MAYO CLINIC

Thunderclap headache
Diagnosis and management

DAVID DODICK, M.D.

PROFESSOR, EMERITUS

MAYO CLINIC

ATRIA INSTITUTE

MAYO CLINIC

Disclosure-5 year

- Other: Consulting, Amgen, AbbVie, Biohaven, Lundbeck, Eli Lilly, Novartis, Pfizer, Teva Atria, CapiThera Ltd., Cerecin, Ceruvia Lifesciences LLC, CoolTech, Ctrl M, Allergan, GlaxoSmithKline, Impel, Satsuma, Theranica, WL Gore, Genentech, Nocira, Perfood, Praxis, AYYA Biosciences, Revance. Honoraria: American Academy of Neurology, Headache Cooperative of the Pacific, Canadian Headache Society, MF Med Ed Research, Biopharm Communications, CEA Group Holding Company (Clinical Education Alliance LLC), Teva (speaking), Amgen (speaking), Eli Lilly (speaking), Lundbeck (speaking), Pfizer (speaking), Vector Psychometric Group, Clinical Care Solutions, CME Outfitters, Curry Rockefeller Group, DeepBench, Global Access Meetings, KLJ Associates, Academy for Continued Healthcare Learning, Majallin LLC, Medlogix Communications, Medica Communications LLC, MJH Lifesciences, Miller Medical Communications, WebMD Health/Medscape, Wolters Kluwer, Oxford University Press, Cambridge University Press. Non-profit board membership: American Brain Foundation, American Migraine Foundation, ONE Neurology, Precon Health Foundation, International Headache Society Global Patient Advocacy Coalition, Atria Health Collaborative, Arizona Brain Injury Alliance, Domestic Violence HOPE Foundation/Panfila. Research support: Department of Defense, National Institutes of Health, Henry Jackson Foundation, Sperling Foundation, American Migraine Foundation, Henry Jackson Foundation, Patient Centered Outcomes Research Institute (PCORI). Stock options/shareholder/patents/board of directors: Ctrl M (options), Aural analytics (options), Axon Therapeutics, ExSano (options), Palion (options), Man and Science, Healint (options), Theranica (options), Second Opinion/Mobile Health (options), Epien (options/board), Nocira (options), Matterhorn (shares/board), Ontologics (shares/board), King-Devick Technologies (options/board), Precon Health (options/board), AYYA Biosciences (options), Axon Therapeutics (options/board), Cephalgia Group (options/board), Atria Health (options/employee). Patent 17189376.1-1466:vTitle: Onabotulinum Toxin Dosage Regimen for Chronic Migraine Prophylaxis (Non-royalty bearing). Patent application submitted: Synaquell® (Precon Health)

MAYO CLINIC

Learning objectives

- At the completion of this presentation, the participant will be able to:
  - Define thunderclap headache and identify the differential diagnosis
  - Describe the diagnostic evaluation of patients with thunderchap headache
  - Describe the evaluation, risk factors and prognosis for, and management of patients with reversible cerebral vasoconstriction syndrome

MAYO CLINIC

THUNDERCLAP HEADACHE: SYMPTOM OF UNRUPTURED CEREBRAL ANEURYSM

JOHN WEST DAY NEIL H. RASKIN

Department of Neurology, University of California, San Francisco, California, USA

Summary

Many patients with a ruptured berry aneurysm report an intense sentinel headache of sudden onset in the weeks before rupture. Such headaches have been attributed to a leak of blood, which implies that partial rupture has occurred. A case is reported of a patient who had severe headaches which seemed to be caused by an unruptured cerebral aneurysm, accompanied by diffuse cerebral vasospasm. Headache episodes with the thunderclap profile may require angiography for diagnosis even if the cerebrospinal fluid is bloodless. *The Lancet Nov 29,1986;1247*

- **Explosive headache with peak intensity at onset <60s**
- **Describes the presentation of an unruptured cerebral aneurysm (as sudden and unexpected as a "*clap of thunder*") associated with multifocal vasospasm**

MAYO CLINIC

Case Report

Nonaneurysmal thunderclap headache with diffuse, multifocal, segmental, and reversible vasospasm

DW Dodick[1], RD Brown Jr[1], JW Britton[1], J Huston III[2]
Department of Neurology[1] and the Section of Neurologic Radiology[2], Mayo Clinic and Mayo Foundation, Rochester, Minnesota, USA

Cephalalgia

Dodick DW, Brown RD Jr, Britton JW, Huston J III. Nonaneurysmal thunderclap headache with diffuse, multifocal, segmental, and reversible vasospasm. Cephalalgia 1999;19:118–23. Oslo. ISSN 0333-1024

Objective. To highlight the clinical profiles and angiographic findings of two patients with recurrent thunderclap headache (TCH) without subarachnoid hemorrhage (SAH) and to present modified diagnostic criteria for this unusual syndrome. *Background*. TCH may be a benign recurrent headache disorder or it may represent a serious underlying process such as SAH or venous sinus thrombosis. The pathophysiology of this disorder in the absence of underlying pathology is not well understood and its potential angiographic features are not well appreciated. *Methods*. Two case descriptions with illustrative angiography. *Results*. Both cases demonstrated the potential for reversible intracranial vasospasm without intracranial aneurysm or SAH and a benign clinical outcome. *Conclusions*. Primary TCH has a distinctive clinical and angiographic profile and must be distinguished from central nervous system vasculitis and SAH. □ *Thunderclap headache, vasospasm*

David D Dodick, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA. Tel. +1 507 284 3335, fax. +1 507 284 2107, e-mail. dodick.david@mayo.edu. *Received 21 August 1998, accepted 4 December 1998*

CLINICAL CORRESPONDENCE

Thunderclap headache associated with reversible vasospasm and posterior leukoencephalopathy syndrome

DW Dodick, EJ Eross, JF Drazkowski & TJ Ingall
Department of Neurology, Mayo Clinic, Scottsdale, AZ, USA

Cephalalgia

David W. Dodick, Department of Neurology, Mayo Clinic, 13400 East Shea Blvd, Scottsdale, AZ 85259, USA. Tel. +480 301 8112, fax +480 301 8451, e-mail dodick.david@mayo.edu *Recived 26 March 2002, accepted 10 December 2002*

EDITORIAL COMMENTARY

Bathing headache: a variant of idiopathic thunderclap headache

As more cases of idiopathic thunderclap headache are reported, a definite clinical picture is beginning to emerge. As these and other cases in the literature demonstrate, ITH appears to be a predominantly uniphasic headache syndrome which may occur spontaneously or be provoked by a variety of factors (e.g. bathing, valsalva, sexual intercourse and other forms of intense exertion, postpartum period) in predisposed individuals during a period of vulnerability (5). During this period, patients experience recurrent thunderclap headaches over a period of 1–2 weeks and may or may not have hypertension, posterior leukoencephalopathy, and diffuse reversible cerebral vasospasm (6, 7). In rare circumstances, transient neurological deficits or cerebral infarction may occur, presumably in cases where vasospasm is sufficiently severe and prolonged to produce cerebral ischemia (8, 9). In some cases of ITH with reversible vasospasm, CSF pleocytosis and protein elevation have been noted (10).

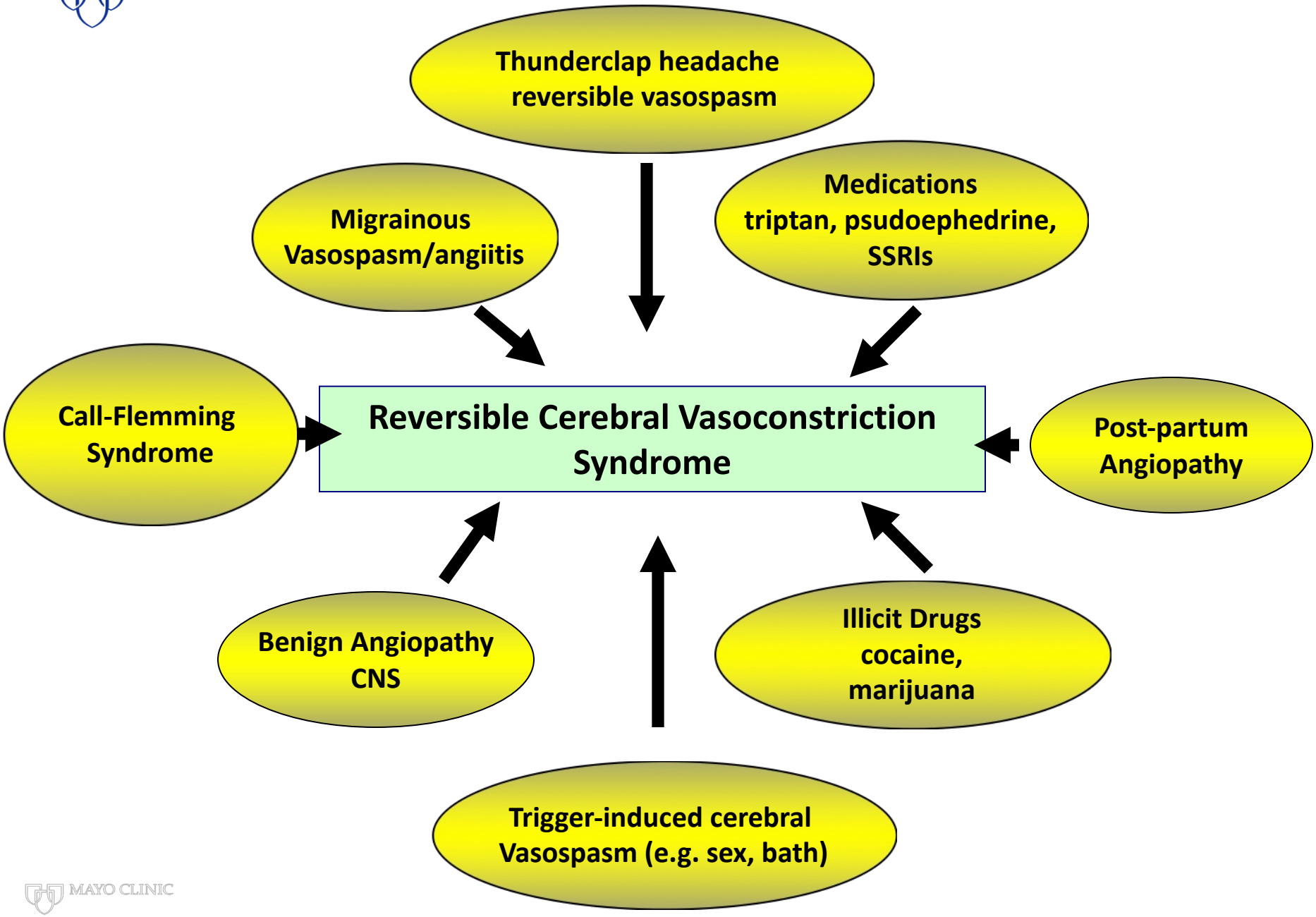
Arthritis & Rheumatism (Arthritis Care & Research)
Vol. 47, No. 6, December 15, 2002, pp 662–669
DOI 10.1002/art.10797

ORIGINAL ARTICLE

Benign Angiopathy of the Central Nervous System: Cohort of 16 Patients With Clinical Course and Long-Term Followup

RULA A. HAJJ-ALI, ANTHONY FURLAN, ALEX ABOU-CHEBEL, AND LEONARD H. CALABRESE

MAYO CLINIC


Thunderclap headache
reversible vasospasm
Migrainous
Vasospasm/angiitis
Medications
triptan, psudoephedrine,
SSRIs
Call-Flemming
Syndrome
Reversible Cerebral Vasoconstriction
Syndrome
Post-partum
Angiopathy
Benign Angiopathy
CNS
Illicit Drugs
cocaine,
marijuana
Trigger-induced cerebral
Vasospasm (e.g. sex, bath)

MAYO CLINIC

Annals of Internal Medicine | Review

Narrative Review: Reversible Cerebral Vasoconstriction Syndromes

Leonard H. Calabrese, DO; David W. Dodick, MD; Todd J. Schwedt, MD; and Aneesh B. Singhal, MD

Reversible cerebral vasoconstriction syndromes (RCVS) comprise a group of diverse conditions, all characterized by reversible multifocal narrowing of the cerebral arteries heralded by sudden (thunderclap), severe headaches with or without associated neurologic deficits. Reversible cerebral vasoconstriction syndromes are clinically important because they affect young persons and can be complicated by ischemic or hemorrhagic strokes. The differential diagnosis of RCVS includes conditions associated with thunderclap headache and conditions that cause irreversible or progressive cerebral artery narrowing, such as intracranial atherosclerosis and cerebral vasculitis. Misdiagnosis as primary cerebral vasculitis and aneurysmal subarachnoid hemorrhage is common because of overlapping clinical and angiographic features. However, unlike these more ominous conditions, RCVS is usually self-limited: Resolution of headaches and vasoconstriction occurs over a period of days to weeks. In this review, we describe our current understanding of RCVS; summarize its key clinical, laboratory, and imaging features; and discuss strategies for diagnostic evaluation and treatment.

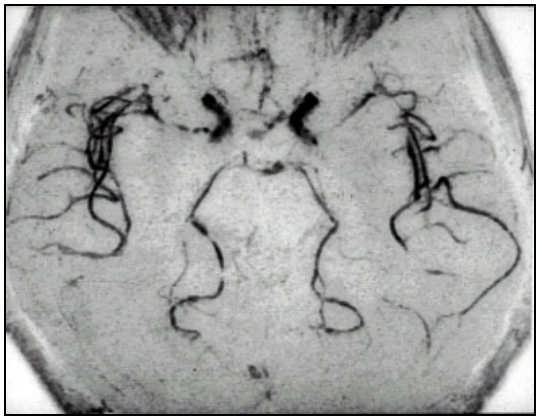
Ann Intern Med. 2007;146:34-44. www.annals.org

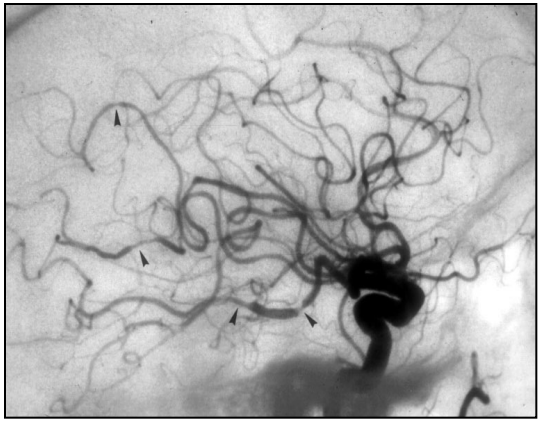
For author affiliations, see end of text.

MAYO CLINIC

Reversible Cerebral Vasoconstriction Syndrome Initial Criteria Proposed

- Severe, acute headache, with or without additional neurologic signs or symptoms
- No evidence for aneurysmal subarachnoid hemorrhage
- Angiography documenting multifocal segmental cerebral artery vasoconstriction
- Normal or near-normal CSF (protein<80mg%, wbc< 10/ mm^3, normal glucose)
- Angiographic reversibility <12 weeks
- Uniphasic course without new symptoms more than 1 month after clinical onset[2]





1. Calabrese LH, Dodick DW, Schwedt TJ, Singhal AB. Ann Intern Med. 2007; 146: 34-44.
2. Ducros A, et al. Lancet Neurol 2012;11:906-917

MAYO CLINIC

Clinical Spectrum

Valslva most common trigger (80%)

Initial angiography normal in 20%

Up to 20% ICH; 39% infarction; 38% PRES; 20% deficit

Mean age (range)	47·7 years (10–76)	43·2 years (19–70)	42·5 years (13–69)
Sex distribution (men:women)	1:8·6	1:2·2	1:4·3
Any precipitant for syndrome	8%	62%	..
Post partum†	1%	13%	11%
Vasoactive substances	3%	52%	42%
Headaches at onset	100%	100%	95%
Recurrent thunderclap	100%	91%	78%
Any trigger for headaches	80%	75%	..
Focal neurological deficit	8%	25%	43%
Seizures	1%	4%	17%
Blood pressure surge	46%	34%	Some‡
Initial CT or MRI normal	..	80%	55%
Any abnormal CT or MRI	12%	37%	81%
Subarachnoid haemorrhage	0%§	30%	34%
Intracerebral haemorrhage	0%§	12%	20%
Cerebral infarction	8%	6%	39%
Posterior reversible encephalopathy syndrome	9%	8%	38%
CSF analysis available	18%	88%	82%
Protein concentration >60 mg/dL	0%	12%	16%
5–10 white blood cells per µL	..	17%	12%
>10 white blood cells per µL	0%	8%	3%
Death	0%	0%	2%
Persistent focal neurological deficit from stroke at follow-up	3%	6%	20%

Chen SP, et al. *Ann Neurol* 2010;67: 648–56.
Ducros A, et al. *Stroke* 2010;41: 2505–11.
Singhal AB, *Arch Neurol* 2011;68: 1005–12.

MAYO CLINIC

Thunderclap Headache: ICHD-3

Description: High-intensity headache of abrupt onset, mimicking that of ruptured cerebral aneurysm, in the absence of any intracranial pathology.

Diagnostic criteria:

1. **Severe head pain fulfilling criteria B and C**
2. **Abrupt onset, reaching maximum intensity in <1 minute**
3. **Lasting for ≥5 minutes**
4. **Not better accounted for by another ICHD-3 diagnosis[1;2].**

Notes:

- **Frequently associated with serious vascular intracranial vascular disorders**
- ***Primary thunderclap headache* should be a diagnosis of last resort, reached only when all organic causes have been demonstrably excluded. This implies normal brain imaging, including the brain vessels, and/or normal CSF.**
- **Vasoconstriction may not be observed in the early stage of RCVS. For this reason, *probable primary thunderclap headache* is not a diagnosis that should be made even temporarily.**
- **Comment: Evidence that thunderclap headache exists as a primary disorder is poor: the search for an underlying cause should be both expedited and exhaustive.**

Cephalalgia. 2018 Jan;38(1):1-211.

MAYO CLINIC

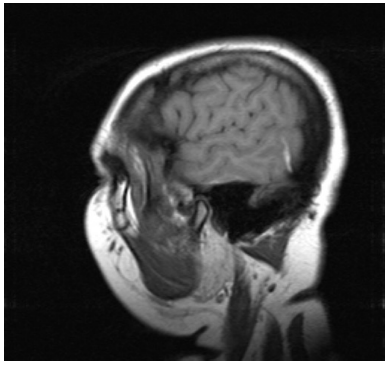
Disorders associated with thunderclap headache

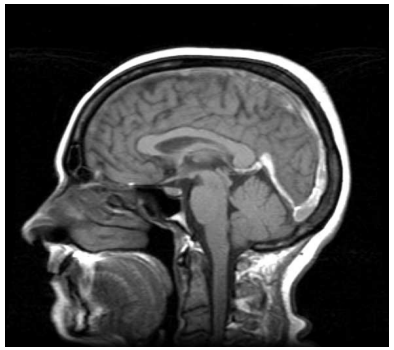
Vascular (vascular imaging required)	Non-Vascular
Subarachnoid hemorrhage	Spontaneous intracranial hypotension
Arterial (vertebral, carotid, intracranial artery) dissection	Pituitary apoplexy
Cerebral venous sinus/cortical vein thrombosis	Colloid cyst of the third ventricle
Reversible cerebral vasoconstriction syndrome	Acute hypertensive crisis

Dodick DW. Neurology Continuum 2021; 27(3):572-585

CEREBRAL VENOUS SINUS THROMBOSIS

- Thunderclap HA in 10% (Headache 75%)
- CT normal in 25%
- CSF: normal in 70% (lymphocytosis, rbcs, and/or increased protein in 30%)
- Up to 40% may have elevated CSF opening pressure
- If CVST suspected, MRI/MRV study of choice

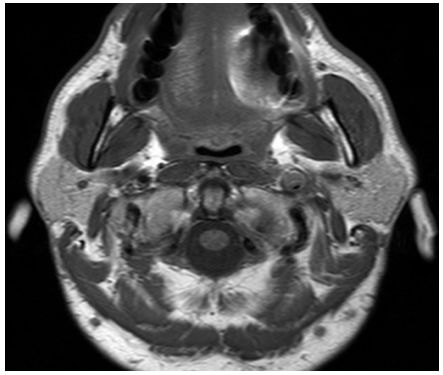


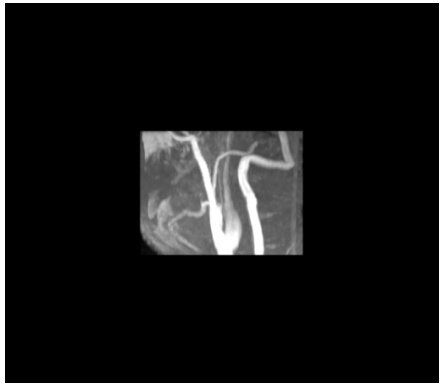


de Bruijn, et al. Lancet 1996;348:1623-5.

ARTERIAL DISSECTION

- Thunderclap HA 13% (Headache 75%)
- Common syndromes
  - Unilateral headache, Horner's
  - Unilateral headache with delayed focal CNS ischemia
- CT/CSF invariably normal
- MRI/MRA diagnostic procedures of choice

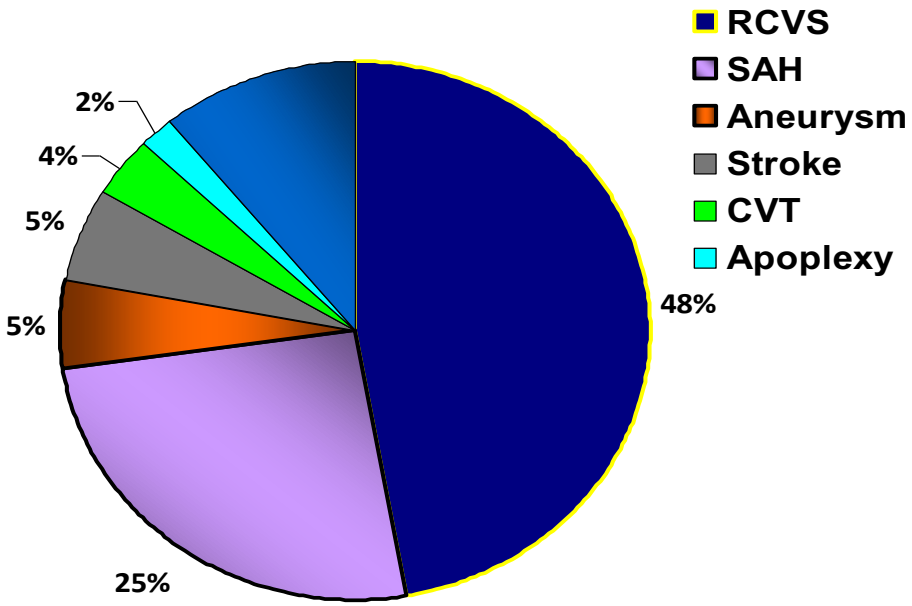




Biousse V, et al. Cephalalgia 1991;17:232-3
Silbert PL, et al. Neurology 1995;45:1517-22
Mokri B. J Neurol 1990;237:356-61.

MAYO CLINIC

Thunderclap Headache
How Common is RCVS?

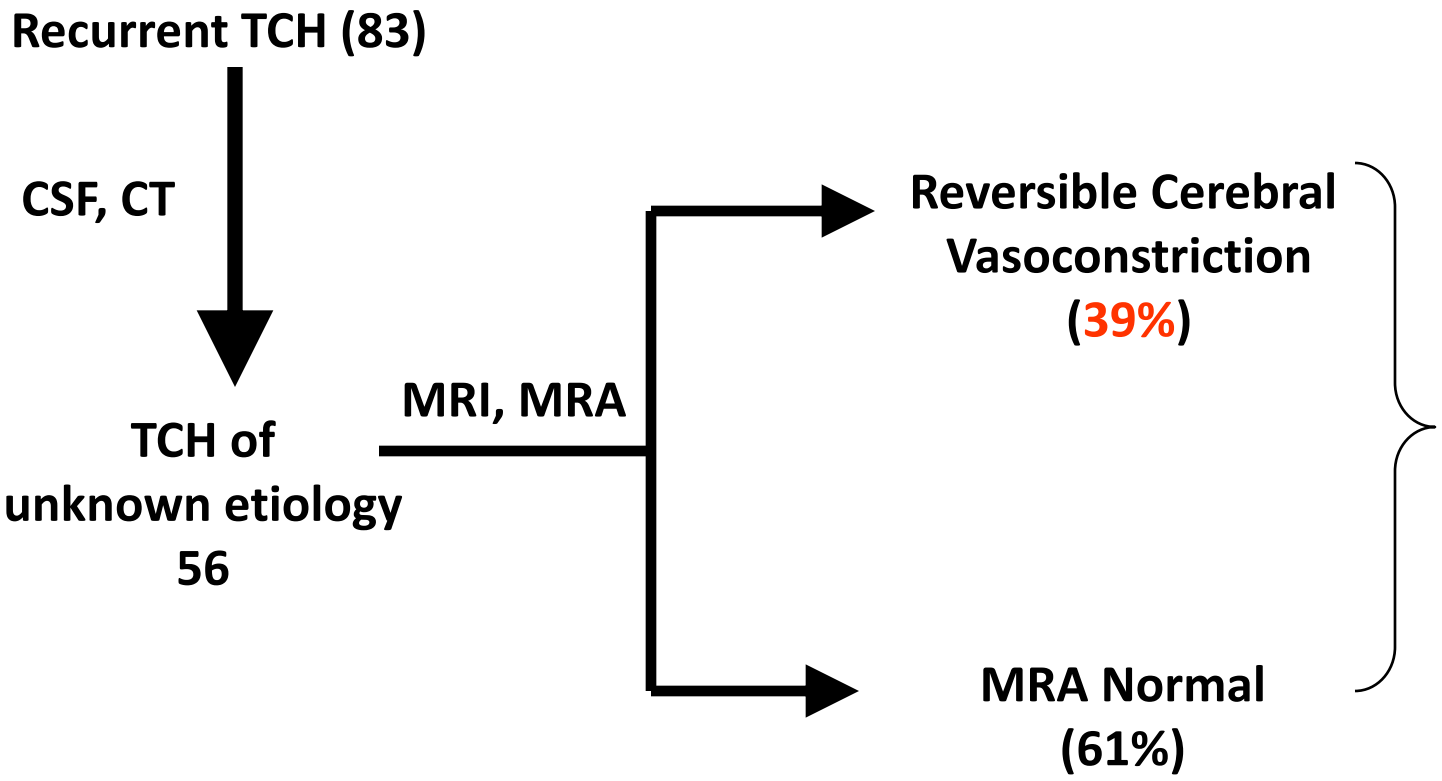


- Prospective study (n=113) of ICHD-11 thunderclap headache)
- Secondary cause in 53%
  - Vascular disorders 89%
  - RCVS most common 48%

Ducros A, Bousser MG. Pract Neurol 2009; 9: 256–267

MAYO CLINIC

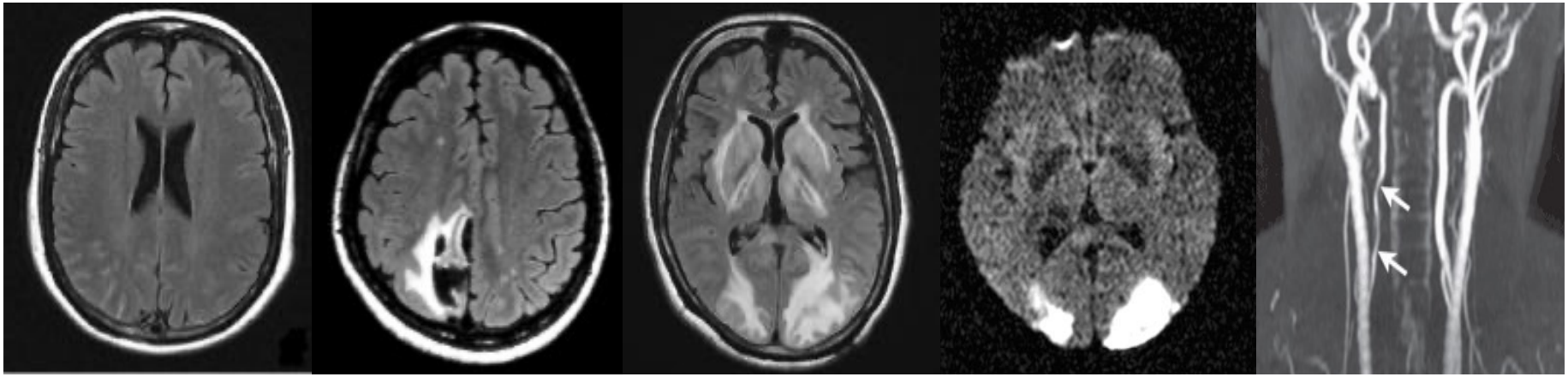
Thunderclap Headache
How Common is RCVS?



Chen S-P, et al. Neurology 2007;67:2164-2169

MAYO CLINIC

RCVS: Complications

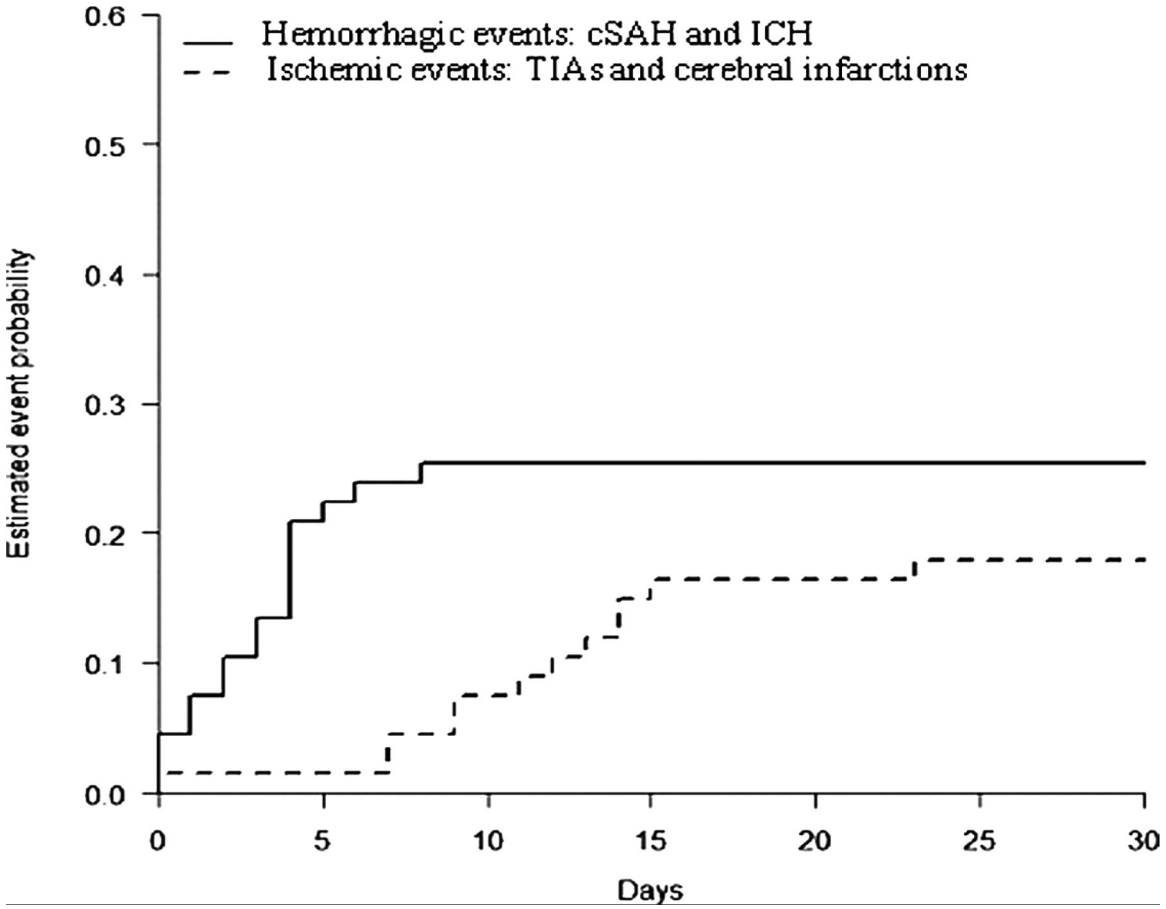


cSAH	ICH	PRES	Ischemic stroke	Dissection
30-34%	12-20%	9-38%	8-39%	12%

Chen el al. Ann Neurol 2010; Ducros et al. Stroke 2010; Mawet et al. Neurology 2013; Singhal et al. Arch Neurol 2011, Stroke 2016

MAYO CLINIC

Ischemic and Hemorrhagic Complications



Ducros A, et al. Brain 2007;130:3091-3101.

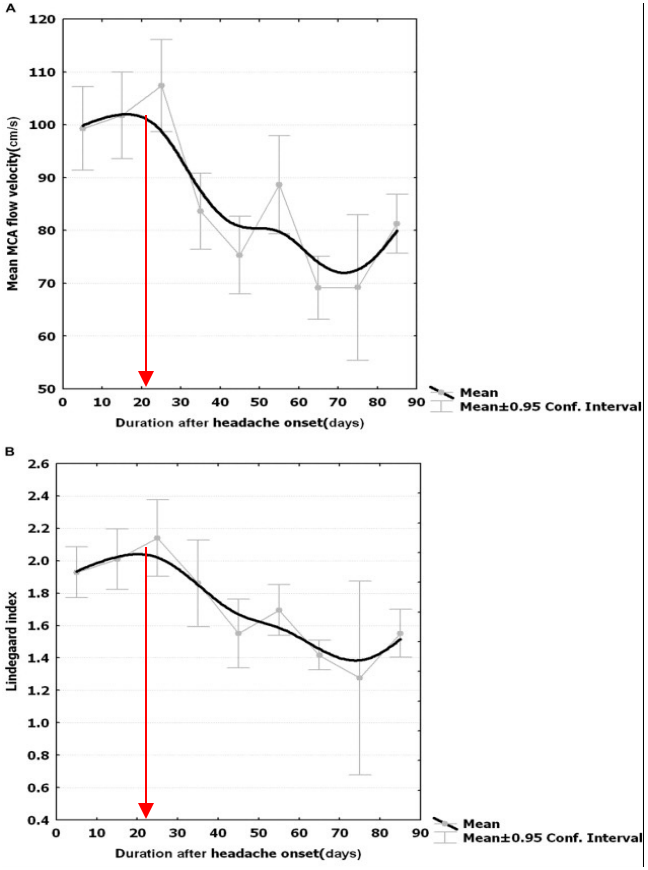
MAYO CLINIC

Predictors of Adverse Outcomes

Elevated vMCA Predicts Marker for Adverse Outcomes

	MCA velocity cm/s	Lindegaard index
RCVS	109.5 ± 30.8	2.2 +/- 0.7
Cont	66.3 ± 9.5	1.4 +/- 0.3
	P < 0.001	P < 0.001

VMCA>120 and LI>3 (n=4) had greater risk of PRES (75% vs 4%;p<0.003) and stroke (50% vs 0;p<0.01)



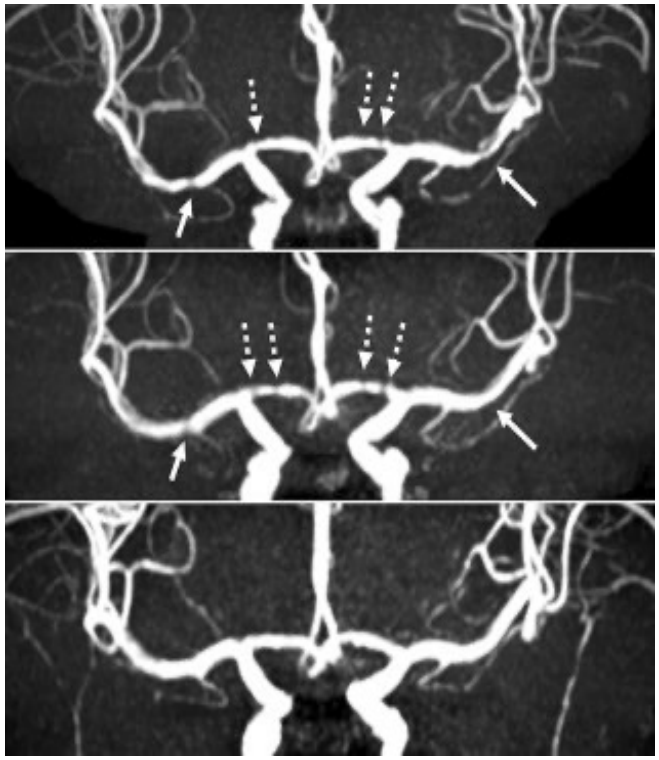
Chen SP, et al. Ann Neurol 2008;63:751-757

MAYO CLINIC

Vasoconstriction of M1-P2 Segments Marker for Adverse Outcomes

- Vasoconstriction scores maximal day 16.3 (10.2 days after headache onset)
- Headache resolution 16.7 (+ 8.6)
- M1–P2 combined score associated with highest risk of PRES (odds ratio [OR], 11.6) and ischemic stroke (OR, 3.4)

Don't be guided by absence *or* persistence (>40%) of headache

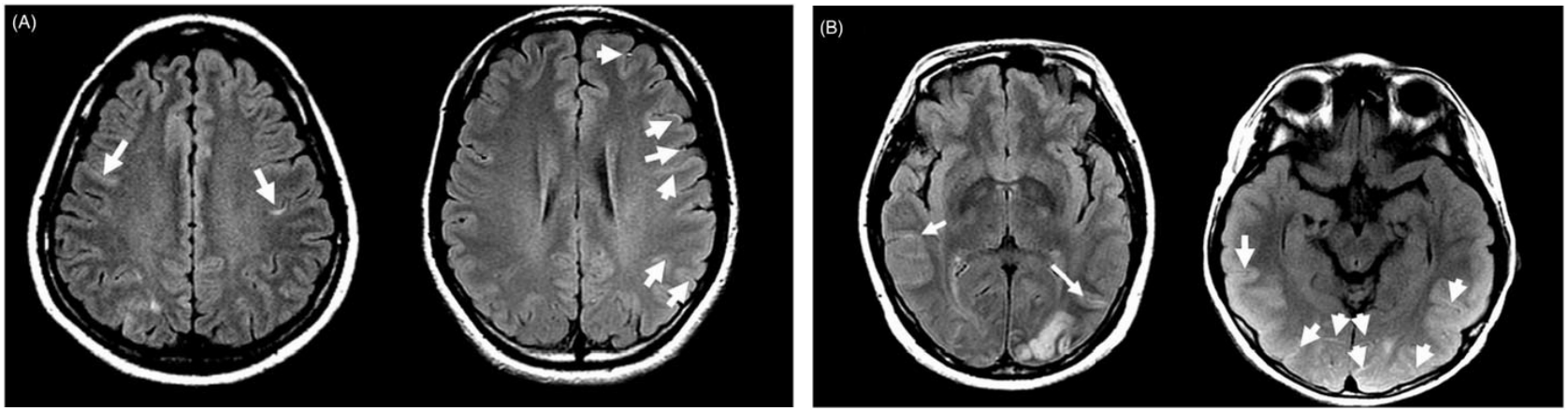


N=77

Chen SP, et al. Ann Neurol 2010;67:648–656
Hastriter E, et al. Neurology 2011

MAYO CLINIC

Hyperintense FLAIR vessels

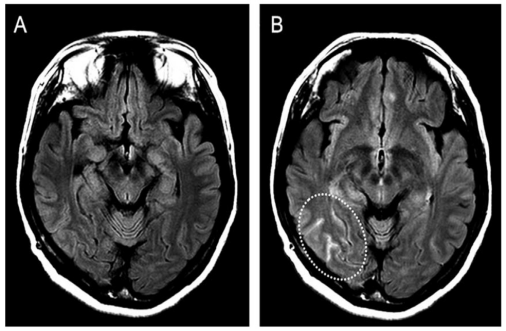


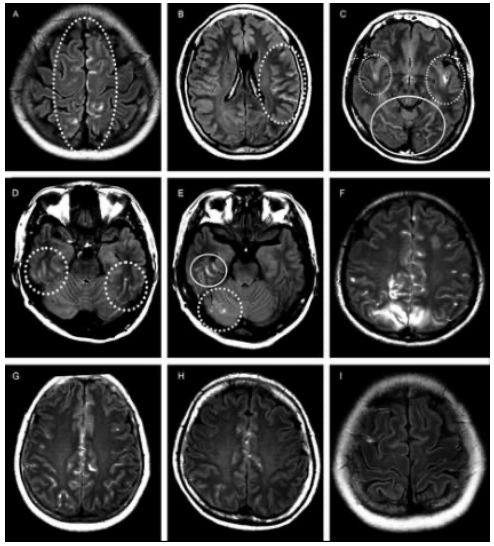
Correlates with severity of vasoconstriction and adverse outcomes PRES (38% vs 0), ischemic stroke (24% vs 1%)

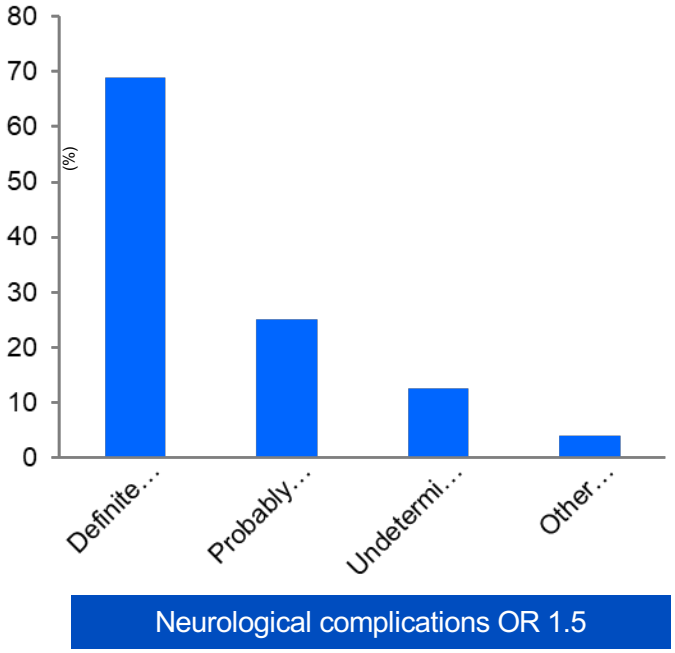
Chen S-P, et al. Cephalalgia 2012; 32(4) 271–278

MAYO CLINIC

RCVS: Blood–brain barrier breakdown on contrast-enhanced FLAIR







Neurological complications OR 1.5

Lee MJ, et al. ANN NEUROL 2017;81:454–466

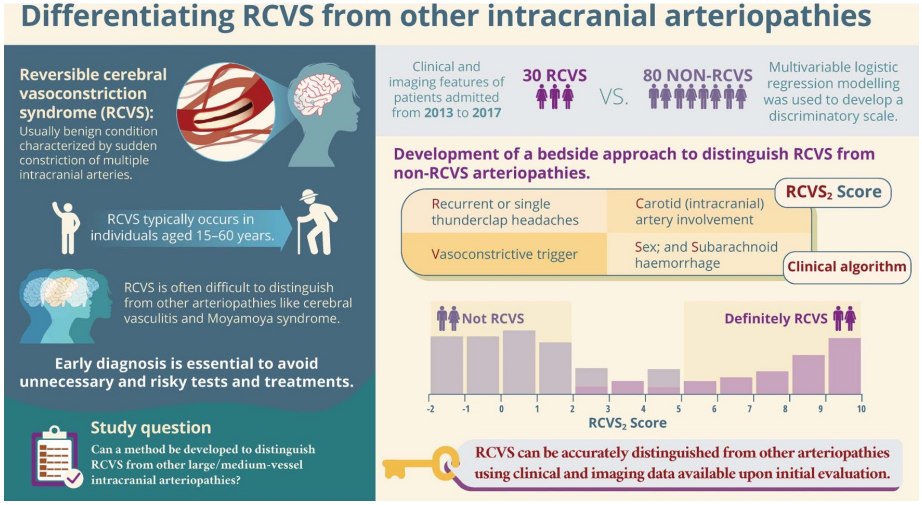
MAYO CLINIC

RCVS: Differential diagnosis

Table 4 $RCVS_2$ score

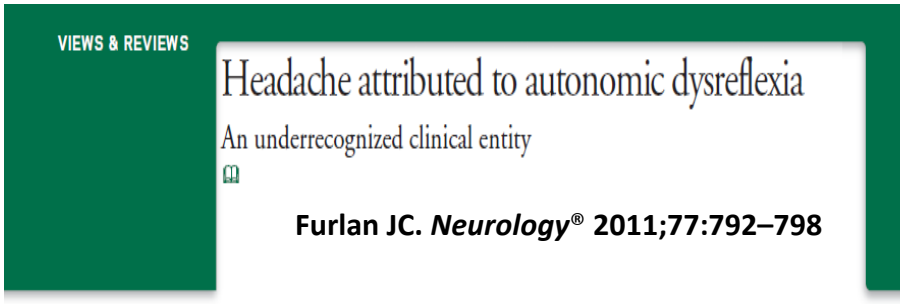
Criteria	Value
Recurrent or single TCH	
Present	5
Absent	0
Carotid artery (intracranial)	
Affected	−2
Not affected	0
Vasoconstrictive trigger	
Present	3
Absent	0
Sex	
Female	1
Male	0
Subarachnoid hemorrhage	
Present	1
Absent	0

$RCVS_2$ ≥5 specificity and sensitivity (99 and 90%) for diagnosing RCVS
$RCVS_2$ ≤2 specificity and sensitivity (100 and 85%) for excluding RCVS

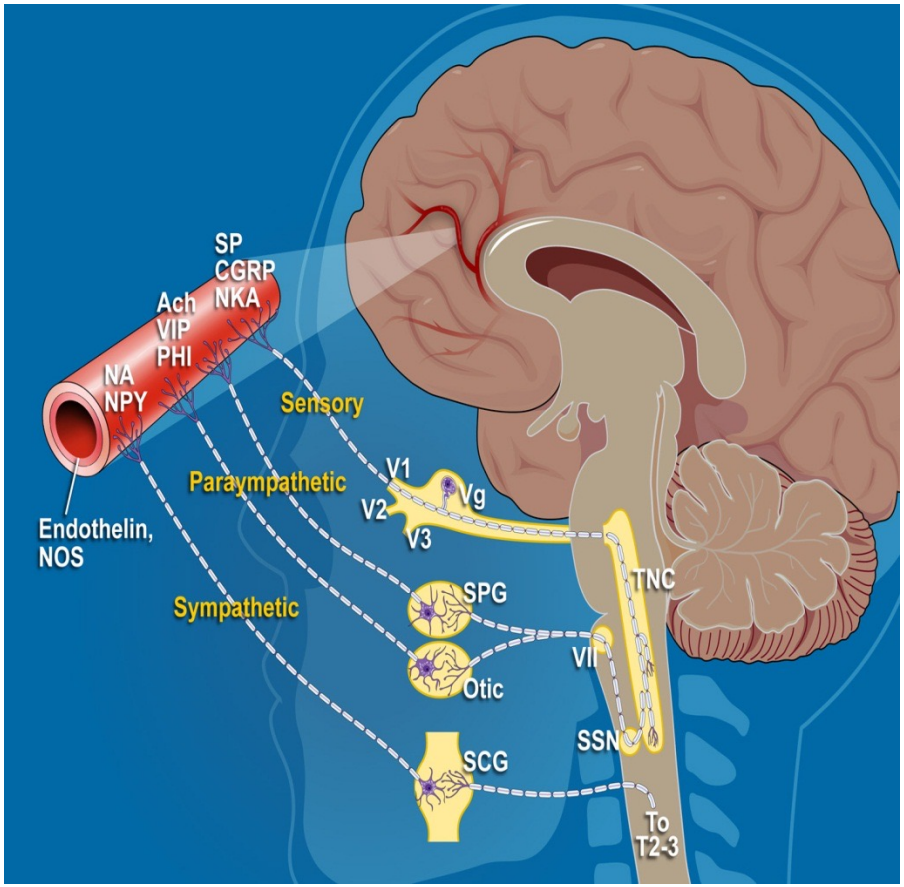


Rocha EA, et al. Neurology Feb 2019, 92 (7) e639-e647;

RCVS: A Cerebral Autonomic Dysreflexia?



"Autonomic Headache" (Thompson 1967)[1]
Thunderclap headache 100%
Associated with PRES[2] and RCVS[3]
Sympathetic overactivity in RCVS[4]



1. Thompson CE. Headache 1967;6:201–203
2. Chaves CJ, Lee G.Spinal Cord 2008;46:760 –761.
3. Edvardsson B, Persson S.J Head Pain 2010;11:277–280.
4. Chen SP et al. J Headache Pain. 2013;14(1):94

OPEN ACCESS Freely available online

PLoS one

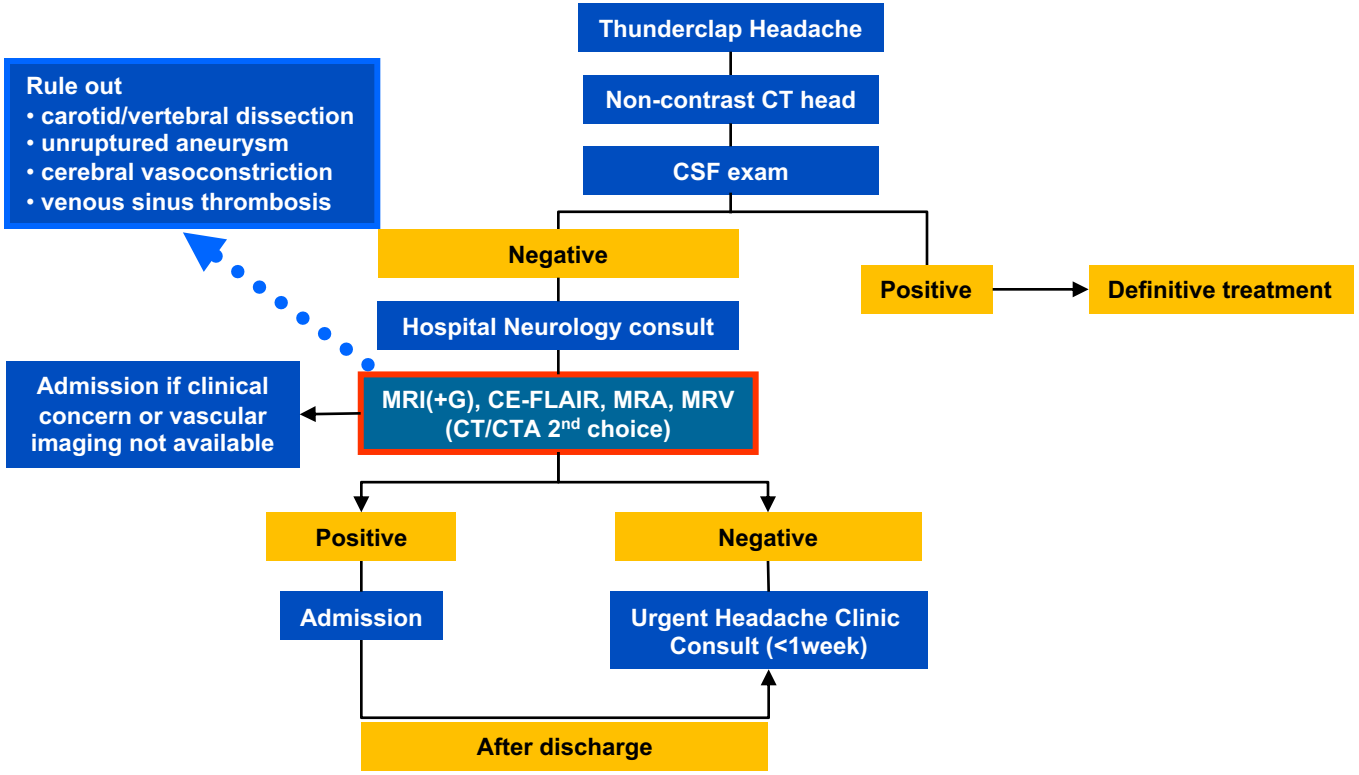
Brain-Derived Neurotrophic Factor Gene Val66Met Polymorphism Modulates Reversible Cerebral Vasoconstriction Syndromes

Shih-Pin Chen[1,2], Jong-Ling Fuh[1,2], Shuu-Jiun Wang[1,2*], Shih-Jen Tsai[2,3], Chen-Jee Hong[2,3], Albert C. Yang[2,4]

- **BDNF has complex interactions with sympathetic neurons and implicated in disorders of vascular tone regulation (e.g. unstable angina)**
- **BDNF leads to severe vasoconstriction in patients with sympathetic over-activity**
- **BDNF dramatically upregulates neuropeptide Y in sympathetic neurons.**

MAYO CLINIC

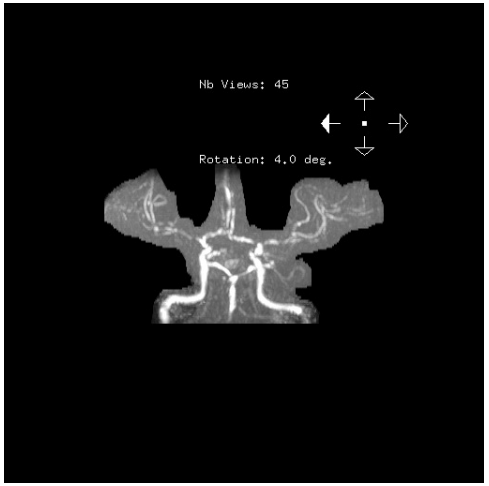
Diagnostic Algorithm for Thunderclap Headache

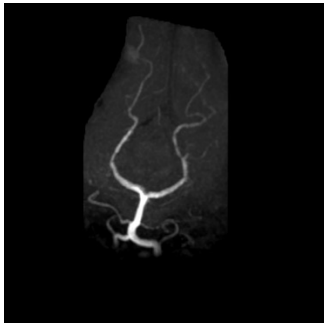


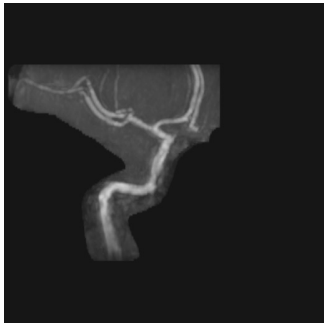
MAYO CLINIC

Treatment

- Stop vasoactive or other potentially offending drugs
- Treat severe hypertension >180mmHg (nicardipine/labetalol) and hypotension <90mmHg (fluids)
- Avoid corticosteroids
- No Valsalva for several weeks
- Nimodipine (30-60mg Q4-8h), magnesium sulfate
- Severe cases, nimodipine [IV/IA 1–2 mg/h],nicardipine [IV/IA 5-15mg/h], prostacyclin [IV 0.9ng/kg/min], milrinone [IA 0.5ug/kg/min]



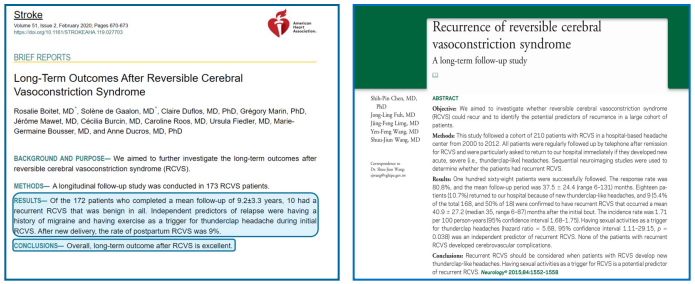




MAYO CLINIC

Clinical course and prognosis

- TCHs typically resolve over days to weeks, but up to 50% experience residual chronic headache
- Vasoconstriction resolution within three months in most
- Residual deficit (<20 percent); 90-95% modified Rankin scale score of 0 to 2)
- Progressive vasoconstriction culminating in massive strokes, brain edema, severe morbidity, or death <5% (more commonly reported in postpartum patients).
- Recurrence TCH ~11%; recurrence of RCVS ~6%
- Risk factors for recurrent RCVS:
  - Sexual activity as initial trigger (HR 5.68)[5]
  - History of migraine; exercise as initial trigger[6]
  - After new delivery, post-partum RCVS 9%



Stroke

BRIEF REPORTS

Long-Term Outcomes After Reversible Cerebral Vasoconstriction Syndrome

Rosalie Boitet, MD, Solène de Gaalon, MD, Claire Duflos, MD, PhD, Grégory Marin, PhD, Jérôme Mawet, MD, Cécilia Burcin, MD, Caroline Roos, MD, Ursula Fiedler, MD, Marie-Germaine Bousser, MD, and Anne Ducros, MD, PhD

BACKGROUND AND PURPOSE— We aimed to further investigate the long-term outcomes after reversible cerebral vasoconstriction syndrome (RCVS).

METHODS— A longitudinal follow-up study was conducted in 173 RCVS patients.

RESULTS— Of the 172 patients who completed a mean follow-up of 9.2±3.3 years, 10 had a recurrent RCVS that was benign in all. Independent predictors of relapse were having a history of migraine and having exercise as a trigger for thunderclap headache during initial RCVS. After new delivery, the rate of postpartum RCVS was 9%.

CONCLUSIONS— Overall, long-term outcome after RCVS is excellent.

Recurrence of reversible cerebral vasoconstriction syndrome

A long-term follow-up study

Shih-Pin Chen, MD, PhD; Jong-Ling Fuh, MD; Jing-Fong Liang, MD; Yen-Feng Wang, MD; Shuu-Jiun Wang, MD

ABSTRACT

Objective: We aimed to investigate whether reversible cerebral vasoconstriction syndrome (RCVS) could recur and to identify the potential predictors of recurrence in a large cohort of patients.

Methods: This study followed a cohort of 210 patients with RCVS in a hospital-based headache center from 2000 to 2012. All patients were regularly followed up by telephone after remission for RCVS and were particularly asked to return to our hospital immediately if they developed new acute, severe (i.e., thunderclap-like) headaches. Sequential neuroimaging studies were used to determine whether the patients had recurrent RCVS.

Results: One hundred sixty-eight patients were successfully followed. The response rate was 80.8%, and the mean follow-up period was 37.5 ± 24.4 (range 6–131) months. Eighteen patients (10.7%) returned to our hospital because of new thunderclap-like headaches, and 9 (5.4% of the total 168, and 50% of 18 were confirmed to have recurrent RCVS that occurred a mean 40.9 ± 27.2 (median 35, range 6–87) months after the initial bout. The incidence rate was 1.71 per 100 person-years (95% confidence interval 1.68–1.75). Having sexual activities as a trigger for thunderclap headaches (hazard ratio = 5.68, 95% confidence interval: 1.11–29.15, $p = 0.038$) was an independent predictor of recurrent RCVS. None of the patients with recurrent RCVS developed cerebrovascular complications.

Conclusions: Recurrent RCVS should be considered when patients with RCVS develop new thunderclap-like headaches. Having sexual activities as a trigger for RCVS is a potential predictor of recurrent RCVS. Neurology® 2015;84:1552-1558

1. John S, Singhal AB, Calabrese L, et al. Long-term outcomes after reversible cerebral vasoconstriction syndrome. Cephalalgia 2016; 36:387.
2. BUCKLE RM, DUBOULAY G, SMITH R. DEATH DUE TO CEREBRAL VASOSPASM. J Neurol Neurosurg Psychiatry 1964; 27:440.
3. Williams TL, Lukovits TG, Harris RT, Harker Rhodes C. A fatal case of postpartum cerebral angiopathy with literature review. Arch Gynecol Obstet 2007; 275:67.
4. Fugate JE, Wijdicks EF, Parisi JE, et al. Fulminant postpartum cerebral vasoconstriction syndrome. Arch Neurol 2012; 69:111.
5. Chen SP, Fuh JL, Lirng JF, et al. Recurrence of reversible cerebral vasoconstriction syndrome: a long-term follow-up study. Neurology 2015; 84:1552.
6. Boitet R, de Gaalon S, Duflos C, et al. Long-Term Outcomes After Reversible Cerebral Vasoconstriction Syndrome. Stroke 2020; 51:670.

Clinical Pearls

ALWAYS image cerebral vasculature in patients with thunderclap headache

Beware the diagnosis of primary thunderclap headache

Beware diagnosing thunderclap headache according to trigger (e.g. sex, cough, exertion)

Vascular imaging initially negative in 20%

MAYO CLINIC

Clinical Bottom-Lines

- Majority of TCHs have an underlying cause (primary TCH is diagnosis of exclusion, if it even exists)
- Majority (90%) of secondary causes are vascular, therefore, workup MUST include angiography (CT/LP is no longer sufficient)
  - Initial imaging may be normal in ≥ 20%
  - MRA preferred (avoids radiation; catheter angiography associated with focal deficits in 9% of patients with RCVS)
- RCVS is most common vascular cause
  - Distinguish between primary cough, exertion, sex headache
  - Distinguish between CNS vasculitis

Clinical Bottom-Lines

- **Serious adverse outcomes in RCVS not uncommon**
  - **Hyperintense FLAIR vessels/sulcal dots, M1-P2 constriction, elevated vMCA/LI marker for adverse outcomes**
  - **Search for and stop offending drugs (illicit, OTC, and prescription)**
  - **Headache does not correlate with presence or severity of vasocontriction – do not use it as a guide to treatment**
- **Treatment: Controlled trials needed.**
  - **For now, oral and/or parenteral calcium channel blockers are treatment of choice – watch dose escalation and avoid hypotension!**