



# Pre-Operative Services Teaching Rounds 13 April 2011

Deborah Richman MBChB FFA(SA)  
Director – Pre-Operative Services  
Department of Anesthesia  
Stony Brook University Medical Center, NY  
[drichman@notes.cc.sunysb.edu](mailto:drichman@notes.cc.sunysb.edu)

## 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’

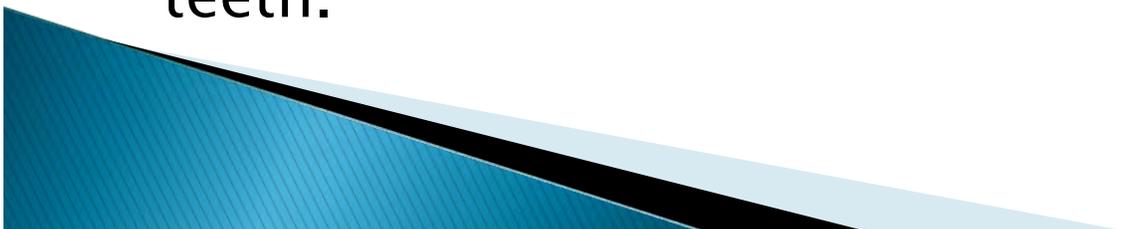
Meds:

Omeprazole, Atenolol, thiazide

Exam:

BMI 37, BP 140/90 P 65. No cardiac failure. Non-remarkable.

Airway: MP 3, FROM, ‘thick neck’, no dental work/loose teeth.



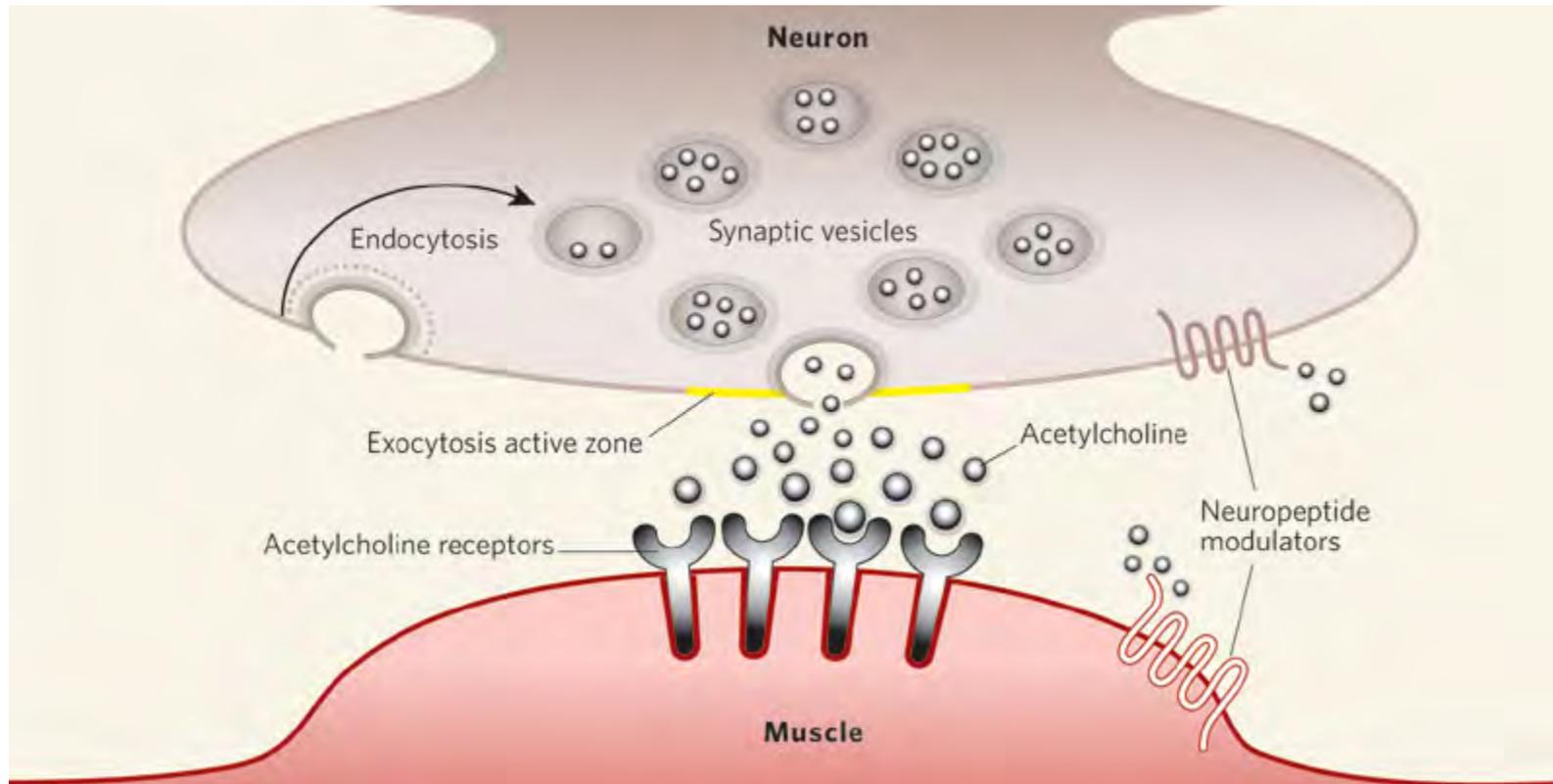
# Case discussion

Differential diagnosis:

- ▶ OSA
- ▶ Heavy handed anesthesiologist
- ▶ “Naïve liver”
- ▶ Pseudocholinesterase deficiency



# Physiology of the neuromuscular junction

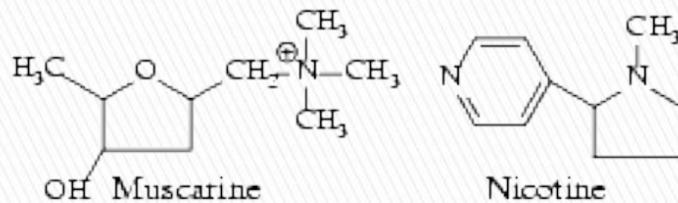
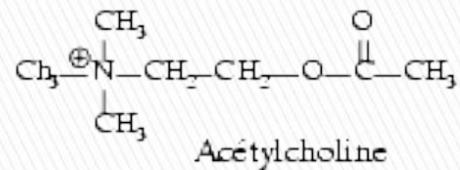


Cholinergic receptors  
Nicotinic type

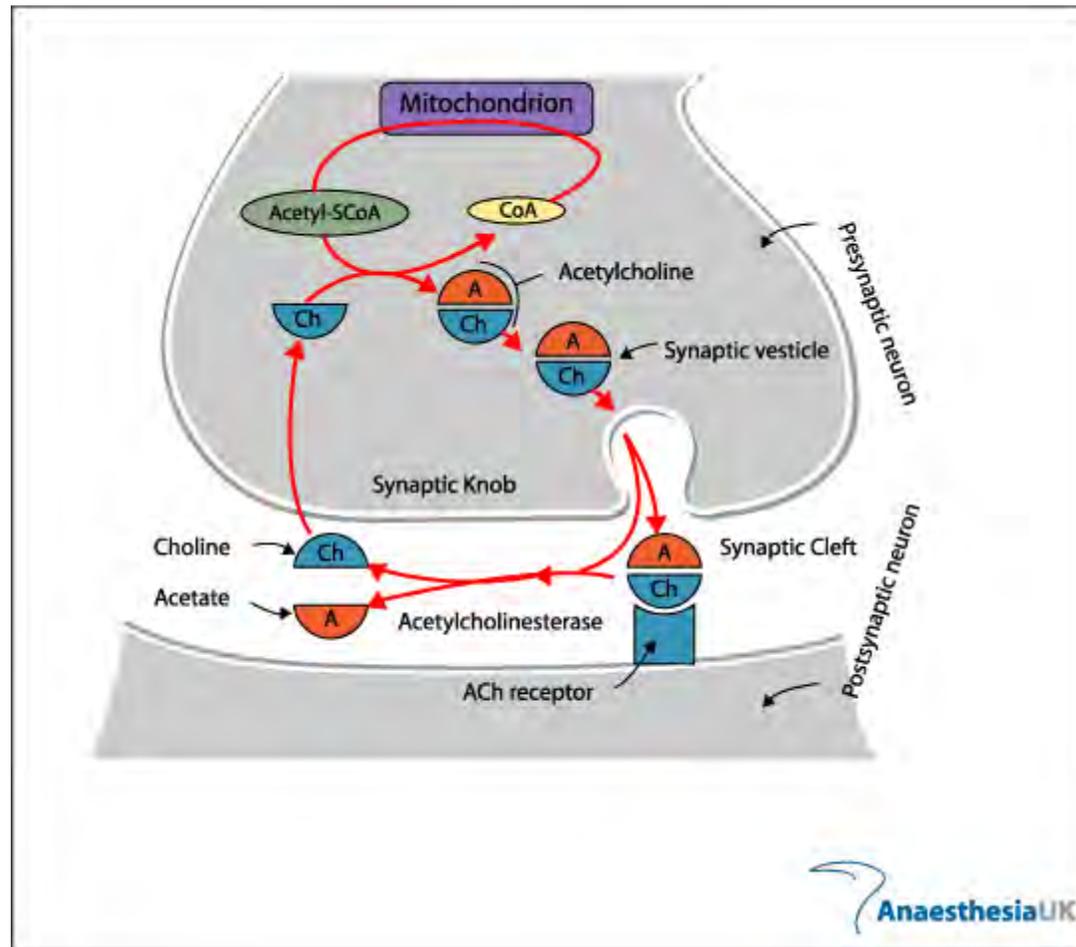


# Neurotransmitter

## Acetylcholine



# Neuromuscular transmission



Acetylcholine is catalysed by hydrolysis to choline and acetic acid by acetylcholinesterase in neural synapse

# Muscle relaxants

## Mimic acetylcholine

### ▶ Act by binding Ach receptors

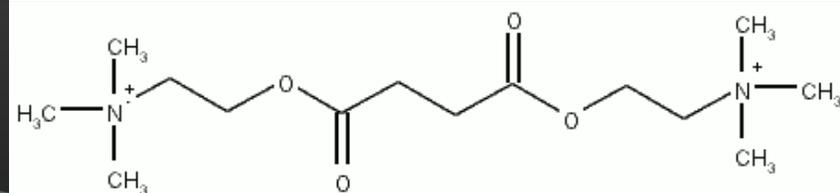
#### ○ Depolarising

- 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
    - Ophthal/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)

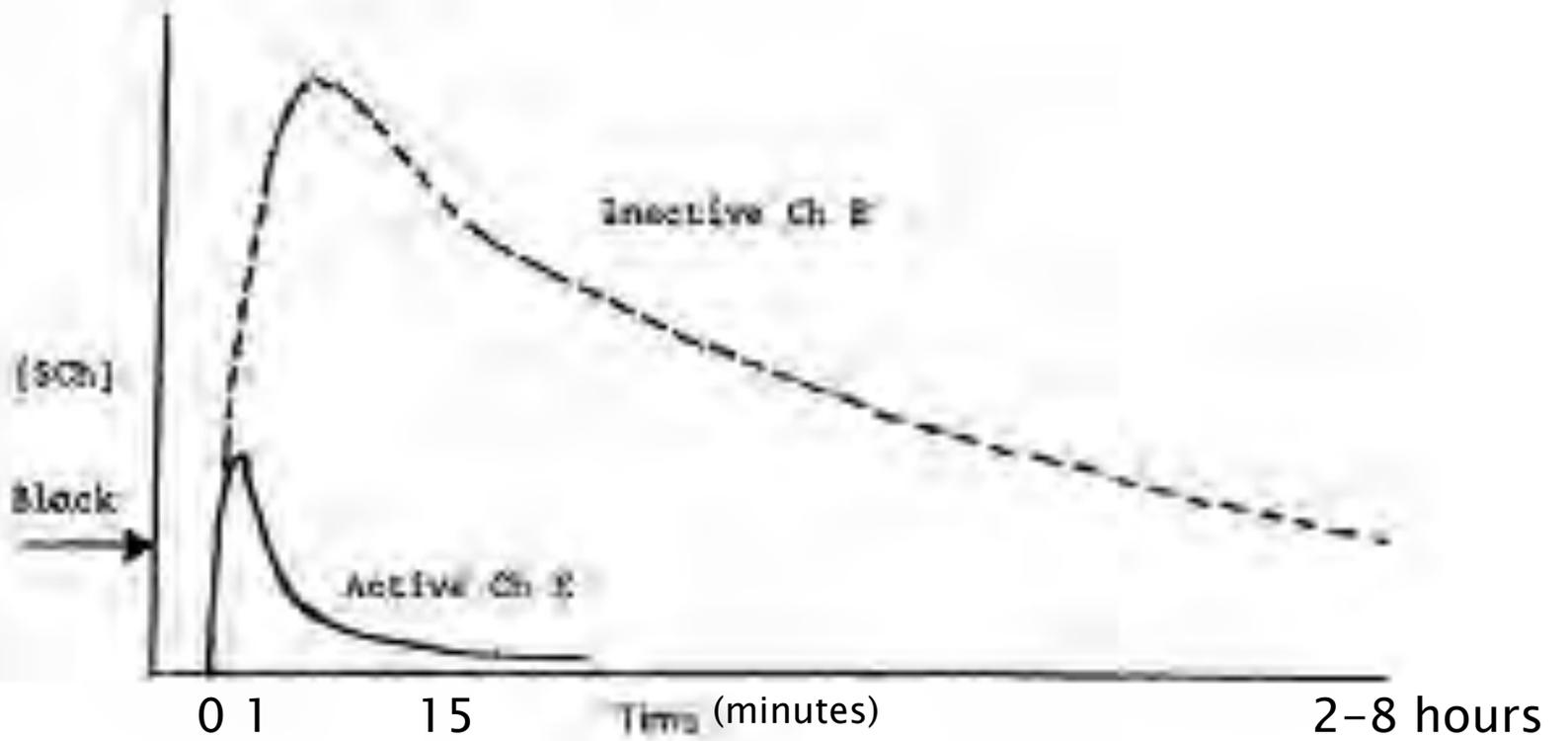
- found in neuro-musc junction
- acetylcholine metabolism and nerve function



# 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 pseudocholinesterase enzyme

- located on E1 locus on the long arm of chromosome 3
- 96% of the population is homozygous for the normal pseudocholinesterase genotype – EuEu.
- Remaining 4% of the population carries one or more of the atypical gene alleles for the pseudocholinesterase 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'



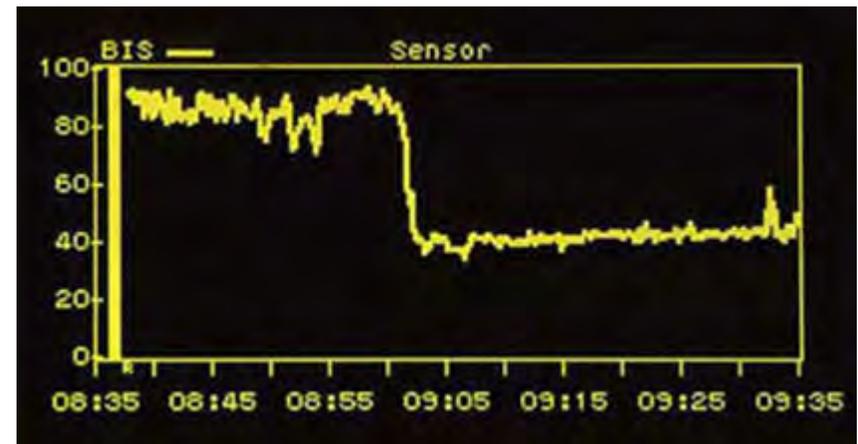
# Awareness

- ▶ 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

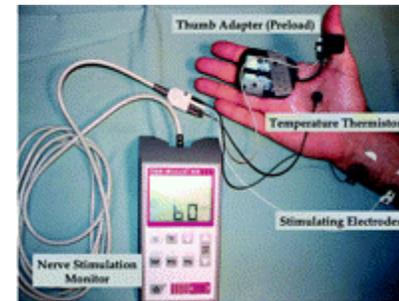


# Diagnosis of pseudocholinesterase deficiency

- ▶ Clinical setting
- ▶ Nerve stimulator



# Nerve stimulator



Normal Responses  
(No drugs present)



Train of four  
at (2 HZ)

Nondepolarizing Block



$\frac{4}{1} = \text{TOF ratio}$

Fade

Depolarizing Block  
(Succinylcholine)

Phase I

Phase II



Constant but  
diminished



TOF < 0.3

Fade

Common TOF Guidelines:

TOF 0.15-0.25: indicates adequate surgical relaxation

TOF > 0.9: needed for safe extubation & recovery after surgery

# Diagnosis

*Fig 1: Acholest test paper*

Reaction Time	Pseudochoolinesterase Enzyme Activity
<5 min	Above normal
5–20 min	Normal
20–30 min	Borderline low
>30 min	Below normal

- ▶ a)Pseudochoolinesterase level
  - Not accurate after succinylcholine
  - Decreased in organo-phosphate poisoning
- ▶ b)Dibucaine number (Salt Lake City – batches – 10 days)
  - Dibucaine inhibits Pseudochoolinesterase 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

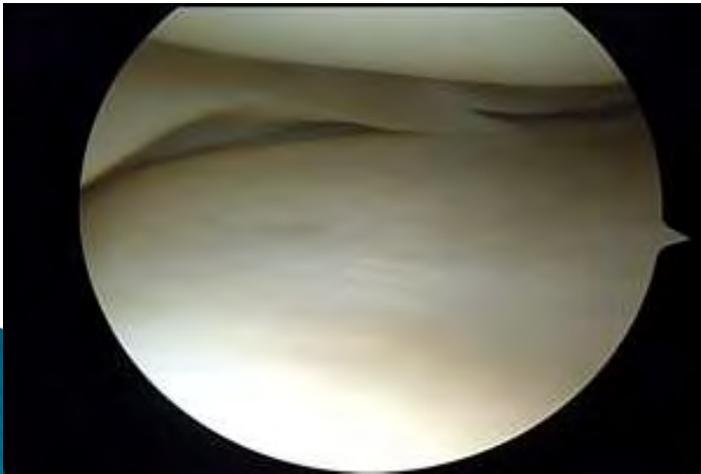
# Drugs to avoid

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



# Arthroscopy

- ▶ Supine
- ▶ Low risk procedure
- ▶ Tourniquet
- ▶ Hip movement
- ▶ DVT risk



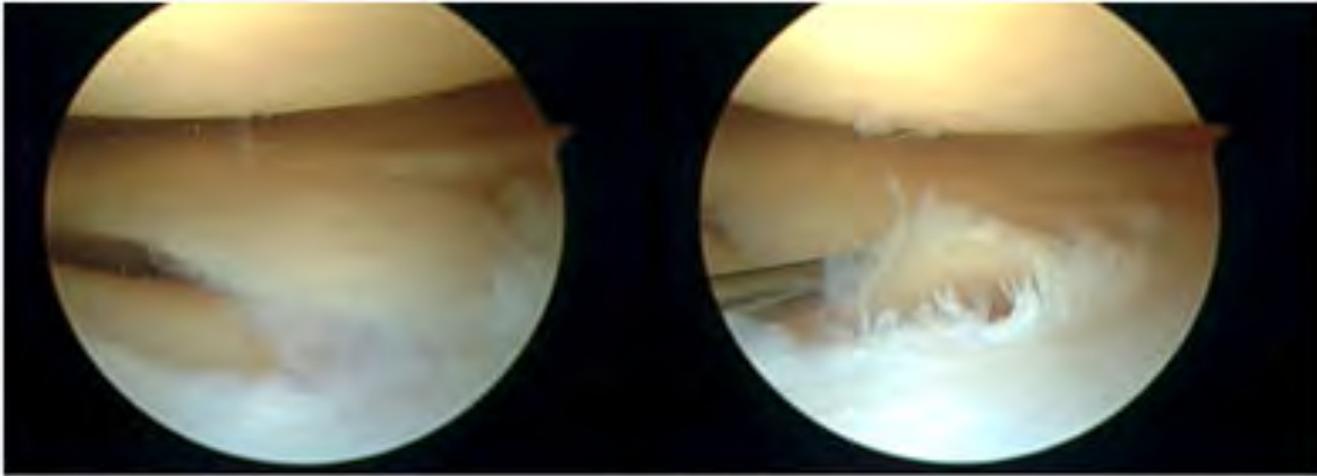


Figure 3A.

Figure 3B.

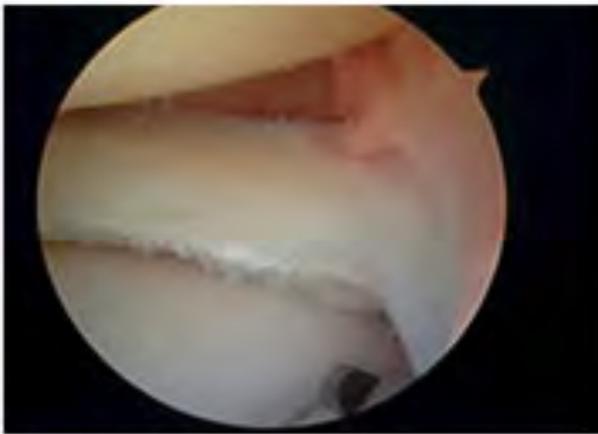


Figure 3C.



Anterior cruciate ligament  
[Creative Commons](#)– wikimediacommons

# 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

## Pseudo- cholinesterase deficiency

- ▶ Test patient, carry on with surgery
- ▶ Notify OR booking
- ▶ Avoid succinylcholine, mivacurium
- ▶ Alert patient and PCP with result

## Knee surgery

- ▶ GA
- ▶ Book early for spinal
- ▶ Bring icepack