

## Quiz Section On Anaesthesia

A Gupta, V Dhulkhed

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### Abstract

### QUESTIONS

#### 1) Cerebral perfusion pressure (CPP)

- a) Is satisfactory if more than 70 mmHg in a patient with a head injury
- b) Is calculated by adding mean arterial pressure (MAP) and ICP
- c) Falls if arterial BP falls following induction of anaesthesia
- d) Can be calculated by "guessing" ICP to be 20 mmHg after a head injury causing 5 min unconsciousness
- e) When low should be treated by infusing dextrose-saline solution

#### 2) Concerning inhalational volatile agents

- a) The increase in ICP with halothane can be minimized by hyperventilating the patient
- b) Halothane is less soluble in blood than sevoflurane
- c) Recovery following anaesthesia with isoflurane is more rapid than after sevoflurane
- d) During ether anaesthesia for neurosurgery, spontaneous respiration is acceptable
- e) When the brain is swollen, if arterial blood pressure falls during halothane anaesthesia, it will not cause harm

#### 3) Oxygen consumption

- a) Is increased in malignant hyperpyrexia
- b) Is increased under general anaesthesia
- c) In health, is critically dependent on oxygen delivery
- d) Is approximately 2L/min in the resting adult
- e) When increased, causes a decrease in the mixed venous PO<sub>2</sub> (assume oxygen delivery remains constant)

#### 4) Pre-oxygenation

- a) Can be started in the ward prior to coming to theatre
- b) As part of a rapid sequence induction occurs following induction of anaesthesia but before intubation of the trachea

- c) Causes a significant increase in the oxygen bound to haemoglobin in the blood
- d) Should take place through an anaesthetic circuit and a high oxygen flow rate and the mask held just off the face
- e) Allows for acceptable oxygenation during 10 minutes of apnoea

5) After recent significant head injury with loss of consciousness and a period of decreased GCS, suitable anaesthetic techniques for fixation of fractured elbow include:

- a) local anaesthetic block
- b) spontaneous ventilation with 2% halothane
- c) intravenous ketamine
- d) ventilation with a low concentration of whatever volatile agent is available to you (eg 0.5% halothane)
- e) avoidance of suxamethonium

6) A pregnant patient complains of difficulty breathing and tingling in the arms soon after a spinal with heavy bupivacaine for Caesarean section. Actions to perform include:

- a) place the patient head down
- b) give oxygen and be ready to control the airway
- c) speed the iv infusion up
- d) place a pillow under the head and shoulders
- e) leave the room to continue scrubbing up for surgery.

#### 7) Concerning pain relief in children:

- a) they have no need for pain relief
- b) morphine is too dangerous to give
- c) NSAIDs should not be used
- d) paracetamol is too weak to be useful
- e) local anaesthetic blocks are useful

8) Treatment of an anaphylactic reaction includes:

- a) adrenaline

- b) steroids
- c) iv fluids
- d) antihistamine
- e) antibiotics

9) The GCS (Glasgow Coma Scale):

- a) Has a minimum score of 0
- b) Scores pupil size
- c) A confused patient would score 13
- d) If reduced in presence of a skull fracture is a worrying sign
- e) If 15 in presence of a skull fracture is reassuring

10) Concerning failed intubation:

- a) Never remove cricoid pressure if the stomach is full
- b) If you cannot intubate or ventilate a surgical airway is indicated
- c) Don't worry how long it takes- try, try, try again until you are successful at intubating
- d) The safest plan is to wake the patient up before using an alternative approach
- e) Repositioning the patient's head and neck may be useful manoeuvres

11) Breathing circuits:

- a) The Mapleson A system is efficient during controlled ventilation.
- b) During spontaneous ventilation, the Mapleson A system requires a fresh gas flow (FGF) of 150ml/kg/min.
- c) During controlled ventilation a Bain circuit requires a FGF of 70-100ml/kg/min.
- d) During spontaneous ventilation a Lack circuit will conserve dead space gas.
- e) The Jackson-Rees modification of the Ayres T piece has a closed bag at the end of the expiratory limb.

12) Ophthalmic anaesthesia:

- a) The oculo-cardiac reflex is mediated by the sympathetic nerve supply.
- b) Suxamethonium is absolutely contraindicated in penetrating eye injury.
- c) An intra-ocular pressure (IOP) of 25mmHg is normal.
- d) Patients with myopia have greater risk of orbit puncture with peribulbar blocks.
- e) Ketamine is an appropriate induction agent in a penetrating eye injury.

13) Paediatric physiology:

- a) Infants have a lower functional residual capacity (FRC) than adults.
- b) Stroke volume is relatively fixed.
- c) An appropriate maintenance fluid requirement for a 26kg child would be 46mls/hr.
- d) Infants have a lower closing volume than adults.
- e) Alveolar minute ventilation (MV) is approximately 60ml/kg/min

14) The following statements about the Rotameter are true:

- a) It is a constant pressure variable orifice flow meter
- b) Viscosity is the most important determinant of flow at high flow rates
- c) Small changes in temperature cause significant inaccuracies in flow measurement
- d) Static electricity may cause inaccuracies in flow meters
- e) CO<sub>2</sub> can safely be administered via a properly calibrated air Rotameter.

15) When performing regional blocks:

- a) An axillary brachial plexus block is appropriate for shoulder surgery
- b) The tourniquet can be released 10 minutes after injection of local anaesthetic for a Bier's block
- c) There is a greater risk of pneumothorax with the supraclavicular than axillary approach to a brachial plexus block
- d) A 3-in-1 block is an appropriate technique for blocking the lumbar plexus
- e) Spinal opioids can cause itching.

16) Postoperative shivering

- a) Is due to the use of volatile anaesthetic agents
- b) May cause hypoxia in recovery
- c) May be arrested by a single dose of 25mg pethidine intravenously
- d) Does not occur after spinal anaesthesia
- e) The incidence of shivering with extradural analgesia is reduced by the concurrent use of an opiate

17) Considering malignant hyperthermia during anaesthesia

- a) Sevoflurane is a precipitant
- b) The incidence is about 1 in 50,000 anaesthetics
- c) Inheritance is by an autosomal dominant mechanism
- d) Mannitol is added to vials of dantrolene to aid management of haemoglobinuria
- e) Profound muscle weakness can result from the effect of

dantrolene on calcium transport

18) In a patient with severe aortic stenosis undergoing a general anaesthetic

- a) There is a direct relationship between calculated aortic valve area and blood flow across the valve
- b) A peak aortic valve gradient of 30mmHg is not compatible with the diagnosis
- c) A faster heart rate will be important to help left ventricular filling
- d) A reduction in systemic vascular resistance has little effect on ventricular emptying
- e) Episodes of myocardial ischaemia should be treated with GTN

19) The following are true concerning humidity and humidification of gases

- a) Relative humidity is the ratio of absolute humidity to saturated humidity at a specified temperature
- b) Operating theatre humidity should be maintained at no more than 30%
- c) Heat and moisture exchangers can achieve 40% humidity
- d) A nebuliser works on the poiseuille effect to entrain water across a pressure drop
- e) The water trap for a simple bottle humidifier must be larger than the humidifier bottle

20) Diathermy safety

- a) Ohm's law states that voltage = current x resistance
- b) Diathermy works because there is a high current density at the active electrode
- c) The heat energy produced by cautery is proportional to the current at the tip of the active electrode
- d) Bipolar diathermy requires a passive electrode ('diathermy plate')
- e) Poor contact of the passive electrode ('diathermy plate') may lead to inadvertent patient burns

### KEY TO QUESTIONS

1) TFTTF

Cerebral perfusion pressure (CPP) is one of the most important variables to understand and have in mind when dealing with neurosurgical patients. Cerebral perfusion pressure is calculated by SUBTRACTING ICP from MAP.

CPP = MAP – ICP Often ICP is not known, but it is reasonable to make a sensible guess that it is approximately 20 mmHg when the brain is swollen. This situation would

exist for 3-5 days following a significant head injury. Head trauma which is sufficient to cause unconsciousness, however brief is significant. CPP will fall if arterial pressure falls, but if the patients have a high ICP; it should be treated quickly with colloid, 0.9% saline (normal) or catecholamine boluses such as ephedrine 3-6 mg. It should never be treated with a potentially hypotonic glucose solution (5% Dextrose or 4% Dextrose/0.18% Saline). These solutions are contraindicated as they will exacerbate cerebral edema.

2. TFFFF

The increase in ICP occurs because CBF and then arterial blood volume increases. Hyperventilation reduces arterial CO<sub>2</sub>; this induces cerebral vasoconstriction which opposes the direct dilating effect of halothane on the cerebral vasculature. Sevoflurane is less soluble than both halothane and isoflurane. Therefore both induction and recovery are rapid. Any fall in blood pressure with halothane may be significant, but is especially important when the patient is decompensated (swollen stiff brain due to oedema, trauma or other pathology). In this situation blood pressure must be kept at control levels by preventing hypovolaemia and supporting the circulation with catecholamines either as boluses or as an infusion. The small doses required in a fully saturated, hypocapnic patient are unlikely to cause arrhythmias. The patient should be carefully monitored for them. Ether is not an ideal agent for neuroanaesthesia, but if it is the only drug available the disadvantages can be reduced by hyperventilating the patient. Spontaneous breathing should not be allowed.

3. TFFFT

Approximately 250 ml of oxygen is consumed by the resting body per minute. Malignant hyperpyrexia increases the metabolic rate and therefore increases oxygen consumption. General anaesthesia causes a reduction in metabolic rate and therefore a reduction in oxygen consumption. In health, oxygen consumption is supply independent. Increased oxygen consumption causes more oxygen to be extracted from the arterial blood (increased extraction ratio) and therefore the venous PO<sub>2</sub> is lower.

4. FFFFF

Preoxygenation involves three minutes breathing 100% oxygen through an anaesthetic circuit with the facemask firmly applied to the face. If performed as part of a rapid sequence induction it should occur before induction of anaesthesia and the increased store of oxygen in the

functional residual capacity can result in a normal PO<sub>2</sub> for up to 8 minutes of apnoea.

### 5. TFFT

Remember that the risk of the patient having a surgically treatable intracranial haematoma must be considered. If this is possible then its investigation and or treatment will take precedence over less urgent surgery. However life saving surgery (e.g. to stop haemorrhage) takes priority over the head injury. Local anaesthesia is ideal in this situation though spinal anaesthesia is contraindicated if there is any risk of raised intracranial pressure. Spontaneous ventilation and high concentrations of volatile agents are a bad mix after significant head injury and can lead to a rise in intracranial pressure and a worsening of the condition. Likewise ketamine will increase intracranial pressure and is contraindicated. Although many anaesthetic textbooks say that suxamethonium can increase intracranial pressure this is a minor point and its benefits in being a quick acting muscle relaxant allowing the anaesthetist to rapidly secure the airway far outweigh any theoretical disadvantage.

### 6. FTTT

The patient is developing a high spinal block. Tingling in the arms represents local anaesthetic spread to low cervical levels. The patient is at risk of apnoea (stopping breathing) if the anaesthetic spreads to higher cervical levels and blocks the nerve supply to the diaphragm. They are also likely to be hypotensive. Head down position encourages flow of the heavy bupivacaine towards the head and will cause total spinal. By raising the height of the head and shoulders you will prevent the local anaesthetic spreading further and possibly prevent a total spinal. The patient may need to be ventilated / intubated if they develop a total spinal

### 7. FFFFT

Children have the same need for good analgesia as adults though their recovery times after surgery can be quicker. As well as being cruel to leave a child without pain relief, it makes management more difficult as a child in pain will be restless, thrashing about the cot and pulling out drips. A well analgesed child will be settled, breathing quietly and much easier to look after as well as being much happier.

Paracetamol is a useful agent- give 20mg/kg as an initial dose then 15mg/kg 6 hourly. NSAIDs may also be usefully used. Morphine works well and 0.1-0.2mg/kg can be given im or pethidine 1-2 mg/kg. Local anaesthetic is very useful

in children but be careful not to use toxic doses.

### 8. TTTT

After any suspected anaphylactic reaction the agent precipitating it should be discontinued. Adrenaline is the agent of choice to stop anaphylaxis. Apart from antibiotics the other agents are useful in the management of anaphylaxis

### 9. FFFT

Minimum GCS score is 3. Noting pupil size is crucial in the assessment of head injury, but is not part of the GCS score. A reduced GCS in association with a skull fracture means that there is a significant possibility (about 1 in 4) of an intracranial

### 10. FTFT

Ventilation of the patient is more important than preventing aspiration - so if cricoid pressure is preventing ventilation, remove it! Decide early that intubation has failed and concentrate of ventilating the patient until they recover spontaneous ventilation.

### 11. FFTT

In spontaneous ventilation the Mapleson A is extremely efficient and requires a FGF of approximately 70ml/kg/min. The Jackson Rees circuit has an open bag.

### 12. FFFT

The oculo-cardiac reflex is mediated by the parasympathetic nerve supply via the vagus. Normal IOP is 10-20mmHg. Ketamine and suxamethonium are not ideal agents for use in induction in these cases but sometimes there are no alternatives e.g. patients with a full stomach.

### 13. TFFF

Maintenance fluid is 4/2/1mls/kg/hr respectively for the first, second and subsequent 10kgs of weight. Infants have a higher closing volume that encroaches upon tidal volumes. Alveolar MV is 100-150ml/kg/min due to higher oxygen demand.

### 14. TFFT

The Rotameter is a constant pressure, variable orifice flowmeter. Inflow occurs via a needle valve into a tapered glass tube, which widens toward the top. When gas flows, a light metal bobbin floats on the gas jet, the height of the bobbin in the calibrated tube indicating the flow rate. At low

flow rates, flow is a function of gas viscosity since the relatively longer and narrower annulus behaves like a tube allowing laminar flow. The Hagen-Poiseuille equation can be applied to calculate flow through a tube:

$$Q = \frac{\pi Pr^4}{8\eta l}$$

8ηl

where Q = flow through a tube

P = pressure across the tube

r = radius

l = length

η = viscosity of the gas.

At high flow rates where the short wide annulus acts like an orifice, flow is turbulent. Here gas density is an important determinant of flow. Each rotameter is accurately calibrated at specific pressure and temperature for its particular gas.

Temperature changes encountered in clinical practice, however, have insignificant effects on accuracy of flow measurement. Inaccuracies may result when the bobbin sticks against the tube because of tilting, static or dirt. Ensuring that the tube is vertical, clean & treated with an antistatic (a thin gold coating or an antistatic spray) will prevent errors in measurement.

15.

a. F

b. F - While intravenous regional anaesthesia is relatively simple, the technique may be extremely hazardous if caution is not exercised. Measures to ensure safety include: siting a second intravenous cannula in a limb other than the operation site; use of an anaesthetic agent considered to be safe for IVRA (e.g. prilocaine, up to 5mg/kg without adrenaline; bupivacaine is contra-indicated for this purpose); use of a double cuffed tourniquet which has been checked for integrity; injecting the drug slowly so as to avoid exceeding the pressure in the tourniquet; not releasing the tourniquet before at least 20 minutes have elapsed since time of injection.

c. T

d. T - Regional anaesthesia for the lower limb:

The lumbar plexus originates from the primary ventral rami of L1-4 ± a contribution from T12. It lies between the quadratus lumborum and psoas muscles. It may be blocked

by either an approach from the groin (3-in-1 block) or a posterior approach (lumbar plexus block).

e. T - Neuraxial opioids:

Opioids were first used clinically by the epidural and intrathecal routes in 1979. Their advantage over local anaesthetic given by these routes is that they produce analgesia without affecting sensory, motor and autonomic function. They bind to opioid receptors in the spinal cord and periaqueductal grey matter of the midbrain, and produce analgesia by inhibiting pain pathways in the dorsal horn of the spinal cord and by stimulating descending inhibitory neuronal pathways. (Gate theory of pain, Melzack & Wall). They are used mainly in combination with local anaesthetics for both intraoperative & postoperative analgesia. The combination may result in better analgesia of longer duration than local anaesthetics alone, and because a lower dose of local anaesthetic is used, there may be less motor block and hypotension. The required dose, onset and duration of action and side effects of spinally administered opioids will depend on their lipid-solubility, molecular weight and shape, degree of ionisation, and the epidural blood flow. These factors affect dural and spinal cord permeability and the systemic absorption of the drugs via epidural veins. Unfortunately, complications of spinally administered opioids include respiratory depression, nausea and vomiting, pruritis (itching) and urinary retention. Pruritis is common after epidural (8.5%) and intrathecal (46%) opioids and may be treated with systemic antihistamines or naloxone. Ref: Ballantyne et al. Pain 1988;33:149-160

16 A. false B. true C. true D. false E. true

The aetiology of shivering remains unknown but is certainly not due to volatile agents. Perioperative cooling and selective transmission of cold sensation because of a differential neural block are possible contributing factors. A small dose of pethidine may abolish it. Doxapram has also been used. Basal metabolic rate can increase 10-fold and hypoxia is common due to increased oxygen requirements for heat production.

Reference: Crossley AWA. Anaesthesia 1992;47:193

17. A. true B. false C. true D. false E. false

Human malignant hyperthermia is inherited as an autosomal dominant with links to gene loci on chromosomes 17 and 19. Triggering agents include suxamethonium, (which can produce a very rapid onset) halothane, enflurane, isoflurane,

desflurane, sevoflurane, methoxyflurane, ether and cyclopropane. The incidence is approximately 1/15,000 anaesthetics. Mannitol is present in bottles of Dantrolene to make the solution isotonic. Miller suggests that 3-4 people will be needed to get a dose of 2gm/kg into solution for an adult. Even in high dose, dantrolene will only produce mild muscle weakness.

Reference: Miller. Anesthesia. Churchill Livingstone. Chapter 31.

18. A. true B. false C. false D. true E. true

In aortic stenosis the normal aortic valve area decreases from 3cm<sup>2</sup> to less than 1cm<sup>2</sup>. Without increased left ventricular systolic pressures the blood flow across the valve is dependent on the pressure gradient. With compensatory hypertrophy of the left ventricle the aortic valve gradient will increase. However later in the disease as the left ventricle dilates and further fails the left ventricular valve gradient will fall as cardiac output falls. A relatively slower heart rate is important to allow adequate time for left ventricular filling and emptying. The increased impedance to left ventricular emptying is at valve level and so changes in systemic vascular resistance will not significantly affect left ventricular emptying. However a decrease in systemic vascular resistance may lead to critical reductions in myocardial perfusion. Episodes of myocardial ischaemia should be treated by firstly increasing systemic perfusion pressure. Vasodilators such as nitrates should be used with extreme caution if at all.

Reference: Hensley. The practice of cardiac anaesthesia. Little, Brown. Anaesthetic management for the treatment of

valvular heart disease. Also Update in Anaesthesia No 14

19. A. true B. false C. true D. false E. true

Absolute humidity is defined as the mass of water in a volume of air. Relative humidity is defined as in the question is usually presented as a %. Humidification devices can be defined as active or passive; vapour or droplet producing; hot or cold and finally functioning in a breathing system or in the atmosphere. Theatre humidity should be around 60% as a compromise between discomfort (if too high) and the increased risk of explosion due to static electricity (if too low). Heat and moisture exchangers can achieve 70% humidification. A nebuliser works on the venturi or bernoulli effect. For a bottle humidifier the water trap should be at least the same size as the humidifier bottle.

20. A. true B. true C. false D. false E. true

Diathermy relies on generation of heat energy from electrical energy. Ohm's law states that voltage = current x resistance ( $V=IR$ ). The heat energy produced = (current)<sup>2</sup> x resistance ( $E=I^2R$ ). At the active electrode there is a high current density due to the small area of the electrode. This leads to the heat energy and cautery. The passive electrode ('diathermy plate') used with unipolar diathermy has a large area and so the current density (and hence the heat produced) is small. However if the contact is poor then either there is a reduced area of contact (with a higher current density) or increased resistance. As  $E=I^2R$  both these faults lead to an increased risk of burning. Bipolar diathermy does not have a passive electrode, and the current passes from an active electrode to a return electrode; these are the two blades of the diathermy forceps.

## References

**Author Information**

**Arun Kumar Gupta, MD**

Dept. of Anaesthesiology, Rural Medical College Loni

**V.K. Dhulkhed, MD**

Dept. of Anaesthesiology, Rural Medical College Loni