

**REPORT OF GENERAL FELLOWSHIP EXAMINATION**  
**AUGUST/SEPTEMBER 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.*

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Twenty-three candidates presented for this examination. Fifteen 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). Twelve 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. It is imperative that candidates answer the specific question asked (eg. differential diagnosis, "the most likely" = give one, or "list five" means list up to five but **not** more).

Station:

1. ***Rest station***
2. ***ECGs.*** Examples included AF with rate dependant bundle branch block, R wave in V1, heart block (Wenckebach), widened QRS, atrial flutter, and right axis deviation.  
Eighteen out of twenty-three candidates passed this section.
3. ***CXR's.*** Examples included left SVC, shoulder dysplasia, sub-diaphragmatic gas, pleural calcification, and mechanical heart valves. Many tubes/devices were inappropriately positioned.  
Fifteen out of twenty-three candidates passed this section.
4. ***Equipment.*** Examples included a McCoy blade, a blood filter, a biphasic defibrillator and an intra-aortic balloon pump.  
Sixteen out of twenty-three candidates passed this section.

5. **Microbiology.** Material presented included central venous catheters (some with anti-bacterial impregnation), anti-bacterial and anti-fungal therapeutic agents, and activated protein C.

Twenty-one out of twenty-three candidates passed this section.

6. **Rest station**

7. **Procedure station.** Candidates were expected to provide a systematic approach to a patient with a tension pneumothorax. The scenario provided was as follows:

*“A twenty-two (22) year old male has been brought to your Emergency Department following a motor vehicle accident. He was the unrestrained driver of a car that collided head-on with a truck. The ambulance officers report that he has been dyspnoeic, tachycardic and shocked en route to the hospital. You are the only doctor available to attend to him.”*

Thirteen out of twenty-three candidates passed this section.

8. **Rest station**

9. **Communication station.** The scenario provided was as follows:

*“A twenty-three (23) year old woman (Jane Bland) was admitted to your Intensive Care Unit last night with a right lower lobe pneumonia, hypoxaemia and hypotension. Her blood pressure is now stable but she is breathless and has a pulse oximeter saturation of 85% while breathing humidified 90% oxygen at a flow of 50L/min. The pulse oximeter values have been consistent with a recent arterial blood gas:*

pH	7.30		7.35 – 7.45
PaCO <sub>2</sub>	61	mmHg	35 -40
PaO <sub>2</sub>	51	mmHg	

*Approximately five (5) years ago she was diagnosed with a form of muscular dystrophy. She is normally wheel chair bound and needs help with feeding and washing. She lives at home with all care provided by her brother.*

*She is now too breathless to speak and has indicated that she wants you to speak to her brother who has medical power of attorney.”*

Eleven out of twenty-three candidates passed this section.

10. **Rest station**

11. **Other X-rays.** Examples included CTs of infarcted basal ganglia, a parasternal mass, aortic dissection and adrenal haemorrhage, and X-rays demonstrating cervical spine subluxation. A list of abnormal findings was requested, as were potential aetiology and complications. Seven out of twenty-three candidates passed this section.

12. **Clinical case.** Material presented included a CXR showing cardiomegaly, pulmonary oedema, a pneumothorax, and a malpositioned pulmonary artery catheter; an ECG showing a new LBBB; blood abnormalities secondary to beta-adrenergic stimulation and the effects of cardiopulmonary bypass/heparin; evidence of pulsus alternans, tricuspid regurgitation and hypotension; and PAWP > PADP, with a wrongly calculated SVRI. Ten out of twenty-three candidates passed this section.

13. **Biochemistry.** Examples included artefact secondary to contamination with potassium EDTA, a hypo-adrenal state, effects of alcohol/malnutrition, and rhabdomyolysis. Nine out of twenty-three candidates passed this section.
14. **Haematology.** Material presented demonstrated pancytopenia secondary to bone marrow suppression. Subsequent questions included use of haematological tests to assess anaemia (including MCV and haemolysis screen). Twelve out of twenty-three candidates passed this section.

## Cross Table Viva Section

There were 6 structured Vivas of ten minutes each. There were two minutes provided to read a scenario outside each viva room. Eighteen out of twenty-three candidates passed this section.

Candidates should be able to provide a systematic approach for assessment and management of commonly encountered clinical scenarios. Candidates should also be prepared to provide a reasonable strategy for management of conditions that they may not be familiar with.

The topics covered, including introductory scenarios and initial questions were:

- **Literature evaluation**

**Scenario:** Consider the following abstract as an example – NEJM 2003, 349: 949 – 58

*“Treatment of opiate addiction with sublingual buprenorphine and naloxone has been proposed, but its efficacy and safety have not been studied.*

*Methods – we conducted a multi-centre, randomised, placebo-controlled trial involving 326 opiate-addicted persons who were assigned to sublingual buprenorphine and naloxone, buprenorphine alone or placebo.....*

*Results – The trial was terminated early because both active treatments were found to have a greater efficacy than placebo.....*

*Conclusions – Buprenorphine/naloxone and buprenorphine are safe and efficacious in reducing opiate craving.....”*

**Introductory question:** What do you understand by the term “evidence-based medicine”?

Nineteen out of twenty-three candidates passed this section.

- **Musculo-skeletal**

**Scenario:** A thirty (30) year old male driver has a high speed collision with a tree. He has a GCS of 8, multiple right sided injuries and fractures, and had been intubated and resuscitated by the trauma team in your Emergency Department. Orthopaedic surgery is planned and you are asked whether you have an ICU bed.

You review in the Emergency Department and are told that he was a difficult intubation with a grade 3-4 larynx. He is nasally intubated, on a transport ventilator with 100% FiO<sub>2</sub>, VT 900ml and respiratory rate of 10. His SBP is 100 mmHg, pulse rate is 130/min. His abdomen is soft. He has one 14 G IV line with Hartmann’s running.

X-rays: # ribs (R 2-3), # pelvis, # R femur, # R tibia (complex)

Chest: diffuse opacities both lungs consistent with ARDS

Cervical: (AP and lateral) normal to C6

Thoracic: # T4

CT head scan: # base of skull

**Introductory question:** *What is your immediate management?*

Sixteen out of twenty-three candidates passed this section.

- **Cardiac surgery**

**Scenario:** *A seventy-two (72) year old ex-heavy smoker underwent “on-pump” coronary artery bypass grafting (LIMA to LAD, RIMA to RCA, free radial to Circumflex). His preoperative left ventricular function was normal. It was not possible to achieve satisfactory retrograde cardioplegia so anterograde cardioplegia was employed.*

*He received a total intravenous anaesthetic technique with propofol and remifentanyl. There were no specific problems separating from cardiopulmonary bypass but a new Right Bundle Branch Block was noted on his ECG.*

*In transit to the ICU he was noted to be awake and obeying commands.*

*Soon after arrival in ICU, he became agitated, dysynchronous with the ventilator and developed marked systemic hypotension.*

*Here are his first haemodynamic measurements in ICU.*

<b>Heart rate</b>	<b>100 reg</b>		
<b>Systolic blood pressure</b>	<b>85</b>		
<b>Mean arterial pressure</b>	<b>55</b>	<b>Systemic vascular resistance</b>	<b>809</b>
<b>Diastolic blood pressure</b>	<b>40</b>	<b>Systemic vascular resistance index</b>	<b>1600</b>
<b>Pulmonary capillary wedge pressure</b>	<b>20</b>		
<b>Cardiac Output</b>	<b>2.7</b>		
<b>Cardiac Index</b>	<b>1.5</b>		
<b>Pulmonary artery systolic pressure</b>	<b>60</b>	<b>Pulmonary vascular resistance</b>	<b>590</b>
<b>Mean pulmonary artery pressure</b>	<b>40</b>	<b>Pulmonary vascular resistance index</b>	<b>1070</b>
<b>Pulmonary artery diastolic pressure</b>	<b>30</b>		
<b>Central venous pressure</b>	<b>25</b>		

**Introductory Question:** *How do you interpret these results?*

Twenty out of twenty-three candidates passed this section.

- **Haematology-oncology**

**Scenario:** *A 45 year old male has been referred to you from the oncologists. He was recently diagnosed with non-Hodgkin’s lymphoma and commenced chemotherapy three (3) days ago. He has been admitted to intensive care with a convulsion, acute renal failure and ventricular arrhythmias.*

**Introductory question:** *What is your initial management?*

All twenty-three candidates passed this section.

- **Nutrition**

**Scenario:** *A fifteen (15) year old female is admitted to your Intensive Care Unit following a laparotomy for perforated appendix and drainage of pelvic abscess.*

*She has developed septic shock necessitating mechanical ventilation and inotropic support.*

*She has an intercurrent history of anorexia nervosa, for which she was attending counselling and was poorly compliant to follow up.*

*Her weight is 34 kg, she is 165 cm tall.*

**Introductory question:** Describe how you will manage this patient in the acute stage of her intensive care stay?

Fourteen out of twenty-three candidates passed this section.

- **Neurology**

**Scenario:** A forty-three (43) year old man, previously fit and well is brought into the Emergency Department having been found at home unconscious by his wife. He had last been seen six (6) hours previously. Pupils are reactive, GCS 8, breathing spontaneously, no focal signs.

**Introductory question:** What is the differential diagnosis?

Fifteen out of twenty-three candidates passed this section.

## **The Clinical Section**

The Clinical Section was conducted at the Royal Adelaide Hospital and the Flinders Medical Centre, Adelaide.

Only eleven out of twenty-three 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:

- ALL and lymphadenopathy
- bronchiectasis and previous lobectomy
- myelofibrosis
- carcinoma right upper lobe
- muscular dystrophies
- aortic valvular disease

Fourteen out of twenty-three candidates passed this section.

Cases encountered as Hot Cases included patients with:

- persistent fever after septic shock
- shock on inotropes
- impaired neurological function after intracerebral haemorrhage
- severe airway obstructive and ventilator dys-synchrony

Only nine out of twenty-three candidates passed this section.

## **WRITTEN SECTIONS**

Twenty out of twenty-three 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**

Twenty out of twenty-three candidates passed this 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**

*You are called to see a 39 year old female driver in the Emergency Department who has been brought in by ambulance after a motor vehicle crash (head on collision). She is eight months pregnant (first pregnancy), and is complaining of abdominal pain.*

Twenty out of twenty-three candidates passed this section.

(a) *Please outline your initial management of this patient.*

The additional complicating factor of pregnancy expands the differential diagnosis, and requires additional investigation and monitoring, and complicates the performance of many interventions. Standard ACLS/EMST management of the initial presentation should be performed. Primary survey: [airway {and cervical spine}, breathing, circulation, disability and exposure] with high flow oxygen and standard monitoring. Standard resuscitation and initial Xrays should be performed with a lead apron covering the abdomen whenever possible. Secondary survey: Abdominal examination is even less reliable than usual, and concern about foetal well-being and the possibility of abruption should be considered. Uterine rupture is rare without previous uterine surgery. Early consultation should occur with an obstetrician, and Cardio-Toco-Graphic monitoring should be implemented. Focused Abdominal Sonography in Trauma is still reliable, and abdominal CT scan is not contraindicated, and may help in the diagnosis of abruption.

(b) *Please discuss the timing and nature of any investigations that you would perform.*

Consider: Immediate: blood for group (consider Rhesus isoimmunisation), cross match, electrolytes, full blood examination and coagulation profile. Xrays of chest and cervical spine (&/or pelvis), delaying other Xrays until stable.

Early: abdominal ultrasound (FAST, uterus and foetal heart rate), CTG

Once stable: abdominal CT, thoracic and lumbar spine films (if can't clear clinically in view of distractors). DPL probably not of additional help, unless other investigations unavailable.

- (c) *Please discuss the expected physiological changes associated with pregnancy and how they would impact on her management.*

Multiple factors: consider the following:

Cardiovascular: vasodilated state with lower baseline BP, higher baseline HR, and higher cardiac output. Masking of initial hypovolaemia, risking foetal circulation, best monitored by foetal heart rate. Large intra-abdominal mass (uterus) puts patient at risk of supine hypotensive syndrome: need to displace uterus or position in left lateral position.

Respiratory: diaphragms pushed up, decreased FRC (need to insert ICCs higher); respiratory alkalosis (expected CO<sub>2</sub> 30, with HCO<sub>3</sub> 20): need to keep in mind when assessing blood gases and if ventilating patient. Swollen airway, larger breasts: intubation often difficult.

Gastrointestinal: decreased gastric emptying, and weakened lower oesophageal sphincter: increased risk of aspiration.

Haematological: hypercoagulable state, risk of Rh incompatibility with foetus: potential for Rhesus isoimmunisation.

Foetus: benefits from supplemental oxygen; avoid tetracyclines, quinolones, NSAIDs (premature ductal closure), etc.

## QUESTION 2

*A 65 year old man has been admitted to your Intensive Care Unit with a presumptive diagnosis of community acquired pneumonia. He is sedated, intubated and ventilated, and is haemodynamically stable.*

Eighteen out of twenty-three candidates passed this section.

- (a) *What specific historical information would you attempt to obtain? Discuss why.*

Specificity of typical or atypical in nature is poor; rapidity of onset (? Prognostic). Factors that might alter aetiology: recent or current hospitalisation, nursing home etc (more nosocomial like, including Gram negatives); areas associated with outbreaks (e.g. legionella); exposure to specific scenarios eg. Birds (psittacosis); exposure to communities with specific resistance patterns (eg. Drug resistant pneumococcus), risk for pseudomonas (structural lung disease e.g. bronchiectasis, corticosteroids, previous broad spectrum antibiotic use, undiagnosed HIV), visits to tropical areas (e.g. Burkholderia pseudomallei). Risk factors for poor prognosis: include age > 65, co-morbidities (eg. Diabetes, renal failure, neoplastic disease, alcoholism, immunosuppression). Usual historical data regarding other major illnesses/comorbidities, drugs, allergies, etc. Information regarding specific immunosuppression may also allow better coverage of potential organisms: consider T cell dysfunction (e.g. AIDS, immunosuppressive therapy and risks of Pneumocystis and TB), neutropaenia (e.g. Pseudomonas, Fungi), previous splenectomy etc.

- (b) *What specific investigations would you order? Discuss why.*

Standard CXR to help delineate areas involved (possibly help with aetiology), and serve as baseline. Blood cultures (diagnose organism), and full blood examination (ideally with film to assess white cell morphology; white cell count may be high, low or normal). Electrolytes including Creatinine (renal impairment, modify drugs) and liver function (organ involvement, modify drugs, help with aetiology). Gram stain (controversial) may help guide therapy, as may sputum culture. Pleural fluid should be tapped (for organism). Legionella urinary antigen (and/or sputum immunofluorescence) may help confirm diagnosis. Bronchoscopy and lavage or protected brush specimen may also help in aetiology.

- (c) *What empiric therapy would you commence (drugs, dosage, route and duration)? Discuss why.*

One example would be: Erythromycin 1 g IV 6 hrly plus ceftriaxone 1 g IV daily. Covers common pathogens including atypicals and Haemophilus (but not pseudomonas, Pneumocystis, Burkholderia), well tolerated, reasonably cheap.

- (d) *What factors would make you subsequently change from your initial choice of antibiotic therapy?*

Altering initial format if other suspected pathogens (e.g. gentamycin and meropenem for Burkholderia; cotrimoxazole for Pneumocystis etc.). Allergies (become known or develop). Discover unexpected resistance pattern. Other organisms causative (eg. Mycobacterium TB). Develop nosocomial superinfection or develop resistance. Develop side effect related to drug (e.g. severe liver function abnormalities). Spectrum may be narrowed if specific organism

### **Short Answer Questions**

Seventeen out of twenty-three candidates passed this section.

#### ***1. Outline your principles of management in the transport of the critically ill patient.***

Twenty out of twenty-three candidates passed this question.

Two inter-collegiate documents have been published (PS39 and IC-10) and cover the principles of management in detail. Intra-hospital transport requires justification of transport (review of risks vs benefits), availability of appropriate and functional equipment (monitoring and emergency intervention), adequately skilled staff, appropriate pre-departure procedures (including checking of equipment and drugs, and accompanying patient records/investigations), planning of appropriate timing and route, confirmation of appropriate clinical status before transport, appropriate monitoring during transport, assessment of monitoring and equipment at destination, appropriate handover if another team assumes responsibility for care, appropriate documentation of clinical status during transport and some process to facilitate quality assurance. Inter-hospital or pre-hospital transport also includes consideration of mode of transport (distance vs efficiency vs risks of road/fixed wing/helicopter), and potential preventative procedures before transport (e.g. chest tubes). For all transports, some forms of monitoring are considered mandatory (i.e. pulse oximetry, capnography [if mechanically ventilated], ECG, and blood pressure).

#### ***2. Critically evaluate the role of hyperbaric oxygen therapy in the management of the critically ill patient.***

Nineteen out of twenty-three candidates passed this question.

Critically evaluate implies evaluation (including risk/benefit assessment) is required rather than just providing a list of indications. Many indications are not supported by high levels of evidence. Recognised indications that may be relevant in the critically ill include: decompression sickness, arterial gas embolism, severe carbon monoxide poisoning, aggressive soft tissue infections (e.g. clostridial myonecrosis, necrotising fasciitis and Fournier's gangrene), and crush injuries. Randomised studies in humans have been performed in carbon monoxide poisoning (with variable results; eg. Scheinkestel MJA 1999, and Weaver NEJM 2002) and crush injuries (with positive results).

Hyperbaric oxygen therapy is not without risks to the patient (including general risks associated with transport, and specific risks of ear and pulmonary barotrauma, and pulmonary and cerebral oxygen toxicity). The delivery of hyperbaric oxygen to the critically ill also raises some significant logistic problems (including inter-hospital transport), but within centres with expertise these are minimised. For most indications in the critically ill there is limited human data (eg. case series, retrospective controls etc.), and minimal animal data.

Discussion is required with the hyperbaric unit on a case-by-case basis, and other supportive/adjunctive therapy is essential in all conditions.

### ***3. Critically evaluate the role of “immunonutrition” in the management of the critically ill patient.***

Sixteen out of twenty-three candidates passed this question.

Critically evaluate implies evaluation (including risk/benefit assessment) is required rather than just providing a list of constituents. Immunonutrition usually refers to enteral feeding formulae that have been enriched with a variety of pharmaconutrients. These include arginine, glutamine, omega-3 fatty acids, nucleotides, or a combination (eg. in commercial products such as Alitraq and Impact). Multiple randomised studies involving thousands of patients, and more recently meta-analyses have been performed. Studies have been heterogeneous with regard to patient groups and nutritional limbs, and results have been variable with regard to specific outcomes (eg. infectious complications and mortality). Some consistent benefits appear to be observed (eg. decreased infectious complications, or length of hospital stay) but are contradicted in other studies. Given the increased cost, the lack of consistent benefit, and the potential for harm, the overall role in the critically ill is still to be established. Recent literature includes:

- Montejo JC et al. Immunonutrition in the intensive care unit. A systematic review and consensus statement. *Clin Nutr.* 2003 Jun;22(3):221-33.
- Bertolini G et al. Early enteral immunonutrition in patients with severe sepsis: results of an interim analysis of a randomized multicentre clinical trial. *Intensive Care Med.* 2003 May;29(5):834-40.
- Heyland DK, Novak F, Drover JW, Jain M, Su X, Suchner U. Should immunonutrition become routine in critically ill patients? A systematic review of the evidence. *JAMA.* 2001 Aug 22-29;286(8):944-53.

### ***4. Compare and contrast the use of the Chi-squared test, Fisher’s Exact Test and logistic regression when analysing data.***

Only four out of twenty-three candidates passed this question.

All these tests are widely used in the statistical reporting of data and give a representation of the likelihood that a given spread of data occurs by chance.

The Chi-square(d) statistic is used when comparing categorical data (e.g. counts). Often, these data are simply displayed in a “contingency table” with R rows and C columns. It’s use is less appropriate where total numbers are small (e.g.  $N < 20$ ) or smallest expected value is less than 5.

Fisher’s Exact test is used when comparing categorical data (e.g. counts), but is only generally applicable in a 2 x 2 contingency table (2 columns and 2 rows). It is specifically indicated when total numbers are small (e.g.  $N < 20$ ) or smallest expected value is less than 5.

Logistic regression is used when comparing a binary outcome (e.g. yes/no, lived/died) with other potential variables. Logistic regression is most commonly used to perform multivariable analysis (“controlling for” various factors), and these variables can be either categorical (e.g. gender), or

continuous (e.g. weight), or any combination of these. The standard ICU mortality predictions are based on logistic regression analysis.

**5. Compare and contrast the roles of the pulmonary artery catheter and transoesophageal echocardiography in the management of the critically ill patient with shock.**

Twenty-one out of twenty-three candidates passed this question.

The PA catheter provides access to pulmonary and central venous circulations, at a relatively low incremental cost. The main information obtained is from measurement of pressures (eg. within right atrium or pulmonary arteries), but additional information includes core temperature, pressure waveforms, occlusion pressure, cardiac output (thermodilution or continuous), mixed venous oxygen saturation (intermittent [including from sites other than PA] or continuous). Standard limitations include the variable relationship between pressure and volume, and the risks of using derived variable. Other risks can be categorised into those associated with central venous catheterisation (e.g. arterial puncture, air embolus, infection), floating of the catheter (e.g. arrhythmias), and balloon inflation (e.g. PA rupture). Some information can be continuously monitored (e.g. pulmonary arterial pressures); other is intermittently sampled (e.g. occlusion pressure, thermodilution cardiac output), but without the risks of reinsertion.

Transoesophageal echocardiography requires additional very expensive monitoring equipment, and an expensive (but re-usable) probe. The TOE allows visualisation of cardiac (and surrounding) structures, and measurement/estimation of a number of haemodynamic parameters. A visual estimate is obtained of various parameters: including volume status (pre-load), contractility (left and right sided systolic and diastolic function), regional wall motion, abnormal masses (eg. vegetations) and peri-cardial/pleural/peri-aortic collections. Using Doppler, assessment of valvular function, and estimate of pressures and cardiac output is also possible. This is an intermittent technique (not usually left in situ for more than a few hours), which is highly operator dependent, where most risks associated with insertion and manipulation (eg. gastrointestinal bleeding/rupture). Insertion and manipulation usually requires some degree of sedation.

Indications depend on specific information desired, and the local expertise. The potential information obtained with either technique must be weighed against the risks in any given clinical scenario. If standard precautions are used, mortality or major morbidity with either technique is thankfully rare.

**6. Outline the clinical scenarios in which you would consider instituting dialysis in the critically ill.**

Twenty-one out of twenty-three candidates passed this question.

Dialytic techniques in the critically ill are becoming more widely used. Traditional indications used for acute renal failure, are concerns about fluid overload (actual or to facilitate nutritional support), hyperkalaemia or other uncontrolled electrolyte disorders, metabolic acidosis, hyponatraemia, uraemic symptoms or elevated urea (e.g. 30 mmol/L). As complications associated with techniques have been minimised, dialysis is often initiated earlier (anticipatory, oliguria, lower urea), and for non-renal indications (including sepsis or septic shock). Dialysis or haemofiltration (e.g. with charcoal filter) can be used to increase the clearance of toxic products from the circulation (e.g. lithium, theophylline, myoglobin). Newer related extracorporeal techniques have also been developed to support liver dysfunction.

**7. Outline the diagnostic features, complications and treatment of patients with an overdose of sodium valproate (valproic acid).**

Only seven out of twenty-three candidates passed this question.

Sodium valproate is becoming more widely used (seizures, bipolar disorders, migraine), and is often prescribed as a slow release preparation. Overdose results in a progressive onset of lethargy and CNS depression, with many potential associated features (including hypotension, hypothermia, vomiting, diarrhoea, agitation and tremors). Complications include cerebral oedema (with prolonged coma), encephalopathy (elevated ammonia), hepatotoxicity (rarely fulminant), and electrolyte disorders (with hypernatraemia, hypocalcaemia, increased osmolality and elevated anion gap metabolic acidosis). Treatment is generally supportive but gastrointestinal decontamination is essential (including multiple dose activated charcoal &/or whole bowel irrigation if sustained release preparations, and increasing valproic acid levels). Carnitine supplementation may attenuate hepatotoxicity and hyper-ammonaemia.

**8. Outline the clinical manifestations of the CREST syndrome, and how these might influence the management of such a patient in Intensive Care.**

Thirteen out of twenty-three candidates passed this question.

CREST syndrome refers to the predominantly cutaneous rheumatological condition with Calcinosis, Raynaud's phenomenon, Esophageal dysmotility, Sclerodactyly and Telangiectasia. Associated conditions include scleroderma (with additional arthralgias, myalgias, contractures, pulmonary fibrosis and pulmonary hypertension, renal impairment etc.). Patients with CREST syndrome therefore may have many manifestation that may complicate ICU management. Some of the many resultant potential problems include difficult intubation (limited mouth opening), risk of aspiration (and oesophageal perforation with TOE), malabsorption and nutritional deficiencies, limited respiratory reserve, risk of digital ischaemia with radial arterial lines and vasoconstrictors, skin breakdown/pressure area, and propensity to renal failure.

**9. Compare and contrast the pharmacology of ceftriaxone, gentamicin and meropenem.**

Seventeen out of twenty-three candidates passed this question.

Ceftriaxone: vial with yellow water soluble powder for reconstitution; only administered parenterally, 33-66% excreted unchanged in urine, no active metabolites, 85-95% protein bound, elimination half life 6-9 hours (> 36 hours with severely impaired renal function), usual dosage 0.5 to 2g IV 12 or 24 hourly; 3rd generation cephalosporin antibiotic, inhibits cell wall synthesis, covers most gram negative rods (except Pseudomonas), and Gram positive cocci (except Methicillin Resistant, and group D streptococci); adverse reactions uncommon, but include overgrowth of non-susceptible organisms, and occasional haematologic, renal and hepatic adverse effects.

Gentamicin: ampoule with 80 mg/2 mL; only administered parenterally, excreted almost entirely by glomerular filtration, elimination half life 2-3 hours, no active metabolites, usual dosage 1 mg/kg tds or up to 5 mg/kg as daily dose, careful monitoring of blood levels required, especially if renal impairment (trough level not > 2 mcg/mL); aminoglycoside antibiotic, inhibits protein synthesis, covers most gram negative rods (including pseudomonas, but variability from hospital to hospital); serious adverse reactions include oto- and renal toxicity, potentiated by other oto- and nephrotoxins, prolongation of neuromuscular blockade may occur, other reactions uncommon.

Meropenem: vial with water soluble powder for reconstitution; only administered parenterally, 70% excreted unchanged in urine (requiring reduction of dosage if significant renal impairment), plasma binding 2%, elimination half life 1 hour, no active metabolites, usual dosage 500mg to 2g every 8

hours; carbapenem antibiotic, inhibits cell wall synthesis, active against a broad spectrum of aerobic and anaerobic bacteria (including Gram positive cocci and Gram negative rods, but excluding MRSA, *Enterococcus faecium*, *Sternotrophomonas* and many *Pseudomonas*); serious adverse reactions are rare, but include overgrowth of non-susceptible organisms, and occasional haematologic, gastrointestinal and hepatic adverse effects.

***10. Outline the diagnostic features, complications and treatment of patients with malignant hyperpyrexia.***

Twenty out of twenty-three candidates passed this question.

Malignant hyperpyrexia is a rare genetic disorder, usually autosomal dominant inheritance, with mutations of the calcium channel (ryanodine) found in the sarcoplasmic reticulum of skeletal muscle. When triggered by drugs (esp. suxamethonium and volatile anaesthetic agents), usually within 1 hour, uncontrolled calcium efflux results in tetany, and markedly increased skeletal muscle metabolism. Diagnostic features include susceptible patient (may be unknown), exposed to triggering agent, with signs of increased metabolic rate (early tachycardia, increased muscle tone, increased oxygen consumption, increased CO<sub>2</sub> production [e.g. ETCO<sub>2</sub>], and later marked hyperthermia). Complications include rhabdomyolysis, shock, disseminated intravascular coagulation, and a mixed metabolic (lactic) and respiratory acidosis. The mainstay of treatment is the removal of triggering agents and administration of the specific antidote (dantrolene 20 mg/vial, diluted to 60 mL with water, dosage e.g. 2 mg/kg every 5 minutes up to 10 mg/kg, repeated every 10 to 15 hours, and continued for three days). Other treatment is supportive initially with active cooling, and detection and treatment of the potential complications listed above. Confirmation of diagnosis (muscle biopsy) and family screening may be necessary.

***11. Outline the clinical manifestations, appropriate investigations and treatment of “volutrauma” in the critically ill patient***

Twelve out of twenty-three candidates passed this question.

Nomenclature used for defining ventilator induced lung damage are complex and continue to evolve. “Volutrauma” should be considered as a potential complication of mechanical ventilation and may be manifest as extra-alveolar air, or acute (ventilator associated) lung injury. A good answer would deal with both aspects.

Exacerbation of acute lung injury is detectable on analysis of BAL fluid, but is hard to differentiate from the inflammatory state associated with the initial lung injury, and its associated conditions. Treatment is the continuation of lung protective strategies (see below).

Extra-alveolar air results from alveolar rupture, and manifestations depend on where the gas passes but include interstitial emphysema, mediastinal emphysema, pneumothorax, pneumoperitoneum, and subcutaneous emphysema. Clinical signs may include haemodynamic and/or respiratory compromise in a ventilated patient (e.g. tension pneumothorax), in particular in a susceptible patient (e.g. obstructive airways disease, heterogeneous lung disease). Manifestations may vary from a subtle deterioration to overwhelming collapse, or may just present with palpable (subcutaneous) emphysema. Investigations should include radiographs to exclude the manifestations mentioned above, and to exclude differential diagnoses. Treatment involves introduction of lung protective strategies to minimise further damage (in particular lower tidal volumes, lower ventilatory rates, lower mean airway pressures, and avoidance of auto-PEEP), drainage of collections of gas (e.g. urgent decompression of tension pneumothorax, and subsequent intercostal catheters, or even subcutaneous tubes). Double lumen tubes and/or differential lung ventilation is occasionally required.

**12. Outline the causes, and principles of management of ventricular fibrillation**

Seventeen out of twenty-three candidates passed this question.

Ventricular fibrillation requires an initiating stimulus in a susceptible myocardium. VF can be induced in a previously normal myocardium as a result of electrical stimulation (electrocution, lightning) or by trauma (commotio cordis). The myocardium can be made more susceptible by the presence of hypoxaemia (e.g. respiratory arrest), electrolyte disturbances (low K and Mg), altered autonomic and vagal inputs, and mechanical stimuli (e.g. wire or catheter in RV). The myocardium may be abnormally susceptible due to congenital (e.g. conduction abnormalities) or acquired disorders (including ischaemia, hypertrophy, myocarditis, pro-arrhythmic drugs, etc).

Principle of management include early defibrillation, but in concert with correction of any correctible cause (e.g. wire, electrolytes, hypoxaemia etc), support of the cardio-respiratory state with adequate basic life support, and restoration of an appropriate metabolic milieu to support a normal rhythm. This latter approach may require performance of cardiopulmonary resuscitation, and administration of specific anti-arrhythmic drugs. Defibrillation is performed with either monophasic (200/200/360J) or biphasic (150/150/150J) defibrillator waveforms in a series of up to three sequential shocks. Subsequent monophasic shocks should be administered at maximal dose.

**13. Outline your approach to the transfusion of red blood cells in the critically ill patient.**

Only six out of twenty-three candidates passed this question.

A sophisticated and broad response is expected for this very common clinical issue.. Clinical Practice Guidelines were issued by NH&MRC (and Australian Society of Blood Transfusion) in 2001.

Strategies should be in place to deal with prevention: minimise blood loss (sampling, other losses, management of anticoagulation, etc.), to supply appropriate haematinics; and to individualise transfusion based on subgroups. In general ICU patients and in elective surgery recent studies suggest benefit associated with the choice of a transfusion threshold of 70 g/L (as opposed to 100g/L), and there seems to be no harm in choosing 80 g/L as opposed to 90 g/L in patients after coronary artery bypass grafting. These levels may be too low for uncorrected ischaemic heart disease (? >100 g/L may be better). In the setting of acute blood loss, earlier transfusion should be considered, based on estimated blood volume lost and haemodynamics (e.g. >1000 mL or 250 mL/hr). Other controversial issues include prophylactic use of erythropoietin, routine use of filters/leukodepletion of red cells prior to transfusion, reinfusion of autologous blood (e.g. drain tubes after cardiac surgery), and the approach to those patients unwilling to be transfused. A strategy should also be in place to deal with the potential complications associated with a massive transfusion (e.g. coagulopathy).

**14. Outline the way in which you would evaluate the aetiology of metabolic acidosis in the critically ill.**

Sixteen out of twenty-three candidates passed this question.

A metabolic acidosis is a process which, if uncorrected, would lead to an acidaemia. It is usually associated with a low bicarbonate concentration (or total CO<sub>2</sub>), but an acidosis may be masked by a co-existing metabolic alkalosis. A simple classification is to categorise acidosis into accumulation of acids (measured, i.e. chloride [hyperchloraemic metabolic acidosis] or unmeasured [increased anion gap metabolic acidosis]), or renal or gastrointestinal loss of bicarbonate (with absorption of chloride, resulting in hyperchloraemic metabolic acidosis). The anion gap ( $\text{Na} + \text{K} - \text{Cl} - \text{HCO}_3$ ) is usually determined primarily by negatively charged plasma proteins and has a range of approximately 10 to 16 mmol/L. This will be decreased by about 2.5 mmol/L for every decrease in

albumin by 10 g/L. An increased anion gap (which can occur in the absence of a low bicarbonate concentration) may be due to a fall in unmeasured cations (Ca, Mg), or more commonly to the presence of unmeasured anions (e.g. lactate [d- or l-], ketoacids, formate [methanol], glycolate and oxalate [ethylene glycol]). Some of these can be specifically measured. Calculation of an osmolar gap may also help as a screening test for methanol or ethylene glycol intoxication once alcohol has been excluded (calculated osmolality =  $2 \times \text{Na} + \text{Glucose} + \text{Urea} + \text{ethanol}/4.6$ ). Urinary pH (inappropriately alkaline for an acidaemia) and electrolytes may facilitate eliciting the specific cause of the renal bicarbonate loss (e.g. renal tubular acidosis).

***15. List the potential causes of profound weakness in the critically ill, and outline how you would determine which factors were contributory.***

Twenty out of twenty-three candidates passed this question.

Profound weakness in the critically ill can be as a result of a number of different pathophysiologic mechanisms. Residual paralysis should be considered and excluded by nerve stimulator examination (minimal response to train of four; post-tetanic facilitation, possibly some improvement with reversal of blockade). Residual sedation should also be considered, but once aroused, patient should be able to demonstrate more appropriate strength (and/or response to antidotes: e.g. naloxone, flumazenil). Critical illness polyneuropathy presents after a week or so of critical illness, typically with limb weakness and atrophy, reduced deep tendon reflexes, loss of peripheral sensation to touch and pin prick, but relative preservation of cranial nerve function. Electrophysiological studies reveal motor and sensory axonal neuropathy, and biopsies reveal axonal degeneration and denervation atrophy of muscles. An acute myopathy (especially in association with neuromuscular blockade and corticosteroids) may present with similar motor findings but with no sensory abnormalities. Creatine kinase should be elevated. Electrophysiological testing is consistent with a myopathy, and muscle biopsy reveals loss of thick filaments. Spinal cord lesions should be associated with a sensory level and hyperreflexia. Cranial nerve abnormalities suggest brain-stem problems or Guillain-Barre syndrome.

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