Scenarios with Anesthesia

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General Anesthetics

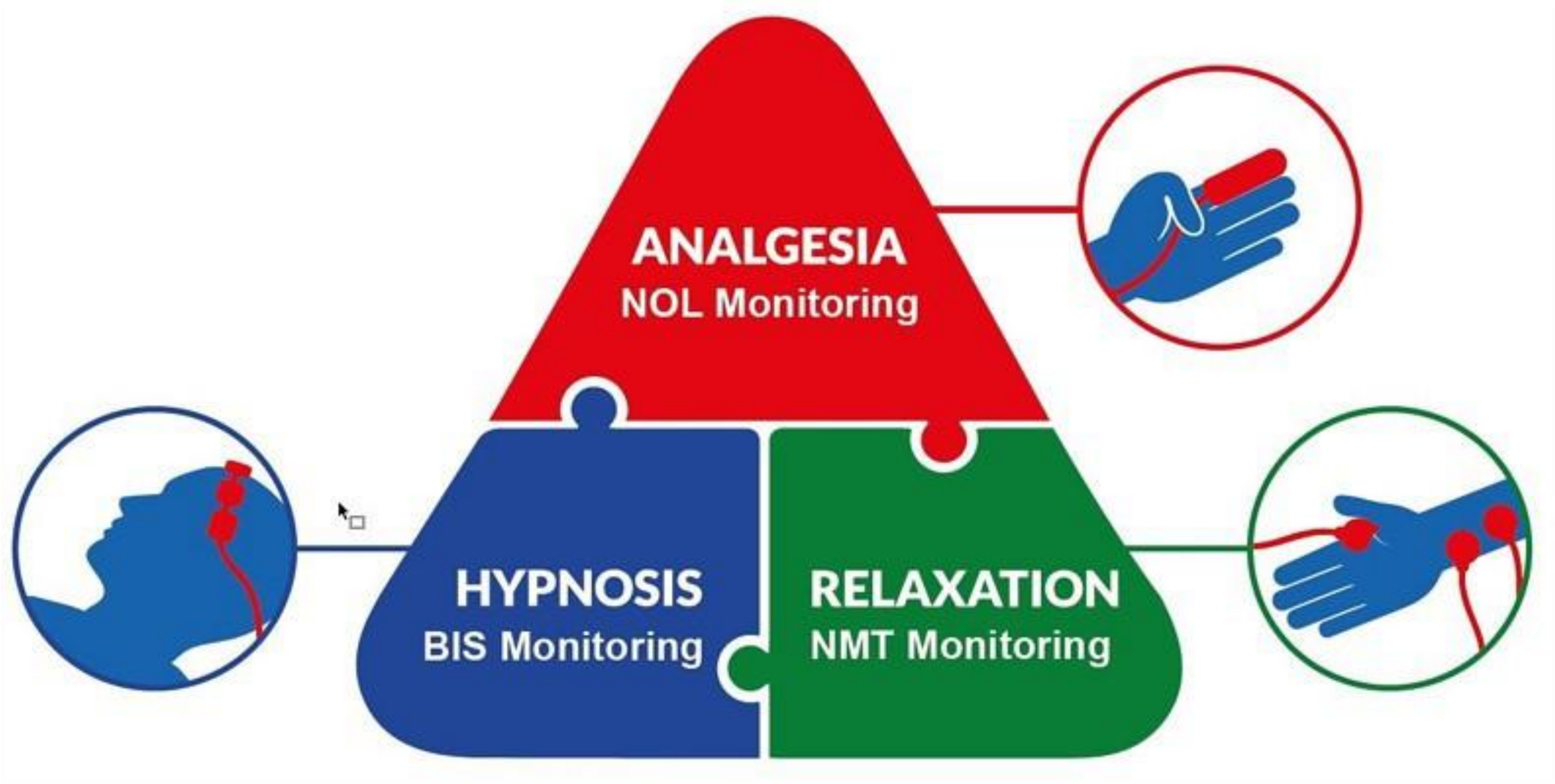
TIVA - **Total intravenous anaesthesia** (TIVA) can be defined as a technique of general **anaesthesia** using a combination of agents given solely by the **intravenous** route and in the absence of all inhalational agents including nitrous oxide.

Balanced Anesthesia:

Although general anesthesia can be produced by only intravenous or only inhaled anesthetic agents, modern anesthesia typically involves a combination of:

1. **IV agents for induction of anesthesia.**
2. **Inhaled agents for maintenance of anesthesia.**
3. **Muscle relaxants.**
4. **Analgesics.**
5. **Cardiovascular drugs to control autonomic responses.**

Anasthesia



Source: https://www.anandic.com/fileadmin/_processed_/c/5/csm_AoA_Main_107de0bc6e.jpg

Inhalation anesthesia - MAC

Minimum alveolar concentration. The **minimum alveolar concentration** (MAC) is the **minimum concentration** of an inhaled **anesthetic** at 1 atm of pressure that prevents skeletal muscle movement in response to a surgical incision in 50% of patients.

MODELLING in HPS

Monitoring of Anasthesia - NOL

NOL® provides superior indication of the presence and severity of pain response vs. individual parameters (such as changes in Heart rate and Blood pressure).

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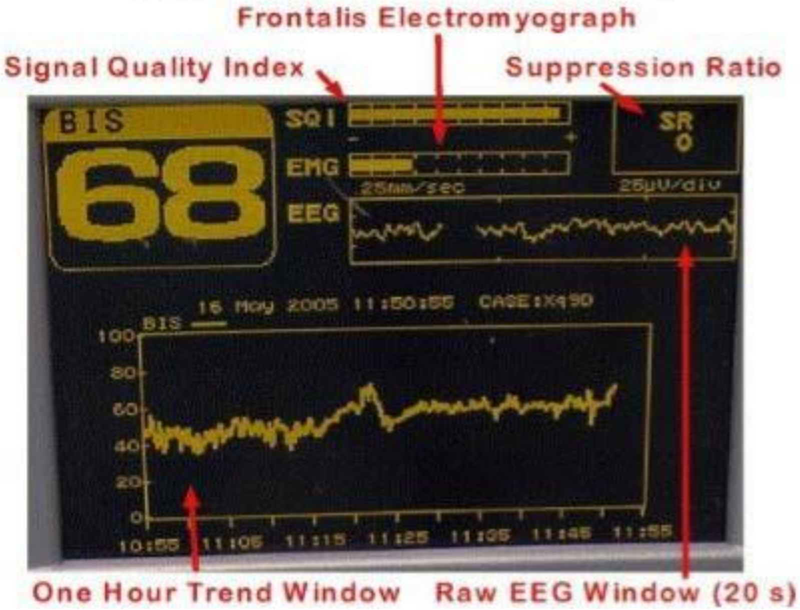
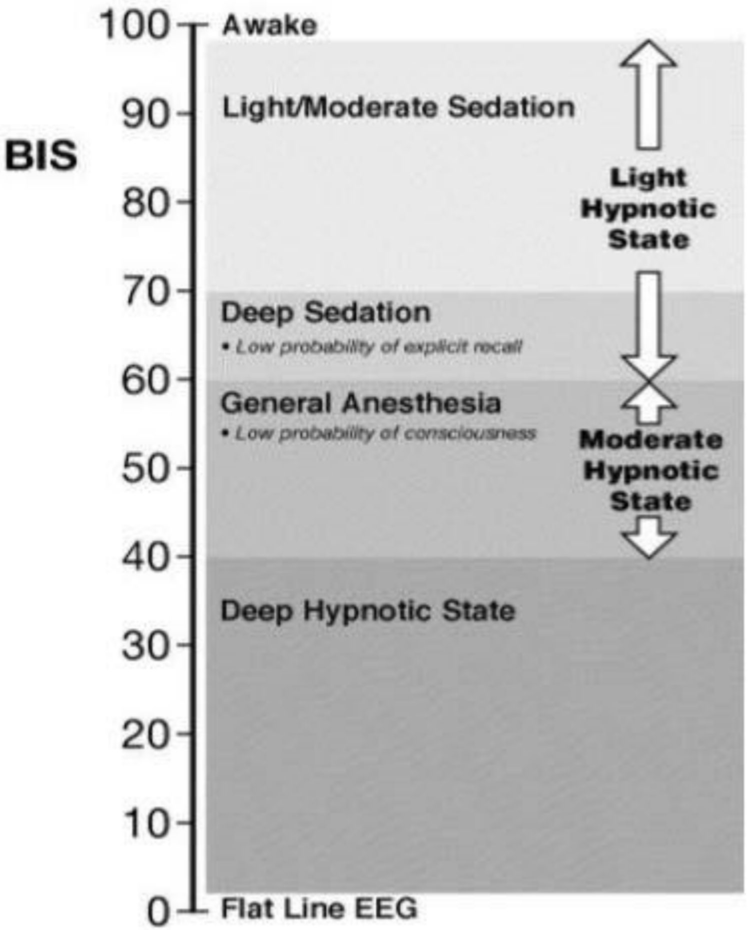
Monitoring of anesthesia - BIS





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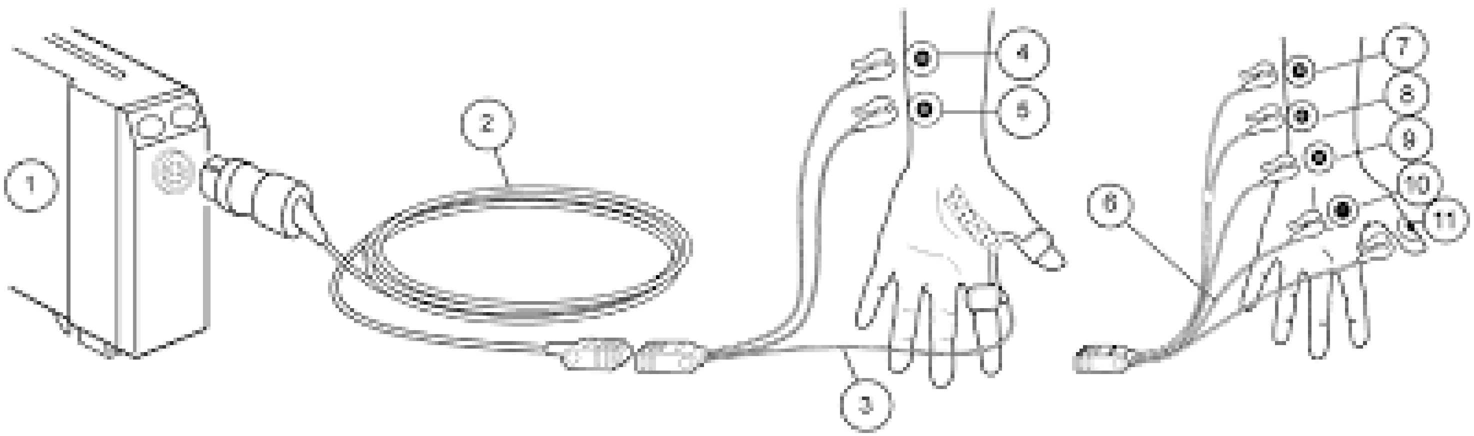
Monitoring of anesthesia - E

Entropy monitoring is a method of assessing the effect of certain anaesthetic drugs on the brain's EEG. It was commercially developed by Datex-Ohmeda, which is now part of GE Healthcare.
Entropy is a quantitative EEG device which captures a single-lead frontal EEG via a 3-electrode sensor applied to the patient's forehead. The system relies on a method of assessing the degree of irregularity in electroencephalogram (EEG) signals. The principle is that the irregularity of an EEG signal decreases with increasing brain levels of anaesthetic drugs and that the entropy is a measure of that irregularity.

Monitoring of anesthesia - NMT

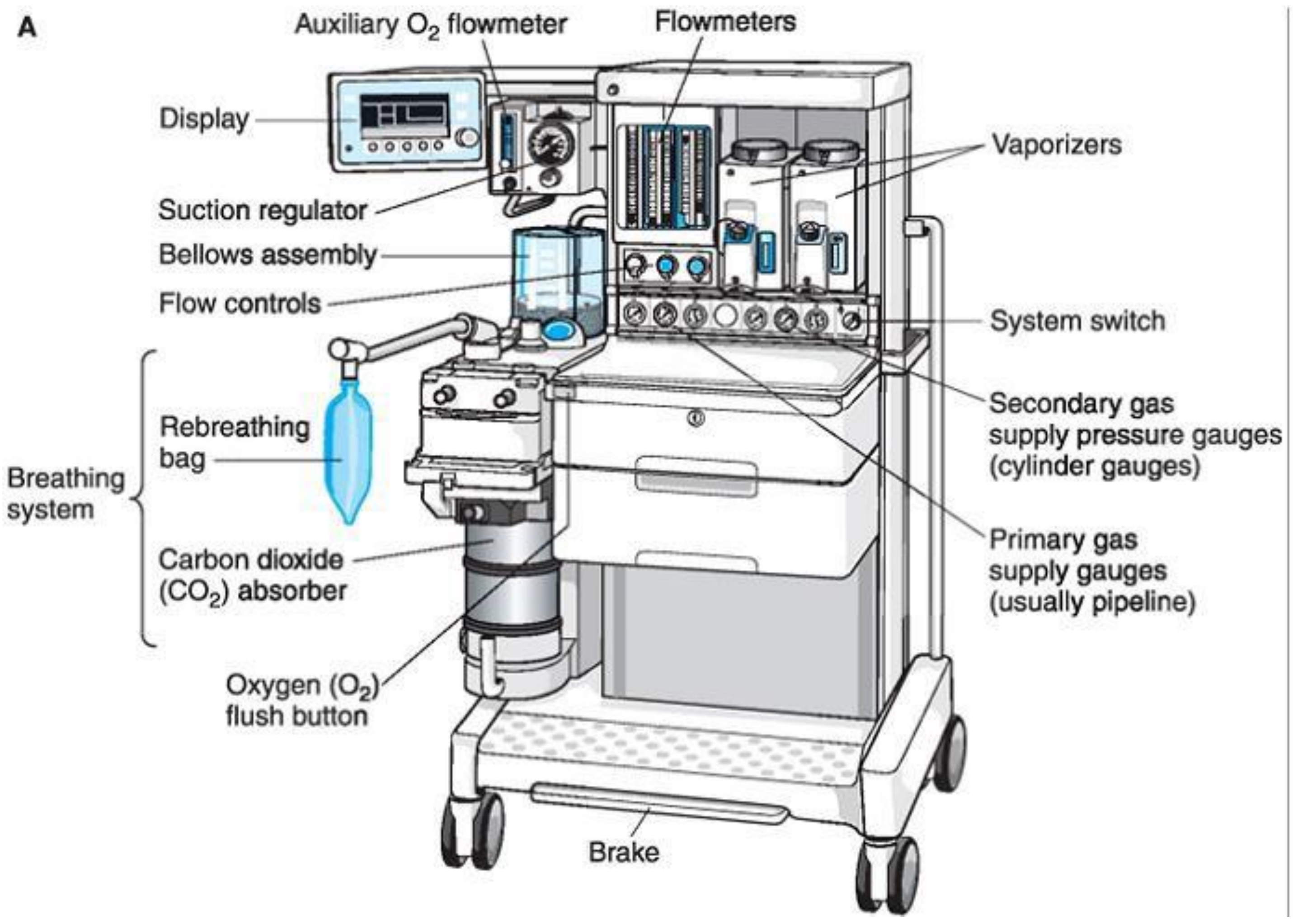
NMT monitoring



https://clinicalview.gehealthcare.com/sites/default/files/styles/teaser_fallback/public/Annotation%202022-03-03%20102350_1.png?h=d4409c39&itok=jNWSXhtv

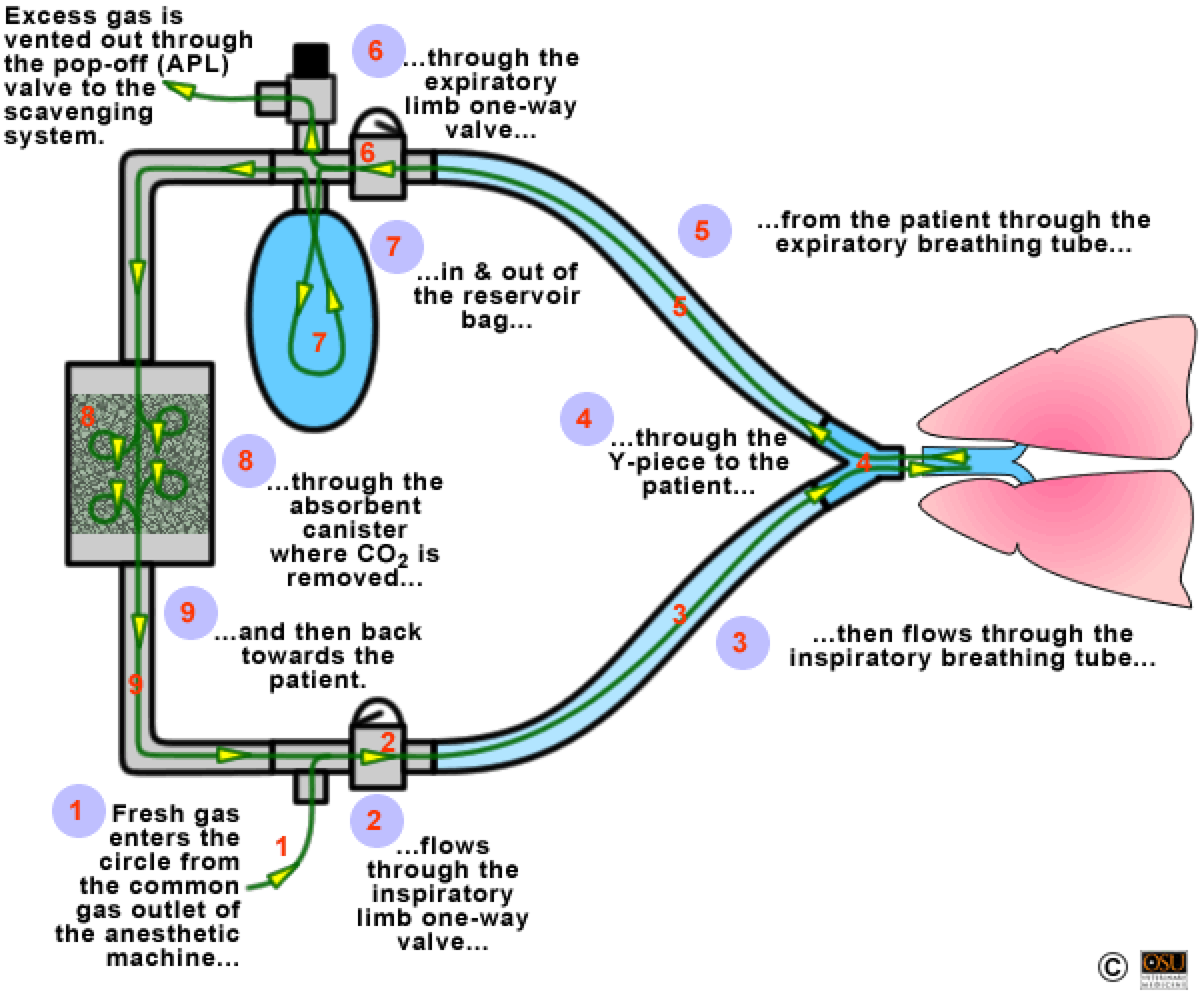
Train of Four (TOF) – Used to describe the pattern of electrical nerve stimulation and evaluate the degree of neuromuscular blockade. After delivery of four successive stimulating currents to a select peripheral nerve with the peripheral nerve stimulator (PNS), the number of twitches correlates with the degree of neuromuscular blockade.

Anesthesia machine



https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.brainkart.com%2Farticle%2FThe-Anesthesia-Machine_26779%2F&psig=AOvVaw1Ox07tnSDlQ7w3p5LjdV9N&ust=1698869922019000&source=images&cd=vfe&opi=89978449&ved=0CBEQjRxqFwoTCLjhx-ONoYIDFQAAAAAdAAAAABAE

Anesthesia - circuit



https://image.slidesharecdn.com/anesthesiamachineandbreathingsystem-170630024005/85/anesthesia-machine-25-320.jpg?cb=1666771071

Operation room – real patient

https://www.ge.com/news/sites/default/files/Reports/2020-04/Aisys-CS2_IMG_0894_2014_B850v2.jpg

Operation room - mannequin

https://www.ge.com/news/sites/default/files/Reports/2020-04/Aisys-CS2_IMG_0894_2014_B850v2.jpg

CaeHealthcare v. Laerdal

Respiratory system
Cardiovascular system
Pharmacokinetic systém

Muse HPS – HW v. SW modelling – User guide
Laerdal Simman – SW modelling – Uder guide

CaeHealthCare - HPS

https://img.yumpu.com/17216525/1/500x640/dow nload-cae-healthcare.jpg

Draeger Zeus

https://www.draeger.com/Media/Content/Products/Slideshow/Draeger-Zeus-Infinity-Empowered-5-D-51152-2015.jpg?imwidth=768

Draeger Zeus - gases

photo - FBMI CVUT

Draeger Zeus - monitor

https://www.draeger.com/Media/Content/Products/Slideshow/Draeger-Zeus-Infinity-Empow ered-8-MT-3931-2008.jpg?imwidth=768

Laboratory

photo - FBMI CVUT

Scenario

- Indukce-podani hypnotik
  - ***Events***
    - **give bolus of** thiopental 400 mg
    - **give bolus of** vecuronium 6 mg
    - **give bolus of** succinylcholine 0.13 mg
    - **give bolus of** fentanyl 100 mcg
  - ***Transitions***
    - **if** Time in State **=** 60 seconds **then go to** *Podani_Isofluranu*
- Podani Isofluranu
  - ***Events***
    - **set** Fixed Alveolar Isoflurane **to** 1 % **over** 1 minute(s)
  - ***Transitions***
    - **if** Time in State **=** 120 seconds **then go to** *Vedeni_anestezie-podani_Fentanylu*
- Vedeni anestezie-podani Fentanylu
  - ***Events***
    - **give bolus of** fentanyl 200 mcg
  - ***Transitions***
    - **if** Time in State **=** 600 seconds **then go to** *Podani_Isofluranu*
- Ukonceni anestezie
  - ***Events***
    - **give bolus of** atropine 0.5 mg
    - **set** Fixed Alveolar Isoflurane **to** 0 % **over** 1 minute(s)
  - ***Transitions***
    - **if** Time in State **=** 300 seconds **then go to** *Normalni_stav_pacienta*
- Normalni stav pacienta

SW HPS - printscreen FBMI CVUT

References:

Meurs, Willem van. Modeling and simulation in biomedical engineering: applications in cardiorespiratory physiology. New York: McGraw - Hill, c2011. ISBN 978-0-07-171445-7.

Kofránek, J., Hozman, J. Pacientské simulátory. [online]. Praha:Creative Connections,2013. http://www.creativeconnections.cz/pacientskeSimulator/ ISBN 978-80-904326-6-6

L. Tejkl, P. Kudrna, J. Rafl and J. Svoboda, Patient Simulators in Medical Education: New Enhancements, IEEE E-HEALTH AND BIOENGINEERING EHB 2019. Iasi: Gr. T. Popa University of Medicine and Pharmacy, ročník 7, číslo 1, 2019, doi: 10.1109/EHB47216.2019.8970044