Neuroanesthesia emergency crisis management (NECM)

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Quiz brought to you on behalf of the education Committee of the SNACC

Thank you to the contributors of the questions
(All cases are imaginary)
Cognitive aids for neuroanesthesia emergencies are available on the SNACC website under the education tab.

1. You are being paged because a 67Y/F is being brought to the OR for urgent craniotomy and evacuation. She has a past H/O hypertension and presented with unresponsiveness at home. She was taken to the ER and an urgent CT scan showed hemorrhage in the basal ganglia. Patient was intubated. Hypertension and Bradycardia are visible on the monitor and you institute hyperventilation for intracranial hypertension. Which of the following is FALSE?

A. Hyperventilation can cause cerebral ischemia
B. Hyperventilation takes 2 hours for clinical effect
C. Hyperventilation when stopped suddenly can cause rebound cerebral edema
D. The effect of Hyperventilation lasts for approximately 8 hours.

Go to Q2
A. Hyperventilation can cause cerebral ischemia

This is a True statement. The vasoconstrictive effect of hyperventilation can cause cerebral ischemia in situations like Sub-arachnoid hemorrhage, stroke and Traumatic brain injury. Hyperventilation can decrease Cerebral blood flow (CBF), increase CMRO2 and decrease PbO2 (brain tissue oxygen tension).

In situations of raised ICP as in the above case, a brief course of hyperventilation (Tier 1 intervention) to a PaCO2 of 30-35mmHg may be considered until definitive treatment is provided. One should monitor PbO2 whenever possible.

B. Hyperventilation takes 2 hours for clinical effect

- This is the False statement and so this is the correct answer.
- The Cerebral blood flow decrease and consequent vasoconstrictive effect of hyperventilation and hypocapnia occurs within minutes.
C. Hyperventilation when stopped suddenly can cause rebound cerebral edema

If hypocapnia has been required as an adjunct to brain relaxation during craniotomy, PaCO2 should be allowed to increase gradually once the retractors are removed. An abrupt increase in PaCO2 at the end of the case will lead to a sudden increase in cerebral blood flow and rebound cerebral edema.
D. The effect of Hyperventilation lasts for approximately 8 hours.

This is a True statement. With the onset of hyperventilation, the pH of both CSF and the brain’s extracellular fluid space increases, and CBF decreases abruptly. However, this cerebral alkalosis is not sustained. By alterations in function of the enzyme carbonic anhydrase, the concentration of bicarbonate in CSF and the brain’s extracellular fluid space is reduced, and in a time course of 8 to 12 hours, the pH of these compartments returns to normal. Simultaneously, CBF returns toward normal levels. Hence patients should be hyperventilated for only as long as a reduction in brain volume is required.
2. A 47Y/Male is admitted to the ICU with a sub-arachnoid hemorrhage. He has been diagnosed with an aneurysm bleed. The surgeon takes him up for aneurysm clipping. During dissection, the surgical field suddenly fills with blood. Which of the following is NOT a treatment option in emergent management of an intraoperative aneurysm rupture.

A. Temporary cardiac arrest with adenosine
B. Blood transfusion
C. Propofol bolus
D. Induced Hypothermia

Question contributed by Dr. Deepak Sharma M.D
Univ of Washington, Seattle
A. Temporary cardiac arrest with adenosine.

- Intravenous Adenosine 0.3-0.6 mg/kg provides a flow arrest of 12-50 second and could enable the neurosurgeon to clip a ruptured aneurysm and see the bleeding vessel. Adenosine induces a high degree of AV blockade, decreases the heart rate within seconds followed by brief asystole.

- Adenosine is not suitable in patients with reactive airways disease, cardiac conduction diseases and coronary artery disease.

Bendok BR1, Gupta DK, Rahme RJ, Eddleman CS, Adel JG, Sherma AK, Surdell DL, Bebawy JF, Koht A, Batjer HH.

B. Blood transfusion

- This is True.
- Blood should always be typed and crossmatched and readily available in patients undergoing intracranial aneurysm clipping.
- One may need to consider the Massive transfusion protocols when the situation arises.
C. Propofol Bolus

- Small doses of Propofol could potentially help by decreasing the Cerebral metabolic rate of oxygen consumption in a situation of cerebral ischemia. However, the risk of decrease in blood pressure due to propofol must be considered and balanced against the beneficial effect of decrease in CMRO2.

- Thiopental has also been used in the past for burst suppression in a situation of aneurysmal rupture.
D. Induced Hypothermia

Induced hypothermia would not be recommended during acute rupture of an intracranial aneurysm. Hypothermia can cause harm like cardiac arrhythmias, platelet function defects and bacteremia. There are no high quality studies supporting the use of induced hypothermia in this situation.

3. A 56 Y/F undergoes posterior fossa craniotomy in the sitting position. As the surgeon performs the craniotomy, she suddenly becomes tachycardic. Blood pressure is 70/40mmHg. ETCO2 drops from 34 to 18mmHg. All of the following are appropriate actions in this situation EXCEPT;

A. Place the patient in a Trendelenberg position

B. Flood the surgical field with saline

C. Decrease the ventilatory rate to increase ETCO2

D. Aspirate the central venous catheter.

Question contributed by S Tyler Schoenfeld; CA-3 resident, Allegheny Health Network, Pittsburgh.
A. Place the patient in a Trendelenberg position

If a VAE is suspected, placing the patient in a head down (Trendelenberg) position helps prevent further air entry into the venous circulation, while also helping to prevent more air entering the pulmonary circulation by trapping air in the apex of the right ventricle.

In a case series by Abcejo et al, they described 8 cases of VAE associated ETCO2 and MAP getting normalized following position change. Repositioning seems to be an important maneuver.

B. Flood the surgical field with saline

Alerting the surgeon to the possibility of a VAE and having them flood the surgical field also helps prevent more air entering into the venous circulation.

Commonly used monitors for VAE are precordial Doppler and Transesophageal echocardiography.

Courtesy Dr. J. Pasternak
C. Decrease the ventilatory rate to increase ETCO2

This answer is incorrect. With a sudden drop in ETCO2, VAE should be high on the differential. Decreasing ventilation would not be beneficial in this situation and could lead to further decompensation. Although the ETCO2 is low, the PaCO2 is not going to be low.
D. Aspirate the central venous catheter.

Placing a central venous catheter (CVC) is common when there is a higher risk of VAE such as with this procedure. Aspirating from the CVC is intended to remove air from the right ventricle decreasing the burden on the RV.

However, in the case series by Abcejo et al, they described 8 cases of VAE and found no difference in outcome from aspiration of the CVP catheter.

Central venous catheters are however commonly inserted in these cases taking care that the tip of the catheter is placed strategically at the junction of the SVC and RA.
4. You are being paged for a carotid bring back to OR stat. Which of the following are TRUE regarding airway compromise after a neck hematoma?

A. Occurs in one in 20,000 surgeries

B. Supraglottic airways can be very helpful

C. Acute decompression can improve conditions for intubation

D. Usually occur within 24-48 hours after surgery

Question contributed by Dr. Jeffrey Pasternak MD
Mayo Clinic, Minnesota
A. Occurs one in 20,000 surgeries

• This is False.

The incidence is higher than that.
Incidence: ~1-2% for symptomatic hematoma requiring re-exploration

• Anterior cervical fusion
Incidence -1.2%-1.8%

• Thyroid surgery
Incidence -0.1-1.5%

• Carotid Endarterectomy
Incidence -1.4%

1. Lied B. Acta Neurochirg 2008;150:111-8
2. Li H. Int J Surg 2017;41:28-33
3. Burkey SH. 2001;130:914-20
B. Supraglottic airways can be very helpful

- Since the hematoma causes airway compression around the level of the glottis as shown by the CT scans, it is easy to see why Laryngeal mask airways are not helpful in this situation.

Hyoid region and cricoid region hematomas

Courtesy Dr. J. Pasternak

Incorrect
Try again
C. Acute decompression can improve conditions for intubation

- This condition is more than just a hematoma.
- Airway compromise can occur not only due to hematoma expansion but also due to impedance to venous drainage leading to glottic edema.
- This is the reason why acute decompression of the hematoma can rapidly improve conditions for intubation.

Courtesy Dr. J. Pasternak
Most neck hematomas occur in the acute period after surgery and rates progressively decrease with time.

In the study by Shakespeare et al, 44 cases out of 3225 patients who underwent carotid endarterectomy had a neck hematoma. All occurred within 32 h but mean time was 6.0 +/- 6.0 hours.

The risk is not zero after 24h.

5. A patient is undergoing scoliosis surgery with neuromonitoring. You are being informed that the IONM (intraoperative neuromonitoring) signals are changing. Surgeons have not yet put in any hardware. The neuromonitoring technician says that there is no lead failure. As an anesthesiologist choose the **BEST** management option from below?

A. Increase Mean arterial blood pressure

B. Optimize oxygen supply and delivery

C. Review anesthetics in use

D. Participate in Diagnosis and management

E. All the Above

Question contributed by Dr. Antoun Koht MD Northwestern University, Chicago
A. Increase Mean arterial blood pressure

- If the cause of the neuromonitoring signal change is hypotension or relative hypotension, increasing the blood pressure can optimize physiology.
B. Optimize oxygen supply and delivery

- Increasing the fraction of inspired oxygen can again help to minimize potential neurologic injury while the cause is being investigated.
C. Review anesthetics in use

One should review the anesthetics in use. Were there any bolus doses of propofol given, what is the MAC of the inhalation agent being used, are questions that need to be asked.

In general opioids do not cause any signal changes.
D. Participate in Diagnosis and management

- When a neuromonitoring change occurs intraoperatively, the surgeon, the anesthesiologist and the neuromonitoring team should work together to determine the etiology of the change and correct cause.
E. All the Above

- Changes in intraoperative neuro monitoring signals can be due to surgical causes, pharmacologic causes (anesthetic agents), physiological causes (low blood pressure, low oxygen carrying capacity of the blood), positional (nerve compression due to positioning etc) and technical (lead failure, electrical interference from operating room equipment) etc.

- The team should work together to analyze the cause, evaluate whether this is global, local and unilateral or bilateral. The anesthesiologist can help to optimize the physiology and correct anesthetic induced changes.

UpToDate- Neuromonitoring in surgery and anesthesia. Antoun Koht, Tod B Sloan, Laura B Hemmer