PEDIATRIC Radiology

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General principles in Ped. Rad.

1. Radiation Safety and Dose Reduction:

- **Children are more sensitive to radiation** than adults, so minimizing radiation exposure is crucial.
- **Use the ALARA principle** (As Low As Reasonably Achievable).
- Prioritize **non-ionizing imaging modalities** (e.g., ultrasound and MRI) over X-ray or CT scans, especially in younger patients.
- **Adjust imaging protocols:** Tailor protocols according to the child's age, weight, and size (e.g., adjusting the kilovoltage (kVp) and milliampere-seconds (mAs) on radiographs or CT scans).

2- Choosing the Right Imaging Modality

- **Ultrasound (US):** Often the first-line imaging modality for pediatric patients, especially for abdominal or pelvic concerns (e.g., appendicitis, kidney anomalies). It's non-invasive, safe, and doesn't use radiation.
- **X-ray:** Fast and commonly used in trauma or bone-related issues, but requires careful consideration of the radiation dose.
- **MRI:** radiation-free imaging that is particularly useful for brain, spinal cord…long scan time? sedation
- **CT Scan**: This should be used cautiously due to higher radiation exposure, but it is useful in assessing complex fractures, head trauma, or abdominal emergencies when other modalities are insufficient.

3- Anatomical Differences in Children:

- Normal variants
- Incomplete ossification
- myelination

4- Technical Challenges

- Movements
- limited cooperation

5- Developmental Physiology and Imaging

- bone growth

6- Pathological Considerations

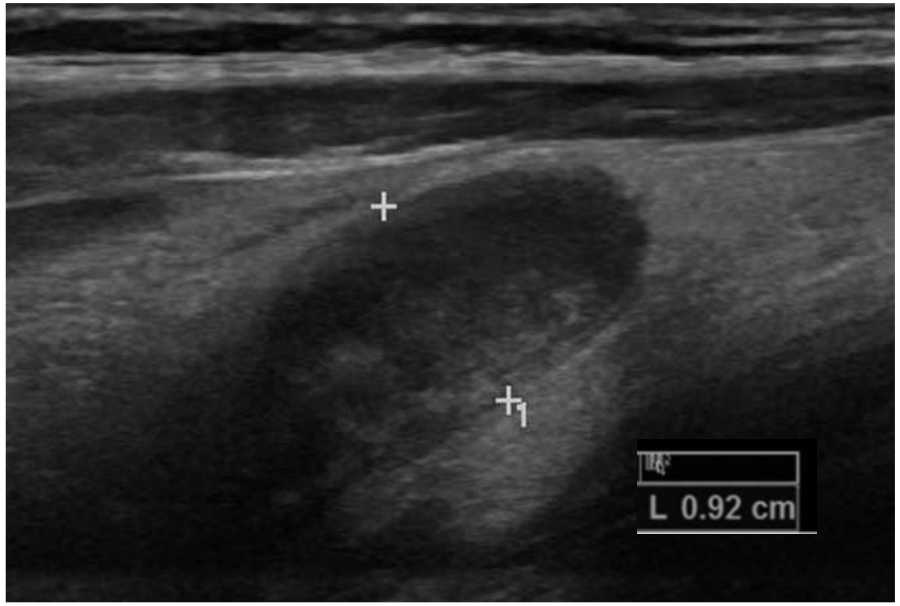
- congenital

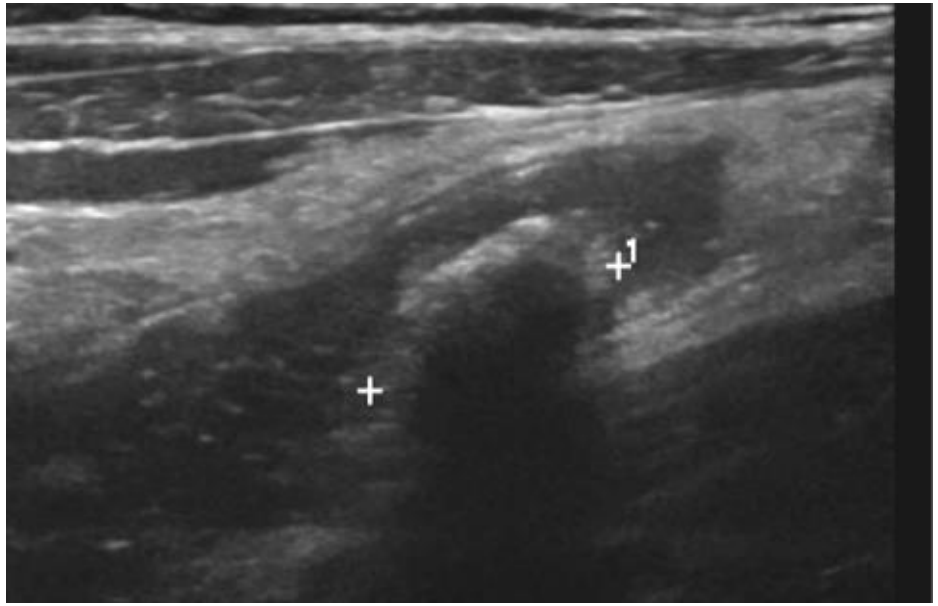
7- Parental Involvement and Communication

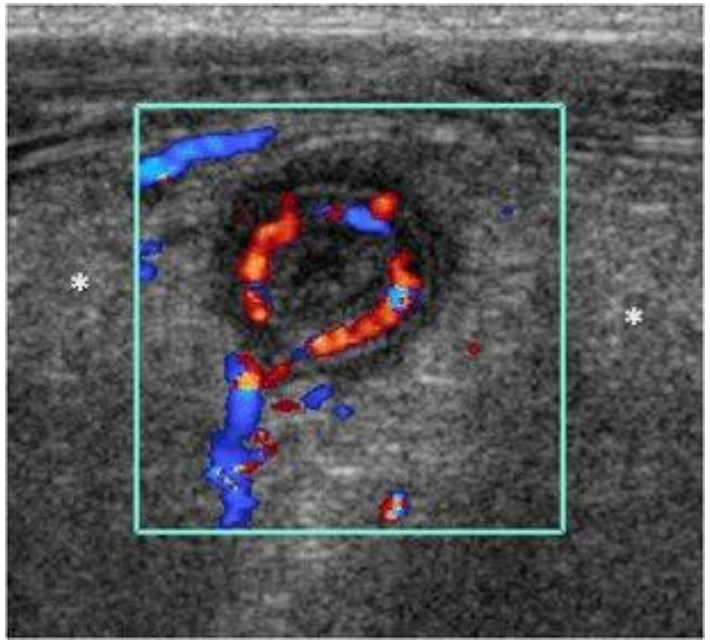
Q1

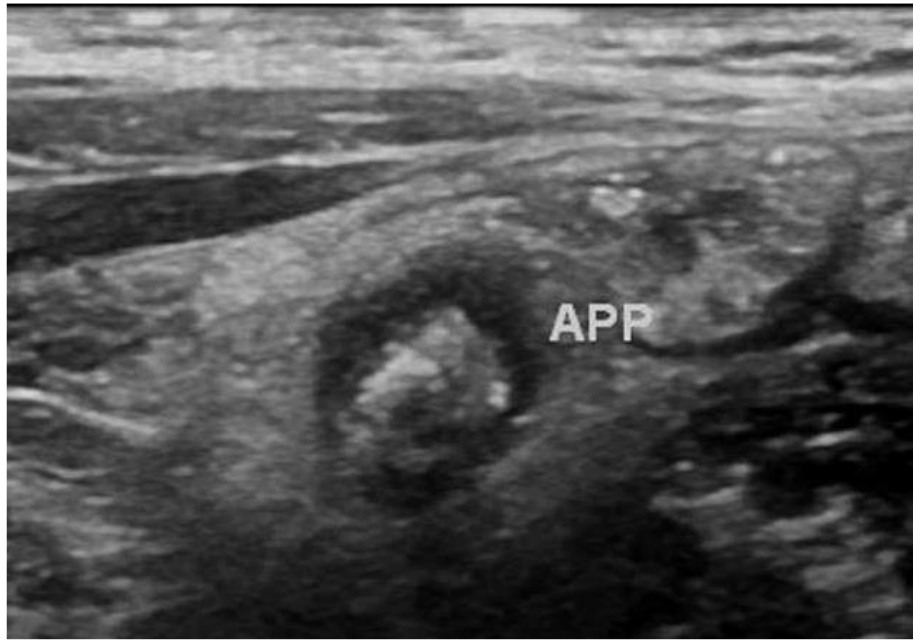
- A 7-year-old female patient presented to ER with 36 hours of abdominal pain, nausea, and loss of appetite.

- - What is your DDX?
- - What do you request imaging-wise?

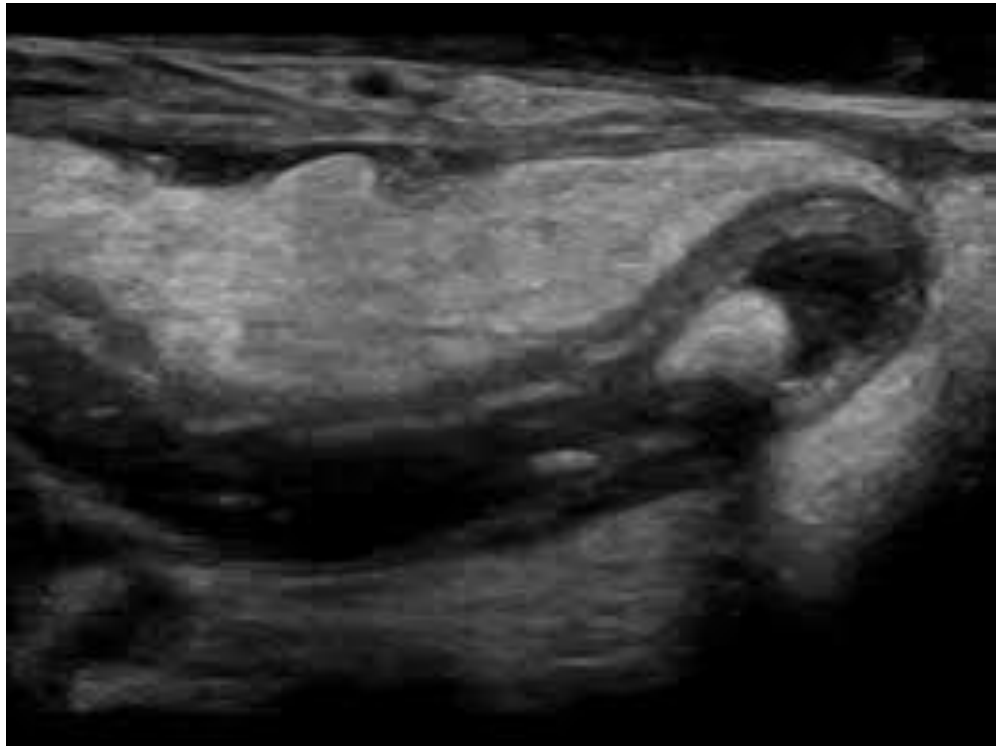

L 0.92 cm





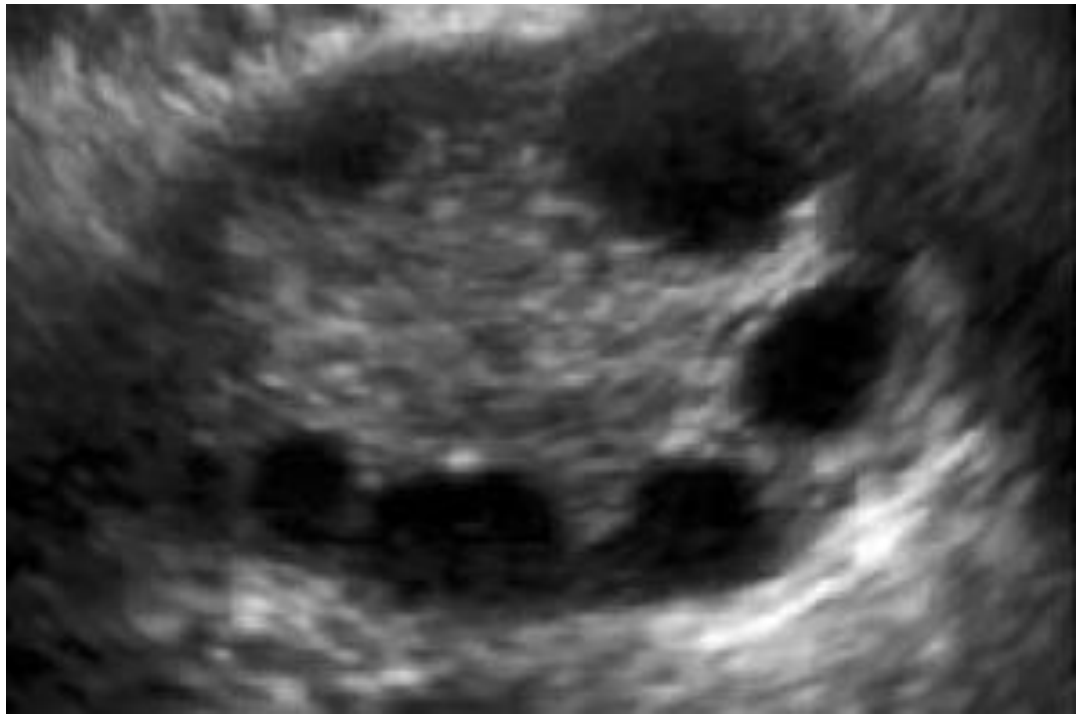

APP







Torted Ovary

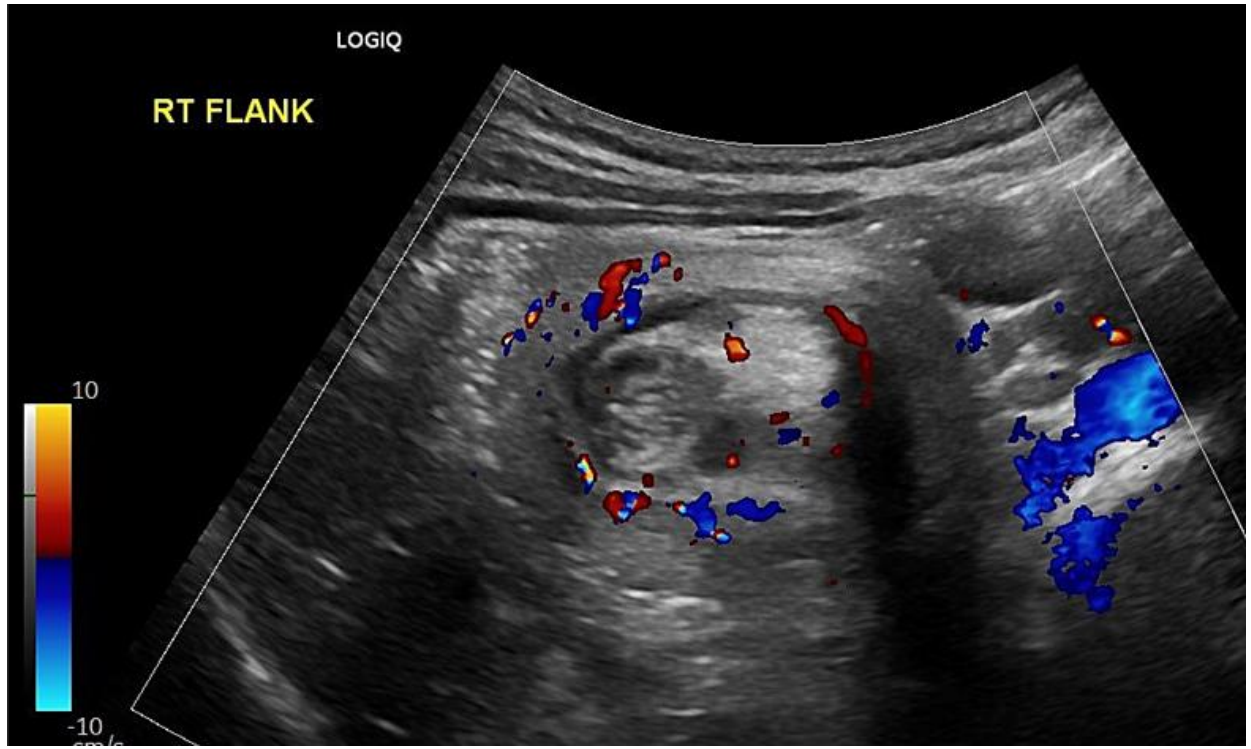


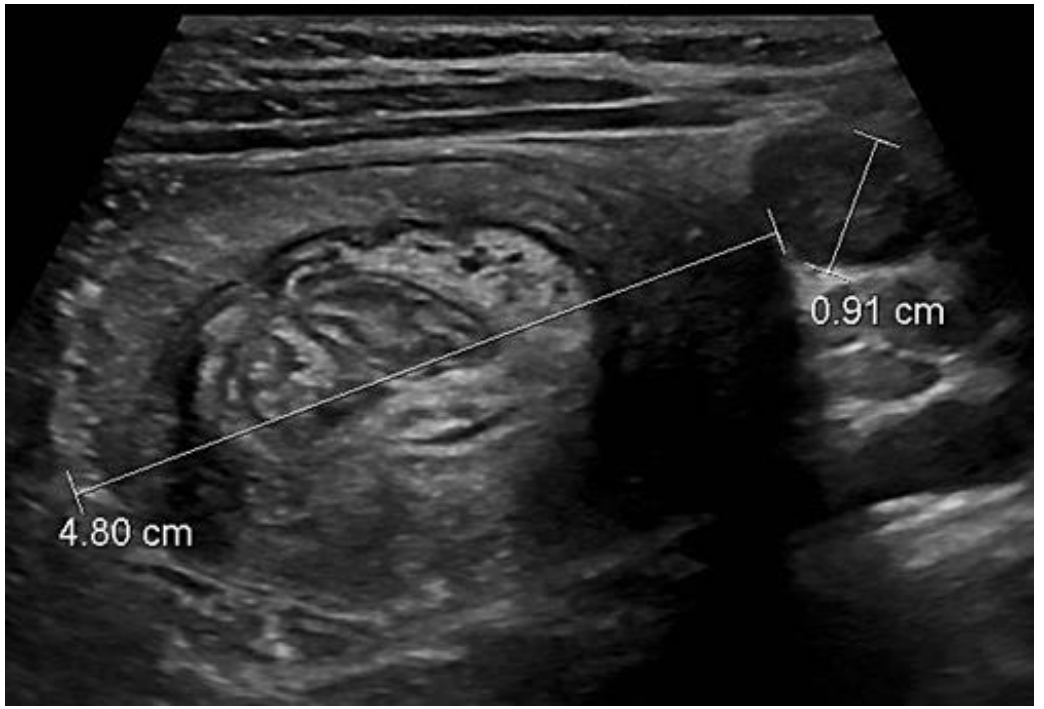
Normal Ovary

Q2

- A 2-year-old boy, recurrent, intermittent abdominal pain for the last 16 hours.

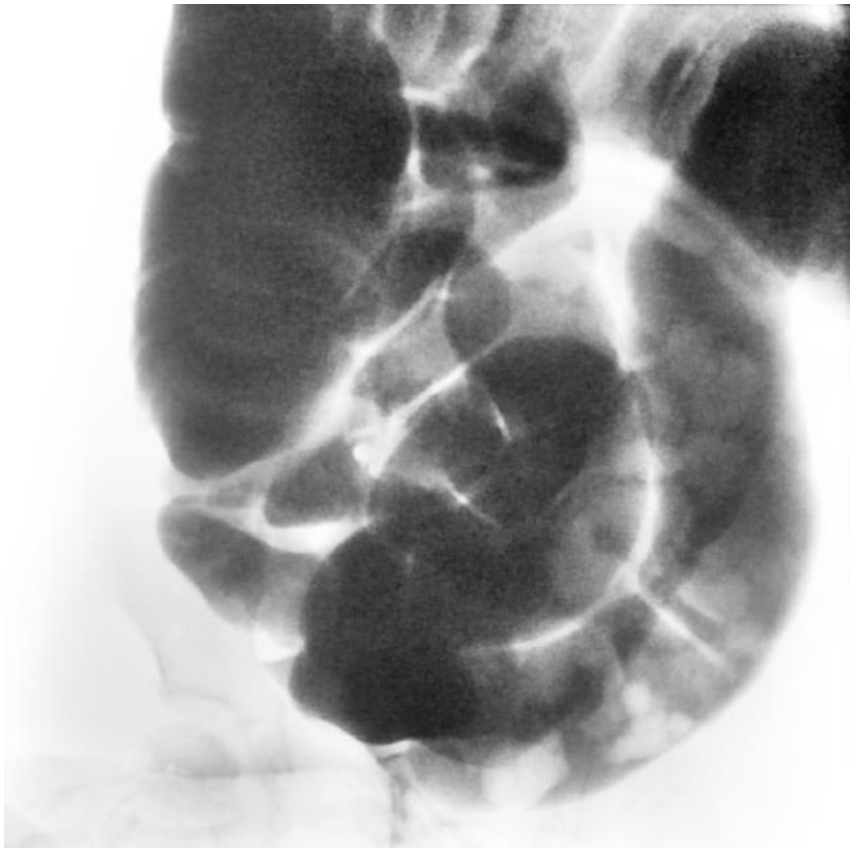
- - DDX?
- - Imaging ?

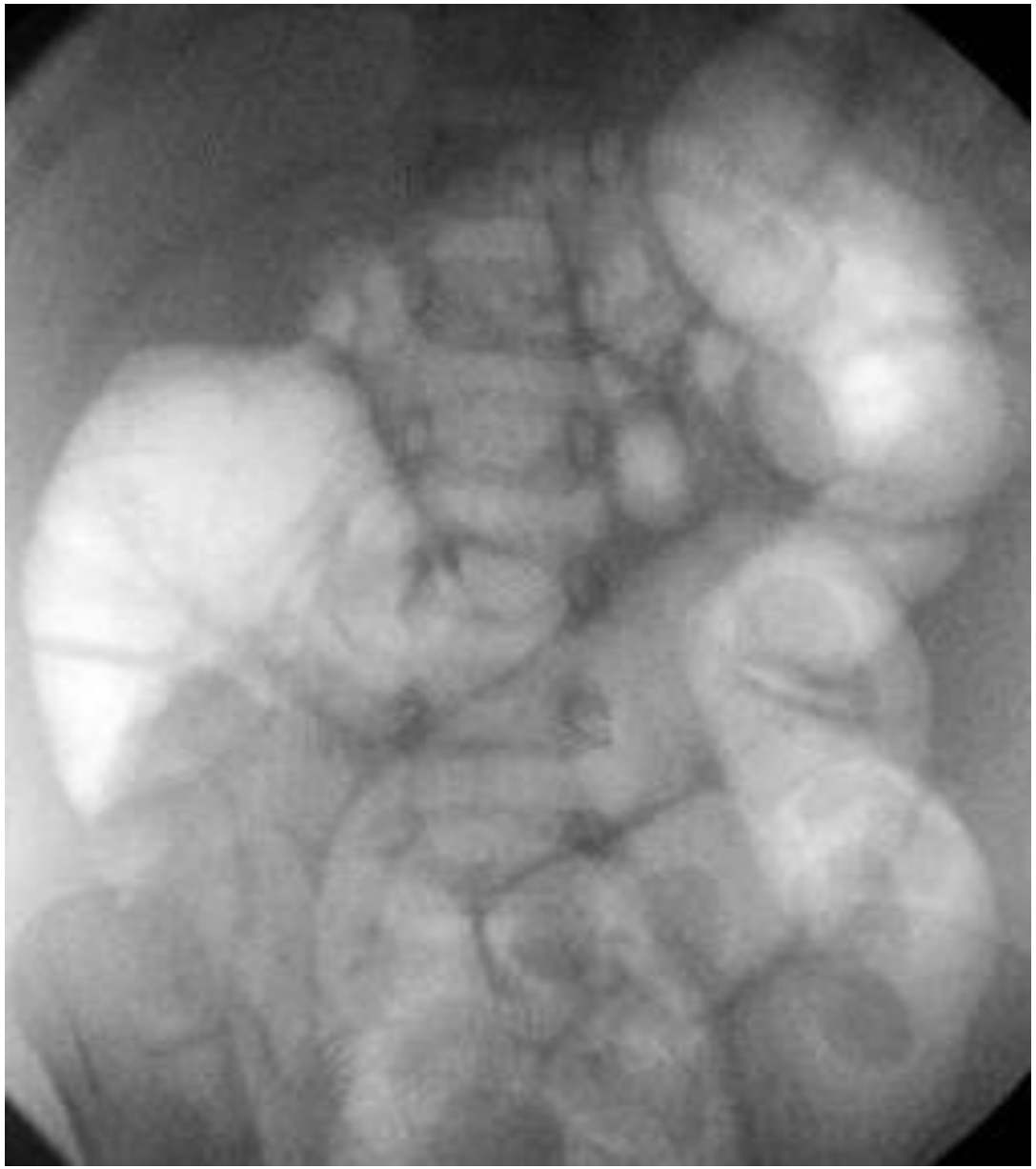

LOGIQ
RT FLANK
10
-10


0.91 cm
4.80 cm


RT FLANK



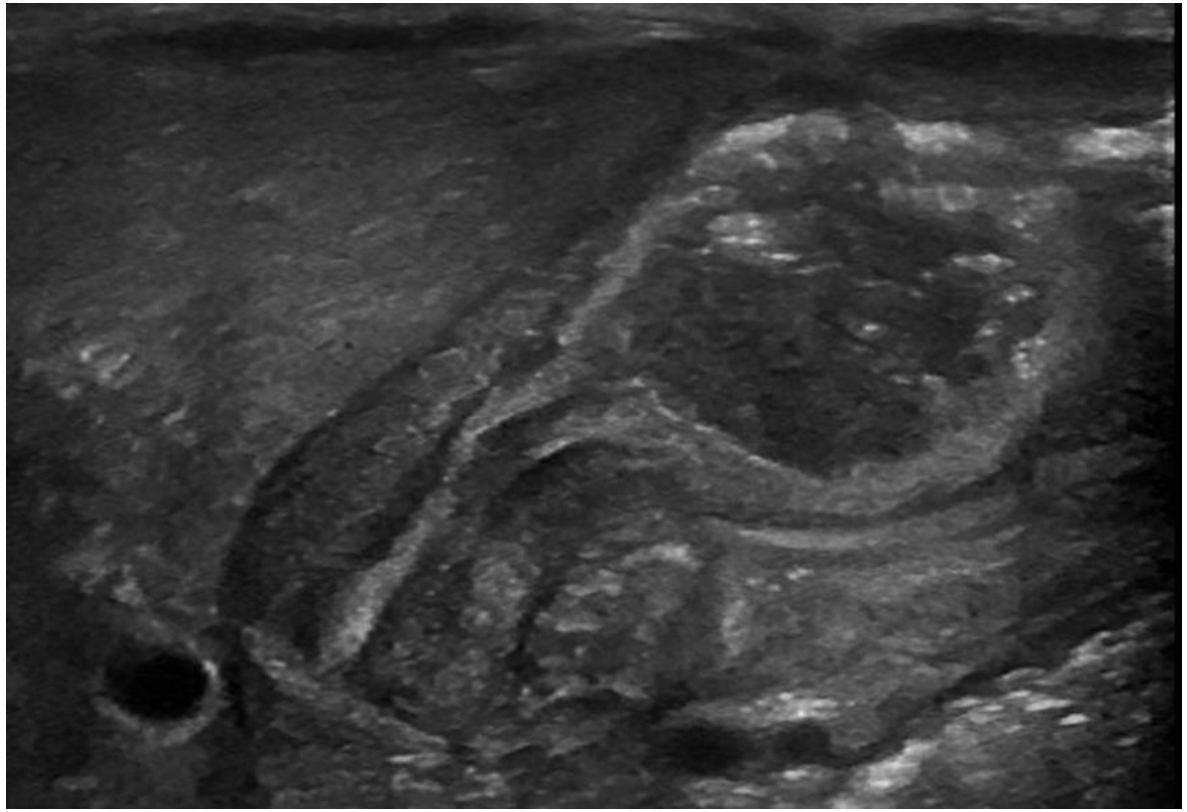


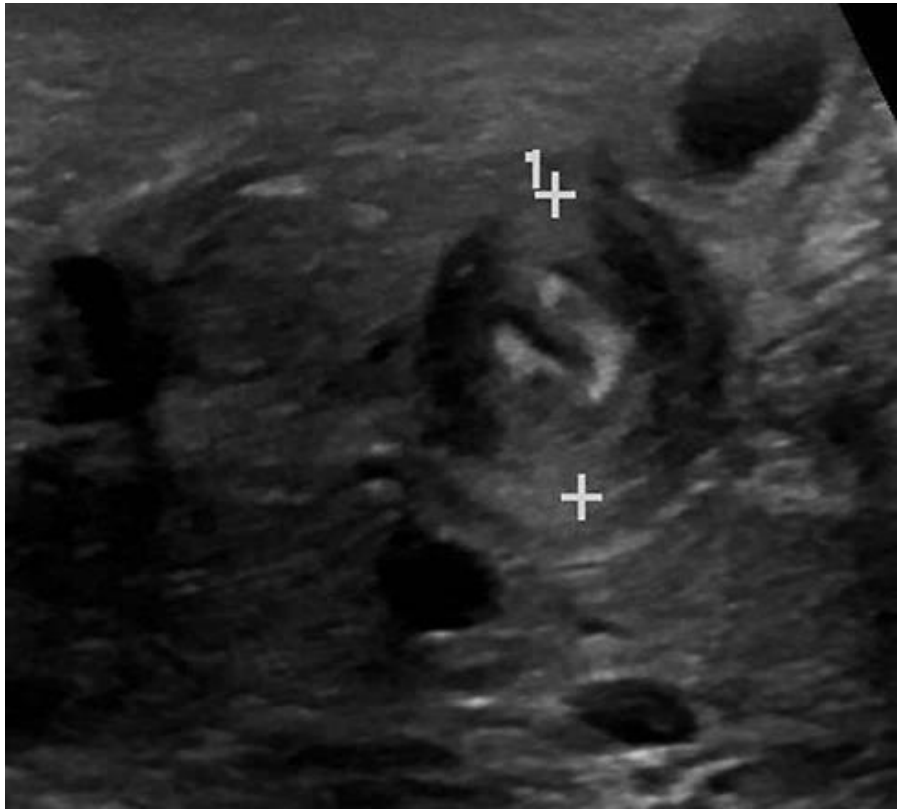


Q3

- A 5-week-old male baby, recurrent vomiting, not gaining weight?

- - Differential diagnosis?
- - Imaging?




1





Normal pylorus

Idiopathic thickening of gastric pyloric musculature ➔ progressive gastric outlet obstruction.

Pyloric stenosis is relatively common
~ 2-5 per 1000 births,

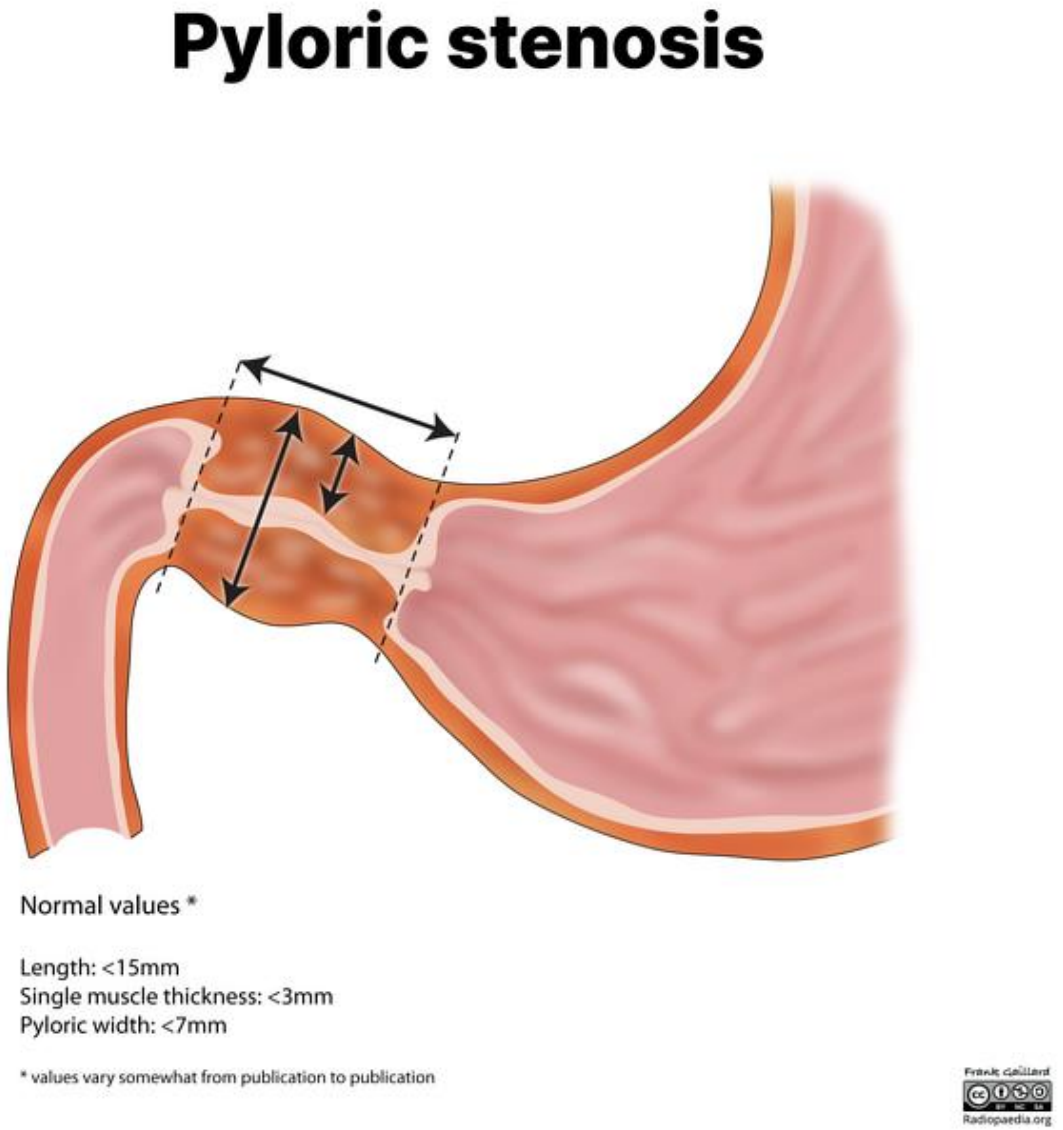
Symptoms usually begin between 3 and 12 weeks of age

male predilection (M:F ~4:1).

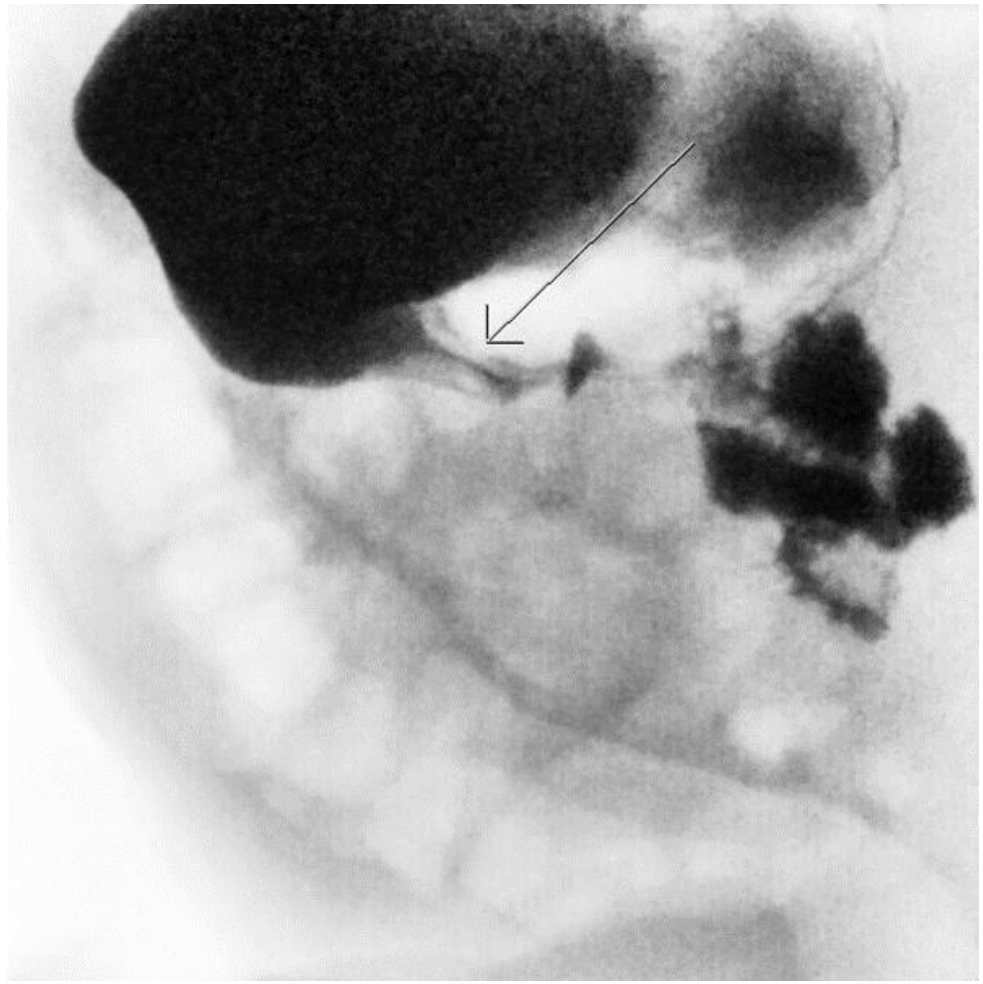
More commonly seen in the **White** population, less common in India, and among Black and other Asian populations.

<u>Risk factors</u>

- **First born**
- **maternal history of pyloric stenosis**

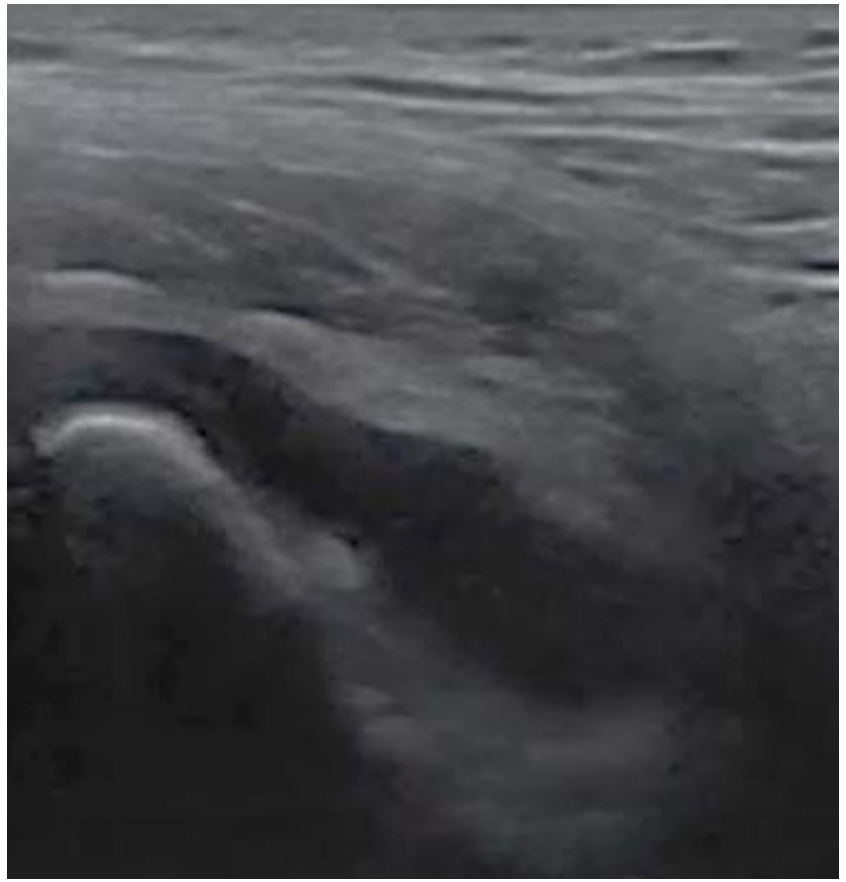


https://radiopaedia.org/articles/pyloric-stenosis-1



Q4

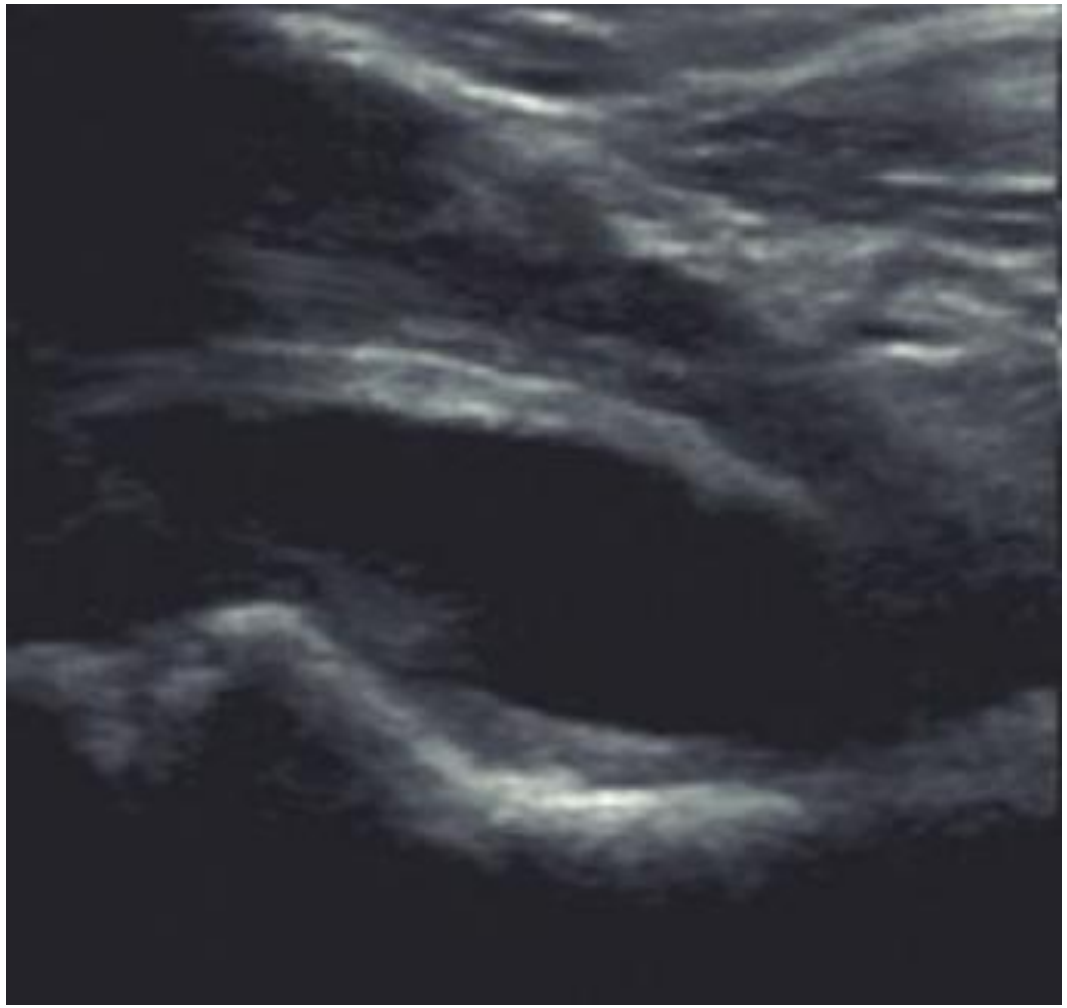
- A 5-year-old by, non-weight bearing on the right side for the last 24 hours, low-grade fever



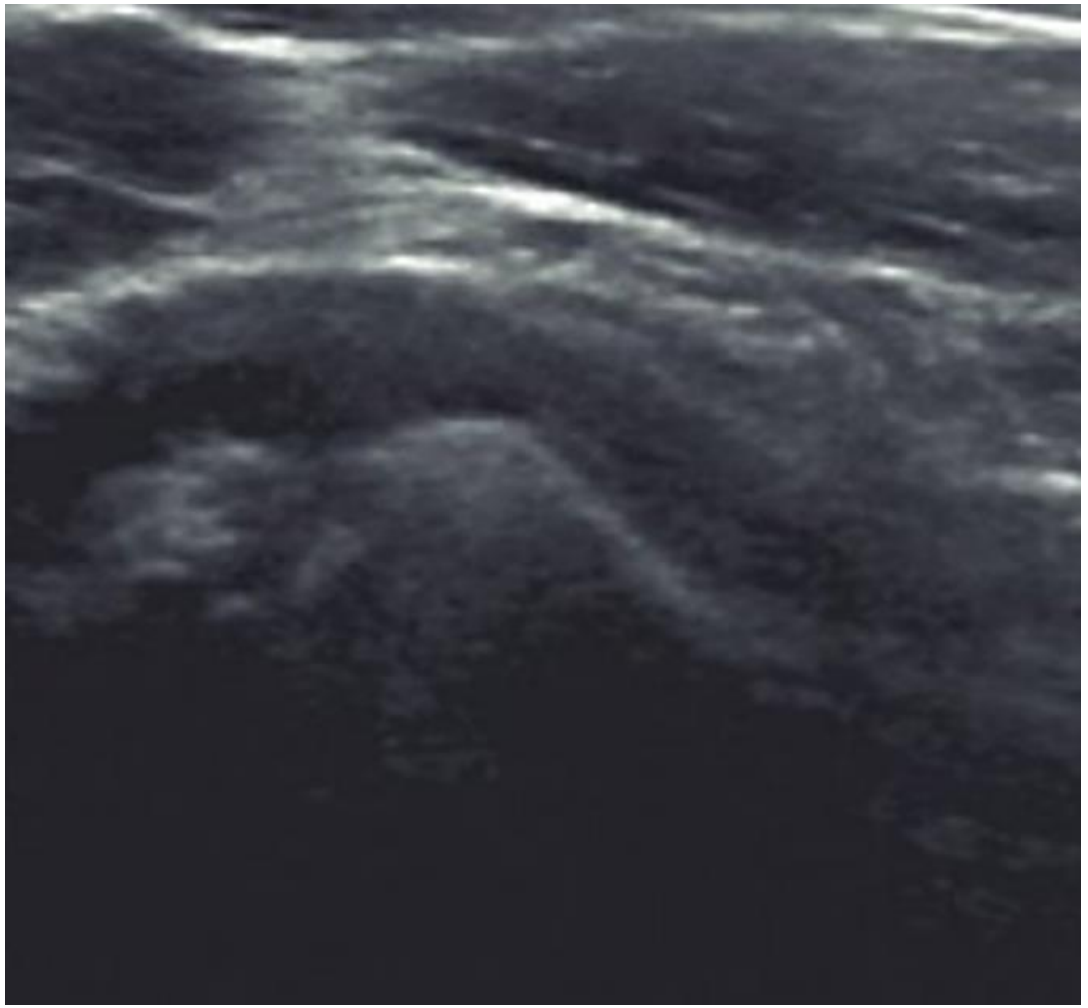
right



left



right

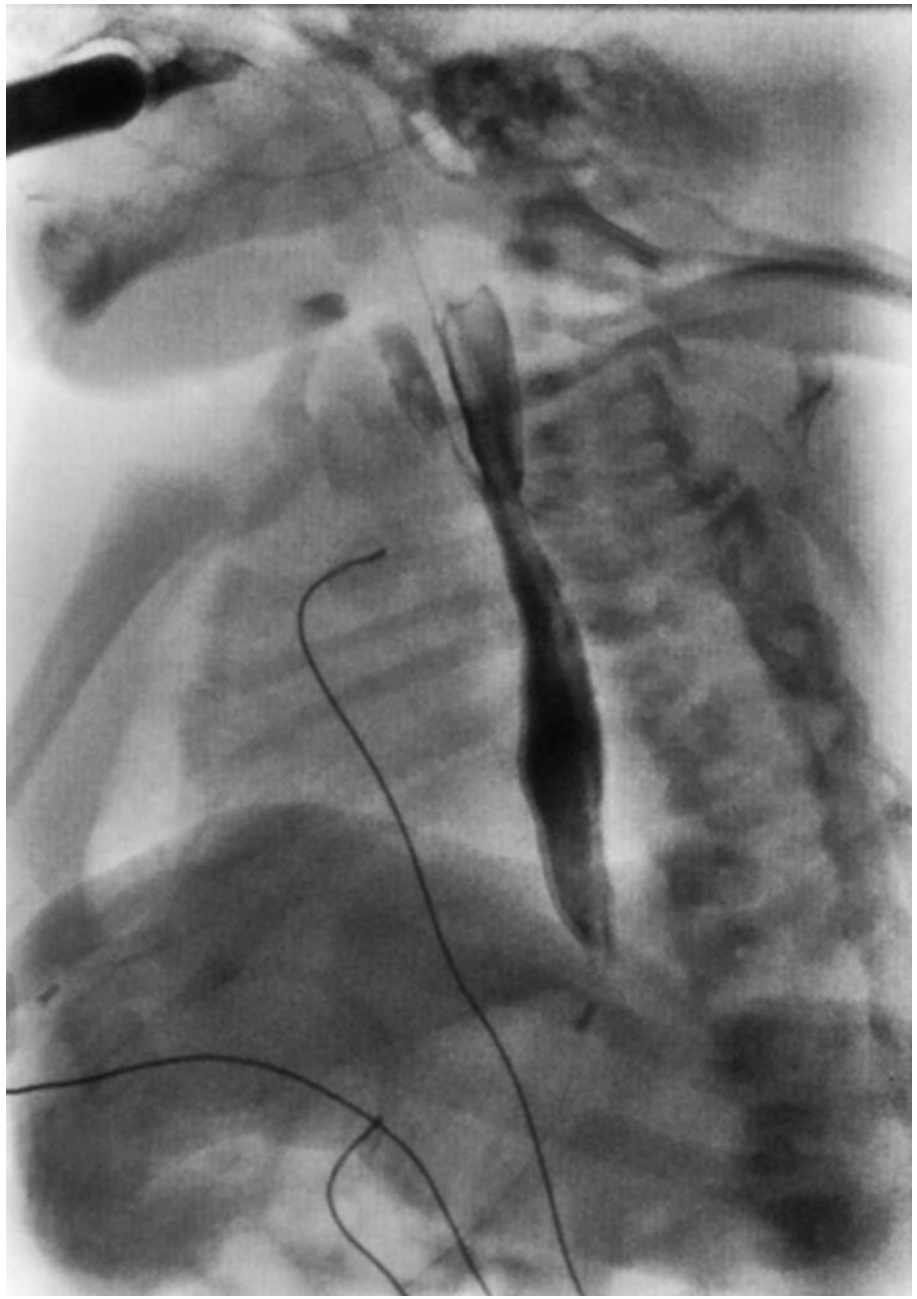


left

Q5

- A 6-week-old baby has recurrent coughing or choking while nursing or taking a bottle.
- Frothing or drooling from the mouth.
- Vomiting.
- Difficulty breathing while feeding.

- - Differential Dx?
- - Imaging investigations?



Tracheoesophageal fistula

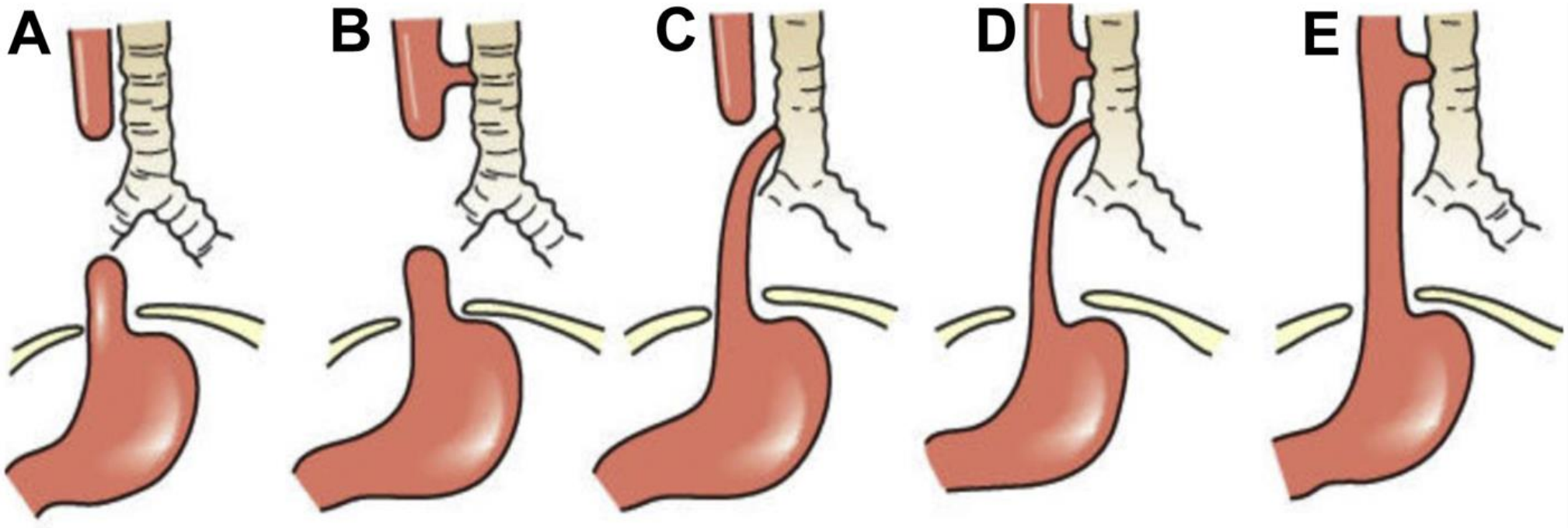


Isolated fistula
H-type

~4%







8%
- Atresia alone, no fistula
- Small stomach, gasless abdomen
- Usually has a long gap between the esophageal ends
- Gross type A

1%
- Proximal tracheoesophageal fistula
- No distal fistula
- Small stomach, gasless abdomen
- Often has a long gap between esophageal ends
- Gross type B

86%
- Most common abnormality
- Gross type C

1%
- Proximal and distal fistulas
- "Double Fistula"
- Gross type D

4%
- No atresia of the esophagus
- Congenital tracheoesophageal fistula
- H or N fistula
- Gross type E

VACTREL Association

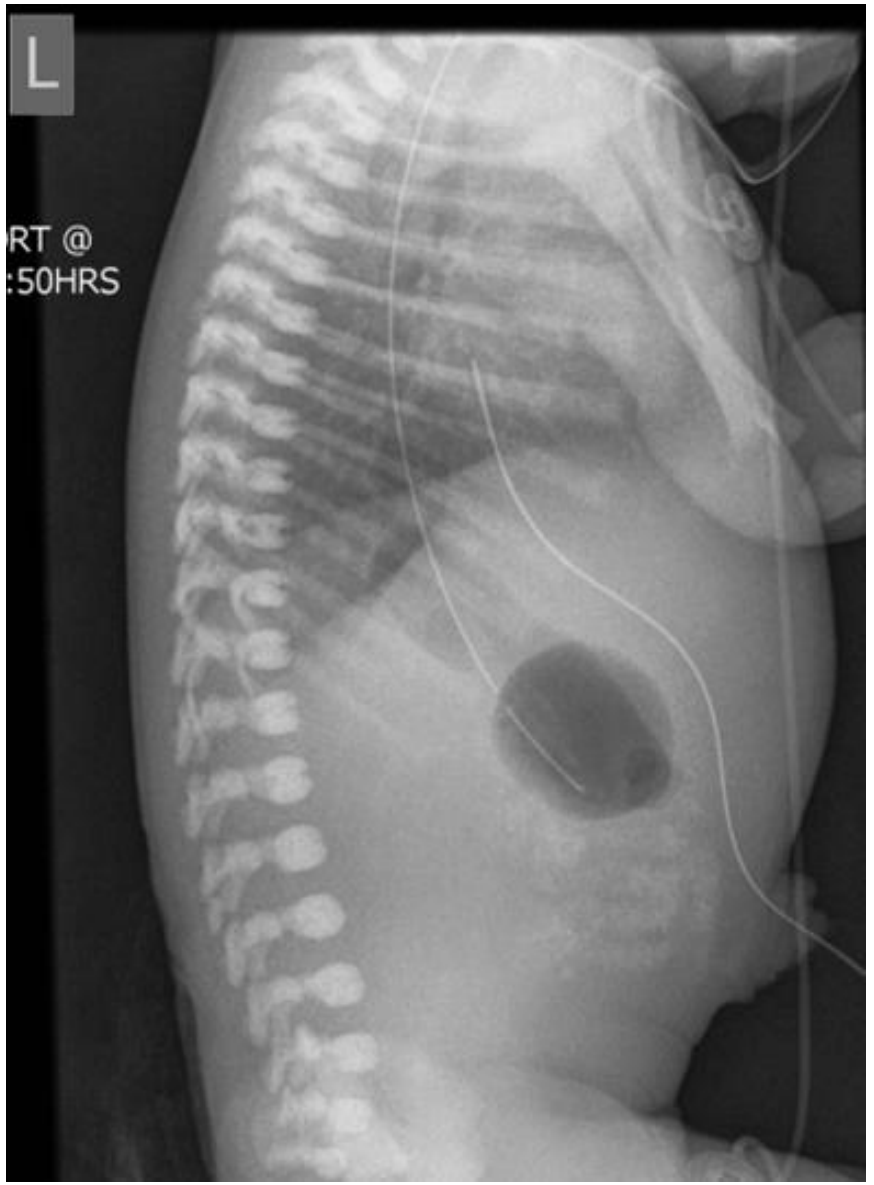
- **V**ertebral
- **A**norectal
- **C**ardiac
- **Tracheoesophageal fistula**
- **R**enal
- **L**imb

Q6

- A 12-hour old baby. Paucity of gas in the abdomen. Air is seen in the stomach and proximal duodenum
- - DDX?





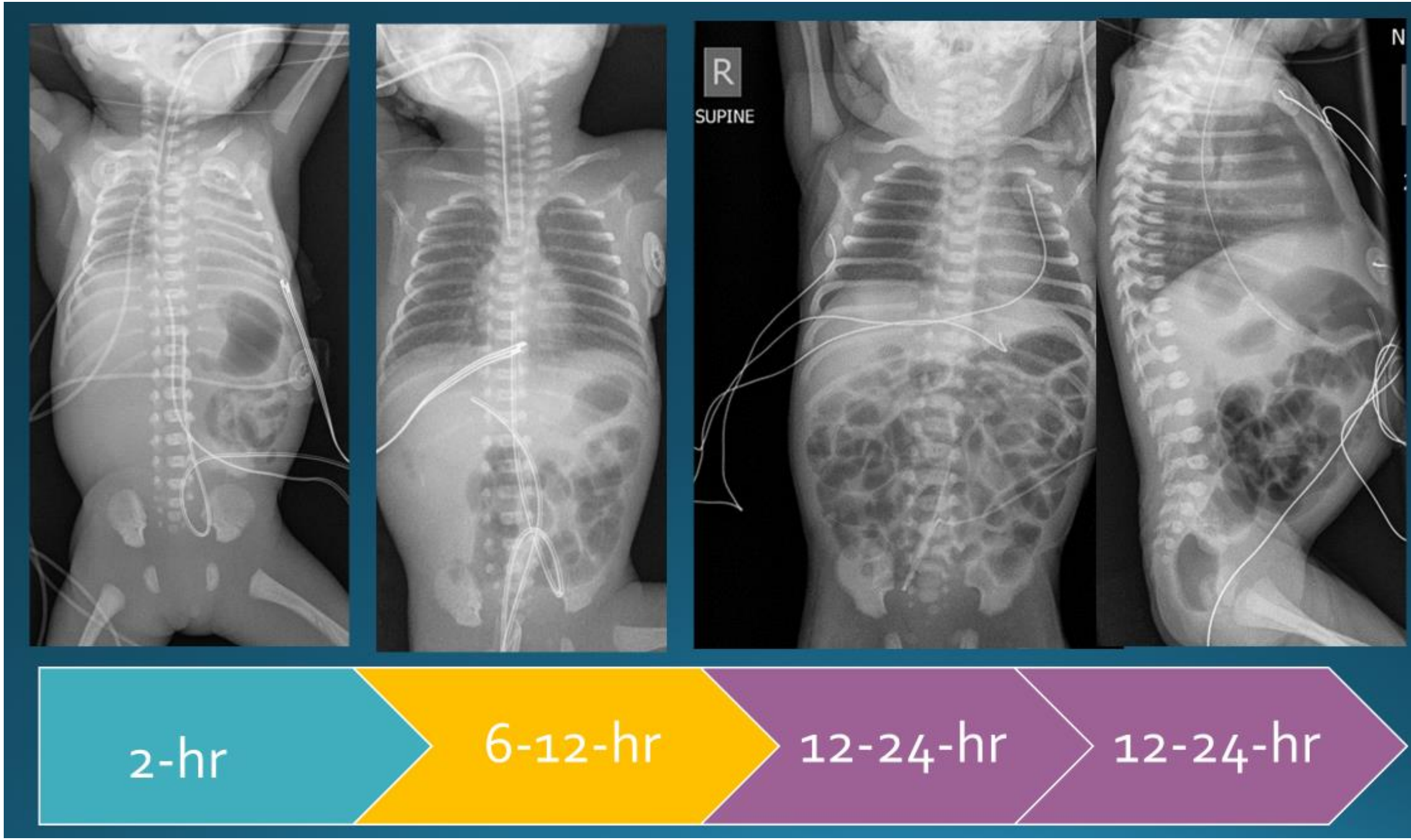

L
RT @
:50HRS

Duodenal Atresia

- **Double Bubble sign**

- Duodenal atresia

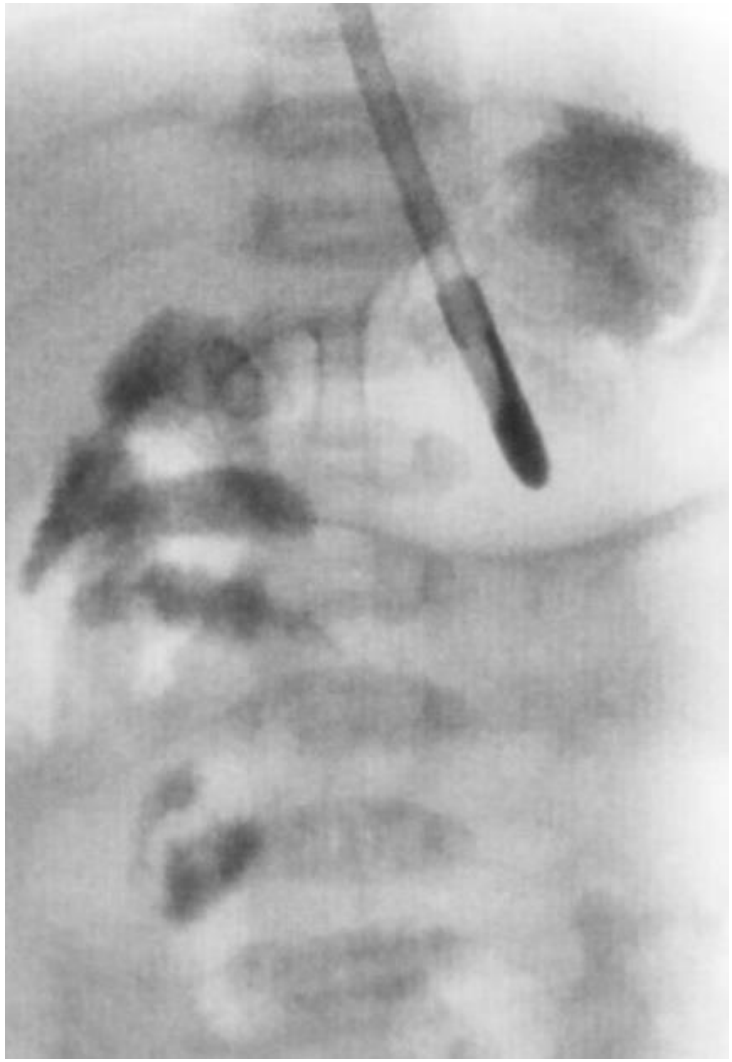
- Results from failure of recanalization of the solid duodenal tube. Most often the atresia occurs distal to Vater's ampulla

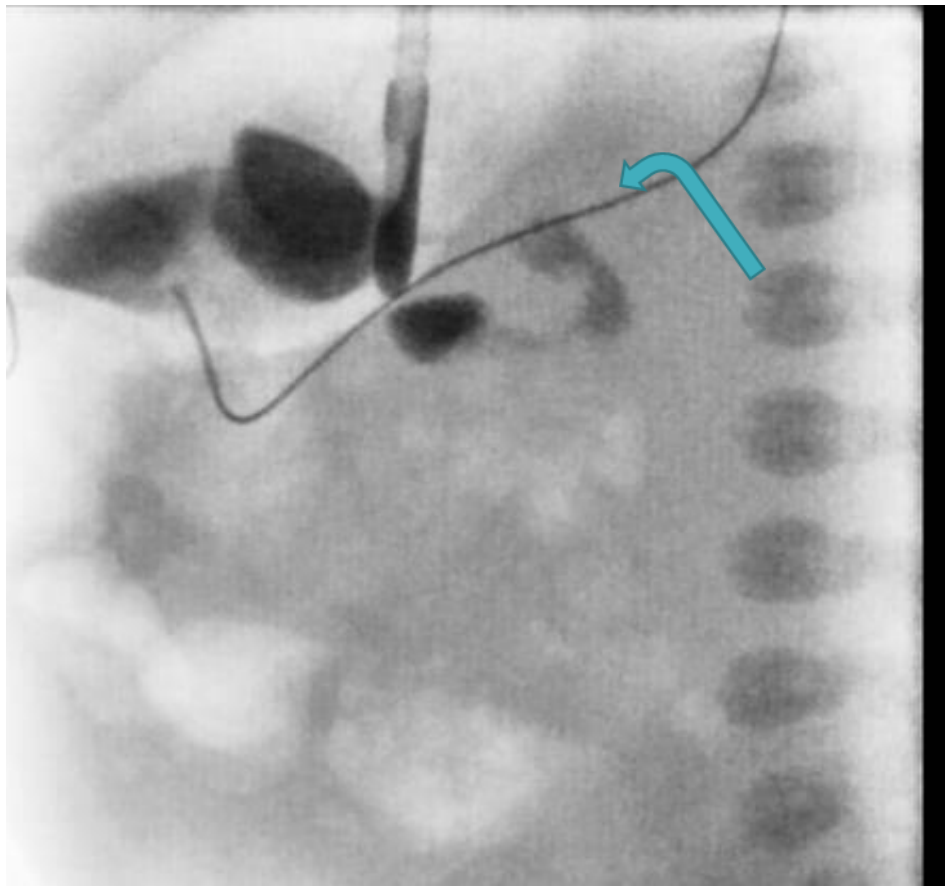

R
SUPINE
2-hr
6-12-hr
12-24-hr
12-24-hr

Q7

- 39 weeks, 0-day, bilious vomiting


mAs kvp
mm
EI:143
EXI:
R

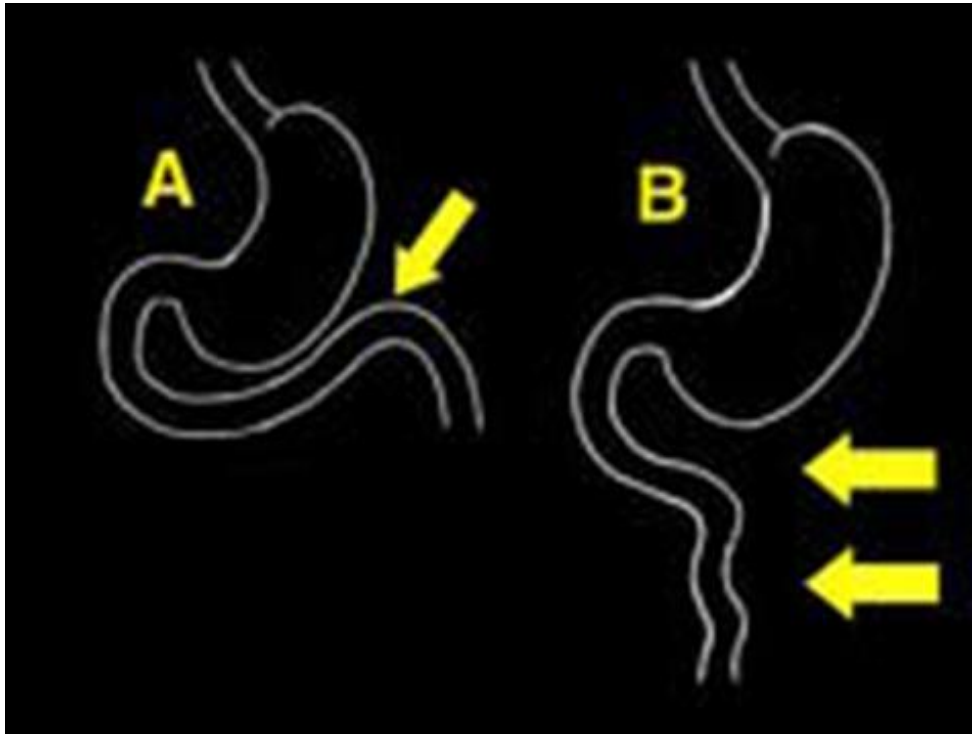


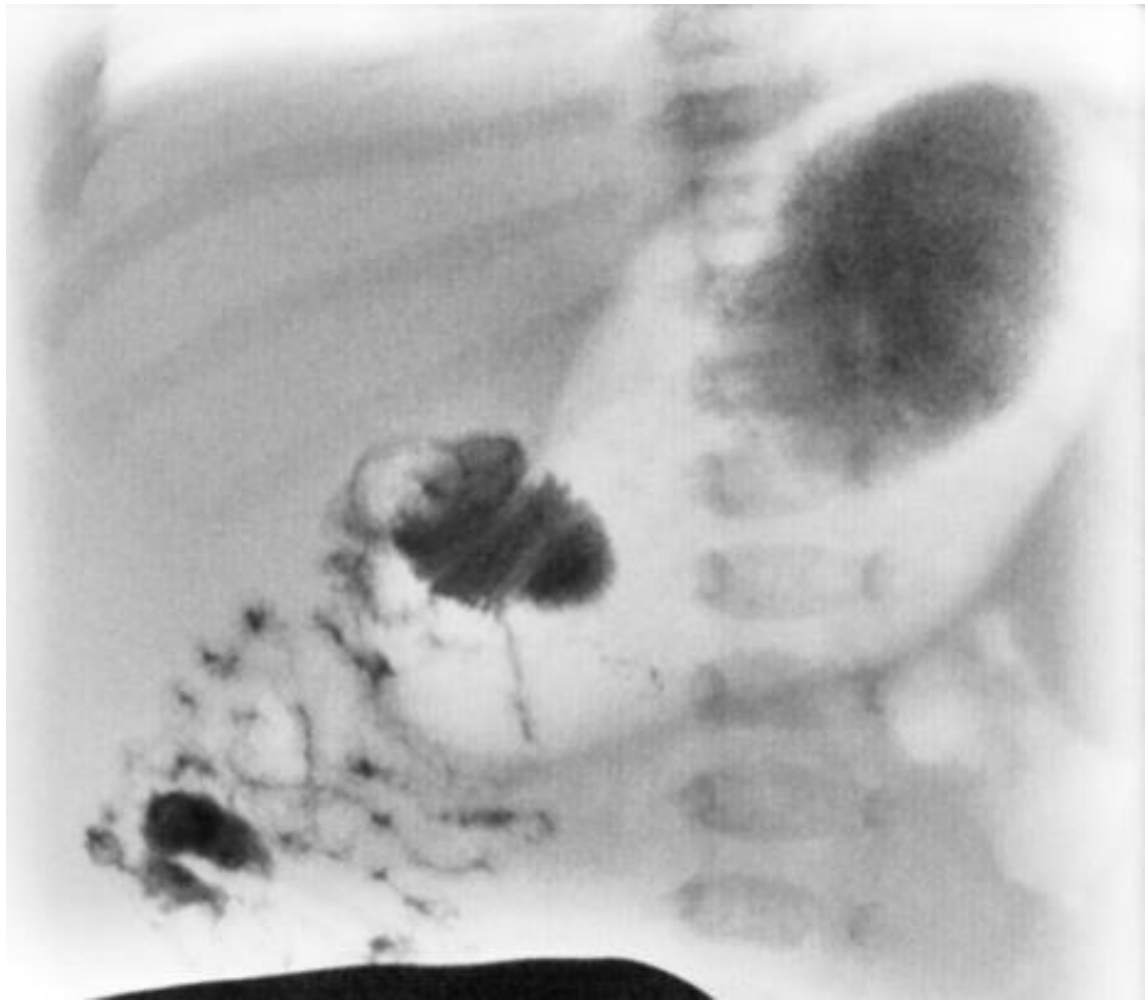


Upward direction of
the D2

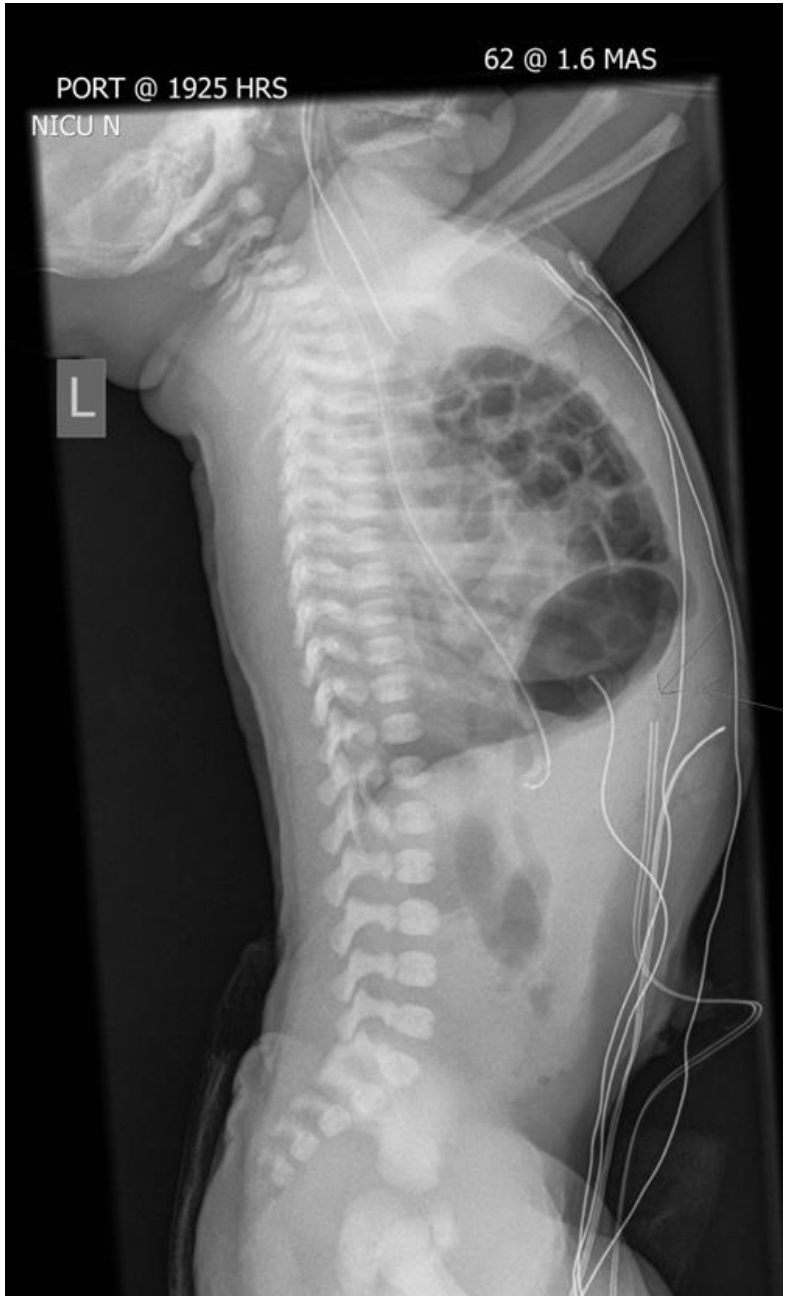


normal



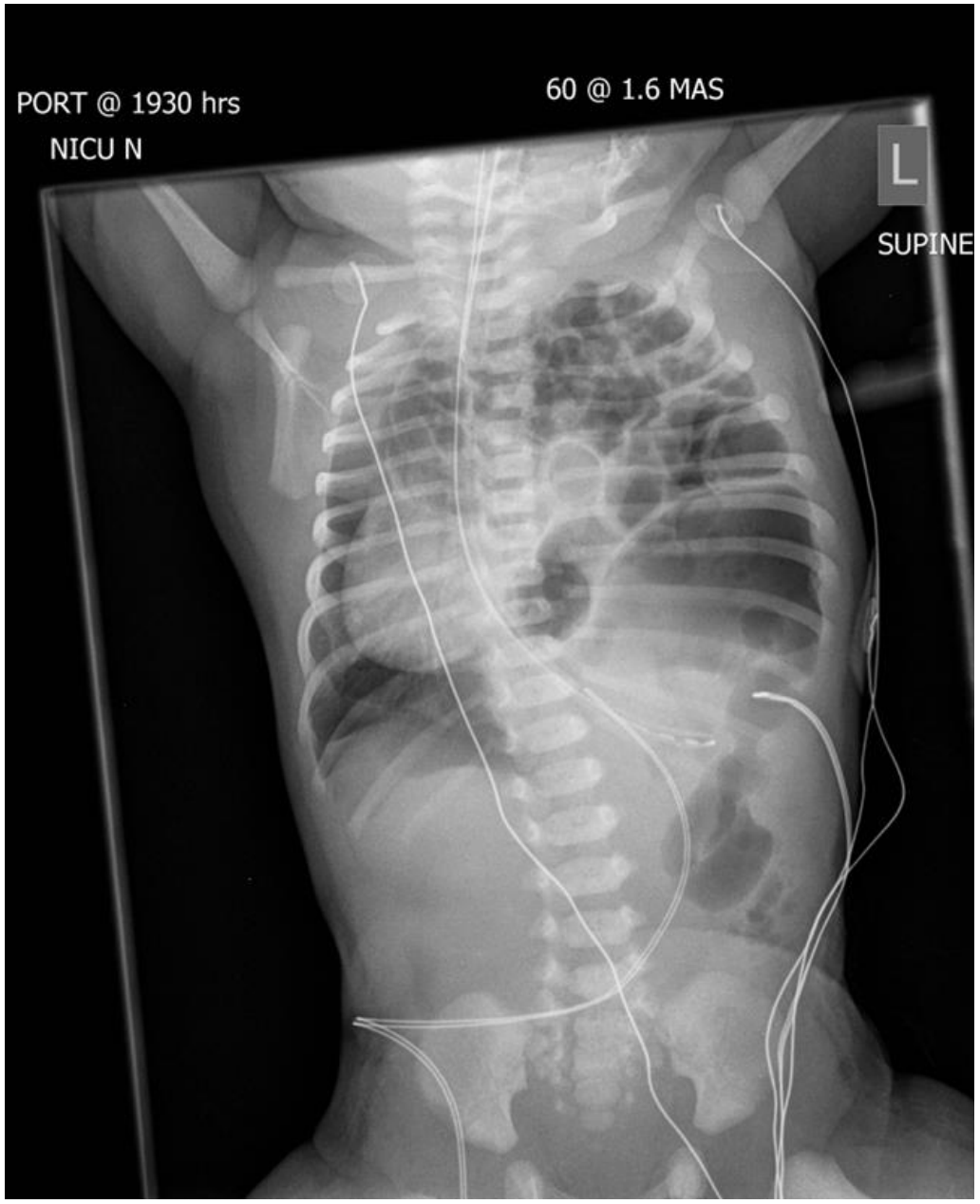






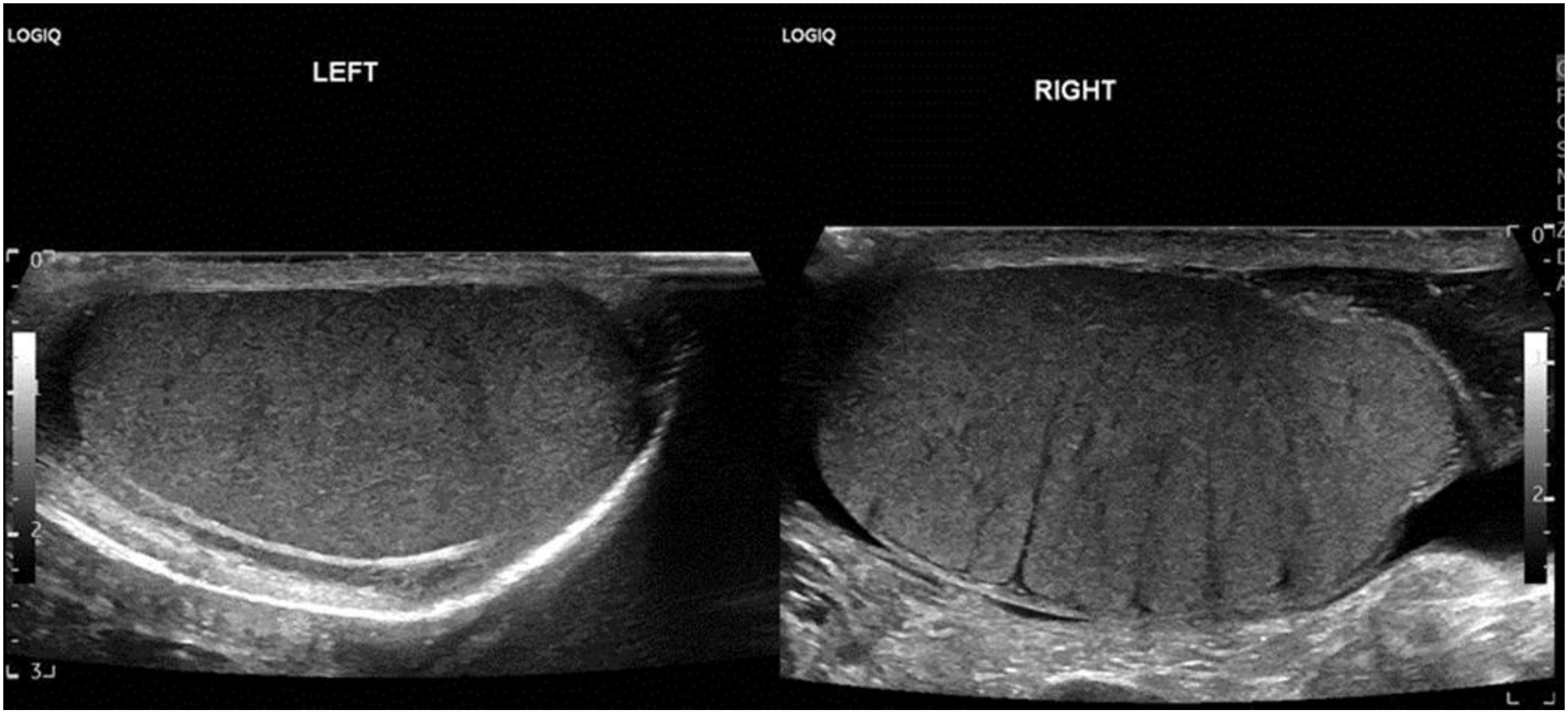
Q8

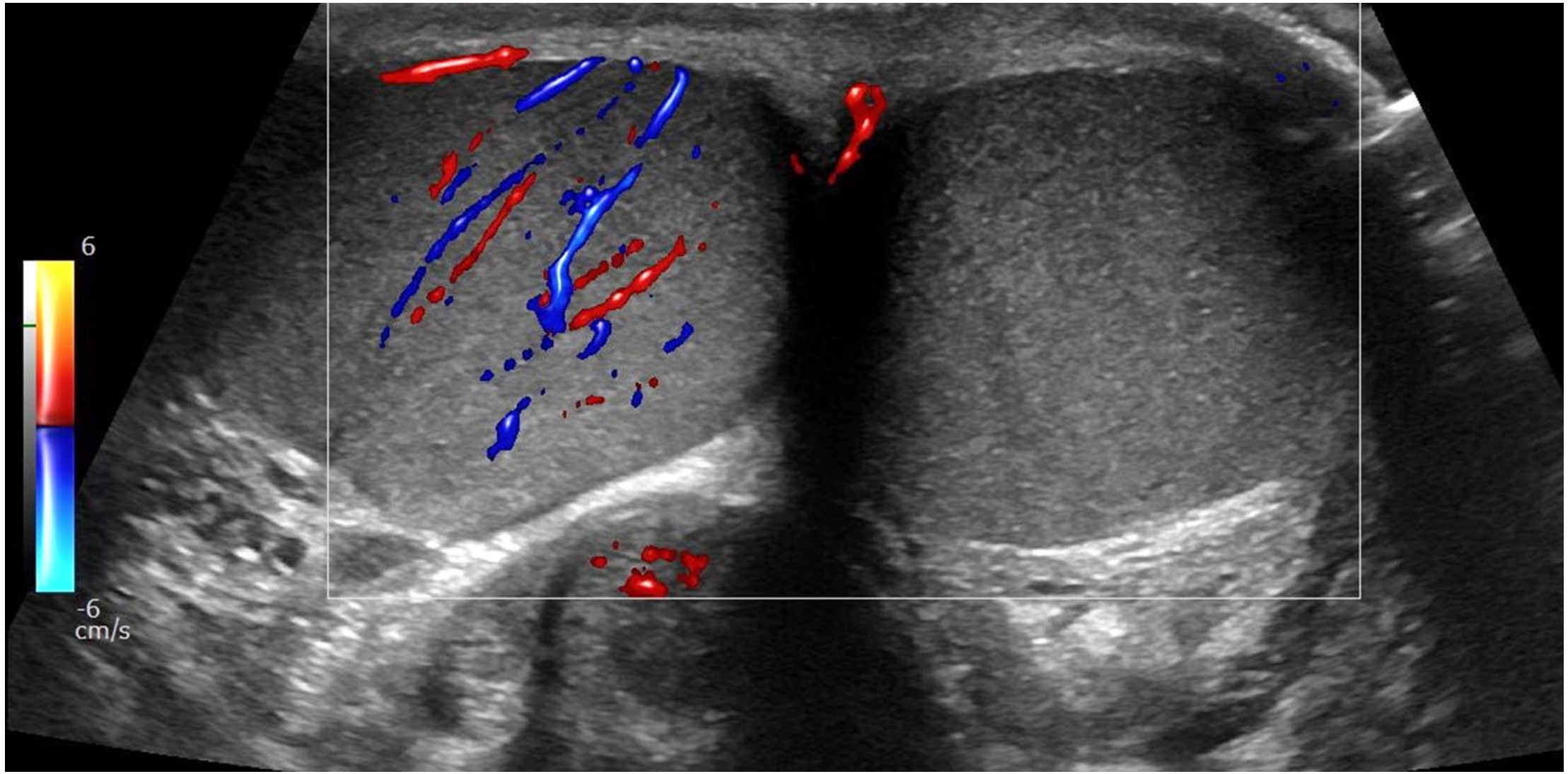
A 0- day old – Difficulty breathing



Q9

- A 13-year-old boy, scrotal pain


LOGIQ
LEFT
LOGIQ
RIGHT


6
-6
cm/s

Q10

- A 3-month-old baby, cough and irritability

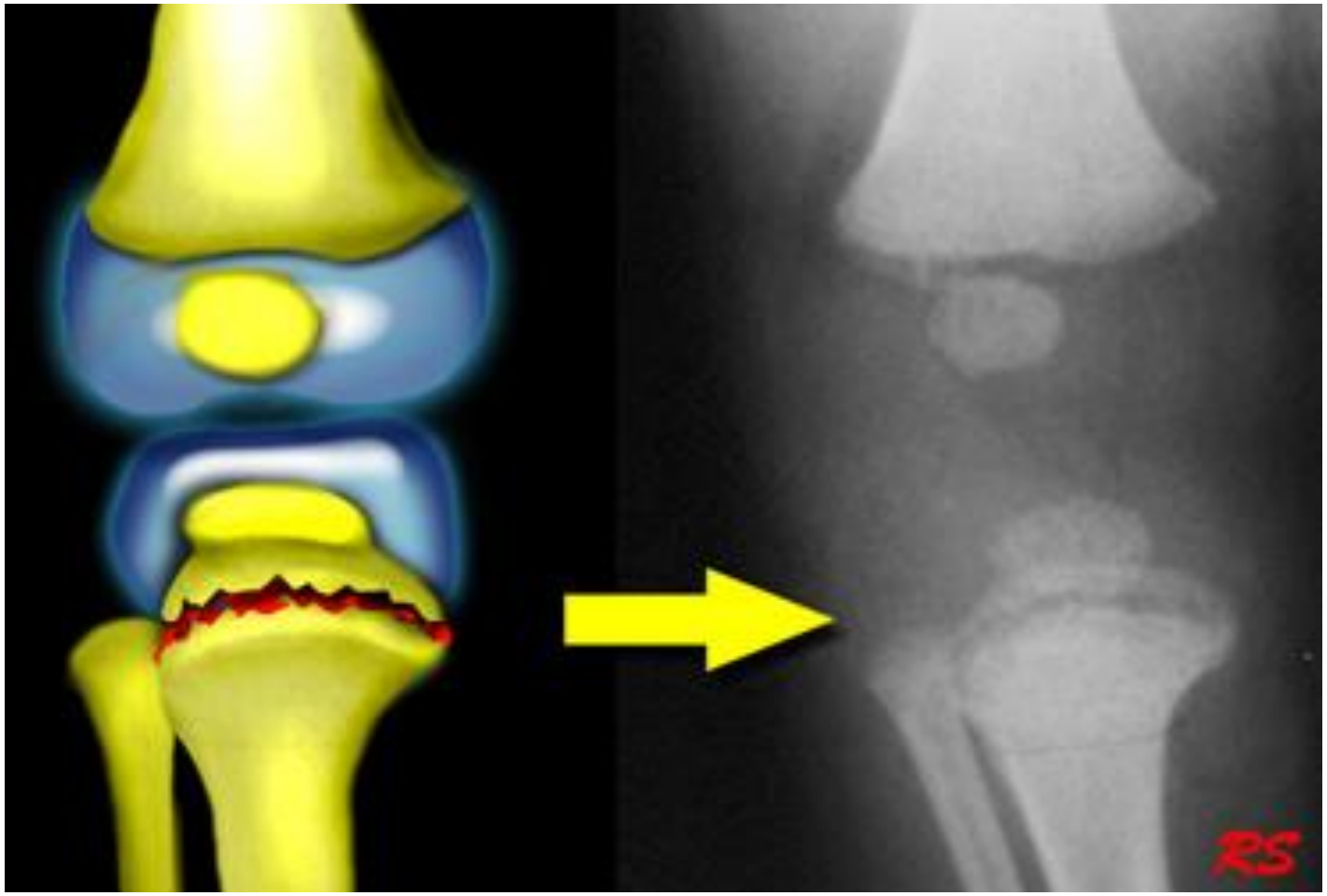


- The classical **metaphyseal corner or bucket handle fracture** is virtually pathognomonic for abuse, although a differential diagnosis does exist.

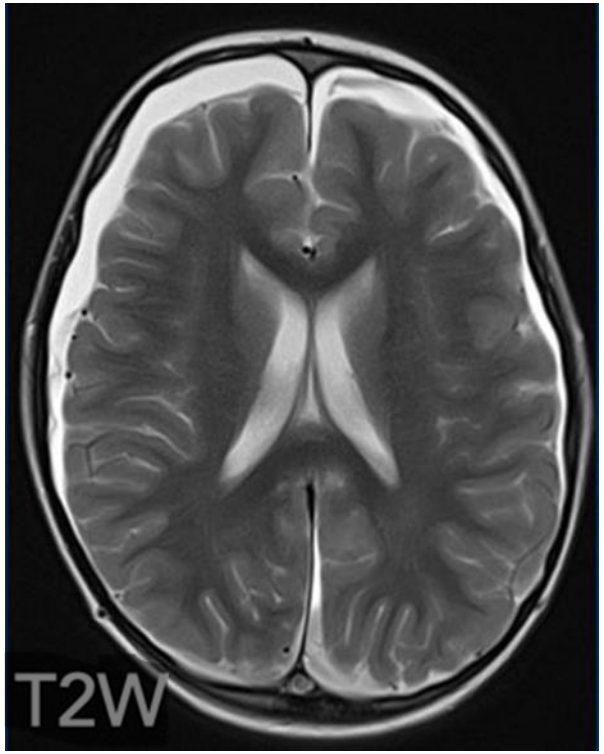
- **Rib fractures** are prevalent and highly specific for abuse in young children less than 2 years.

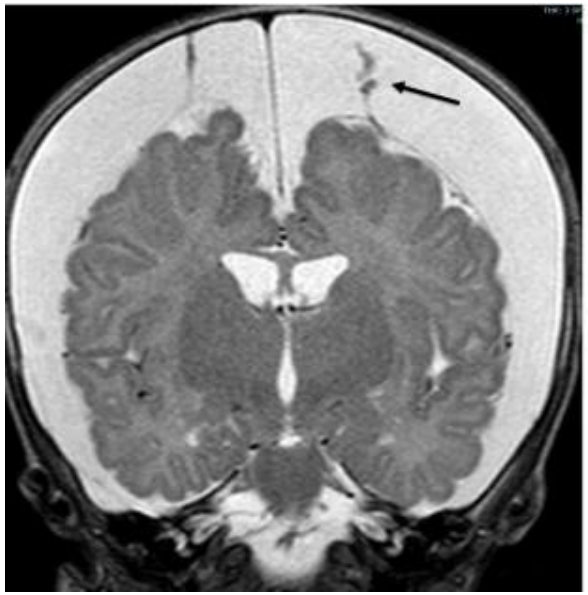
- Fractures of **the acromion, sternum** and **spinous processes** are so rare in accidental conditions, giving them a high specificity for abuse.





The metaphyseal lesion in abused infants: a radiologic-histopathologic studyPK Kleinman, SC Marks, and B Blackbourne, Am. J. Roentgenol., 146: 895 - 905.


T2W




a
0.47 cm


B

Peds. MSK

SALTER Harris Physeal Injury Classifications

Type	Characteristics
I	Separation through the physis, usually through areas of hypertrophic and degenerating cartilage cell columns.
II	Fracture through a portion of the physis that extends through the metaphyses.
III	Fracture through a portion of the physis that extends through the epiphysis and into the joint.
IV	Fracture across the metaphysis, physis and epiphysis.
V	Crush injury to the physis.



SH Classification from I - V

https://www.emnote.org/emnotes/salter-harris-fractures

Minimally displaced oblique Salter Harris II fracture of the distal
tibia



14-Year-old, ankle injury



14-year-old, ankle injury

Un-displaced **Tillaux fracture**

Tibial epiphysis = Salter III



Salter 4,
Above and below growth plate



ELBOW

The appearance of the ossification centers around the elbow
The order of appearance, but necessarily the same order of fusion

Capitellum: **1** Y

Radial head: **3** Y

Int. epicondyle: **5** Y

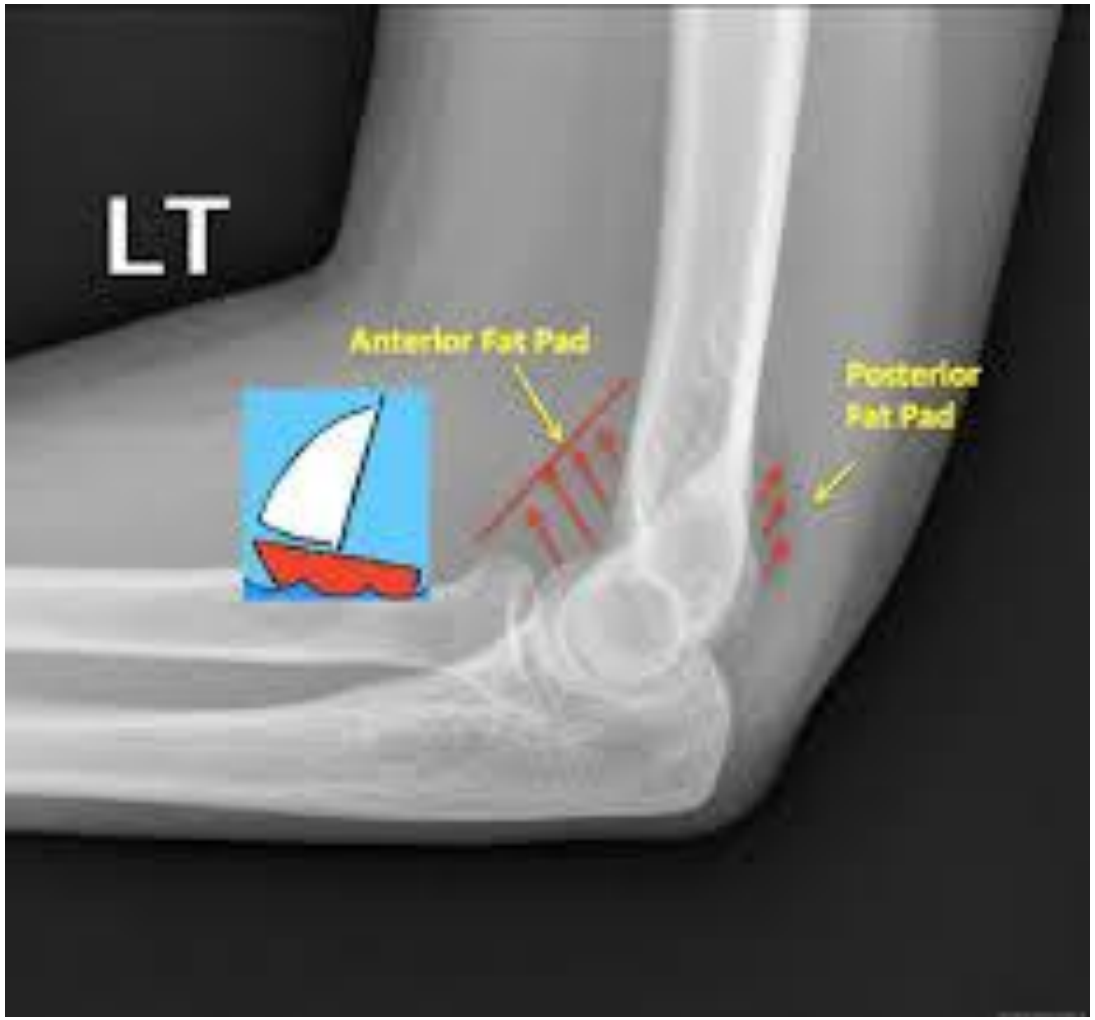
Trochea: **7** Y

Olecranon: **9** Y

Ext. epicondyle: **11** Y

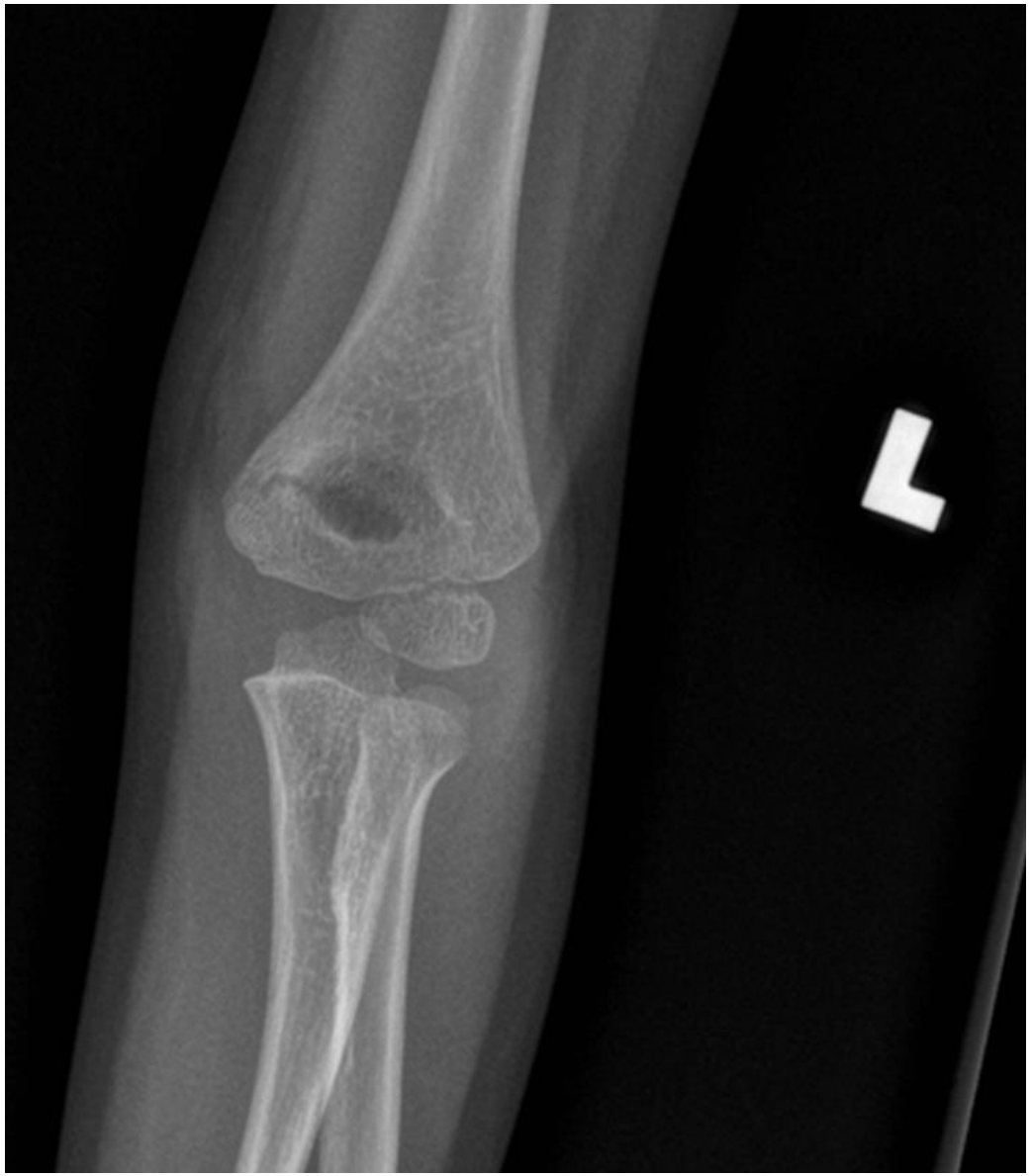


Elbow fractures- Joint effusion



https://coreem.net/core/radial-head-fracture/





Nondisplaced supracondylar humeral fracture



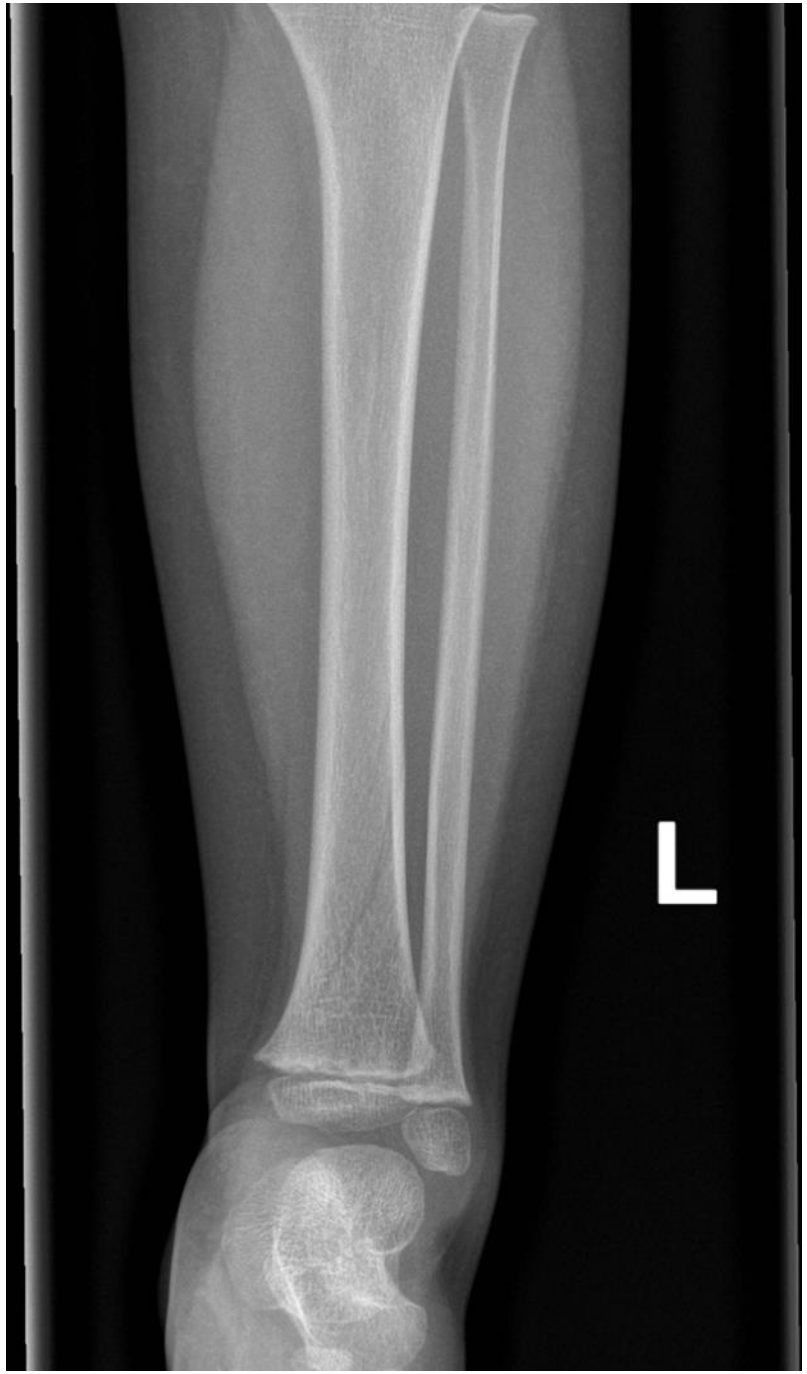




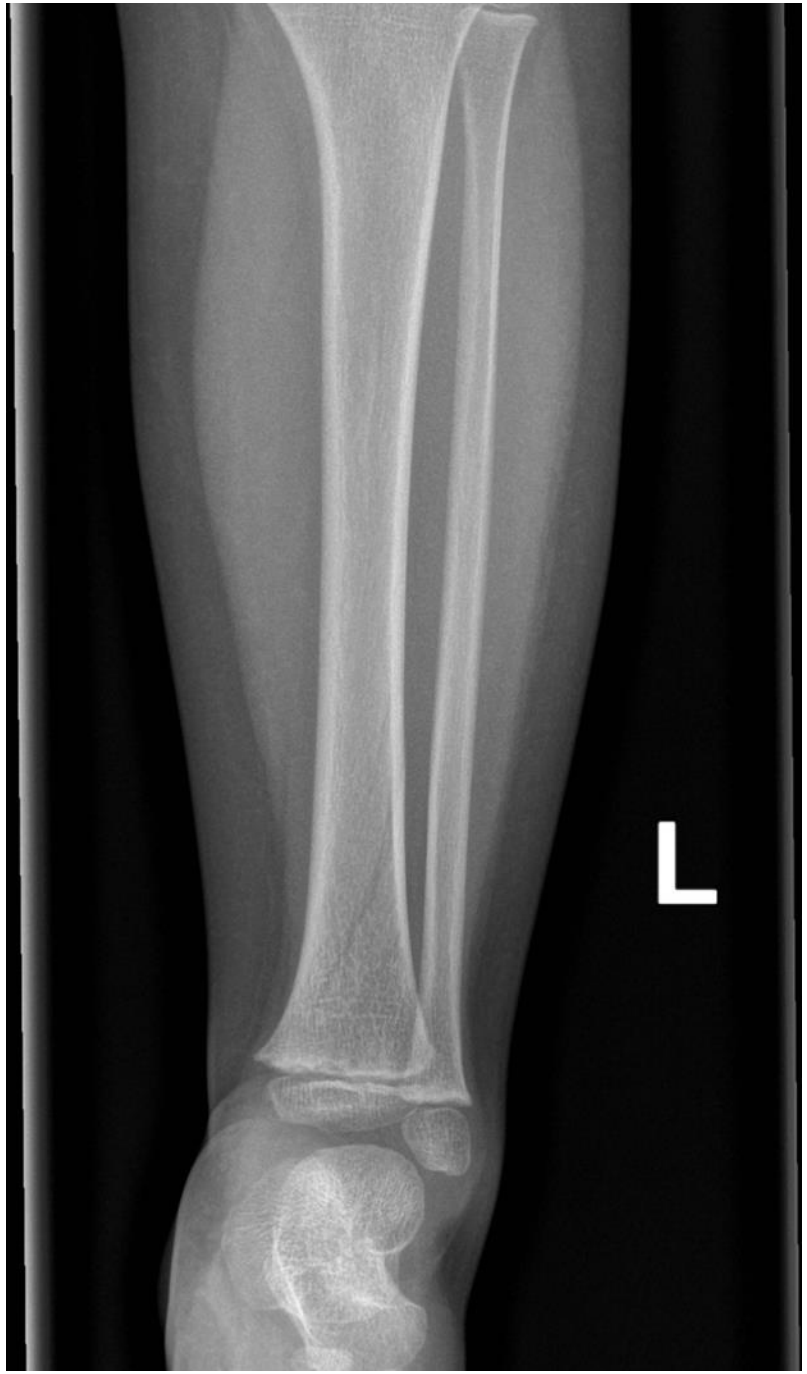

R



Buckle fracture of distal radial metaphysis


L



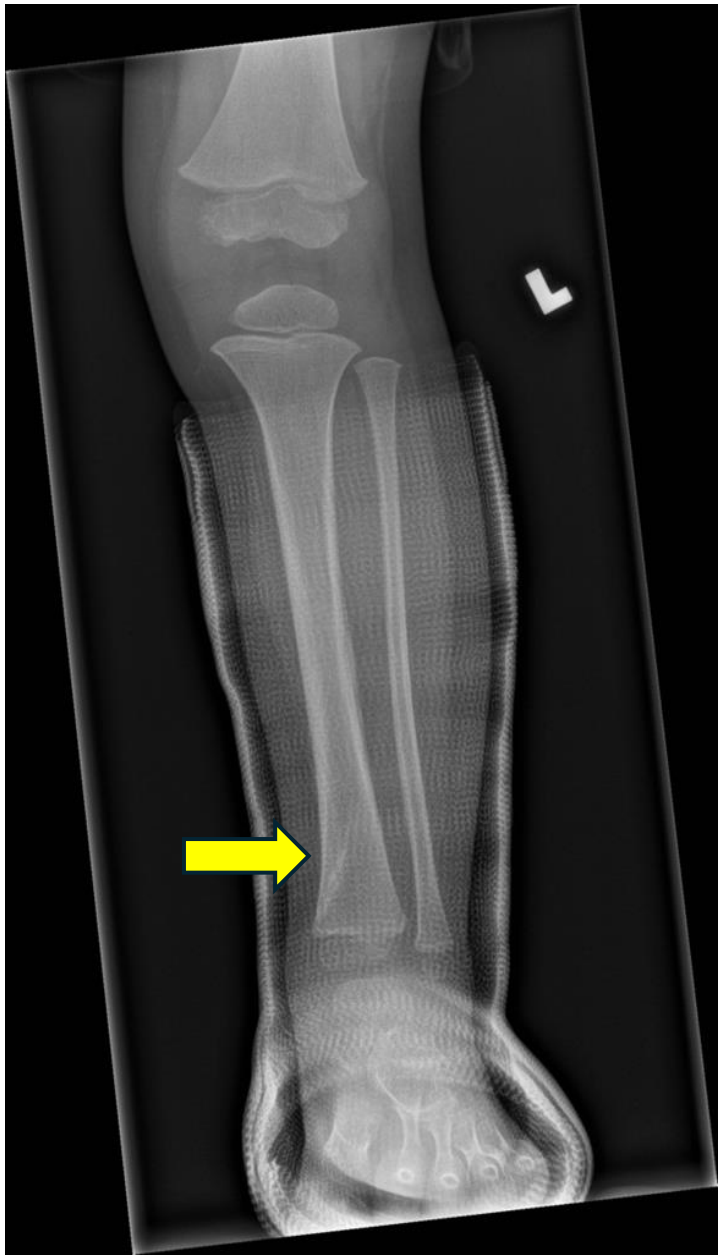




Toddler’s fracture of the distal tibial metaphysis

Follow-up x-ray ➔:
Ongoing healing

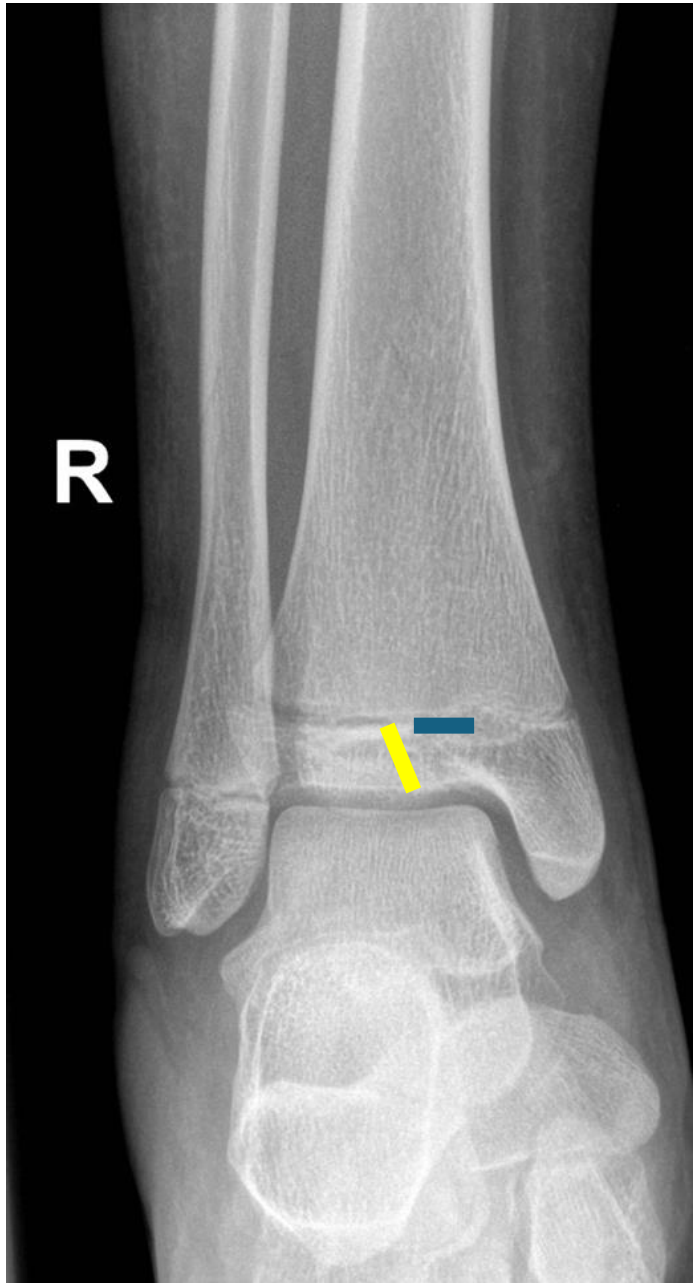


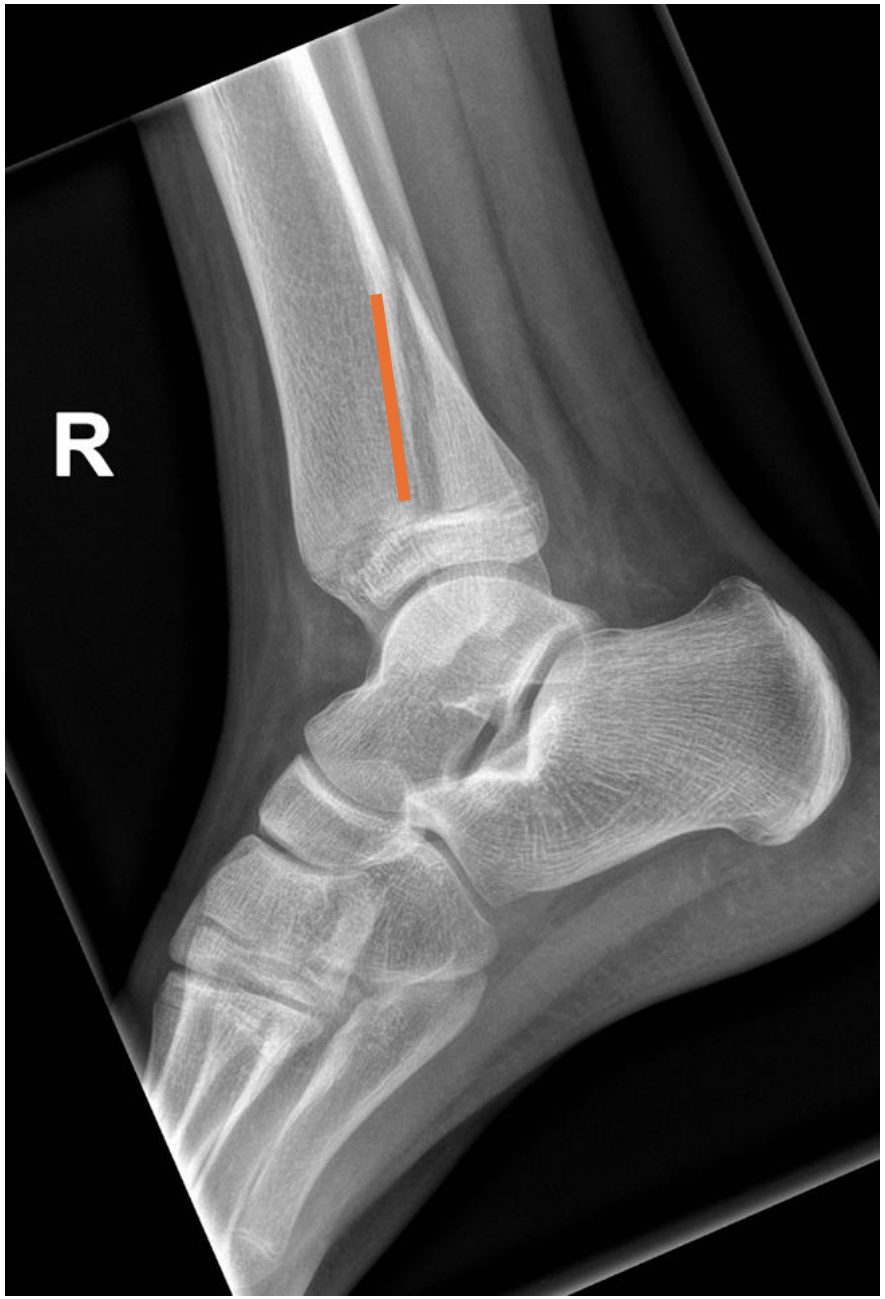





R


R





Triplane fracture

Triplane (triplanar) fracture

- Only occurring in **adolescents➔** As the physiological closure of the physeal plate begins **medially,** the lateral (open) physis is prone to this type of fracture.

- Usually considered as a **type 4 Salter-Harris** fracture.
    - Salter-Harris 3 fracture on AP
    - Salter-Harris 2 fracture on lateral

- It comprises 3 components:
    - a vertical (**sagittal**) fracture through the **epiphysis**
    - a horizontal (**axial**) fracture through the **physis**
    - an oblique (**coronal)** fracture through the **metaphysis**

Salter-Harris type 2 fracture

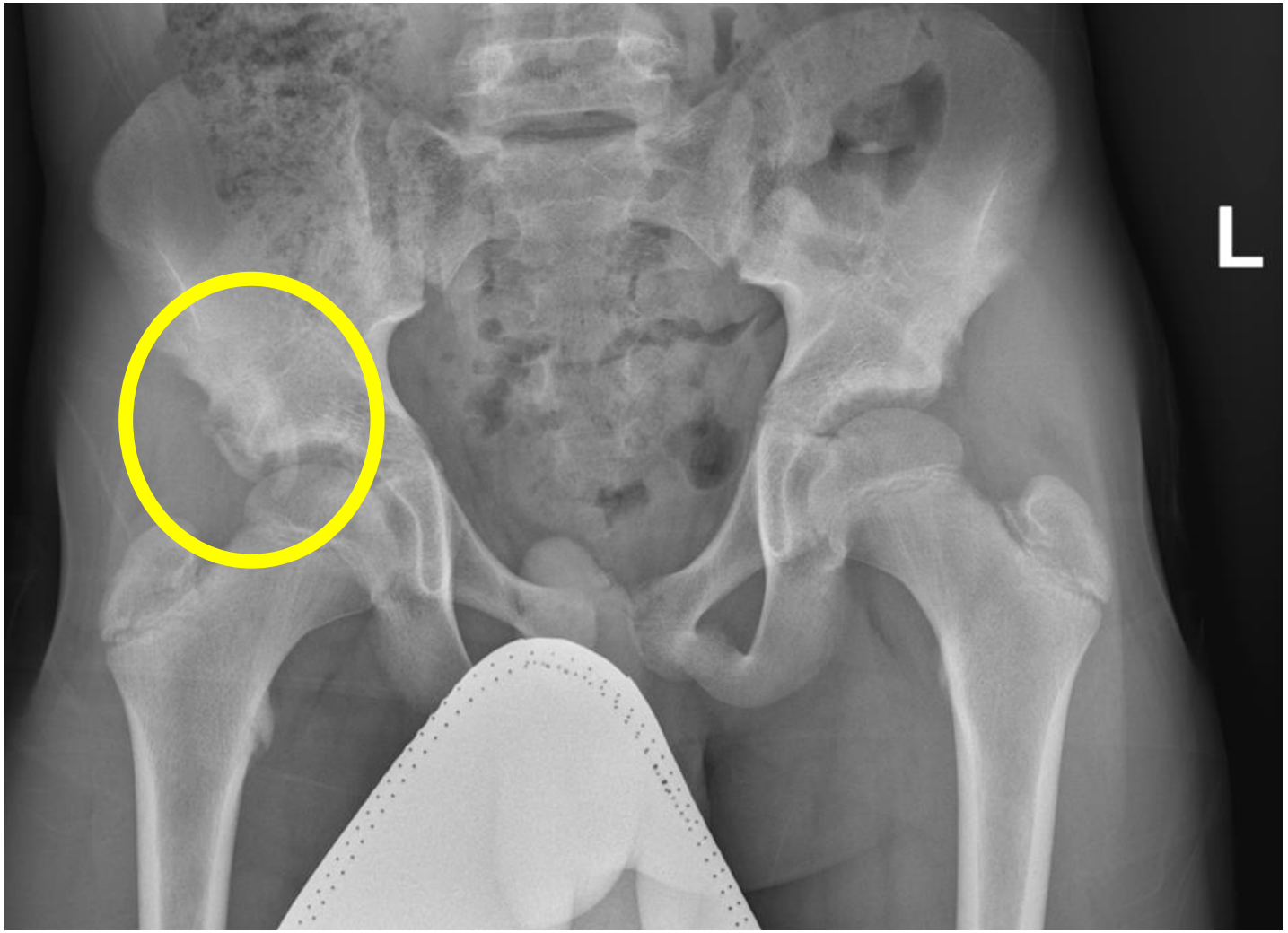


A 13-year-old male with 1 month of right hip pain, decreased internal rotation of the right hip.



Abnormal calcific densities in the region of the **superior right hip joint** ➔

in keeping with a **subacute avulsion injury of the rectus femoris** muscle.



Minimally displaced oblique Salter Harris II fracture of the distal tibia





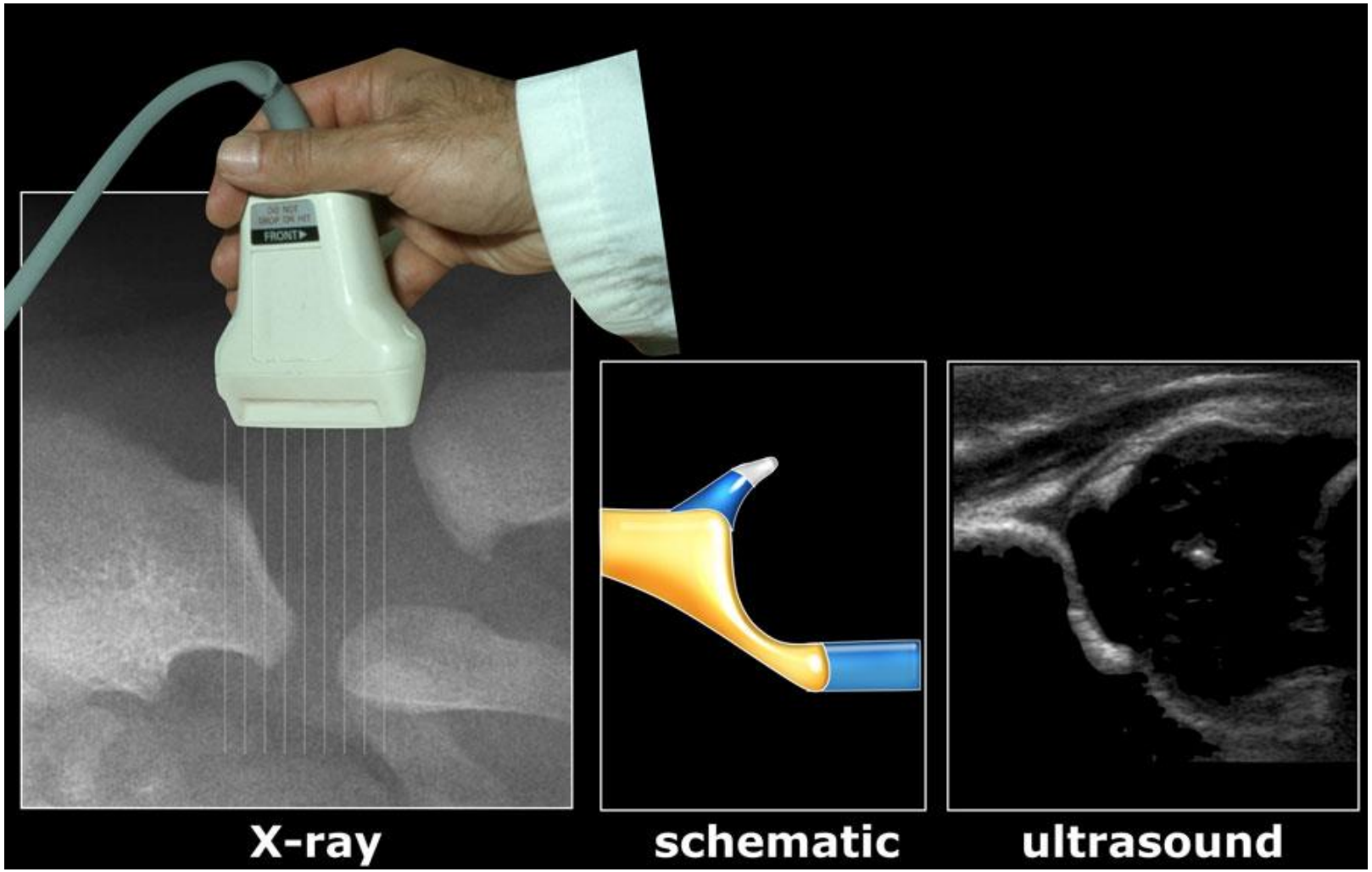
DDH

Developmental dysplasia of the hip (DDH) denotes aberrant development of the hip joint and results from an abnormal relationship of the femoral head to the acetabulum.

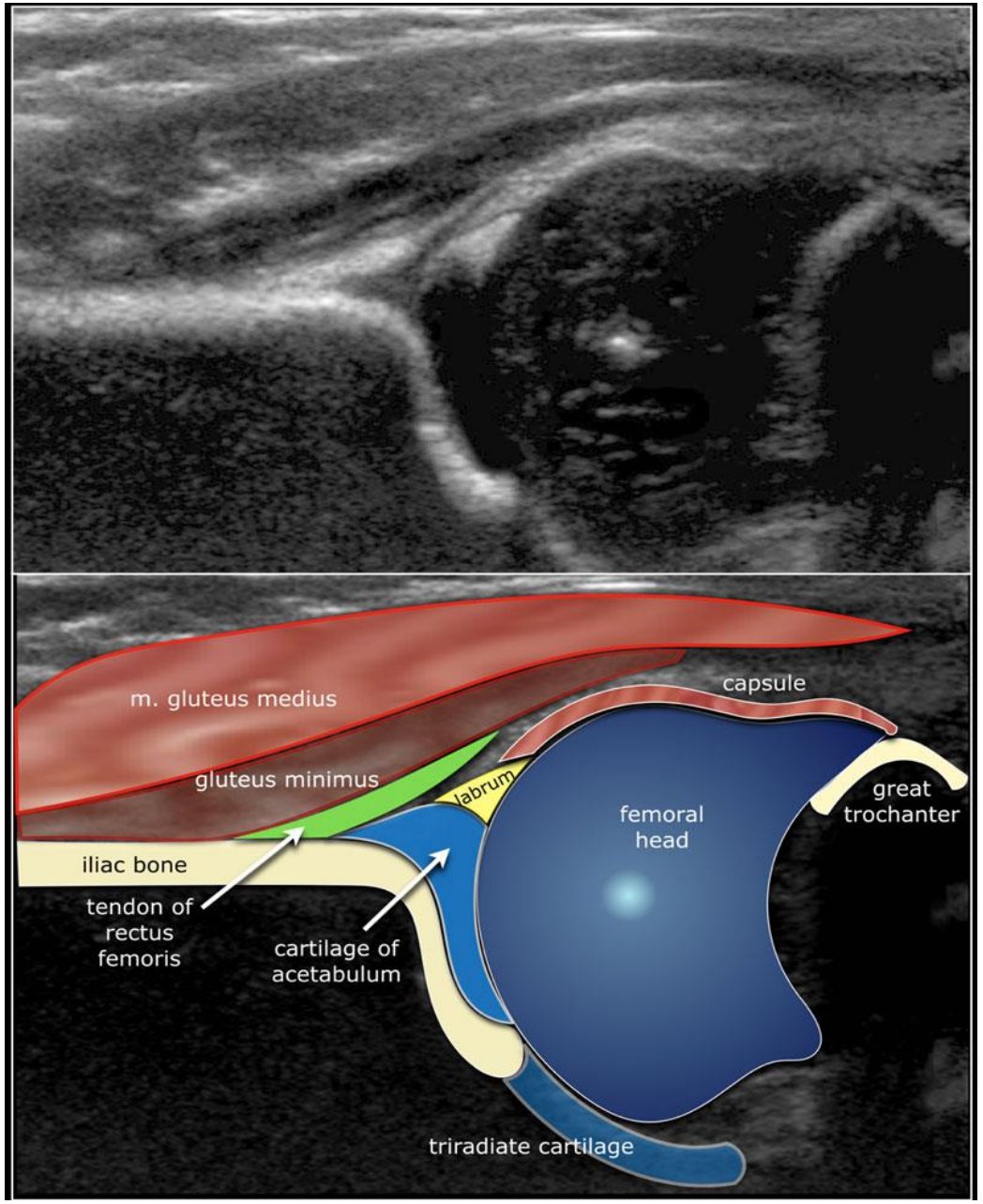
Risk factors include

- Female gender (M:F ~1:8)
- Firstborn baby
- Family history
- Breech presentation
- Oligohydramnios

DDH

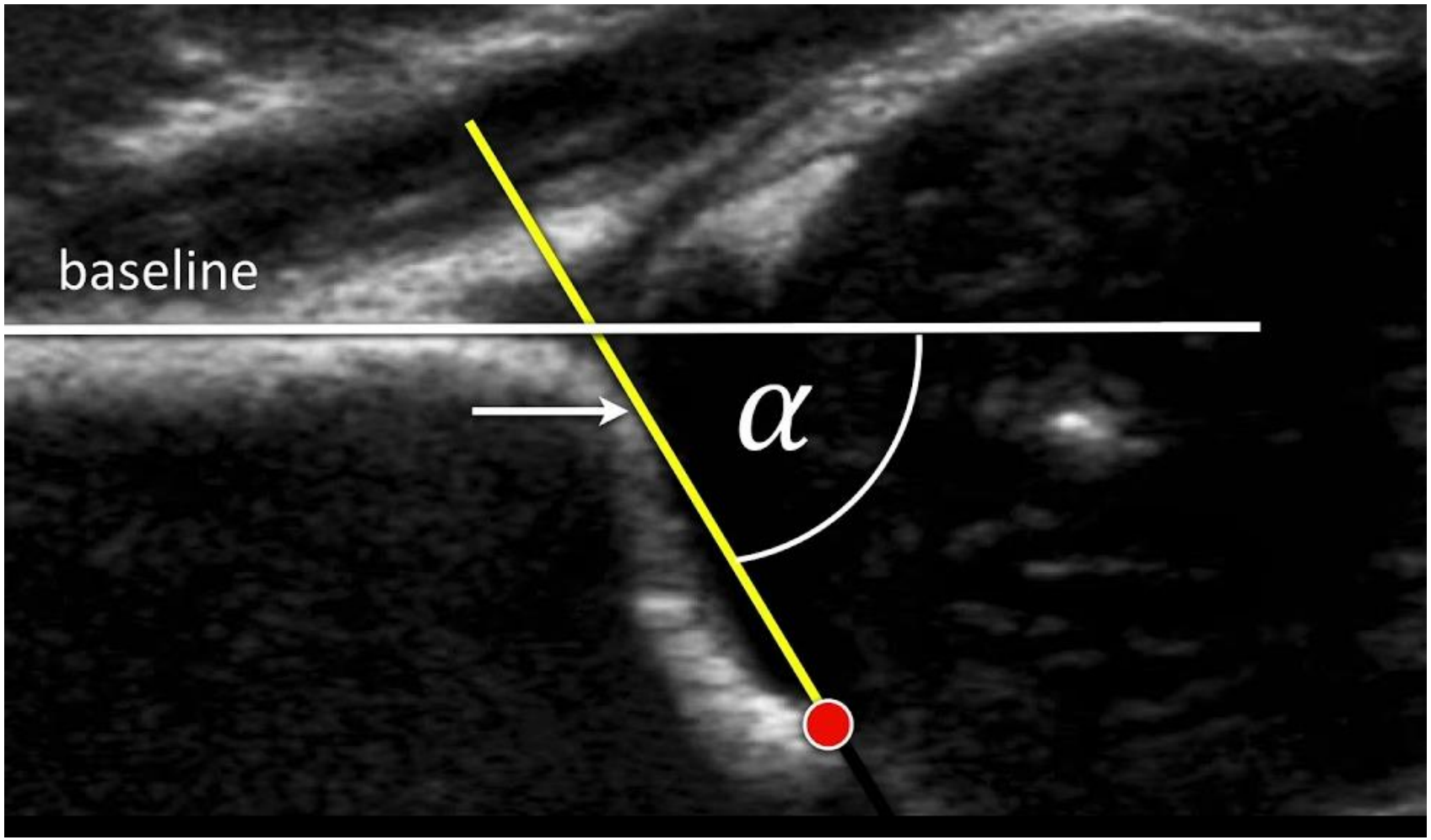


https://radiologyassistant.nl/pediatrics/hip/developmental-dysplasia-of-the-hip-ultrasound



ULTRASOUND

https://radiologyassistant.nl/pediatrics/hip/developmental-dysplasia-of-the-hip-ultrasound


baseline
α





Urinary system

Voiding cystourethrography (VCUG)

To look for the presence of vesicoureteric reflux :

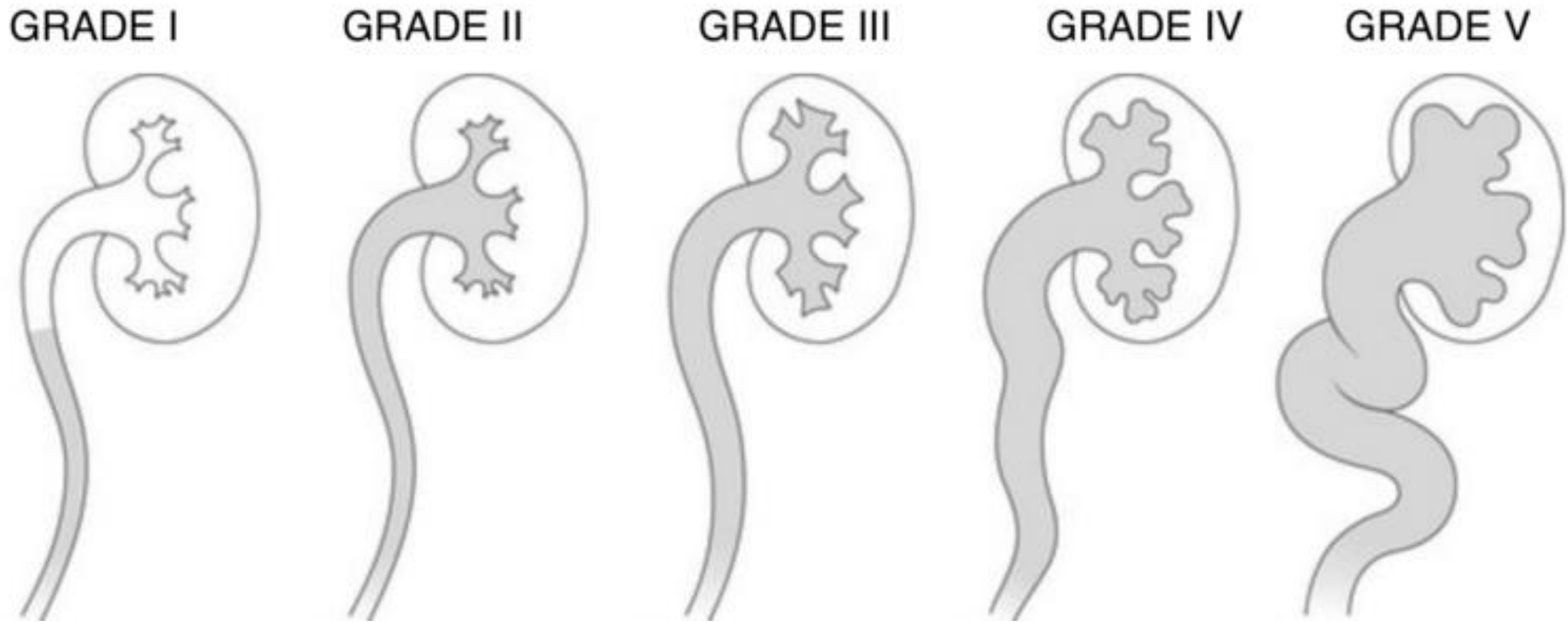
- **Technique**
- The patient empties their bladder before the examination
- A urinary catheter is inserted into the bladder. An infant feeding tube can be inserted under aseptic precautions for infants or young children; a Foley catheter can be used for older children
- Contrast medium is slowly dripped or infused through the catheter into the bladder. The contrast is monitored initially to confirm the position of the catheter [7]
- Intermittent screening images can be taken while distending the bladder with contrast to check for a ureterocele or VUR
- After the bladder is filled to its capacity (which will vary as per age of patient), the catheter is removed and the patient asked to void. Younger children can void on absorbant pads while older children can urinate into a urine receiver. Suprapubic pressure may be applied to increase the rate of voiding. The catheter should only be removed when it is confident that the patient can urinate, the patient unable to tolerate further infusion, or there is no more contrast medium for infusion
- Spot images are taken to look for VUJ obstruction [8]. The lower ureter is best seen in the anterior oblique position. Oblique or lateral positions are also useful to visualize the whole of the urethra
- An abdominal view is taken to detect any reflux into the kidneys or record the postmicturition volume of the bladder [7]
- A lateral view is useful to determine and delineate fistula formation into the rectum or vagina [7]



Rt VUR



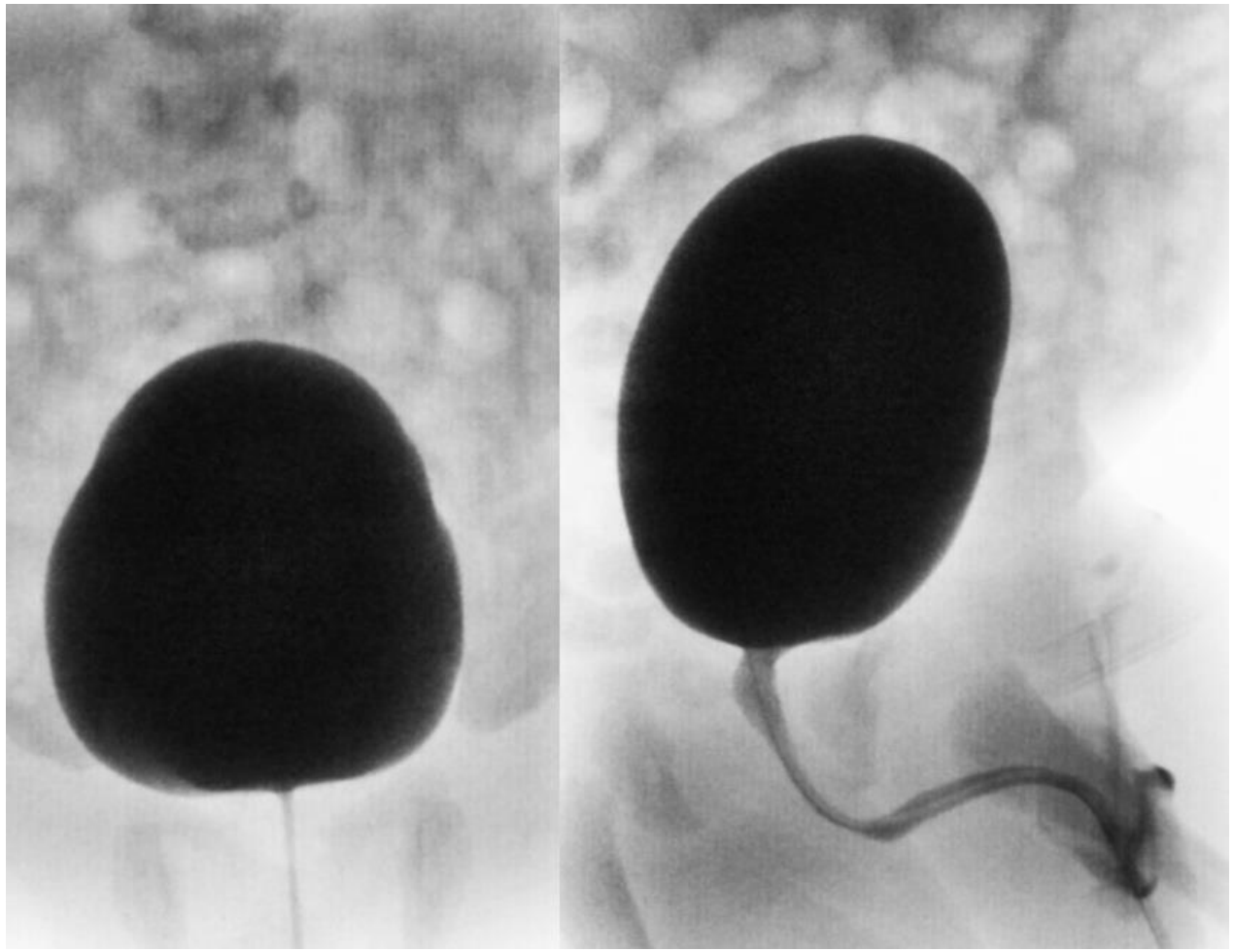
Bilateral VUR

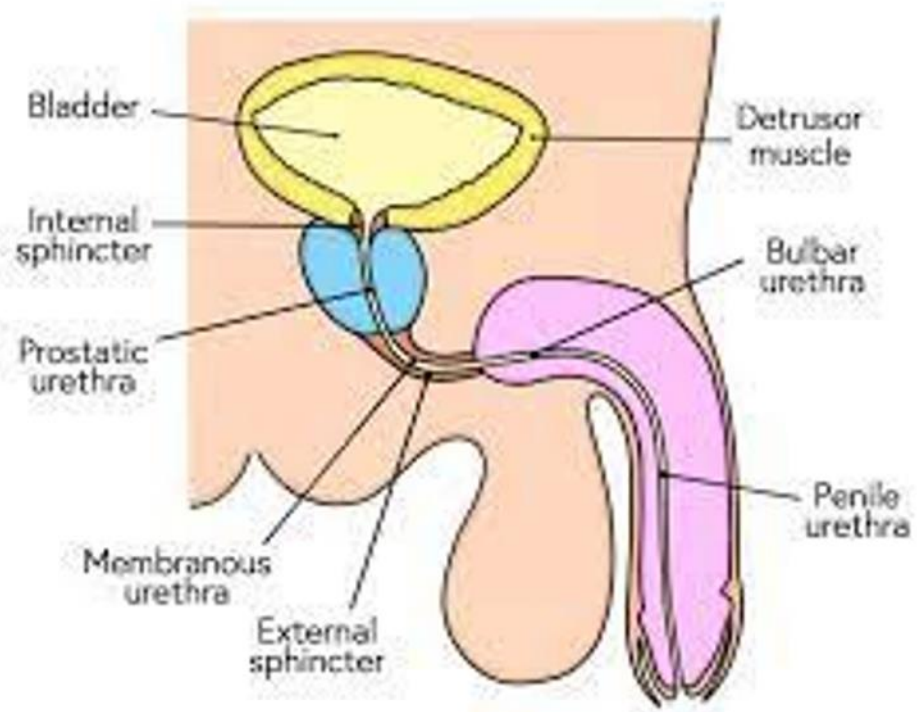

GRADE I
GRADE II
GRADE III
GRADE IV
GRADE V

VESICOURETERIC REFLUX (VUR) GRADING

Divides vesicoureteric reflux according to the height of reflux up the ureters and degree of dilatation of the ureters:

grade 1	reflux limited to the **ureter**
grade 2	reflux up to the **renal pelvis**
grade 3	**mild dilatation** of ureter and pelvicalyceal system
grade 4	tortuous ureter with **moderate dilatation** blunting of fornices but preserved papillary impressions
grade 5	tortuous ureter with **severe dilatation of ureter and pelvicalyceal system** loss of fornices and papillary impressions

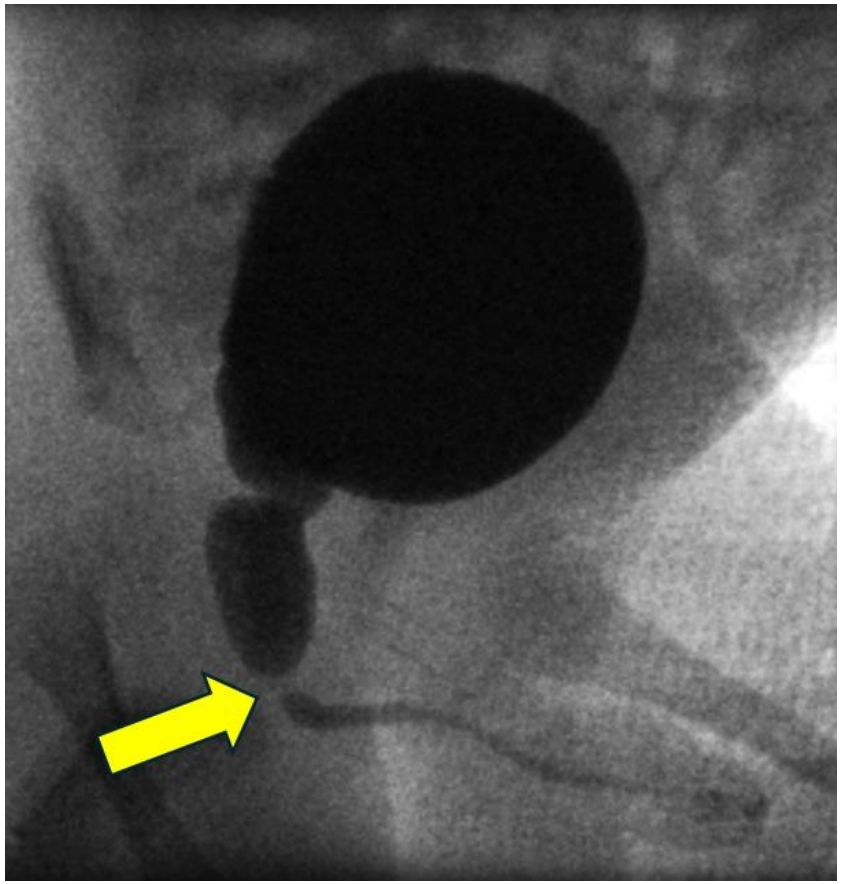




Normal UB and urethra

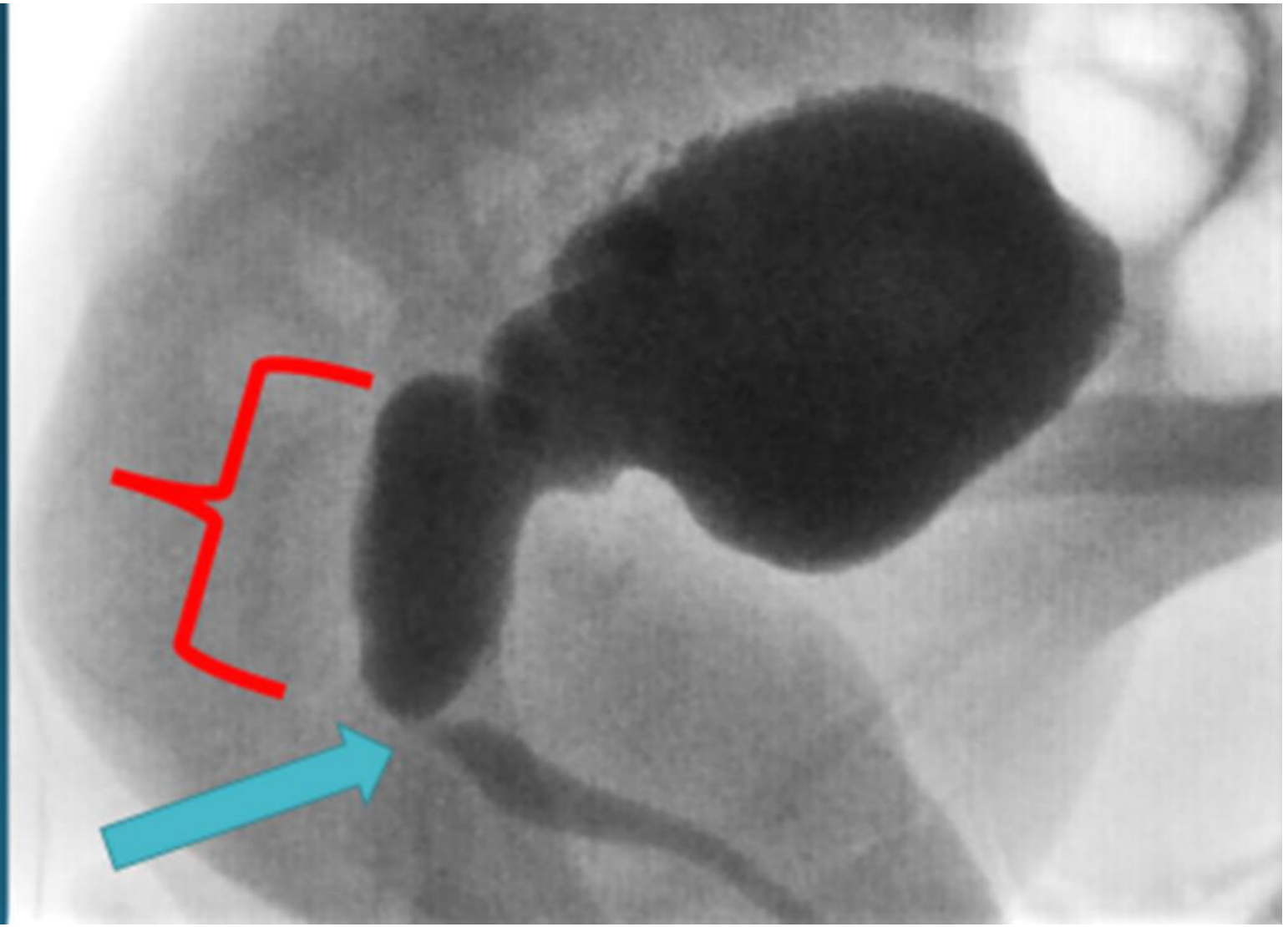
Posterior urethral valves (PUV)

- The most common congenital obstructive lesion of the urethra and a common cause of obstructive uropathy in infancy.



Dilated posterior urethra

Posterior urethral valve




THANK
YOU