X-rays and fluoroscopy

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Wilhelm Conrad Röntgen 1845-1923

- 8.11.1895 Würzburg, Germany
- 1901 the first Nobel prize in physics
On a New Kind of Rays

- A discharge from a large induction coil is passed through a Hittorfs vacuum tube
- The tube is surrounded by shield of black paper
- in a completely darkened room
- paper covered on one side with barium platino-cyanide lights up with brilliant fluorescence when brought into the neighbourhood of the tube
Electromagnetic waves

forms of electromagnetic waves
(wave length + frequency)

- Gamma rays
- X-rays
- Ultraviolet
- Visible
- Infrater
- Radio waves
X ray tube

- a vacuum tube
- uses a high voltage to accelerate electrons released by a hot cathode to a high velocity
- the high velocity electrons collide with the anode, creating the X-rays
Influence of physical parameters

- intensity electric current: mAs
- tension, voltage: KV (50-100)

quantity of X ray

quality of X ray
Soft X ray technique

- tension less than 50 KV
- longer wave length
- photons of X-ray beam absorbed by superficial tissue
- increased radiation dose
- mammography
Hard X-ray technique

- tension above 100 KV
- shorter wave length
- photons of X-ray beam have higher energy, less absorbed
- decreased radiation dose (like in CT)
Features

- Straightforward spread of photons
- Absorbed by tissue
- Different absorption of X-ray beam
  (increased atomic number … increased absorption)
Adverse effects

- **Non stochastic** deterministic
treshold dependent
  (X ray burns, dermatitis, sarcomas)

- **stochastic**
treshold independent
  (genetic mutations)
Protection against adverse effects

- Dosimeter (evaluated every month)
- Lead vest (1 mm Pb)
- Barium within walls (3.5 cm barium sulphate)
- Shutters
- Dose decreases with square of distance
ALARA (As Low As Reasonably Achievable)

potential risks from a procedure be carefully balanced with the benefits of the procedure for the patient

• Shielding use proper barriers to block or reduce ionizing radiation
• Time spend less time in radiation field
• Distance increase distance between radioactive sources and workers or population
• Amount reduce the quantity of radioactive material for a practice
Radiation dose

- Radiation dose from natural radioactive sources equals 2.3 mSv/year
- 115 lung X-rays
- 1 brain CT
X-ray terminology

- Negative (photographic film, not photo itself)
- White - shadow, increased attenuation
- Black - lucency
- Decreased attenuation
Development of X-ray image

- developer
- water
- fixative
- water
- drying procedure
- AgBr
Digital radiography

- film less X ray cassette
- RTG sensitive layer of crystals
- negative electric charge
- after exposition negative charge is canceled
- laser is used to read charge on crystal
<table>
<thead>
<tr>
<th>Digital radiography</th>
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<tbody>
<tr>
<td><strong>DR</strong> digital radiography</td>
<td>direct digitalisation</td>
</tr>
<tr>
<td></td>
<td>(detector in mobile X-ray equipment)</td>
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<tr>
<td><strong>CR</strong> computed radiography</td>
<td>undirect</td>
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<td>(film less cassette)</td>
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X-ray projections

- Antero-posterior A-P and postero-anterior P-A (to X-ray tube)
- Lateral and oblique (to cassette)

Right posterior oblique (R shoulder and back to cassette)
X-ray report

• 1 identification (name, ID, dept)
• 2 date (site sign R/L)

• 3 normal x abnormal
• 4 conclusion
differential diagnosis

recommendation of further imaging (CT more sensitive for lung metastasis than X-rays)
X-ray image of lung

normal

venous congestion
Positional influence X-ray lung

fluidothorax upright

fluidothorax supine
Fluoroscopy

- X-ray in real time
- C arm, U arm, Fluoroscope

1. an X ray source
2. fluorescent screen
i.e. X ray image intensifier
Image intensifier

Electro-optic convertor
• primary input screen (large area) photon turns into electron
• dinodes (multiplication of electrons)
• secondary output screen (small area) electron into photon
• increases brightness of image (dose reduction)
the output image is approximately 105 times brighter than the input image. This **brightness gain** comprises a

- **flux gain** (amplification of photon number)
- **minification gain** (concentration of photons from a large input screen onto a small output screen)
Contrast media

- **positive** barium sulphate
  iodine water soluble c.m. (1 ml/kg)

- **negative** air, CO₂
Flat-panel detectors

- increased sensitivity to X-rays, potential to reduce patient radiation dose
- temporal resolution is also improved over image intensifiers, reducing motion blurring
Fluorocopic examinations  Upper GIT

- p.o. swallow of CM till duodenum
- per rectum irrigography till terminal ileum

single contrast
contrast fill lumen
Single x double contrast

single contrast
• contrast fill lumen

double contrast
• mucosal relief
Double contrast - Lower GIT

- Mucosa (barium + air)
  Enteroclysis (duodenal tube, barium + methylcelulose)
Uro/genital tract

- micturating cystourethrogram (MCUG)
- retrograde pyelography
- hysterosalpingography
Angiography

- Arteries
- Veins
Orthopaedic surgery to guide fracture reduction and the placement of metalwork
Placement of peripherally inserted central venous catheters, pacemaker
Voiding urography

Upper urinary pathways
(dynamic process, but without fluoroscopic control)

- native (urinary stones)
- i.v. iodine CM (1ml/kg) cubital vein
- 3 X-ray in time delay
  (7 min, 15 min, 30 min)