



# Entonox

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# What is entonox?

- ▶ Mixture: 50% N<sub>2</sub>O (nitrous oxide) and 50% O<sub>2</sub> (oxygen)
- ▶ N<sub>2</sub>O was used for the first time 200 years ago
- ▶ 1880 – pain relief during the birth – administered without oxygen – asphyxia
- ▶ 50 years 20. century – mixture 50% N<sub>2</sub>O with 50% O<sub>2</sub>
- ▶ The part of general anesthesia, pain relief
- ▶ Administered by anesthesiologists, non – anesthesiologists, after training also intermediate medical staff
- ▶ Extremely mild influence on CNS and cardiovascular system
- ▶ Individual effect, influenced by suggestion
- ▶ Serious side effects are minimal

# Benefits

- ▶ Easy and safe application
- ▶ It could be administered by non-anesthesiologists and intermediate medical staff (obstetrics, gastroenterology, dentistry)
- ▶ Minimal occurrence of side effects
- ▶ Rapid onset of sedation and analgesia
- ▶ Fast psychomotor recovery

# History

- ▶ 1772 – Josef Priestley discovered  $N_2O$
- ▶ 1778–1829 – Humprey Davy discovered effect of  $N_2O$  – laughing gas, Lachgas, rajský plyn – used for entertainment purposes
- ▶ 1815 – 1848 – Horace Wells – dentist, he discovered analgesic effect
- ▶ 20. century – analgesic for oral surgery
  - Weak effect on pain relief, high risk of hypoxia, imperfect technical equipment
  - Anxiolytic and sedative effects are more important than weak analgesic effects
- ▶ 80 %  $N_2O$  and 20%  $O_2$  today 50%  $N_2O$  with 50%  $O_2$

# Pharmacodynamics of N<sub>2</sub>O in CNS

- ▶ Minimal effect on EEG and bispectral index (form of EEG monitoring of sedation depth and anesthesia)
- ▶ Increased blood flow to the brain and slightly increased blood volume in the brain
- ▶ Neurological manifestations of chronic exposure only in its frequent recreational usage in the past (numbness, decreased activity of tendon reflexes, feelings of electric shocks in the body, cognitive dysfunction, swelling of mitochondria of neurons and apoptosis)
- ▶ NMDA receptor antagonist
- ▶ At concentrations of 10 and 20%, it affects psychomotoric functions

# Pharmacodynamics N<sub>2</sub>O in CNS

- ▶ Amnestic effect – information are different, anterograde amnesia, mediated by the interaction of N<sub>2</sub>O with NMDA receptors
- ▶ Analgesic effect – effect on opioid receptors, its stimulation releases endogenous opioid peptides – endorphins and enkephalins.
  - It corresponds to 15 mg of morphium, max. threshold in 10 minute
  - Rapid development of tolerance
  - Significant reduction of sensitivity after application of local anesthetic
- ▶ Anesthetic effect – used to accelerate the induction of other inhalation anesthetics

# Pharmacodynamics of N<sub>2</sub>O

- ▶ The tolerance to nitrous oxide could be created
  - The tolerance develops between 10 minutes and 2 hours
  - Significant differences in acute tolerance – various neurotransmitters are involved in the transmission of information
  - The decrease in the density of opioid receptors in individual brain regions is also important
- ▶ Respiratory system – increase in respiratory frequency, slight reduction in tidal volume, pCO<sub>2</sub> unchanged
- ▶ Cardiovascular system – slight increase in heart rate, heart rate and peripheral resistance – slight sympathomimetic effect, release of catecholamines » increase in blood pressure, heart rate, increased incidence of cardiac arrhythmias
- ▶ Gastrointestinal system – in 50% nausea, vomiting
- ▶ Kidneys, liver – does not influence their metabolic activity, can be used in patients with severe diseases of these organs

# Pharmacokinetics

- ▶ Inhalation from lungs to bloodstream and further to CNS
- ▶ Slightly soluble in blood, rapid equalization of alveolar concentration in the lungs with blood = rapid onset of action, fast disappearance
- ▶ The transport in blood is free, not bound to hemoglobin, it is not metabolized, excreted by the lungs
- ▶ Rapid diffusion into closed body cavities and it could lead to their expansion (intestinal loops, processus mastoideus, pneumothorax)
- ▶ Oxygen in the lungs is diluted during elimination – temporary hypoxia, there is no risk of hypoxia with a 50:50 mixture



# Clinical manifestation of inhalation

- ▶ Feeling of intoxication, vertigo, paresthesia in the upper and lower limbs, in the oral cavity, feeling of warm in the body, feeling of euphoria, analgesia begins
- ▶ Blood pressure, heart rate and respiratory rate is rising
- ▶ Peripheral vasodilation
- ▶ Flush – redness on the face
- ▶ Decrease in muscle tone, changes in perception, hyperacusis
- ▶ Laugh or crying

# Indication

- ▶ Surgical procedures (joint reposition, insertion and removal of drains, abscess incision, fracture reposition, treatment of wounds and contusions)
- ▶ Gynecology and obstetrics – minor gynecological procedures and the first phase of childbirth
- ▶ Urology
- ▶ Dentistry
- ▶ Gastroenterology – endoscopic procedures
- ▶ Dermatology
- ▶ Hematology
- ▶ Treatment of pressure ulcers
- ▶ Podiatrics
- ▶ Psychiatry and psychology
- ▶ Radiology
- ▶ Neurology
- ▶ Sick patients in the terminal phase

# Contraindications

- ▶ Pneumothorax, pneumopericardium, severe emphysema, air embolism, COPD
- ▶ Acute myocardial infarction
- ▶ After intracutaneous gas injections
- ▶ Dilatation of the digestive tract – ileus
- ▶ Heart failure, cardiac dysfunction
- ▶ Increased intracranial pressure
- ▶ With reduced consciousness and lack of cooperation
- ▶ Untreated vitamin B12 or folic acid deficiency
- ▶ In case of facial injuries disables the usage of an breathable valve
- ▶ Ear surgery (tympanoplasty)
- ▶ Intraocular gas injections or perforating eye injuries
- ▶ Damage to the blood–brain barrier
- ▶ First trimester of pregnancy – interference with the metabolic pathway of vit B = disruption of DNA synthesis
- ▶ Children under 3 years

# Side effects

- ▶ Short-term headache
- ▶ Vertigo
- ▶ Nausea, vomiting
- ▶ Inhibition of methionine synthetase interferes with the metabolism of folic acid and methionine
- ▶ Prolonged administration leads to vitamin B12 and folic acid deficiency – erythropoiesis disorders with the development of macrocytic anemia, leuko- and thrombo-cytopenia to agranulocytosis
- ▶ Neurotoxic complications – acute funicular myelosis

# Inhalation in childhood

- ▶ In children in 3–4 years, cooperation is necessary
- ▶ Younger child needs higher concentration N<sub>2</sub>O to reach desired effect
- ▶ The fear leads to flat breathing and decreased tidal volumes, suggestion and calming of atmosphere is necessary.
- ▶ Sometimes it is necessary to interrupt analgosedation and choose another form of analgesia
- ▶ Combinations with various drugs can also be performed under the supervision of an anesthesiologist:
  - Surface anesthesia
  - Combination with paracetamol rectally, orally and intravenously
  - Tramadol – orally
  - Nalbuphine – intravenously
  - Midazolam – orally, rectally or intravenously

# Entonox in dentistry – adult patient

- ▶ Anxiolytic and narcotic (euphoric) effect is applied, pain reduction with LA application
- ▶ Inhalation is accompanied by soothing speech, inducing a feeling of confidence
- ▶ N<sub>2</sub>O makes the patient accessible to suggestion
- ▶ Instructions:
  - Inhalation before treatment
  - Application of LA
  - Inhalation before dental treatment
- ▶ Inhalation is also possible with a nasal mask – lower efficiency
- ▶ Not suitable for patients with odontophobia

# Entonox in dentistry – child as a patient

- ▶ Cooperation is necessary
- ▶ Consider combination with midazolam per os, per rectum, or nasally (supervision by anesthesiologist is necessary)
- ▶ Amnesia after inhalation is very frequent
- ▶ Defensives reflexes are preserved, the child still defends himself after inhalation, but the patient does not usually remember the procedure.
- ▶ In children younger than 3 years is the effect of N<sub>2</sub>O insufficient, general anaesthesia is necessary

# Practical design of inhalation sedation

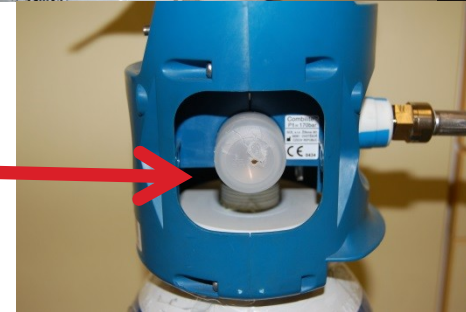
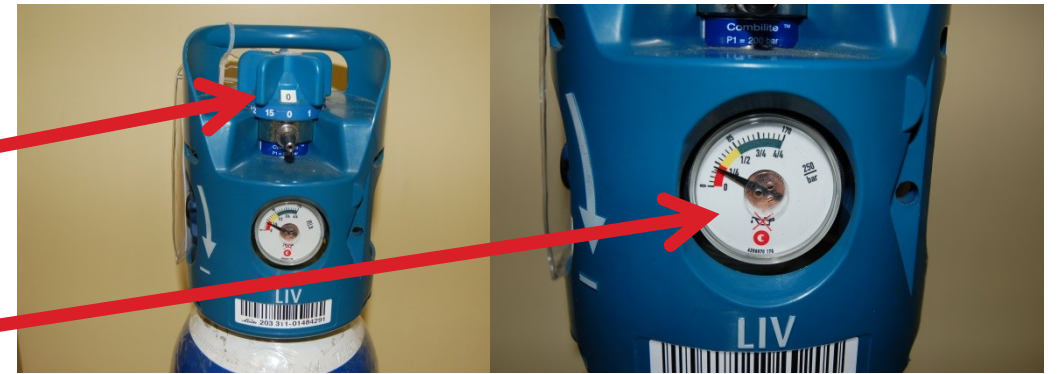
- ▶ Mixture 50% N<sub>2</sub>O with 50% O<sub>2</sub>
- ▶ It is delivered in gas bottles (5 a 10 l) with LIV valve (Linde integrated valve)
- ▶ The upper part of the bottle is marked with a white and blue stripes – mark for a mixture of oxygen and nitrous oxide
- ▶ White cylinder body – designation for medical gas
- ▶ Average number of procedures (lasting about 10 minutes) 20–40





# Gas bottle Entonox

1. Continuous flow controller with output
2. Active manometer – gas quantity indicator
3. Shut-off valve
4. Handrail
5. Quick coupling with blanking plug
6. Technological input for bottle filling



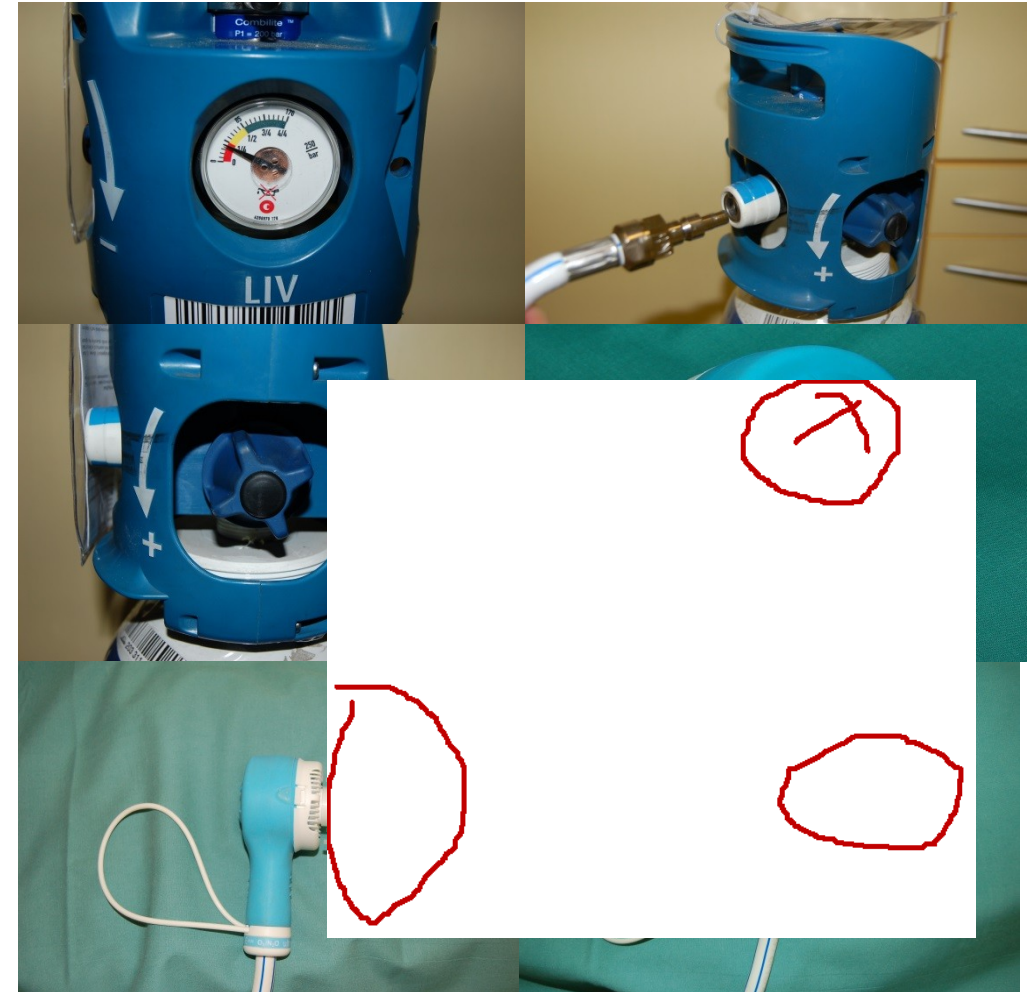
# Breathing valve Carnét

- ▶ Valve body with test button and loop
- ▶ Hose for connection to the bottle
- ▶ Inhalation attachment / mask



# Instructions before the application

- ▶ 1. to control the amount of gas on active manometr, continuous flow controller is closed
- ▶ 2. to connect quickcoupler, of breathing valve Carnét
- ▶ 3. to open closing valve in the direction of mark
- ▶ 4. to check the flow of gas by the botton Press
- ▶ 5. The filter and mouthpiece or mask is put on breathing valve.



# Application

- ▶ We put a white strap on the patient's hand and insert the inspiratory valve with the filter and mouthpiece into the patient's hand
- ▶ The patient wraps the mouthpiece with his mouth and inhales – deep breaths only through the mouth and exhalations through the nose and mouth
- ▶ With the inhalation mask you can inhale through the nose even through the mouth
- ▶ Inhale for at least 1 minute, max for effect after 2–3 minutes



# After the application

- ▶ Close the valve in the direction of the arrow
- ▶ Drain the rest of gas from carnét
- ▶ Disconnect the valve in place of quickcoupler
- ▶ Remove filter with mouthpiece or mask
- ▶ Desinfect Carnét
- ▶ Patient is waiting in the waiting room for 30 minutes till the effect of gas will fade.

# Bottle storage

- ▶ At a temperature higher than  $-5^{\circ}\text{C}$
- ▶ Out of reach of flammable material
- ▶ In well-ventilated rooms
- ▶ Do not expose to strong heat
- ▶ Move to a safe place if there is a risk of fire
- ▶ The bottle must be clean, free of oil or grease
- ▶ Stored in areas reserved for the storage of medical gases
- ▶ Secure the bottle from falls and punches
- ▶ Store and move with closed valves

# Conclusion

- ▶ Contact patient–doctor is necessary – calm speech, suggestion
- ▶ Eliminate negative perceptions – loud speech, manipulation with instruments, we can not hurry, we are quiet
- ▶ Patient reacts to your question, he/she is able to cooperate with the staff
- ▶ Patient is recovered within a few minutes, adults are able to drive a car after 30 minutes
- ▶ Severe side effects are missing

# Thank you for your attention

