

Lumbar Puncture First? An old test and a new approach to lone acute sudden headaches

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RÉSUMÉ : On évoque souvent le diagnostic de l'hémorragie sous-arachnoïdienne chez les patients qui se présentent à l'urgence pour un mal de tête violent et soudain, mais dont l'examen physique est normal. La norme de soins de nos jours consiste à soumettre ces patients à une tomographie par densitométrie (TDM) sans substance de contraste suivie d'une ponction lombaire pour les TDM négatives. Cependant, comme la plupart des céphalées évaluées sont bénignes, la plupart des résultats de la TDM et de la ponction lombaire sont normaux.

Le présent article a pour but d'analyser l'impact d'un protocole diagnostique de rechange, où la ponction lombaire serait la première (et dans la plupart des cas, la seule) épreuve diagnostique effectuée chez les patients chez qui l'on soupçonne une hémorragie sous-arachnoïdienne et qui présentent ce symptôme isolé de mal de tête violent. Selon une hypothèse raisonnable, pour chaque 100 patients évalués, le protocole de «ponction lombaire en premier» nécessiterait 81 TDM de moins et seulement 9 ponctions lombaires additionnelles, comparativement à la stratégie diagnostique traditionnelle. Ces avantages demeurent stables même en variant les hypothèses à l'intérieur des limites cliniquement plausibles.

Nous croyons que ce protocole pourrait entraîner une utilisation beaucoup plus efficace des ressources en limitant le taux de morbidité additionnel, tout en offrant une précision diagnostique équivalente pour l'hémorragie sous-arachnoïdienne chez le patient à l'urgence qui répond au critère de mal de tête isolé violent et soudain.

The problem

Headaches are a frequent presenting complaint in the emergency department (ED), representing up to 4.5% of visits.¹ While most patients have benign headache syndromes, some have dangerous secondary causes such as subarachnoid hemorrhage (SAH). This condition, which often occurs in young people, has a 50% mortality rate²⁻⁵ and leaves almost half its survivors with neurologic sequelae. ED physicians must maintain a high index of suspicion for SAH and aggressively investigate this potentially devastating disease.

About 70% of ED patients with acute sudden onset (< 1 minute) headaches suggestive of SAH will have a normal neurologic exam, normal vital signs and temperature, nor-

mal level of consciousness, and no neck stiffness.² Such patients are termed as having a lone acute sudden headache (LASH). Most LASH patients (80–90%) have benign conditions, but they require further investigation, since 8–12% will prove to have SAH.^{2,6,7}

The traditional diagnostic strategy is to begin with a CT (computed tomography) scan of the head. CT sensitivity at 24 hours varies from 81–100% and decreases rapidly thereafter.⁸⁻¹⁵ CT sensitivity also varies depending on the patient's neurologic status (spectrum bias), being 99.4% sensitive in stuporous or comatose patients but only 86% sensitive in alert patients.^{5,10} Therefore, CT by itself cannot rule out SAH. Lumbar puncture is highly sensitive, and virtually 100% of SAH victims will develop spinal fluid (CSF)

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xanthochromia within 12 hours of the onset of bleeding. Consequently, in patients with suspected SAH, a normal CT must be followed by a lumbar puncture (LP). The CSF should be analyzed using a spectrophotometer, since direct visual identification of xanthochromia may be false negative in up to 50% of cases.^{5,8,9,12,16-18}

Recently, we posed the question of whether a CT need be

done prior to LP.¹⁹ To answer this, we must distinguish between two subgroups of patients: those with normal versus those with abnormal clinical findings. CT scanning prior to LP is recommended in all non-LASH patients, but for patients who fulfil LASH criteria, we propose an alternate approach — the LP First model — in which LP is the first and, in most cases, the only diagnostic test performed. A more detailed description of the LP First model has been published previously.¹⁹

The LP First approach

Within the LP First model (Fig. 1), patients fulfilling LASH criteria would initially undergo lumbar puncture at least 12 hours after headache onset. Those with negative LPs would be discharged home with follow-up; those with positive LPs would undergo CT scanning and other appropriate tests (e.g., angiography); and those with indeterminate LPs (i.e., unable to obtain CSF, or elevated red blood cell [RBC] count without xanthochromia) would undergo CT scanning and further investigations as indicated.

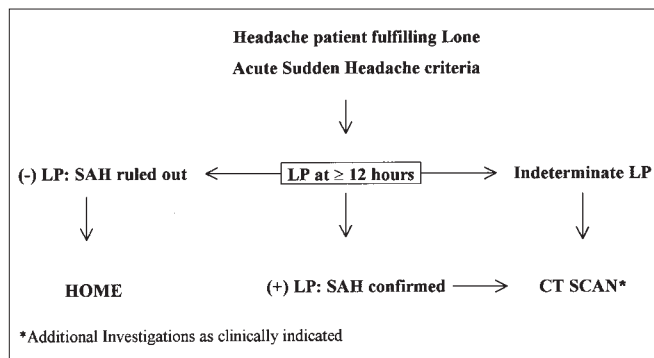


Fig. 1. LP First: a new approach for an old test

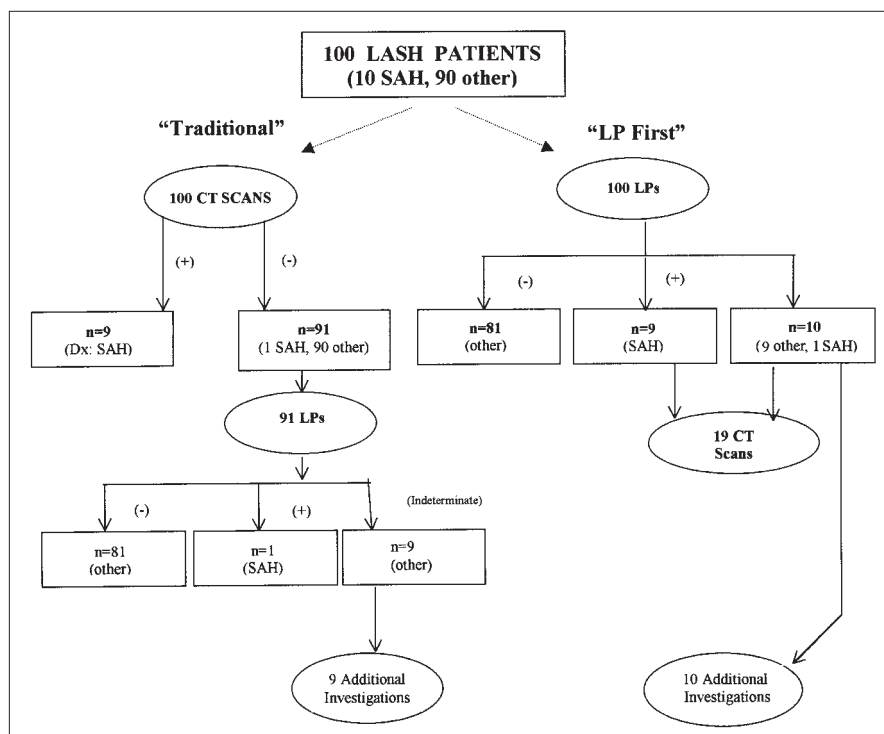


Fig. 2. LP First vs. traditional diagnostic pathway

Table 1. Totals		
Traditional	vs.	LP First
100 CT scans	vs.	19 CT scans
91 LPs	vs.	100 LPs
9 "additional investigations"	vs.	10 "additional investigations"

What are the benefits of this approach? Since the majority of LASH patients do not have an SAH, the LP first model would shorten time to diagnosis by eliminating the intervening CT. This is especially true in centres without CT scanners who must transfer LASH patients, and in centres that lack 24-hour CT availability, who must call in technicians or hold LASH patients overnight. Given standard assumptions (CT sensitivity [90%], specificity [99.9%], SAH prevalence among LASH patients [10%], rate of indeterminate LPs [10%]), then for every 100 patients presenting with LASH, the traditional strategy would lead to 100 CTs, 91 LPs, and 9 patients requiring further investigation. The LP First strategy would lead to 100 LPs, 19 CTs, and 10 patients requiring further investigation, a reduction of 81 CTs (Fig. 2). Even if the above assumptions are varied over clinically plausible ranges, the benefits of this model remain stable. In fact, the lower a physician's threshold for investigating SAH (i.e., the lower the prevalence of SAH among investigated patients), the greater the benefit of the LP First model.¹⁹ Since LP is the gold standard test for SAH, both the LP First and

the traditional strategies would have equal diagnostic accuracy for SAH.

The primary roadblock to implementing this model is the fear many physicians have that LP is unsafe without prior CT. There is a general consensus, and some evidence, that CT should be performed before LP in patients with abnormal neurologic findings or altered mentation. In one report of 283 patients with SAH, all 4 patients who suffered complications following LP were described as having neck stiffness and being in "Hunt-Hess grades 1 to 3" (i.e., from normal neurological exam to major neurological deficit).^{15,20} In another report, all 7 patients who suffered complications after LP were classified as Hunt-Hess grades 2 or 3.²¹ None of these patients would have met the LASH criteria defined above. In fact, evidence for LP risk is either anecdotal or extrapolated from patients with abnormal neurological exams.^{10,12,22} There is little evidence that LP is dangerous in LASH patients. Despite this, and the suggestions of several authors that it is unnecessary,^{15,23-26} many centres require CT before LP in all patients.

Limitations of the LP First model

Some patients with acute sudden headache have a secondary etiology that cannot be diagnosed by LP. In such cases, a normal tap may be falsely reassuring. In a recent study of 148 patients with acute sudden headache, 103 (70%) had normal neurological exams and 16 of these had secondary causes, including 12 with SAH and 1 with meningitis. Three patients (2.9%) had intracranial pathology not detectable by LP alone (one intracerebral hematoma, one giant aneurysm without bleed and one arterio-venous malformation with hematoma).² This 2.9% "diagnostic miss rate" is concerning but is no higher than that seen in patients with slow-onset headaches and normal neurological exams, in whom the prevalence of intracranial pathology ranges from 3.0% to 6.9%.²⁷ These LP First "misses" could be reduced further by excluding high-risk patients, including the elderly and those with known cancer or HIV, and arranging good patient follow-up to assure that patients with persistent symptoms undergo further investigation. This follow-up "safety net" is not unlike many other diagnostic models used in emergency medicine, such as those used to assess febrile infants.

The LP First strategy might, in some cases, cause diagnostic delays. To maximize sensitivity, LPs should be performed at least 12 hours after headache onset, unless meningitis is suspected. Since over half of LASH patients present later than 24 hours,²⁸ most would experience no delay. Those who present early could be investigated in the traditional manner (immediate CT) or observed in the ED until the 12-

hour mark. In some cases, this would mean delaying a diagnosis that could have been made earlier by CT. The impact of such a delay, however, is likely to be small, since surgical intervention is typically delayed for many hours or even overnight, pending cerebral angiography.

Performing more LPs might lead to more complications. The LP First model would result in 9 additional LPs per 100 patients investigated. This would cause from 0 to 3 additional post-LP headaches. Other LP complications are so rare that no discernible increase would be expected using the LP First model.¹⁹

Finally, the most important limitation of the LP First model is that it is untested. Before it can be advocated or widely used, prospective clinical trials are necessary to prove its safety. Younger patients without risk factors might be the ideal candidates for the LP First model, and prospective studies are needed to better characterize the patient group who will benefit most from this strategy.

Conclusion

The LP First model is intended for patients with LASH compatible with SAH, who have a normal neurologic exam, normal vital signs and temperature, normal level of consciousness, and no neck stiffness. Given that most patients with acute sudden headaches meet these criteria,^{2,6} the LP First model has the potential to expedite the investigation of headache patients and substantially reduce the need for CT scanning. Greater efficiency and improved utilization would result, but would not be expected to reduce diagnostic accuracy. Before the LP First model can be widely advocated, however, a prospective clinical evaluation is required to determine its safety, costs and benefits.

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