

Spontaneous Intracerebral Hemorrhage

Emergency assessment through neurosurgical decision-making, graded by clinical priority — with trial evidence mapped to each recommendation.

● Critical / act now ● High-yield number ● Caution / avoid ● Trial evidence ● Safe / reassuring

A. Stabilization B. BP mgmt C. Airway drugs D. Raised ICP signs E. Pupil pathway F. Investigations G. CT choice
H. CT progression I. Grading J. Reversal K. BP targets L. Surgery M. Hyperosmolar N. ICP monitoring
O. Ventilation P. Temp/glucose Q. DVT prophylaxis Trials (PICO)

A First 10 Minutes — Assessment & Stabilization

ACT IMMEDIATELY

Intubate if **GCS ≤ 8** , loss of airway reflexes, or anticipated deterioration (posterior fossa bleed). Falling GCS or new anisocoria = herniation until proven otherwise.

- **Airway** — patency, gag reflex, indications for RSI
- **Breathing** — SpO₂, RR; target **94-98%** normoxia
- **Circulation** — BP both arms, HR, ECG, two IV lines
- **Disability** — GCS, pupils, focal deficits, capillary glucose

DO IN PARALLEL

Start BP control early, obtain urgent neurosurgical consult once CT confirms ICH, and ask about anticoagulant/antiplatelet use immediately — it dictates the reversal timeline.

B Acute BP Management — BP 220/120 mmHg

APPROACH TO ACUTE BP CONTROL

Parameter	Recommendation
Target	SBP 130-150 mmHg (commonly ~140) within 1 hour; avoid SBP <130
First-line agent	Nicardipine infusion (5 mg/hr, titrate by 2.5 mg/hr q5-15min, max 15 mg/hr), or Labetalol / Clevidipine
Avoid	Hypotension and BP variability; sublingual nifedipine; nitroprusside/nitrates (may raise ICP)
Monitoring	Arterial line for continuous BP during titration
Reassessment	Repeat CT at 6 hrs, or immediately on neuro decline

C Medications for Securing the Airway

- **Induction:** **Etomidate** (hemodynamically neutral) or Propofol (lowers ICP, watch for hypotension)
- **Paralytic:** Rocuronium (preferred) or succinylcholine
- **Pretreatment:** Lidocaine to blunt laryngoscopy-related ICP rise (evidence mixed)

AVOID

Hemodynamic swings in either direction — hypotension risks hypoperfusion, hypertension risks hematoma expansion.

D Signs & Symptoms of Raised ICP

- Headache, vomiting, declining consciousness
- **Cushing's triad** — hypertension, bradycardia, irregular respiration (late, ominous)
- Papilledema, unilateral pupil dilation (uncal herniation)
- False localizing sign: CN VI palsy
- Posturing progression: decorticate → decerebrate

E Why the Pupil Dilates — Herniation Pathway

MECHANISM, STEP BY STEP

1. Raised supratentorial pressure → uncal herniation through the tentorial notch
2. Uncus compresses **CN III** against the tentorial edge / posterior cerebral artery
3. Parasympathetic fibers run superficially on CN III — compressed *first*
4. Loss of constrictor tone → unopposed dilation → **ipsilateral fixed, dilated pupil**
5. Further compression → motor fibers affected → ptosis, "down-and-out" eye
6. Progression → contralateral CN III compressed (Kernohan's notch) → bilateral fixed pupils (poor prognosis)

F Initial Investigation Panel

- CBC, PT/INR, aPTT, platelets, renal function, electrolytes, glucose, LFTs, troponin, group & crossmatch
- DOAC-specific: anti-Xa activity, dilute thrombin/ecarin clotting time for dabigatran
- ECG, toxicology screen if indicated, pregnancy test in women of childbearing age

G Which CT — Plain / CTA / Venogram?

Scan	When
CT plain	Always first — confirms ICH, location, volume, IVH, shift
CTA brain	Young patient, lobar/atypical bleed, no HTN history; look for spot sign (predicts expansion) — get early with initial CT
CT venogram	Atypical location (parasagittal, bilateral), young/prothrombotic/pregnant patient, suspected venous sinus thrombosis

H Radiological Features of Progression

- **Hematoma expansion** — >33% or >6 mL, mostly within first 6 hours (~30% of cases)
- **Spot sign** on CTA — strong predictor of expansion

- Perihematomal edema — increases over 24–72 hrs, peaks day 5–6
- Heterogeneous density: "black hole," "swirl," "blend" signs
- IVH extension, midline shift, hydrocephalus

I Severity Grading

a. ABC/2 Hematoma Volume

FORMULA

Volume (mL) = $(A \times B \times C) / 2$ — A = greatest diameter, B = perpendicular diameter, C = number of slices $\times$ slice thickness

b. ICH Score

Component	Points
GCS 13–15 / 5–12 / 3–4	0 / 1 / 2
ICH volume ≥ 30 mL	1
IVH present	1
Infratentorial origin	1
Age ≥ 80	1

Score 0–6 — higher score correlates with higher 30-day mortality. Not to be used alone for withdrawal-of-care decisions (self-fulfilling prophecy bias).

J Reversal of Anticoagulation

Agent	Reversal
Warfarin	4-factor PCC (25–50 U/kg by INR) + IV vitamin K 10 mg
NOACs (Xa inhibitors)	Andexanet alfa if available, else 4-factor PCC (off-label)
Antiplatelets	Platelet transfusion not routinely recommended (PATCH trial showed harm); DDAVP if surgery planned
Thrombolysis-associated	Stop infusion; cryoprecipitate (target fibrinogen >150 mg/dL) $\pm$ tranexamic acid
Heparin (UFH)	Protamine sulfate 1 mg per 100 U (max 50 mg)
Dabigatran	Idarucizumab 5 g IV — rapid, specific reversal
Thrombocytopenia	Platelet transfusion if <50 – 100 k and surgery planned

K BP Control Targets — Summary

TARGET & DURATION

SBP **~ 130 – 140 mmHg**, avoid <130 ; achieve within 1 hour, maintain 24–72 hrs

Preferred agents: Nicardipine (first-line, most studied), Labetalol, Clevidipine. Avoid nitroprusside/nitroglycerin first-line.

L Neurosurgical Options

Procedure	Advantage	Disadvantage	Evidence
Craniotomy + evacuation	Direct decompression	Brain retraction injury, no clear benefit	STICH, STICH II
Decompressive craniectomy alone	Reduces ICP, controls herniation	Doesn't remove clot	SWITCH
EVD	Treats hydrocephalus/IVH, allows ICP monitoring & thrombolysis	Infection risk, catheter obstruction	CLEAR III
Minimally invasive + thrombolysis	Less invasive clot evacuation	Needs stereotactic expertise	MISTIE III
Endoscopic evacuation	Real-time visualization, minimally invasive	Learning curve	ENRICH — positive for lobar bleeds

INTRAVENTRICULAR THROMBOLYTICS

Alteplase **1 mg every 8 hours**, up to 12 doses via EVD (CLEAR III protocol) — improved ventricular clearance and mortality; no significant functional outcome benefit at 6 months.

M Hyperosmolar Agents

Agent	Dose	Target	Side effects
Mannitol 20%	0.25–1 g/kg bolus, q4–6h	Osmolality <320 mOsm/L	Diuresis, hypotension, renal injury, rebound ICP
Hypertonic saline	3% infusion or 23.4% bolus (30 mL/10–20 min)	Na <155–160	Central pontine myelinolysis if corrected fast, volume overload

N ICP Monitoring — Pros & Cons

- **Advantages:** targeted therapy, CPP calculation, early deterioration detection
- **Disadvantages:** invasive (hemorrhage ~1–2%, infection risk); no RCT shows outcome benefit specific to ICH

O Ventilation & Oxygenation Targets

SpO₂ **94–98%**; PaCO₂ **35–45 mmHg** (normocapnia). Hyperventilation (PaCO₂ 30–35) only as a **temporizing bridge** for acute herniation, never sustained.

P Temperature & Glycemic Targets

Normothermia **36–37.5°C**; treat fever aggressively. Glucose **140–180 mg/dL** — avoid both hypoglycemia and overly tight control.

Q **DVT Prophylaxis**

Mechanical (IPC devices) **immediately on admission** . Pharmacological (SC heparin/LMWH) once hematoma stability confirmed — typically **48-72 hours** after onset.

Landmark Trials — PICO Summary

BLOOD PRESSURE CONTROL				
Trial	Population	Intervention	Comparison	Outcome
INTERACT2 (2013)	ICH, SBP 150–220, <6 hrs	Intensive lowering (SBP <140/1hr)	Standard (<180)	Neutral on primary; improved on shift analysis
ATACH-2 (2016)	ICH, SBP >180, <4.5 hrs	Intensive (110–139)	Standard (140–179)	No benefit , more renal AEs
SAMURAI-ICH (2013)	Acute ICH, Japan	Early intensive lowering	Historical control	Feasible/safe , low expansion rate

SURGICAL INTERVENTION				
Trial	Population	Intervention	Comparison	Outcome
STICH (2005)	Supratentorial ICH, equipoise	Early craniotomy	Initial conservative	No overall benefit
STICH II (2013)	Superficial lobar ICH	Early craniotomy	Conservative	Neutral , survival signal only
MISTIE III (2019)	ICH ≥30 mL	MIS catheter + alteplase	Standard medical	Neutral overall ; benefit if clot ≤15 mL residual
CLEAR III (2017)	ICH with IVH + EVD	Intraventricular alteplase	Intraventricular saline	Neutral function; reduced mortality
ENRICH (2024)	Lobar / anterior basal ganglia, 30–80 mL	Early MIS parafascicular evacuation	Standard medical	Improved outcome at 180 days (lobar)
SWITCH	Deep ICH with mass effect	Decompressive craniectomy	Best medical care	Largely neutral

ANTIPLATELET REVERSAL & ICP MONITORING				
Trial	Population	Intervention	Comparison	Outcome
PATCH (2016)	ICH on antiplatelets	Platelet transfusion	Standard care	Worse outcomes — practice-changing
BEST TRIP (2012, TBI)	Severe TBI	ICP-monitor-guided therapy	Exam/imaging-guided	No difference — often extrapolated to ICH

Educational summary for exam/viva preparation. Confirm doses and thresholds against current local protocols and the latest AHA/ASA and ESO ICH guidelines.

