

# Looking at “thunderclap headache” differently? Circa 2016

K. Ravishankar

The Headache and Migraine Clinics, Jaslok Hospital and Research Centre, Lilavati Hospital and Research Centre, Mumbai, Maharashtra, India

## Abstract

The term “thunderclap headache” (TCH) was first coined in 1986 by Day and Raskin to describe headache that was the presenting feature of an underlying unruptured cerebral aneurysm. The term is now well established to describe the abrupt onset headache seen with many other conditions and is also now included in *The International Classification of Headache Disorders 3<sup>rd</sup> edition beta version* rubric 4.4. An essential to label an acute headache as “TCH” and differentiate it from other “sudden onset, severe headaches” is the arbitrary time frame of 1 min from onset to peak intensity for “TCH.” What happens in practice, however, is that even those “sudden onset, severe headaches” that do not strictly fulfill the definition criteria are also labeled as “TCH” and investigated with the same speed and in the same sequence and managed based on the underlying cause. This article begins by questioning the validity and usefulness of this “one minute” arbitrary time frame to define “TCH,” particularly since this time frame is very difficult to assess in practice and is usually done on a presumptive subjective basis. The article concludes with suggestions for modification of the current investigation protocol for this emergency headache scenario. This proposal for “a change in practice methodology” is essentially based on (1) the fact that in the last two decades, we now have evidence for many more entities other than just subarachnoid hemorrhage that can present as “TCH” or “sudden onset, severe headache” and (2) the evidence from literature which shows that advances in imaging technology using higher magnet strength, better contrast, and newer acquisition sequences will result in a better diagnostic yield. It is therefore time now, in our opinion, to discard current theoretical time frames, use self-explanatory terminologies with practical implications, and move from “lumbar puncture (LP) first” to “LP last!”

## Key Words

Cerebrospinal fluid examination, investigation protocol, lumbar puncture, magnetic resonance imaging, subarachnoid hemorrhage, sudden onset severe headache, thunderclap headache

## For correspondence:

Dr. K. Ravishankar, A/64, Kalpataru Residency,  
Sion (East), Mumbai - 400 022, Maharashtra, India.  
E-mail: dr.k.ravishankar@gmail.com

*Ann Indian Acad Neurol* 2016;19:295-301

The term “thunderclap headache” (TCH) was first introduced by Day and Raskin in 1986<sup>[1]</sup> to describe the severe headache that was the presenting feature of an unruptured cerebral aneurysm. This term has now come to stay and is defined as “severe explosive abrupt onset headache that reaches peak intensity within one-minute from onset.” “TCH” can be a presenting feature of many underlying conditions and not just of unruptured aneurysm or subarachnoid hemorrhage (SAH) [Table 1]. Regardless of the underlying etiology, the essential difference between “TCH” and “sudden onset, severe headache” is the arbitrary time frame of “one minute” from

onset to peak intensity that is included as criterion B (rubric 4.4) in *The International Classification of Headache Disorders 3<sup>rd</sup> edition beta version*.<sup>[2]</sup> In practice, however, of all patients who present to the emergency department with “sudden onset, severe headache,” many do not fit the definition of “TCH,” but all the same they are put through the same investigation protocol. There is no difference in the way we approach this emergency

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

**For reprints contact:** reprints@medknow.com

**How to cite this article:** Ravishankar K. Looking at “thunderclap headache” differently? Circa 2016. *Ann Indian Acad Neurol* 2016;19:295-301.

**Received:** 03-03-16, **Revised:** 28-04-16, **Accepted:** 02-05-16

## Access this article online

### Quick Response Code:



### Website:

www.annalsofian.org

### DOI:

10.4103/0972-2327.186783

**Table 1: Causes of thunderclap headache**

Vascular	
Subarachnoid hemorrhage - aneurysmal and nonaneurysmal causes	
Unruptured intracranial aneurysms	
Ischemic/hemorrhagic stroke	
Arterial dissection: Cervical or vertebral	
Cerebral venous thrombosis	
Pituitary apoplexy	
Acute hypertensive crisis, posterior reversible encephalopathy syndrome	
Reversible cerebral vasoconstriction syndrome	
Nonvascular	
Colloid cyst	
Cerebrospinal fluid hypotension (spontaneous intracranial hypotension)	
Exertion, cough, sexual headaches	
Primary thunderclap headache – only after exclusion of all	

situation, based on the 1 min time frame from onset to peak intensity. The term “TCH” therefore, in our opinion, only serves to forewarn that workup should be expedite and exhaustive but the workup of “TCH” is not in any way different from that of other acute headaches that we label as “sudden onset, severe headache!”

Through this viewpoint article, we wish to raise queries regarding the rationale and usefulness of this arbitrary 1 min time frame in the definition of “TCH.” We will also discuss the need for a revision of the investigation protocol for “TCH” and “sudden onset, severe headache” and include our suggestions for modification of the current protocol. This, we feel, is necessary in light of recent advances in imaging technology that are available today in 2016. (Many of these investigative modalities were nonexistent when the term was first coined thirty years back in 1986!) In keeping with our contention and also our conviction, both terms “TCH” and “sudden onset, severe headache” will be used synonymously to include all abrupt onset severe headache emergencies.

### What are Some of the Important “Thunderclap Headache-”related Issues that Need a Relook in 2016, Based on the Progress in Clinical Neurology in the Last Two Decades?

1. When, in practice, the investigative approach to all “sudden onset, severe headaches” is the same and does not differ based on whether or not it fits the 1 min definition of “TCH,” does labeling an abrupt onset, severe headache as “TCH” or “non-TCH,” imply a different approach to the emergency? Therefore, when the term “TCH” is for all practical purposes used synonymously with “sudden onset, severe headache,” why is there a need to differentiate between the two? Is it necessary in practice to set an arbitrary time limit of “one minute” from onset to peak intensity as an imperative criterion for headache to be labeled as “TCH?” Setting this time frame can sometimes mislead clinicians by lulling them into a false sense of security in certain situations, for example, when dealing with a serious SAH that develops slowly over 5 min and therefore does not fit the definition of “TCH?”

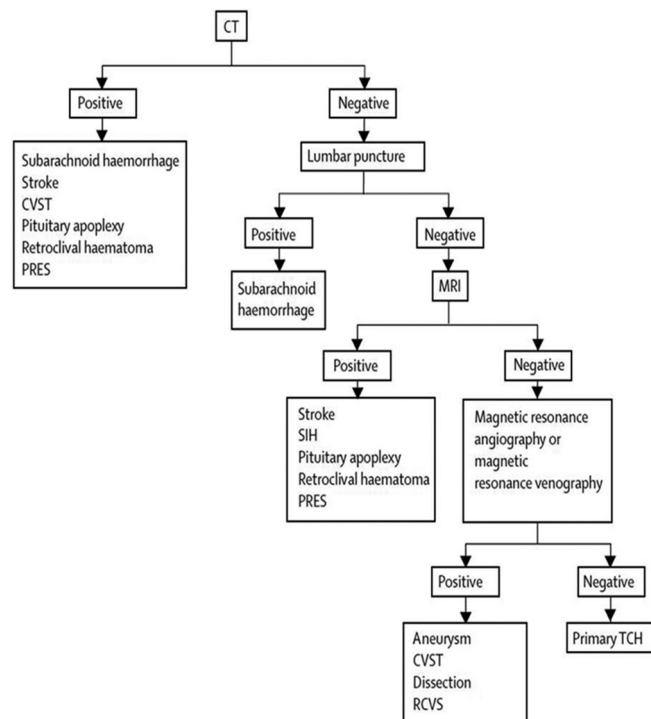
2. It is important to realize that we have moved on from the era of SAH being the only diagnosis to be excluded in patients presenting with “TCH.” In the last three decades between 1986 when the term “TCH” was first coined and today in 2016, clinical neurology has progressed to include other vascular and nonvascular conditions that may present with “TCH” or “sudden onset, severe headache” [Table 1]. These conditions were not so well known before the 21<sup>st</sup> century and include entities such as spontaneous intracranial hypotension (SIH), reverse cerebral vasoconstriction syndrome (RCVS), and posterior reversible encephalopathic syndrome (PRES). All these newer entities that could present with “TCH” or “sudden onset, severe headache” can be diagnosed through advanced magnetic resonance imaging (MRI) and do not need a lumbar puncture (LP) for diagnostic confirmation
3. Given the advantages of modern vascular imaging techniques of MRI using high-strength magnet and special acquisition sequences with greater yield, do we still need to cling on to the older invasive procedure of doing an LP? LP was the test of choice when MR technology was in its infancy, but we now have better noninvasive techniques that offer the same, if not more information. Therefore, doing only a plain computerized tomography (CT) scan followed by cerebrospinal fluid (CSF) examination and if needed by a conventional angiography to investigate “TCH” will today be considered less inclusive for the investigation of “TCH” or “sudden onset, severe headache.”

### What are the Practice Dilemmas that Surround the above Issues?

1. The arbitrary “one-minute” time limit for “TCH” is difficult to assess in actual practice. Patients have a tendency to perceive explosive headaches that are “sudden and severe” or “first and worst” as peaking instantaneously and since neither patients nor clinicians have a stopwatch with them or are forewarned to note the duration of the time taken to peak intensity; it is a subjective perception and not an objective record of timing that most clinicians use for labeling a headache as “TCH.” Subsequent investigative approach is based on the suddenness of onset and severity of headache and not on whether headache peaks within “one-minute” or not. It is time, therefore, to discard this strict time frame. Alternatively, for those clinicians who wish to cling on to older terminologies, we can label all “sudden onset, severe headaches” as “True TCH” for those that peak within “one minute” and “TCH-like” for those that do not fit the time frame of “one minute” and are instead labeled as “sudden onset, severe headache.” We do not in practice, stop short of complete workup based on whether a sudden severe headache peaks in 1-min or not. When we have anyways to investigate all in the same manner, why do we need self-imposed constraints that are redundant?
2. It is well accepted that SAH is the most ominous condition that needs to be first ruled out when investigating “TCH” or “sudden severe headache.” When the term was coined and even today, SAH is no doubt the leading cause for “TCH.” However, with medicine being a progressive science, we now have evidence for other conditions that

can also present similarly [Table 1]. Therefore, "TCH" today is not synonymous with SAH as it might have been in 1986 when the term was coined. These other conditions may not necessarily have headaches that peak within 1-min like SAH. Moreover, not all SAH also peaks within 1-min! Therefore, the "one minute" definition is not applicable to all patients presenting with "sudden onset, severe headache." We need to address this gap between theory and practice and change the mindset of practicing clinicians

- Having addressed the futility of the "one-minute" arbitrary time frame for defining "TCH," let us now look at the investigation protocol that is currently advocated and question the inadequacy of this protocol, given the technological advances currently available. We are referring here only to the patient who presents with lone, severe "first and worst" headache without neurologic deficit and where the suspicion of SAH is high but other possible causes of "TCH" also need to be ruled out. SAH is the most catastrophic and also the most easily missed or misdiagnosed cause of "TCH" or "sudden onset, severe headache." With the ominous possibility of rebleed, the main focus when investigating "TCH" or "sudden onset, severe headache" is always to first rule out SAH. Current teaching advocates a "fixed" sequence of diagnostic testing to be followed in all patients presenting with "TCH." The first test that is suggested is always a plain CT head scan, which if negative, is followed up with an LP to check for the presence of blood and evaluate for xanthochromia in the CSF. This is the standard approach globally and is presently considered most appropriate.<sup>[3-8]</sup> The currently advocated flowchart is shown in Figure 1.



**Figure 1: Current protocol that is followed for thunderclap headache. Schwedt TJ, Matharu MS, Dodick DW. Thunderclap headache. *Lancet Neurol* 2006;5:621-31**

This sequence of investigation was conceived at a time when MRI was in its infancy and other causes of "TCH" were not well detailed. This protocol has unfortunately not been modified in parallel with advances in imaging modalities that are now available at most tertiary hospitals.

### What is the Evidence in Literature for this Current Investigation Protocol for "Thunderclap Headache"?

To understand the significance of the modifications to the existing investigation protocol that we are advocating, it is essential to be aware of the current literature evidence regarding the investigation protocol to be followed in patients presenting with "TCH" or "sudden onset, severe headache." Most authors are in agreement regarding the test sequence to be followed when the initial plain CT is normal. Schwedt *et al.*<sup>[3,4]</sup> have specified that CSF assessment is needed in patients who present with "TCH" and have normal or nondiagnostic CT scan. Matharu *et al.*<sup>[5]</sup> have stated that if the CT is nondiagnostic, an LP is required. Duncan<sup>[6]</sup> stated that patients with a normal CT scan require an LP while Mortimer *et al.*<sup>[7]</sup> and Ducros and Bousser<sup>[8]</sup> considered an LP mandatory in the investigation of "TCH" when a plain CT is negative.

The importance of correct timing of the plain CT and increase in yield using advanced generation CT scanners and interpretation by a highly trained neuroradiologist have been emphasized by all authors. An advanced plain CT scan and a trained eye can help suspect or diagnose SAH due to even the nonaneurysmal causes.<sup>[2,3]</sup> If the plain CT scan is normal and noncontributory in a patient with "TCH," the next step that is usually suggested by all these authors in the current diagnostic plan is the LP. Most authors have emphasized the importance of (a) measuring the opening pressure, (b) looking for the presence of blood in the CSF, and (c) detecting xanthochromia by ordering spectrophotometry between 12 h and 2 weeks following the acute headache episode. However, the hurdles involved in confirming xanthochromia through visual inspection or spectrophotometry have not been discussed. CSF examination is today the next test of choice when the plain CT is negative. If the plain CT is abnormal, one would follow it up appropriately with MRI with or without contrast or do a CT angiography or MR angiography (MRA) or MR venography (MRV) or conventional angiography digital subtraction angiography (DSA) as the situation may demand. Doing a plain CT in the emergency setting followed by an LP and CSF examination if the plain CT is negative, has thus become the standard norm in the diagnostic evaluation of "TCH."

### Why is There a Need to Modify this Existing Protocol?

Given a "TCH" presentation and in a tertiary setup with state-of-the-art facilities, we now need to consider more conditions other than just SAH and deviate from this present protocol. When a patient presents with "TCH" or "sudden onset, severe headache," there are usually some pointers to the underlying diagnosis in the form of circumstances in the background, setting, associated symptoms, and subtle findings on neurological examination. Without focusing on

these indirect pointers, we always follow the same flowchart or sequence while investigating “TCH,” namely, plain CT, then LP and CSF examination, then vascular imaging with an MRA or DSA. The sequence of testing should ideally be planned after prioritization of possible underlying causes based on these pointers. CSF hypotension (SIH), RCVS, and PRES have now been fully described in detail only through better MRI protocols. Taking into consideration all these entities, we wish to propose a modified flowchart that is outlined in Figure 2.

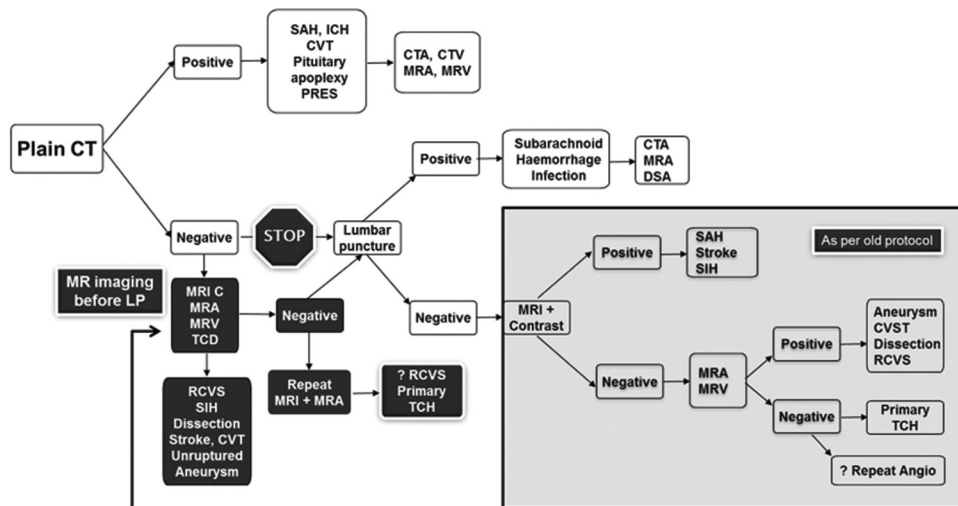
We advocate doing a plain CT first, which if normal should be followed next by an MR with and without contrast using the appropriate sequences based on clinical suspicion. There is no great advantage of doing an invasive test as similar to the LP just to rule out SAH or infection when both these conditions can also be picked up on MRI using the T2 fluid-attenuated inversion recovery (FLAIR) sequence and with contrast. This should be followed if necessary by an MRA/MRV instead of an invasive LP to evaluate the CSF for blood/xanthochromia. If exhaustive MRI using this sequence fails to demonstrate SAH or any of the other conditions that can present as “TCH,” then and only then should we go back to doing the LP and CSF examination to rule out that elusive rare possibility of a spinal bleed that may be missed on both Plain CT and MRI. We should therefore move from “LP first” to “LP last!” If the CSF examination done after detailed MRI is also normal, even after repeat testing, we might be justified labeling the abrupt onset headache as “primary thunderclap.”<sup>[2]</sup> Headache or as some experts would like to maintain “TCH of undetermined origin!”<sup>[8]</sup>

**What are the Reasons why a Lumbar Puncture Done after Negative Plain Computerized Tomography Scan is not Ideal for “Thunderclap Headache” with Normal Neurology?**

1. LP is an invasive procedure and not an innocuous procedure without any complications.<sup>[9,10]</sup> If not performed

by an experienced physician, it can often end up as a traumatic tap which will only worsen the dilemma and make CSF analysis unreliable

2. The LP has strict timelines when it is likely to be more yielding. An LP done before 12 h may give a false negative result. It takes between 6 and 12 h to form bilirubin from the breakdown of erythrocytes in the CSF.<sup>[11]</sup> At the same time, waiting for 12 h in an acute setting may not be appropriate from an ethical viewpoint and may have litigational risks. Performing an LP too early or too late can therefore miss the right diagnosis
3. CSF xanthochromia is confirmed by visual inspection and spectrophotometry. This has to be done ideally between 12 h and 2 weeks and the spectrophotometry equipment is not available even in many tertiary centers. Therefore, an LP done too early (before 12 h) and xanthochromia confirmed only by visual inspection may still be reported negative for xanthochromia and you may miss SAH
4. An LP is usually advised primarily to confirm SAH because the possibility of an acute infection presenting as “TCH” is rather remote. The other causes of “TCH” cannot be ruled out through LP
5. The sequence of doing an LP when plain CT is normal was established at a time when MR technology was not so advanced and only DSA was available. At that time, it was also not known that there were many other conditions such as SIH, RCVS, PRES, and dissection that could present with “TCH”
6. One may argue that an LP can tell us about the opening pressure and can be used for the diagnosis of pressure syndromes, but idiopathic intracranial hypertension rarely presents as “TCH” and CSF leak (SIH) can easily be suspected on plain MR and confirmed with contrast MR
7. LP can give rise to postdural puncture headache (PDPH) which may worsen the clinical picture and show abnormal pachymeningeal enhancement on the subsequent MRI contrast and make the clinician wonder if this was SIH presenting as “TCH” to begin with or whether the MRI findings are due to PDPH following on the LP?



**Figure 2: Magnetic resonance imaging with contrast and detailed cerebral and cervical vascular imaging before doing the lumbar puncture will help rule out/confirm the newer entities that can present as “thunderclap headache.” As these cannot be confirmed through cerebrospinal fluid examination, the suggestion is to move from “lumbar puncture first” to “lumbar puncture last”**

8. Doing just a plain CT and then an LP, if both are normal, you may be lulled into a false sense of security that further investigation is not necessary because you have ruled out SAH
9. We do have two studies where they retrospectively analyzed their SAH cases to see the yield of CT and CSF examination.<sup>[12,13]</sup> They had shown the presence of SAH in a small number of cases when both CT scan and CSF were negative. Therefore, this combination is not a foolproof method for diagnosing SAH.

### What are the Hurdles in Confirming Cerebrospinal Fluid Xanthochromia?

CSF xanthochromia can be confirmed in two ways – (a) by visual inspection and (b) by spectrophotometry. Because of differing levels of technical expertise and operational hurdles, outcomes for confirming xanthochromia are not uniform across all centers. Standards differ across regions and this may have an impact on diagnosis, treatment, and outcome.<sup>[14]</sup>

1. The most basic method for confirming xanthochromia is by visual inspection because normal CSF is colorless and transparent. Most centers use this as the main method but it is well established that spectrophotometry has a superior diagnostic accuracy. CSF examination for SAH also includes red blood cell counts, CSF cytology, and ferritin measurement<sup>[10,15]</sup>
2. Ideally, visual inspection needs the sample to be centrifuged and the supernatant has to be compared with water, against a white background. This also takes into account the sensitivity of the human eye in detecting mild xanthochromia. A traumatic tap may also cause confusion. Therefore, because of poor diagnostic sensitivity, visual inspection alone is not so perfect a method and most authors on this subject advise spectrophotometry to rule out xanthochromia<sup>[14]</sup>
3. Spectrophotometry analyzes the absorption spectrum of CSF pigments. CSF xanthochromia due to hemoglobin oxidation products, 12 h or more after headache onset, is considered an important proof for the diagnosis of SAH. Raised CSF oxyhemoglobin and bilirubin on spectrophotometry is consistent with SAH whereas a traumatic tap may lead to raised oxyhemoglobin.<sup>[16]</sup> However, it is important to know that there are many other conditions that can affect the oxyhemoglobin and bilirubin levels and lead to false positive and false negative values on spectrophotometry<sup>[16]</sup>
4. Contrary to prevailing notion, Perry *et al.* state that more than 99% of North American Hospitals do not have access to spectrophotometry<sup>[15]</sup> and use only visual inspection and when used there are inconsistent definitions of what represents a positive spectrophotometry result. Therefore, it has moderate to low specificity for SAH
5. There are other factors that can affect the interpretation of spectrophotometry results. Apart from timing, it needs a trained technician and right transportation methodology to avoid false positive results<sup>[14]</sup>
6. Perry *et al.* conducted a multicentric prospective study from three tertiary care emergency departments to study the diagnostic accuracy of spectrophotometry for SAH.<sup>[17]</sup>

They enrolled 220 neurologically intact acute headache patients and concluded that it is rare to diagnose SAH through an LP when the CT is negative. They concluded that most cases of SAH were identified on CT and it was rare to diagnose SAH through LP and spectrophotometry had moderate to poor specificity and large false positive rates

7. They were of the opinion that spectrophotometry is not useful in diagnosing the elusive case of SAH where the CT is normal and CSF is clear to visual inspection. The definition of xanthochromia by visual inspection and spectrophotometry were not found to be adequate for clinical practice. They felt that false positivity on spectrophotometry also led to unacceptably high angiography rates<sup>[17]</sup>
8. In a prospective study, Morgenstern found that of 107 patients, only two patients out of 18 SAH were missed in CT. They concluded that very few aneurysmal SAHs are diagnosed by spectrophotometry<sup>[18]</sup>
9. There have been other similar studies before 2005 that looked at the yield of CSF in CT negative “TCH” patients.

### Why is Magnetic Resonance Imaging before doing Lumbar Puncture Ideal for “Thunderclap Headache” or “Sudden Onset, Severe Headache” with Normal Neurology?

1. There are timelines to doing the CT and ideal is within 24 h and the sensitivity at the end of one week drops to approximately 50%.<sup>[19]</sup> The plain CT can therefore be more likely negative the further in time that it is done from the acute “headache” episode
2. Not all patients with “TCH” reach an imaging facility within 24 h, the timeline that is ideal for a plain CT scan to be positive for SAH
3. The generation of the scanner and the experience of the neuroradiologist matter, particularly in diagnosing the nonaneurysmal causes of SAH and suspecting other subtle changes that could point to other causes of “TCH.” In both these situations, MRI will be more informative than CSF analysis
4. It is not so well recognized that MRI is also as sensitive as CT for the detection of blood and becomes more sensitive after the first day. Therefore, the small group of SAH that can be missed on Plain CT and which can be diagnosed by CSF examination can be picked up by doing MRI even before an LP. We have grown up with the same “LP first” thinking, but it is time now for our mindset to change
5. Modern MRI is very sensitive for the detection of SAH. T2 FLAIR is useful for the detection of subarachnoid bleed when the patient comes into the hospital even a few days after the acute headache when a plain CT may not pick up the bleed. Although MRI may not be available in smaller centers, it is useful for the detection of SAH that is late in presentation for vasospasm or ischemia
6. Given that the list of underlying causes of “TCH” have expanded over the last 15 years and the fact that MRI equipment and protocols are also more sensitive and specific for different conditions, an MR scan with contrast + MRA/MRV will help diagnose the following conditions that can also present as “TCH” – SIH, RCVS, PRES, cerebral venous thrombosis, dissection, arteriovenous

malformation, unruptured aneurysm, pituitary apoplexy, and acute sphenoid sinusitis. A plain CT and LP may be normal in these settings but the abnormality can be diagnosed on MRI

7. MRI will therefore noninvasively increase the yield in "TCH" by allowing us to exclude not only SAH but also other causes of "TCH"
8. Given the advances in MR technology, it will also not miss out on the diagnosis of the SAH. Since MRI abnormalities may persist longer than the findings of blood on CT, the timelines that apply to CT may not apply to MRI
9. Doing an MR before the LP eliminates the diagnostic dilemma created by a traumatic tap and the complicated scenario of a painful PDPH and low CSF pressure headache which in some studies occurs 30% of the time with the conventional bevel LP needle<sup>10</sup>
10. Doing an MR angio before an LP will also help in those situations where the possibility of an aneurysm exists such as in those with a family history of SAH, connective tissue disorder or polycystic kidney disease. This is however subject to the resolution limitations of MRA
11. If the LP is normal, you can still not stop investigating further to rule out other causes. However, if MRI is conclusive, you can avoid doing the LP, unless you are suspecting Primary "TCH."

## Conclusion

To think that all "TCH" is secondary to SAH is wrong. TCH or "sudden onset, severe headache" is also not always due to aneurysmal SAH. There are many other conditions that can present with "TCH" or "sudden onset, severe headache." With advancing imaging technology, we need to revise the sequence in which we order tests. Unfortunately, the basic tenets of teaching have not changed in this area. Given the clinical relevance and low pretest probability of the CSF revealing a significant finding that warrants further investigation, we advocate doing an MR study before doing the LP, until such time that we have a prospective multicentric study that looks at the small percentage of cases where the diagnosis was missed on CT and MRI but picked up through LP and CSF examination.

It is therefore time that we underplay the role of the LP for the evaluation of "TCH" and use MRI instead. If MRI is done before the LP and it is positive for a cause other than SAH, it will help avoid a needlessly potentially painful test that is not entirely without complications. If the plain CT and extensive MRI with contrast, MRA, and MRV do not point to the underlying cause of "TCH," then one may pursue an LP. If the LP too is nonyielding and a repeat MRA over a period does not point to the likelihood of RCVS, one may be justified in using the label of primary "TCH" with instructions to the patient to follow up in case of recurrence.

Through revisions to the current protocol as suggested, all the diagnostic suspicions for "TCH" can be better evaluated. Advocating any change to "practice methodology" always needs to take into consideration different viewpoints. It is now up to the reader to decide what would be the optimal way in which to evaluate "TCH" or "sudden onset, severe headache,"

without needlessly entangling ourselves in knots of our own making.

To put it a little differently, we need to "preach what we practice!" We await feedback and suggestions on this modified protocol for "TCH" and hope that someday in the near future the practice of routinely ordering an LP after negative CT for a patient with "TCH" will be replaced by plain CT and advanced MRI using the right protocol. After all "primum non nocere-first do no harm" is what good medicine is all about!

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

1. Day JW, Raskin NH. Thunderclap headache: Symptom of unruptured cerebral aneurysm. *Lancet* 1986;2:1247-8.
2. Headache Classification Committee of the International Headache Society (IHS). The international classification of headache disorders, 3<sup>rd</sup> edition (beta version). *Cephalalgia* 2013;33:629-808.
3. Schwedt TJ, Matharu MS, Dodick DW. Thunderclap headache. *Lancet Neurol* 2006;5:621-31.
4. Schwedt TJ. Thunderclap headaches: A focus on etiology and diagnostic evaluation. *Headache* 2013;53:563-9.
5. Matharu MS, Schwedt TJ, Dodick DW. Thunderclap headache: An approach to a neurologic emergency. *Curr Neurol Neurosci Rep* 2007;7:101-9.
6. Duncan CW. Neuroimaging and other investigations in patients presenting with headache. *Ann Indian Acad Neurol* 2012;15 Suppl 1:S23-32.
7. Mortimer AM, Bradley MD, Stoodley NG, Renowden SA. Thunderclap headache: Diagnostic considerations and neuroimaging features. *Clin Radiol* 2013;68:e101-13.
8. Ducros A, Bousser MG. Thunderclap headache. *BMJ* 2013;346:e8557.
9. Evans RW. Diagnostic testing for migraine and other primary headaches. *Neurol Clin* 2009;27:393-415.
10. Evans RW, Armon C, Frohman EM, Goodin DS. Assessment: Prevention of post-lumbar puncture headaches: Report of the therapeutics and technology assessment subcommittee of the American Academy of Neurology. *Neurology* 2000;55:909-14.
11. Vermeulen M, van Gijn J. The diagnosis of subarachnoid haemorrhage. *J Neurol Neurosurg Psychiatry* 1990;53:365-72.
12. Eggers C, Liu W, Brinker G, Fink GR, Burghaus L. Do negative CCT and CSF findings exclude a subarachnoid haemorrhage? A retrospective analysis of 220 patients with subarachnoid haemorrhage. *Eur J Neurol* 2011;18:300-5.
13. Vermeulen M. Subarachnoid haemorrhage: Diagnosis and treatment. *J Neurol* 1996;243:496-501.
14. Nagy K, Skagervik I, Tumani H, Petzold A, Wick M, Kühn HJ, *et al.* Cerebrospinal fluid analyses for the diagnosis of subarachnoid haemorrhage and experience from a Swedish study. What method is preferable when diagnosing a subarachnoid haemorrhage? *Clin Chem Lab Med* 2013;51:2073-86.
15. Perry JJ, Sivilotti ML, Stiell IG, Wells GA, Raymond J, Mortensen M, *et al.* Should spectrophotometry be used to identify xanthochromia in the cerebrospinal fluid of alert patients suspected of having subarachnoid hemorrhage? *Stroke* 2006;37:2467-72.
16. Sulaiman RA, Gama R. Pitfalls in cerebrospinal fluid spectroscopy results for the diagnosis of subarachnoid haemorrhage. *Br J Neurosurg* 2010;24:726.

17. Perry JJ, Spacek A, Forbes M, Wells GA, Mortensen M, Symington C, *et al.* Is the combination of negative computed tomography result and negative lumbar puncture result sufficient to rule out subarachnoid hemorrhage? *Ann Emerg Med* 2008;51:707-13.
18. Morgenstern LB, Huber JC, Luna-Gonzales H, Saldin KR, Grotta JC, Shaw SG, *et al.* Headache in the emergency department. *Headache* 2001;41:537-41.
19. van Gijn J, van Dongen KJ. The time course of aneurysmal haemorrhage on computed tomograms. *Neuroradiology* 1982;23:153-6.

### **"Quick Response Code" link for full text articles**

The journal issue has a unique new feature for reaching to the journal's website without typing a single letter. Each article on its first page has a "Quick Response Code". Using any mobile or other hand-held device with camera and GPRS/other internet source, one can reach to the full text of that particular article on the journal's website. Start a QR-code reading software (see list of free applications from <http://tinyurl.com/yzlh2tc>) and point the camera to the QR-code printed in the journal. It will automatically take you to the HTML full text of that article. One can also use a desktop or laptop with web camera for similar functionality. See <http://tinyurl.com/2bw7fn3> or <http://tinyurl.com/3ysr3me> for the free applications.