Hypertensive Hemorrhages & Hemorrhagic Strokes

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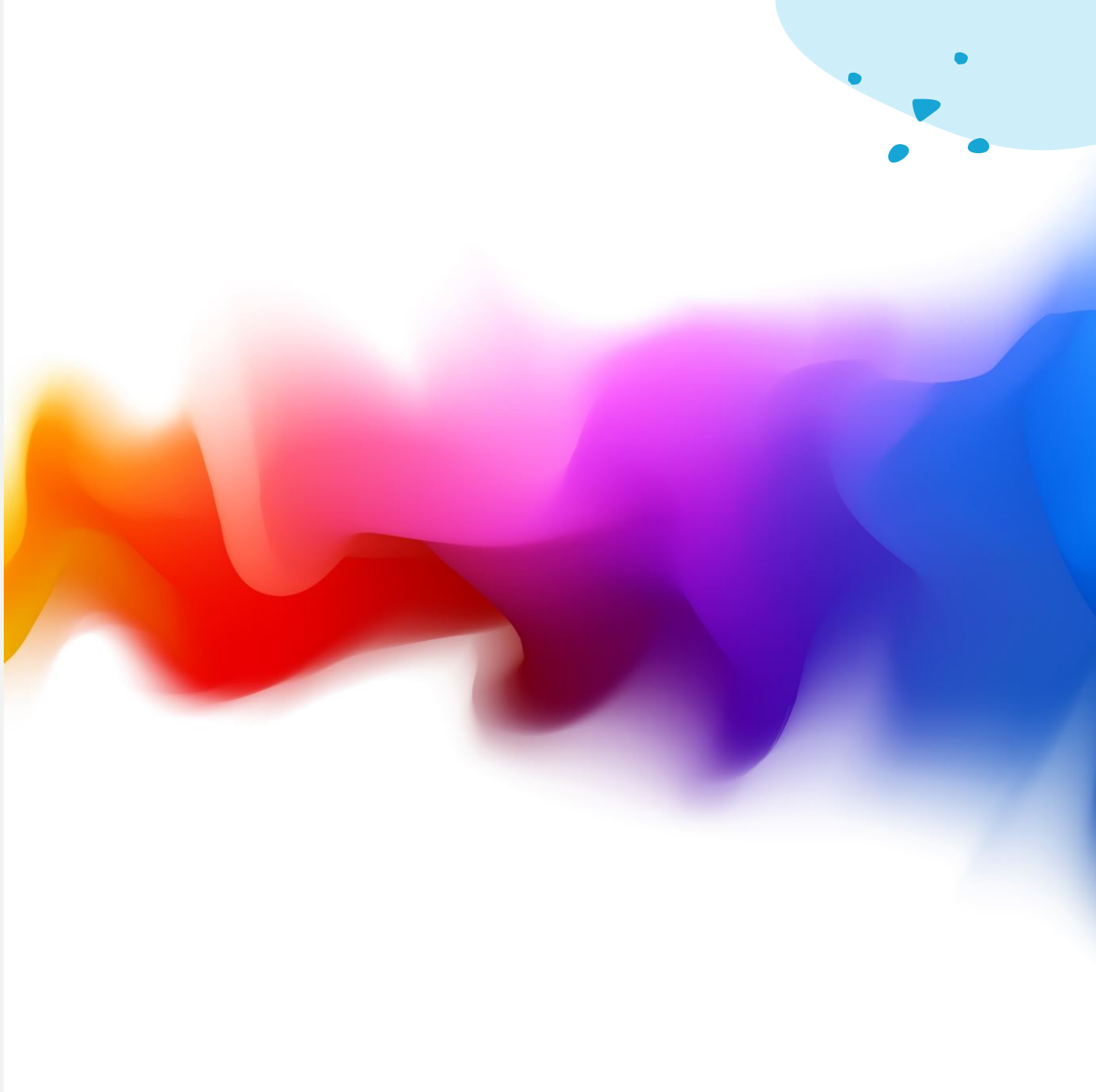
Neurosurgeon

Saint Francis Hospital



Epidemiology of ICH

Occurs in about 15-30% of strokes

Increases with advanced age

More common in men

Hypertension, smoking, previous stroke (either ischemic or hemorrhagic) and ETOH use increases risk

More common in African Americans

Cocaine, amphetamines and PCP all increase risk

Most Common Causes

HTN

Acute increases in CBF (Reperfusion Injury following LVO and CEA)

Vascular Anomalies AVM Aneurysm

Brain Tumor (Renal, Thyroid, Choriocarcinoma, Melanoma)

Amyloid Angiopathy (lobar bleeds)

Bleeding Dyscrasias Genetic or iatrogenic

CNS Infections

Venus or dural sinus thrombosis

Pre-eclampsia

Common Site for ICH

Basal Ganglia 50%

Thalamus 15%

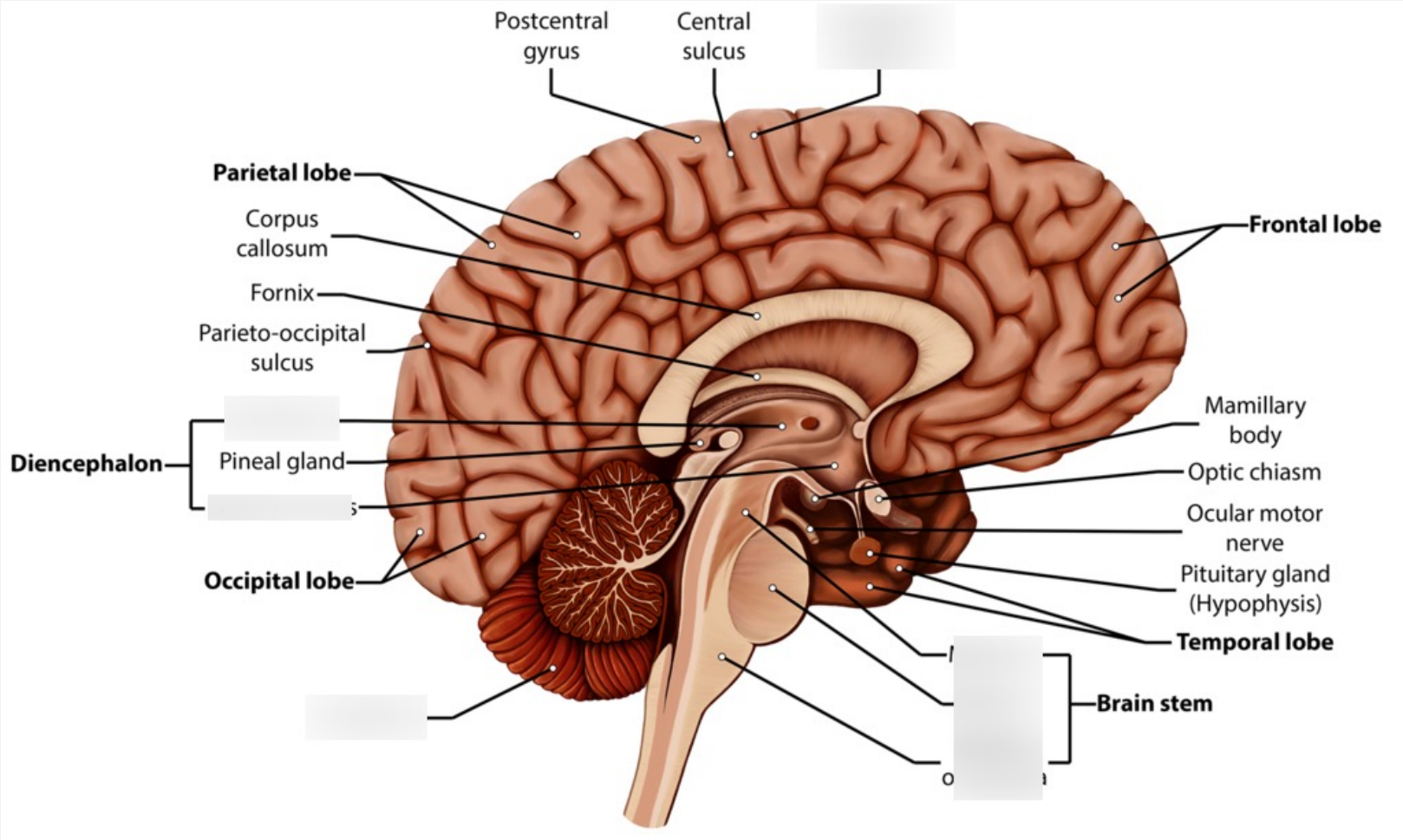
Pons 10-15%

Cerebellum 10%

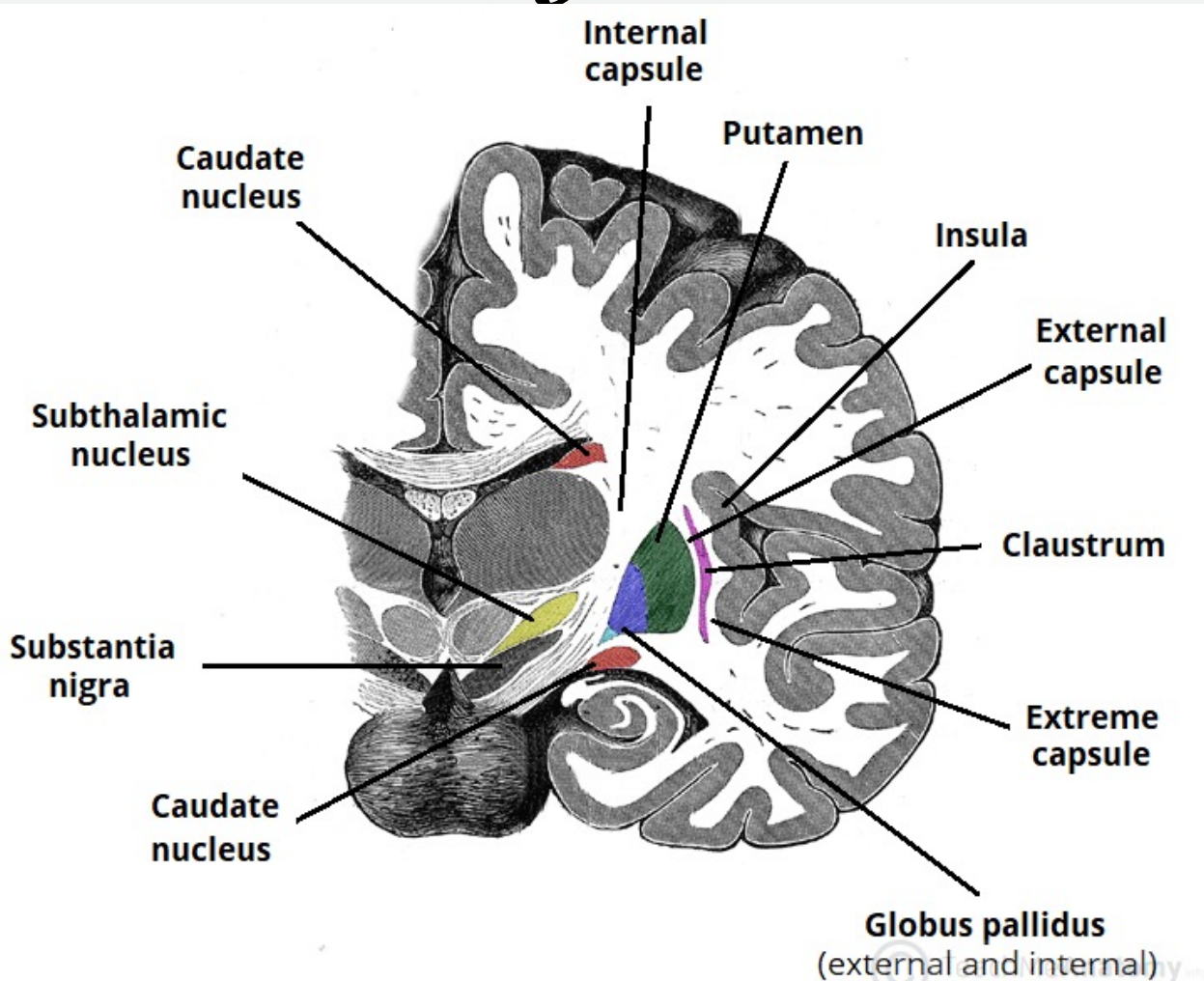
Cortical 10-20%

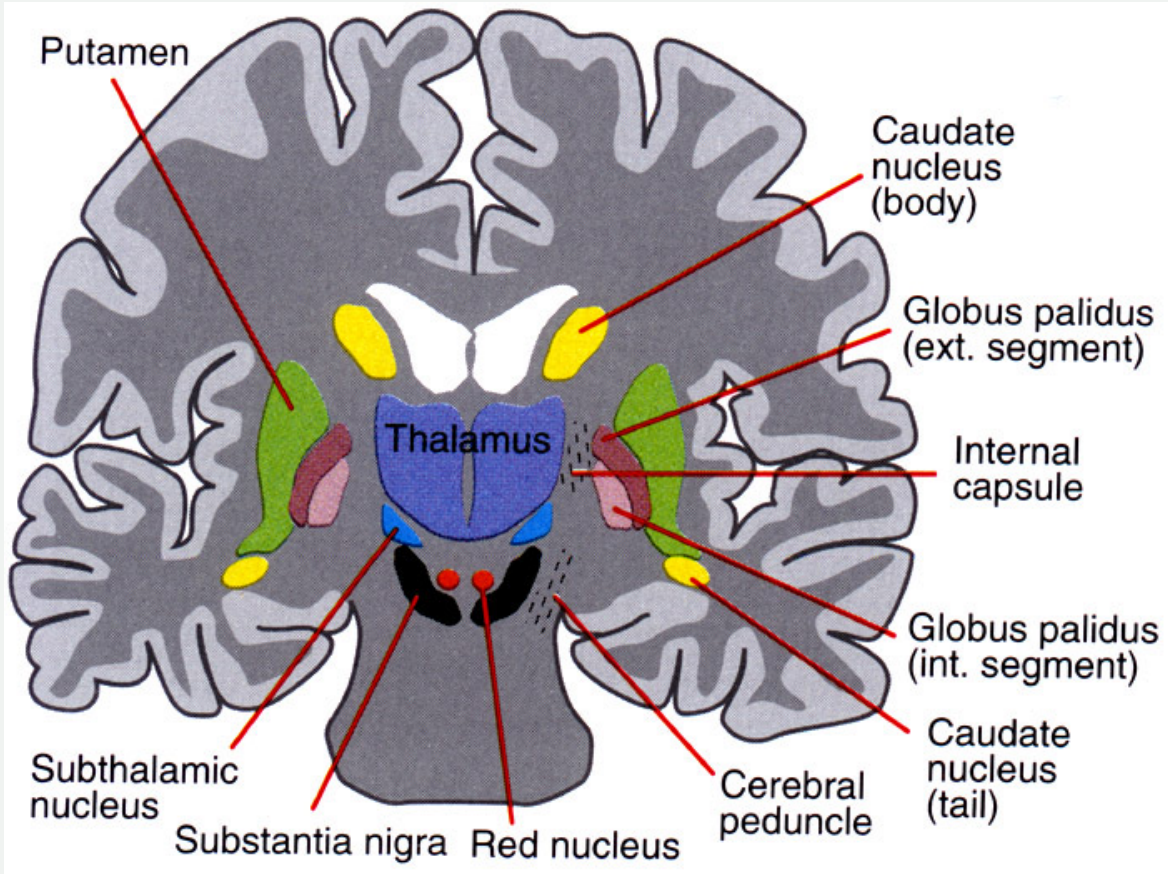
Brain Stem 1-6%

Basic Intracranial Anatomy

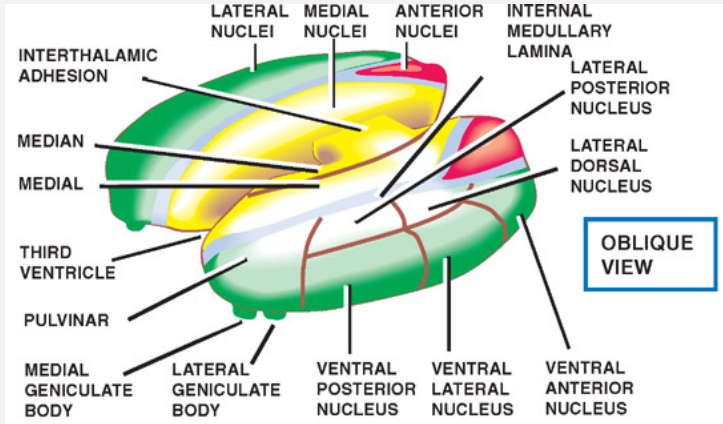


Basal Ganglia





Thalamus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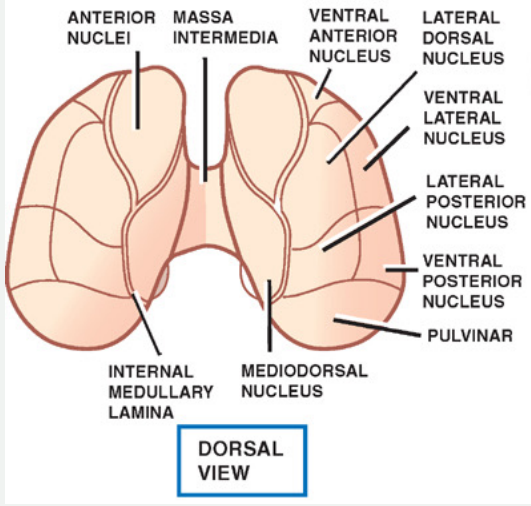
INTERTHALAMIC ADHESION
LATERAL POSTERIOR NUCLEUS
MEDIAN
LATERAL DORSAL NUCLEUS
MEDIAL
THIRD VENTRICLE
PULVINAR
MEDIAL GENICULATE BODY
LATERAL GENICULATE BODY
VENTRAL POSTERIOR NUCLEUS
VENTRAL LATERAL NUCLEUS
VENTRAL ANTERIOR NUCLEUS
OBLIQUE VIEW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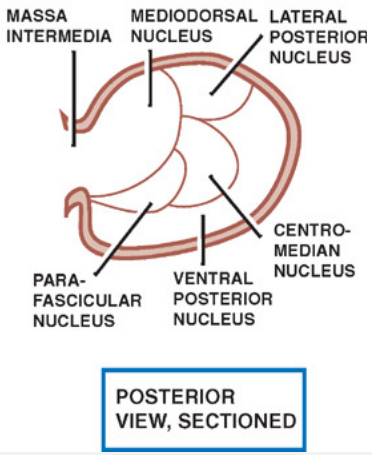
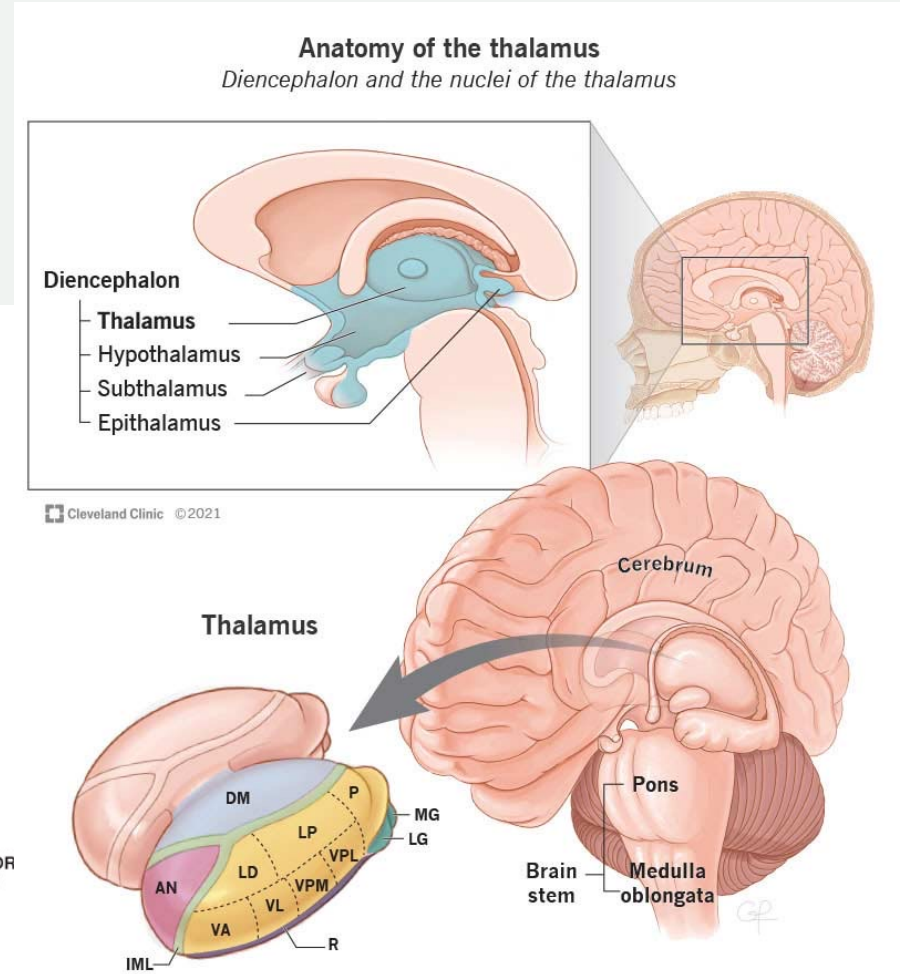
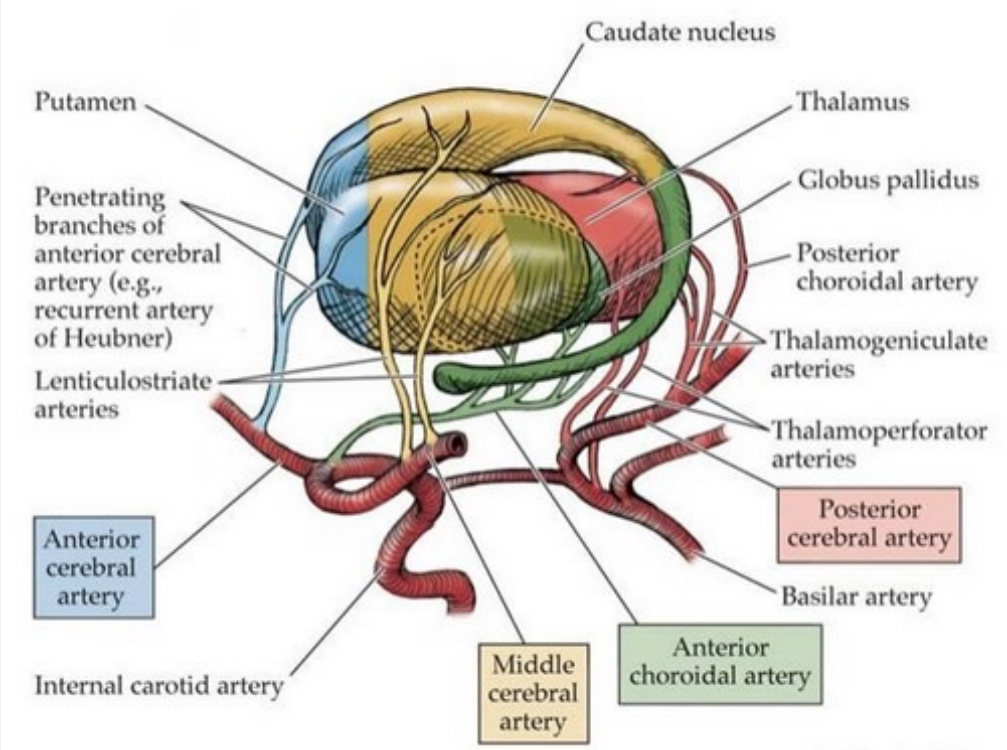
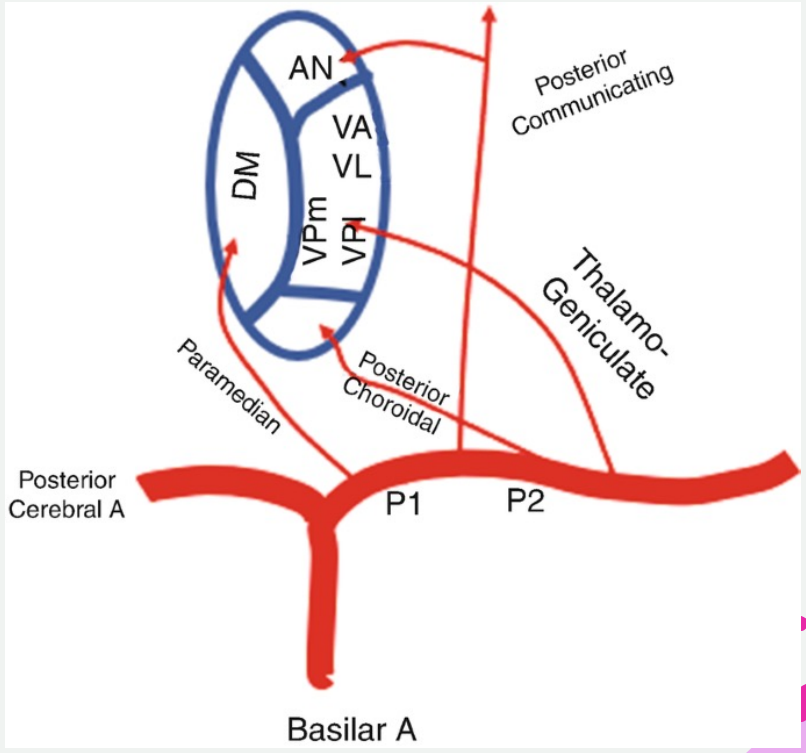
LATERAL POSTERIOR NUCLEUS
VENTRAL POSTERIOR NUCLEUS
PULVINAR
INTERNAL MEDULLARY LAMINA
MEDIODORSAL NUCLEUS
DORSAL VIEW


MASSA INTERMEDIA
MEDIODORSAL NUCLEUS
LATERAL POSTERIOR NUCLEUS
CENTRO-MEDIAN NUCLEUS
PARA-FASCICULAR NUCLEUS
VENTRAL POSTERIOR NUCLEUS
POSTERIOR VIEW, SECTIONED

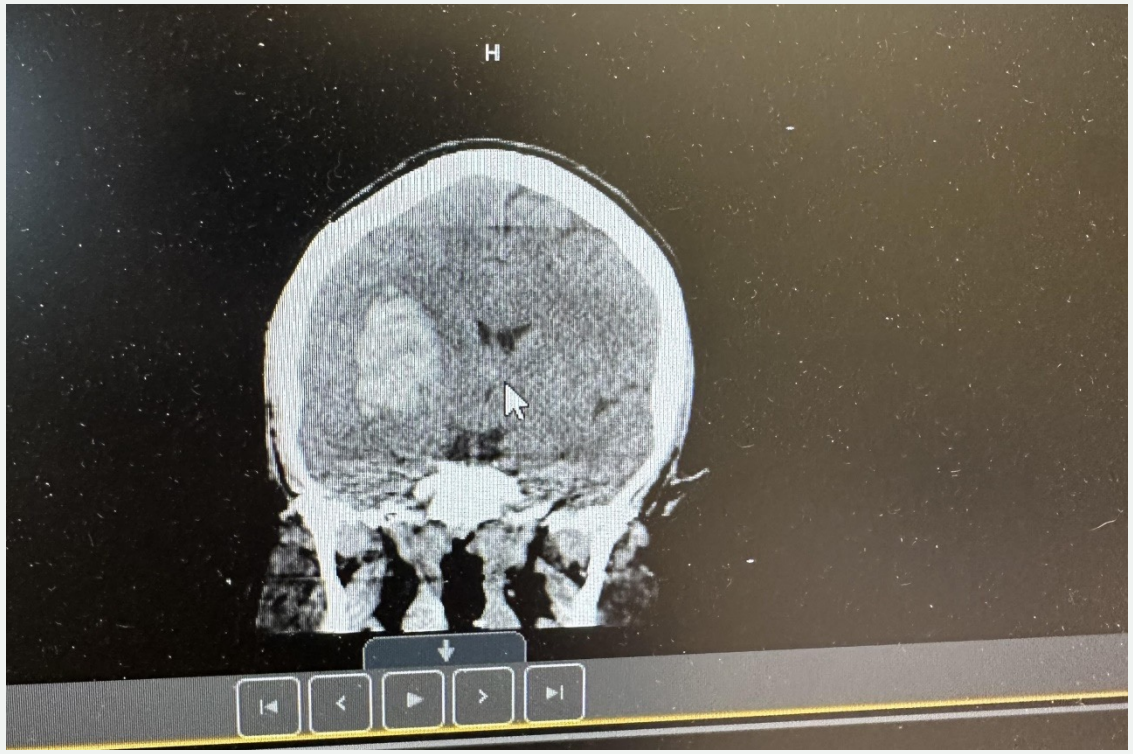

Anatomy of the thalamus
Diencephalon and the nuclei of the thalamus
Diencephalon
Thalamus
Hypothalamus
Subthalamus
Epithalamus
Cleveland Clinic ©2021
Cerebrum
Thalamus
DM
P
MG
LG
LP
VPL
LD
VPM
AN
VL
VA
IML
R
Pons
Brain stem
Medulla oblongata
AN Anterior nucleus
IML Internal medullary lamina
DM Dorsomedial nucleus
LD Lateral dorsal nucleus
LP Lateral posterior nucleus
P Pulvinar nucleus
VA Ventral anterior nucleus
VL Ventrolateral nucleus
VPM Ventral posteromedial nucleus
VPL Ventral posterolateral nucleus
MG Medial geniculate nucleus
LG Lateral geniculate nucleus
R Reticular nucleus

Arterial Feeders

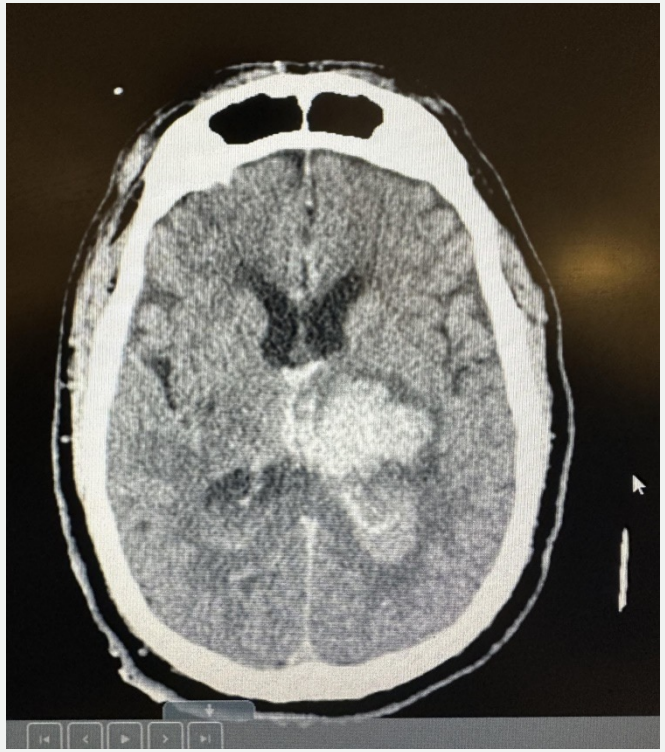


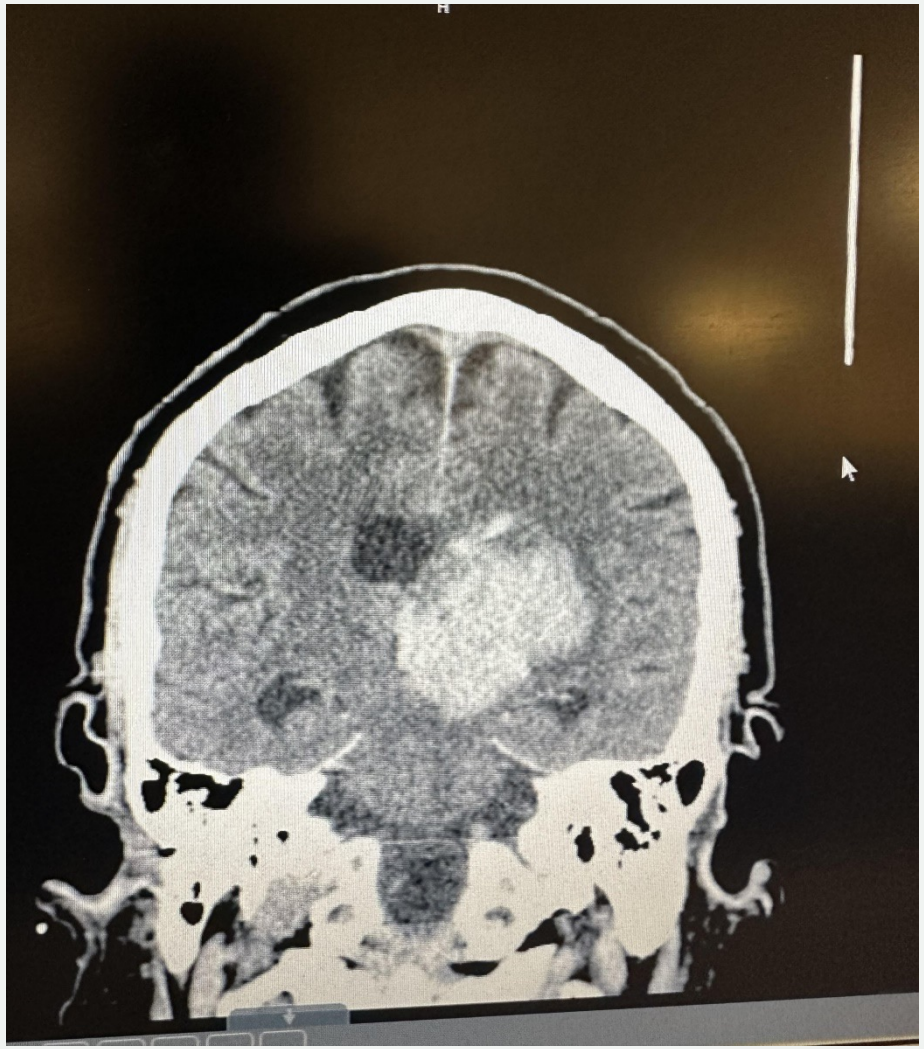


Patient 1

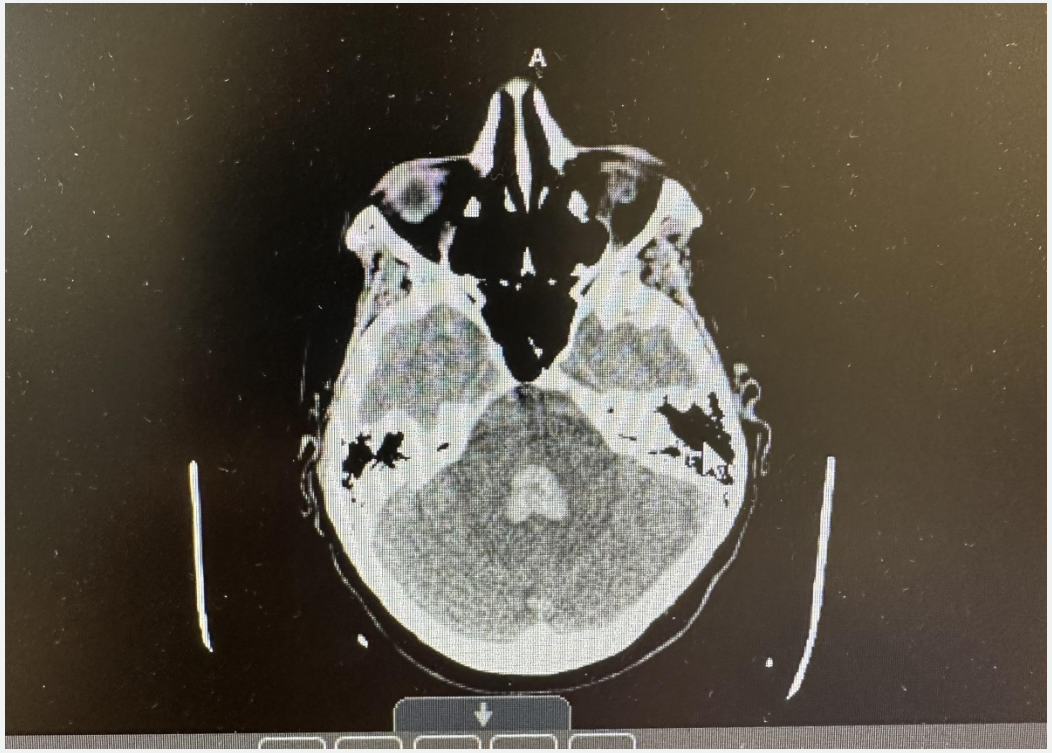


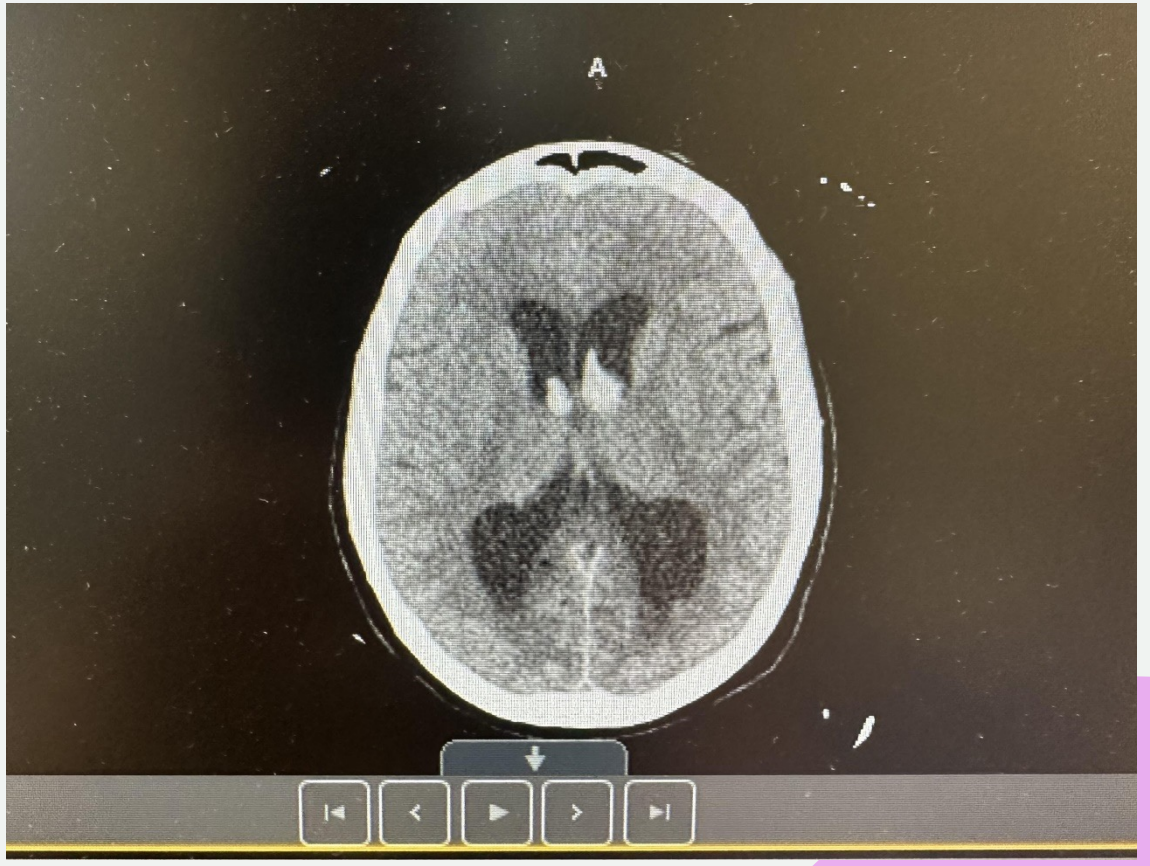
Patient 2





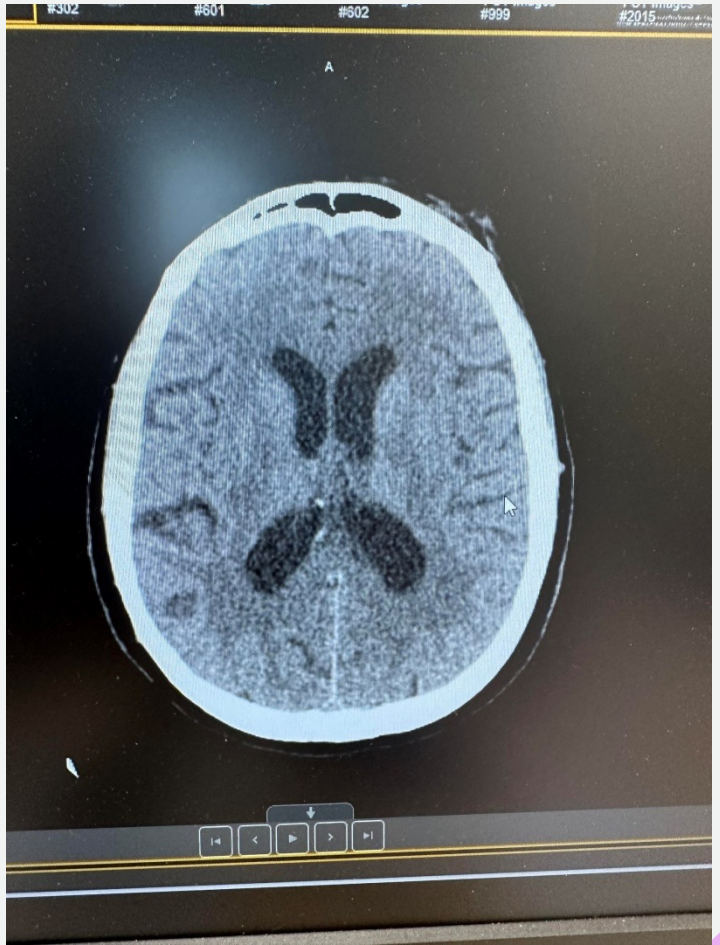
Patient 3





Patient 3


Dose Report
1 CT Images
#999
Viz ICH Results
1 CT Images
#2015
Detected ICH
A


#502
#601
#502
#999
#2015
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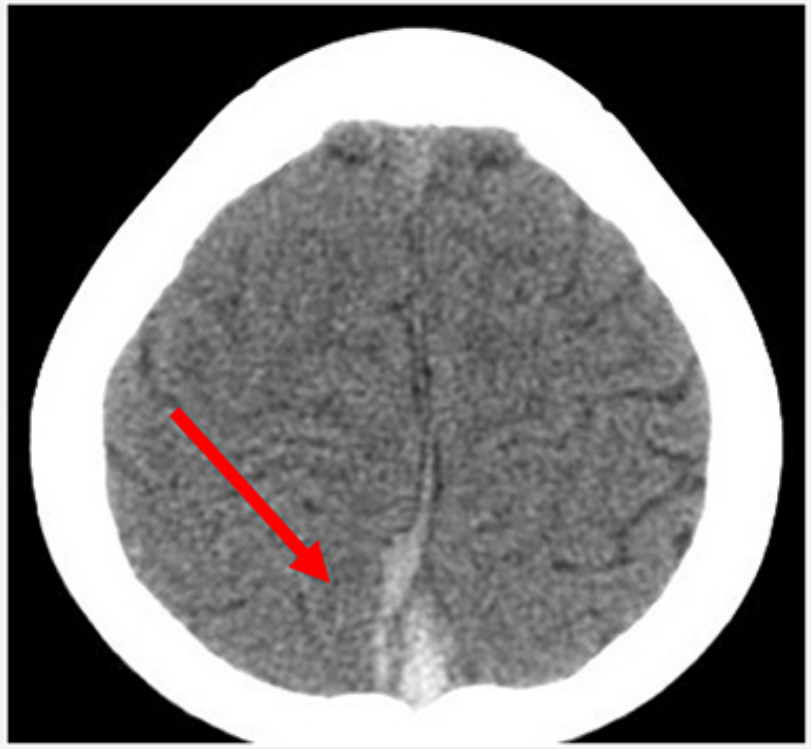
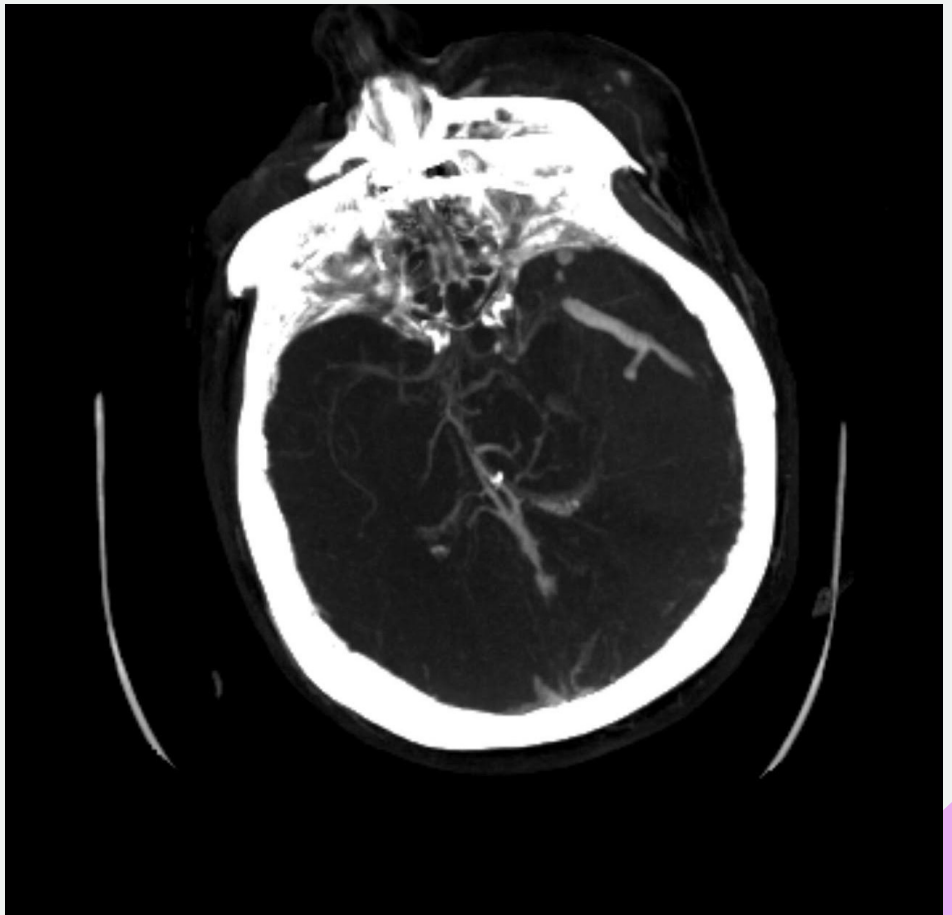
Patient 4

Patient 5

Patient 6



Patient 7



Work Up Methodology

First and foremost ABC's

Full stroke neurological workup neurology PA/NP

- ICH Score

Imaging CTH, CTA, MRI, MRA, Formal Angiogram

Neurological Interventions:

- Observation with reimaging
- EVD
- Decompressive Hemicraniectomy with evacuation
- Tumor resection
- Anticoagulation??
- (Minimally invasive resection)

ICH Score

Intracerebral Haemorrhage

ICH Score (Hemphill et al.)

Feature	Finding	Points
GCS	3-4	2
	5-12	1
	13-15	0
Age	>=80	1
	<80	0
Location	Infratentorial	1
	Supratentorial	0
ICH volume	>=30cc	1
	<30cc	0
Intraventricular Blood	Yes	1
	No	0
ICH SCORE		0-6 points

ICH Score	30 Day Mortality
0	0%
1	13%
2	26%
3	72%
4	97%
5	100%
6	100%

Current Literature Evidence

Class 1 evidence:

- ICU Monitoring
- BP control (Controversial for perfusion)
- Anticonvulsants
- ICP monitoring/EVD placement
- Steroids are not indicated for ICH!!!!
- Control of intracranial swelling (cytotoxic edema)

Surgical vs Non-Surgical

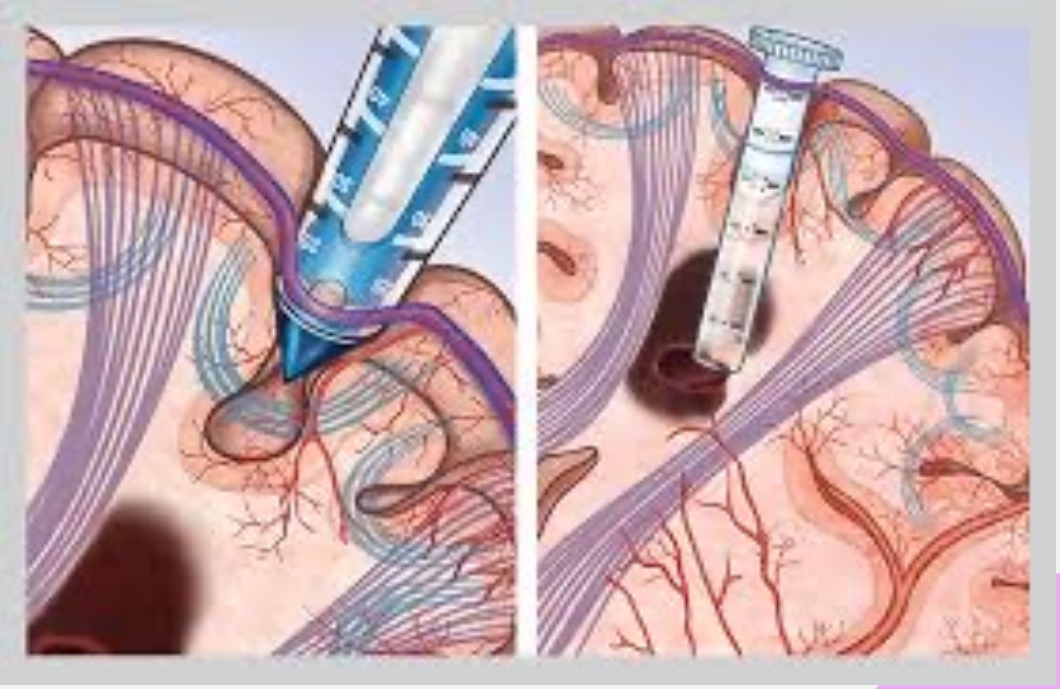
Surgical:

- Large Lesion with mass effect
- Symptomatic lesions
- Volume of hemorrhage
- Subcortical location
- Persistent ICP issues
- Posterior fossa location

Non-Surgical:

- Minimally symptomatic
- Good GCS >10
- High ICH score
- Large bleed in dominant hemisphere
- Poor GCS <4, dilated pupils
- Age >75
- BG of thalamic hemorrhage

New Literature/Devices



ENRICH Study

This trial enrolled 300 patients in a multicenter RTC

Enrolled with ICH in lobar or basal ganglia location with 30-80cc of ICH

Utilized modified Rankin scale for disability grading

Findings showed improved functional outcome as well as improved mortality for lobar hemorrhages

Excluded patients with <30 or >80cc of blood as well as thalamic and IVH extension

Subset analysis showed improved outcomes in basal ganglia bleeds as well

RESEARCH SUMMARY

Trial of Early Minimally Invasive Removal of Intracerebral Hemorrhage

Pradilla G et al. DOI: 10.1056/NEJMoa2308440

CLINICAL PROBLEM

Current treatment guidelines for a spontaneous intracerebral hemorrhage (ICH) support surgical evacuation of the hematoma by means of conventional craniotomy only as lifesaving treatment, because randomized trials have not shown improvement in functional outcomes except in selected subgroups. Whether early minimally invasive surgical removal of the hematoma might improve functional outcomes is unknown.

CLINICAL TRIAL

Design: A prospective, multicenter, open-label, adaptive, randomized trial assessed early (within 24 hours) minimally invasive surgical removal of the hematoma as compared with guideline-based medical management in patients with an acute supratentorial ICH.

Intervention: 300 adults presenting within 24 hours after a lobar or anterior basal ganglia ICH with a hematoma volume of 30 to 80 ml were randomly assigned to minimally invasive trans-sulcal parafascicular surgery plus medical management or medical management alone. The primary efficacy end point was the mean score for disability on the utility-weighted modified Rankin scale (UW-mRS) at 180 days (range, 0 to 1, with higher scores indicating better outcomes).

RESULTS

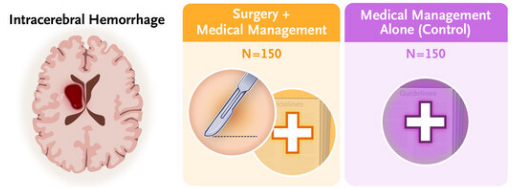
Efficacy: Among evaluable patients, the mean UW-mRS score was better with surgery than with medical management alone. The benefit of surgery appeared to be attributable to intervention for lobar hemorrhages and not for anterior basal ganglia hemorrhages.

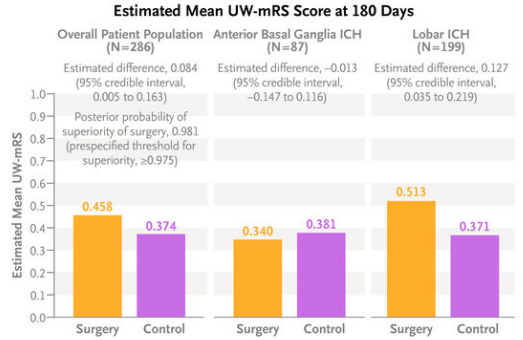
Safety: The percentage of patients who died within 30 days was lower in the surgical group.

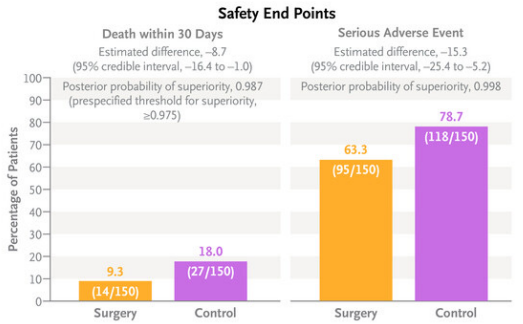
LIMITATIONS AND REMAINING QUESTIONS

- The trial excluded patients with hematoma volumes of <30 or >80 ml and those with substantial thalamic or intraventricular extension.
- Recruitment of patients with anterior basal ganglia hemorrhages was halted for futility after relatively few patients had been enrolled, so inferences of potential benefit in these patients are limited.

Links: Full Article | NEJM Quick Take | Editorial







CONCLUSIONS

In patients presenting within 24 hours after an acute supratentorial lobar ICH of 30 to 80 ml, minimally invasive surgical evacuation of the hematoma plus guideline-based medical management improved functional outcomes as compared with medical management alone.

References/Further Reading

Pradilla G, et all; ENRICH trial investigators; ENRICH Trial Investigators. Trial of Early Minimally Invasive Removal of Intracerebral Hemorrhage. N Engl J Med. 2024 Apr 11;390(14):1277-1289. doi: 10.1056/NEJMoa2308440. PMID: 38598795.

Hanley DF, et all; MISTIE III Investigators. Efficacy and safety of minimally invasive surgery with thrombolysis in intracerebral haemorrhage evacuation (MISTIE III): a randomised, controlled, open-label, blinded endpoint phase 3 trial. Lancet. 2019 Mar 9;393(10175):1021-1032. doi: 10.1016/S0140-6736(19)30195-3. Epub 2019 Feb 7. Erratum in: Lancet. 2019 Apr 20;393(10181):1596. doi: 10.1016/S0140-6736(19)30859-1. PMID: 30739747; PMCID: PMC6894906.

Mendelow AD, et all; STICH II Investigators. Early surgery versus initial conservative treatment in patients with spontaneous supratentorial lobar intracerebral haematomas (STICH II): a randomised trial. Lancet. 2013 Aug 3;382(9890):397-408. doi: 10.1016/S0140-6736(13)60986-1. Epub 2013 May 29. Erratum in: Lancet. 2013 Aug 3;382(9890):396. Erratum in: Lancet. 2021 Sep 18;398(10305):1042. doi: 10.1016/S0140-6736(21)02012-2. PMID: 23726393; PMCID: PMC3906609.

Greenberg MS. *Handbook of Neurosurgery*. 10th ed.; 2023.