

## RESIDENTS AND FELLOWS

# The unforgivable curse of Harry Potter's thunderclap headaches

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Email: [umbertopensato91@gmail.com](mailto:umbertopensato91@gmail.com)**Keywords:** cerebral venous thrombosis, cervical artery dissection, reversible cerebral vasoconstriction syndrome, secondary headache, spontaneous intracranial hypotension, subarachnoid hemorrhage

Several attempts to pigeonhole Harry Potter's headaches into a Muggles' Headache Classification System have been done, examining the characteristics of pain and the evolution of Harry's attacks through the entire saga. The diagnoses proposed so far include migraine,<sup>1</sup> supraorbital neuralgia,<sup>1,2</sup> chronic headache attributed to head trauma,<sup>1,3</sup> symptomatic trigeminal neuralgia,<sup>3</sup> and nummular headache.<sup>4</sup> A secondary life-threatening headache has been repeatedly excluded since all of Harry's attacks resolved without consequences. However, we invite the readers to put themselves in the shoes of a doctor who examines Harry's case for the first time.

An 11-year-old boy presents to the emergency room because of recurrent attacks of severe headache. He describes "a pain like he's never felt before" that "pierced his head," "so bad he fell to his knees" and each time "the pain had gone as quickly as it had come." The general examination is unremarkable, except for a "curiously shaped cut, like a bolt of lightning" over his forehead. Considering the abrupt onset of pain, its severity, and the rapid escalation to peak intensity, thunderclap headache (TH) should be the first suspect that comes to your mind.

TH is defined as an excruciating headache with an abrupt onset, reaching maximal intensity within 1 min.<sup>5</sup> In patients presenting with such a clinical scenario, a comprehensive and urgent evaluation is mandatory to rule out the underlying disorders associated with high mortality and morbidity, mostly subarachnoid hemorrhage (SAH). Several disorders are potentially responsible for TH, yet five of them represent the most common and threatening ones.<sup>6</sup> Table 1 summarizes the main clinical and investigative findings of those conditions. Medical history and neurological examination may reveal distinctive

findings, pointing toward a specific etiology. For instance, recurrent short-lasting THs are suggestive of reversible cerebral vasoconstriction syndrome (RCVS),<sup>7</sup> whereas orthostatic headache is the hallmark of spontaneous intracranial hypotension.<sup>8</sup> Nonetheless, clinical features alone are unable to discriminate with certainty among different causes and a rapid stepwise diagnostic approach is always recommended (Figure 1).<sup>6,9,10</sup>

Noncontrast brain CT should be obtained promptly as its sensitivity for SAH decreases progressively (95%–99% at Day 1; 90% at Day 2; 75% at Day 3; 50% at Day 5).<sup>11–14</sup> Whenever a brain CT is unrevealing, a lumbar puncture (LP) should be performed to fully rule out SAH. Although its sensitivity increases progressively over time, as opposed to brain CT, reaching maximal sensitivity from 12 h to 2 weeks since disease onset, it must not be delayed. Cerebrospinal fluid analysis should include opening pressure, blood cell count, and visual inspection for xanthochromia. Four tubes are recommended in order to distinguish SAH from traumatic LP; indeed, red blood cell count remains unchanged in all tubes in the former. Additionally, immediate centrifugation usually aids to this end, revealing a xanthochromic supernatant only in SAH. Whenever available, spectrophotometry should also be used to measure products of red cell lysis (bilirubin), because it increases sensitivity for SAH. Negative CT brain and LP, if performed within a few days, reasonably exclude SAH. However, patients should be further investigated with contrast-enhanced brain magnetic resonance imaging and/or noninvasive vascular imaging to rule out other potential threatening etiologies.<sup>13</sup> Additionally, whenever a high suspicion of RCVS remains despite negative diagnostic workup (e.g., recurrent, triggered

**Abbreviations:** RCVS, reversible cerebral vasoconstriction syndrome; SAH, subarachnoid hemorrhage.

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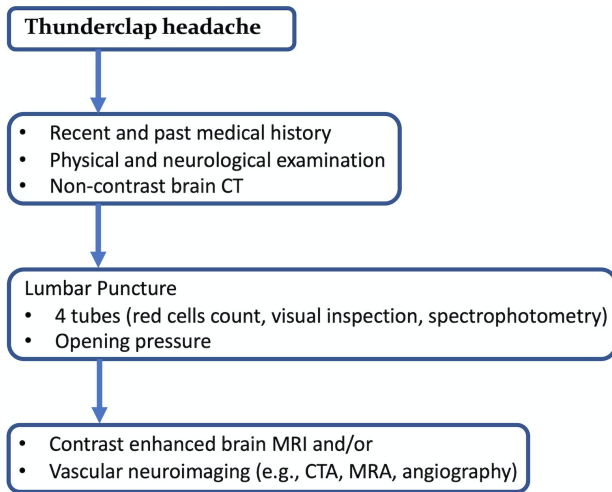
TABLE 1 Clinical and investigative findings of the most common causes of TH

Etiology	TH frequency at presentation	TH-specific features	Associated clinical features	Brain CT findings	LP findings	Brain MRI findings	Angiography findings
Subarachnoid hemorrhage (SAH)	50% <sup>8</sup>	May be preceded by physical exertion	Impaired consciousness, neck stiffness, seizure, focal defects	Subarachnoid blood	Elevated blood cells, xanthochromia	Subarachnoid blood	Ruptured aneurysm, vasospasm
Reversible cerebral vasoconstriction syndrome	94% <sup>19</sup>	Recurrent short-lasting THs, triggered by physical exertion, Valsalva maneuvers, or hot/cold water exposure	Transient or persistent focal neurological defects, seizures	Normal, sulcal SAH, ischemic stroke	Normal	Normal, sulcal SAH, ischemic stroke	Multifocal, multivessel vasoconstriction
Carotid and vertebral artery dissection	9.2% and 3.6%	Pain located in unilateral ear and face (carotid) or occipital/nuchal region (vertebral)	Focal neurological defects, Horner syndrome, pulsatile tinnitus, audible bruit, lower cranial neuropathies, amaurosis fugax	Normal, ischemic stroke	Normal	Normal, ischemic stroke	Dissected artery
Cerebral venous thrombosis	5% <sup>20</sup>	May worsen in supine position in response to Valsalva maneuvers	Papilledema, impaired consciousness, seizures, focal neurological defects	Dense triangle sign, cord sign, venous hemorrhages	Elevated opening pressure, elevated protein level	Venous hemorrhages, evidence of intraluminal thrombus	Venous sinus thrombosis
Spontaneous intracranial hypotension	15% <sup>21</sup>	Worsened standing and relieved lying (orthostatic)	Spine pain, tinnitus, diplopia/visual changes, nausea/emesis (often orthostatic symptoms)	Normal, subdural fluid collections	Low opening pressure	Diffuse pachymeningeal enhancement, engorgement of cerebral venous sinuses, subdural fluid collections, brain sagging	Normal

Note: Other less common causes of TH include complicated sinusitis, hemorrhagic stroke, subdural hematoma, brain tumor, cardiac cephalalgia, giant cell arteritis, pituitary apoplexy, and third ventricle colloid cyst.

Abbreviations: CT, computer tomography; LP, lumbar puncture; MRI, magnetic resonance imaging; TH, thunderclap headache.

Source: Modified from Schwedt (2015).<sup>6</sup>



**FIGURE 1** Diagnostic algorithm for patients presenting with thunderclap headache. Contrast-enhanced brain magnetic resonance imaging and vascular neuroimaging should be performed based on clinical suspicion and not routinely [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

TH attacks), vascular imaging tests should be repeated after a few weeks.<sup>7,15</sup> Indeed, vasoconstriction usually starts distally and only later involves medium-large cerebral vessels detectable on radiological investigations.<sup>15</sup>

Primary TH remains a diagnosis of exclusion, and some experts believe that such an entity does not exist and those patients reflect poor diagnostic investigations or unrevealed structural changes/small blood seepage of cerebral unruptured aneurysms.<sup>5</sup>

Magnetic resonance vessel wall imaging is an emerging technique that provides details of the vessel walls, different from conventional neuroimaging for which the assessment is limited to the vessel's lumen.<sup>16</sup> Such properties make this technique promising for the evaluation of patients presenting with TH, showing distinctive features across RCVS, arterial dissections, and unstable intracranial aneurysms.<sup>16-18</sup>

## CONCLUSIONS

Secondary headaches may be challenging for physicians, especially trainees and residents, but should always be excluded prior to diagnosing a primary headache. TH represents the most worrisome clinical feature in headache medicine, unfolding threatening underlying etiologies of secondary headaches. Therefore, it should not be underestimated and all patients must be expeditiously and comprehensively investigated; famous magicians are no exceptions. Unfortunately, we doctors can not rely on magical powers to appropriately diagnose and manage our patients, nonetheless remembering *HARRY POTTER* headaches and their strict association with serious danger, namely Voldemort to Harry, may aid us in this particularly difficult diagnostic challenge, reminding us of the five most important underlying disorders and the diagnostic

**H**aemorrhage (subarachnoid)  
**A**rtery dissections  
**R**CVS  
**th****R**ombosis (cerebral venous)  
**h****Y**potension (intracranial)  
**P**uncture (lumbar)  
**O**pening pressure  
**T**ubes (four)  
**c****T** brain (non contrast CT and angio-CT)  
**E**xamination (physical and neurological)  
**R**ecent and past medical history

**FIGURE 2** Main underlying etiologies and diagnostic workup suggested by the HARRY POTTER acronym

workup to perform (Figure 2). The present work is not meant to be an exhaustive review, but an attempt to discuss with a humorous tone, yet a clear didactic purpose, the main causes of TH, and its initial diagnostic approach. Indeed, the range of differential diagnosis is wider than we described, and controversy still exists over its best management.

Regarding Harry Potter's recurrent headaches, considering his long follow-up, we may now reasonably exclude threatening underlying causes. Therefore, a primary headache diagnosis might be sought, as previously reviewed. However, it remains uncertain if Muggles' headache classification may be extendable to the wizard world, and a headache related to an *unforgivable* curse remains the most likely diagnosis.

## CONFLICT OF INTEREST

The authors report no relevant conflict of interest.

## AUTHOR CONTRIBUTIONS

*Study concept and design:* Umberto Pensato. *Acquisition of data:* Umberto Pensato, Eleonora Matteo. *Analysis and interpretation of data:* Umberto Pensato, Eleonora Matteo, Sabina Cevoli. *Drafting of the manuscript:* Umberto Pensato. *Revising it for intellectual content:* Umberto Pensato, Eleonora Matteo, Sabina Cevoli. *Final approval of the completed manuscript:* Umberto Pensato, Eleonora Matteo, Sabina Cevoli.

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## REFERENCES

- Sheftell F, Steiner TJ, Thomas H. Harry Potter and the curse of headache. *Headache*. 2007;47:911-916.
- Hagen K. Harry Potter's headache. *Headache*. 2008;48:166.
- Lewis D, Hershey A. Harry Potter's headaches. *Headache*. 2008;48:167-168.
- Mohen SA, Robbins MS. Harry Potter and nummular headache. *Headache*. 2012;52:323-324.
- Headache Classification Committee of the International Headache Society (IHS). The International Classification of Headache Disorders, 3rd edition. *Cephalalgia*. 2018;38:1-211.
- Schwedt TJ. Thunderclap headache. *Continuum*. 2015;21:1058-1071.
- Ducros A, Wolff V. The typical thunderclap headache of reversible cerebral vasoconstriction syndrome and its various triggers. *Headache*. 2016;56:657-673.
- Mokri B. Spontaneous low pressure, low CSF volume headaches: spontaneous CSF leaks. *Headache*. 2013;53:1034-1053.
- Ducros A, Bousser MG. Thunderclap headache. *BMJ*. 2013;346:e8557.
- Cortelli P, Cevoli S, Nonino F, et al. Evidence-based diagnosis of nontraumatic headache in the emergency department: a consensus statement on four clinical scenarios. *Headache*. 2004;44:587-595.
- Backes D, Rinkel GJ, Kemperman H, Linn FH, Vergouwen MD. Time-dependent test characteristics of head computed tomography in patients suspected of nontraumatic subarachnoid hemorrhage. *Stroke*. 2012;43:2115-2119.
- Perry JJ, Sivilotti MLA, Émond M, et al. Prospective implementation of the Ottawa subarachnoid hemorrhage rule and 6-hour computed tomography rule. *Stroke*. 2020;51:424-430.
- American College of Emergency Physicians Clinical Policies Subcommittee on Acute Headache, Godwin SA, Cherkas DS, et al. Clinical policy: critical issues in the evaluation and management of adult patients presenting to the emergency department with acute headache. *Ann Emerg Med*. 2019;74:e41-e74.
- Carpenter CR, Hussain AM, Ward MJ, et al. Spontaneous subarachnoid hemorrhage: a systematic review and meta-analysis describing the diagnostic accuracy of history, physical examination, imaging, and lumbar puncture with an exploration of test thresholds. *Acad Emerg Med*. 2016;23:963-1003.
- Ducros A. Reversible cerebral vasoconstriction syndrome. *Handb Clin Neurol*. 2014;121:1725-1741.
- Leao DJ, Agarwal A, Mohan S, Bathla G. Intracranial vessel wall imaging: applications, interpretation, and pitfalls. *Clin Radiol*. 2020;75:730-739.
- Pensato U, Cevoli S, Cirillo L. Vessel wall imaging in thunderclap headache: a reversible cerebral vasoconstriction syndrome (RCVS) case. *Headache*. 2020;60:2633-2635.
- Correa DG, Hygino da Cruz LC, Jr. High-resolution vessel wall imaging for a differential diagnosis of thunderclap headaches. *J Emerg Med*. 2020;58:826-828.
- Ducros A, Boukobza M, Porcher R, Sarov M, Valade D, Bousser MG. The clinical and radiological spectrum of reversible cerebral vasoconstriction syndrome. A prospective series of 67 patients. *Brain*. 2007;130:3091-3101.
- Wasay M, Kojan S, Dai AI, Bobustuc G, Sheikh Z. Headache in cerebral venous thrombosis: incidence, pattern and location in 200 consecutive patients. *J Headache Pain*. 2010;11:137-139.
- Schievink WI, Wijdicks EF, Meyer FB, Sonntag VK. Spontaneous intracranial hypotension mimicking aneurysmal subarachnoid hemorrhage. *Neurosurgery*. 2001;48:513-516; discussion 6-7.

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