



## Anesthesia in Traumatic Brain Injury

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## Disclosures

- IP for monitoring technology licensed to Medtronic



## Set up audience participation

1. Take out your silenced phone
2. Open a web browser
3. Go to: [PollEv.com/kenbrady584](https://PollEv.com/kenbrady584)



## Test question



## Outline

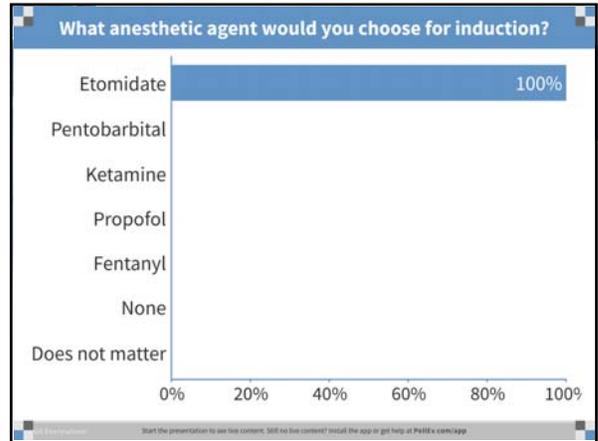
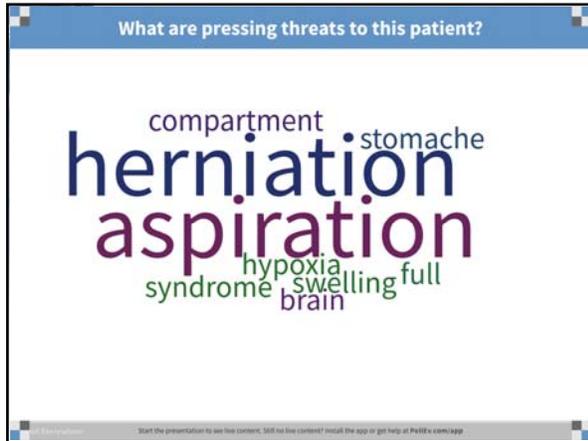
- Case-based care-decisions:
  - ICP monitoring and management
  - Ventilation
  - Anesthetic agents
  - Temperature management
  - CPP management
  - Steroids
  - DVT prophylaxis
  - Seizure management and prophylaxis



## Case #1: Multi-system trauma

- 20-year old rollover MVA. Unconscious, 30 min to ED in Collar:
  - GCS 7: Eyes closed (1), unintelligible mumbling (2) and withdrawal to painful stimulus 4 extremities(4)
  - HR110; ABP 95/55; T 35.5°C
  - Pulmonary contusion (SpO<sub>2</sub> 90% on 100%NRB)
  - Angulated mid-shaft radius/ulna fracture
  - Scalp laceration

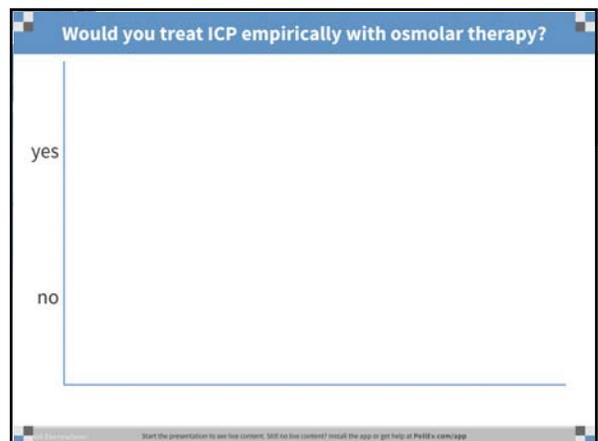
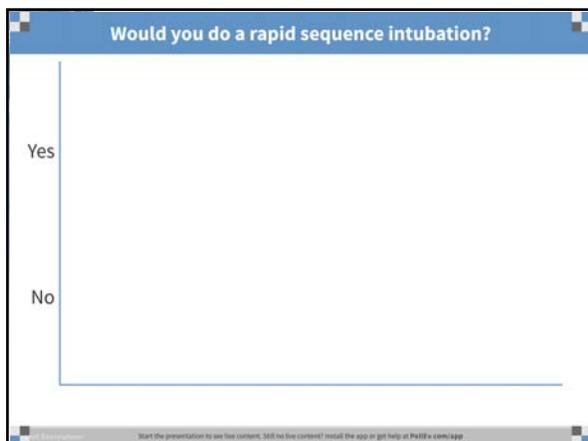
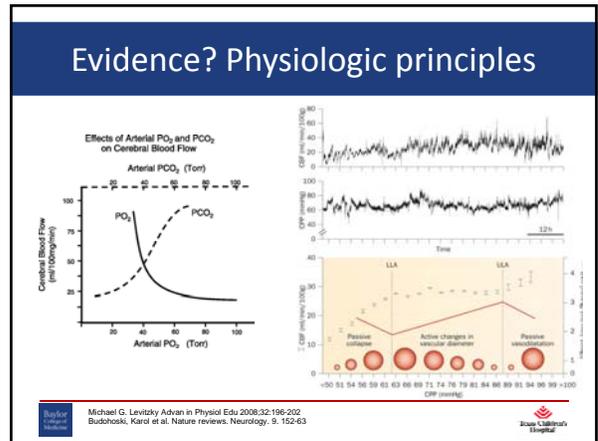


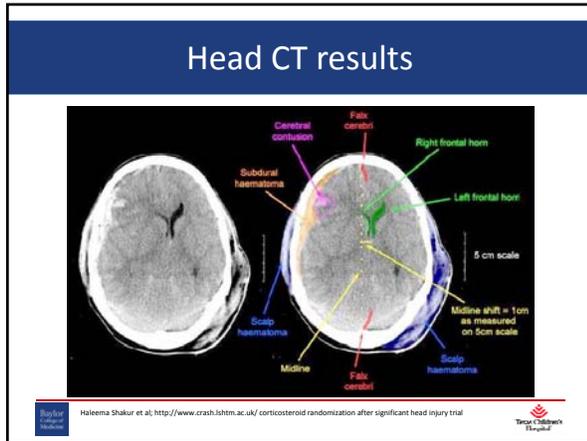


### Acute brain trauma management

- Step 1: Avoid herniation
  - Airway control
  - Oxygenation
  - Ventilation
  - ABP support
  - Anesthesia
  - Osmolar therapy

Smith, Julian et al. (2006), Textbook of Surgery, Wiley-Blackwell, p. 446





### Would you monitor ICP in this patient?

Yes

No

Start the presentation to see live content. Still no live content? Install the app or get help at [PallEx.com/app](#)

### Brain Trauma Foundation Guidelines 4<sup>th</sup> edition

**12. INTRACRANIAL PRESSURE MONITORING**  
**LEVEL I AND II A**  
 There was insufficient evidence to support a Level I or II A recommendation for this topic.

**LEVEL II B**  
 Management of severe TBI patients using information from ICP monitoring is recommended to reduce in-hospital and 2-week post-injury mortality.

- Does this patient have severe TBI? Not defined in 4<sup>th</sup> edition!

### Brain Trauma Foundation Guidelines 3<sup>rd</sup> edition

“Intracranial pressure (ICP) should be monitored in ... severe TBI (GCS 3-8 after resuscitation) and an abnormal computed tomography (CT) scan. An abnormal CT scan of the head is one that reveals hematomas, contusions, swelling, herniation, or compressed basal cisterns.”

Kerr M, Crago EA. Nursing management: acute intracranial problems. In: O'Brien PG, Giddens JF, Bucher L, eds. Medical-Surgical Nursing: Assessment and Management of Clinical Problems. St Louis, Mo: CV Mosby Inc; 2004: 1493-1524.

### ICP monitoring kerfuffle

- Alali et al:** retrospective n = 10,000  
 - OR of death compared to no ICP monitor: 0.44 (0.31 to 0.63)
- Chesnut et al:** RCT n = 324 ← kaboom  
 - Mortality, GOS no difference
- Farahvar et al:** retrospective n = 1,307  
 - OR of 2-week mortality compared to no ICP monitor: 0.64 (0.41 - 1.00)
- Gerber et al:** retrospective n = 2,320  
 - Temporal improvements in guideline adherence (ICP monitoring) associated with temporal decrease in mortality
- Talving et al:** prospective cohort, n = 216  
 - OR of death 0.15 (-0.03 - 0.74) longer ICU/Hospital stay with ICP monitoring

### Posted to the OR

Patient intubated, ICP monitor (EVD) and Licox monitor placed at bedside, trended on the Moberg system.

Now posted for angiography, vascular exploration and fasciotomy due to pulsatile hematoma in the forearm

### Elevated ICP

Frequent ICP elevations lasting 10-20 minutes with associated decrease in  $P_{BT}O_2$

- Sedated, paralyzed, 36.5°C
- $SpO_2$  98%, TV450, rate 12, PIP 24, PEEP 4,  $F_iO_2$  40%
- HR 80, ICP, ABP,  $P_{BT}O_2$  shown on right.
- Na 142, Hb 10.3, 7.43/37/120

ICP is 45 mmHg positioning for angiography injection

The figure consists of three vertically stacked line graphs. The top graph shows ICP (mmHg) on the y-axis (0-45) and time on the x-axis. A blue arrow points to a peak in the ICP trace reaching approximately 45 mmHg. The middle graph shows  $P_{BT}O_2$  (mmHg) on the y-axis (0-100) and time on the x-axis, showing a corresponding dip during the ICP peak. The bottom graph shows ABP (mmHg) on the y-axis (70-120) and time on the x-axis, showing a slight increase. A 10-minute scale bar is provided between the middle and bottom graphs.

### What is your first response?

- Ventilate to CO2 25
- Propofol or other IV anesthetic
- Raise the ABP with phenylephrine
- Administer hypertonic saline or mannitol
- Cool the patient to 34 degrees
- Administer 100% oxygen
- Give steroids

### BTF guidelines: Osmolar therapy

“The Committee is universal in its belief that hyperosmolar agents are useful in the care of patients with severe TBI. However, the literature does not currently support recommendations that meet the strict criteria for contemporary evidenced-based medicine approaches for guideline development.”

### How do you use the forced air warmer in this patient with severe TBI?

- Set to low and cool the patient to 34 degrees
- Set to high and do not allow the temperature to exceed 36.5 degrees
- Set to high and use normally

### BTF guidelines: hypothermia

- Early (within 2.5 h), short-term (48 h post-injury), prophylactic hypothermia is not recommended to improve outcomes in patients with diffuse injury

The image shows a medical device with a blue top and white base, featuring a circular opening and various adjustment knobs, typical of a forced air warmer used in clinical settings.

### Rank your preference of anesthetic maintenance agents

- Pentobarbital
- Propofol
- Volatile anesthetic
- Dexmedetomidine
- Benzodiazepene
- Remifentanyl

### BTF guidelines: Anesthetic

- Administration of barbiturates to induce burst suppression measured by EEG as prophylaxis against the development of intracranial hypertension is not recommended.
- High-dose barbiturate administration is recommended to control elevated ICP refractory to maximum standard medical and surgical treatment. Hemodynamic stability is essential before and during barbiturate therapy.
- Although propofol is recommended for the control of ICP, it is not recommended for improvement in mortality or 6-month outcomes. Caution is required as high-dose propofol can produce significant morbidity.

### What is your ventilation strategy?

The graph plots Cerebral Blood Flow (CBF) on the y-axis against PaCO2 on the x-axis. Three curves are shown:
 

- Permissive hypercapnea:** Shows a steep increase in CBF as PaCO2 rises, reaching the highest values.
- Normocapnea:** Shows a moderate, linear increase in CBF with PaCO2.
- Hypocapnea:** Shows a decrease in CBF as PaCO2 falls below normal levels.

Low TV; high PEEP; permissive hypercapnea  
 nl TV; low PEEP; normocapnea  
 nl TV; low PEEP; hyperventilation to hypocapnea

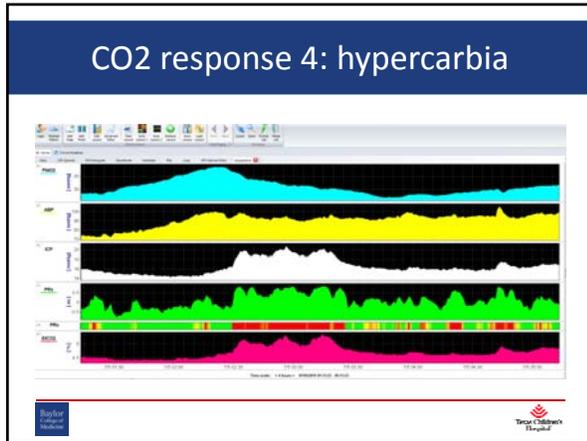
### BTF guidelines: Ventilation

- Prolonged prophylactic hyperventilation with PaCO2 of  $\leq 25$  mm Hg is not recommended

### CO2 response 1: Vasoconstriction

### CO2 response 2: Pressure Passive

### CO2 response 3: Preserved CBF



- ### BTF guidelines: Ventilation
- Hyperventilation is recommended as a temporizing measure for the reduction of elevated ICP.
  - Hyperventilation should be avoided during the first 24 h after injury when CBF often is reduced critically.
  - If hyperventilation is used, SjO2 or BtpO2 measurements are recommended to monitor oxygen delivery.

### Would you give this patient steroids for brain swelling?

Yes

No

- ### BTF guidelines: steroids
- The use of steroids is not recommended for improving outcome or reducing ICP. In patients with severe TBI, high-dose methylprednisolone was associated with increased mortality and is contraindicated.

### Case #2: DVT concerns

78 year old man falls from third stair.

- GCS 12: eyes open to voice(3) confused(4) localizes to pain(5).
- CT shown on right:
- Pelvic fracture of superior and inferior pubic rami.

- ### How would you prevent DVT in this patient
- pneumatic compression devices only
  - LMWH or heparin at admission
  - LMWH or heparin only after stable CT for 24-48 hrs
  - coumadin after stable CT for 24-48 hrs
  - aspirin only

### BTF guidelines: DVT prophylaxis

- LMWH or low-dose unfractionated heparin may be used in combination with mechanical prophylaxis. However, there is an increased risk for expansion of intracranial hemorrhage.
- In addition to compression stockings, pharmacologic prophylaxis may be considered if the brain injury is stable and the benefit is considered to outweigh the risk of increased intracranial hemorrhage.
- There is insufficient evidence to support recommendations regarding the preferred agent, dose, or timing of pharmacologic prophylaxis for deep vein thrombosis.

### Case #3: Surgery in setting of TBI

11 year old boy pedestrian struck.

- GCS 10: eyes open to pain(2) inappropriate words(3) localizes pain(5)
- HR 130, ABP 145/95, R 45 S<sub>p</sub>O<sub>2</sub> 95% NRB
- Rib fractures on CXR
- CT shown

Admitted to the ICU for observation

### Case #3: Surgery in setting of TBI

11 year old boy pedestrian struck.

- Overnight his GCS fluctuates from 7 to 12, agitated and combative
- CXR in AM shows massive pleural effusion and mediastinal shift
- HR: 125; ABP 95/45; R 45; S<sub>p</sub>O<sub>2</sub> 90% NRB

Posted for thoracotomy/hematoma evacuation

### How would you rank the effectiveness of the following recommendations?

- Place a chest tube at the bedside with local anesthetic and fentanyl
- Provide standard general anesthesia with ETT
- Provide general anesthesia with ETT after placement of an ICP monitor
- Provide general anesthesia with ETT using rapidly reversible agents (remifentanyl)

### What concern about this patient most influenced your decision?

### Summary

- Wear a helmet when skiing