Ultrasound In Abdominal Emergencies

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“Acute Abdomen”

- A medical emergency, in which there is recent onset of sudden and severe pain .
- Ranging from a benign and self-limiting disease to a surgical emergency.

- Only one quarter of patients who have previously been classified with an acute abdomen actually receive surgical treatment

“Acute Abdomen”

- **Only** in a small proportion of patients

  A confident and accurate diagnosis can be made solely on the basis of medical history, physical examination, and laboratory test findings ,

- **So imaging plays a pivotal role**.

Imaging strategies for detection of urgent conditions in patients with acute abdominal pain: diagnostic accuracy study

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The 11 imaging strategies investigated

- 1) Clinical diagnosis

Single test strategies

- 2) Clinical diagnosis after plain radiographs

- 3) Ultrasonography in all patients

- 4) Computed tomography (CT) in all patients

Conditional strategies

- 5) Ultrasonography in all patients; CT if ultrasonography negative or inconclusive

- 6) Ultrasonography in all patients; CT if ultrasonography inconclusive

Strategies driven by patients' characteristics

- 7) If age <45 then ultrasonography and CT if ultrasonography negative or inconclusive; if age ≥45 then CT

- 8) If body mass index <30 then ultrasonography and CT if ultrasonography negative or inconclusive; if body mass index ≥30 then CT

- 9) If body mass index <30 or age <45 then ultrasonography and CT if ultrasonography negative or inconclusive; CT in all other patients

Strategies driven by location of pain

- 10) If tenderness in right upper quadrant then ultrasonography; if tenderness in right lower quadrant, left upper quadrant, or left lower quadrant then CT; if diffuse tenderness then CT; CT in all other patients

- 11) If tenderness in right upper quadrant or right lower quadrant then ultrasonography; if tenderness in left lower quadrant or left upper quadrant then CT; if diffuse tenderness then CT; CT in all other patients

Table 2 Diagnostic accuracy and use of imaging for each imaging strategy. Values are percentages (95% confidence intervals); numbers

Imaging strategies	Sensitivity (true positives)	Specificity (true negatives)	Missed urgent diagnoses (false negatives)	False positives*	CT use	US use
1) Clinical diagnosis	88 (86 to 91); 582	41 (36 to 46); 147	12 (79)	27; 213/795	0	0
Single imaging strategies						
2) Clinical diagnosis after plain radiographs	88 (86 to 91); 583	43 (38 to 48); 154	12 (78)	26; 206/789	0	0
3) Ultrasonography in all patients	70 (67 to 74); 465	85 (81 to 88); 305	30 (196)	11; 55/520	0	100; 1021
4) Computed tomography in all patients	89 (87 to 92); 591	77 (72 to 81); 276	11 (70)	12; 84/675	100; 1021	0
Conditional strategies						
5) US in all patients; CT if US negative†	94 (92 to 96); 620	68 (64 to 73); 246	6 (41)	16; 114/734	49 (46 to 52); 501	100; 1021
6) US in all patients; CT if US inconclusive	85 (82 to 88); 563	76 (71 to 80); 272	15 (98)	14; 88/651	27 (24 to 29); 271	100; 1021

BMI=body mass index; CT=computed tomography; LLQ=left lower quadrant; LUQ=left upper quadrant; RLQ=right lower quadrant; RUQ=right upper quadrant; US=ultrasonography.

*Calculated as false positives/all positives.

†Including inconclusive ultrasonography.

Strategies driven by patients' characteristics						
7) If age <45 then US and CT if US negative†; if age ≥45 then CT	90 (87 to 92); 593	72 (67 to 76); 258	10 (68)	15; 102/695	78 (76 to 81); 800	47 (44 to 50); 484
8) If BMI <30 then US and CT if US negative†; if BMI ≥30 then CT	91 (88 to 93); 599	71 (67 to 76); 257	9 (62)	15; 103/702	56 (53 to 59); 570	85 (82 to 87); 864
9) If BMI <30 or age <45 then US and CT if US negative†; CT in all other patients	90 (87 to 92); 593	72 (68 to 77); 260	10 (68)	14; 100/693	81 (78 to 83); 825	42 (39 to 45); 426
Strategies driven by location of pain						
10) If tenderness RUQ then US; if tenderness RLQ, LUQ, or LLQ then CT; if diffuse tenderness then CT; CT in all other patients	89 (87 to 92); 591	78 (73 to 82); 279	11 (70)	12; 81/672	95 (93 to 96); 970	5 (4 to 7); 51
11) If tenderness RUQ or RLQ then US; if tenderness LLQ or LUQ then CT; if diffuse tenderness then CT; CT in all other patients	84 (81 to 87); 555	79 (75 to 83); 285	16 (106)	12; 75/630	65 (62 to 68); 660	35 (32 to 38); 361

BMI=body mass index; CT=computed tomography; LLQ=left lower quadrant; LUQ=left upper quadrant; RLQ=right lower quadrant; RUQ=right upper quadrant; US=ultrasonography.

*Calculated as false positives/all positives.

†Including inconclusive ultrasonography.

Results

- CT detected more urgent diagnoses than did US:
- Sensitivity was **89% for CT** and **70% for US**
- A conditional strategy with CT only after negative or inconclusive US yielded **the highest sensitivity**, missing only 6% of urgent cases.

Conclusion

- Although CT is the most sensitive imaging investigation for detecting urgent conditions in patients with abdominal pain, using **US first** and **CT only in those with negative or inconclusive** US **results in the best sensitivity and lowers exposure to radiation.**

Advantages Of US Compared To CT:

- Widely available
- Lower cost
- Lack of radiation exposure are the most important.
- A real-time dynamic examination
- The possibility to correlate **the US** findings with the point of maximal tenderness.

- **Information provided by the patient may lead to a specific search for a US** finding, while, **vice versa**, certain US findings may lead to a specific question to the patient.

- This **interactive aspect** is perhaps the greatest secret of a successful US examination.

A special US Technique

The Graded-compression :

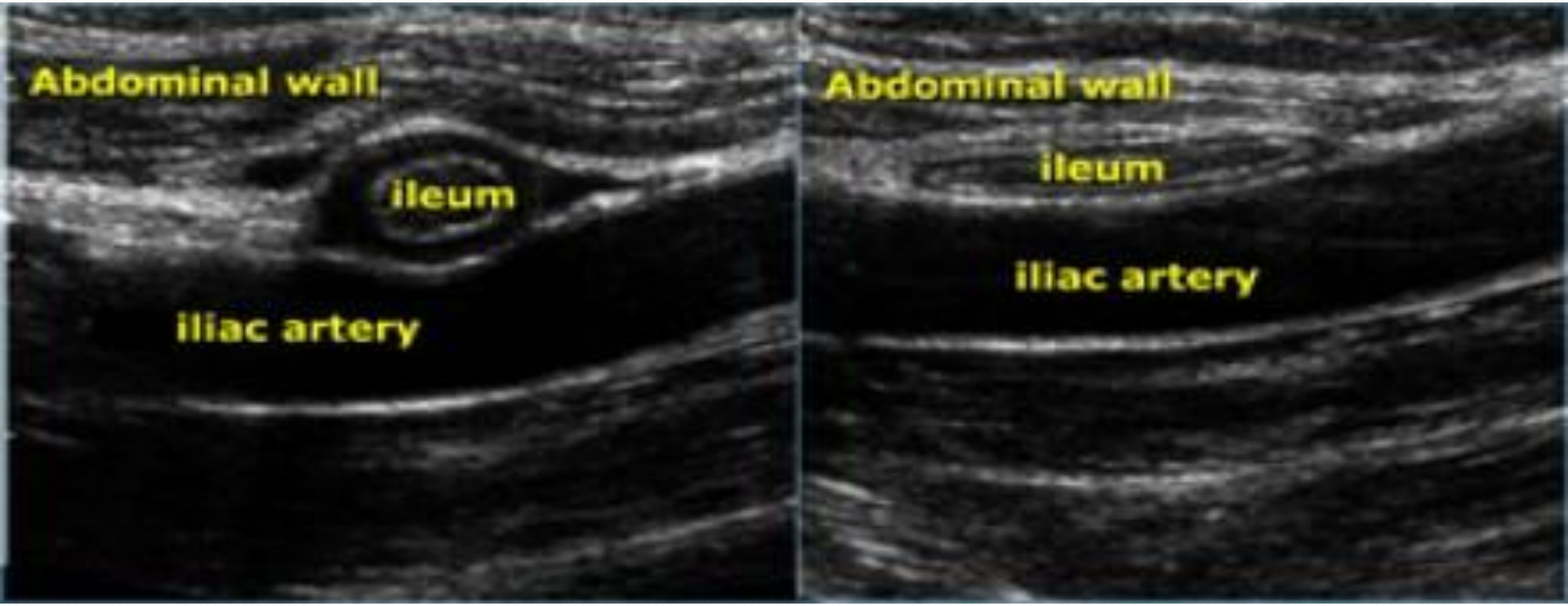
- The most common US **technique** used to examine patients with acute abdominal pain
- Interposing fat and bowel can be displaced or compressed by means of gradual compression to show underlying structures.
- **If the bowel cannot** be compressed, the non compressibility itself is an indication of pathology

The Valsalva Maneuver:

- Another example of dynamic examination for evaluation of abdominal wall , **bowel hernias, mesentery, and omentum through**

Effect of compression

- That is useful to judge whether organs or tissues are **soft** or **rigid**.



Color And Power Doppler Imaging

Increased vascularity/hyperemia:

- Visualized in a number of inflammatory, infectious or neoplastic diseases.

Diminished vascularity:

- Is a specific, although probably not sensitive, sign of ischemia.

US in Pediatric Acute Abdomen

Several factors are unique in children **favoring** the initial use of us, including:

- Increased radio sensitivity to ionizing radiation
- Smaller body size and less body fat makes CT Exam more difficult to interpret .

US in Pediatric Acute Abdomen

The goal of emergency management is to ensure that life-threatening surgical causes are not missed,

These include:

- Appendicitis
- non -reducible intussusception
- intestinal obstruction
- incarcerated hernia
- Volvulus
- ovarian/testicular torsion
- perforated viscus with diffuse peritonitis
- rupture tumor

US in Pediatric Acute Abdomen

- **US** abdomen examination is the first investigation in almost all cases with moderate and severe abdominal pain:

1. **Appendicitis:** US is the imaging procedure of choice with a sensitivity of 85 % to 90 %
2. **Adenomesenteritis:** also sensitive
3. **Bowel obstruction:** with accuracy of about 81%

US in Pediatric Acute Abdomen

4. **Intussusception:**

US findings in intussusceptions include the target sign and the “pseudokidney” sign

Doppler flow may be used to identify complications like bowel ischemia.

5. **Genitourinary conditions**

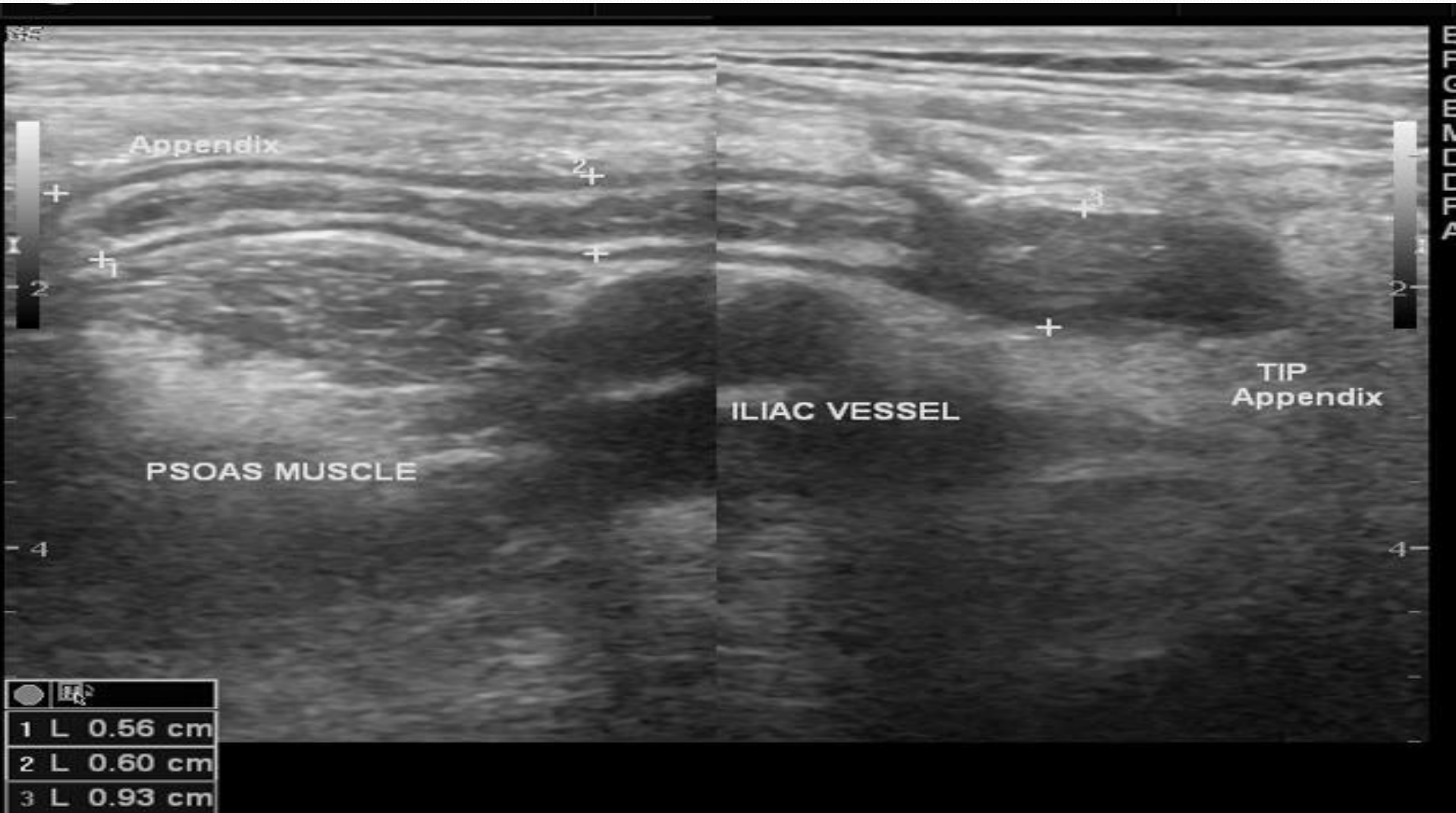
US represents the investigation of choice for suspected cases such as **ovarian torsion and testicular torsion**

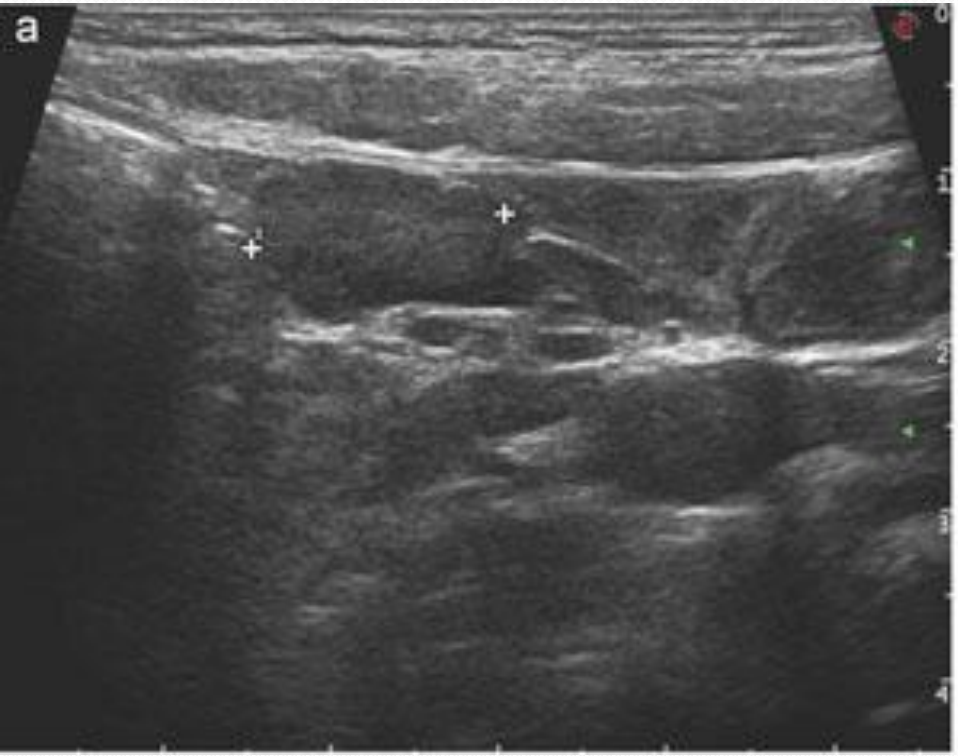

a
1 cm


b
2 cm


c

Tip Appendicitis

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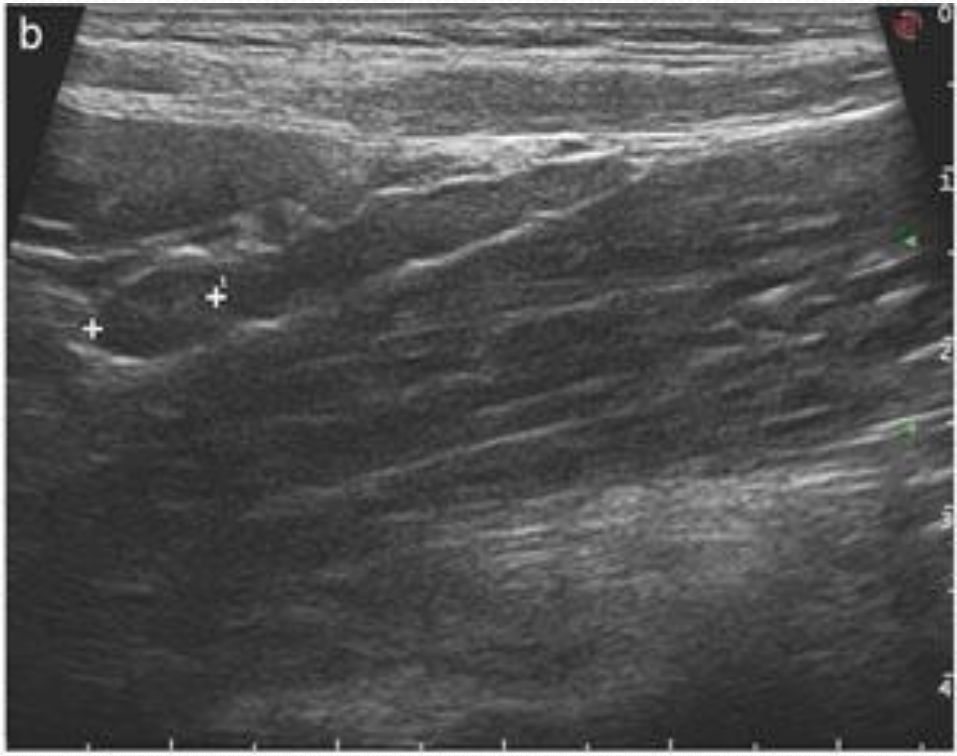
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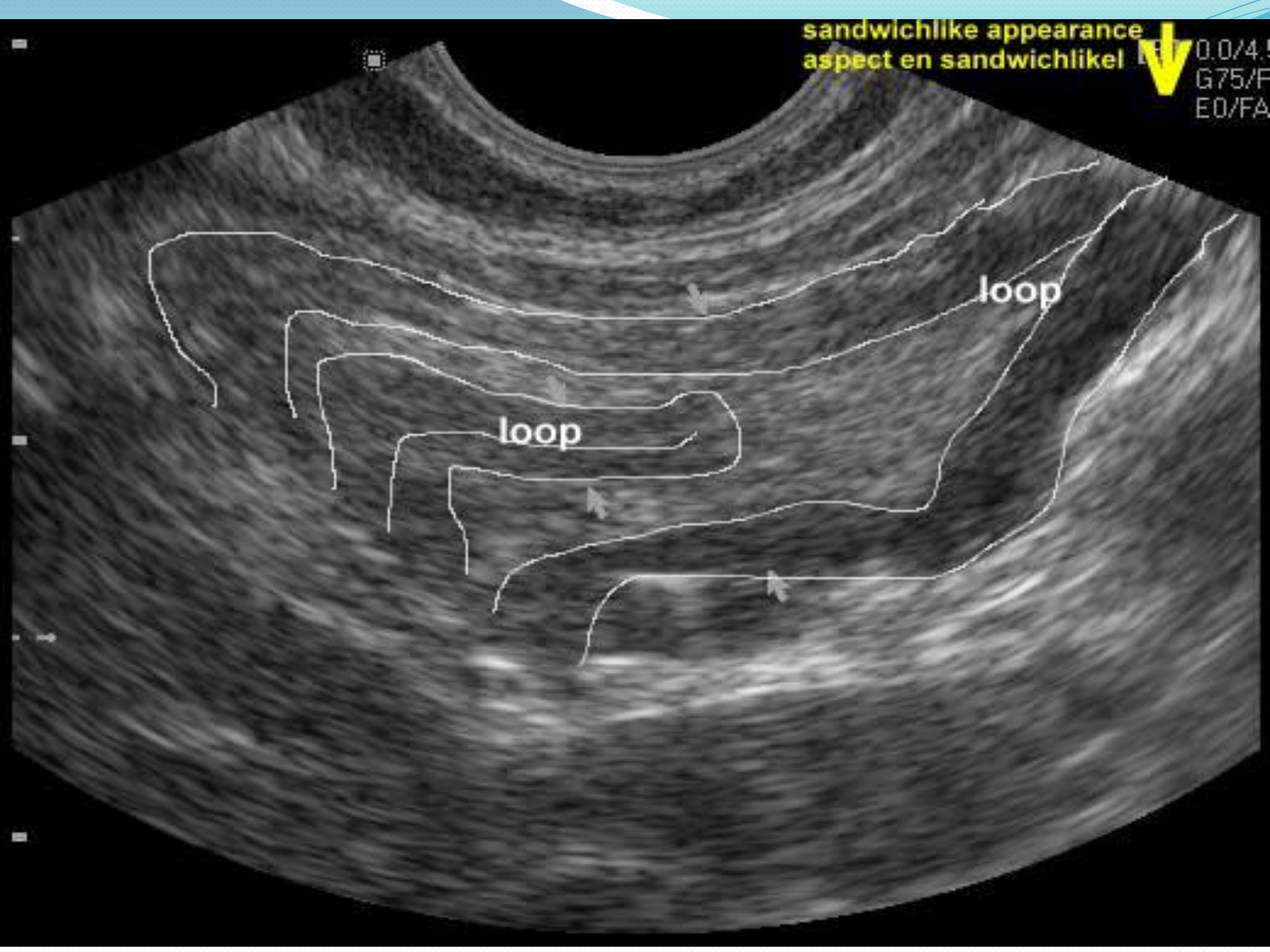
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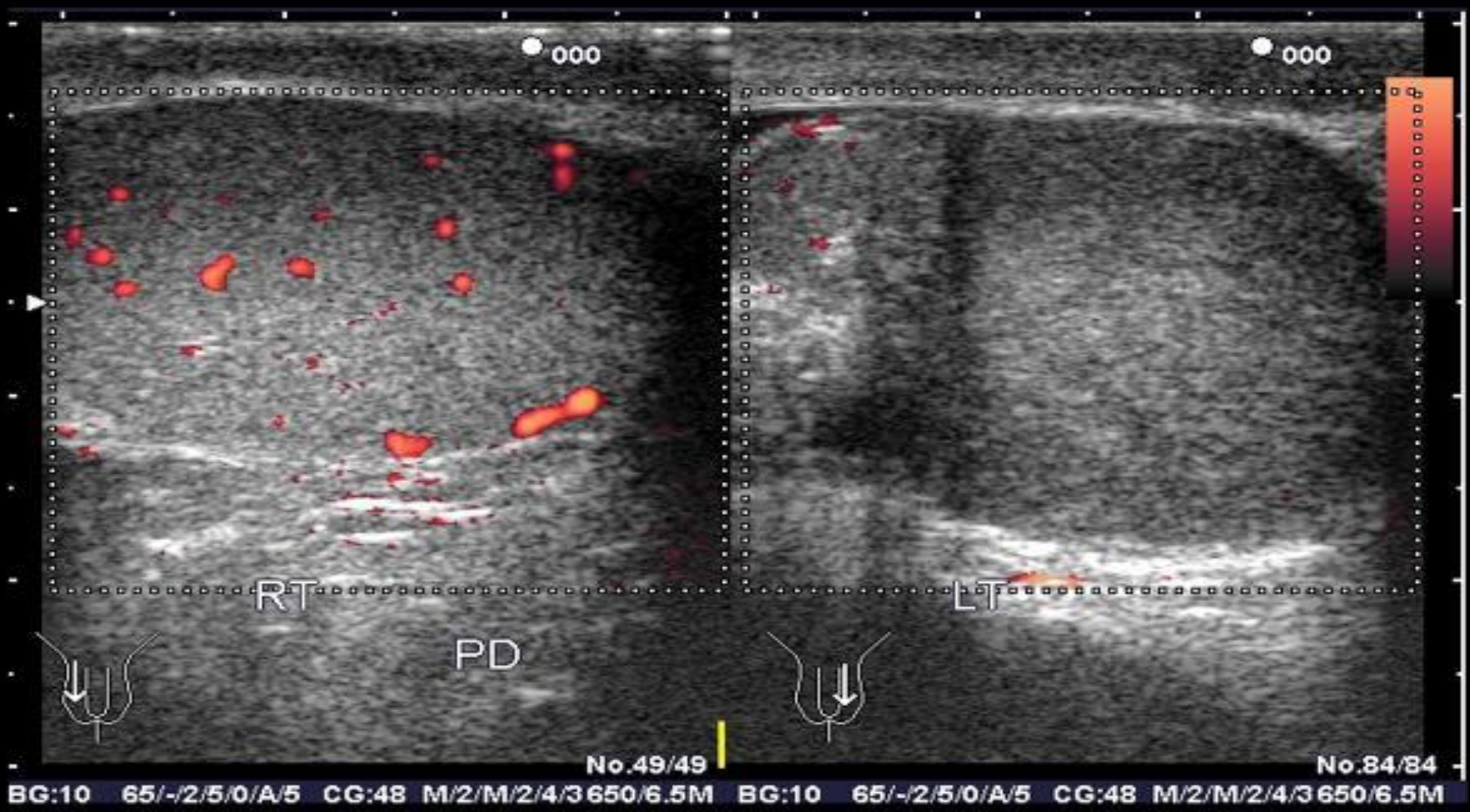
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P
3.5
BOTH TesticleS

US in Adult Acute Abdomen

In the adult population the goal of emergency management is the same of that in the pediatric population:

- life-threatening surgical causes are not missed.

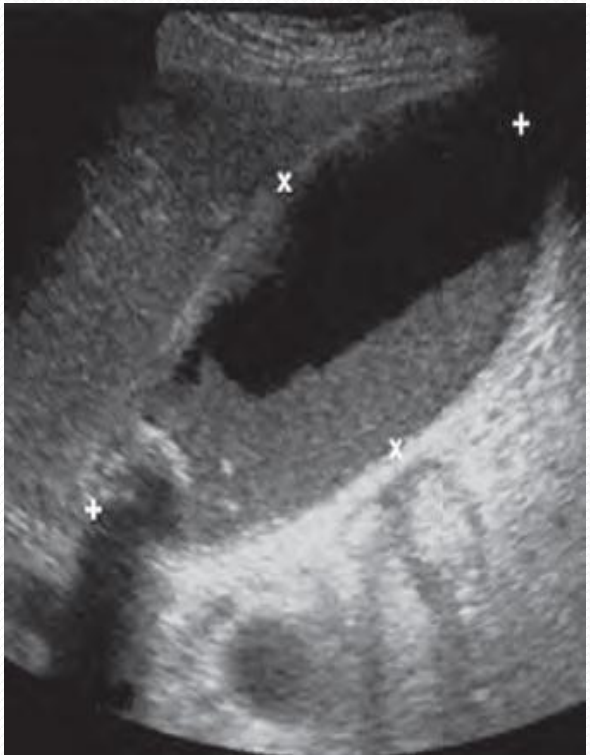
- **Acute appendicitis, diverticulitis, cholecystitis, and bowel obstruction, perforated viscus or vascular diseases such as aortic dissection and mesenteric ischemia**.


a


b

Acute cholecystitis in different patients.

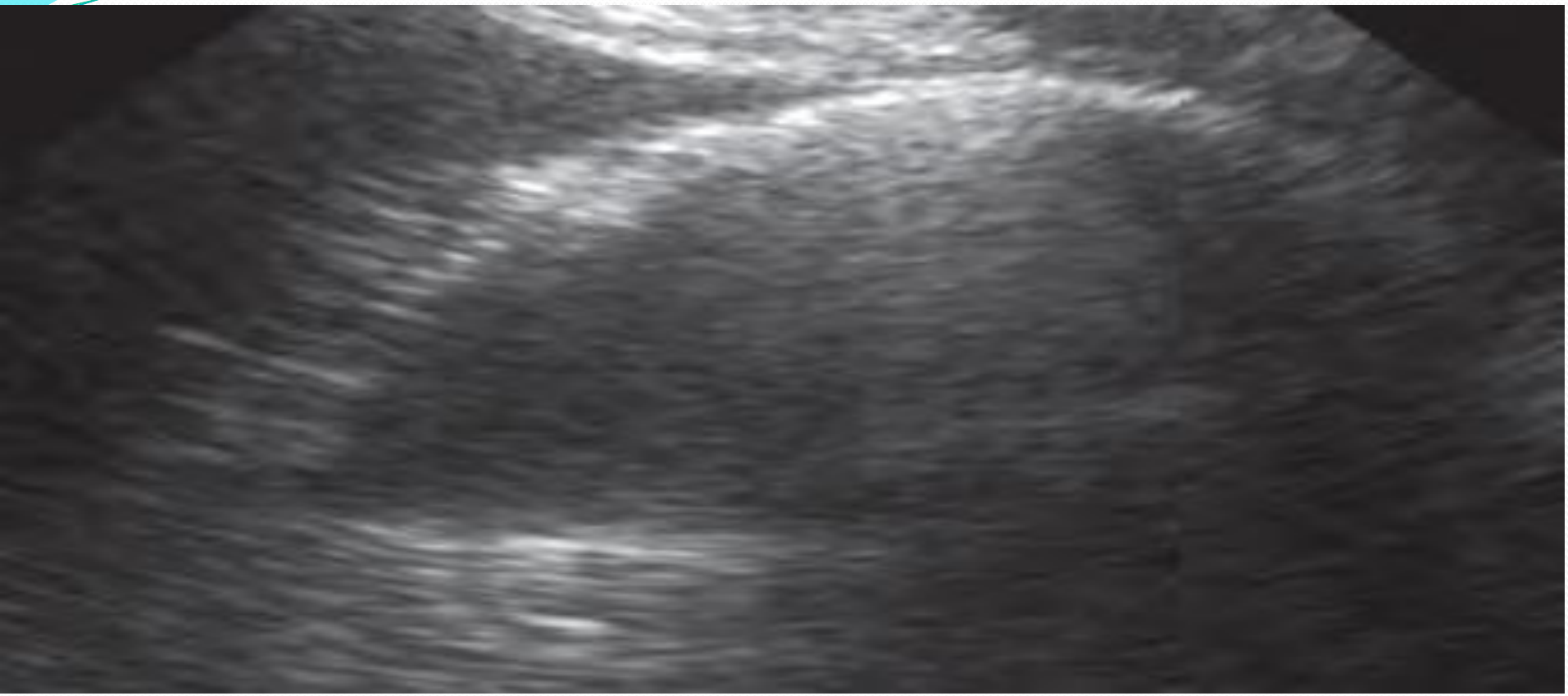
A, Longitudinal view shows wall thickening (5.7 mm) and a stone impacted in the neck of the gallbladder *(arrow)*.
B, Transverse view shows stones, sludge, and gallbladder wall thickening.
C, Longitudinal view shows an enlarged gallbladder (116 × 51 mm) with a stone impacted in the neck and sludge.



Emphysematous cholecystitis

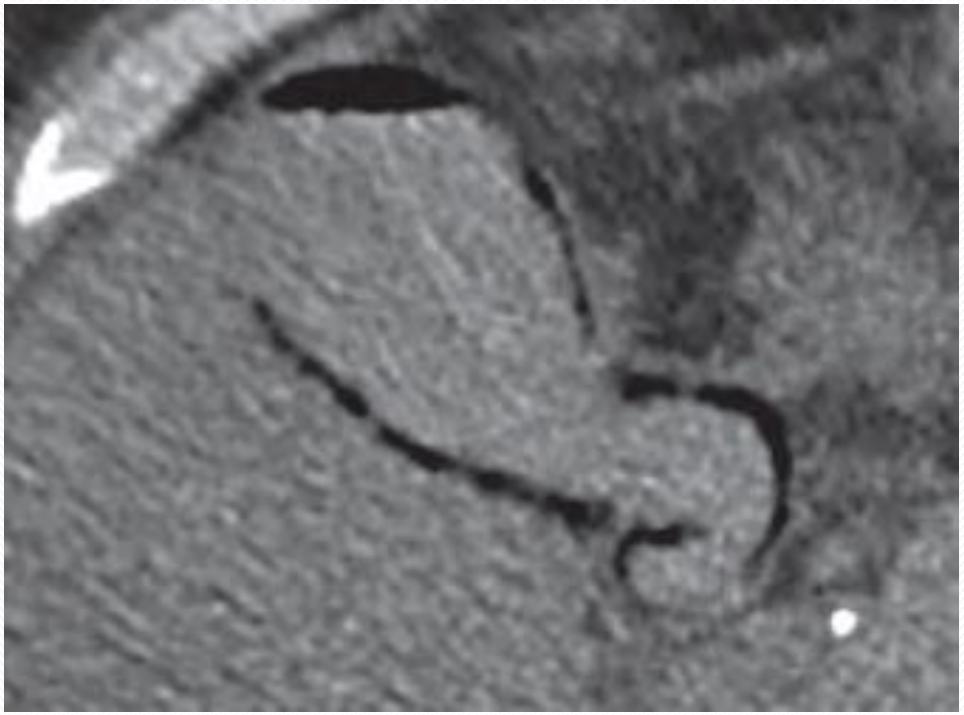
- **Emphysematous cholecystitis:** is a rare form of acute cholecystitis where gallbladder wall necrosis causes gas formation in the lumen or wall.

  It is a surgical emergency, due to the high mortality from gallbladder gangrene and perforation.
- **Epidemiology:**
- Men are affected twice as commonly as women (reverse is true in most cases of acute cholecystitis).
- The majority of patients are between 50 and 70 years of age and have underlying diabetes mellitus.



Longitudinal sonogram shows a bright curvilinear reflection from the nondependent wall of
the gallbladder with a dirty shadow **reverberation artifact**

Emphysematous gallbladder



Gangrenous cholecystitis

- Is the most common complication of Acute cholecystitis, affecting ~15% (range 2-30%) of patients.
- Gangrenous cholecystitis occurs as a result of ischemia with necrosis of the gallbladder wall .
- less likely to have a positive **Murphy's sign due to injury to gallbladder enervation.**

- **Risk factors**
  - male
  - increasing age
  - Diabetes mellitus

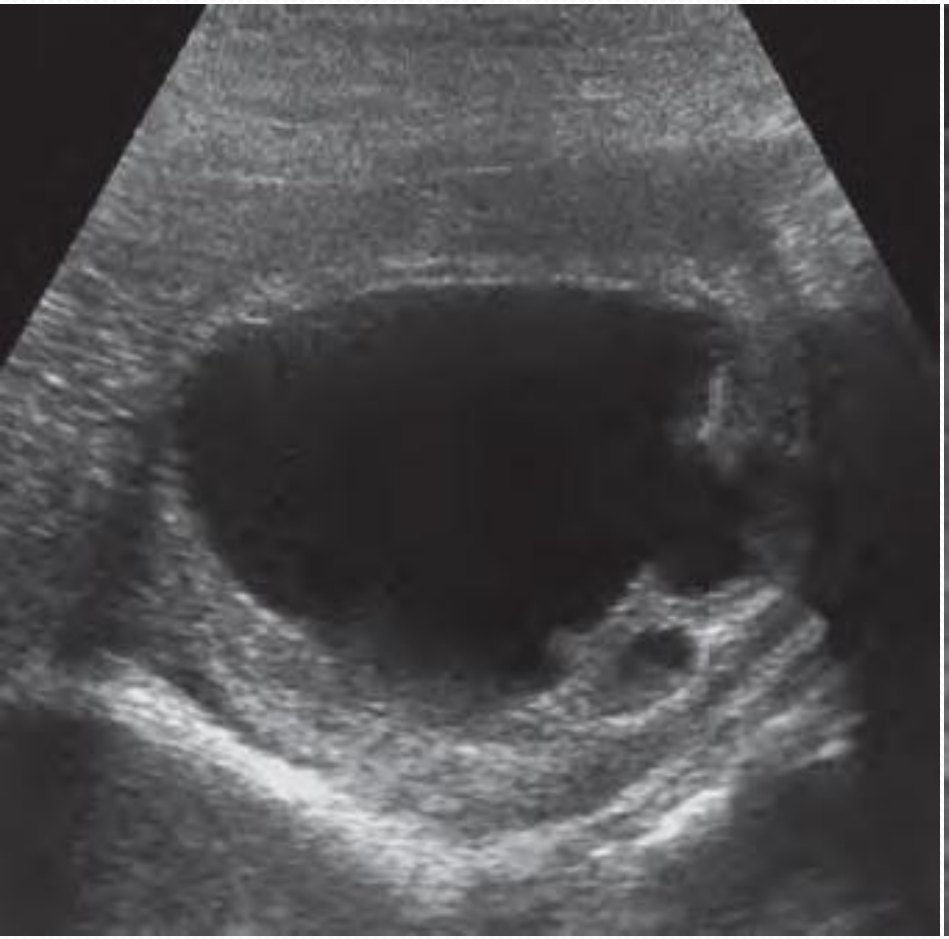
Ultrasound

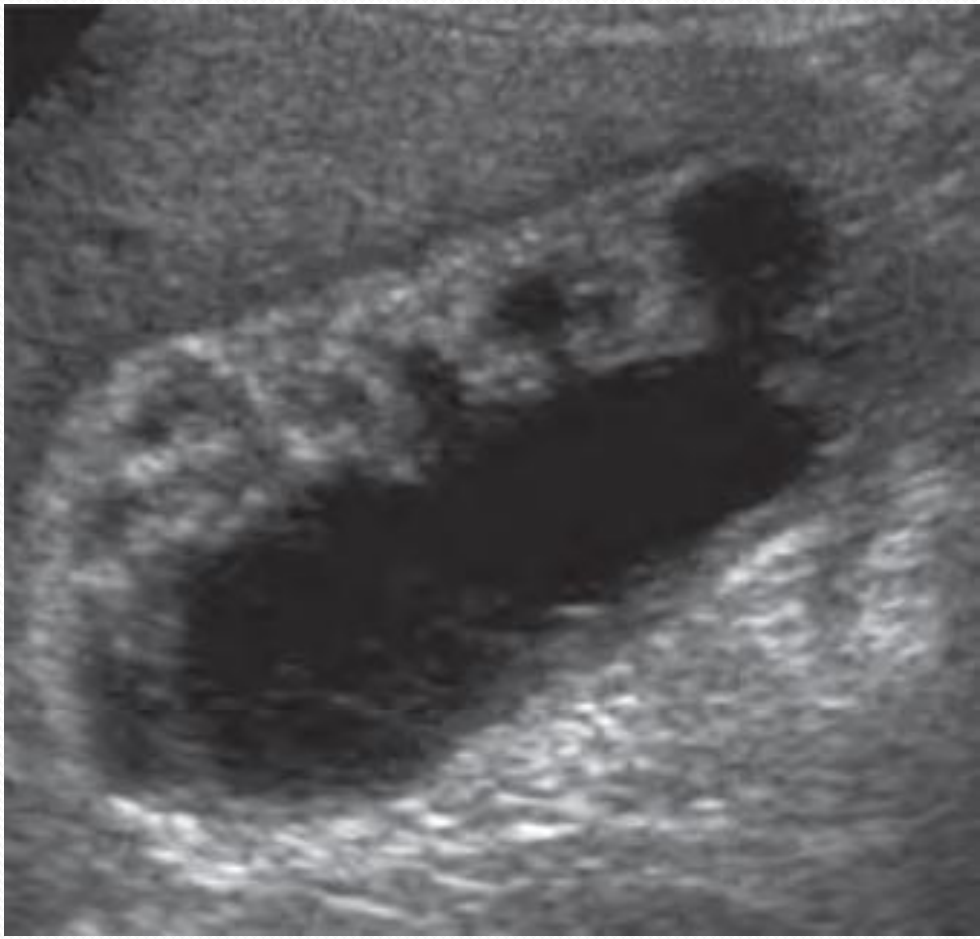
In addition **to features** of **acute cholecystitis**, the following may help diagnosis

- intraluminal membranes (**Sloughed mucosa**)
- asymmetrical wall thickness (**Focal or multiple Ulcers**)
- focal **perfusion defects** on Doppler (representing areas of necrosis)

Sloughed Mucosa

Thick GB Wall With Intramural Ulcerations.





Gallbladder Perforations

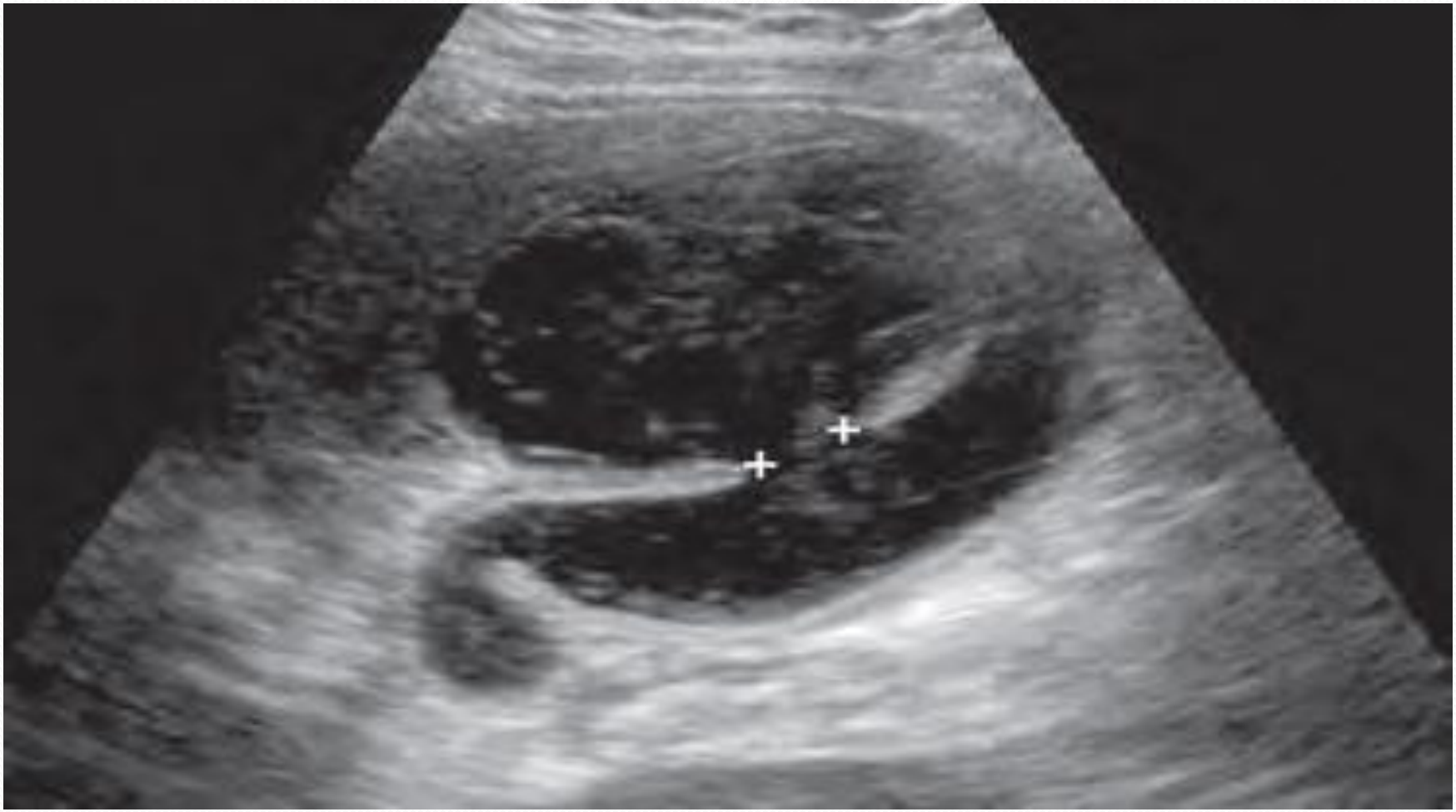
- Occurs most frequent as a result of acute cholecystitis .
- It can carry **a relatively high mortality rate**
- Clinical presentation of can range from an acute generalized peritonitis to benign non-specific abdominal symptoms.
- The **fundus** is the most common area to perforate because it is the least vascularized portion of the gallbladder wall.

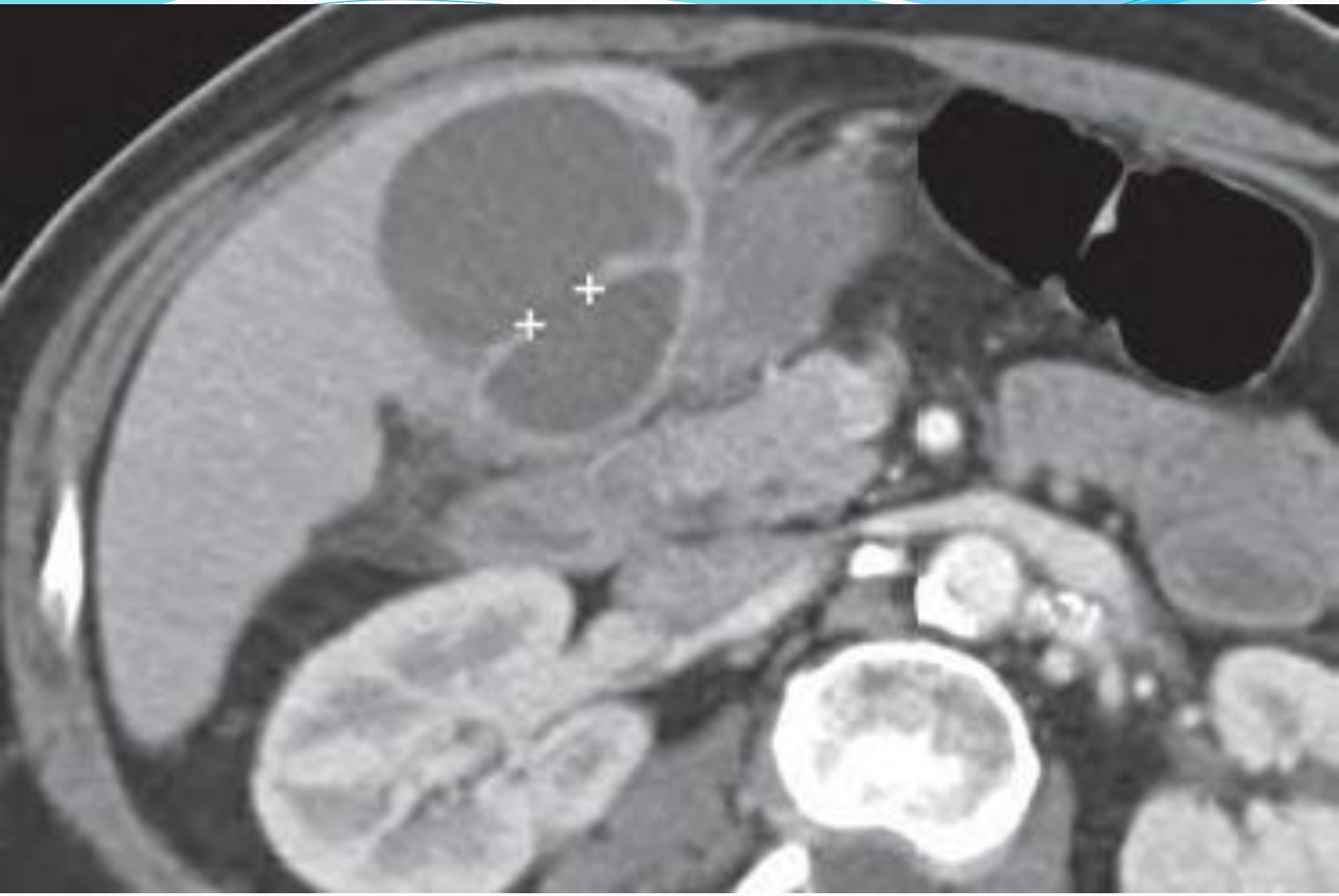
Gallbladder perforations

Pathology:

- A perforation can occur as early as two days after the onset of acute cholecystitis, or can occur after several weeks.
- The sequence of events that , results from occlusion of the cystic duct (most often by a calculus) with resultant retention of intraluminal secretions. Distension of the gallbladder with a consequent rise in intraluminal pressure can impede venous and lymphatic drainage, leading to vascular compromise and ultimately to necrosis and perforation of the gallbladder wall.

Moderate-sized defect in the gallbladder wall *(cursors)* and a communicating fluid collection between the gallbladder and liver.



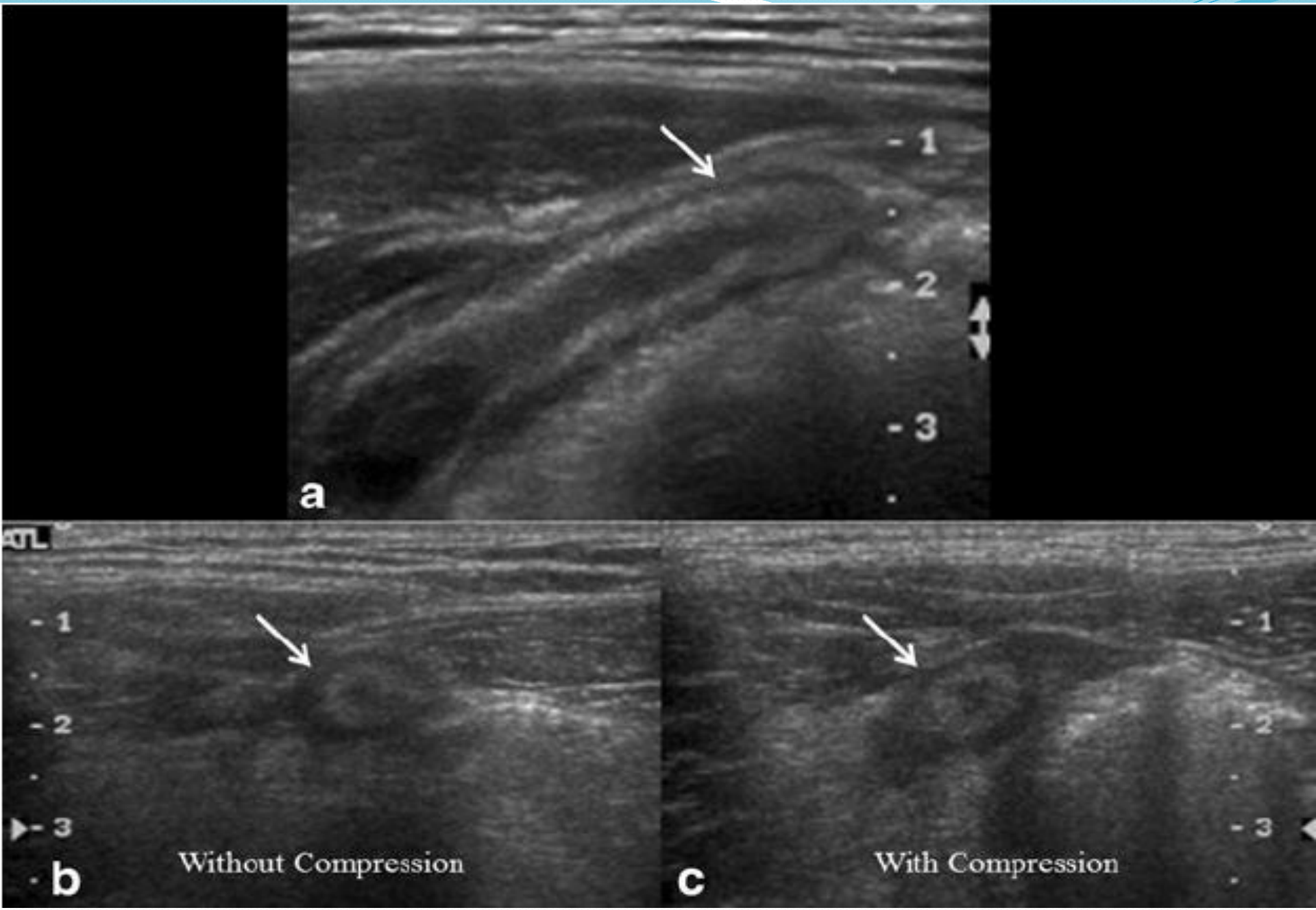


Complications

- ***Bile pertonitis***
- ***Hepatic abscess*** formation (possible mechanisms include a direct extension, subcapsular extension and hematogenous dissemination via the portal vein)

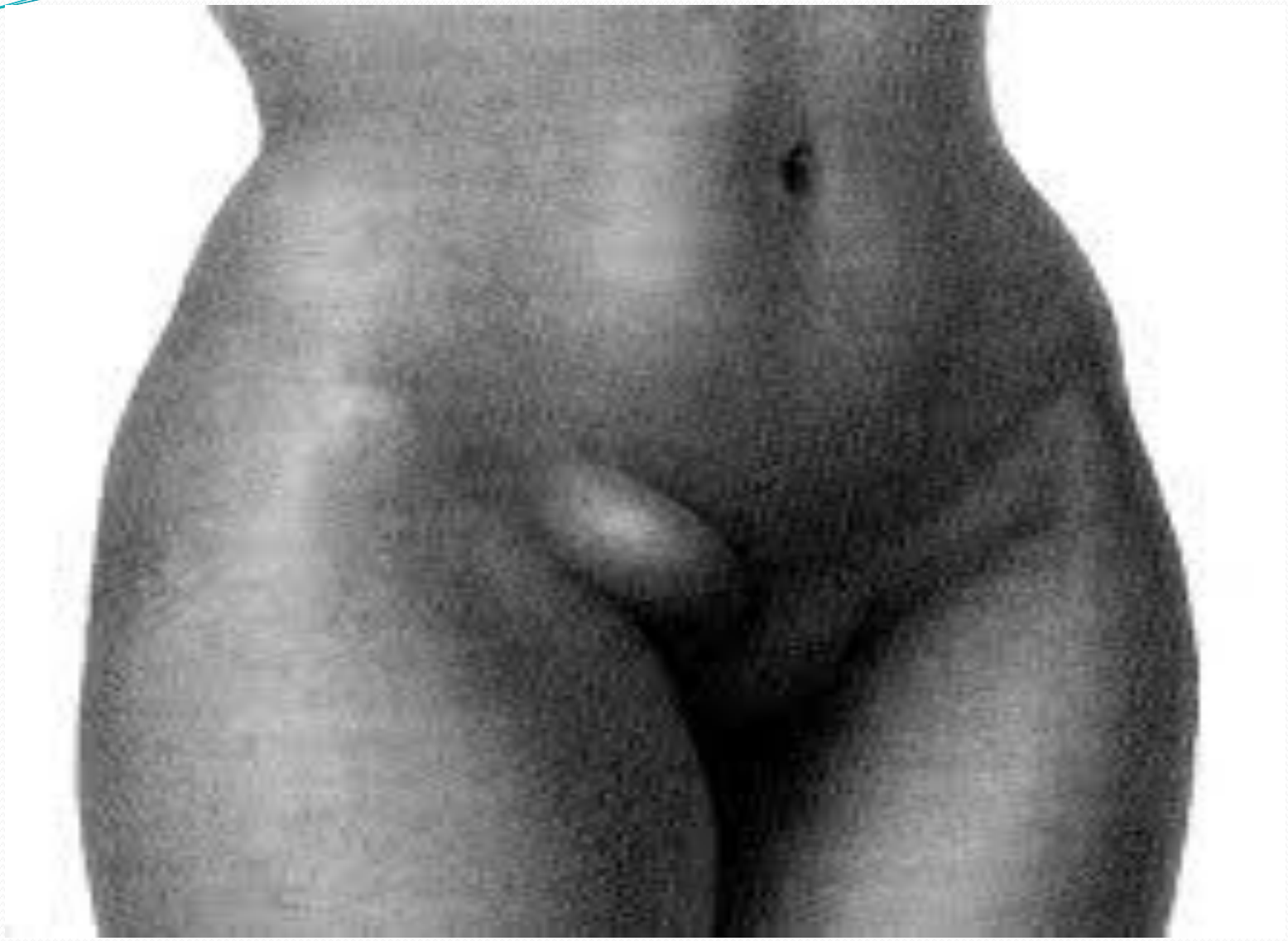
Acute Appendicitis

CT		US
Enlarged appendix	Acute appendicitis	Enlarged appendix (greater than 6 mm)
Wall thickening		Wall thickening
Appendicolith		Appendicolith
Periappendiceal lymphadenopathy		Periappendiceal lymphadenopathy
Target sign		Target sign
Periappendiceal fat stranding		Blind ending aperistaltic tubular structure
Focal cecal apical thickening		
Arrowhead sign		
Cecal bar		
Wall enhancement		
Extraluminal appendicolith	Perforated appendicitis	Extraluminal appendicolith
Appendiceal wall defect		Appendiceal wall defect
Abscess		Abscess
Periappendiceal fluid collection		Periappendiceal fluid collection
Phlegmon		
Extraluminal air		


a
b
Without Compression
c
With Compression

CASE

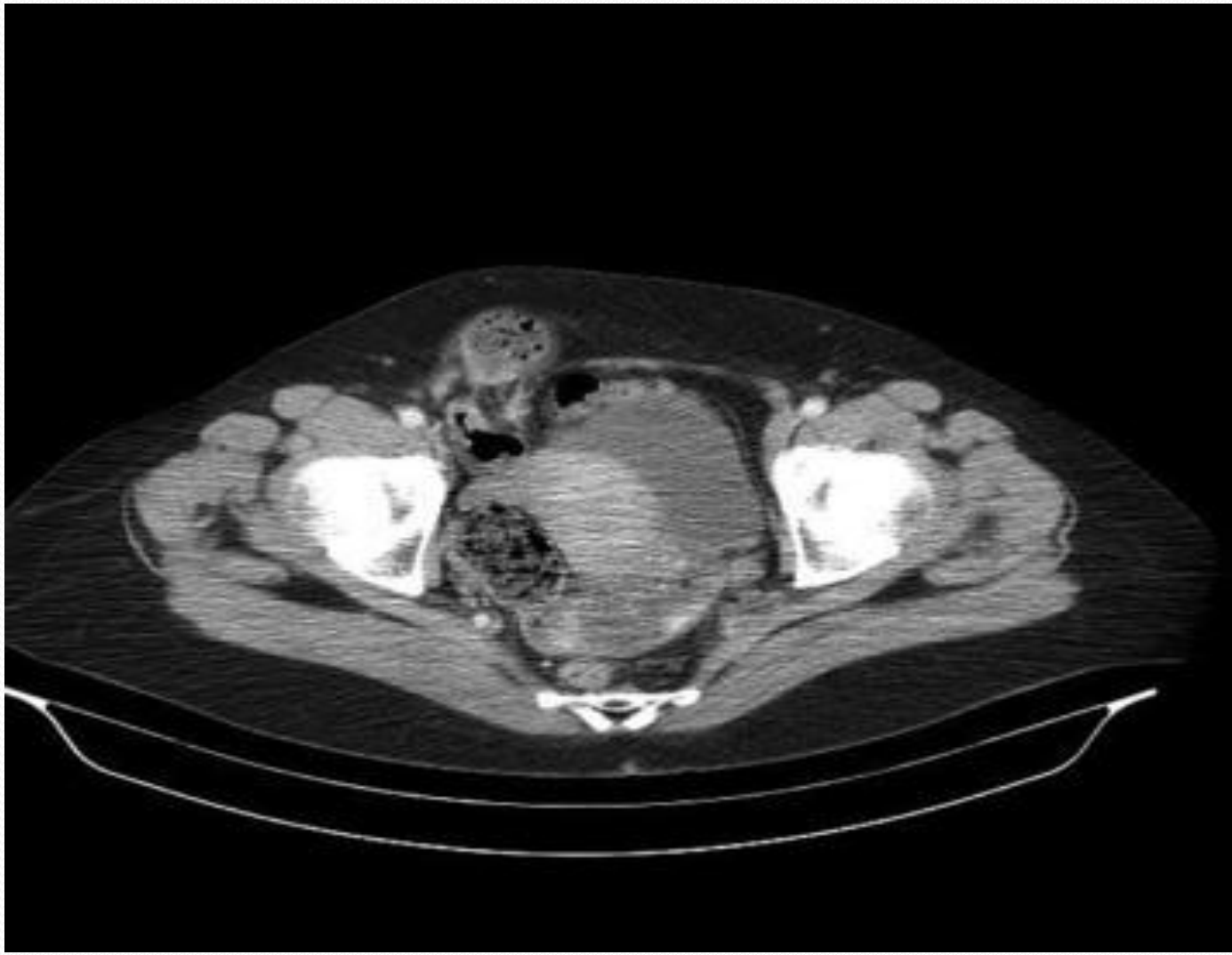
- A 49-year-old female was referred to emergency department with a **right-sided groin swelling and pain .**
- The routine lab test showed an increase in white blood cells and CRP.
- Clinical examination revealed tenderness and a **mass in the right groin** that increased during Valsalva maneuver




M
DC
B1
FH3
FR2
48/96


M
89/159

Ultrasound & CT of the inguinal mass showing blind-ended tubular structure with a thick wall inside hernia sac, corresponding to the incarcerated appendix



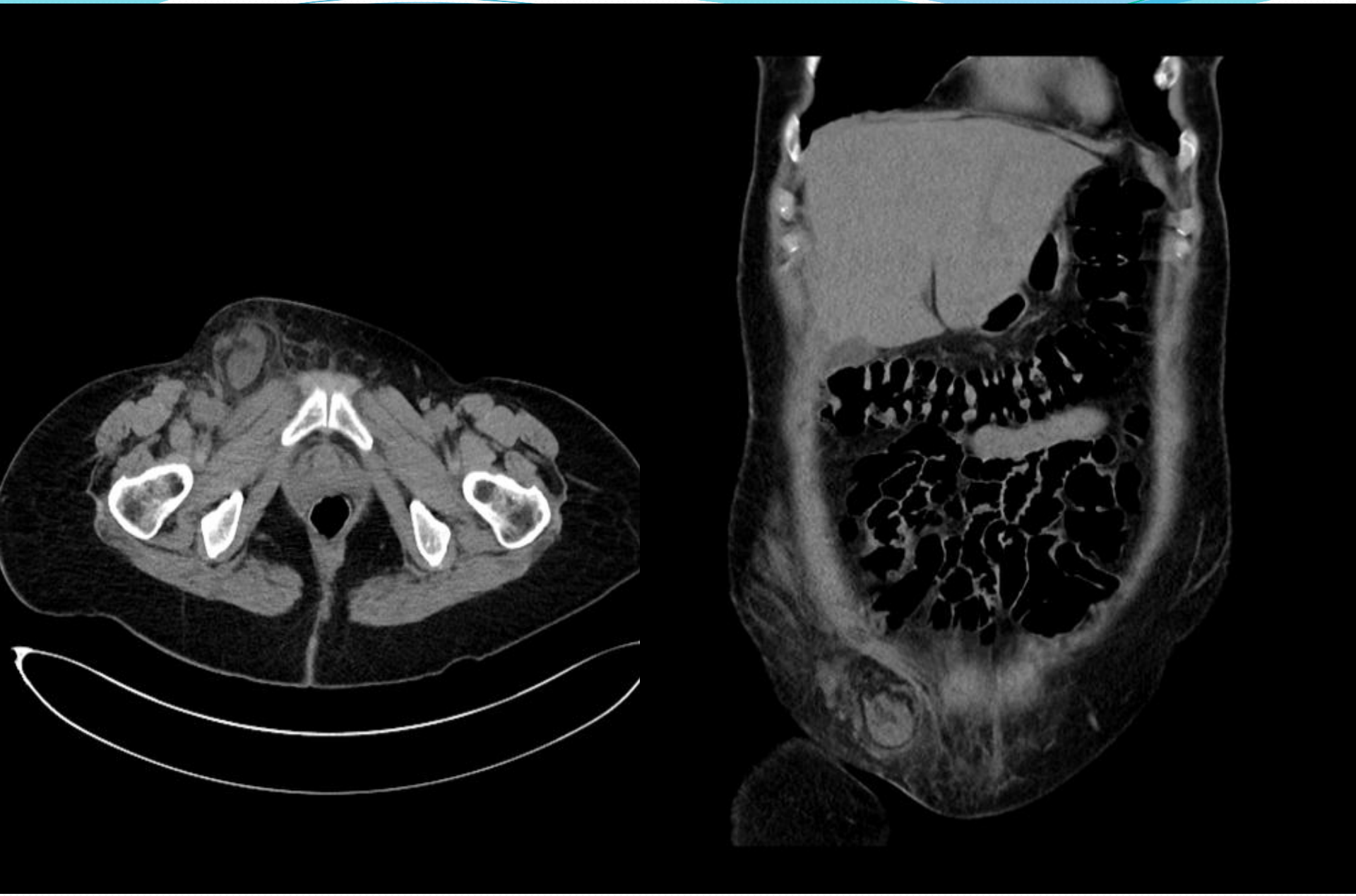
- Inguinal hernia is the most common acquired abdominal wall hernia. Hernia may contain uncommon components like the bladder, ovaries, fallopian tube .
- Appendix may be rarely seen inside the hernia sac, and the particular condition is termed as **Amyand's hernia**. Most of these cases are not diagnosed preoperatively, and only a few cases have been reported so far.

Why its called like that?

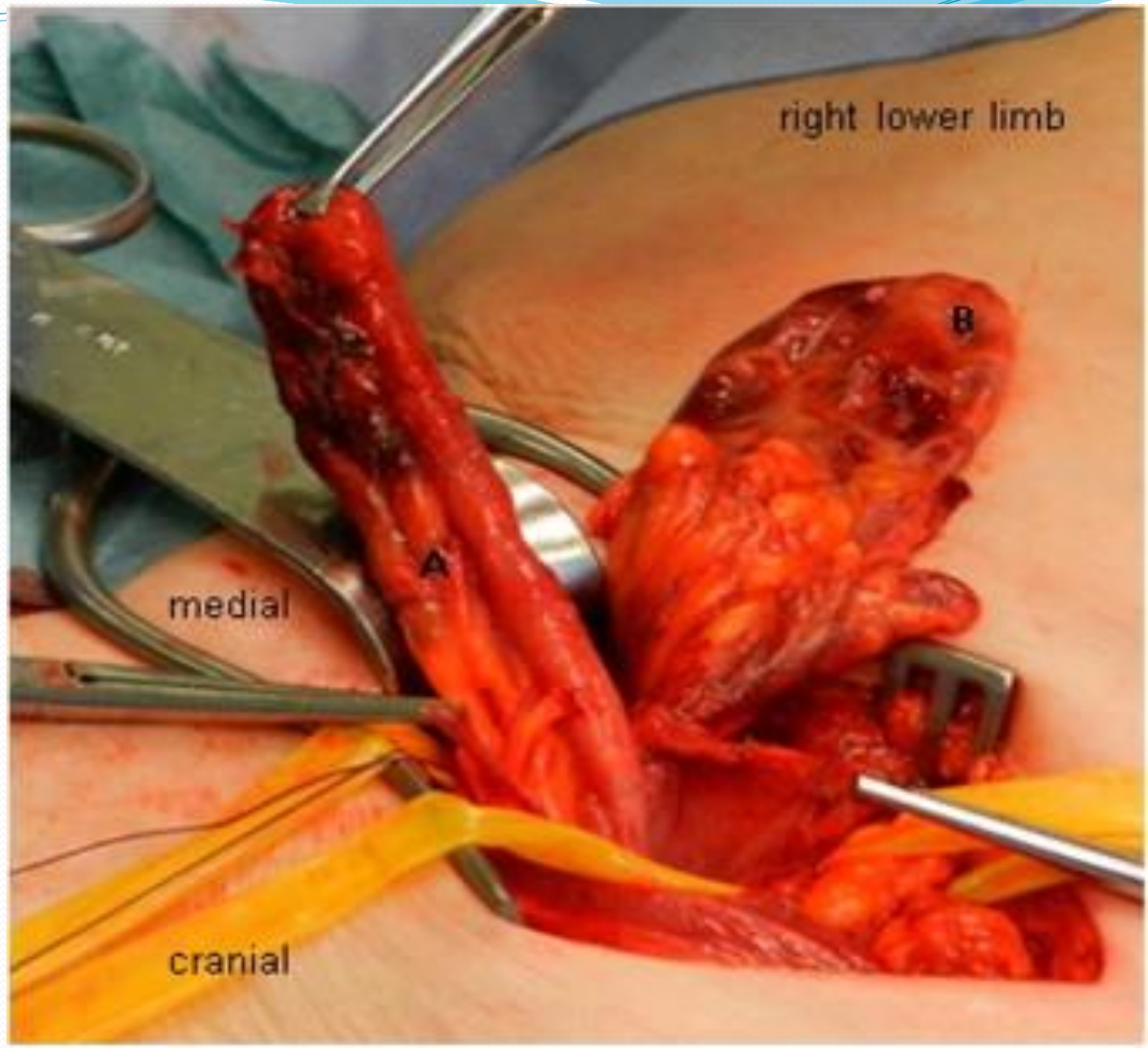
- **Claudius Amyand**, was a French surgeon who performed the first successful appendectomy in 1735, on an 11-year-old boy who presented with an inflamed, perforated appendix in **his inguinal hernia sac.**

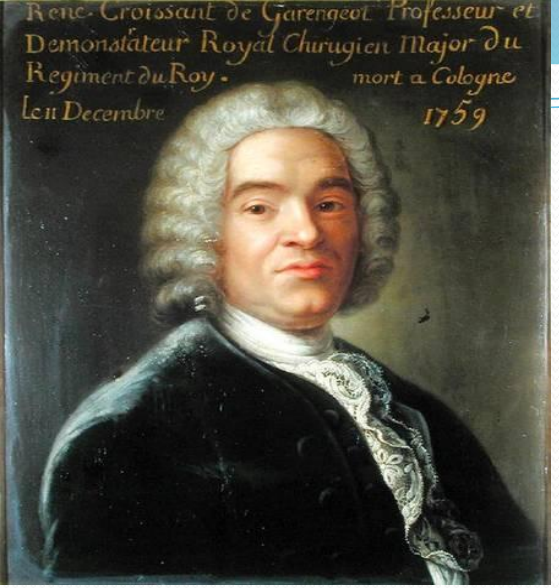
- A case of a 71-year-old woman with a **swelling of the right medial thigh for over more than 30 years**.
- When the swelling suddenly grew in size and became tender, she was referred to emergency department.

Sonography was performed and showed a cystic lesion (10 cm × 4 cm × 3 cm) with an intraluminal tubulous structure, protruding from intraabdominally through a 3 mm opening



Open appendectomy and femoral hernia repair using the McVay technique was performed





De Garengeot hernia

- is defined as a femoral hernia containing the appendix. It is a rare phenomenon, with only 1% of all femoral hernias containing the appendix (and usually found incidentally at surgery), containing an incarcerated acute appendicitis .

- It is named after **Rene Jacques Croissant de Garengeot** (1688-1759), Parisian surgeon, first described this pathology in 1731.


SAMSUNG


Point of care Ultrasonography Course
19-20 Fabruary 2016
University of Jordan
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Thank You