REPORT OF GENERAL FELLOWSHIP EXAMINATION

APRIL/MAY 2003

This report is prepared to provide candidates, tutors and their Supervisors of training with information about the way in which the Examiners assessed the performance of candidates in the Examination. Answers provided are not model answers but guides to what was expected. Candidates should discuss the report with their tutors so that they may prepare appropriately for the future examinations.

Twelve candidates presented for this examination. Eight were successful.

ORAL SECTIONS

Objectives Structured Clinical Examination (OSCE) Section

There were fourteen stations with four rest stations (including one before and after each of the two interactive stations). Seven candidates passed this section. A systematic approach to the types of investigations examined was more likely to maximise the candidate's score. Candidates should ensure that they take note of the clinical information provided when considering their answer.
Station:

1. *Rest station*

2. *Chest X-rays.* Examples included pneumothoraces, abnormalities after pneumonectomy, and abnormalities after chest trauma (including collapse and consolidation). Lists of abnormal findings and medical equipment were requested, as was associated management. Seven out of twelve candidates passed this section.

3. *ECGs.* Examples included Wolff-Parkinson-White Syndrome, supra-ventricular tachycardia, paced rhythm, hyperkalaemia and posterior infarction. The rhythm or a list of abnormal findings was requested, as were relevant causes and associated management. Seven out of twelve candidates passed this section.

4. *Biochemistry*. Examples included a hyperosmolar state due to methanol poisoning, thrombotic thrombocytopaenic purpura. The likely diagnoses and/or possible causes were requested, as were rationale or further tests. Ten out of twelve candidates passed this section.

5. *Paediatrics*. Material presented included an intra-osseous needle, and an ECG demonstrating supra-ventricular tachycardia. X-rays demonstrated cardiomegaly and pulmonary oedema, and cystic changes in lung. Additional requested information included abnormalities, management, and potential complications. Three out of twelve candidates passed this section.

6. *Rest station*

7. *Procedure station*. Candidates were expected to demonstrate a safe technique for radial artery cannulation. Additional requested information included local anatomy and performance characteristics of the monitoring system. Eleven out of twelve candidates passed this section.

8. *Rest station*

9. *Communication station*. Candidates were expected to discuss the issues surrounding brain death and organ donation with a patient's next of kin. Seven out of twelve candidates passed this section.

10. *Rest station*

11. *Other X-rays.* Examples included CTs and X-rays demonstrating liver and spleen lacerations, fractures of hyoid and mandible, and cirrhosis with enlarged gall bladder showing gas in the gall bladder wall. A list of abnormal findings was requested, as were potential aetiology and complications. Four out of twelve candidates passed this section.

12. *Chest X-rays.* Examples included tension pneumothorax and extra-alveolar air, chest trauma and multiple medical devices. A list of findings was requested, including the type and placement of the multiple devices and tubes. For full marks, candidates were expected to comment on the anatomical position and acceptability of the position of the invasive devices. Seven out of twelve candidates passed this section.

13. *Miscellaneous Equipment.* Examples included a self-inflating paediatric resuscitation device, a calibrated drainage system with an underwater seal, a vacuum drain bottle, a fenestrated tracheostomy tube and a Passey-Muir valve. Identification of the device was requested, with additional questions related to use and/or complications of the equipment. Five out of twelve candidates passed this section.

14. *Arterial Blood Gases.* Examples included metabolic acidosis with respiratory alkalosis, mixed respiratory and metabolic acidoses, mixed respiratory and metabolic alkaloses, and respiratory acidosis with metabolic alkalosis. A list of abnormal findings was requested (including abnormalities in pH, ie. acidaemia or alkalaemia), as was a possible aetiology. Nine out of twelve candidates passed this section.

Cross Table Viva Section

There were 6 structured Vivas of ten minutes each, and 1 rest station. There were two minutes provided to read a scenario outside each viva room. Ten out of twelve candidates passed this section. Candidates should be able to provide a systematic approach for assessment and management of commonly encountered clinical scenarios (eg. overdose, high airway pressures during mechanical ventilation, sepsis). Candidates should also be prepared to provide a reasonable strategy for management of conditions that they may not be familiar with.

The topics included:

- The management of an infant with failed extubations, including management of stridor post-extubation. Nine out of twelve candidates passed this section.
- Management of sepsis due to a fungal infection. Ten out of twelve candidates passed this section.
- Management of mixed overdose, with discussion of techniques for reducing absorption and enhancing elimination. Ten out of twelve candidates passed this section.
- Management of severe respiratory failure due to ARDS following abdominal sepsis. Ten out of twelve candidates passed this section.
- Diagnosis and management of hypernatraemia (including urinary electrolytes) in a patient with diabetic ketoacidosis. Eight out of twelve candidates passed this section.
- Diagnosis and management of diarrhoea and intestinal pseudo-obstruction in a patient with pancreatitis. Seven out of twelve candidates passed this section.

The Clinical Section

The Clinical Section was conducted at the Liverpool Hospital, Sydney.

Only six out of twelve candidates passed this combined section. Candidates should listen carefully to the introduction given by the examiners and direct their examination accordingly. Patients were presented as problem solving exercises. For maximal marks, candidates should demonstrate a systematic approach to examination, clinical signs should be demonstrated, and a reasonable discussion regarding their findings should follow. Exposing the patients should be limited to those areas that are necessary for that component of the examination, and in keeping with the modesty requirements of the patients.

Cases encountered as Cold cases included patients with:

- Endocrine and systemic disorders: eg. Cushing's disease and scleroderma
- Cardiovascular disease: eg. Mitral stenosis, VSD, carotid bruits, mechanical heart valve, endocarditis
- Neurological disorders: eg. CVA, arm weakness, cranial nerve abnormalities, visual field defects, and Multiple Sclerosis
- Abdominal findings: eg. splenomegaly and polycystic kidney

Only five out of twelve candidates passed this section.

Cases encountered as Hot cases included patients with:

- failure to wean from ventilation
- multiple trauma patients with chest problems eg. flail chest, febrile, empyema
- subarachnoid haemorrhage with neurological impairment
- rhabdomyolysis

Eight out of twelve candidates passed this section.

WRITTEN SECTIONS

Seven out of twelve candidates passed this section overall.

It is imperative that candidates answer the specific question asked. A structured, orderly response considering all aspects of management is required. Writing should be legible to allow candidates to gain optimal marks.

This guide below is meant to be an information resource and the views of a practising intensivist. It is not written under exam conditions and does not provide ideal answers, but it does include the type of material that should be included in a good answer.

Long Answer Questions

Five out of twelve candidates passed this sub-section.

The questions release information piecemeal and incompletely as in the clinical situation. Specific issues in the specific setting were expected to be addressed rather than broad generalities. The examiners apportioned marks according to difficulty and required time within each question. An organised/systematic approach is expected.

QUESTION 1.

Eight out of twelve candidates passed this question.

A 50-year-old man with motor neurone disease presents to hospital with respiratory distress following two (2) days of fever and malaise. He is alert and anxious, and an arterial blood gas performed on oxygen (8L/min semi-rigid mask) revealed PaO2 45 mmHg, PaCO2 65 mmHg, pH 7.36 and HCO3 36 mmol/L. He has used a motorised wheelchair for three (3) years but continues to work as an accountant. His attentive wife states that they have discussed mechanical ventilation and are keen for him to receive full Intensive Care support.

- **How will you approach the issue of mechanical ventilation in this man?**

A decision about mechanical ventilation is necessary but is not urgently required. Time should be taken to talk through the potential problems, and ensuring that the patient and wife are aware of the actual implications of ventilation (likely need for and potential complications of intubation & tracheostomy, difficult or impossible wean, prolonged ICU, long term hospital and home ventilation [if available!]). Discussion should include what factors are likely to be reversible (including time frame). Other input may be appropriate and should be sought (parent unit, treating doctors, neurologists, pastoral care). The issues of consent (who and for what must be clarified). After detailed discussion, patient and wife (if appropriate surrogate) should be able to decide.

- **His respiratory function deteriorates and the decision is made to ventilate him. Your registrar induces anaesthesia with thiopentone, fentanyl, and suxamethonium. He is intubated with difficulty using a bougie and during this process he becomes pulseless. Discuss your management.**

Immediate management should be according to an appropriate ACLS protocol (including confirmation of lack of central pulse, management according to rhythm, vasoconstrictor and external cardiac compression as appropriate, confirm placement of ETT [check position and ETCO2]; search for and correct reversible factors especially vasodilatation, profound hypoxaemia,

excessive ventilation and hyperkalaemia [suxamethonium plus chronic muscle wasting). Other management includes ongoing supportive care of ICU patient (eg. further communication and discussion with family, pressure care, DVT and stress ulcer prophylaxis, cultures and antibiotics if appropriate, etc.)

- **On day 7 of his admission he become febrile, develops a leukocytosis and a chest x-ray shows a new infiltrate in his left lower lobe. Discuss the investigation and management of this problem.**

Unfortunately nosocomial pneumonia is a common sequelae of mechanical ventilation after 7 days. A standard approach should be considered, which must include some culturing of secretions (tracheal aspirates, or more invasive eg. bronchoscopic lavage or protected brush). Gram stain may provide quantitative information of potential pathogens, as may quantitative cultures. Antibiotics should be introduced if bacterial aetiology suspected, and should be appropriate to local factors (including usual bacterial sensitivities, previous antibiotic use and unit protocols) but should include cover for MRSA and resistant gram negatives for a specified period of time (eg. 3 days and review). Plan for review of antibiotics should be discussed. Differential diagnosis includes other causes of WCC/temperature elevation (eg. line sepsis, UTI, sinus infection, pulmonary embolus, myocardial infarction etc.) and other causes of infiltrates (eg. collapse/atelectasis, pulmonary oedema and pulmonary embolus) and each may require specific investigation and treatment depending on other clinical information. This event provides another opportunity to revisit the direction of management when necessary discussion regarding developments occurs with wife and family.

- **On day 40 of his admission he remains ventilator-dependent with a vital capacity of 200 mL. His chest x-ray is essentially normal and his renal and cardiovascular function are good. Discuss your management.**

This scenario should have been previously discussed in detail with wife and family (and patient!) and ideally a formal plan developed in advance. Reversible causes of failure to wean must be considered and treated as appropriate (eg. sepsis, cardiac failure, nutrition, adequate rest, absence of sedative drugs, tracheostomy, etc.). Follow-up discussions are required and options need to be discussed in detail. Given the underlying chronic progressive disease, in the absence of reversible causes it is unlikely that any significant improvement should be expected. Major options include withdrawal, long term hospital ventilation (ICU/ward) and home ventilation (depending on local factors). Hopefully well planned before now!

QUESTION 2.

A 24-year-old male mountain bike rider crashes into a tree, resulting in a severe hyperextension neck injury, and fractured lower left ribs. He now presents to hospital with shock and a painful distending abdomen.

Four out of twelve candidates passed this question.

a) Describe your initial management.

Initial management of trauma should be according to standard protocol. Initial primary survey and resuscitation would address adequacy of airway (patency, need for ETT) and breathing (eg. excluding tension pneumothorax and major haemothorax). At the review of "circulation" phase, the presence of shock with obvious abdominal signs means urgent surgery is required (with simultaneous insertion of 2 wide bore IVs if not already present, removal of blood for Hb/platelets, crossmatch and clotting profile, rapid infusion of 2 litres of fluid [blood if significant previous non-blood resuscitation]. In the time until surgery is organised, it may be possible to perform a supine CXR, pelvic X-ray and/or a FAST (ultrasound) examination. He must be treated with spinal

precautions (including for intubation) as it must be assumed that there is an unstable cervical spine, with possible thoraco-lumbar spine injuries. Attempts should be made to maintain his temperature stable (eg. >35-36°C). Full secondary survey and specific investigations must be deferred until the haemodynamic state is adequately dealt with.

b) He returns from the operating theatre after a splenectomy. He is haemodynamically stable, but little is known of his other injuries. What is your plan for the next 24 hours?

At this stage stability must be confirmed in other areas as well as haemodynamic. Blood pressure goals should consider spinal perfusion pressure if spinal injury is suspected, and steroids should be considered in the first 8 hours.

Now is the time to ensure that oxygenation and ventilation are stable; coagulation should be assessed and corrected if abnormal; and temperature should be in target range. Secondary survey should be completed, including detailed neurologic examination (eg. in an attempt to exclude spinal injury). Spinal precautions should be continued for the interim. The primary x-rays should be obtained (CXR, pelvic x-ray, lateral cervical spine) but now additional x-rays should be obtained as indicated (repeat CXR, spinal series ± CTs eg. of cervical spine, chest, abdomen). Long bone injuries should be sought and excluded (or treated). Other specialists should be asked to review patient as indicated (eg. cardiothoracic, spinal). Antibiotics and tetanus prophylaxis should be prescribed if indicated. Anti-ulcer prophylaxis should be instituted, and as should pharmacological prophylaxis for DVTs when contraindications subside. Enteral feeding should be started as soon as practical.

c) After another 24 hours it is apparent that he has a complete spinal cord lesion at C4. What signs of this lesion are likely to be present?

Tone may well still be decreased (though with time this will increase, with posturing developing in an upper motor neurone distribution). Anal tone would be lax with a complete lesion. Quadriparesis would be expected, with no movement below deltoid. Respiratory muscles may be significantly compromised. Reflexes may still be absent, though with time will increase. The plantar reflex should be upgoing. A sensory level is expected between C2 to C6, and to all modalities (eg. touch, pain, temperature, JPS and vibration).

d) Despite regular pressure area care, he develops a deep, 5cm by 5cm sacral ulcer. How should this be managed and how may it have been prevented?

Initial management involved complete evaluation and staging, close monitoring, and providing adequate pain relief. Further treatment involves correcting any precipitating factors, review preventative measures, correct nutritional status (deficiencies diagnosed and corrected), manage tissue pressure (eg. specialised beds) remove necrotic tissue, manage wound infections and maintain a moist environment.

Preventative techniques require identification of patients at risk, daily skin inspections, patient positioning (two hour turning, pressure reducing mattresses, special beds), encouraging mobility (physical therapy, reduce sedatives), and provision of adequate nutrition.

Short Answer Questions

Eight out of twelve candidates passed this sub-section.

1. Critically evaluate the strategies for prevention of gastrointestinal bleeding in the critically ill.

All twelve candidates passed this question.

Answers should address more than just prevention of gastric erosions/stress ulceration. Consideration should be given to other causes including patients with known gastro-oesophageal varices (where sclerotherapy/banding, beta-blockers and techniques to lower venous pressure, and avoidance of local trauma should be considered).

With regard to stress ulceration many strategies have been employed, and should be considered in a broad answer. General resuscitation of patients, correction of coagulopathy, early enteral feeding and avoidance of precipitants (eg. NSAIDs) in patients at risk are assumed to be beneficial (but not well studied). Prospective randomised trials have generally compared drug regimens (antacids vs sucralfate vs H2-blockers vs proton pump inhibitors). Other agents include prostaglandin analogs. Controversy surrounds the issues of widespread use of prophylactic agents, value of drugs vs placebo, nosocomial infection rates, and cost-benefit analyses.

2. Critically evaluate the strategies for prevention of deep venous thrombosis in the critically ill.

Eleven of the twelve candidates passed this question.

Many different strategies are employed and should be considered. Reviews and recommendations are widely published (eg. Geerts, WH, Heit, JA, Clagett, GP, et al. Prevention of venous thromboembolism. Chest 2001; 119:132S). Good placebo controlled RCTs are rare.

Simple techniques such as passive mobilisation, and early active mobilisation are encouraged but not well studied. The use of elastic compression stockings (knee-length or whole leg) is simple, widespread and effective for low risk patients. The addition of intermittent pneumatic compression devices has been recommended (limited evidence) where higher risk exists but other pharmacology is deemed contraindicated. Most studies have assessed the use of low dose unfractionated heparin or low molecular weight heparins (though few studies have used placebo control). LMW heparins (when compared with unfractionated heparin) seem to provide similar or better prophylaxis, with less thrombocytopaenia, though with a small increase in the incidence of bleeding. Other agents including pentasaccharides or hirudin are showing promise. Older agents such as dextran and warfarin are used less frequently.

Other controversies include cost-benefit, and side-effect profiles etc.

3. Compare and contrast the role of Troponin and CKMB in the management of myocardial ischaemia in the critically ill.

Seven of the twelve candidates passed this question.

CKMB is creatine kinase dimer of M and B chains and exists as 4. It is found in a high ratio predominantly in myocardial cytosol, but is also present in skeletal muscle (especially in myopathies or after injury). Levels of CK MB rise within 4 to 12 hours of myocardial infarction (high sensitivity and specificity), peak at 18 to 24 hours and return to baseline by 36 to 40 hours. Diagnosis of MI may be enhanced by measuring MB isoforms (higher sensitivity) or use of MB

fraction of total CK (problem if significant skeletal muscle damage [eg. surgery, cardioversion], hypothyroidism or renal failure [CKMB elevated in approximately 30 to 70 percent of dialysis patients]). Not increased in myocarditis. CKMB level is indicative of infarct size, and is independent prognostic marker. Rapid return of level to normal allows potential for diagnosis of reinfarction.

Cardiac troponins are cardiac regulatory proteins and exist as "T" and "I" forms. Early release is from cytosol, and subsequent release from damaged structural components. Many results from early studies hindered by variability in assays. More recent (second generation) assays are highly specific for cardiac troponins (both forms). Levels rise within 4 to 12 hours after myocardial infarction (high specificity but less sensitivity if rely on 6 hour specimen), peak at 18 to 24 hours, but levels stay elevated for up to 10 days (allows late diagnosis of MI, but not reinfarction). cTpI preferred in renal failure (false positive elevations of cTnT: in one study 82 percent of asymptomatic dialysis patients had elevated cTnT levels when the cutoff value was 0.01 µg/L!). Elevations may occur in pulmonary embolism or myocarditis, but potentially better than CKMB for situations where skeletal muscle damage is present (eg. DCR, trauma, post-op). Level of troponin also associated with prognosis (? clinical relevance of subtle elevations).

Elevation of cardiac enzymes (if not a false positive) without ECG changes is now considered to represent a non-ST elevation myocardial infarction.

4. List the potential causes of anaemia in critically ill patients, and outline how you would determine which factors were contributory.

Nine of the twelve candidates passed this question.

Anaemia in critically ill patients is usually multifactorial. Potential causes can be categorised into decreased production (as a small proportion [approx 1%] of circulating RBCs are destroyed each day), increased destruction, loss of RBCs and haemodilution. Decreased production includes problems with nutrients (eg. iron, folate, B12), disease involving bone marrow (eg. infiltration, myelodysplasia), depressant effects of drugs (eg. chemotherapy) or irradiation, and low levels of stimulatory hormones (eg. EPO in renal failure, thyroid hormones). Increased destruction can occur in haemolytic anaemias: either congenital (eg. thalassaemia major, sickle cell) or acquired (eg. Coomb's positive auto-immune, TTP-HUS, infection with malaria or clostridiae etc). Increased RBC loss can occur via injuries, bleeds into viscera or organs (eg. GI tract, GU tract, lungs) and iatrogenic (procedures, blood samples for testing). Dilutional anaemia usually occurs in the context of rapid or extensive non-blood fluid resuscitation.

Evaluation of cause includes obvious but essential role of history (trauma, drugs and therapies, nutrition, chronic disease, infection, review of blood tests and procedures etc) and examination (trauma, sites of potential blood loss [including PR], jaundice, hepato-splenomegaly etc.). Simple investigations include morphological assessment of blood (eg. MCV, blood film: red and white cell mophology), reticulocyte count, electrolytes and renal and liver function tests. More specific tests as indicated include assays for folate/B12/ferritin, indicators of haemolysis (eg. haptoglobin, Coomb's test), Hb electropheresis, cultures for infection (±thick/thin film) etc.

5. Critically evaluate the role of high volume haemofiltration in Intensive Care patients.

Seven of the twelve candidates passed this question.

The definition of high volume haemofiltration and its potential role in Intensive Care patients is unclear. Purported benefits include clearance of "bad" cytokines/mediators, with improvement in cardiovascular function and even mortality. More aggressive dailysis may have some survival advantages (Ronco et al Lancet 2000). Though, in this large prospective RCT, there was no further benefit demonstrated when increasing the ultrafiltration rate > 35ml/hr/kg (ie. approx 2000 mL/hr).

No adequately powered studies assessing other benefits, especially in those without renal failure have been published. Additional risks of the use of higher volumes are largely centre dependent, but certainly include potential problems with fluid and electrolyte balance.

6. Critically evaluate the use and limitations of End-Tidal Carbon Dioxide measurement in Intensive Care practice.

Nine of the twelve candidates passed this question.

Measurement of $ETCO_2$ implies the use of a quantitative device, and usually this is one which allows assessment of waveform morphology ($ETCO_2$ vs time). Specific roles include: confirmation of tracheal placement of artificial airway, pattern recognition of $ETCO_2$ waveform, use of value of $ETCO_2$ during cardiac arrest or hypotensive states, prediction of arterial $PaCO_2$.

Confirmation of tracheal placement is highly sensitive and specific in the presence of pulmonary blood flow. False negative values may occur with minimal pulmonary blood flow, but should not usually occur with adequate CPR. False positives are very uncommon and short lived (eg. CO_2 in stomach).

Waveform pattern can assist in the diagnosis in particular of expiratory flow obstruction (and gas trapping) and attempts at spontaneous breathing.

During cardiac arrest, the absolute level of $ETCO_2$ is proportional to pulmonary blood flow (and hence cardiac output). It may be used to guide cardiac compression, but apart from this it adds little to prognostication (ie. confirms that patient is likely to die). Sudden decreases in $ETCO_2$ may be indicative of the decrease in pulmonary blood flow associated with pulmonary emboli.

Prediction of $PaCO_2$ from $ETCO_2$ is fraught with difficulty. The major limiting factors are pulmonary blood flow and V/Q balance. Unless these factors are unchanging, even the trending of the relationship of between $PaCO_2$ and $ETCO_2$ unreliable. Unfortunately if the $PaCO_2$ is important (eg. major head injuries), it must be measured.

7. Compare and contrast the pharmacology of propofol, midazolam and thiopentone when used by infusion for the treatment of raised intra-cranial pressure.

Eight of the twelve candidates passed this question.

Pharmacology includes pharmaceutics (including preparation), pharmacokinetics (including distribution, elimination and biotransformation) and pharmacodynamics (including dose, mechanism of action, effect of various disease states, adverse effects and interactions). Effects of **all** drugs are augmented by other CNS depressant drugs.

Propofol is formulated as a white isotonic aqueous emulsion (containing soya oil and egg lecithin) at a concentration of 10 mg/mL. It supports the growth of bacteria if accidentally introduced so syringes/bottles should be changed every 12 hours. It is widely and rapidly distributed (98% protein bound), with an initial half life of redistribution of 2 to 8 minutes, but a terminal elimination of 3 to 20 hours (which may influence waking time after prolonged infusion [many days]: context sensitive half-time). Inactive metabolites are renally excreted. Usual ICU sedation dose is infusion of 1 to 3 mg/kg/hr (higher infusion rates in Intensive Care have been associated with rhabdomyosysis). Mechanism of action is not clear. Lipid formulation of approx. 1 kcal/mL should be taken into account, and high triglyceride levels may be seen in susceptible patients. Hypotension and depression of cardiac output may occur (more so when bolus doses are used). Compatible with 5% dextrose but not with many other solutions or drugs. Time to wake after cessation of infusion is short (minutes to hours) depending on duration of infusion (context sensitive half time). Rapid awakening may increase likelihood of convulsions in those susceptible. Relatively expensive.

Midazolam is formulated as a colourless isotonic but acidic solution (pH 3.3) as 1 or 5 mg/mL. Onset usually seen within minutes (97% protein bound), and usual elimination half-life quoted at 1 to 3 hours, but often seen 6 times longer in critically ill especially elderly or renal failure Metabolised by P450-3A to active metabolite 1-OH-methyl midazolam, and then renally excreted. Usual ICU dosage 0.03 to 0.2 mg/kg/hr. Mechanism of action is via activation of benzodiazepine receptor, which augments the inhibitory effect of the GABA receptor. Cardiorespiratory depression is expected. Rapid cessation may lead to withdrawal. Compatible with many solutions and drugs (except hartmanns), infusions should be discarded after 24 hours. Time to wake after cessation of infusion is intermediate (hours to days) depending on duration of infusion and presence of renal or hepatic dysfunction.

Thiopentone is prepared from a powder and dissolved in water giving an alkaline solution with a final concentration of 25 mg/mL. Onset of action within minutes (80% protein bound, with very large volume of distribution), usual elimination half life quoted at 3 to 8 hours (but presumably longer after prolonged infusion). Metabolised predominantly in the liver to (?) inactive metabolites which are renally excreted. Usual ICU dosage is 25 to 100 mg/hour (0.5 to 1.5 mg/kg/hr), with boluses of 25 to 100 mg as required. Very effective CNS depressant (including resultant isoelectric EEG and fixed dilated pupils). Incompatible with many solutions (especially if acidic), and infusions should be discarded after 24 hours. Time to awakening after cessation of infusion is delayed (up to many days), depending on duration of infusion and the presence of hepatic dysfunction. Barbiturates may precipitate acute porphyria in susceptible patients by enhancing porphyrin synthesis.

8. List the causes of a sudden acute fall in systolic blood pressure to 50 mmHg one hour after an uneventful coronary artery bypass operation. Outline your principles of management for each cause.

Eight of the twelve candidates passed this question.

Potential causes are many, and more than one may co-exist. Could be divided according to causes of shock: artefactual, hypovolaemic, obstructive, cardiogenic, and distributive (with principles of management in brackets). Simple manoeuvres should be considered early (eg. raise legs to autotransfuse).

Artefactual: transducer error (check transducer: zero, level, calibration), damping of waveform (assess damping coefficient), malfunction of NIBP.

Hypovolaemic: blood loss (observe drain tubes, CXR, dressings; give fluid ± blood products), massive diuresis (observe urine output; give fluid).

Obstructive: pericardial tamponade (observe chest drainage ± clots, high filling pressures: may need to open chest), tension pneumothorax (observe expanded hemi-thorax, listen to chest: check existing chest drains, may need needle thoracostomy and replace/insert ICC), elevated intrathoracic pressure (gas trapping: disconnect from ventilator; shivering/valsalva/fighting: sedate ± paralyse; ensure ETT not blocked).

Myocardial: decreased contractility (ischaemia due to blockage/kinking/spasm: treat with GTN, inotropes &/or short term vasoconstrictor ± fix technical problem; sudden removal of inotropic drug: restart drug) or rhythm disturbance on monitor/ECG (brady-asystole: pace ± atropine/isopenaline/adrenaline; SVT: eg. K/adenosine; AF eg. K/Mg/amiodarone, VT eg. K/Mg/lignocaine).

Distributive: anaphylaxis (rash/bronchospasm: remove hapten, adrenaline, fluids); vasodilator excess (recent boluses/infusion too high: stop responsible drug, ± titrated dose vasoconstrictor); sympathetic block (recent bolus epidural LA: titrated dose vasoconstrictor).

9. List the potential causes of diffuse pulmonary infiltrates in a patient with AIDS, and outline how they would influence your management.

Seven of the twelve candidates passed this question.

Many potential causes should be considered. **High pressure pulmonary oedema** (fluid overload: CPAP/PEEP, diurese, fluid restrict, remove blood; cardiac failure: diurese, vasodilate ± inotropes; acute ischaemia: nitrates, morphine ± betablockers, anticaogulants). **Low pressure pulmonary oedema/ARDS** (CPAP/PEEP, fluid restrict, diurese, treat underlyimg cause eg. sepsis). **Diffuse pneumonia** (diffuse typical or atypical: CPAP/PEEP, likely to need invasive investigation [eg. lavage], diurese and fluid restrict, specific treatment [anti-agent therapy] according to underlying cause: bacteria [eg. strep or TB], viral [eg. CMV/influenza/SARS], protozoal [eg. pneumocystis], fungal [eg. cryptococcus]). **Others**: could uncommonly also be malignant (eg. Karposi's sarcoma), pulmonary haemorrhage (eg. if low platelets: consider platelet transfusion) or auto-immune/vasculitic (consider steroids, immunosuppression).

10. Outline the diagnostic features of Horner's Syndrome and list the likely causes in patients in Intensive Care.

Nine of the twelve candidates passed this question.

Horner's Syndrome is due to damage to the cervical sympathetic pathway, and exhibits a smaller pupil [miosis: due to reduced pupilo-dilation], a variable degree of ptosis and anhydrosis [impaired sweating over variable area] ± bloodshot eye [loss of vasoconstrictor]. The presence of enophthalmos is controversial. Likely causes include common lesions along the path of the sympathetic pathway: including from brainstem (CVA) and cervical cord lesions (including trauma and local anaesthetic eg. epidural), through T1 root lesions (malignant disease eg. Pancoast syndrome; traction injuries to arm or aneurysms of aortic arch or subclavian artery), along the chain in the neck (malignancy, neck surgery, carotid artery dissection). Transient Horner's can occur with cluster headaches and with migraine. Many cases have no demonstrable cause.

11. Outline the possible effects on oxygenation of the prone position and the potential mechanisms underlying these effects.

Six of the twelve candidates passed this question.

The effects of prone positioning on oxygenation are best studied in ARDS patients. Short lived improvements in oxygenation are common (eg. 70%) and sometimes dramatic. Some patients have no effect, and others have a long lasting effect (persisting well after rolling supine again). Potential mechanisms for improving oxygenation during proning include: an increase in end-expiratory lung volume (with better response to applied PEEP and tidal recruitment), better ventilation–perfusion matching (with more homogeneous distribution of ventilation, and less shunting), and regional changes in ventilation associated with alterations in chest-wall mechanics (allowing more of applied pressure to inflate the lungs). Prolonged benefits may be seen if inflation of recruitable lung has resulted in more lung units being held open when returned to the baseline ventilatory settings (Vt and PEEP).

12. Critically evaluate the role of clinical examination in the management of the critically ill patient.

Only three of the twelve candidates passed this question.

Few studies have addressed the potential benefits of clinical examination in the critically ill. Those that have addressed estimation of filling pressures have been disappointing. In general benefits of

clinical examination are only supported by lower levels of evidence (including extrapolation from other patient populations).

In the critically ill, as history may be difficult to obtain, especially in an emergency, clinical signs alone are used to guide treatment and investigation until more definitive information is available. Candidates should discuss potential risks & benefits (eg. early detection guiding treatment vs lack of sensitivity [missing disease states] and sensitivity [wrongly excluding differential diagnoses].

Types of information that are available and may influence management (either in an emergency or otherwise) include: assessment of airway and breathing (eg. position of ETT cuff, chest movement, breath sounds), circulation (eg. presence of pulses: peripheral/central and estimate of peripheral perfusion); neurological assessment (AVPU/GCS/pupils, localising signs, tone & reflexes, sensation); presence of skin lesions (rash: purpura, erythematous, papular; spider naevi etc); localised tenderness (eg. limb, abdominal quadrant etc); presence of abnormal masses (eg. lymph nodes, hepatosplenomegaly); fundoscopic assessment (eg. subhyaloid haemorrhages, papilloedema); assessment of invasive devices/dressings/drains etc.

13. What is a Standardised Mortality Ratio? What are the limitations of using this ratio to compare the performance of Intensive Care Units?

Six of the twelve candidates passed this question.

Standardised Mortality Ratio is defined as the observed mortality rate/expected mortality rate. Need to estimate expected mortality rate using a scoring system (eg. APACHE II or III, SAPS II or MPM). Better than comparison of non-adjusted mortality data.

The potential limitations of the system are multiple including: inconsistencies and inaccuracies associated with collection of data and scoring (eg. GCS, recording of parameters); problems of missing data limiting inclusion of all patients; problems of patient mix not adequately accounted for by the original population used for calculation of formulae (eg. transferred patients or delays before admission); small numbers of patients (increasing the error of the SMR estimate); accuracy of the prediction model; relying on mortality as a surrogate marker for quality of care; cost of use of proprietary system; etc.

14. List the potential aetiology of a severely altered mental status in a 65-year-old man, 48 hours after major hepatic resection for hepatocellular carcinoma. Outline your management of this patient.

Nine of the twelve candidates passed this question.

Mental state could be severely depressed or patient may be agitated or confused. In general the potential aetiologies are the same, though some more likely in each type of state. Consider: decreased oxygen delivery to braiin (hypoxaemia, low cardiac output, low blood pressure), effects of drugs (those administered or those withdrawing from), intracerebral pathology (thromboembolism, rarely bleed eg. into undetected secondaries), electrolyte disorders (especially glucose, Na and Calcium), infections (unlikely; eg. systemic/meningitis/encephalitis), postoperative confusional state (uncertain but probably multifactorial aetiology), post-ictal or psychiatric disorder.

Management involves exclusion of reversible and specific treatable causes considered likely/possible (eg. SpO2, vital signs, glucose, electrolytes, review drugs and history). Appropriate treatment of any specific abnormalities detected. Protection of patient and staff with cautious use of restraint (chemical or physical) if absolutely necessary or specifically indicated.

15. Compare and contrast the advantages and disadvantages of enteral feeding via a nasogastric tube, a PEG and a percutaneous feeding jejunostomy.

Nine of the twelve candidates passed this question.

Nasogastric tube: simple, commonly used, cheap, can assess and retrieve residual gastric contents (depends on tube size), advantages of gastric feeding (tolerant of bolus and continuous feeds, buffers gastric acids, bactericidal action of acid, gastric pepsin and lipase facilitate absorption of most feeds) **BUT** aesthetic appearance, potential trauma of insertion, potential misplacement during insertion (especially critically ill), requires radiological confirmation of placement, easily dislodged, sinusitis, increase aspiration risk (less competence gastro-oesophageal sphincter), potential for gastric distension, tolerance of feeding susceptible to gastroparesis (emesis, regurgitation).

PEG: avoids nose/mouth issues, better tolerated than nasogastric, less likely to be displaced than nasaogastric, can assess and retrieve gastric contents (if large bore and in stomach), advantages of gastric feeding (see above), avoids interfering with gastro-oesophageal sphincter **BUT** more complex to insert, less commonly performed, more expensive tube, requires endoscopy (with associated complications), percutaneous wound, often larger bore tube with potential for trauma and displacement, potential for gastric distension, tolerance of feeding susceptible to gastroparesis (emesis, regurgitation).

Percutaneous feeding jejunostomy: avoids nose/mouth issues, better tolerated than nasogastric, less likely to be displaced than others, avoids interfering with gastro-oesophageal sphincter, bypasses stomach and allows earlier feeding (avoids gastric distension and problems of gastroparesis), theoretically better for pancreatitis (less pancreatic exocrine secretion) **BUT** more complex to insert, less commonly performed, more expensive tube, requires endoscopy &/or surgery (with associated complications), percutaneous wound, small bore tube with potential for displacement and blockage (eg. with enteral drugs), less tolerant of bolus or high volume infusions.

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