Radiology - introduction
Purpose of training

Provision of clinically relevant basic knowledge:
- indications,
- diagnostic algorithm
- accuracy of diagnostic imaging and interventional radiology.

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Department of Radiology, University Medical School, Szeged
Sources of information

Textbook

Lectures
Clinically oriented, slides available at
http://www.szote.u-szeged.hu/medcentrum/radiology/

Seminars
Clinically oriented, case-based

Teaching files
Appr. 800 images with comments on
http://www.szote.u-szeged.hu/medcentrum/radiology/
Exam

Core knowledge: textbook + lecture + seminar

1st semester: MCQ test
2nd semester: oral - questions & images available on the website
# Curriculum

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<td>Introduction to imaging diagnostics: role, development, present and future</td>
<td>Imaging diagnostics: role, development, present and future</td>
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<td>dr. Palkó András</td>
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<td>2. SEPT 13.</td>
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<td>3. SEPT 20.</td>
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<td>4. SEPT 27.</td>
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<td>5. OCT 4.</td>
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<td>Chest I (lung)</td>
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<td>Esophagus, stomach</td>
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<td>11. NOV 29.</td>
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<td>12. DEC 6.</td>
<td>Musculoskeletal system: Bones</td>
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Radiology

Have you ever wondered what you look like on the inside? You can find out in Radiology, where they have cool machines that can take pictures of the inside of your body.

These pictures are called X-rays, and they help your doctors find out what's going on inside you. You might have other special picture tests done, like an MRI or a CAT scan. It doesn't hurt when they take these pictures, but some of the machines can be pretty noisy. (Pal was happy to find out that there are no real cats in the CAT scan machine.)
Radiology

= 

diagnostic imaging + 

therapeutic intervention guided by imaging procedures

OR

the art of interpreting visual information by the use of very complex equipment creating very complex images
DIAGNOSTIC IMAGING

- Roentgen: x-ray 1895
- Cannon: contrast material (bismuth) 1896
- Krause: " (barium) 1904
- Graham: brachial arteriography 1923
  " : cholecystography 1923
- Swick: i.v. pyelography 1928
- Donald: ultrasound (sonar) 1950
- Seldinger: catheter-technique 1953
- Hounsfield: CT 1967
- Lauterbur: MR 1973
The avalanche

PACS, RIS
teleradiology

US  MR  fMR

intervention

CT  MDS-CT

double contrast

non-ionic  Gd  US

Ba  iodine

fluorosc.  image intensifier

DSA  DF

PP, DDR

X-ray  radiogr.  tomography

The Magic Mountain

1900  1925  1950  1975  2000

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DIAGNOSTIC IMAGING

- Purpose: create visible image of morphology and function of the human body
- Image: visual information (visualization in 2 or 3 D, vector, curve, spectrum, etc.)
- To bring about an image:
  - Energy has to be conducted to the body
  - Interaction of the energy and the components of the body
  - Detection of the modified energy
  - Visualization of the detected pattern
Types of imaging:

- absorption (X-ray, CT)
- reflection (ultrasound)
- induction (MRI)
- emission (NM)
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DIAGNOSTIC IMAGING

• image generation
• image reading
• image interpretation (report)
• data processing and archiving
DIAGNOSTIC IMAGING

clinical problem

indication

consultation

examination

consultation

therapy
DIAGNOSTIC IMAGING

Methods:

- x-ray
- ultrasound
- computed tomography
- magnetic resonance imaging
- (PET-CT)
- (optical imaging)
- (thermography)
Trends of development:

- full digital imaging
- „intelligent“ equipments
- 3D, virtual reality, functional imaging
- genetically modified, molecular markers
- biologically specific contrast materials
- PACS, neural network, automatic image reading and interpretation

- faster, easily generated, more relevant information
- shorter way to diagnosis
Stagnation or progress?

Thomas W. Lawson, 1902
Stagnation or progress?

Thomas W. Lawson, 1902

Clermont, 1807
Where are we today?
Cardio-CT
Cardio-MR

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Cardio-MR

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MR-phlebography

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CT-arteriography
CT-arteriography
CT-arteriography
DSA

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CT-arteriography

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MR-tractography
Functional MRI
MR-spectroscopy
CT-endoscopy

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Computer-assisted detection
Automatic segmentation

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Hybrid imaging (UH - CT/MR)
Hybrid imaging (PET/SPECT - CT/MR)
Dilemmas of development:

lower back pain – MRI vs. acute abdomen – CT
The future

- Integrated diagnostics
- Mass computing
X-ray imaging
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Absorption of x-ray is influenced by:

- wave-length of radiation
- atomic number
- density
- thickness
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Radiography

X-ray tube

patient

detector (film, dd)
Radiography

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Fluoroscopy

- Image intensifier
- Detector (fluoro screen)
- TV monitor

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negative image

positive image

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Analog x-ray imaging

- **Detector**
  - Film (emulsion suffering photochemical reaction if exposed to x-ray and light; image visible after development)
  - Fluoroscopic screen (scintillates if exposed to x-rays; image visible directly or by an image intensifier – TV set)
Digital x-ray imaging

- **Detector:**
  - Storage phosphor plate (radiogram, digital read-out by laser-light) = computed radiography, CR
  - Direct digital detector (radiogram and fluoroscopy)
  - Both visible on computer monitor
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Direct Digital Radiographic Receptor

X-Ray → Analog/Digital Converter → Digital Image

Pixel → Analog Data → Computer Memory

X-Ray Exposure → Radiation Detector
Digital imaging

● Today:
  - Digital archive and communication (picture archive and communication system, PACS)
  - Computer assisted detection (CAD)
  - Image optimization
  - Teleradiology
  - Electronic patient record

● In the future (Web 2, cloud computing)
  - Data mining, decision support
collimation

X-ray tube

X-ray

lesion

body

shadow

detector

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X-ray tube → X-ray → object → shadow

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X-ray tube

X-ray

object I.

object II.

shadow

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X-ray imaging:

- magnification
- distortion
- summation
- loss of data
X-ray imaging:

- magnifies
- distorts
- summarizes
- forgets

The solution:

- more than one direction
- tomography
Poor contrast resolution
Poor contrast resolution

Solution:
- low voltage
- contrast material
- other modalities