

PEDIATRIC RADIOLOGY

CHILDREN ARE NOT SMALL ADULTS !!!
CHILDREN ARE SPECIALS

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CHILDREN ARE NOT SMALL ADULTS

Premature is not a newborn



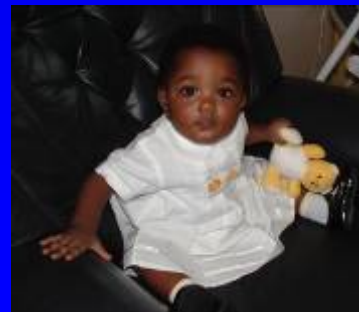
Newborn is not an infant



Infant is not a child



Child is not a teenager



ADULT AND PEDIATRIC RADIOLOGY DIFFERENCES

Size of the patient

ADULT
variable

CHILD
obese teenager 100 kg- premature 400g



ADULT AND PEDIATRIC RADIOLOGY

DIFFERENCES

PATHOLOGY

ADULT

Knowledge of normal and abnormal



CHILD

To recognize the normal image at each stage of development



ADULT AND PEDIATRIC RADIOLOGY DIFFERENCES

- EQUIPMENTS:
- Special immobilization
- MR: special pediatric coils
- Nuclear medicine: pediatric collimators
- US: high frequency, small size transducers

- STAFF
- Not everyone can work with children



THE CHILD AS PATIENT IN DIAGNOSTIC IMAGING

- For adults the hospital is not particular pleasant, but most can cope
- For a child admission to hospital is a kind of trap from which there is no escape
- Fear of the unknown
- Parents should always accompany their children
- To prepare the child
- Large machines, darkness



CT

X-ray, fluoroscopy

PET-CT

ULTRASOUND

PET

SCINTIGRAPHY

PACS

MRI



X-RAY

- As immature tissue is more sensitive to radiation damage than mature tissue
- Red bone marrow is much more sensitive for irradiation
- Gonads are near to the examined organs
- No pediatric examination should be „routine”



CONTRAST MEDIA EXAMINATIONS

- The same contrast media are used in children as in adults
- Air in GI investigation is the cheapest and safest of all contrast media



ULTRASOUND

ADVANTAGE

- No known side effect
- No need for c.m.
- Non-invasive
- No contraindication
- Quick, easy, cheap
- Real time

DISADVANTAGE

- Bone, meteorism, obese patients
- Operator dependent



ULTRASOUND

- Prenatal US
- Brain-US – spine-US
- Chest- near to the diaphragm, jugulum, chest wall (thymus)
- Joints (dysplasia, fluid)
- Bone (osteomyelitis, small fractures)
- Soft tissue
- Bowels

PRENATALIS DIAGNOSIS

ULTRASOUND

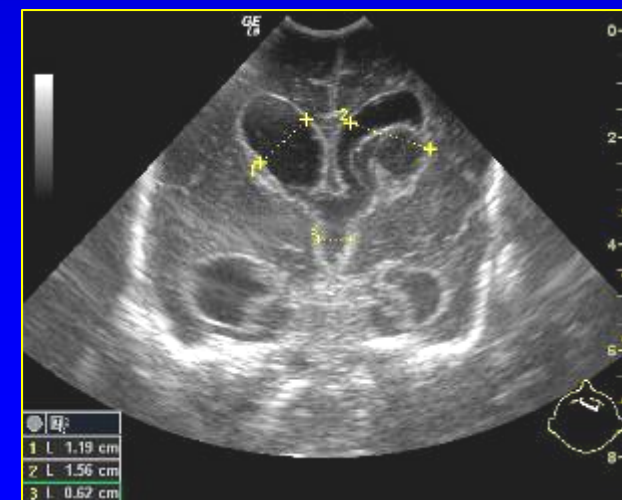
- Nervous system
- Urogenital
- Gastrointestinal
- Chest

NEWBORN BRAIN-US

- positive findings are important
- Operator dependent

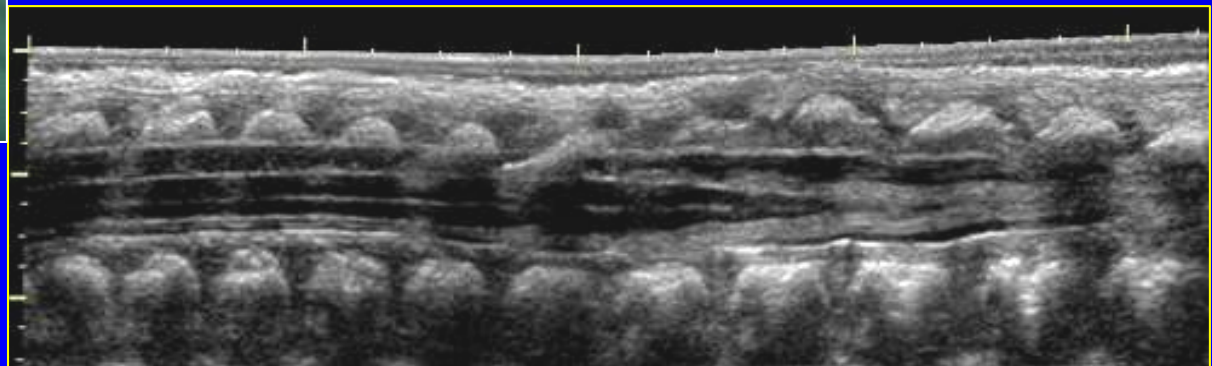
INDICATION

- Low birth weight
- Hypoxia - bleeding
- Postasphyxia
- Congenital malformation
- Sepsis
- cramp



US OF THE SPINE

- newborn : 7-10 MHz, linear transducer



HIP



CHEST ULTRASOUND

- Neglected area (bone-lung barrier)

true, but

- Pathology occupies the area of the bone, lung
- Child: small
thymus
CT, MR - anesthesia
No radiation
- visible: some lung pathology
pleural space
mediastinum
chest wall

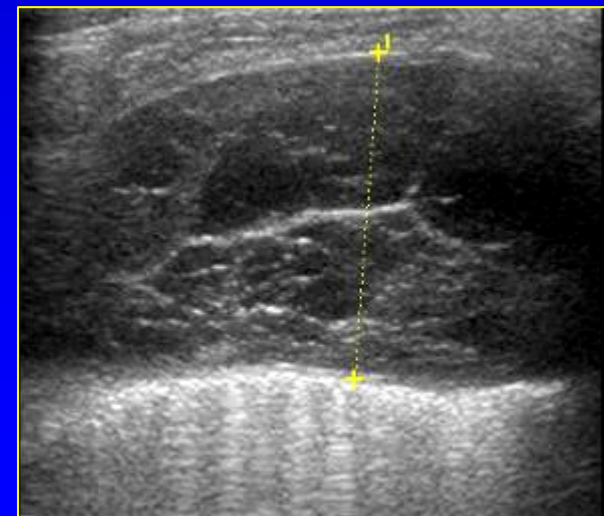
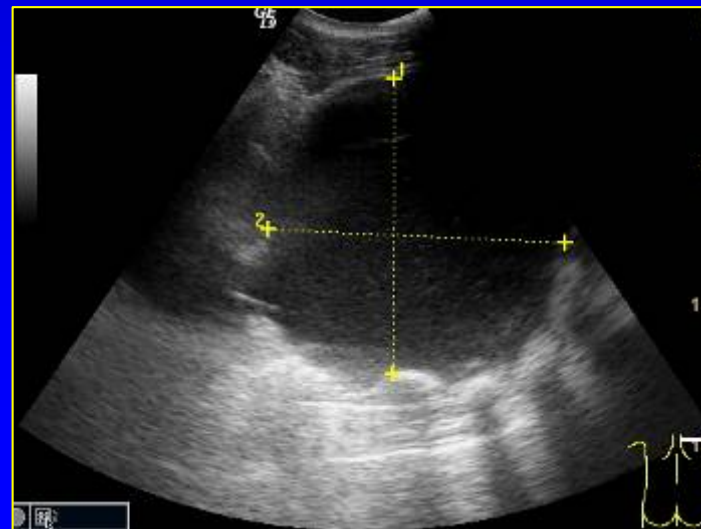
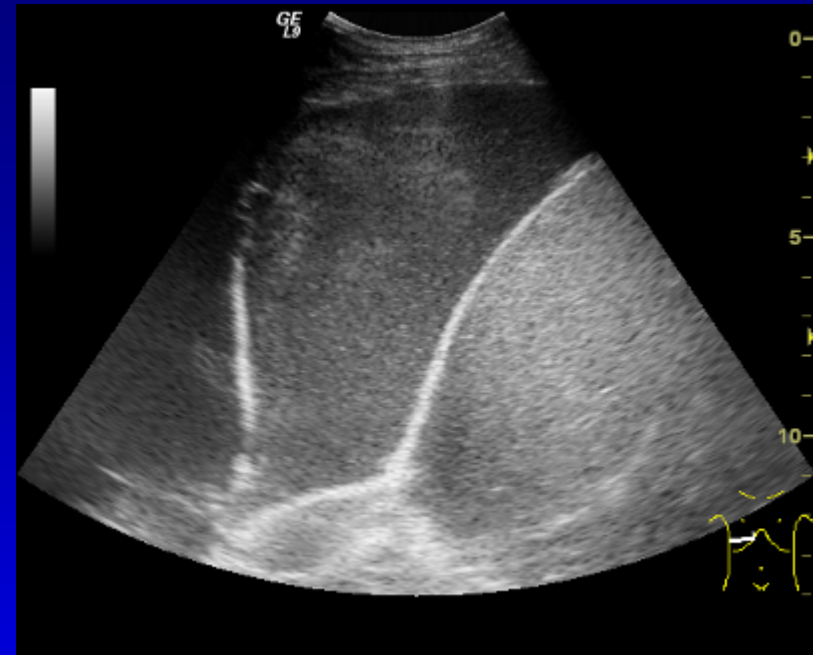
CHEST ULTRASOUND

- First: X-Ray
- Position of the patient
- Color Doppler



PLEURAL SPACE: ULTRASOUND

- fluid ?
- Structure of the fluid
 - simple
 - complex
- Thoracocentesis
- follow up



ISOTOPE

- Functional examination
- Much lower irradiation like X-ray
- Bone, parenchymal organs, bowel, ect.

CT

- Indication:
- Central nervous system - bleeding
- chest – lung, trachea, bronchi
- Abdominal : trauma
- Bone - trauma
- Sedation
- Irradiation !
- Contrast media!
- Multislice CT



CT

- ALARA (as low as reasonable achievable)
- 1 chest CT = 150 chest X-Ray
- 1 head CT = 200 chest X-Ray
- 1 abdominal CT = 250 chest X-Ray

MR - INDICATION

- Central nervous system
- Musculoskeletal
- Mediastinum
- Abdominal
- Vessel, cardiac

MR UROGRAPHY

Advantage:

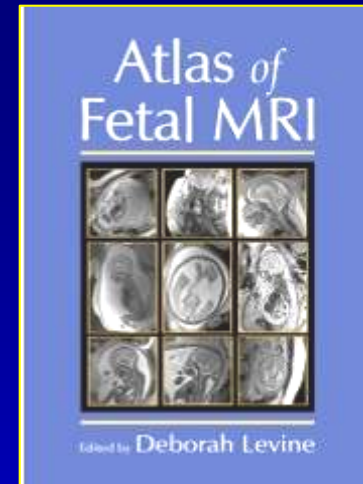
- Good anatomy, without contrast material
- With contrast material:
 - anatomy
 - function

Disadvantage:

- Long time, anesthesia, expensive

PRENATAL MR

- 2.3. trimester
- After 24. weeks
- Fast sequents
- Very fat patient (US limited)
- Before i.u. intervention



GASTROINTESTINAL DISEASES



VOMITUS IN NEWBORN AND INFANTS

- Frequent and not specific symptom in childhood
- Anamnesis, physical examination
- Differential diagnosis: age of child
characteristic of vomiting

IMAGING

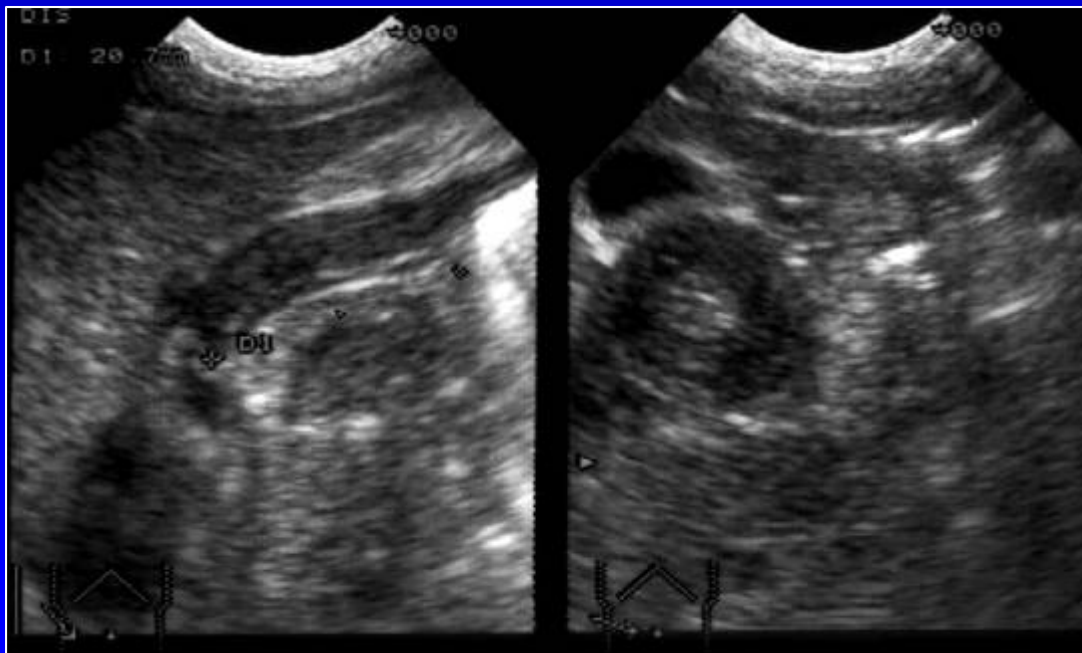
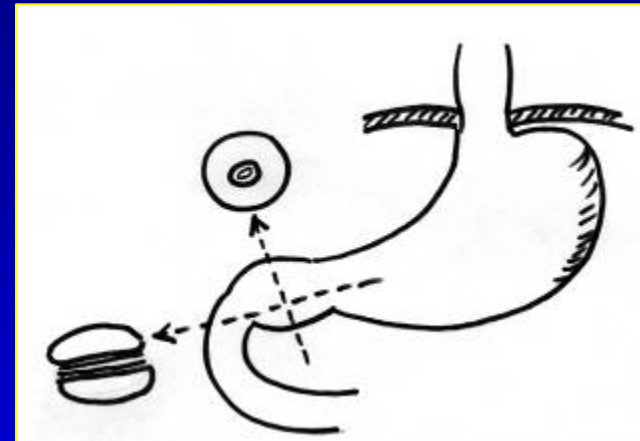
- Why do I make the examination ?
- What kind of imaging: anatomical? Functional?
- To choose the method:
 - US
 - plane film
 - enema
 - swallowing
 - isotope

DIFFERENTIAL DIAGNOSIS

- First 2 month:
 - A. non-bilious:
 - a) overfeeding
 - b) gastroesophageal reflux (GOR)
 - c) pyloric stenosis
 - B. bilious
 - a) bowel atresia
 - b) small bowel volvulus
 - c) small bowel obstruction
 - d) Hirschsprung disease

HYPERTROPIC PYLORIC STENOSIS (HPS)

- Non-bilious vomiting, 4-6 weeks old, boys
- US
- Length: above 17 mm
- Wall-thickness: above 3 mm



BILIOUS VOMITING-NEWBORN

- The level of obstruction is below the common bile duct
- Symptom:
 - bilious vomiting in the first hours, sunken belly – high atresia
 - bilious vomiting later abdominal distension - low atresia

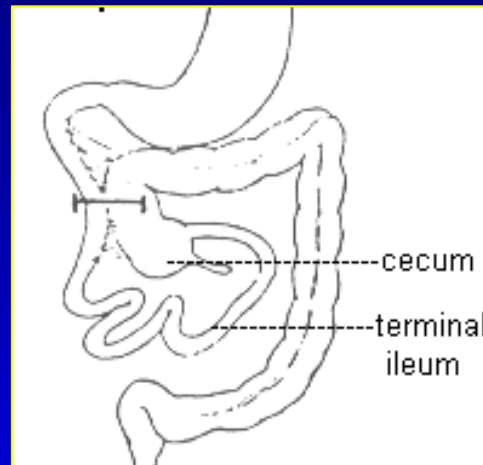
Plane film – air, as negative contrast material

MALROTATION - VOLVULUS

MALROTATION

symptoms:

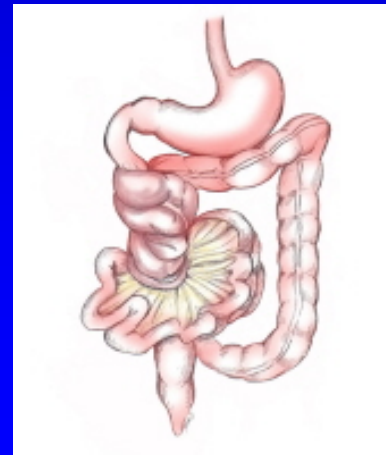
- often asymptomatic
- sometimes bilious vomiting, high ileus
- boody stool,
- malabsorptio



VOLVULUS

Symptoms:

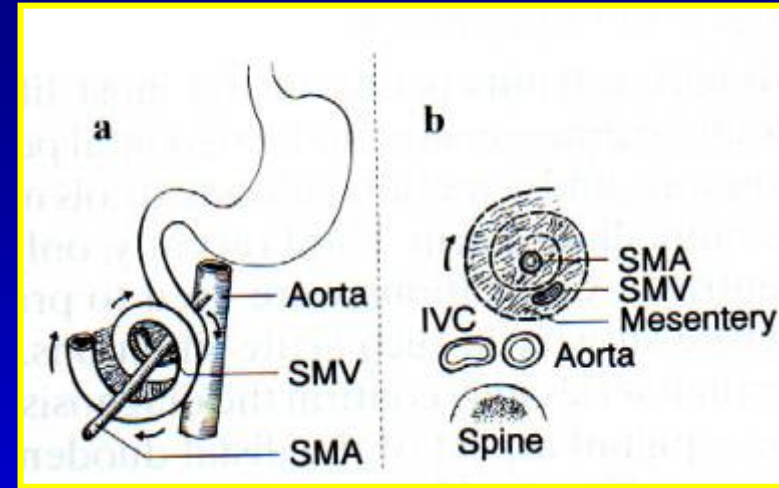
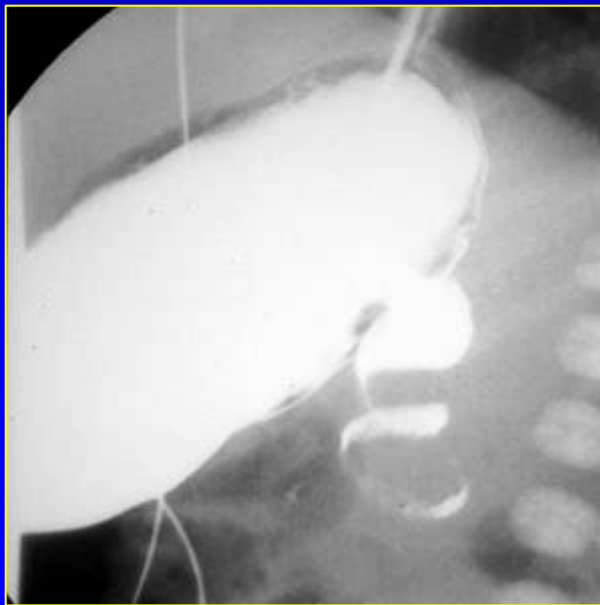
- ileus
- bowel ischemia
- peritonitis
- Shock



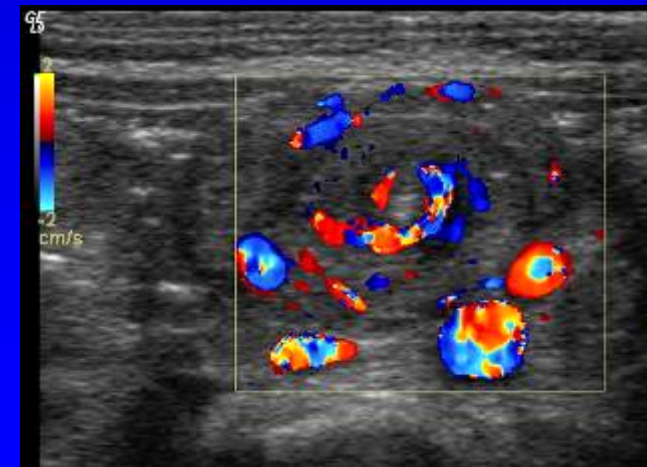
VOLVULUS

US sings:

- “whirlpool” sign –diagnosis
- Swallow-examination

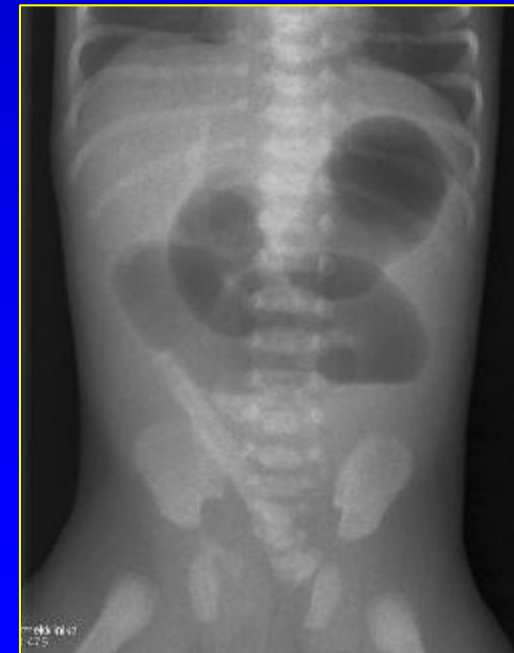


Pracos, JP. et al : *Pediatr Radiol*
22 :18-20 , 1992



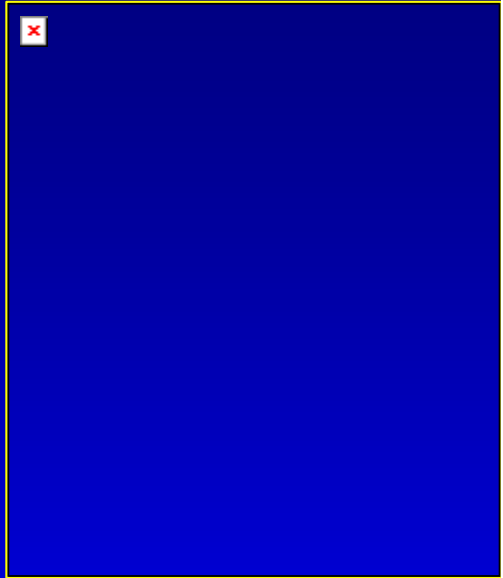
HIGH ILEUS

- Plane film
- Duodenal atresia
- Pancreas annulare
- jejunal atresia



LOW ILEUS

- symptoms: vomitus, bowel distension
- Plain film
 - Ileal atresia
 - Meconium ileus
 - Small left colon
 - Hirschsprung disease



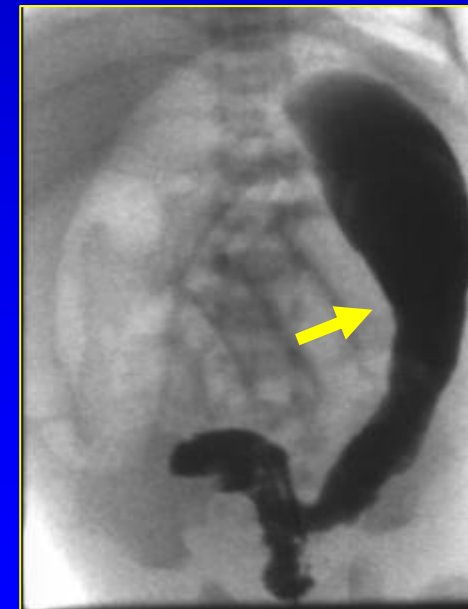
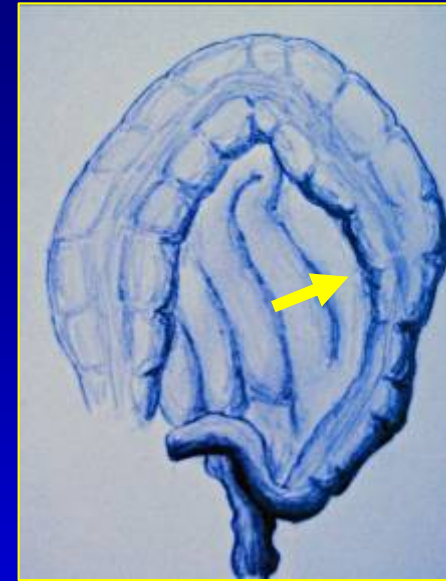
SMALL BOWEL ATRESIA

- Symptoms: vomiting, abdominal distension, failure to pass meconium
- Prenatal intrauterine ischaemic episode
- aXR: dilated small bowels, air-fluid level
- Enema: „non-used” or microcolon



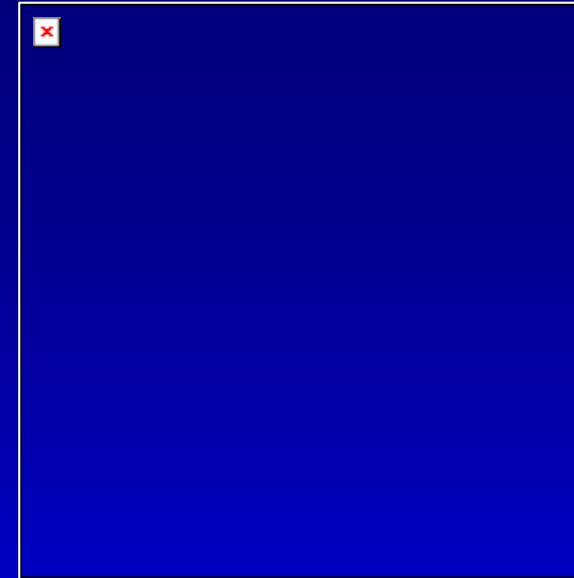
HIRSCHSPRUNG DISEASE

- Etiology/Pathophysiology: large bowel obstruction due to congenital absence of ganglion cells in the myenteric plexus of the colon starting at a transition point and extending all the way to the rectum.
- Present in : 1: 5000-8000 live births
Diagnosis: 80%-in the first 6 weeks
boy/girl= 4-9:1
- Symptoms: failure to pass meconium in the first 24 hours coupled with a gradual onset of abdominal distension and vomiting,

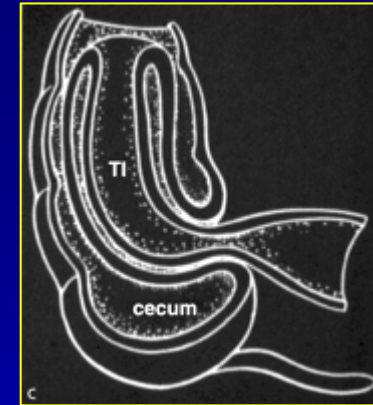


ENEMA

- The radiographic diagnosis is made by demonstrating the transition zone, but this may not be possible in the newborn because it takes weeks for the bowel to dilate. The aganglionic segment is of normal caliber without stricture or constriction. The normally innervated bowel is dilated above the transition zone.



INTUSSUSUSCEPTION



PRESENT: 3 months-2 years
unknown origin

later leading point – 5 %

(lymphoma, bowel duplication, Meckel diverticulum)

SYMPTOMS:

colicky abdominal pain causing the infant to cry and draw their legs up onto their abdomen, hematochezia with, and a palpable abdominal mass.

- colicky abdominal pain 100%
- Bowel distension 90%
- palpable abdominal mass. 80%
- vomiting 70%
- "currant jelly" stools 70%

DIAGNOSIS: US (plane film – perforation)
Lymph node enlargement



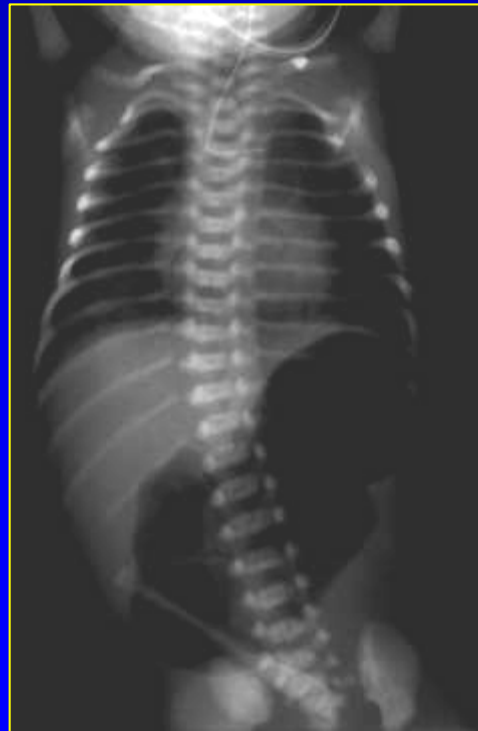
THERAPY

- Therapeutic examination such as an air enema may be performed. Air should be instilled into the rectum under fluoroscopy while maintaining a maximum of 110 mm. of mercury.
 - US guided enema
- contraindication: severe peritonitis
- Painful!
- Sedation



OESOPHAGEAL ATRESIA

- Native babygram
- Tube into the eosophagus
- Lower fistula: gas in ther bowel



NECROTIZING ENTEROCOLITIS (NEC)

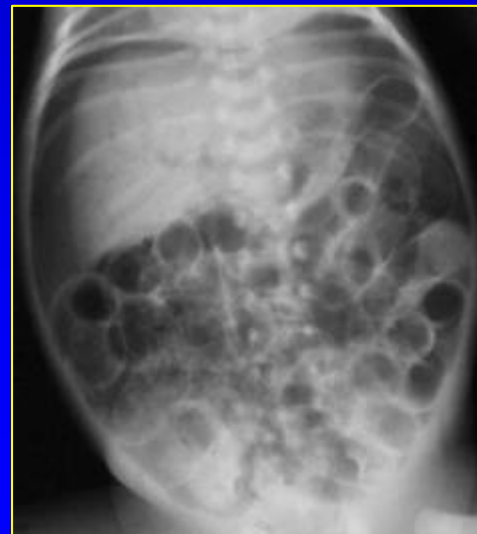
Seen most often in small preterm infants in intensive care units

Symptoms: abdominal distension, bloody stool, apnoe, acidosis

DIAGNOSIS:

X-Ray:

- pneumatosis intestinalis,
- portal venous gas,
- free air
- Post inflammatory strictures most commonly develop in the colon, and are best demonstrated by barium enema
- US:
- Abscess, portal gas

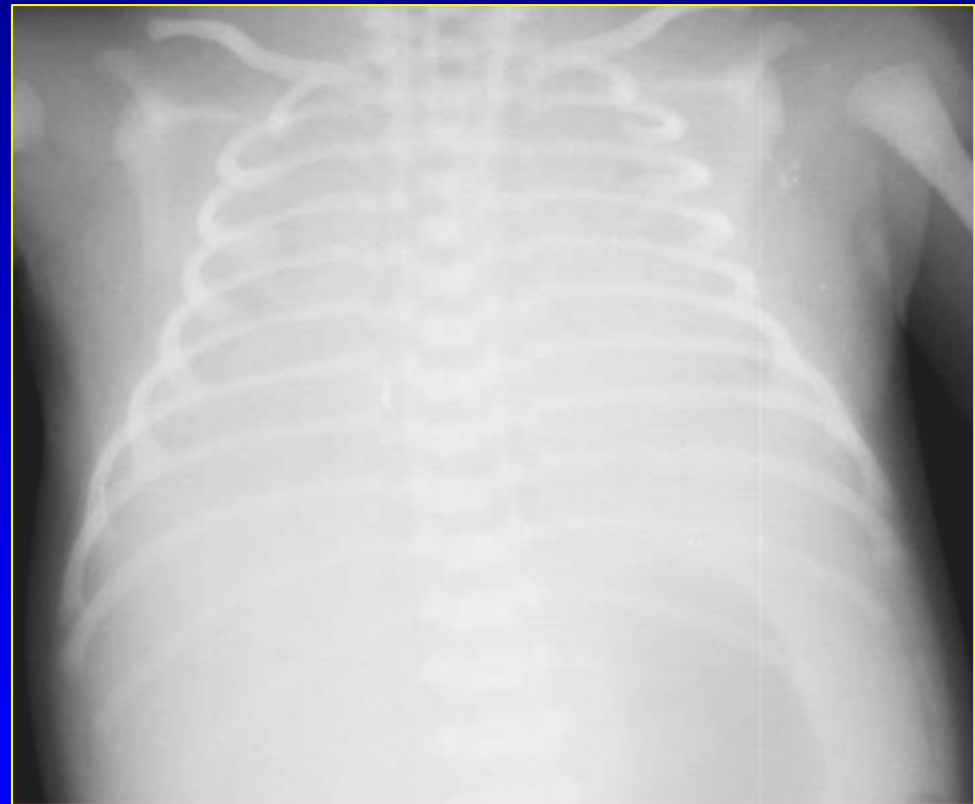


CHEST



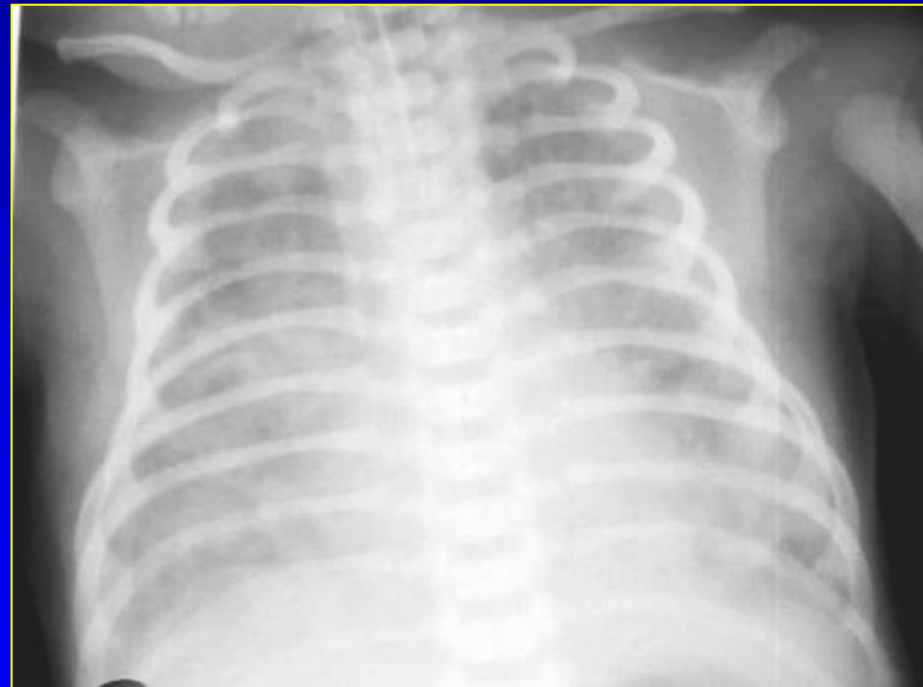
HYALIN MEMBRAN DISEASE (HMD)

- lack of surfactant
- premature
- radiology: 6-24 hours age
- reticulogranular nodules
- air - bronchogram
- I-IV. stadium



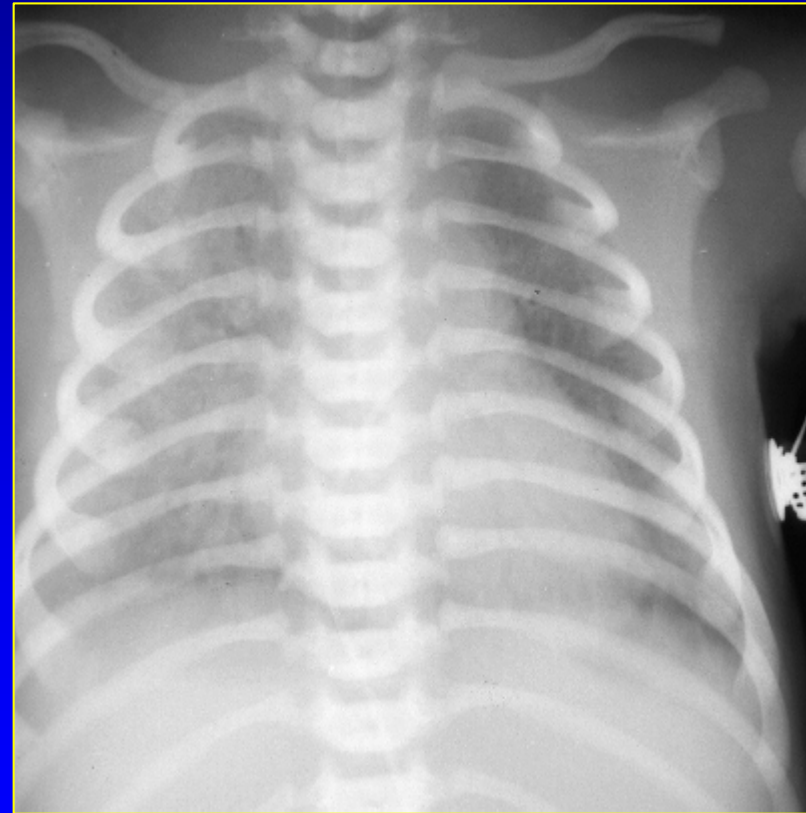
MECONIUM ASPIRATION

- intrauterine or intrapartum inhalation of meconium
- Obstruction of the small and medium airways, atelectasia, air lacking, chemical pneumonia
- often ptx, pneumomediastinum



NEONATAL PNEUMONIA

- Infection in utero or near delivery
- Streptococcus B pneumonia
- Radiology: similar to other respiratory distress
- Chest X ray



CONSOLIDATION

- As in adulthood

BUT

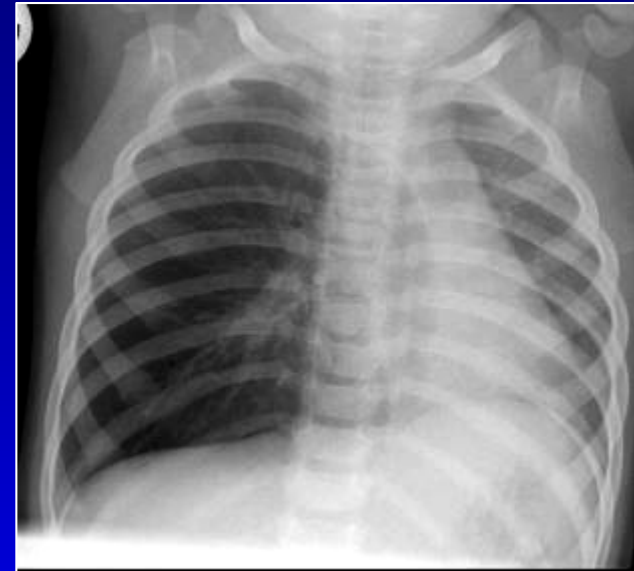
consolidation in the middle or lower lobe: could be because of foreign body aspiration





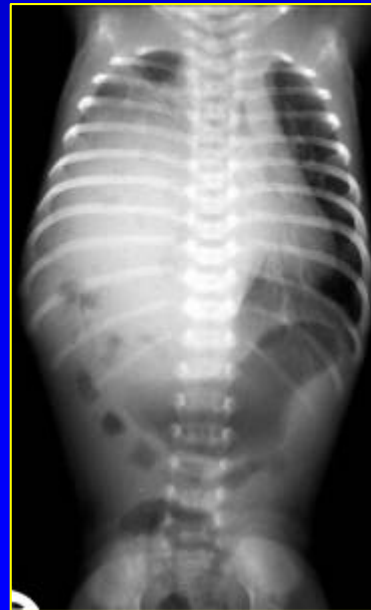
FOREIGN BODY ASPIRATION

- Ninety-five percent of foreign bodies are non opaque
- On an expiratory film there is air trapping on the affected side and mediastinal shift to the unaffected side.
- On the inspiratory film there is mediastinal shift back to affected side as the other lung aerates normally.
- Fluoroscopy
- Bronchoscopy



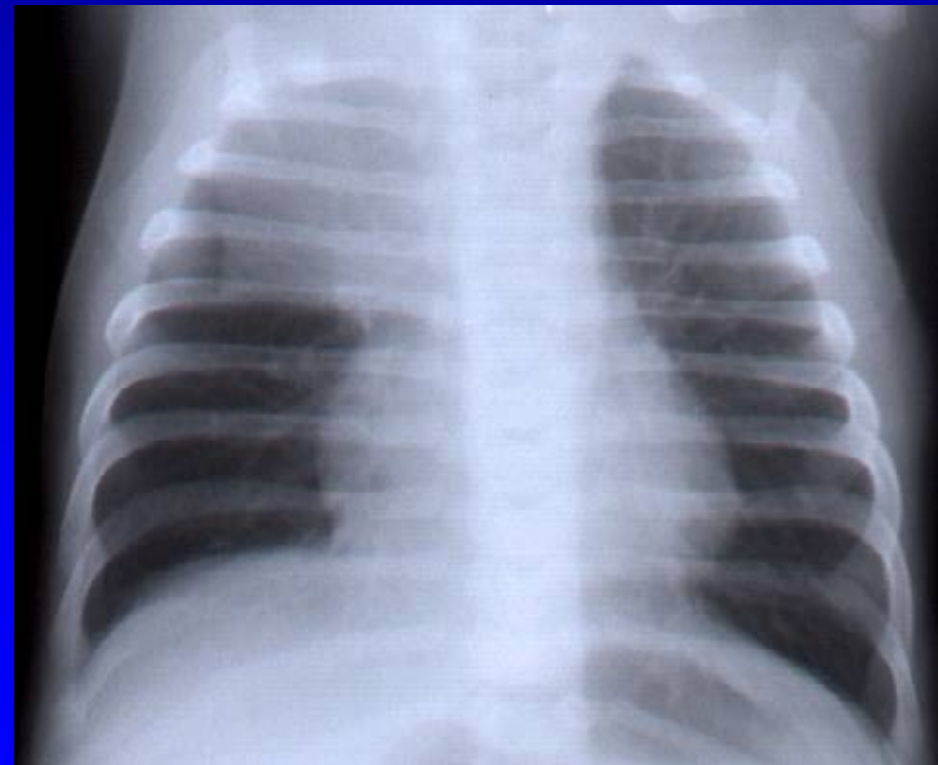
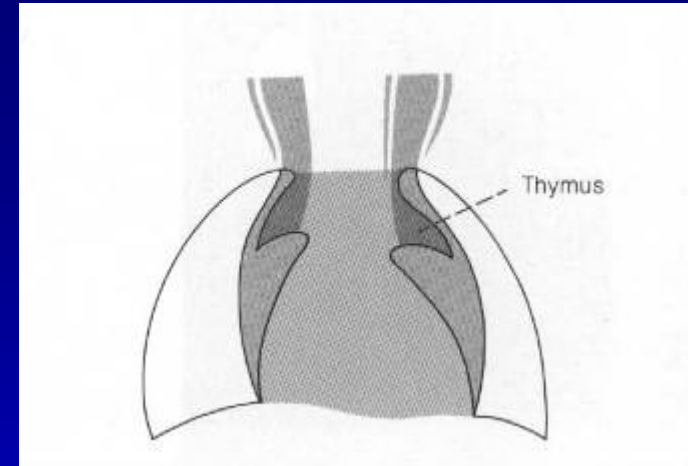
CONGENITAL DIAPHRAGMATIC HERNIA

- **INCIDENCE:**
1/4000 live birth
- Left side 80 %
- Lung hypoplasia, persistent foetal circulation

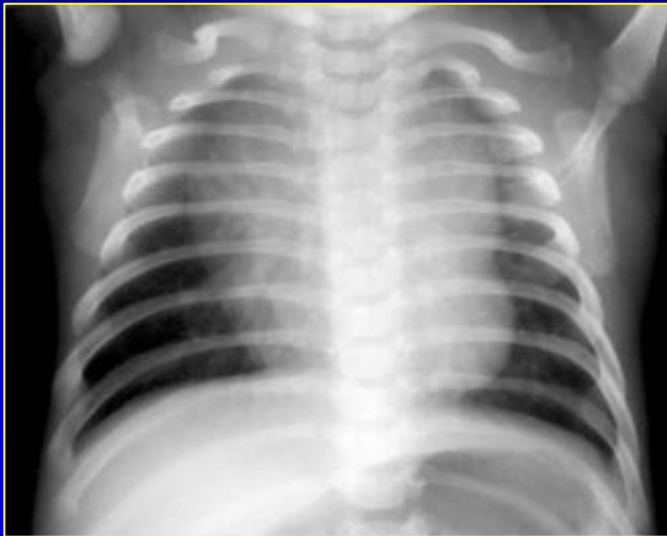


THYMUS

- Normal thymus may be visible up to the age of 3
- Great variation - problem in diagnosis
- Normally it does not compress the trachea or oesophagus
- Relatively radiolucent
- Us: echostructure is similar to the liver
- Ectopic thymus (posterior mediastinum, neck)
- Differential diagnosis: mediastinal masses
- CT, MR - rarely !

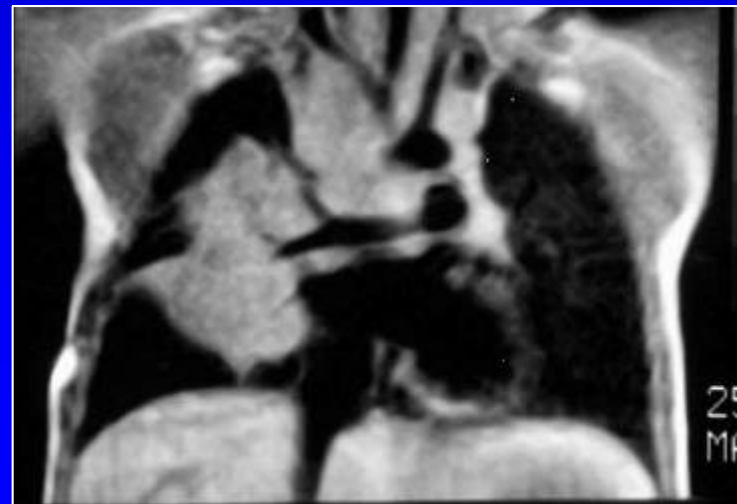
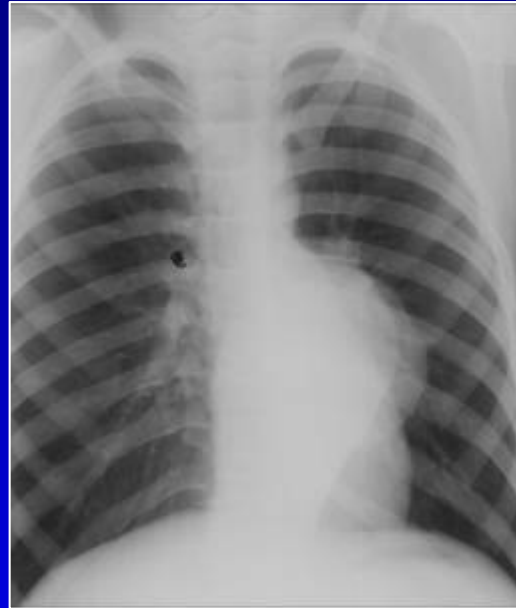


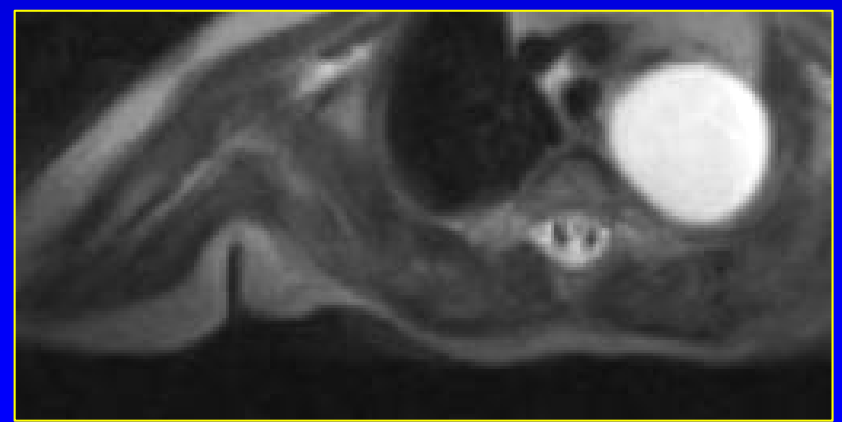
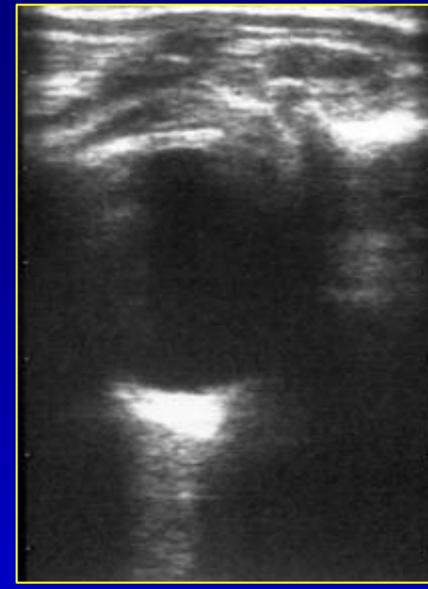
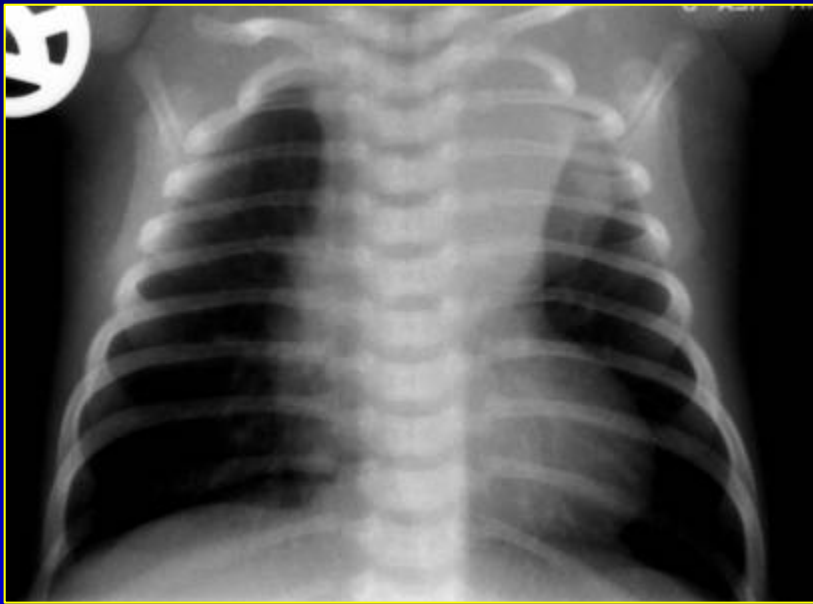
THYMUS - US



MEDIASTINUM

- Chest X-Ray
- US: anterior mediastinum, thymus
- CT: trachea, bronchi
- MRI: posterior mediastinum



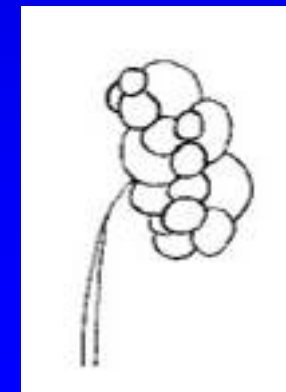
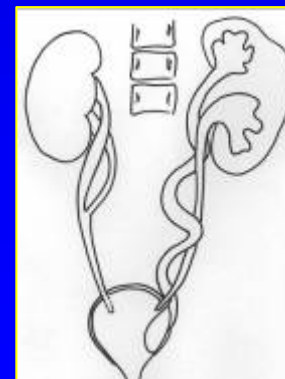
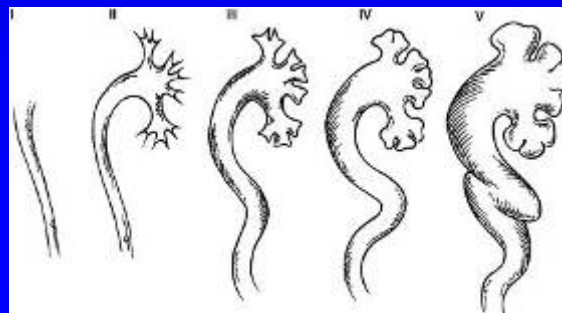
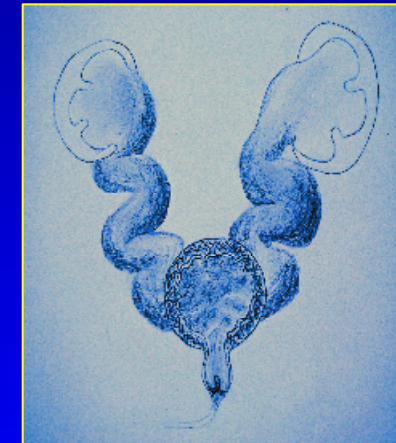


UROGENITAL SYSTEM



CONGENITAL OBSTRUCTIVE UROPATHIES

- Pelviureteral obstruction
- Ureterovesical obstruction
- Subvesical (Posterior urethral valve)
- Double system with or without ureterocele
- Multicystic dysplastic kidney
- VUR



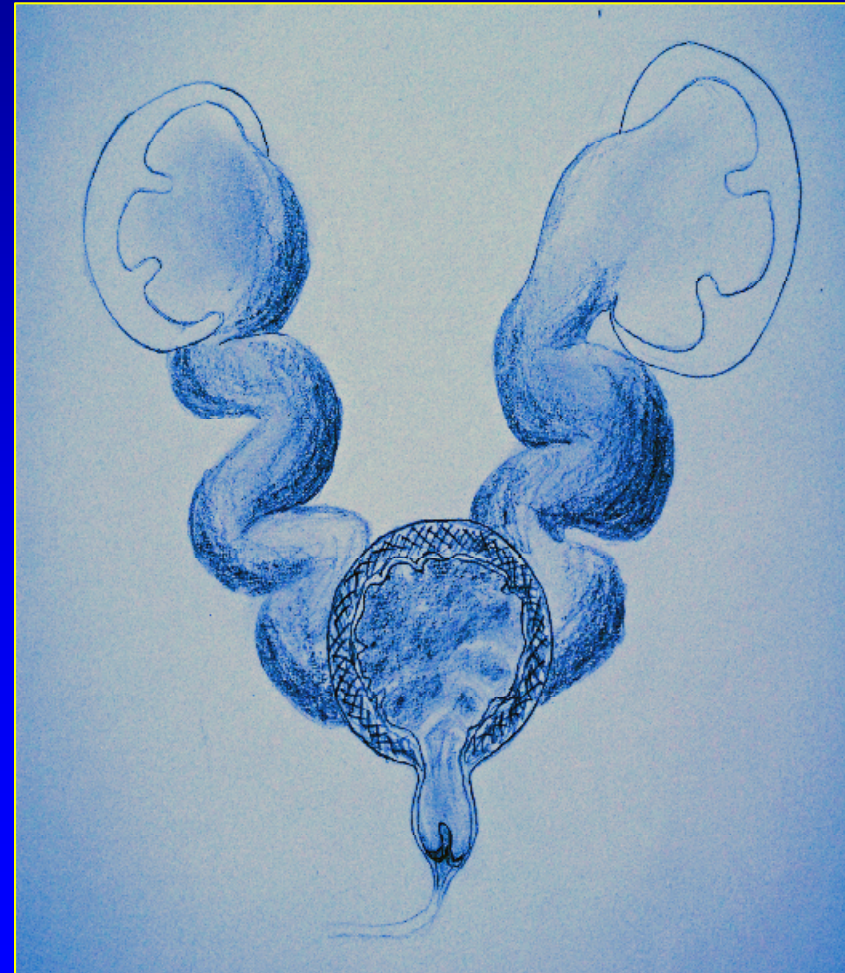
PELVIURETERAL OBSTRUCTION

- Most frequent obstructive uropathy ,35-40%
- Incidence: boy/girl=5: 1, bilateral : 25 %.
- US - morphology: hydronephrosis, narrow parenchymal, no ureter
- Tc-99m-MAG3 isotope: function



SUBVESICAL OBSTRUCTION

- A congenital malformation of the male urethra,
- This obstruction leads to vesicoureteral reflux which can lead to renal dysplasia.
- Incidence: 1: 5000-8000, in male
- The distension can also lead to a calyceal leak of urine which can cause a perinephric urinoma or a urinary ascites, also prenatally
- Clinical presentation:
newborn: distended bladder, failure to void, renal damage, hydronephrosis, hydroureter, urinoma, ascites

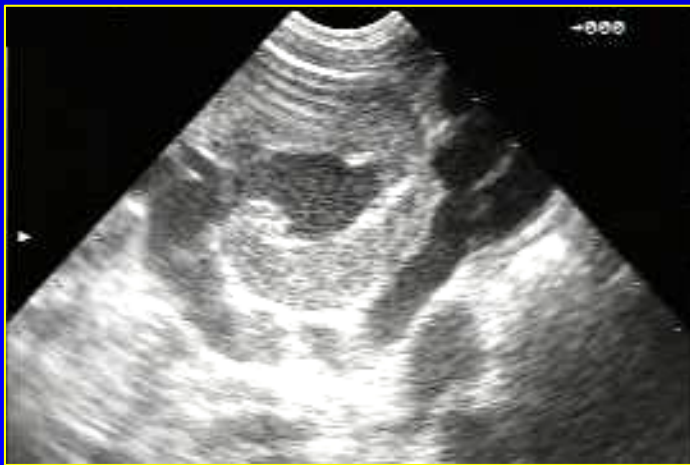


Prenatal US, MR

enlarged posterior urethra, thickened
bladder wall, hydronephrosis, hydroureter

POSTNATAL US :

- Thick walled bladder,
- hydronephrosis,
hydroureter,
- dysplastic kidney

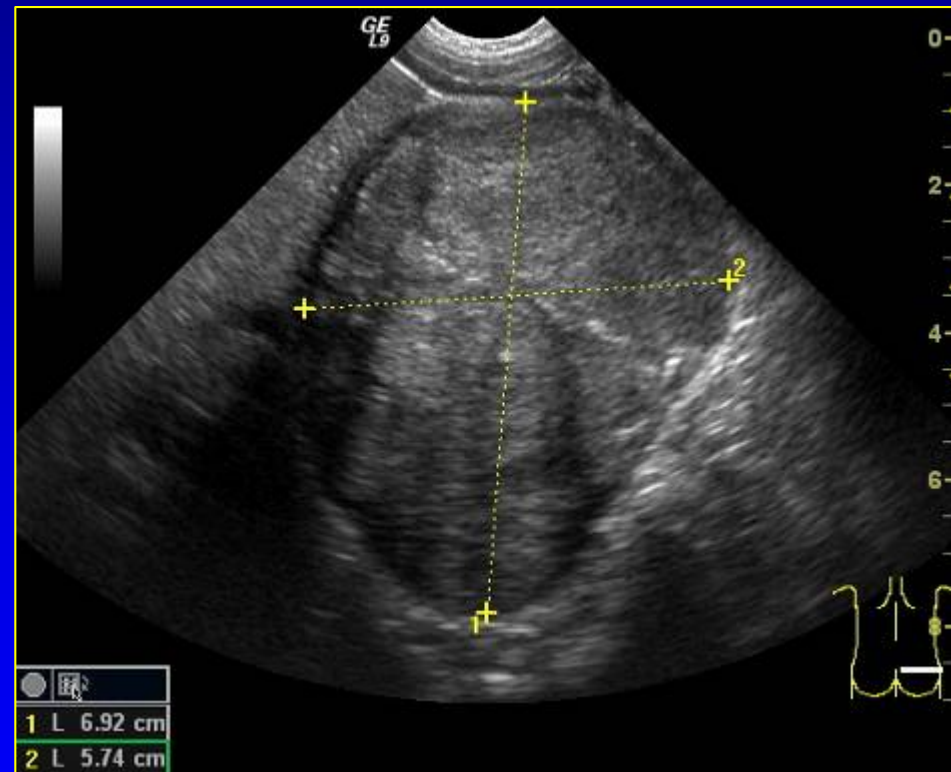


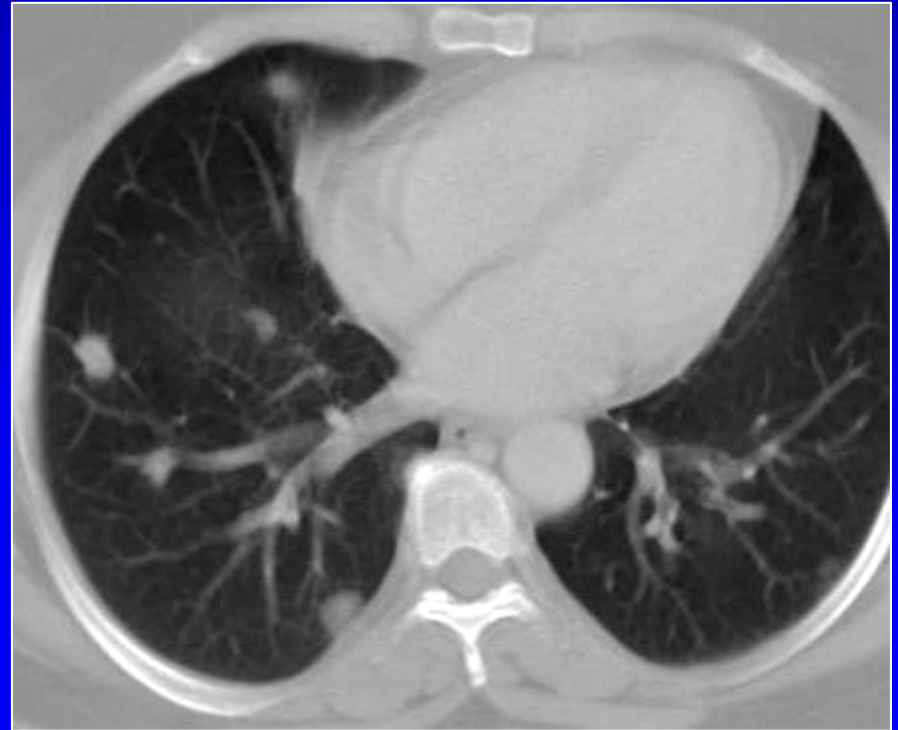
VOIDING CYSTOURETHROGRAPHY (VCUG)



WILMS TUMOR

- Most frequent renal tumor
- 1-5 years old
- Diagnosis: US, CT (MRI), chest CT
- Unilateral, bilateral
- Size, connection with organs, vessels
- Follow-up





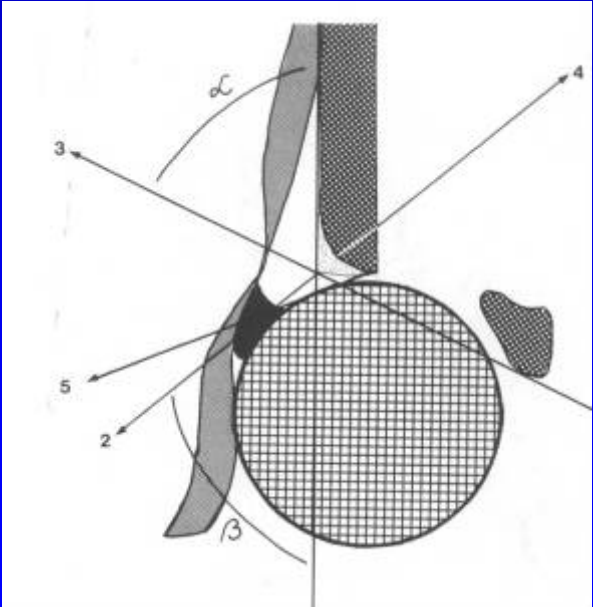
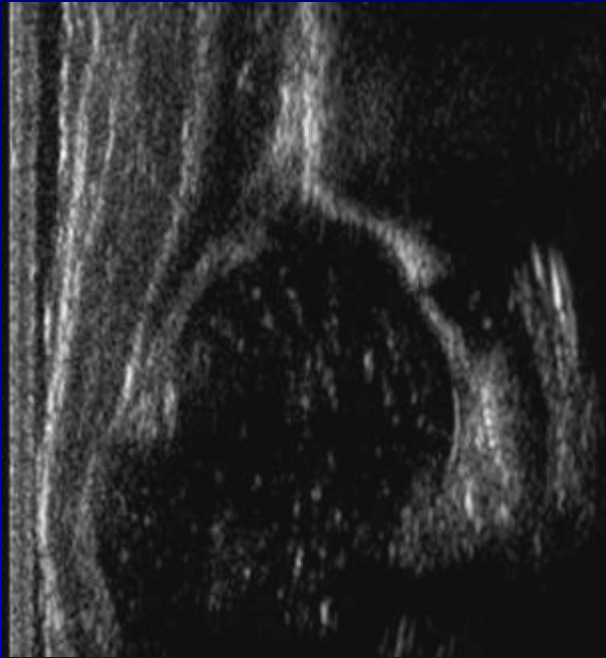
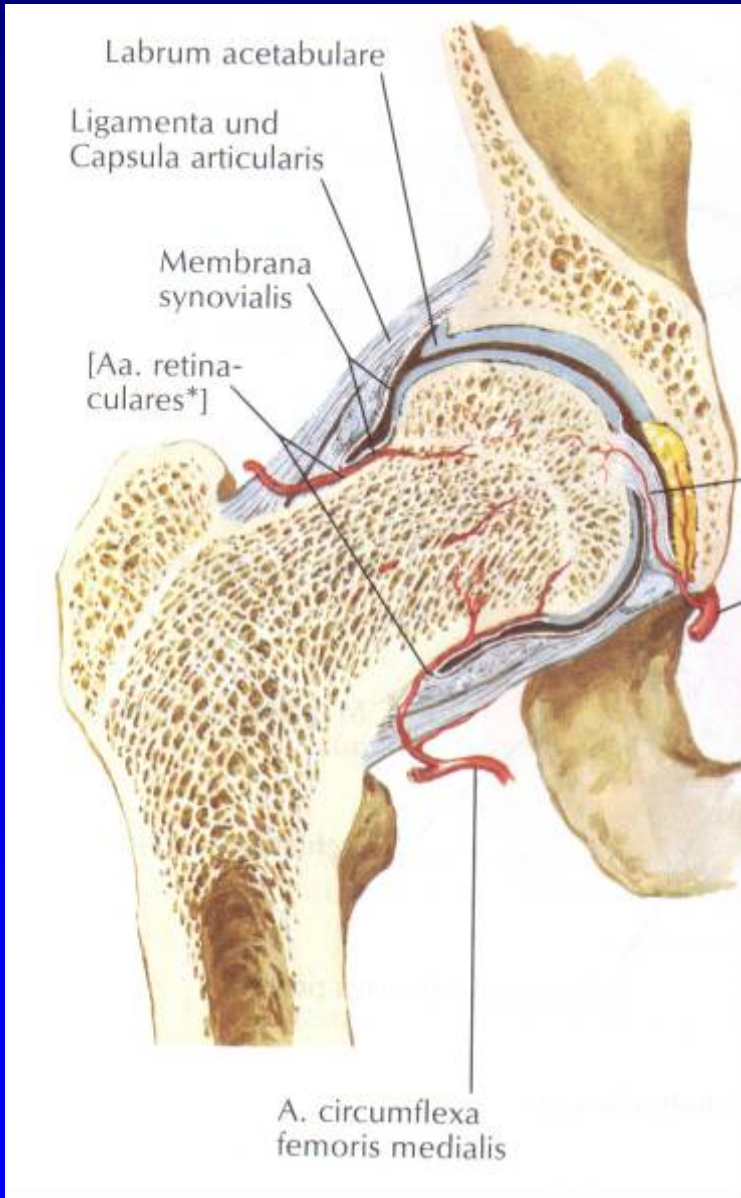
MUSCULOSKELETAL DISEASES



HIP DYSPLASIA

- incidence:1:200 000
- Boy-girl = 1: 9
- Clinical symptoms
- imaging:
- US (4-5 months)
- Later: X-ray
- Screening: 6 weeks old
- Risk patients: twins, familiar hip oligohydramnion, club-foot, neuromuscular diseases





ABUSED CHILD, BATTERED CHILD

- Clinical, radiological, social
- Most severe cases in infant age
- Important role of radiologist in the diagnosis

MAIN POINT OF VIEW

- Risk factors: „different” child, mental or physical
- Social risk factors: unemployment, poverty, alcoholism, drugs, depression

WHEN COULD WE THINK ON IT?

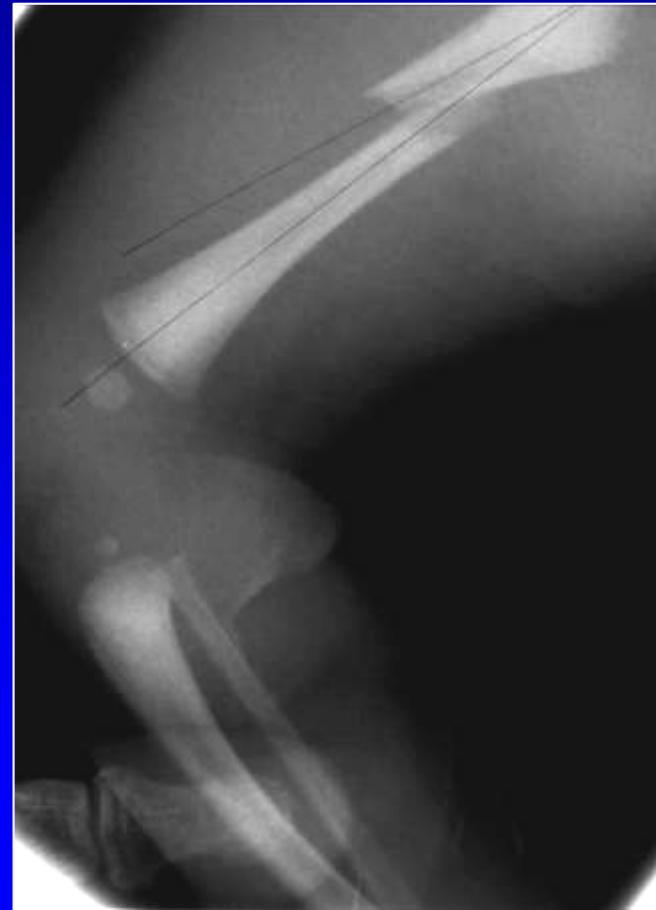
- incongruous anamnesis and symptoms
- Contradiction in the stories of the parents
- Wheeled fractures without medical treatment
- Very ill, underweight child
- Abdominal trauma , unknown cause
- Suspicious burns

BONE FRACTURES

- More fractures, different time
- Under 2 years of age more frequent

Diaphyseal fractures

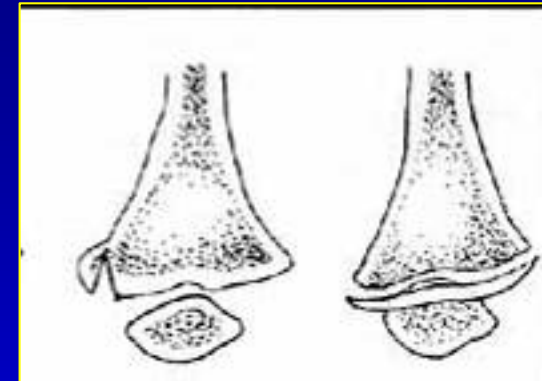
- femur, humerus, tibia
- Spiral fracture of the long bones



METAPHYSEAL FRACTURES

- Most frequent
- Lower limb
- Bilateral in different stadium

Epiphyseal fractures are rare

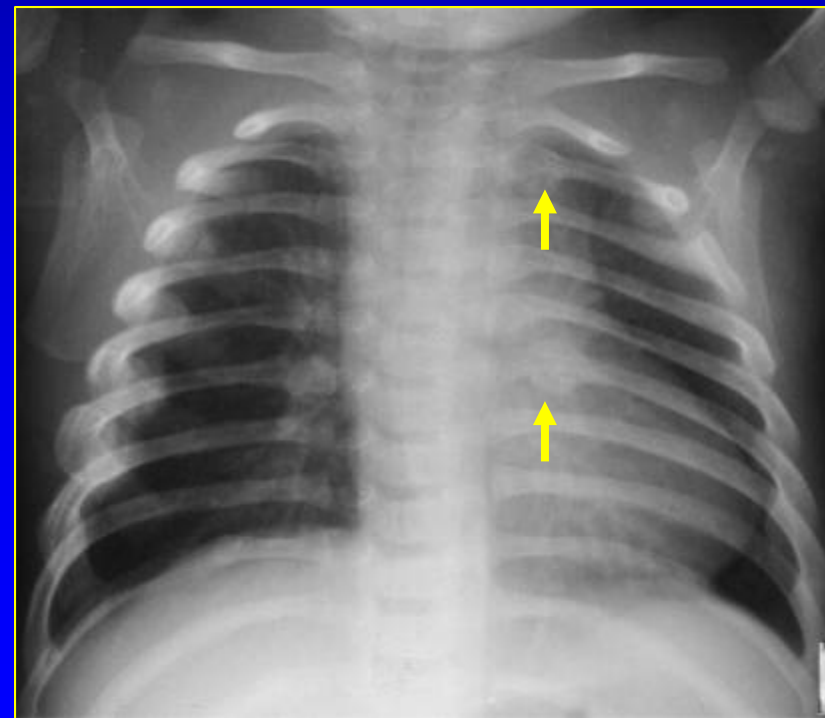
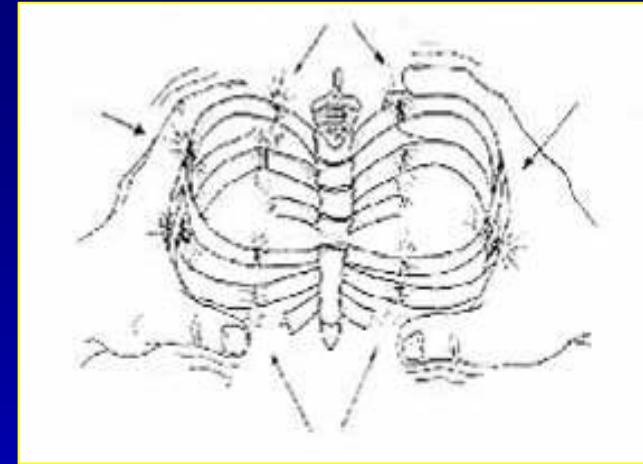


Corner fracture bucket-handle fracture



RIB FRACTURES

- Rib fracture on the chest X-Ray
- Sometimes bilateral, multiple (shaken baby)



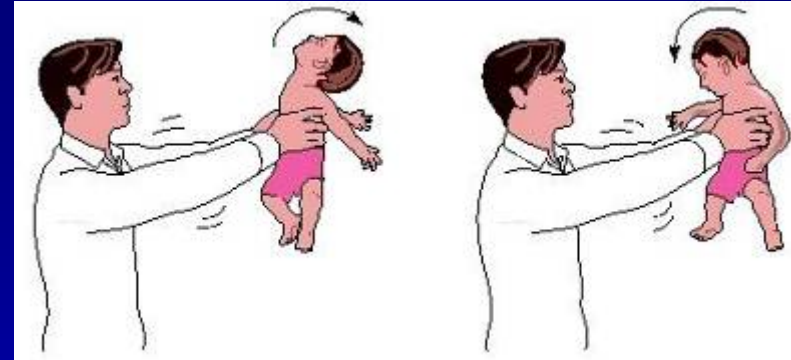
X-RAY

- skull
- spine
- chest
- pelvis
- Bones, elbow, ankle, knee
- Callus: 6. day, not later then 8. day

CEREBRAL INJURIES

(13-25%)

- subdural haematoma, oedema, ventricular and cerebral bleeding
- Shaking
- Generally subdural hematomas are bilateral after abusing



ABDOMINAL INJURIES (3%)

- Parenchymal injuries: liver, spleen, pancreas, kidney
- Free abdominal fluid
- US, CT

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