



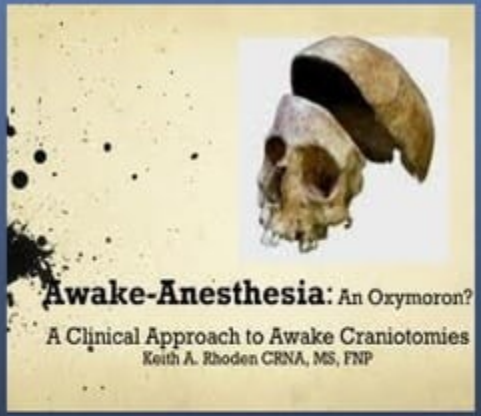
Neurologic Complications of Anesthesia

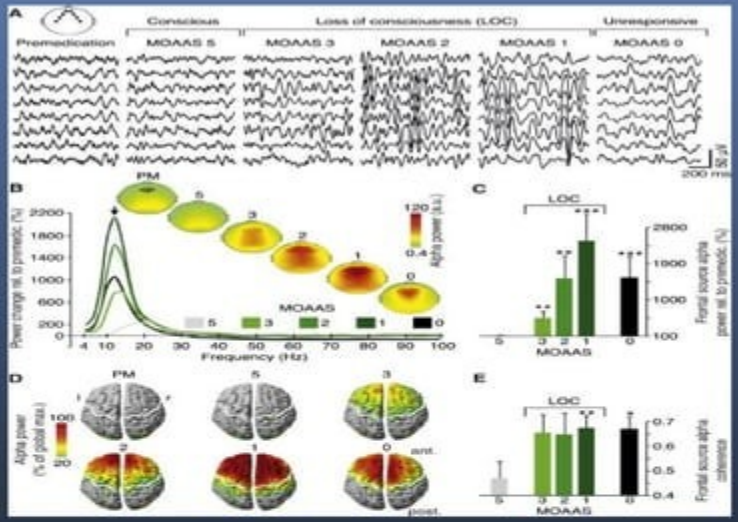
Dr Pamela Correia
DNB Neurology Trainee

John Michenfelder first coined the term "Neuroanesthesia" in 1969

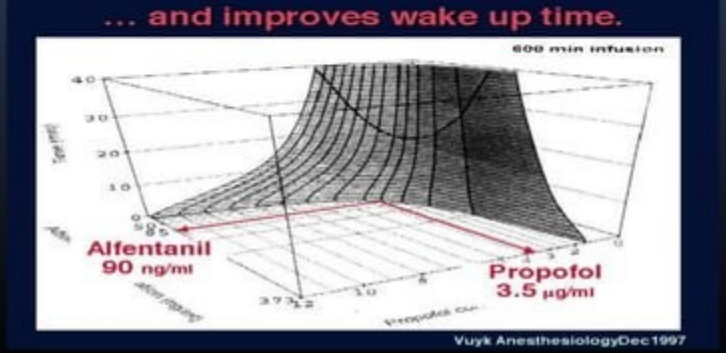
Almost 167 years after W.T.C. Morton used Ether in the first surgical operation




Awake-Anesthesia: An Oxymoron?
A Clinical Approach to Awake Craniotomies
Keith A. Rhoden CRNA, MS, FNP


A
Conscious
Loss of consciousness (LOC)
Unresponsive
Premedication
MOAAS 5
MOAAS 3
MOAAS 2
MOAAS 1
MOAAS 0
50 µV
200 ms
B
PM
Power change rel. to premed. (%)
Alpha power (a.u.)
MOAAS
Frequency (Hz)
C
LOC
Frontal source alpha power rel. to premed. (%)
MOAAS
D
PM
Alpha power (% of global max.)
ant.
post.
E
LOC
Frontal source alpha power
MOAAS


DEEP BRAIN STIMULATOR LEAD
ELECTRODES
SUBTHALAMIC NUCLEUS
SUBSTANTIA NIGRA
CONNECTIVE WIRES
PACEMAKER


... and improves wake up time.
600 min infusion
Alfentanil
90 ng/ml
Propofol
3.5 µg/ml
Vuyk AnesthesiologyDec1997



INCLUSIVE OF:

1)Adverse effects when drugs are used for surgery

2)Induction of coma in ICU

VARIATION OF RISK:

1)Surgery performed for Brain disease

2)Surgery in Preexistent Neurologic disease

3)General or Regional Anesthesia



Major Subdivisions:

- General Anesthesia
- Regional Anesthesia

Further Subdivisions:

- In Neurosurgery
- In General Surgery
- In Neurovascular Surgery
- In Pediatric Surgery
- In the ICU



In Neurosurgery

Most common complications:

1)Arterial Hypotension

2) Reduced Cerebral blood flow

3) Cerebral Ischemia from hyperventilation

4) Increased Intracranial pressure

5) Perioperative Seizures

6) Postoperative arterial hypotension



Complication	Propofol	Inhalational Agent
Arterial Hypotension	+	++
Reduced Cerebral blood flow	+	-
Cerebral Ischemia from hyperventilation	-	++ #
Increased Intracranial pressure	-	++
Perioperative Seizures	-	+(Sevoflurane)
Postoperative arterial hypotension	+	+/-

+ = A higher risk of complications
- = A lower risk of complications
#= This effect is seen in
1)Mass lesions with raised ICP
2)Effect is dose dependent
3)Worse with Isoflurane, Desflurane than Sevoflurane



- **Propofol is the most preferred in mass lesion with increased ICP**
- **Propofol is a potent antiepileptic**
- **Least interference with intraoperative electrophysiological monitoring**
- **Time to recovery similar to inhalational agents**

Recommendations for Specific situations:

Dexmedetomidine in awake craniotomies

Midazolam/Fentanyl for postoperative sedation/analgesia

Fentanyl & Remifentanil are also effective



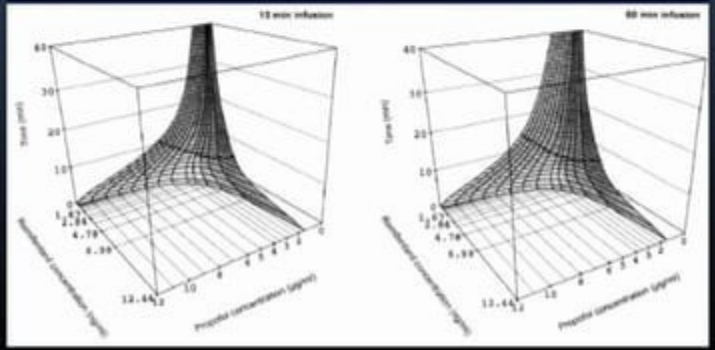
NEWER DRUGS AND APPLICATIONS

DEXMEDETOMIDINE
a novel sedative analgesic

Combining optimal doses of a Narcotic with an Anaesthetic



Propofol / Remifentanil





IDEAL NEUROANESTHETIC REGIMEN FOR CRANIOTOMIES

- Smooth induction
- Adequate brain relaxation and control of intracranial pressure
- Hemodynamic stability
- Maintainence of cerebral perfusion
- Preservation of cerebral autoregulation
- Anticonvulsive effect
- Neuroprotective effect
- Lack of interference with electrophysiologic monitoring
- Preserved patient coopertion in awake surgeries
- Rapid emergence and neurological recovery
- Antiemetic effect



In General Surgery

Problems:

1) Delayed Arousal:

Elderly
Prolonged Anesthesia
Preexistent Brain disease
Complicated surgeries with Hypotension and Organ failure

2) Failure to Arouse:

Stroke
Hypoxic-Ischemic Brain Injury
Status Epilepticus
Sepsis
Multiorgan dysfunction



3) **Postoperative Delirium**

Older adults
Cognitive impairment
Polypharmacy
Narcotics/Benzodiazepines
Incidence: 40 to 60%
Anesthesia Route/Type: Unclear

4) **Post Operative Cognitive Dysfunction:**

Older adults
H/o Postoperative delirium
Incidence: Greater after major Cardiovascular Surgery
30 to 60% - First few weeks
10 to 60% - 3 to 6 months
Risk: Alcohol, Old Stroke, Lower educational level

Important Associations:

- ✓Worse Long term Cognitive outcome
- ✓Greater disability
- ✓Increased risk of death



Precautions:

1)Maintain physiologic homeostasis During and After surgery

2)Anesthetic Regimen: No evidence

3)Depth of Anesthesia: Deeper intraoperative level of Propofol should be avoided

4)Special care in patients with Degenerative Brain disease



Degenerative Brain disease:

1. Alzheimer disease:

A) Problems with Inhalational agents: Isoflurane

Possible mechanisms:

- ✓ Increased neuronal calcium dysregulation
- ✓ Increased Amyloid Beta production
- ✓ Increased Tau phosphorylation
- ✓ Activation of Apoptotic pathways



B) Problems with General Anesthetics:

Decrease Central AcetylCholine release

Depress Cholinergic transmission

Precautions:

- Using Propofol, Rumifentanil:

Less Cholinergic function interference

- Restricted use of :

Hypnotics
Opioids
Inhalational drugs
Neuromuscular blockers

Reason: Variable response



2) Parkinson's Disease:

Medication Regimen:

Continue medicines close to beginning of Anesthesia
Restart soon Post operatively
In prolonged surgery: Intraop Levodopa via NGT

Risks in PD:

Increased rigidity postop

Post extubation respiratory failure & Aspiration Pneumonia (From UpperAirway Obstruction)

Delirium

Autonomic instability



Anesthetic Agents:

Drug	Side Effects
Succinyl Choline	Unsafe, Risk of severe Hyperkalemia
Inhalational drugs	Hypotension, Arrhythmias
Ketamine	Excessive Sympathetic Response
Fentanyl	Increased rigidity
Opioids	Naloxone responsive severe Dystonia
Thiopental	May decrease striatal dopamine release
Non Depolarizing agents	Safe
Propofol	Preferred



Avoid:

Antiemetics in recovery room: Droperidol, Metoclopramide

Meperidine in those taking Selegiline: Agitation, rigidity, hyperthermia

Specific Cases: Functional Surgeries

Hurdle: Anesthesia should not mask Clinical signs

Requirement: Adequate monitoring needed
Target Site of lesion: Thalamotomies, Pallidotomies
Stimulation: DBS (VIM of thalamus)

Drugs:
Mild Sedation: Dexmedetomidine
General Anesthesia: Propofol



Preanaesthetic Parkinson's check-up :

- Diagnosis and duration of disease
- Assessment of associated changes in various systems
- The surgical procedure intended (elective or emergency)
- Antiparkinsonian drugs & potential interactions with anesthetic drugs
- Preoperative continuation of levodopa
- Premedication and acid aspiration prophylaxis



3) Epilepsy:

Low risk of perioperative seizures: exception Children

Proconvulsant:

Etomidate
IV Lidocaine
Sevoflurane
Short acting opioids:
Alfentanil
Sufentanil
Remifentanil

Anticonvulsant:

Propofol
Barbiturates
Benzodiazepines
Isoflurane
Desflurane



4) **Other Neurodegenerative & Neuromuscular:**

Multiple System Atrophy:
Risk : Blood pressure fluctuation (Autonomic dysfunction)
General anesthesia Safe with precautions
Spinal : Smoother perioperative course

5) **Huntington's Disease:**
Avoid : Psychotropic medications
Normal responses to:
Muscle relaxants
Volatile Anesthetics
Benzodiazepines
Opioids

6) **ALS:**
Avoid:
Succinyl Choline: Rhabdomyolysis/ Hyperkalemia
For Muscle relaxation: ND blockers
Safe Regimen: Propofol & Remifentanil



7) **Myesthenia Gravis:**

Preoperative Treatment: Plasma exchange
Postoperative :
Early weaning
Early reinstitution of medicines
Short post op course of high dose IV steroids
Avoid drugs worsening disease:
Muscle relaxants
Antibiotics(Quinolones)

8) **Muscular Dystrophies:**
Risks:
Inhalational Anesthetics: Malignant Hyperthermia
(Ryanodine type 1 receptor mutation)
Succinyl Choline is contraindicated



In Neurovascular Surgery:

Cognitive Dysfunction: ¼ th pts of Carotid Endarterectomy
(Day 1 to 1 month post procedure)
No relation to regimen
Dependent on preop Ischemic Brain Injury

Stenting V/S Endarterectomy:

Increased Cognitive dysfunction
More Cerebral Micro embolism

In Pediatric Patients:

Acclerated Neurodegeneration : Experimental animal models
Learning Disability : Early, Repeated anesthetic exposure



In the ICU:

Usage:

Sedation
Control of IntraCranial hypertension
Refractory Seizures

Problems:

1)Delirium:

Avoid prolonged sedation & High dosage
Daily sedative interruption
Daily monitoring: CAM for ICU
Preferred : Dexmedetomidine V/S Lorazepam/Midazolam

2) Propofol Infusion Syndrome:

At High doses:>4 to 5 mg/kg/h for >48 hrs
Presenting features:
Unexplained Metabolic Acidosis
Refractory Bradycardia
Cardiac Failure, Rhabdomyolysis
Lactic Acidosis, Lipemia
Hyperkalemia, Renal Failure



At Risk:

Prolonged high dose infusion in:
Refractory Status Epilepticus
Refractory Intracranial Hypertension (TBI)

To avoid Propofol:

Altenatives	Adverse effects
High dose Midazolam	Safe, but Pharmacoresistance develops
High dose Lorazepam	Severe Acidosis (propylene glycol toxicity)
Barbiturates(Thiopental/ pentobarbital)	Hypotension, Myocardial depression, Hepatotoxicity, Increased infections(Pneumonia)
Isoflurane	Effective – No Prolonged coma but MRI changes if high dose used>2 weeks (S/o Neurotoxicity)



Regional Anesthesia

Advantage : Reduced Cardio Pulmonary Complications

Mechanisms of Neurologic Injury:

Mechanical:

Direct: Injury from needle/catheter
Indirect: Hemorrhage
Stretching/Compression from positioning

Toxic:

Effects of local anesthetics on Neural Structures/Muscle

Ischemic:

When Epinephrine is co administered



Frequent Regional Anesthesia techniques

Neuroaxial Blockade	Peripheral Nerve Blockade
Spinal Anesthesia (Intathecal)	Brachial Plexus block: Interscalene, Supraclavicular, Axillary, Midhumeral block
Epidural Anesthesia (Extrathecal)	Lumbar plexus block: Lumbar Plexus & Femoral nerve block
	Sacral Plexus block: Sciatic & Popliteal nerve block



Neurological Complications after Regional Anesthesia

Neuropathy
CNS toxicity : Seizures, dizziness, perioral numbness, visual& auditory disturbances
Transient pain in buttocks &legs
Epidural Hematoma
Epidural Abscess
Worsening/Relapse of Preexistent Neurologic Disease



- **Neuropathy** is the most common complication.
  <0.04% - Neuroaxial Block , <3% - Peripheral Block
- Severe Neurological Complications are rare (<0.4%)
- Local anesthetics can occasionally produce neurotoxicity
- ***Transient Neurologic Symptoms:***

After Spinal Anesthesia
Location: Severe bilateral, in buttocks & legs
Not explained by structural abnormality
Not influenced by dose/concentration of drug
Resolve spontaneously in 5 days

- **Epidural Haematoma:**

Risk:
Advanced Age
Anatomic abnormalities of Vertebral Column
Coagulopathy (Bleeding Diathesis/Anticoagulant effect)



Recommendations of ASRA:

1)Stop Warfarin 5 days before

2)Reverse Anticoagulation to **INR ≤ 1.5**

3)High risk for thromboembolism:

Bridging with unfractionated heparin (**Stop 4 hrs before surgery**)

LMWH (**Last dose 24 hrs before surgery, Reduce to ½ dose**)

4)After Surgery:

Warfarin resumed on 1st day

Heparin: 24hrs: **Minor**, 48 to 72 hrs :**Major surgeries**

5) If necessary Aspirin may be continued

6) Stop Clopidogrel **5 to 10 days** before & restart **24 hrs after procedure**



Perioperative Neuropathies:

Suspected Factors:
Intraoperative positioning: Mechanical Stress/Compression
Prolonged Surgeries

Other predisposing factors:

Male sex
Diabetes
Smoking
Hypertension
Vascular disease
Obesity
Very thin Body habitus
Clinical/Sub Clinical nerve dysfunction



Frequently affected nerves:

Ulnar
Sciatic
Brachial Plexus
Limbo Sacral nerve roots

Type:

Sensory
Sensorimotor

Recovery:

Full recovery: days to weeks
Few patients have persistent disability



THANK YOU