Cerebral edema and brain compression

By Amy Sanderson, MD

Cerebral edema and brain compression are the result of significant brain abnormalities that can be life-threatening. It is important for clinicians to recognize and treat these conditions promptly. Properly documenting these diagnoses in the medical record is important to accurately reflect just how sick these patients are. Physician may use “mass effect” or “midline shift” to describe brain compression or cerebral edema, or a neurosurgeon may only state that she performed a “decompression” or “tumor resection.” None of these phrases, however, allows coders to capture the specific diagnoses of cerebral edema and brain compression.

To understand these diagnoses, let’s first review the structure of the cranial vault. Brain parenchyma, blood flow, and cerebrospinal fluid all contribute to intracranial volume. The blood-brain barrier is comprised of cells that separate brain tissue from the contents of blood vessels. Finally, the skull surrounds the brain, protecting it from trauma.

When intracranial pressure increases, the brain has compensatory measures to mitigate damage. However, when these measures are exhausted, worsening brain injury ensues. Damage can be exacerbated by the rigidity of the skull, limiting the amount that the brain can swell and worsening intracranial hypertension. This leads to decreased cerebral blood flow, further depriving the brain of oxygen.

Cerebral edema results from abnormal buildup of water within the brain tissue. Understanding the different types is important because treatment options differ depending on the physiologic derangement (see the references at the end of the article). Different types of cerebral edema include:

- Vasogenic
- Cytotoxic
- Hydrostatic

Vasogenic edema is caused by increased permeability of the blood-brain barrier with water and other substances moving from blood vessels into brain tissue. Common causes include brain tumors and cerebral abscesses. On the other hand, injury on the cellular level leads to cytotoxic edema. In this case, there is disruption of individual brain cell membranes, which leads to water shifting from the outside to the inside of cells. Most commonly, this is due to lack of blood flow and oxygen to the brain, as can happen during a stroke or cardiac arrest. Hydrostatic cerebral edema can occur with obstructive hydrocephalus and happens when cerebral spinal fluid moves from the ventricles into the brain parenchyma.

Brain compression results from something such as a tumor, abscess, or hematoma pressing on brain structures. Herniation ensues when part of the brain is displaced into an adjacent space and can be due to cerebral edema and/or a space-occupying lesion that causes brain compression. It is important for clinicians to recognize when cerebral edema and brain compression are present as both are serious and can be life-threatening. Although cerebral edema and brain compression may have different underlying mechanisms, patients with either or both can present with similar findings.

Common signs and symptoms of both conditions include:

- Confusion and disorientation
- Headache
- Depressed mental status
- Coma
Vomiting
Abnormal pupil exam (fixed, dilated)
Hemiparesis or quadriplegia

To look for evidence of cerebral edema and/or brain compression, CDI specialists can review the diagnostic section of the medical record. CT and MRI are excellent modalities to identify brain abnormalities, but it's important to note that imaging is not an absolute requirement for the diagnosis of brain compression or cerebral edema; physicians can make these diagnoses based on a patient's history and physical exam. Other documented diagnoses can be a clue to cerebral edema and/or brain compression (see table below).

Examples of medical conditions that may be associated with brain compression and/or cerebral edema

- Brain tumor
- Hydrocephalus
- Ventriculo-peritoneal shunt malfunction
- Intracranial hemorrhage
- Stroke (ischemic, hemorrhagic)
- Diabetic ketoacidosis
- Hypo/hypernatremia
- Meningitis/Encephalitis
- Cardiac arrest
- Cerebral abscess
- Acute liver failure & hyperammonemia

CDI specialists can also look at documented therapies and treatment plans. Osmotic agents such as hypertonic saline and mannitol are commonly used to decrease intracranial pressure. Hyperventilation can be used as a temporizing measure to decrease intracranial hypertension since this causes a decrease in cerebral blood flow. Corticosteroids such as dexamethasone are a mainstay of treatment for vasogenic edema due to brain tumors. In addition, hypothermia and sedative medications are sometimes used when a patient has suffered a significant brain injury because they can decrease cerebral metabolism, which may provide some benefit to the injured brain. Reviewing procedure notes or operative reports may supply insight. CDI specialists can look for placement of an external ventricular drain, placement or revision of a ventriculo-peritoneal shunt, decompressive craniectomy, brain tumor excision, drainage of a cerebral abscess, or evacuation of an intracranial hemorrhage/hematoma.

In summary, cerebral edema and brain compression are important diagnoses to identify, treat, and document. However, physicians don’t always document them in a way that can be coded. CDI specialists can find clues to these important diagnoses in several parts of the medical record and can aid in their capture.

For those looking for more resources on brain compression and cerebral edema, here are a few references:

- Koenig, M. Cerebral Edema and Elevated Intracranial Pressure. Continuum (Minneap Minn). 2018; 24(6): 1588-1602

Editor’s note: Sanderson is a pediatric intensivist at Boston Children’s Hospital. She has been the physician advisor of the CDI program since its inception in 2014. She is also an assistant professor in anaesthesia at Harvard Medical School. She was a contributor to the book Pediatric CDI: Building Blocks for Success. Opinions expressed do not necessarily represent those of ACDIS or its Advisory Board. Contact Sanderson at Amy.Sanderson@childrens.harvard.edu.