Does This Patient Have a Hemorrhagic Stroke?

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

Keegan Selby Jan 29 2025

I have no disclosures or conflicts of interest

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Other JAMA Rational Clinical Exam Articles

- Does This Adult Patient Have Community-Acquired Pneumonia?
- Does This Patient With Headache Have a Migraine or Need Neuroimaging?
- Does This Dyspneic Patient in the Emergency Department Have Congestive Heart Failure?
- Make the Diagnosis: Septic Arthritis

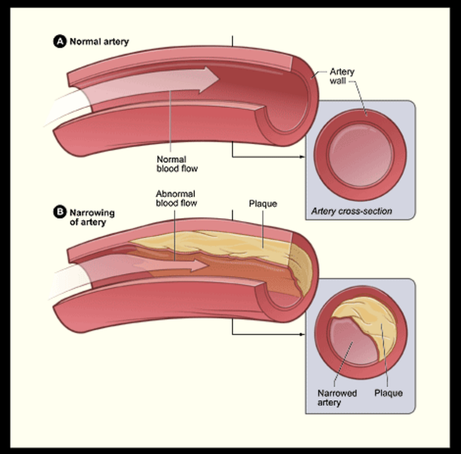
Learning Objectives

- To compare the clinical findings distinguishing hemorrhagic stroke from ischemic stroke.
- To remember the use of Likelihood Ratios and identify how they can be useful in determining pertinent clinical findings
- To differentiate the emergency department management of hemorrhagic stroke from ischemic stroke.

Causes of Stroke

Ischemic ~90%

- Thrombotic



- Embolic

Hemorrhagic ~10%

- Hypertensive
- Cerebral Amyloid Angiopathy
- Vascular abnormalities (Aneurysms/Malformations)
- Cerebral venous thrombosis, vasculopathies, tumours, coagulopathies

Major Risk factors for all Strokes

Regardless of Ischemic or Hemorrhagic

- High blood pressure
- High cholesterol
- Physical inactivity
- Poor diet
- Smoking
- Diabetes
- Heart Disease
- Obesity
- Family History
- Age

Case

- 64M smoker with a history of alcoholism and hypertension
- Progressive left facial droop, slurred speech and left arm and leg weakness with onset ~4 hours prior to arrival to ED
- HR 90, BP 230/115, Sats 94%RA, Glu 8.2, GCS 14 (unsure of date or time of day)
- Hospital has a CT scanner but is not a stroke centre so the ER doctor tells EMS to load the patient back up and drive ~30 minutes to the stroke centre
- On the way out the door the patient vomits
- After EMS departs the local ER doctor calls the stroke centre to advise a patient is on their way

Case

- 64M smoker with a history of alcoholism and hypertension presents with stroke like symptoms…maybe within the thrombolysis window

- To be continued…

Is this a Hemorrhagic or Ischemic Stroke

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

- Why does it matter?

Is this a Hemorrhagic or Ischemic Stroke

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

- Why does it matter?
- Everyone gets a CT

Is this a Hemorrhagic or Ischemic Stroke

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

- Why does it matter?
- Everyone gets a CT
- What if you cant get a CT?

Is this a Hemorrhagic or Ischemic Stroke

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

- It is nighttime and will take 30-60 min for CT to arrive
- CT is down
- Nearest CT is a transfer out to another hospital

Is this a Hemorrhagic or Ischemic Stroke

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

- Or maybe CT is available but
  - What is this patients short term prognosis?
    - What is their projected LOC
    - Should I go with them to the scanner?
  - High suspicion of a hemorrhagic stroke
    - Call Internist/Telestroke now or wait to see initial scan first?

Likelihood Ratio

- A likelihood ratio (LR) is a statistical value that helps determine how likely a test result is for a patient with a condition compared to a patient without the condition.
- LRs are basically a ratio of the probability that a test result is correct to the probability that the test result is incorrect
- Used to assess the value of symptoms, signs, or diagnostic tests.

Likelihood Ratio

- LR > 1: The finding is associated with the condition
- LR < 1: The finding is associated with the absence of the condition
- LR ≈ 1: The finding has no effect on the probability of the condition

Likelihood ratio	Approximate* change in probability[11]	Effect on posttest Probability of disease[12]
Values between 0 and 1 *decrease* the probability of disease (–LR)		
0.1	–45%	Large decrease
0.2	–30%	Moderate decrease
0.5	–15%	Slight decrease
1	–0%	None
Values greater than 1 *increase* the probability of disease (+LR)		
1	+0%	None
2	+15%	Slight increase
5	+30%	Moderate increase
10	+45%	Large increase

Likelihood Ratio in ER terms

- LR > 2: hey this might be useful
- LR 0.5-2: who cares
- LR <0.5: hey this might be useful

Risk Factors

For distinguishing Hemorrhagic from Ischemic

Finding	Positive LR (95% CI)
Risk factors	
Age ≤60 y[35]	1.7 (1.4-1.9)
Alcohol consumption[10]	1.6 (1-2.5)
Male[16-18,28,35]	1.2 (1.1-1.3)
Hypertension[10,11,16-18,28,35]	1.1 (1.0-1.2)
Cigarette smoking[11,28]	0.79 (0.45-1.4)
Diabetes mellitus[11,13,16,28,29,35]	0.64 (0.43-0.95)
Prior stroke[17,35]	0.59 (0.17-2.0)
Hyperlipidemia[10,11,16]	0.48 (0.2-1.1)
Coronary artery disease[11,16,35]	0.44 (0.31-0.61)
Atrial fibrillation[11,16,35]	0.44 (0.25-0.78)
Peripheral artery disease[10,35]	0.41 (0.2-0.83)
Prior transient ischemic attack[10,11,16,35]	0.34 (0.18-0.65)

- Patients having a hemorrhagic stroke are more likely to be less than 60 year old men who drink alcohol and have high blood pressure.
- They are more likely to be having an ischemic stroke if they smoke, have diabetes, a previous stroke or TIA, hyperlipidemia, atrial fibrillation, or peripheral artery disease

Symptoms

For distinguishing Hemorrhagic from Ischemic

Finding	Positive LR (95% CI)
Symptoms	
Seizures accompanying neurologic deficit[11,18,35]	4.7 (1.6-14)
Vomiting[13,16-18,29,35]	3.0 (1.7-5.5)
Headache[10,11,13,16-18,29,35]	2.9 (1.7-4.8)
Loss of consciousness[17]	2.6 (1.6-4.2)
Acute onset of deficit[11]	0.65 (0.52-0.81)

- Patients having a hemorrhagic stroke are more likely to have a seizure, be vomiting, complain of headache, or have a loss of consciousness episode
- They are more likely to be having an ischemic stroke the quicker the onset of symptoms

Symptoms

For distinguishing Hemorrhagic from Ischemic

Finding	Positive LR (95% CI)
Physical signs Kernig sign, Brudzinski sign, or both[29]	8.2 (0.44-150)
Level of consciousness: coma[11,17,18]	6.2 (3.2-12)
Neck stiffness[17,29]	5.0 (1.9-12.8)
Diastolic blood pressure >110 mm Hg[29]	4.3 (1.4-14)
Level of consciousness: drowsy[11,17,18]	2.0 (1.0-3.9)
Plantar response: both extensor[10,17]	1.8 (0.99-3.4)
Plantar response: single extensor[10,17]	1 (0.87-1.2)
Hemiparesis[11,16,35]	0.96 (0.9-1.0)
Plantar response: both flexor[10,17]	0.45 (0.25-0.81)
Level of consciousness: alert[17,18]	0.35 (0.24-0.5)
Cervical bruit[35]	0.12 (0.03-0.47)

- Patients having a hemorrhagic stroke are more likely to have a positive Kernig or Brudzinski sign, drowsy or in a coma, neck stiffness and a diastolic blood pressure over 110mm Hg
- They are more likely to be having an ischemic stroke if they have bilateral plantar flexor response, are alert, or have a cervical bruit

Siriraj Stroke Scale

Pooled results of clinical findings into decision making tool

Score	No. of Patients	Hemorrhages, No. (%)	Definition[b]	Threshold Values	LR for Hemorrhage (95% CI)
Siriraj stroke score[13,15-17,26-34]	3439	1051 (31)	(2.5 × semicoma or 5 × coma) + (2 × vomiting) + (2 × headache within 2 h) + (0.1 × diastolic blood pressure) – (3 × ≥1 of diabetes, angina, intermittent claudication) – 12	<–1: infarction –1 to 1: uncertain >1: hemorrhage	0.29 (0.23-0.37) 0.94 (0.77-1.1) 5.7 (4.4-7.4)

Siriraj Stroke Scale

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- Not bad…but a bit complicated for an ER doctor?

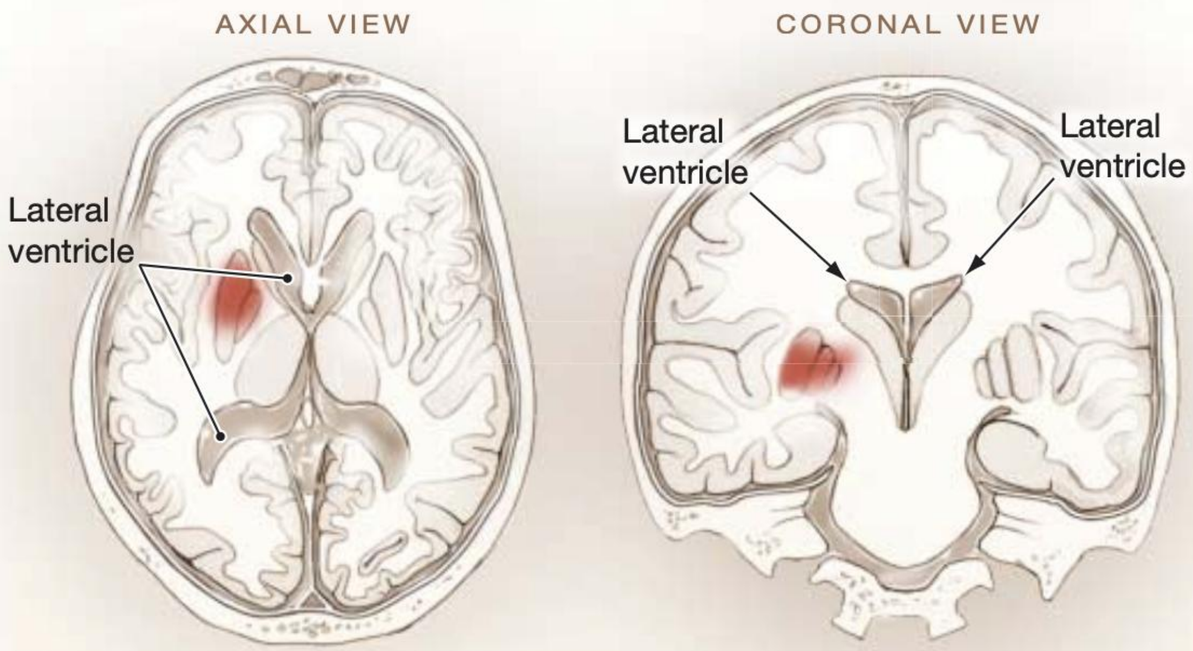
Symptoms

For distinguishing Hemorrhagic from Ischemic

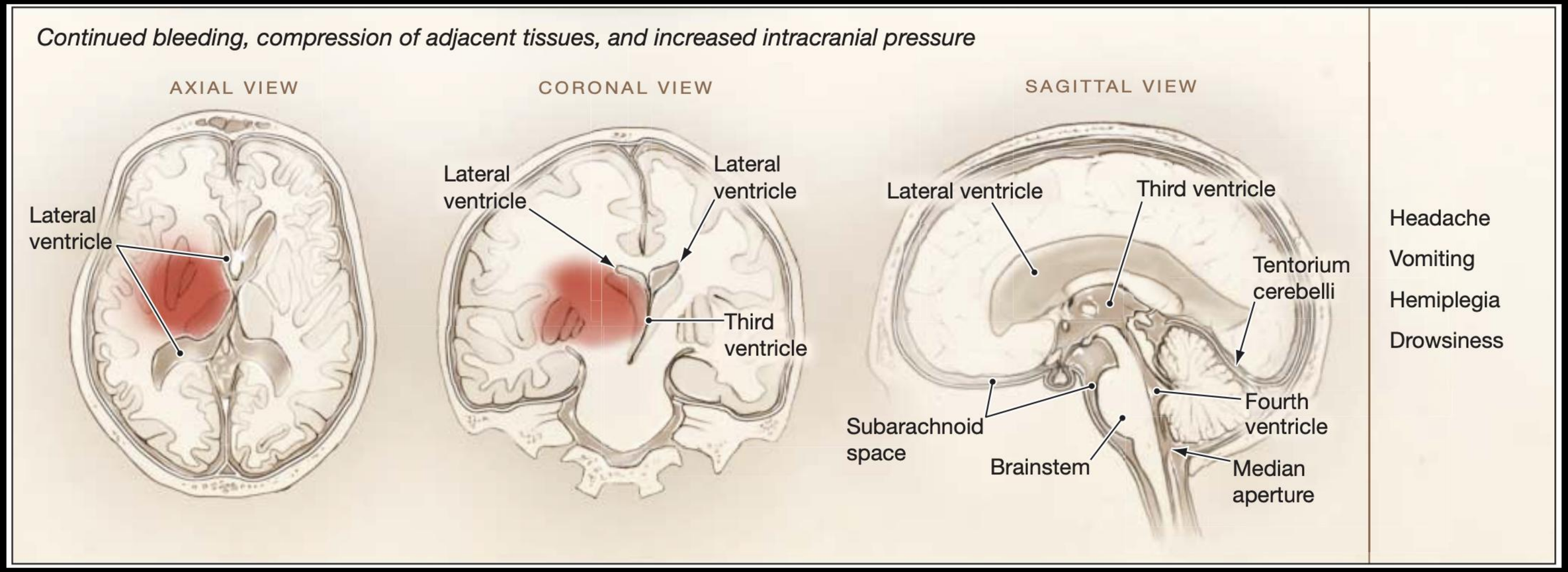
Finding	Positive LR (95% CI)
Clinician's overall impression Hemorrhage most likely diagnosis[28]	6.2 (4.2-9.3)

- You are probably doing alright without any clinical decision tool though!

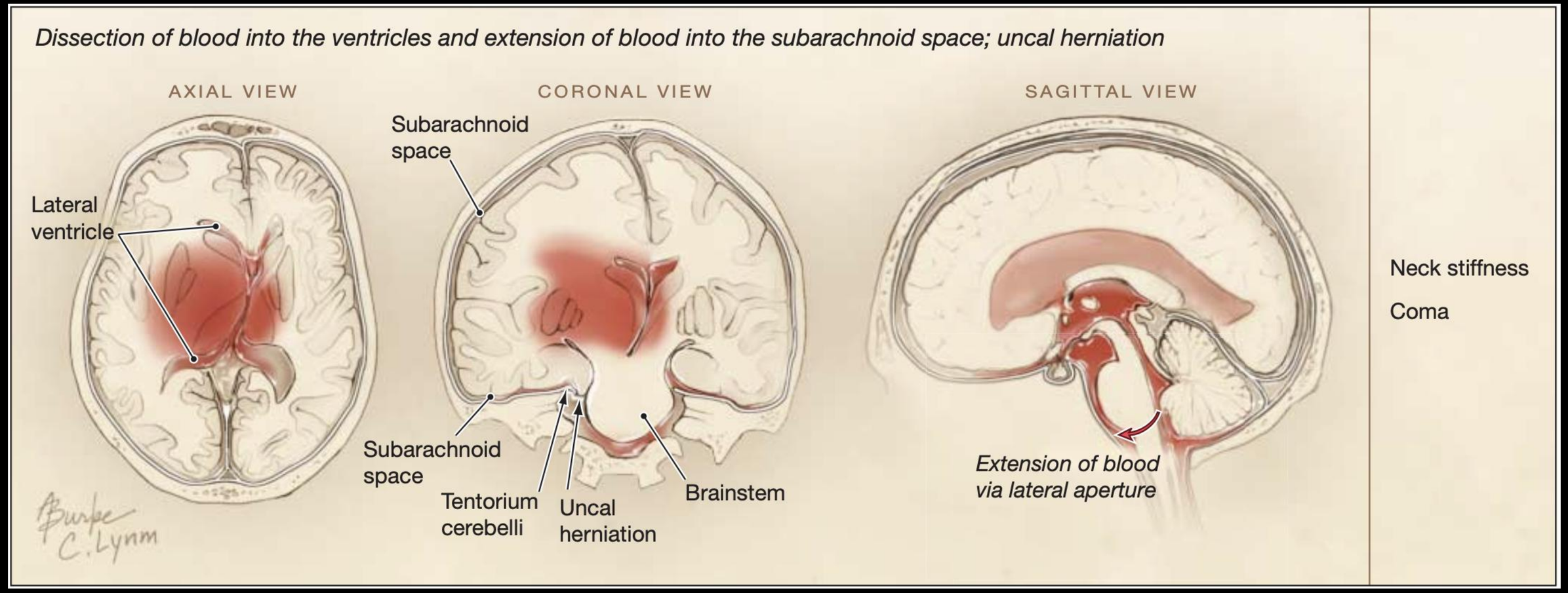
Hemorrhagic = Ischemic PLUS

Pathophysiological events	Clinical findings
Initial hemorrhage 	Hemiparesis

Hemorrhagic = Ischemic PLUS



Hemorrhagic = Ischemic PLUS




35.6 mm


35.2 mm

- Announcement

Case

- I answer the phone
- 64M smoker with a history of alcoholism and hypertension
- Progressive left facial droop, slurred speech and left arm and leg weakness with onset 4 hours prior to arrival to ED
- HR 90, BP 230/115, Sats 94%RA, Glu 8.2, GCS 14

Case

- I answer the phone
- 64M smoker with a history of alcoholism and hypertension
- Progressive left facial droop, slurred speech and left arm weakness with onset 2 hours prior to arrival to ED
- HR 90, BP 230/115, Sats 94%RA, Glu 8.2, GCS 14
- No CT scan was done and they have already left
- And the patient vomited just prior to departure
- And then the patch phone rings

Case

- During transfer with a BLS paramedic crew ~10 min into transfer his LOC deteriorated
- Difficulty oxygenating and maintaining airway due to large beard and have been unable to get reliable sats ever since

Case

- Arrives at stroke centre with a GCS of 3, BP 250/130, Sats unobtainable with BVM assisted respirations
- Intubated, hypertonic saline, labetalol and then sent for CT scan
- Large ICH with mass effect
- Flown out to neurosurgical unit and ultimately care withdrawn days later

Case

In retrospect

- Despite local protocols to bypass patients with stroke like symptoms, clinical findings suggested a hemorrhagic stroke
- Would outcome have changed? What if…
- CT prior to transfer
  - Hemorrhage identified
  - Progression witnessed, airway managed
  - Earlier and direct transfer to neurosurgical unit for decompression
- MD assisted in transfer
  - Progression witnessed, airway managed

Case

In retrospect

- Most of the time we have access to CT quickly

- But when we don’t…
  - Are there findings consistent with hemorrhage
  - Should we be prepared for potential deterioration.

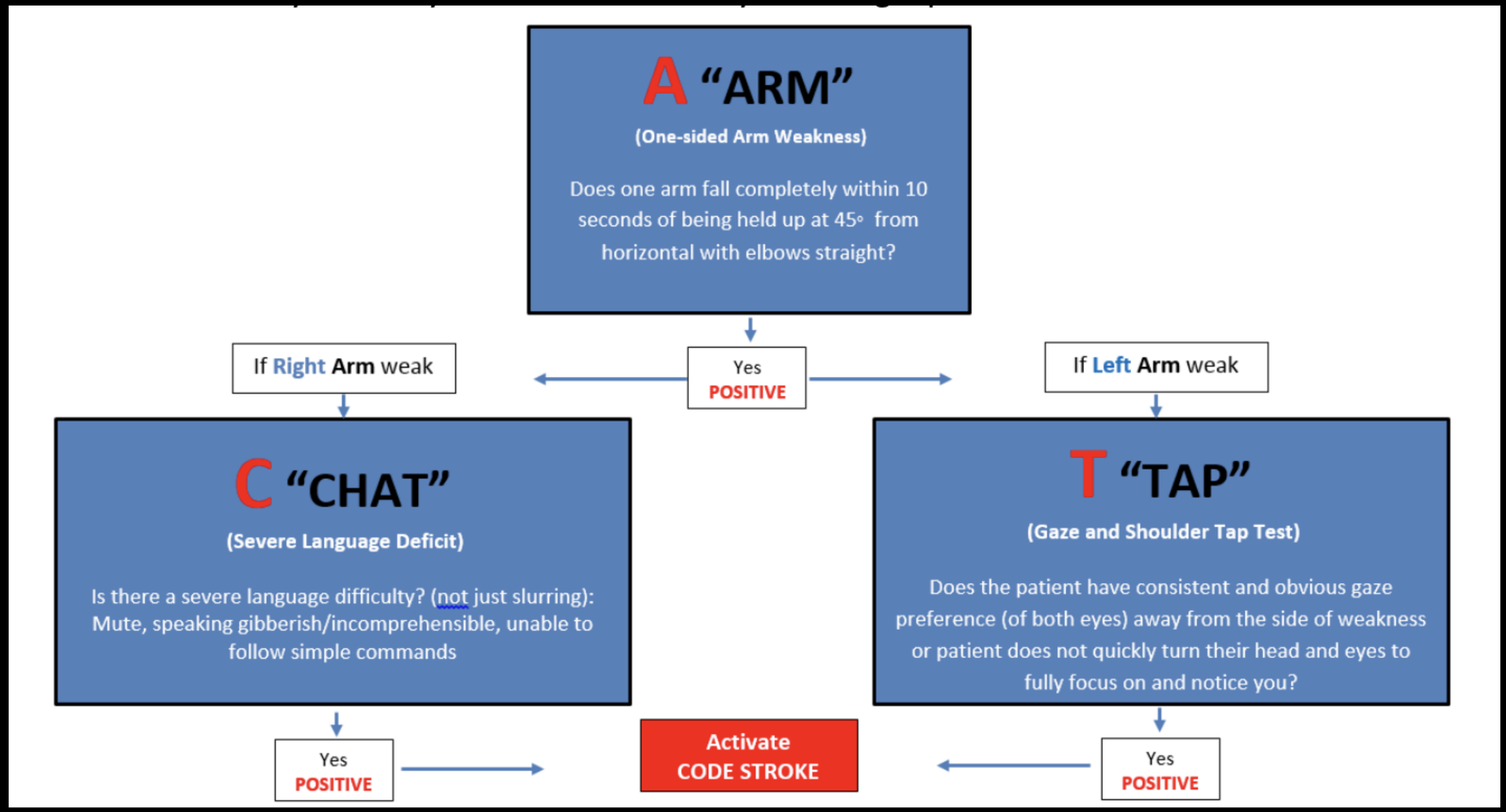
Treatment

Ischemic Stroke

- Onset within 4.5hours
    - Thrombolysis if NIH>4 or disabling symptom
    - EVT if large vessel occlusion on CTA

Treatment

Ischemic Stroke 4.5-24 hours



Treatment

Hemorrhagic Stroke

- Prevent extension

- Manage ICP

Treatment

Hemorrhagic Stroke

- Prevent extension
  - Reverse anticoagulation
  - No role to attempt to reverse antiplatelets
  - No role for recombinant factors
  - No role for TXA
  - Blood Pressure?
    - If initial systolic 150-220mmHg, lower to 140mmHg within an hour
    - If initial systolic >220mmHg, rapidly reduce to 220mmHg, then gradually over hours to 140-160mmHg

Treatment

Hemorrhagic Stroke

- Manage ICP (if signs present)
  - Blood pressure control
  - Hypertonic saline (more used to it in ER and better outcomes in trauma patients)
  - Head midline and head of bed at 30%
  - Urgent neurosurgical opinion for surgical decompression!

In Summary

Summary

Clinical Findings

- Likelihood ratios for clinical findings can help us make decisions on the probability of a disease
- Clinical gestault is probably as good as clinical scoring tools for differentiating hemorrhagic and ischemic stroke
- Ultimately diagnosis requires neuroimaging

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

With LR of >2 or <0.5 and a confidence interval that doesn't cross 1

Risk Factor	Likelihood Ratio
Coronary Artery Disease	0.44
Afib Fibrillation	0.44
Peripheral Arterial Disease	0.41
Prior TIA	0.34

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

With LR of >2 or <0.5 and a confidence interval that doesn’t cross 1

Symptoms	Likelihood Ratio
Seizure	4.7
Vomiting	3
Headache	2.9
Loss of Consciousness	2.6

Clinical Findings Distinguishing Hemorrhagic Stroke From Ischemic Stroke

With LR of >2 or <0.5 and a confidence interval that doesn't cross 1

Physical Sign	Likelihood Ratio
Kernig/Brudzinski	8.2
Coma	6.2
Neck Stiffness	5.0
Diastolic BP >110mm Hg	4.3
Drowsy	2
Plantar response bilaterally flexes	0.45
Alert	0.35
Cervical Bruit	0.12

Summary

Treatment

- Prevent extension
  - Reverse anticoagulation
  - Lower BP to targets
- Manage ICP
  - Standard increased ICP management including hypertonic saline
  - Neurosurgical decompression?

Thank you