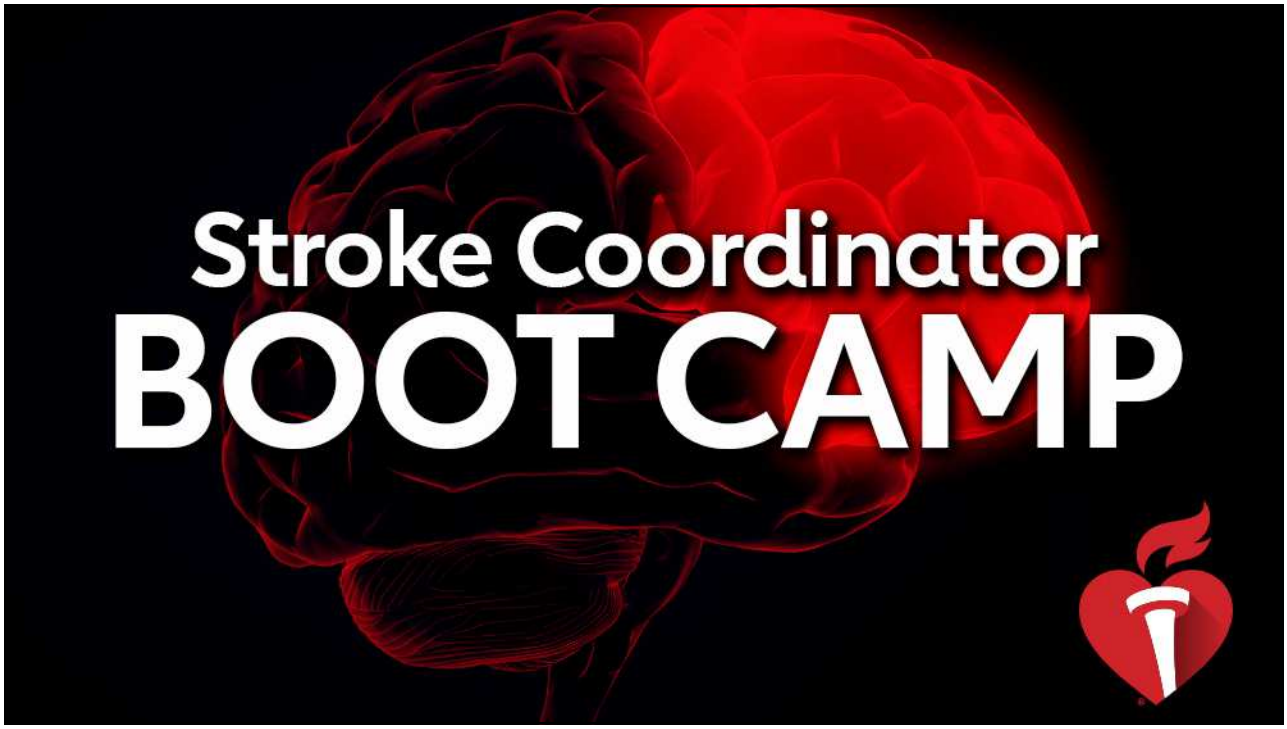

1

Stroke Coordinator
BOOT CAMP

'NEURO IMAGING OF ACUTE STROKE'

ALICIA RICHARDSON, MSN, RN, ACCNS-AG, ANVP-BC

WENDY SMITH, MA, RN, MBA, SCRN, FAHA

LYNN HUNDLEY, APRN, CNRN, CCNS, ANVP-BC

2

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DISCLOSURES

Alicia Richardson: Stryker Neurovascular Consultant

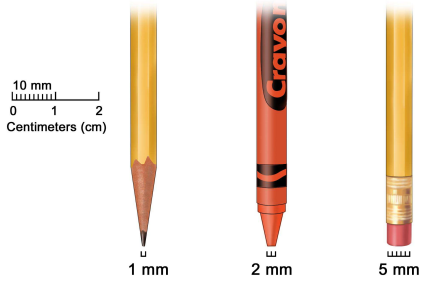
Wendy Smith: None

Lynn Hundley: Medtronic: Speaker Bureau, modest; Arbor Pharmaceuticals: Speaker Bureau, modest

3

NCCT

Bone	Very White
Acute Blood	Very White
Enhanced tumor	Very White
Subacute Blood	Light Grey
Muscle	Light Grey
Grey Matter	Light Grey
White Matter	Medium Grey
CSF	Medium Grey to Black
Air, Fat	Very Black



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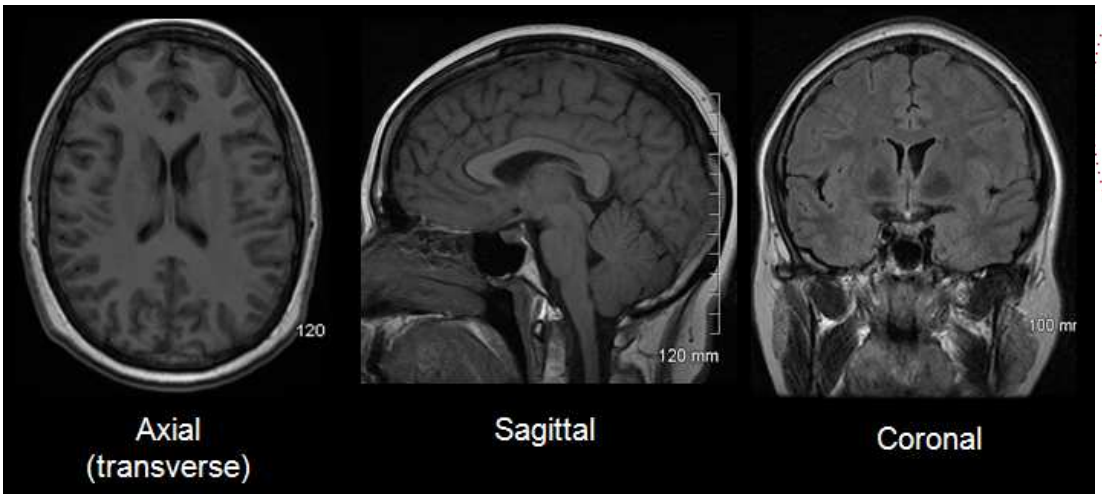


5

5

WHAT DO THESE WORDS MEAN?

Diffuse	• It's everywhere
Mass effect	• Stuff is pressing on stuff
Sulcal Effacement	• Now you can't see the difference between the sulci & gyri
Cytotoxic	• Swelling of white and grey matter
Midline shift	• Stuff is pressing really hard, into the other hemisphere hard

Edema

6

6

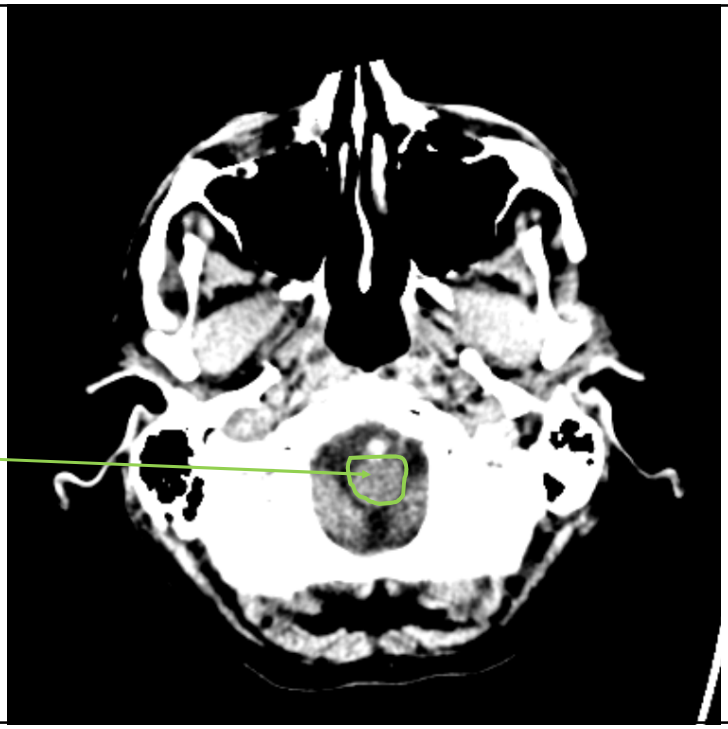
WHAT DO THESE WORDS MEAN?

Encephalomalacia	• Loss of brain tissue, dark area
Hypointense	• Dark
Hypodense	• Dark area
Isointense	• Neutral or same as other tissues
Hyperintense	• Bright
Hyperdense	• Bright area

Color

7

7



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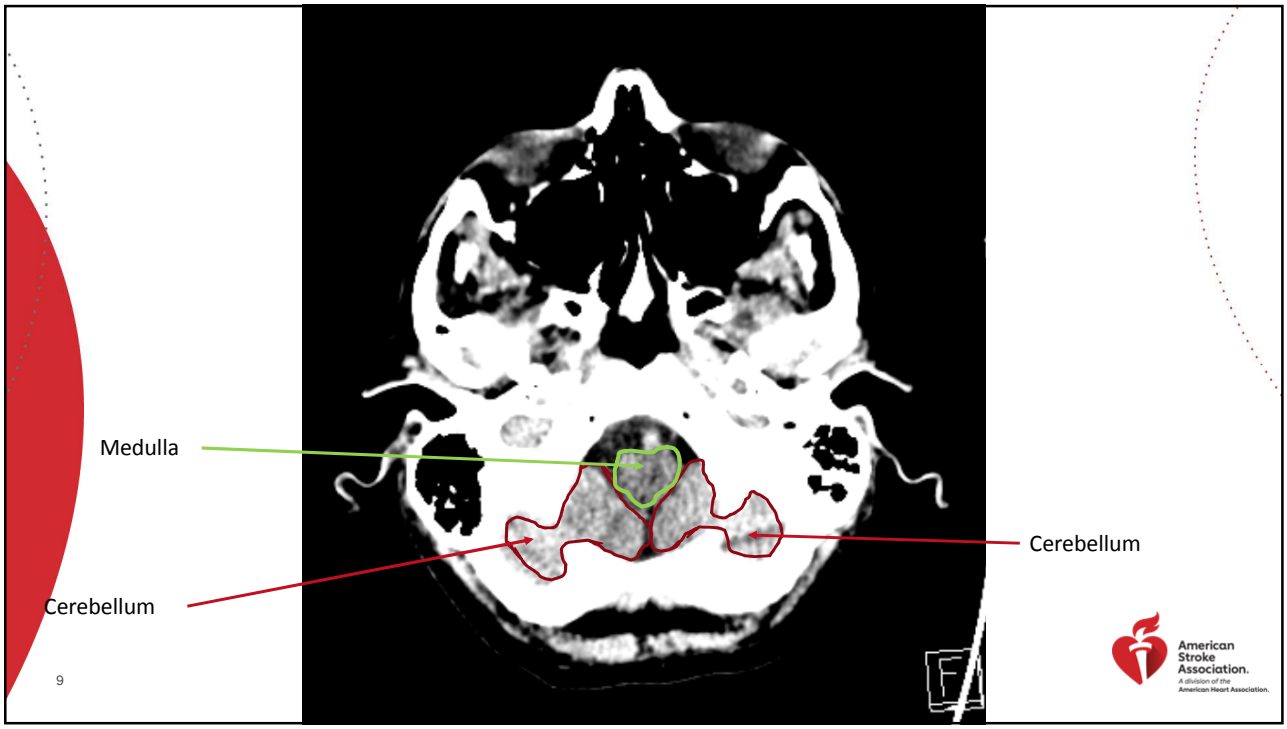
Medulla
Cerebellum
Cerebellum
9
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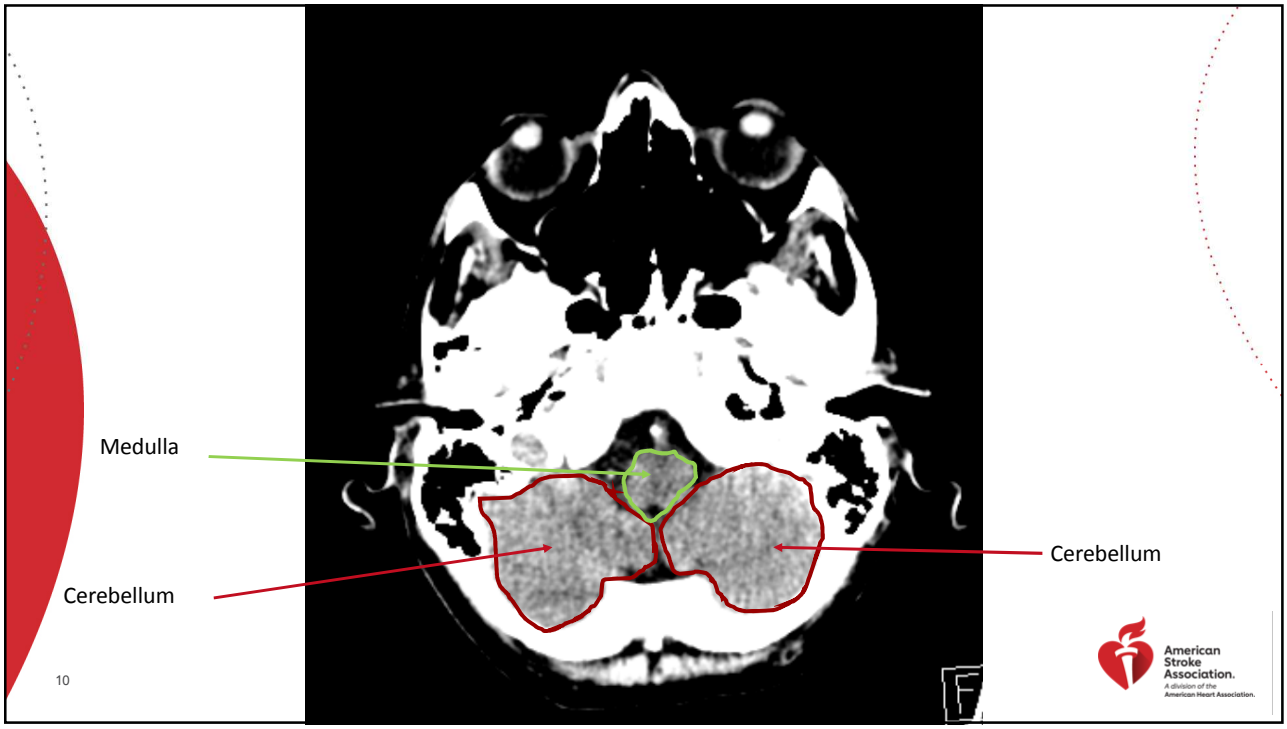
Medulla
Cerebellum
Cerebellum
10
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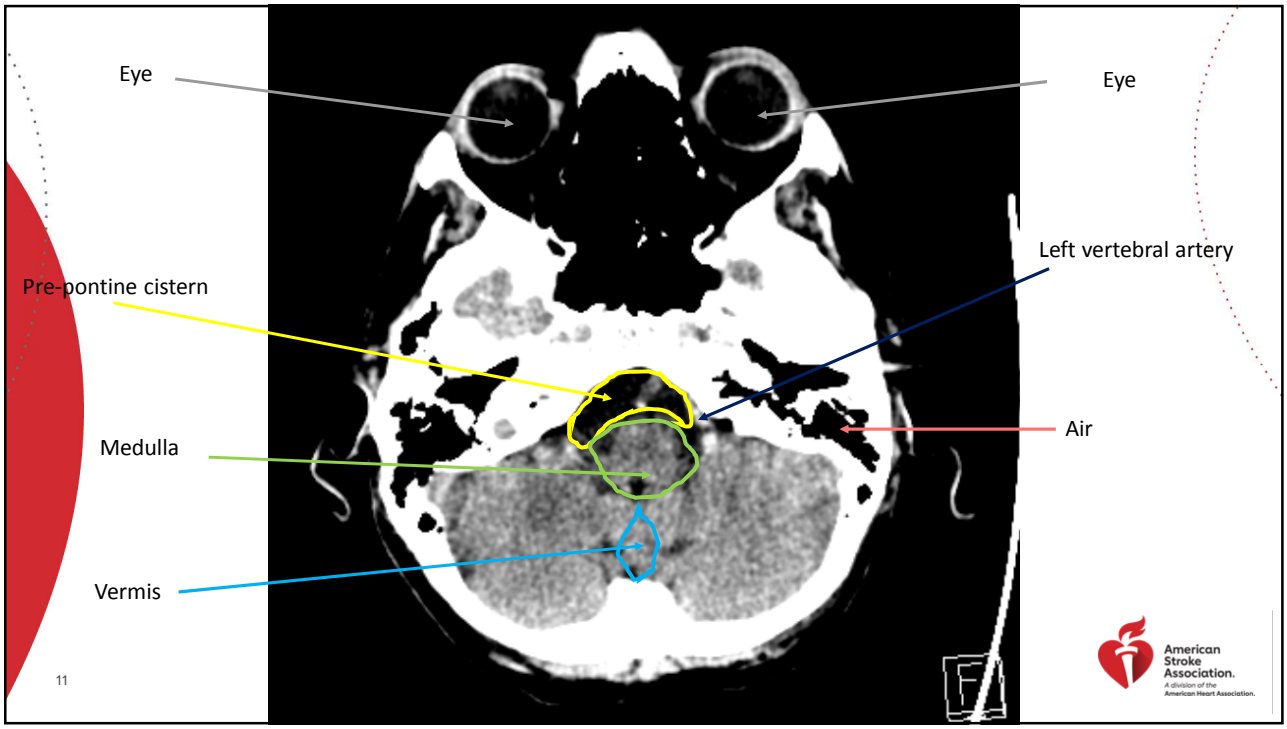
Eye
Eye
Left vertebral artery
Pre-pontine cistern
Air
Medulla
Vermis
11
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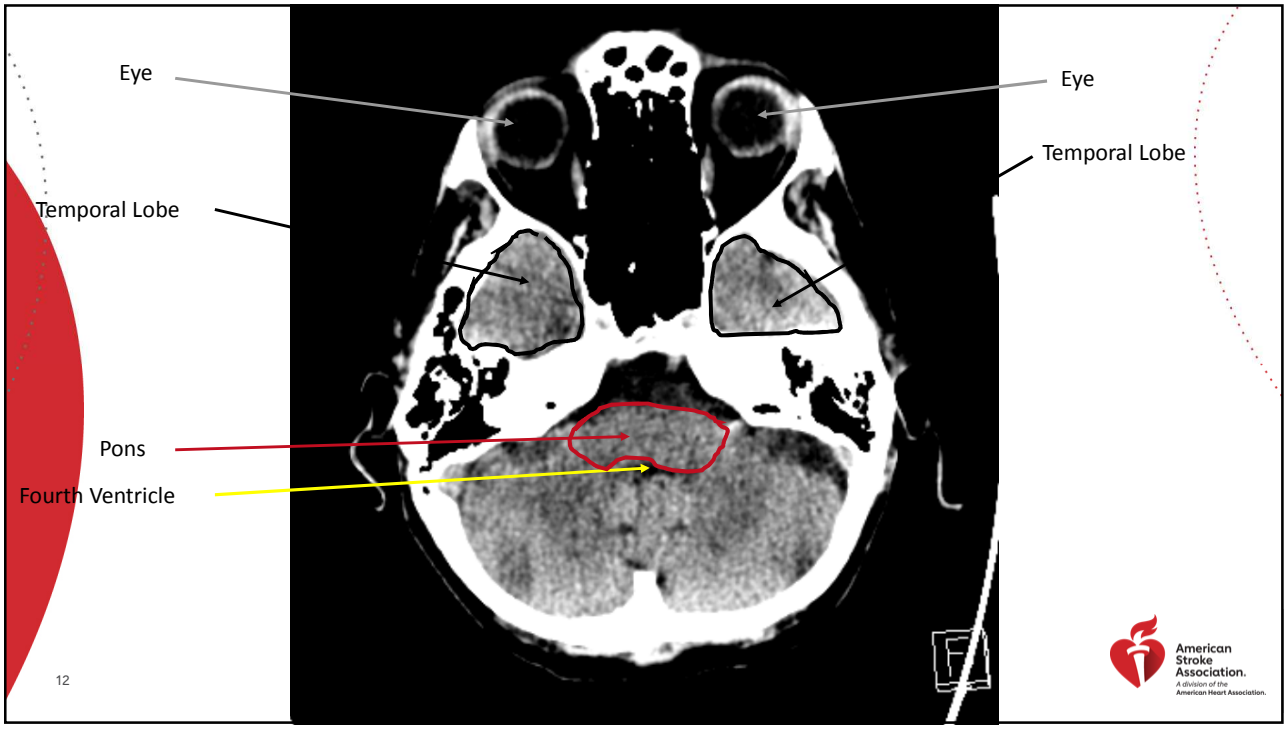
Eye
Eye
Temporal Lobe
Temporal Lobe
Pons
Fourth Ventricle
12
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12

Temporal Lobe
Sella
Pons
Fourth Ventricle
Temporal Lobe
13
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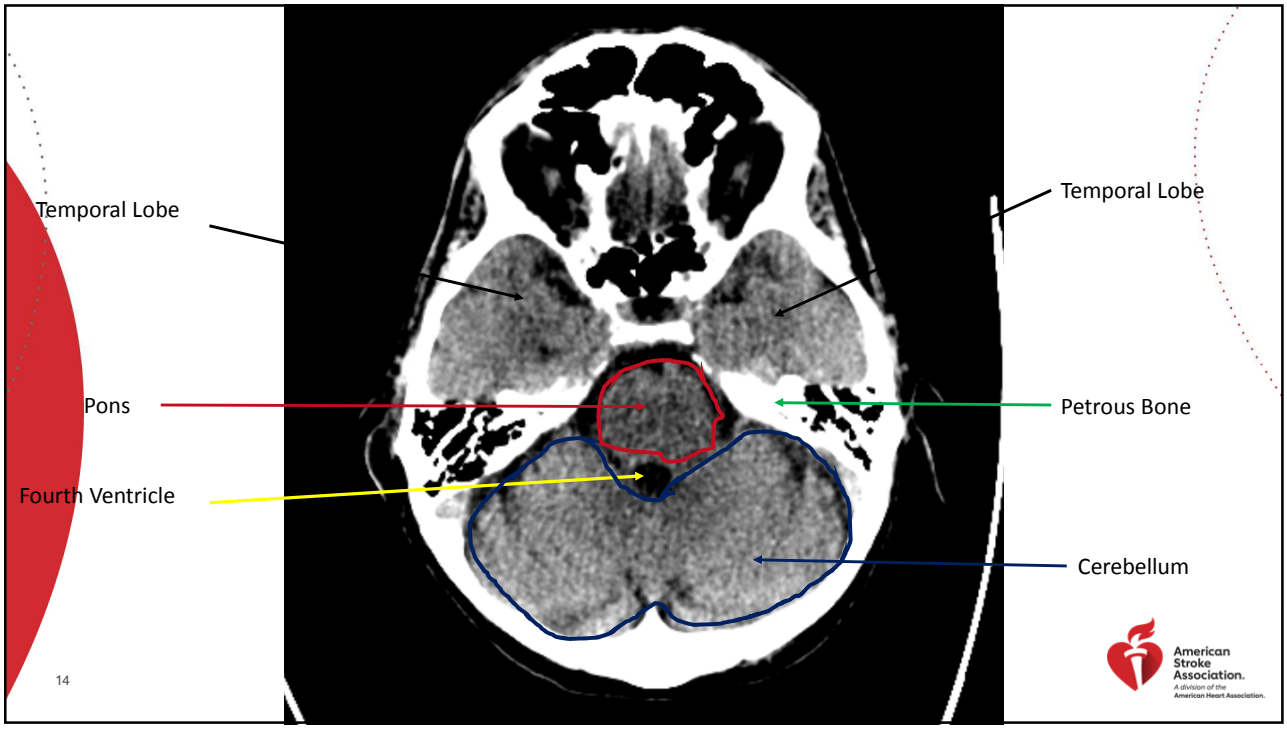
Temporal Lobe
Pons
Fourth Ventricle
Temporal Lobe
Petrous Bone
Cerebellum
14
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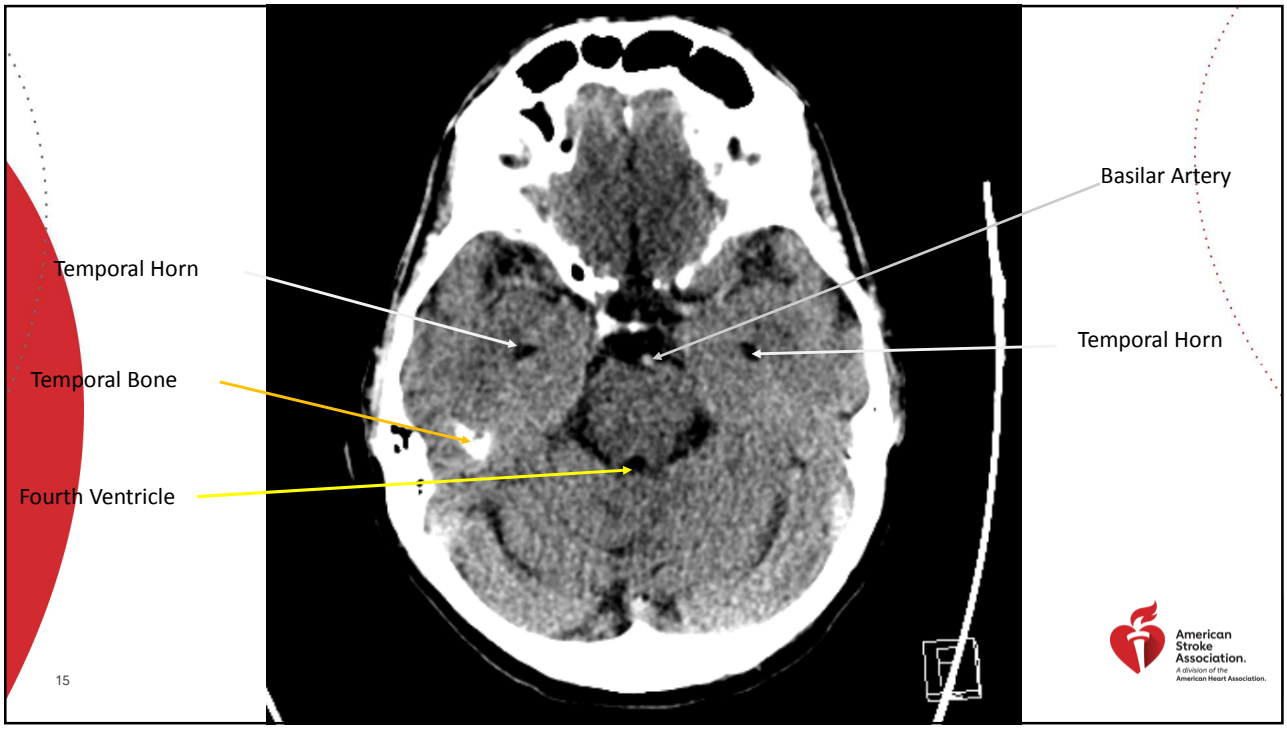
Basilar Artery
Temporal Horn
Temporal Horn
Temporal Bone
Fourth Ventricle
15
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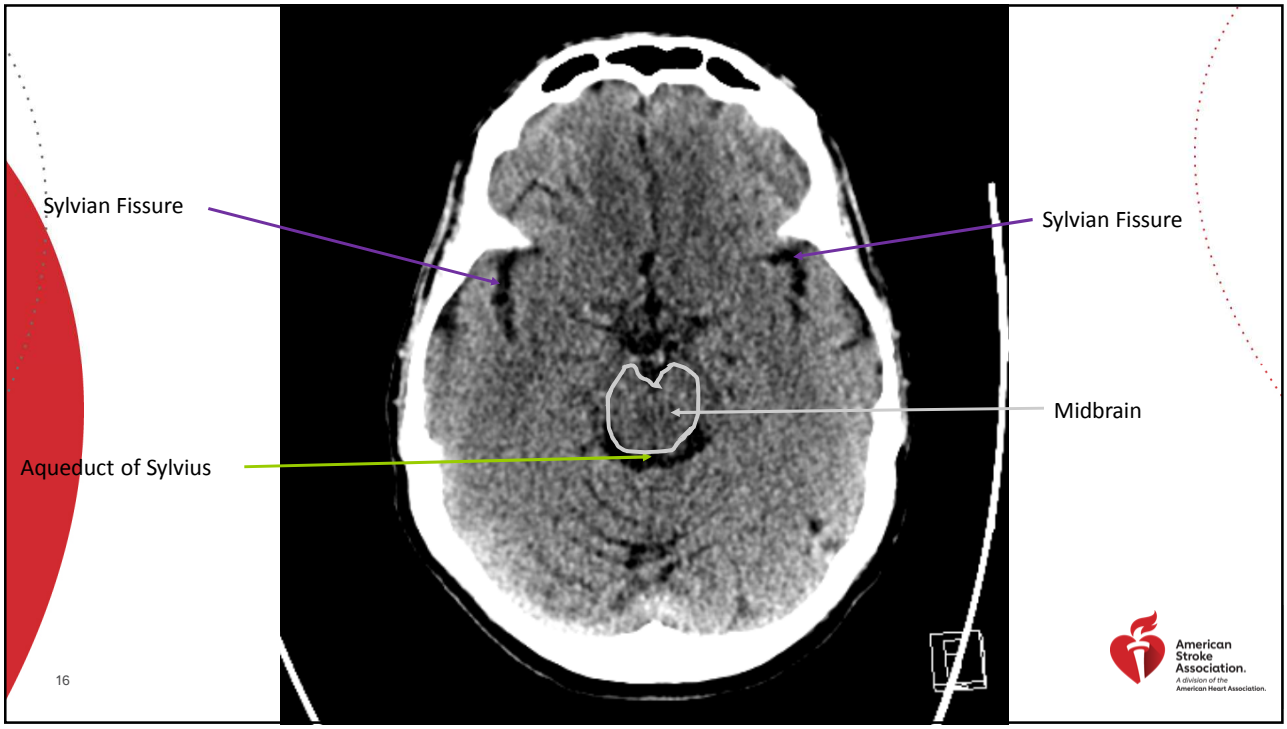
Sylvian Fissure
Sylvian Fissure
Midbrain
Aqueduct of Sylvius
16
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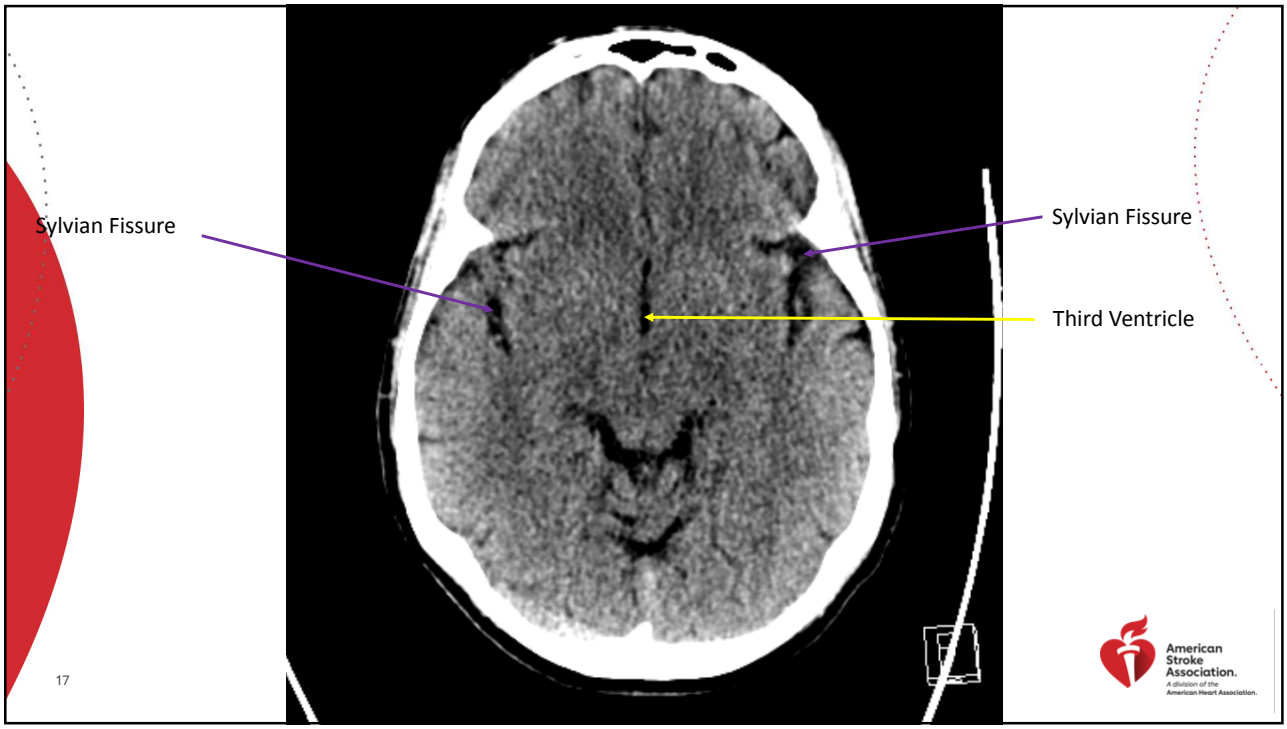
16


Sylvian Fissure
Sylvian Fissure
Third Ventricle
17
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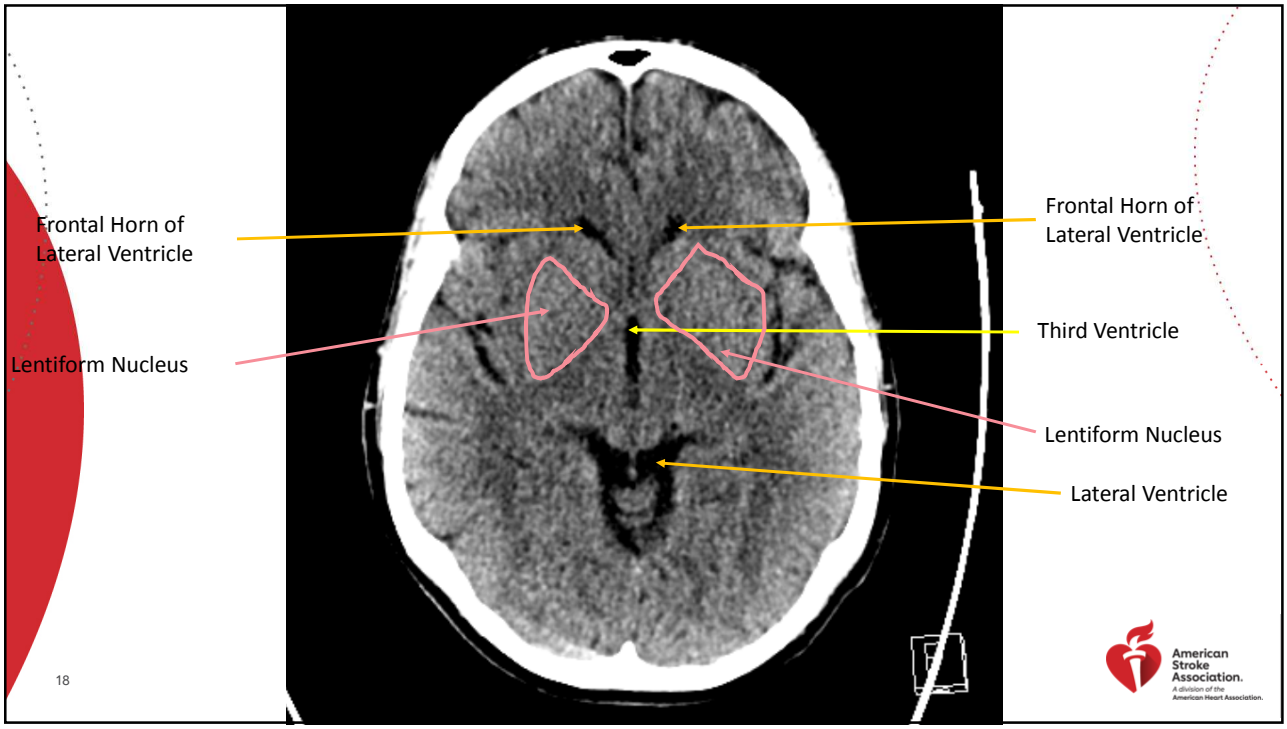
17


Frontal Horn of Lateral Ventricle
Lentiform Nucleus
Frontal Horn of Lateral Ventricle
Third Ventricle
Lentiform Nucleus
Lateral Ventricle
18
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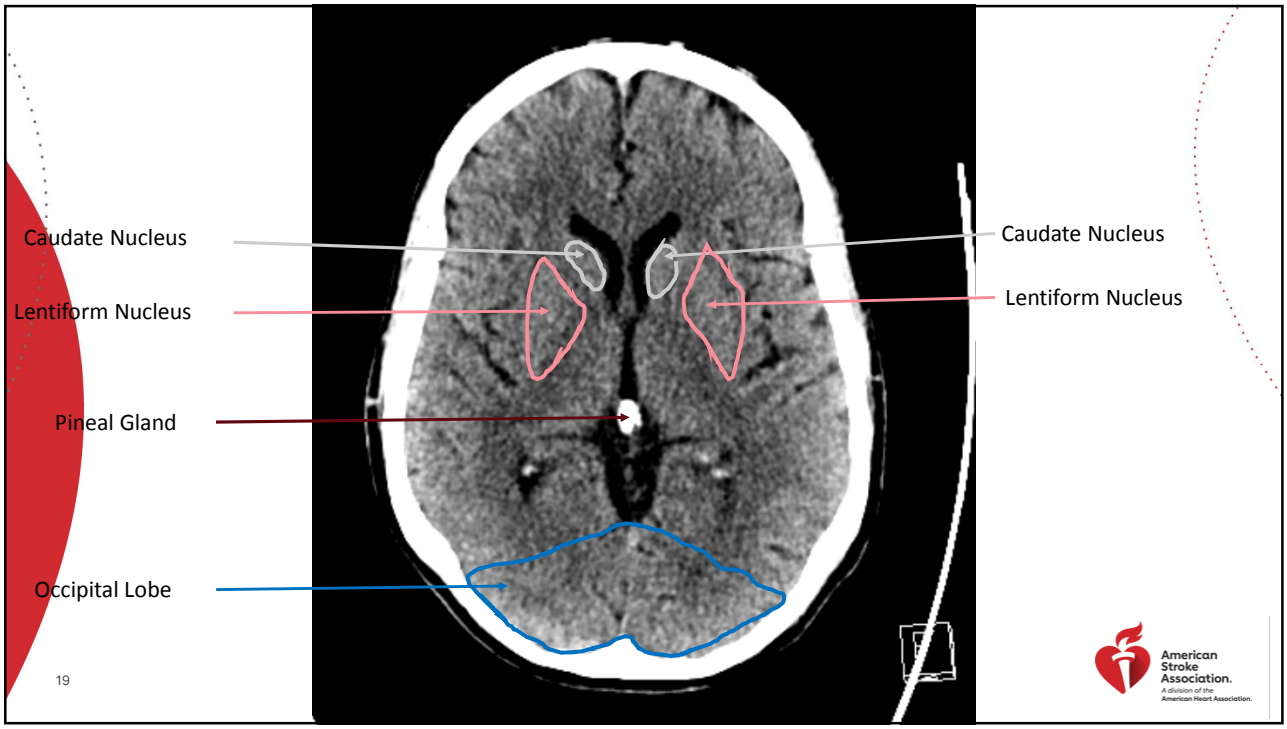
Caudate Nucleus
Lentiform Nucleus
Pineal Gland
Occipital Lobe
Caudate Nucleus
Lentiform Nucleus
19
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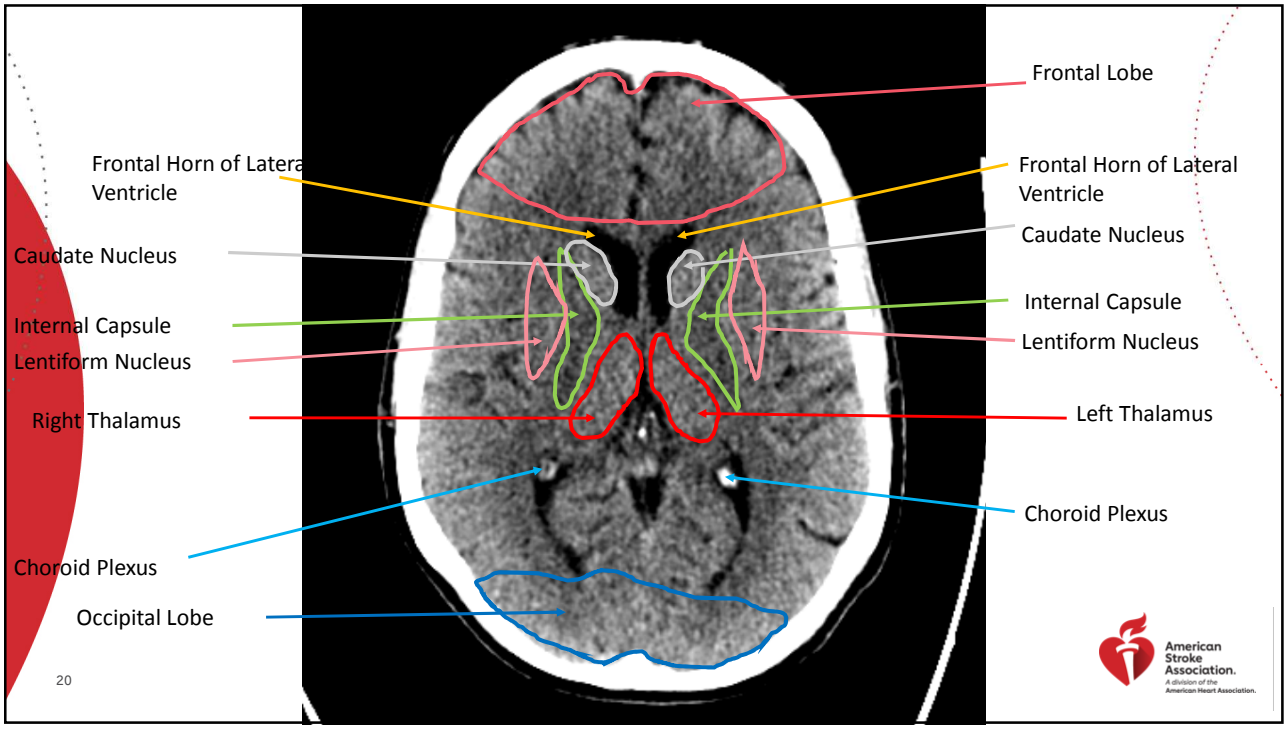
19


Frontal Horn of Latera
Ventricle
Caudate Nucleus
Internal Capsule
Lentiform Nucleus
Right Thalamus
Choroid Plexus
Occipital Lobe
Frontal Lobe
Frontal Horn of Lateral
Ventricle
Caudate Nucleus
Internal Capsule
Lentiform Nucleus
Left Thalamus
Choroid Plexus
20
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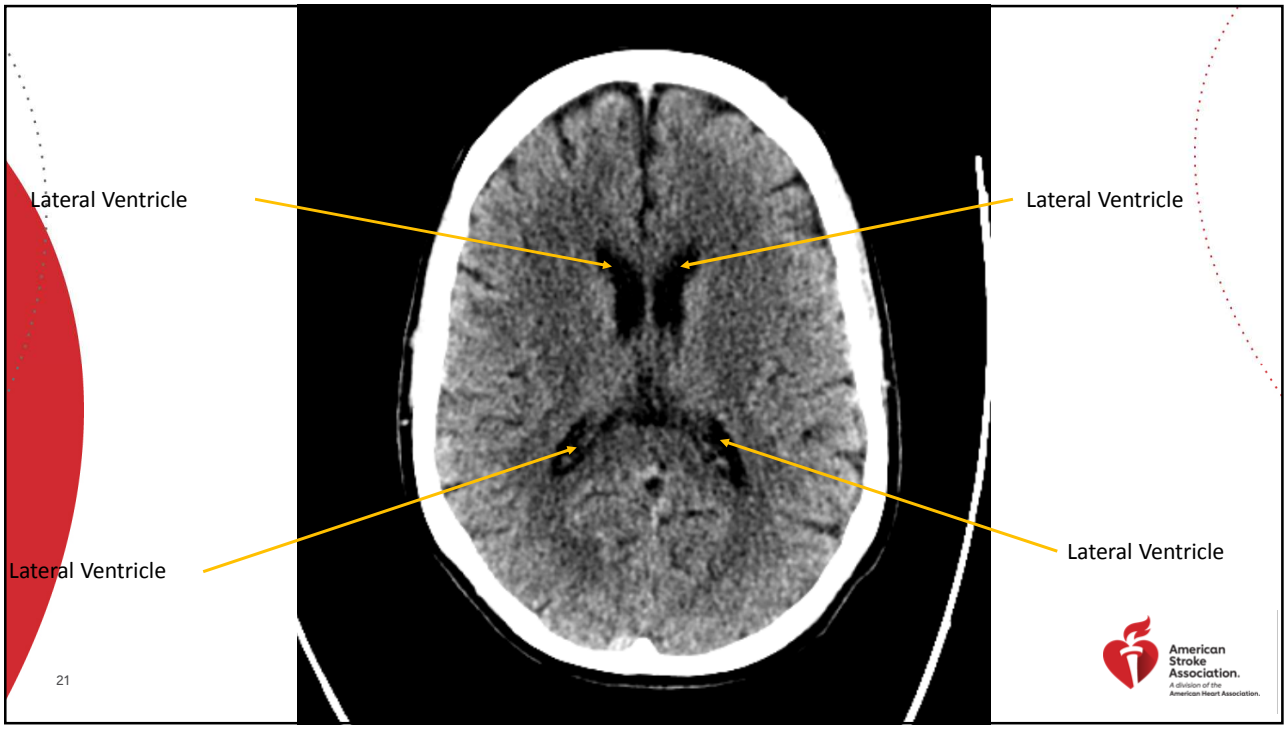
Lateral Ventricle
Lateral Ventricle
Lateral Ventricle
Lateral Ventricle
21
American Stroke Association.
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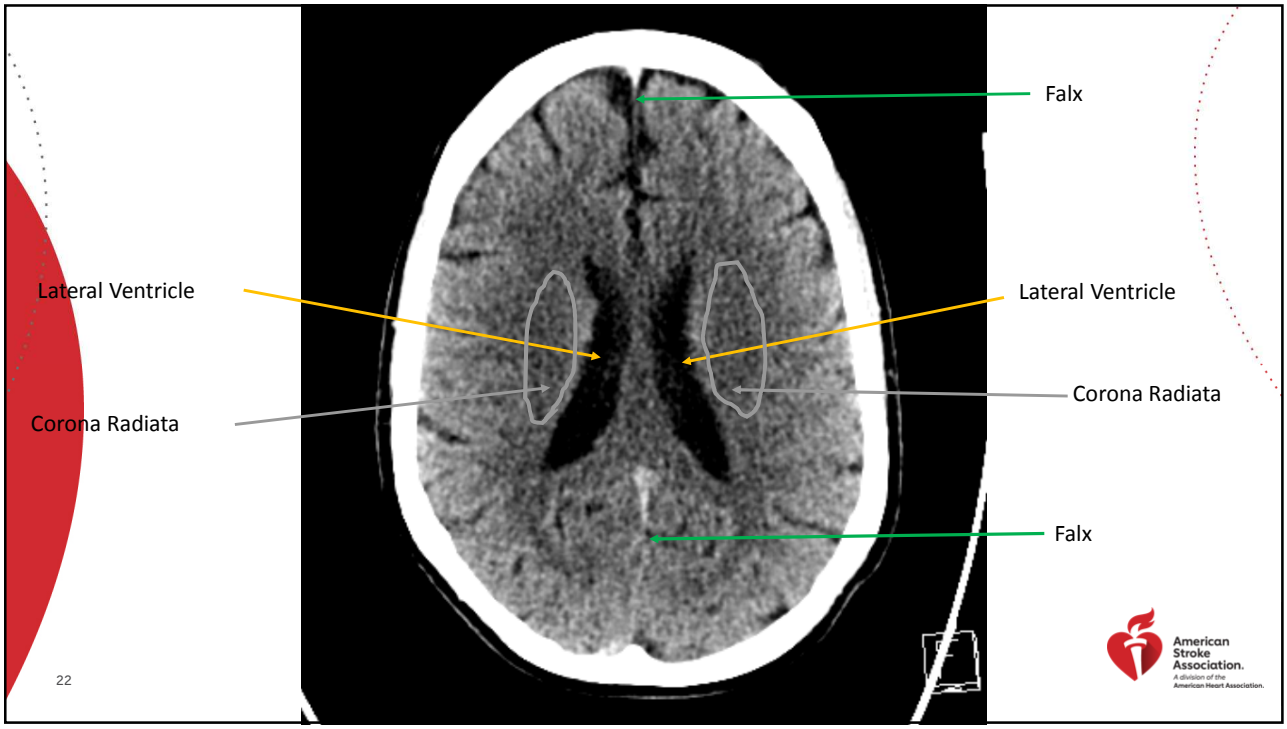
21


Falx
Lateral Ventricle
Lateral Ventricle
Corona Radiata
Corona Radiata
Falx
22
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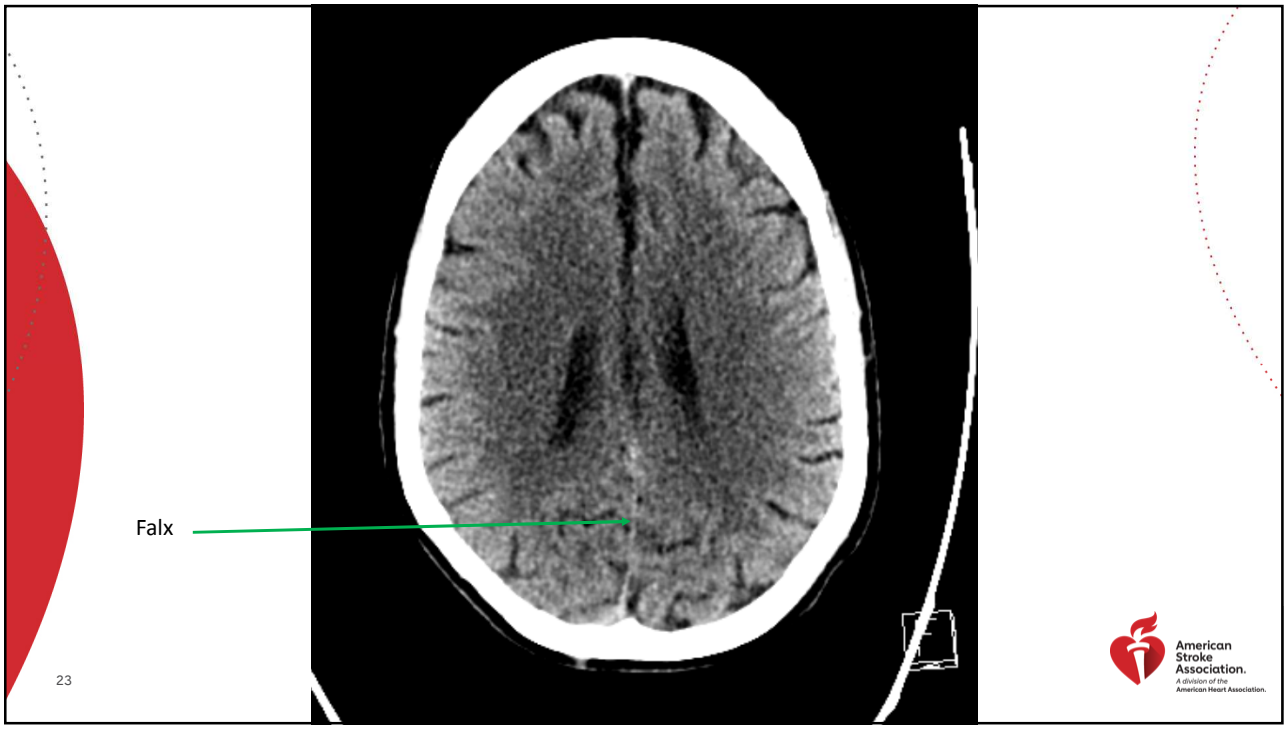
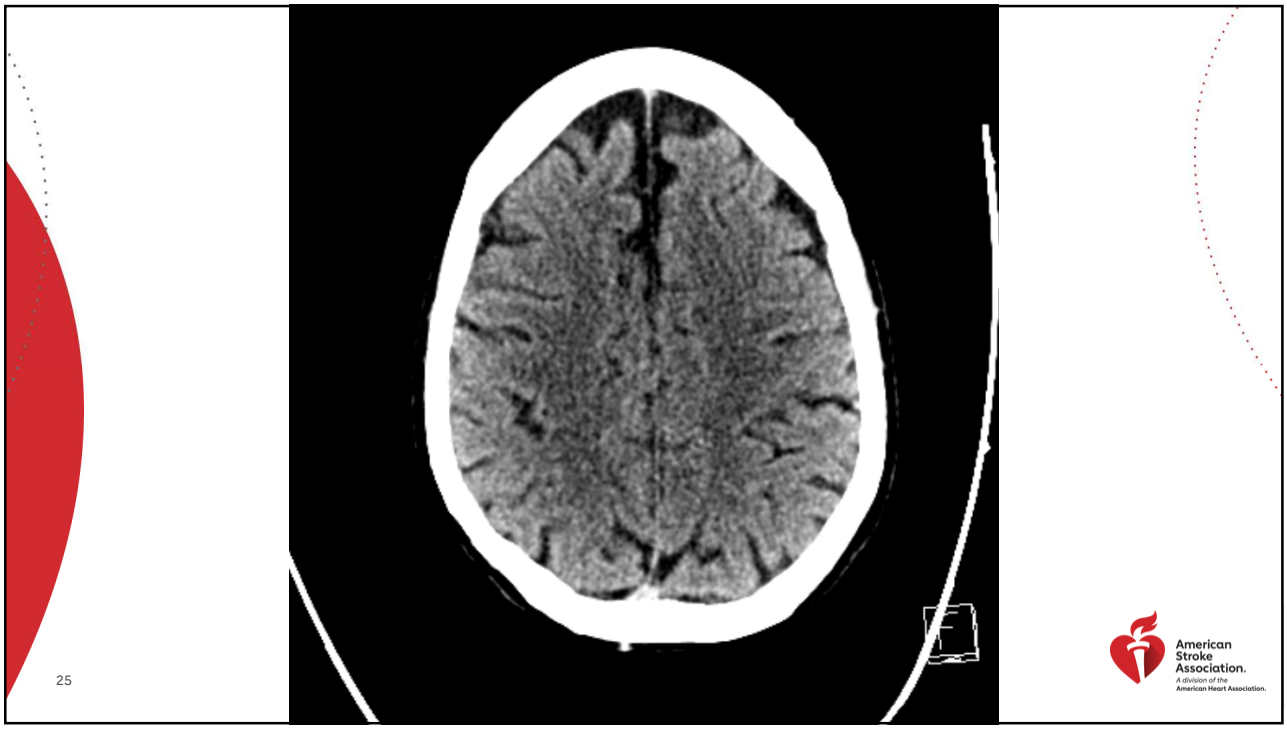
22


Falx
23
American Stroke Association.
A division of the American Heart Association.

23

24
American Stroke Association.
A division of the American Heart Association.

24


25
American
Stroke
Association.
A division of the
American Heart Association.

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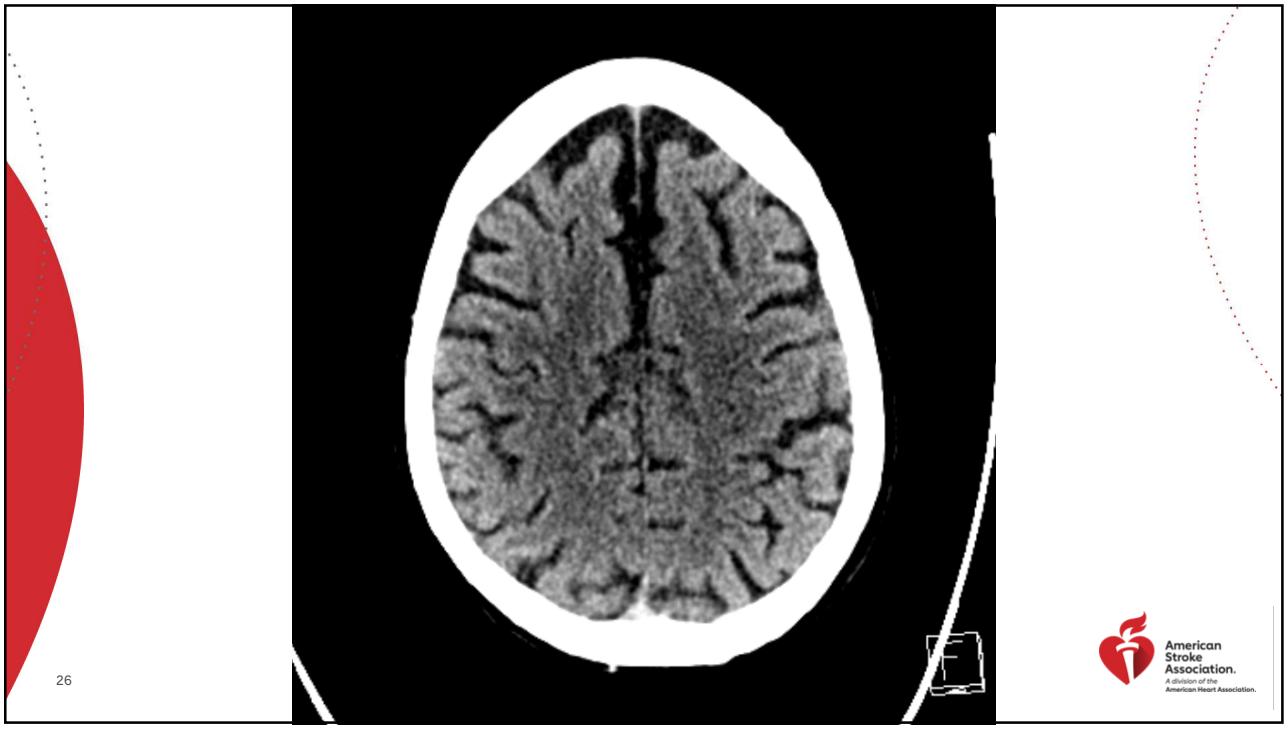
26
American
Stroke
Association.
A division of the
American Heart Association.

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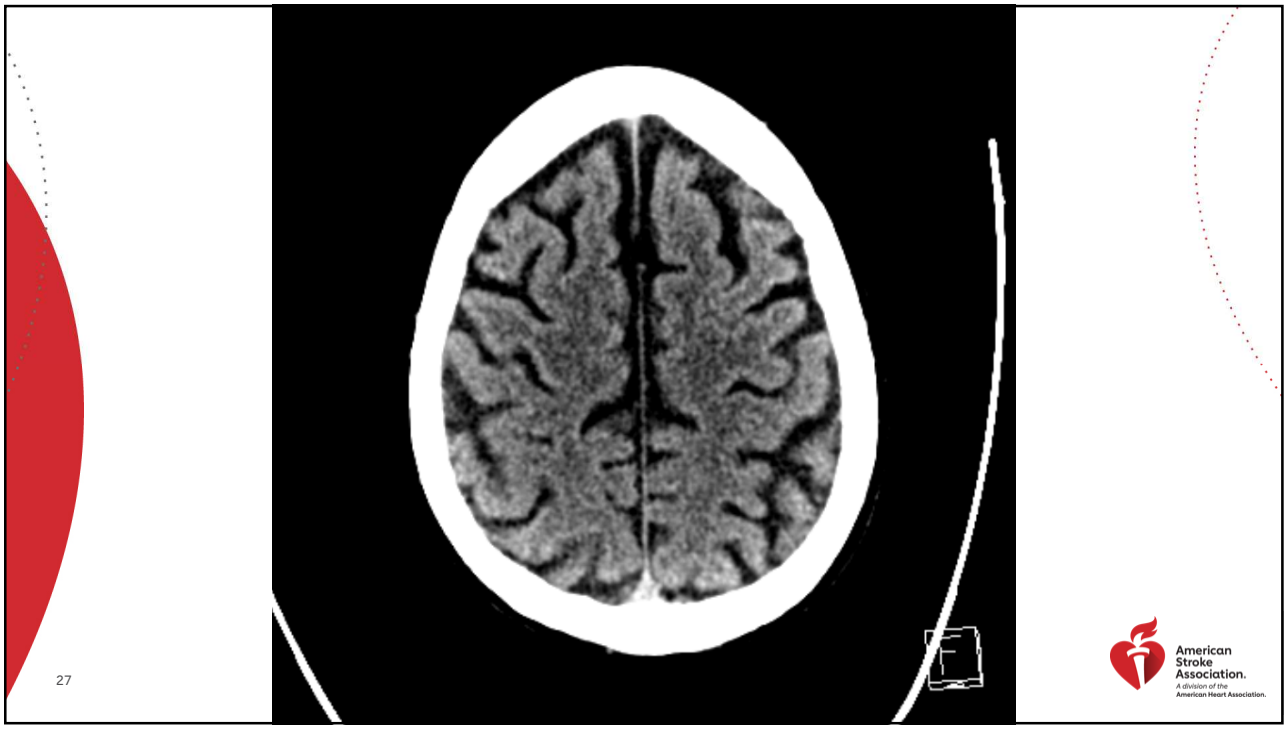
27
American Stroke Association.
A division of the American Heart Association.

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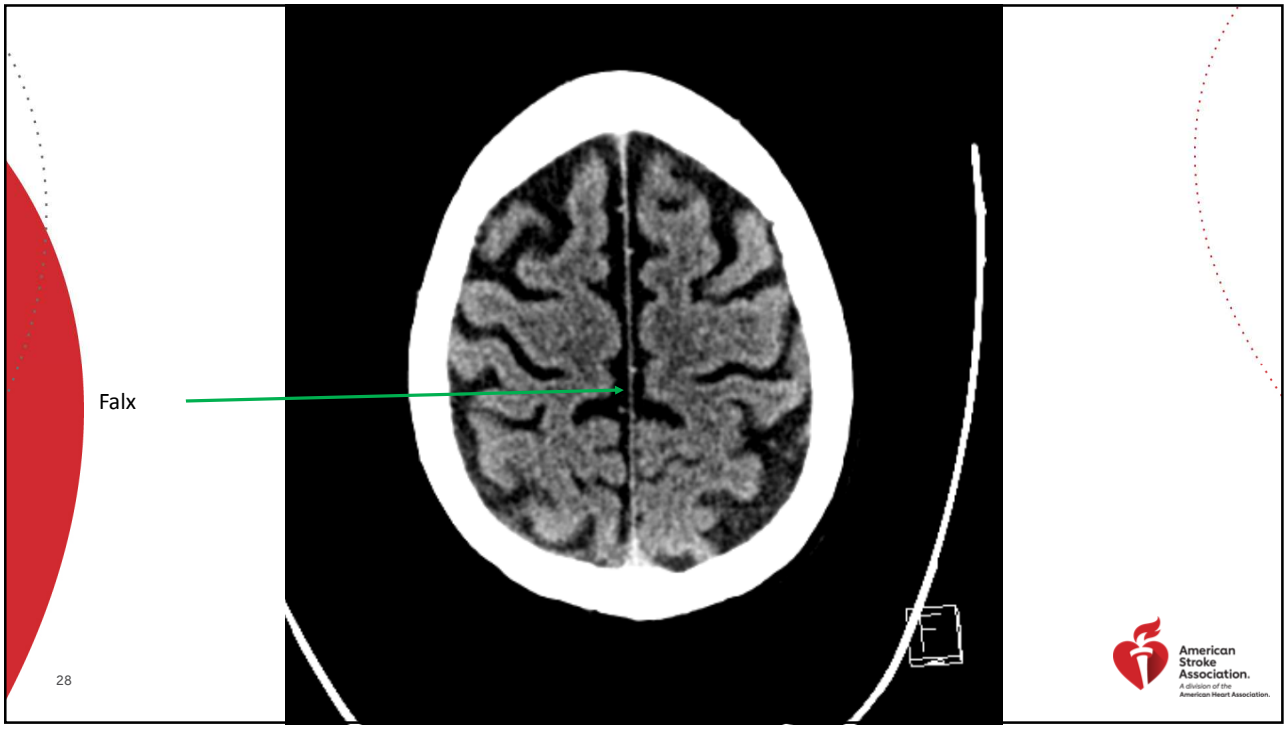
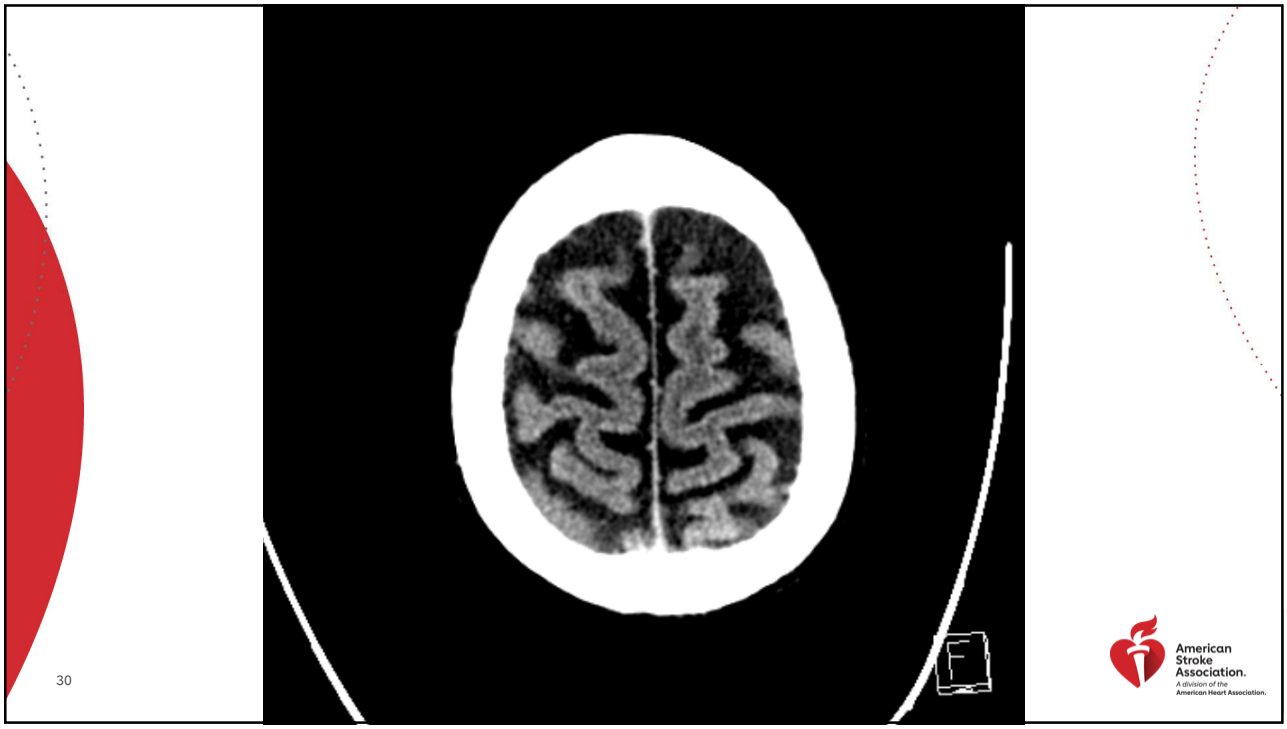

Falx
28
American Stroke Association.
A division of the American Heart Association.

28

29
American
Stroke
Association.
A division of the
American Heart Association.

29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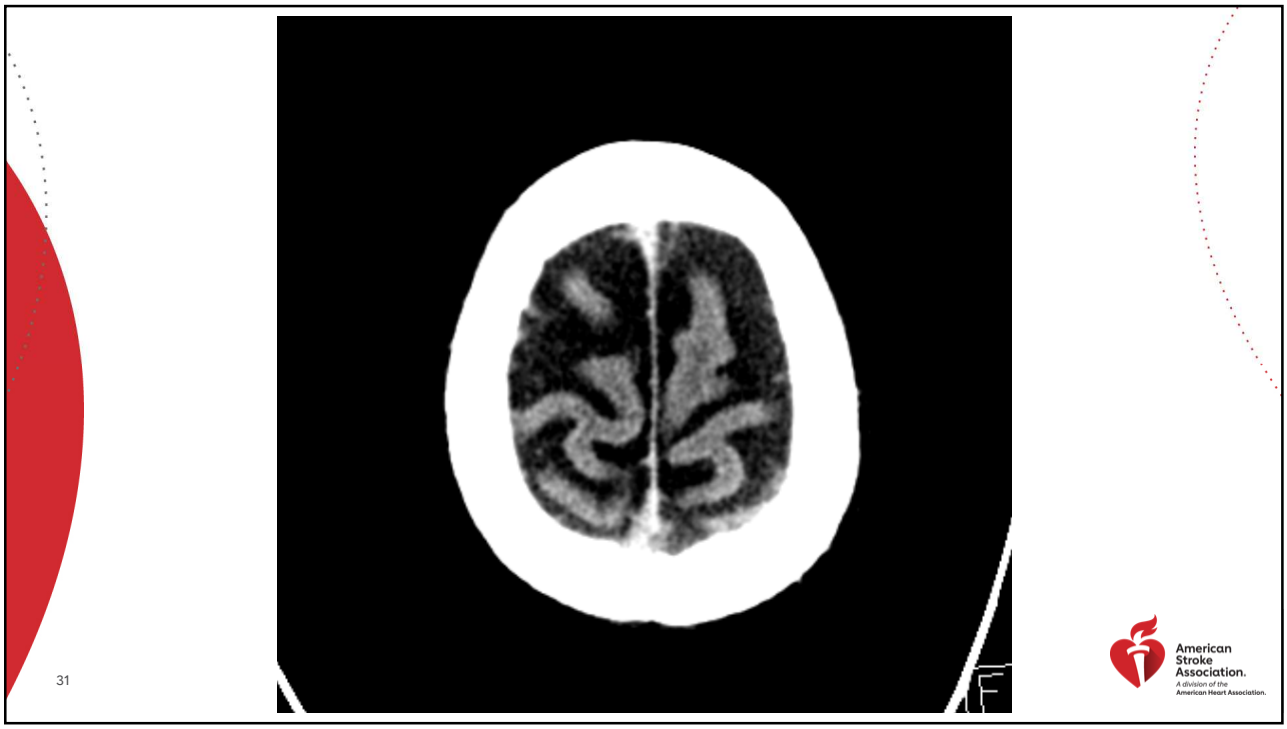
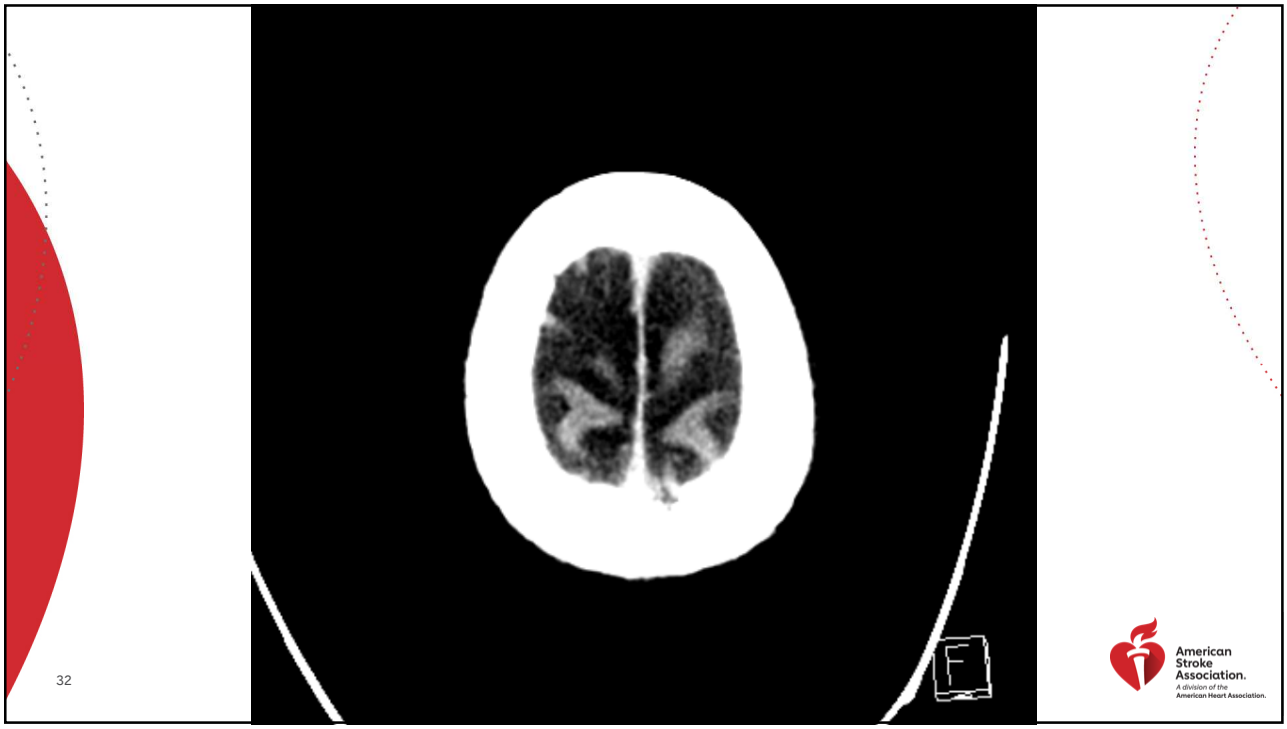
American
Stroke
Association.
A division of the
American Heart Association.

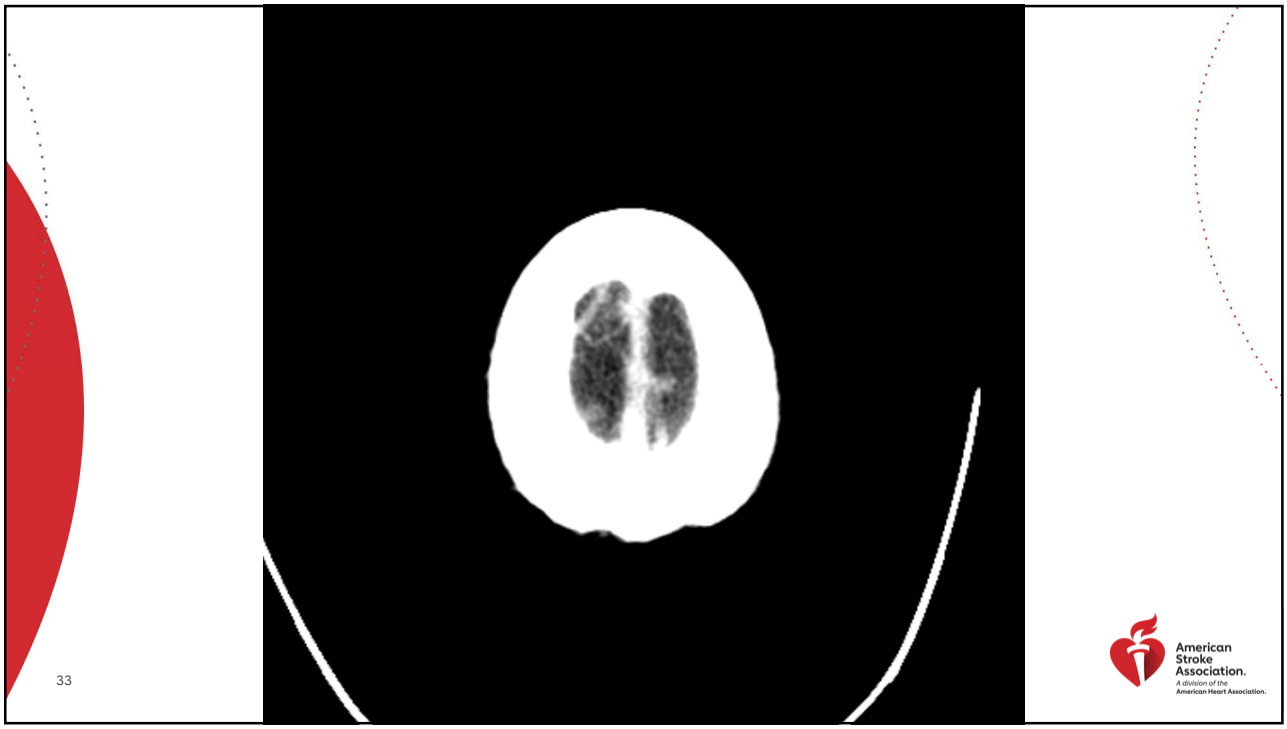
30


31
American
Stroke
Association.
A division of the
American Heart Association.

31


32
American
Stroke
Association.
A division of the
American Heart Association.

32


33
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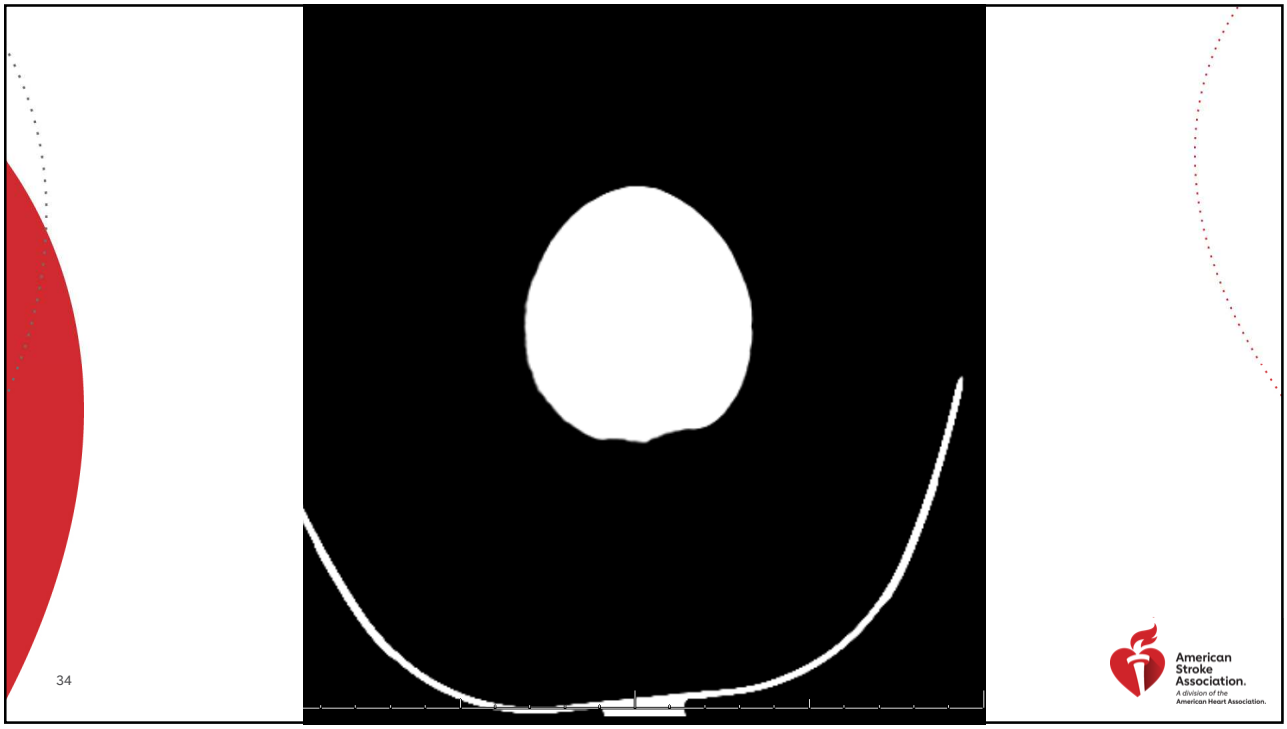
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NCCT CHECKLIST

1. EVIDENCE OF HEMORRHAGE?
   a) Ventricular
   b) Subdural
   c) Subarachnoid
   d) Epidural

   Is it intra-axial?
   a) Follow the distribution of an arterial branch?
   b) Align itself with the anatomical location of the perforating arteries?

35

35

NCCT CHECKLIST

2. IS THERE FRANK HYPODENSITY?
3. IS THERE MASS EFFECT WITH A SHIFT CROSS MIDLINE?
4. EARLY INFARCT SIGNS?
   A) SULCAL EFFACEMENT
   B) BLURRING OF THE GRAY- WHITE INTERFACE
   C) HYPERDENSE ARTERY
5. DIFFUSE BRAIN EDEMA?
   A)OVERALL FLATTENING OF SULCI
   B) SMALL CISTERNAL SPACES
   C) SMALL VENTRICLES
   D) DIFFUSE LOSS OF GRAY-WHITE DIFFERENTIATION

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36

NCCT CHECKLIST

6. IS THERE HYDROCEPHALUS?
   a) Opening of the temporal horns
   b) Localized enlargement of the lateral ventricles suggesting non-communicating hydrocephalus
7. IS THERE EVIDENCE OF CALCIFICATION AND IS IT IN AREAS THAT DO BECOME CALCIFIED?
8. DO YOUR CT FINDINGS MATCH THE CLINICAL PICTURE?!

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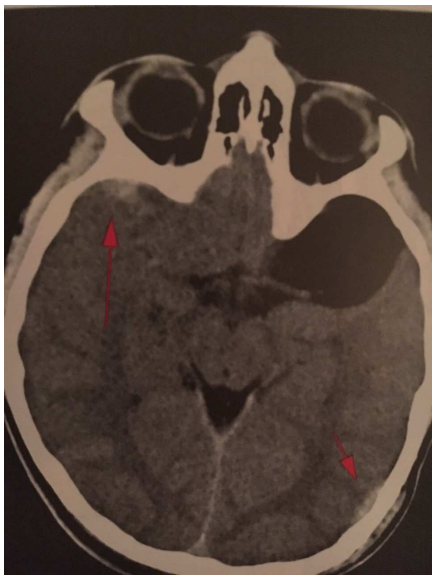
"JEWEL PATHOLOGY"



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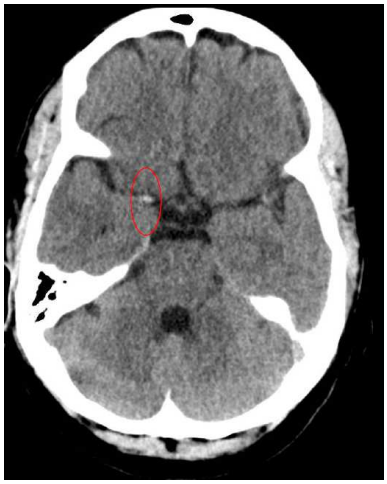
ISCHEMIC CHANGES ON CT

39

39

HYPERDENSE MCA SIGN



40

40

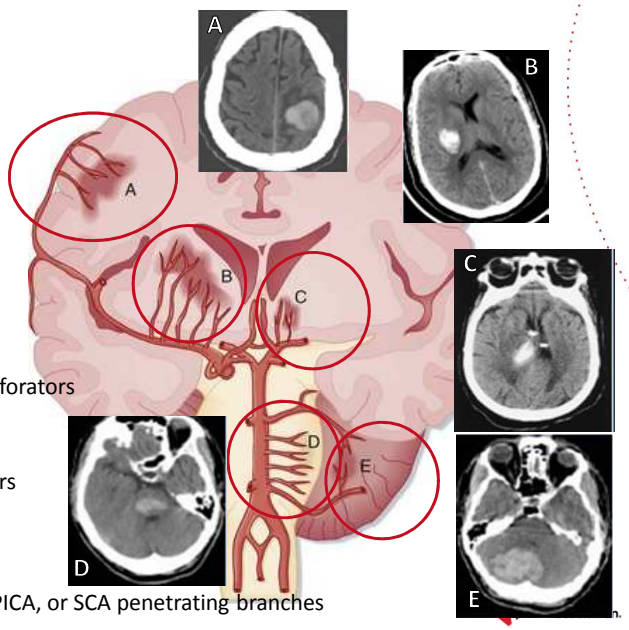
Cortical penetrating branches of ACA, MCA, or PCA
(~20-30%)

Basal Ganglia- lenticulostriate perforators
(~40-50%)

Thalamus- thalmogeniculate perforators
(~20-30%)

Pons- pontine perforators
(~8%)

Cerebellum- AICA, PICA, or SCA penetrating branches
(~8%)



41

41

CT ANGIOGRAPHY

CTA

- VESSEL IMAGING
  - Occlusions
  - Stenosis
  - Aneurysms
- SHOULD PERFORM HEAD AND NECK
  - Carotid/vertebral arteries
    - Dissection
    - "Road map" for intervention

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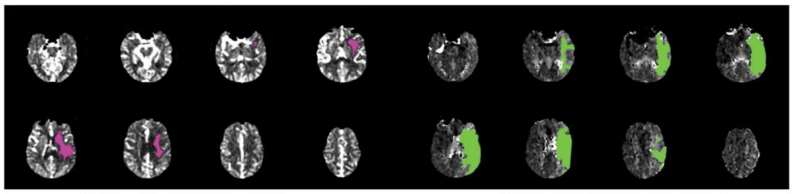
CT PERFUSION

CTP

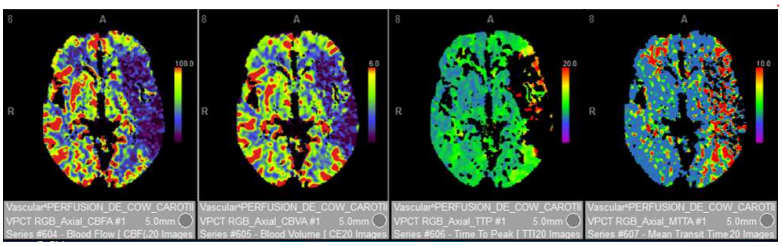
- CEREBRAL BLOOD FLOW/VOLUME
  - Helps with timing- Unknown onset, late window
  - Infarct vs penumbra to show at risk tissue



Volume of Ischemic Core, 23 ml

Volume of Perfusion Lesion, 128 ml

Mismatch volume, 105 ml
Mismatch ratio, 5.6



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MRI – T1 AND T2

	T1	T2	T2 Flair
Bone	Very Black	Very Black	Very Black
Air	Very Black	Very Black	Very Black
Muscle	Dark Grey	Dark Grey	Dark Grey
Grey Matter	**Grey**	**White**	**White**
White Matter	**White**	**Grey**	**Grey**
Fat	White	Grey	
CSF	***Very Black***	***Very White***	***Very Black***
Acute Ischemia	Dark Grey	Light Grey to White	
	Good for Anatomical Definition	Good for Identifying Edema	Best for Identifying Edema

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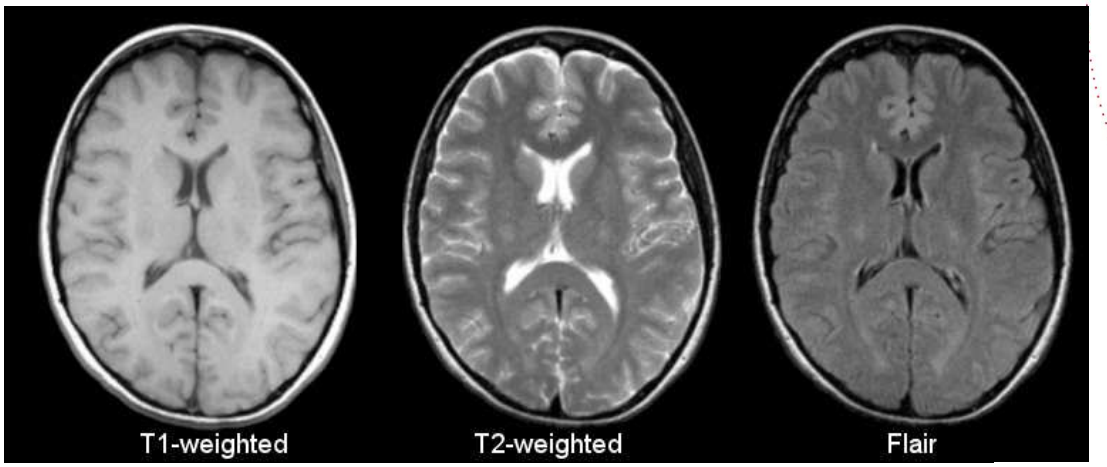
44



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45

STROKE MRI SEQUENCES

GRE
- **Highly sensitive to blood**
- **Blood**-Black
- **CSF**- White
- Must be done with ADC/DWI otherwise hemorrhage can be missed

SWI
- **Also highly sensitive to blood**
- **Blood**- Black
- **CSF**-Grey

ADC
- **Ischemic tissue**- Dark grey/Black
- **CSF**- White
- Normalizes by 5-10 days, good for lesion age

DWI
- **Highly sensitive to infarcted tissue**
- **Ischemic tissue**- White
- **CSF**- Dark grey/Black
- May be positive in up to 50% of TIA patients with full symptom resolution
- Can be used to select tPA candidates outside window

Flair
- Benefit- Suppresses CSF signal to enhance older infarcts
- **Bright white**= old

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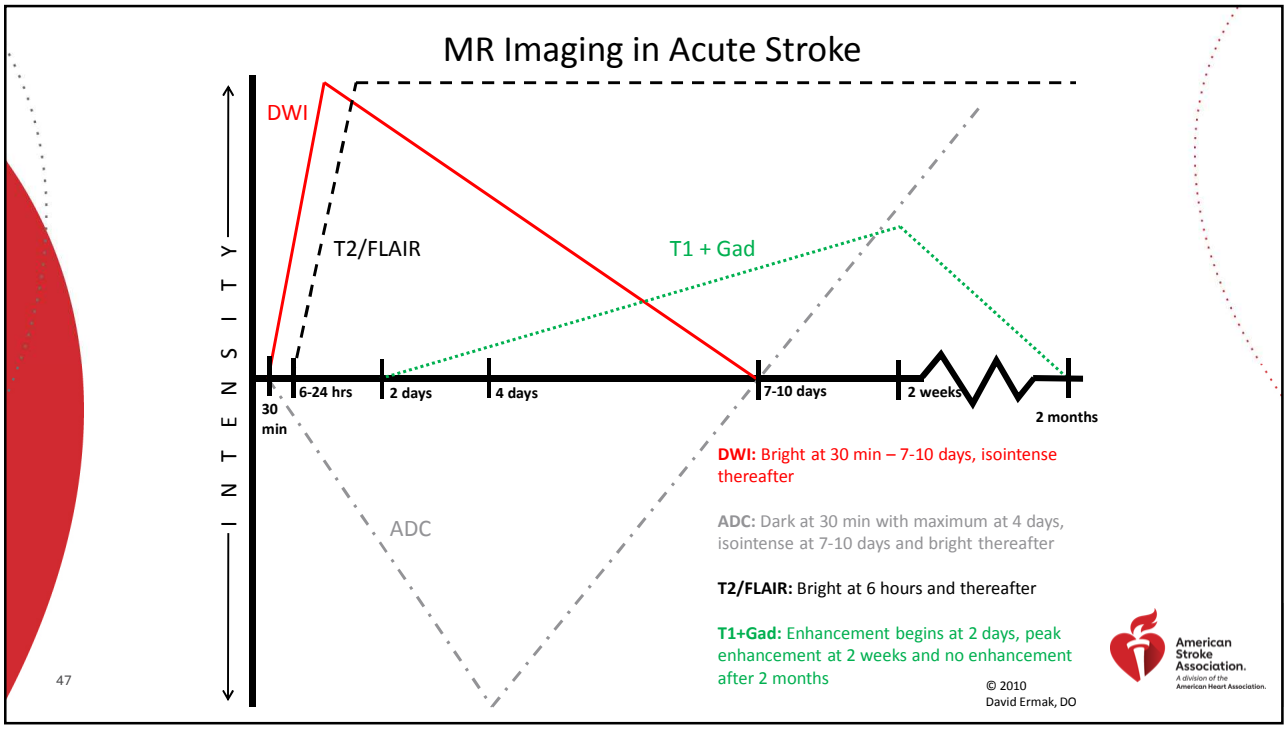
MR Imaging in Acute Stroke
INTENSITY
DWI
T2/FLAIR
T1 + Gad
ADC
30 min
6-24 hrs
2 days
4 days
7-10 days
2 weeks
2 months
DWI: Bright at 30 min – 7-10 days, isointense thereafter
ADC: Dark at 30 min with maximum at 4 days, isointense at 7-10 days and bright thereafter
T2/FLAIR: Bright at 6 hours and thereafter
T1+Gad: Enhancement begins at 2 days, peak enhancement at 2 weeks and no enhancement after 2 months
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David Ermak, DO
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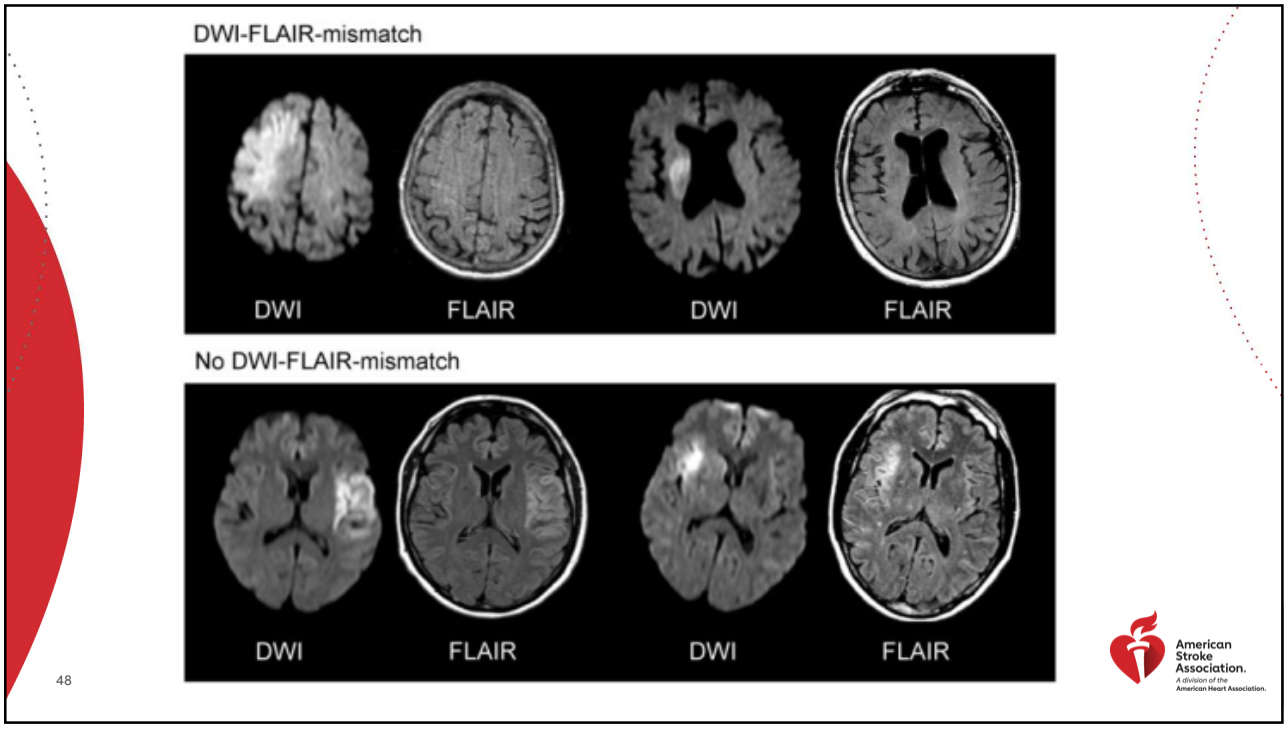
DWI-FLAIR-mismatch
DWI
FLAIR
DWI
FLAIR
No DWI-FLAIR-mismatch
DWI
FLAIR
DWI
FLAIR
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48

48

THANK YOU!

ALICIA RICHARDSON: ARICHARDSON2@PENNSTATEHEALTH.PSU.EDU

WENDY SMITH: SMITHW@CCF.ORG

LYNN HUNDLEY: LYNN.HUNDLEY@NORTONHEALTHCARE.ORG

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