Episode 193: Pharmacology of Inhaled Anesthetics

On this episode: Drs. Gillian Isaac and Jed Wolpaw

In this 193rd episode I welcome Dr. Gillian Isaac back to the show to discuss another ABA Key Word topic. This time we discuss the pharmacology of inhaled anesthetic agents.

All Keyword Episodes

Questions & Notes

Click → jump to answers/notes.

PHYSICAL PROPERTIES

Vapor Pressure

VAPOR PRESSURE OF VOLATILE DEPENDS ON

a) Temp only

b) Ambient pressure

c) Temp and ambient pressure

d) Pressure and volume of system

e) None of above

- Answer

BLOOD:GAS (BG) COEFFICIENT

BG COEFFICIENT FOR INHALED ANESTHETIC OF 13. RECOVERY TIME DEPENDS PRIMARILY ON?

a) Oil:gas solubility

b) Cardiac output

c) Tidal volume

d) Duration of administration

e) MAC of drug

- Answer

NEW ANESTHETIC BG OF 0.2. WHICH STATEMENT IS TRUE COMPARED TO ISOFLURANE?

a) MAC lower

b) Diff b/w F_A and Fi during maintenance is greater

c) Time to emergence shorter

d) Rapid induction requires pressure

e) Equilibrium within circle system is same when FGF slower

- Answer

WHICH CHARACTERISTIC OF INHALED ANESTHETIC MOST CLOSELY CORRELATES WITH RECOVERY OF ANESTHESIA?

a) Blood:gas coefficient

b) Blood:brain coeffiecient

c) Fat:Blood coefficient

d) MAC

- Answer

WHICH CONCEPT MOST CLOSELY ASSOCIATED WITH MAC?

a) Blood:gas coefficient

b) Oil:gas (OG) coefficient

c) Vapor pressure

d) Brain:blood coefficient

- Answer

COMPARED TO OTHER VOLATILE ANESTHETIC, DESFLURANE HAS WHICH CHARACTERISTIC?

a) Equipotency to isoflurane

b) Greater extent of biotransformation than enflurane

c) Less airway irritation than halothane

d) Lower BG than enflurane

e) Lower VP than iso

- Answer

MINIMUM ALVEOLAR CONCENTRATION (MAC), FACTORS AFFECTING MAC *

Pathologic states increase

Pathologic states decrease

Negligible effect

WHICH OF FOLLOWING LOWERS MAC?

a) Na 151

b) Red hair

c) Increased body temp

d) Acute ethanol ingestion

- Answer

FOLLOWING PHYSIOLOGIC STATES DECREASE MAC EXCEPT?

a) Anemia

b) Hypercarbia

c) Pregnancy

d) Hyperthermia

- Answer

SYSTEMIC EFFECTS

Cardiovascular system effects

Respiration effects

CNS effects

WHICH NORMAL EEG FINDING IN ADULT

a) ↓ Frequency during induction w/ halogenated anesthetic

b) ↓ Frequency in frontal areas w/ N2O

c) Dominance of 20-30 Hz during awake/relaxed state

d) Electrical silence w/ iso 2.5 MAC

e) Burst suppression during natural sleep

- Answer

DURING SPONTANEOUS BREATHING, VOLATILE AGENTS

a) ↑ TV, ↓ RR

b) ↑ TV, ↑ RR

c) ↓ TV, ↓ RR

d) ↓ TV, ↑ RR

Answer

WHICH INHALATIONAL AGENT MODERATELY ↑ CARDIAC OUTPUT?

a) Sevoflurane

b) Iso

c) Des

d) Nitrous oxide

- Answer

ABRUPT LARGE INCREASE IN WHICH INHALATIONAL AGENT MOST LIKELY PRODUCE TRANSIENT ↑ MAP AND HR?

a) Sevo

b) Iso

c) Des

d) Nitrous oxide

- Answer

AT 1.0 MAC, ISOFLURANE WILL DECREASE ALL FOLLOWING EXCEPT

a) Cardiac output

b) Contractility

c) Stroke volume

d) SVR

- Answer

COMPARED W/ OTHER VOLATILE ANESTHETIC, DES HAS WHICH CHARACTERISTIC?

a) Equipotency to iso

b) Greater extent of biotransformation to isoflurane

c) Less airway irritation than halothane

d) Lower BG solubility than enflurane

e) Lower VP than iso

- Answer

WHICH OF FOLLOWING ↑ CBF WHILE ↓ CMR?

a) Etomidate

b) Fentanyl

c) Iso

d) Midazolam

- Answer

METABOLISM

PREDISPOSING FORMATION OR REBREATHING OF COMPOUND A INCLUDE ALL EXCEPT?

a) Low FGF

b) Use of hydroxide calcium rather than Soda lime

c) High absorbent temp

d) Fresh absorbent

- Answer

70F W/ PREOP CR OF 2.1 DEVELOPS OLIGURIA DURING ENFLURANE ANESTHESIA. UNA 10, UOSM 450. MOST LIKELY CAUSE?

a) Acute renal failure

b) Chronic renal insufficiency

c) Decreased renal perfusion

d) Fluoride nephrotoxicity

e) Intraop admin of Lasix

- Answer

FOLLOWING ENFLURANE ANESTHESIA, SERUM FREE FLUORIDE CONCENTRATION MOST LIKELY INCREASED IN ASSOCIATED W/ LONG TERM USE OF ?

a) Diazepam

b) Ethanol

c) Isoniazid

d) Phenobarbital

e) Phenytoin

- Answer

HIGHER SERUM FLUORIDE LEVELS SEEN AFTER ADMIN OF WHICH OF FOLLOWING?

a) Des

b) Enfl

c) Halotha

d) Iso

e) Sevo

- Answer

TRACE CONCENTRATIONS

HIGHEST TRACE CONCENTRATION OF NITROUS ALLOWED IN OR?

a) 1 PPM

b) 5 PPM

c) 25 PPM

d) 50 PPM

- Answer

HIGHEST CONCENTRATION OF VOLATILE IN OR WHEN ADMIN W/ NITROUS?

a) 0.5ppm

b) 2ppm

c) 5ppm

d) 25ppm

- Answer

GREATEST SOURCE OF CONTAMINATION OF OR W/ VOLATILE ANESTHETICS?

a) Around mask

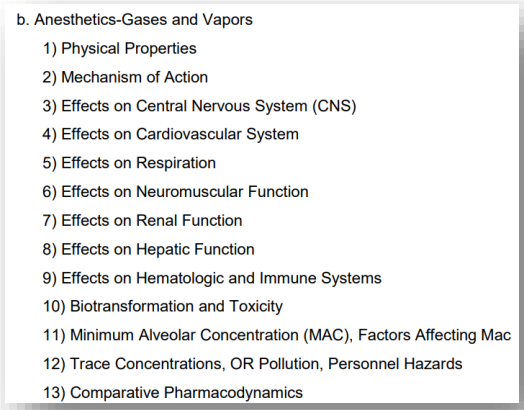
b) Vaporizer

c) Co2 absorber

d) ETT

- Answer

ABA Content Outline:



Physical Properties

Vapor Pressure

4:43

- In a closed container, molecules that escape liquid phase becomes vapor
- Correlated with temperature

Vapor pressure of volatile depends on

5:24

a) Temp only
b) Ambient pressure
c) Temp and ambient pressure
d) Pressure and volume of system
e) None of above

- Answer
    - A: may confuse this with ambient pressure

Blood:gas (BG) coefficient

6:26

- How gas will partition itself in two phases after equilibrium reached
- Higher coefficient (lipophilicity ~ solubility) = more in blood than gas = more uptake needed = slower induction

BG coefficient for inhaled anesthetic of 13. Recovery time depends primarily on?

7:28

a) Oil:gas solubility
b) Cardiac output
c) Tidal volume
d) Duration of administration
e) MAC of drug

- Answer
    - High BG = very soluble = take longer for onset/offset
    - Longer duration → difference in coefficient magnified eg des vs iso

New anesthetic BG of 0.2. Which statement is true compared to isoflurane?

9:18

a) MAC lower
b) Diff b/w F_A and Fi during maintenance is greater
c) Time to emergence shorter
d) Rapid induction requires pressure
e) Equilibrium within circle system is same when FGF slower

- Answer
    - In general, iso BG is higher than des/sevo (~0.4-0.67), so relative to this – new agent is more insoluble = time to emergence shorter

Which characteristic of inhaled anesthetic most closely correlates with recovery of anesthesia?

10:34

a) Blood:gas coefficient
b) Blood:brain coeffiecient
c) Fat:Blood coefficient
d) MAC

- Answer
    - Induction/recovery: BG

Which concept most closely associated with MAC?

11:24

a) Blood:gas coefficient
b) Oil:gas (OG) coefficient
c) Vapor pressure
d) Brain:blood coefficient

- Answer
  - OG ~potency ~ MAC
  - Different than induction/recovery

Compared to other volatile anesthetic, desflurane has which characteristic?

12:28

a) Equipotency to isoflurane
b) Greater extent of biotransformation than enflurane
c) Less airway irritation than halothane
d) Lower BG than enflurane
e) Lower VP than iso

- Answer
  - Des is insoluble = BG low. Enflurane, like iso is more soluble
  - Des causes most airway irritation
  - Des is still bronchodilatory, but is irritating

Minimum Alveolar Concentration (MAC), Factors Affecting MAC *

14:11

Pathologic states increase

- hyperthermia
- hypernatremia
- chronic alcohol use
- acute sympathomimetics

Pathologic states decrease

- anemia
- hypercarbia
- hypoxia
- hypothermia
- hypotension
- pregnancy

Negligible effect

- gender

- height
- weight

Which of following lowers MAC?

15:06

a) Na 151
b) Red hair
c) Increased body temp
d) Acute ethanol ingestion

- Answer
  - D

Following physiologic states decrease MAC EXCEPT?

15:55

a) Anemia
b) Hypercarbia
c) Pregnancy
d) Hyperthermia

- Answer
  - D

Systemic effects

16:56

Cardiovascular system effects

- MAP? ↓
- HR? minimal
- Rapid administration of desflurane will ↑ both

Respiration effects

- RR? ↑
- TV? ↓
- "rapid and shallow"

CNS effects

- CBF? Minimal no to increased effect, though ↓ CMRO2

Which normal EEG finding in adult

18:57

a) ↓ Frequency during induction w/ halogenated anesthetic
b) ↓ Frequency in frontal areas w/ N2O
c) Dominance of 20-30 Hz during awake/relaxed state
d) Electrical silence w/ iso 2.5 MAC
e) Burst suppression during natural sleep

- Answer
    - Test taking tip: if you don't know, ask yourself what you do know rather than just taking a random guess.
    - 2.5 MAC sounds like a lot, and already know volatiles can ↓ CMRO2, so will go with this one
    - A: increase in frequency into disinhibition
    - B: doesn't make sense that it localizes in one area
    - D: likely wouldn't see burst suppression

During spontaneous breathing, volatile agents

21:32

a) ↑ TV, ↓ RR
b) ↑ TV, ↑ RR
c) ↓ TV, ↓ RR
d) ↓ TV, ↑ RR

Answer

- "rapid shallow breathing"

Which inhalational agent moderately ↑ cardiac output?

21:55

a) Sevoflurane
b) Iso
c) Des
d) Nitrous oxide

- Answer
    - Think of nitrous as supporting BP, while other ↓ SVR

Abrupt large increase in which inhalational agent most likely produce transient ↑ MAP and HR?

23:18

a) Sevo
b) Iso
c) Des
d) Nitrous oxide
- Answer
    - Des

At 1.0 MAC, isoflurane will decrease all following except

23:35

a) Cardiac output
b) Contractility
c) Stroke volume
d) SVR
- Answer
    - Volatiles have some myocardial depressant activity thus also contractility and stroke volume, and some cardiac output which may be balanced by ↓ SVR

Compared w/ other volatile anesthetic, des has which characteristic?

24:26

a) Equipotency to iso
b) Greater extent of biotransformation to isoflurane
c) Less airway irritation than halothane
d) Lower BG solubility than enflurane
e) Lower VP than iso
- Answer
    - D

Which of following ↑ CBF while ↓ CMR?

25:05

a) Etomidate
b) Fentanyl
c) Iso
d) Midazolam
- Answer
    - Volatiles are good for this reason

Metabolism

25:31

- Microsomal enzymes in liver and kidney that metabolize certain amount
- Halothane most 10-20% likely associated with halothane hepatitis
- 0.2% isoflurane
- ~0% nitrous
- 3% sevo
    - p450 → Inorganic fluoride byproduct → renal toxicity
    - Circle system
        - certain amount of compound A in rats for certain duration caused nephrotoxicity
        - concern for human relevance

Predisposing formation or rebreathing of compound A include all except?

27:19

a) Low FGF
b) Use of hydroxide calcium rather than Soda lime
c) High absorbent temp
d) Fresh absorbent

- Answer
    - Another strategy: look at each as T/F
    - B

70F w/ preop Cr of 2.1 develops oliguria during enflurane anesthesia. uNa 10, uOsm 450. Most likely cause?

28:17

a) Acute renal failure
b) Chronic renal insufficiency
c) Decreased renal perfusion
d) Fluoride nephrotoxicity
e) Intraop admin of Lasix

- Answer
    - Prerenal picture = ↓ renal perfusion

Following enflurane anesthesia, serum free fluoride concentration most likely increased in associated w/ long term use of ?

29:11

a) Diazepam
b) Ethanol
c) Isoniazid
d) Phenobarbital
e) Phenytoin
- Answer
    - C – ramp up p450

Higher serum fluoride levels seen after admin of which of following?

30:10

a) Des
b) Enfl
c) Halotha
d) Iso
e) Sevo
- Answer
    - Sevo

Trace concentrations

30:28

- Just memorize it!

Highest trace concentration of nitrous allowed in OR?

30:49

a) 1 PPM
b) 5 PPM
c) 25 PPM
d) 50 PPM
- Answer
    - Test taking strategy: not picking extreme, going for one in middle
    - Statistically C is more likely to be correct
    - C

Highest concentration of volatile in OR when admin w/ nitrous?

31:28

a) 0.5ppm
b) 2ppm
c) 5ppm
d) 25ppm
- Answer
    - Safety, probably lower: answer A

Greatest source of contamination of OR w/ volatile anesthetics?

32:03

a) Around mask
b) Vaporizer
c) Co2 absorber
d) ETT
- Answer
    - A

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