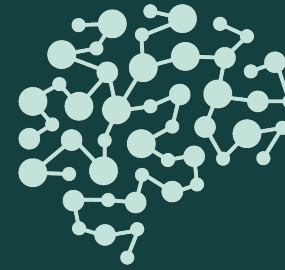


European Society of
Anaesthesiology and
Intensive Care



Safe Brain Initiative

*An European Society of Anaesthesiology
and Intensive Care Research Group*

-A network-based approach to precision anaesthesia-

*EEG and processed EEG,
utility and methods to improve perioperative care*

introducing the ESAIC SBI RG Topic II:

-The EEG Bootcamp for Anaesthesia international consortium-

Why do we need EEG perioperatively?

Decrease awareness risk

Decrease POD/PND risk

monitor changes in human brain electrical activity
during changing states of consciousness

detection of cerebral insults

Avoid oversedation

depth of anaesthesia monitoring

Decrease length of stay in PACU

Understand the brain reaction to sedatives

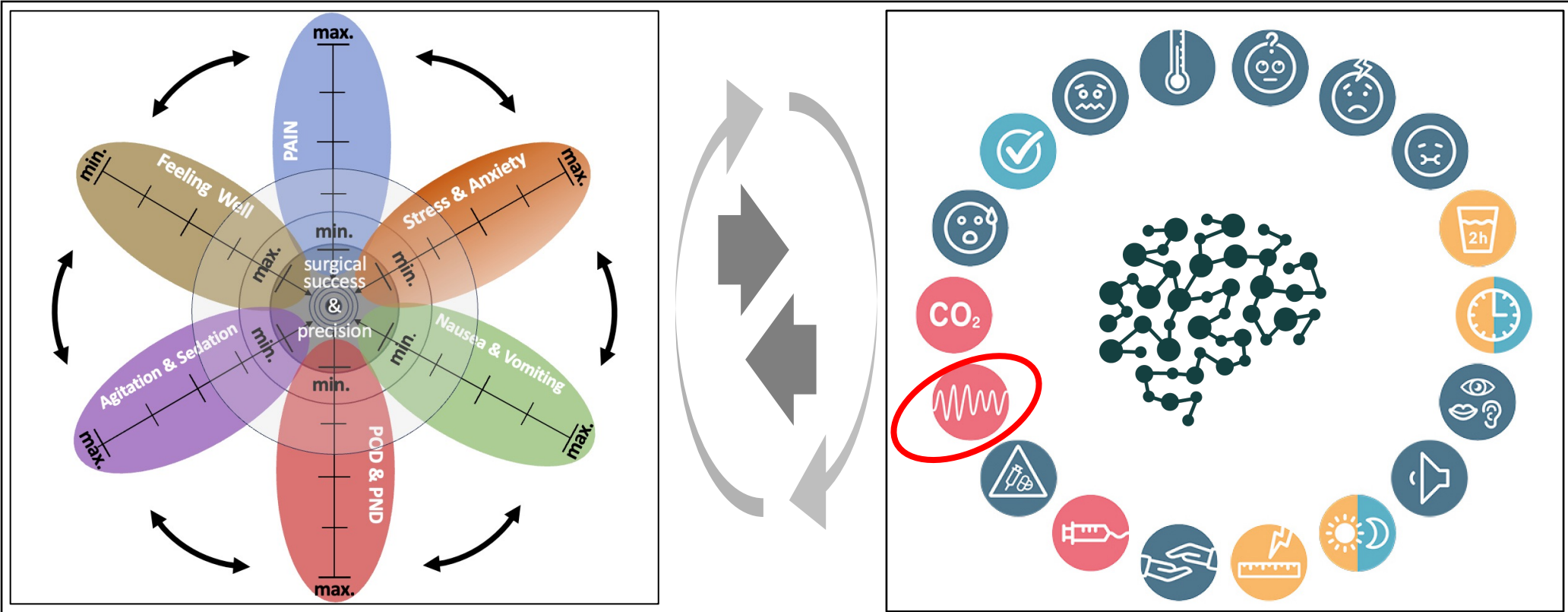
Visualize and Confirm nociceptive stimuli

Decrease length of hospital stay

...

Postoperative Outcomes & side-effects are interdependent and complex

EEG and processed EEG, utility and methods to improve perioperative care



To achieve best possible Outcomes in a constantly developing system, a multifactorial approach is essential - including monitoring and improving of undesired side-effects in a continuous cycle.



American Society of
Anesthesiologists

Info for Professionals :

Effects of Anesthesia...



American Society of
Anesthesiologists

Effects of Anesthesia

Ease your mind and feel more comfortable by understanding what side effects to expect from anesthesia and how to prep for them. Most are minor and temporary.

Side effects of general anesthesia can include:

- Nausea and vomiting
- Sore throat
- **Postoperative delirium**
- Muscle aches
- Itching
- Chills and shivering (hypothermia)

Rarely, general anesthesia can cause more serious complications, including:

- **Postoperative delirium or cognitive dysfunction**
- Malignant hyperthermia

&

Other relevant aspects:

- Pain
- Stress
- Anxiety
- Well-being

Also important?:

- Pat. satisfaction w/ anaesthesia care
- Pat. w/ ideal outcomes

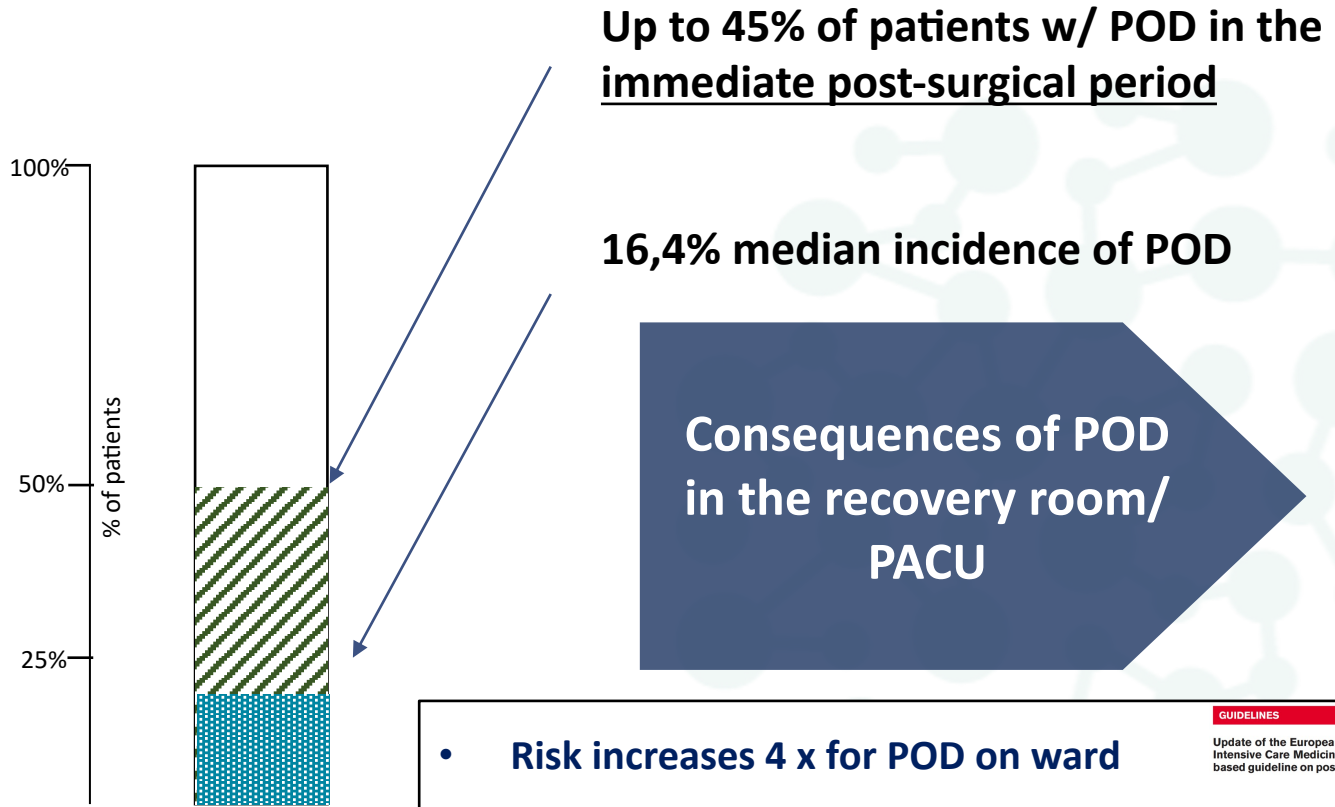
Question I: Does anaesthesia and our perioperative care affect outcomes?

How did your patients do last week, month etc.?

Postoperative Delirium - a problem solved?

EEG and processed EEG, utility and methods to improve perioperative care

I - Clinical example



- Risk increases 4 x for POD on ward
 - with impact on patients health & life perspective
 - severe consequences for the families, healthcare system and the society as a whole
- GUIDELINES
Update of the European Society of Anaesthesiology and Intensive Care Medicine evidence-based and consensus-based guideline on postoperative delirium in adult patients



EEG monitoring and Index based EEG monitoring

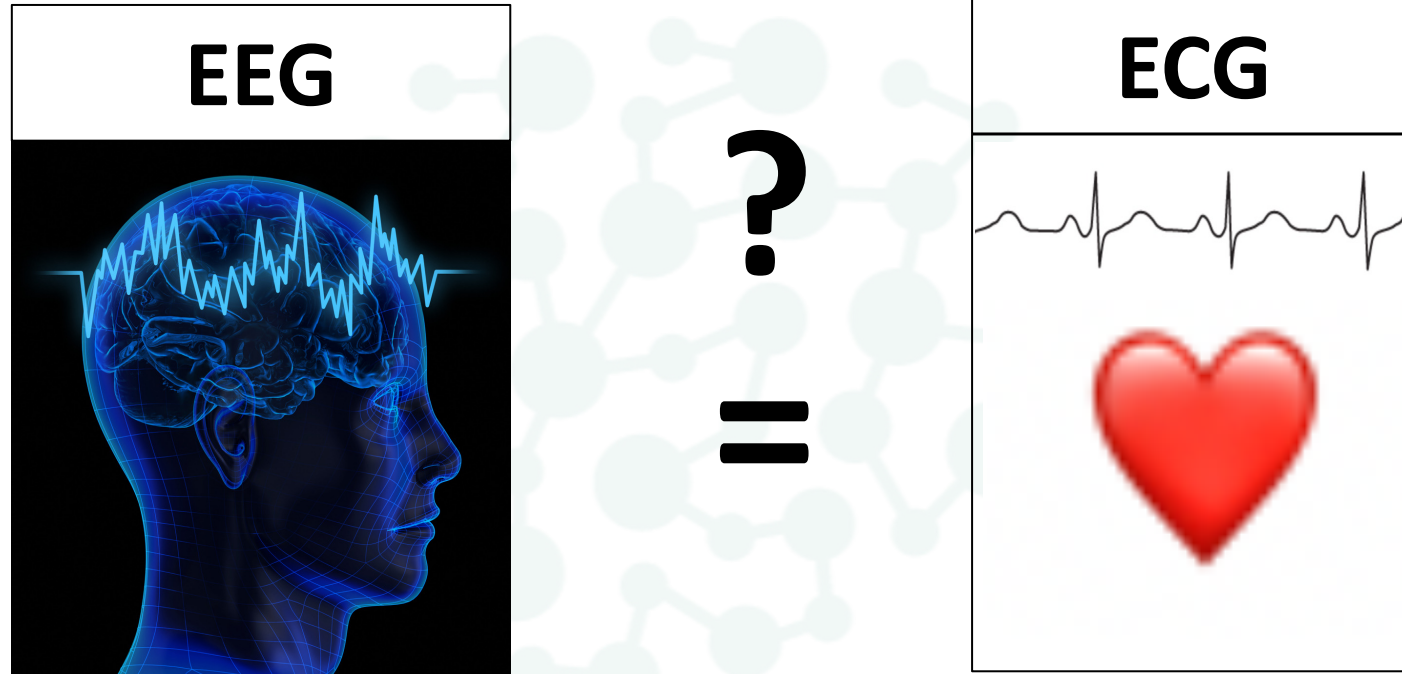
summarised evidence:

Prevention: I. EEG monitoring and II. Index based EEG monitoring

Recommendation 5.1	Quality of the evidence	Strength of recommendation	Recommendation 5.2	Quality of the evidence	Strength of recommendation
We suggest Index-based EEG-monitoring depth of anaesthesia guidance to decrease the risk of POD.	Low	Weak	We suggest multiparameter, intraoperative EEG monitoring (burst suppression, density spectral array, DSA) during anaesthesia to decrease the risk of POD.	Low	Weak

Anaesthesia and Brain monitoring

*EEG and processed EEG,
utility and methods to improve
perioperative care*

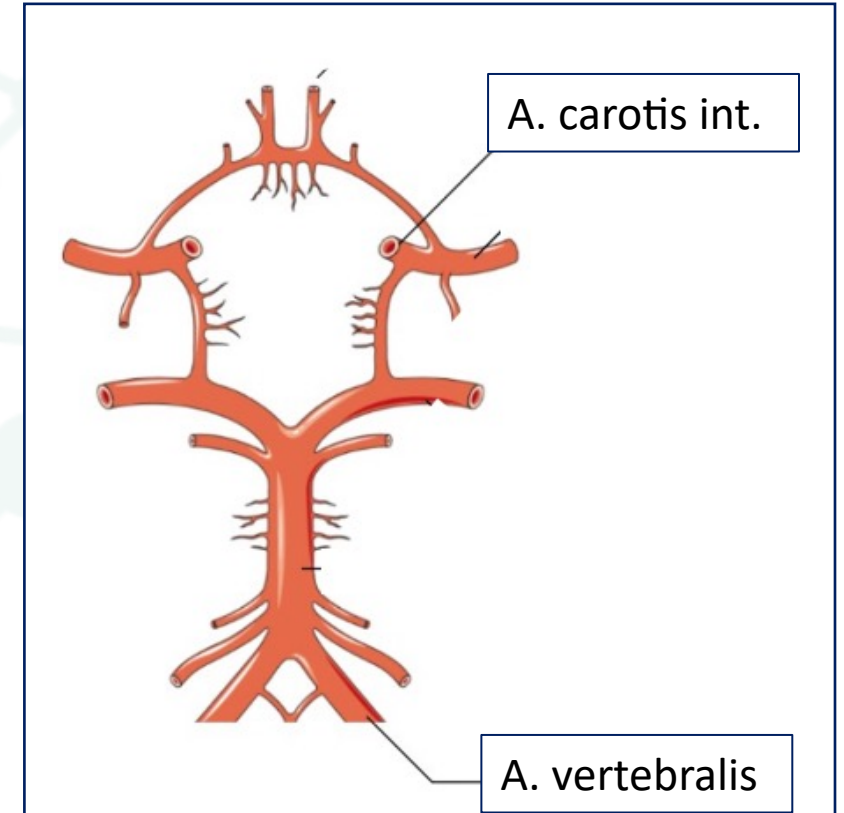
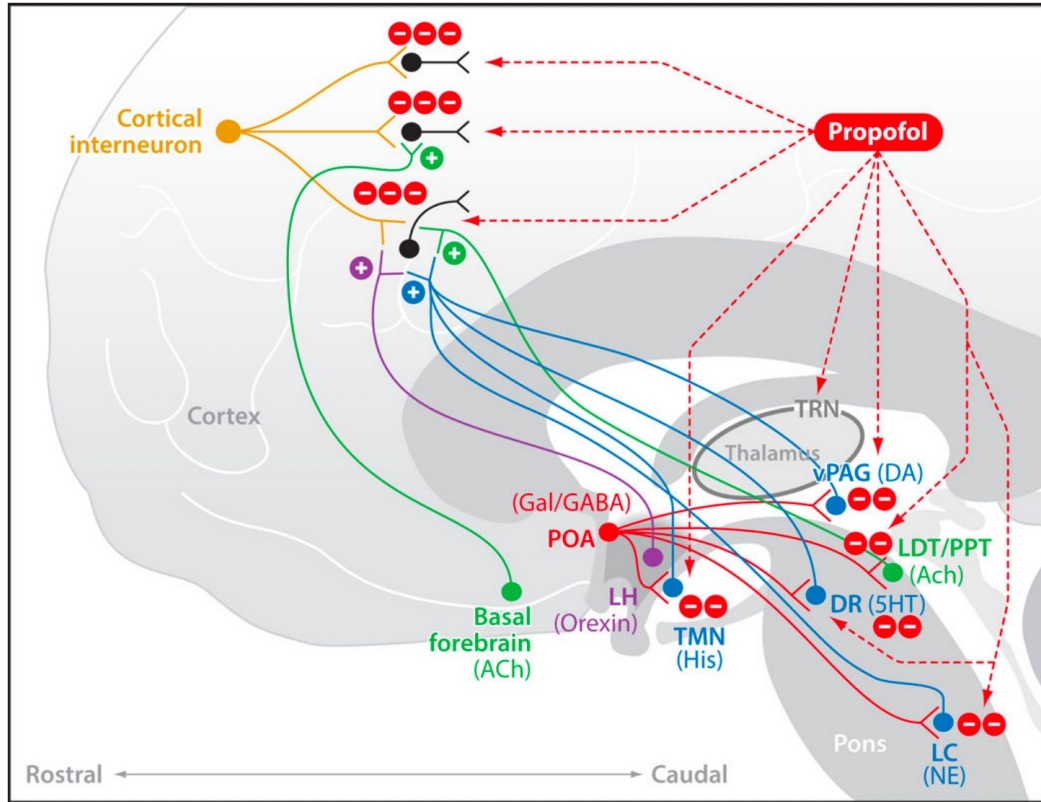


How does anaesthesia affect the functional connectivity?

EEG and processed EEG, utility and methods to improve perioperative care

Induction

Example: Propofol

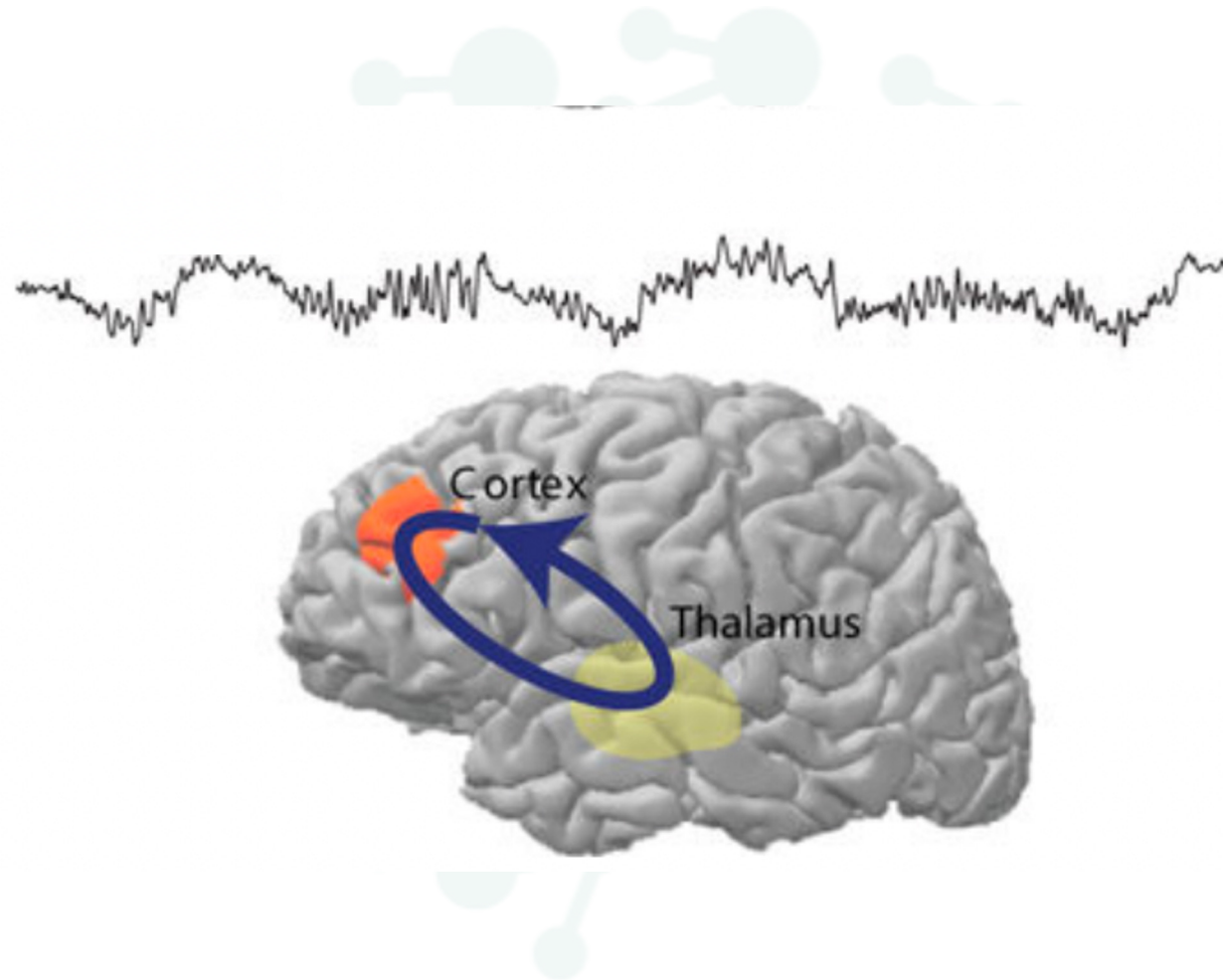


Propofol

& the Thalamocortical circuit

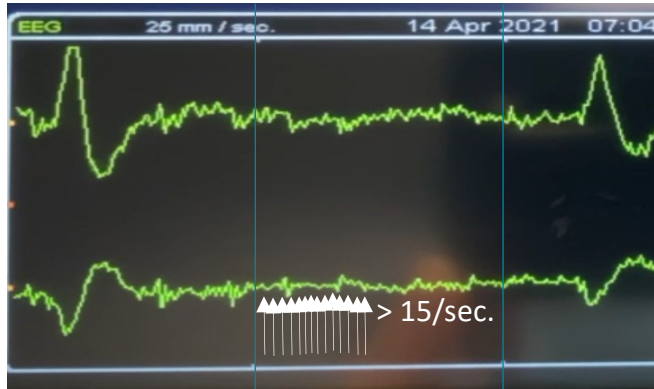
EEG and processed EEG, utility and methods to improve perioperative care

Induction

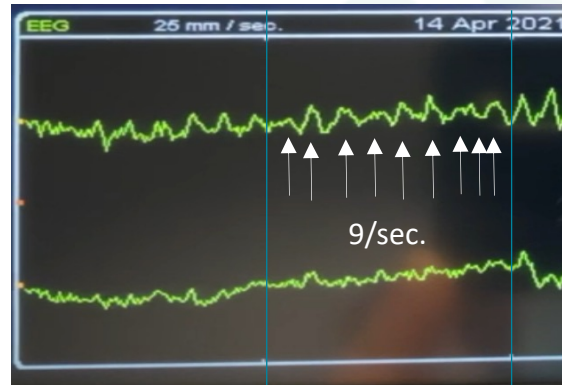


Change from beta dominant rhythm to delta dominant rhythm

Induction



beta-dominant
Beta 14-30 Hz



alpha-dominant
Alpha 8-13 Hz

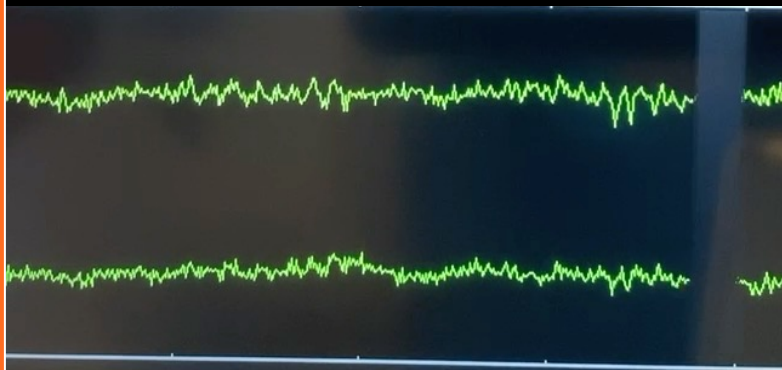


theta-dominant
Theta 4-7 Hz



delta-dominant
Delta < 4 Hz

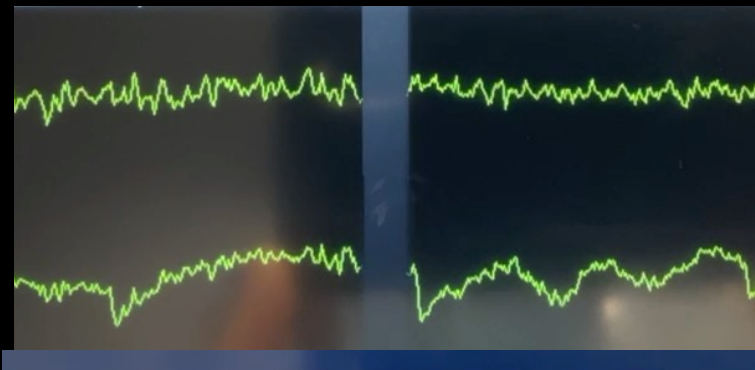
Induction



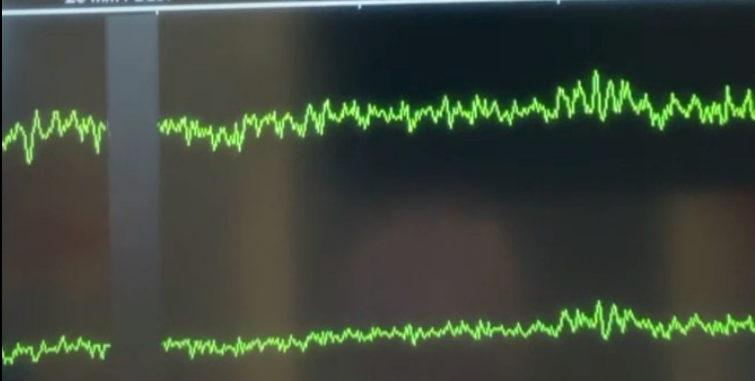
25 mm / sec. 13 May 2020 15:51:24 if3x 50 μ v / division



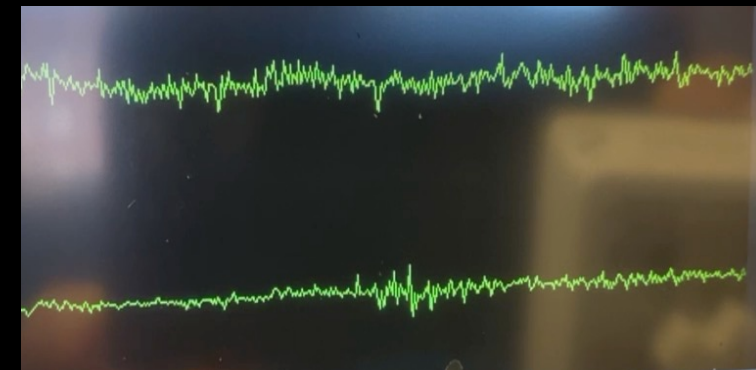
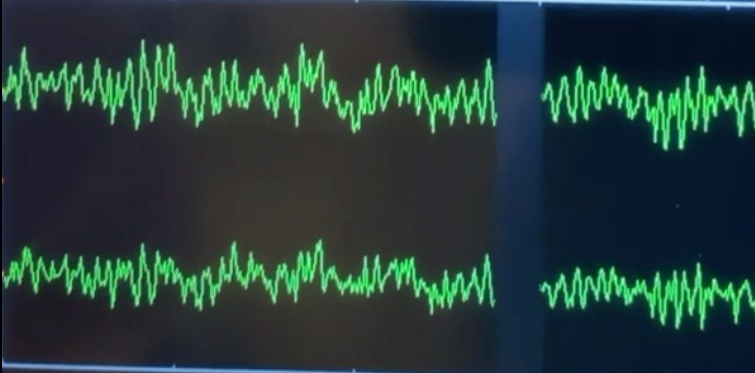
EEG 25 mm / sec. 14 Apr 2021 07:05:15 LH5r 50 μ v / division



25 mm / sec. 26 Jun 2021 12:27:18 j04Q 50 μ v / division



EEG 25 mm / sec. 21 Feb 2021 04:16:55 aG3n 50 μ v / division



EEG 20 mm / sec. 10 May 2020 17:05:20 b2ep 50 μ v / division



Burst suppression is easy to recognize



Burst suppression I: Outcome

EEG and processed EEG,
utility and methods to improve
perioperative care

burst-suppression is a predictor for adverse Outcomes:

Observational Study

Medicine[®]

OPEN

Intraoperative monitoring parameters and postoperative delirium
Results of a prospective cross-sectional trial

Carolin Jung, MD, Lukas Hinken, MD, Moritz Fischer-Kumbruch, MD, Dominik Trübenbach, MD, Rieke Fielbrand, MD, Isabel Schenk, MD, Oliver Diegmann, MD, Terence Krauß, MD, Dirk Scheinichen, MD, Barbara Schultz, MD*

ELSEVIER
British Journal of Anaesthesia

Br J Anaesth. 2018 Jul; 121(1): 241–248.
Published online 2018 Jan 17. doi: [10.1016/j.bja.2017.10.024](https://doi.org/10.1016/j.bja.2017.10.024)

PMCID: PMC6200110
PMID: 29935578

Intraoperative electroencephalogram suppression at lower volatile anaesthetic concentrations predicts postoperative delirium occurring in the intensive care unit

B.A. Fritz,* H.R. Maybrier, and M.S. Avidan

ANESTHESIOLOGY

Electroencephalogram Burst-suppression during Cardiopulmonary Bypass in Elderly Patients Mediates Postoperative Delirium

Juan C. Pedemonte, M.D., George S. Plummer, M.D., Shubham Chamadia, Ph.D., Joseph J. Locascio, Ph.D., Eunice Hahn, B.S., Breanna Ethridge, B.A., Jacob Gitlin, B.S., Reine Ibalá, B.S., Jennifer Mekonnen, B.S., Katia M. Colon, B.S., M. Brandon Westover, M.D., Ph.D., David A. D'Alessandro, M.D., George Tolis, M.D., Timothy Houle, Ph.D., Kenneth T. Shelton, M.D., Jason Qu, M.D., Oluwaseun Akeju, M.D., M.M.S.C.I.

ANESTHESIOLOGY 2020; 133:280–92

Intraoperative Electroencephalogram Suppression Predicts Postoperative Delirium

Bradley A. Fritz, M.D.,

Department of Anesthesiology, Washington University School of Medicine, St. Louis, Missouri

RESEARCH ARTICLE

Open Access

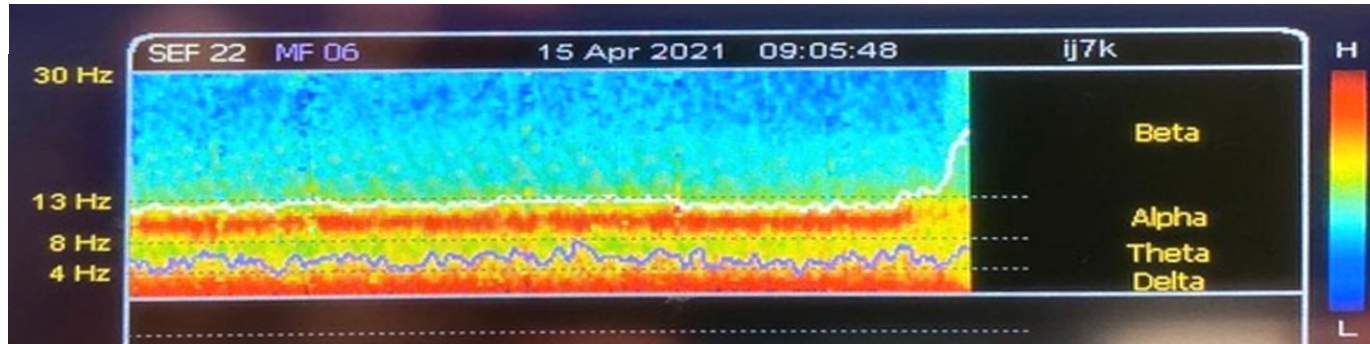
Intraoperative burst suppression is associated with postoperative delirium following cardiac surgery: a prospective, observational study

Martin Soehle^{1*}, Alexander Dittmann^{2†}, Richard K Ellerkmann¹, Georg Baumgarten¹, Christian Putensen¹ and Ulf Guenther¹

**EEG suppression is an independent risk factor for postoperative delirium!
each 5 Minutes in EEG suppression lead to a 22% higher POD Risk**

Density Spectral Array (DSA)

*EEG and processed EEG,
utility and methods to improve
perioperative care*



- Density spectral array (DSA) is a quantitative and simplified EEG method that uses
- By Fourier transformation use, it transforms and reflect EEG signals by color and frequency (y-axis) over time (x-axis).
- The interpretation of DSA is easy and more intuitive!

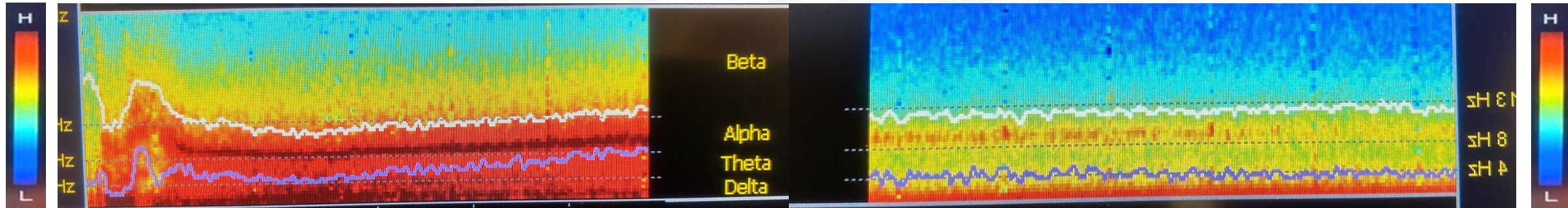
Spectrogram changes:

*EEG and processed EEG,
utility and methods to improve
perioperative care*

Identifying the vulnerable Brain

younger Patient

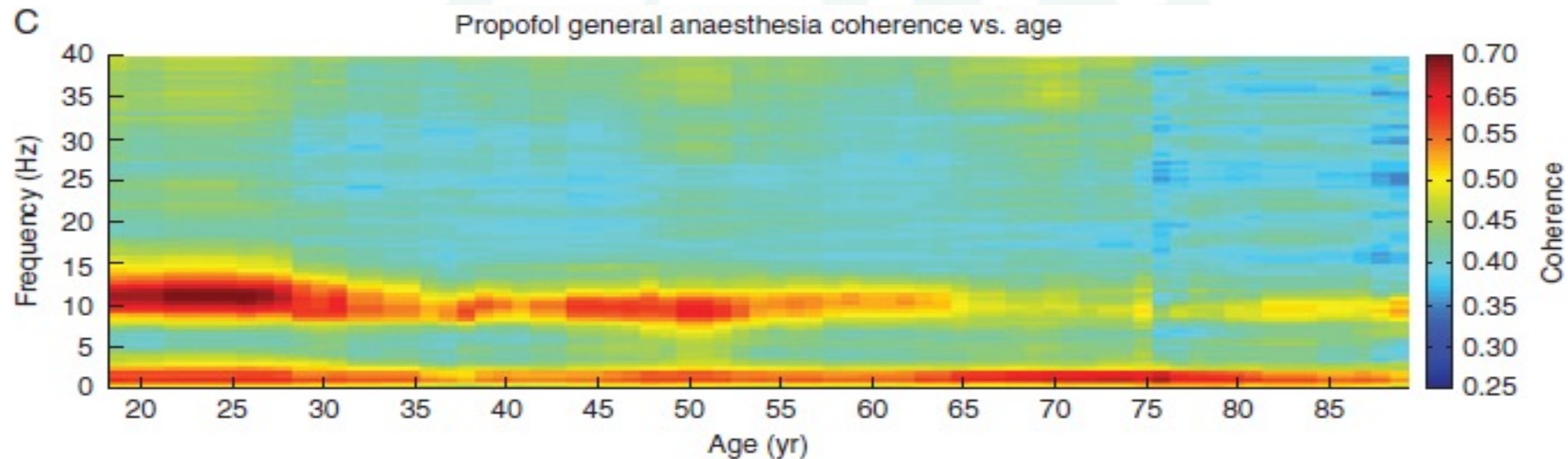
older Patient



The vulnerable Brain

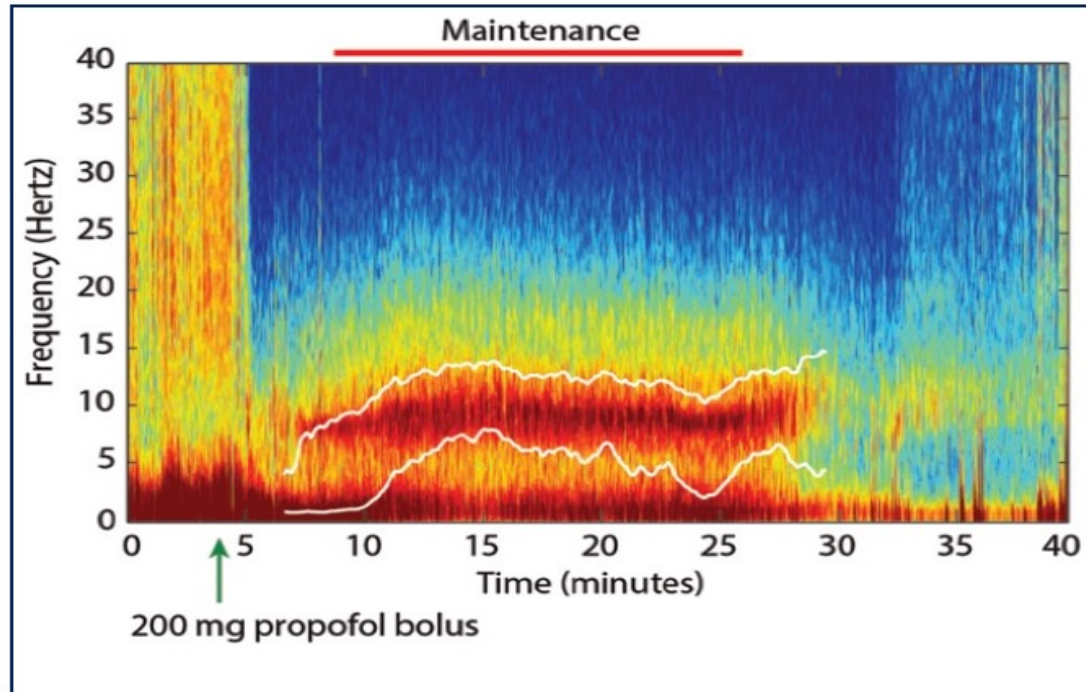
EEG and processed EEG,
utility and methods to improve
perioperative care

- Reduced frontal alpha power is associated w/ an increased risk of burst suppression
- Vulnerable Brain: - increased propensity for burst suppression & - low alpha power

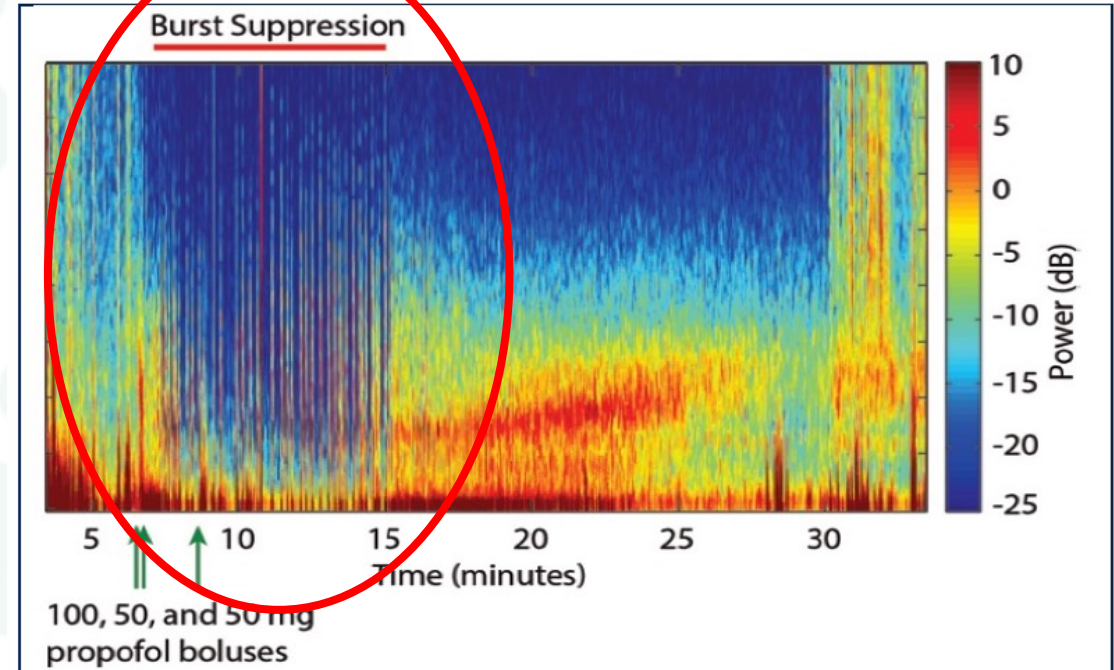


Burst-Suppression is easy to recognize in DSA

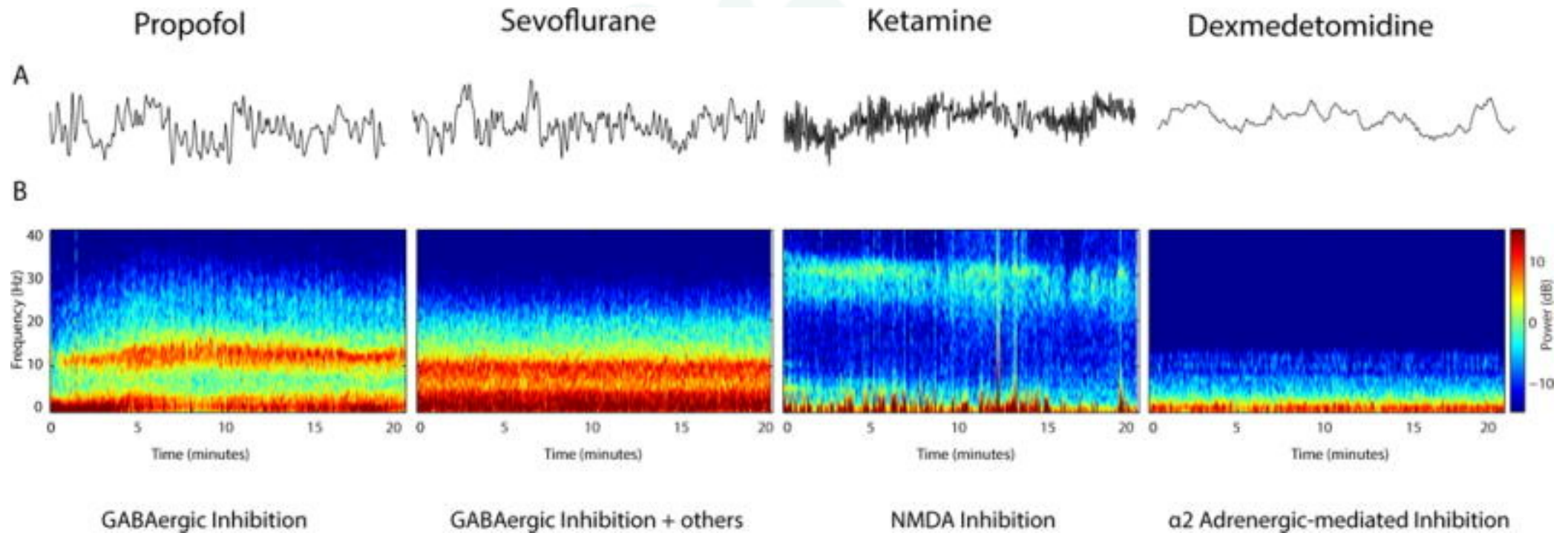
EEG and processed EEG,
utility and methods to improve
perioperative care

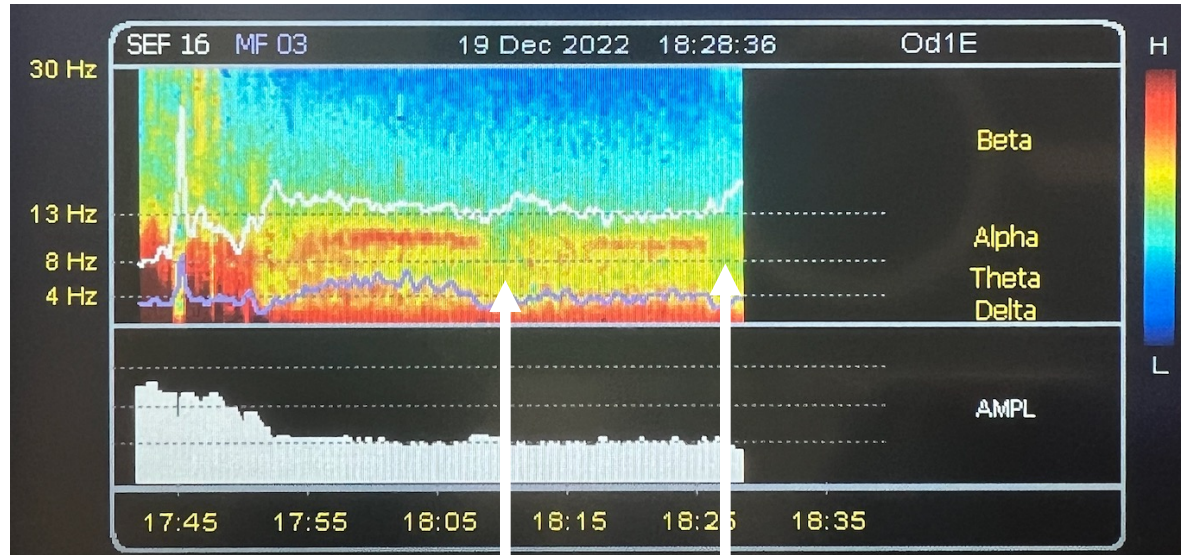


Propofol induced frontal α - / sub-d activity

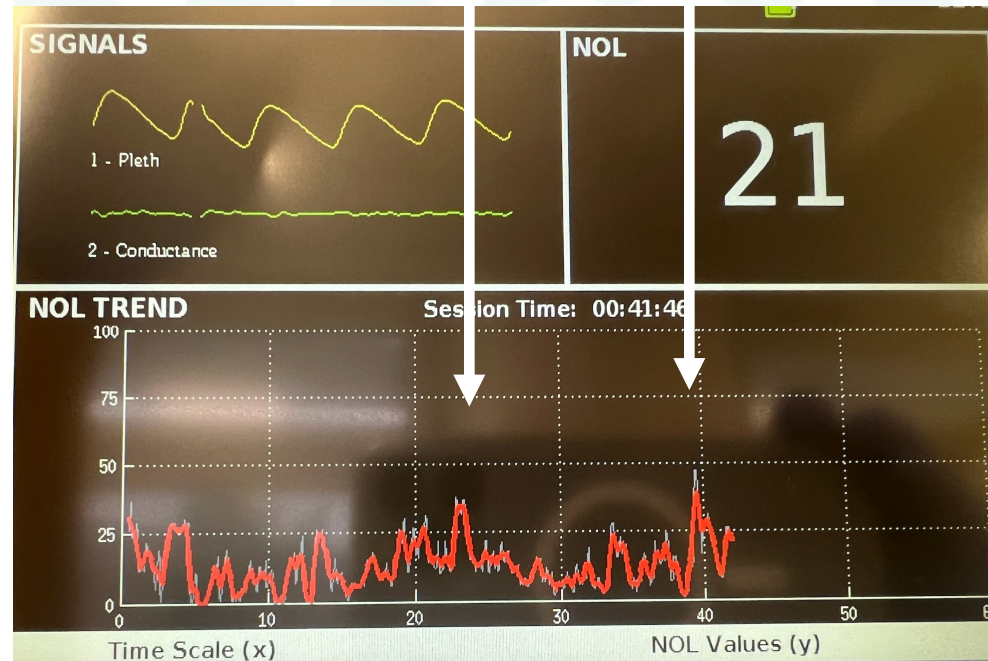


Repetitive Propofol Bolus application -> Burst
suppression



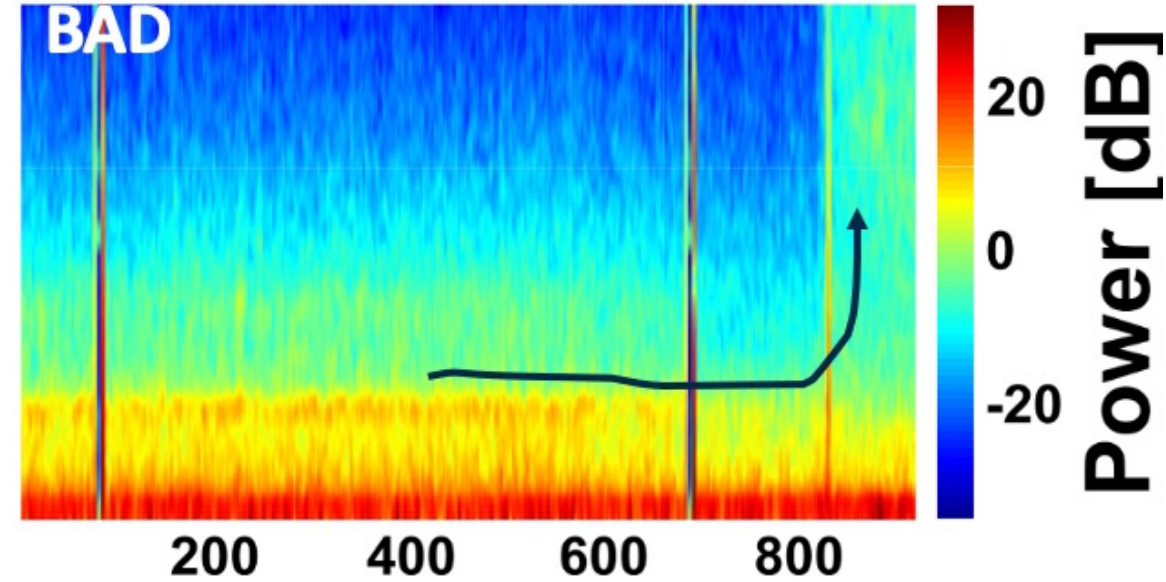
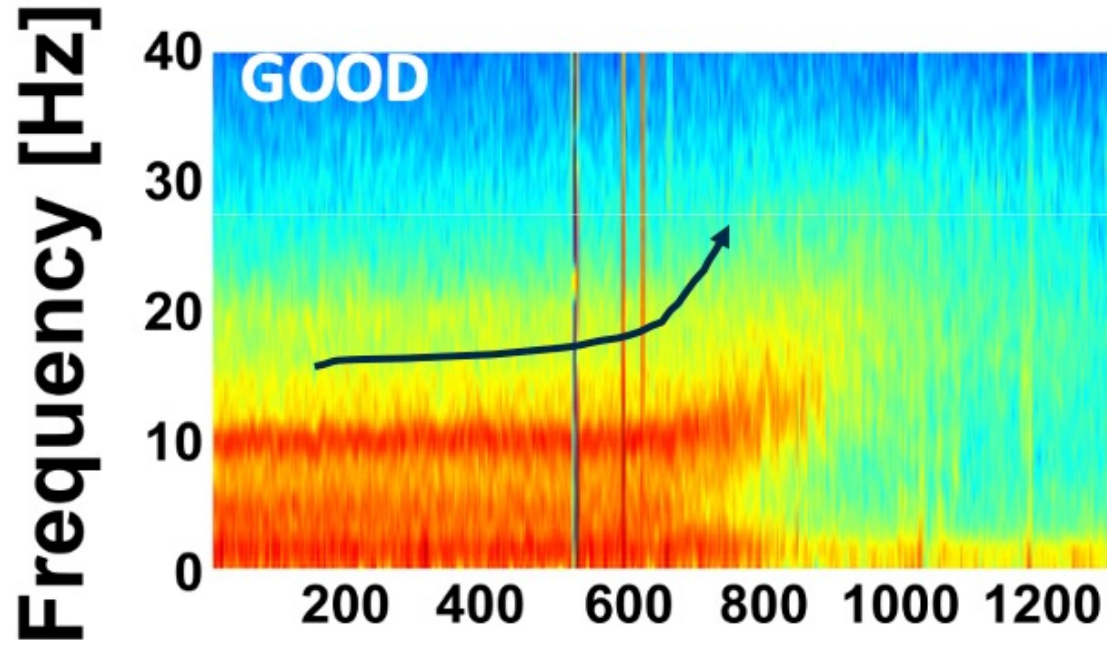


EEG and processed EEG, utility and methods to improve perioperative care

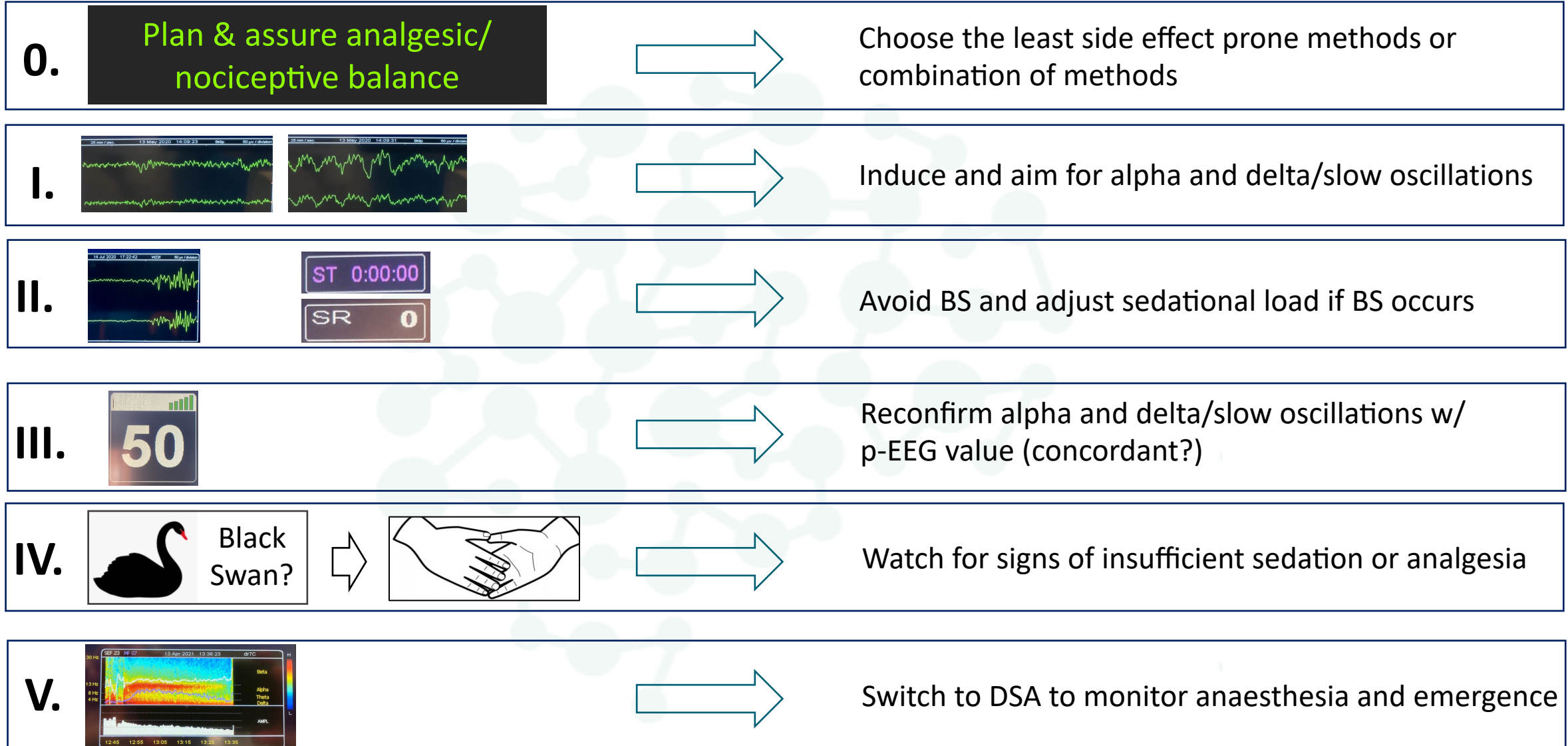


EMERGENCE

EEG and processed EEG, utility and methods to improve perioperative care



This is how we use the EEG monitor...



The SBI-EEG-Bootcamp for Anaesthesia

- Basic training (4h) -

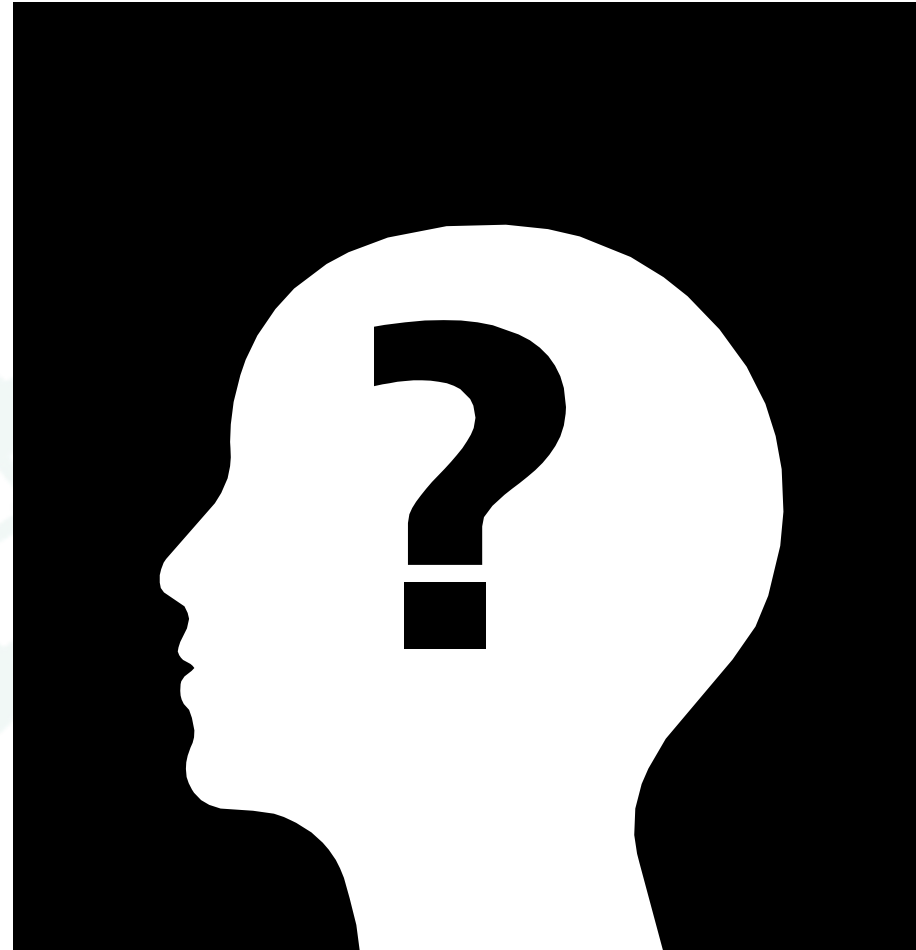
- gain confidence in EEG interpretation
- be able to extract the entire information provided by the monitor and to go „beyond“ the index
- learn algorithms that can immediately be applied in daily clinical practice



The SBI-EEG-Bootcamp for Anaesthesia

- an international consortium -

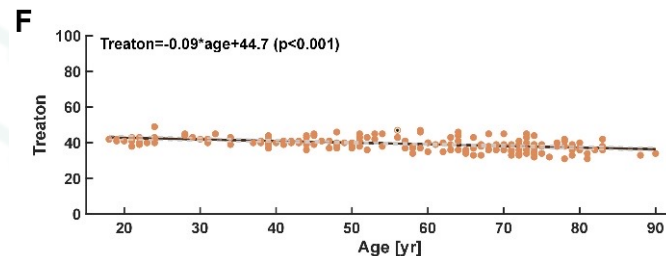
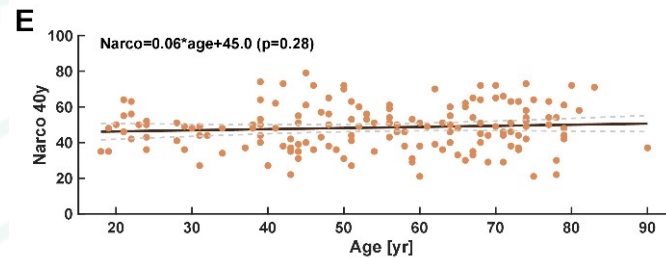
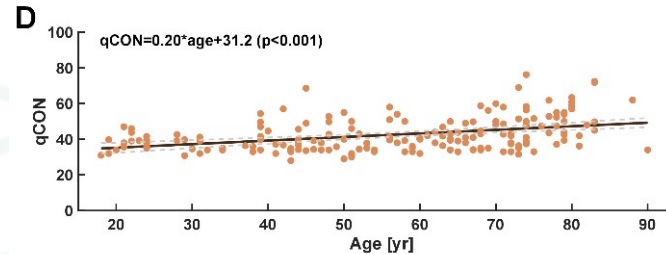
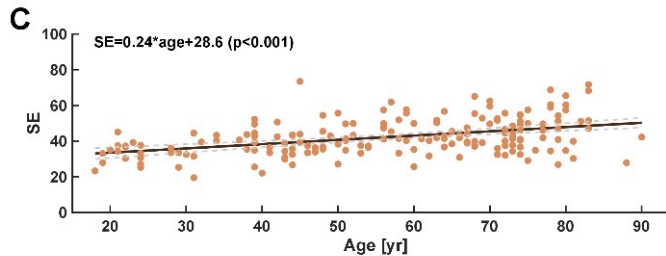
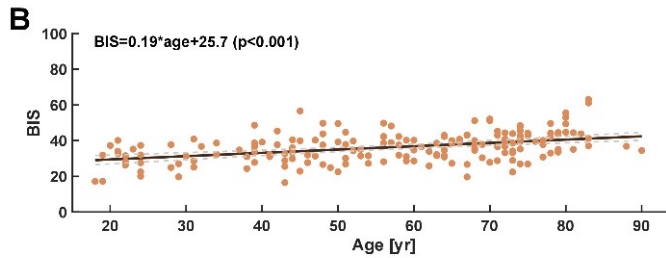
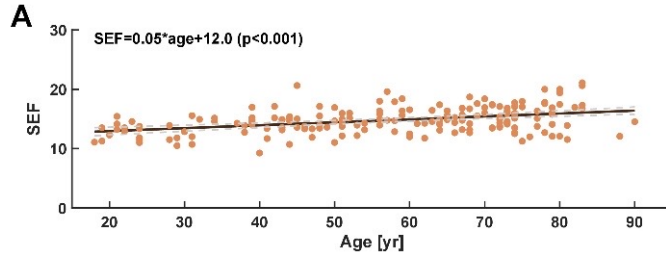






What we can derive from the monitor that
may not be reflected in the index?

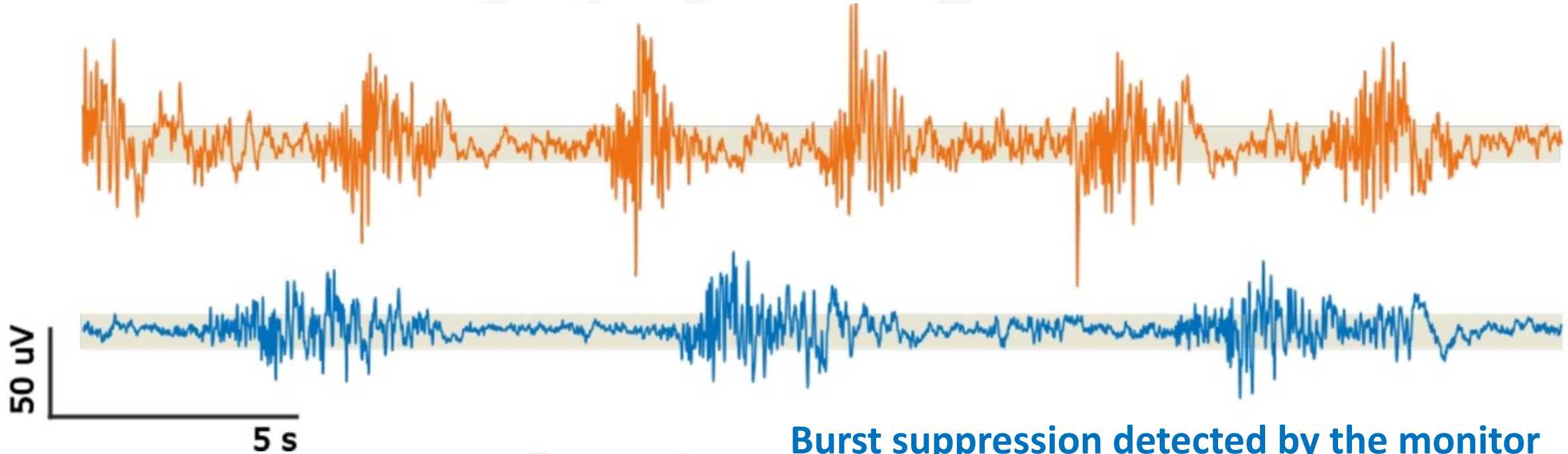
Better chance of avoiding overdosing in elderly



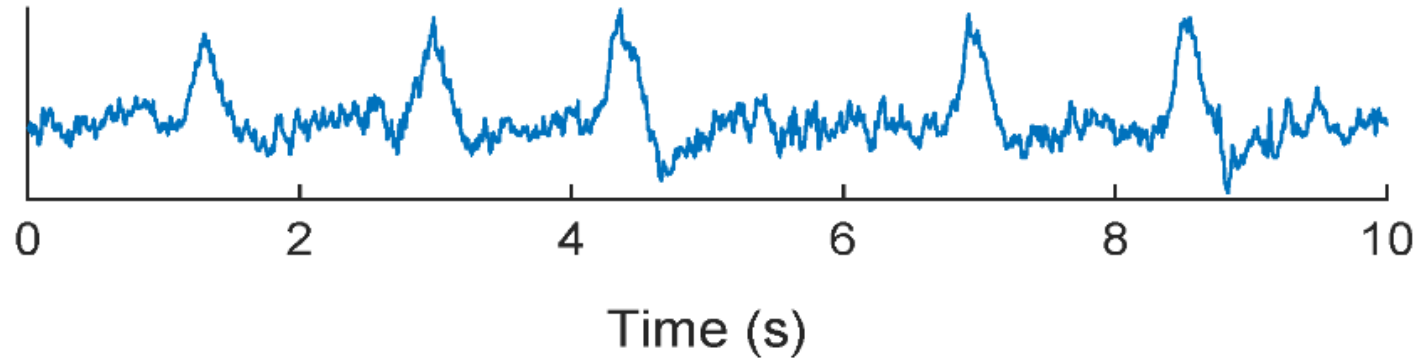
The indices increase with age and could hence influence anesthesia navigation
 → possible overdosage of elderly patients

Better chance of detecting Burst Suppression

Burst suppression not detected by the monitor



Burst suppression detected by the monitor



Breathing

Sweat

ECG

Eye blink

„slow peaks“

„higher than EEG“

~ 1-2/s

awake

The SBI-EEG-Bootcamp for Anaesthesia

- an international consortium -

Maintaining structure
Identifying experts
Dissemination

At least in the beginning: Integration into the ESAIC's educational and scientific framework

Advisory & Supervision Board

- Jamie Sleight
- Gerhard Schneider
-

International level boot camps

providing and maintaining educational contents

National / Regional Chapters

Bi-annual update of the contents

Steering Group:

Thomas Kreuzer
Finn Radtke
Ana Berger-Estilita

Regional Boot camps

Feedback on contents and structure

Identification of regional peculiarities

Contact: m.kreuzer@tum.de
finnradtke@me.com

SBIs comprehensive implementation standard for precision care

A three step interlinked implementation process and key measureables of success, effect and further development:

1) The Teaching Package:

Did the clinicians effectively grasp and apply the teaching method and algorithms linked to the devices proper usage? Were these methods seamlessly incorporated into their routine practices?

Confirmed by

2) The Targeted Clinical Parameters of the Device:

Were the predefined target parameters identified accurately and considered appropriate?
Did the teaching package ensure comprehensive and correct application of these parameters in daily clinical practice?

Confirmed by

3) The Outcome Package:

Did the EEG device deliver the projected impact on patient outcomes as advertised?
Was there any variance in this impact across different hospitals as opposed to the preliminary clinical research? Did we encounter any unforeseen effects—be they positive or negative—on patient outcomes, in-hospital and post-discharge cost savings, user and patient satisfaction, among others?
How did these variables influence the durability of perioperative care?

Confirmed by