Awake-Anesthesia: An Oxymoron?

A Clinical Approach to Awake Craniotomies

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Objectives

- **1)** Understand an evidence-based anesthetic management strategy for an awake craniotomy
- **2)** Verbalize two high priority goals in the anesthetic management of an awake craniotomy
- **3)** Define the AAA technique and list two benefits of its utilization
- **4)** Enjoy the lecture & buy the lecturer a starbucks afterwards.

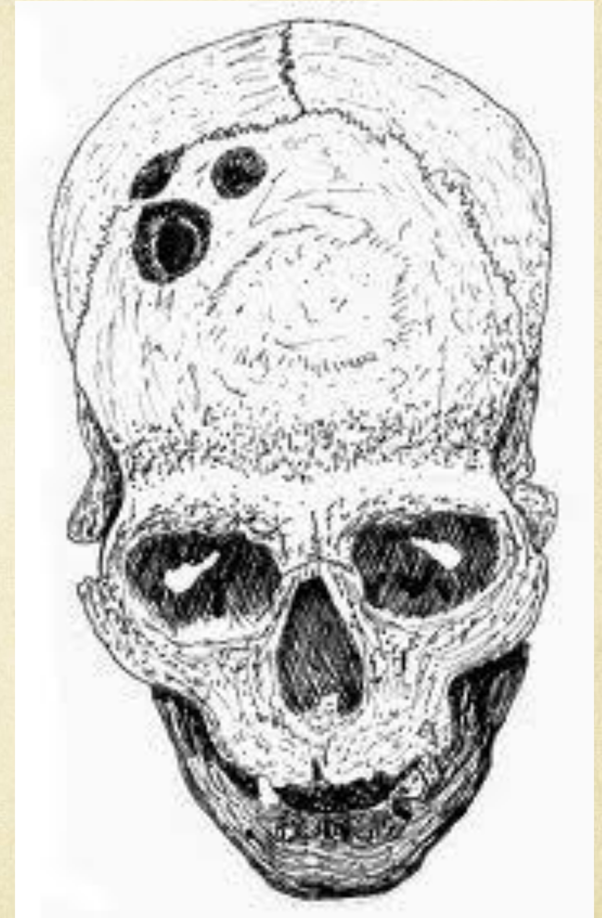
The Evolution of the Awake Craniotomy

(3,7,9)

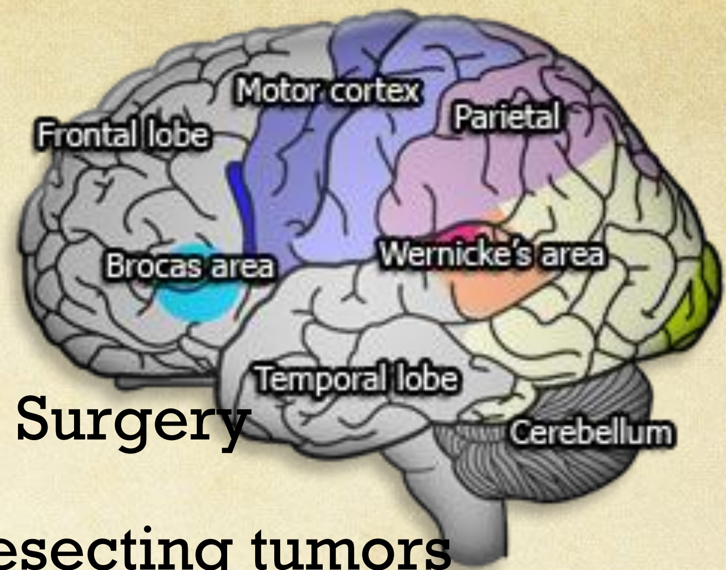
- Trepanations >1000 yrs ago
  - Pts with contusions or skull fxs (permit the "escape of evil air")
- Rudimentary awake craniotomy technique 1st documented use in the early 17th century for tumor surgery in epileptic pts

Evolution (cont)

- Hughlings Jackson 1864-1870
- Fritsch and Hitzig 1870 Bartholow 1874
- Horsley 1886
- Penfield 1920
- Davidoff 1934
- Pasquet 1950s
- De Castro & Mundeleer 1959
- Archer 1988
- Silbergeld 1992



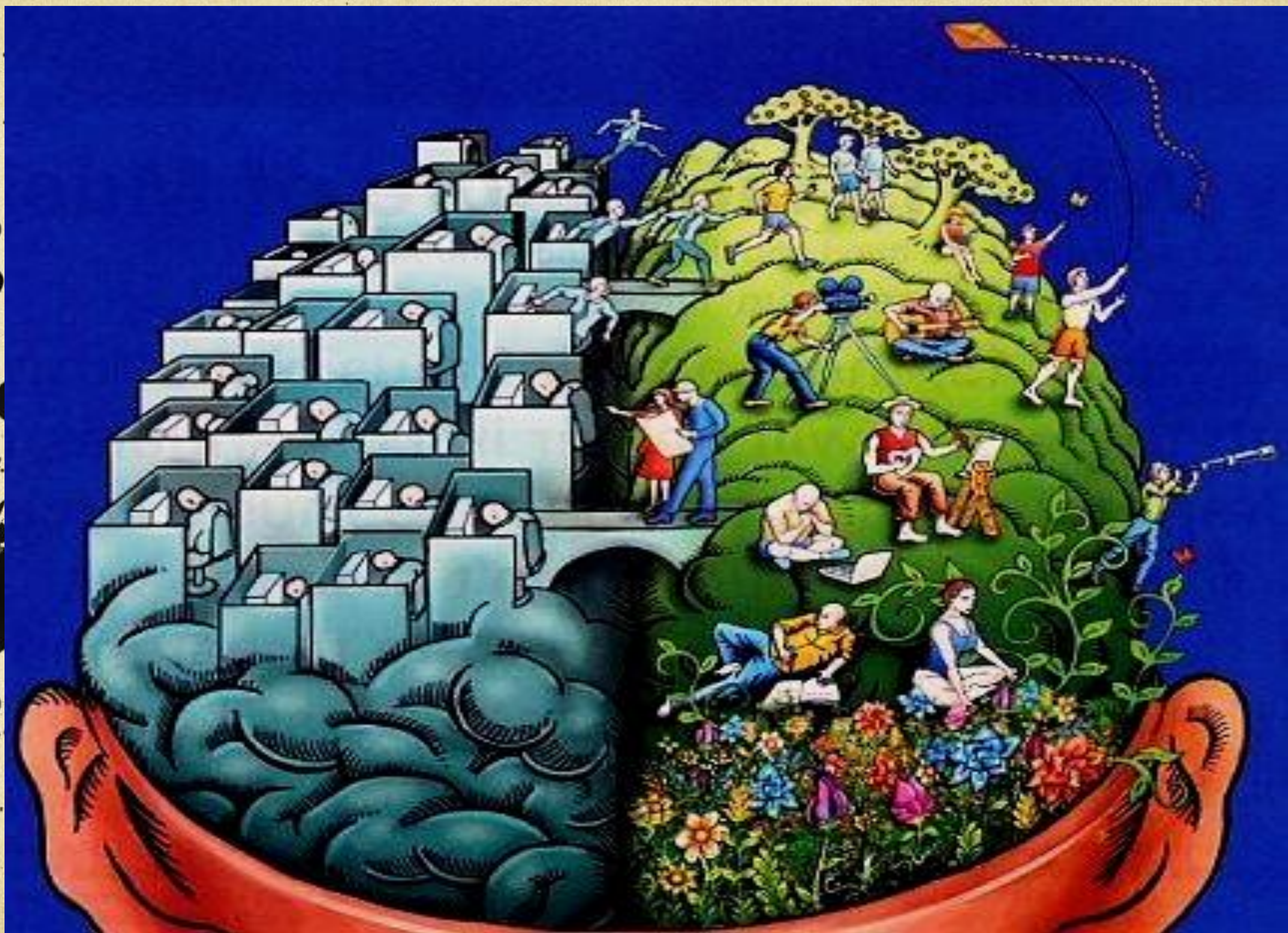
Evolution: Current



- Primarily performed for Epileptic Surgery
- More recently implemented for resecting tumors located in the **eloquent* cortex.
  - Frontal lobe: the motor strip & Broca's speech area *(dominant hemisphere)*
  - Temporal lobe: Wernicke's speech area *(dominant hemisphere)*
- Intra-operative neurologic testing permits maximal tumor resection while preserving neurologic function.
- ****eloquent:*** fluent, forceful & persuasive or… vividly expressive. Eloqui means to speak out, utter.

Anesthesia Goals

- **1**. Smooth transition between anesthesia & consciousness.
  - ASLEEP: Sufficient anesthetic depth during opening and closing of bone flap
    - Manipulate cerebral/systemic hemodynamics
  - AWAKE: Full consciousness during cortical mapping
    - Adequate ventilation/airway safety
    - Pt immobile & comfortable/cooperative
    - Maintain electro-physiologic monitoring capability (2)
- **2**. Facilitate excising max amt of lesion without impairing neurological fxn. (6)

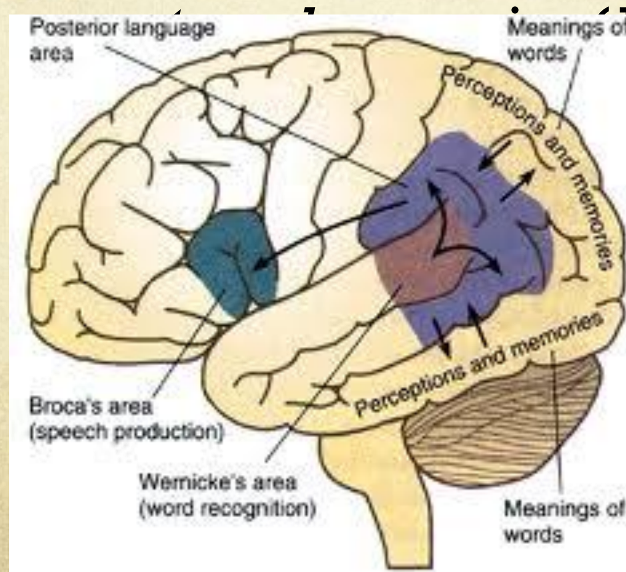


Brain Mapping

- Originally used for epileptic surgery, is now utilized for tumor resection.
- More widely used within the last 2 decades
- Identifies:
  - Regions of **language** representation *(dominant cerebral hemisphere)*
  - **Motor** cortex *(either hemisphere)*
- Intra-op mapping helps distinguish between eloquent cortex and tumor tissue, which facilitates:
  - accessing the tumor from safest transcortical route
  - aggressive tumor resection while preserving functional tissue.

Brain Mapping: **Language**

- Indicated if the surgical site is near language associated cortical sites or "speech areas"
  - **<u>Broca's</u>** *(expression)*: posterior/inferior/frontal lobe of dominant hemisphere.
  - **<u>Wernicke's</u>** *(comprehension)*: posterior/temporal lobe of dominant hemisphere. (14)
- Direct electrical stimulation of the cortex during language tasks while observing for *speech hesitation,* (12, 14)



Brain Mapping: **Motor**

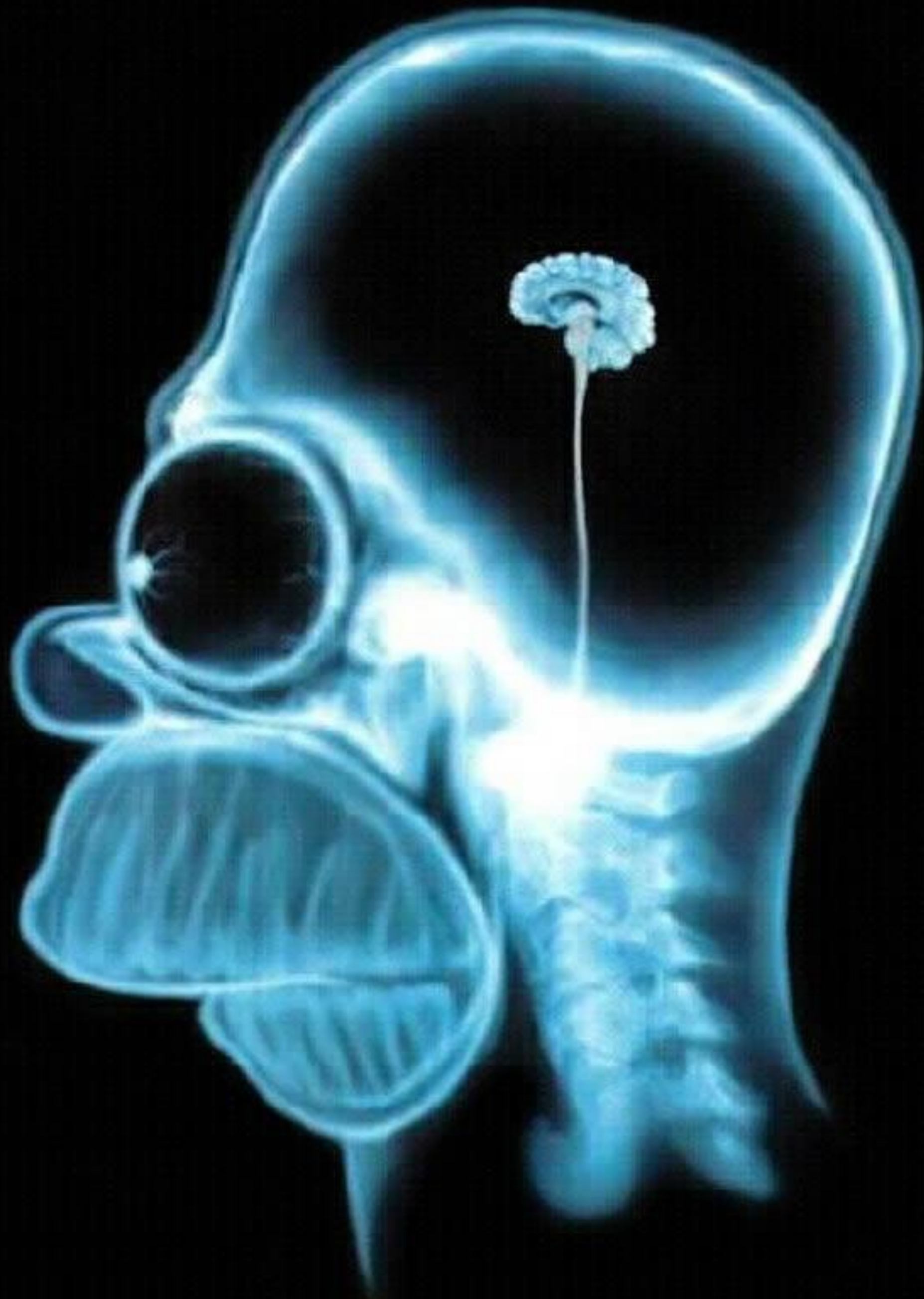
- Grid of electrodes placed on brain surface to identify a phase reversal of SSEPs recorded over the *posterior sensory cortex* and *precentral motor gyrus*.
- Direct electrical stimulation of the cortex to elicit motor movement.
- MEPs, more recently, used to map and monitor *sub*cortical motor pathways.(14)
- **<u>+ findings</u>:**
  - 1) inability to make specific movements when commanded
  - 2) presence of involuntary movements. (12)

MCHUMOR.com by T. McCracken

"Let's sue the writers of *General Hospital*. I had the same symptoms someone had on the soap, but I wasn't cured when I had brain surgery."

Pre-op: Patient Selection

- Contraindication (*absolute*):
  - **uncooperative pt.**
- Contraindication (*relative*):
  - OSA
  - morbidly obese
  - lg vascular tumor
  - tumor with dural involvement. (12)



Pre-Op: Pt Preparation

- Obtaining the patient's confidence & agreement to cooperate during surgery is key.
- Developing good rapport with pt & their family is crucial.
- Inform pt of our expectations of them during the awake phase… and what they can expect from us…. "*Commitment, safety, comfort.*" (10)

Pre-Op: H&P

- Upper airways: difficult intubation/ventilation?
- Epilepsy: type/severity of sz, antiepileptics?
- N/V risk?
- Hemorrhagic risk: type/location of tumor, med hx, anticoag therapy?
- Patient Cooperation: anxiety, pain tolerance
- pre-existing neurologic deficits? (9)

Pre-Op: Meds

- Thorough explanation may provide superior anxiolysis (9)
- Meds may include: benzodiazepines, opioids, anti-emetics, antibiotics, anticonvulsants, steroids, clonidine, atropine.
  - **Midazolam**: most common pre-op med
  - Bolus of **Dexmedetomidine** started.
- Some authors administer NSAIDS (diclofenac or acetaminophen)

Pre-Op: Room Prep

- Complete set up for case: airway equipment, lines, monitoring devices, MRI avail…
- Comfort measures: warm room/blankets, pillows, decreased noise.(9)
- Sign on door stating Pt Awake!
- Anticipate pt positioning.. **MUST** have full access to pts face/airway/line of vision (13)

Technique

- Numerous techniques have evolved along with surgical indications.(4)
  - MAC **(Maximum Anesthesia Caution)**
  - AAA (Asleep-Awake-Asleep)

MAC (Monitored Anesthesia Care)

- Sedatives, analgesics, and hypnotics.
- Careful monitoring/support of VS
- Ensure spontaneous ventilation with minimal/non-invasive airway management.
  - NC or FM
- <u>Airway obstruction</u> risk **DEMANDS** clinical vigilance.
- Always potential for GA. (9)

AAA (Asleep-Awake-Asleep)

- General anesthesia before/after brain mapping.
- Good airway control & adequate sedation → no pain/discomfort.
- Airway devices:
  - LMA: most widely implemented by authors.(9)
  - ETT: only secure airway but difficult to place.
  - COPA:

AAA

- LMA: Spont. or mechanical ventilation. (11)
  - May not be considered <u>*secure*</u> airway
  - Well tolerated
  - Easy reinsertion
    - Avoids laryngoscopy
    - Avoids head extension
  - Reduced coughing/gagging upon emergence.(2, 9)
  - Proseal LMA better? Offers gastric suctioning.

Local Anesthesia (Adjunct)

- Mayfield pin sites.(13)
- Block *sensory* branches of trigeminal nerve:
  1.auriculo-temporal, 2.zygomatico-temporal, 3.supra-orbital, 4.supra-trochlear, 5.greater occipital, 6.lesser occipital nerves.
  - Provides reversible regional loss of sensation reducing pain perception & global energy expenditure (2)
  - Usually surgical side.. Some suggest bilateral.
  - Ropivacaine/levobupivacaine ? safer than bupivacaine 40-60ml. (8)
    - Inc risk toxicity in pts prone to szs.

BIS monitor (Bispectral Index)

- Measures anesthetic depth (correlates with hypnotic component of anesthesia) (13)
  - 40-60 (asleep phase)
  - >85 (awake phase)
- Ensure proper placement before drapes.
- May significantly reduce anesthetic agents.
- Cost?

"Relax doctor...it ain't rocket science."

Pharmacology

- **Propofol:** widely employed for neurosurgical anesthesia (and awake craniotomy) d/t:
  - Easily titratable sedative effect
  - Rapid recovery with clear-headedness
  - Decreased CMRO2
  - Reduced ICP
  - Potent anti-convulsant properties
  - Antiemetic properties(9)

Pharmacology (cont)

- **Remifentanil:** ultra short-acting opioid is becoming more popular. (12)
  - Rapid onset/short duration → rapid awakening for neurologic testing.
  - Smoother hemodynamic profile

Pharmacology (cont)

- **Dexmedetomidine**: selective *a*2 adrenergic receptor agonist. (1)
  - Provides sedation & analgesia without respiratory depression.
  - Pts appear to sleep comfortably but are easily arousable to verbal stimuli.
  - HOTN/bradycardia are common side effects (12)

Complications (3,9,10,13,14)

- **Airway obstruction**: oversedation?
- **Seizures**: focal/short vs. generalized
- **Nausea/vomiting**
- **Hemodynamic complications:** HTN/HOTN
- **Local anesthetic toxicity**
- **Pain**
- **Poor cooperation**
- **Venous air embolism**: rare in awake craniotomy

Protocol: **Awake Craniotomy**

- Community Regional Medical Center, Fresno, CA – by Keith Rhoden CRNA/Michael Hough CRNA
- Neurosurgeon: Verrees MD
- Initial cases performed following Sarang et al research, utilizing the AAA technique and administration of a Remifentanil/Propofol combo.
  - Dexmedetomidine is now frequently substituted for Propofol secondary to its lack of respiratory depression.
- Further changes were incorporated resulting in current protocol.

Protocol (cont.)

- Interview pt/family
- Airway evaluation
- Determine baseline neurologic status
  - ABCs, #s, flash cards
  - motor movement/strength
  - hobbies, family history, work, etc
- Premedication
  - Versed 1-2mg IV
  - Dexmedetomidine: IV load bolus (*1 mcg/kg/30"*)
  - Reglan 10mg IV
  - Robinul 0.2 mg IV ??

Protocol (cont.)

- Standard monitors/O2
- BIS sensor to forehead *(get baseline #)*
- Routine LMA induction (propofol, opioid)
- LMA placed/secured
- Sevoflurane on
- Pressure support with rescue rate at 8 bpm
  - maintains ETCO2 within normal levels
  - decreases work of breathing
- Decadron 10 mg IV
- Anticonvulsants?

Protocol (cont.)

- Dex gtt *(0.4 mcg/kg/hr)* after load bolus
- Remifentanil gtt *(0.1 mcg/kg/min)*
  - maintaining spont. ventilation
- Titrate sevo to BIS 50-60
- NC & BAIR hugger
- SC central line
- A-line
- 5-10 mls 0.25% Bupivacaine + 1:400K Epi to each Mayfield pin site

Protocol (cont.)

- Zofran 4 mg IV *(~30 min before wake phase)*
- Acetaminophen 650mg PR *(30 min before wake)*
- Titrate off sevo & remi (~*20 min before wake up)*
- Reduce dex to *0.1-0.2 mcg/kg/hr* when preparing for awake phase
- Turn NC O2 on 2-4 L/min
- Remove LMA when pt awake (suction avail)
- Fentanyl 25 mcg IV prn discomfort

Protocol (cont.)

- Communicate with pt as needed to facilitate region specific brain mapping
- Upon completion of brain mapping, induce pt with propofol
- LMA reinserted (must have failed airway plan B & C)
  - If unable to reinsert LMA, surgeon should localize and close wound (AA technique)
- Re-establish dex & remi gtts and Sevo.

Protocol (cont.)

- Titrate meds to obtain spont ventilation
- D/C sevo & Dex while titrating down remi
- Titrate longer acting narcotics to ETCO2 & RR
- LMA out when meet appropriate criteria
- Re-orient pt & assess/tx pain/nausea
- Thank OR team for their assistance!

Tips

- Order dexmedetomidine from pharmacy early
- Establish strong communication with pt.
- Review ABCs, #s, and flash cards in pre-op
- Localize pin sites well
- Lidocaine jelly at f/c entrance in men
- Well organized preop → ez intraop
- Ensure good access to airway/face
- Develop good rapport with surgeon, ask for 45 min warning to pt awake phase (usually once dura is opened)

Conclusion

- Although one of the older surgical specialties, neurosurgery is currently where many important advancements are being made. Neuro-anesthesia practice must evolve... adapting to optimize surgical conditions and patient tolerance of these complex procedures.

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