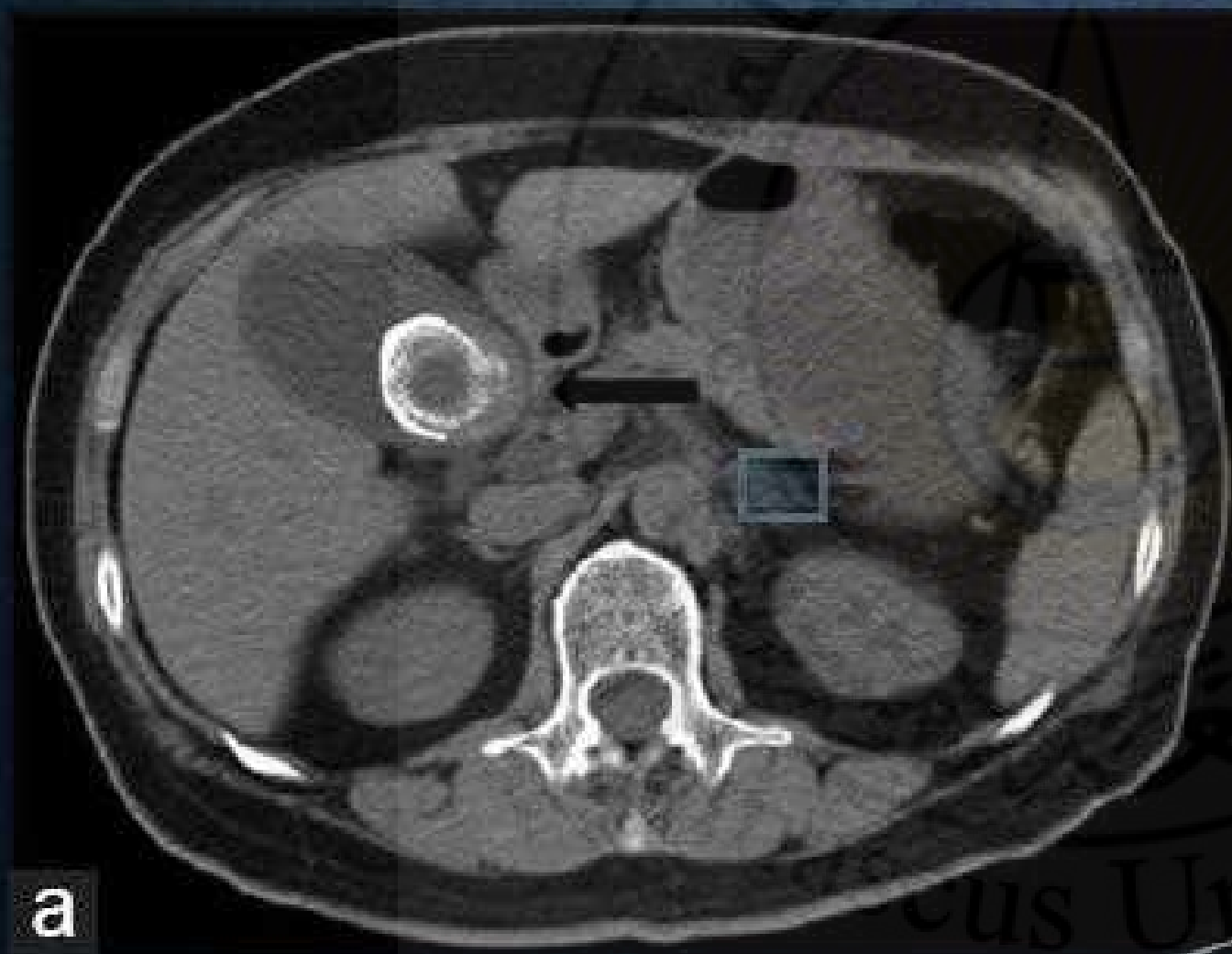
Frame: [54] 54 / 98
Zoom: 164.35%
Series No: 2
Lung Abdomen
Thickness: 5 mm
Location: 375.1 mm

Frame: [54] 54 / 98
Zoom: 164.35%
WindowLevel: 400/30
Pixel: 998 - HU - (443,307)
CT (512x512) - AXIAL

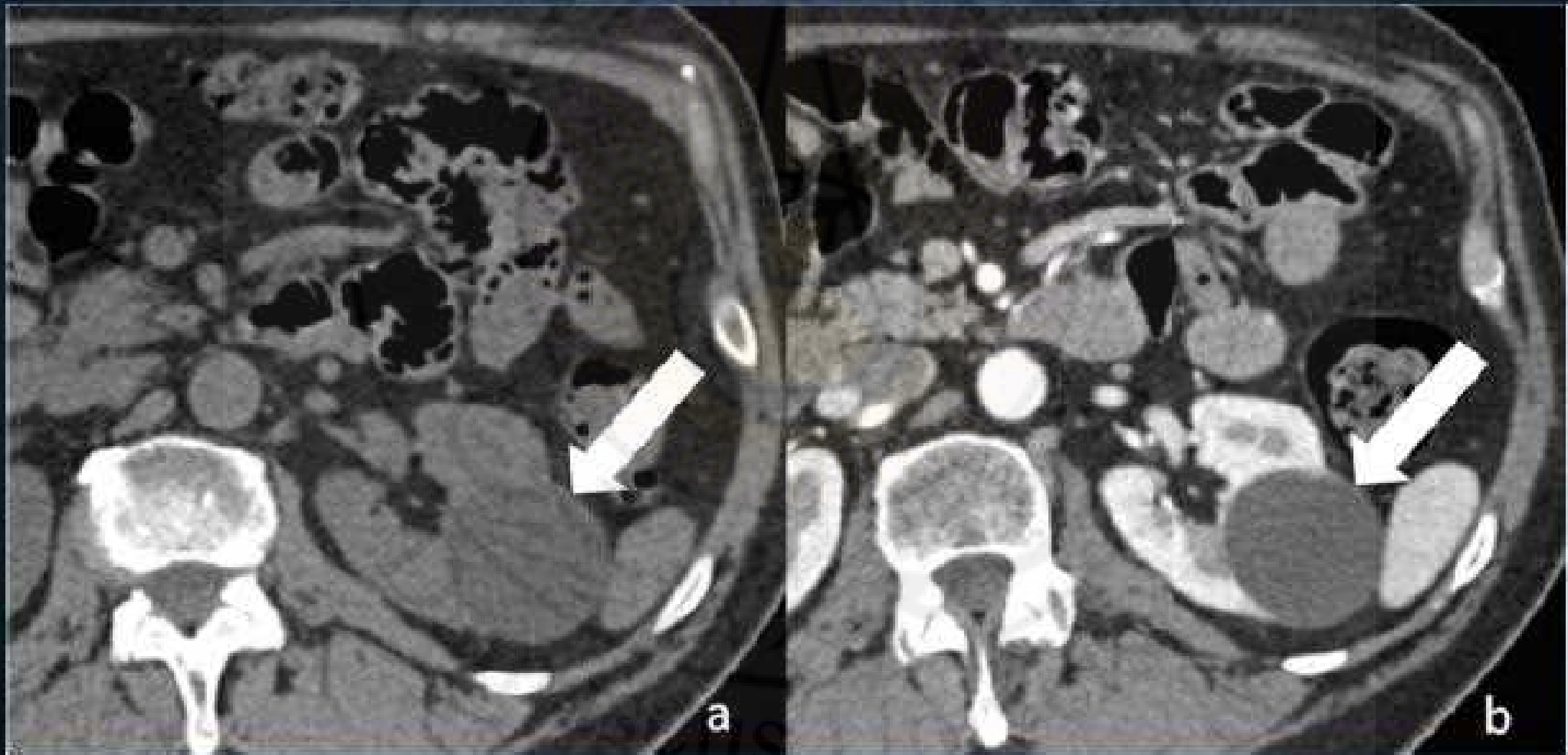
Series No: 2
Lung Abdomen
Thickness: 5 mm
Location: 471.1 mm

Measure Spleen CT

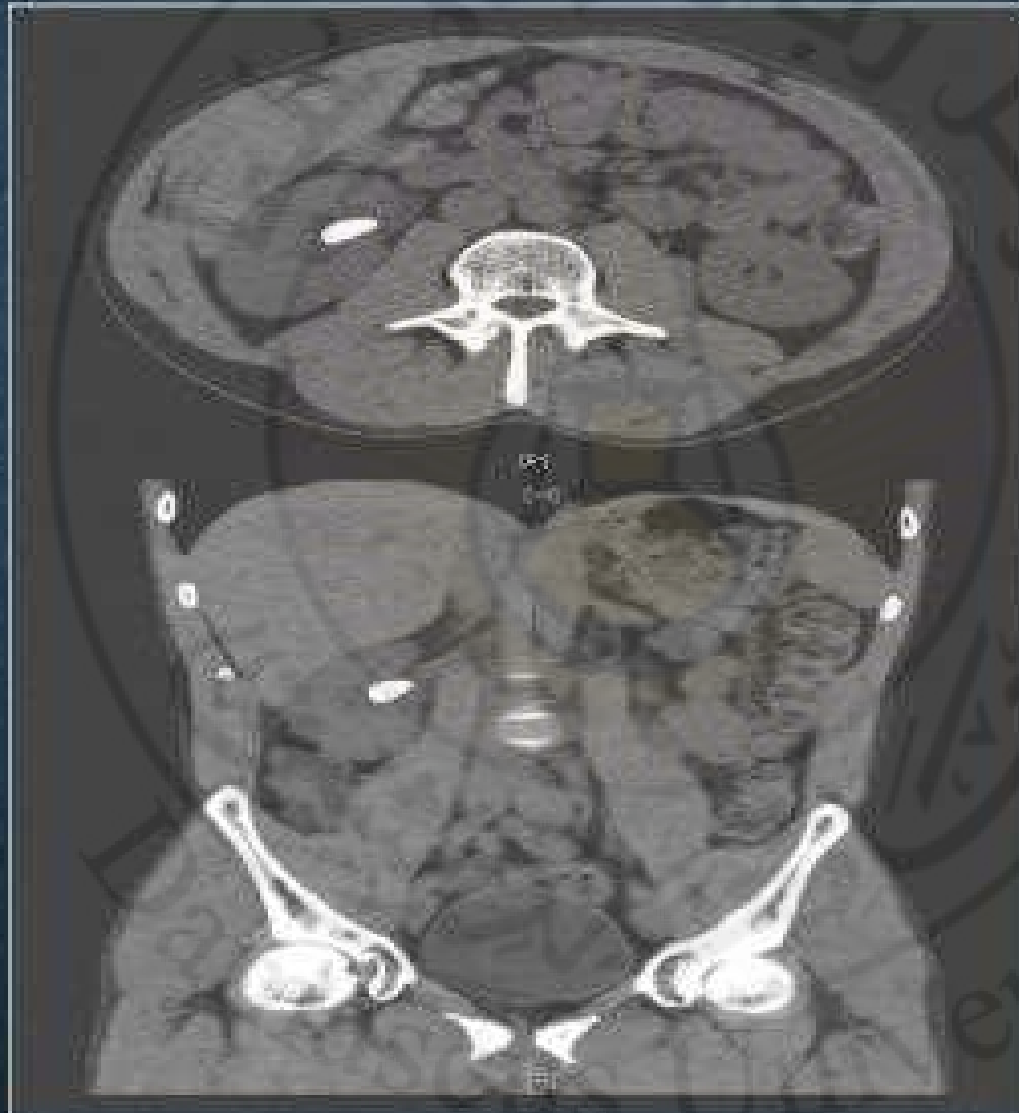
GALL STONES



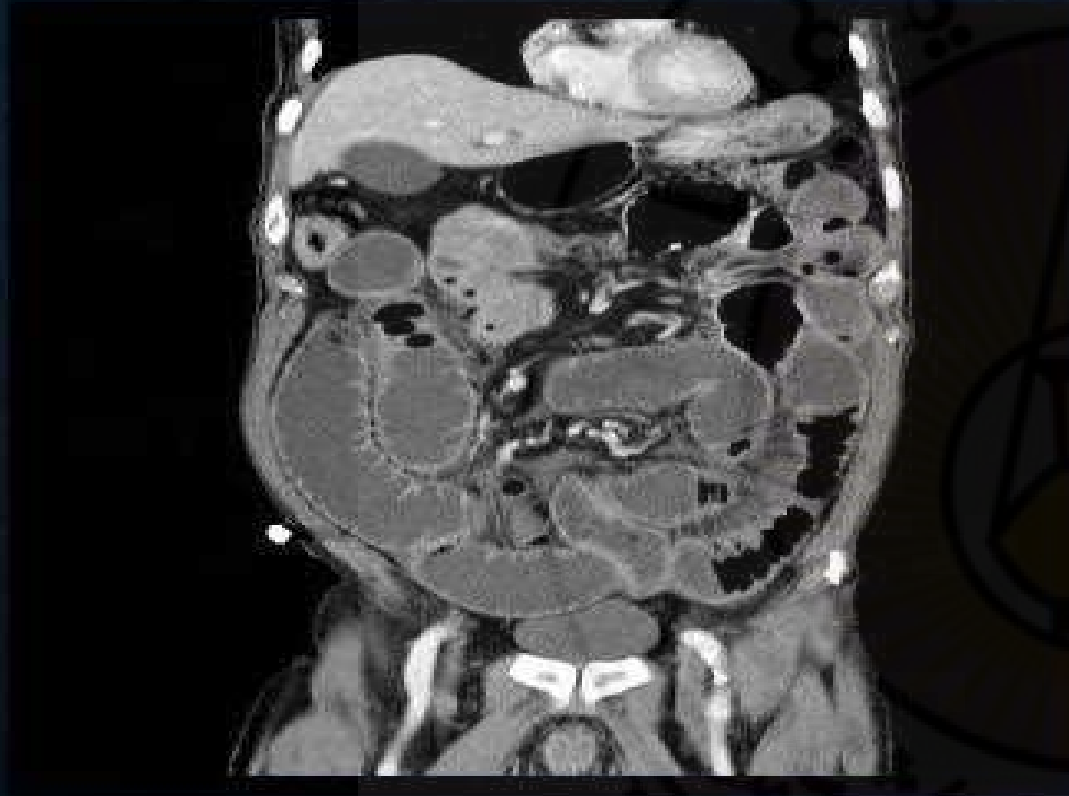
RENAL CYST



RENAL STONE



BOWEL OBSTRUCTION



Bowel obstructions are common and account for 20% of admissions with "surgical abdomens". Radiology is important in confirming the diagnosis and identifying the underlying cause.

Etiology

Small bowel obstruction

adhesions

hernias

malignancies³

Large bowel obstruction

cancer

volvulus

diverticular disease³

CT FINDINGS

A DISTINCT TRANSITION POINT WHERE BOWEL CALIBER CHANGES FROM NORMAL TO ABNORMAL

DILATED BOWEL LOOPS PROXIMAL TO THE TRANSITION POINT .1

small bowel >3.0 cm •

large bowel >5 cm •

a small bowel size threshold of 2.5 cm increases sensitivity for partial small bowel obstruction

COLLAPSED OR NORMAL CALIBER BOWEL DISTAL TO THE TRANSITIONAL POINT.

BOWEL WALL THICKENING.

SURROUNDING MESENTERIC FAT STRANDING INDICATING INFLAMMATION.

TWISTING OF THE MESENTERY IN CASES OF VOLVULUS .

Figure 2. Small bowel obstruction, CT with intravenous contrast only. Without orally administered contrast, fluid and air within the small bowel provide inherent contrast. IV contrast assists in recognition of bowel viability.

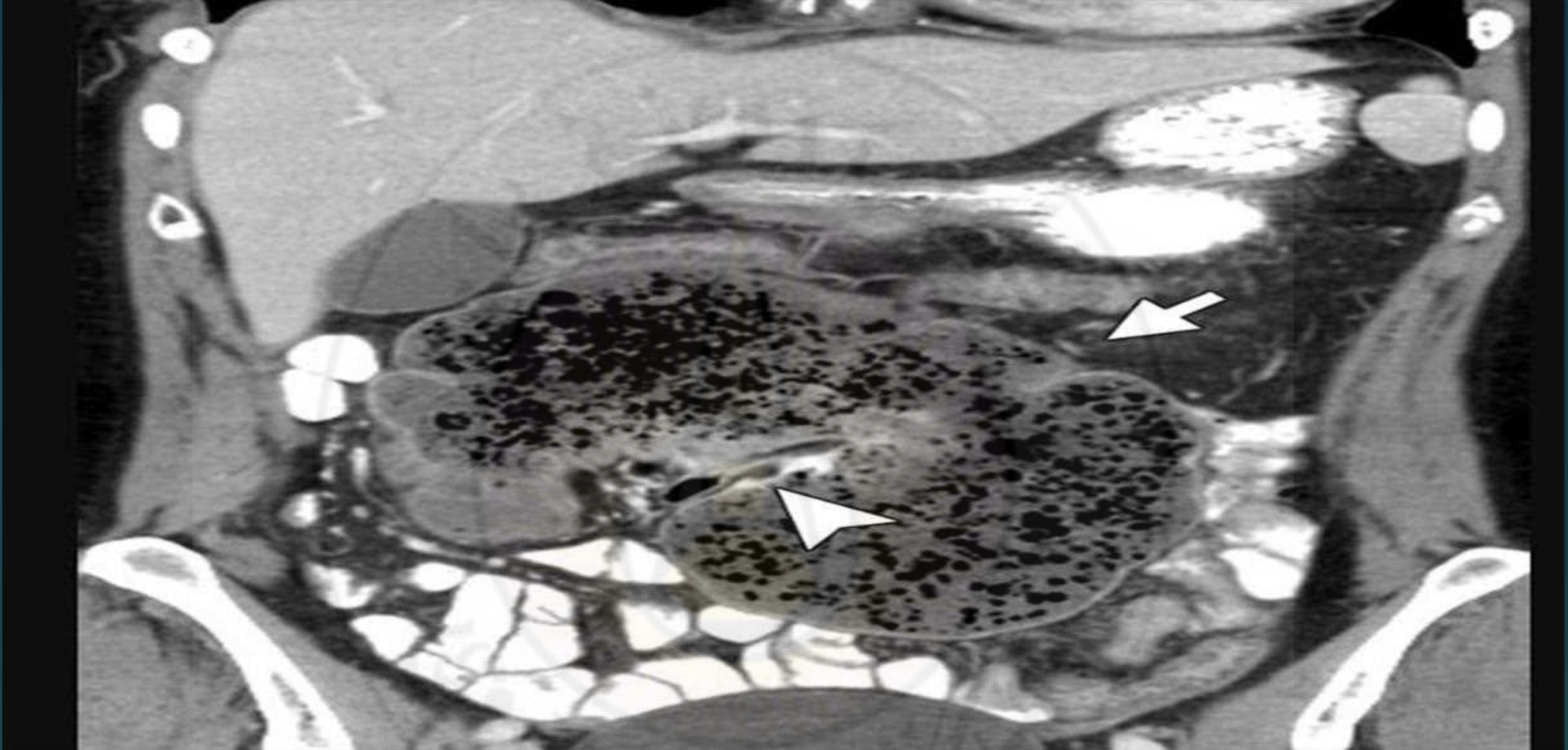
decompressed
small bowel
distal to the
point of
obstruction

the point of
obstruction, or
transition point

dilated bowel (>2.5cm diameter)
containing fluid

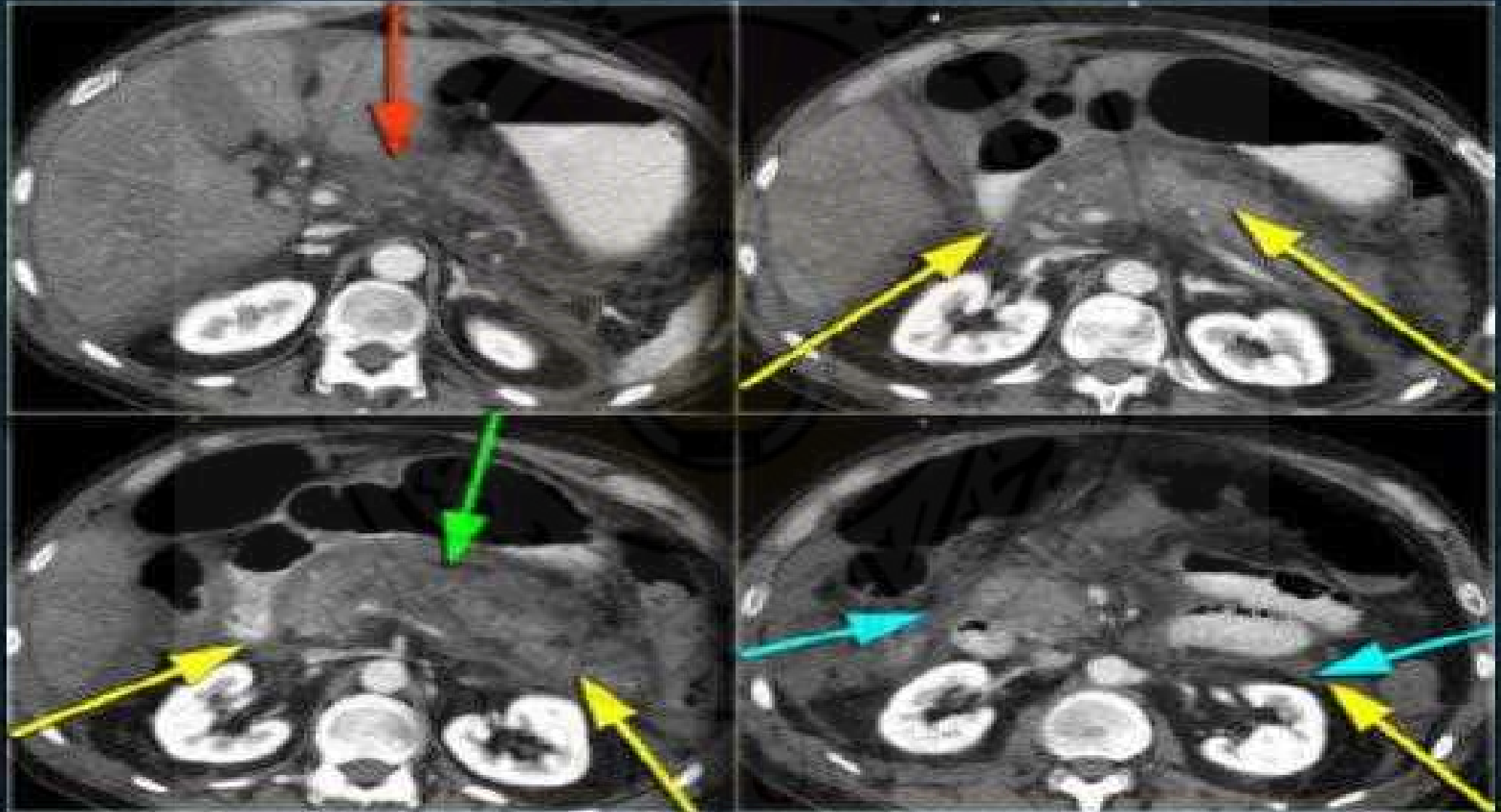
dilated bowel
with bright
enhancement
of viable bowel
wall with IV
contrast





LARGE BOWEL OBSTRUCTION

PACREATITIS



Pancreatitis

refers to inflammation involving the pancreas.

acute pancreatitis

chronic pancreatitis

Causes of pancreatitis

idiopathic

gallstones, genetic - cystic fibrosis

trauma

steroids

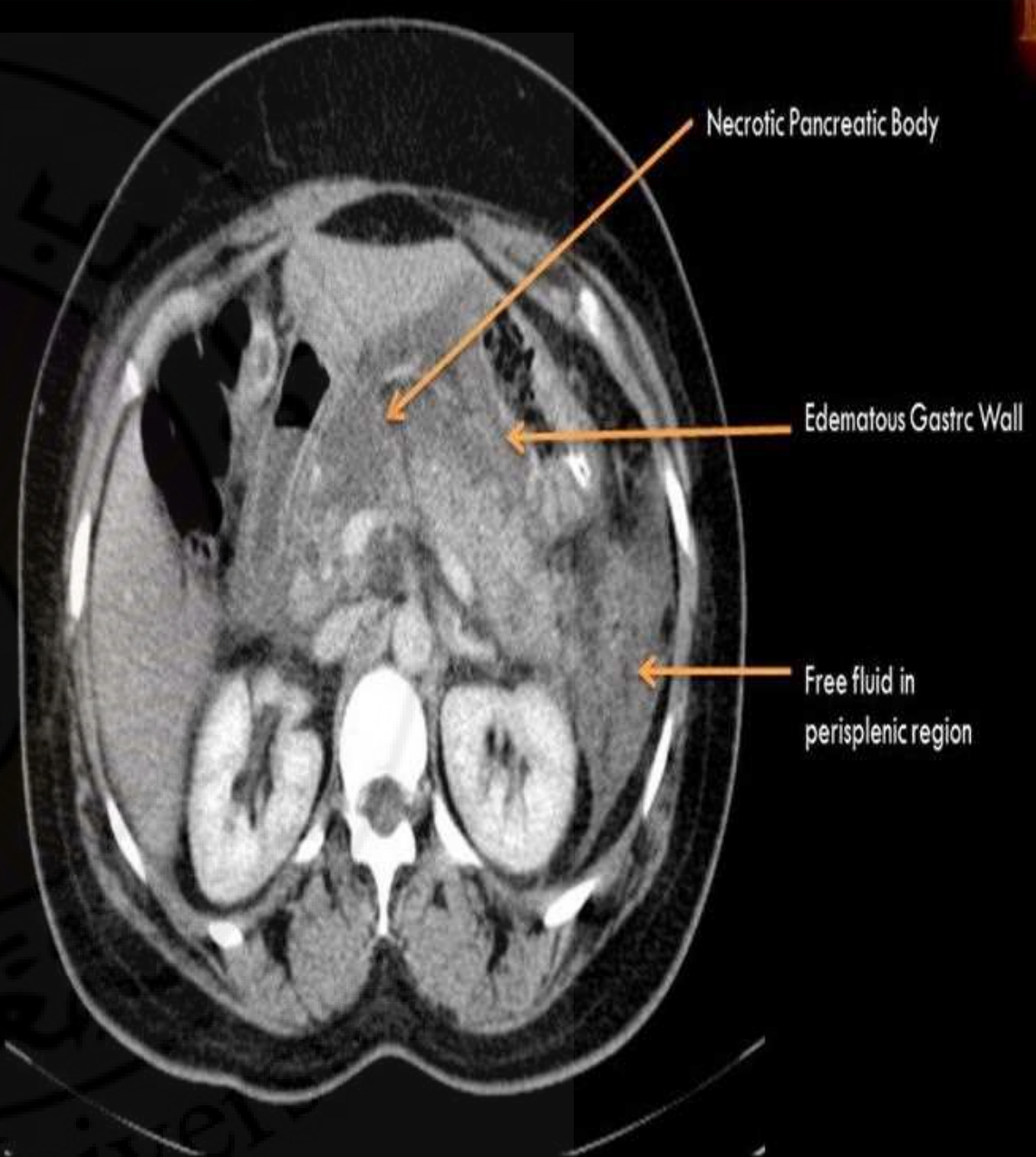
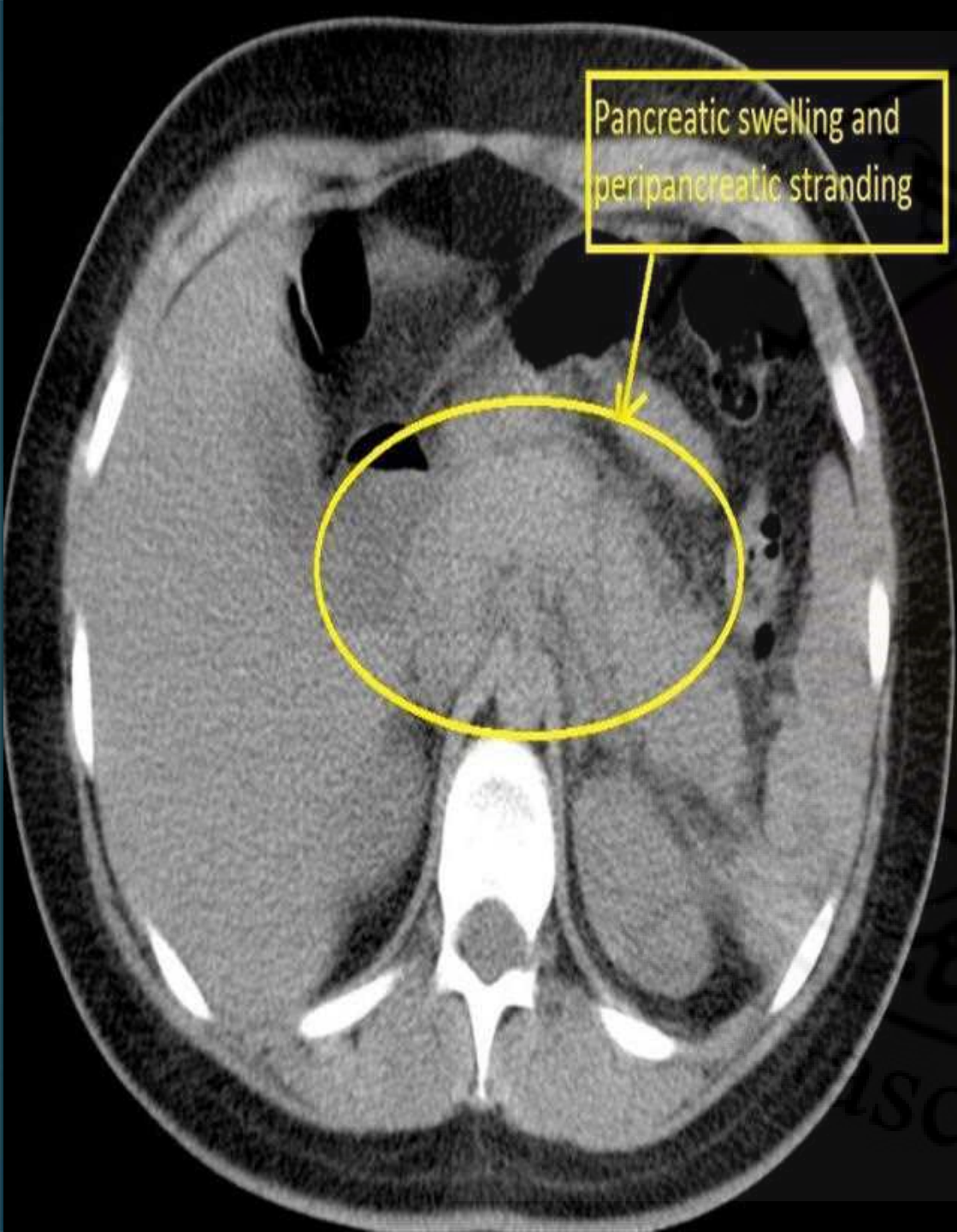
mumps (and other infections)/malignancy

autoimmune

hyperlipidemia/hypercalcemia/hyperparathyroidism (metabolic disorders)

ERCP

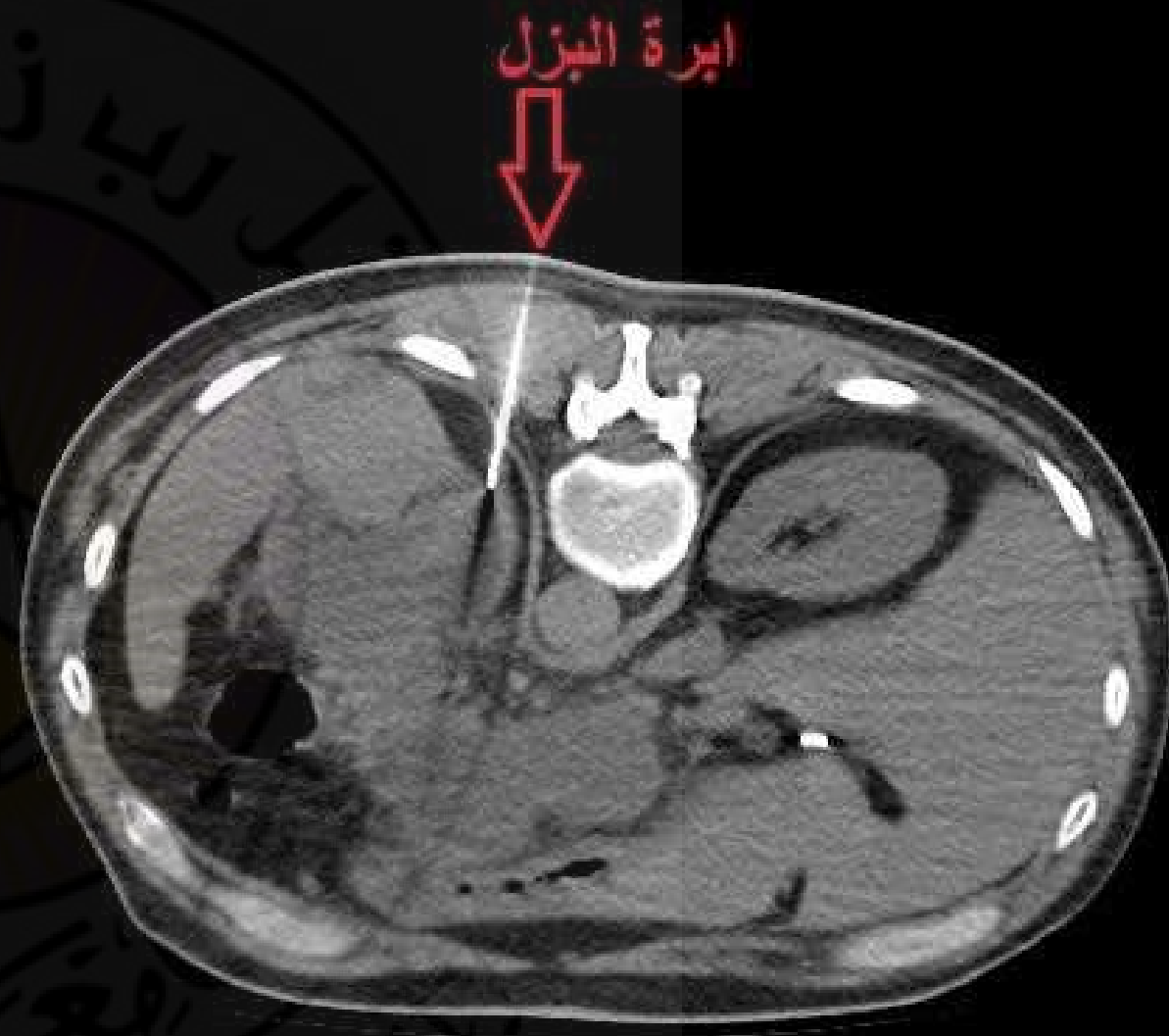
drugs (tetracyclines, furosemide, azathioprine, thiazides and many others)



The pancreatic necrosis is ~50%. Along with ascites, pleural effusion (+2), Peripancreatic fat standing and fluid (+4), the >30% parenchymal necrosis (+4) makes a Modified CT Severity Index score of 10 out of 10 → SEVERE ACUTE PANCREATITIS.

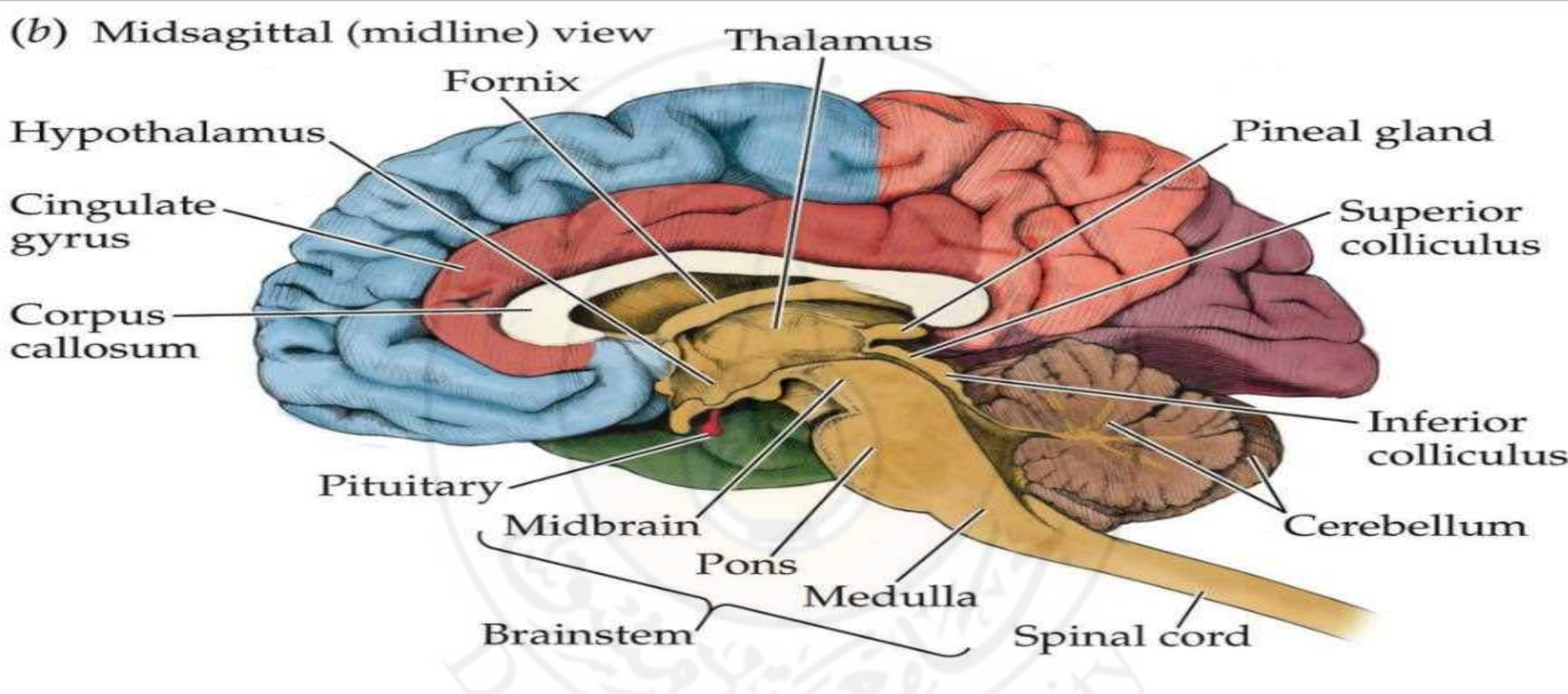


**CHRONIC PANCREATITIS
CALCIFICATIONS**



تفميم التهاب بنكرياس نخري
د.مهند إبراهيم

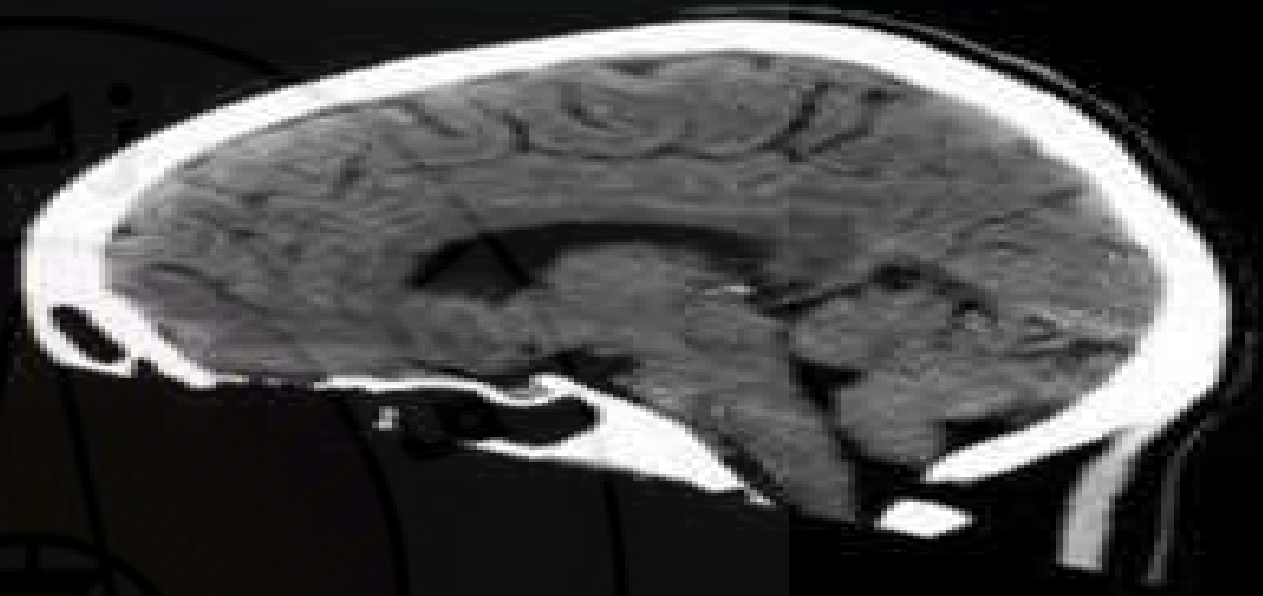




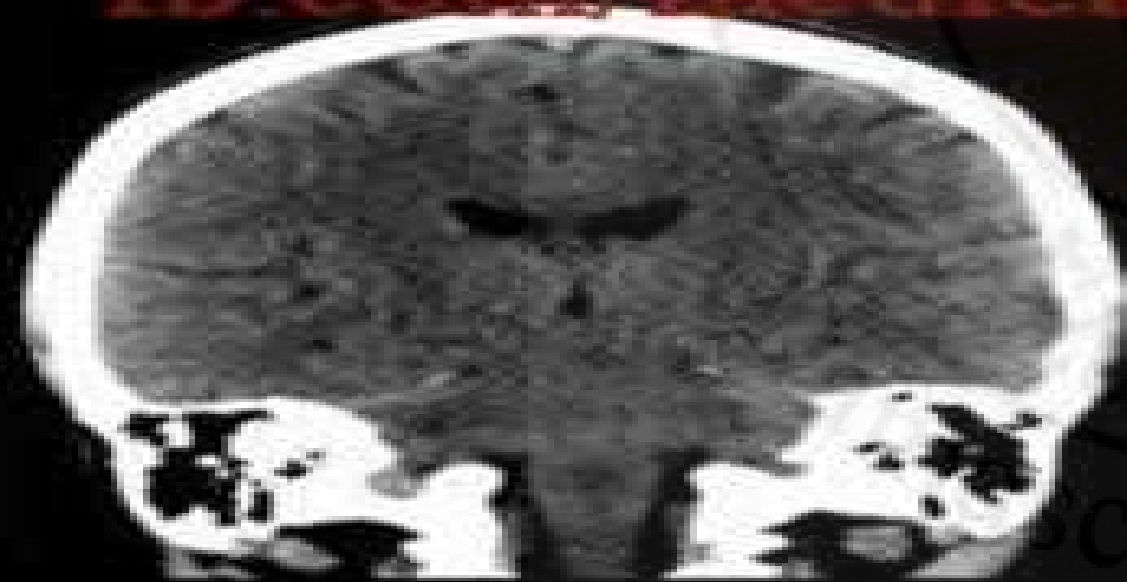
BRAIN ANATOMY



Axial plane



Sagittal plane

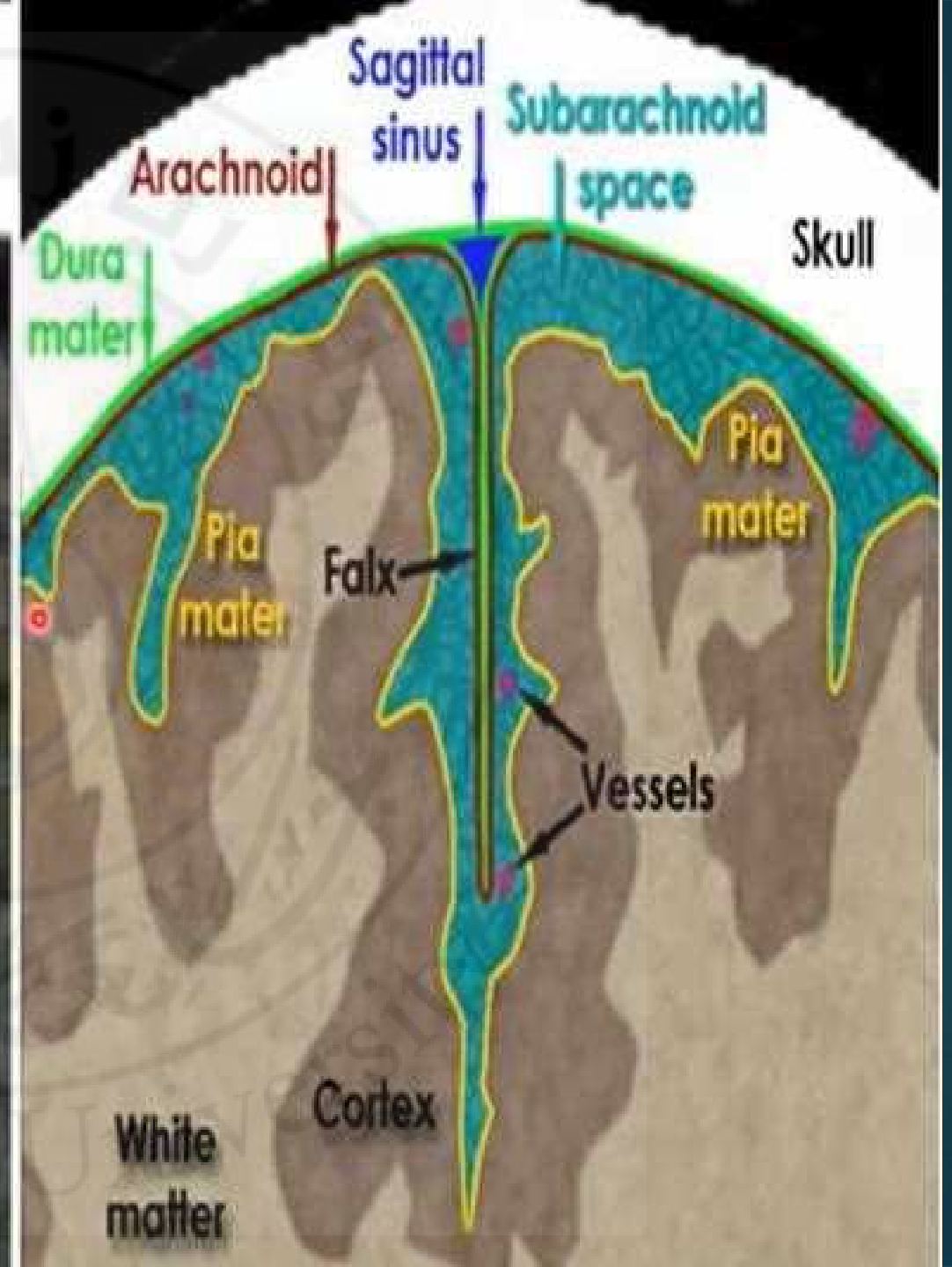
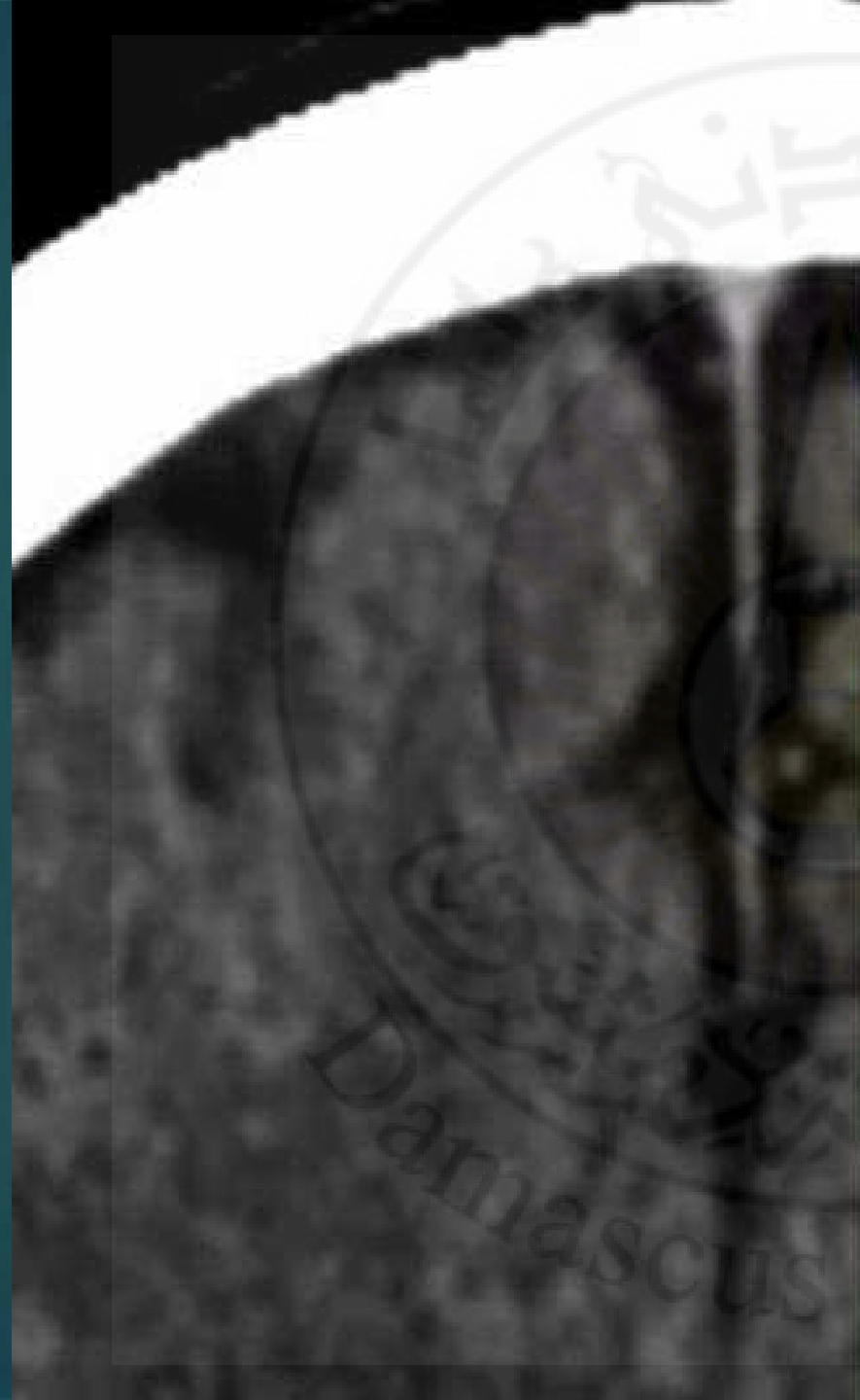


Coronal plane

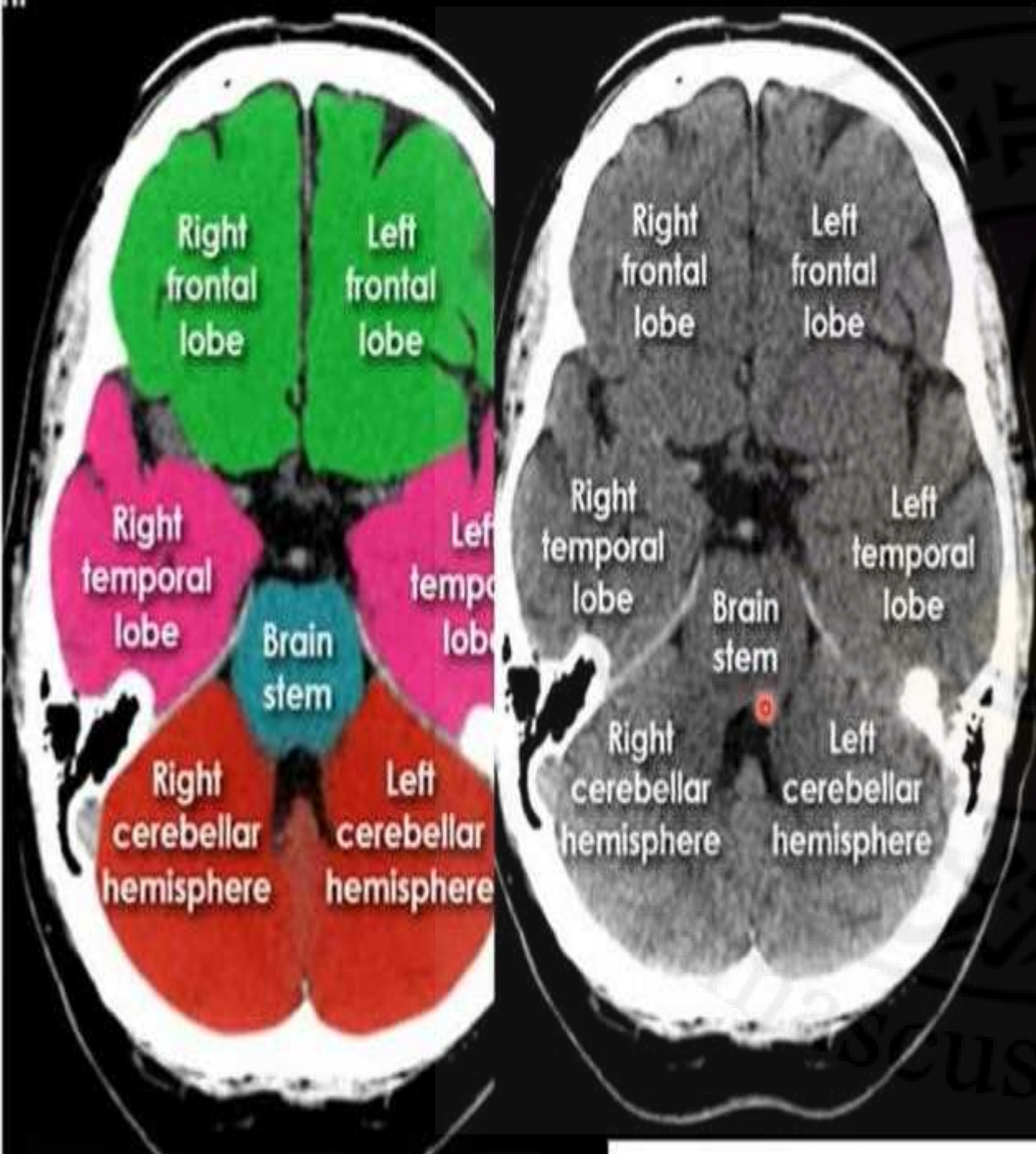
fb.com/medicalonline1

Scus University

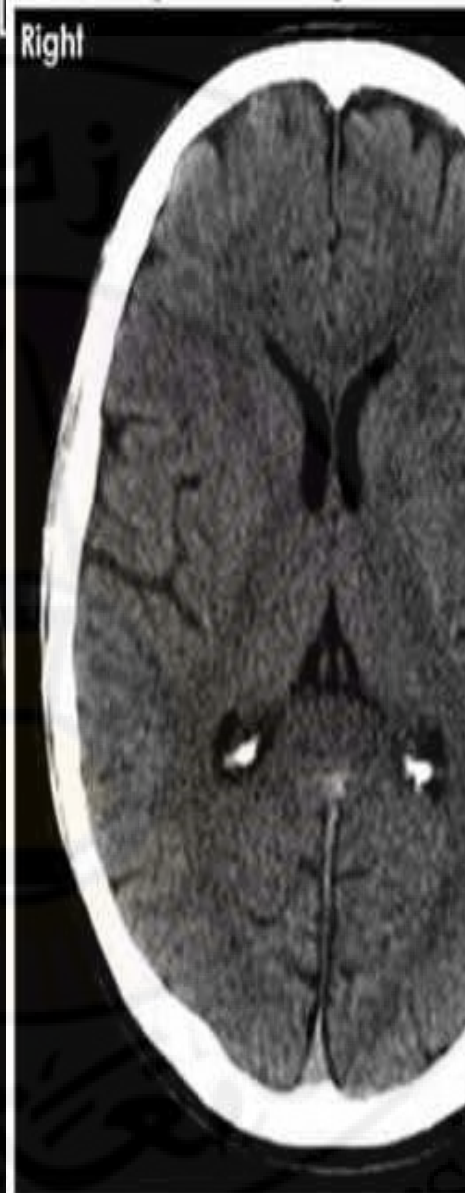




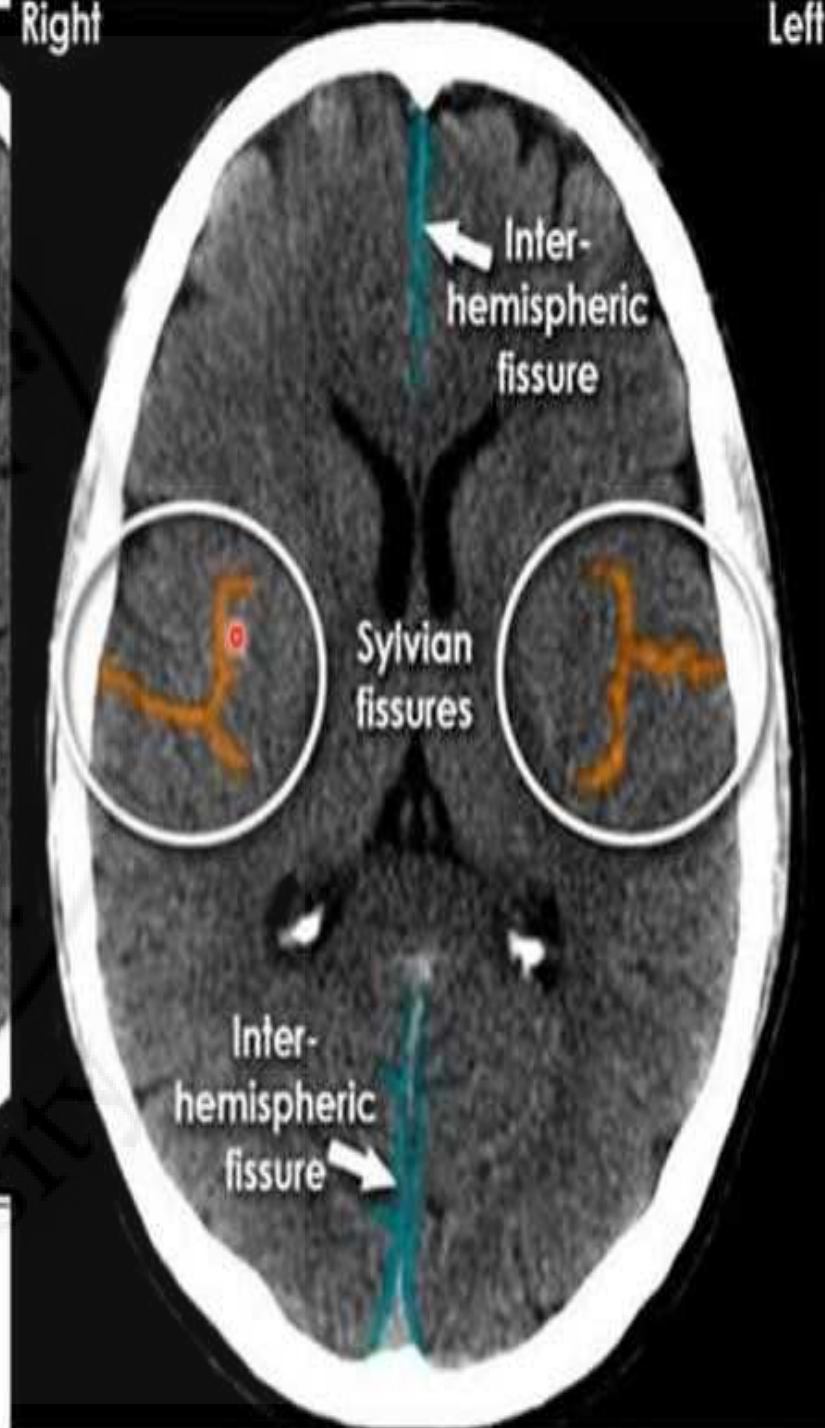
nt



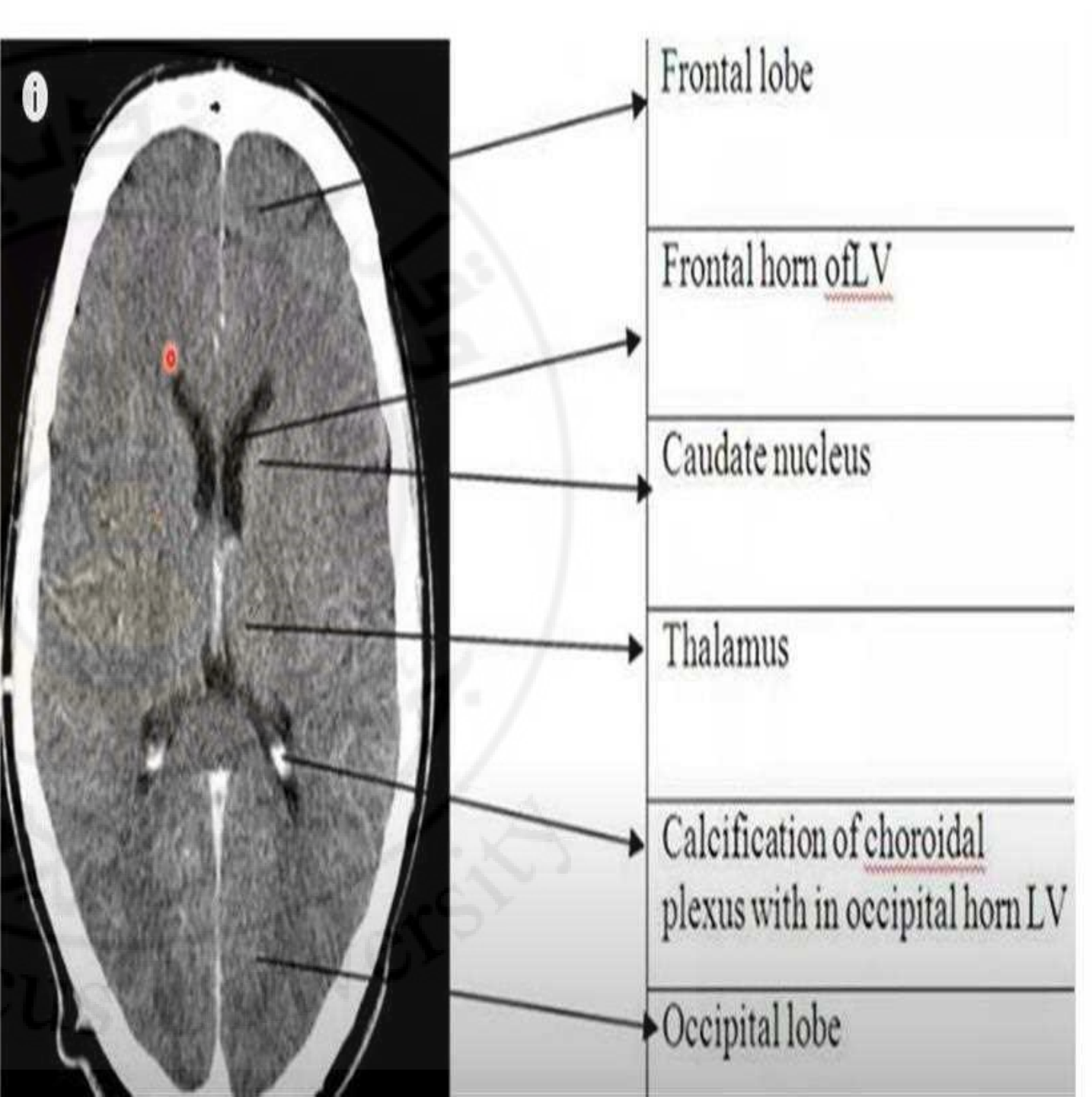
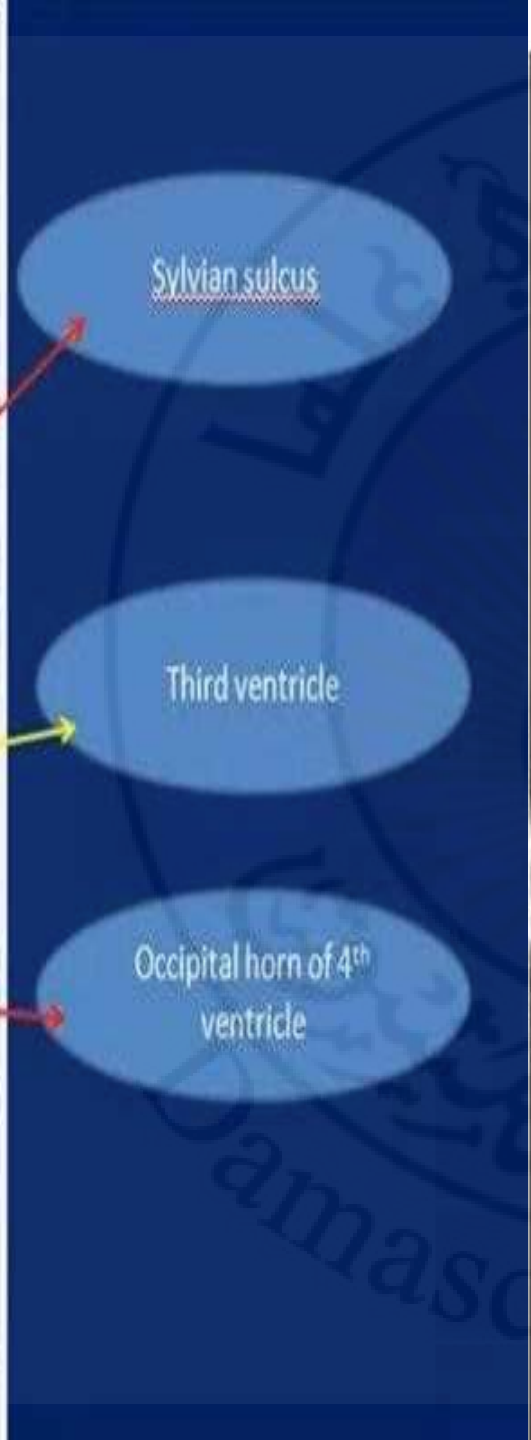
Right



Right



Left



CT scan of brain

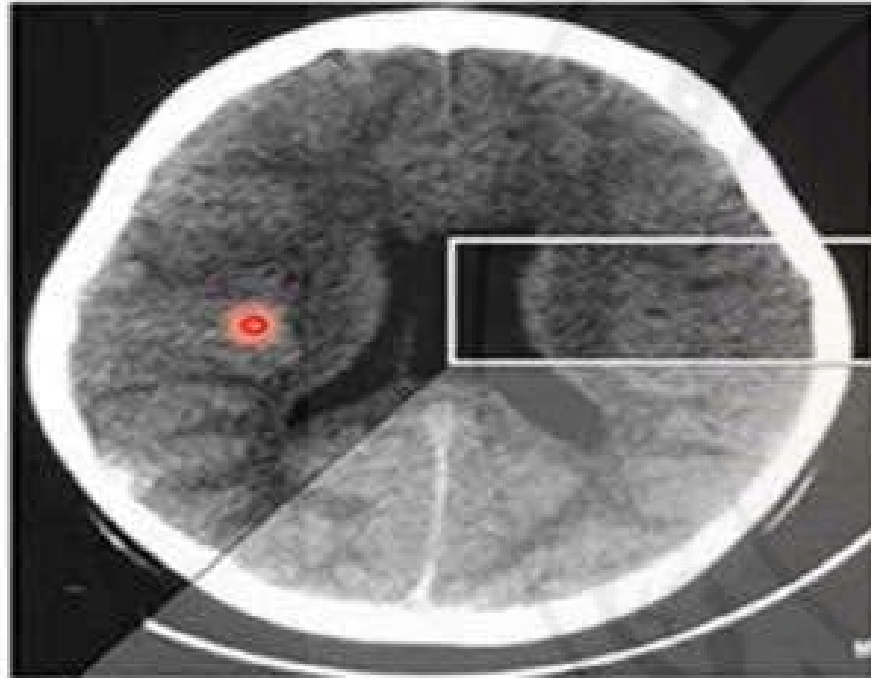
It has 3 densities

iso dens –brain

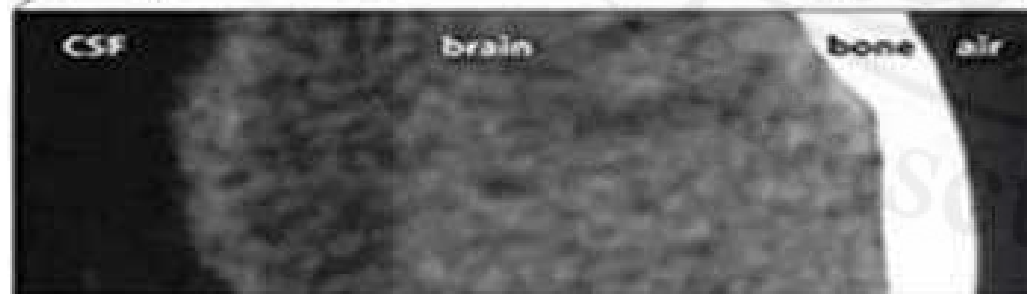
Hypo dens ---CSF

Hyper dense ---bone

I



Hypodense Isodense Hyperdense Hypodense



Here density means = whiteness

Hypo dens = is black

Normally found in CSF

Abnormally is infarction

Peri lesional edema

Hyper density = bright white

Normally found in the
bone / calcification

Abnormally hemorrhage

**Iso-dens= it is the colour in between
black@ White**

Normally brain matter

Don't Forget

Brain CT Densities:

- ▶ **Air** -1000 Hu
- ▶ **Fat** -10 : -300
- ▶ **CSF** 0 : 15
- ▶ **Edema** 20
- ▶ **Infarct** 25
- ▶ **Parenchyma** → 30 : 40
- ▶ **Recent blood** → 60 : 90
- ▶ **Calcification** > more 100

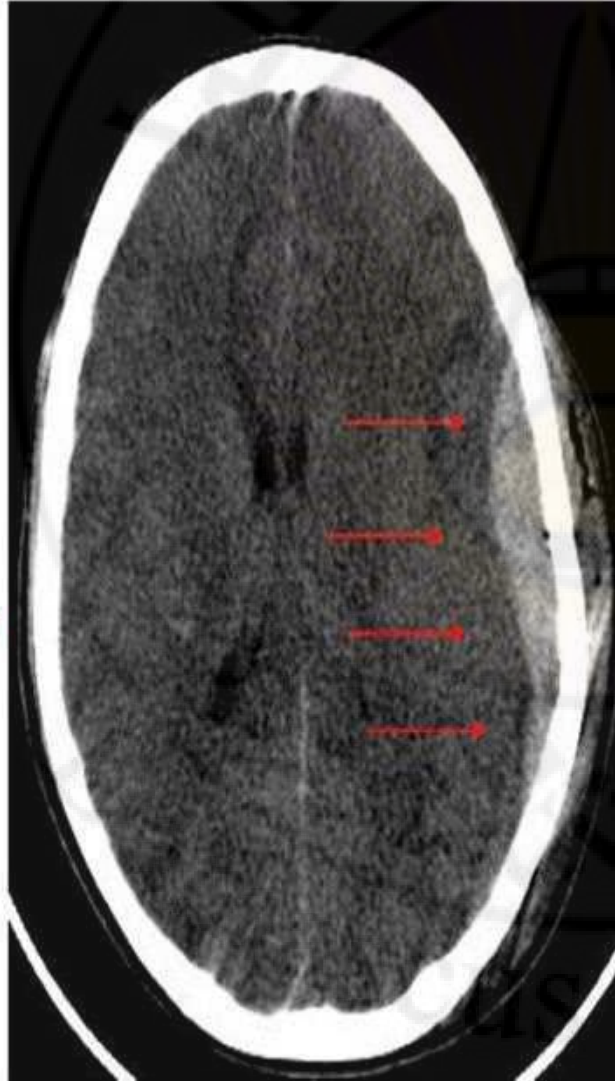


▶ **Hu** = Hounsfield Unit of CT density.

CASE I

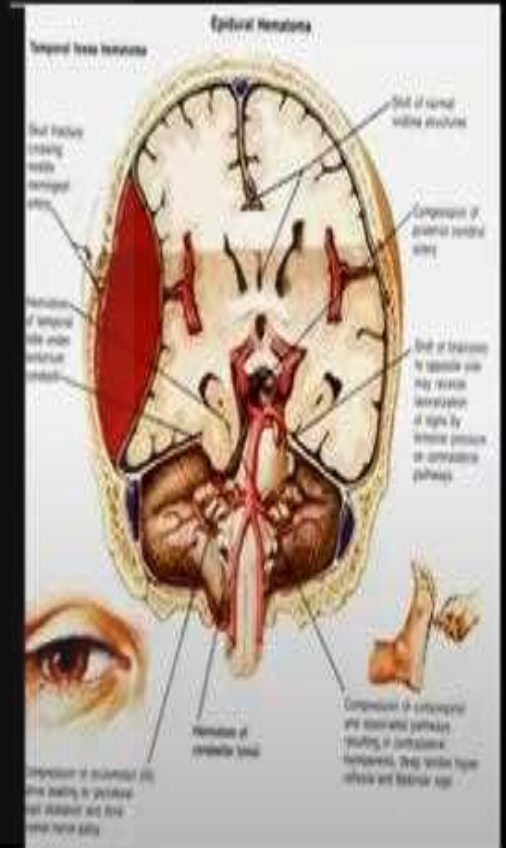
Lt parietal Extra dural Hematoma

- ▶ CT Brain
- ▶ Head Trauma
- ▶ Lt parietal , extra axial ,
biconvex shape, hyperdense
lesion of **fresh blood density**



Epidural Hematoma

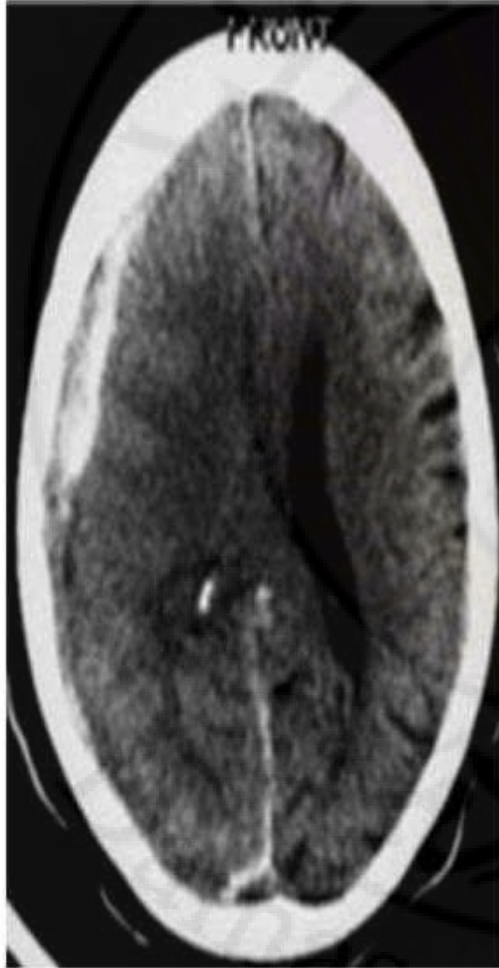
- Convex inner margin
- Almost always acute
- Post traumatic



CASE 2

Rt parietal (Acute) Sub dural Hematoma

- ▶ **CT Brain**
- ▶ Head Trauma
- ▶ Rt parietal , extra axial ,
crescent shape
hyperdense lesion
of **fresh blood density**



Subdural Hematoma

- Concave inner margin
- Can be acute , subacute or chronic
- Usually seen in elderly patient
- History of minor trauma
- Can occur in the interhemispheric fissure

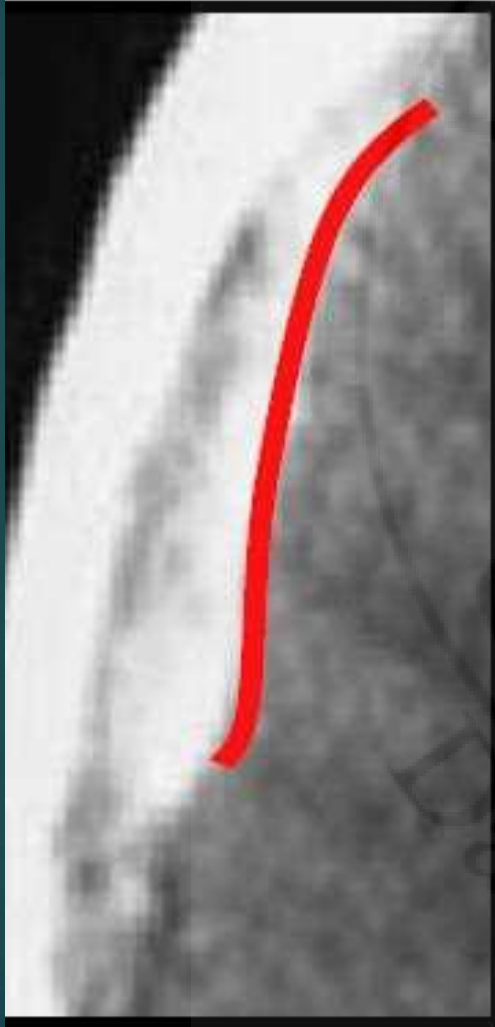


▶ NB. Subdural Hematoma types : - Acute - Subacute & - Chronic

SUB

Vs

EXTRA



CASE 3

Rt parietal Skull Depressed Fracture

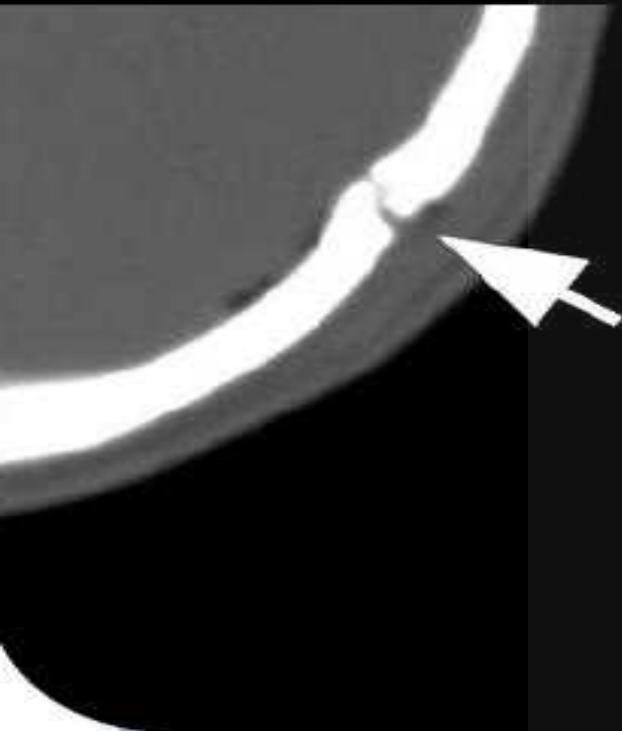
- ▶ **CT Brain** (Bone window)
- ▶ Head Trauma
- ▶ **Rt** parietal bone fracture ,
with **outer table** of fractured
bone **under** inner table of
adjacent intact bone



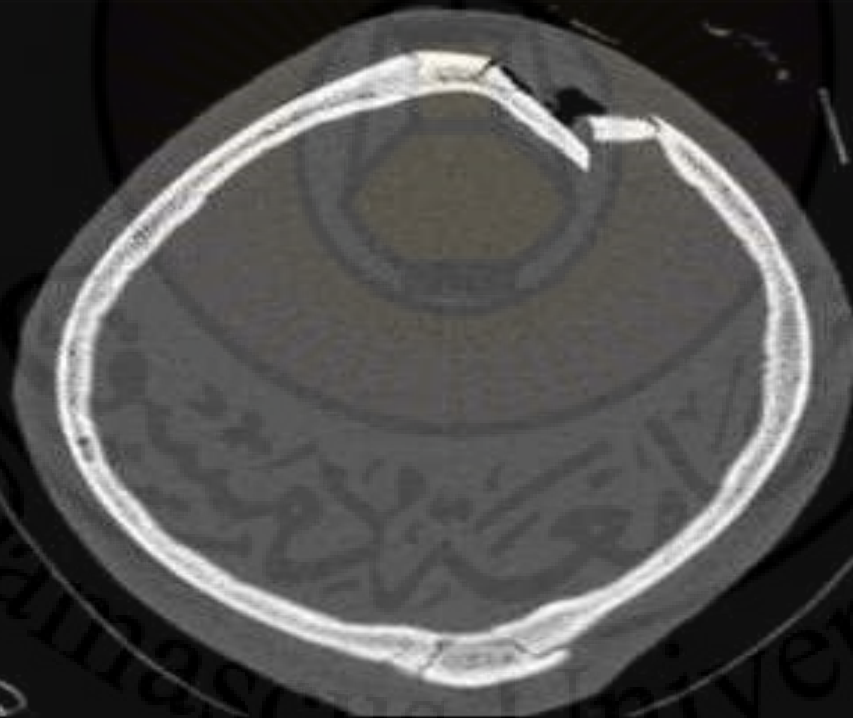
NB. Skull fractures : - Fissure - Depressed & - Comminuted

Skull Fractures

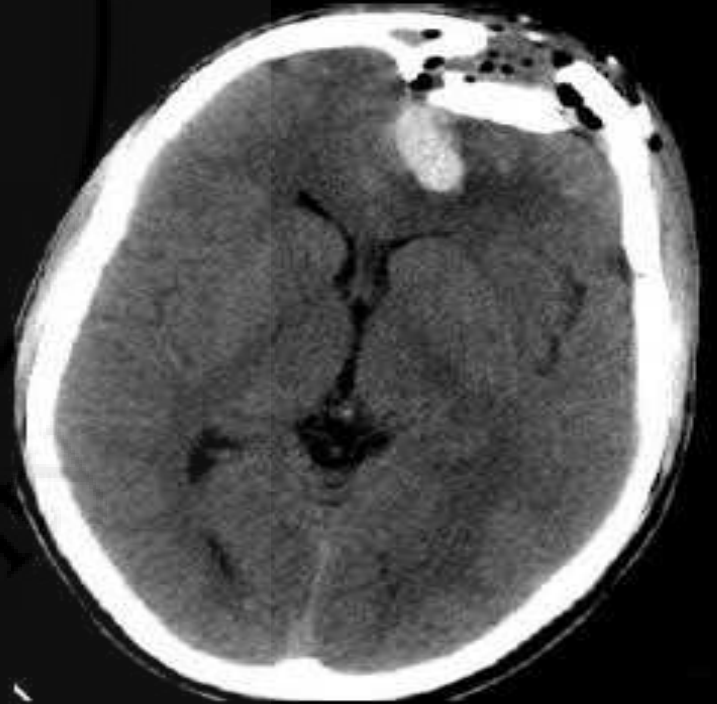
Fissure



Depressed



Comminuted



CASE 4

Subarachnoid Haemorrhage

- ▶ **CT Brain**
- ▶
- ▶ Rt Parietal , fresh blood density smearing cortical sulci

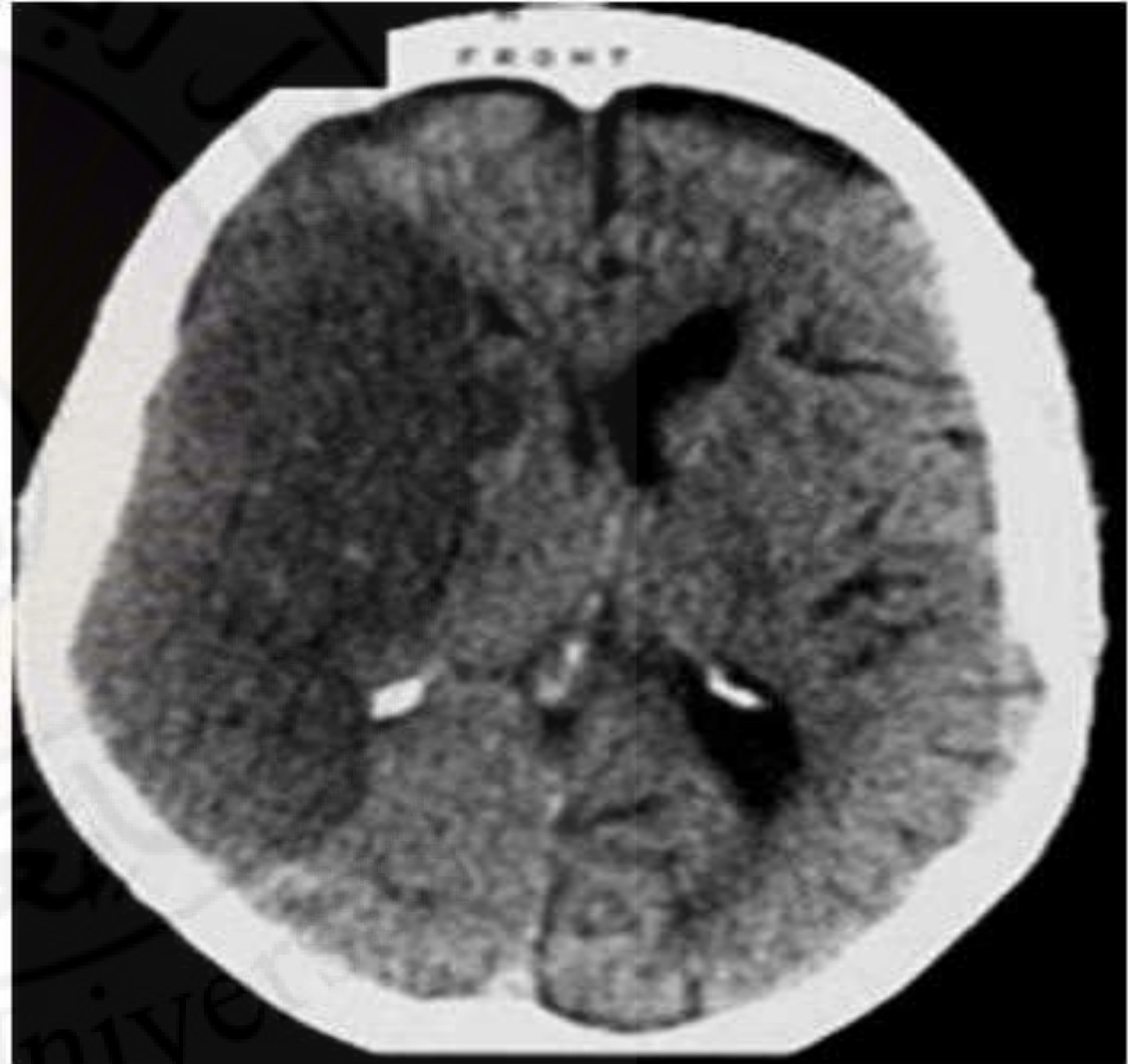


CASE 5

Acute Cerebral Infarction

▶ CT Brain

- ▶ Recent Lt Hemiplegia
- ▶ Rt cerebral (*Fronto – Parieto – occipetal*) well defined cortical & subcortical hypodense area.
- ▶ with Associated **mass effect** on adjacent ventricle



- ▶ **NB. Mass effect of acute infarction is caused by associated edema**

Mass effect

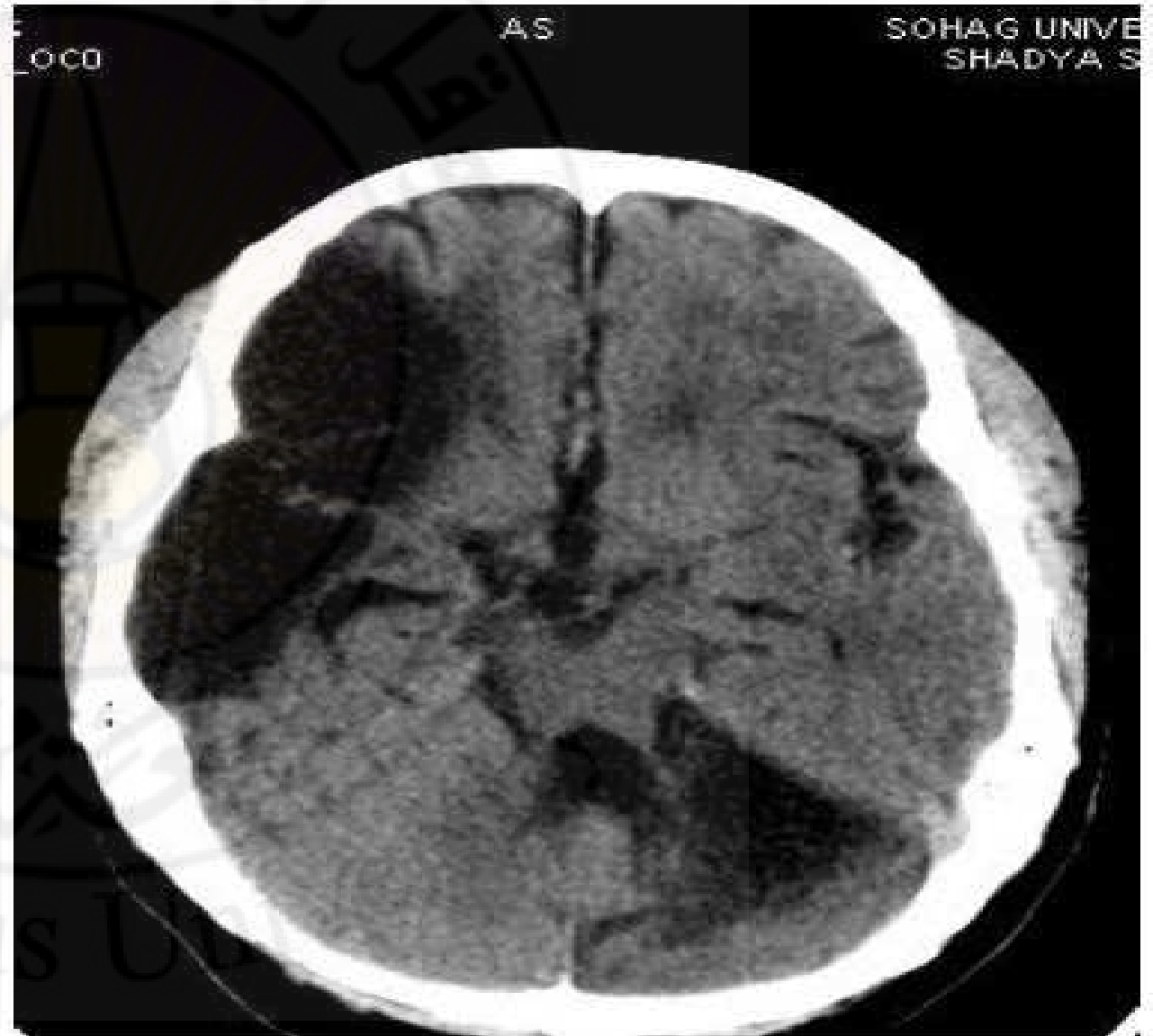
- ▶ Effacement of cortical sulci
- ▶ Shift of Medline
- ▶ Compression of Ipsilateral ventricle
- ▶ **Causes :**
 - ▶ **SOL** (**S**pace **o**ccupying **l**esion) , as tumor ,Abscess.
 - ▶ Large Acute cerebral infarction

CASE 6

Chronic Cerebral Infarction

CT Brain

Bilateral cortical areas of
CSF density
(Porencephalic areas)



CASE 8

Intra Cerebral Hemorrhage

▶ CT brain

- ▶ Headache / Rt Hemi paresis
- ▶ Lt parieto-temporal,
Intra-axial irregular area of
fresh blood density



CASE 10

Intra Ventricular Hemorrhage

▶ CT Brain

- ▶ Fresh blood density is
seen in both lateral
ventricles .



CASE 12

Brain Abscess

- ▶ **CT Brain** (Contrast Enhanced)
 - ▶ Fever, Headache
- ▶ Rt parietal , Cystic lesion , with hypodense content , & regular marginal enhancing wall
- ▶ The lesion & surrounding edema causing mass effect



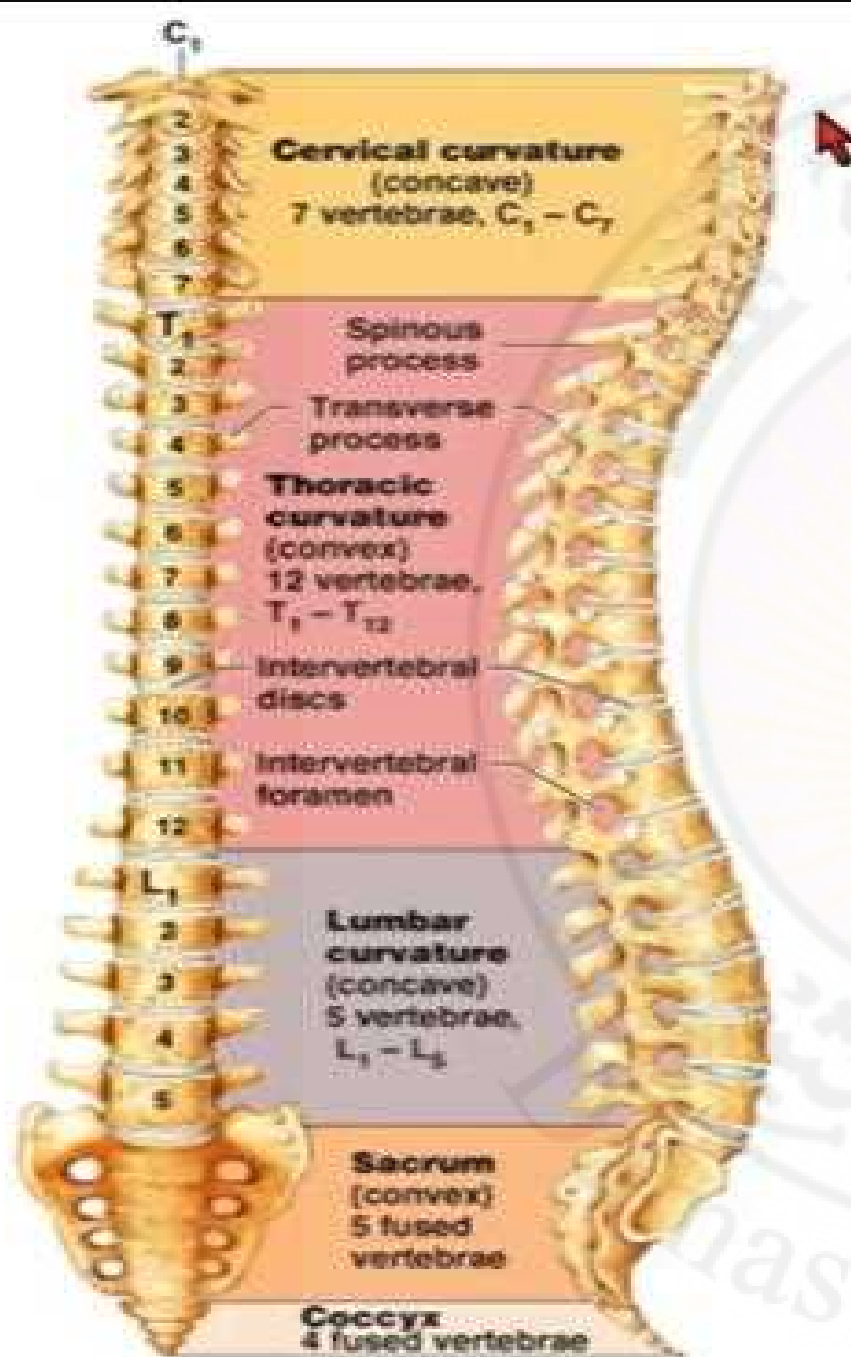
Remember **What is mass effect ?**

CASE 14

Hydrocephalus

- ▶ **CT Brain**
- ▶ Diffuse dilatation of both lateral ventricles





Anterior view

THORACIC SPINE AP VIEW



LATERAL THORACIC SPINE

CLAVICAL

PEDICLE

DISC SPACE

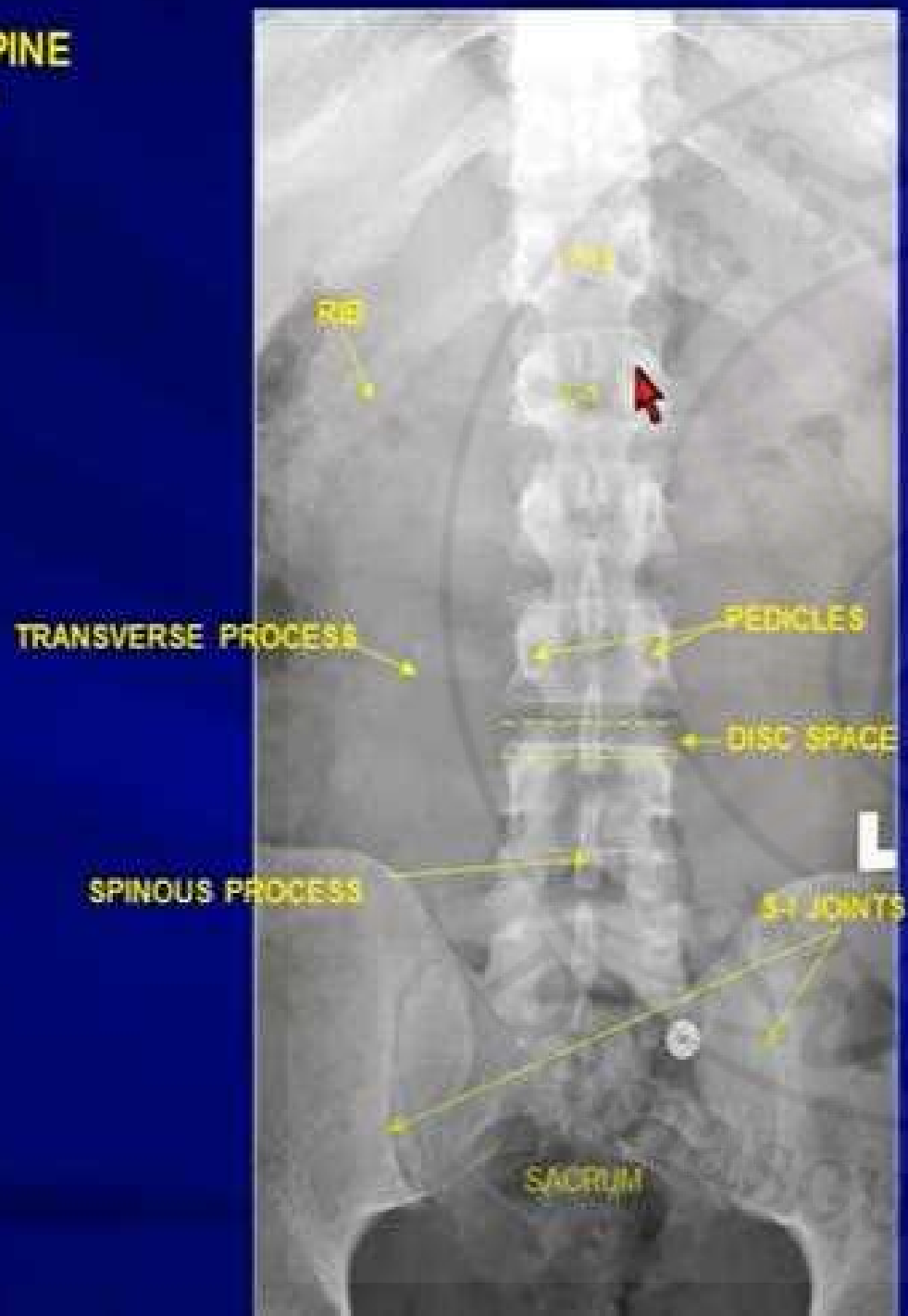
VERTEBRAL BODY

RIB

SPINOUS PROCESS

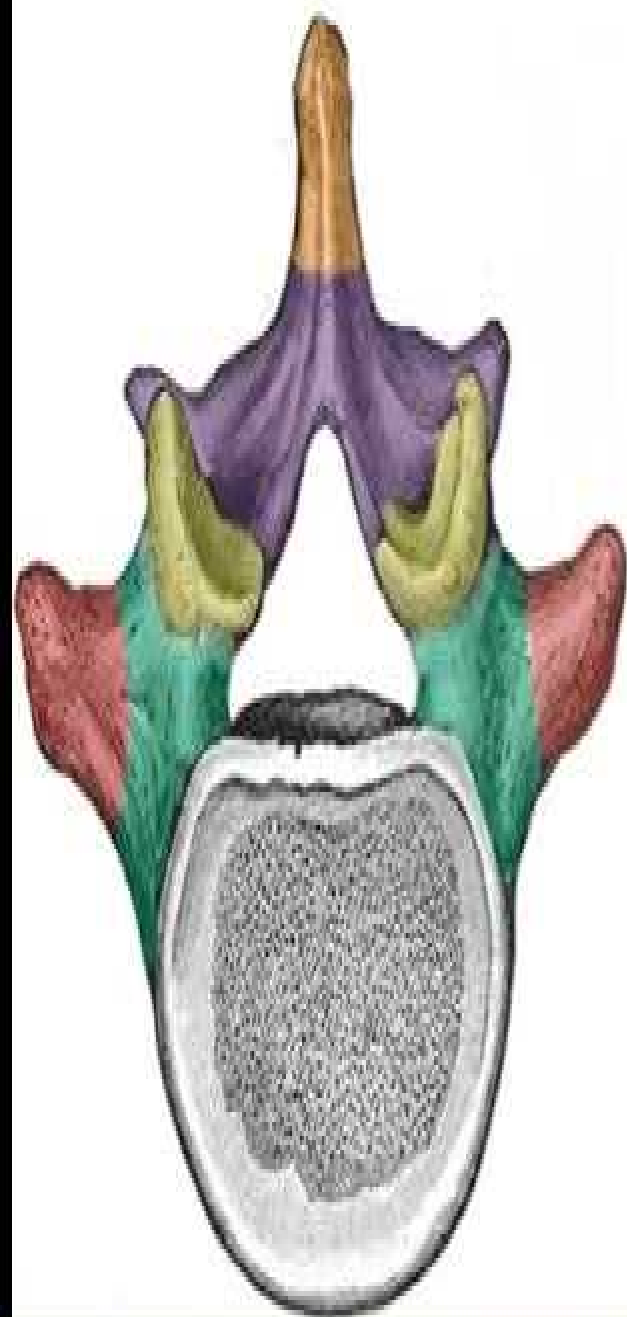


LUMBAR SPINE
AP VIEW

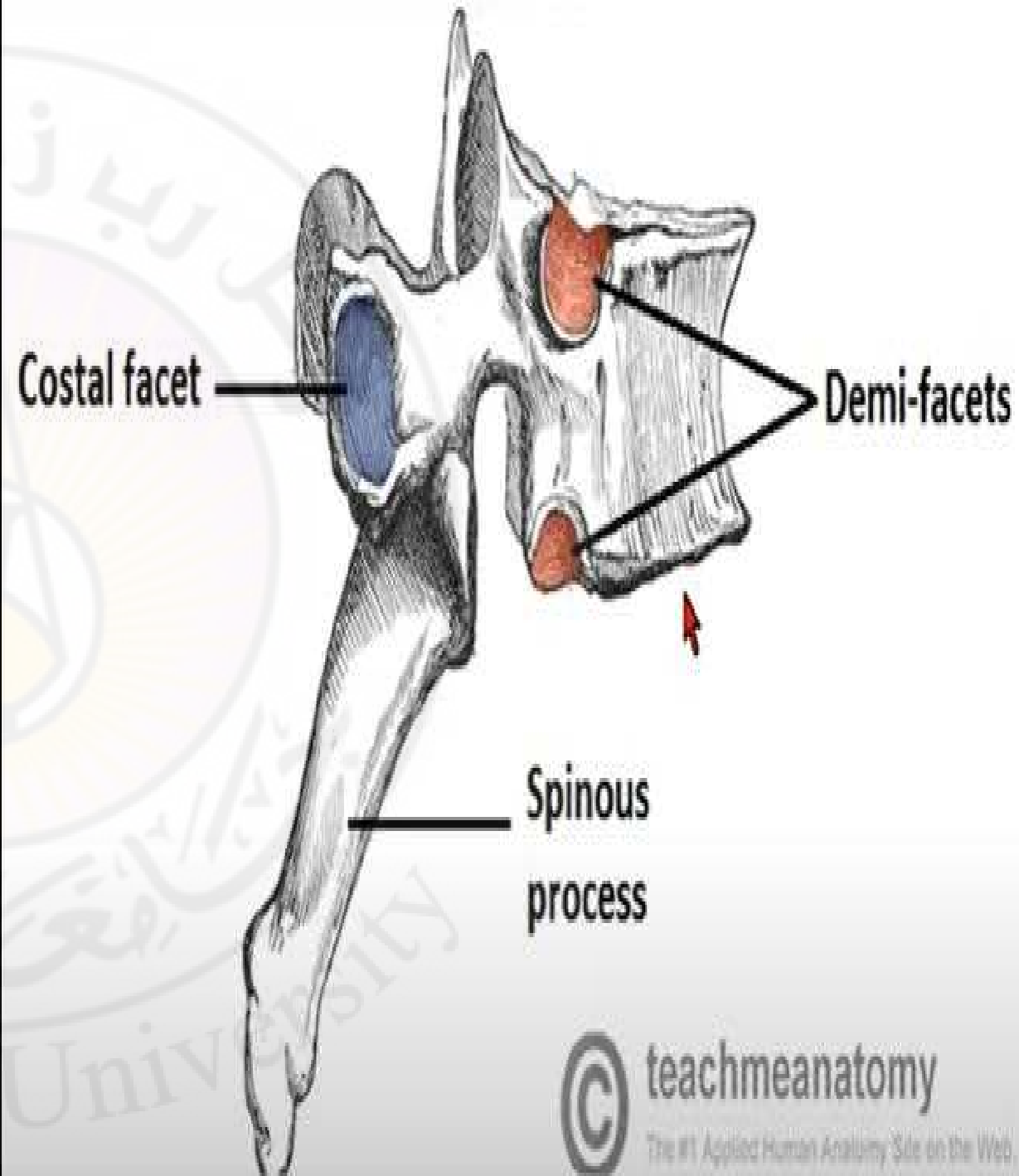


LUMBAR SPINE
LATERAL VIEW

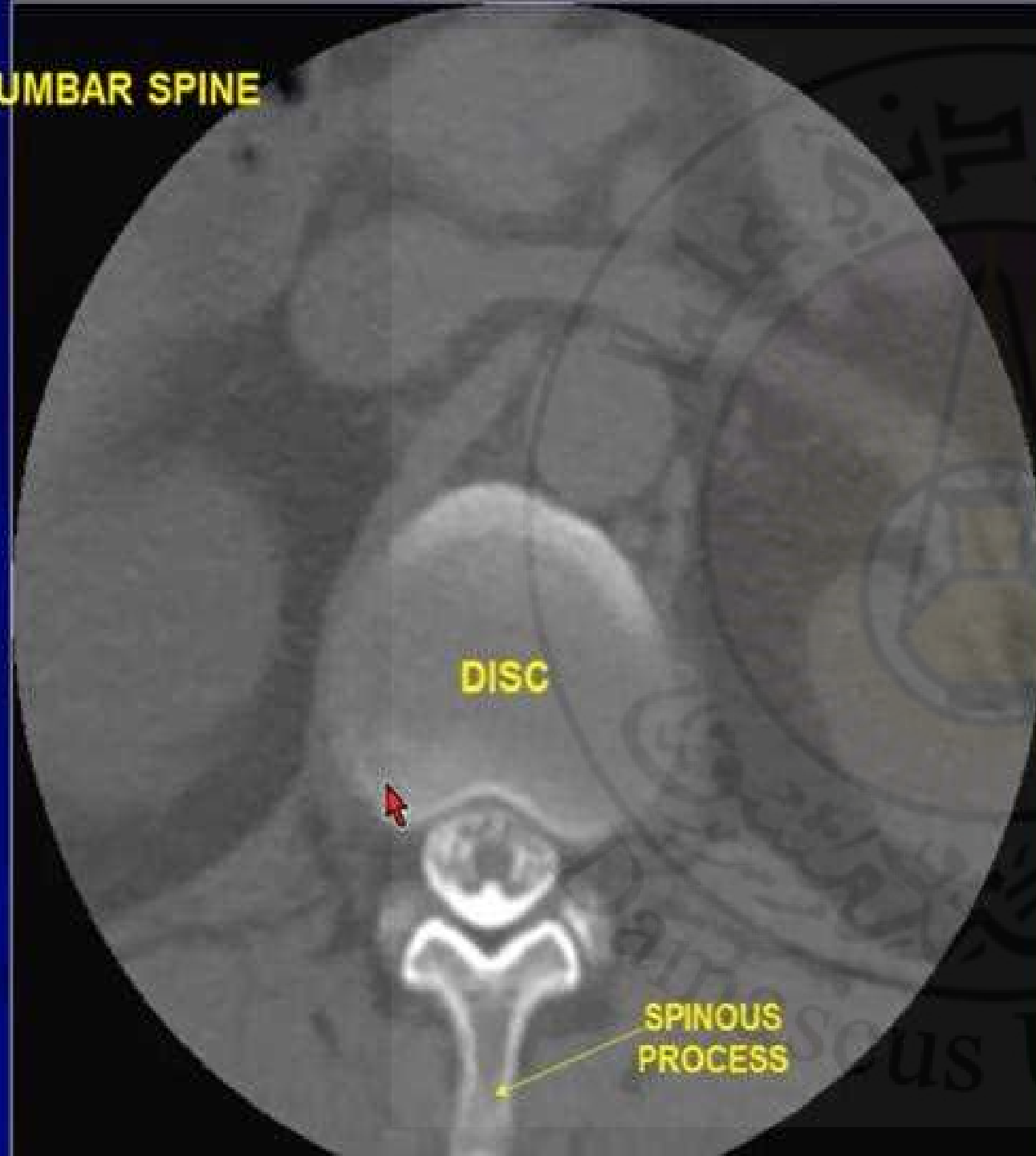




-  Spinous process
-  Lamina
-  Superior articular processes
-  Pedicles
-  Transverse processes



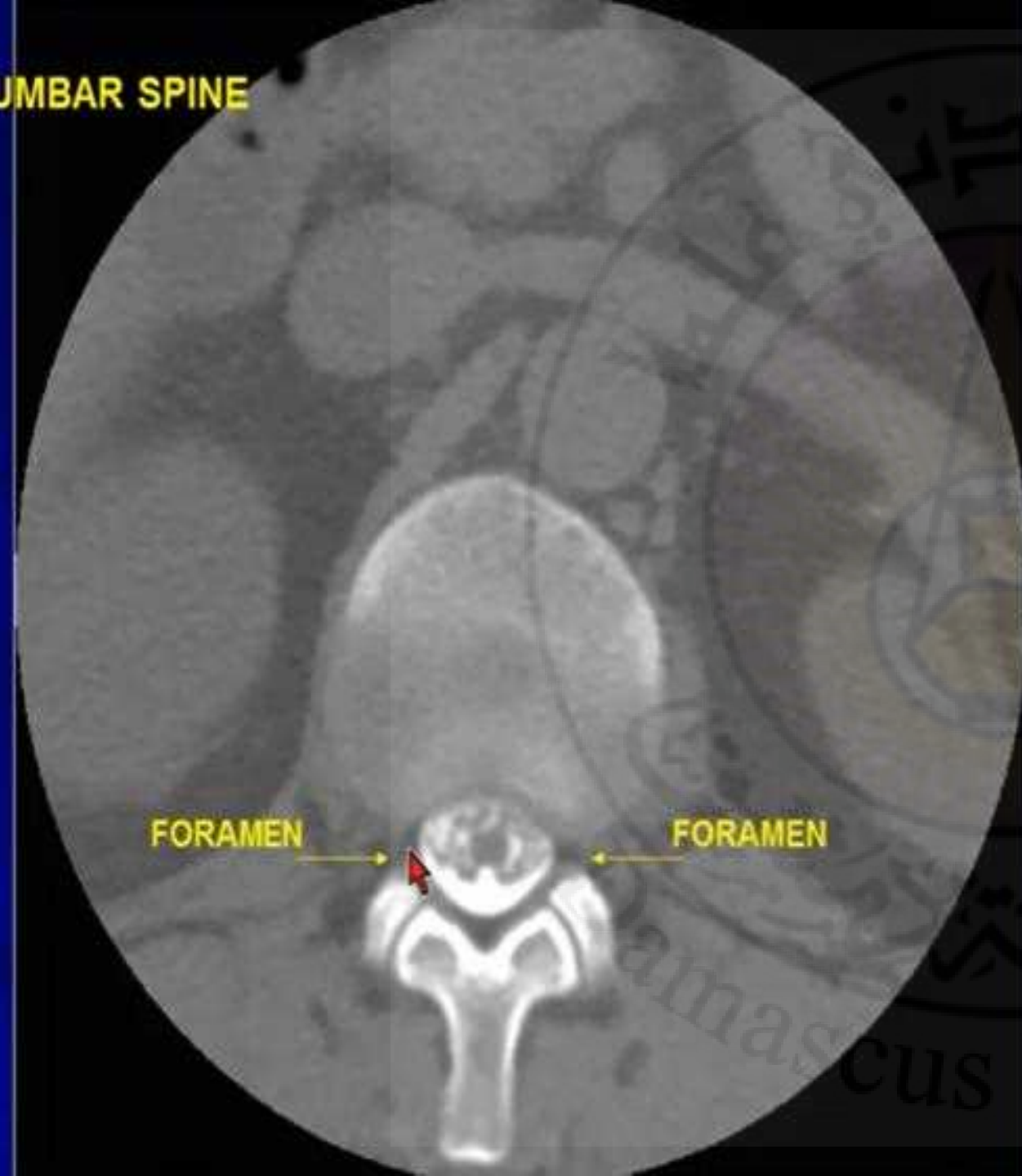
LUMBAR SPINE



LUMBAR SPINE



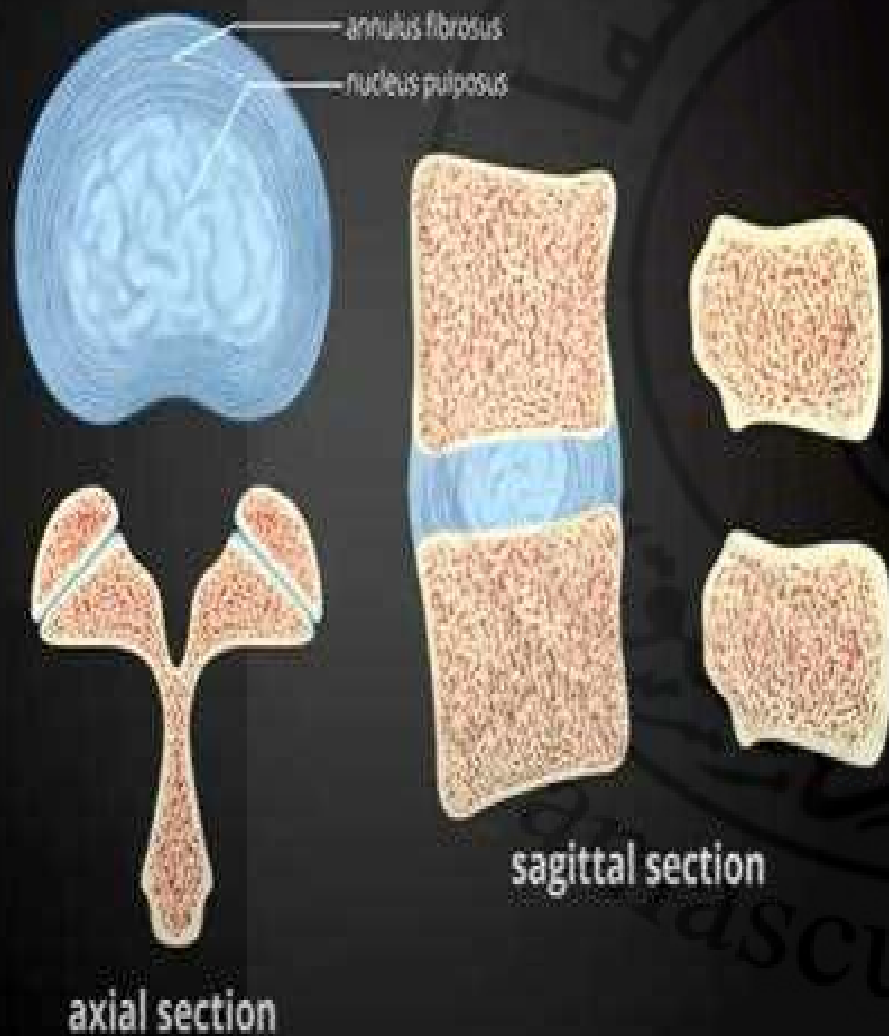
LUMBAR SPINE



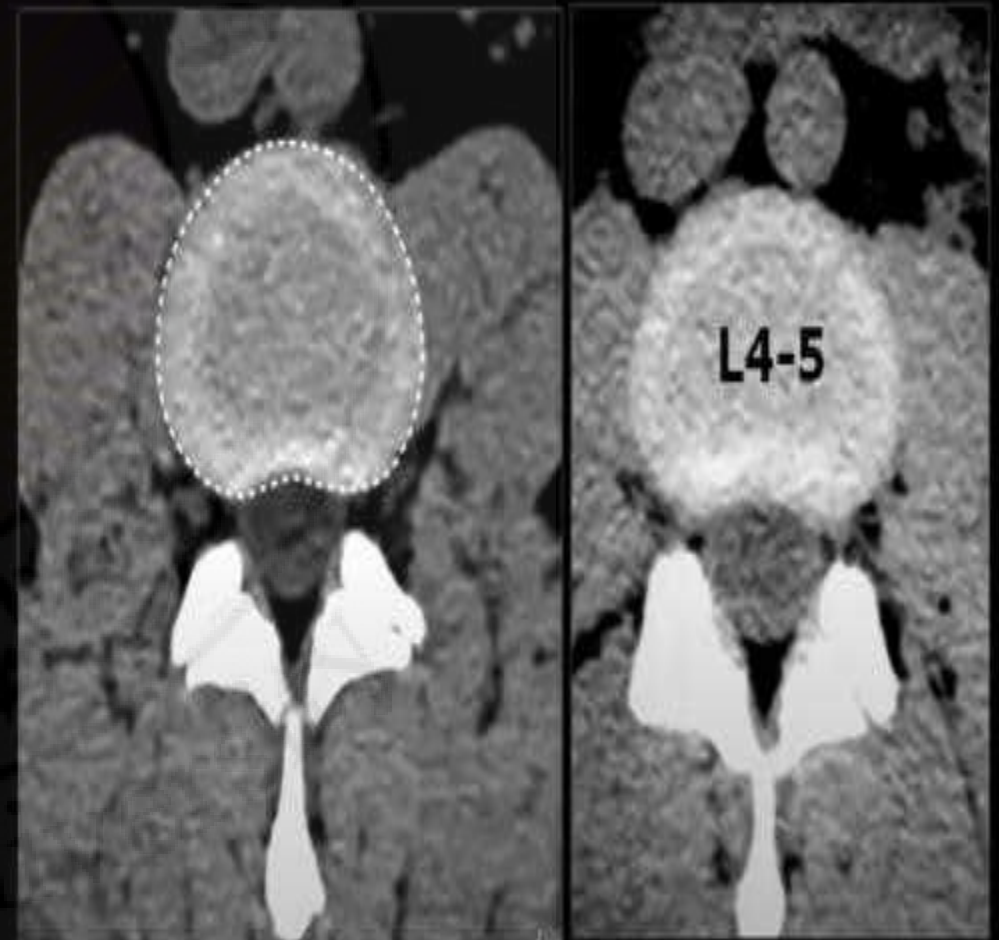
LUMBAR SPINE



Normal disc morphology



Normal lumbar disc



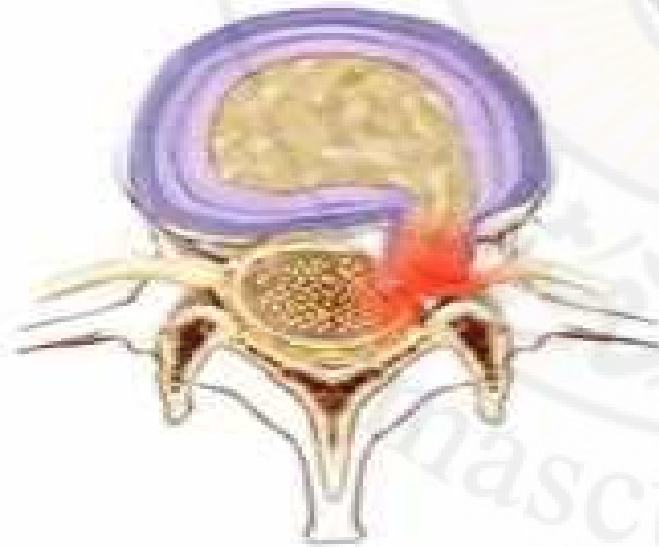
Stages of disc herniation



Protrusion



Herniation



Migration



Sequestration

Disc Herniation



Disc bulge



Degenerative arthritis

- Narrowing of joint space
- Subchondral bone sclerosis
- Marginal osteophyte lipping
- Subchondral pseudocysts
- Intra - articular gas
- Loose bodies

F75Y





Kyphosis

Kyphosis is a condition of over-curvature of the upper back. It can occur due to degenerative diseases (such as arthritis), developmental problems (the most common example being Scheuermann's disease), osteoporosis with compression fractures of the vertebrae, or trauma.



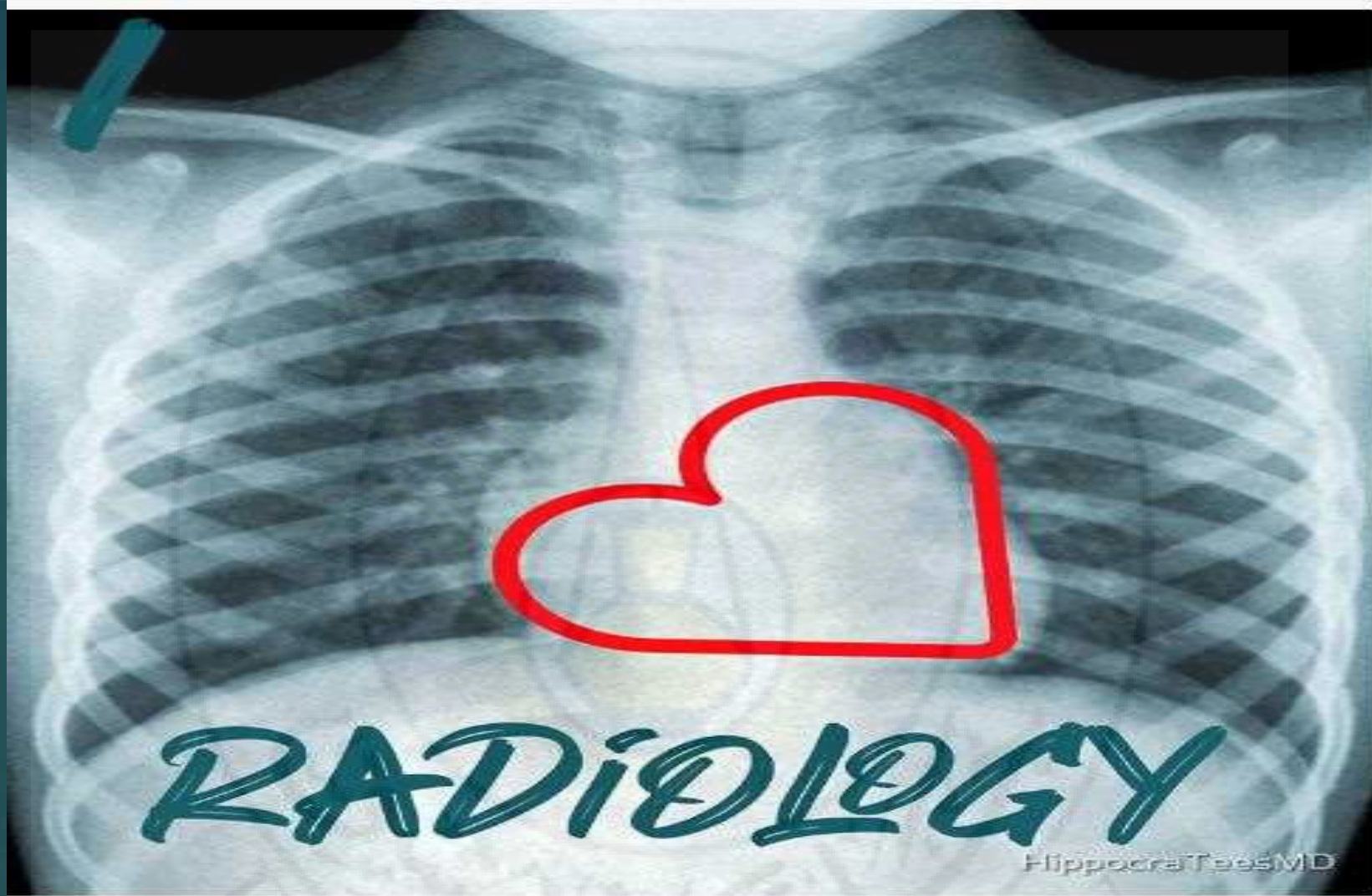


What is Scoliosis?

- Abnormal curvature of the spine greater than 10° in the sideways or coronal plane (Cobb angle)
- Spine looks more like an “S” or “C” than a straight line
- Many cases have rotational component
 - Shoulders and/or waist appear uneven (3)







THANK YOU



Multiple transducers



Convex Array Probe

A white, curved ultrasound probe with a long cable, shown against a dark background.

- Frequency: Central 3.5 MHz
- Min. 2.0 MHz
- Max. 5.5 MHz
- Number of Elements: 128



Linear Array Probe:

A white, straight ultrasound probe with a long cable, shown against a dark background.

- Frequency: Central 7.5 MHz
- Min. 6.0 MHz
- Max. 12.0 MHz
- Number of Elements: 128



Intra-Cavity Probe:

A white, thin, and flexible ultrasound probe with a long cable, shown against a dark background.

- Frequency: Central 6.5 MHz
- Min. 5.0 MHz
- Max. 9.0 MHz
- Number of Elements: 128



Phased Array Probe:

A white, curved ultrasound probe with a long cable, shown against a dark background.

- Frequency: Central 3.0 MHz
- Min. 2.0 MHz
- Max. 5.0 MHz
- Number of Elements: 128



4D Volume Probe (Optional)

A white, curved ultrasound probe with a long cable, shown against a dark background.

- Frequency: Central 4.0 MHz
- Min. 2.0 MHz
- Max. 5.5 MHz
- Number of Elements: 128

Abdominal UltraSound

DR. MUHANNAD IBRAHIM

DIAGNOSTIC RADIOLOGIST

HEAD DEPARTMENT OF INTERVENTIONAL
RADIOLOGY,

TISHREEN MILITARY HOSPITAL

What are the benefits vs. risks

► Benefits :

1. Ultrasound scanning is noninvasive
2. Ultrasound is widely available and easy to use , and less expensive than other imaging methods .
3. Doesn't use any ionizing radiation .
4. Ultrasound is the preferred imaging modality for diagnosis and monitoring of pregnant women and unborn babies .
5. Provides real time imaging .
6. A good tool for guiding minimally invasive procedures such as needle biopsies and needle aspiration.

► Risks :

There are no known harmful effects on human

Abdominal ultrasound indications

- ▶ Localized abdominal pain with indefinite clinical picture .
- ▶ Suspected intra abdominal abscess .
- ▶ Abdominal mass .
- ▶ Abdominal trauma .
- ▶ Suspected cholecystitis .
- ▶ Jaundice .
- ▶ Liver cirrhosis .
- ▶ Suspected metastasis .
- ▶ Renal pain .



Hyperechoic

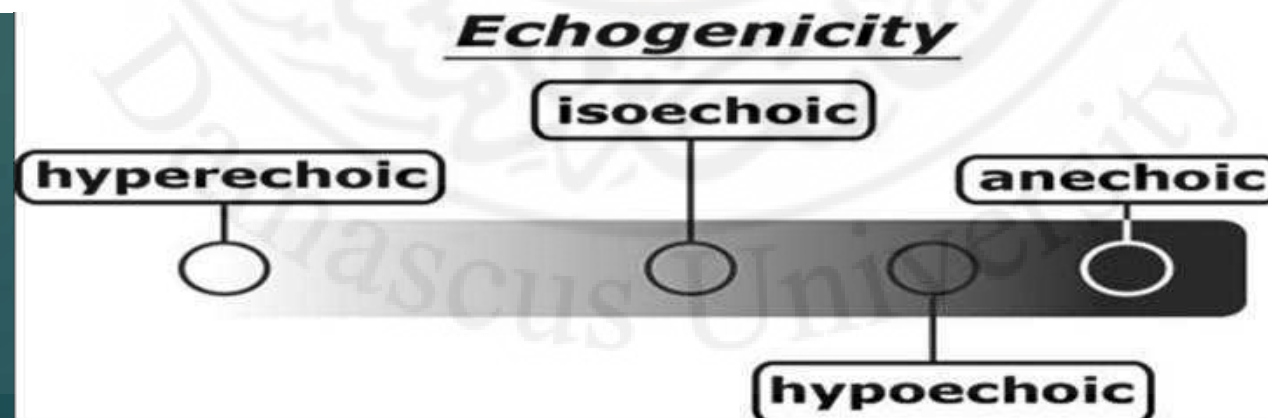


Isoechoic

Hypoechoic



Anechoic



Transverse View



Transverse View



**Normal Right
Lobe**

**Normal Right
Lobe**

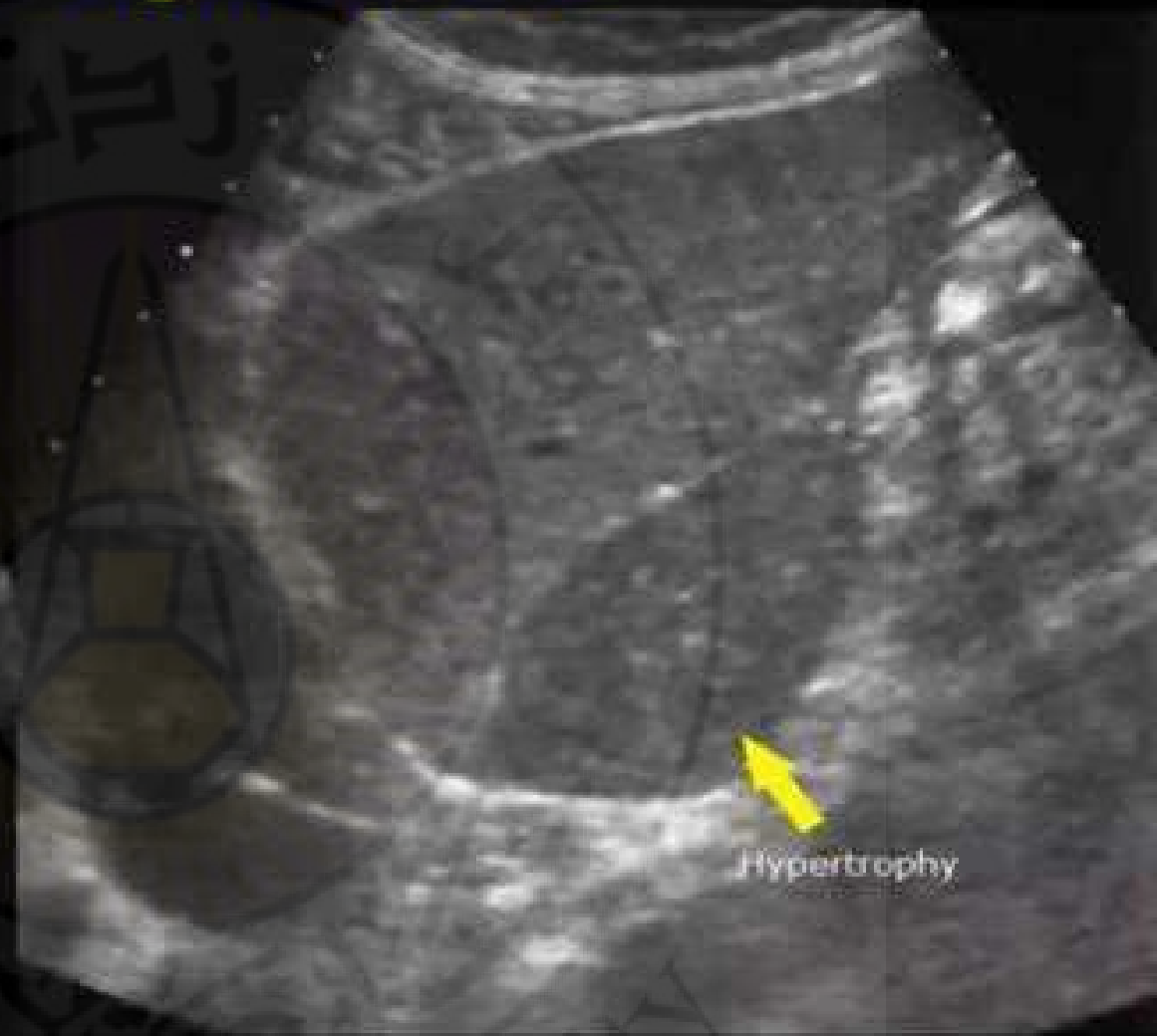
Sagittal View



Normal Caudate Lobe

- AP Diameter: up to 35mm

Sagittal View



**Caudate Lobe
Hypertrophy**

Sagittal View



**Normal Left
Lobe**

Sagittal View



Simple Hepatic Cyst

- Round
- Anechoic
- Posterior acoustic enhancement

Transverse View



**Normal Right
Lobe**

Transverse View



Simple Hepatic Cyst

- Round
- Anechoic
- Posterior acoustic enhancement

Transverse View



**Normal Right
Lobe**

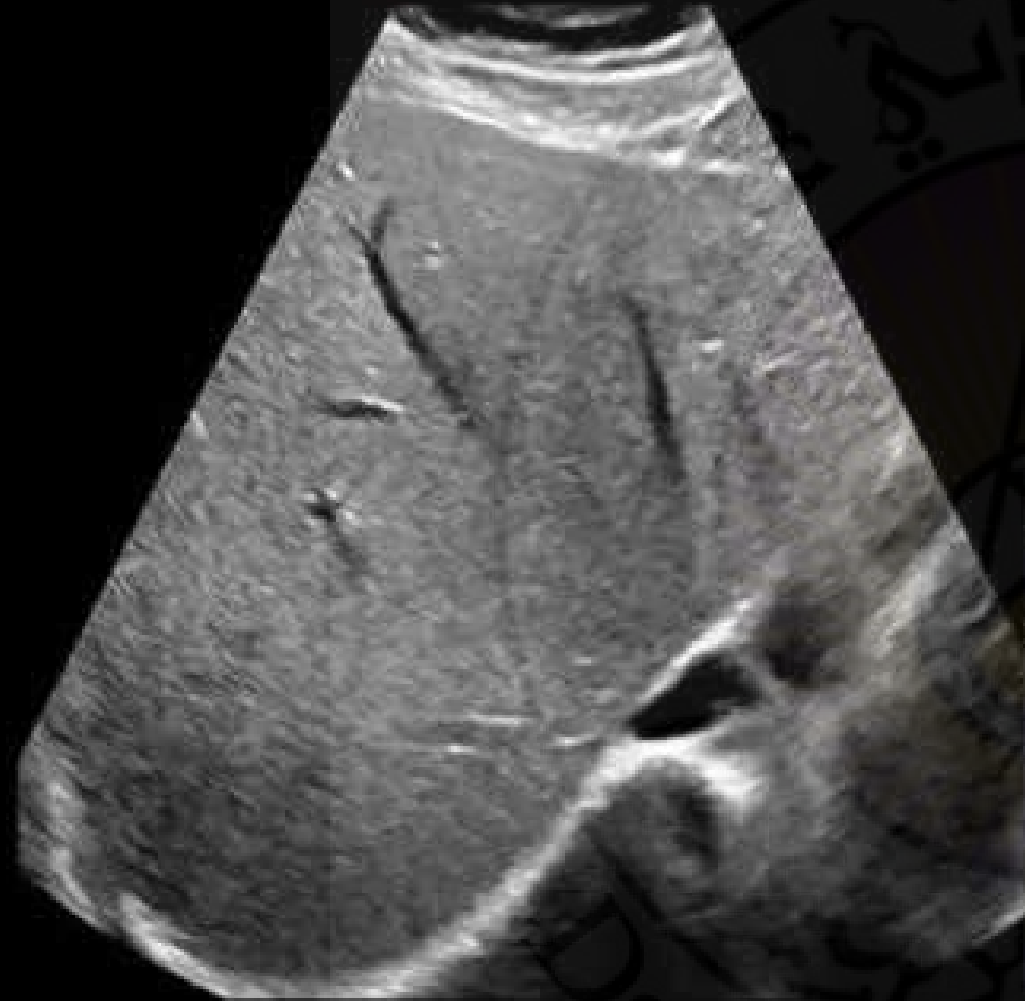
Transverse View



Hydatid Cyst

- Septated cyst
- Echogenic material within the cyst
- Daughter cysts

Transverse View



**Normal Right
Lobe**

Transverse View



Calcified Hydatid Cyst

- Calcified rim
- Posterior shadowing
- Septated cyst

Sagittal View



**Normal Left
Lobe**

Sagittal View



Hepatic Abscess

- Mostly Hypoechoic (Sometimes hyperechoic) and heterogeneous
- Absence of flow on Doppler

Transverse View



**Normal Right
Lobe**

Transverse View



Hepatic Abscess

- Mostly Hypoechoic (Sometimes hyperechoic) and heterogeneous
- Absence of flow on Doppler

Transverse View



**Normal Right
Lobe**

Transverse View



Hemangioma

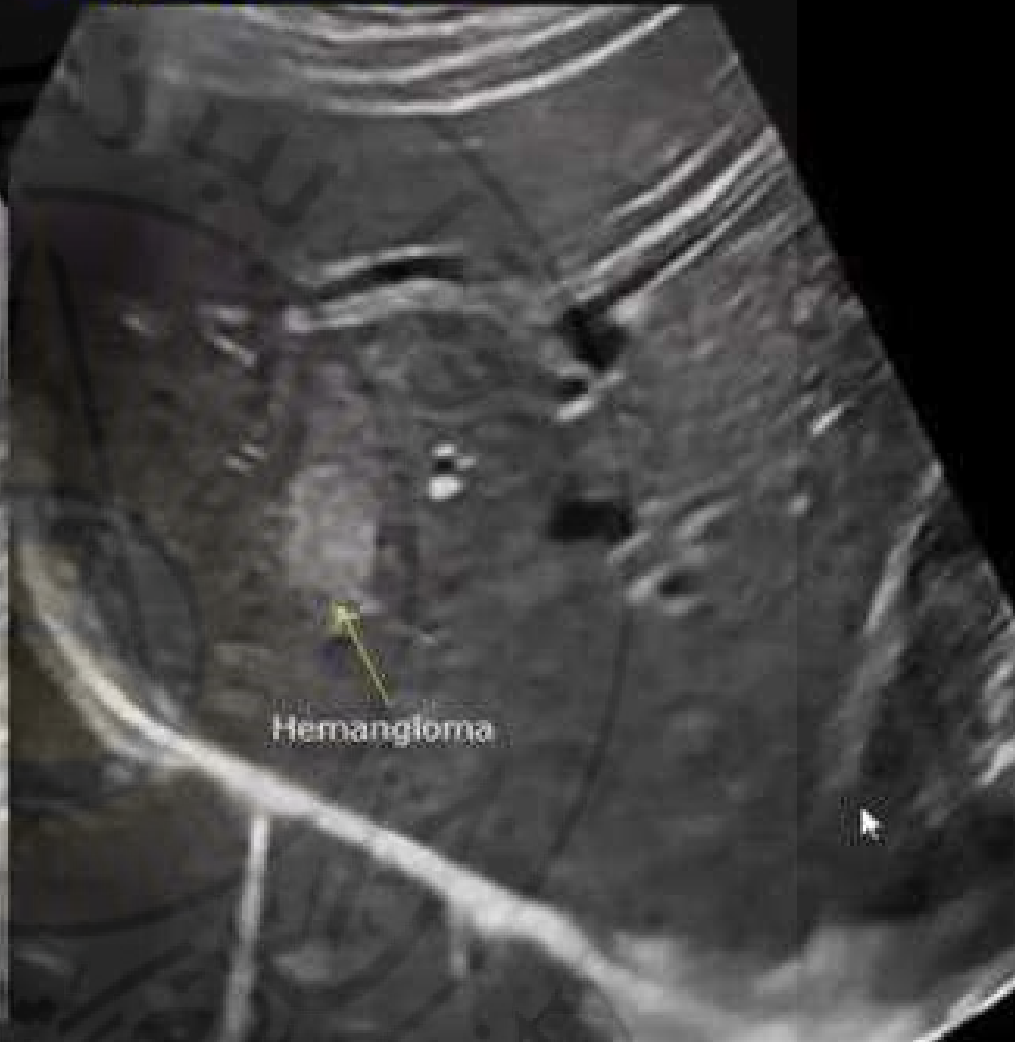
- Hyperechoic, well-defined
- Absence of central flow on Doppler

Sagittal View



**Normal Right
Lobe**

Sagittal View



Hemangioma

- Hyperechoic, well-defined
- Absence of central flow on Doppler

Sagittal View



**Normal Right
Lobe**

Sagittal View



**Focal Nodular
Hyperplasia**

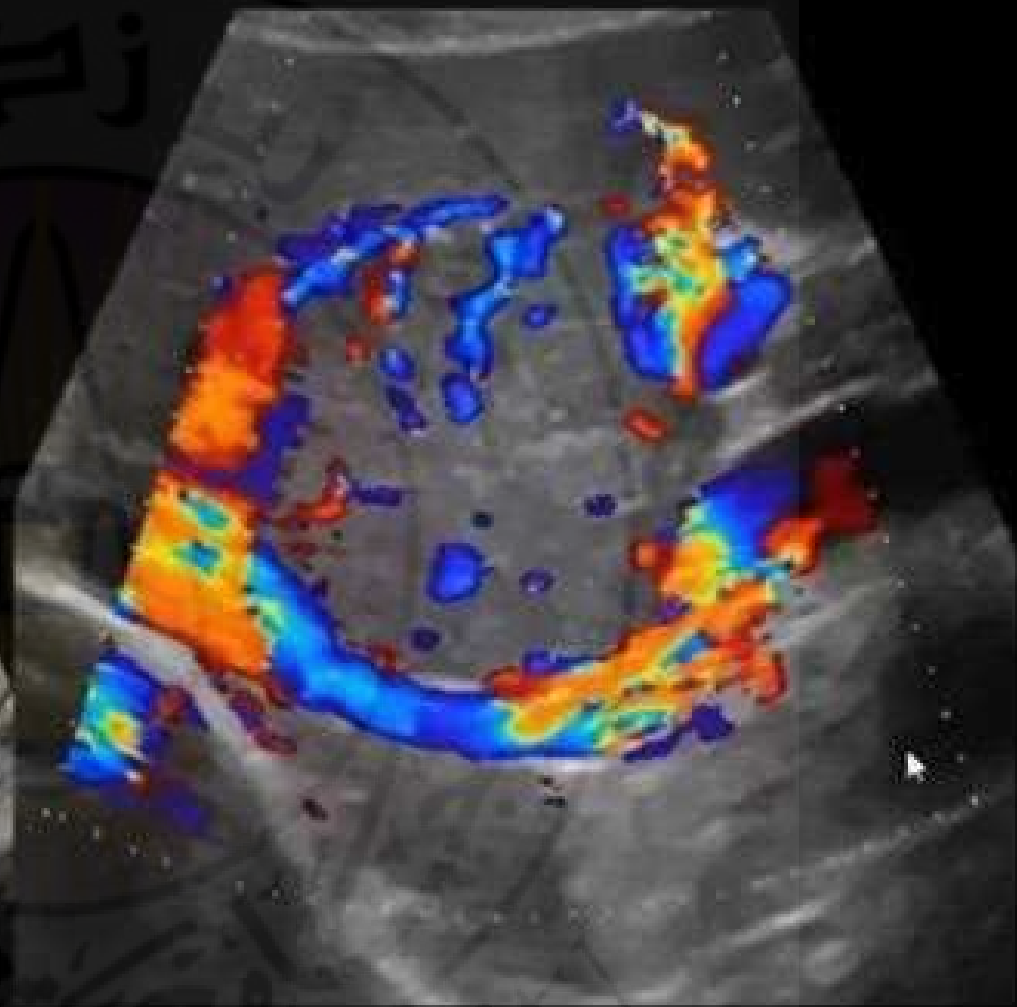
- Variable appearance
- Spoke-wheel flow on Doppler

Sagittal View



**Normal Right
Lobe**

Sagittal View



**Focal Nodular
Hyperplasia**

- Variable appearance
- Spoke-wheel flow on Doppler

Sagittal View



**Normal Right
Lobe**

Sagittal View



Hepatic Adenoma

- Solitary, well-defined mass
- Heterogenous appearance (mostly hypoechoic)

Sagittal View



**Normal Right
Lobe**

Sagittal View



Hepatocellular Carcinoma

- Hypoechoic mass
- Larger masses may have heterogenous appearance

Sagittal View



**Normal
Caudate Lobe**

Sagittal View



Hepatocellular Carcinoma

- Hypoechoic mass
- Larger masses may have heterogenous appearance

Transverse View



**Normal Right
Lobe**

Transverse View



Metastases

- Well defined and rounded
- Hypoechoic halo with hyperechoic center.
- Hyperechoic or cystic appearance may also occur

Transverse View



**Normal Right
Lobe**

Transverse View



Metastases

- Well defined and rounded
- Hypoechoic halo with hyperechoic center.
- Hyperechoic or cystic appearance may also occur

Transverse View



**Normal Right
Lobe**

Transverse View



Metastases

- Well defined and rounded
- Hypoechoic halo with hyperechoic center.
- Hyperechoic or cystic appearance may also occur

Transverse View



**Normal Right
Lobe**

Transverse View



Metastases with Fatty Liver

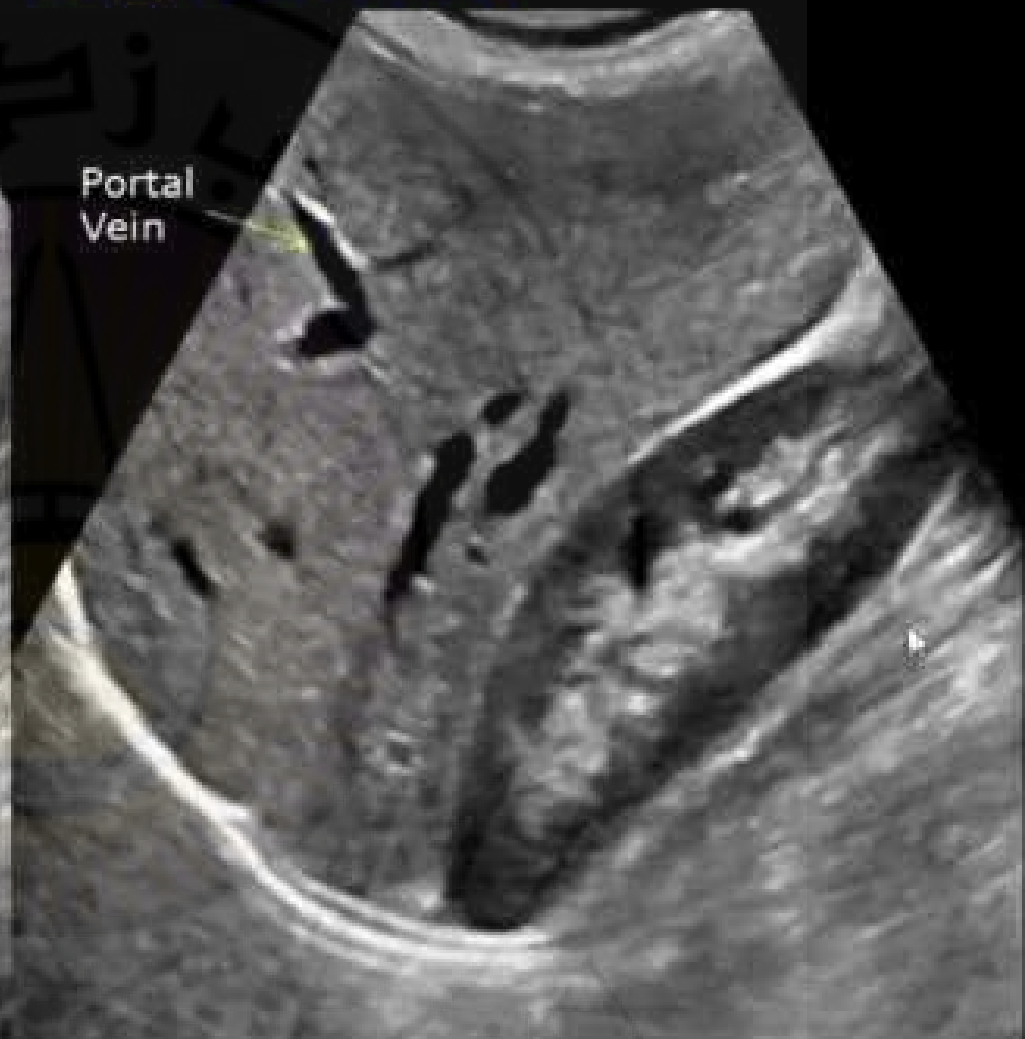
- Well defined and rounded
- Hypoechoic halo
- Hyperechoic or cystic appearance may also occur

Sagittal View



**Normal Right
Lobe**

Sagittal View



Grade 1 Steatosis

- Liver appears hyperechoic
- Normal diaphragm appearance
- Normal portal vein wall echogenicity

Sagittal View



**Normal Right
Lobe**

Sagittal View



Grade 2 Steatosis

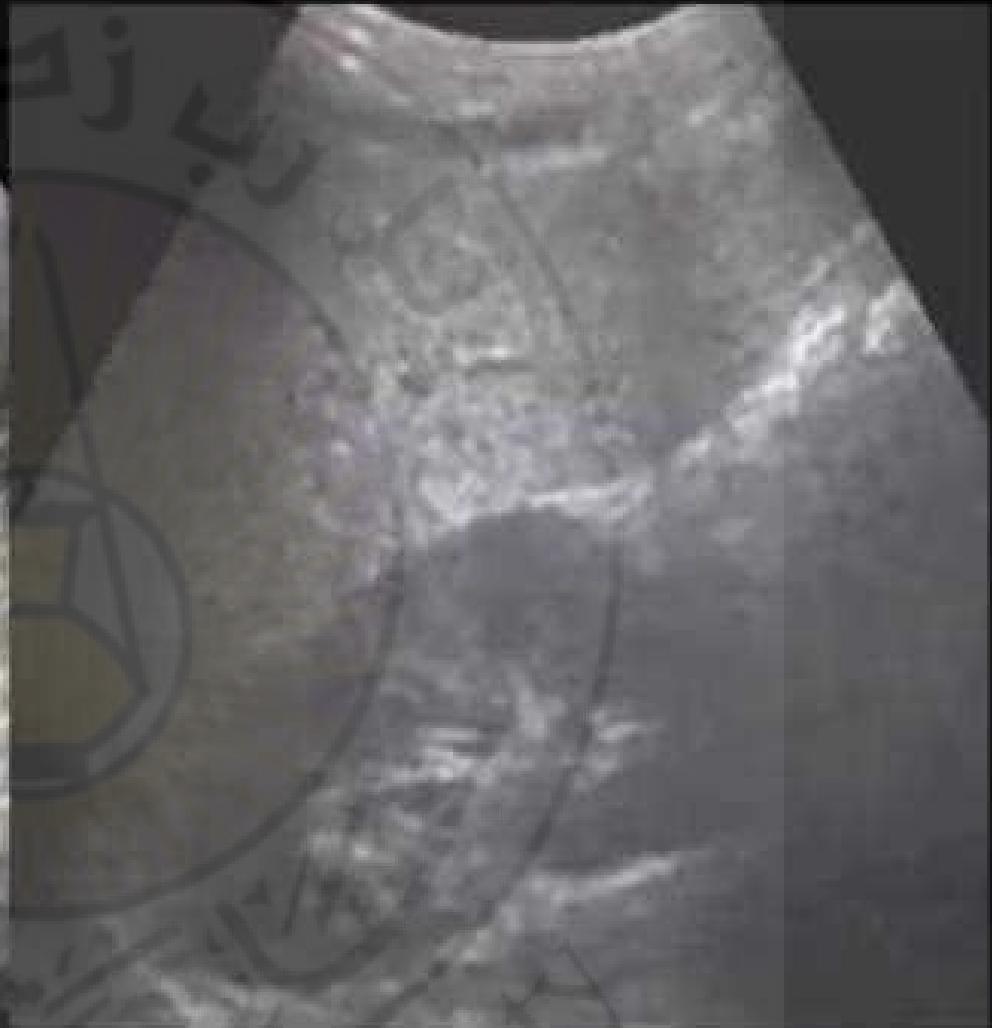
- Increased echogenicity of liver
- Loss of portal vein wall echogenicity
- Normal diaphragm appearance

Sagittal View



**Normal Right
Lobe**

Sagittal View



Grade 3 Steatosis

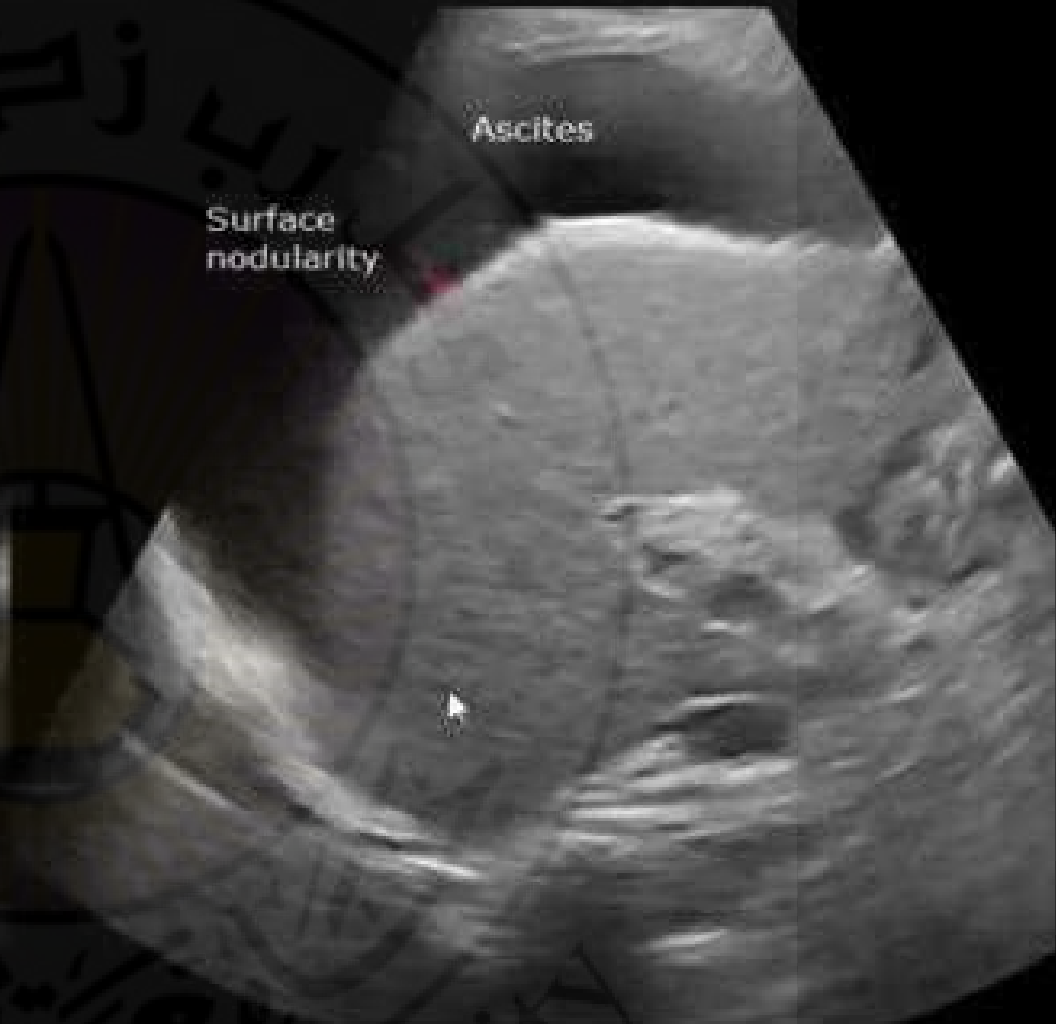
- Very high echogenicity of liver
- No visualization of diaphragm
- Poor visualization of vessels

Transverse View



**Normal Right
Lobe**

Transverse View



Cirrhosis

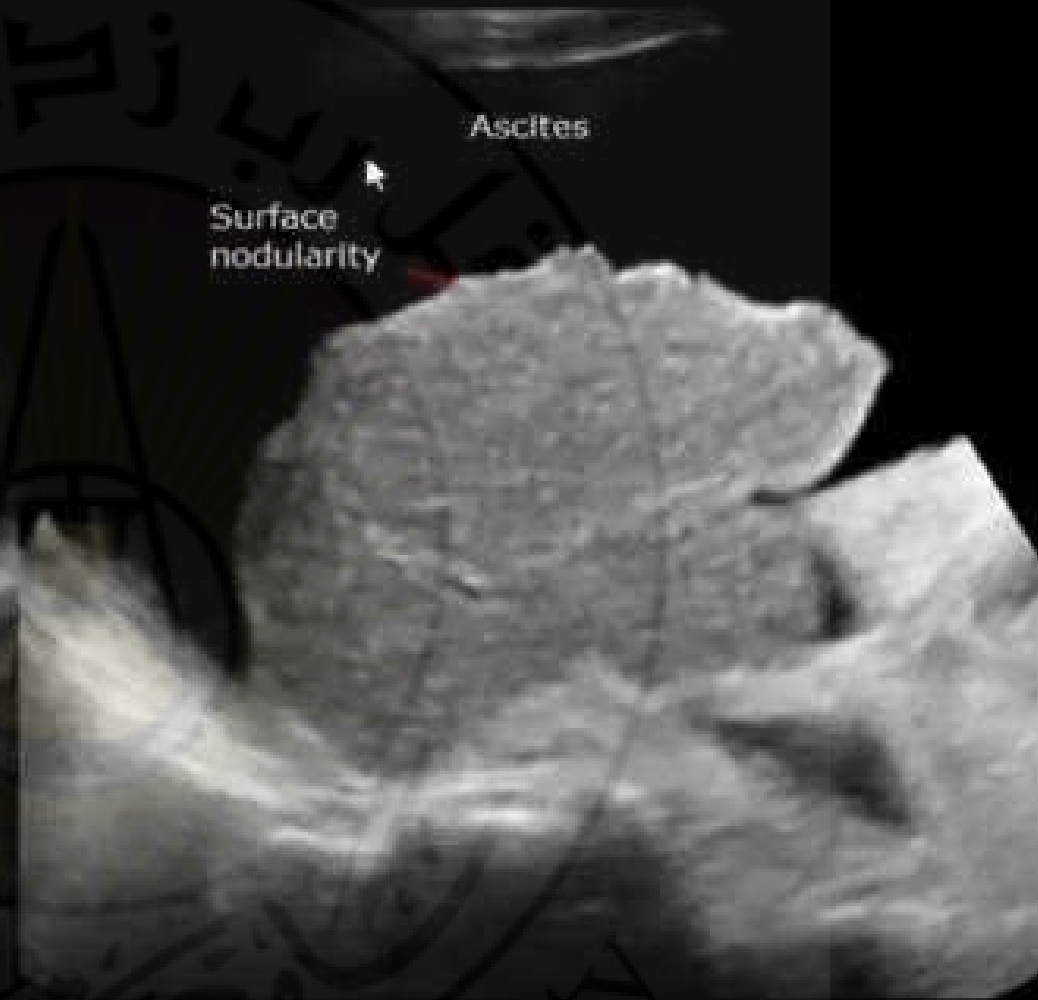
- Surface nodularity
- Shrunken liver
- Coarse echotexture

Transverse View



**Normal Right
Lobe**

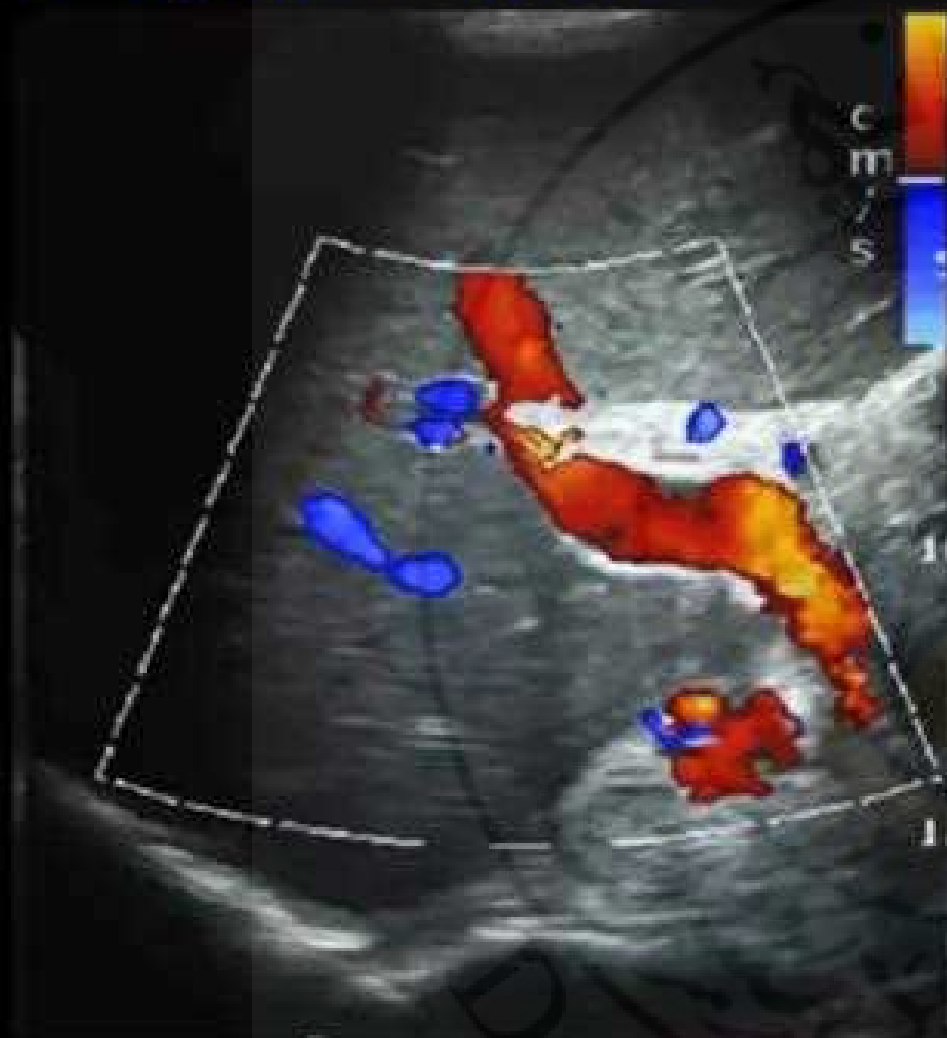
Transverse View



Cirrhosis

- Surface nodularity
- Shrunken liver
- Coarse echotexture

Longitudinal View



**Normal Portal
Vein Flow**

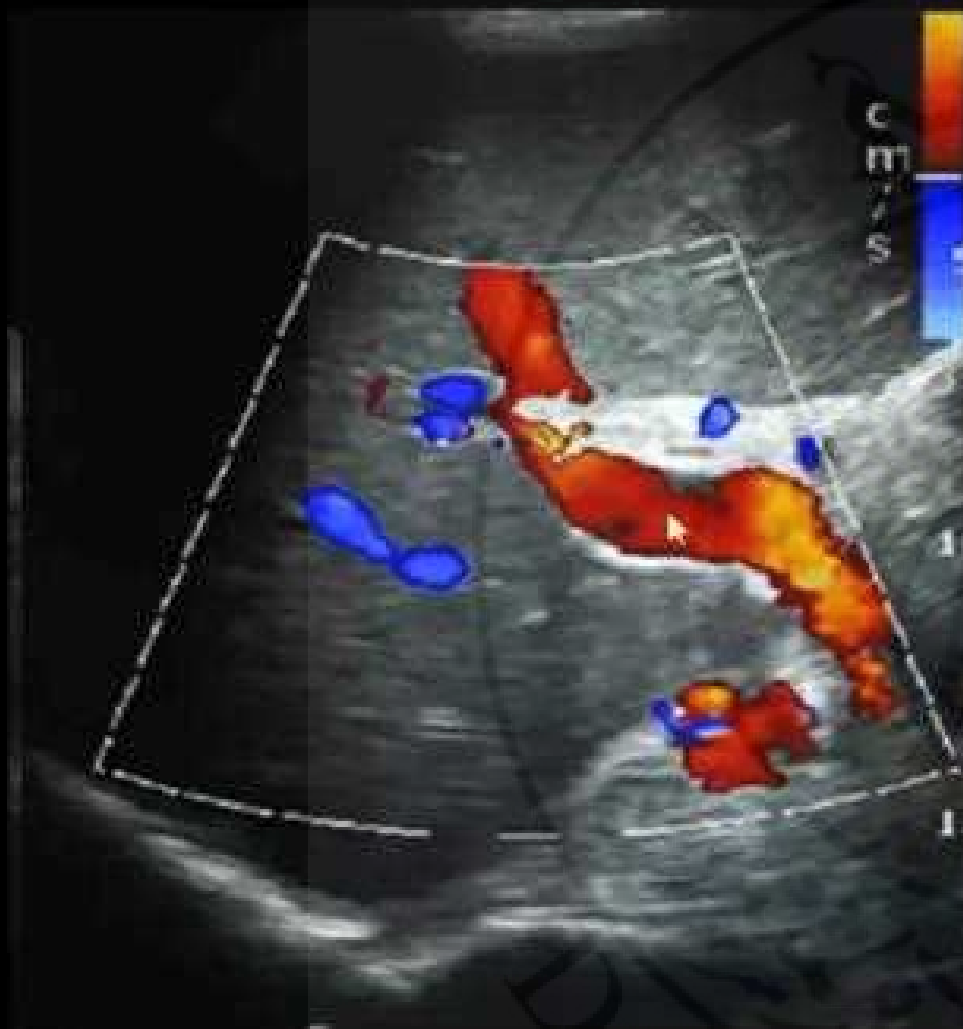
Longitudinal View



Portal Hypertension

- Portal Vein Diameter $>13\text{mm}$
- Little flow detected in intrahepatic portion

Longitudinal View



**Normal Portal
Vein Flow**

Longitudinal View



Portal Hypertension

- Portal Vein Diameter $>13\text{mm}$
- Flow reversal

Longitudinal View

Longitudinal View

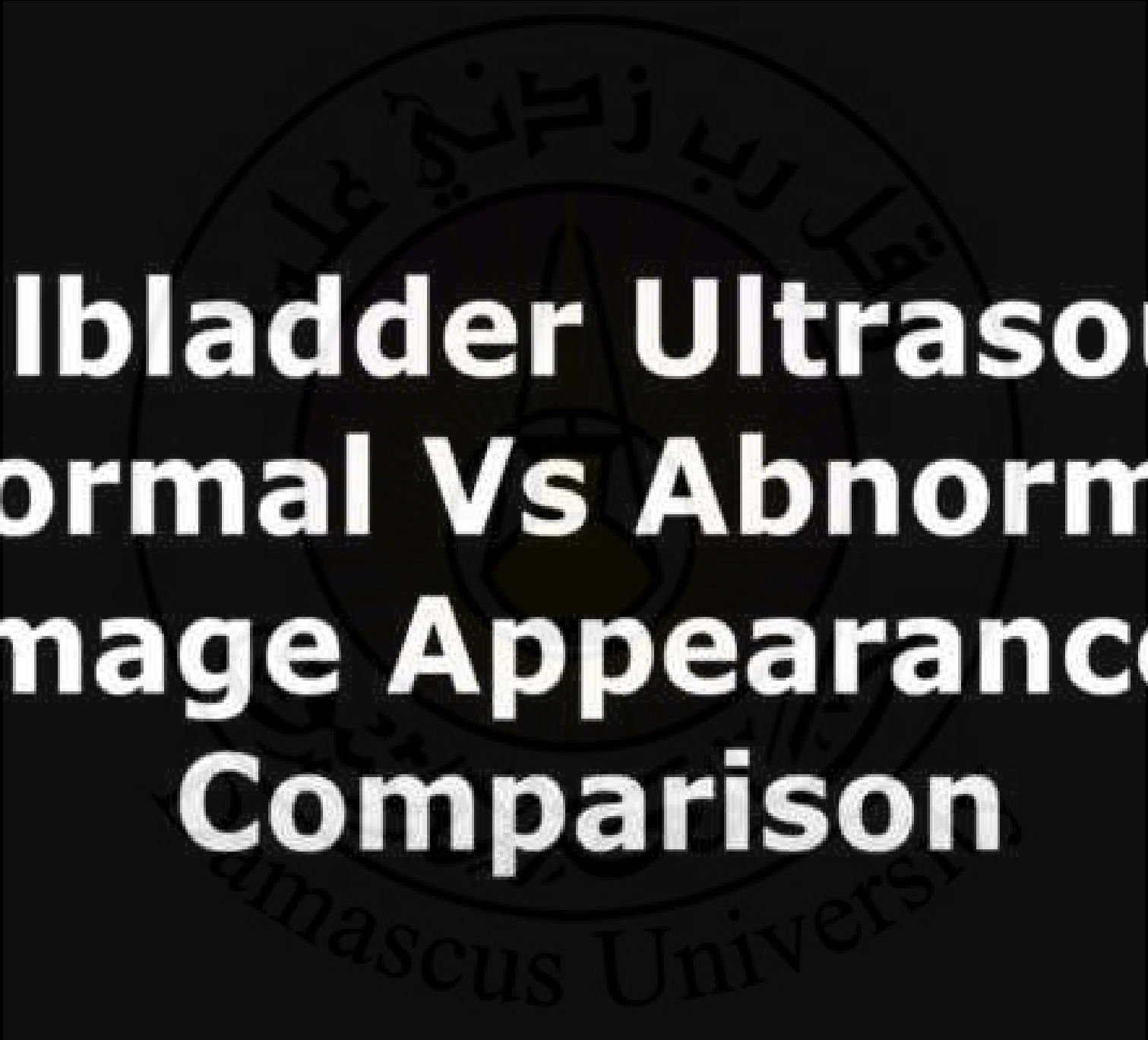


**Normal Right
Lobe**



Viral Hepatitis

- Starry Sky sign
- Also known as centrilobular pattern

A large, faint watermark of the Damascus University seal is centered in the background. The seal is circular, featuring a central emblem with a cross and a crescent, surrounded by Arabic calligraphy. The words "Damascus University" are written in English at the bottom of the seal.

Gallbladder Ultrasound Normal Vs Abnormal Image Appearances Comparison

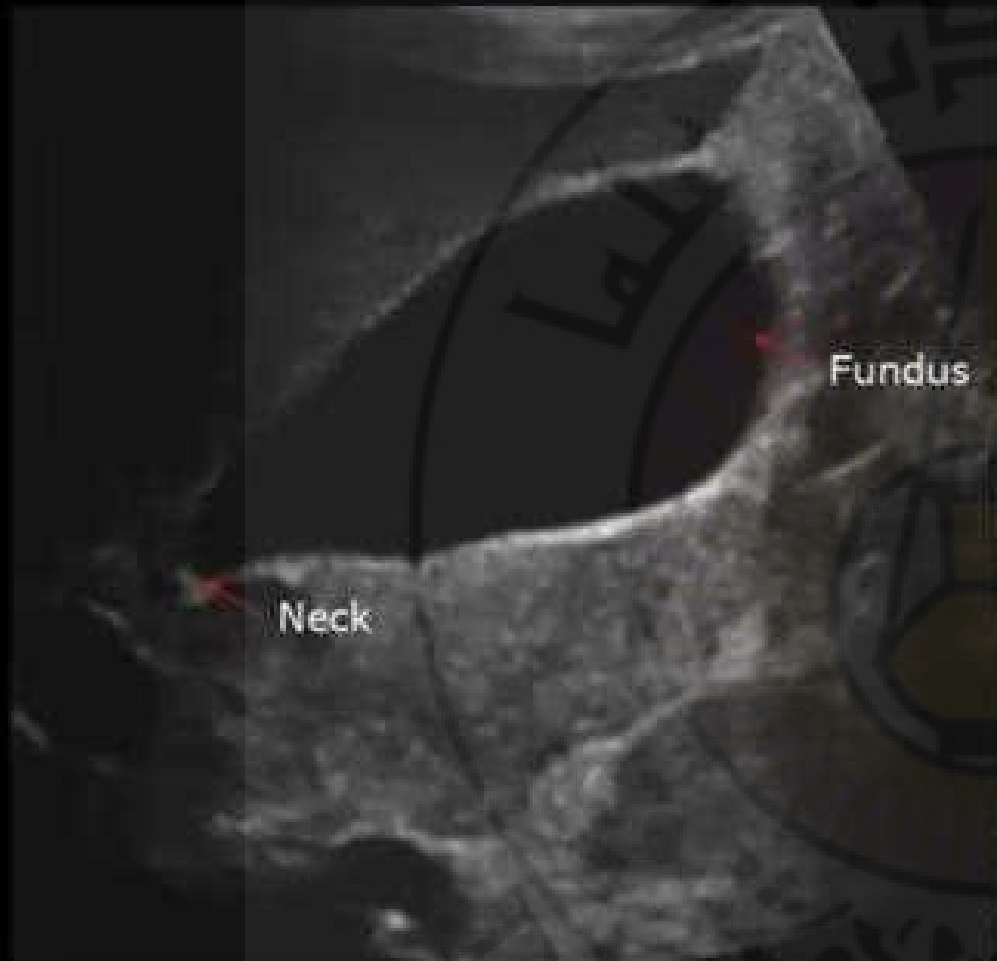
Longitudinal View

Transverse View



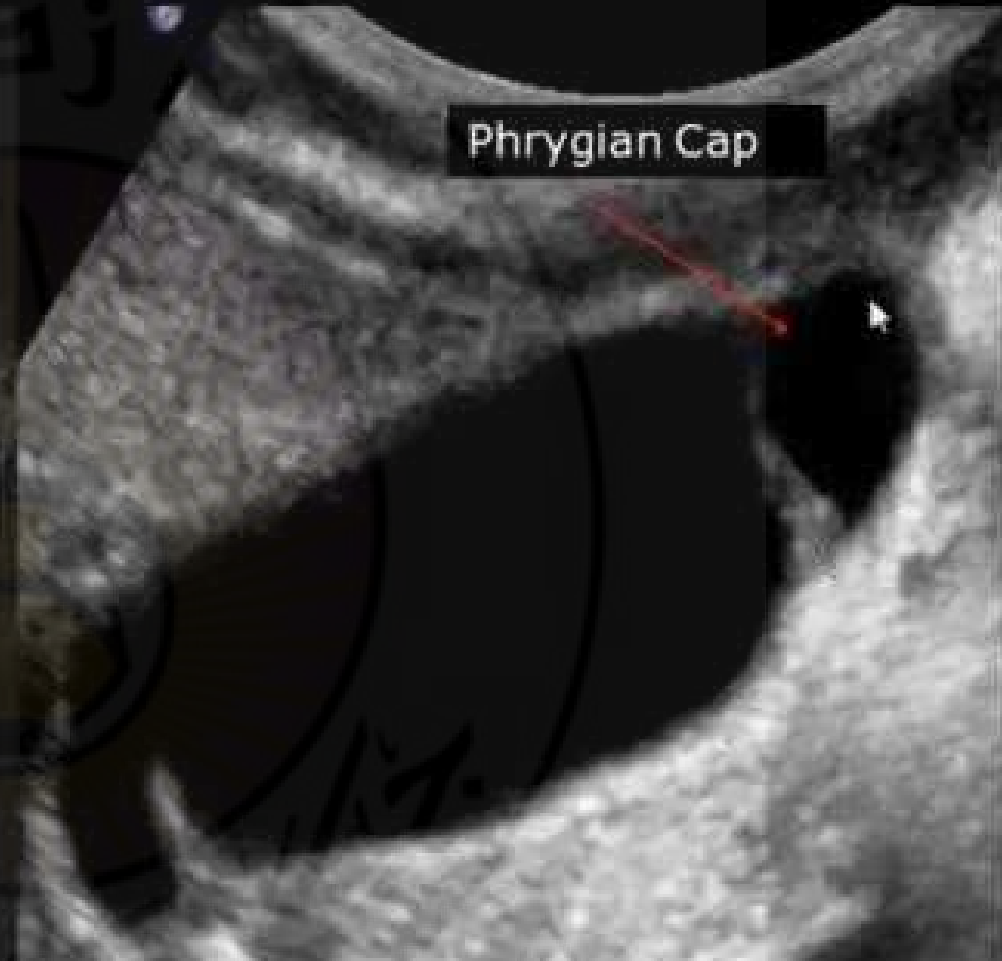
Normal Gall Bladder

Longitudinal View



**Normal
Gall Bladder**

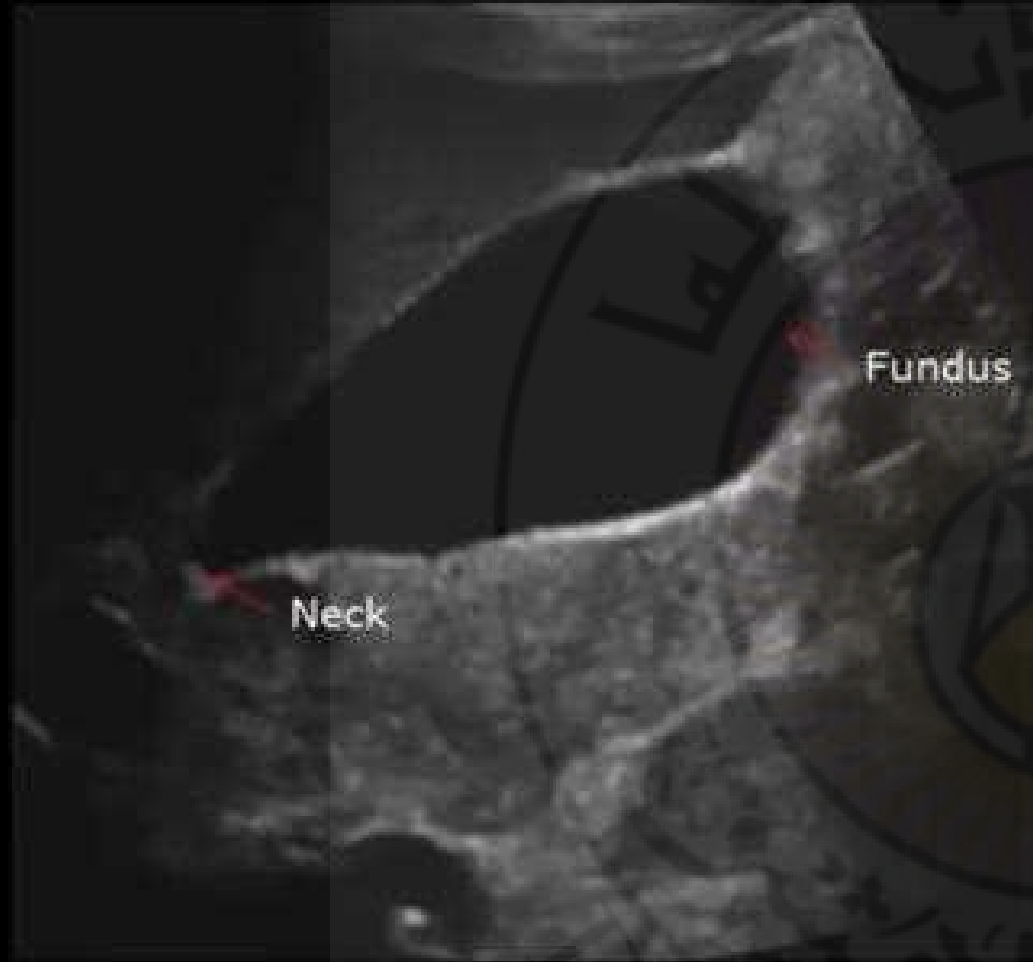
Longitudinal View



Phrygian Cap

- Normal occurrence
- Fundus folds on itself

Longitudinal View



**Normal
Gall Bladder**

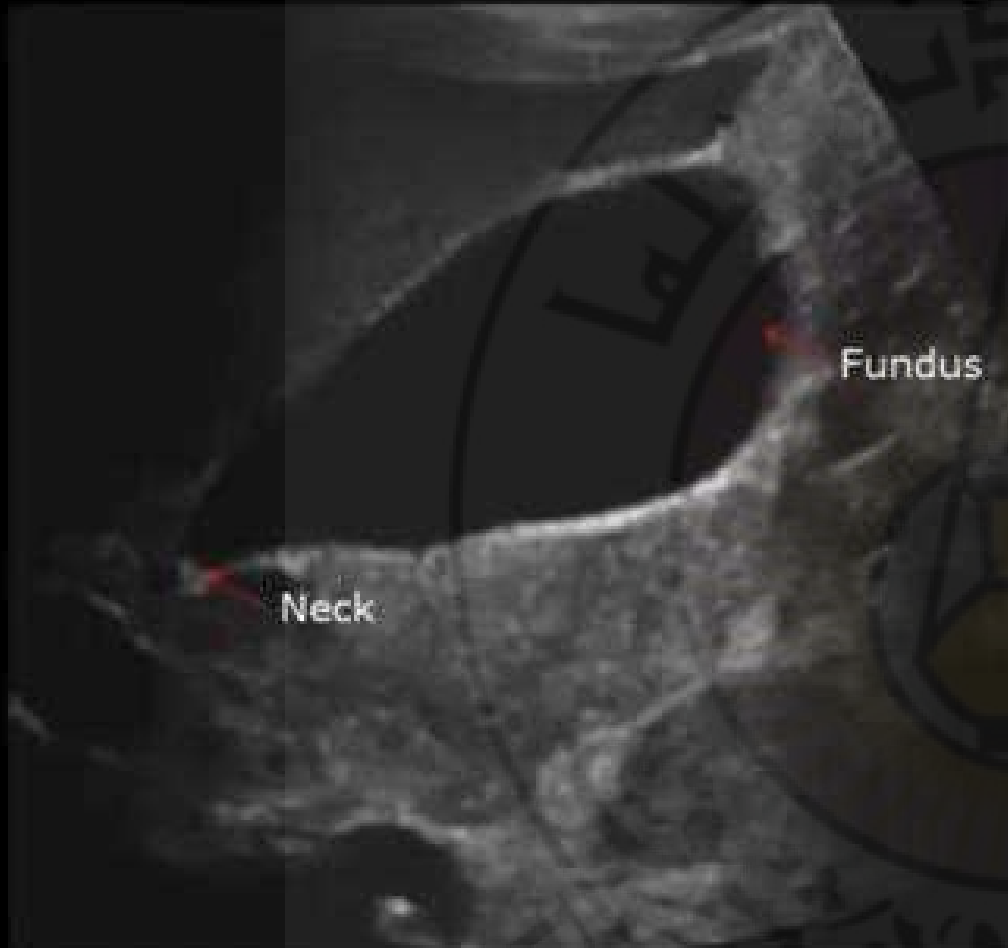
Longitudinal View



**Multiseptated
Gallbladder**

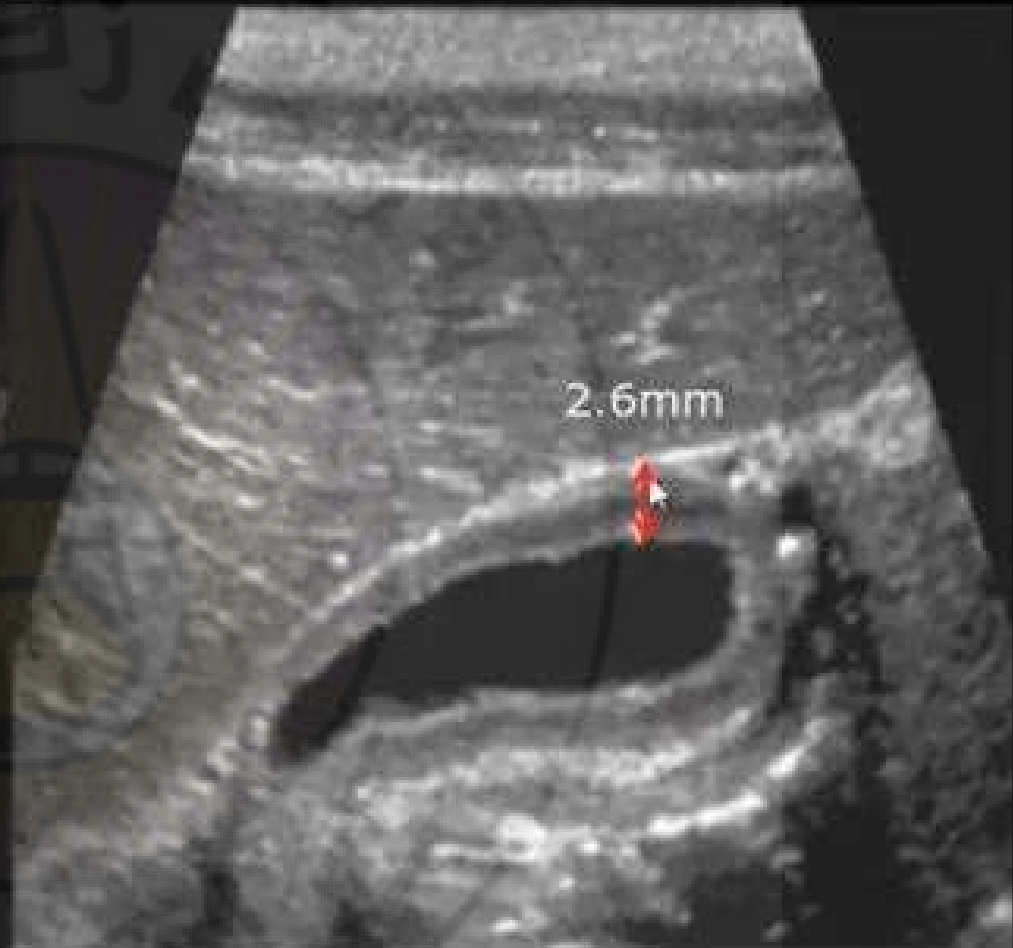
- Honeycomb appearance
- Asymptomatic but should not be ignored

Longitudinal View



**Normal
Gall Bladder**

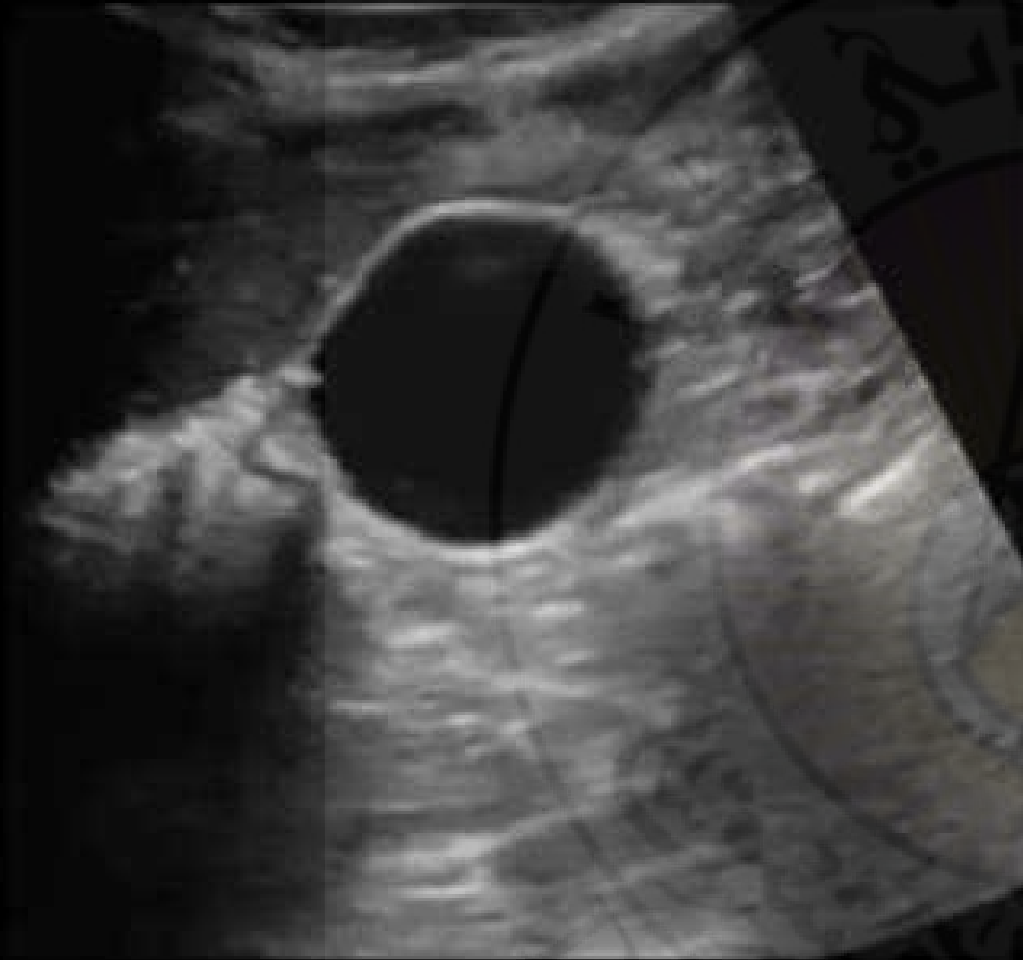
Longitudinal View



**Contracted
Gallbladder**

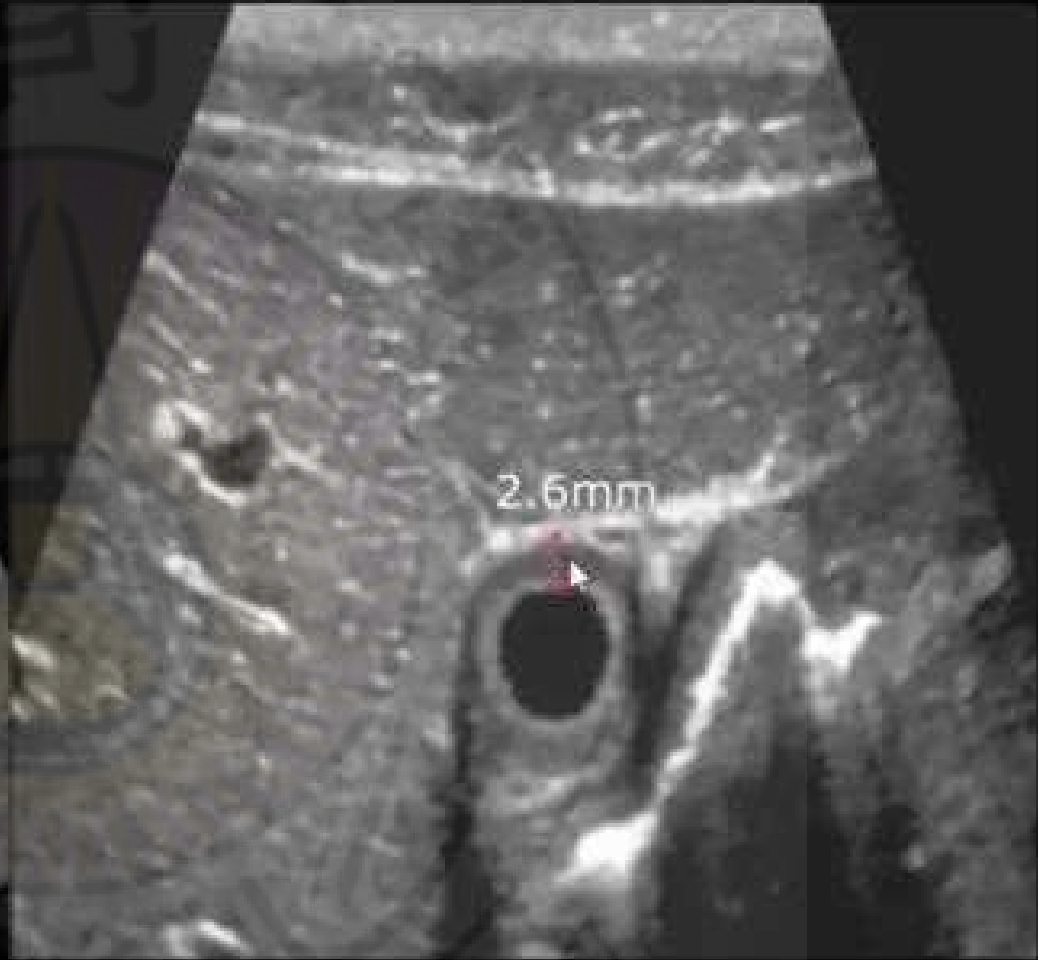
- The wall may appear thickened
- Normal wall thickness: $<3\text{mm}$

Transverse View



**Normal
Gall Bladder**

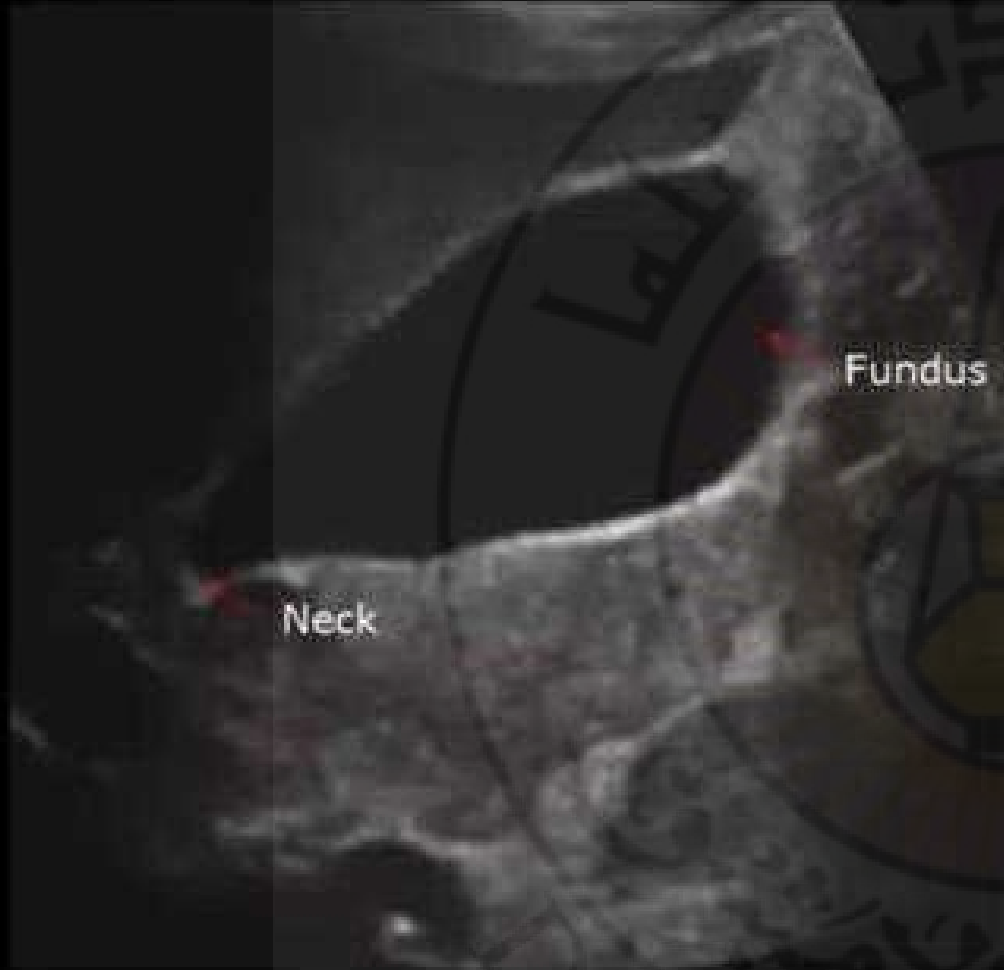
Transverse View



**Contracted
Gallbladder**

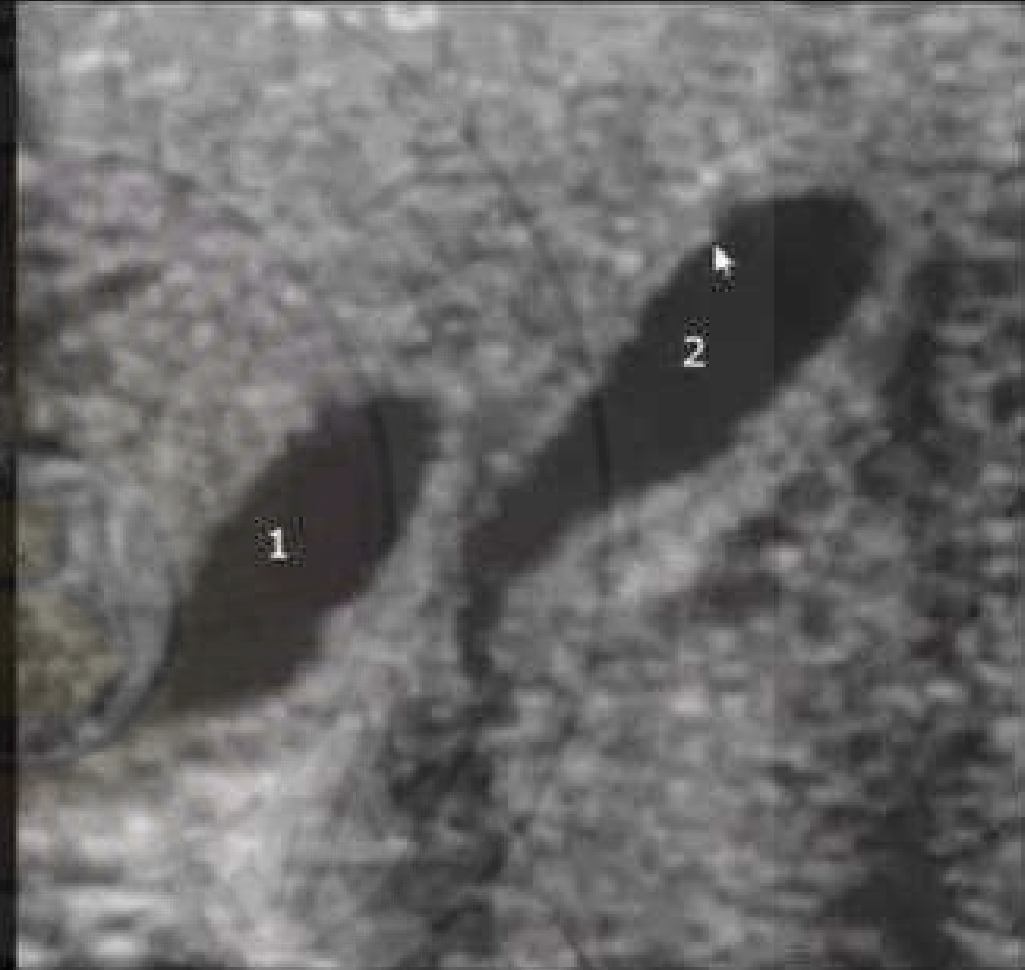
- The wall may appear thickened
- Normal wall thickness: $<3\text{mm}$

Longitudinal View



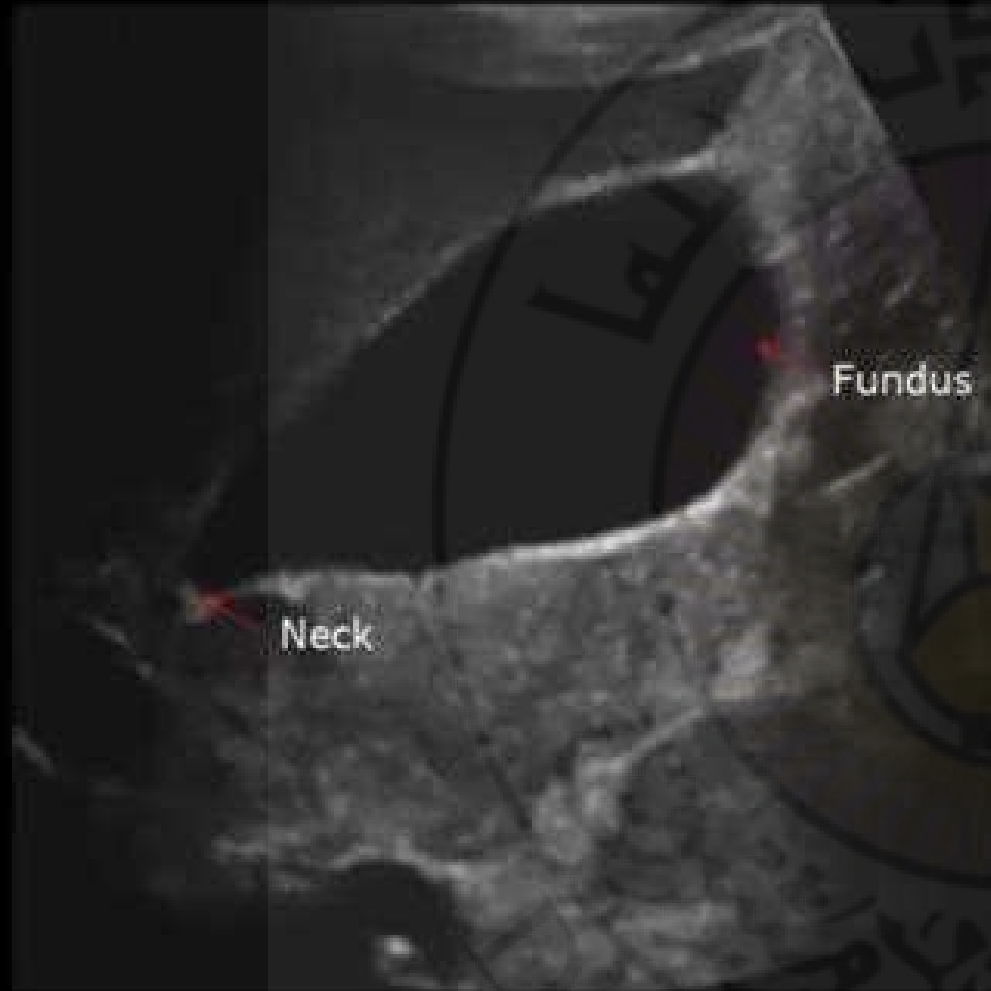
**Normal
Gall Bladder**

Longitudinal View



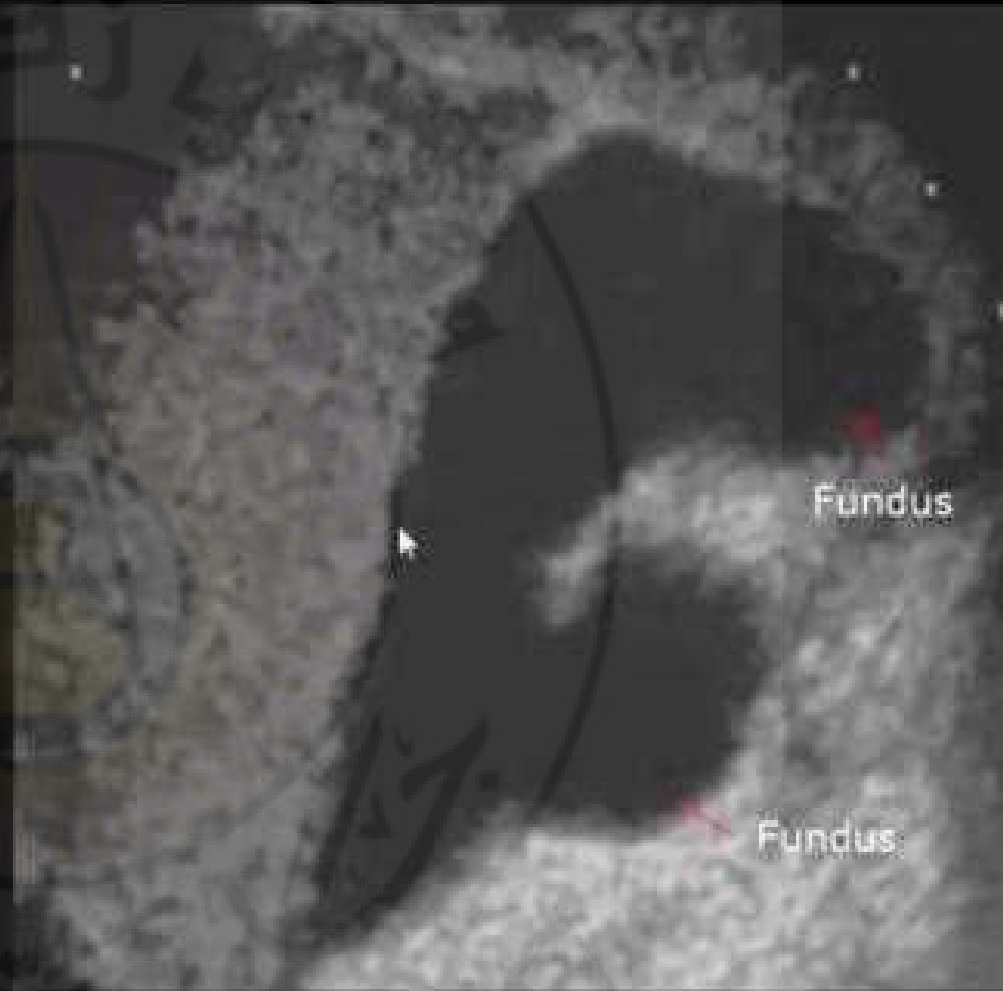
**Complete
Gallbladder
Duplication**

Longitudinal View



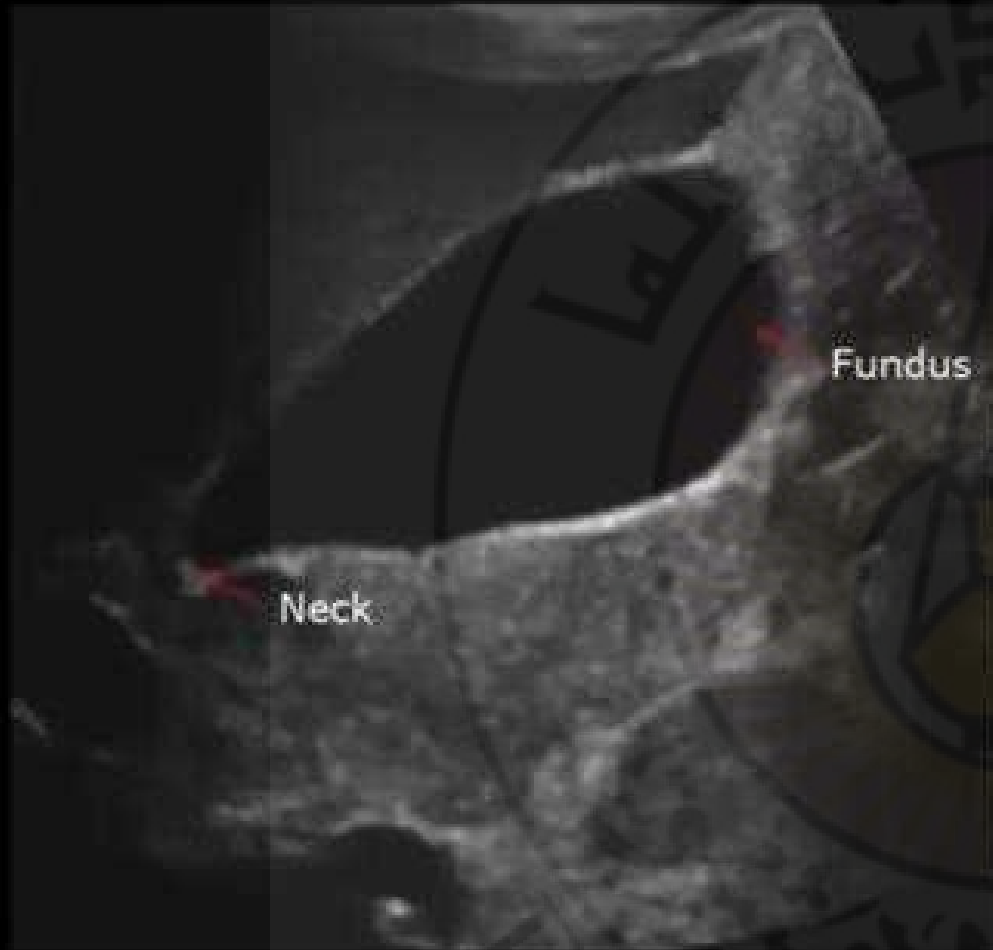
**Normal
Gall Bladder**

Longitudinal View



**Partial Gallbladder
Duplication**

Longitudinal View



**Normal
Gall Bladder**

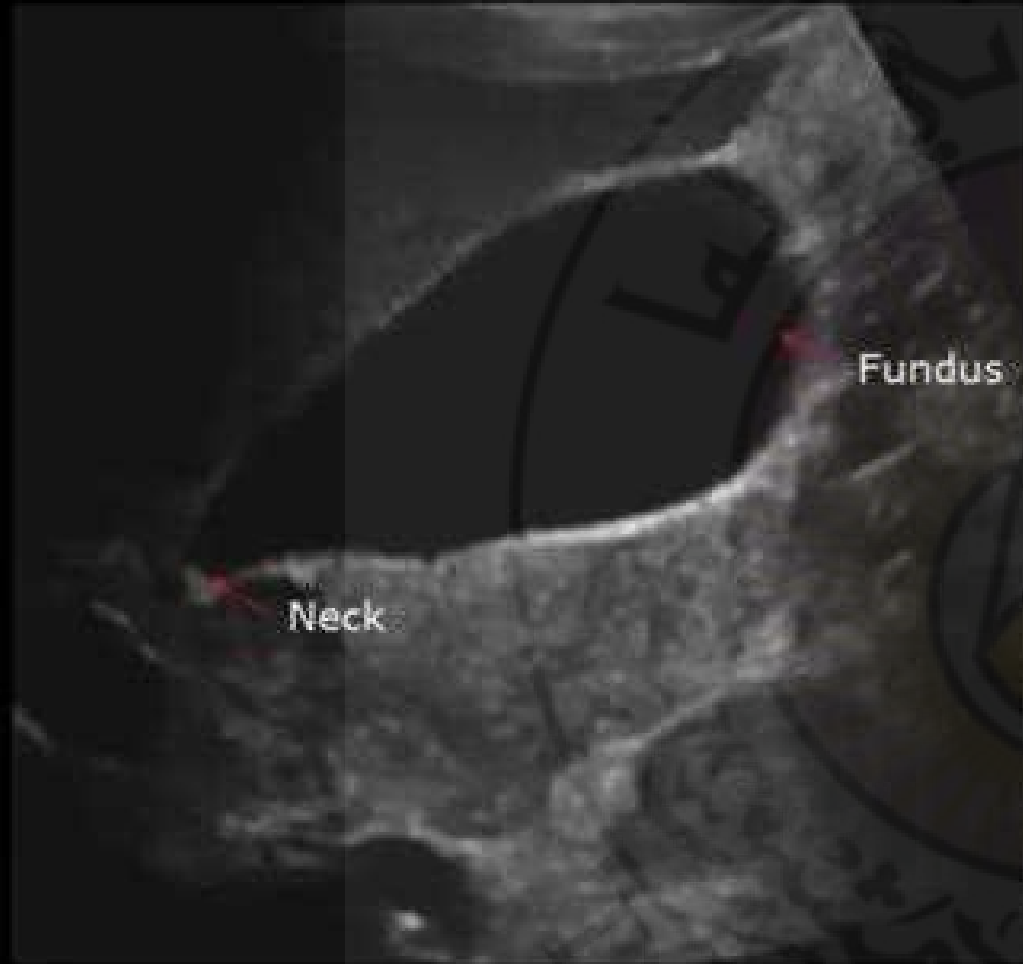
Longitudinal View



Gallstones

- Hyperechoic, mobile
- Posterior acoustic shadowing occurs due to the stone.

Longitudinal View



**Normal
Gall Bladder**

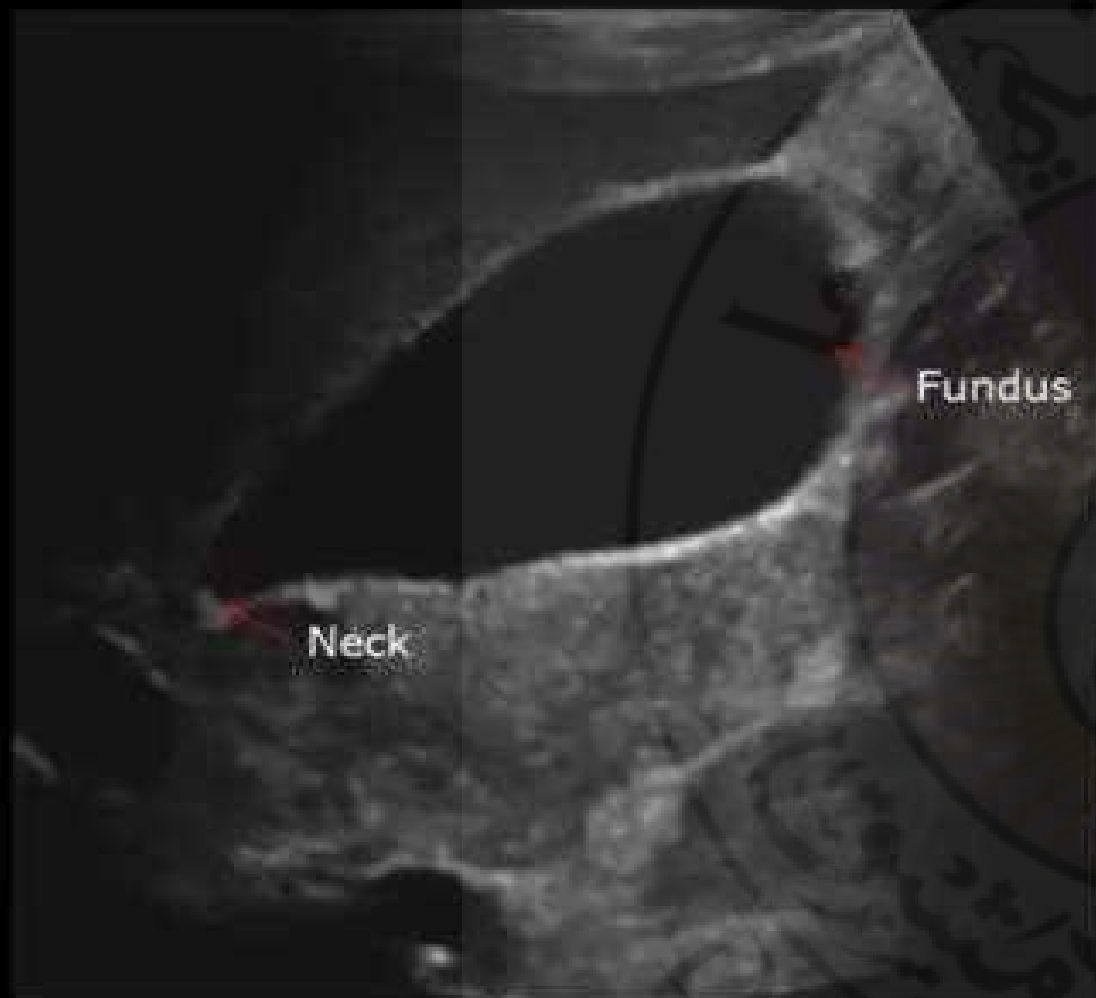
Longitudinal View



Gallstones

- Hyperechoic, mobile
- Posterior acoustic shadowing occurs due to the stone.

Longitudinal View



**Normal
Gall Bladder**

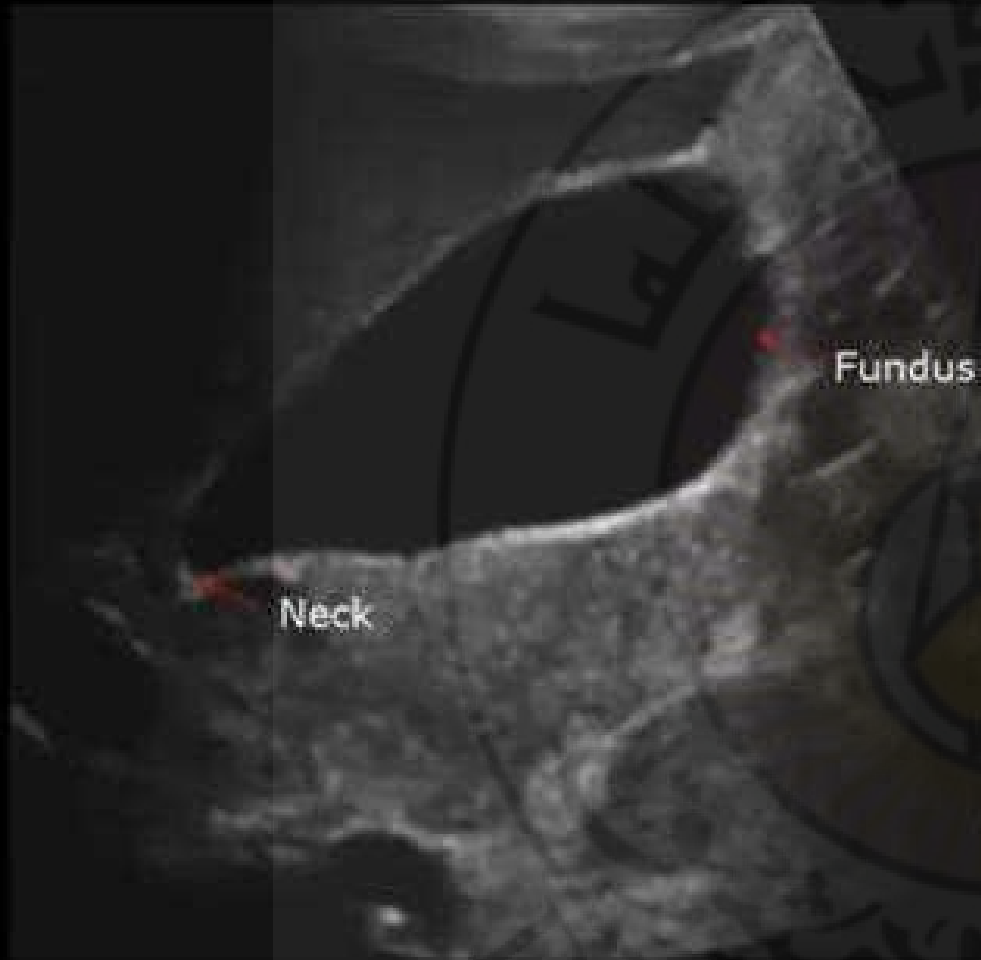
Longitudinal View



Gallstones

- Hyperechoic, mobile
- Posterior acoustic shadowing occurs due to the stone.

Longitudinal View



**Normal
Gall Bladder**

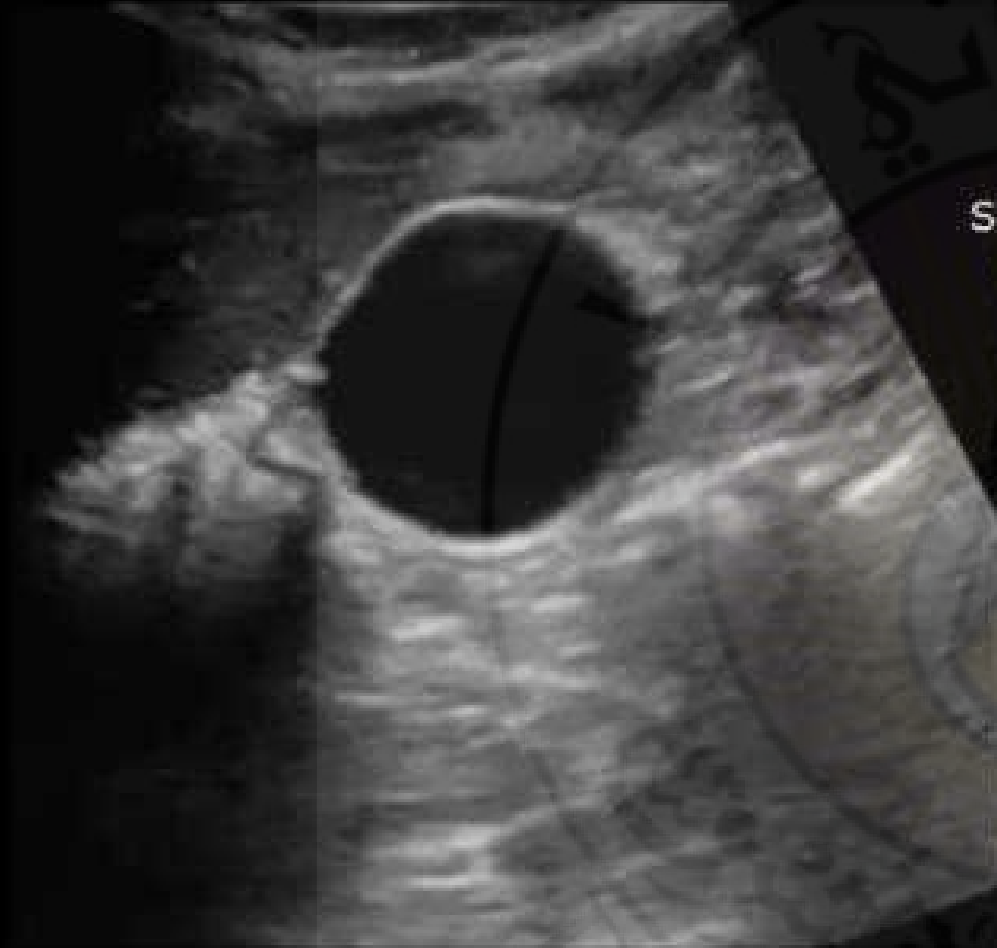
Longitudinal View



Sludge

- Formed due to thickening of bile
- Hyperechoic reflectors without posterior shadowing and is mobile.

Transverse View



**Normal
Gall Bladder**

Transverse View

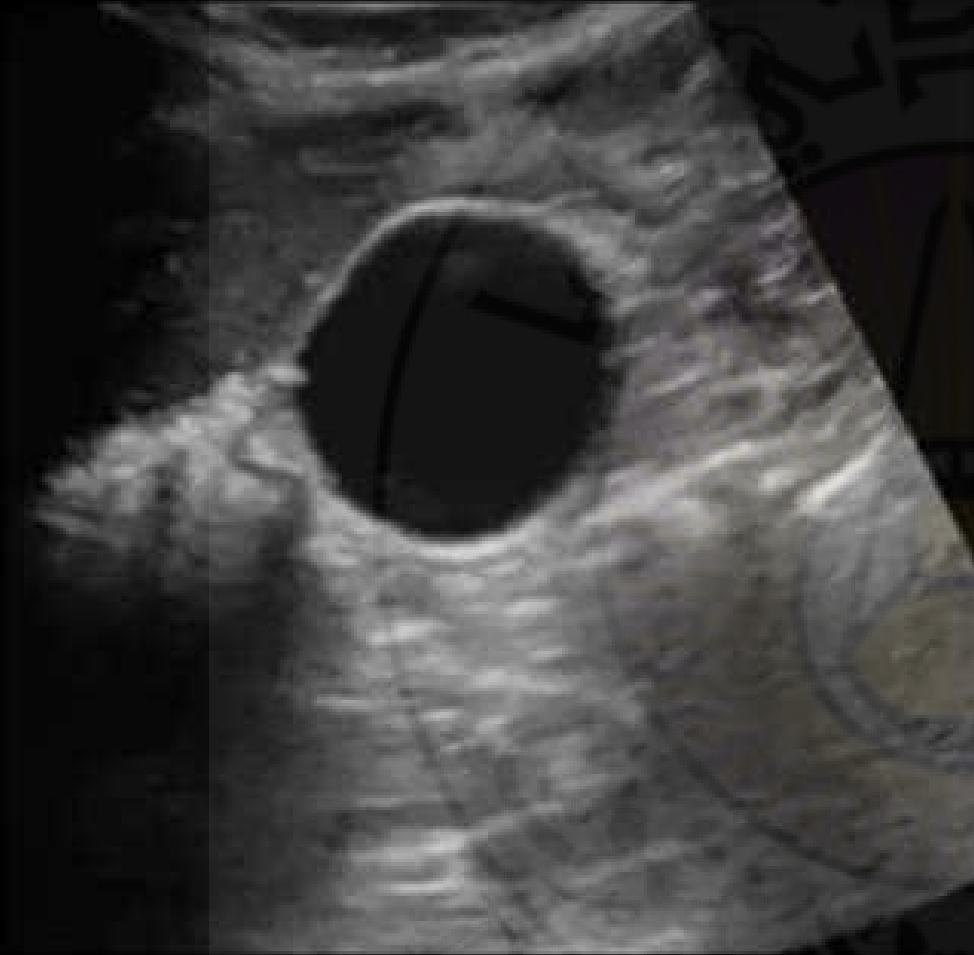


Sludge

Sludge

- Formed due to thickening of bile
- Hyperechoic reflectors without posterior shadowing and is mobile.

Transverse View



**Normal
Gall Bladder**

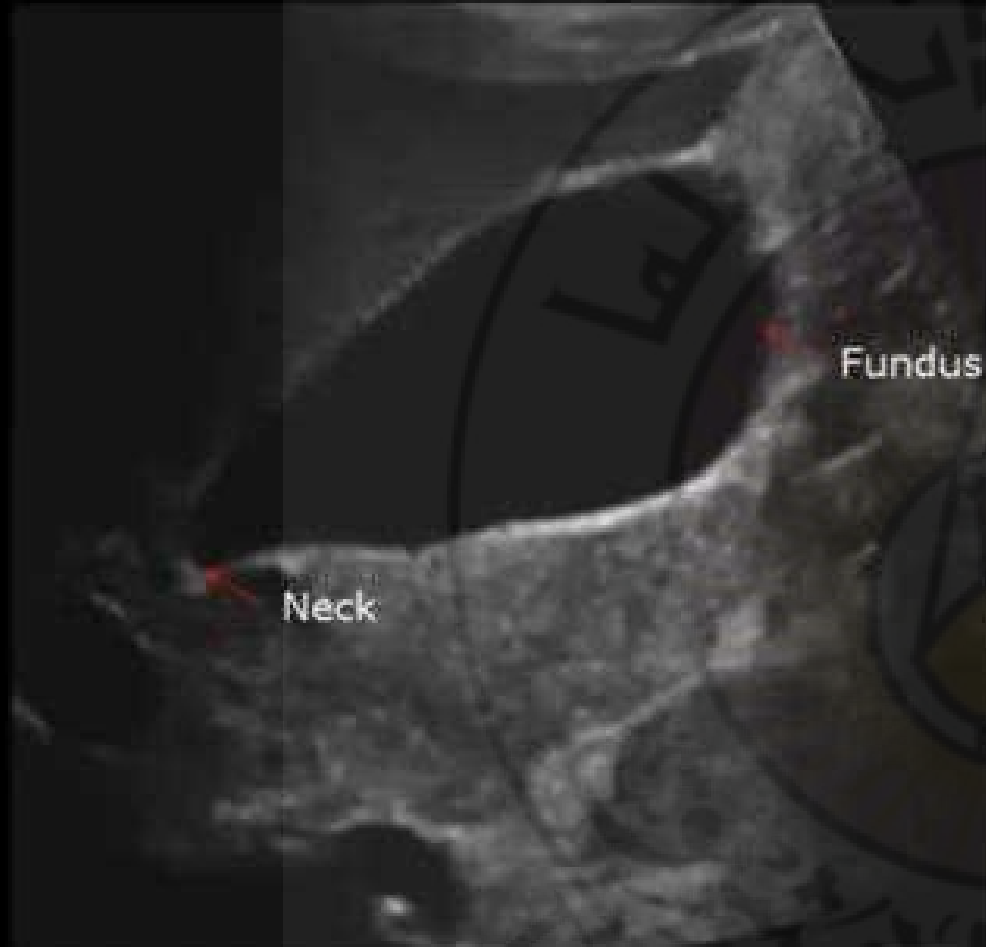
Transverse View



Acute Cholecystitis

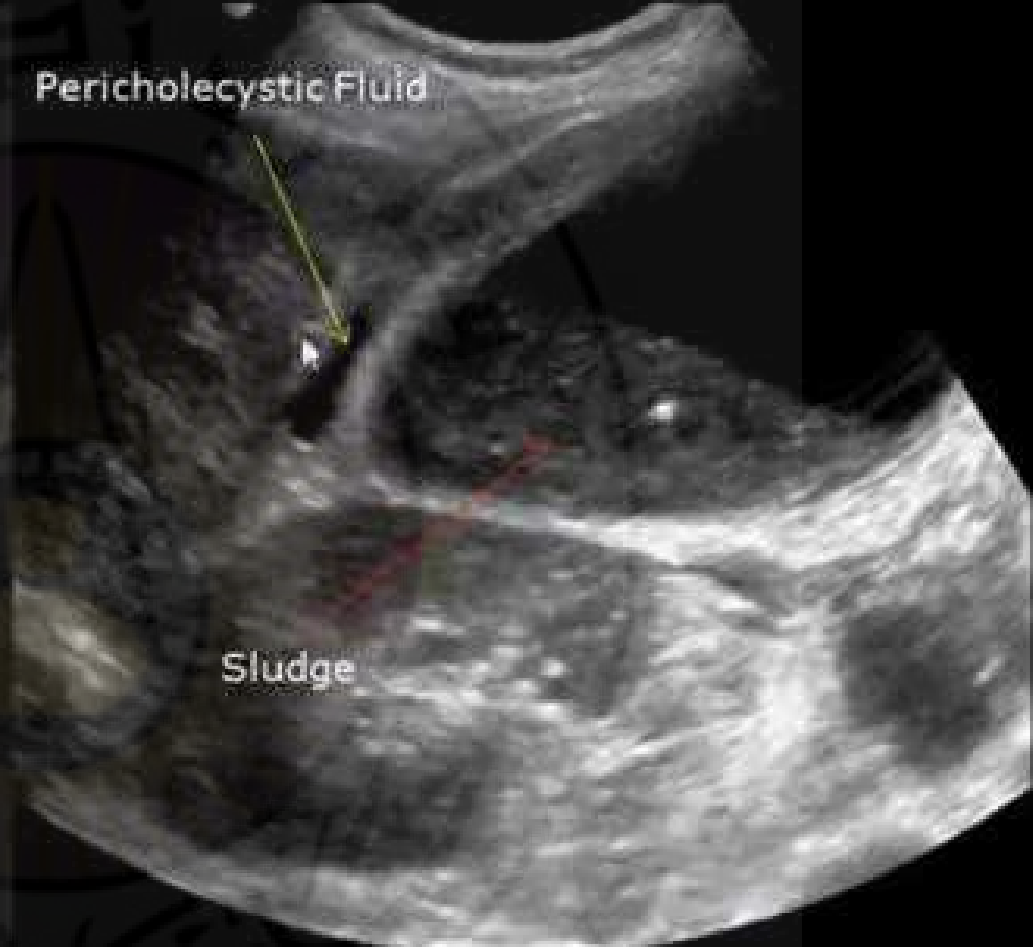
- Wall thickness $> 3\text{mm}$
- Gallstones/sludge present
- Pericholecystic fluid

Longitudinal View



**Normal
Gall Bladder**

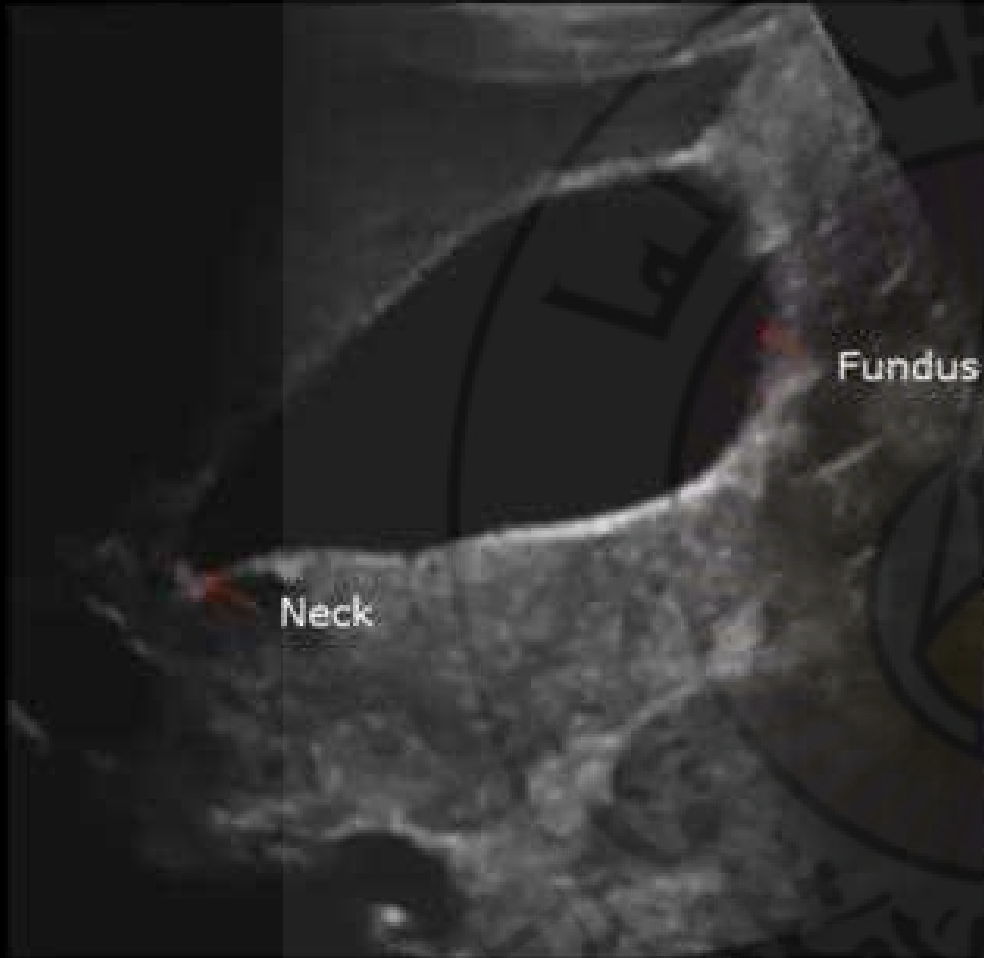
Longitudinal View



Acute Cholecystitis

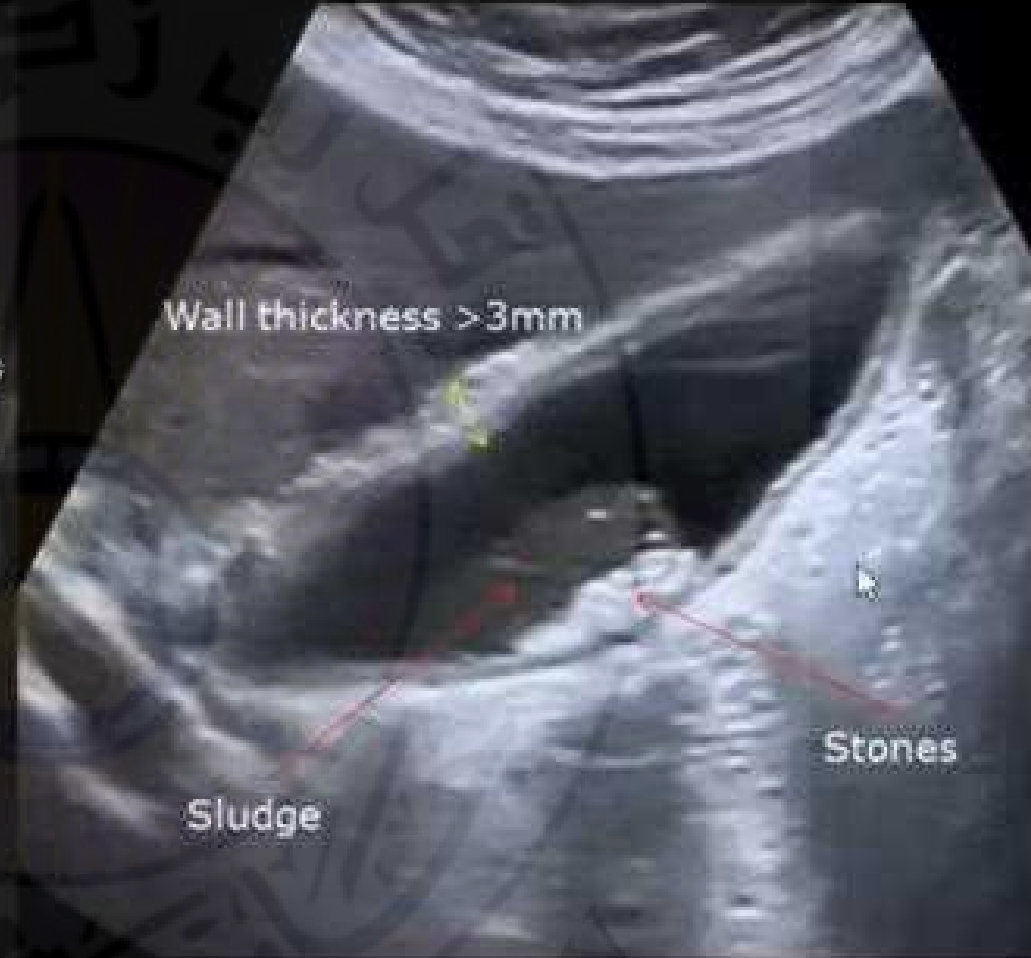
- Wall thickness $> 3\text{mm}$
- Gallstones/sludge present
- Pericholecystic fluid

Longitudinal View



**Normal
Gall Bladder**

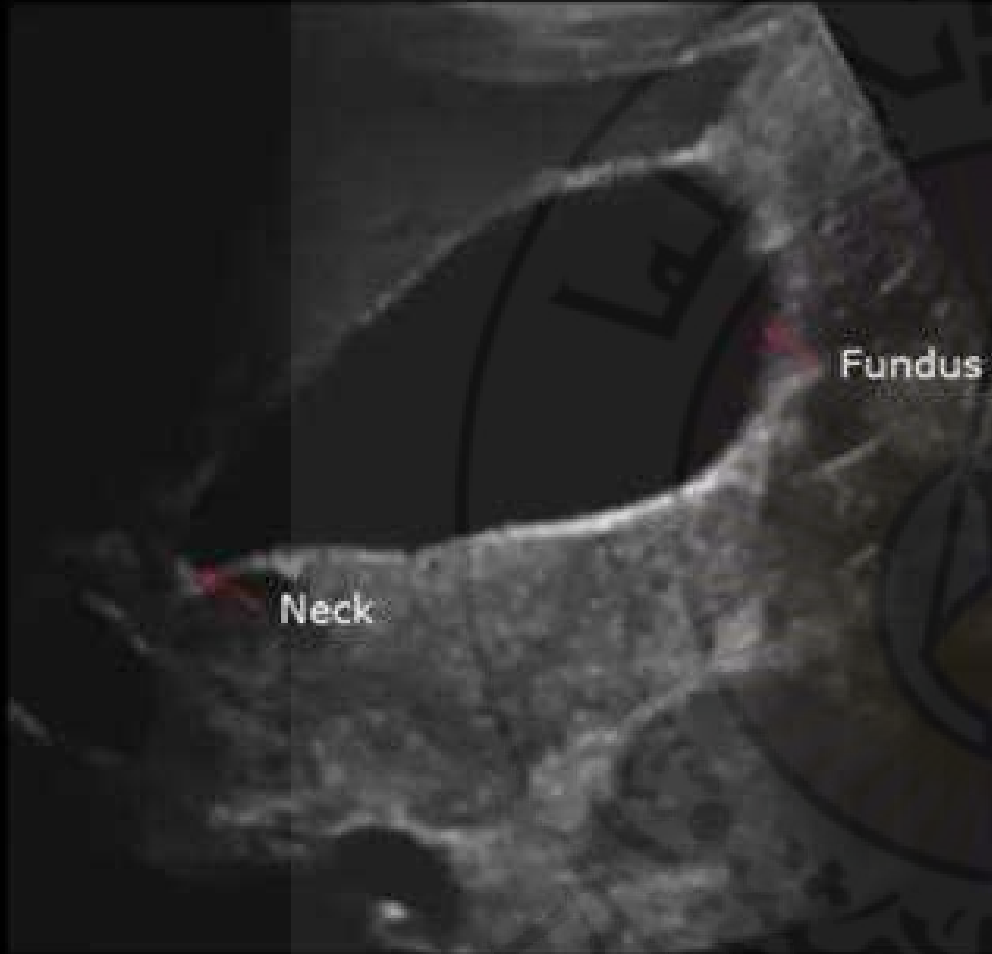
Longitudinal View



Acute Cholecystitis

- Wall thickness >3mm
- Gallstones/sludge present
- Sonographic Murphy's Sign

Longitudinal View



**Normal
Gall Bladder**

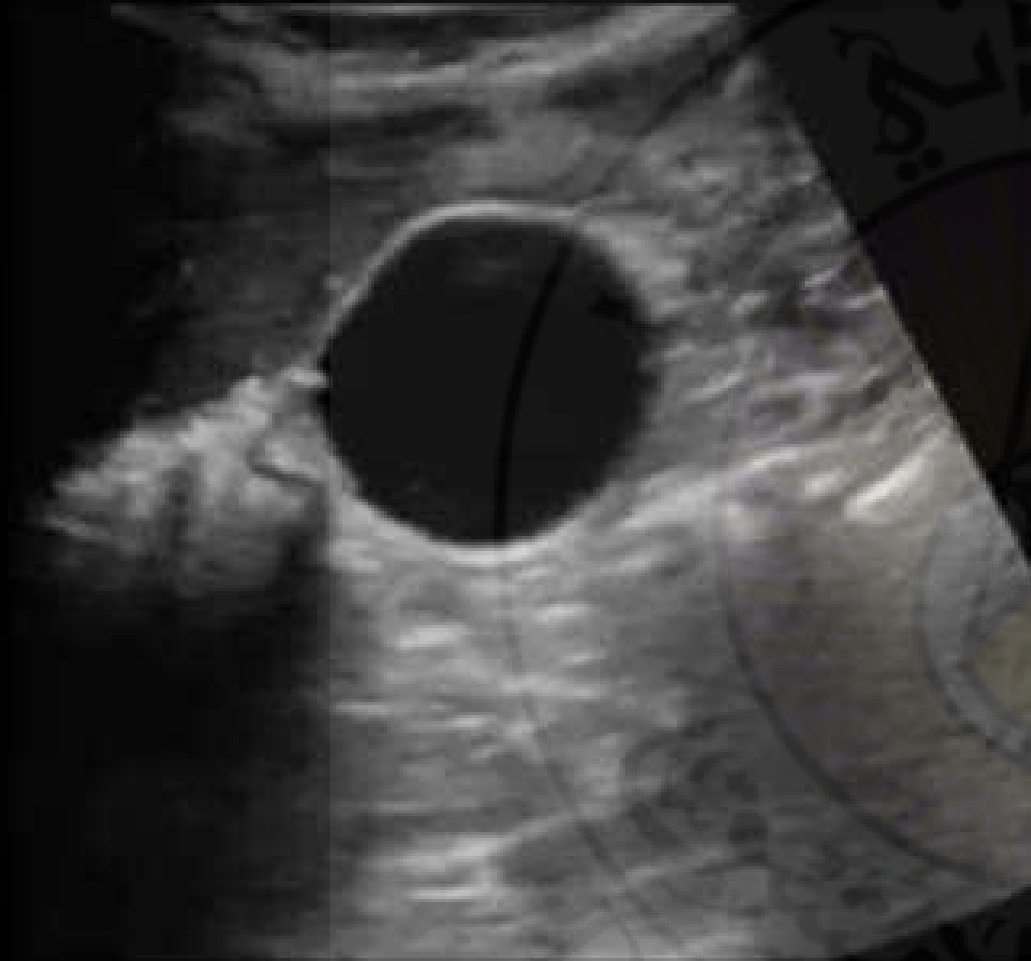
Longitudinal View



Gangrenous Cholecystitis

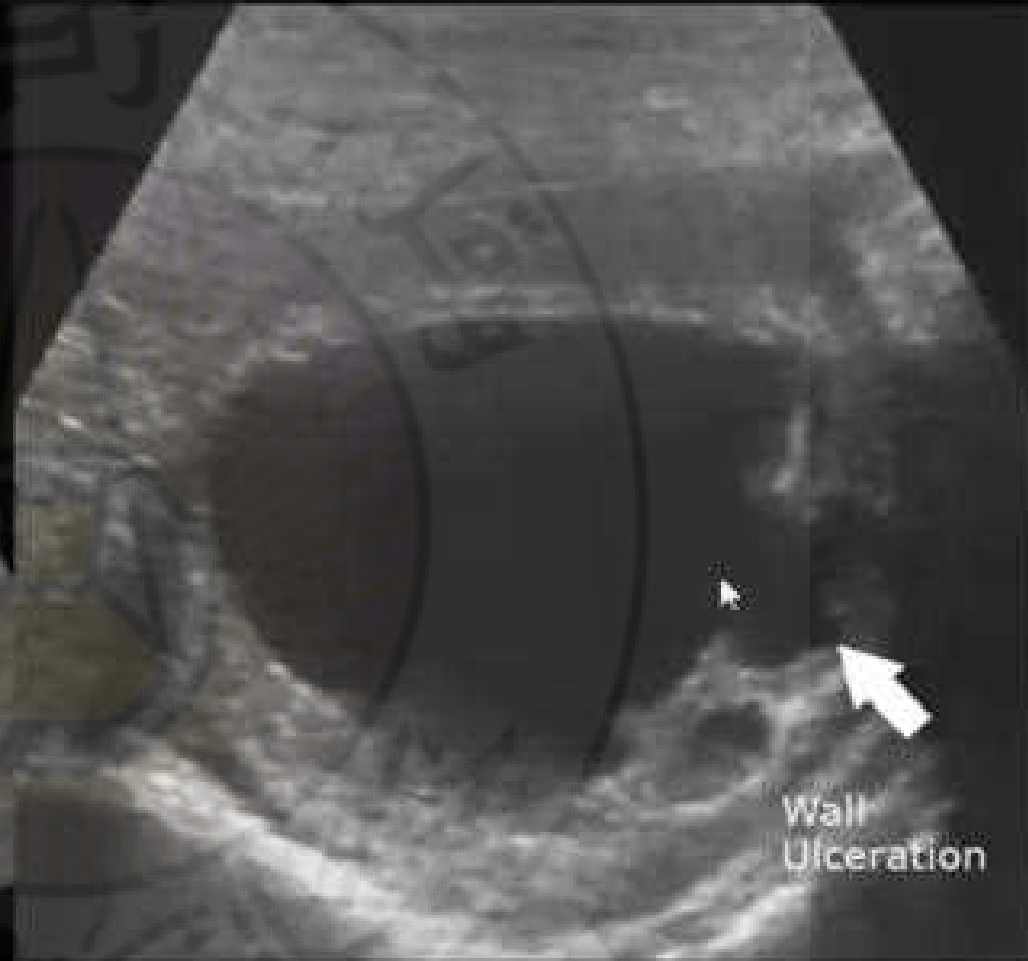
- Pericholecystic fluid
- Wall disruption/ulceration
- Sloughed membranes

Transverse View



**Normal
Gall Bladder**

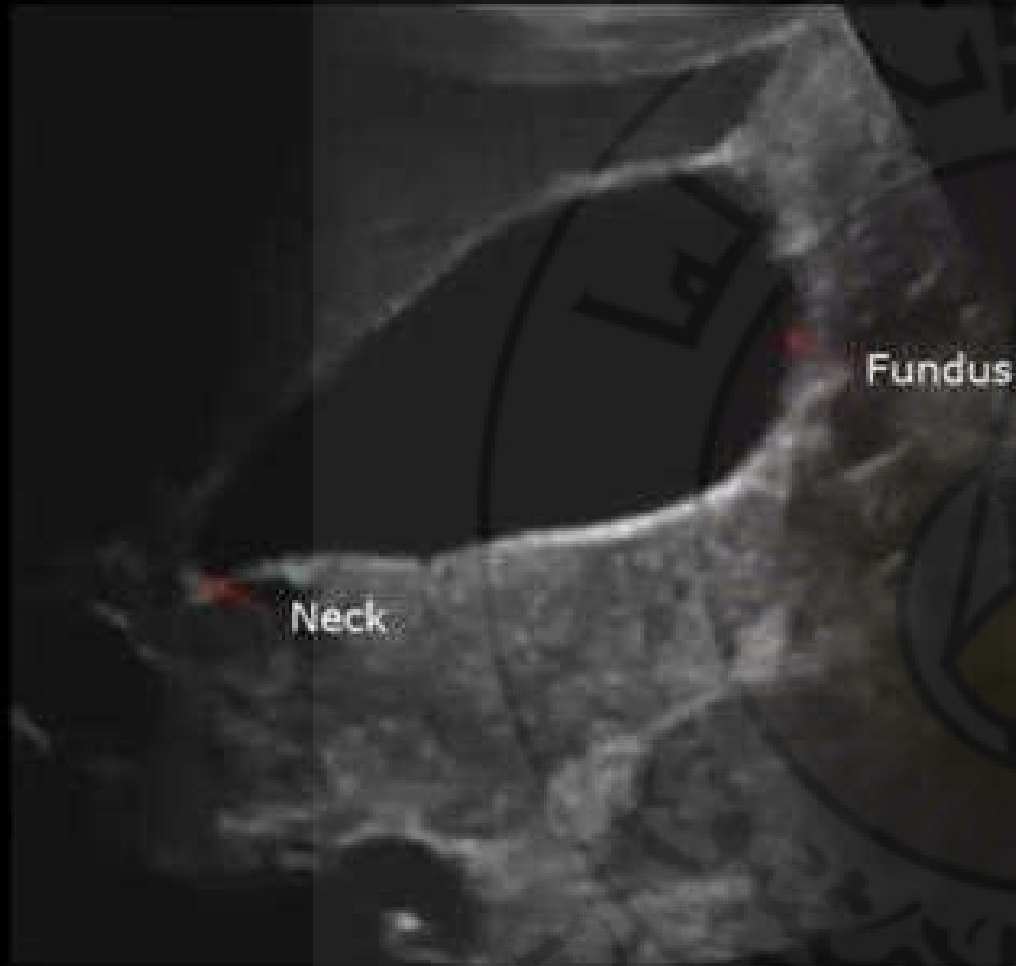
Transverse View



Gangrenous Cholecystitis

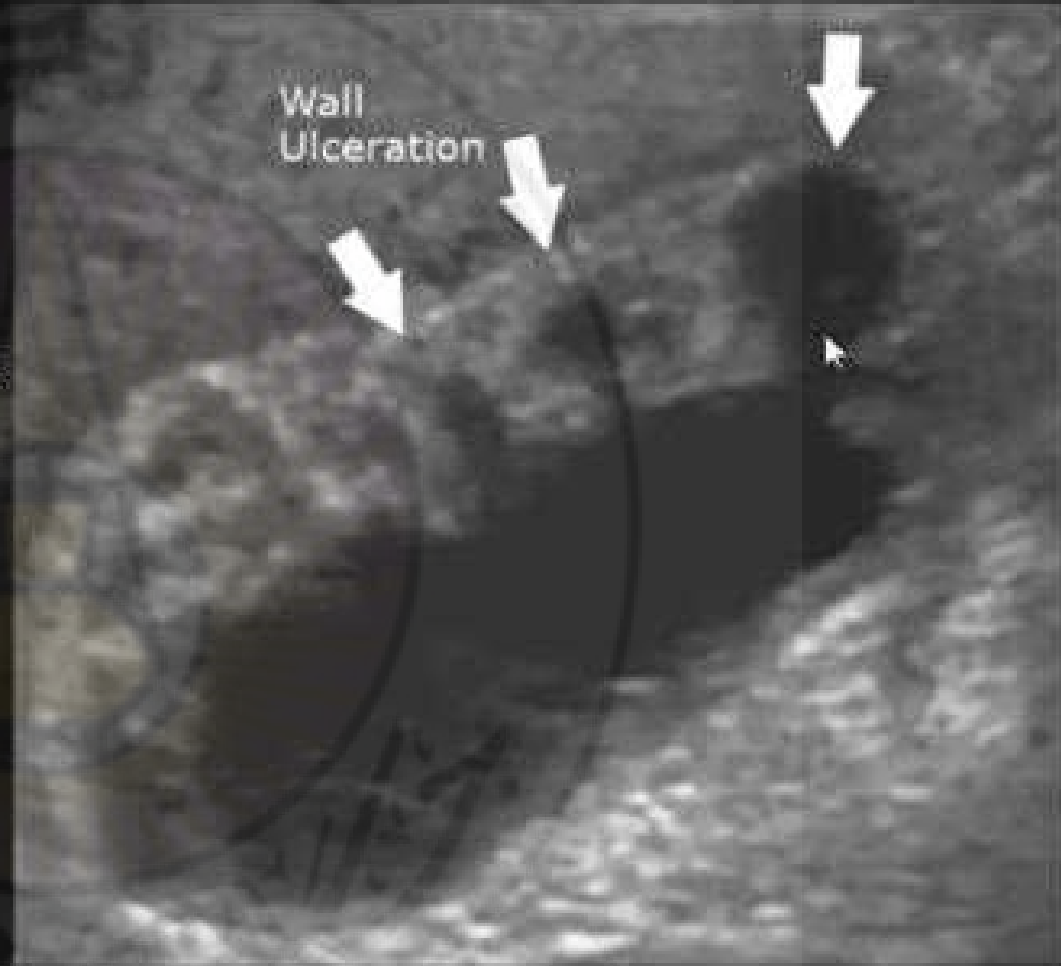
- Pericholecystic fluid
- Wall disruption/ulceration
- Sloughed membranes

Longitudinal View



**Normal
Gall Bladder**

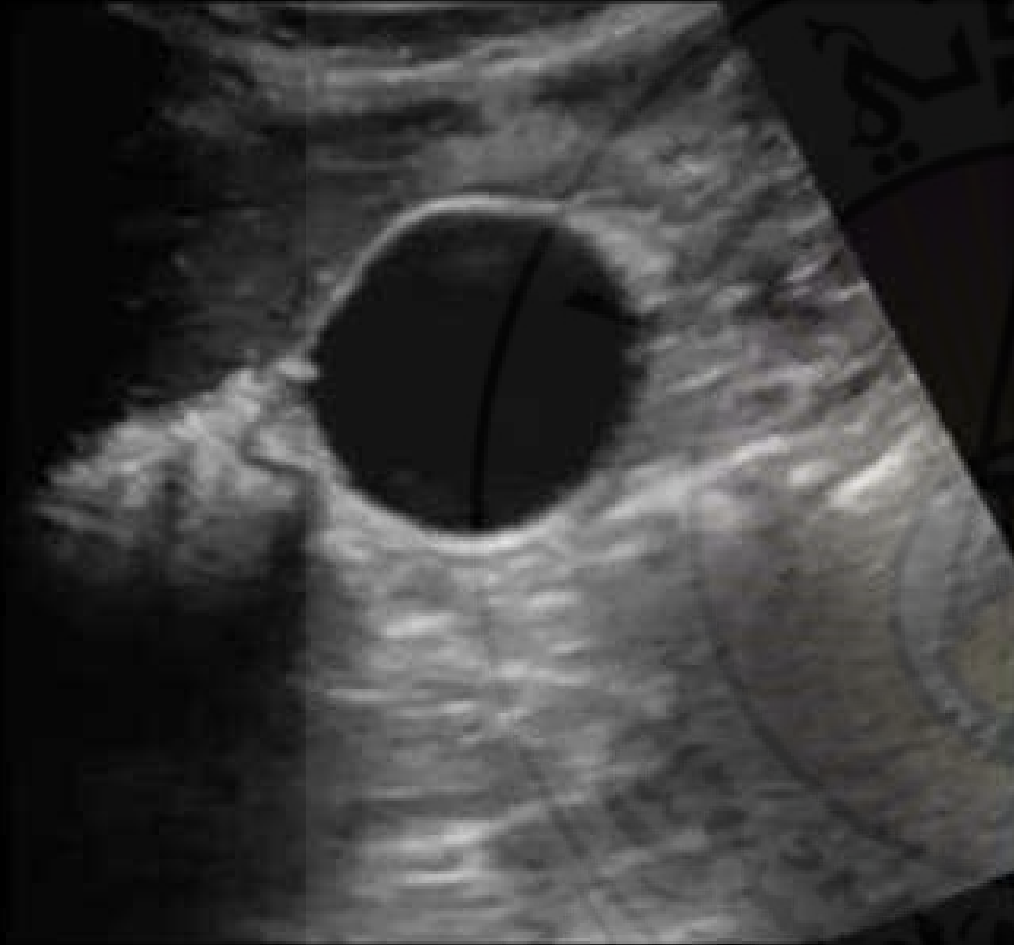
Longitudinal View



Gangrenous Cholecystitis

- Pericholecystic fluid
- Wall disruption/ulceration
- Sloughed membranes

Transverse View



**Normal
Gall Bladder**

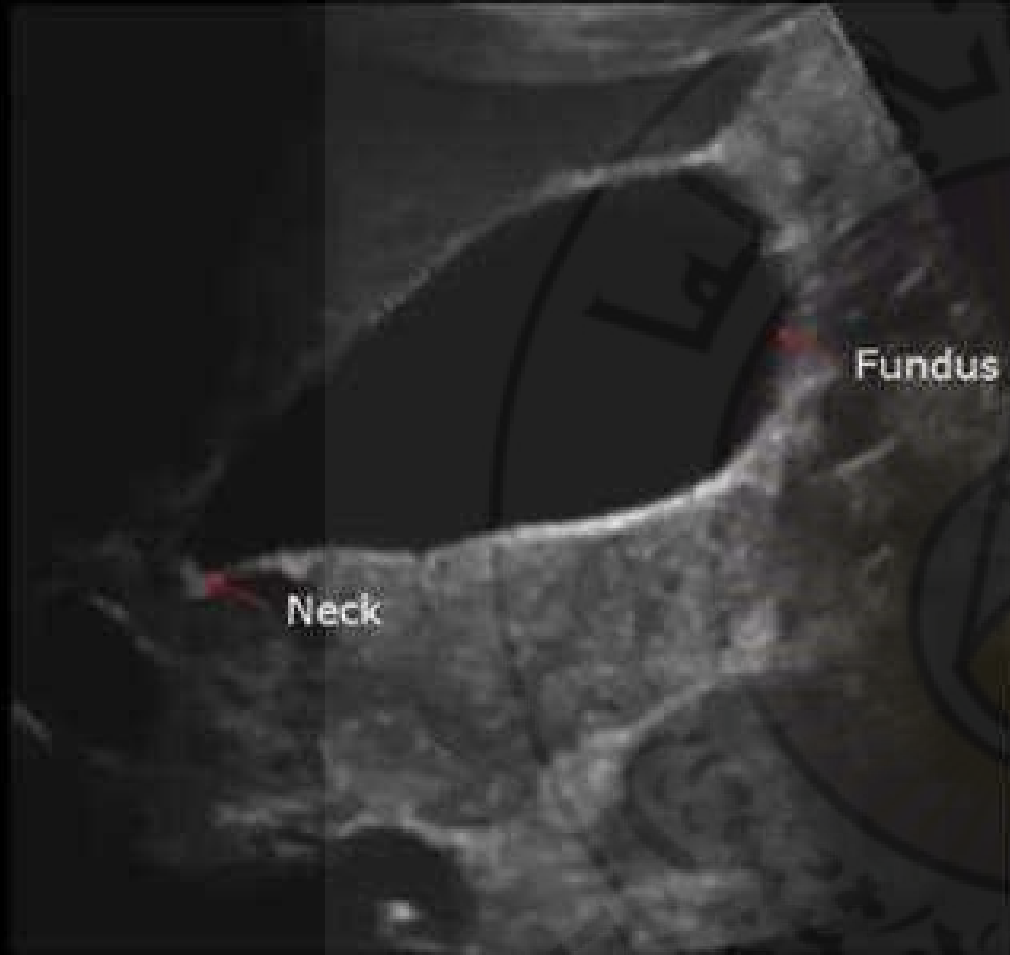
Transverse View



Gallbladder Perforation

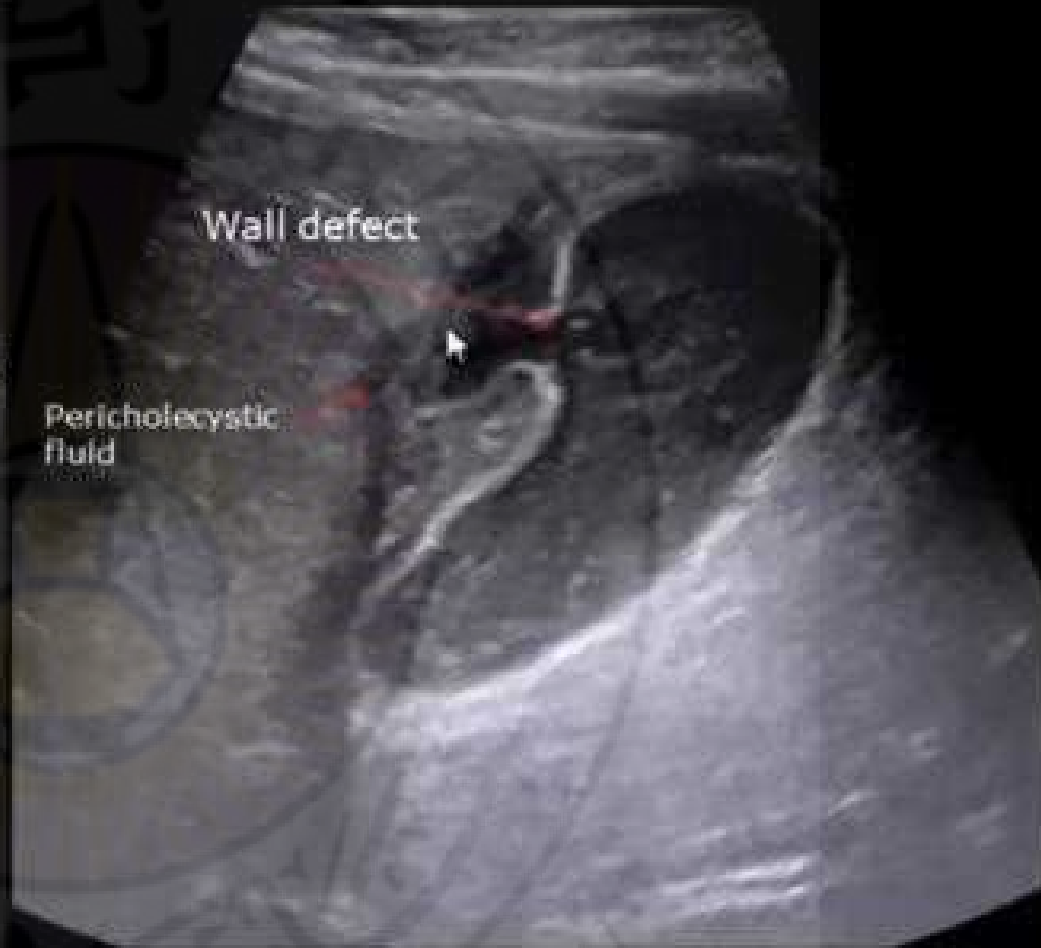
- Large defect in the gallbladder wall along with communicating pericholecystic fluid

Longitudinal View



**Normal
Gall Bladder**

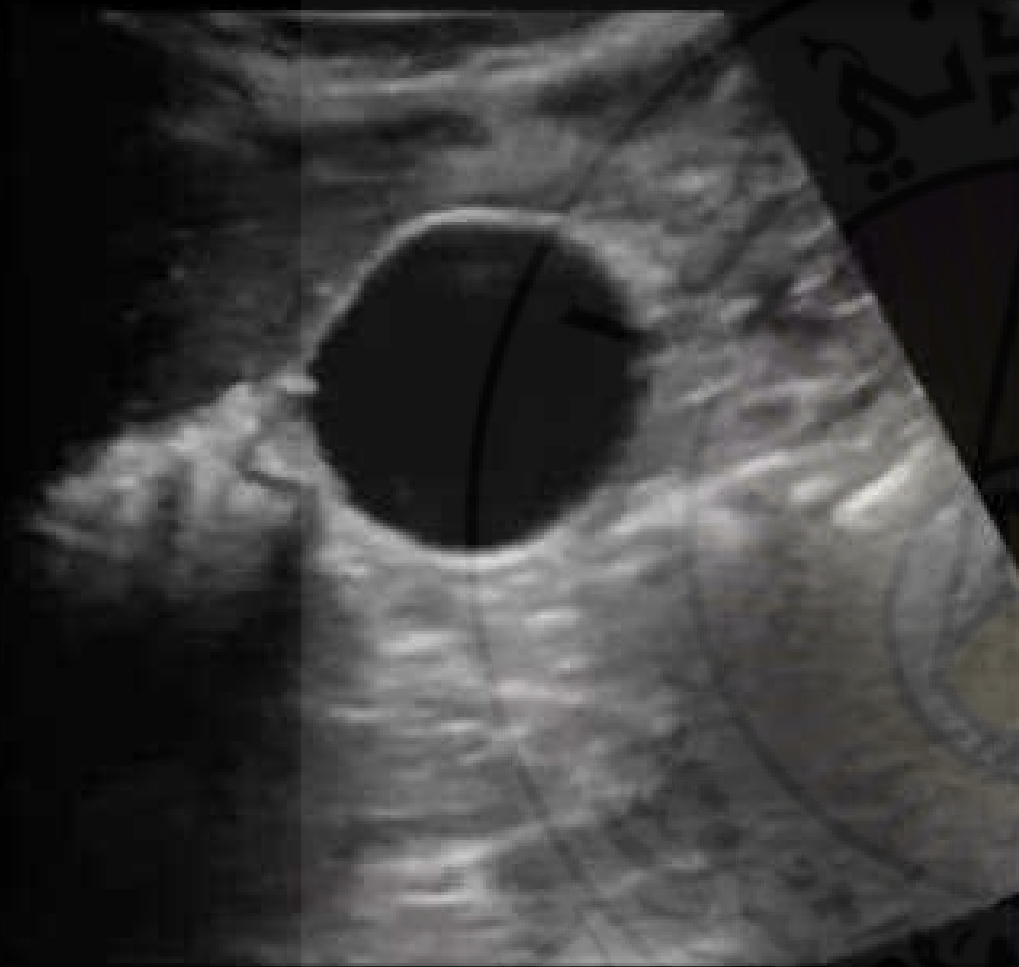
Longitudinal View



Gallbladder Perforation

- Large defect in the gallbladder wall along with communicating pericholecystic fluid

Transverse View



**Normal
Gall Bladder**

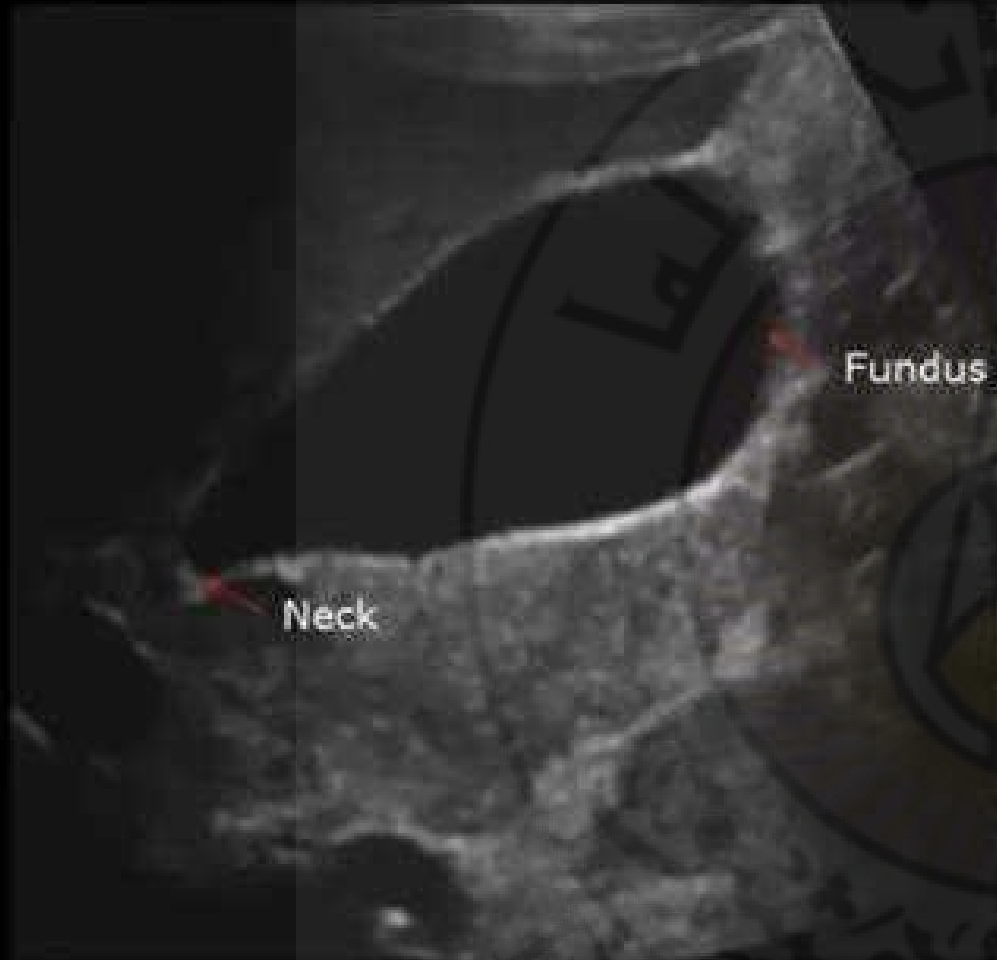
Transverse View



Gallbladder Polyps

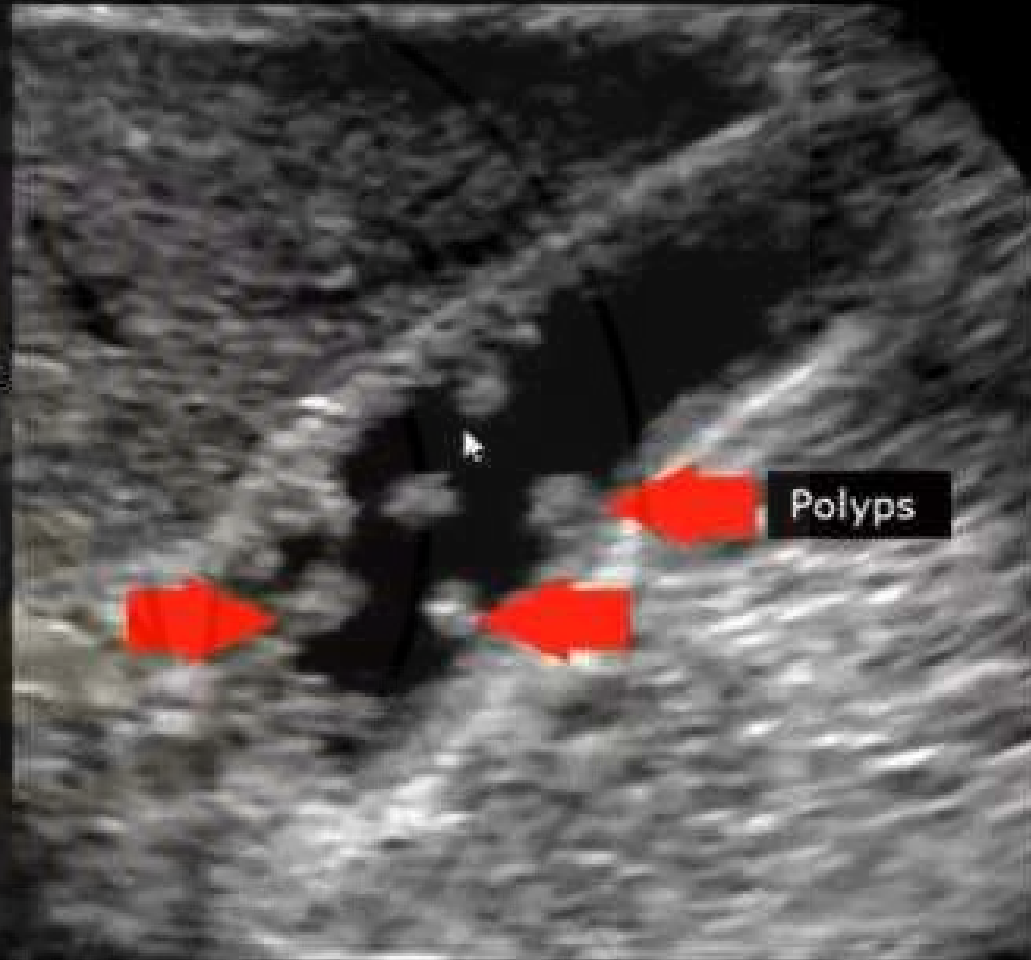
- Masses attached to gallbladder wall by a stalk
- Also called Ball-On-The-Wall Sign

Longitudinal View



**Normal
Gall Bladder**

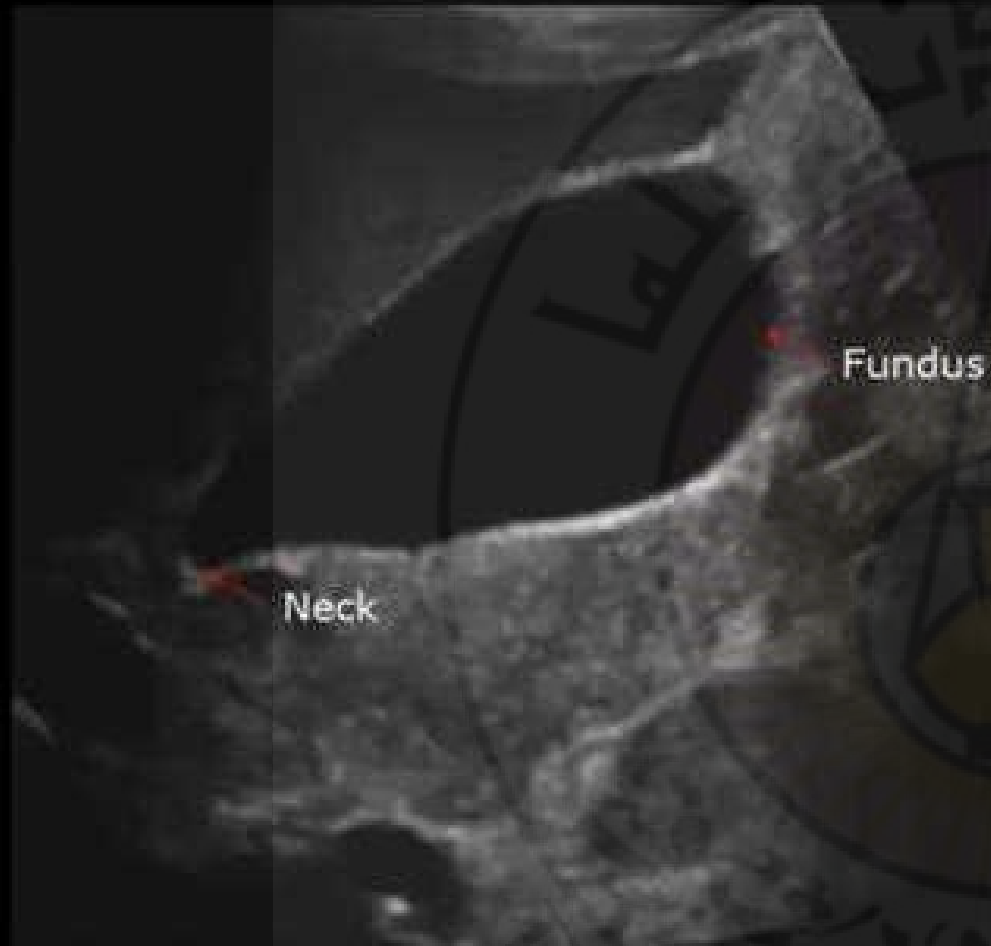
Longitudinal View



Gallbladder Polyps

- Masses attached to gallbladder wall by a stalk
- Also called Ball-On-The-Wall Sign

Longitudinal View



**Normal
Gall Bladder**

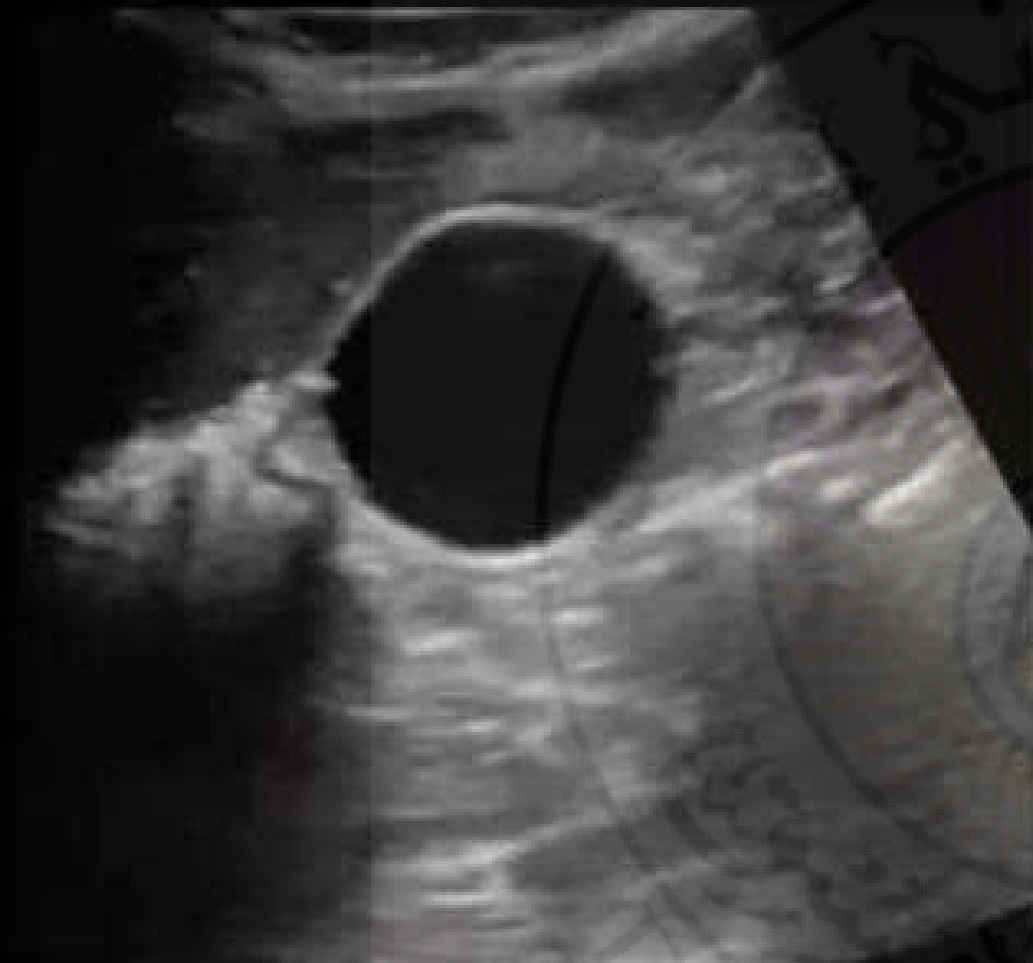
Longitudinal View



Adenomyomatosis

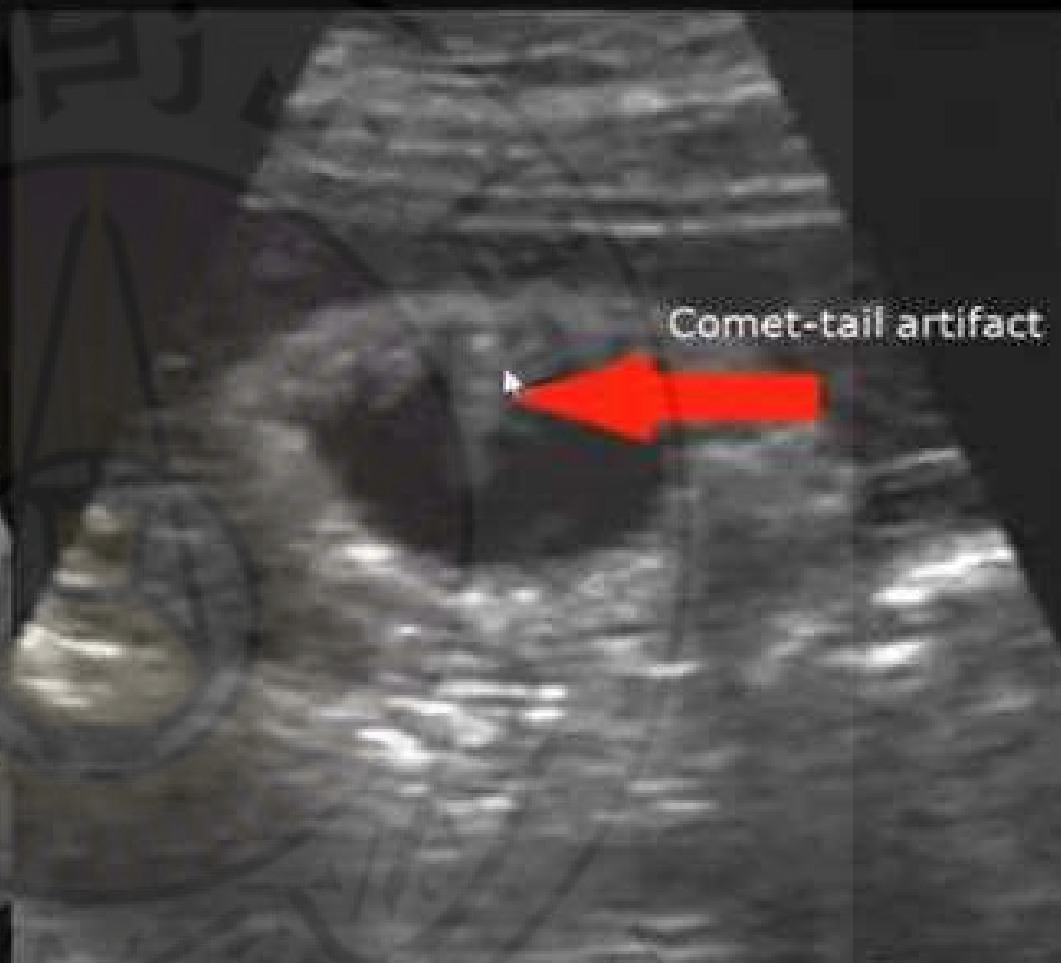
- Cholesterol crystals in Rokitansky-Aschoff sinuses.
- Present with Comet-tail artifacts and bright reflections.

Transverse View



**Normal
Gall Bladder**

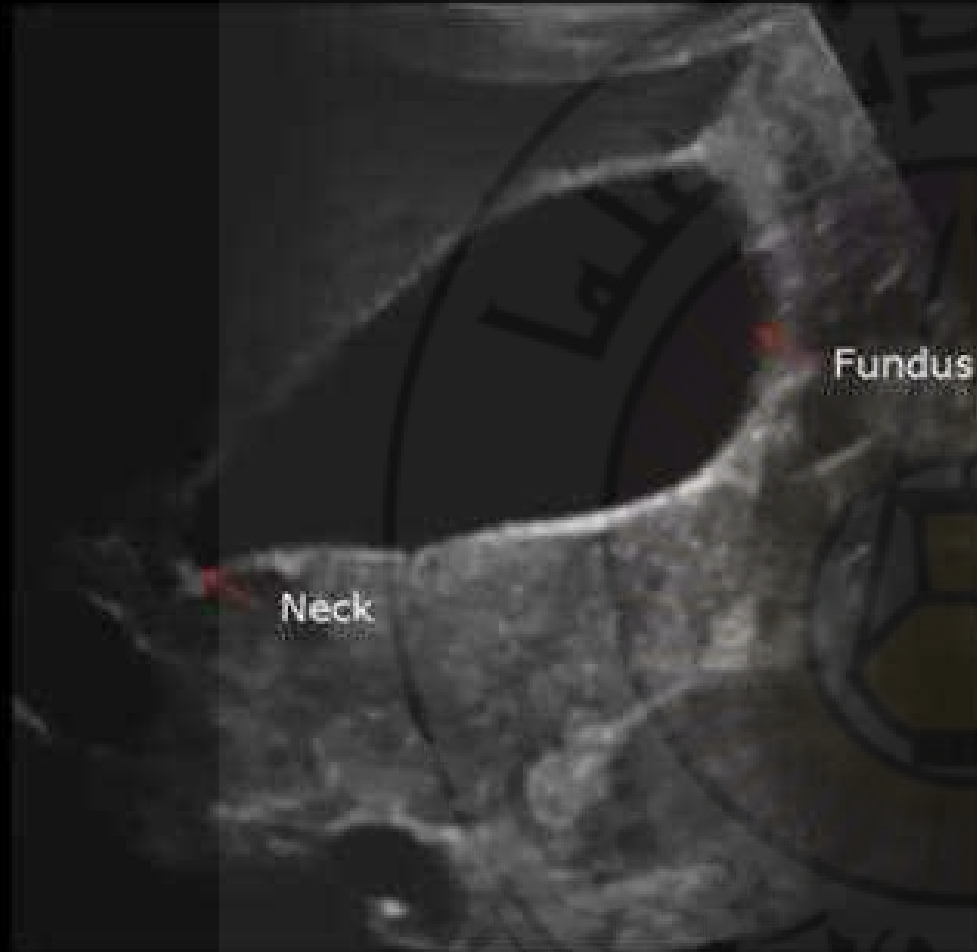
Transverse View



Adenomyomatosis

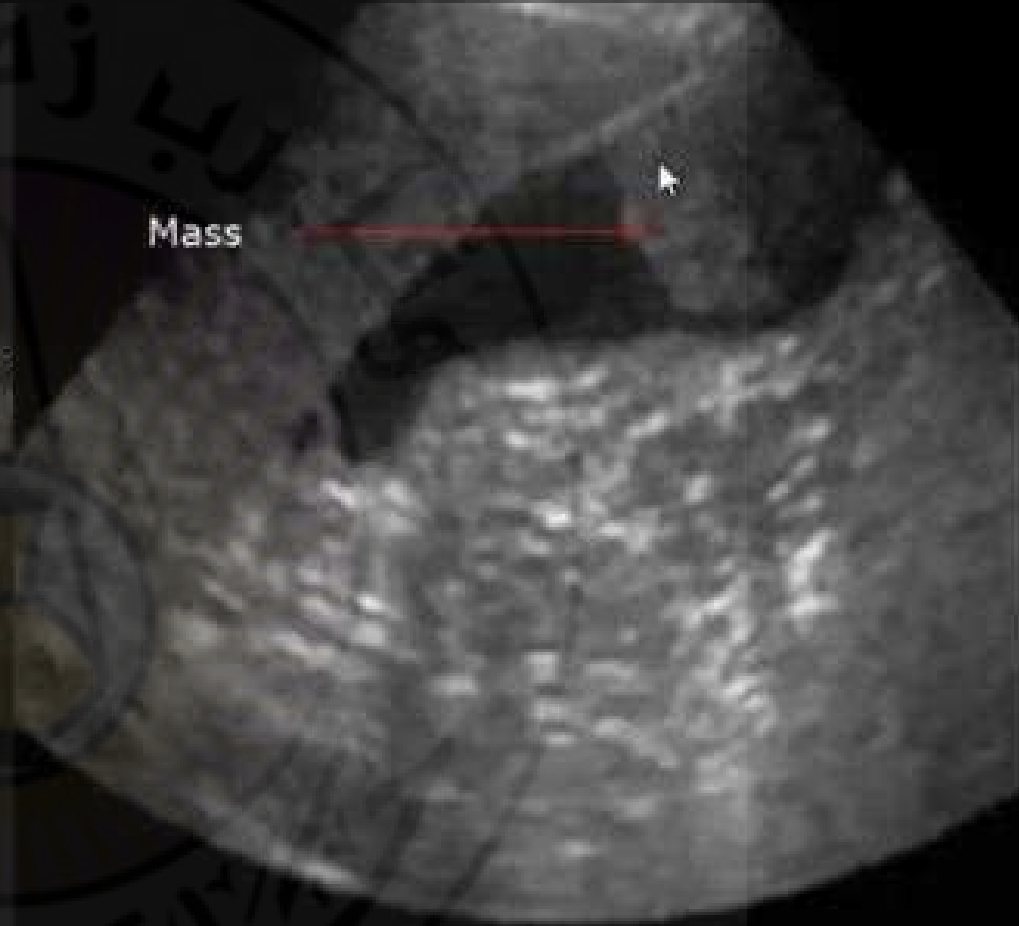
- Cholesterol crystals in Rokitansky-Aschoff sinuses.
- Present with Comet-tail artifacts and bright reflections.

Longitudinal View



**Normal
Gall Bladder**

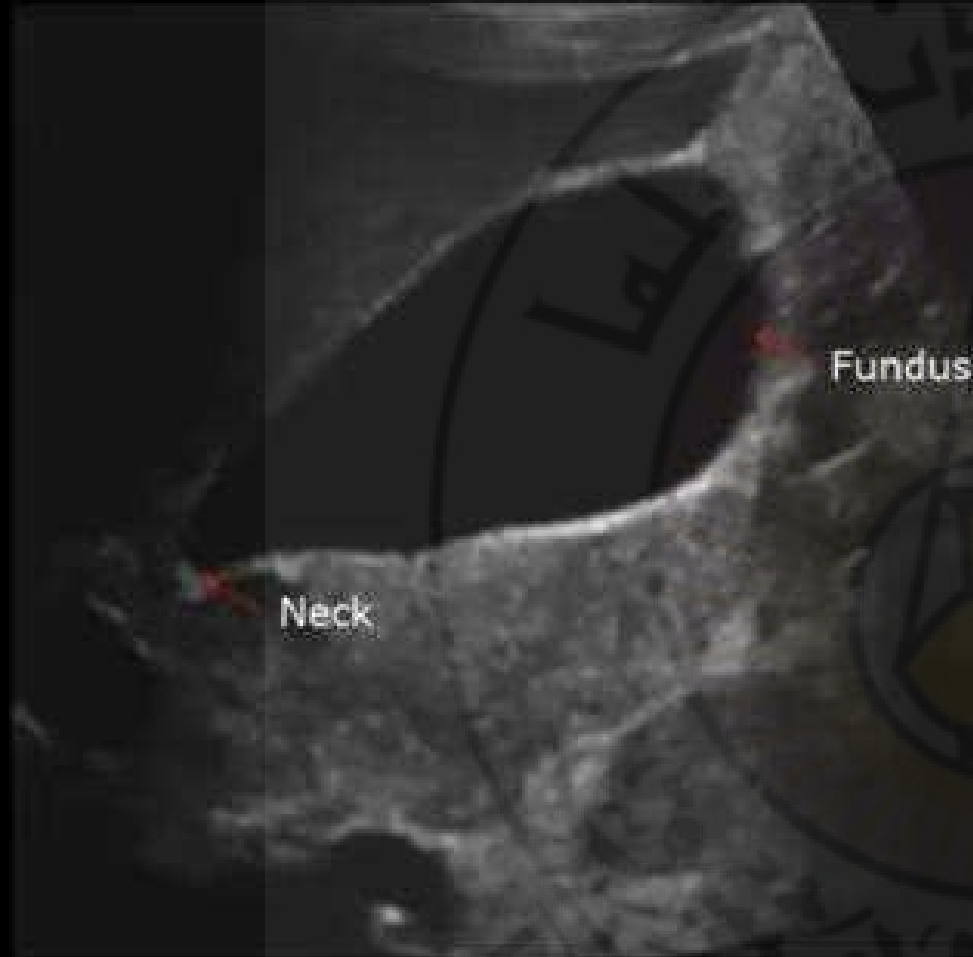
Longitudinal View



Gallbladder Cancer

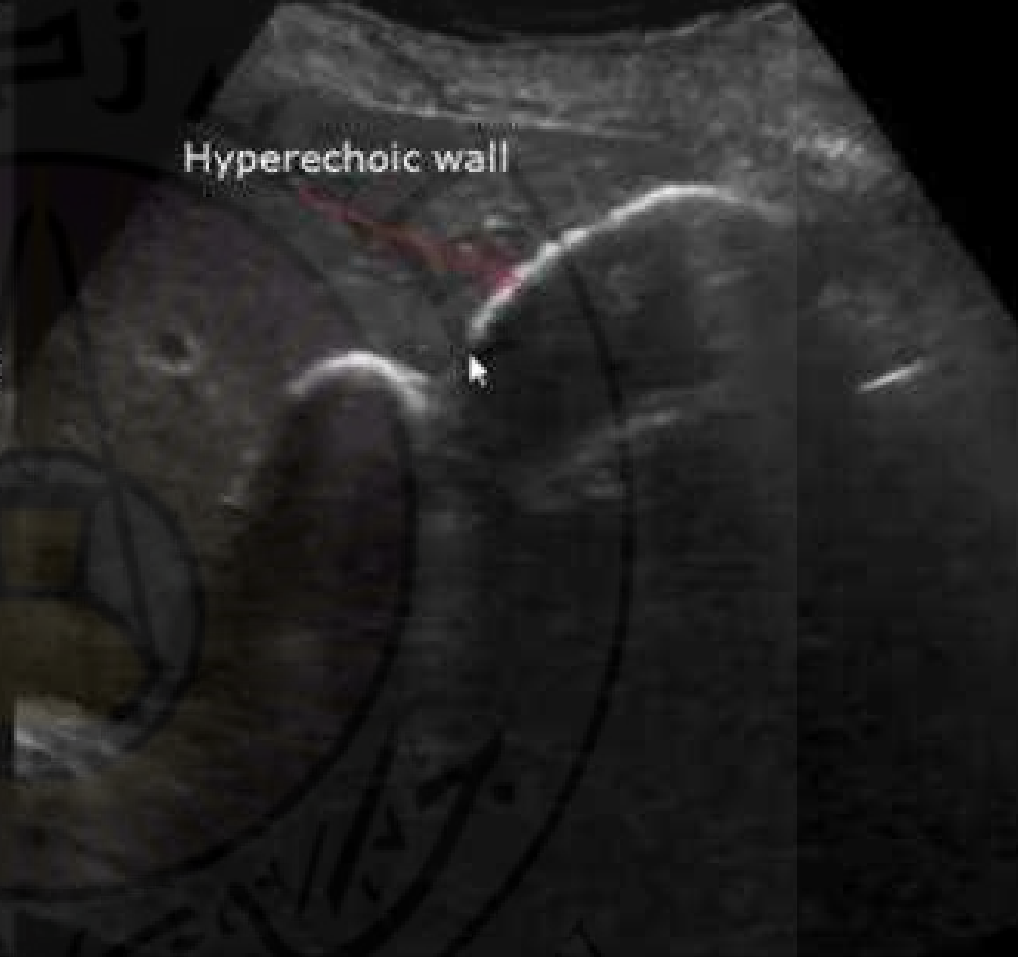
- Mass, usually heterogeneous and hypoechoic, attached to gallbladder wall.
- Wall thickening and infiltration to liver or other nearby structures.

Longitudinal View



**Normal
Gall Bladder**

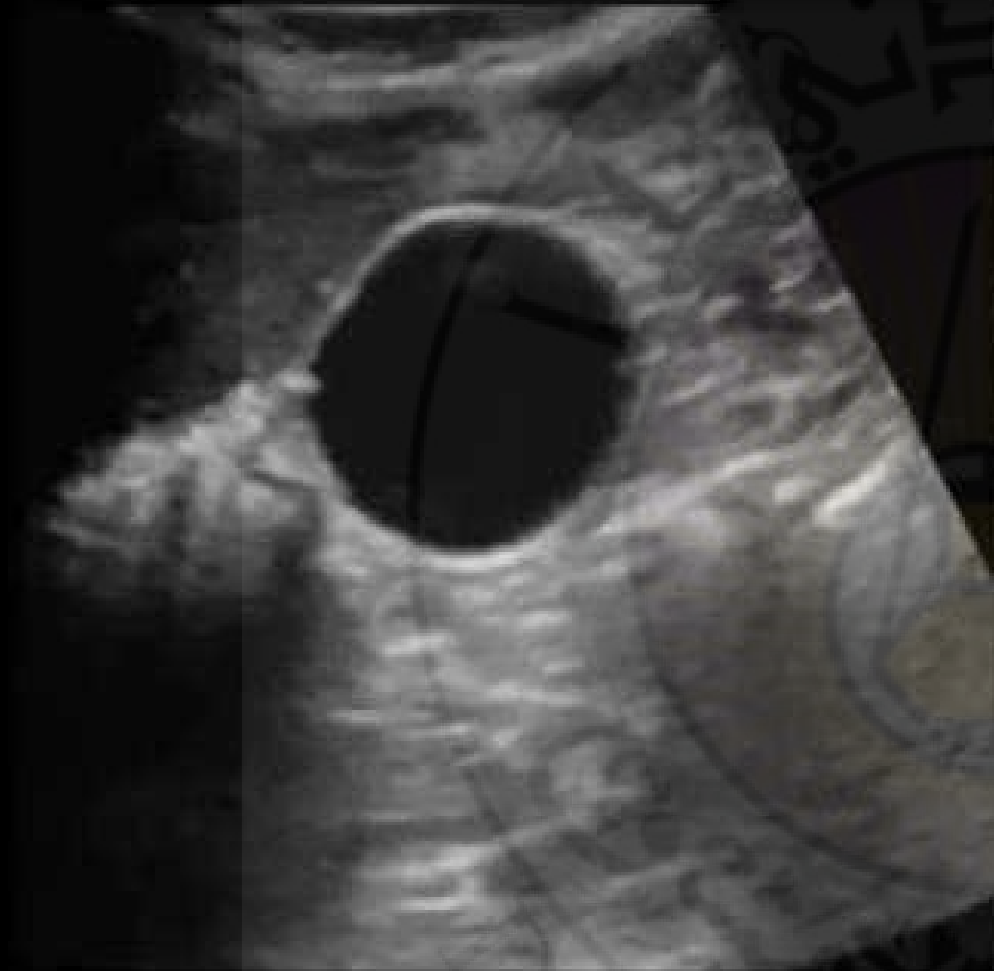
Longitudinal View



Porcelain Gallbladder

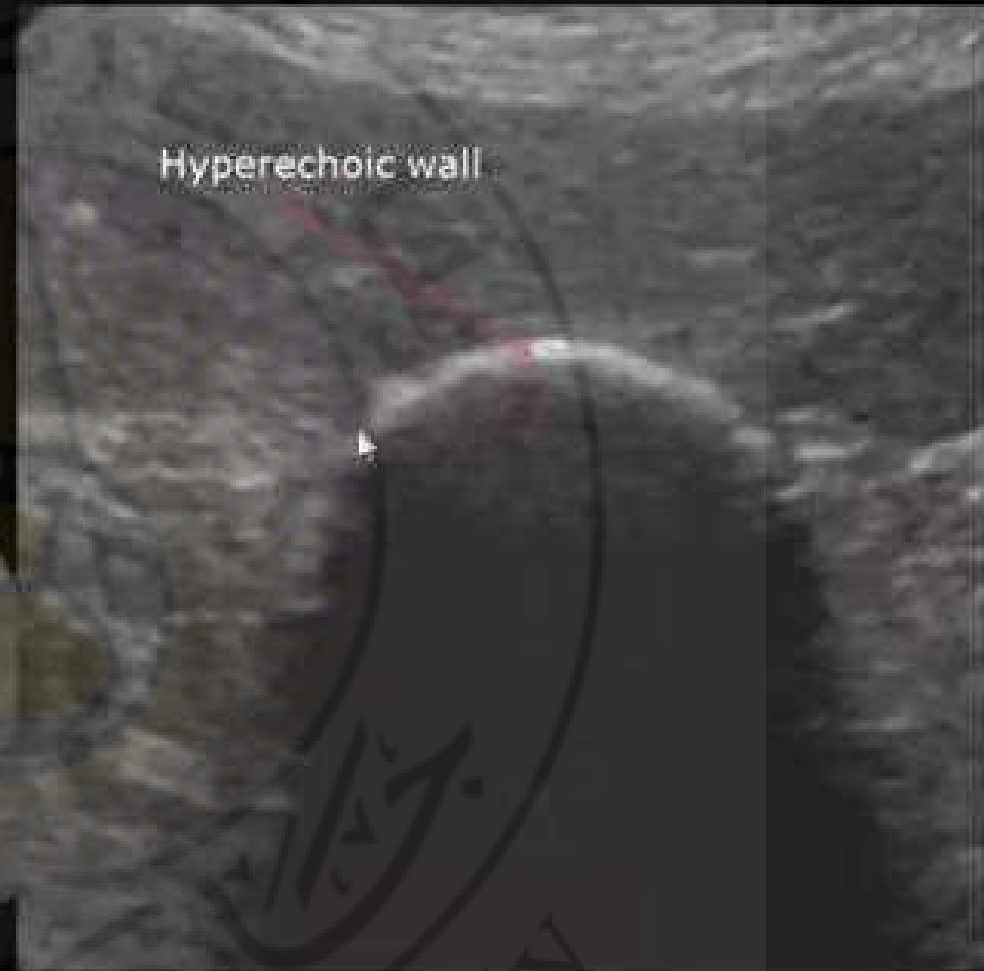
- Calcification of gallbladder wall.
- Hyperechoic wall with posterior shadowing.

Transverse View



**Normal
Gall Bladder**

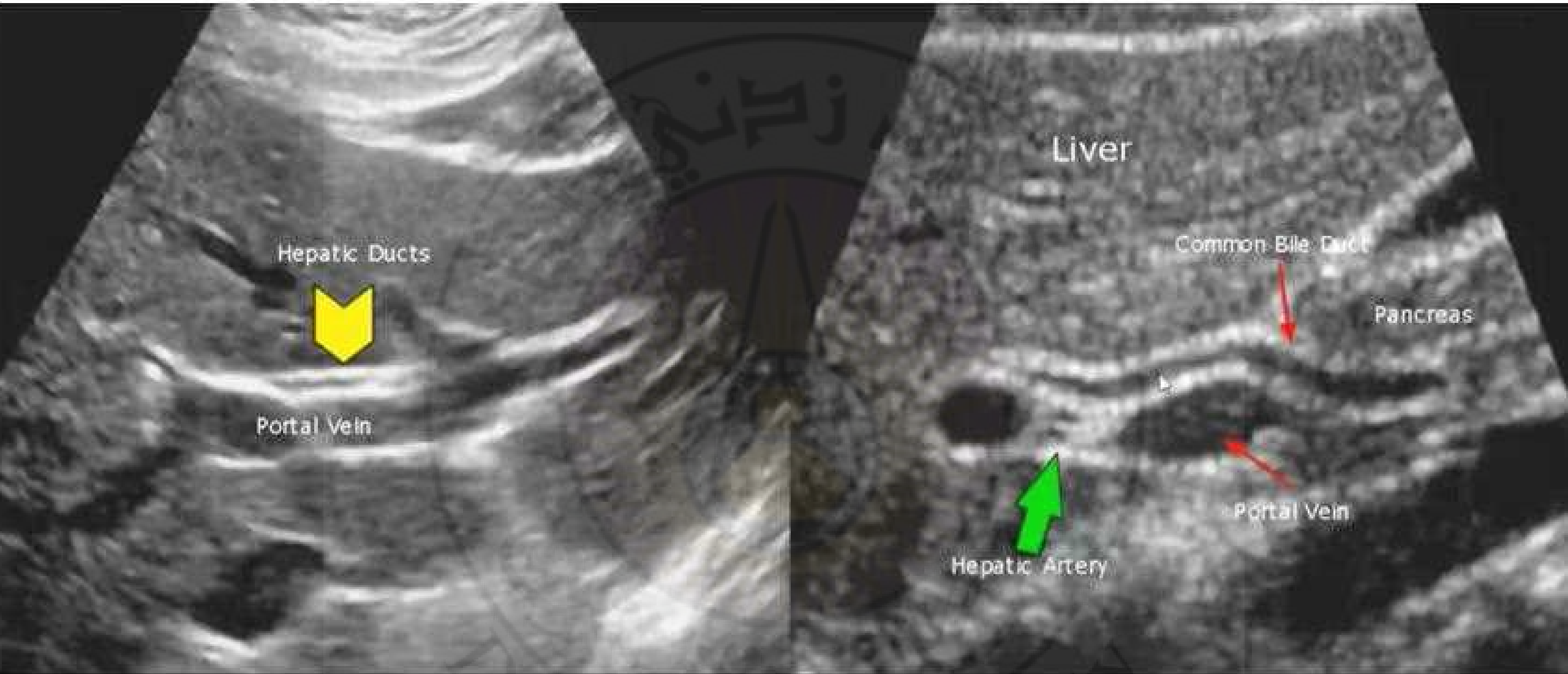
Transverse View



Porcelain Gallbladder

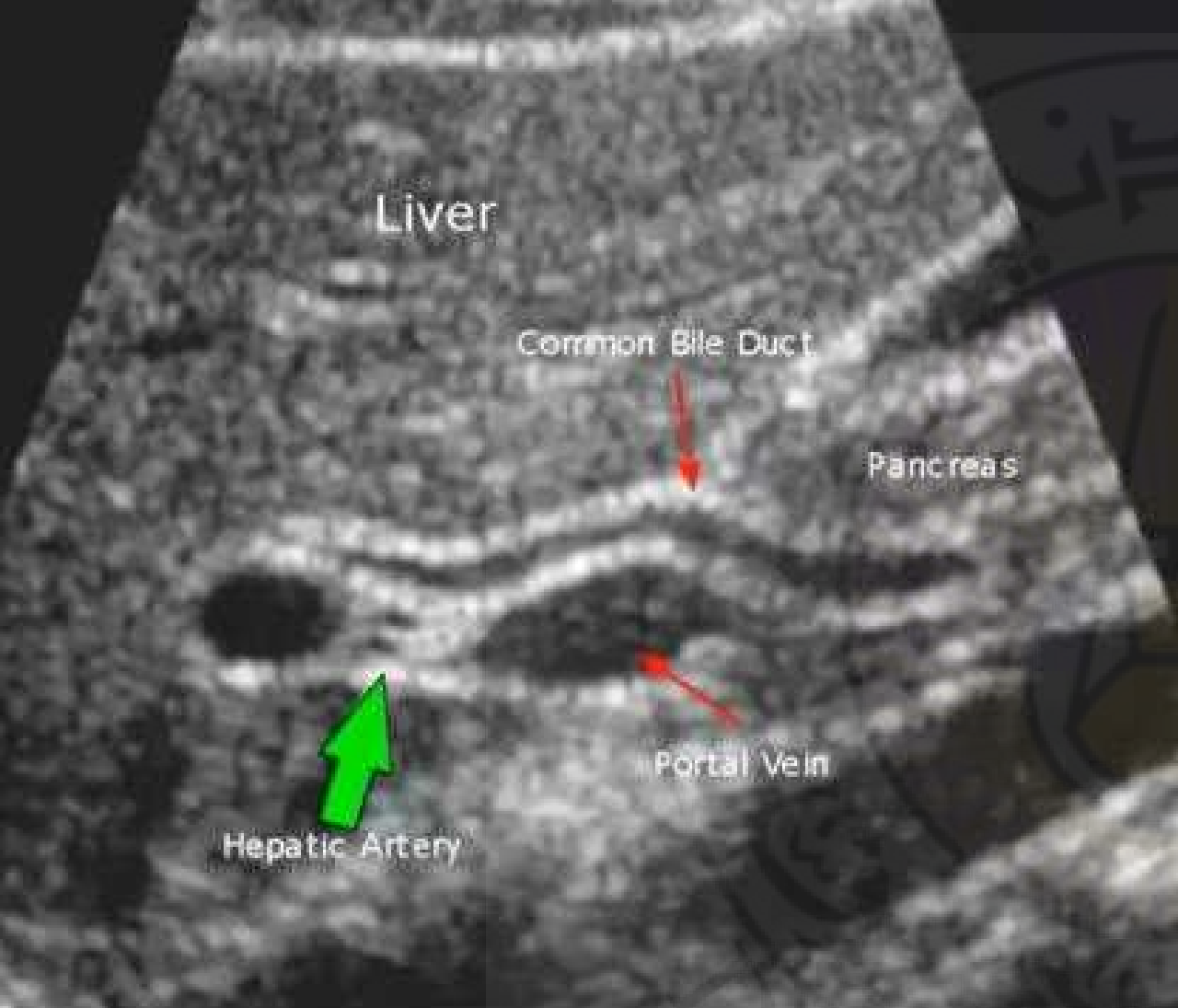
- Calcification of gallbladder wall.
- Hyperechoic wall with posterior shadowing.

Bile Duct Ultrasound Normal Vs Abnormal Image Appearances Comparison



Normal Bile Duct

- **Hepatic Duct Diameter:** $<2\text{mm}$
- **Common hepatic duct Diameter:** $<7\text{mm}$
- Seen anterior to portal vein
- Anechoic with hyperechoic walls
- **Common Bile Duct Diameter:** $<7\text{mm}$
- Diameter increases after cholecystectomy.

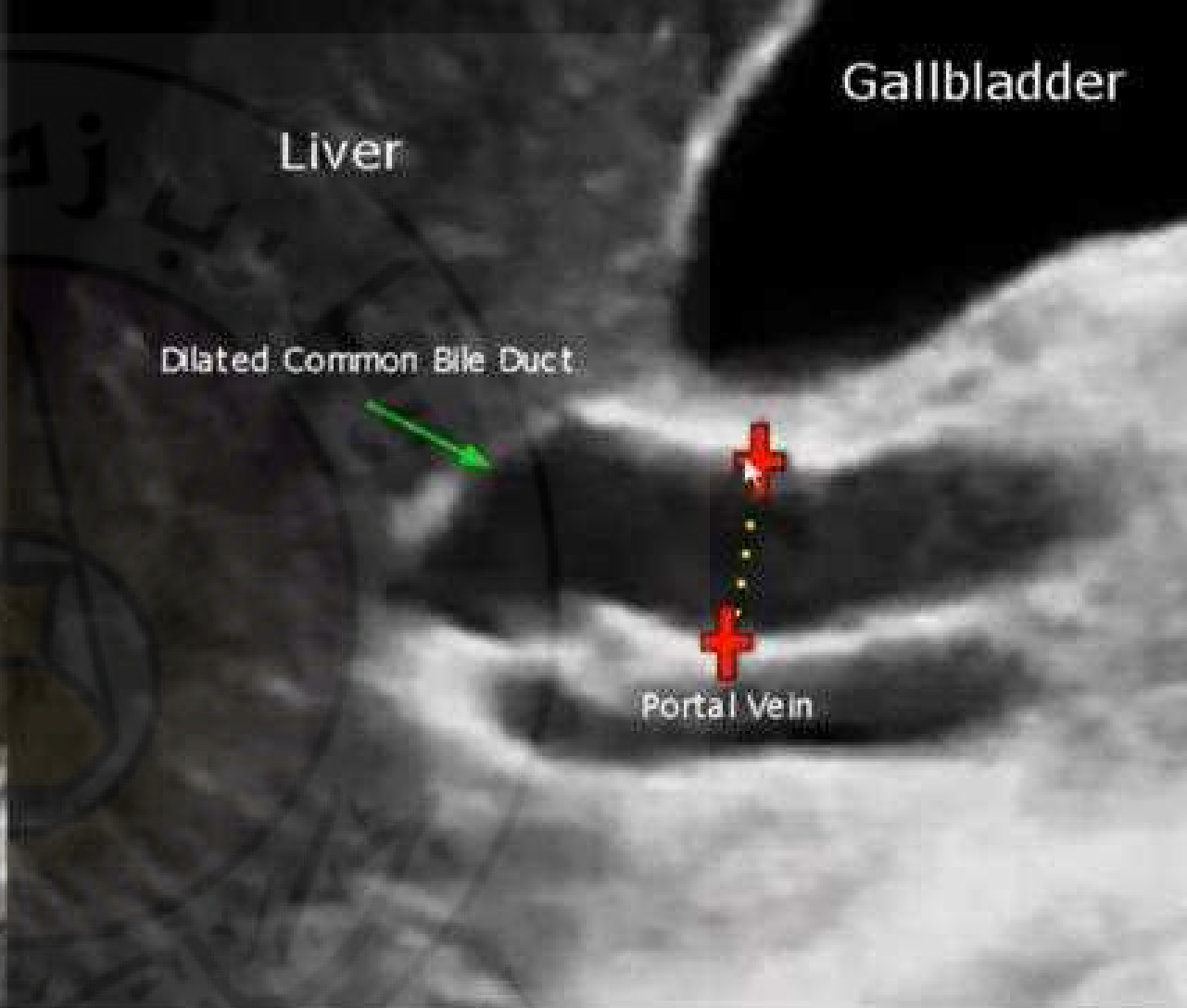
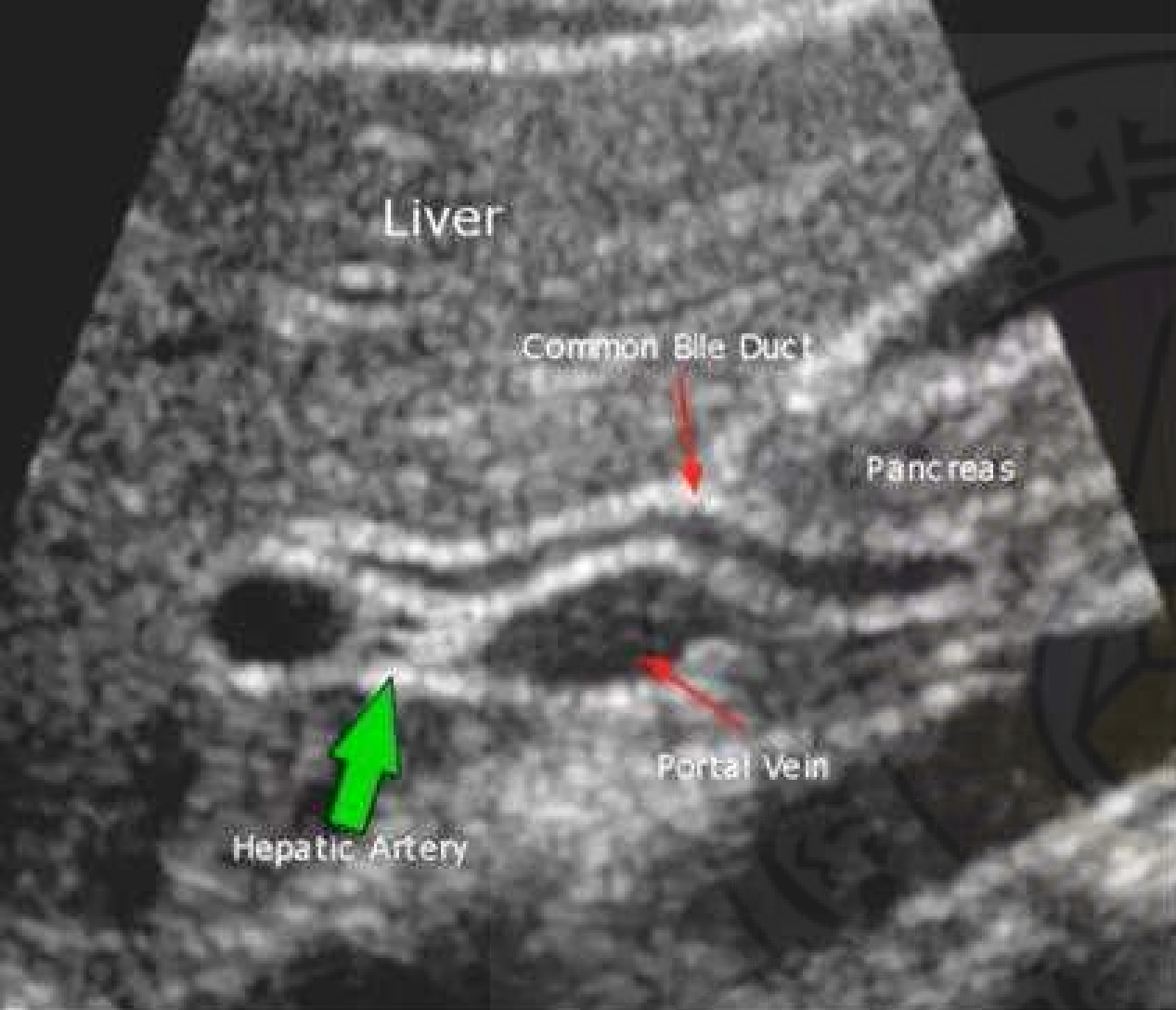


Normal Bile Duct

- **Common Bile Duct Diameter:** <7mm
- Seen anterior to portal vein
- Anechoic with hyperechoic walls

Fusiform Dilation

- Choledochal cyst type 1
- Most common type
- Dilated Common Bile Duct



Normal Bile Duct

- Common Bile Duct Diameter: $<7\text{mm}$
- Seen anterior to portal vein
- Anechoic with hyperechoic walls

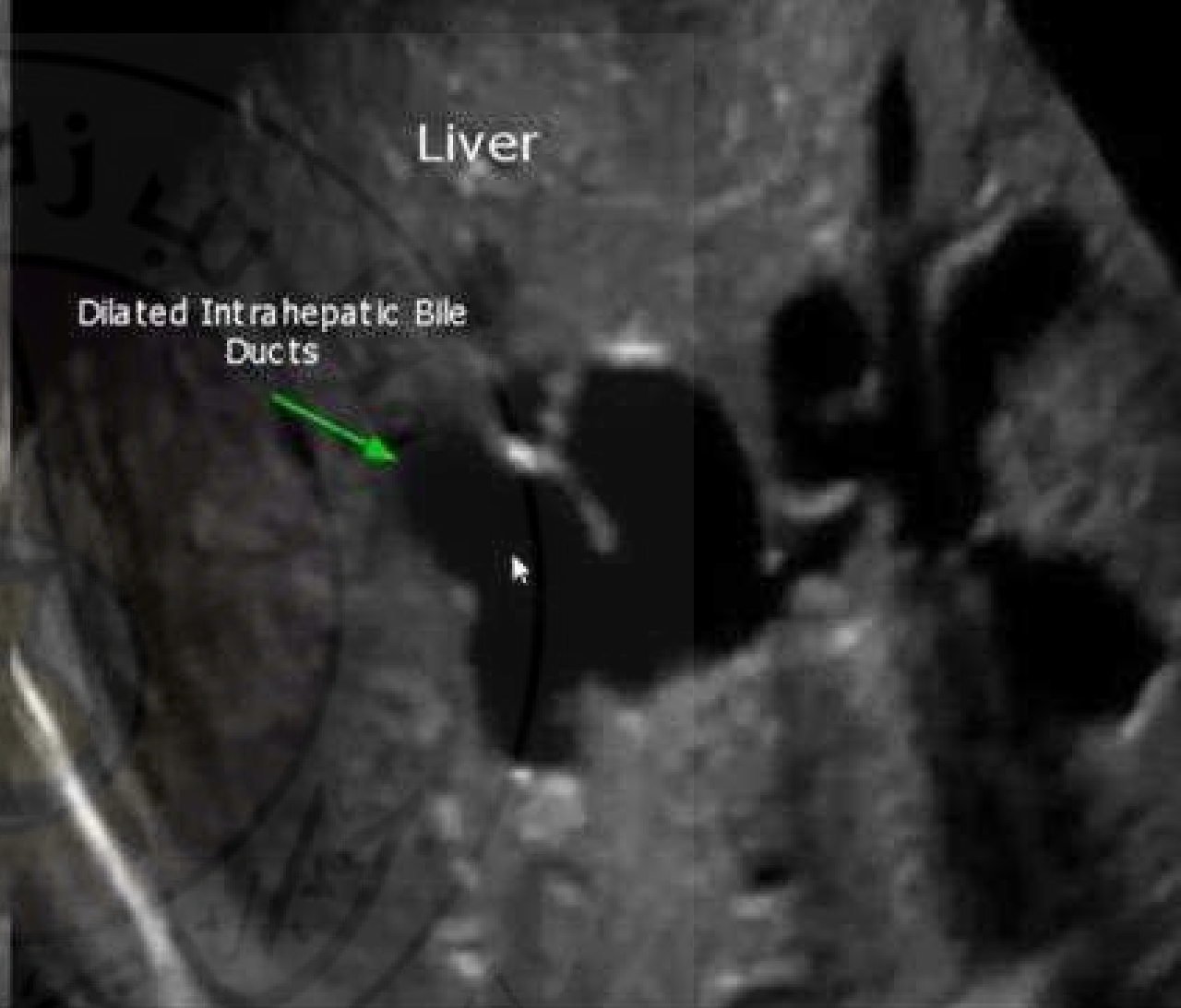
Dilated Common Bile Duct

- CBD Diameter $>7\text{mm}$
- No doppler signal
- Double barrel sign



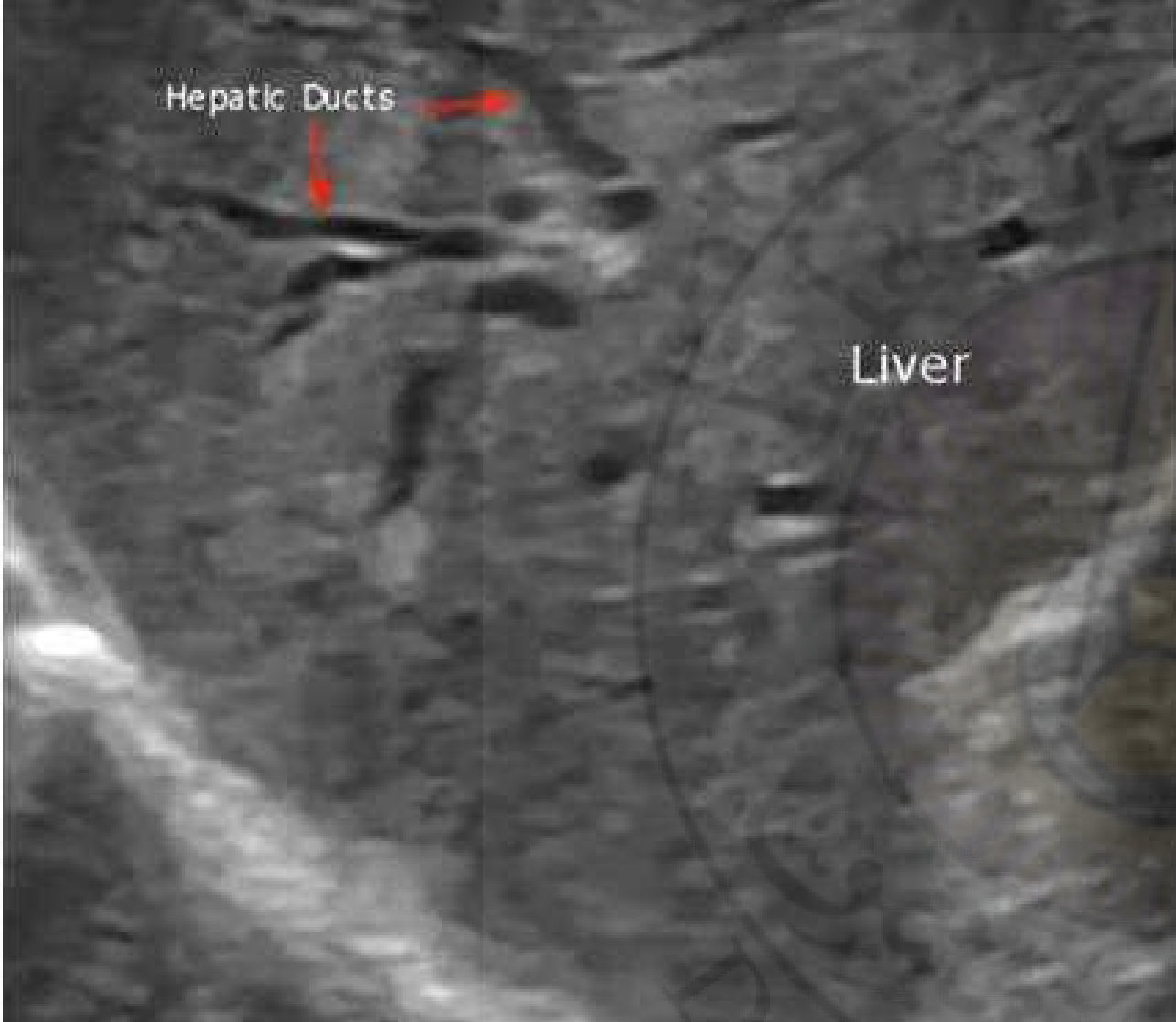
Normal Hepatic Ducts

- Hepatic Duct Diameter: $<2\text{mm}$



Caroli Disease

- Multifocal cystic dilatation of intrahepatic ducts
- Dilated intrahepatic bile ducts
- Type 5 Choledochal cyst



Normal Hepatic Ducts

- **Hepatic Duct Diameter:** $< 2\text{mm}$



Caroli Disease

- **Central Dot Sign:** Formed by dilated bile duct surrounding the hepatic artery and portal vein.



Normal Hepatic Ducts

- Hepatic Duct Diameter: $<2\text{mm}$

Intrahepatic Biliary Stones

- Hyperechoic stones
- Posterior acoustic shadowing



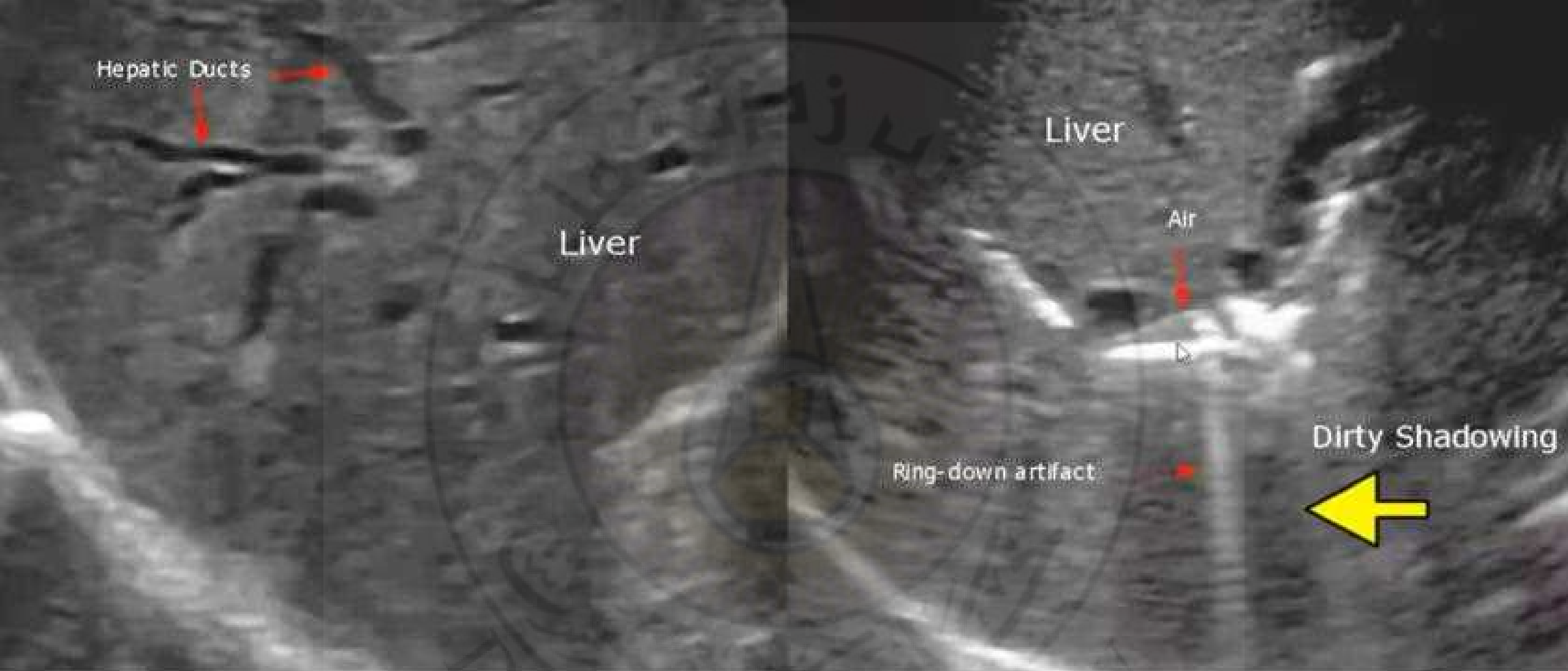
Normal Bile Duct

- Common Bile Duct Diameter: $<7\text{mm}$
- Seen anterior to portal vein
- Anechoic with hyperechoic walls



Common Bile Duct Stones

- Hyperechoic Stones
- Posterior acoustic shadowing

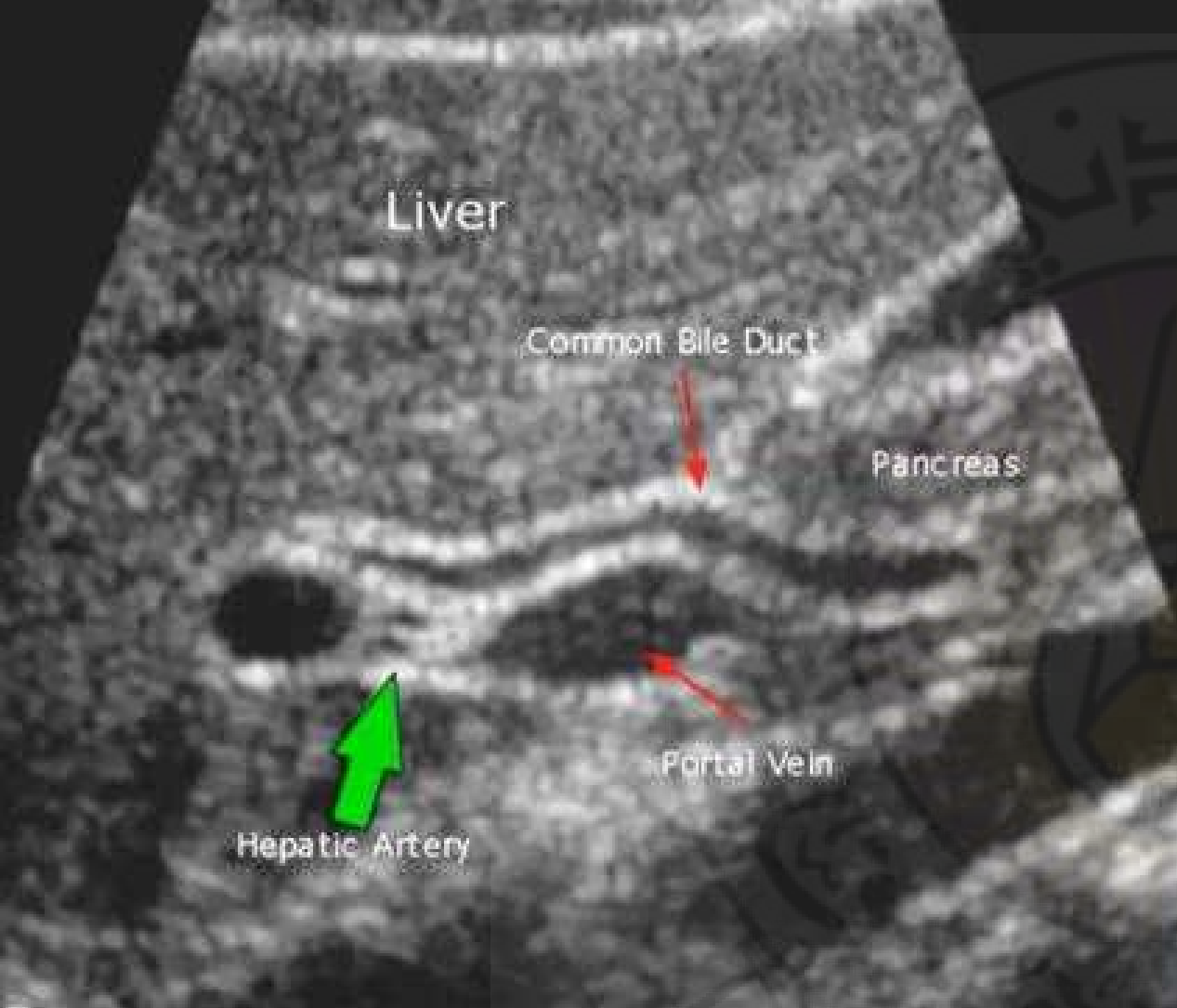


Normal Hepatic Ducts

- Hepatic Duct Diameter: $<2\text{mm}$

Pneumobilia

- Caused by air in biliary duct
- Hyperechoic linear structure
- Dirty posterior acoustic shadowing



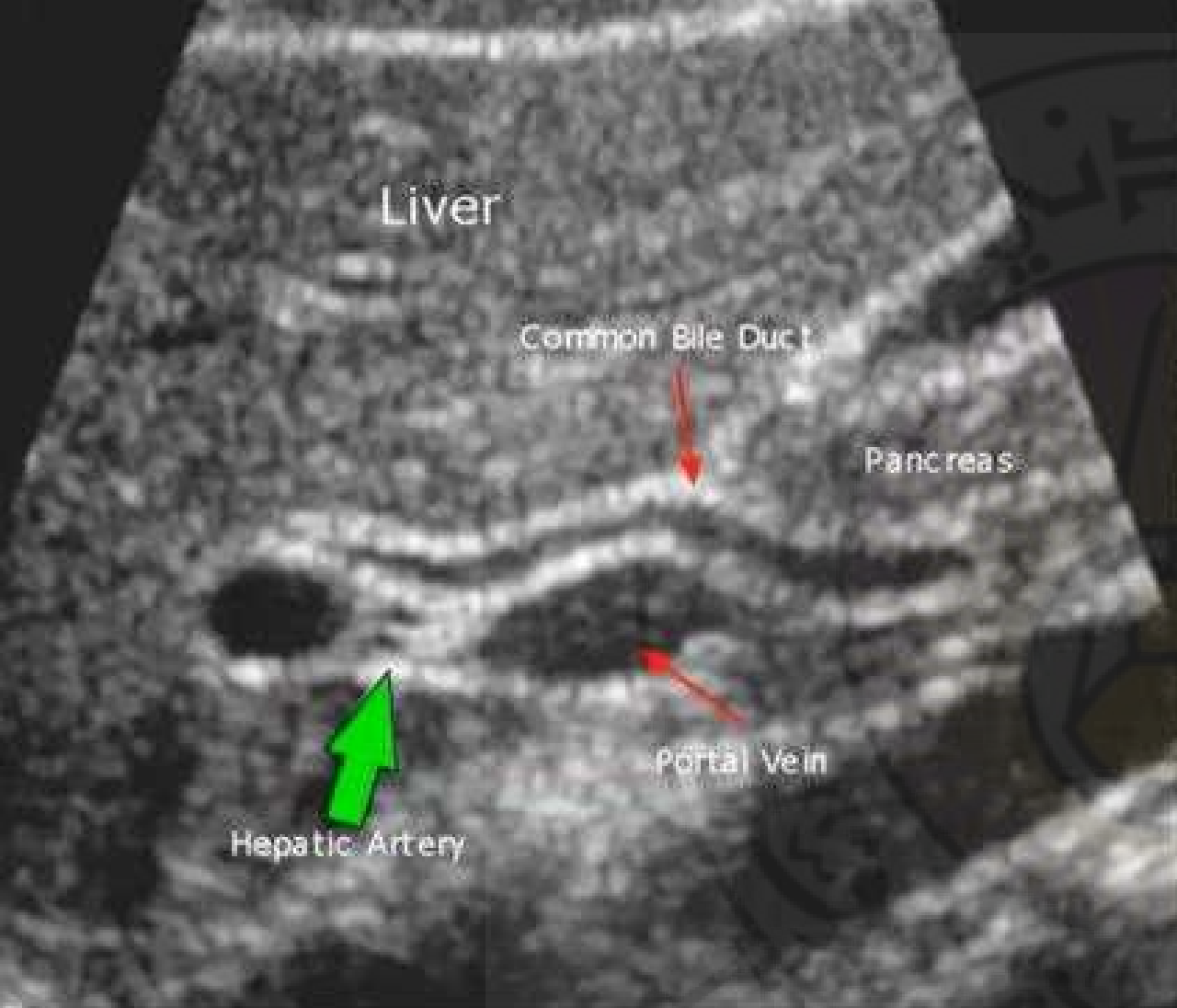
Normal Bile Duct

- **Common Bile Duct Diameter:** <7mm
- Seen anterior to portal vein
- Anechoic with hyperechoic walls



Intraductal Cholangiocarcinoma

- Mass in bile duct
- Isoechoic/hyperechoic to liver
- Biliary obstruction



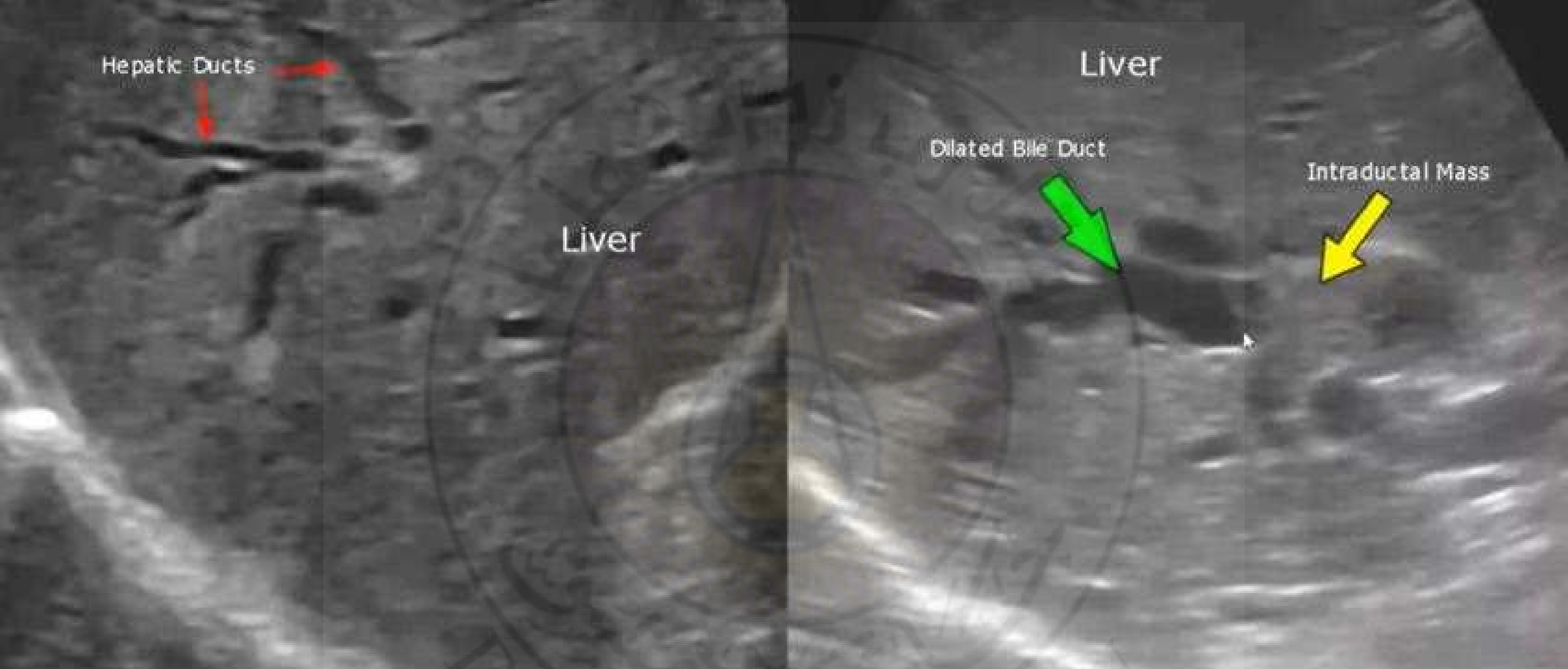
Normal Bile Duct

- **Common Bile Duct Diameter:** <7mm
- Seen anterior to portal vein
- Anechoic with hyperechoic walls



Intrahepatic Cholangiocarcinoma

- Large hepatic mass
- Heterogeneous
- Biliary obstruction

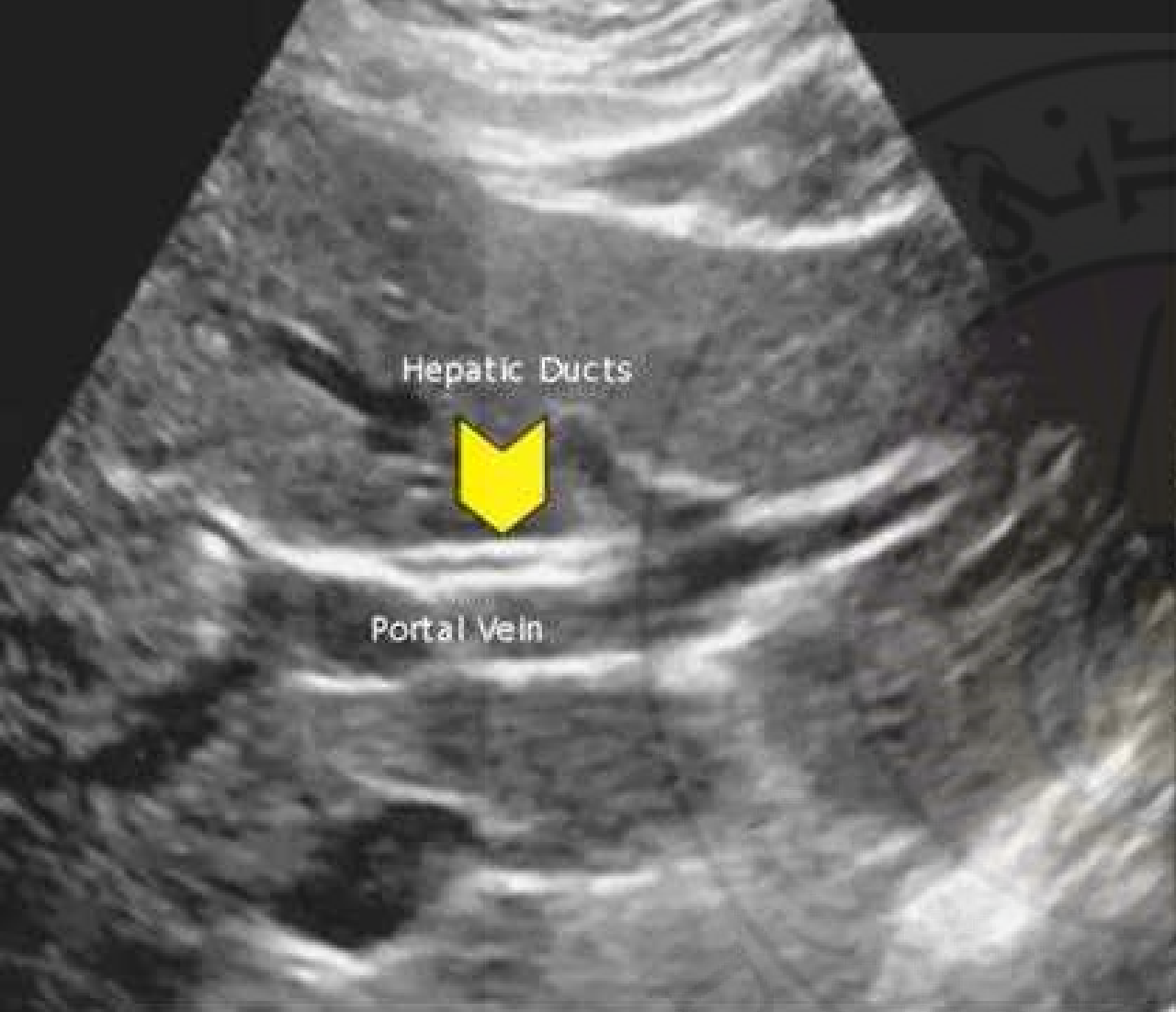


Normal Bile Duct

- **Common Bile Duct Diameter:** $<7\text{mm}$
- Seen anterior to portal vein
- Anechoic with hyperechoic walls

Hilar Cholangiocarcinoma

- Found in the hilar region or common hepatic duct bifurcation
- Also known as Klatskin Tumor
- Mostly hyperechoic to liver
- Can also be hypoechoic or isoechoic



Normal Bile Duct

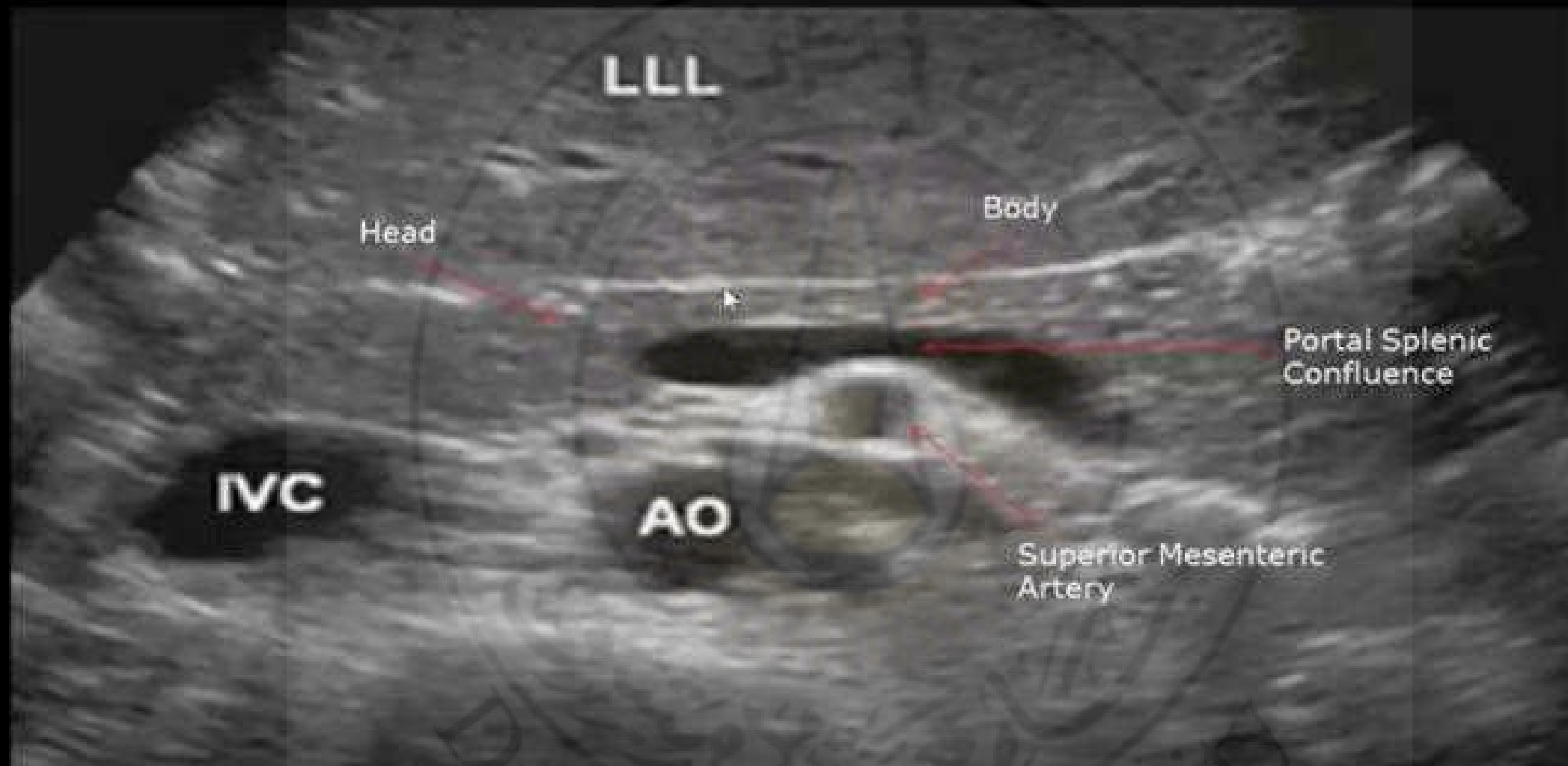
- **Common Bile Duct Diameter:** <7mm
- Seen anterior to portal vein
- Anechoic with hyperechoic walls

Hilar Cholangiocarcinoma

- Found in the hilar region or common hepatic duct bifurcation
- Nonunion of right and left hepatic ducts

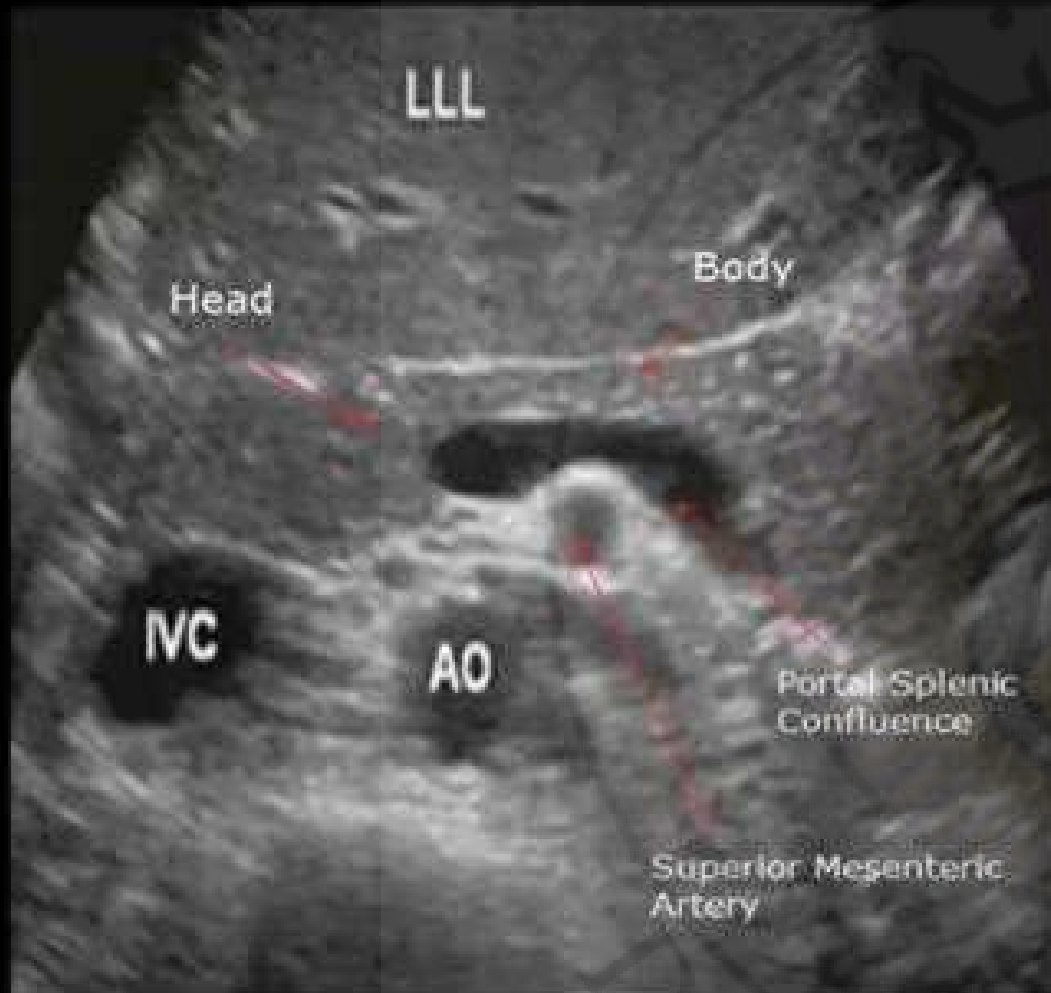
Pancreas Ultrasound Normal Vs Abnormal Image Appearances Comparison

Transverse View



**Normal
Pancreas**

Transverse View



Normal Pancreas

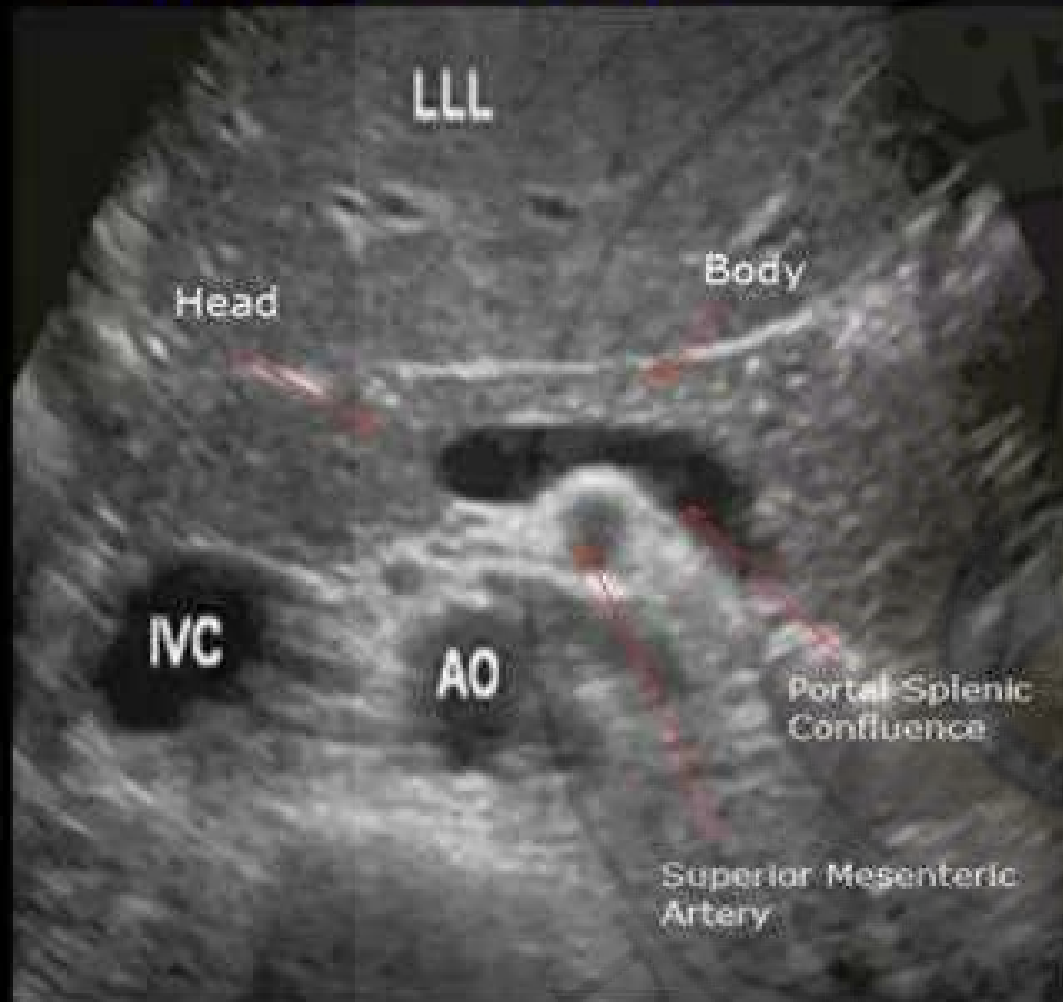
Transverse View



Acute Pancreatitis

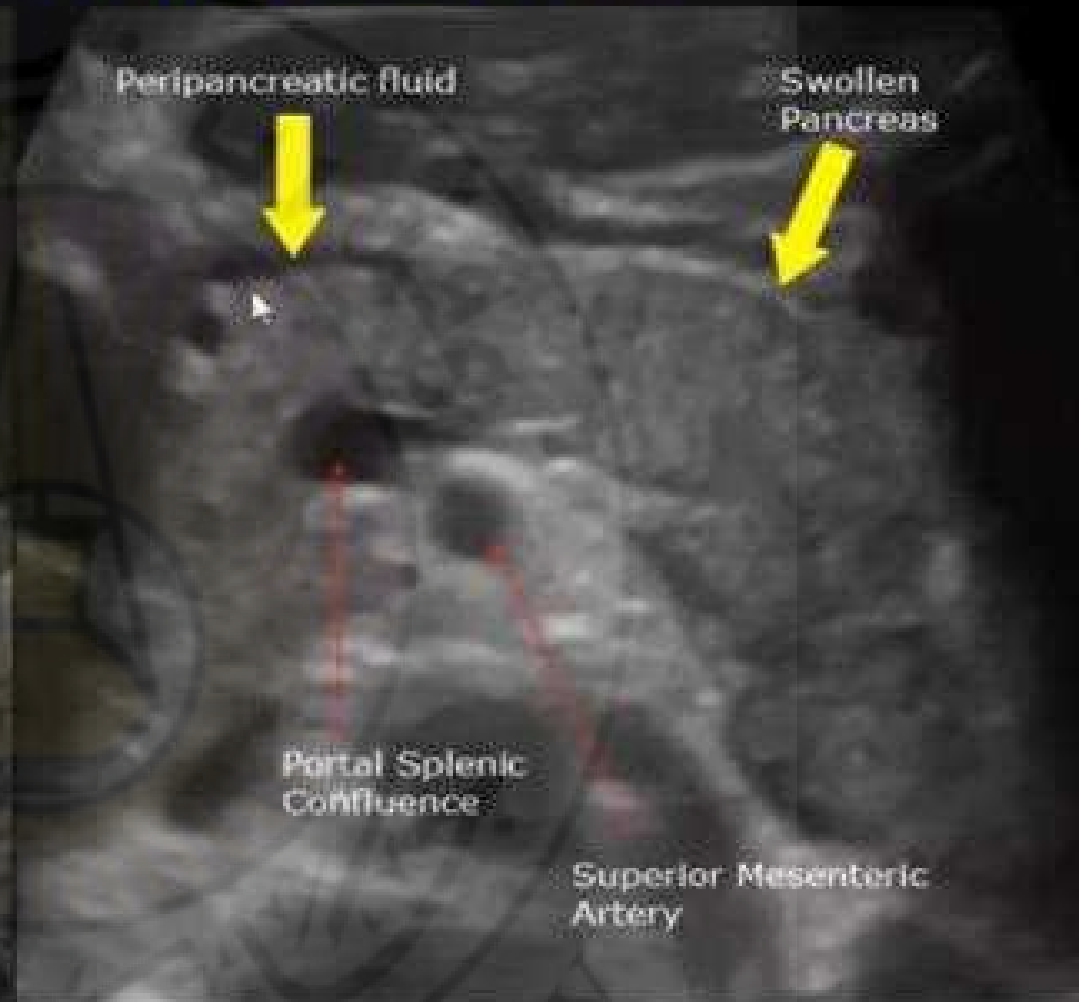
- Enlarged Pancreas
- Peripancreatic fluid
- Heterogeneous appearance

Transverse View



**Normal
Pancreas**

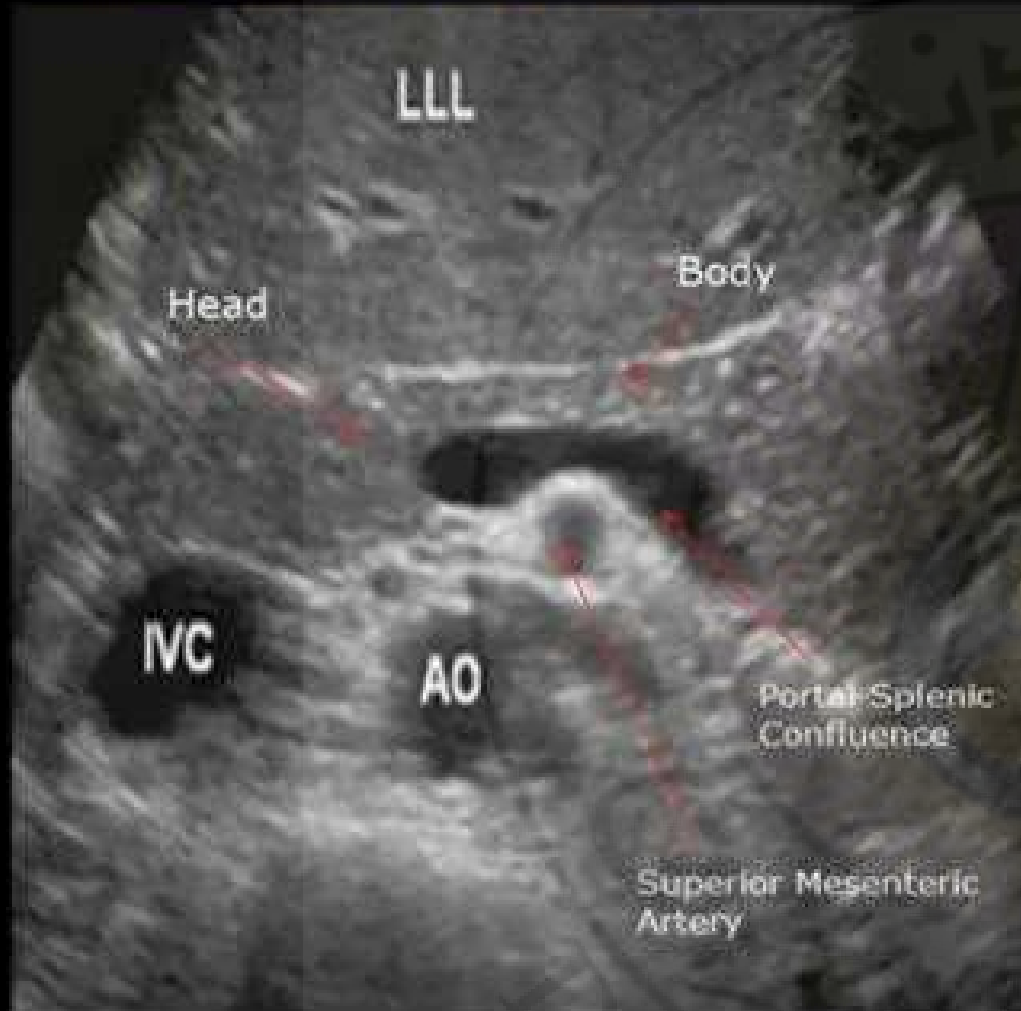
Transverse View



Acute Pancreatitis

- Enlarged Pancreas
- Head Diameter $> 3\text{cm}$
- Body Diameter $> 2.5\text{cm}$

Transverse View



**Normal
Pancreas**

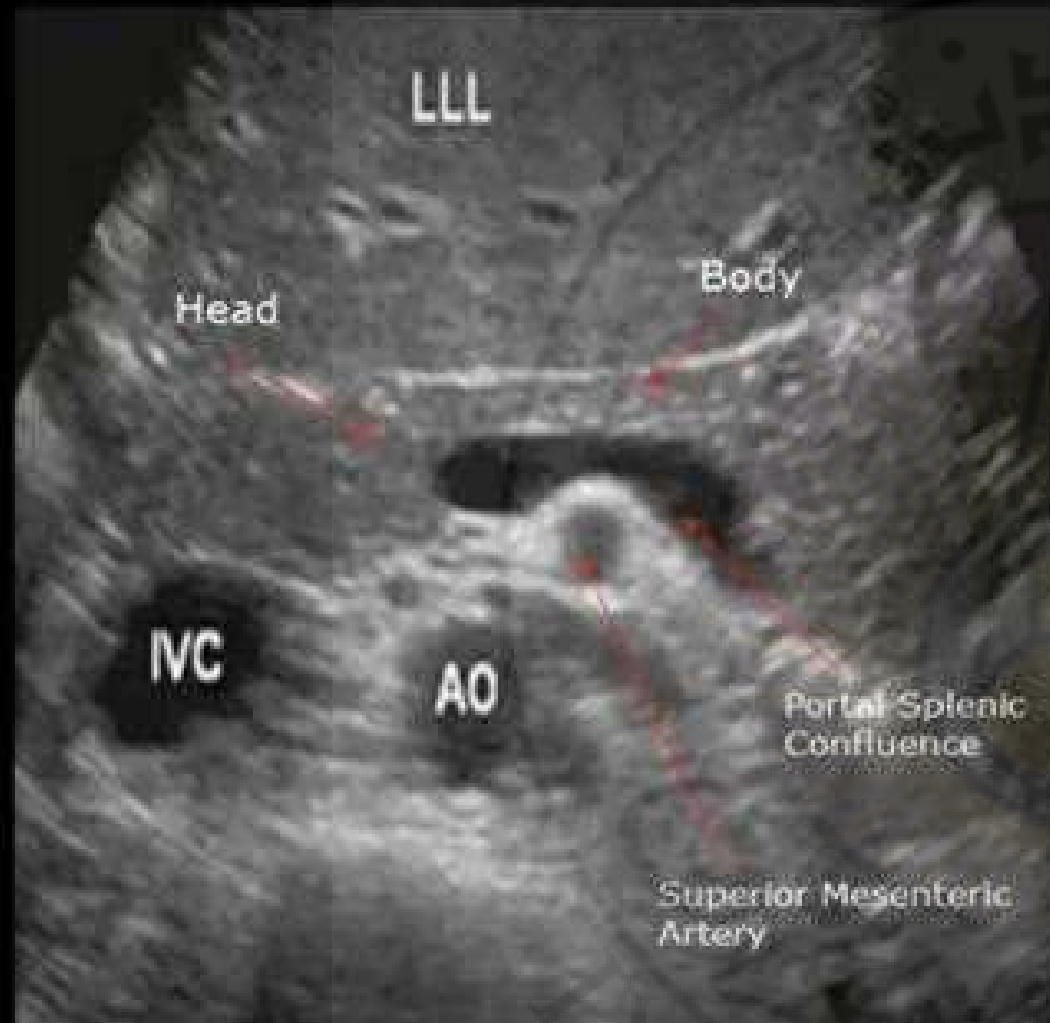
Transverse View



Chronic Pancreatitis

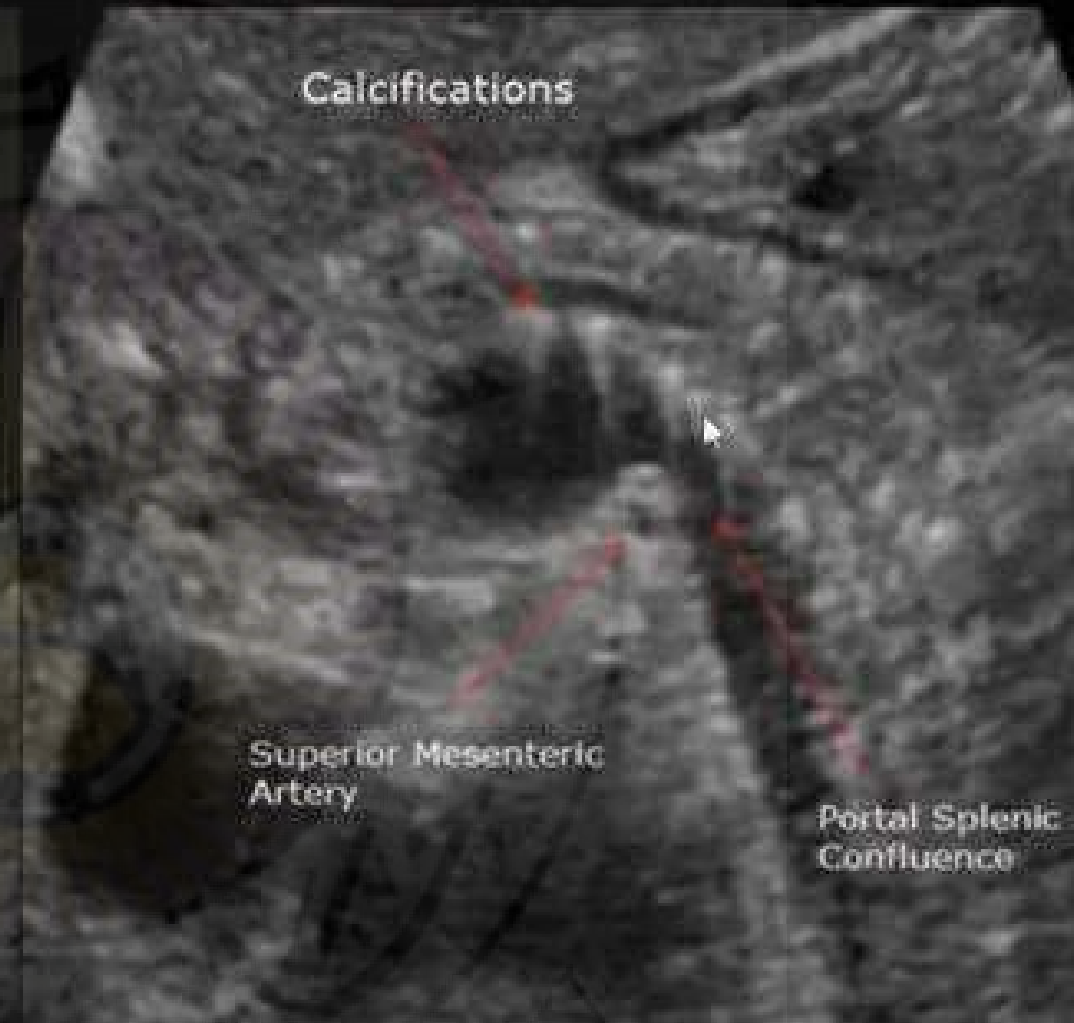
- Multiple calcifications producing shadowing
- Heterogeneous appearance

Transverse View



**Normal
Pancreas**

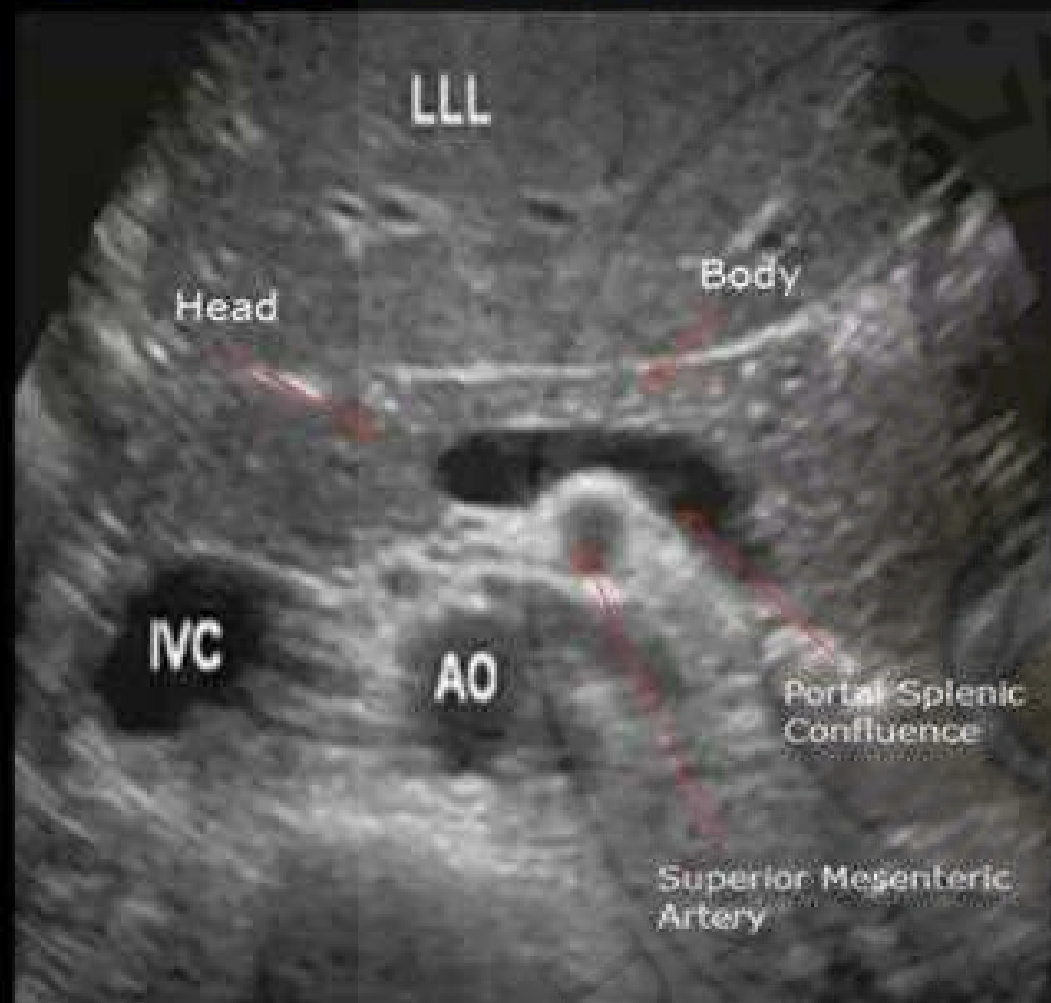
Transverse View



Chronic Pancreatitis

- Multiple calcifications producing shadowing
- Heterogeneous appearance

Transverse View



**Normal
Pancreas**

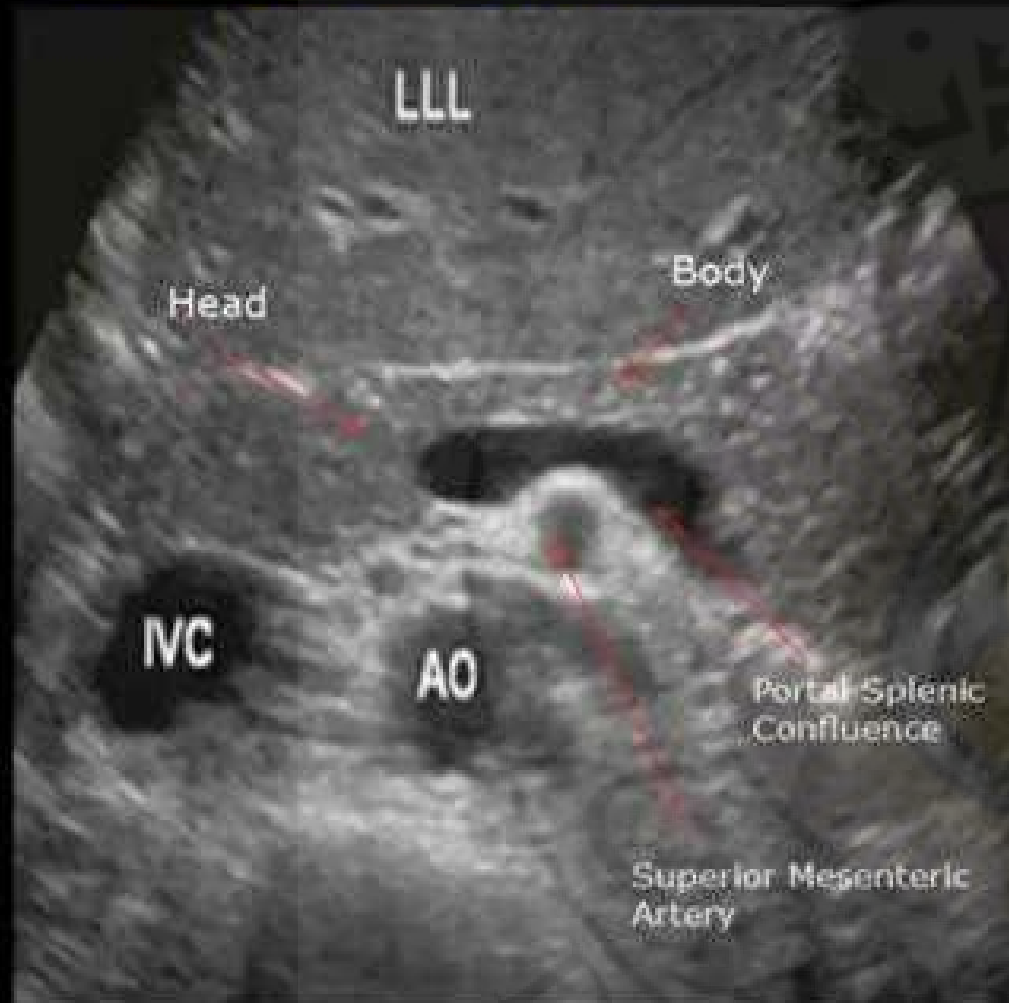
Transverse View



Parenchymal Atrophy

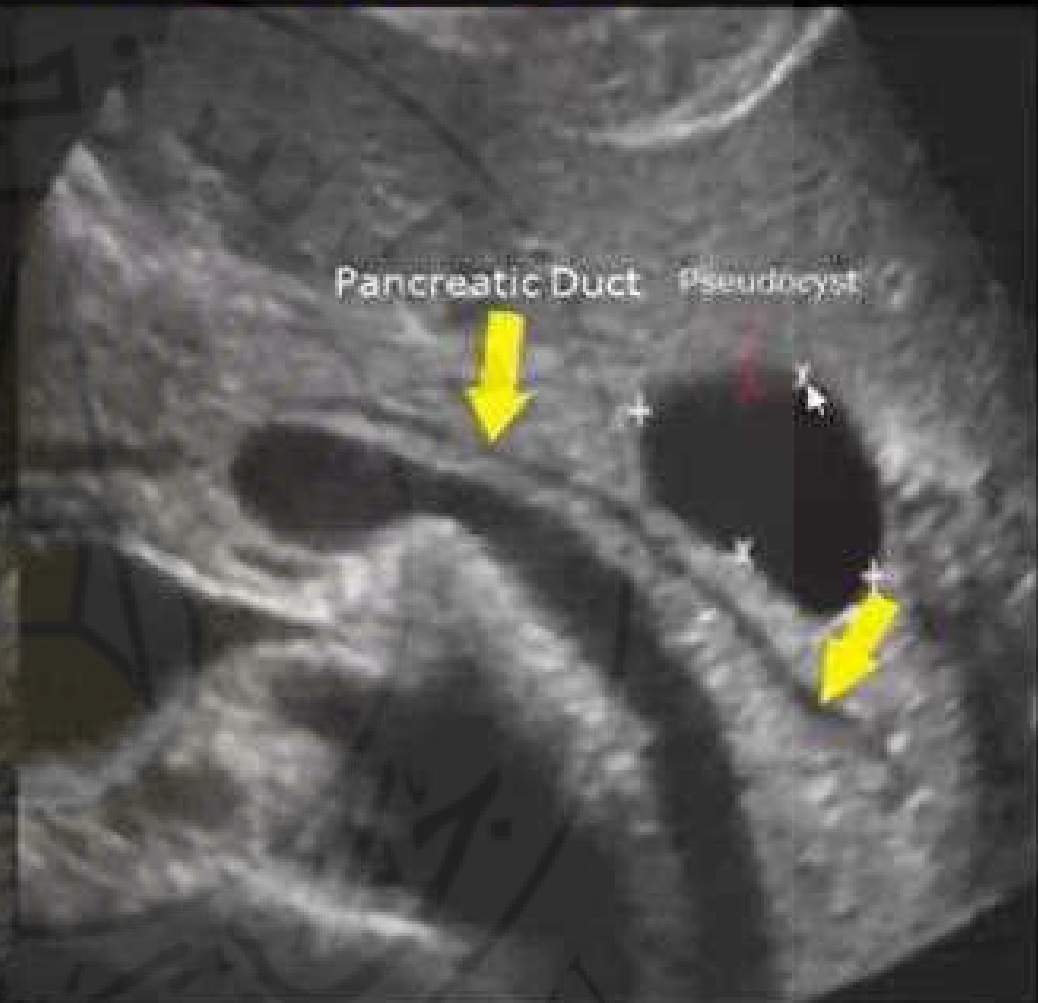
- Poor visualization of pancreatic parenchyma
- Dilated pancreatic duct

Transverse View



**Normal
Pancreas**

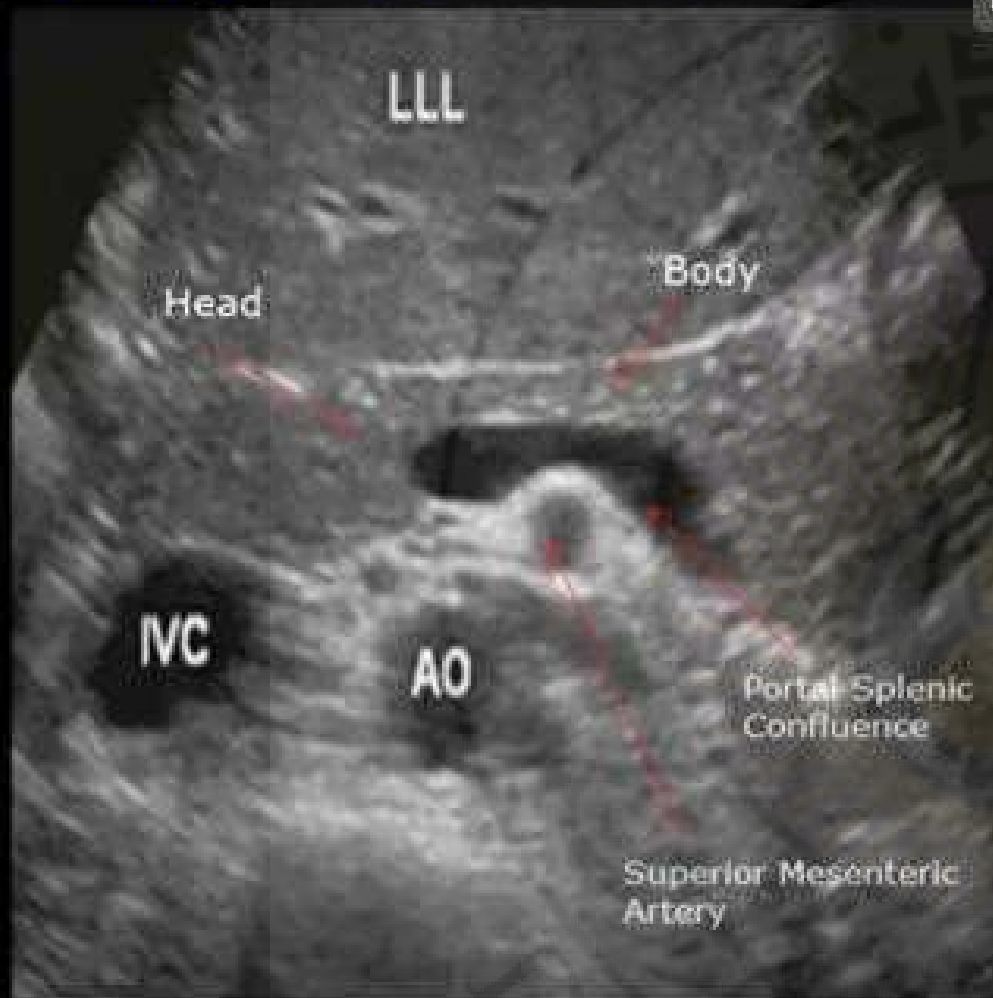
Transverse View



Pancreatic Pseudocyst

- Well-defined fluid collection
- Cyst is comprised of pancreatic enzymes

Transverse View



**Normal
Pancreas**

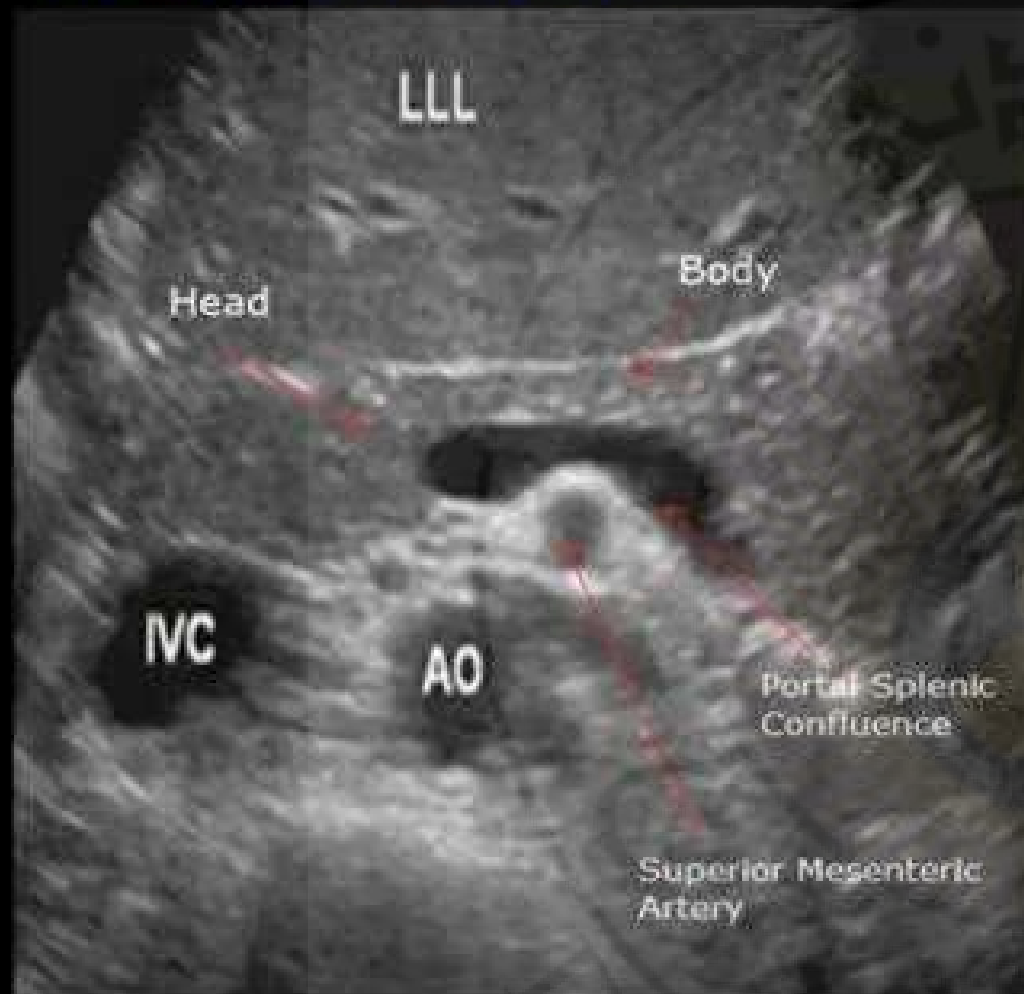
Transverse View



Pancreatic Pseudocyst

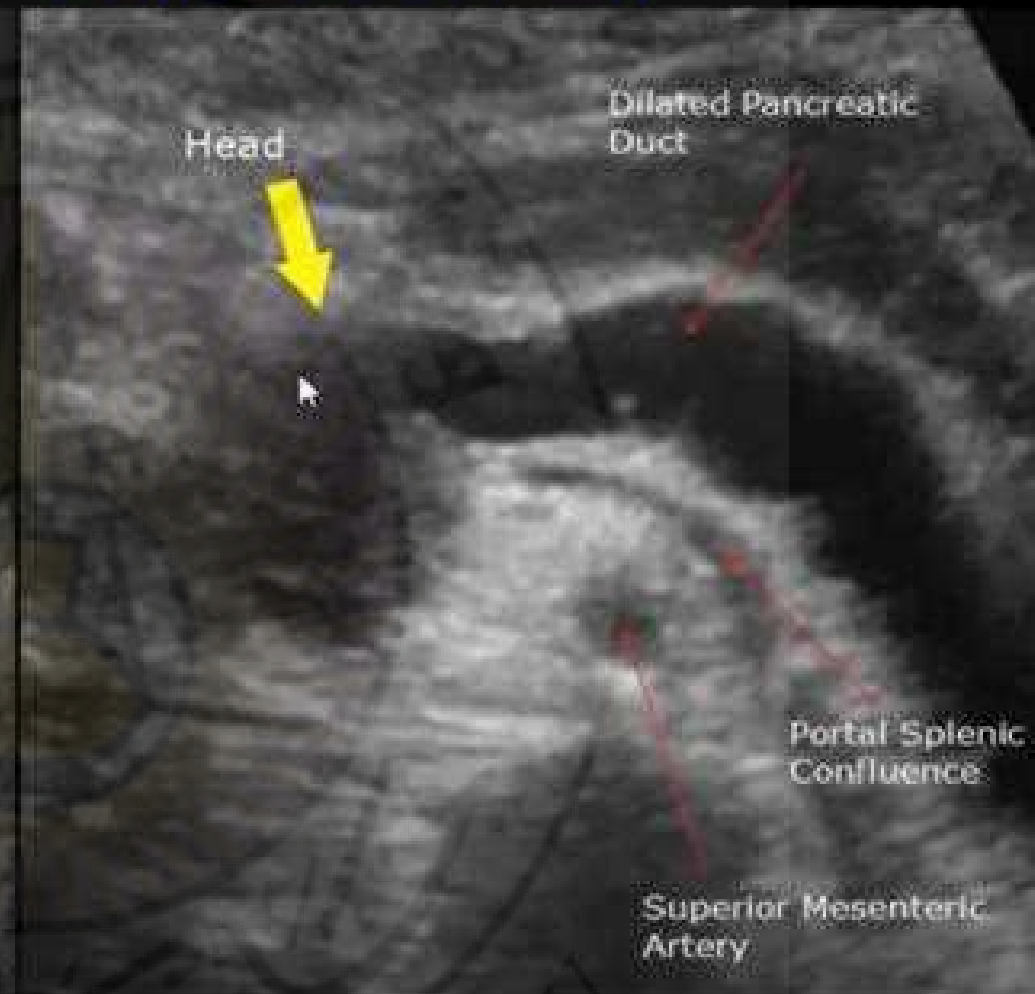
- Well-defined fluid collection
- Cyst is comprised of pancreatic enzymes

Transverse View



**Normal
Pancreas**

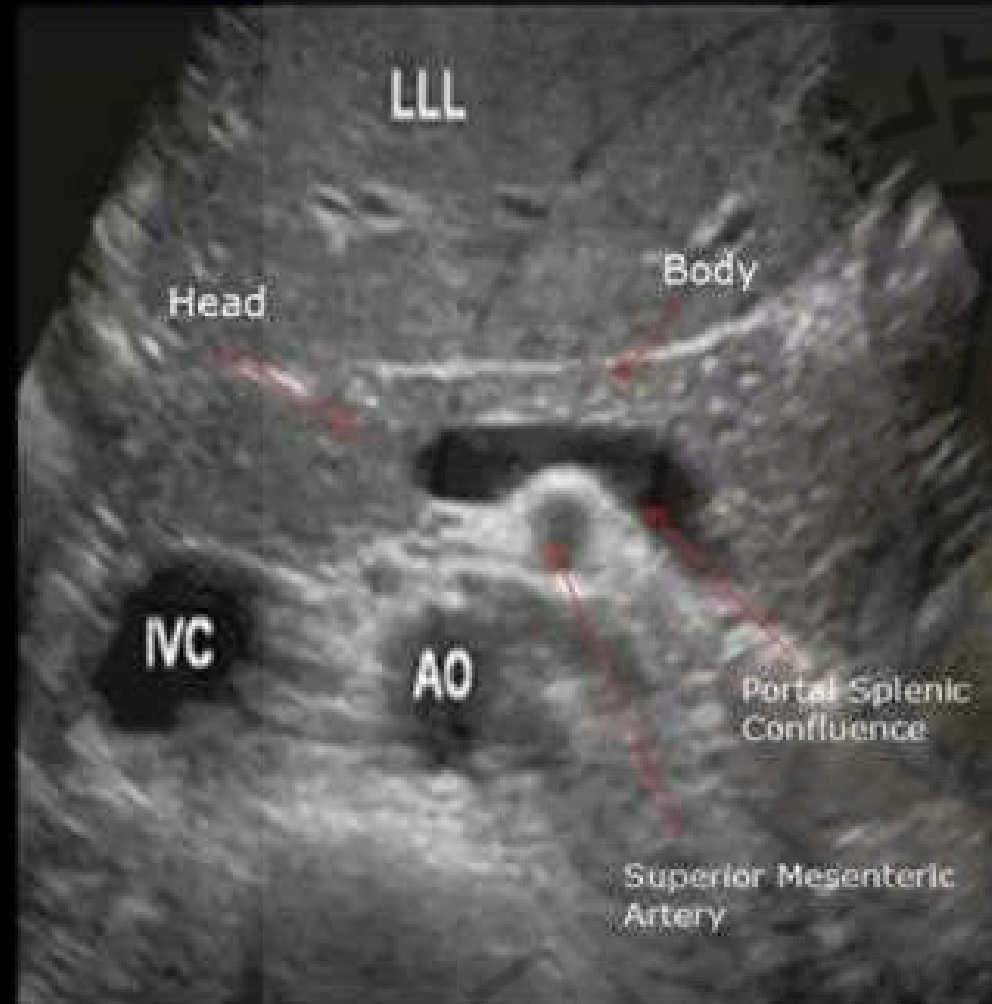
Transverse View



Adenocarcinoma

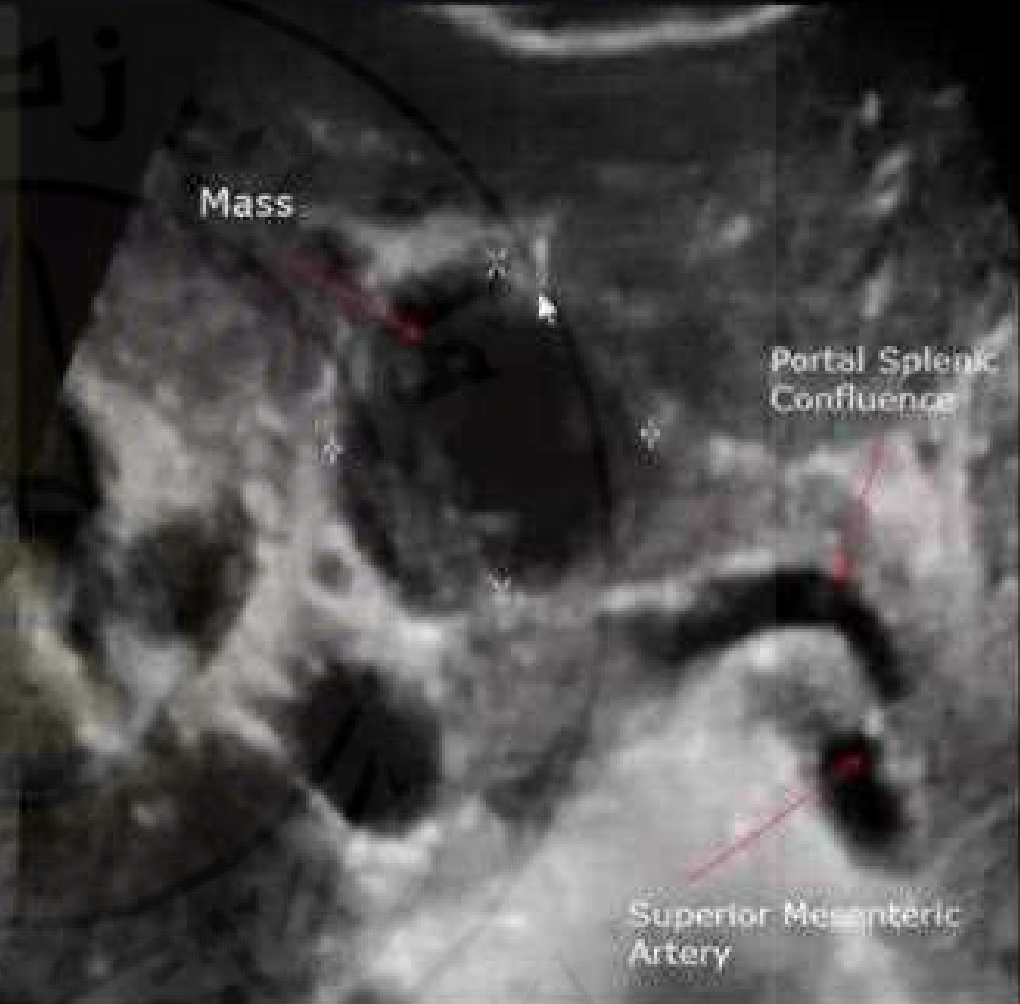
- Hypoechoic mass
- Dilated Pancreatic Duct

Transverse View



**Normal
Pancreas**

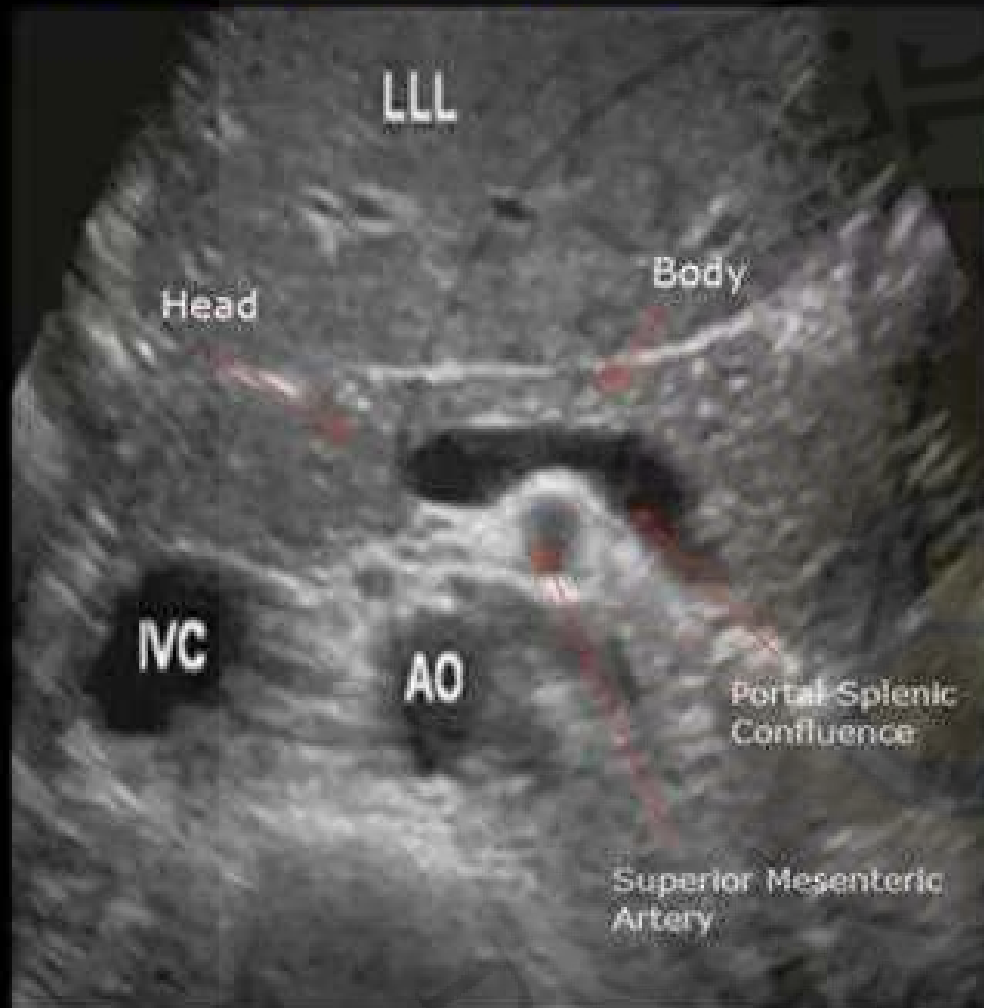
Transverse View



Adenocarcinoma

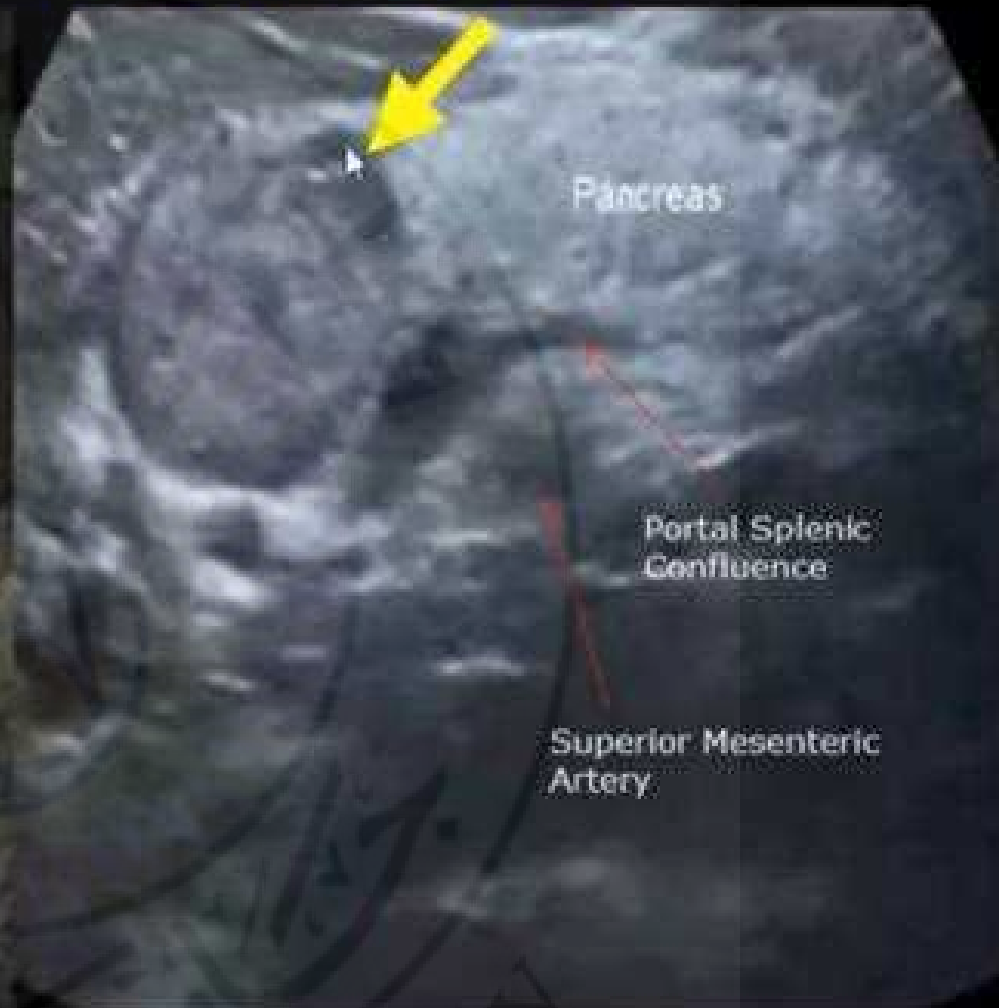
- Hypoechoic mass
- Dilated Pancreatic Duct

Transverse View



**Normal
Pancreas**

Transverse View



Adenocarcinoma

- Heterogeneous mass
- Dilated Pancreatic Duct

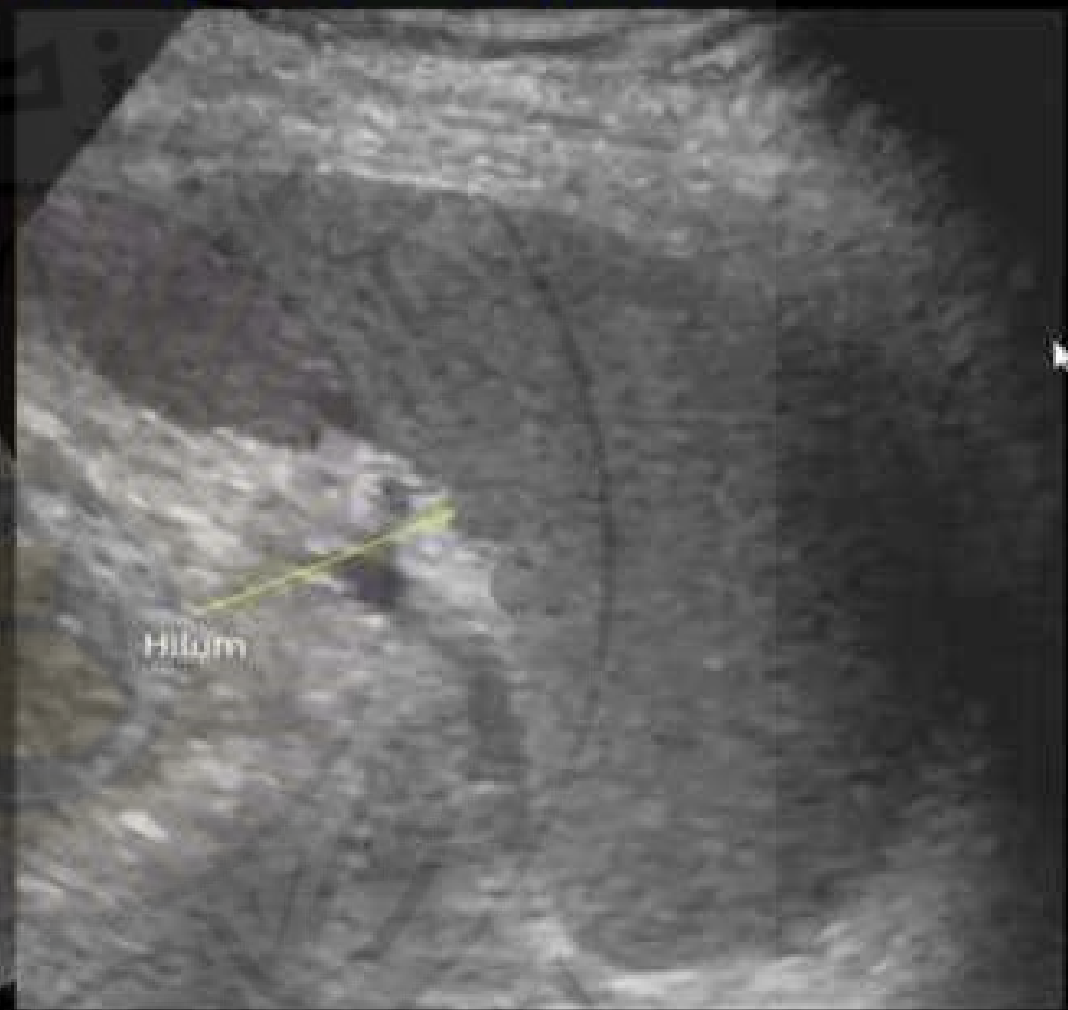
Spleen Ultrasound Normal Vs Abnormal Image Appearances Comparison

Damascus University

Longitudinal View



Transverse View



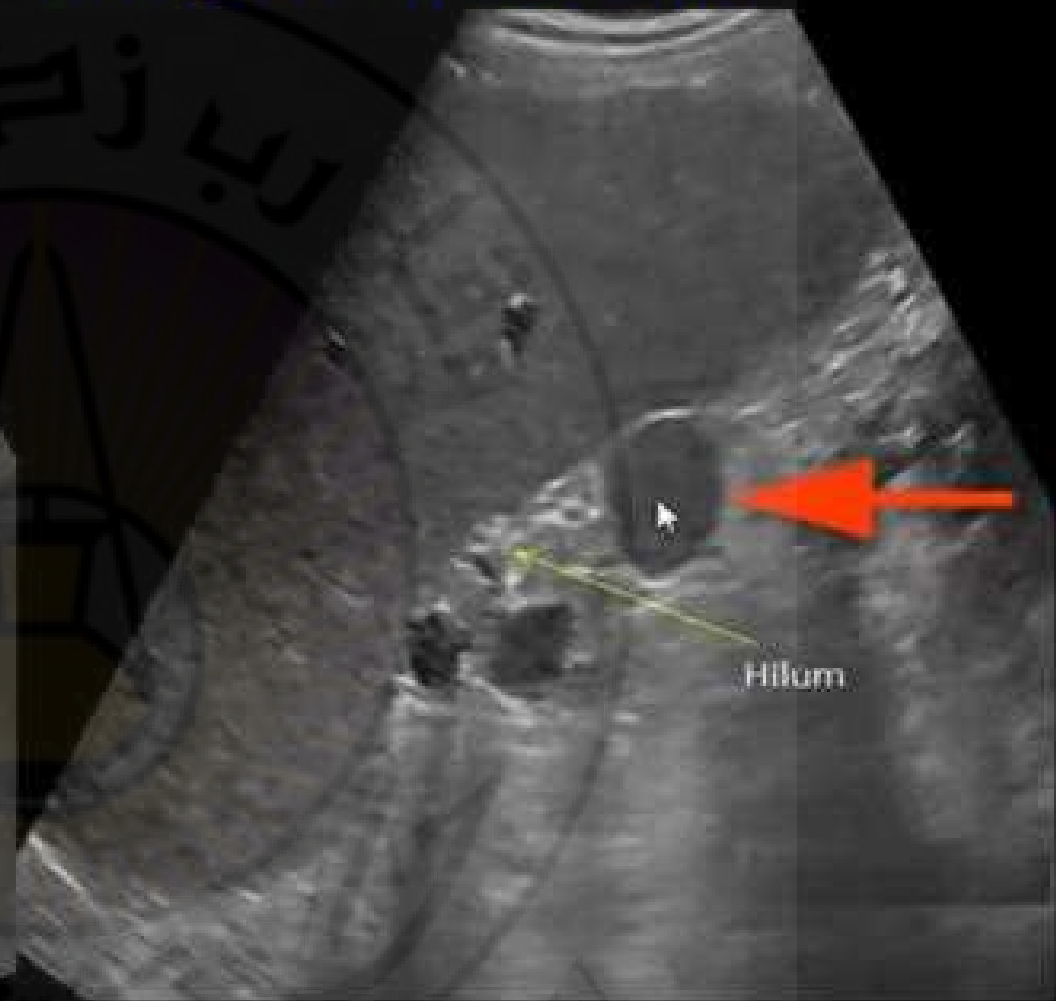
**Normal
Spleen**

Longitudinal View



**Normal
Spleen**

Longitudinal View



Splenule

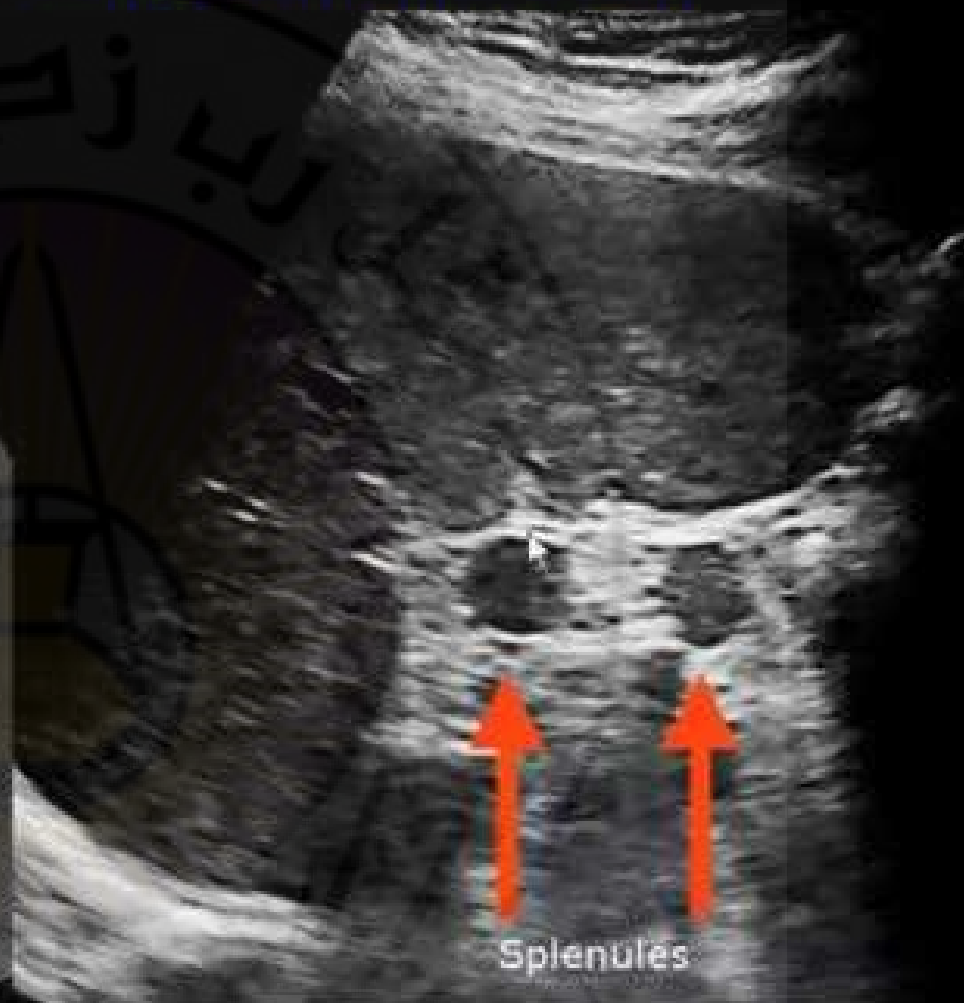
- Accessory splenic tissue
- Isoechoic, located near the hilum/lower pole.

Longitudinal View



**Normal
Spleen**

Longitudinal View



Splenule

- Accessory splenic tissue
- Isoechoic, located near the hilum/lower pole.

Longitudinal View



**Normal
Spleen**

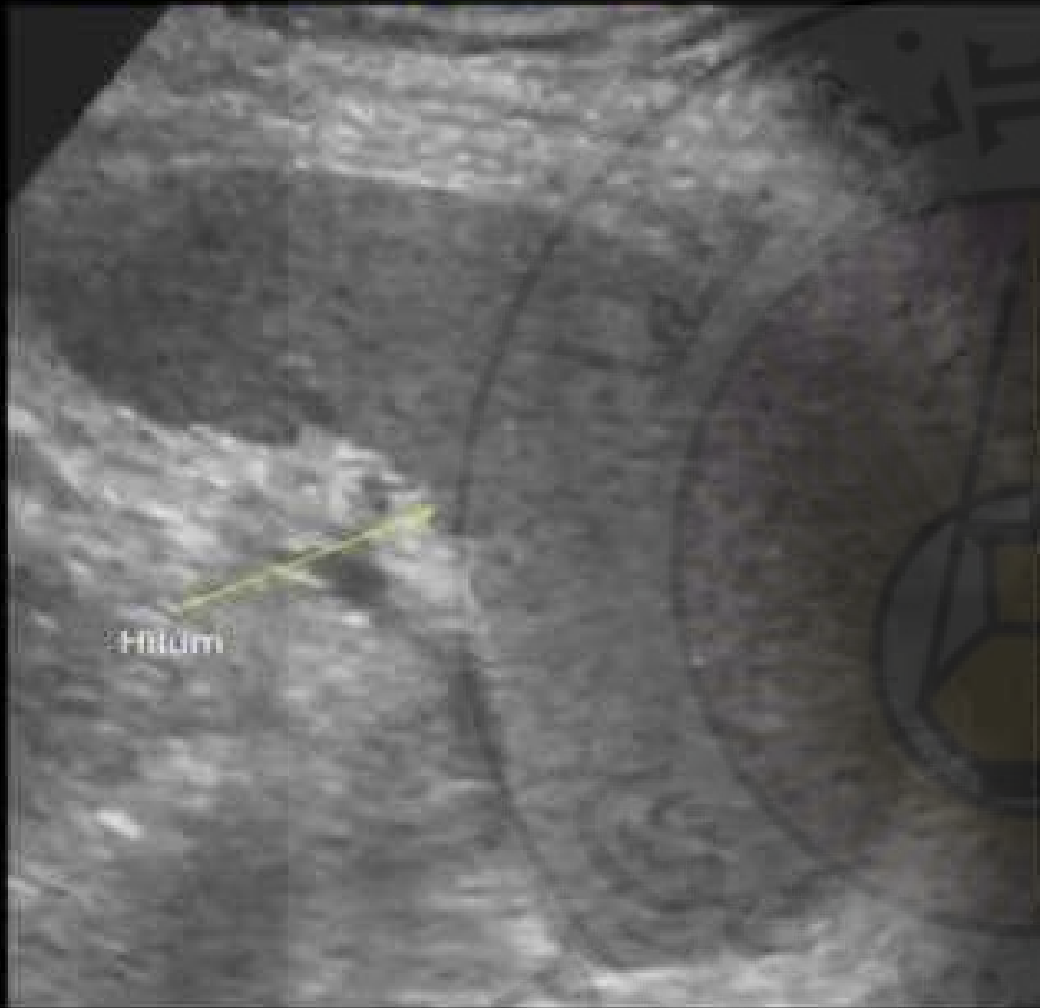
Longitudinal View



Splenomegaly

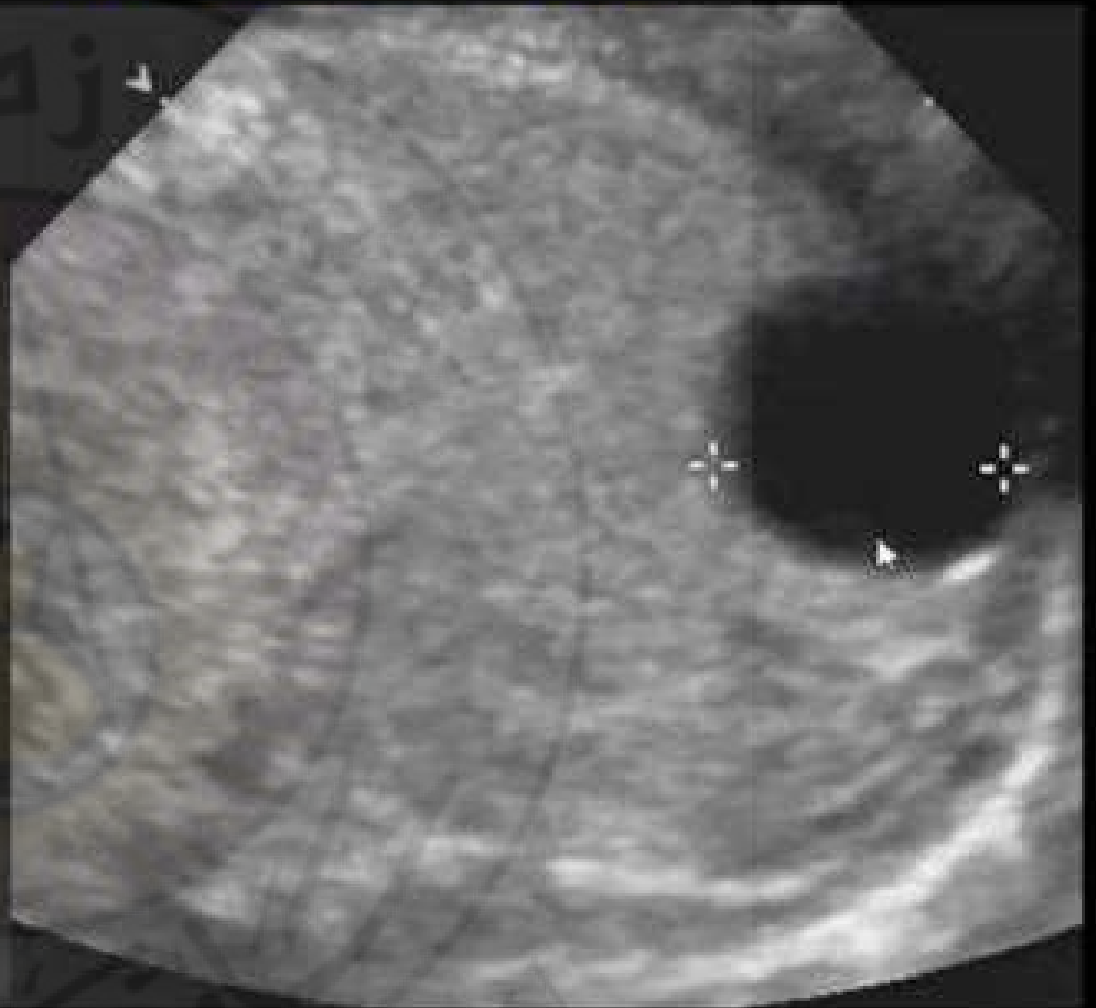
- Length > 13cm
- Thickness > 6cm

Transverse View



**Normal
Spleen**

Transverse View



Splenic Cyst

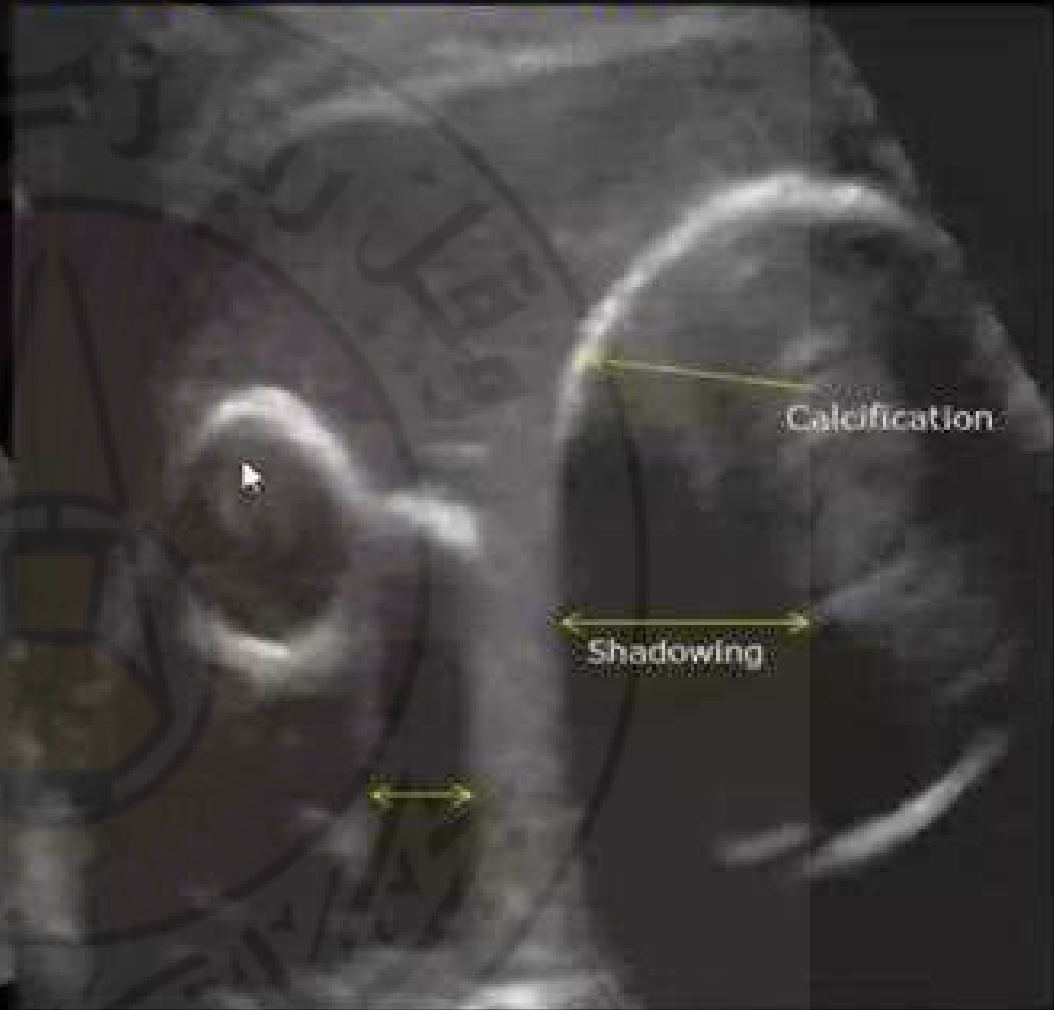
- A well defined, anechoic structure

Longitudinal View



**Normal
Spleen**

Longitudinal View



**Splenic Cyst With
Calcified Walls**

- Cysts with hyperechoic walls due to calcification.

Longitudinal View



**Normal
Spleen**

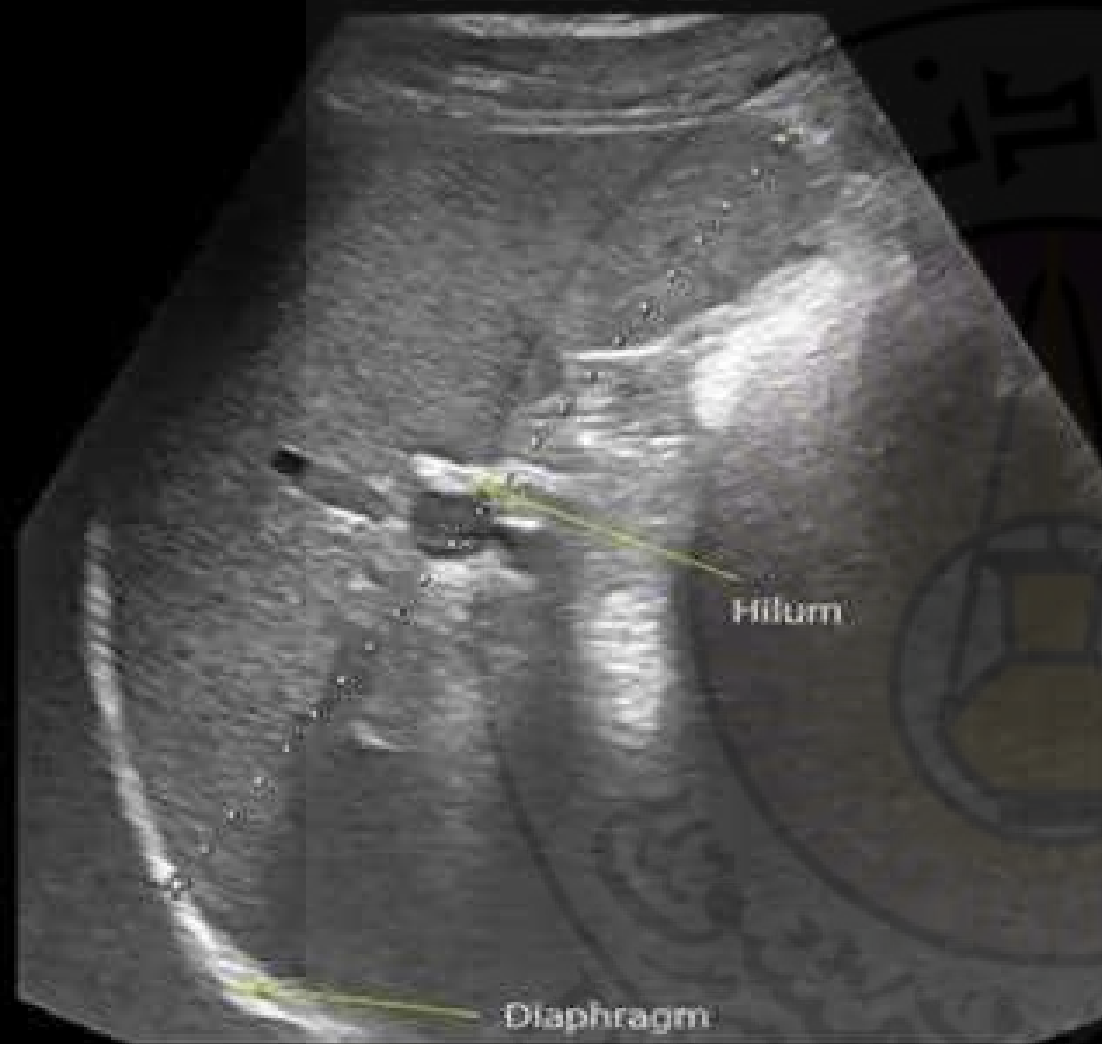
Longitudinal View



Complex Cyst

- Multiple septations
- Internal echoes

Longitudinal View



**Normal
Spleen**

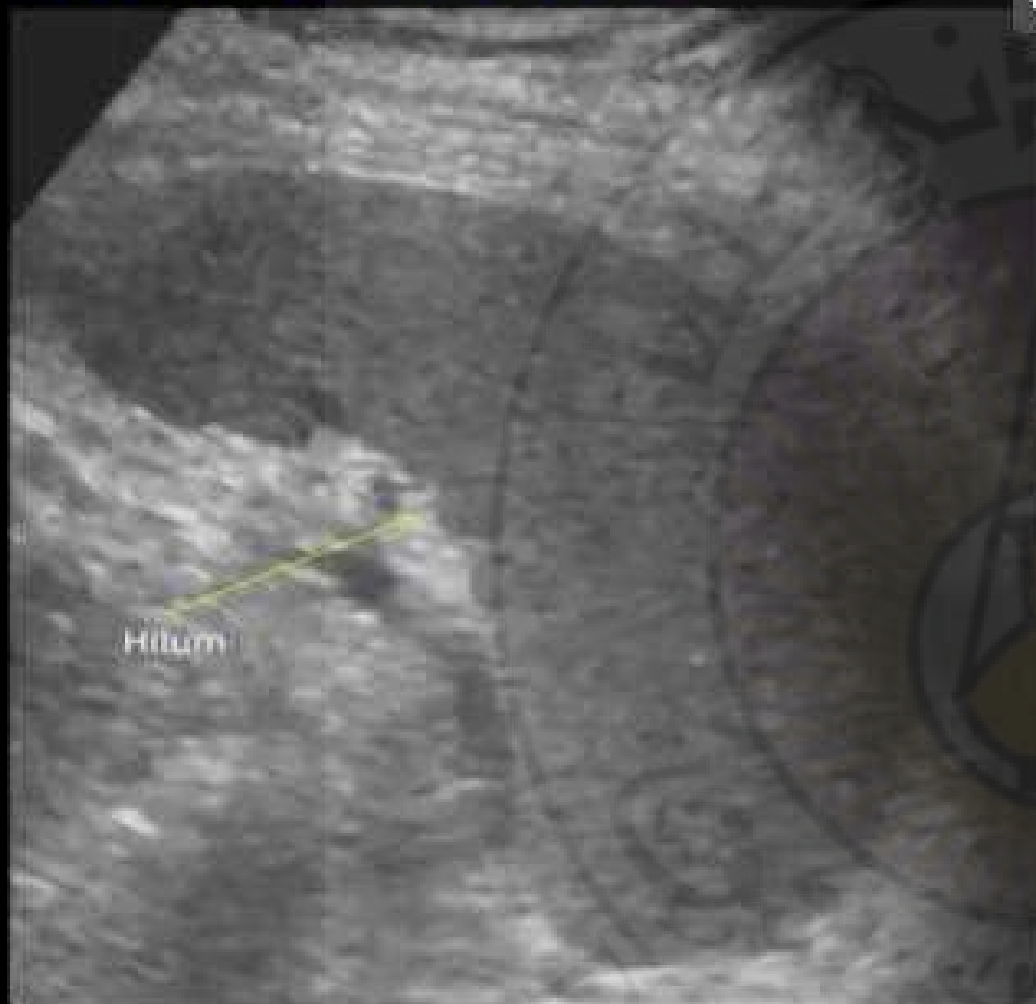
Longitudinal View



Hemangioma

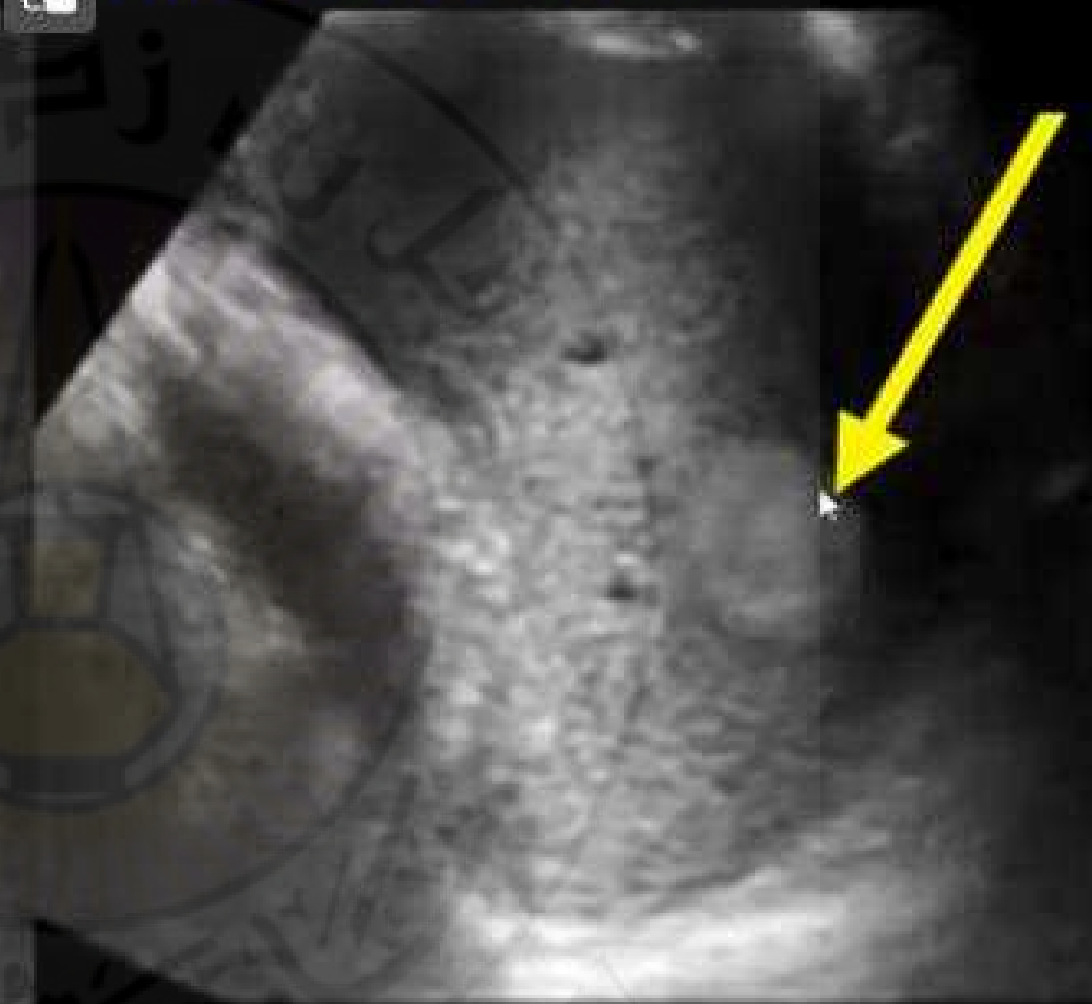
- Hyperechoic
- Homogeneous

Transverse View



**Normal
Spleen**

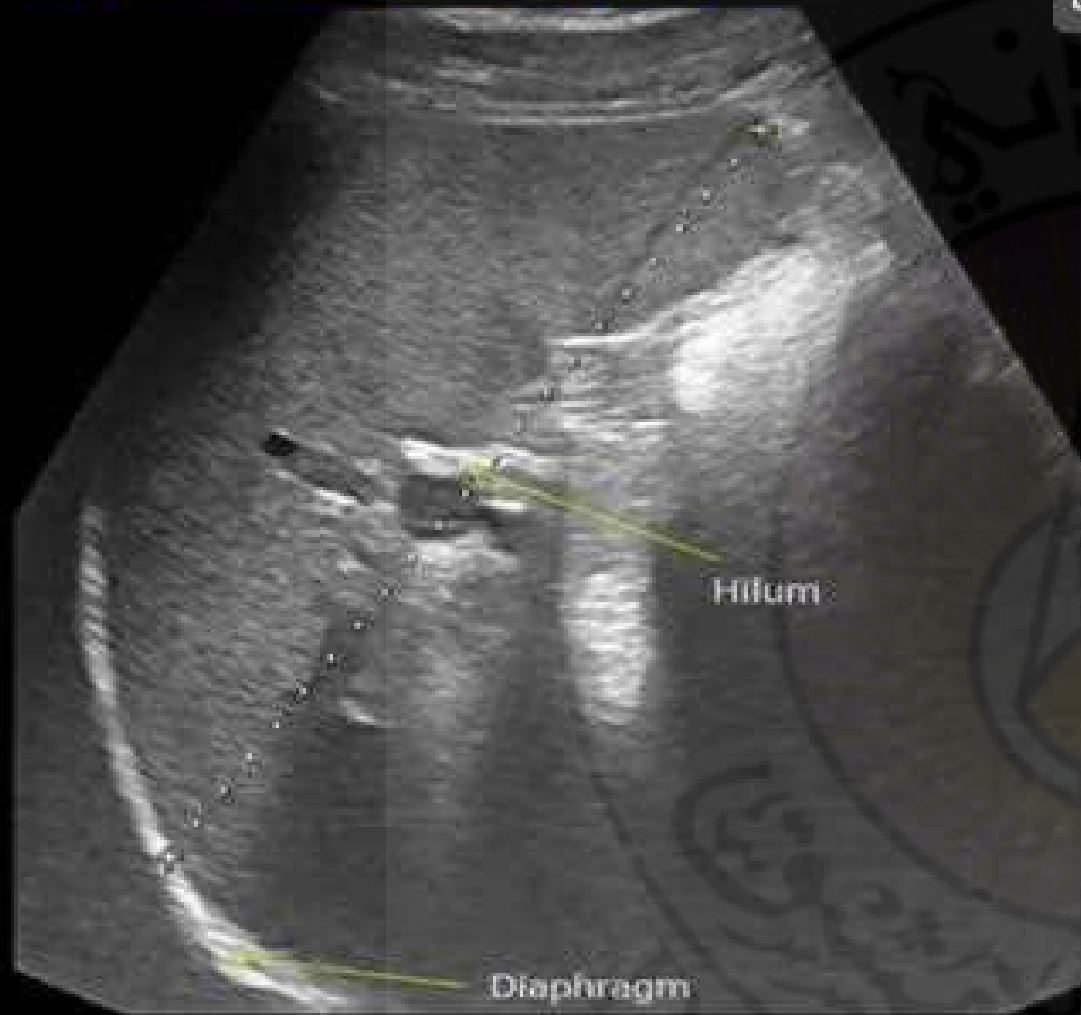
Transverse View



Hemangioma

- Hyperechoic
- Homogeneous

Longitudinal View



**Normal
Spleen**

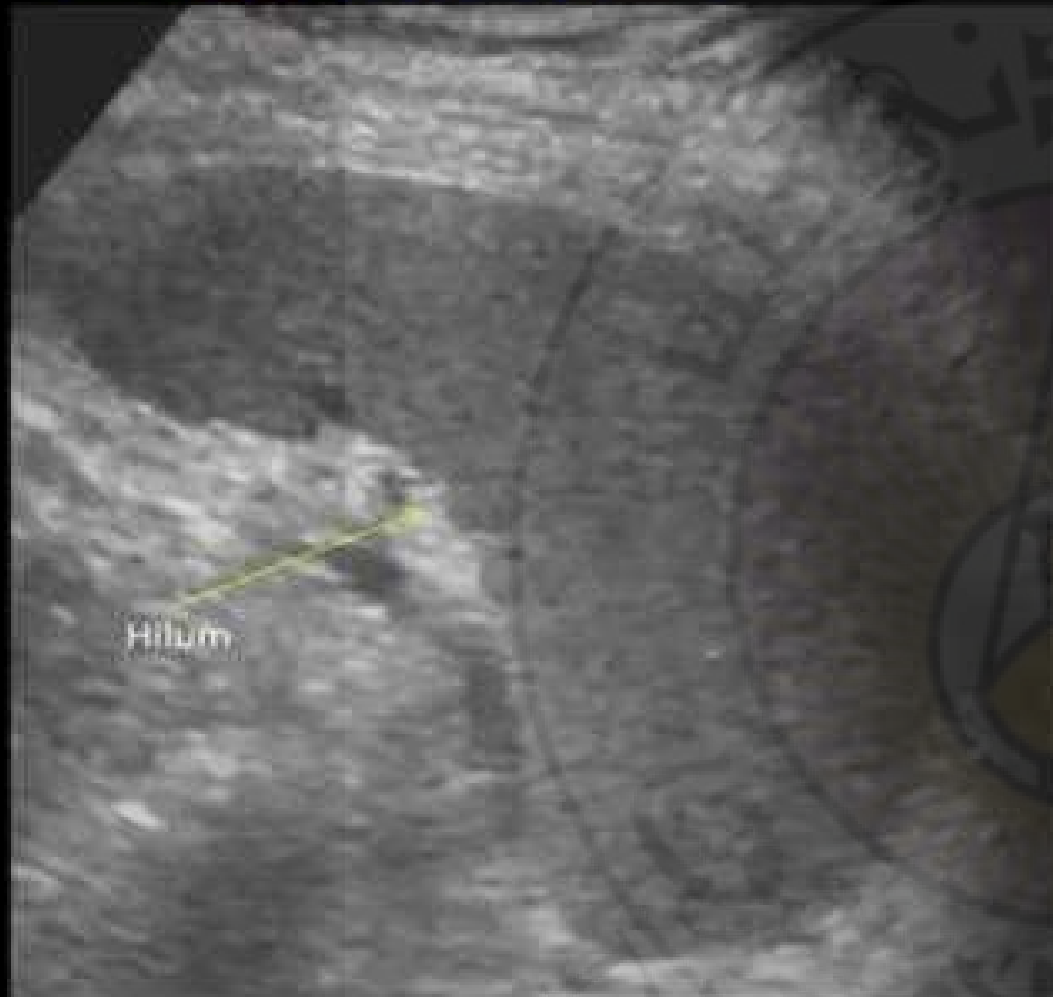
Longitudinal View



Lymphoma

- Hypoechoic mass
- Well-defined, spherical

Transverse View



**Normal
Spleen**

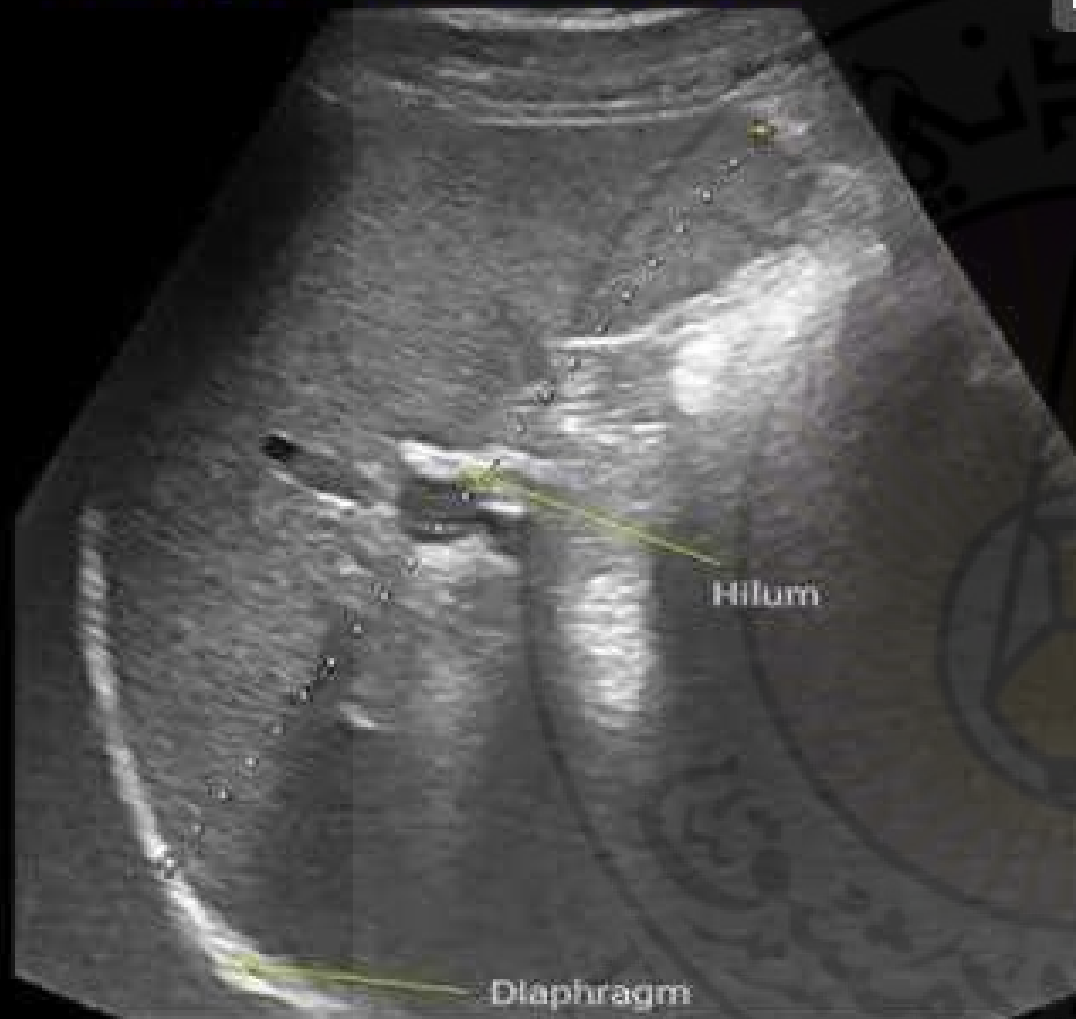
Transverse View



Lymphoma

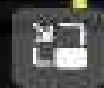
- Hypoechoic mass
- Can be more than one

Longitudinal View



**Normal
Spleen**

Longitudinal View



Metastases

- Target lesions
- Hypoechoic halo with hyperechoic center

Transverse View



**Normal
Spleen**

Transverse View



Metastases

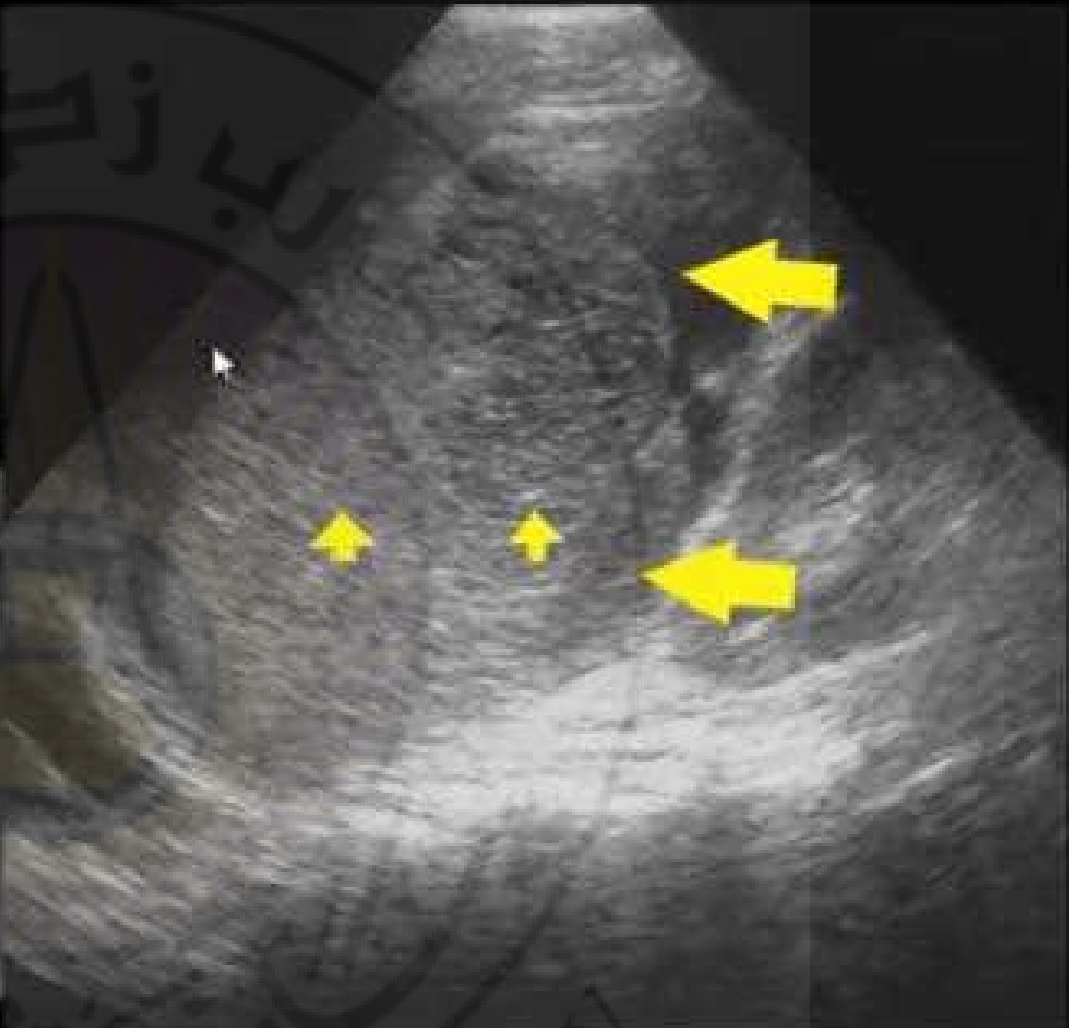
- Target lesions
- Hypoechoic halo with hyperechoic center

Longitudinal view

Longitudinal view



**Normal
Spleen**



Trauma

- Presence of free fluid in abdomen
- Anechoic fluid is fresh blood
- Hypoechoic/Heterogeneous areas

Longitudinal View



**Normal
Spleen**

Longitudinal View

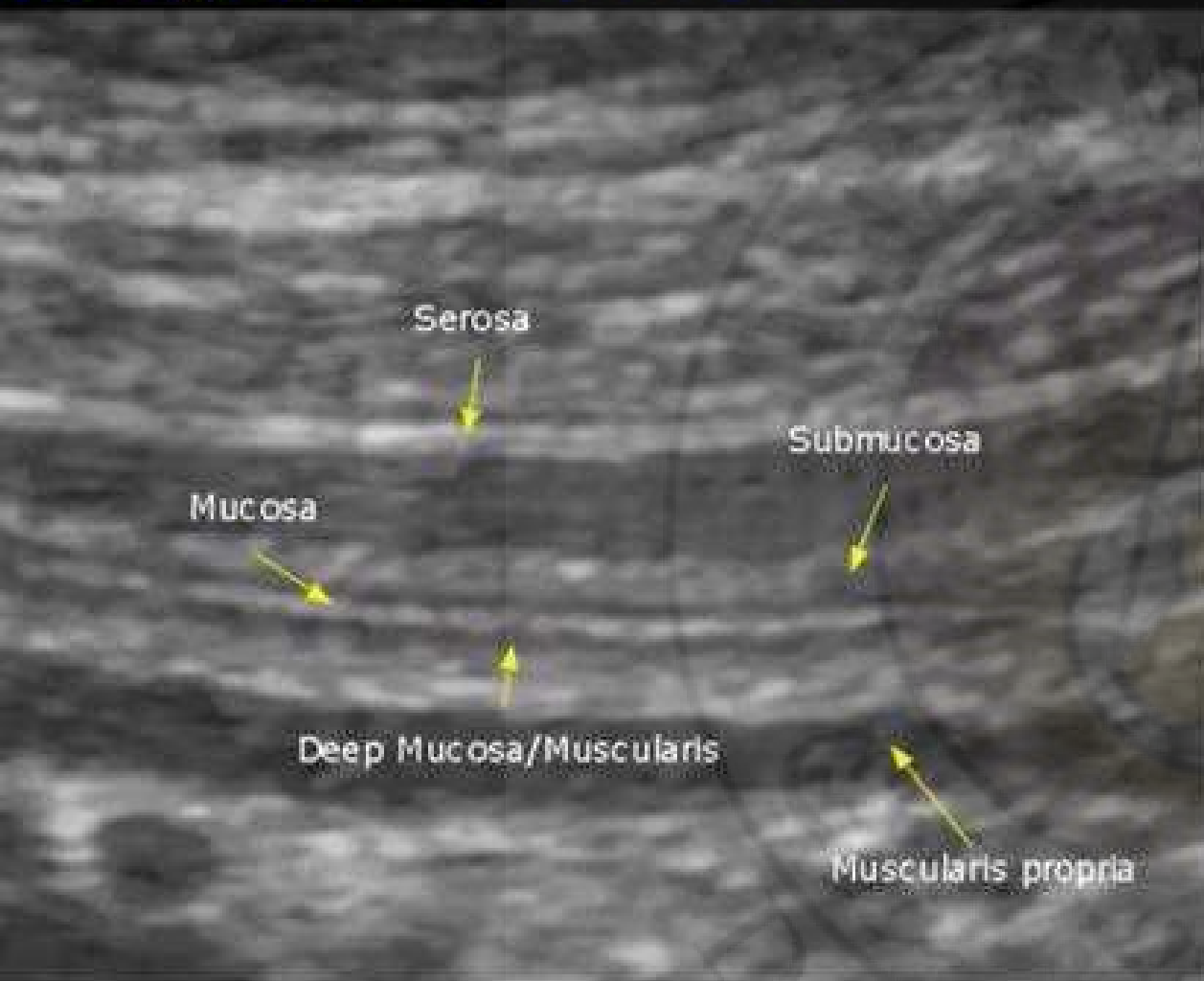


Trauma

- Presence of free fluid in abdomen
- Anechoic fluid is fresh blood
- Hypoechoic/Heterogeneous areas

Small Bowel Ultrasound Normal Vs Abnormal Image Appearances Comparison

Longitudinal View



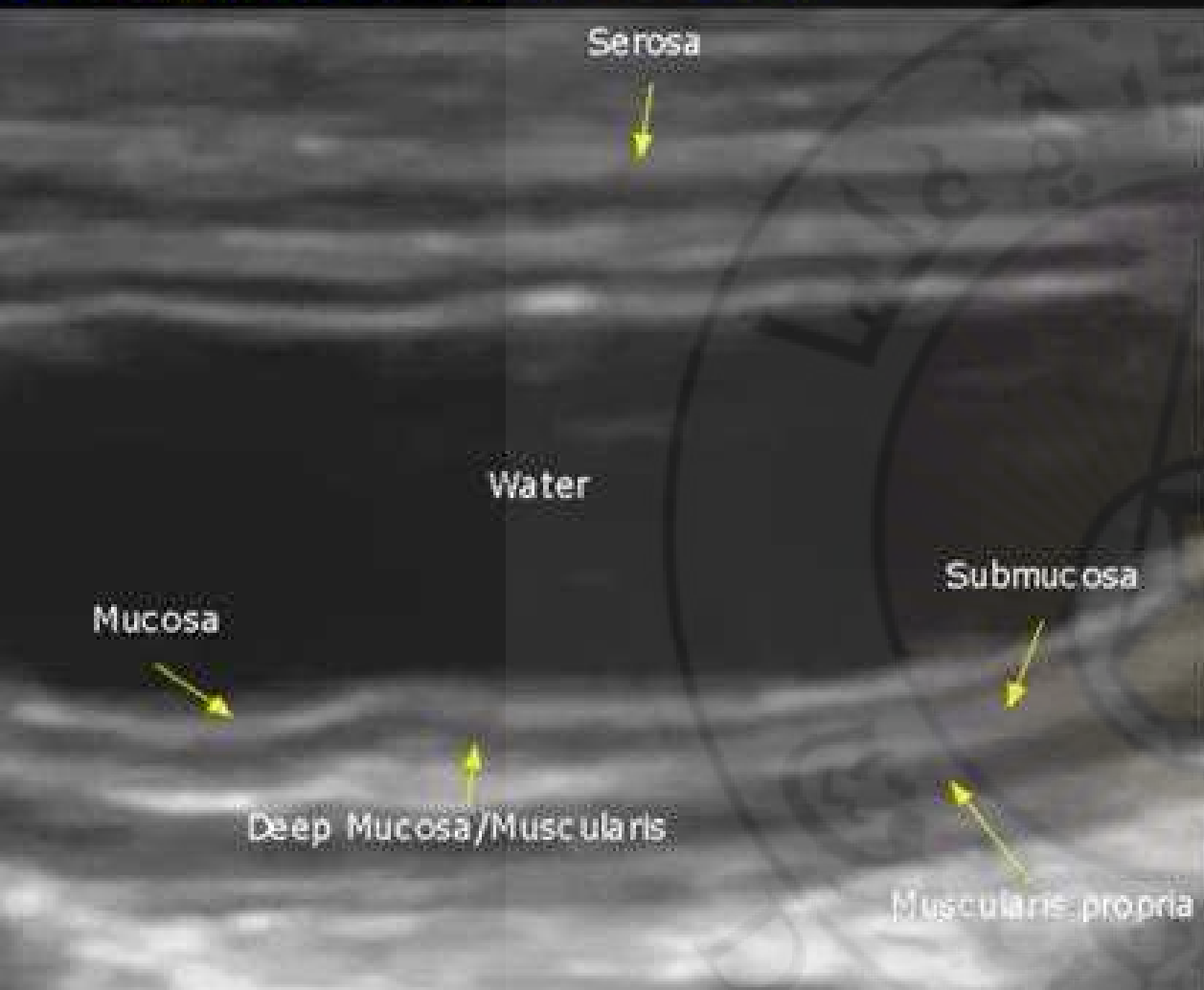
Transverse View



Normal Small Bowel

- **5 Layers:** Mucosa, Deep mucosa/Muscularis mucosa, Submucosa, Muscularis propria, Serosa

Longitudinal View



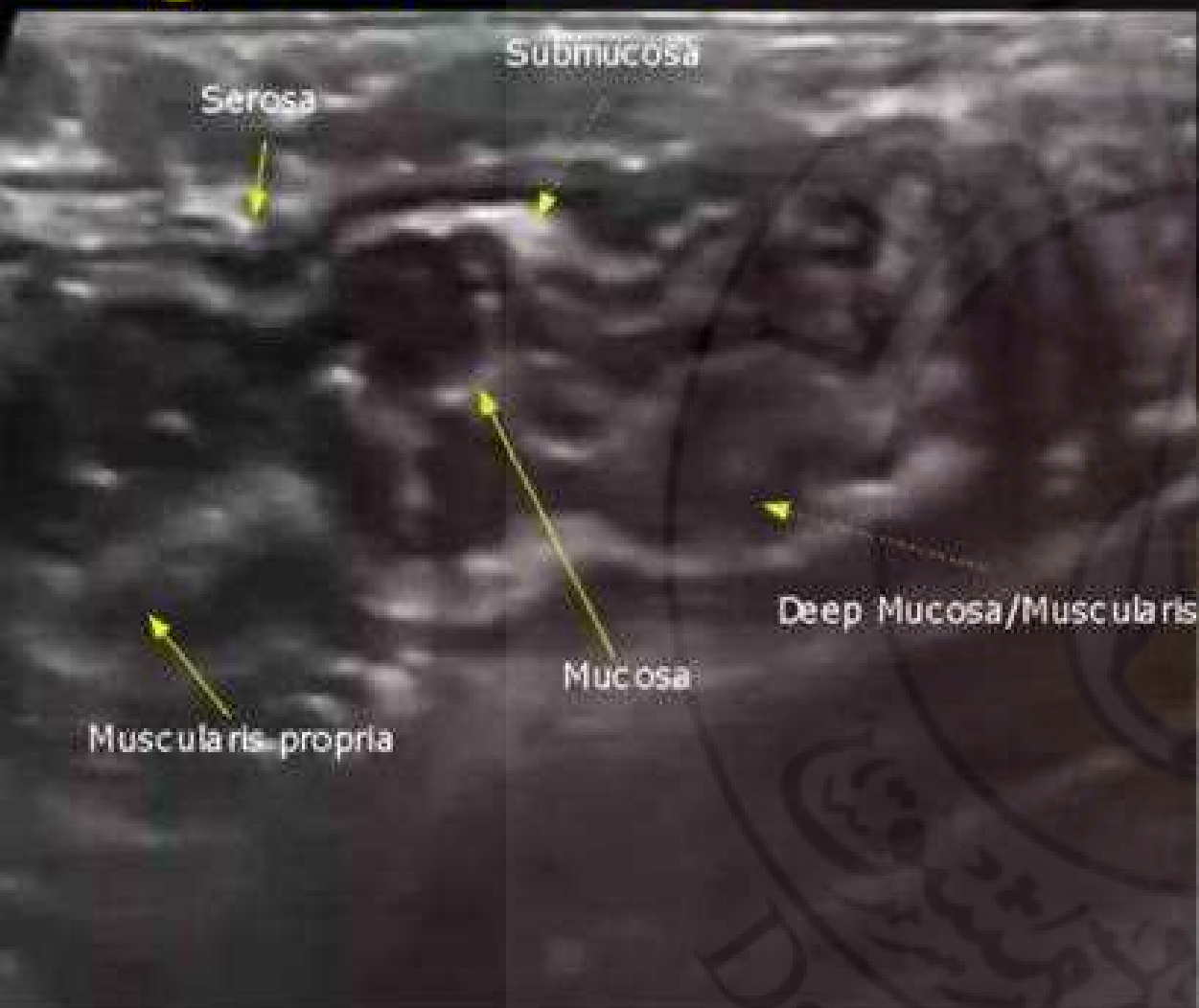
Transverse View



Normal Small Bowel

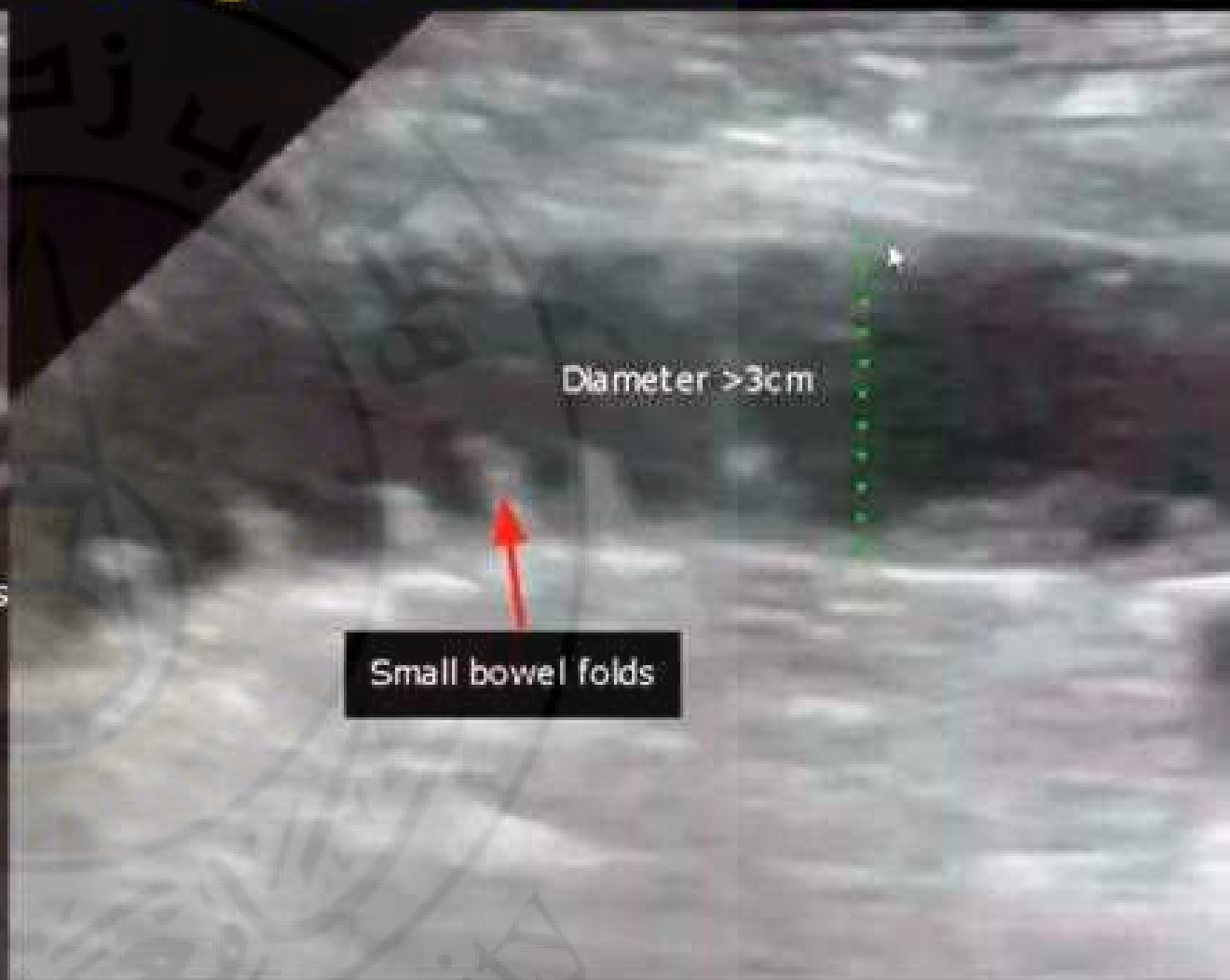
- **5 Layers:** Mucosa, Deep mucosa/Muscularis mucosa, Submucosa, Muscularis propria, Serosa

Longitudinal View



Normal Bowel

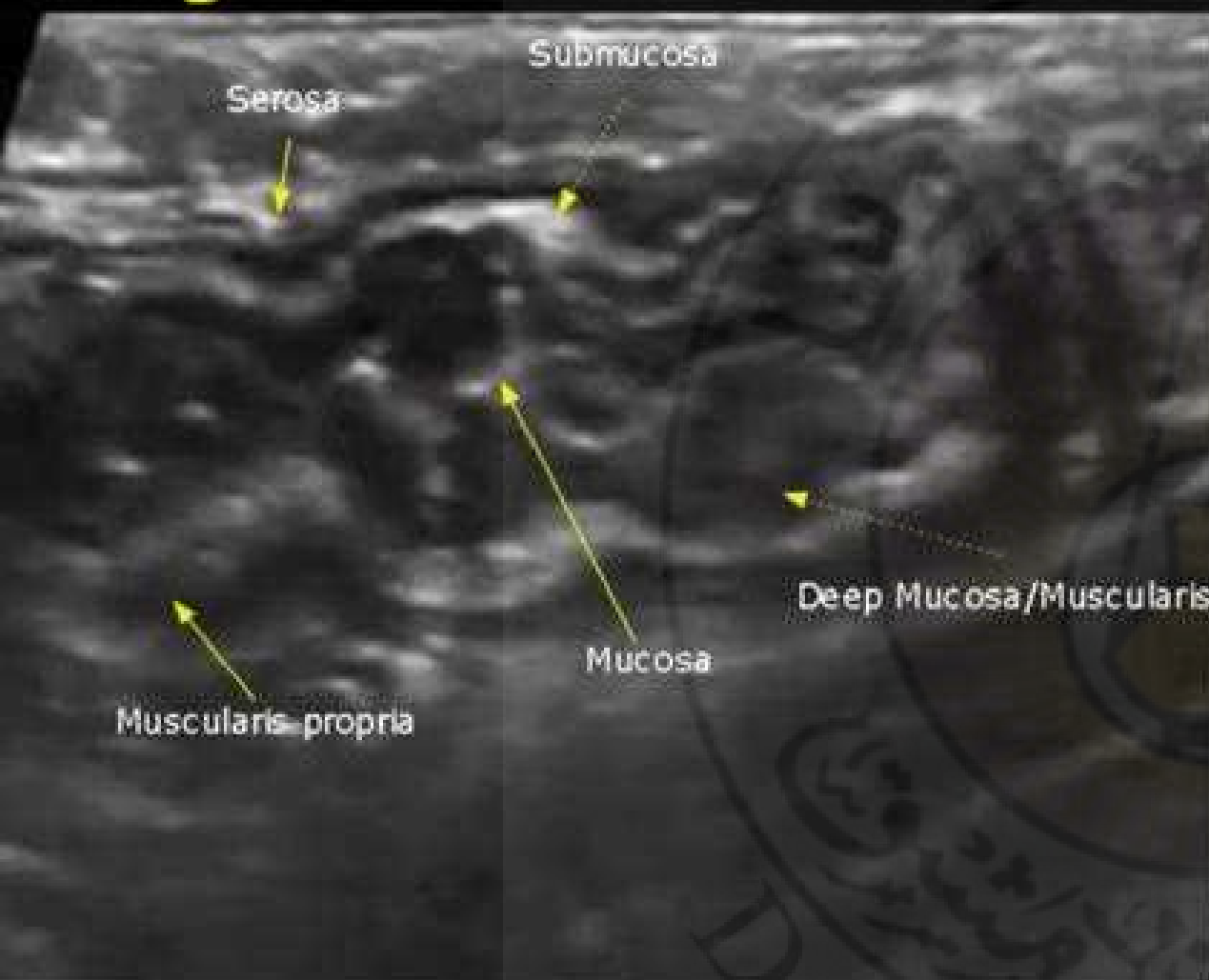
Longitudinal View



Small Bowel Obstruction

- Diameter: $>3\text{cm}$
- Visible small bowel folds
- Wall thickness $>3\text{mm}$

Longitudinal View



Normal Bowel

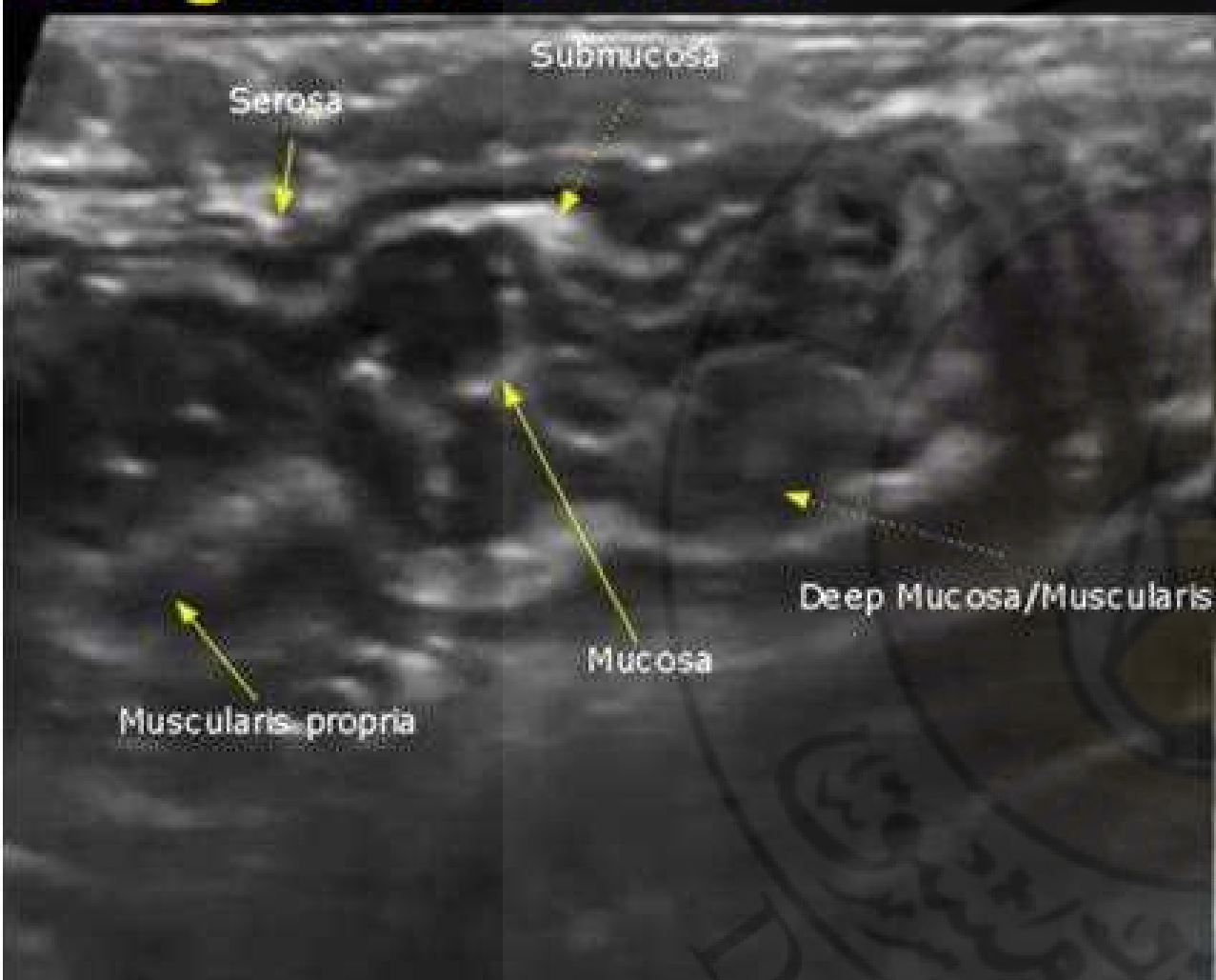
Longitudinal View



Small Bowel Obstruction

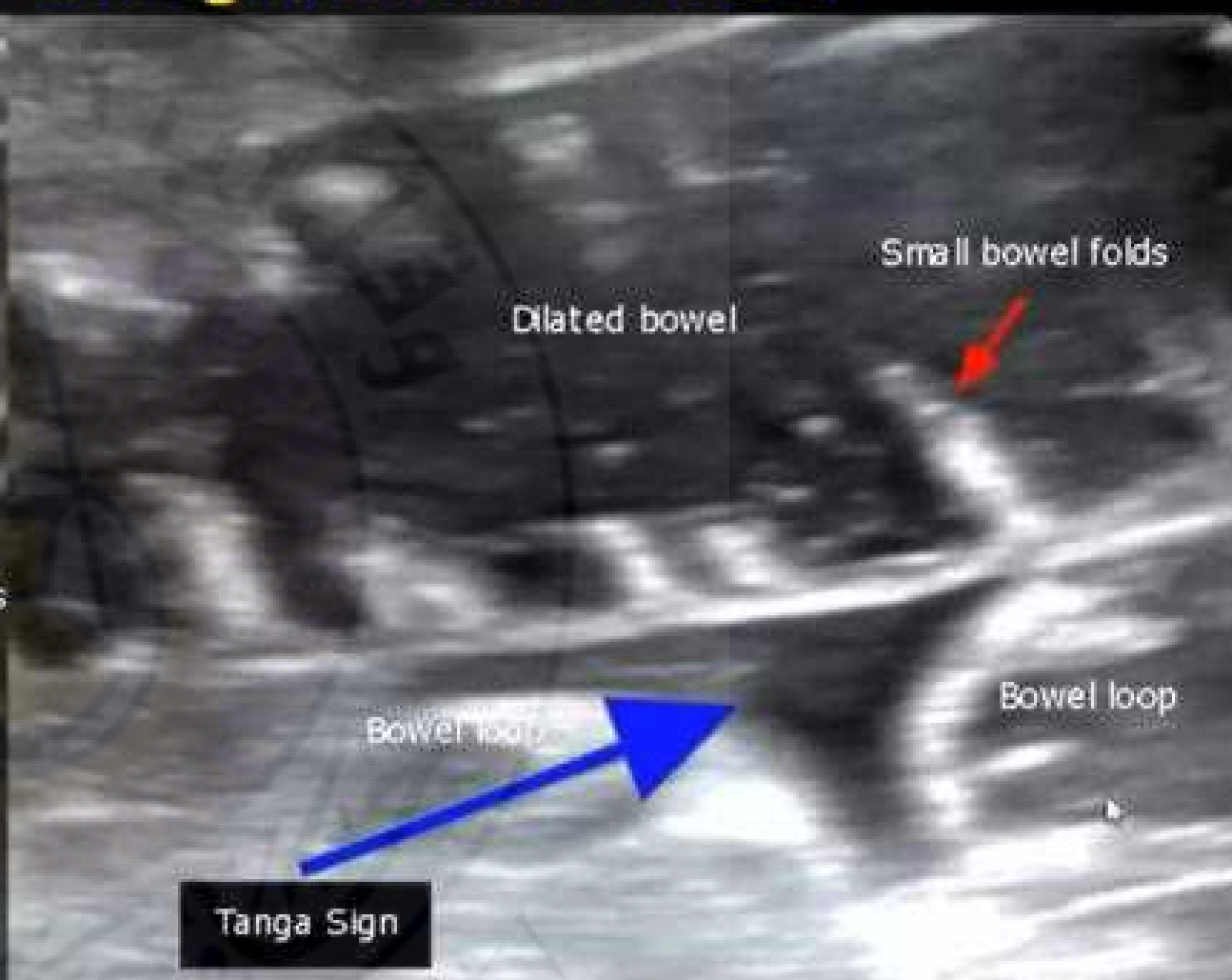
- Diameter: $>3\text{cm}$
- To-and-fro appearance of intraluminal contents.
- Aperistalsis may also occur in some cases

Longitudinal View



Normal Bowel

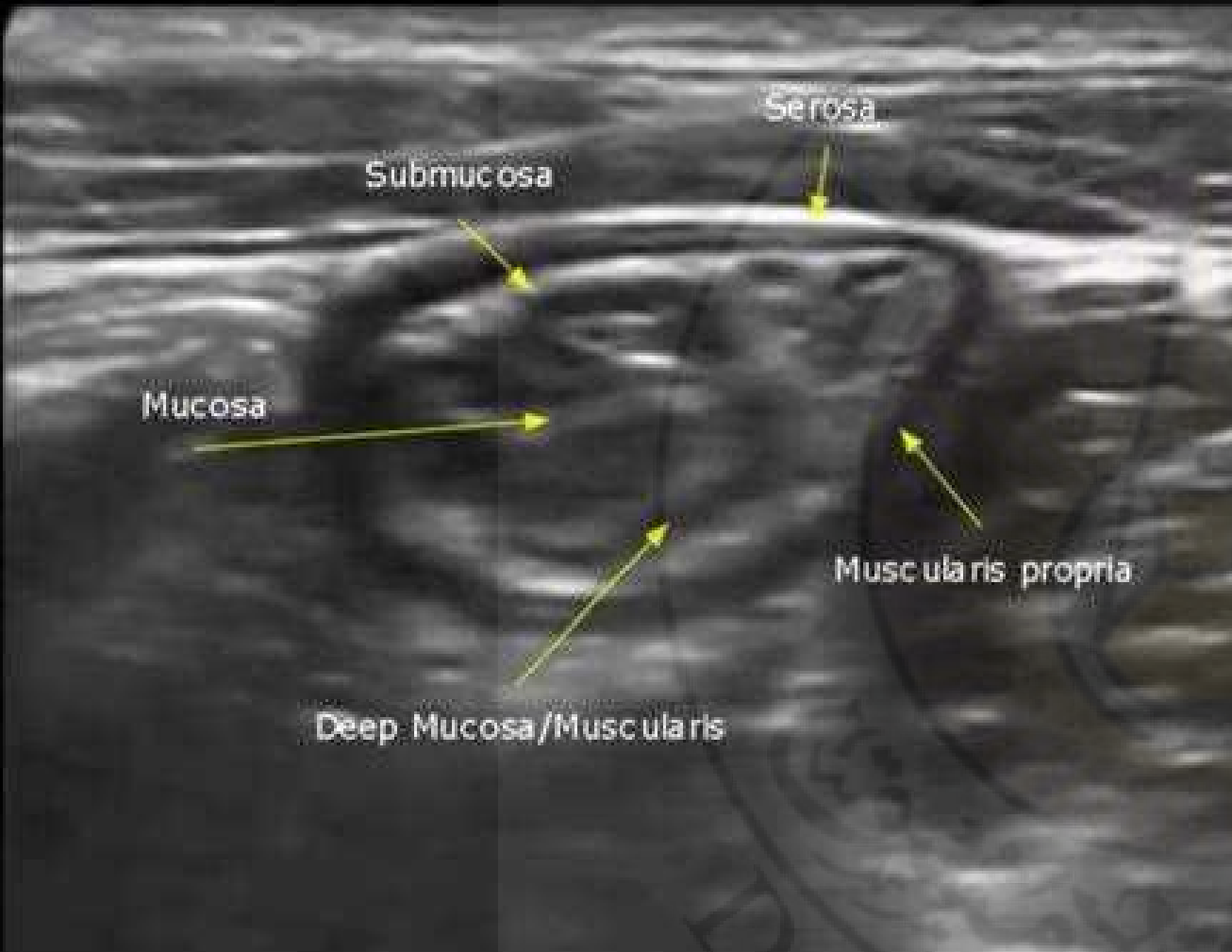
Longitudinal View



Small Bowel Obstruction

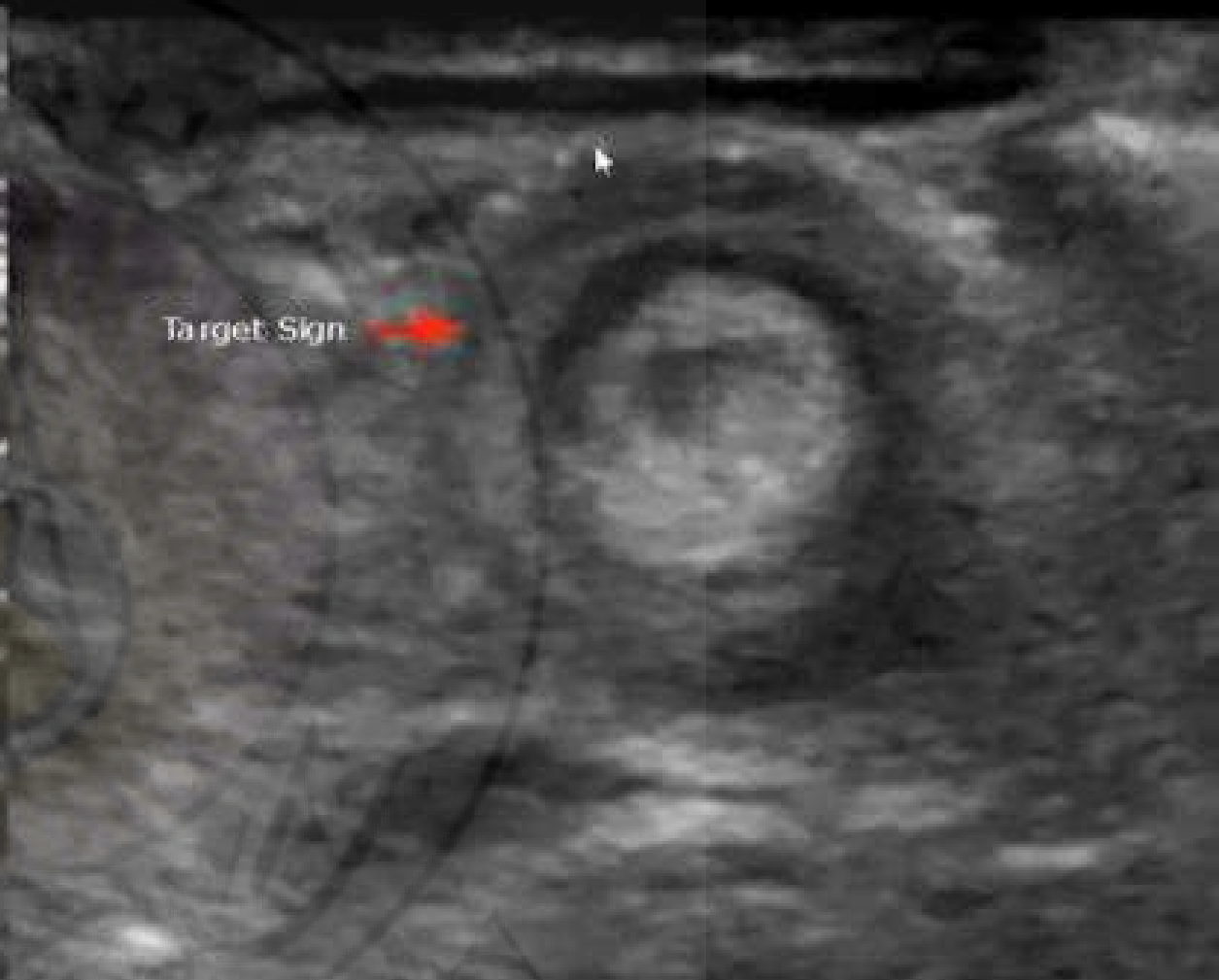
- Extraluminal fluid
- **Tanga Sign:** Triangular shaped appearance of extraluminal free fluid

Transverse View



Normal Bowel

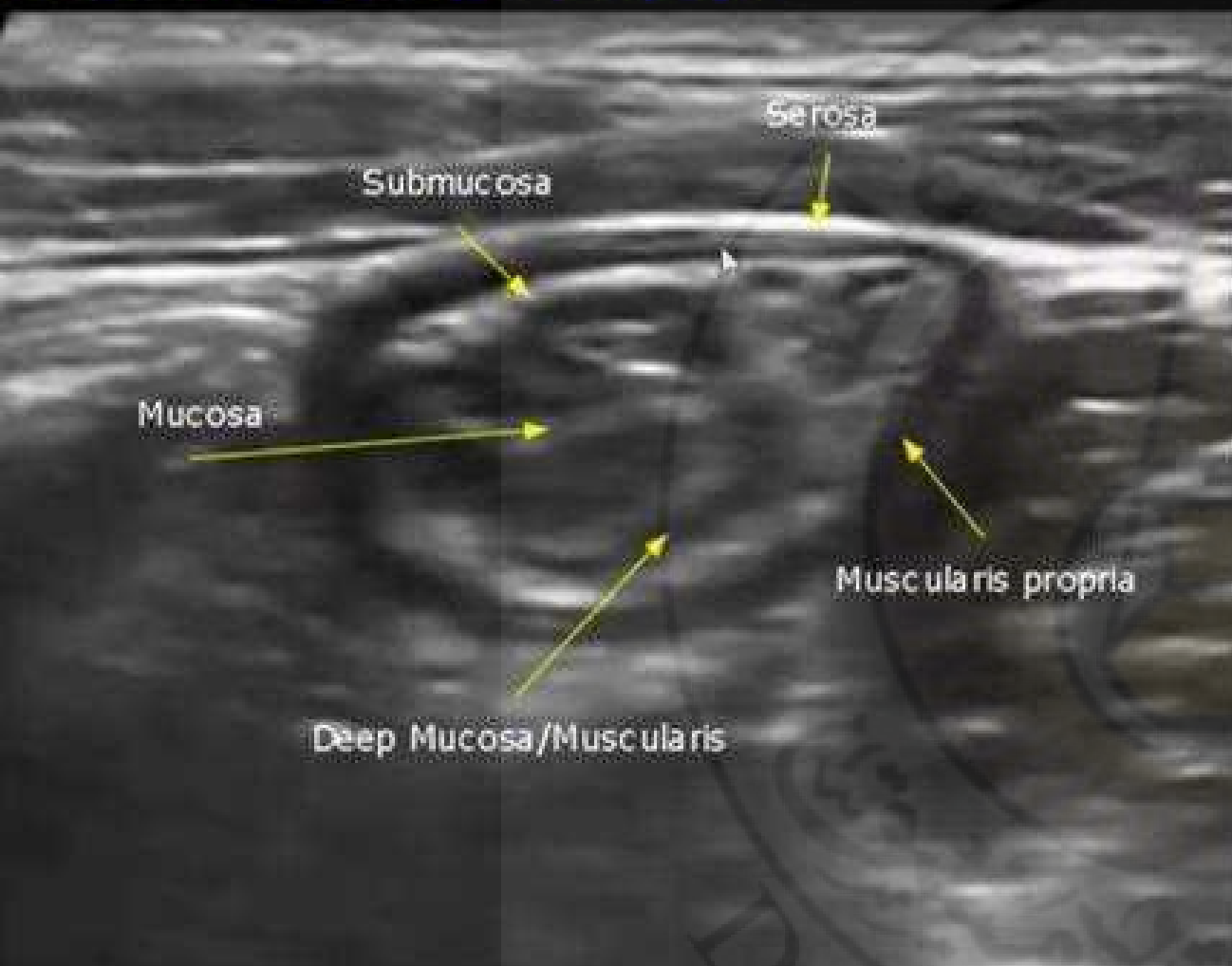
Transverse View



Intussusception

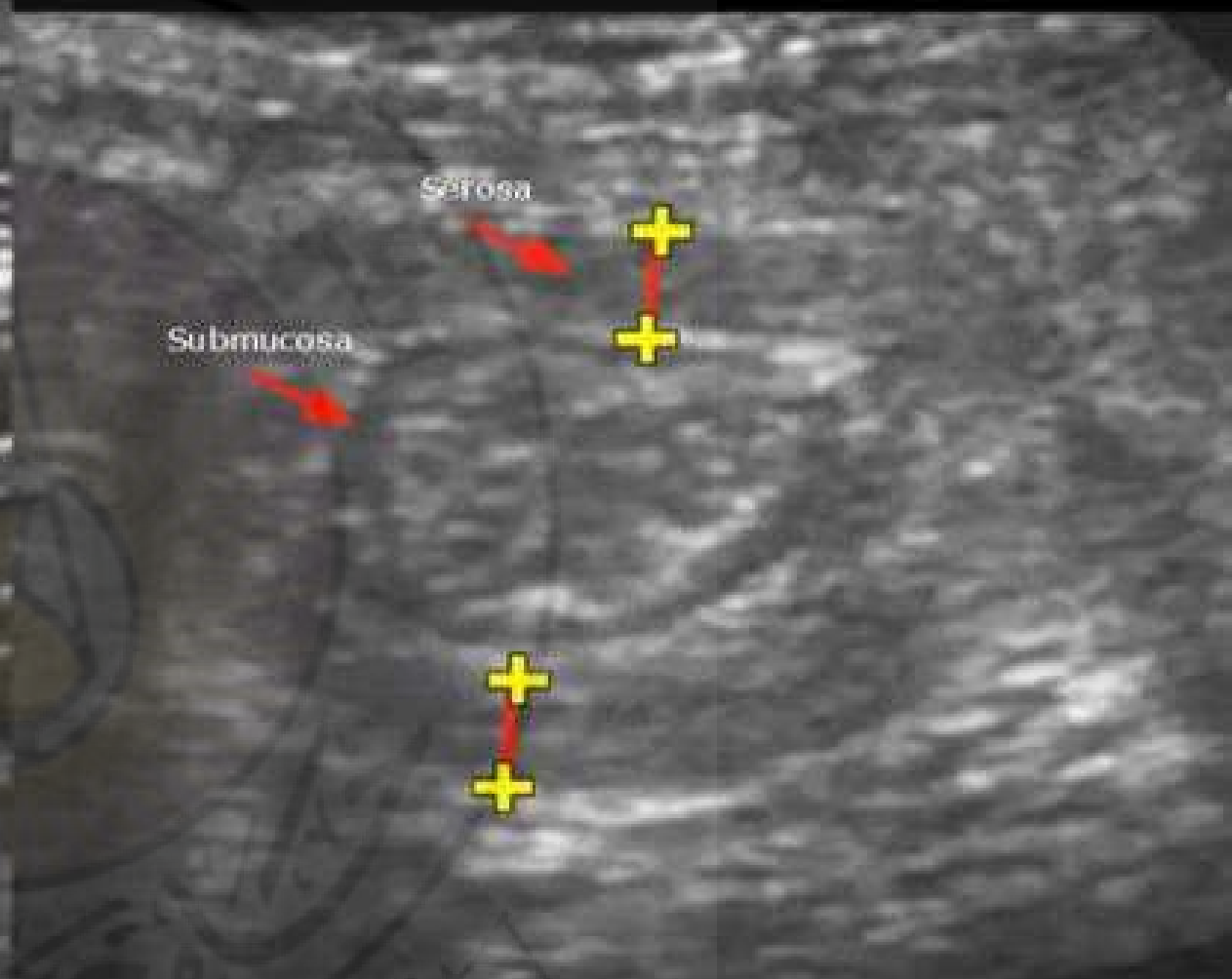
- **Target Sign:** Alternating hyperechoic and hypoechoic bands.

Transverse View



Normal Bowel

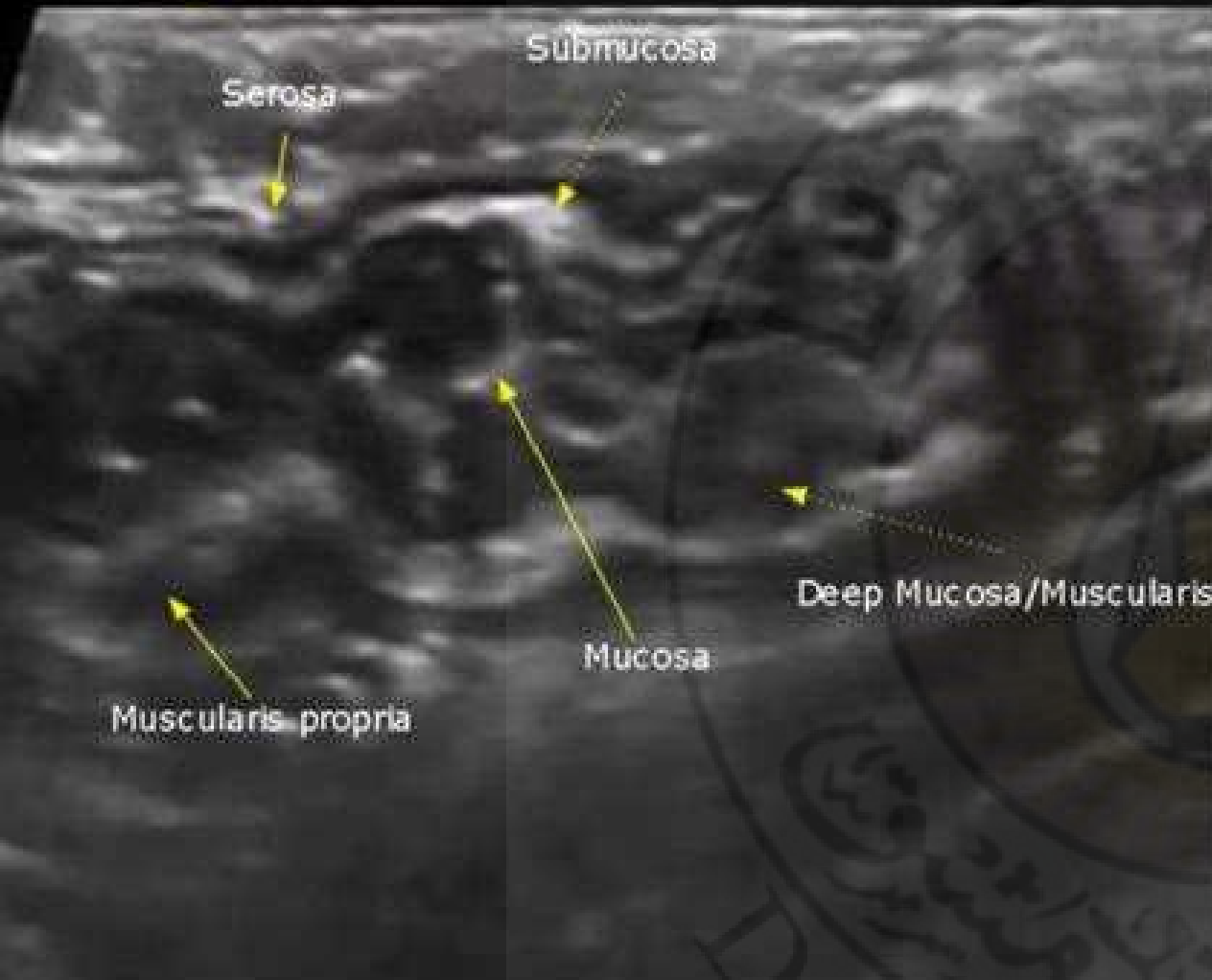
Transverse View



Intussusception

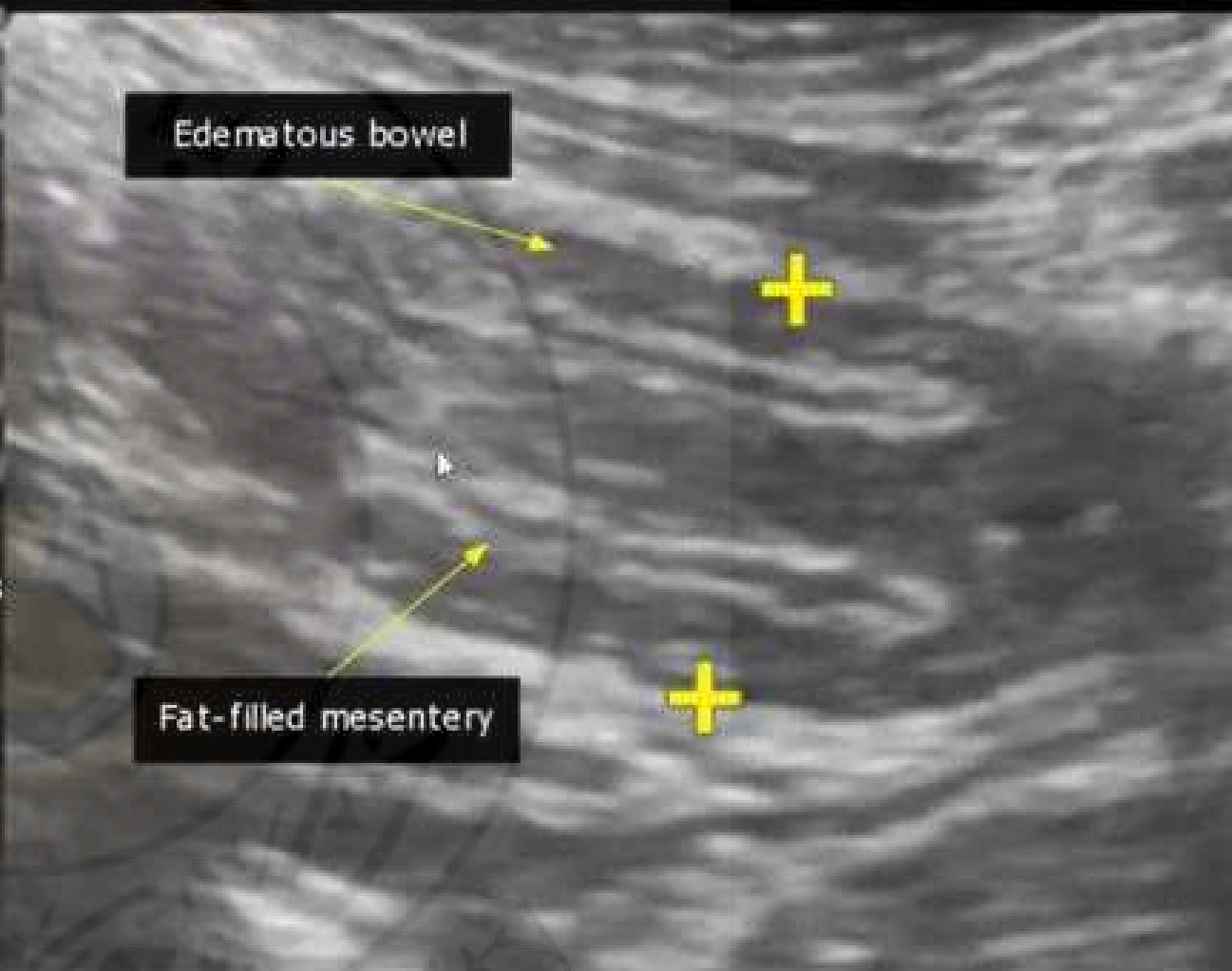
- **Target Sign:** Hyperechoic bands are formed by mucosa and muscularis layers.
- Submucosa is hypoechoic.

Longitudinal View



Normal Bowel

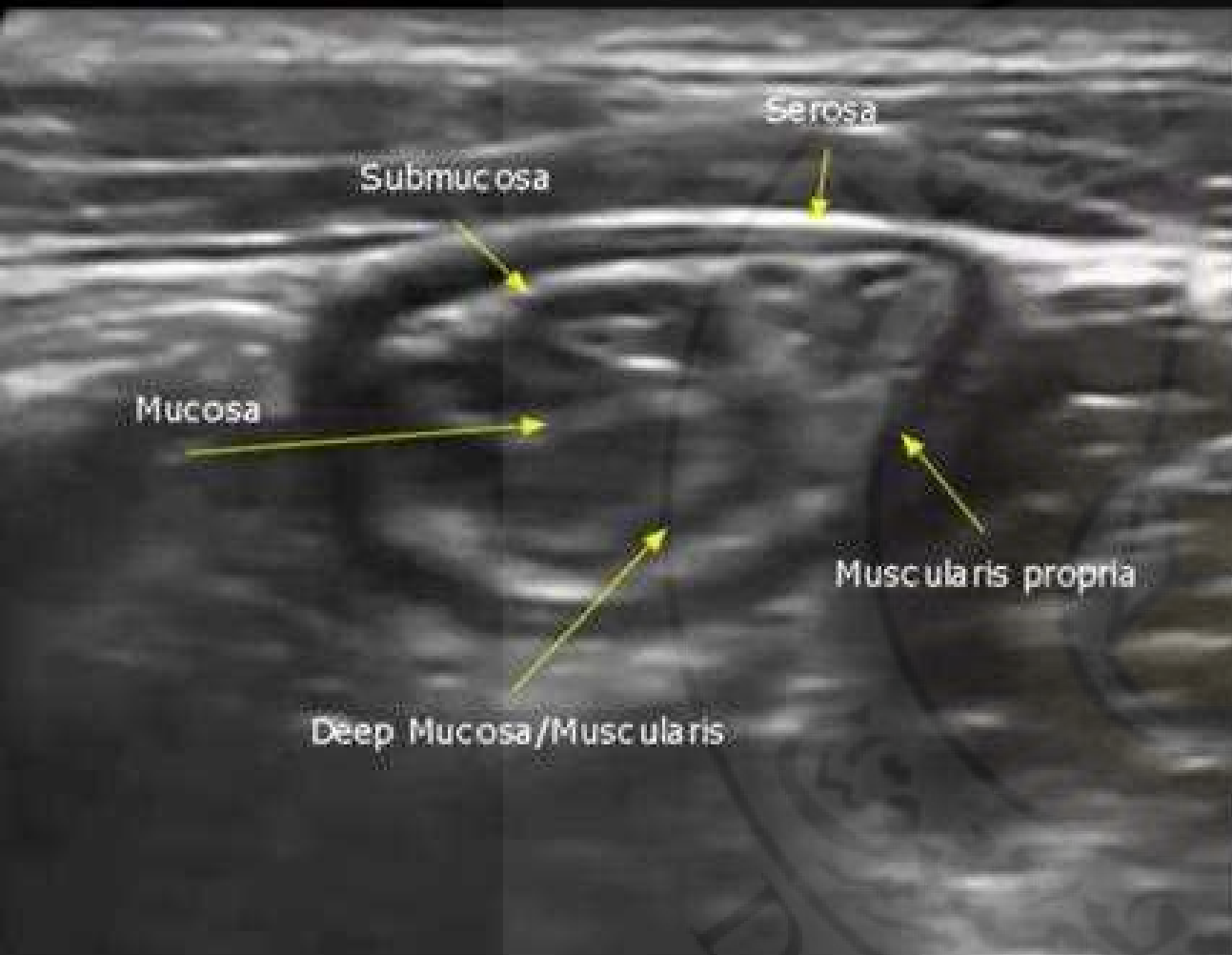
Longitudinal View



Intussusception

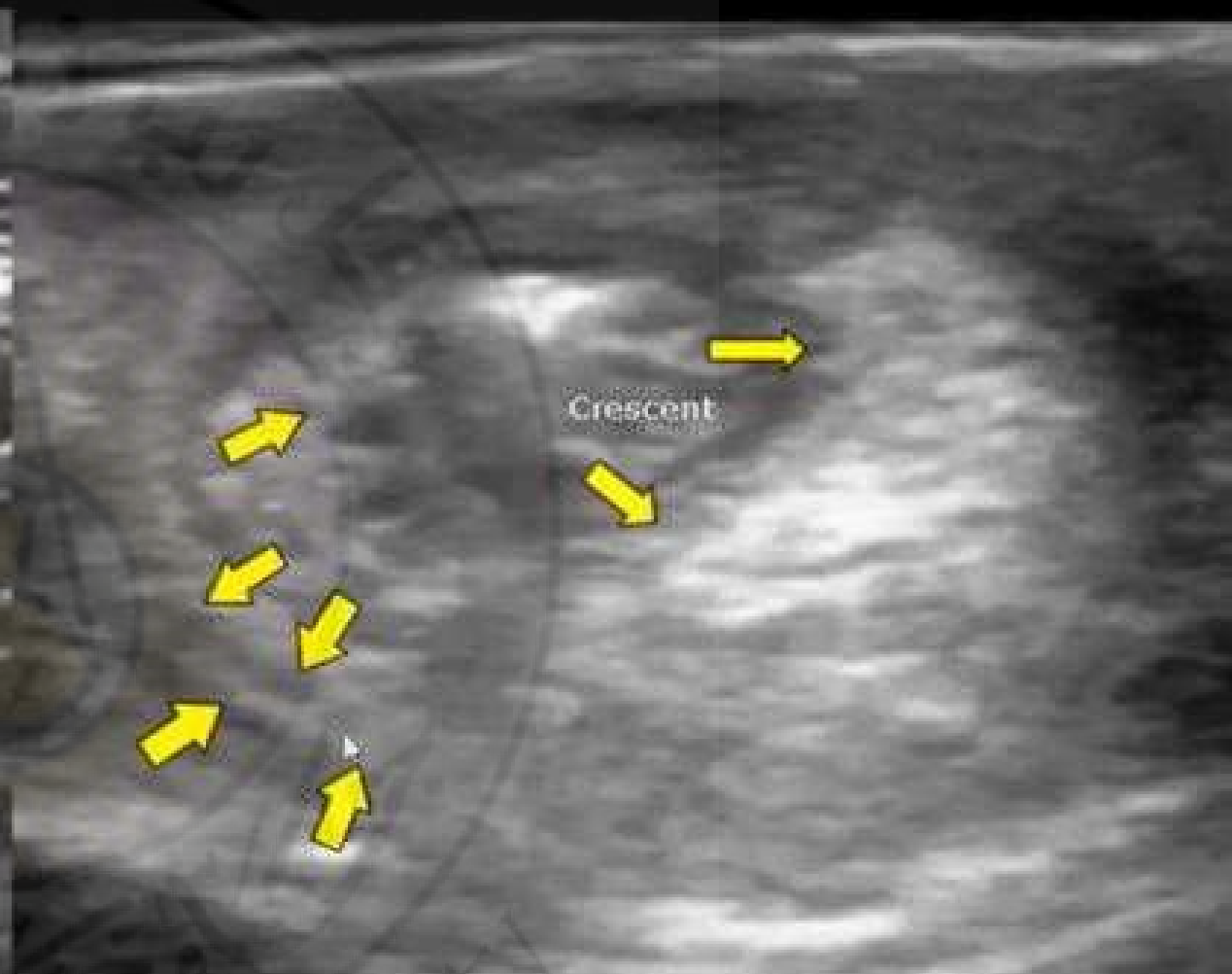
- **Pseudokidney Sign:** Intussuscepted part of bowel mimics a kidney

Transverse View



Normal Bowel

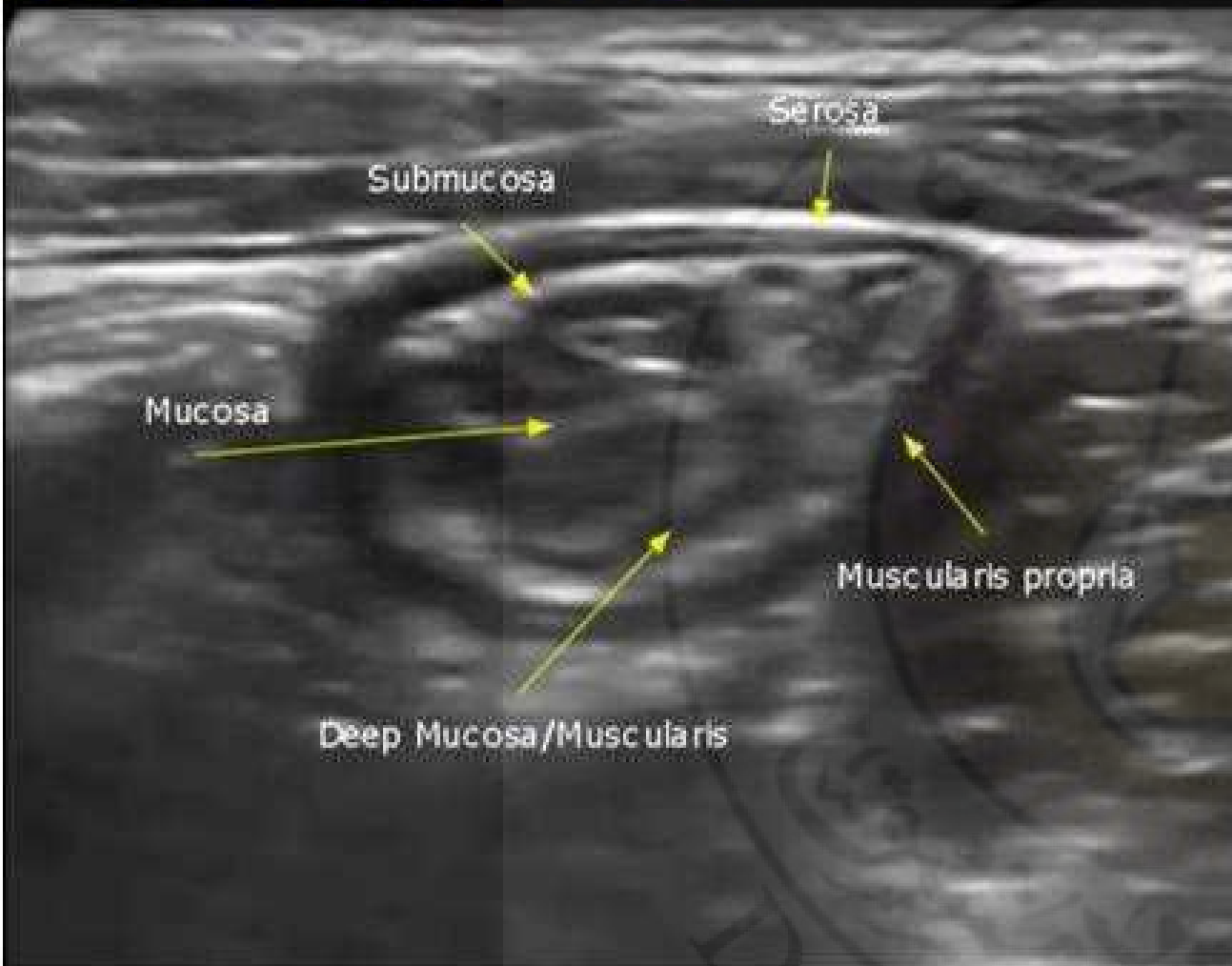
Transverse View



Intussusception

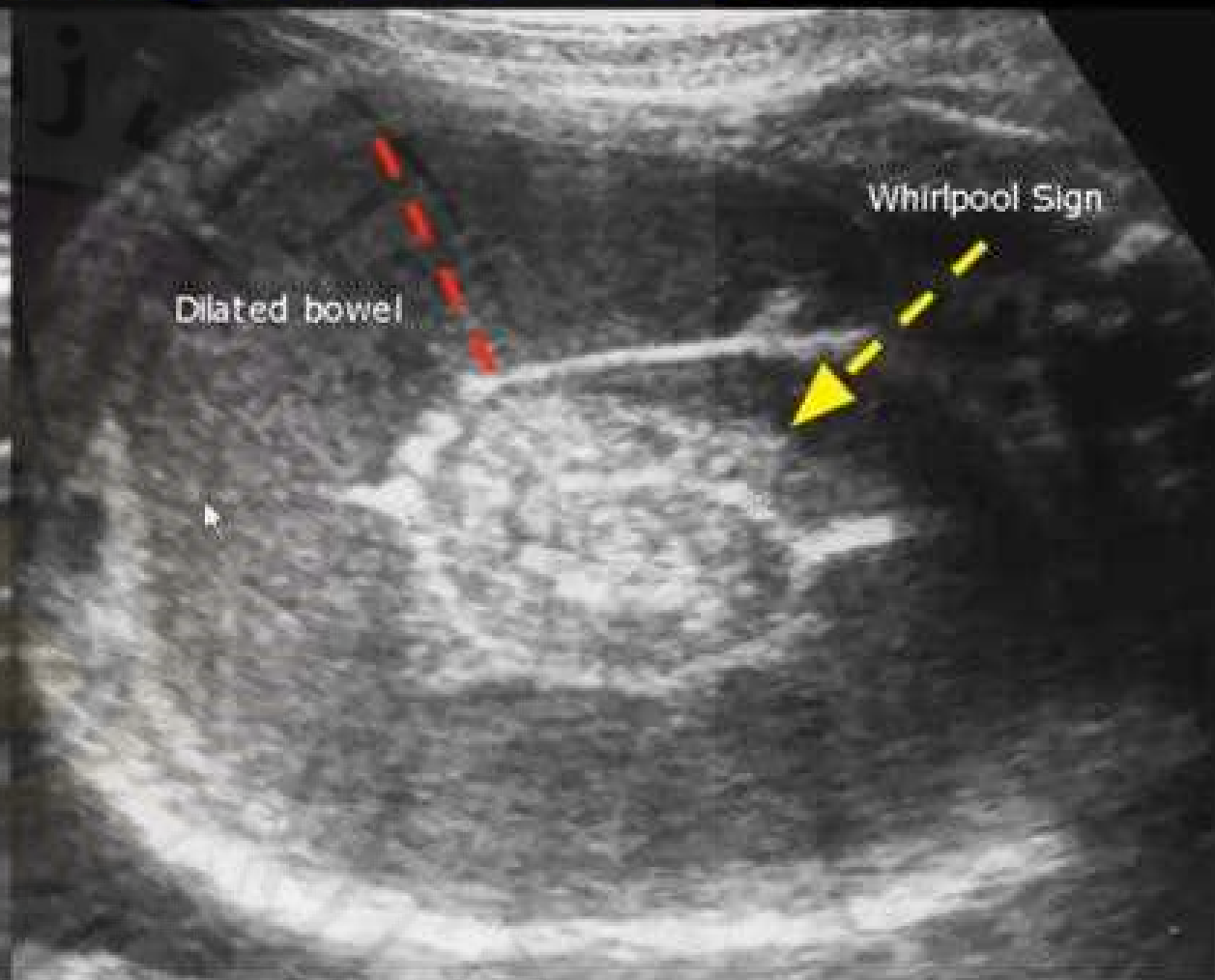
- **Crescent In A Donut Sign:** Alternating hyperechoic and hypoechoic bands followed by a crescentic shaped mesentery.

Transverse View



Normal Bowel

Transverse View



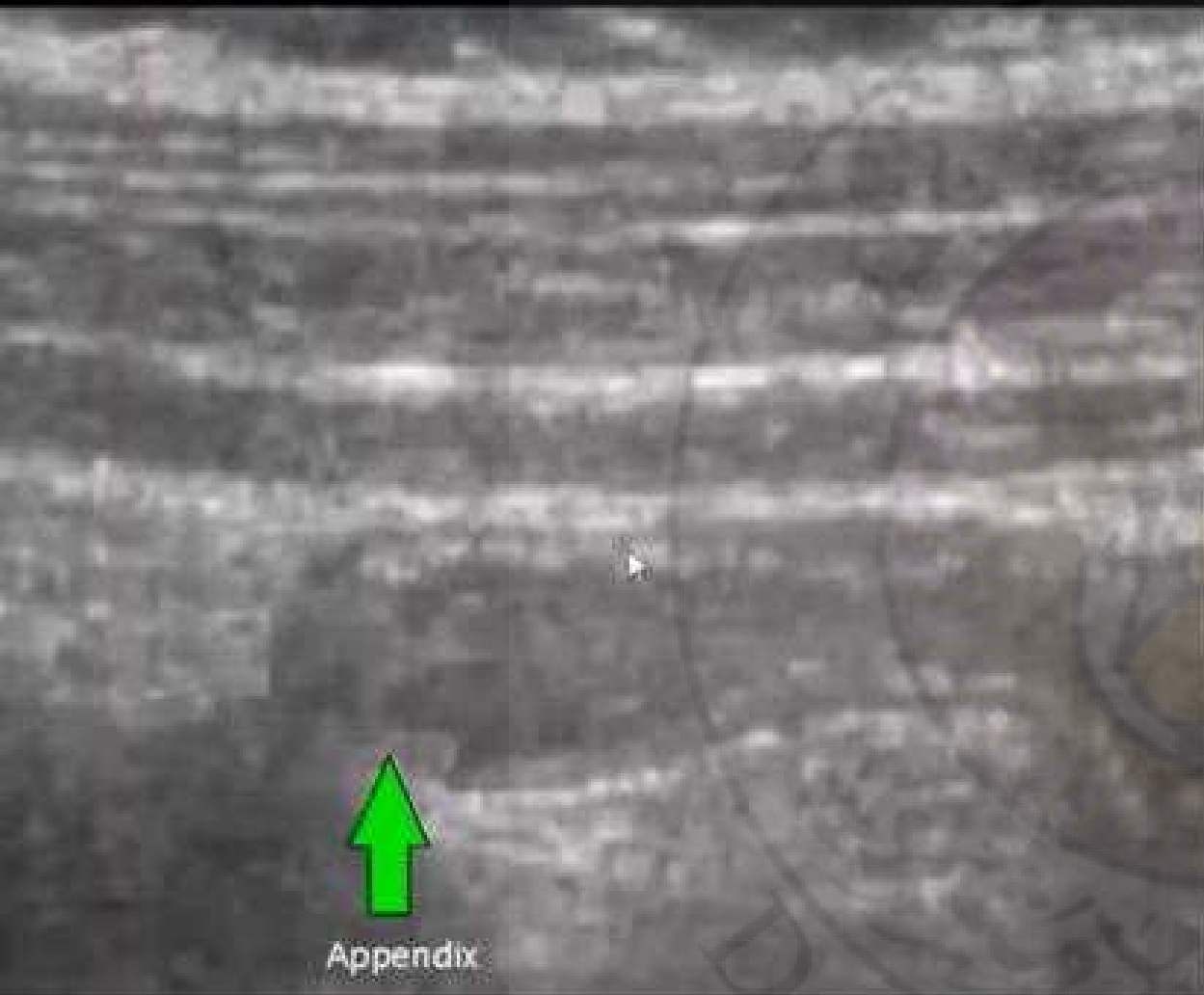
Midgut Volvulus

- Whirlpool Sign
- Dilated duodenum
- Thickened bowel walls

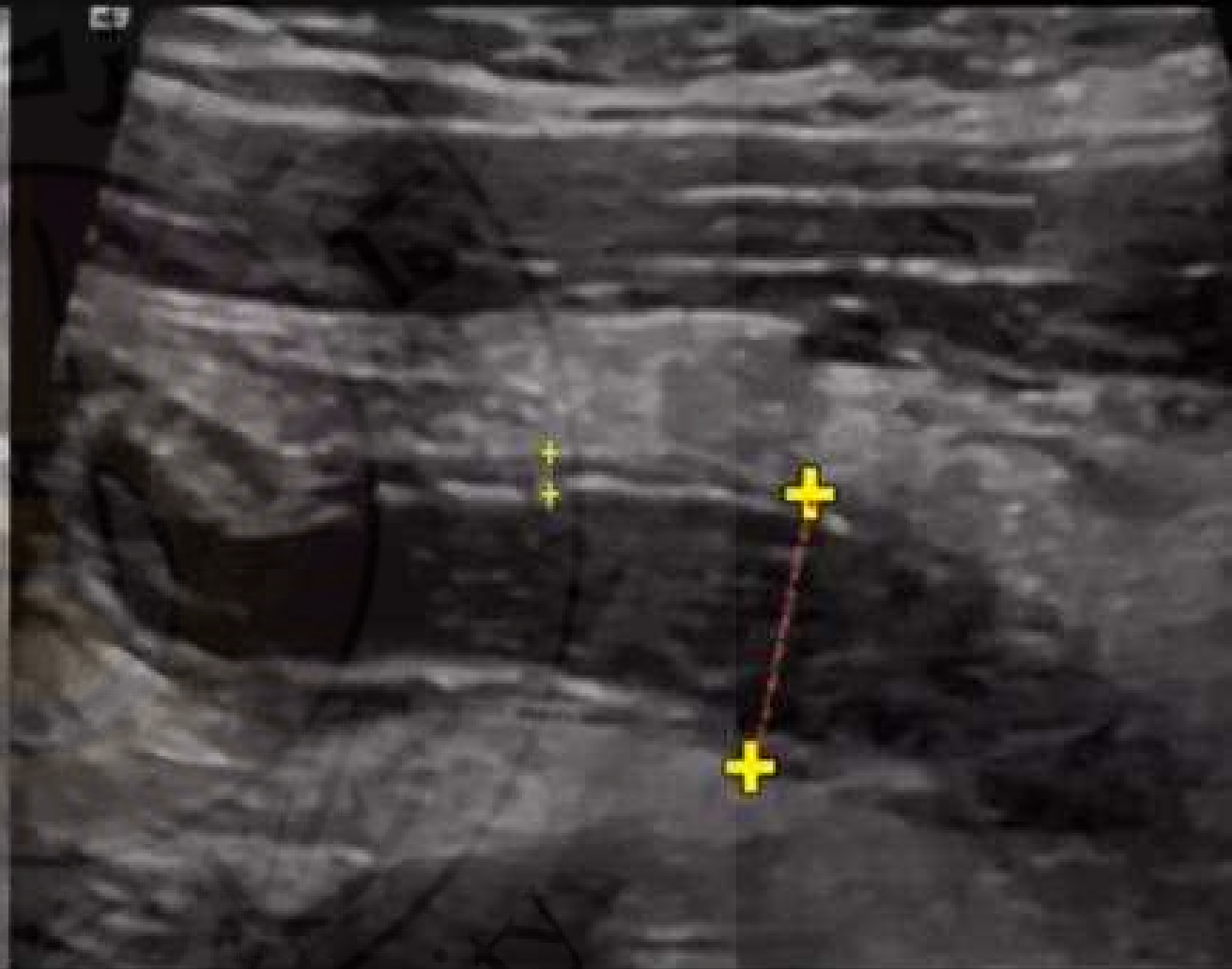


Appendix Ultrasound Normal Vs Abnormal Image Appearances Comparison

Longitudinal View



Longitudinal View



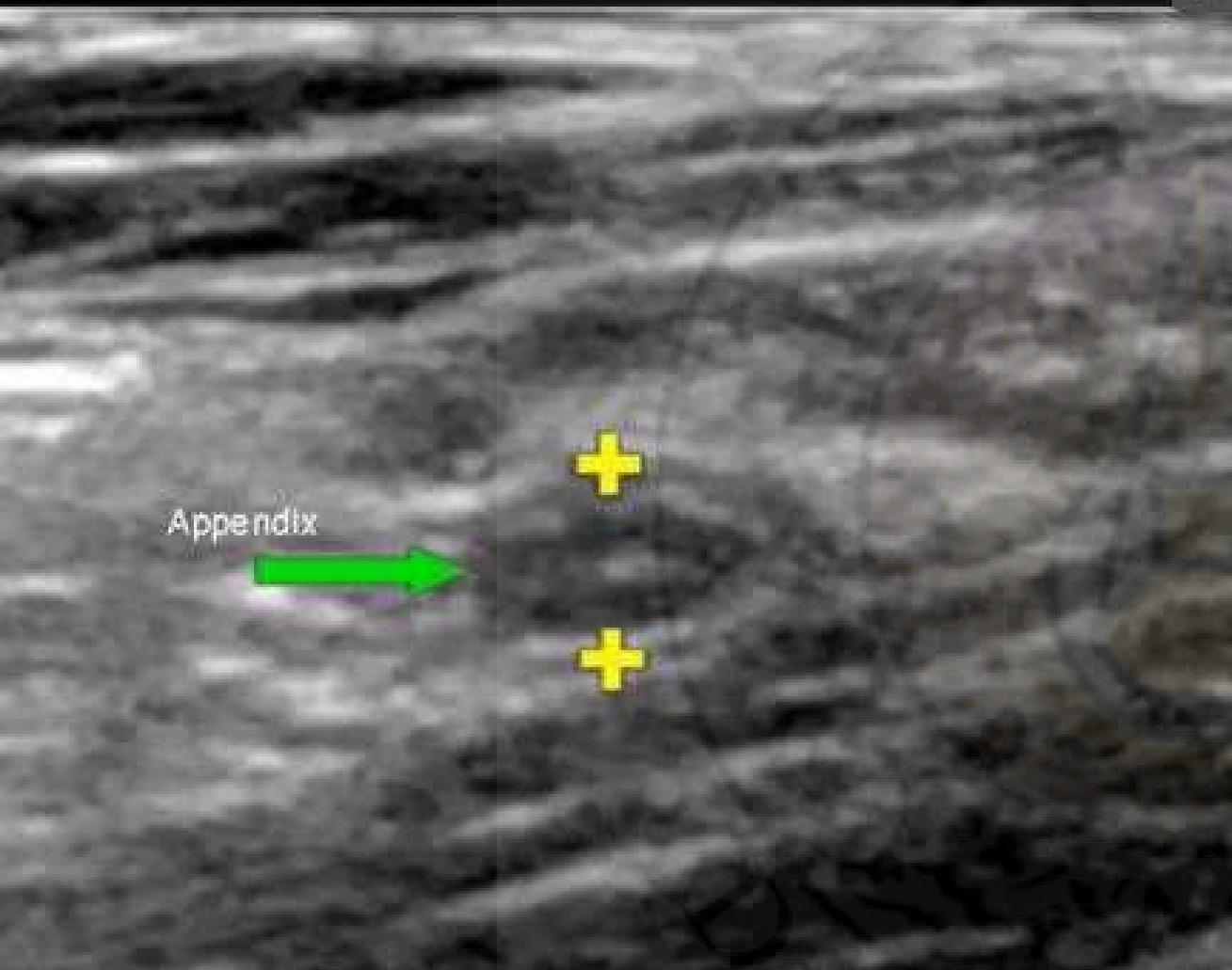
Normal Appendix

- Diameter: $<6\text{mm}$
- Tube-shaped

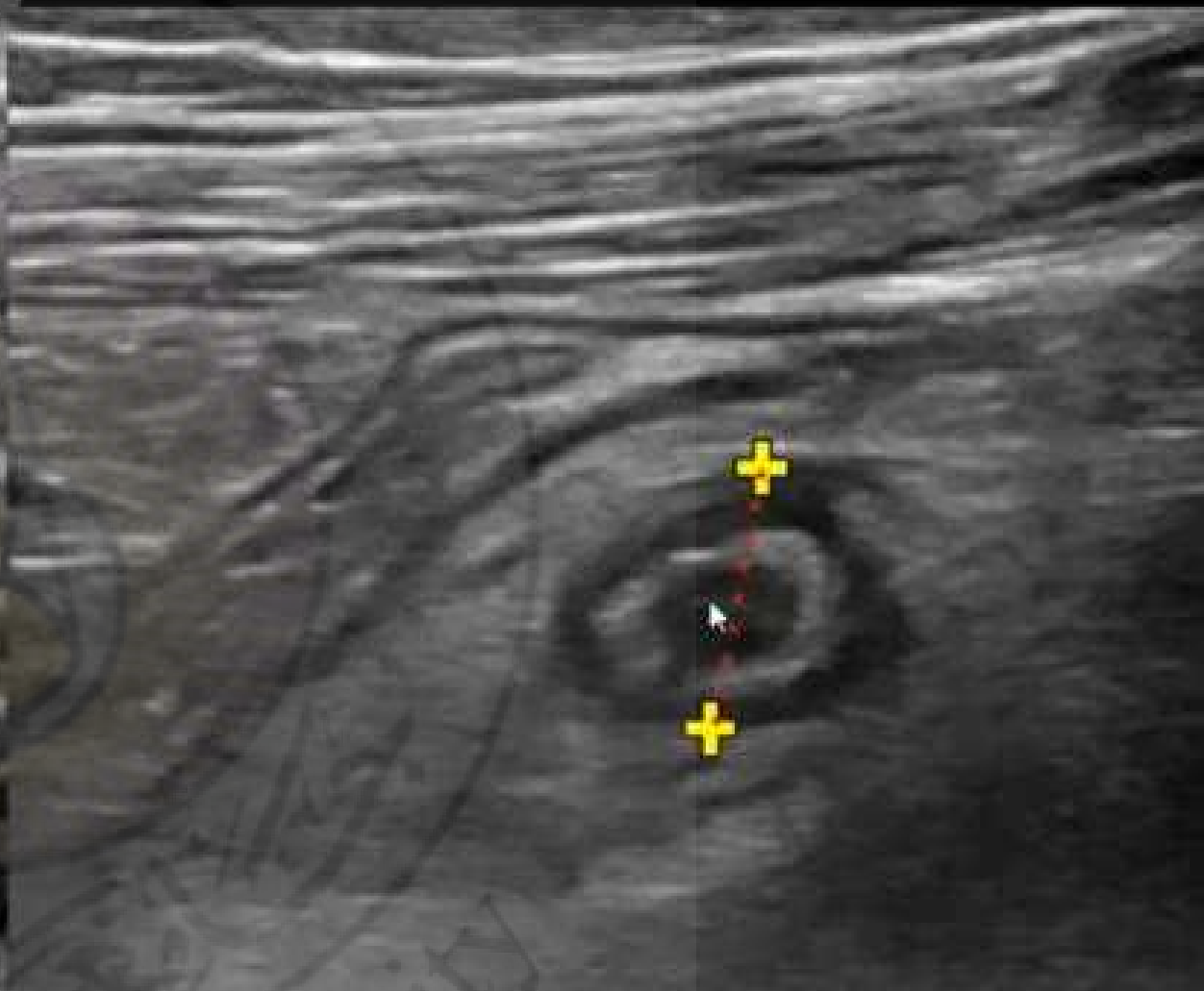
Appendicitis

- Dilated appendix
- Diameter $>6\text{mm}$
- Wall thickness $>3\text{mm}$

Transverse View



Transverse View



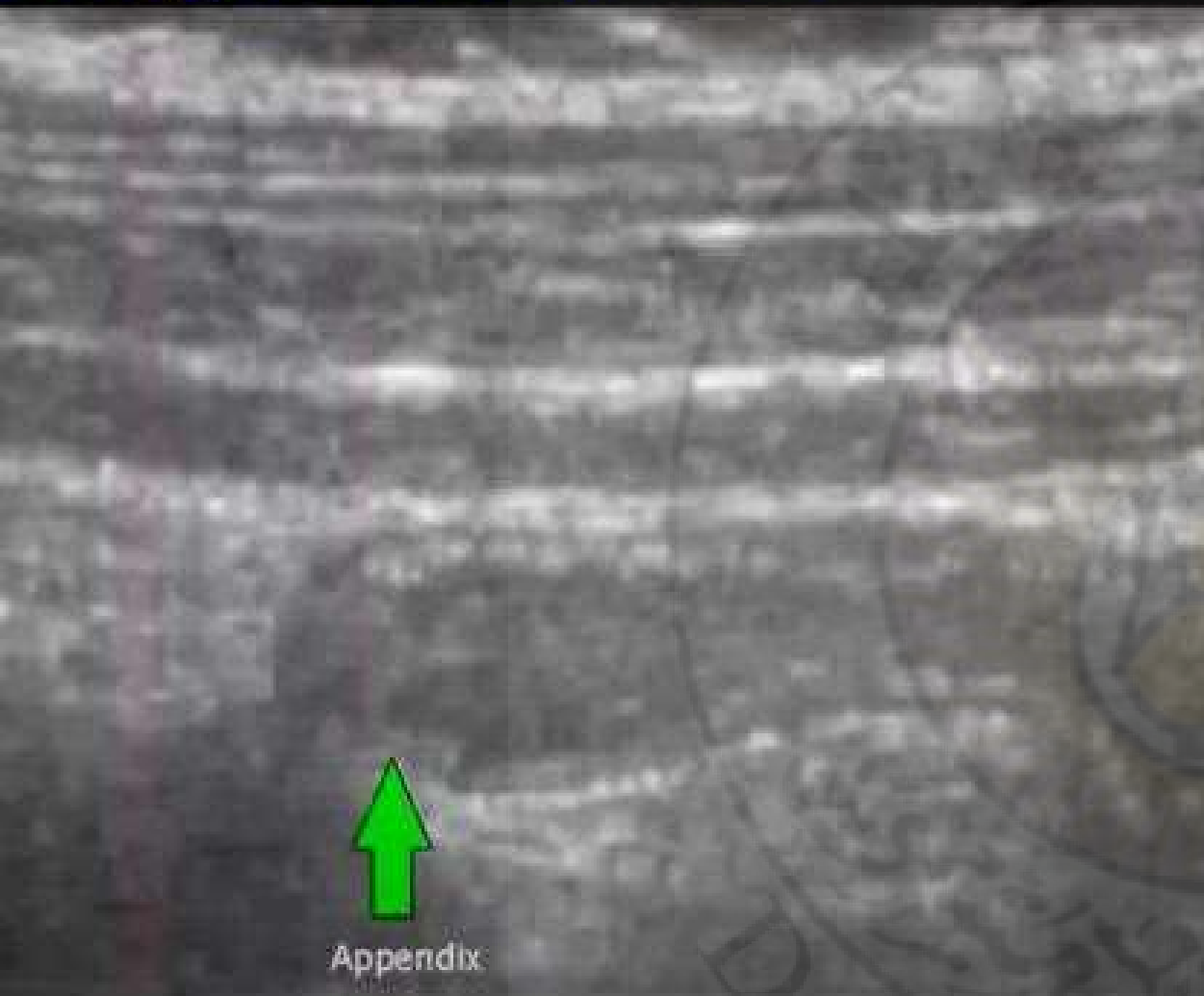
Normal Appendix

- Diameter: $< 6\text{mm}$
- Tube-shaped

Appendicitis

- Dilated appendix
- Diameter $> 6\text{mm}$
- Wall thickness $> 3\text{mm}$

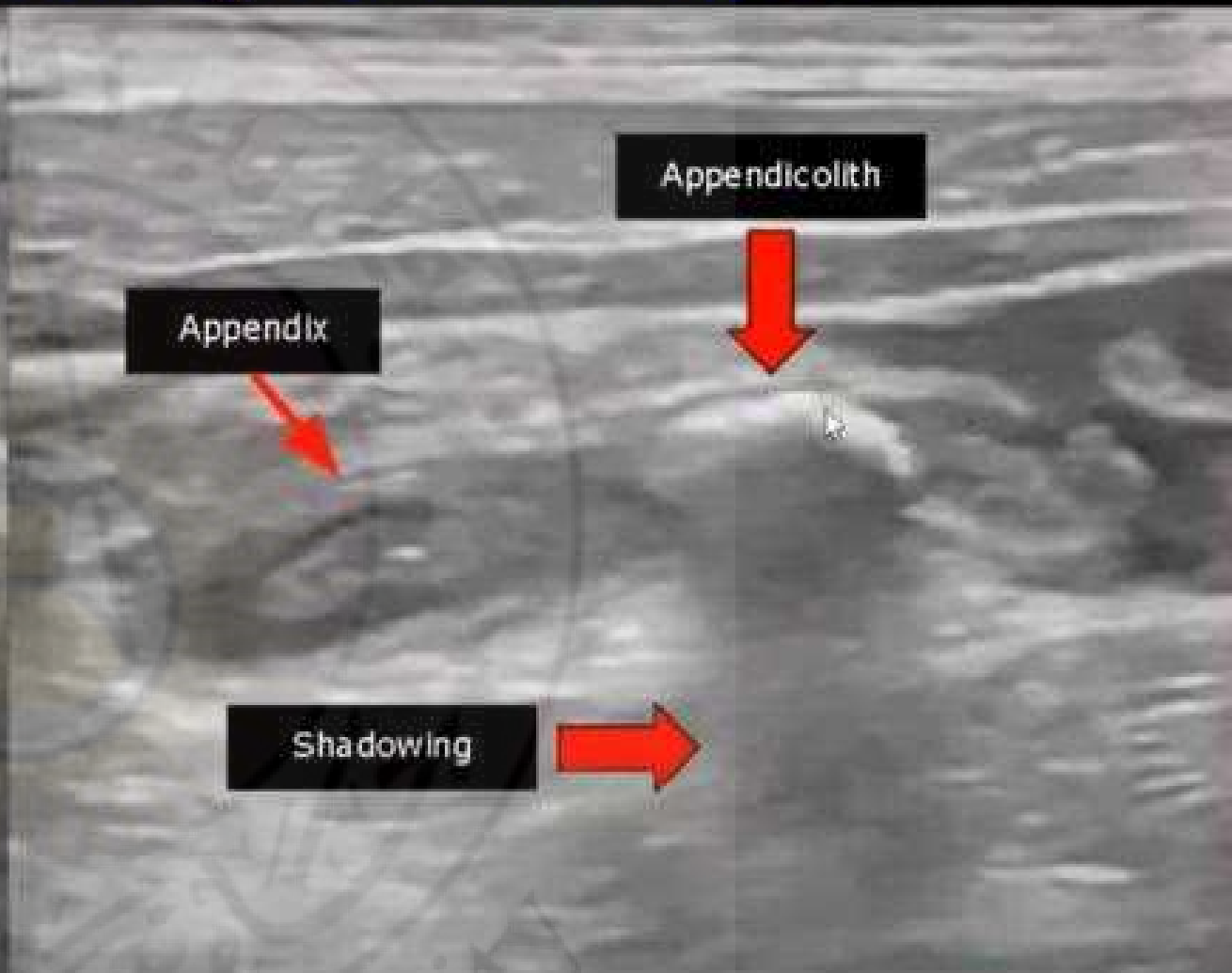
Longitudinal View



Normal Appendix

- Diameter: $<6\text{mm}$
- Tube-shaped

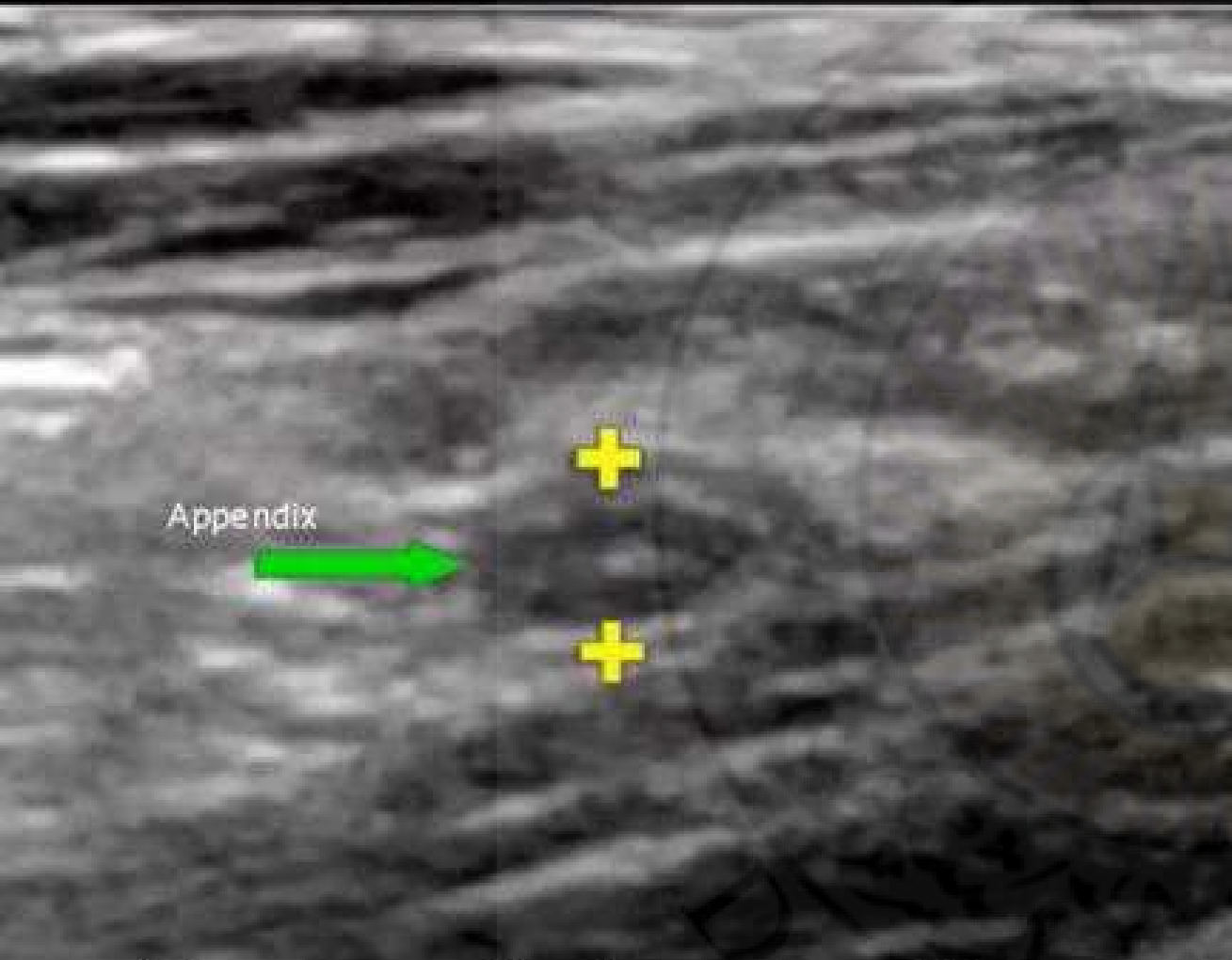
Longitudinal View



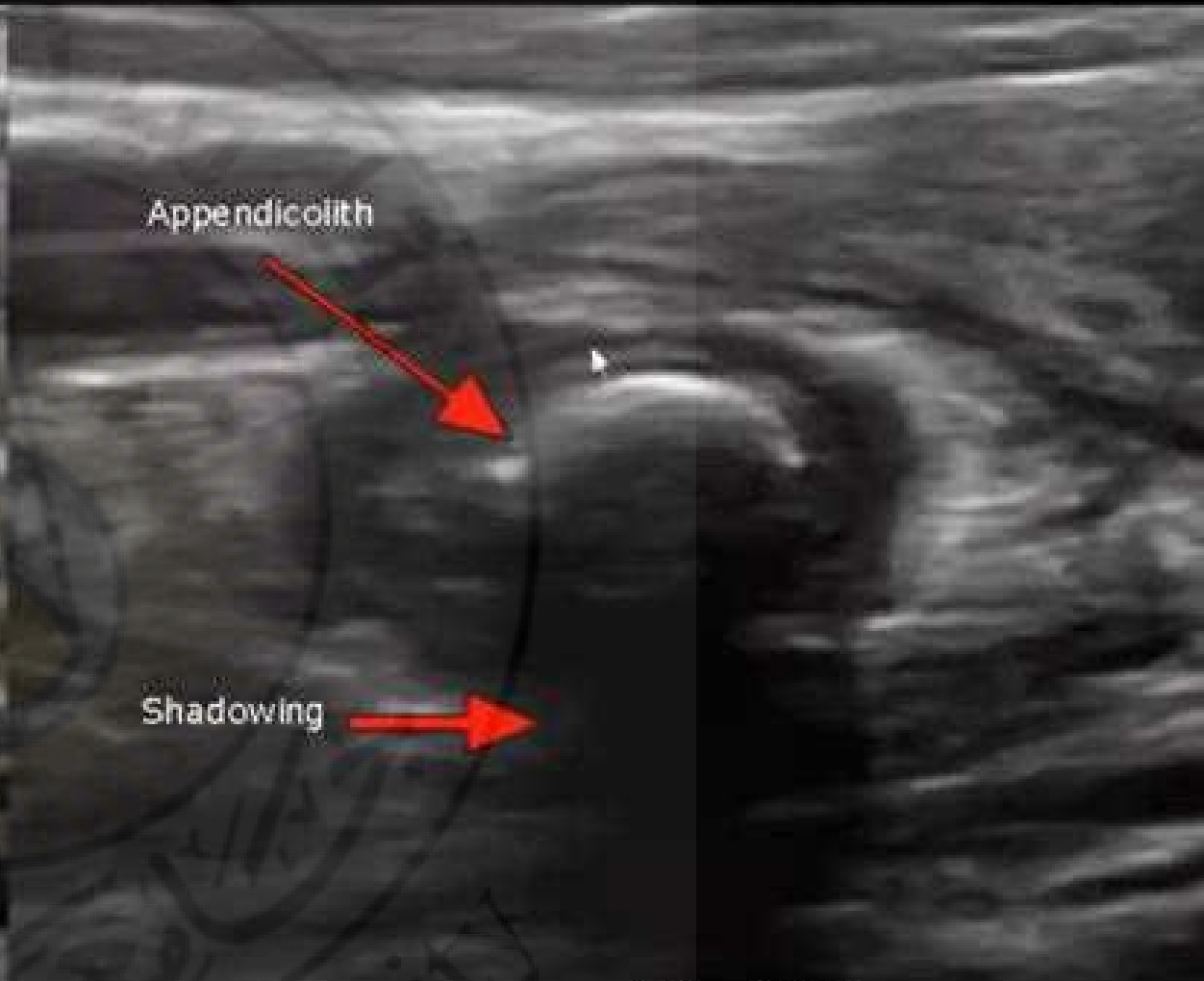
Appendicitis

- Appendicolith: Hyperechoic calcification with posterior shadowing

Transverse View



Transverse View



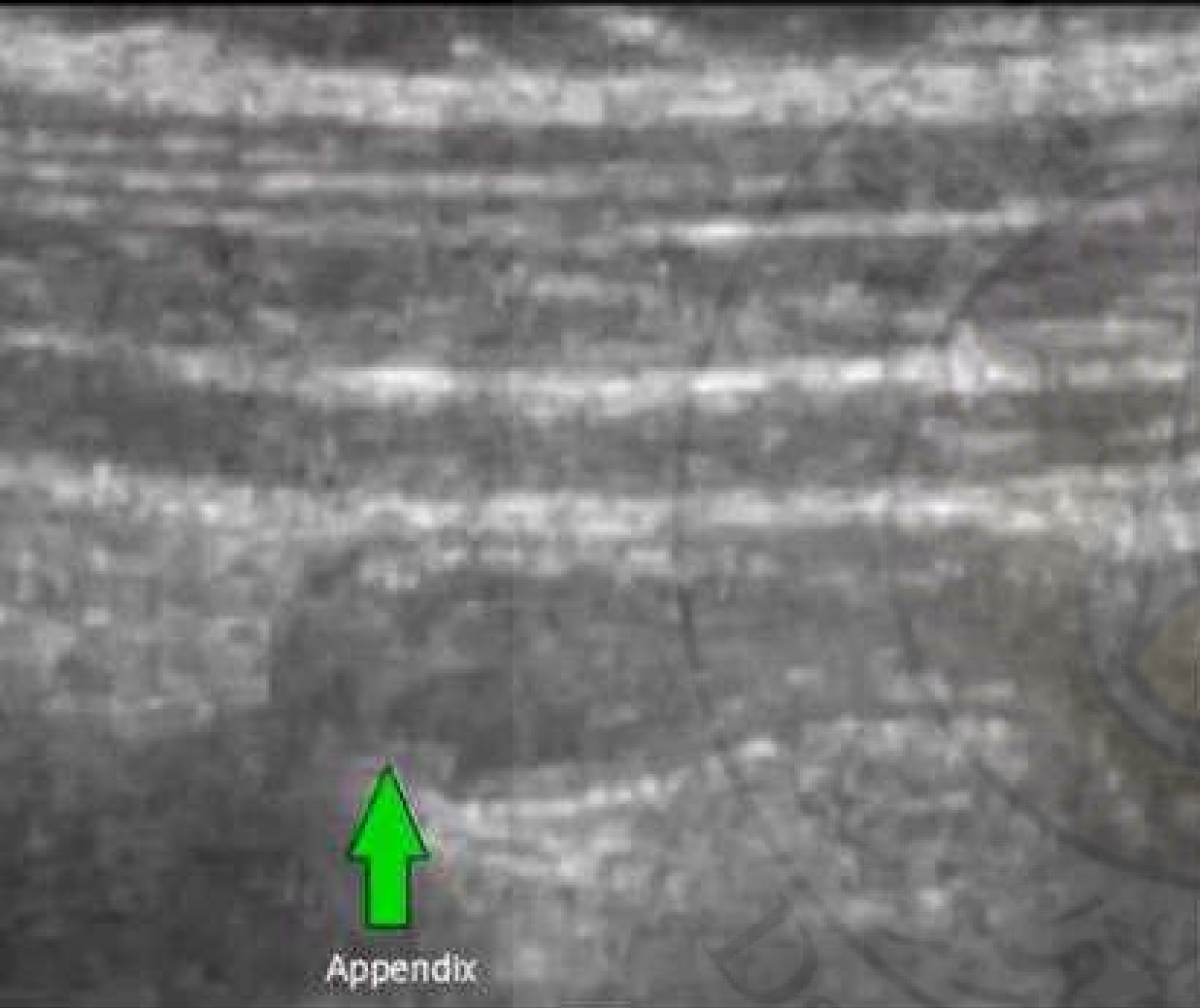
Normal Appendix

- Diameter: $<6\text{mm}$
- Tube-shaped

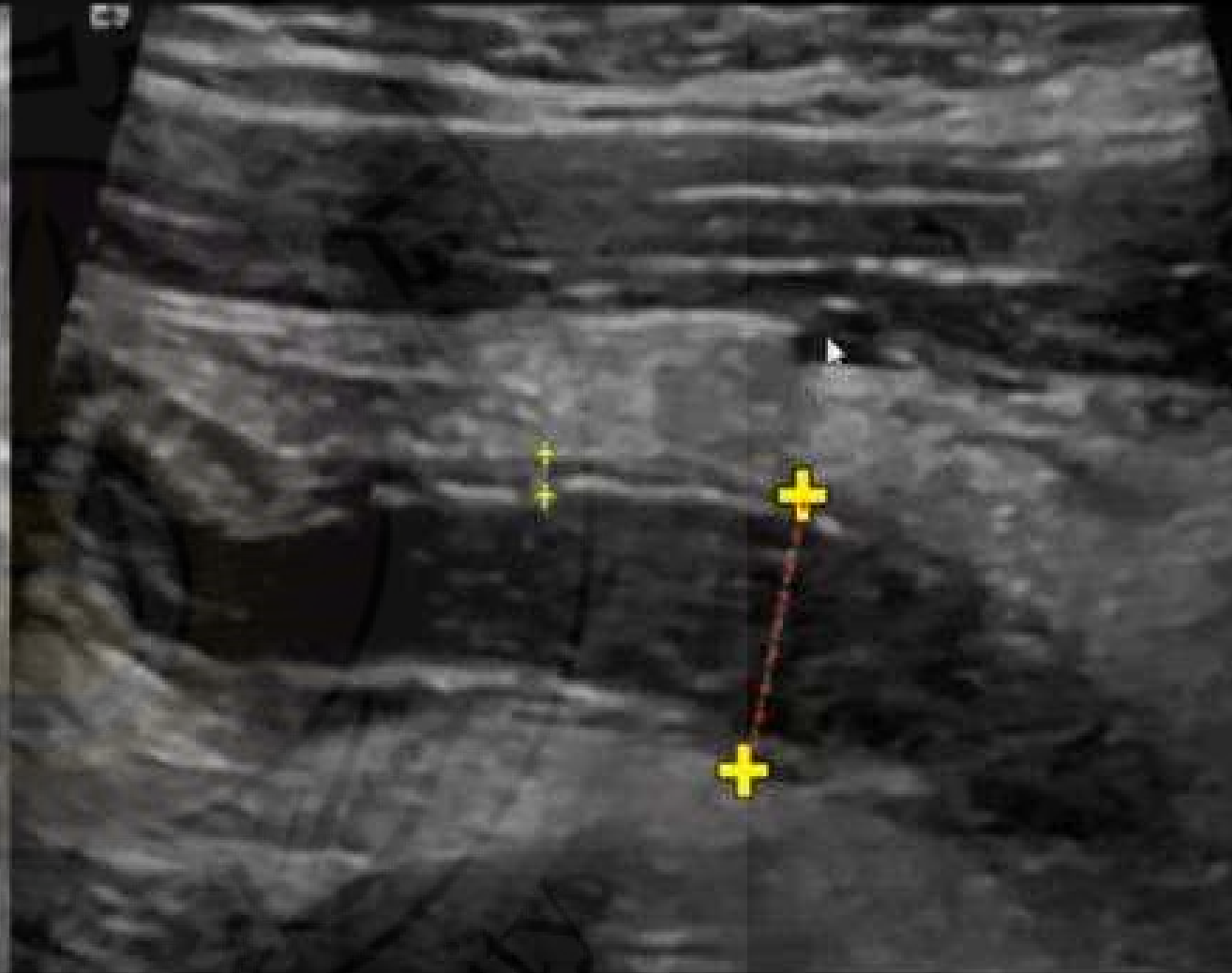
Appendicitis

- Appendicolith: Hyperechoic calcification with posterior shadowing

Longitudinal View



Longitudinal View



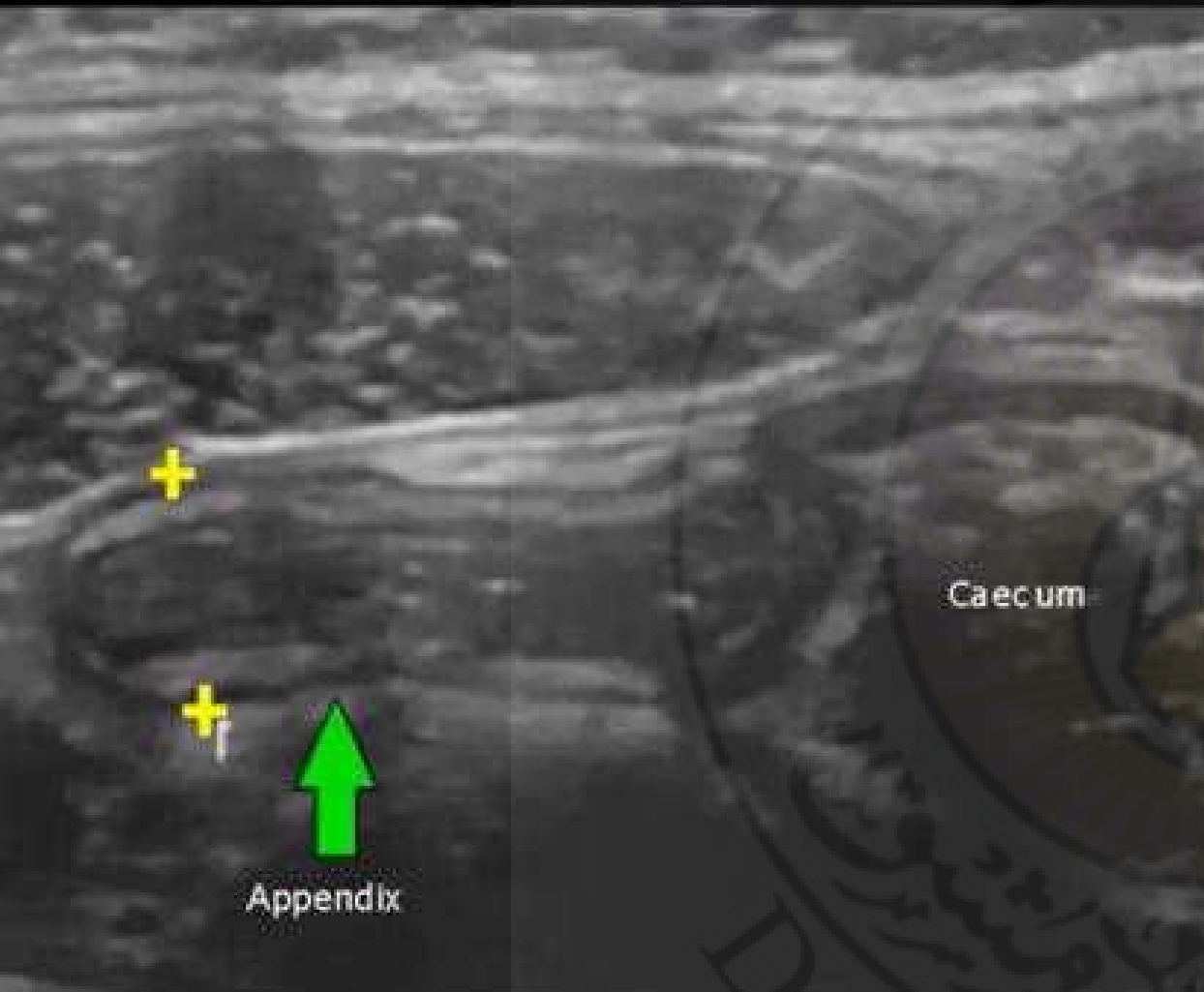
Normal Appendix

- Diameter: $<6\text{mm}$
- Tube-shaped

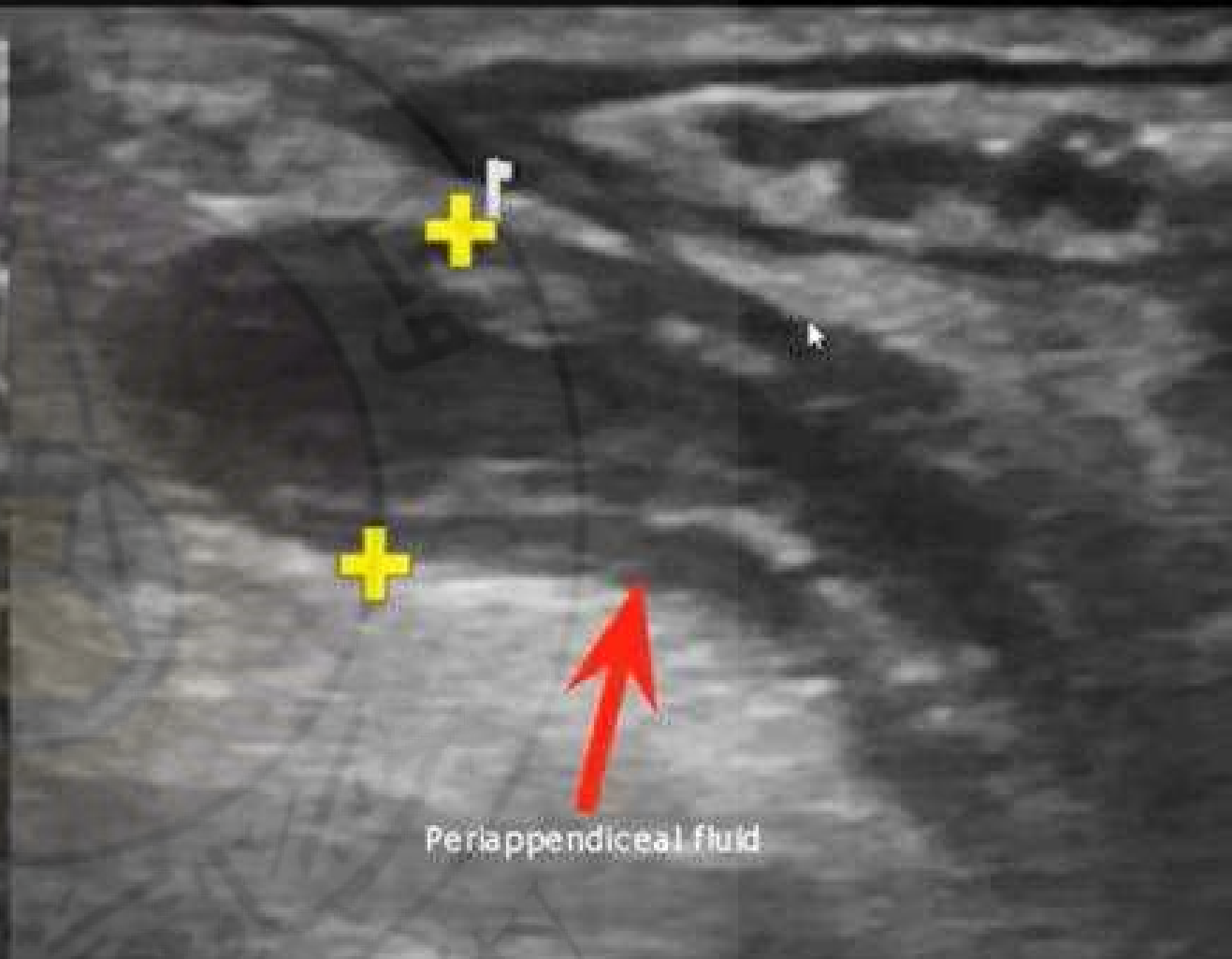
Appendicitis

- Hyperechoic periappendiceal fat

Longitudinal View



Longitudinal View



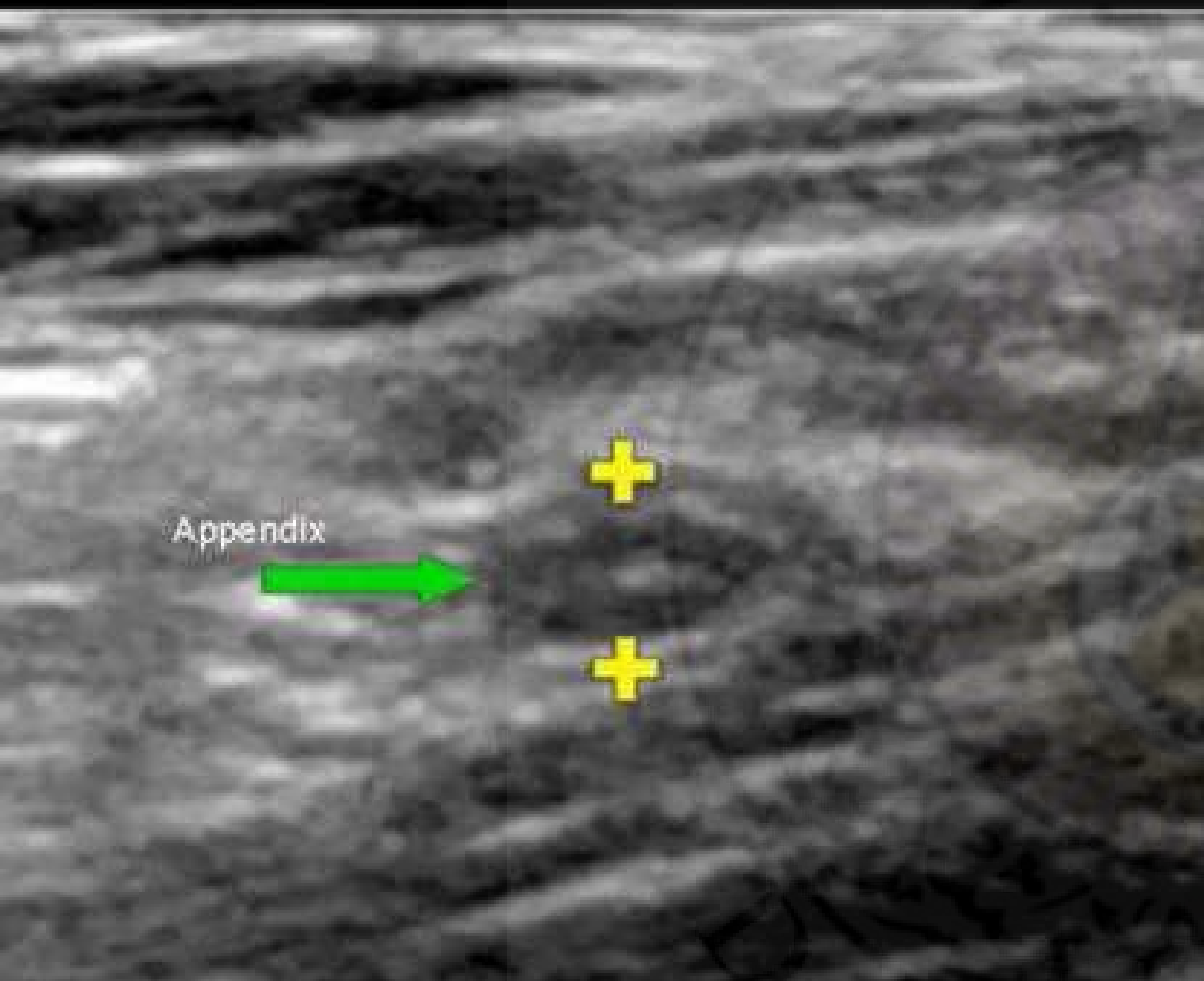
Normal Appendix

- Diameter: $<6\text{mm}$
- Tube-shaped

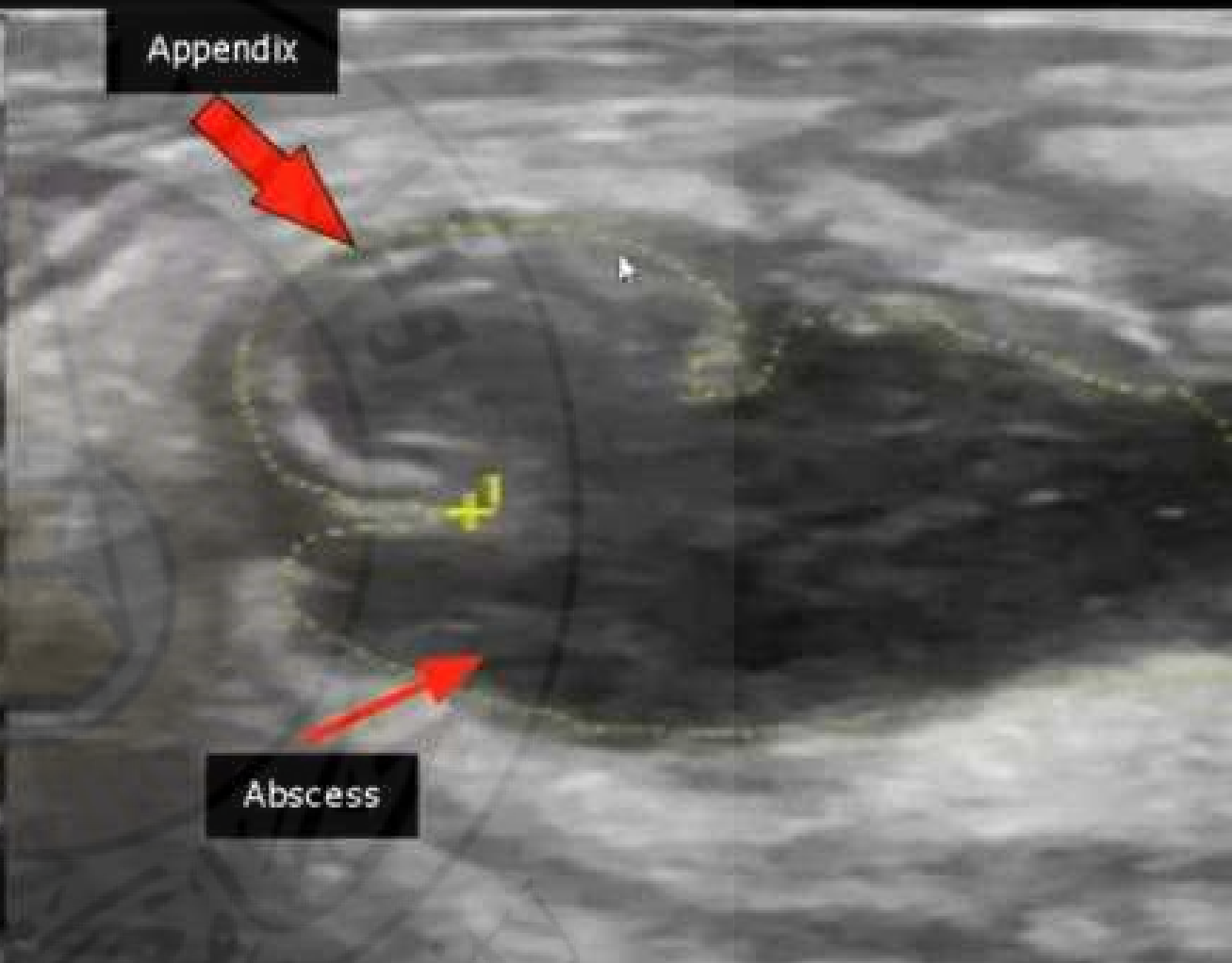
Appendicitis

- Periappendiceal fluid

Transverse View



Transverse View



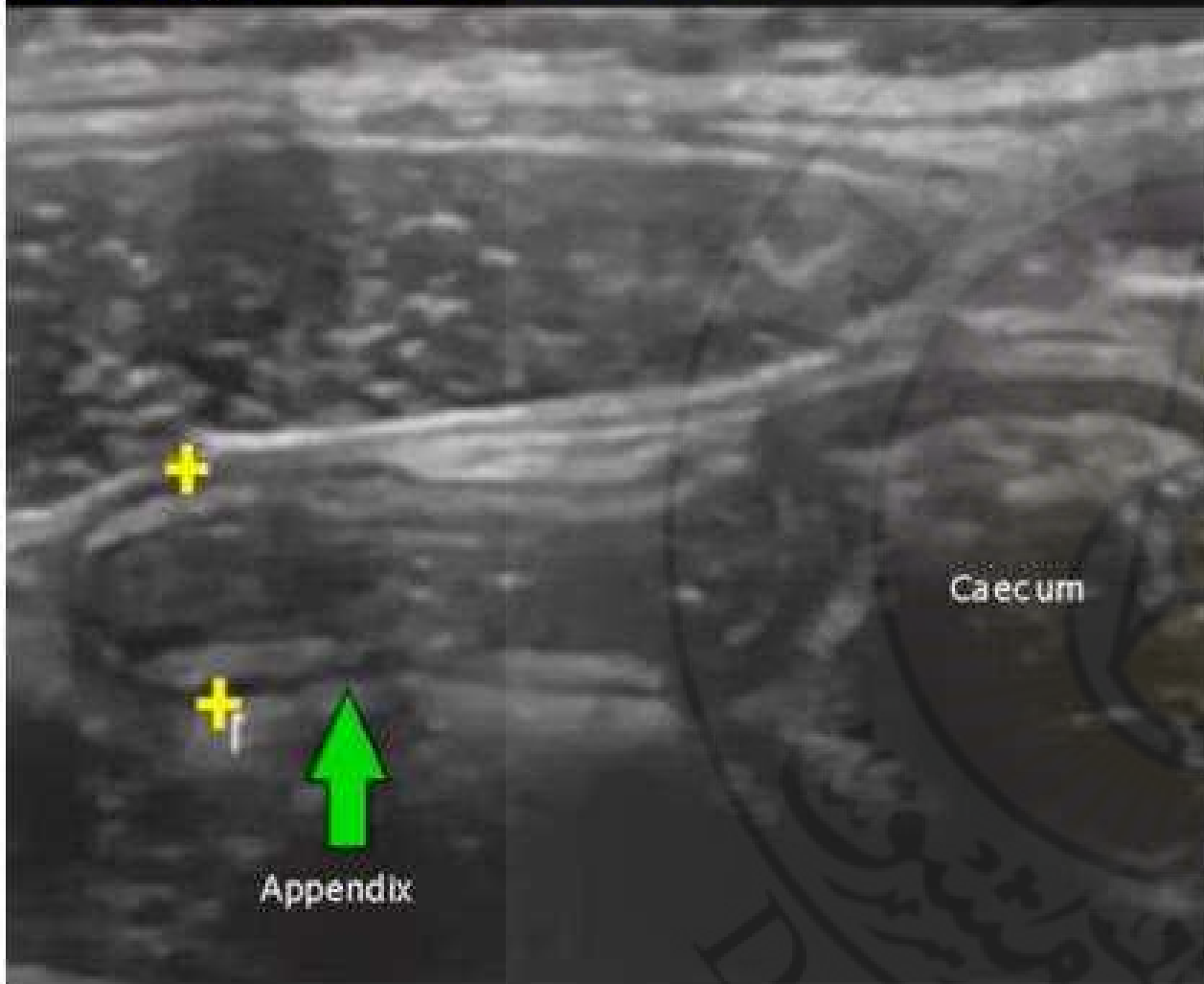
Normal Appendix

- Diameter: $<6\text{mm}$
- Tube-shaped

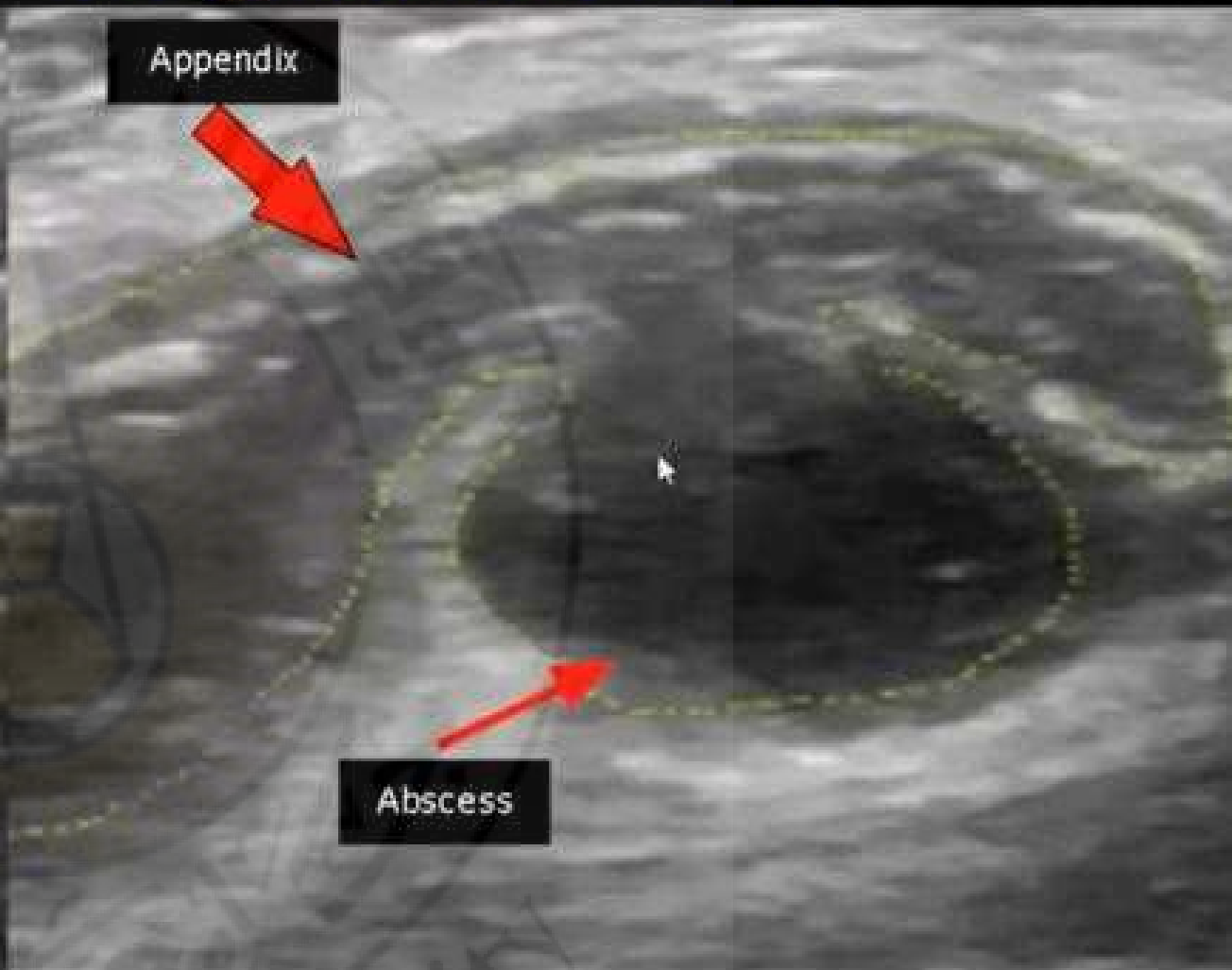
Perforated Appendix

- Full thickness Appendiceal wall defect
- Abscess in right iliac fossa

Longitudinal View



Longitudinal View

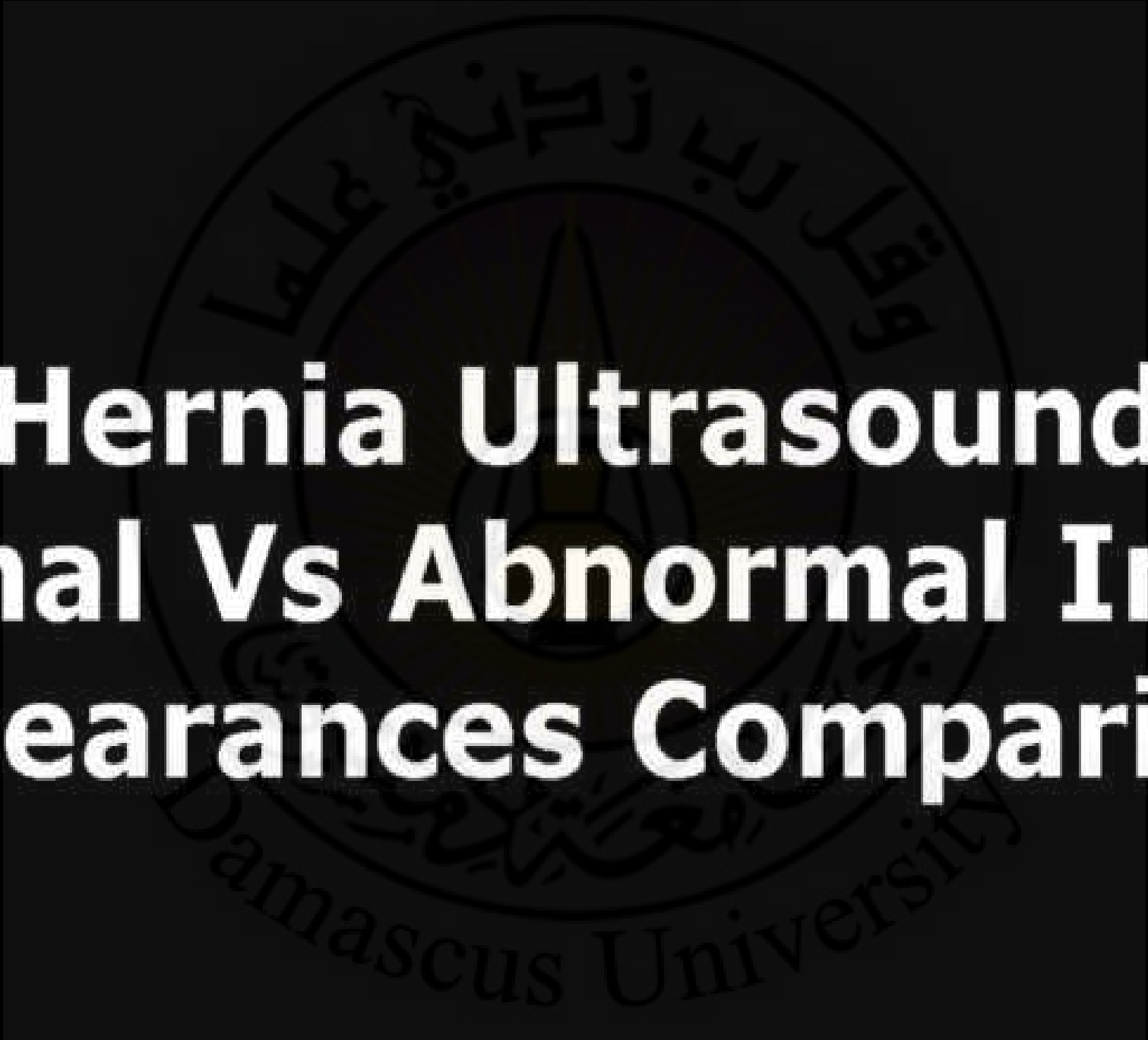


Normal Appendix

- Diameter: $<6\text{mm}$
- Tube-shaped

Perforated Appendix

- Abscess in right iliac fossa
- Full thickness Appendiceal wall defect

A large, faint, circular watermark of the Damascus University seal is centered in the background. The seal features Arabic calligraphy around its perimeter and a central emblem.

Hernia Ultrasound Normal Vs Abnormal Image Appearances Comparison

Transverse View



Normal Abdominal Wall

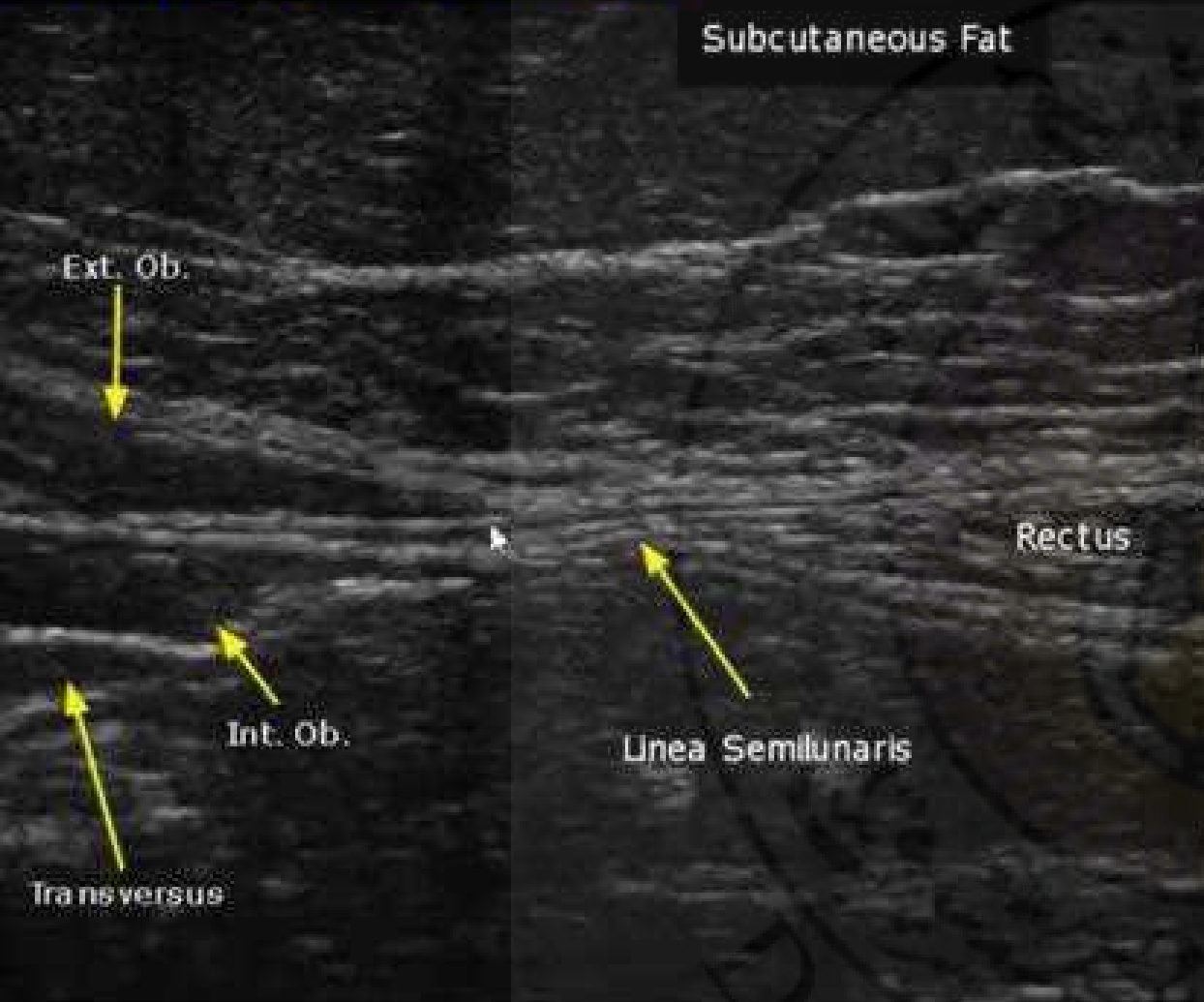
Transverse View



Epigastric Hernia

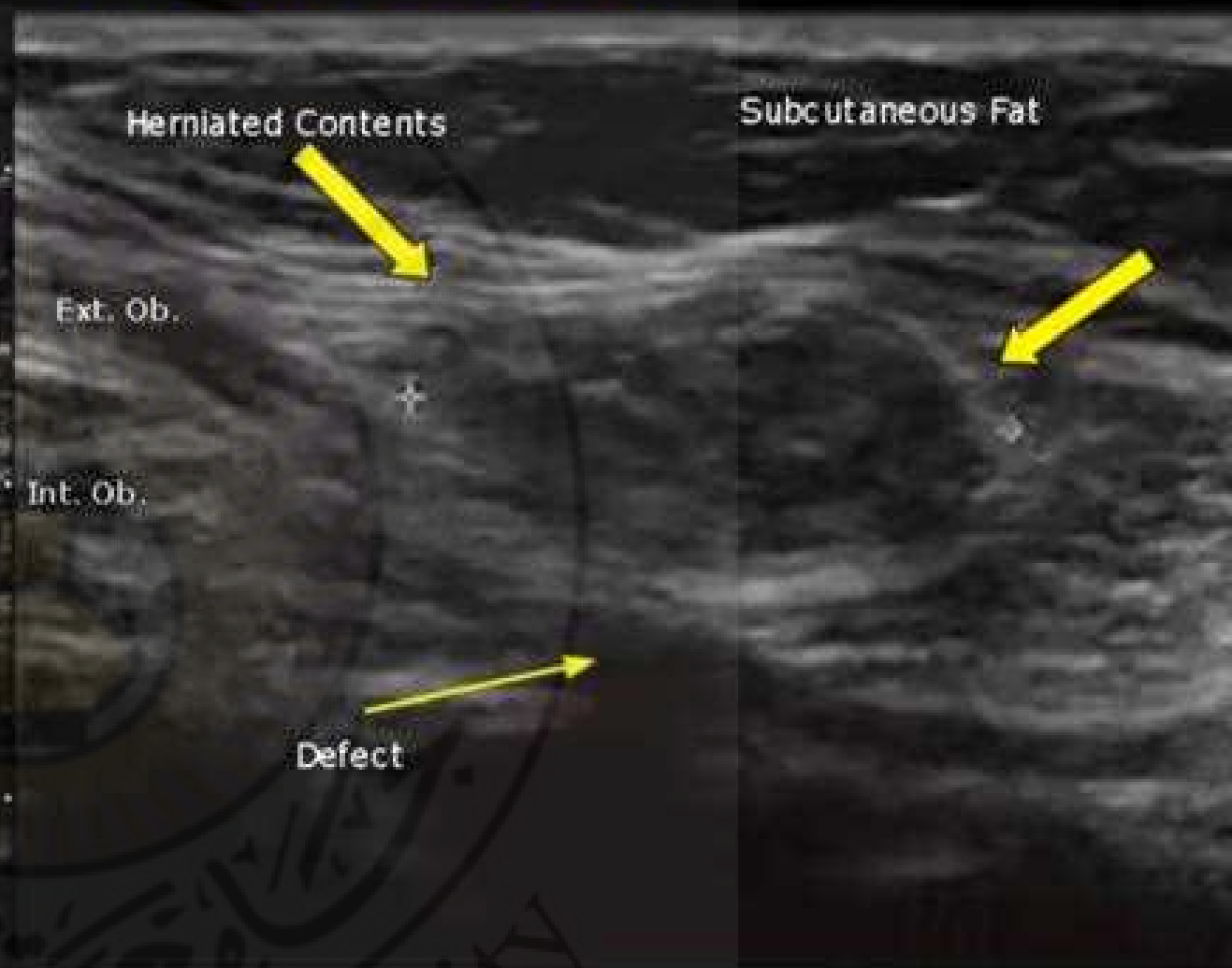
- Small midline defect in linea alba, above umbilicus
- Herniated contents are usually omental fat or preperitoneal fat

Transverse View



Normal Abdominal Wall

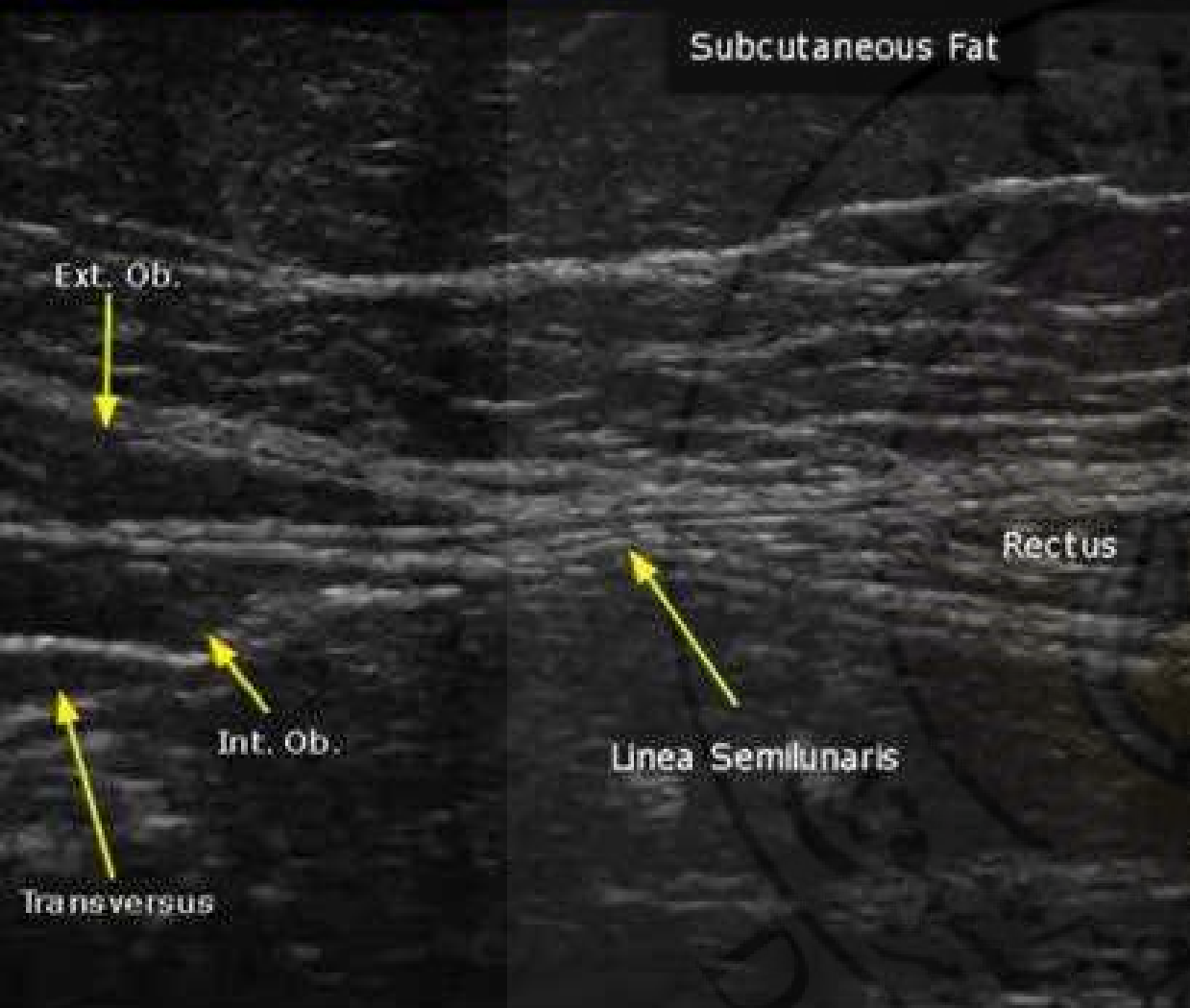
Transverse View



Spigelian Hernia

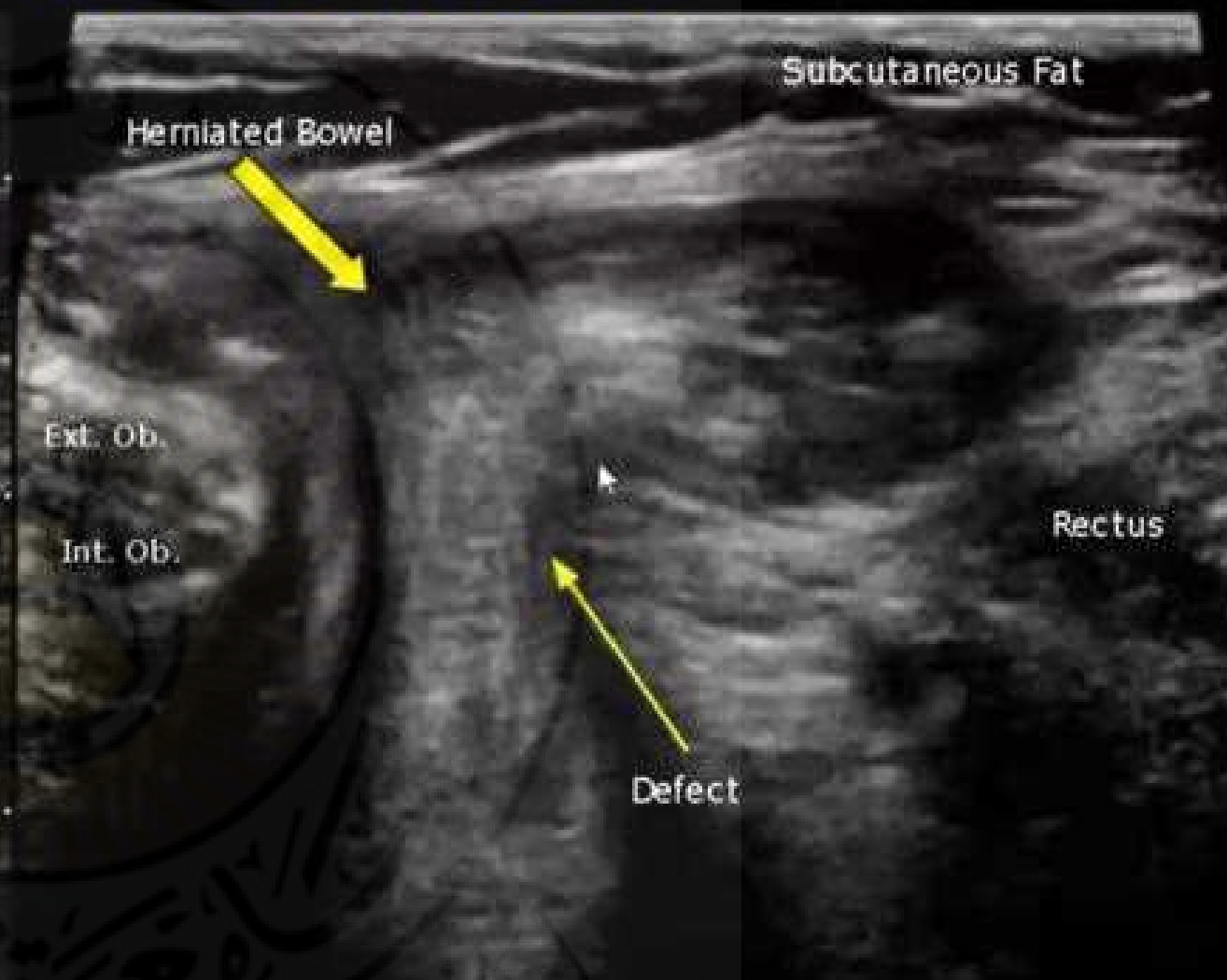
- Lower anterior abdominal wall hernia.
- Herniated contents: fat or bowel

Transverse View



Normal Abdominal Wall

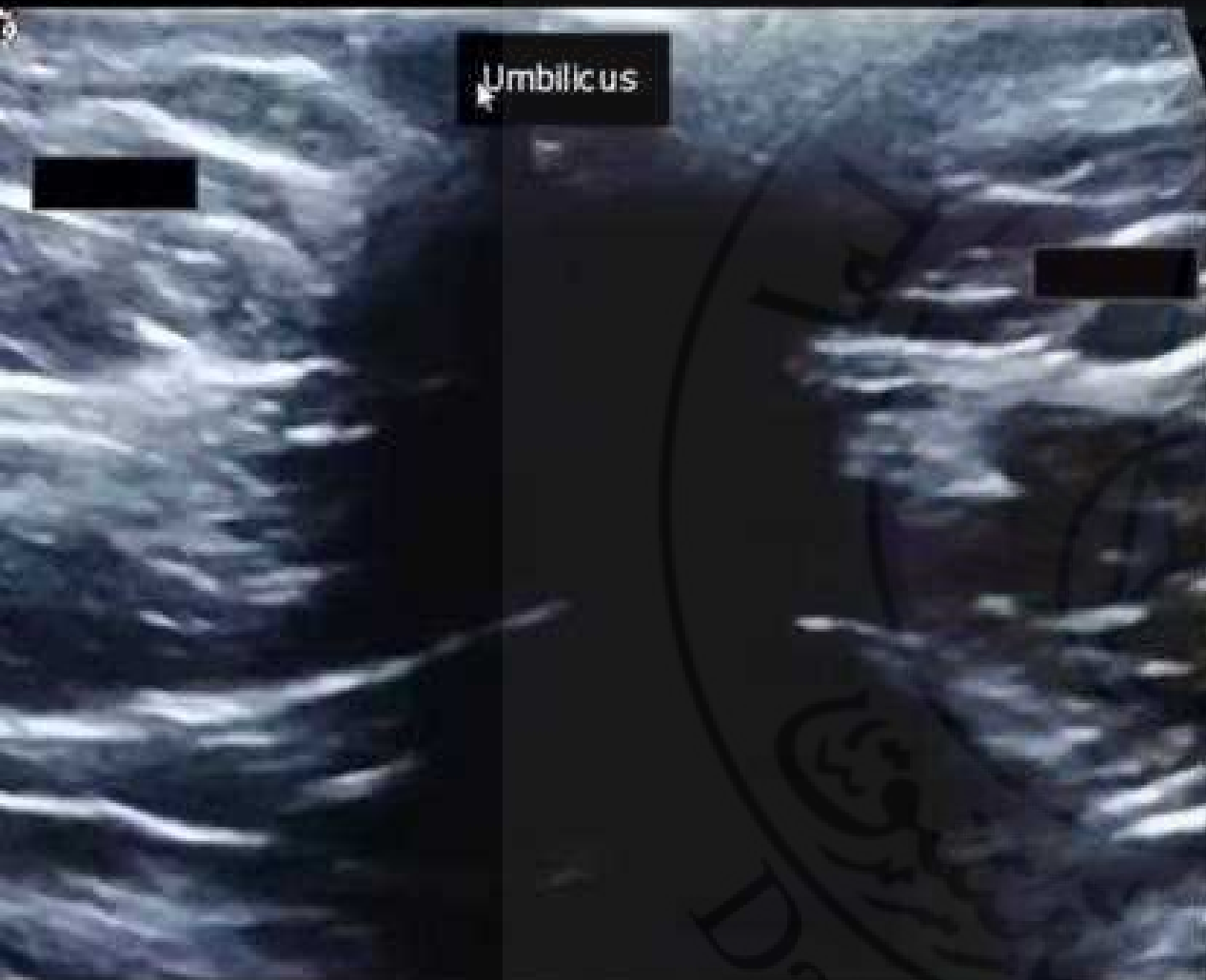
Transverse View



Spigelian Hernia

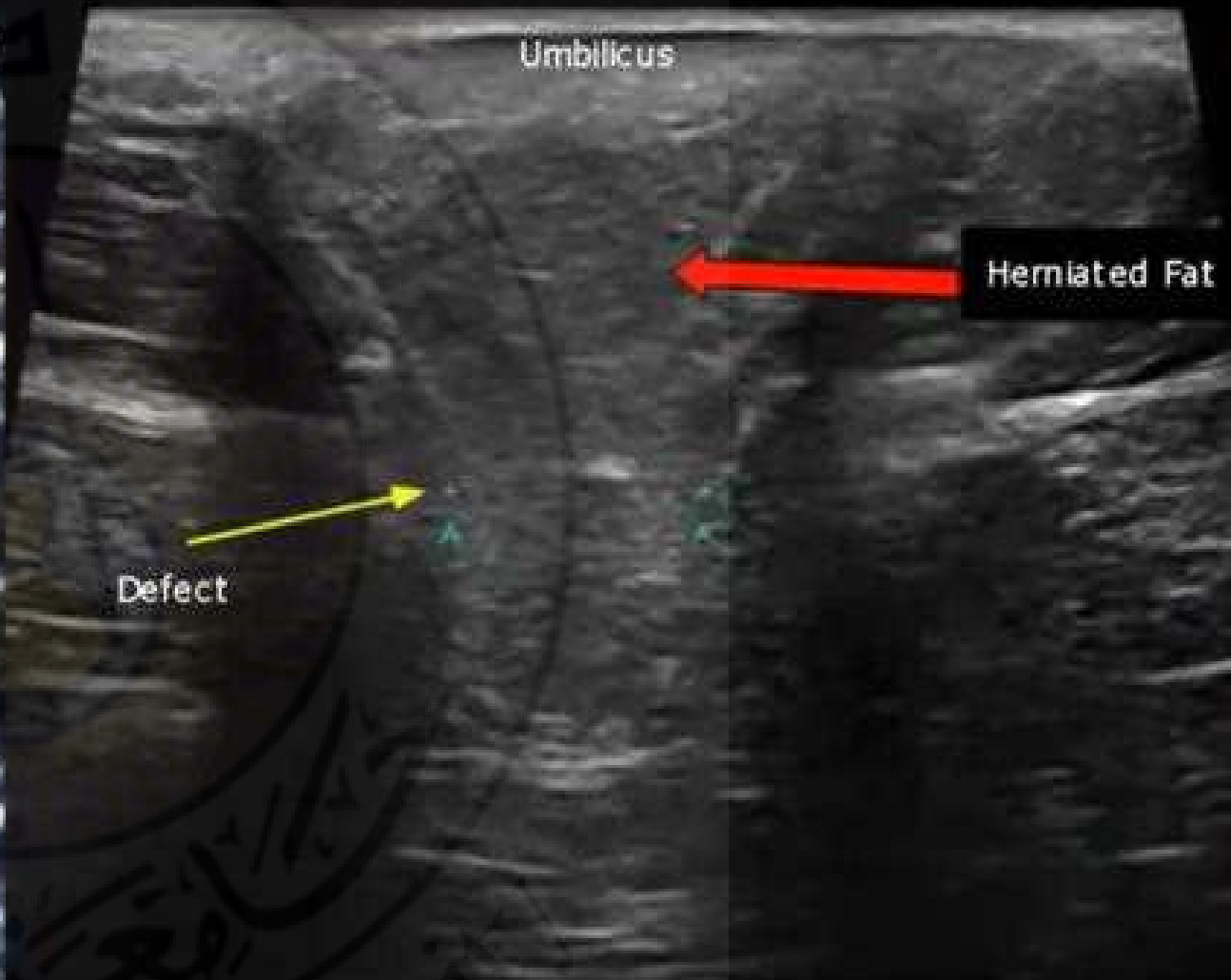
- Lower anterior abdominal wall hernia.
- Herniated contents: fat or bowel

Transverse View



Normal Umbilicus

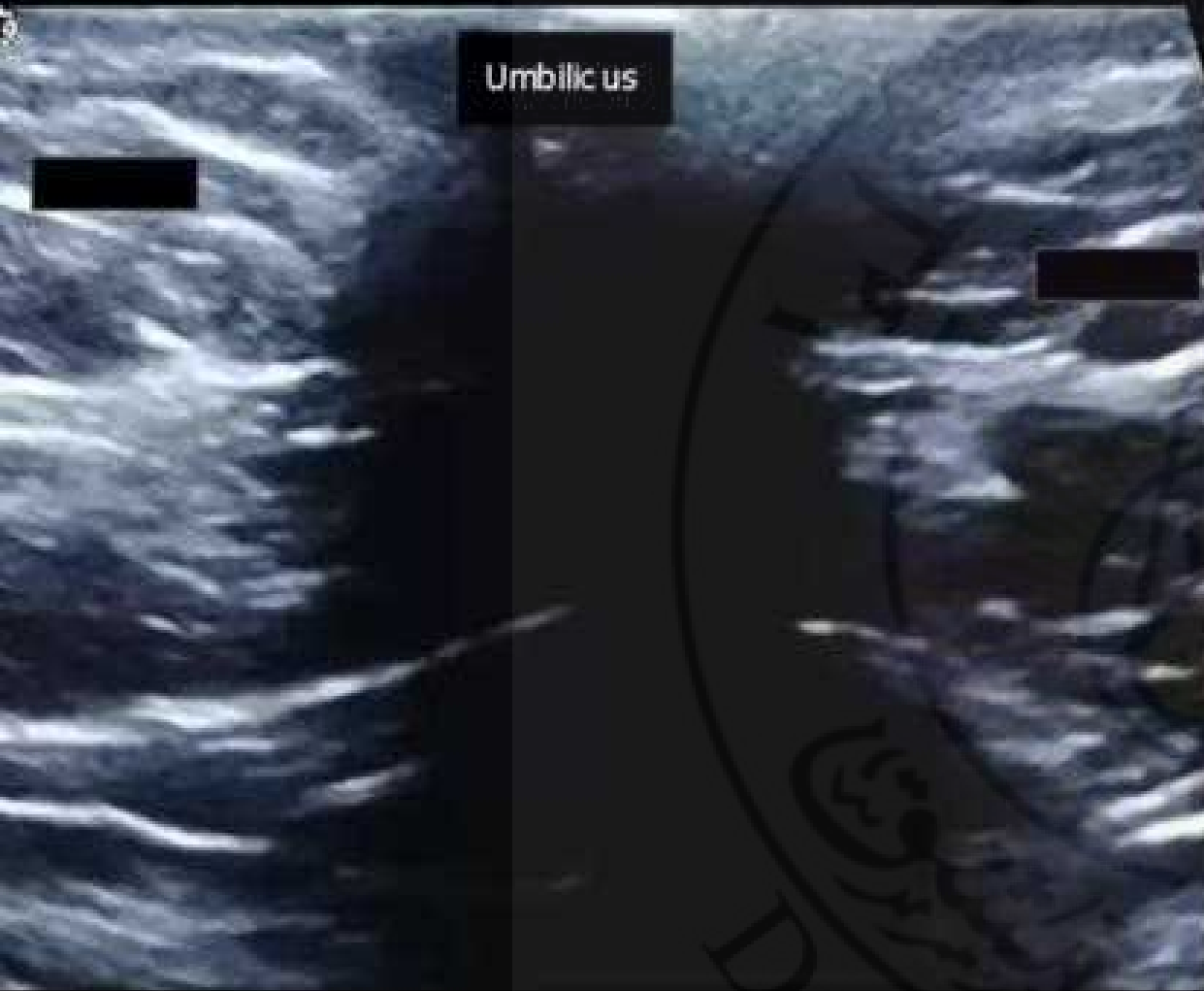
Transverse View



Umbilical Hernia

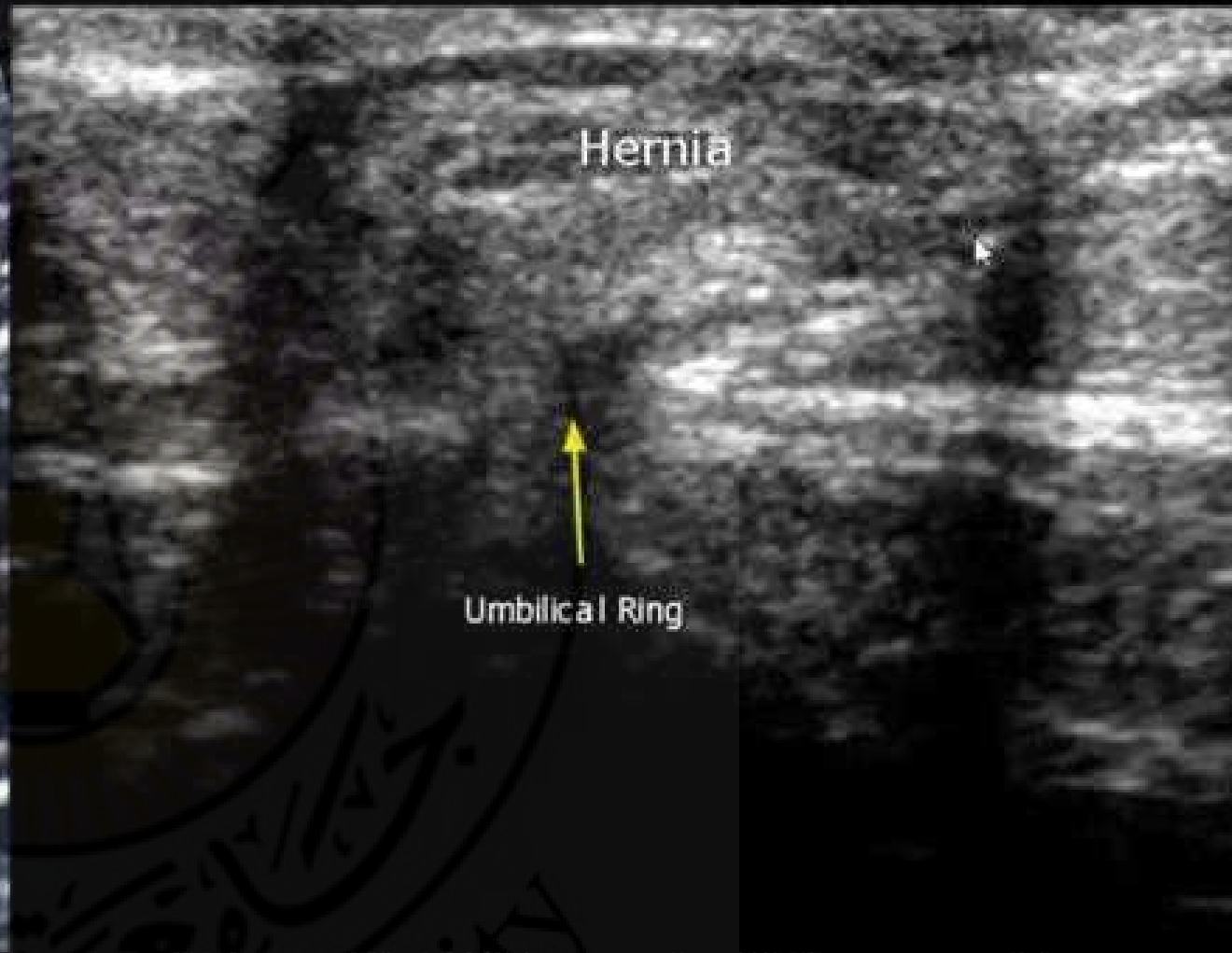
- Midline hernia through the umbilicus
- Herniated contents: fat or bowel

Transverse View



Normal Umbilicus

Transverse View



Umbilical Hernia

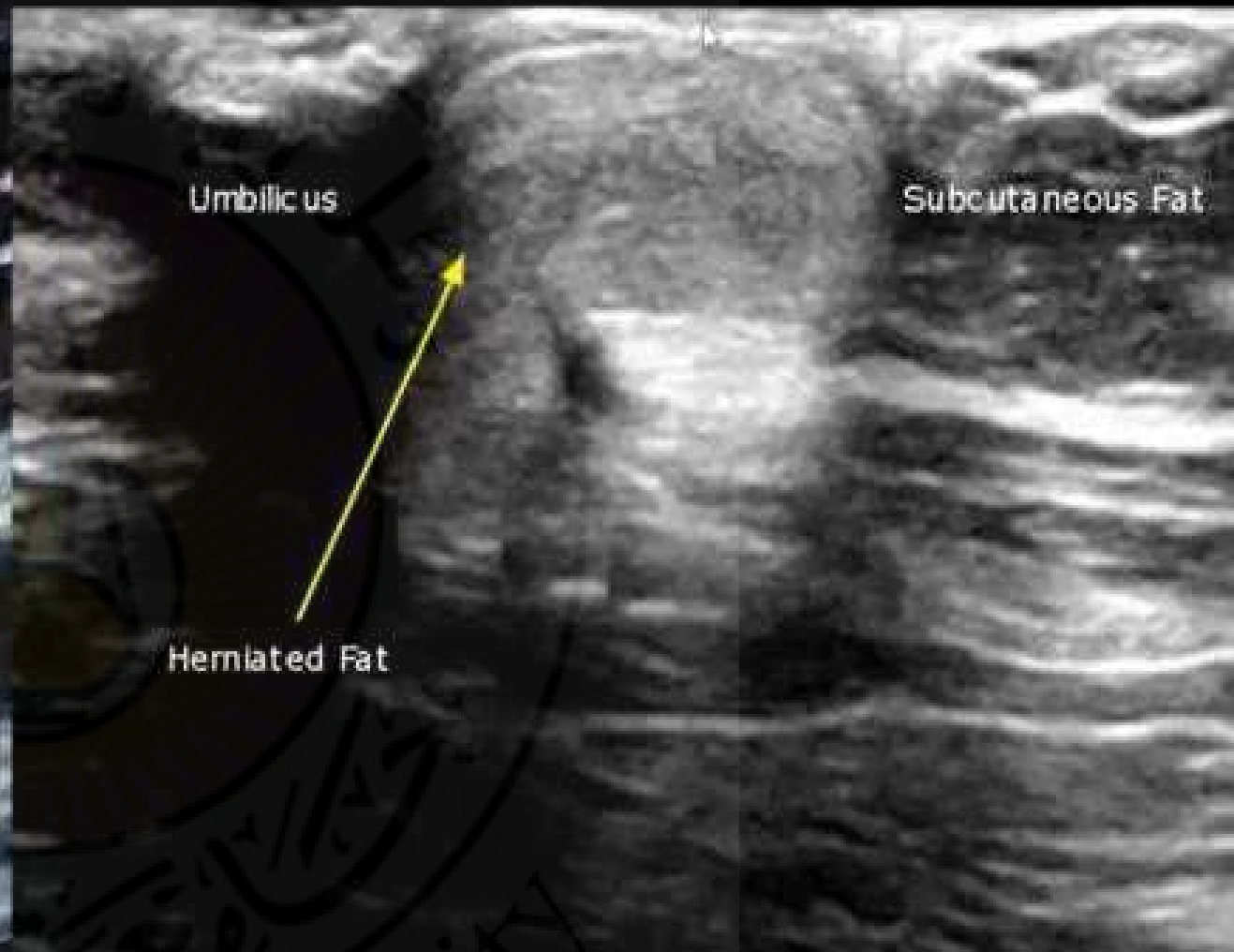
- Midline hernia through the umbilicus
- Herniated contents: fat or bowel

Longitudinal View



Normal Umbilicus

Longitudinal View



Hypogastric Linea Alba Hernia

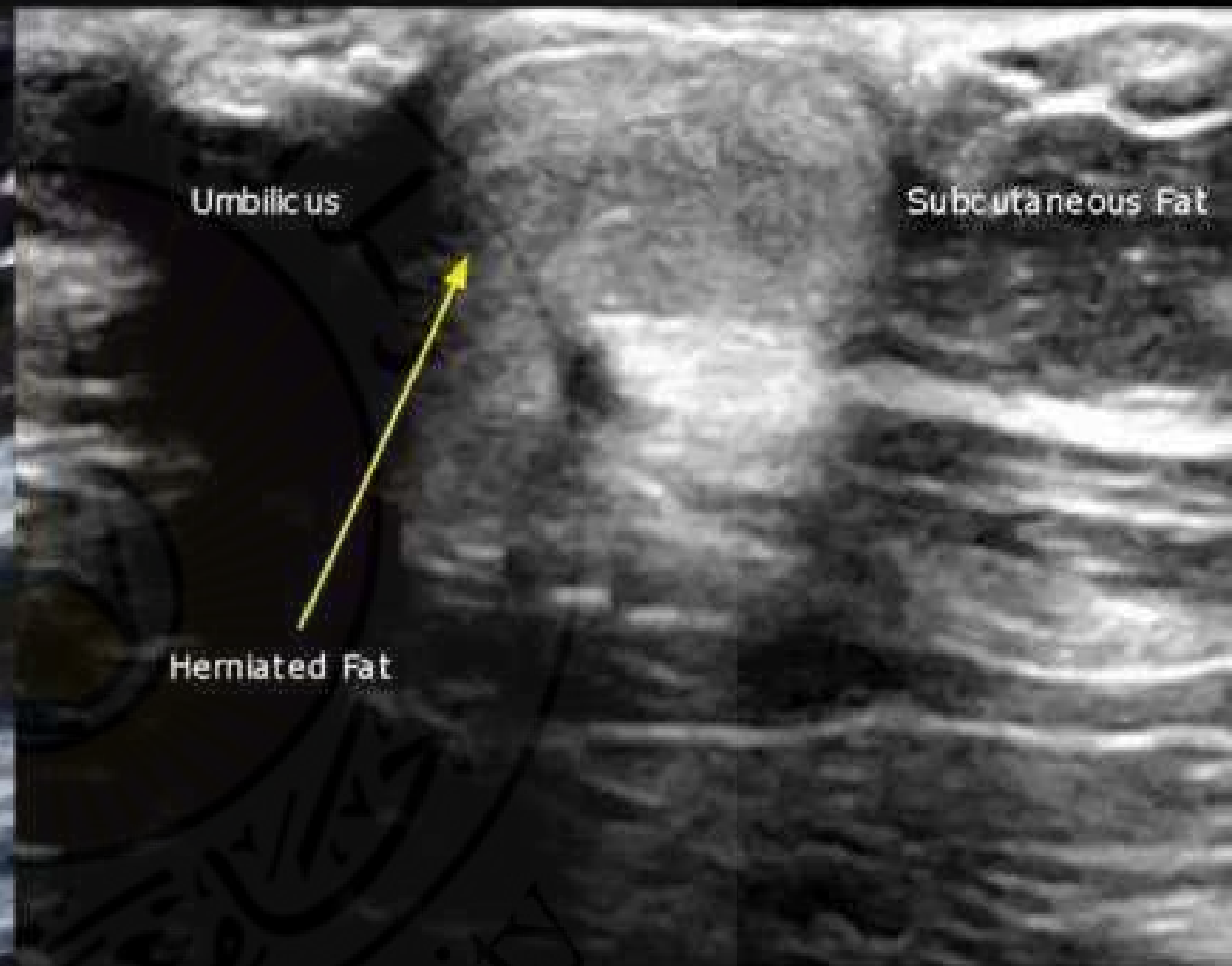
- Hernia inferior to umbilicus
- Edematous hyperechoic strangulated fat

Longitudinal View



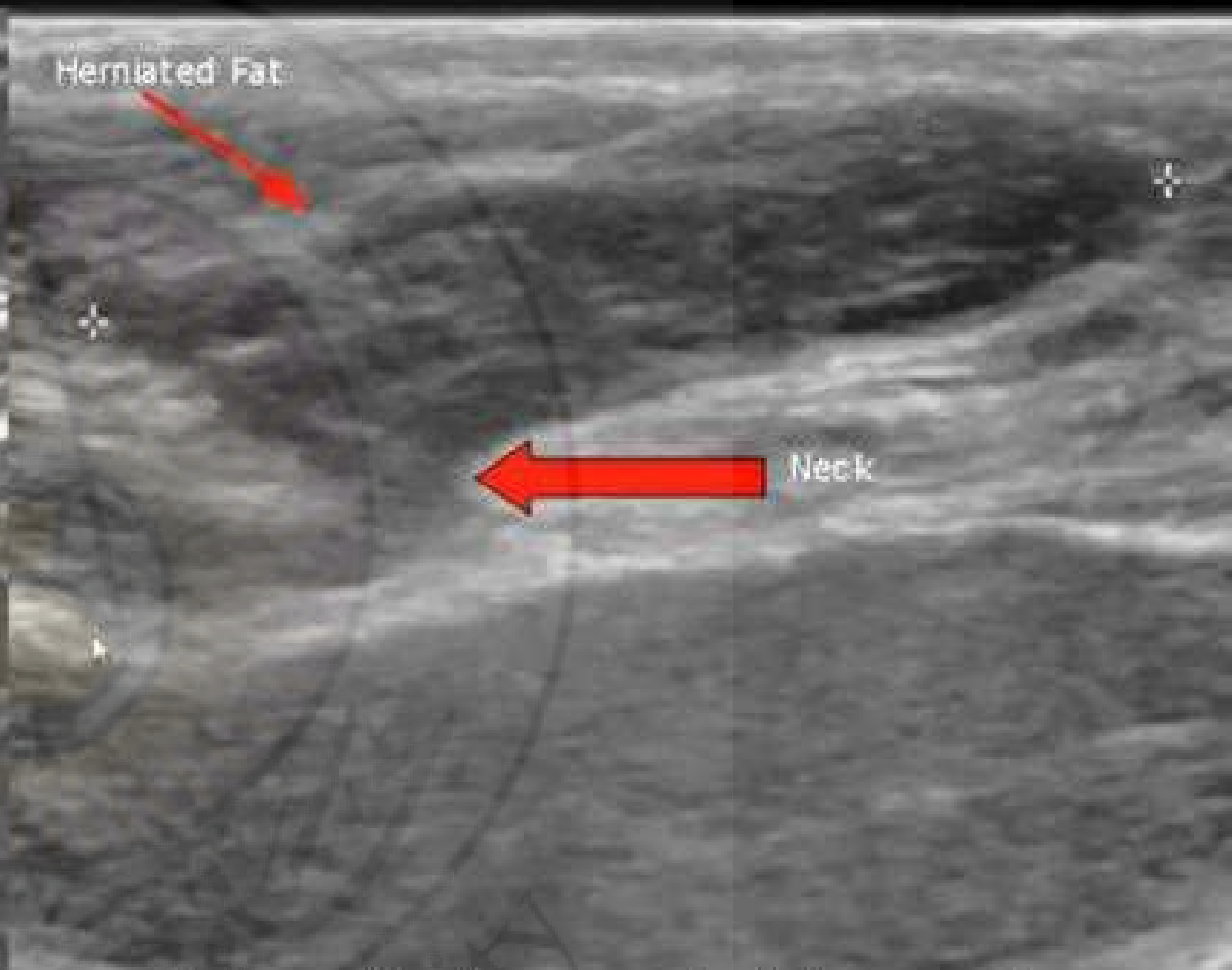
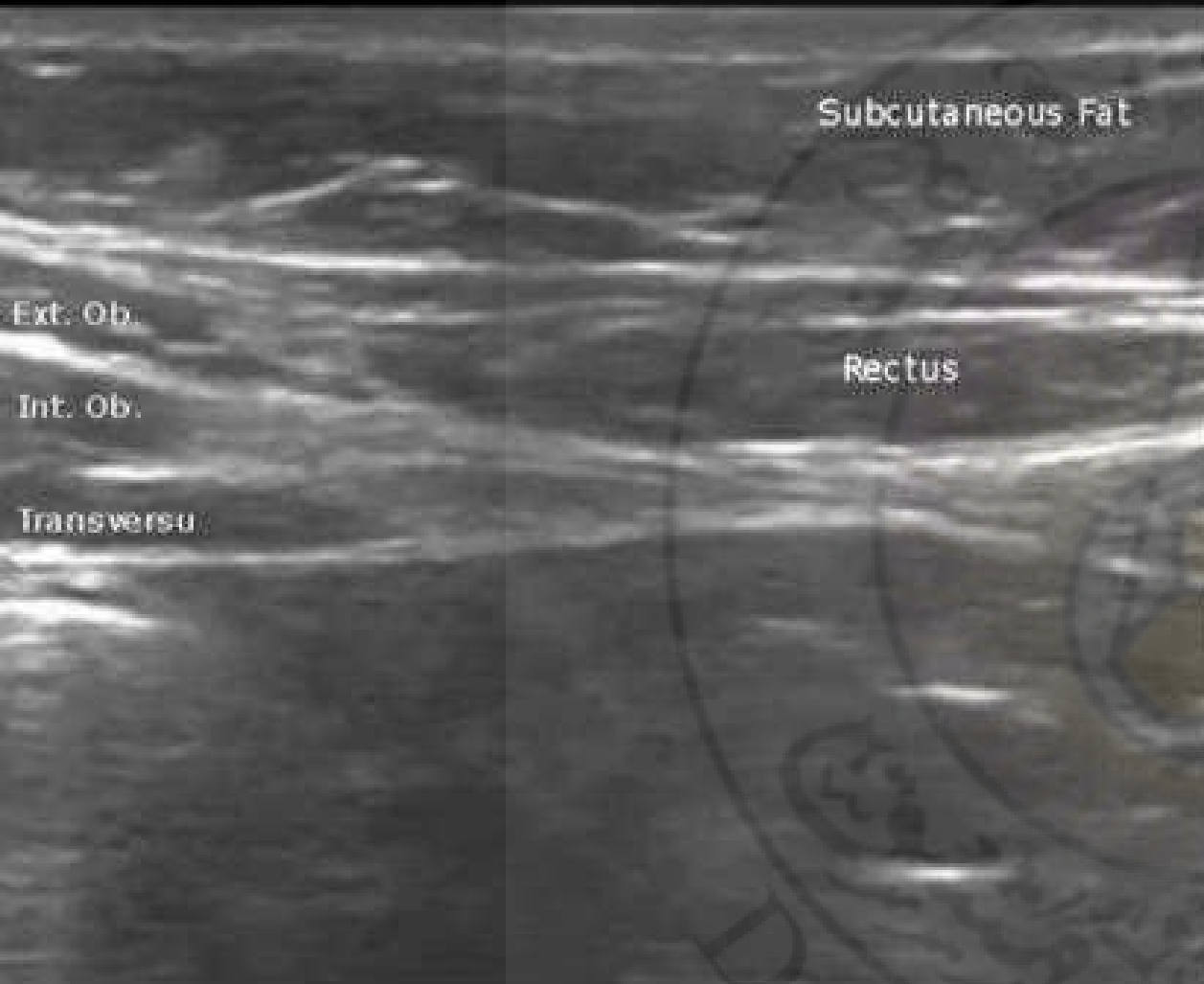
Normal Umbilicus

Longitudinal View



Hypogastric Linea Alba Hernia

- Reducible hernia: Contents can be pushed back through the defect with probe pressure. Neck of hernial sac is wide

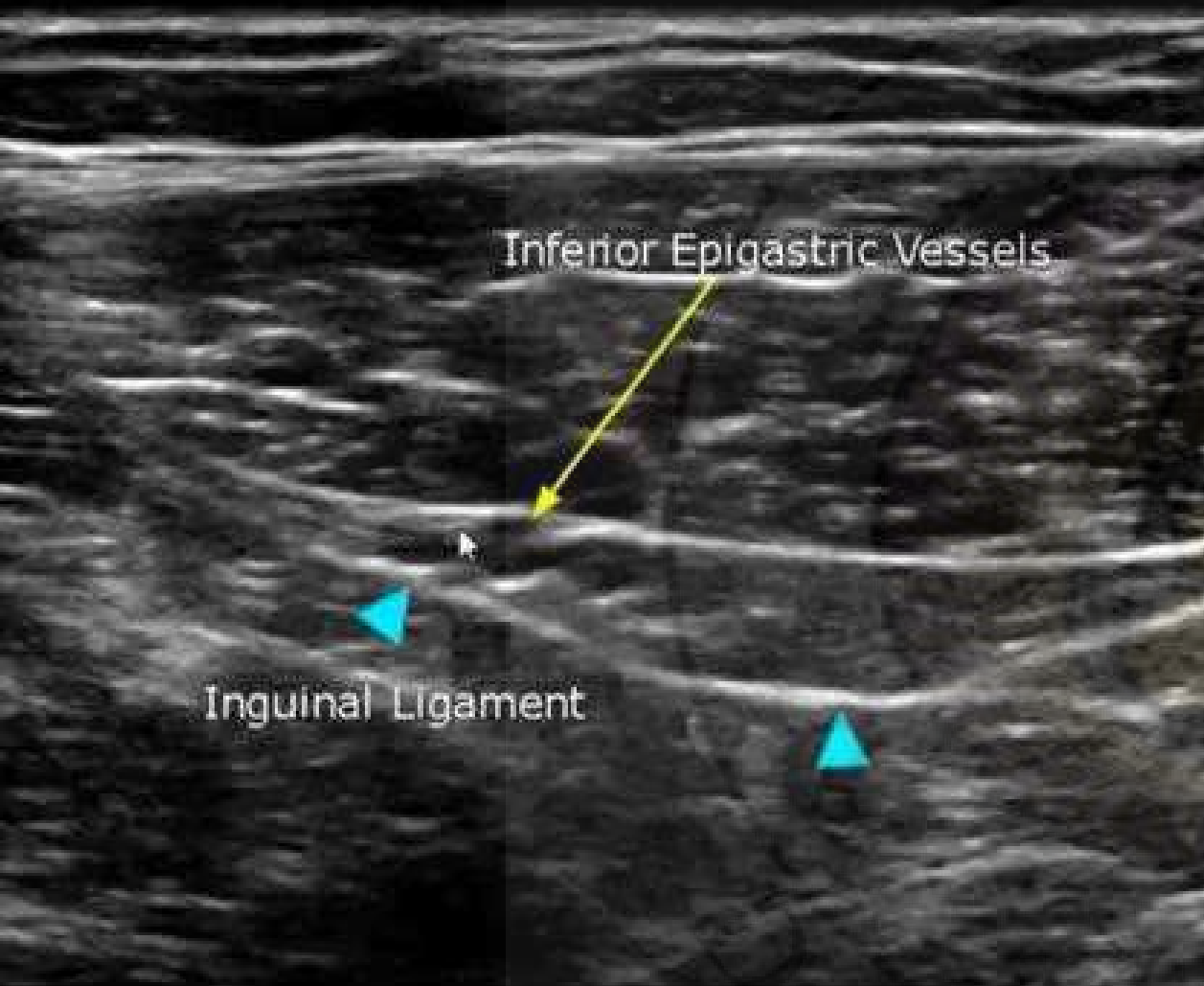


Normal Abdominal Wall

Incisional Hernia

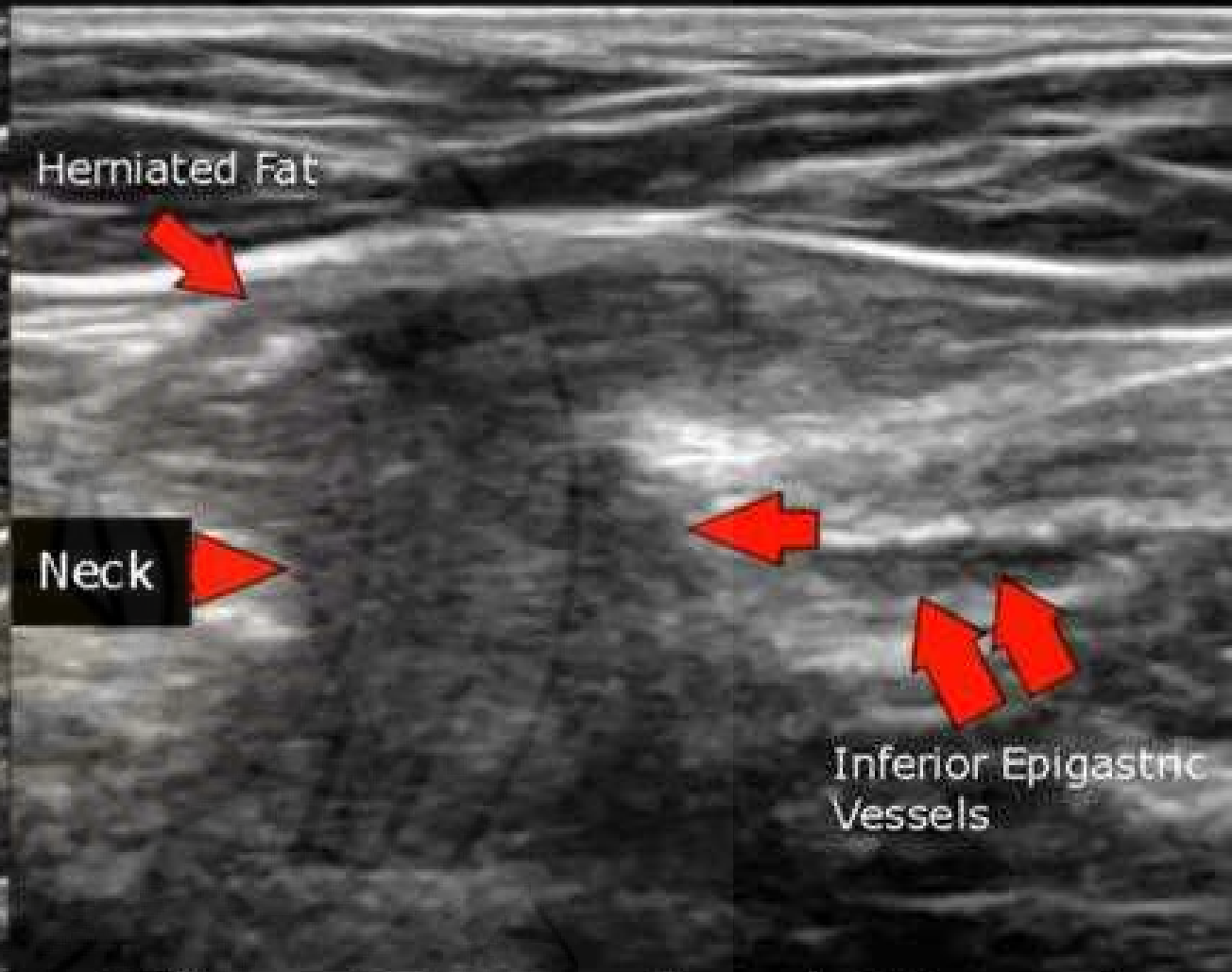
- Can occur after a surgery (laparotomy)
- Hernia occurs through an incisional scar

Transverse View



Normal Inguinal Canal

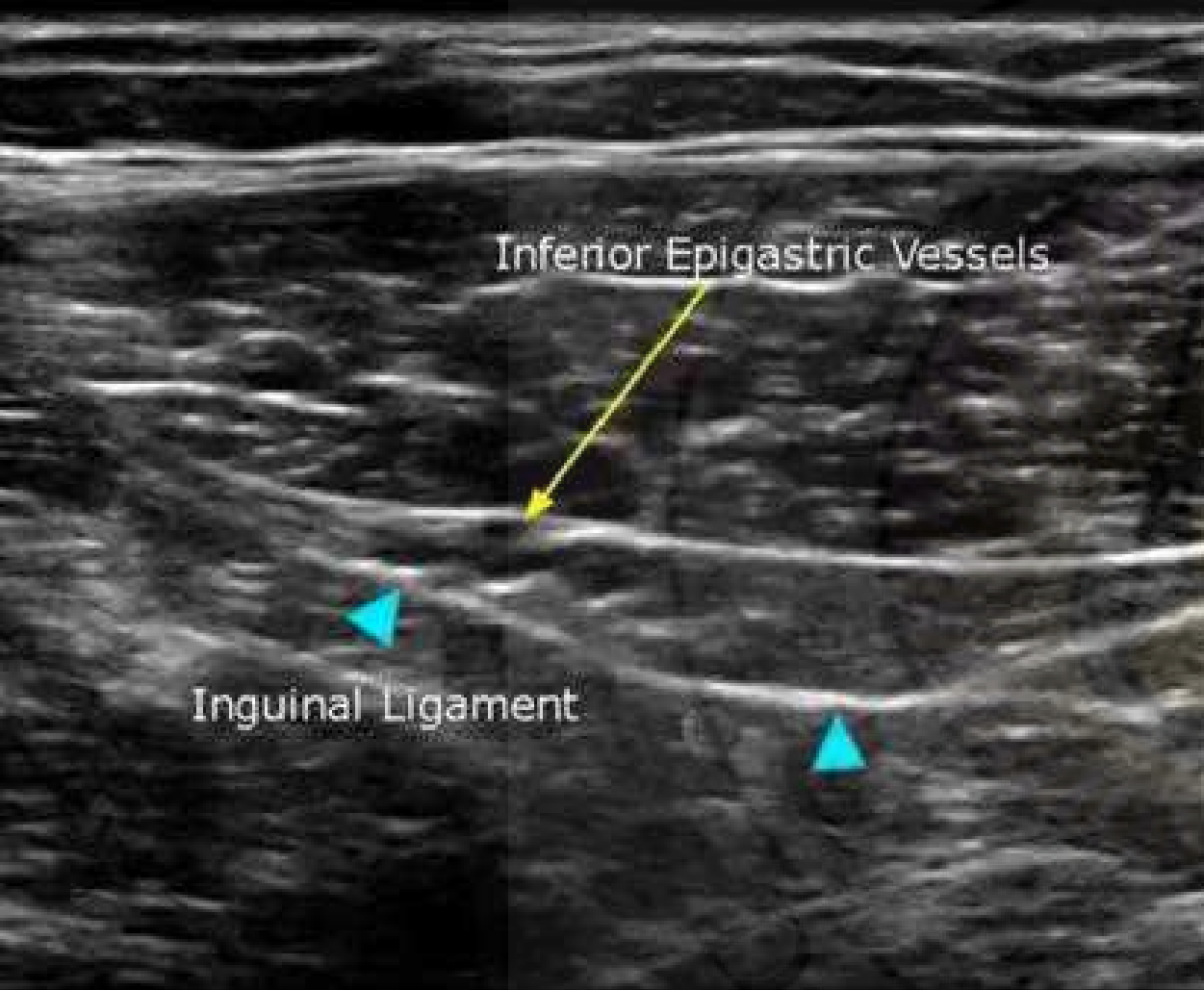
Transverse View



Direct Inguinal Hernia

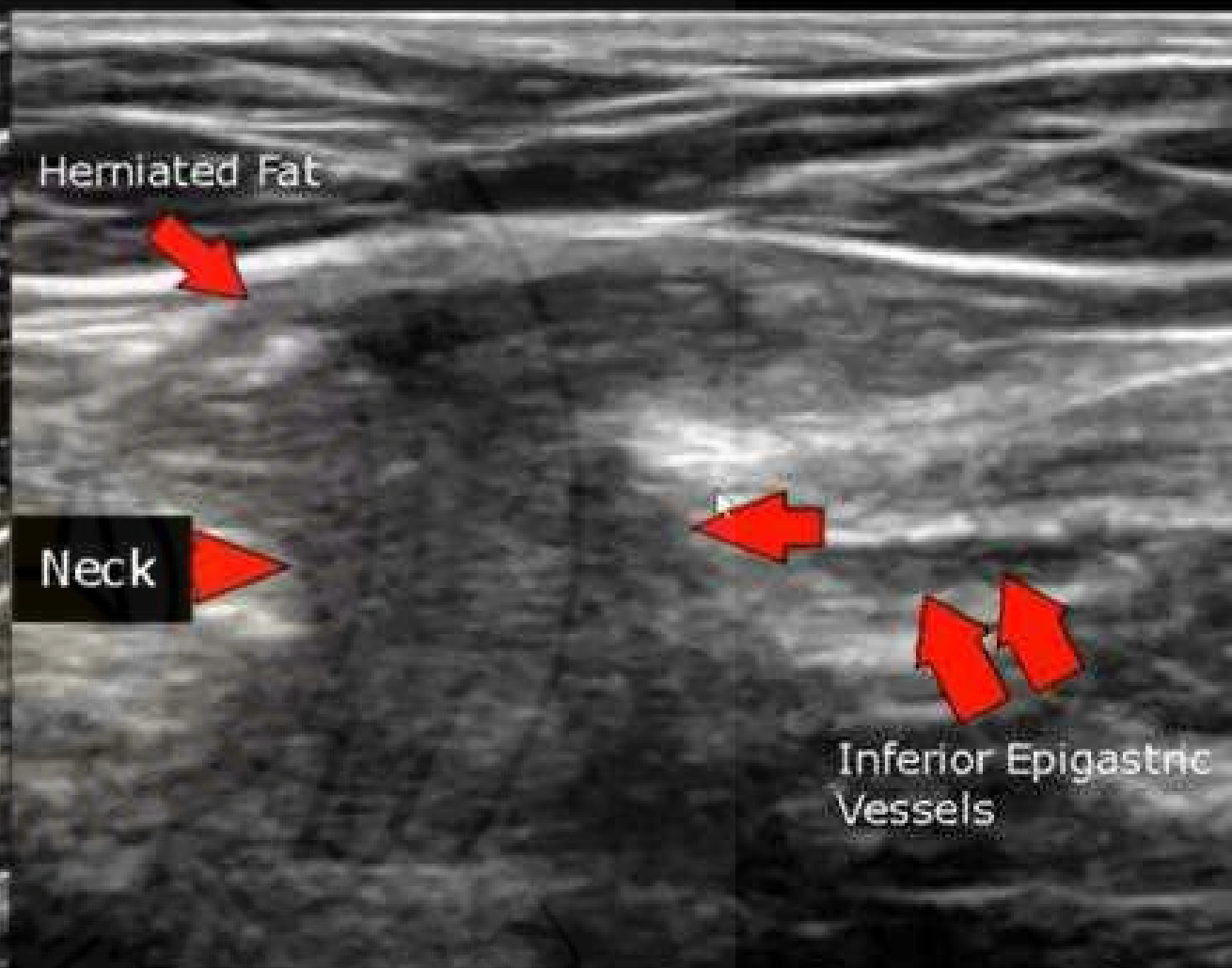
- Hernial sac protrudes directly through inguinal canal
- Contents: Fat or bowel

Transverse View



Normal Inguinal Canal

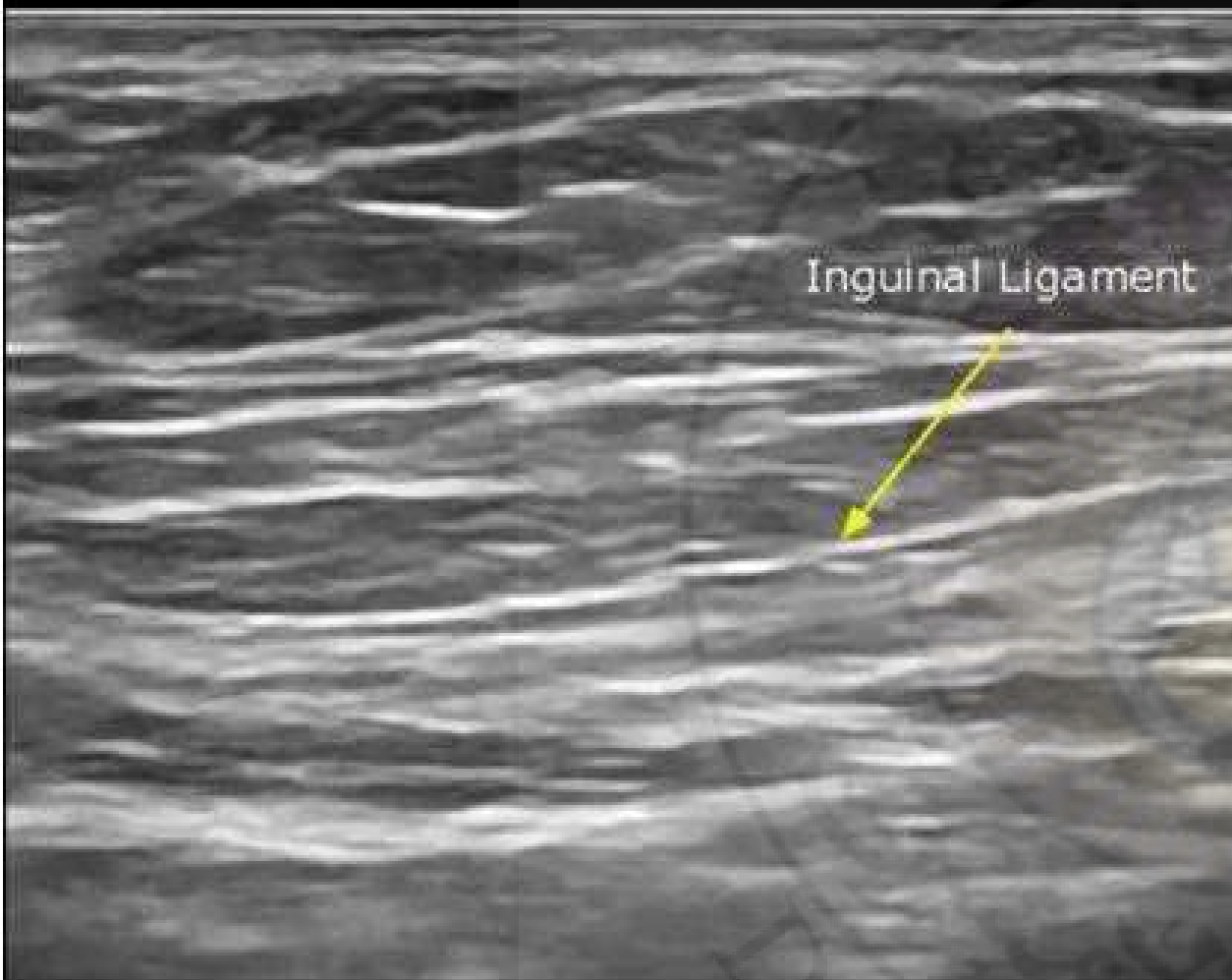
Transverse View



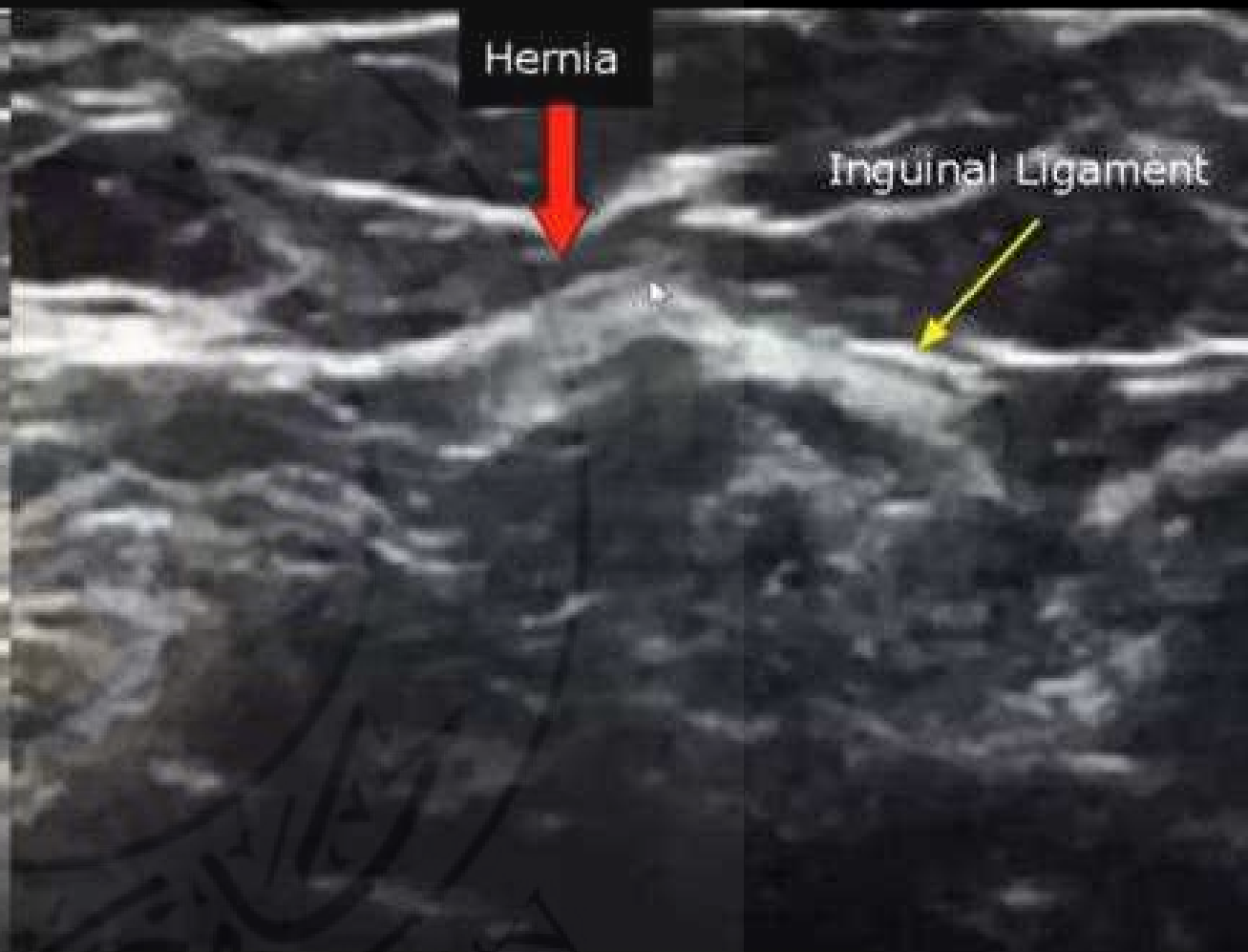
Direct Inguinal Hernia

- Direct Hernias are usually bilateral
- Wide neck; Less chance of strangulation
- Medial to inferior epigastric vessels

Longitudinal View



Longitudinal View

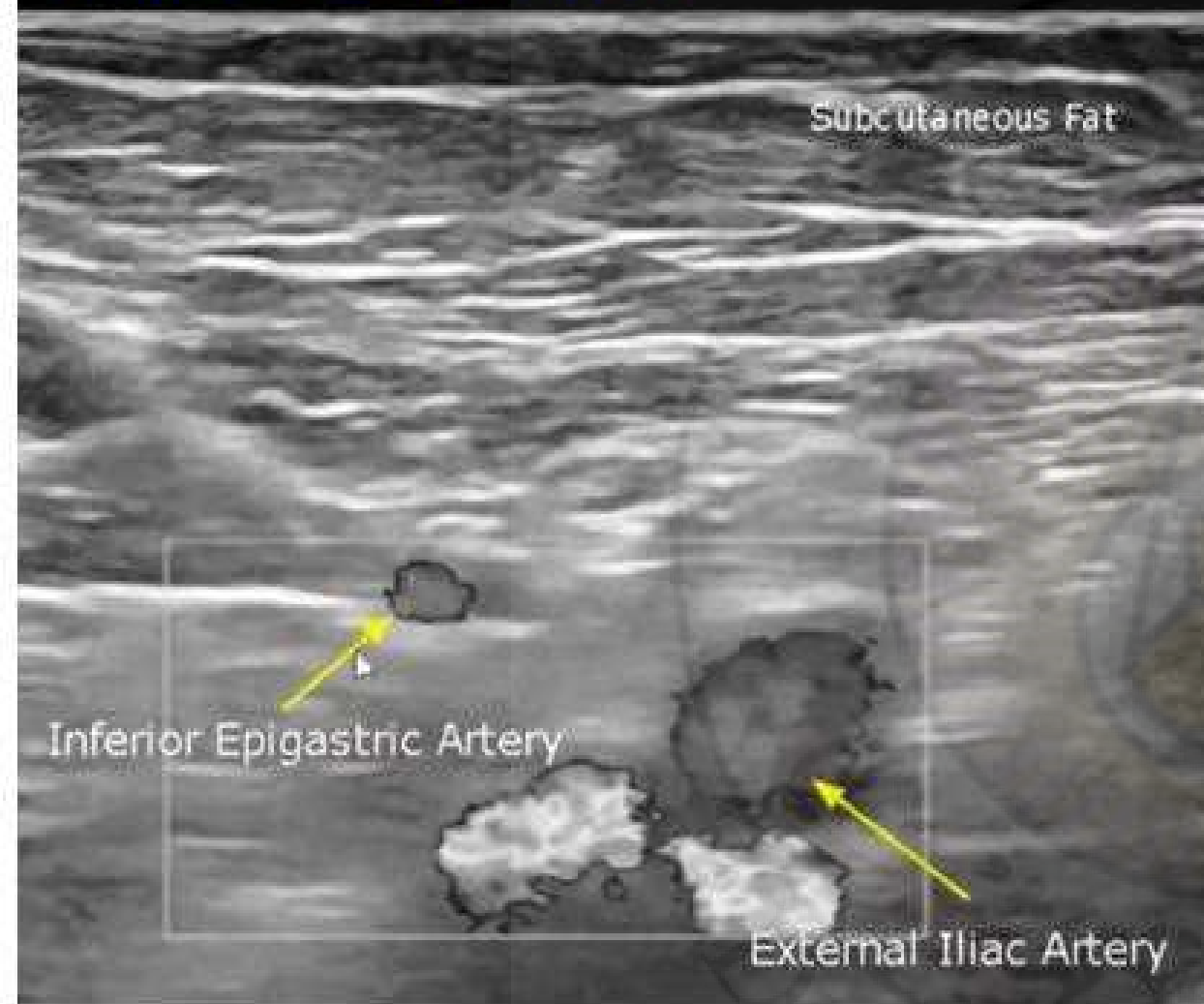


Normal Inguinal Canal

Direct Inguinal Hernia

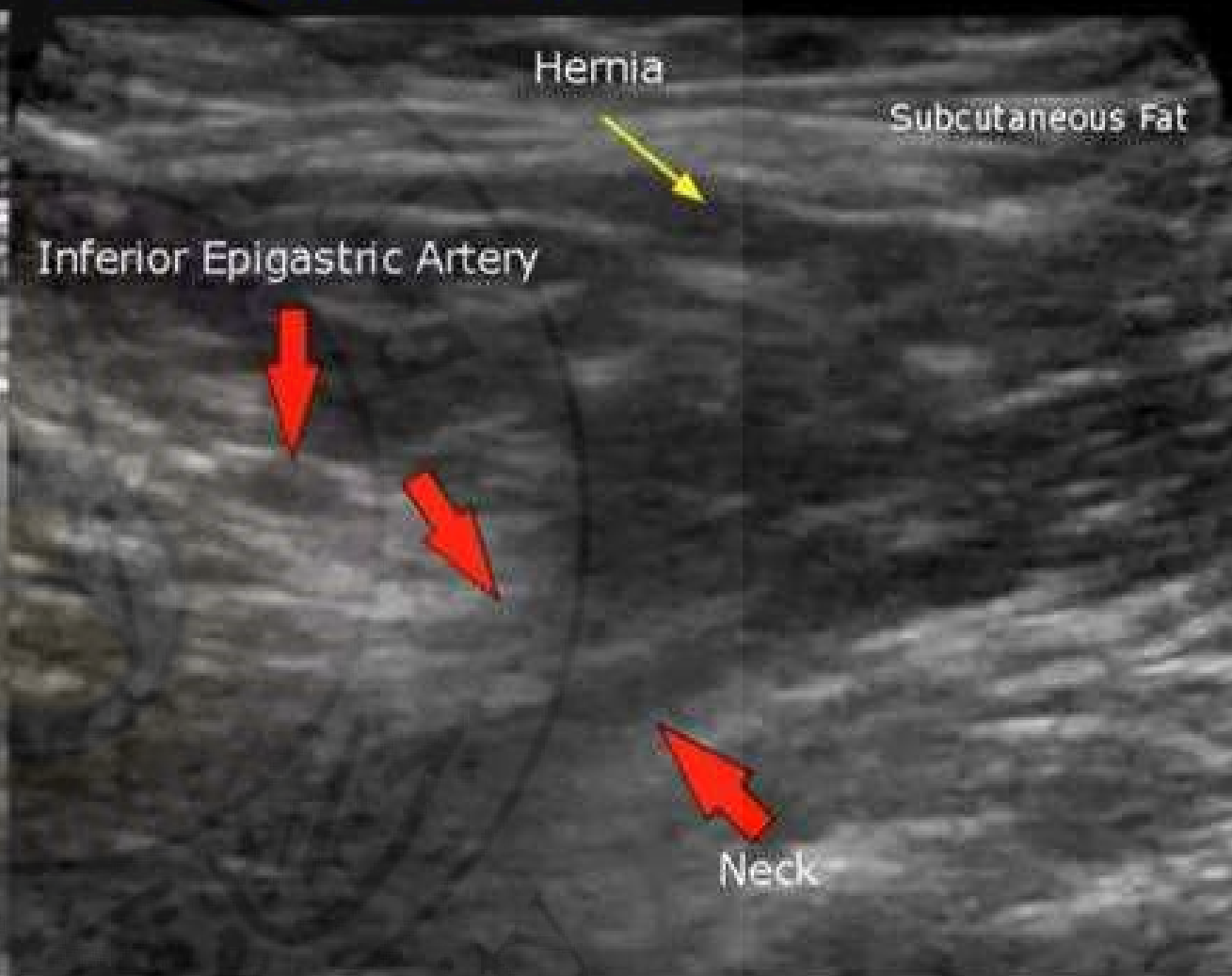
- Hernial sac protrudes directly through inguinal wall
- Contents: Fat or bowel

Transverse View



Normal Inguinal Canal

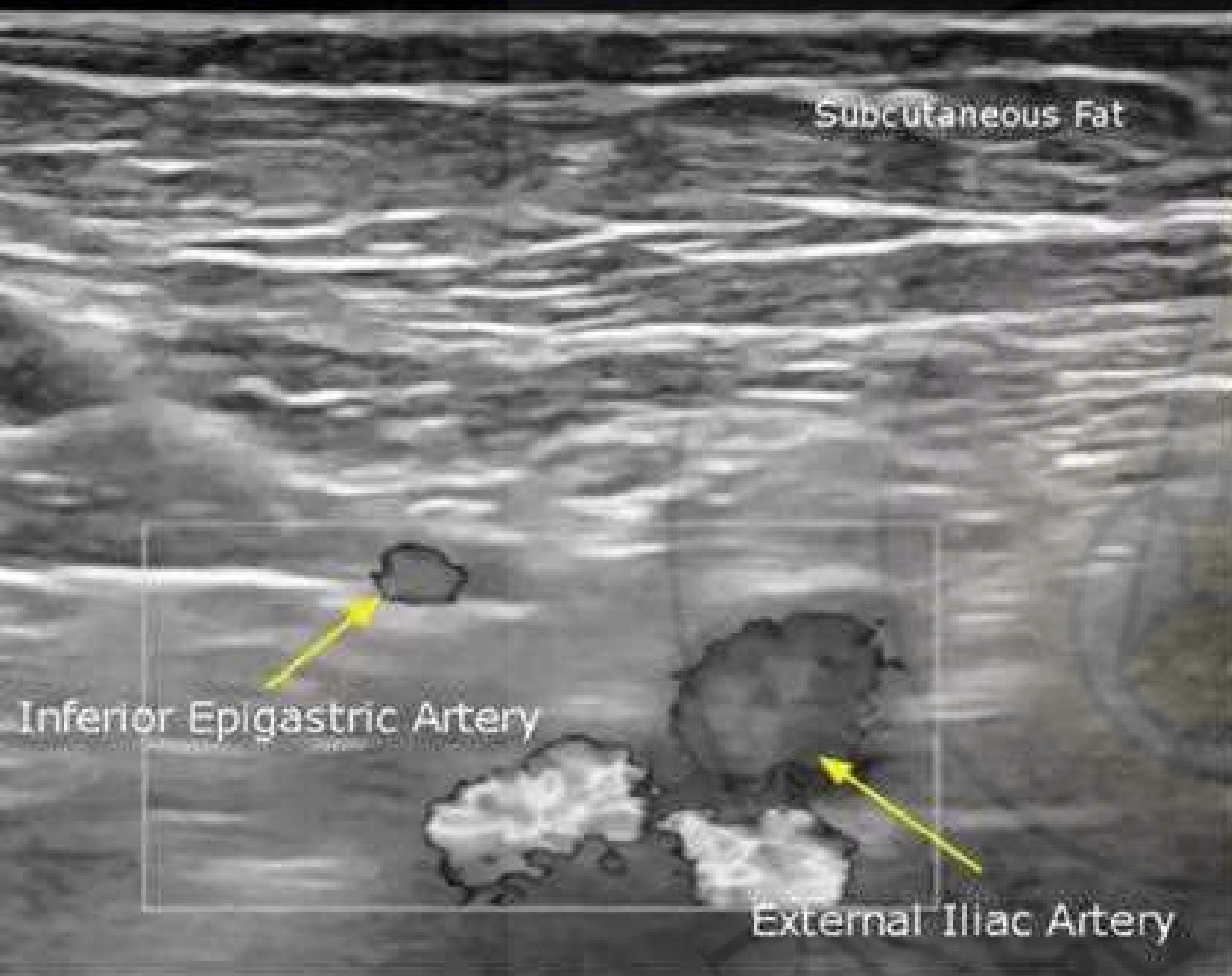
Transverse View



Indirect Inguinal Hernia

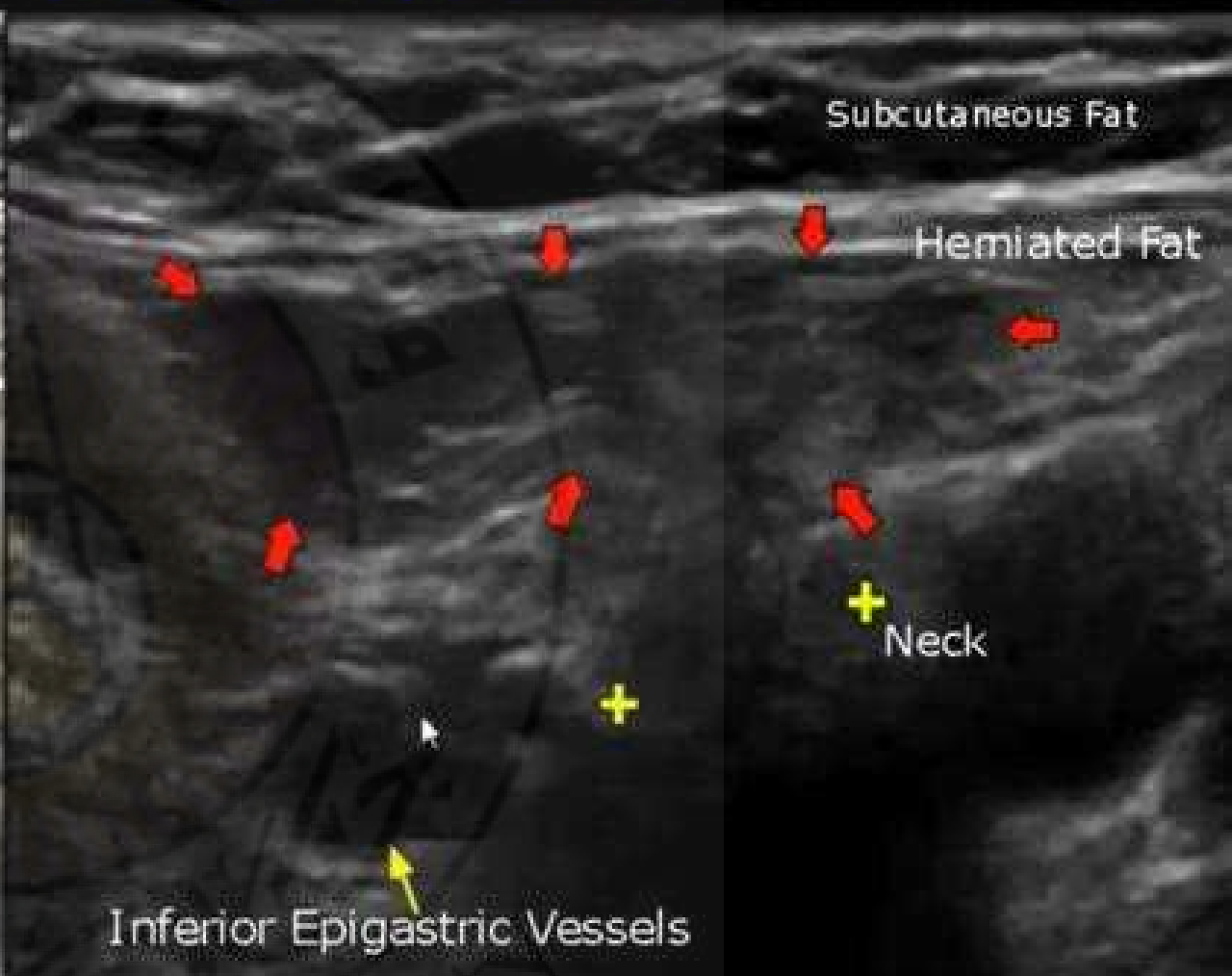
- Indirect hernia is lateral to the inferior epigastric artery
- Contents: Fat, bowel or peritoneal fluid
- Hypoechoic herniated fat

Transverse View



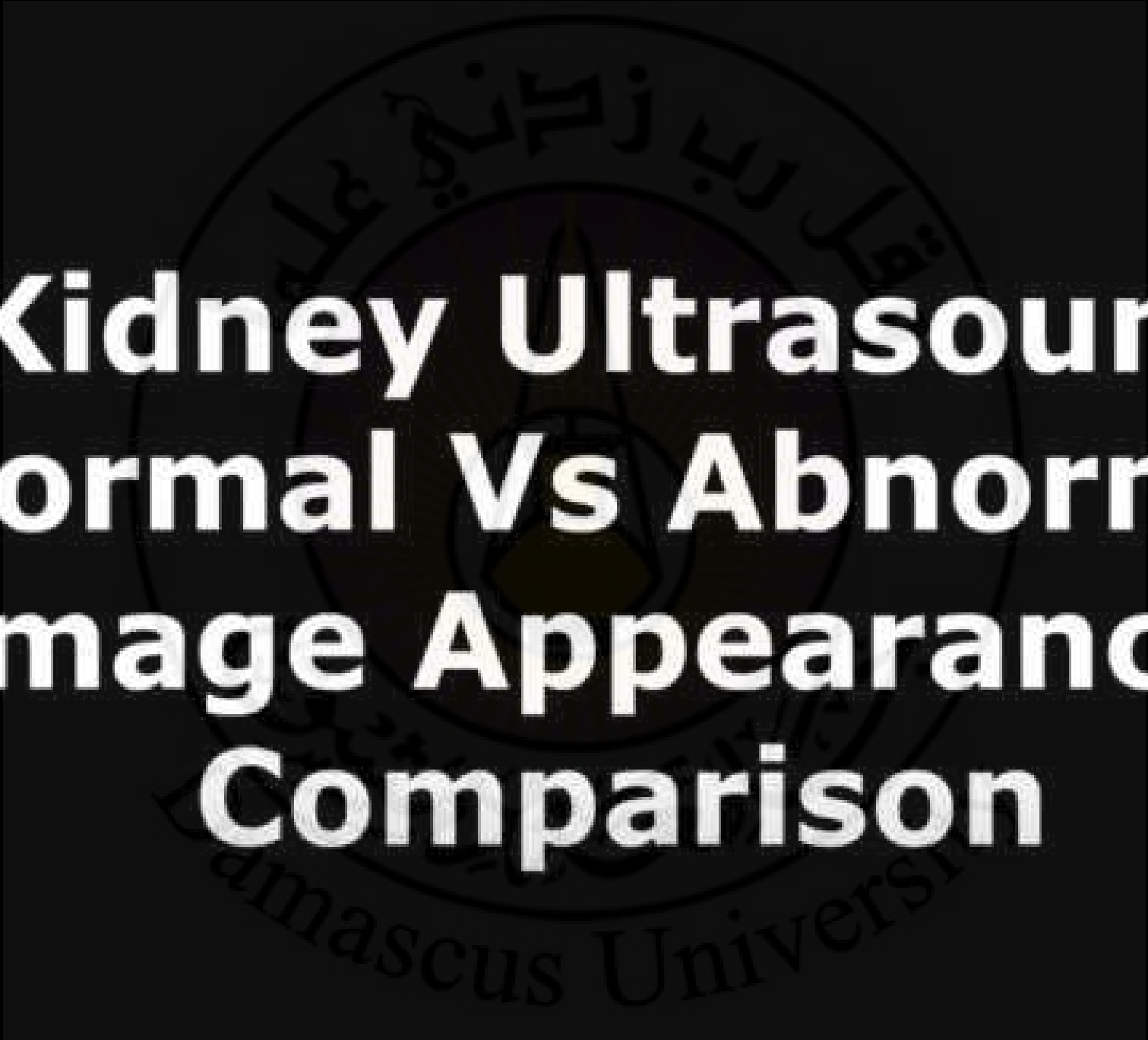
Normal Inguinal Canal

Transverse View



Indirect Inguinal Hernia

- Indirect hernia is lateral to the inferior epigastric artery
- Contents: Fat, bowel or peritoneal fluid
- Hypoechoic herniated fat

A large, faint watermark of the Damascus University seal is centered in the background. The seal is circular, featuring Arabic calligraphy around the top and the words "Damascus University" at the bottom. In the center of the seal is a stylized emblem.

Kidney Ultrasound Normal Vs Abnormal Image Appearances Comparison

LEFT

Coronal View

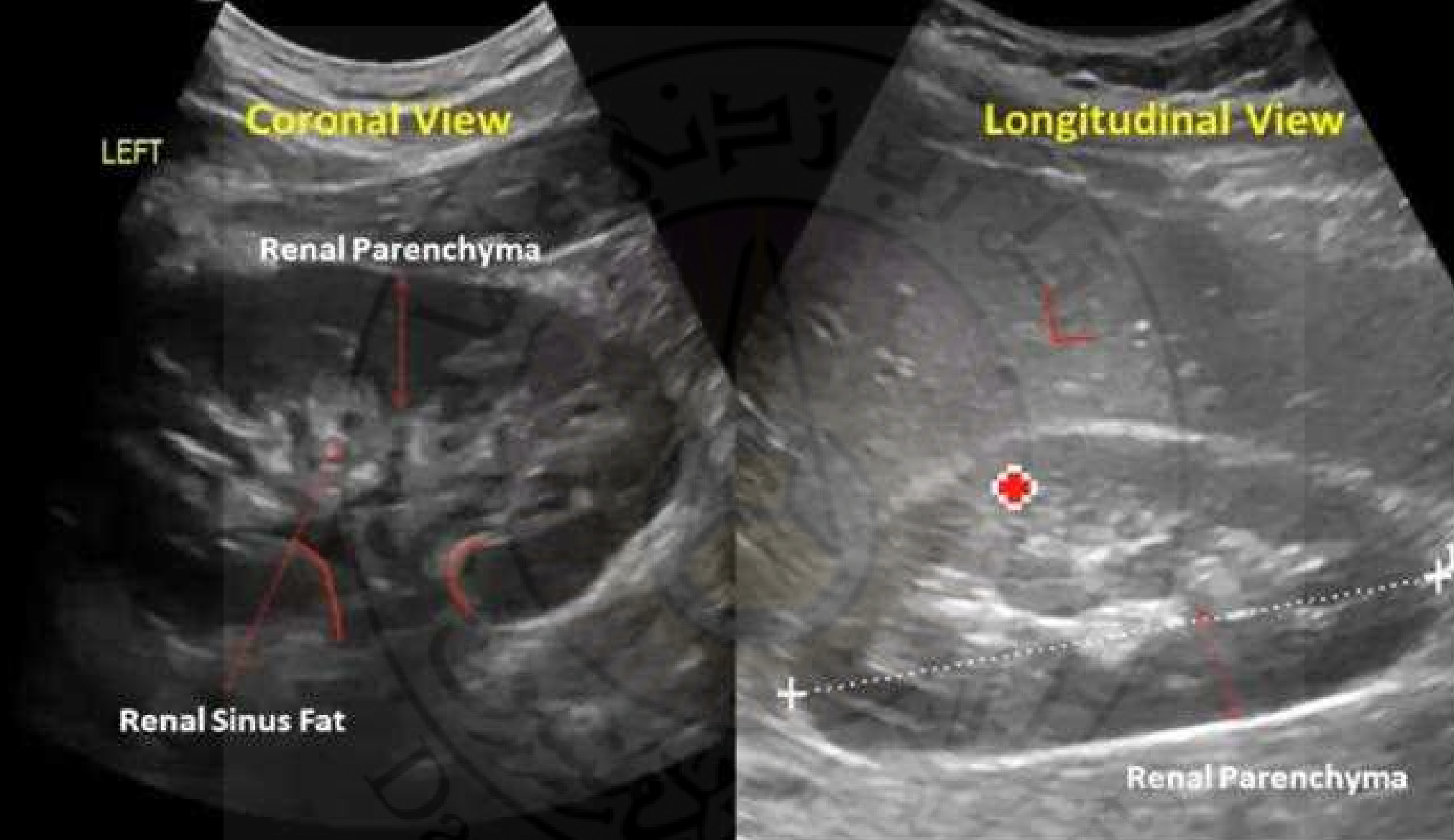
Renal Parenchyma

Renal Sinus Fat

Longitudinal View

Renal Parenchyma

Normal



Transverse View

Transverse View

Cortex

Liver

Renal Sinus Fat

Normal

Transverse View



Transverse View

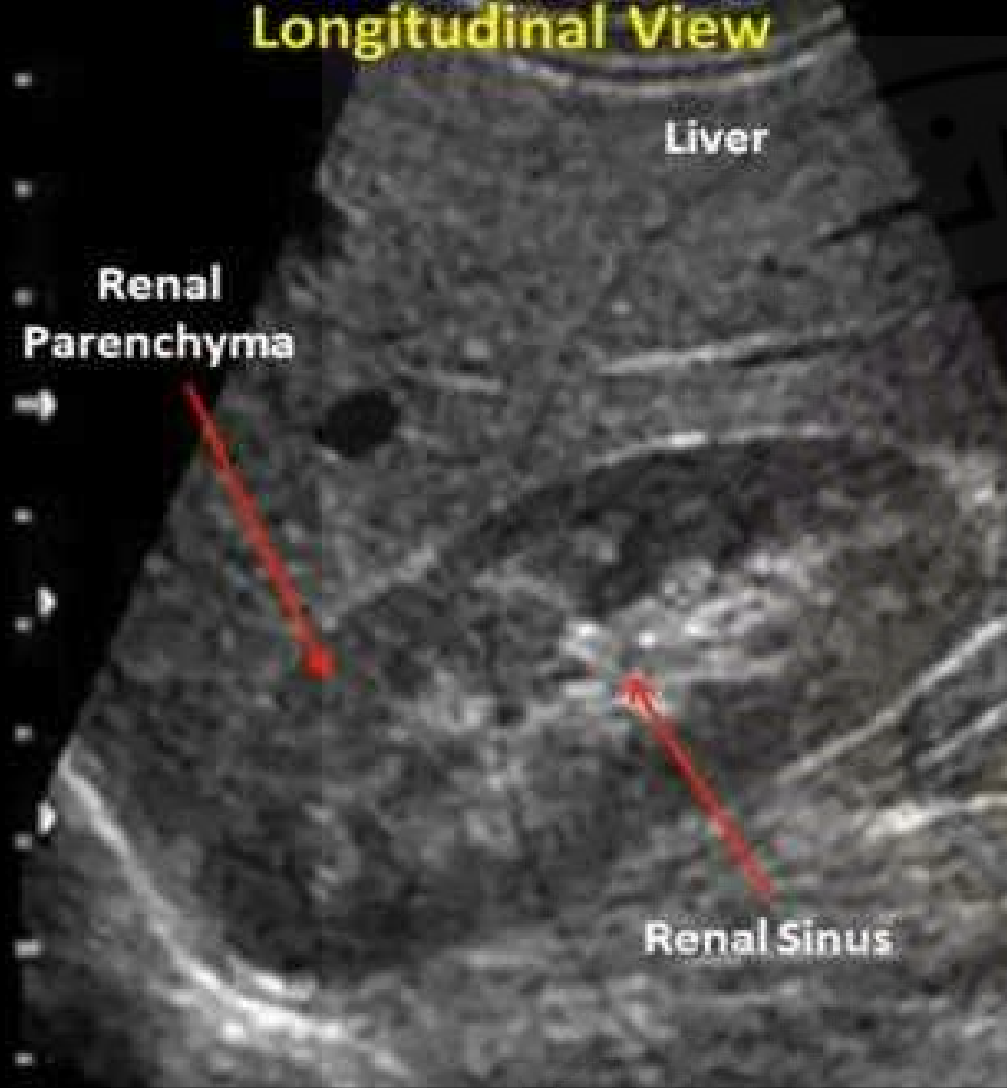


Normal

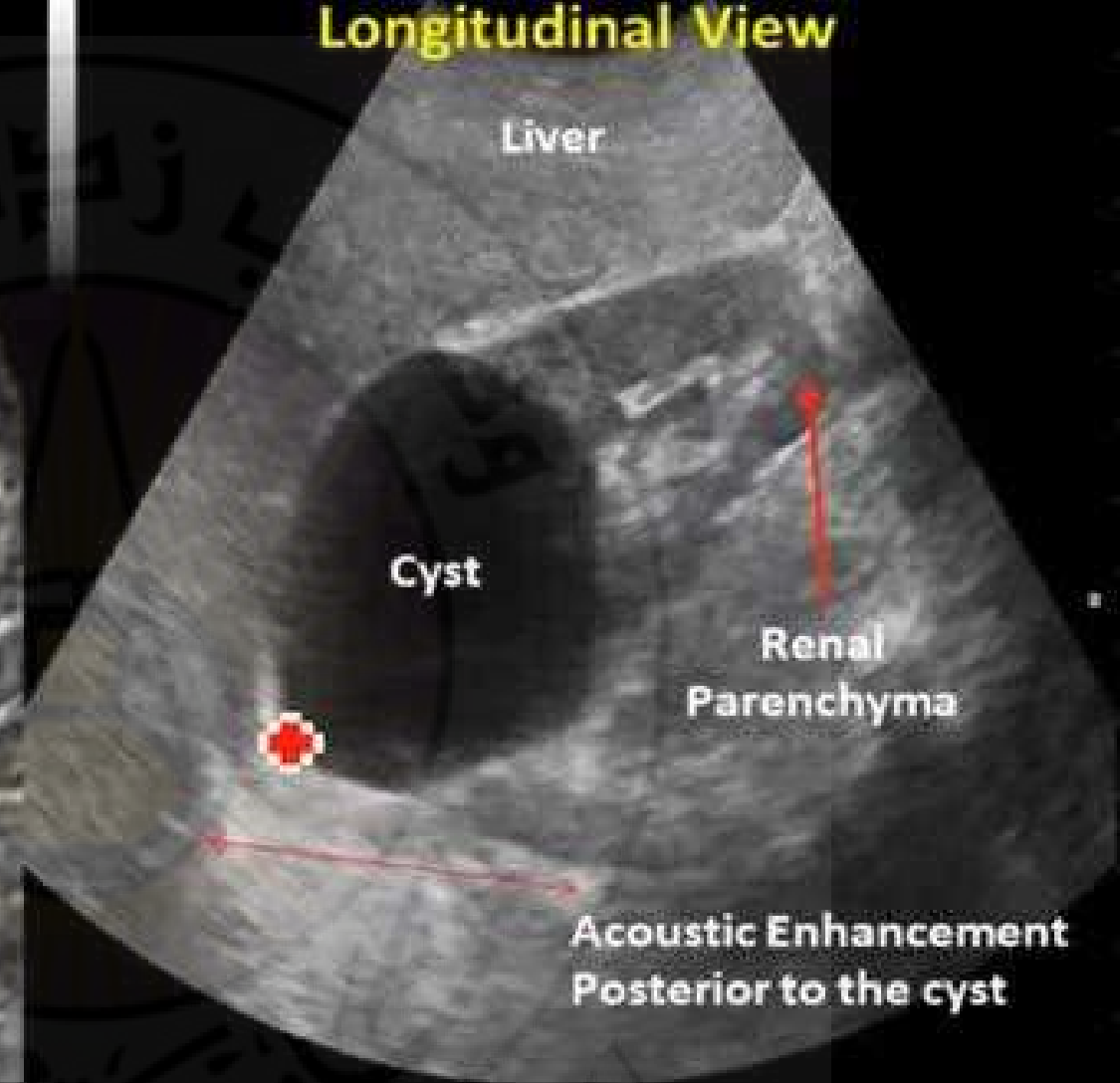
Renal Cysts

- Thin sacs filled with water-like fluid.
- Usually harmless

Longitudinal View



Longitudinal View



Normal

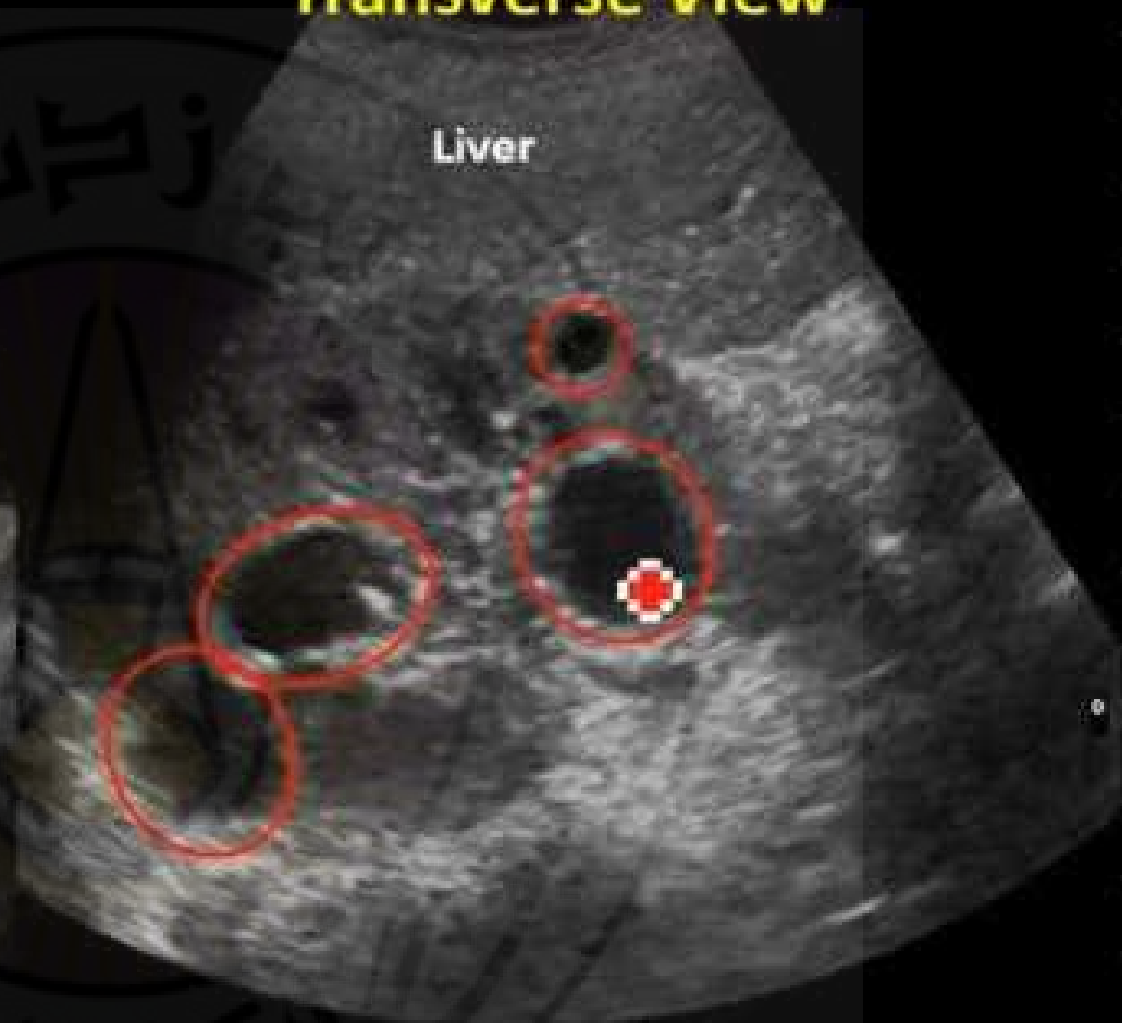
Renal Cysts

- Thin sacs filled with water-like fluid.
- Usually harmless

Transverse View



Transverse View

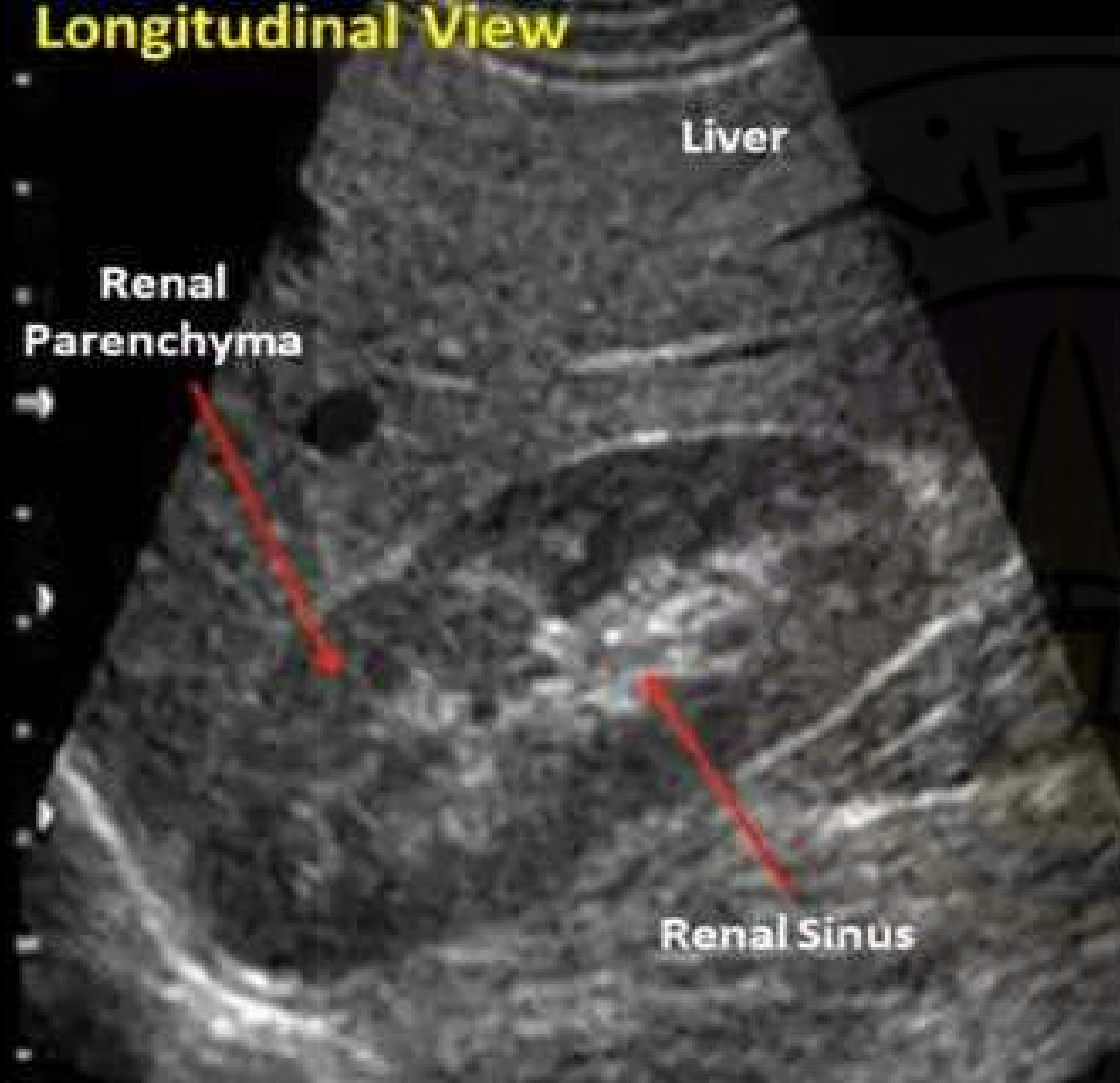


Normal

Polycystic Kidney Disease

Inherited disorder which produces multiple cysts in kidneys. Can also affect other organs like liver.

Longitudinal View



Longitudinal View



Normal

Renal Stone

Hard crystalline masses found in kidneys. Mostly cause posterior shadowing.

Transverse View



Normal

Transverse View



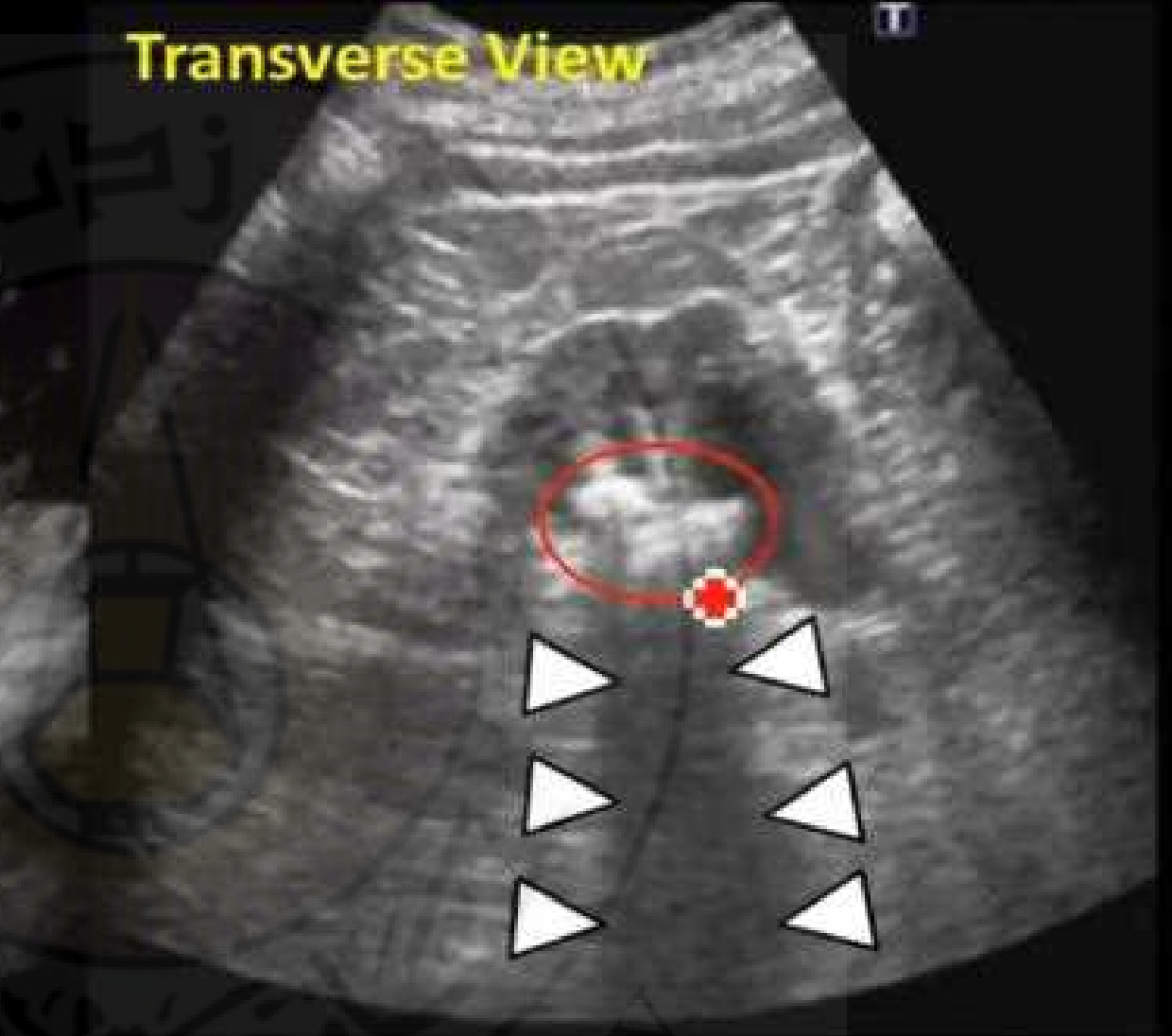
Renal Stone

Hard crystalline masses found in kidneys. Mostly cause posterior shadowing.

Transverse View



Transverse View



Normal

Staghorn Calculi

Calculi that involve the renal pelvis and at least 2 calyces

Longitudinal View



Longitudinal View



Normal

Staghorn Calculi

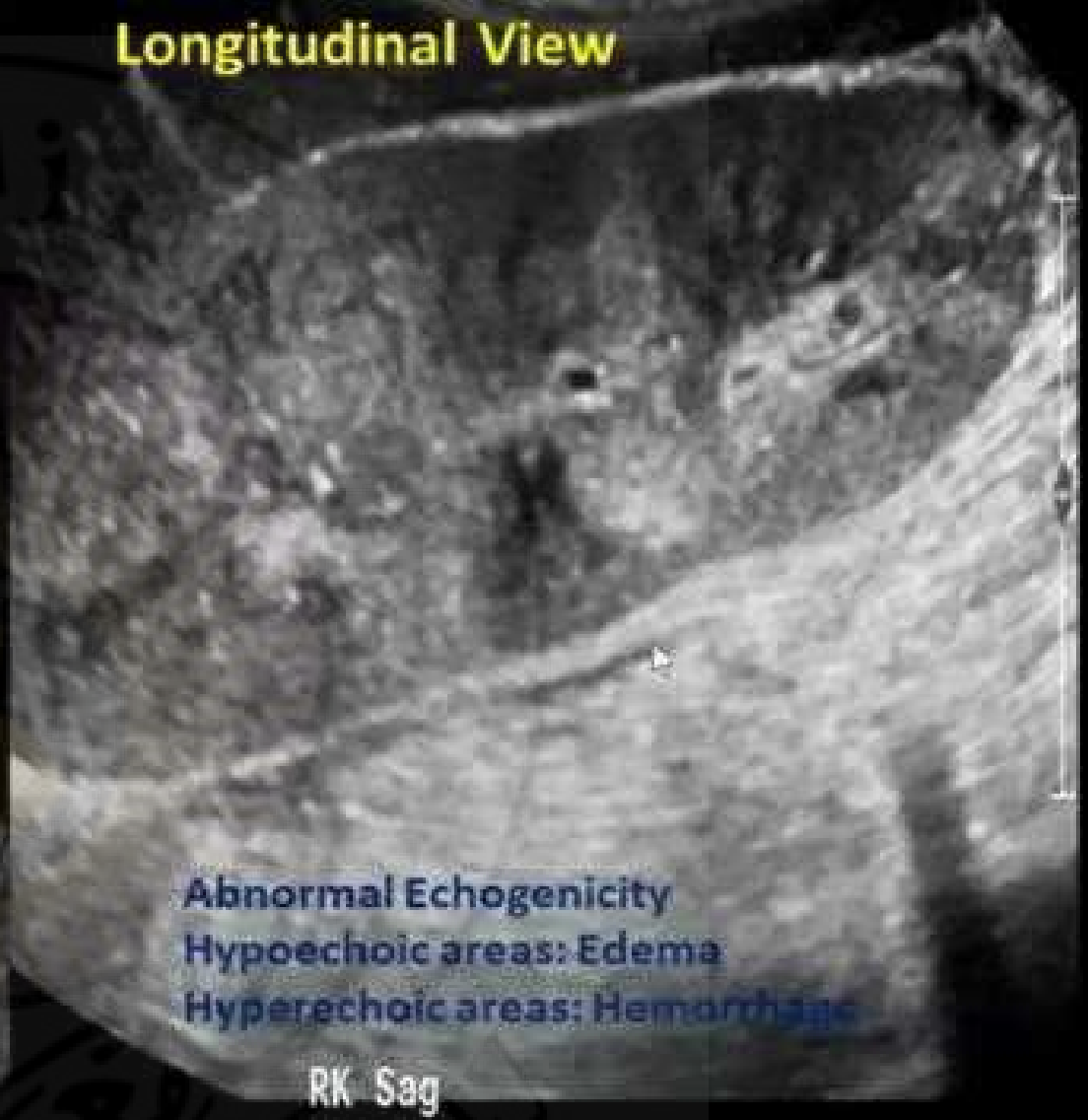
Calculi that involve the renal pelvis and at least 2 calyces

Longitudinal View



Normal

Longitudinal View



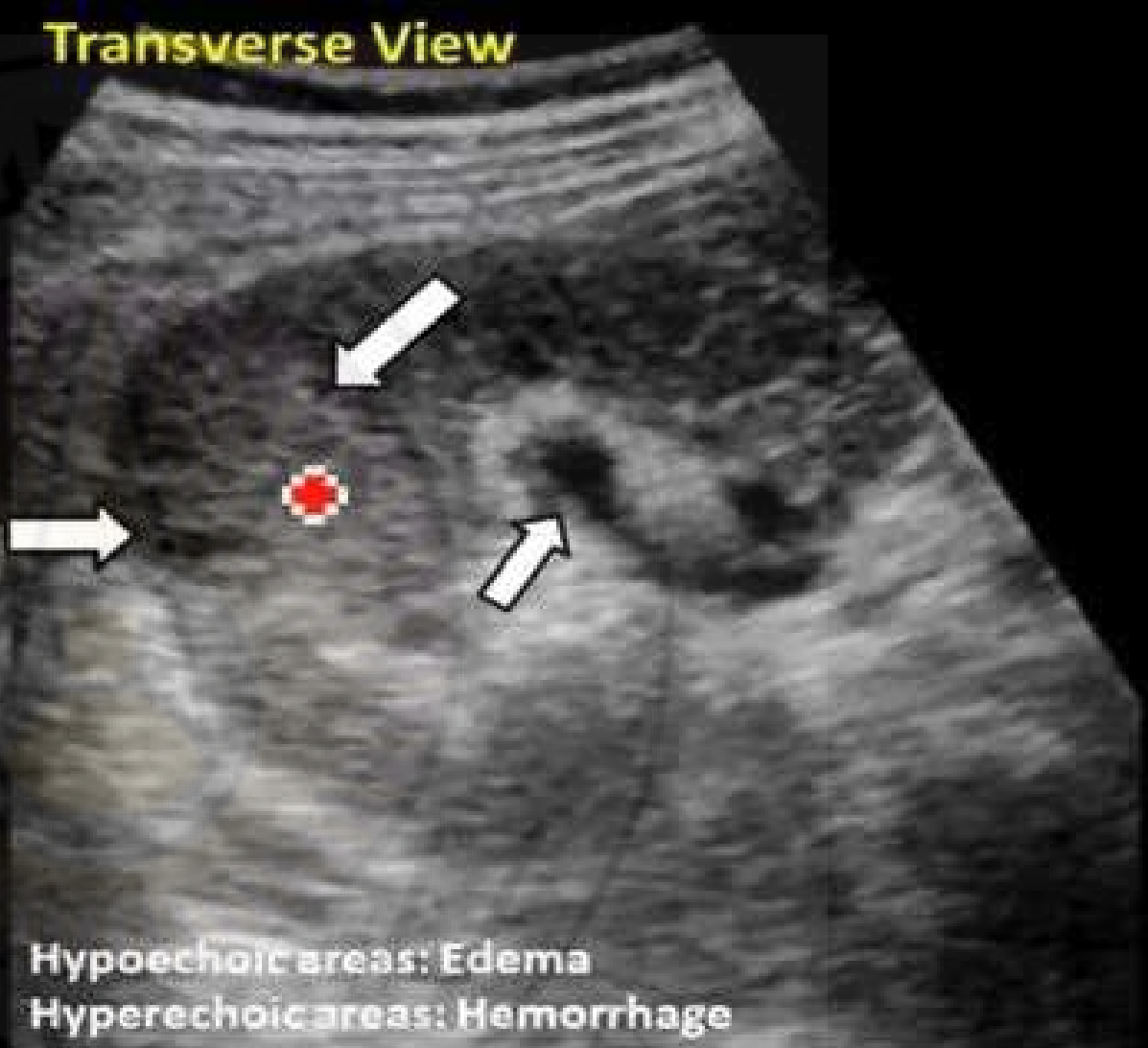
Pyelonephritis

Infection of the renal pelvis and renal parenchyma. Infection usually begins at the ureter and bladder.

Transverse View



Transverse View

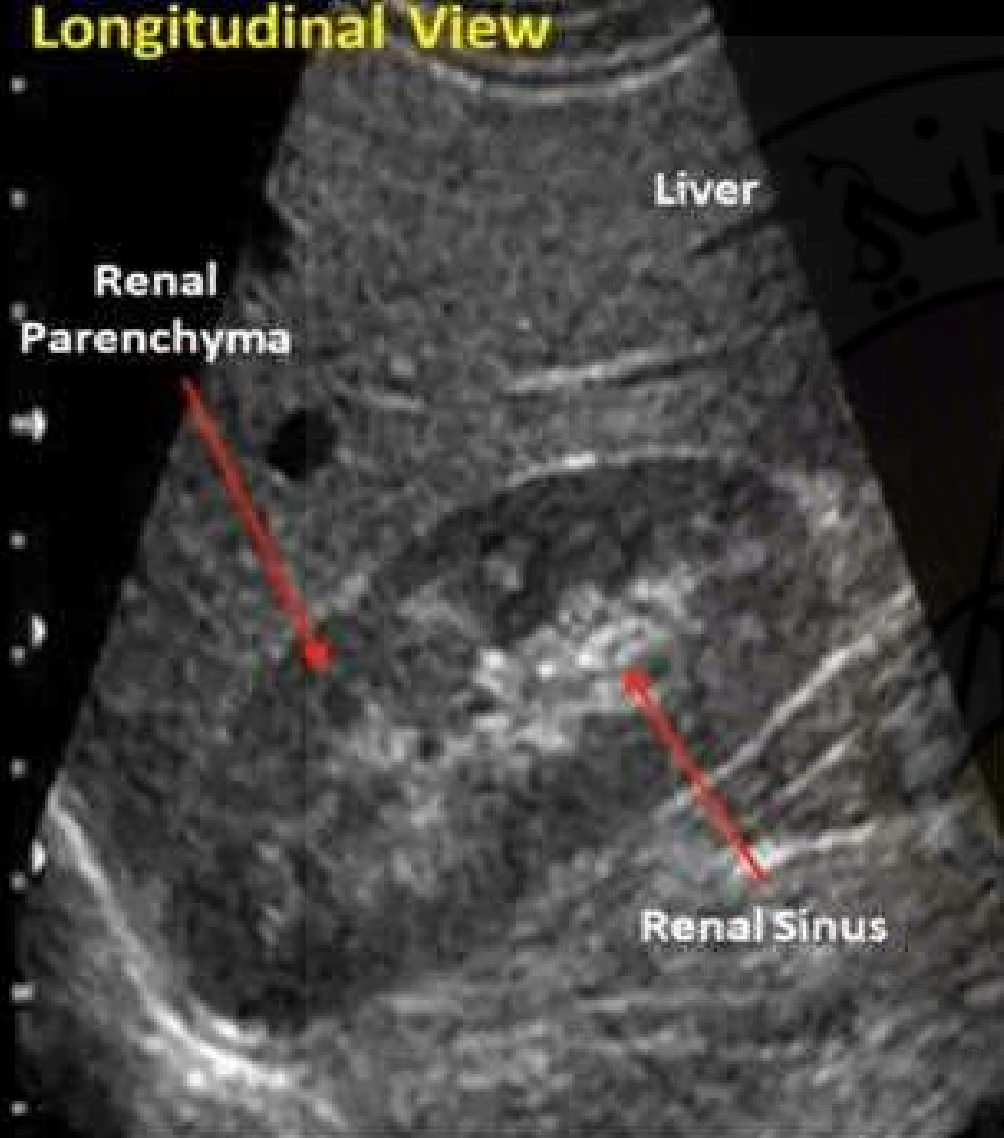


Normal

Pyelonephritis

Infection of the renal pelvis and renal parenchyma. Infection usually begins at the ureter and bladder.

Longitudinal View



Normal

Longitudinal View



Abnormal Echogenicity, markedly increased

Pyelonephritis

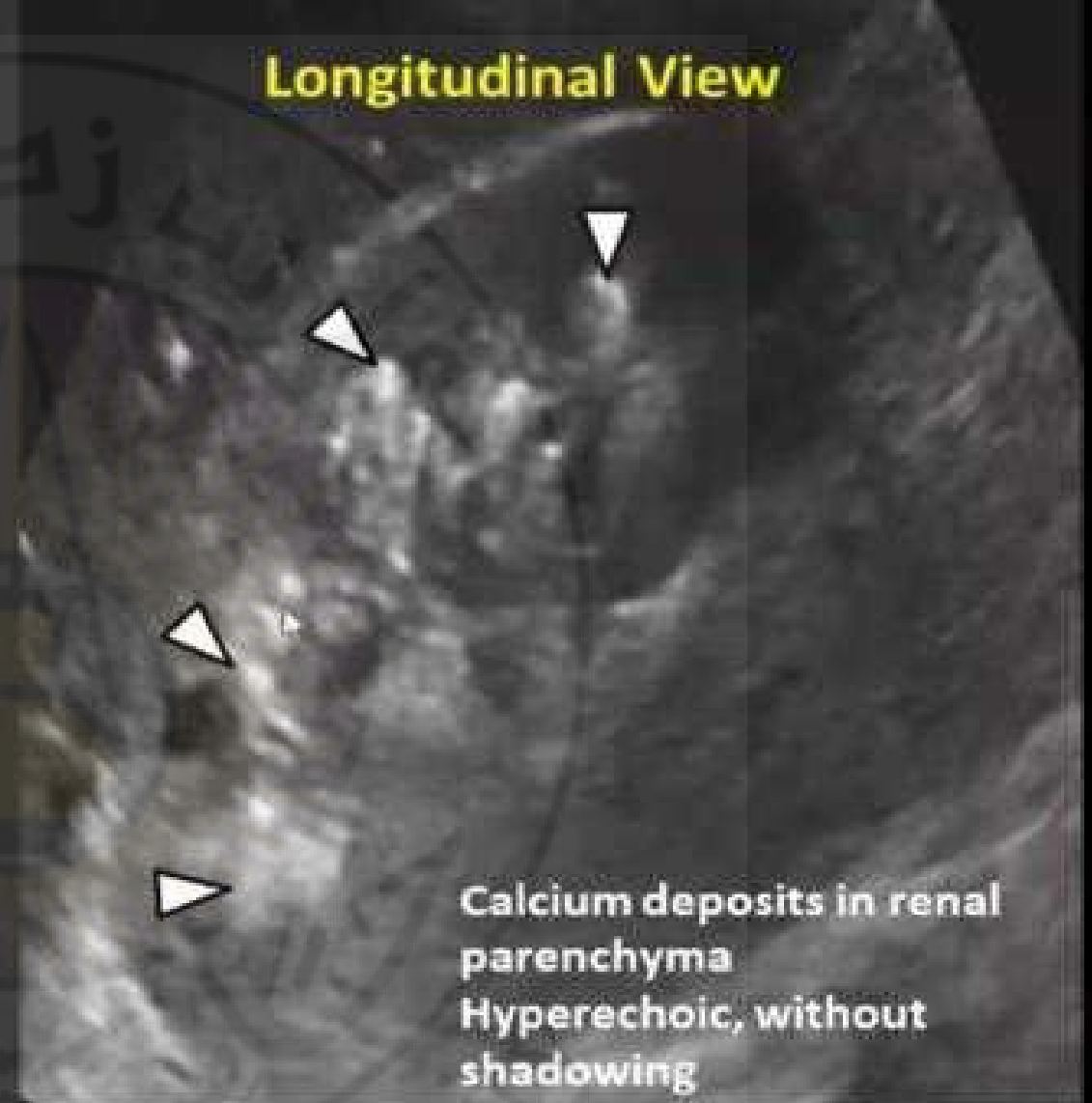
Infection of the renal pelvis and renal parenchyma. Infection usually begins at the ureter and bladder.

Longitudinal View



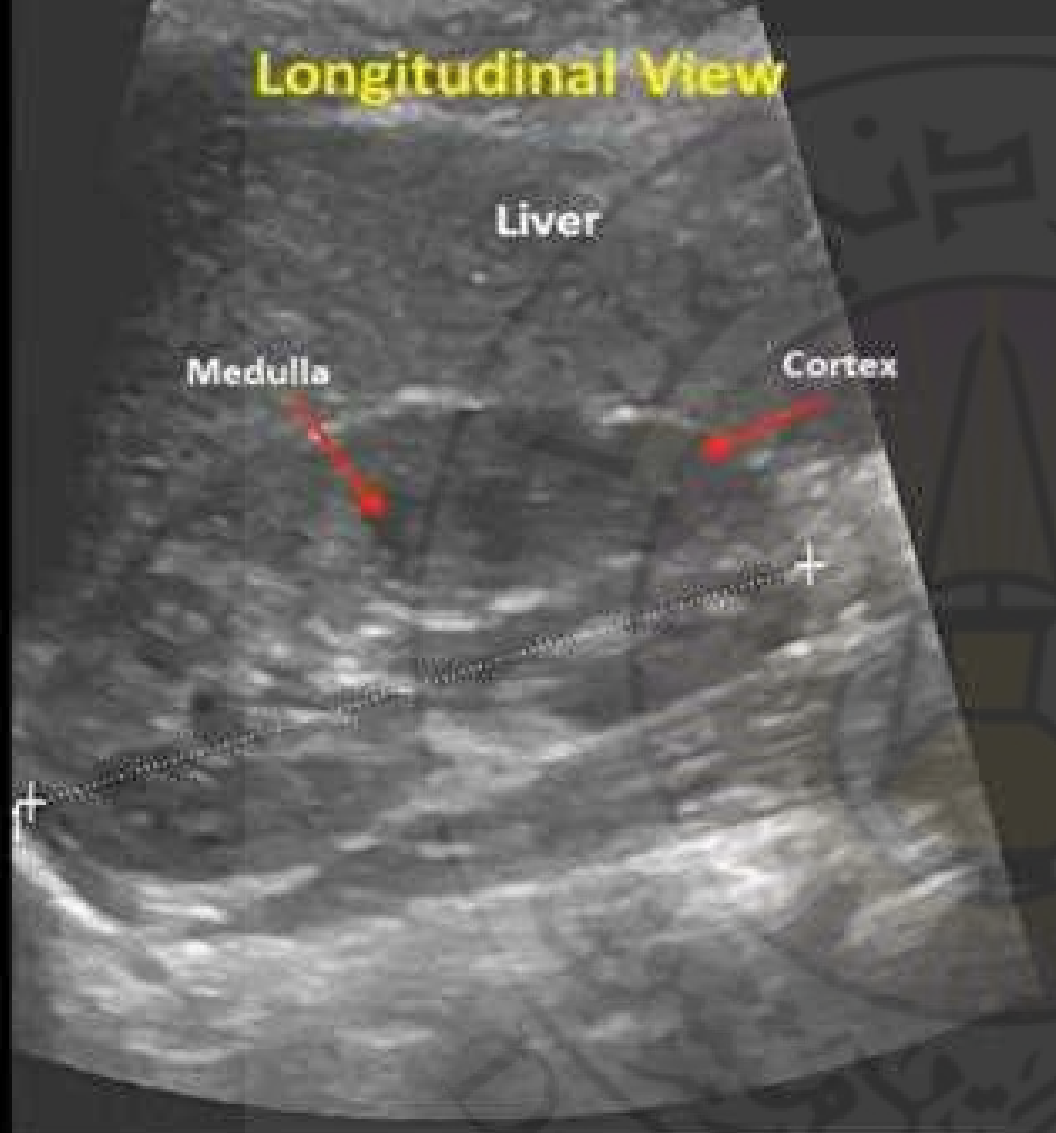
Normal

Longitudinal View

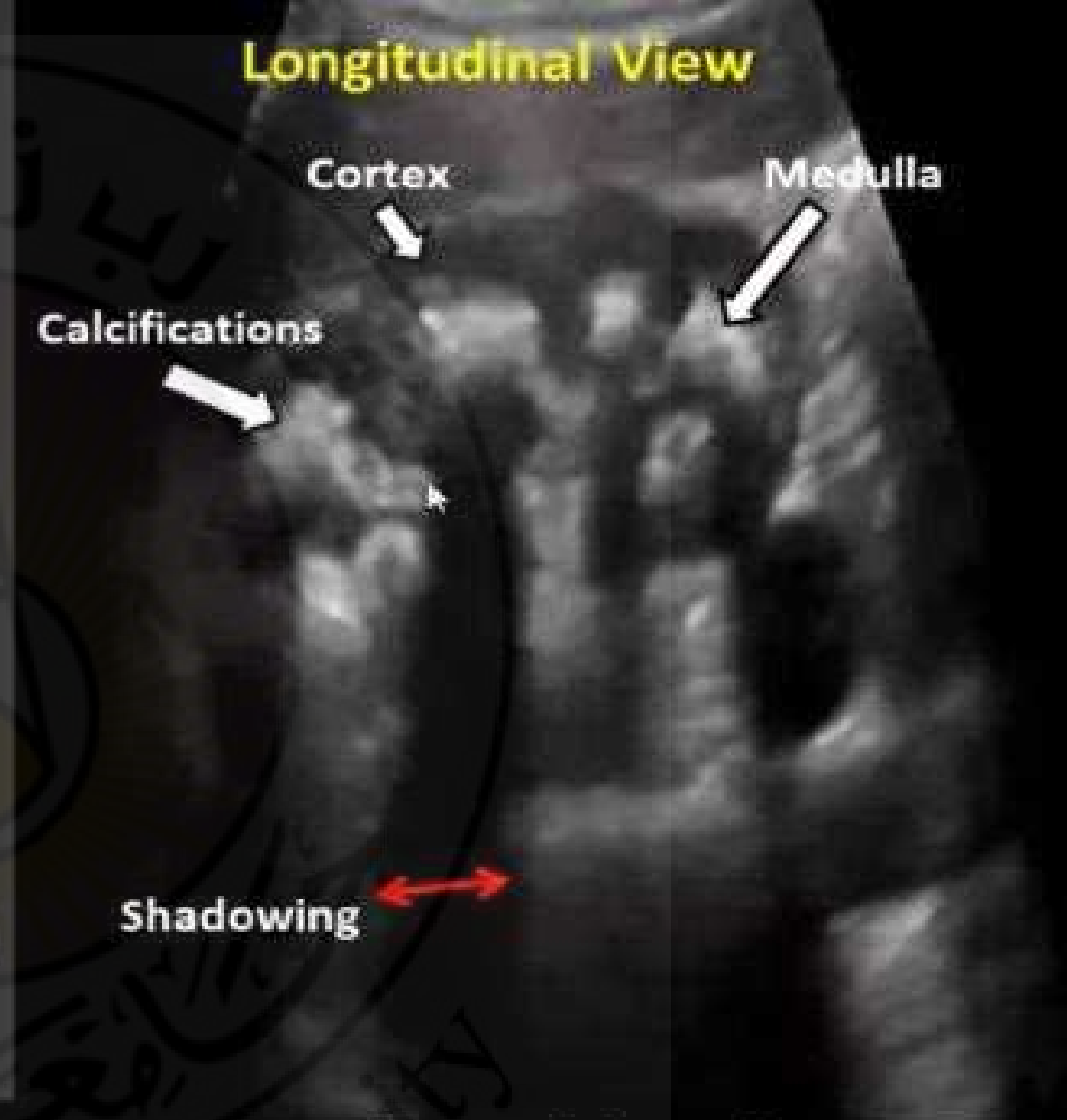


Nephrocalcinosis

Calcium deposits in renal parenchyma.
Most common location of deposition is
medulla



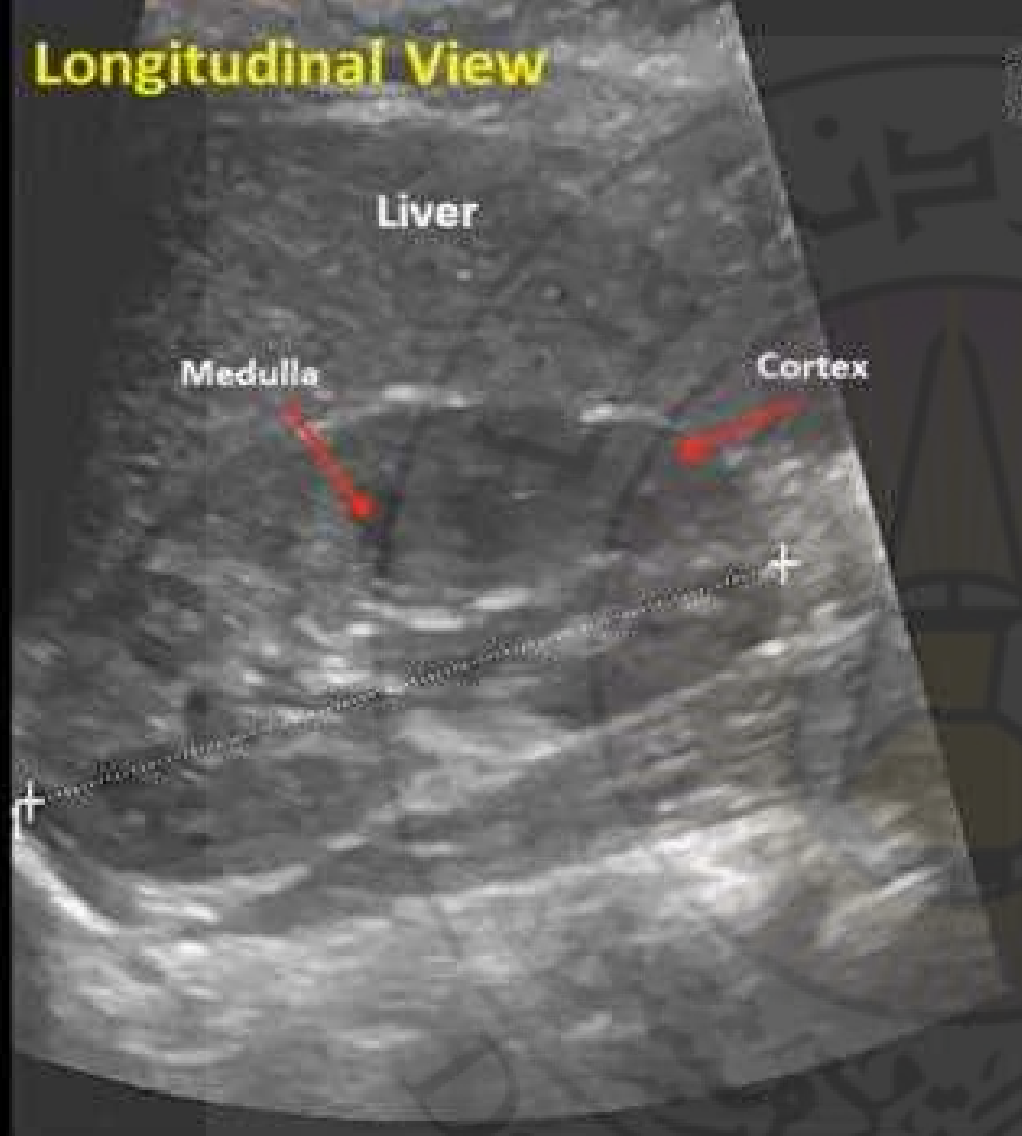
Normal



Nephrocalcinosis

Calcium deposits in renal parenchyma.
Most common location of deposition is
medulla

Longitudinal View



Longitudinal View



Normal

Chronic Kidney Disease

Gradual loss of kidney function over time

Longitudinal View

Liver

Medulla

Cortex

Renal
Sinus

Normal Grade 0

Renal Echogenicity less than liver
echogenicity

Longitudinal View

Liver

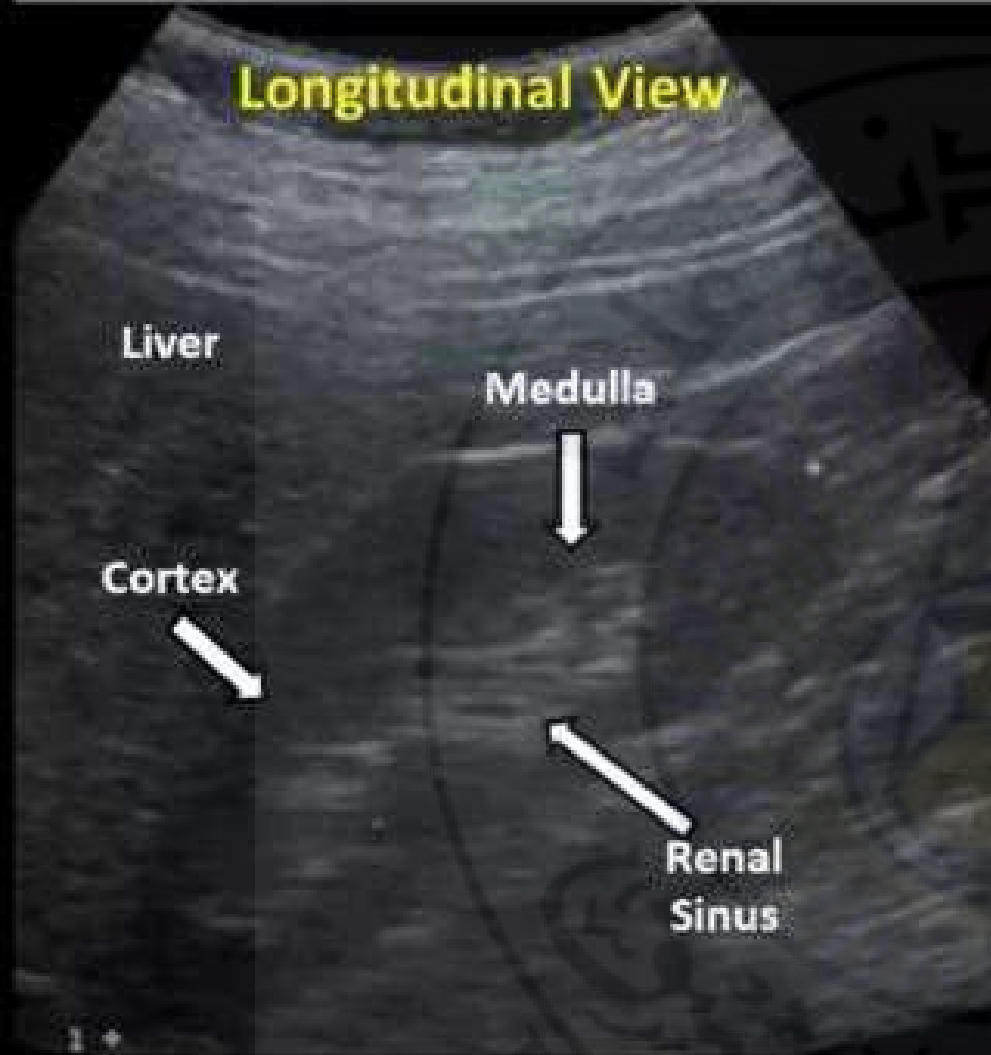
Medulla

Cortex

Renal
Sinus

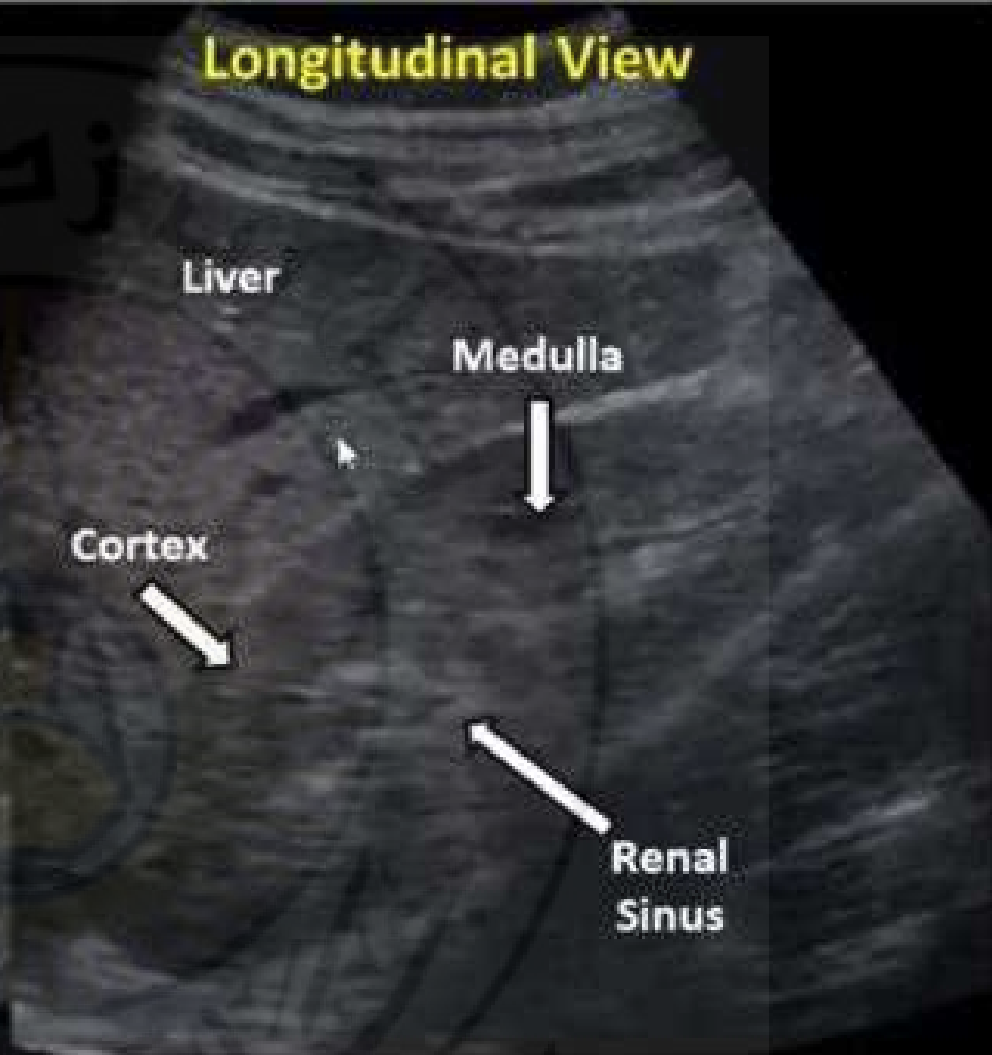
Grade 2 Echogenicity

Renal Echogenicity greater than liver
echogenicity



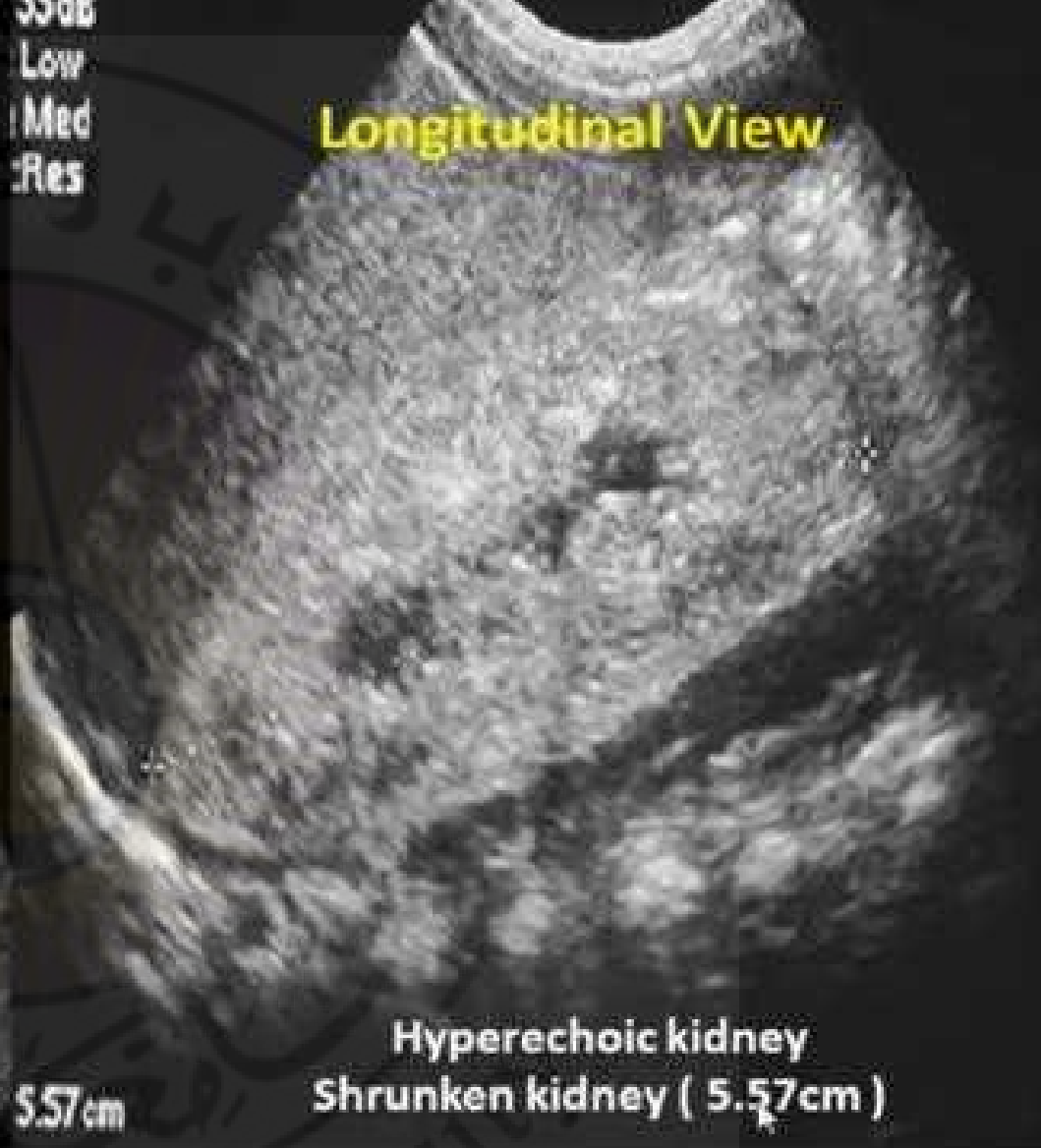
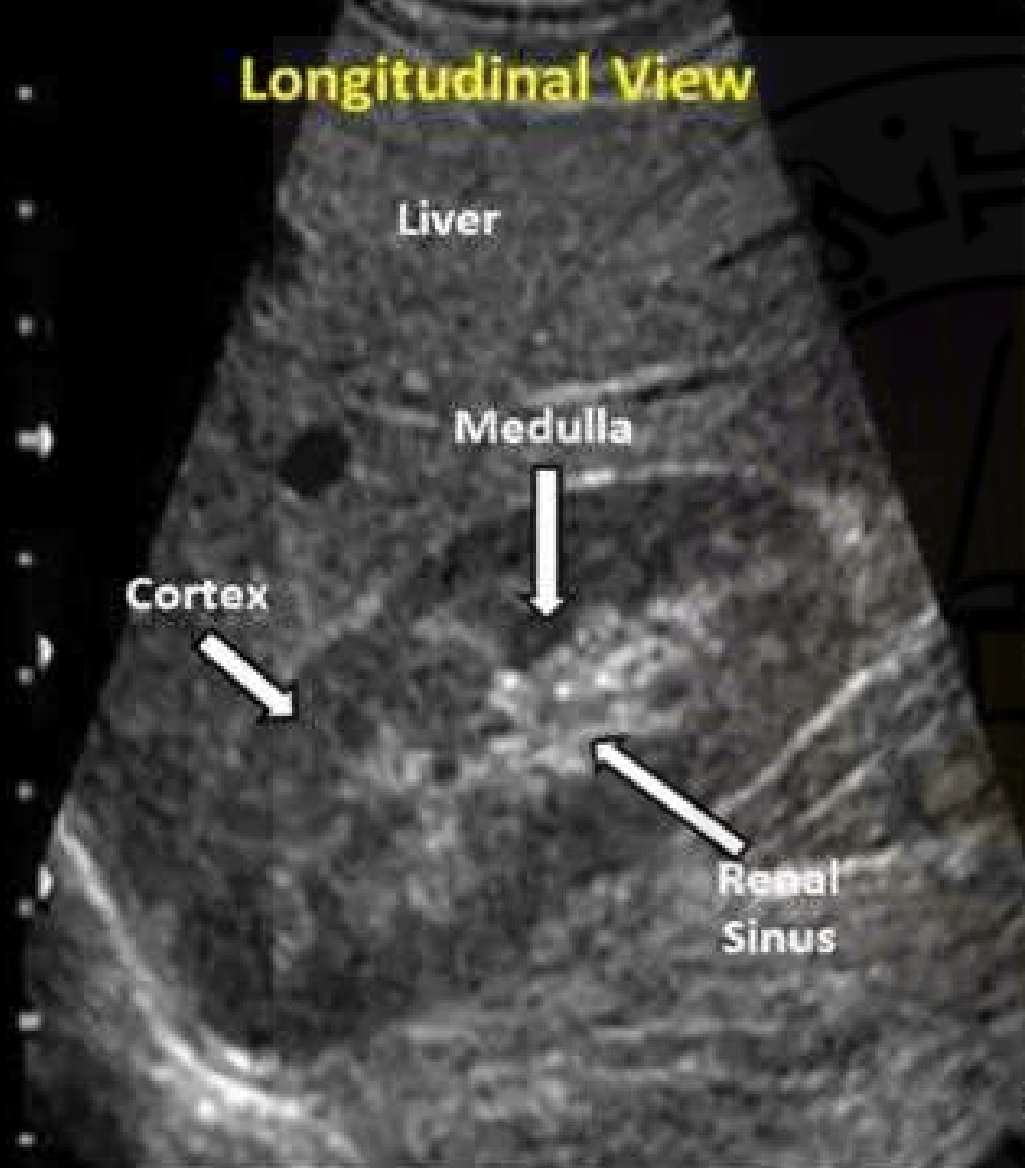
Normal Grade 0

Renal Echogenicity less than liver echogenicity



Grade 1 Echogenicity

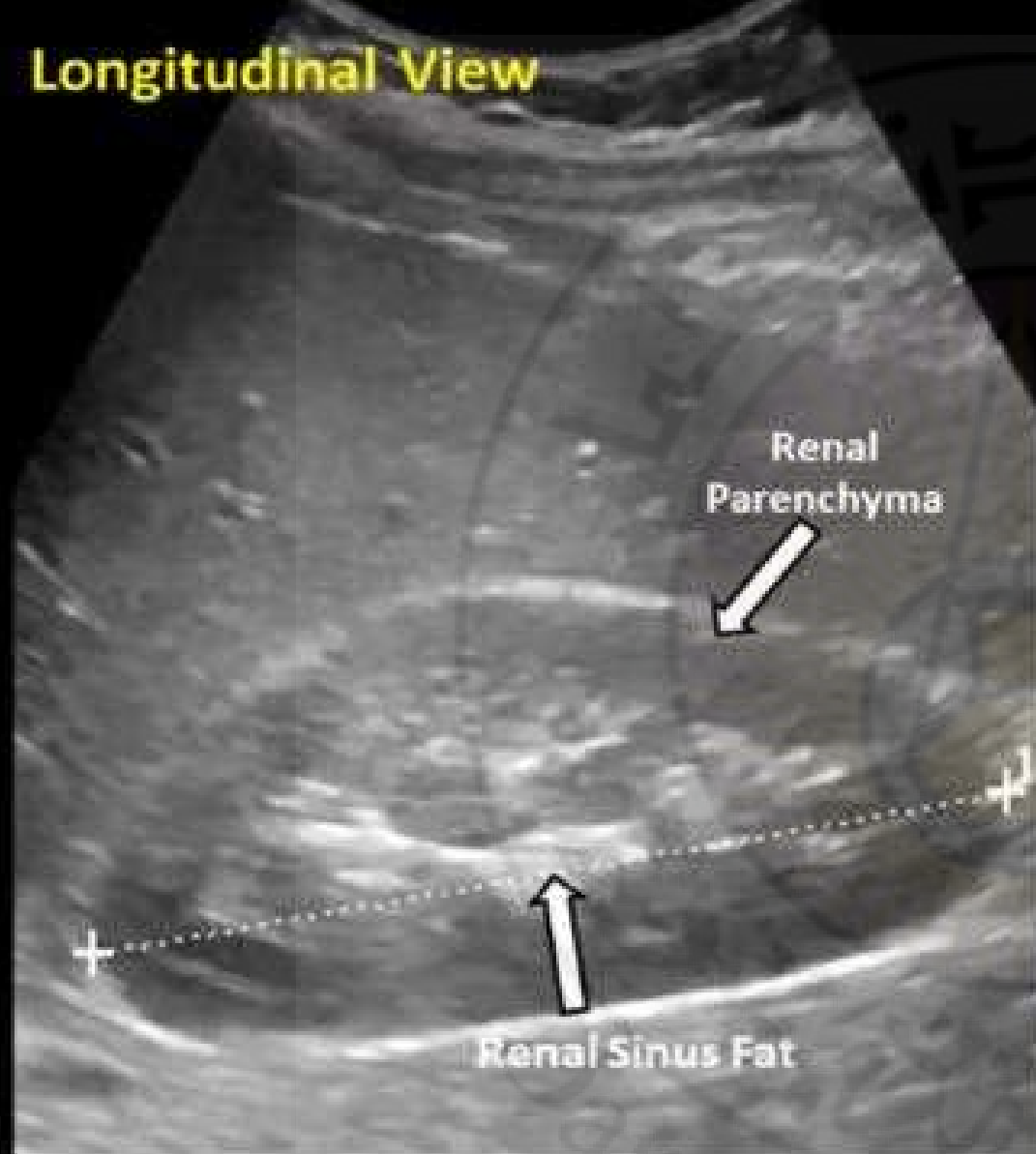
Renal Echogenicity equal to that of liver



Normal

Renal Failure
Kidneys completely lose
their function to filter blood

Longitudinal View



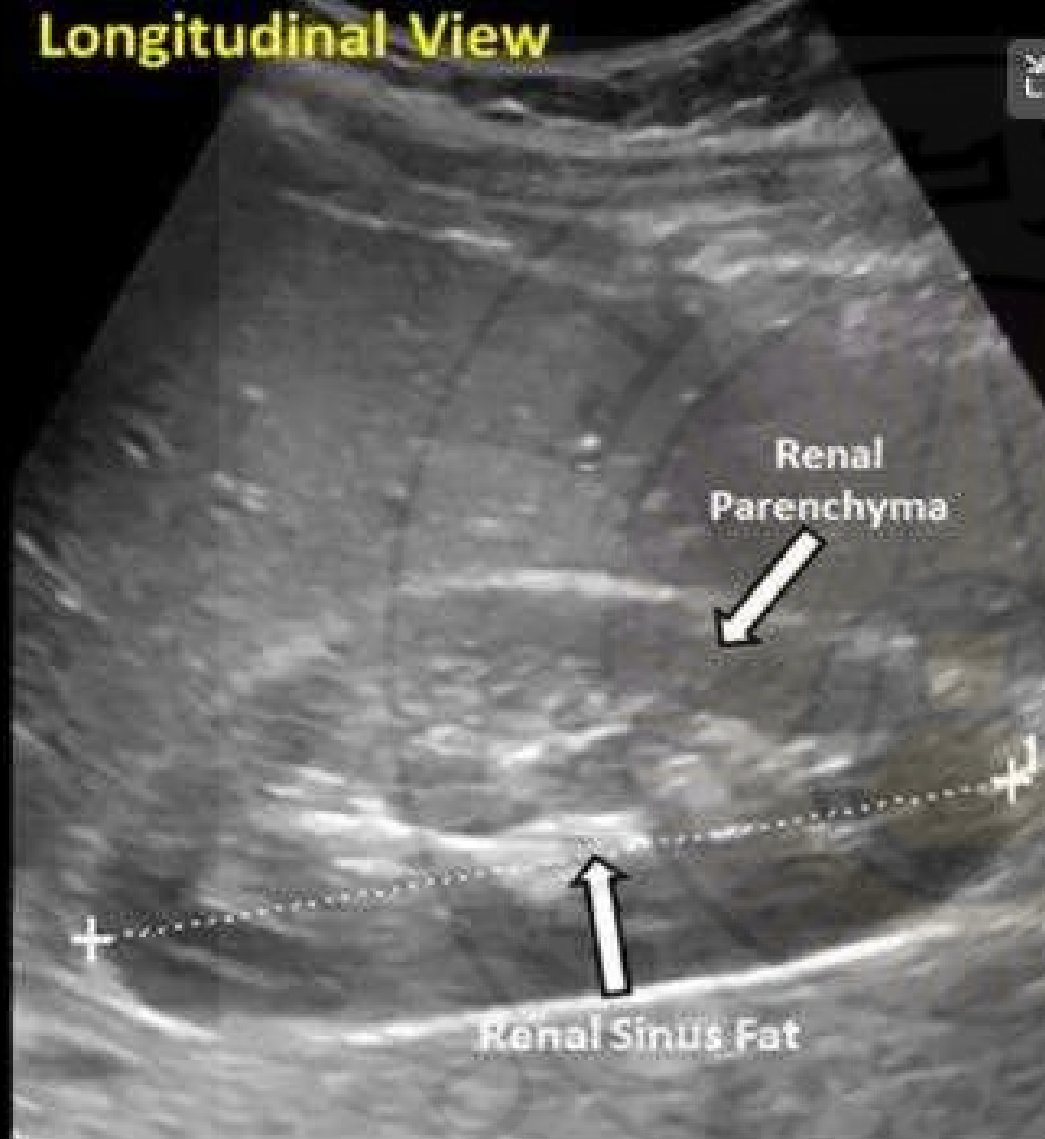
Normal

Longitudinal View



Angiomyolipoma
Benign renal tumor consisting of
vascular, smooth muscle and fat

Longitudinal View



Normal

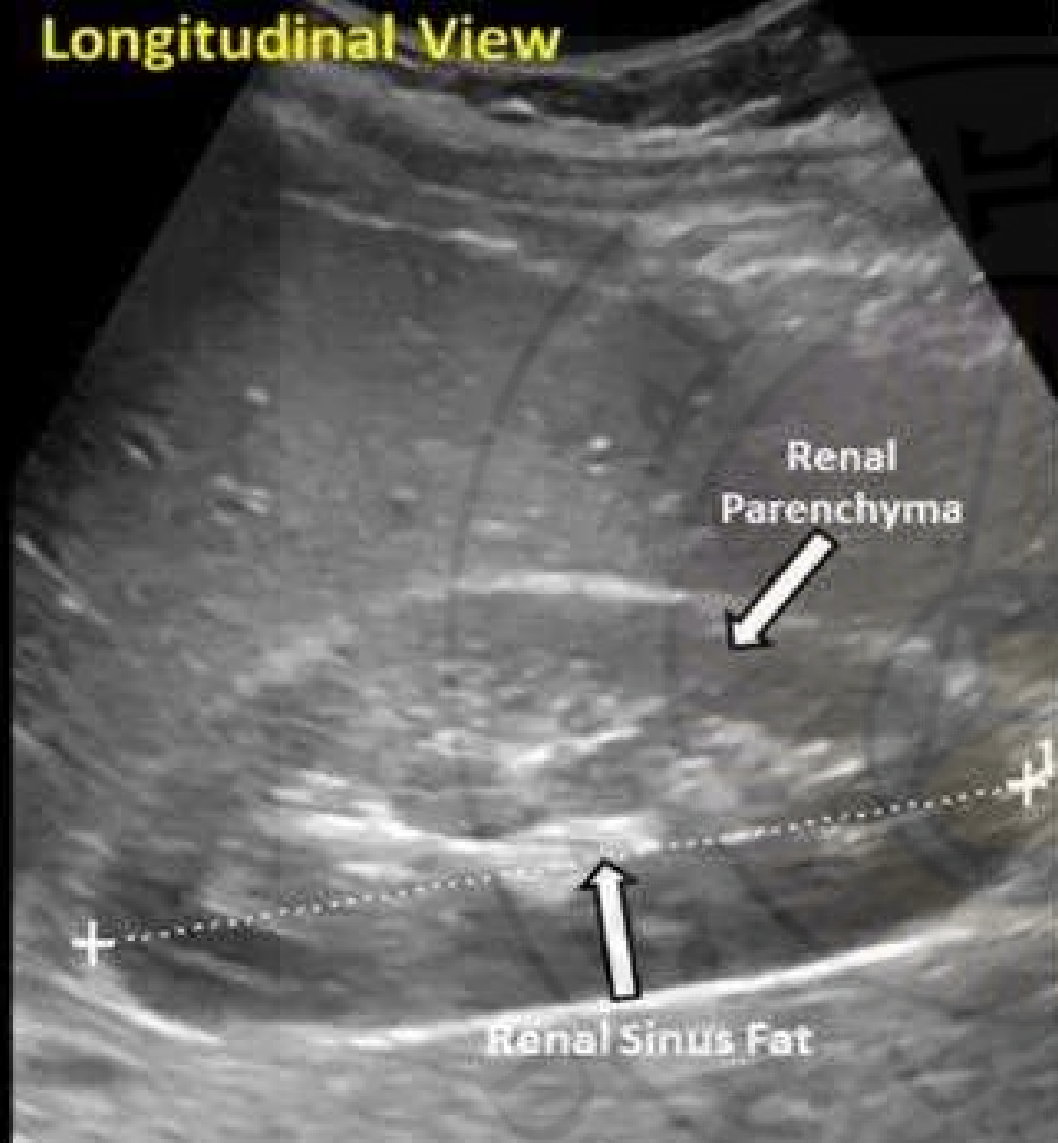
Longitudinal View



Angiomyolipoma

Benign renal tumor consisting of vascular, smooth muscle and fat

Longitudinal View



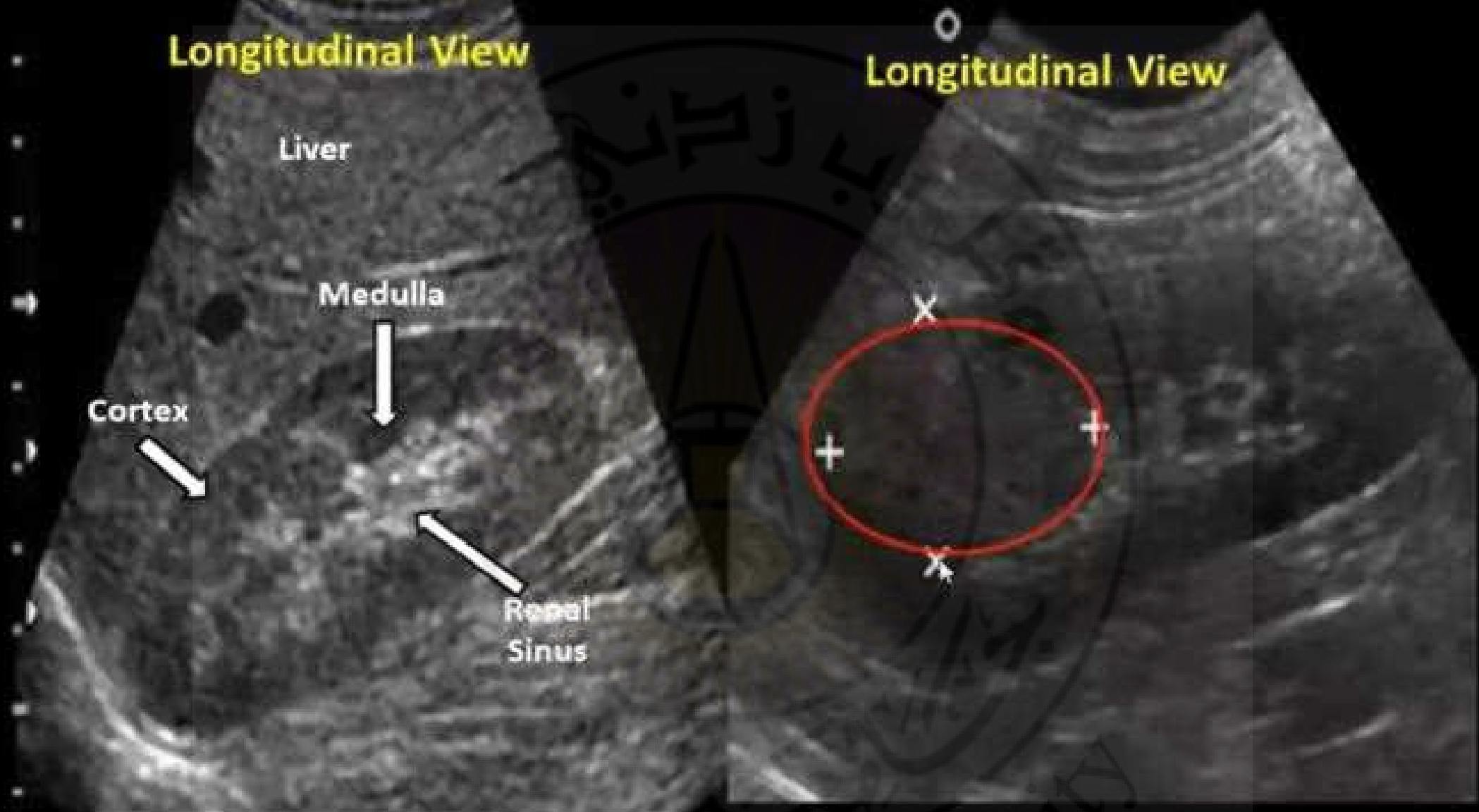
Normal

Longitudinal View



Wilm's Tumor

Large heterogeneous mass located in kidney



Normal

Renal Cell Carcinoma

- Malignant carcinoma of kidney
- Heterogenous mass

Transverse View

Liver

Renal
Parenchyma

Renal Sinus Fat

Transverse View

Renal
Parenchyma

Renal Sinus Fat

Normal

Renal Cell Carcinoma

- Malignant carcinoma of kidney
- Heterogenous mass

Coronal View



Coronal View



Normal

**Hydronephrosis
Grade 1**

Dilated renal pelvis without dilatation of
the calyces

Longitudinal View



Normal

Longitudinal View



Proximal Ureteral Stone

Kidney stones can be stuck in proximal ureter

Coronal View



Coronal View



Normal

**Hydronephrosis
Grade 2**

Mild renal pelvis and calyces
dilatation

Longitudinal View



Longitudinal View



Normal

**Hydronephrosis
Grade 3**

Moderate dilatation of the renal
pelvis and calyces

Longitudinal View



Normal

Longitudinal View

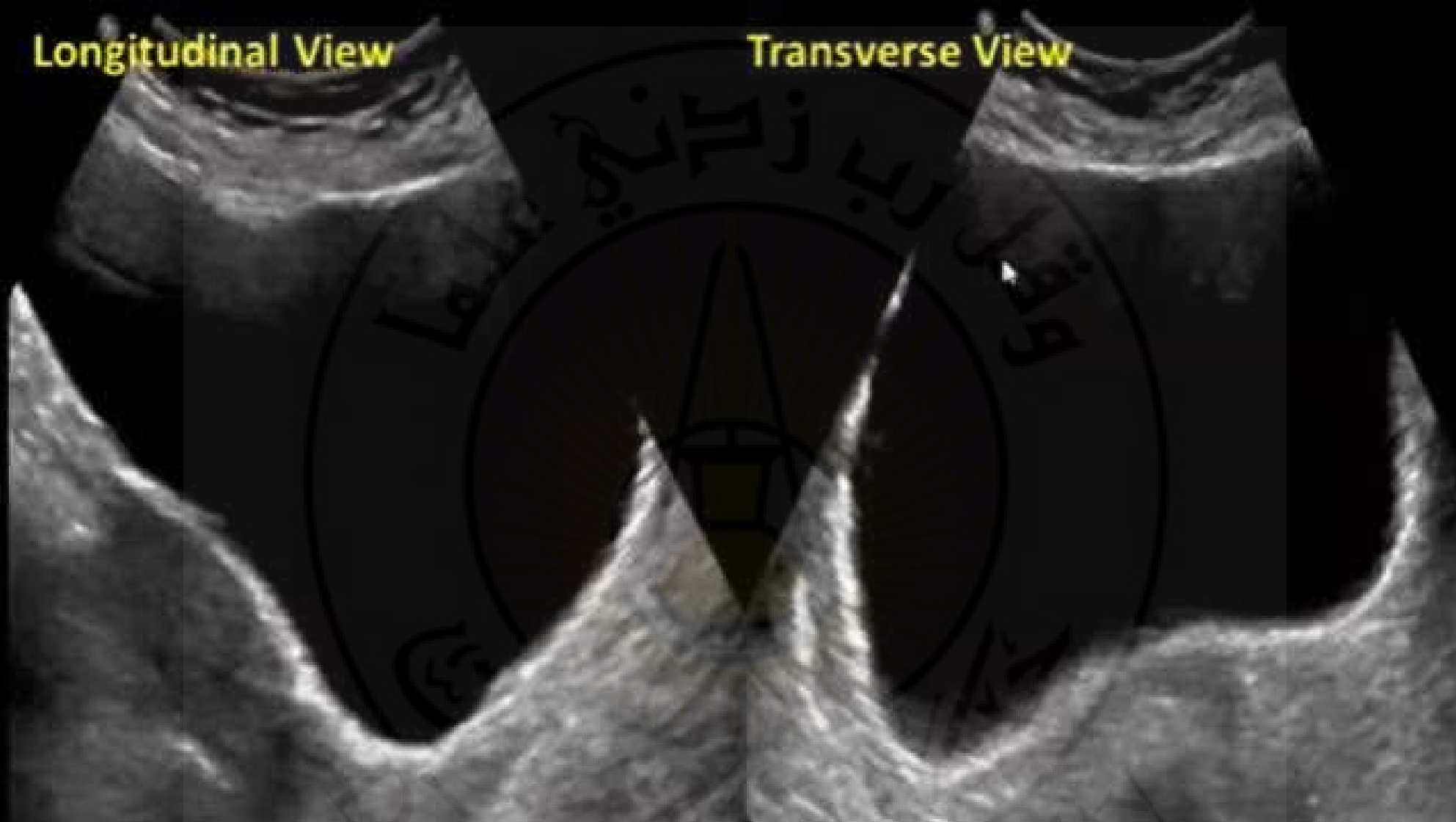


Hydronephrosis Grade 4

Severe dilatation of renal pelvis and calyces. Cortical thinning indicates renal atrophy

Longitudinal View

Transverse View



Normal Bladder

Transverse View



Transverse View



Normal

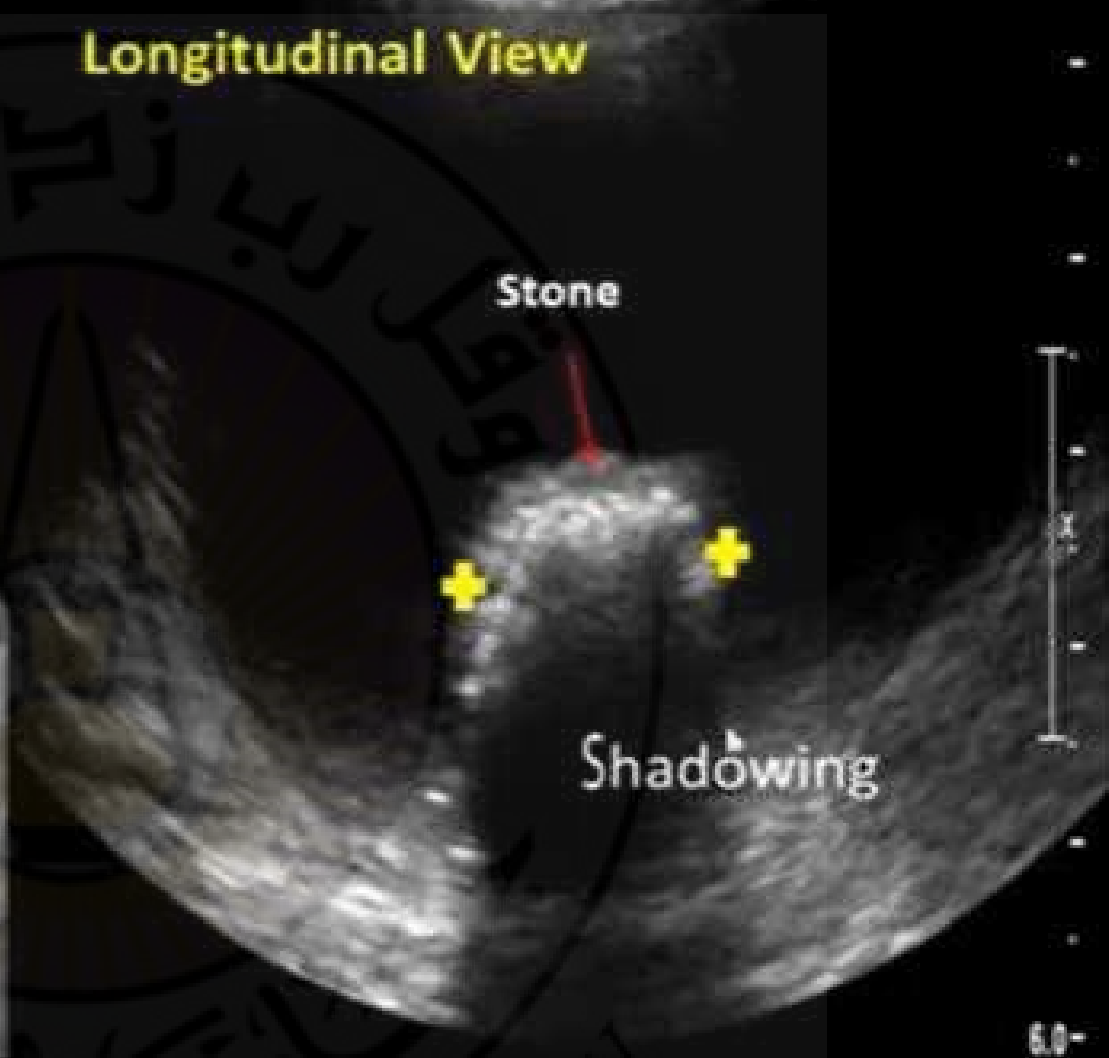
Cystitis

Inflammation of bladder
Bladder wall thickness $>5\text{mm}$

Longitudinal View



Longitudinal View

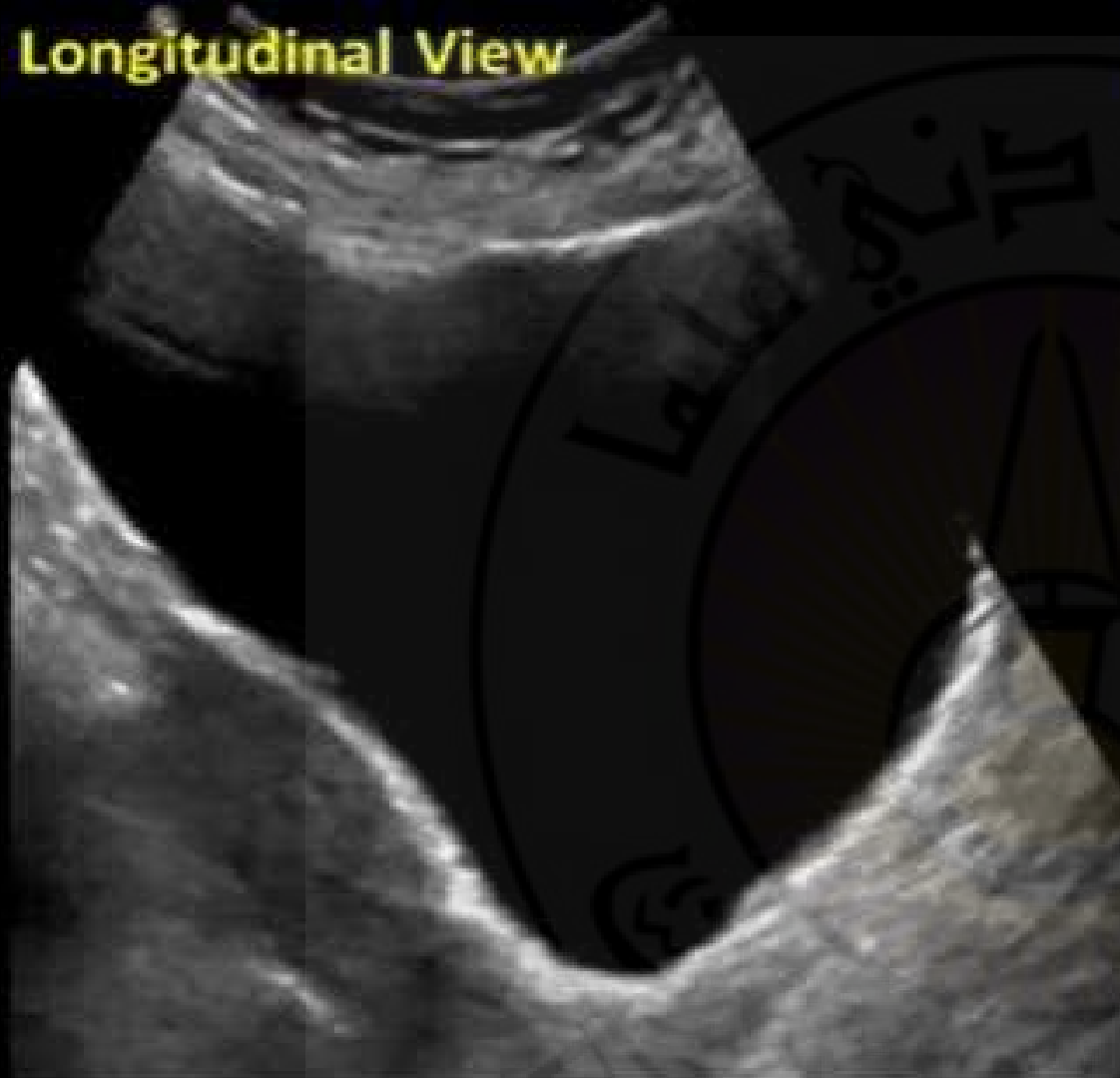


Normal

Bladder Stone

Formed in the bladder due to hardening of minerals

Longitudinal View



Longitudinal View



Hyperechoic Debris

Normal

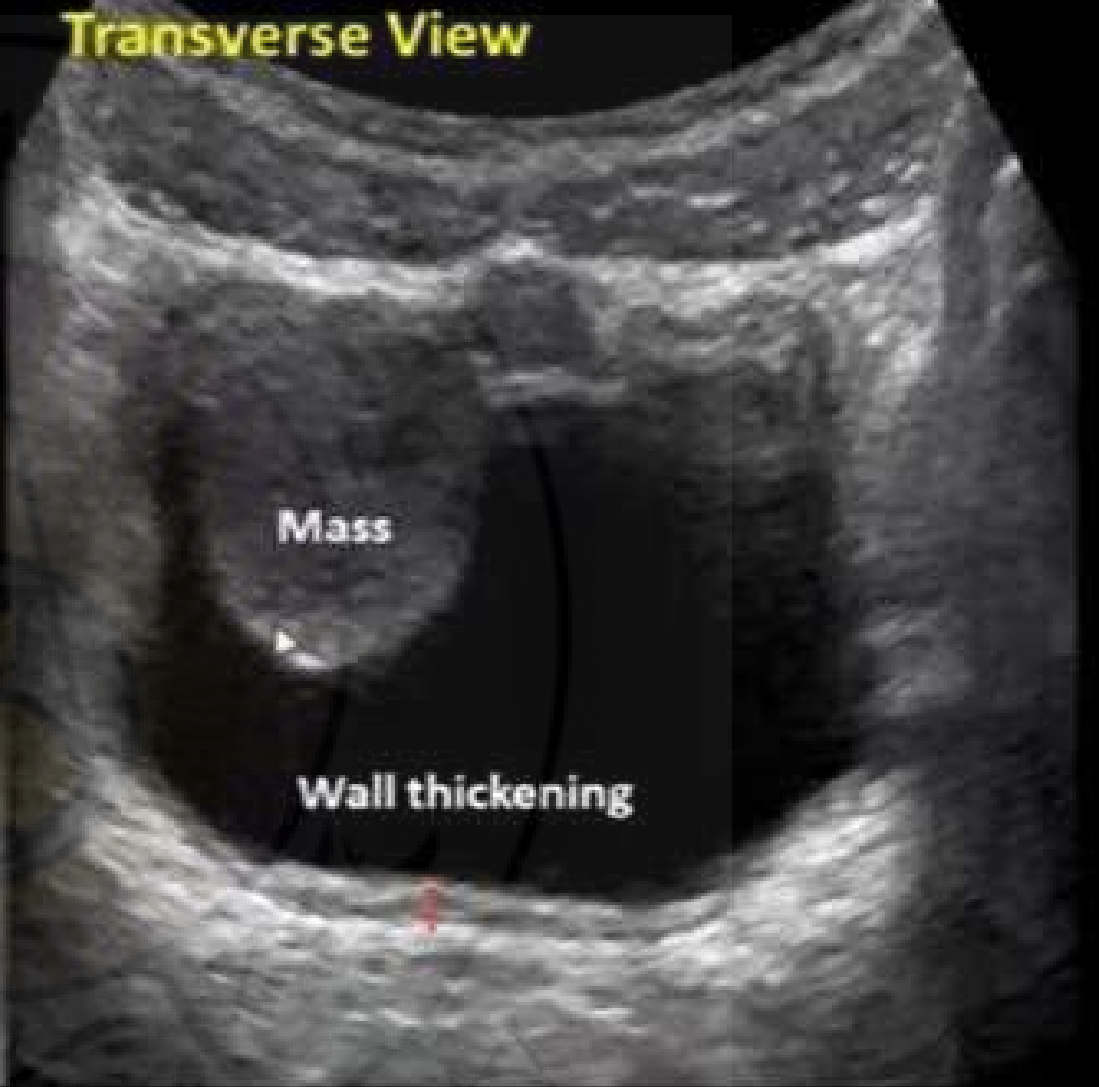
Bladder Debris

Can be caused by dehydration, inflammation, infection, and hemorrhage.

Transverse View



Transverse View



Normal

Bladder Cancer

Transitional cell carcinoma (TCC), also called urothelial cell carcinoma (UCC) is most common type of bladder cancer

Thank You

