

---

**Neurology Publish Ahead of Print**  
**DOI: 10.1212/WNL.000000000207828**

## Clinical Reasoning: An Older Woman With Headaches and Lethargy After a fall

**Author(s):**

Sara K Heide, MD<sup>1</sup>; Rachel Gnanaprakasm, MBBS<sup>2</sup>; Yarden Bornovski, MD<sup>3</sup>; Eric Feldstein, MD<sup>4,4</sup>; Marina Keller, MD<sup>2</sup>; Jon Rosenberg, MD<sup>3</sup>

**Corresponding Author:**

Sara K Heide, sara.k.heide@gmail.com

**Affiliation Information for All Authors:** 1. Department of Neurology, Mount Sinai Beth Israel Medical Center; 2. Department of Infectious Disease, Westchester Medical Center; 3. Department of Neurology, Westchester Medical Center; 4. Department of Neurosurgery, Westchester Medical Center

**Equal Author Contribution:**

**Contributions:**

Sara Kate Heide: Drafting/revision of the manuscript for content&comma; including medical writing for content; Major role in the acquisition of data; Study concept or design; Analysis or interpretation of data; Additional contributions (in addition to one or more of the above criteria)

Rachel Gnanaprakasm: Drafting/revision of the manuscript for content&comma; including medical writing for content; Additional contributions (in addition to one or more of the above criteria)

Yarden Bornovski: Drafting/revision of the manuscript for content&comma; including medical writing for content; Additional contributions (in addition to one or more of the above criteria)

Eric Feldstein: Drafting/revision of the manuscript for content&comma; including medical writing for content; Additional contributions (in addition to one or more of the above criteria)

Marina Keller: Drafting/revision of the manuscript for content&comma; including medical writing for content; Analysis or interpretation of data; Additional contributions (in addition to one or more of the above criteria)

Jon Rosenberg: Drafting/revision of the manuscript for content&comma; including medical writing for content; Study concept or design; Analysis or interpretation of data; Additional contributions (in addition to one or more of the above criteria)

**Figure Count:**

2

**Table Count:**

0

**Search Terms:**

[ 295 ] Critical care, [ 139 ] Bacterial infections, [ 6 ] Infarction, [ 297 ] Status epilepticus, [ 264 ] Brain trauma

**Acknowledgment:**

**Study Funding:**

The authors report no targeted funding.

**Disclosure:**

The authors report no relevant disclosures.

**Preprint DOI:**

**Received Date:**  
2023-04-04

**Accepted Date:**  
2023-07-19

**Handling Editor Statement:**

Submitted and externally peer reviewed. The handling editor was Resident and Fellow Section Editor Whitley Aamodt, MD, MPH.

## Abstract

In this case, a 77- year old woman presented with generalized weakness, difficulty ambulating, lethargy, loss of appetite, and headaches after a mechanical fall. This case discusses the management of acute neurologic emergencies such as subdural hematoma, status epilepticus, and bacterial meningitis. Potential etiologies for stroke and central nervous system infection are highlighted. Readers are led through the diagnostic approach to a patient presenting with a complex array of neurologic symptoms causing rapid clinical decompensation.

ACCEPTED

## Section 1

A 77-year-old woman, named AP, with a history of hypertension and hyperlipidemia presented with generalized weakness, difficulty ambulating, lethargy, loss of appetite, and headaches. She was in her usual state of health until 4 days prior to admission when she fell in her bathroom while attempting to sit. Her family brought her to the emergency department (ED) due to her evolving symptoms.

Upon arrival, AP was alert, oriented, and able to follow commands. Her neurologic exam showed intact cranial nerves, including a brisk and symmetric pupillary reflex, and intact motor strength and sensation in her extremities. She was hypertensive to 158/81 with all other vital signs stable and within normal limits. Her labs were significant for elevated white blood cell count of 17.9, a blood urea nitrogen of 40, and a creatinine of 1.84. As seen in Figure 1A, a CT head demonstrated a 9mm subacute right isodense subdural collection with 4mm of midline shift. Neurosurgery was consulted for subdural hematoma (SDH), and they recommended no acute neurosurgical intervention given the hematoma size and AP's intact neurological exam.

Questions for Consideration:

1. How would you manage the patient after the CT findings?
2. Should surgical evacuation be considered?

All patients with SDH should have a prompt evaluation of their airway, breathing, and circulation. In addition, any anticoagulation and antiplatelet agents should be reversed given the risk of hematoma expansion<sup>1</sup>. Common surgical indications for SDH evacuation include clot thickness >10mm, midline shift >5mm, and intracranial pressure (ICP) exceeding 20 mmHg.<sup>2</sup> All patients with acute intracranial hemorrhage should be placed on basic measures to protect against elevated ICP and hematoma expansion, such as: elevating the head of the bed to 30 degrees, minimizing pain, maintaining normothermia, and decreasing the systolic blood pressure below 160 mmHg. Furthermore, patients initially managed conservatively should have a repeat CT scan within 6 hours to assess for expansion<sup>3</sup>.

AP was admitted to the medicine service for evaluation of acute kidney injury and electrolyte abnormalities. The next day, she was febrile to 38.8<sup>0</sup>C and had multiple seizures described as left head tilt and left arm shaking followed by rigidity of the entire body. The convulsions lasted 10 minutes without return to baseline. She was intubated for airway protection in the setting of status epilepticus (SE).

Questions for consideration:

1. How would you manage a patient in SE?
2. What other tests would you order once the patient is stabilized?

## Section 2

The goals of managing SE include rapid cessation of the seizure and establishment of adequate airway, breathing, and circulation. First line therapy is high dose benzodiazepines; diazepam, lorazepam, or midazolam are most commonly used<sup>4</sup>. Neurocritical Care Society guidelines recommend 4mg of IV lorazepam or 10mg of IM midazolam (maximum benzodiazepine dose 0.1mg/kg) as first line therapy. If patients do not respond after 5-10 minutes, a second round of high dose benzodiazepines is indicated in addition to a long-acting antiseizure medication<sup>4</sup>. A recent randomized control trial showed no significant difference in efficacy of IV fosphenytoin, valproate, or levetiracetam in the treatment of convulsive status epilepticus<sup>5</sup>. If the seizures continue, the patient should be intubated and started on an IV anesthetic such as midazolam, propofol, or pentobarbital<sup>4</sup>.

AP was given 2 mg of IV midazolam without clinical improvement. She was then given 4mg more of midazolam and intubated. Following intubation, AP was loaded with brivaracetam 400mg and sedated with propofol, after which time her seizures aborted, and she was transferred to the Neuro-ICU.

Blood glucose fingerstick was unremarkable and a full set of labs including blood cultures and urine cultures were sent. After the airway was secured, the patient was sent for stat CT head and CT angiogram of the head and neck. The CT head showed an enlarging subdural collection, now measuring 11mm with increased midline shift and mass effect (Figure 1B). There was also an increased hypoattenuation within the right parietooccipital lobe suggestive of an acute infarct. The CTA showed vasospasm of the middle cerebral arteries. Following emergency head imaging she was connected to continuous video electroencephalogram (EEG) due to persistently poor neurological exam. The EEG showed diffuse slowing and right hemisphere lateralized periodic discharges without seizures.

Questions for consideration:

1. What etiologies would you consider to explain the new found stroke and vasospasm?
2. What empiric therapy if any should be considered?
3. What additional testing and information would you want?

### Section 3

After reviewing the CT, one could consider the patient's clinical decompensation to be secondary to an expanding subdural hematoma in the setting of new ischemic strokes. However, the presence of an enlarging subdural collection in the absence of acute blood on imaging makes this less likely. Given the patient's decompensation, recent fever, and expanding collection on CT imaging, there was a greater concern for subdural empyema and bacterial endocarditis. Of note, vasospasm, though traditionally seen in the context of an aneurysmal subarachnoid hemorrhage, can also occur in the setting of bacterial meningitis, thus further suggesting that AP was suffering from a central nervous system (CNS) infection.

AP was started on vancomycin and ceftriaxone to cover for gram-positive skin and mouth flora such as streptococcus and methicillin-resistant staphylococcus aureus, in addition to common gram-negative organisms. Blood cultures came back positive for *Streptococcus intermedius* in two bottles. Off sedation AP opened her eyes to noxious stimulation, did not follow commands nor track, had intact cranial nerves, withdrew to noxious in her right arm and leg, and had minimal movement on the left side of her body.

After EEG confirmed no seizures, AP underwent an emergent MRI brain to better delineate the etiology of her CNS lesions. The MRI brain, as seen in Figure 2, showed an extensive right hemispheric multi-loculated subdural empyema extending over the right hemisphere. The collection tracked along the inferior temporal lobe and into the subdural space causing mass effect on the right dorsal midbrain. Diffuse leptomeningeal enhancement and cerebral edema with diffusion restriction in the right parietal-occipital lobe was suggestive of meningitis and cerebritis. Thus, the patient's hypodensity on CTH, believed to be an infarct, was likely secondary to infectious embolic particulate. Neurosurgery performed a right craniotomy and subdural evacuation which improved the mass effect and midline shift. Intraoperative cultures grew *Streptococcus intermedius*.

Questions for consideration:

1. What are the possible etiologies for subdural empyema?
2. What other questions might you have about her history?

## Section 4

AP's bacteremia in the setting of stroke or intracranial hemorrhage was concerning for infective endocarditis. Infectious Disease was consulted to assist with antibiotic recommendations and workup of her bacteremia. The blood cultures rapidly cleared with initiation of antibiotics, making an endovascular infection unlikely. Transthoracic and transesophageal echocardiograms showed no cardiac valve vegetations.

Upon further discussion with the patient's family, they revealed that 10 days prior to her presentation, AP had right facial swelling after placement of prosthetic teeth. Oral and maxillofacial surgery was consulted and described purulence over the right mandible, though a maxillofacial CT with contrast did not reveal an odontogenic abscess.

AP's neurological exam remained at a GCS of 6 in the weeks following her surgery, thus she required a tracheostomy and PEG tube placement. She was continued on ceftriaxone for 8 weeks post-operatively and discharged to a long-term acute care hospital where she died one month later.

## Discussion

Common etiologies for subdural empyema include head trauma with depressed skull fractures, cranial surgery, infected subdural hematoma, and improperly treated ear and sinus infections<sup>6</sup>. Of these, sinonasal and otomastoid infections are the leading causes<sup>7</sup>. For cases of subdural empyema secondary to paranasal sinusitis, the most common organism is *Streptococcus milleri*<sup>6,7</sup>.

*Streptococcus intermedius* is a member of the *Streptococcus milleri* group. While *S. milleri* are a part of the normal microbiota in many mucosal sites, they are also found in suppurative infections that include periodontal abscesses, intracranial abscesses and infective endocarditis<sup>8</sup>. *S. intermedius* bacteremia has been found in patients after dental work as it is part of the normal oral flora and may spread hematogenously with manipulation<sup>9</sup>. Issa et. al., showed that 18.8% of patients with *S. intermedius* infections experienced a recent dental manipulation<sup>10</sup>. Of note, 98% of these infections were associated with abscess development, which were most commonly in the brain at 41.6%<sup>10</sup>. Whiley et. al, also showed a strong association between *S. Intermedius* with infections involving the CNS<sup>11</sup>. In May 2022, the CDC identified 81 cases of pediatric brain abscess, epidural empyema or subdural empyema with 41.6% of them identified as *S. Intermedius*<sup>12</sup>.

It is probable that our patient with *S. intermedius* bacteremia after recent dental manipulation had bacterial hematogenous spread resulting in subdural empyema. Surgical evacuation and antibiotics are recommended for treatment, with the commonest agents being cefotaxime and metronidazole<sup>13</sup>.

In an older woman with a recent fall and subsequent subdural collection, SDH might be assumed. However, AP's fever and seizures prompted us to get further imaging and history. Clinicians must remain vigilant when managing a patient with a seemingly classic presentation and consider *S. intermedius* subdural empyema in patients with unexplained CNS collections following dental work.

ACCEPTED

## References

1. Mehta V, Harward SC, Sankey EW, Nayar G, Codd PJ. Evidence based diagnosis and management of chronic subdural hematoma: A review of the literature. *J Clin Neurosci*. 2018 Apr;50:7-15. doi: 10.1016/j.jocn.2018.01.050. Epub 2018 Feb 7. PMID: 29428263.
2. Karibe H, Hayashi T, Hirano T, Kameyama M, Nakagawa A, Tominaga T. Surgical management of traumatic acute subdural hematoma in adults: a review. *Neurol Med Chir (Tokyo)*. 2014;54(11):887-94. doi: 10.2176/nmc.cr.2014-0204. Epub 2014 Oct 31. PMID: 25367584; PMCID: PMC4533344.
3. Servadei, Franco MD; Nasi, Maria Teresa MD; Cremonini, Anna Maria MD; Giuliani, Giuliano MD; Cenni, Patrizia MD; Nanni, Andrea MD. Importance of a Reliable Admission Glasgow Coma Scale Score for Determining the Need for Evacuation of Posttraumatic Subdural Hematomas: A Prospective Study of 65 Patients. *The Journal of Trauma: Injury, Infection, and Critical Care* 44(5):p 868-873, May 1998.
4. Brophy GM, Bell R, Claassen J, Alldredge B, Bleck TP, Glauser T, Laroche SM, Rivello JJ Jr, Shutter L, Sperling MR, Treiman DM, Vespa PM; Neurocritical Care Society Status Epilepticus Guideline Writing Committee. Guidelines for the evaluation and management of status epilepticus. *Neurocrit Care*. 2012 Aug;17(1):3-23. doi: 10.1007/s12028-012-9695-z. PMID: 22528274.
5. Kapur J, Elm J, Chamberlain JM, Barsan W, Cloyd J, Lowenstein D, Shinnar S, Conwit R, Meinzer C, Cock H, Fountain N, Connor JT, Silbergleit R; NETT and PECARN Investigators. Randomized Trial of Three Anticonvulsant Medications for Status Epilepticus. *N Engl J Med*. 2019 Nov 28;381(22):2103-2113. doi: 10.1056/NEJMoa1905795. PMID: 31774955; PMCID: PMC7098487.
6. Suthar R, Sankhyan N. Bacterial Infections of the Central Nervous System. *Indian J Pediatr*. 2019 Jan;86(1):60-69. doi: 10.1007/s12098-017-2477-z. Epub 2018 Jan 3. PMID: 29297142.
7. Chokkappan K, Lohan R. Rapidly Developing Subdural Empyema in an Adult with Sinusitis: A Neurosurgical Threat Alert. *Asian J Neurosurg*. 2018 Apr-Jun;13(2):458-461. doi: 10.4103/ajns.AJNS\_97\_16. PMID: 29682060; PMCID: PMC5898131.
8. Han JK, Kerschner JE. Streptococcus milleri: An Organism for Head and Neck Infections and Abscess. *Arch Otolaryngol Head Neck Surg*. 2001;127(6):650-654. doi:10.1001/archotol.127.6.650
9. Livingston, L. V., and Perez-Colon, E. (2014). Streptococcus intermedius bacteremia and liver abscess following a routine dental cleaning. *Case Rep. Infect. Dis*. 2014:954046. doi: 10.1155/2014/954046
10. Issa E, Salloum T, Tokajian S. From Normal Flora to Brain Abscesses: A Review of Streptococcus intermedius. *Front Microbiol*. 2020 May 7;11:826. doi: 10.3389/fmicb.2020.00826. PMID: 32457718; PMCID: PMC7221147.
11. Whiley RA, Beighton D, Winstanley TG, Fraser HY, Hardie JM. Streptococcus intermedius, Streptococcus constellatus, and Streptococcus anginosus (the Streptococcus milleri group): association with different body sites and clinical infections. *J Clin Microbiol*. 1992 Jan;30(1):243-4. doi: 10.1128/jcm.30.1.243-244.1992. PMID: 1734062; PMCID: PMC265033.
12. Accorsi EK, Chochua S, Moline HL, et al. Pediatric Brain Abscesses, Epidural Empyemas, and Subdural Empyemas Associated with Streptococcus Species — United



States, January 2016–August 2022. *MMWR Morb Mortal Wkly Rep* 2022;71:1169–1173.  
DOI: <http://dx.doi.org/10.15585/mmwr.mm7137a2>.

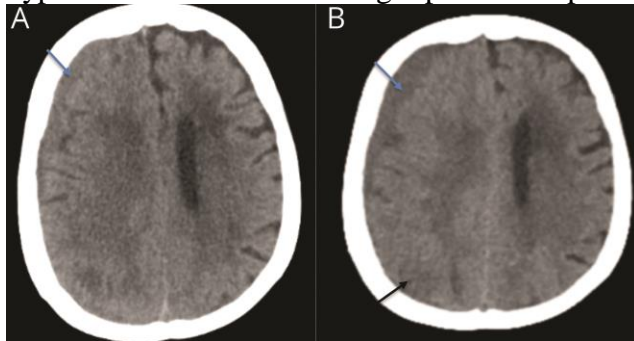
13. Kowlessar PI, O'Connell NH, Mitchell RD, Elliott S, Elliott TS. Management of patients with *Streptococcus milleri* brain abscesses. *J Infect.* 2006 Jun;52(6):443-50. doi: 10.1016/j.jinf.2005.08.028. Epub 2005 Oct 18. PMID: 16239034

ACCEPTED

## Figures

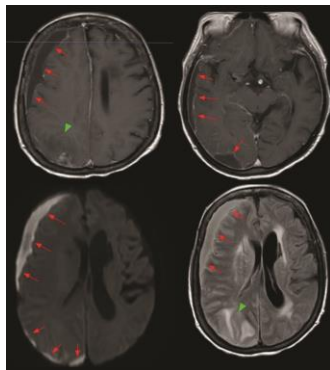
### Figure 1: Axial computed tomography (CT) scans of the head without contrast

(A) Initial CT Head upon presentation to the ED showing a 9mm subacute right subdural collection (blue arrow) with 4mm of midline shift. (B) Repeat CT Head 24 hours later, fever and status epilepticus, showing enlargement of the right subdural collection to 11mm (blue arrow) and increased midline shift and mass effect on the adjacent parenchyma. There is also increased hypoattenuation within the right parietooccipital lobe suggesting an acute infarct (black arrow).



### Figure 2: Initial MRI Brain

MRI Brain shows an extensive right hemispheric, multiloculated restricting and enhancing subdural fluid collection tracking along the right frontal and inferior temporal lobe and extending into the subdural space (red arrows). There is increased intensity in the subarachnoid space consistent with meningitis and cortical edema in the right posterior parietooccipital lobe suggesting cerebritis (green arrowheads).



# Neurology<sup>®</sup>

## **Clinical Reasoning: An Older Woman With Headaches and Lethargy After a fall**

Sara K Heide, Rachel Gnanaprakasam, Yarden Bornovski, et al.

*Neurology* published online August 21, 2023

DOI 10.1212/WNL.0000000000207828

### **This information is current as of August 21, 2023**

<b>Updated Information &amp; Services</b>	including high resolution figures, can be found at: <a href="http://n.neurology.org/content/early/2023/08/21/WNL.0000000000207828.full">http://n.neurology.org/content/early/2023/08/21/WNL.0000000000207828.full</a>
<b>Subspecialty Collections</b>	This article, along with others on similar topics, appears in the following collection(s): <b>Bacterial infections</b> <a href="http://n.neurology.org/cgi/collection/bacterial_infections">http://n.neurology.org/cgi/collection/bacterial_infections</a> <b>Brain trauma</b> <a href="http://n.neurology.org/cgi/collection/brain_trauma">http://n.neurology.org/cgi/collection/brain_trauma</a> <b>Critical care</b> <a href="http://n.neurology.org/cgi/collection/critical_care">http://n.neurology.org/cgi/collection/critical_care</a> <b>Infarction</b> <a href="http://n.neurology.org/cgi/collection/infarction">http://n.neurology.org/cgi/collection/infarction</a> <b>Status epilepticus</b> <a href="http://n.neurology.org/cgi/collection/status_epilepticus">http://n.neurology.org/cgi/collection/status_epilepticus</a>
<b>Permissions &amp; Licensing</b>	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: <a href="http://www.neurology.org/about/about_the_journal#permissions">http://www.neurology.org/about/about_the_journal#permissions</a>
<b>Reprints</b>	Information about ordering reprints can be found online: <a href="http://n.neurology.org/subscribers/advertise">http://n.neurology.org/subscribers/advertise</a>

*Neurology*® is the official journal of the American Academy of Neurology. Published continuously since 1951, it is now a weekly with 48 issues per year. Copyright © 2023 American Academy of Neurology. All rights reserved. Print ISSN: 0028-3878. Online ISSN: 1526-632X.

