

Louisiana Emergency Response Network (LERN)

Stroke Workgroup

July 19, 2024

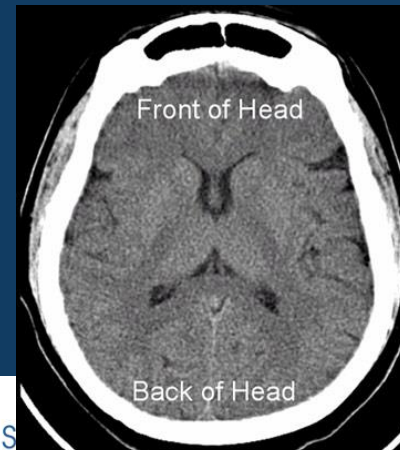


Goals of Stroke Workgroup

- Identification of Challenges
- System Integration
- Provide Education

Definition - Blood in the parenchyma of the brain

- Not to be confused with intracranial hemorrhage
 - Epidural hematoma = EDH
 - Subdural hematoma = SDH
 - Subarachnoid hemorrhage = SAH
 - **Intracerebral hemorrhage = ICH**
 - **Intraventricular hemorrhage = IVH**



Normal CT Scan
Slice of Brain



Intracerebral Hemorrhage
(bright white area)
CT Scan Slice of Brain

Intracerebral hemorrhage

- 10-15% of all strokes (~800,000/year)
- ICH is 3x more common than SAH
- Most patients do not need neurosurgical treatment

ICH - Race

	All Locations	Lobar	Deep Cerebral	Brain Stem	Cerebellum
All whites	26.6 (24.8–28.5)	9.4 (8.4–10.5)	12.9 (11.6–14.2)	1.3 (0.9–1.7)	2.9 (2.3–3.5)
All blacks	48.9 (42.3–55.5)	15.2 (11.5–18.9)	25.2 (20.5–30.0)	5.1 (3.0–7.1)	2.9 (1.3–4.5)
All men	32.2 (29.2–35.2)	9.7 (8.0–11.3)	17.8 (15.6–20.0)	1.8 (1.1–2.4)	3.0 (2.1–4.0)
All women	26.5 (24.3–28.6)	10.2 (8.8–11.6)	12.0 (10.6–13.5)	1.8 (1.2–2.3)	2.8 (2.1–3.6)

*Annual incidence rates per 100 000 persons ≥ 20 years of age calculated from the periods May 1998 through July 2001 and August 2002 through April 2003.

Age, race, and sex were adjusted to the 2000 US white and black population as appropriate.

Parentheses indicate 95% CIs.

Kissela B et al. Stroke in a biracial population: the excess burden of stroke among blacks. *Stroke* 2004;35(2) 426-31.

	Men vs Women		Blacks vs Whites	
	RR	95% CI	RR	95% CI
Lobar	0.8	0.7–1.0	1.4	1.0–1.8
Deep	1.3	1.1–1.6	1.7	1.4–2.1
Brain stem	1.0	0.6–1.6	3.3	2.0–5.5
Cerebellar	0.9	0.6–1.4	0.9	0.5–1.6

*RRs calculated from unadjusted incidence rates.

RR >1 indicates greater risk among men vs women and blacks vs whites.

Flaherty ML et al. Racial variations in location and risk of intracerebral hemorrhage. *Stroke* 2005;36:934-7.

Intracranial hemorrhage

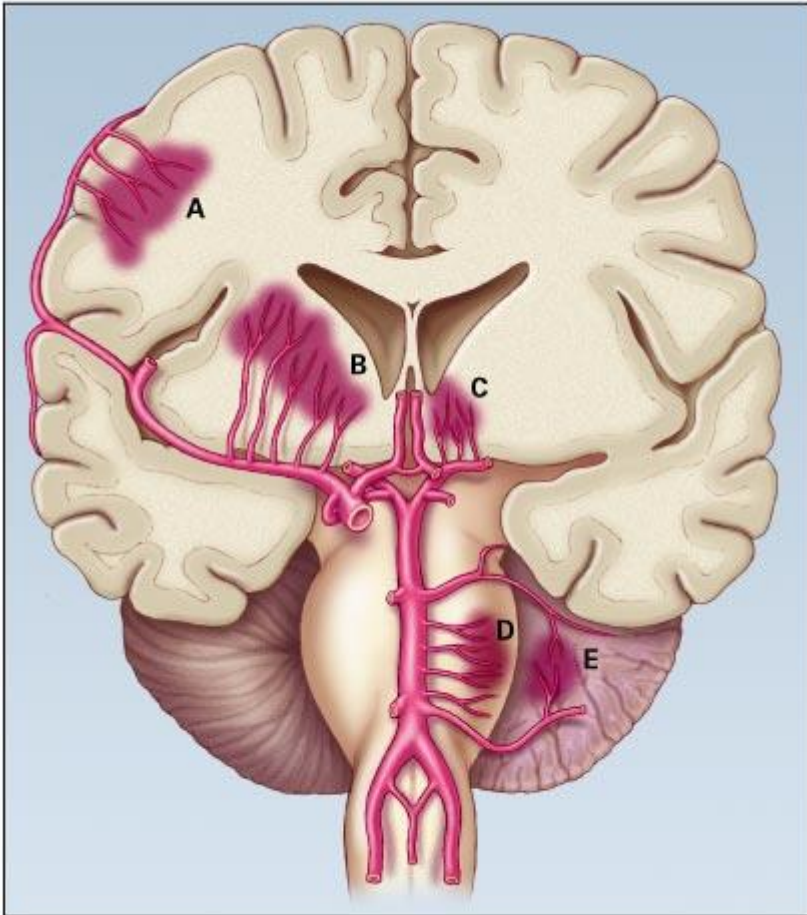
Common causes:

- **Hypertension**
- Amyloid angiopathy
- Sympathomimetic drug abuse
- Tumor
- Coagulopathy
- Hemorrhagic transformation of an ischemic infarct

Other causes:

- Moyamoya
- Sickle cell disease
- Eclampsia or postpartum vasculopathy
- Infection
- Vasculitis
- Traumatic contusions
- Arteriovenous malformation, angiomas
- Dural sinus thrombosis

Predilection sites for ICH



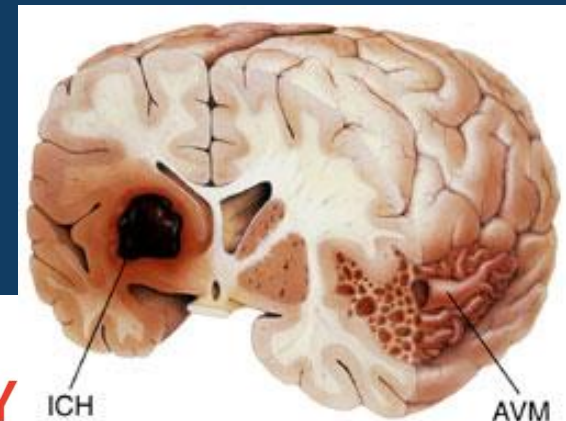
- A) Penetrating cortical branches → lobar ICH (20-50%), of ACA, MCA, PCA
- B) Basal ganglia (40-50%), lenticulostriate branches of the MCA
- C) Thalamus (10-15%), thalamogeniculate branches of the PCA
- D) Pons (5-12%), paramedian branches of the basilar artery
- E) Cerebellum (5-10%), penetrating branches of the cerebellar arteries

Symptoms more typical of ICH than ischemic stroke

- How can you tell the difference between ICH and ischemic stroke?
 - Younger patients
 - Occur while awake (only 15% upon awakening)
 - Headache (40% vs 17% in ischemic stroke)
 - Elevated blood pressure (SBP >200)
 - Reduced level of consciousness (about 50%)
 - Vomiting (more with posterior fossa ICH)
 - Seizures (more common with lobar ICH)

Most importantly...

- Noncontrast CT scan

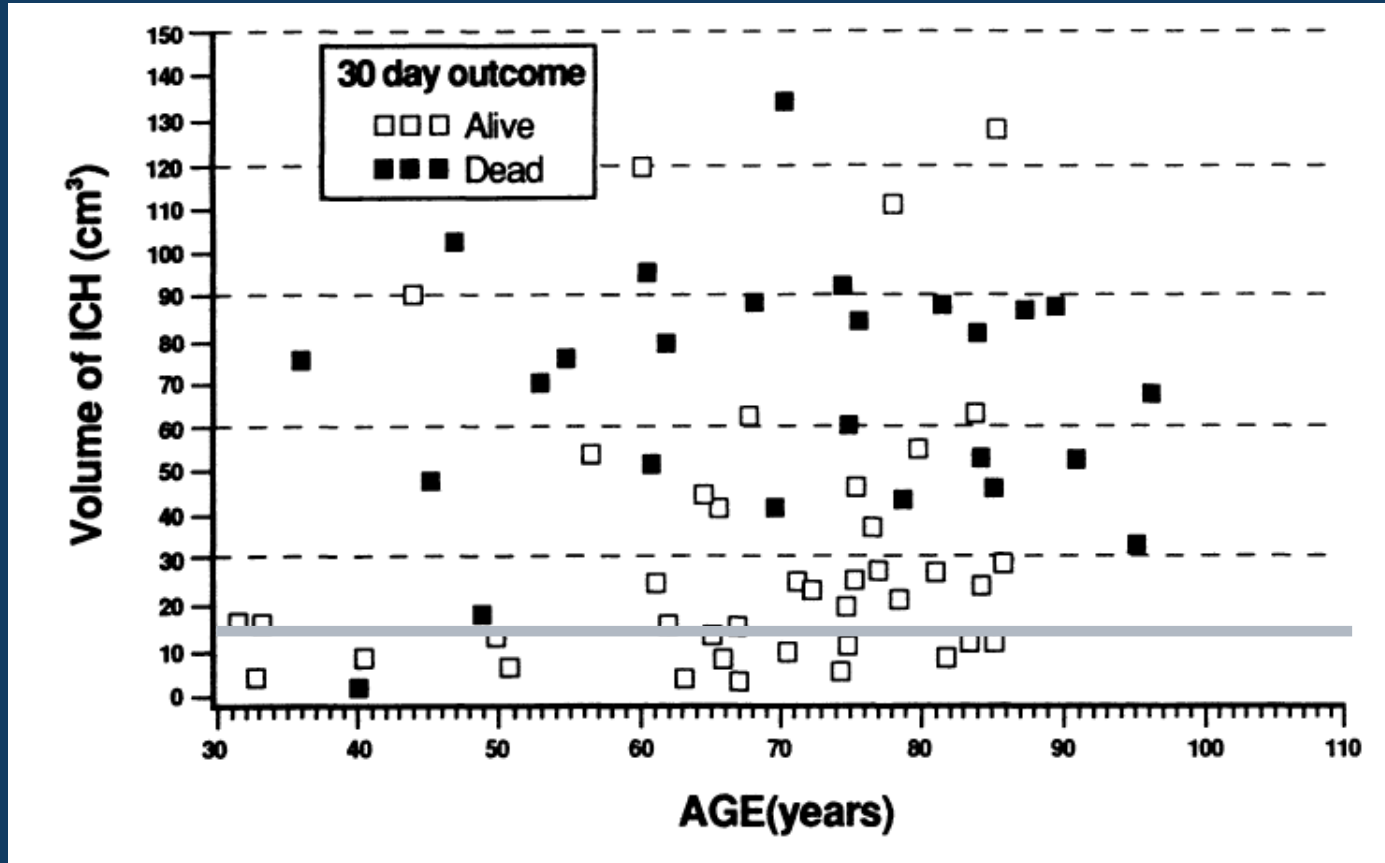


Why the depressed level of consciousness?

Unlike acute ischemic stroke...

- Immediate space-occupying lesion
- Little time to equilibrate pressures
- Rise in intracranial pressure
- Obstruction to flow of CSF → hydrocephalus

ICH - Outcomes



Broderick JP et al. Volume of intracerebral hemorrhage. A powerful and easy-to-use predictor of 30-day mortality. *Stroke* 1993;24:987-93.

Impact of ICH volume on mortality

- Data: 60 cc blood, GCS < 9, mort 91%
- Data: 30 cc blood, GCS > 8, mort 19%

ICH – Independent Predictor of Outcomes

- 1) Low GCS
- 2) Volume of ICH

Lethal volume of parenchymal hemorrhage varies by location

- 1) pontine hemorrhage $>5 \text{ cm}^3$ or
- 2) cerebellar hemorrhage $>30 \text{ cm}^3$
- 3) Volume of intraventricular hemorrhage
- 4) Infratentorial location
- 5) Age ≥ 80

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%

Hematoma Enlargement

18:11



19:21



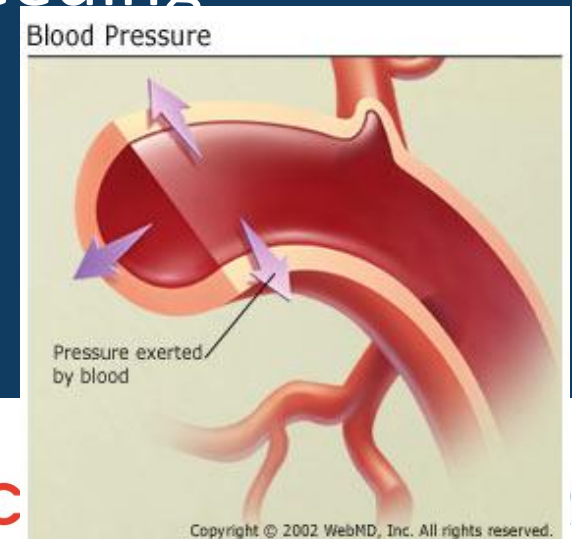
- 38% of patients have hematoma enlargement within the first 24 hours; majority will be in the first few hours and is associated with neurologic deterioration¹
- Hematoma enlargement is an independent risk factor for worsened clinical outcome and mortality²

¹Brott et al. *Stroke*. 1997 Jan;28(1):1-5

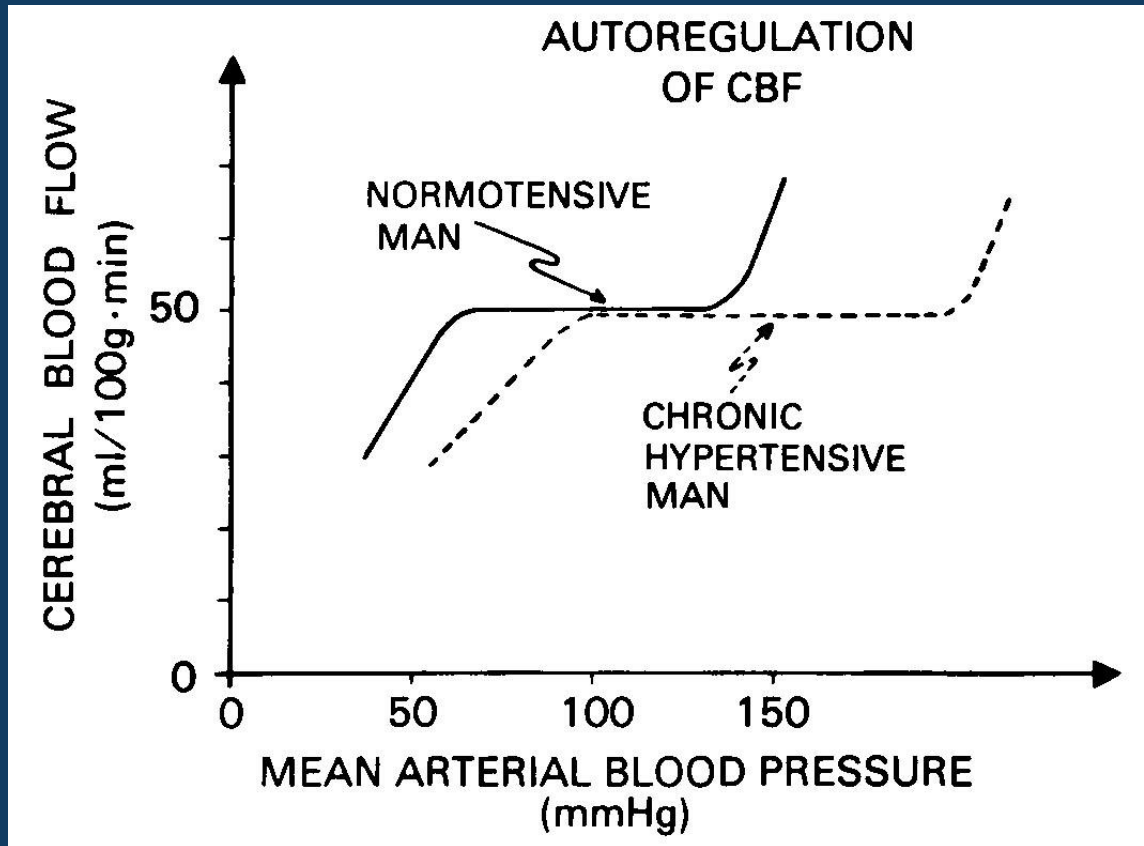
²Davis SM et al. *Neurology*. 2006 Apr 25;66(8):1175-81

ICH- blood pressure

- Elevated BP – most common etiology
- Bleeding until tamponade, stasis, and clotting
- Lowering BP to stop damage to broken vessel, active bleeding, and prevent rebleeding
- How low? How fast?



ICH- blood pressure



$$CBF = CPP / CVR$$

$$CPP = MAP - ICP$$

Elevated BP in ICH is bad

Observational studies

- Higher mortality correlates with elevated BP
- Higher rates of hematoma expansion
 - SBP > 160mmHg → 30% of cases
 - SBP < 150mmHg → 9% of cases

Three rules for blood pressure management in acute intracerebral hemorrhage

Rules

1. Fast Initiate BP lowering treatment using intravenous infusion ASAP
 2. Intense Achieve target systolic BP < 140 mm Hg (130 mm Hg if possible) ASAP
 3. Stable Keep stable control of systolic BP
-

Influence of time to achieve and maintain target systolic blood pressure of 120-140 mmHg on outcomes after acute intracerebral hemorrhage



Population
N=5761 patients
mean age 64.0, 36.8% females
median time from symptom onset to randomization of 3.8 hours (2.6 – 5.3)

Exposure

Time from symptom onset to achieve and maintain target systolic blood pressure of 120-140 mmHg

Outcomes

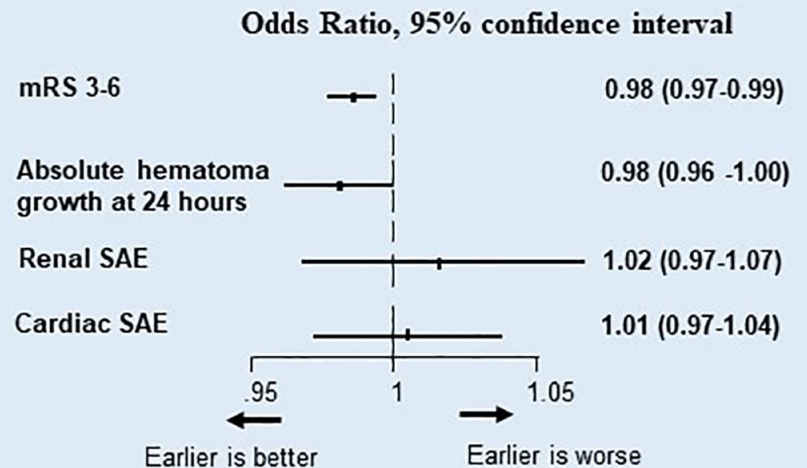
Functional status measured by Modified Rankin scale score (mRS 3-6); Absolute hematoma growth at 24 hours; Renal serious adverse events (SAE), Cardiac SAE

Findings

Approximately one-third of participants achieved and maintained SBP at 120-140 mmHg over 24 hours post-randomization. Earlier SBP control to target of 120-140 mmHg was associated with better functional status (odds ratio 0.99, 95% confidence interval 0.98-0.99, $p=0.001$), and a significant lower risk of hematoma expansion at 24 hours (0.98, 0.96-1.00, $p=0.049$). It was not associated with an increased risk of cardiac and renal SAEs.

Conclusions

An earlier achievement and maintenance of this target reduces the likelihood of growth of small-medium sized hematomas, which translates into improved odds of recovery.



Current Guidelines

Table 2 current stroke guideline recommendations regarding acute blood pressure management in ICH

	When?	How much?	How long?
American Heart Association/ American Stroke Association [1]	Within 2 h of onset, ideally at target within 1 h <i>Class 2a</i>	SBP 140mmHg (range 130-150mmHg) in patients with mild-moderate ICH presenting with SBP 150-220mmHg <i>Class 2b</i>	No recommendation
European Stroke Organisation [12]	As early as possible, ideally within 2 h <i>Expert consensus</i>	SBP 140mmHg (and above 110mmHg) if presenting within 6 h <i>Weak recommendation</i>	24–72 h <i>Expert consensus</i>
Chinese Stroke Association [13]	No recommendation	SBP 140mmHg in patients with SBP > 150mmHg <i>Class 2b</i>	No recommendation
Australian Stroke Foundation [14]	No recommendation	Less than 140mmHg, but not substantially lower <i>Weak recommendation</i>	No recommendation

Influence of time to achieve target SBP in ICH

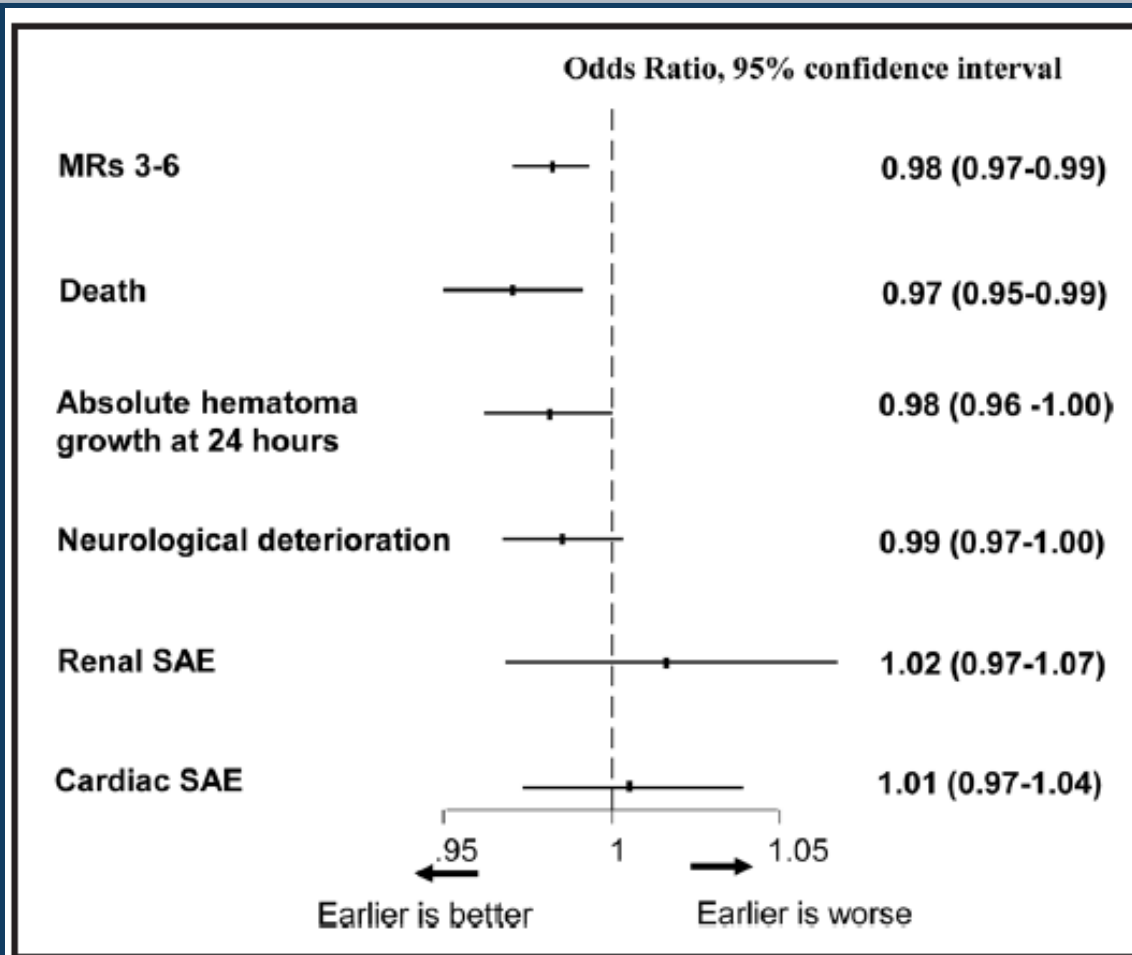


Figure 1. Association of time to achieve systolic blood pressure (SBP) of 120 to 140 mm Hg and maintained until 24 h, and the primary and secondary clinical, and safety and radiological outcomes.

ICP reduction strategies

- head-of-bed elevated at 30°
- patient's neck in a neutral position to maximize venous outflow
- minimizing the patient's agitation and pain
- hyperventilation
- hyperosmolar therapies- mannitol and hypertonic saline
- Ventriculostomy for CSF drainage
- barbiturate-induced comas

ICH Form Group Measures

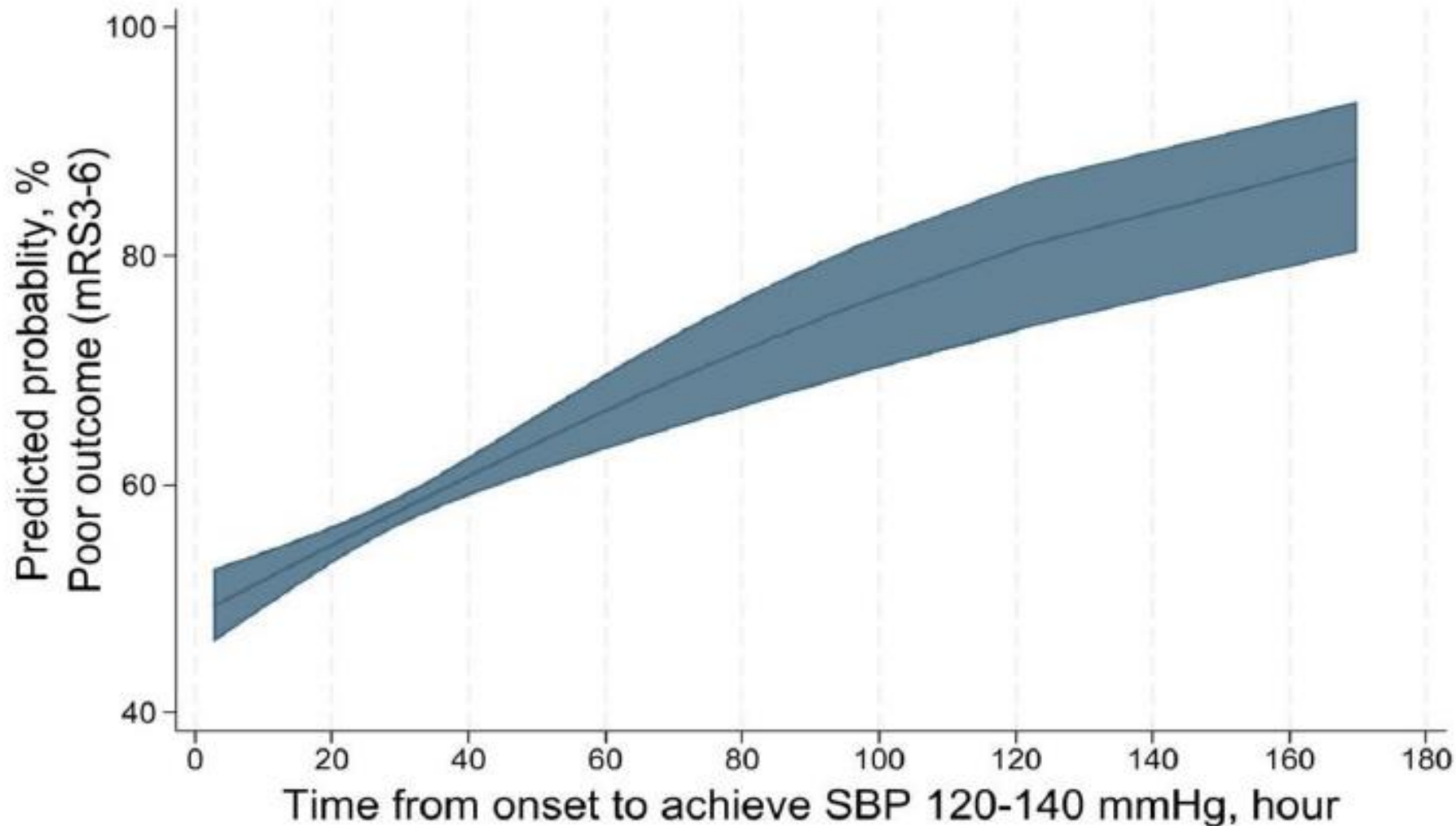
Performance Measures (Rate Based)

- AHASTR155: Admission Unit
- AHASTR296: Anticoagulant Reversal (DOACs)
- AHASTR156: Assessed for Rehabilitation
- AHASTR157: Avoidance of Corticosteroid Use
- AHASTR158: Baseline Severity Score
- AHASTR159: Blood Pressure Treatment at Discharge
- AHASTR160: Coagulopathy Reversal (Warfarin)
- AHASTR161: Dysphagia Screening within 24 Hours
- AHASTR163: Passed Dysphagia Screen Before First Oral Intake
- AHASTR164: Venous Thromboembolism (VTE) Prophylaxis

Descriptive Measures

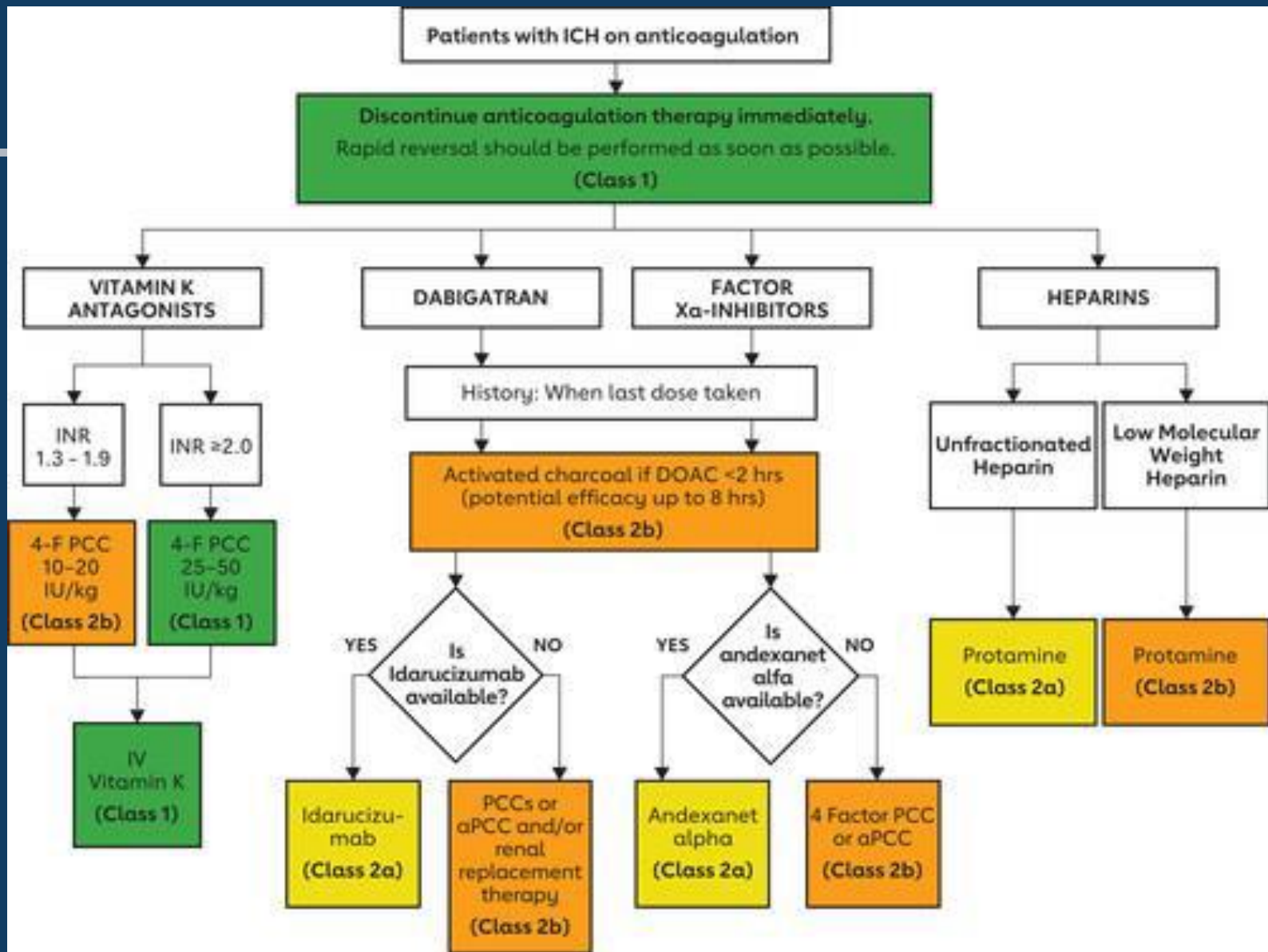
- AHSTR162: ICH Records with Missing Times
- AHASTR299: Anticoagulant Reversal Agents
- AHASTR300: Reasons No Anticoagulant Reversal was Administered
- AHASTR301: Time to Anticoagulant Reversal

Figure 2. The predicted probability of poor outcome (modified Rankin Scale [mRS] score, 3–6) by time to achieve and maintain systolic blood pressure (SBP) of 120 to 140 mm Hg.



Recommendations

- Please defer to anticoagulant-associated Intracranial Hemorrhage for patients taking an anticoagulant.
 - o Outside of patients with ICH going to surgery, there is no defined role for platelet transfusion in patients taking antiplatelet prior to ICH
- For most patients, reduce SBP to 130-140mmHg, to reduce hemorrhagic expansion and mortality; if transferred, ensure BP has reached target before sending
 - o AHA Guidelines do not specify the antihypertensive to use, but IV nicardipine is the most frequently used medication in modern clinical trials; other options include labetalol (if not bradycardic), clevidipine, hydralazine (if bradycardic), enalapril
- HOB elevated to 30 degrees; do not leave HOB flat for prolonged imaging or during transfer
- Prophylactic antiseizure medication is not recommended
- Treatment of glucose <60mg/dL is recommended; if >180mg/dL, it is reasonable.
- Cardiac monitoring for at least 24hrs
- Frequent neurocheck and vital signs
 - o 0-6 hours from symptom detection – every 30 minutes
 - o 6-24 hours from symptom detection – every 1 hour
 - o >24 hours and blood pressure not at goal or worsening exam – every 1 hour
 - o >24 hours and blood pressure at goal – every 4 hours, in neurologically stable patient
- Consult with neurology and/or neurosurgery for determination of neurosurgical intervention
- Repeat head CT without contrast, if neurological deterioration occurs



Questions

