

神經放射線學

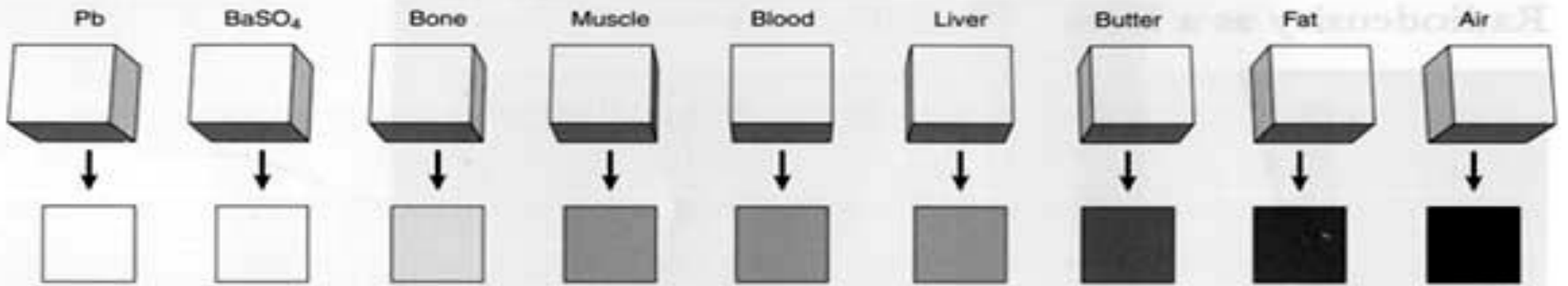
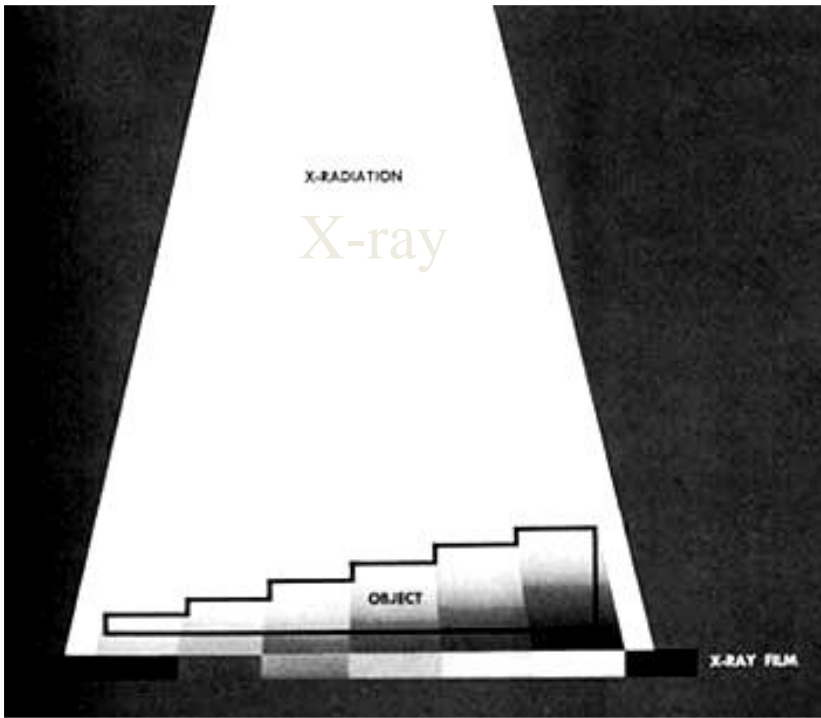
(判讀CT & MRI of Brain)

基本概念

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附設醫院 醫學影像部 顧問醫師

X-ray attenuation (X-光的衰減)

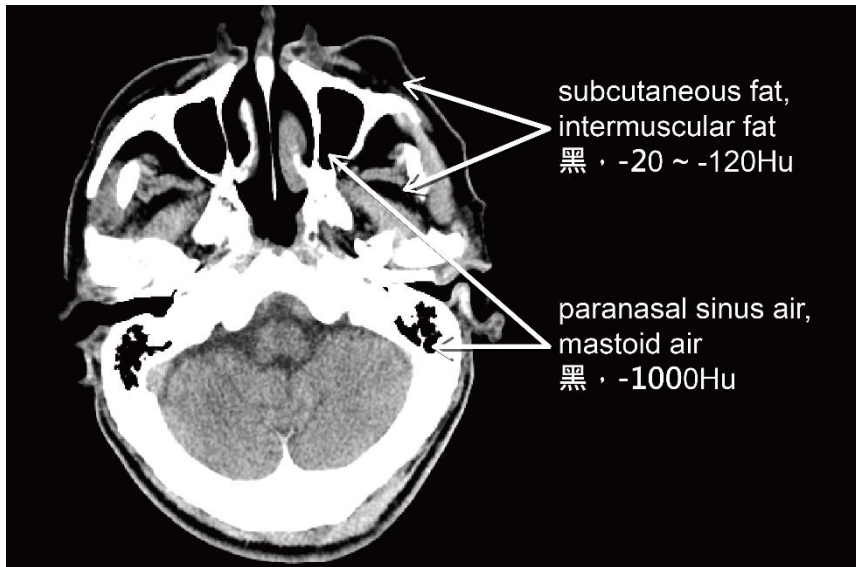
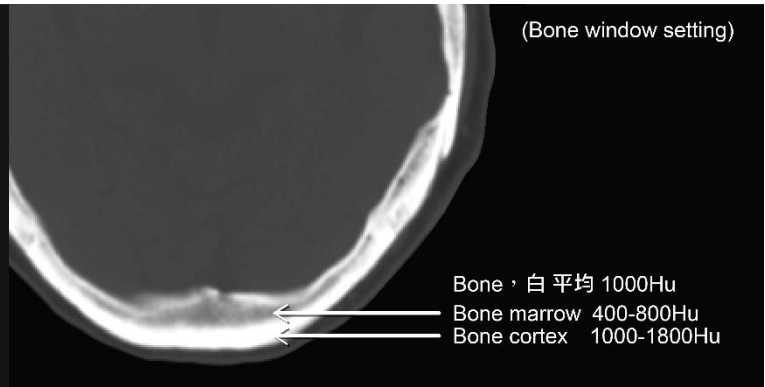
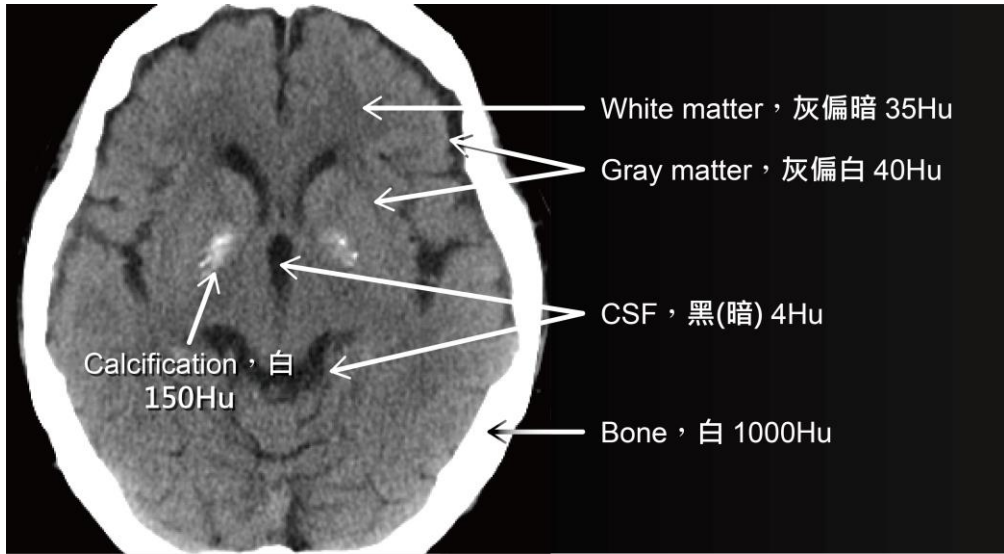


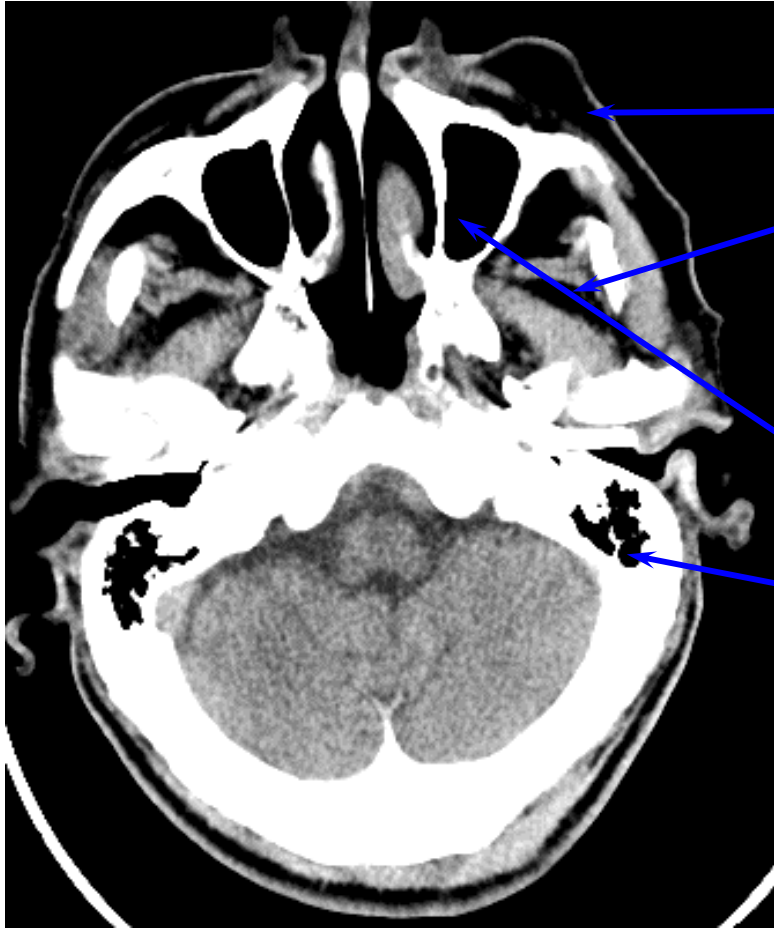
空氣未衰減X光，最暗色。骨骼衰減大部份X光，呈白色。
Soft tissue衰減一些X光，呈灰色。

CT gray scale

Hu: Hounsfield unit

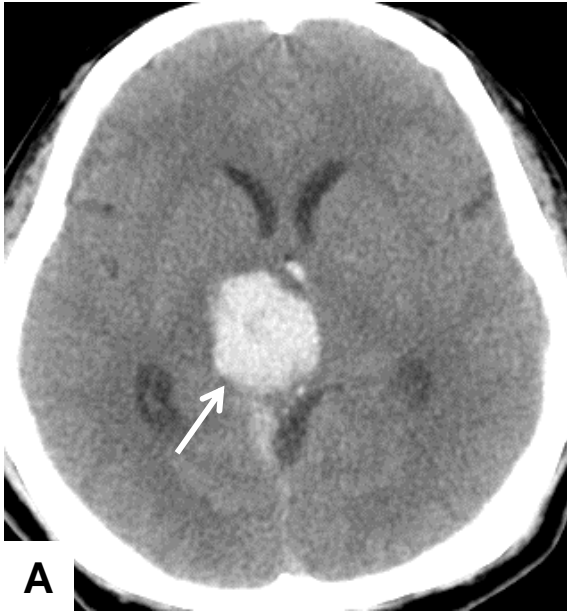
Tissue and pathology	Hu	Density
金屬		產生假影
骨頭 cortex	1000-1800	白
骨頭 bone marrow	400-800	白，bone window 下 灰暗
鈣化	100-500	白
血塊(急性)	60-90	白
軟組織	35-45	灰
軟組織水腫(soft tissue edema)	15-30	灰暗，有壓力
軟組織壞死(例如encephalomalacia)	10-20	灰暗
體液(例如CSF)	2-4	黑
水	0	黑
脂肪	-20~-120	黑
空氣	-1000	黑





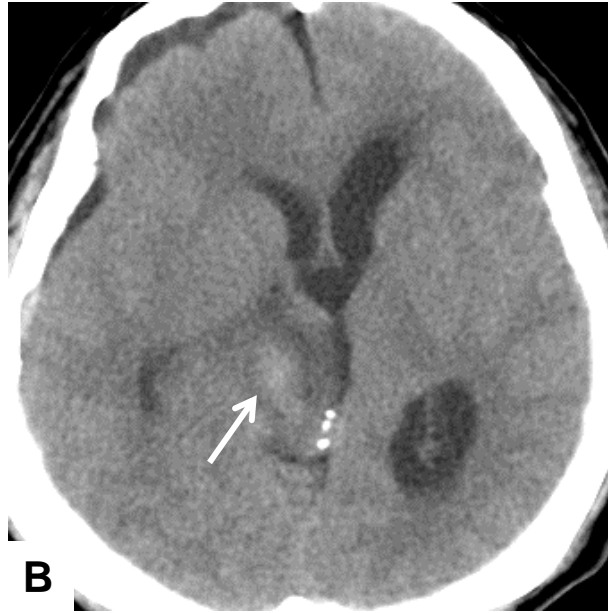
subcutaneous fat,
intermuscular fat
黑, -20 ~ -120Hu

paranasal sinus air, mastoid air
黑, -1000Hu



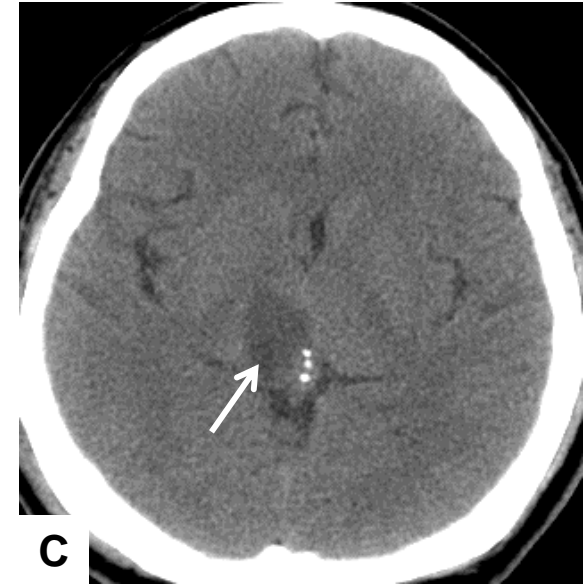
A

1st day 74Hu



B

26th day 46Hu

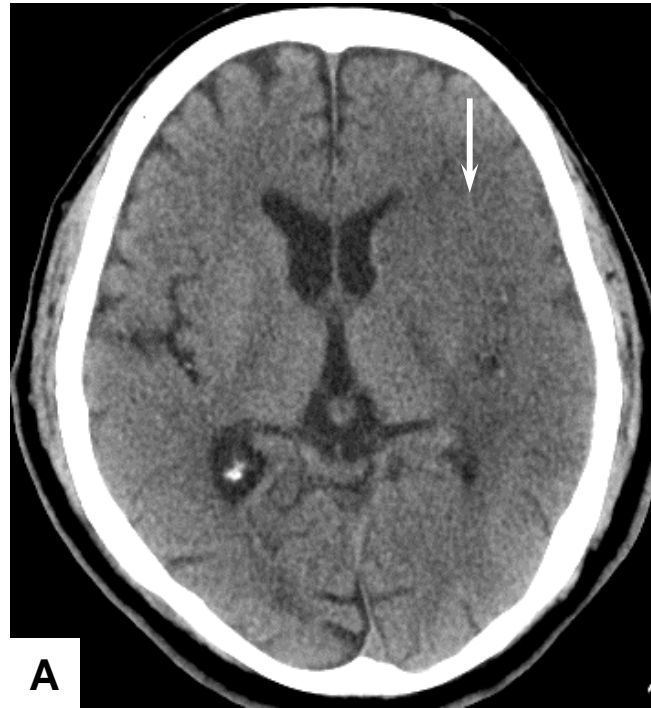


C

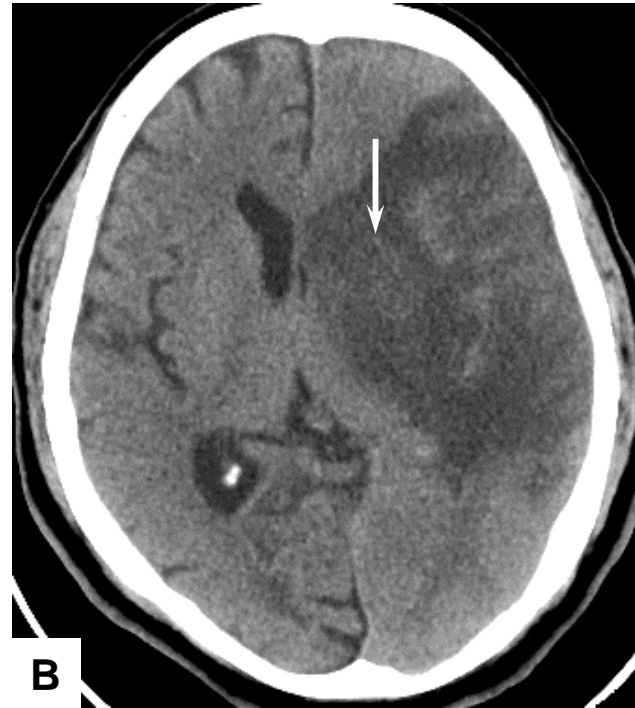
50th day 24Hu

M/47 CVA due to right thalamic hemorrhage

在CT，新鮮的血塊是白的，隨著時間逐漸變淡，變灰暗
當血塊變灰暗時，很容易被誤為是brain tissue edema.



24-28 Hu



10-16 Hu

M/73 MCA infarction

Soft tissue edema 10-28Hu

軟組織水腫(edema)-----

變暗之外，有腫塊效應(mass effect) (注意: sulci disappeared)。

(A)Infarction 第1天，早期brain tissue edema, density 稍降為灰暗，mass effect 不強。

(B)Infarction 第6天，brain tissue edema 達最高峰, density 降得更暗，mass effect 很強。

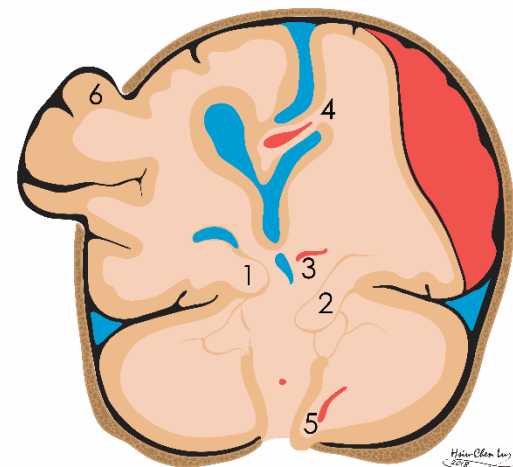


Calcification: 100-500 Hu

鈣化也是白色的，通常雙側對稱性存在。

腫塊效應 Mass Effect

- 在判讀CT及MRI時, 腫塊效應的觀念非常重要。腫瘤, 血塊, 腦水腫等等會對腦組織造成壓迫, 就是一種腫塊效應。通常具有活性的病灶都有腫塊效應。
- 腫塊效應的判讀以觀察蜘蛛網膜下腔構造被壓迫較觀察腦組織被壓迫來得明顯, 其徵象如下:
 - 1. 病灶周圍的腦室, 腦池, 腦裂, 腦溝等蜘蛛網膜下腔構造被壓扁或完全消失。
 - 2. 中線構造, 如大腦簾, 透明中隔(septum pellucidum)往對側移。
 - 3. 如foramen of Monro也被壓迫, 引起對側腦室CSF循環不良, 對側側腦室會稍為擴張。
 - 4. 當腫塊效應壓迫第三或第四腦室, 或大腦導水管時, 會造成腦室積水(hydrocephalus)。
 - 5. 當雙側都有腫塊效應時, 側腦室的額角因被壓迫, 呈現兔耳朵狀。
 - 6. 嚴重的腫塊效應會造成腦的疝脫(herniation), 即大腦簾下疝脫(subfalcial herniation), 海馬鉤疝脫(uncal herniation), 經小腦天幕疝脫(transtentorial herniation), 小腦舌部疝脫(tonsillar herniation)。

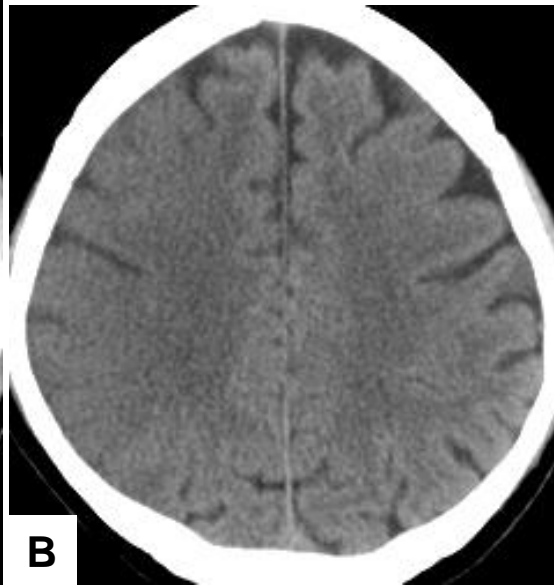


男/54 metastasis with tumor bleeding.

右額葉有一腫瘤，有tumor bleeding，周圍有白質水腫，共同造成腫塊效應 (mass effect)，右側腦室稍微被壓扁 (arrow)，右側額頂葉的皮質腦溝 (cortical sulci) 全部消失 (請對照左側腦室及左側額頂葉的cortical sulci)。



A



B



C

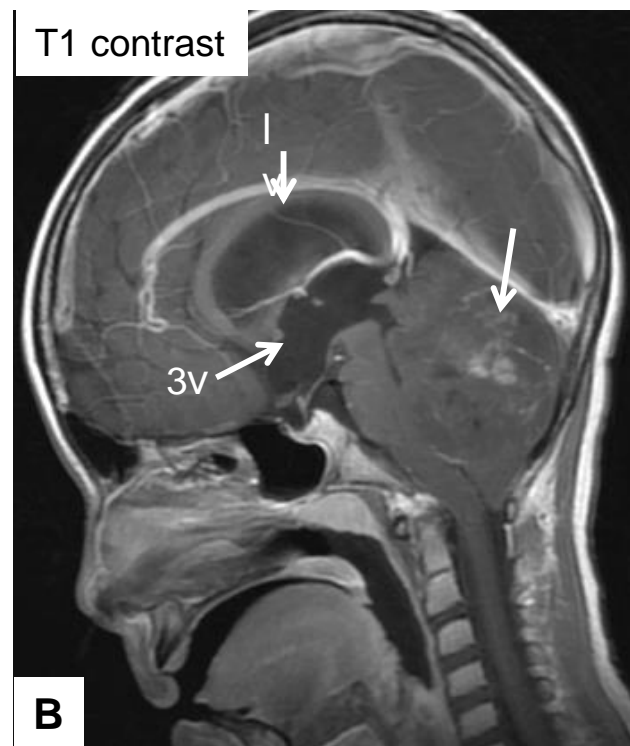
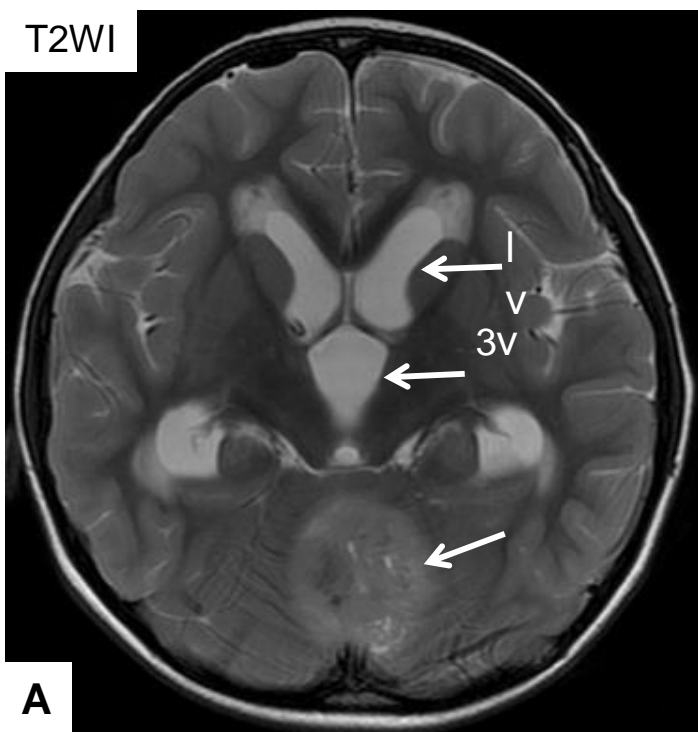


D

男/65，右MCA梗塞，造成輕微及嚴重mass effect.

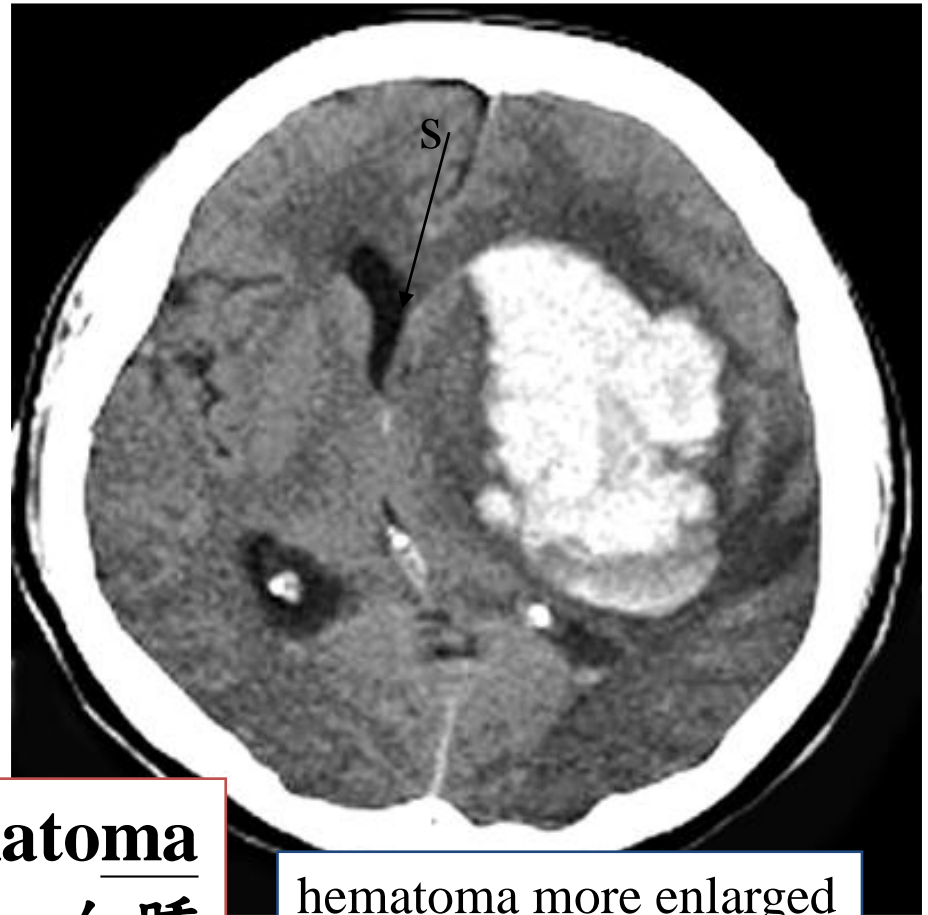
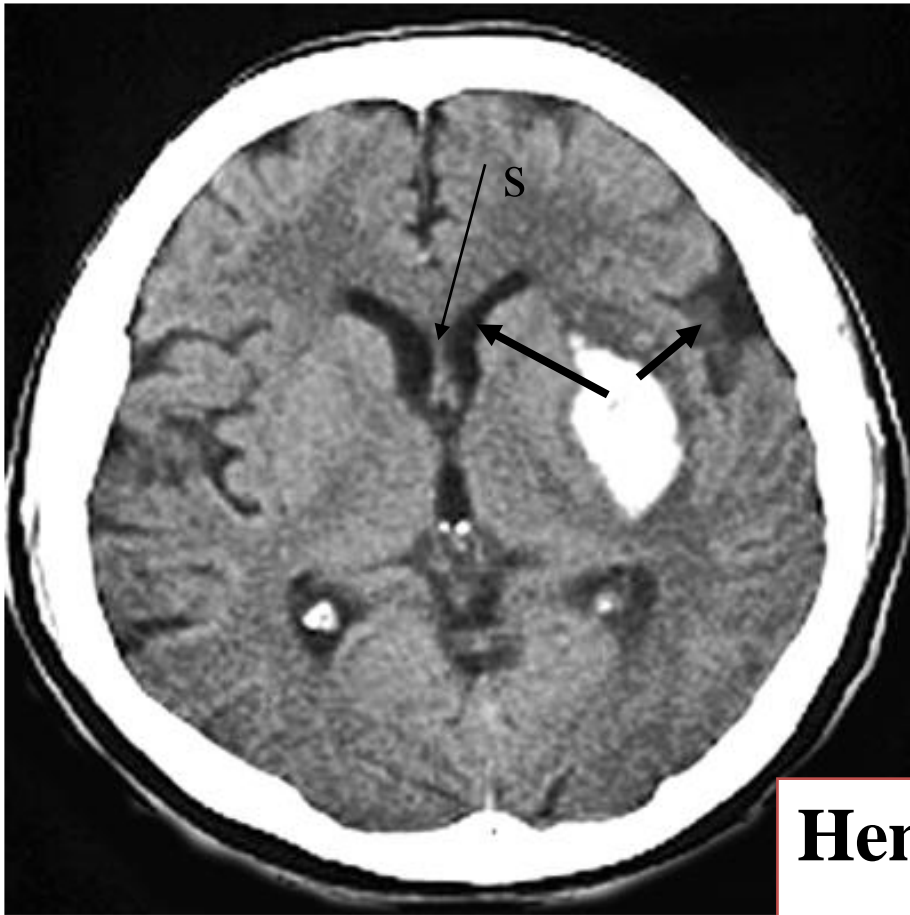
(A)(B)中風症狀出現後10小時所做之CT，可見右側額-顳-頂葉腦組織初期水腫(edema)，側腦室稍微被壓迫，右半球之腦溝被壓迫變小。

(C)(D)第三天CT，梗塞區水腫更明顯，並合併出血，因此mass effect更強，右側腦室完全壓扁，右半球之腦溝完全消失，中線之septum pellucidum偏左移動。事實上，連對側左半球之腦溝也變小。



女/7，medulloblastoma引起hydrocephalus (腦室積水)

小腦vermis上有一個腫瘤(arrow)，有mass effect，壓迫第四腦室及大腦導水管，引起阻塞性hydrocephalus，第三腦室(3v)及雙邊側腦室(lv)擴大。



Hematoma 血腫

hematoma more enlarged
mass effect is stronger

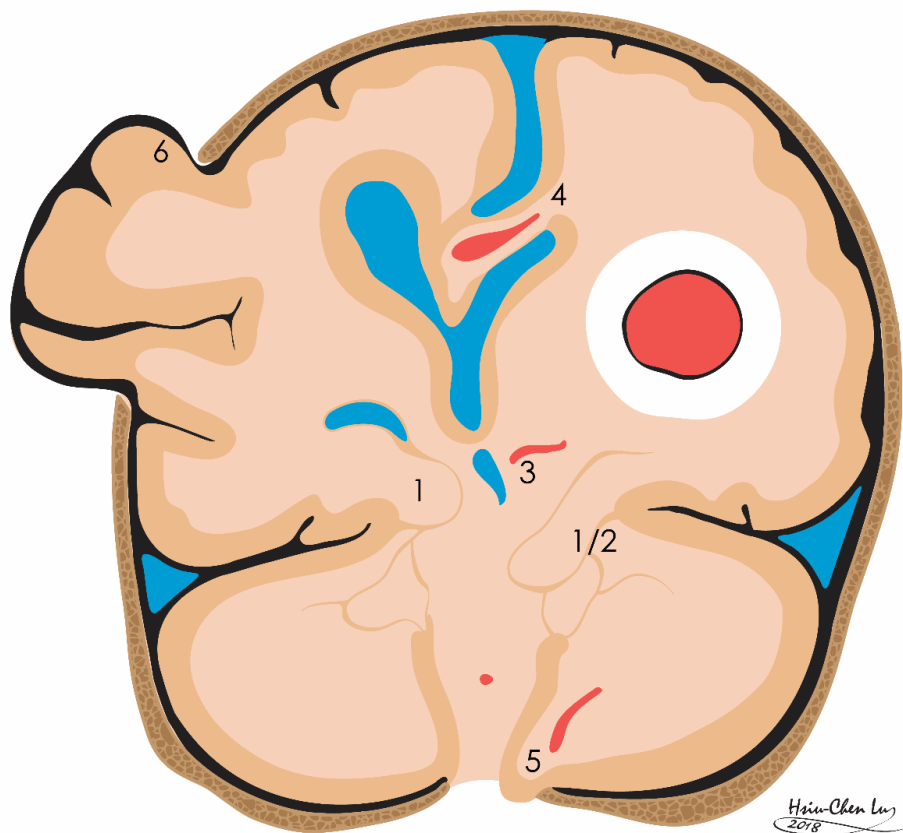
Mass effect:

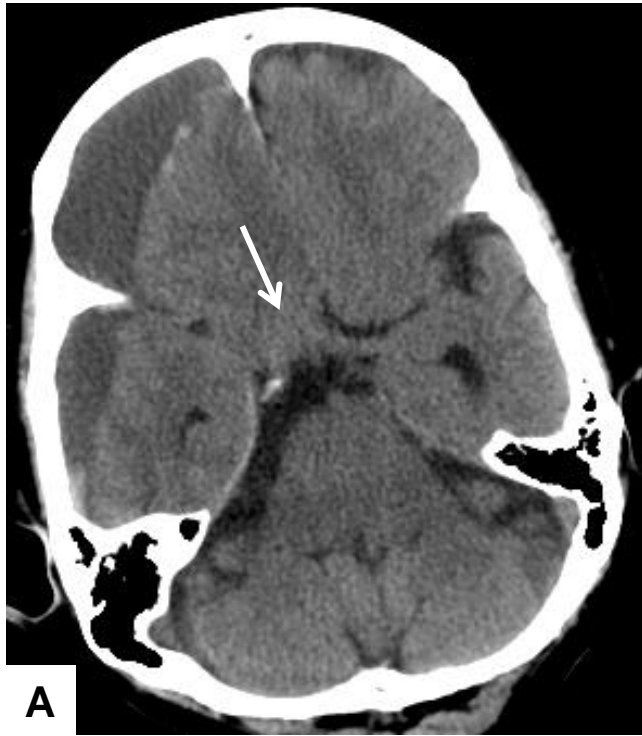
1. The ipsilateral ventricle, sulci, fissures are compressed and obliterated, disappeared.
2. Midline is shifted.
3. The contra-lateral ventricle is dilated.

腦組織的疝脫(brain tissue herniation)

嚴重的腫塊效應會造成腦的疝脫(herniation), 有下列6種:

1. Uncal herniation (海馬鉤疝脫)
2. Uncal/transtentorial herniation (經小腦天幕疝脫).
3. Central herniation.
4. Subfalcine or cingulate herniation (大腦簾下或扣帶回疝脫)
5. Tonsillar herniation (小腦舌部疝脫)。
6. External herniation (往顱外疝脫).

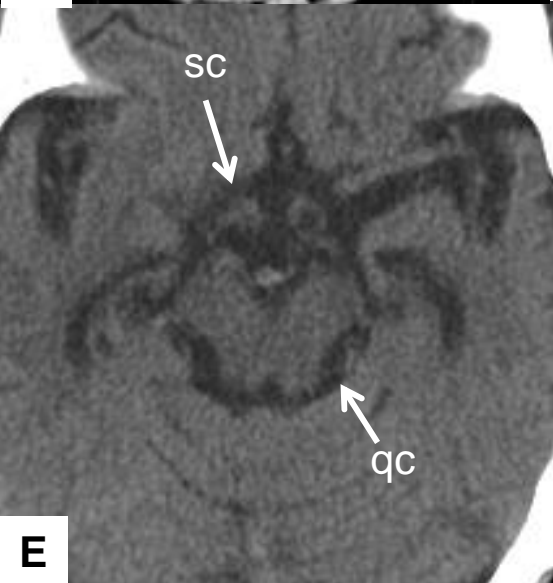
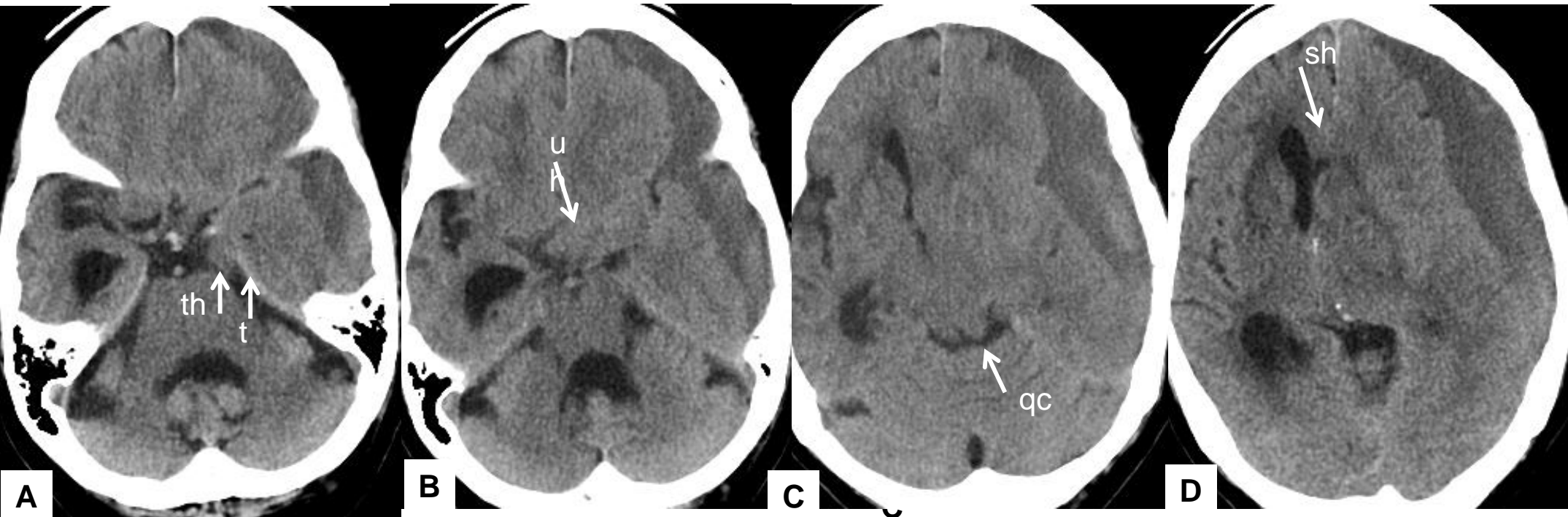




女/85，硬腦膜下腔積水 (subdural effusion) 形成巨大壓力

(A) CT: 右側額顳區有一subdural effusion，形成很大mass effect，額葉腦組織滑入suprasellar cistern，使五角型的腦池變形，這是一種central herniation(arrow)。

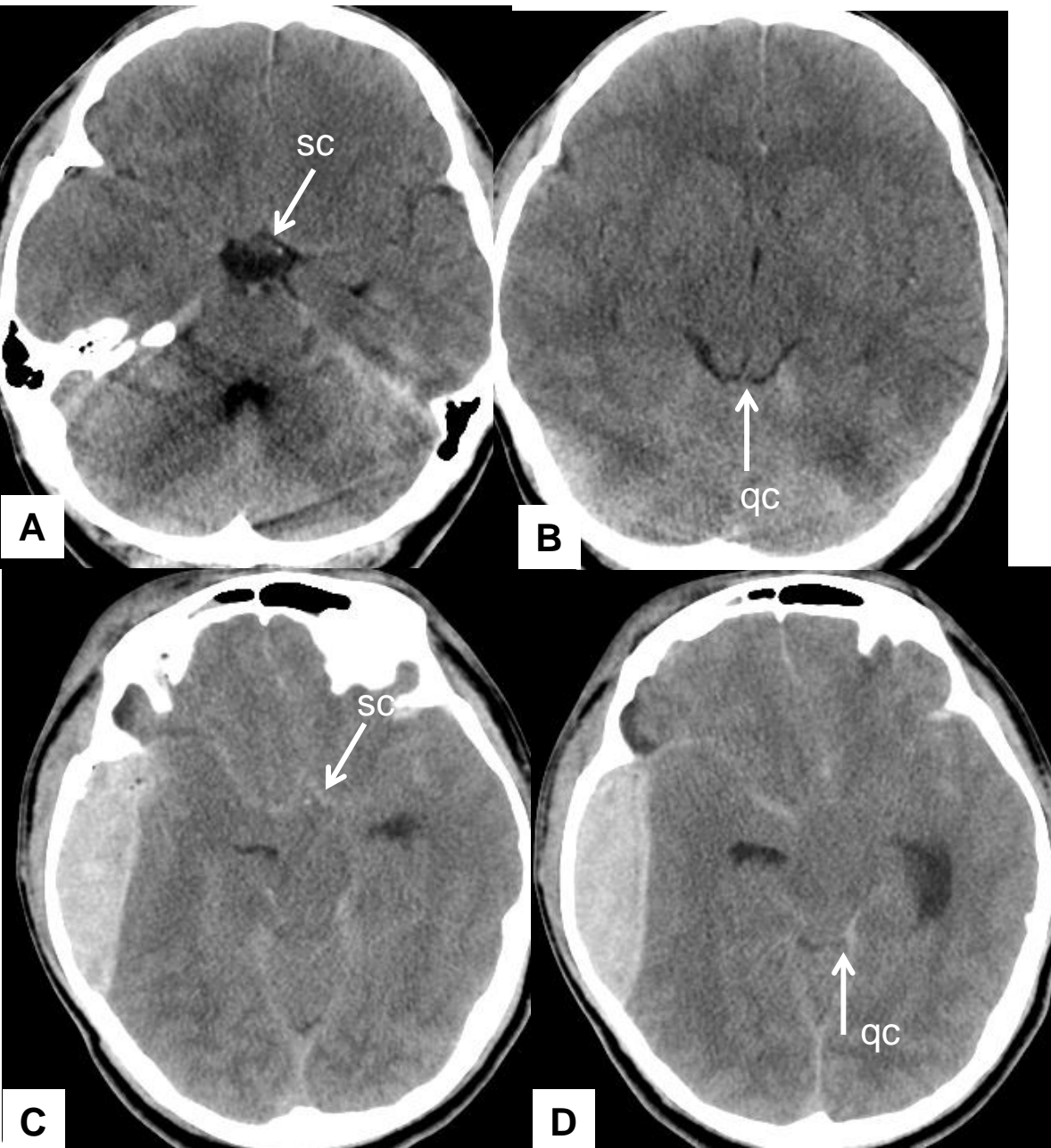
(B) CT: 引流後SDH變小，壓力減小，suprasellar cistern又恢復五角形。



女/81，慢性硬腦膜下腔血腫 (chronic SDH) 造成巨大壓力 (A,B,C)左側有一hypodense chronic subdural hematoma，造成巨大 mass effect，可以看到temporal lobe 之uncus 滑入五角形的 suprasellar cistern以及稍微往tentorium(t)下滑，代表有 uncal/transtentorial herniations (uh/th)。

(D) Subfalcine herniation (sh)。

(E)經手術取出SDH後，壓力消失，suprasellar cistern (sc)及 quadrigeminal cistern (qc)恢復正常形狀。



男/18，硬腦膜上腔血腫(EDH)造成強大mass effect。

(A)(B)頭部外傷急做CT，沒看到明顯出血或腦水腫。五角形的suprasellar cistern(sc)及微笑形quadrigeminal cistern(qc)都正常。

(C)(D)6小時後病患突然意識昏迷，再做CT，顯示右側有一巨大EDH，造成強大壓力，五角形的suprasellar cistern及微笑形quadrigeminal cistern都消失，代表有uncal/transtentorial herniations。

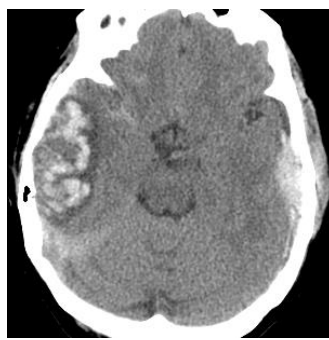
1. Intracerebral hemorrhage (ICH) 腦組織內出血
Intracerebral hematoma (ICH) 腦組織內血腫



Deep hemorrhage due to hypertension



Lobar hemorrhage due to amyloid angiopathy

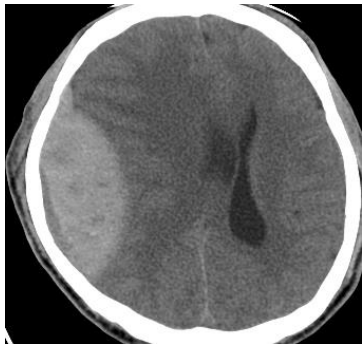


Contusion hemorrhage due to trauma

顱內出血的5種型態

5 H: 5 patterns of intracranial hemorrhages.

2. Epidural hematoma (EDH) 硬腦膜上腔血腫

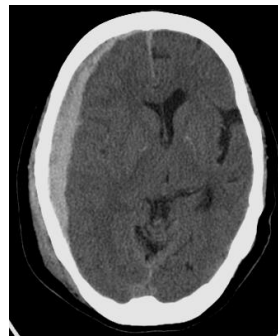


EDH due to trauma



EDH in posterior fossa due to trauma

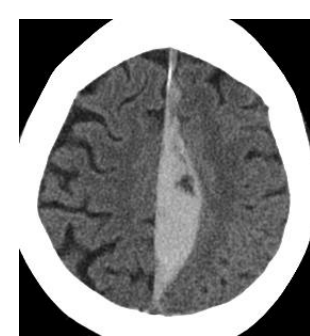
3. Subdural hematoma (SDH) 硬腦膜下腔血腫



SDH due to trauma

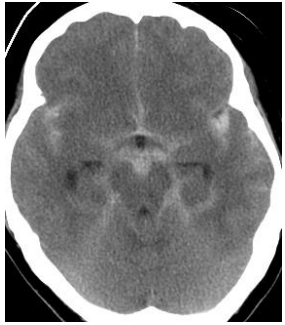


SDH caused by AVM rupture

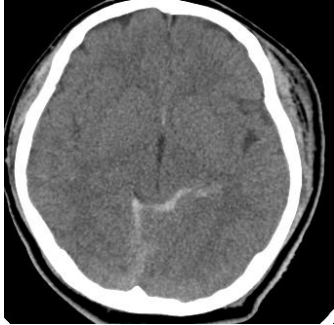


SDH in interhemispheric fissure due to trauma

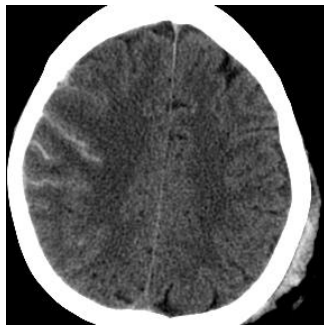
4. Subarachnoid hemorrhage (SAH) 蜘蛛網膜下腔出血



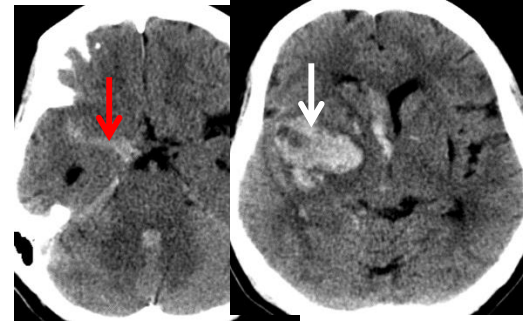
spontaneous SAH
due to aneurysm rupture



Traumatic SAH



Traumatic SAH



secondary SAH (red arrow)
ICH (white arrow) ruptures into cistern (red arrow)

5. Intraventricular hemorrhage (IVH) 腦室內腔出血



IVH caused by rupture
of aneurysm



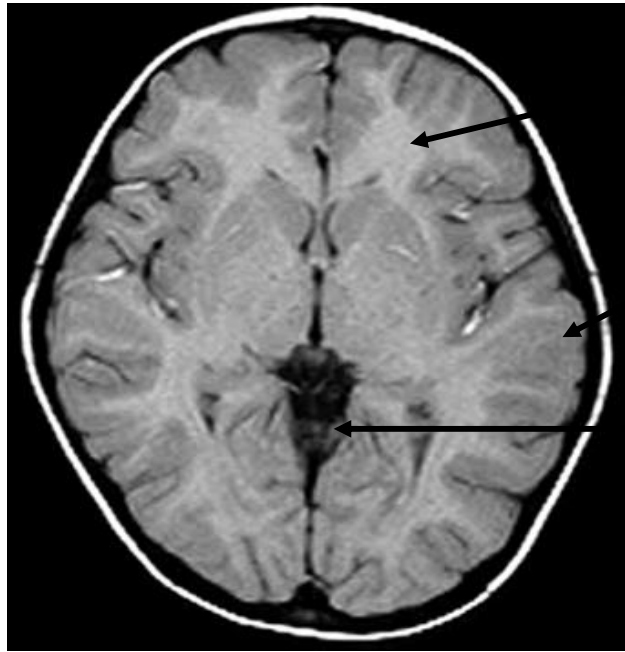
Secondary IVH,
ICH ruptured into ventricles

顱內出血的5種型態

5 H: 5 patterns of intracranial hemorrhages.

MRI常用的波序：

- T1 weighted image (T1WI), TR/TE:500/20msec
(短TR)
- Long TR images
 - T2 weighted image (T2WI), TR/TE 2000-3000/80-120 msec
 - **FLAIR** (fluid attenuated inversion recovery), TR/TE 9000/120 msec, inversion 2200msec
- Gradient echo T2*WI
- Inversion recovery images, fat-suppression images
- Diffusion weighted images (DWI)
- MR angiography (MRA)

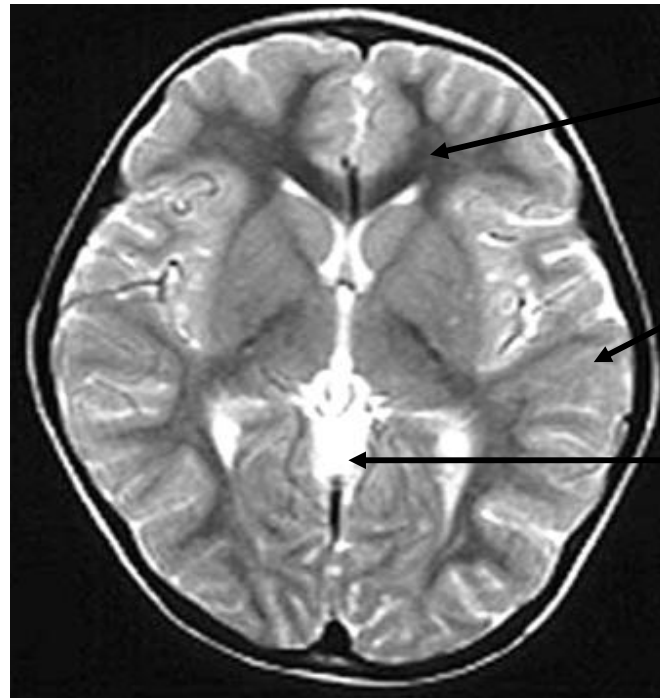


白質 (灰)

灰質 (灰暗)

CSF (水) (暗)

T1WI

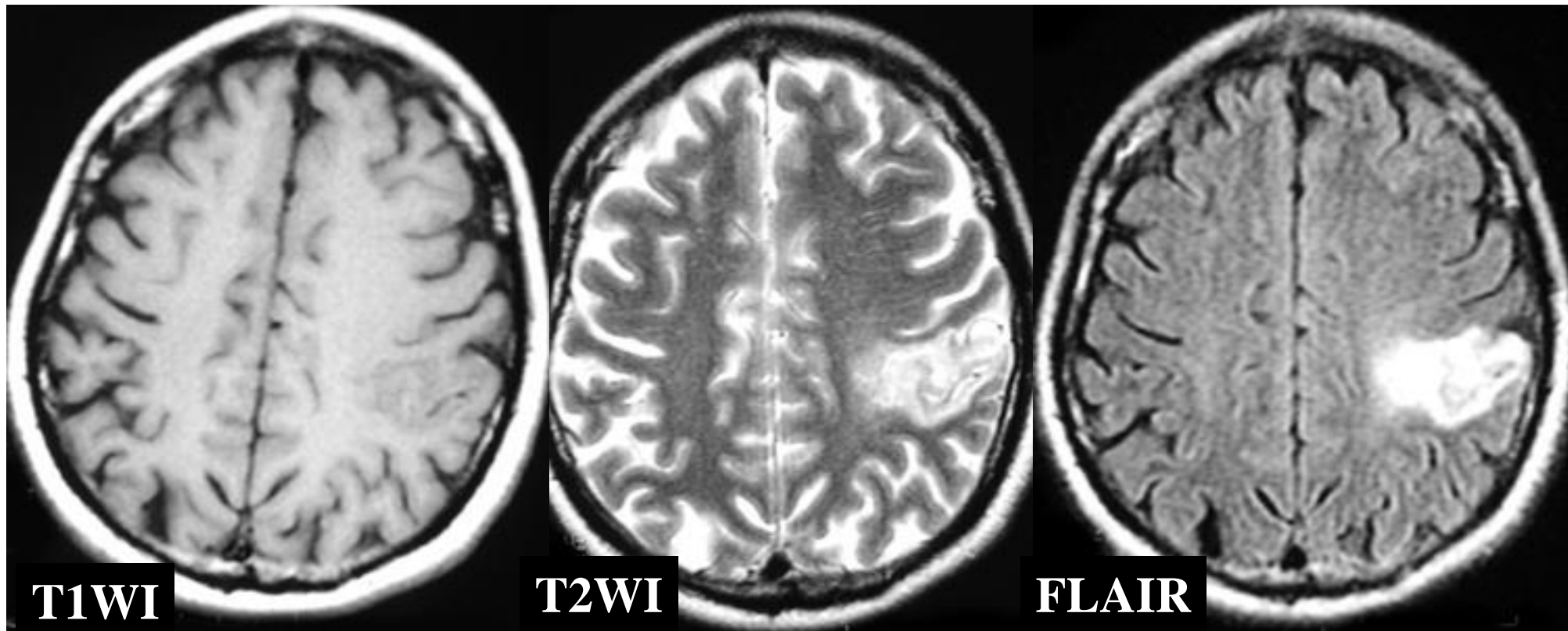


白質 (灰暗)

灰質 (灰)

CSF (水) (白)

T2WI



T1WI

T2WI

FLAIR

T1WI

T2WI

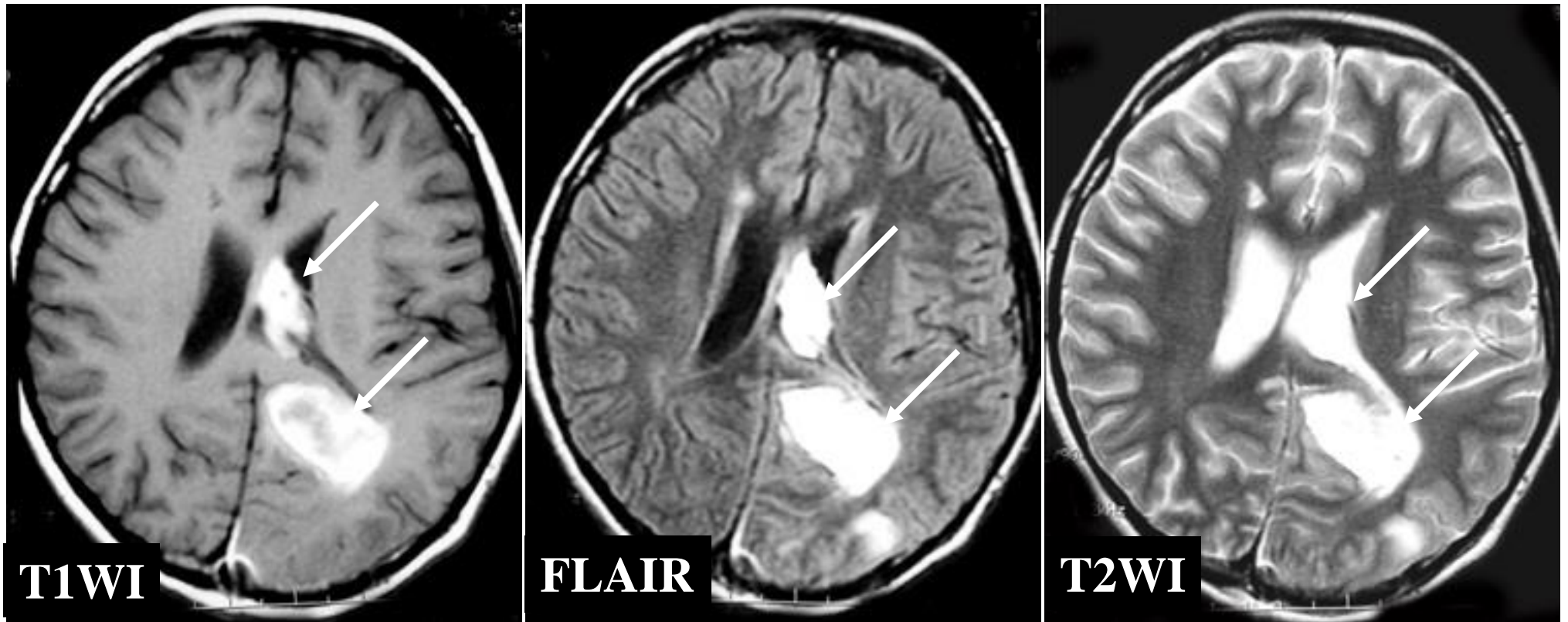
FLAIR (fluid attenuated inversion recovery)

CSF
 腦灰質
 腦白質
 脂肪
腦水腫

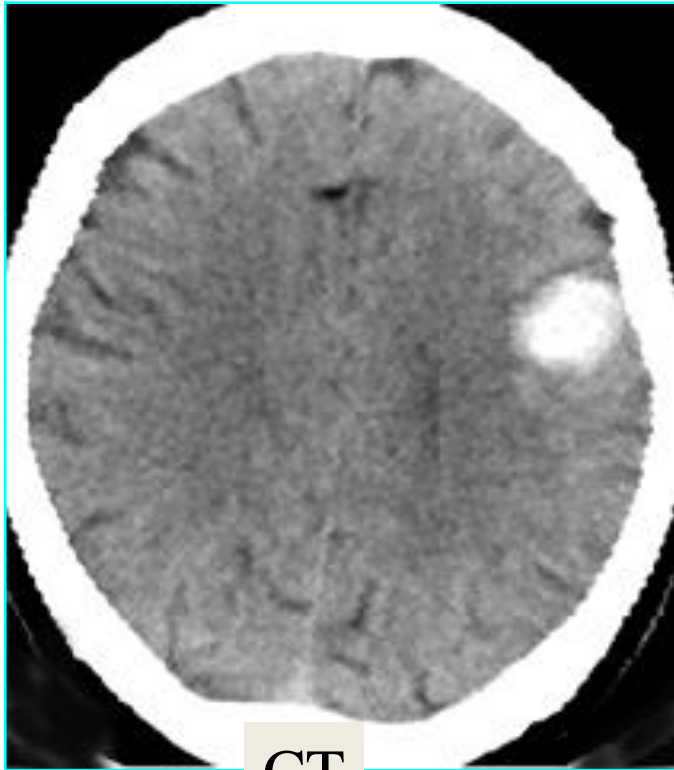
暗
 灰暗
 灰
 白
 灰暗

白
 灰
 灰暗
 灰暗
 白

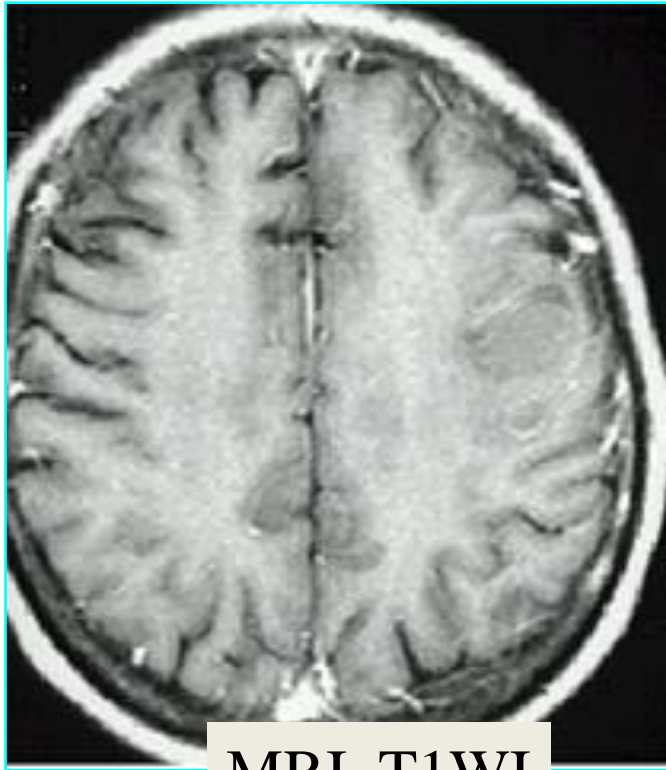
暗
 灰
 灰暗
 灰暗
 白



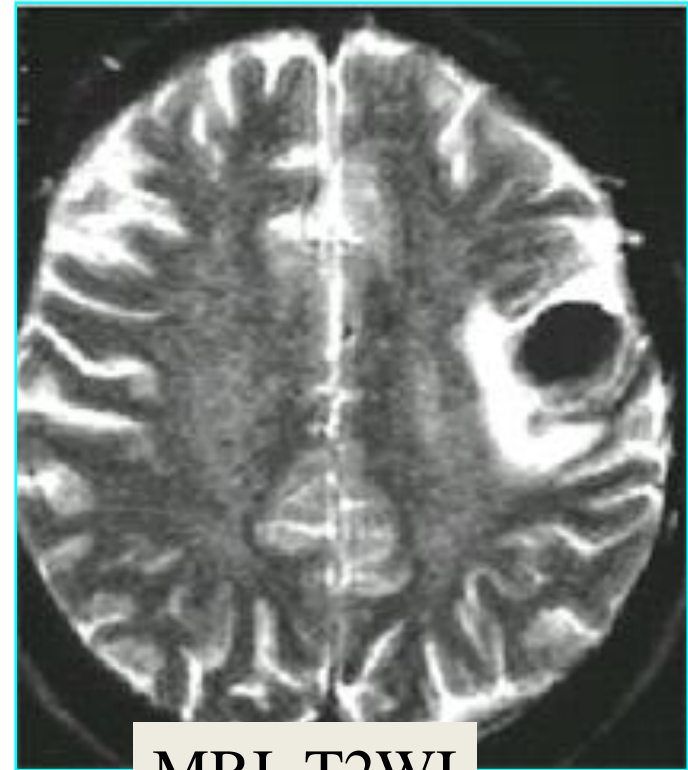
亞急性血塊在 T1WI, FLAIR, T2WI 都是白的
含 methemoglobin



CT

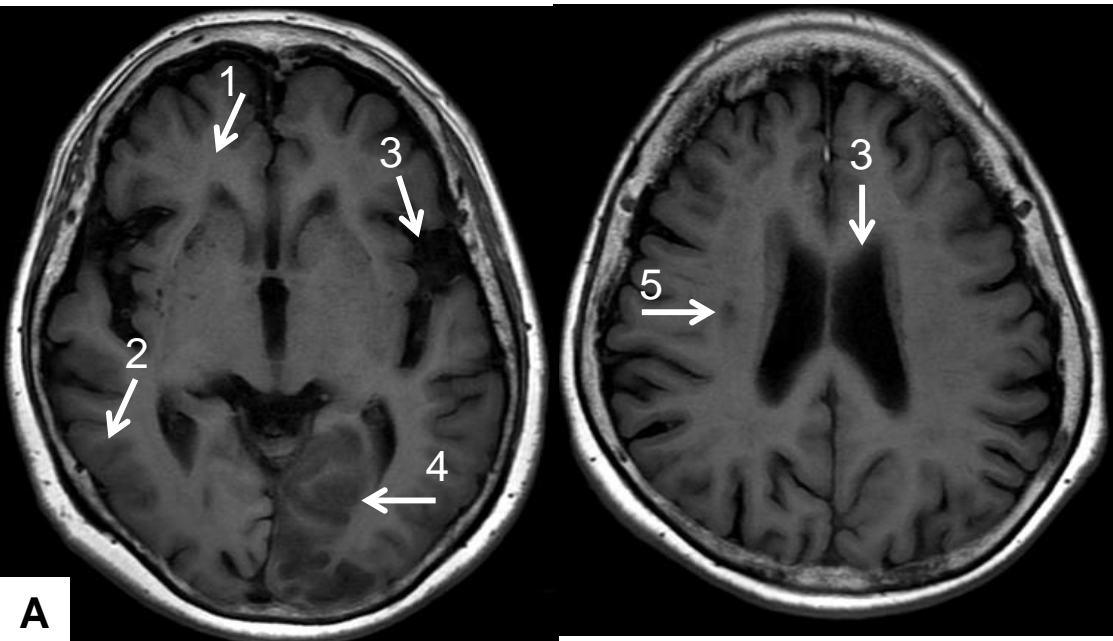


MRI, T1WI



MRI, T2WI

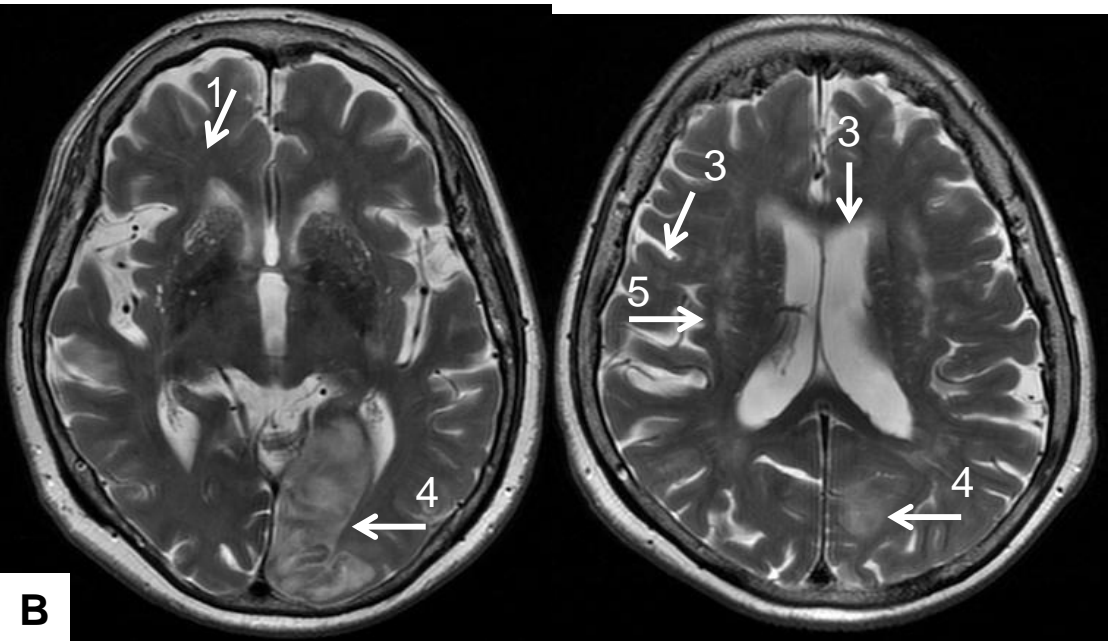
急性血塊在 T1WI 灰，
FLAIR, T2WI 都是暗的
含 deoxyhemoglobin



F85 acute infarction
枕葉急性梗塞腦水腫

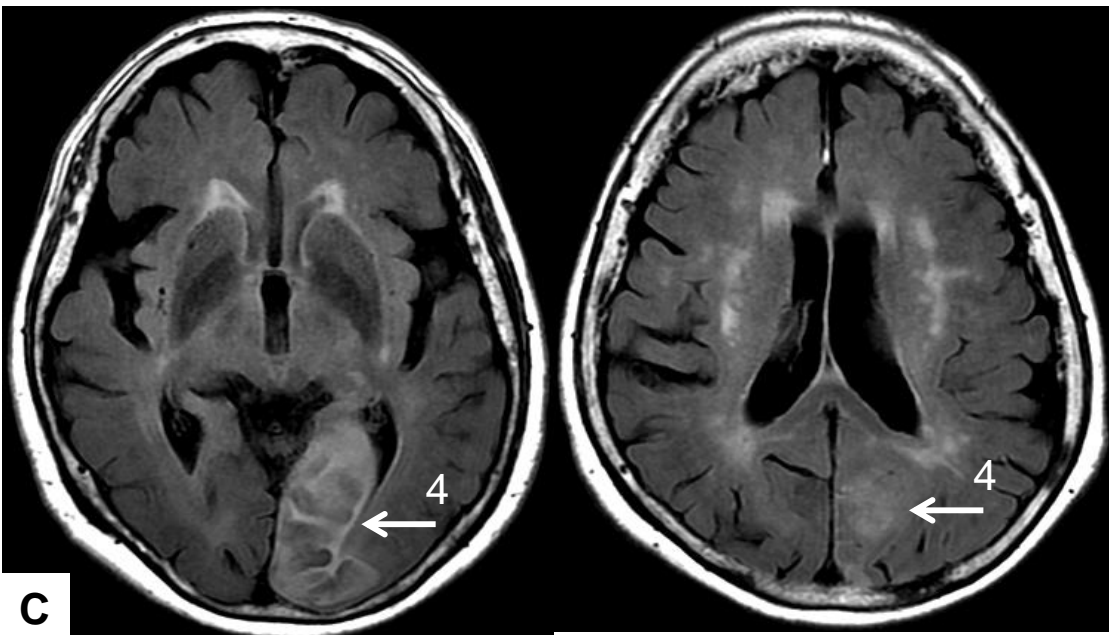
T1WI

- 1. white matter: 灰白
- 2. gray matter: 灰暗
- 3. CSF: 暗(黑)
- 4. edema: 灰暗
- 5. chronic infarct: 灰暗



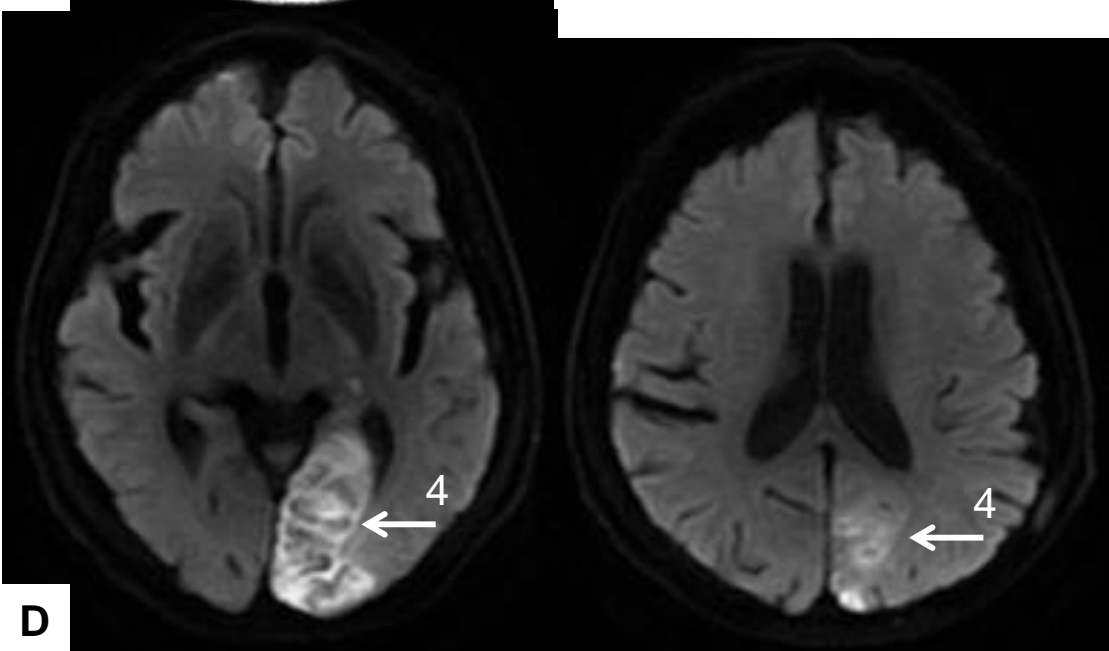
T2WI

- 1. white matter: 灰暗
- 2. gray matter: 灰暗
- 3. CSF: 白
- 4. edema: 灰白
- 5. chronic infarct: 灰白
- 6. leukoaraiosis (demyelination): 灰白



FLAIR

1. white matter: 灰暗
2. gray matter: 灰暗
3. CSF: 暗
4. edema: 灰白
5. chronic infarct: 灰白
6. leukoaraiosis (demyelination): 灰白



DWI

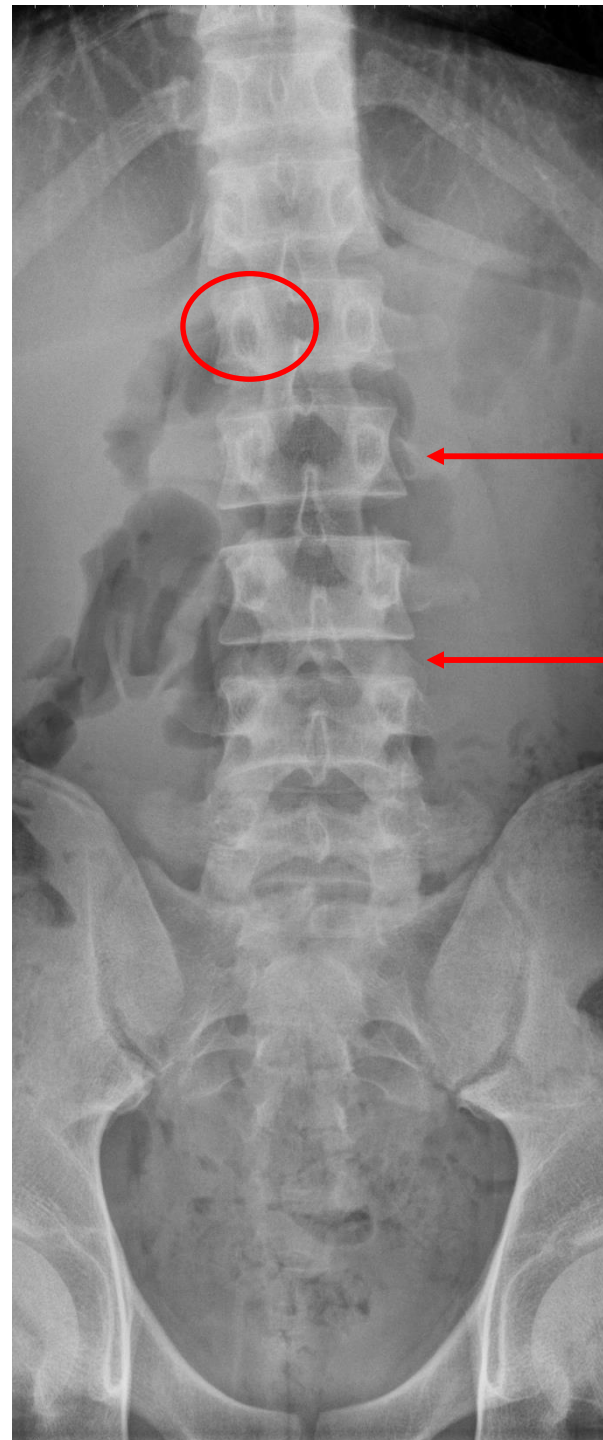
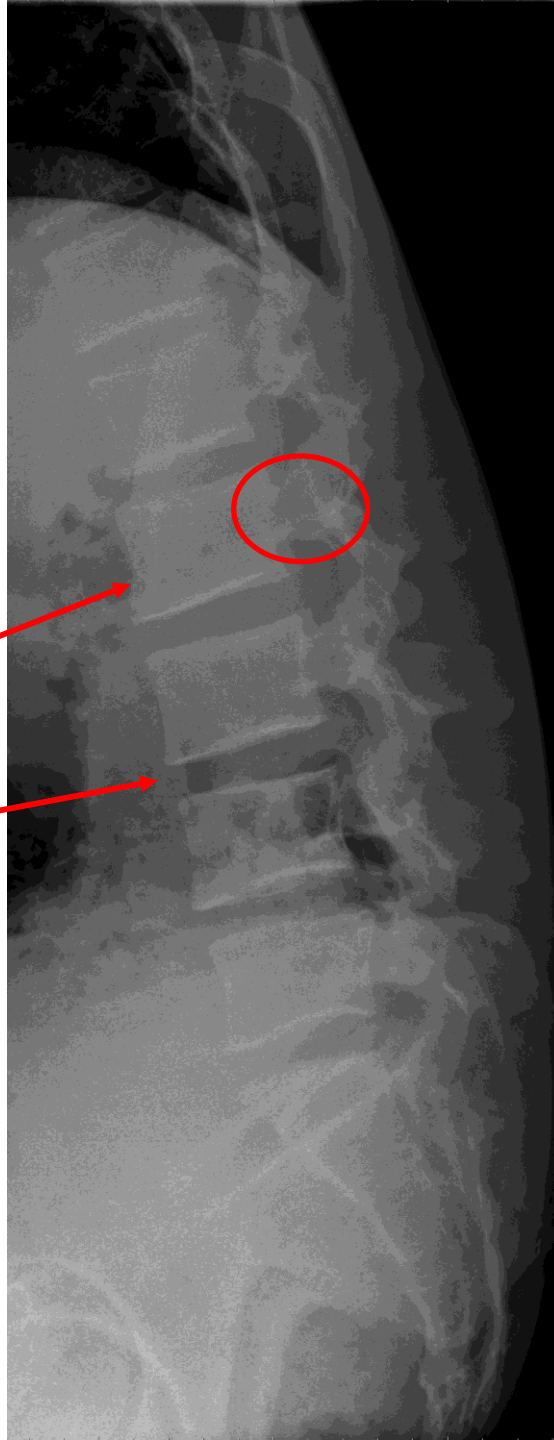
infarction edema : 白

只infarction edema 有 water-diffusion restriction , 很白 , 其餘 chronic infarct, leukoaraiosis (demyelination) 都no signal change.

M/20
normal L-spine

脊椎體
Vertebral
body

椎間盤
Intervertebral
disc

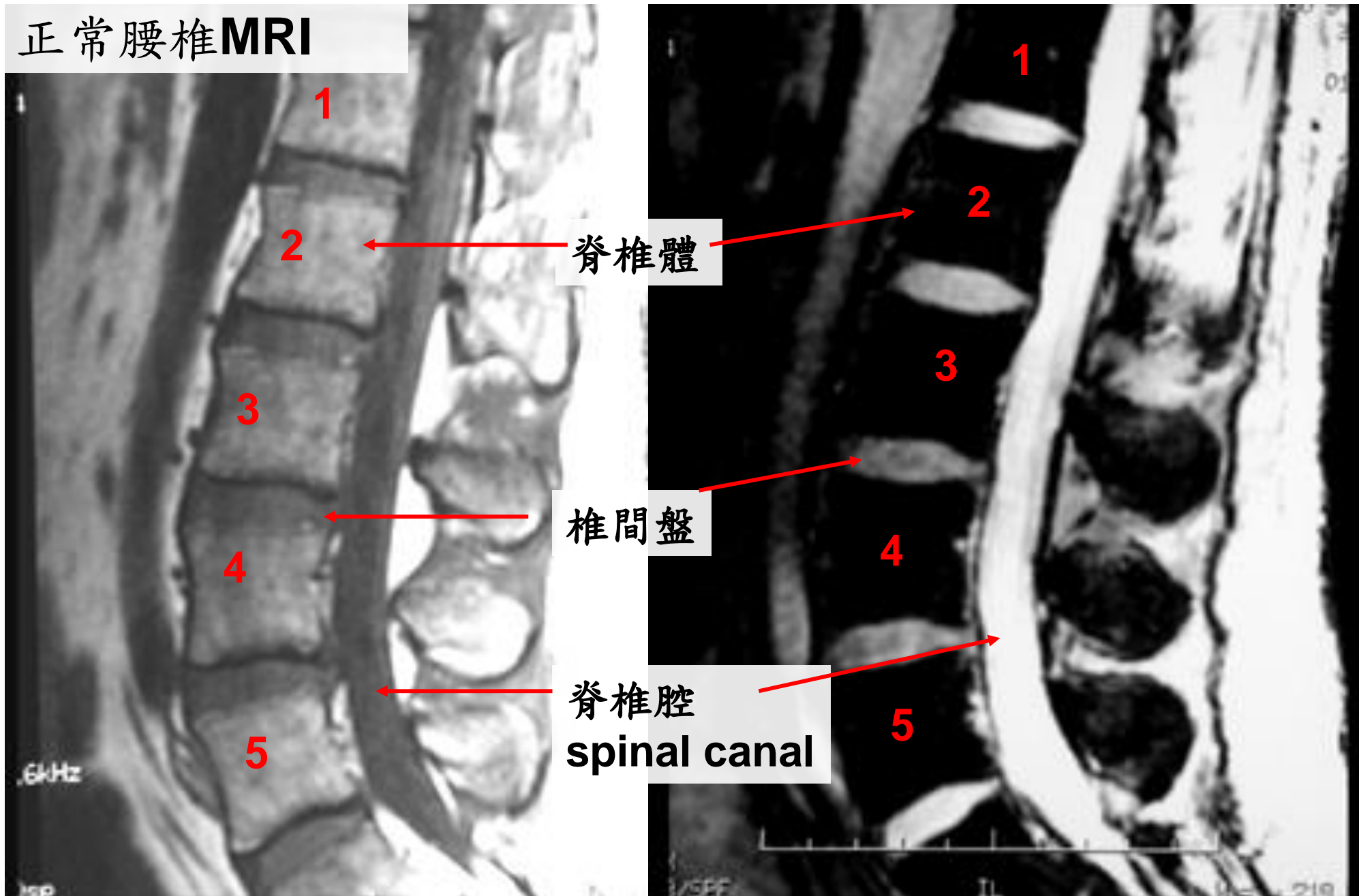


pedicle

脊椎體

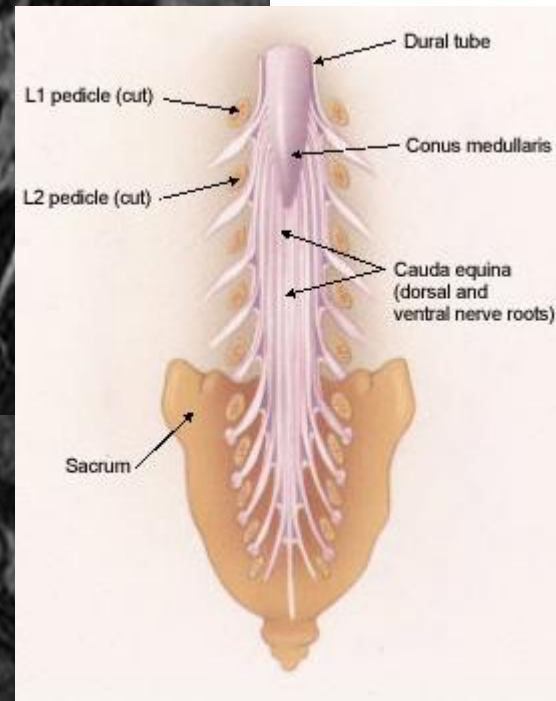
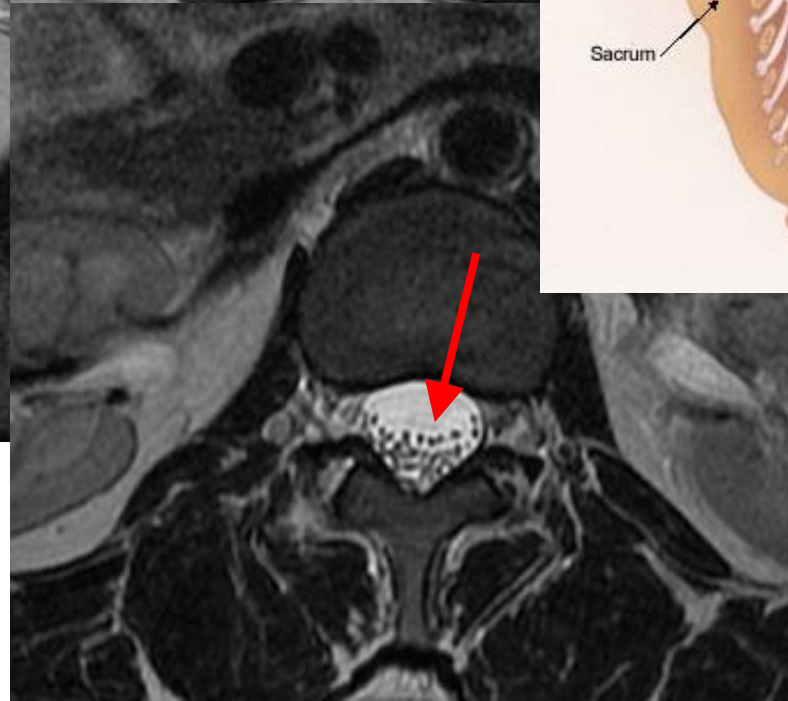
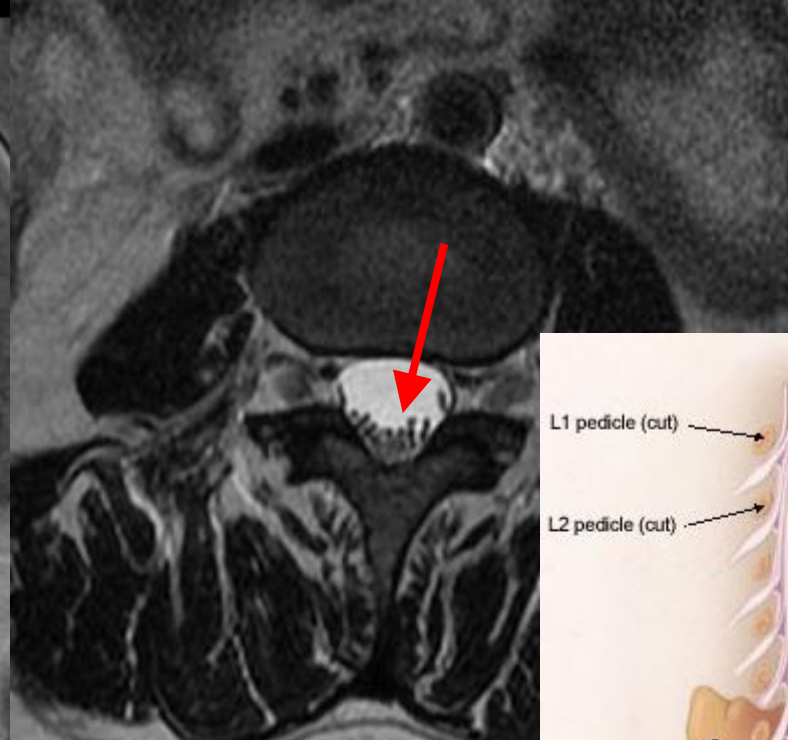
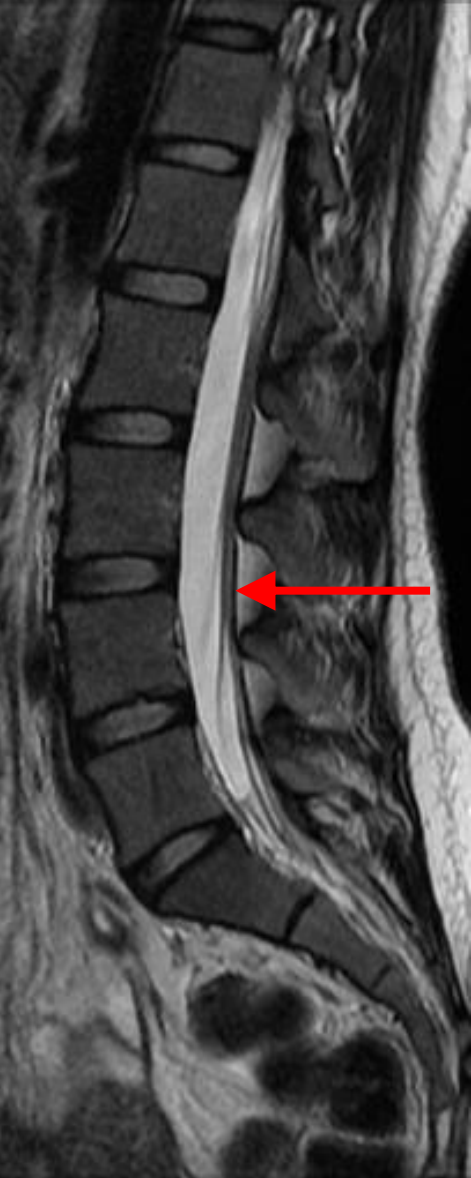
椎間盤

正常腰椎MRI

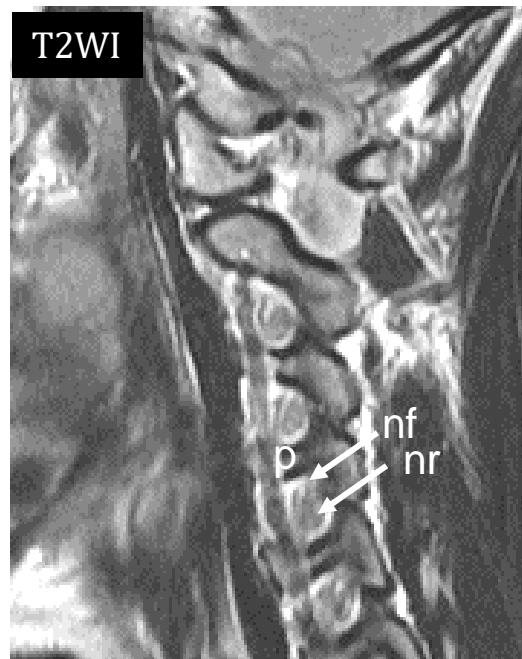
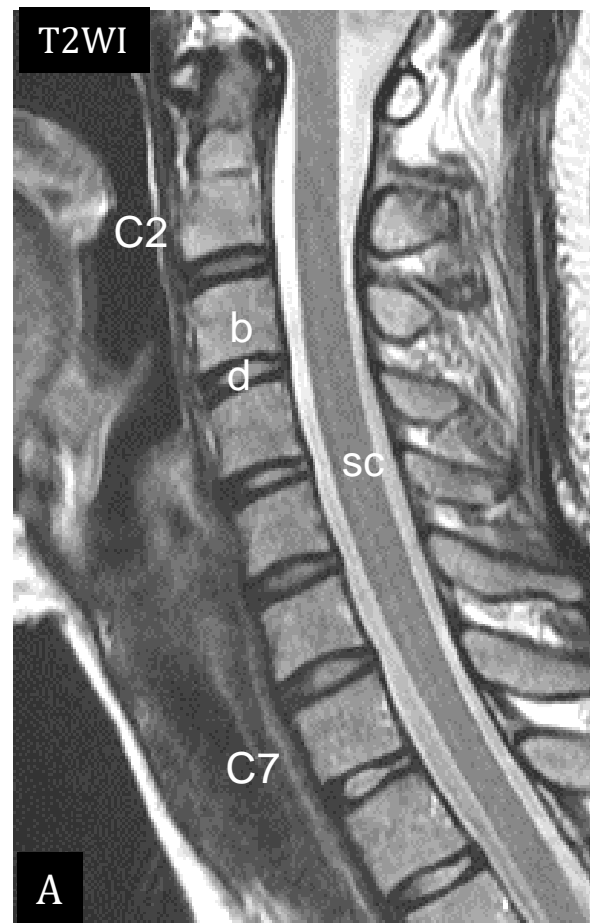


T1WI

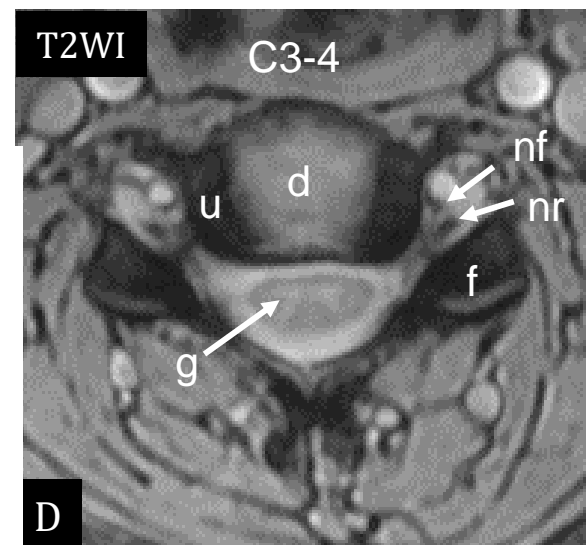
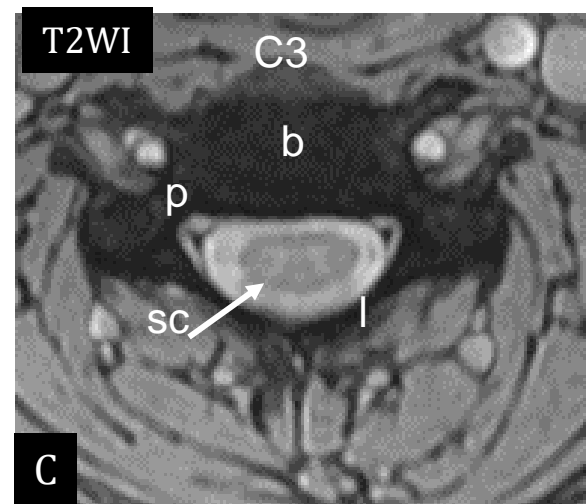
T2WI

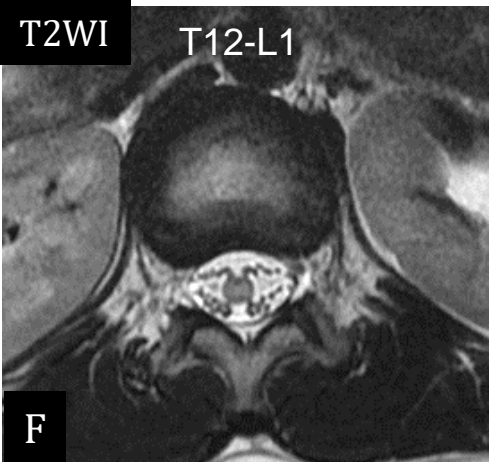
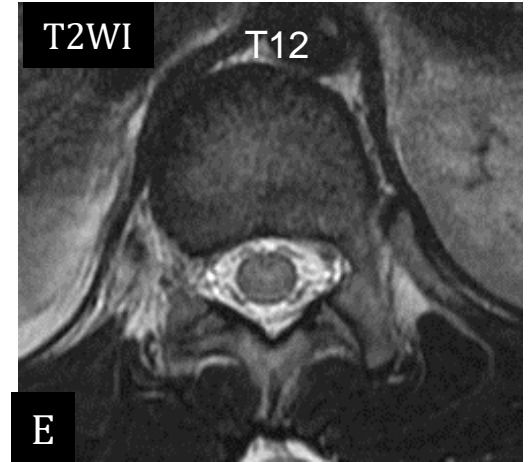
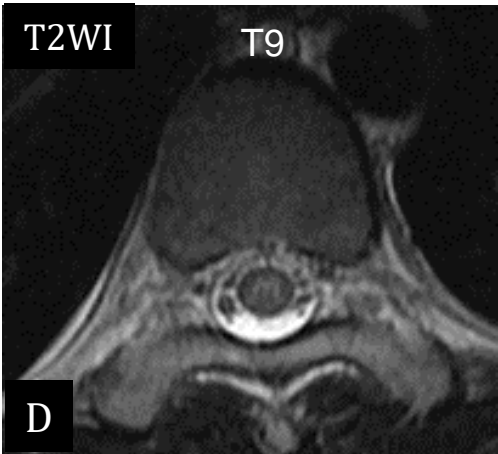
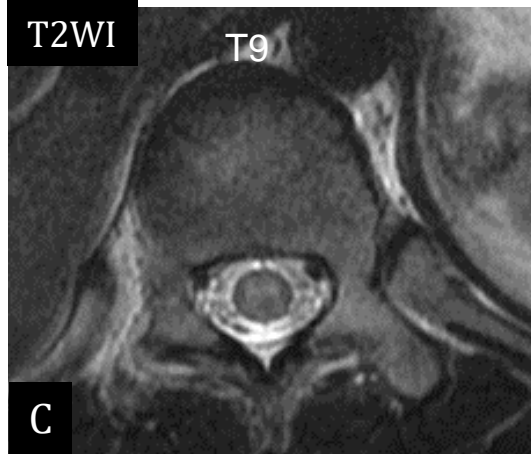
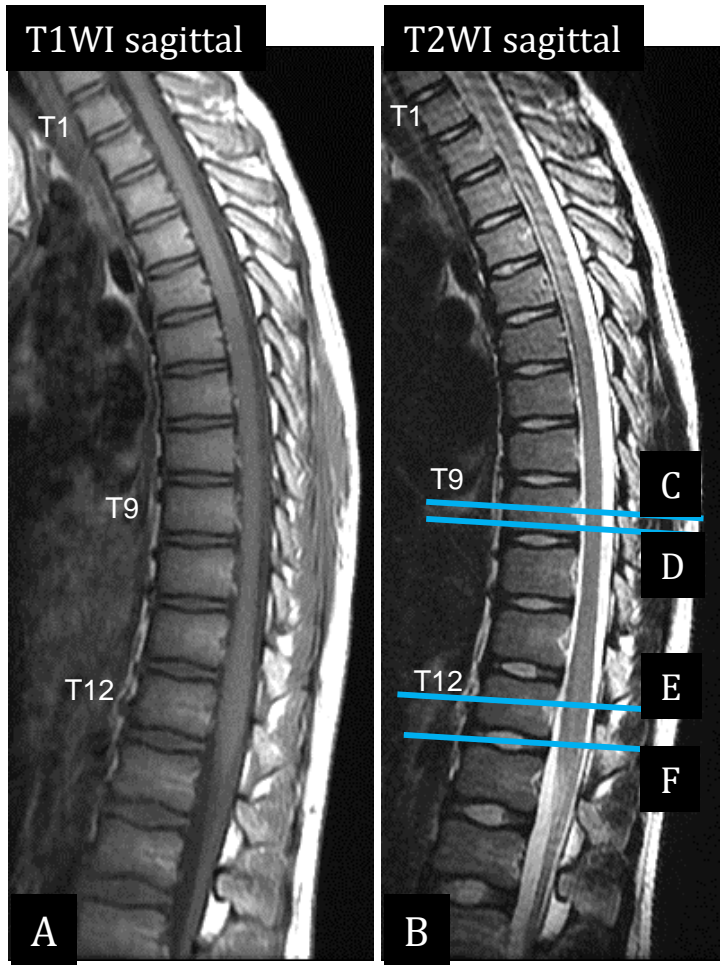


Normal caudal equine nerves
馬尾束 神經叢



B
 正常頸椎之 MRI
 b: 脊椎體 C3 vertebral body
 p: 脊椎根 pedicle
 u: 鈎狀突 uncinat process
 d: 椎間盤 C3-4 intervertebral disc
 nf: 神經孔 neuroforamen
 nr: 神經根 nerve root
 f: 小面關節 facet joint
 l: 脊椎板 lamina
 sc: 脊髓 spinal cord.
 g: 脊髓灰質 gray matter of spinal cord





正常胸椎之 MRI

- (A,B) Sagittal, discs 在T2WI很亮，spinal cord 很清楚。
- (C,D) 胸椎的脊髓在T1-T11，都是圓形，中間的灰質清晰可見。
- (E) 到了T12，spinal cord 稱為 conus medullaris, 稍微膨大，像螃蟹。
- (F) 至L1以下就縮小形成filum terminale，像蜘蛛。

T12

T12-L1

灰色的世界
無限的天空

