Neurology

Things to address:

- Bell's palsy
- Vertebral artery dissection -> PICA occlusion -> CN findings
- Vertigo

Altered Mental Status

The patient with altered mental status can feel especially challenging because, on the one hand, the patient cannot reliably communicate their symptoms and history and, on the other hand, the etiologies of AMS run the full gamut from benignly self limited to evolving CNS catastrophe. However, a systematic approach can quickly and reliably triage these patients and direct your care to a well defined management pathway.

Etiologies to consider for patients with AMS include:

1. Trauma
2. Intracranial processes compromising intracranial perfusion
    - Stroke
    - Hemorrhage (not necessarily secondary to significant trauma especially in setting of coagulopathy)
    - Mass
    - Vasculitis
3. Extracranial processes compromising intracranial perfusion or oxygenation
    - Shock from any cause (septic, hemorrhagic, cardiogenic)
    - Obstruction of major vessels due to embolism or dissection
4. Inflammatory processes
    - Meningitis (either septic or aseptic)
    - Encephalitis
    - Acute demyelinating encephalomyelitis (ADEM)
    - Vasculitis (including SLE)
5. Toxic ingestion or exposure
6. Metabolic and electrolyte derangements
    - Hypoglycemia
    - Hyponatremia
    - Hyper- or hypo-calcemia

- Hypomagnesemia
- Hyperammonemia
- Uremia
- Profound acidosis or alkalosis
- Thiamine deficiency
- Acute intermittent porphyria
- Wilson's disease

7. Subclinical seizures or post-ictal state
8. Medication side effect
    - Steroids
    - Some antibiotics (in particular, Amoxicillin, clarithromycin, and erythromycin)
9. Psychiatric illness

The inital work up for patients presenting with AMS is presented in the table below.

> ✅ **Initial evaluation of patients presents with AMS**
>
> For all patients presenting with AMS, consider the following workup elements. Not every element will be indicated in every situation, but every element should be considered.
>
> - BLS and PALS resuscitation as indicated
> - Stat POC glucose
> - CMP
> - Comprehensive drug screen
> - Blood gas
>
> If evidence of infectious process:
>
> - CBC
> - Blood culture
> - Urine culture
> - Procalcitonin
> - LP
> - Broad spectrum antibiotics as indicated
>
> If history of trauma, or if focal neurological signs or obtunded:
>
> - Stat CT head without contrast
> - MRI / MRA brain to follow.
>   - Note: MRI/MRA might be selected as initial imaging modality depending on availability
> - Note: in many cases such patients should be handled via either a Trauma Code or Stroke Code pathway unless these etiologies can be ruled out by available history and/or exam findings

Further details about the diagnosis and management of many of these conditions will be provided below.

Seizures

Differentiating seizures from non-epileptic movements is a frequent challenge in hospital pediatrics. True generalized seizures are characterized by (1) lack of consciousness followed by (2) a post ictal state featuring decreased arousal but, at a minimum, response to noxious stimuli. Seizures are frightening to witness, particularly for family members. However, is most cases seizures pose little or no acute danger to the patient and treatment and workup can largely be managed as an outpatient. There are several very important exceptions to this rule, however. These are detailed in the table below.

> 🛑 **Seizure Red Flags**
>
> - Seizures that are focal, or begin with focality followed by secondary generalization
> - Seizures ocurring in the context of electrolyte abnormalities
> - Seizures following trauma
> - Seizures in a child less than 6 months of age
> - Seizures at any age in the absence of fever
> - First time seizures in a child older than 6 years of age

The first priority in treating the seizing patient is to stop the seizure. The usual anti-epileptic regimen is summarized in the table below. Stopping a seizure in the face of electrolyte derangements can be difficult or impossible, so stat POC glucose and BMP should be obtained for any seizing infant and also for older children whose seizures are not responding promptly to anti-epileptic medications or are otherwise prolonged.

> 💊 **Acute treatment of generalized seizures**
>
> Proceed in a step wise fashion until seizure stops. All medications to be given IV.
>
> 1. Lorazepam 0.1 mg/kg
> 2. Lorazepam 0.05 mg/kg
>
>   (Consider escalation to ICU setting or be prepared to secure airway if further treatment needed.)
> 3. Fosphenytoin 15-20 mg/kg PE (phenytoin equivalents) over 10-15 minutes **or** Levetiracetam 20mg/kg.
> 4. Phenobarbitol 15-20 mg/kg
> 5. Propofol 1mg/kg

> 💭**Food for thought:** How long does it take to get medications to the bedside in your institution once the order is placed? It is important to be proactive in placing orders for patients at risk of seizure to ensure abortive medications are availalbe in a timely fashion when needed.

For seizing patients with concurrent electrolyte or glucose derangements, these must be corrected emergently as outlined in the table below.

> 💊 **Emergent correction of glucose or electrolyte derangements for seizing patients**
>
> - Hypoglycemia: 50% dextrose 1 ml/kg (or equivalent, such as 25% dextrose 2 ml/kg, etc.)
>   - Recheck glucose and repeat as needed
>   - In the event of profound malnutrition or other concerns for thiamine deficiency, supplement thiamine at the same time (or nearly the same time--despite conventional wisdom, there is no need to pre-treat these

patients with thiamine and glucose administration in a seizing hypoglycemic patient should not be delayed for any reason. Simply provide IV thiamine as soon as reasonably possible in such patients.)

- Severe Hyponatremia (serum sodium < 120meq/L): Sodium chloride 3% 5 ml / kg.
  - Hypertonic saline **can** be given safely through a peripheral IV!
  - This will raise sodium level about 4 meq/L
  - If still seizing or persistent altered mental status, recheck sodium level and repeat
  - **Note**: The goal of therapy is **not** to normalize sodium level, but rather to stop seizures. Seizures secondary to hyponatremia should stop even with sodium levels well below normal and typically stop after raising the serum sodium level by about 5 meq/L. After seizures are stopped, continue to slowly correct hyponatremia with a goal of increasing serum sodium by no more than 10 meq/L in the first 24 hours. For further discussion see the Fluids, Electrolytes, and Nutrition chapter.
- Severe hypocalcemia: Calcium gluconate 10% 0.6 ml/kg (5.6 mg/kg elemental calcium)
  - If central line available, calcium chloride 10% 0.2 ml/kg is preferred due to increased bioavailability.
- Severe hypophosphatemia: Guidelines for this rare scenario are not established. Consider 0.5 mmol/kg phosphorous (as either potassium phosphate or sodium phosphate or both depending on the levels of other electrolytes) over 4 hours.

🔪 **Not so breaking news:** The evidence linking glucose administration with Wernicke's encephalopathy in thiamine deficient patients is entirely based on individuals who had prolonged periods (multiple days) of refeeding without thiamine supplementation. There is in fact no evidence that one or even several doses of dextrose prior to thiamine administration has any adverse effects in malnourished patients.