Pre-Operative Services Teaching Rounds 13 April 2011

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Pseudo–cholinesterase deficiency:

- Patho–physiology
- Clinical presentation
- Diagnosis
- Management
- Contra–indicated drugs

Knee arthroscopy procedures:

- Anesthesia
- Positioning
- Post op analgesia
Case

63 yr old lady for knee arthroscopy in ASC
PMH:
HTN, Obesity, GERD, OSA dx 4 months ago, not using CPAP
PSH:
Lap chole 2 years ago “difficulty waking up”
FH:
Difficulty breathing after anesthesia, ‘allergy to drug’
Meds:
Omeprazole, Atenolol, thiazide
Exam:
BMI 37, BP 140/90 P 65. No cardiac failure. Non-remarkable.
Case discussion

Differential diagnosis:
- OSA
- Heavy handed anesthesiologist
- “Naïve liver”
- Pseudocholinesterase deficiency
Physiology of the neuromuscular junction

Cholinergic receptors
Nicotinic type
Neurotransmitter

Acetylcholine

\[
\text{Acetylcholine}
\]

\[
\text{Muscarine}
\]

\[
\text{Nicotine}
\]
Acetylcholine is catalysed by hydrolysis to choline and acetic acid by acetylcholinesterase in neural synapse.
Mimic acetylcholine

- Act by binding Ach receptors
  - Depolarising
    - Succinylcholine/suxamethonium
      - Metabolized by pseudocholinesterase
  - Non-depolarising
    - Pancuronium/vecuronium/rocuronium/atracurium
      - Metabolized – liver/kidney/Hoffman degradation
    - Mivacurium
      - Metabolized by pseudocholinesterase

succinylcholine: 
Muscle relaxants

Indications:
- Facilitate intubation
- Facilitate surgery
  - Abdominal wall relaxation
- Facilitate ventilation
  - Laparoscopic/trendelenberg
  - ICU
- Prevent movement
  - Ophthalm/neurosurgery

- Succinylcholine
  - Rapid acting
    - Rapid sequence induction
    - Difficult mask
    - Obesity
    - Short procedure
Pseudocholinesterase enzyme
(plasma or butrylcholinesterase)

- glycoprotein enzyme
- produced by the liver
- circulates in plasma
- hydrolyzes exogenous choline esters
  - Succinylcholine
  - Ester local anesthetics
  - mivacurium
- no known physiologic function
- clinically significant if >75% reduction in enzyme activity

Acetylcholinesterase (True cholinesterase)
- found in neuro–musc junction
- acetylcholine metabolism and nerve function
Succinylcholine metabolism in normal cholinesterase activity

- 90% metab in blood before reaching NMJ
- <10% clinical effect
- Agonist at post junctional endplate
- Reversible
- in equilibrium across junction/plasma
Acquired abnormal pseudocholinesterase activity

- Liver disease
- Pregnancy
- Neonates/elderly
- Malnutrition
- Chronic infections
- Extensive burns
- Organophosphate poisoning
- Uremia
- Medications
  - Echothiopate
  - neostigmine
Inherited plasma enzyme deficiency or decreased activity

‘BCHE’ gene that codes for the pseudochoolinesterase enzyme

- located on E1 locus on the long arm of chromosome 3
- 96% of the population is homozygous for the normal pseudochoolinesterase genotype – EuEu.
- Remaining 4% of the population carries one or more of the atypical gene alleles for the pseudochoolinesterase gene in either a heterozygous or homozygous fashion.
- <0.1% are homozygous for the abnormal gene
- Eu normal
- Ea Atypical dibucaine–resistant variant
- Ef Fluoride–resistant variant
- Es Silent variant (absent enzyme)

These alleles may occur either in the homozygous form or in any heterozygous combination with each other, with the normal Eu allele, or with a number of additional rare variant abnormal alleles.

C5 variant – increased activity – shortened succinylcholine time

*More common in Europeans than Asians*

*Hindu Arya Vysya community in India*
EuEu – normal activity

Heterozygous
EuEa
succinylcholine activity 50–100% < 1 hour
EaEa
succinylcholine activity 4–6 hours
EsEs
succinylcholine activity 8 hours (no activity)
Clinical presentation of pseudo-cholinesterase deficiency

- Family/personal history “scoline apnea”
- No physical exam findings
- Prolonged paralysis after administration of succinylcholine
- Decreased or absent twitch height on nerve stimulator
Paralyzed and awake

Signs and symptoms of awareness

- Movement
- Tachycardia
- Hypertension
- Sweating
- Lacrimation

Movement

- Diaphragm
- Limb twitching ‘floppy fish’
Awareness

- Hearing most common remembered sense
- Pain – most frightening
- ETT – unable to speak – also common
- Big concern
- Can recur
- Recently in the press – “Awake” – movie
- Redheads
- PTSD

- Reassure patients
- Communicate with anesthesia personnel
- BIS monitoring
BIS monitoring

- Modified EEG
- Not a standard monitor
- Readily available
- 90 awake
- 40 anesthetized
Diagnosis of pseudocholinesterase deficiency

- Clinical setting
- Nerve stimulator
Nerve stimulator
### Normal Responses (No drugs present)

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<tr>
<th></th>
<th>Nondepolarizing Block</th>
<th>Depolarizing Block (Succinylcholine)</th>
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<tbody>
<tr>
<td></td>
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<td>Phase I</td>
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<td>Phase II</td>
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\[ \frac{4}{1} = \text{TOF ratio} \]

- **Fade**
- **Constant but diminished**
- **Fade**

**Common TOF Guidelines:**
- **TOF 0.15-0.25:** indicates adequate surgical relaxation
- **TOF >0.9:** needed for safe extubation & recovery after surgery
Diagnosis

- **a) Pseudocholinesterase level**
  - Not accurate after succinylcholine
  - Decreased in organo-phosphate poisoning
- **b) Dibucaine number (Salt Lake City – batches – 10 days)**
  - Dibucaine inhibits Pseudocholinesterase activity
  - 80% inhibition = normal genes
  - 40–60% heterozygous
  - 20% inhibition homozygous
  - Varying penetrance

(Also fluoride inhibition 60%=normal / 36%= defic)
**Treatment**

**Acute event**
- Supportive
  - Ventilate
  - Anesthetize
  - Consider FFP
  - Usually reverse by 8 hrs

**Preoperative**
- Alert anesthesia staff (OR booking)
- Avoid specific drugs
- Reassure patient
- Dibucaine number
Drugs to avoid

- Succinylcholine
- Mivacurium
- Ester local anesthetics
  - procaine
  - cocaine
Arthroscopy

- Supine
- Low risk procedure
- Tourniquet
- Hip movement
- DVT risk
Open procedures

- Supine
- Tourniquet
- Hip movement
- Intermediate risk procedures
- DVT risk
Anesthesia:

1. General
   earlier discharge
2. Spinal
   ?better in OSA
3. Intra-articular
   sedation for:
      • hip movement
      • tourniquet pain
   operator dependent

(Segreto in ASC only one using intra-articular anesthesia with sedation)
Post op analgesia

- Femoral nerve block/catheter for analgesia if big repair/graft
- Ice packs – patients to fill prescription to bring their own
## Take home points

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<thead>
<tr>
<th>Pseudo–cholinesterase deficiency</th>
<th>Knee surgery</th>
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<tr>
<td>Test patient, carry on with surgery</td>
<td>GA</td>
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<tr>
<td>Notify OR booking</td>
<td>Book early for spinal</td>
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<tr>
<td>Avoid succinylcholine, mivacurium</td>
<td>Bring icepack</td>
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<td>Alert patient and PCP with result</td>
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