

**Special Section: Guidelines for the
MANAGEMENT OF ANEURYSMAL SUBARACHNOID HEMORRHAGE**

MANAGEMENT OF ANEURYSMAL SUBARACHNOID HEMORRHAGE

I. DIAGNOSIS OF SUBARACHNOID HEMORRHAGE (SAH)

Clinical – may present with sudden, severe headache (thunderclap headache), loss of consciousness or adult-onset seizures.

Neurological examination – signs of meningeal irritation (i.e., neck rigidity), altered or decreased level of consciousness, CN III or VI nerve palsy.

Patients may or may not have focal neurological deficits

Emergent referral to a neurologist/neurosurgeon and transfer to a facility with capabilities of managing acute stroke are recommended.

II. NEURODIAGNOSTIC EXAMINATIONS

1. Non-contrast cranial CT scan should be done and interpreted immediately. Hyperdense blood in the basal cisterns is usually diagnostic, but parenchymal clot in the temporal or basal frontal, and intraventricular hemorrhage are also suggestive of an underlying aneurysm.
2. Lumbar tap with CSF analysis in the absence of focal neurological signs is an option in the following cases:
 - Cranial CT scan is negative
 - Cranial CT scan is unavailable
 - Special circumstances (e.g., issues with CT scan cost)Multiple specimens (at least 3 tubes) should be collected to rule out traumatic tap. Opening pressures should be measured.
3. Cerebral angiogram is the gold standard in determining the cause of SAH. Early angiography should be performed in all cases, whether poor- or good-grade SAH. If the initial angiogram is negative, a repeat angiogram should be performed after 2 weeks.
4. Good-quality CT angiogram and MR angiography are other options.

III. SAH GRADING

1. Hunt and Hess Classification is recommended for the clinical grading of SAH.

Table 9: Hunt and Hess Classification

Grade	Description
1	Asymptomatic, or mild headache, slight nuchal rigidity
2	Moderate to severe headache, nuchal rigidity, no neurologic deficit other than cranial nerve palsy
3	Drowsiness, confusion, or mild focal signs
4	Stupor, moderate to severe hemiparesis, possibly early

	decerebrate signs
5	Deep coma, decerebrate rigidity, moribund appearance

- Fisher grading may be used as a guide in considering therapeutic options.

Table 10: Fisher Grading

Grade	Description (Blood on CT)
1	No subarachnoid blood detected
2	Diffuse or vertical layers <1 mm thick*
3	Localized clot or vertical layer \geq 1 mm thick*
4	Intracerebral or intraventricular clot with diffuse or no SAH

*"Vertical layer" refers to blood in the subarachnoid spaces including in the interhemispheric fissure and cisterns

IV. GENERAL SYMPTOMATIC TREATMENT

- Absolute bed rest in a quiet, comfortable environment
- Cardiac monitoring and frequent assessment of neuro-vital signs
- Soft diet for alert patients, nasogastric-tube (NGT) feedings if with impaired consciousness
- Analgesics, including opiates for headache. Avoid aspirin and other NSAIDs
- Paracetamol and cooling blankets, if febrile
- Maintenance of euglycemia
- Sedatives, if agitated
- Antiemetics, as needed for nausea and vomiting
- Stool softeners

V. EARLY SPECIFIC TREATMENT

- Nimodipine: A systematic review showed a significant reduction in poor outcomes with calcium antagonists for SAH. The evidence rests mainly on one large trial with oral nimodipine. It is uncertain whether nimodipine acts through neuroprotection or through reduction of the frequency of vasospasm, or both. Nimodipine 60 mg every 4 hours by mouth or NGT for 3 weeks is recommended.
- Anticonvulsants: Short-term anticonvulsants are recommended for patients with documented seizures in the acute phase of SAH. Although no randomized trial has proven that prophylactic anticonvulsants in SAH is effective, they can be considered in patients with significant cortical damage, thick cisternal clot, parenchymal hemorrhage, or those in coma. Phenytoin is the recommended anticonvulsant, given as a 15 mg/kg IV loading dose followed by 3 to 5 mg/kg/day in divided doses.
- Steroids: Corticosteroids have no proven role and are not recommended for use in SAH.

4. Antifibrinolytic agents are not recommended. Although they reduce the risk of rebleeding, they are associated with a higher rate of cerebral ischemia.
5. Manage increased ICP
6. BP management: Although the best antihypertensive agent and BP remains unsettled, IV nicardipine to a target SBP<150 in the pre-operative phase is reasonable.

VI. PREVENTION AND MANAGEMENT OF VASOSPASM

1. Monitoring: Serial transcranial Doppler (TCD) is recommended for the diagnosis and monitoring of vasospasm.
2. Maintenance of euvolemia: Evidence on the use of blood volume expansion alone or in combination with induced hypertension and hemodilution (triple H therapy) in the prophylaxis and management of secondary ischemia (vasospasm) following aneurysmal SAH is lacking.
3. Endovascular angioplasty (chemical +/- mechanical) is a effective way of managing vasospasm. Intervention has to be early before clinical signs suggesting irreversible infarction (i.e., hemiplegia) are present.
4. Treatment strategies undergoing current investigation include intravenous magnesium sulfate and statins.

VII. TREATMENT OF SAH

Excluding the aneurysm from the circulation is the main goal of treatment. Obliteration the aneurysm can be achieved through surgical clipping or endovascular coiling.

VIII. TIMING OF SURGERY

1. Definitions:
 - Early surgery is surgery performed within 72 hours from ictus
 - Late surgery is surgery performed more than 3 days from ictus.
 2. Indications:
 - a. Early, immediate surgery is recommended for good- to moderate-grade (Hunt and Hess I-III) aneurysmal SAH patients to minimize the chance of a devastating rebleed.
 - b. For poor grade patients (Grade IV-V), early surgery is recommended in the presence of:
 - Hematoma
 - Hydrocephalus
- Surgery may be delayed in the presence of:
- Ischemia or infarction
 - Severe angiographic vasospasm

- Casted ventricles
 - Diffuse SAH (Fisher Grade III) Complex aneurysm on angiography.
- c. A maximum cut-off age for early surgical management (for the elderly) is not recommended in the absence of organ failure.

IX. COILING

1. Can be performed early in both good- and poor-grade patients.
2. Reduces the rebleed rate for poor-grade patients who would otherwise be treated conservatively.
3. Vasospasm is not a contraindication and can be dealt with endovascularly during coiling
4. Can be performed under local anesthesia if needed.

X. WHERE TO ADMIT

SAH patients should be admitted at the Stroke Unit or Intensive Care Unit. In the absence of an ASU/ICU, patients may be placed in a quiet, regular room with very close monitoring.

XI. NURSING ISSUES:

SOLICITUDE, THOUGHTFULNESS, PROTECTIVENESS

1. Acute Phase
 - a. Care must be exercised to prevent further ICP increase
 - b. There should be close monitoring of fluid status and for possible secondary cardiac, respiratory or metabolic insults.
 - c. Persistent headache, deteriorating level of consciousness, other signs of increased ICP and development of focal neurological deficits should be recognized for urgent referral to a neurologist or neurosurgeon.
2. Convalescent Phase
 - a. Presence of sensory or perceptual alterations, motor deficits, and impaired verbal communication and physical mobility should be addressed in nursing care.
 - b. Feelings of depression should be monitored. Emotional support and encouragement should be provided.
 - c. Upon discharge, patients and relatives should be educated on continuity of care, medication intake and follow-up

XII. REHABILITATION

1. Supportive rehabilitation is done initially in the pre-operative phase.

2. Early rehabilitation is recommended for all SAH patients in the post-operative period.

Bibliography

Academy of Filipino Neurosurgeons (AFN) Guidelines on the Management of Aneurysmal Subarachnoid Hemorrhage (unpublished).

Alberico RA, Patel M, Casey S; et al. Evaluation of the circle of willis with three-dimensional CT angiography in patients with suspected intracranial aneurysms. *Am J Neuroradiol* 1995;16:1571-1578.

Andaluz N, Tomsick TA, Tew JM, et al. Indications for Endovascular Therapy for Refractory vasospasm After Aneurysmal Subarachnoid Hemorrhage. *Surg Neurol* 2002;58:131-138

Anderson GB, Steinke DE, Petruk KC et al. Computed tomographic angiography versus digital subtraction angiography for the diagnosis and early treatment of ruptured intracranial aneurysms. *Neurosurg* 1999;45:1315-1320.

Anzalone N, Triulzi F, Scotti G. Acute subarachnoid hemorrhage: 3D time of flight MR angiography versus intra-arterial digital angiography. *Neuroradiol* 1995;37:257-261.

Asano T, Takakura K, Sano K, et al. Effects of hydroxyl radical scavenger on delayed ischemic neurological deficits following aneurysmal subarachnoid hemorrhage: results of a multicenter, placebo-controlled double-blind trial. *J Neurosurg* 1996;84:792-803.

Babikian V, Feldmann E, Wechsler L, et al. Transcranial doppler ultrasonography year 2000 update. *J Neuroimaging* 2000;10:101-115.

Baker C, Prestigiacomo, et al. Short term perioperative anticonvulsant prophylaxis for the surgical treatment of low-risk patients with intracranial aneurysms. *Neurosurg* 1995;37:863-871.

Butzkueven H, Evans AH, Pittman A, et al. Onset seizures independently predict poor outcome after subarachnoid hemorrhage. *Neurology* 2000;55:1315-1320.

De Gans K, Nieuwkamp DJ, Rinkel G, Algra A. Timing of surgery in subarachnoid hemorrhage: a systematic review of literature. *Neurosurg* 2002;50:336-342.

Feigin VL, Rinkel GJ, Algra A, et al. Calcium antagonists in patients with aneurysmal subarachnoid hemorrhage: a systematic review. *Neurology* 1998;50:876-883.

Findlay JM and Canadian Neurosurgical Society Practice Guidelines Review Group. Current management of aneurysmal subarachnoid hemorrhage Guidelines from the Canadian Neurological Society. *Can J Neurol Sci* 1997;24:161-170.

Fisher CM, Kristler JP, Davis JM. Relation of Cerebral Vasospasm to Subarachnoid Hemorrhage visualized by CT Scanning. *Neurosurg* 1980;6:1-9.

Greenberg, M. *Handbook of Neurosurgery* 2nd ed. FL: Greenberg Graphics; 1991.

Haley EC Jr, Kassell NF, Apperson-Hansen C, et al. A randomized, double-blind, vehicle controlled trial of Tirilazad mesylate in patients with aneurysmal subarachnoid hemorrhage: a cooperative study in North America. *J Neurosurg* 1997;86:467-474.

Hope JK, Wilson JL, Thomson FJ. Three-dimensional CT angiography in the detection and characterization of intracranial berry aneurysm. *Am J Neuroradiol* 1996;17:437-445.

Hunt WE, Hess RM. Surgical risk as related to time of intervention in the repair of intracranial aneurysms. *J Neurosurg* 1968;28:14-19.

ISAT Collaborative Group. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with intracranial aneurysms: a randomised trial. *Lancet* 2002;360:1267-1274.

Johansson M, Cesarini KG, Contant CF, et al. Changes in intervention and outcome in elderly patients with subarachnoid hemorrhage. *Stroke* 2001;32:2845-2949.

Kassell NF, Haley EC Jr, Apperson-Hansen C, et al. Randomized, double-blind, vehicle controlled trial of tirilazad mesylate in patients with aneurysmal subarachnoid hemorrhage: a cooperative study in Europe, Australia, and New Zealand. *J Neurosurg* 1996;84:221-228.

Lanzino G, Kassell NF. Double-blind, randomized, vehicle controlled study of high dose tirilazad mesylate in women with aneurysmal subarachnoid hemorrhage. Part II. A cooperative study in North America. *J Neurosurg* 1999a;90:1018-1024.

Lanzino G, Kassell NF, Dorsch NW, et al. Double-blind, randomized, vehicle controlled study of high-dose tirilazad mesylate in women with aneurysmal subarachnoid hemorrhage. Part I. A cooperative study in Europe, Australia, New Zealand, and South Africa. *J Neurosurg*. 1999b;90:1011-1017.

Lennihan, Laura MD, Mayer, Stephan MD, Fink, Matthew MD et al. Effect of hypervolemic therapy on cerebral blood flow after subarachnoid hemorrhage: a randomized controlled trial. *Stroke* 2000; 31: 383-391.

Linn FH, Rinkel GJ, Algra A, van Gijn J. Headache characteristics in subarachnoid hemorrhage and benign thunderclap headache. *J Neurol Neurosurg Psychiatry* 1998;65:791-793.

Lysakowski C, Walder B, Costanza MC, Tramer MR. Transcranial Doppler versus angiography in patients with vasospasm due to a ruptured cerebral aneurysm: A systematic review. *Stroke* 2001;32:2292-2298.

Mayberg, Marc MD, Batjer H. et al. Guidelines in the management of aneurysmal subarachnoid hemorrhage : A statement for healthcare professionals from a special writing group of the Stroke Council, American Heart Association. *Stroke*1994;25:2315-2328.

Molyneux AJ, Kerr Rs, Yu LM, et al. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with intracranial aneurysms: a randomised comparison of effects on survival, dependency, seizures, rebleeding, subgroups and aneurysm occlusion. *Lancet* 2005;366:809 -817.

Ohman J, Heiskanen O. Timing of operation for ruptured supratentorial aneurysms: a prospective randomized study. *J Neurosurg* 1989;70:55-60.

Pickard JD, Murray GD, Illingworth R, et al. Effect of oral nimodipine on cerebral infarction and outcome after subarachnoid hemorrhage: British aneurysm nimodipine trial. *BMJ* 1989;298:636-642.

Pinto AN, Canhao P, Ferro JM. Seizures at the onset of subarachnoid hemorrhage. *J Neurol* 1996;243:161-164.

Rhoney DH, Tipps LB, Murry KH, et al. Anticonvulsant prophylaxis and timing of seizures after aneurysmal subarachnoid hemorrhage. *Neurology* 2000;55:258-265.

Rinkel GJE, Feigin VL, Algra A, et al. Calcium antagonists for aneurysmal subarachnoid hemorrhage (Review). *The Cochrane Database of Systematic Reviews* 2005. Issue 1. CD 00027.pub2

Rinkel GJE, Feigin VL, Algra A, van Gijn J. Circulatory volume expansion therapy for aneurysmal subarachnoid hemorrhage. *The Cochrane Database of Systematic Reviews* 2004. Issue 4. CD 000483 pub2.

Roos Y; for the STAR Study Group. Antifibrinolytic treatment in subarachnoid hemorrhage A randomized placebo-controlled trial. *Neurology* 2000;54:77-82.

Sloan MA, Haley EC Jr, Kassell NF, et al. Sensitivity and specificity of transcranial doppler ultrasonography in the diagnosis of vasospasm following subarachnoid hemorrhage. *Neurology* 1989;39:1514-1518.

Sloan Mam Burch CM, Wozniak MA, et al. Transcranial doppler detection of vertebrobasilar vasospasm following subarachnoid hemorrhage. *Stroke* 1994;25: 2187-2197.

Tolias CM, Choksey MS. Will increased awareness among physicians of the significance of sudden agonizing headache affect the outcome of subarachnoid hemorrhage? Coventry and Warwickshire Study: audit of subarachnoid hemorrhage. *Stroke* 1996;27:807-812.

Treggiari-Venzi M, Suter P, Romand JA. Review of medical prevention of vasospasm after aneurysmal subarachnoid hemorrhage: a problem of neurointensive care. *Neurosurg* 2001;48:249-262.

van Gijn J and Rinkel GJE. Subarachnoid hemorrhage: diagnosis, causes and management. *Brain* 2001;124:249-279.

van Gijn J, van Dongen KJ. Computed tomography in the diagnosis of subarachnoid hemorrhage and ruptured aneurysm. *Clin Neurol Neurosurg* 1980a;82:11-24.

van Gijn J, van Dongen KJ. The time course of aneurysmal hemorrhage on computed tomograms. *Neuroradiol* 1982;23:153-156.

van der Wee N, Rinkel GJ, Hasan D, van Gijn J. Detection of subarachnoid hemorrhage on early CT: is lumbar puncture still needed after a negative scan? *J Neurol Neurosurg Psychiatry* 1995; 58:357-359.

Velthuis BK, van Leeuwen MS, Witkamp TD, et al. CT angiography: source images and postprocessing techniques in the detection of cerebral aneurysms. *AJR AM J Roentgenol* 1997;169:1411-1417.

Velthuis BK, Rinkel GJ, Ramos LM, et al. Subarachnoid hemorrhage: aneurysm detection and preoperative evaluation with CT angiography. *Radiology* 1998;208:423-430.

Velthuis BK, Rinkel GJ, Ramos LM, et al. Computerized tomography angiography in patients with subarachnoid hemorrhage: from aneurysm detection to treatment without conventional angiogram. *J Neurosurg* 1999a;91:761-767.

Vermeulen M, Lindsay KW, Murray GD, et al. Antifibrinolytic treatment in subarachnoid hemorrhage. *N Engl J Med* 1984. 311: 432-7.

Vermeulen M, van Gijn J. The diagnosis of subarachnoid hemorrhage. *J Neurol Neurosurg Psychiatry* 1990;53:365-372.

Vermeulen M, Lindsay KW, Murray GD, et al. Antifibrinolytic treatment in subarachnoid hemorrhage. *N Engl J Med* 1984;311:432-437.

Wardlaw JM, White PM. The detection and management of unruptured intracranial aneurysm (Review). *Brain* 2000;123:205-221.

Whitfield PC, Kirkpatrick PJ. Timing of surgery for aneurysmal subarachnoid hemorrhage. *Cochrane Database System Rev* 2001 (2): CD 001697

Wiebers D, Fiegen V, Brown R. *Handbook of Stroke*, PA: Lippincott-Raven Publishers; 1997.

Yvo R, Rinkel G, Vermeulen M, et al. Antifibrinolytic therapy for aneurysmal subarachnoid hemorrhage: a major update of a cochrane review. *Stroke* 2003;34:2308-2309.

