Approach to the CT Head

Presented by:

Victoria Myers MD, FRCPC

Module authors:

Nazanin Meshkat MD, FRCPC, MHSc

GHEM Global Health Emergency Medicine

This session will be recorded

We are recording this Zoom session so that it can be watched again at your convenience, and so that we can share it with your colleagues who were not able to join us today.

If you would prefer that this recording **not** be shared with your EM colleagues, please email hgirdler@ghem.ca within 24 hours of the session.

We will share the presentation slides and other materials (journal articles, etc.) by email; you will have access to all materials regardless of whether the recording is shared.

Global Health Emergency Medicine

Please also note:

The information in this presentation and the video recording is up to date as of the date it was recorded: May 16, 2023.

It has not been updated to include any subsequent advances in practice, and the information presented in this video does not replace hospital, health centre, or governmental guidelines.

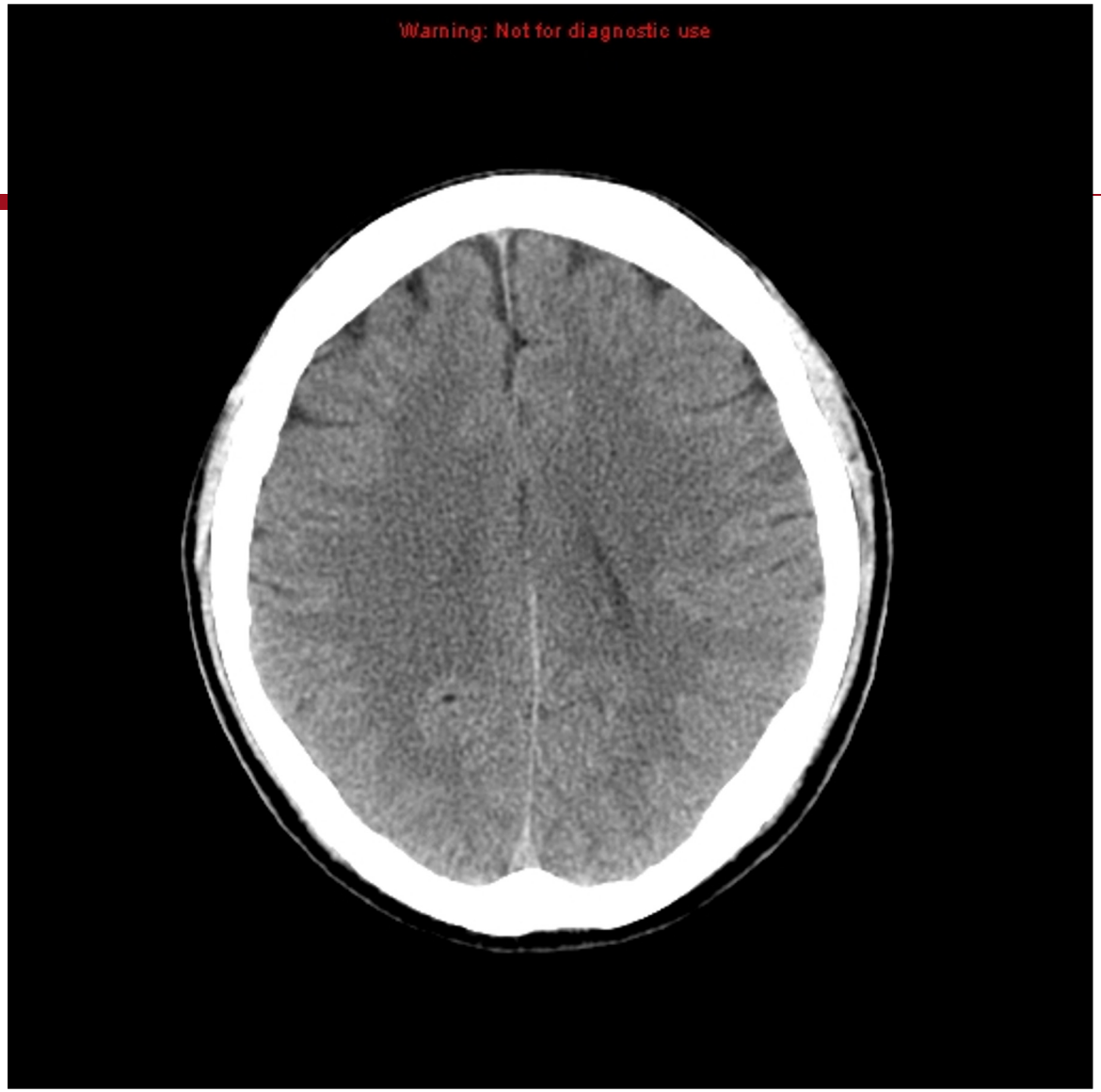
Global Health Emergency Medicine

Learning Objectives

- Develop an approach to CT brain interpretation:
  - Understand different CT slices and windows
  - Identify normal anatomy
  - Understand the differences between contrast vs non-contrast CT
- Case based CT head interpretation of pathology

THE BASICS

Anterior



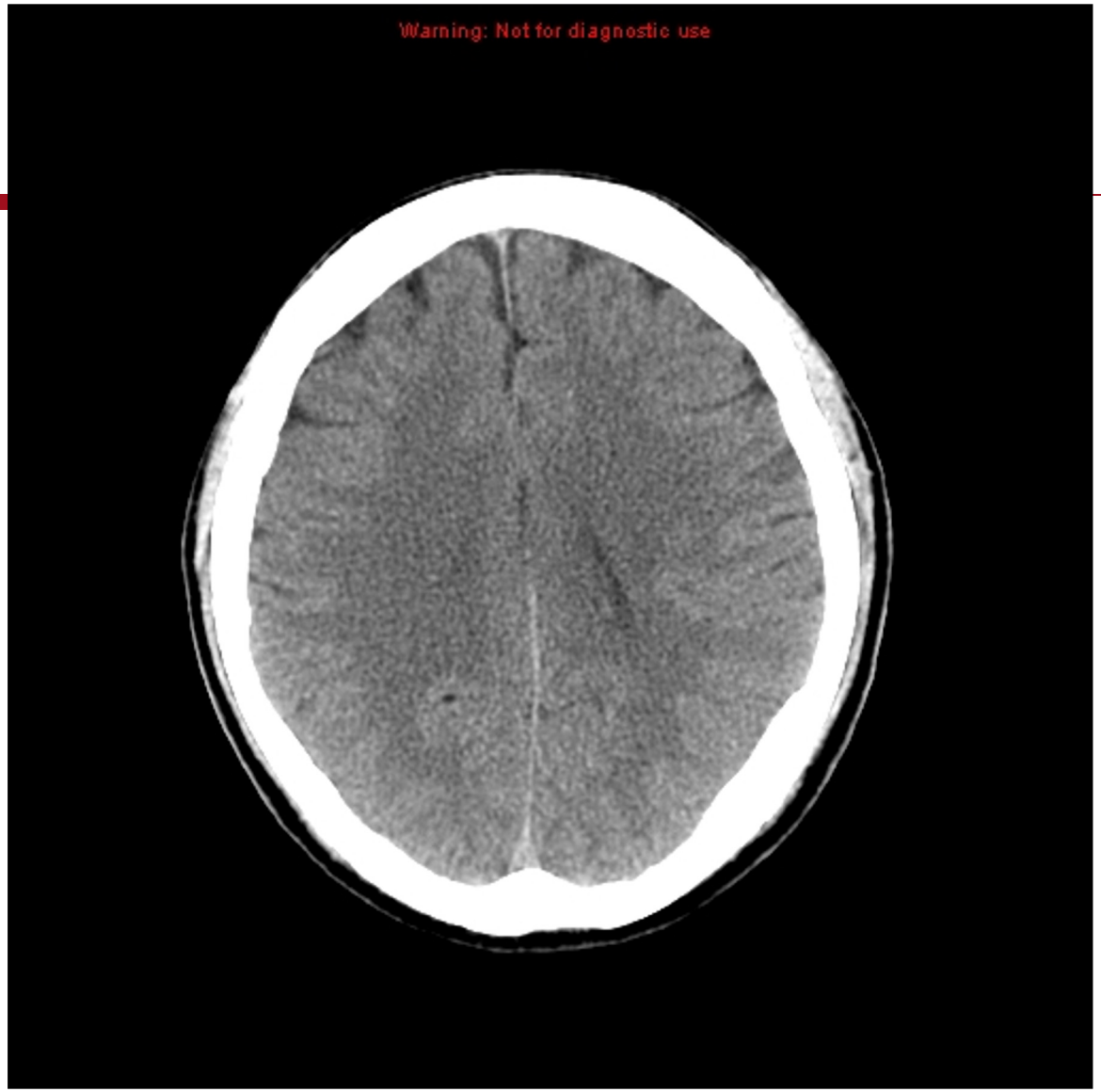
Right

Left

Posterior

Global Health Emergency Medicine

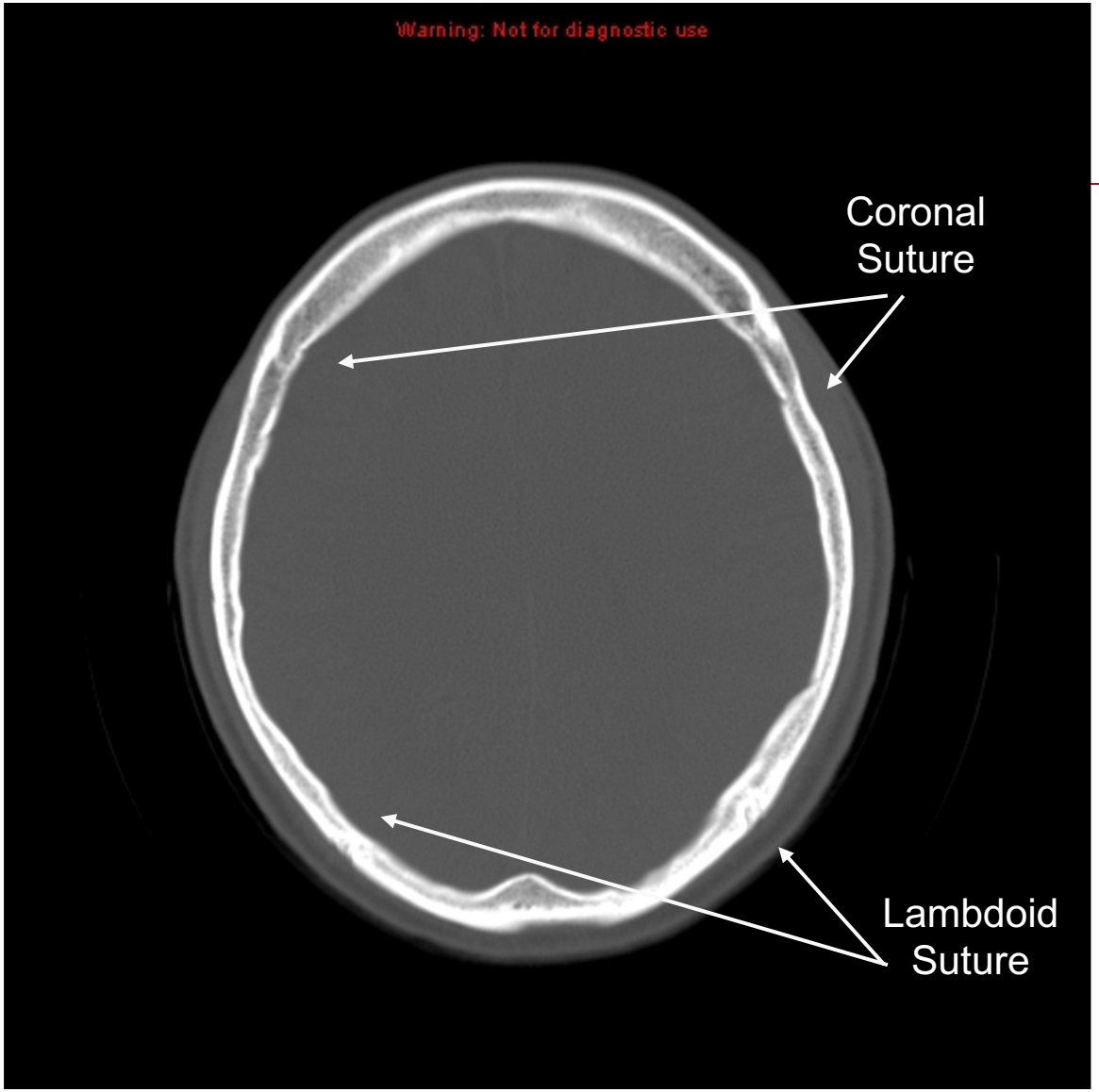
THE BASICS



BRAIN WINDOW

Global Health Emergency Medicine

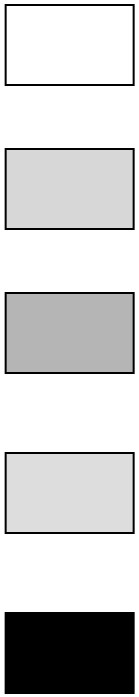
THE BASICS



BONE WINDOW

Global Health Emergency Medicine

THE BASICS



HYPERDENSE
(White)

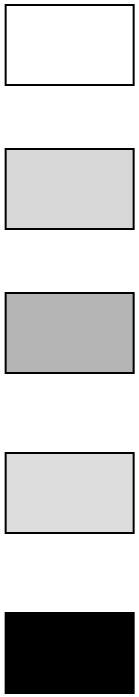
BONE

HYPODENSE
(Black)

AIR

Global Health Emergency Medicine

THE BASICS



HYPERDENSE
(White)

HYPODENSE
(Black)

BONE
Blood
Grey Matter
White Matter

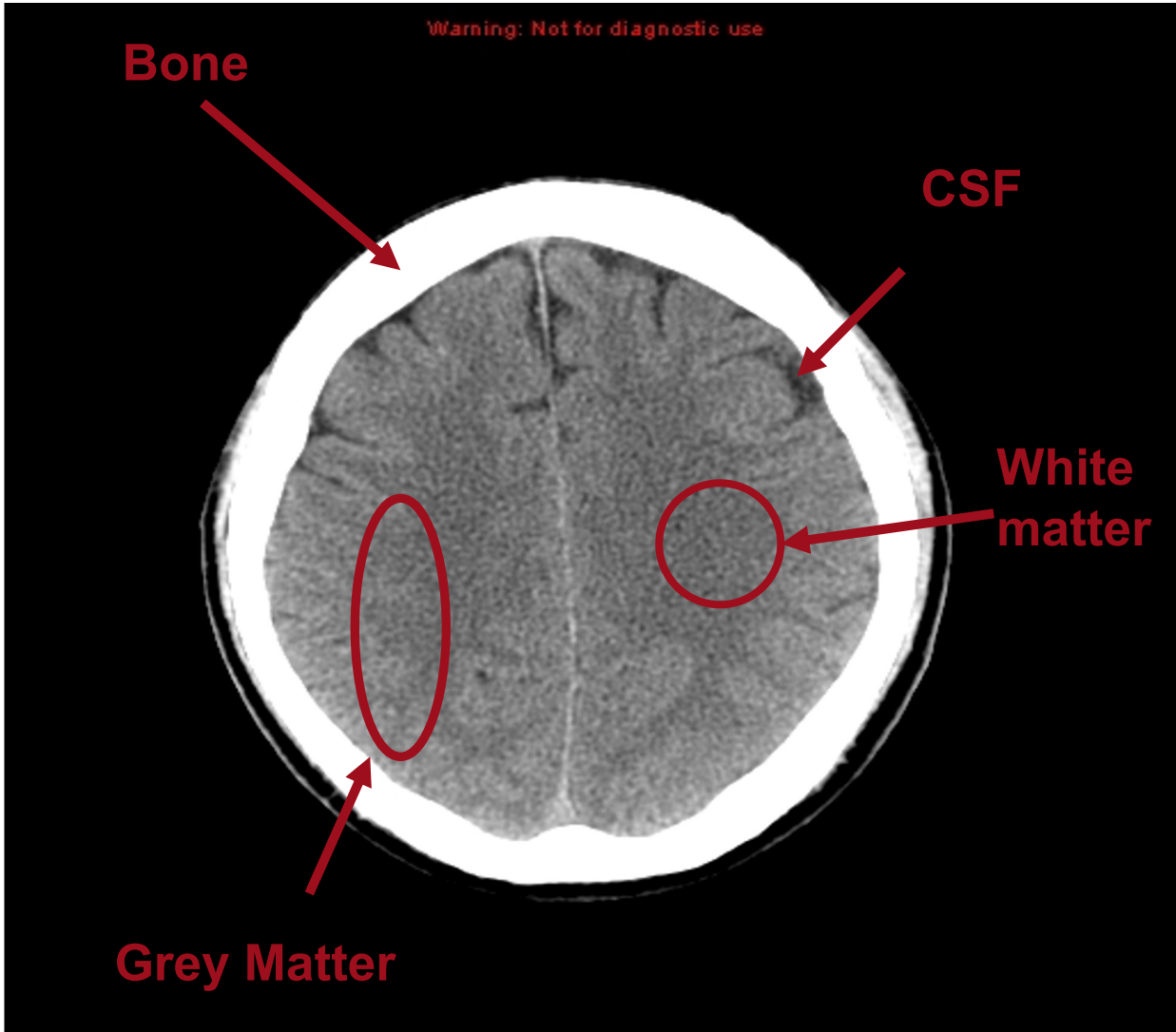
CSF
AIR

Global Health Emergency Medicine

Identify bone, grey and white matter & CSF

HYPERDENSE
(White)

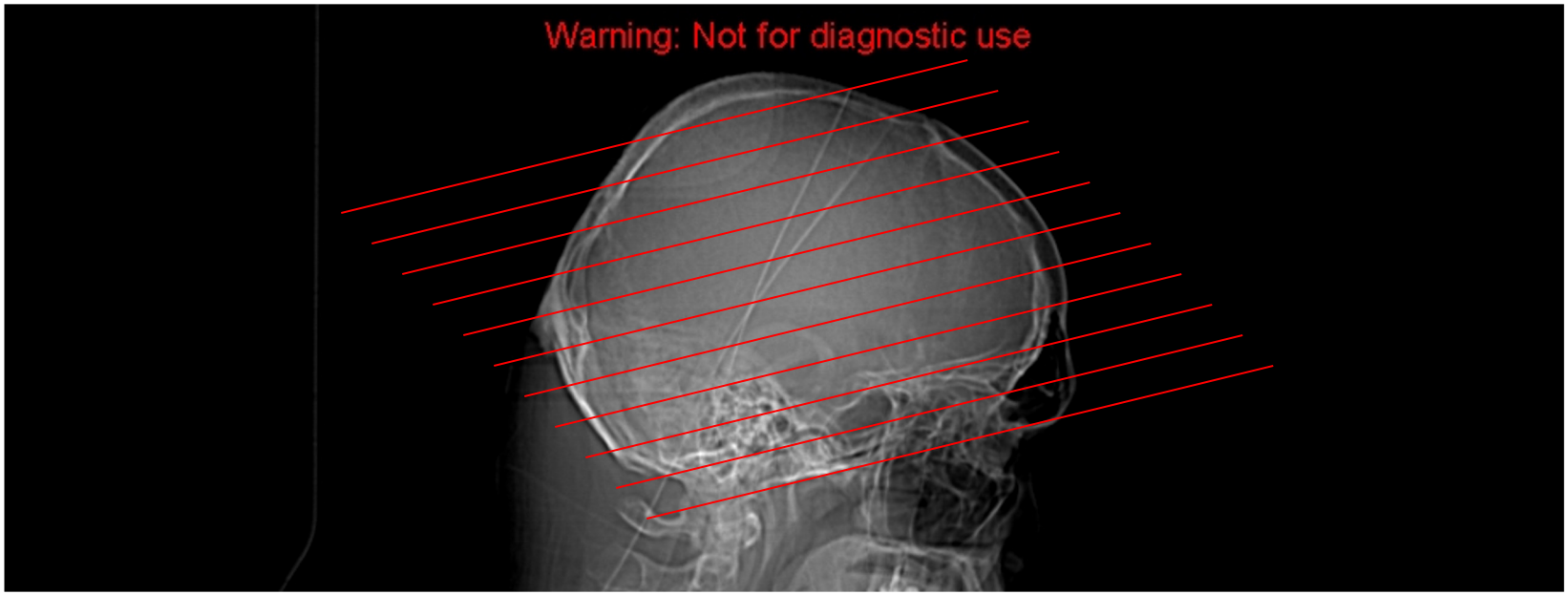
HYPODENSE
(Black)



TOP TO BOTTOM

Start from the top, and identify all the landmarks

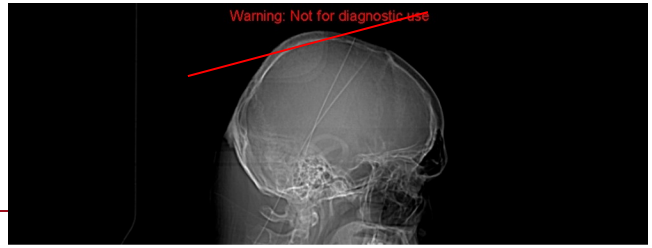
Cephalad



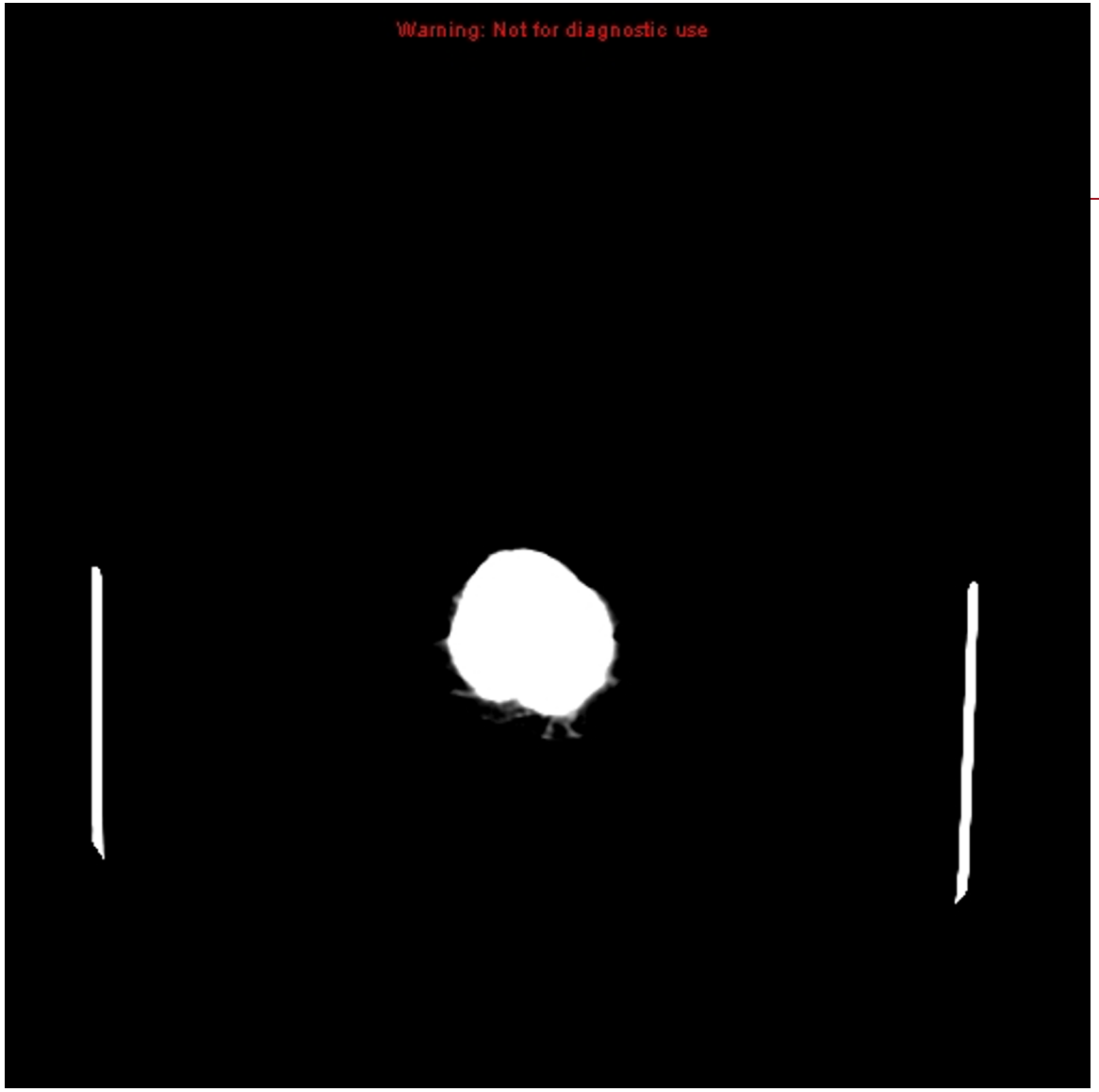
Caudad

Global Health Emergency Medicine

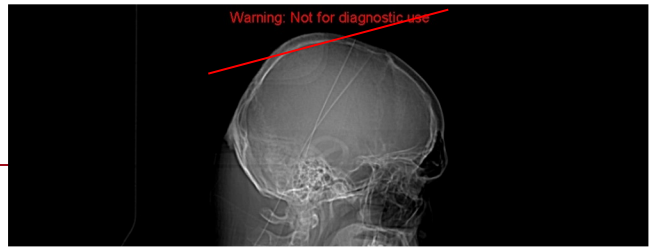
Cephalad



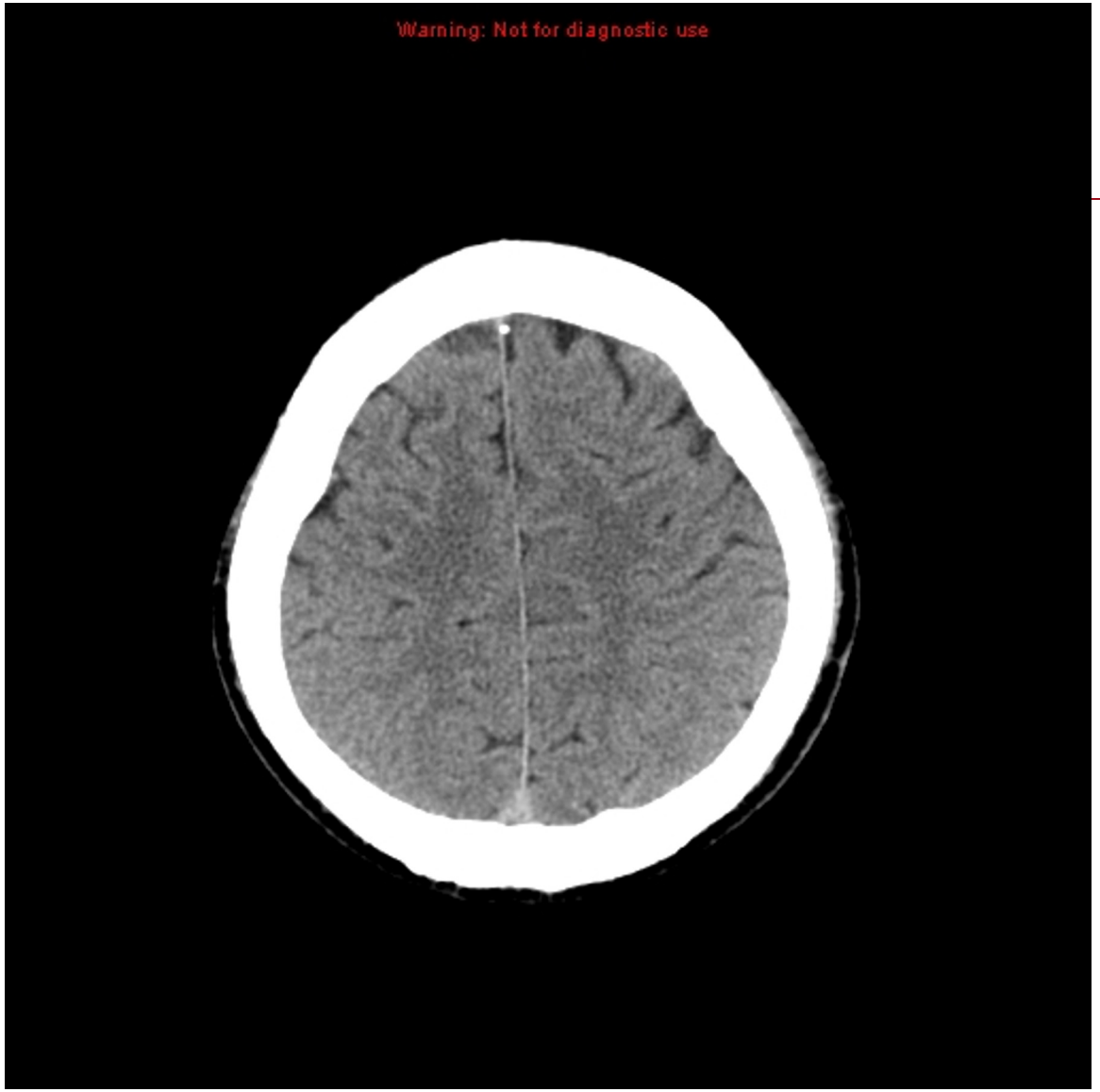
Caudad

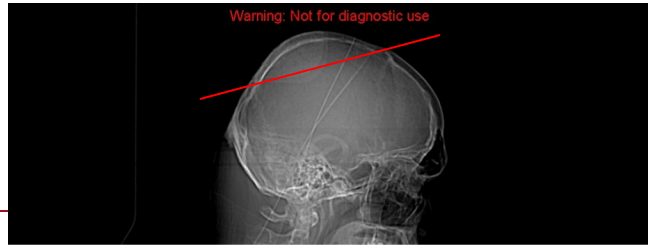


Global Health Emergency Medicine

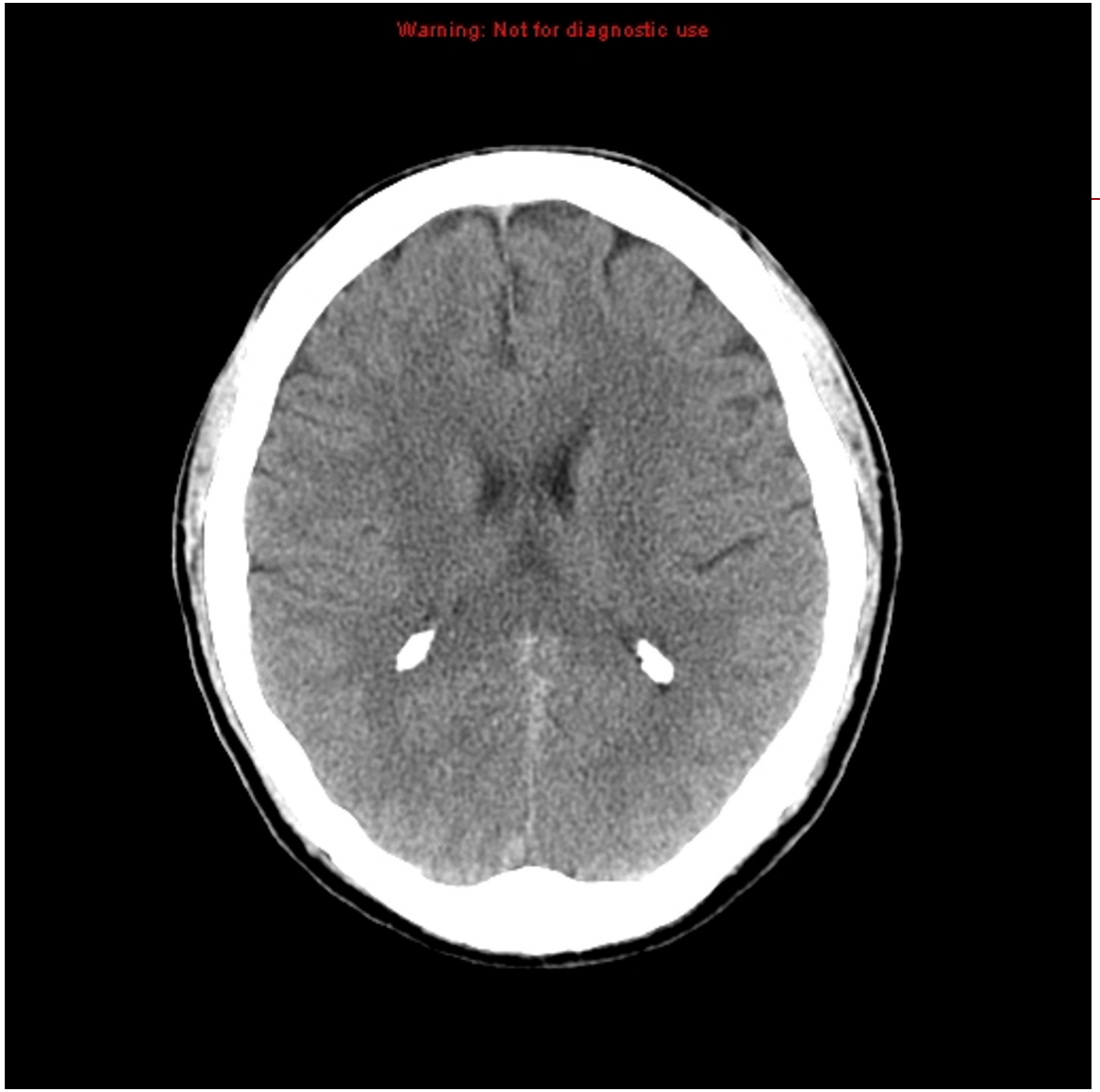


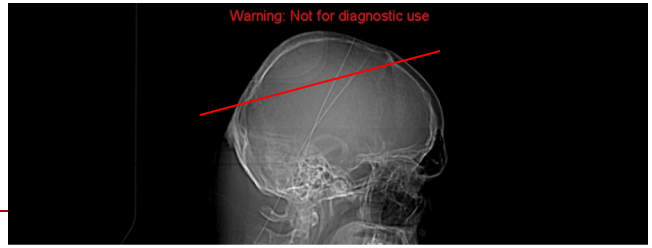
Global Health
Emergency Medicine



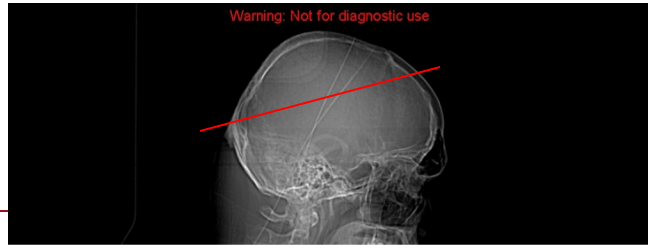


Global Health
Emergency Medicine

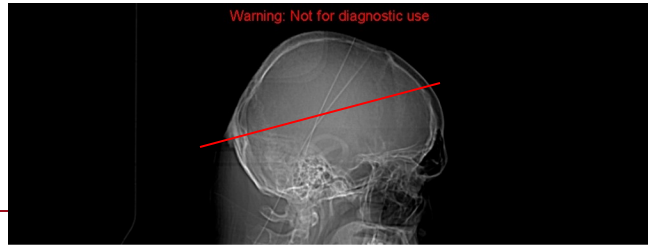




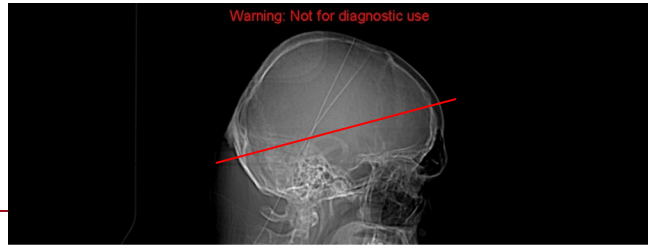
Global Health
Emergency Medicine



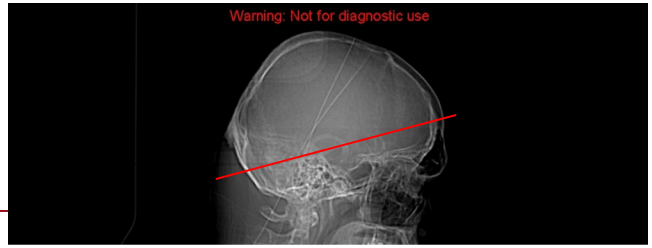
Global Health Emergency Medicine



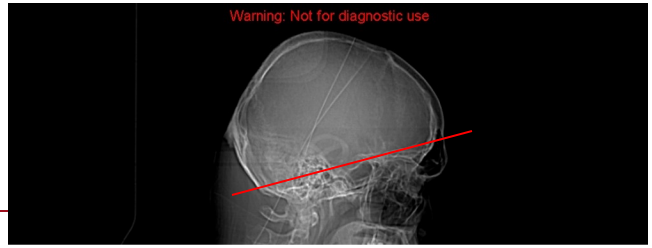
Global Health
Emergency Medicine



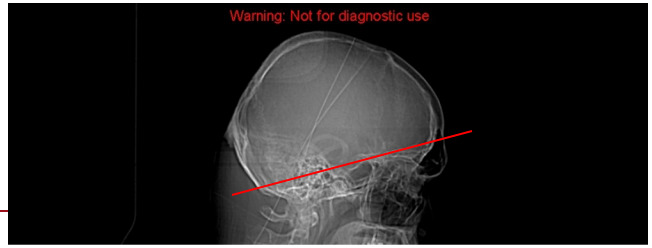
Global Health
Emergency Medicine



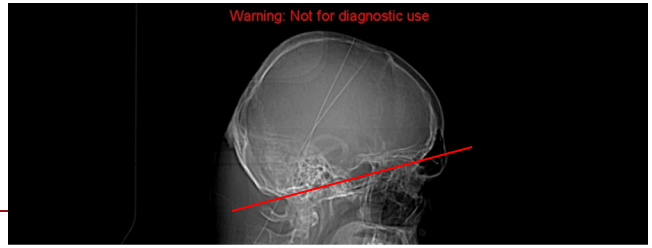
Global Health
Emergency Medicine



Global Health
Emergency Medicine



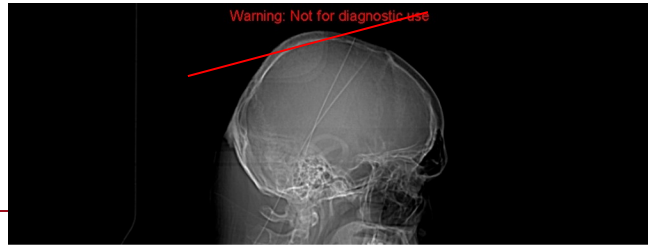
Global Health
Emergency Medicine



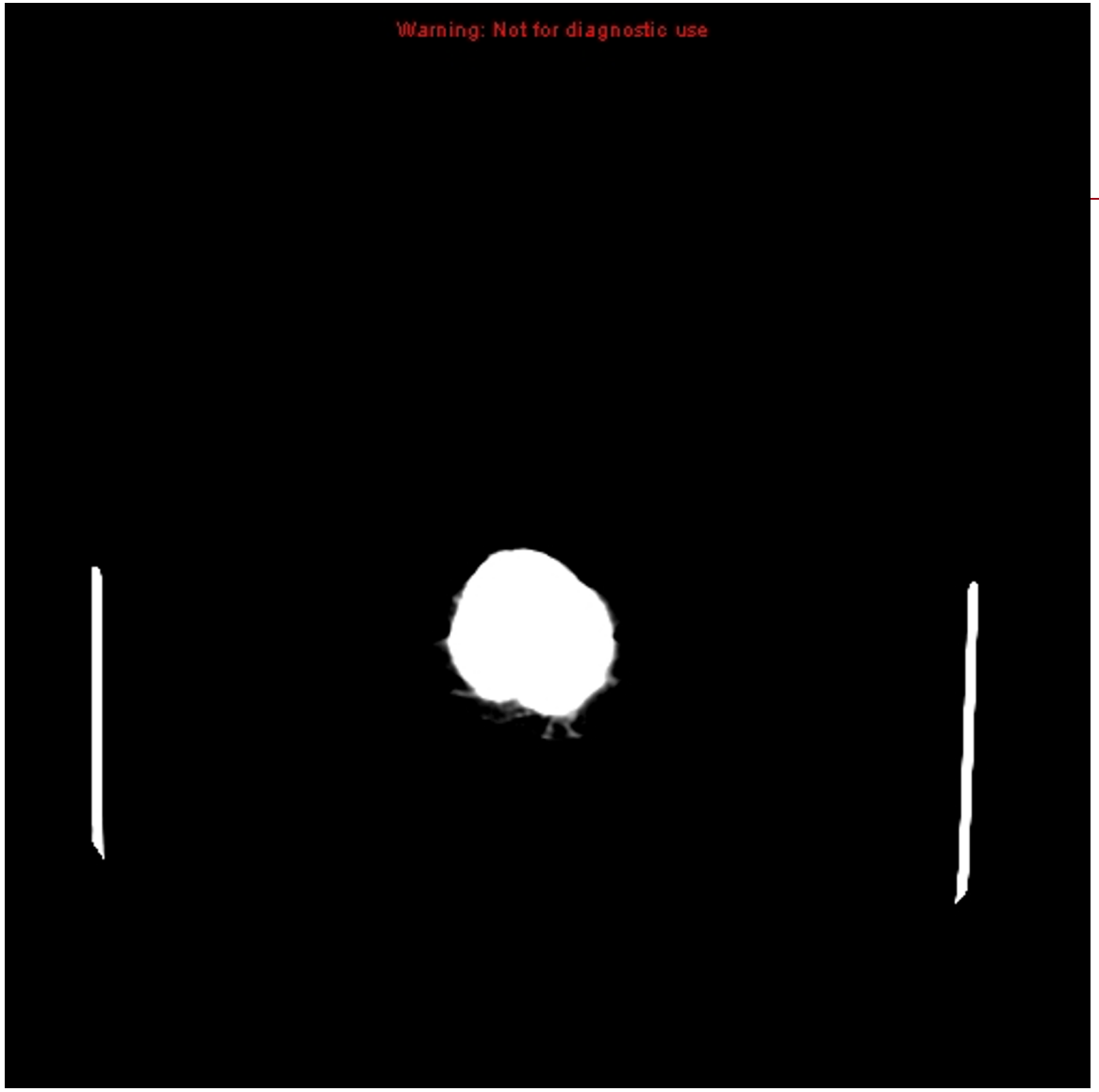
Global Health
Emergency Medicine

ANATOMY

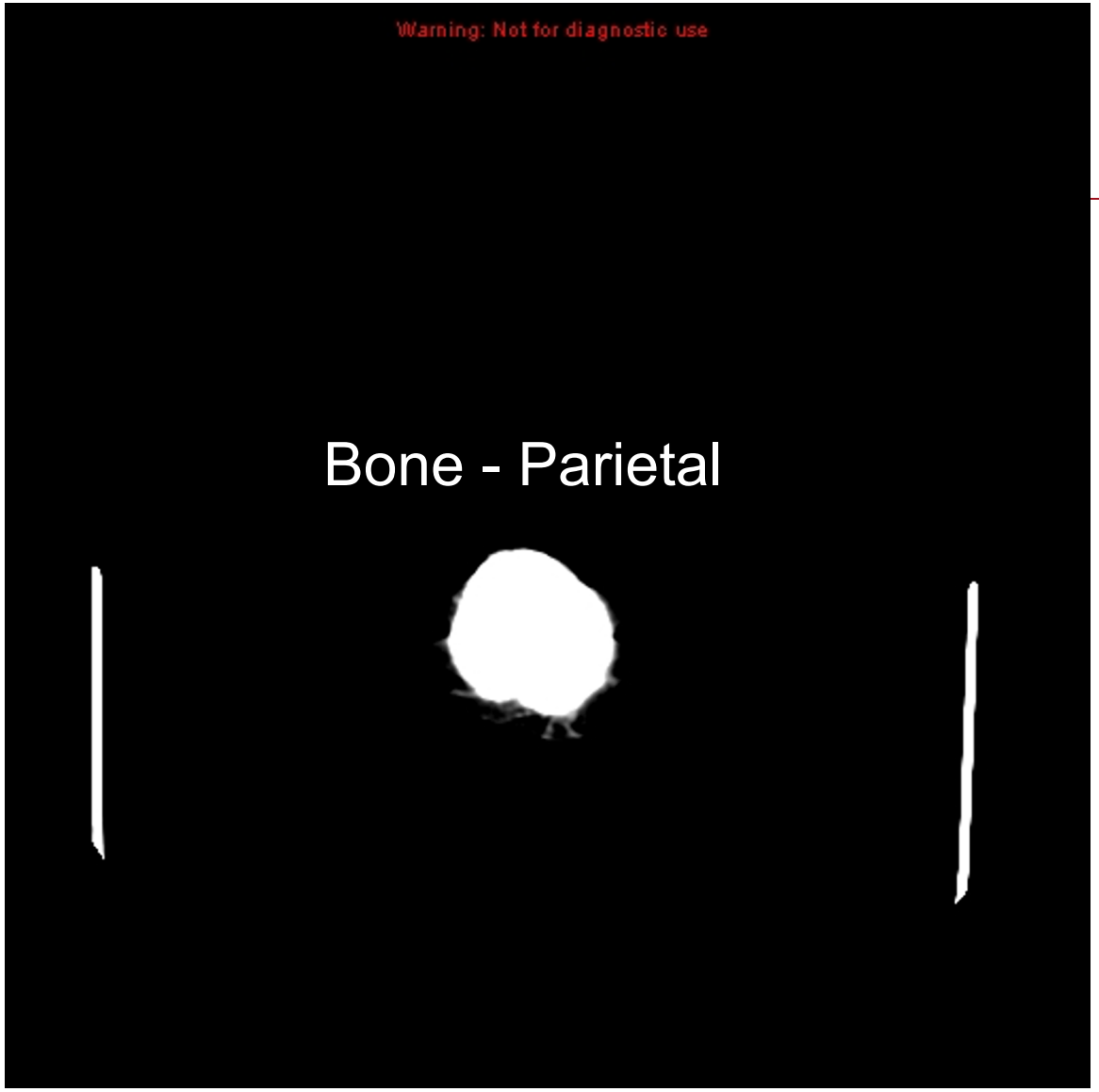
Cephalad

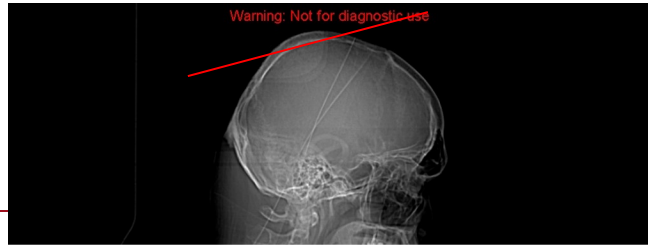


Caudad

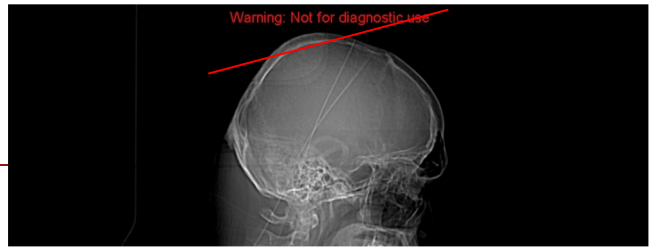


Global Health Emergency Medicine

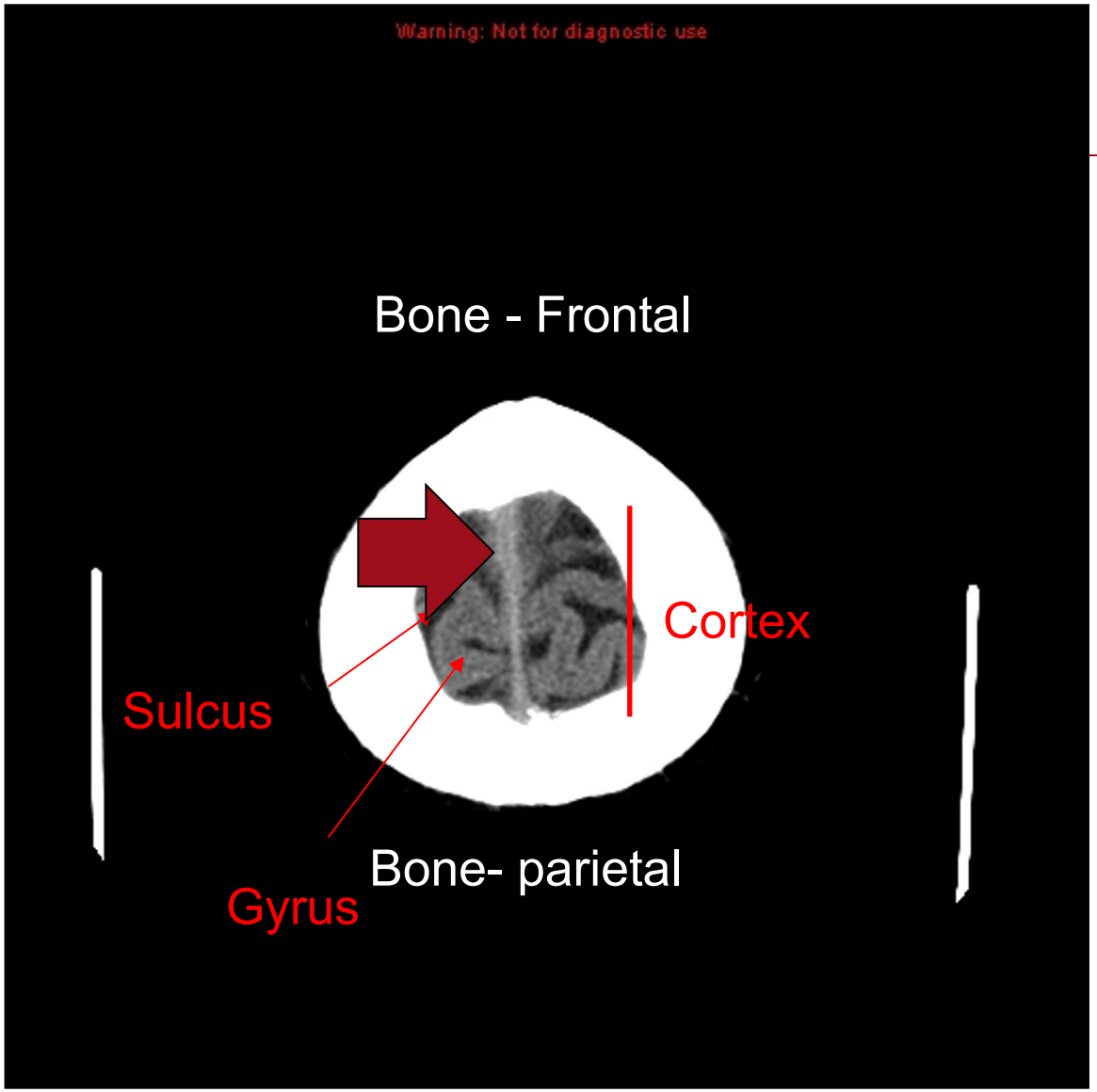


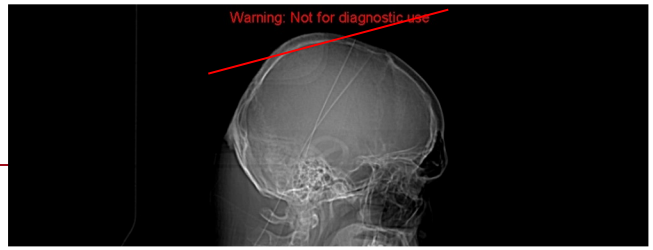


Global Health
Emergency Medicine

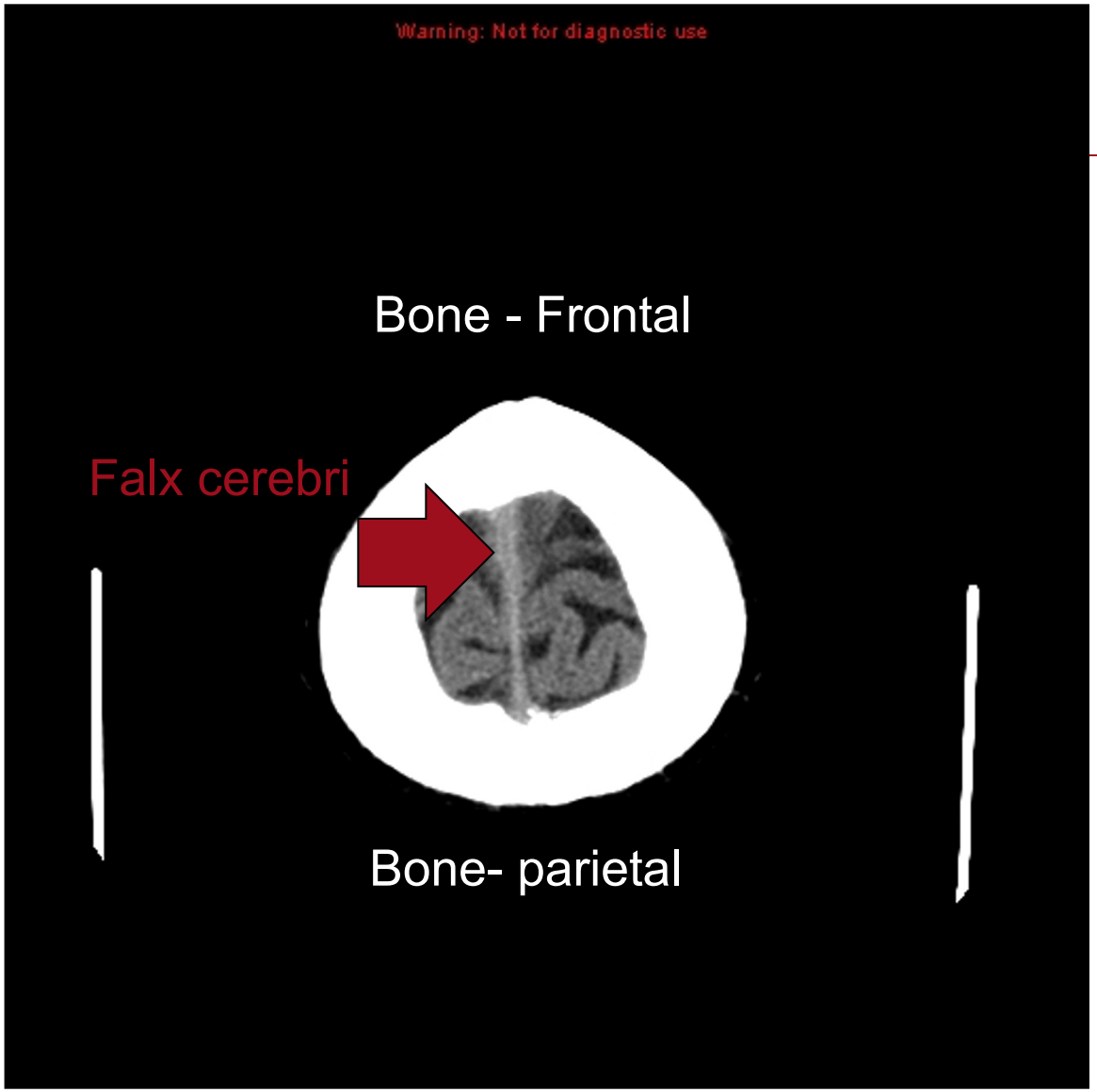


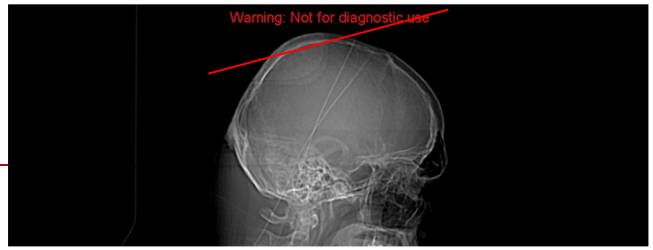
Global Health
Emergency Medicine





Global Health Emergency Medicine

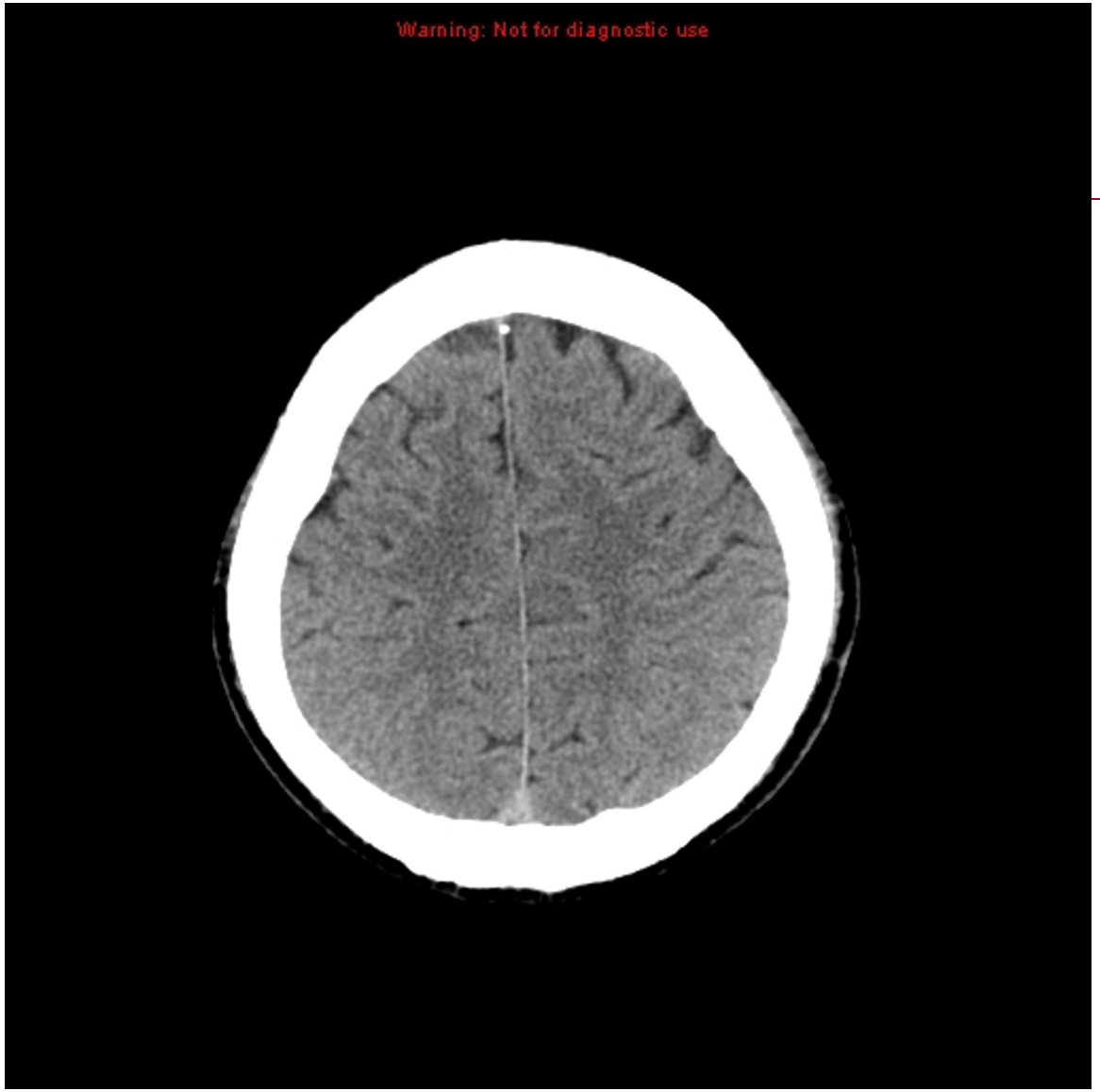


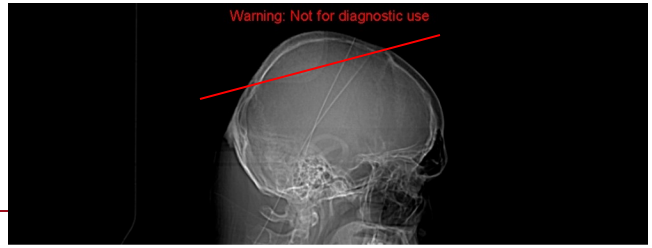


Falx cerebri =
a fold of the dura
that divides the
right and left cortex

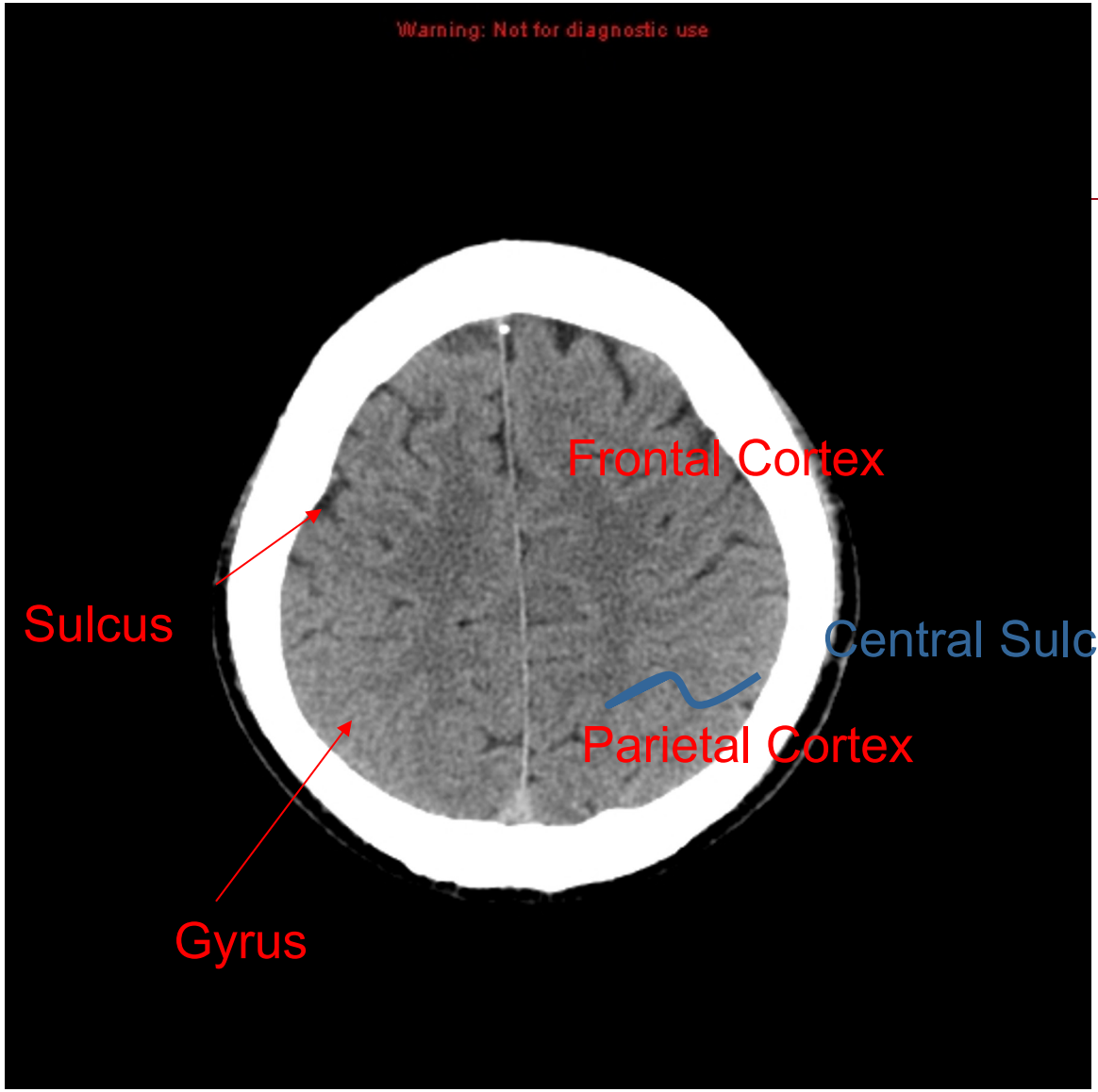
Why is the Falx
cerebri more
hyperdense?

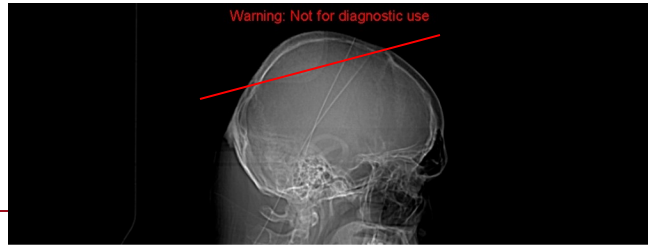
Global Health
Emergency Medicine



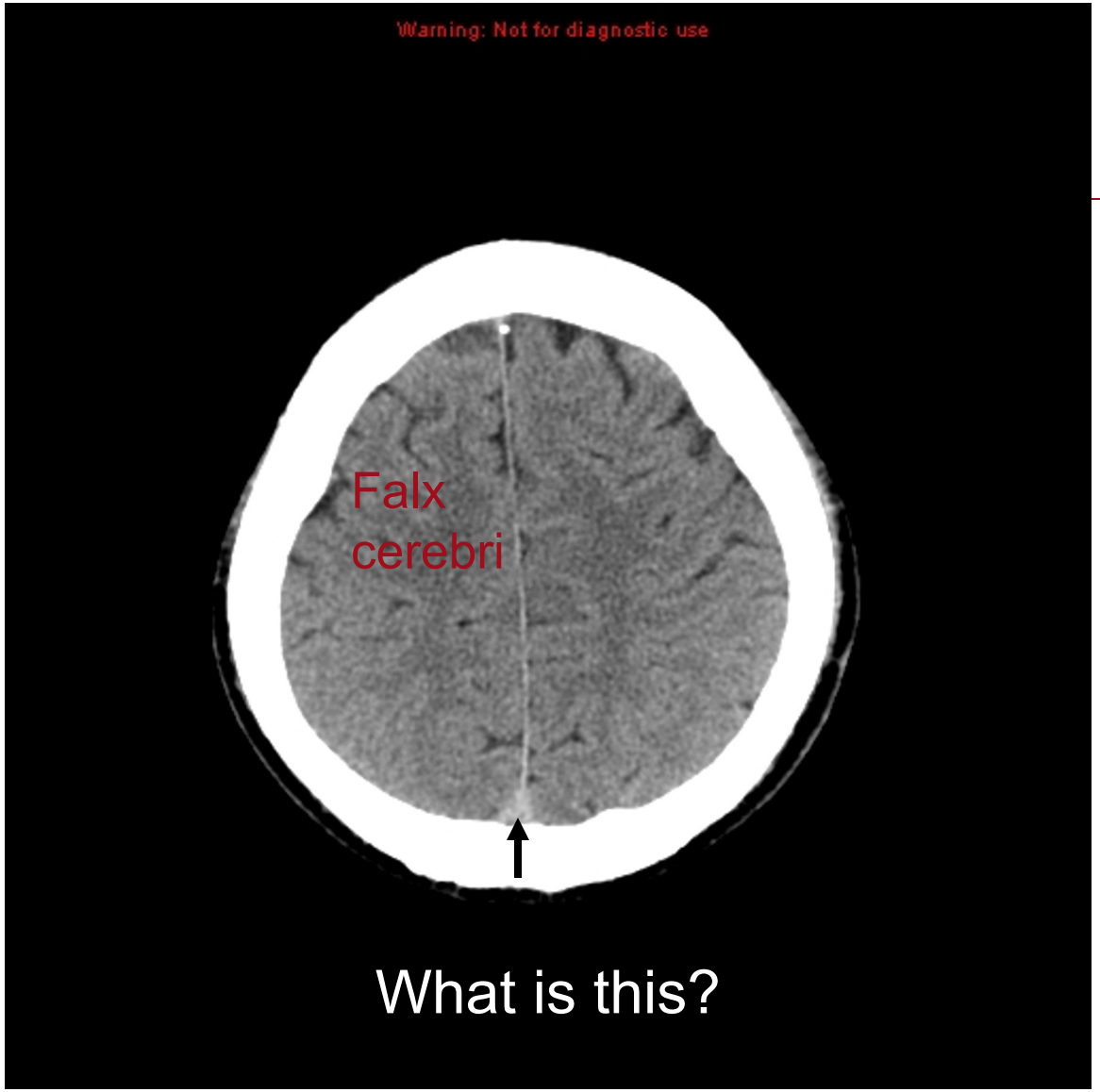


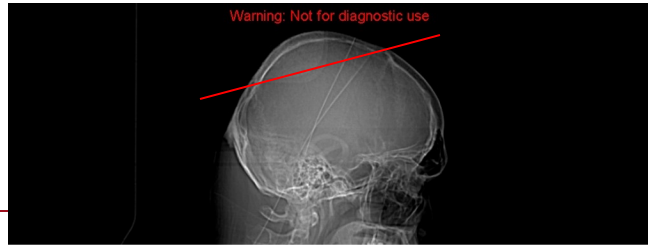
Global Health
Emergency Medicine





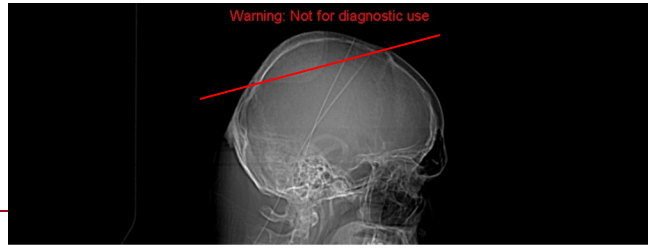
Global Health Emergency Medicine





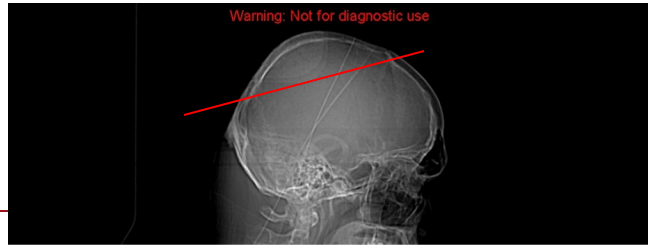
The sagittal sinus in cross section

Global Health
Emergency Medicine



Centrum semiovale = collection of white matter

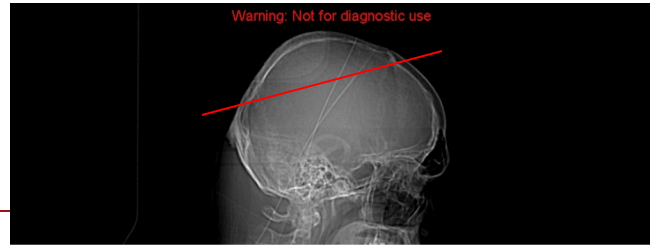
Global Health
Emergency Medicine



Lateral ventricle

Falx cerebri

Global Health Emergency Medicine



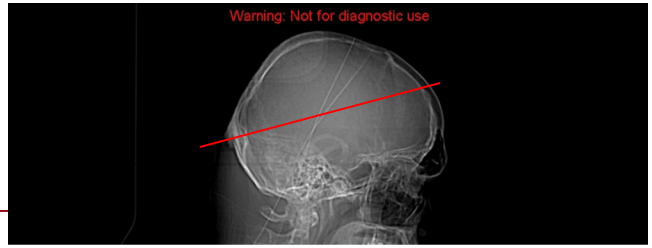
Anterior horn Lateral ventricle

Posterior horn Lateral ventricle

Is this hyperdensity abnormal?

Choroid Plexus

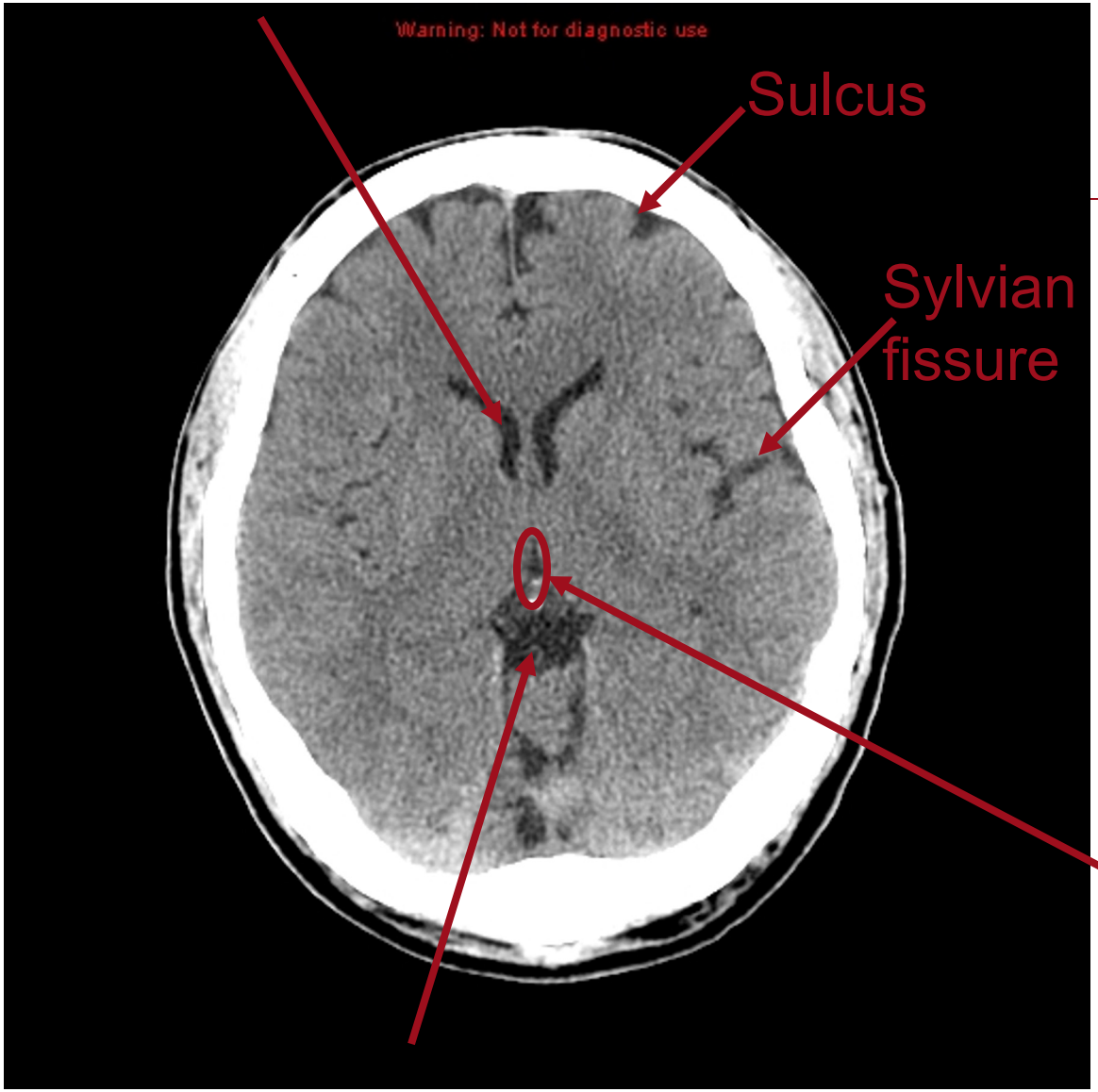
Global Health Emergency Medicine

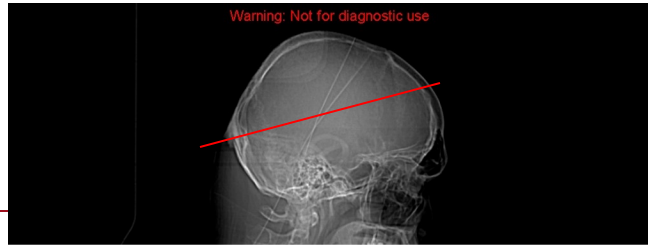


Identify the Structures filled with CSF

Global Health Emergency Medicine

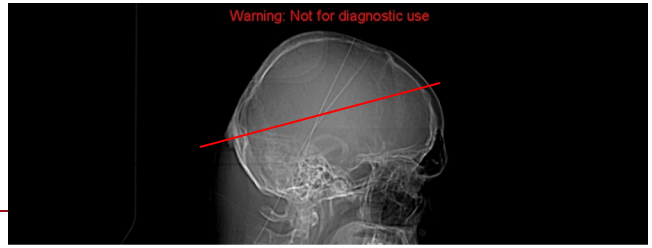
Anterior horn of lateral ventricle





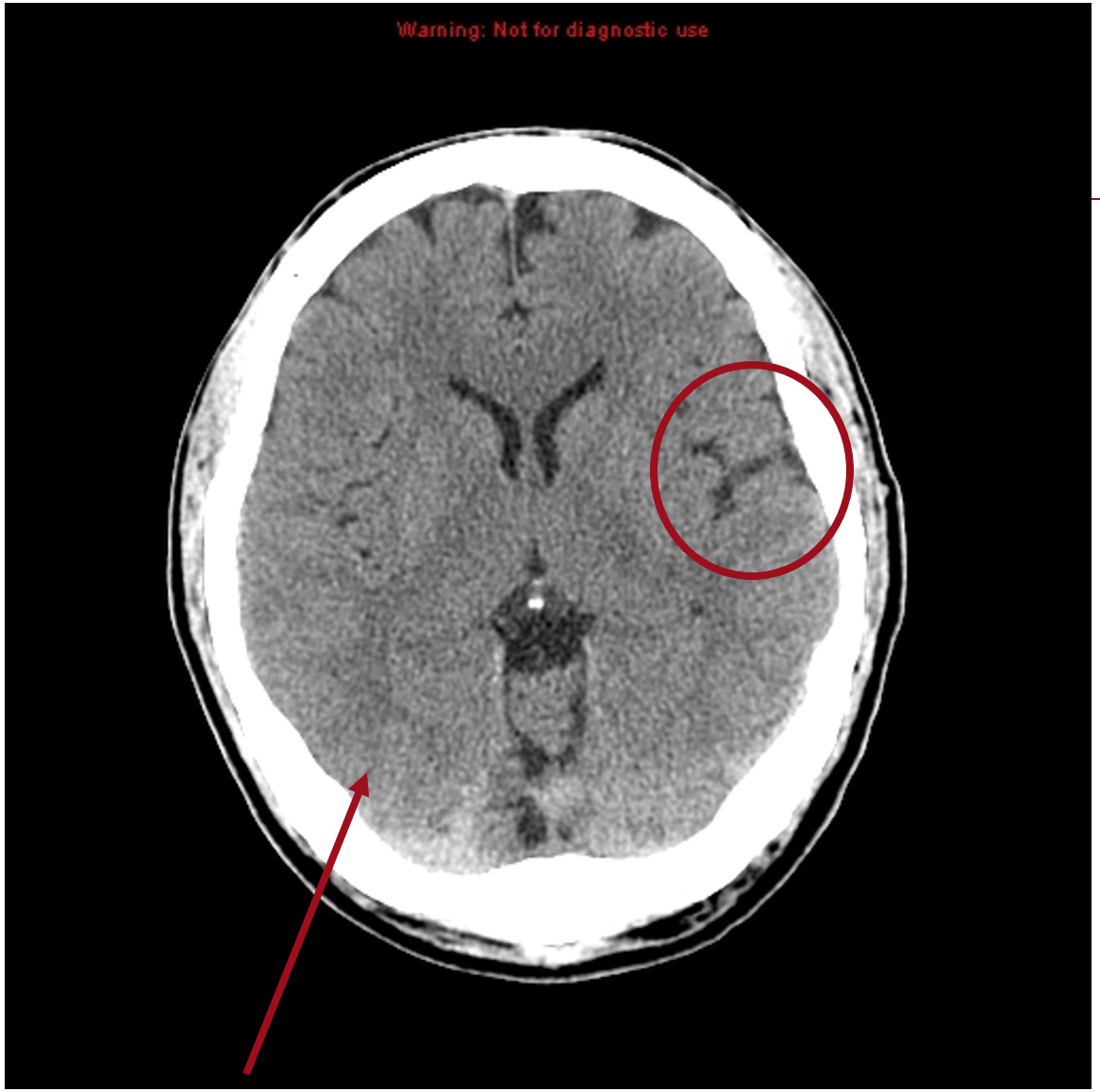
CSF filled Structures

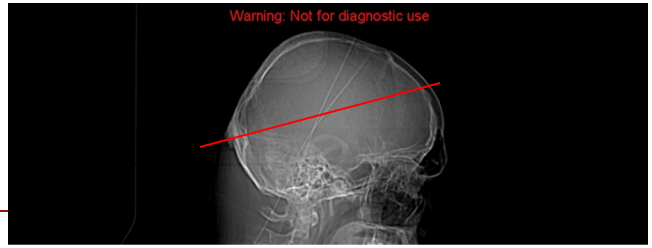
Global Health Emergency Medicine



Grey matter?

Global Health Emergency Medicine

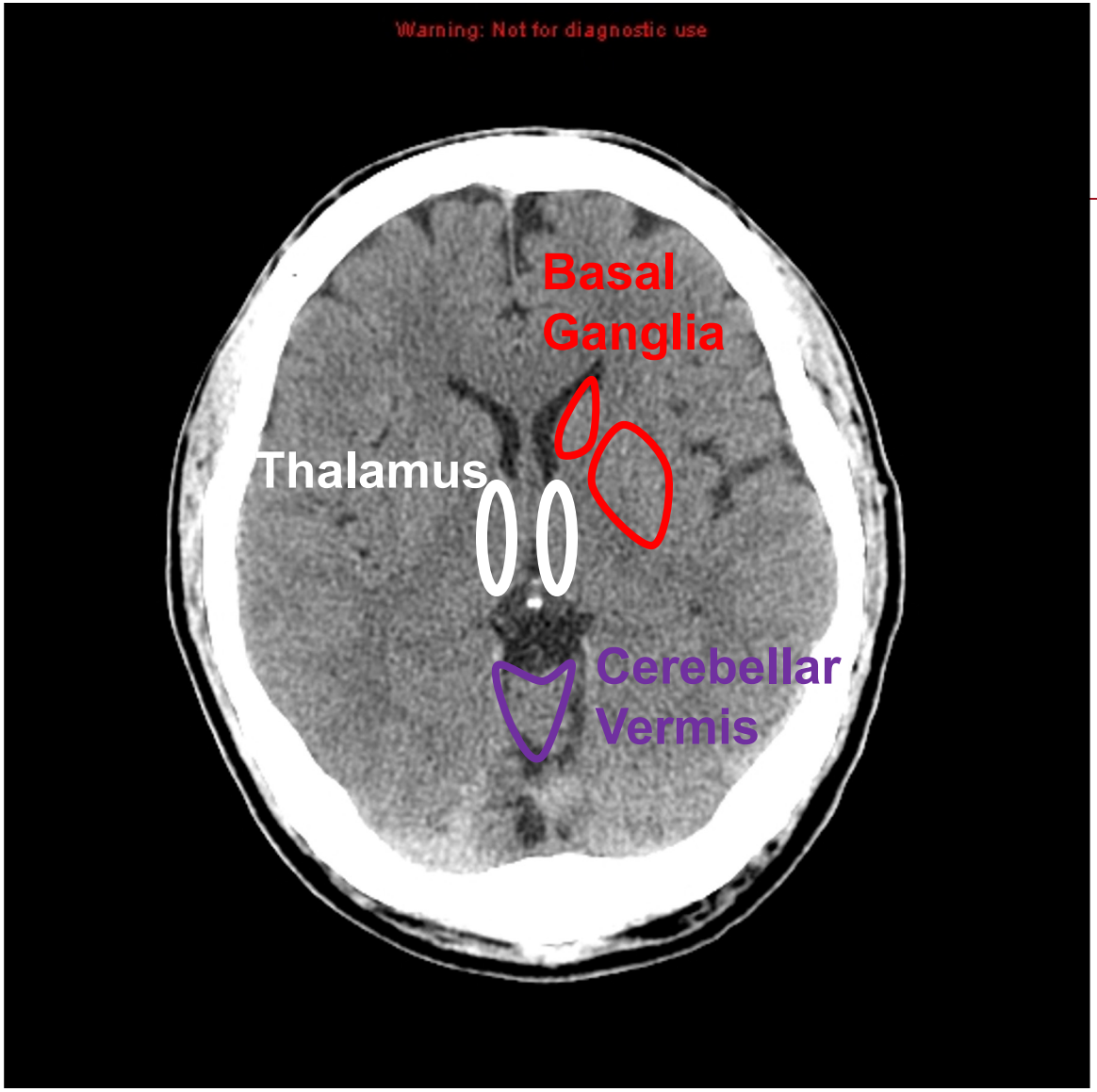


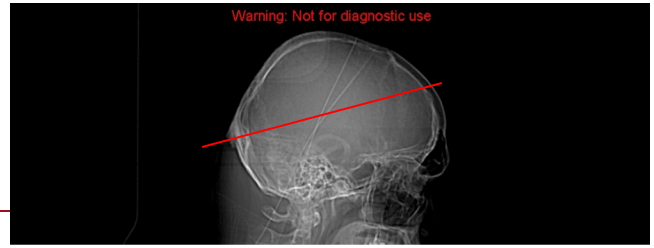


Grey matter

Cortex

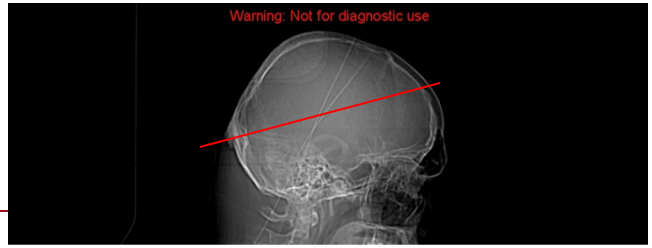
Global Health Emergency Medicine





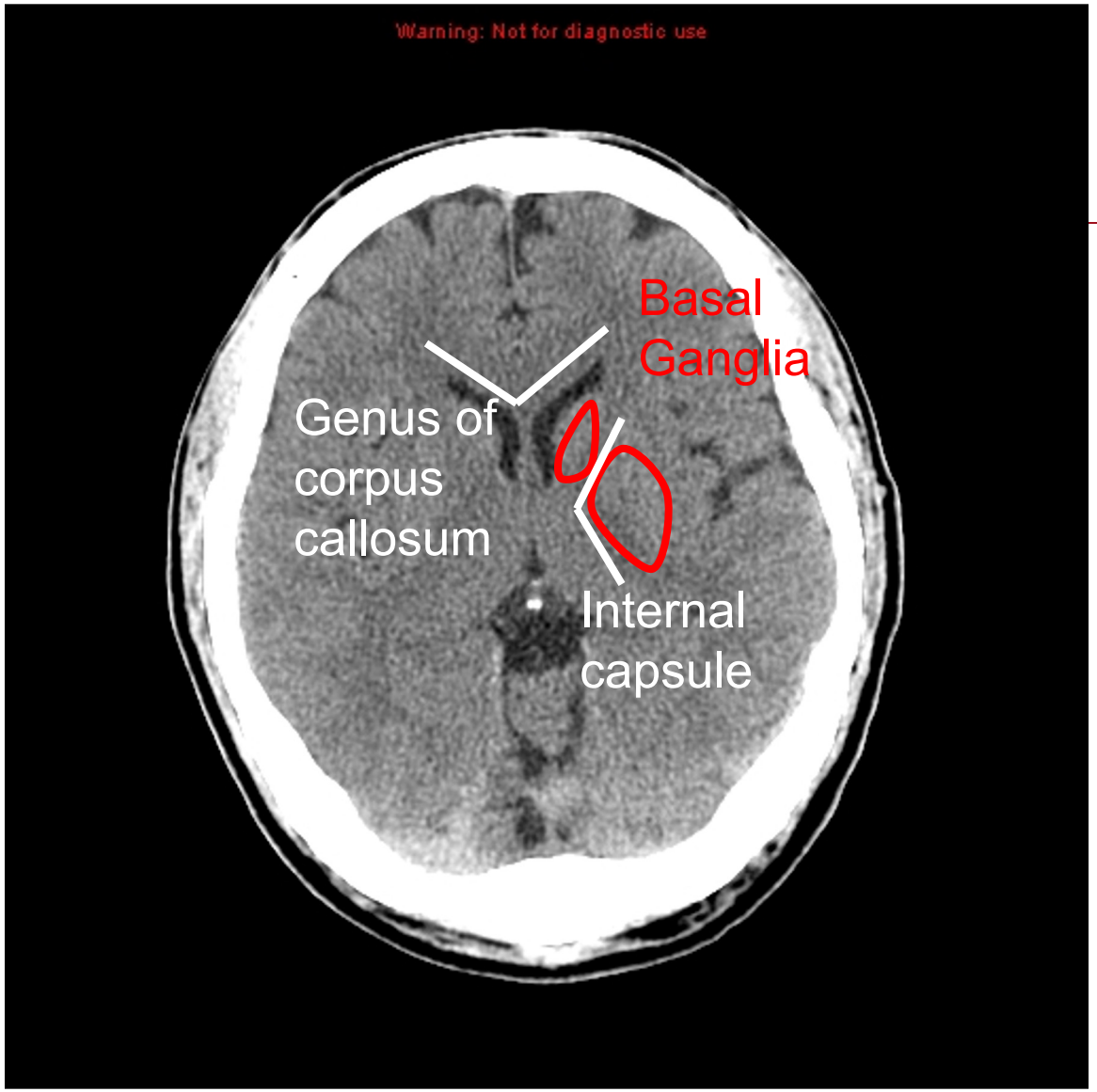
Grey matter

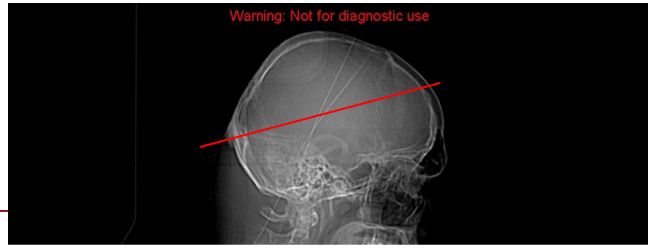
Global Health Emergency Medicine



White Matter?

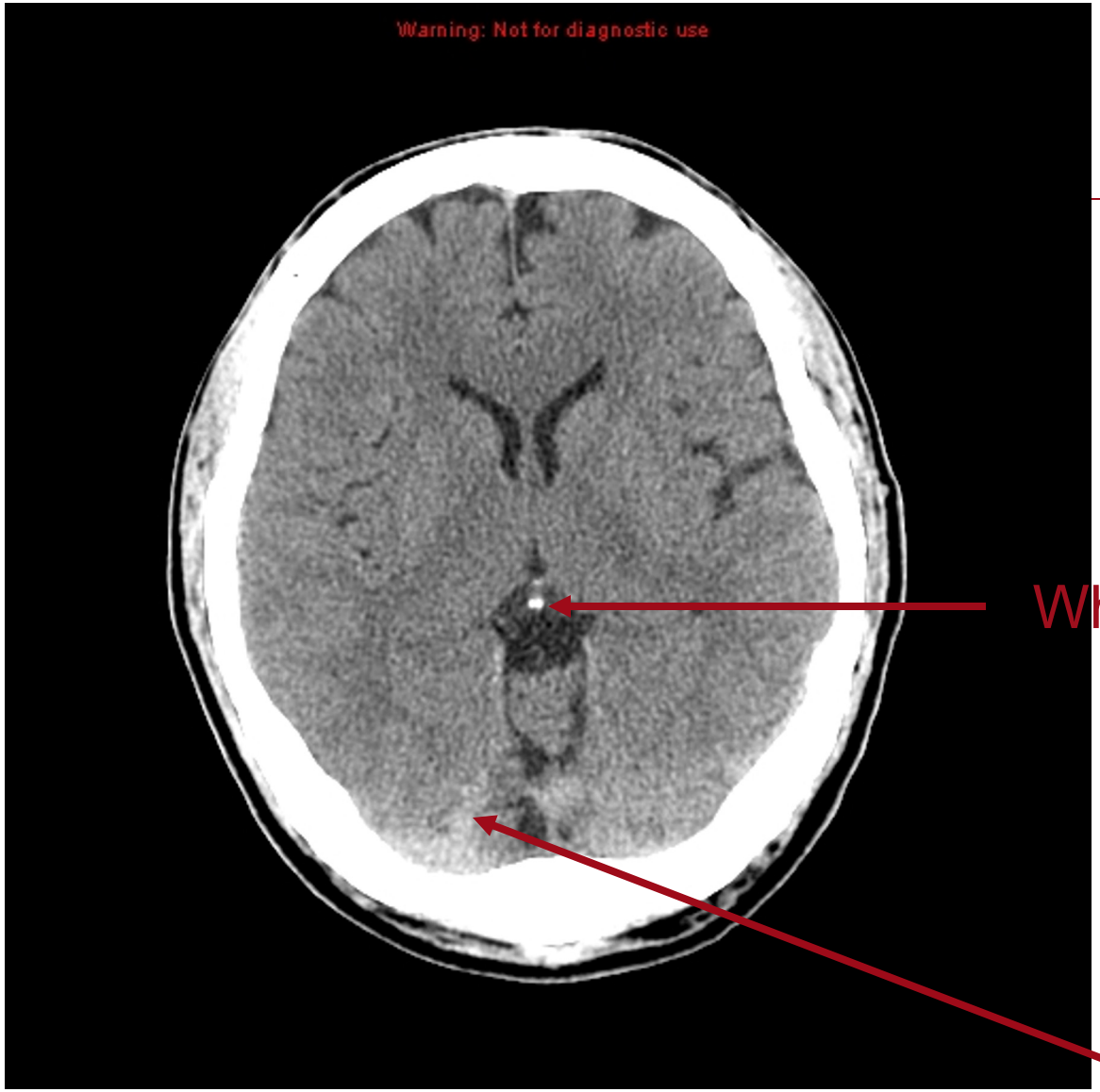
Global Health Emergency Medicine

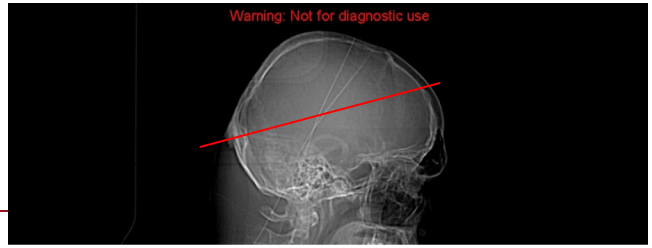




White matter

Global Health Emergency Medicine





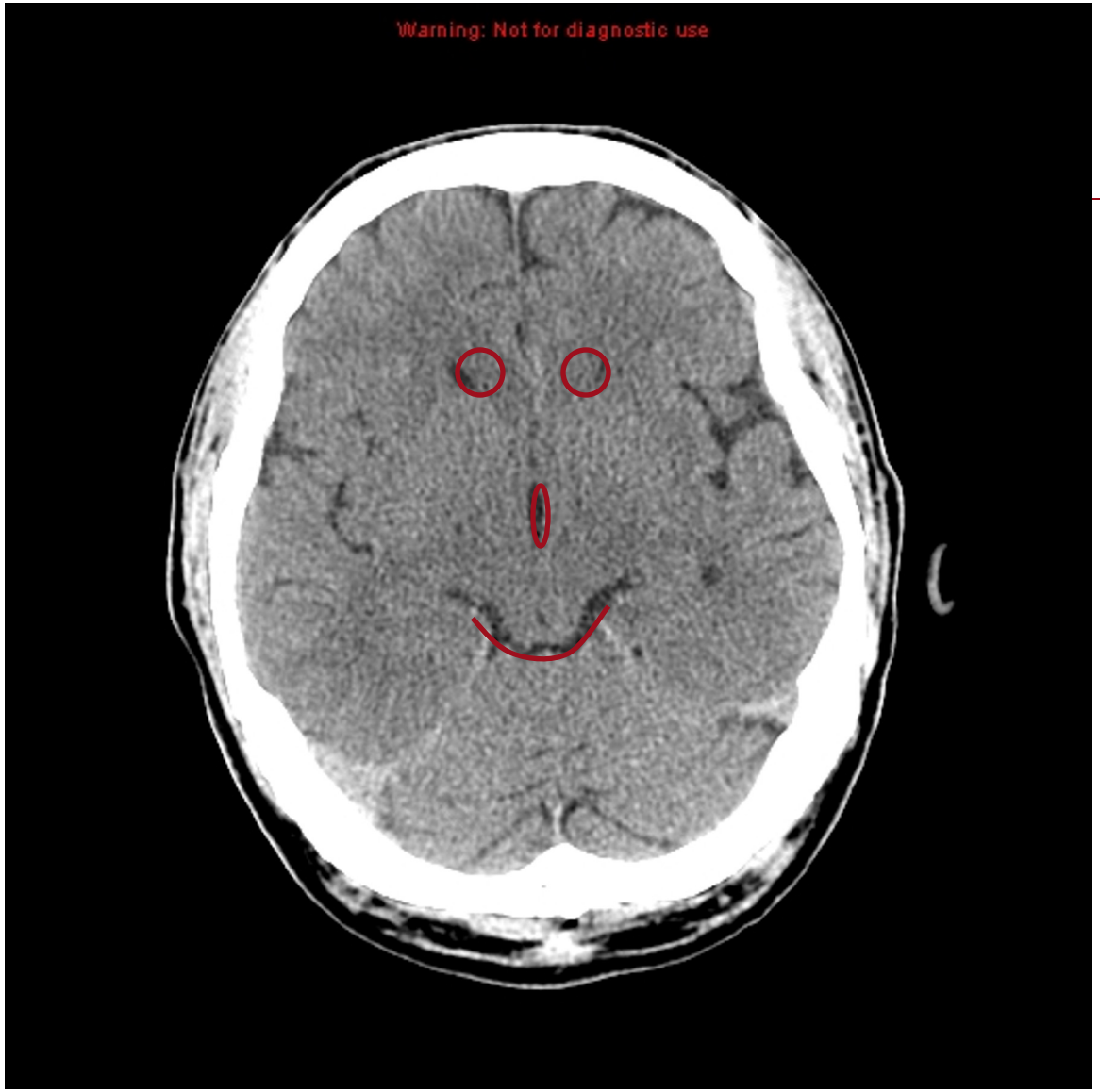
What is this hyperdensity?

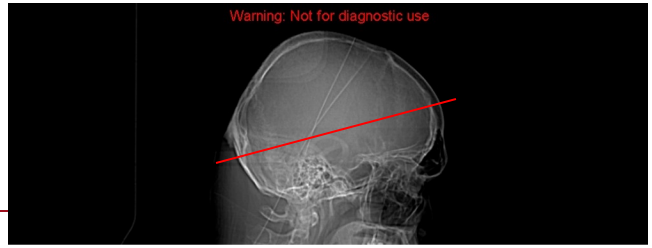
Pineal Gland

And this one?

Transverse Sinus

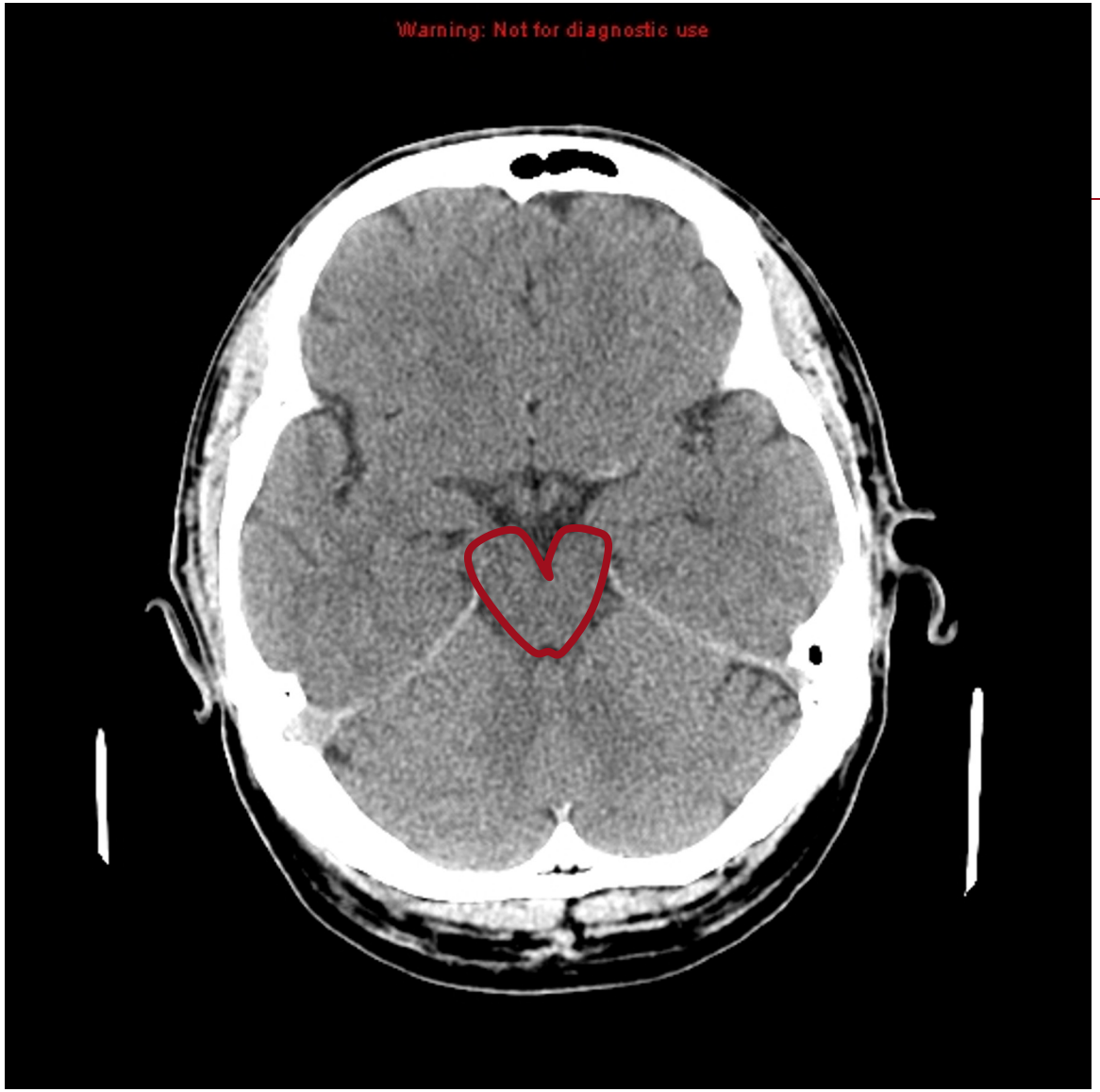
Global Health Emergency Medicine

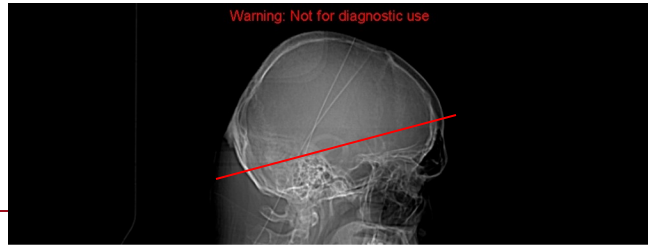




Smiley Face

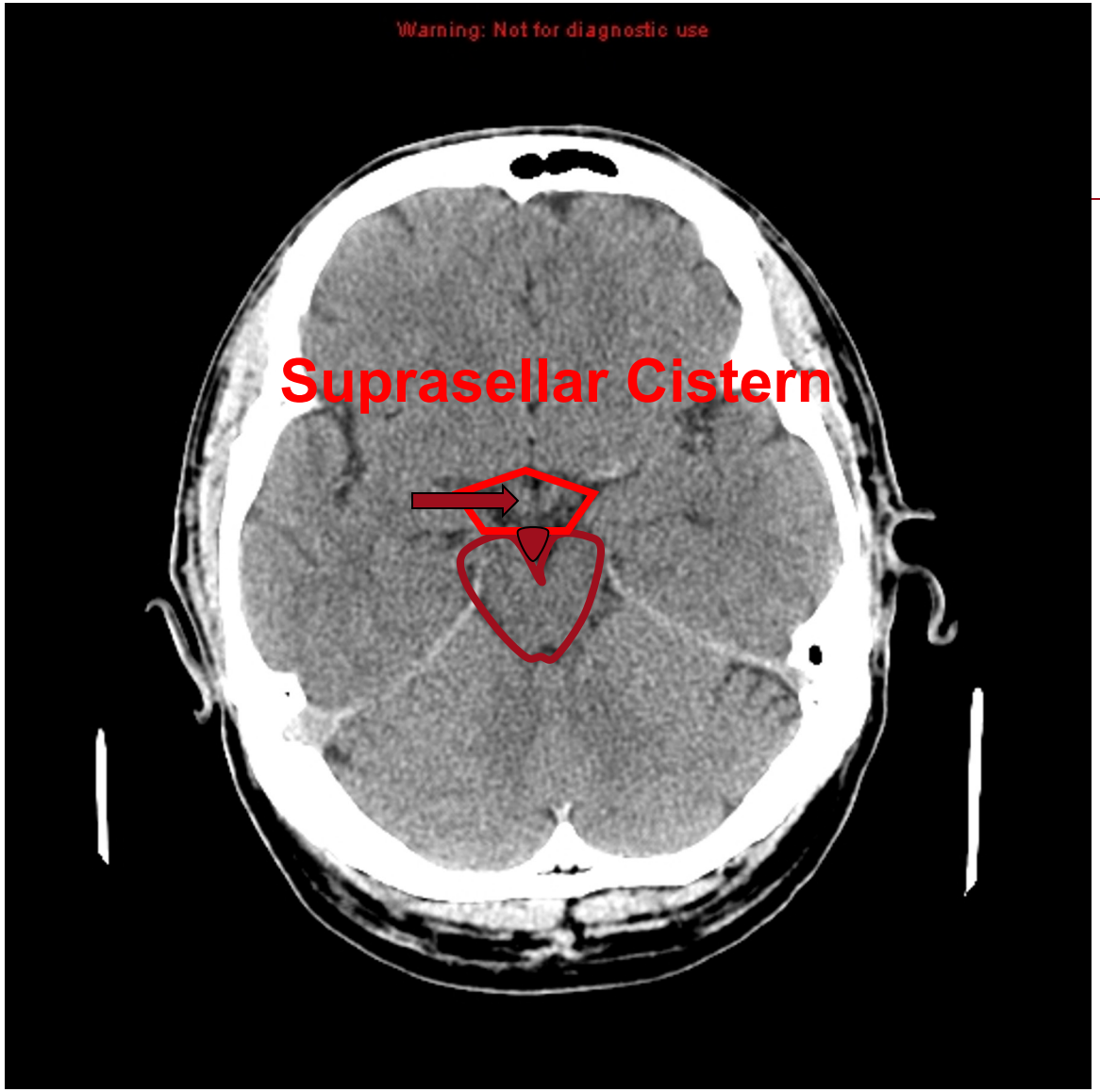
Global Health Emergency Medicine

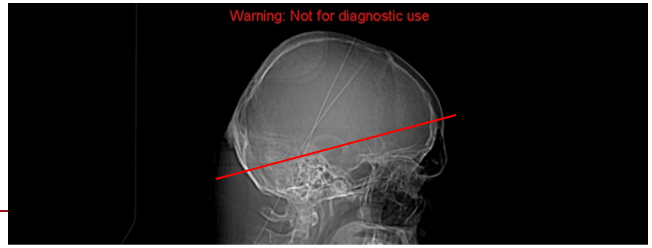




Identify the midbrain!

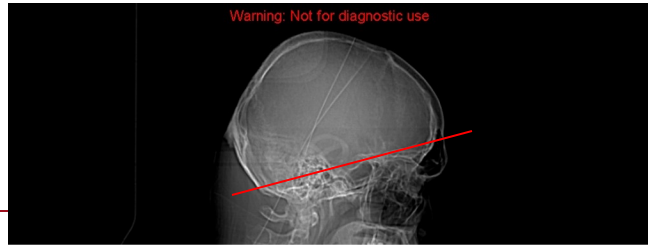
Global Health Emergency Medicine



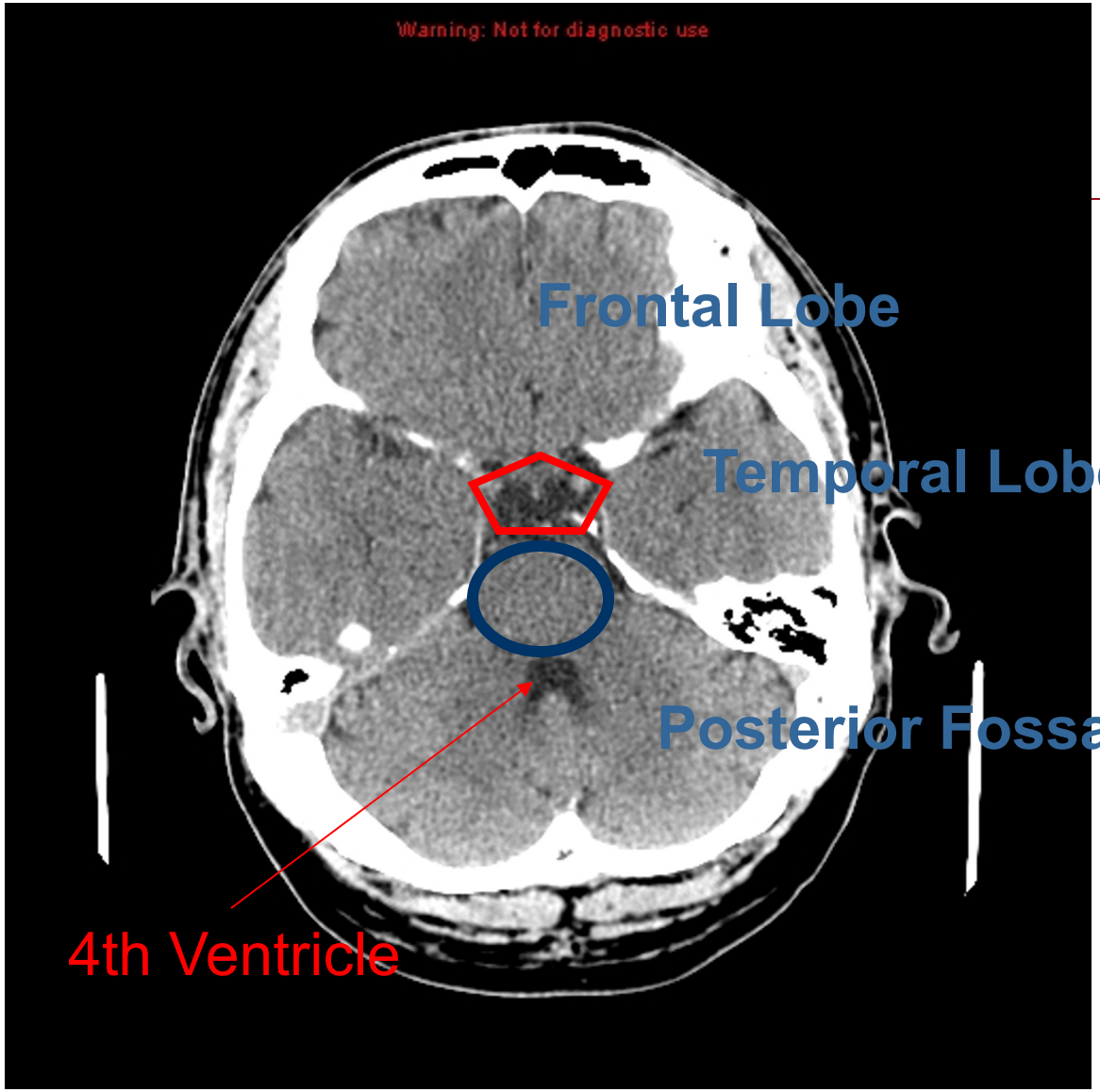


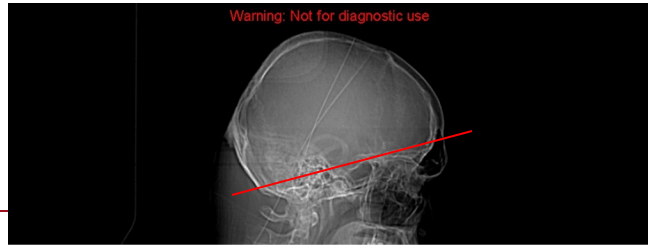
What is important about the suprasellar cistern?

Global Health Emergency Medicine



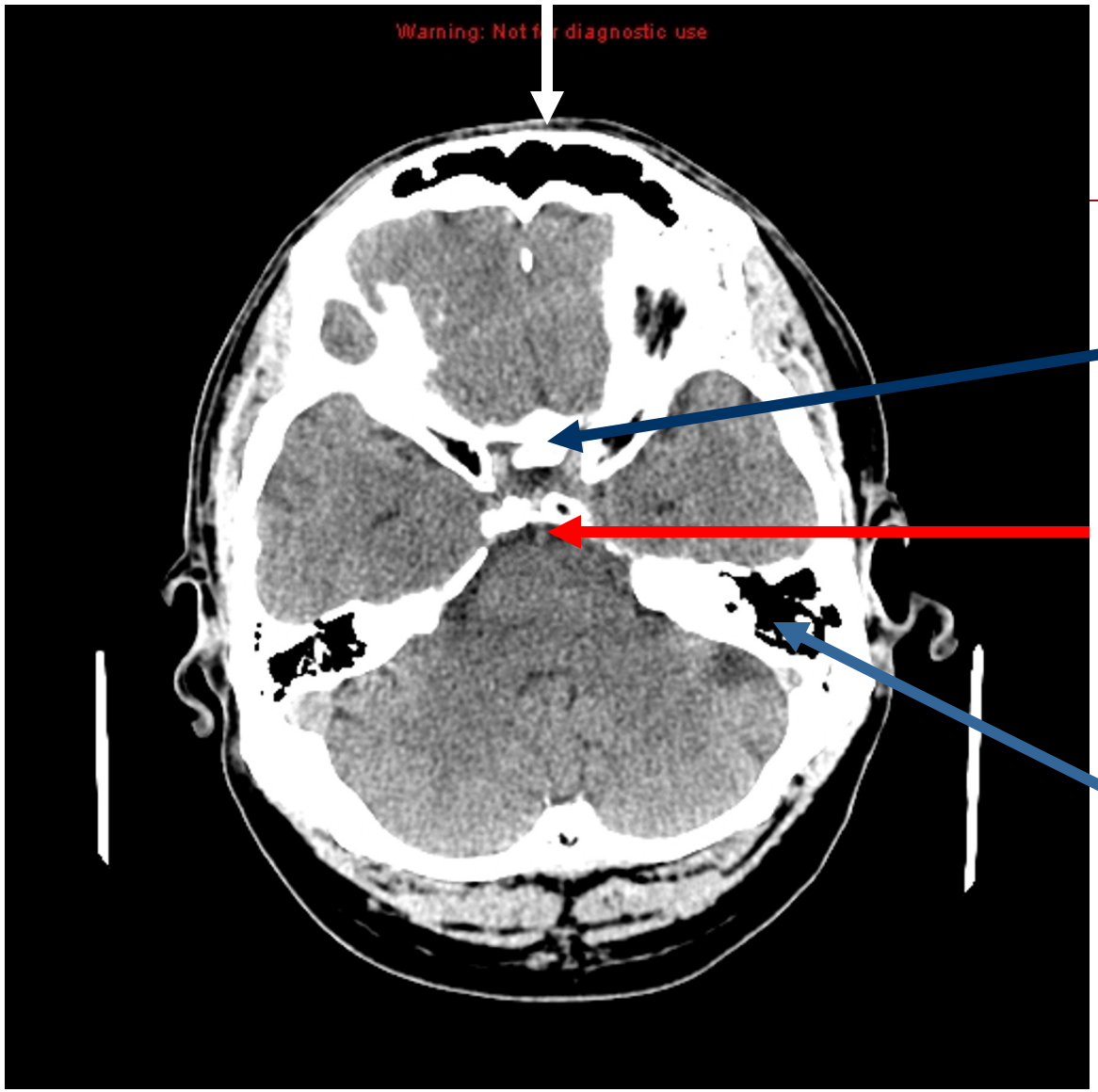
Global Health
Emergency Medicine





Global Health Emergency Medicine

Frontal Sinus

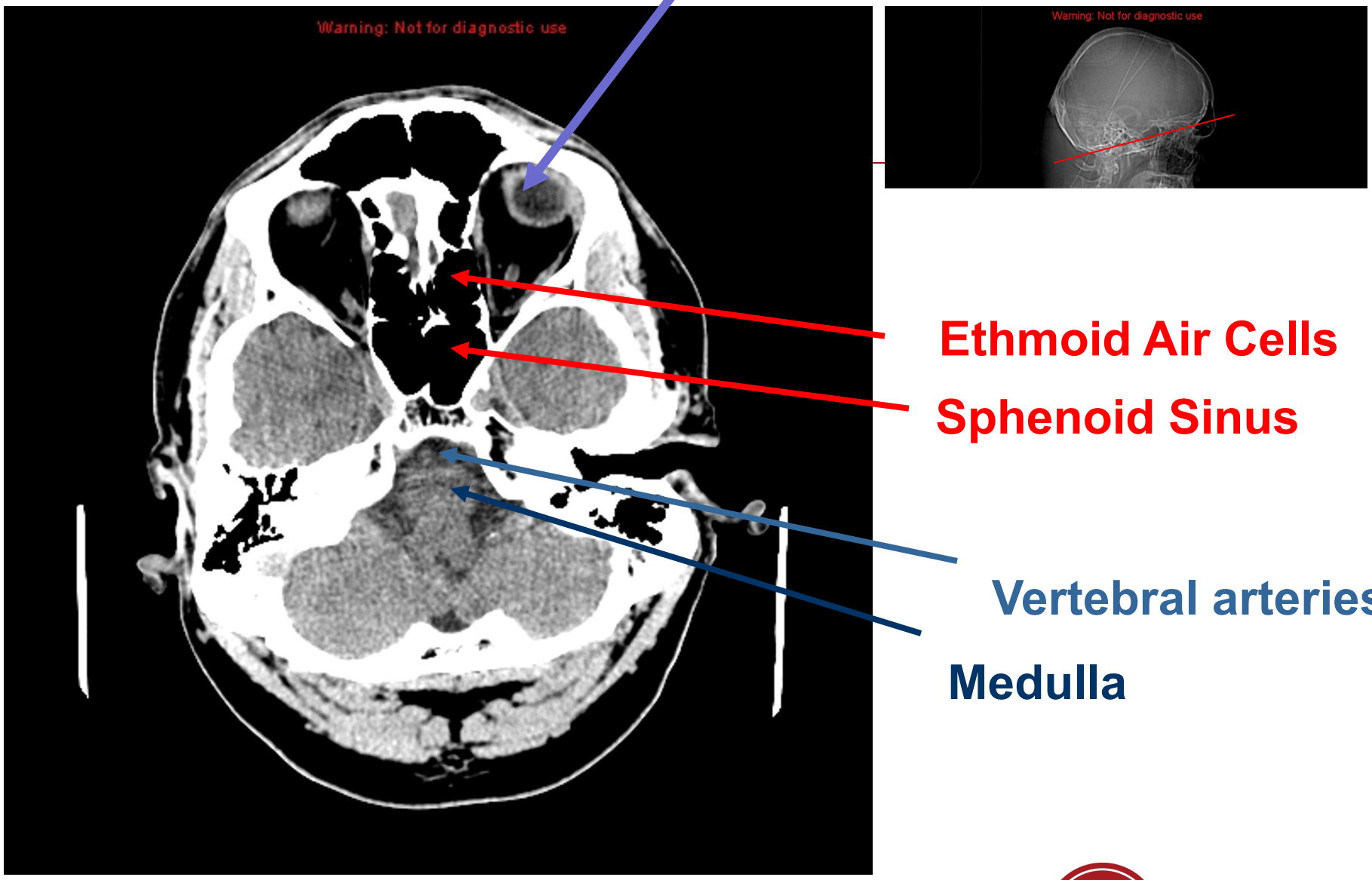


Dorsum Sella

Basilar artery

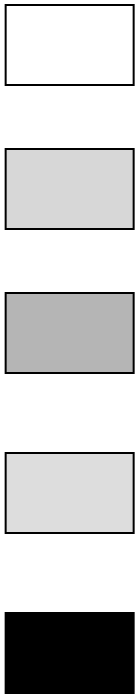
Mastoid Air Cells

Global Health Emergency Medicine



Global Health Emergency Medicine

THE BASICS



HYPERDENSE (White)

HYPODENSE (Black)

BONE

Blood

Grey Matter

White Matter

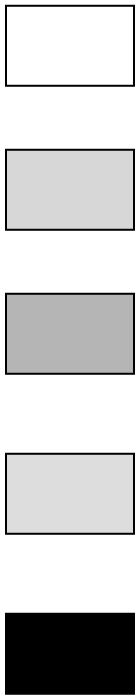
Infarct or tumor

CSF

AIR

Global Health Emergency Medicine

Hyperdensities



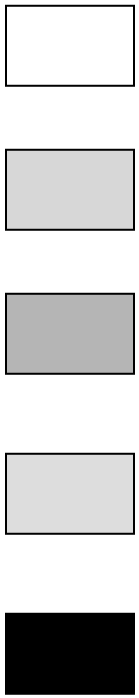
HYPERDENSE (White)

HYPODENSE (Black)

- **Normal** = Bone, pineal glands and choroid plexus, age-related calcification in arteries
- **Abnormal** = calcifications in tumour, AVM, aneurysms, fresh blood

Global Health Emergency Medicine

Hypodensities



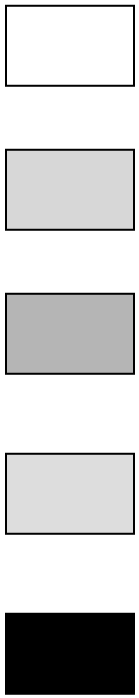
HYPERDENSE (White)

HYPODENSE (Black)

- Edema
- Infarction
- Resolving hematoma
- Inflammation – encephalitis
- Encephalomalacia

Global Health Emergency Medicine

Mixed densities



HYPERDENSE (White)

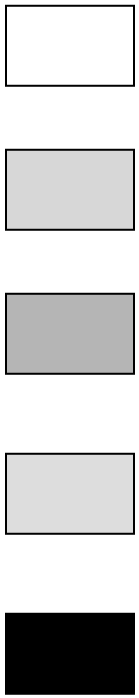
HYPODENSE (Black)

- Tumor
- Abscess
- AVM
- Contusion
- Hemorrhagic infarct

Global Health Emergency Medicine

Contrast CT

What are the differences?



HYPERDENSE (White)

HYPODENSE (Black)

- Vascular structures become more **hyperdense**
  - Arteries
  - Veins
- Structures outside of blood brain barrier (falx and tentorium) also become more **hyperdense**

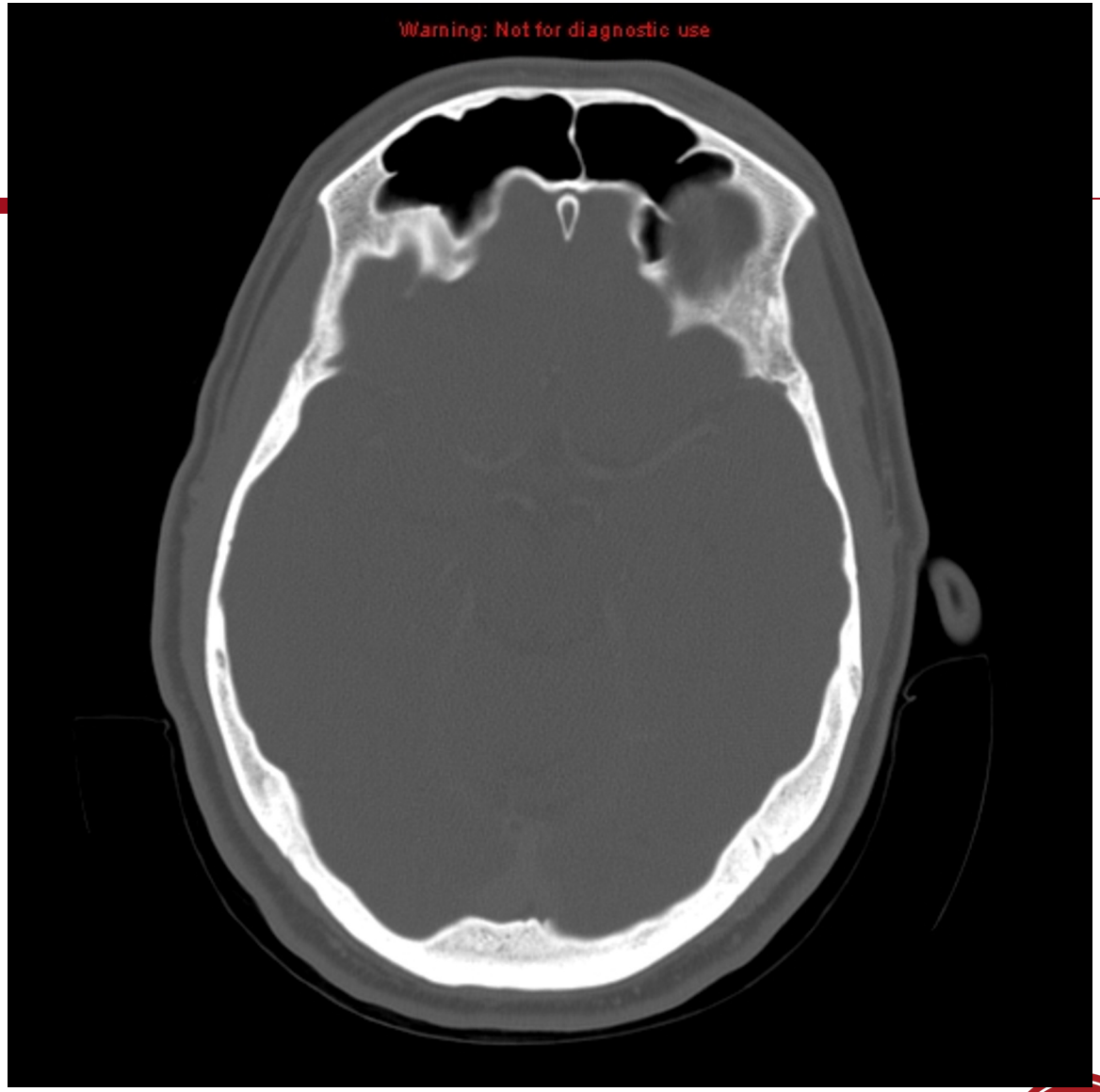
Global Health Emergency Medicine

What are the differences?

- Vascular supply to abscesses and some tumours = usually in the periphery of the lesion = **enhancement**

- Extra-axial tumours have **homogenous enhancement** = meningiomas and cranial nerve tumours (e.g. Schwannoma)

Global Health
Emergency Medicine

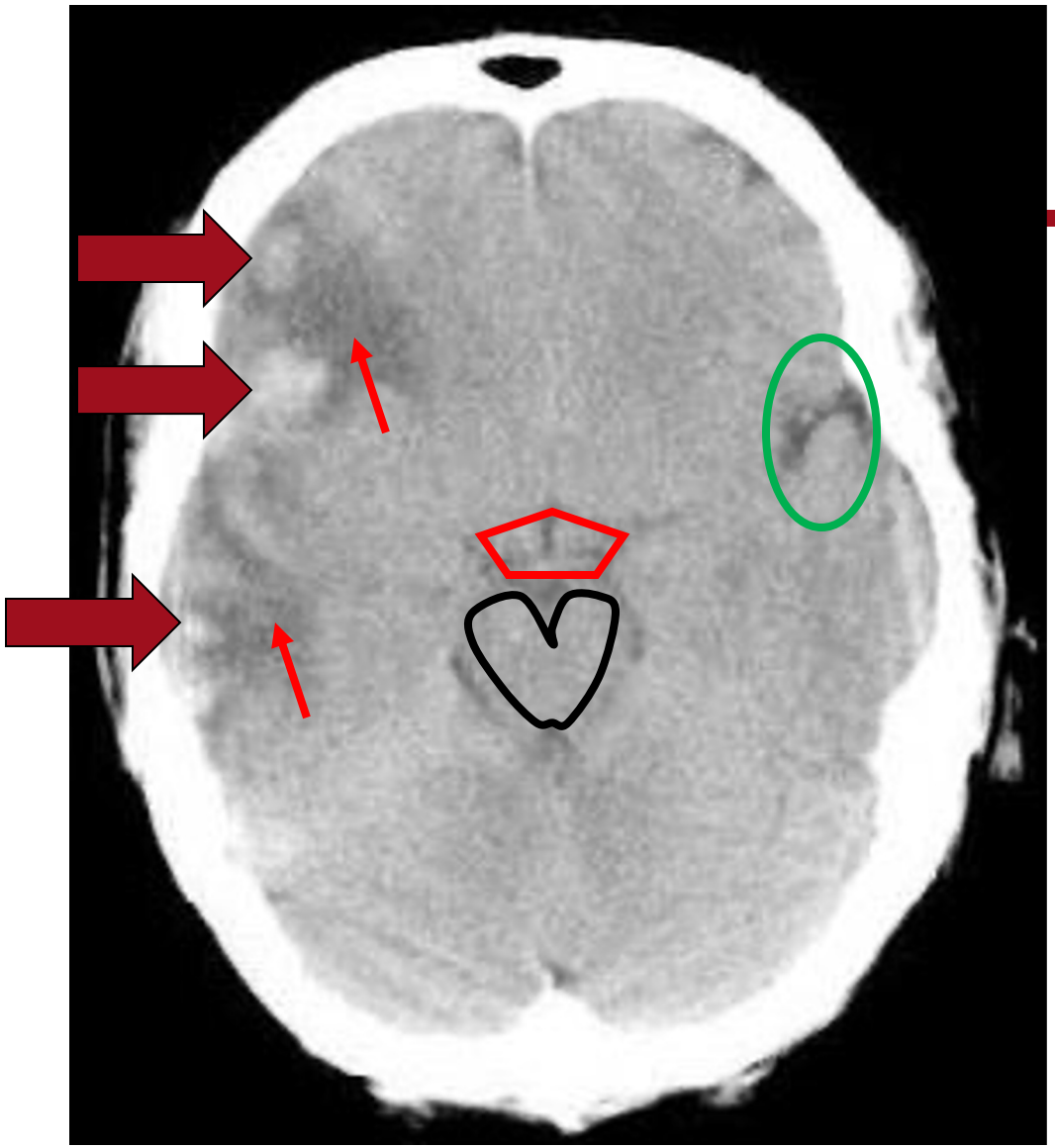


Global Health
Emergency Medicine

Trauma

Approach to Trauma

- Look for **Blood**
  - Soft tissue swelling of scalp can give you a hint
- Look for **Fractures**
  - Look for abnormal “air” = pneumocephalus
- Look for the appearance of **Ventricles** – is there effacement or enlargement
- Look for **edema, midline shift, herniation**



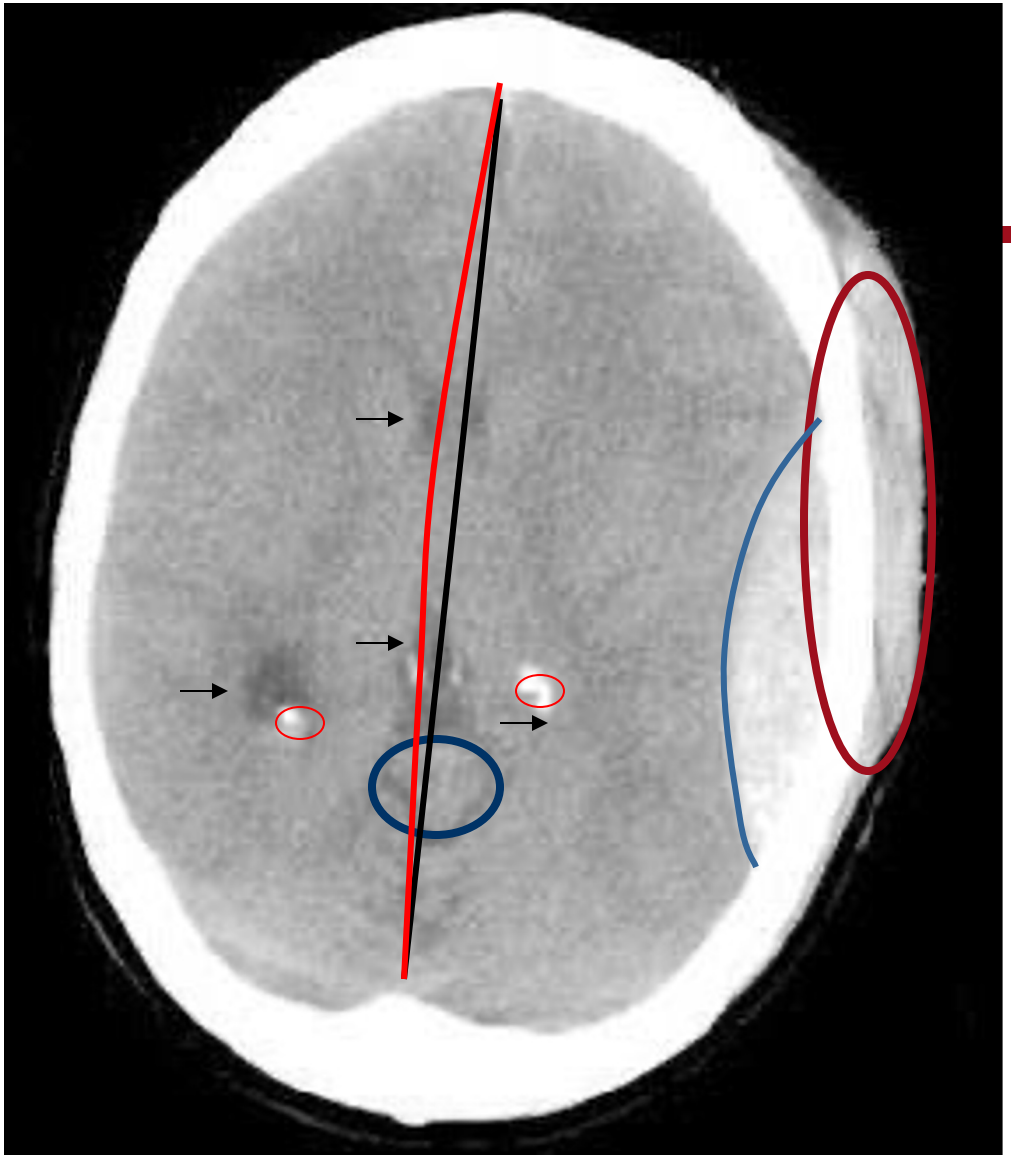
1. Identify the Midbrain

2. Identify the Suprasellar Cistern

3. Identify the Sylvian fissure

4. What are the abnormalities (blood, fractures, ventricles, edema or shift)?

Global Health Emergency Medicine



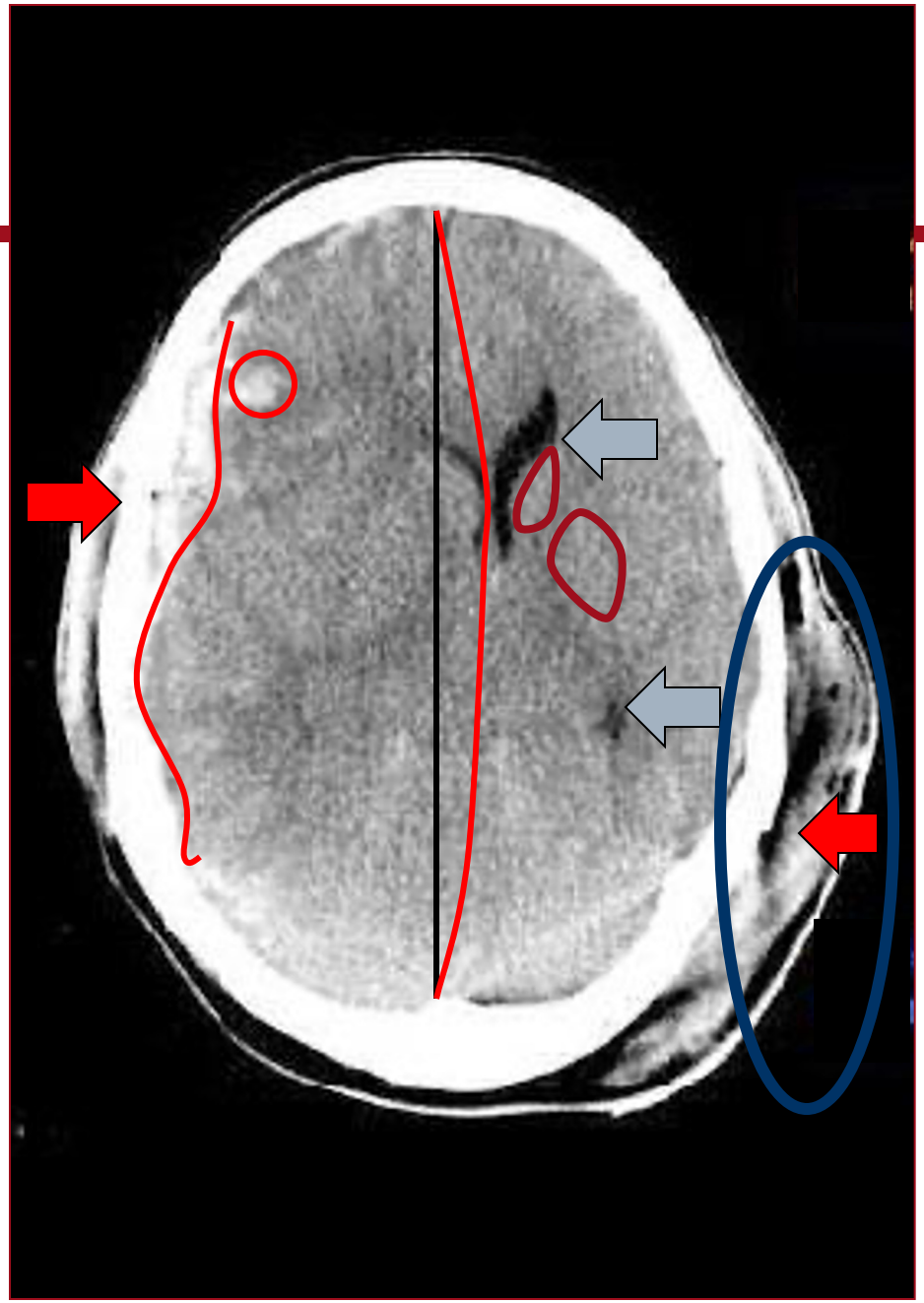
1. Identify the Ventricles

2. Identify the Choroid Plexus

3. Identify the cerebellar vermis

4. What are the Abnormalities (Blood, Fractures, Ventricles, Edema or Shift)?

Global Health Emergency Medicine

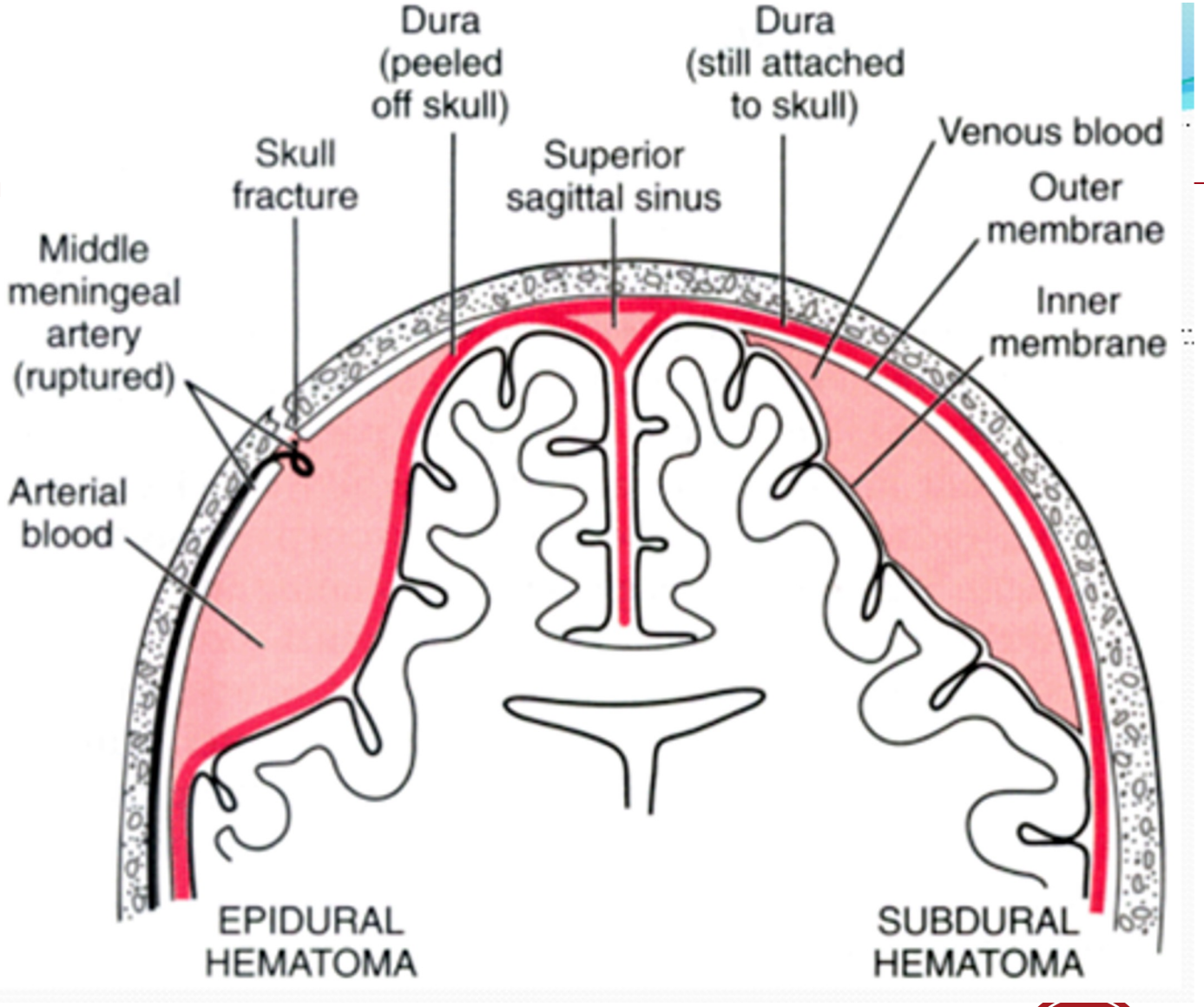


1. Identify the Ventricles

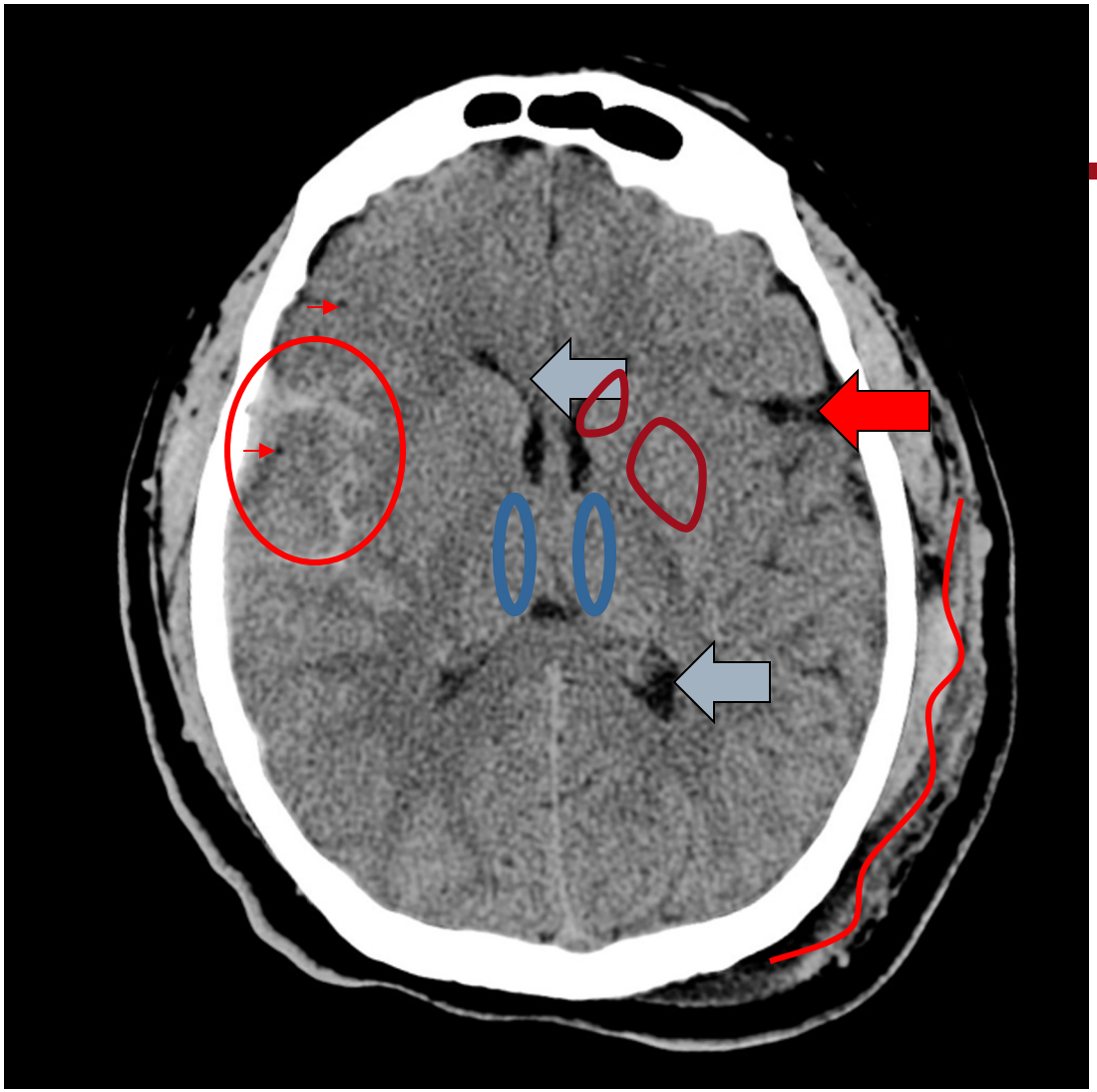
2. Identify the basal ganglia on the left

3. What are the Abnormalities (Blood, Fractures, Ventricles, Edema or Shift)?

Global Health Emergency Medicine



Global Health
Emergency Medicine



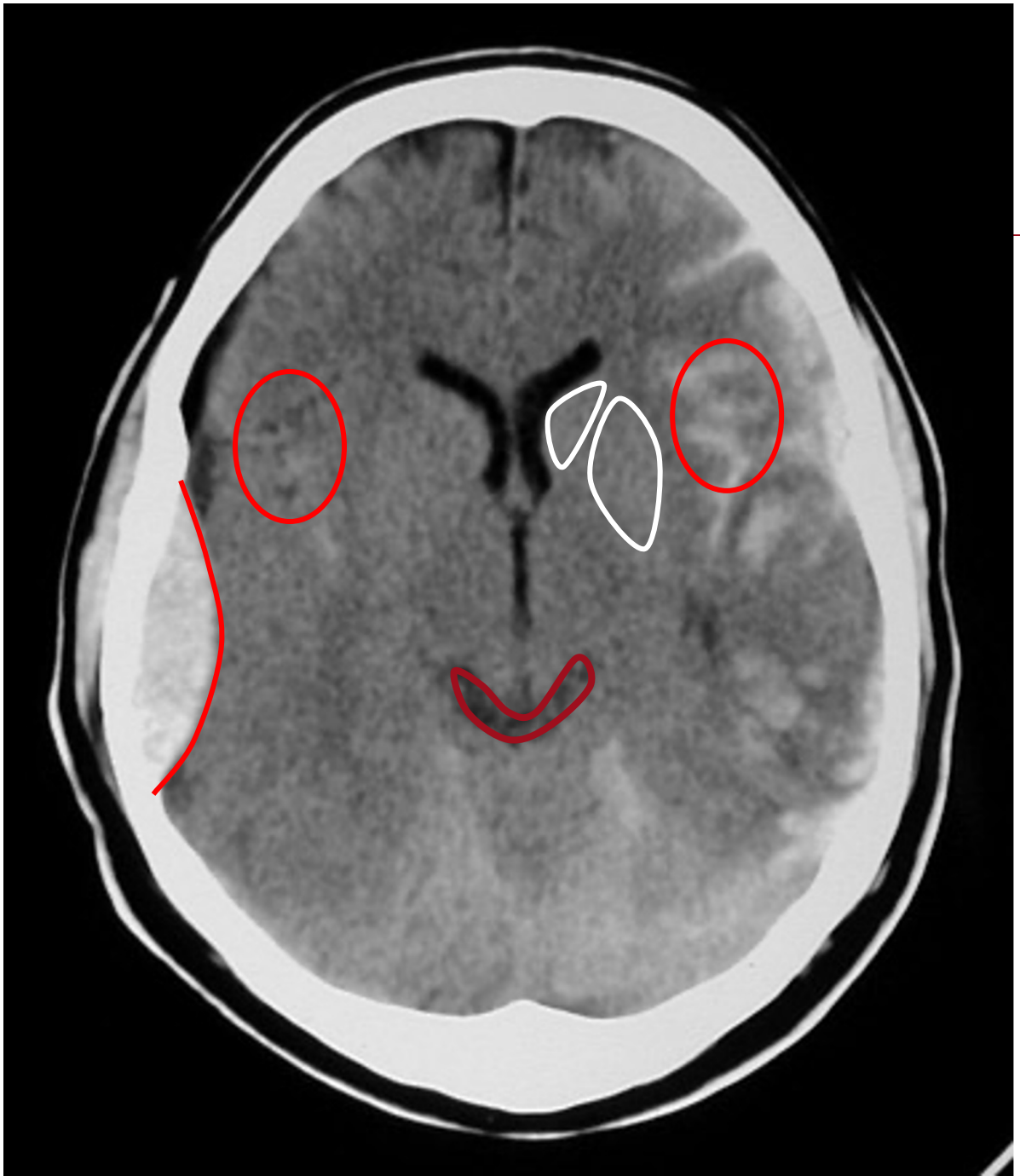
1. Identify the Lateral Ventricles

2. Identify the basal ganglia

3. Identify the thalamus

4. What are the Abnormalities (Blood, Fractures, Ventricles, Edema or Shift)?

Global Health Emergency Medicine



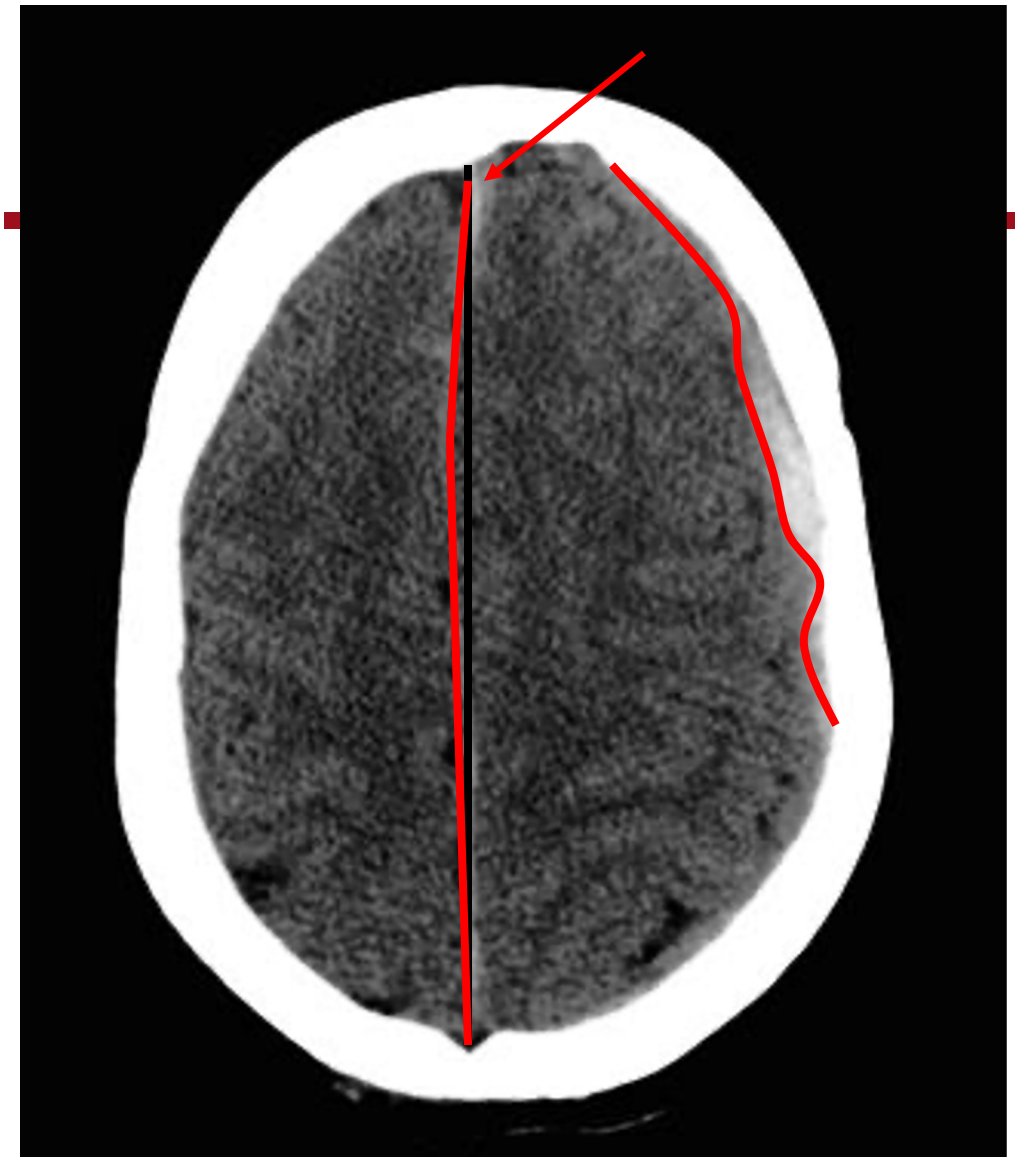
1. Identify the quadrigeminal cistern

2. Identify the basal ganglia

3. Can you identify the sylvian fissure?

4. What are the Abnormalities?

Global Health Emergency Medicine



What are the Abnormalities?

Global Health Emergency Medicine

Blood in Trauma

	Epidural	Subdural	Parenchymal	Subarachnoid
Location				
Shape				
Crosses sutures				
Crosses midline				

Blood in Trauma

	Epidural	Subdural	Parenchymal	Subarachnoid
Location	**Outside of the Dura**			
Shape	**Lens (biconvex)**			
Crosses sutures	**No**			
Crosses midline	**Yes**			

Global Health Emergency Medicine

Blood in Trauma

	Epidural	Subdural	Parenchymal	Subarachnoid
Location	Outside of the Dura	**Under the Dura**		
Shape	Lens (biconvex)	**Crescent**		
Crosses sutures	No	**Yes**		
Crosses midline	Yes	**No**		

Global Health Emergency Medicine

Blood in Trauma

	Epidural	Subdural	Parenchymal	Subarachnoid
Location	Outside of the Dura	Under the Dura	**Parenchyma**	
Shape	Lens (biconvex)	Crescent	**Depends**	
Crosses sutures	No	Yes	**N/A**	
Crosses midline	Yes	No	**N/A**	

Blood in Trauma

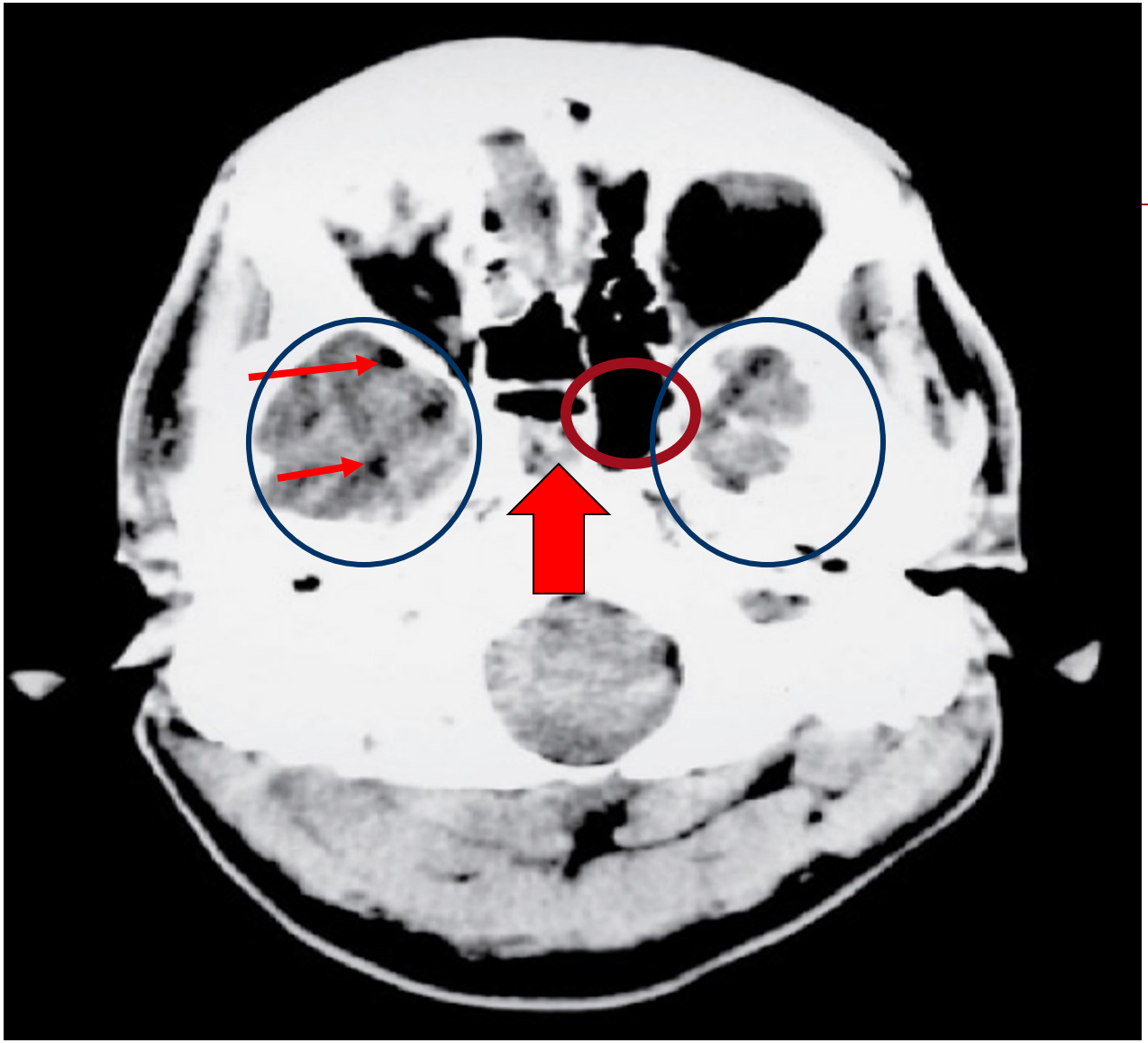
	Epidural	Subdural	Parenchymal	Subarachnoid
Location	Outside of the Dura	Under the Dura	Parenchyma	**Under the arachnoid**
Shape	Lens (biconvex)	Crescent	Depends	**Follows shape of sulci (if large enough can enter ventricles and cisterns)**
Crosses sutures	No	Yes	N/A	**N/A**
Crosses midline	Yes	No	N/A	**N/A**

Subdural Hematoma

- Acute
  - Hyperdense
- Subacute
  - Isodense
- Chronic
  - Hypodense

Where is the Sudural hematoma?

Global Health Emergency Medicine

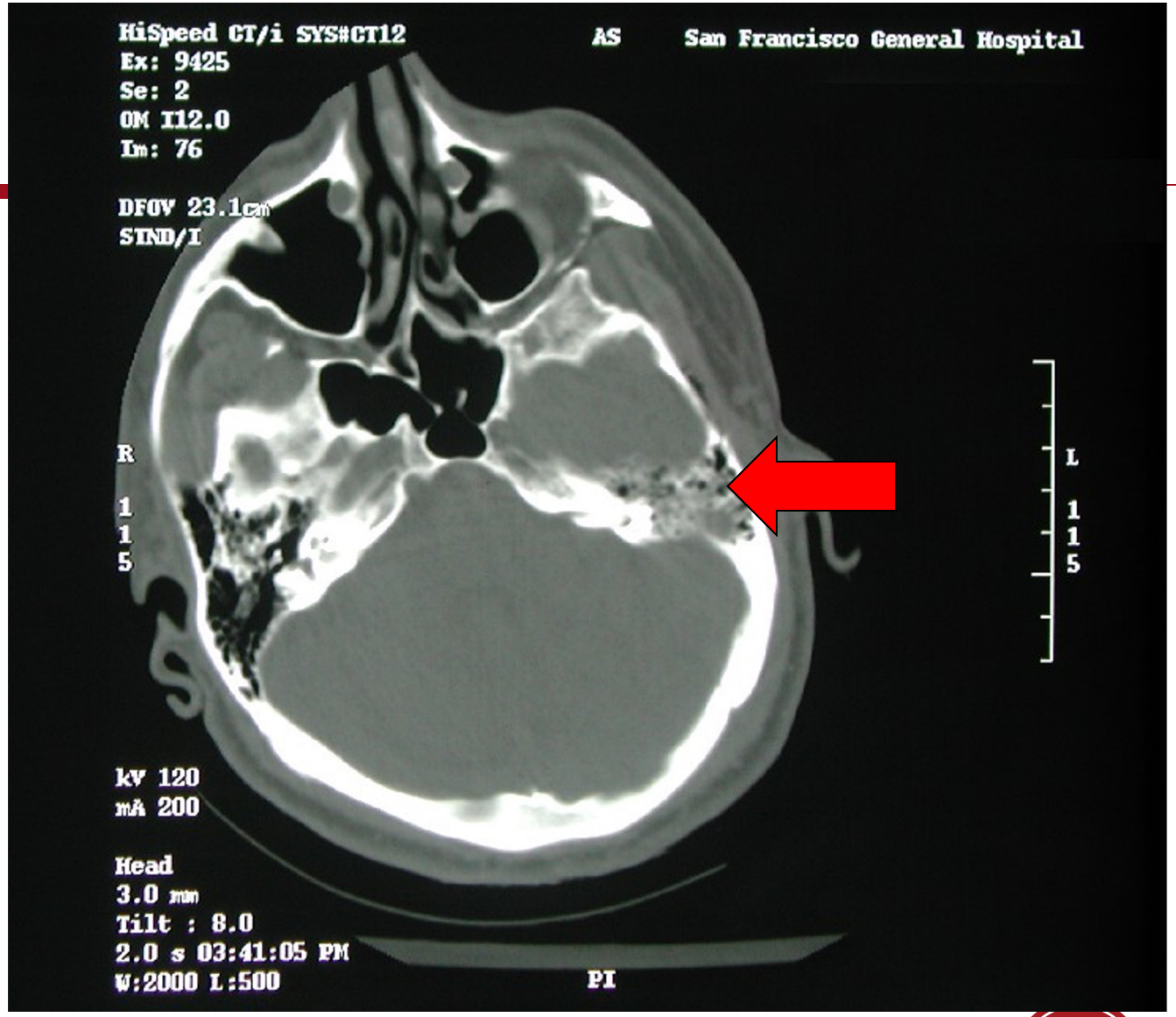


1. Identify the temporal cortex
2. Identify the Sphenoid sinus
3. What are the Abnormalities?

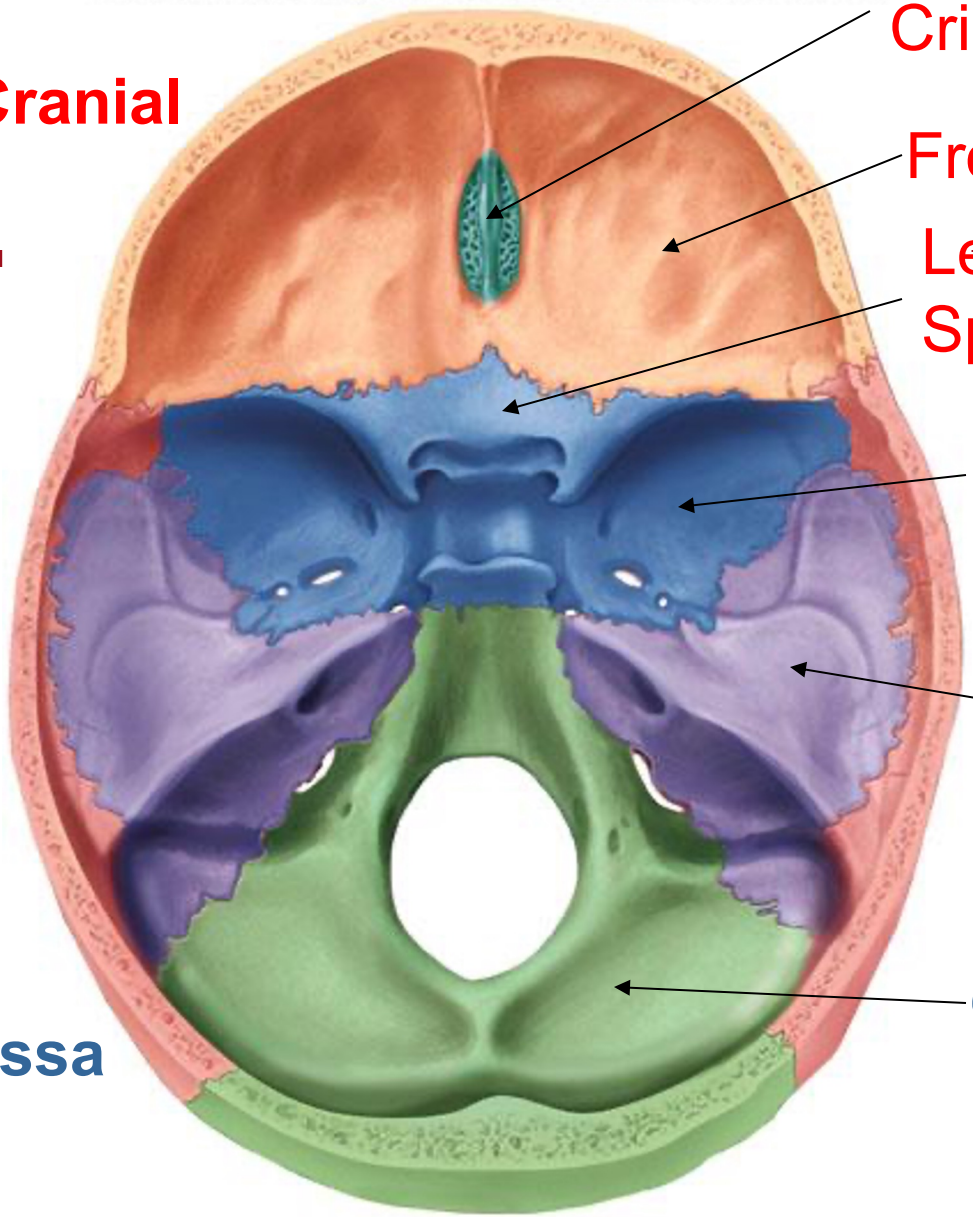
Global Health Emergency Medicine

Indirect CT Head Findings of Basilar Skull Fracture

- Pneumocephalus
- Air/fluid levels sphenoid sinuses
- Mastoid air cell opacification



Global Health Emergency Medicine



Anterior Cranial Fossa

Cribriform Plate

Frontal Bone

~~Lesser Wing~~ Sphenoid

Greater Wing Sphenoid

Middle Cranial Fossa

Temporal Bone

75%

Posterior Fossa

Occipital Bone

(b) Superior view of cranial floor

Global Health Emergency Medicine

Summary

- Develop a systematic approach
- Practice CT anatomy
  - Your best weapon against missing abnormalities
  - Look for landmarks - Ventricles, sylvian fissure, midbrain, suprasellar cistern etc.

Practice…

- Emergency Radiology by David T. Schwartz - Chapter pp 435-522