

NEUROMONITORING AND ANESTHESIA CONSIDERATIONS

Martha Richter, MSN, CRNA

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

- $>15-20$ = affects CBF
- $CPP=MAP-ICP$
- $>70 \rightarrow$ 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 encephelopathy

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

EEG AND ANESTHESIA

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!