Agent conc (MAC) vs Time — Lung and Brain curves

- Reliable visualizations of agent concentration in the brain – the target organ
- Improved control of depth of anesthesia
- Controlled consumption of anesthetic agent

MAC Brain short guide
Tool for better anesthetic agent dosing

Due to pharmacokinetics there is a time delay in agent concentrations between the lungs and the target organ, the brain. Getinge's unique MAC Brain tool visualizes the difference to support better dosing and planning of agent delivery, reducing the risk of over- and underdosing.[1, 2]

The MAC Brain value is an estimation of the development of the partial pressure of a volatile anesthetic agent in the brain.

The partial pressure of anesthetic agents changes slower in the brain than in the lung. This delay is given by a time constant dependent on the volume of the brain, the solubility of the agent in brain tissue, the perfusion of the brain, and the solubility of the agent in blood. These four entities define the time constant describing the partial pressure delay in the brain. If the variability of the agent's alveolar concentration is known, which it is from the continuous end tidal gas measurement, the differential equation describing the agent concentration in the brain, MAC-brain, can be solved.

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Every. Breath. Counts.

Getinge's innovative technologies for *Dynamic Anesthesia Delivery* widen the scope for true personalization. Our proprietary innovations for ventilation to ICU standards, active hypoxia prevention, lung recruitment maneuvers and precision agent dosage contribute to enhanced patient safety and improved care even for very complex patients. The intuitive interface and ease of use promote a streamlined workflow. And thanks to a controlled use of anesthetic agent the clinic can lower costs and reduce environmental impact.

End tidal measurements

When the age adjusted calculated MAC value based on the end tidal measurement are in steady-state, i.e when the partial pressure of agent in the blood, brain and alveolar compartments are in equilibrium, we can assume that it reflects a probability of unconsciousness, but when the end tidal based MAC are in a transitory stage of anesthesia, like induction, concentration changes or emergence, this is no longer true. The MAC Brain is designed to be a drug advisory display that reflects the hysteresis between exhaled partial pressure and CNS partial pressure and thus helping the anesthetist.

The system continuously calculates the estimated MAC Brain value based on the end tidal measurement of anesthetic agent and/or nitrous oxide. The value is updated at the end of each expiratory breath phase.

Requirements

The MAC Brain value is available both in manual and controlled ventilation modes.
To get a valid MAC Brain value displayed on the screen, there are some requirements that need to be fulfilled.

- MAC Brain value should be enabled in the Start-up configuration.
- The patients' age must be more than 1 year.
- The $EtCO_2$ must be more than 1.7% for more than three consecutive breaths.

During the use of the Pause function or Inspiratory/Expiratory hold function, or a disconnection lasting less than 40 seconds, the MAC Brain value will be paused during that time.
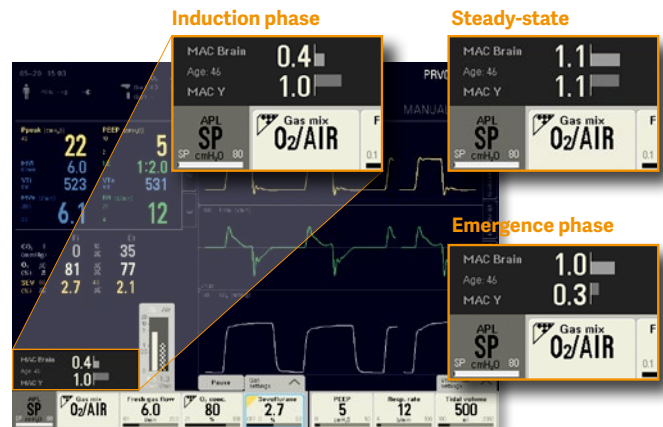
During induction, the MAC Y value, reflecting the alveolar concentration, increases much faster than in the target organ.

During emergence, the MAC Brain will clearly show the delay of decreasing target organ concentration compared to the lungs.

Incidences of invalid data

Why does the MAC Brain value become invalid?
*(Displayed as "**")*

- If the first three consecutive breaths measured by the system have a MAC value of more than 0.3 MAC_{age}
- If the patient's age is altered during a case and volatile agent is being delivered.
- If the $EtCO_2$ – $FiCO_2$ difference is less than 1.6%
- If no breaths are detected for 60 sec.

If any of the four above mentioned incidences occurs, the system will consider the MAC Brain invalid for the time it would take for alveolar/brain equilibrium to occur, which is approximately 10 minutes for the anesthetic agents used by the system.

MAC Brain, a Getinge proprietary innovation, is a standard feature on all Flow Family anesthesia machines (Flow-i, Flow-e & Flow-c).

For more references and information please use QR-code or visit www.getinge.com/int/solutions/operating-room/anesthesia/mac-brain/

References:
[1] Ref Kennedy R. et al. Sevoflurane End-Tidal to Effect-Site Equilibration in Women Determined by Response to Laryngeal Mask Airway Insertion. Anesth Analg 2013;117:786–91
[2] Drews F.A et al. Drug delivery as control task: improving performance in common anesthetic task. Hum Factors 2006;48:85–94.

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