

CRITICAL CARE ORDER SET

Subarachnoid Hemorrhage

ED-to-ICU management of aneurysmal SAH. Two clocks run at once — prevent re-rupture before the aneurysm is secured (< 24 h), then watch days 7–10 for delayed cerebral ischemia. Control the pressure, reverse coagulopathy, start nimodipine, and admit to a high-volume center. Adapt every threshold to your protocol and the patient.

PATIENT -----	MRN -----	ICTUS DATE / TIME -----	HUNT-HESS / WFNS -----
ALLERGIES -----	ANTICOAGULANT / ANTIPLATELET -----	ORDERING CLINICIAN -----	ATTENDING -----

01 First-hour checklist & presentation

HOURL-1 ABCs → noncontrast CT → LP if CT non-diagnostic · stat labs + 12-lead ECG · lower SBP < **140–160 mmHg** · reverse coagulopathy · neurosurgery consult · treat hydrocephalus · admit / transfer to a **high-volume center (> 35 aneurysms/yr)**.

RAPID CHECKLIST

- | | |
|---|---|
| ☐ Start ABCs — secure airway, breathing, circulation | ☐ Noncontrast head CT; LP if CT non-diagnostic |
| ☐ 12-lead ECG | ☐ Control BP; correct coagulopathy; treat hydrocephalus if present |
| ☐ Neurosurgery consult | ☐ Admit / transfer to high-volume aneurysm center |

CLINICAL CLUES

- ☐ **Thunderclap headache** — sudden, peaks < 1 min, qualitatively new / worst-ever; ± neck pain, nausea, vomiting, transient LOC or coma
- ☐ Atypical — headache not reported as severe, relieved by non-opioids / migraine meds, or self-resolving in hours; **~50% have a normal neuro exam**
- ☐ **Sentinel headache** — a prior thunderclap from rapidly expanding aneurysm, often 2–8 weeks before overt SAH
- ☐ Focused exam — GCS, pupils, fundoscopy for subhyaloid hemorrhage, nuchal rigidity, focal deficits

02 Severity grading

Hunt-Hess · +1 if vasospasm / severe systemic disease

1	Asymptomatic / mild headache, slight nuchal rigidity
2	Moderate–severe headache, nuchal rigidity; no deficit except cranial-nerve palsy
3	Drowsiness / confusion, mild focal deficit
4	Stupor
5	Coma, decerebrate posturing

WFNS · GCS + motor deficit

1	GCS 15
2	GCS 13–14, no motor deficit
3	GCS 13–14, with motor deficit
4	GCS 7–12
5	GCS 3–6

03 Imaging & lumbar puncture

NEUROIMAGING

- ☐ **Noncontrast CT** — gold standard; most sensitive in the first days, falling to **60–85%** by day 5 (false negatives with anemia, small bleed, poor image quality)
- ☐ **CTA** at the same sitting to detect aneurysm — a negative CTA alone does **not** exclude aSAH (unclear negative predictive value)
- ☐ **MRI** (hemosiderin-sensitive sequences) — most useful in delayed presentations (several days)

- ☐ Digital subtraction angiography (DSA) per neurosurgery / neuro-IR for definitive aneurysm characterization

LUMBAR PUNCTURE — if CT non-diagnostic; unnecessary once aSAH confirmed

- ☐ **Xanthochromia** — yellow CSF from hemoglobin breakdown (bilirubin); time-dependent, usually present ≥ 12 h after onset
- ☐ RBC count tubes 1 & 4 — $< 2000 \times 10^6/L$ RBCs in the last tube with no xanthochromia gives ~100% NPV for excluding SAH
- ☐ CSF protein > 100 mg/dL can cause false-positive xanthochromia; visual inspection vs spectrophotometry per lab

04

Admission, monitoring & positioning

LEVEL OF CARE

- ☐ Admit / continue in **Neuro-ICU** capable of q1h neuro checks and invasive monitoring; bedrest with cardiac monitoring

MONITORING

- | | |
|---|--|
| ☐ Vital signs q1 h (more frequent during active titration) | ☐ Continuous ECG, pulse oximetry, NIBP / arterial line |
| ☐ Neuro checks (GCS, pupils, focal deficits) q1 h or per neurosurgery; GCS on admission and with any change | ☐ Arterial line for continuous BP / frequent ABGs; central access if vasoactive infusions anticipated |

POSITIONING & ACTIVITY

- ☐ Head of bed **30°**, neck midline, avoid jugular venous obstruction; bedrest
- ☐ PT / OT / SLP consults when stable and cleared by neurosurgery

05

Airway & ventilation

INTUBATION INDICATIONS

- ☐ Inability to protect the airway · refractory hypoxemia · anticipated deterioration during intra-/inter-hospital transport

- ☐ RSI minimizing BP swings (avoid hypertensive surge that risks re-rupture); maintain $\text{PaO}_2 > 80$, PaCO_2 35–40 mmHg

06

Blood pressure, hemodynamics & fluids

BEFORE SECUREMENT Unsecured aneurysm — target **SBP < 160 mmHg** (or MAP < 110), commonly SBP 120–140; treat hypertension while avoiding hypotension. **After securement**, goals liberalize to permit higher pressures for DCI management — follow neurosurgery / ICU attending.

A · ANTIHYPERTENSIVES (SBP ABOVE GOAL)

Nicardipine

- ☐ Start 5 mg/h IV, titrate 2.5 mg/h q5–15 min, max 15 mg/h

Clevidipine

- ☐ Titratable dihydropyridine; double q2–5 min to SBP goal per protocol

Labetalol

- ☐ 10–20 mg IV over 2 min, repeat q10 min, max 300 mg; or infusion 0.5–2 mg/min

Hydralazine · caution

- ☐ 5–10 mg IV q4–6h PRN; slower onset, less titratable

AVOID Nitroprusside and nitroglycerin — cerebral vasodilation may raise ICP.

B · VASOPRESSORS (HYPOTENSION / DCI THERAPY)

- ☐ Maintain euvolemia and MAP ≥ 65 mmHg (or higher per DCI protocol) — **norepinephrine** start 0.02–0.05 mcg/kg/min IV, titrate q5–10 min
- ☐ Add vasopressin / phenylephrine per local protocol if refractory

C · FLUIDS — TARGET EUVOLEMIA

- ☐ Maintenance 0.9% NaCl 75–125 mL/h IV; strict I/O and daily weights to reduce ischemic complications
- ☐ Avoid hypotonic fluids / D5W, hypovolemia, and aggressive diuresis (unless ICP-directed and tolerated)

07 Coagulopathy reversal

STOP & REVERSE Stop all anticoagulants / antiplatelets and reverse their effect until the aneurysm is secured by clipping or coiling.

- ☐ **Warfarin / VKA with INR ≥ 1.4 — 4-factor PCC + vitamin K 10 mg IV**; FFP if PCC unavailable
- ☐ DOACs — andexanet alfa (Xa inhibitors) or idarucizumab 5 g IV (dabigatran) per protocol; 4F-PCC if specific antidote unavailable
- ☐ Thrombocytopenia $< 100,000/\mu\text{L}$ — transfuse platelets

Antiplatelet agents (aspirin / clopidogrel / prasugrel)

- ☐ Transfuse platelets **only if going to neurosurgery; not recommended** if no surgical procedure planned
- ☐ Weigh risk/benefit of **DDAVP** and other hemostatic agents case-by-case

08 Aneurysm securement & surgery

< 24 H Definitive treatment is aneurysm occlusion by **endovascular coiling or surgical clipping** — both isolate the aneurysm from the circulation and should be done as early as possible, ideally within the first **24 hours**.

- ☐ **External ventricular drain** for hydrocephalus — treats hydrocephalus and provides ICP monitoring
- ☐ If no neurosurgeon on site **and** hydrocephalus present — give **mannitol 1 g/kg** and expedite transfer to a neurosurgical center within the hour

09 Nimodipine & vasospasm / DCI monitoring

DAY 7–10 Delayed cerebral ischemia peaks days 7–10. Nimodipine improves outcomes (neuroprotective, not a vasospasm cure) — give to **every** aSAH patient unless contraindicated.

NIMODIPINE

- ☐ **60 mg PO/NG q4h × 21 days** (oral solution or crushed capsule via NG/OG — **never IV**)
- ☐ If hypotension limits therapy — reduce to **30 mg q2h** rather than discontinue; hold / reduce for **SBP < 90 mmHg** or per attending

DCI / VASOSPASM SURVEILLANCE

- ☐ Hourly neuro exam to catch deterioration through the first **7–10 days**
- ☐ **Transcranial Doppler** — every 2 days for Hunt-Hess grades 1–2, **daily** for higher grades
- ☐ For confirmed DCI after securement — induced hypertension / euvolemia; consider endovascular therapy per neuro-IR

10 ICP & EVD management (co-managed with neurosurgery)

- ☐ EVD opening / target pressure and drainage level per neurosurgery (e.g., **10–15 cm H₂O** above tragus, or continuous drainage with **ICP < 20 mmHg**); goal ICP < 20 mmHg
- ☐ CSF sampling per neurosurgery, sterile technique, only when clinically indicated

PRN ICP Maintain head/neck alignment, avoid agitation / coughing, ensure adequate sedation and analgesia before escalating to osmotherapy.

Mannitol

- ☐ **0.25–1 g/kg IV** over 20–30 min; check Na + osmolality before repeats; avoid if hypotensive / hypovolemic

Hypertonic saline 3%

- ☐ Bolus **2–3 mL/kg IV** over 10–20 min, or infusion **0.5–2 mL/kg/h** to Na 145–155 and ICP goal

11 Seizure management

CONTEXT ~20% seize pre-hospital, another 5–10% after admission; early seizures raise re-rupture and ICP risk. Routine prophylaxis is debated — AHA / NCS suggest considering short-term ASM in high-risk patients immediately post-bleed.

PROPHYLAXIS — short-term, poor-grade / cortical involvement, institution-dependent

- ☐ **Levetiracetam** load **1–2 g IV** once, then **500–1000 mg q12h** (renal adjust) — often 3–7 days or per EEG / neurosurgery

ACUTE SEIZURE

- ☐ **Lorazepam 2 mg IV** (0.1 mg/kg, max 4 mg), may repeat once after 5 min; then levetiracetam **1–3 g IV** load → **1–1.5 g q12h**; escalate per status epilepticus protocol
- ☐ Persistent altered mental status → **continuous EEG** for nonconvulsive status. Prefer agents other than phenytoin (worse long-term cognition)

12 Sedation, analgesia & delirium

RE-RUPTURE Discomfort, straining, Valsalva, or writhing can rupture an unsecured aneurysm — treat pain / anxiety. But avoid **over-sedation**, which masks hydrocephalus-related obtundation. Use short half-life IV agents (e.g., fentanyl).

ANALGESIA

- ☐ Acetaminophen **650–1000 mg PO/NG/PR q6h PRN** (max 3–4 g/day); fentanyl **25–50 mcg IV q30–60 min PRN** or **25–200 mcg/h**; alt hydromorphone **0.2–0.6 mg IV q2–4h PRN**

SEDATION (IF INTUBATED / AGITATED)

- ☐ **Propofol** start **5–10 mcg/kg/min IV**, titrate to RASS –1 to 0 (deeper for ICP); range **5–80** (watch PRIS); or **dexmedetomidine 0.2–1.5 mcg/kg/h**, no bolus

DELIRIUM

- ☐ Avoid benzodiazepines unless specific indication; daily sedation breaks when safe; nonpharmacologic bundle (orientation, early mobility, glasses / hearing aids)

13 Glucose, temperature, prophylaxis & labs

GLUCOSE & TEMPERATURE

- ☐ POC glucose **q4–6 h**; target **140–180 mg/dL**, avoid hypoglycemia
- ☐ Treat fever aggressively (normothermia is neuroprotective) — acetaminophen, surface cooling, intravascular cooling if refractory

DVT, GI & BOWEL PROPHYLAXIS

- ☐ **SCDs on admission**; pharmacologic VTE prophylaxis (heparin 5,000 units SC q8–12h or enoxaparin 30–40 mg SC) only **after securement** when neurosurgery agrees

- ☐ Stress ulcer — pantoprazole **40 mg IV/PO daily** or famotidine **20 mg IV/PO q12h** if intubated / coagulopathic / high-risk
- ☐ Bowel — docusate **100 mg BID**, senna **8.6–17.2 mg daily**, bisacodyl **10 mg PR PRN** no BM 48–72 h (prevent straining)

LABS & ELECTROLYTES

- ☐ Admission — CBC, CMP, Mg, Phos, PT/INR, aPTT, ABG, troponin, type & screen, lipid panel, HbA1c
- ☐ Daily (or more) CBC, CMP, Mg, Phos; **serum Na + osmolality** if on hypertonic therapy — watch for cerebral salt wasting / SIADH
- ☐ Maintain Na **135–145 mEq/L** (or higher per ICP/HTS protocol), K $\geq$ **4.0**, Mg $\geq$ **2.0 mg/dL**

14 Neurologic deterioration — differential

ANY DECLINE For new deterioration, work the differential immediately — most are reversible if caught early.

Re-rupture

Repeat noncontrast CT is diagnostic.

Hydrocephalus

Repeat CT diagnostic → EVD.

Seizure

Consider continuous EEG.

Vasospasm / DCI

Flow change on TCD; confirm with imaging.

Cardiopulmonary

Neurogenic pulmonary edema or catecholamine (stress) cardiomyopathy presenting as worsening hypoxia / hypotension — echocardiography is diagnostic for the cardiomyopathy.

15 Consults & medications to avoid

CONSULTS

- ☐ **Neurosurgery** — securement, EVD, surgical decisions
- ☐ **Interventional neuroradiology** — endovascular coiling
- ☐ **Neurology** — EEG, seizure, DCI monitoring
- ☐ **Rehab (PT/OT/SLP)**; social work / case management; palliative care for poor-

AVOID / USE WITH CAUTION

- ☐ Anticoagulants / antiplatelets unless specifically ordered (usually delayed until neuro decision)
- ☐ Hypotonic / glucose-only fluids; large or rapid BP drops
- ☐ Nitroprusside / nitroglycerin (raise ICP); deep sedation without clear indication

EDUCATIONAL USE ONLY

Not a substitute for clinical judgement. Verify doses, allergies, renal/hepatic function, and contraindications. Adapt all agents, BP targets, and timing to your institutional neurocritical-care protocol and the individual patient.

Spreading knowledge
Improving outcomes