ANAESTHESIA

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Scenario 1

You are a SpR3 working in a large teaching hospital. Tonight you are second on call. Your first on is a ST3, who has been doing solo lists and on calls for 4 months, and is anaesthetising the plastic surgery emergencies. Your 3rd on is in another theatre, doing an overrunning neurosurgical list which looks as if it will go on for at least another 2 hours. The on call consultant is in his office at the other end of the hospital.

Question 1

As you looking at the daunting list of general surgical and orthopaedic cases to be done, there is an emergency call for help from the ST3. He has just induced a 25 year old fasted patient for Manipulation Under Anaesthesia (MUA) +/- K wire of a fractured right 5th metacarpal, and has put in a Laryngeal Mask Airway (LMA). The patient is desaturating.

a. What should be your immediate action?
b. What are the common causes of a patient desaturating under anaesthesia?
c. You note there is a lot of vomit around, what is the management of aspiration?
d. How should this patient be cared for post operatively?
e. What should you tell the patient?

Question 2

Having sorted out that patient, you get on with anaesthetising a 19 year female patient for an appendicectomy. She has not eaten for 2 days, and has had an IV running all day.

a. What technique of anaesthesia is indicated for this patient?
b. What equipment will you need to get ready?
c. Discuss your choice of drugs
d. What precautions will you need to take when waking this patient up?

Question 3

You have put that patient in recovery, and go to see the next, a 73 year male with an incarnated hernia. At your pre operative assessment, he gives a history of well controlled non insulin dependant type 2 diabetes mellitus but little else, apart from an admission for chest pain 4 months ago. His blood results are essentially normal and his ECG is shown below.

a. What does this ECG show? (Figure 1)
b. Do you require any more pre operative tests?
c. What precautions are you going to take during the operation, and how would like to care for him afterwards?
d. What is his American Society of Anesthesiologists (ASA) grade, and how does that predict his chances of survival?

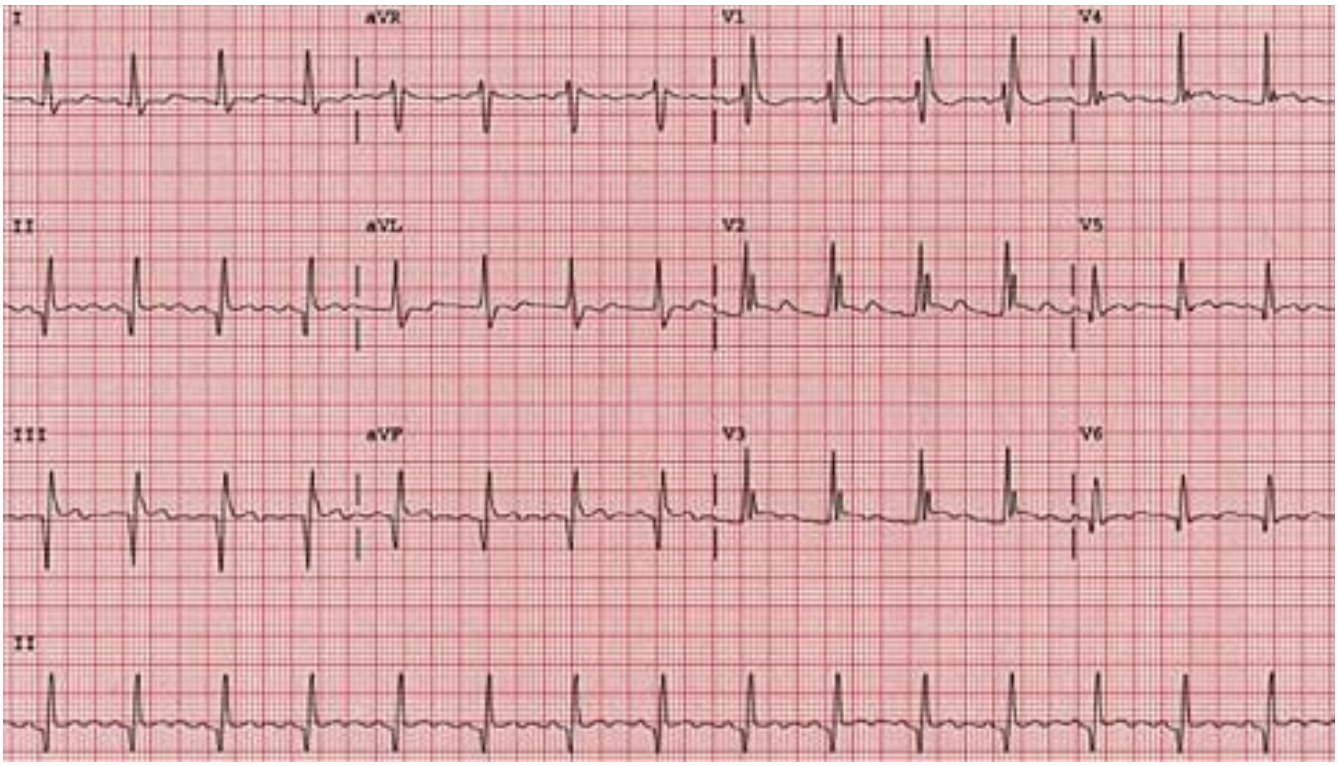

Figure 1. ECG of the patient in Question 3

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Question 4

Before you have a chance to take this gentleman to theatre, you are called to the resuscitation room. On arrival you find a 56 year old gentleman with a history of hypertension, who had been found collapsed earlier this evening. When the paramedics attended he was confused and tachycardic. They gave him some oxygen and fluids, and bought him in. He is now GCS 14/15, with a pulse of 110, BP90/50, and saturations of 92% on high flow oxygen.

a. What is the most likely diagnosis and how would confirm it?
b. What should be the immediate management plan?
c. What precautions should you take prior to anaesthetising him?
d. What monitoring you will use, and when should they be put on?
e. What are the major prognostic indicators in a patient with this problem?

Question 5

Just as the operating for the night has finished, and you are about to go to the on call room, the 3rd on finds you, to inform you that his patient has had to go to ITU. Unfortunately there are no beds in your hospital so you are going to have to transfer a patient out to a nearby DGH, which is about 25 minutes away by road.

a. Who needs to be involved in arranging this transfer?
b. Do you need anymore information?
c. What equipment and monitoring will you need?
d. How much oxygen will you need?
e. What are the insurance arrangements for the journey?

Answer 1

a. A desaturating patient post LMA insertion requires immediate restoration of ventilation with 100% oxygen. In practical terms the LMA is removed and bag valve mask ventilation commenced. The causes of hypoxia are sought and dealt with whilst the airway is secured. The onset of surgery is delayed.
b. Hypoxia under anaesthesia can be divided into equipment causes and patient causes.

Patient causes are:

- Hypoxaemic hypoxia: - hypoventilation
  - diffusion impairment
  - shunt
  - V/Q mismatch
- Ischaemic hypoxia; reduced blood flow through tissues
- Anaemic hypoxia; decreased oxygen carriage in the presence of adequate oxygen (anaemia or extreme left shift of oxyhaemoglobin dissociation curve)
- Tissue hypoxia; poisoning of the respiratory chain

Equipment causes are:

- Obstruction of breathing system; blockages and kinks
- Disconnection of breathing system
- Inadequate FiO_2
- Ventilator error or failure

c. Further aspiration should be minimised and the airway secured whilst 100% oxygen is administered. The patient must be tipped head down and suction applied to the oropharynx. The airway can be secured via a rapid sequence induction although cricoid pressure should not be applied if the patient is actively vomiting (risk of oesophageal rupture). Once the trachea is intubated positive pressure ventilation is gently commenced by hand prior to tracheal suction to clear some of the misplaced gastric contents.
   Ventilation with high positive end expiratory pressure (PEEP) can reduce shunt. A chest radiograph is indicated and in severe cases bronchoscopy with lavage is performed.
d. Patients with a high PEEP requirement or a low PaO_2/FIO_2 ratio should remain intubated and managed on the Intensive Care Unit (ICU) with intensive physiotherapy and supportive care. Patients with minimal X-ray changes and oxygen requirements within the scope of a facemask should be referred to the High Dependency Unit (HDU). However they are often managed on general wards provided intensive physiotherapy and critical care outreach are available. The stomach should be emptied using an oro- or nasogastric tube prior to extubation. Antibiotics have no place in the early management but may be required if secondary infection supervenes.
e. The patient should be told that despite fasting, the stomach was not empty and vomit entered the lungs, the prognosis is good. Fractures of the 5th metacarpal are often associated with alcohol consumption which delays gastric emptying.

Discussion

Mendelson first described the phenomenon of aspiration of gastric contents in 66 patients who underwent Caesarean Section between 1932 and 1945. Two of these patients died, both from upper airway obstruction and not from pulmonary sequelae. However pulmonary aspiration of gastric contents remains one of the most feared complications of anaesthesia.

The risk of aspiration during general anaesthesia is small and this is due to the precautions taken in order to minimise it. When it occurs the morbidity appears to be minimal and the mortality is negligible in the otherwise fit surgical patient (1). Risk factors for pulmonary aspiration of gastric contents:

- Full stomach
- Gastro Oesophageal Reflux
- Reduced gastric emptying - Trauma
  - Drugs (opioids/ ethanol)
  - Endocrine (diabetes/ hypothyroidism)
- Raised intragastric pressure - The acute abdomen
  - Pregnancy
  - Pneumoperitoneum
- Loss of airway reflexes (decreased conscious level/ topical LA)

The pathophysiology is one of a chemical pneumonitis with atelectasis causing shunt. Large foreign bodies may be present causing lobar collapse, other sequelae include Acute Respiratory Distress Syndrome (ARDS).

In making the diagnosis the patient may have risk factors as above but they often present without overt vomiting:

- Tachypnoea
- Hypoxia
- Bronchospasm; capnograph changes, fall in lung compliance
- Wheeze and crackles on auscultation
- Tachycardia

Steroids have been trialled to diminish the inflammatory pneumonitis but have no proven benefit. In the critically ill with aspiration there is an adverse effect on mortality (1).

Answer 2

a. This patient has an acute abdominal problem which raises the possibility of raised intragastric pressure and decreased gastric emptying. She requires a rapid sequence induction (RSI) of anaesthesia to minimise the possibility of pulmonary aspiration of gastric contents.
b. Anaesthesia should be induced in the theatre or anaesthetic room environment with appropriate resuscitation facilities and a suitably qualified assistant. The patient should be anaesthetised on a trolley or operating table that tips should

she vomit on induction. Suction apparatus should be switched on and immediately to hand. A pair of serviceable laryngoscopes and a selection of tracheal tubes with aids to intubation if required must be immediately available to your assistant.

Equipment required in the event of a failed tracheal intubation must be available so that the patient can be safely woken. This includes simple airway adjuncts, LMAs and even provision for surgical airway formation. In the event of catastrophic anaesthetic machine failure, a self inflating bag, valve, mask is kept in every theatre or anaesthetic room.

c. Preoxygenation for three minutes prior to induction allows for a period of apnoea without desaturation. The drugs used to induce anaesthesia during RSI must have a rapid onset in order to secure the airway quickly and provide good intubating conditions. Equally, should the patient prove difficult to intubate or ventilate then a rapid wake up and return of spontaneous ventilation may be indicated; the offset of drug action should also be rapid. An RSI has therefore conventionally used three drugs; oxygen, thiopentone and suxamethonium.
d. Following surgery she is still at risk of aspiration. Her pharynx is suctioned prior to extubation and she is placed in the left lateral position on a bed or trolley that tips, in case of vomiting on emergence from anaesthesia. If she has a nasogastric tube in place then it shall be suctioned too. Her trachea should be extubated upon return of airway reflexes, i.e. once awake.

Discussion

A rapid sequence induction of anaesthesia is indicated when tracheal intubation is required whilst there is a risk of aspiration of gastric contents. The patient is preoxygenated by breathing 100% oxygen to replace nitrogen in the lungs with oxygen, usually for 3min or 4 vital capacity breaths. In the event of complications, with the lungs at functional residual capacity (FRC); approximately 2.5l there might be 10min supply of oxygen at basal oxygen consumption of 250ml min-1.

Cricoid pressure, a force of 30N is applied to the cricoid cartilage on loss of consciousness (10). This is to occlude the oesophagus with pressure between the cricoid ring and the cervical vertebrae. It is released only on the instruction of the anaesthetist or if the patient actively vomits. In case of vomiting on induction the patient should be on a trolley that can tip head down and suction apparatus should be switched on and immediately available to the anaesthetist. A nasogastric tube (NGT) should be aspirated pre induction but there is no need to routinely site NGTs for RSIs. During induction the patient is not ventilated by facemask in order to avoid inflation of the stomach and risk vomiting.

Answer 3

a. Of note there are Q waves in II, III and aVF indicative of an old inferior myocardial infarct (MI). The lateral T waves are flattened but the heart is in sinus rhythm with a normal axis.
b. No further tests are necessary. A transthoracic echocardiogram may be indicated if valvular disease is suspected, however this may have been done 4 months ago and will not necessarily need repeating.
c. There are four main concerns that need addressing here:

- Cardiovascular system. Large bore iv access and invasive arterial monitoring should be sited prior to induction. Continuous measurement of blood pressure in this way allows for a rapid reaction to adverse haemodynamic values. Beta blockade as tolerated or to achieve heart rate 50-60bpm is beneficial. Diastolic BP should be maintained with alpha-1 agonists given peripherally. Urine output should be measured.
- Pain should be controlled with nerve blockade +/- Patient Controlled Analgesia (PCA) to minimise the sympathetic response. Consideration should be given to discussing the siting of a thoracic epidural catheter with the patient, should the operation convert to a midline laparotomy.
- Tight glycaemic control using a sliding scale of insulin throughout the perioperative period is important. This is started on the ward using your hospital's approved protocol.
- Maintenance of normothermia by the use of a forced air blanket or fluid warming coil.

Post operatively he should be cared for in a High Dependency environment.

d. His ASA grade is III which does not reliably predict survival.

Discussion

History and clinical examination remain the cornerstones of preoperative risk assessment. Although these risk assessments are based upon cardiac evaluation, most post operative mortality is not cardiac, but due to poor end organ perfusion secondary to cardiac dysfunction. The three components to the assessment are (3):

- Patient risk factors
- Patient functional capacity
- Surgery

Major factors (markers of unstable coronary artery disease):

- Disturbance of the coronary circulation within 6 weeks. E.g. MI, ischaemic symptoms, coronary artery bypass graft (CABG) or percutaneous coronary intervention (PCI)
- Angina class III/IV
- Heart failure
- Malignant arrhythmias

Intermediate factors (markers of stable coronary disease):

- Disturbance to the coronary circulation >6 weeks and <3 months
- Angina class I/II
- Previous perioperative ischaemia
- Ventricular arrhythmias
- Diabetes mellitus
- Age (physiological) >70 yr
- Compensated or prior heart failure

Minor factors (increased probability of coronary artery disease)

- Risk factors for ischaemic heart disease (IHD)
- Peripheral vascular disease (PVD)
- ECG abnormalities (arrhythmia, LVH, bundle branch block)
- MI >3 months and asymptomatic
- Post CABG or PCI >3 months and <6y and asymptomatic

Functional Capacity in this situation would be gauged from the history; the inability to climb two flights of stairs represents an 89% positive predictive value for cardiopulmonary complications.

Minor procedures (cardiac complication rate <1%)

- Endoscopic procedures
- Plastic and reconstructive surgery

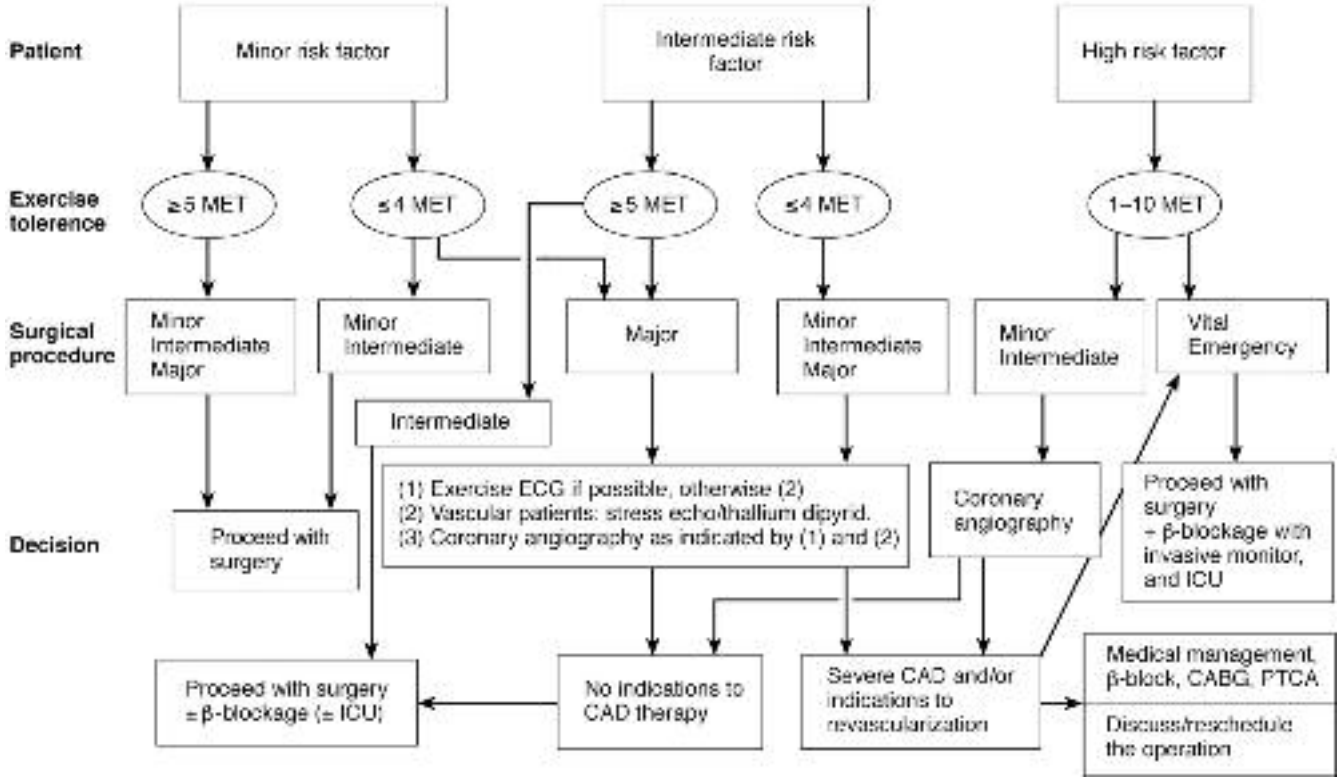
Intermediate procedures (cardiac complication rate 1-5%)

- Minor vascular surgery, including carotid endarterectomy
- Abdominal and thoracic procedures
- ENT procedures

Major procedures (cardiac complication rate >5%)

- Aortic and major vascular surgery
- Prolonged surgical procedures, large fluid shifts or blood loss
- Unstable haemodynamic situations

The guidelines have been summarised by Chassot et al below (3):



CAD= coronary artery disease, PTCA= PCI. 4 metabolic equivalents (MET) are equivalent to walking 1-2 blocks on the flat at 3-4kmh-1 and 5 MET are equivalent to climbing a flight of stairs. 10 MET represents strenuous sport.

Answer 4

a. In a shocked patient with risk factors for vascular disease one should always suspect a ruptured aortic aneurysm. The diagnosis can be rapidly confirmed by ultrasound examination or, if time allows by computed tomography (CT).

b. The overriding concern here is that the patient needs emergency surgery as soon as possible. Prior to transfer to theatre he needs two large bore peripheral iv cannulas with fluid attached but only running to keep his systolic pressure at about 90mmHg or to maintain conscious level. Pain can be controlled with titrated doses of an iv opioid. Ensure that the patient has at least 6 units of blood cross matched, FBC, U&E, Coag and ECG as part of his A&E admission. Liaise with the intensive care unit in order that they are aware of the case and can make necessary preparation.

c. In the event of any delay in transfer then the opportunity to place an arterial line and urinary catheter should not be missed as ideally these need siting pre-induction. Once in theatre, blood should be checked and ready to infuse. Inotropes, vasopressors and antihypertensives should also be ready. Warming equipment, Level 1® infusor and cell saver should be prepped and ready.
The surgeon should be scrubbed and have prepped and draped the patient. Induction is by RSI and the surgeon starts once the tracheal tube is confirmed.

d. Minimum standards of monitoring are augmented by invasive arterial blood pressure measurement which also allows for intraoperative blood sampling. This is sited preinduction if possible, a central venous line and temperature probe are sited intraoperatively. A urinary catheter is much more easily sited preoperatively than intraoperatively. ECG might include CM5 lead in order that myocardial ischaemia can be identified earlier.

e. Prognosis depends upon the Hardman index; 3 or more positives confer approximately 75% mortality (5):

- Age >76
- Loss of consciousness during presentation
- Ischaemic ECG
- Haemoglobin <9gdl-1
- Creatinine >190 moll-1

Discussion

These patients need emergency surgery, death is inevitable unless the aneurysm's leak is contained by the retroperitoneal space. Approximately 50% of patients die before reaching hospital. Overall mortality for open AAA repair after emergency admission is 36% (7).

Judicious pre-operative fluids prevent hypertension which may compromise any clot formation around the leak. At induction fluids are run through rapidly. Blood is transfused according to losses and supplemented with cell saved blood. Aggressive temperature control can often reduce the need for FFP and platelets.

Once the aorta is cross clamped then the change in aortic compliance creates a large increase in afterload and therefore blood pressure via the Anrep effect. At this stage of relative control the table can be tipped and a central venous line inserted. Whilst the cross clamp is on, the lower limbs have no blood supply and metabolise anaerobically. During this time the central venous pressure (CVP) is increased using fluid including blood and the patient hyperventilated in preparation for cross clamp release.

The surgeon should release the cross clamp one limb at a time in order to minimise the metabolic upset. Cold acidaemic blood with high K+, PCO_2 and other myocardial depressants combined with a sudden decrease in systemic vascular resistance will cause profound hypotension. This is managed with iv fluids, calcium and other inotropes/ vasopressors.

Approximately 75% of patients will need a period of post operative ventilation (7). It is important to liaise with intensive care as early as possible. There is usually no place for epidural analgesia in emergency repair, however they can be sited on ICU prior to extubation in the absence of coagulopathy. Endovascular repair by interventional radiologists is reserved for elective cases and rarely done in an emergency.

Answer 5

a. The transfer should be arranged through discussions between consultant intensivists within the local critical care network. The final decision rests with the consultant intensivist at the receiving hospital. Specialist consultant to consultant referral for the patient's condition should also be made and separate discussions between nursing staff should occur.

b. The information required is:

Patient:

- History
- Examination findings on admission
- Results of every investigation
- Any treatment/ surgery performed
- Current overall patient status, problems, organs failing etc.
- Current airway and ease of intubation
- Ventilator settings and latest arterial blood gas analysis (ABG)
- Circulatory support in use
- Sedation, neurology and blood glucose
- Renal status
- Feed
- Microbiology, MRSA status and antimicrobials in use
- Lines and dates of insertion
- Other therapy
- Next of kin informed

Journey:

- How to summon ambulance to home unit
- Paramedic or technician crew
- Any accompanying staff
- Location of receiving ITU
- Receiving consultant's name
- Telephone numbers for receiving unit and home unit
- Arrangements for return home if abandoned by ambulance

c. Ideally a dedicated transfer trolley is available however this is limited by non- standardised ambulance fits. They consist of room for infusion pumps and monitoring beneath the patient. A med bergen containing resuscitation equipment and drugs in addition to the ambulance's own must be carried. Monitoring must include ECG, SpO_2, invasive pressures, capnography, FIO_2 and temperature. Bear in mind that capnography and non invasive blood pressure use more power, other monitoring may be appropriate for longer journeys or more unstable patients such as CVP, blood glucose and intracerebral pressure (ICP).

A portable ventilator with a second means of ventilating, via facemask if necessary, is mandatory. An ambulance will carry its own defibrillator and suction apparatus but power outlets are 12V DC, therefore an inverter is necessary to power mains devices and to recharge batteries. Oxygen is also available fitted to the ambulance and in the form of a CD cylinder for journeys within hospital and from the ambulance parking bay.

Drugs that are stored in the fridge are easily forgotten and it is often easier to add drugs that you anticipate using rather than drawing them up during the journey from the med bergen. Spare drugs for infusion e.g. noradrenaline, insulin should be pre-prepared.

Finally, notes, X ray films, transfer observation form, pen, money, charged mobile phone, snacks, drinks and appropriate clothing.

d. You should allow 1 hour for this journey and 1-2 hour reserve supply of oxygen running an FIO_2 of 1, should this be required, at the patient's current minute volume. Therefore, a minute volume of $7lmin^{-1}$ for 2-3h equates to 840- 1260l of oxygen. This is well within the capacity of a UK ambulance; most carry 2 F size cylinders, when full each one contains 1360l. For long journeys that must be by road insist that the cylinders are full.

e. Should the ambulance be involved in an accident then the insurance arrangements are complex if death or injury should occur. Therefore it is important for staff to ensure that adequate financial arrangements are in place for themselves and their dependents. Organisations such as the Intensive Care Society and the Association of Anaesthetists of Great Britain and Ireland offer arrangements with membership.

Discussion

The decision to transfer a critically ill patient is always a balance of risk against benefit and always a consultant decision (8). When the purpose of the transfer is to make room for a patient then the benefits to the individual are none. The Department of Health published guidance on this in 1996 (9).

The transfer itself should be undertaken by an experienced clinician with adequate anaesthetic or intensive care experience accompanied by a suitably qualified assistant; an operating department practitioner (ODP), ITU nurse or ambulance paramedic.

The patient should be optimised prior to transfer including attention to fluid status, a hypovolaemic patient will develop hypotension upon movement and vibration. The only exceptions to this are patients which penetrating trauma or ruptured aortic aneurysm (8). Staff involved in the transfer should expect to be working in cramped, noisy and often emetogenic conditions. It is vital therefore that the patient is adequately prepared to minimise the risk of performing interventions in a suboptimal environment. This usually means tracheal intubation and ventilation, long acting neuromuscular blockade with adequate sedation, nasogastric tube and urinary catheter. Preparations should be made for every likely catastrophe such as siting more than 1 large bore cannula or chest drains if there is chest trauma.

For the journey, attention should be paid to temperature and pressure care and the patient strapped in. All equipment must be secure and visible to the attending clinician, nothing should rest on the patient. Recognise that loosely secured items become projectiles in the event of an accident. Be prepared to offer advice on the urgency of the transfer, generally high speed transfers are dangerous and unnecessary. However, traffic delays can be justifiably avoided by the use of blue lights and sirens. Ultimately the decision lies with the driver. Do not attempt unforeseen procedures whilst the ambulance is moving, request that the ambulance stops in a safe area. It is dangerous for the patient; a moving target and the attending clinician who will have removed his seat belt.

The handover at the receiving hospital should be to medical and nursing staff in the form of a verbal presentation of the case, handover of copies of the notes and a transfer record. There is usually time for refreshments and to contact the transferring unit to give them a sitrep. Ultimately the journey home should be taken advantage of to its fullest extent. Recognise that there are no patients to look after, your bleep is with the boss and there is an empty stretcher.

The development of critical care networks has leant governance to the issue of patient transfers through the use of standardised equipment, data collection and audit. Each hospital in the network has a lead consultant responsible for liaison and development of transfer guidelines and equipment. Some tertiary centres have dedicated transfer teams, this is of particular benefit in the transfer of critically ill children; a difficult and relatively uncommon event.

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