Brockville Stroke Update 2022

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Ontario,

Objectives

- Review how to do a comprehensive and rapid bedside stroke examination in the ED
- Learn how to rapidly read a plain CT head to identify early ischemic change, acute thrombosis
- Review the common stroke syndromes and common stroke mimics
- Review the role of EVT and the evolving role of thrombolysis
- Review the approach to starting/restarting anticoagulation after ischemic or hemorrhagic stroke in patients with atrial fibrillation
- Review the prognosis and expected outcomes after ICH
- Review seizure after ischemic and hemorrhagic stroek

Outline

- Acute Stroke in Brockville ED
  - Examination before and in the ED
  - Reading a CT head for early ischemia and acute thrombosis
  - Common stroke syndromes
  - Stroke mimics
  - EVT and thrombolysis

Outline - 2

- Inpatient Care Issues
  - Antithrombotic management
    - Atrial fibrillation: when to anticoagulate?
  - Intracerebral hemorrhage
    - Prognosis and expected course
  - Seizure
    - How often do stroke patients have seizure? What to do?

ED examination of the acute stroke patient

- Two screening tools – LAMS, ACT-FAST - and one standardized bedside examination – NIHSS - have proven useful in the initial assessment
- LAMS: Los Angeles Motor Scale
- ACT-FAST: Arm Chat Tap – Face Arm Speech Time
- NIHSS: National Institutes of Health Stroke Scale

Rapid ED screen for Large Vessel Occlusion (LVO) using ACT-FAST

CLINICAL AND POPULATION SCIENCES

Utility of Severity-Based Prehospital Triage for Endovascular Thrombectomy

ACT-FAST Validation Study

Henry Zhao, MBBS; Karen Smith, PhD; Stephen Bernard, PhD; Michael Stephenson, BHlthSc; Henry Ma, PhD; Ronil V. Chandra, MMed; Thanh Phan, PhD; Christopher F. Bladin, PhD; Leonid Churilov, PhD; Douglas Crompton, PhD; Helen M. Dewey, PhD; Tissa Wijeratne, MD; Geoffrey Cloud, MBBS; Vincent Thijs, PhD; Timothy J. Kleinig, PhD; Jo Lyn Ng, MBBS; Cameron Williams, MBBS; Fana Alemseged, MD; Felix Ng, MBBS; Peter J. Mitchell, MMed; Mark W. Parsons, PhD; Nawaf Yassi, PhD; Stephen M. Davis, MD; Bruce C.V. Campbell, PhD

Stroke. 2021;52:70–79. DOI: 10.1161/STROKEAHA.120.031467

ACT-FAST Stroke Algorithm (Simplified)

Step 1

Yes

ARM – only one arm completely falls to stretcher <10 secs when positioned at 45 degrees from horizontal

Step 2

Yes

CHAT – if right arm weak -> severe language deficit, OR

TAP – if left arm weak -> obvious gaze away from weak side or ignores examiner after shoulder tap on weak side

Step 3

Yes

ACT-FAST POSITIVE

Eligibility screen

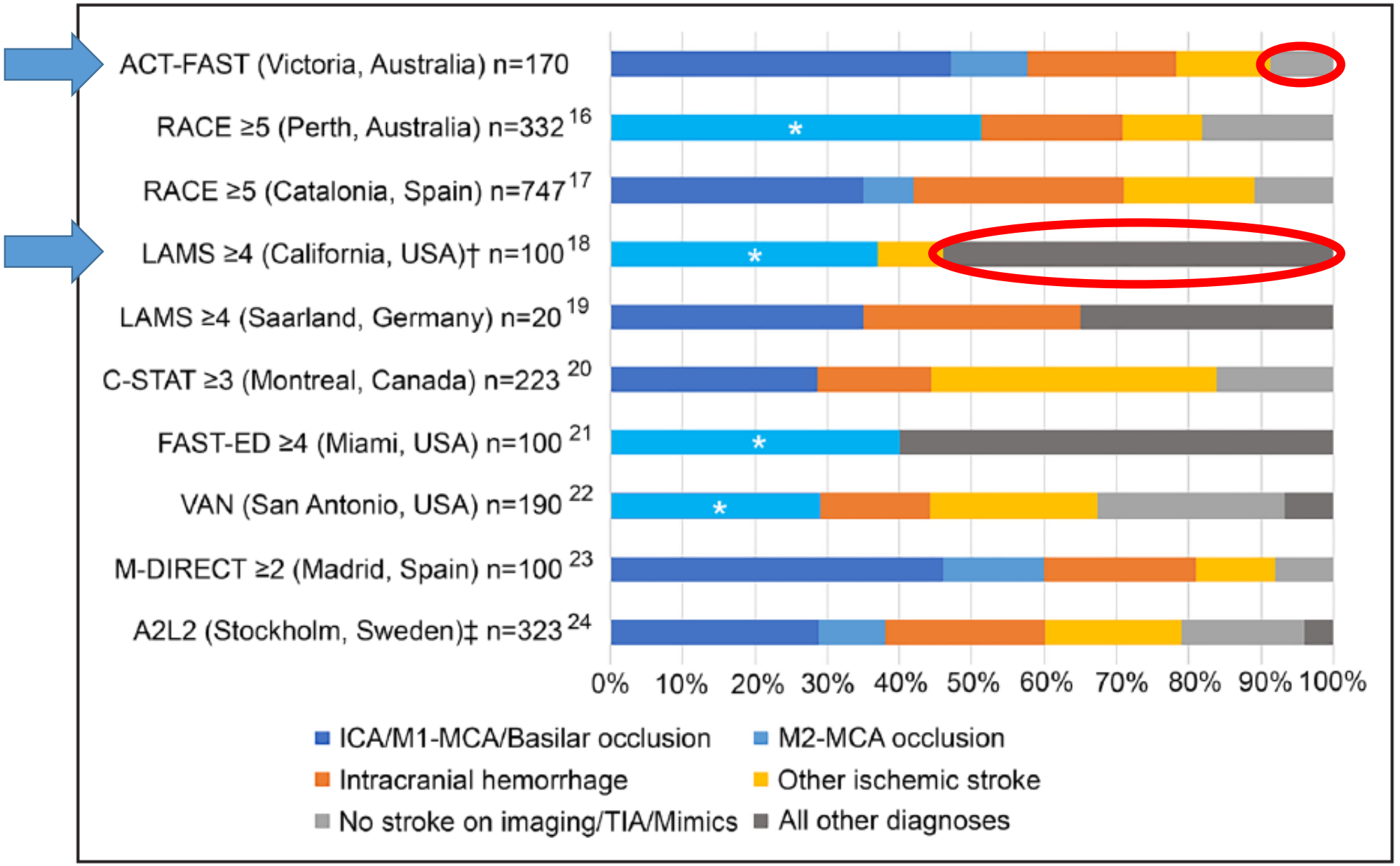
- < 24hrs onset
- Independent at home with minimal assistance
- Exclude mimics – BSL, seizure, coma, brain cancer
- No rapid spontaneous improvement at scene of attendance

If NO at any step – patient is ACT-FAST negative

Rapid EMS screen for LVO

- Why does EMS use LAMS and ED use ACT-FAST?
- LAMS was chosen by EMS because it is easy to implement and has reasonable sensitivity for LVO
- ACT-FAST seems to be better at identifying stroke vs non-stroke patients

Los Angeles Motor Scale (LAMS)[22]		
Face	0	Both sides move normally
	1	One side is weak or flaccid
Arm	0	Both sides move normally
	1	One side is weak
	2	One side is flaccid/doesn't move
Grip	0	Both sides move normally
	1	One side is weak
	2	One side is flaccid/doesn't move
Total	0–5	



Stroke. 2021;52:70–79. DOI: 10.1161/STROKEAHA.120.031467

ED Stroke Examination with the NIHSS

- Focused neurological exam:
  - Can use the NIHSS to structure your neuro exam
    - Don’t worry if you miss an item on the NIHSS

Examination in 3 minutes

- **NIH Stroke Scale**
- *Consciousness*
- *Gaze, Visual Fields, Face*

↓

- *Arm & leg: weak, clumsy, numb*

↓

- *Language*
- *Dysarthria*
- *Inattention*

Start at head

↓

Move to arms and legs

↓

Back up to the head

The main point of the exam is to determine if the deficits are disabling or not

The actual NIHSS score is not as important.

Deficits can be disabling even if the NIHSS is low.

NIHSS

1a. Level of Consciousness (LOC)*

0 = Alert (keenly responsive)
1 = Not alert but arousable by minor stimulation
2 = Not alert: requires repeated stimulation to attend, or is obtunded and requires strong or painful stimulation to make movements
3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, and flexic

1b. LOC Questions*

Ask the patient: "What month is it? How old are you?"
0 = Answers both correctly
1 = Answers one correctly
2 = Answers neither correctly

1c. LOC Commands*

Command the patient to: "Open and close your eyes. Grip and release your hand."
0 = Performs both correctly
1 = Performs one correctly
2 = Performs neither correctly

2. Best Gaze*

Establish eye contact and ask the patient to: "Follow my finger."

0 = Normal
1 = Partial gaze palsy
2 = Forced deviation or total gaze paresis

3. Visual Fields*

Use confrontation, finger counting, or visual threat.
Confront upper/lower quadrants of visual field.

0 = No visual loss
1 = Partial hemianopsia
2 = Complete hemianopsia
3 = Bilateral hemianopsia

4. Facial Palsy*

By words or pantomime, encourage the patient to: "Show me your teeth. Raise your eyebrows. Close your eyes."

0 = Normal symmetrical movement
1 = Minor paralysis (flattened nasolabial fold, asymmetry on smiling)
2 = Partial paralysis (lower face)
3 = Complete paralysis

5. Arm Motor*

Alternately position patient's arms. Extend each arm with palms down (90° if sitting, 45° if supine).

0 = No drift 1 = Drift
2 = Some effort vs gravity
3 = No effort vs gravity
4 = No movement

6. Leg Motor*

Alternately position patient's legs.
Extend each leg (30°, always while supine).

0 = No drift 1 = Drift
2 = Some effort vs gravity
3 = No effort vs gravity
4 = No movement

7. Limb Ataxia*

Ask patient (eyes open) to: "Touch your finger to your nose. Touch your heel to your shin."

0 = Absent
1 = Present in one limb
2 = Present in two or more limbs

8. Sensory*

Test as many body parts as possible (arms [not hands], legs, trunk, face) for sensation using pinprick or noxious stimulus (in the obtunded or aphasic patient).

0 = Normal
1 = Mild-to-moderate sensory loss
2 = Severe-to-total sensory loss

9. Best Language*

Using pictures and a sentence list (see reverse), ask the patient to: "Describe what you see in this picture. Name the items in this picture. Read these sentences."

0 = No aphasia
1 = Mild-to-moderate aphasia
2 = Severe aphasia
3 = Mute, global aphasia

10. Dysarthria*

Using a simple word list (see reverse), ask the patient to: "Read these words" or "Repeat these words".

0 = Normal articulation
1 = Mild-to-moderate dysarthria
2 = Severe dysarthria

11. Extinction and Inattention*

Sufficient information to determine these scores may have been obtained during the prior testing.

0 = No abnormality
1 = Visual, tactile, auditory, spatial, or personal inattention
2 = Profound hemi-inattention or extinction to more than one modality

A couple of points about aphasia and neglect

- Why do patients with **left hemiparesis not follow commands**?
- It’s often due to impairment of **selective focus**, i.e patient is unable to maintain attention for more than a few seconds
- This is what I usually see when I examine patients who are alert, weak on the left side and don’t do what I ask them to do on exam

- Why do patients with **right hemiparesis seem to neglect one or both sides**?

- Usually it’s due to global aphasia. Patients can often speak and understand a little, but more complex tasks which require distinguishing left vs right, specific body parts, or multiple steps are often not understood

- Some patients have had previous stroke with aphasia or neglect and these can re-emerge in the context of a new stroke. In this case the patient has new stroke deficits and a **recrudescence of prior stroke deficits**

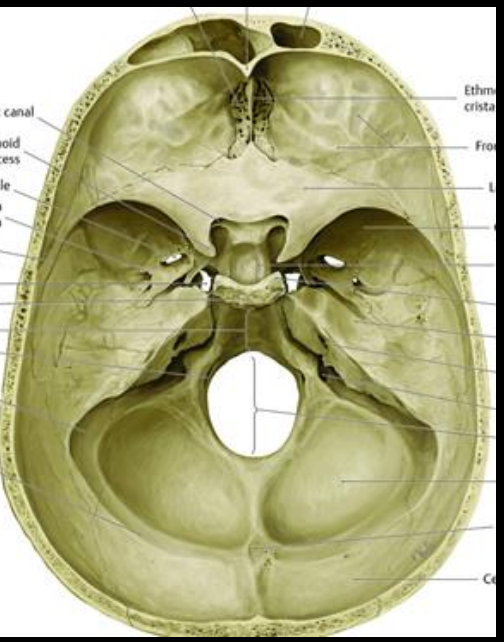
- Some patients have **underlying cognitive impairment with mild aphasia or inattention** which is exacerbated by a new stroke

How to read a CT scan quickly without a radiologist

Reading a plain CT head

- **“Skull base”:**
  - Medulla, Cerebellum, and Vertebral Arteries
- **“The bridge”:**
  - Pons, and Basilar Artery
- **“Mickey Mouse”:**
  - Midbrain, and Proximal Middle Cerebral Arteries
- **“The angry face”:**
  - Basal ganglia, Insula, MCA ACA and PCA territory
- **“Larva”**
  - Corona radiata
- **“Walnut”:**
  - Centrum semiovale

“Skull base”



Medulla

Cerebellum

Left vertebral artery

Pons

“The bridge”

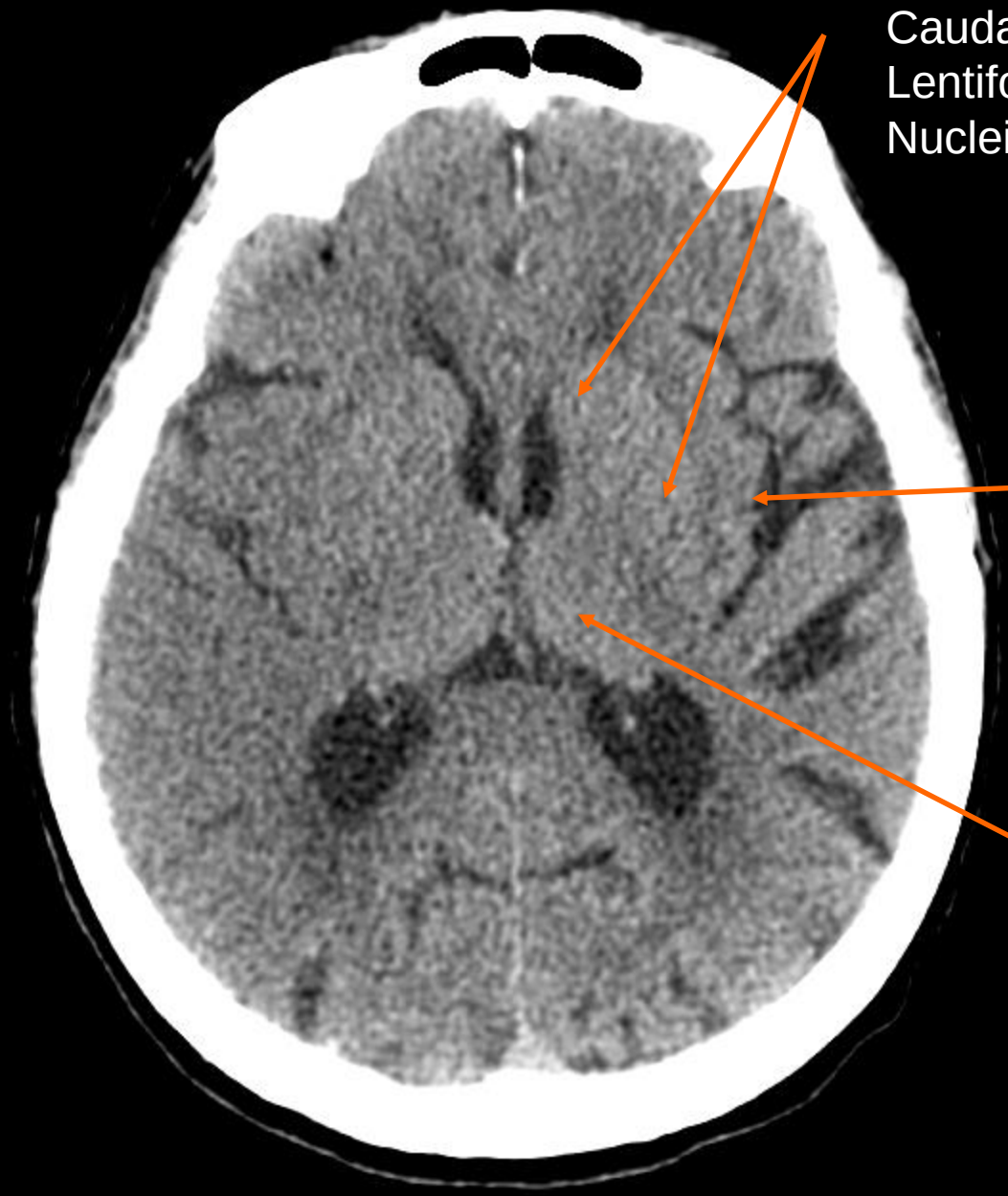
Basilar artery

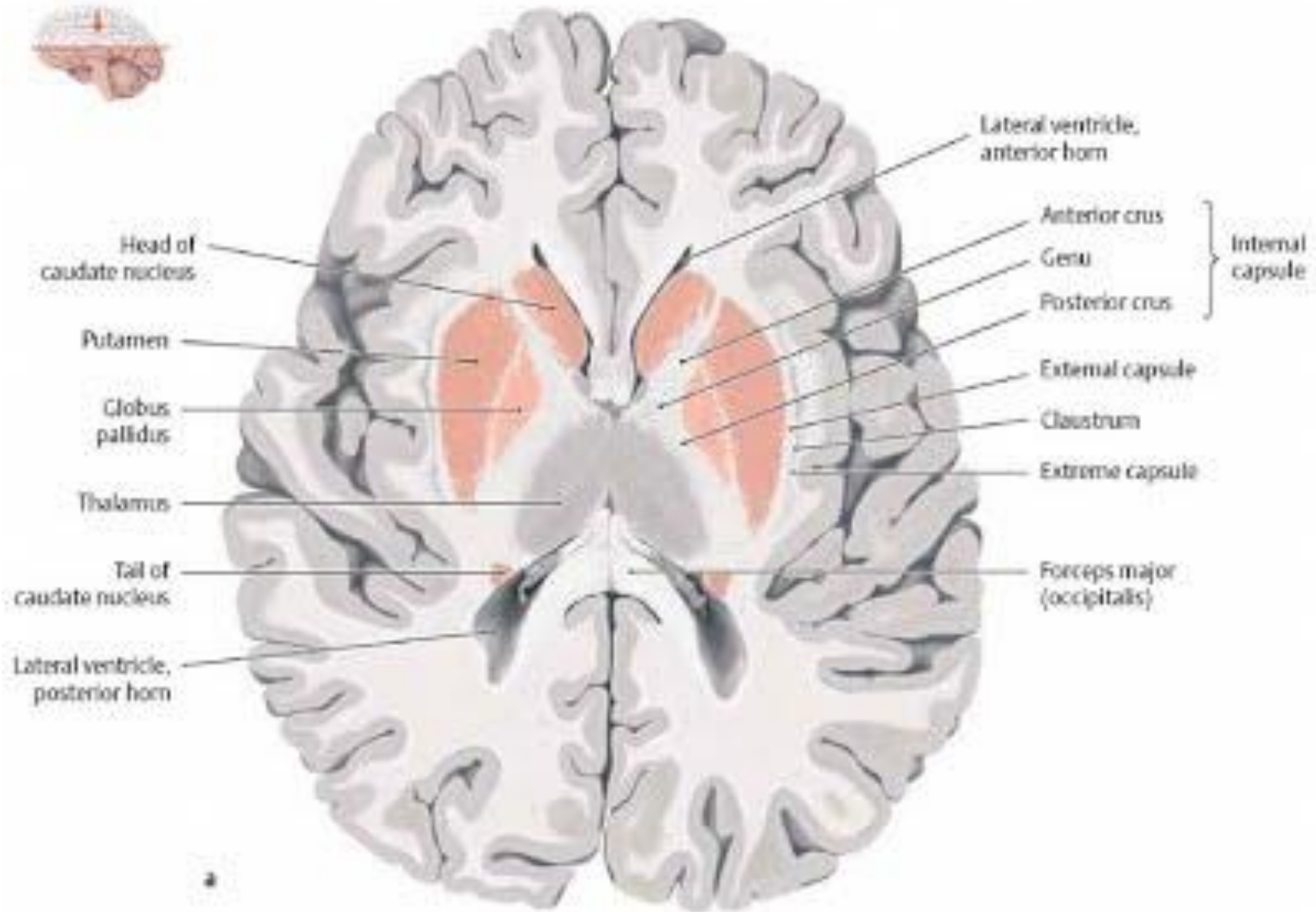
Midbrain

“Mickey Mouse”

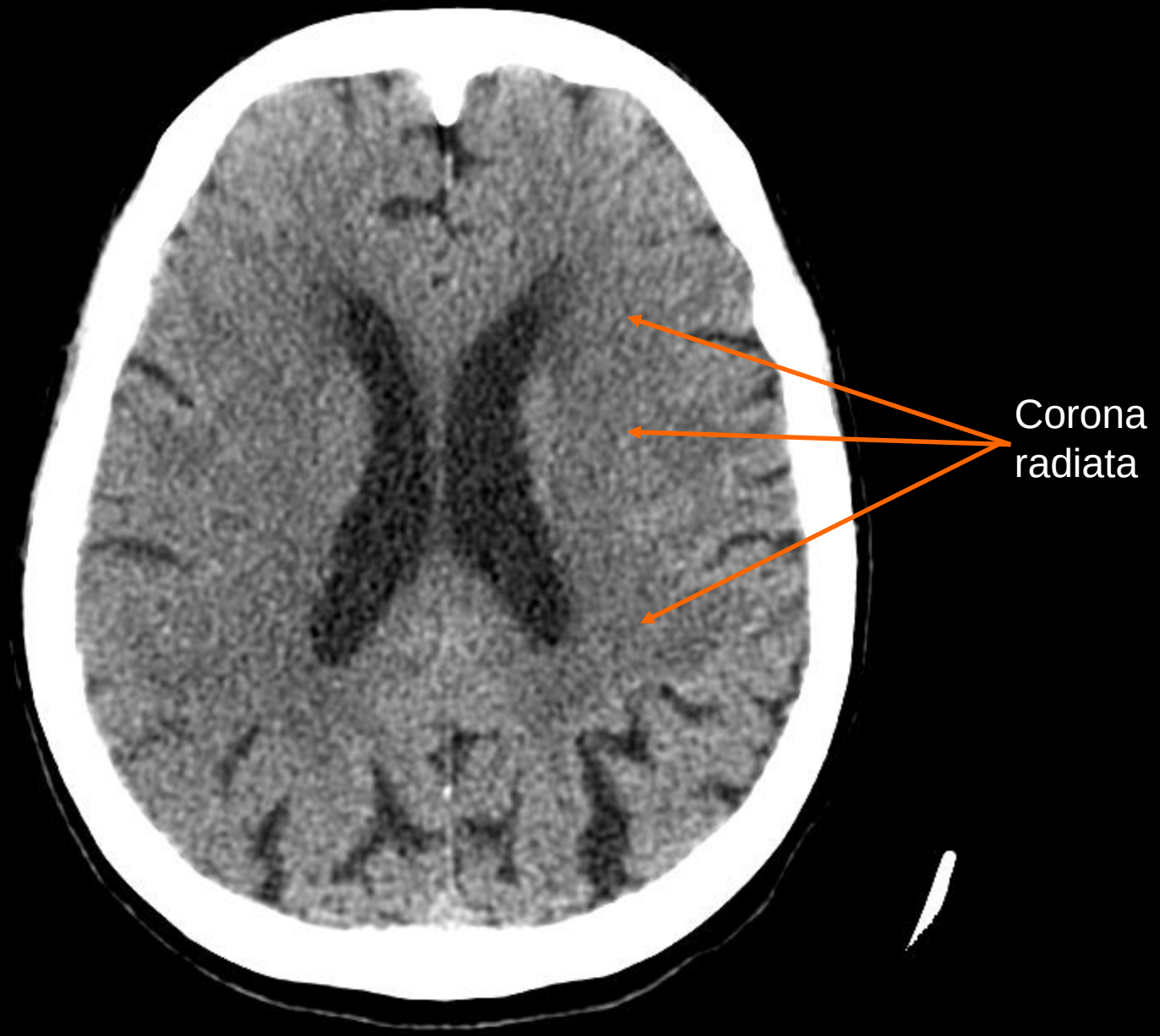
Middle
cerebral artery

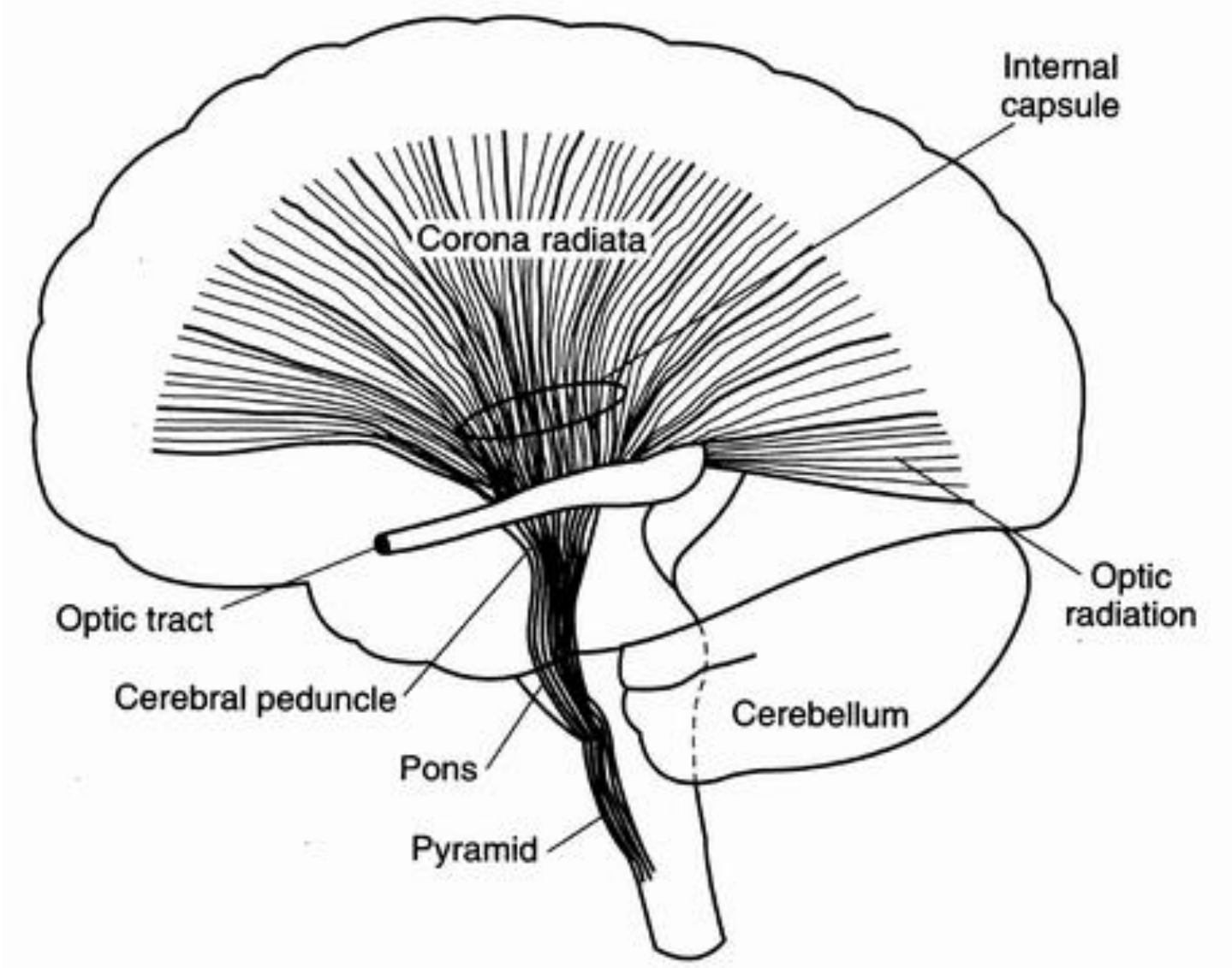
“The angry face”



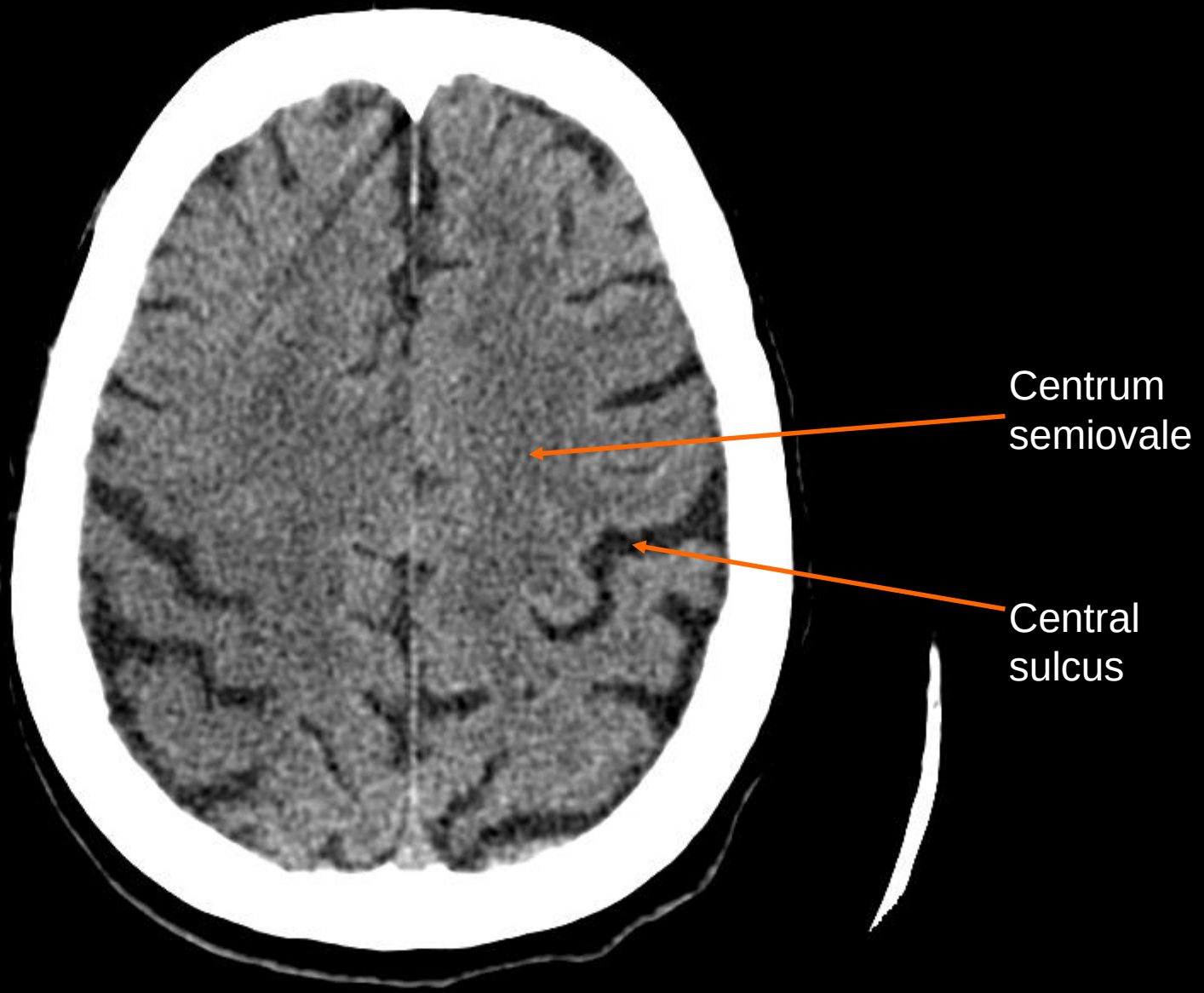

Lateral ventricle, anterior horn
Anterior crus
Genu
Posterior crus
Internal capsule
Head of caudate nucleus
Putamen
Globus pallidus
Thalamus
Tail of caudate nucleus
Lateral ventricle, posterior horn
External capsule
Claustrum
Extreme capsule
Forceps major (occipitalis)
a

“Larva”



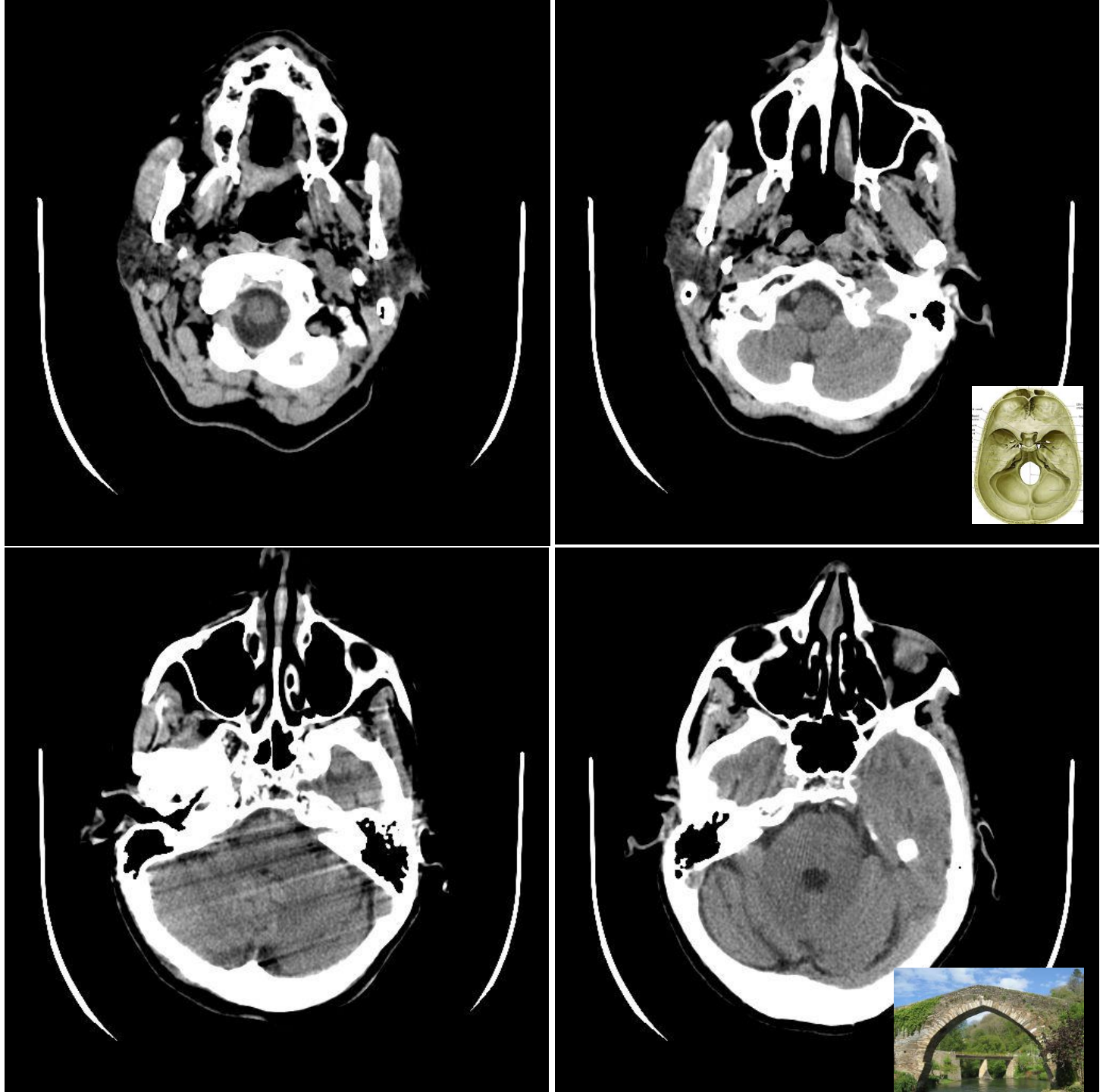

Internal capsule
Corona radiata
Optic radiation
Optic tract
Cerebral peduncle
Cerebellum
Pons
Pyramid

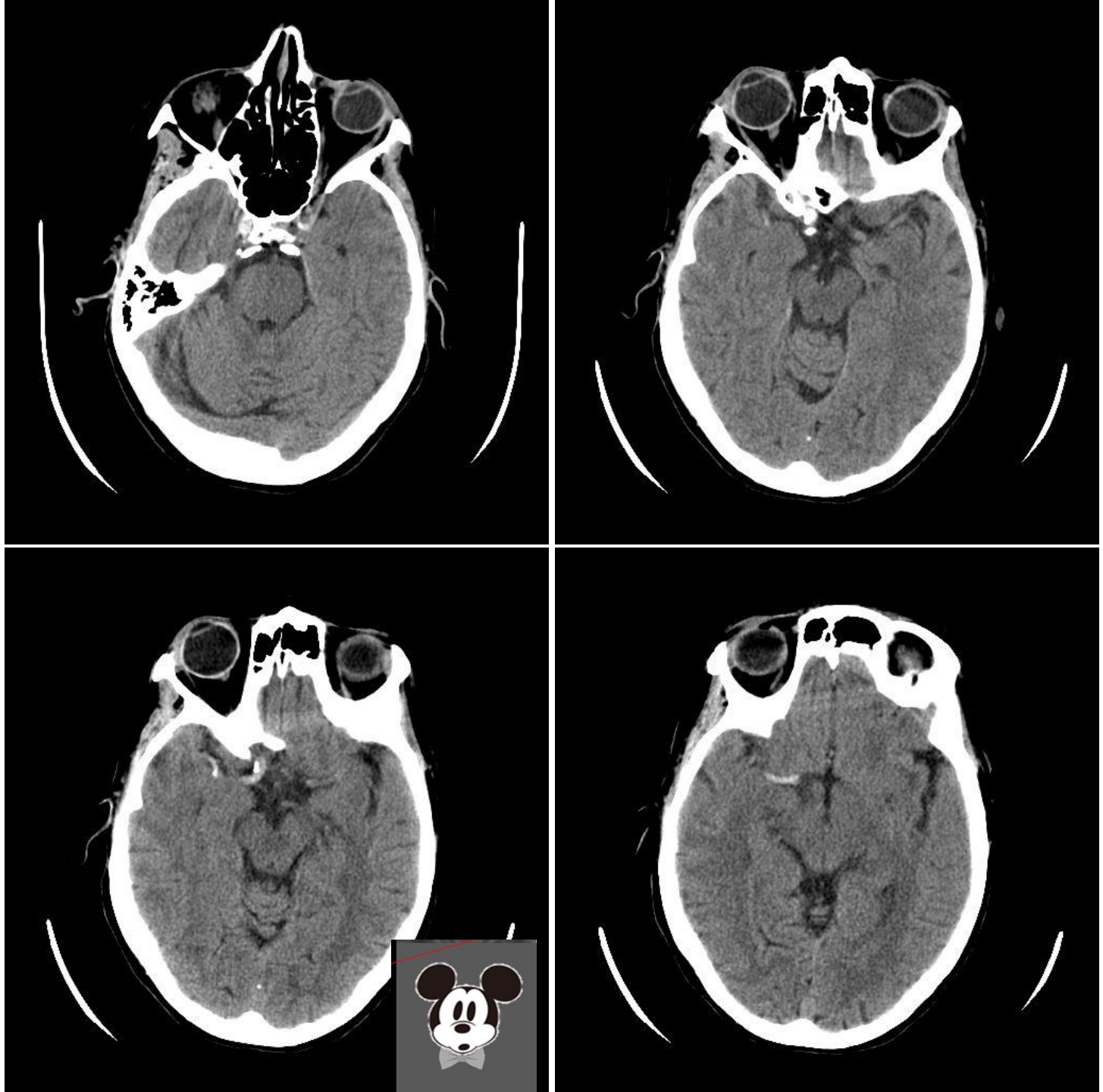
“Walnut”

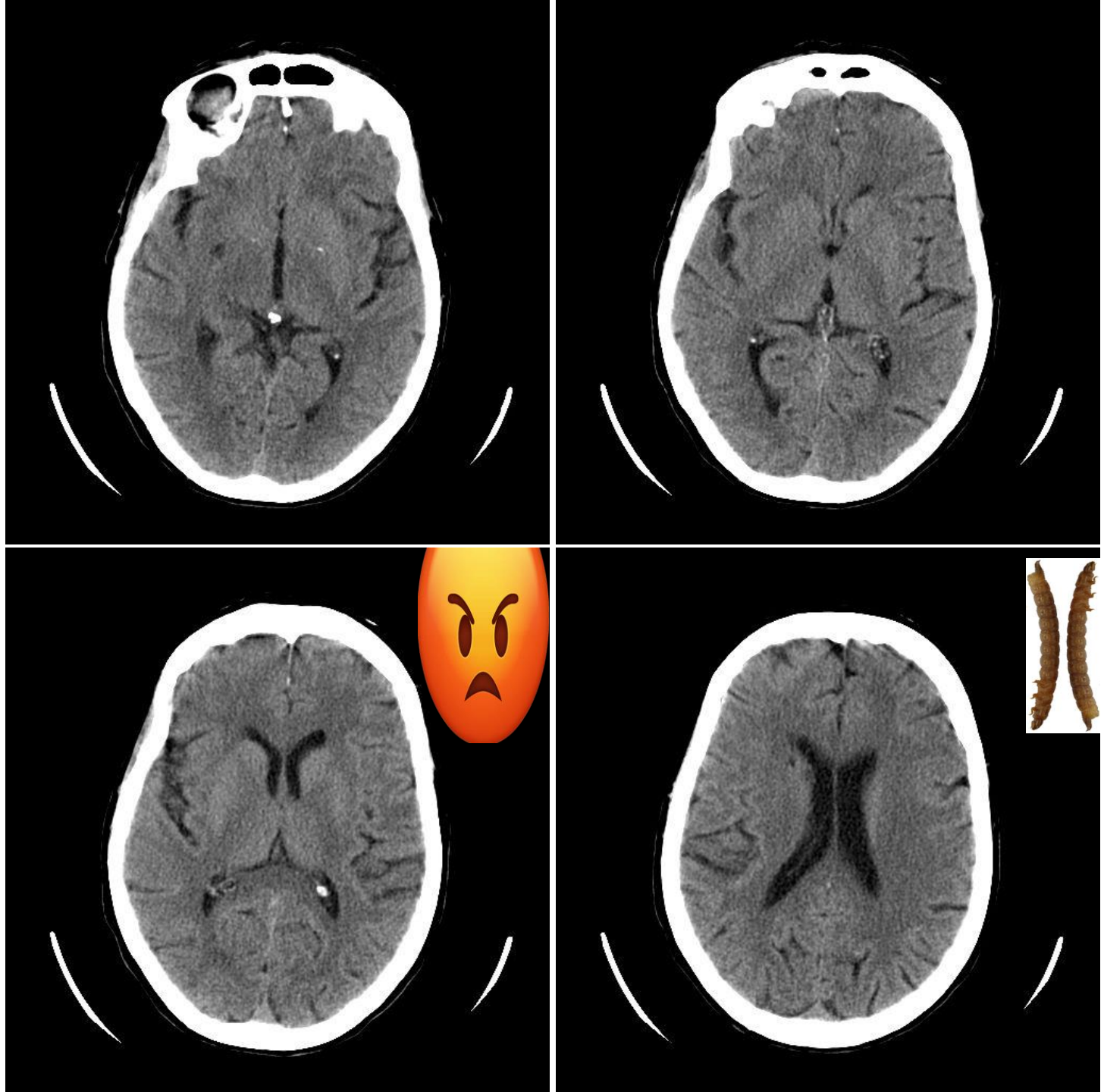


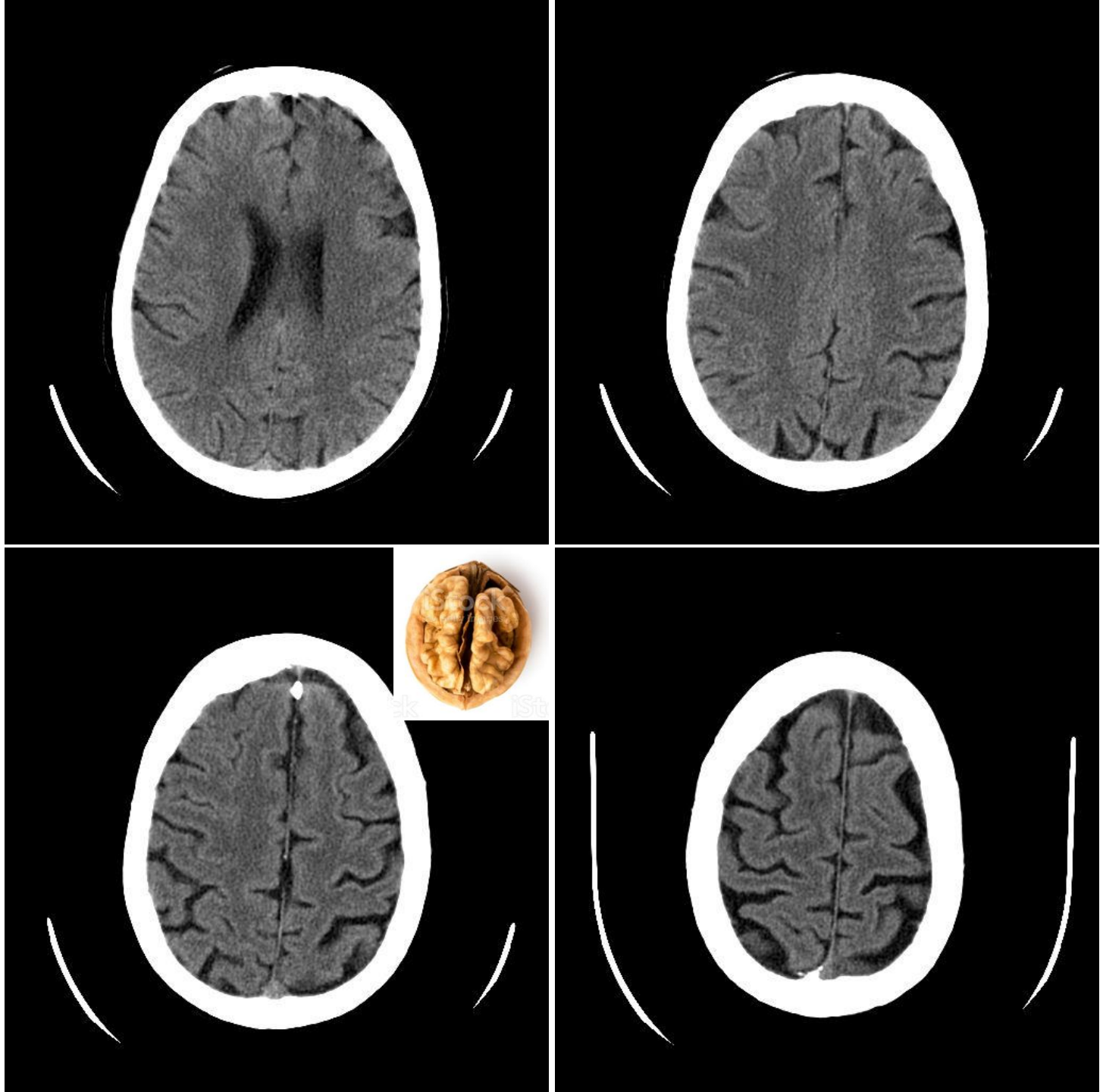
Recognize acute thrombus

- As you review the following slides, recall that the Midbrain level is where you see the proximal MCA (and distal ICA)





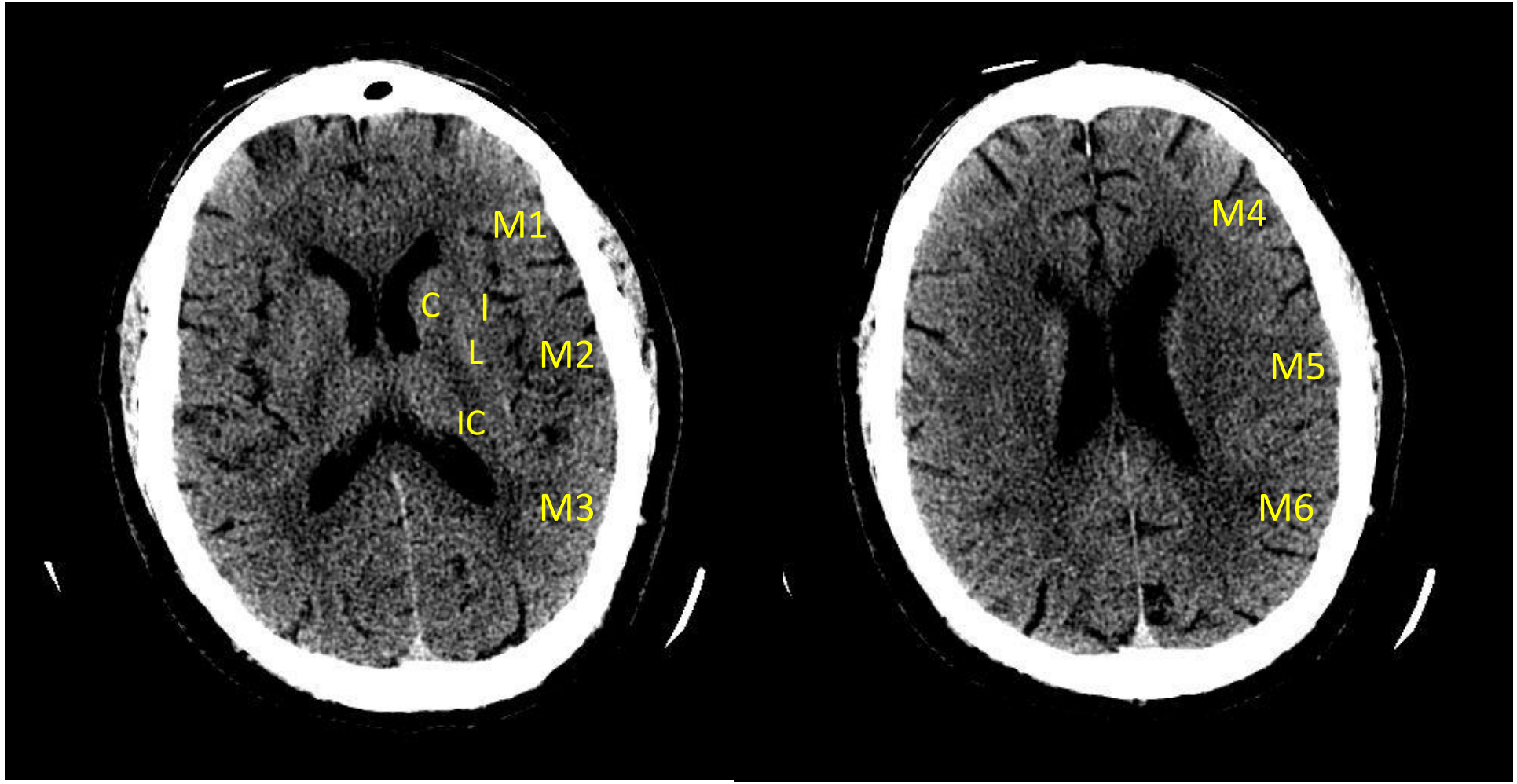




Detecting early cerebral ischemia on CT scan

- Loss of grey-white differentiation
  - You may have to adjust the brightness and contrast (the “window width” and “window level”)
- Loss of sulci
- Use the same system every time you look at a CT for possible acute stroke
  - For example, the Alberta Stroke Program Early CT Score (ASPECTS)

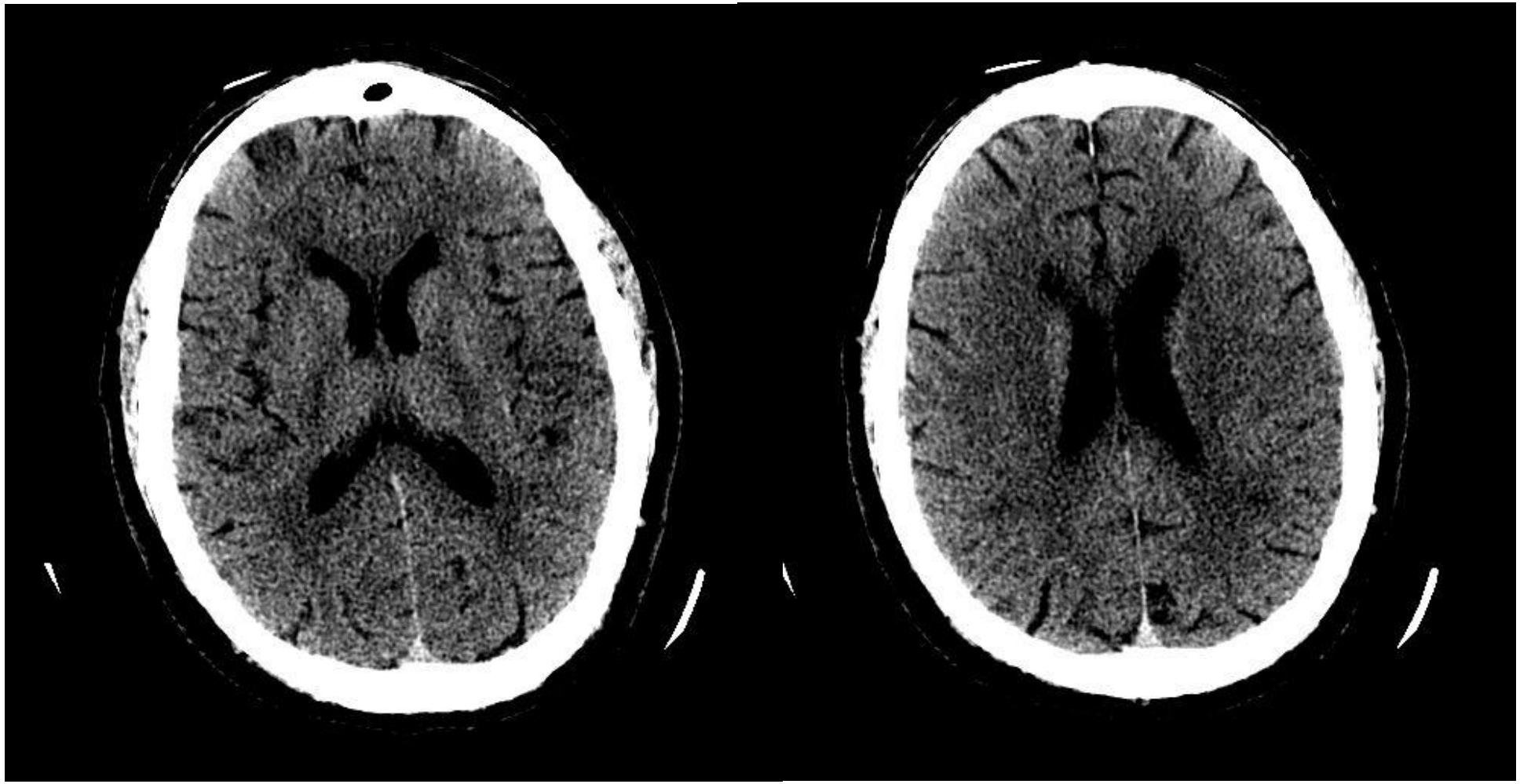
Alberta Stroke Program Early CT Score



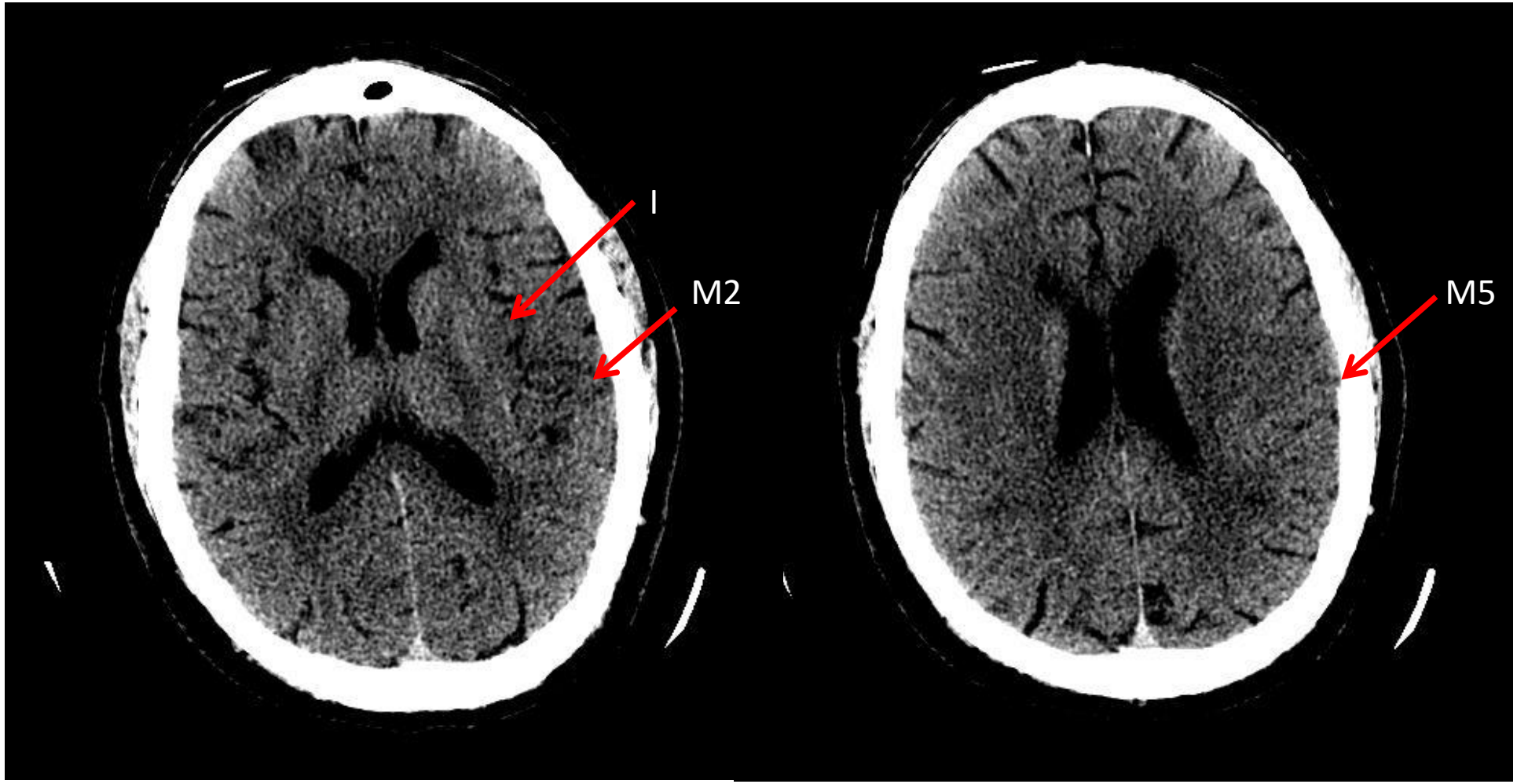
C = caudate, L = lentiform, I = insula, IC = internal capsule

M1, M2, M3 = anterior, lateral, posterior MCA territory; M4 to M6 are above the lentiform nuclei

Right hemiparesis and aphasia: Where is the infarct?

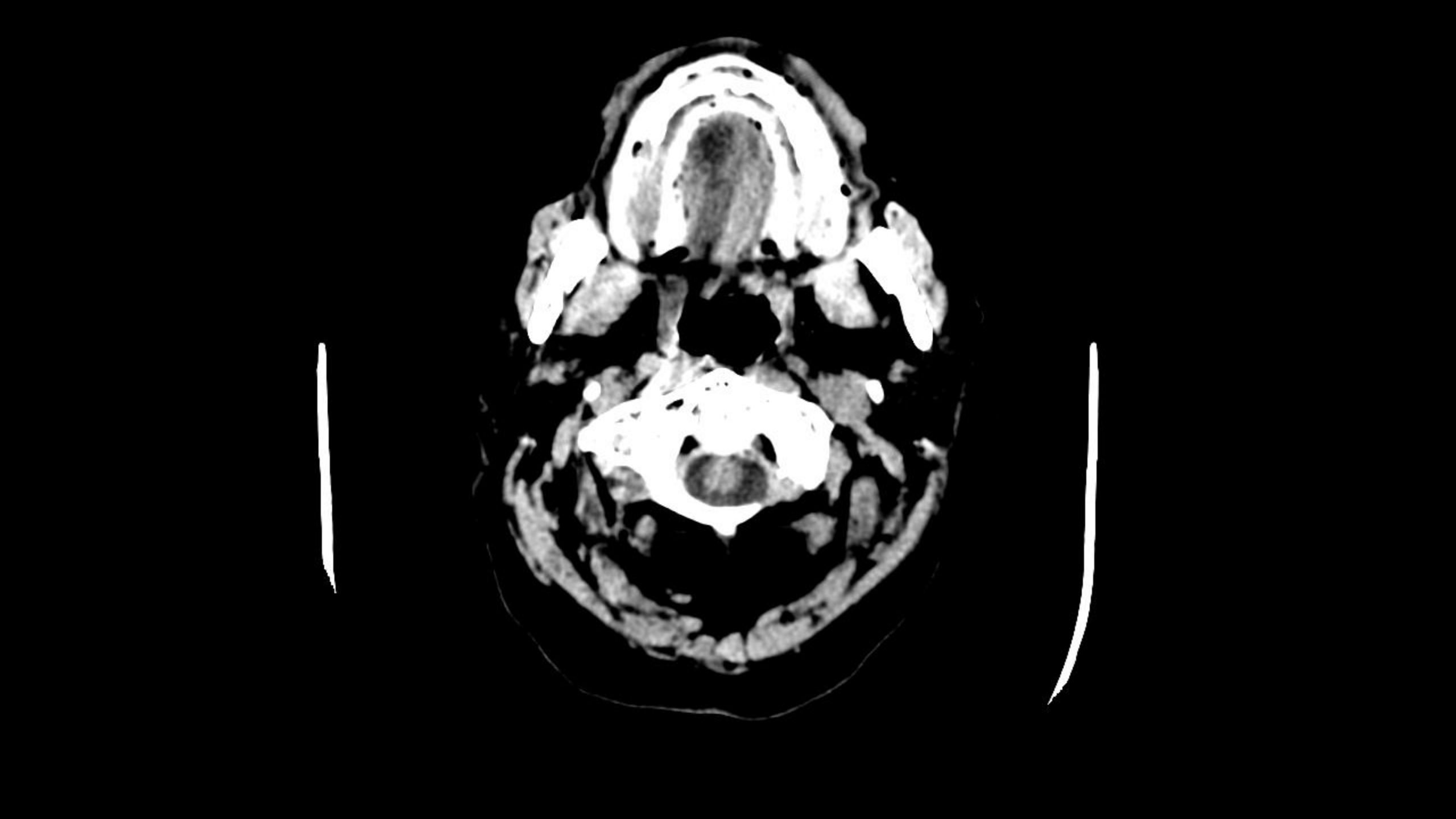


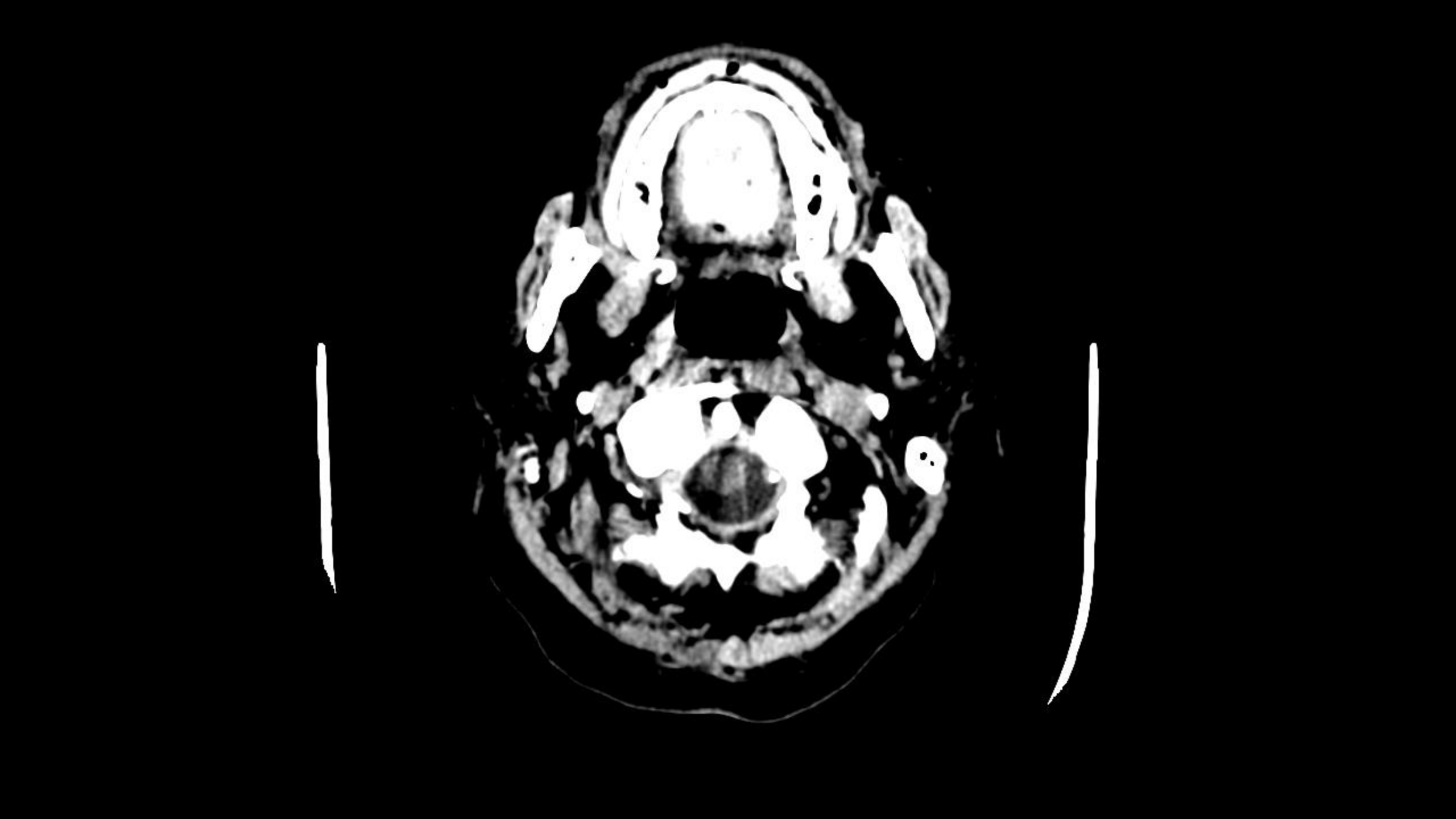
Can you see the infarct using ASPECTS?

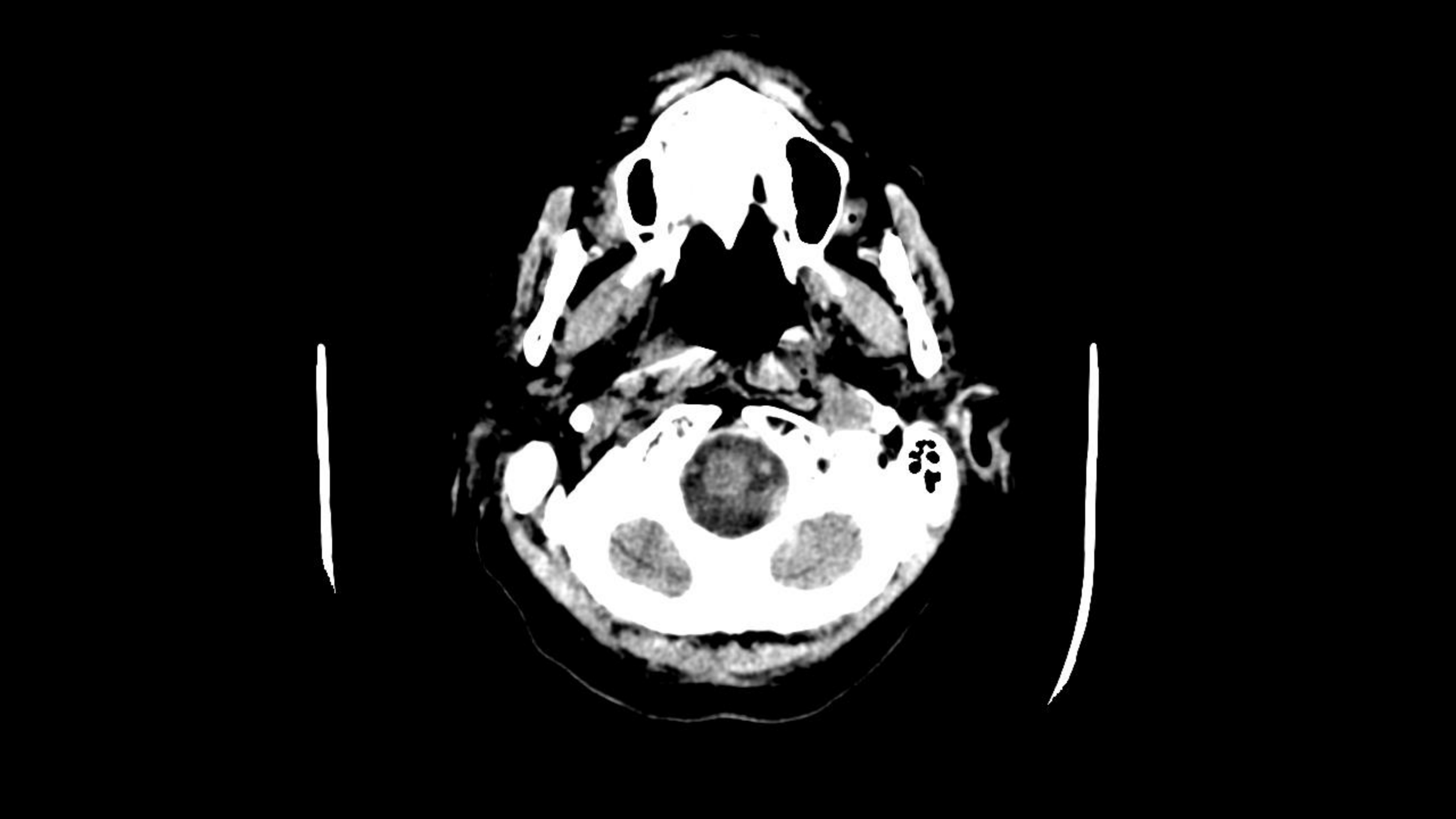


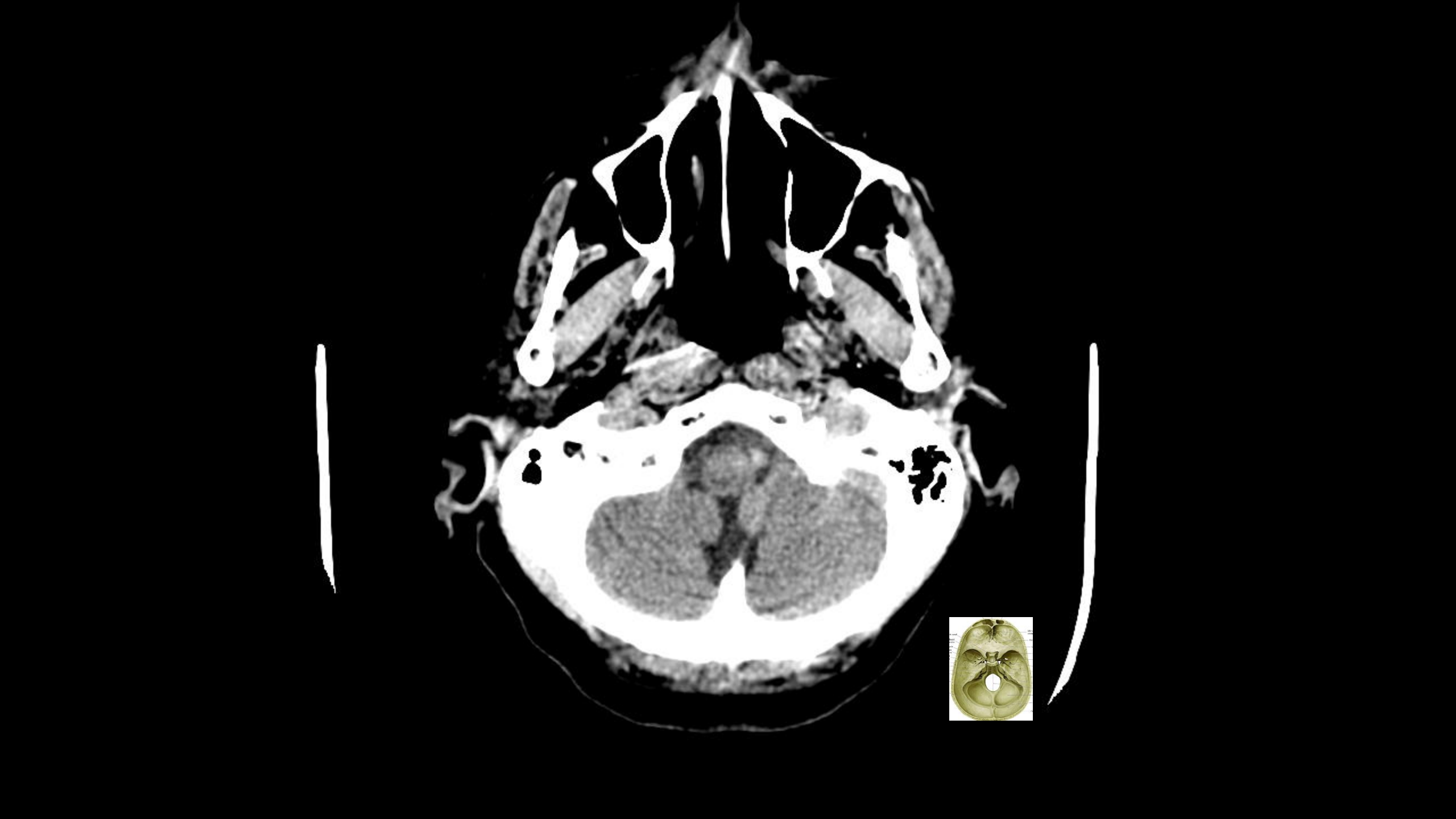
Case

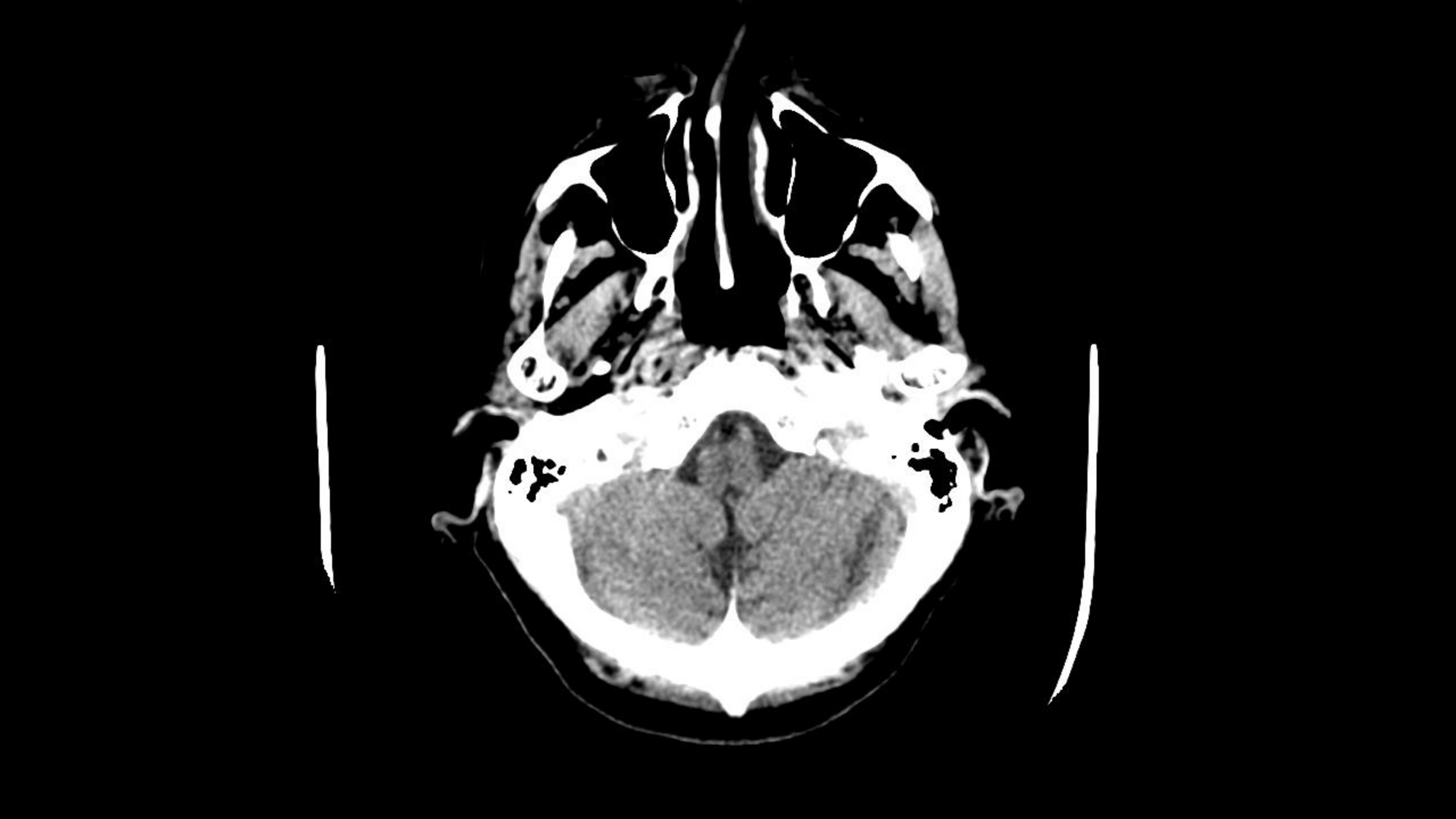
- 77 year old female with left hemiparesis, left homonymous hemianopia, left side sensory loss

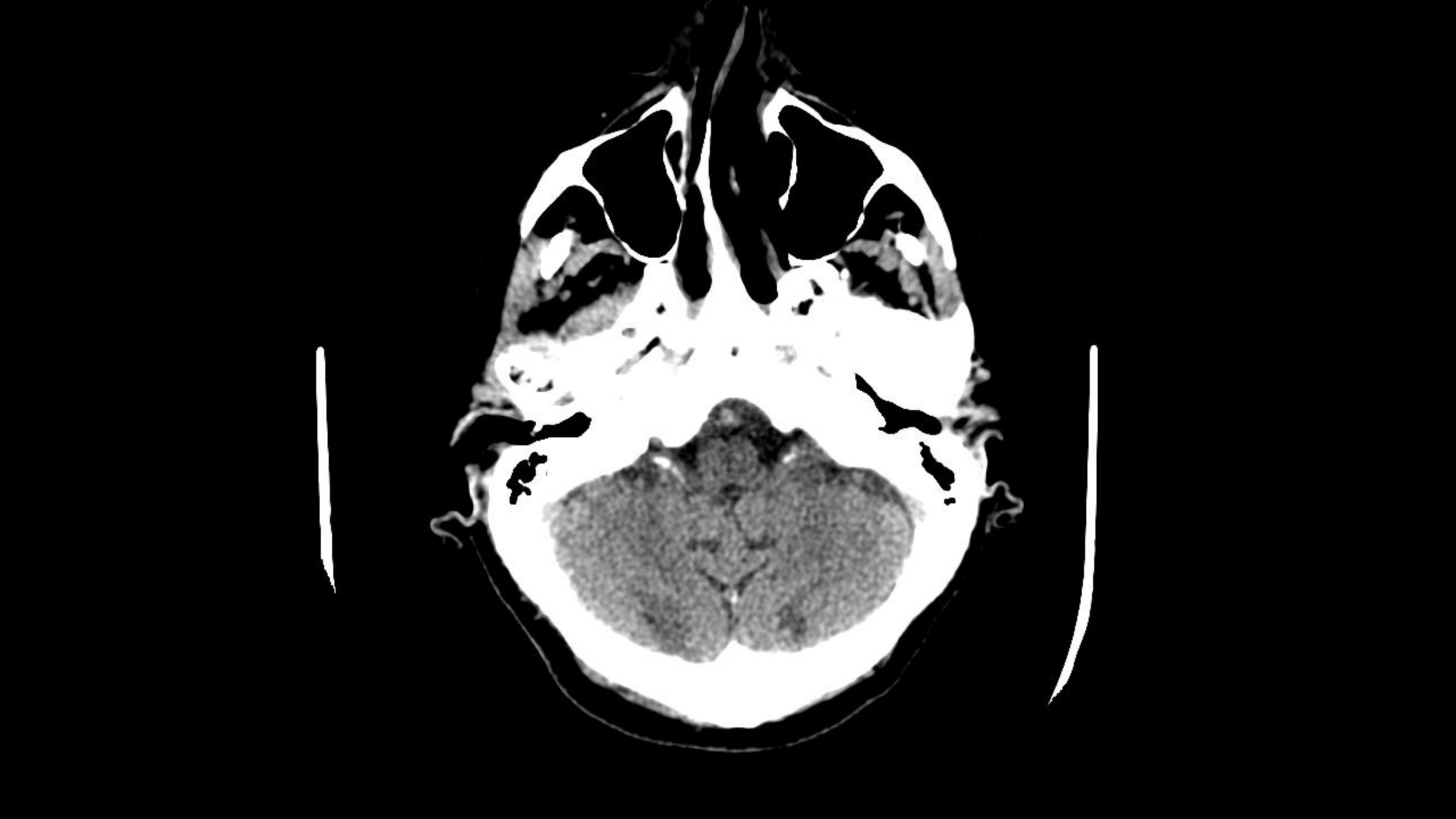


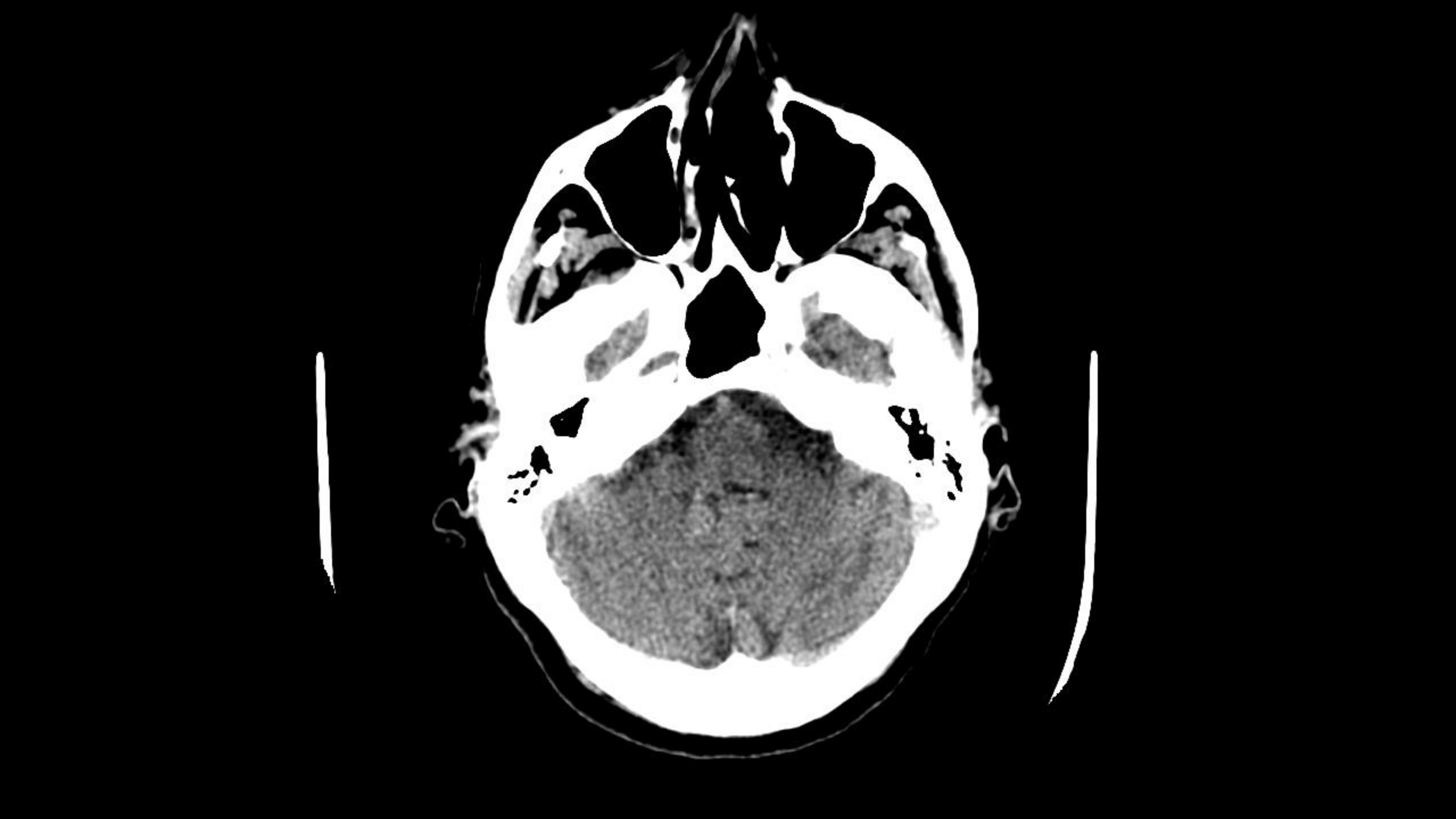


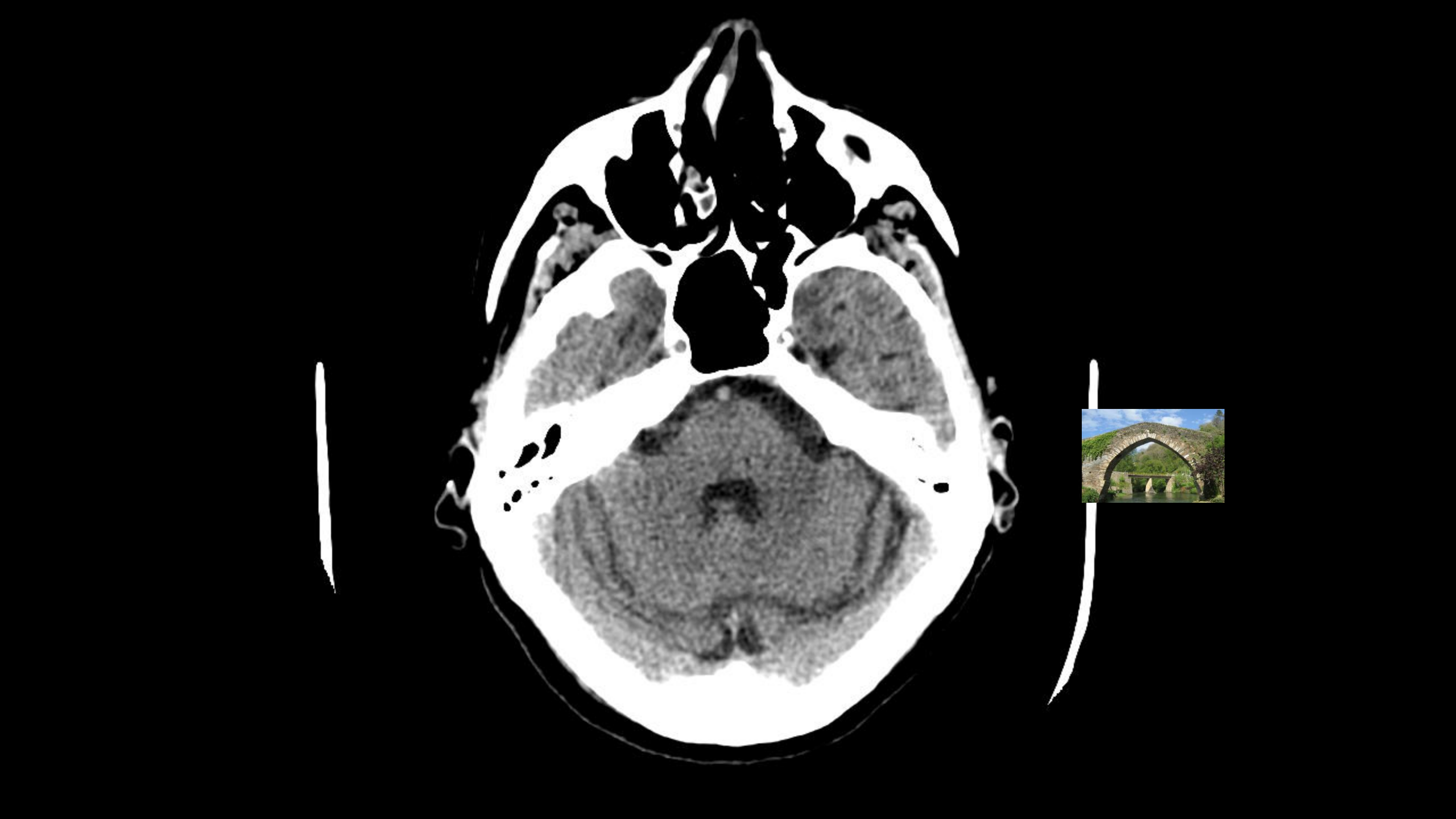


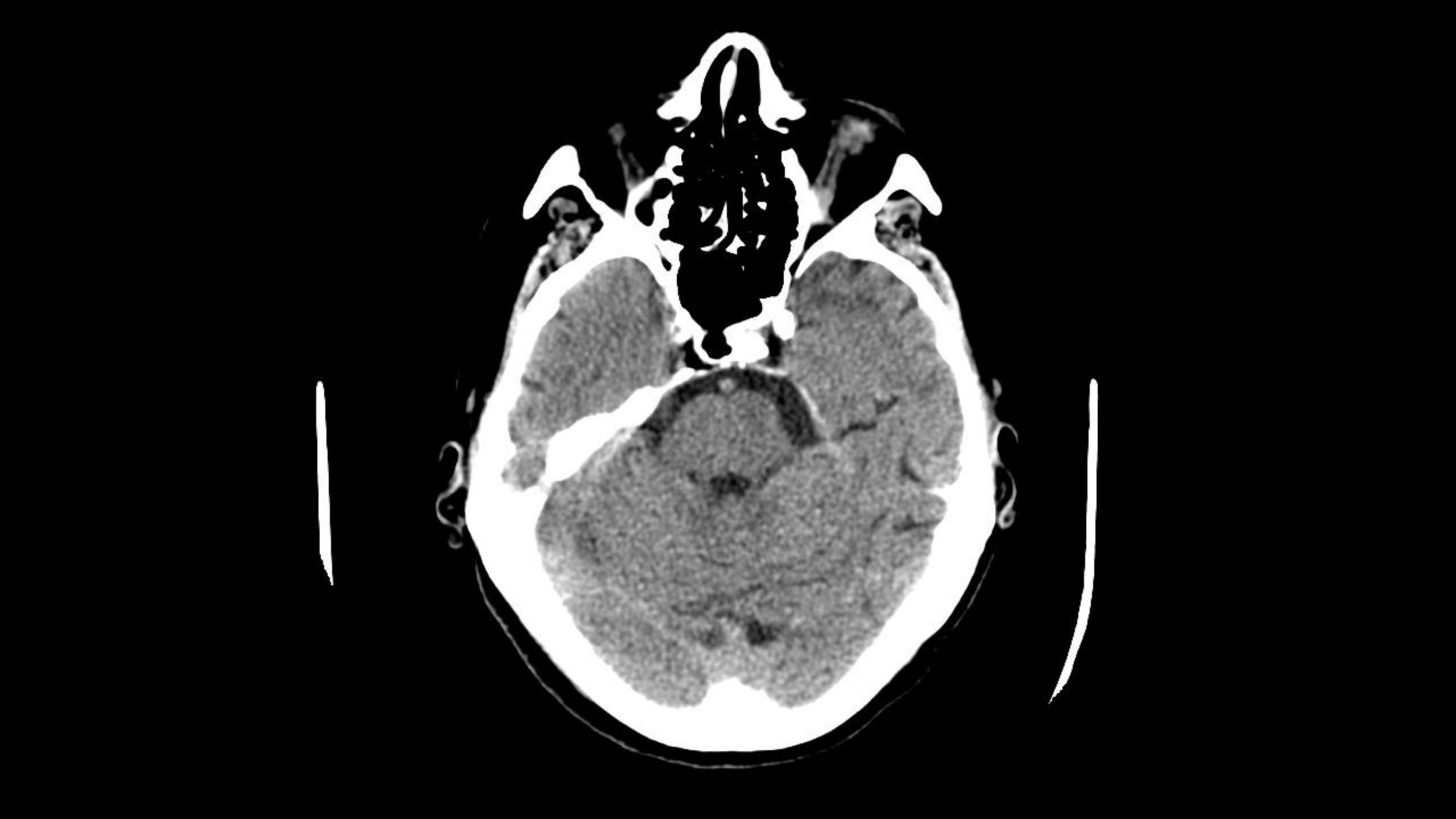


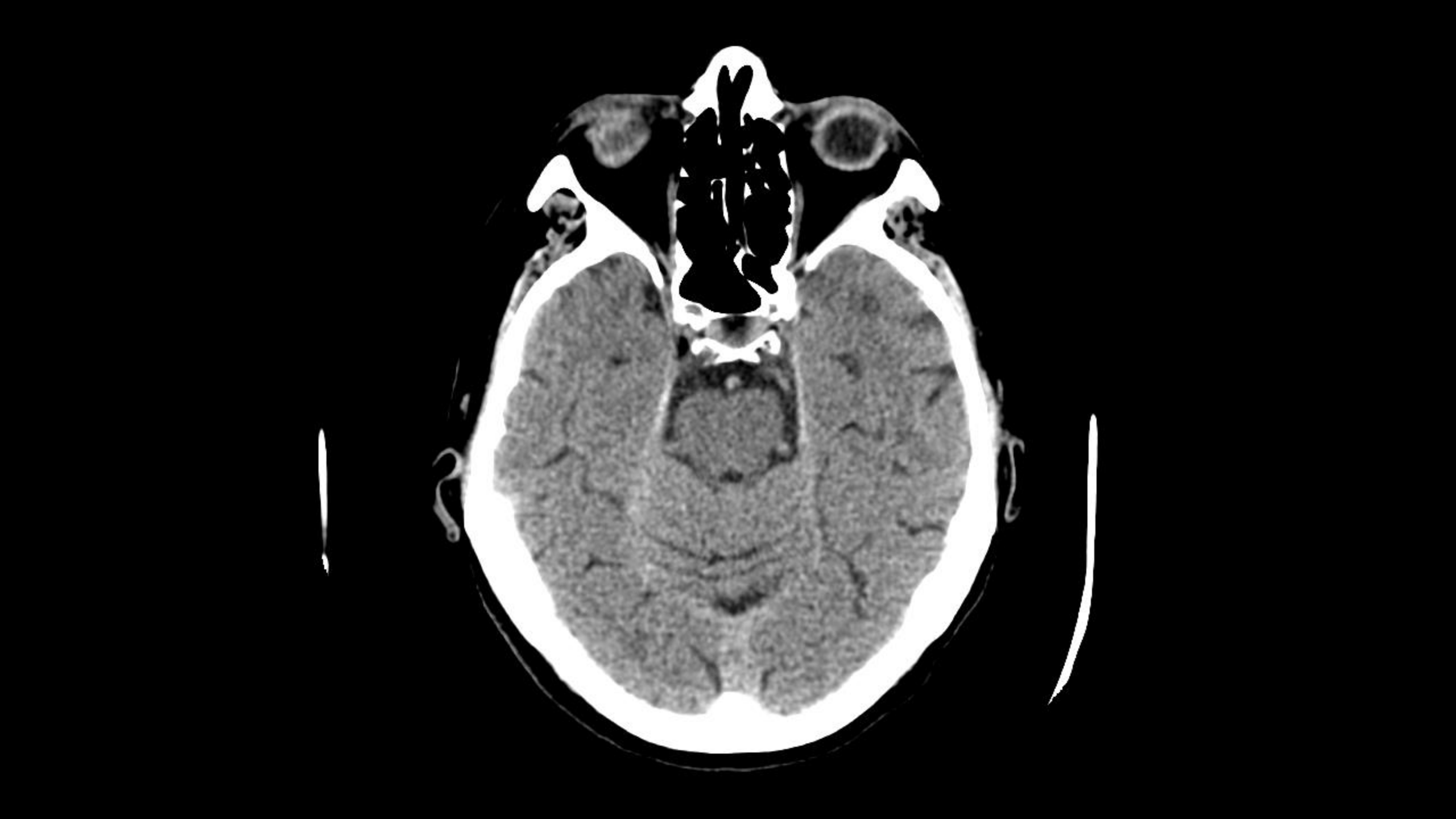


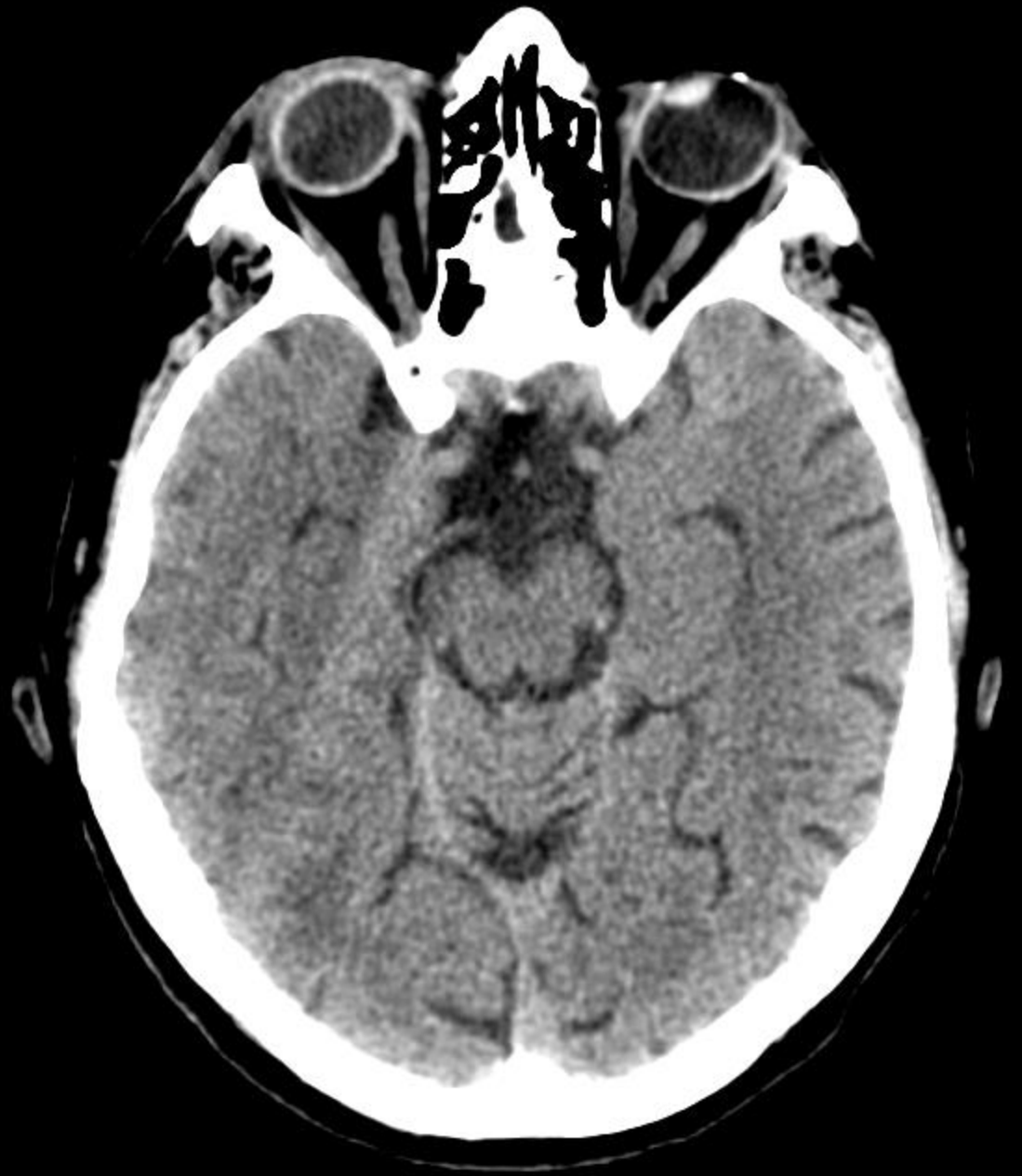


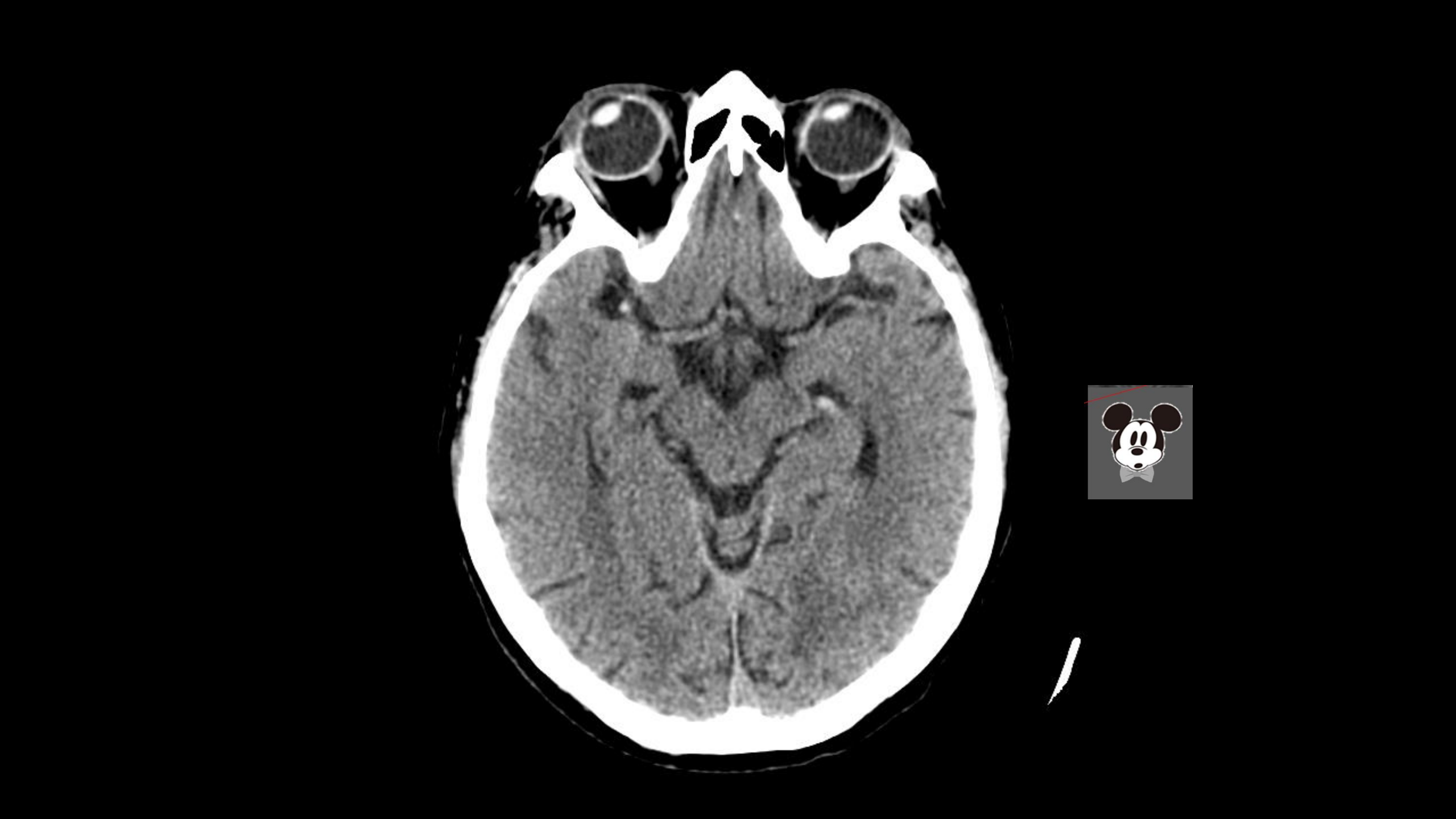


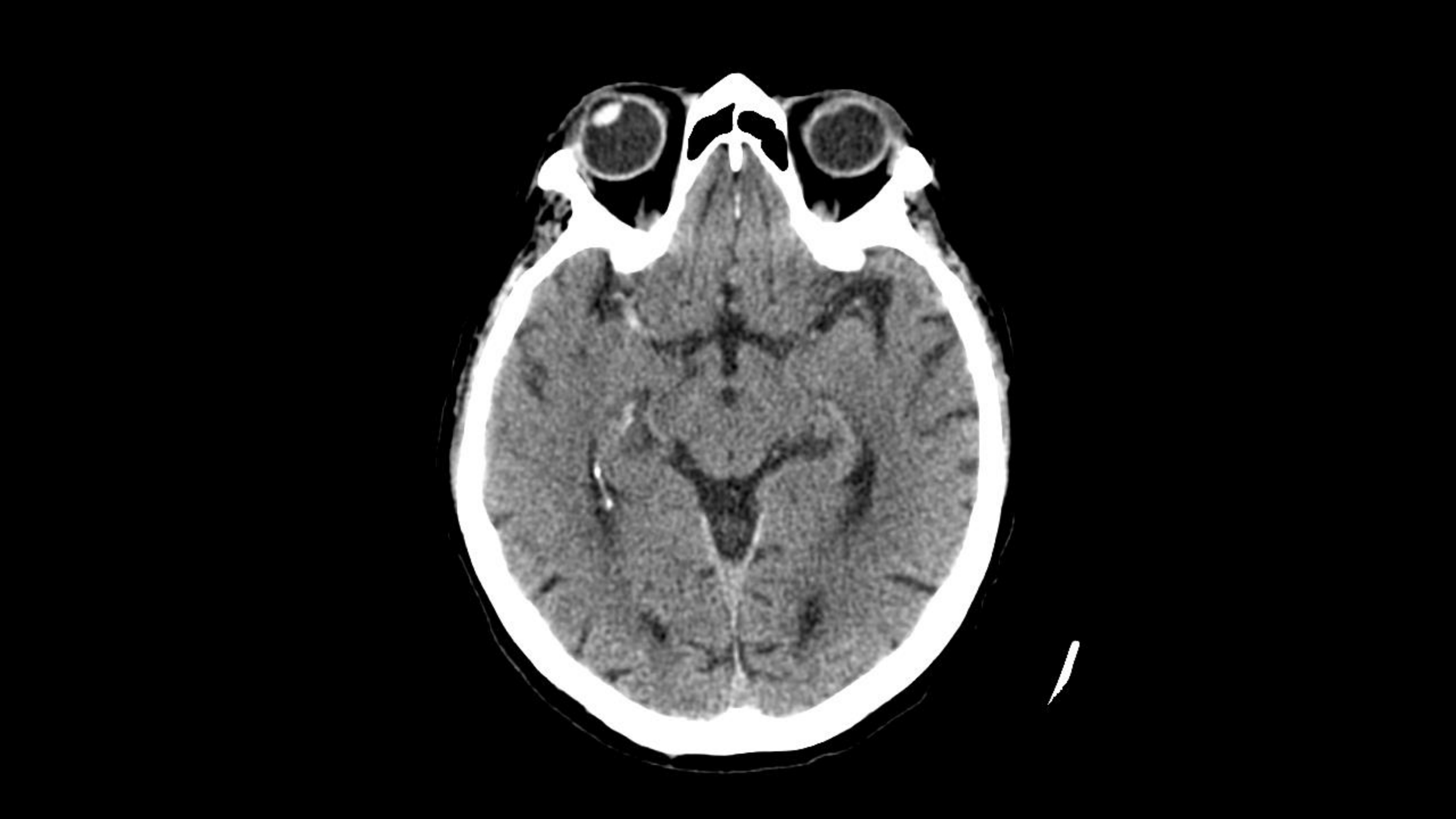


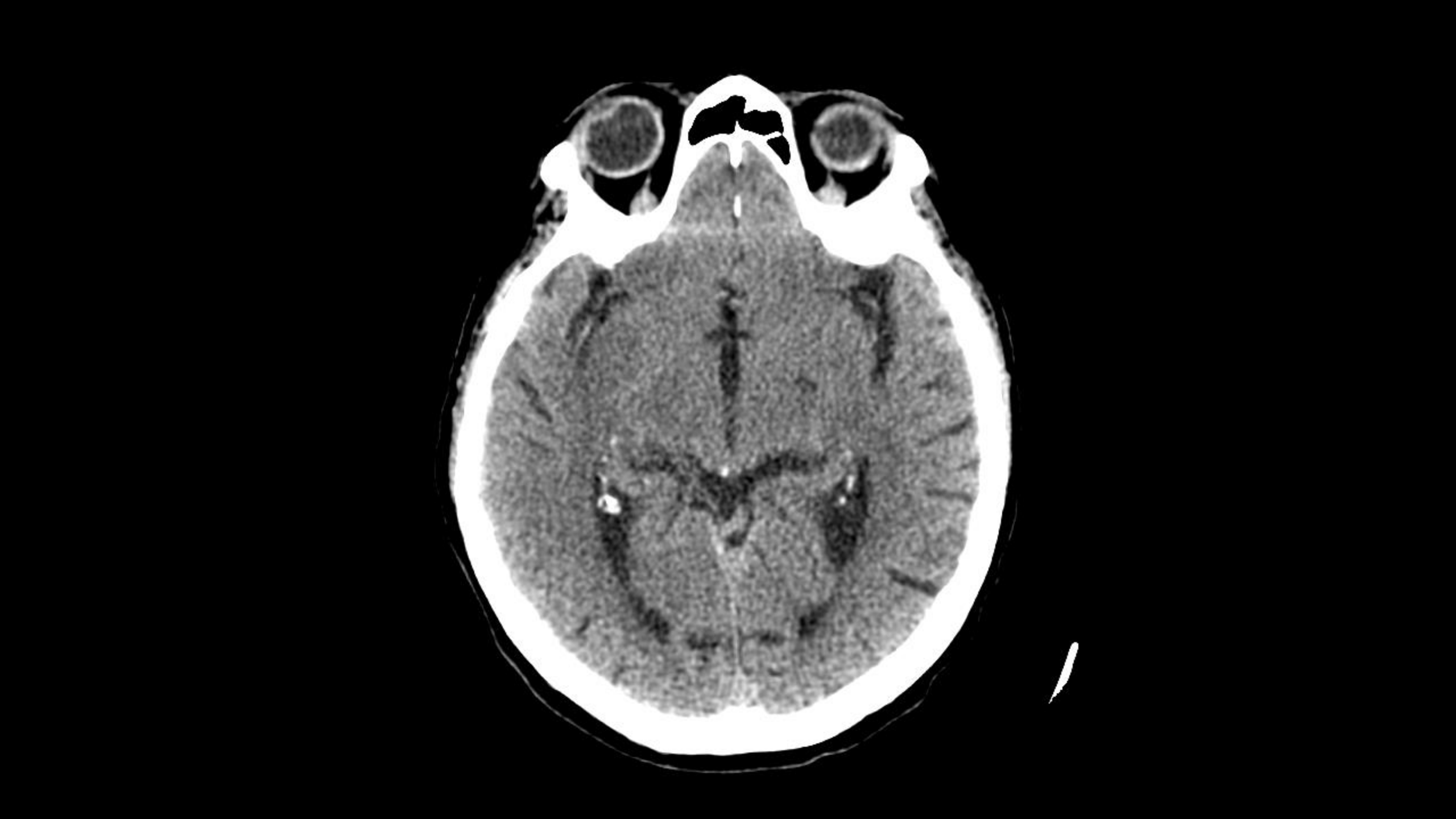


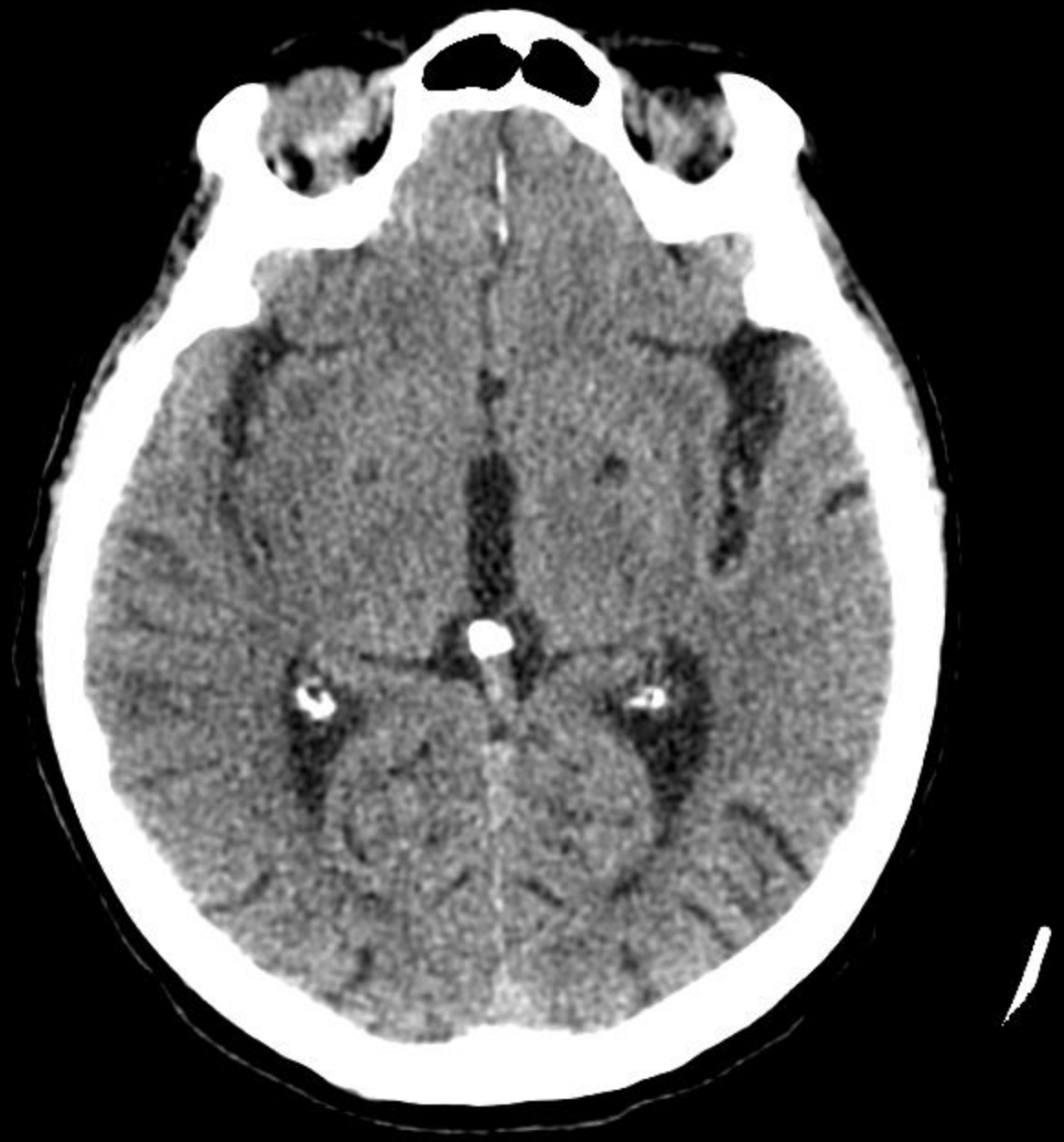


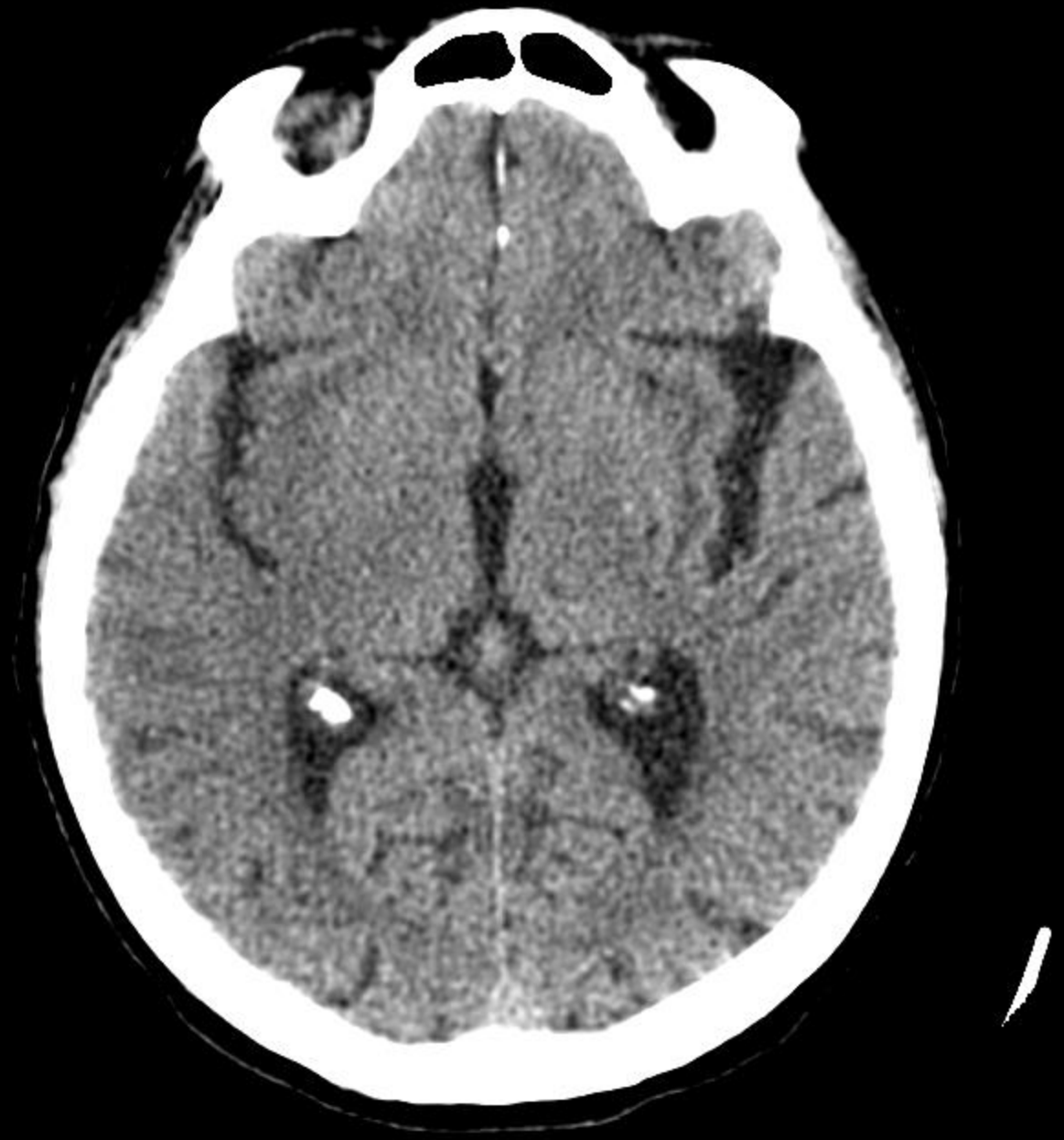


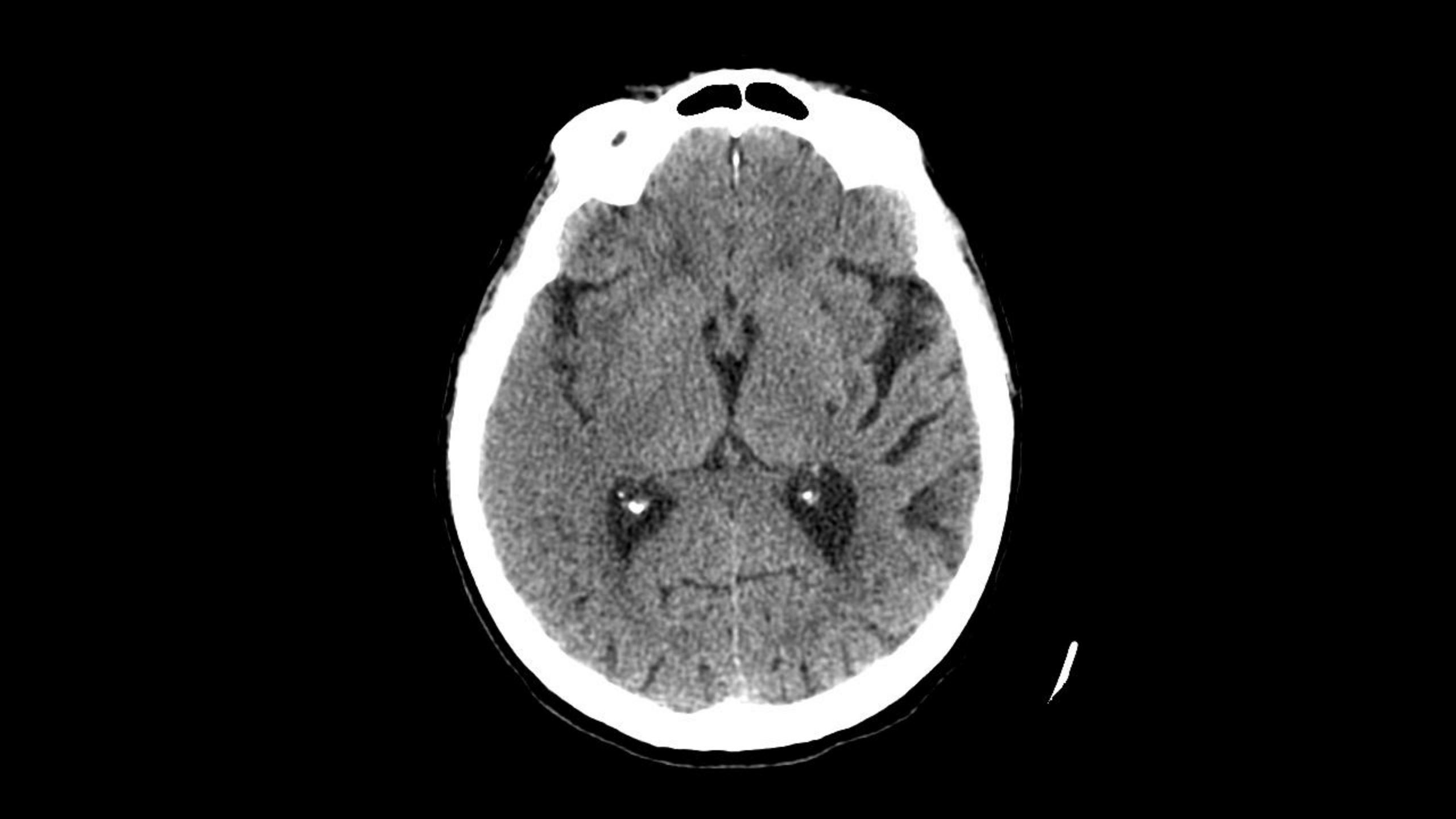


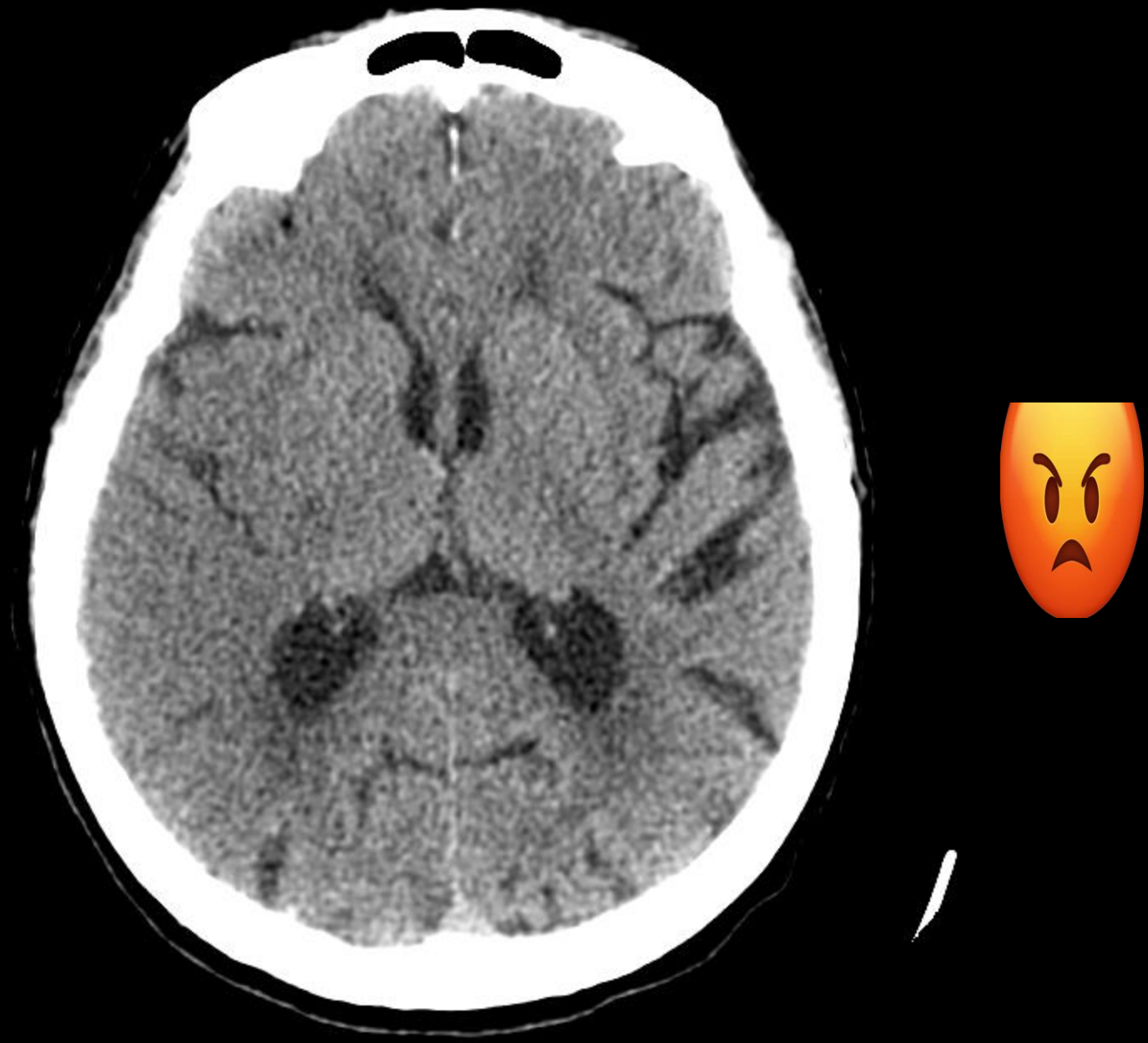


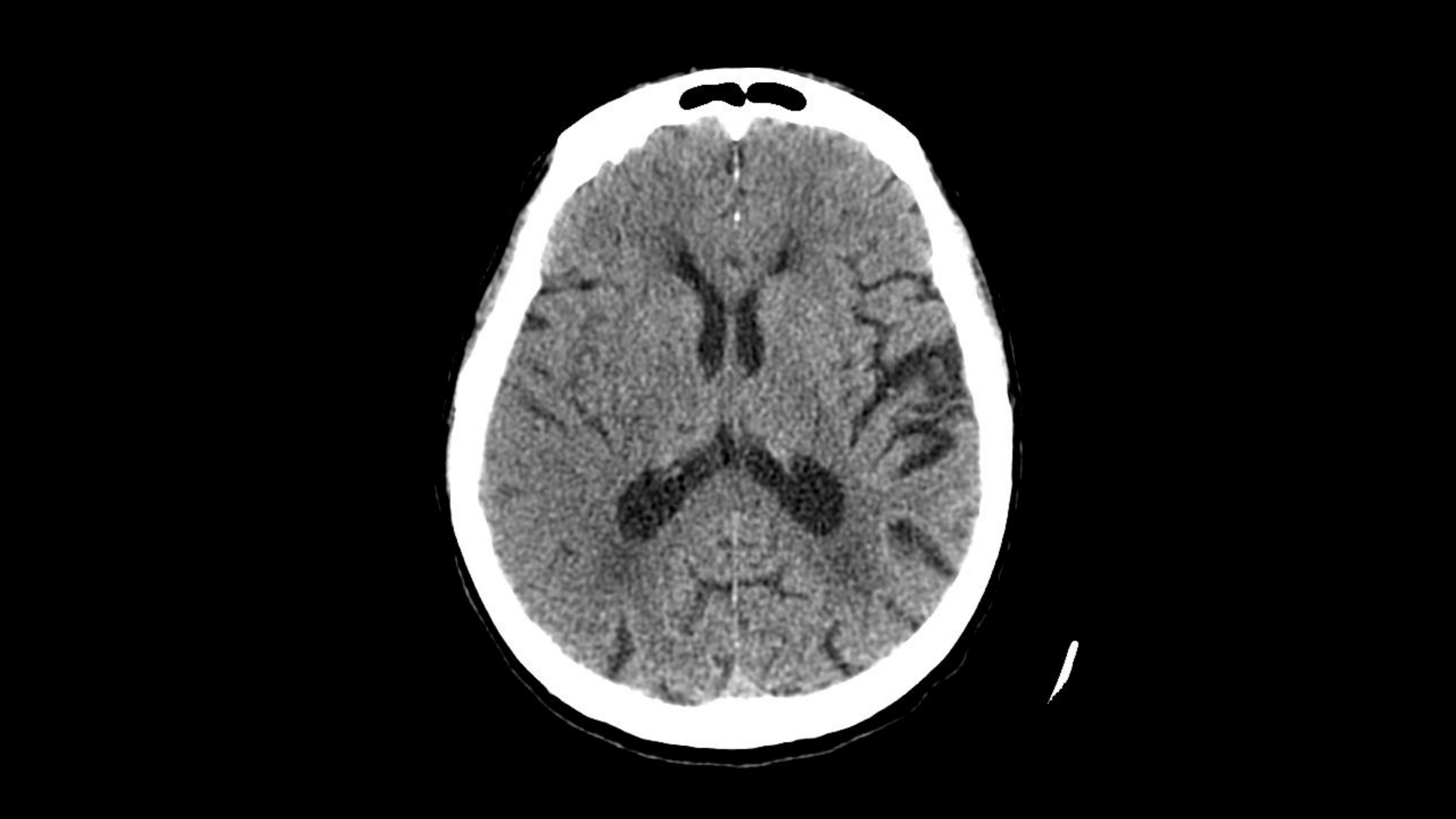


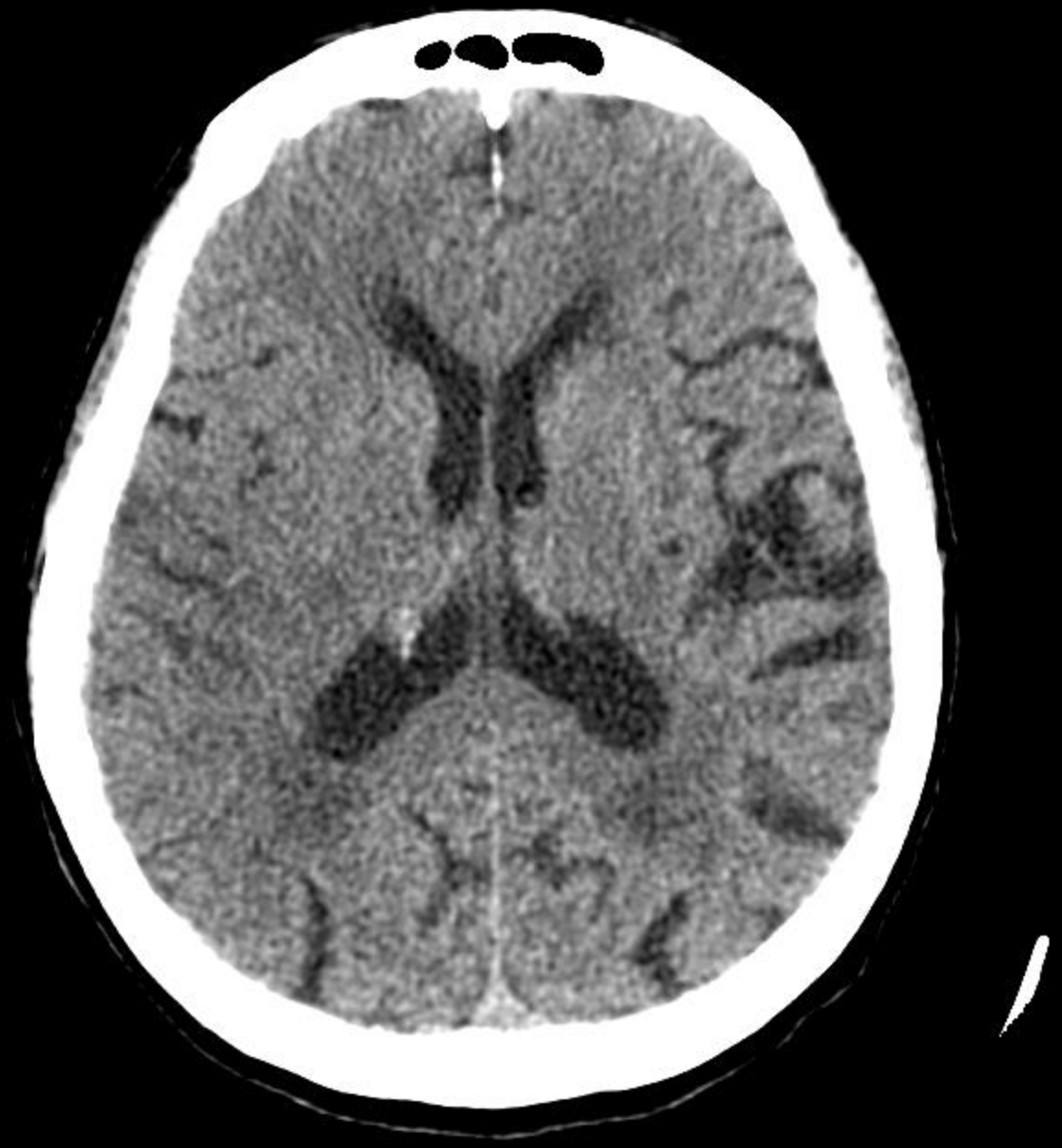


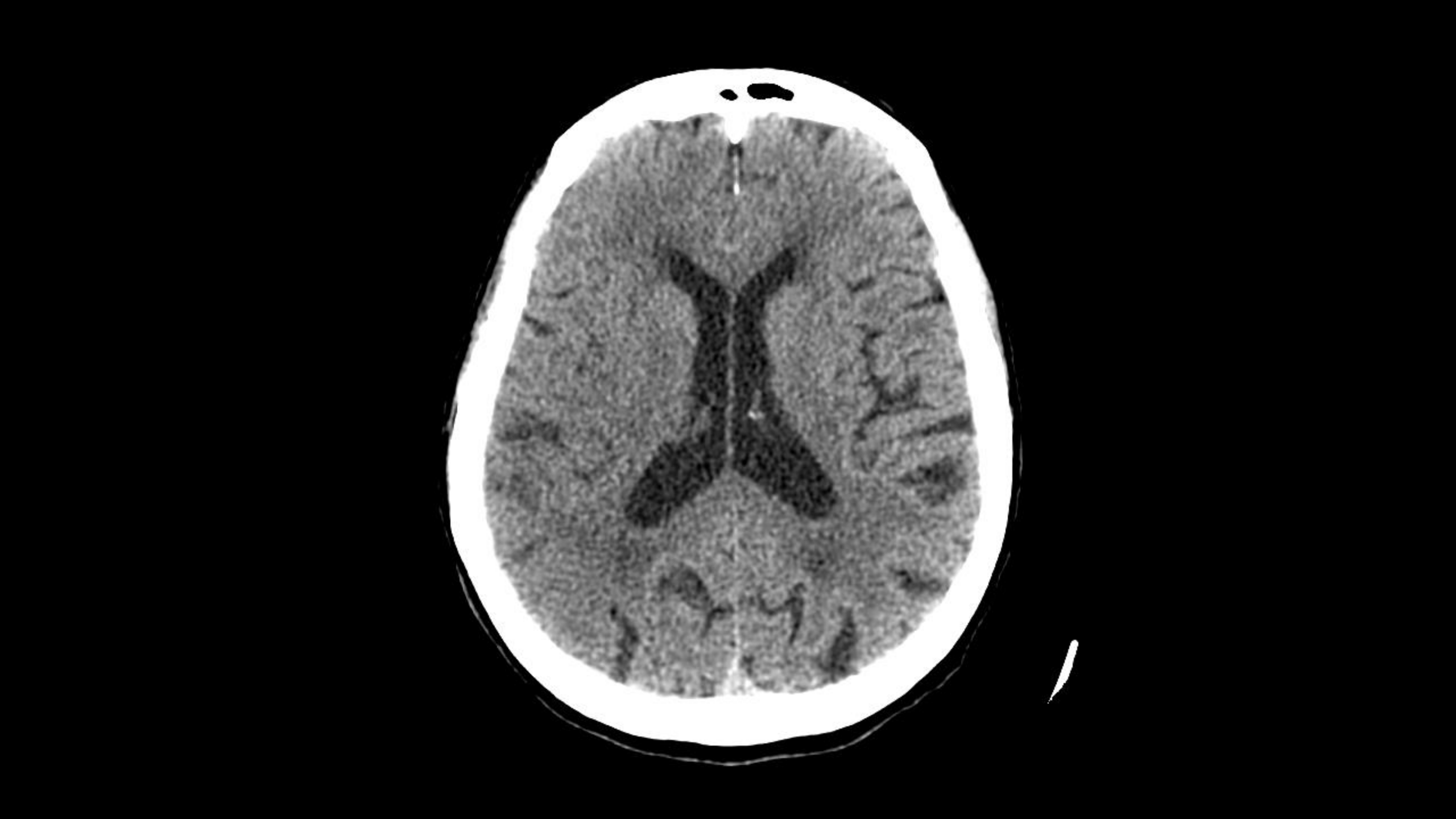


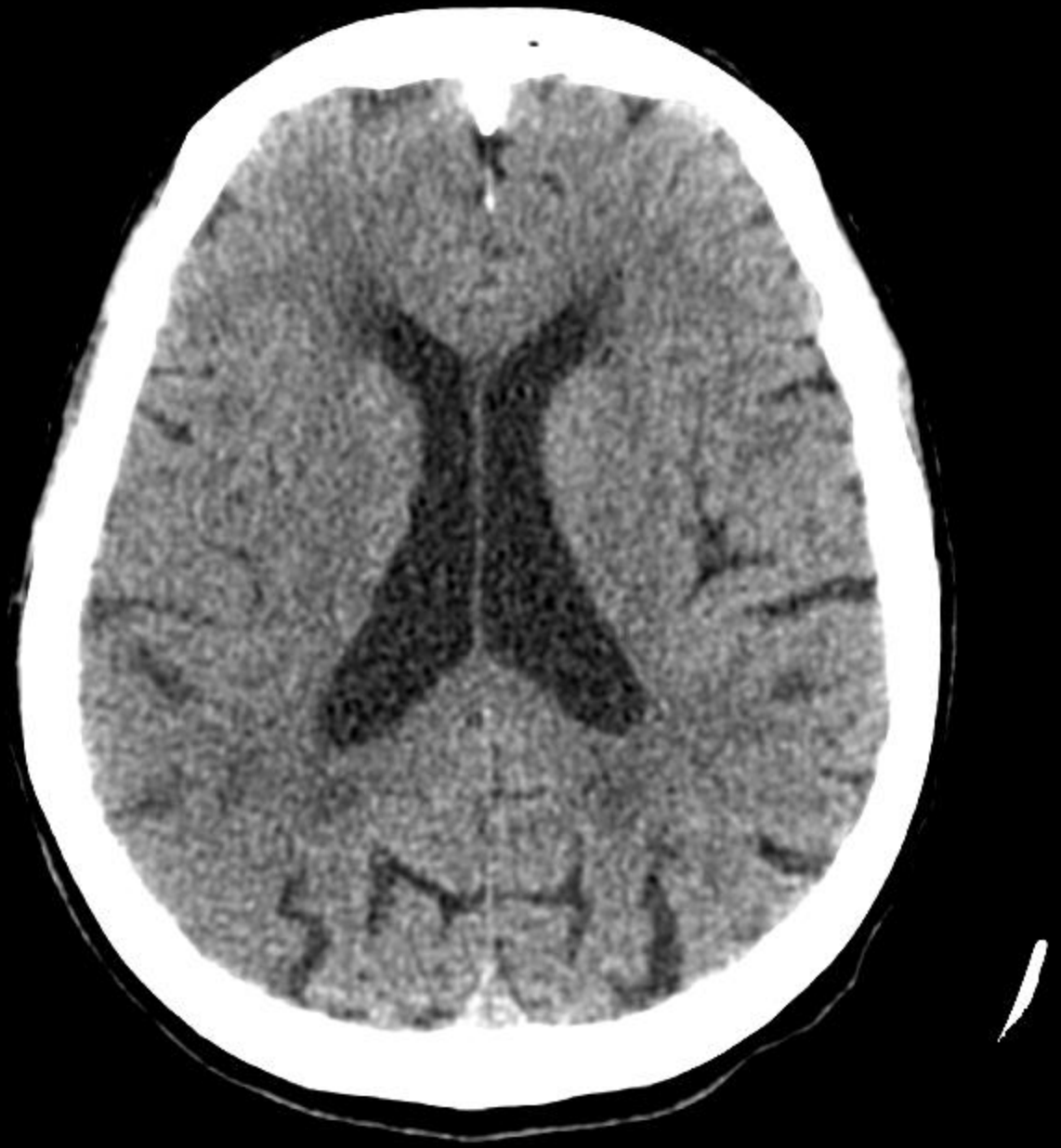


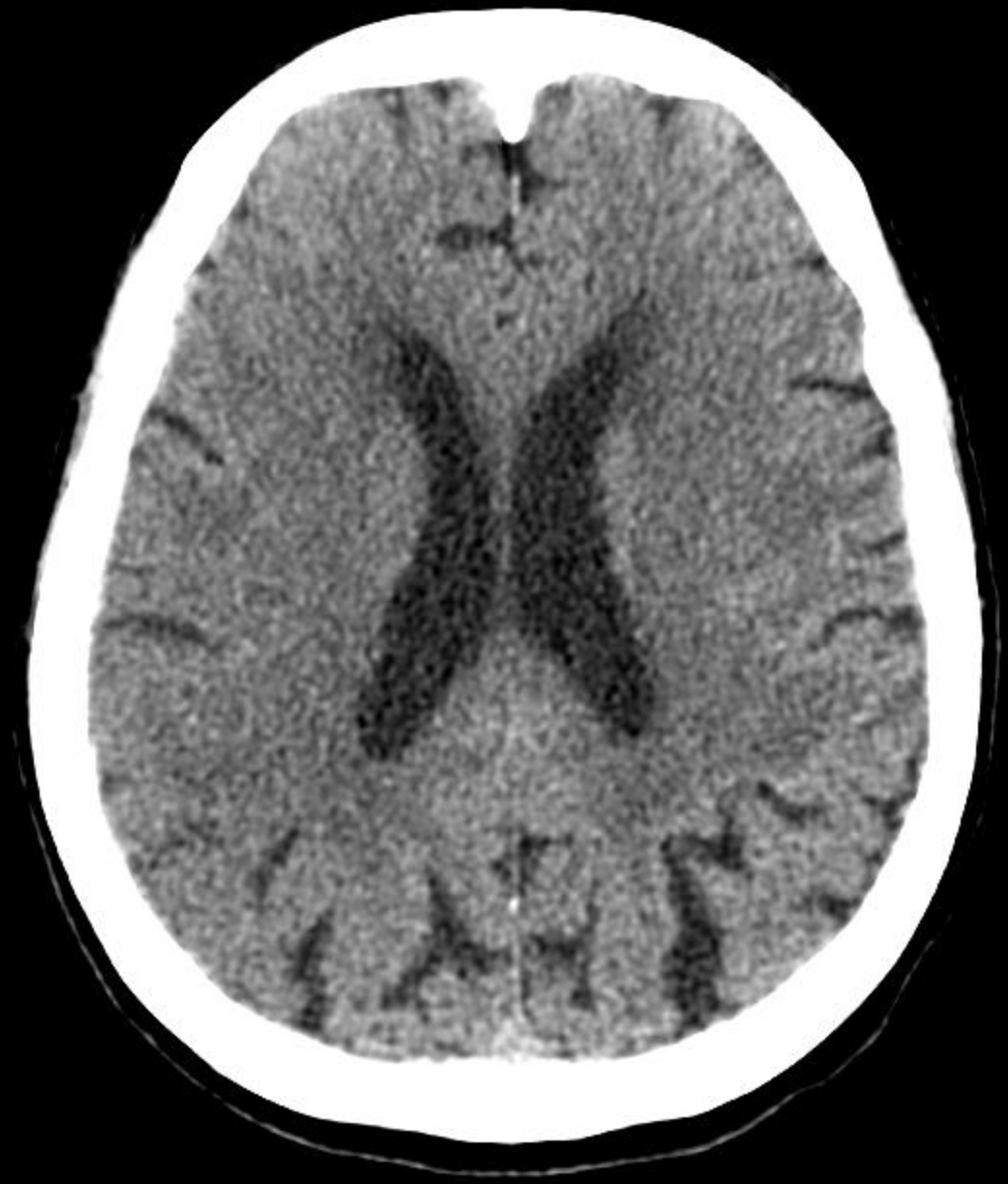


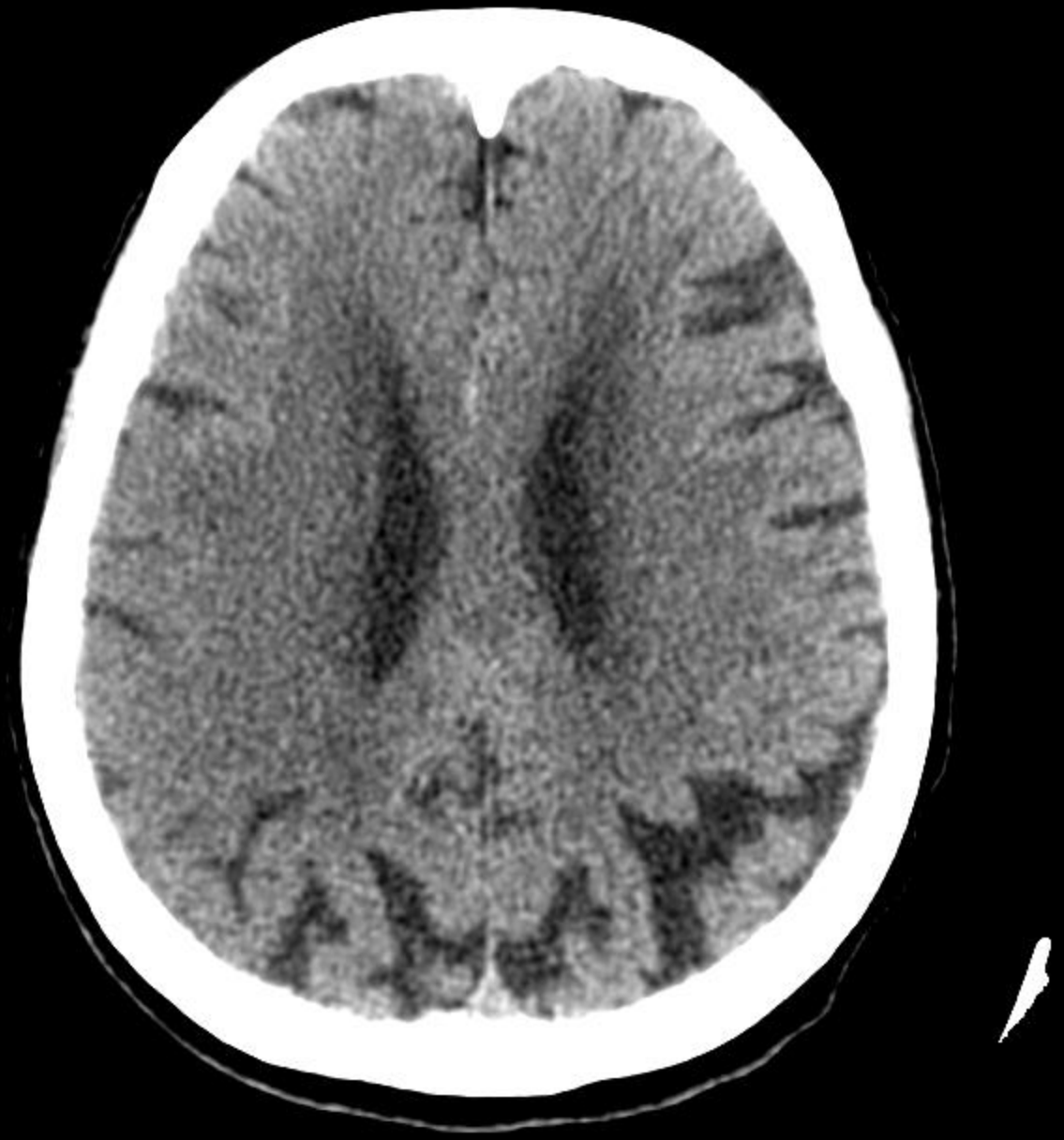


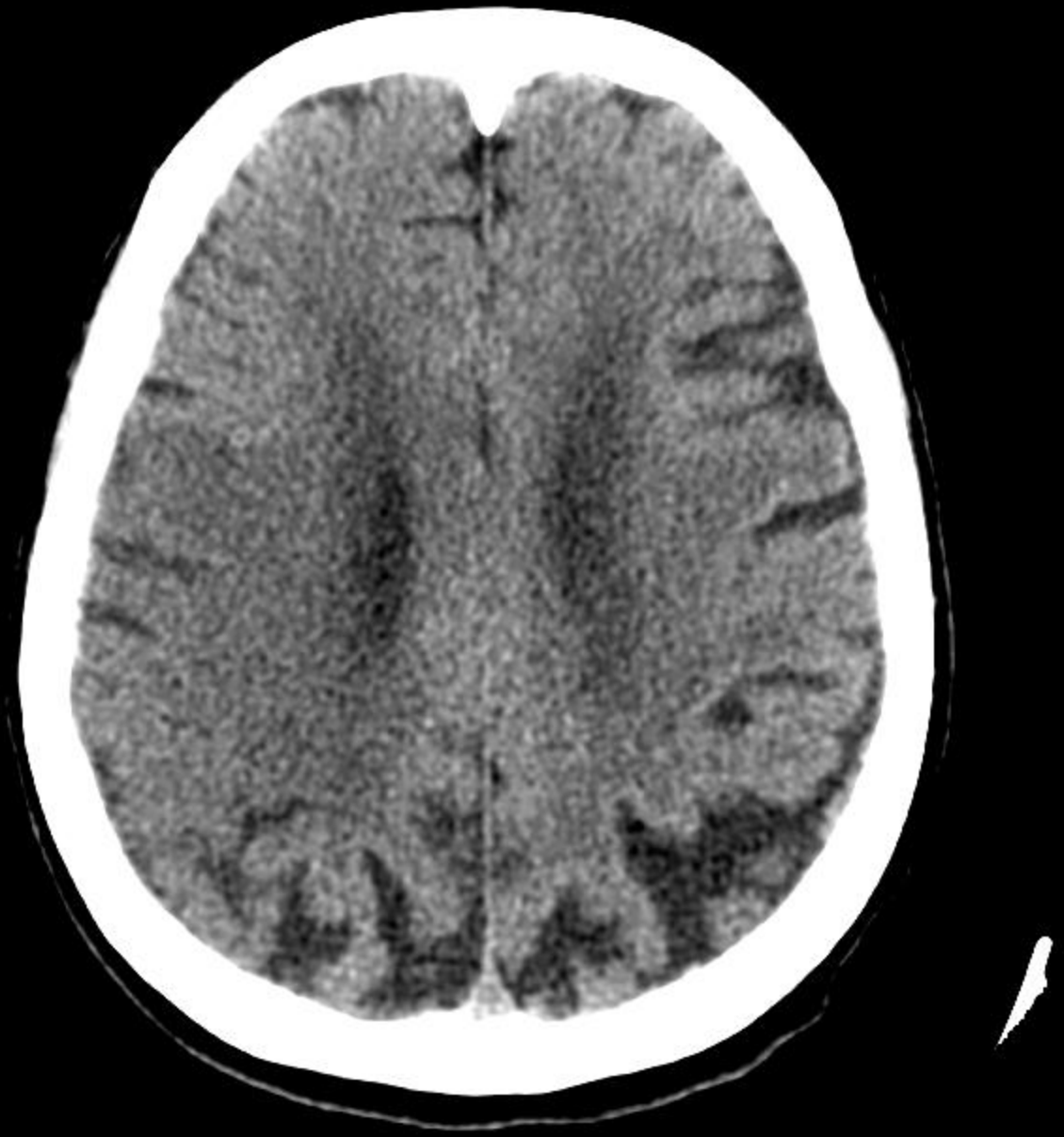


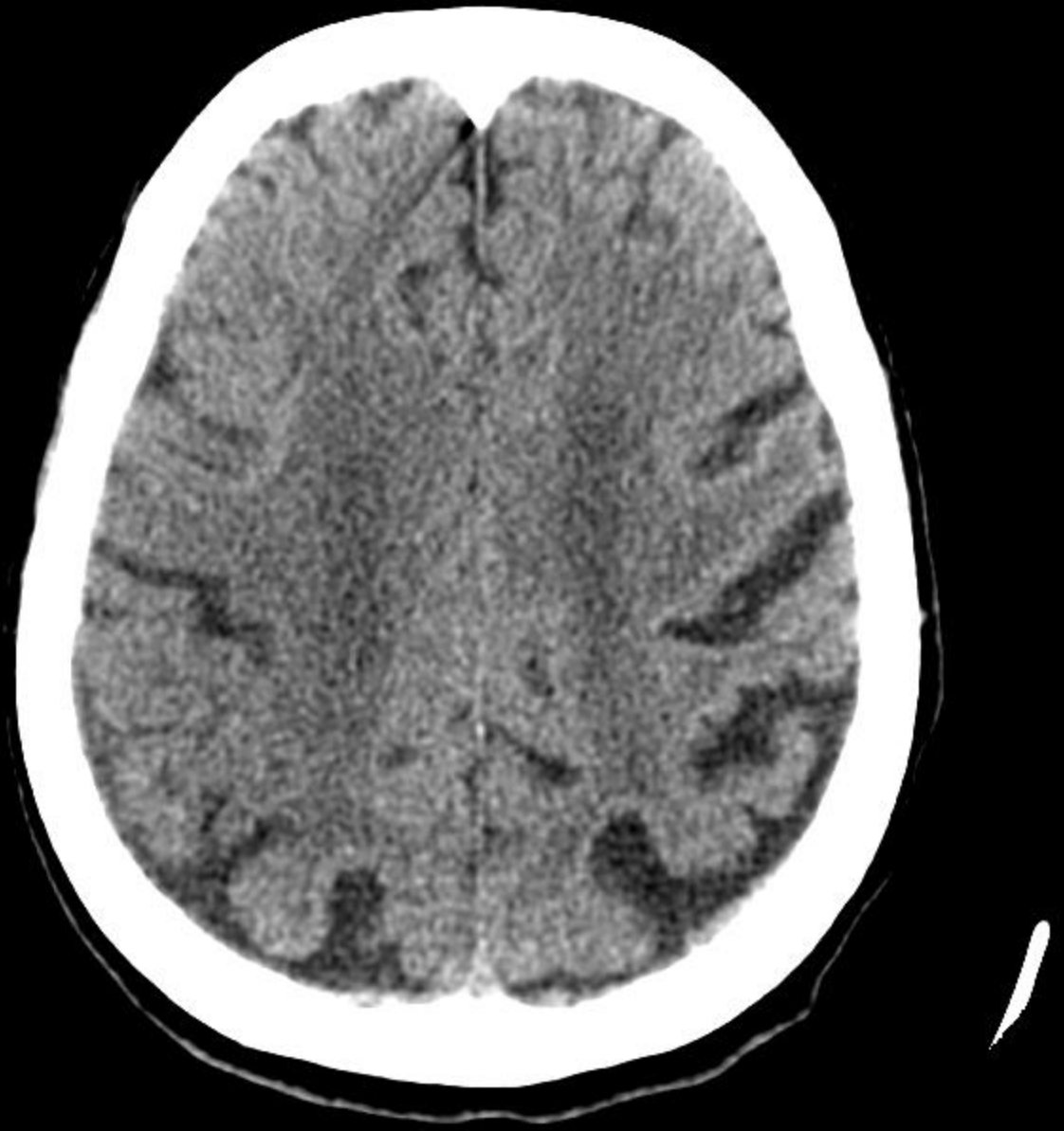


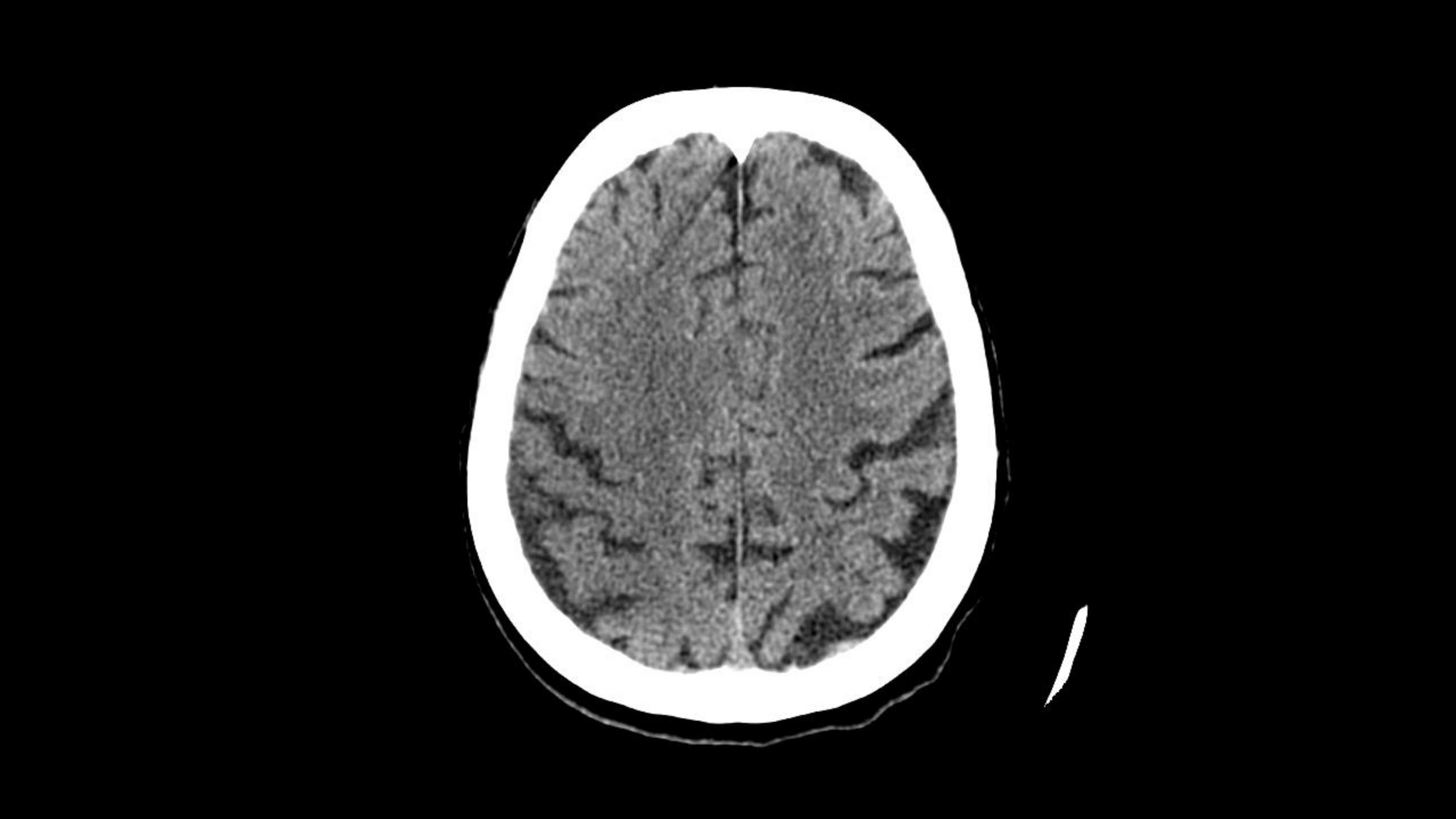


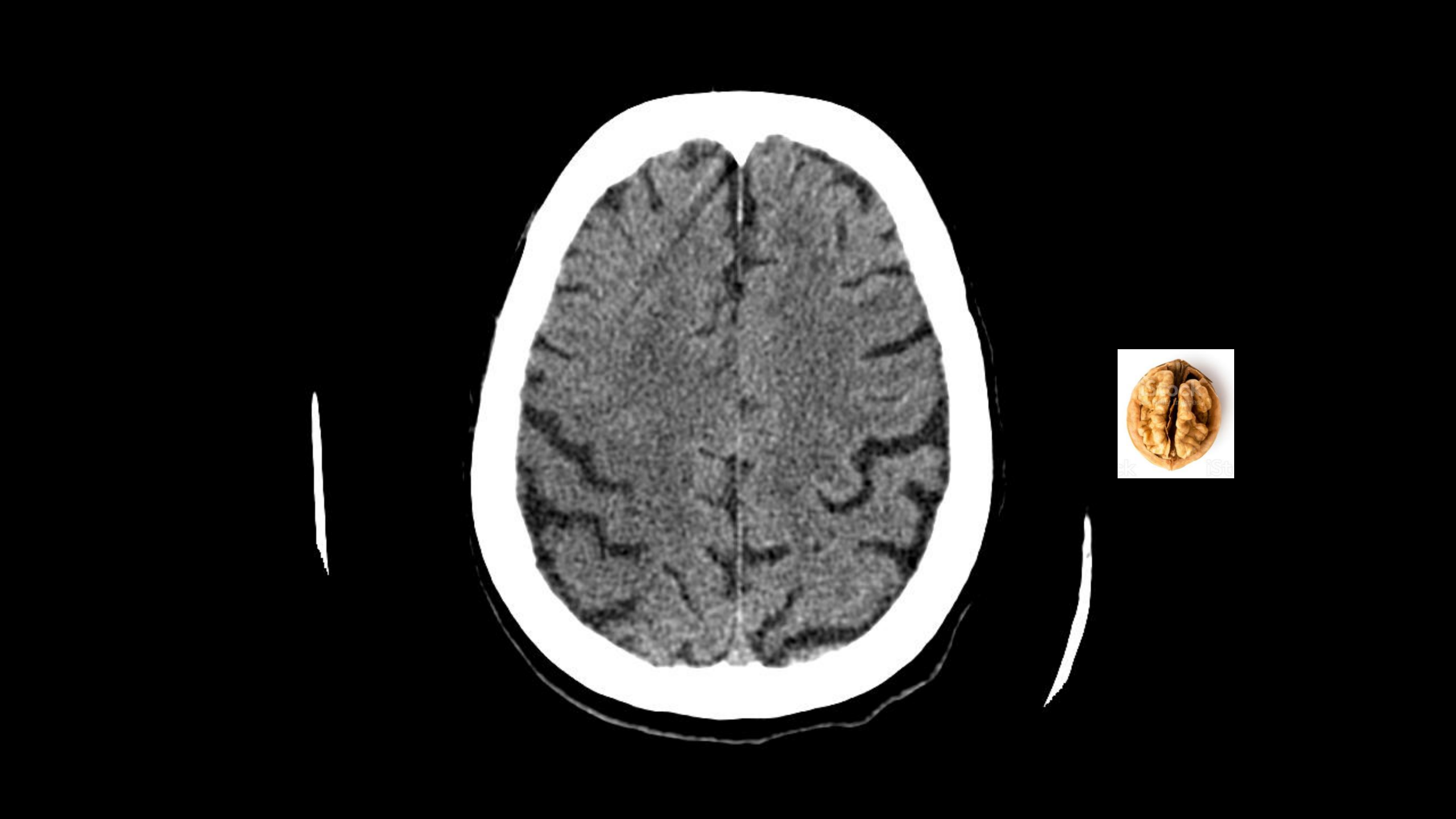


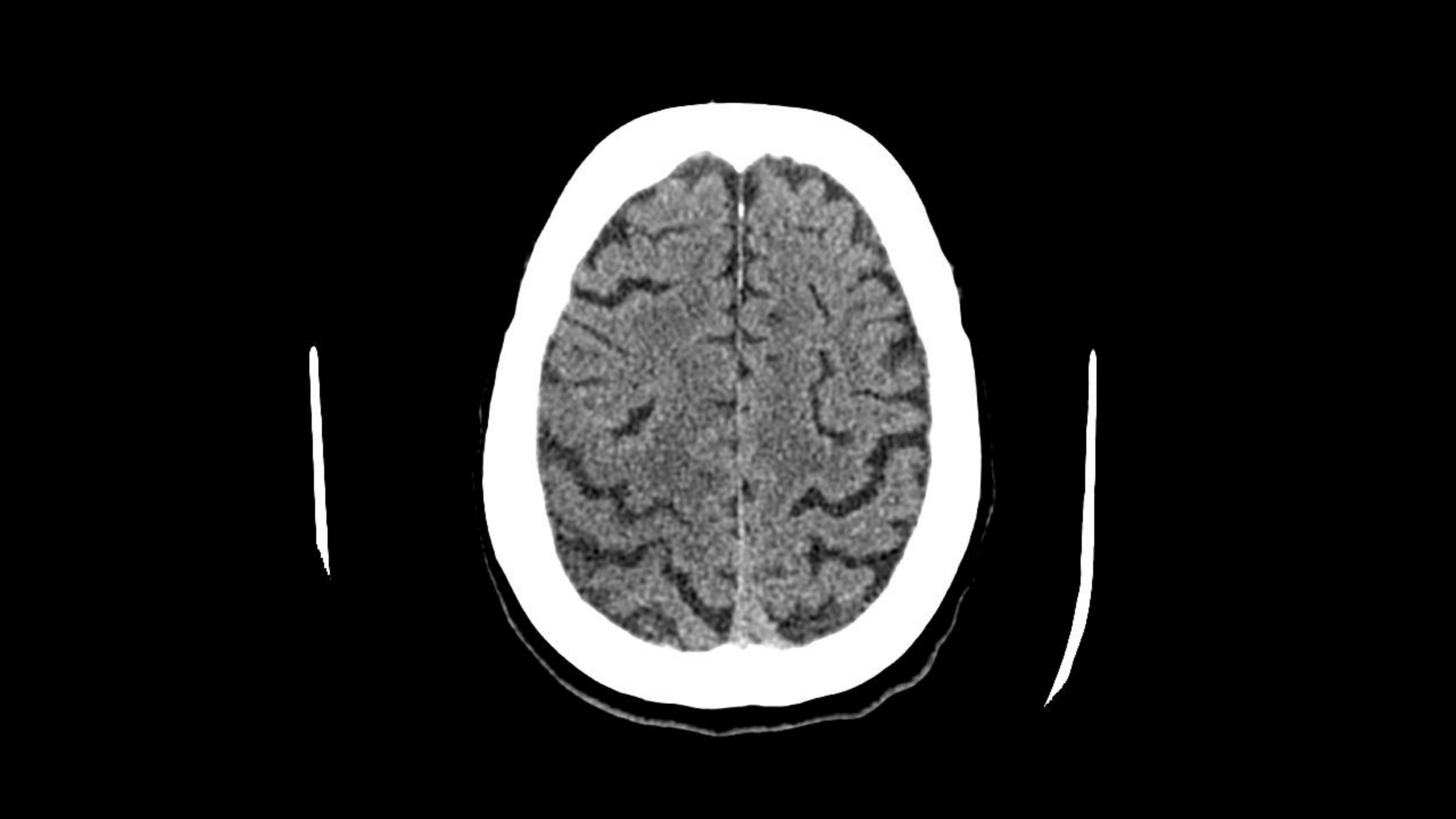


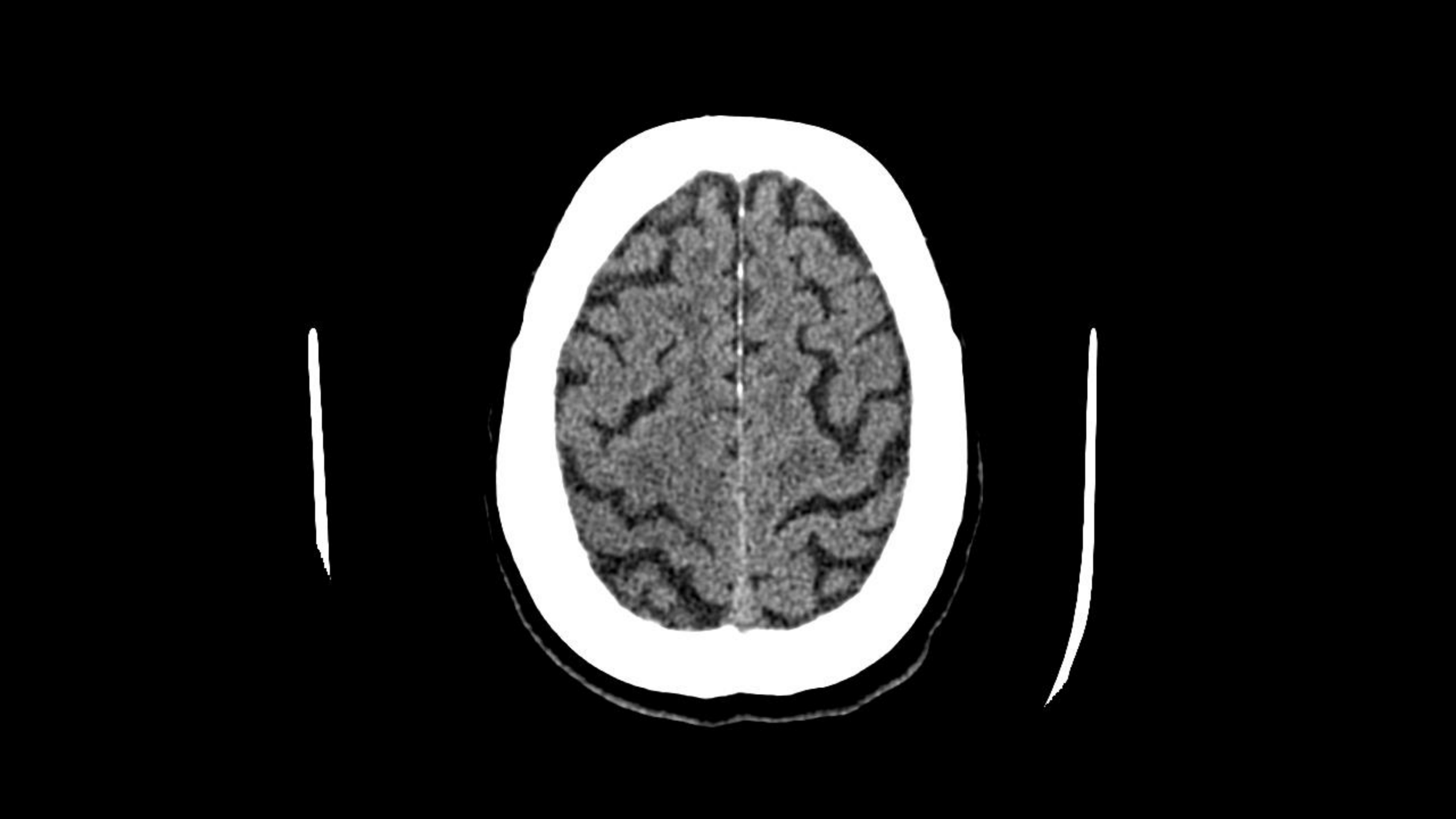


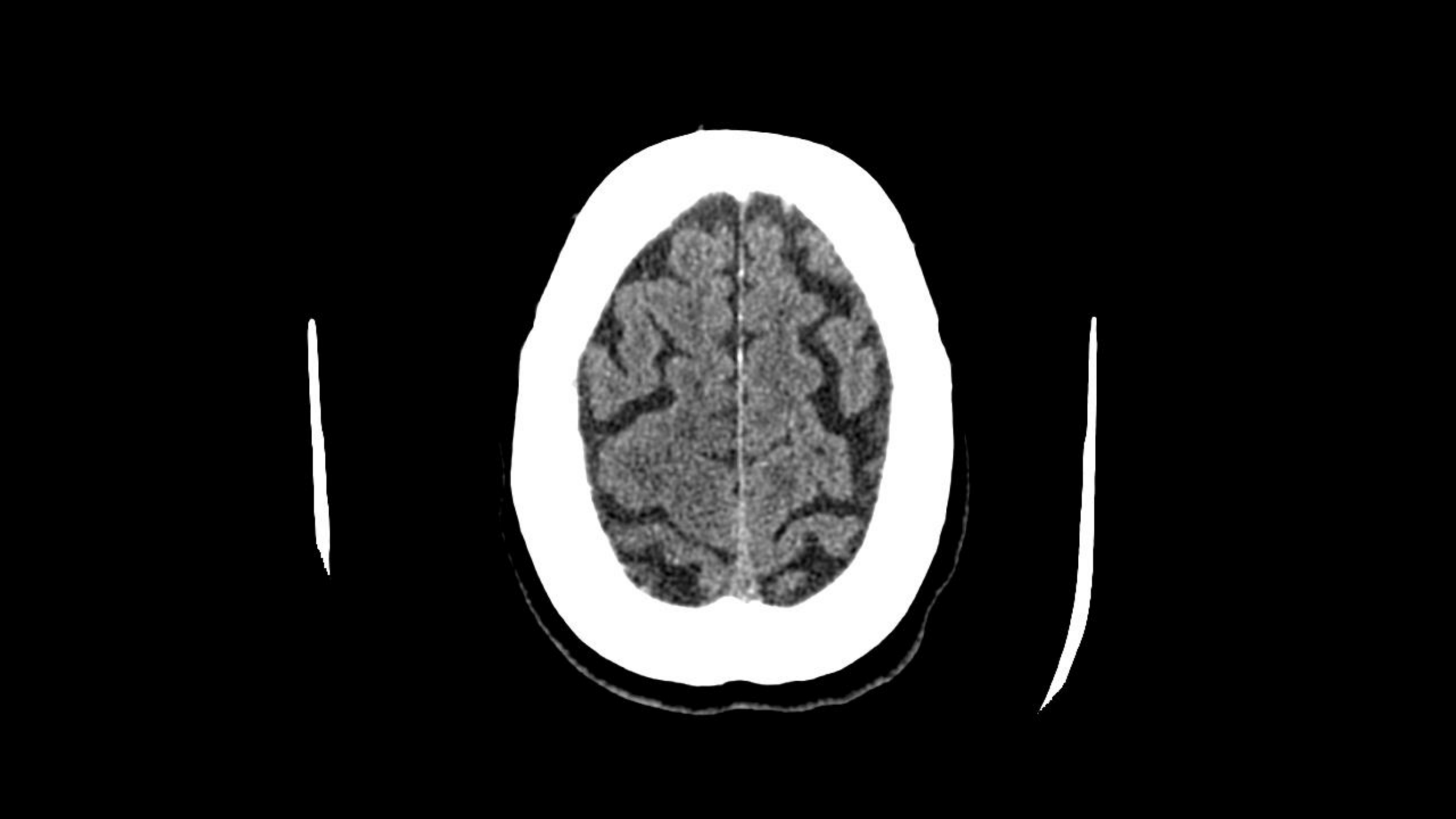


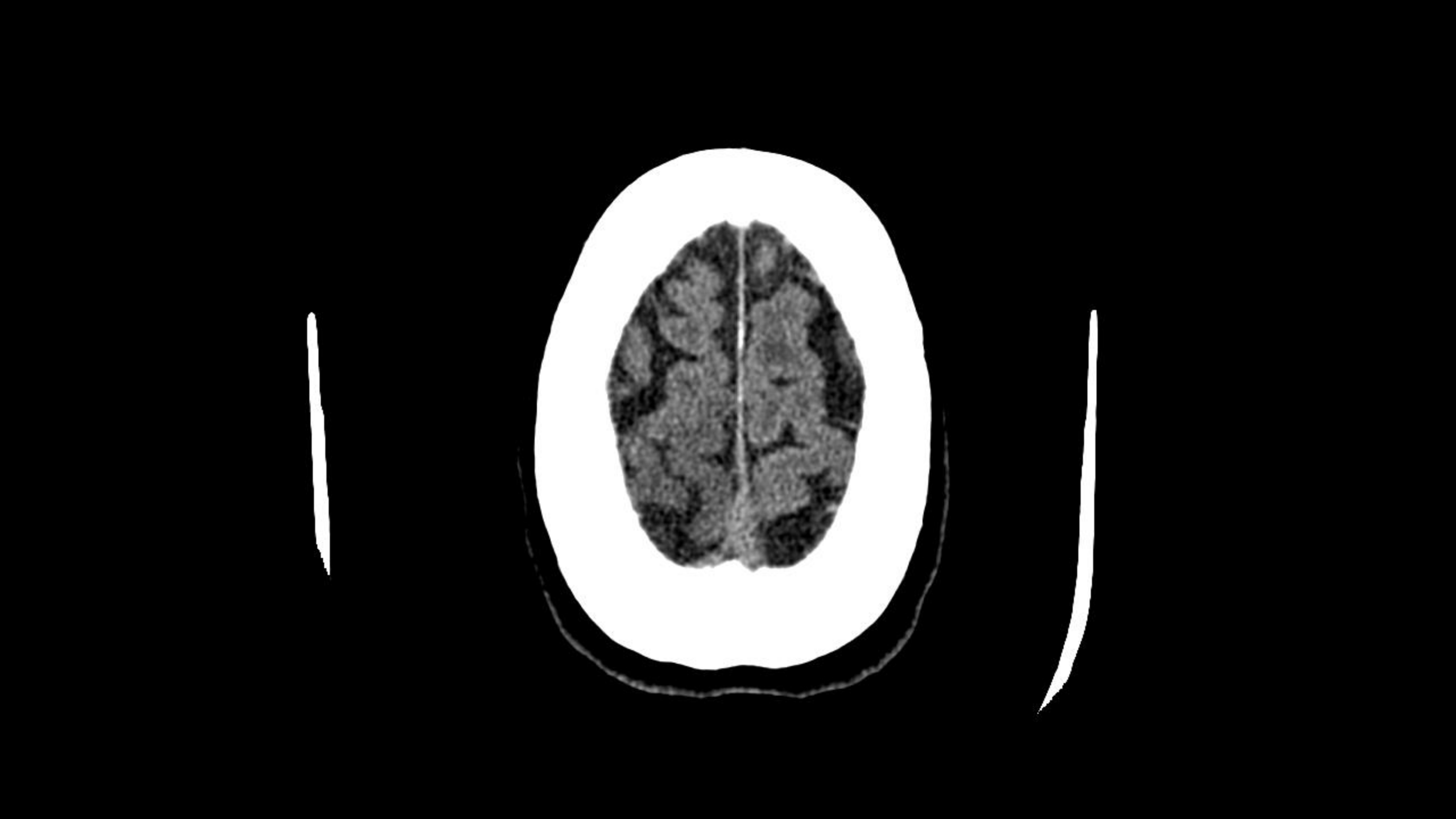


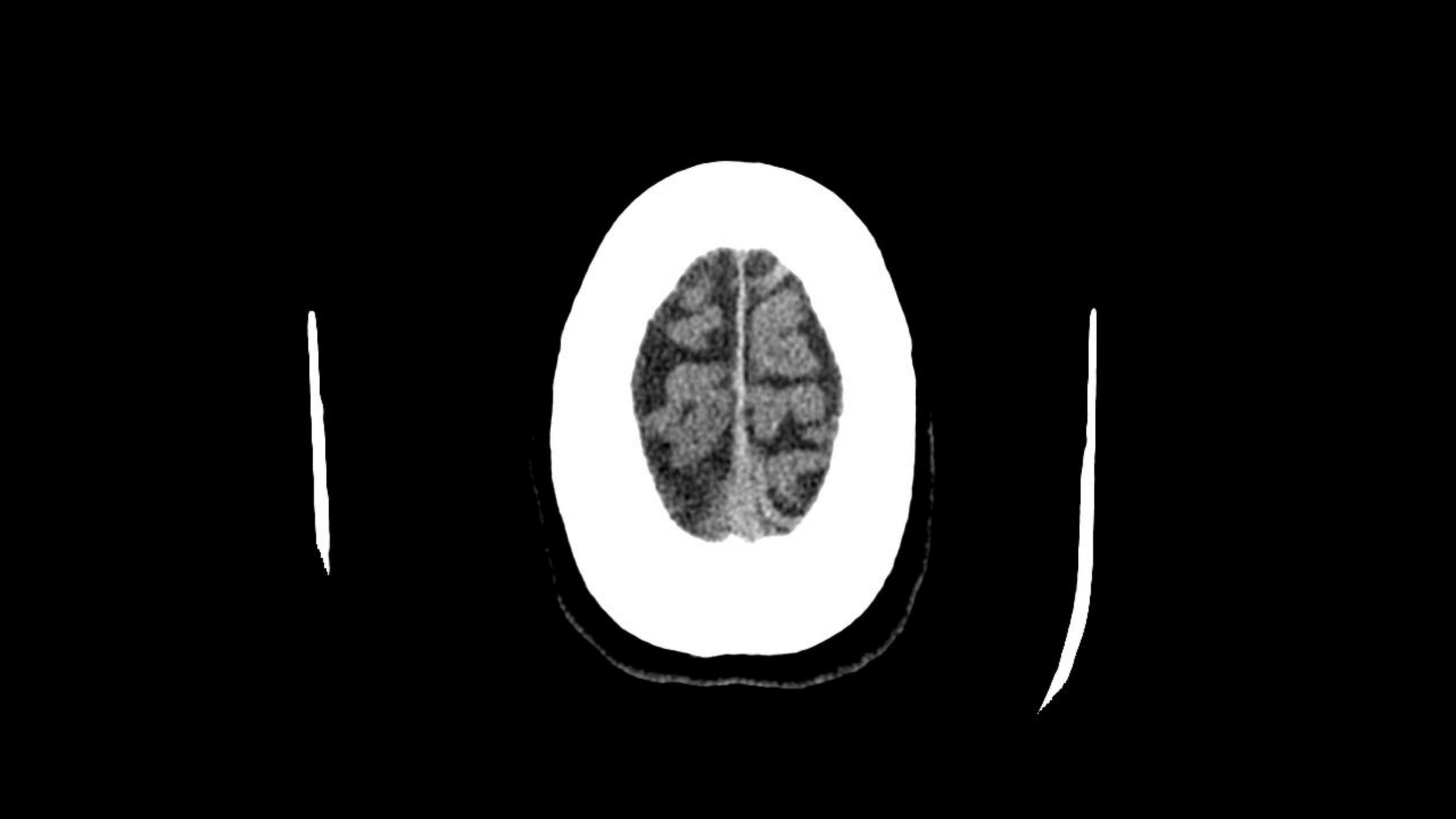


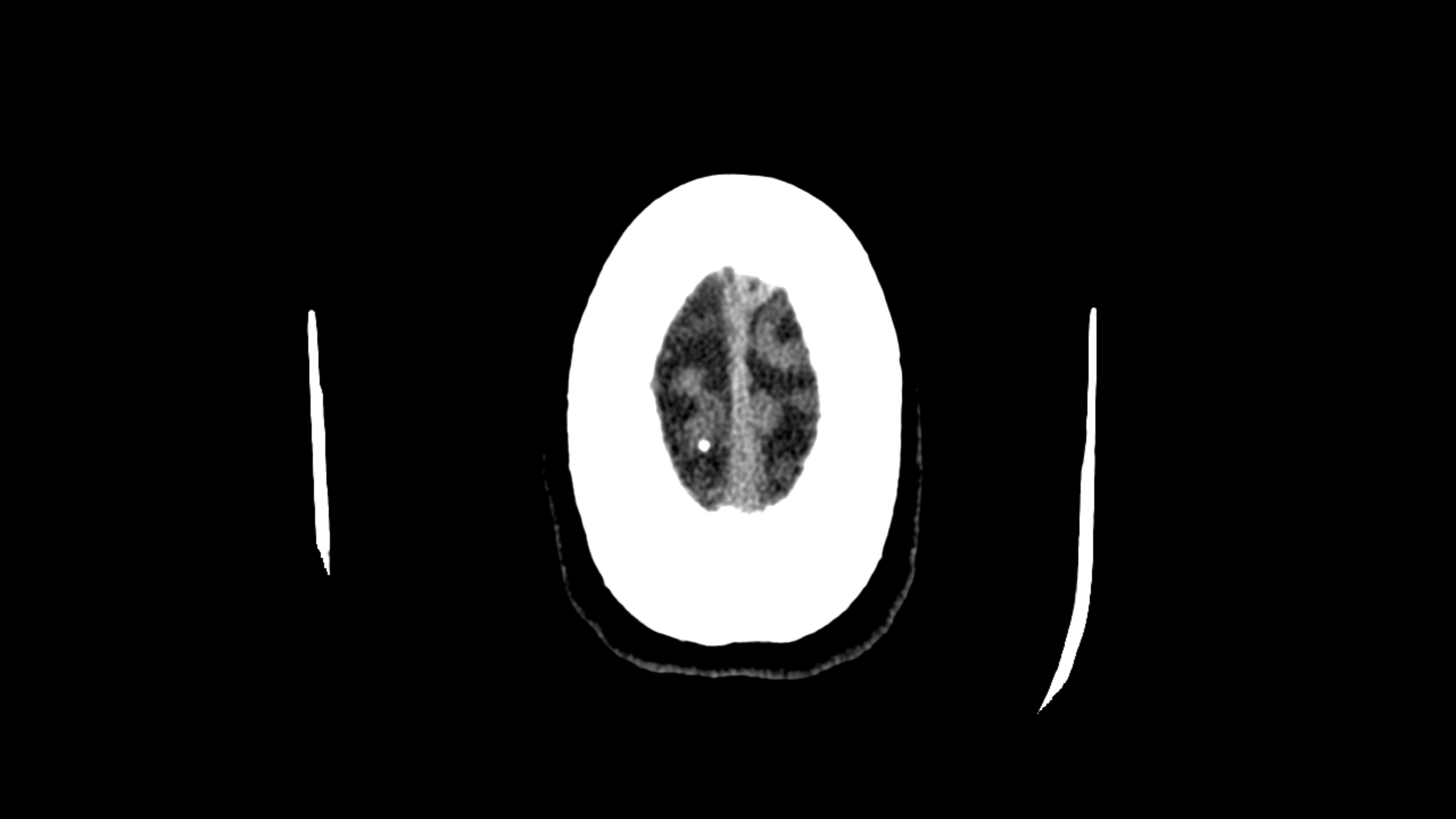






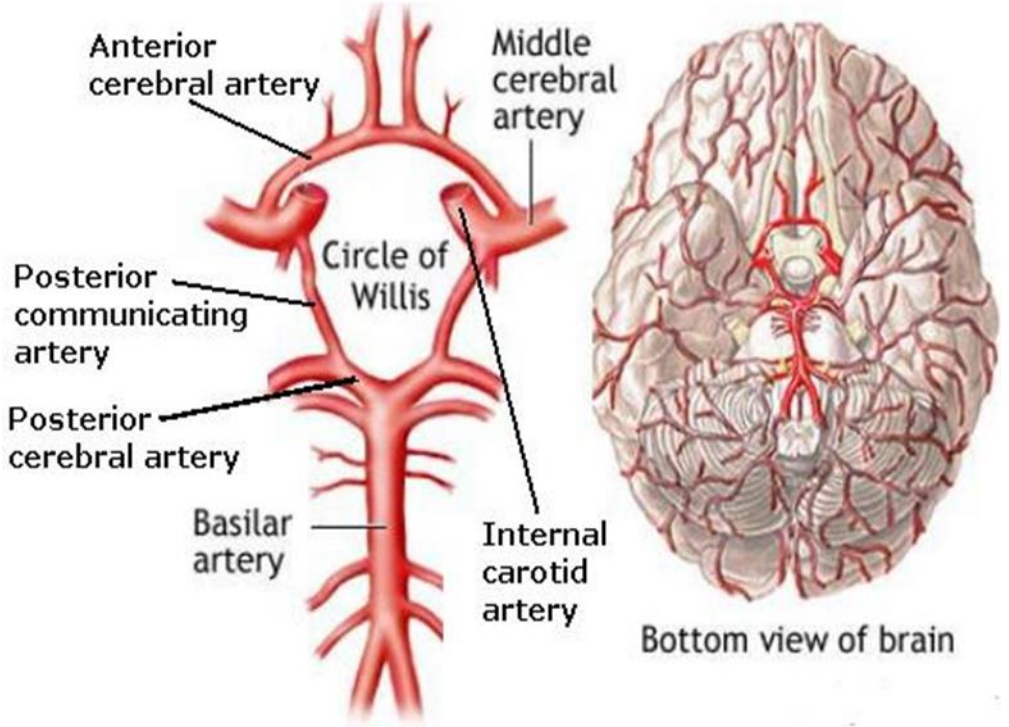




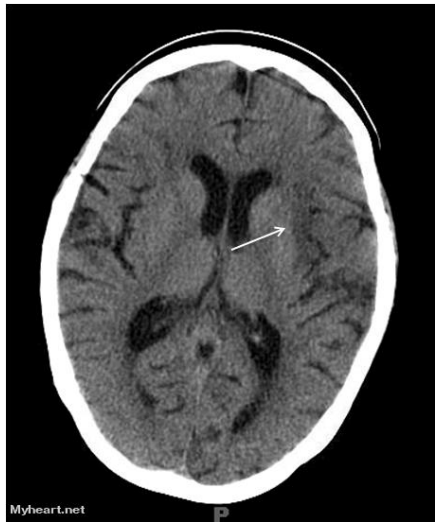


Putting it all together: Stroke syndromes

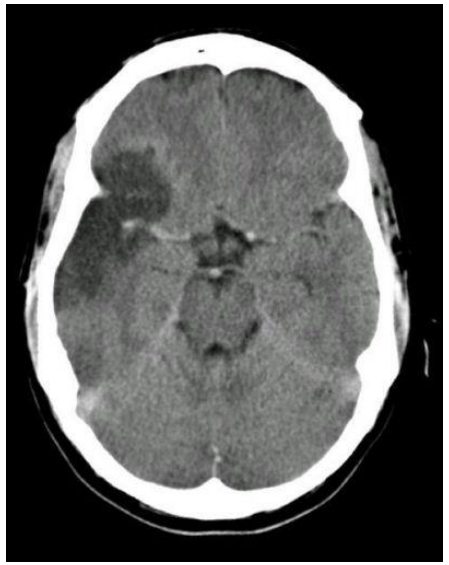
- Middle cerebral artery
- Anterior cerebral artery
- Posterior cerebral artery
- Brainstem and cerebellum
- Lacunar stroke syndromes



Middle cerebral artery



- Left MCA:
  - Right hemiparesis, aphasia, right hemianopia, right side sensory loss, dysarthria
  - Doesn't have to have all of these deficits
  - Sometimes just aphasia

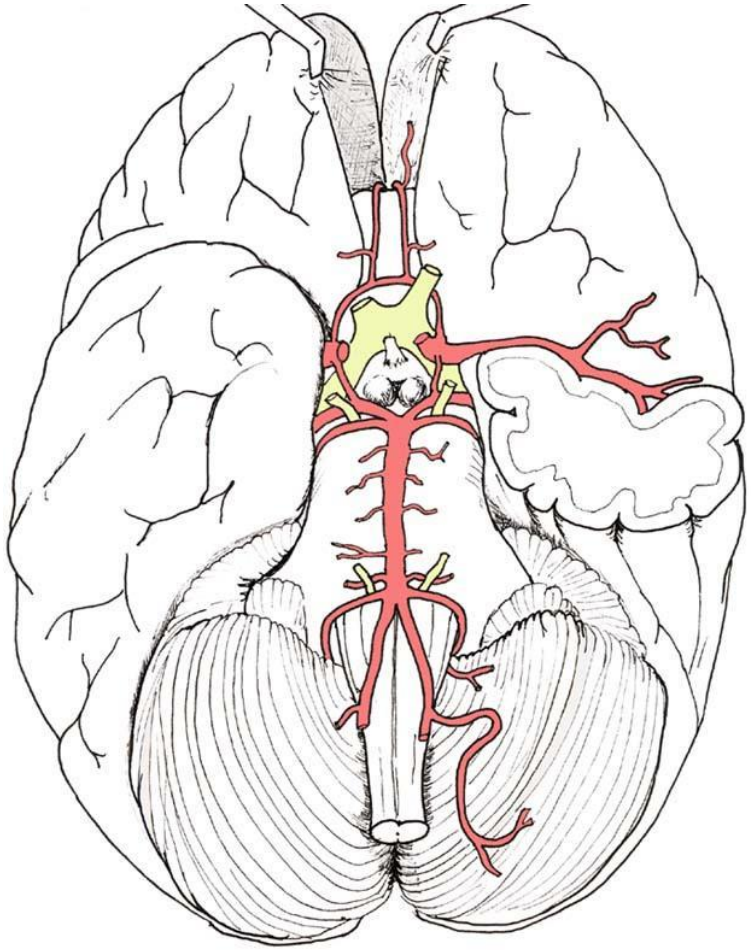


- Right MCA:
  - Left hemiparesis, inattention or neglect, left hemianopia, left side sensory loss, dysarthria
  - Sometimes patients don't follow commands but they aren't aphasic, they are just unable to process any information quickly (not just language)
  - Inattention can be for visual, auditory or tactile stimuli

Why does it sometimes seem that someone with a RMCA stroke is aphasic?

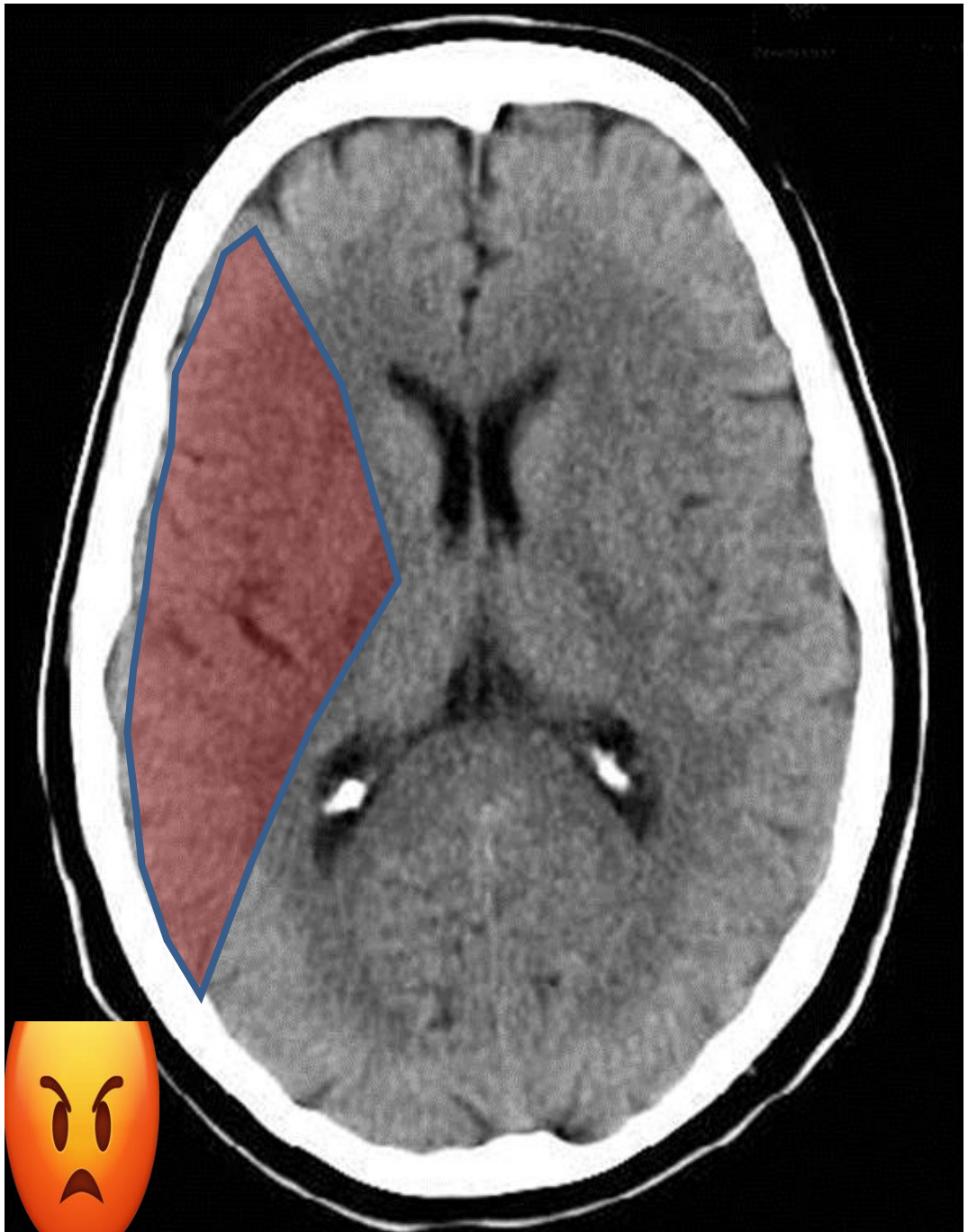
- With RMCA stroke, **consciousness or attention** are often compromised
- This can be misinterpreted as aphasia when the patient doesn't follow commands or when they don't speak clearly
- **Selective focus** can be affected even if patient is alert
  - Inattention or neglect of left side
  - Inability or slow to process multiple stimuli, i.e. confusion
  - When patients are confused or overwhelmed with stimuli, they sometimes aren't able to focus on speech
  - Often patients will be easily distracted or not focus on the exam

Middle cerebral artery

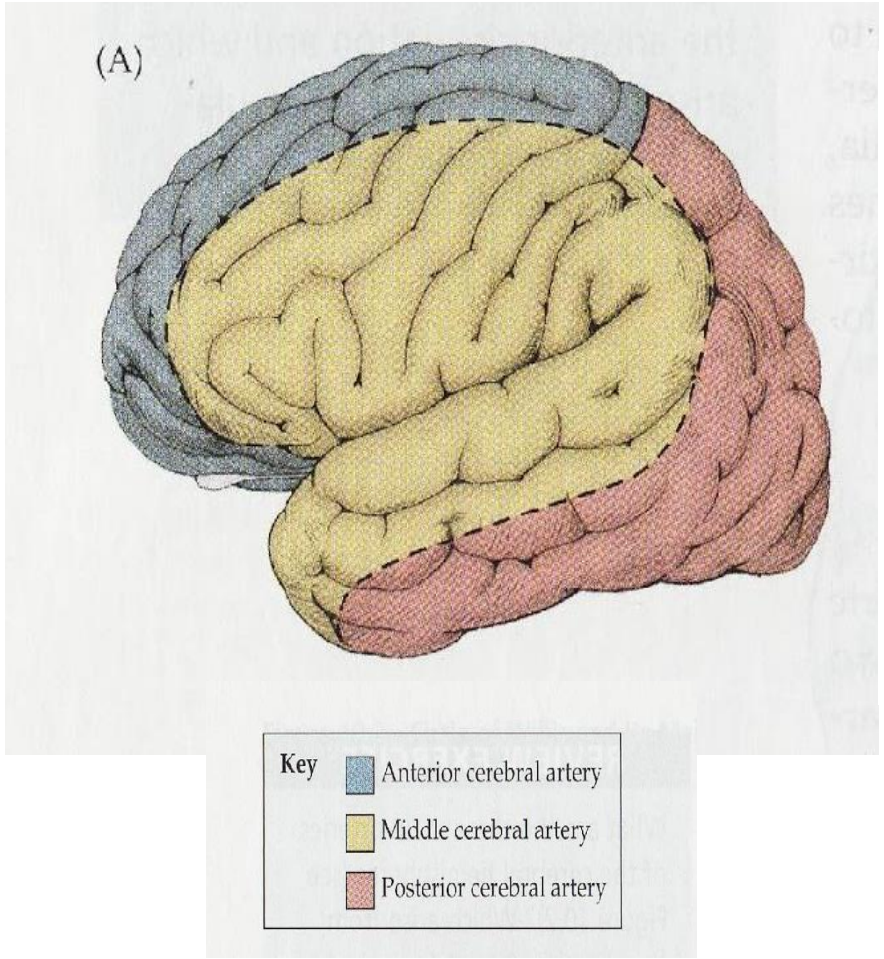


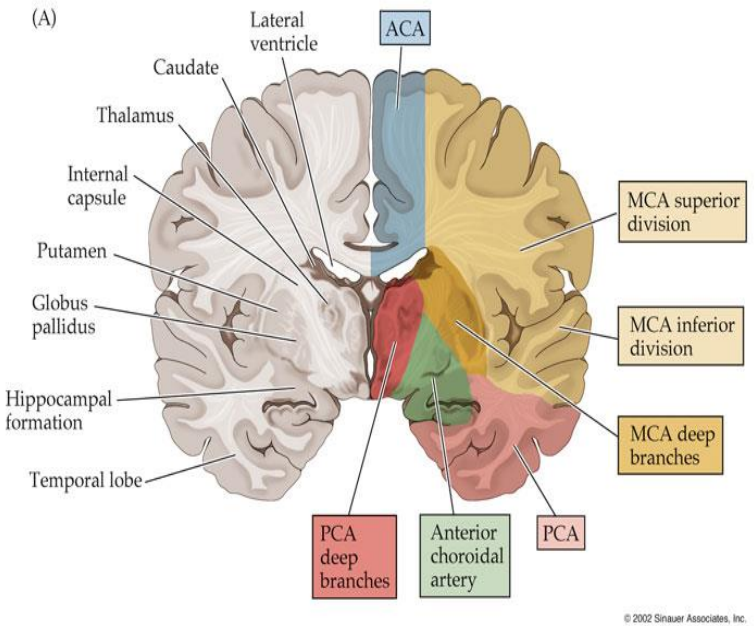
- About two-thirds of all ischemic stroke occurs in the middle cerebral artery territory
- MCA stroke can involve the frontal, temporal, and parietal lobes
- MCA stroke can also involve the basal ganglia through the *lenticulostriate arteries*

- The MCA covers a large territory shown in blue on this CT scan image taken at the basal ganglionic level

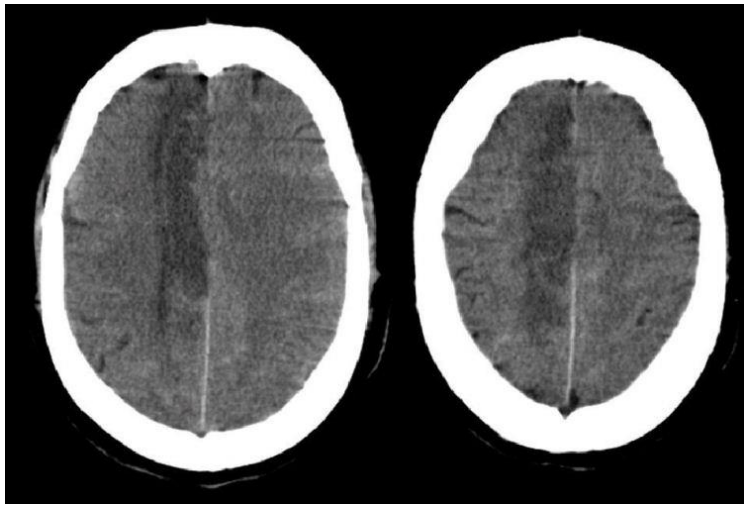


MCA (yellow) covers a large portion of the hemisphere

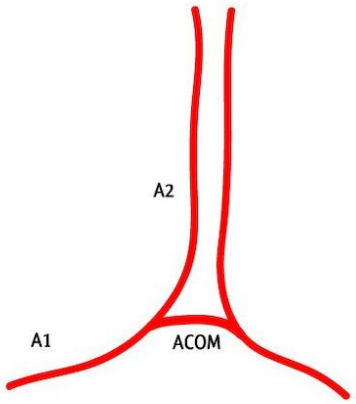




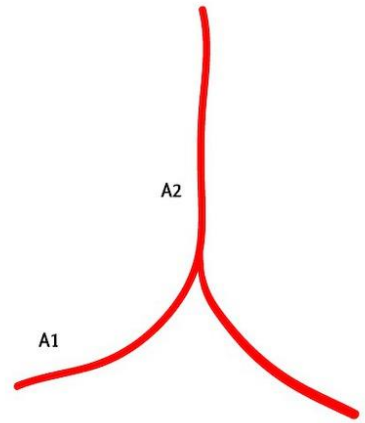
Anterior cerebral artery



- Leg > arm, face weakness, abulia, changes in emotional affect
- In some cases both ACA territories are perfused by the same vessel

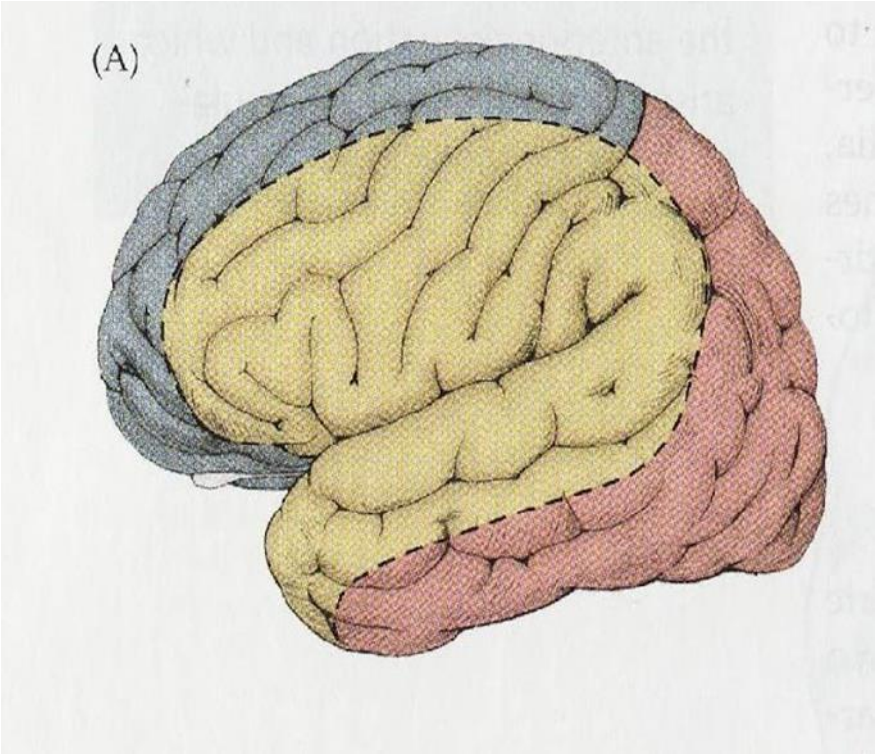


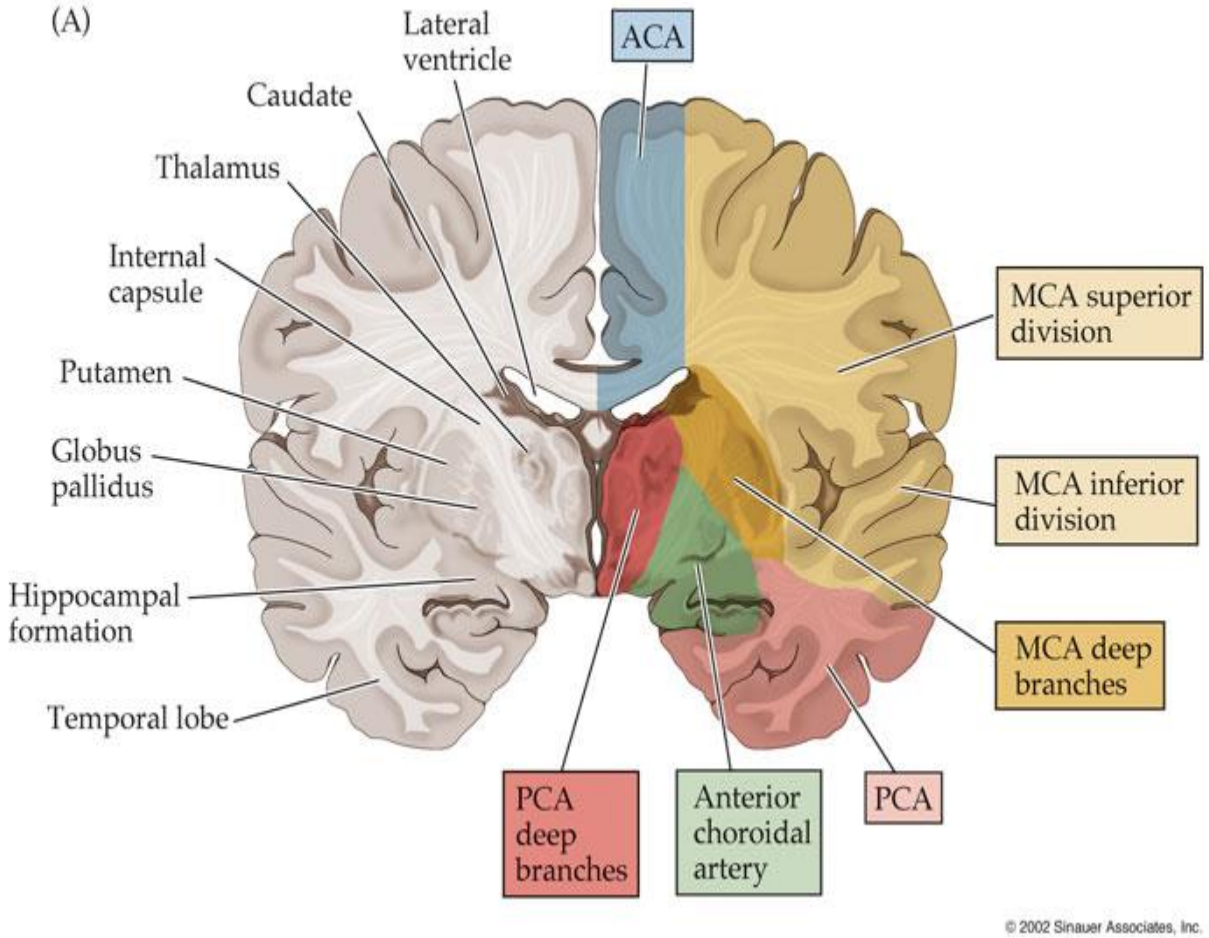
Conventional anatomy



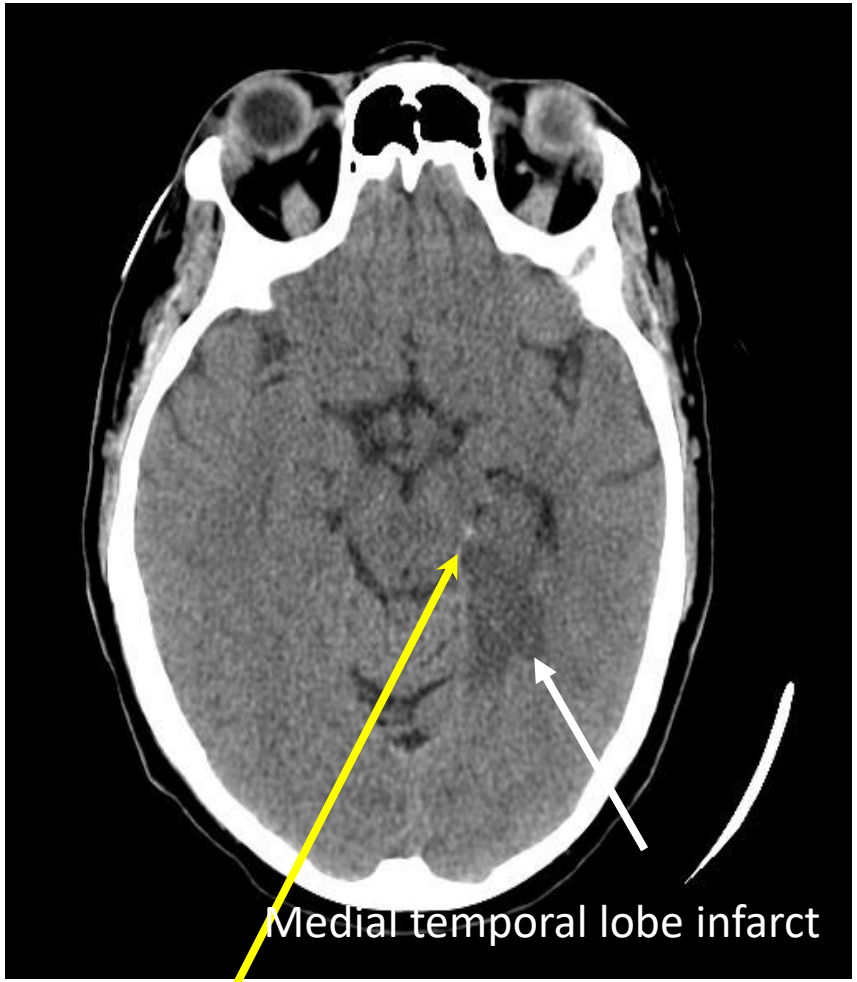
Azygous anatomy

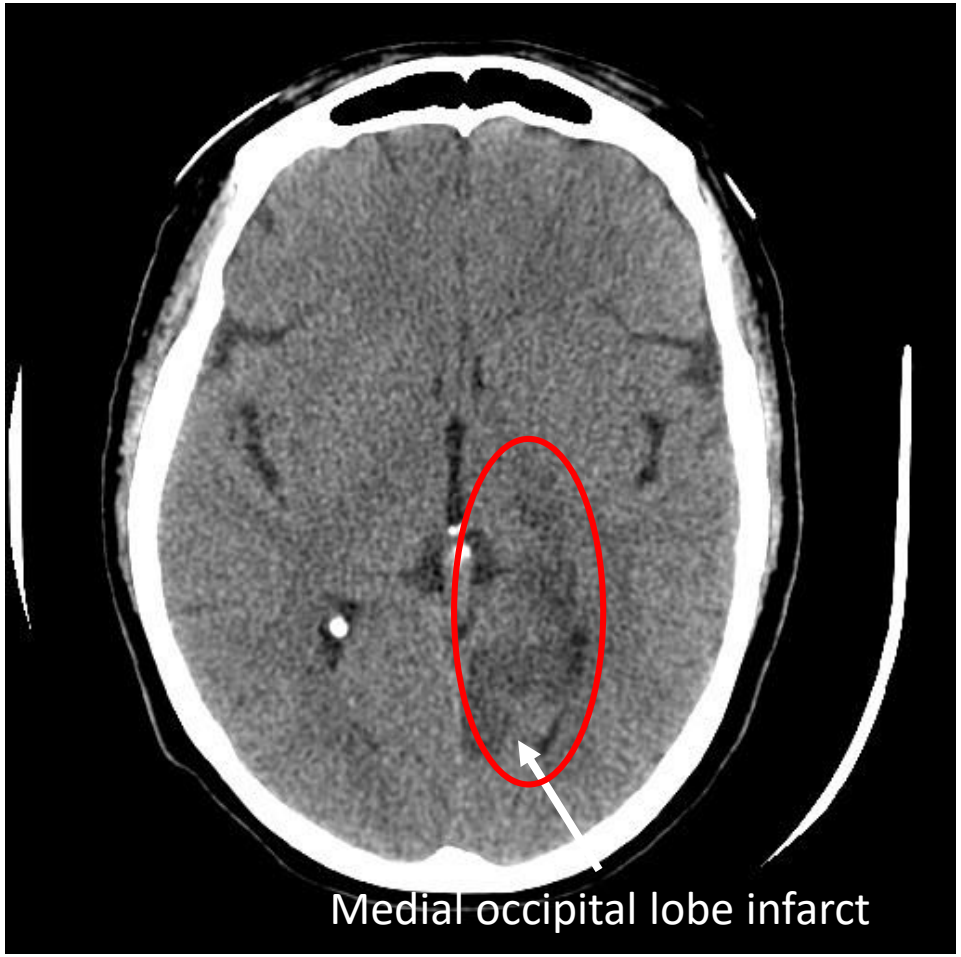
ACA (blue) covers the medial portion of the brain





Left PCA infarction on CT

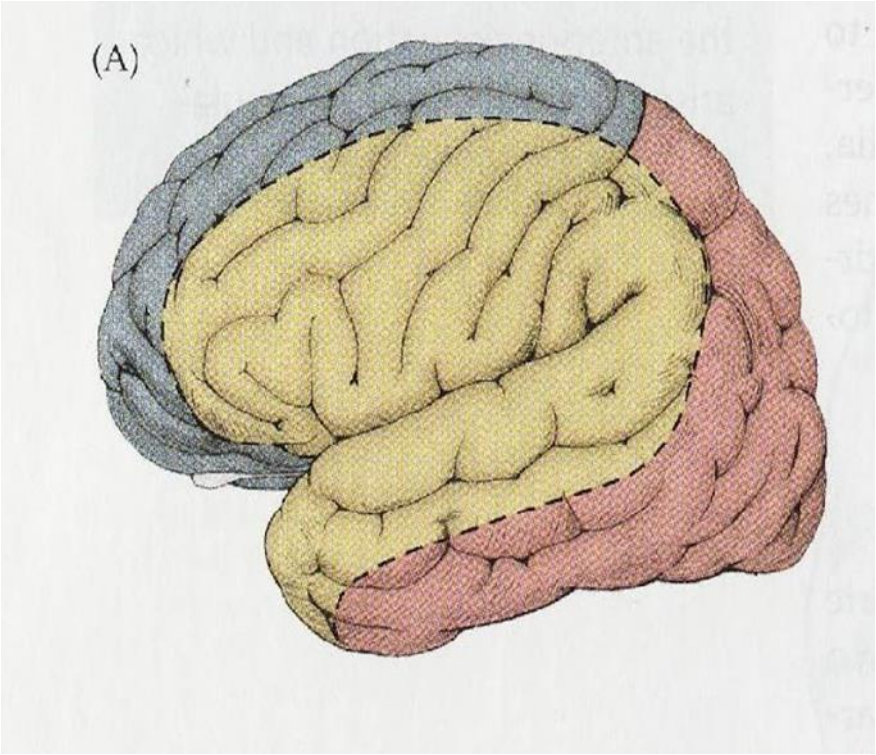


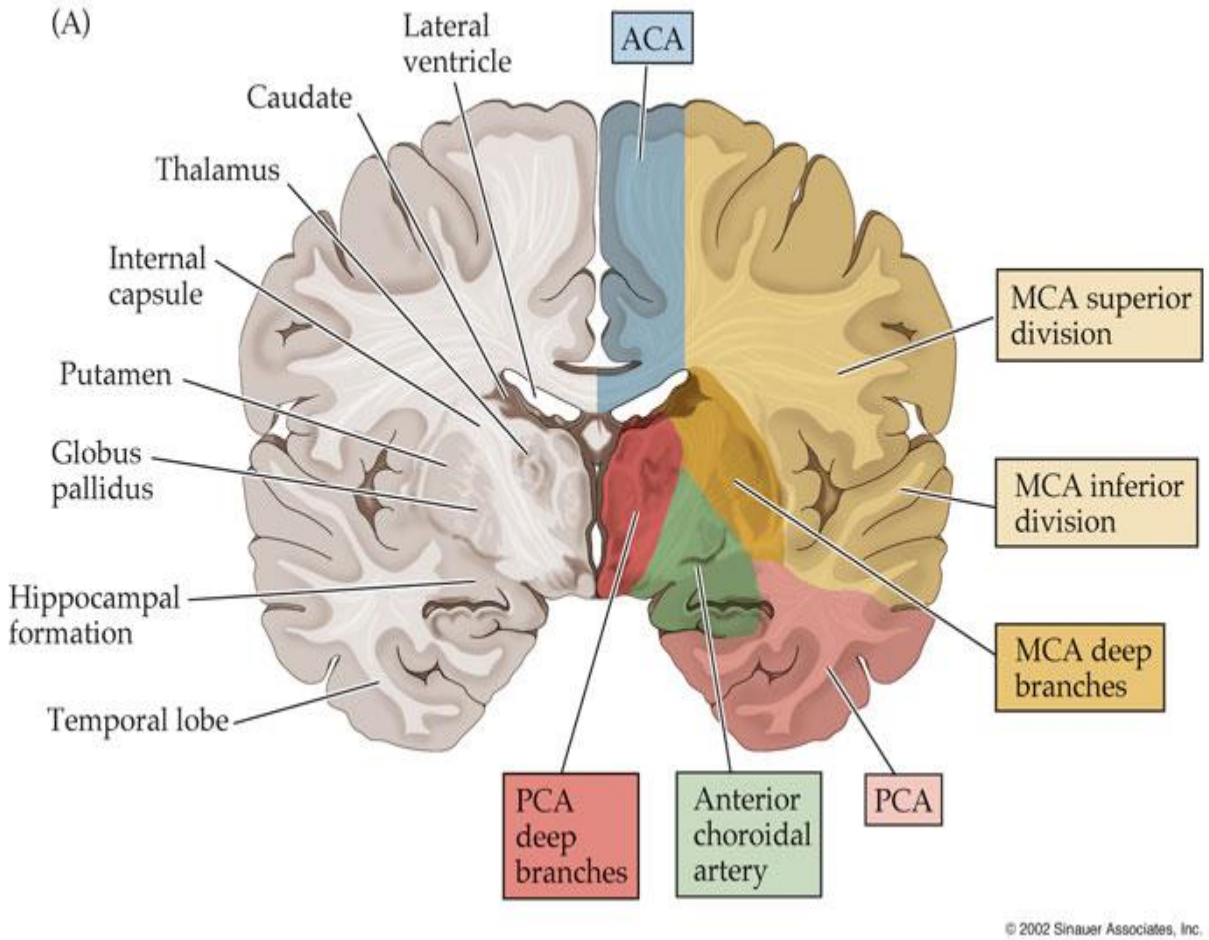


PCA infarction

- Hemianopia
  - Sometimes **cortical blindness**, i.e. blind but confabulates because the patient is unaware they are blind
- Acute short term memory impairment
- Sometimes also aphasia
- Acute altered consciousness
- Sensory loss, often with minimal weakness

PCA (pink) covers the occipital and inferior/medial temporal lobe, and thalamus





Brainstem stroke syndromes

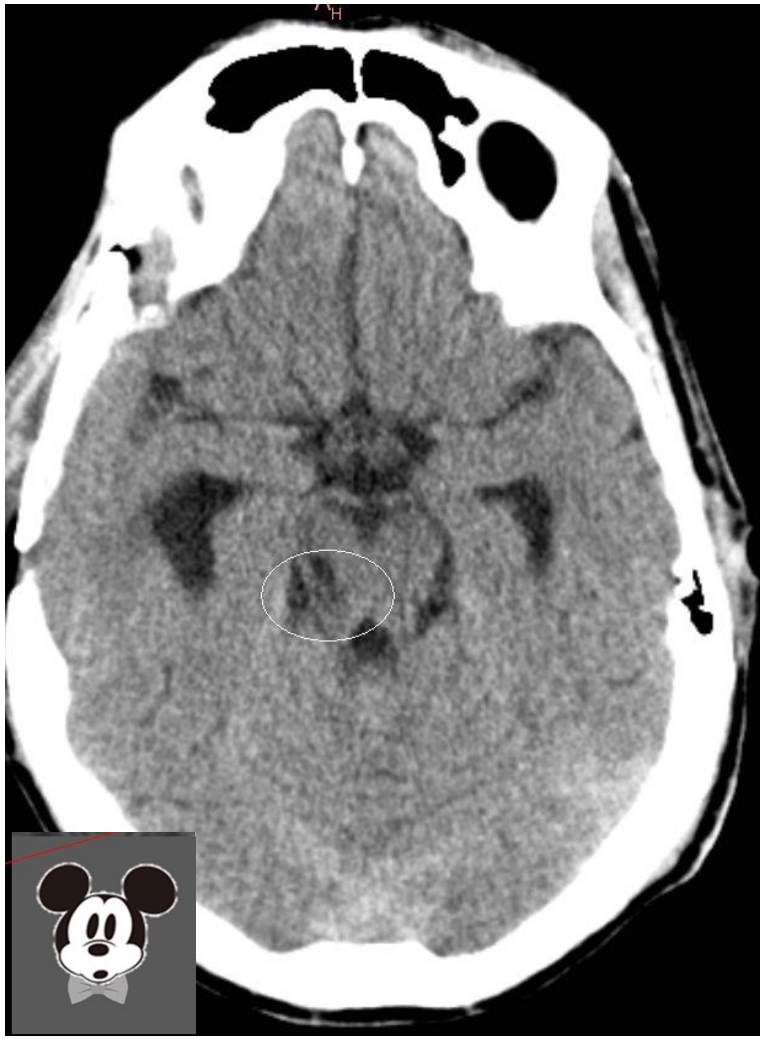
- Some of the clinical features seen are:
  - **Crossed sensory findings (e.g. ipsilateral face and contralateral body numbness)**
  - **Crossed motor findings (ipsilateral face, contralateral body)**
  - **Gaze-evoked nystagmus**

Other findings in brainstem stroke

- Ataxia and vertigo, limb dysmetria
- Diplopia and eye movement abnormalities
- Dysarthria, dysphagia
- Tongue deviation
- Deafness (very rare)
- Locked-in syndrome (can’t move any limb, can’t speak, can sometimes blink

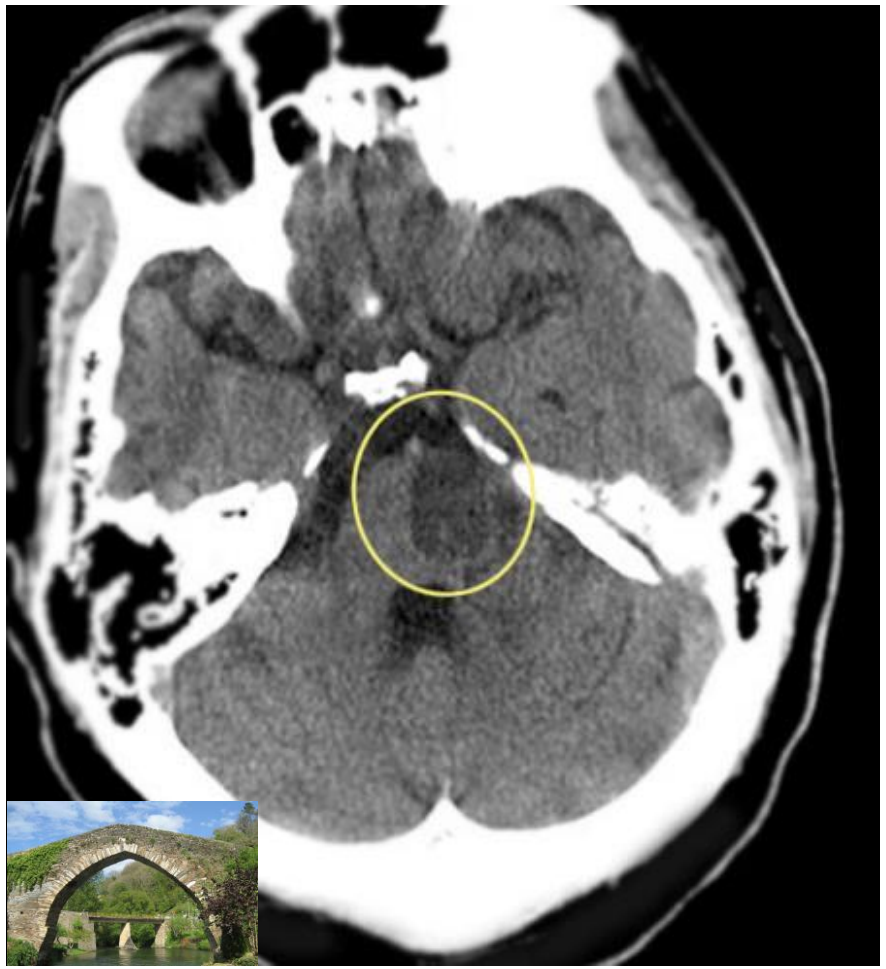
Midbrain stroke

- Ipsilateral 3rd nerve palsy
- Contralateral hemiparesis of the arm and leg, sometimes with hemiplegia of the face
- Contralateral hemiataxia



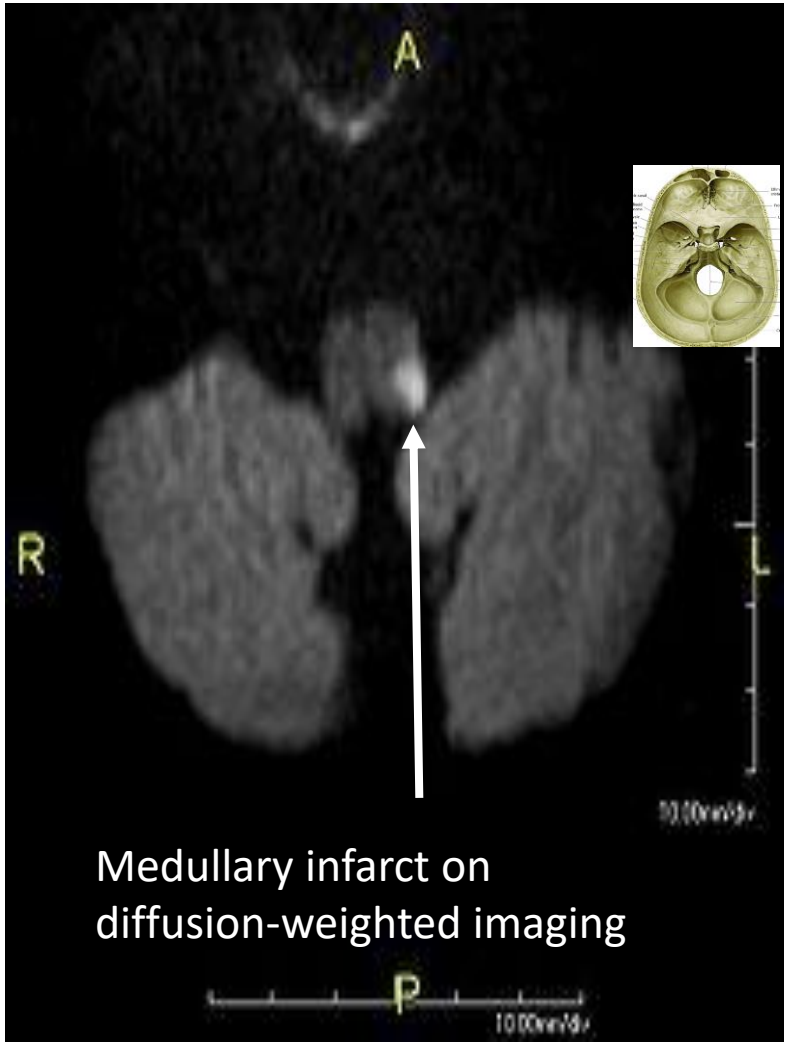
Pontine stroke

- Ipsilateral signs:
  - Horner's syndrome
  - 6th or 7th nerve palsy (diplopia, whole side of face is weak)
  - Hearing loss (rare)
  - Loss of pain and temperature sense
- Contralateral signs:
  - Weakness in leg and arm
  - Loss of sensation in arm and leg
- Nystagmus, nausea



Medullary stroke

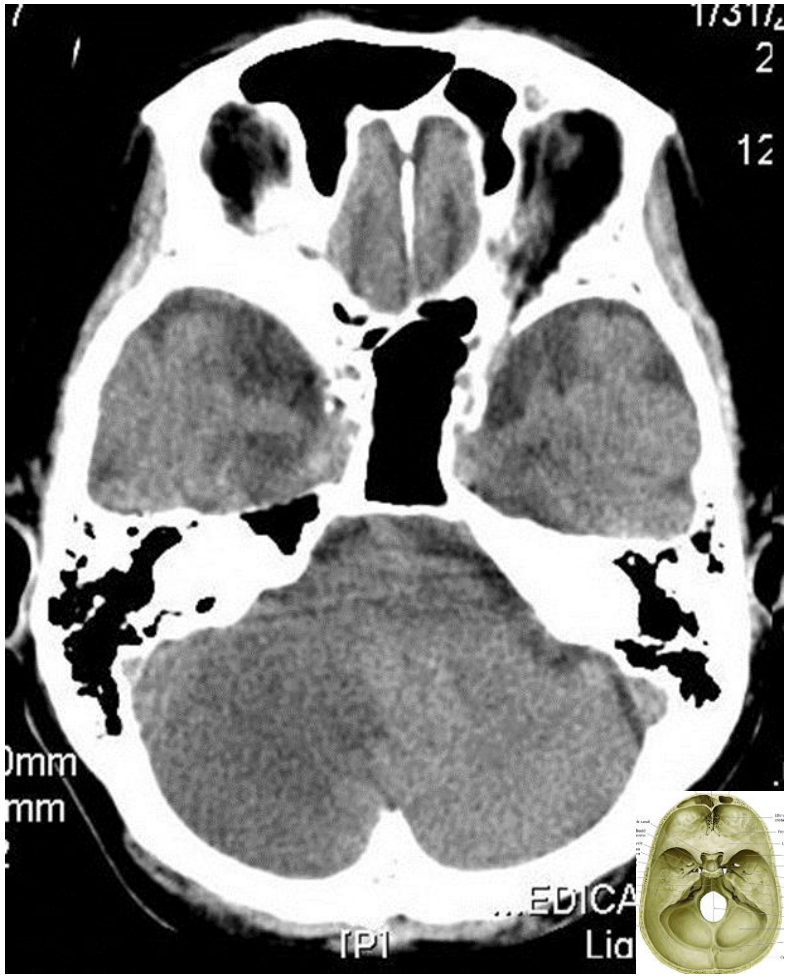
- Ipsilateral signs:
  - Tongue weakness
  - Sensory loss in face
  - Horner’s syndrome
  - Ataxia
  - Palate weakness (dysphagia)
- Contralateral signs:
  - Weakness, sensory loss in arm and leg
- Nausea, nystagmus, dysphagia, dysarthria



Medullary infarct on diffusion-weighted imaging

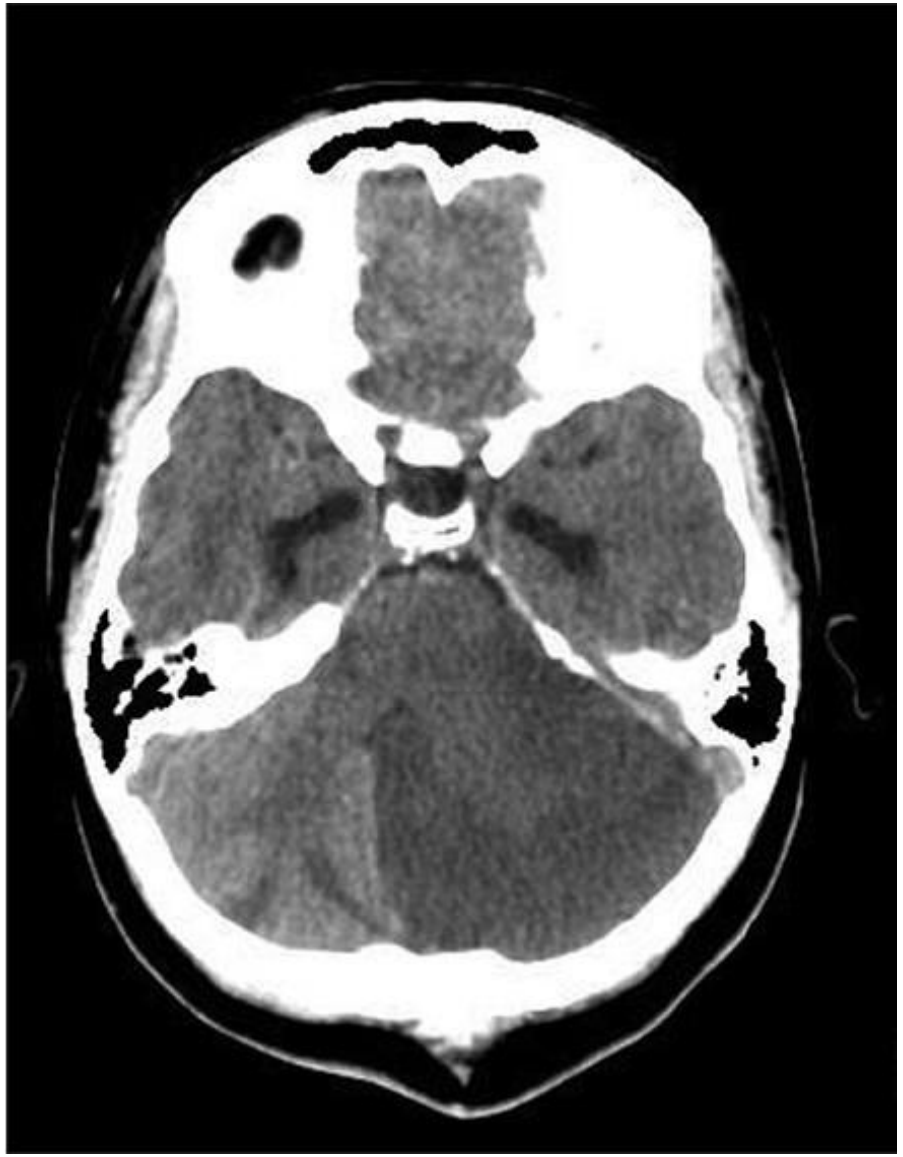
Cerebellar stroke

- Ataxia, vertigo, nausea, vomiting, dysarthria
- Often headache and nystagmus
- Can also have rapid deterioration in level of consciousness



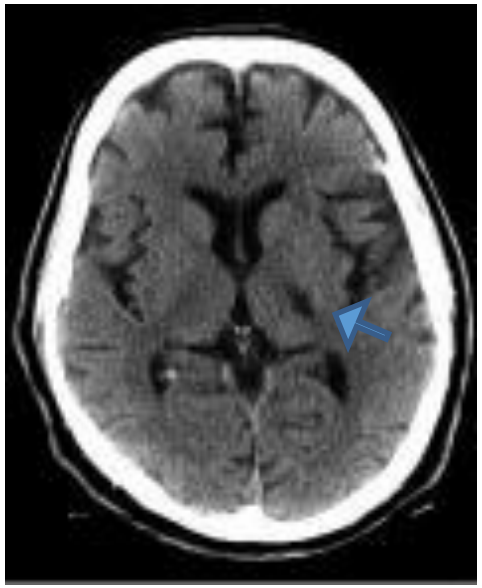
Cerebellar infarction

- Infarction causes edema resulting in mass effect, herniation and compression of the fourth ventricle
- This can lead to rapid deterioration in level of consciousness
- Surgical decompression is often necessary in these circumstances

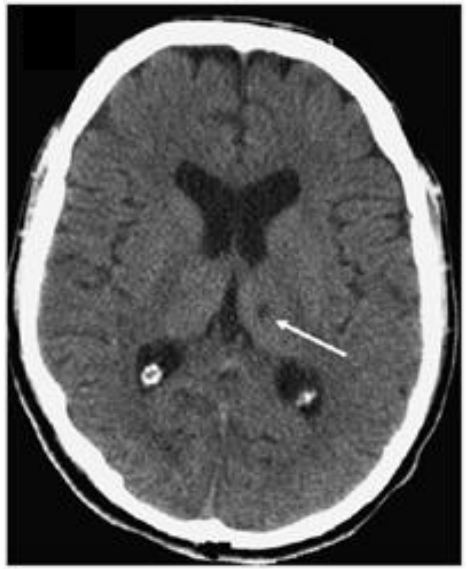


Lacunar stroke syndromes

- **Pure motor stroke** usually arises from infarction in the posterior limb of the internal capsule; course is often stuttering over hours to days:

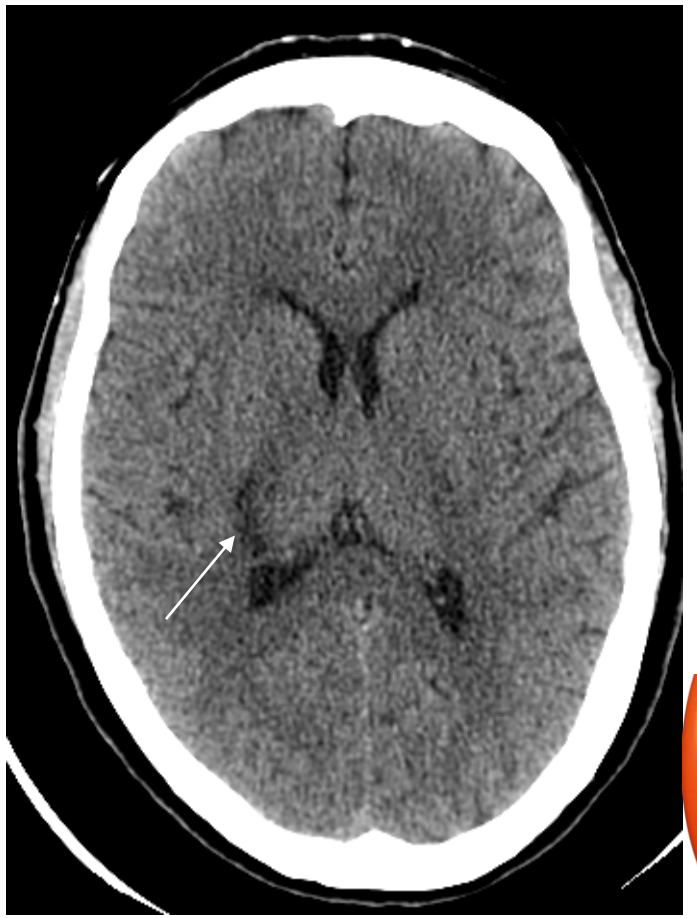


- **Pure sensory stroke** usually arises from thalamic infarction



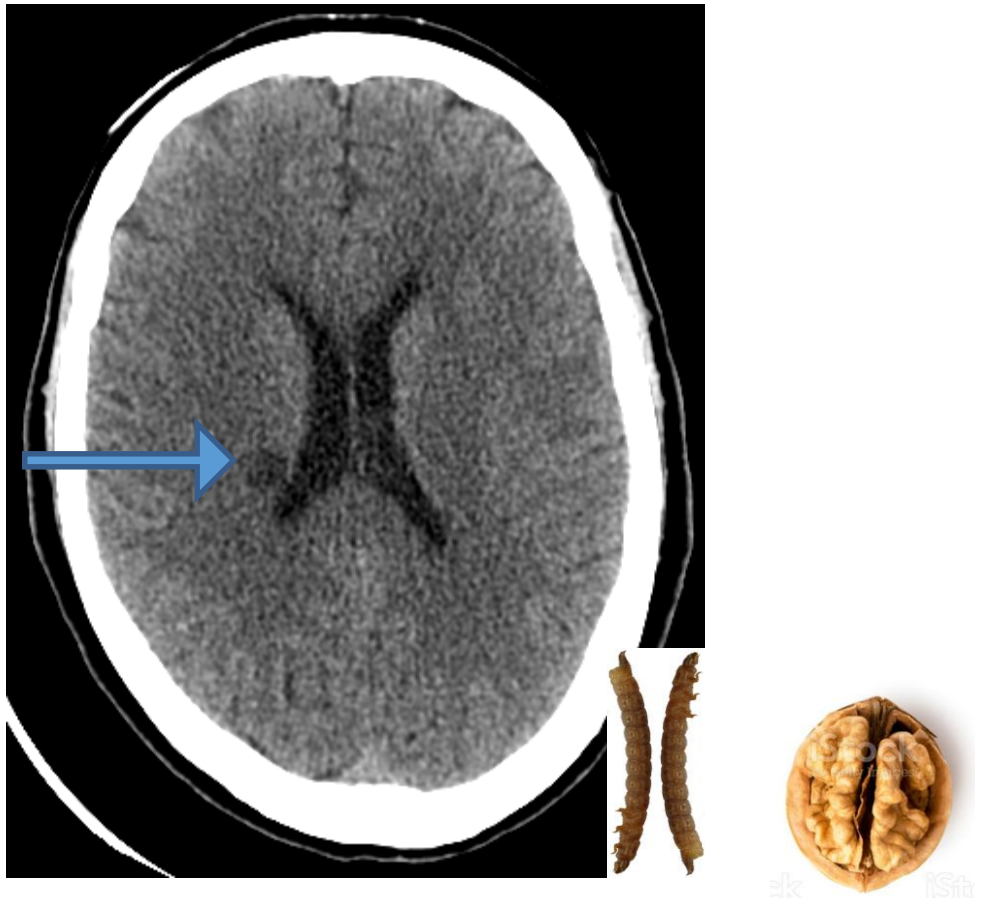
Lacunar stroke syndromes

- **Sensorimotor stroke** can arise from infarcts at the junction between the thalamus and the internal capsule
- As the name implies, the symptoms consist of weakness and sensory loss with no visual field deficit, aphasia, neglect or other symptoms



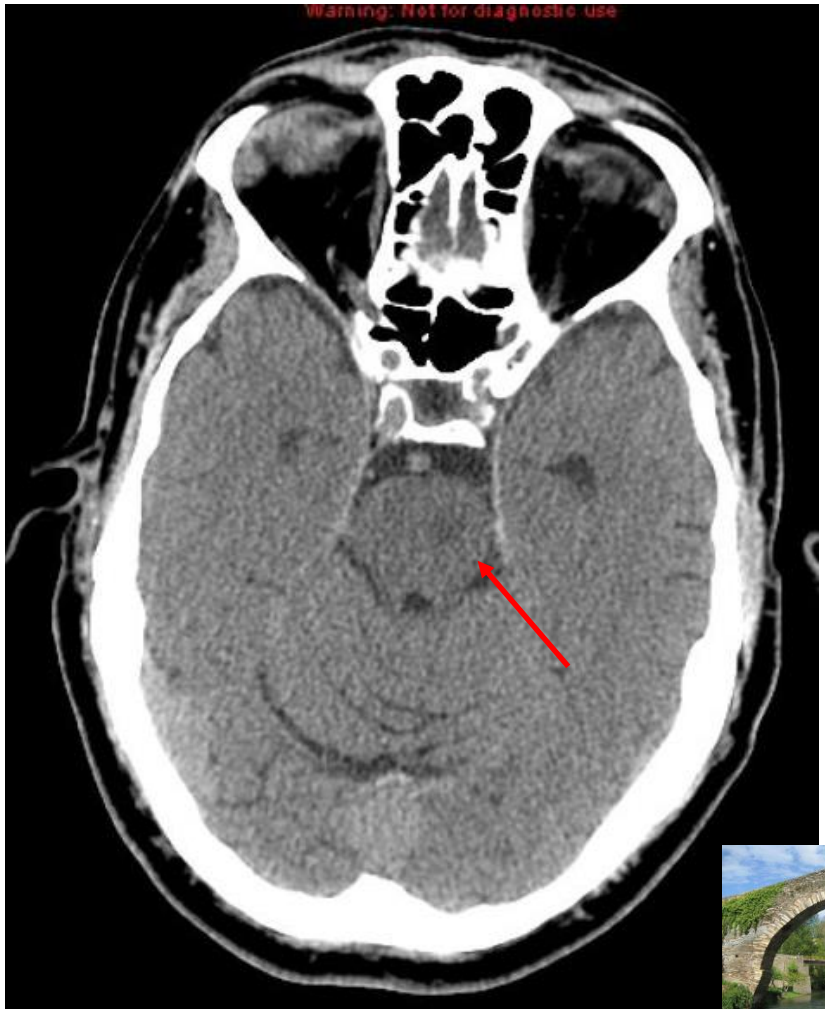
Lacunar stroke syndromes

- **Ataxic hemiparesis** often arises from infarction in the corona radiata
- Ataxia is unilateral and is in excess of the mild weakness found on exam



Lacunar stroke syndromes

- **Clumsy hand-dysarthria** is caused by infarction in the pons, but can also occur in corona radiata and the internal capsule
- Contralateral facial weakness with dysarthria and dysphagia occurs with contralateral hand weakness/ataxia, and sometimes weakness in the arm or leg



A brief word on stroke mimics

- **Stroke**: Maximum severity within a few minutes, typically
- **Migraine**: about 10 to 20 minutes and often symptoms such as paresthesia change in distribution or severity during that time
- **Seizure**: Altered LOC plus focal deficits such as aphasia sometimes point to a specific location in the brain for a seizure focus

- **Hyper- and hypoglycemia, and even electrolyte abnormalities** can present with speech impairments (usually dysarthria) but also focal motor deficits

- **Brain tumor** can present with sudden onset focal deficits, often reflecting seizure

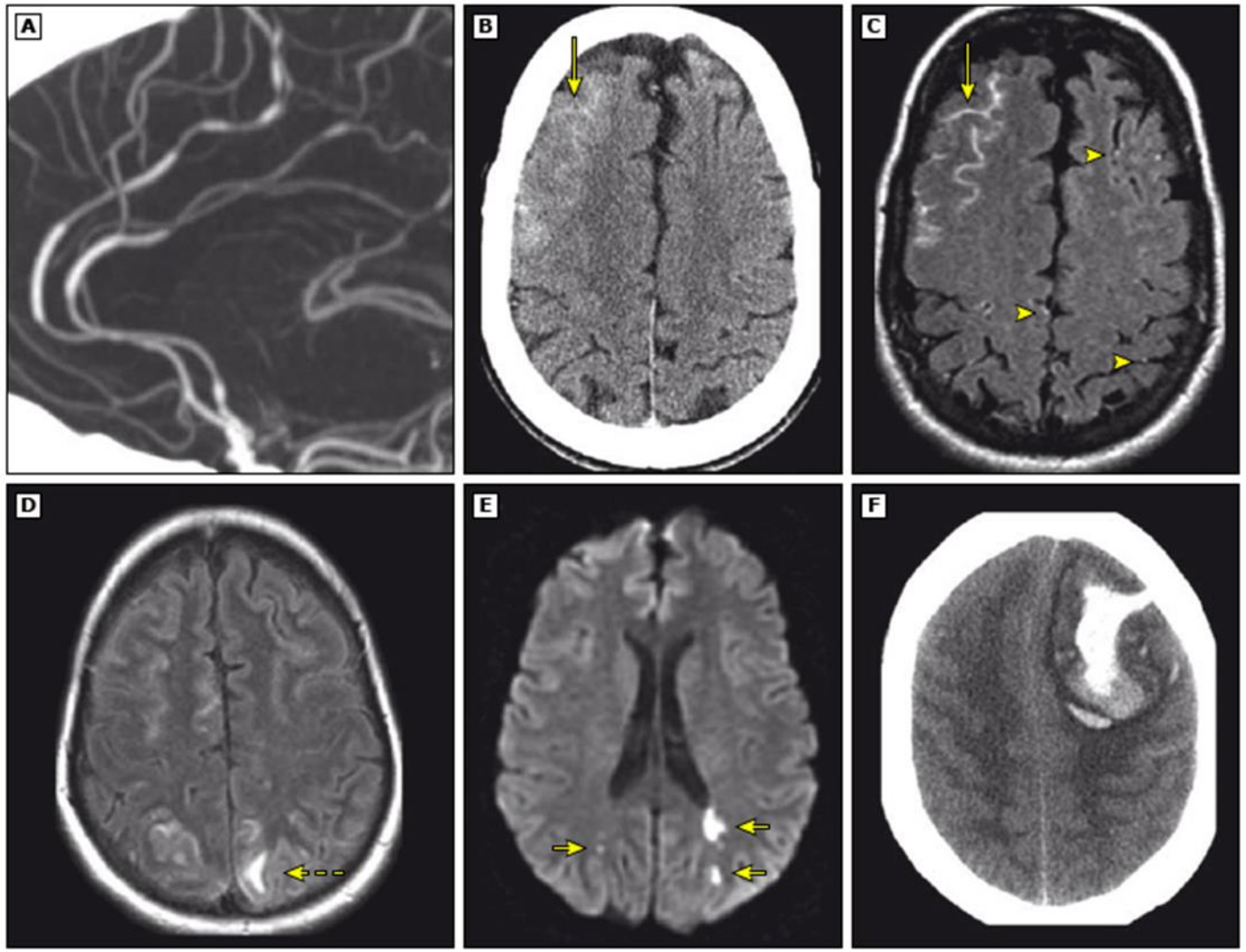
- **Transient global amnesia (TGA)** is rarely due to stroke and should resolve within 24 hours except for a short period of time that will always have no memory associated with it.

Stroke diagnoses that are rare and can share some of the clinical features of ischemic infarction

- **RCVS** (Reversible Cerebral Vasoconstriction Syndrome)
- **Cerebral venous sinus thrombosis**
- **PRES** (Posterior Reversible Encephalopathy Syndrome)

RCVS (Reversible Cerebral Vasoconstriction Syndrome)

- Thunderclap headache at onset
- Vasoconstriction of intracranial vessels
- Can result in both ischemic and hemorrhagic infarct
- Associated with nasal decongestants (pseudoephedrine), cannabis, SSRI



Cerebral venous sinus thrombosis

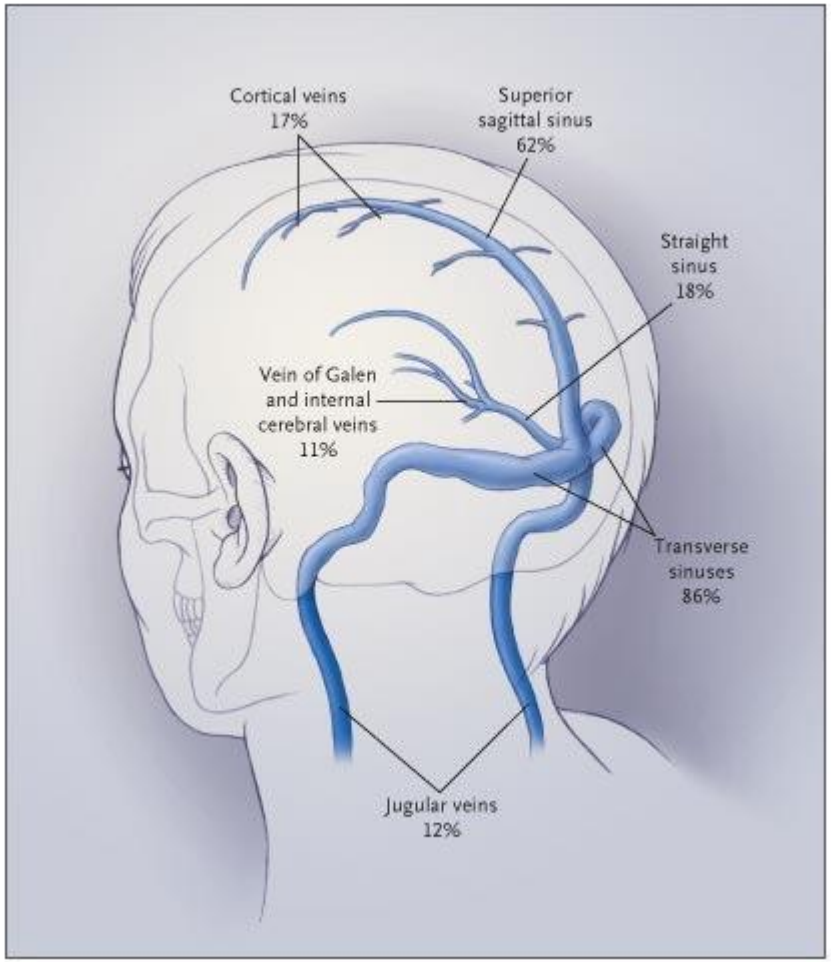
- Presents with headache, visual blurring, nausea, sometimes focal deficits, often seizure
  - Onset can be sudden, but often takes days to build up in headache intensity

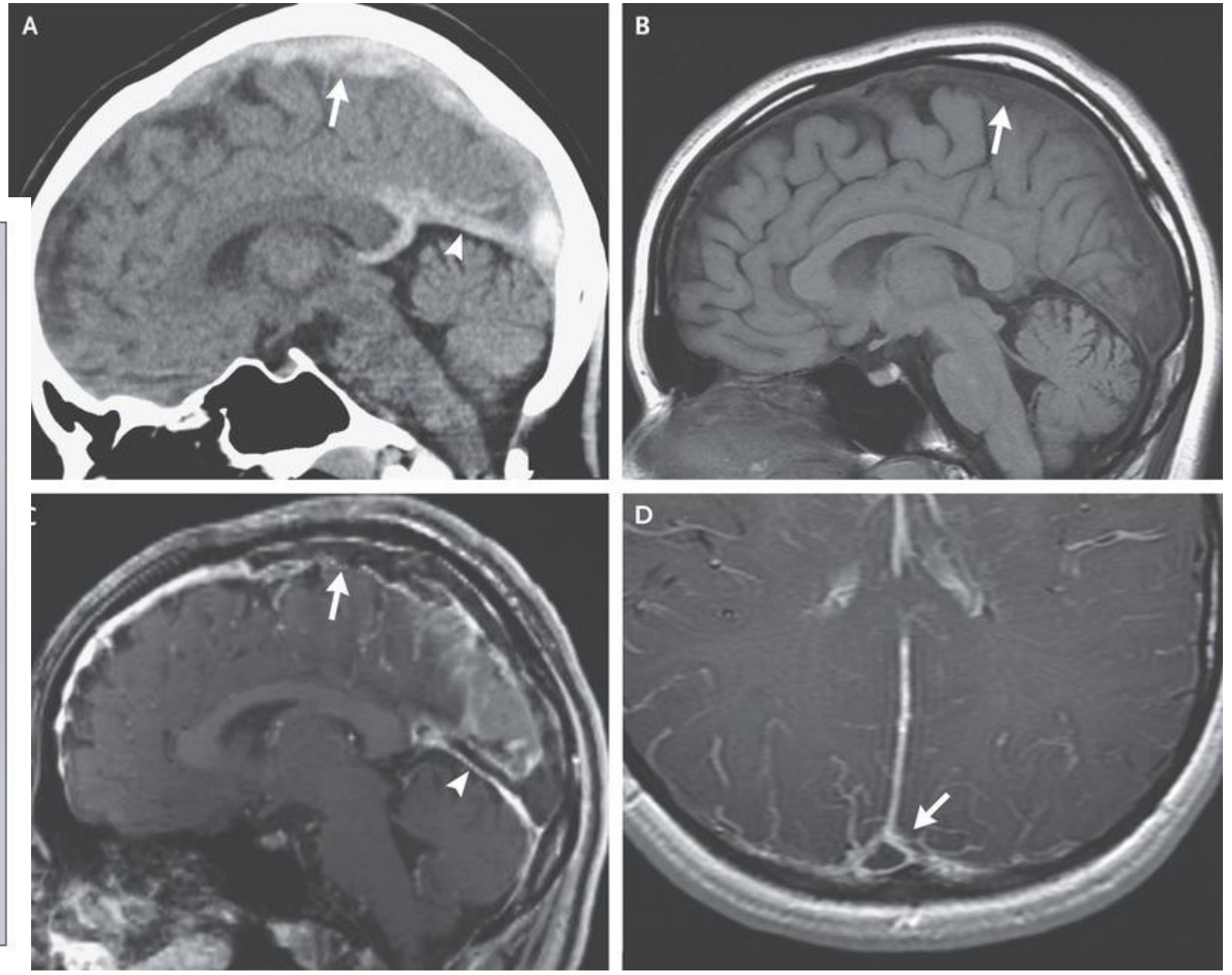
- Risk factors include: clotting disorders, pregnancy (and first few weeks post-partum), cancer, inflammatory bowel disease, collagen vascular disease

- Imaging with CT or MRI with CT or MR venogram can show thrombosis in cerebral veins, ischemic infarction, hemorrhage

- Treatment is with anticoagulation, even if there is small amount of hemorrhage!

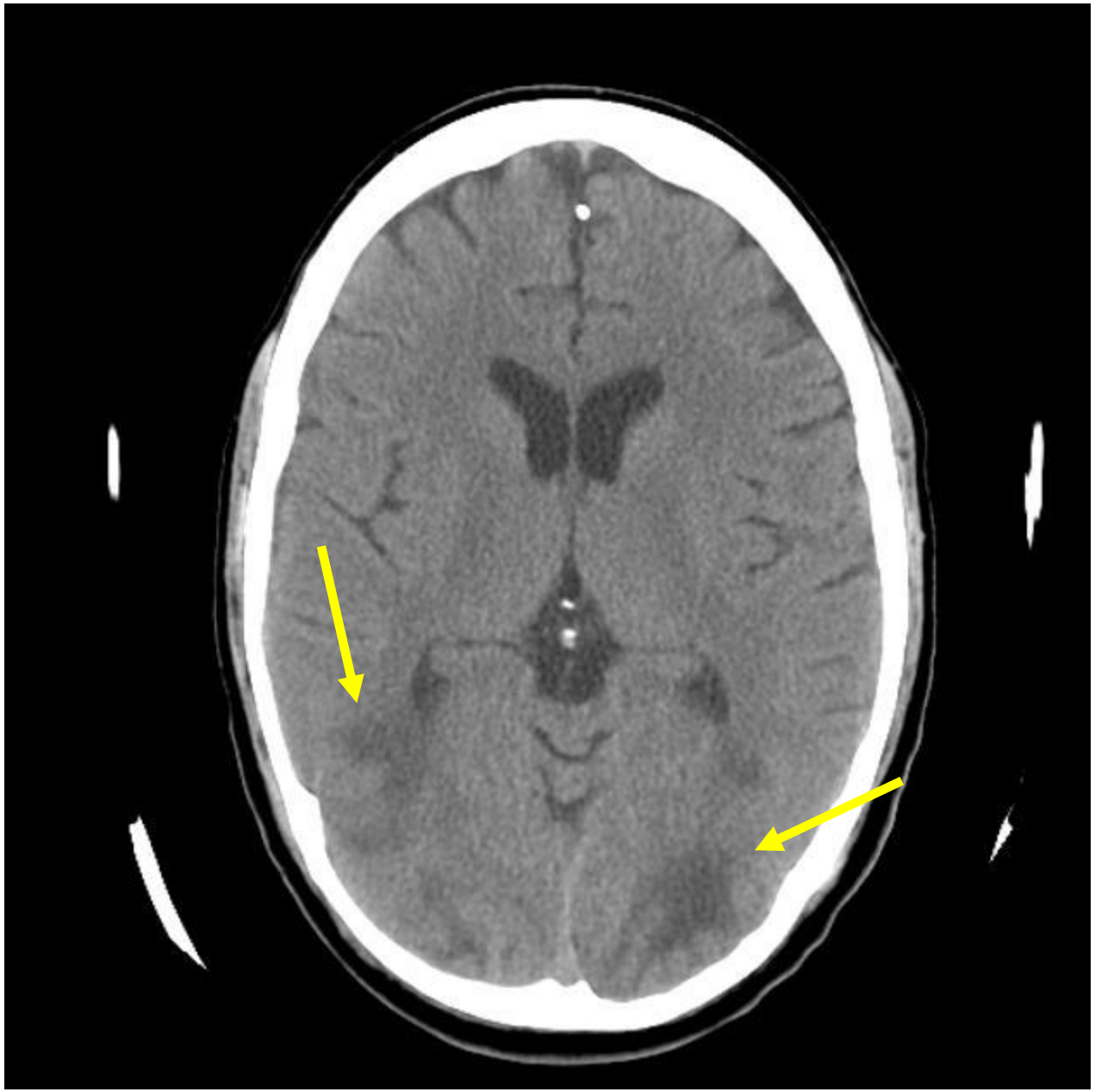
CVST


Cortical veins
17%
Superior
sagittal sinus
62%
Straight
sinus
18%
Vein of Galen
and internal
cerebral veins
11%
Transverse
sinuses
86%
Jugular veins
12%


A
B
D

PRES (Posterior Reversible Encephalopathy Syndrome)

- Generally occurs with sBP > 180 and usually over 200
  - Can occur in normotensive patients in the presence of other risk factors such as IVIG or chemotherapy (especialy bevacizumab)
- Vasogenic edema is prominent posteriorly, but can also occur anywhere in the brain
- Often presents with seizure, headache, blindness and sometimes focal deficit
- Treatment is BP control



If stroke mimic is suspected, play it safe

- It’s best to play it safe and if the patient has a significant deficit then either call Stroke on call at KHSC to discuss further or just send on ASP if appropriate on screening tests or your own exam
  - Stroke mimics can be very difficult to identify with certainty in the first 24 hours
  - It’s not uncommon for the Stroke Team at KHSC to thrombolyse stroke mimics

- Fortunately, the risk of hemorrhagic transformation in stroke mimic patients who receive thrombolysis is very low

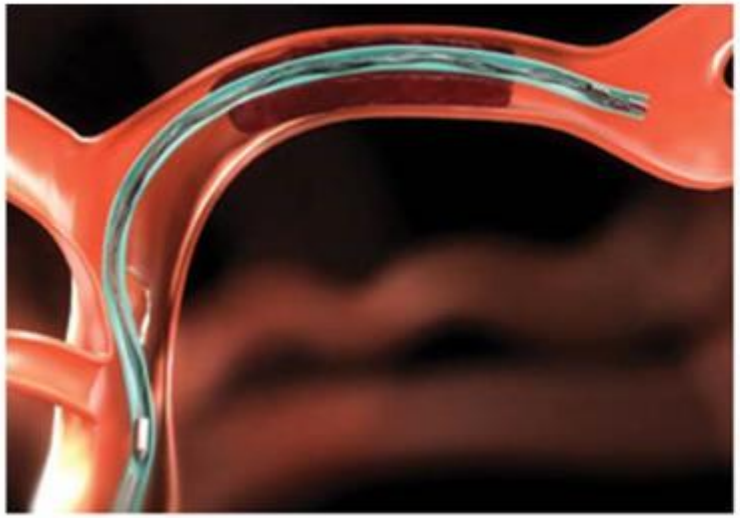
A few comments about thrombolysis

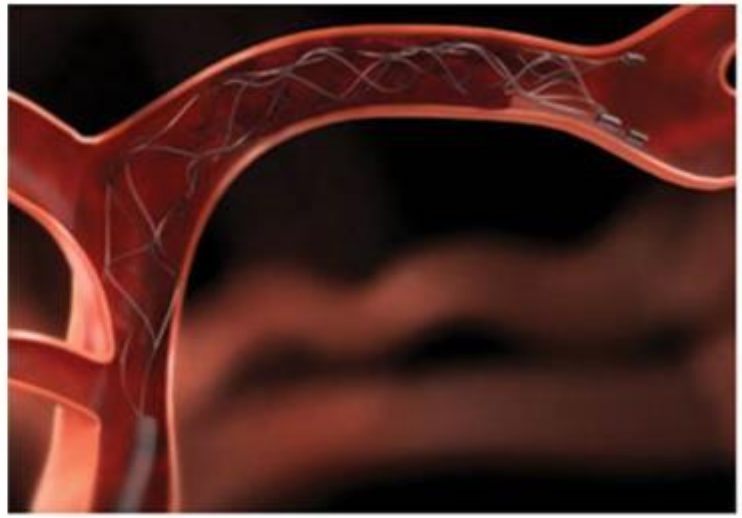
- Thrombolysis is evolving rapidly in Canada and worldwide with an expected transition from **tissue plasminogen activator** to **tenecteplase**
- The recently completed AcT trial demonstrated that **TNK is non-inferior to tPA**
- This trial is supposed to be published in NEJM soon
- In Kingston, we are examining what adjustments will need to be made to Acute Stroke Protocol if we stop using tPA and start using TNK

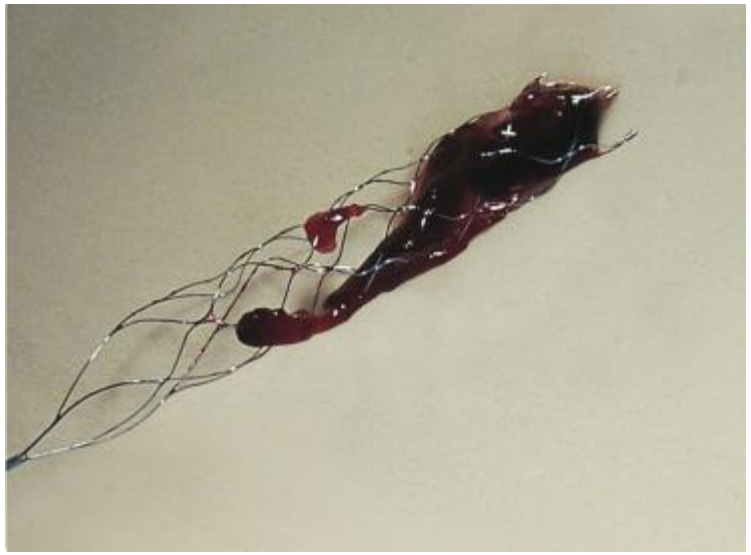
A few comments on EVT

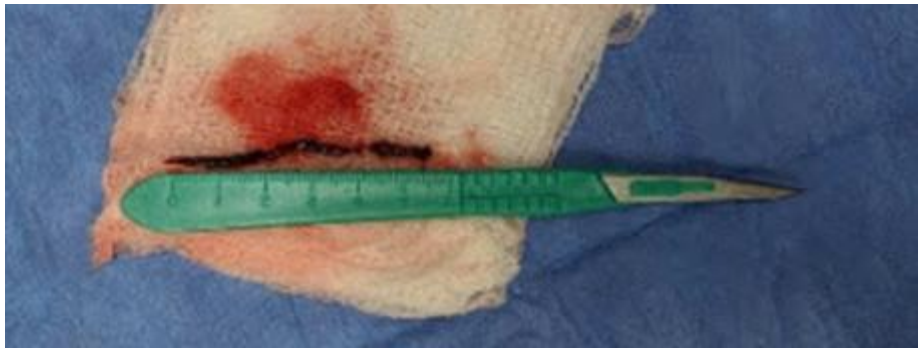
- Direct treatment using a catheter to effect removal or lysis of a thrombus from an extracranial or intracranial artery
  - Can also include intra-arterial tPA
  - Retrievable stent
  - Aspiration via catheter

Stent retriever









The Big Five EVT Trials of 2015

- In 2015, there were five RCTs comparing IV tPA against an endovascular approach using a “retrievable stent”
  - MR CLEAN
  - EXTEND IA
  - **ESCAPE**
  - REVASCAT
  - SWIFT PRIME

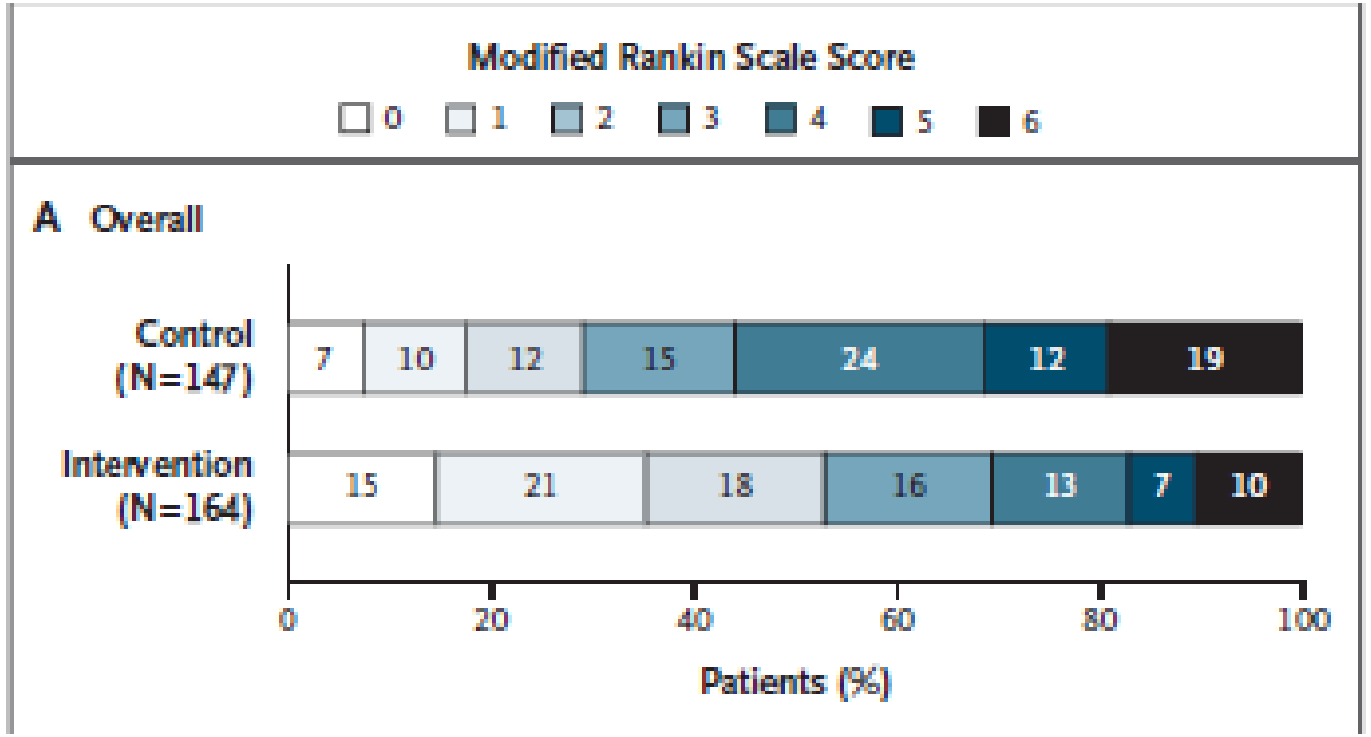
N Engl J Med 2015;372:1019-30

ORIGINAL ARTICLE

Randomized Assessment of Rapid Endovascular Treatment of Ischemic Stroke

M. Goyal, A.M. Demchuk, B.K. Menon, M. Eesa, J.L. Rempel, J. Thornton, D. Roy, T.G. Jovin, R.A. Willinsky, B.L. Sapkota, D. Dowlatshahi, D.F. Frei, N.R. Kamal, W.J. Montanera, A.Y. Poppe, K.J. Ryckborst, F.L. Silver, A. Shuaib, D. Tampieri, D. Williams, O.Y. Bang, B.W. Baxter, P.A. Burns, H. Choe, J.-H. Heo, C.A. Holmstedt, B. Jankowitz, M. Kelly, G. Linares, J.L. Mandzia, J. Shankar, S.-I. Sohn, R.H. Swartz, P.A. Barber, S.B. Coutts, E.E. Smith, W.F. Morrish, A. Weill, S. Subramaniam, A.P. Mitha, J.H. Wong, M.W. Lowerison, T.T. Sajobi, and M.D. Hill for the ESCAPE Trial Investigators*

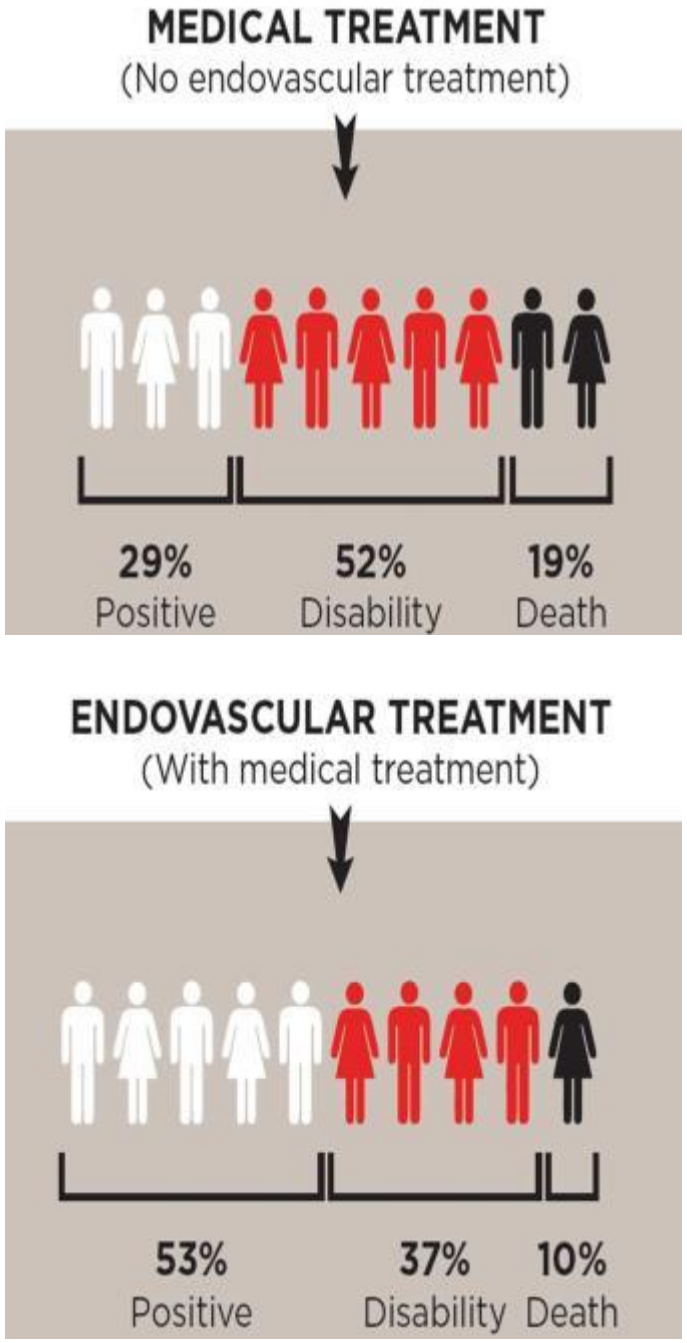
ESCAPE Trial Results



- Intervention: 53% good outcome
- Control: 29% good outcome

Benefits of EVT

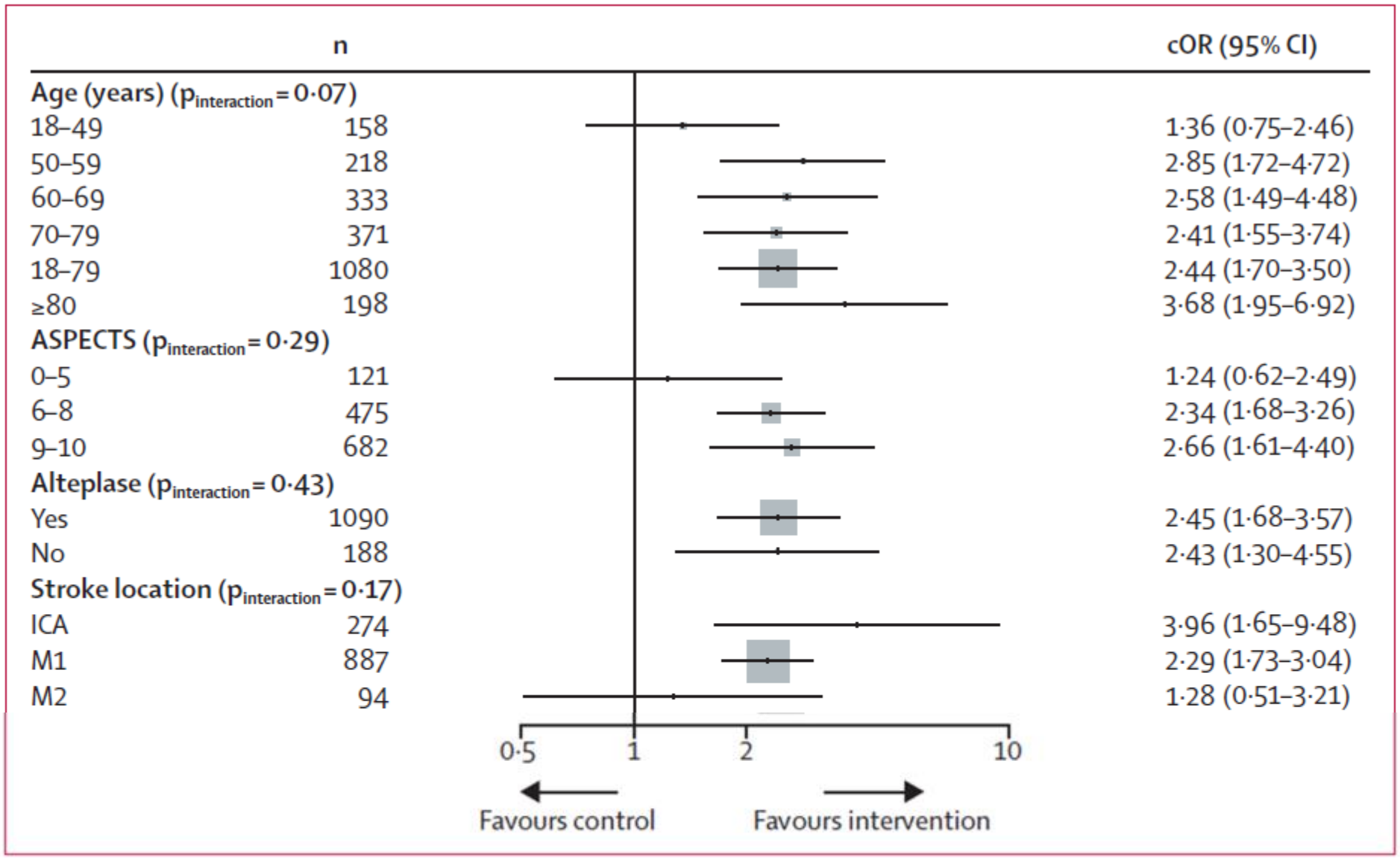
- ARR = 23.7%
- NNT = 4 (to live independently)
- Risk of ICH = 3%

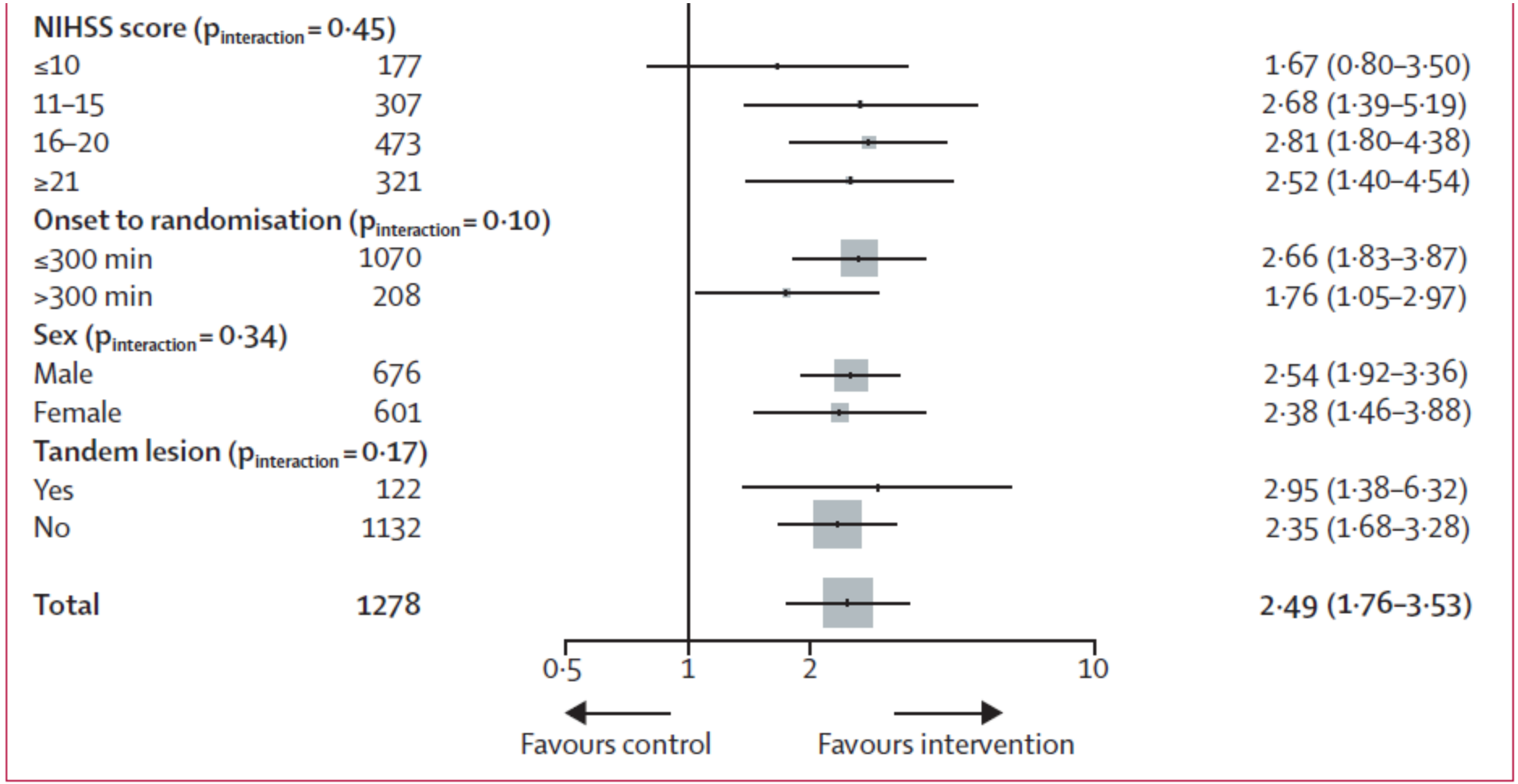


Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient data from five randomised trials

Mayank Goyal, Bijoy K Menon, Wim H van Zwam, Diederik W J Dippel, Peter J Mitchell, Andrew M Demchuk, Antoni Dávalos, Charles B L M Majoie, Aad van der Lugt, Maria A de Miquel, Geoffrey A Donnan, Yvo B W E M Roos, Alain Bonafe, Reza Jahan, Hans-Christoph Diener, Lucie A van den Berg, Elad I Levy, Olvert A Berkhemer, Vitor M Pereira, Jeremy Rempel, Mònica Millán, Stephen M Davis, Daniel Roy, John Thornton, Luis San Román, Marc Ribó, Debbie Beumer, Bruce Stouch, Scott Brown, Bruce C V Campbell, Robert J van Oostenbrugge, Jeffrey L Saver, Michael D Hill, Tudor G Jovin, for the HERMES collaborators

Lancet 2016; 387: 1723–31


n
cOR (95% CI)
Age (years) ($p_{interaction}$ = 0·07)
18–49 158 1·36 (0·75–2·46)
50–59 218 2·85 (1·72–4·72)
60–69 333 2·58 (1·49–4·48)
70–79 371 2·41 (1·55–3·74)
18–79 1080 2·44 (1·70–3·50)
≥80 198 3·68 (1·95–6·92)
ASPECTS ($p_{interaction}$ = 0·29)
0–5 121 1·24 (0·62–2·49)
6–8 475 2·34 (1·68–3·26)
9–10 682 2·66 (1·61–4·40)
Alteplase ($p_{interaction}$ = 0·43)
Yes 1090 2·45 (1·68–3·57)
No 188 2·43 (1·30–4·55)
Stroke location ($p_{interaction}$ = 0·17)
ICA 274 3·96 (1·65–9·48)
M1 887 2·29 (1·73–3·04)
M2 94 1·28 (0·51–3·21)
0·5
1
2
10
Favours control
Favours intervention


NIHSS score ($p_{interaction}$ = 0·45)
≤10 177 1·67 (0·80–3·50)
11–15 307 2·68 (1·39–5·19)
16–20 473 2·81 (1·80–4·38)
≥21 321 2·52 (1·40–4·54)
Onset to randomisation ($p_{interaction}$ = 0·10)
≤300 min 1070 2·66 (1·83–3·87)
>300 min 208 1·76 (1·05–2·97)
Sex ($p_{interaction}$ = 0·34)
Male 676 2·54 (1·92–3·36)
Female 601 2·38 (1·46–3·88)
Tandem lesion ($p_{interaction}$ = 0·17)
Yes 122 2·95 (1·38–6·32)
No 1132 2·35 (1·68–3·28)
Total 1278 2·49 (1·76–3·53)
0·5
1
2
10
Favours control
Favours intervention

Post-admission issues

- These topics are based on the questions which we encounter most frequently at KHSC:
  - Seizure
  - Recurrent stroke symptoms
  - Antithrombotic management (when to start antiplatelet or anticoagulation therapy)
  - Prognosis after ICH

Neurology®

Influence of seizures on stroke outcomes: A large multicenter study

Chin-Wei Huang, Gustavo Saposnik, Jimming Fang, et al.

Neurology published online January 31, 2014
DOI 10.1212/WNL.0000000000000166

- Registry of Canadian Stroke Network
- 10,261 patients
- 157 patients had seizure at stroke presentation (1.53%)
- 208 patients had seizure during hospitalization (2.03%)

Multivariable analysis of variables associated with SSP and SDH. Multivariable analysis demonstrated that the following variables were associated with SSP: younger age (age 60–79 vs age <60, odds ratio [OR] = 0.551, $p = 0.015$), female sex (OR = 1.485, $p = 0.039$), absence of motor weakness (OR = 0.346, $p < 0.001$), and more severe stroke (low Canadian Neurological Scale score) (OR = 0.796, $p < 0.001$) (figure).

Younger age (age 60–79 vs age <60, OR = 0.663, $p = 0.025$), SSP (OR = 15.10, $p < 0.001$), the presence of hemineglect (OR = 2.176, $p < 0.001$), low Canadian Neurological Scale score (OR = 0.902, $p < 0.001$), ICU admission (OR = 1.764, $p = 0.014$), and pneumonia as complication (OR = 1.928, $p = 0.003$) were associated with SDH (figure).

Worse outcomes in seizure and ischemic stroke

- Death within 30 days: OR 2.8
- Death within a year: OR 2.6
- mRS greater than 3: OR 2.4

- But thrombolysis did not make any difference in seizures at presentation or during hospitalization

Diseases which can present with stroke and seizure

- The most common conditions are AVMs and cavernous malformations (ICH + seizure)
- **Cerebral Venous Sinus Thrombosis**
- Mitochondrial disorders (MELAS)
- Takayasu’s arteritis
- Homocystinuria

Prediction of late seizures after ischaemic stroke with a novel prognostic model (the SeLECT score): a multivariable prediction model development and validation study

Marian Galovic, Nico Döhler, Barbara Erdélyi-Canavese, Ansgar Felbecker, Philip Siebel, Julian Conrad, Stefan Evers, Michael Winklehner, Tim J von Oertzen, Hans-Peter Haring, Anna Serafini, Giorgia Gregoraci, Mariarosaria Valente, Francesco Janes, Gian Luigi Gigli, Mark R Keezer, John S Duncan, Josemir W Sander, Matthias J Koepp, Barbara Tettenborn

Summary

Background Stroke is one of the leading causes of acquired epilepsy in adults. An instrument to predict whether people are at high risk of developing post-stroke seizures is not available. We aimed to develop and validate a prognostic model of late (>7 days) seizures after ischaemic stroke.

Lancet Neurol 2018; 17: 143–52

See Comment page 106

Department of Neurology, Kantonsspital St Gallen,

	SeLECT score (points)
(Se) Severity of stroke	
NIHSS ≤3	0
NIHSS 4–10	1
NIHSS ≥11	2
(L) Large-artery atherosclerosis	
No	0
Yes	1
(E) Early seizure (≤7 days)	
No	0
Yes	3
(C) Cortical involvement	
No	0
Yes	2
(T) Territory of MCA	
No	0
Yes	1

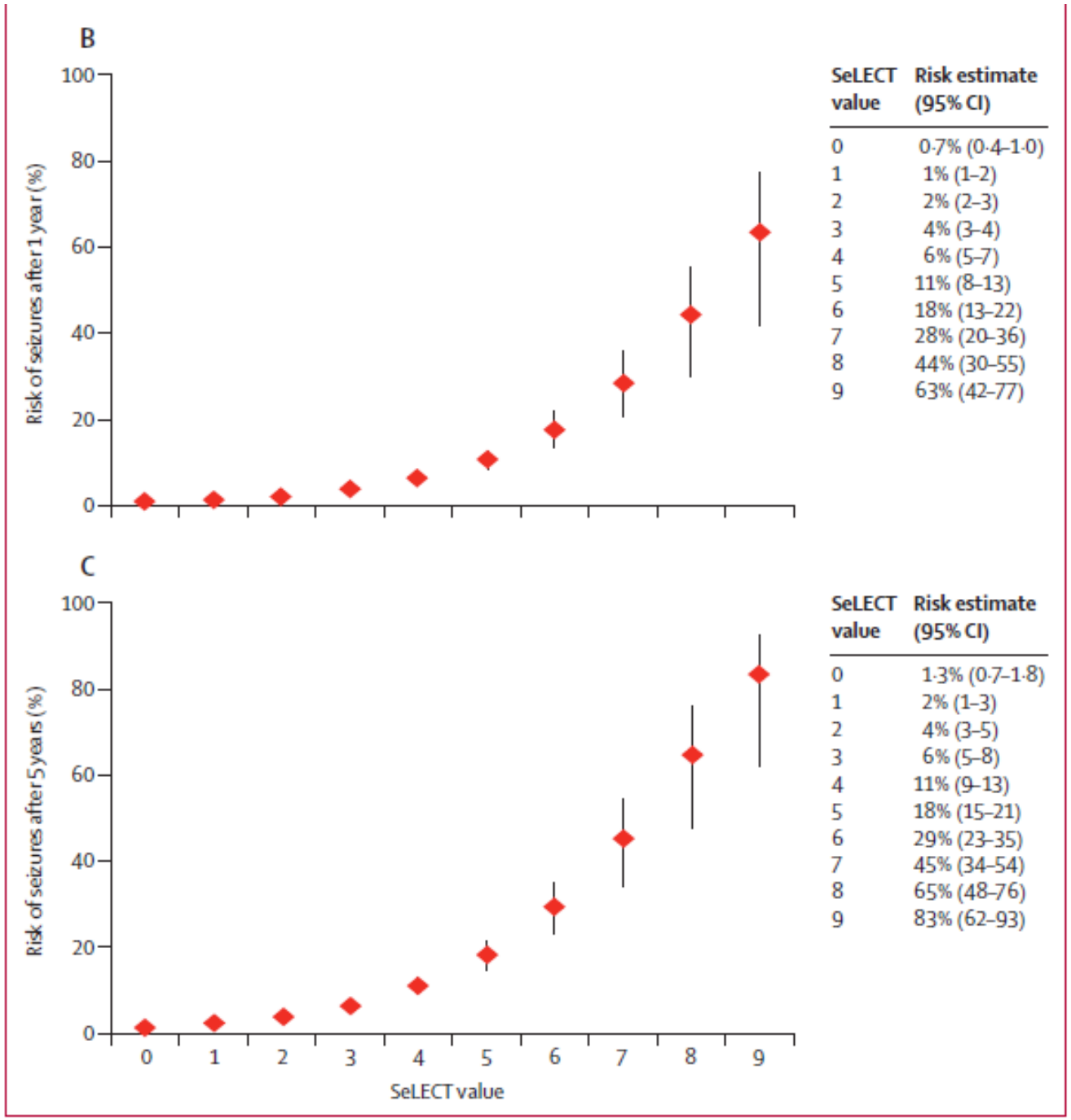


Figure 3: **Predicted risk of late seizures according to SeLECT score**

No early seizures

	No cortical involvement				Cortical involvement			
Territory of MCA	No		Yes		No		Yes	
Large-artery atherosclerosis	No	Yes	No	Yes	No	Yes	No	Yes
NIHSS 0–3	0·7% (1%)	1% (2%)	1% (2%)	2% (4%)	2% (4%)	4% (6%)	4% (6%)	6% (11%)
NIHSS 4–10	1% (2%)	2% (4%)	2% (4%)	4% (6%)	4% (6%)	6% (11%)	6% (11%)	11% (18%)
NIHSS ≥11	2% (4%)	4% (6%)	4% (6%)	6% (11%)	6% (11%)	11% (18%)	11% (18%)	**18% (29%)**

Early seizures

	No cortical involvement				Cortical involvement			
Territory of MCA	No		Yes		No		Yes	
Large-artery atherosclerosis	No	Yes	No	Yes	No	Yes	No	Yes
NIHSS 0–3	4% (6%)	6% (11%)	6% (11%)	11% (18%)	11% (18%)	**18% (29%)**	**18% (29%)**	**28% (45%)**
NIHSS 4–10	6% (11%)	11% (18%)	11% (18%)	**18% (29%)**	**18% (29%)**	**28% (45%)**	**28% (45%)**	**44% (65%)**
NIHSS ≥11	11% (18%)	**18% (29%)**	**18% (29%)**	**28% (45%)**	**28% (45%)**	**44% (65%)**	**44% (65%)**	**63% (83%)**

Very low risk
Low risk
Moderate risk
High risk
Very high risk

Figure 4: **Prediction chart of late seizures after stroke**
Numbers in the prediction chart correspond to the risk of late seizures 1 year after stroke (numbers in parentheses are risks 5 years after stroke). MCA=middle cerebral artery. NIHSS=National Institutes of Health Stroke Scale.

The CAVE Score for Predicting Late Seizures After Intracerebral Hemorrhage

Elena Haapaniemi, MD; Daniel Strbian, MD; Costanza Rossi, MD; Jukka Putaala, MD; Tuulia Sipi, MB; Satu Mustanoja, MD; Tiina Sairanen, MD; Sami Curtze, MD; Jarno Satopää, MD; Reina Roivainen, MD; Markku Kaste, MD; Charlotte Cordonnier, MD; Turgut Tatlisumak, MD; Atte Meretoja, MD

(*Stroke*. 2014;45:1971-1976.)

CAVE score and risk of seizure >7 days after ICH

CAVE Score	Risk of late seizure
0	0.6%
1	3.6%
2	9.8%
3	34.8%
4	46.2%

1 point for: cortical involvement, age < 65 yrs, volume > 10 mL, early seizure within 7 days of ICH

What to expect with hemorrhagic stroke

- Deficits are based on the location of the hematoma
- But the clinical course can change very quickly if the hematoma expands

Intracerebral hemorrhage has high mortality

- About a third will die in the first month
- Age is a major factor with over 50% mortality in patients > 80 yo

Mortality after hemorrhagic stroke
Antonio González-Pérez, David Gaist, Mari-Ann Wallander, GillianMcFeat, Luis A. García-Rodríguez
Neurology Aug 2013, 81 (6) 559-565

Recovery is slow

Hemphill JC 3rd, Farrant M, Neill TA Jr. Prospective validation of the ICH Score for 12-month functional outcome. Neurology. 2009 Oct 6;73(14):1088-94. doi: 10.1212/WNL.0b013e3181b8b332. Epub 2009 Sep 2. PMID: 19726752; PMCID: PMC2764394.

Table 2 **Modified Rankin Scale (mRS) score at various timepoints (n = 243)**

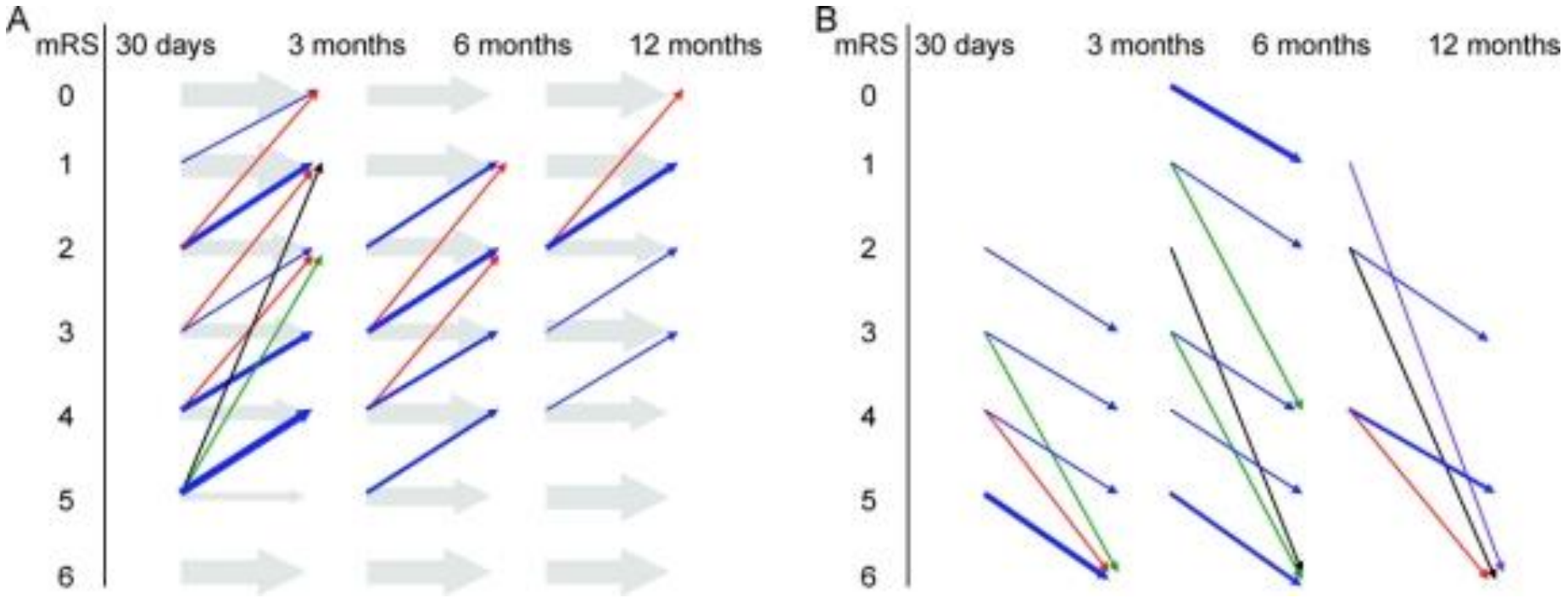
mRS score	Hospital discharge	30 d	3 mo	6 mo	12 mo
0	3 (1)	3 (1)	5 (2)	4 (2)	5 (2)
1	21 (9)	25 (10)	29 (12)	32 (13)	35 (14)
2	13 (5)	15 (6)	17 (7)	21 (9)	16 (7)
3	31 (13)	27 (11)	31 (13)	29 (12)	31 (13)
4	55 (23)	55 (23)	42 (17)	36 (15)	26 (11)
5	25 (10)	18 (7)	8 (3)	7 (3)	13 (5)
6	95 (39)	100 (41)	111 (46)	114 (47)	117 (48)

Values are expressed as n (%).

But many ICH patients change after hospital discharge

- 34% will improve by one point or more on mRS after hospital discharge
  - 13% will improve by 2 or more points

- 22% will deteriorate by one or more points
  - 10% will deteriorate by 2 or more points, often due to other conditions not related to ICH



- Grey: no improvement
- Blue: mRS changed by 1
- Line thickness indicates # patients

Be cautious when offering palliation based on ICH score

- One of the greatest predictors of in-hospital mortality is discussion of DNR within the first 24 hours

Severity assessment in maximally treated ICH patients

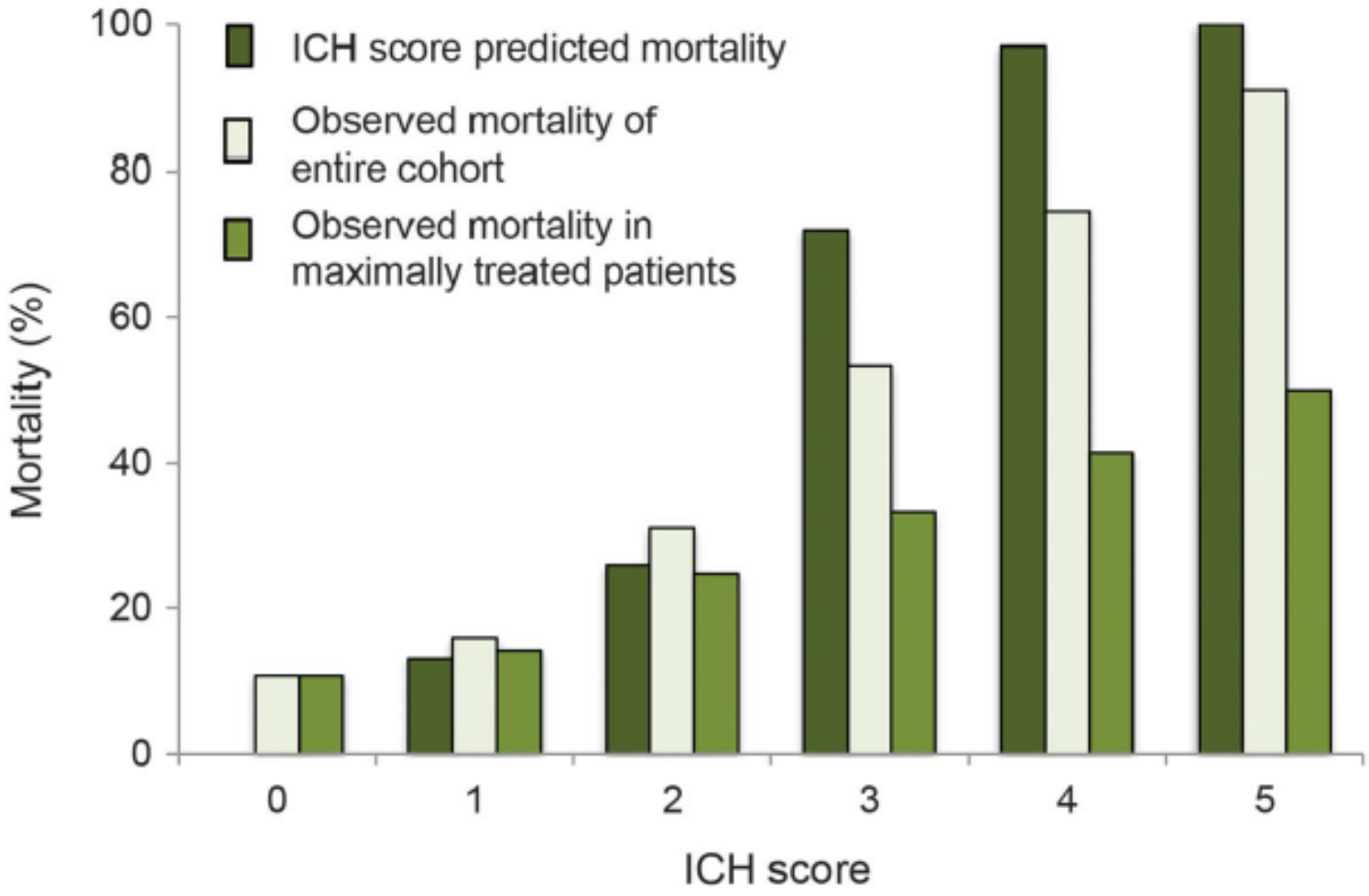
The max-ICH score

Conclusions: Care limitations significantly influenced the validity of common prognostication models resulting in overestimation of poor outcome. The max-ICH score demonstrated increased predictive validity with minimized confounding by care limitations, making it a useful tool for severity assessment in ICH patients. *Neurology*® 2017;89:423-431

- **Early care limitations are a self-fulfilling prophecy**

Jochen A. Sembill, MD
Stefan T. Gerner, MD
Bastian Volbers, MD
Tobias Bobinger, MD
Hannes Lücking, MD
Stephan P. Kloska, MD
Stefan Schwab, MD
Hagen B. Huttner, MD
Joji B. Kuramatsu, MD

Figure 1 **Comparison of mortality rates**



Observed short-term mortality rate in the entire intracerebral hemorrhage (ICH) cohort (n = 583) and in maximally treated patients (n = 471) in contrast to predicted short-term mortality rate by the ICH score.

- Prevalence of ECL 19.2% (n=112/583) and all of these patients died

- But, propensity score matching showed that **50.7% theoretically could have survived** and **18.8% possibly reaching favorable outcome** (modified Rankin Scale score of 0 to 3).

Antithrombotic Management

- Dual or single antiplatelet therapy after stroke?
- If there is hemorrhagic transformation after ischemic stroke, when can I start antiplatelet therapy?
- If my patient has atrial fibrillation and intracerebral hemorrhage, when is it safe to (re)start anticoagulation?

Dual vs Single Antiplatelet Therapy

- For TIA or minor stroke, i.e. non-disabling, dual antiplatelet therapy is preferred
  - POINT trial: NEJM 2018; 379: 215-225
  - CHANCE trial: NEJM 2013; 369: 11-19

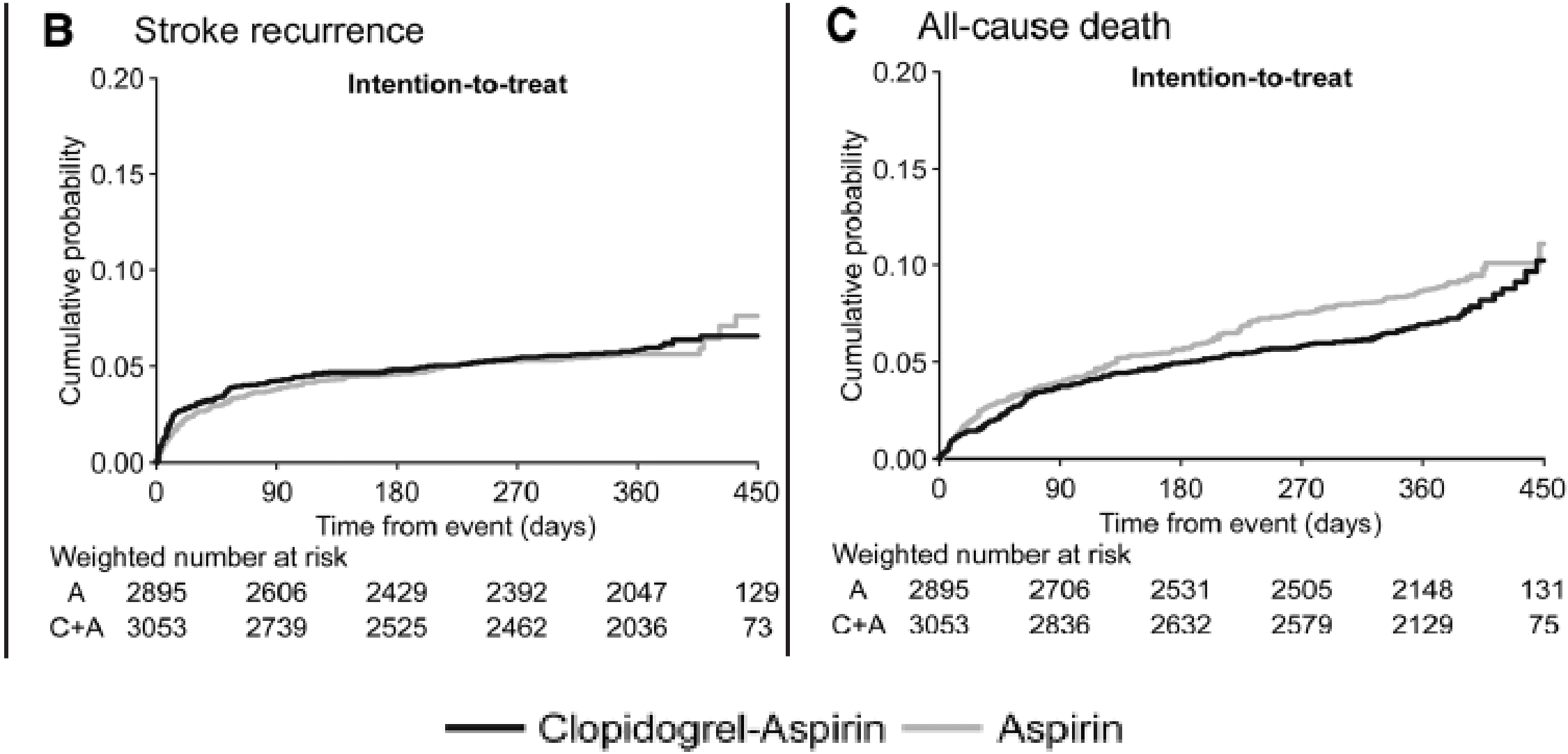
- For disabling stroke, it isn’t so clear…

Dual Versus Mono Antiplatelet Therapy in Large Atherosclerotic Stroke

A Retrospective Analysis of the Nationwide Multicenter Stroke Registry

Dohoung Kim, MD, PhD; Jong-Moo Park, MD, PhD; Kyusik Kang, MD, PhD; Yong-Jin Cho, MD, PhD; Keun-Sik Hong, MD, PhD; Kyung Bok Lee, MD, PhD; Tai Hwan Park, MD, PhD; Soo Joo Lee, MD, PhD; Jae Guk Kim, MD, PhD; Moon-Ku Han, MD, PhD; Beom Joon Kim, MD, PhD; Jun Lee, MD, PhD; Jae-Kwan Cha, MD, PhD; Dae-Hyun Kim, MD, PhD; Hyun-Wook Nah, MD, PhD; Dong-Eog Kim, MD, PhD; Wi-Sun Ryu, MD, PhD; Joon-Tae Kim, MD, PhD; Kang-Ho Choi, MD, PhD; Jay Chol Choi, MD, PhD; Byung-Chul Lee, MD, PhD; Kyung-Ho Yu, MD, PhD; Mi Sun Oh, MD, PhD; Wook-Joo Kim, MD, PhD; Jee-Hyun Kwon, MD, PhD; Dong-Ick Shin, MD, PhD; Sung-Il Sohn, MD, PhD; Jeong-Ho Hong, MD, PhD; Ji Sung Lee, PhD; Juneyoung Lee, PhD; Philip B. Gorelick, MD, MPH; Hee-Joon Bae, MD, PhD; on behalf of Clinical Research Collaboration for Stroke in Korea (CRCS-K) Investigators

***Conclusions*—**Compared with patients receiving aspirin monotherapy, the primary outcome seemed to occur less frequently in patients receiving dual antiplatelet therapy, which is explained mainly by the decrease of all-cause death. Since this is a nonrandomized, retrospective, observational study, our study should be cautiously interpreted. **(*Stroke*. 2019;50:1184-1192. DOI: 10.1161/STROKEAHA.119.024786.)**


B
Stroke recurrence
Intention-to-treat
Cumulative probability
0.20
0.15
0.10
0.05
0.00
0
90
180
270
360
450
Time from event (days)
Weighted number at risk
A 2895 2606 2429 2392 2047 129
C+A 3053 2739 2525 2462 2036 73
C
All-cause death
Intention-to-treat
Cumulative probability
0.20
0.15
0.10
0.05
0.00
0
90
180
270
360
450
Time from event (days)
Weighted number at risk
A 2895 2706 2531 2505 2148 131
C+A 3053 2836 2632 2579 2129 75
Clopidogrel-Aspirin
Aspirin

- Clinical considerations for single vs dual antiplatelet therapy after stroke include risk of systemic bleeding, and potential revascularization surgery

Can I restart antiplatelet agents after hemorrhagic transformation?

- Hemorrhagic transformation on post-admission CT usually warrants stopping antithrombotic therapy at least temporarily
- If restarting antiplatelet therapy is being considered, then it’s reasonable to wait a few days and re-scan.
- If there is no change in hematoma size or the hematoma is resolving, then it’s usually safe to start antiplatelet therapy

If my patient had a primary ICH, can I restart antiplatelet therapy at some point?

Effects of antiplatelet therapy after stroke due to intracerebral haemorrhage (RESTART): a randomised, open-label trial

*RESTART Collaboration**

Summary

Background Antiplatelet therapy reduces the risk of major vascular events for people with occlusive vascular disease, although it might increase the risk of intracranial haemorrhage. Patients surviving the commonest subtype of intracranial haemorrhage, intracerebral haemorrhage, are at risk of both haemorrhagic and occlusive vascular events, but whether antiplatelet therapy can be used safely is unclear. We aimed to estimate the relative and absolute effects of antiplatelet therapy on recurrent intracerebral haemorrhage and whether this risk might exceed any reduction of occlusive vascular events.

Methods The REstart or STop Antithrombotics Randomised Trial (RESTART) was a prospective, randomised, open-label, blinded endpoint, parallel-group trial at 122 hospitals in the UK. We recruited adults (≥18 years) who were taking antithrombotic (antiplatelet or anticoagulant) therapy for the prevention of occlusive vascular disease when they developed intracerebral haemorrhage, discontinued antithrombotic therapy, and survived for 24 h. Computerised randomisation incorporating minimisation allocated participants (1:1) to start or avoid antiplatelet therapy. We followed participants for the primary outcome (recurrent symptomatic intracerebral haemorrhage) for up to 5 years. We analysed data from all randomised participants using Cox proportional hazards regression, adjusted for minimisation covariates. This trial is registered with ISRCTN (number ISRCTN71907627).

Lancet 2019; 393: 2613–23

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See **Comment** page 2567

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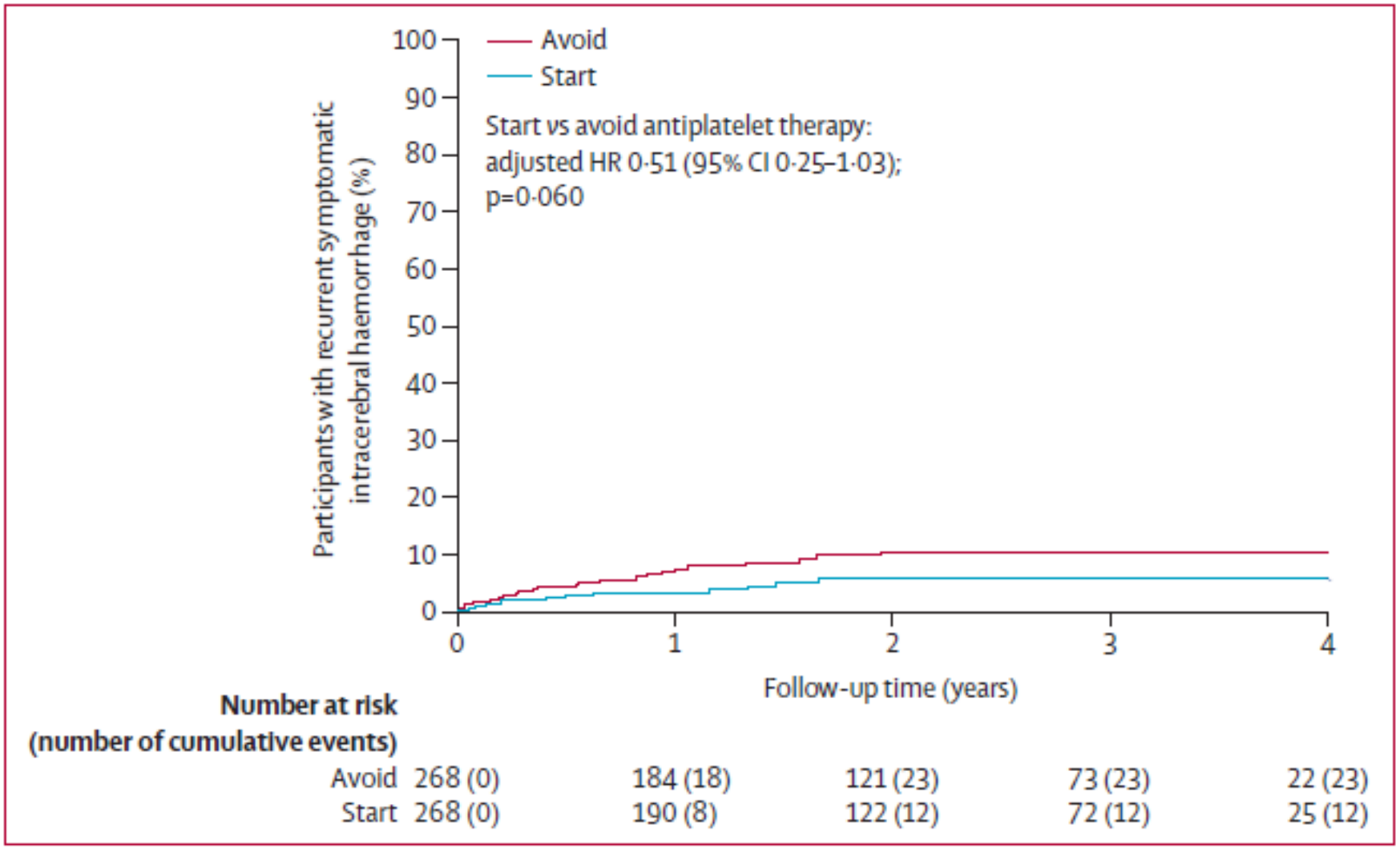


Figure 2: **Kaplan-Meier plot of the first occurrence of recurrent symptomatic intracerebral haemorrhage**
Numbers at risk refer to survivors under follow-up at the start of each year according to treatment allocation. Cumulative events indicate the participants in follow-up with a first event. HR=hazard ratio.

In summary, RESTART excluded all but a very modest increase in the risk of recurrent intracerebral haemorrhage with antiplatelet therapy, which seemed too small to exceed the established benefits of antiplatelet therapy for secondary prevention of major vascular events (video). Antiplatelet therapy might have reduced the recurrence of intracerebral haemorrhage. These findings provide reassurance about the use of antiplatelet therapy for similar patients in clinical practice. Ongoing randomised trials, their meta-analysis with RESTART, and an adequately powered definitive randomised trial should be done to strengthen the evidence.

Anticoagulation after HT?

Hemorrhagic Transformation in Patients With Acute Ischemic Stroke and Atrial Fibrillation: Time to Initiation of Oral Anticoagulant Therapy and Outcomes

- J Am Heart Assoc. 2018;7:e010133
- In HT patients anticoagulation was started 12 days later than patients without HT
- **No increase in ischemic recurrence**

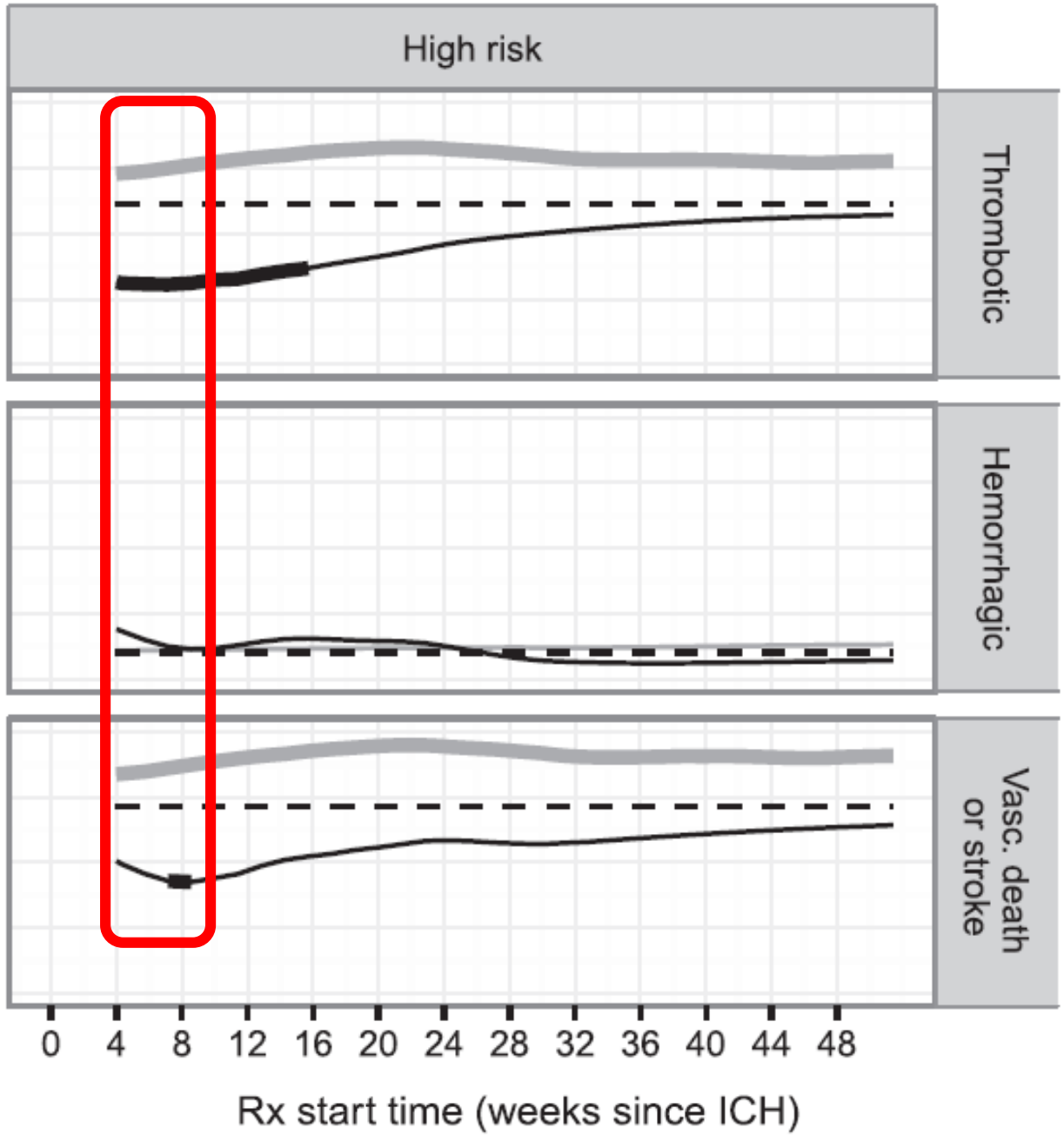
Optimal Timing of Anticoagulant Treatment After Intracerebral Hemorrhage in Patients With Atrial Fibrillation

Johanna Pennlert, MD; Rosanna Overholser, PhD; Kjell Asplund, MD, PhD; Bo Carlberg, MD, PhD; Bart Van Rompaye, PhD; Per-Gunnar Wiklund, MD, PhD; Marie Eriksson, PhD

- Stroke 2017;48:314-320
- Observational study in Sweden with 2619 ICH survivors, 5759 person-years of follow-up

- Greatest benefit when anticoagulation was started 7 to 8 weeks after ICH

- Benefits similar for both men and women with high risk of cardioembolic stroke (i.e. CHA_2DS_2-VASc score of 6 for men and 7 for women)


High risk
Thrombotic
Hemorrhagic
Vasc. death or stroke
0
4
8
12
16
20
24
28
32
36
40
44
48
Rx start time (weeks since ICH)

Questions or Comments?

Thanks for your attention!
If you have any questions email me at Albert.Jin@kingstonhsc.ca