



# **THE X-RAY**



## **APPLICATIONS IN CLINICAL PRACTICE**

**Dr N M kimani**  
**Dept. Diag imaging**



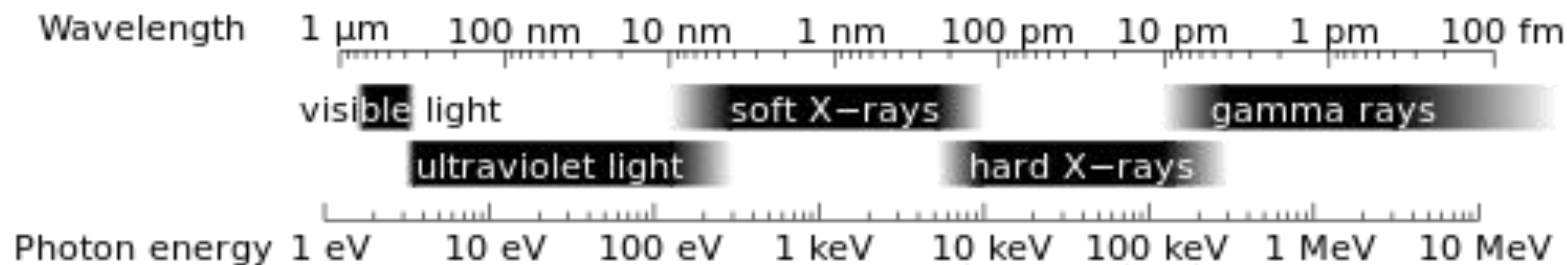
- Wellcome to the school of medicine

# X - RAY

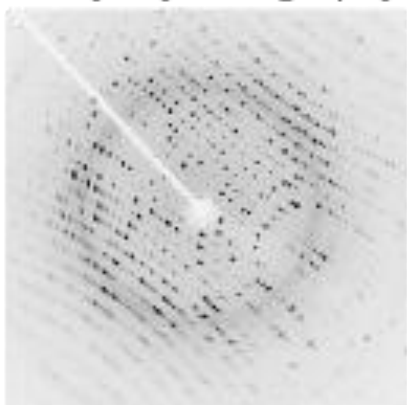
- Discovered on Nov. 8th 1895 by Wilhem Conrad Roentgen.
- Dec. 22nd 1895. 1st radiographic image produced. This was a 15 minute exposure of Berthas hand.
- - Birth of radiology as a medical specialty
- Feb 2nd 1990 -phenomenon observed by Prof. A. W. Good speed.



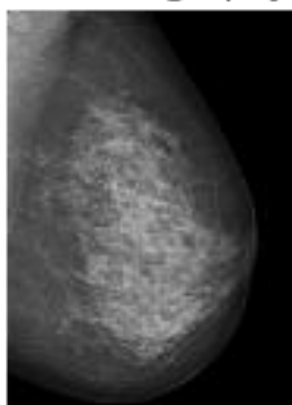




X-ray crystallography



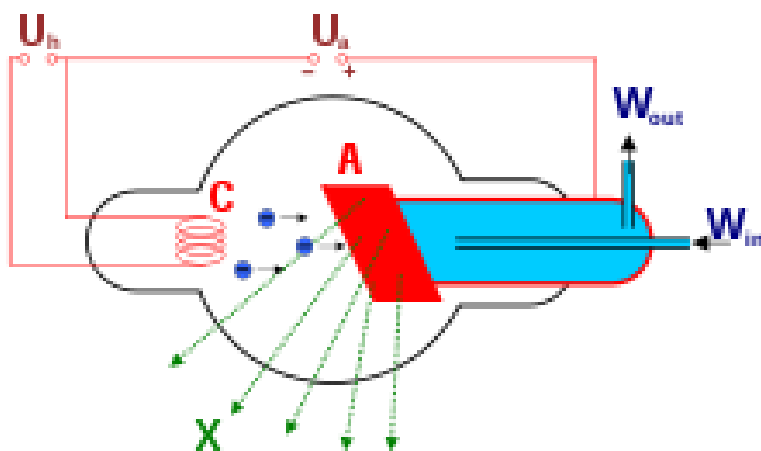
Mammography



Medical CT



Airport security



# APPLICATIONS

1. X-ray imaging

2. Therapeutic

- malignancy
- hypertrophic tissue e.g keloids.

# X-ray imaging methods

- Plain Radiography/ conventional tomography
- Fluoroscopy (Trans illumination)
- Computed Tomography



# X-RAY MACHINE



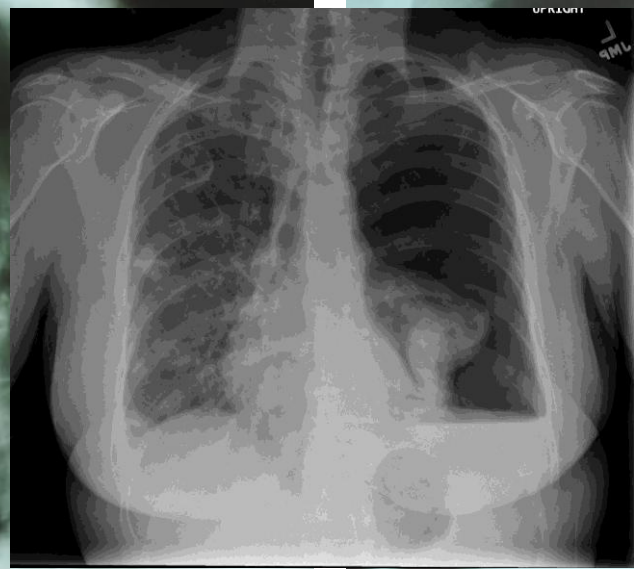
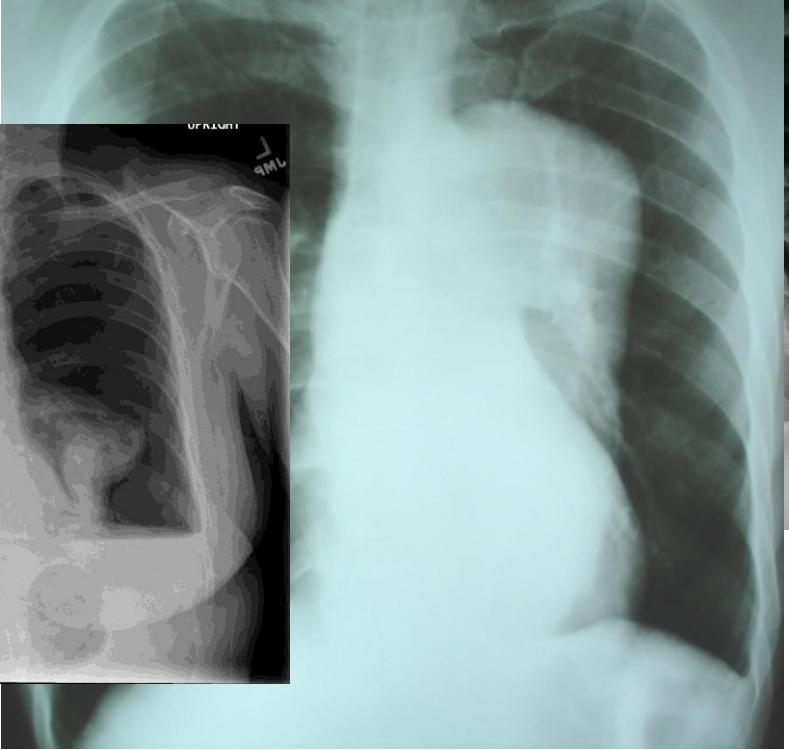
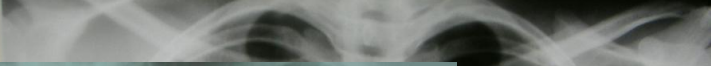


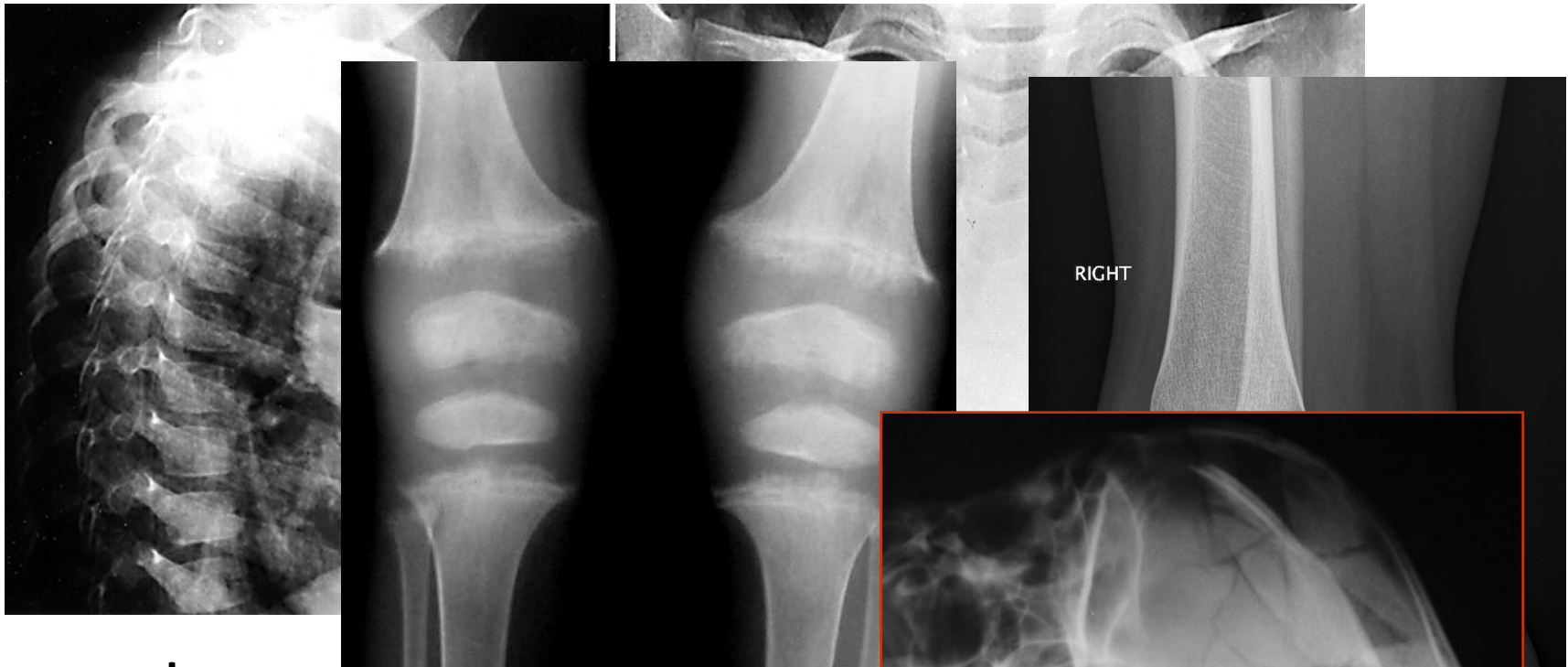
# Plain radiography

Spine

Pelvis-prostatic calculi

- Chest-normal, aortic aneurysm, lung collapse





- Lung abscess
- Rickets
- Lat. Ankle
- Skull fracture



- cassette

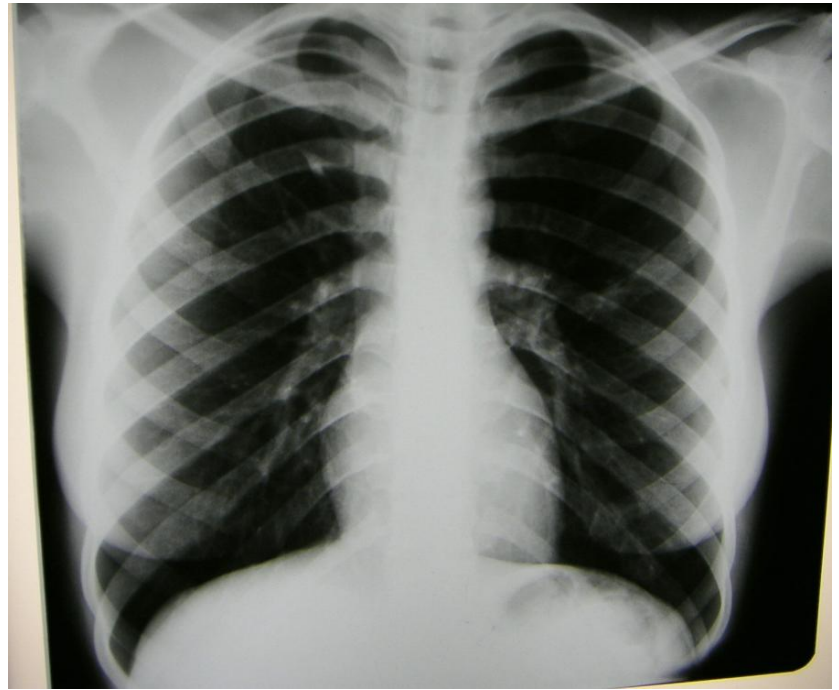


# Advantages

- Full size radiography - anatomy shown in full size.
- Provides static images with the highest spatial resolution
- Availability
- In expensive

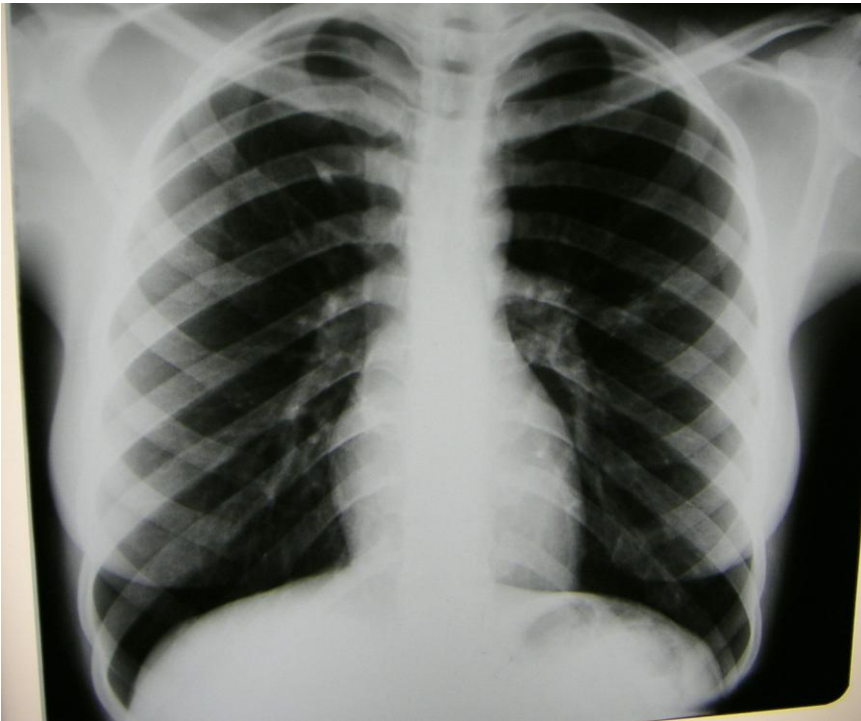
# Disadvantages

- Poor resolution.
- Overlap of structures.
- Non differential of structures.
  - -soft tissues anonymous
  - -fat
  - -air
  - -bone /calcification
- Non visualization of hollow structures.
- High radiation dose: film is a poor receptor of radiation and hence high dose is required.
- Cannot demonstrate physiological activity



# Advances

- Digital radiography
- CRS, digital cassettes



We will die for you,  
Comrade President!

I know, that's why I've  
been starving you all along...





# CONVENTIONAL TOMOGRAPHY

- A thin plane through the patient imaged
- Movement of the x-ray source
- Movement of film
- Structures in planes other than the one being imaged are subjected to blurring due to gross movement in sharpness.



# Fluoroscopy

Primary image created on a fluorescent screen.

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Screen is part of an x-ray image intensifier that enhances the brightness(luminance by a factor of about 5000).

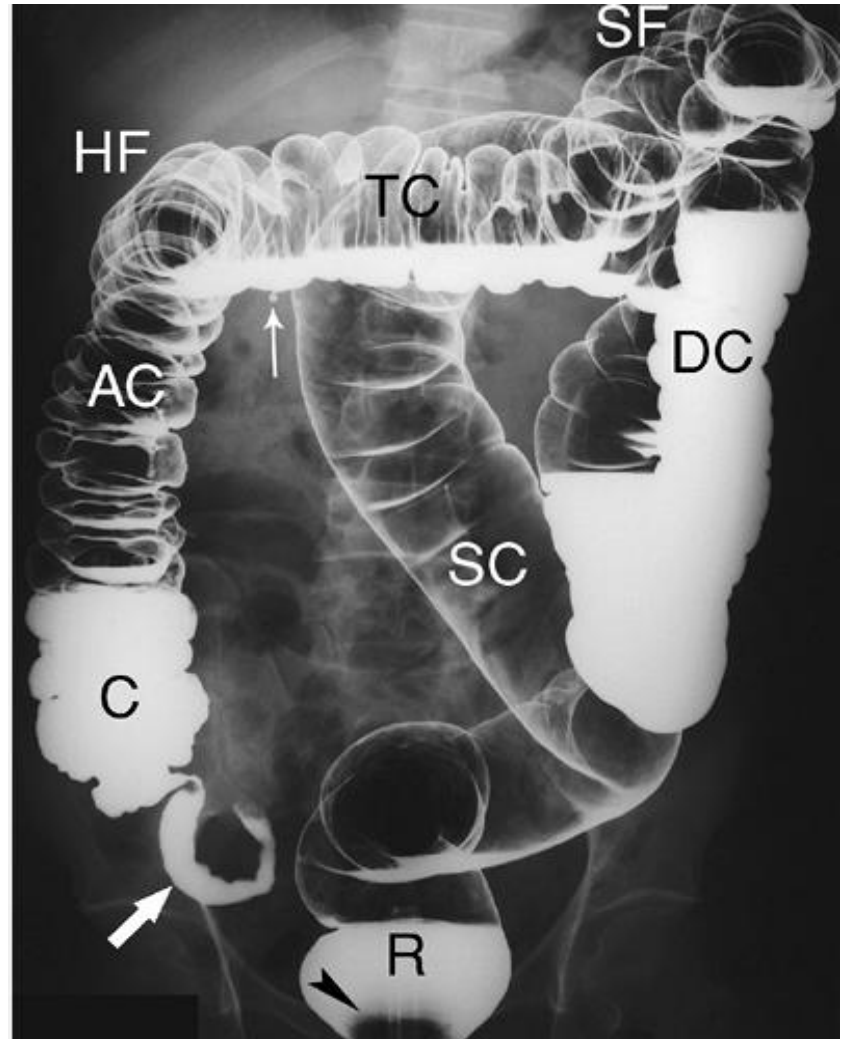
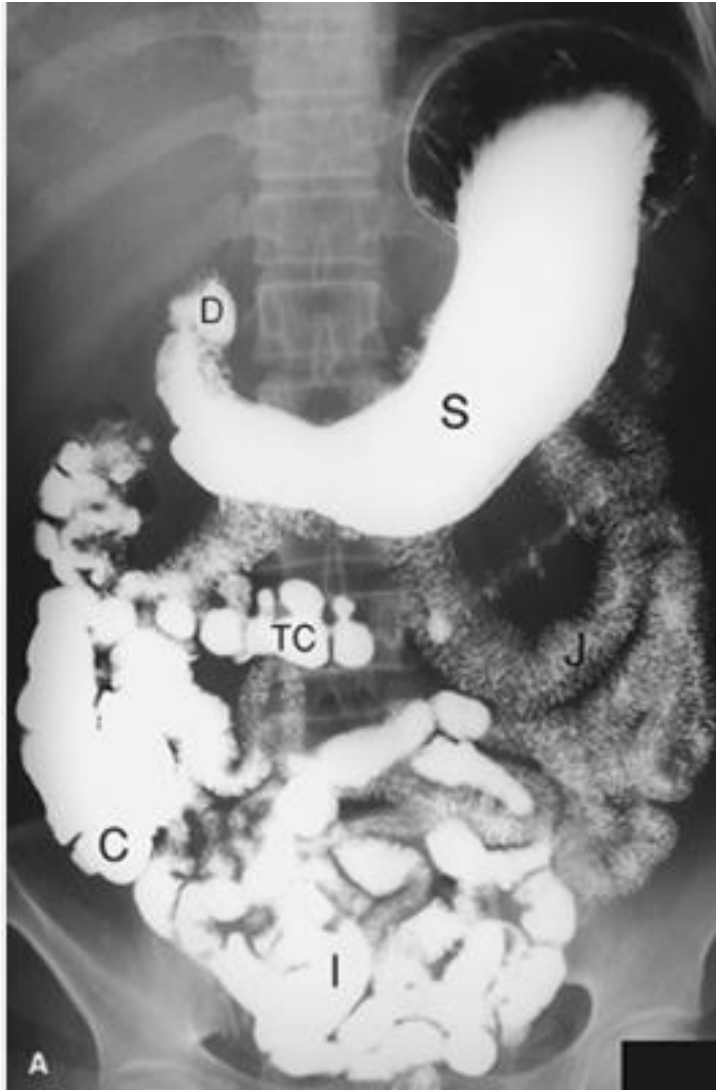
Image from intensifier recorded via lenses by a T.V camera and shown on a monitor.

Image may be reflected by mirrors to a small still camera or cine camera (fluorography)

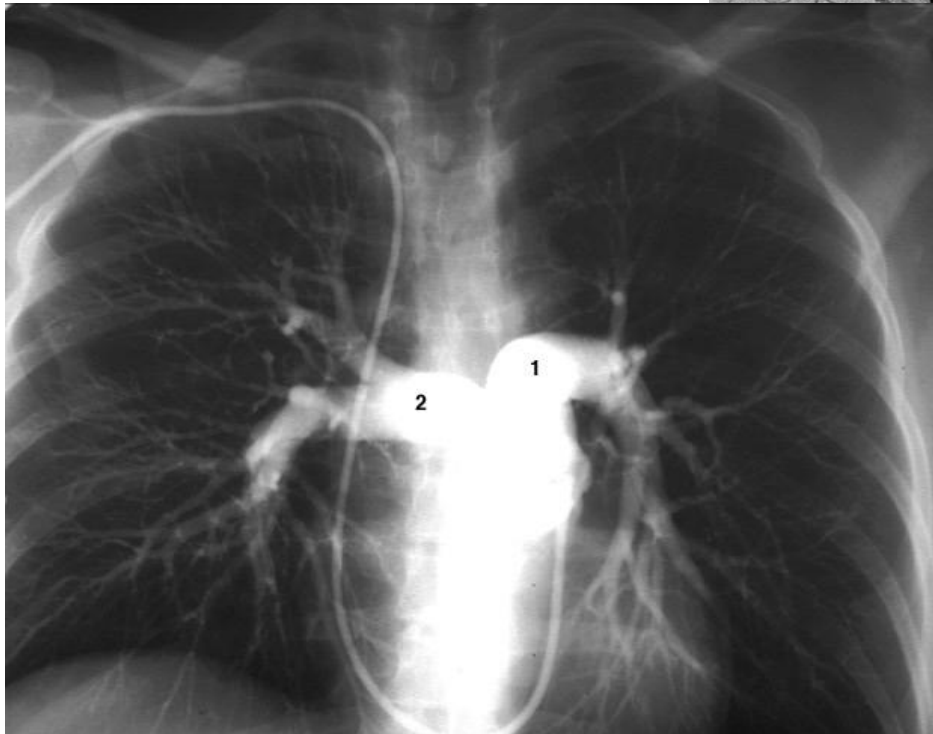
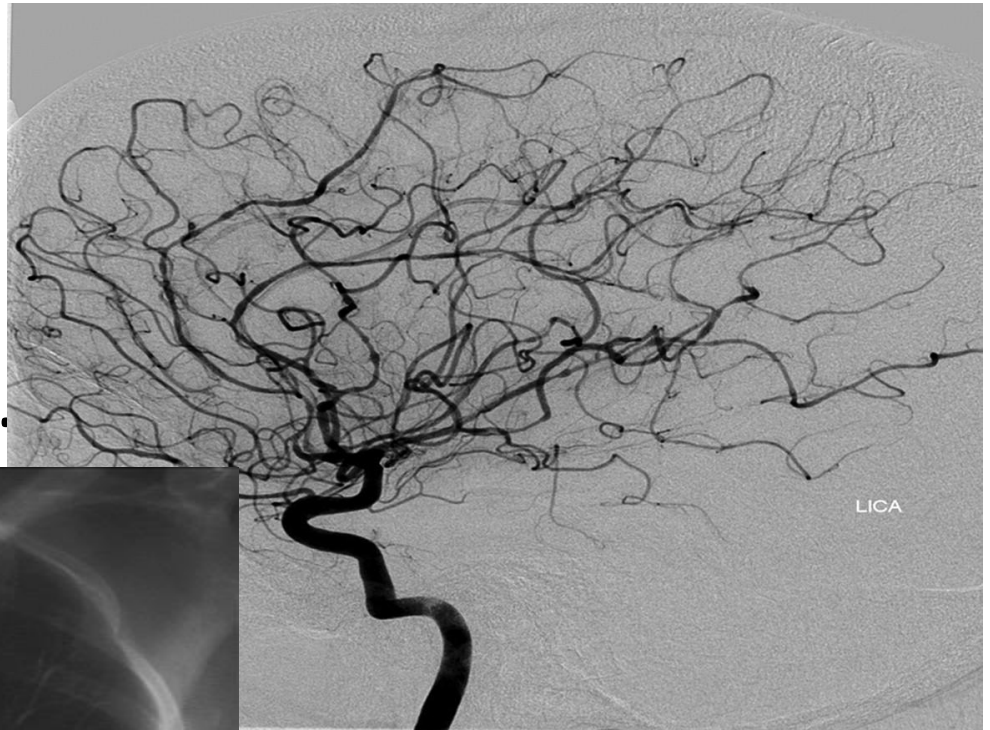




- C-arm KNH

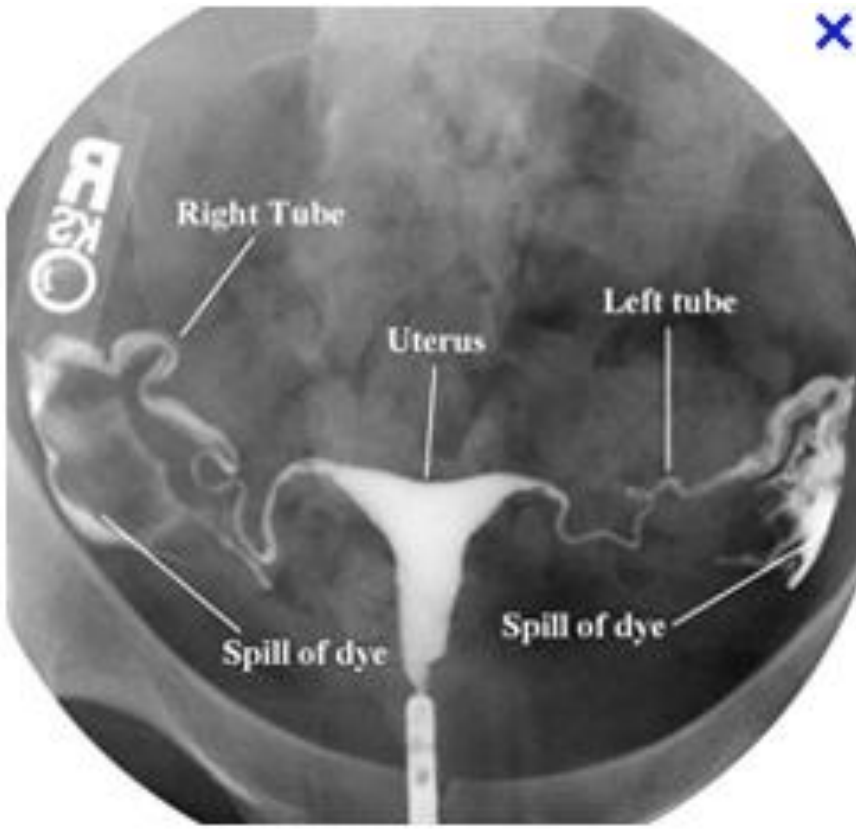


- ICA ANGIO
- PULMONARY ANGIO....





- HYSTEROSALPHINGORAM(HSG)





- Interventional suite



# Renal artery aneurysm -endovascular repair of the aneurysm



# COMPUTER TOMOGRAPHY (CT)

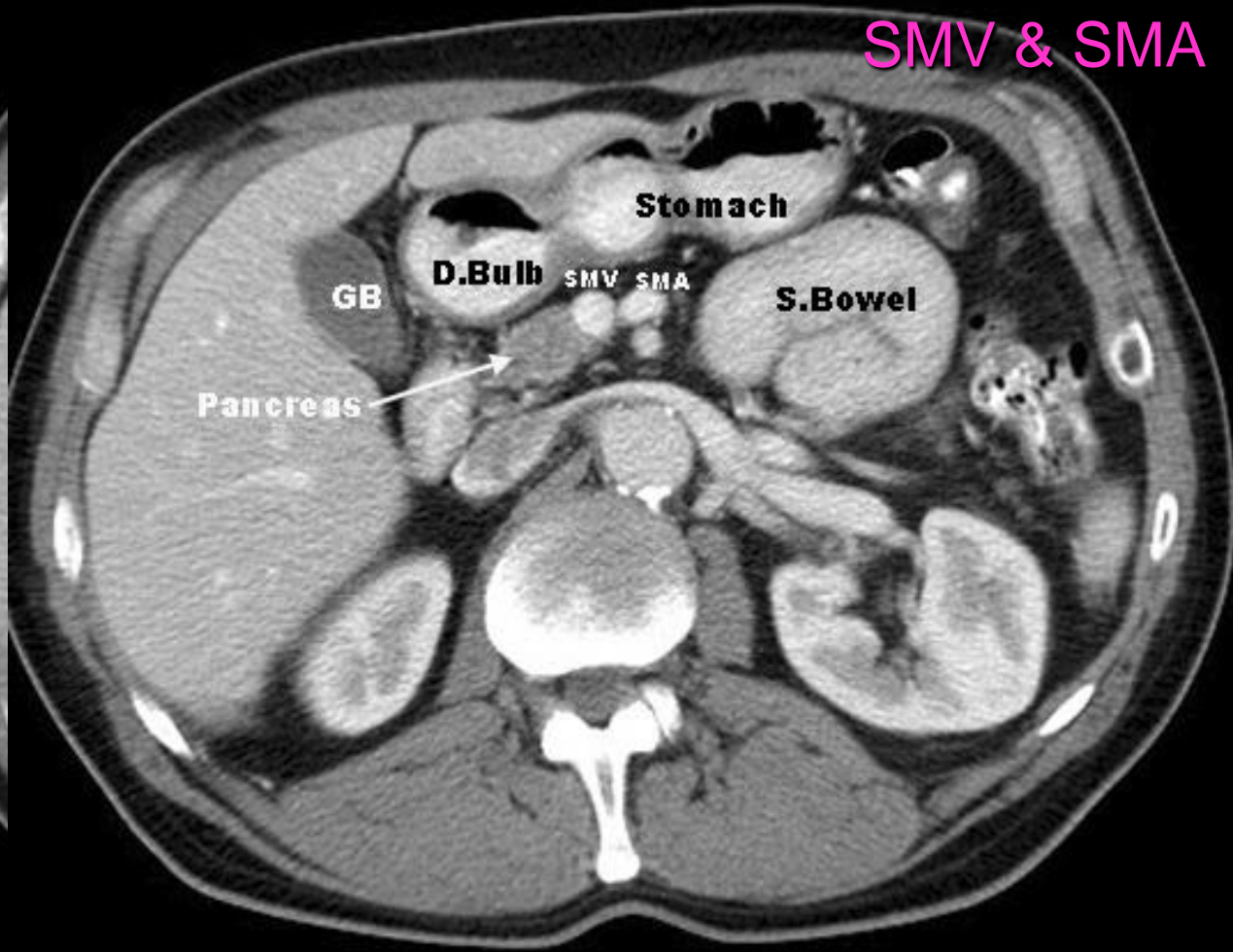
- -Invention by Sir Godfrey Hounsfield in 1972.
- Greatest step forward in radiology since the discovery of x-rays.
- Initial scanners designed for head studies only but soon whole body scanners became available.
- Used for imaging any part of the body today.
- depends on the fact that different tissues provide different degrees of x-ray attenuation.
- Thin slices of tissue exposed.



- **KNH 128 SLICE CT SCANNER**

WIF

SMV & SMA

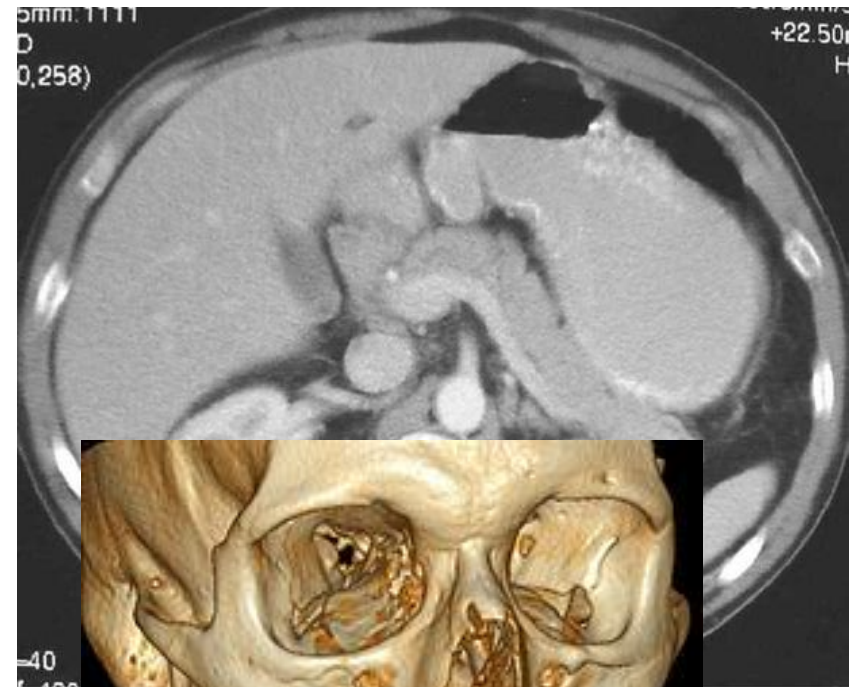


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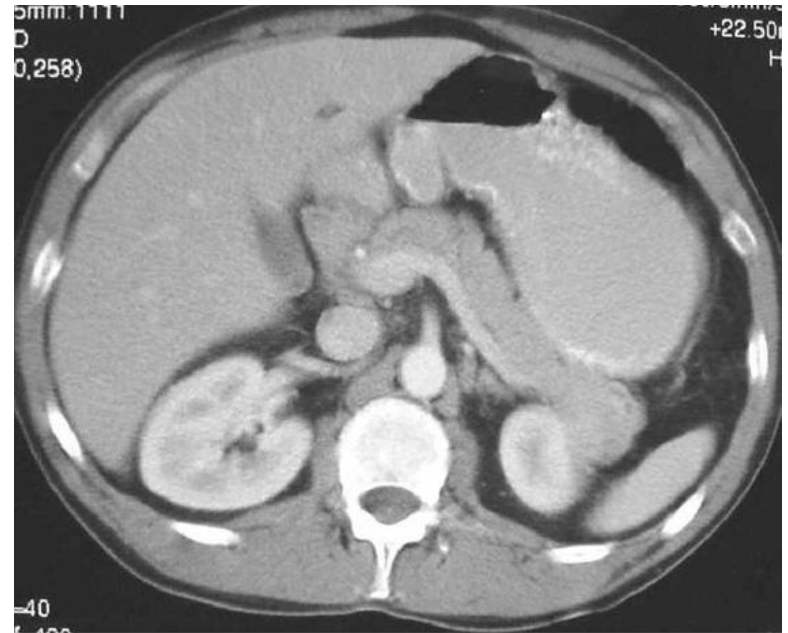


# Computerized tomography



# Advantages

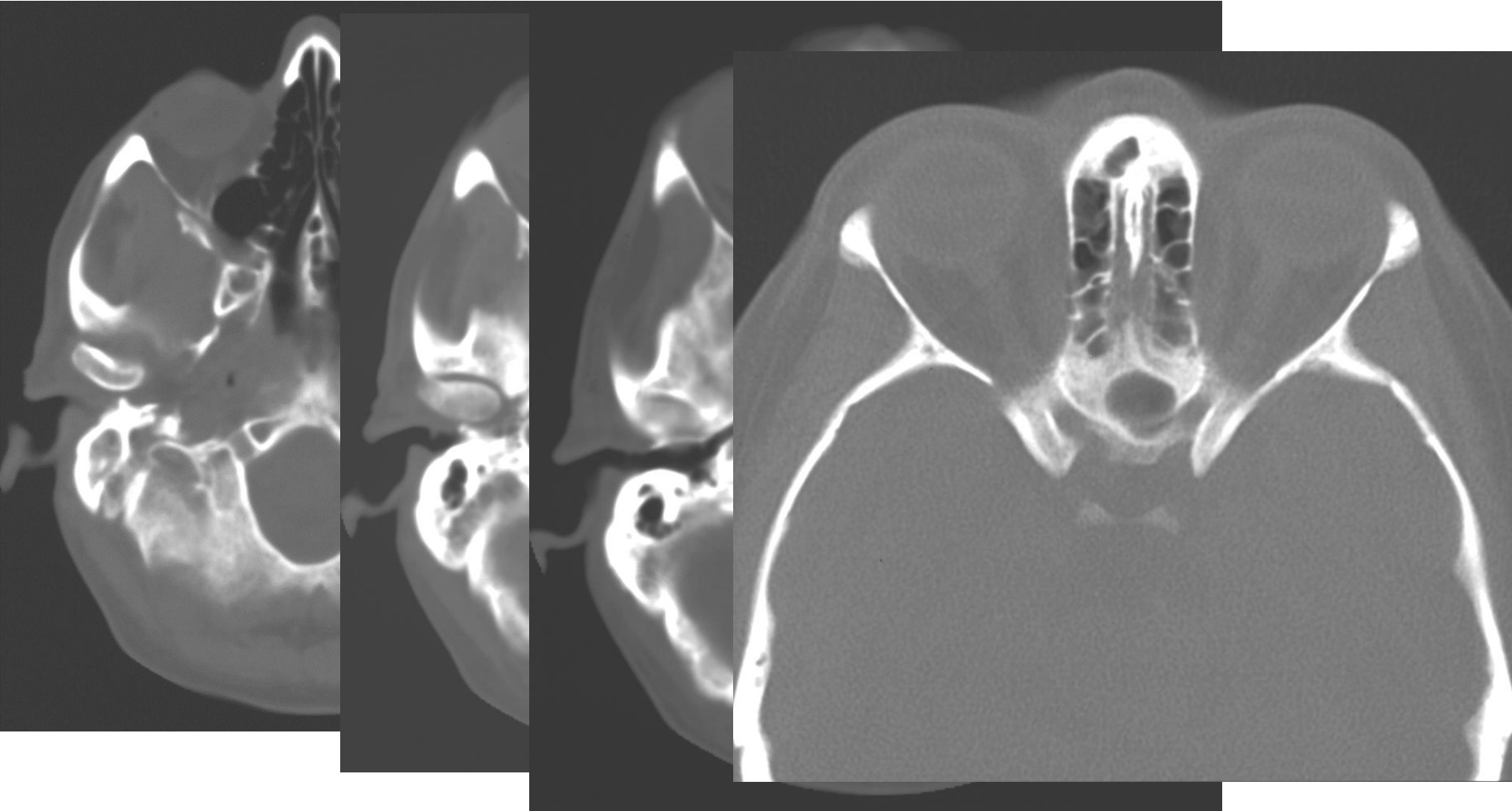
- high contrast resolution.
- no disturbing superimposition.
- axial scans done
- detectors about 100 times more sensitive to x-rays than radiographic film = less radiation.
- better bone detail
- soft tissues and fluid can be differentiated.
- Reconstruction with appropriate software



**CT scan showing a normal pancreas.**



# BASE OF SKULL



# Disadvantages

- Radiation
- Cost
- availability

# Radiotherapy

The 'x-ray' in high doses is used for treatment of various cancers.

Examples - Breast

- Cancer of the cervix
- Sarcomas
- prostate cancer

etc.

image (radiotherapy equipment).

# Radiotherapy dept KNH





- A 3-D Linear Accelerator used for External Beam Radiation (at Aga Khan University Hospital, a private hospital in Nairobi)

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end

# Limitations of conventional radiology

- Three dimensional subject projected on to a two dimensional image

- Poor contrast resolution.

A radiographic film only differentiates between -bone /calcification

- soft tissue/fluid

- fat

- air/gas

- Impossible to differentiate between different soft tissues.

- Radiation.

- Hollow viscous not visualized



- may be visualized if;
- containing gas/air
- equipment required is bulky
- storage of film.

# Contrast

## Definition

Exhibition or emphasizing of differences between things by placing them actually or in imagination over against each other.

## Contrast in Radiology

visual differentiability of variations in photographic or film density produced on a radiograph/image by the structural composition of the object or objects radiographed/imaged.

## Contrast media

- Agents used to enhance this differentiability
- Structures in the body enhanced by the use of contrast media.

# Images

- CXR /swallow/Bronchogram
- Angiogram /plain film
- abdomen / follow through.

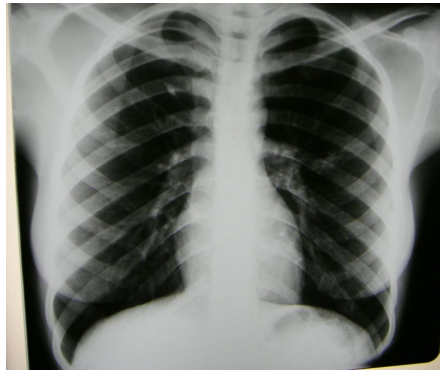
# X-RAY IMAGING METHODS

- Plain Radiography with screen and film (casette) > 100yrs old.
- Fluoroscopy (Trans illumination)
  - from the beginning of the previous century.
  - image intensifier and television camera introduced in 1960s.
  - Computerized Tomography- 1970s.

Can also be divided into.

- Conventional 3 dimensional object is projected on to a 2 dimensional image.
  - Shadows of different organs are summated on a film.
  - The entire tissue volume is exposed.
  - Much scatter reduction generated which degrades image quality.
- Computed Tomography
  - used to analyse and display axial image in digital limits.

# Chest





# FLUOROSCOPY

## Direct fluoroscopy

- used until 1960s
- still in use in some parts of the country
- obsolete
- transmitted x ray beam falls on a fluorescent screen resulting on a dynamic light image.
- Observed directly by the radiologist.
- Used to study physiological movement e.g respiration, etc.
- radiation doses too high (patient/radiologist)
- replaced by indirect fluoroscopy.

# DIRECT RADIOGRAPHY

- Original means of imaging
- X-rays pass through the patient and create an image on a photographic film.
- Cassette film.

## Film

- photographic emulsion- silver bromide.
- Sensitive to photons having a wide range of energies -X-rays, ultraviolet radiation visible light.
- Silver bromide ionized by photons
- Ag<sup>+</sup> ions created depends on number of photons transmitted.

Development  $\text{Ag}^+$  metallic Ag.

Fixation - fixer removes the Ag Br.

-Visible image on a radiographic film is related to varying degrees of blackening caused by varying densities of microscopic silver granules.

# Intensifying screens

- Film placed within cassette between fluorescent screen. (Intensifying screens).
  - Absorb x-ray photons and produces light photon.
  - Light photon responsible for the blackening of the film.
  - Calcium tungstate, lanthanamides.
  - 10-100 times more effective on film above.
- Image (cassettes).

# Disadvantages of plain film radiography.

Poor resolution.

- Overlap of structures.

- Non differential of structures.

  - soft tissues anonymous

  - fat

  - air

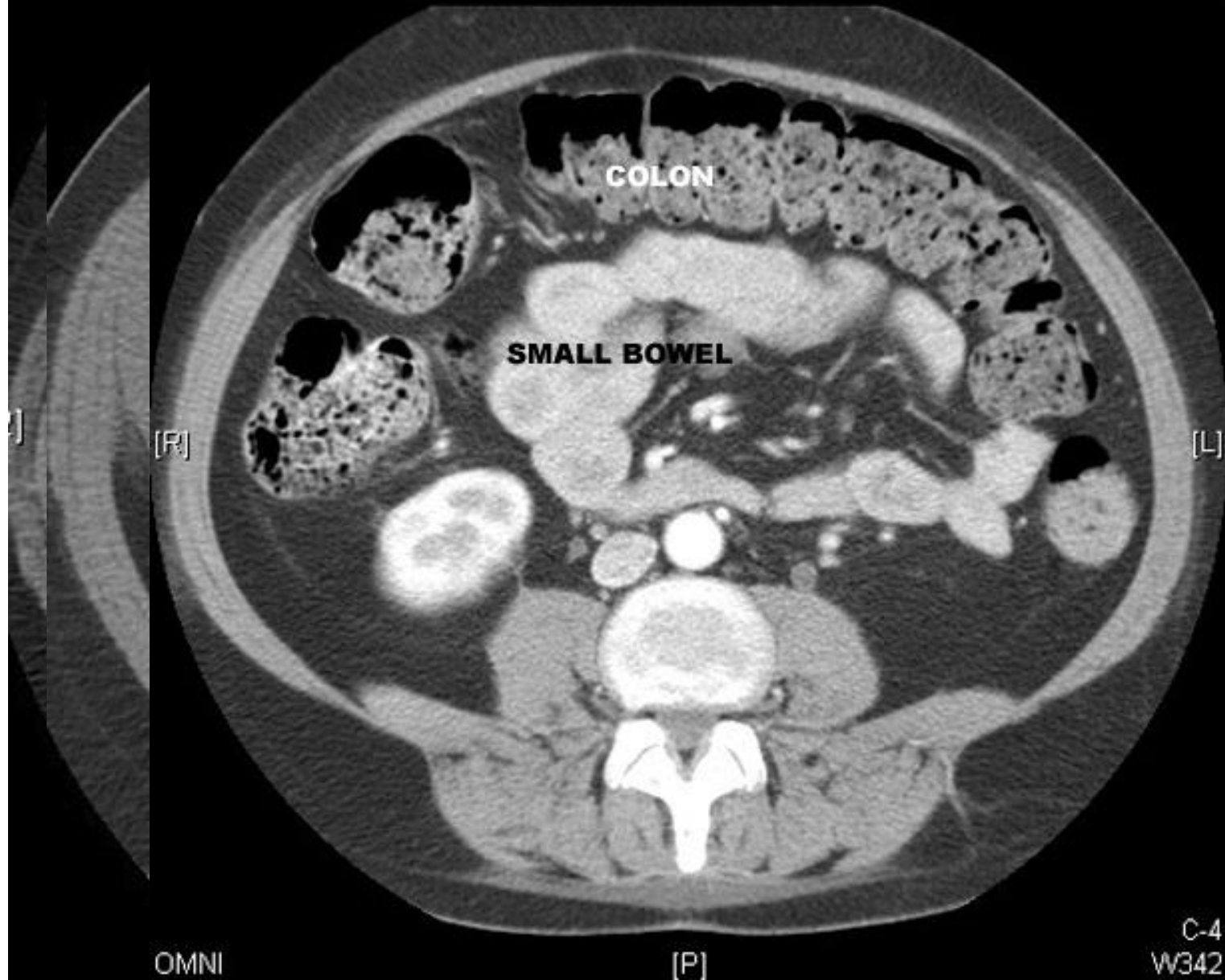
  - bone /calcification

- Non visualization of hollow structures.

- High radiation dose: film is a poor receptor of radiation and hence high dose is required.

- Cannot demonstrate physiological activity.

**COLON IN THE PERIPHERY WITH SMALL BOWEL  
IN THE CENTER OF THE ABDOMEN**





Direct radiography still the most important radiological modality

- Full size radiography - anatomy shown in full size.

- Provides static images with the highest spatial resolution.

