Anesthesia for Awake Craniotomy

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Rutgers New Jersey Medical School
Awake Craniotomy: Rationale

- The need to perform intraoperative functional cortical mapping
- To minimize drug-induced interference with intraoperative electrophysiological recordings
Awake Craniotomy: A Little Bit of Anatomy
Purported Advantages of Awake Craniotomy

- Extent of resection
- Neurological morbidity
- Length of hospital stay
Prospective study of awake craniotomy used routinely and nonselectively for supratentorial tumors

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Division of Neurosurgery, Toronto Western Hospital, Toronto, Ontario, Canada

Single center
610 cases
Reduced ICU time (compared with historical control)
Reduced hospital length of stay
Awake Mapping Optimizes the Extent of Tumor Resection

De Benedictis A, Neurosurgery, 2010
Survival graphs showing the overall mortality in AC, GA, GA(E)

## Awake Craniotomy versus General Anesthesia

<table>
<thead>
<tr>
<th>Author &amp; Year</th>
<th># of Patients</th>
<th>Hospital Stays (days)</th>
<th>New Neurologic Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AC/GA</td>
<td>AC/GA</td>
<td></td>
</tr>
<tr>
<td>Sacko, 2011</td>
<td>214(Y)/289(N)</td>
<td>5.4/8.5</td>
<td>3.3%/13%</td>
</tr>
<tr>
<td></td>
<td>72(Y)</td>
<td>5.4/12.7</td>
<td></td>
</tr>
<tr>
<td>DeBenedictis, 2010</td>
<td>9(Y)/9(N)</td>
<td>7/NR</td>
<td>22%/66%</td>
</tr>
<tr>
<td>Peruzzi, 2011</td>
<td>20 (Y)/19(N)</td>
<td>3.5/4.6</td>
<td>18%/27%</td>
</tr>
<tr>
<td>Manninen, 2002</td>
<td>50 (Y)/57(Y)</td>
<td>4/12</td>
<td>4%/12%</td>
</tr>
<tr>
<td>Ali, 2009</td>
<td>20 (Y)/20(Y)</td>
<td>3.8/8.15</td>
<td>10%/60%</td>
</tr>
<tr>
<td>Gupta, 2007</td>
<td>26(Y)/27(Y)</td>
<td>6/4</td>
<td>19%/11.1%</td>
</tr>
</tbody>
</table>
What do we want and when do we want it?

Awake/Alert

Intense stimulation

Awake

Does not really matter stage

General Anesthesia

Coma

Time
Characteristics of the Anesthetic Regimen for Procedures Requiring Variable Level of Consciousness

- Level of consciousness that permits functional (language/motor) testing
- Non-interference with ECoG (epilepsy surgery)
- Non-interference with microrecording (DBS)
- Rapid onset and rapid offset
- Wide therapeutic window
- Antiemesis
- Minimal respiratory depression
What are Our Choices?

SEDATION
- Just say no to drugs
- Propofol
- Dexmedetomidine
- Ketamine
- Benzodiazepines

ANALGESIA
- Fentanyl
- Sufentanil
- Alfentanil
- Remifentanil
- Dexmedetomidine

It is not the drug *per se*, it is how you use it.
“The brain is not a sausage, it’s more like a well tuned musical instrument”

Rudolfo Llinas

Endogenous sleep

Loss of response to external stimuli

Sedative component of anesthesia
Propofol: Intraoperative Neurocognitive Testing

ADVANTAGES

► Rapid onset and offset of action
► Antiemetic properties
► Anxiolysis (?)

DISADVANTAGES

► Oversedation/disinhibition
► Significant respiratory depression
► Significant decrease in BP
► Wide variability in the therapeutic drug concentration
► Propofol sedation has to be suspended 15-30 minutes prior to neurocognitive testing
Maximum Propofol

115 (100-150) mcg/kg/min

Maximum Remifentanil

.05 (.05-.09) mcg/kg/min

Incision to request for wake up

48 (28-51) min

Start drug to request for wake up

78 (58-98 min)

Infusion off to eyes open

9 (6-13) min

Keifer I: Anesth Analg 2005
## Propofol Based Technique: Complications

<table>
<thead>
<tr>
<th>Study</th>
<th>Technique</th>
<th>Events</th>
<th>%</th>
<th>Clinical significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiefer 2005</td>
<td>Propofol + Remifentanil AAA</td>
<td>30 seconds of apnea</td>
<td>69</td>
<td>Minor; no patient required ET intubation; no pt with “tight brain”</td>
</tr>
<tr>
<td>N=98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maninnen 2006</td>
<td>Propofol + Remifentanil or + Fentanyl</td>
<td>Transient O2 desaturation, mild obstruction, nasal airway required,</td>
<td>18</td>
<td>Minor; all events brief and easily treated</td>
</tr>
<tr>
<td>N=50</td>
<td>Conscious sedation analgesia</td>
<td>decreased RR required, mask ventilation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skucas 2006</td>
<td>Propofol AAA</td>
<td>Respiratory event requiring any maneuver beyond placing a nasal airway</td>
<td>16</td>
<td>LMA (2) ETT (1) Risk factor BMI $\approx$ 30</td>
</tr>
<tr>
<td>N=332</td>
<td></td>
<td>Sat 91-95%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dexmedetomidine

**Advantages**
- Sedation & analgesia
- No respiratory depression
- No disinhibition

**Use**
- Alone
- As adjunct
- As rescue drug

**Neurocognitive Testing**
- Adequate in most reports
- Excessive sedation has been reported

**Recommendation:**
- DEX infusion at lower range for intraoperative functional testing e.g. 0.1-0.3 mcg/kg/hr
# Dexmedetomidine: Clinical Applications

<table>
<thead>
<tr>
<th>Reported Problems</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fogarty, <em>JNA, 04</em></td>
</tr>
<tr>
<td></td>
<td>N=10</td>
</tr>
<tr>
<td>Pain</td>
<td>10</td>
</tr>
<tr>
<td>Seizures</td>
<td>0</td>
</tr>
<tr>
<td>Oversedation</td>
<td>10</td>
</tr>
<tr>
<td>Agitation</td>
<td>N/A</td>
</tr>
<tr>
<td>Nausea/Vomiting</td>
<td>0</td>
</tr>
<tr>
<td>Respiratory problems</td>
<td>10</td>
</tr>
<tr>
<td>Conversion to GA</td>
<td>10</td>
</tr>
<tr>
<td>Hypotension</td>
<td>10</td>
</tr>
</tbody>
</table>
Scalp Block
Patient Experience

Goebel S, *Neurosurgery* 2010

- Intraoperative experience
  - 61% highly satisfied
  - 39% some dissatisfaction
  - Pain, seizure, anxiety, exhaustion
- **88%** would undergo procedure again


- Intraoperative experience
  - 57% entirely satisfied
  - 30% minor difficulties
  - 20% moderate difficulties
- **87%** would undergo procedure again

Goebel S, *Neurosurgery* 2010

<table>
<thead>
<tr>
<th>Having an awake craniotomy is like…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surreal, not of this world</td>
</tr>
<tr>
<td>“.An out of this world experience..” (n = 4)</td>
</tr>
<tr>
<td>“.unreal..” (n = 4)</td>
</tr>
<tr>
<td>“.I’m on another planet.” (n = 2)</td>
</tr>
<tr>
<td>“.science fiction..” (n = 2)</td>
</tr>
<tr>
<td>“.a star..” (n = 1)</td>
</tr>
<tr>
<td>“.touching the sun with my hands..” (n = 1)</td>
</tr>
<tr>
<td>“.for me..like being born again..” (n = 2)</td>
</tr>
<tr>
<td>“.purgatory because I feel purified/cleansed..” (n = 1)</td>
</tr>
<tr>
<td>“.a film..” (n = 2)</td>
</tr>
<tr>
<td>“.a flower..” (n = 1)</td>
</tr>
<tr>
<td>“.I had a valve..they took it out..” (n = 1)</td>
</tr>
</tbody>
</table>

Part of my life, my worldly experience
Overall 93% of patients were completely satisfied
Final Thought

If the human brain were simple enough for us to understand it, we would be too simple to understand it.