From Strep Throat to Cerebral Storm: Hidden dangers of a sinus brain connection in a pediatric patient

Sarah Spelsberg MD[1], Daniel Schroder DO[1]
[1]Department of Emergency Medicine, UNC Health Southeastern, Lumberton, North Carolina
sspelsberg@gmail.com

Introduction

The incidence of subdural empyema is relatively rare, estimated to occur in approximately 1 in 10,000 hospital admissions. It accounts for about 15-20% of all intracranial infections. Subdural empyema primarily affects males more than females and tends to occur most frequently in children and young adults. Risk factors include sinusitis, otitis media, trauma, and post-neurosurgical procedures.

Subdural empyema typically begins with an infection in a nearby structure, such as the sinuses, middle ear, or mastoid process. Bacterial pathogens, most commonly *Streptococcus* species, invade the bloodstream or spread through venous channels or bony abnormalities from these primary infection sites. Once the bacteria reach the meninges, they penetrate the subdural space, where the immune response leads to the accumulation of pus in the subdural space. Inflammation in this space causes pressure on the brain tissue and disrupts normal cerebrospinal fluid flow, contributing to increased intracranial pressure and neurological deficits. This process can also cause direct damage to brain tissues by compressing blood vessels and leading to ischemia. The condition often progresses rapidly and patients present with symptoms such as fever, headache, seizures, and focal neurological deficits. If untreated, the infection can spread into the brain parenchyma, forming a brain abscess or leading to severe complications like sepsis. Subdural empyema is a neurosurgical emergency requiring prompt diagnosis and treatment.

Pediatric patients frequently have infections, such as *Streptococcus* pharyngitis and otitis media, that can be treated as an outpatient. A thorough physical exam on this patient revealed abnormal neurologic findings. The patient initially improved after dexamethasone and antipyretics but continued to refuse to look to the right past the midline. This persistent physical exam abnormality warranted additional investigation. This case report describes the presentation, diagnosis, and management of a pediatric patient found to have subdural empyema secondary to sinusitis and Group A *Streptococcus* infection.

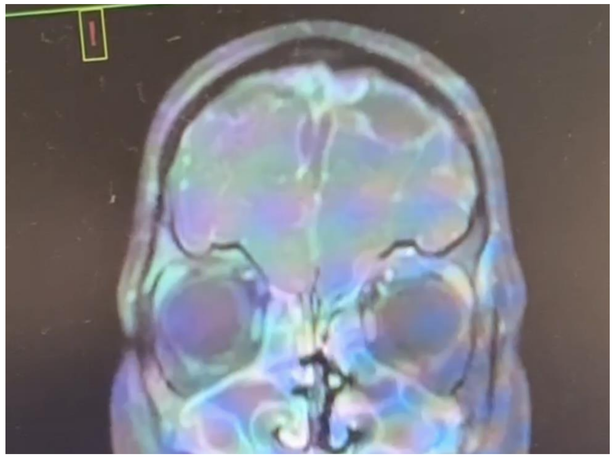
Case Description

Patient: A 7-year-old male with a medical history significant for sickle cell trait, multiple bouts of pneumonia and febrile seizures from 0-3 years of age, presented to the emergency department with a two-day history of fever, headache, nausea, vomiting, and sore throat. Several regional pediatric patients were testing positive for Streptococcus pharyngitis and Covid19.

History: The patient had no known allergies and had a previous history of a seizure disorder until the age of three, sickle cell trait, and recurrent pneumonia. He was up to date on all vaccinations.

Initial Presentation: On examination, the patient appeared ill but was oriented. He exhibited a left ptosis which was noted to be preexisting, he kept his head tilted to the left with reluctance to turn his head past midline to the right. He endorsed pain to palpation of his neck and there was a fullness with lymphadenopathy. Uvula was midline and there was erythema of the oropharynx with enlarged tonsils. Vitals showed temperature of 37’ Celsius, last acetaminophen was two hours prior to arrival, BP of 108/79 mmHg, heart rate of 130 beats per minute, respiratory rate of 23, and SpO2 at 99% on room air.

Figure 1: MRI Brain with Empyema.



Laboratory Findings:
Significant for leukocytosis with a white blood cell count of 26.3 10*3/uL, hyponatremia (sodium 129 mmol/L), elevated C-reactive protein (258.62 mg/L), and elevated ESR (78 mm/h). Group A Streptococcus was detected from swab of the oropharynx by PCR. He was negative for Covid19, Influenza, RSV.

Imaging:
* CT scan to assess for head injury and peritonsillar abscess revealed moderate sinusitis. No abscess. Normal prevertebral space.
* MRI face, orbit and neck with and without contrast revealed a large subdural empyema and severe sinusitis.
* MRV revealed a superior sagittal sinus thrombosis
* Follow up MRV resolution of superior sagittal sinus thrombosis
* Repeat MRI demonstrated a reduction in the size of the empyema

Management:
The patient received intravenous fluid boluses, initial antibiotic ceftriaxone with broader-spectrum antibiotics added later in the course (ampicillin sodium-sulbactam-sodium and vancomycin), Decadron, and symptomatic treatments for fever and pain. His physical exam improved after steroids and anti-pyretics but the refusal to look right past midline persisted which prompted the team to aggressively procure permission for an after-hours MRI.

After the MRI demonstrated a subdural empyema, the patient was emergently transferred by air to a tertiary care center for neurosurgery and ear nose and throat (ENT) consultation and evaluation. Upon arrival, the neurosurgery and ENT teams were consulted, and the patient underwent urgent bifrontal craniotomy with excision of the subdural empyema and sinus washout with reoperation approximately one week later. Post-operatively, the patient was admitted to the pediatric intensive care unit (PICU) for close monitoring.

Surgical Intervention:
. A bifrontal craniotomy was performed on 6/24/2024.
. Due to incomplete drainage, a subsequent craniotomy was performed on 7/2/2024. Post-operative imaging showed gradual improvement in the size of the subdural collections.

Outcome and Follow-Up
The patient showed significant clinical improvement following the second surgical intervention. On discharge, his evolving physical exam demonstrated: Cognition: He was able to remember 1 out of three words after 1 minute. Proprioception: Romberg negative. No pronator drift. He was able to perform finger-to-nose test and heel-to-shin test. Strength: Superior movement of his eyes limited bilaterally but extraocular movements were otherwise intact. Cranial Nerves 2 - 12 intact. Strength +5/5 right and +4/5 left. Outpatient follow-up was arranged with hematology, neurosurgery, and infectious disease specialists.

Discussion

This case highlights an unusual complexity and severity of infection in a pediatric patient, emphasizing the importance of rapid identification and treatment of potential complications such as subdural empyema. The patient presented for routine symptoms of fever, headache, nausea, vomiting, and sore throat but was found to be much more complex than a simple pharyngitis. The patient's presentation and diagnostic challenges after hours presented a unique opportunity.

Subdural empyema is a serious complication of sinusitis, often leading to neurological deterioration if not promptly treated. This case highlights the importance of early recognition and aggressive management, including the use of broad-spectrum antibiotics and surgical drainage. Patients with sickle cell disease (sickle cell anemia) are known to be at increased risk of pneumococcal and other infections which can have subdural spread. There are case reports of sinogenic subdural empyema in patients with sickle cell anemia. Sickle cell disease is considered an immunocompromised condition. In most circumstances, individuals with **sickle cell trait** do not have a significantly increased risk of infections compared to the general population. However, they can have the same presentations as sickle cell disease if the patient is exposed to sickling conditions such as hypoxia, dehydration, increased sympathetic outflow, hypothermia, hyperthermia, or inflammation (Bhatt et al). Patients with sickle cell trait suffering from stressful conditions such as vomiting, hyperthermia, dehydration and inflammatory response, like our patient, may be at increased risk of severe infections due to immune dysfunction secondary to these stressors.

References

U. Nestler, D. Memia-Zolo, N. Salloum, M. Mejdoubi, F. Lengelle, R. Santiago, W. Cécile, R. Stegaru and N. Manzo, "Sinogenic Subdural Empyema in a Ten-Year-Old Boy with Sickle Cell Anemia," *Open Journal of Modern Neurosurgery*, Vol. 3 No. 4, 2013, pp. 53-58.

Ashorobi D, Ramsey A, Killeen RB, et al. Sickle Cell Trait. [Updated 2024 Feb 25]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537130/

Acknowledgements

UNC Health Southeastern Emergency Department Staff