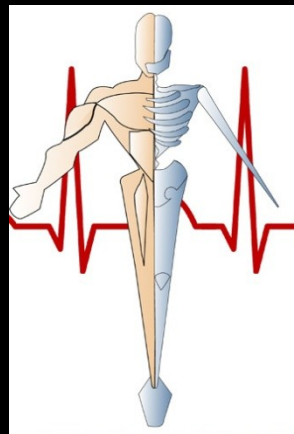


Three Phase CEUs &
SCS Continuing Education Presents:

*Fundamentals of
Radiographic Pathology* ©

by

John Fleming, M.Ed. RT(R)(MR)(CT)



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Forward

The premise behind the creation of this partnership is to provide imaging professionals with access to high quality yet affordable continuing education units (CEUs). Please feel free to share this disk with your colleagues and have them contact John Fleming at (727) 796-0397 for information regarding the submission of these 12 CEUs for credit with the Florida Department of Health and the American Registry of Radiologic Technologists. Thanks for your support and be sure to look for additional courses to be developed in the near future by Three Phase CEUs and SCS Continuing Education.

Course Abstract & Objectives:

Course Abstract:

The objective of this home study course is to provide the learner with a computer based tutorial that will give them with the means to learn the fundamentals of radiographic pathology. After completion of this home study course, the participant will be able to identify the major characteristics of the radiographic pathologies that are associated with the body systems covered in this course. A 100 question mastery test will be administered at the end of this home study course in order to ensure that competency of the material has been achieved.

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Introduction to Pathology Menu

1. Disease
2. Pathology
3. Pathogenesis
4. Inflammation
5. Inflammatory Reactions
6. Edema
7. Abnormal Fluids
8. Ischemia
9. Infarct
10. Hemorrhage
11. Aplasia
12. Atrophy
13. Hypertrophy
14. Neoplasm

Disease:

- Simply put, pathology is the study of disease.
- Disease is a term that literally refers to a lack of “ease.”
- It is a condition that is marked by an abnormal disturbance in the function and or structure of the human body as a result of some type of injury or trauma.

Pathology:

- The study of disease and how it impacts the human body.
- The following is a partial list of sources for pathology:

Hereditary or Congenital

Tumors

Iatrogenic

- Any adverse conditions that results from medical treatment.
- An example would be a pneumothorax that occurs as the result of a thoracentesis.

Infections

- A nosocomial infection is acquired from a health care environment.

Pathogenesis:

- The study of the origin and development of a disease.
- Pathogenesis will lead to observable changes that are known as manifestations.

Sign

- This is a manifestation that is observable by the health care worker.
- Examples would be swelling or a skin rash.

Symptom

- This pertains to the patient's perception of what is wrong and is subjective.
- An example would be a headache.

Pathogenesis:

- Syndrome

This is a group of signs and symptoms that characterize an abnormal disturbance.

An example would be Marfan's Syndrome.

- This is a genetic disorder of connective tissue
- It is characterized by a predisposition to cardiac disorders, long limbs, long fingers, and a tall stature.
- Abraham Lincoln had Marfan's Syndrome.

- Etiology

This is the study of the cause and origin of a disease.

Pathogenesis:

- Idiopathic

This refers to the fact that there may be no real cause for the disease.

Examples would be hypertension and a spontaneous pneumothorax.

Inflammation:

- Inflammation refers to the body's ability to wall-off and sequester an injurious agent.
- The ultimate goal of this process is the safe removal of said injurious agents.
- Hyperemia is the process of dilating capillaries to allow fluids and leucocytes to infiltrate the infected area.
- The leucocytes will act to remove cellular debris through a process known as phagocytosis.
- The cardinal signs of inflammation include heat (results from hyperemia), redness, pain, and often a decrease in function.

Inflammatory Reactions:

- Abscess

This type of inflammatory reaction causes the injurious agent to become a walled-off ball of pus.

Antibiotics cannot penetrate an abscess since they do not contain a blood supply like a neoplasm.

As a result, an abscess must be aspirated with a needle and drained.

- Ulcers

This is another type of inflammatory reaction that is the result of a healing wound that is located on the skin or a mucous membrane

Inflammatory Reactions:

- Cellulitis

This is an acute bacterial infection of the skin and is a third example of an inflammatory reaction.

It can be found anywhere in the body but it is more often seen in areas where the skin can be damaged and thus allow a portal of entry for bacteria.

A byproduct of bacterial reproduction within the tissue is the excretion of methane.

This can sometimes be demonstrated on a radiograph as depicted on the next slide.

Inflammatory Reaction: Cellulitis



The arrows on this image are pointing to an area where the excrement of a bacterial infection has resulted in the formation of air within the tissue of this patient's foot. This is an indication of **cellulitis**.

Edema:

- This is an abnormal accumulation of fluid in body cavities or intercellular spaces.
- The increase in fluid can be localized within a structure or dispersed throughout the body.

An example of a localized edema would be ascites which is essentially edema of the peritoneal cavity.

Generalized edema can be caused by congestive heart failure

- This is characterized by peripheral edema, pulmonary edema, pleural effusions, and ascites.

Abnormal Fluids:

- Transudates

This abnormal, extracellular fluid essentially consists of water that contains a low cell count.

As a result, they are usually clear.

A good example would be a pleural effusion.

- Exudates

This fluid filters from the circulatory system into lesions and generally contains water, pus, and/or blood.

Since exudates contain infected fluid (pus/bacteria), they are therefore not clear.

Ischemia:

- This term refers to an obstruction of the normal blood flow to an organ or structure.
- It usually results from either a narrowing of blood vessels from plaque formation (fatty cholesterol deposits) or as the result of a thrombotic occlusion.
- As humans age, primary blood vessels into an organ may become stenotic due to plaque formation within their lumen.

As a response to this gradual change, secondary blood vessels may enlarge and play an increasingly important role in that organ's blood supply.

This process is called collateral circulation and it is the body's natural defense against ischemia.

Infarct:

- Loss of blood supply to an organ or structure will cause the surrounding tissue to become necrotic.
- This process is referred to as an infarct.
- The following is a list of diseases that are either caused by an infarct or may result in an infarct:

Myocardial Infarction (Heart Attack)

Pulmonary Embolus

Cerebrovascular Accident (Stroke)

Hernia (Mechanical Obstruction)

Volvulus (Mechanical Obstruction)

Hemorrhage:

- Hemorrhage or bleeding is simply the loss of blood from the circulatory system.
- The following is a list of a few examples of a hemorrhage:

Hematoma

- This occurs as the result of a break in a blood vessel that causes a pooling of blood below the surface of the skin, organ, or structure.

Ecchymosis

- This is a type of hematoma that is commonly referred to as a bruise or contusion.
- Capillaries below the skin are damaged usually as the result of some type of trauma.

Hemorrhage:

Purpura

- These are red or purple spots on the body that are caused by a hemorrhage.
- They are often the result of some type of platelet or coagulation disorder.

Petechia

- This is a type of purpura that consists of very small red or purple spot on the body.

Aplasia:

- This is the inability of an organ or structure to form properly.
- The defective development of an organ can result in the partial or complete loss of an organ.

Atrophy:

- Atrophy is the decrease in size of the cells within an organ or structure.
- The following is a list of some of the common causes of atrophy:

Lack of Physical Activity

Poor Nourishment

Nerve Damage

Poor Circulation

Hypertrophy:

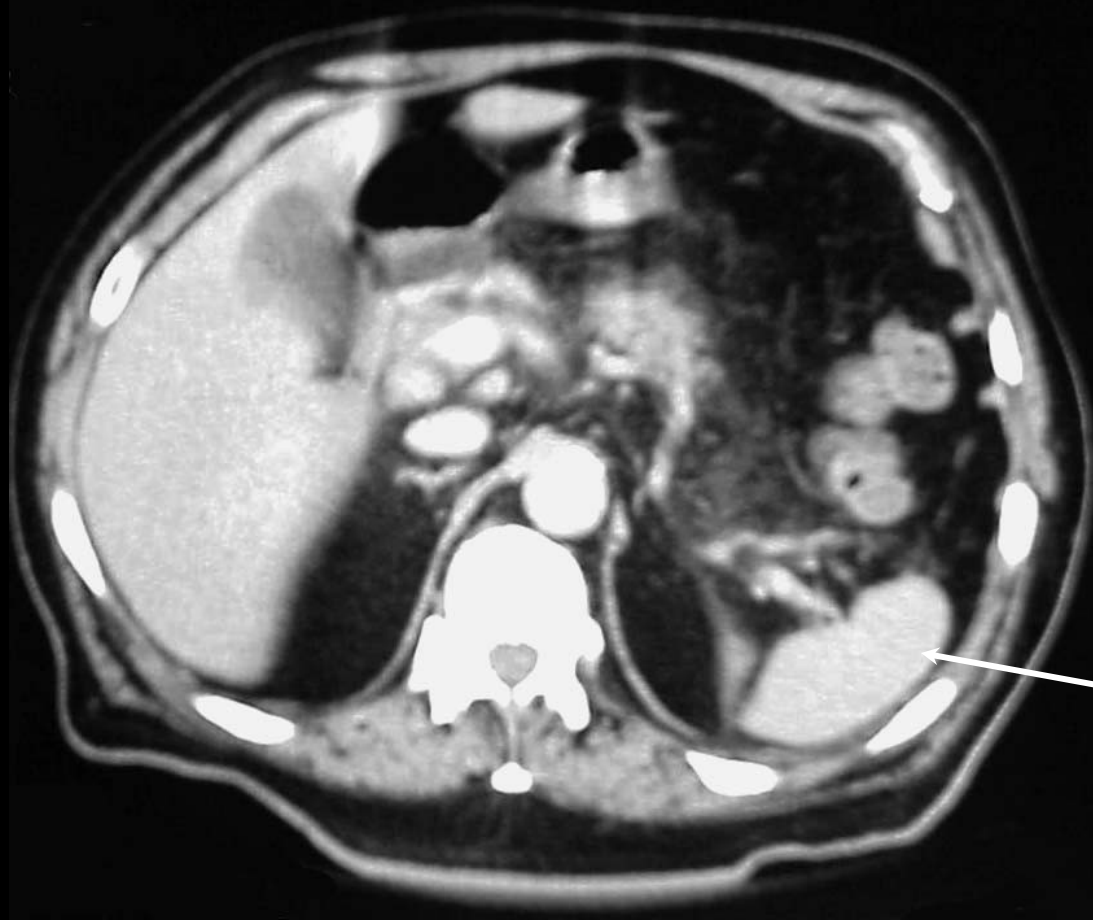
- This is the opposite of atrophy in that there is an abnormal increase in cell size.
- This condition is also sometimes referred to as hyperplasia or hypergenesis.
- The following is a list of some of the common causes of hypertrophy:

An Increase in Physical Activity

Hormonal Changes

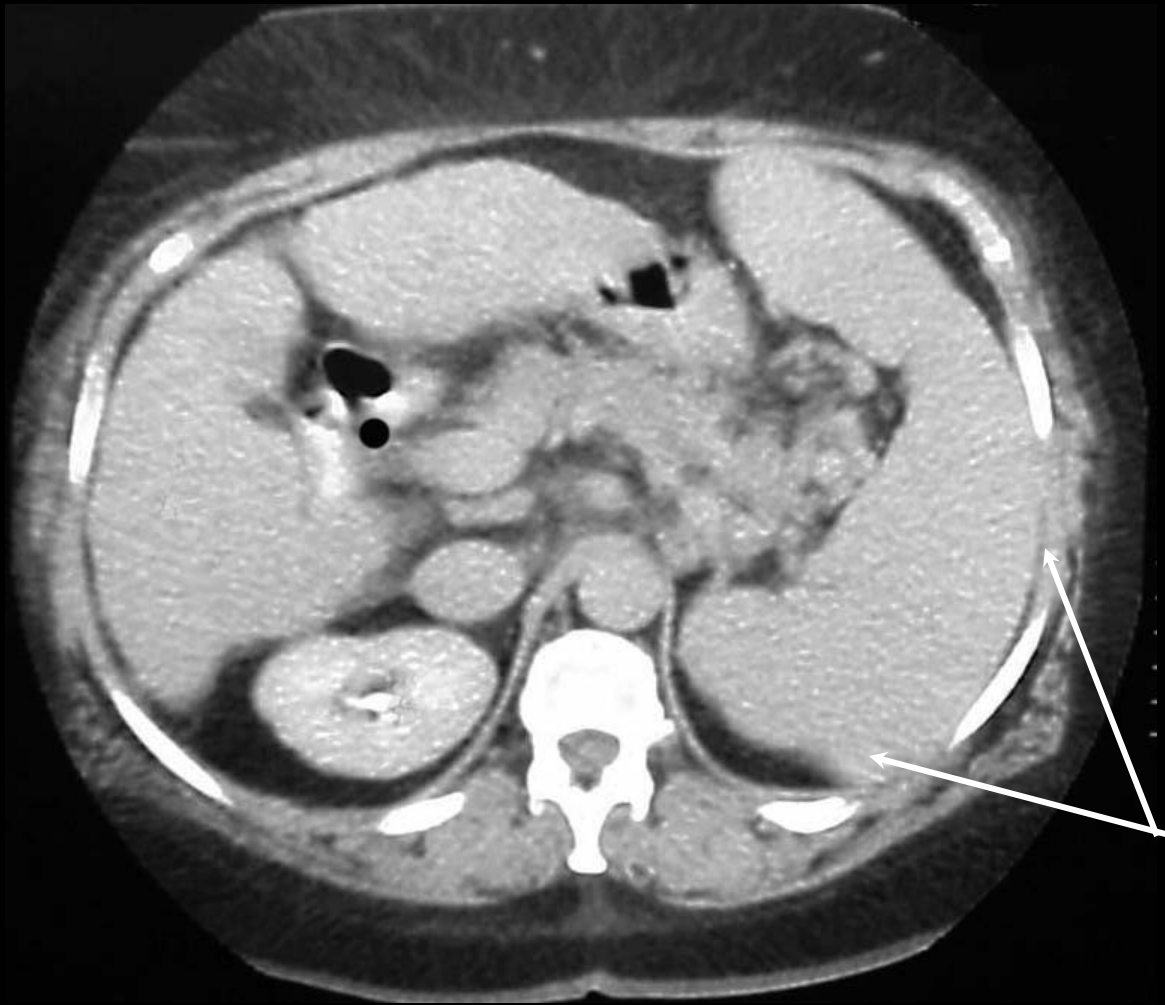
Chronic Inflammation

Hypertrophy: Splenomegaly



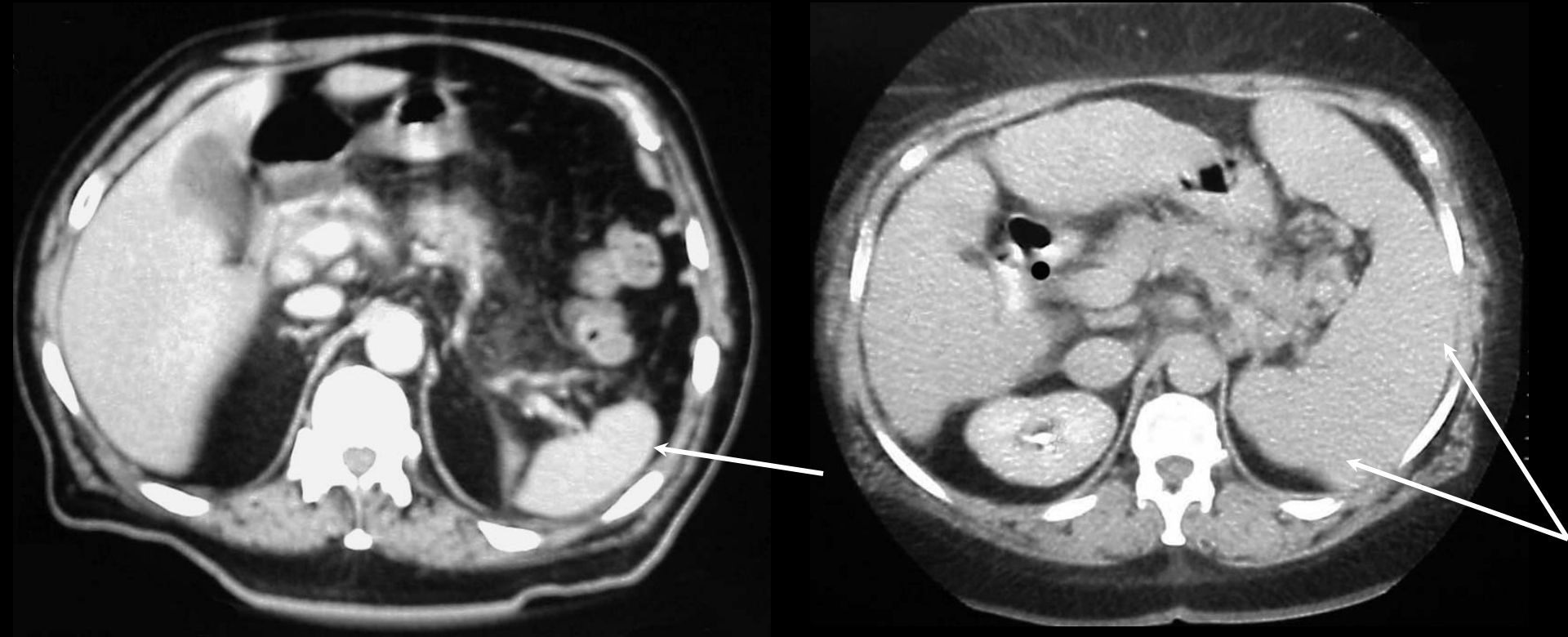
The arrow on this CT scan of the abdomen is pointing to a **normal spleen**.

Hypertrophy: Splenomegaly



The arrows on this CT scan of the abdomen are pointing to an **enlarged spleen**. This condition is referred to as **splenomegaly**.

Hypertrophy: Splenomegaly



This is a side-by-side comparison of a CT scan of a **normal spleen** on the left (arrow) and an **enlarged spleen** on the right (arrows).

Neoplasm:

- This is the abnormal proliferation of foreign cells that form a mass of tissue within an organ or structure.
- A neoplasm will compete for nutrients from the cells that normally comprise the host organ and it is often referred to as a mass or tumor.
- Oncology is the study of neoplasms.
- A benign neoplasm is one that is self-limited and will not spread or seed to distant sites within the host organism.

Neoplasm:

- A malignant neoplasm (cancer), on the other hand, does possess the ability to spread to distant sites in the body.

This type of tumor will seed by employing either the lymphatic system (primary method) or by using the circulatory system (hematogenous spread).

Cachexia

- If left untreated or undetected, malignant neoplasms will ultimately result in this condition.
- It is characterized by fatigue, atrophy, weakness, and anorexia.
- Cachexia is often seen as an end-stage to cancer.

Neoplasm:

- Four major cancer categories are as follows:

1. Carcinoma/Adenocarcinoma

- This type of cancer will arise from epithelial cells or tissues such as the breast, colon, or pancreas.

2. Sarcoma

- Relatively rare but highly malignant.
- This is cancer of soft tissue or connective tissue such as bone, cartilage, muscle, and fat.

Neoplasm:

3. Leukemia

- This is cancer of the blood and blood forming tissues.
- Acute leukemia is characterized by an abnormal proliferation of *immature* blood cells that do not possess the ability to fight infection.
- Chronic leukemia is characterized by an abnormal proliferation of *mature* blood cells that do not possess the ability to fight infection.

Neoplasm:

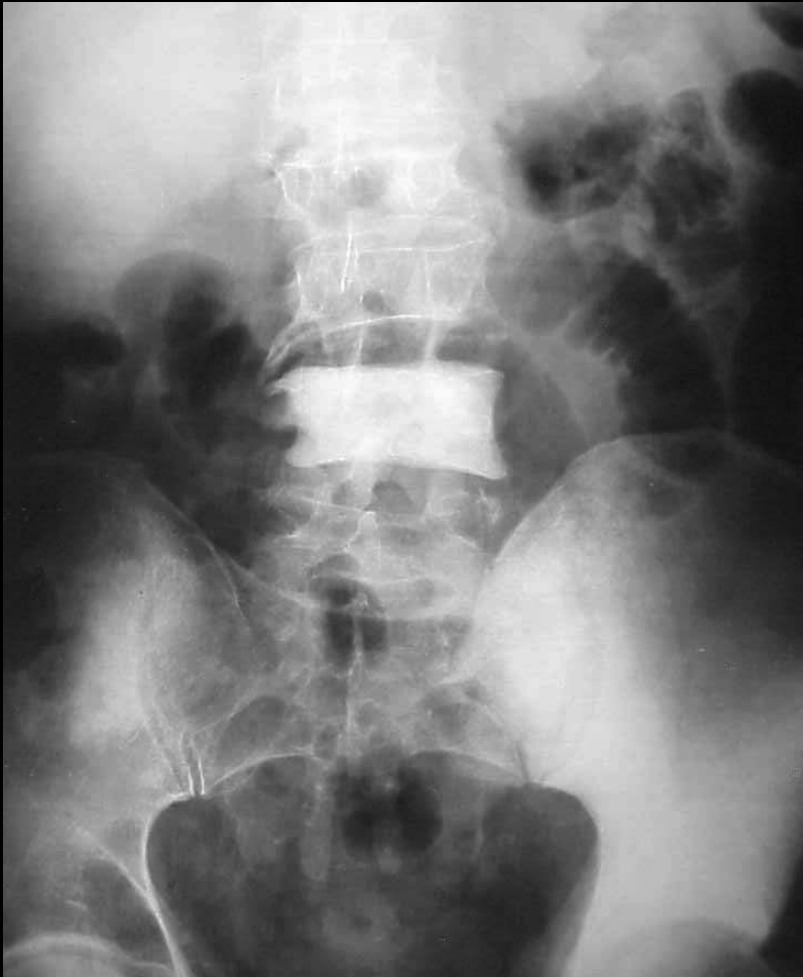
4. Lymphoma

- This type of cancer originates in lymphatic tissues and affects the production of lymphocytes (white blood cells).
- There are two major categories.
- Non Hodgkin's Lymphoma (NHL)

This is the most common type of lymphoma and it is found in the spleen, liver, bone marrow, lymph nodes, and GI tract.

NHLs are a diverse group of diseases that can develop in any organ that is associated with the lymphatic system and has an unknown etiology.

Neoplasm:



Non Hodgkin's Lymphoma will begin with the lymph nodes and spleen and can then **metastasize** to the liver, kidneys, spine, brain, lungs, and bone. In this example, it has spread to the spine and has formed an osteoblastic condition that is commonly referred to as an **ivory vertebra**.

Neoplasm:

- Hodgkin's Lymphoma/Disease

This type of cancer is also associated with lymphatic tissue and it was first describe by Thomas Hodgkin in 1832.

This cancer is characterized by the lymph nodes becoming swollen and rubbery yet they remain pain free.

It is definitively diagnosed via lymph node biopsy and finding the presence of Reed-Sternberg Cells.

Hodgkin's disease has an unknown etiology.

Neoplasm:

- Cancer treatment varies according to the type of cancer that is diagnosed and what stage it is in.
- The three primary methods of treating malignancies are as follows:
 1. Surgery
 2. Chemotherapy
 2. Radiation Therapy
 - In some instances, a combination of these treatments may be indicated.

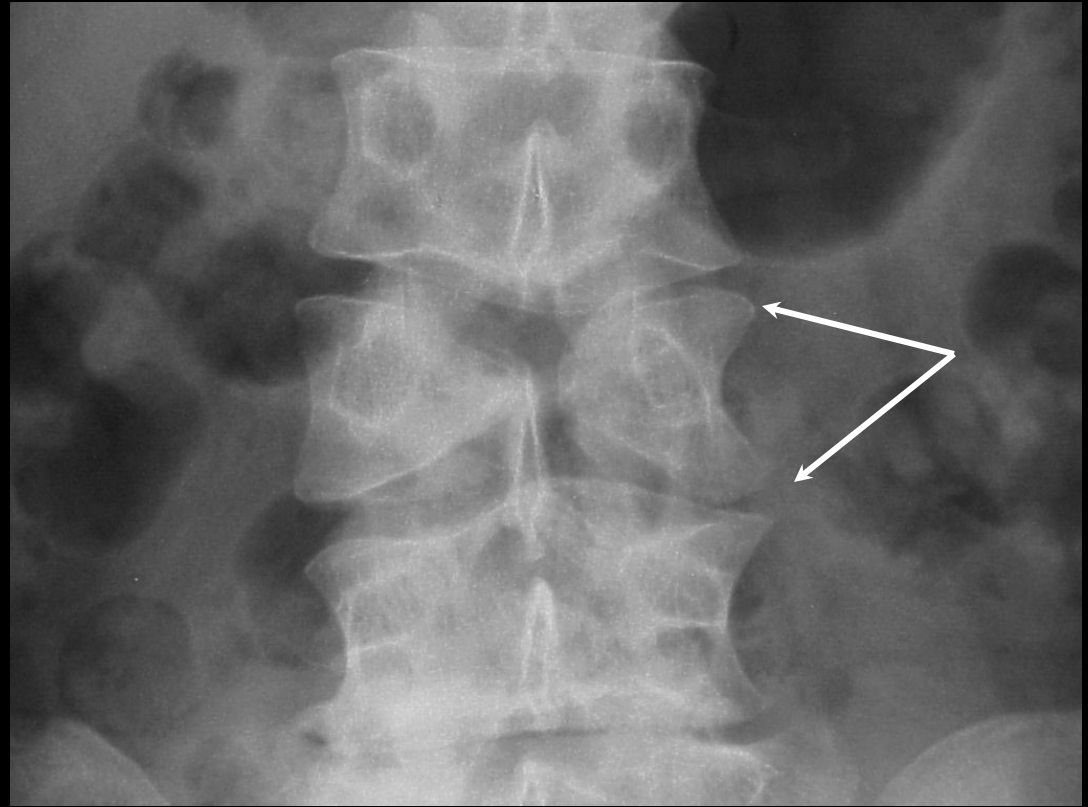
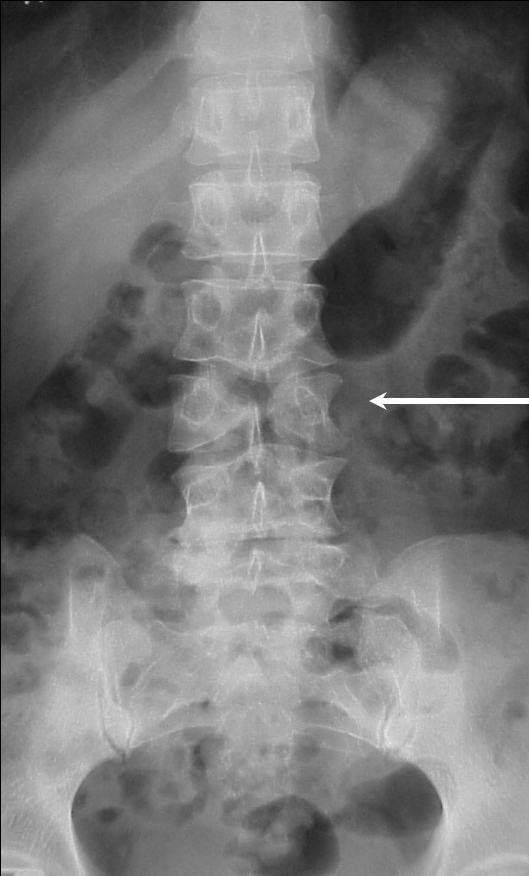
Skeletal System Menu

1. Butterfly Vertebra
2. Cervical Rib
3. Osgood-Schlatter's Disease
4. Osteogenesis Imperfecta
5. Osteopetrosis
6. Osteoporosis
7. Osteomalacia
8. Osteomyelitis
9. Rheumatoid Arthritis
10. Ankylosing Spondylitis
11. Gout
12. Osteoarthritis
13. Paget's Disease
13. Avascular Necrosis
14. Spondylosis
15. Spondylolisthesis
16. Osteopoikilosis
17. Bone Cysts
18. Bone Tumors
19. Enchondroma
20. Osteochondroma
21. Multiple Myeloma
22. Osteosarcoma
23. Chondrosarcoma
24. Fibrosarcoma
26. Secondary Bone Cancer

Butterfly Vertebra:

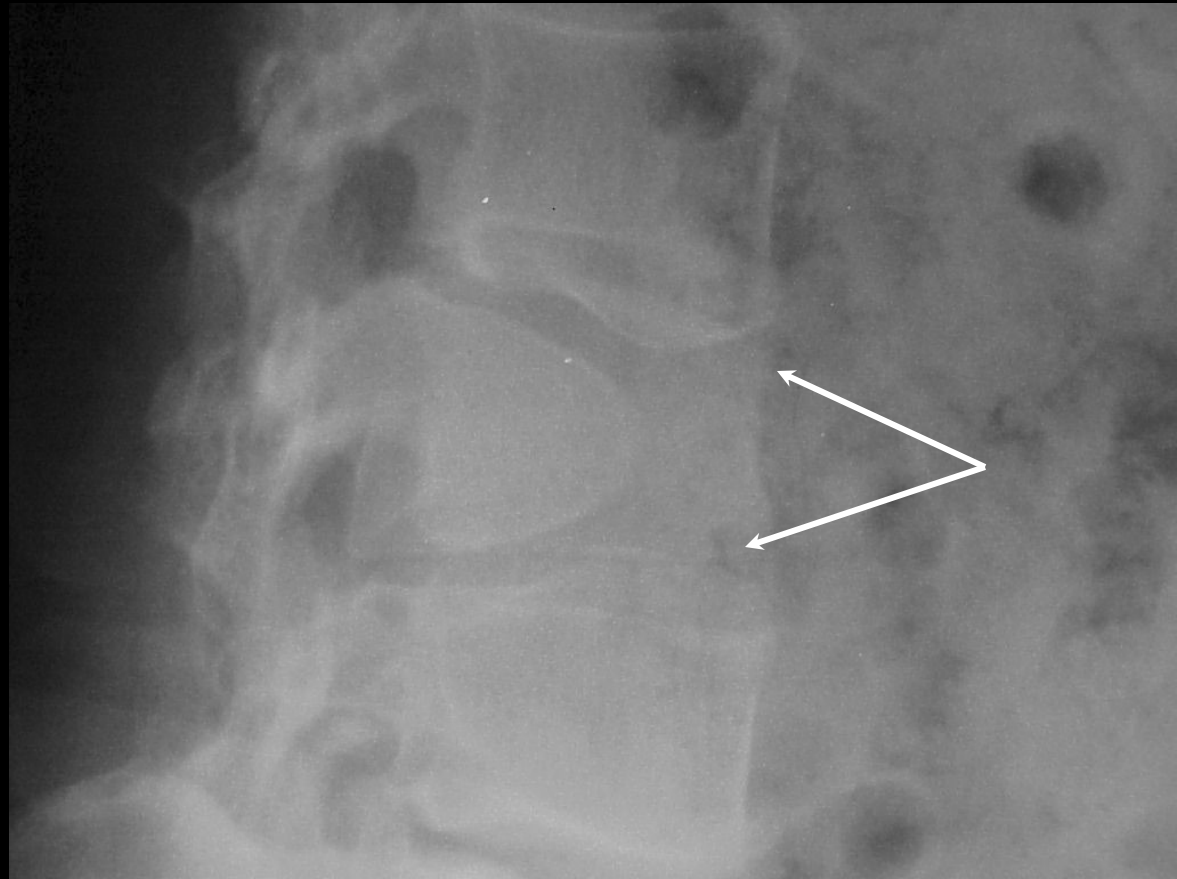
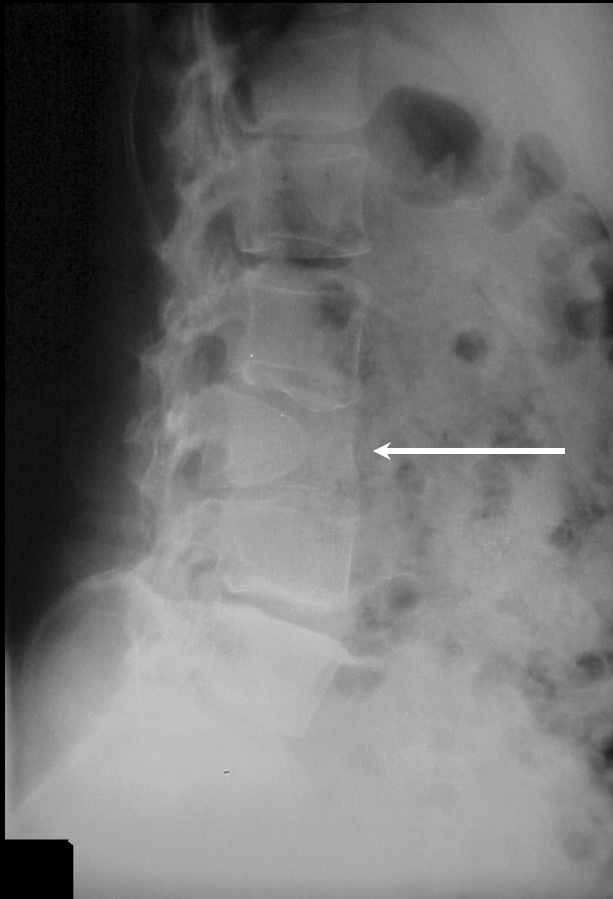
- A butterfly vertebra is a congenital defect of a vertebra that produces the radiographic appearance of a butterfly on an AP projection.
- Most are of no significance but they do have the potential for causing instability or altering the shape of the spinal canal.

Butterfly Vertebra:



The arrows on this image are pointing to a **butterfly vertebra**. This is a congenital defect that usually has no clinical significance.

Butterfly Vertebra:

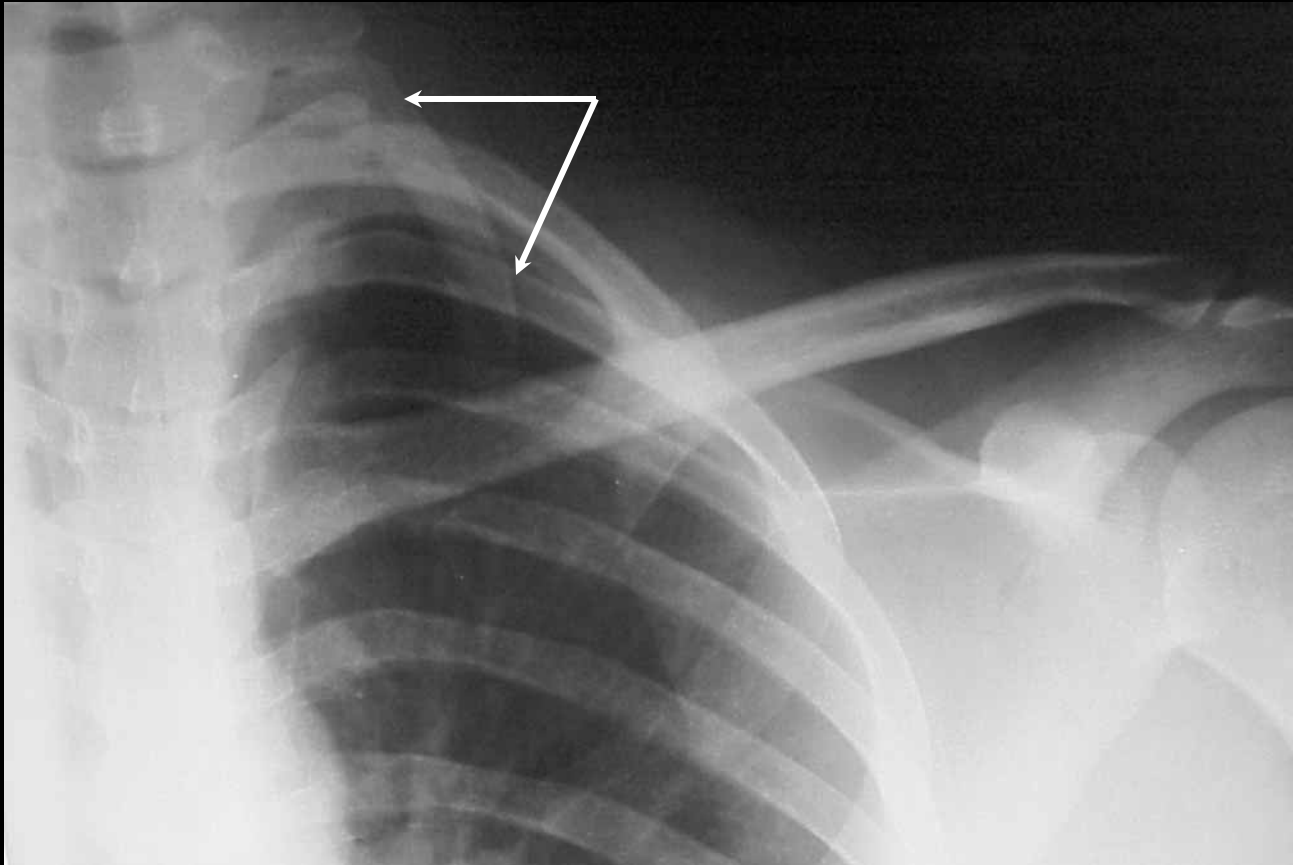


This is a lateral position of the previous patient demonstrating the radiographic appearance of a **butterfly vertebra**.

Cervical Rib:

- This is a supernumerary or extra rib that is attached to C7.
- It is a poorly developed or rudimentary rib that is present in approximately 0.05% of the population.
- It is usually unilateral but in some cases, they can be bilateral.
- The concern with a cervical rib is that it may compress the brachial nerve plexus or the subclavian artery and thus require surgical removal.

Cervical Rib:



The arrows on this image are pointing to a **rudimentary rib** that is attached to C7.

Osgood-Schlatter Disease:

- This disease is one of the most common causes of knee pain in young athletes.
- Osgood-Schlatter disease mainly affects boys ages 10 to 16.
- It is a condition where the tibial tuberosity becomes inflamed following exercise.
- Treatment primarily consists of rest.

Osgood-Schlatter Disease:



The arrow on this diagram demonstrates how the patellar tendon is attached to the tibial tuberosity of the tibia.

Osgood-Schlatter Disease:



The arrow on this image depicts how the patellar tendon has avulsed a portion of the tibial tuberosity away from the tibia thus indicating that the patient is suffering from a condition known as **Osgood-Schlatter's Disease**.

Osteogenesis Imperfecta (OI):

- This is a relatively rare congenital bone disorder that is characterized by bones that easily break.

This condition is sometimes referred to as “brittle bone” disease.

- People with this OI are born with insufficient amounts of a protein called type I collagen which plays an important role in bone formation.

This collagen deficiency will result in osteopenia which is a decrease in the number of osteocytes.

The net result is the formation of fragile or severely deformed bones.

Osteogenesis Imperfecta (OI):

- In severe cases, multiple fractures can form while the fetus is in the womb.

As a result, many infants are stillborn or die shortly after birth.

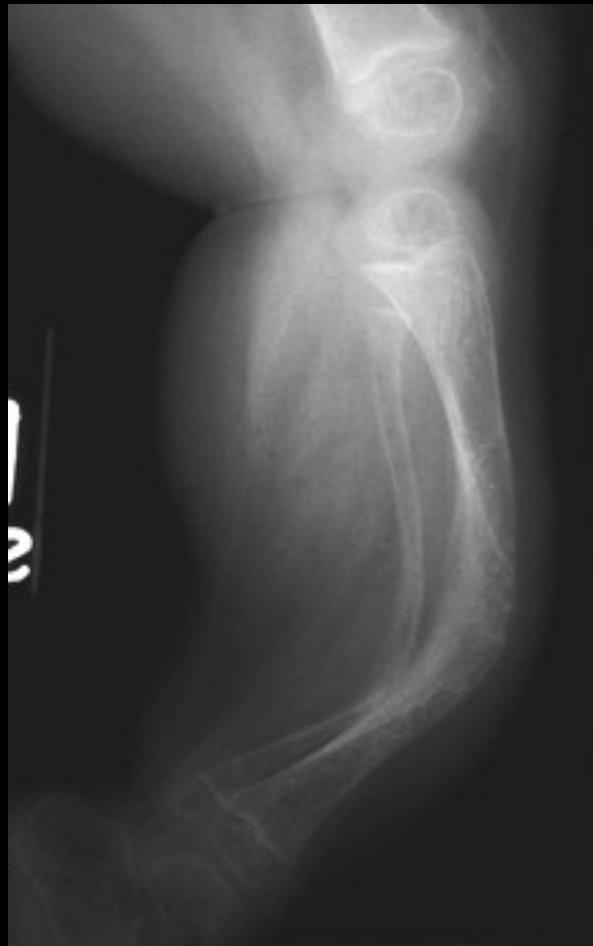
- In 2000, Samuel L. Jackson played a character with OI called Mr. Glass in a movie with Bruce Willis entitled, *Unbreakable*.

Osteogenesis Imperfecta (OI):



The severe bowing that has occurred in this patient's humerus and forearm are an indication that the patient is suffering from a condition known as **osteogenesis imperfecta**.

Osteogenesis Imperfecta (OI):



The severe bowing that has occurred in this infant's tibia is an indication that the patient is suffering from a condition known as **osteogenesis imperfecta**.

Osteopetrosis:

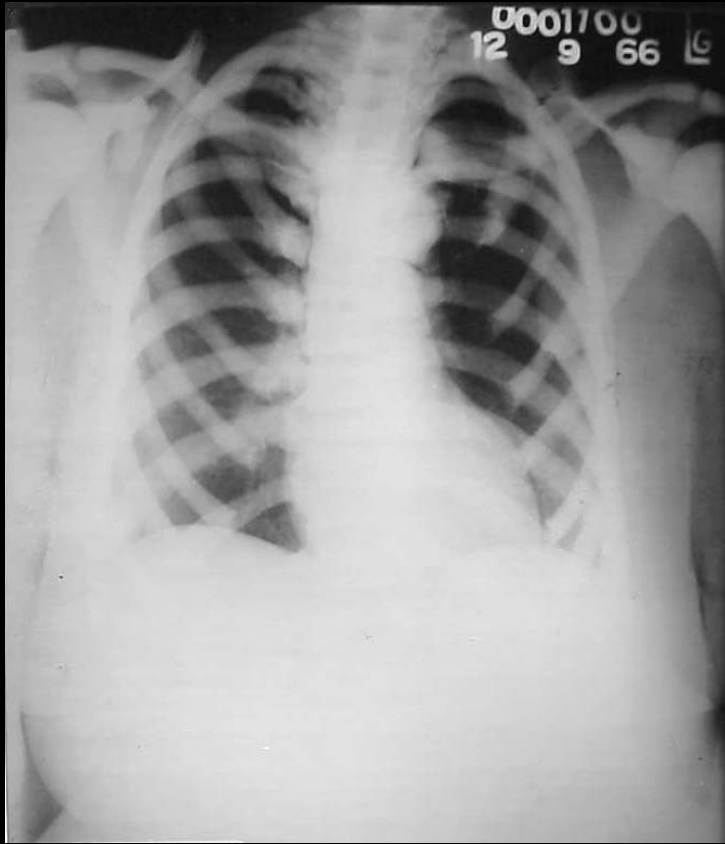
- This disorder results from a disorder of endochondral ossification and is the opposite of osteoporosis.
- Patients with this very rare condition possess bones that are very hard and dense.

As a result, osteopetrosis is sometimes referred to as “marble bone” disease.

Oddly enough, their bones tend to be more brittle than normal.

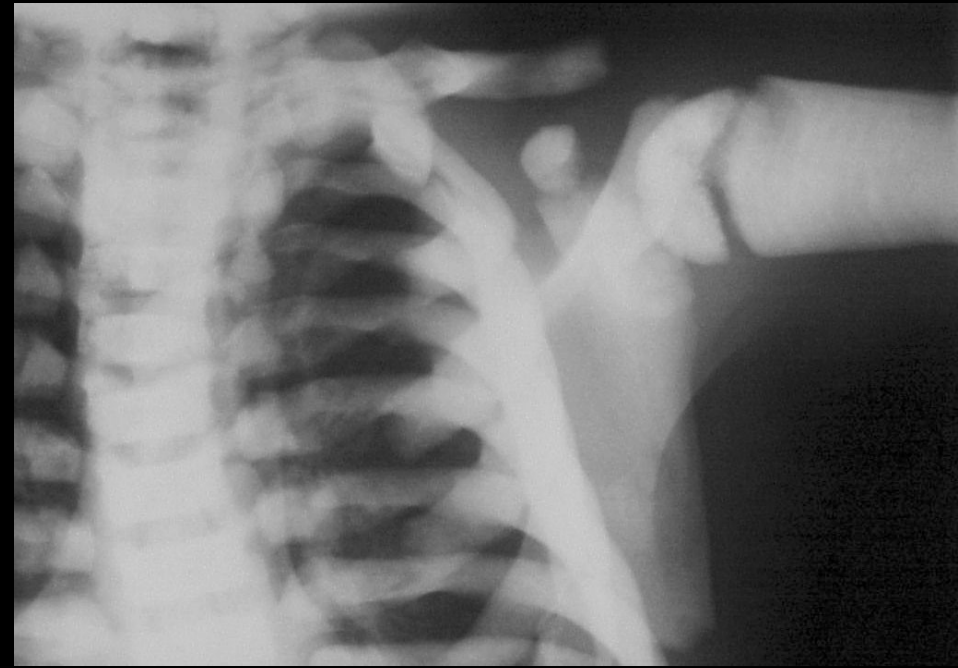
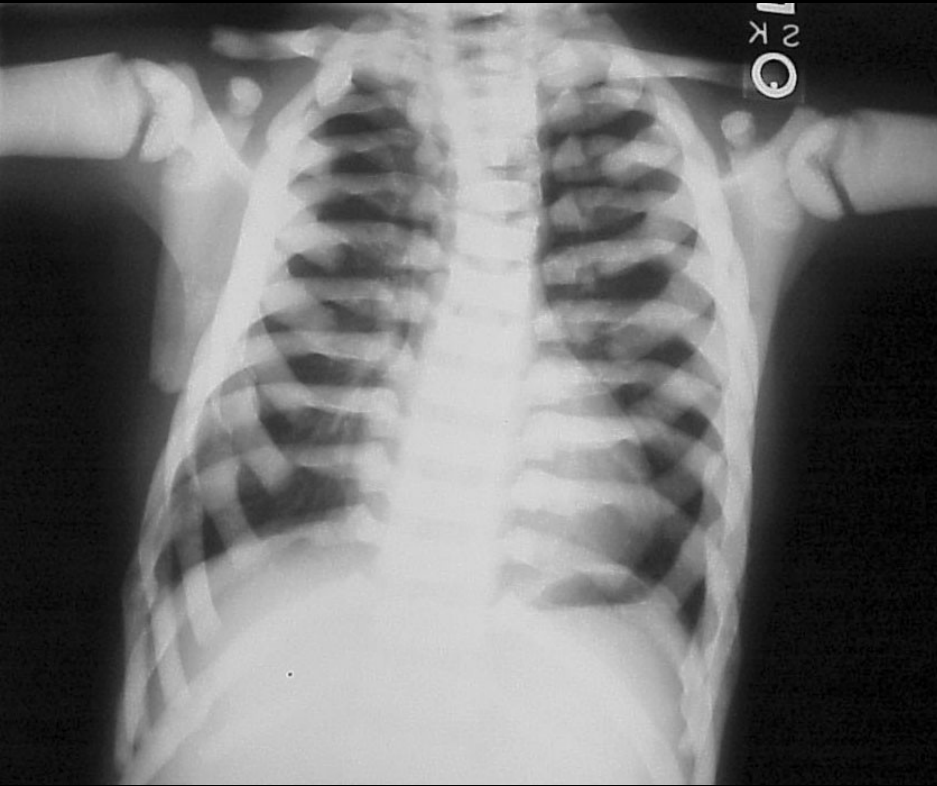
- It can be fatal at birth or asymptomatic into adulthood.
- There is currently no definitive treatment for osteopetrosis.

Adult Osteopetrosis:



The marbled radiographic appearance on these images is an indication that this patient has a condition known as **adult osteopetrosis**. This is the benign form of the disease.

Infantile Osteopetrosis:



The marbled radiographic appearance on these images is an indication that this child has a the lethal form of **infantile osteopetrosis**.

Infantile Osteopetrosis:



This is another example of the lethal form of **infantile osteopetrosis**.

Osteoporosis:

- This disease is characterized by a reduction in bone mass that makes patients with this condition susceptible to fracture formation.

The underlying mechanism in all cases is an imbalance between the body's normal process of bone destruction followed by bone growth.

- There are many factors involved in the pathogenesis of osteoporosis.

The primary causes are aging and postmenopausal hormone changes.

Other causes include steroid use, osteogenesis imperfecta, multiple myeloma, and inactivity.

Osteoporosis:

- Patients with this condition are prone to hip fractures, compression fractures of the vertebral bodies, and Colles' fractures of the wrist.
- A common method to diagnose this condition is by the use of a dual energy X-ray absorptiometry (DEXA) scan.

A DEXA scan provides a non invasive means to measure bone mineral density (BMD).

Osteoporosis:



The “washed-out” radiographic appearance of these images is the result of a loss of bone density and is an indication that the patient has a condition known as **osteoporosis**.

Osteomalacia:

- This disease is characterized by a softening of bones that results from insufficient mineralization.
- Osteomalacia may cause a “bowing” of bones or lead to greenstick fractures.
- It can be caused by a decrease in absorption of either vitamin D or calcium.
- It can also be manifested in children who ingest an insufficient amount of vitamin D or who are not exposed to enough sunlight

This is commonly called rickets.

Osteomyelitis:

- This condition is the result of a bacterial bone infection that causes bone destruction and abscess formation.

One characteristic is the formation of a Brodie's abscess.

It is typically found in the tibia and is an indication of osteomyelitis.

- Another characteristic of osteomyelitis is a sequestrum formation.

This is an avascular "island" of bone that forms within an abscess.

It is commonly referred to as a bone-in-bone formation.

- Osteomyelitis can be acute or chronic.
- It is usually treated with prolonged antibiotic therapy.

Osteomyelitis:



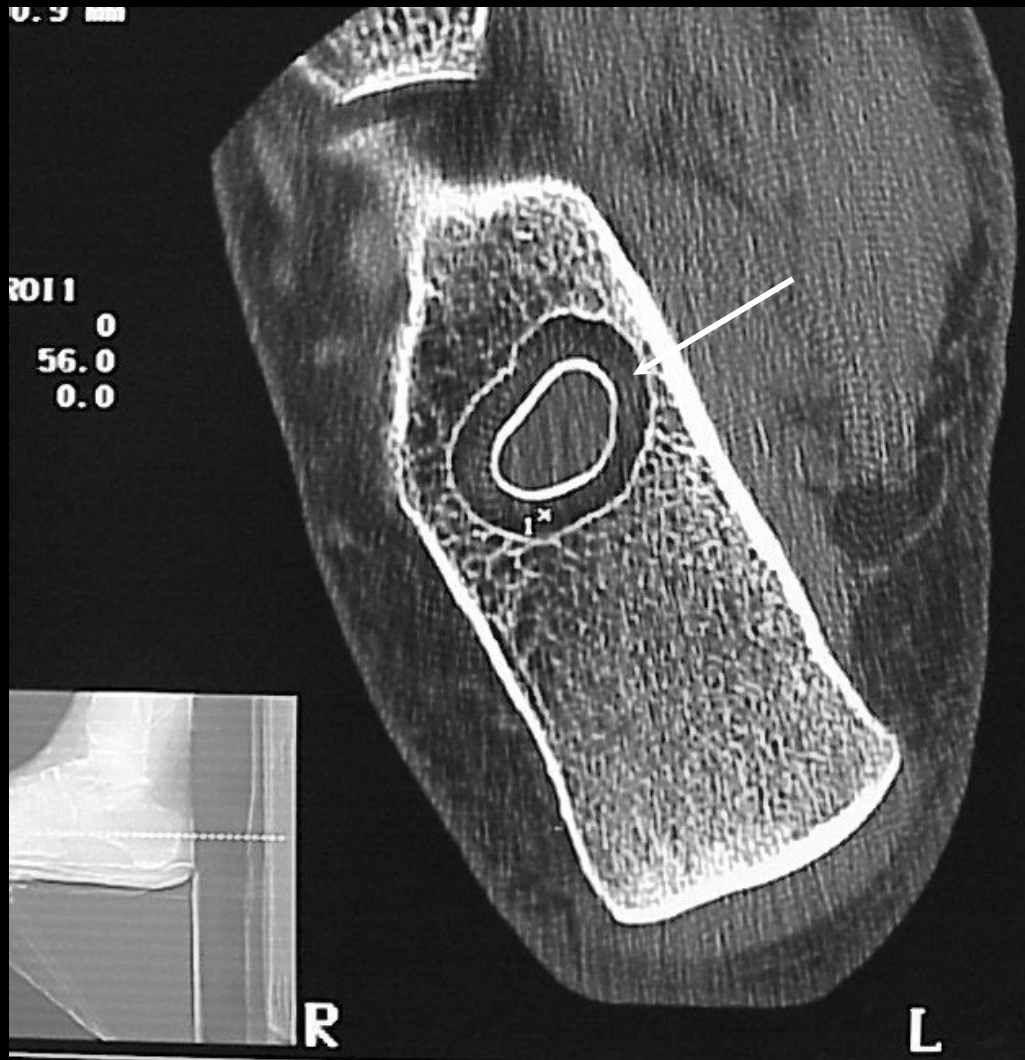
The black arrow on this tomography slice through the proximal tibia is pointing to a **Brodie's abscess**. This is an indication that the patient has a condition known as **osteomyelitis**.

Osteomyelitis:



Sequestrum formation is another indication that the patient has **osteomyelitis**. The arrows are pointing to a classic example of how an avascular bone “island” can form within the abscess. The second image is a magnified view of the first image.

Osteomyelitis:



The arrow on this CT image of the calcaneus is pointing to a bone cyst that has formed in reaction to **osteomyelitis**. This reaction is commonly referred to as a cyst-in-cyst reaction to the infection.

Rheumatoid Arthritis (RA):

- This type of arthritis can involve joints, muscles, tendons, ligaments, and blood vessels.
- It begins as a chronic inflammation of synovial membranes that line joints.
- Thickened tissue (pannus) forms as a result of the inflammation and this causes erosion of the articular cartilage.
- Fibrous scarring occurs followed by ankylosis or “freezing” of the affected joint.
- The net result is a crippling deformity which begins in the extremities and progresses toward the trunk.

Rheumatoid Arthritis (RA):

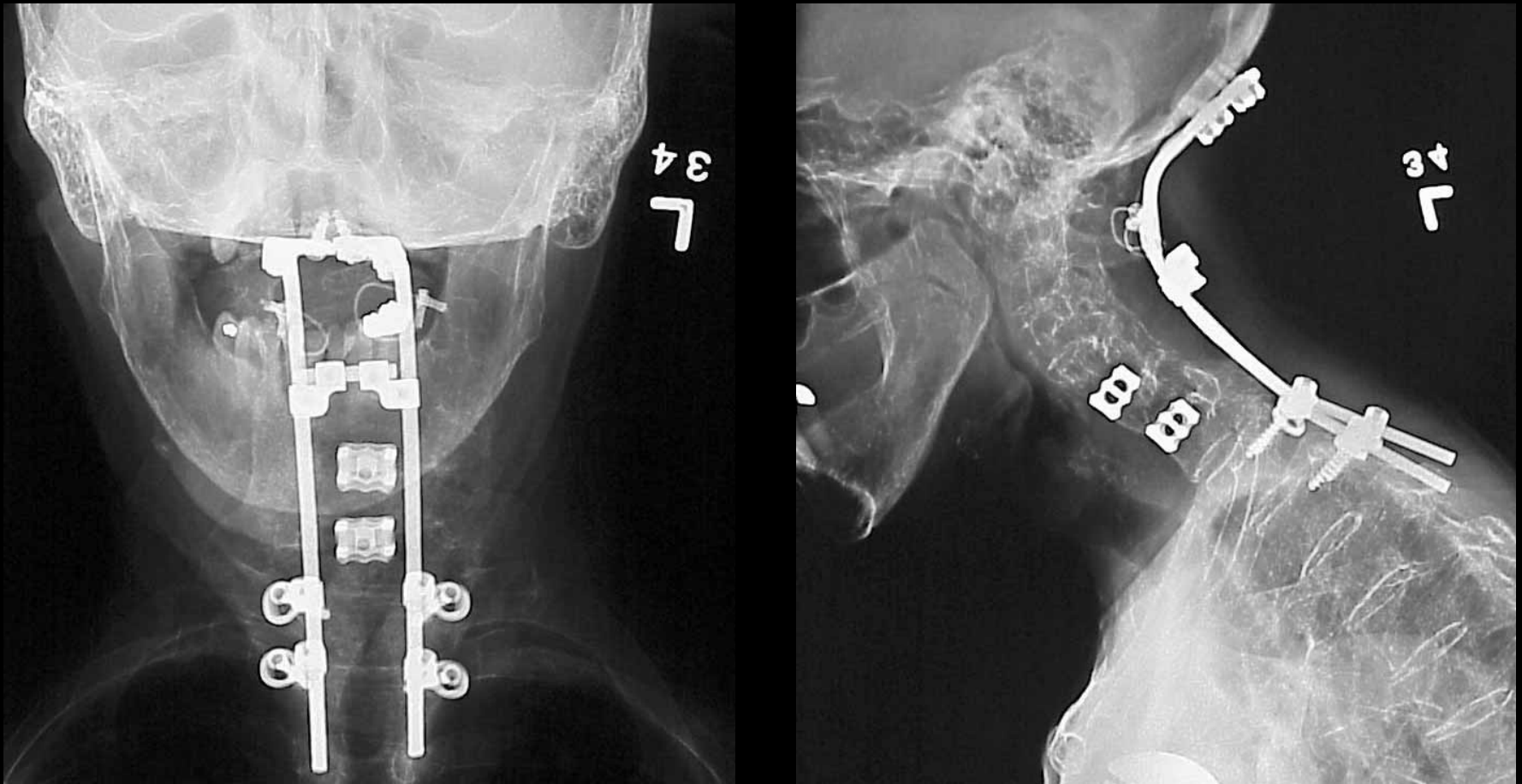
- RA can relapse but may still have intermittent flare ups.
- This disease affects women three times more often than men.
- Signs and symptoms of RA include morning stiffness, pain, and ulnar deviation of the fingers.
- Treatment includes steroids to reduce the inflammation and analgesics (aspirin) for pain.

Rheumatoid Arthritis (RA):



The radiographic appearance of **rheumatoid arthritis** demonstrates how this crippling deformity results in ulnar deviation of the fingers.

Rheumatoid Arthritis (RA):



This patient had rods surgically inserted to help stabilize their neck from the debilitating effects of **rheumatoid arthritis**.

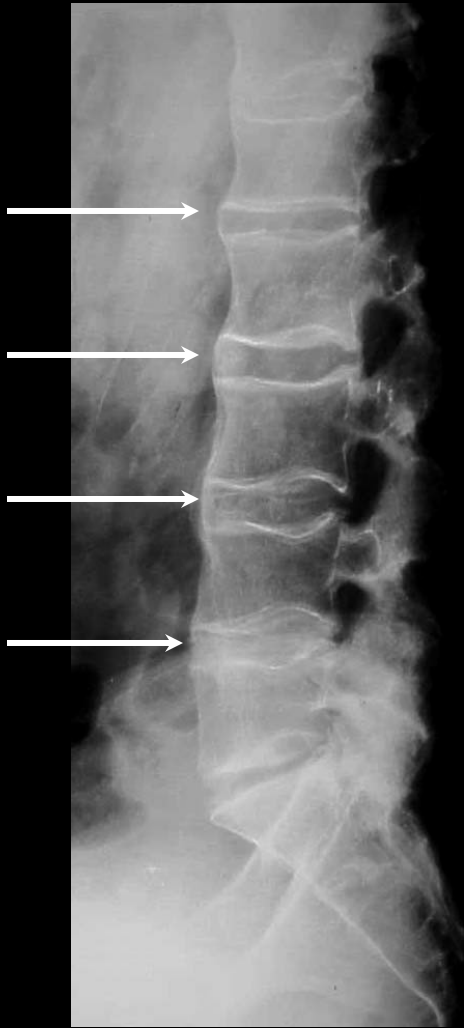
Ankylosing Spondylitis:

- This is a chronic, degenerative arthritis that usually begins in the sacroiliac (SI) joints and spreads to the spine.
- It is characterized by osteoporosis and fusion of the SI joints and vertebral bodies.
- Due to its very distinctive radiographic appearance, it is commonly referred to as “bamboo spine” disease.
- Treatment includes steroids to reduce the inflammation and analgesics (aspirin) for pain.

Ankylosing Spondylitis:

- Back in the early 20th century, x-rays were considered a panacea for most any illness including ankylosing spondylitis.
- Between the years 1935 and 1954, approximately 10,000 male patients suffering from ankylosing spondylitis were treated with doses ranging from 1 to 40 Gy in Great Britain.
- The treatment proved to be an effective means for these patients to receive relief from this painful condition.
- Unfortunately the high doses required to provide this relief often lead to leukemia formation.

Ankylosing Spondylitis:



Notice how the vertebral bodies appear washed-out due to calcium deficiencies and how they are becoming fused (arrows). That combined with the lumbar spine losing its concave forward curvature gives it a “bamboo-like” appearance. This is all an indication that the patient has a condition known as **ankylosing spondylitis**.

Gout:

- Gout, or metabolic arthritis, is a disorder of purine metabolism that results in an increase in uric acid production.
- The excess uric acid is deposited in the blood, kidneys, and joints.
- Joint deposits form as crystals that cause a very painful inflammatory reaction.
- Gout is primarily manifested in the feet (great toe) but it can also affect other areas such as the hands and knees.

Gout:



This radiograph is a classic example of how uric acid is deposited within the metatarsophalangeal joint space of the great toe as a result of **gout**.

Gout:



Gout can also affect the hands as indicated by the inflammatory reaction of the joints in the above images.

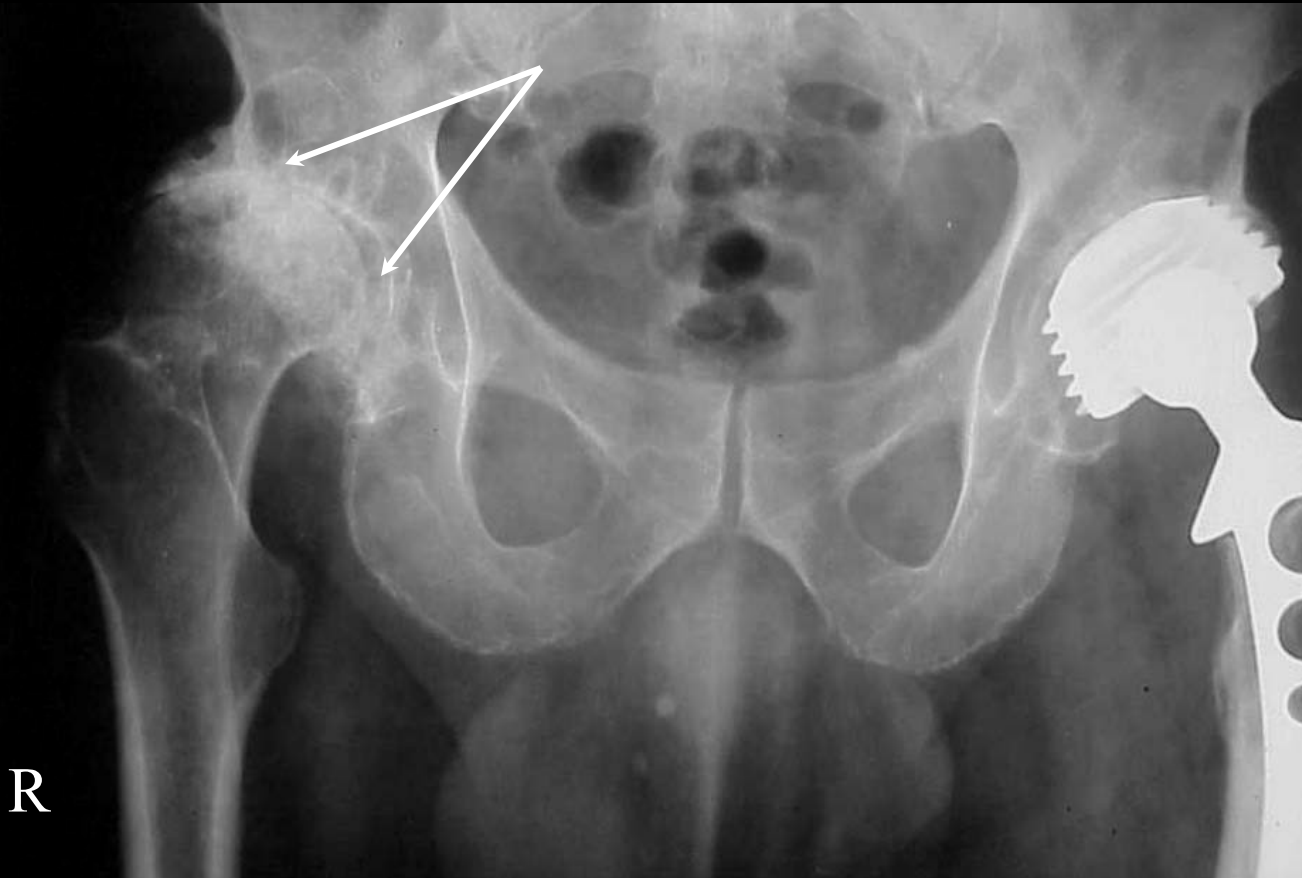
Osteoarthritis:

- This is the most common degenerative joint disease.
- Osteoarthritis is characterized by a natural loss of joint cartilage that is related to but not caused by aging.
- The body replaces this loss of cartilage with the formation of new bone in the form of spurs.
- These bone spurs cause the painful inflammation that is associated with this condition.
- Osteoarthritis can affect most joints in the body including the hands, wrists, hips, and spine.
- Signs and symptoms include joint stiffness and pain that increases with activity.

Osteoarthritis:

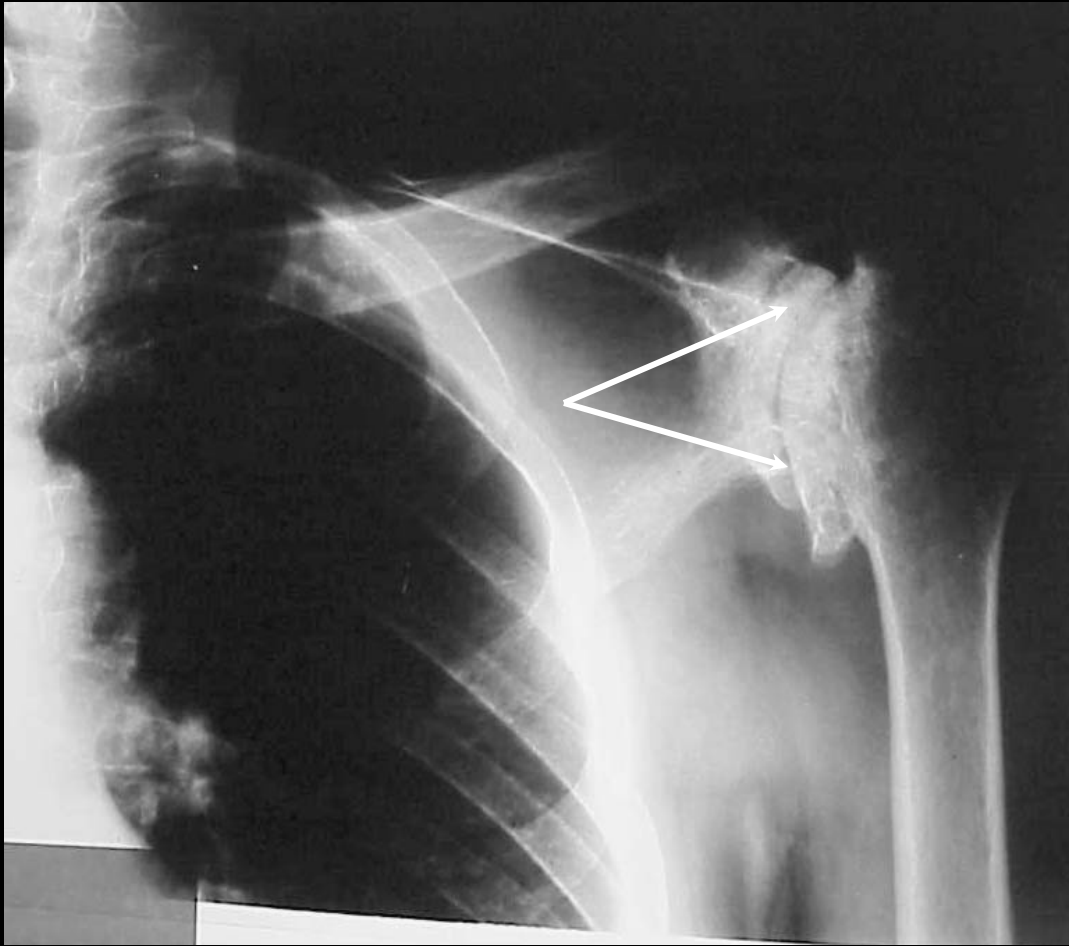
- It is also affected by the weather and obesity.
- Treatment includes steroids to reduce the inflammation, analgesics (aspirin) for pain, and joint replacement surgery (total hip replacements).

Osteoarthritis:



The arrows on the above radiograph are pointing to a disease known as **osteoarthritis**. Note how the joint space has been compromised. The left hip has already been replaced as a result of this painful and degenerative condition.

Osteoarthritis:

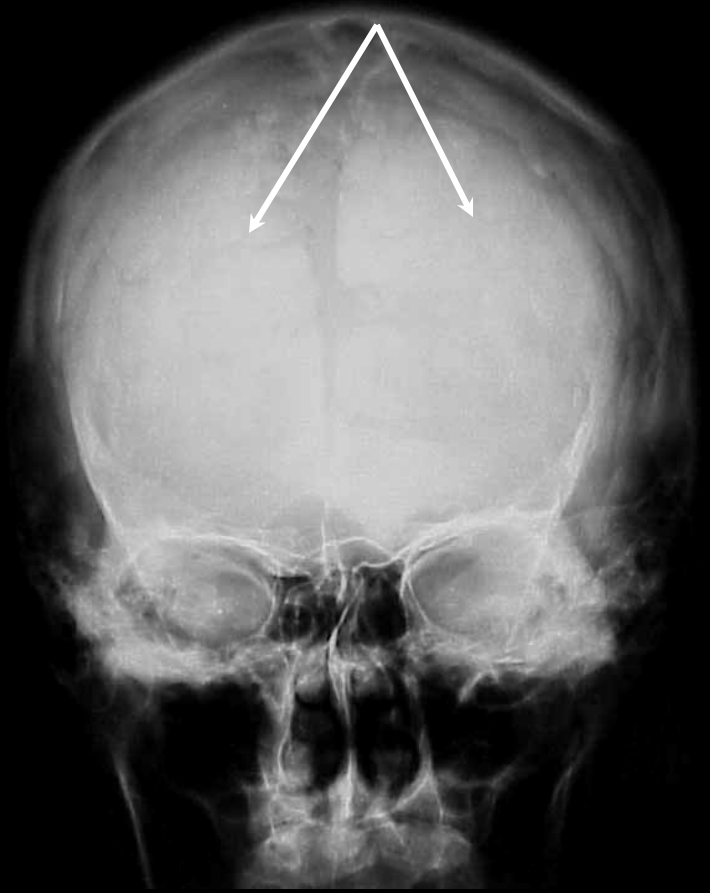
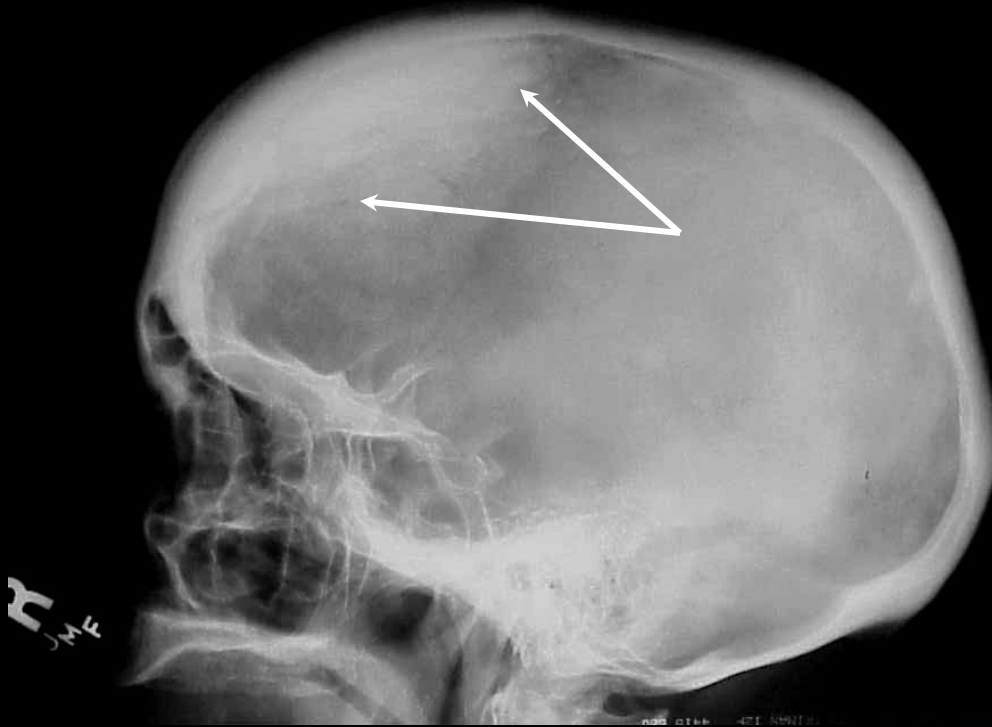


This patient's shoulder is suffering from the effects of a very painful degenerative disease known as **osteoarthritis**. Note how the joint space has been compromised.

Paget's Disease:

- Paget's disease is also known as osteitis deformans.
- It is characterized by an abnormal cycle or process of bone destruction followed by excessive bone growth and thickening.
- Paget's disease is commonly seen in the pelvis, lumbar spine, and skull.
- Signs and symptoms include bone pain, deformity, arthritis, and fractures.

Paget's Disease:



The arrows on the above skull images are pointing to areas where **Paget's disease** has caused an increased thickening of the skull.

Paget's Disease:



The arrows on the above pelvis image are pointing to areas where **Paget's disease** has caused an increased thickening of the proximal femur.

Paget's Disease:



This patient's pelvis has been grossly deformed as the result of damage from **Paget's disease**.

Avascular Necrosis (AVN):

- AVN is characterized by bone ischemia followed by bone inflammation and necrosis.
- It can occur with navicular fractures but is most commonly seen in the femoral head, knee, and shoulder.

AVN of the femoral head is often treated with a total hip replacement.

- Some causes of AVN include excessive steroid use, trauma, and alcoholism.
- MRI is the imaging modality of choice in the diagnosis of AVN.

Avascular Necrosis (AVN):



This MR scan depicts the bone ischemia that can be caused from a navicular fracture (arrows). This condition is called **avascular necrosis**.

Avascular Necrosis (AVN):



This is a magnified view of the previous slide.

Avascular Necrosis (AVN):



This MR scan depicts the bone ischemia that can develop in the head of the femur (arrows). This condition is called **avascular necrosis**. The black void in the area of the patient's left hip is from a hip prosthesis.

Spondylosis:

- This condition is characterized by a cleft between the superior and inferior articulating processes at the pars interarticularis.
- It is usually bilateral and the net result is a loss of the neural arch continuity.
- It is commonly found 90% of the time between L5 and S1.

Spondylolisthesis:

- This condition is secondary to spondylosis.
- Spondylolisthesis is characterized by the forward movement (subluxation) of one vertebral body on the one below it.
- This causes the vertebral canal to narrow and thus impinge on the nerve roots.
- It has four grades (I, II, III, IV).
- It is possible for a patient to have spondylosis without having spondylolisthesis.
- Treatment includes back support/braces and surgery.

Spondylolisthesis:

Grade I



Grade II



Spondylosis can result in the forward movement (subluxation) of one vertebral body on another and result in a condition called **spondylolisthesis**. The white lines on the above images demonstrate the extent of the dislocation.

Osteopoikilosis:

- Osteopoikilosis is an osteosclerotic bone dysplasia that is literally translated as “spotted bones.”
- It produces many small radiopaque densities that are sometimes referred to as bone islands.
- It has an unknown etiology and is usually asymptomatic.

Osteopoikilosis:



The multiple round radiopaque densities found throughout this patient's hip and pelvis are the result of an osteosclerotic bone dysplasia known as **osteopoikilosis**. It has an unknown etiology and is usually asymptomatic.

Osteopoikilosis:



These images provide another example of an osteosclerotic bone dysplasia known as **osteopoikilosis**.

Bone Cysts:

- Bone cysts are common, benign, expansile, radiolucent lesions that are filled with fluid.
- They are more prevalent in males than females and have an unknown etiology.
- Depending on their location, they may cause pain or even a pathologic fracture.

Otherwise, they have no significance.

Bone Cyst: Pathologic Fracture



Bone cysts are expansile, fluid-filled, and radiolucent lesions that have an unknown etiology. These cysts have resulted in a **pathologic fracture** in the distal tibia on the left image and the proximal tibia on the right image.

Bone Tumors:

- There are two general categories of bone tumors:
 1. Osteolytic
 - They result in a decrease in bone density and have a lucent radiographic appearance.
 2. Osteoblastic
 - They result in an increase in bone density and have an opaque radiographic appearance.

Bone Tumors:



Osteolytic bone tumors cause bone destruction and result in a decrease in calcium deposits. As a result, they have a lucent radiographic appearance.

Bone Tumors:



Osteoblastic bone tumors cause excessive bone growth and result in an increase in calcium deposits. As a result, they have an opaque radiographic appearance.

Enchondroma:

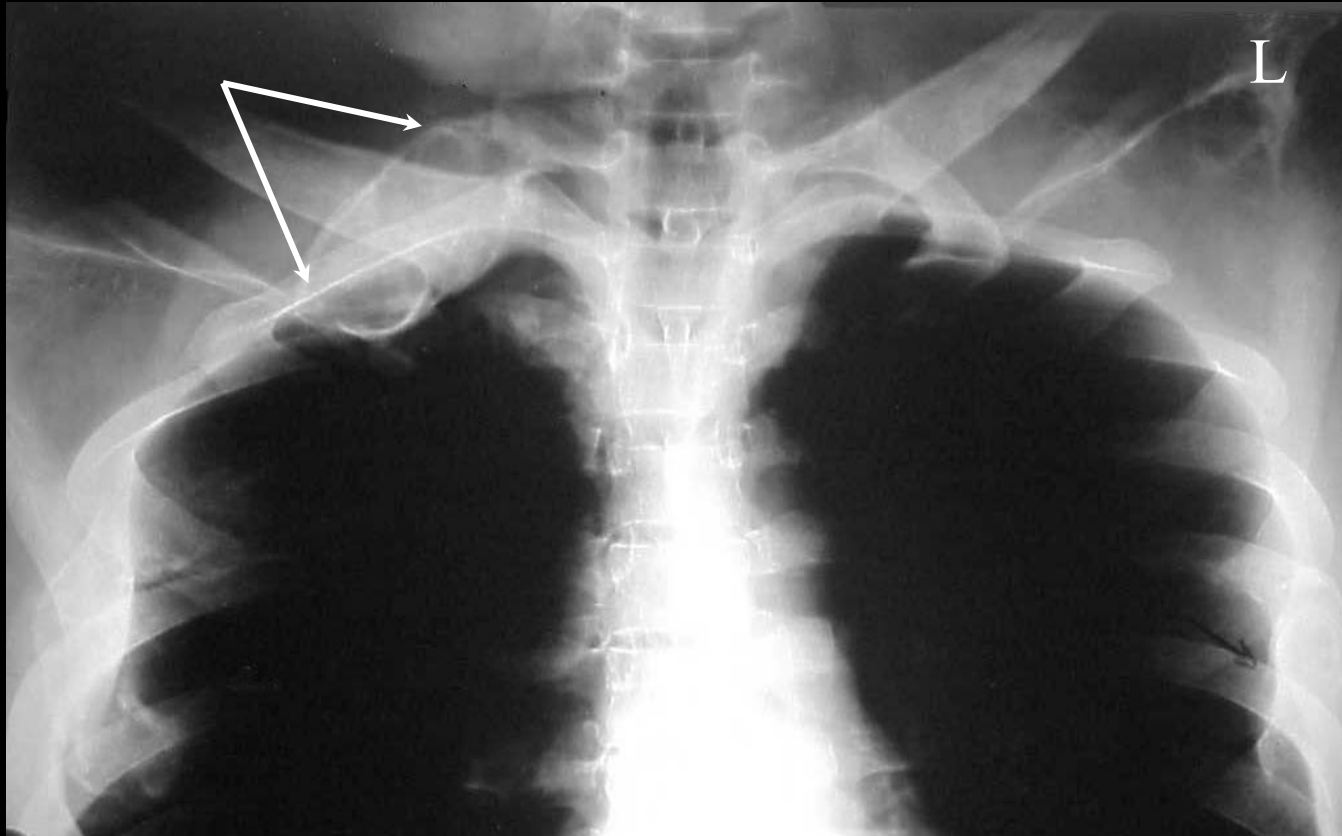
- This is a cartilaginous, benign bone lesion that is found in bone marrow.
- It is most commonly found in young adults.
- Enchondromas are most often located in the bones of the hands, feet, and ribs.
- They present with a radiolucent, “cystic” appearance with calcium deposits.

Enchondroma:



An **enchondroma** is a benign tumor that is often found in the hands, feet, and ribs of young adults. Note their lucent radiographic appearance.

Enchondroma:



This patient has an **enchondroma** located in their right 1st rib. Note its expansile and lucent radiographic appearance with calcium deposits.

Osteochondroma:

- An osteochondroma or exostosis consists of a benign projection of bone that has a cartilaginous cap.
- They are generally found in the metaphysis of long bones, the ribs, and the pelvis.
- Osteochondromas often produce a mushroom or cauliflower radiographic appearance and are sometimes referred to as a bone spur.

Osteochondroma:



An **osteochondroma** or **exostosis** is a benign projection of bone with a cartilaginous cap. It is often found in the metaphysis of long bones, ribs, and pelvis.

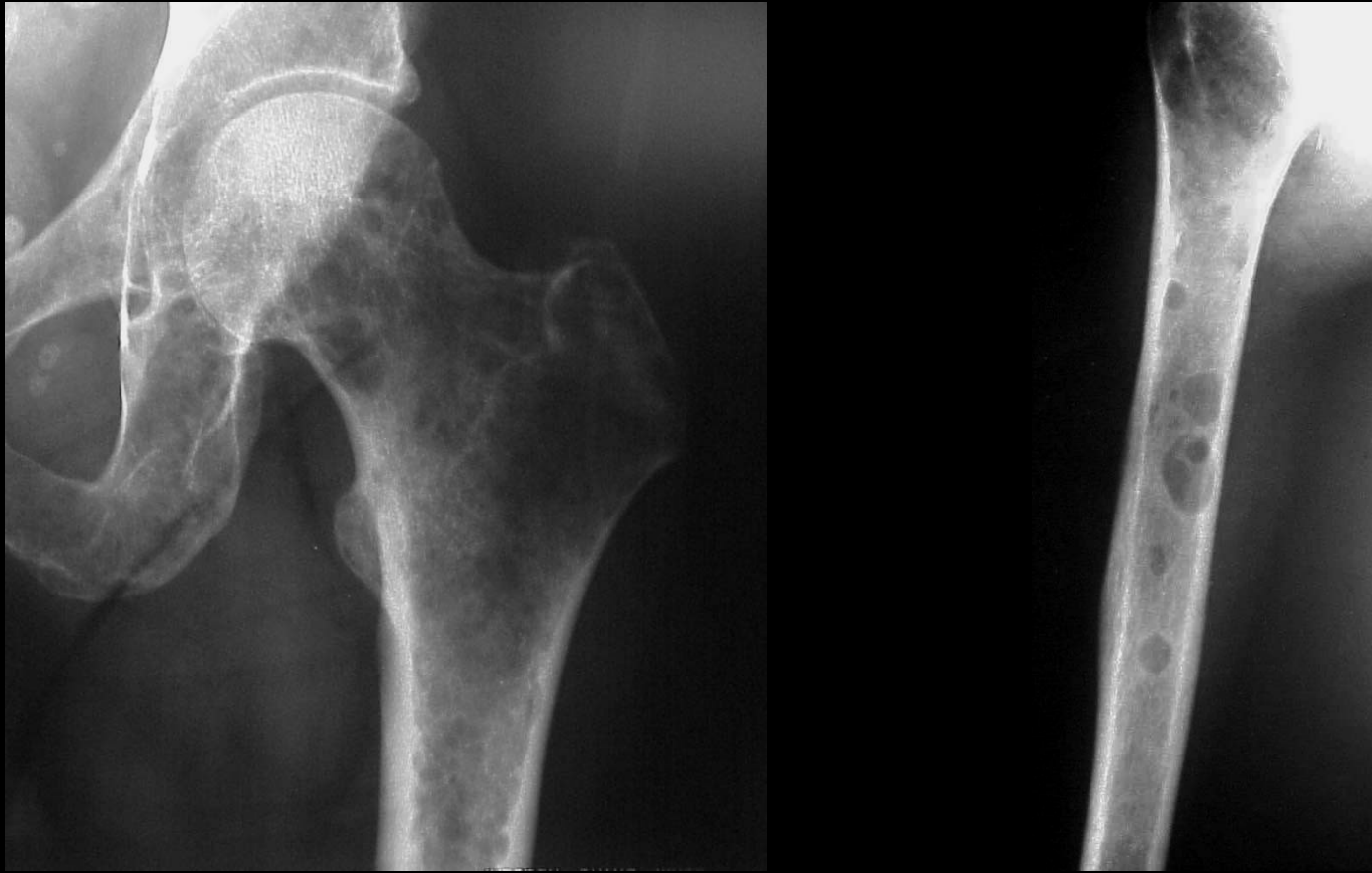
Multiple Myeloma:

- This is the most common type of primary, malignant bone tumor.
- It is characterized by an increase in plasma cells within RBC producing bones.
 - Plasma cells are immune system cells that are found in the bone marrow and produce antibodies.
- The cardinal signs of multiple myeloma are as follows:
 - Possess “multicentric” or “punched-out” osteolytic lesions.
 - Bence-Jones proteins are found in the urine.
 - Possess marked osteoporosis with compression fractures of the vertebral bodies.

Multiple Myeloma:

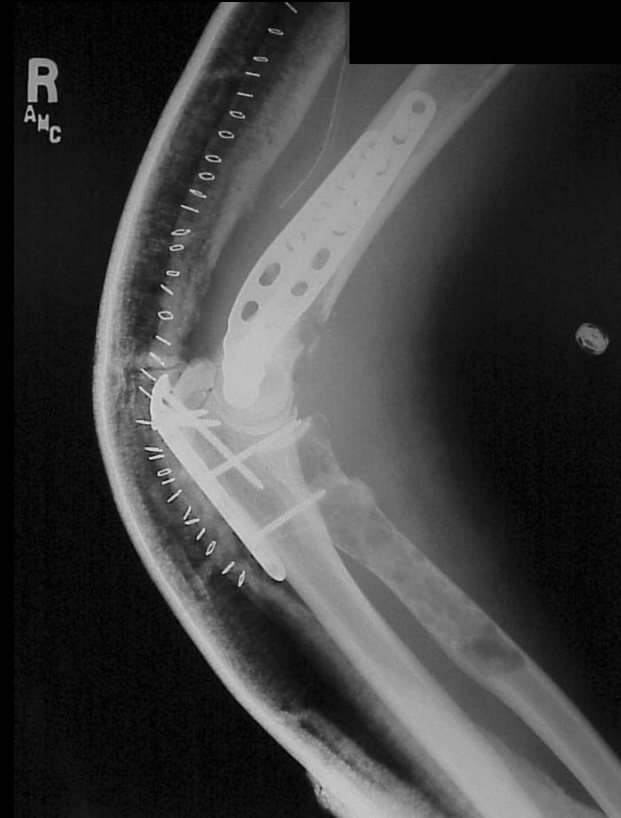
- Since there is no curative treatment for multiple myeloma, treatment is focused on suppression and containment.
- Remission can be induced with the use chemotherapy, stem cell treatment, and steroids.

Multiple Myeloma:



This is an example of how the “multicentric” or “punched-out” lesions from **multiple myeloma** appear on a radiograph.

Multiple Myeloma:



This **pathologic fracture** on the distal humerus (arrow) was the result of bone destruction caused by **multiple myeloma**. The image on the right demonstrates how it was reduced using internal fixation devices.

Multiple Myeloma:



These images depict how **multiple myeloma** can affect the spine with marked osteoporosis. This can result in a compression fractures of the vertebral bodies.

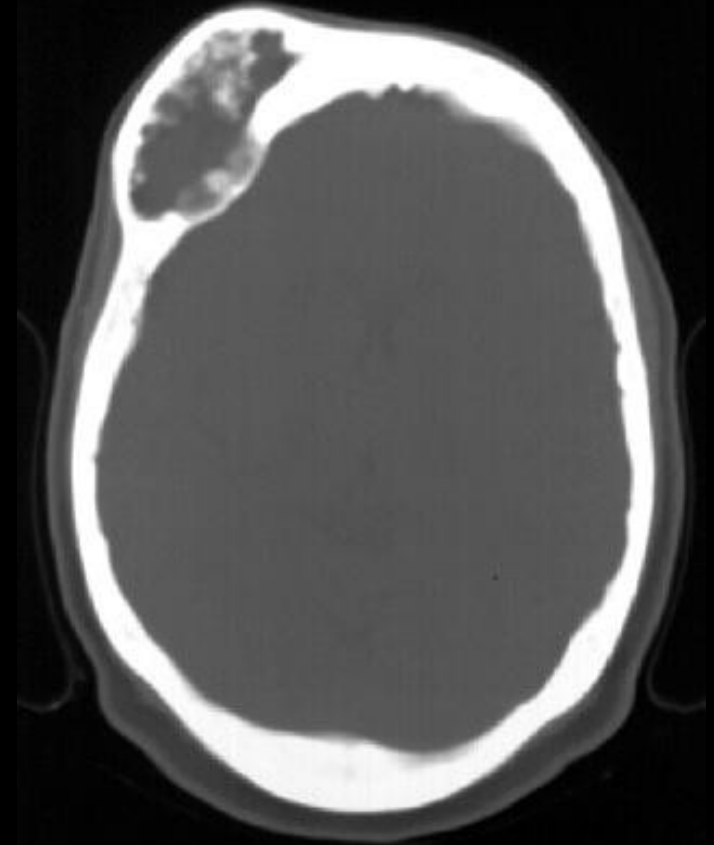
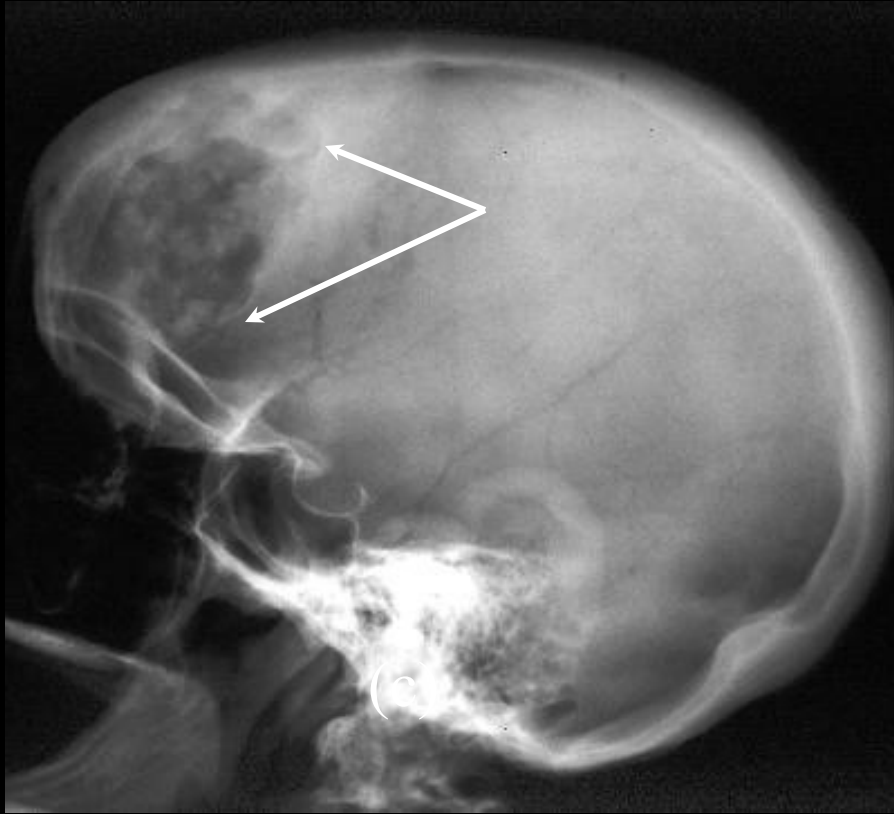
Osteosarcoma:

- Osteosarcoma is the second most common type of malignant bone tumor.
- This is an osteoblastic lesion that may extend into the surrounding soft tissue structures.
- It is primarily found in ages 10 to 25 and 50% of all cases occur around the knee.
- Osteosarcomas commonly metastasize to the lungs and they have a very poor prognosis.

Chondrosarcoma:

- A chondrosarcoma is an expansile, osteolytic, primary bone tumor.
- They represent approximately 10% of all malignant skeletal cancers.

Chondrosarcoma:



A **chondrosarcoma** is an osteolytic primary bone tumor. Also note the expansile characteristic it possesses on the CT image. They make up about 10% of all malignant skeletal cancers.

Fibrosarcoma:

- A fibrosarcoma is an osteolytic, malignant cancer of the skeletal system that often has a moth-eaten radiographic appearance.
- It is a primary cancer of the skeletal system and it often affects the knee and pelvis.

Fibrosarcoma:

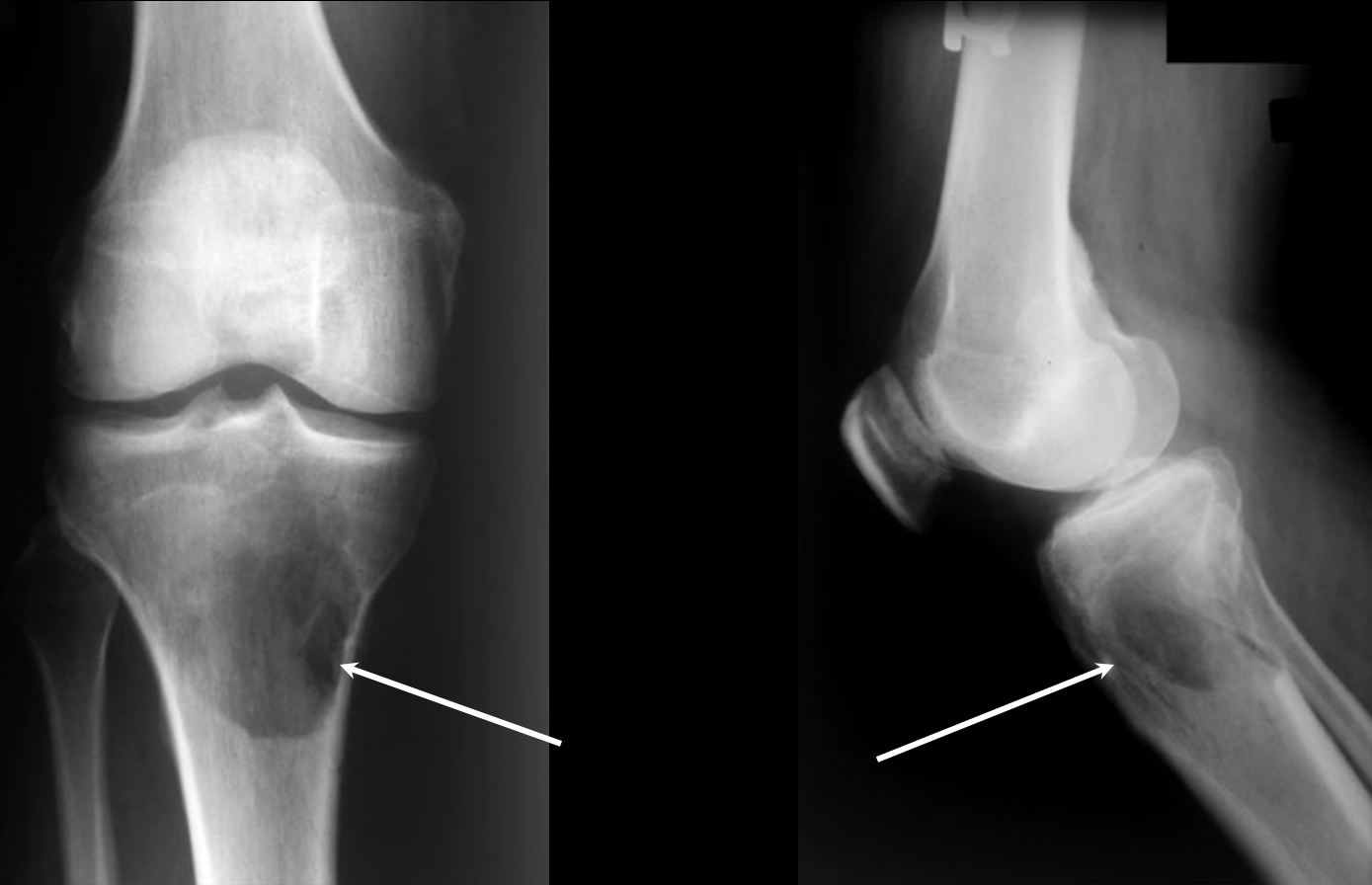


A **fibrosarcoma** is an osteolytic cancer that often has a moth-eaten appearance. This is a primary cancer of the skeletal system and it often affects the knee and pelvis.

Secondary Bone Cancer:

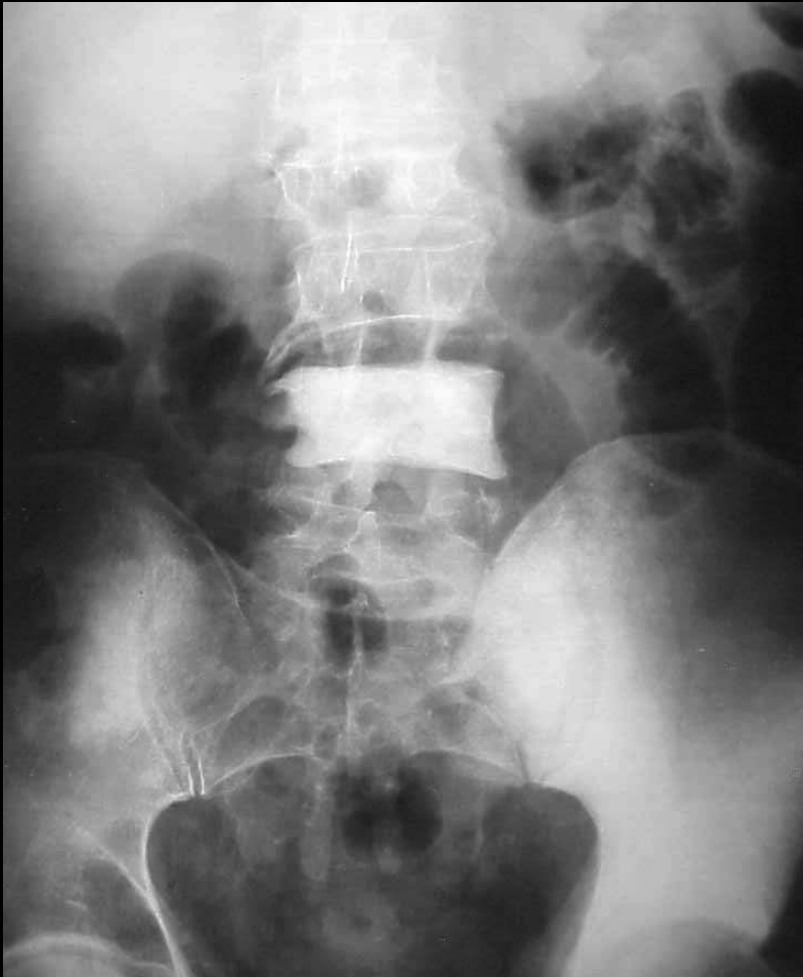
- This is the most common type of bone malignancy.
- Cancers originating from the prostate gland, breast, thyroid gland, colon, and kidneys often metastasize to the skeletal system.
- These cancers often seed into the long bones, ribs, and spine.
- Secondary bone cancer can possess either an osteolytic or osteoblastic radiographic appearance.

Secondary Bone Cancer:



This osteolytic lesion **metastasized** to the tibia from the patient's **renal cell carcinoma**.

Secondary Bone Cancer:



This patient has **non Hodgkin's lymphoma** and it caused an osteoblastic lesion to **metastasize** to the body of this lumbar vertebra. This condition is commonly referred to as an **ivory vertebra**.

Respiratory System Menu

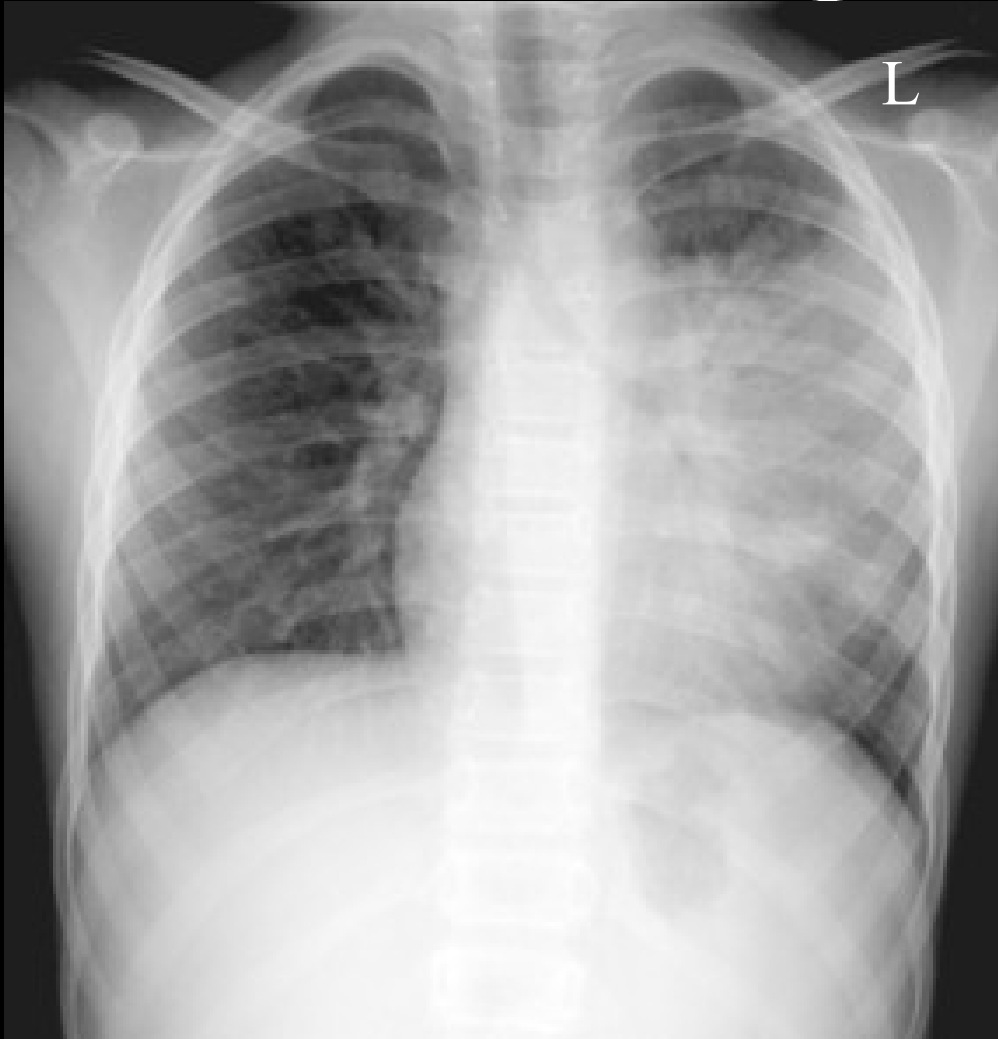
1. Bronchopneumonia
2. Aspiration Pneumonia
3. Lung Abscess
4. Tuberculosis
5. Primary Tuberculosis
6. Secondary Tuberculosis
7. Miliary Tuberculosis
8. Multi-drug Resistant TB
9. Plumbage
10. Thoracoplasty
11. Histoplasmosis
12. Bronchiectasis
13. COPD
14. Emphysema
15. Pneumoconiosis
16. Pulmonary Embolus
17. Lung Cancer
18. Bronchogenic Carcinoma
19. Pulmonary Metastasis
20. Pulmonary Edema
21. Atelectasis
22. Pneumothorax
23. Subcutaneous Emphysema
24. Pleural Effusion
25. Infant Respiratory Distress Syndrome

Bronchopneumonia:

- This type of pneumonia is caused by a bacterial infection that originates in the airway and spreads out to the alveoli.
- It produces an immune response within the lungs that causes the alveolar sacs to fill with an exudate.

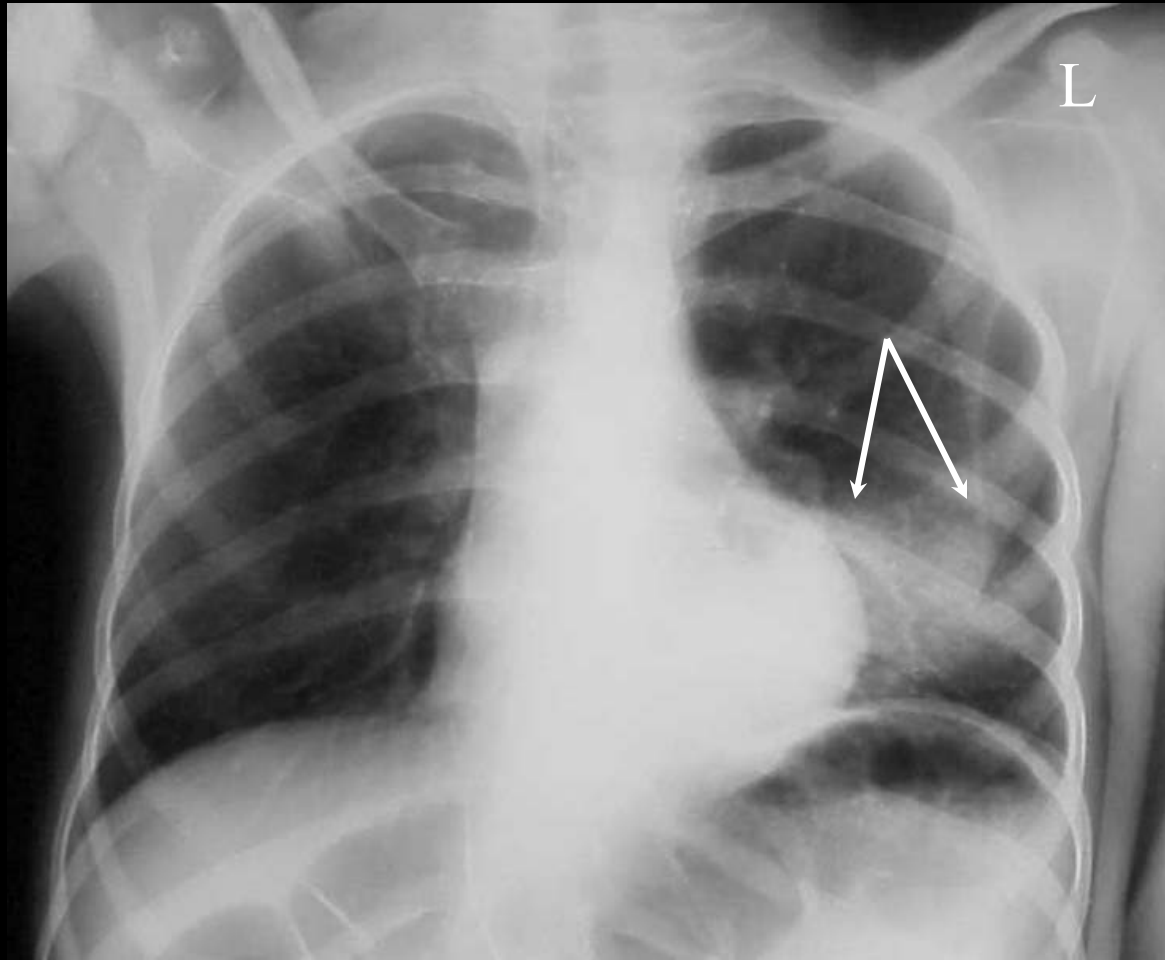
Radiographically, this appears as a patchy consolidation within the lungs.

Bronchopneumonia:



The patchy consolidation found in this patient's left lung is consistent with a bacterial infection that is characteristic of **bronchopneumonia**.

Bronchopneumonia:

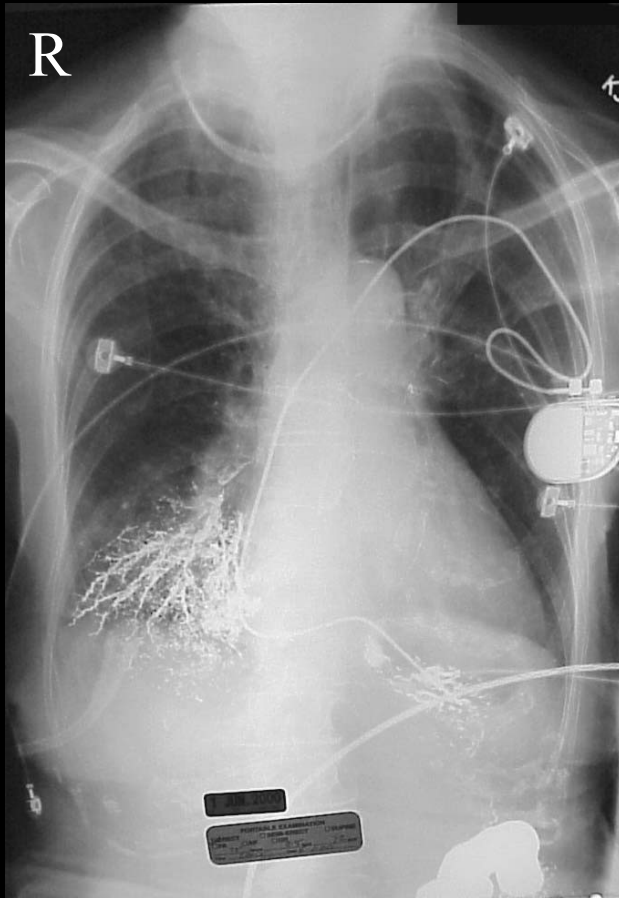


This patient has a “patchy” left lower lobe infiltrate (arrows) that is a classic sign of **bronchopneumonia**.

Aspiration Pneumonia:

- This type of pneumonia occurs as the result of the patient inhaling a foreign material into their bronchial tree.
- It is often caused by a swallowing dysfunction.

Aspiration Pneumonia:

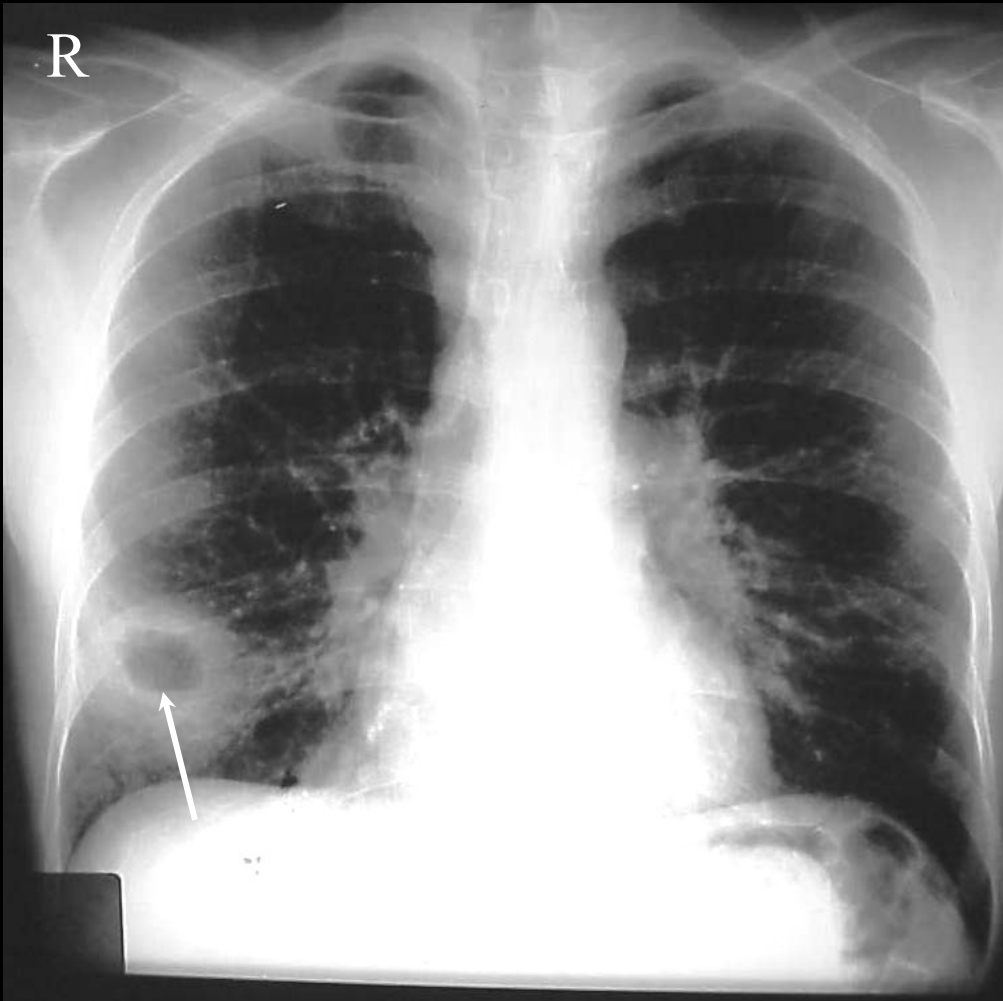


These PA and Lateral chest radiographs depict a classic example of how barium can be **aspirated** into the lungs during an UGI.

Lung Abscess:

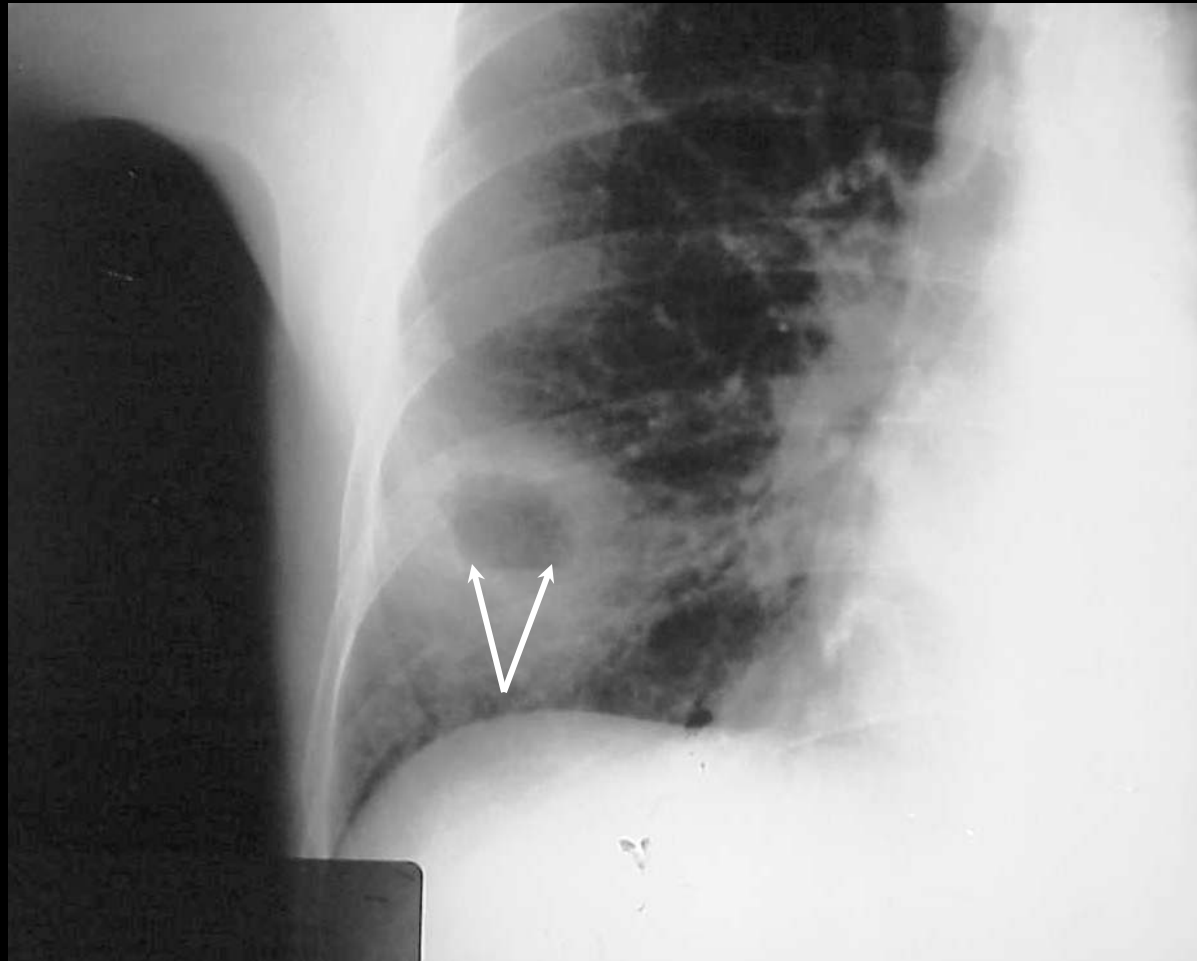
- A lung abscess is a walled-off, necrotic area of lung tissue containing pus.
- It is usually a complication of alcoholism but it can also be caused by bacterial pneumonia.
- The use of antibiotics is the primary course of treatment but in some instances, a needle aspiration may be indicated.

Lung Abscess:



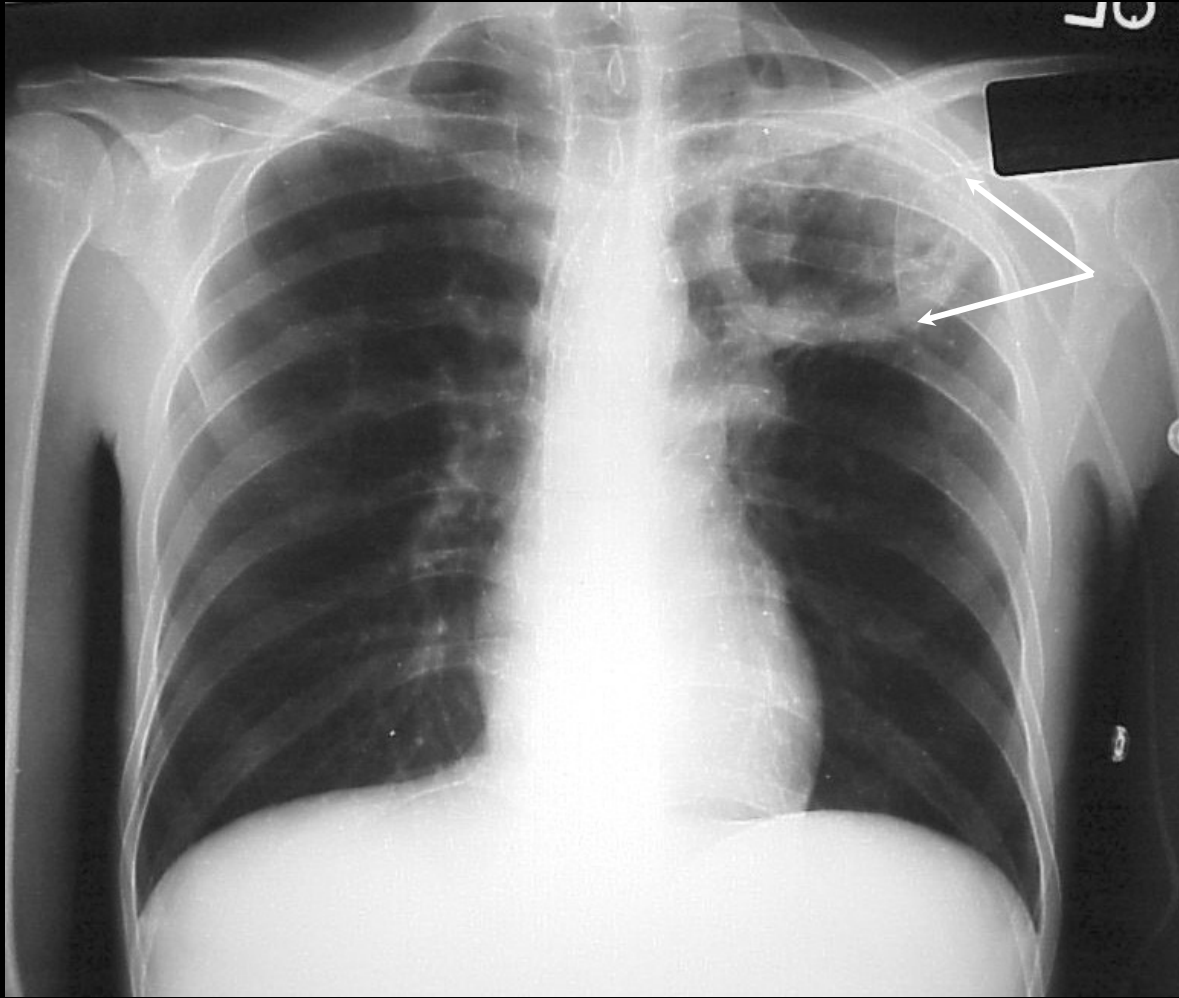
Note the fluid level found within the **lung abscess** on this upright PA chest radiograph.

Lung Abscess:



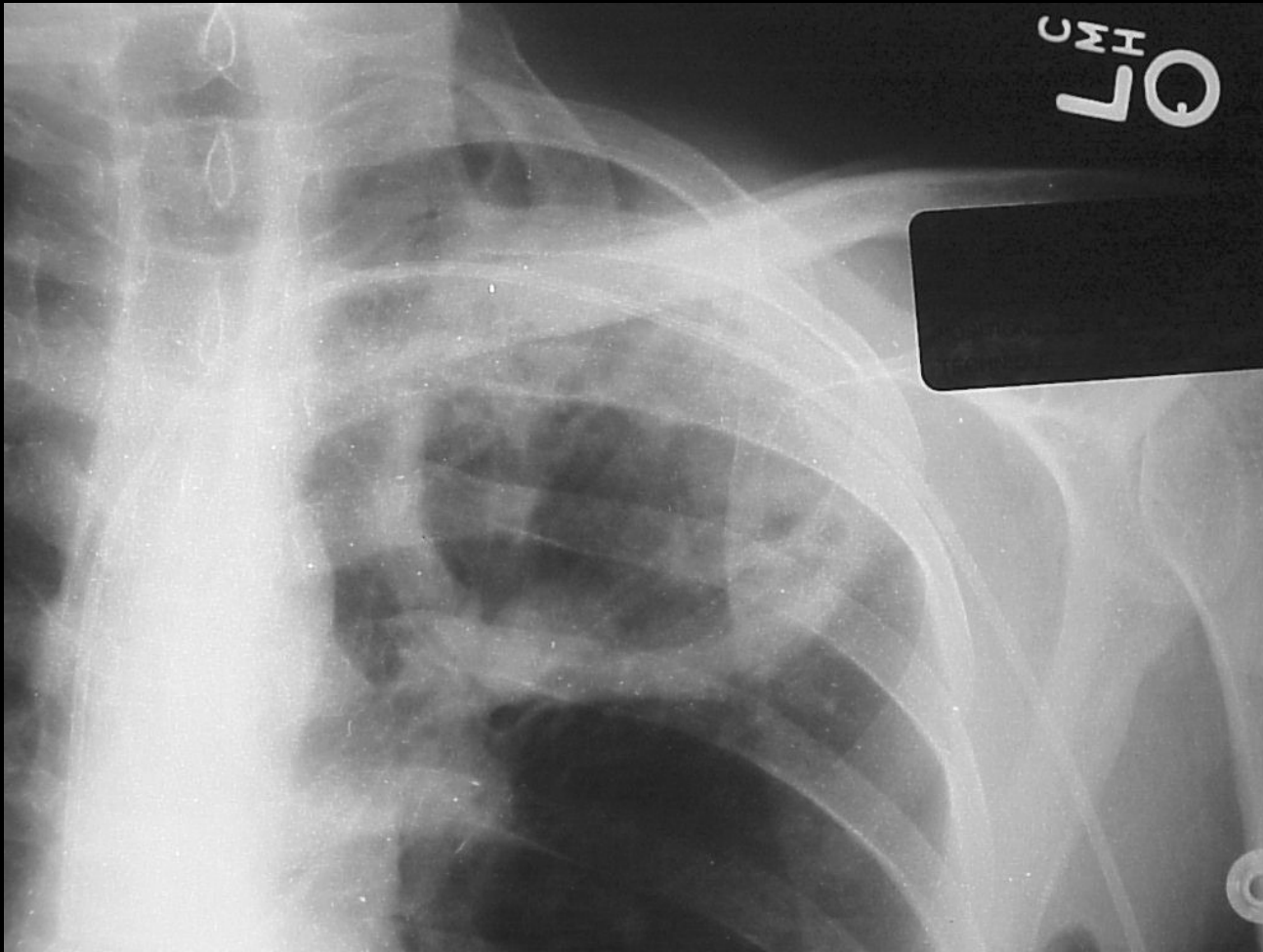
This is a magnified view of the previous image.

Lung Abscess:



This **lung abscess** (arrows) is located in the patient's left upper lobe and has produced a very large cavity on this PA chest radiograph.

Lung Abscess:



This is a magnified view of the previous image.

Tuberculosis (TB) or Consumption:

- TB is caused by inhaling mycobacteria.
- It is spread primarily by air droplets but may be spread by inhaling dried mycobacteria as well.
- Diagnosis

A TB skin test (Mantoux/PPD) is the method of choice to determine exposure.

Small, red bumps will appear within 72 hours after the injection if the patient has been exposed to TB.

Future TB skin tests are no longer necessary as the patient will always test positive.

Tuberculosis (TB) or Consumption:

A positive test result will be confirmed with a sputum test (AFB) and the presence of the active disease can be ruled out with a chest radiograph.

Yearly chest radiographs may be ordered to rule out the active disease.

Isoniazid is a common medication prescribed to treat the active disease and it must be taken for at least six months.

Primary TB:

- This refers to the initial attack of TB and it does not cause noticeable symptoms in the early stages.

Fortunately, the victim is not contagious at this point.

- In healthy patients, the body's normal immune system will take the mycobacteria to lymph nodes where it will be neutralized.

If this fails to occur, the mycobacteria can multiply and this then marks the onset of active TB.

Patients experience symptoms such as coughing, hemoptysis, night sweats, fever, and weight loss.

The patient is now at a contagious point in the progression of the disease.

Primary TB:

In an attempt to neutralize the infection the body's immune system will form a wall around the mycobacteria.

This walled off area will usually appear as a tubercle or a calcification in the upper lung fields on a radiograph.

Secondary or Reinfection TB:

- The proliferation of dormant mycobacteria within the tubercles marks the onset of secondary TB.
- Large scars and cavitation will form within the lungs as the body struggles to once again contain the infection.

The net result is the permanent loss of lung tissue and lung volume.

- Patients who are HIV positive are at a higher risk of developing secondary TB due to their compromised immune system.

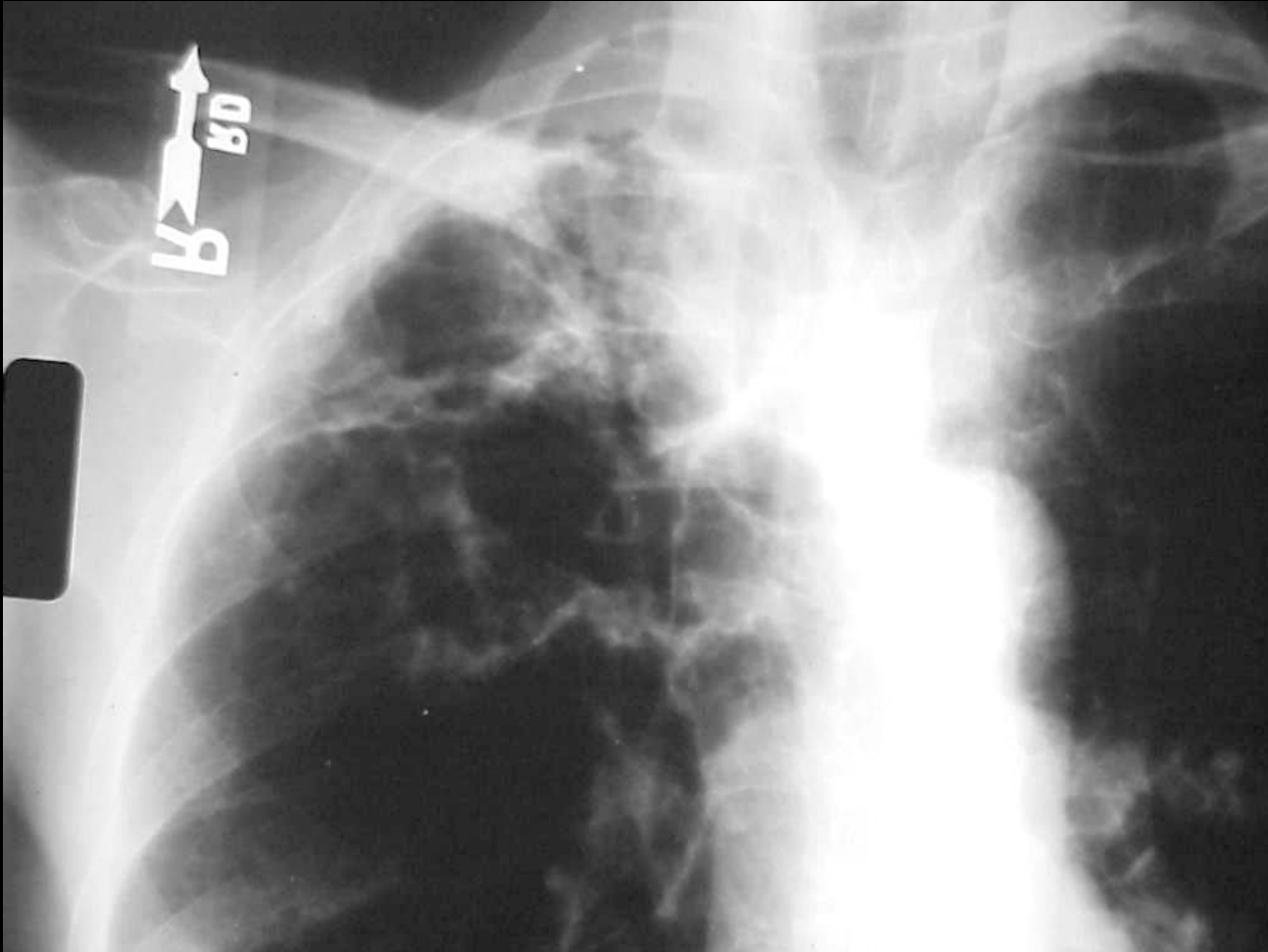
Secondary TB:



Note the upper right lobe scarring on this PA chest radiograph.

Mycobacteria are attracted to the oxygen rich upper lung fields.

Secondary TB:



This is a magnified view of the previous image.

Secondary TB:



This is a rather extreme example of the damage that can occur in the later stages of **cavitation** formation.

Miliary or Hematogenous TB:

- The mycobacteria can enter the circulatory system by eroding the pulmonary vein.
- If this occurs, it can seed in such organs as the liver and spleen through the systemic circulation.
- Since it is now bloodborne, the bacteria may enter the blood flow to the lung and produce innumerable fine densities uniformly distributed in both lungs.

This presents as a bird seed or “millet” type of radiographic appearance and hence the name, miliary TB.

- This is a serious condition and if left untreated, it is almost always fatal.

Miliary TB:



Miliary TB is so named because of its radiographic appearance to millets which are a group of small-seeded species of cereal crops or grains.

Miliary TB:



The uniformly distributed grainy or **millet-like** appearance of the lung fields is caused by the hematogenous characteristic of this disease.

Miliary TB:



This is a magnified view of the previous image.

Multi-drug Resistant TB:

- This is a type of TB that is resistant to two or more of the medications used to combat TB.
- This type of TB is often found in HIV positive patients and is due to their already compromised immune system.
- It can also occur when patients do not take their prescriptions properly.

TB Treatment: Plumbage

- Prior to the discovery of isoniazid, early methods to treat patients with TB relied heavily upon rest and isolation in sanatoriums.
- A common treatment was to collapse the lung in order to allow it to “rest.”

This technique had absolutely no value in fighting this disease.

One method employed to “rest” the lung was to surgically insert ping pong balls into the pleural space of the upper lung field in order to compress the lung.

- This technique was know as plumbage.

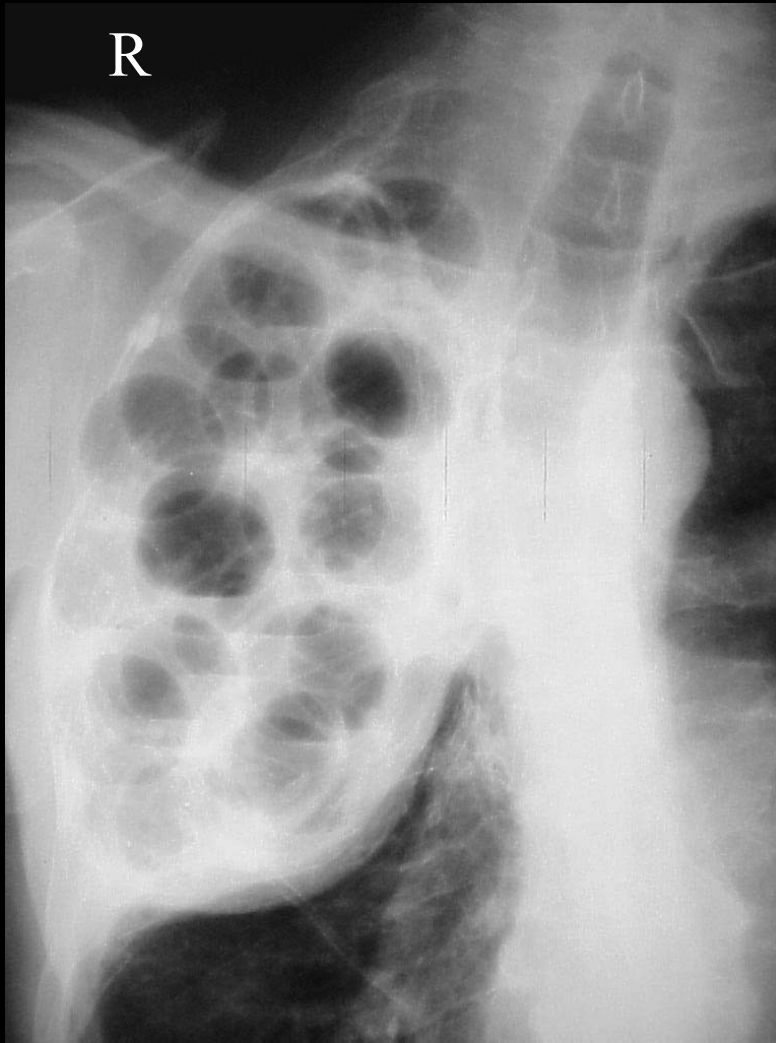
TB Treatment: Plumbage



The spherical lucencies on this radiograph are actually **ping pong balls** (below) that have been surgically inserted into the patient's thorax to prevent the mediastinal structures from shifting into the empty right lung field.



TB Treatment: Plumbage



This is a magnified
view of the
previous image.



TB Treatment: Thoracoplasty

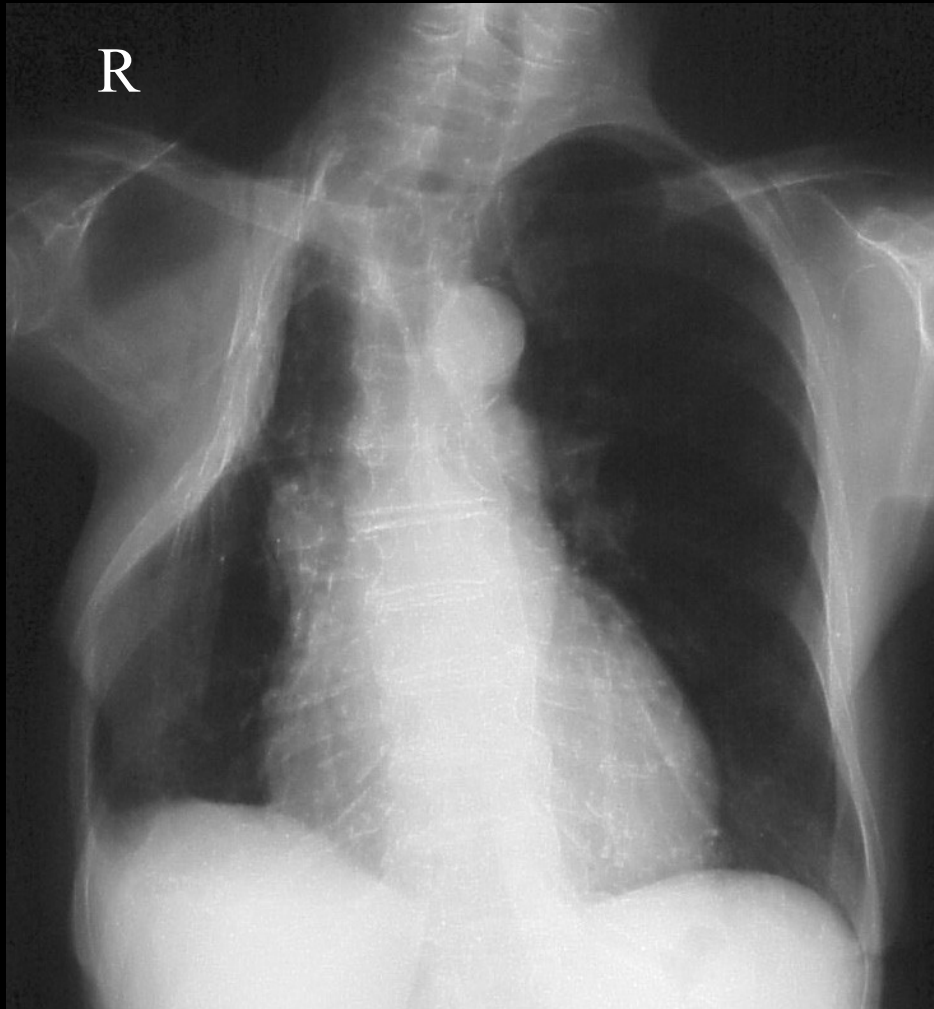
- Another type of treatment for TB prior to the use of effective medications was a procedure called a thoracoplasty

This technique involved removing some of the ribs from the chest wall in order to cause the upper lobe of the lung to collapse.

Ideally, a total of 7 to 8 ribs would be removed.

Physicians generally would only remove 2 or 3 at a time and as a result, the patient would have to endure several surgeries.

TB Treatment: Thoracoplasty



The deformity seen on the right side of this patient's thorax is the result of an antiquated method to treat TB called **thoracoplasty**. This procedure required the removal of 7 to 8 ribs in order to facilitate the collapse of the upper lobe of the lung.

TB Treatment: Thoracoplasty

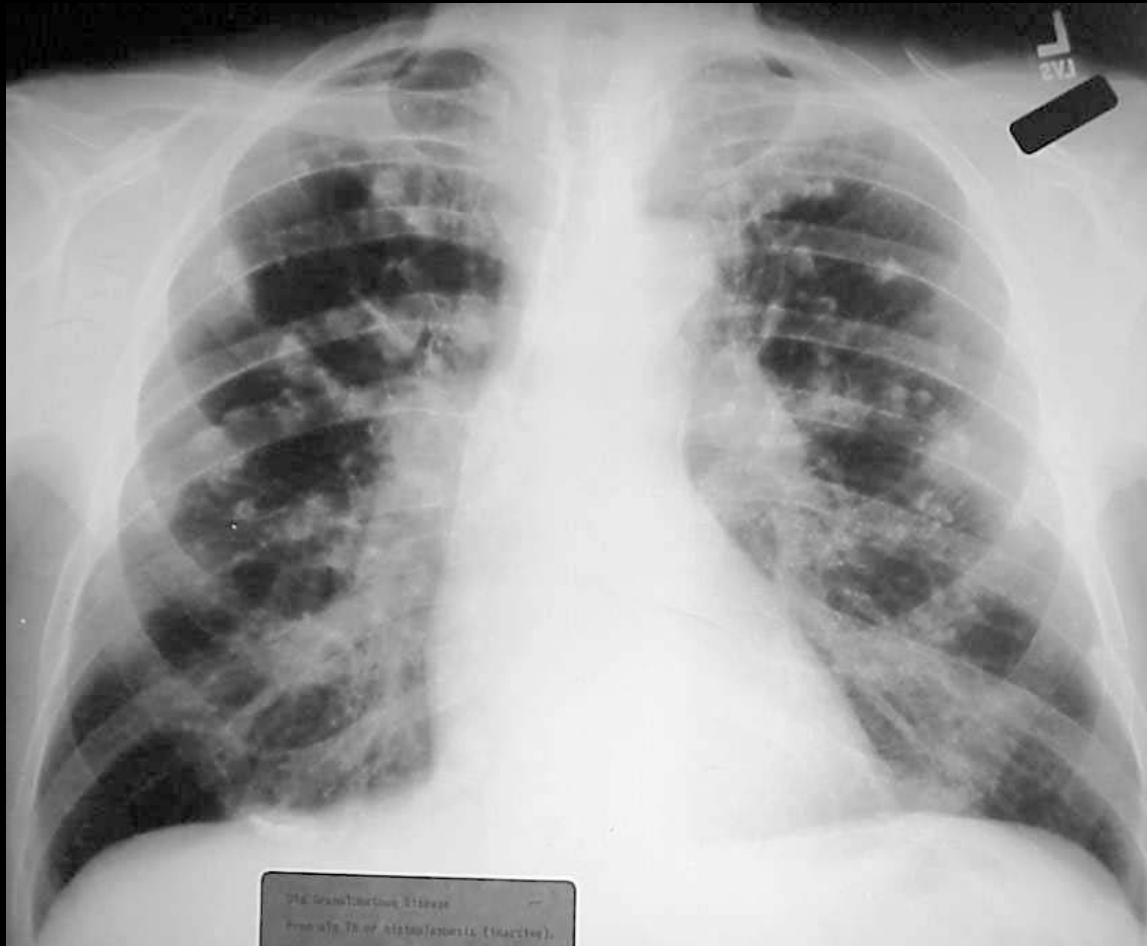


This is a magnified
view of the
previous image of a
thoracoplasty.

Histoplasmosis:

- This condition occurs as the result of inhaling soil and/or bat/bird droppings that have been infected with a fungus called *Histoplasma capsulatum*.
- It has a similar radiographic appearance to TB.
- Most cases of histoplasmosis are self limiting but in some extreme cases, anti-fungal medications may be indicated.

Histoplasmosis:



The radiopaque calcifications found within the lung fields of this patient are caused by a fungal infection. This condition is called **histoplasmosis** and it has a similar radiographic appearance to that of TB.

Histoplasmosis:



This is a magnified view of the previous image.

Bronchiectasis:

- Bronchiectasis is characterized by an irreversible dilation of the bronchi caused by a bacterial infection.
- It usually affects the base of both lungs.
- Signs and symptoms of this disease include a chronic cough, acute pneumonia, and hemoptysis.
- Treatment includes controlling infections, postural drainage, and surgical resection of the affected area.

Chronic Obstructive Pulmonary Disease:

- Chronic obstructive pulmonary disease (COPD) is a term used to describe two lung diseases, chronic bronchitis and emphysema.

These two diseases tend to coexist.

They also both pertain to an obstruction of the normal flow of air within the lungs.

As a result, physicians collectively refer to them as COPD.

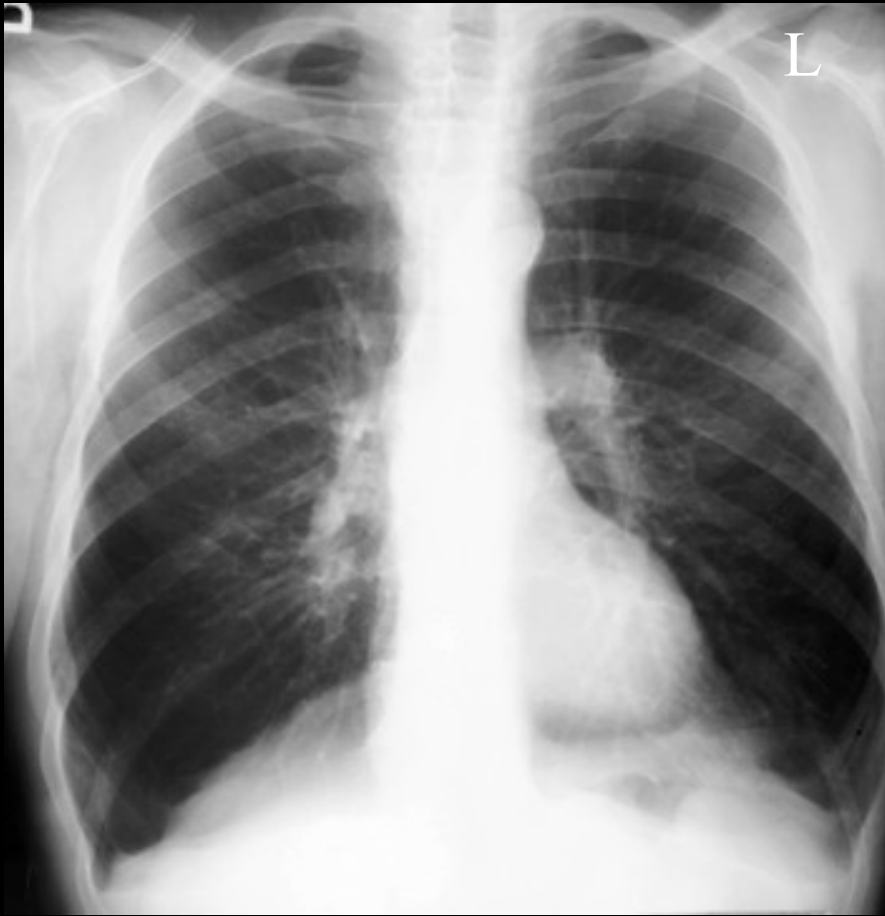
- Smoking is the primary risk factor for COPD.

Up to 90% of COPD related deaths are related to smoking.

Emphysema:

- Emphysema is a type of COPD that is characterized by a chronic destruction of bronchi and alveoli.
 - The destruction and rupture of the alveolar walls will lead to the formation of large pockets of empty space within the lungs called bulla.
 - The net result is a decrease in air flow, hyperaeration (barrel chest), and dyspnea.
- Smoking is the primary risk factor for emphysema but it can also be caused by pollution or an inherited lack of an enzyme called alpha-1-antitrypsin.

Emphysema:



Note the “**barrel-chest**” look on the lateral chest radiograph and the loss of the normally “dome-shaped” diaphragm.

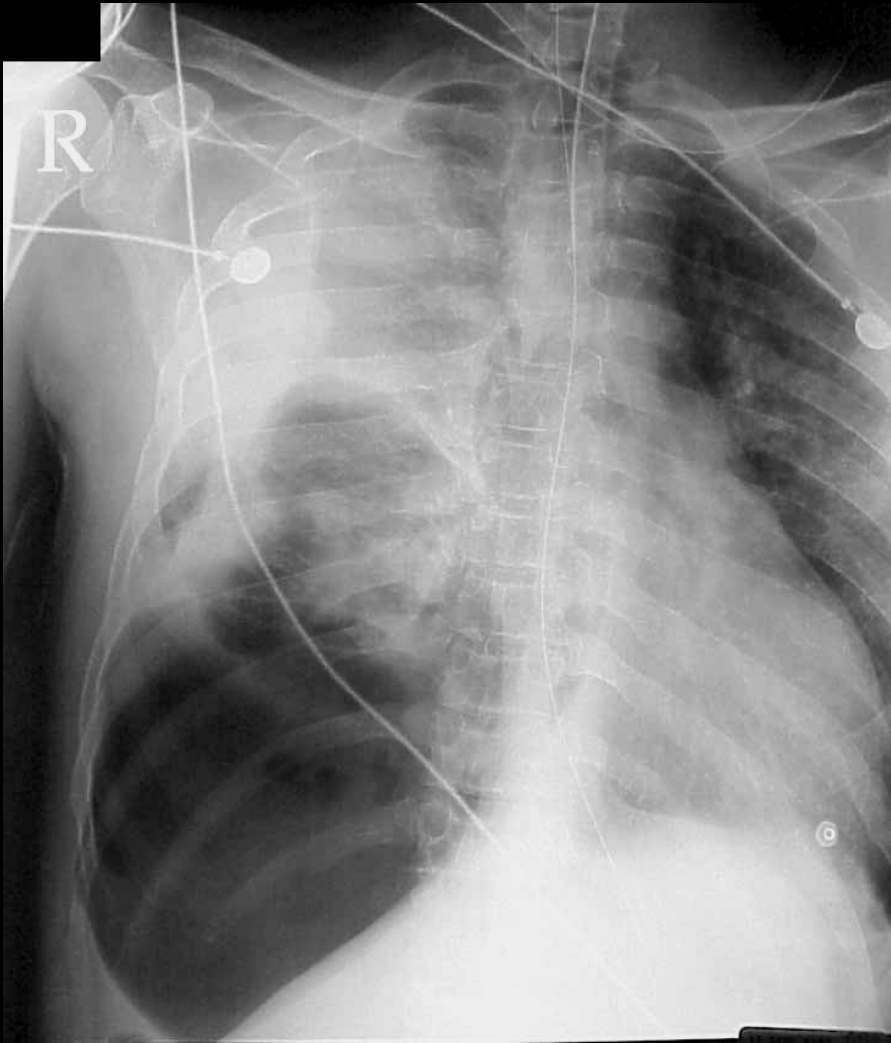
Emphysema:



This patient has **emphysema** with marked **oligemia** which is a lack of blood volume. In this case, the oligemia results in a lack of lung markings (blood vessels) in the upper lung fields.



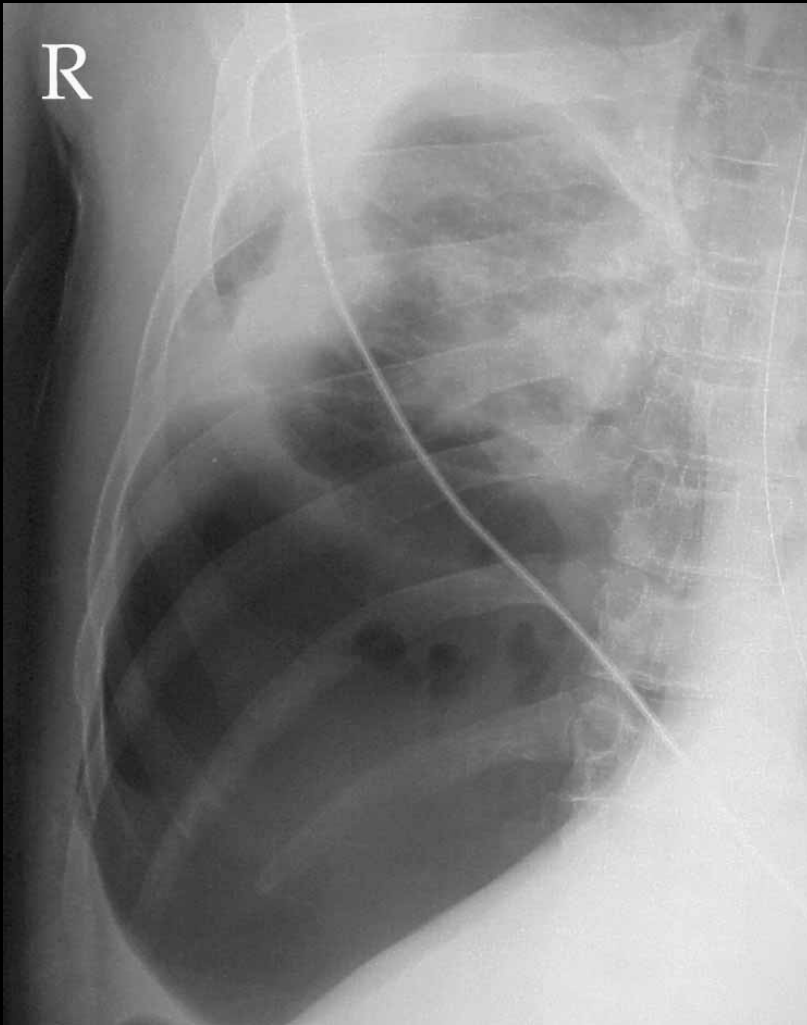
Emphysema:



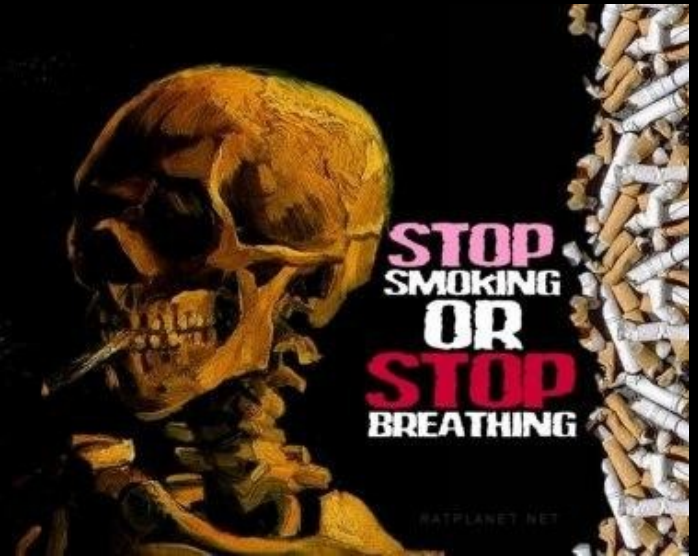
This patient suffers from a large ruptured **bull**a in the right lower lung field. This is often referred to as **bullous emphysema**.



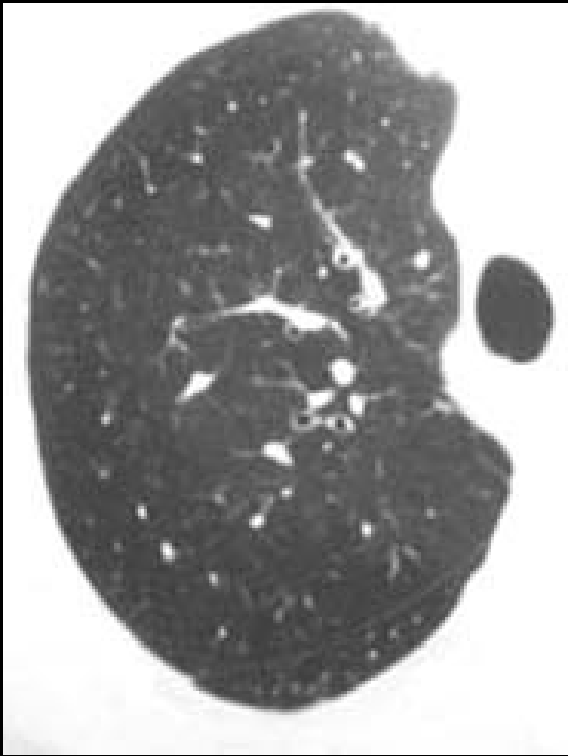
Emphysema:



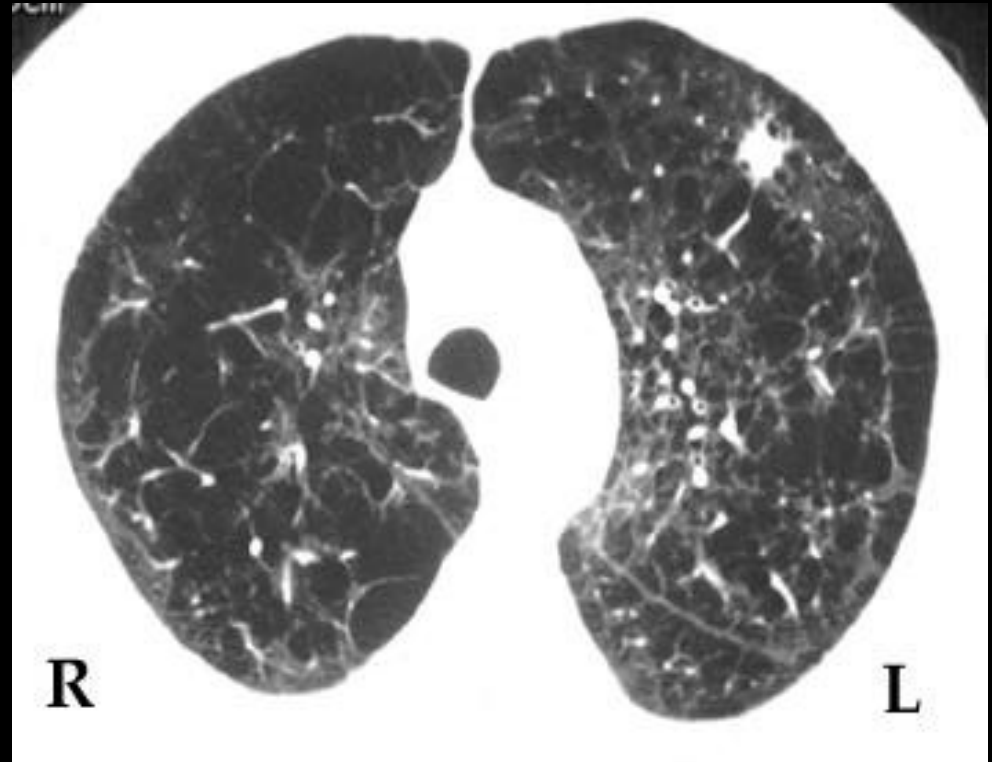
This is a magnified view of the previous image.



Emphysema:



Normal CT of the lung that has a uniform density that is traversed by vessels (solid circles or lines) and airways (open circles).



The lungs here show multiple, large, black, radiolucent, **emphysematous** spaces. The small, rounded, radiopaque circles and adjacent circles with black centers represent arteries and airways, respectively.

Emphysema:



This is another CT scan that clearly demonstrates severe **bullous emphysema**.



Pneumoconiosis:

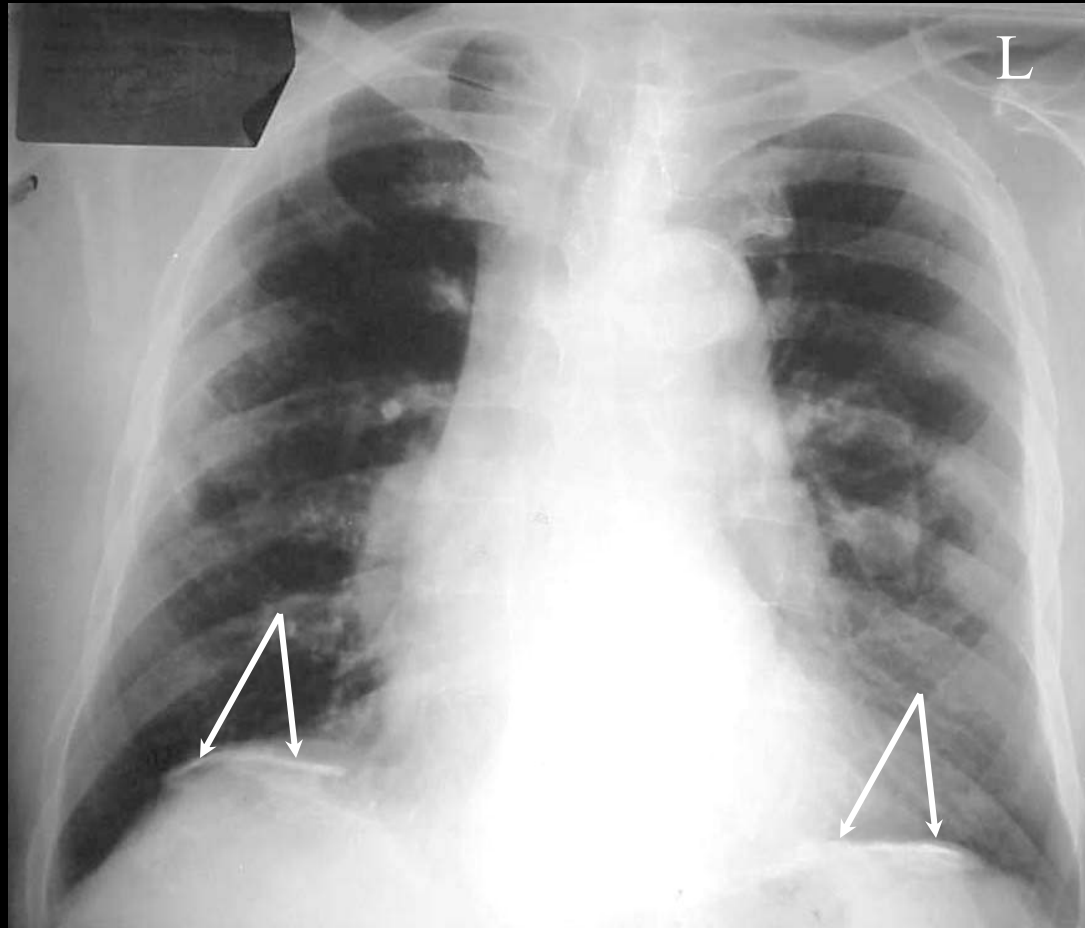
- This is an occupational disease where dust or particulate matter is inhaled.
- This causes the formation of pulmonary fibrosis.
- Types:
 - Silicosis is caused by inhaling silicon dioxide (sand).
 - Asbestosis occurs as the result of inhaling asbestos dust.
 - Patients who present with this disease possess very distinct radiopaque pleural plaques.
 - Black lung disease is caused by inhaling coal dust.

Pneumoconiosis: Silicosis



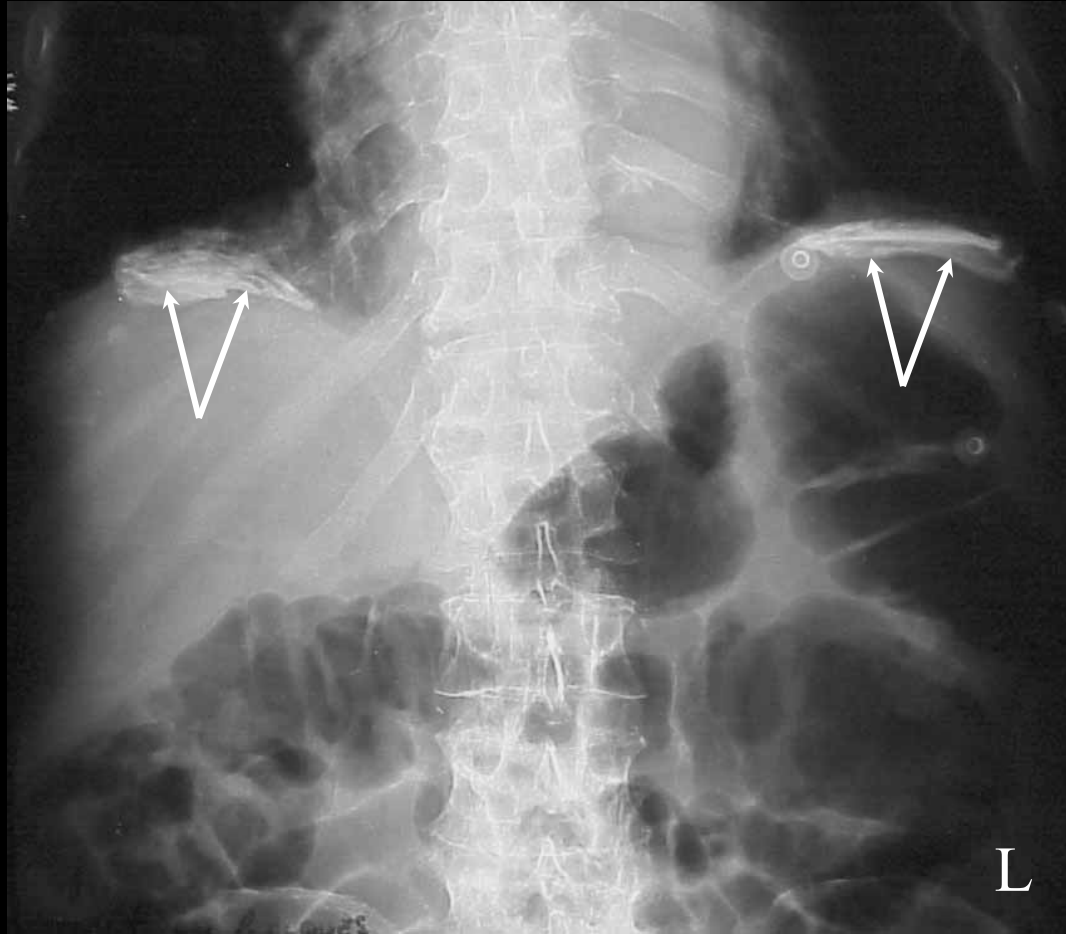
The patchy lung consolidations found on this image are the result of inhaling dust or particulate matter over a period of time.

Pneumoconiosis: Asbestosis



This patient suffers from a chronic exposure to asbestos. Note the pleural plaques that have formed (arrows). This is a classic sign of **asbestosis**.

Pneumoconiosis: Asbestosis



This is a different patient but a better representation of the pleural plaques (arrows) that are characteristic of **asbestosis**.

Pulmonary Embolus (PE):

- Pulmonary emboli are often caused by blood clots that break off from veins in the legs.

These clots form emboli that can obstruct the lumen of the pulmonary arteries.

Many times this will resolve on its own but large obstructions can infarct the lung and lead to death.

A patient with blood clots in the veins of their legs is said to have a condition called deep vein thrombosis (DVT).

- A PE is most often seen in elderly, bedridden patients, and in postoperative patients.
- A chest X-ray may demonstrate an area of consolidation that is commonly referred to as “Hampton’s Hump.”

Pulmonary Embolus (PE):

- The following is a list of symptoms for a PE:

Chest Pain

Dyspnea (Shortness of Breath)

Cough

Hemoptysis (coughing up blood)

Dyspnea (difficulty breathing)

Pneumothorax (lung collapse)

Cyanosis (blue discoloration)

Pulmonary Embolus (PE):

- Diagnostic tests for this condition are as follows:

Arterial Blood Gas

Pulse Oximetry

Routine Chest X-ray

Ventilation/Perfusion Scan in Nuclear Medicine

Pulmonary Arteriogram

CT Angiogram of the Chest

Doppler Ultrasound to Detect DVT

Pulmonary Embolus (PE):

- A variety of treatment options are available for a PE.
- The definitive choice is dependent upon the severity of the condition.
- Treatment options are as follows:

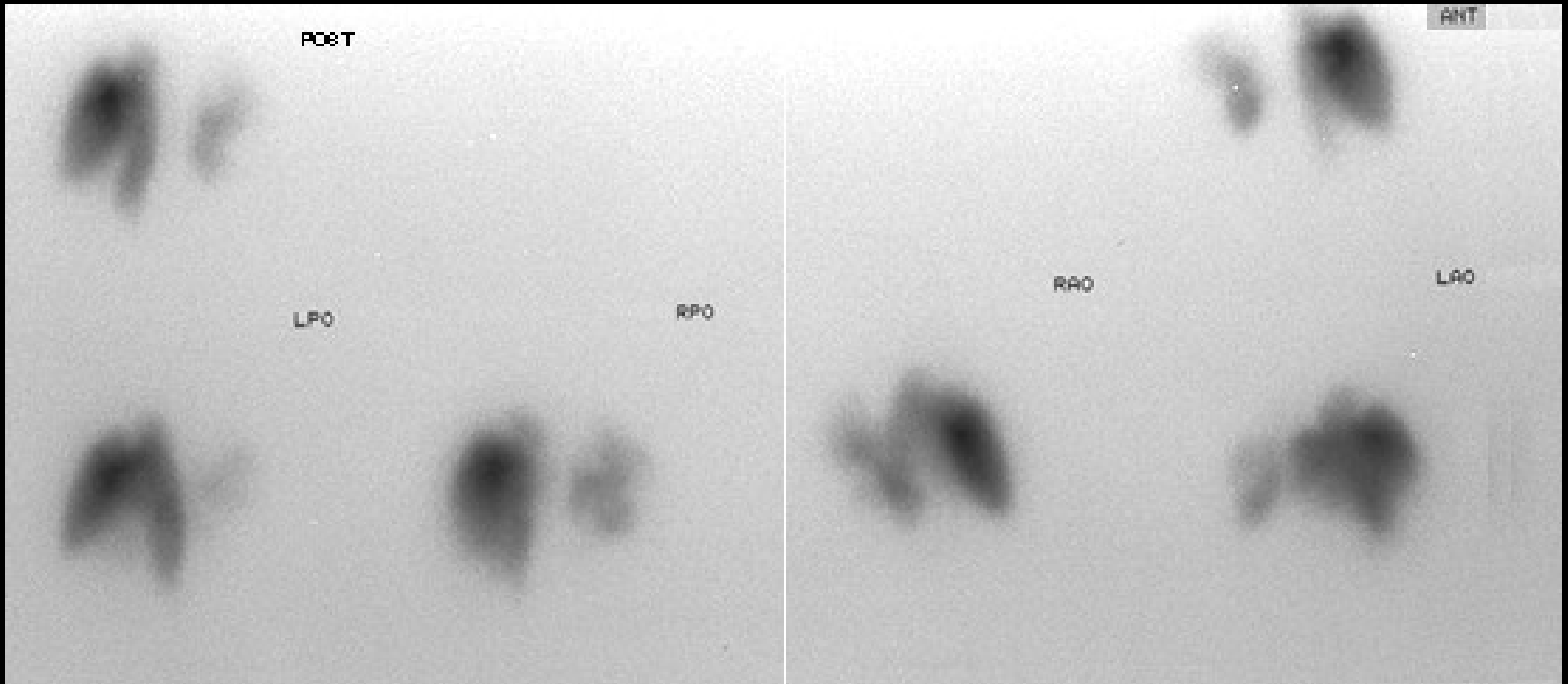
Blood Thinners (heparin)

Thrombolytic Therapy (streptokinase/urokinase) to
Dissolve the Clot

Insertion of an Inferior Vena Cava Filter

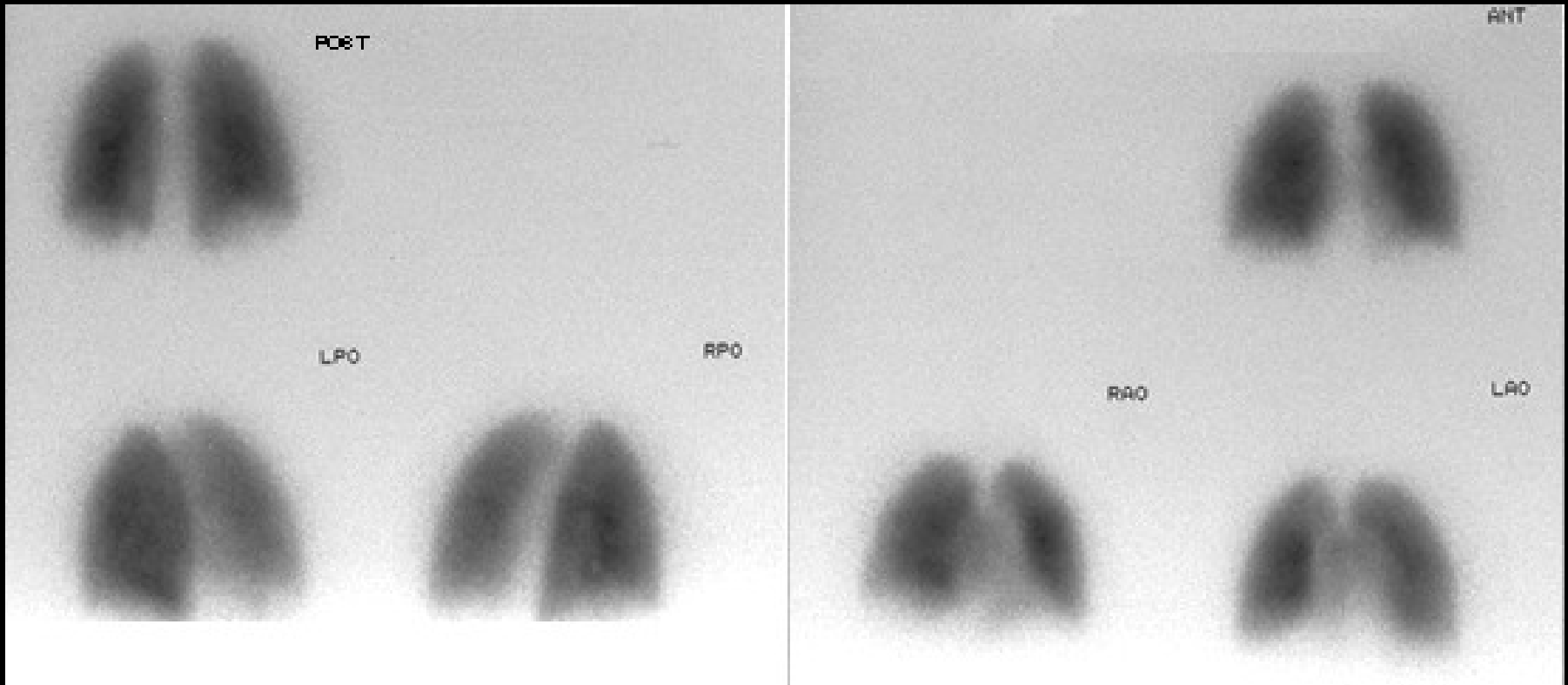
Surgery

Pulmonary Embolus (PE):



This is a ventilation/perfusion nuclear medicine scan of a patient that is suffering from a **pulmonary embolus**. The arterial blockage is preventing the radionuclides from reaching the periphery of the lungs.

Pulmonary Embolus (PE):



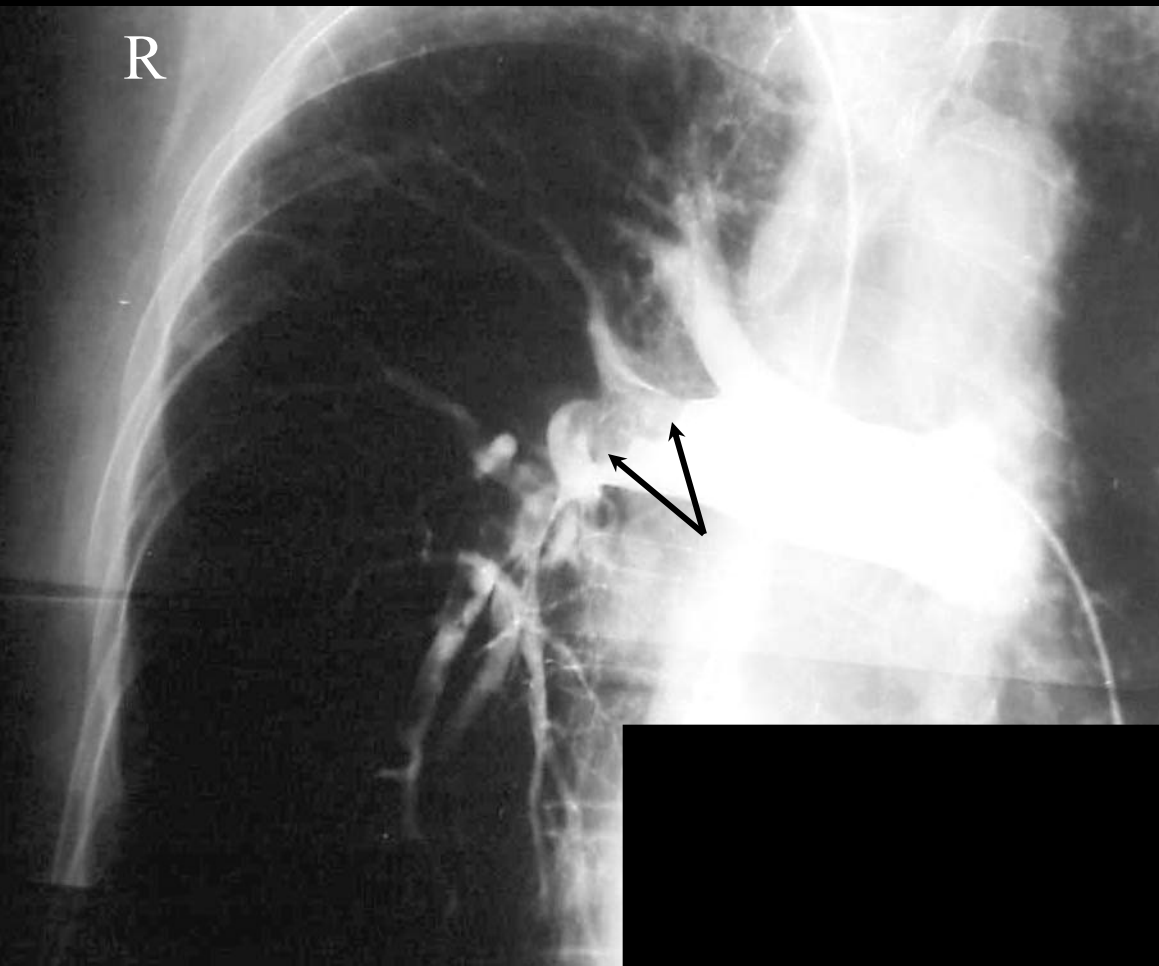
A repeat ventilation scan 5 days after treatment with systemic **thrombolysis** showed near complete resolution of segmental defects.

Pulmonary Embolus (PE):



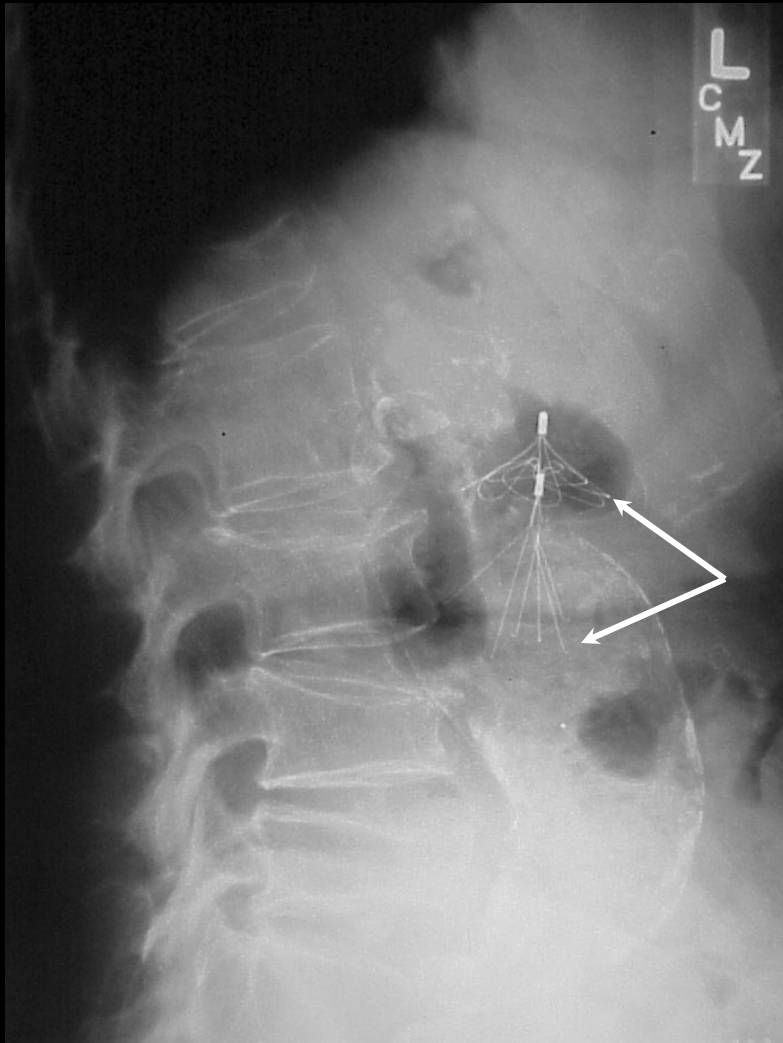
This is a normal **pulmonary arteriogram** that demonstrates how the iodinated contrast material should evenly disperse throughout the pulmonary arteries.

Pulmonary Embolus (PE):



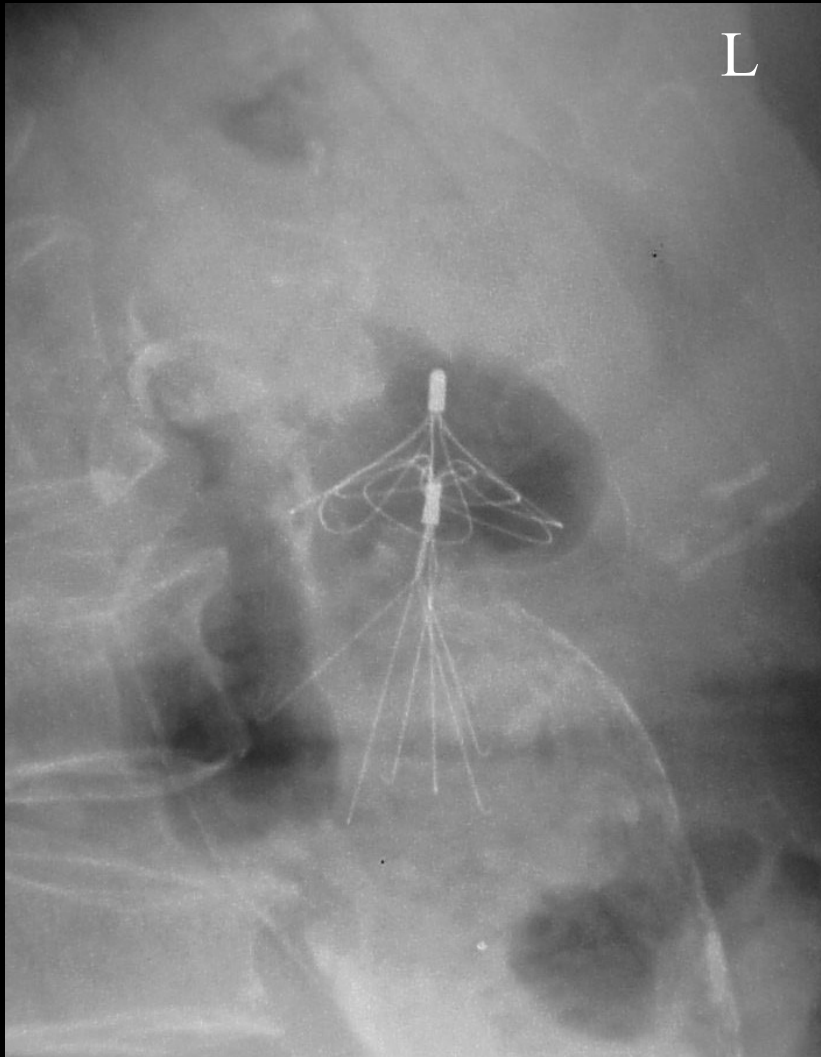
This **pulmonary arteriogram** demonstrates how a **pulmonary embolus** (arrows) can obstruct the flow of contrast material (and blood) from the pulmonary arteries.

Inferior Vena Cava (IVC) Filter:



An **IVC filter** (arrows) is a device that is used to combat deep vein thrombosis. It is designed to prevent large clots or emboli that break off from veins within the legs from causing a pulmonary embolism.

Inferior Vena Cava (IVC) Filter:



This is a magnified view of the previous image. It depicts how the **IVC filter** is designed to snare clots from the legs and thus prevent the potential for a life-threatening **pulmonary embolus**.

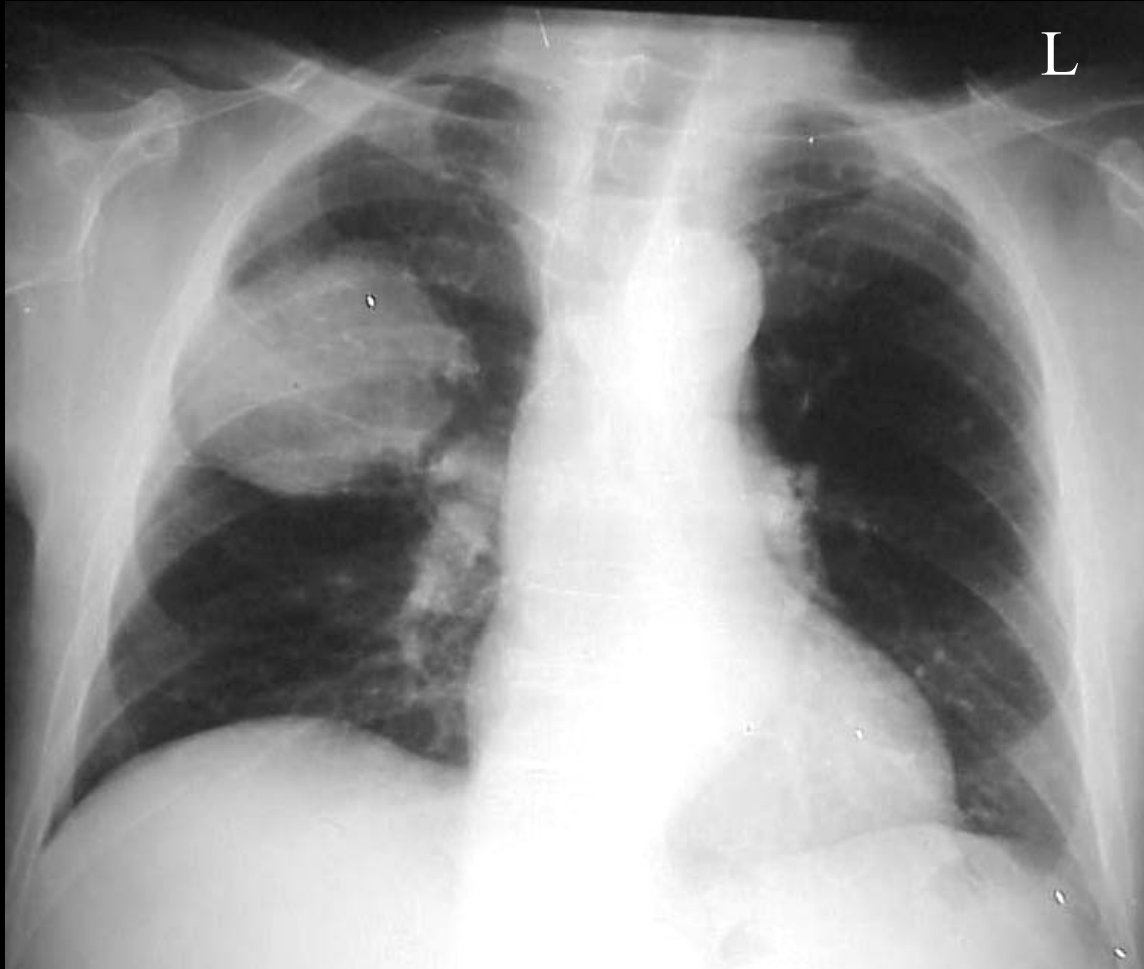
Lung Cancer:

- Lung cancer represents approximately 35% of all cancer deaths and it is the most common cause of death in both men and women.
- The average onset is age 60.
- Smokers are 10 times more likely to develop lung cancer than non smokers.
- The most common symptoms of lung cancer are coughing, hemoptysis, dyspnea (SOB), and anorexia (weight loss).
- A biopsy is required to make a definitive diagnosis.
- Common treatments for lung cancer include surgery, radiation therapy, and chemotherapy.

Bronchogenic Carcinoma:

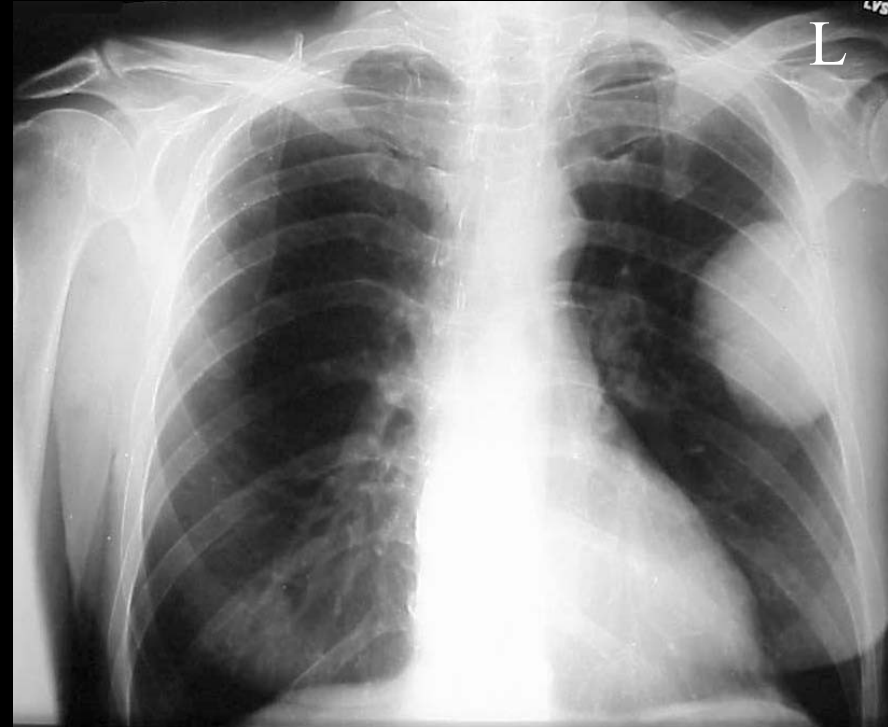
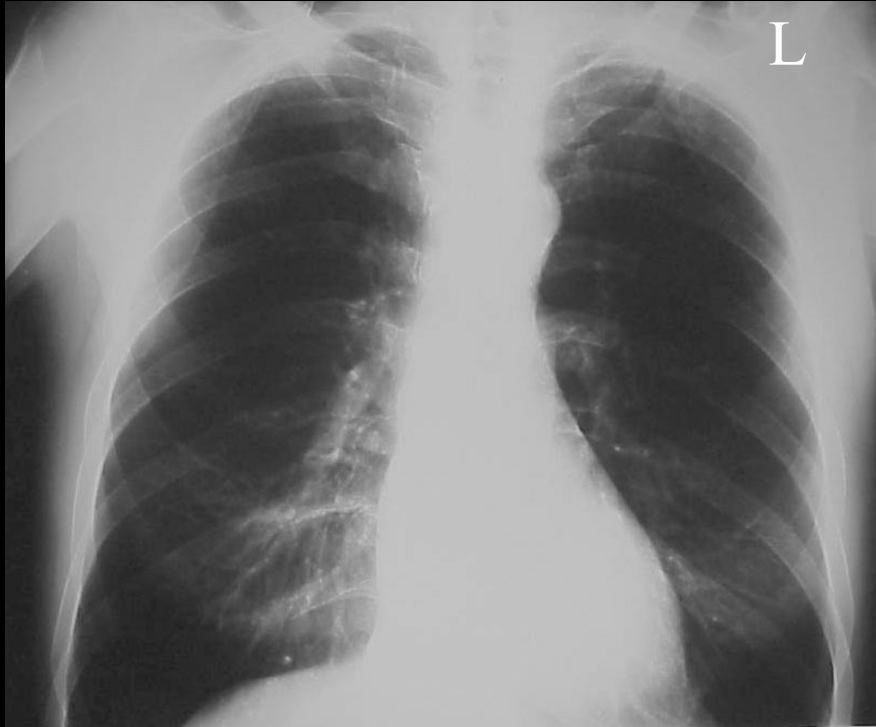
- This is a primary lung cancer that arises from the respiratory epithelium.
- It is divided into the following two broad categories:
 - Small Cell Lung Cancer (SCLC)
 - Non Small Cell Lung Cancer (NSCLC)
- Bronchogenic carcinoma has a poor prognosis with a 5-year survival rate of 12 to 14%.

Bronchogenic Carcinoma:



The large mass in this patient's lung is a type of primary lung cancer called **bronchogenic carcinoma**.

Bronchogenic Carcinoma:



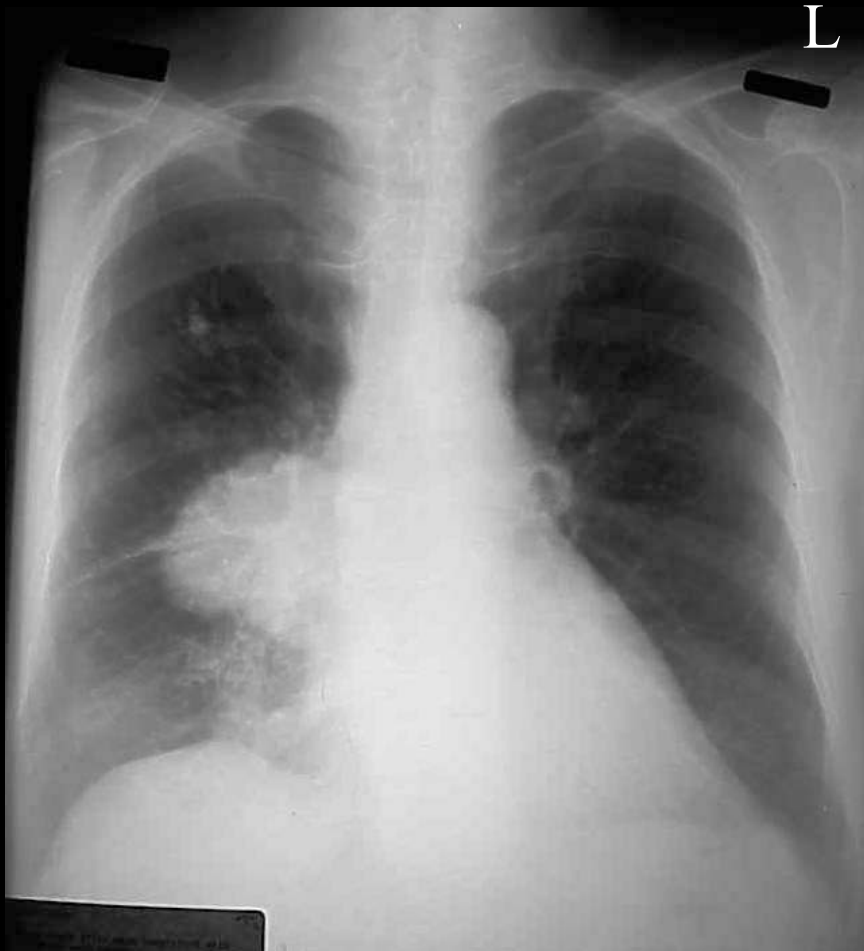
This mass is another example of **bronchogenic carcinoma**.

Bronchogenic Carcinoma:



This is a very severe example of how **bronchogenic carcinoma** can affect both lungs.

Bronchogenic Carcinoma:

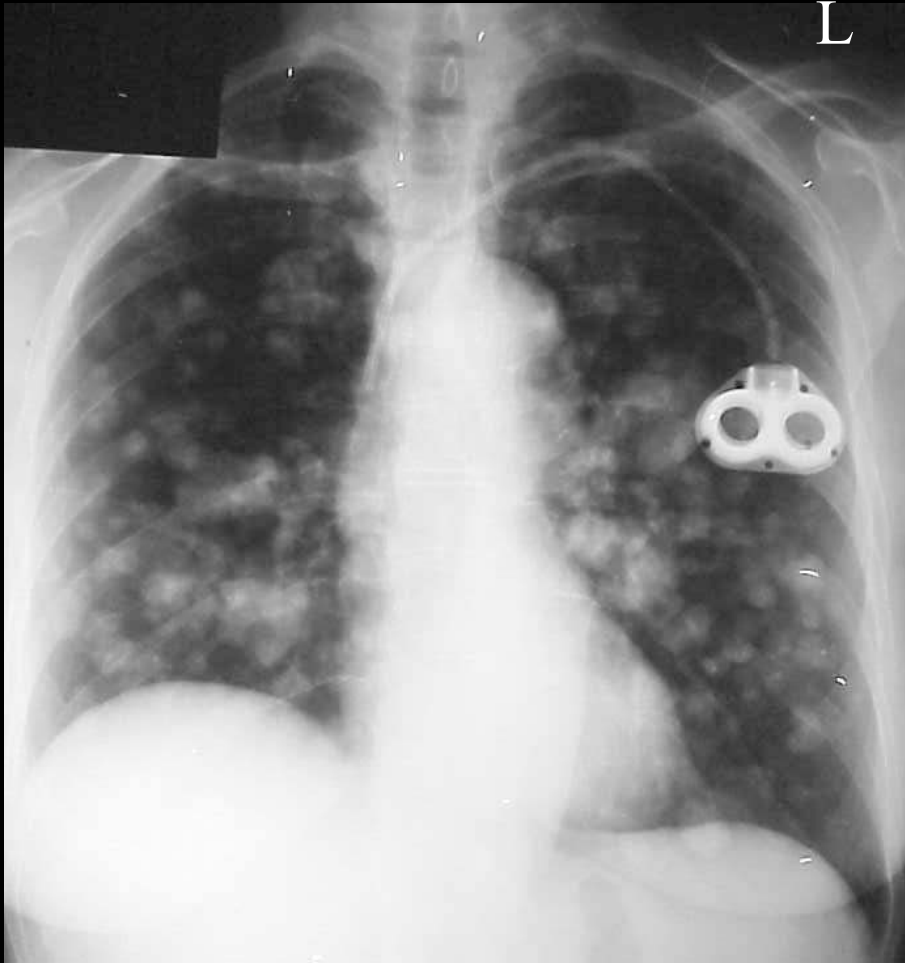


This primary lung cancer was later diagnosed as a type of **bronchogenic carcinoma** know as **squamous cell carcinoma**.

Pulmonary Metastasis:

- Pulmonary metastasis (secondary lung cancer) is much more common than primary lung cancer.
- It primarily occurs via the lymphatic system or the circulatory system.
- It is common from the following types of primary cancer:
 - Breast Cancer
 - Colon Cancer
 - Prostate Cancer
- Treatment for pulmonary metastasis varies according to the type of primary cancer that is involved.

Pulmonary Metastasis:



Secondary lung cancer or **pulmonary metastasis** possesses a classic cotton ball radiographic appearance as demonstrated on this image.

Pulmonary Metastasis:



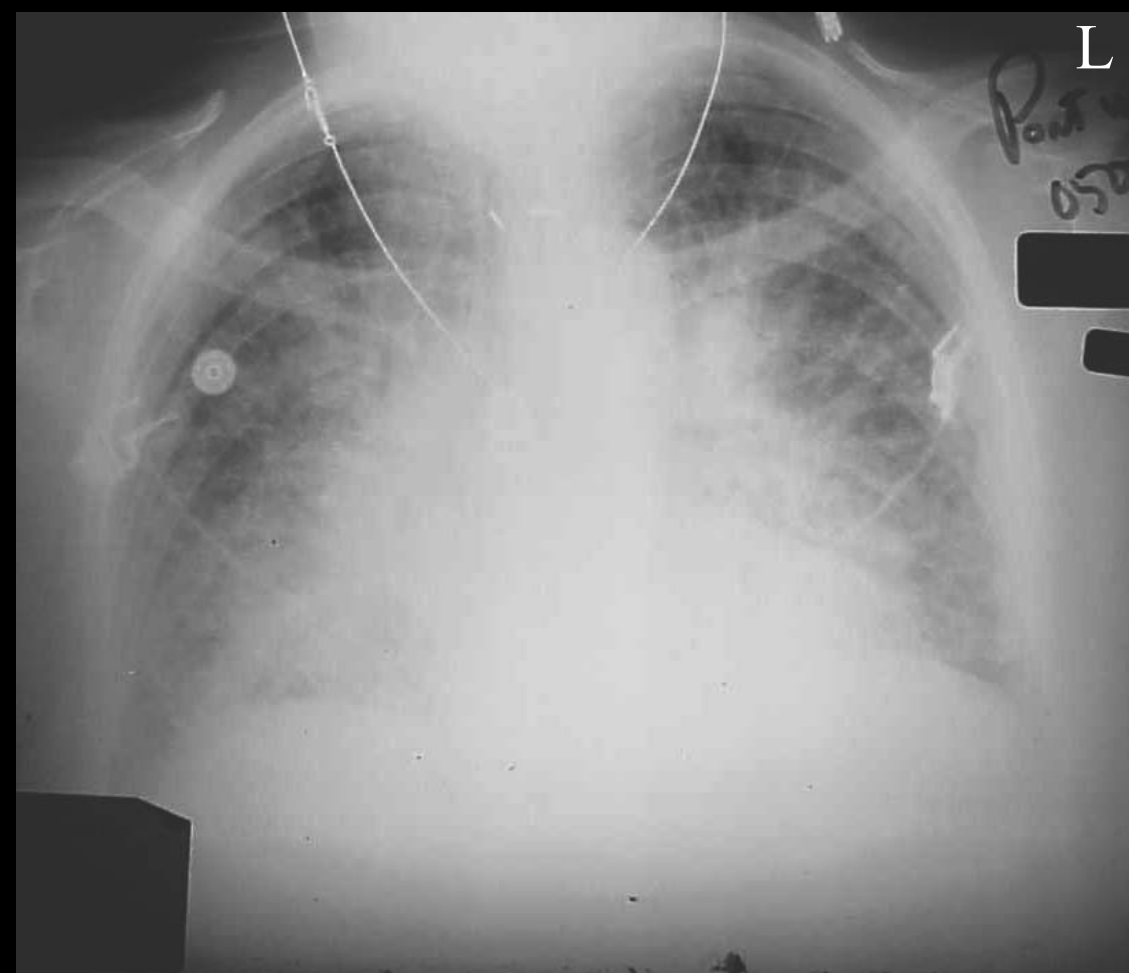
This is another classic example of the cotton ball radiographic appearance of secondary lung cancer or **pulmonary metastasis**.

Pulmonary Edema:

- Pulmonary edema occurs when air within the lungs is replaced with fluid.
- It leads to a decrease in gas exchange and may cause respiratory failure.
- It often occurs secondary to congestive heart failure (CHF) or renal failure.
- Treatment includes the administration of oxygen and diuretics.

Removing the underlying cause of the pulmonary edema is the most important consideration for treatment.

Pulmonary Edema:



This patient is suffering from **congestive heart failure (CHF)**. The congested radiographic appearance of this image is the result of **pulmonary edema**.

Atelectasis:

- Atelectasis refers to a condition where either a portion of or the entire lung has collapsed and is without air.
- It results from a bronchial obstruction that can be caused by any of the following conditions:

Tumor

Foreign Body

Mucous Plug

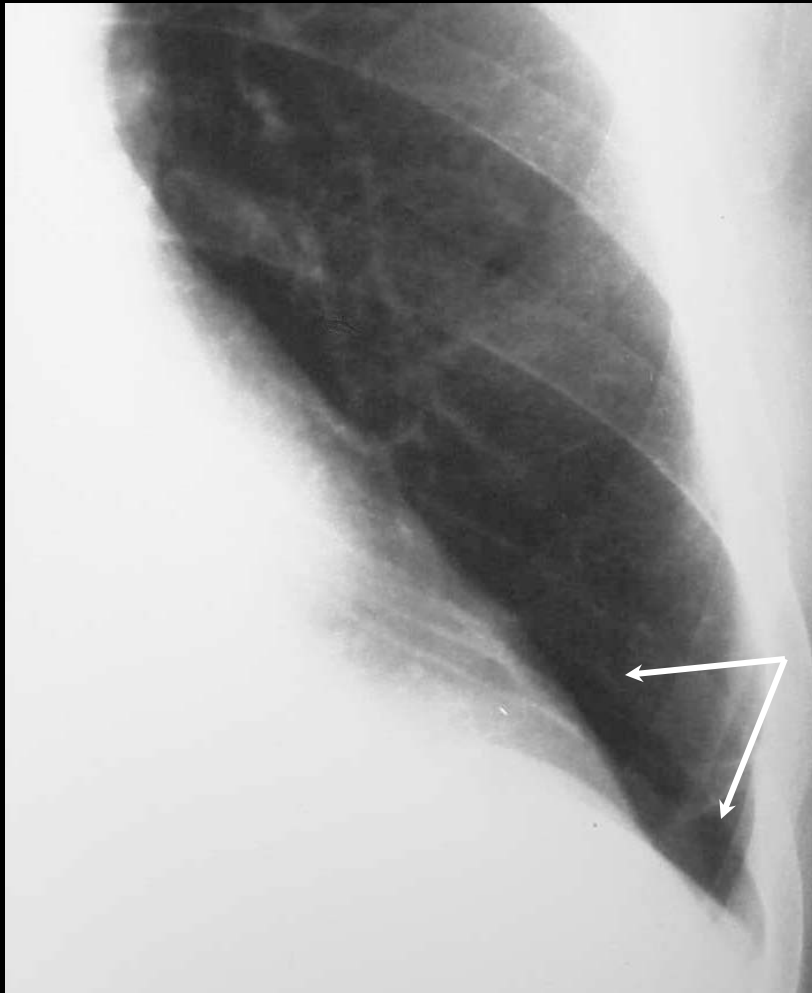
- This is a common cause for acute atelectasis especially postoperatively following chest or abdominal surgery.

Atelectasis:



A portion of this patient's left lower lung has collapsed (arrows) and this condition is referred to as **atelectasis**.

Atelectasis:



This is a magnified view of the previous image and better demonstrates the sometimes subtle radiographic appearance of **atelectasis**.

Pneumothorax:

- A pneumothorax is a condition occurs when air is introduced into the pleural space.
 - The net result of this phenomena is a collapsed lung.
- Common causes of a pneumothorax include the following:
 - Trauma
 - May be the result of a penetrating chest wound.
 - Ruptured Bulla from Emphysema
 - Spontaneous
 - Most commonly found in tall, thin, young males.
 - Iatrogenic
 - May be caused during a thoracentesis or chest tube insertion.

Pneumothorax:

- A tension pneumothorax is a life-threatening condition that is caused by a ball-valve type of fistula.

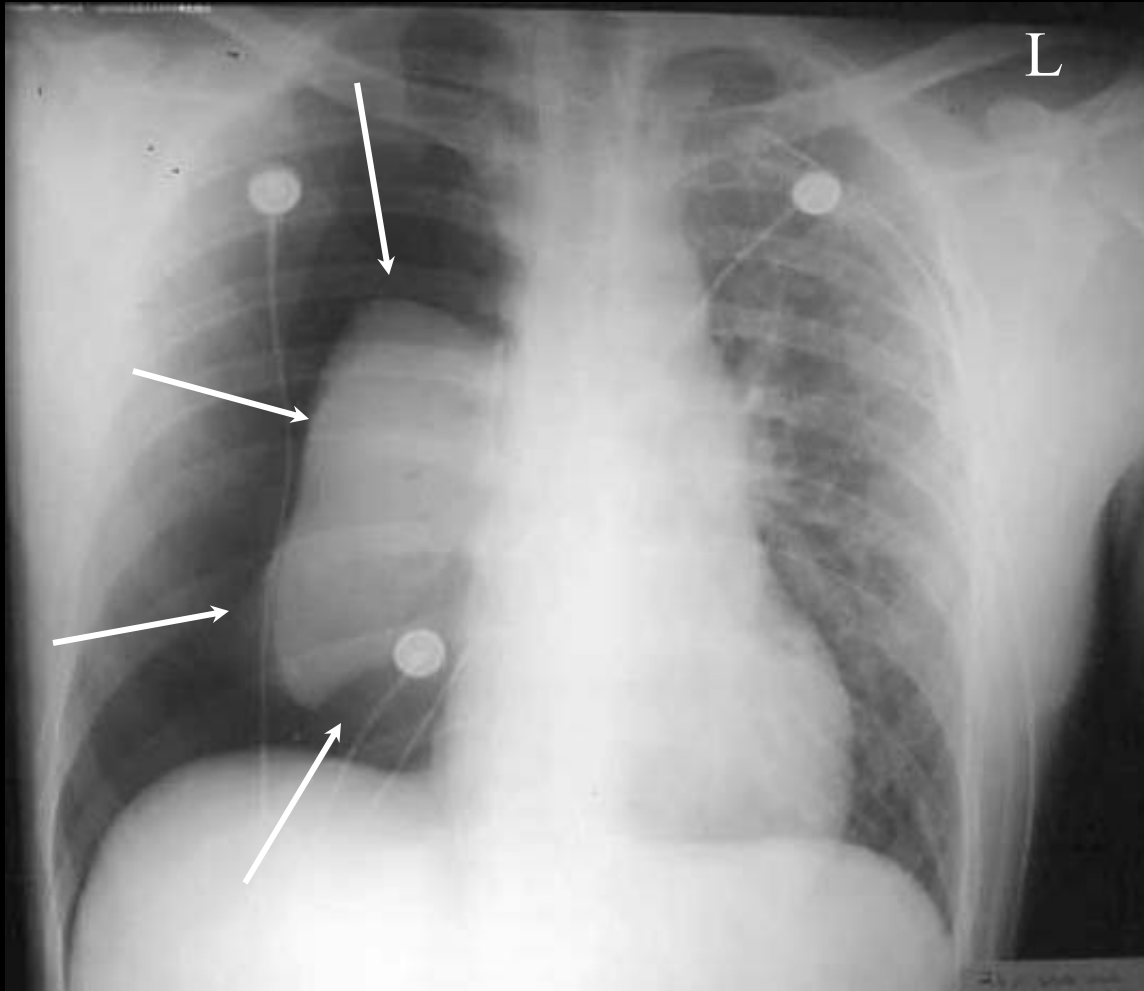
A fistula is an abnormal passageway between two structures that do not normally connect.

- Treatment for a pneumothorax often includes the insertion of a chest tube.

The chest tube will restore the normal “negative pressure” within the pleural space thus providing the means for the lung to aerate.

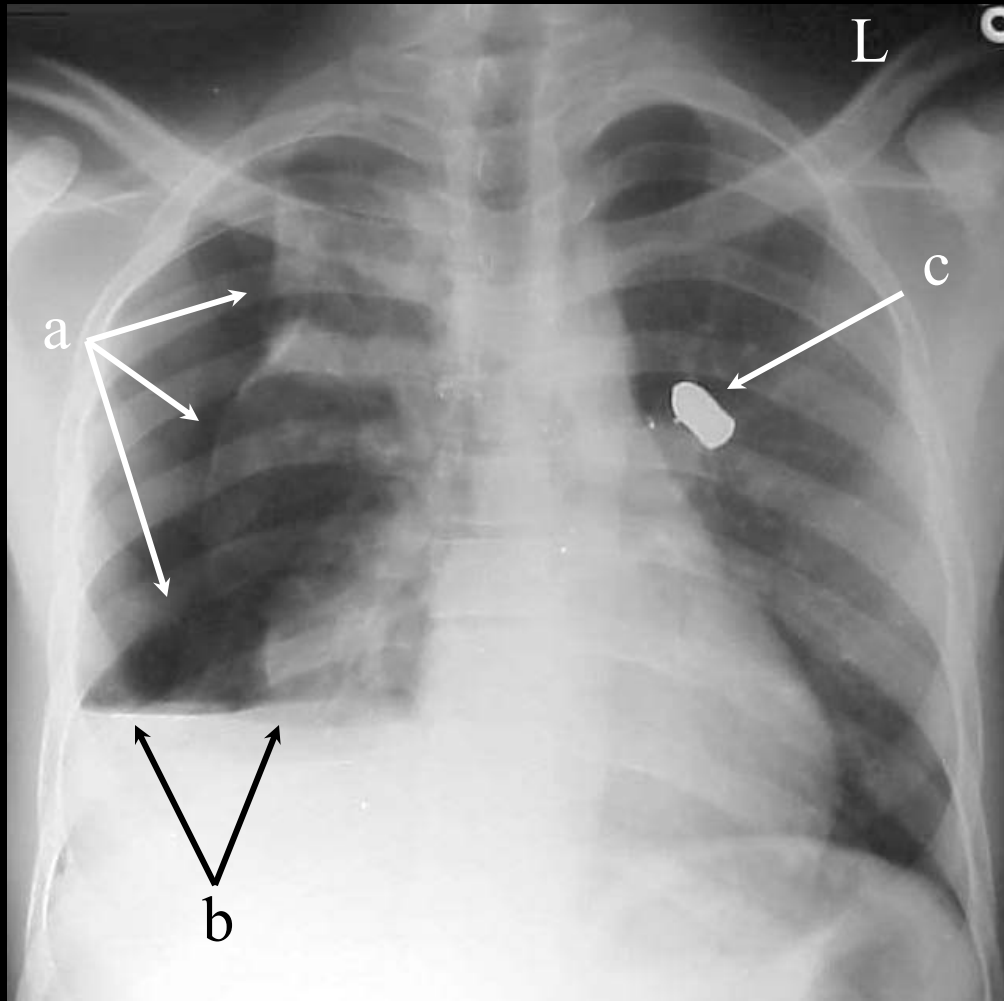
It will also remove any excess fluid that may have accumulated within the pleural space.

Pneumothorax:



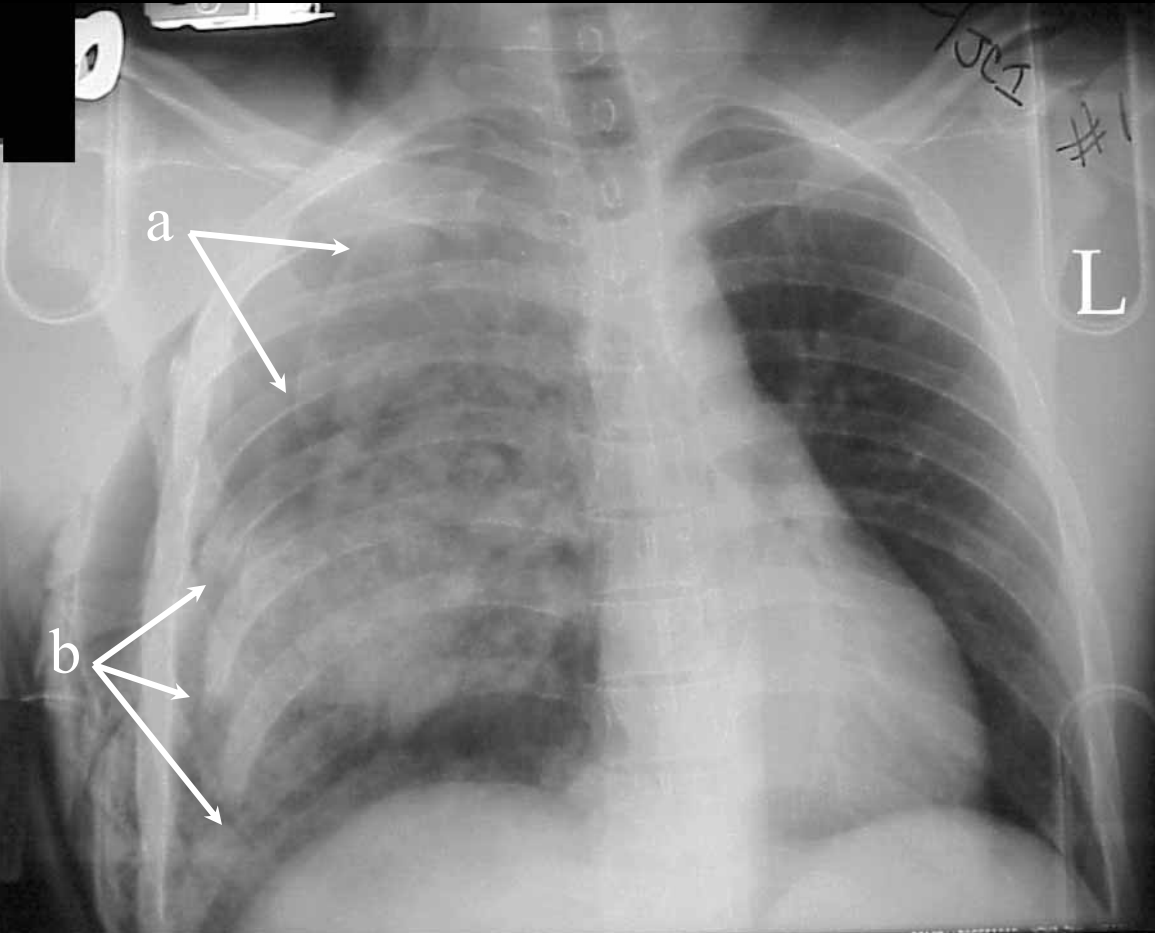
This image of a **pneumothorax** clearly demonstrates how the lung collapses like a deflated balloon towards the mediastinum.

Pneumothorax:



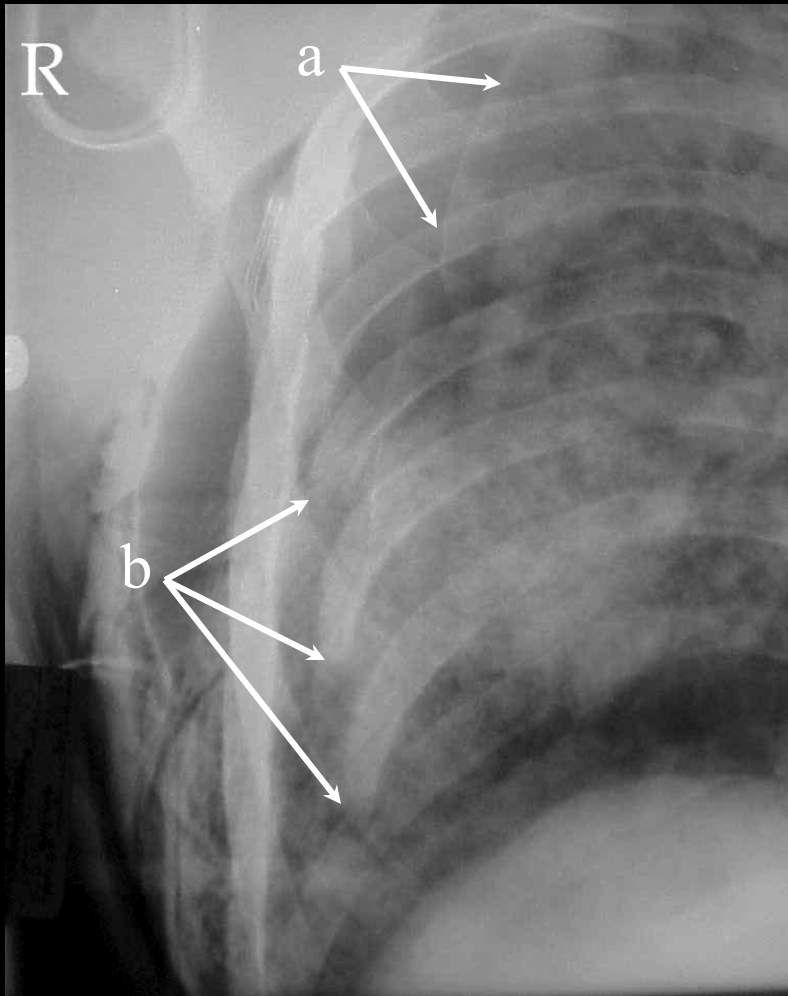
This patient was shot with a bullet (c) and this resulted in a **pneumothorax** (a) and a **pleural effusion** (b). This condition can also be referred to as a **hydropneumothorax**.

Pneumothorax:



This patient was in a motor vehicle accident and suffered many **broken ribs** (b). This resulted in the formation of a **pneumothorax** (a).

Pneumothorax:



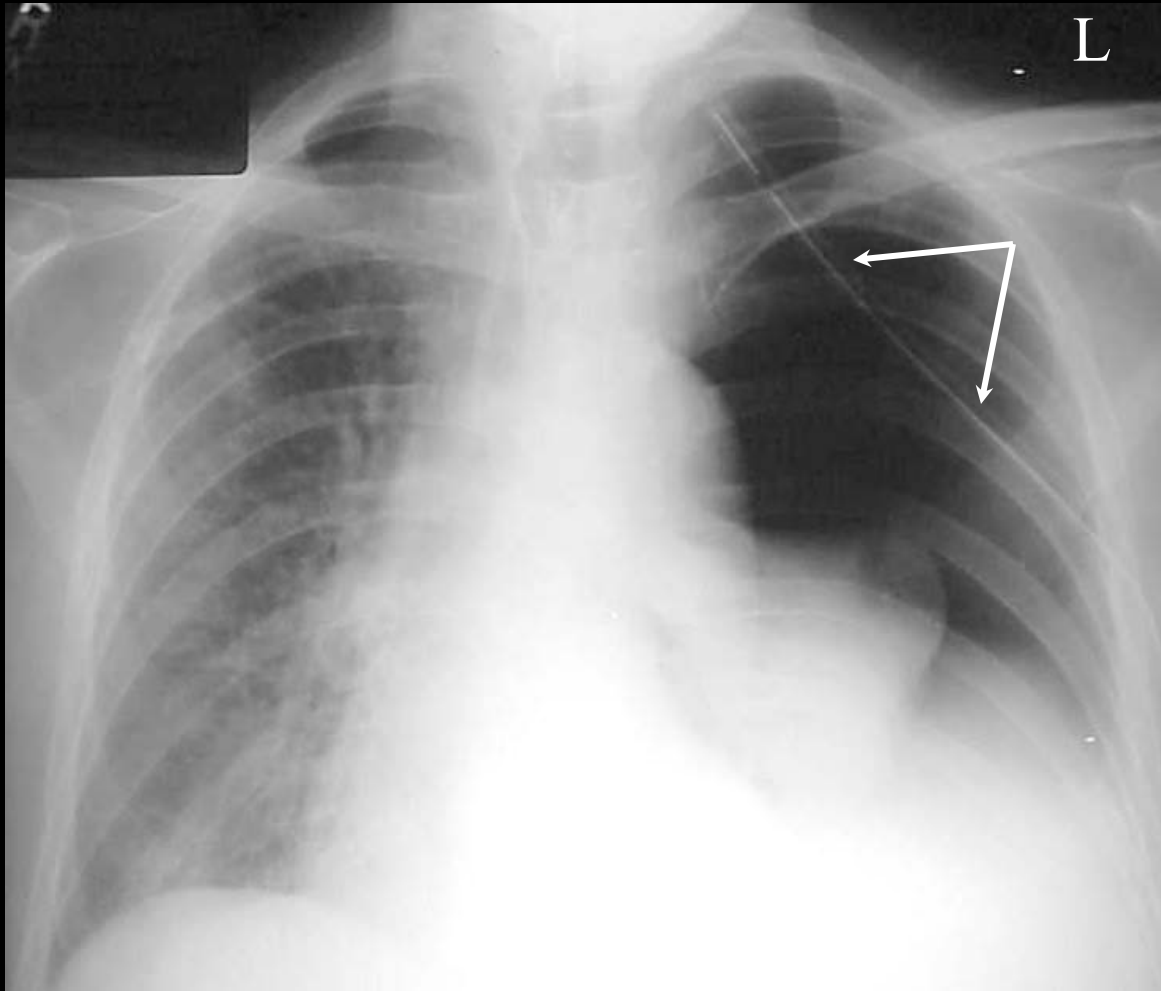
This is a magnified view of the previous image demonstrating the **pneumothorax** (a) and the multiple **broken ribs** (b).

Pneumothorax:



This CT scan further depicts how the lung deflates towards the mediastinum (arrows) during a **pneumothorax** and the large pocket of air that forms in the absence of the lung.

Tension Pneumothorax:

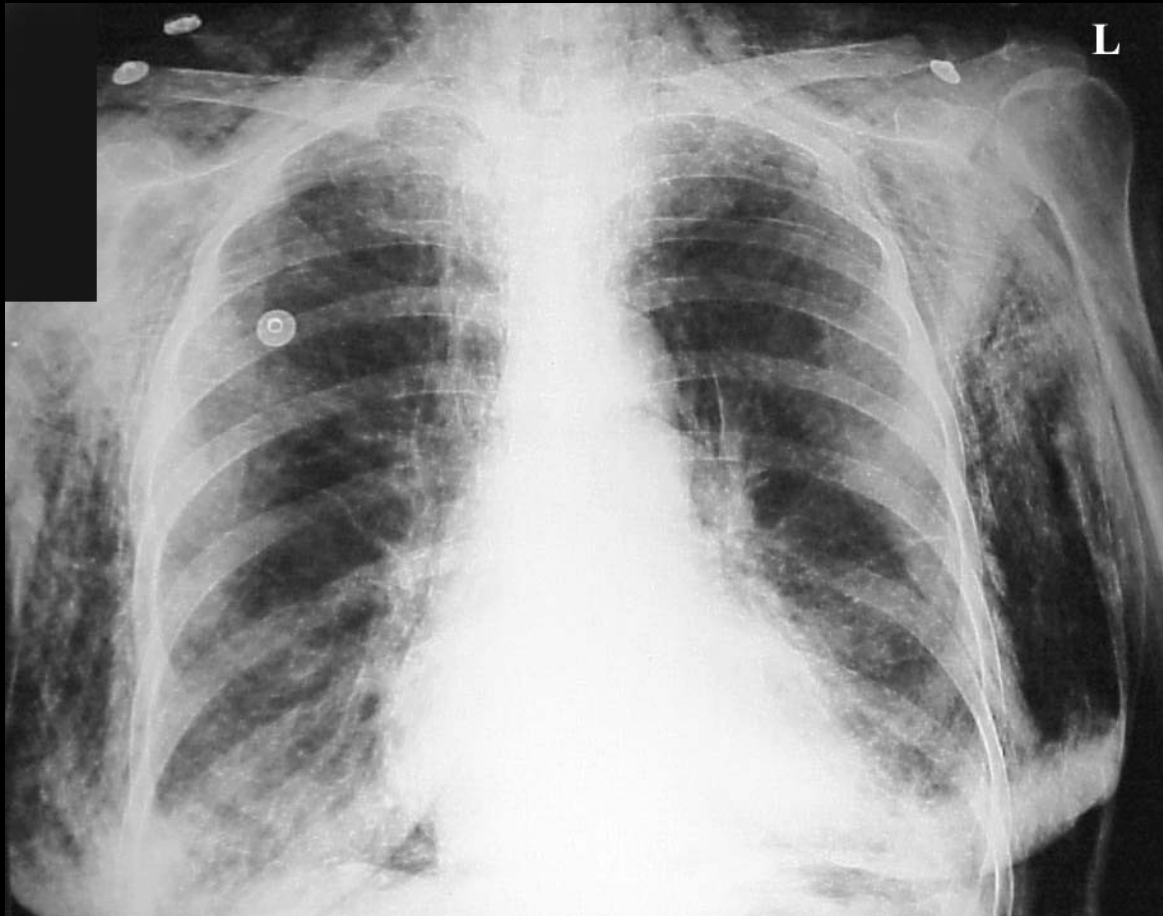


A “ball-valve” type fistula is the cause of this **tension pneumothorax**. The arrows are pointing to the chest tube that was inserted in order to help restore the negative pressure required to inflate the lung.

Subcutaneous Emphysema:

- Air escaping the patients lungs following a traumatic pneumothorax may enter the patients surrounding tissues.
- This condition is know as subcutaneous emphysema and if palpated, it will make a very distinct crackling or popping noise that is referred to as crepitation.
- This air is eventually absorbed by the body.

Subcutaneous Emphysema:



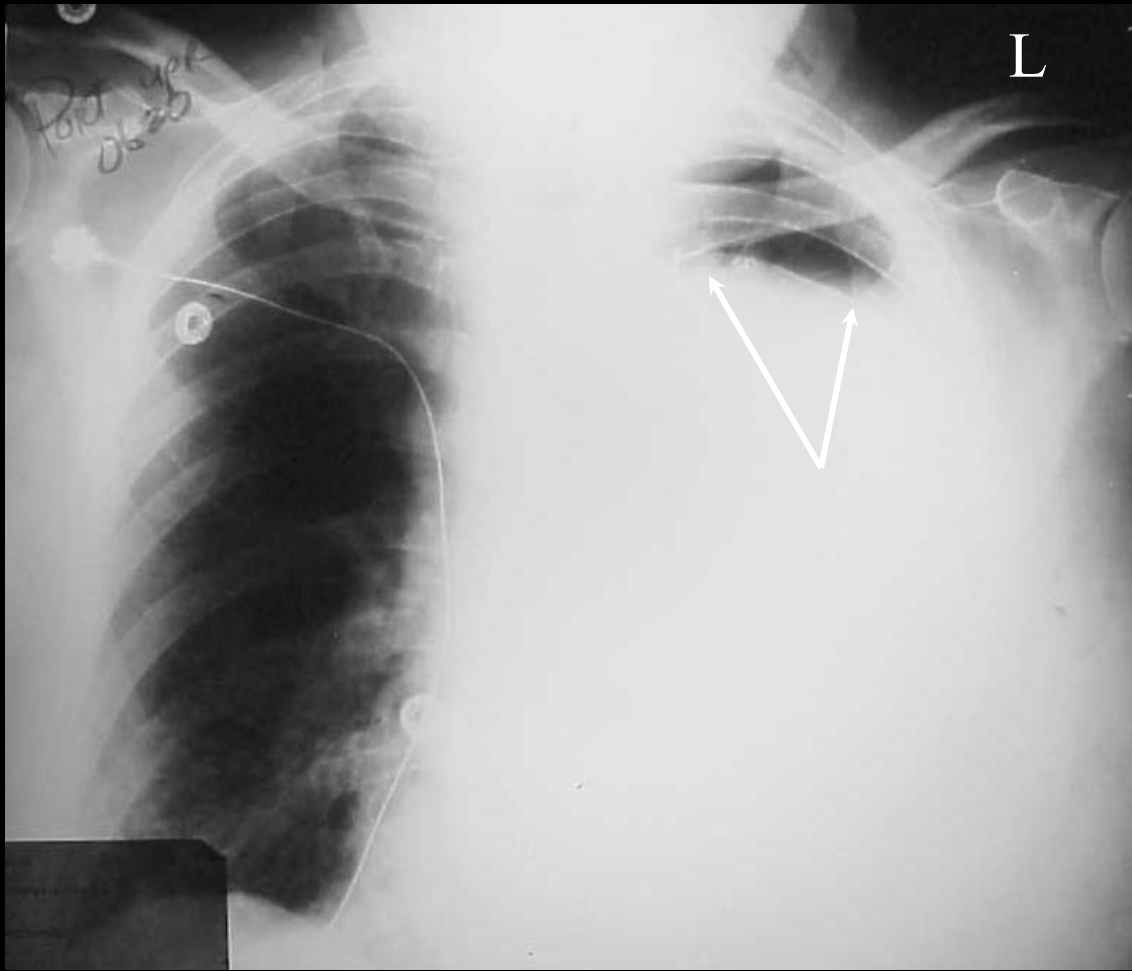
The odd artifacts found on this image is the result of air escaping from the patient's lungs and entering the surrounding tissues. This condition is know as **subcutaneous emphysema** and if palpated, it will make a very distinct crackling or popping noise that is called crepitation.

Pleural Effusion/Hydrothorax:

- Excess fluid that accumulates within the pleural space is known as a pleural effusion.
- It can be caused by a myriad of conditions such as congestive heart failure (CHF) or pulmonary emboli.
- Large pleural effusions may require the insertion of a chest tube to remove the excess fluid.
- Another course of treatment would be the use of a needle to aspirate or remove the effusion.

This procedure is referred to as a thoracentesis.

Pleural Effusion/Hydrothorax:



This patient likely has more than a liter of fluid within their pleural space. This condition is known as a **pleural effusion**. A chest tube will have to be inserted in order to remove it.

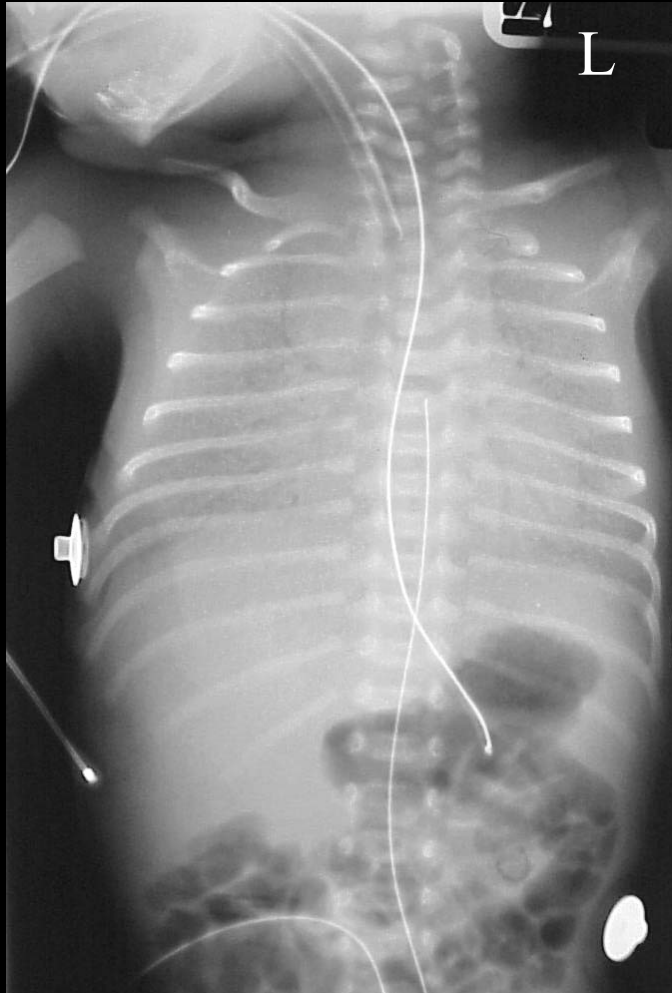
Infant Respiratory Distress Syndrome:

- Respiratory distress syndrome (RDS) was formerly referred to as hyaline membrane disease.
- It is characterized by a lack of surfactant in premature infants.

This causes the alveoli to poorly aerate resulting in hypoxia.

- RDS has a very distinctive “ground glass” radiographic appearance on a chest X-ray.

Infant Respiratory Distress Syndrome:



The “ground glass” radiographic appearance of the newborn’s AP chest is a classic sign of **respiratory distress syndrome (RDS)**. This condition is was formerly referred to as **hyaline membrane disease**.

Cardiovascular System Menu

1. Aneurysm
2. Aortic Abdominal Aneurysm (AAA)
3. Congestive Heart Failure
4. Dextrocardia
5. Elephantiasis
6. Tetralogy of Fallot

Aneurysm:

- An aneurysm is a weakening of an arterial wall that results in a bulge or balloon-like appearance.

A rupture of this bulge is potentially fatal.

They are most commonly associated with cerebral arteries and the abdominal aorta.

Aortic Abdominal Aneurysm (AAA):

- Aortic abdominal aneurysms often form with minimal symptoms and are easily diagnosed with an ultrasound.

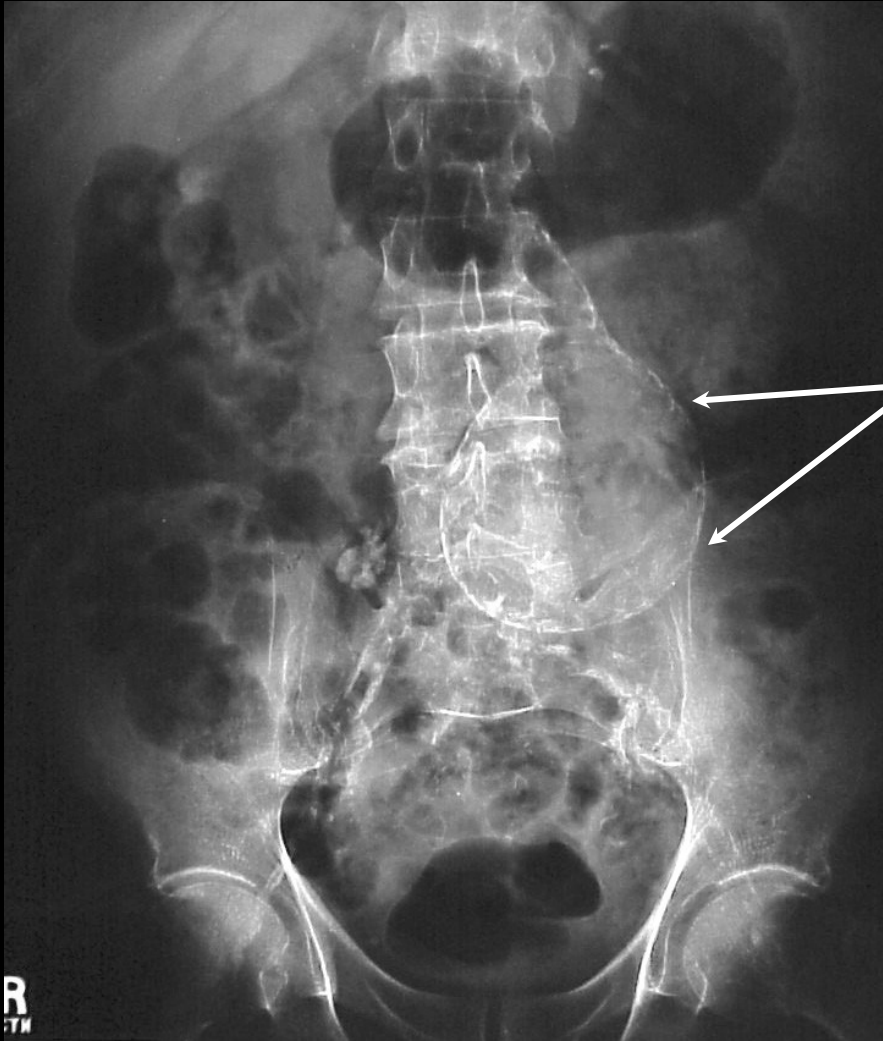
The average age for diagnosis is between 65 to 70.

The risk of rupture begins at 5 cm and they can swell to over 15 cm in diameter.

Inserting an endovascular stent through the femoral artery or surgically replacing the aneurysm with a graft or synthetic patch tube are two common means of treatment.

A non surgical approach for aneurysms less than 5 cm would be to lower cholesterol levels, reduce hypertension, and smoking cessation.

Aortic Abdominal Aneurysm (AAA):



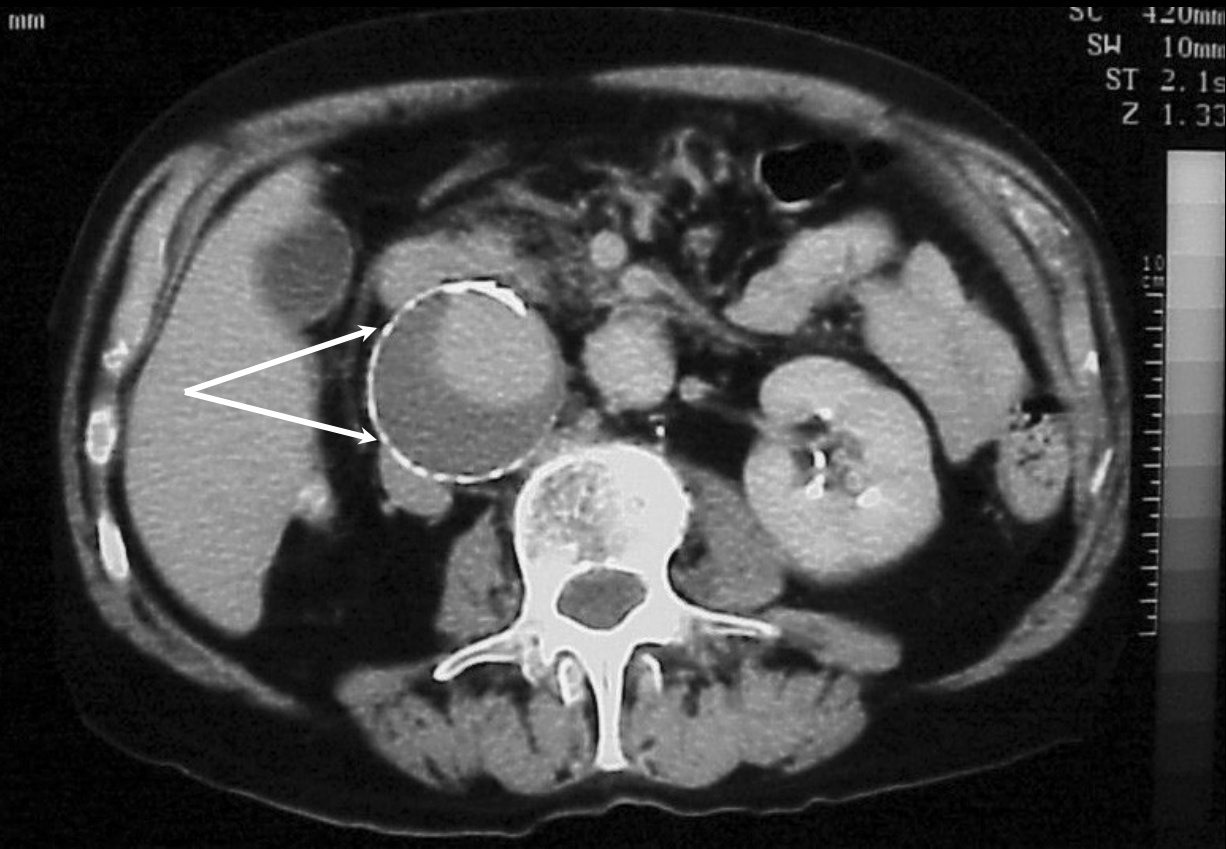
The arrows are pointing to a very large, calcified **AAA**. Although they are usually diagnosed with ultrasound, this particular case was discovered on a routine KUB.

Aortic Abdominal Aneurysm (AAA):



This is a magnified view of the previous image of a calcified **AAA**.

Aortic Abdominal Aneurysm (AAA):



The arrows on this CT scan of the abdomen are pointing to an **AAA**. CT is another diagnostic tool that is often employed to further delineate the extent of an aneurysm.

Congestive Heart Failure (CHF):

- CHF refers to a condition or conditions that result in a decrease in cardiac output.
- For people over 65, it is the leading cause for hospitalization.
- Victims commonly suffer from dyspnea after even mild physical activity.
- Other common symptoms for patients with CHF include peripheral edema and ascites.
- A chest X-ray may demonstrate cardiomegaly, pulmonary edema, or a pleural effusion.

Congestive Heart Failure (CHF):

- There are a myriad of conditions that can cause CHF.

Conditions affecting the left side of the heart include:

- Hypertension
- Aortic Coarctation (narrowing of the aorta)
- Aortic and Mitral Valve Disease

Conditions affecting the right side of the heart include:

- Pulmonary Hypertension
- Pulmonary or Tricuspid Valve Disease

Congestive Heart Failure (CHF):

Both side of the heart are affected by:

- Ischemic Heart Disease
- Acute Myocardial Infarction (heart attack)
- Cardiomyopathy
- Cardiac Fibrosis
- Anemia
- Chronic Arrhythmia
- Thyroid Disease

Congestive Heart Failure (CHF):

- Treatment for CHF is dependent upon determining the cause and then treating the signs and symptoms.

Management of the disease may include:

- Improve Diet
- Moderate Physical Activity
- Weight Reduction
- Sodium Restriction
- Fluid Restriction
- Smoking Cessation
- Alcohol Cessation

Congestive Heart Failure (CHF):

Medical treatment for CHF includes the following:

- Diuretics to Reduce Fluid Retention

- ACE Inhibitors

Work with diuretics to increase cardiac output and reduce hypertension.

- Beta Blockers

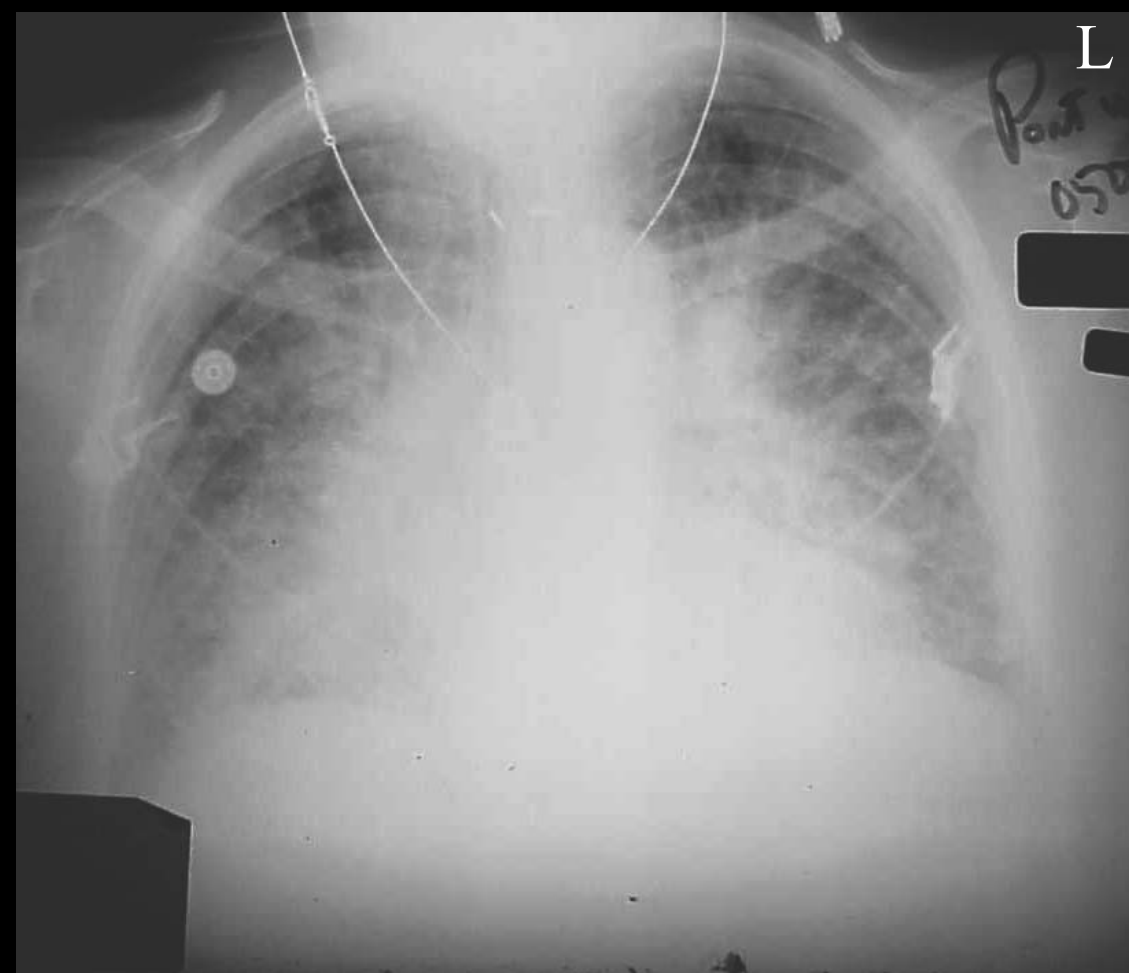
Help to improve left ventricular contraction.

- Positive Inotropes

Work to increase the strength of heart contractions. Digoxin is a commonly prescribed positive inotrope.

- Vasodilators to Reduce Hypertension

Congestive Heart Failure (CHF):



This patient is suffering from **congestive heart failure**. The congested radiographic appearance of this image is the result of **pulmonary edema**.

Dextrocardia:

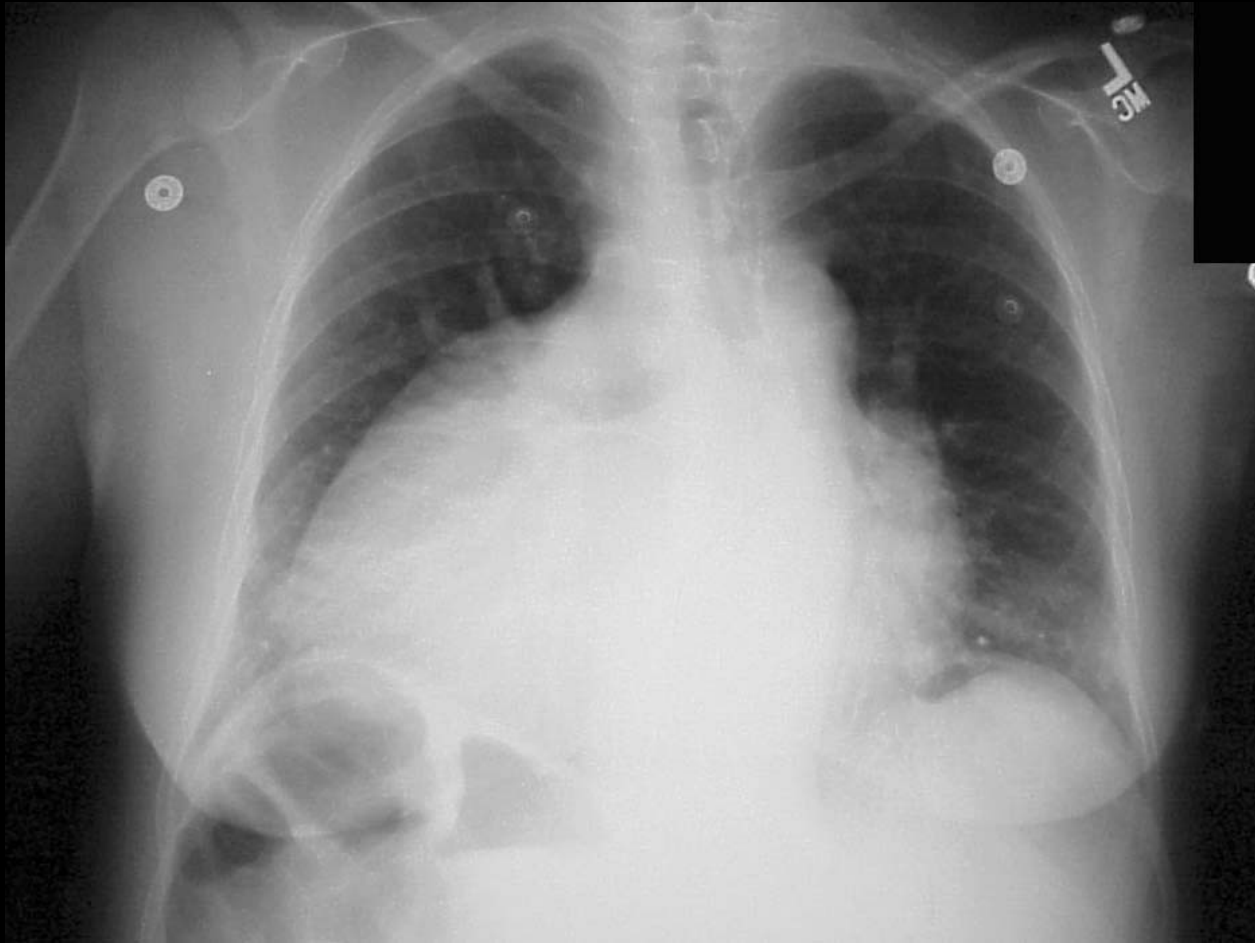
- Situs inversus is a very rare congenital condition where all of the organs in the body are transposed to the opposite side.

It has an unknown etiology.

- Dextrocardia is also a congenital defect where the heart is transposed to the opposite side of the body within the thorax.

Dextrocardia can occur independently of situs inversus and is somewhat more common.

Dextrocardia:



This patient has **situs inversus** and her PA chest radiograph is a good example of the radiographic appearance of **dextrocardia**.

Elephantiasis:

- Elephantiasis is a thickening of the skin and underlying tissue of the legs and genitalia in the form of a hydrocele.
- It is usually caused by a parasitic roundworms that block the lymphatic system.

It can, however, also be caused by a persistent contact with volcanic ash.

- Treatment includes rigorous scrubbing of the affected area combined with drug treatment to kill the worms.

Elephantiasis:



This patient suffers from a condition known as **elephantiasis**. It results from a blockage of the lymphatic system caused by an infestation with parasitic round worms or a chronic exposure to volcanic ash.

Tetralogy of Fallot:

- Tetralogy of Fallot is a very rare congenital heart defect that presents at birth.
- As the name indicates, it consists of the following 4 defects:

Pulmonary Stenosis

- The narrowing of the pulmonary valve restricts the flow of blood into the pulmonary arteries.
- This causes the heart to have to pump harder and it leads to hypertension.

Right Ventricular Hypertrophy

- The right ventricle has to work harder to pump blood and enlarges due to the pulmonary stenosis.

Tetralogy of Fallot:

Ventricular Septal Defect

- This is a hole that is located between the ventricles.
- It allows oxygenated blood to flow from the left ventricle to the right ventricle instead of into the aorta and the rest of the body.
- As a result, the body is being deprived of oxygenated blood and the newborn becomes cyanotic (blue).

An Overriding Aorta

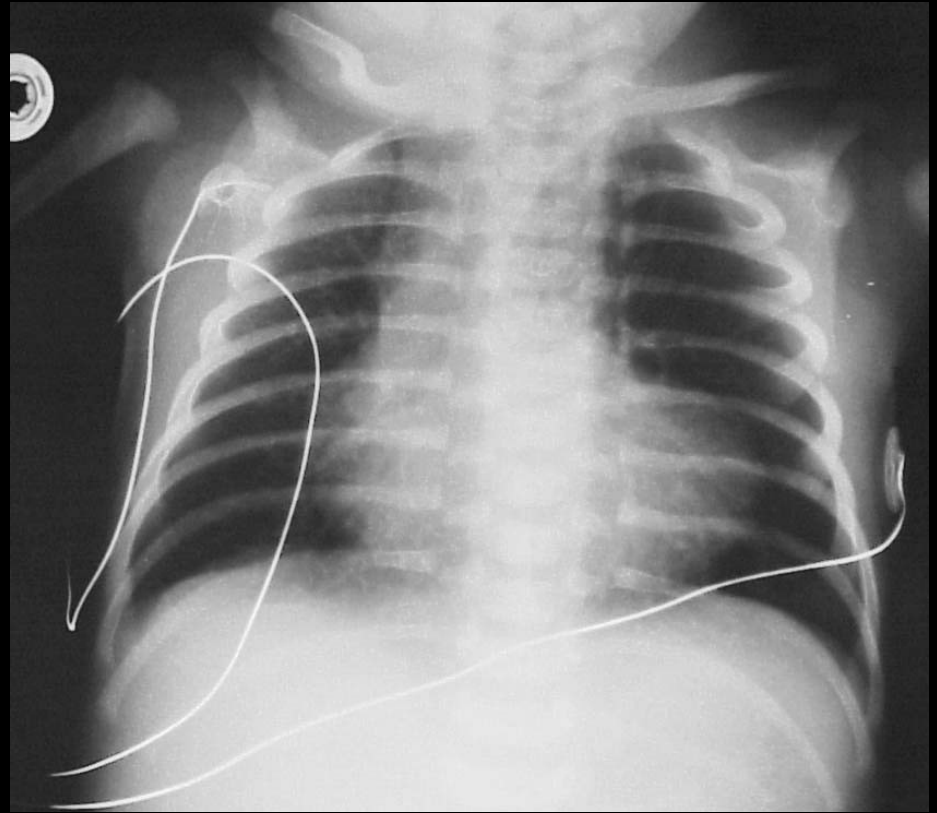
- A defective aorta causes deoxygenated blood to flow directly into the aorta and bypass the lungs.
- Once again, the body is deprived of oxygenated blood.

Tetralogy of Fallot:

- The combination of these four heart defects causes the heart to have a very distinctive “boot-shaped” radiographic appearance.
- Fortunately, the diagnosis and surgical treatment for Tetralogy of Fallot has greatly improved.

With proper medical care, these children can live into adulthood.

Tetralogy of Fallot:



The “**Boot-Shaped**” heart on this newborn represents a classic example of a condition called **Tetralogy of Fallot**.

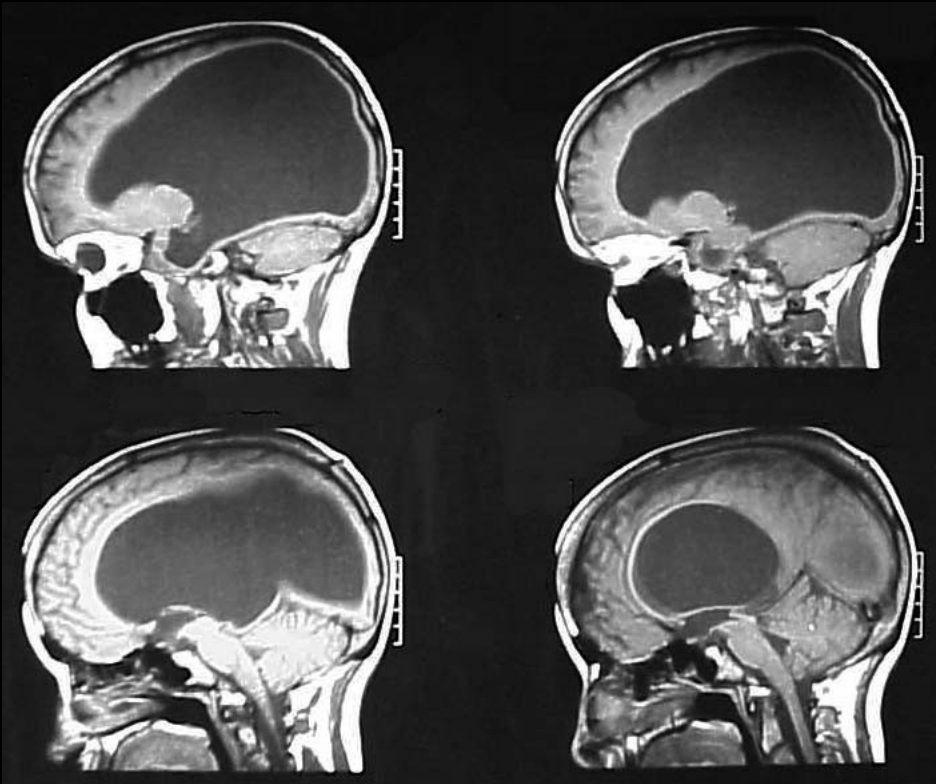
Nervous System Menu

1. Hydrocephalus
2. Cerebrovascular Accident (CVA)
3. CVA: Stroke
4. CVA: Transient Ischemic Attack
5. CVA: Intracranial Hemorrhage
6. CVA: Intracerebral Bleeding
7. CVA: Subarachnoid Bleeding
8. CVA: Extracerebral Bleeding
9. CVA: Subdural Hematoma
10. CVA: Epidural Hematoma
11. Astrocytoma
12. Meningioma
13. Acoustic Neuroma
14. Pituitary Adenoma
15. Spina Bifida
16. Spina Bifida Occulta
17. Arnold Chiari Malformation
18. Spinal Stenosis
19. Disc Herniation
20. Calcified Choroid Plexus
21. Calcified Pineal Gland

Hydrocephalus:

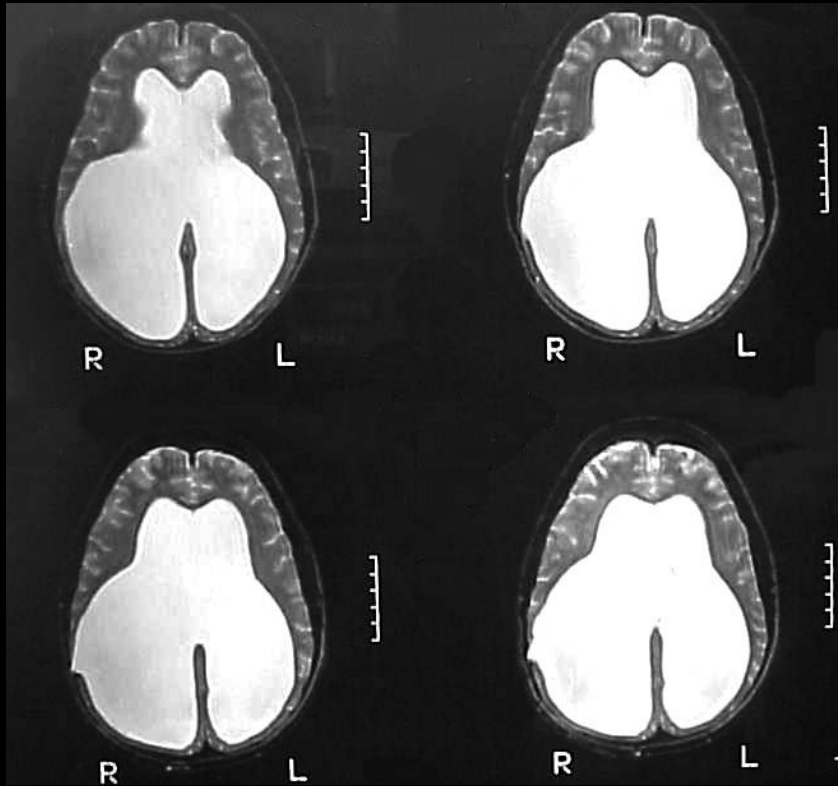
- People with this condition have an excess of cerebral spinal fluid (CSF) within the ventricles of their brain.
- This results in increased intracranial pressure, enlarged heads in infants, and possible brain damage.
- Two Common Types of Hydrocephalus:
 - Noncommunicating
 - This is caused by the presence of an obstruction such as a tumor.
 - Communicating
 - This occurs when the CSF cannot be absorbed properly
- A shunt inserted between the ventricles and the heart or abdomen is a common method to relieve the pressure.

Hydrocephalus:



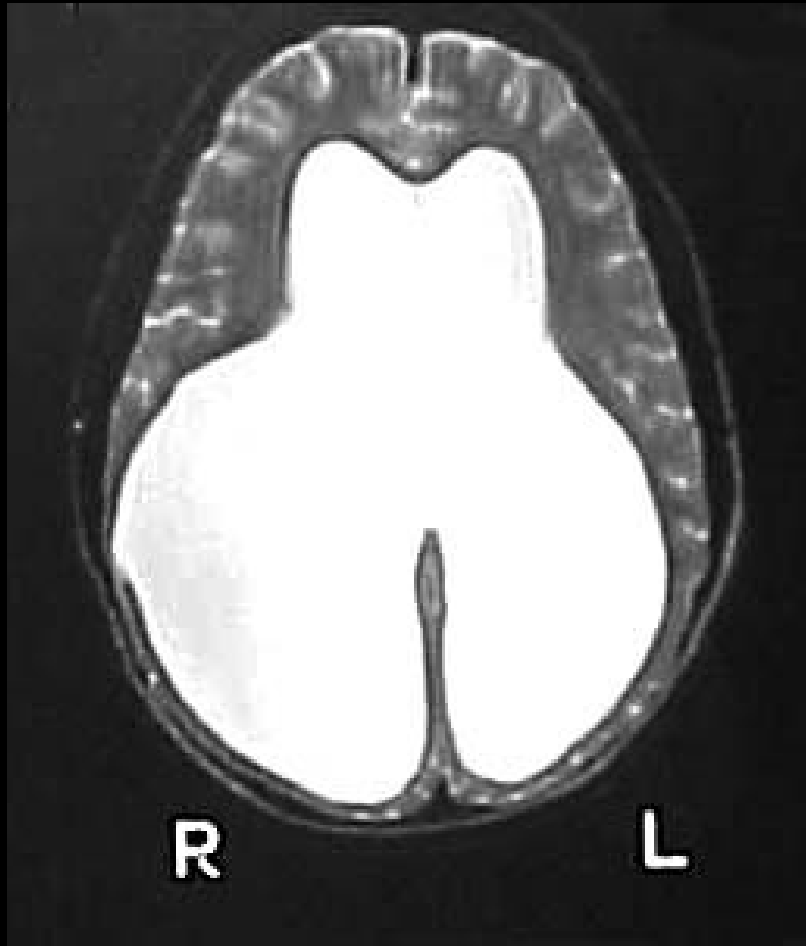
These are sagittal MR slices through the brain. An increase in CSF production within this patient's ventricles have resulted in a condition known as **hydrocephalus**.

Hydrocephalus:



These are coronal MR slices through the brain of this same patient further depicting the severity of this condition.

Hydrocephalus:



This is a side-by-side and magnified comparison of the previous two slides depicting **hydrocephalus**.

Cerebrovascular Accident (CVA):

- A CVA refers to a cut-off of blood supply (ischemia) to part of the brain resulting in an infarct.
- This process will result in a loss of brain function with 50% of the cases being fatal.
- A thrombus is an accumulation of plaque within the lumen of blood vessels.
 - A piece of this plaque may break off and form an embolus which could result in the a CVA.
- A CVA can also be caused by a rupture of blood vessels from trauma, an aneurysm, or hypertension.
- Symptoms include headaches, aphasia, paralysis, hemiparalysis, confusion, or coma.

CVA Hierarchy:

1. Stroke
2. Transient Ischemic Attack (TIA)
3. Intracranial Hemorrhage
 - a. Intracerebral (Parenchymal) Bleeding
 - b. Subarachnoid Bleeding
 - c. Extracerebral Bleeding
 - (1) Subdural Hematoma
 - (2) Epidural Hematoma

CVA: Stroke

- A stroke is a type of CVA that is caused by an embolus with the net result being brain damage from ischemia.
- Treatment for a stroke usually consists of rehab, blood thinners for prevention, and reducing risk factors such as smoking.

CVA: Transient Ischemic Attack (TIA)

- A TIA is essentially a small stroke that is caused by the same factors that cause a full stroke.
- They are often considered a warning sign for a larger stroke.
- A TIA presents with minimal symptoms that usually resolve within 24 hours.

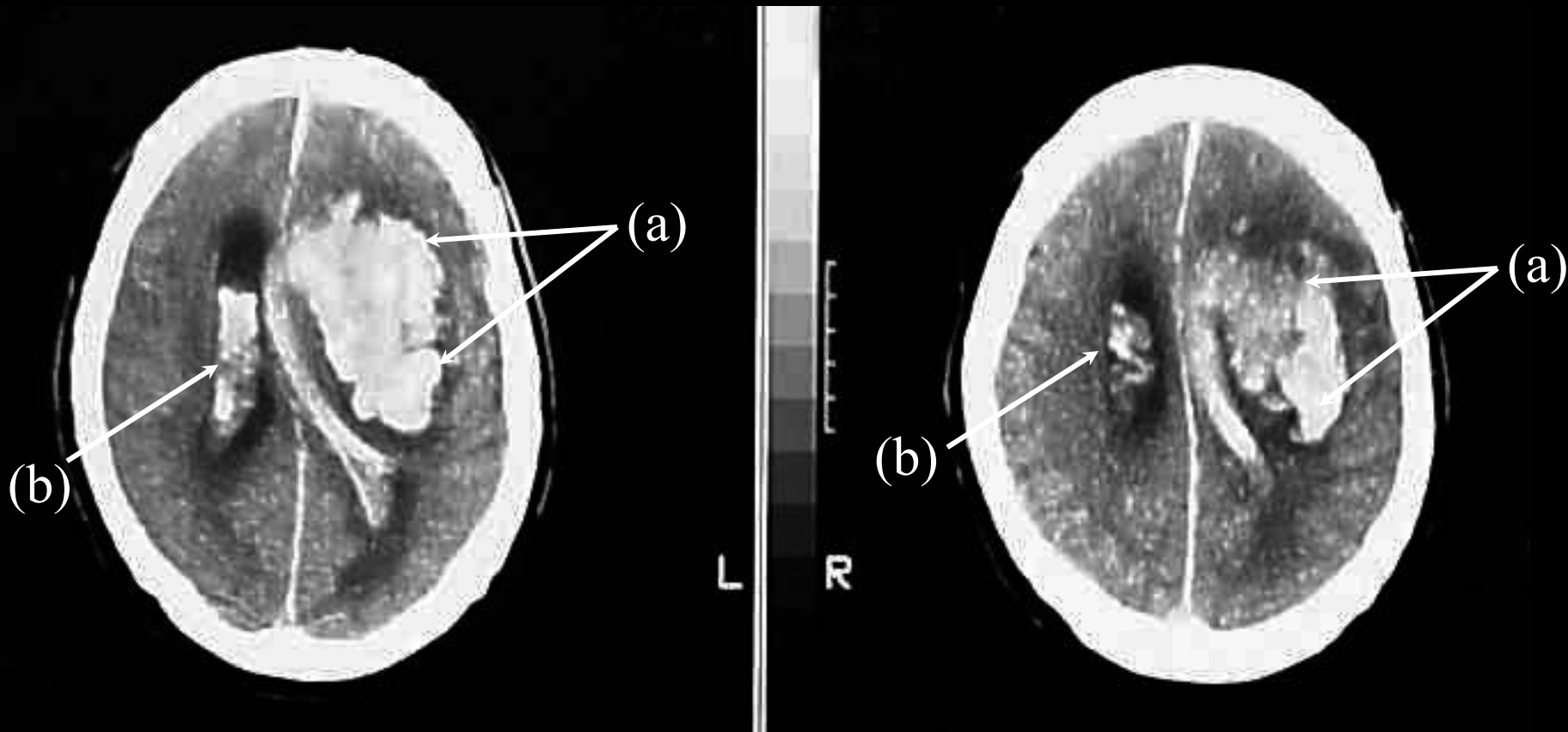
CVA: Intracranial Hemorrhage

- An intracranial hemorrhage is a general term that refers to an escape of blood from an artery or vein.
- It can be caused by hypertension, trauma, a bleeding tumor, or a ruptured aneurysm.
- The three types of intracranial hemorrhage are as follows and will be described on subsequent slides:
 1. Intracerebral or Parenchymal Bleeding
 2. Subarachnoid Bleeding
 3. Extradural Bleeding

CVA: Intracerebral Bleeding

- As the name implies, intracerebral or parenchymal bleeding refers to a loss of blood within the cerebrum.

Intracranial Hemorrhage:

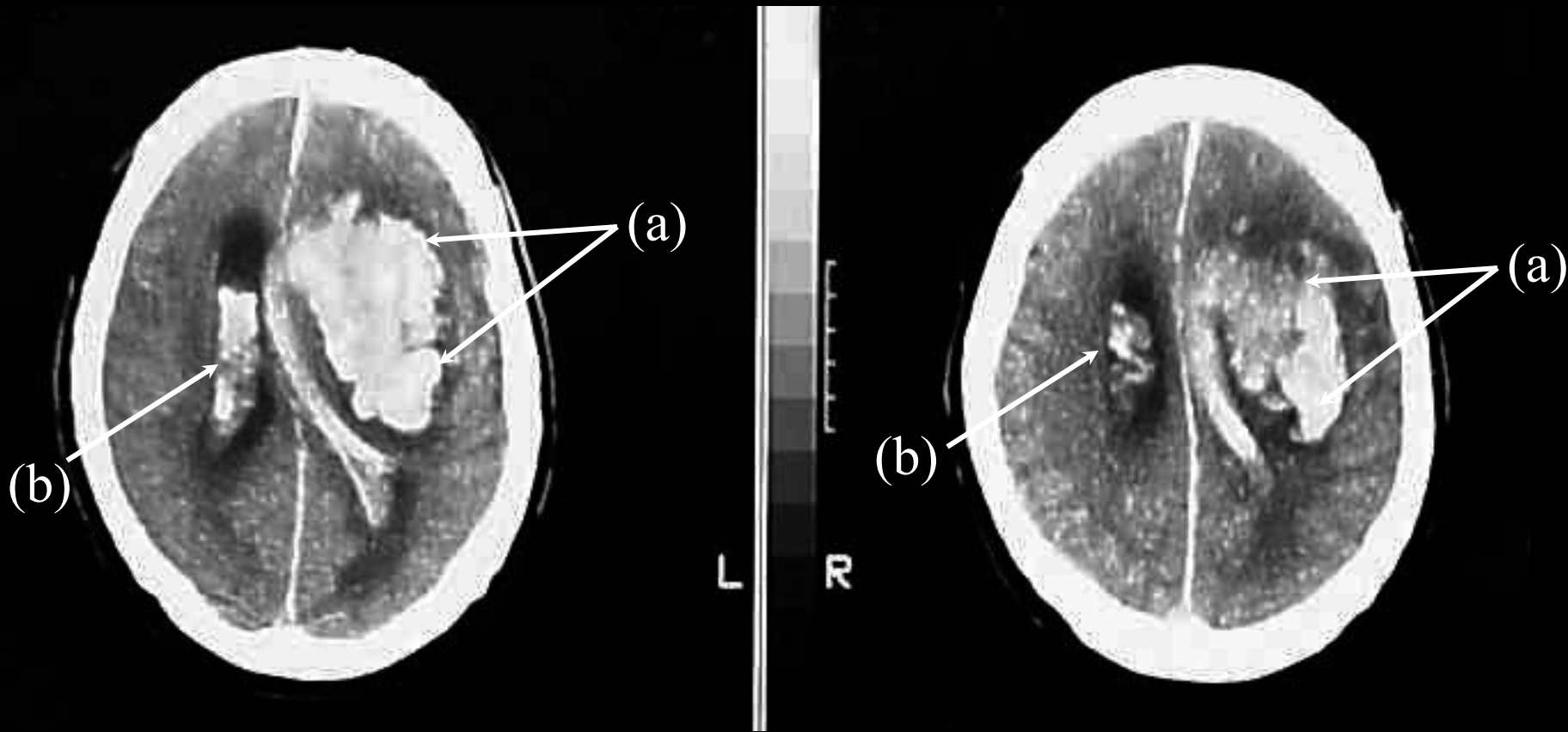


These images demonstrate two types of Intracranial Hemorrhage: **Intracerebral (Parenchymal) Bleeding** (a) and **Subarachnoid Bleeding** (b).

CVA: Subarachnoid Bleeding

- Subarachnoid bleeding refers to bleeding into the ventricles of the brain.

Intracranial Hemorrhage:



These CT images demonstrate two types of Intracranial Hemorrhage: **Intracerebral (Parenchymal) Bleeding** (a) and **Subarachnoid Bleeding** (b).

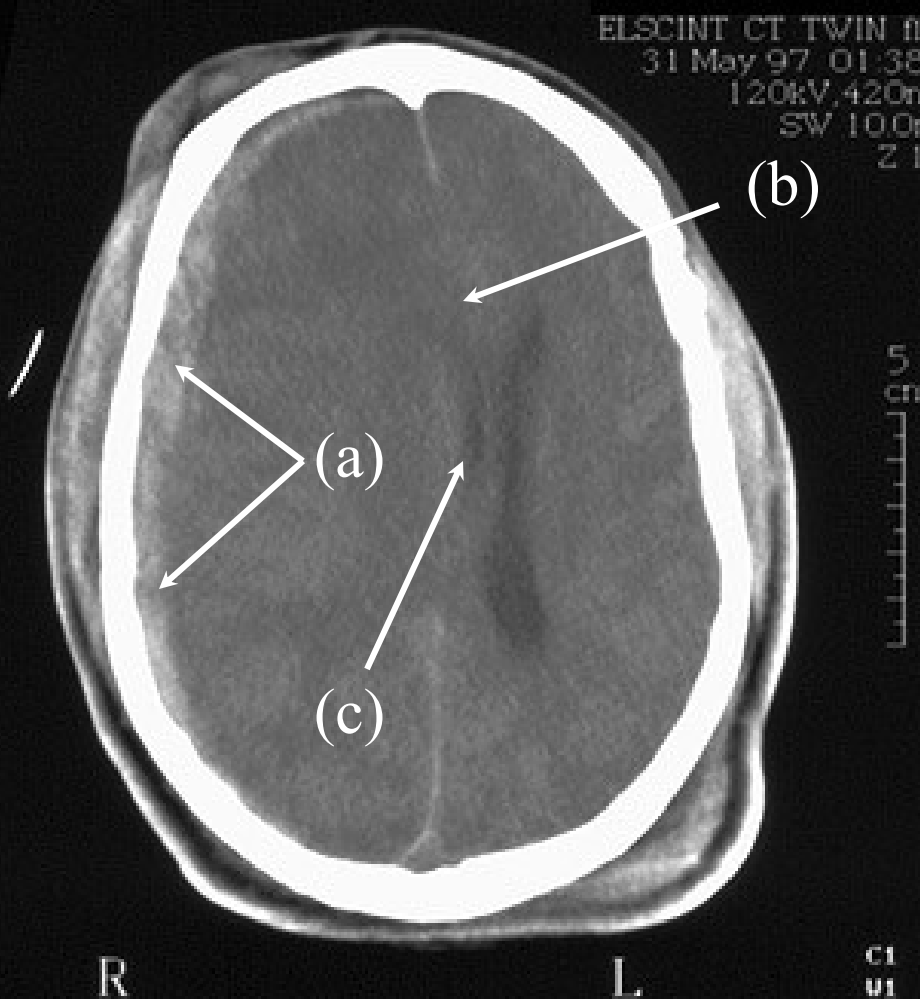
CVA: Extracerebral Bleeding

- Extracerebral bleeding is a type of intracranial hemorrhage that results in bleeding outside of the brain but within the skull.
- Trauma is often the etiology of this type of CVA.
- The net result is compression on the brain and possible brain damage if it is severe.
- This may be treated with a craniotomy to relieve the pressure on the brain.
- There are two types of extracerebral bleeding and they will be described on subsequent slides:
 1. Subdural Hematoma
 2. Epidural Hematoma

CVA: Subdural Hematoma

- This results from the leaking of subdural veins into the space found between the dura mater (outermost covering of the brain) and the arachnoid mater (middle layer of meninges).
- This low pressure venous bleeding may result in chronic symptoms.
- It can also produce acute, rapid bleeding if the trauma is severe.

Intracranial Hemorrhage:



The type of **extracerebral bleeding** that is found on this CT image is called a **subdural hematoma**. Note the right crescent shaped blood collection (a), midline shift (b), and fluid in the right ventricle (c).

CVA: Epidural Hematoma

- This is caused by the build up of blood between the dura mater and the skull.
- It is often caused by trauma to the temporal bone that damages the middle meningeal artery.
- It often results in rapid death unless medical attention is close at hand.
- Epidural hematomas produce a characteristic biconvex or lentiform (lens) configuration on CT scans of the brain.

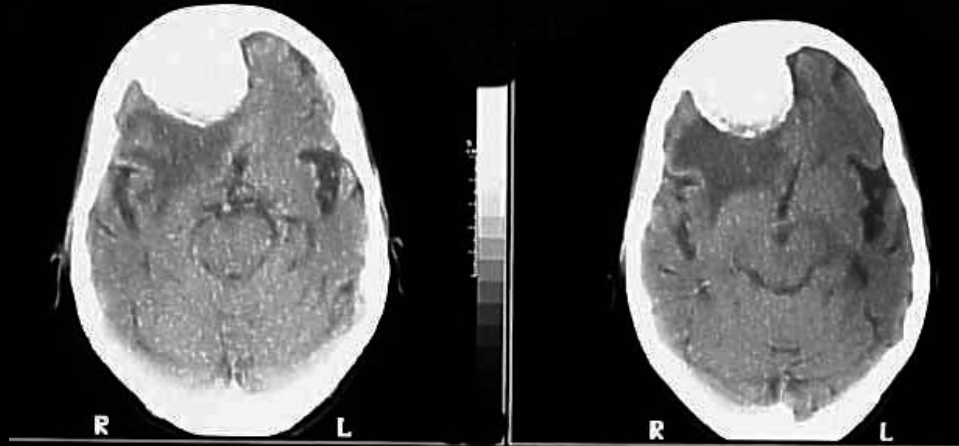
Astrocytoma:

- Astrocytomas make up approximately 30% of all primary brain neoplasms.
- They are derived from astrocytes which are star shaped neuroglial cells with many branching processes.
- They present as a vascular mass that enhances with contrast on CT and MR scans.
- Astrocytomas will become malignant but have a good prognosis of 90% of diagnosed patients living past 5 years.
- Treatment can include surgery, chemotherapy, and radiation therapy.

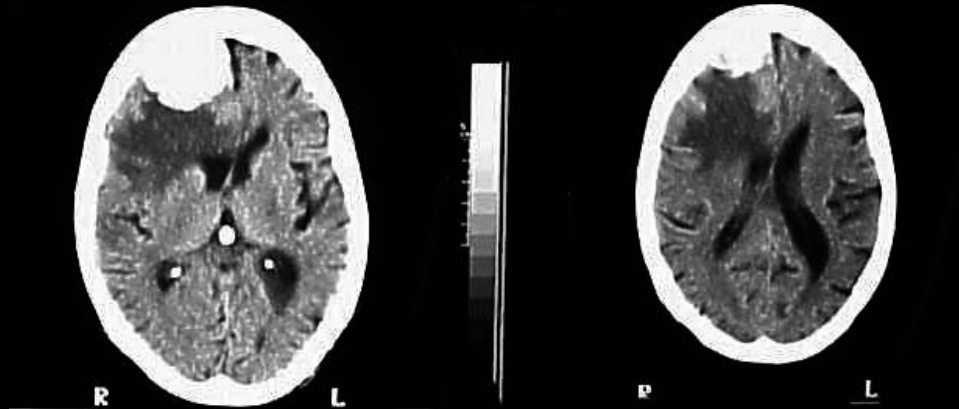
Meningioma:

- This primary brain neoplasm is slow growing and usually benign.
- Meningiomas account for about 15% of all intracranial tumors.
- They originate within arachnoid tissue and compress the brain as they grow in.
- Meningiomas present as a round, smooth mass that can calcify on CT and MR scans.
- Treatment usually includes surgical resection but radiation therapy may be indicated for inoperable cases.

Meningioma:



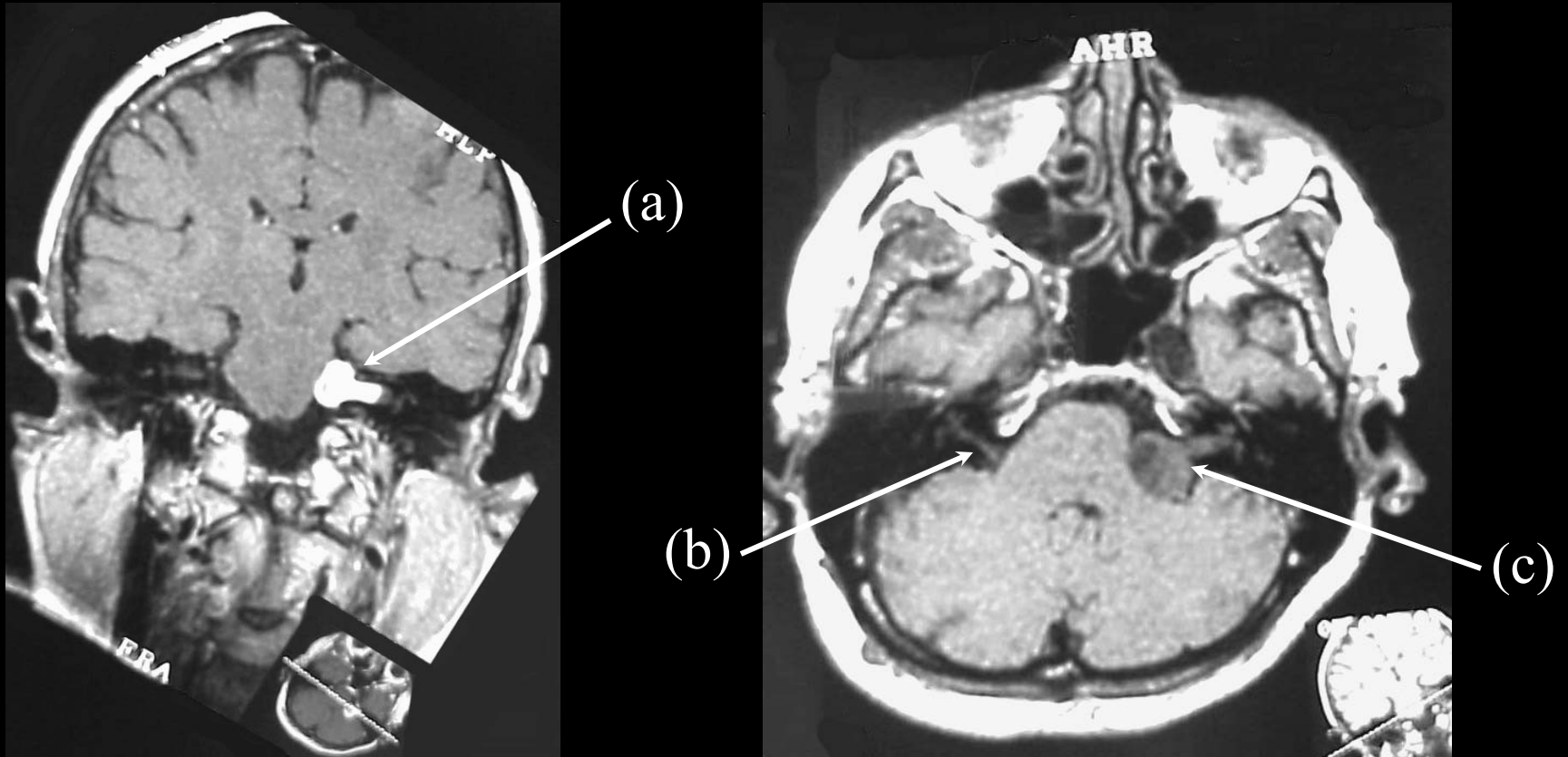
These images depict a large
**right, frontal calcified
meningioma.**



Acoustic Neuroma:

- An acoustic neuroma is a benign tumor most commonly associated with the VIII cranial (acoustic) nerve housed within the temporal bone.
- Symptoms include hearing loss, tinnitus (ringing in the ears), vertigo, and ataxia (loss of balance).
- Small tumors may not require treatment but surgery and chemotherapy are options for larger tumors.

Acoustic Neuroma:



Arrows (a) and (c) are pointing to an **acoustic neuroma** on these MR images. Note how a healthy nerve (b) has a “palm tree-like” appearance.

Pituitary Adenoma:

- This is a slow growing, usually benign tumor of the pituitary gland.
- They will affect the hormones produced by the pituitary gland.
- CT and MR scans will yield an increase in the size of the sella turcica with the possibility of extension into the optic chiasm.
- Small tumors may be treated medically but advanced tumors may require surgical removal possibly followed by radiation therapy.

Pituitary Adenoma:



This MR image is a sagittal slice through the brain approximately at the midline. The arrow is pointing to a **pituitary adenoma** which is located within the sella turcica above the sphenoid sinus (dark area).

Spina Bifida:

- Spina bifida is a congenital defect where the lamina fail to unite posteriorly to form the spinous process.
- It is most commonly manifested at L5-S1.
- In severe cases, the spinal cord and/or the meninges may herniate which may result in varying degrees of paralysis.

Meningocele is when only the meninges herniate

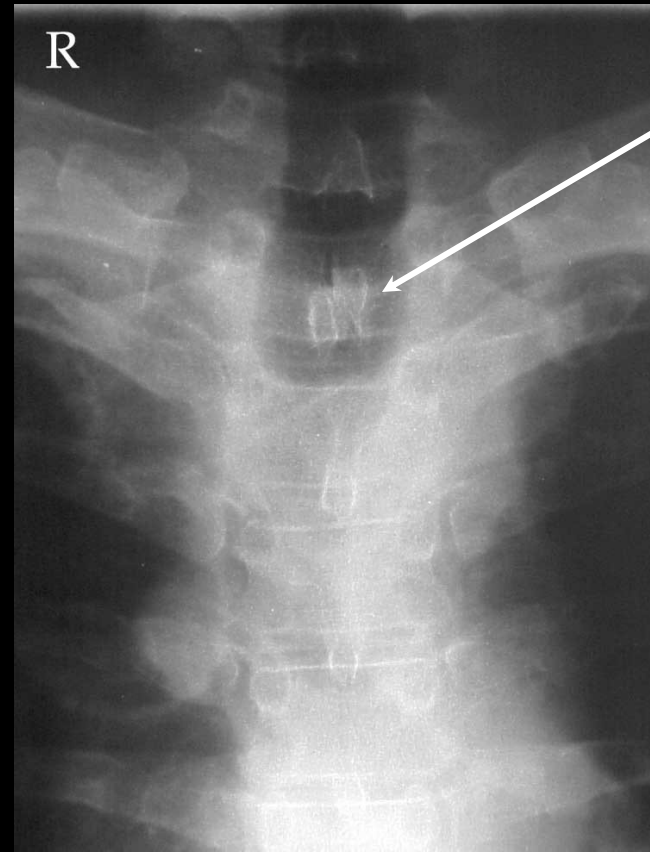
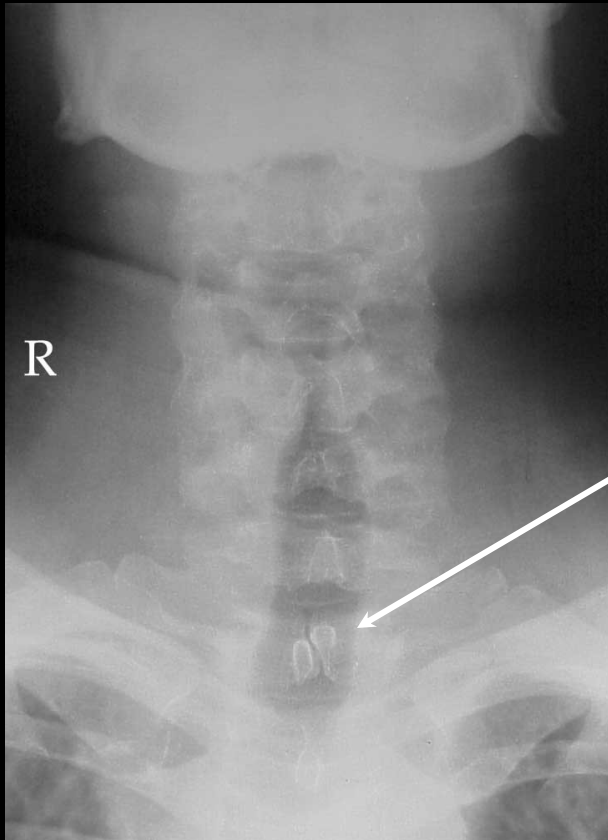
A meningomyelocele occurs when both the meninges and spinal cord herniate.

- This is a very serious condition and requires surgical intervention.

Spina Bifida Occulta:

- This type of spina bifida is usually a mild occurrence that rarely results in the protrusion of the meninges or spinal cord.
- It is often a serendipitous discovery on routine radiographic images of the lumbar spine.

Spina Bifida Occulta:



The arrow is pointing to T1 on a patient that has **spina bifida occulta**. This is a mild condition with usually no protrusion of the meninges or spinal cord. The second image is a magnified version of the first image.

Spina Bifida Occulta:

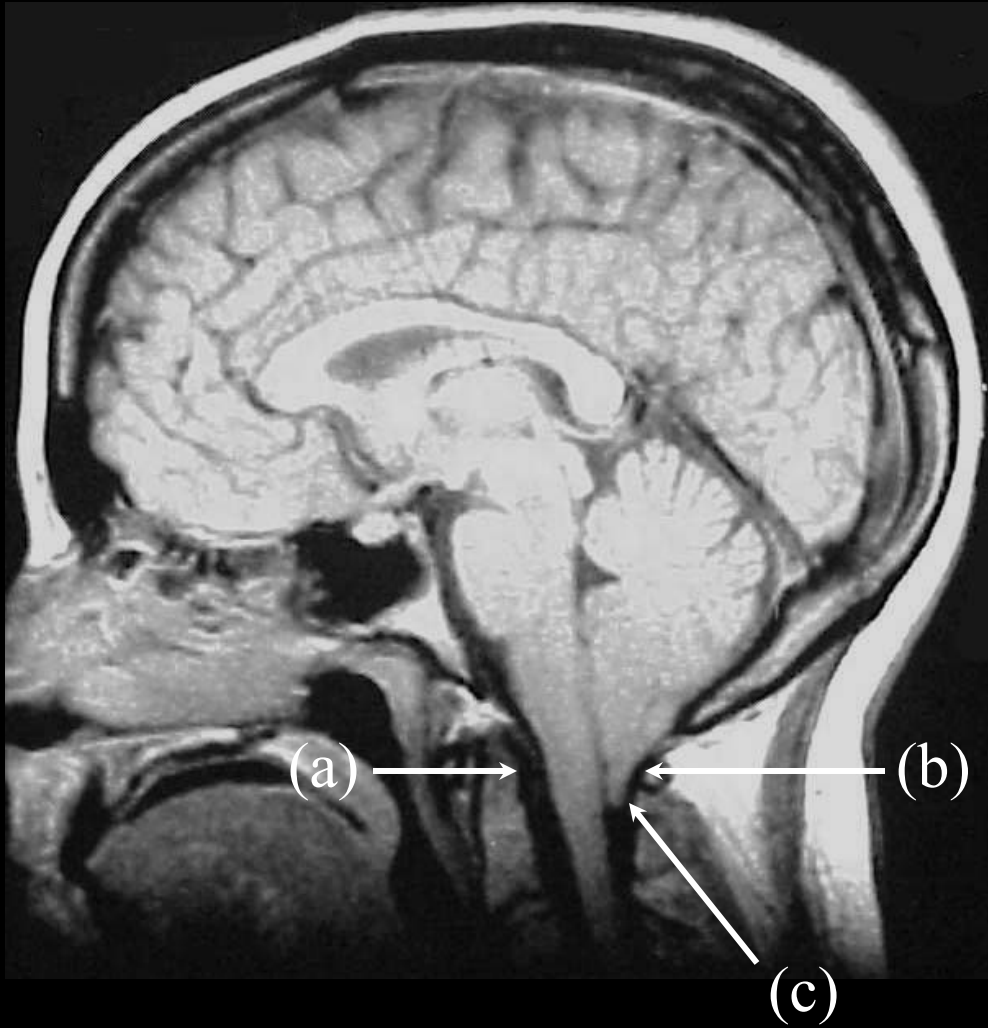


The arrow is pointing to L1 on a patient that has **spina bifida occulta**. Note how the lamina have failed to connect posteriorly to form a proper spinous process.

Arnold Chiari Malformation:

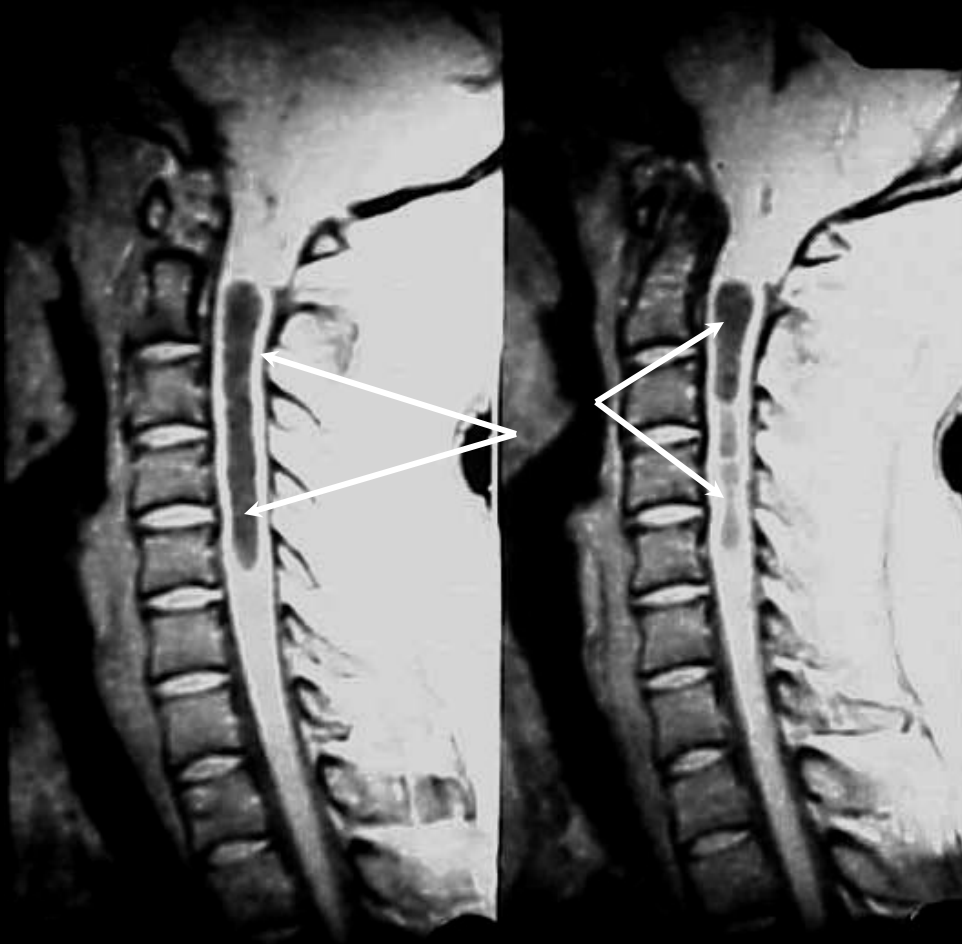
- Children born with spina bifida and hydrocephalus often have Arnold Chiari Malformation
- This congenital defect allows the cerebellar tonsils to herniate through the foramen magnum and into the spinal canal.
- This can block the flow of CSF and cause the brain stem and cerebellum to become stretched and compressed.
- This condition will require surgical correction.
- Arnold Chiari Malformation will often cause the formation of syrinx within the spinal cord which is a fluid filled cavity which may also obstruct the flow of CSF.
- MR is the imaging modality of choice for this condition.

Arnold Chiari Malformation:



Arrows (a) and (b) are pointing to the level of the foramen magnum on this sagittal MR image. The cerebellar tonsils (c) have herniated below this point thus resulting in a condition known as **Arnold Chiari Malformation**.

Arnold Chiari Malformation:

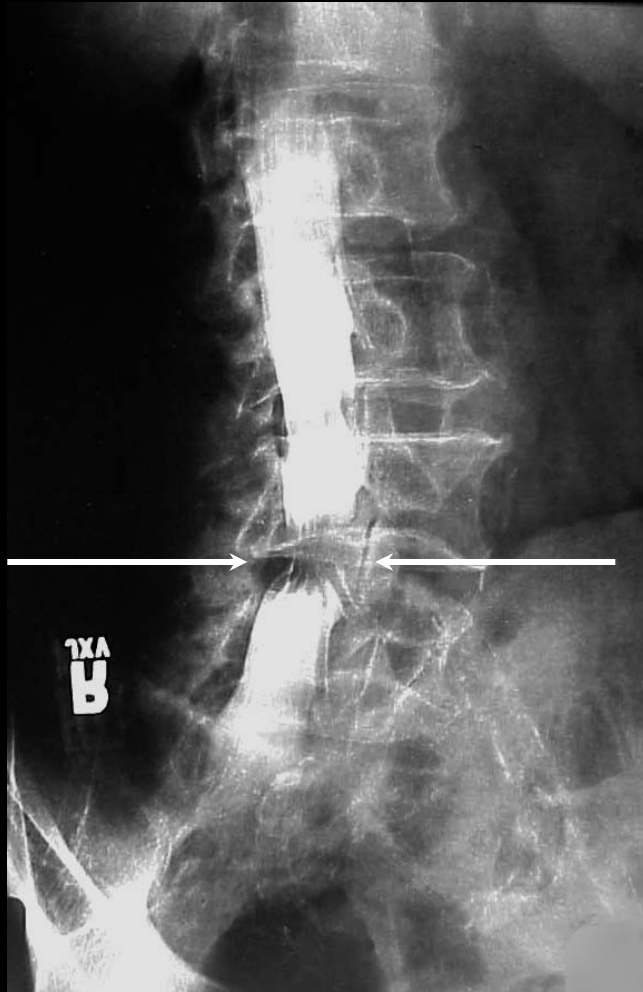


Arrows on this sagittal MR image are pointing to a **syrinx** of the cervical spinal cord which is also an indication that the patient has a condition known as **Arnold Chiari Malformation**.

Spinal Stenosis:

- Spinal stenosis is simply a narrowing of the spinal canal.
- It can be caused by a disc herniation, spinal fracture, degenerative changes, or a tumor.

Spinal Stenosis:

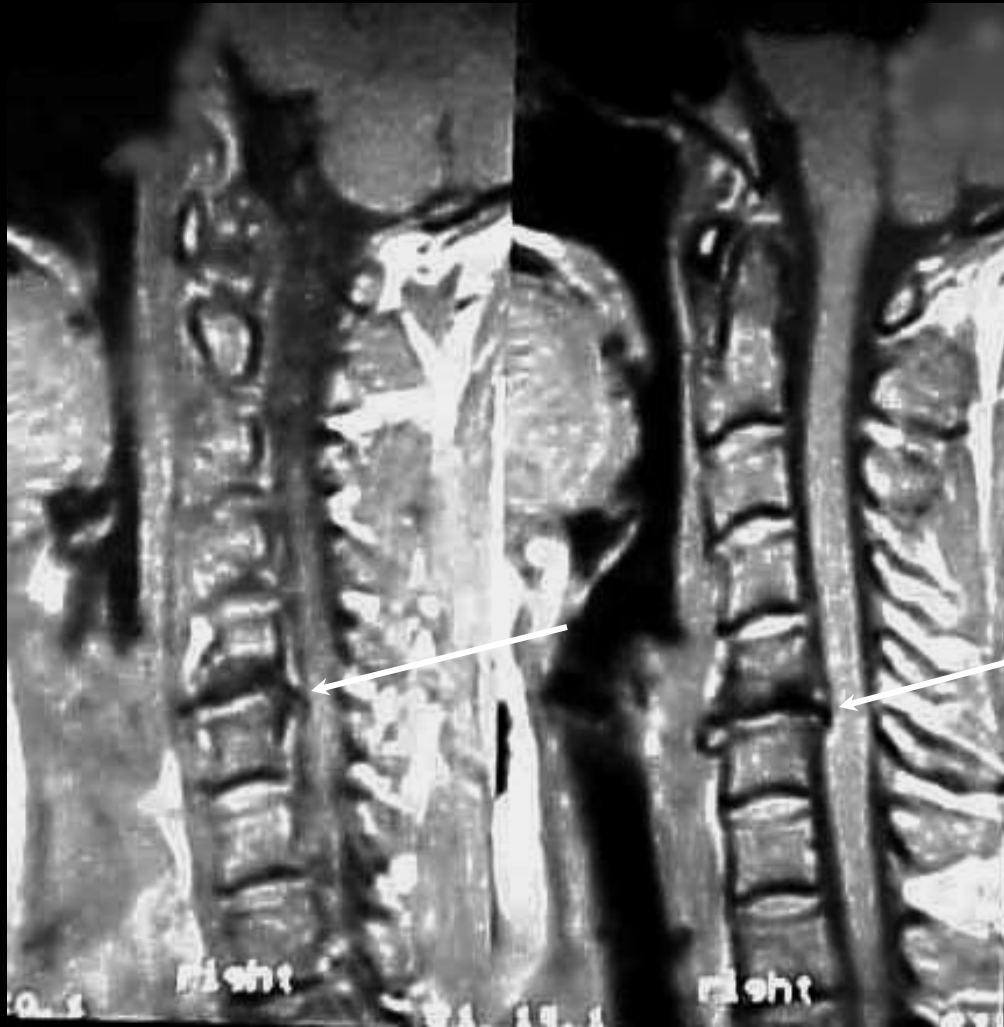


Arrows on this LPO position for a myelogram are pointing to an area where the spinal canal is being compressed causing **spinal stenosis**. The likely cause for this condition would be a herniated nucleus pulposus (HNP).

Disc Herniation:

- A herniated nucleus pulposus (HNP) or slipped disc, is a condition in which part or all of the soft, gelatinous central portion of an intervertebral disk (the nucleus pulposus) is forced through a weakened portion of the outer disk (the annulus fibrosis).
- A posterior herniation can result in back and leg pain caused by nerve root irritation.
- A conservative treatment for this condition would be bed rest, analgesics, physical therapy, and steroids to reduce the inflammation.
- An invasive treatment would include possibly a laminectomy or discectomy.

Disc Herniation:

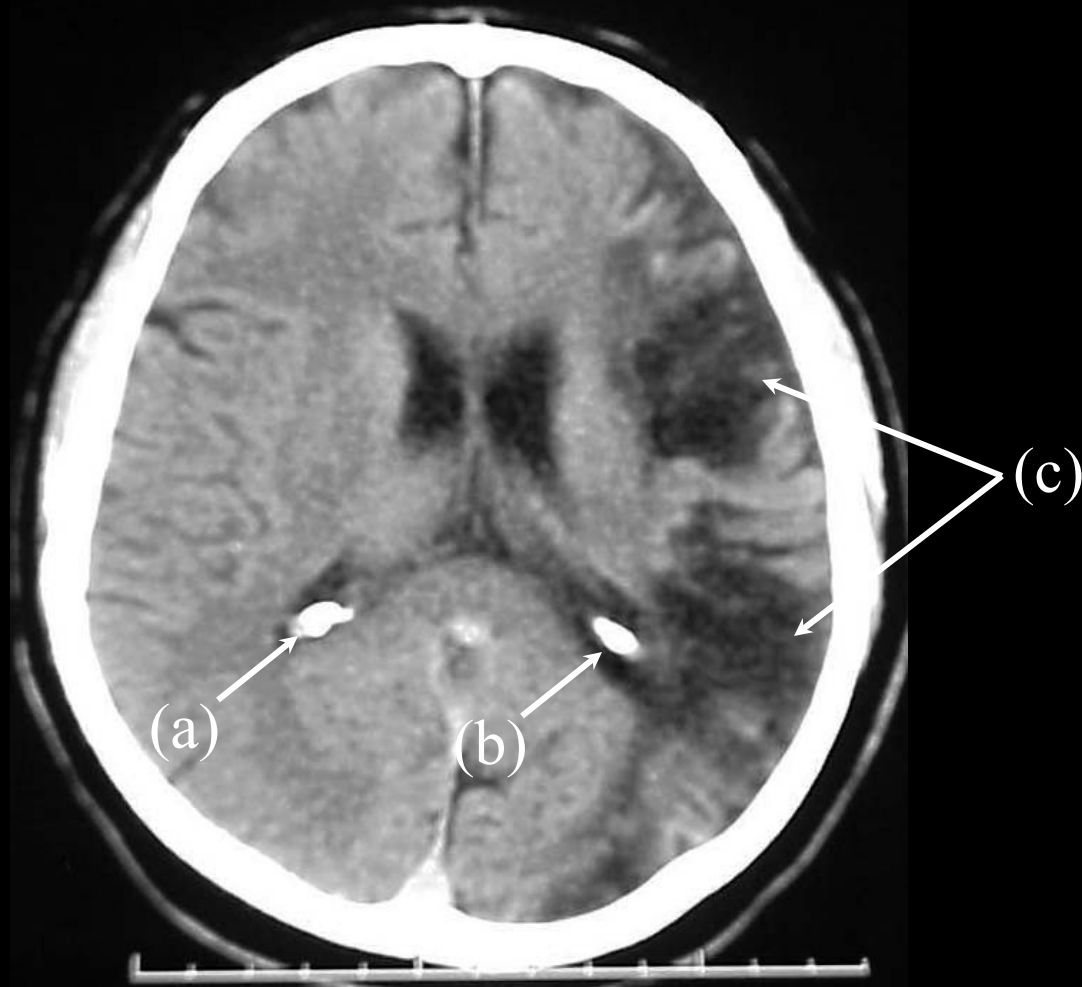


Arrows on this sagittal MR image of the cervical spine are pointing to a **herniated nucleus pulposus** of C5-C6.

Calcified Choroid Plexus:

- The choroid plexus is an area found within the ventricles of the brain that is responsible for producing cerebral spinal fluid (CSF).
- On occasion, a portion of the choroid plexus may become calcified and this usually has no clinical significance.

Calcified Choroid Plexus:

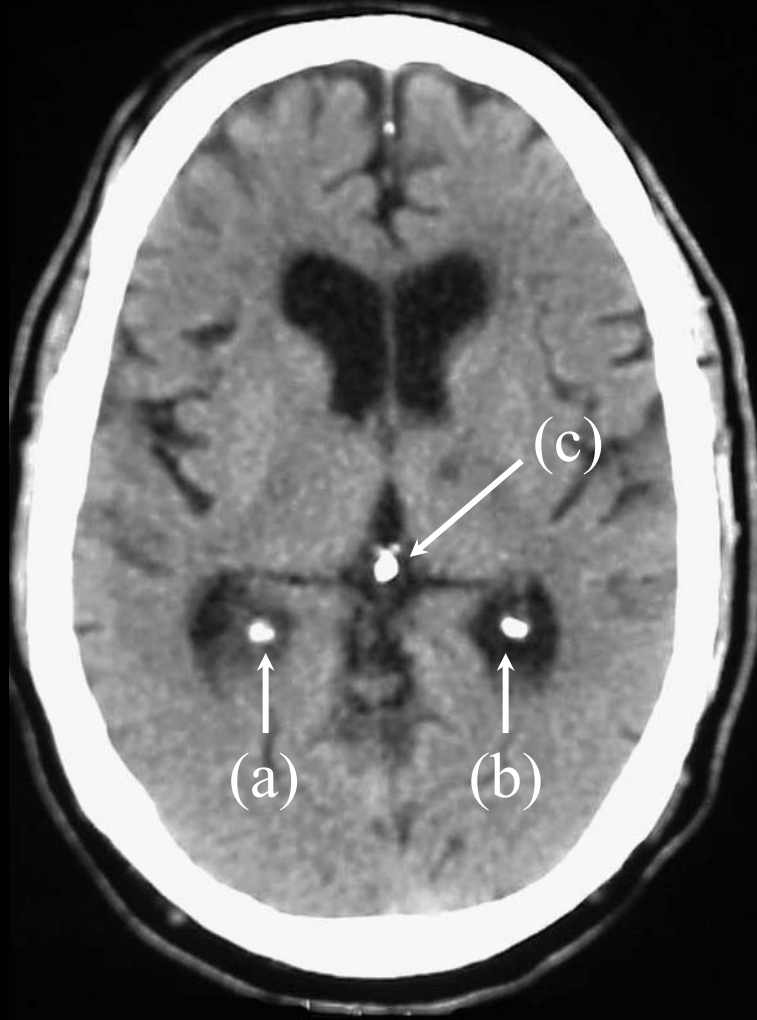


Arrows (a) and (b) on this CT image are pointing to a calcified portion of the **choroid plexus** that is located within the ventricles of this patient's brain. The arrows for (c) are pointing to an old left parietal CVA.

Calcified Pineal Gland:

- The pineal gland is an endocrine gland that is located within the brain.
- It produces a hormone called melatonin which is believed to play a role in regulating sleeping patterns.
- On occasion, a pineal gland may become calcified and this usually has no clinical significance.

Calcified Pineal Gland:



Arrows (a) and (b) on this CT image are pointing to a calcified portion of the **choroid plexus** that is located within the ventricles of this patient's brain. The arrow for (c) is pointing to the calcified pineal gland.

Urinary System Menu

1. Kidney Agenesis/Atresia
2. Kidney Hypoplasia
3. Renal Abscess
4. Renal Cysts
5. Polycystic Kidneys
6. Horseshoe Kidneys
7. Duplicate Collecting Systems
8. Ectopic Kidneys
9. Renal Calculi
10. Vesicoureteral Reflux
11. Renal Cell Carcinoma
12. Wilm's Tumor
13. Ureteral Diverticula
14. Bladder Diverticula
15. Phleboliths
16. Transitional Cell Carcinoma

Kidney Agenesis or Atresia:

- A congenital defect where an organ is not formed is called atresia.
- In this particular instance, kidney atresia would be the congenital absence of a kidney.
- These patients often have other congenital defects as well and there is no treatment.

Kidney Agenesis or Atresia:



Note the complete absence of a right kidney on this IVP radiograph. This patient has not had their kidney surgically removed. Rather, they suffer from a congenital defect where the kidney was never formed. This is known as **kidney agenesis or atresia**

Kidney Hypoplasia:

- Hypoplasia refers to an organ that has a diminished growth. This can be a congenital defect or the result of a chronic infection.
- In this particular instance, the diminished growth of a kidney would be referred to as kidney hypoplasia.
- There is no treatment for this condition.

Kidney Hypoplasia:



Either a congenital defect or an infection has caused a decrease in size of the right kidney on this IVP radiograph. This is known as **kidney hypoplasia**.

Kidney Hypoplasia:



A tomogram on this same patient reveals a more recognizable difference in the size of the right kidney as compared to the left kidney.

Renal Abscess:

- A bacterial infection is usually the etiology for the formation of a renal abscess.
- The origin may be from sepsis (blood infections) or from bacteria that has worked their way up from the bladder.
- Treatment includes antibiotic therapy and in some instances, the aspiration of fluid from within the abscess.

Renal Abscess:

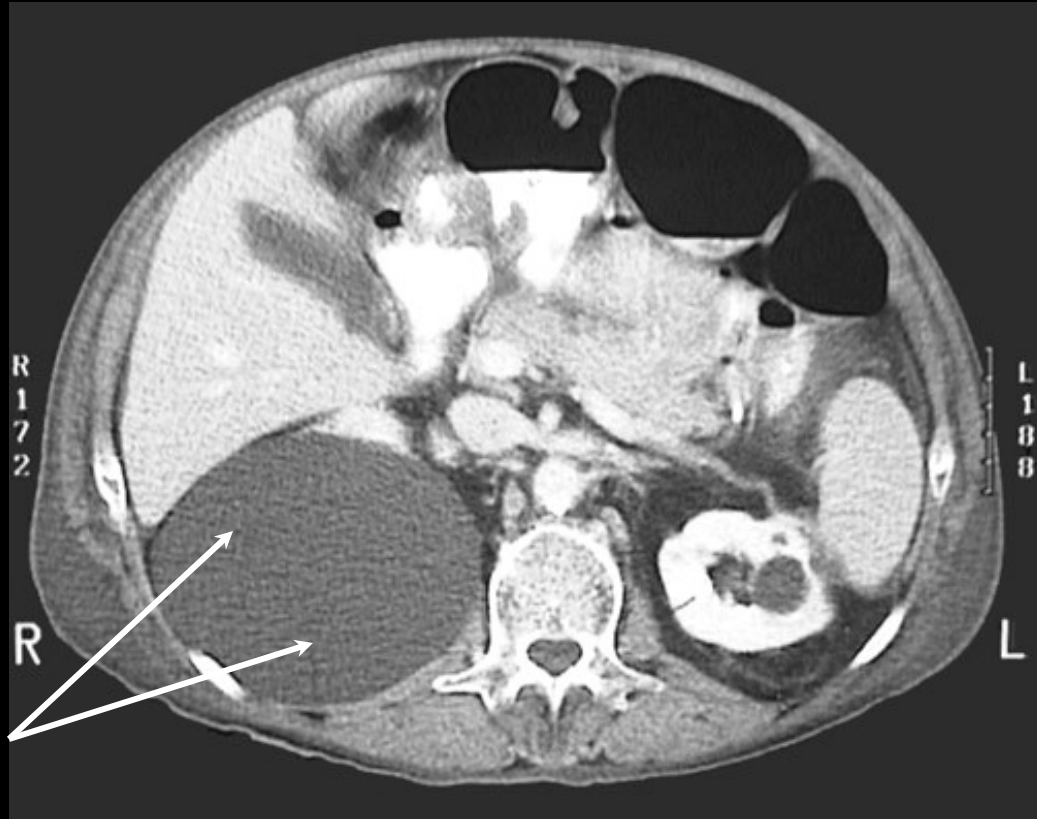


A bacterial infection is the cause of this **renal abscess** (arrows).

Renal Cysts:

- A cyst is a fluid filled, non vascular sac that can form anywhere in the body.
- In this particular instance, the cyst has formed on and is attached to the outside of the kidney.
- This is the most common unifocal mass found on a kidney.
- They are found in greater than 50% of the population that is 50 years or older.
- Ultrasound is the imaging modality of choice for their diagnosis.
- Most kidney cysts resolve on their own and are no cause for concern.

Renal Cysts:



The growth (arrows) on this CT image of the abdomen is caused by a large **renal cyst**. Most kidney cysts are harmless, as in this case, and do not need to be removed.

Renal Cysts:



This IVP tomogram provides another example of a **renal cyst** (arrows).

Polycystic Kidney Disease (PKD):

- This is a hereditary disease that is characterized by the presence of multiple cysts within the kidneys.
- Unlike renal cysts, polycystic kidneys lose function.
 - As the cysts expand, they put pressure on the nephrons which will ultimately cause an obstruction and a decrease in urine production.
- PKD can also affect the liver and pancreas.
- This disease can be diagnosed with an IVP, CT scan, and ultrasound which is the modality of choice.
- Treatment in advanced stages of PKD includes dialysis and kidney transplants.

Polycystic Kidney Disease (PKD):



Polycystic kidney disease is the cause of the distorted appearance of the renal pelvis of each kidney on this infant IVP radiograph.

Polycystic Kidney Disease (PKD):



The multifocal densities found within the kidneys (arrows) on this CT image of the abdomen are the result of damage caused by **polycystic kidney disease**.

Horseshoe Kidneys:

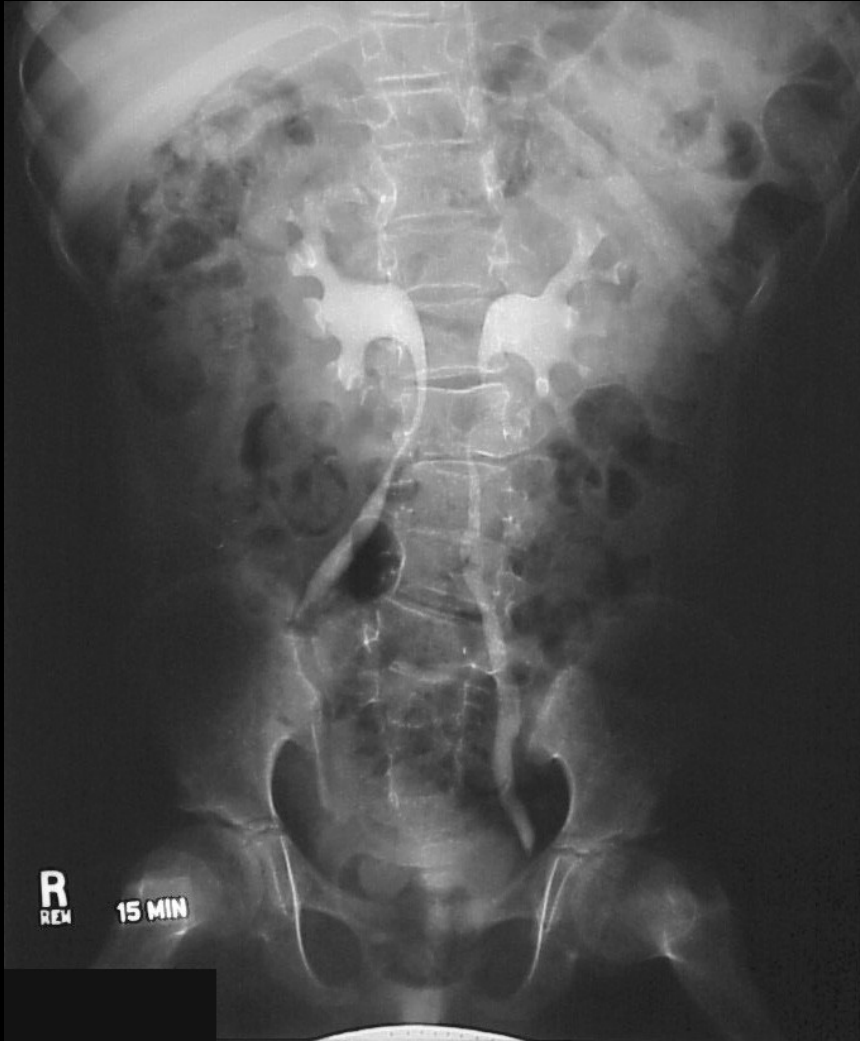
- Horseshoe kidneys is a congenital disease where the lower poles of both kidneys fuse causing both collecting systems to sit at an angle.

This odd angle has a propensity to produce stagnant urine that can eventually become infected.

If no infection is present, their presence will produce no discernable signs and symptoms.

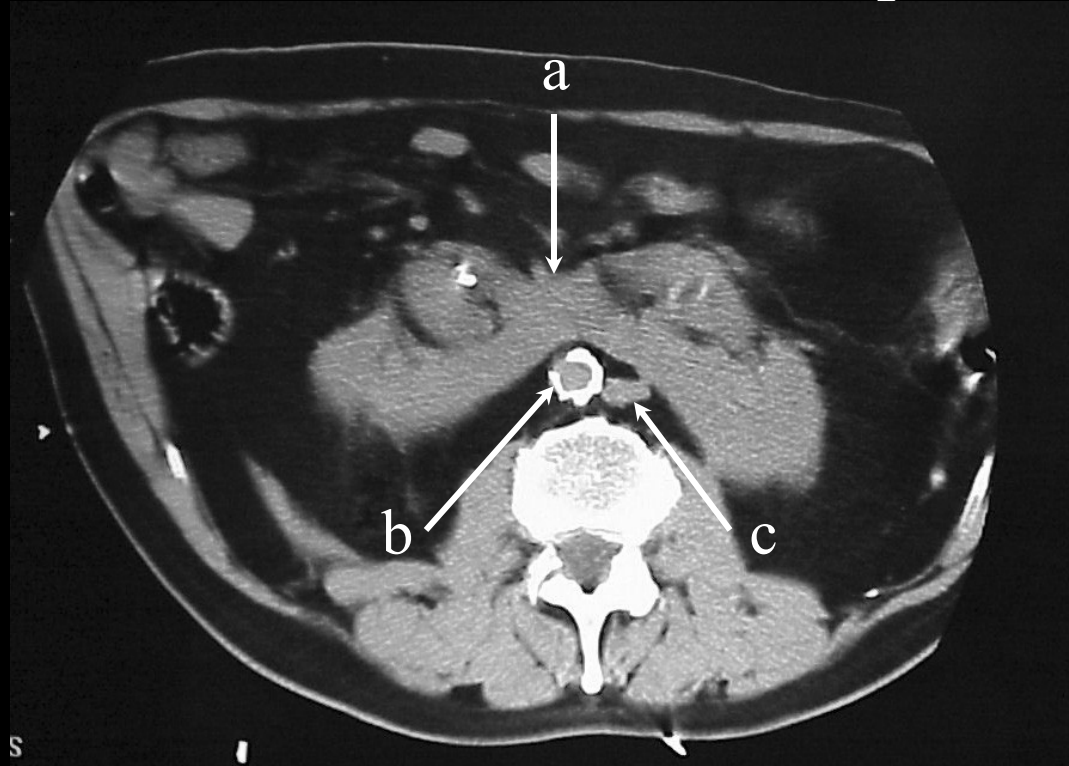
- There is no cure for this condition other than treating the symptoms.

Horseshoe Kidneys:



Note how the lower poles of the kidneys are rotated at an angle on this IVP radiograph. This is an indication that the patient has a condition known as **horseshoe kidneys**.

Horseshoe Kidneys:



The arrow labeled (a) on this CT image of the abdomen is pointing to the point where the lower poles of the kidneys are joined. It also demonstrates the close proximity between the **horseshoe kidney**, the abdominal aorta (c) and the inferior vena cava (b).

Duplication of Collecting Systems:

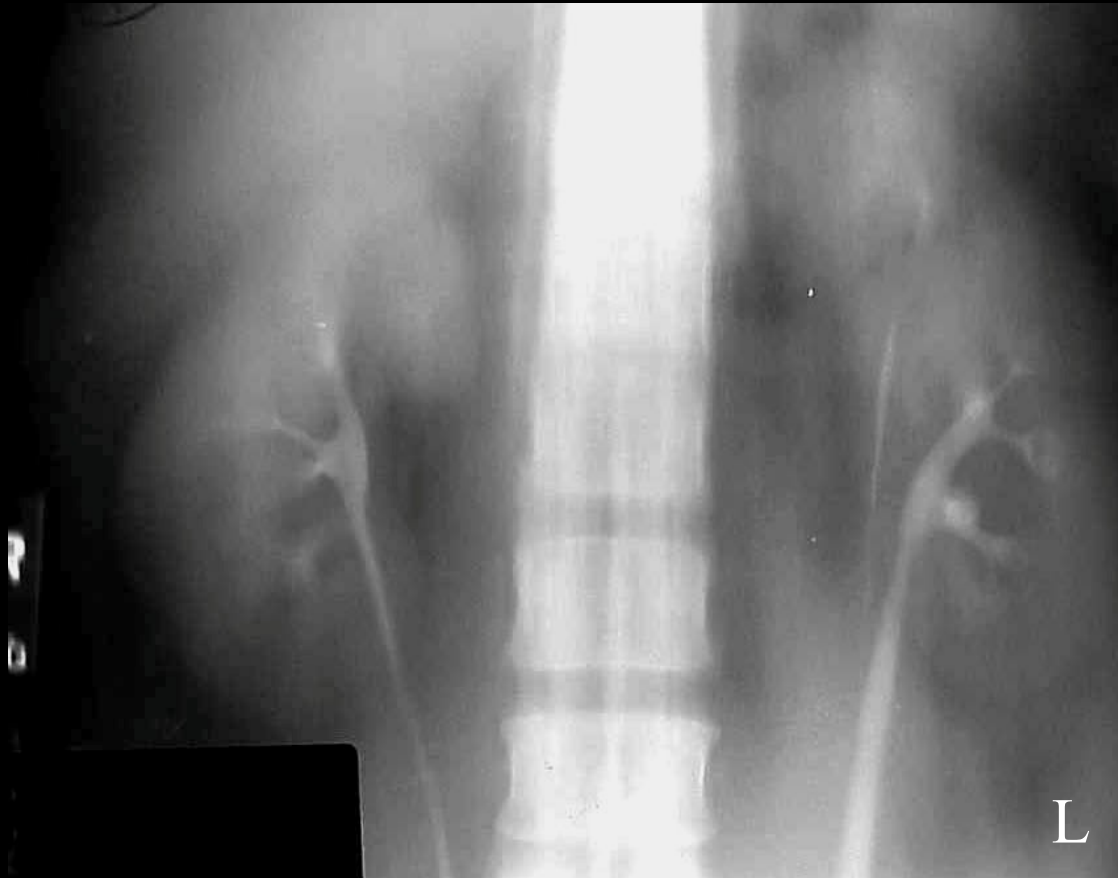
- The most common congenital anomaly of the urinary system is a duplication of the collecting systems.
- This is a defect where two ureters and one renal pelvis are present.
- The ureters may join or enter the bladder separately.
- This condition can be either unilateral or bilateral and usually does not require treatment.

Duplication of Collecting Systems:



This IVP radiograph demonstrates a **double collecting system** and two distinct ureters exiting the same kidney on the right.

Duplication of Collecting Systems:



This tomogram for an IVP demonstrates a **double collecting system** and two ureters on the left that appear to join.

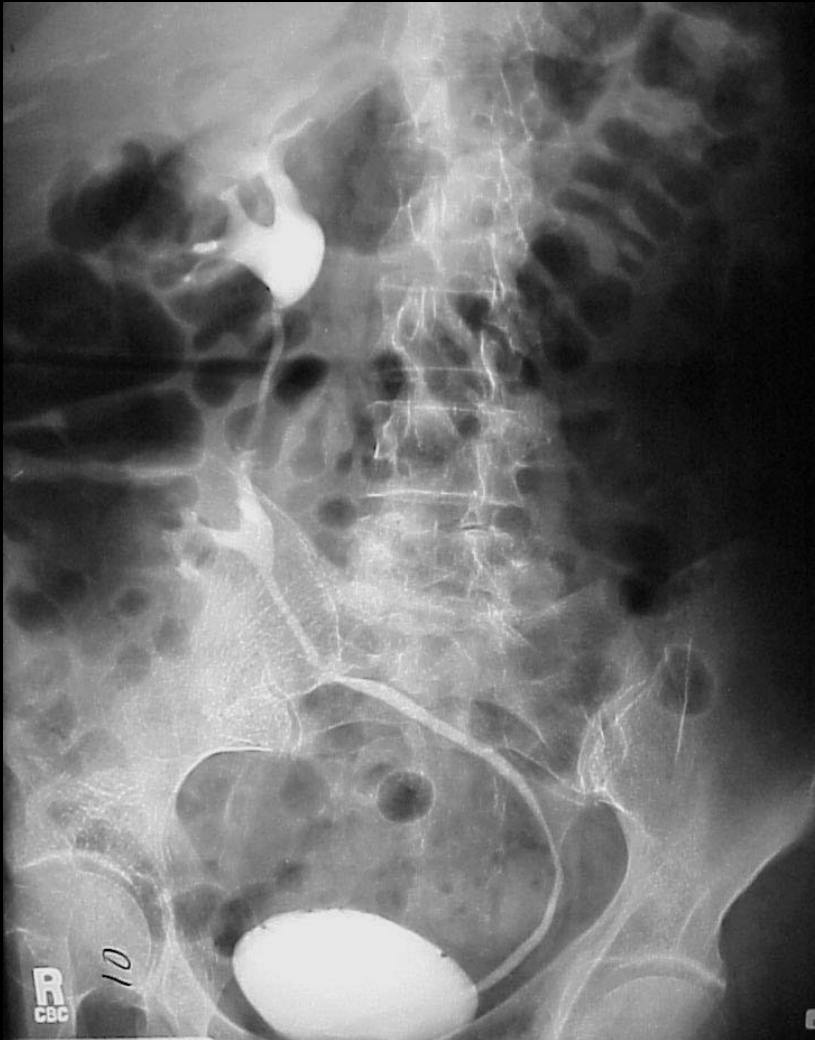
Ectopic Kidneys:

- An ectopic kidney is a congenital defect where the kidney is located in an abnormal position within the body.

They can be located within the boundary of the pelvis or even within the thorax.

- In most cases, this will have no affect on urine production but they may cause infections and kidney stones in some individuals.
- A common course of action is to just treat the symptoms that may be caused as a result of an ectopic kidney.

Ectopic Kidneys:



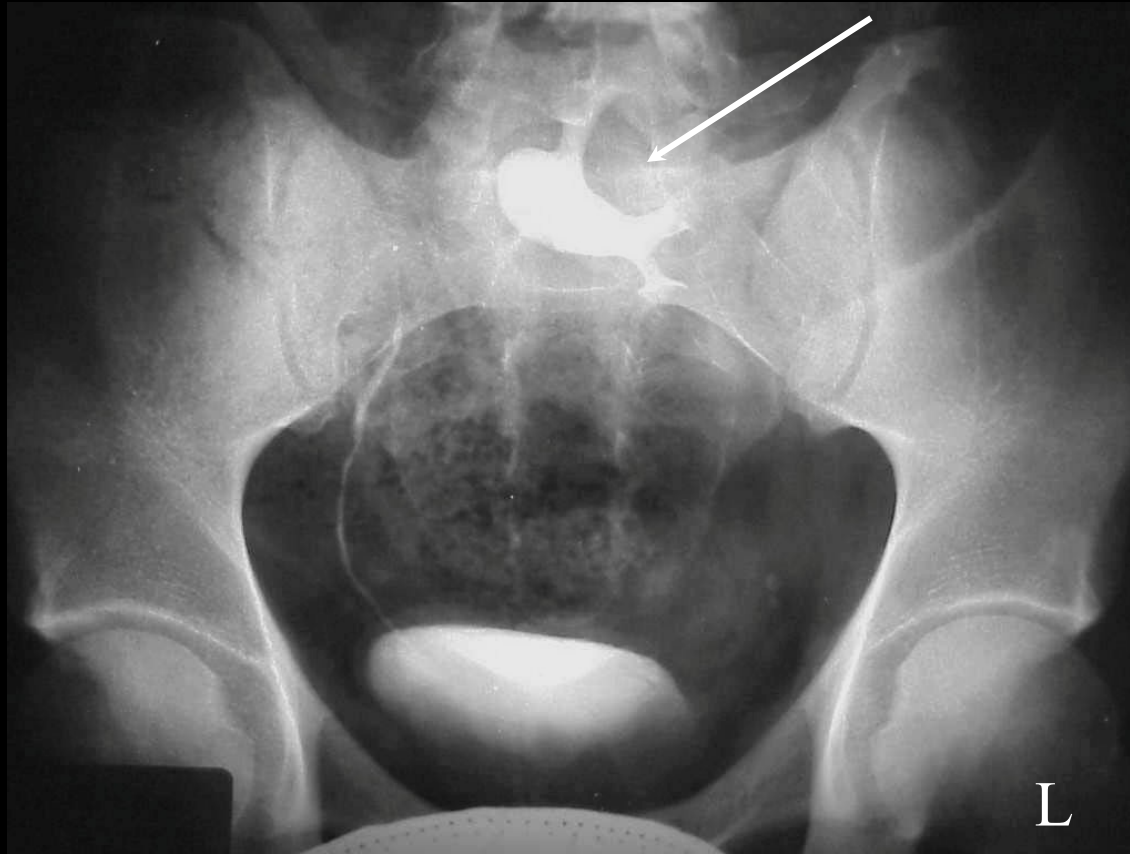
This RPO position for an IVP demonstrates how the left kidney is missing from its normal location within the abdomen. This would be an example of a congenital defect known as an **ectopic kidney**.

Ectopic Kidneys:



This IVP radiograph demonstrates another example of an **ectopic kidney** (arrow). Due to its location within the boundaries of the pelvis, this condition may also be referred to as a **pelvic kidney**.

Ectopic Kidneys:



This is a magnified view of the previous image. It clearly demonstrates how the left kidney (arrow) lies within the boundaries of the pelvis.

Renal Calculi:

- The presence of a kidney stone is the most common indication for an IVP
- They are commonly found in men ages 30 to 50.
- Kidney stones that develop within the collecting system may become lodged in the following areas:

The connection of the proximal ureter to the kidney which is called the ureteropelvic junction (UPJ).

Within the ureter.

The connection between the ureter and the bladder which is called the ureterovesical junction (UVJ).

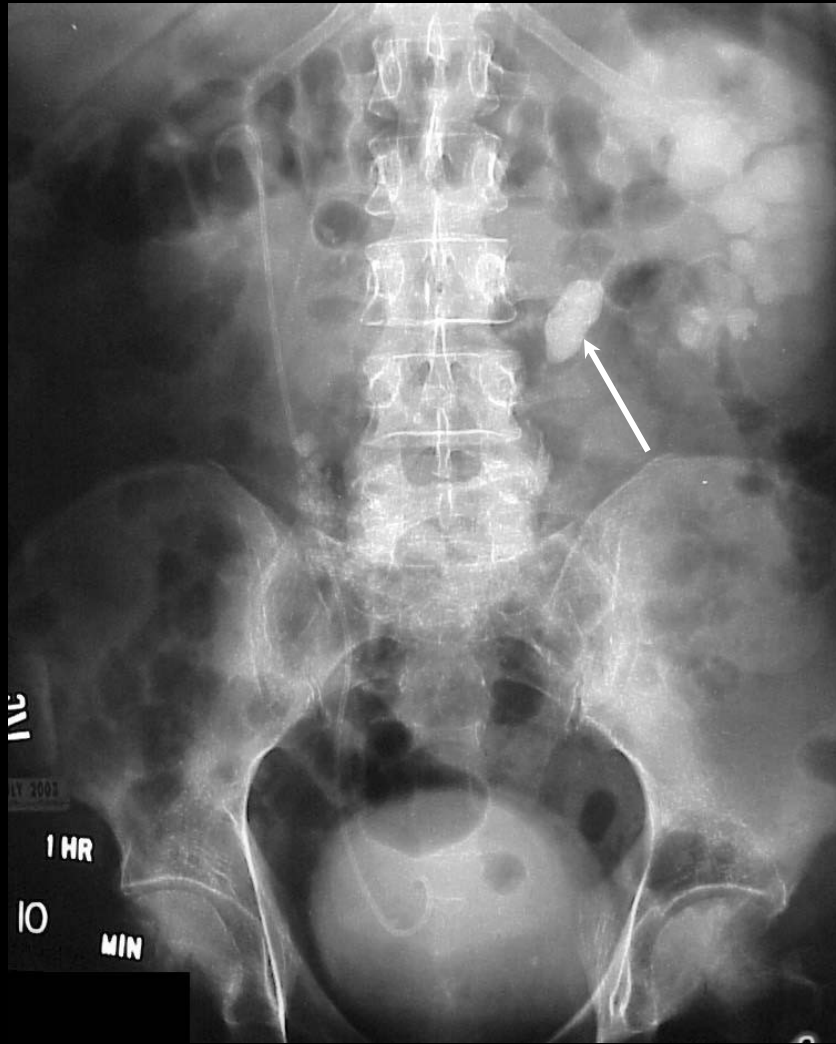
Within the bladder.

Within the urethra.

Renal Calculi:

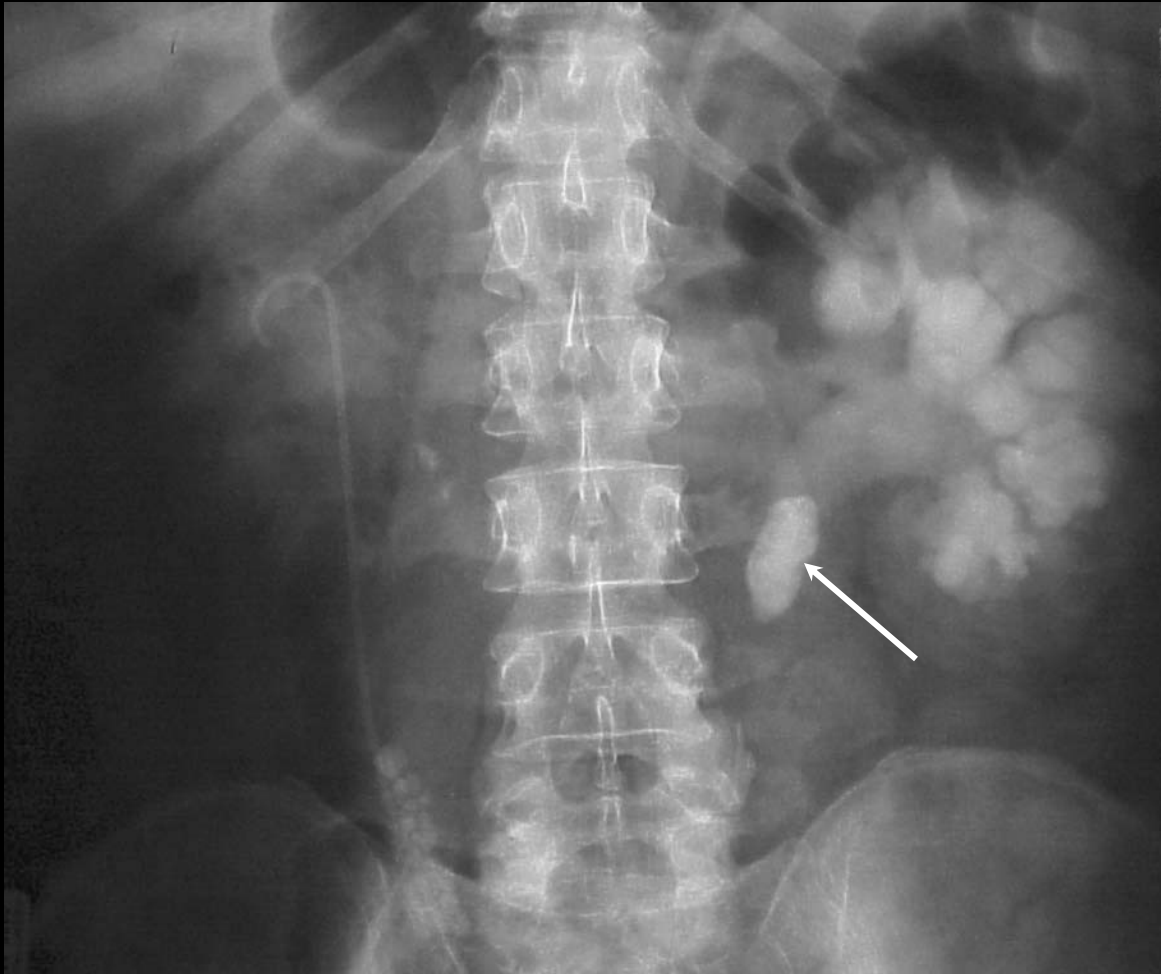
- Up to 80% of all kidney stones are made of calcium (radiopaque) and the rest are from uric acid (radiolucent).
- The common symptoms of kidney stones are as follows:
 - Flank Pain
 - Hydronephrosis (from the obstruction)
 - Pyonephrosis (infection)
 - Hematuria (blood in the urine)
- Treatment includes:
 - Pain Medications
 - Increase Fluids (to “flush” the stone)
 - Lithotripsy
 - Surgery

Right UPJ Calculus:



This patient is a prolific kidney stone producer. The arrow is pointing to an example of how a large stone can exit the renal pelvis and block the proximal ureter at the **UPJ**. Note the stent in the right kidney.

Right UPJ Calculus:



This is a magnified view of the previous image depicting a good example of a large **UPJ calculus** (arrow).

Right UVJ Calculus:



This post void IVP radiograph demonstrates how a **UVJ calculus** can cause a “columning” of contrast material within the ureter.

This would not normally occur because urine travels through the ureter via peristalsis. Also note the right hydronephrosis that has been caused by the obstruction. All of this is the result of a stone blocking the right **UVJ**.

Right UVJ Calculus:



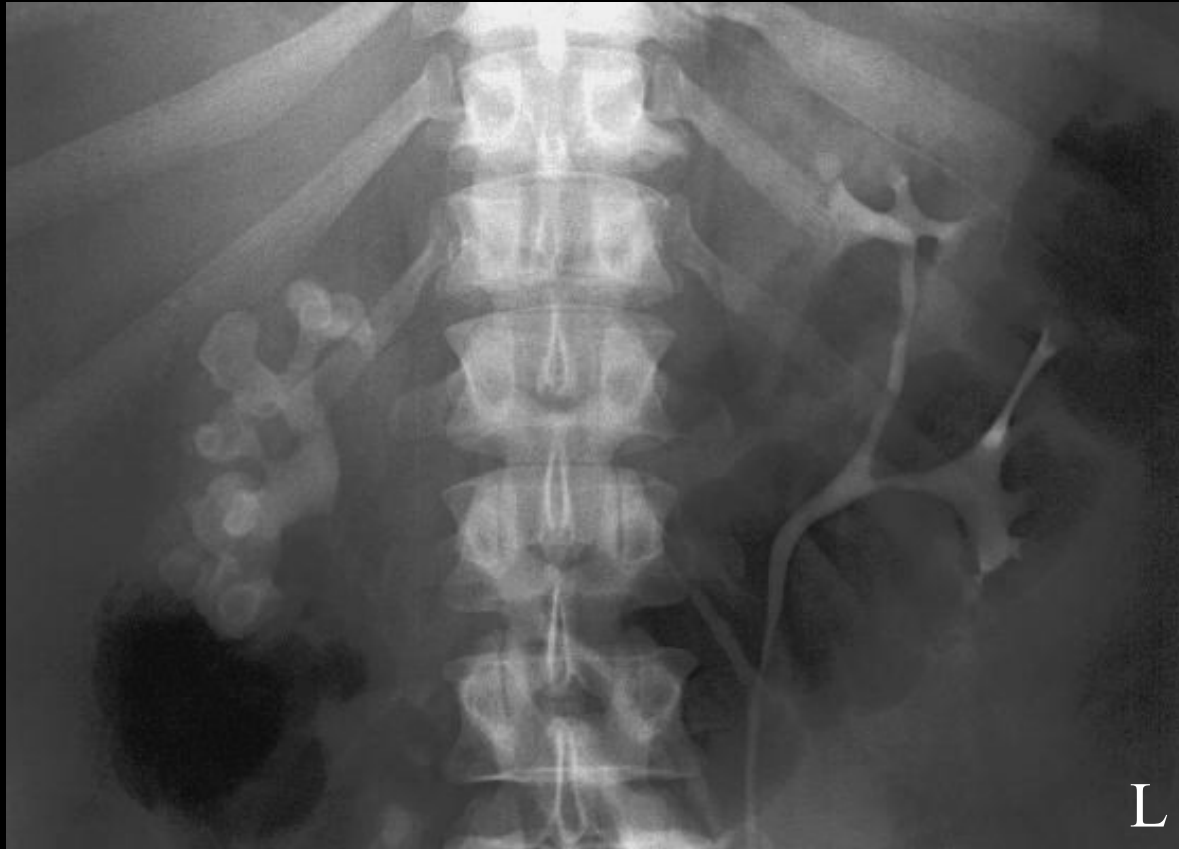
This is a magnified view of the previous image depicting a good example of a small **UVJ calculus** (arrow).

Staghorn Calculus:



This scout radiograph for an IVP demonstrates the formation of bilateral **staghorn calculi** with the collecting systems of both kidneys.

Staghorn Calculus:



This IVP radiograph demonstrates how the formation of a **staghorn calculus** can impair or in this case, prevent renal function.

Staghorn Calculus:



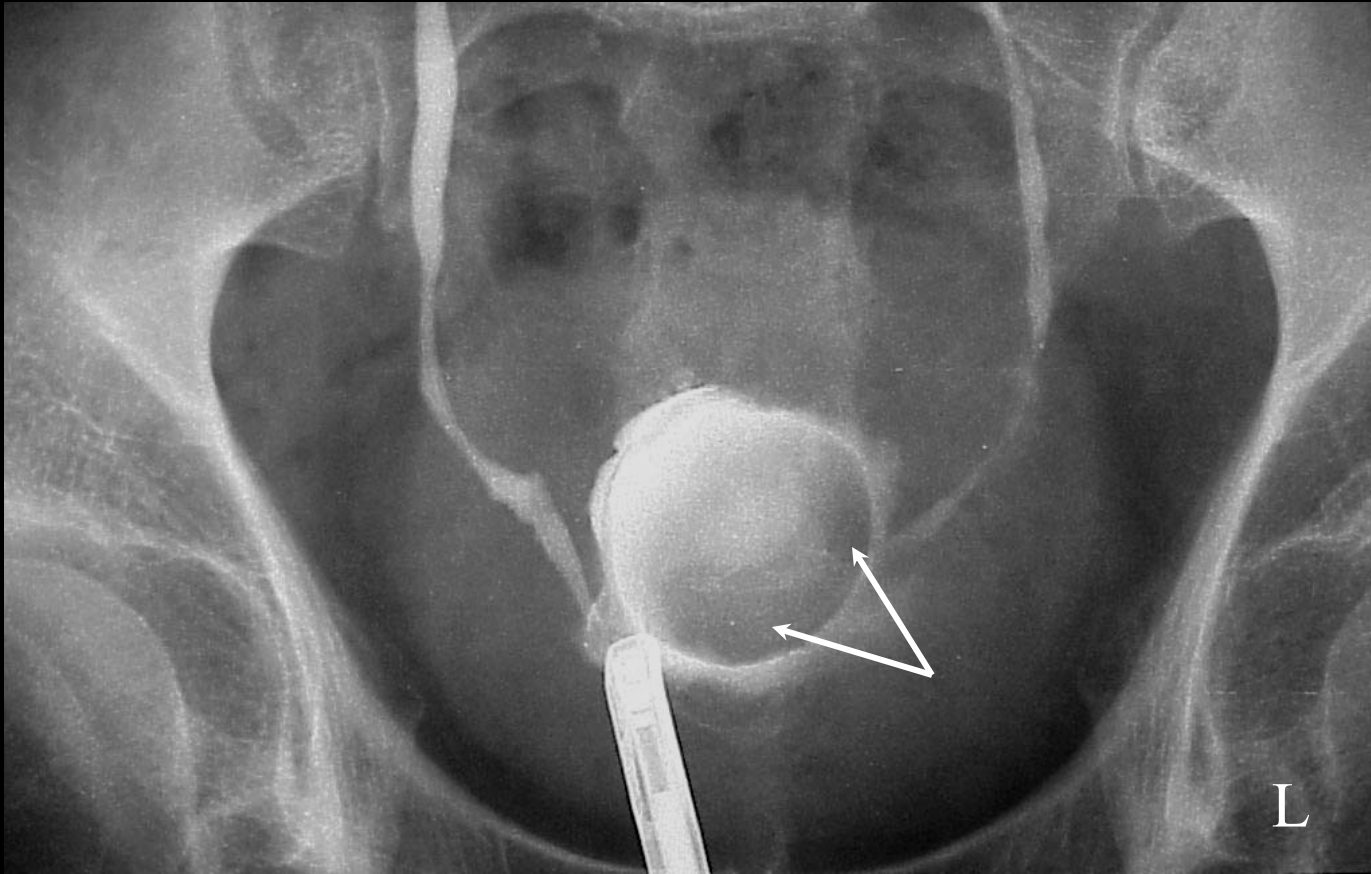
The arrow on this CT image of the abdomen is pointing one of many branches of a radiolucent **staghorn calculus**.

Bladder Calculus:



This RPG radiograph demonstrates a very large **bladder calculus** (arrow).

Bladder Calculus:



This is a magnified view of the previous image demonstrating a very large **bladder calculus** (arrow).

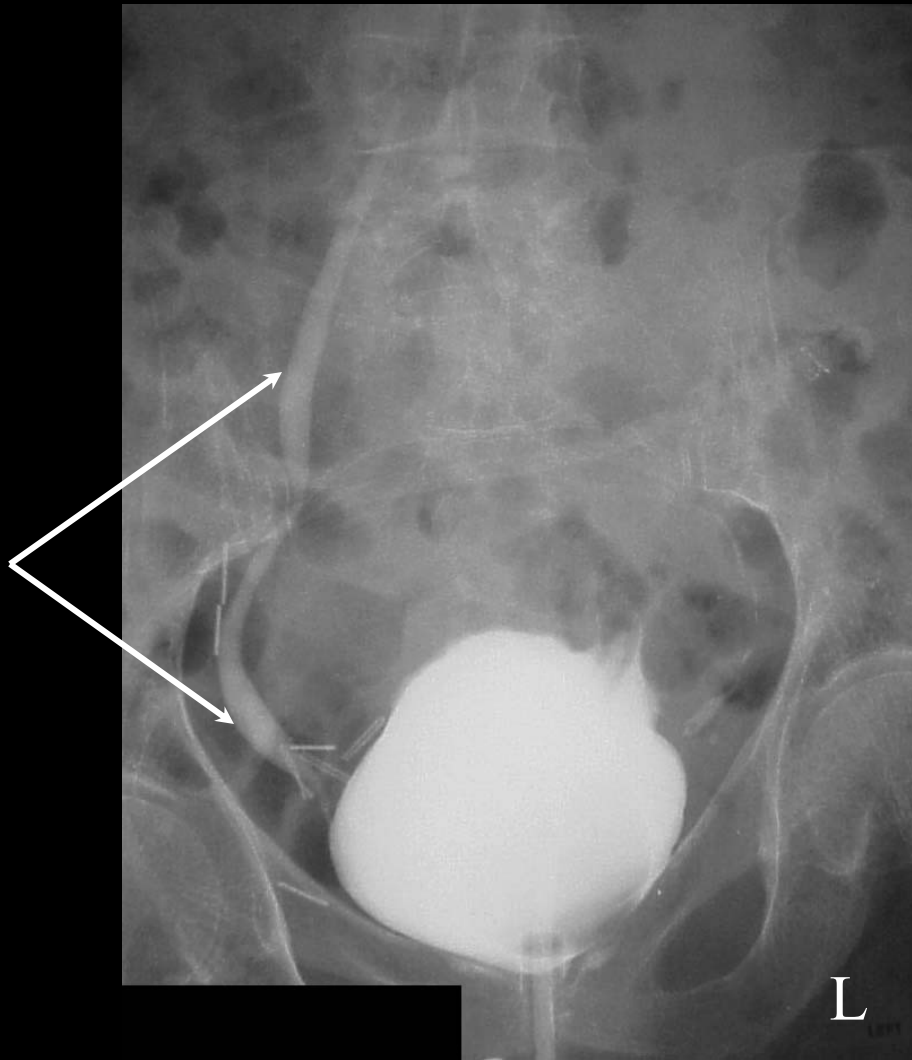
Vesicoureteral Reflux (VUR):

- Vesicoureteral reflux is characterized by an abnormal flow of urine from the bladder back into the ureter.
- This can be caused as a result of a hereditary condition, a bladder infection, or from bladder dysfunction.
- Symptoms include the following:
 - Cystitis
 - Nephritis
 - Polyuria
 - Dysuria
 - Pyuria
 - Hematuria
 - Hydroureter/Hydronephrosis

Vesicoureteral Reflux (VUR):

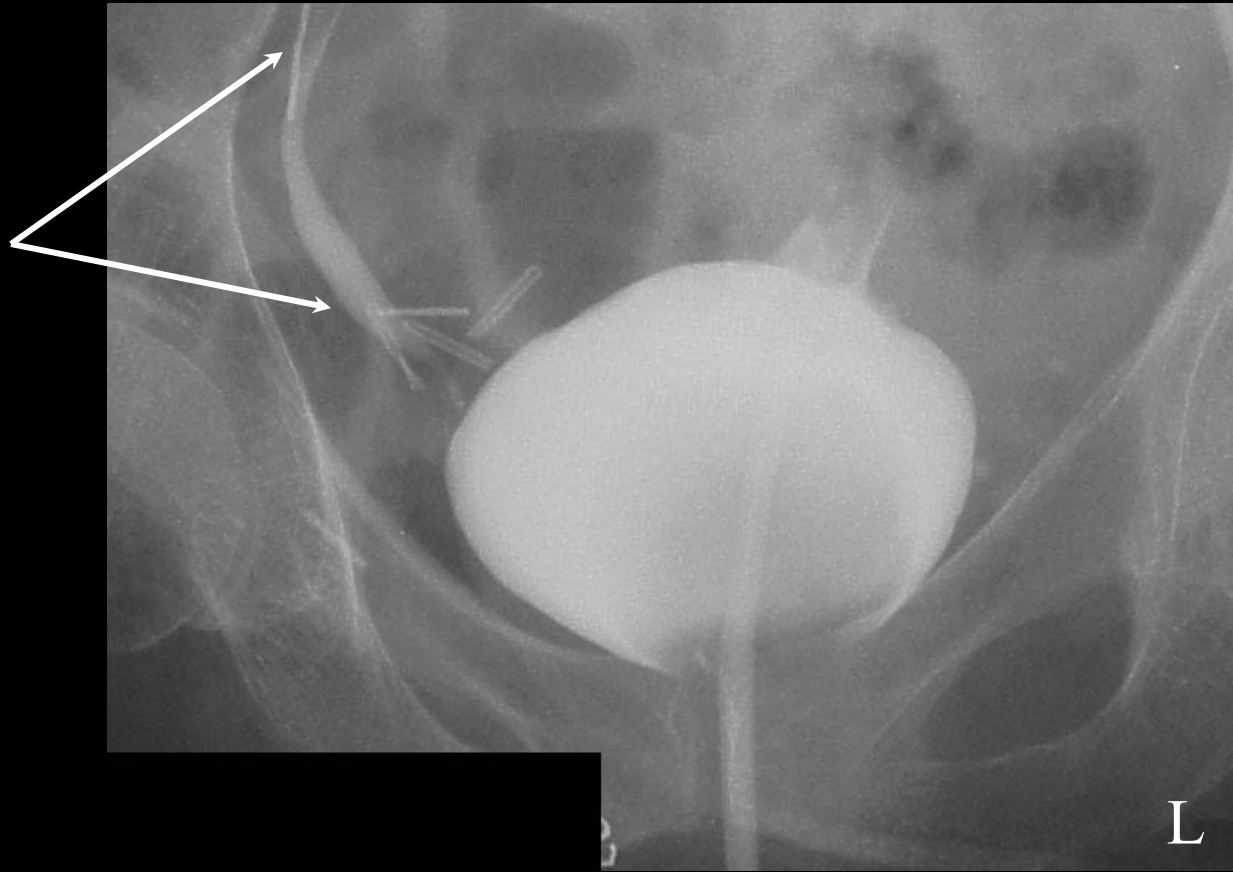
- This condition is commonly diagnosed by using a voiding cystourethrogram (VCUG).
- The underlying cause of a urinary track infection in approximately one third of all children is VUR.
- VUR is usually corrected with antibiotic therapy but surgery may be indicated in severe cases.

Vesicoureteral Reflux (VUR):



This retrograde cystogram resulted in a **reflux** of contrast material into the right ureter (arrows). This condition is referred to as **VUR**.

Vesicoureteral Reflux (VUR):



This is a magnified view of the previous image demonstrating **VUR** (arrows).

Renal Cell Carcinoma:

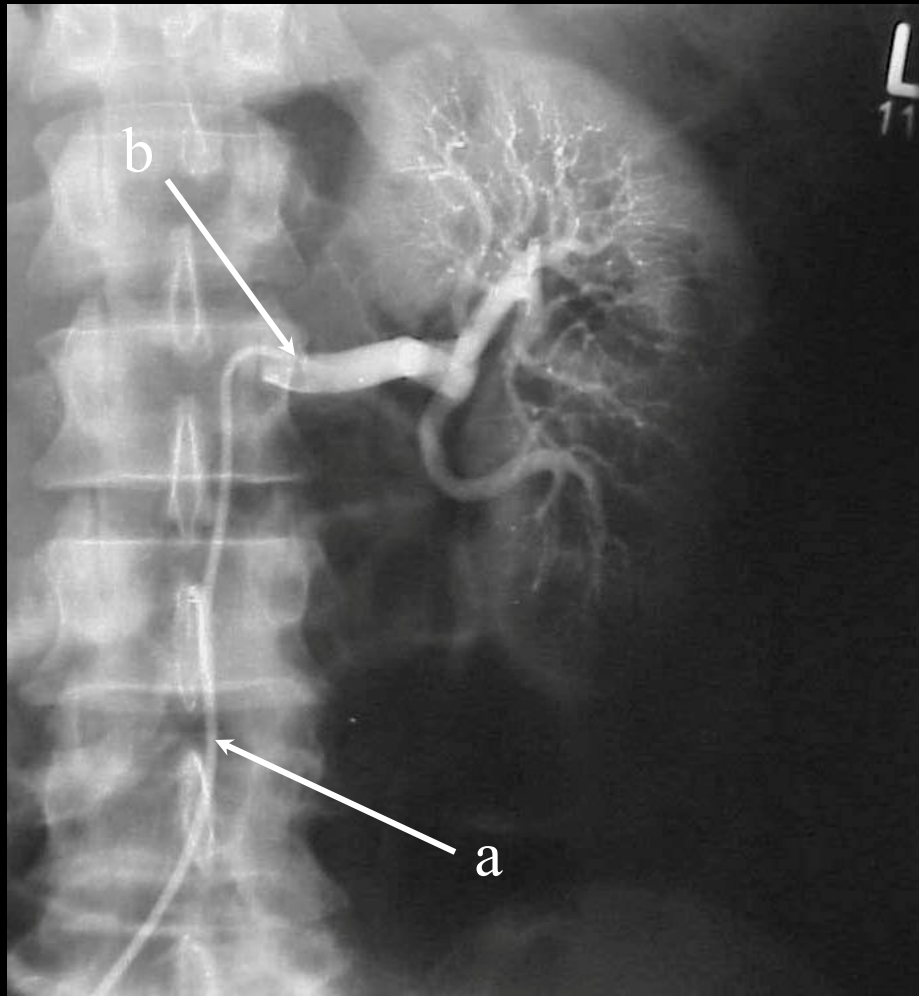
- Renal cell carcinoma is the most malignancy of the kidneys.
- Unlike with renal cysts, there is vascular perfusion which originate at the renal tubules.
- Renal cell carcinoma has a propensity to metastasize to the lungs, brain, liver and bone.
- Common symptoms include flank pain, hematuria, and an abdominal mass.

Unfortunately, these symptoms often do not present until the cancer is in an advanced stage.

As a result, renal cell carcinoma has a very high mortality rate.

- Treatment usually consists of nephrectomy.

Renal Cell Carcinoma:



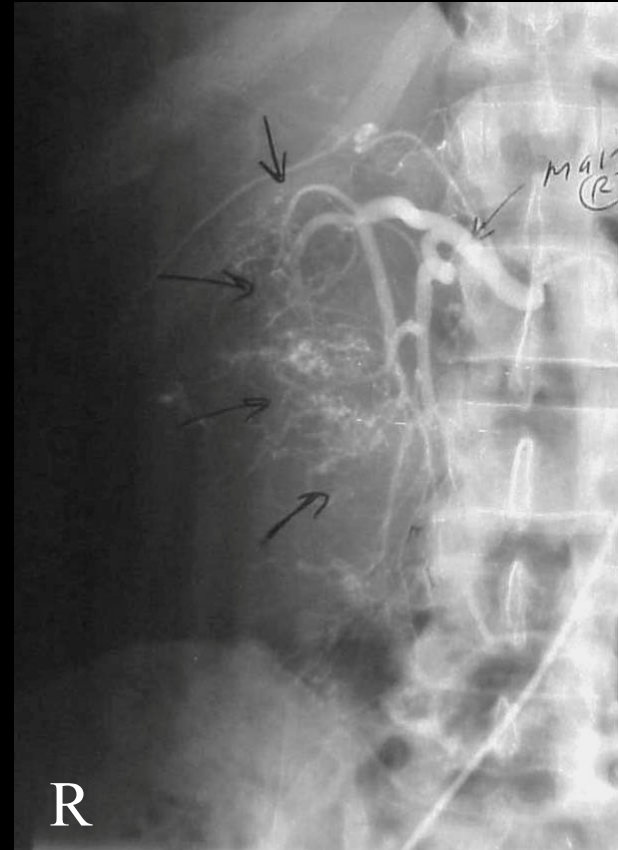
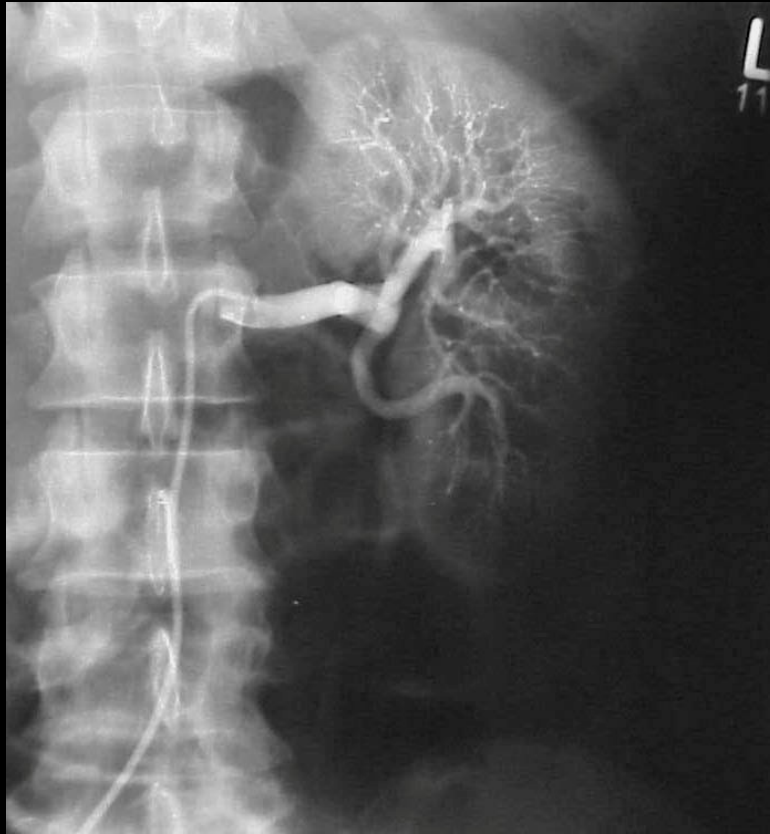
This is a **renal arteriogram** and it is performed in order to evaluate kidney arterial circulation. A catheter (a) was inserted into the femoral artery. It was advanced and manipulated until the tip of the catheter was positioned within the lumen of the left renal artery (b). Contrast material was injected and revealed the arterial circulation of a normal, healthy kidney.

Renal Cell Carcinoma:



This renal arteriogram, on the other hand, demonstrates vascular irregularities (arrows) which would indicate the presence a renal mass. This patient was later diagnosed with **renal cell carcinoma**.

Renal Cell Carcinoma:

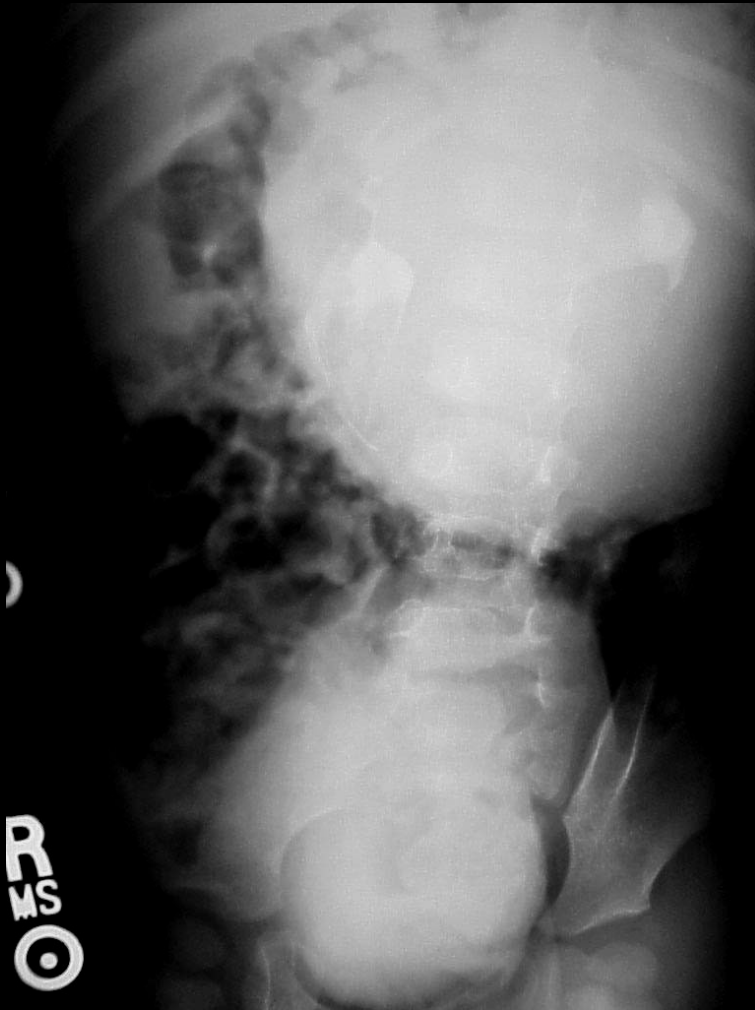


This is a side-by-side comparison of the arterial circulation of a healthy kidney on the left and one with **renal cell carcinoma** on the right.

Wilm's Tumor:

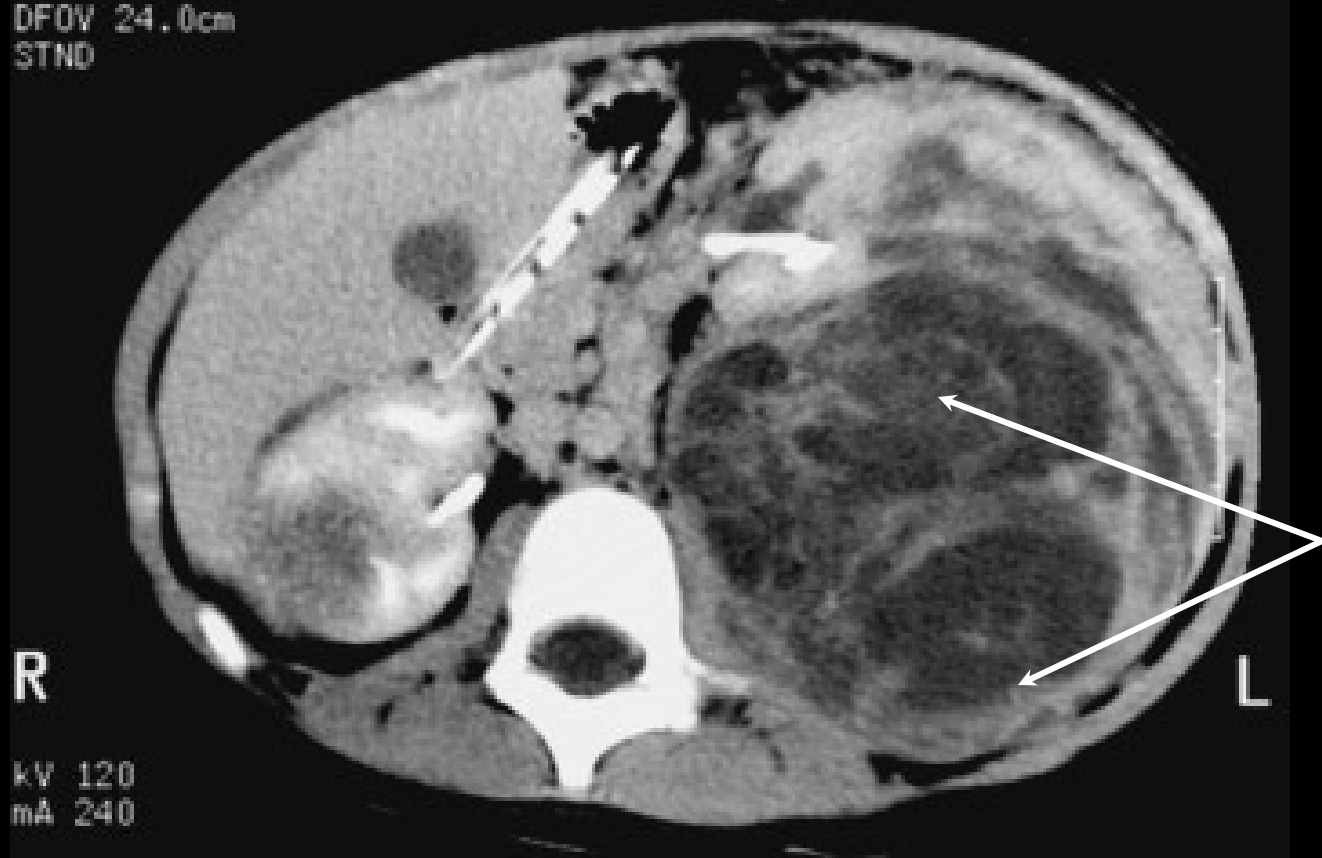
- Wilm's tumor is also referred to as a nephroblastoma.
- It is the most common abdominal neoplasm of infancy and early childhood with an average onset of three years old.
- Wilm's tumor produces a large, palpable abdominal mass
- It has a propensity to metastasize to the lungs, liver, and skeletal system.
- Early detection and treatment results in a nearly 90% five year survival rate.

Wilm's Tumor:



The IVP performed on this infant revealed the presence of a very large neoplasm of the kidneys known as **Wilm's tumor**. This is the most common neoplasm of infancy and early childhood.

Wilm's Tumor:



The large mass (arrows) found on this CT image of the abdomen is the result of a kidney neoplasm known as **Wilm's tumor**.

Ureteral Diverticula:

- A diverticulum is an outpouching that occurs due to a weakening in the lining of, in this particular instance, the ureter.

This is not to be confused with a neoplasm which is an actual growth that usually develops in towards the lumen of the of the structure that is is attached to.

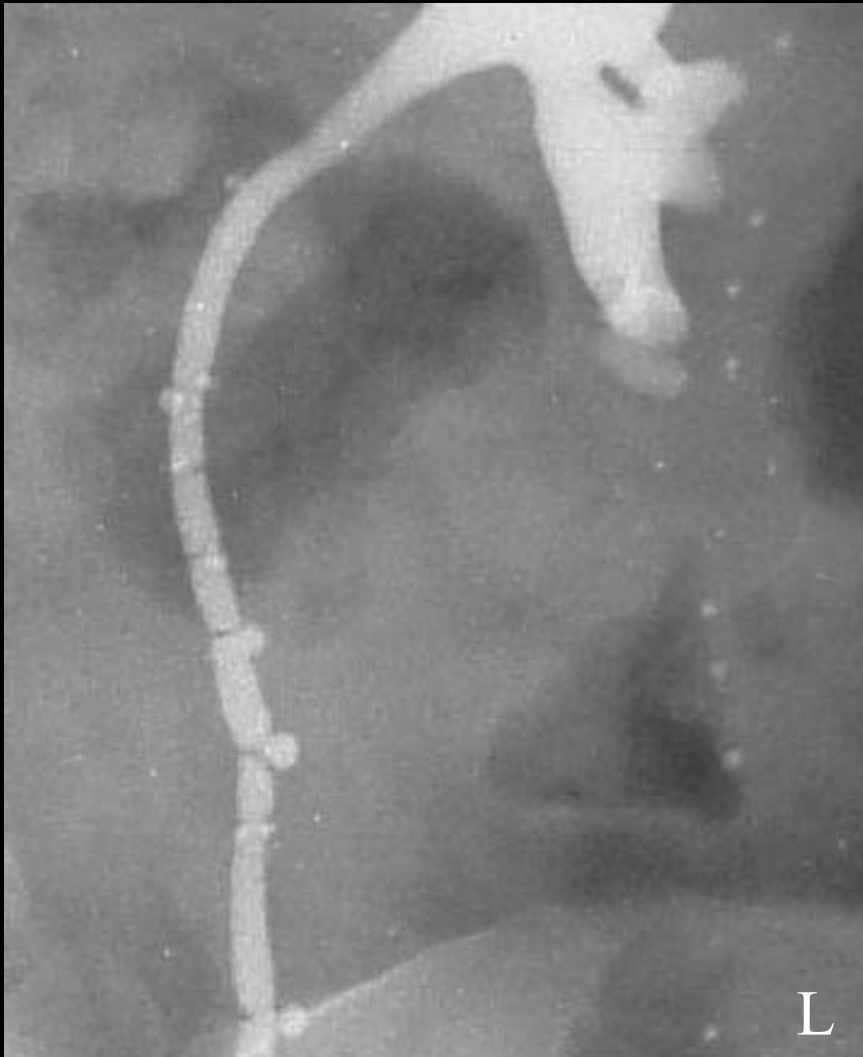
- Ureteral diverticula may also be the source of future infections or may, in some instances, trap kidney stones.
- They are best demonstrated during an RPG.
- Other than antibiotics to combat infection, there is no treatment for ureteral diverticula.

Ureteral Diverticula:



The source of the **ureteral diverticula** demonstrated on this RPG radiograph is likely inflammation from a bacterial infection.

Ureteral Diverticula:

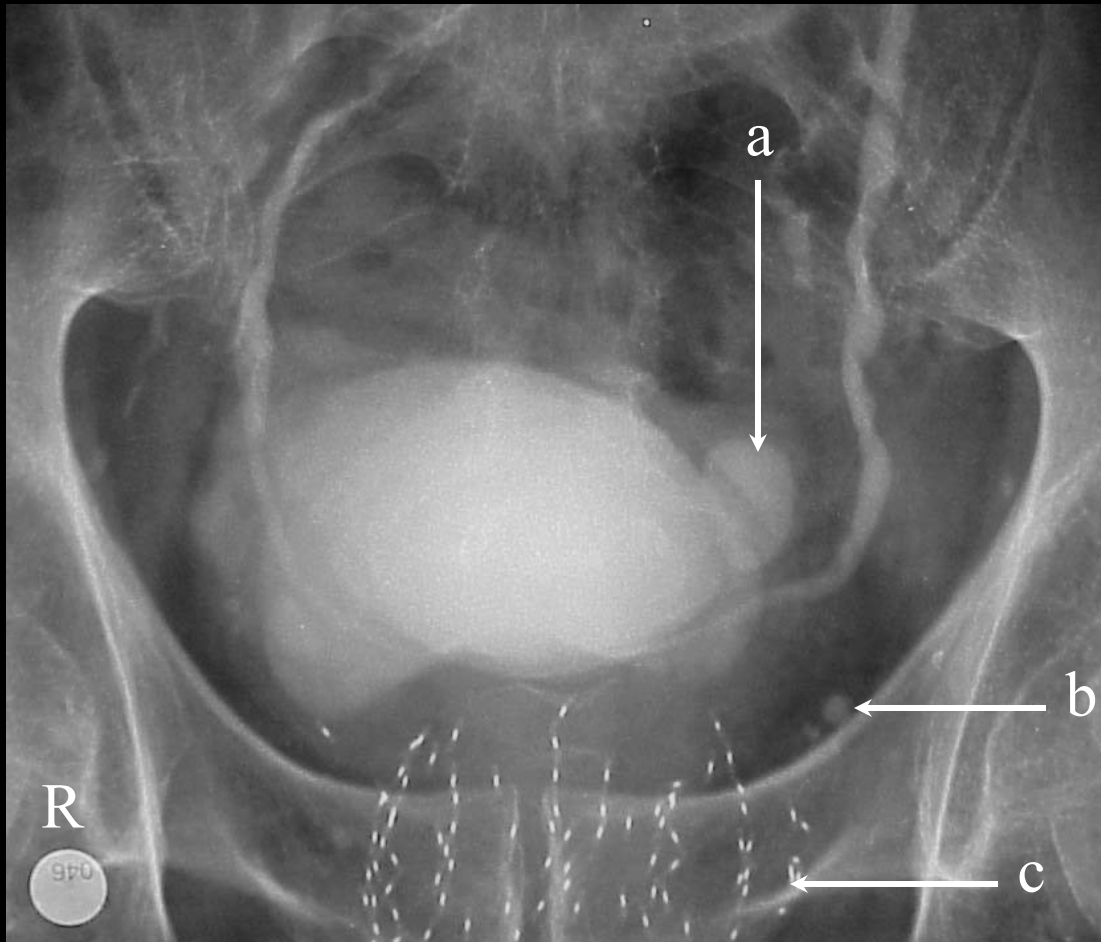


This is a magnified view of the previous image and more clearly demonstrates this patient's extensive formation of **ureteral diverticula**.

Bladder Diverticula:

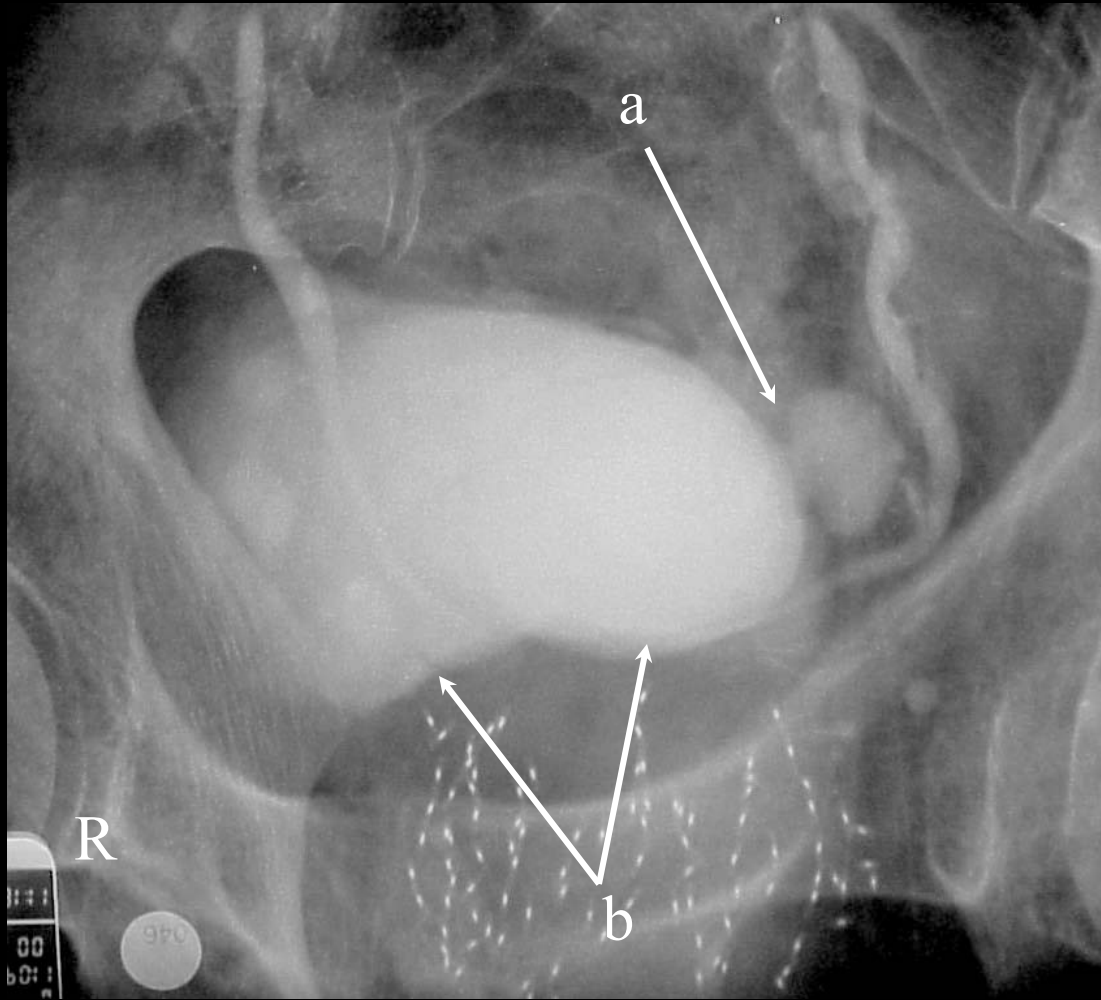
- Bladder diverticula can be hereditary, caused by an enlarged prostate, or the result of a chronic bladder infection.
- They may also be the source of future infections or may, in some instances, trap kidney stones.
- Other than antibiotics to combat infection, there is no treatment for bladder diverticula.

Bladder Diverticula:



This large **bladder diverticula** (a) has been formed as the result of the inflammation caused by the insertion of **radium seeds** (c) into this patient's prostate gland. The small, round nodules (b) are calcified valves of veins that surround the bladder. These nodules are called **phleboliths** and are sometimes mistaken for kidney or bladder stones.

Bladder Diverticula:

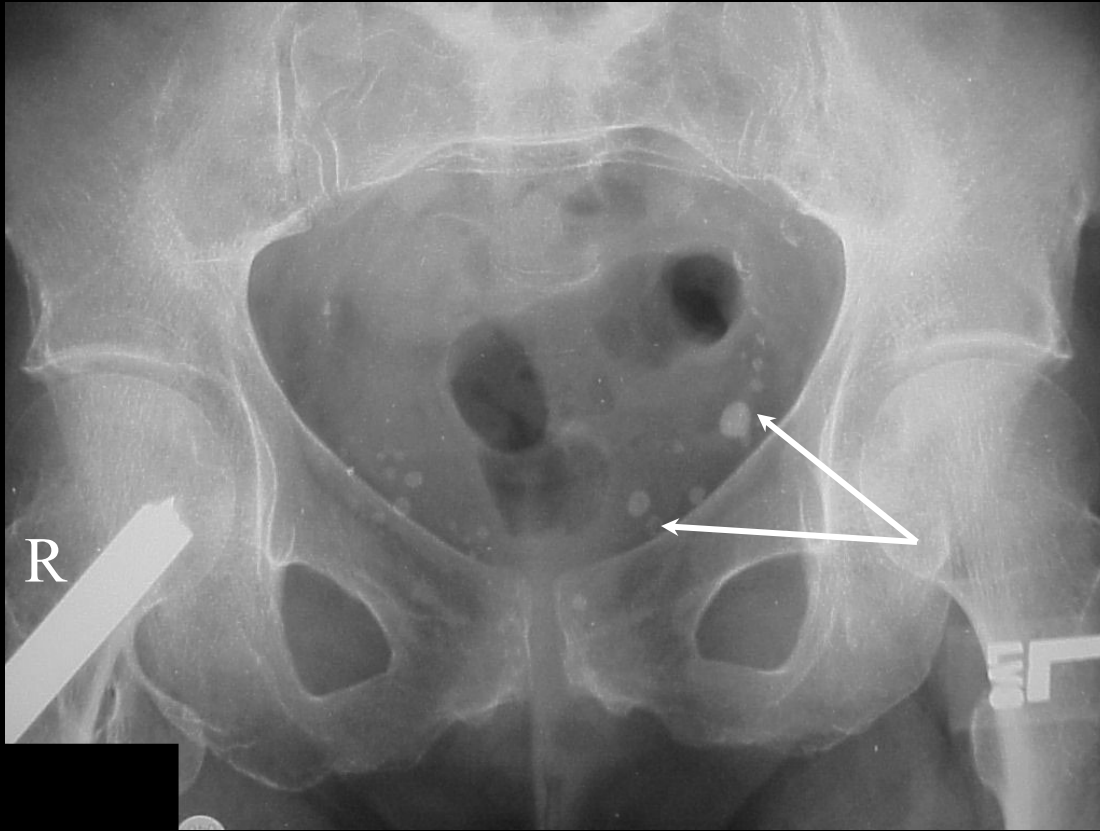


This is an LPO position of the previous patient. It nicely reveals the stalk (a) of the **bladder diverticula**. Notice how the enlarged prostate gland is pushing up on the bladder (b).

Phleboliths:

- A phlebolith is nothing more than small, usually round, calcified valve within a vein that surround the urinary bladder.
- They are sometimes mistaken for kidney or bladder stones and have no clinical importance.

Phleboliths:



The small, round nodules on this radiograph are the result of calcified valves of veins that surround the bladder. These nodules are called **phleboliths** and are sometimes mistaken for kidney or bladder stones.

Transitional Cell Carcinoma (TCC):

- TCC makes up 90% of all urinary bladder cancers.
- It is a metastatic cancer that is mostly seen in men after the age of 50.
- TCC is clearly related to some industrial chemicals and to smoking.
- The primary symptom is painless hematuria.
- An IVP will demonstrate a filling defect in the area of the trigone but a cystoscopy is the method of choice for diagnosis.
- Treatment includes surgery, radiation therapy, and chemotherapy.

Transitional Cell Carcinoma (TCC):



This IVP radiograph revealed a large neoplasm located within this patient's bladder. This was later confirmed to be **transitional cell carcinoma** of the urinary bladder.

Transitional Cell Carcinoma (TCC):



This is a magnified view of the previous image depicting **transitional cell carcinoma** of the urinary bladder.

Reproductive System Menu

1. Colovaginal Fistula
2. Dermoid
3. Ovarian Cyst
4. Pessary

Colovaginal Fistula:

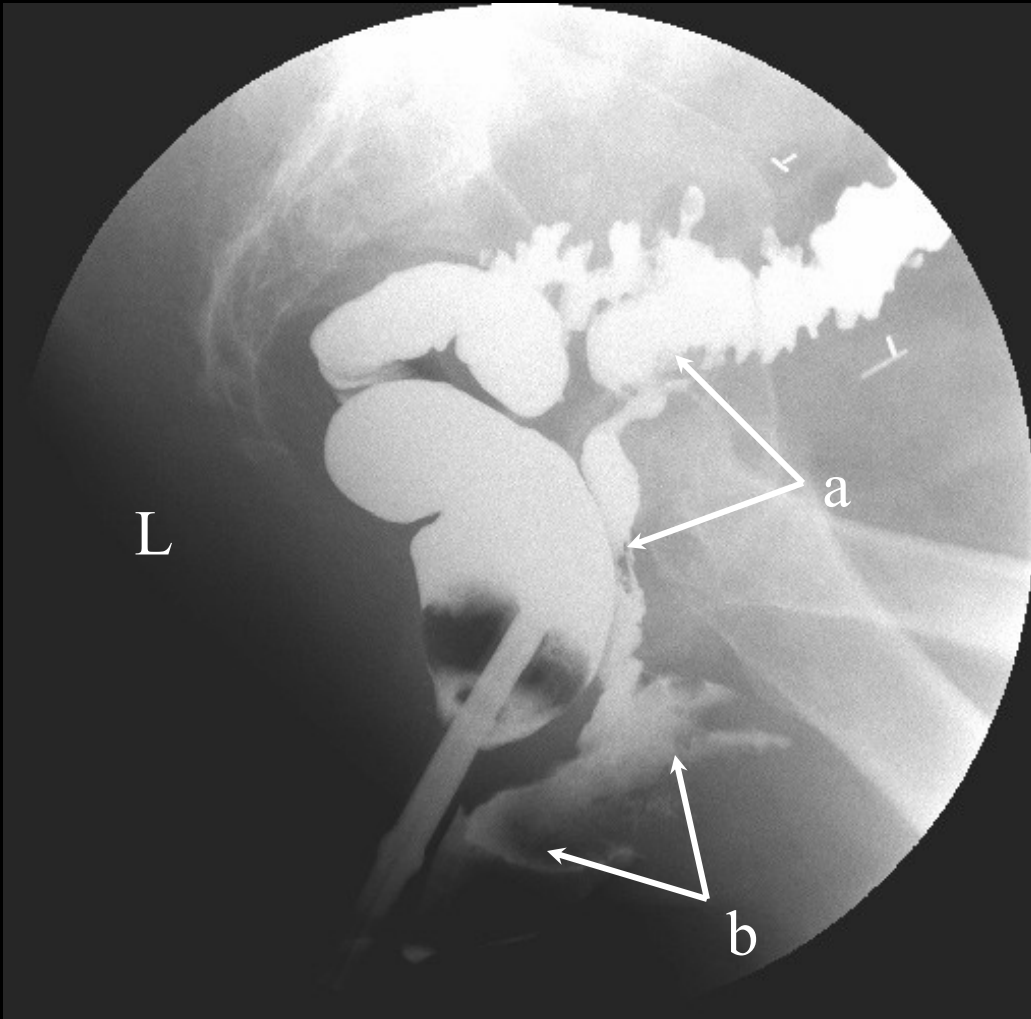
- A fistula is an abnormal passageway between two structures that do not normally connect.
- A fistula can form between two adjacent structures or between an organ and the surface of the body.
- A colovaginal fistula is a case where a passageway has been created between the vagina and the rectum.

This provides an alternate path for both feces and flatulence to exit the body.

This condition will often lead to recurrent infections of the urinary system and the vagina.

This condition can be caused by trauma, vaginal surgery, or colon cancer.

Colovaginal Fistula:



This BE examination revealed an abnormal opening between the colon (a) and the vagina (b). This is known as a **colovaginal fistula**.

Dermoid:

- A dermoid is a type of teratoma (benign cyst) that contains developmentally mature skin that can take the following forms:

Hair, Teeth, Nails

Cartilage

Thyroid Tissue

Sebaceous Secretions (oil)

- A dermoid can account for up to 25% of all ovarian tumors but can occur in other areas of the body as well.

In some instances, surgical removal may be indicated.

Dermoid:



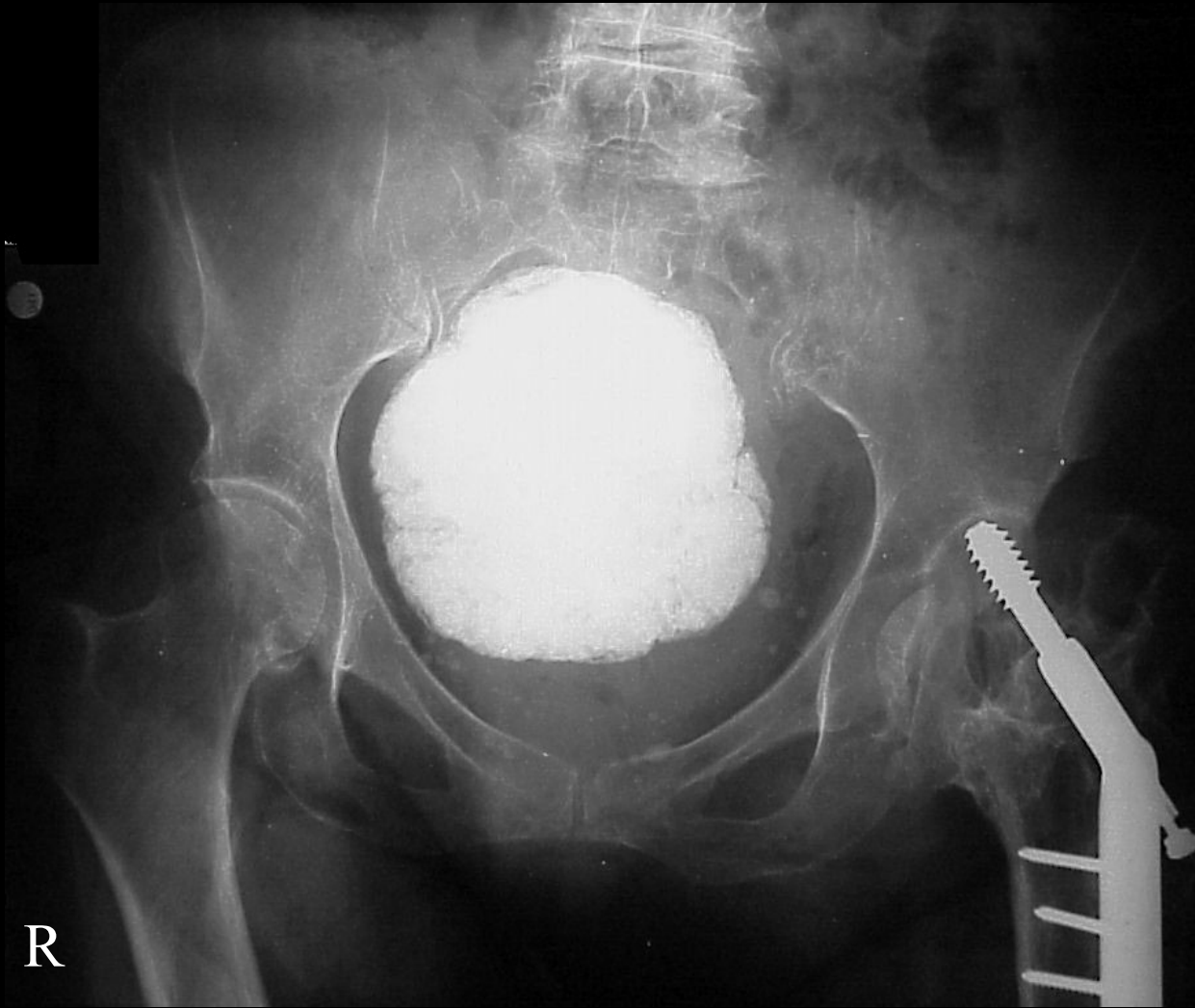
This is a type of ovarian cyst known as a **dermoid**. The cells within this cyst are able to make hair, teeth and other types of tissues. In this case, the cyst has formed multiple teeth.

Dermoid:



This is a magnified view of the previous image of a **dermoid** consisting of multiple teeth that are forming within a cyst attached to the right ovary.

Dermoid:



This abdominal radiograph depicts an extremely large and calcified **ovarian dermoid**.

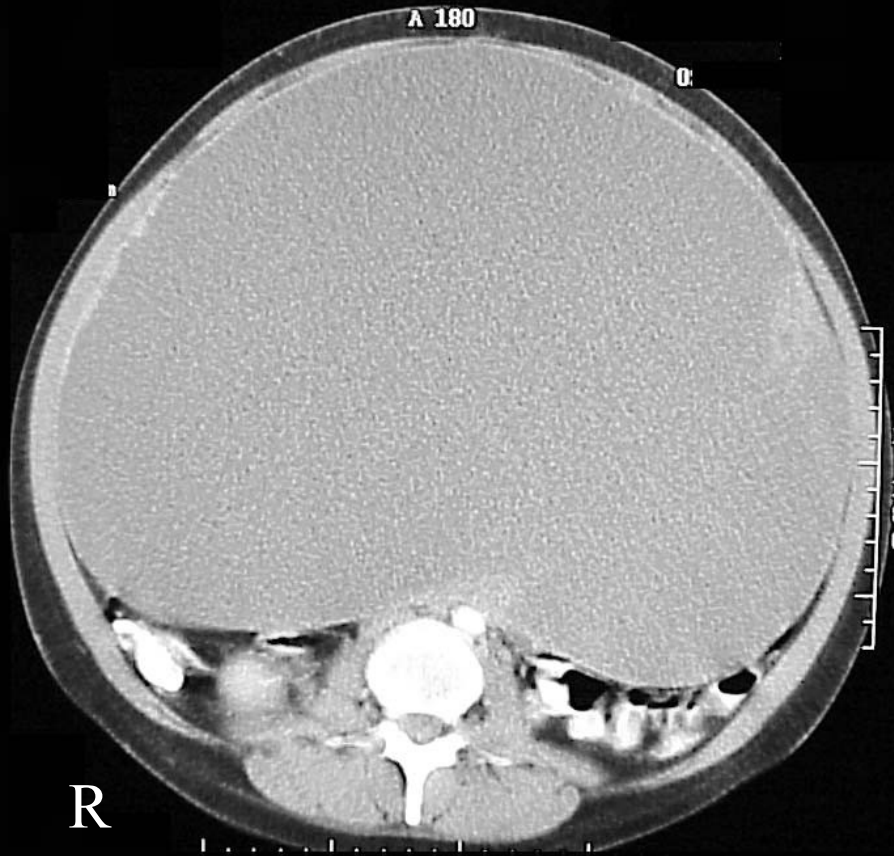
Ovarian Cyst:

- A cyst is a fluid filled sac that can form anywhere in the body.
- In this particular instance, the cyst has formed on and is attached to the outside of the ovary.

The most common type of cyst to form on the ovary is called a functional cyst.

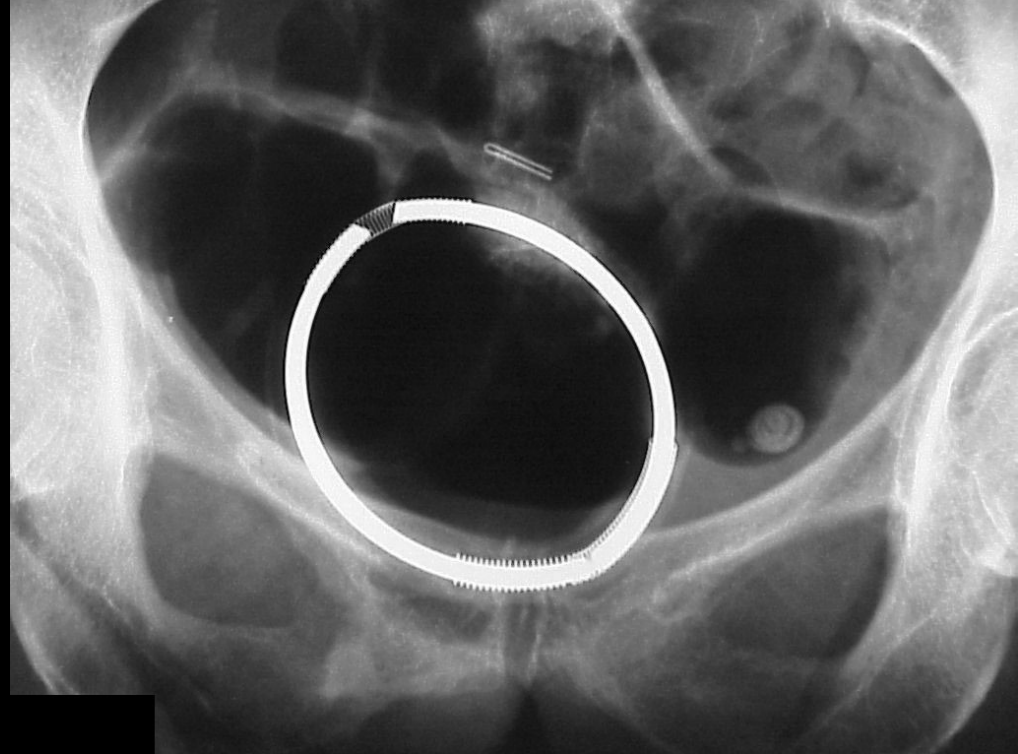
- These will often form during the normal menstrual cycle as an egg is released.
- Often they will rupture and resolve on their own.
- However, they can cause pressure, a dull back ache, weight gain, and breast tenderness.
- Cysts that don't resolve may require surgical removal.

Ovarian Cyst:



This CT image depicts an extremely large ovarian cyst.

Pessary:



A **pessary** is a therapeutic device that is used to support the uterus, vagina, bladder, or rectum. They can also be used as a contraceptive device.

Gastrointestinal System Menu

1. Zenker's Diverticulum
2. Traction Diverticulum
3. Epiphrenic Diverticulum
4. Hiatal Hernia
5. Gastroesophageal Reflux
6. Achalasia
7. Esophageal Varices
8. Esophagus Cancer
9. Candida
10. Peptic Ulcers
11. Gastric Carcinoma
12. Bezoar
13. Bowel Obstruction
14. Adynamic Ileus
15. Mechanical Bowel Obstruction
16. Hernia
17. Bowel Adhesion
18. Volvulus
19. Intussusception
20. Adenomatous Polyp
21. Adenocarcinoma
22. Crohn's Disease
23. Constipation
24. Diverticulosis
25. Diverticulitis
26. Appendicitis
27. Diverticula of the Appendix
28. GI Bleed

Zenker's Diverticulum:

- A diverticulum is an outpouching that occurs due to a weakening in the lining of, in this particular instance, the digestive system.

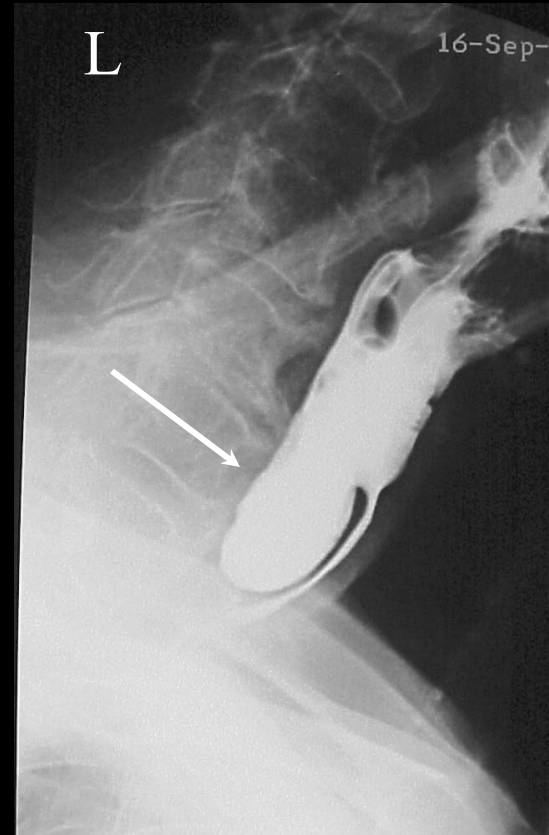
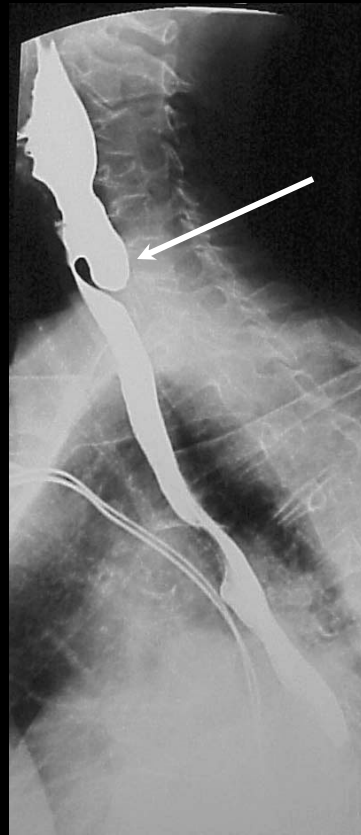
This is not to be confused with a neoplasm which is a new growth that usually develops in towards the lumen of the digestive system.

Diverticulum are often diagnosed with barium studies of the digestive system.

- Zenker's diverticulum arise from the posterior wall of the upper esophagus in the area of the pharynx.

Although often asymptomatic, they can cause dysphagia (difficulty in swallowing) and halitosis (bad breath).

Zenker's Diverticulum:

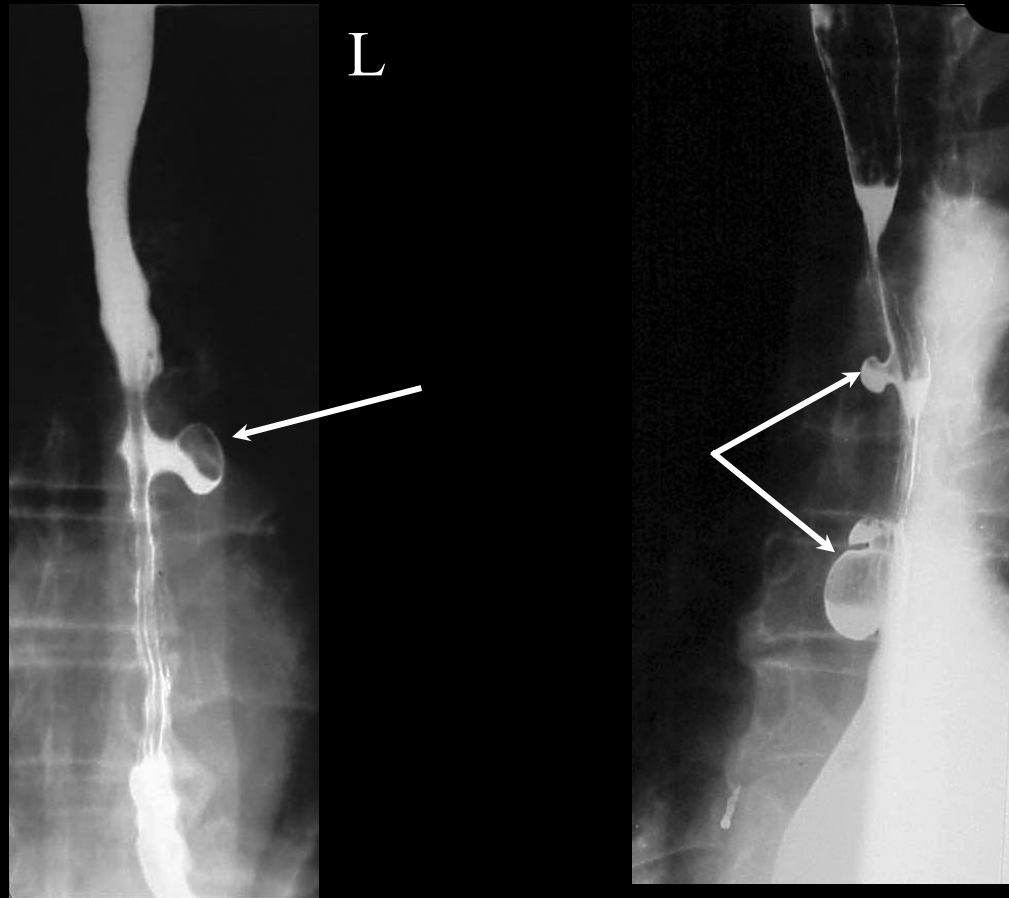


This barium swallow study clearly depicts an outpouching of the posterior aspect of the upper esophagus. This is called a **Zenker's diverticulum**.

Traction Diverticulum:

- This type of diverticulum forms in the mid esophagus area.
- Traction diverticulum may form due to scarring from pulmonary tuberculosis or an inflammatory process within the mediastinum.

Traction Diverticulum:

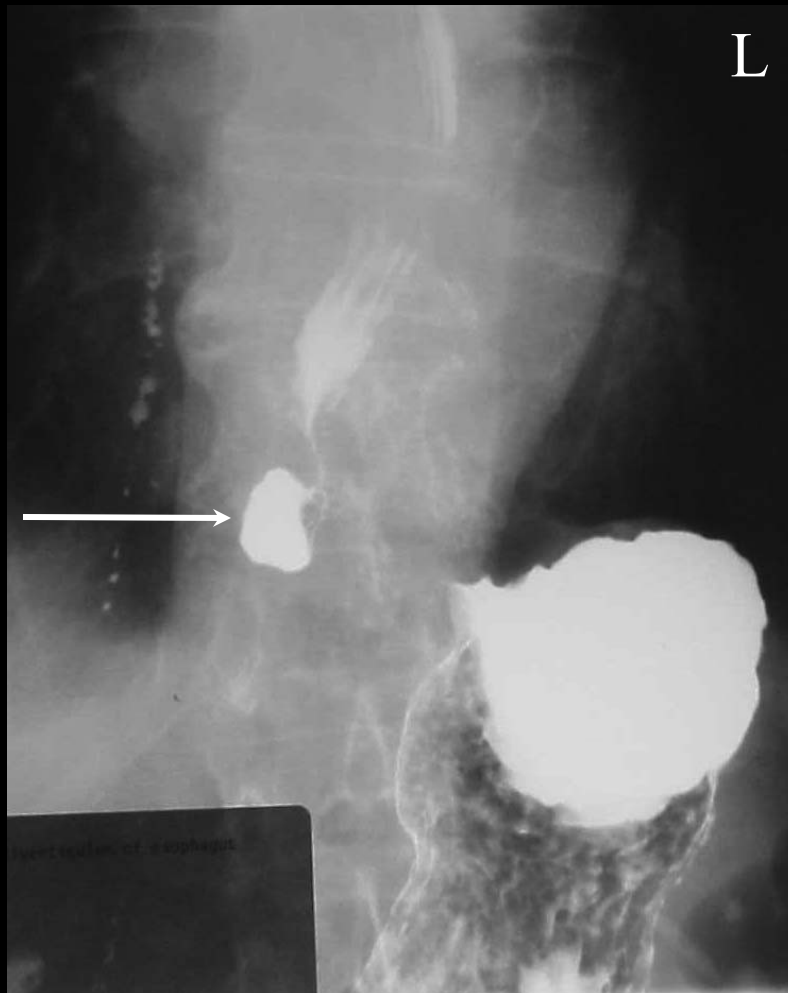


The arrows on these images are pointing to a **mid esophageal diverticulum**. The most likely etiology is an inflammatory process within the mediastinum.

Epiphrenic Diverticulum:

- As the name implies, an epiphrenic diverticulum arises in the distal esophagus just superior to the lower esophageal sphincter (LES).
- They may form as a complication to achalasia.

Epiphrenic Diverticulum:



Diverticula located within the distal 10 cm of the esophagus are referred to as an **epiphrenic diverticula** (arrow).

Hiatal Hernia:

- A hiatal hernia occurs when a portion of the stomach protrudes (herniates) into the thorax through the esophageal opening in the diaphragm.

This is known as a sliding hiatal hernia and it is the most common type of hiatal hernia encountered.

A rolling or paraesophageal hiatal hernia is very rare but occurs when a portion of the stomach herniates into the thorax while the gastroesophageal junction remains stationary.

- This is one of the most common findings on an UGI series.
- It can affect up to 50% of the population at some point in their lives.

Hiatal Hernia:

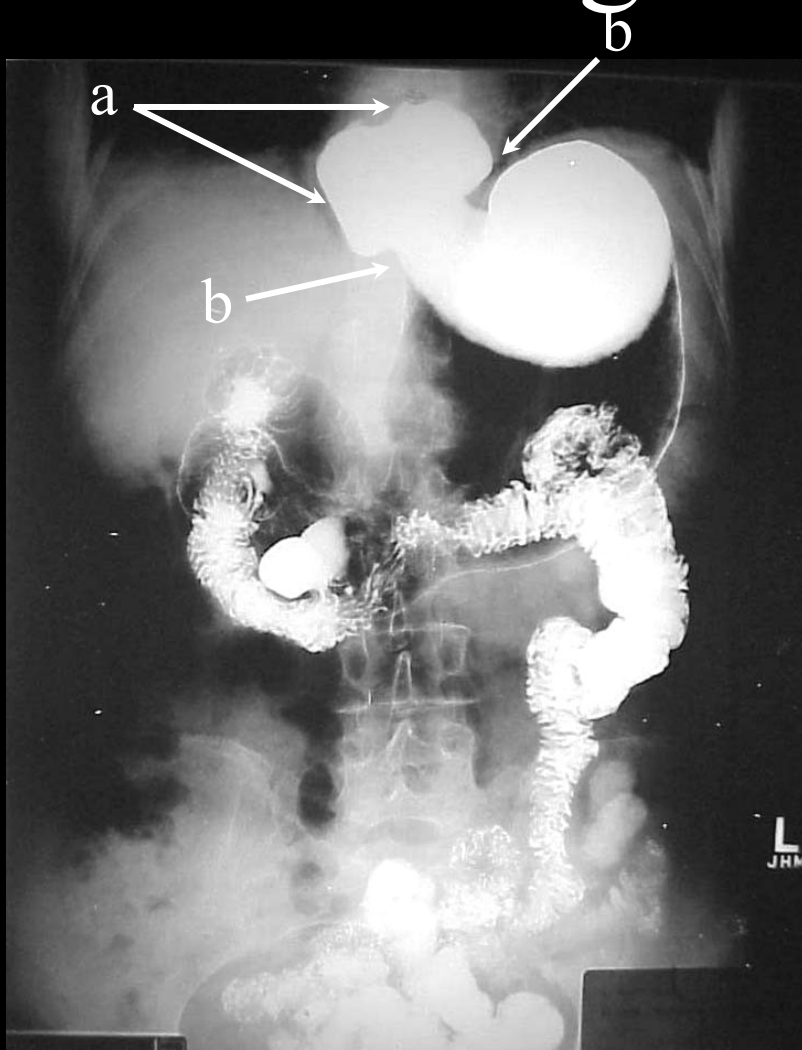
- A hiatal hernia is usually asymptomatic but the patient may experience a fullness in their chest or regurgitation.

This acid reflux may lead to inflammation and ulceration of the esophagus.

Chronic herniation of the stomach may be associated with gastroesophageal reflux disease (GERD).

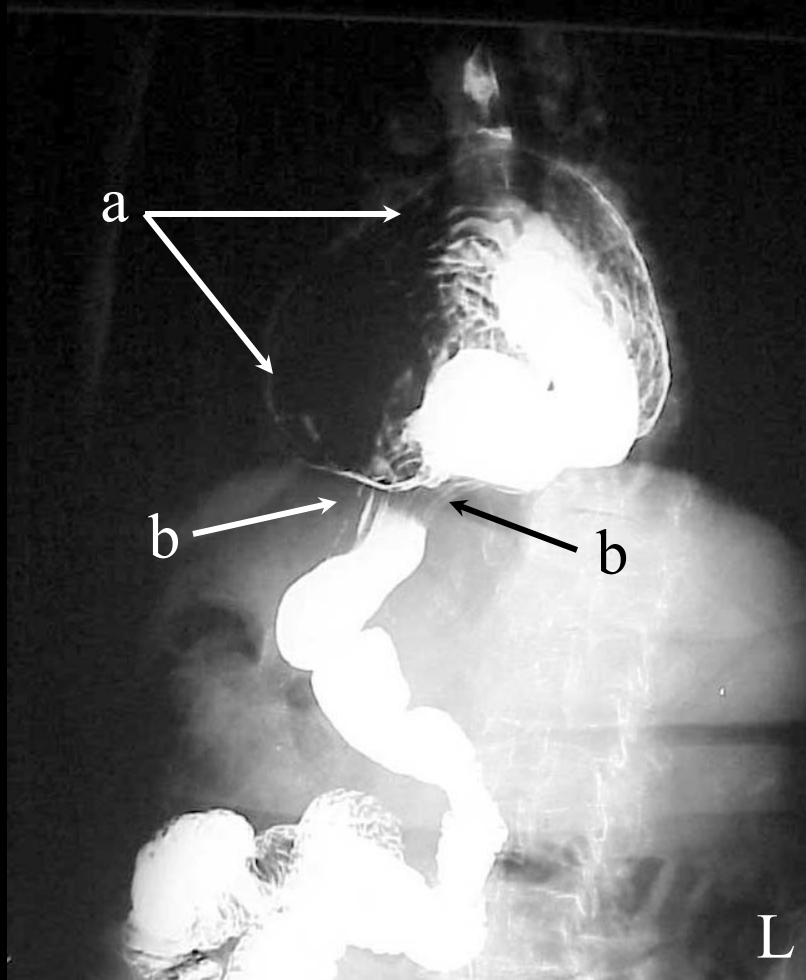
- Treatment includes a bland diet, antacids, and medications to reduce reflux.

Sliding Hiatal Hernia:



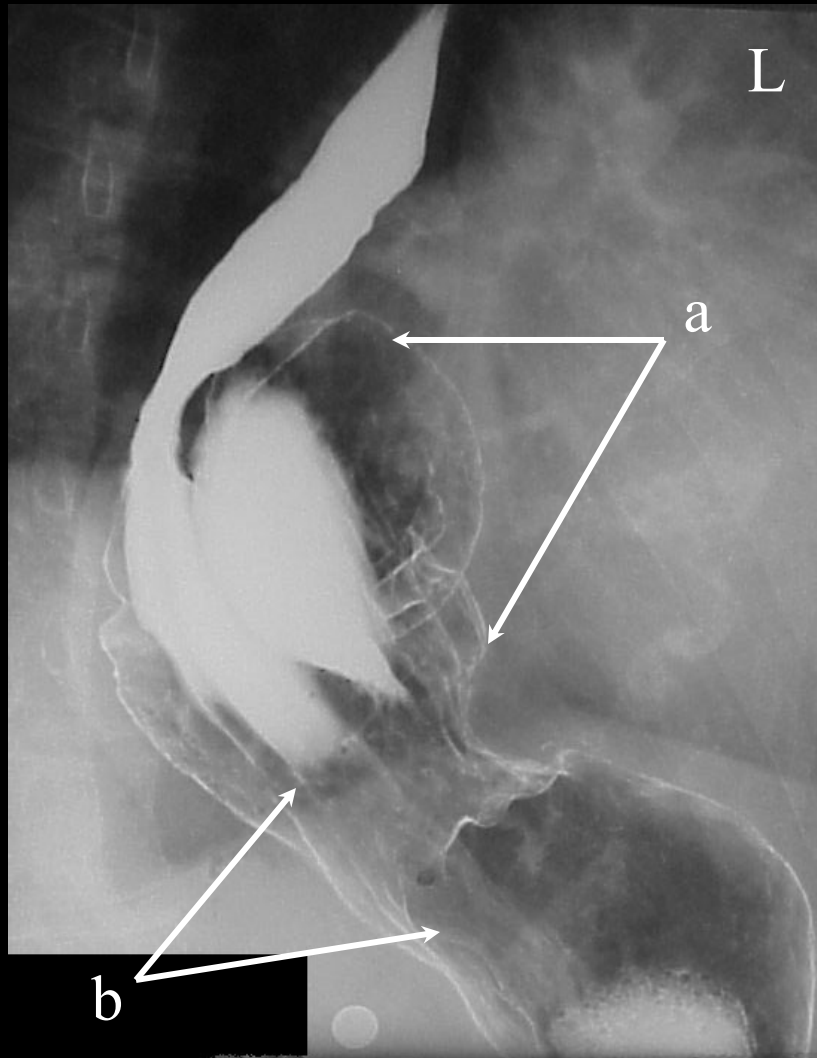
The protrusion of a portion of the stomach (hernia) through the esophageal opening of the diaphragm (hiatus) is referred to as a **hiatal hernia**. In this particular case (a) is pointing to the fundus of the stomach that has herniated through the esophageal opening in the diaphragm (b).

Sliding Hiatal Hernia:



On this UGI radiograph, a significant portion of the stomach (a) has herniated through the esophageal opening of the diaphragm (b).

Paraesophageal Hiatal Hernia:

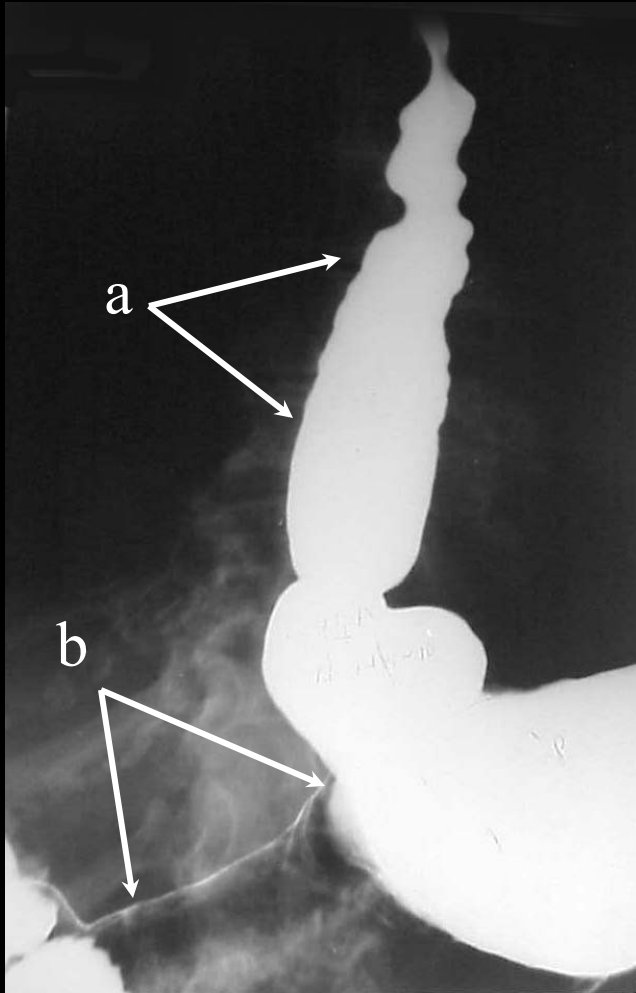


This UGI study provides a great example of a relatively rare **paraesophageal hiatal hernia**. In this case, a portion of the stomach has herniated into the thorax (a) while the esophagus and lower esophageal sphincter remain in place (b).

Gastroesophageal Reflux Disease:

- This is often abbreviated as GERD and it is also often referred to as heartburn and acid reflux.
- This disease is characterized by a backward flow of gastric contents into the esophagus due to an incompetent lower esophageal sphincter (LES).
- GERD is commonly associated with a hiatal hernia.
- It is acquired by poor eating habits, obesity, pregnancy, NG tubes, alcohol abuse, tobacco, and as a side effect of morphine.

Gastroesophageal Reflux Disease:



This UGI radiograph demonstrated a reflux of barium from the stomach (b) back into the esophagus (a). This condition is known as **gastroesophageal reflux disease (GERD), acid reflux, or heartburn.**

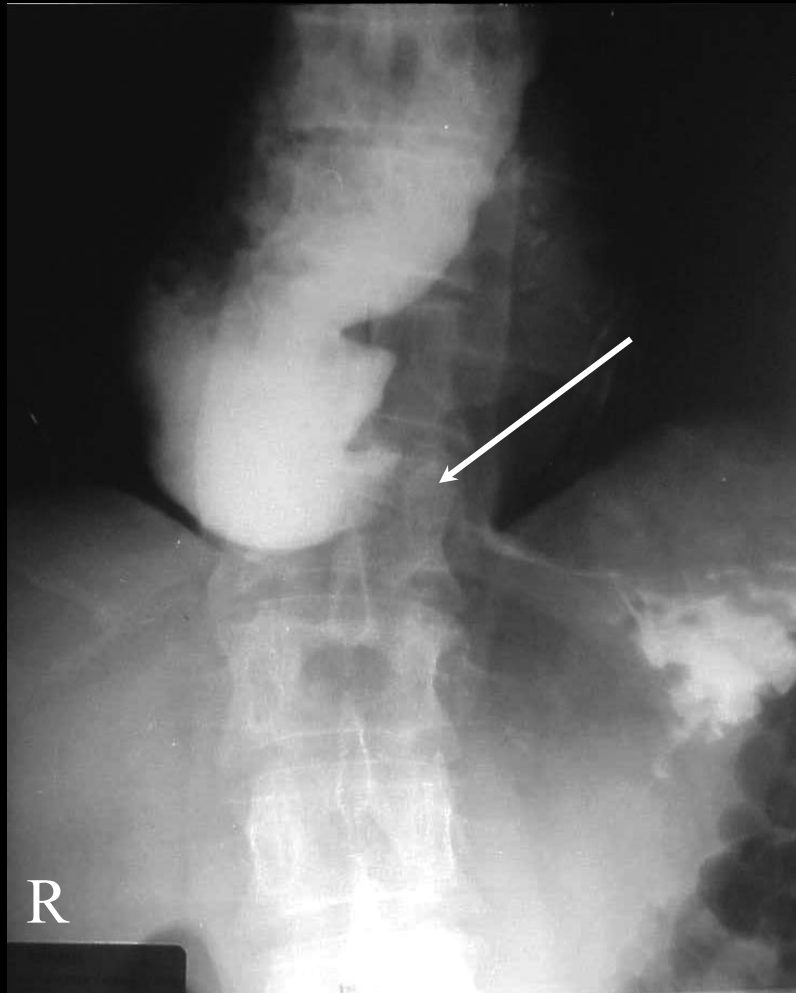
Achalasia:

- This is the exact opposite of acid reflux.
- Achalasia is an esophageal motility disorder that occurs due to the inability of the lower esophageal sphincter (LES) to relax.

As a result, the esophagus fills with ingested food and fluids.

- Treatment includes a bland diet, medication to relax the LES, surgery, and an upright position to reduce regurgitation.

Achalasia:



This UGI radiograph demonstrates a condition called **achalasia**. This is an esophageal motility disorder that is caused by a lack of peristalsis. As a result, the lower esophageal sphincter (arrow) fails to relax during swallowing and the esophagus fills with, in this case, barium.

Achalasia:



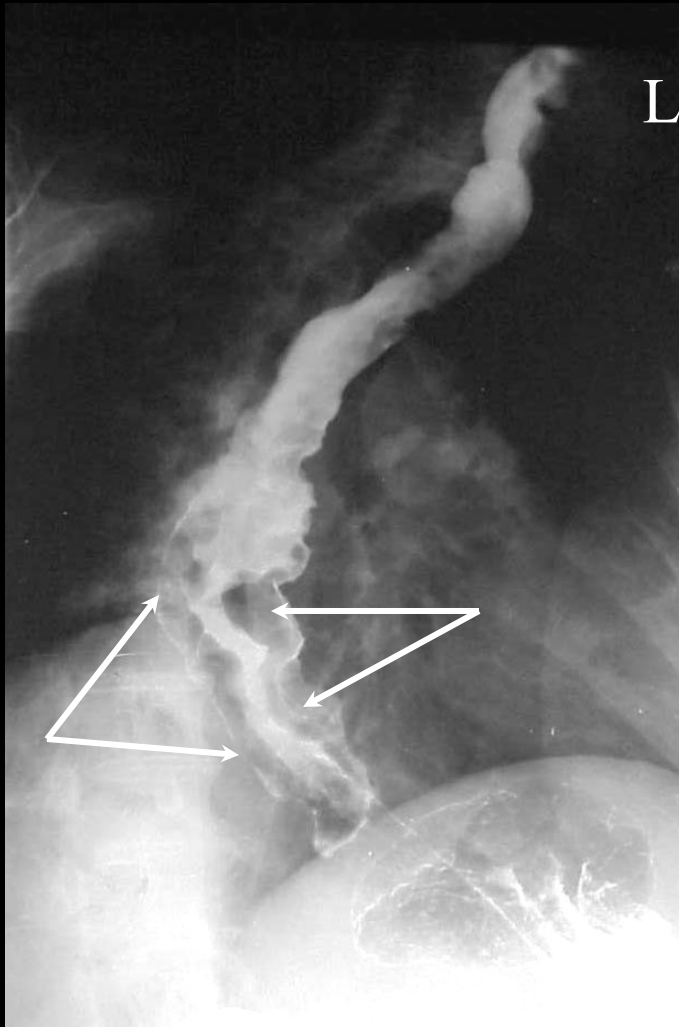
The entire length of this patient's esophagus has been filled with barium during an UGI as a result of a nonfunctional lower esophageal sphincter (arrow). This condition is known as **achalasia**.

Esophageal Varices:

- Esophageal varices are dilated, tortuous veins of the esophagus which may rupture.
- They are commonly a result of portal hypertension and/or liver cirrhosis.

Esophageal varices are often a complication of alcoholism.

Esophageal Varices:

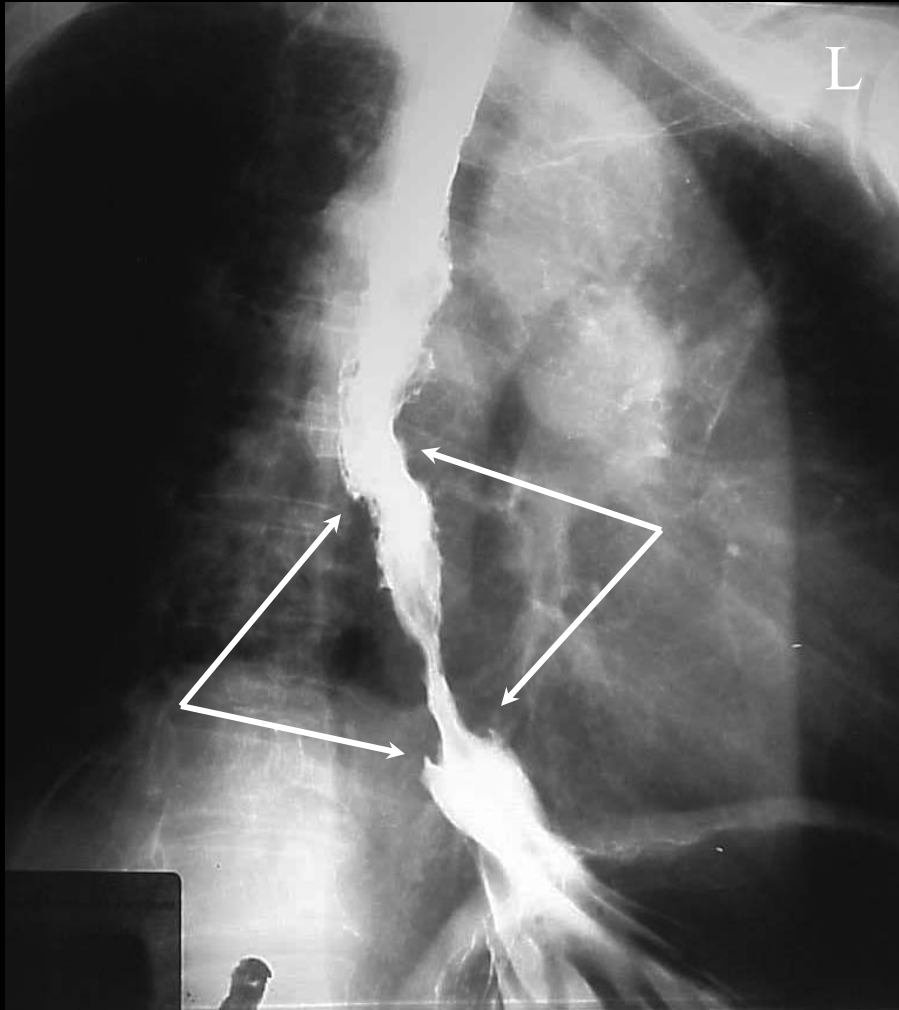


The arrows on this esophagram are pointing to tortuous varicose veins of the esophagus known as **esophageal varices**. They are the result of portal hypertension that is often caused by **cirrhosis** of the liver. This disease is commonly found in patients suffering from alcoholism.

Esophagus Cancer:

- Esophagus cancer represents 2% of all cancers and there is a high incidence in smokers and alcoholics.
- The prognosis for this cancer is very poor as it has a 5 year survival rate of 25%.
- It presents with a very “ratty” radiographic appearance on a barium swallow.
- Treatment includes the following
 - Chemotherapy
 - Radiation Therapy
 - Esophagogastrectomy (gastric pull-up)
 - The affected portion of the esophagus is removed and the stomach is pulled up into the thorax.

Esophagus Cancer:



The arrows on this esophagram are pointing to areas where stenosis of the esophagus has occurred due to the presence of **esophageal cancer**. This type of cancer has a very low survival rate and has a high incidence in smokers and alcoholics. Notice how the distal portion of the lesion has taken on the classic “apple-core” appearance of an **adenocarcinoma**.

Candida:

- Candida occurs as the result of a fungus that has affected the esophagus.

This is sometimes referred to as thrush.

- It is an opportunistic infection that is often found in HIV positive and cancer patients due to the state of their suppressed immune system.

Candida:



Candida is an opportunistic fungus that commonly inhabits the mouth, throat, GI tract and vagina. When it over grows within the body it can lead to conditions such as **thrush** and **candidiasis**.

Immunocompromised patients that are HIV positive or patients on chemotherapy are predisposed to this infection.

Peptic Ulcer Disease (PUD):

- PUD is a general term that is used to describe ulcers of the stomach and duodenum.
- This is usually a chronic disease.
- Causes include the use of aspirin, steroids, spicy foods, stress, and it can be the result of a bacterial infection.
- Complications include the potential for an obstruction, perforation, and bleeding.
- Treatment consists of a bland diet, antacids, decrease stress, surgery, antibiotics and abstinence from smoking, alcohol, and aspirin.

Peptic Ulcer Disease (PUD):

- Gastric Ulcers

These are very rare and may be a complication of gastric carcinoma.

- Peptic Ulcers

These are located in the duodenum and are much more common than gastric ulcers.

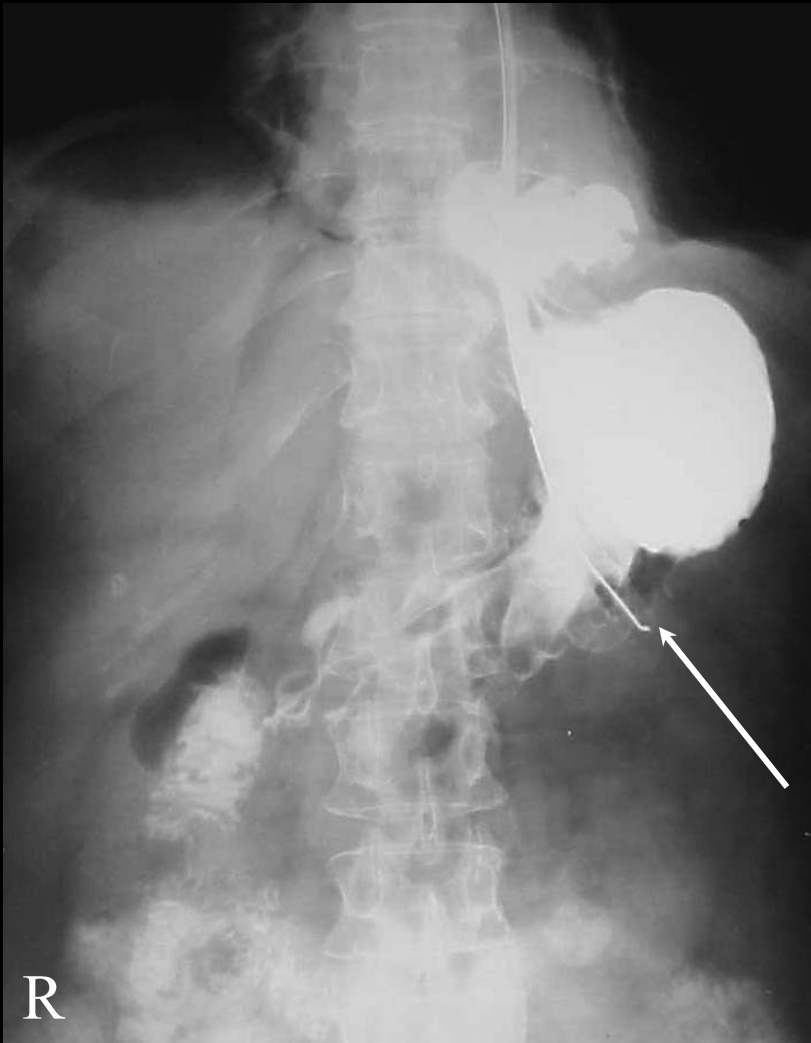
They are mostly located in the duodenal bulb and are usually not associated with cancer.

Peptic Ulcer Disease: Duodenal



The arrow on this radiograph is pointing to a **duodenal ulcer**. This is the most common type of peptic ulcer and it is usually located within the duodenal bulb. Duodenal ulcers are usually not associated with cancer.

Peptic Ulcer Disease: Gastric

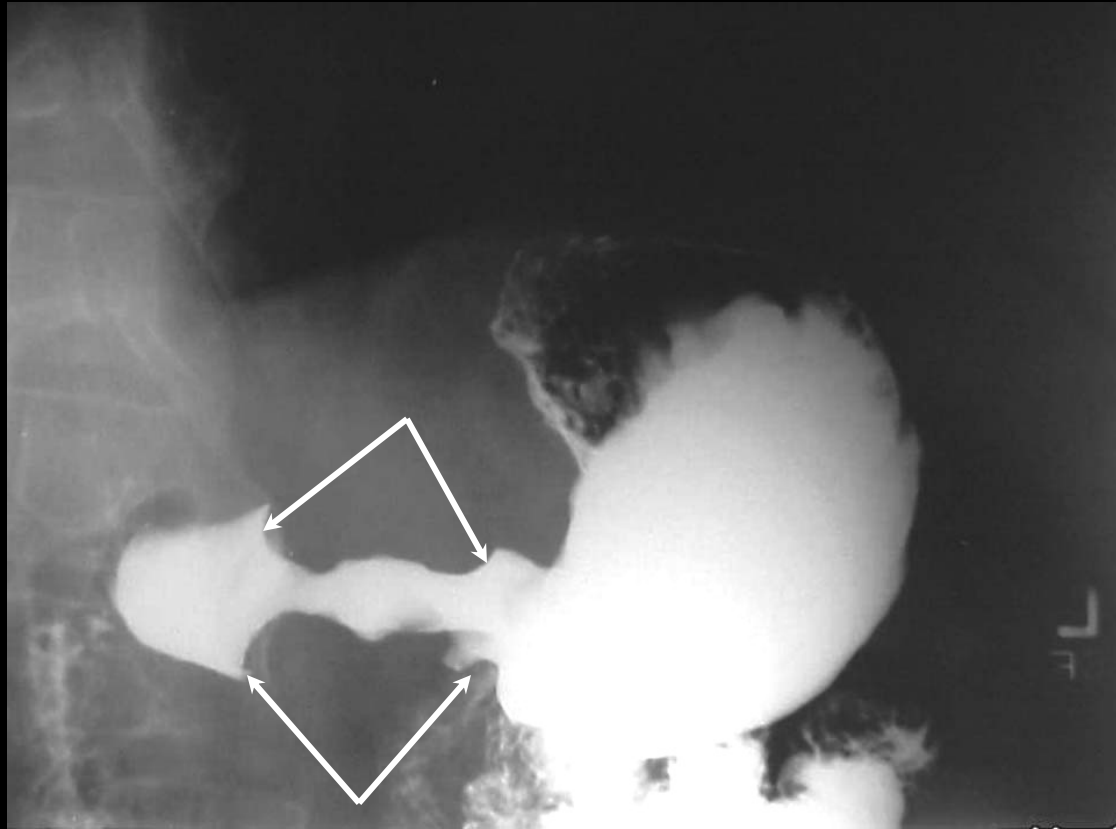


It is imperative that the etiology of a **gastric ulcer** be determined to ensure that it was not caused by stomach cancer. A biopsy of the stomach will be performed to rule this out. On this UGI radiograph, the tip of the NG tube (arrow) is lodged within a gastric ulcer.

Gastric Carcinoma:

- It is generally asymptomatic in the early stages and has generally metastasized to other areas of the body by the time it has been diagnosed.
- As a result, it has a poor prognosis.
- UGI studies present thick, irregular, and rigid (linitis plastica) folds.
- Treatment includes gastrectomy, chemotherapy, and radiation therapy.

Gastric Carcinoma:

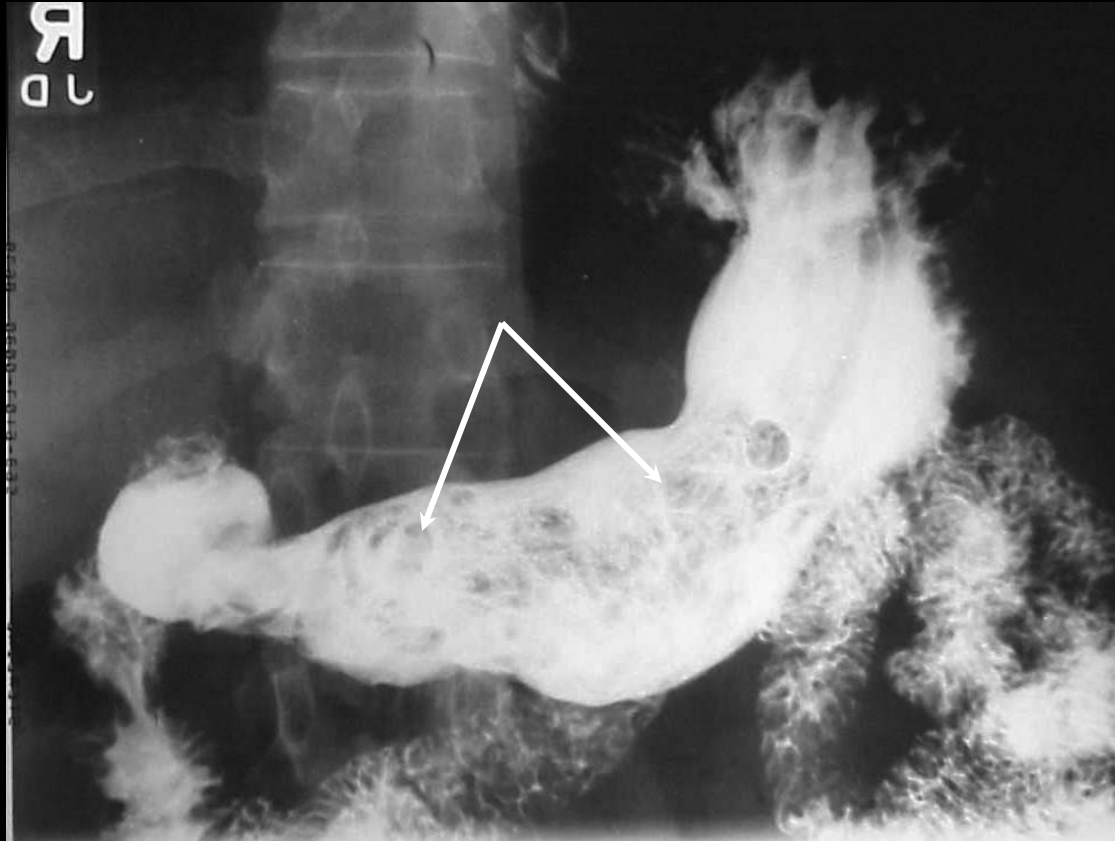


The arrows on this UGI radiograph are pointing to a **gastric carcinoma**. Note the classic “apple-core” appearance that is a characteristic of an adenocarcinoma.

Bezoar:

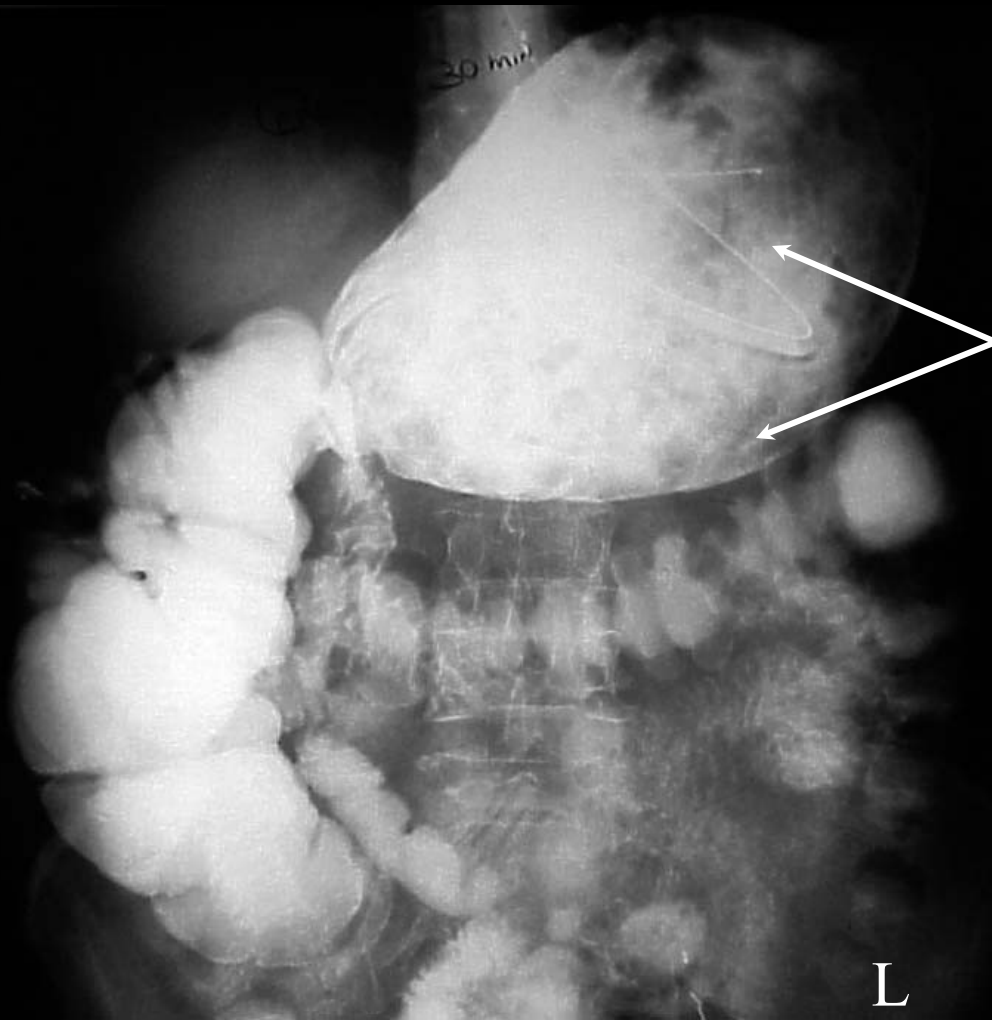
- This is a hard mass of entangled material found within the stomach or intestines that cannot be digested.
- They are often made of hair and food fibers.

Bezoar:



The artifact (arrows) depicted on this radiograph consists of a hard ball of entangled materials called a **bezoar**. It consists of large mass of hair and/or vegetable fibers that cannot be digested.

Bezoar:



The arrows on this radiograph are pointing to another example of how large a **bezoar** can become. In fact, they can sometimes be found to be the cause of a **mechanical bowel obstruction**.

Bowel Obstruction:

- The two broad categories of bowel obstructions are as follows: adynamic or paralytic ileus and a mechanical bowel obstruction.
- In either case, the net result is a partial or complete loss of the normal parastaltic action of the small and/or large intestine thus impeding the normal transit of chyme.
- Signs and symptoms of a bowel obstruction would include the following:
 - Abdominal Pain and/or Cramping
 - Abdominal Distention
 - Vomiting and Fecal Vomiting (unpalatable!)
 - Constipation

Adynamic or Paralytic Ileus:

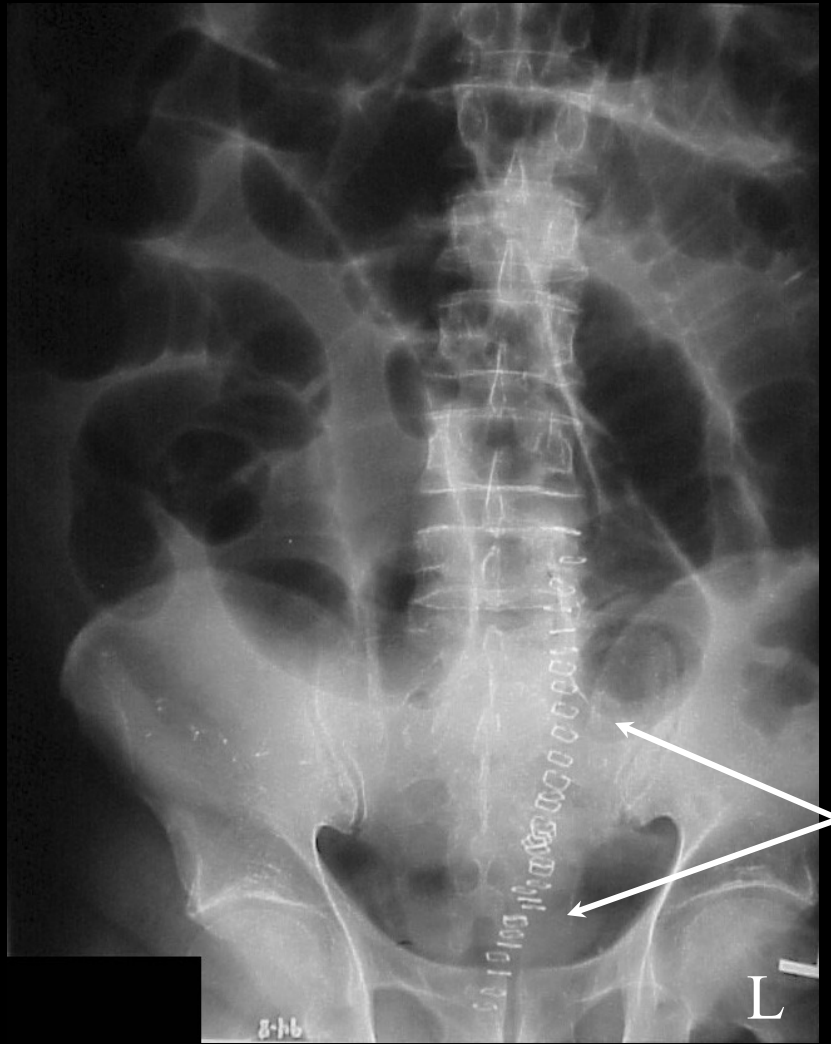
- This type of bowel obstruction is caused by a reduction in the normal peristaltic action of the intestines.
- This loss of peristalsis will cause the lumen of both the small and large intestines to fill with air and fluid.
- Therefore, the radiographic appearance of air in both the small and large intestines is an indication of this condition.
- Some common causes of an adynamic ileus are as follows:

Anesthesia/Some Medications

Abdominal Surgery

Illness

Adynamic or Paralytic Ileus:



The dilated loops of small bowel found on this radiograph indicate the presence of a **small bowel obstruction**. The surgery staples (arrows) in the lower abdomen are an indication that this obstruction may have been caused by a combination of exposure to anesthesia and abdominal surgery. Therefore, this obstruction would be categorized as an **adynamic** or **paralytic ileus**.

Mechanical Bowel Obstruction:

- This is the second category for bowel obstructions.
- A mechanical obstruction is caused by a motility disorder that results from some type of structural abnormality.

Many factors can contribute to a mechanical bowel obstruction and some of them are listed below:

- Hernia
- Adhesions
- Volvulus
- Intussusception
- Neoplasm (Adenoma/Polyp, Adenocarcinoma)
- Crohn's Disease
- Constipation

Hernia:

- This type of obstruction is caused by a weakening of the abdominal wall that allows a portion of the small and/or large intestine to protrude through it.
- A *reducible hernia* can be pushed back into the abdominal cavity while an *incarcerated hernia* cannot and could therefore lead to a bowel obstruction.
- A common hernia in men is called an inguinal hernia.
 - This condition occurs when the inguinal ring is compromised thus allowing a portion of the bowel to rupture through the abdominal wall.
 - In some instances, the bowel will descend into the scrotum.

Hernia: Inguinal



A large portion of this patient's bowel (arrows) has protruded through an unnatural opening within the abdominal wall. This is called an **inguinal hernia** and it is estimated that about 5% of the population will develop an abdominal wall hernia.

Bowel Adhesion:

- Adhesions are bands of fibrous connective tissue that connect organs and tissues that are normally separate.
- They are an almost inevitable outcome of abdominal surgery.
- Adhesions can lead to abdominal pain, infertility, and bowel obstruction.

This blockage will lead to death in about 5% of all cases.

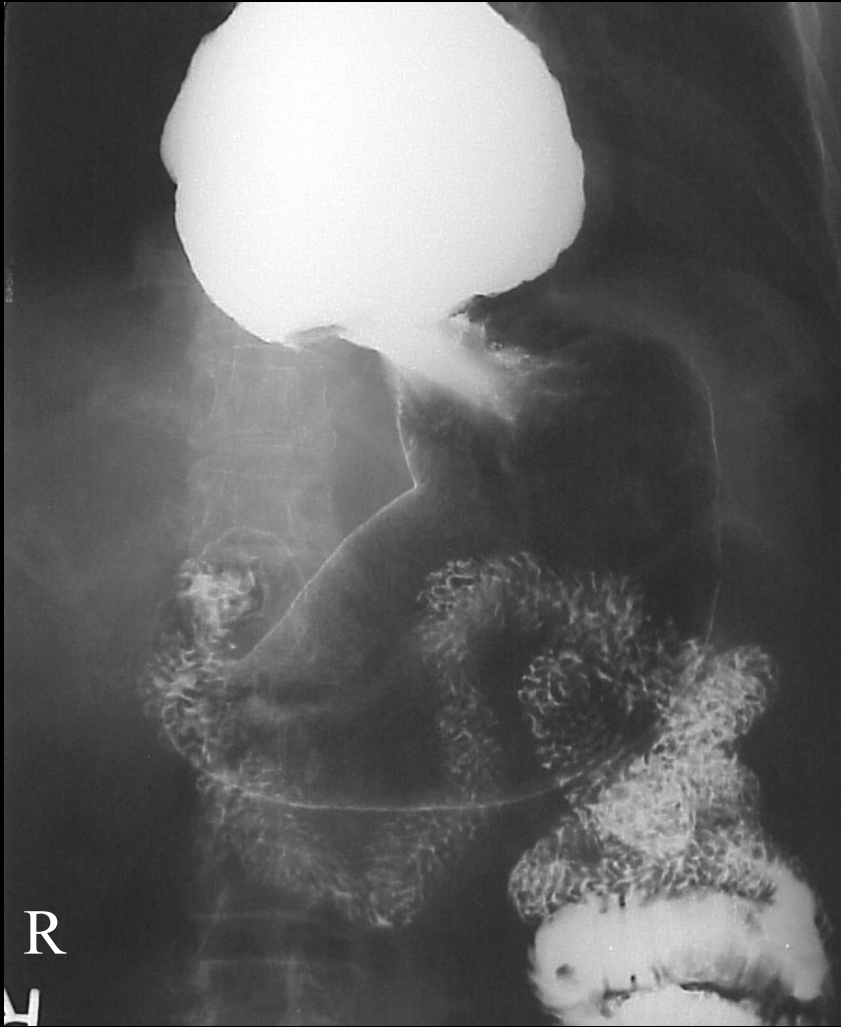
- A bowel adhesions can cause a twisting of the bowel and loss of blood supply to the affected area.

The resultant bowel strangulation will result in death in as high as 37% of all cases.

Volvulus:

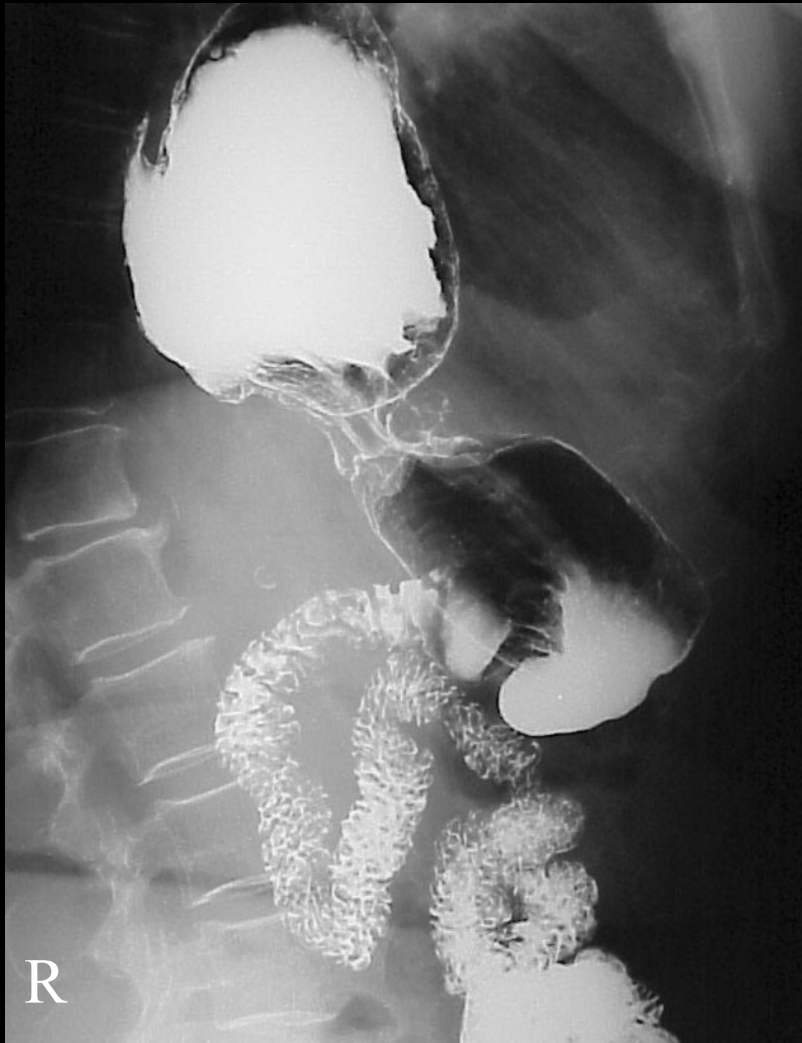
- A volvulus is a loop of intestine that has twisted around itself causing either a partial or complete obstruction.
- They may resolve on their own but some will require surgical intervention in order to prevent a loss of blood supply to the affected area and relieve the obstruction.

Volvulus: Gastric



This AP UGI radiograph depicts an abnormal twisting of the stomach which can lead to an obstruction. This is called a **gastric volvulus** or **stomach torsion**.

Volvulus: Gastric



This is a lateral on the same patient demonstrating a **gastric volvulus or stomach torsion.**

Volvulus: Gastric

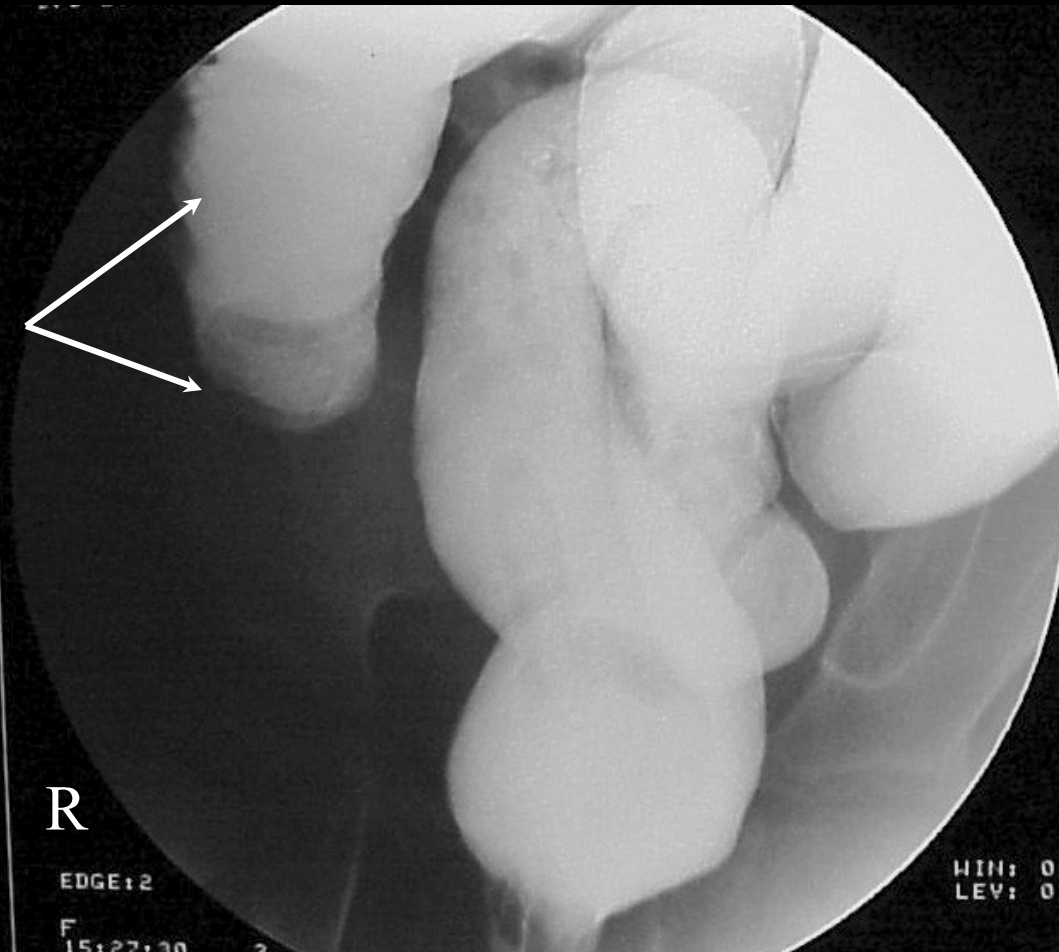


This is an RAO on the same patient demonstrating a **gastric volvulus or stomach torsion.**

Intussusception:

- Intussusception occurs when a section of bowel is constricted by peristalsis causing it to prolapse or telescope into itself.
- This condition is primarily confined to infants aged 2 to 36 months and occurs more frequently in boys than girls at a ratio of 3:1.
- Intussusception is the cause of approximately 1% of all adult bowel obstructions and commonly affects the ileocecal valve.
- It is commonly corrected with a barium enema.

Intussusception:



The arrows on this barium enema on a 2 year old are pointing to an area near the cecum that has constricted by peristalsis and has prolapsed or telescoped in to itself. This condition is a type of **bowel obstruction** referred to as **intussusception**.



Intussusception:



This is a KUB on the previous patient after successful reduction of the **intussusception** by means of applying pressure with a barium enema.

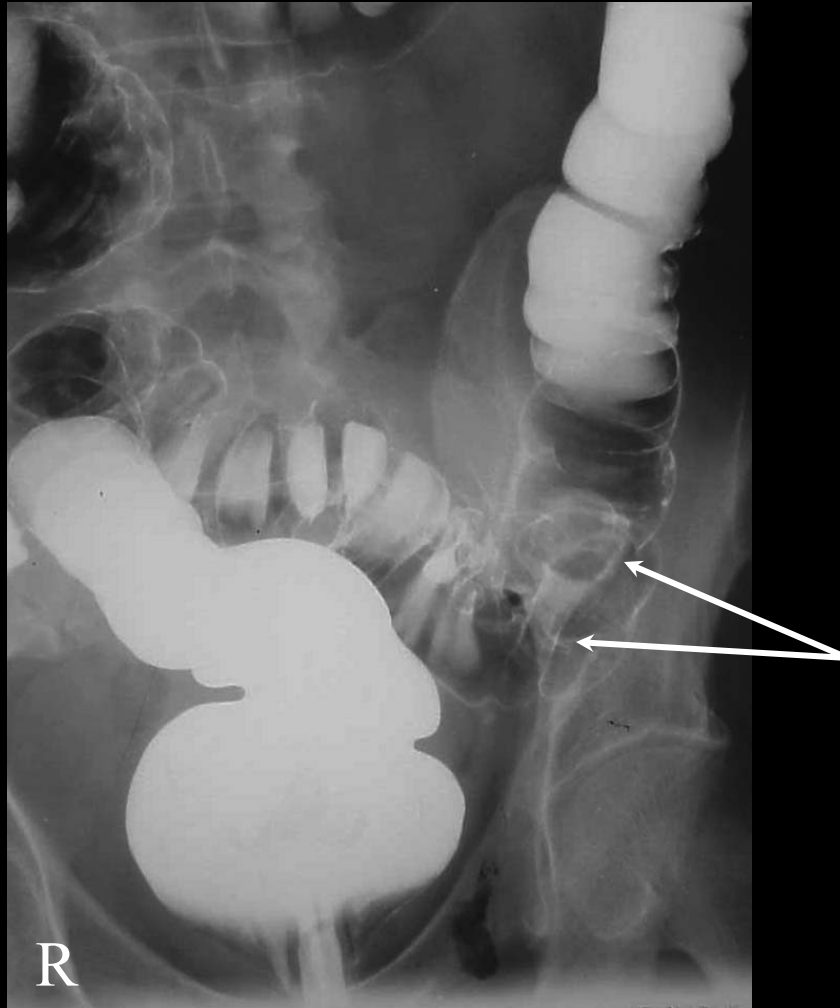
Adenomatous Polyp:

- A neoplasm that grows into the lumen of the colon is called a polyp.
- A pedunculated polyp possess a stalk while a sessile (barnacle) polyp is attached directly to the bowel wall.
- Most polyps are benign but an adenomatous polyp may transform into a malignancy and must be removed.

This is sometimes referred to as simply an adenoma.

- Colon polyps are generally asymptomatic but some may cause rectal bleeding, pain, diarrhea, and/or constipation.

Adenomatous Polyp:



The arrows on this image are pointing to a **pedunculated polyp**. This type of neoplasm can lead to cancer and is therefore routinely removed.

Adenomatous Polyp:

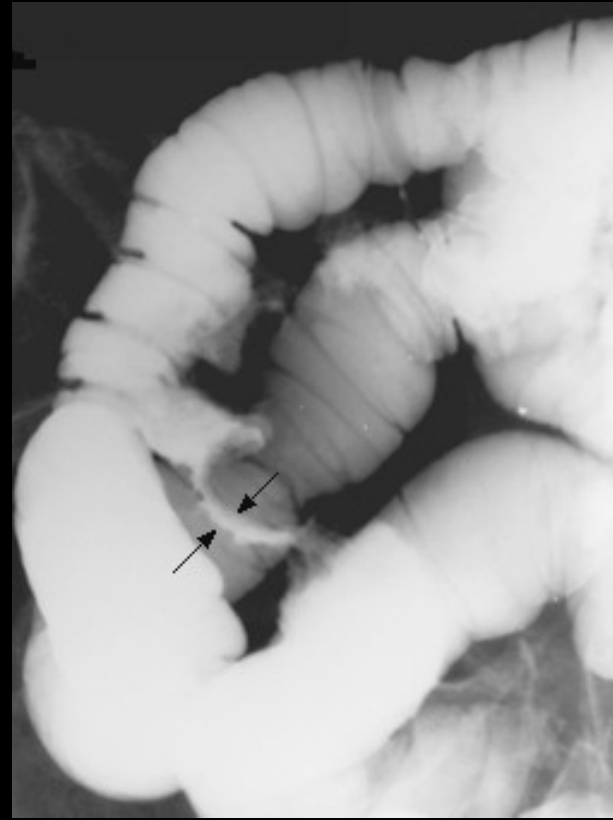
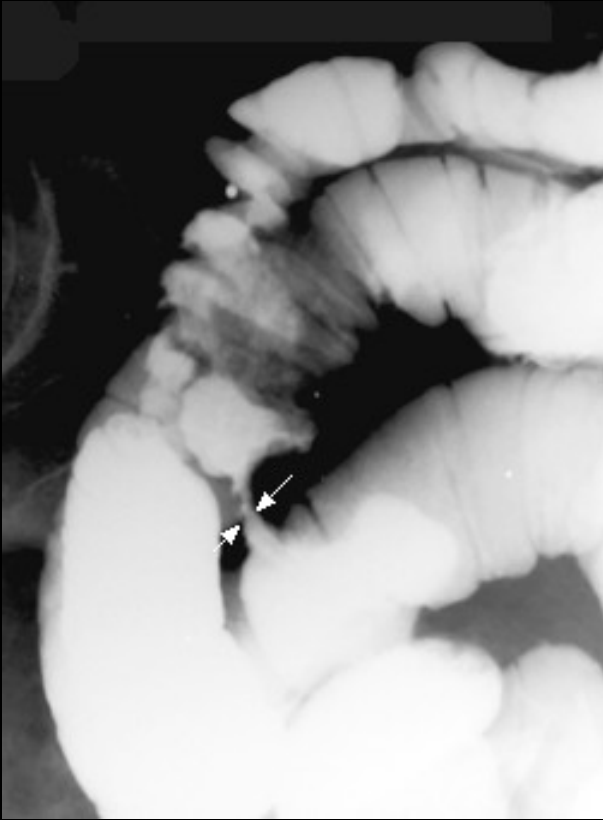


This is a magnified view of the previous image. The presence of a stalk (arrows) is a characteristic of a **pedunculated polyp**.

Adenocarcinoma:

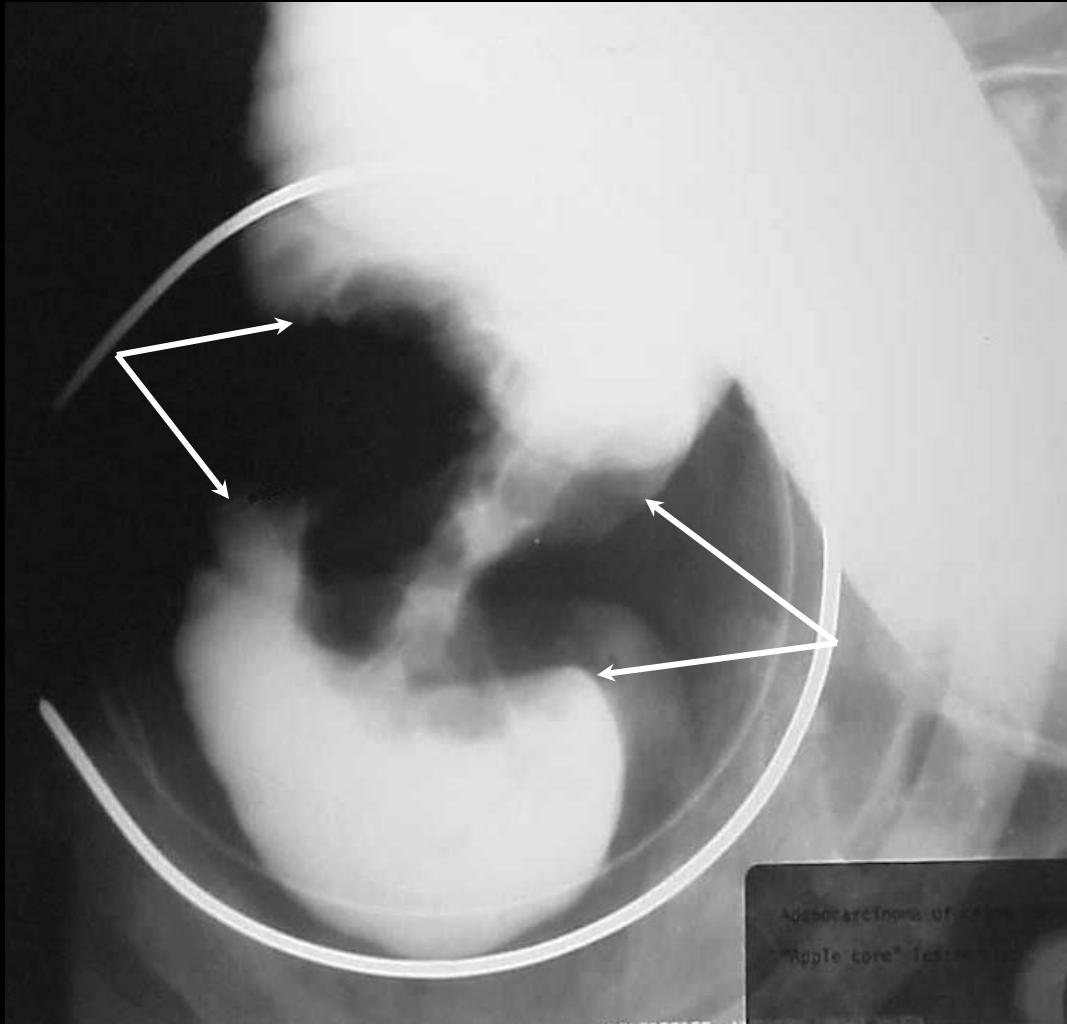
- An adenocarcinoma is a type of neoplasm that originates in glandular tissue and can be the cause a bowel obstruction.
- In the colon, it is also commonly referred to as colorectal cancer and is thought to arise from adenomatous polyps.
- The lifetime risk of developing colon cancer in the US is 7% and it is the second most common cause of cancer mortality.
- Unfortunately, this type of metastatic cancer often goes unnoticed until it reaches a relatively advanced stage.
- A colonoscopy is the method of choice for diagnosis.
 - A positive diagnosis is followed by surgical removal and in many instances, chemotherapy.

Adenocarcinoma :



The arrows on this image are pointing to a cancer that has formed within the lining of the small intestine. This type of cancer is called an **adenocarcinoma** since it originates within glandular tissue.

Adenocarcinoma :



This **adenocarcinoma** has formed in the large intestine and possesses a classic the “**apple-core**” appearance (arrows) that it is often characterized by. This type of metastatic cancer is often referred to as **colorectal cancer**.

Regional Enteritis or Crohn's Disease:

- This is the last example of a disease that may be the cause of a mechanical bowel obstruction.
- Crohn's disease is characterized by a chronic inflammation of the bowel and has an unknown etiology.
- It is characterized by abdominal cramping, diarrhea, constipation, weight loss or gain, and vomiting.
- Fistulas may form in response to the chronic inflammation that characterizes this disease.
- There is no known cure for Crohn's disease.

Regional Enteritis or Crohn's Disease:



This image demonstrates the classic radiograph appearance of the “string sign” that is a characteristic of Crohn's disease.

Regional Enteritis or Crohn's Disease:



This is an even better depiction of the classic radiograph appearance of the “**string sign**” that is a characteristic of **Crohn's disease**.

Regional Enteritis or Crohn's Disease:



This is a magnified view of the previous image depicting the radiographic appearance of the “**string sign**” that is a characteristic of **Crohn's disease**.

Constipation:

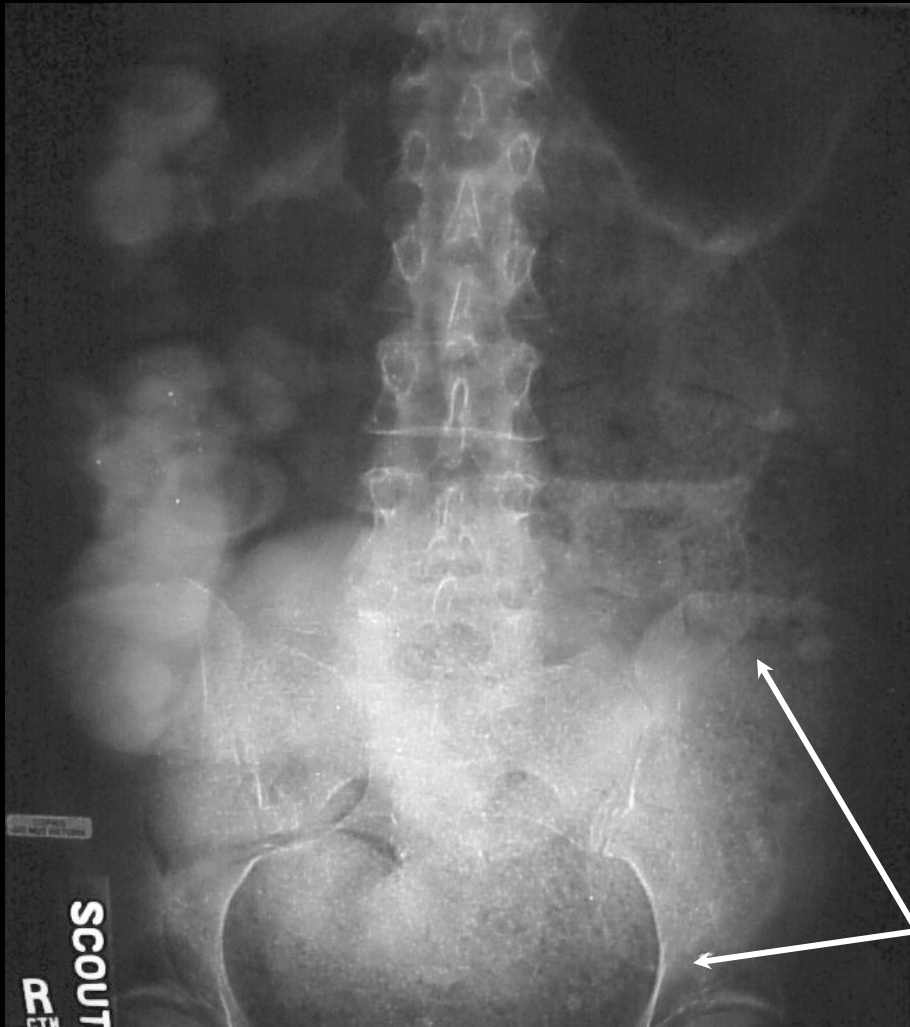
- Constipation is a very common digestive complaint where the patient experiences hard stool that can be difficult to defecate.
- Straining to defecate can lead to anal fissures and hemorrhoids (varicose veins of the rectum).
- Severe cases can lead to a mechanical bowel obstruction called a fecal impaction.
- Causes of constipation include lack of dietary fiber, dehydration, a decrease in peristalsis, stenosis, tumors, anxiety, and abdominal surgery.

Constipation:

- Treatment usually consists of an increased intake of fluid and dietary fibers and the use of laxatives.

In some instances, the impaction will require the use of enemas and/or manual removal.

Constipation:



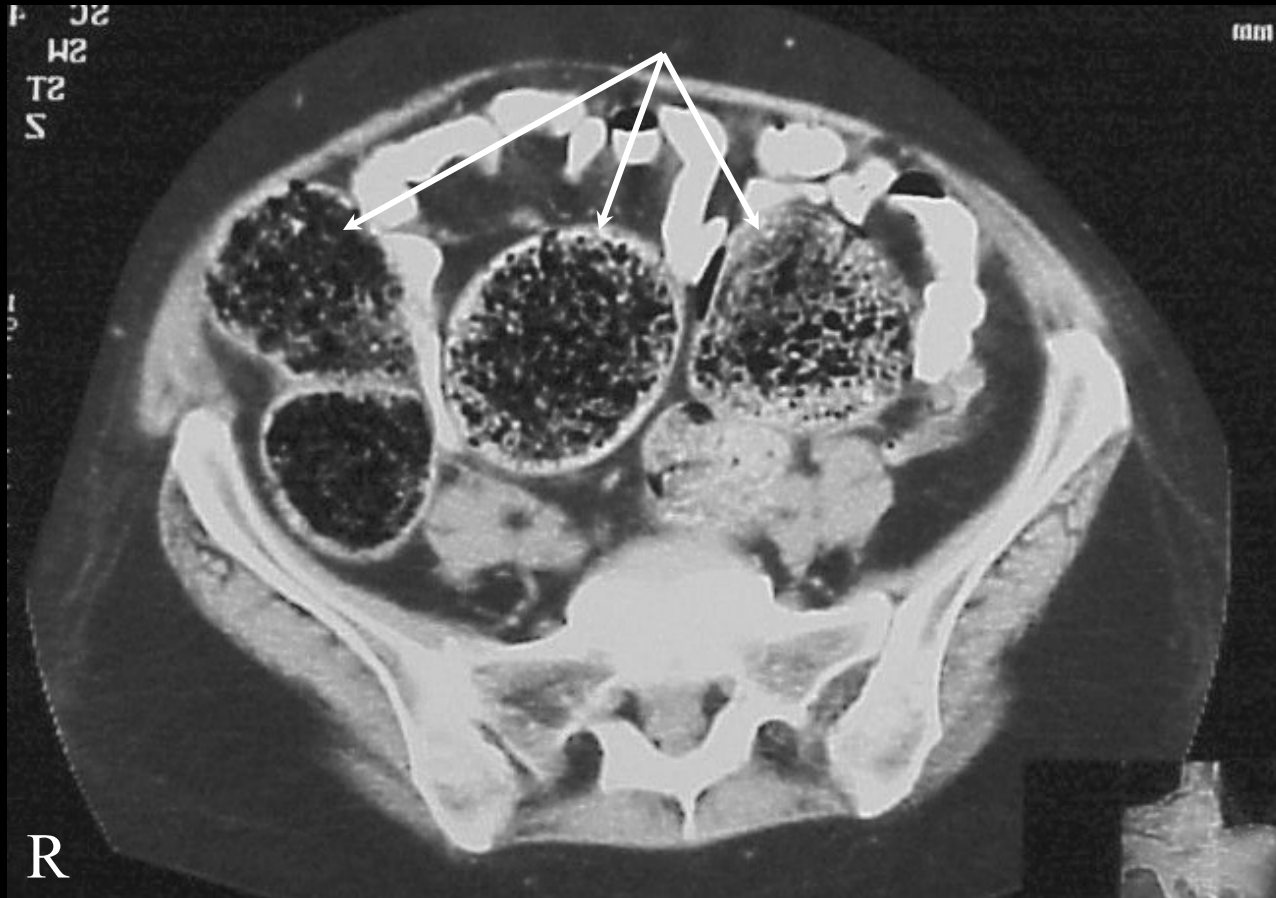
The grainy appearance on this KUB is the result of a **fecal impaction** (arrows). **Constipation** is a very common digestive complaint where the patient experiences hard stool that can be difficult to defecate.

Constipation:



This is a magnified view of the previous image that demonstrates how a **constipation** can lead to a **fecal impaction**.

Constipation:

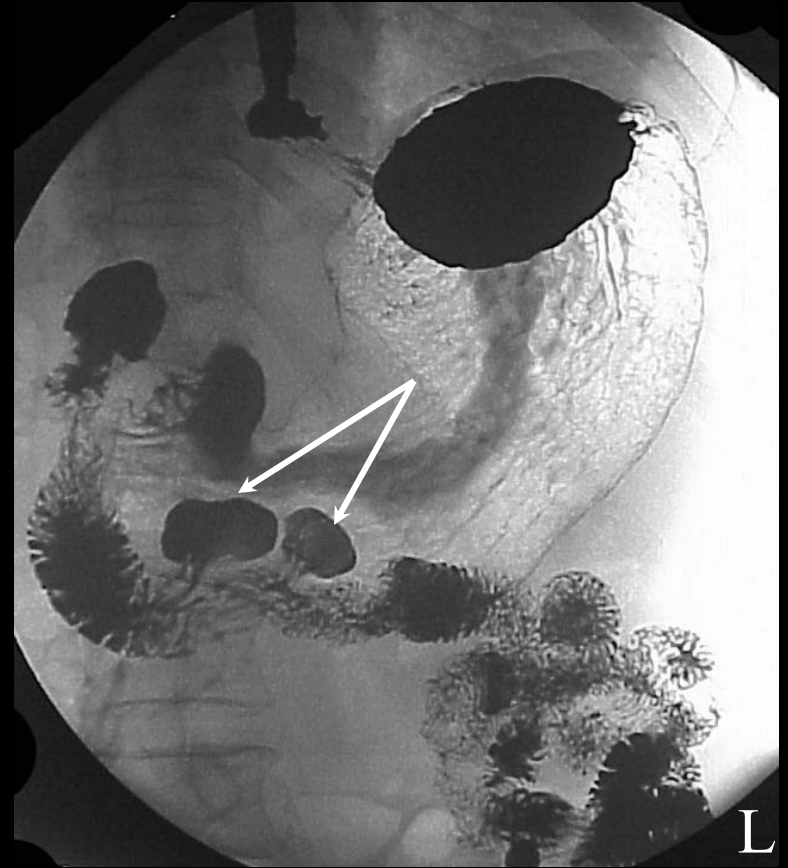
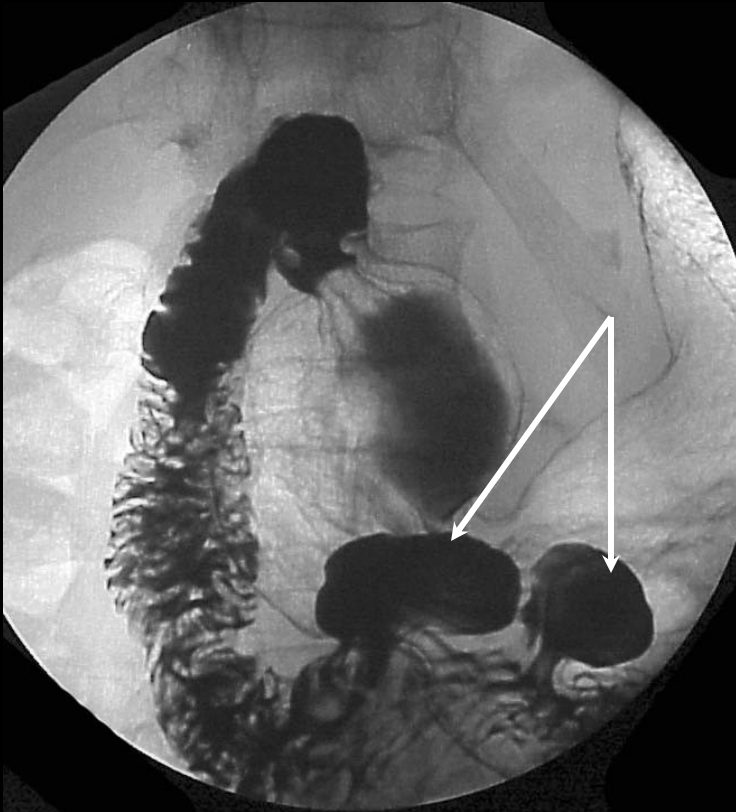


The arrows on this CT are pointing to a large **fecal impaction** that is located throughout the large intestine. The etiology was **constipation**.

Diverticulosis:

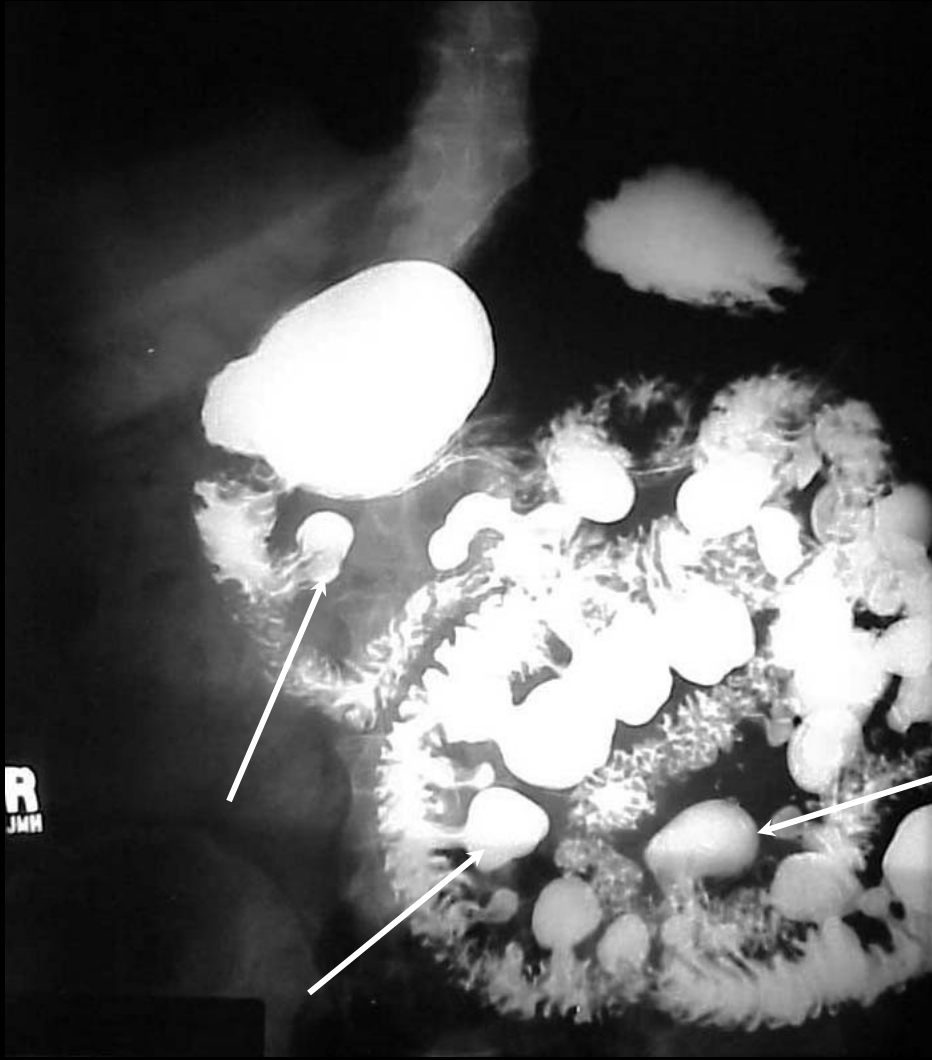
- As mentioned earlier, diverticulum can occur along the entire length of the GI tract.
- In regards to the large intestine, they are commonly found in the area of the sigmoid colon.
- Diverticulum often have no signs or symptoms and are often a serendipitous discover on a barium study or colonoscopy.

Diverticulosis:



The arrows on these UGI radiographs are pointing to multiple **diverticula** that have formed on the distal portion of the duodenum.

Diverticulosis:



The arrows on this small bowel series radiograph are pointing to innumerable **diverticula** that have formed throughout the small intestine.

Diverticulosis:

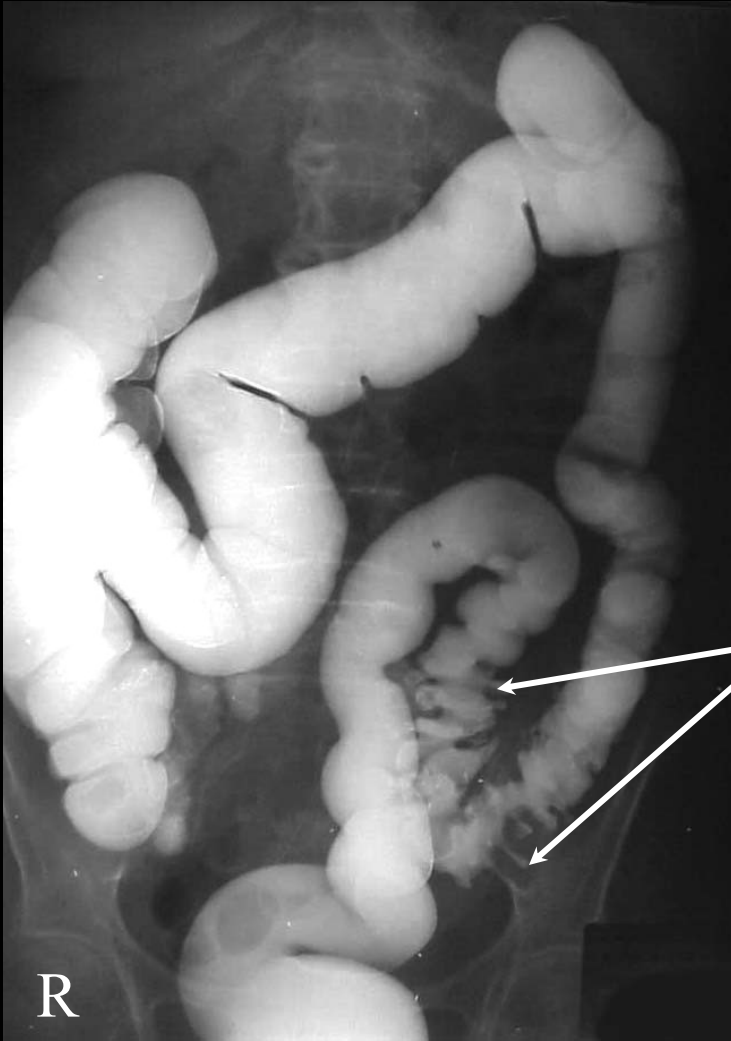


The arrows on this barium enema radiograph are pointing to innumerable **diverticula** that have formed throughout the large intestine.

Diverticulitis:

- Diverticulitis occurs when a diverticulum become infected and bleeds.
- This is often caused by entrapment of chyme or feces within the diverticulum.

Diverticulitis:

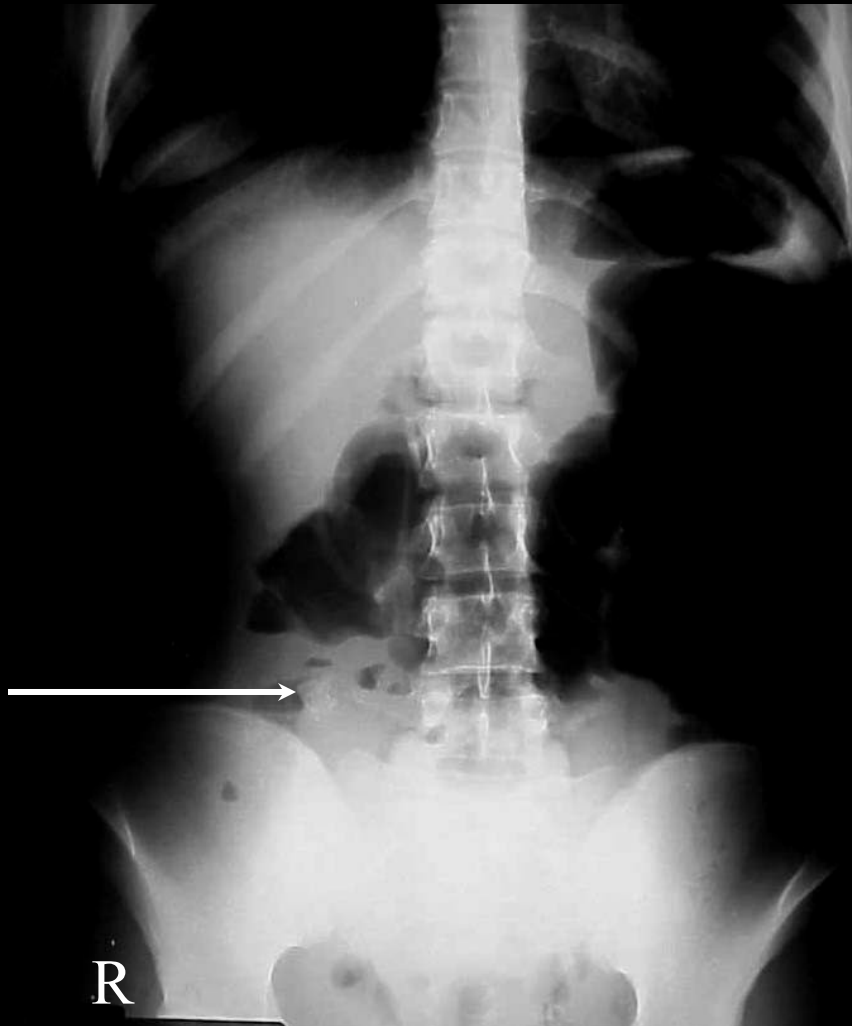


The arrows on this barium enema radiograph are pointing to **diverticula** within the large intestine that have become infected with feces. This condition is referred to as **diverticulitis** and will likely result in rectal bleeding.

Appendicitis:

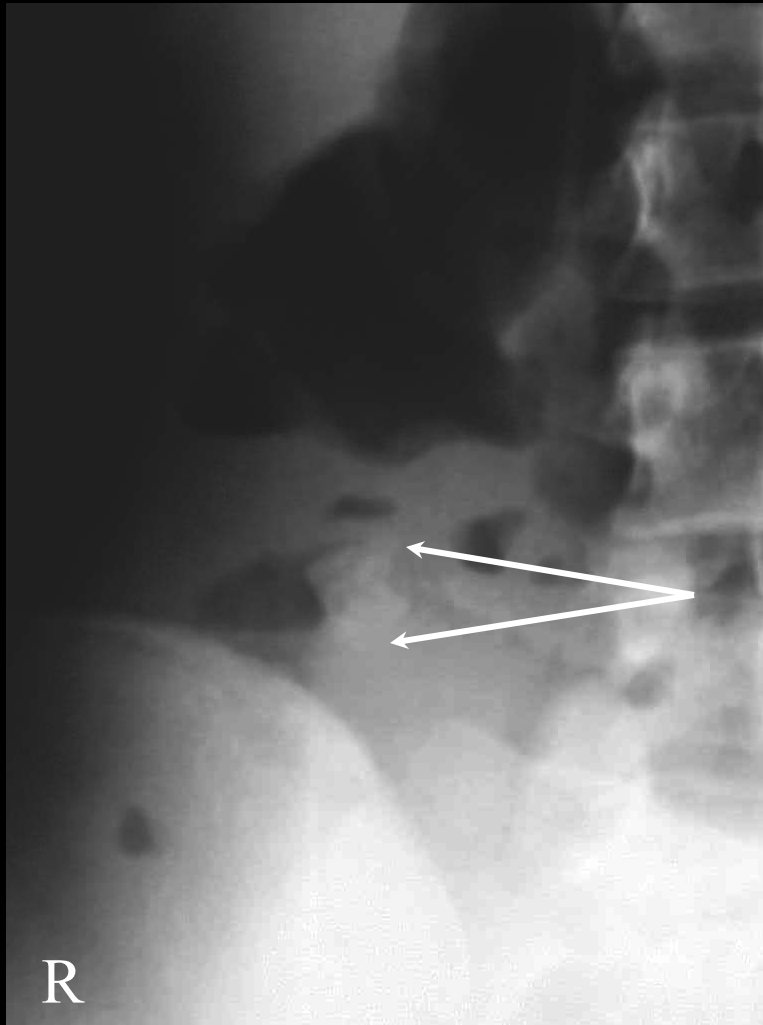
- Appendicitis occurs as a result of entrapment of feces within the appendix and the presence of an appendicolith.
- Symptoms include right lower quadrant pain and an increase in the white blood cell count.
- A barium enema will demonstrate a spasm of the cecum and a non filling appendix.
- Mild cases may resolve on their own but more severe infections may require the surgical removal of the appendix.

Appendicitis:



The arrow on this radiograph is pointing to an **appendicolith** that has become inflamed. As a result, this patient was diagnosed with **appendicitis** and had the appendix surgically removed.

Appendicitis:



This is a magnified view of the previous image and better depicts the size and shape of the **appendicolith** (arrow).

Diverticula of the Appendix:



Diverticula can form anywhere along the alimentary canal. In this instance, the lining of the appendix has weakened resulting in the formation of a small diverticula.

GI Bleed:

- A GI bleed can occur throughout the GI tract.
- The most common causes of lower GI bleeding are diverticulitis and angiodysplasia.

The primary symptom is rectal bleeding with bright red blood.

- Endoscopy, nuclear medicine scans, and/or special procedure studies (IMA/SMA) can be performed to diagnose this condition.
- Transcatheter embolization or an infusion of vasopression have proven to be effective strategies employed to stop the bleeding.

Hepatobiliary System Menu

1. Co-Joined Twins at the Liver
2. Hepatic Cysts
3. Hepatic Hemangioma
4. Hepatocellular Carcinoma
5. Hepatomegaly
6. Liver Metastasis
7. Cholelithiasis
8. Emphysematous Cholecystitis
9. Porcelain Gallbladder
10. Splenomegaly
11. Spleen with a Calcified Cyst

Co-Joined Twins at the Liver:

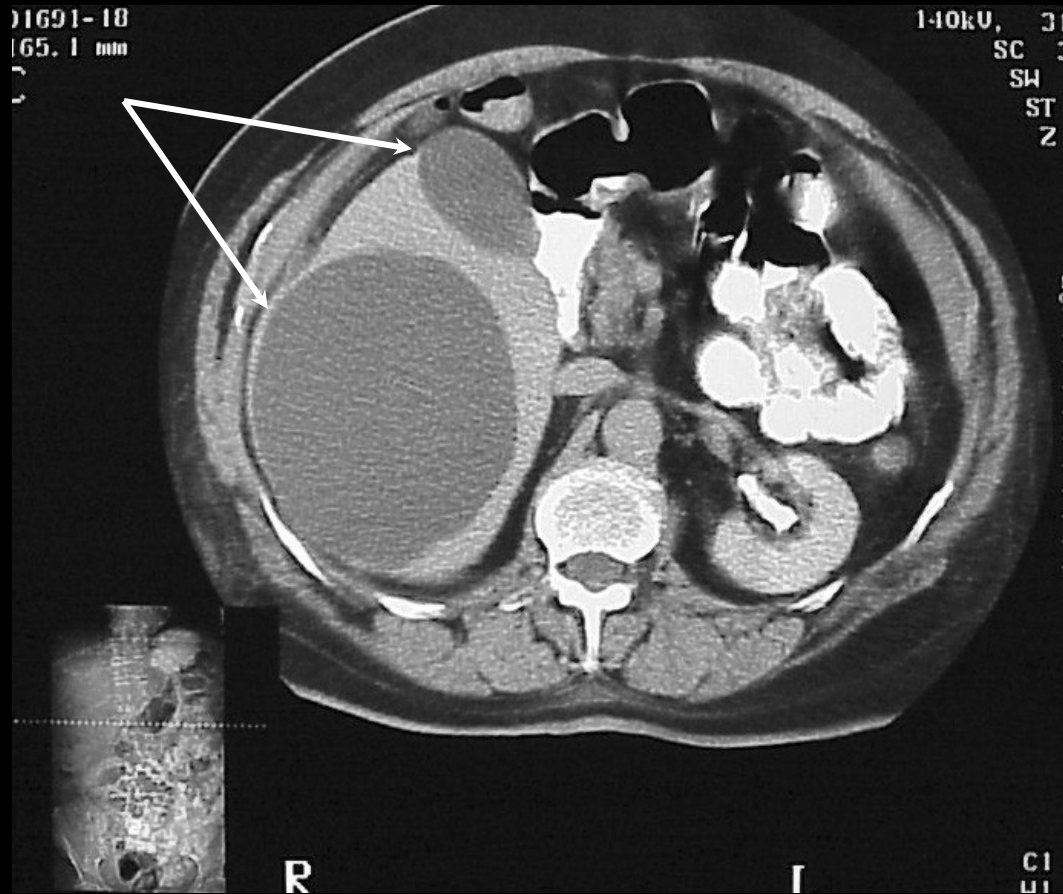


The radiograph depicts two twins that are joined at the liver.

Hepatic Cysts:

- A hepatic cyst is a benign, thin-walled sac that may be either empty or full of fluid.
- They may be located within the liver or on its external surface.
- Hepatic cysts generally have no symptoms and are usually incidental findings on ultrasounds, CT scans and/or MRI scans of the abdomen.
- No treatment is usually required.

Hepatic Cysts:



The arrows on this CT scan of the abdomen are pointing to rather large **hepatic cysts**. These are usually incidental findings and no treatment is usually required.

Hepatic Hemangioma:

- A hepatic hemangioma is the most common benign tumor of the liver.
- It consists of dilated blood vessels that create pools or lakes of blood within the liver.
- They commonly manifest between the ages of 30 to 50 and are more prevalent in women than in men.
- A needle biopsy is not indicated with this condition and may even be considered a contraindication due to the increased potential for excessive bleeding.
- MRI is the modality of choice in differentiating between a hepatocellular carcinoma and a hepatic hemangioma.
- There is no treatment for this condition although surgery may be indicated in severe cases.

Hepatic Hemangioma:



The arrows (b) on this MRI scan of the abdomen are pointing to large **hemangioma**. The hepatocytes of the liver enhance with contrast material (a) while the “lakes” of blood within the neoplasm do not (b).

Hepatocellular Carcinoma:

- Hepatocellular carcinoma is a rare primary liver cancer that is also known as a hepatoma.
- It is very common in alcoholics and patients with hepatitis.
- It has a propensity to metastasize to the lungs but it will also spread to the colon and breasts.
- This type of cancer may not have any symptoms.

However, patients may experience any combination of the following:

- Dull Pain in the Right Upper Quadrant
- Anorexia
- Hepatomegaly
- Jaundice

Hepatocellular Carcinoma:

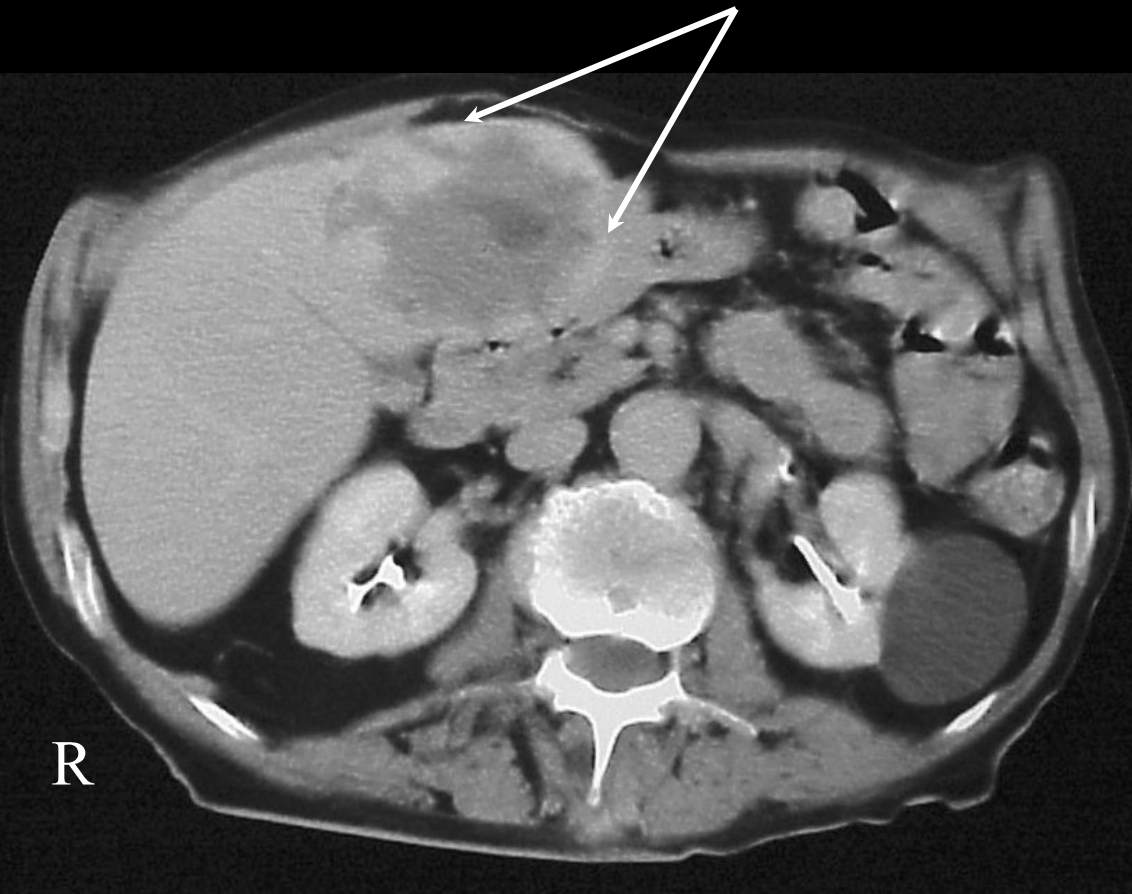
- MRI is the method of choice to diagnose this type of cancer but CT and ultrasound are often employed as well.
- There are a myriad of treatments available for hepatocellular carcinoma including surgical resection, liver transplant, and chemotherapy.

Hepatocellular Carcinoma:



The arrows on this CT scan of the abdomen are pointing to a large **hepatocellular carcinoma**. This rare primary liver cancer is also referred to as a **hepatoma**.

Hepatocellular Carcinoma:



The arrows on this CT scan of the abdomen are pointing to another example of **hepatocellular carcinoma** or **hepatoma**.

Hepatomegaly:

- Hepatomegaly refers to an enlarged liver.
- It can have a plethora of causes some of which are as follows:
 - Infection
 - Drugs and Alcoholism (Cirrhosis)
 - Tumors
 - Hepatitis
- Treatment varies according to the cause of the hepatomegaly.

Liver Metastasis:

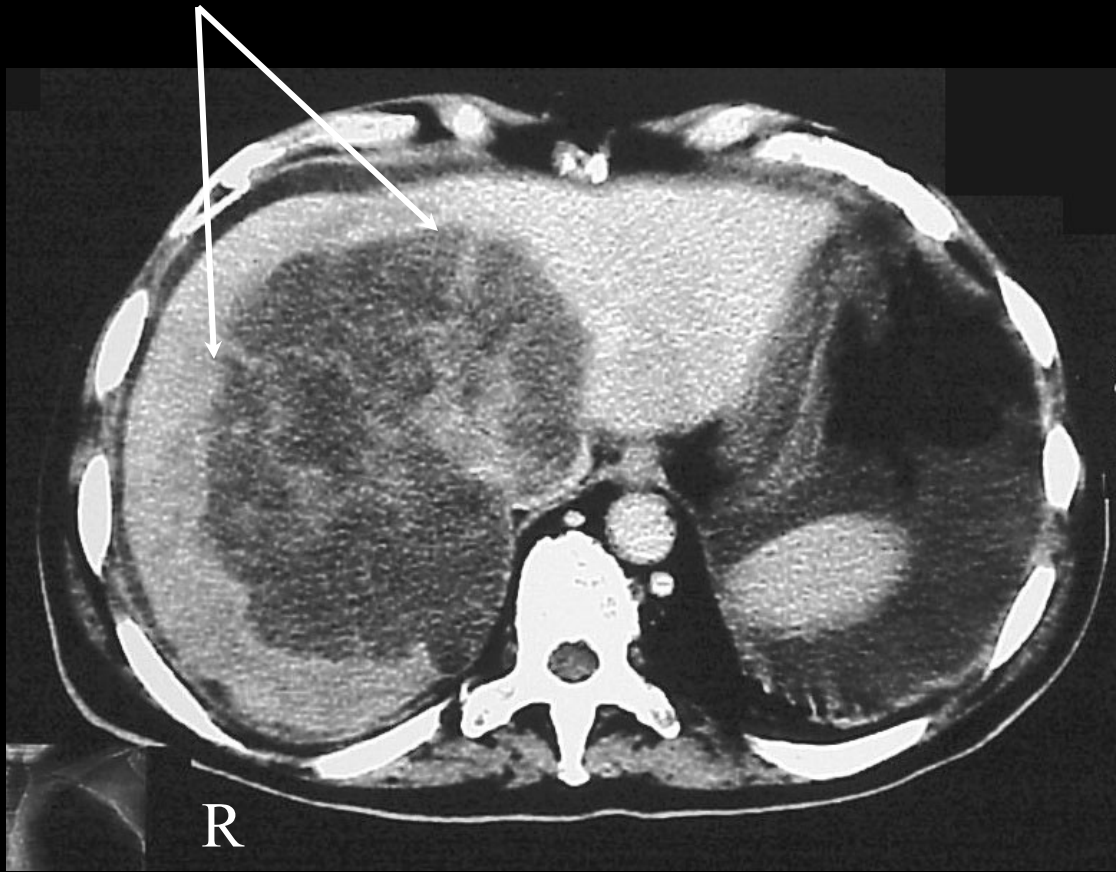
- The liver is a common site for most any cancer metastasis.
- The following is a partial list of cancers that like to spread to the liver:
 - Breast Cancer
 - Colon Cancer
 - Malignant Melanoma
 - Ovarian Cancer
- Symptoms include abdominal pain, jaundice, ascites, and distension.
- It is almost always treated with chemotherapy and the response is dependent on controlling the underlying primary cancer.

Liver Metastasis:



This CT image of the abdomen demonstrates multiple circular densities that are consistent with **liver metastasis**. The liver is a very common site for malignant cancers to metastasize.

Liver Metastasis:



This CT image of the abdomen demonstrates a large neoplasm that has been caused by **liver metastasis** (arrows). This patient had colon cancer that metastasized to the liver.

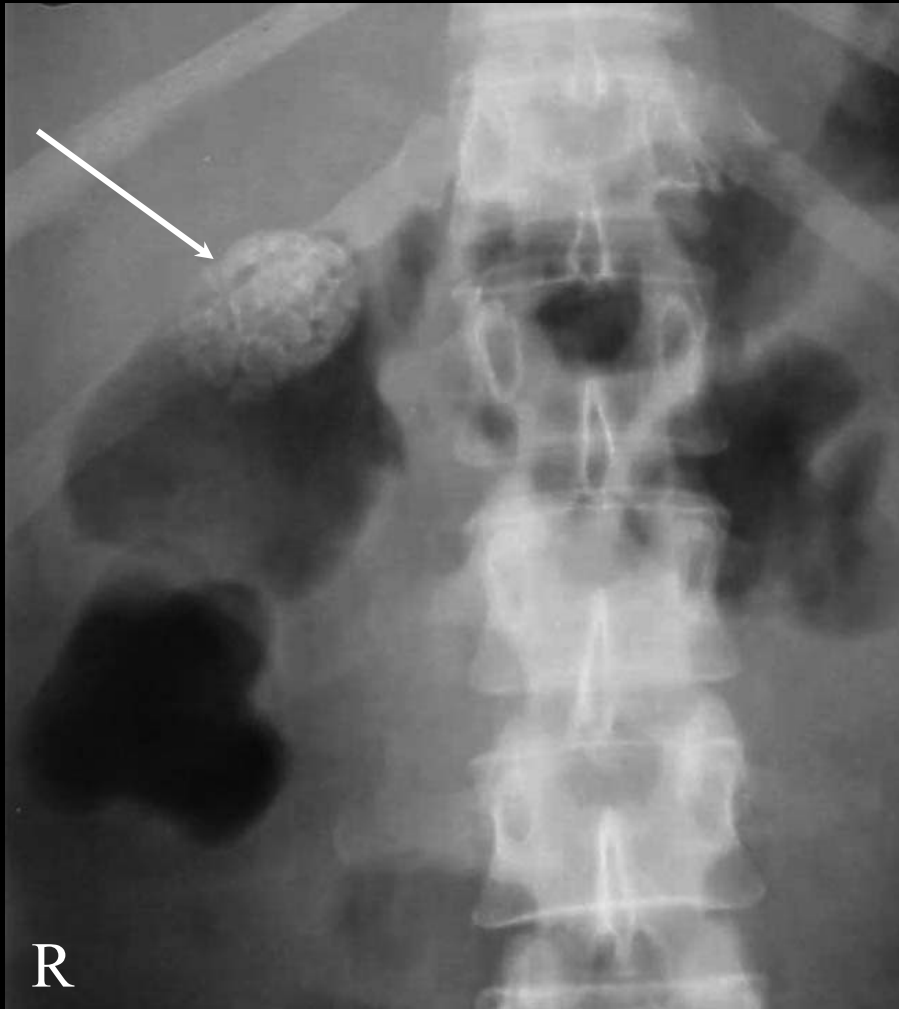
Cholelithiasis:

- Cholelithiasis is the condition of having gallstones.
- This only becomes a problem if the stones cause an inflammation of the gallbladder which is called cholecystitis.

This is often secondary to cystic duct obstruction.

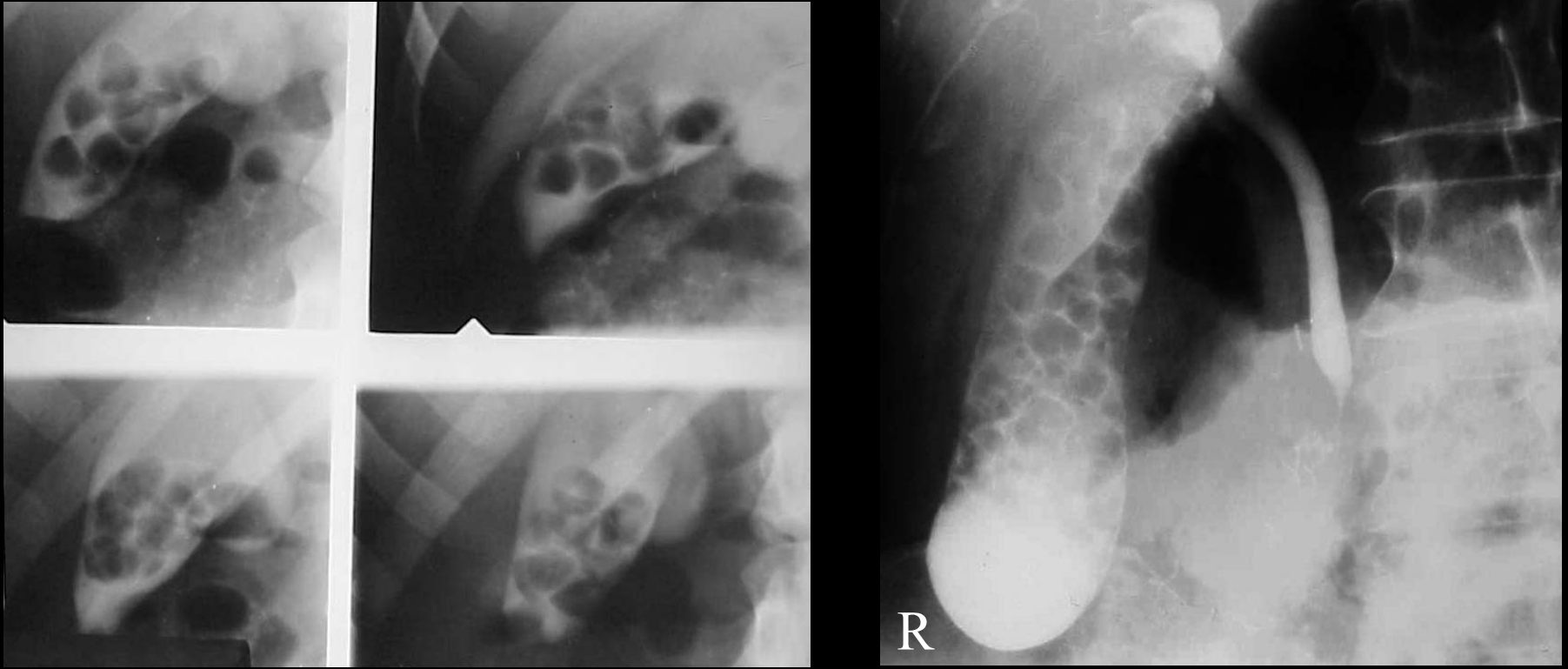
- Nuclear medicine and ultrasound are the imaging modalities of choice in the diagnosis of cholelithiasis although 15% of gallstones appear radiopaque on a KUB.

Cholelithiasis:



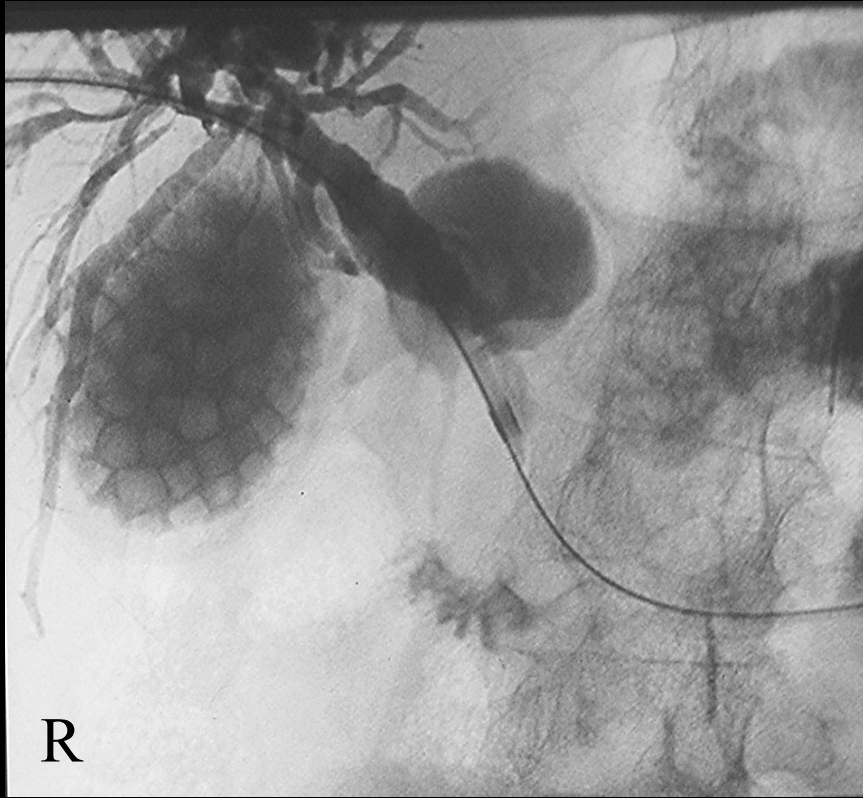
The arrow on this abdominal radiograph is pointing to a large radiopaque cholelith.

Cholelithiasis:



These radiographs were taken as part of an antiquated exam called an oral cholecystogram (OCG). This study clearly demonstrates innumerable **radiolucent choleliths**.

Cholelithiasis:



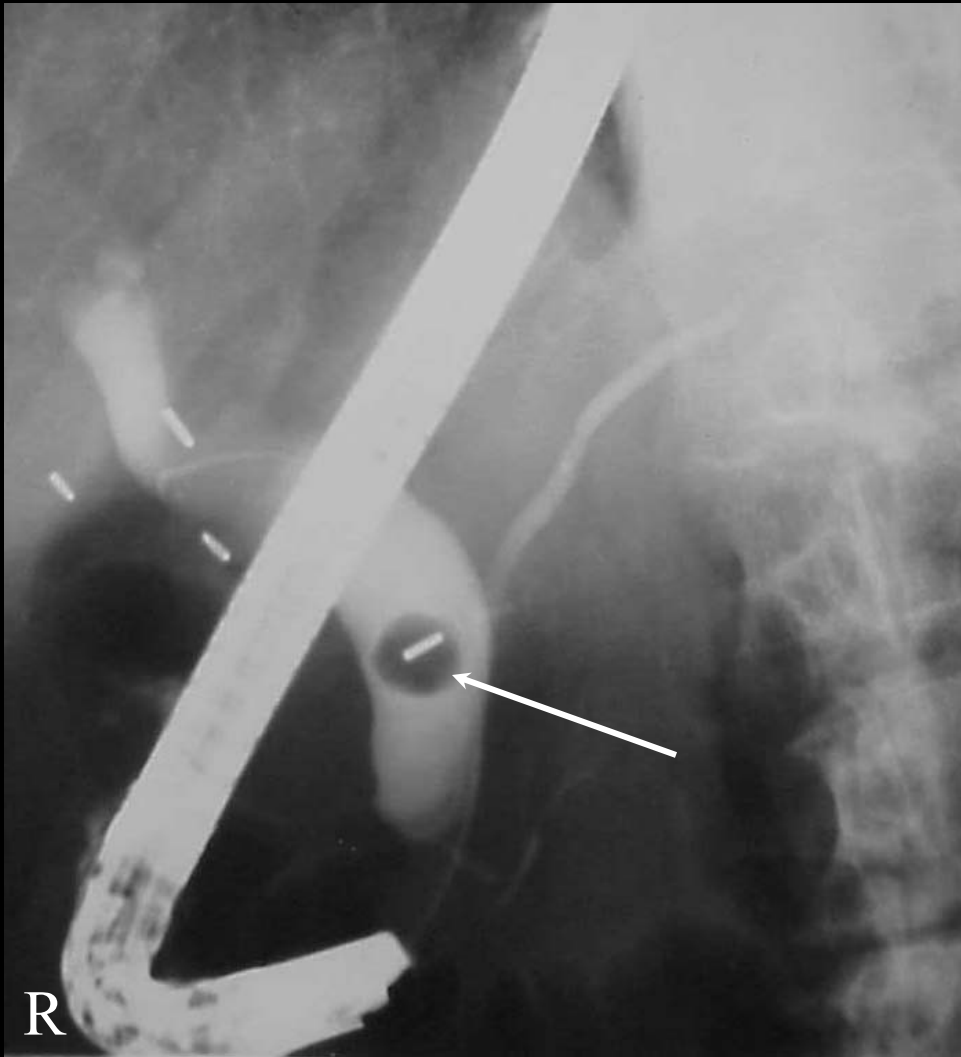
These cholecystograms demonstrate innumerable **radiolucent choleliths**.

Cholelithiasis:



This percutaneous transhepatic cholangiogram (PTC) clearly demonstrates a large **radiolucent cholelith** in the distal common bile duct.

Cholelithiasis: Pearl Stone



This ERCP demonstrates a **radiolucent cholelith** that has formed around a surgical clip within the common bile duct. This is sometimes referred to as a **pearl stone**.

Emphysematous Cholecystitis:

- Emphysematous cholecystitis is characterized by the presence of bacteria within the gallbladder.

In this particular instance, bacteria has managed to work their way from the small intestine, through the biliary tree, and finally into the gallbladder.

Bacteria produce gas as an excrement and as a result, the gallbladder will produce a distinct air-fluid level on an upright abdomen radiograph.

- Treatment involves cholecystectomy and broad spectrum antibiotic coverage.

Emphysematous Cholecystitis:



The arrows on this radiograph of the abdomen are pointing the gallbladder that has been outlined with air. This has been caused by an air producing bacterial infection that has reached the confines of the gallbladder and is referred to as **emphysematous cholecystitis**.

Emphysematous Cholecystitis:



This is a magnified view
of the previous image
depicting
**emphysematous
cholecystitis.**

Emphysematous Cholecystitis:



The arrows on this upright abdomen radiograph are pointing to an air producing bacterial infection of the gallbladder. This infection is referred to as **emphysematous cholecystitis**. Note the air-fluid (bile) level that has been created within the gallbladder as a result of this infection.

Emphysematous Cholecystitis:

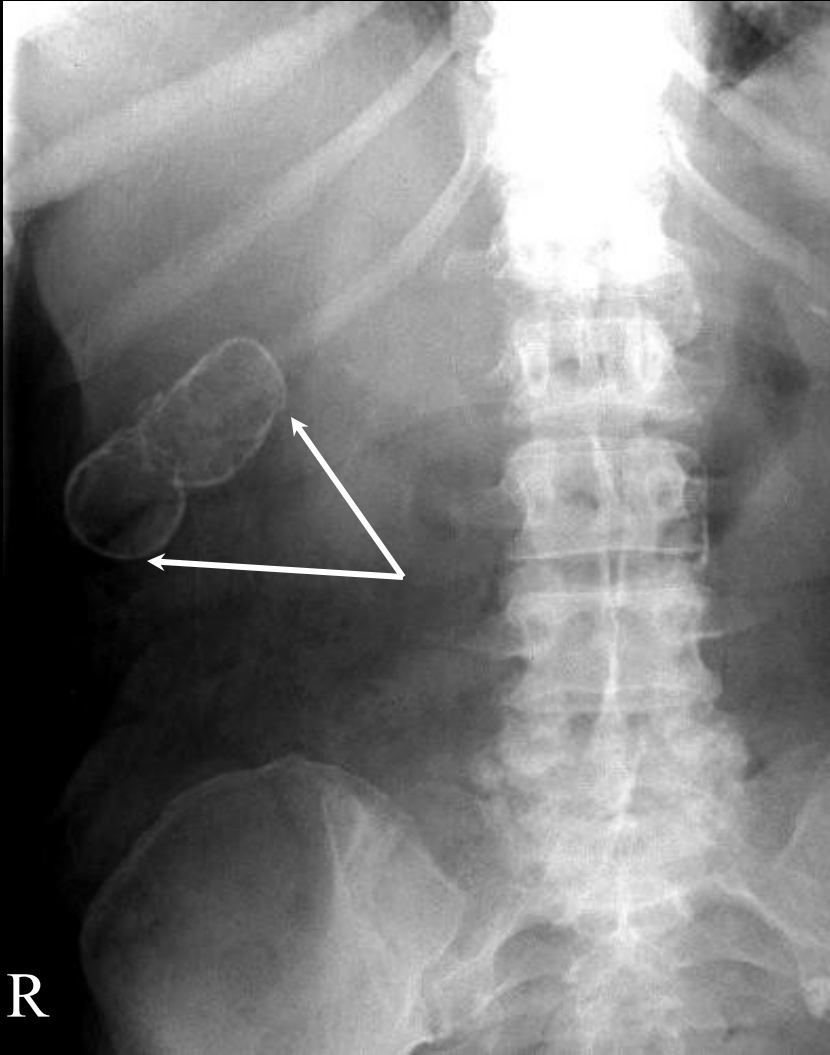


This is a magnified view of the previous image depicting an air-fluid level caused by **emphysematous cholecystitis**.

Porcelain Gallbladder:

- Calcification of the gallbladder is commonly referred to as a porcelain gallbladder.
 - The walls of the gallbladder can calcify and form a hard, bluish color that resembles porcelain.
- It may be associated with gallbladder cancer which is very rare or it may be brought on by excessive gallstone production.
- Treatment includes cholecystectomy.

Porcelain Gallbladder:



The arrows on this abdominal radiograph are pointing to a **porcelain gallbladder**. This condition occurs when the walls of the gallbladder calcify and form a hard, bluish white texture that resembles porcelain.

Porcelain Gallbladder:



This CT image of the abdomen demonstrates a **porcelain gallbladder** that contains a large gallstone (arrow). The presence of a porcelain gallbladder is clinically significant because it may be an indication that the patient may have gallbladder cancer.

Splenomegaly:

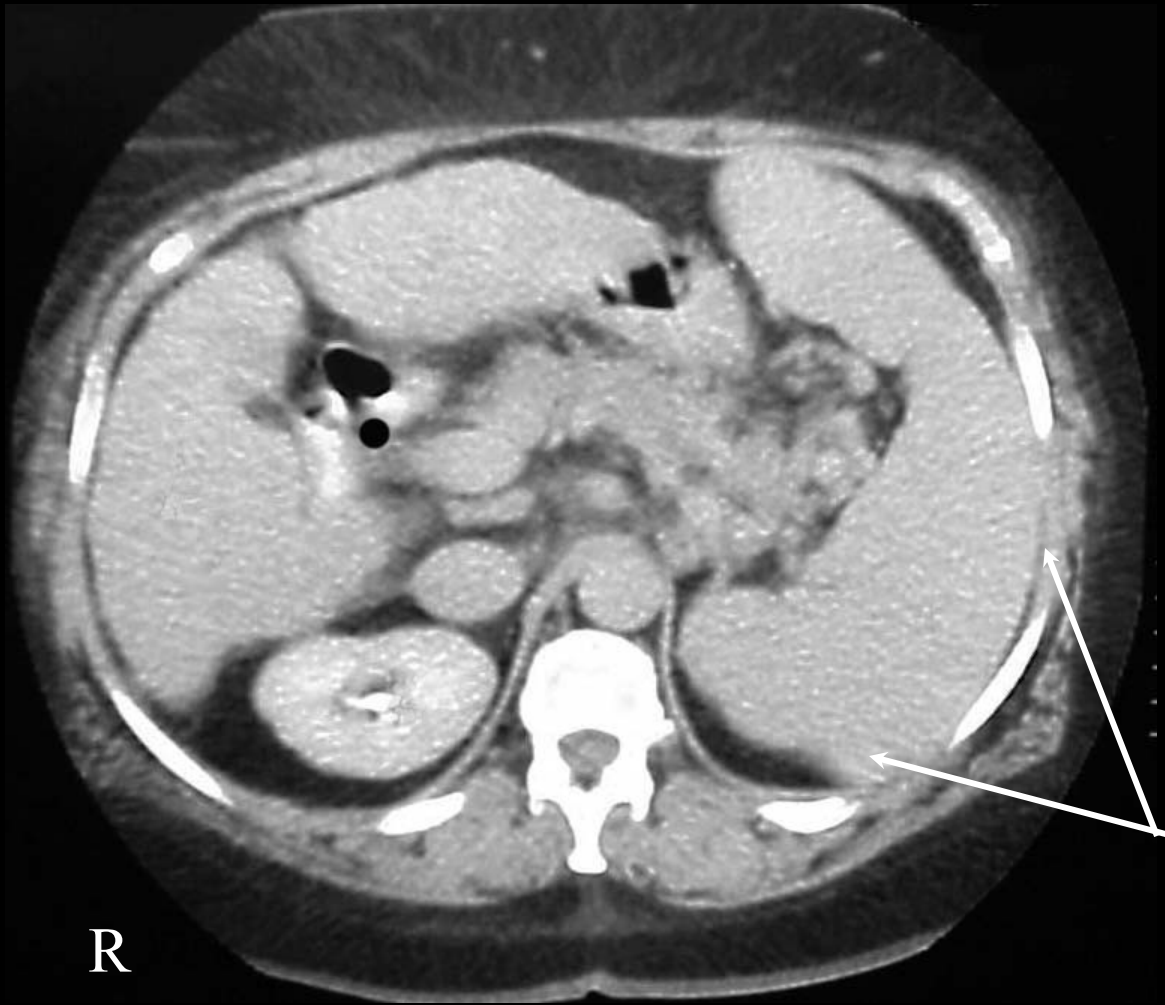
- Splenomegaly simply refers to an enlargement of the spleen.
- It is usually associated with any disease that involves the destruction of a large number of defective red blood cells.
It is also linked to leukemia, lymphoma, and portal hypertension.
- Treatment for this condition usually includes a splenectomy.

Splenomegaly:



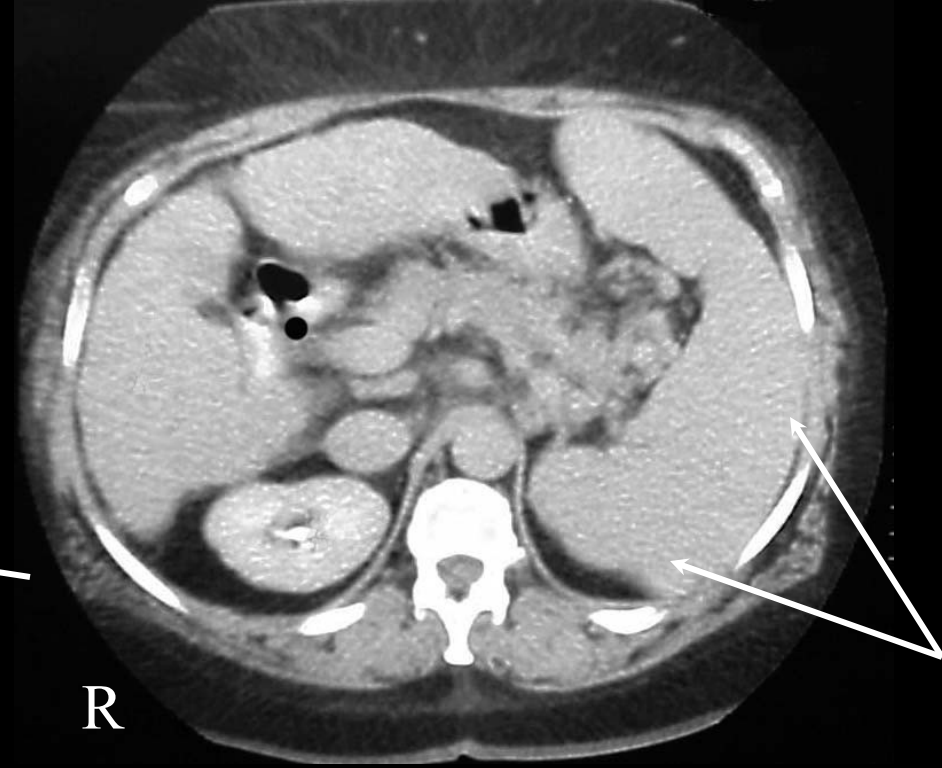
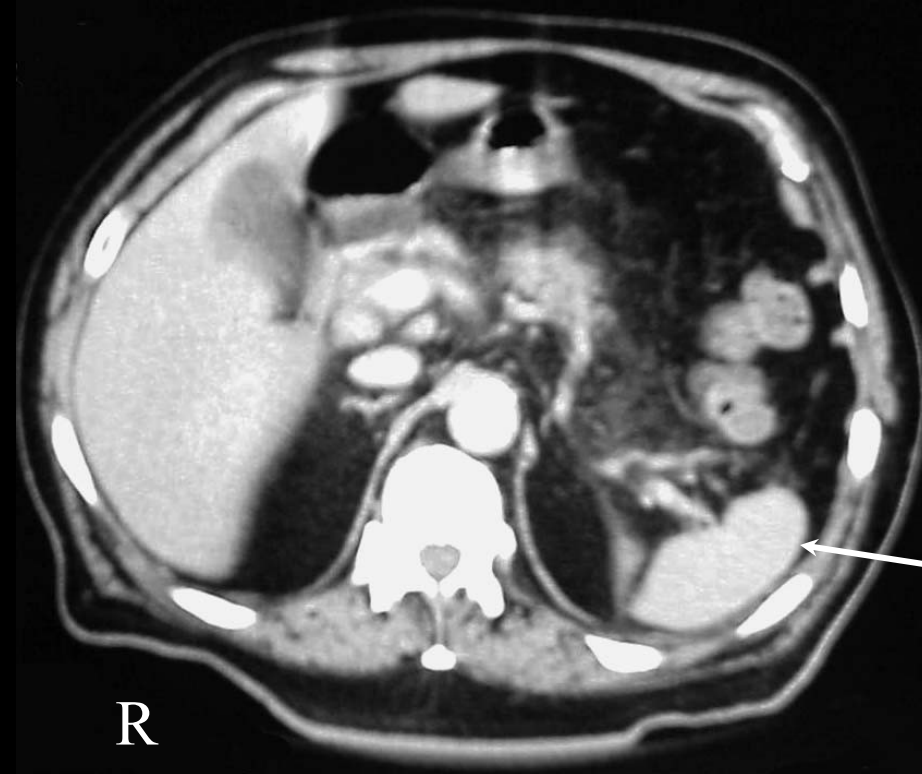
The arrow on this CT scan of the abdomen is pointing to a **normal spleen**.

Splenomegaly:



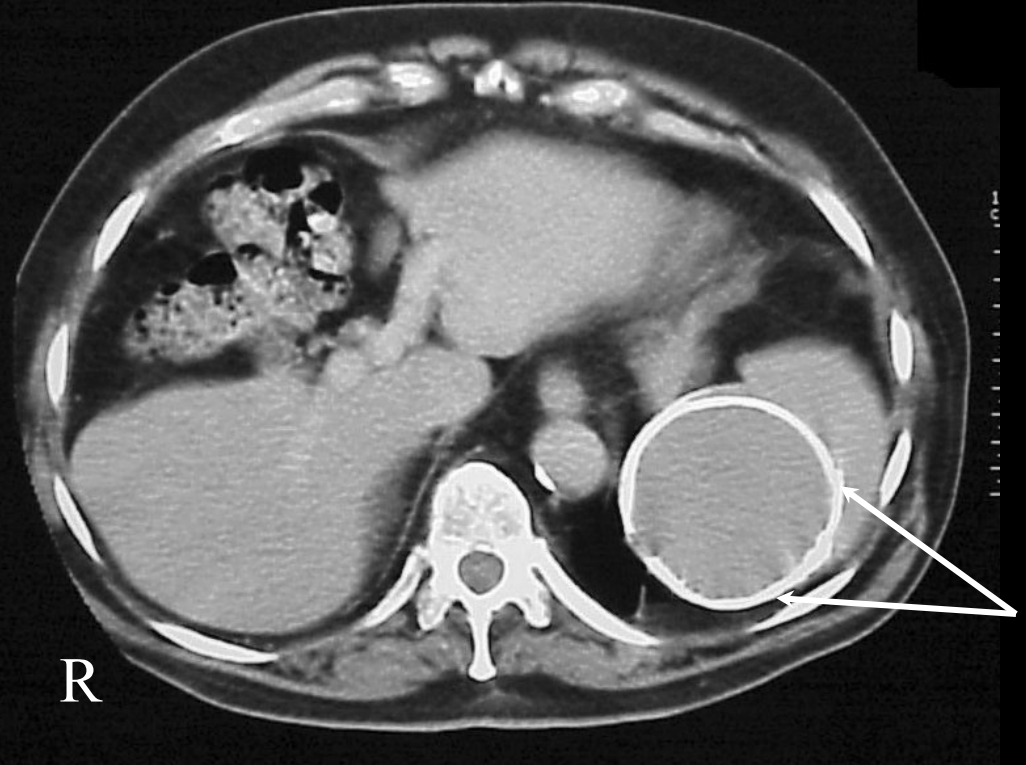
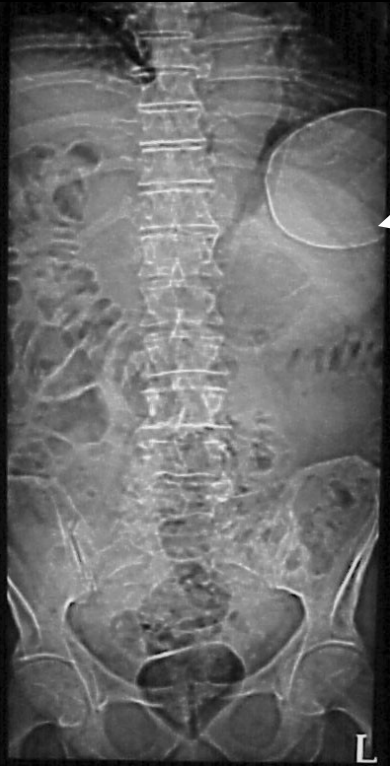
The arrows on this CT scan of the abdomen is pointing to an **enlarged spleen**. This condition is referred to as **splenomegaly**.

Splenomegaly:



This is a side-by-side comparison of a CT scan of a **normal spleen** on the left (arrow) and an **enlarged spleen** on the right (arrows).

Spleen with a Calcified Cyst:



This patient has a very large cyst attached to their spleen that has become calcified. There is no clinical significance for this condition

Trauma Radiography Menu

1. Avulsion Fracture
2. Boxer's Fracture
3. Blow-out Fracture
4. Colles' Fracture
5. Comminuted Fracture
6. Compression Fracture
7. Decapitation
8. Elbow Fracture: Fat Pad Sign
9. Greenstick Fracture
10. Hip Fractures
11. Jones Fracture
12. Monteggia Fracture
13. Compound Fracture
14. Salter-Harris Fracture
15. Scaphoid Fracture
16. Spiral Fracture
17. Torus Fracture
18. Transverse Fracture
19. Tripod Fracture

Avulsion Fracture:

- An avulsion fracture occurs when there is trauma to where a ligament or tendon attaches to a bone.
- This type of fracture occurs when the tear causes a piece of bone to be pulled off.
- An avulsion fracture can be seen anywhere in the body but a common site is at the base of the 5th metatarsal.
- Most avulsion fractures are treated as a soft tissue injury and do not require surgical repair.

Avulsion Fracture:



The most common fracture of the 5th metatarsal is called an **avulsion fracture**. This is sometimes called a “**Pseudo-Jones**” fracture and it occurs when the **peroneus brevis tendon** tears off a piece of the base of the 5th metatarsal (arrow). It is usually not badly displaced and is often treated with a walking cast or boot.

Boxer's Fracture:

- A boxer's fracture occurs at the head of the 4th or 5th metacarpal of the hand.
- It almost always occurs as the result of striking a firm object with a closed fist.
- Most boxer's fractures can heal with a cast but some severe cases may require surgical repair.

Boxer's Fracture:



This **boxer's fracture** occurred at the head of the 5th metacarpal (arrow) and it is almost always the result of the patient striking another person or a wall. Surgery may be indicated to reduce this fracture in severe cases.

Blow-out Fracture:

- A blow-out fracture of the eye socket may involve the orbital floor, wall, or roof.
- The most common type of blow-out fracture involves the floor of the orbit and specifically the maxillary bone.
- Following blunt trauma to the eye, the contents of the orbit compress and push down into the maxillary sinus.
- Surgery may be indicated in some instances in order to relieve the symptoms of double vision and/or muscle entrapment.

Blow-out Fracture:

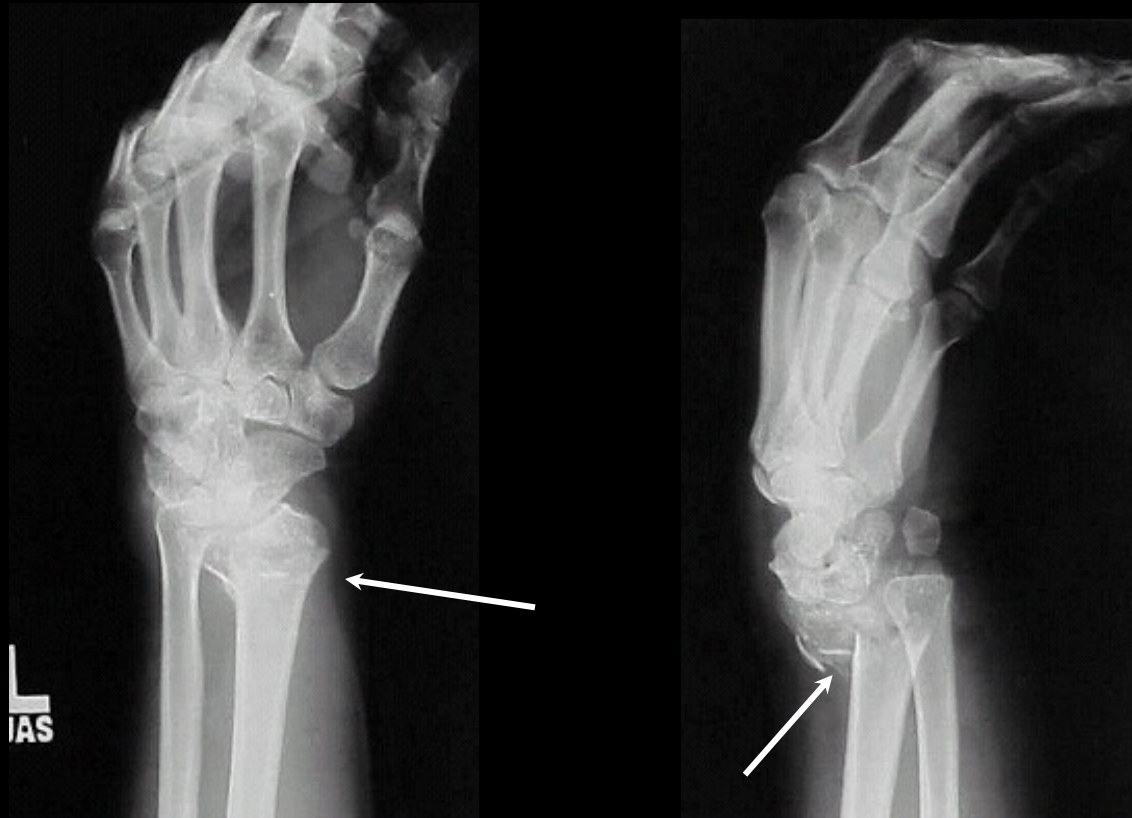


This patient has a fracture of the portion of the maxillary bone that makes up the floor of the orbit as indicated by the arrow on this tomogram. This type of fracture is called a **blow-out fracture** because the contents of the orbit compress and push down into the maxillary sinus as the result of blunt trauma to the eye. Surgery may be indicated in some instances in order to relieve double vision and/or muscle entrapment.

Colles' Fracture:

- A Colles' fracture is most often caused when an individual falls backwards onto a hard surface and braces themselves with an open hand.
- It consists of a fracture of the distal radius with posterior and lateral displacement of the distal fragment.
- It can most often be treated with a closed reduction and a cast.
- Some severe fractures may require the surgical insertion of an internal fixation device.

Colles' Fracture:



A **Colles' fracture** occurs in the wrist and is most often the result of falling backwards on an outstretched hand. It is characterized by a posterior fracture of the distal radius and may require surgery if badly displaced.

Comminuted Fracture:

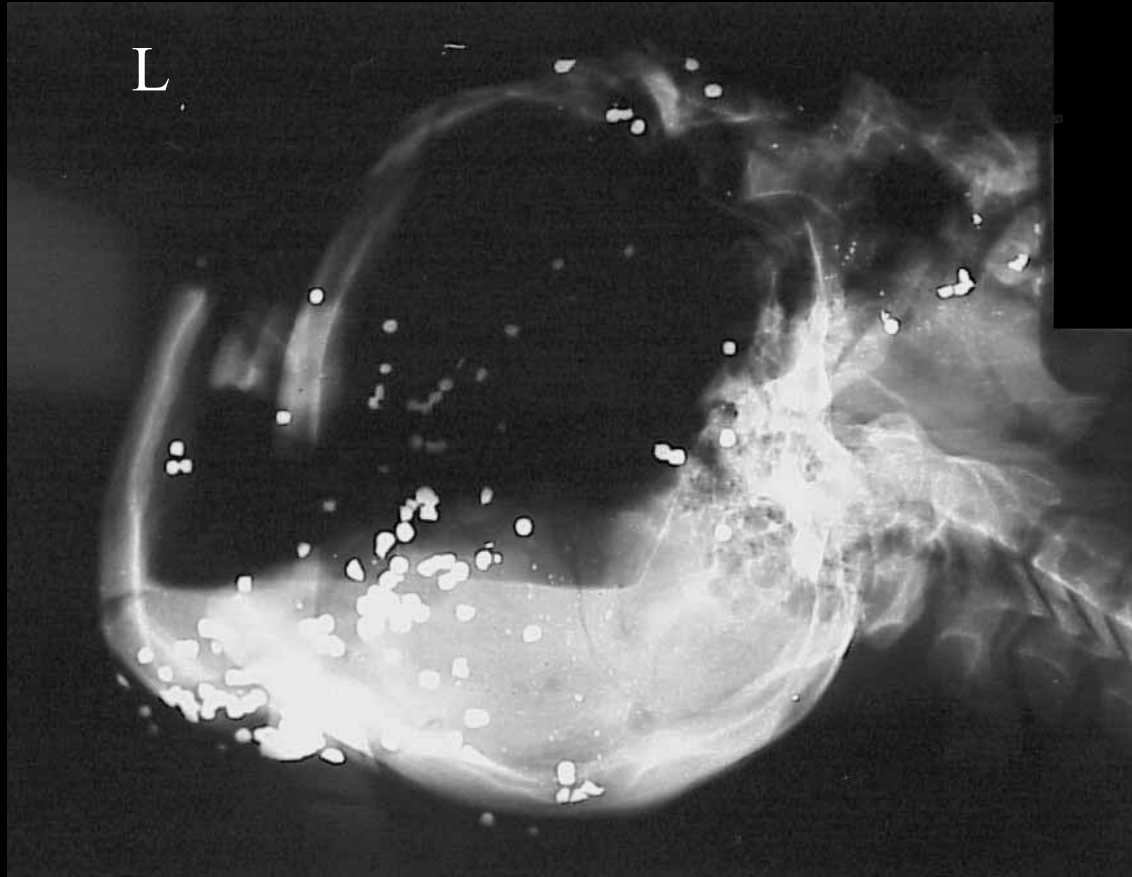
- A comminuted fracture occurs when there are multiple bone fragments.
- This often occurs as the result of some type of crushing injury or as the result of gun shot wound.

Comminuted Fracture:



A **comminuted fracture** occurs when there are two or more bone fragments. This often occurs as the result of some type of crushing injury or in this case, from the impact a bullet.

Comminuted Fracture:



This individual shot himself with a shotgun to produce this **comminuted fracture**. Note the fluid level within the skull.

Comminuted Fracture:



This **comminuted fracture** of the calcaneus occurred as the result of falling feet first into an empty pool with no shoes on.

Compression Fracture:

- A compression fracture occurs when a vertebral body is crushed and collapses down upon itself.
- It can be the result of trauma, cancer, or osteoporosis.
- Treatment may include the any of the following depending on the severity of the fracture and its potential impact on the spinal cord:

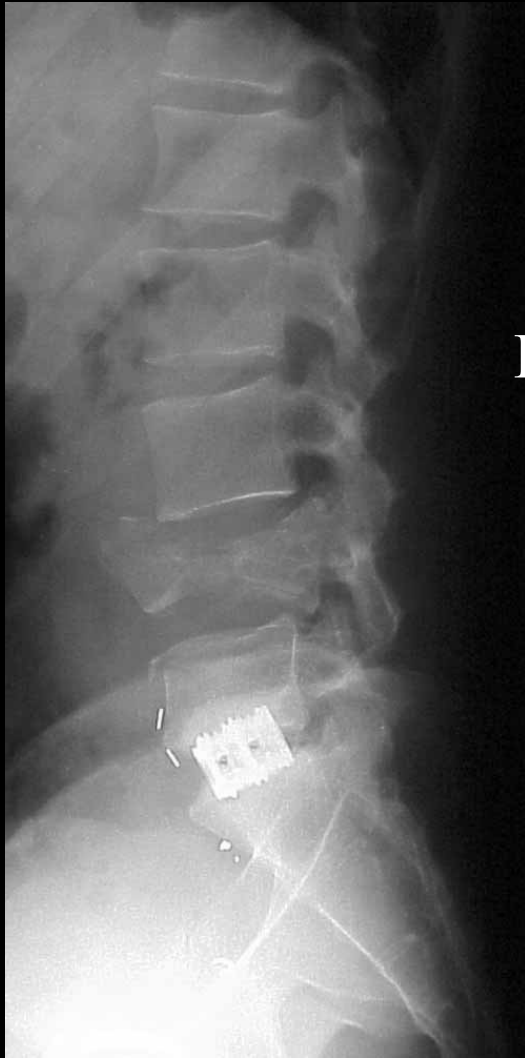
A back brace to stabilize the fracture while it heals.

The surgical insertion of internal fixation devices.

A vertebroplasty may be performed.

- This requires the injection of cement into the vertebral body by an interventional radiologist as a means to prevent further collapse of the vertebral body.

Compression Fracture:

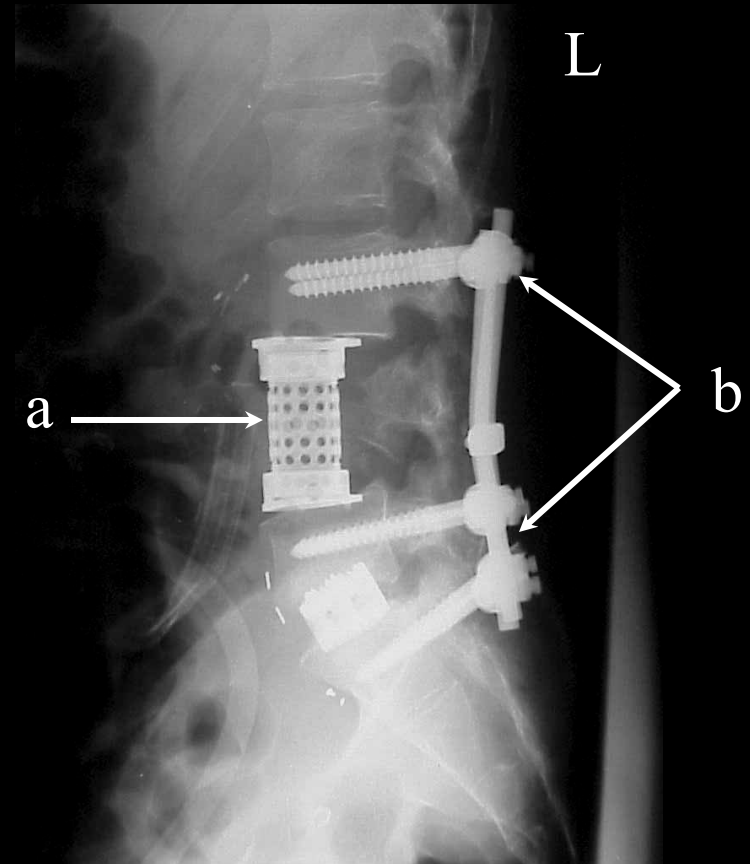


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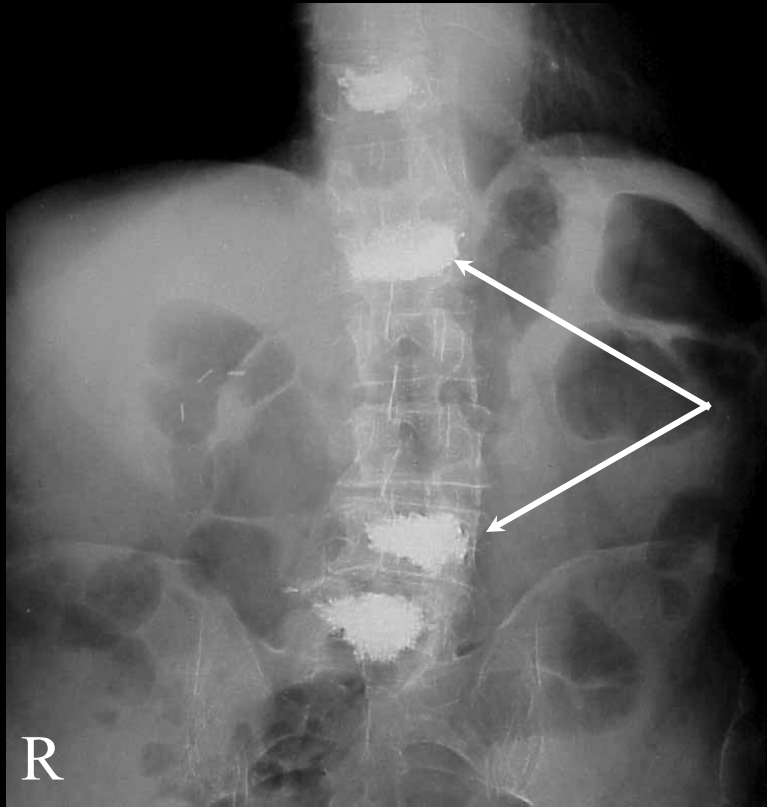
This **compression fracture** of L4 is the result of a motor vehicle accident. This type of fracture occurs when the normal height of the vertebral body has been compromised.

Compression Fracture:



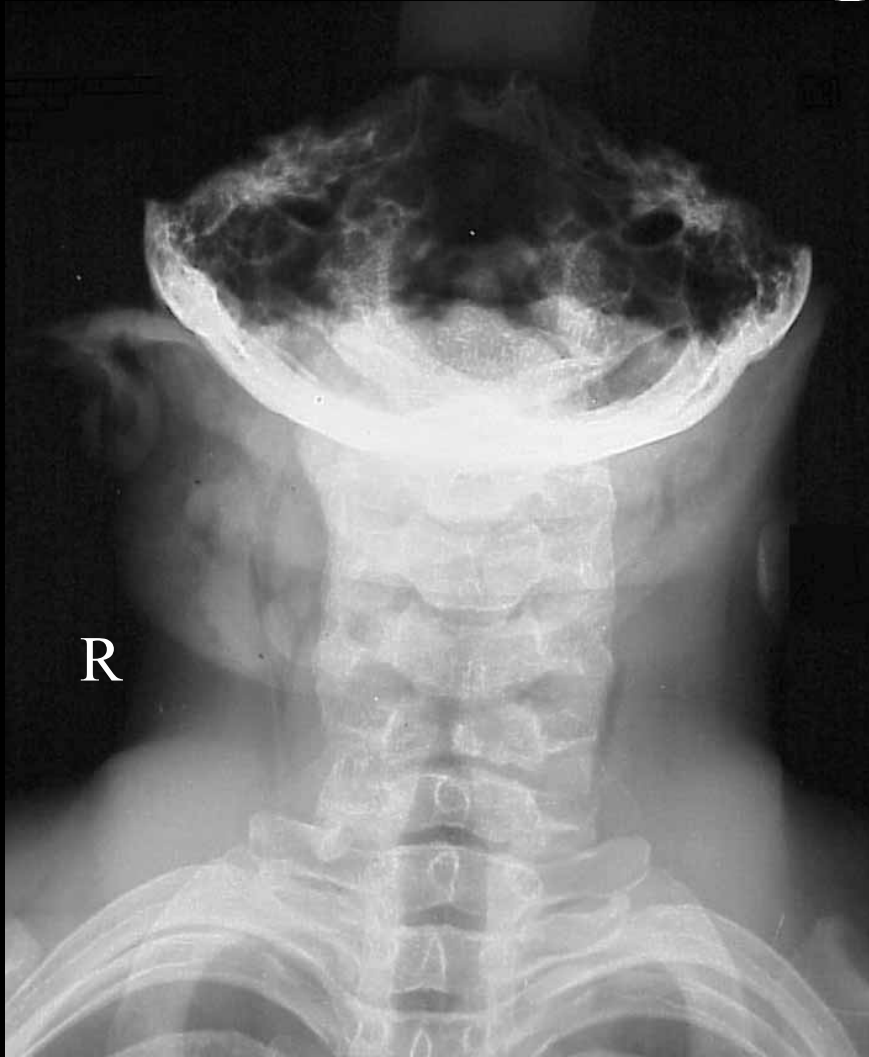
The surgical insertion of a cage (a) and rods (b) were required to stabilize the **compression fracture** depicted on the previous slide.

Compression Fracture:



A **vertebroplasty** was performed on these **compression fractures** (arrows).
Cement was inserted into the vertebral body by an interventional radiologist as a means to prevent further collapse of the vertebral bodies.

Decapitation:



This individual was struck with a helicopter blade and was **decapitated.**

Elbow Fracture: Fat Pad Sign

- A subtle fracture to the elbow in the area of the distal humerus can be very difficult to visualize radiographically.
- The best position to view is the lateral.
- On the anterior surface of the elbow, there is a fat pad that is normally visualized as a small radiolucency.
- There is also a fat pad located on the posterior surface of the distal humerus however, it is normally not demonstrated.
- If there is trauma to the elbow with an underlying fracture to the distal humerus, this posterior fat pad will be displaced and it will be visualized as a radiolucent density.

Elbow Fracture: Fat Pad Sign



This is a normal lateral elbow that has no injury to the distal humerus. The arrow is pointing to the area that would exhibit a **fat pad sign** if there was an injury.

Elbow Fracture: Fat Pad Sign



This lateral elbow did experience trauma to the distal humerus. The arrow is pointing to a radiolucent area that is indicative of a positive **fat pad sign**.

Elbow Fracture: Fat Pad Sign



This is a side-by-side comparison of the two previous images. The image on the left is normal while the image on the right demonstrates a positive **fat pad sign** as the result to trauma to the distal humerus.

Greenstick Fracture:

- A greenstick fracture is a type of partial fracture that is commonly associated with children.
- The analogy is between the pliable nature of their bones and the inability to cleanly break a green twig.
- These fractures are usually easily repaired and most often can be corrected with a closed reduction.
- Greenstick fractures are sometimes associated with rickets.

Greenstick Fracture:



This radiograph of the wrist demonstrates a **greenstick** fracture of the distal radius and ulna. This type of partial fracture is commonly associated with children. The analogy is between the pliable nature of their bones and the inability to cleanly break a green twig.

Hip Fractures:

- A hip fracture occurs on the proximal end of the femur and is usually the result of a fall from an elderly patient with osteoporosis.
- There are four classifications of hip fractures:

Femoral Head Fracture

- This is often the result of a high energy impact and is often combined with a dislocation.

Femoral Neck or Transcervical Fracture

- The blood supply to the femoral head is almost always disrupted with this type of fracture.
- As a result, many are treated with a total hip replacement.

Hip Fractures:

Intertrochanteric Fracture

- These fractures usually do not damage the blood supply to the hip and can often be reduced with the surgical insertion of a metal plate and screws.

Subtrochanteric Fracture

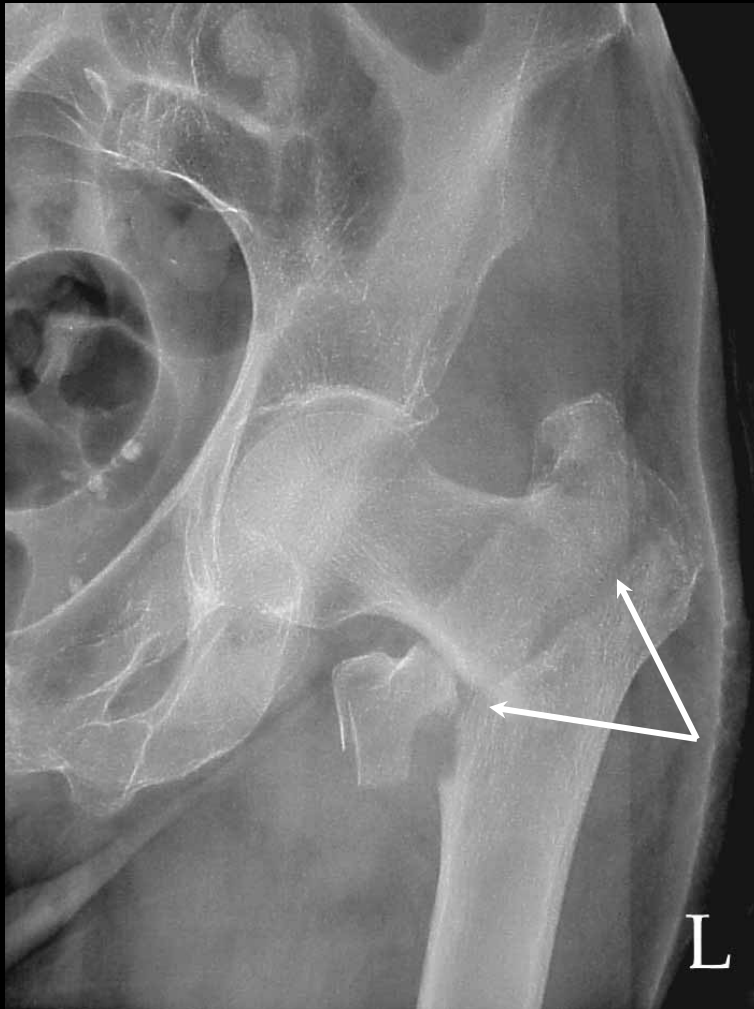
- This fracture occurs just below the level of the intertrochanteric crest.
- It is actually physically located on the shaft of the femur and may extend down the femur.

Hip Fracture: Femoral Neck



The **femoral neck** (arrow) on this patient has been fractured and this is sometimes referred to as a **transcervical fracture**. The blood supply to the femoral head is almost always disrupted with this type of fracture and as a result, there is always a risk that these fracture may not heal. Therefore, many are treated with a total hip replacement.

Hip Fracture: Intertrochanteric



This hip fracture occurred through the **intertrochanteric crest** (arrows). These fractures are usually do not damage the blood supply to the hip like **femoral neck fractures** do and can therefore be reduced with a metal plate and screws as opposed to the more invasive total hip replacement usually required for neck fractures.

Hip Fracture: Subtrochanteric



This patient suffered a **subtrochanteric hip fracture**. This type of fracture occurs just below the intertrochanteric crest. They often travel down the shaft of the femur as is the case with this example.

Open Reduction Internal Fixation:



The reduction of this intertrochanteric hip fracture required the surgical insertion of an **AMBI hip pin**, plate, and screws. The surgery is referred to as an **open reduction with internal fixation (ORIF)**.

Jones Fracture:

- A Jones fracture occurs on the shaft of the 5th metatarsal.
- It should not be confused with an avulsion fracture which often occurs at the base of the 5th metatarsal.
- Most often a Jones fracture occurs without significant injury or impact.
- It is more difficult to heal than an avulsion fracture but usually only requires the wearing of a walking boot or cast for 4 to 8 weeks.
- However, in some instances, it may require the surgical insertion of a screw or bone graft in order to stimulate a healing response.

Jones Fracture:



A **Jones fracture** occurs on the shaft of the 5th metatarsal and should not be confused with an **avulsion fracture** which often occurs at the base of the 5th metatarsal. Most often a Jones fracture occurs without significant injury or impact. It is more difficult to heal than an avulsion fracture and in some instances, it may require the surgical insertion of a screw or bone graft in order to stimulate a healing response.

Monteggia Fracture:

- A Monteggia fracture is usually the result of a fall on an outstretched arm.
- It involves a fracture of the proximal third of the ulna combined with a dislocation of the radial head within the elbow joint.
- These are very unstable injuries that usually require surgical repair.

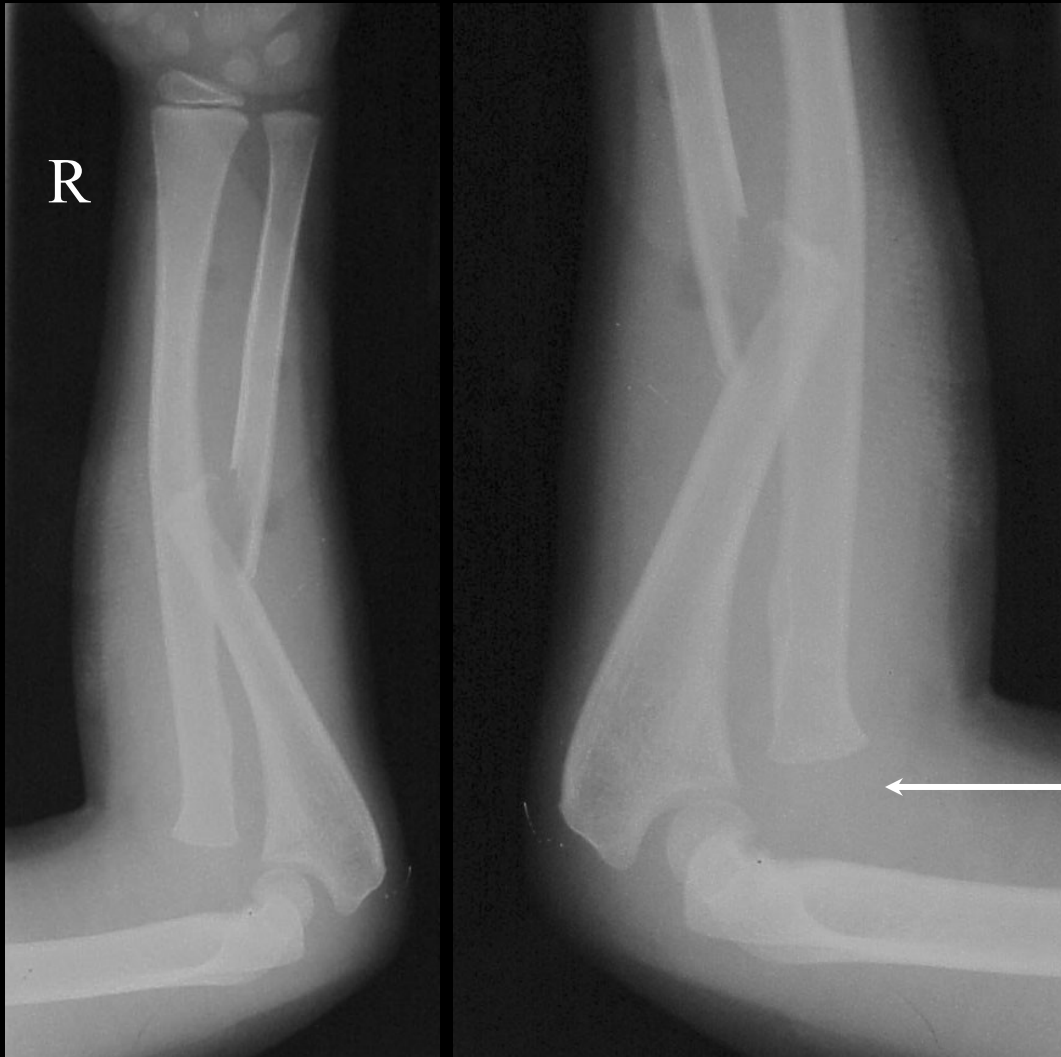
The ulna will require an internal fixation device and once this will usually reduce the radial head dislocation.

Monteggia Fracture:



This radiograph is a classic example of a **Monteggia fracture**. It is usually the result of a fall with an outstretched arm and it involves a fracture within the proximal third of the ulna combined with a dislocation of the radial head (arrow).

Monteggia Fracture:



These images provide another example of a **Monteggia fracture**. Note that there is a fracture of the proximal third of the ulna combined with a dislocation of the radial head (arrow).

Open or Compound Fracture:

- An open or compound fracture occurs when the bone actually manages to pierce the skin.
- These fracture almost always require the surgical insertion of internal fixation devices.

Open or Compound Fracture:



This patient fell and broke her humerus at the distal portion of her prosthesis. This resulted in a **compound fracture**.

Salter-Harris Fractures:

- Salter-Fractures involve fractures of the growth plate in children.
- There are five categories of this fracture:

Type I

- The epiphysis is completely dislocated from the metaphysis (shaft) of the bone.
- This type usually only requires a cast for treatment.

Type II

- This is the most common type.
- It involves a partial dislocation of the epiphysis and a fracture of the metaphysis.

Salter-Harris Fractures:

Type III

- This one involves a partial dislocation and a fracture of the epiphysis.

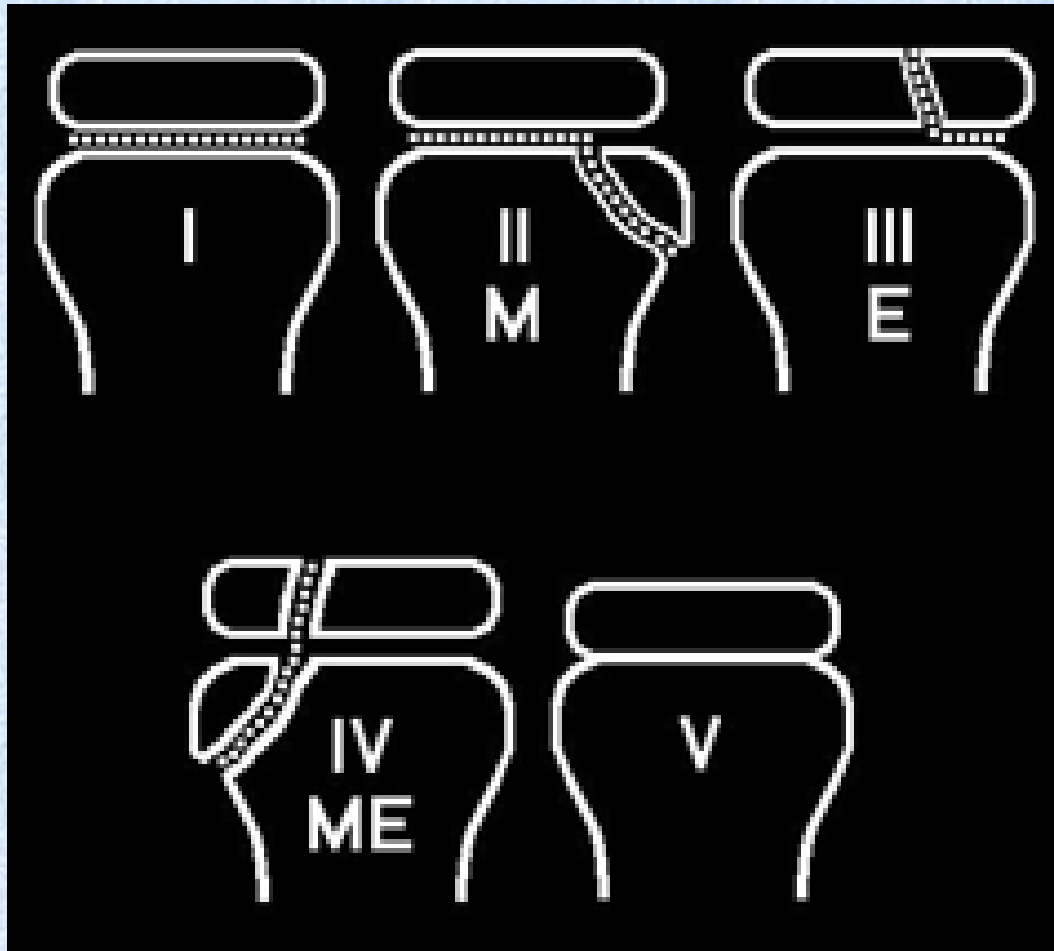
Type IV

- This type is the result of a fracture of both the epiphysis and the metaphysis.

Type V

- This one involves the impaction of the epiphysis into the metaphysis.

Salter-Harris Fractures:



These diagrams illustrate the five types of **Salter-Harris fractures**. This classification system has been the standard for describing growth plate fractures since the 1960s.

Salter-Harris Fractures: SH II



A **Salter-Harris Type II fracture** is the most common type of growth plate fracture. It occurs when the epiphysis has been partially dislocated from the metaphysis (a). Additionally, the metaphysis has also been cracked (b). Reduction of this fracture often does not require manipulation by the physician.

Salter-Harris Fractures: SH III



A **Salter-Harris Type III fracture** is a relatively rare type of growth plate fracture. It usually occurs at the distal portion of the tibia and it is characterized by a fractured epiphysis (b) combined with a partial dislocation between the epiphysis and the metaphysis (a). Surgery is often recommended to reduce this fracture and it has a good prognosis.

Scaphoid Fracture:

- The scaphoid is the most commonly fractured carpal bone and it can be difficult to heal due to its unpredictability.
- The scaphoid has an unusual retrograde blood supply.

The arterial blood vessels that supply it enter at the distal portion of the bone.

As a result, healing can be slow and result in a delayed union or not at all (non union).

- Electrical stimulation may be used for delayed union.
- In the case of non union, surgery may be indicated.

In some instances, the blood supply may be damaged and lead to a condition called avascular necrosis.

- This will eventually lead to degenerative arthritis.

Scaphoid Fracture:

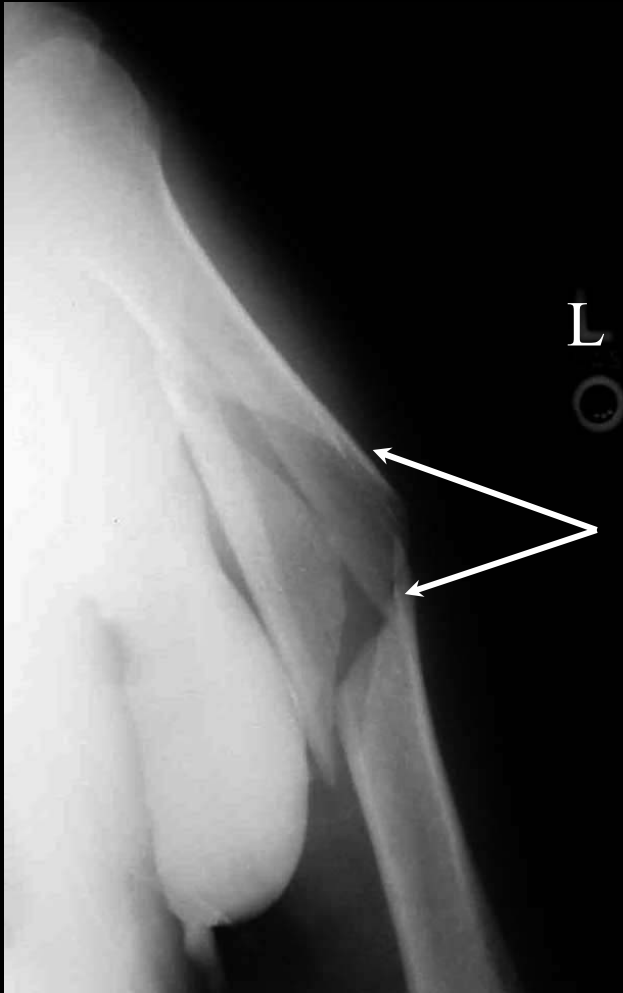


The **scaphoid fracture** depicted on this radiograph (arrow) can be very difficult to heal due to its unusual blood supply. The scaphoid has a retrograde blood flow in that the arterial blood vessels that supply it enter at the distal portion of the bone. As a result, healing can be slow (**delayed union**) if it heals at all (**non union**). Surgery will be indicated in the case of non union.

Spiral Fracture:

- A spiral fracture occurs when the bone has been twisted apart.
- It will have a similar appearance to a spiral staircase.
- This fracture is sometimes referred to as a torsion fracture.
- Spiral fractures in babies and children can be a warning sign of abuse.

Spiral Fracture:



Spiral fractures run around the axis of long bones much like a spiral staircase. This patient has a spiral fracture of the humerus (arrows).

Spiral Fracture:



This patient has a **spiral fracture** of their distal tibia.

Spiral Fracture:



This patient has a **spiral fracture** of their distal fibula.

Torus Fracture:

- Torus comes from the Latin word tori which refers to a swelling or protuberance.
- The impact from a fall on an outstretched hand is usually the cause of this fracture.
- It commonly occurs in the distal forearm of young children and it is sometimes referred to as a “buckle” fracture.
- It is characterized by a small buckle or protuberance on one side of the bone but not on the other.
- Treatment usually consists of a short cast for three weeks in order to prevent any further injury.

Torus Fracture:



A **torus fracture** is sometimes called a “**buckle**” fracture and it is a common fracture in children. Torus comes from the Latin word “Tori” which means swelling or protuberance. This is a type of **incomplete fracture** where one side of the bone will buckle but not affect the other side (arrow).

Transverse Fracture:

- A transverse fracture is characterized by a horizontal fracture in relation to the long axis of the bone.

Transverse Fracture:



L

This patient fell directly on their knee and that trauma resulted in a **transverse fracture** of their patella. To reduce this type of fracture, an internal fixation device will have to be surgically inserted.

Callus Formation:



This radiograph depicts advanced **callus formation** (arrows) following a **transverse fracture** of the femur.

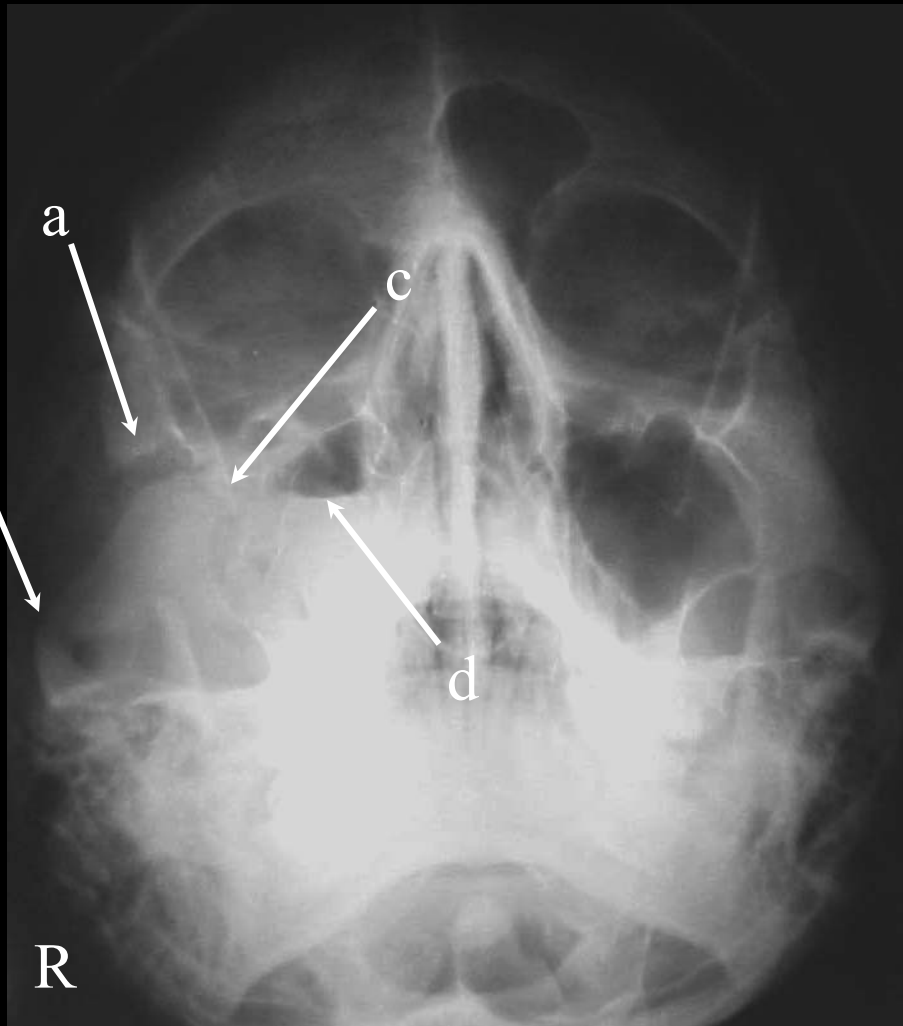
Tripod Fracture:

- The malar or zygomatic bone articulates with the frontal bone, temporal bone, and the maxillary bone.
- Trauma directly to the malar bone may cause a fracture at each of these articulations.

This would be known as a tripod fracture.

- Treatment of this type of fracture usually requires a surgical reduction of the fracture sites.

Tripod Fracture:



A **tripod fracture** occurs when the three articulations of the zygomatic or malar bone are fractured. In this radiograph, (a) is pointing to a fracture of the articulation with the frontal bone, (b) is pointing to a fracture of the articulation with the temporal bone, and (c) is pointing to a fracture of the articulation with the maxillary bone. As a result of the trauma to the zygoma, (d) is pointing to blood in the maxillary sinus.

Test:

There are **100** questions on this test. All answers can be found within the context of this program. The “hint” button located next to each question will provide you the information needed to answer the question. At any time during the test you may skip a question and return to it later. You must successfully answer 70% of the questions in order to receive credit for the course. To access the test, please close out of this course by clicking the “x” in the top right corner.

Good luck!!!

About the Author:

I graduated from the St. Petersburg College (SPC) Radiography Program in Pinellas Park, Florida in December of 1985. I have been employed by SPC since May of 1987 and I am currently the Radiography Program Director.

I completed a Master of Education Degree from the University of South Florida in Instructional Technology in December of 1998 and I have also passed the American Registry of Radiologic Technology's Computed Tomography and Magnetic Resonance Imaging certificate examinations.

Three Phase CEUs has been in existence since December of 2001. The motivation for establishing my company was in response to my graduates having to pay up to \$10 and sometimes more per hour of continuing education. My research indicated that most companies consistently charged top dollar for CEUs and that there were limited options for radiographers. I knew that there had to be a way to produce quality educational materials at a reasonable price and hence the creation of Three Phase CEUs. I formed a partnership with Shane Smith of SCS Continuing Education in June of 2006 and with your continued support, it is our intention to continue to provide radiographers with an affordable option to satisfy their continuing educational needs.



References:

Mace, James D. and Kowalczyk, Nina; Radiographic Pathology for Technologists, Fourth Edition, Elsevier-C.V. Mosby-Saunders Co., St. Louis, MO., 2004.

Eisenberg, Ronald L. and Johnson, Nancy M.; Comprehensive Radiographic Pathology, Fourth Edition, Elsevier-C.V. Mosby-Saunders Co., St. Louis, MO, 2007.

Laudicina, Paul; Applied Pathology for Radiographers, First Edition, Elsevier-C.V. Mosby-Saunders Co., St. Louis, MO, 1989.

Wicke, Lothar; Atlas of Radiologic Anatomy, Sixth Edition, Williams & Wilkins, 1998

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