Intracerebral Hemorrhage

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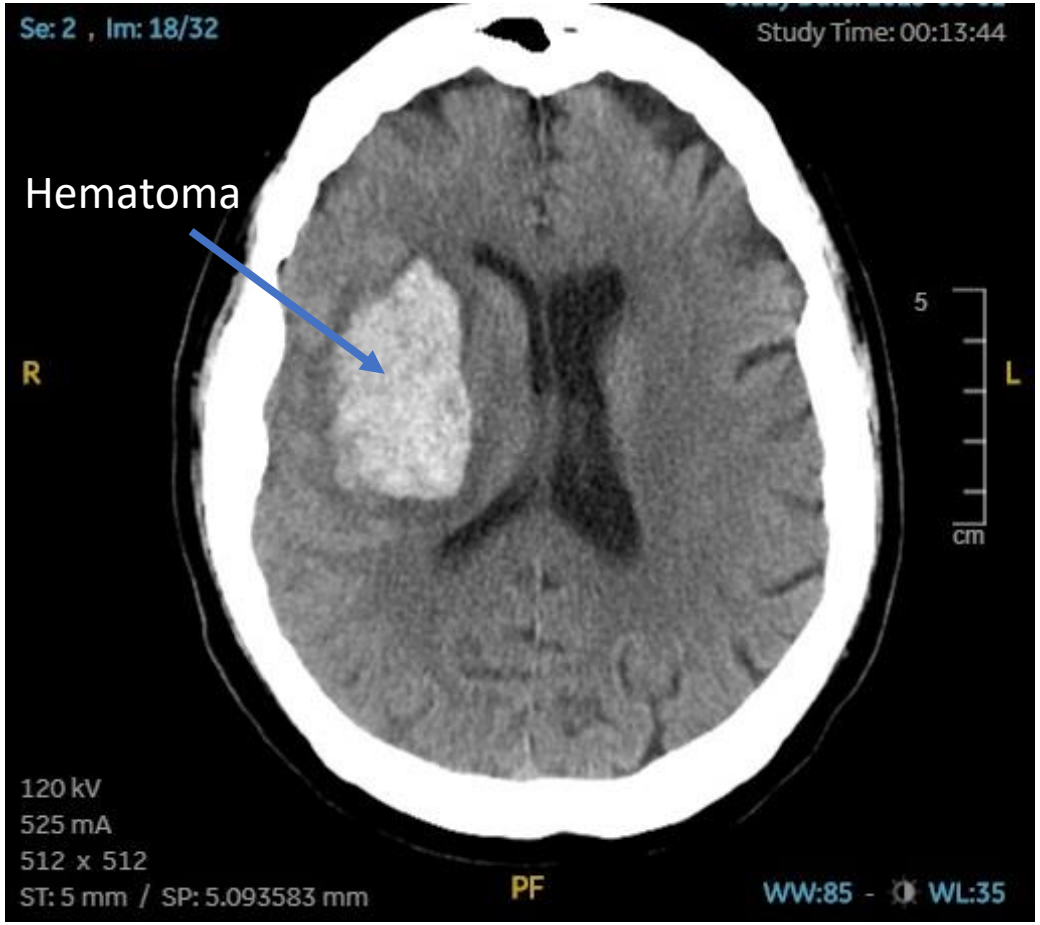
Disclosures

- I have no disclosures or conflicts of interest

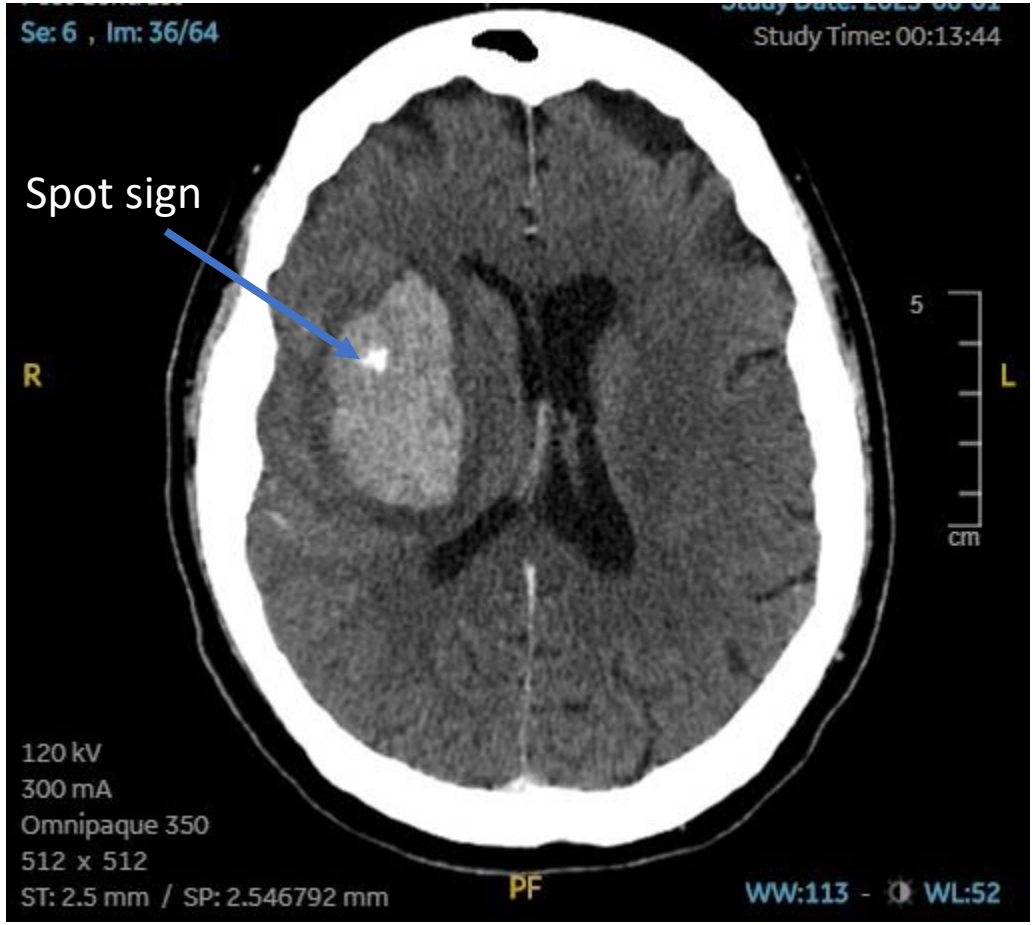
Case 1: 64F with hypertension, atrial fibrillation

- Acute onset mild headache and left side weakness
- Can speak and understand well but is unaware of any weakness
- Blood pressure: 210/113
- She is taking apixaban for atrial fibrillation

CT scan



Non-contrast scan



Contrast-enhanced scan

ICH management

- This ICH is due to two things: hypertension and anticoagulation
- 1. Ensure airway is protected if patient has impaired consciousness
- 2. Reverse anticoagulation:
  - Prothrombin complex concentrate, 25-50 mg/kg, usual dose 2000 units (max dose 3000 units)
  - Tranexamic acid 1g IV bolus, then 1g over 8 hrs
  - If the patient is taking dabigatran, the specific reversal agent is idarucizumab

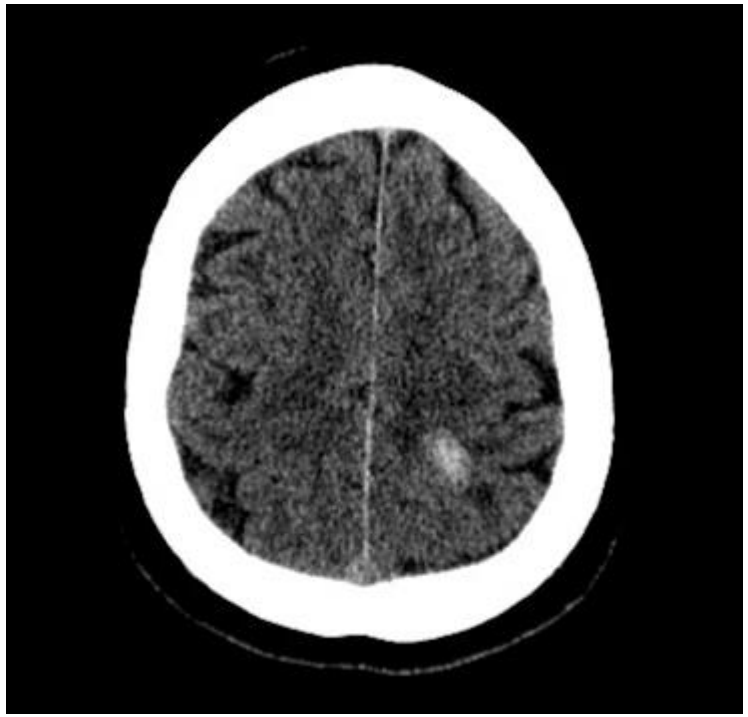
ICH management

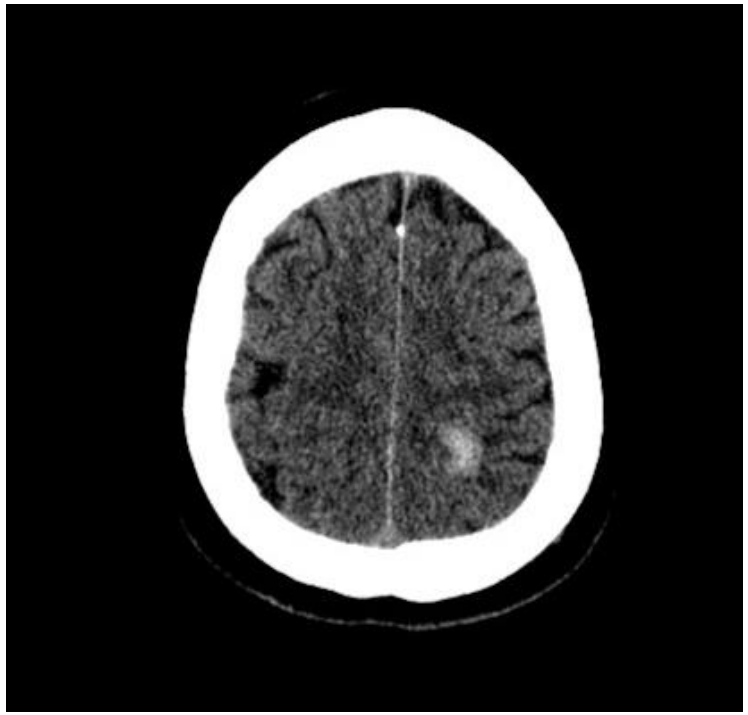
- 3. Maintain systolic BP < 140 mm Hg
  - We have known for many years that the higher the sBP, the worse the outcome in ICH
  - There were two clinical trials of BP lowering in ICH: INTERACT2 and ATACH2
  - Although neither showed that targeting sBP < 140 mm Hg was better than targeting 160 mm Hg, it was shown that targeting sBP < 140 mm Hg was safe
  - IV labetalol is commonly used to lower blood pressure quickly
  - IV hydralazine can also be used

Case 2: 75F with no history of hypertension

- Sudden onset “cold to the bone” sensation in the right face, arm and leg. Lasted 1 to 2 days then resolved.
- Saw family doctor who advised to go to ER immediately for TIA workup. Examination was normal.

CT scan

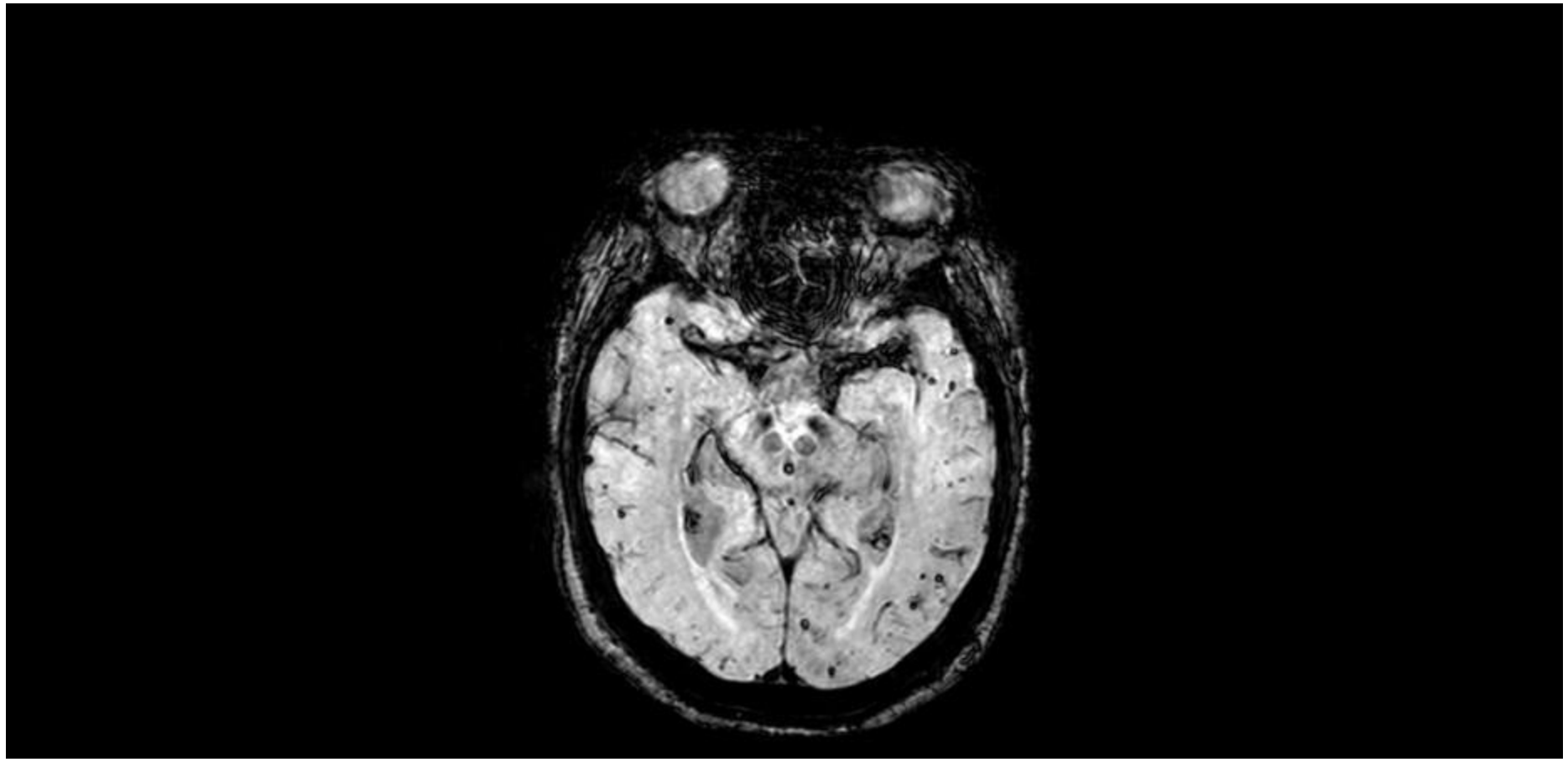


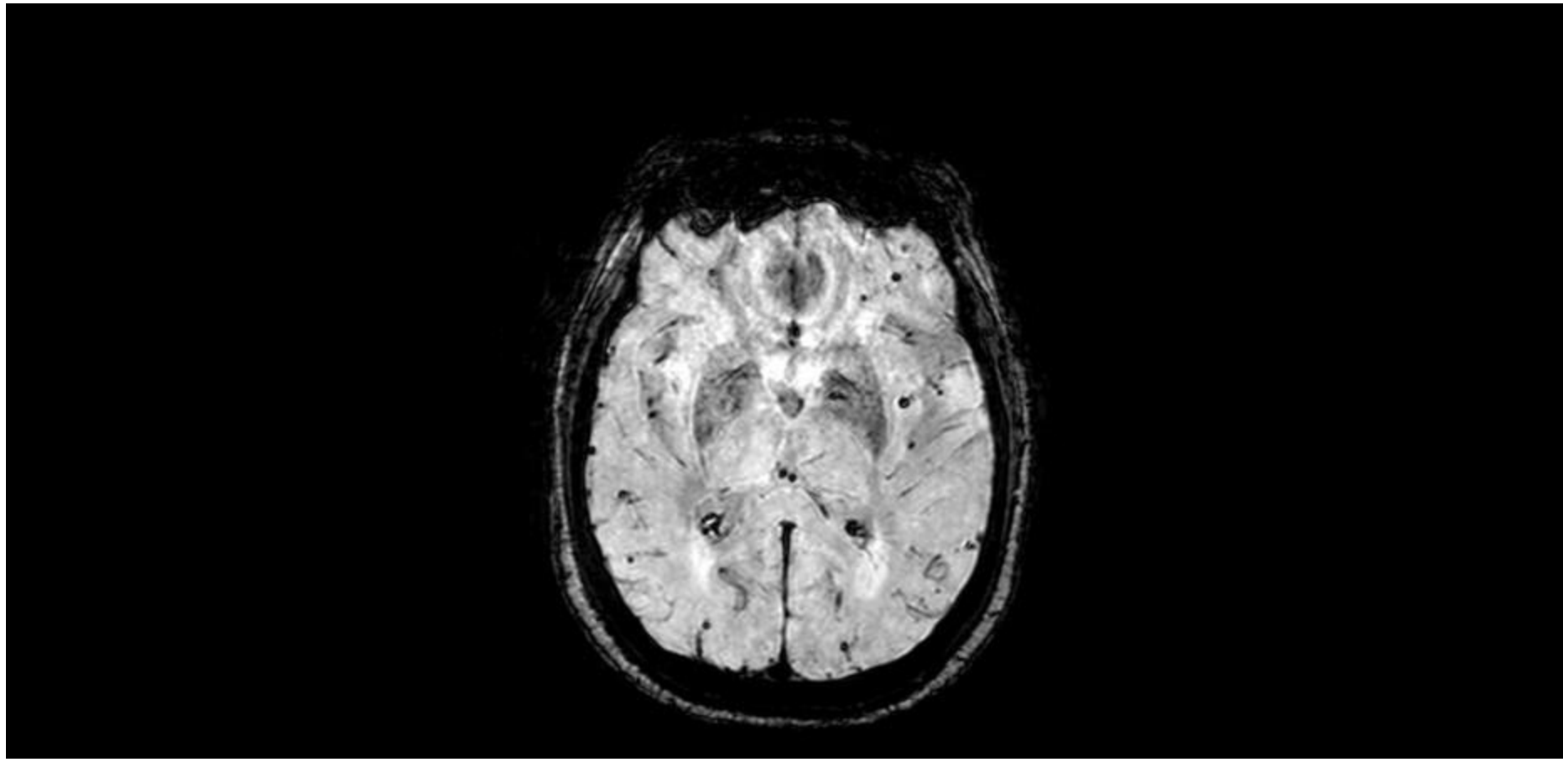


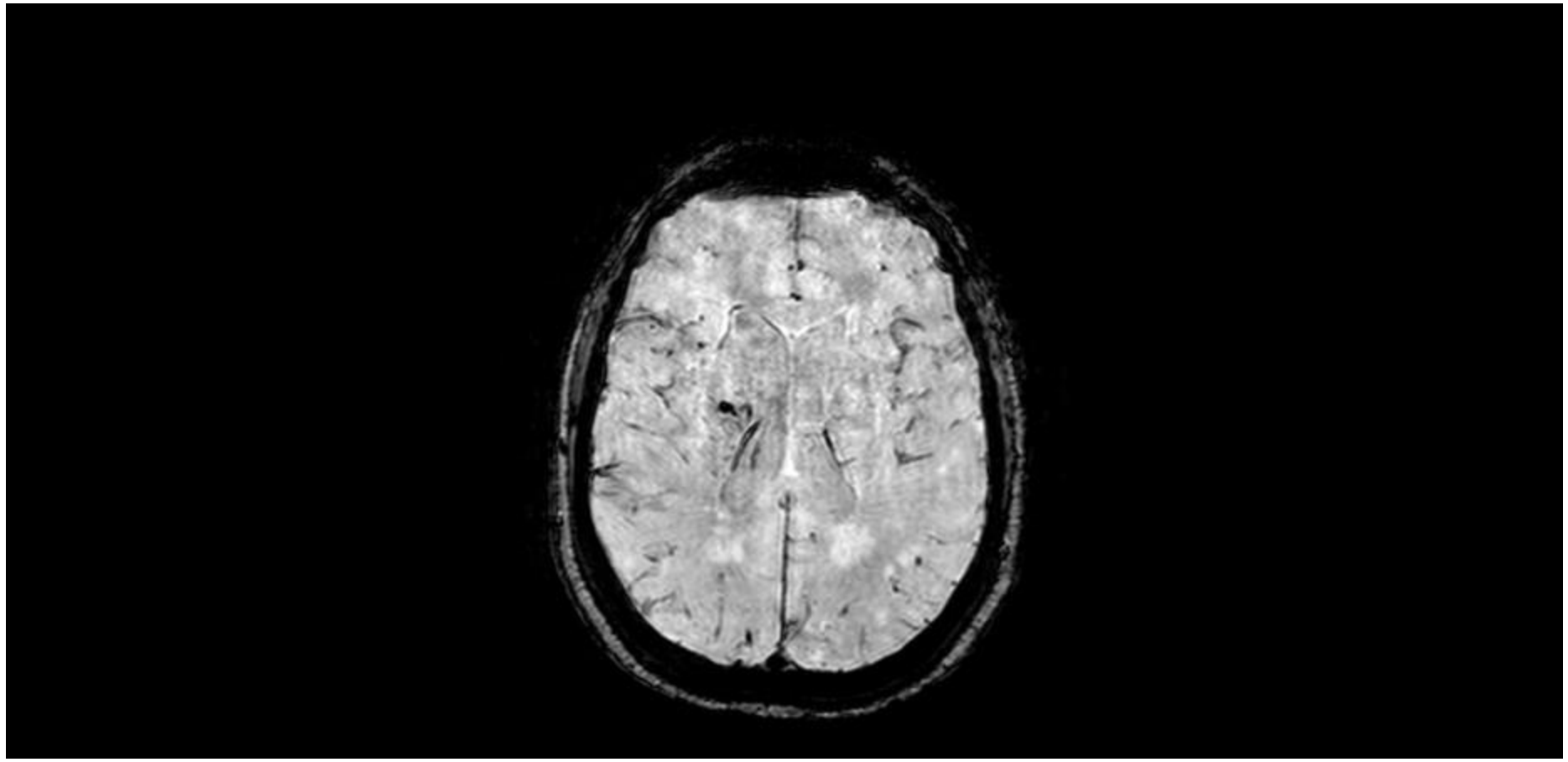
Small hematoma in left superior parietal lobe

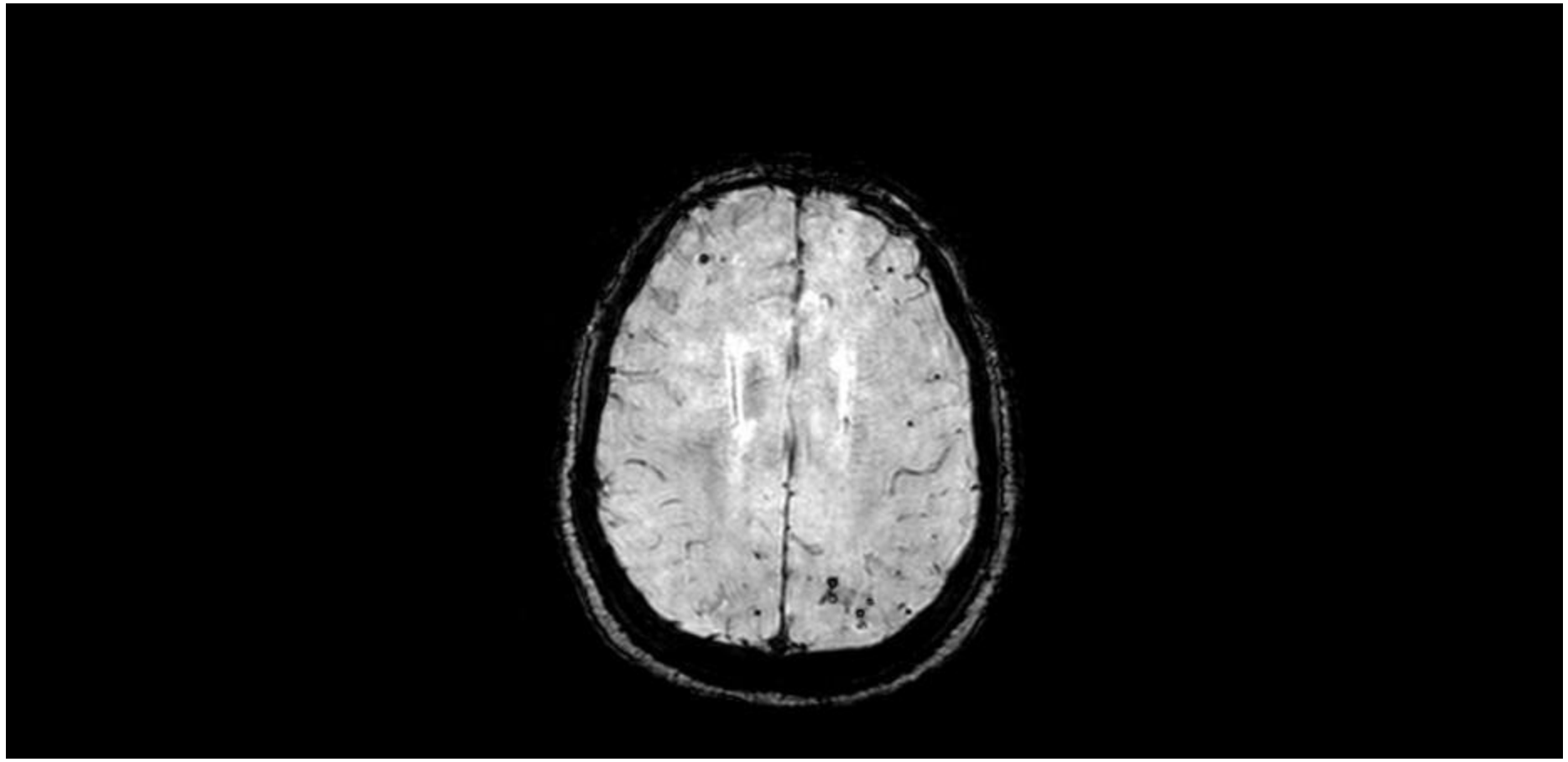
MRI scan with Gradient Echo Sequence

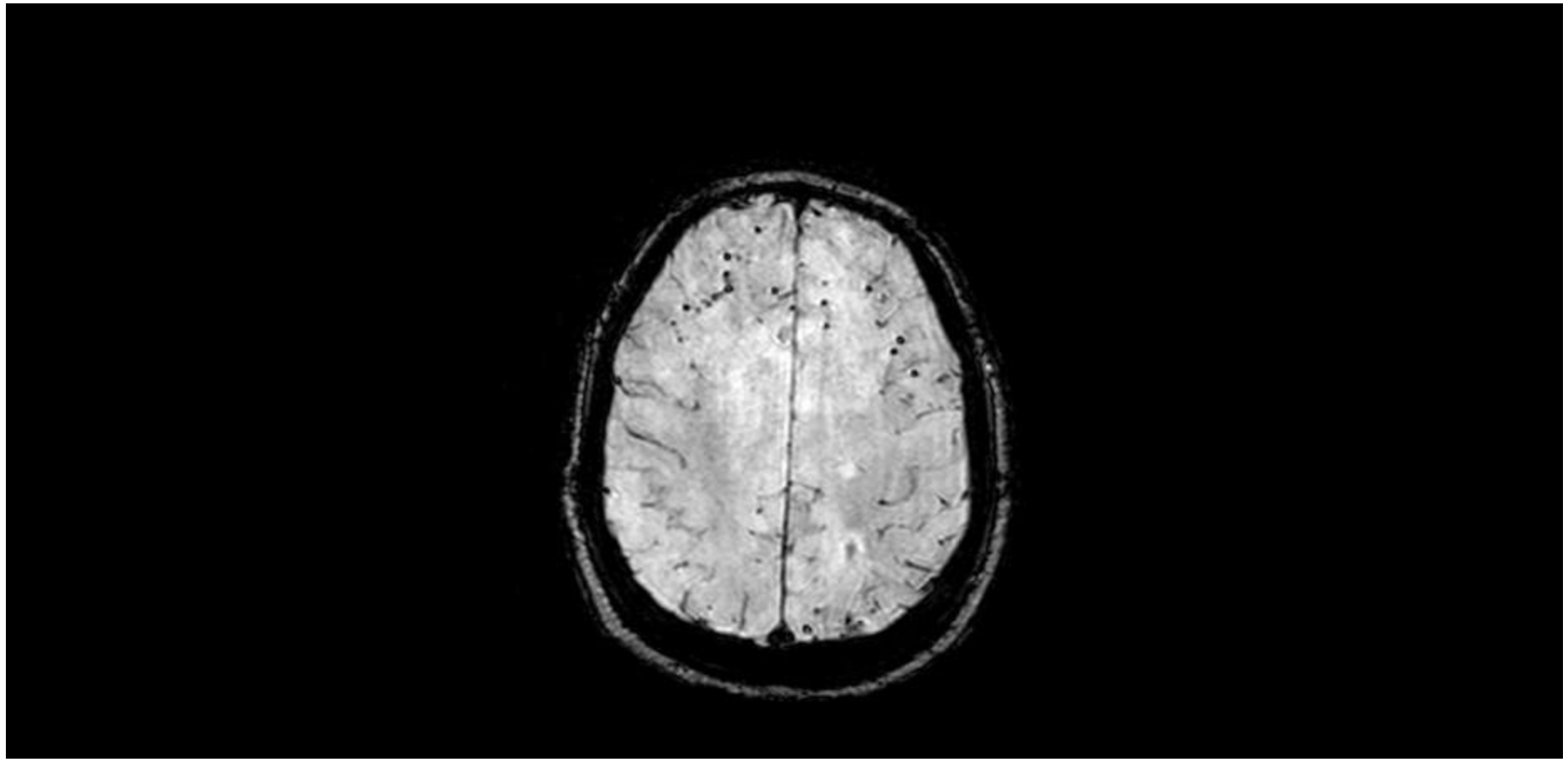
- *These images are from over a decade ago and instead of Gradient Echo, we now use Susceptibility-Weighted Imaging. But both GRE and SWI are MRI techniques which show areas of hemosiderin deposition from past or present hemorrhage.*

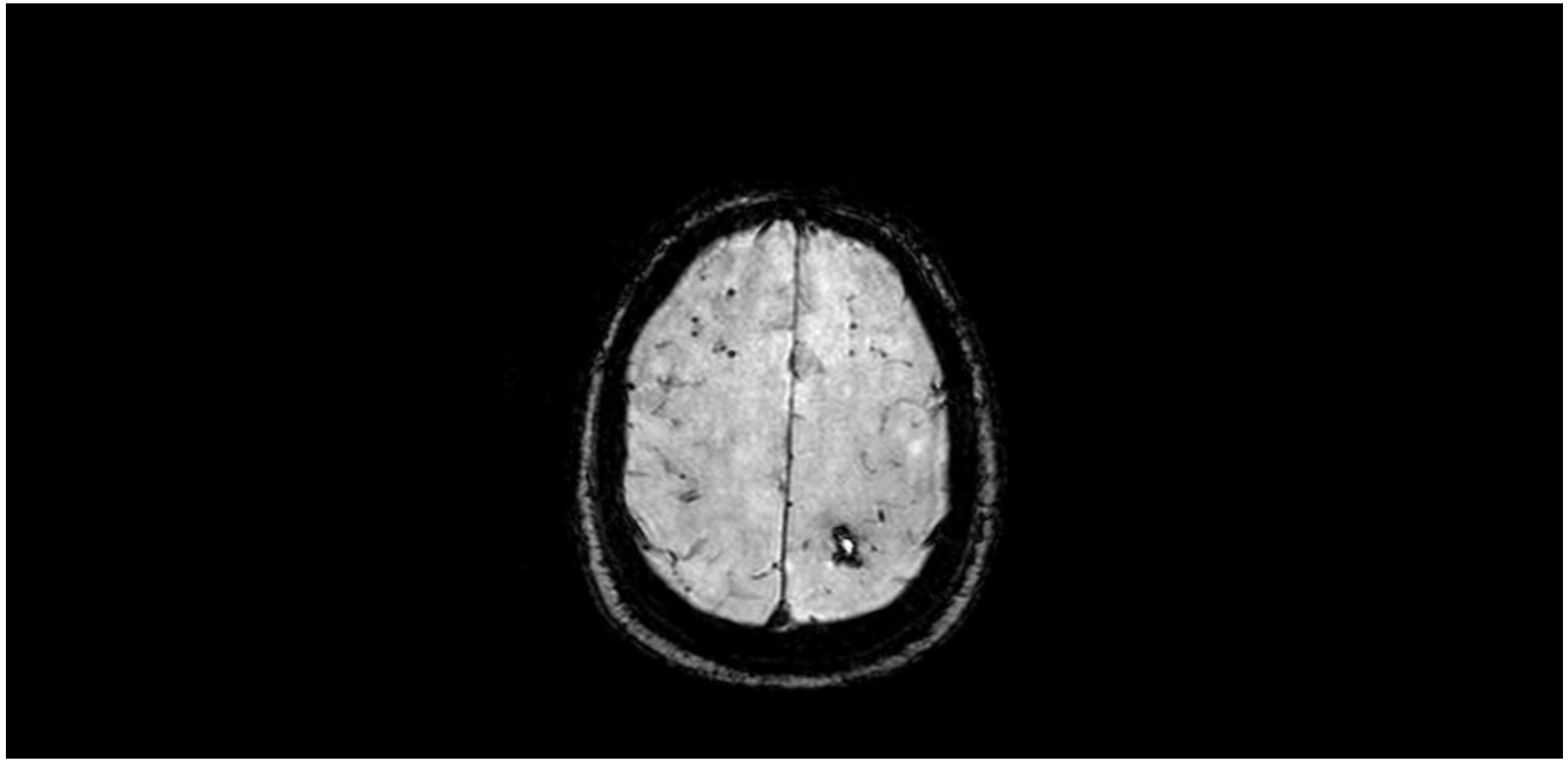












ICH Management

- Patient was stable and at baseline level of function
- The diagnosis was cerebral amyloid angiopathy
- Patient was advised to maintain normal blood pressure (ideally 120/80) and avoid antithrombotic medications if possible

- Patient survived for another decade but passed away eventually from heart failure

Causes of Hemorrhagic stroke

- Cerebral amyloid angiopathy
- Hypertension
- Hemorrhagic transformation of ischemic infarction
- Cerebral venous sinus thrombosis
- Vascular anomalies:
  - Arteriovenous malformation
  - Cavernous angioma
  - Aneurysm

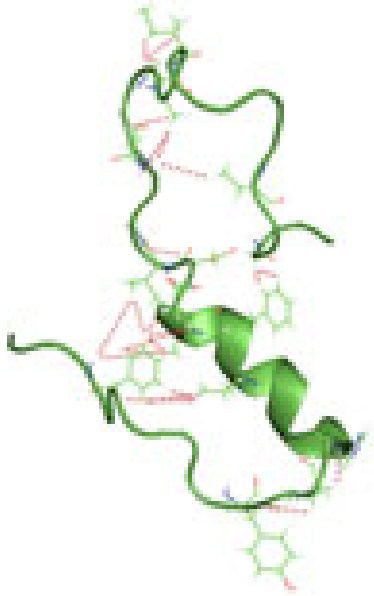
Main Risk Factors for Hemorrhagic Stroke

- Hypertension
- Age
- Alcohol, cocaine, amphetamines
- Anticoagulants and antiplatelet agents
- Coagulopathy in context of other illnesses (e.g. liver disease)

Cerebral amyloid angiopathy

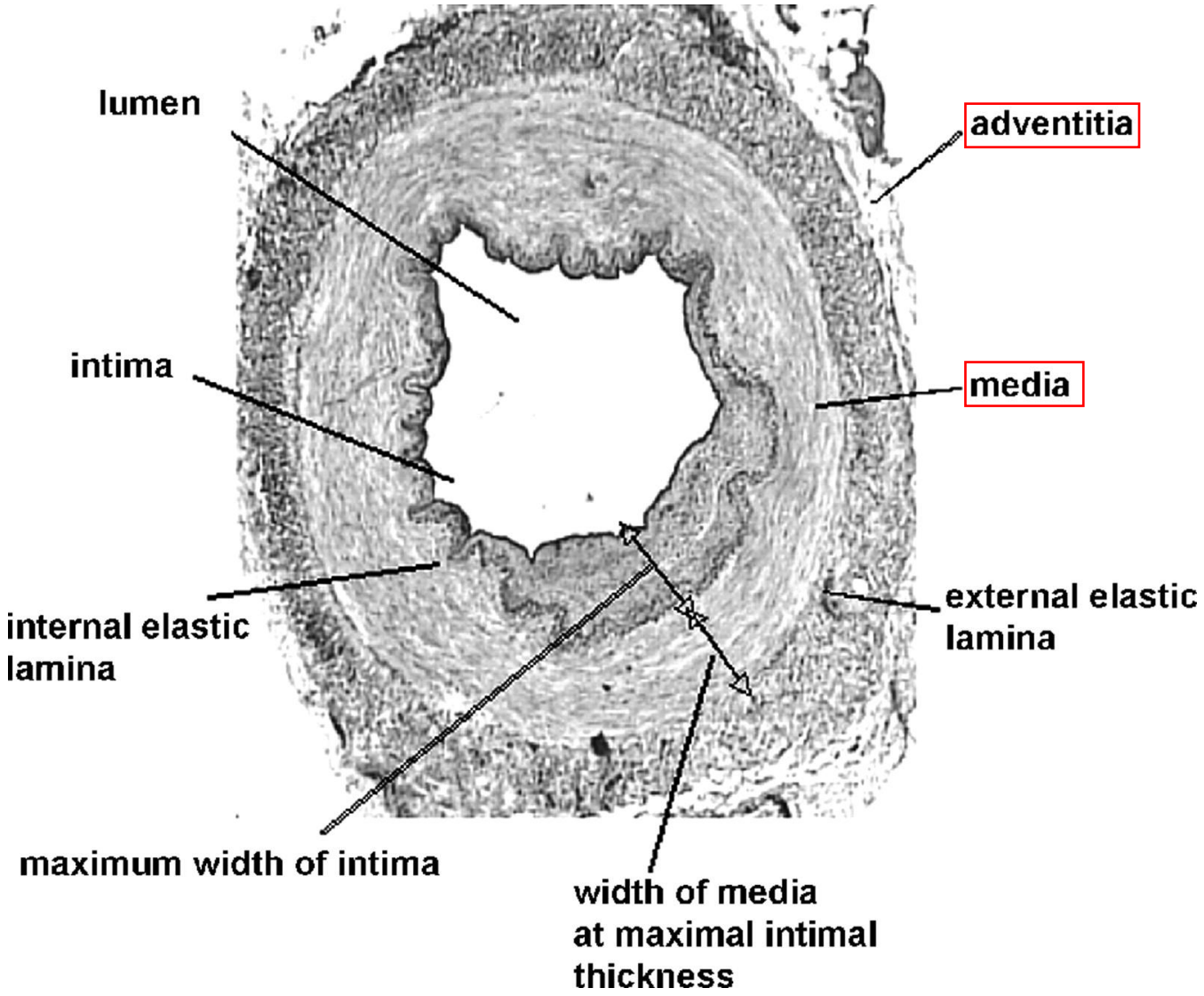
- Most common cause of ICH in elderly patients

Amyloid beta 1-40 peptide

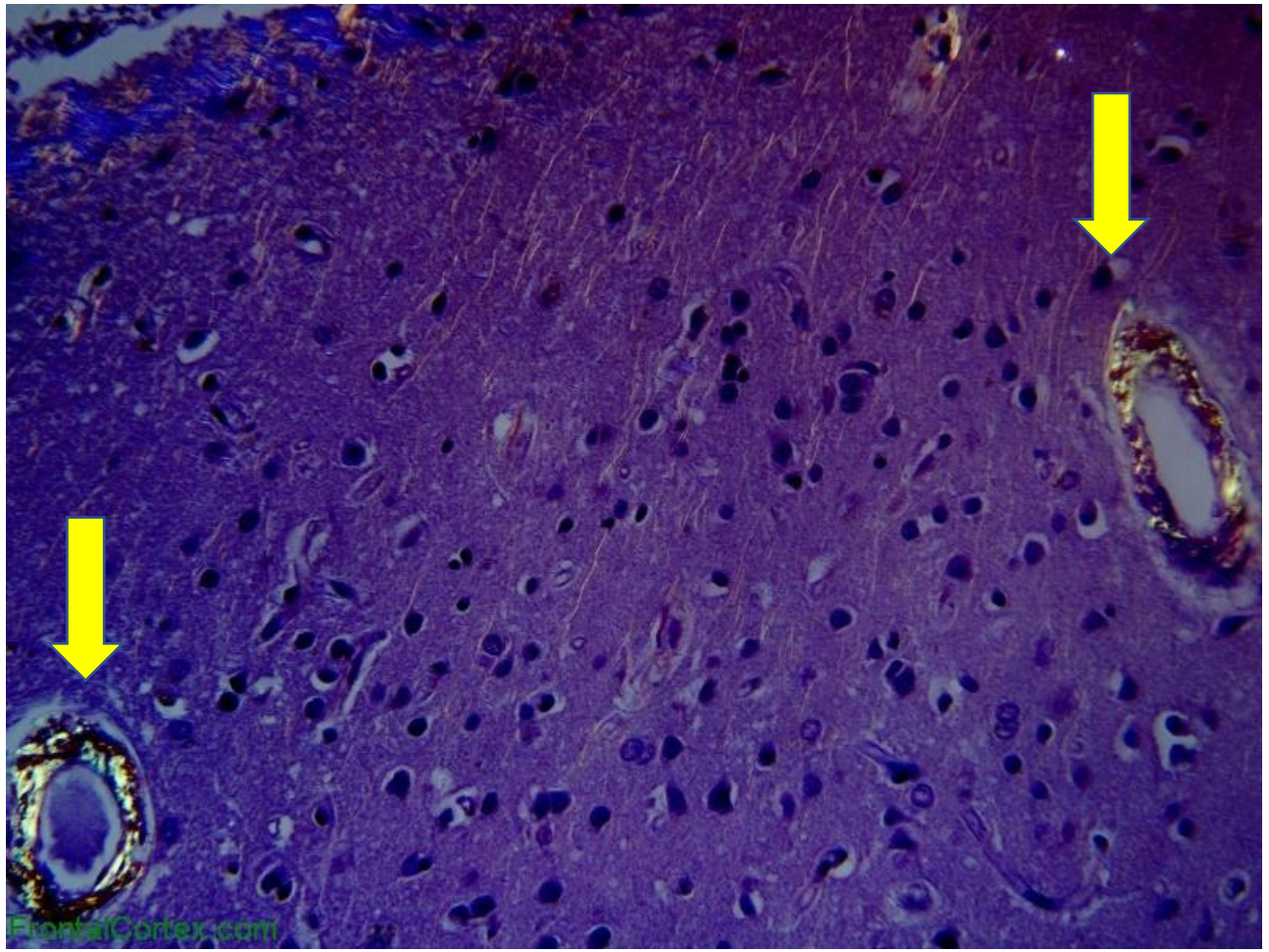


Arterial blood vessel

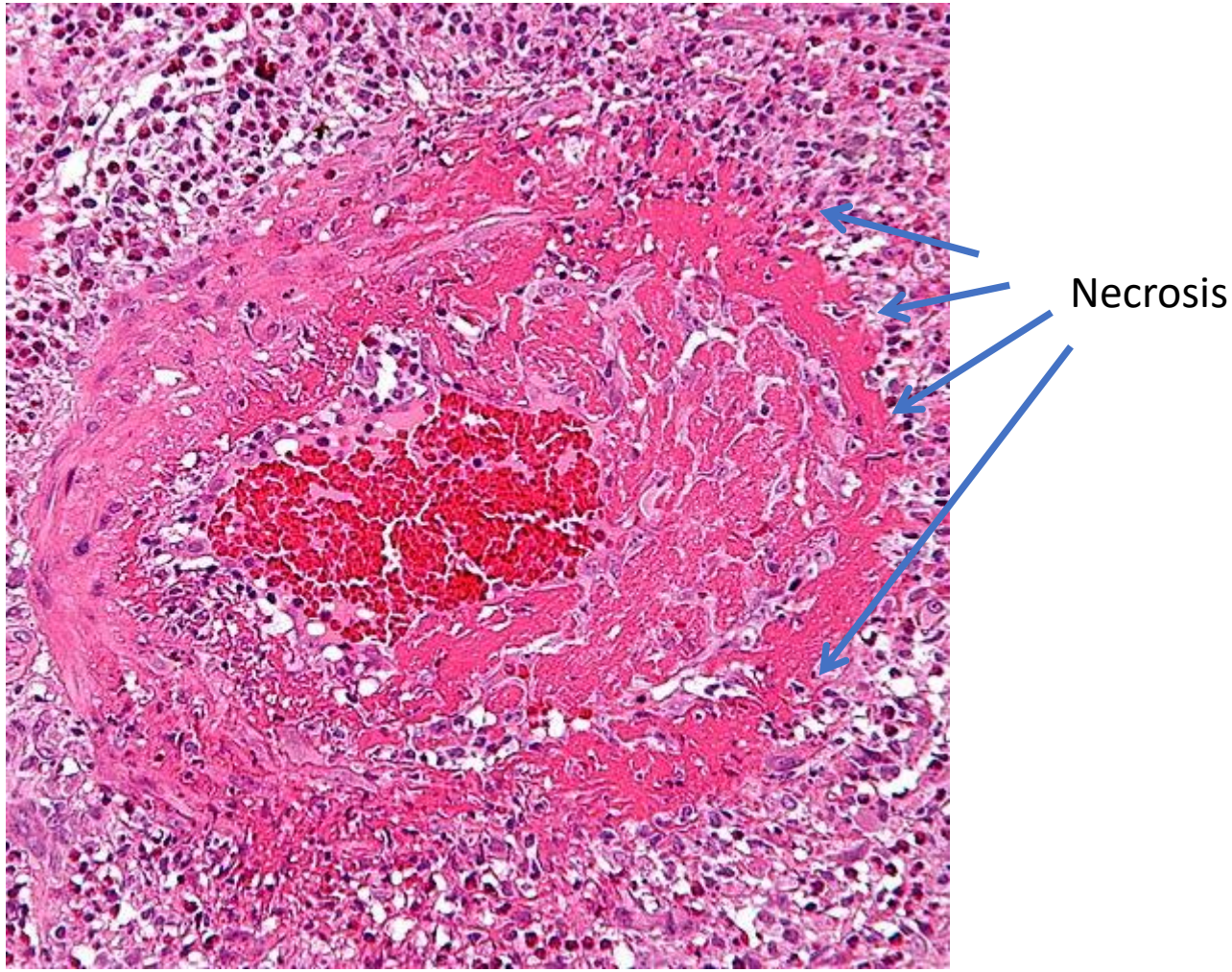
Amyloid deposition in **the media** and **adventitia** of cortical and leptomeningeal vessels



Amyloid deposition in the media and adventitia



Fibrinoid Necrosis

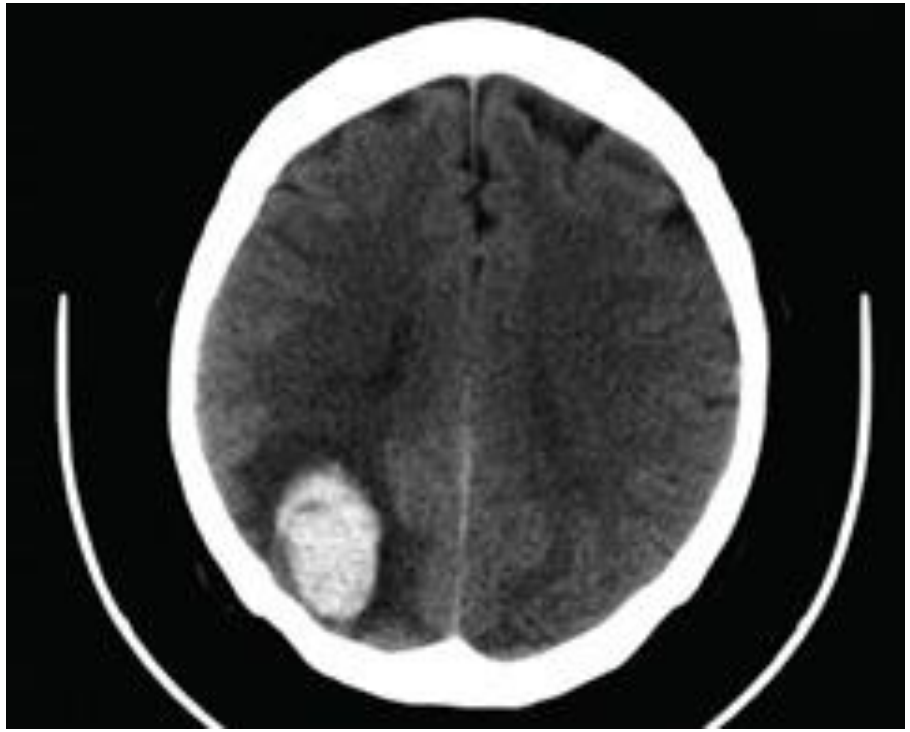


Microaneurysm

Microaneurysm

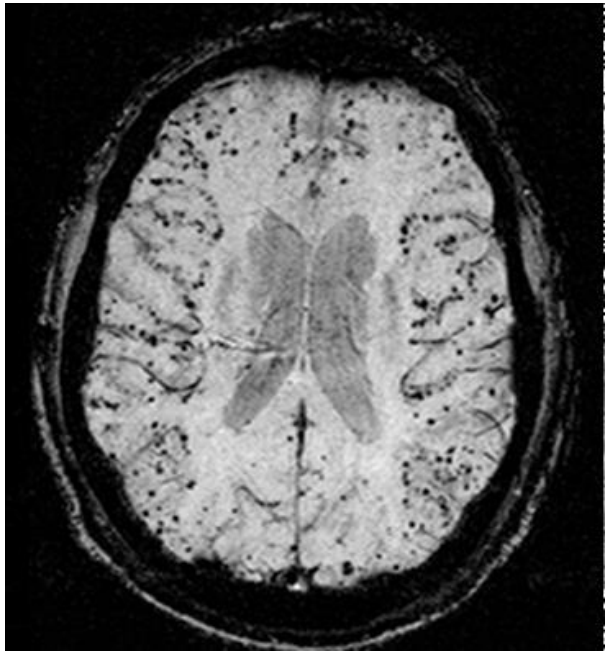
Cerebral amyloid angiopathy commonly causes lobar hemorrhage

- Hematoma is within a lobe, involving grey and white matter
- Mass effect and increased intracranial pressure is often fatal



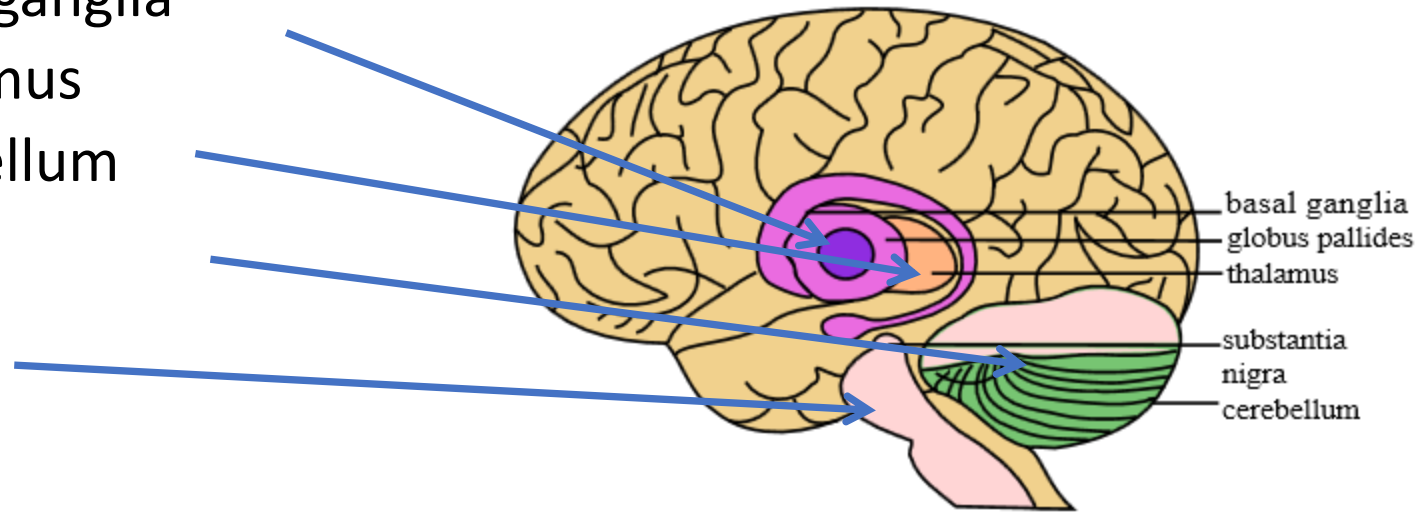
MRI of amyloid angiopathy

- Susceptibility-weighted imaging
  - Hemosiderin deposition appears black
  - Multiple “microbleeds” throughout the brain



Hypertensive hemorrhage

- Occurs in:
  - basal ganglia
  - thalamus
  - cerebellum
  - pons



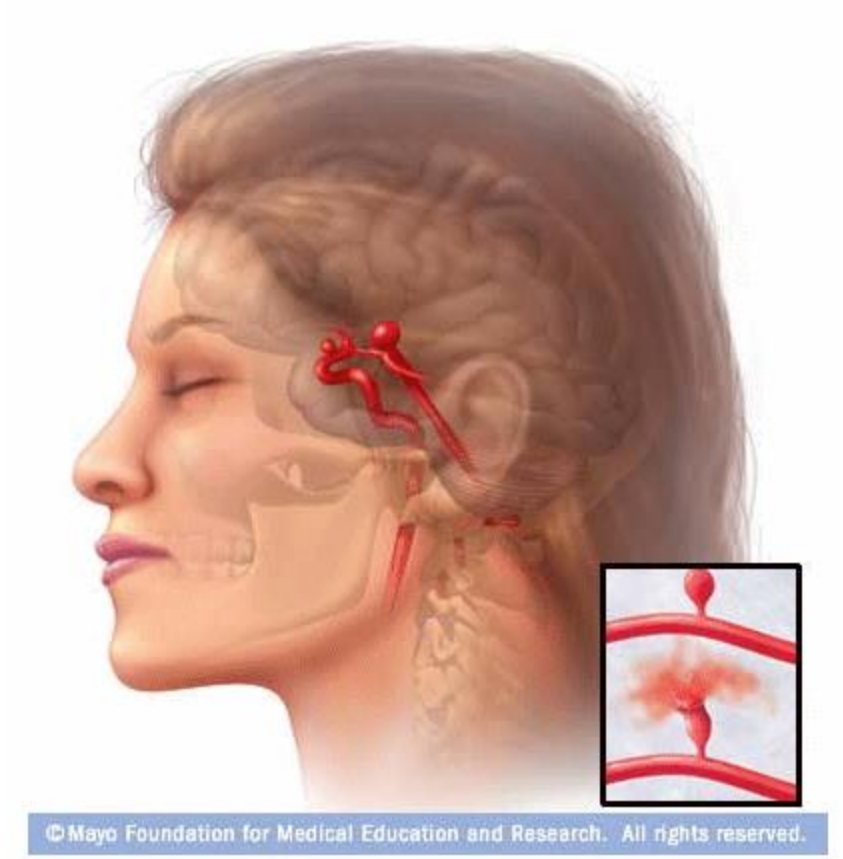
As in amyloid angiopathy, fibrinoid necrosis and microaneurysm affect the small blood vessels of the brain

ntracerebral
-lemorrhage from
-lypertension

Hypertensive cerebral hemorrhage:
Imaging the leak with 7T MRI
Biessels et al *Neurology* 2010;75;572-3

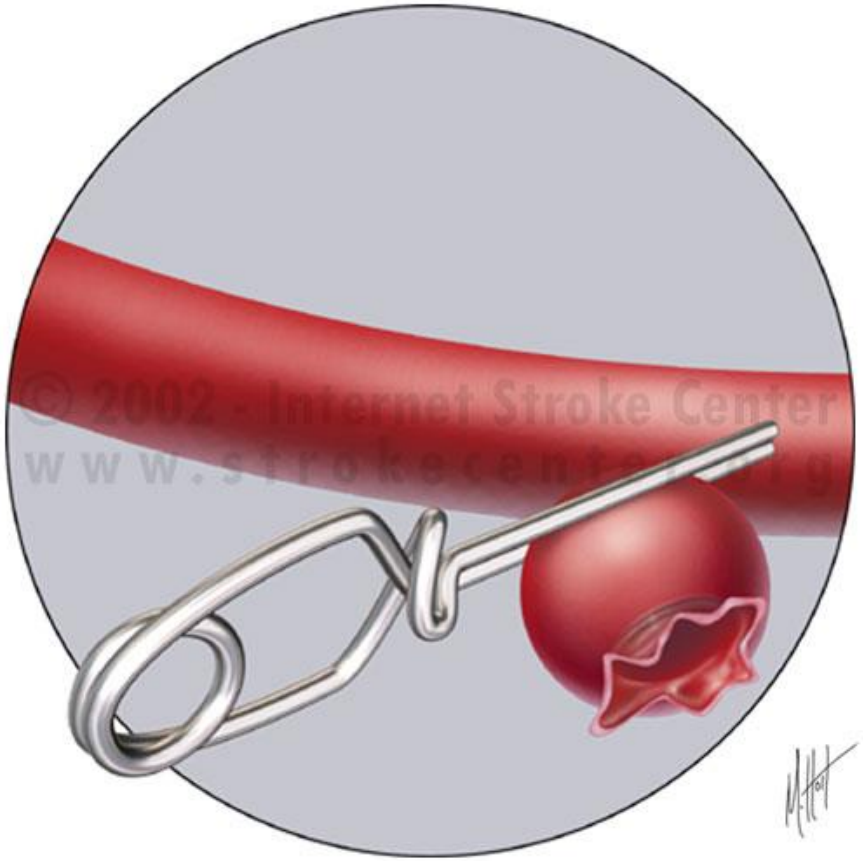

UNIV.

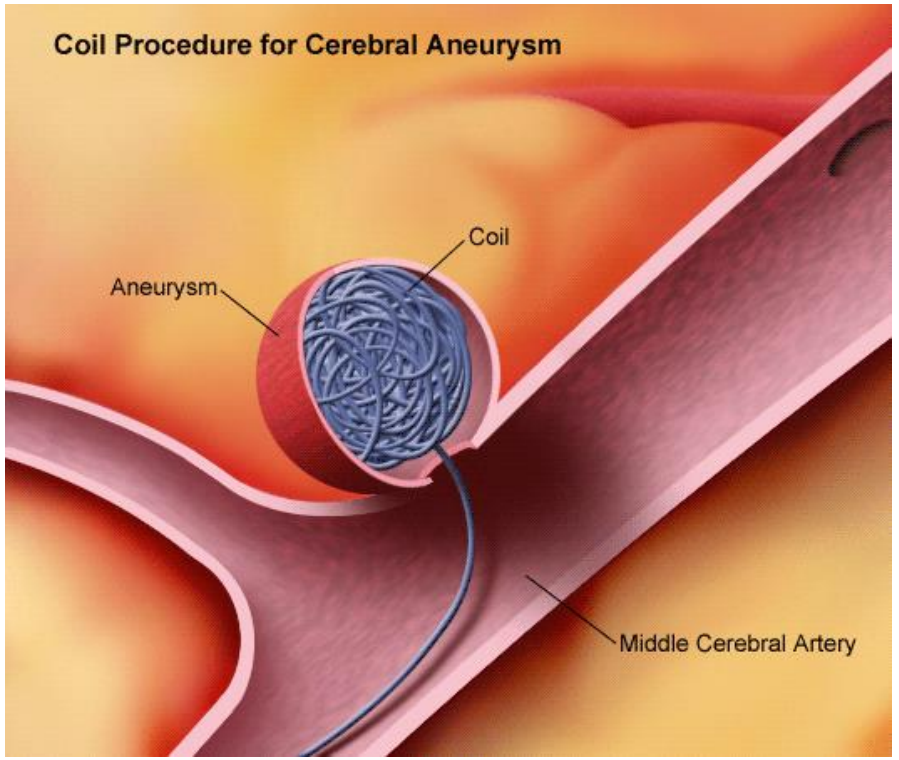
Aneurysm and Subarachnoid hemorrhage



Subarachnoid hemorrhage

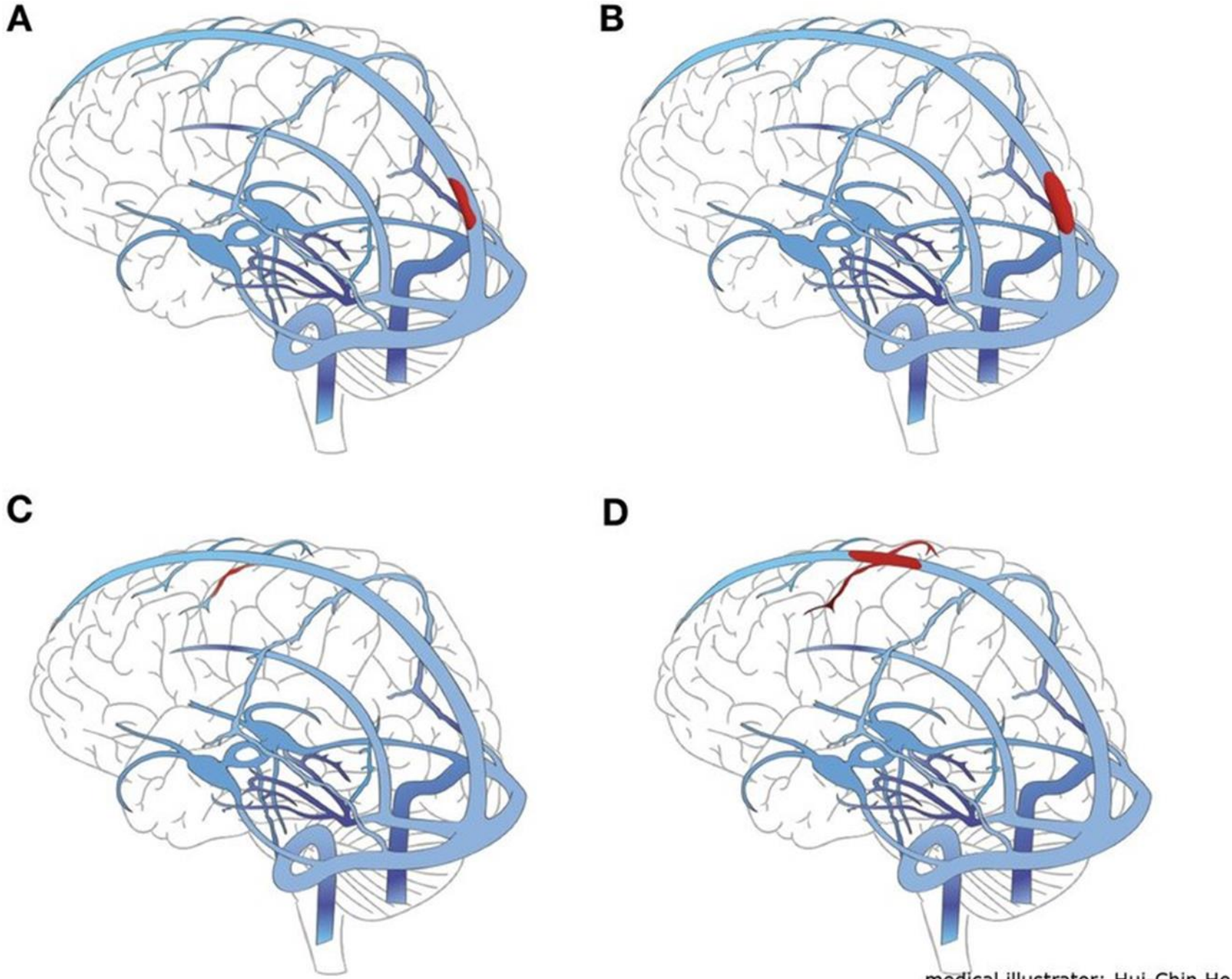
- ~30% mortality
- Treatment is by either aneurysm clipping or by aneurysm coiling



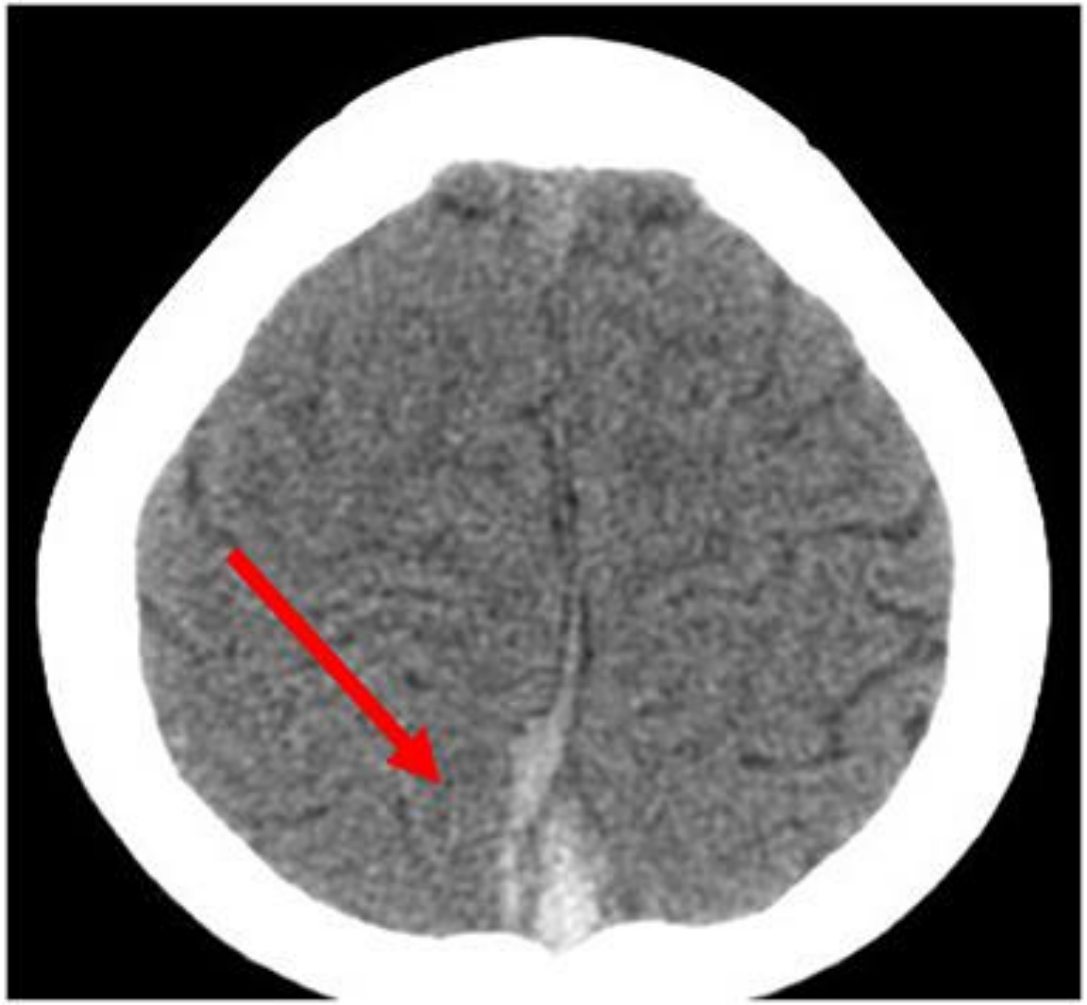


Cerebral Venous Sinus Thrombosis (CVST)

- Occurs when one of the major intracerebral venous sinuses is blocked.
- Usually presents with headache, focal deficits and frequently seizures
- CT shows hemorrhage due to back-pressure
- CT/MR venography may be necessary to diagnose
- Usually treated with heparin (!) to prevent worsening of the clot


A
B
C
D
medical illustrator: Hui-Chin Ho

CVST in superior sagittal sinus



Risk Factors for CVST

- Cerebral venous sinus thrombosis is more common in particular situations. 85% of patients have at least one of these risk factors:[1]
- Thrombophilia, a tendency to develop blood clots due to abnormalities in coagulation, e.g. factor V Leiden, deficiency of protein C, protein S or antithrombin, or related problems
- Nephrotic syndrome, a kidney problem causing protein loss in the urine
- Chronic inflammatory diseases, such as inflammatory bowel disease, lupus and Behçet's disease
- Pregnancy and puerperium (the period after giving birth)
- Particular blood disorders, especially polycythemia vera and paroxysmal nocturnal hemoglobinuria
- Use of estrogen-containing forms of hormonal contraception , anabolic steroids
- Meningitis and infections of the ear, nose and throat area such as mastoiditis and sinusitis
- Direct injury to the venous sinuses
- Medical procedures in the head and neck area

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

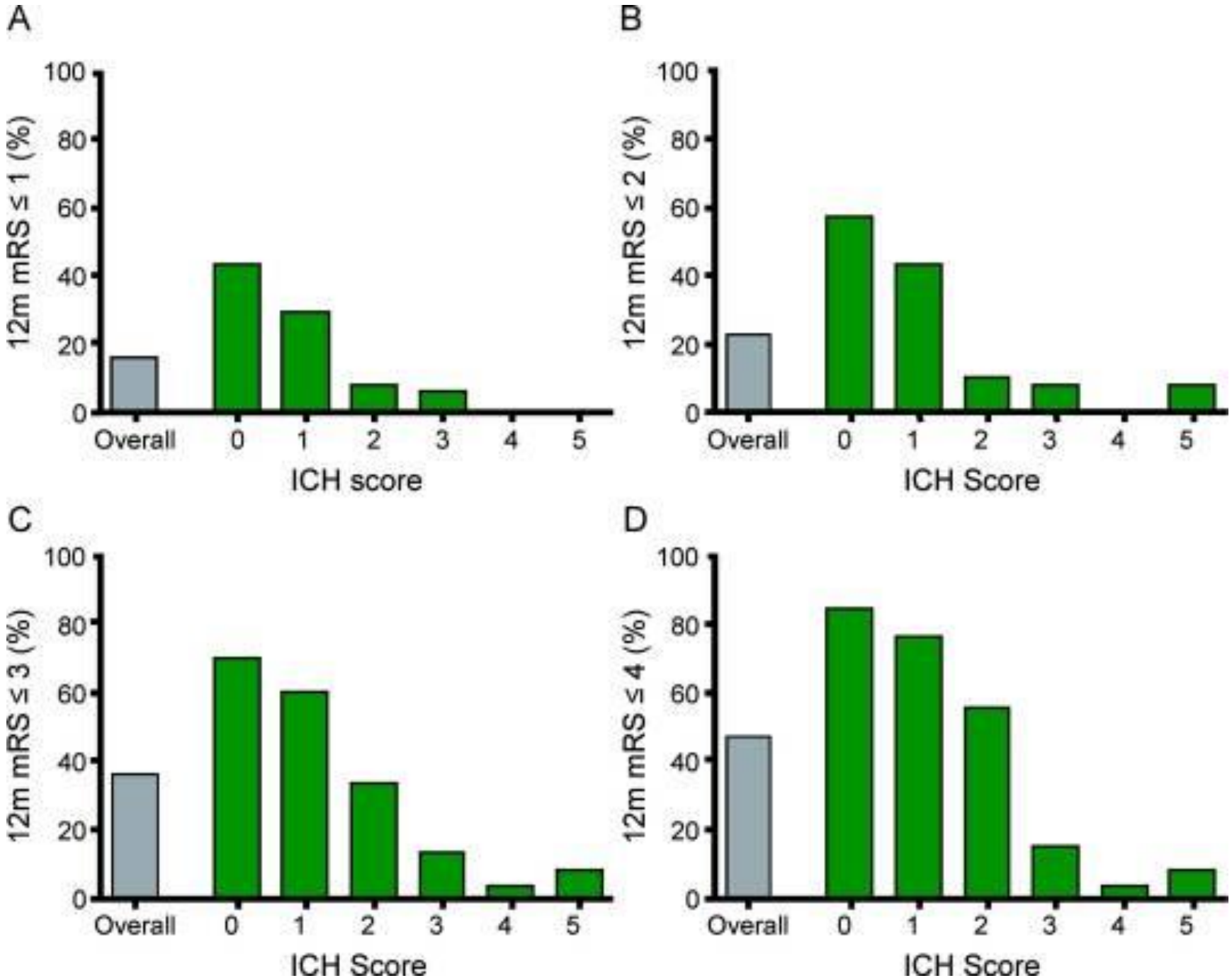
Recovery is slow

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 (%).

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.


A
12m mRS ≤ 1 (%)
100
80
60
40
20
0
Overall
0
1
2
3
4
5
ICH score
B
12m mRS ≤ 2 (%)
ICH Score
C
12m mRS ≤ 3 (%)
ICH Score
D
12m mRS ≤ 4 (%)
ICH Score

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

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

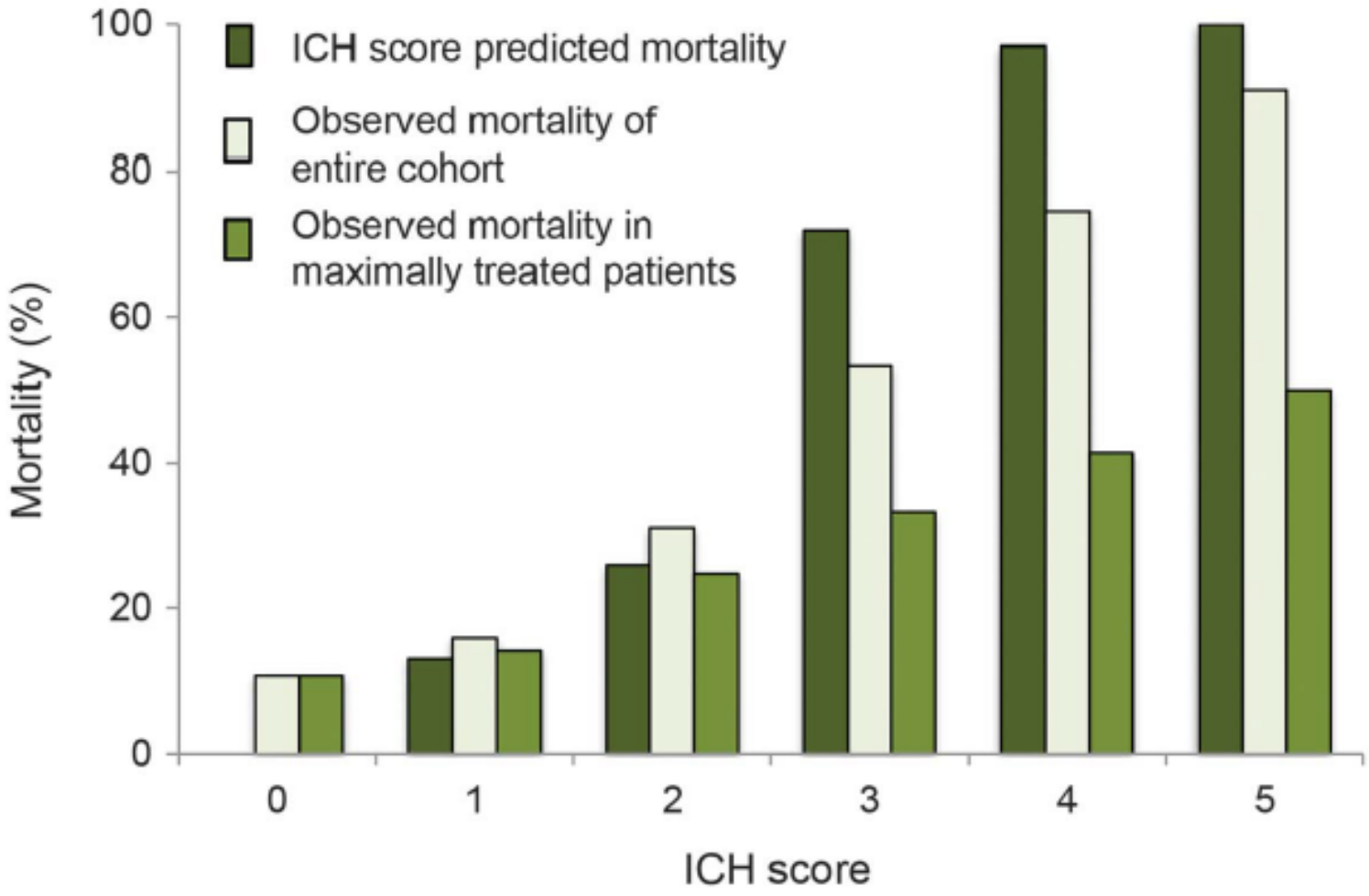
The max-ICH score

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).

Summary

There are many different causes of intracerebral hemorrhage with hypertension and cerebral amyloid angiopathy as two of the most common causes.

For hypertensive hemorrhages, we aim to keep systolic BP < 140.

We reverse anticoagulation, often with PCC, sometimes with idarucizumab for dabigatran.

MRI with SWI sequences can be helpful to assess if CAA is present.

Most patients will need several weeks to show even the slightest improvement, but with consistent stroke unit care the outcome is often better than predicted.

Many ICH patients look moribund for at least a month, and about a third will eventually pass away by 90 days.

But almost 40% will be able to walk unassisted by one year.

Be cautious in predicting outcome. Don't rely on the sICH score. Rely on the quality of care you can provide in the Acute Stroke Unit to give the patient their best chance of recovery, even if it takes a long time.

Thank you.