Anesthesia sheet

Doctor :

Ashraf Dmour

Done by:

Hala Alzenaty

Bushra Albashaierh

Mona Alzoubi

Corrected by:

Safaa Matar & Ansam Alzubaidi

Definition of general anesthesia

General anesthesia ; is altered physiological state characterized by reversible loss of consciousness , analgesia of the entire body , amnesia , and some degree of muscle relaxation .

Irreversible loss of consciousness = brain death

Diethyl Ether

- 1st inhaled anesthetic

- No longer used as an anesthetic agent

- Others anesthetic agent like chloroform

- later , another agents like cyclopropane ethylene .

- The main problem of these agents : toxicity and flammability .

Pharmacokinetics & Pharmacodynamics

- **Pharmacokinetics** : (how a body affects a drug) the relationship between a drug's dose, tissue concentration , and elapsed time

- **Pharmacodynamics** : (how a drug affects a body) the study of drug action including toxic responses .

maybe cause toxic reaction and release of the histamine which cause bronchoconstriction , edema ,skin rash , VD and tachycardia .

Factors affecting inspiratory concentration (Fi)

1-The fresh gas flow rate

2- The volume of the breathing system

3- Any absorption by the machine or breathing circuit

Factors affecting alveolar concentration (fA)

- Uptake :

1- solubility in the blood

2- Alveolar blood flow (CO)

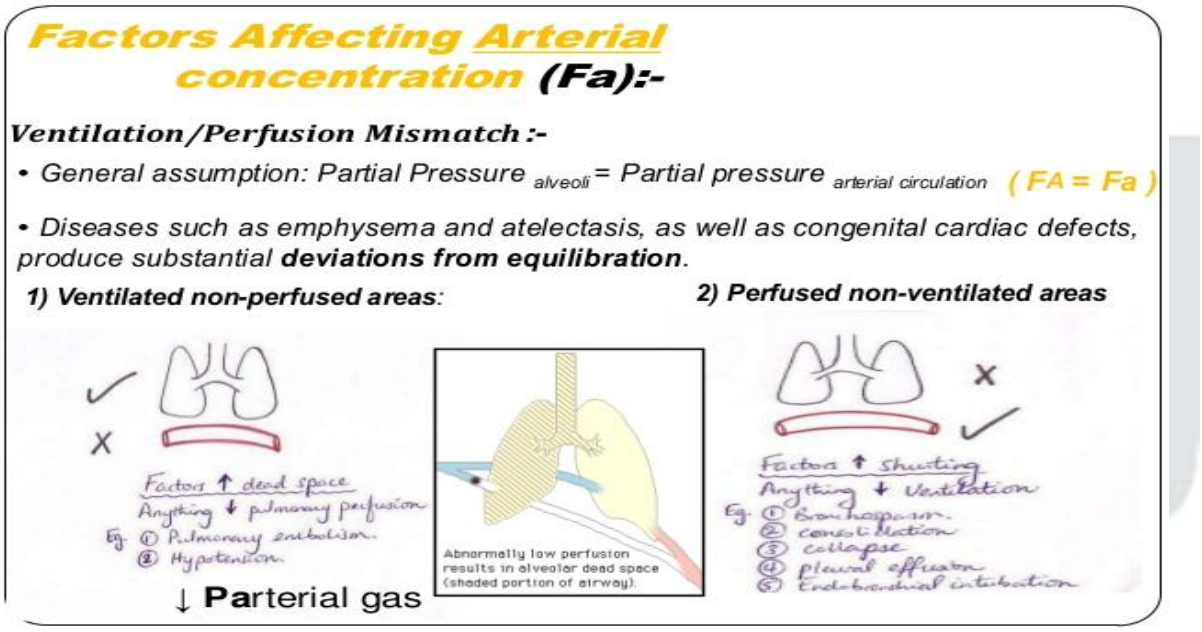
3- The difference in partial pressure between alveolar gas and venous blood .

- Concentration

- Ventilation **(tidal volume * respiratory rate)**

Factors affecting arterial concentration

-Ventilation /perfusion mismatch



Mv =TV x RR

CO = SV x HR

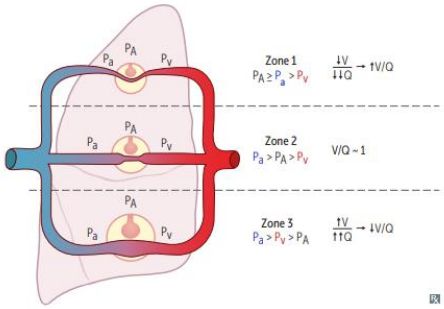
SV = amount of blood /beat

Td the volume of air deliverd to lung with each breath

Ventilation/perfusion mismatch

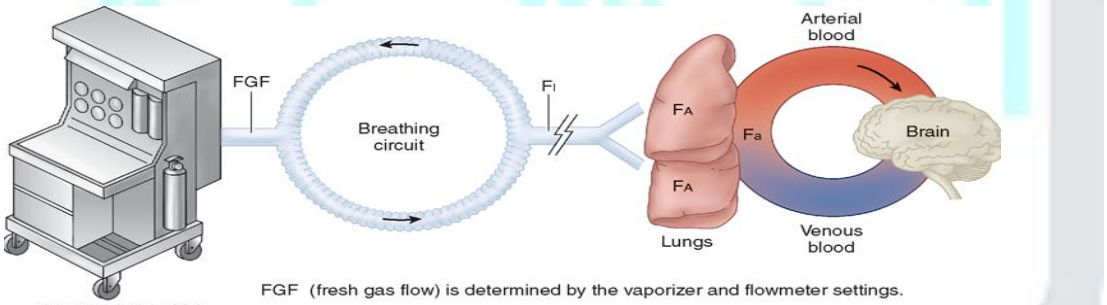
Ideally, ventilation is matched to perfusion (ie, $\dot{V}/\dot{Q} = 1$) for adequate gas exchange.
Lung zones:
- $\dot{V}/\dot{Q}$ at apex of lung = 3 (wasted ventilation)
- $\dot{V}/\dot{Q}$ at base of lung = 0.6 (wasted perfusion)

Both ventilation and perfusion are greater at the base of the lung than at the apex of the lung.
With exercise (↑ cardiac output), there is vasodilation of apical capillaries → $\dot{V}/\dot{Q}$ ratio approaches 1.
Certain organisms that thrive in high O_2 (eg, TB) flourish in the apex.
$\dot{V}/\dot{Q} = 0$ = "oirway" obstruction (shunt). In shunt, 100% O_2 does not improve Pao_2 (eg, foreign body aspiration).
$\dot{V}/\dot{Q} = \infty$ = blood flow obstruction (physiologic dead space). Assuming < 100% dead space, 100% O_2 improves Pao_2 (eg, pulmonary embolus).



- Diseases that affect **ventilation** : COPD , asthma , airway obstruction , foreign body , pneumonia , aspiration , atelectasis

- PE & Hypotension affects **perfusion**



FGF (fresh gas flow) is determined by the vaporizer and flowmeter settings.

FI (inspired gas concentration) is determined by (1) FGF rate; (2) breathing-circuit volume; and (3) circuit absorption.

FA (aveolar gas concentration) is determined by (1) uptake (uptake = λb/g x C(A-V) x Q); (2) ventilation; and (3) the concentration effect and second gas effect:
a) concentrating effect
b) augmented inflow effect

Fa (arterial gas concentration) is affected by ventilation/perfusion mismatching.

- The content of vaporizer is the inhalational agent

- Flowmeter contains three gasses (O2 ,NO, Air) from central medical supply in hospital .

- Inhalational agent is liquid and we well put it in vaporizer to convert it to gas and deliver it to patient

- Flowmeter (1-10)L/min maximum

- When the gas mixed it gives FGF (fresh gas flow) its determined by vaporizer (volume%) and flow meters

- Fi = inspired gas concentration

- Increased diameter & length of breath circuit increases the dead space & decrease Fi

- increased flexibility of breathing circuit if its expired lead to increase absorption of gas by machine it self

- Increase FGF >> increase Fi

- Alveolar concentration (FA) determined by : uptake by pulmonary circulation

- Higher blood solubility of agent = More uptake = FA will increase slowly = slower induction & recovery = more potent

- More lipid soluble agent = FA will increase slowly = slower induction & recovery = more potent

- less lipid soluble agent = rapid induction & recovery = less potent

In obese patient = drug will dissolve in high amount of lipid so small amount will reach the brain = slow induction

Fa = V/Q mismatch

Upright position = apical lung 1/0

middle lung 1/1 =1

base of lung 0/1 =0

V= 0 (Asthma / Atelectasis / COPD / Pneumonia / Emphysema)

P=0 (PE)

Theories of anesthetics action

1- The reticular activating system

2- The cerebral cortex

3- The cuneate nucleus

4- The olfactory cortex

5- The hippocampus

> How to determine the potency of the anesthtetic agent ?

- MAC .. minimum concentration of alveolar gas that prevent movement in 50% of patient for any surgical stimulation

- Blood solubility .. More blood soluble = more potent

- Meyer- overtone role .. More lipid soluble agent = more potent

Pharmacologic Properties of Common Inhaled Anesthetic Agents							
Agent	Blood/ Gas	Brain/ Blood	Muscle/ Blood	Fat/ Blood	Vapor Pressure (mm Hg, 20°C)	MAC (%) 30–60 yrs	MAC(%) >65yrs
Nitrous oxide	0.46	1.1	1.2	2.3	—	104	—
Halothane	2.5	1.9	3.4	51	243	0.75	0.64
Isoflurane	1.5	1.6	2.9	45	248	1.2	1.0
Desflurane	0.42	1.3	2.0	27	669	6.6	5.2
Sevoflurane	0.65	1.7	3.1	48	157	1.8	1.45

- more potent = decreased MAC

- Halothane more potent and more lipid soluble = 0.75

1 MAC = effective dose 50%

MAC x 1.3= 95% effective dose

1 MAC halothane we should open the vaporizer on 0.75

1 MAC desflurane we should open the vaporizer on 6.6

Pregnant can be exposed to anesthesia after 3 months

MAC awake = 0.3 * MAC (when patient get awake)

Factors affecting MAC:

1) Temperature (either hypo/hyper= decreased MAC)

2) Age (one decade increase in age = 6% decrease in MAC)

3) Alcohol

Chronic alcohol intoxication = increase the MAC (due to intolerance)

Acute alcohol intoxication = decrease the MAC (brain already depressed)

4) Anemia = decrease MAC

5) PaO2< 40 = decrease MAC

6) PaCO2> 95 = decrease MAC

7) Blood pressure= decrease MAC

8) Electrolytes (hypercalcemia , hyponatremia) = decrease the MAC

9) Pregnancy (at 8th week , decrease MAC)

10) Iv anesthetic agents

11) Amphetamine(sympathomimic)

acute intoxication on brain stimulation = need high dose = increase MAC

12) Cocaine

13) Ephidrine } Increase MAC

Halogenated Organic Compounds:

- Isoflurane and sevoflurane are the most commonly used agents in this class

- Others include Desflurane, Halothane, Methoxyflurane, and Enflurane, but these are not commonly used

- Liquid at room temperature

- Stored in a vaporizer on an anesthetic machine

- Vaporized in oxygen that flows through the vaporizer

Blood:Gas Partition Coefficient:

- The measure of the solubility of an inhalation anesthetic in blood as compared to alveolar gas (air)

- Indication of the speed of induction and recovery for an inhalation anesthetic agent

- Low blood:gas partition coefficient

  - Agent is more soluble in alveolar gas than in blood at equilibrium

  - Agent is less soluble in blood

  - Faster expected induction and recovery

Uptake and Distribution of Halogenated Organic Compounds

- Liquid anesthetic is vaporized and mixed with oxygen

- Mixture is delivered to the patient via a mask or endotracheal tube (ET tube)

- Mixture travels to lungs (alveoli) and diffuses into the bloodstream

- Diffusion rate is dependent on concentration gradient (alveoli/capillary) and lipid solubility of the anesthetic gas

- Concentration gradient is greatest during initial induction

Elimination of Halogenated Organic Compounds

- Reducing amount of anesthetic administered reduces amount in the alveoli

- Anesthetic will move from the brain into the blood and then into the alveoli where it is finally breathed out

- Patient wakes up

Isoflurane

Most commonly used inhalant agent in North America

Approved for use in dogs and horses; commonly used in other species

Properties :

- Low blood:gas partition coefficient = rapid induction and recovery

- Not Good for induction with mask or chamber

- MAC = 1.2 : helps determine initial vaporizer setting

Effects and Adverse Effects:

- Maintains cardiac output, heart rate, and rhythm

- Fewest adverse cardiovascular effects

- Depresses the respiratory system

- Maintains cerebral blood flow

- Almost completely eliminated through the lungs- 0.2% metabolized by the liver

- Induces adequate to good muscle relaxation

- Provides little or no analgesia after anesthesia

- Difficult to mask patient (bad smell & irritation to airway)

- Can produce carbon monoxide when exposed to a desiccated carbon dioxide absorbent (as soda lime)

When we increase the MAC rapidly from 1-3 cause transient increase in the heart rate and cause coronary steal syndrome

Sevoflurane

- Low Blood:gas partition coefficient = rapid induction and recovery
- Good for induction with a mask or chamber
- High controllability of depth of anesthesia
- MAC = 2.0
- Cost about 10x more than Isoflurane
- Easier to mask a patient, more pleasant smelling

Effects and Adverse Effects :

- Minimal cardiovascular depression
- Depresses respiratory system
- Eliminated by the lungs, minimal hepatic metabolism- 2-5%
- Maintains cerebral blood flow
- Induces adequate muscle relaxation
- Some paddling and excitement during recovery
- No post-op analgesia
- Can react with potassium hydroxide (KOH) or sodium hydroxide (NaOH) in desiccated
- CO_2 absorbent to produce a chemical (Compound A) that causes renal damage

Desflurane

- Closely related to isoflurane
- Expensive
- Lowest blood:gas partition coefficient: very rapid induction and recovery
- Used with a special heated electronic precision vaporizer
- MAC = 6.0 (Least potent inhalant agent)
- Eliminated by the lungs- 0.02% metabolized in liver

Effects and Adverse Effects

- Strong vapors cause coughing and holding the breath= difficult to mask

- Other effects are similar to isoflurane

- Transient increase in heart rate and blood pressure (humans)

- Produces carbon monoxide with spent soda lyme

Other Halogenated Inhalation Agents

Halothane (Fluothane):

- Not available anymore

- replaced by isoflurane and sevoflurane

- B:G -2.54

- 20-46% metabolized in the liver

- MAC= 0.75

- Sensitizes heart to catecholamine and induces arrhythmias

- Cardiac, respiratory depression

- Increased cerebral blood flow

Nitrous Oxide :

- Used primarily in human medicine; some veterinary use

- A gas at room temperature; no vaporizer is required

- Mixed with oxygen at 40-67%, then delivered to patient

- Reduces MAC 20-30%

- Used with Halothane and Methoxyfluraneto reduce the adverse effects of these gases

Archive Questions

MCQs :

1) Halothane effects in CNS except one:

a. Increases cerebral blood flow

b. Maintain organ stores lation

c. Decreases cerebral 02 consumption

d. Decreases cerebral metabolism

e. Increases ICP.

Ans : b

2) The main reason Desflurane is not used for inhalational induction in clinical practice is because of?

a. Its low blood/gas partition coefficient

b. Its propensity to produce hypertension in high concentration

c. Its propensity to produce airway irritability

d. Its propensity to produce tachyarrhythmias

e. Its lipid solubility.

Ans : c

3) Which of the following is known as laughing gas?

a. C02 b. N20 c. N02 d. B20.

Ans: b

4) What mixture of gases are used in anesthesia?

a. 02 and N2O

b. 02 and CO2

c. CO2 and N20

d. 02 , CO2 and N20

e. 02 and He

Ans: d

5) Which of the following is Wrong about desflurane:

a. closely related to isoflurane

b. uses special electronic vaporizer

c. can produce compound A

d. highly fluridated agent

e. has B:G CO of 2.6

Ans: e

6)What's MAC for isoflurane in awake pt ?

a. 1.2 b. 0.3 c. 2.4 d. 0.6

Ans : b

Written:

1)Factors affect inhalational anesthesia

2)Factors which influence the rate of uptake (inhalational)

3)Factors that decrease MAC

ففُزْ بعلم تعِشْ حيّا بهِ أبدًا فالنّاسُ مَوتى وأَهلُ العلمِ أحياءُ