



# The anaesthetist's perspective: what monitoring is needed for what clinical problem?

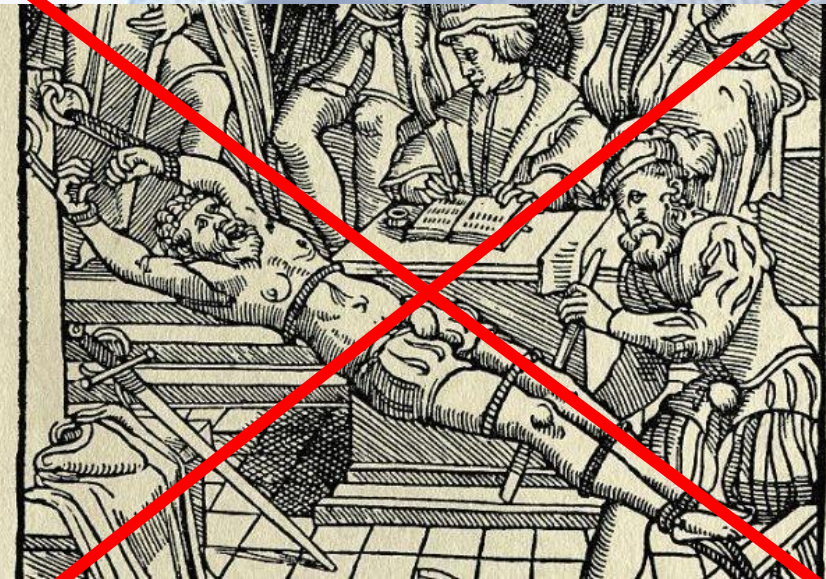
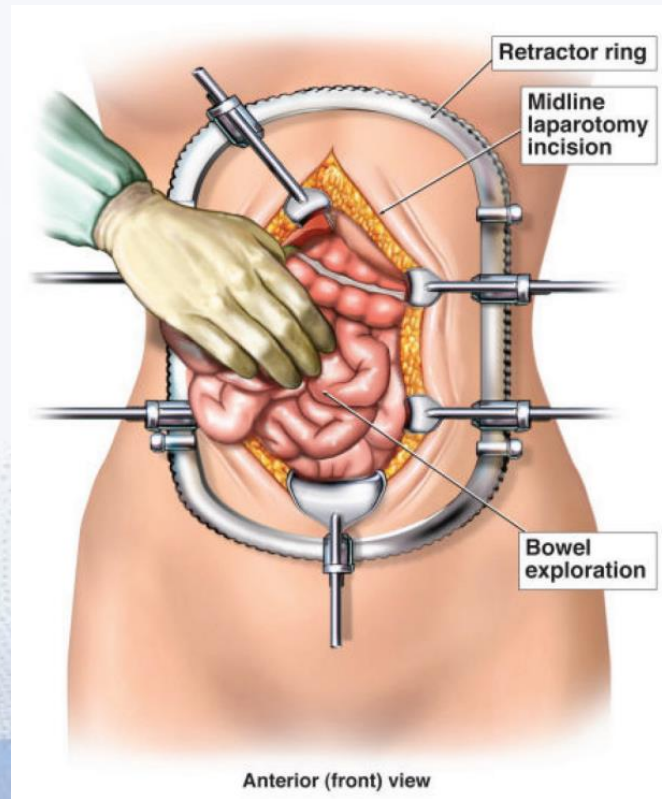
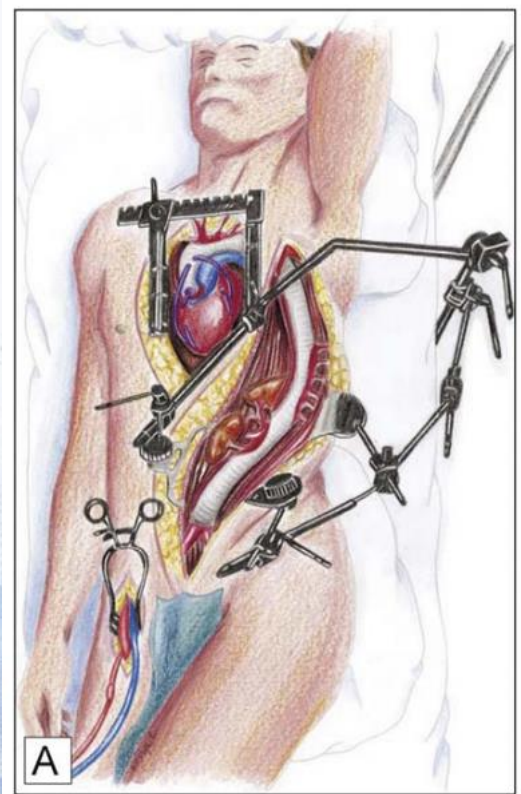
Dr Grégoire Cane

Neuro – anesthésie – réanimation  
hôpital Pellegrin, Bordeaux, France

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# Anesthesia ...





- What is anesthesia ?

## Immobility

Surgical act

Loss of tone

Neuromuscular junction

Curares

## Analgesia

No psychological trauma

Reduce hemodynamic effects

Autonomous nervous system

Morphinics

## Lost of consciousness / Amnesia

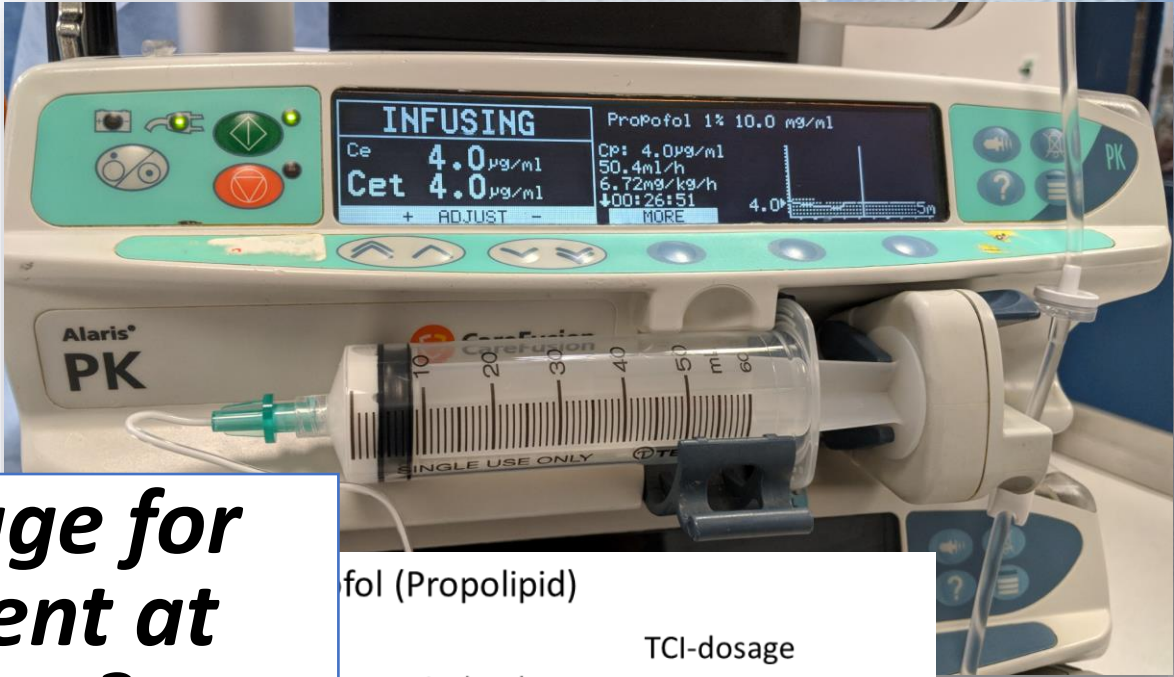
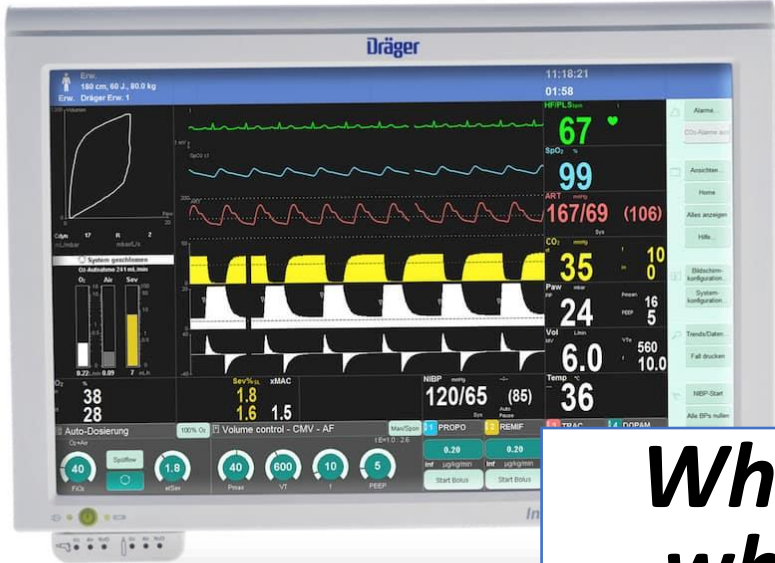
No psychological trauma

Better experience of surgery

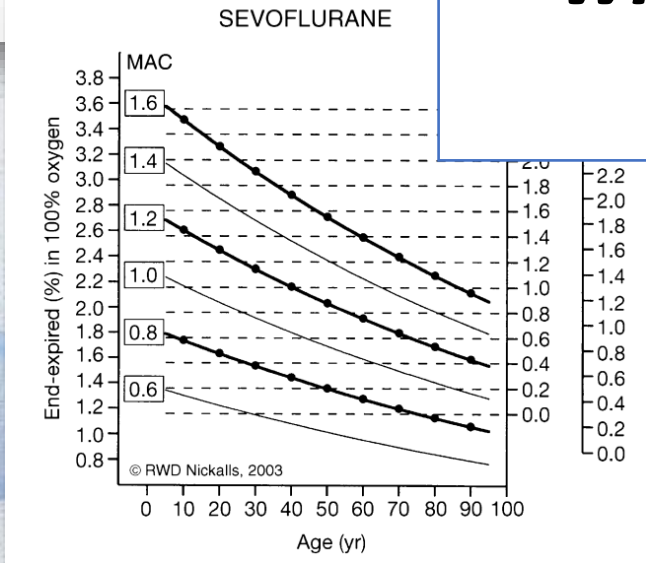
Central nervous system

Hypnotics





*Which dosage for which patient at which time?*



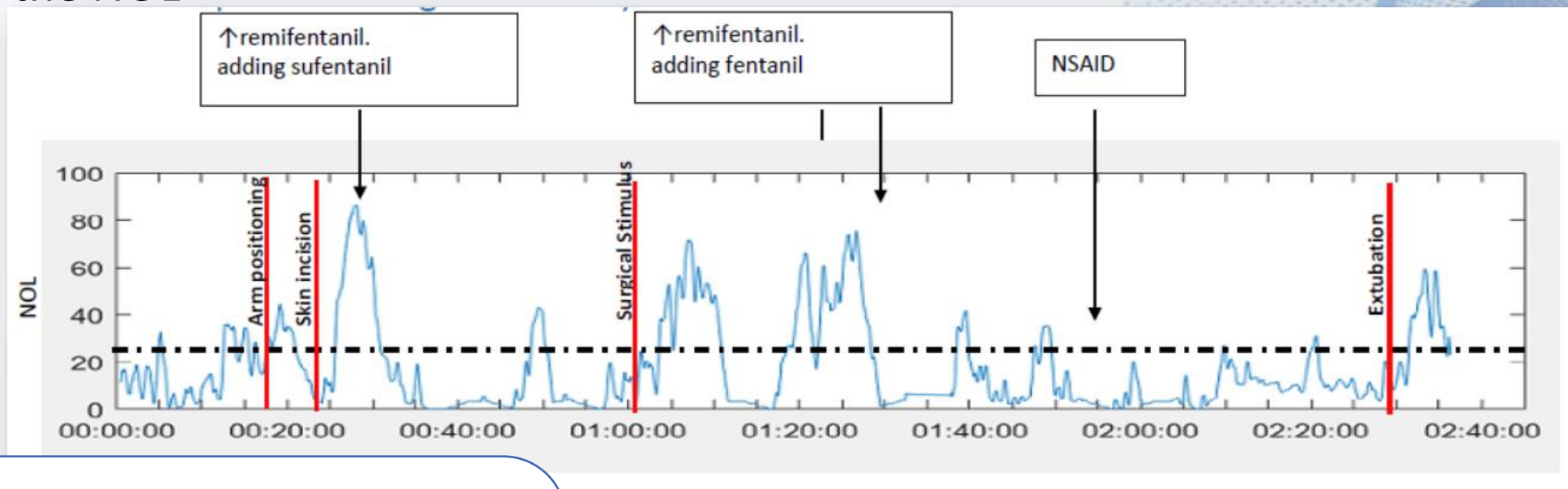
fol (Propolipid)

anesthesia depth	TCI-dosage µg/ml
Sedation	1.5
Light pain	2.0
Laryngeal mask	3.0
Moderate pain	3.5
Surgical anesthesia	4.0
Intubation	5.0
Strong pain	6.0
Deep anesthesia	6.0

Target Concentration (Cpt)



- The challenge: the right product at the right time. Example of shoulder surgery and of the NOL<sup>®</sup>



Overdosing

Hemodynamic instability  
Delayed recovery  
**Post-operative delirium**

Post-operative pain  
Breathing difficulties  
**Awareness with recall**

Underdosing

=

**Monitoring**

?

# What are we trying to assess?

- Immobility / Muscle paralysis

- TOF



- Nociception / Pain

- ANI
- NOL



- Hypnosis / Consciousness

- BIS
- Entropy

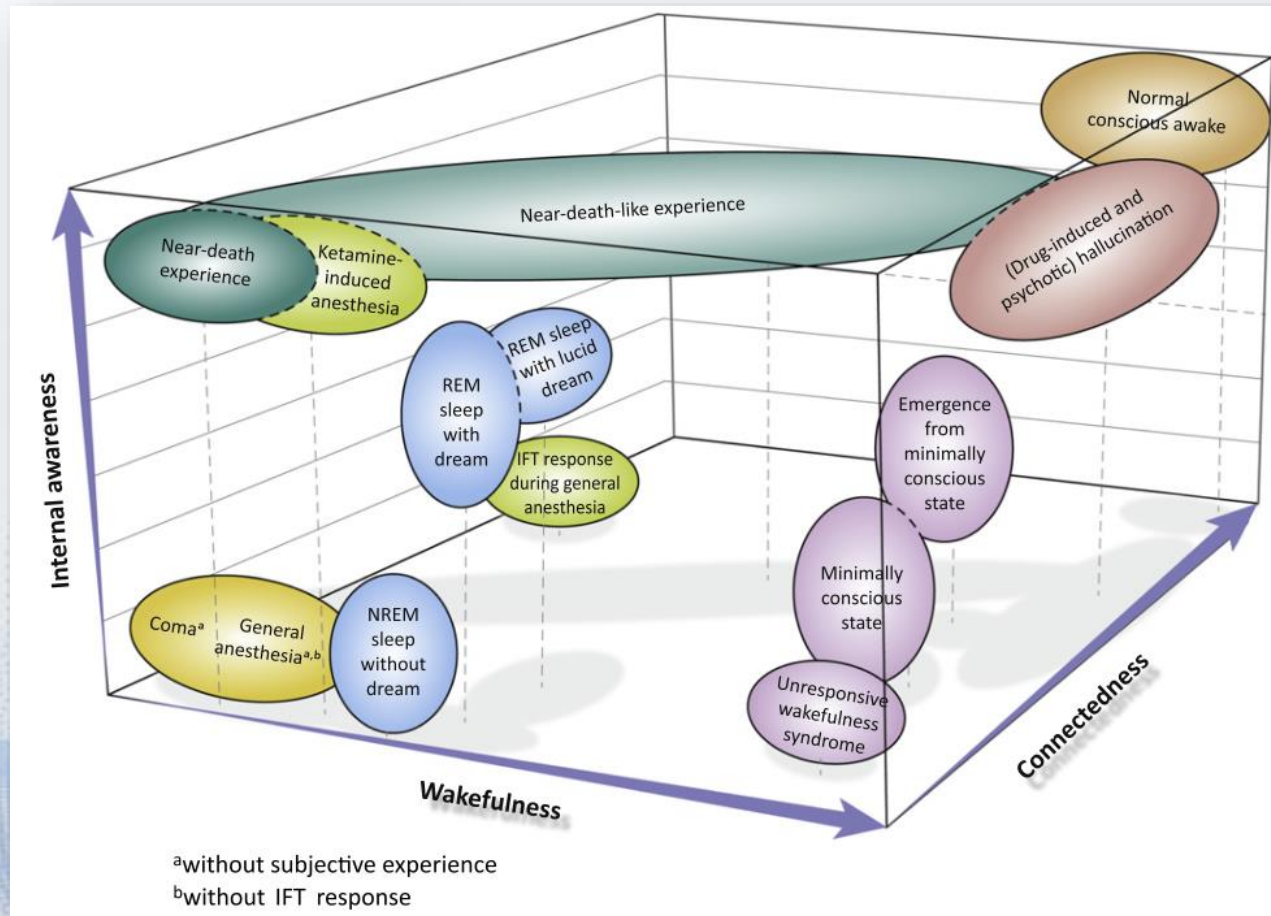


- **Ideal monitor = clinical impact**

- Therapeutic anticipation
- Under- and overdosing measurement
- Adapted to the operating room environment (interference, robust, easy to install)



# • How to define consciousness?



## • Clinically:

- Eyes opening  $\approx$  Wakefulness
- Response to simple commands  $\approx$  Connectedness
- Patient memory  $\approx$  Internal awareness

## • **Anesthesia ?? Coma in brain injured patients ???**

- How can we assess these different states during anesthesia?

- Wakefulness :

- Ciliary reflex
- Spontaneous breathing

- Connectedness :

- Responses to simple commands

- Internal Awareness :

- Memorization of the patient

1. What is the last thing you remember before going to sleep?
2. What is the first thing you remember waking up?
3. Do you remember anything between going to sleep and waking up?
4. Did you dream during your procedure?
5. What was the worst thing about your operation?

## Brice Interview

## Isolated Forearm Test

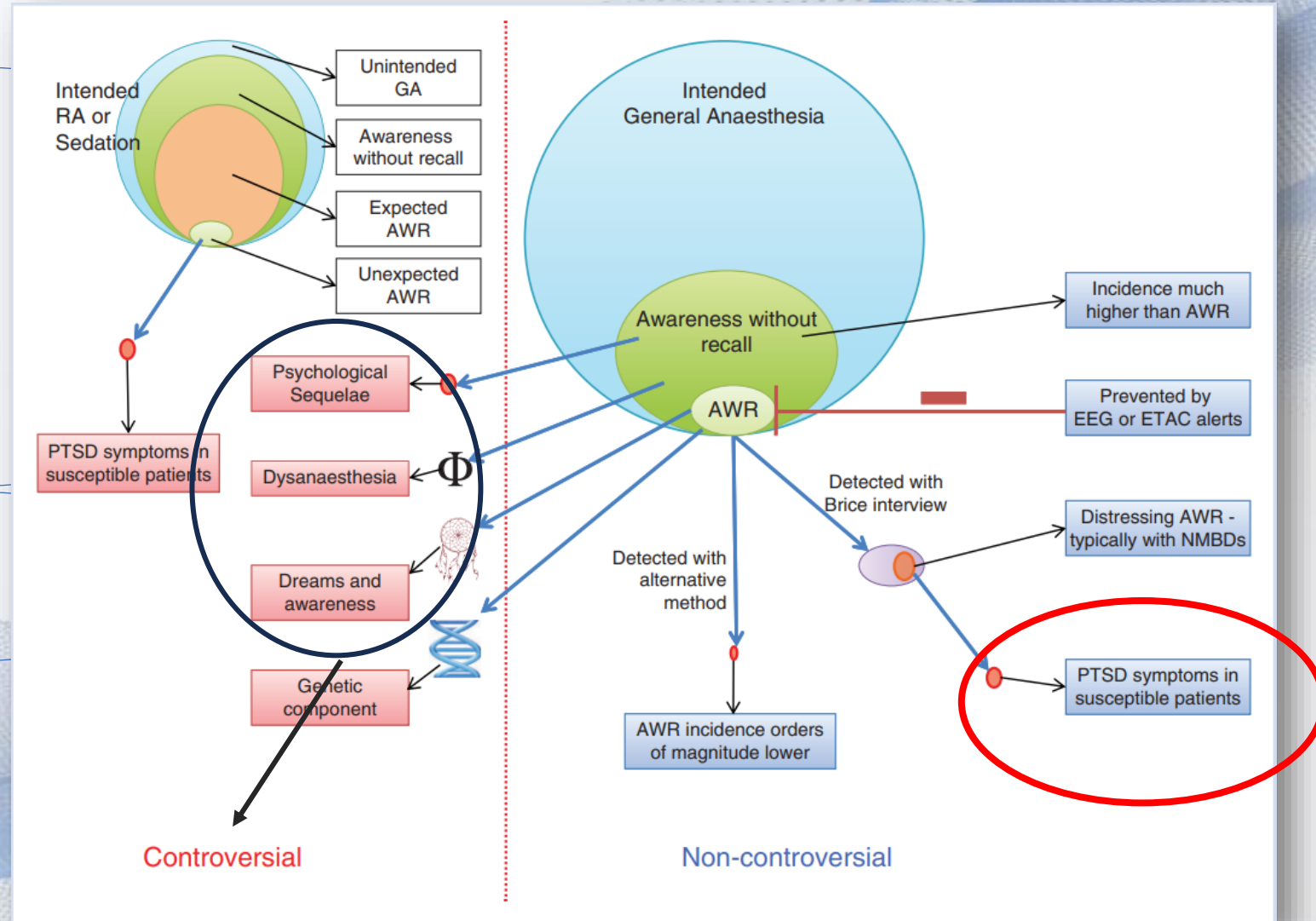




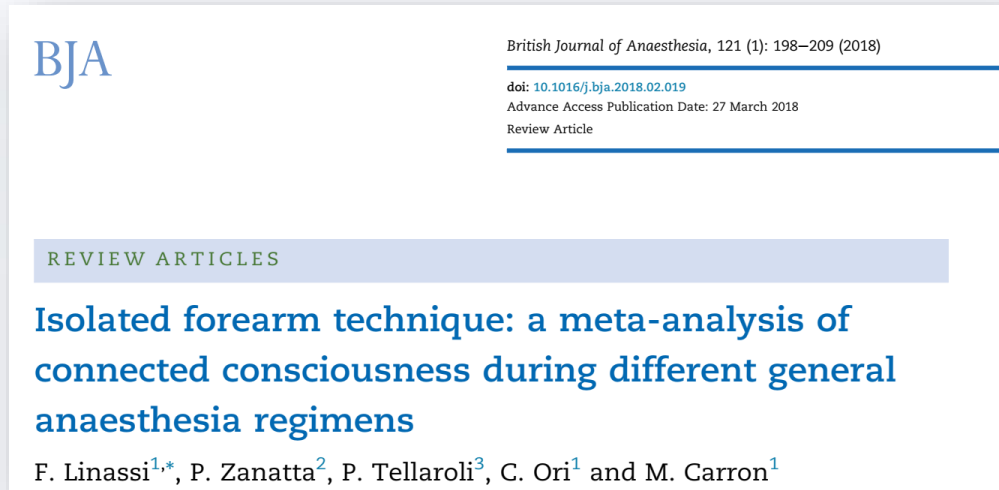
# Altered states of consciousness during anesthesia

## Dreams

- Internal awareness
  - No response to IFT
  - Awareness without recall
  - Response to IFT
  - Negative Brice interview
- 
- Awareness with recall
  - Positive Brice interview

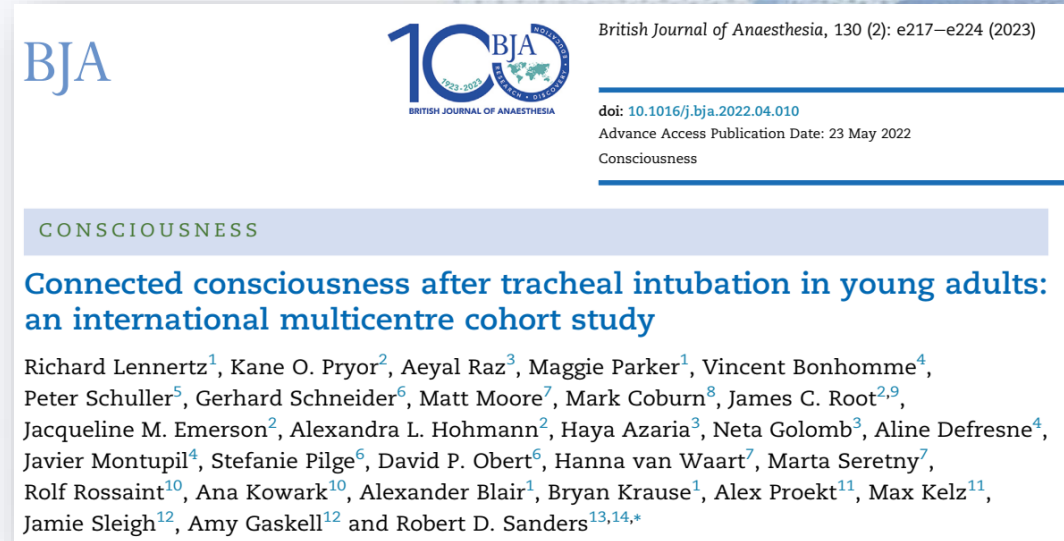
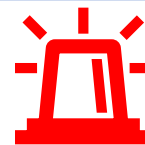


# • How common is this ??



- 1131 General Anesthesia
  - 35 % Awareness without recall

- Awareness without recall  $\approx 10 \%$
- Awareness with recall  $\approx 0.1 \%$



- 338 General Anesthesia
  - 14 % Dreams
  - 11 % Awareness without recall
  - 0,3 % Awareness with recall (1,5 % possible)
  - No implicit memory



- Posttraumatic stress disorders (PTSD)

ARTICLES

**Bispectral index monitoring to prevent awareness during anaesthesia: the B-Aware randomised controlled trial**

13 awareness with recall confirmed

5 years of follow – up

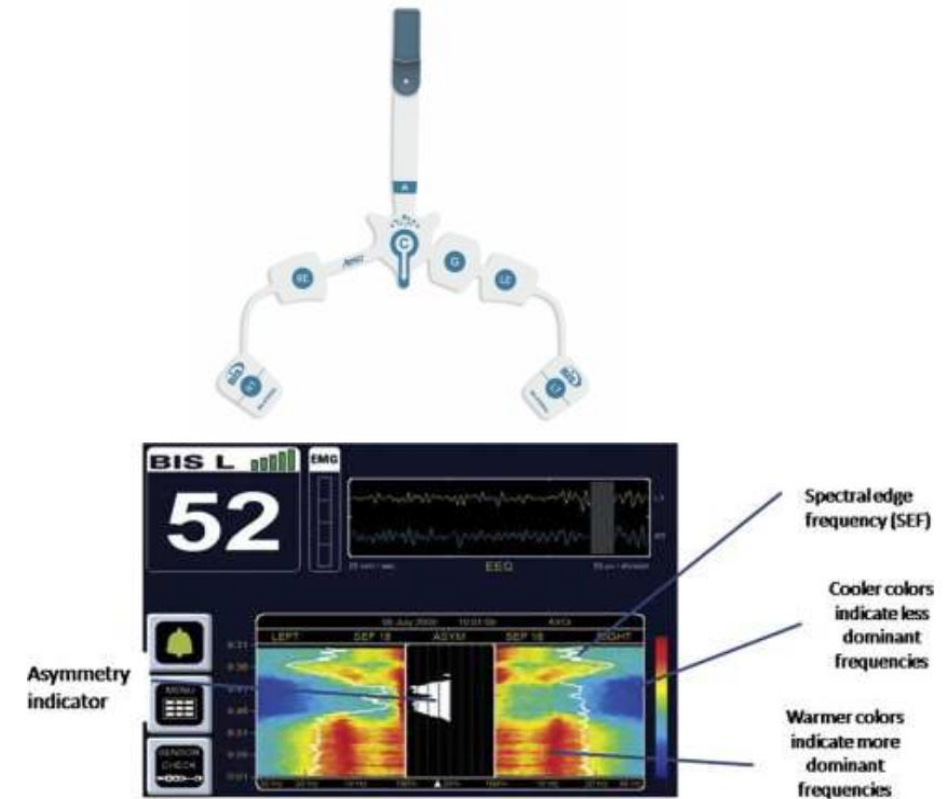
6 dead

5 on 7 with PTSD (71% vs 12% in control group)

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- **Bispectral index = processed EEG**

- Adimensional number between 0 and 100
- 60 – 80 : light sedation
- 40 – 60 : suitable for surgery







Cochrane Database of Systematic Reviews

## Bispectral index for improving intraoperative awareness and early postoperative recovery in adults (Review)

Lewis SR, Pritchard MW, Fawcett LJ, Punjasawadwong Y

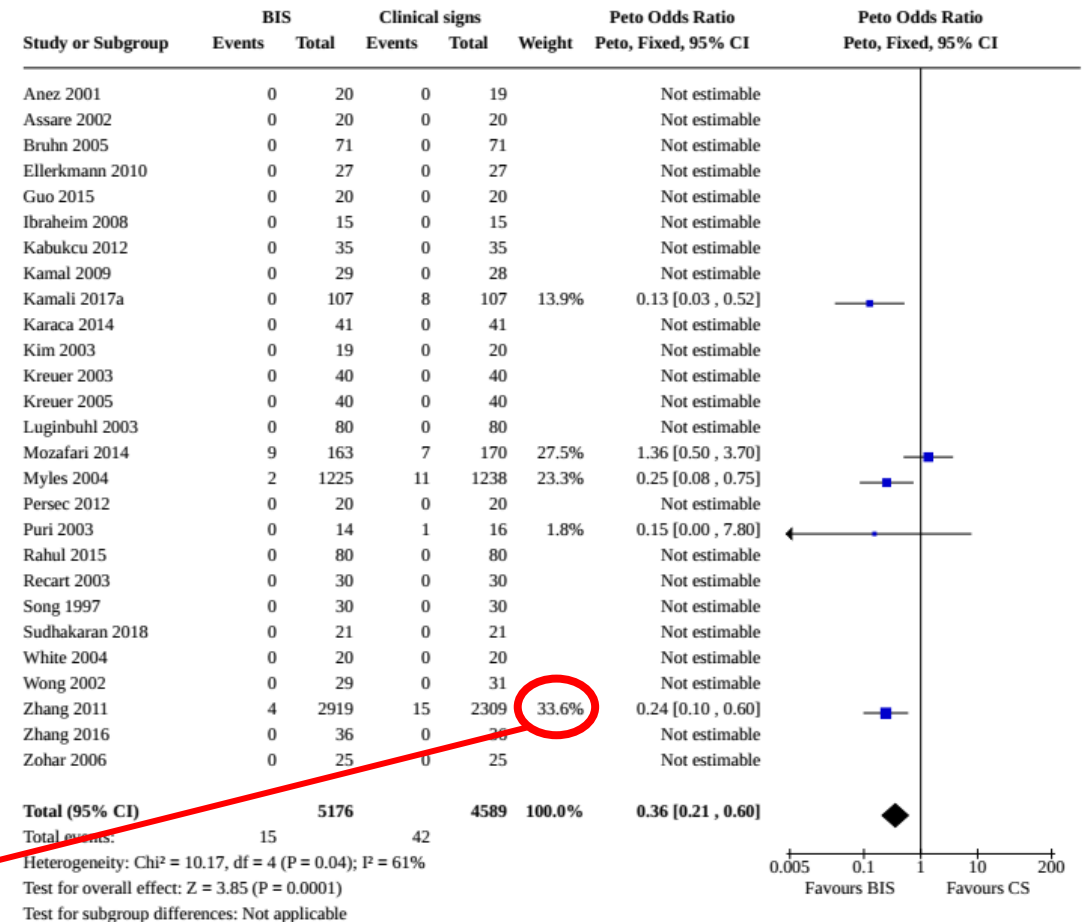
- Odds ratio lower ...
- ... But thanks to a low – quality study

Random sequence generation (selection bias)  
Allocation concealment (selection bias)  
Blinding of participants and personnel (performance bias): All outcomes  
Blinding of outcome assessment (detection bias): All outcomes  
Incomplete outcome data (attrition bias): All outcomes  
Selective reporting (reporting bias)  
Other bias

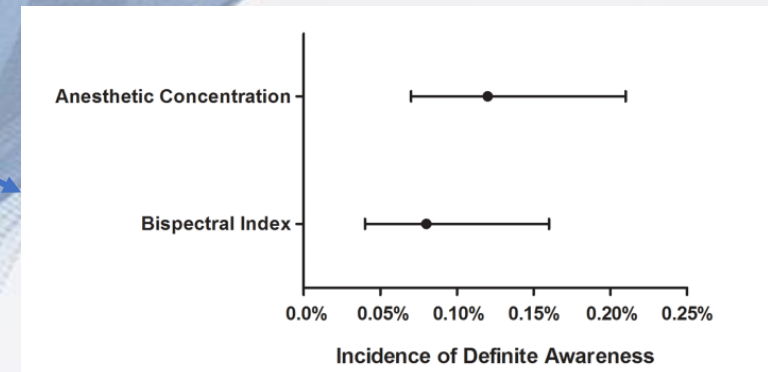
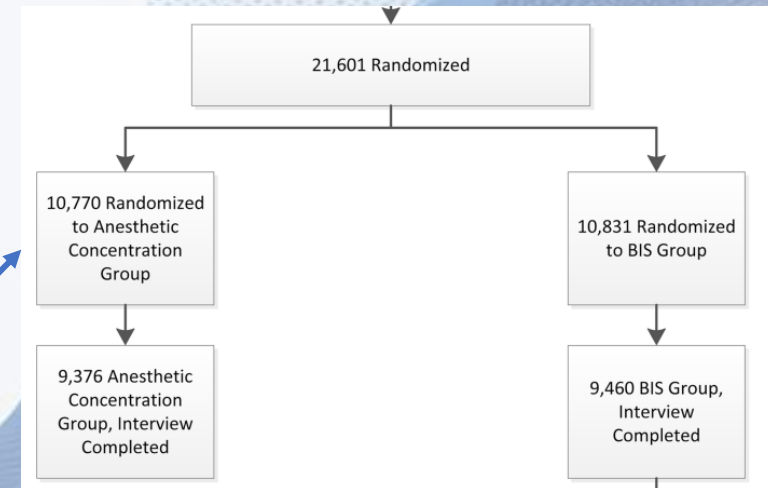
Zhang 2011



### Analysis 1.1. Comparison 1: BIS versus clinical signs, Outcome 1: Occurrence of intraoperative awareness

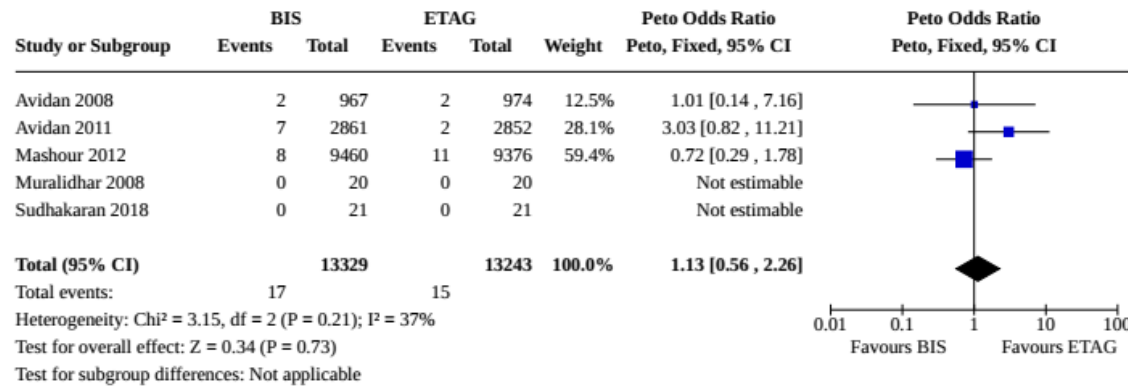


- No differences with well conducted anesthesia and MAC monitoring !



- 20 000 patients, no differences

### Analysis 3.1. Comparison 3: BIS versus ETAG, Outcome 1: Occurrence of intraoperative awareness



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*Anesthesiology*. 2012 October ; 117(4): 717–725. doi:10.1097/ALN.0b013e31826904a6.

## Prevention of Intraoperative Awareness with Explicit Recall in an Unselected Surgical Population: A Randomized Comparative Effectiveness Trial

George A. Mashour, M.D., Ph.D.<sup>†,\*</sup>, Amy Shanks, M.S.<sup>‡,\*</sup>, Kevin K. Tremper, Ph.D., M.D.<sup>§</sup>, Sachin Kheterpal, M.D., M.B.A.<sup>||</sup>, Christopher R. Turner, M.D., Ph.D., M.B.A.<sup>¥</sup>, Satya Krishna Ramachandran, M.D., F.R.C.A.<sup>||</sup>, Paul Picton, M.D., F.R.C.A.<sup>||</sup>, Christa Schueller, B.S.<sup>Δ</sup>, Michelle Morris, M.S.<sup>♦</sup>, John C. Vandervest, B.S.<sup>††</sup>, Nan Lin, Ph.D.<sup>‡‡</sup>, and Michael S. Avidan, M.B.B.Ch.<sup>§§</sup>



ARTICLE

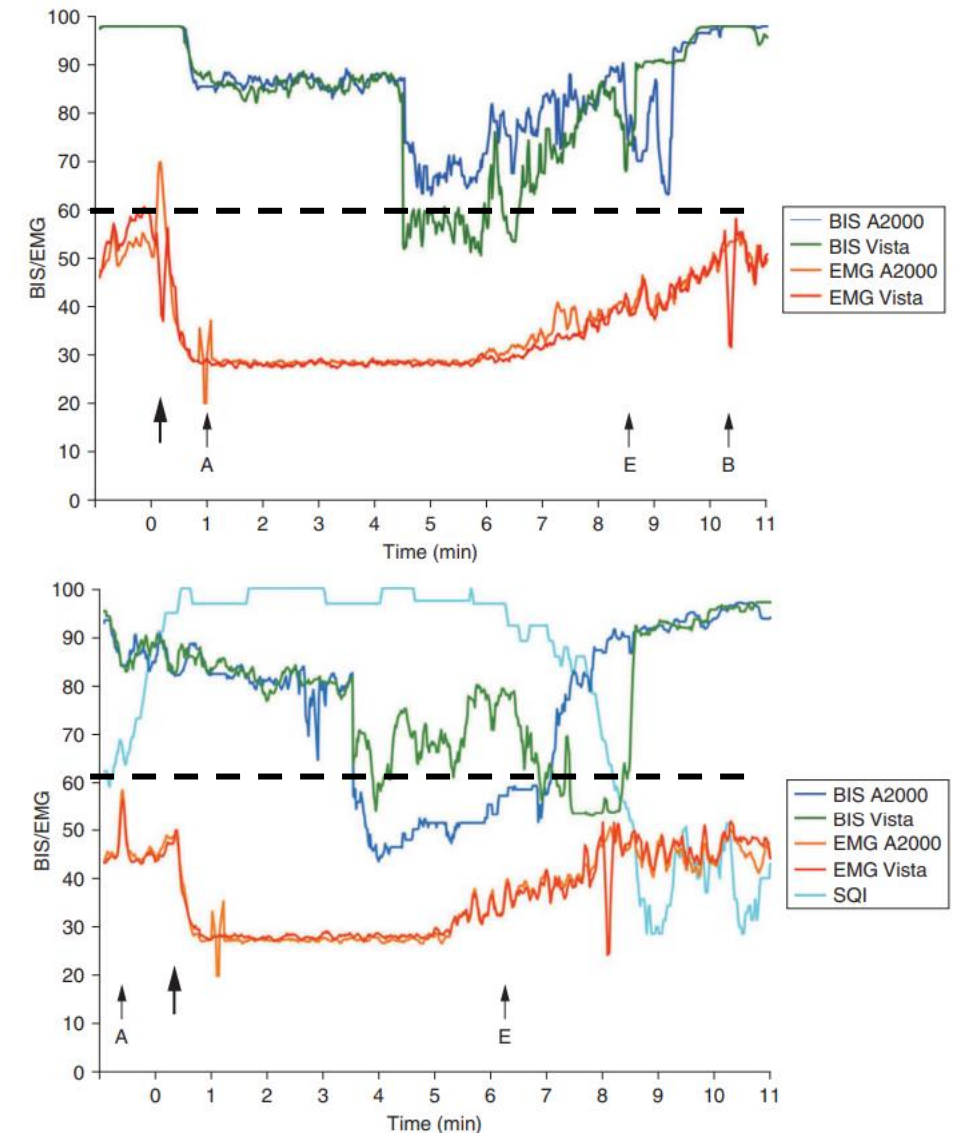
# Response of bispectral index to neuromuscular block in awake volunteers†

P. J. Schuller\*, S. Newell, P. A. Strickland, and J. J. Barry

Department of Anaesthesia & Intensive Care, Cairns Hospital, PO Box 902, Cairns QLD 4870, Australia

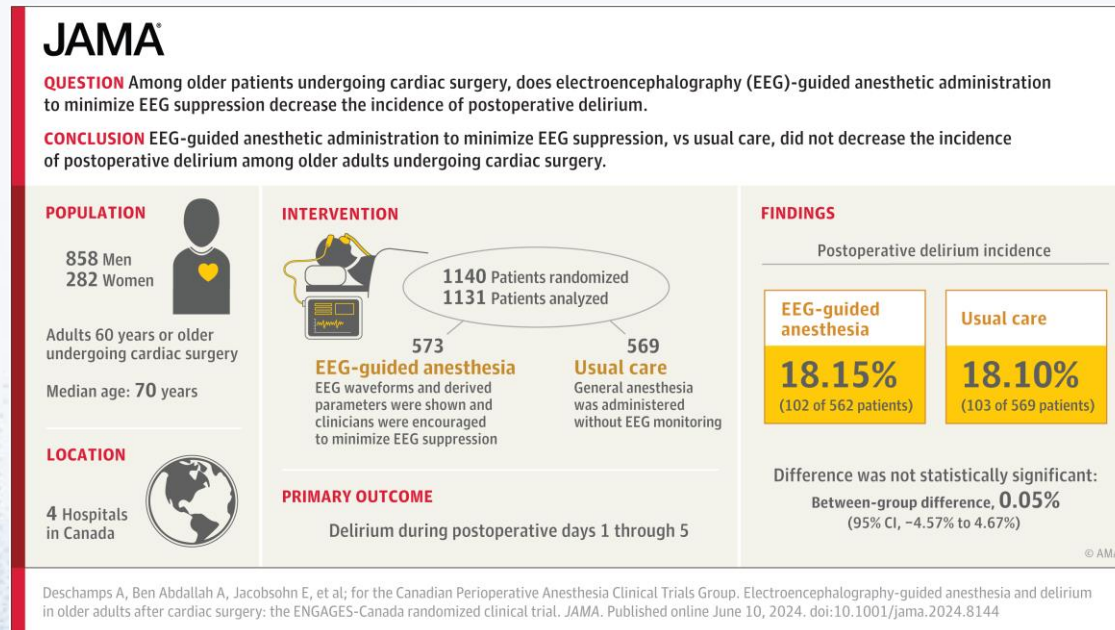


- Raw EEG with rapid frequencies = awake patient
- However, low BIS values with disparition of EMG



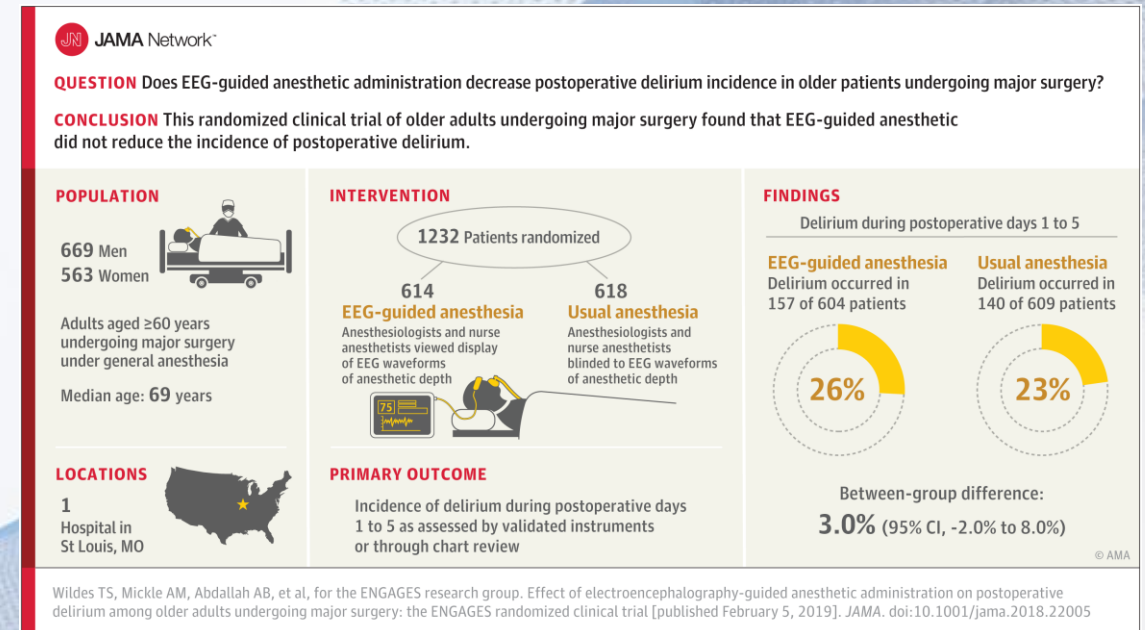
# • What about surdosage and delirium ?

## Cardiac surgery ...



... NS

## Older patients ...



... NS



## GUIDELINES

# Update of the European Society of Anaesthesiology and Intensive Care Medicine evidence-based and consensus-based guideline on postoperative delirium in adult patients

## Recommendation 5.1

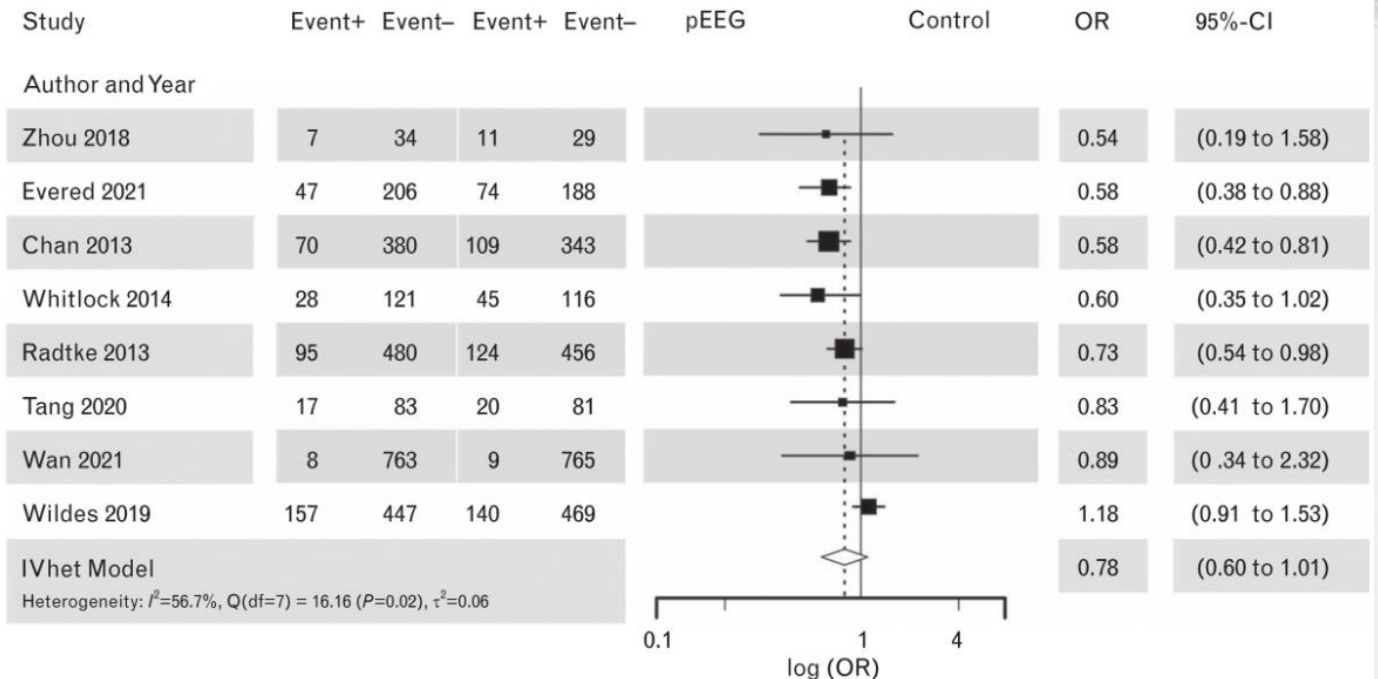
### Quality of the evidence

### Strength of recommendation

We suggest Index-based EEG monitoring depth of anaesthesia guidance to decrease the risk of POD.

Low  
 Chan *et al.*, 2013<sup>129</sup>  
 Radtke *et al.*, 2013<sup>130</sup>  
 Whitlock *et al.*, 2014<sup>131</sup>  
 Zhou *et al.*, 2018<sup>132</sup>  
 Wildes *et al.*, 2019<sup>133</sup>  
 Tang *et al.*, 2020<sup>134</sup>  
 Evered *et al.*, 2021<sup>22</sup>  
 Wang *et al.*, 2022<sup>135</sup>

Weak



- Anaesthesia = continuous adaptation between noxious stimuli and drug infusion
- Awareness with recall is a rare but severe complication
- Awareness without recall is frequent but of dubious clinical interest
- ***Most commonly used monitor, BIS, has not been proven effective through evidence based medicine protocols for overdosing and underdosing***



■ **Ideal monitor of consciousness  
(nociception ?)**

- Therapeutic anticipation
- Under- and overdosing measurement
- Adapted to the operating room environment (interference, robust, easy to install)

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