NEUROMONITORING AND ANESTHESIA CONSIDERATIONS

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OBJECTIVES

• The student will
  – 1. Review the types of neuromonitoring currently in use
  – 2. Identify possible procedural applications for monitoring
  – 3. Develop anesthesia care plan based on sound rationale when neuromonitoring is used
NEUROMONITORING

- ICP
- EEG
- EMG
- SSEP
- MEP
- Cerebral oxygenation guides
ICP MONITORING

• Direct measure of ICP
  – Ventricular catheters
  – Subdural/subarachnoid bolts
  – Epidural transducers
  – Intraparenchymal fiberoptic devices

» Barash et al
ICP MONITORING

• ICP determined by
  – Brain mass – 80%
  – Blood flow -10%
  – CSF volume – 10%
ICP MONITORING

- $>15-20 = \text{affects CBF}$
- $\text{CPP} = \text{MAP - ICP}$
- $>70 \rightarrow \text{Improved outcomes}$
ICP MONITORING

• Physical setup
• Connection of device to transducer
• Requires watertight fluid interface
• Deformation of transducer membrane → converted to electrical pulsations → amplified → displayed as waveform
ICP MONITORING

• Requires zeroing to room air
• Catheter tip transducers only zeroed prior to insertion
• External transducers can be zeroed anytime
ICP MONITORING

- Ventricular
- GOLD STANDARD FOR ACCURACY
- Allows for drainage/measurement
- Subdural/epidural less accurate
ICP MONITORING

• Uses
  – Effects of intracranial masses
  – Influences Rx of ICP control
  – Drainage
  – Prognostic predictor
    • SAH
    • Hydrocephalus
    • Encephalitis
    • Venous sinus thrombosis
    • Ischemic infarct w/ swelling
    • Hepatic encephalopathy
ICP MANAGEMENT

• Dec brain water
  – Hyperosmolar diuretics
    • Mannitol w/intact BBB
      – .25G-1G/kg
  – Loop diuretics
    • Lasix
  – Corticosteroids

  » Mass, flow, csf
ICP MANAGEMENT

• Reduce CSF volume
  – Drainage
    • Ventricular
    • Lumbar subarachnoid
    • Head elevation

mass,flow,csf
ICP MANAGEMENT

• Reduce CBF-not recommended 1st 24 hrs post trauma
  – Hyperventilation
    • Hypocapnia no less than 25
  – Pharmacologic vasoconstriction
    • Etomidate, propofol, barbs
  – Head elevation
  – Minimize possibilities of inc intrathoracic pressures
    • Sedation, paralysis
      » Mass, flow, csf
ICP MANAGEMENT

• Control CBF
  – B/P management
  – Labetalol
  – Trimethaphan

» Mass, flow, csf
ICP MANAGEMENT

• Control CMRO2
  – Hypothermia
  – Barb-induced coma
ICP MANAGEMENT

• Decrease brain mass
  – removal
  – chemotherapy
  – Radiation therapy
  – Decompression
  – Craniectomy

  » Mass, flow, csf
ANESTHESIA INFLUENCES

• In addition:
  • Autoregulation is impaired by
    – Inhalational anesthetics
    – Direct-acting vasodilators
      • Adenosine
      • Prostacyclin
      • Ca++Channel blockers
      • NTG
      • Nitroprusside
EEG MONITORING

• Assists in evaluation CPP
  – Carotid endarterectomy
  – Controlled hypotension
• Seizure evaluation/surgery
  – Mapping
  – resection
EEG MONITORING

• Technician looks for signs of:
  • Activation
    – High-frequency
    – low-voltage
  • Depression
    – Low-frequency
    – High voltage
EEG

- Technician looks for signs of:
  - Activation
    - Light anesthesia
    - Surgical stimulation
  - Depression
    - Deep anesthesia
    - Cerebral compromise
EEG

• “most anesthetics produce a biphasic pattern…initial activation…followed by dose-dependent depression”

  » Morgan et al
Agents to activate
subanesthetic inhalationals
lo dose barbs/benzos
sm doses etomidate
N2O
ketamine
EEG AND ANESTHESIA

• Agents that depress
  – 1-2 MAC gases
  – Barbs/propofol/etomidate
  – Narcotics-dose dependent
EEG AND ANESTHESIA

• Other things that we influence:
  • Activate
    – Mild hypercapnia
    – Stimulation (surgical)
    – Early hypoxia
  • Depress
    – Hypocapnia
    – Hypothermia
    – Late hypoxia
EVOKED POTENTIALS

• SSEP
  – Measures activity of dorsal spinal column and cortex

• MEP
  – Measures activity of ventral spinal column
  – Contra after cranial injury/seizures
  – Percut needle electrode c-spine
EVOKED POTENTIALS

• Technician looks at poststimulation latencies
  – Short = from n stim or brain stem
    • Least affected by anes
  – Medium = primarily cortical
  – Long = primarily cortical
    • Most sensitive to anes
EVOKED POTENTIALS

• SSEP-sensory and motor paths
  – Spinal cord resections
  – Instrumentation of spine
• MEP-motor paths
  – AAA (cord perfusion)
• BAERs (brain stem auditory response)
  – VIIIth cranial Nerve-auditory pathways
  – Microvascular decomp (tic)
  – Acoustic neuroma/meningioma
  – Posterior fossa procedures
EVOKED POTENTIALS

• Visual EP
  – Optic n and upper brain stem
  – Large pituitary tumors
  – Craniopharyngiomas
  – Suprasellar meningiomas
EVOKED POTENTIALS AND ANESTHESIA

• VOLATILES
  – Dec amplitude and inc latency
  – Most inhalationals = .5 MAC
  – N2O controversy
    • Dec amplitude
EVOKED POTENTIALS AND ANESTHESIA

• OTHER ANESTHETIC DRUGS

• Muscle relaxants
  – Talk to tech
  – Often 1-2 tw needed

• Narcotics, benzos and barbs
  – Usually dose related effects
  – High doses = dec amp and inc latencies
  – Demerol and Ketamine may inc amplitude
EMG

• Records electrical activity of muscle
• Indirect indicator of innervating nerve function
• May be recorded continuously or measured non continuously
EMG

• May monitor any muscle to evaluate cranial nerves or peripheral nerves
  – Tongue
  – Face
  – sphincters
EMG

• Cranial nerve evaluation
  • Trigeminal
  • Glossopharyngeal
  • Vagus
  • Spinal accessory
  • hypoglossal
    – Posterior fossa (acoustic neuroma)
    – Vestibular neurectomy
    – Temporal bone
    – Parotid
EMG

• Surgeon may also directly stimulate n. with sterile n stimulator and observe muscles
EMG

• Continuous monitoring
  – Pedicle screw placement
    • Helps evaluate proper tightening of screw
  – Tethered spinal cord release
    • Lower extremities
    • Anal sphincters
  – Selective dorsal rhizotomy
    • Reduces spasticity e.g. CP
    • Monitoring shows reduction of excitation of motor nerves
EMG

• Will need to show TOF X4 prior to surgical testing.
SjvO2 MONITORING

- Jugular venous oxygen saturation
- Obtained from triple lumen catheter inserted into jugular bulb
- Attached to pressurized system
- Reflects degree of oxygen extraction by brain
SjvO2 MONITORING

• Calculated by %O2 bound to O2
• Normal = 55-75%
  – <55%
    – Blood flow insufficient to meet requirements → greater amount extracted
  – >75%
    – Brain injury so great → unable to extract O2.
    – Brain death: SjvO2 = SaO2
SjvO2 MONITORING

• Limits
  – Only allows sampling one side of brain
  – Non-specific
SjvO2 SAMPLING

• Drawn from distal port
• Heparinized syringe (as with any blood gas)
• Catheter flushing should be SLOW and GENTLE (prevents retrograde flow into head)
• Be sure the lab distinguishes this from mixed venous gases!