ANSWERS to MCQ questions on page 59.

1. TTTFF

The PO_2 of alveolar gas is a balance between the oxygen supplied by breathing (decreased by low minute volume or hypoxic inspired mixture of gases) and the oxygen removed by the blood and used in metabolic processes in the body (increased by shivering). Ventilation / perfusion mismatch will cause a low arterial PO_2 as described in the text but the alveolar PO_2 will be unaffected. In cardiac failure pulmonary congestion may cause ventilation / perfusion mismatch but alveolar PO_2 does not fall unless the minute volume is reduced.

2. FTFTT

The transfer of oxygen from the alveoli to the blood is usually complete by the time the blood has passed a third of the way along the pulmonary capillary. Pulmonary veins take oxygenated blood back to the heart which is then pumped into the aorta. Deoxygenated blood returns to the heart from the lower half of the body via the inferior vena cava. It is then pumped from the right ventricle into the pulmonary arteries.

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 (see fig 3). Increased oxygen consumption causes more oxygen to be extracted from the arterial blood (increased extraction ratio) and therefore the venous PO_2 is lower.

4. FFTFF

Normally the amount of oxygen in the body is only sufficient to sustain life for a few minutes. Oxygen stores are increased dramatically by pre-oxygenation (see figure 4). They depend on blood volume and haemoglobin concentration and on the functional residual capacity (decreased in pregnant women) and the alveolar concentration of oxygen. A pulse oximeter only measures arterial haemoglobin saturation.

5. FTTFF

Anaesthesia is commonly associated with hypoventilation. The chemoreceptor response to hypoxia and hypercapnia is reduced by anaesthesia. Uncomplicated general anaesthesia results in a reduction in metabolic rate.

6. FTFFT

A shunt equivalent to 40% of cardiac output is very large and would need more than 40% oxygen to correct the resultant hypoxia (see figure 6). Hypoxia due to hypoventilation is relatively easily corrected by increasing the inspired oxygen concentration but complete upper airway obstruction requires manoeuvres to clear the airway. Hypovolaemic shock requires 100% oxygen and fluid replacement. 40% oxygen would be suitable prophylactic therapy for a patient with ischaemic heart disease.

7. 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_2 for up to 8 minutes of apnoea.

8. TTTTF

The PO_2 in the trachea while breathing air is about 150 mmHg and in the arterial blood is about 100 mmHg (13 kPa). Atmospheric pressure is 760 mmHg and when breathing 100% oxygen the only other gases in the alveoli are carbon dioxide (40 mmHg) and water vapour (47

mmHg). The PO_2 of oxygen could therefore be as high as 760-(40+47)=673. When cardiac output is low, oxygen delivery is low and more oxygen is extracted from each unit of blood (high oxygen extraction). This causes a low venous PO_2. The PO_2 in mitochondria is very low.

9. TFFTF

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 precidence 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 contraindicatied if there is any risk of raised intracranial pressure. Spontaneous vetilation 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.

10. TTTTF

Answers a-d are all associated with difficult intubation, but a Mallampati 1 score is associated with an easy intubation.

11. TTFTT

Regional anaesthesia is an ideal way to avoid the difficulties of an awkward airway. Spontaneous vetilation allows for maintenance of the airway and anaesthesia can be maintained in this manner or an attempt at larygoscopy and intubation can be made when the patient is deeply anaesthetised. Don't use long acting paralysis in patients who may be difficult to intubate. Ketamine can be used slowly and incrementally to induce and maintain anaesthesia allowing the patient to continue breathing and the airway to be maintained. This is a useful drug if you are inexperienced and unable to consider some of the other options.

12. FFTTT

The hand is better anaesthetised with axillary or supraclavicular block. Twitches or paraesthesiae should be felt in the arm or hand when placing the block as sensation over the shoulder are often due to superficial nerve stimulation. Paralysis of the diaphragm on the ipsilateral (same) side means that this block may not be suitable for patients with very poor respiratory function.

13. TTTTT

Remember ABC (airway, breathing, circulation) in any emergency. Although local anaesthetics can cause cardiac arrythmias and cardiac arrest, another important cause is hypoxia related to airway obstruction or stopping breathing (apnoea). Give oxygen and gently maintain the airway. You may need to ventilate the patient if they stop breathing. Place the patient in the lateral position so that aspiration is less likely should they regurgitate. Many fits are self terminating but if they last for longer than 1-2 minutes they can be terminated with drugs. Thiopentone usually stops fitting quite quickly - give just enough to stop the fit. Diazepam takes a minute or two to work - give 5-10 mgs iv initially. Both these drugs may cause respiratory depression so be ready to maintain the airway.

14. TTTTT

Preoxygenation is especially important in pregnancy for the reasons given in a-c. A vital capacity breath is from maximal expiration to maximal inspiration.

15. TTTTF

a & b are suitable agents, c & d can be used to reduce the pressor response. Do not use ketamine in pre-eclampsia as it may cause dangerous rises in blood pressure leading to stroke or heart failure. Spinal anaesthesia is perfectly acceptable in pre-eclampsia especially if this is a familiar technique for you.

16. FTTTF

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.

17. TFTTT

NSAIDs worsen renal fuction and should not be used in renal failure and used with caution in the old and frail. Some asthmatic patients are made wose by NSAIDs but if they do not currently have wheeze and have taken aspirin uneventfully in the past it is reasonable togive them a

NSAID for pain. NSAIDs inhibit platelets and should not be given if problems controlling bleeding are anticipated.

18. 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.

19. TTTTT

Any or all of these may occur after an anaphylactic reaction

20. TTTTF

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

21. TTTTT

22. TTTTT

The most important thing to exclude and treat when faced with bradycardia is hypoxia. A slow pulse may be caused by a variety of surgical stimuli including cervical dilatation and traction on the eyeball. Unopposed neostigmine causes bradycardia which is why atropine should be given at the same time. Suxamethonium may also cause bradycardia especially when a second dose is given so atropine should also be given in this situation.

Editorial Note:

In Update in Anaesthesia No:9; 17-22 the authors for the article "The role of the Anaesthetist in the Management of Pre-eclampsia" should have been GJ Torr and MFM James, Department of Anaesthesia, University of Capetown, South Africa. Apologies for this omission.