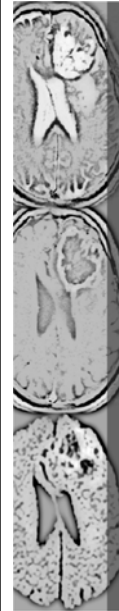




Magnetic Resonance in Medicine Examination Procedure

Chia-Feng Lu (盧家鋒), Ph.D.
 Department of Biomedical Imaging and Radiological Sciences, NYCU
alvin4016@nycu.edu.tw



Contents & Goals <http://cflu.lab.nycu.edu.tw/>

After today's class, you should be able to...

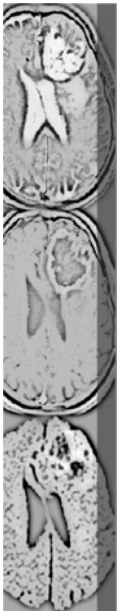
- **Patient screening & safety issues**
 - evaluate the patient's conditions and determine whether they can receive MRI examination
- **Imaging techniques**
 - describe and apply the imaging procedure to successfully perform MRI examination



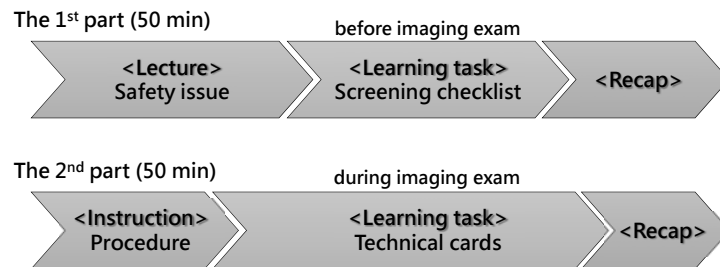
<http://cflu.lab.nycu.edu.tw>

2023/4/23

2



What do we have today?



T1+C with fatsat, T2-FLAIR, Dixon method, DWI, DTI, TOF-MRA, PC-MRA, CE-MRA, DSC-MRP, DCE-MRP, SWI

<http://cflu.lab.nycu.edu.tw>

2023/4/23

3

Patient screening & safety issues

To evaluate the patients' conditions and determine whether they can receive MRI examination



<http://cflu.lab.nycu.edu.tw>

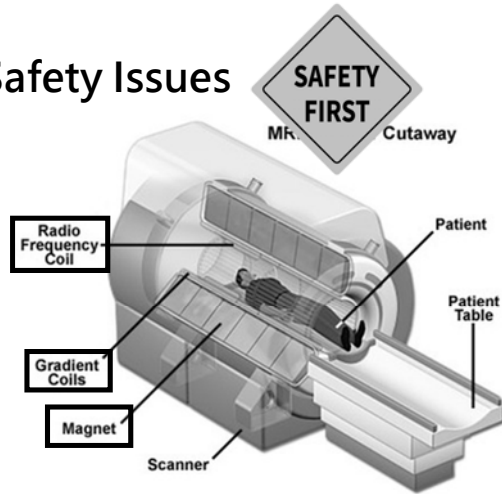
2023/4/23

4

We've learned...

MRI Hardware ↔ Safety Issues

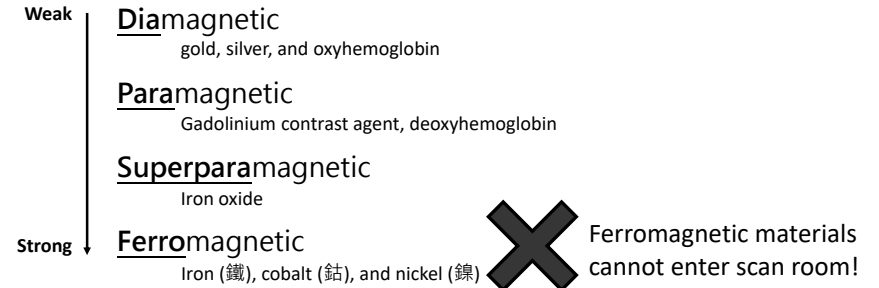
- **Main magnet**
 - Generates a high static magnetic field
- **Gradient coils**
 - Generate rapidly changing magnetic fields
- **Radio-frequency coils**
 - Excite the protons to generate signals



Coyne, K., 2012. MRI: A Guided Tour

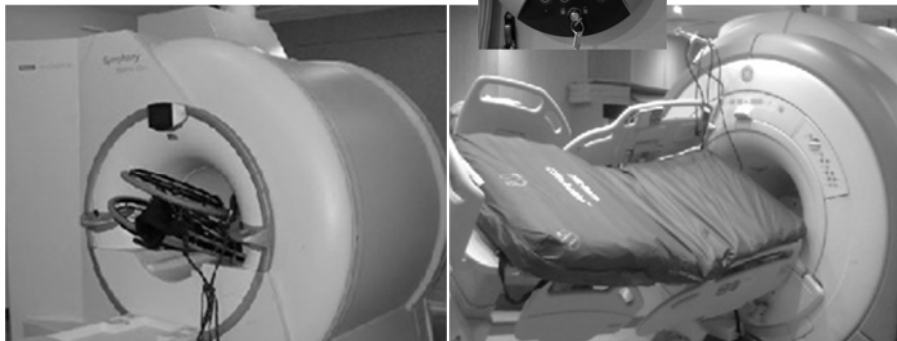
Magnetic Susceptibility 磁化率

- How much a material will become magnetized in an magnetic field.



Safety concerns of...

Main Magnetic Fields



<http://www.impactedenurse.com/?p=2927>

Safety concerns of...

Rapidly alternating magnetic fields

Changes of magnetic fields →
coil vibration → acoustic noise

- MRI generates 110~120 dB of noise.



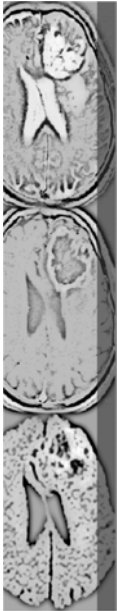
ear plugs

MR-compatible
head phones



Hearing protection is required!

- Simple foam earplugs can reduce the acoustic noise to 10~20 dB.



Safety concerns of...

Radiofrequency Electromagnetic Fields

- Specific absorption rate (in W/kg) → Heat

$$SAR \propto (\sigma \cdot A^2 \cdot B_0^2 \cdot \alpha^2 \cdot \frac{tp}{TR}) / 2\rho$$

- σ : electrical conductivity of tissue (metal objects are highly conductive)
 - A: body cross-sectional area (body size)
 - B_0 : Strength of magnetic field
 - α : flip angle of RF pulse
 - tp/TR: The ratio of the pulse duration tp and the TR of the sequence, the duty cycle
 - ρ : body mass.
- Patient's weight must be correctly input to ensure the SAR does not exceed the permitted levels.


Hospitals warn patients: Your Lululemon yoga pants could burn you during MRIs

Published: May 12, 2018 9:24 a.m. ET



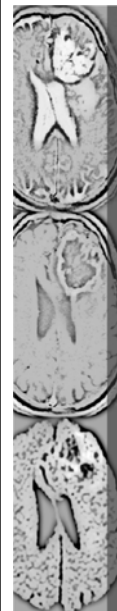
One 11-year-old girl took an MRI wearing an athleisure top and ended up with second-degree burns



Many clothing companies, like, lululemon  athletica, are now using metallic fibers in exercise, spandex, and stretch clothing. These fibers can burn you if worn in the MRI scanner. If you have on clothing, even undergarments, that could potentially have these fibers, please notify the technologist. We will provide you with clothing to wear. We care about your safety!

Learning Task

Let's make a screening checklist.



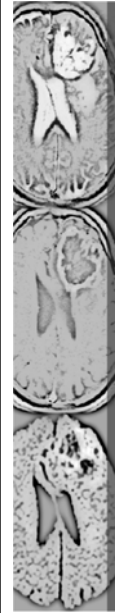
Recap

- Ferromagnetic materials cannot enter MRI scan room.
- Carefully screen the patient and anyone else accompanying the patient into the scan room.
 - Surgical histories, pacemakers, metal implants,...
- Remove all belongings, wear an examination gown and ear plugs correctly.
- When contrast injection is required, please check patient's renal function.
- If you are in any doubt about patient's safety, do not send them into the scan room.



Imaging techniques

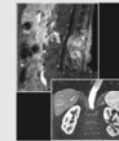
To describe and apply the imaging procedure to successfully perform MRI examination



Technical Cards

- Scan time**
- Short (< 3 min)
 - Medium (3 to 5 min)
 - Long (> 5 min)
- Use frequency**
- Seldom
 - Sometimes
 - Very often
- Contrast agent**
- required
 - not required

T1+C with fatsat



WHEN (Clinical Applications)

- Pre- and post-operation tumors
- Infection
- Inflammation
- Infarction
- Post-traumatic lesions

HOW (Examination Steps)

1. Check patient's renal function and body weight.
2. Acquisition of a set of T1W before contrast injection is needed.
3. After the contrast injection, acquire another set of T1W with fat saturation.

WHAT (Imaging Parameters)

1. T1W imaging with short TR and short TE
2. T1W+C and T1W-C should have same slice center, number, thickness, and FOV.
3. Gd contrast agent shortens tissue T1 relaxation time, and therefore CHES technique is required to saturate fat.
4. Shimming is required to improve magnetic field homogeneity.

Learning Task Assignment

Groups	Card 1	Card 2
G1	T2 FLAIR	Phase Contrast (PC) MRA
G2	Dixon Method	Contrast-Enhanced (CE) MRA
G3	Diffusion Weighted Imaging (DWI)	Dynamic Susceptibility Contrast (DSC)
G4	Diffusion Tensor Imaging (DTI)	Dynamic Contrast Enhancement (DCE)
G5	Time-of-Flight (TOF) MRA	Susceptibility Weighted Imaging (SWI)

Sharing & Recap

THE END

alvin4016@nycu.edu.tw