Neurocritical Care – Management of Elevated Intracranial Pressure

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Disclosures

None
What is ICP?

CSF volume = 150ml (10%)

Blood volume = 150ml (10%)

Brain parenchyma volume = 1400ml (80%)
Monroe-Kellie Hypothesis
Causes of Elevated ICP
Why Care?

CPP = MAP – ICP

Maximum dilatation
50 mm Hg
80 mm Hg
Range of hypoperfusion
Maximum constric.

Cerebral blood flow (ml/100g/min)

Cerebral perfusion pressure (mm Hg)
When to consider ICP monitor

- GCS < 8
- Significant IVH or hydrocephalus
- Clinical evidence of herniation
ICP Monitors

Ventricular

Subarachnoid

Intraparenchymal

Epidural

Subdural
ICP Monitors: Extraventricular Drain

Advantages:
- Accuracy
- Therapeutic and diagnostic
- Can calibrate in-situ

Disadvantage
- Most invasive
- Difficult to place in collapsed ventricles
- Skilled nursing required
- Obstruction of fluid column by clot can make pressure measurements inaccurate
- Transducer must be maintained at fixed reference point to patient’s head
ICP Monitors: Intraparenchymal devices

Advantages
• Less invasive
• Can be used with collapsed ventricles
• Not dependent on fluid coupling
• Low infection rate

Disadvantages
• Diagnostic only
• Looses accuracy – “Zero Drift”
• Local measurement of pressure
Management of Elevated ICP
Monroe-Kellie Hypothesis
General Care

- Optimize cerebral venous outflow
  - HOB 30°
  - Keep head straight
  - Avoid tight head/neck ties for endotracheal/tracheostomy tubes
  - Treat elevated intra-thoracic or intra-abdominal pressures

- Respiratory Failure
  - Maintain eucapnea to very mild hypocapnea

- Sedation and Analgesia
  - Agitation and pain may worsen ICP
  - Shorter duration agents preferred

- Seizures
  - Prophylaxis for TBI patients vs. other etiologies

- Anemia
  - Goal H/H closer to 10/30?

- Fever Management
Fever Management

Fever is not uncommon

Clear association with worse outcome

Aggressive treatment
  - antipyretics, surface cooling, cold saline, intravascular cooling catheter
BP and Volume Management

Optimize intravascular volume status
- Isotonic crystalloid solution (0.9% saline)
- Target euvolemia to mild hypervolemia
  - May require use of hemodynamic monitoring

Optimize blood pressure
- Permissive HTN where applicable
- Avoidance of hypotension
Medical ICP management

- Decrease metabolic demand
  - Sedation/Paralysis
  - Fever Management

- Hyperosmolar Therapy
  - Mannitol
  - Hypertonic Saline
    - 3% NaCl
    - Goal Na 140-150 – titrate to individual patients
    - Strict avoidance of rapid declines in Na levels
Malignant MCA Stroke with D5W

April 9

April 10

April 17

April 18
Herniation

Clinical Manifestations

• Decreased mental status, change in respiration patterns, unilateral dilated and non-reactive pupil, hemiparesis, posturing of limbs
• Failure to recognize and respond likely fatal

Management

• Hypertonic Saline
  – 23.4% 30ml push over 3-5 minutes
  – BP Monitoring q2 min x 10 min
  – Serial Na levels
• Mannitol 1-2 gm/kg
• Hyperventilation
  – Goal pCO2 25-30
• STAT surgical decompression
Decompressive Hemicraniectomy

- Early decompression (<48 hrs)
  - Decreased mortality by 30%
  - Number needed to treat = 2
  - Increases number of patients with favorable functional outcome

- No specific guidelines
  - Age <60
  - <48 hours from stroke onset
  - Non-dominant hemisphere

Early decompressive surgery in malignant infarction of the middle cerebral artery: a pooled analysis of three randomised controlled trials

Katayoun Vahedi, Jeannette Hofmeijer, Eric Juettler, Eric Vicaut, Bernard George, Ale Algra, G Johan Amelink, Peter Schmiedeck, Stefan Schwab, Peter M Rothwell, Marie-Germaine Bousser, H Bart van der Worp, Werner Hacke, for the DECIMAL, DEFSTINY, and HAMILT investigators

ICH?
67 yo male
67 yo male
36 yo female with Basal Ganglia Hemorrhage
Brainpath and Myriad

Specialized cannulas that part the white matter

Specialized suction device
Respect the Fiber Tracts
36 yo female with Basal Ganglia Hemorrhage
36 yo female with Basal Ganglia Hemorrhage

**Pre-op**

**Post-op**
36 yo female with Basal Ganglia Hemorrhage
36 yo female with Basal Ganglia Hemorrhage

Pre-op

Post-op
54 yo Male with Basal Ganglia Hemorrhage

10/9/14
54 yo Male with Basal Ganglia Hemorrhage

10/9/14

10/25/14
Summary

• When to consider monitoring ICP?
  • GCS < 8
  • Significant IVH or Hydrocephalus
  • Clinical evidence of herniation
  • EVD vs Intraparenchymal

• Medical Treatment
  • Optimize venous outflow
  • Ensure adequate ventilation (Hyperventilate temporarily only)
  • Sedation and analgesia
  • Fever Management
  • Optimize intravascular volume and blood pressure
    • CPP = MAP – ICP
    • Hyperosmolar Therapy
      • Mannitol
      • Hypertonic Saline

• Surgical Treatment