COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

**SECOND PART EXAMINATION**

**EXAM REPORT SEPTEMBER / OCTOBER 2016**

This report is prepared to provide candidates, tutors and Supervisors of Training with information regarding the assessment of candidates' performance in the CICM Second Part Examination. Answers provided are not necessarily model answers but a guide as to what was expected and for use as an educational resource. Trainees should discuss the report with their tutors so that they may prepare appropriately for future examinations. Trainees should not rely solely on writing practice answers to previous exam questions for exam preparation and first establish a strong knowledge base from learning at the bedside and studying relevant texts, journals and on-line sources.

The exam comprises a written section and an oral section. The written exam consists of two 2.5 hour papers of 15 ten-minute short answer questions each. Candidates are required to score at least 50% in the written section to be eligible to sit the oral section. The oral exam consists of eight interactive vivas and two separate clinical "hot cases".

The tables below provide an overall statistical analysis as well as information regarding performance in the individual sections. A comparison with data from the five previous exams is provided.

**In all sections of the exam the candidate has to demonstrate performance consistent with that of a junior consultant, i.e. demonstrate he/she has the ability for safe, effective, independent practice as an Intensivist. Candidates who are not at this level are encouraged to defer their attempt at the exam.**

| Overall Performance | October 2016 | May 2016 | October 2015 | May 2015 | October 2014 | May 2014 |
|---|---|---|---|---|---|---|
| Presenting for written (Including OTS) | 49 | 41 | 52 | 35 | 53 | 35 |
| Carrying a pass from a previous attempt | 14 | 14 | 12 | 21 | 3 | 8 |
| OTS Exempt | 0 | 0 | 0 | 0 | 0 | 0 |
| Total number presenting (written + carry + OTS) | 63 | 55 | 64 | 56 | 56 | 43 |
| Invited to orals (>50% in written section) | 34 | 27 | 35 | 27 | 40 | 15 |
| Total number invited to oral section | 48 | 41 | 47 | 48 | 43 | 23 |

| Analysis of Performance in Individual Sections | October 2016 | May 2016 | October 2015 | May 2015 | October 2014 | May 2014 |
|---|---|---|---|---|---|---|
| Successful in the written section | 34/49<br>69% | 27/41<br>66% | 35/52<br>67% | 27/35<br>77% | 40/53<br>75% | 15/35<br>43% |
| Successful in the Hot Case section | 33/48<br>69% | 18/41<br>44% | 26/47<br>55% | 32/48<br>67% | 21/42<br>50% | 15/23<br>65% |
| Successful in both Hot Cases | 24/48<br>50% | 7/41<br>17% | 13/47<br>28% | 17/48<br>35% | 12/42<br>29% | 6/23<br>26% |
| Successful in the Viva section | 38/48<br>79% | 18/41<br>44% | 31/47<br>66% | 40/48<br>83% | 25/42<br>60% | 22/23<br>96% |

| Sectional Pass Rates | October 2016 | | May 2016 | | October 2015 | | May 2015 | | October 2014 | | May 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pass rate | Highest individual mark | Pass rate | Highest individual mark | Pass rate | Highest individual mark | Pass rate | Highest individual mark | Pass rate | Highest individual mark | Pass rate | Highest individual mark |
| Hot Case 1 | 65% | 93% | 37% | 80% | 45% | 80% | 60% | 80% | 36% | 88% | 43% | 70% |
| Hot Case 2 | 65% | 90% | 46% | 90% | 62% | 85% | 56% | 88% | 57% | 85% | 61% | 85% |
| Viva 1 | 65% | 88% | 71% | 92% | 53% | 93% | 83% | 90% | 76% | 95% | 91% | 85% |
| Viva 2 | 67% | 85% | 32% | 70% | 45% | 88% | 96% | 95% | 90% | 92% | 83% | 90% |
| Viva 3 | 77% | 95% | 66% | 90% | 77% | 85% | 79% | 100% | 31% | 78% | 61% | 89% |
| Viva 4 | 46% | 90% | 51% | 80% | 79% | 78% | 52% | 88% | 55% | 90% | 87% | 85% |
| Viva 5 | 44% | 95% | 76% | 85% | 66% | 85% | 92% | 90% | 86% | 100% | 87% | 85% |
| Procedure Viva | 79% | 100% | 66% | 85% | 40% | 90% | 46% | 81% | 48% | 80% | 74% | 90% |
| Radiology Viva | 100% | 92% | 41% | 89% | 40% | 95% | 84% | 90% | 2% | 61% | 61% | 94% |
| Communication Viva | 60% | 95% | 10% | 85% | 47% | 78% | 65% | 100% | 24% | 85% | 78% | 100% |

| Oral Section Pass Rates | October 2016 | May 2016 | October 2015 | May 2015 | October 2014 | May 2014 |
|---|---|---|---|---|---|---|
| Candidates who scored >50% in written section and passed the overall exam | 25/34<br>**74%** | 15/27<br>**56%** | 27/35<br>**77%** | 19/27<br>**70%** | 20/40<br>**50%** | 15/15<br>**100%** |
| All candidates invited to oral section and passed the overall exam (written + carry + OTS) | 39/48<br>**81%** | 18/41<br>**44%** | 32/47<br>**68%** | 37/48<br>**77%** | 22/42<br>**52%** | 19/23<br>**82%** |
| Overall Pass Rate | 39/63<br>**62%** | 18/55<br>**33%** | 32/64<br>**50%** | 37/56<br>**66%** | 22/55<br>**40%** | 19/43<br>**44%** |

## EXAMINERS' COMMENTS

### Written Paper

Eight of the thirty questions had an overall pass rate of less than 50%. Topics covered by questions with a pass rate of less than 50% related to the implementation of a Rapid Response System, the role of procalcitonin, saliciylate toxicity, medical gas supply, assessment of nutritional state, brain herniation, ECG interpretation and the setting of PEEP in ARDS.

As in previous exams, candidates who failed questions did so for one or more of the following reasons:

- Insufficient knowledge of the topic in question.
- Insufficient detail and/or depth of the answer, i.e. the answer was not at the level of a junior consultant.
- Poorly structured answer.
- Inadequate reference to supportive evidence where relevant.
- Failure to answer the question as asked.
- Omission of all or part of the question.

Additional Examiners' comments may be found after the relevant question in the written paper displayed below.

Candidates are advised to read the questions carefully and thoroughly and ensure they answer the question as asked and address all parts of each question. **Candidates are reminded to make sure their writing is legible and to avoid using non-standard abbreviations**. Candidates are also reminded that professional conduct is assessed throughout the exam process and that inappropriate comments written on the answer paper are not acceptable.

Candidates who failed the written section passed an average of 14/30 questions compared with candidates scoring ≥50% and gaining an invitation to the oral section, passing an average of 20/30 questions.

## SECOND PART WRITTEN EXAMINATION

(A) Write your answers in the blue book provided.

(B) Start each answer on a **new page** and indicate the **question number**. It is not necessary to rewrite the question in your answer book.

(C) You should aim to answer each question in **ten** minutes.

(D) The questions are worth **equal** marks.

(E) Record your **candidate number** and each **question number** on the cover of each book and hand in all books.

## GLOSSARY OF TERMS

**Critically evaluate:** Evaluate the evidence available to support the hypothesis.

**Outline:** Provide a summary of the important points.

**List:** Provide a list.

**Compare and contrast:** Provide a description of similarities and differences (E.g. Table form).

**Management:** Generic term that implies overall plan. Where appropriate, may include diagnosis as well as treatment.

**Discuss:** Explain the underlying key principles. Where appropriate, this may include controversies and/or pros and cons

## NOTE

Where laboratory values are provided, abnormal values are marked with an asterisk (*****).

***Please note that in this report all images from the SAQs have been removed.***

### Question 1

a) Outline the distinguishing features that differentiate between diabetic ketoacidosis (DKA) and hyperosmolar hyperglycaemic state (HHS). (70% marks)

b) List six possible complications seen during treatment of HHS. (30% marks)

### Answer Template

a)

a. History
   i. Known type 1 DM; discontinuation of or inadequate insulin therapy in DKA
   ii. HHS – history of type 2 DM +/- non-compliance
   iii. Age – DKA usually younger, HHS usually older
   iv. Presentation: DKA evolves rapidly (24 hours); HHS typically days-weeks with polydipsia, polyuria and weight loss.
   v. Abdominal pain may be a presenting symptom in DKA

b. Clinical features
    i. Neurological symptoms more common in HHS.
    ii. Abdominal pain more common in DKA.
    iii. Kussmaul respiration / hyperventilation in DKA
    iv. Ketotic breath
c. Laboratory features
    i. Degree of hyperglycemia (HHS typical higher, exceeding 56 mmol/l; DHA usually < 44 mmol/l)
    ii. Degree of acidosis: severe in DKA, mild in HHS
    iii. Anion gap acidosis present in DKA; absent (or mild in case of concomitant lactic acidosis) in HHS
    iv. Ketones: HHS small ketonuria, absent to low ketonaemia [there is sufficient basal insulin secretion to prevent ketogenesis]; both high in DKA
    v. Hyperosmolality more severe in HHS, typically > 320 mosm/l
d. NOTE: Significant overlap can occur in 30% of patients

b)

a. Hypoglycaemia
b. Hypokalaemia
c. Hypophosphataemia
d. Hypo or Hypernatremia
e. Cerebral oedema (more common in DKA, has been reported in HHS), may result in decreased LOC, seizures, bradycardia and respiratory arrest
f. Pulmonary oedema
g. Deep venous thrombosis and pulmonary embolism
h. Hyperchloraemic acidosis (usually not clinically significant)

*Additional Examiners' Comments:*
*There was a lack of reference to clinical features. Surprisingly few candidates mentioned the presence of ketones and ketoacidosis as a distinguishing feature.*

| | |
|---|---|
| Percentage Passed | 71% |
| Maximum Score | 8.5 |

**Question 2**

Discuss the diagnosis and early management of necrotising fasciitis associated with Group A Streptococcal (GAS) infection.

**Answer Template**

The management of necrotizing fasciitis associated with Group A Streptococcal infection consists of

- Diagnosis,
- Antibiotic therapy,
- Supportive therapy for associated shock, and
- Prompt surgical intervention.

**Diagnosis**
**History**

- Necrotising infections are likely to have pain far in excess of superficial appearance
- May have history of recent trauma, cuts, wounds or IVDU
- Predisposition: diabetes, peripheral vascular disease, immunosuppression, steroid use
- May have history of systemic symptoms; fever, chills, nausea, myalgia, headache

**Examination**
**Local**

- Red, swollen, tender, area, dark discoloration of the skin
- Bullous formation and areas of necrosis are late signs

**Systemic**

- Signs of systemic toxicity and organ failure may be present (renal impairment, coagulopathy, liver abnormalities, acute respiratory distress, erythematous rash)

**Investigations**

- Culture of swabs, tissue in selective media
- PCR
- Frozen section biopsy at time of surgery
- Blood culture
- CT or MRI may show extent of infection
- Routine investigations: ABG, FBC, Coags and fibrinogen, LFTs, EUC, lactate
- Streptozyme test – need antibody production. Better at detecting post-streptococcal disease like PSGN, rheumatic fever
    - Anti-streptolysin (ASO)
    - Anti-hyaluronidase (AHase)
    - Anti-streptokinase (ASKase)
    - Anti-nicotinamide-adenine dinucleotidase (anti-NAD)
    - Anti-DNAse B antibodies
- Rapid Antigen Detection test – more useful for diagnosis of pharyngitis

**Antibiotic therapy**

- Group A Strep. remain susceptible to beta-lactam antibiotics.
- Penicillin is still drug of choice
- Clindamycin should be added to the regimen as clindamycin may be more effective in invasive infections. The efficacy of clindamycin is unaffected by the size of the inoculum and the stage of bacterial growth. Clindamycin also inhibits the production of toxin by streptococci.
- In a patient where the initial microbiology is uncertain a broad spectrum antibiotic – such as meropenem should be considered.

**Supportive management**

- Often requires monitoring in an intensive care unit with insertion of arterial and central lines, aggressive fluid resuscitation, inotropic support, invasive respiratory support and not infrequently renal replacement therapy.
- IVIG is of benefit in TSS to help limit spread of disease and improve mortality.
- Hyperbaric oxygen therapy may be considered but is adjunctive and other therapy should not be delayed.

**Prompt Surgery**

- Early and extensive surgical intervention is key with remove all affected tissue.
- Daily returns to operating theatres until there is no longer further evidence of spread are often necessary

*Additional Examiners' Comments:*
*Many candidates' answer contained lists of facts with very little clinical perspective. Although the pass rate overall was good, much better marks would have been possible if candidates actually read the question and discussed the diagnosis and early management rather than just reciting textbook facts.*

| | |
|---|---|
| Percentage Passed | 94% |
| Maximum Score | 8.5 |

**Question 3**

3.1

A 62-year-old male has been admitted to your ICU for routine post-operative monitoring after a vascular surgical procedure.

His pre-operative full blood count (FBC) is displayed below:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 125 g/L* | 130 – 180 |
| White Cell Count | 7.4 x $10^9$/L | 4.5 – 11.0 |
| Platelets | 255 x $10^9$/L | 150 – 400 |
| Mean Cell Volume | 110 fL* | 80 – 98 |
| Mean Cell Haemoglobin | 30 pg/cell | 27 – 33 |
| Mean Cell Haemoglobin Concentration | 320 p/L | 310 – 360 |

Give six possible causes for the findings on his FBC. (20% marks)

**Answer Template**

Liver disease (including alcoholism)
Folate deficiency
B12 deficiency
Hypothyroidism
Myelodysplasia
Drug related (one example required for mark – methotrexate, AZT, trimethoprim, phenytoin, some chemotherapeutic agents, cyclophosphamide. Multiple examples do not gain more marks)
Reticulocytosis
Familial

3.2

Inspect the following full blood count:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 96 g/L* | 130 – 175 |
| White Cell Count | 17.4 x $10^9$/L* | 4.0 – 11.0 |
| Platelets | 168 x $10^9$/L | 150 – 450 |
| Neutrophils | 12.4 x $10^9$/L* | 1.8 – 7.5 |
| Lymphocytes | 2.06 x $10^9$/L | 1.50 – 4.00 |
| Monocytes | 0.5 x $10^9$/L | 0.2 – 0.8 |
| Eosinophils | 0.3 x $10^9$/L | 0.0 – 0.4 |

Film: Circulating nucleated red blood cells, immature granulocytes and band forms observed.

a) What is the term used to describe these findings on a blood film? (20% marks)

b) Give four possible reasons these findings may be observed in a critically ill patient. (20% marks)

**Answer Template**

a) Leucoerythroblastic anaemia/reaction

b) Sepsis
Trauma
Any marrow infiltrative process, carcinomas, myeloproliferative disorders
Rebound following bone marrow failure or suppression

3.3

A 52-year-old female was admitted the previous night with an altered level of consciousness that improved rapidly with administration of glucose. She is referred to ICU the day following admission with confusion, ataxia and a worsening level of consciousness. Her CT head scan was normal.

The blood sugar level in the morning is 8 mmol/l on a 5% Dextrose infusion at 80 ml/hr. Her full blood count from the previous night is as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 88 g/L* | 130 – 175 |
| White Cell Count | 7.4 x $10^9$/L | 4.0 – 11.0 |
| Platelets | 88 x $10^9$/L* | 150 – 450 |
| Mean Cell Volume | 110 fl* | 80 – 98 |
| Mean Cell Haemoglobin | 30 pg/cell | 27 – 34 |
| Mean Cell Haemoglobin Concentration | 320 g/L | 310 – 360 |
| Prothrombin Time | 12 sec | 12 – 18 |
| Actjvated Partial Thromboplastin Time | 36 sec | 32 – 38 |

a) What is the likely cause of her confused state? (20% marks)

b) What specific treatment would you institute for resolution of her mental status? (10% marks)

c) What blood test would support the diagnosis? (10% marks)

**Answer Template**

a) Wernickes encephalopathy

b) Thiamine IV

c) Red blood cell transketolase activity (reduced)

| | |
|---|---|
| Percentage Passed | 78% |
| Maximum Score | 8.0 |

**Question 4**

You are asked to head a working party to establish a Rapid Response System (RRS) in your hospital.

Outline the steps you will take to do this.

**Answer Template**

A hospital-wide system to recognise and respond to the deteriorating patient is a requirement as set out in Standard 9 of the National Safety and Quality Healthcare Standards.

Implementation of RRS

- Engage all hospital staff and involve representation from all groups: hospital executive, senior nursing and medical, junior nursing and medical, allied health and ancillary staff and community representative
- Appoint "champions" from these groups to promote the system and to form the working party
- Review the literature and RRS models in other institutions and seek help from experts in the field
- Collect baseline data pre-implementation
- Determine appropriate RRS model for the hospital based on
    - Hospital case-mix
    - Hospital culture
    - Resources and funding
    - Pre-existing system e.g.: cardiac arrest team
- Issues to consider
    - Criteria for activation
    - Team composition
    - Home team involvement
    - ICU involvement
    - Projected number of calls
    - Consequent effects on existing services as staff take up these additional responsibilities & service provision
- Education of users of system hospital-wide
- Team training for MET personnel including clinical skills, communication, teamwork and end-of-life decision-making
- Source appropriate equipment / drugs for RRS calls and storage when not in use, with systems for checking & maintenance
- Establish system for data collection and audit
- Consider phased introduction of RRS or pilot project initially
- Data collection and audit from first day of implementation
- Review of data and benchmarking with other hospitals
- Feedback from RRS users and RRS team
- Modification of RRS as needed
- On-going education of staff and RRS team training
- Contribute to national database

*Appropriate information not in the template was given credit.*

*An acceptable answer addressed the following points:*

- *The elements of the audit cycle*
- *The need to engage staff hospital-wide in the process*
- *Design of the system to suit hospital culture, case-mix, resources*
- *Team training and education*
- *Data collection and audit*

*Additional Examiners' Comments:*
*Many candidates lost marks for an answer that included relevant points but was clearly not at the level of a junior consultant.*

| | |
|---|---|
| Percentage Passed | 49% |
| Maximum Score | 7.0 |

**Question 5**

You are working as an ICU specialist in a small regional hospital. You are called to give urgent assistance to a 65-year-old male who has presented to the Emergency Department with increasing shortness of breath, one week after discharge from a metropolitan hospital following apparently uncomplicated cardiac surgery.

Post intubation he has rapidly deteriorated and is now unresponsive with no recordable blood pressure. The cardiac monitor shows sinus tachycardia.

a) Outline your response to this crisis. (40% marks)

b) Other than cardiac tamponade; what additional diagnoses need to be considered? (25% marks)

c) List the clinical signs indicating cardiac tamponade that may have been present prior to the cardiac arrest. (15% marks)

d) Describe how you would perform blind pericardiocentesis. (20% marks)

**Answer Template**

a)
Confirm cardiac arrest
Good BLS i.e.:
- Check ETT position
- Listen to chest
- Confirm $ETCO_2$ trace (may not be reliable in complete arrest with absent pulmonary blood flow)
- Check adequate CPR:
  - Correct position (lower half of sternum)
  - Correct rate/depth and technique (depress 4 – 5 cm at 100 – 120 compressions/min
  - Asynchronous ventilation with respiratory rate 8 – 10)

Call for additional help
- Local surgical team may be able to re-open sternotomy

Confirm IV access/intraosseous if needed
Adrenaline 1 mg IV immediately and then with alternate cycles
Bolus i.v. fluid as PEA
Continue CPR for 2 min
Rhythm check at 2 min – continue chest compressions, other responders stand clear, charge defibrillator to 200J, pause compressions, all clear, check rhythm and if non-shockable dump charge
Immediately continue CPR for further 2 min
Look for and treat reversible causes (needle thoracostomy / pericardiostomy etc – 4Hs and 4Ts)

b)
Massive pulmonary emboli
Pneumothorax with tension
Hypovolaemia from bleeding elsewhere
Graft occlusion and myocardial infarction
Septic shock possible (post op pneumonia/empyema/sternal wound infection)

c)
Distended neck veins
Muffled heart sounds
Hypotension & tachycardia
Pulsus paradoxus (may be seen on oximetry trace)
Absent apex beat

d)
Some asepsis
Identify landmarks: Left paraxiphoid (traditional) Left parasternal (4th intercostal space left parasternal)
For a left paraxiphoid approach 45° to the abdominal wall, head for the left shoulder, aspirate as the needle is advanced
Could connect a V lead to the base of the needle and watch ECG to look for a change in the QRS morphology, or ST elevation if the needle contacts the myocardium
Aspirate fluid/blood
Consider placing a catheter/pigtail
Blood stained pericardial fluid will not clot whereas intraventricular blood will

*Additional Examiners' Comments:*
*A substantial number of candidates failed to recognise a cardiac arrest. Many of the answers were at a junior level e.g. listing the causes of cardiac arrest (Hs and Ts) without reference to this clinical scenario. The question on the technique of blind pericardiocentesis was also badly answered.*

| | |
|---|---|
| Percentage Passed | 94% |
| Maximum Score | 8.0 |

**Question 6**

Critically evaluate the utility of monitoring procalcitonin (PCT) levels for the diagnosis and management of sepsis in the intensive care unit.

**Answer Template**

**Introductory statement**
PCT is the pro-peptide of calcitonin, produced by the parafollicular cells of the thyroid and neuroendocrine cells of lung and intestine, and has been studied as a sepsis biomarker to help with the diagnosis/exclusion of sepsis and to guide the time course of antibiotic therapy

**Rationale**
PCT is secreted in low concentrations in health (plasma level <0.1 ng/ml)
Rises in response to pro-inflammatory stimulus, especially of bacterial origin, mostly from neuro-endocrine cells of lungs and intestine
Lag time of 2 – 4 hours after onset of sepsis, peaking at 24 – 36 hours
Does not rise significantly with viral and non-infectious inflammations
To exclude sepsis a cut-off plasma level of ≤ 0.2 ng/ml is used with levels ≥0.5 ng/ml suggesting sepsis
Circulating levels halve daily when the infection is controlled

**Advantages**
Theoretical use for diagnosis of bacterial infections, differential diagnosis of inflammatory response
Predictor of outcome – high levels correlate with organ dysfunction and persistently high levels associated with higher mortality
Correlation with extent and severity of bacterial infections
Guide duration of antibiotic therapy
Faster response than waiting for incubation of blood cultures
Better at discriminating sepsis from SIRS than CRP or cytokines
Better diagnostic marker of bacterial sepsis than CRP
Relatively cheap although more expensive than CRP

**Disadvantages**
Increases in non-septic inflammatory conditions with massive necrosis e.g. major trauma, tumour lysis, cardiogenic shock and case report of massive amphetamine overdose
Not useful for identifying viral or fungal infections or localised infections without systemic involvement
May not be elevated in immunocompromised
Serial measurements needed with added cost
May be no better than experienced clinician in differentiating infectious from non-infectious cause of fever

**Evidence**
Conflicting

Meta-analysis – Hoeboer et al 2015
Approx. 60 studies
Concluded low PCT values could be used to rule out bacteraemia
Further studies needed on safety and efficacy of PCT as single diagnostic tool

Studies using PCT algorithms to guide duration of therapy

- PRORATA
  Multi-centre RCT approx. 600 patients
  No difference in outcome but PCT algorithm group used fewer antibiotics

- ProGUARD
  Used lower level of PCT for initiation and cessation of antibiotics
  No difference between 2 arms on antibiotic duration

- PASS
  Danish multi-centre RCT with 1200 patients
  Use of PCT algorithm for escalation of antibiotic therapy

Did not improve survival
Associated with more organ failure and longer ICU stay

- SAPS – Lancet 2016
  Dutch study with approx. 1600 patients

Used PCT guided algorithm
Found reduction in antibiotic use and mortality benefit

**Summary Statement**
*For example:*
The evidence for the efficacy of PCT as a biomarker in sepsis is conflicting. Low values may be helpful in ruling out bacterial infection. Some studies show a benefit in using PCT algorithms to guide antibiotic therapy duration. In my practice I use PCT levels as a biomarker of sepsis judiciously in conjunction with careful clinical assessment and other elements of antibiotic stewardship on a case-by-case basis.

*An acceptable answer addressed the following:*

- *Rationale for the use of PCT*
- *Pros and cons*
- *Some reference to the evidence*
- *Statement of candidate's own practice*

*Additional Examiners' Comments:*
*Most candidates were extremely vague and failed to deliver specific information. While often times the information provided was at least partially correct it was very non-specific and more in keeping with general comment rather than the knowledge expected of a specialist. Very few candidates demonstrated even a passing knowledge of the relevant literature.*

| | |
|---|---|
| Percentage Passed | 25% |
| Maximum Score | 7.0 |

**Question 7**

You are called to assist with the management of a 5-month-old, 6 kg female infant who has been brought into the Emergency Department of your small rural hospital with a 4-day history of diarrhoea and vomiting.

On review, she is drowsy, mottled and cold with a heart rate of 155 beats/min and blood pressure 72/37 mmHg.

Her blood results are as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| $FiO_2$ | 0.5 | |
| pH | 6.90* | 7.35 – 7.45 |
| $PCO_2$ | 44 mmHg (5.8 kPa) | 37 – 50 (4.9 – 6.6) |
| $PO_2$ | 41 mmHg (5.4 kPa) | |
| Bicarbonate | 8.5 mmol/L* | 22.0 – 28.0 |
| Base Excess | -20 mmol/L* | -2 – +2 |
| Sodium | 146 mmol/L* | 135 – 145 |
| Potassium | 6.2 mmol/L* | 3.5 – 5.0 |
| Chloride | 110 mmol/L | 100 – 110 |
| Glucose | 2.2 mmol/L* | 3.0 – 5.4 |
| Calcium ionised | 1.13 mmol/L | 1.12 – 1.32 |
| Urea | 31.0 mmol/L* | 3.0 – 8.0 |
| Creatinine | 305 µmol/L* | 45 – 90 |

Outline the principles of management for this infant.

**Answer Template**

Concurrent resuscitation, assessment and treatment of this extremely sick child, addressing the hypotension, acute kidney injury, severe shock and dehydration and profound metabolic derangement.

Stabilisation of the child prior to transfer to a tertiary paediatric institution with close liaison with paediatric team for advice on management.

Use Broselow tape, guidelines on paediatric drug doses, dedicated paediatric resuscitation equipment etc. to ensure appropriate doses of fluids and drugs, tube sizes, ventilator settings etc.

<u>Steps in management</u>

- Call for help
- Assess airway and breathing
    - inadequate ventilation, depressed level of consciousness, profound dehydration and shock

  100% oxygen and support ventilation with BVM if required. This child will need intubation but need to optimise cardiac output before proceeding with this (consider waiting until transport team arrive for maximum support)
- Establish venous access, IO line or peripheral venous (central venous access only if second person available to perform or if child more stable)

- Immediate treatment of hypoglycaemia with 2 – 5 ml/kg 10% dextrose. Ongoing glucose to maintain blood sugar levels measured hourly at the very least.
- Ongoing volume resuscitation with 10 – 20 ml/kg boluses of 0.9% sodium chloride, reassess perfusion and repeat as needed. Some children require up to 100 ml/kg fluid resuscitation (caution if cardiogenic shock present)
- Electrolyte replacement as required
- Ongoing maintenance fluid – e.g. add 100 ml of 50% dextrose to 900 ml 0.9% NaCl and infuse this at 2/3 maintenance rate (16 ml/hr in this case) (accept 24 ml/hr for 1$^{st}$ 48 hours)
- Assess % dehydration and replace over 48 hours using maintenance fluid (unless sodium increases > 150 mmol/L) Formula: Vol = % Dehydration x body weight x 10 (in mls)
- Use an inotrope: e.g. adrenaline (other inotropes acceptable)
- IV antibiotics within one hour. These can be stopped after 48 hours if cultures negative
- Treat hyperkalaemia if still present after treatment of shock (usually $K^+$ levels drop as shock treated)
    - IV $CaCl_2$
    - IV boluses 8.45% $NaHCO_3$ (Dose in mmol or ml = desired $HCO_3$ – measured $HCO_3$ x (weight in kg x 0.6)
    - Dextrose/insulin
- Urinary catheter to monitor hourly urine output
- Consideration of non-infectious causes
- Organisation of transfer/retrieval team
- Keep the parents up to date

*Exact doses of drugs/fluids not expected but reference to need to look up/check dosing carefully in this instance*

*Additional Examiners' Comments:*
*Most candidates did well in this question. Failure to immediately treat the hypoglycaemia was a fatal error.*

| | |
|---|---|
| Percentage Passed | 82% |
| Maximum Score | 8.0 |

**Question 8**

With respect to salicylate toxicity:

a) List <u>four</u> severe complications. (20% marks)

b) List the associated haematological abnormalities. (10% marks)

c) List the options for enhancing salicylate removal and briefly explain the rationale for each option listed. (50% marks)

d) Give your interpretation of a declining serum salicylate level. (20% marks)

**Answer Template**

a) List <u>four</u> severe complications:
    - Pulmonary oedema
    - Cerebral oedema
    - Arrhythmias
    - Hyperpyrexia
    - Shock and cardiovascular collapse

- Acid-base disturbance (high anion gap metabolic acidosis and respiratory alkalosis)

b) List the associated haematological abnormalities:
   - Hypoprothrombinaemia
   - Thrombocytopaenia

c) List the options for enhancing salicylate removal, and briefly outline the rational for each option listed:

   **Haemodialysis**. Most of the drug is protein-bound, and is concentration dependant. The volume of distribution is small, and binding site saturation leads to large levels of free drug, which is easily dialyzable

   **Multiple-dose charcoal**. Many aspirin forms are slow release and after ingestion they clump together in the GI tract, forming a large slow release preparation. It is also poorly soluble in the stomach leading to delayed absorption.

   **Forced alkaline diuresis**. Renal excretion of salicylates becomes important when the metabolic pathways become saturated. There is a 10 – 20 x increase in elimination when the urine pH increased from 5 – 8. Current role is questionable as haemodialysis is more efficient at removal, with less metabolic disturbance. Reasonable, as initial therapy whilst waiting for circuit prime and line insertion.

d) Give your interpretation of a declining serum salicylate level:

   It may indicate that the drug is moving into the tissues, and not necessarily being eliminated
   This means that clinical assessment is paramount

*Additional Examiners' Comments:*
*Most candidates were able to give general statements but were unable to give specifics – in particular about how the therapies worked. There was poor understanding of the pharmacokinetics of salicylates and the rationale for the use of haemodialysis.*

| | |
|---|---|
| Percentage Passed | 49% |
| Maximum Score | 8.0 |

**Question 9**

You are asked to review a confused 65-year-old female in the Emergency Department, who has presented with abdominal pain and vomiting. She has a history of ischaemic heart disease, obstructive airways disease and atrial fibrillation.

On examination she is jaundiced, mildly confused and has right upper quadrant tenderness.

Her vital signs, after 4 litres intravenous 0.9% saline are as follows:

| | |
|---|---|
| Temperature | $39.5^{o}C$ |
| Respiratory rate | 30 breaths/min |
| $SpO_2$ | 92% on 15 l/min oxygen via a reservoir mask |
| Heart rate | 120 beats/min (atrial fibrillation) |
| Blood pressure | 88/48 mmHg |

An abdominal ultrasound scan shows a dilated common bile duct and enlarged gall bladder with mural oedema.

Outline your management of this patient.

**Answer Template**

The patient is most likely to have acute ascending cholangitis, which needs rapid resuscitation and definitive treatment.

a) Admit to the intensive care unit
Provide resuscitative and organ supportive care.
- Resuscitate, investigate and treat simultaneously.
- Actively consider the need intubation and ventilation given her respiratory failure, confusion and haemodynamic instability,
- Central venous and arterial lines need to be inserted and monitoring commenced.
  Blood taken for investigations:
  FBC, Coags, UECs, LFTs, ABGs, cultures
- No further intravenous fluid bolus
- Commence vasopressor support, aiming for a MAP > 65mmHg.
- Ensure referral to gastroenterology team for further investigation and management
- Consider MRCP or abdominal CT scan if diagnosis uncertain

b) Commence broad-spectrum empiric antibiotic therapy.
Need good gram negative, gram positive and include anaerobic cover if very unwell:
Examples include:
amoxycillin and gentamicin and metronidazole
piperacillin/tazobactam

c) Source control with decompression & drainage of her biliary tract.
- By most recent international guidelines this is Grade III (severe) acute cholangitis and thus the biliary tree must be urgently decompressed and drained.
- This can be done either endoscopically (ERCP) or percutaneously.
- Open surgery is not indicated in this situation.
- **ERCP +/- sphincterotomy (provided the patient is not coagulopathic) is the gold standard and the best method of decompression and drainage.**

*Additional Examiners' Comments:*
*Candidates' description of the management of the case was superficial with lack of perspective or explanation of rationale, e.g. "I would assess the airway…may need to regularly assess" with no indication as to why, causes for concern, what they would look for etc. There was poor discussion and/or explanation of airway management, source control techniques, fluid assessment, antibiotic choice, differential diagnosis of hypoxia, impact of co-mobidities. There was over-emphasis on the utility of echo before addressing the basics of oxygenation.*

| | |
|---|---|
| Percentage Passed | 65% |
| Maximum Score | 8.0 |

**Question 10**

With reference to gas supplies in the Intensive Care Unit:

a) Briefly describe the systems for the storage and delivery of oxygen supplied from a wall outlet (50% marks)

b) List the safety features that are in place to prevent incorrect connection of hoses and regulators to gas outlets (e.g. $O_2$ hose connected to air outlet). (50% marks)

**Answer Template**

a) Systems for storage and delivery

Large supply of oxygen in a remote storage area and piped to the wall outlets
Two main types of supply:

- Cylinder manifold
- Liquid oxygen tank or vacuum insulated evaporator (VIE)

Oxygen may also be supplied by an oxygen concentrator but this is a relatively new technology

<u>Cylinder manifold</u>
Multiple cylinders are arranged in banks with each bank containing enough cylinders to last for 2 days normal use for that hospital.
Each cylinder is connected to a pipeline which passes to a central control box with

- High-pressure gauges indicating the contents of the cylinder banks:
- High-pressure reducing valves lowering the cylinder pressure from 137 bar to 10 bar
- Changeover valve that switches automatically from the in-use bank to the reserve bank of cylinders when the pressure falls to a certain value.

At the outlet of the changeover valve is a second-stage pressure-reducing valve to reduce the pipeline pressure from 10 bar to 4.1 bar, the pressure at the wall outlet.

<u>VIE</u>
Main source of supply in large hospitals
Vacuum insulation allows storage of oxygen at or below its critical temperature (-118$^{o}$C) in liquid form
Normally temperature of around -160$^{o}$C with pressure at about 7 bar (vapour pressure of oxygen at this temperature)
Oxygen is taken form top of storage vessel and passed through superheater coil then pressure regulator to keep pipeline pressure at 4.1 bar
The supply usually has a capacity to last for at least 6 days
Reserve manifold of cylinders as back-up

b) Safety features for hoses

- Colour coding: ($O_2$ white, air black, suction yellow)
- Sleeve indexing:
  - The internal threads are the same for each outlet, but the sleeves are differently configured to prevent placing the wrong hose on the wrong outlet
- Pin indexing:
  - When attaching regulators to cylinders
  - Schraeder quick release valves (most commonly where gas line attaches to the high pressure inlet of ventilators)

*Additional Examiners' Comments:*
*Most candidates had little or no knowledge about oxygen storage and delivery. Some could describe a VIE, but then gave bizarre pressure levels or storage temperatures, which were possibly just guesses. The safety systems aspect of the question highlighted poor learning – candidates frequently realised that a sleeve index system was used, but couldn't name it.*

| | |
|---|---|
| Percentage Passed | 8% |
| Maximum Score | 6.0 |

**Question 11**

Describe your management of a patient who develops neck swelling with palpable crepitus, difficulty in ventilation and rapid desaturation immediately following a percutaneous tracheostomy.

**Answer Template**

This is a life-threatening emergency. Declaration of the emergency and communication to all members of the team.

The most likely diagnosis is misplacement of the tracheostomy tube.

Differential diagnosis includes (tension) pneumothorax, (tension) mediastinum, secondary to lung injury major airway injury – e.g. from dilatation / bougie / bronchoscopy / ETT etc. used in procedure or endotracheal tube exchange.

First priority is to establish the tracheostomy is in place with $ETCO_2$ / bronchoscopy (should have been used in tracheostomy insertion so readily available).

If tracheostomy is in place, A=Airway is established, and problem is related to large airway/lung leak. This is likely to be under tension requiring decompression.

If tracheostomy not in place, or unable to confirm then patient should be re-intubated with ETT from above and distal tip advanced below the tracheostomy site, and ventilation confirmed.

**Immediate assessment and resuscitation**
Will need management by a multi-disciplinary team. May need to summon help from senior anaesthetist +/- ENT surgeon. Multiple co-ordinated simultaneous actions.

Check position of the tracheostomy tube (confirm misplacement)

- Check capnography
- Pass a bronchoscope down tracheostomy tube

Cease ventilation via tracheostomy tube.

Gentle ventilation by bag valve mask +/- oro-pharyngeal airway if possible.

**Reintubation**
Remove tracheostomy tube.
Prepare for re-intubation. (including difficult airway Kit)

- Position the oral ETT more distally so that the hole in the trachea is excluded from circuit.

Confirm position of ETT with capnography and bronchoscope.

CXR post reintubation to check for pneumothorax.

**Further management:**
Assess for other related damage:

- Trachea
- Oesophagus
- Venous
- Arterial
- Thoracic duct

Re-evaluate need for tracheostomy

- Re-do by ENT or most experienced operator
- Consideration for use of Uniperc / adjustable flange if regular tube too short for thick neck

Thorough answer should consider –

- Care of the patient NOK- including open disclosure etc.
- Systems issue- e.g. incident reporting, case review, adherence to guidelines or lack of
- Prevention of future events.

*Additional Examiners' Comments:*
*A significant number of candidates described removal of the tracheostomy tube without checking position/patency and/or did not mention use of capnograph or bronchoscope.*

| | |
|---|---|
| Percentage Passed | 45% |
| Maximum Score | 8.0 |

**Question 12**

With respect to delirium in critically ill patients:

a) Define delirium. (20% marks)

b) List the causes and predisposing factors. (30% marks)

c) Briefly outline its assessment and treatment. (50% marks)

**Answer Template**

a) **Definition**:
The acute onset of a disturbance of consciousness with inattention, changes in cognition and/or perception, that fluctuates over time, occurs as a consequence of a general medical condition and is not better accounted for by a pre-existing, established or evolving dementia.

b) **Causes / Predisposing factors:**
- Age >80
- Pre-existing cognitive impairment
- Severity of illness
- Visual impairment
- Dehydration
- Infection/Fever/Hypothermia
- Hypoxia
- Drugs/Polypharmacy
    - Esp Psychoactive drugs
    - Anticholinergics,
    - Narcotics
    - Steroids

- Drug withdrawal
    - Etoh, Benzos, SSRI
- Metabolic shifts- [Na], renal failure, BSL, Wernickes
- Cardiorespiratory disease
- Sensory deprivation, overstimulation
- Trauma/Post op
    - Esp – Cardiac sx, Cataract sx, Orthopedics and TURP

c) **Assessment**
DSM V
CAM, CAM ICU
Memorial delirium assessment scale

**Treatment**
High-level supportive care
Sleep hygiene
Hydration nutrition- thiamine
Minimize medications and interactions
Early mobilization
Avoid physical restraints
Visual and hearing aids
Minimize staff changes and utilize family members
Frequent reorientation
Do not directly engage or oppose hallucinations/ paranoid behaviours
Treat underlying cause and precipitant
Treat psychotic phenomenology
Haloperidol
Risperidone
Olanzapine
Dexmetomidine

*Additional Examiners' Comments*
*In general, well answered.*

| | |
|---|---|
| Percentage Passed | 80% |
| Maximum Score | 9.0 |

**Question 13**

13.1

A 26-year-old male found was collapsed in the street. On arrival in the Emergency Department he was unresponsive and hypotensive with a temperature 42°C. The following is his arterial blood gas result following intubation.

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| $FiO_2$ | 1.0 | |
| pH | 7.21* | 7.35 – 7.45 |
| $PCO_2$ | 54 mmHg* | 35 – 45 |
| $PO_2$ | 500 mmHg | |
| Bicarbonate | 21 mmol/L | 21 – 28 |
| Base Excess | -6 mmol/L* | -2 – +2 |
| Sodium | 143 mmol/L | 135 – 145 |
| Potassium | 4.9 mmol/L* | 3.5 – 4.5 |
| Chloride | 112 mmol/L* | 95 – 110 |
| Calcium Ionised | 1.09 mmol/L* | 1.12 – 1.32 |
| Glucose | 9.6 mmol/L* | 3.0 – 5.4 |
| Lactate | 2.3 mmol/L* | < 1.3 |
| Creatinine | 219 µmol/L* | 60 – 110 |
| Haemoglobin | 139 g/L | 135 – 180 |

a) Describe the acid-base abnormality (20% marks)

b) Give the likely underlying cause for this clinical picture (15% marks)

**Answer Template**

a) Mixed respiratory, high anion gap and normal anion gap metabolic acidosis.

b) Toxidrome – sympathomimetic agent.

13.2

A 52-year-old male with a history of chronic alcohol abuse was brought to the Emergency Department with a reported change in his mental state for 3 – 4 days. He was drowsy and lethargic but communicated appropriately when roused. He did not appear dehydrated. The following are his blood results on presentation:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Sodium | 116 mmol/L* | 135 – 145 |
| Potassium | 2.9 mmol/L* | 3.5 – 5.0 |
| Chloride | 67 mmol/L* | 95 – 110 |
| Bicarbonate | 14 mmol/L* | 22 – 32 |
| Urea | 2.9 mmol/L* | 3.0 – 8.0 |
| Creatinine | 46 μmol/L | 45 – 90 |
| Glucose | 6.8 mmol/L | 3.5 – 7.8 |
| Phosphate | 0.60 mmol/L* | 0.65 – 1.45 |
| Magnesium | 0.51 mmol/L* | 0.70 – 1.05 |
| Calcium adjusted | 2.31 mmol/L | 2.10 – 2.60 |
| Albumin | 34 mmol/L* | 36 – 52 |
| Bilirubin total | 13 μmol/L | < 18 |
| Alanine transferase | 67 U/L* | < 35 |
| Aspartate transaminase | 80 U/L* | < 40 |
| Alkaline phosphatase | 148 U/L* | 30 – 110 |
| γ-Glutamyl transferase | 480 U/L* | < 40 |
| Lipase | 492 U/L* | < 95 |
| Amylase | 189 U/L* | < 130 |
| Free T4 | 14.2 pmol/L | 12 – 31 |
| Thyroid stimulating hormone | 0.65 mU/L | 0.5 – 5.0 |
| Cortisol | 1440 nmol/L* | 150 – 700 |
| β-Hydroxybutyrate | 4.4 mmol/L* | < 0.4 |
| Osmolality | 254 mOsm/L* | 275 – 295 |
| | | |
| **Urine Chemistry** | | |
| Sodium | <20 mmol/L | |
| Potassium | 37 mmol/L | |
| Osmolality | 198 mOsm/L | |

a) Give the likely diagnosis with the rationale for your decision. (25% marks)

b) Briefly outline your management of the hyponatraemia in this patient. (20% marks)

**Answer Template**

a) Beer potomania (alcoholic intoxication / ketoacidosis acceptable)
History
Abnormal LFTs with predominantly raised GGT
Acidosis with elevated BOHB with normal glucose
Low urine osmolality
Normal endocrine profile

b) Likely chronic hyponatraemia so replace slowly < 10 mmol/24 hrs
Stop non-essential fluids
At risk of seizures from alcohol withdrawal

13.3

The following blood tests are from an otherwise well 53-year-old female, admitted to a general medical ward five days previously for intravenous antibiotic therapy for lower limb cellulitis. Her admission blood tests were all normal. Over the last 24 hours she has become progressively oliguric, but remains otherwise stable with normal vital signs.

The results of her full blood count and urea and electrolytes are as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 132 g/L | 130 – 175 |
| White Cell Count | 9.8 x $10^9$/L | 4.0 – 11.0 |
| Platelets | 321 x $10^9$/L | 150 – 450 |
| Neutrophils | 10.4 x $10^9$/L* | 1.8 – 7.5 |
| Lymphocytes | 2.06 x $10^9$/L | 1.50 – 4.00 |
| Monocytes | 0.3 x $10^9$/L* | 0.2 – 0.8 |
| Eosinophils | 4.3 x $10^9$/L* | 0.0 – 0.4 |
| Haematocrit | 0.35 | 0.4 – 0.52 |
| MCV | 92 fl | 82 – 98 |
| MCH | 29.9 pg | 27.0 – 34.0 |
| MCHC | 326 g/L | 310 – 360 |
| Sodium | 140 mmol/L | 135 – 145 |
| Potassium | 3.8 mmol/L | 3.2 – 4.5 |
| Chloride | 106 mmol/L | 100 – 110 |
| Bicarbonate | 22 mmol/L | 22 – 27 |
| Urea | 28.0 mmol/L* | 3.0 – 8.0 |
| Creatinine | 0.31 mmol/L* | 0.07 – 0.12 |
| Total Calcium | 2.17 mmol/L | 2.15 – 2.60 |
| Phosphate | 1.6 mmol/L* | 0.7 – 1.4 |
| Albumin | 31 g/L* | 33 – 47 |
| Total Bilirubin | 20 μmol/L | 4 – 20 |
| Conjugated Bilirubin | 4 μmol/L | 1 – 4 |
| GGT | 22 U/L | 0 – 50 |
| ALP | 60 U/L | 40 – 110 |
| LDH | 213 U/L | 110 – 250 |
| AST | 34 U/L | < 40 |
| ALT | 25 U/L | < 40 |

Give the likeliest cause of her oliguria. (20% marks)

**Answer Template**

Allergic / Acute Interstitial nephritis secondary to antibiotic use.

| | |
|---|---|
| Percentage Passed | 55% |
| Maximum Score | 8.0 |

**Question 14**

With respect to nutritional support in the critically ill:

a) Outline how you would assess the nutritional status of a patient with suspected malnutrition. (70% marks)

b) Outline the pathophysiology of severe re-feeding syndrome. (30% marks)

**Answer Template**

a) <u>Assessments of nutritional status:</u>

This is notoriously unreliable as there are many conditions that can alter the non-specific markers of nutritional status.

A good history should include the circumstances of poor intake (duration, cause, etc.), a background of previous eating behaviours, and GIT symptoms (nausea, vomiting diarrhoea, weight loss)

a. Specifics in the examination, beyond the general examination and vital signs are:
Anthropometric
Weight, height and BMI calculation
Arm circumference
Triceps skin fold thickness

b. Clinical:
Hair: Hair loss or abnormal distribution (lanugo),
Skin: Conjunctival pallor and skin pallor, xerosis (dry skin, A), spooning of nails (Iron), ecchymoses or petechiae (C or K), pressure ulcers, poor wound healing
Mouth: Glossitis (Niacin, Folate, B12, B2, B6), bleeding or sores on the gums and oral mucosa (C), angular cheilosis or stomatitis (B2, B6), leucoplakia, poor dentition
Neck: Thyromegaly
Extremities: loss of muscle mass (arm circumference, bitemporal wasting), loss subcutaneous fat (triceps skin thickness), bone tenderness (Vit D)
Neurologic: Peripheral neuropathy, reflexes, tetany, mental status, handgrip strength

Investigations to assess protein status for protein calorie malnutrition, must all be taken in context of other evidence of acute and chronic illness and will alter as part of acute phase response.
Serum albumin (longest half-life at 18 – 20d)
Serum transferrin (half-life of 8 – 9d), but also reflects iron status, and low transferrin should be considered an indicator of protein status only in the setting of normal serum iron.
Serum pre albumin (half-life at 2 – 3d) - responds quickly to the onset of malnutrition and rises rapidly with adequate protein intake, but altered in the acute phase response due to acute or chronic inflammation.

Other investigations:
- Anaemia with Fe levels, or B12 / Folate if macrocytic.
- Vitamin and trace elements
- Ca, PO4, Mg, Glucose, UEC are all non-specific
- Retinol binding protein

b) Pathophysiology of Re-feeding Syndrome

Reintroduction of glucose into diet after a considerable period of fasting with a low BMI
Insulin in response to glucose load moves the glucose into cells (with K and Mg)
The first step of glycolysis is the phosphorylation of glucose. This holds the glucose in cells.
This leads to sudden and precipitous fall in phosphate that is the hallmark of refeeding syndrome
Severely reduced phosphate is available for ATP, cAMP
Failure of tissues with high energy requirement - heart, kidney, muscle (rhabdomyolysis), brain, respiratory (diaphragm)
Untreated leads to death

*Additional Examiners' Comments:*
*Poorly answered, with no specific details about the relative importance of measures of nutritional status. Candidates were expected to comment that nutritional assessment in the critically ill is difficult with many of the objective measures confounded by the consequences of the acute illness. A simple list of anthropometry, clinical signs and investigations was not sufficient as it missed the point that a careful history is crucial.*

| | |
|---|---|
| Percentage Passed | 20% |
| Maximum Score | 8.0 |

**Question 15**

A 72-year-old male was admitted to ICU five days ago following primary resection and anastomosis of a perforated sigmoid diverticulum. He is receiving antibiotic treatment with ciprofloxacin, vancomycin and metronidazole. Over the last 12 hours he has produced a total of 200 mls of urine, and his creatinine has doubled from baseline to a value of 300 µmol/L.

a) Outline how the renal dysfunction will influence antimicrobial dosing for the 3 antibiotics in use. (30% marks)

His abdomen becomes progressively distended, and he develops anuria and a metabolic acidosis. The surgical team requests a contrast CT scan.

b) Outline possible strategies to minimise the risk of further renal injury from the CT. (30% marks)

c) List the factors that would influence your decision to start renal replacement therapy in this case. (40% marks)

**Answer Template**

a) Outline how the renal dysfunction will influence antimicrobial dosing:

- Vancomycin: High dosing on Day 1 may be required to ensure adequate distribution. Dose adjustments made on trough levels. Consider Vancomycin infusion with steady state levels of 20-25 to maximise duration above MIC.
- Ciprofloxacin: Reduce frequency and maintain dose
- Metronidazole: No change

Consider Therapeutic Drug Monitoring (TDM) where available- e.g. Vancomycin, Ciprofloxacin.

b) Outline possible strategies to minimise the risk of further renal injury from the CT:
   - Review indication for CT and need for contrast
     Consider progressing straight to surgery without CT if indicated by clinical condition
   - CT without contrast an option.
   - If decision that contrast vital – lowest reasonable volume and isosmolar contrast (specifically avoid high osmolar contrast). Water contrast if ischaemic bowel a consideration
   - Ensure euvolaemic, no real evidence for bicarbonate, weak evidence for N-acetylcysteine
   - Correct other factors contributing to renal injury – adequate renal perfusion, stop nephrotoxics, monitor drug levels, monitor intra-abdominal pressures

c) List the factors that would influence your decision to start renal replacement therapy in this case:
   Traditional indications for renal replacement therapy in AKI include:
   - Refractory fluid overload
   - Hyperkalaemia (plasma potassium concentration >6.5 mmol/L) or rapidly rising potassium levels
   - Signs of uraemia, such as pericarditis, neuropathy, or an otherwise unexplained decline in mental status
   - Severe metabolic acidosis (pH <7.1)
   - Toxin elimination (IV contrast in this case)

   However, there are limitations to restricting to these traditional indications in the critically ill patient, i.e.
     - AKI part of MODS and negative influence of fluid overload on other organs – lungs and brain
     - Ongoing fluid input exacerbates fluid overload– nutrition, vasoactives, antibiotics- so may need CRRT purely to achieve appropriate fluid balance.
     - Acid-base and biochemical abnormalities poorly tolerated in critical illness

*Additional Examiners' Comments:*
*In general, many candidates were not familiar with dosing of vancomycin, and ciprofloxacin. Many candidates did not address the strategy of reconsidering the need for contrast or alternatives. With respect to part (c), many candidates could not provide adequate detail and overall the answers were brief and superficial.*

| | |
|---|---|
| Percentage Passed | 57% |
| Maximum Score | 8.5 |

**Question 16**

You are called to review an 86-year-old female, with severe pleuritic chest pain and difficulty breathing following dilation of an oesophageal stricture.

Her CT thorax scan confirms an oesophageal perforation.

Outline your management of this problem, including the options for definitive treatment.

**Answer Template**

This is an emergency situation. Leakage of oesophageal and gastric contents results in a severe necrotising mediastinitis with sequelae of septic shock, multi-organ failure and death. Mortality is about 20% and probably higher in this age group.

The principles of management are:

- Resuscitation
- Supportive care including haemodynamic monitoring
- Broad-spectrum antibiotics
- Control of extra-luminal contamination
- Analgesia
- Nil by mouth
- Plan for definitive treatment to close or bypass the perforation
- Nutritional support
- Ensure adequate oxygenation and ventilation
    - NIV and bag-valve-mask assisted ventilation contra-indicated
    - If severely hypoxic or shocked needs intubation (unless palliative approach appropriate)
- Haemodynamic support with fluid resuscitation and vasopressor support as indicated. Cautious fluid replacement in 86-year-old with echo or other haemodynamic monitoring guidance. Monitoring including A-line and CVC and transfer to ICU/HDU
- Early broad-spectrum antimicrobials to cover gram positives, gram negatives and anaerobes, e.g. Tazocin, Meropenem. May need addition of Vancomycin if MRSA likely and consider anti-fungal if immunocompromised or long stay in hospital
- Drainage of pleural and mediastinal collections (source control) with surgical and/or interventional radiology assistance
- Analgesia – opiates and adjuncts as needed
- Strictly nil by mouth
- Surgical opinion
- Treatment options
    - Operative
        - Surgical repair
        - Oesophagectomy
        - Oesophageal diversion
    - Non-operative- Covered oesophageal stent – appropriate if early diagnosis, contained perforation and limited extra-luminal soilage
    - Conservative approach - antibiotics and feeding tube (jejunostomy) ± drains
- Nutrition – likely to need TPN if poor baseline state of nutrition. NJ tube or jejunostomy can be sited at time of stent placement or surgical repair
- Follow-up imaging – CT gastrografin swallow
- Consider treatment limitations with advanced age if significant co-morbidities, underlying inoperable cancer.

*An acceptable answer for a pass mark included the following elements:*
*Resuscitation*
*Antimicrobial therapy*
*Surgical and non-surgical options*
*Nutrition*

*Additional Examiners' Comments:*
*Most candidates were able to describe surgical and non-surgical options for definitive treatment. However candidates who did not pass provided superficial answers with insufficient detail. Most candidates addressed the ABCs but did not address the specific issues for the case. For example, issues such as consideration of nutrition, keeping the patient nil by mouth, analgesia and treatment limitations were commonly missed in the answers. Some candidates did not appreciate the need for resuscitation.*

| | |
|---|---|
| Percentage Passed | 51% |
| Maximum Score | 7.5 |

**Question 17**

17.1

A 75-year-old female with a past history of Parkinson's disease and a recent admission for behavioural disturbance, presents with a fluctuating conscious state.

Her temperature is 37.2°C, her respiratory rate is 26 breaths/min, blood pressure is 100/80 mmHg, pulse rate 100 beats/min, and $SpO_2$ 98% on 0.4 $FiO_2$.

Her investigations are as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 85 g/L* | 115 – 160 |
| White Cell Count | 20.9 $x10^9$/L* | 4.0 – 11.0 |
| Platelets | 82 $x10^9$/L* | 150 – 400 |
| | | |
| Albumin | 34 g/L* | 35 – 50 |
| Total Bilirubin | 10 μmol/L | < 20 |
| Alanine Transferase | 421 U/L* | < 35 |
| Alkaline Phosphatase | 60 U/L | 30 – 110 |
| Gamma-Glutamyl Transferase | 23 U/L | < 40 |
| | | |
| Sodium | 140 mmol/L | 135 – 145 |
| Potassium | 3.4 mmol/L* | 3.5 – 5.2 |
| Bicarbonate | 12 mmol/L* | 22 – 32 |
| Chloride | 103 mmol/L | 100 – 110 |
| Urea | 3.6 mmol/L | 3.0 – 8.0 |
| Creatinine | 88 μmol/L | 45 – 90 |
| Lactate | 17 mmol/L* | < 2 |
| | | |
| INR | 2.9* | |
| APTT | 58.0 sec* | 25.0 – 37.0 |
| | | |
| $FiO_2$ | 0.4 | |
| pH | 7.21* | 7.35 – 7.45 |
| $PCO_2$ | 25 mmHg (3.3 kPa)* | 35 – 45 (4.6 – 6.0) |
| $PO_2$ | 104 mmHg (13.7 kPa) | |
| Bicarbonate | 10 mmol/L* | 22 – 28 |

a) Comment on her acid base status. (20% marks)

b) List <u>three</u> differential diagnoses for this patient's presentation, with confirmatory investigations for each. (50% marks)

**Answer Template**

a)

Raised anion gap metabolic acidosis, lactic acidosis, with appropriate respiratory compensation (Anion gap 143 – 115 = 28)

b)

- Sepsis / Septic shock – Meningo-encephalitis, biliary, urinary
  - Blood, Urine cultures

    - CT brain or chest/abdo
    - LP
- Drug toxicity: quetiapine, side effects of Parkinson's meds, paracetamol
    - Urinary drug screen
    - Paracetamol levels
- Seizures
    - EEG
- Ischaemic gut less likely but possible
    - CT abdo
- Serotonin syndrome – less likely
    - CK
- *Acute liver failure unlikely as LFTs only mildly deranged, bilirubin normal and although coagulopathy, albumin is normal*

17.2

A 60-year-old male presents following a generalised tonic clonic seizure. He has chronic abdominal pain and Crohn's disease with previous complicated small bowel surgery resulting in an ileostomy. The seizure spontaneously resolves after 3 minutes.

Blood investigations taken after the seizure are as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Sodium | 135 mmol/L | 135 – 145 |
| Potassium | 2.5 mmol/L* | 3.5 – 5.2 |
| Chloride | 105 mmol/L | 100 – 110 |
| Bicarbonate | 11 mmol/L* | 22 – 32 |
| Lactate | 6.8 mmol/L* | < 2.0 |
| Calcium (Total) | 1.45 mmol/L* | 2.15 – 2.60 |
| Magnesium | 0.28 mmol/L* | 0.70 – 1.00 |
| | | |
| $FiO_2$ | | |
| pH | 7.06* | 7.35 – 7.45 |
| $PCO_2$ | 40 mmHg (5.3 kPa) | 35 – 45 (4.6 – 6.0) |
| $PO_2$ | 280 mmHg (37 kPa) | |
| Bicarbonate | 11 mmol/l* | 22 – 28 |

a) What is the likely cause of his seizure? (10% marks)

b) Describe and explain the acid base abnormality with potential causes. (20% marks)

**Answer Template**

a)

Hypomagnesemia.
Other possibility is hypocalcaemia however corrected and iCa++ not given.

b)

- Severe metabolic acidosis
- Concurrent respiratory acidosis ($CO_2$ high for bicarbonate)
    - Respiratory depression post seizure
- High anion gap due to lactic acid
    - Seizure activity
- Concurrent normal anion gap acidosis (Delta Ratio 0.7)

- GI loses from high output stoma
- RTA e.g. from NSAIDs for analgesia
- Chloride resuscitation

| | |
|---|---|
| Percentage Passed | 88% |
| Maximum Score | 8.0 |

**Question 18**

An 18-year-old male presents following a fight in a bar with obvious facial injuries. He has profuse bleeding from the mouth and nose and insists on sitting up at 90°. He has bruising under both eyes, his face is significantly swollen and his mid-face is mobile. His breathing is “noisy”.

His vital signs are as follows:

| | |
|---|---|
| Heart rate | 105 beats/min |
| Blood pressure | 115/60 mmHg |
| Respiratory rate | 30 breaths/min |
| $SpO_2$ | 92% on room air |
| Glasgow Coma Scale | 15 |

He has no cervical spine injury and no other significant injuries.

List the possible techniques for securing the airway in this patient and the pros and cons of each.

**Answer Template**

**Rapid Sequence Induction:**

*Pro*:
Rapid technique - may be only option should patient’s condition deteriorate to peri-arrest
No special expertise required
May be best technique with ENT/Surgical backup at bedside to perform immediate tracheostomy if intubation fails.

*Con:*
Obscured / absent landmarks (potential to lose airway with RSI)
- Airway swelling
- Haematomata and ongoing haemorrhage
- Bony and soft tissue trauma

Co-existing upper airway / tracheal injuries
Patient unable to lie flat
Left lateral position may be preferred but increases degree of difficulty
Limited respiratory reserve
Pre-oxygenation, bag-mask ventilation problematic
Likely to become haemodynamically unstable with sedation

**Cricothyroidotomy / Awake tracheostomy**

*Pro:*
Safe – no risk of losing airway
Patient breathing throughout

*Con*:
May be difficult without sedation
Positioning may be problematic

May be technically challenging in the setting of local tissue damage and haemorrhage

**Fibreoptic intubation**

*Pro:*
No risk of losing airway
Patient breathing throughout

*Con:*
Likely to be extremely challenging in the setting of ongoing haemorrhage
Attempted nasotracheal intubation could result in nasocranial passage of tube and/or severe nasal haemorrhage
Need expert/experienced airway assistance

**Awake direct laryngoscopy / intubation**

*Pro:*
Quick – no time wastage
Reduced risk of losing airway
Patient breathing throughout
Uses standard intubating equipment
May be method of choice with senior operator
Allows easy transition to a back-up technique

*Con:*
Technically challenging
Needs adequate local anaesthesia
Positioning patient problematic

*Credit was given to discussion of any sensible technique and any relevant introductory or concluding statement giving a summary of the issues.*

*Additional Examiners' Comments:*
*In general, well-answered, using a good structure.*

| | |
|---|---|
| Percentage Passed | 90% |
| Maximum Score | 7.5 |

**Question 19**

Describe the various types of brain herniation, including their radiological and clinical features.

**Answer Template**

**Supratentorial herniation**

1. **Subfalcine (cingulate or transfalcine)**
   - This occurs when the brain extends under the falx cerebri.

   Radiological features include
   - a shift of the septum pellucidum,
   - effacement of the anterior horn of the lateral ventricle.

   Clinical features may be mild or absent, including
   - headache,
   - drowsiness,
   - contralateral leg weakness.

2. **Uncal (or temporal transtentorial)**
    - The uncinate process or medial portion of the temporal lobe is displaced downwards onto the tentorium cerebelli and suprasellar cistern.

   Radiological features
    - Shift of brainstem and distortion of adjacent cisterns
    - Dilation of contralateral temporal horn
    - PCA territory infarct due to compression of posterior cerebral artery as it crosses tentorium

   Clinical features include
    - ipsilateral pupillary dilation and lack of reactivity to light and
    - deviation of eye to “down and out position” due to pressure on the third cranial nerve.
    - Compression of ipsilateral posterior cerebral artery results in ischaemia of ipsilateral visual cortex and contralateral visual field deficits in both eyes (contralateral homonymous hemianopia)
    - There is also a decreased conscious level and
    - There may be a contralateral hemiparesis due to the primary lesion causing the uncal herniation
    - There may also be ipsilateral hemiparesis and leg extension (referenced to the side of herniation). This is referred to as a false localising sign due to compression of contralateral cerebral peduncle with corticospinal and some corticobulbar fibres (Kernohan’s notch)
    - Progression will lead to decreased conscious state, bradycardia, decorticate posture, respiratory depression and death

3. **Central**
    - Symmetrical downward movement of thalamus through tentorium cerebelli

   Radiological appearance:
    - Peri-mesencephalic cistern effacement
    - May be diffuse loss of grey-white matter differentiation

   Clinically
    - Loss of consciousness with small reactive pupils and
    - Paralysis of upward eye movements (‘sunset eyes’)
    - May progress to decorticate posturing
    - Diabetes insipidus may be present

4. **Transcalvarial**
   Brain squeezes through a fracture or surgical site in the skull
   Clinical features relate to side and lobe involved

**Infratentorial herniation**

1. **Cerebellar Tonsillar (downward cerebellar herniation, transforaminal herniation)**
   Cerebellar tonsils move downwards through the foramen magnum.
   Clinically causes
    - cardiac and respiratory depression.

2. **Upward transtentorial herniation or reverse coning**
    - Increased pressure in posterior fossa causing upward movement of cerebellum through tentorial notch with compression of midbrain, e.g. when CSF is abruptly drained above the level of the tentorium

   Clinical features
    - Coma, respiratory depression, haemodynamic instability and death

*Additional Examiners' Comments:*
*Many candidates had large knowledge gaps and were factually incorrect with their answers. Division between supratentorial and infratentorial herniation was fundamental to the question. Many candidates mixed uncal and cerebellar tonsil herniation and there was little mention of lateralising signs and general impact on conscious state.*

| | |
|---|---|
| Percentage Passed | 31% |
| Maximum Score | 7.0 |

**Question 20**

Evaluation of a novel serum biomarker for the rapid diagnosis of sepsis is performed in a sample of 100 patients with fever. The biomarker is compared with positive culture results as the gold standard and yields the following information:

| | **Sepsis present (culture positive)** | **Sepsis absent (culture negative)** |
|---|---|---|
| **Biomarker positive** | 30 | 10 |
| **Biomarker negative** | 30 | 30 |
| **n** | 60 | 40 |

With reference to these results, define the following and give the values for the performance of the test:

a) Sensitivity (20% marks)

b) Specificity (20% marks)

c) Positive predictive value (20% marks)

d) Negative predictive value (20% marks)

e) Accuracy (20% marks)

**Answer Template**

| | **Sepsis present (culture positive)** | **Sepsis absent (culture negative)** | |
|---|---|---|---|
| **Biomarker positive** | 30 (a) | 10 (b) | (a + b) |
| **Biomarker negative** | 30 (c) | 30 (d) | (c + d) |
| **n** | 60 (a + c) | 40 (b + d) | (a+b+c+d) |

a) Ability of test to identify true positives
Or the probability the test will be positive in individuals who do have the disease
Sensitivity a/(a+c) 30/60 50%

b) Ability of test to identify true negatives
Or the probability the test will be negative in individuals who do not have the disease.
Specificity d/(b+d) 30/40 75%

c) Likelihood of positive test meaning patient has sepsis
PPV a/(a+b) 30/40 75%

d) Likelihood of negative test meaning patient does not have sepsis
NPV d/(c+d) 30/60 50%

e) The ability to differentiate patient and healthy cases correctly.
Accuracy (a+d)/(a+b+c+d) 60/100 60%

*Additional Examiners' Comments:*
*The question clearly stated that a definition was required. Many candidates either could not define the terms or just missed this part of the question and therefore missed out on marks. This question has come up a number of times in past exams and these are basic statistical concepts that some candidates clearly do not understand.*

| | |
|---|---|
| Percentage Passed | 65% |
| Maximum Score | 10 |

**Question 21**

A 23-year-old female is admitted to your intensive care unit following her first presentation with seizures. A collateral history suggests that she had been acting unusually for the previous few days before she was seen to collapse with a tonic-clonic seizure. She continued to fit during transfer to hospital.

On arrival to the Emergency Department she was given further doses of midazolam IV and loaded with levetiracetam IV. After 20 minutes she continued to have sporadic seizure activity with a best GCS of 6 (E1 M4 V1) and was intubated using propofol and rocuronium.

a) List six possible causes for her presentation. (30% marks)

On admission to ICU she is on a propofol infusion at 20 mg/hr, minimal ventilatory support and is haemodynamically stable. She continues to have intermittent seizures.

b) Briefly outline your specific management with respect to the seizures. (70% marks)

**Answer Template**

a)
Acute structural brain injury (stroke, HI, SAH)
Infection (encephalitis, meningitis, abscess)
Tumour (CNS, Paraneoplastic syndromes / autoantibodies to remote tumours)
Withdrawal (Alcohol, barbiturates, BDZ)
Metabolic (hypoglycaemia, HE, uraemia, hyponat, hypergly/Ca/Mg)
Drug OD
Eclampsia
Autoimmune encephalitis

*Or any acceptable cause – PRES, CNS vasculitis etc.*

b)
Look for and treat underlying cause of refractory status epilepticus (RSE)

Principles of treatment for RSE

- Look for and treat underlying cause
  History including travel, examination, CT, LP, BSL, U&E, metabolic screen, drug screen, auto-immune screen, beta-HCG, paraneoplastic markers, MRI

- Additional agents (one to three or more) to prevent emergence seizures, e.g.
  Phenytoin, Fosphenytoin, Levetiraetam, Valporate, Phenobarbitone
  BDZ – clonazepam / diazepam / lorazepam
- General Anaesthesia with EEG monitoring
  Propofol / thiopentone / inhalational anaesthetics
- EEG to burst suppression OR seizure suppression only (controversial)
- No guidelines for duration of therapy - initially 24 to 48 hours (controversial)
- If emergence seizures develop treat for longer or deeper or both (controversial)
- Try to avoid rapid switches or changes in agent dosing (as per conventional seizure Mx)
- Avoid NMBs unless continuous EEG monitoring
- Avoid hyperthermia and consider hypothermia

*Additional Examiners' Comments:*
*Almost all the candidates were able to answer the first part. Although all the candidates wrote something about the management of the case, it tended to be limited and largely disorganised. There was a lot of generic information not related to the "specific management with respect to the seizures", e.g. 'FAST HUG' that did not score the candidate any marks.*

| | |
|---|---|
| Percentage Passed | 82% |
| Maximum Score | 7.0 |

**Question 22**

22.1

A 56-year-old male presents with one-month history of weight loss and shortness of breath.

The results of his blood tests are as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 128 g/L* | 135 – 180 |
| White Cell Count | 6.1 x $10^9$/L | 4.0 – 11.0 |
| Platelets | 35 x $10^9$/L* | 150 – 400 |
| Prothrombin time | 23.3 sec* | 12.0 – 16.5 |
| INR | 2.0* | 0.9 – 1.3 |
| APTT | 45.7 sec* | 27.0 – 38.5 |
| Fibrinogen | 0.7 g/L* | 2.0 – 4.0 |
| Total Protein | 39 g/L* | 60 – 80 |
| Albumin | 24 g/L* | 35 – 50 |
| Total Bilirubin | 215 µmol/L* | < 20 |
| ALT | 202 U/L* | < 40 |
| ALP | 243 U/L* | 30 – 110 |
| GGT | 394 U/L* | < 60 |
| Ferritin | 120000 µg/L* | 30 – 620 |
| Iron | 15 µmol/L | 9 – 30 |
| Transferrin | 13 µmol/L* | 23 – 43 |
| Transferrin saturation | 58%* | 14 – 45 |

a) Give the diagnosis indicated by these results. (20% marks)

b) Give <u>three</u> possible underlying causes. (15% marks)

**Answer Template**

a) Haemophagocytic lymphohistiocytosis (HLH)

b) Viral infection e.g. EBV, HSV, HINI influenza
Lymphoma
Malignancy
Immune deficiency states
Rheumatological disorders
Other infection – bacterial and fungal less likely

22.2

A 52-year-old female presents with bruising and a retroperitoneal haematoma five weeks after starting warfarin for a proximal deep vein thrombosis (DVT) with a target international normalised ratio (INR) of 2.5.

Her investigations are as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 122 g/L* | 135 – 180 |
| White Cell Count | 10.1 x $10^9$/L | 4.0 – 11.0 |
| Platelets | 298 x $10^9$/L | 150 – 400 |
| Prothrombin time | 29.3 sec* | 12.0 – 16.5 |
| INR | 2.3* | 0.9 – 1.3 |
| APTT | 117.0 sec* | 27.0 – 38.5 |
| Fibrinogen | 3.9 g/L | 2.0 – 4.0 |

a) Give the likely underlying cause for this coagulation profile. (20% marks)

b) Give a test you could do to confirm this. (15% marks)

**Answer Template**

a) Factor deficiency - either VIII, IX, XI or XII

b) Mixing study (patient plasma mixed with normal plasma 1:1 should show correction of APTT if case of factor deficiency).

Factor levels.

22.3

A 49-year-old female presents with confusion. The results of her blood tests are as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Haemoglobin | 86 g/L* | 135 – 180 |
| White Cell Count | 11.2 x $10^9$/L* | 4.0 – 11.0 |
| Platelets | 23 x $10^9$/L* | 150 – 400 |
| Prothrombin time | 14 sec | 12.0 – 16.5 |
| APTT | 35 sec | 27.0 – 38.5 |
| Fibrinogen | 2.1 g/L | 2.0 – 4.0 |
| Thrombin time | 14.0 sec* | 11.5 – 13.5 |
| Urea | 12.1 mmol/L* | 3.0 – 8.0 |
| Creatinine | 356 µmol/L* | 45 – 90 |
| Lactate dehydrogenase | 2342 U/L* | 140 – 280 |

a) Give <u>one</u> likely diagnosis (20% marks)

b) Give an additional test to support your diagnosis (10% marks)

**Answer Template**

a) Thrombotic thrombocytopaenic purpura
Haemolytic-uraemic syndrome
Systemic lupus erythromatosis
MAHA *(1 mark only)*

b) ADAMTS13 (TTP)
Positive Shiga toxin / Entero-haemorrhagic E coli test (HUS)
ANA / anti-dsDNA (SLE)
Blood film
Reticulocyte count
Haptoglobins

| | |
|---|---|
| Percentage Passed | 53% |
| Maximum Score | 9.0 |

**Question 23**

A 65-year-old male is in ICU following an out of hospital cardiac arrest secondary to a large anterior ST elevation myocardial infarction. His ICU stay has been complicated by aspiration pneumonia. He is now day 14 from admission, with a tracheostomy in situ, and has started weaning from the ventilator.

You have been asked to review him as he is communicating that he ‘can’t get enough air’ despite on-going mechanical ventilatory support.

Outline your approach to this problem.

**Answer Template**

Urgent attention to A, B, C – Give 100% oxygen and exclude/treat immediate threats to life.

Focused history and examination considering differential diagnoses:

Patient factors
Airway / trache – blocked, displaced or too small diameter
Respiratory e.g. pneumonia, PE, PTX
Cardiac – ongoing ischaemia, cardiac failure, fluid overload
Neuromuscular – weakness, fatigue
Sepsis
Metabolic
Central – increased respiratory drive, pain, agitation

Ventilator factors
Unsuitable mode
Triggering threshold too high
Inspiratory flow rate too low
Prolonged inspiratory time
Inappropriate cycling
Inadequate pressure support
Inadequately set tidal volume
Ventilator malfunction

Treatment:
100% $O_2$, suction trache, exclude obstruction/malposition, end tidal $CO_2$ etc.

Assess ventilation
Mode, respiratory rate and pattern
Spontaneous and delivered TV / MV / airway pressures
Expiratory flow-time curve, PEEPi (if possible)

Titrated pain relief
May need to carefully sedate to gain control of the situation if he is very distressed and agitated.
Rarely need to paralyse after sedation

Investigations
Basic Investigations – e.g. ABG, ECG, CXR, cultures
Further investigations as indicated – e.g. Echo, CTPA, BNP, Troponin etc.

Management of underlying cause:
Change trache if indicated
Consider change ventilator settings or mode
Increase pressure support etc
ACV Vs SIMV Vs BiLevel

*An acceptable answer included the following elements:*
*Resuscitation*
*Address causes of dyssynchrony*
*Patient factors*
*Ventilator factors*
*Approach to management*

*Additional Examiners' Comments:*
*Most candidates put together a reasonable answer. Some treated it only as a blocked airway question. Many were not well organised for such a common and important clinical question that has been asked previously. Few candidates thought broadly.*

| | |
|---|---|
| Percentage Passed | 82% |
| Maximum Score | 8.0 |

**Question 24**

With respect to haemodynamic monitoring in the critically ill patient:

a) Define fluid responsiveness. (10% marks)

b) Outline the physiological basis and the limitations of the following methods of assessment of fluid responsiveness in a patient on mechanical ventilation:

   i. Passive leg raise
   ii. Central venous pressure
   iii. Pulse pressure variation (90% marks)

**Answer Template**

a) Fluid responsiveness is not synonymous with hypovolaemia and is defined as an increase in stroke volume (or cardiac output/index) by 10 – 15% after fluid administration (volumes vary), depending on technique. The assessment is therefore functional: to induce a change in cardiac preload and observe the effects on cardiac output and arterial pressure.

b) i. Passive Leg Raise-
Basis- Involves lifting the legs passively from the horizontal position to $45^{o}$ with the patient supine. This draws venous blood stored in the lower body veins to the inferior vena cava, increasing the right then the left ventricle pre-load. It represents a 'reversible volume challenge' which can help to predict the haemodynamic response to real volume challenge.

Limitations-

- Leg movement may be contraindicated in some patients e.g. pelvic trauma, limbs that are not intact, presence of IABP, femoral ECMO, recent angiography etc.
- Unreliable in severely hypovolaemic patients as blood stored in lower body veins may be insufficient to augment stroke volume
- May be unreliable in the presence of intra-abdominal hypertension.
- Should not be performed in the presence of raised ICP

ii. Central Venous Pressure-
Basis- The CVP is an approximation of right atrial pressure, which is a major determinant of RV filling. It has been assumed that the CVP is a good indicator of RV preload. Furthermore, because RV stroke volume determines LV filling, the CVP is assumed to be an indirect measure of LV preload. A change in the CVP (delta-CVP) with a fluid challenge is thought to be useful in determining fluid management decisions.

Limitations-

- CVP is determined by factors other than intravascular volume –i.e. venous tone, intrathoracic pressures, LV and RV compliance, and geometry that occur in critically ill patients, which results in a poor relationship between the CVP and RV end-diastolic volume.
- The RV end-diastolic volume may not reflect the patients' position on the Frank-Starling curve and therefore the preload reserve.

iii. Pulse Pressure Variation-
Basis- Pulse pressure variation is derived from the arterial pressure waveform. The reduction in RV preload and increase in RV afterload with positive pressure ventilation both lead to a decrease in RV stroke volume, which is at a minimum at the end of the inspiratory period. The inspiratory reduction in RV ejection leads to a decrease in LV filling after a phase lag of two or

three heartbeats because of the long blood pulmonary transit time. Thus, the LV preload reduction may induce a decrease in LV stroke volume, which is at its minimum during the expiratory period when conventional mechanical ventilation is used. The cyclic changes in pulse pressure are greater when the ventricles operate on the steep rather than the flat portion of the Frank-Starling curve.

PPV variation % = $(PP_{max} – PP_{min}) / PP_{mean}$ x 100

The magnitude of the respiratory changes in pulse pressure is an indicator of biventricular preload dependence. A PPV of 10-15% is likely to indicate potential for fluid responsiveness. The higher the PPV the more likely the patient is to be fluid responsive.

Limitations-

- Unable to interpret in the presence of arrhythmias.
- Limited utility in patients ventilated with small tidal volumes (<8 ml/kg) and spontaneously breathing patients
- Cannot be used in patients with an open chest.

*Candidates were not expected to provide the same level of detail as is in the template.*

*Additional Examiners' Comments:*
*For a core topic, the overall understanding of the topic was lacking in a significant number of candidates.*

| | |
|---|---|
| Percentage Passed | 53% |
| Maximum Score | 8.0 |

**Question 25**

*Please note: The images have been removed from this question.*

25.1

The following ECG is from a 41-year-old female admitted for management of anorexia.

a) List the ECG abnormalities. (10% marks)

b) Give the underlying cause. (10% marks)

c) List <u>four</u> other ECG abnormalities that may be seen in this condition. (10% marks)

**Answer Template**

a)
ST depression
T wave flattening and inversion
U waves
Long QT/QU interval (fusion of T and U waves)

b) Hypokalaemia

c) P wave amplitude increased (>2.5 mm in limb leads, >1.5 mm in chest leads)
P wave width increased (>120 msec)
PR interval prolonged (>200 msec)
Supraventricular ectopics

Ventricular ectopics
Atrial fibrillation
Atrial flutter
Atrial tachycardia
Torsade de pointes

25.2

The following ECG is that of a 26-year-old patient who collapsed while playing football.

a) Describe the ECG abnormalities. (5% marks)

b) Give the likely diagnosis. (5% marks)

c) What other features would you look for on examination of the cardiovascular system? (20% marks)

**Answer Template**

a) LVH with strain pattern.

b) Hypertrophic obstructive cardiomyopathy (HOCM).

c) Late systolic murmur / midsystolic murmur at left lower sternal edge and apex (due to LVOT obstruction). Pansystolic murmur at apex due to mitral regurgitation (LVOT obstruction lead to pressure effect on anterior mitral valve leaflet causing systolic anterior motion and mitral regurgitation).

25.3

The following ECG is that of a 76-year-old male presenting with acute appendicitis requiring surgery. He is haemodynamically stable.

a) Comment on this ECG. (20% marks)

The anaesthetist would like a temporary pacing wire placed before surgery.

b) What is your advice? (20% marks)

**Answer Template**

a) Secondary degree AV block, Mobitz type 1

b) Patients with Mobitz type 1 block who are asymptomatic and haemodynamically stable do not require a pacing wire. If unstable then atropine could be tried. Transcutaneous or transvenous pacing is then indicated. Reversible causes like myocardial ischaemia, high vagal tone or drugs (beta blockers, Ca channel blockers or digoxin) should be sought and corrected.

*Additional Examiners' Comments:*
*There were a number of common difficulties candidates encountered. The main one was lack of knowledge in this area, and the main gap was in recognising the second-degree AV block – type 1. Many of the answers were 'scattergrams' of all the ECG patterns/phrases the candidates could remember – sometimes contradictory! Another systemic problem seemed to be time allocation. A*

*number of candidates missed whole parts of the question or answered part 3 with less care and attention than parts 1 and 2.*

| | |
|---|---|
| Percentage Passed | 35% |
| Maximum Score | 8.0 |

**Question 26**

A 54-year-old previously healthy male was admitted to the intensive care unit within one hour after sustaining burns to 45% total body surface area. He had been pulled out of his garden shed, unconscious, by the fire brigade and intubated at the scene of the incident by the paramedics.

a) Describe your initial fluid resuscitation plan for this patient including type of fluid, rationale for your choice and estimation of the fluid requirements. (60% marks)

Three hours after presentation, despite adequate fluid resuscitation, the patient remains haemodynamically unstable.

| | |
|---|---|
| Heart rate | 125 beats/min |
| Blood pressure | 85/45 mmHg (on noradrenaline 30 mcg/min and vasopressin 0.04 units/min) |

Arterial blood gas result is as follows:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| $FiO_2$ | 0.5 | |
| pH | 7.21* | 7.35 – 7.45 |
| $PCO_2$ | 22 mmHg (2.9 kPa)* | 35 – 45 (4.6 – 6.0) |
| $PO_2$ | 90 mmHg (11.8 kPa) | |
| $HCO_3$ | 8 mmol/L* | 22 – 28 |
| Base excess | -15 mmol/L* | -2 – +2 |
| Lactate | 10.5 mmol/L* | < 2.0 |

b) List the possible causes for this clinical picture. (40% marks)

**Answer Template**

a) **<u>Type of fluid:</u>**

- Fluid resuscitation of patient with moderate to severe burns consists of an isotonic crystalloid solution, such as Hartmann's solution or plasmalyte. Large volumes of 0.9% NaCl may be associated with hyperchloremic metabolic acidosis.
- The colloids (albumin) are more expensive, and do not improve survival, compared to crystalloids.
- The use of hypertonic saline does not provide better outcomes than isotonic saline.

**<u>Estimating fluid requirements:</u>**

- No formula provides a precise method for determining the burn victim's fluid requirements; the formulas described provide only a starting point and guide to initial fluid resuscitation. Patient age, severity of burns and co-morbidities can substantially alter the actual fluid requirements of individual patients.
- *Parkland (or Baxter or consensus) Formula* (most widely used):
  Fluid requirement (ml) = 4 x body weight x percentage of burns. (Only deep)
  One half of the calculated fluid is given over the first eight hours and the remaining over the next 16 hours.
  The rate of infusion should be as constant as possible; sharp decrease in infusion rates can cause vascular collapse and increase in edema.

- *Modified Brooke Formula:* Fluid requirement (ml) over the initial 24 hours = 2 x body weight x percentage of burns.
  This formula may reduce the total volume used in fluid resuscitation without causing harm.
- Following initial resuscitation, IV fluids are administered to meet baseline fluid needs and maintain urine output.
- Care should be taken to avoid fluid overload, as associated with pulmonary edema, peripheral edema leading to compartment syndrome.
- Inadequate resuscitation suggested by poor urine output should be managed by judicious fluid boluses and an increase in the infusion rate.

b) **List the diagnostic possibilities**
- Cardiogenic Shock (severe myocardial suppression caused by burns, pre-existing myocardial dysfunction)
- Cyanide toxicity
- Compartment Syndrome, including abdominal compartment
- Carbon monoxide poisoning
- Blast injury
- Ingestion of toxins (ethylene glycol, methanol, salicylates)
- Acute Liver Failure

*Additional Examiners' Comments:*
*Most of the candidates answered this question very well. Candidates who did not pass showed knowledge gaps, poor synthesis of knowledge and poorly structured answers.*

| | |
|---|---|
| Percentage Passed | 94% |
| Maximum Score | 8.0 |

**Question 27**

Outline your initial management of a 46-year-old female cyclist presenting to the Emergency Department of a district hospital with apparent tetraplegia after a fall from a bicycle. She has a Glasgow Coma Scale of 15 and no other obvious injuries.

**Answer Template**

EMST/ATLS protocol with trauma team.
Concurrent resuscitation, assessment, treatment and early transfer to spinal unit when stabilised.

**Primary survey**
**Airway**
- Apply high flow oxygen
- Assess need for intubation
- Potential indications
  - VC < 10 ml/kg, Vt < 3.5 ml/kg
  - Weak cough
  - Shallow rapid breathing
  - Diaphragmatic impairment
  - Inadequate gas exchange
  - May be required to safely facilitate transfer
  - Impending airway obstruction from fracture haematoma
- If safe to do so, perform and document thorough neurological examination prior to sedation and paralysis
- C-spine immobilisation initially
- Intubate with C-spine precautions (consider awake fibreoptic intubation)

**Breathing**
Maintain normal $O_2$ and $CO_2$
Exclude chest trauma: reduced pain due to spinal injury and attribution of hypotension to neurogenic shock may result in missed injuries (pneumothorax, haemothorax, open chest wound).

**Circulation**
- 2 x IV large bore access and fluid resuscitation 20 ml/kg bolus
- Look for and exclude other causes of hypotension including haemorrhagic shock, obstructive shock prior to attribution as due to neurogenic shock
- Vasopressors may be needed maintain MAP >70 for spinal cord perfusion, once obstructive and hypovolaemia excluded

**Secondary survey**
**Disability**
Full neuro assessment pre-intubation if time allows
- Assess motor level – highest myotome level >3/5 power
- Assess sensory level – highest sensory dermatome with normal sensation
- Log roll and assess spine
- Anal sensation and tone
- Presence of cord syndrome, e.g. central, anterior, Brown-Sequard
- Complete/incomplete with zone of partial preservation if incomplete
- ASIA classification

**Exposure**
Temperature control. Hypothermia a problem and should be prevented

Full examination, from head to toe to identify other injuries. Important to be aware that lack of pain sensation will make examination more difficult
**Investigations**
- Trauma blood panel in G+H
- Radiology – trauma series plus CT whole spine. Low threshold for CT chest/abdo pelvis as reduced sensitivity of clinical exam, and need for transfer increases risk/consequences of missed injuries
- Consider MRI in consultation with referral centre and with regards to timing of transfer and stability of the patient

**Treatment**
- Arterial line
- Central venous access – femoral route may be easier access
- Log roll 2 hourly
- Analgesia
- IDC and NGT
- Replace spinal collar with Philadelphia or similar
- Move off spinal board as soon as possible
- Thrombo-prophylaxis mechanically
- Early liaison with spinal unit and retrieval unit
- Liaise with patient (if remains awake) and or family re diagnosis and need for transfer.
- Prepare patient for retrieval/transfer

**ASIA classification** *(For reference only)*
The neurological level of SCI is the lowest level of spinal cord with normal sensation and motor function bilaterally

| | | |
|---|---|---|
| A | Complete | No motor or sensory function at S4-5 |

| | | |
|---|---|---|
| B | Incomplete | Sensory but not motor function preserved below neurological level and includes S4-5 |
| C | Incomplete | Motor function preserved below the level but more than half the muscles below level have ≤3/5 grade |
| D | Incomplete | ≥ 50% muscles have ≥3/5 grade |
| E | Normal | Motor and sensory function are normal |

Points that needed to be included:

- EMST approach
- Relevant aspects of primary and secondary survey
- The need to document a thorough neurological examination prior to sedation and paralysis if safe to do so
- The concept that missed injuries are more prevalent in this population and should be actively sought.

*Detail in above template not needed for a pass.*
*Details of ASIA classification not expected.*
*Additional Examiners' Comments:*
*Many answers contained lists of EMST principles without reference to specific points relevant in this case e.g. assessment of ventilatory impairment. Many missed the point that other injuries need to be sought and took the comment in the stem "no other obvious injuries" to mean there were no other injuries. A number of candidates referred to a neurogenic shock as "spinal shock"*

| | |
|---|---|
| Percentage Passed | 59% |
| Maximum Score | 9.0 |

**Question 28**

A 52-year-old male, who had a heart-lung transplant 5 years earlier, is admitted to your ICU with suspected community-acquired pneumonia (CAP).

Outline the key clinical issues <u>specific</u> to this clinical situation that will need consideration for the management of this patient.

**Answer Template**

Respiratory failure in a cardiopulmonary transplant patient is most commonly due to infection, rejection or a combination of the two and has a high mortality. A multi-disciplinary approach with quaternary level consultation is warranted including the transplant unit and infectious diseases.

**<u>Issues related to pneumonia</u>**
*Causative organisms*- Opportunistic infections e.g. PJP, CMV, Aspergillus, Scedosporium as well as other bacterial, viral or atypical causes of community-acquired pneumonia.
*Early aggressive investigation* – appropriate specimens/nasopharyngeal swabs and PCR testing, CXR, CT scan, bronchoscopy and consideration of lung biopsy
*Early aggressive antimicrobial therapy* – To cover standard CAP organisms and likely opportunistic organisms eg co-trimoxazole, ganciclovir, antifungal agents.
*Steroid therapy* if severe PJP

**<u>Issues related to respiratory function</u>**
Need to rule out rejection (cellular or antibody mediated)- often treated empirically for both infection and rejection. Enhanced antibody response developed to combat infection may result in concurrent antibody mediated rejection (AMR).
Impaired cough and clearance of secretions.
Impaired lung function due to obliterative bronchiolitis (a manifestation of chronic rejection)- small

airway disease
Bronchial or tracheal stenosis relating to the original anastomotic site may be present- large airway disease

**Issues related to immunosuppression**
On-going immunosuppression will need to be carefully managed in consultation with the transplant unit
Stress dose steroids if associated shock
Therapeutic drug monitoring of immunosuppression

**Issues related to cardiac function**
The transplanted heart is denervated. It is only responsive to directly acting drugs/hormones present in the circulation.
Normal compensatory cardiac autonomic reflexes are not present and therefore the heart is more sensitive to directly acting drugs and less able to rapidly respond to changes in intravascular volume.
Careful titration of fluid boluses needed- likely diastolic dysfunction.
Difficult to clinically assess response to and adequacy of therapy
Premature diffuse obliterative coronary atherosclerosis occurs resulting in impaired ventricular function

**Issues related to other organ function**
Renal – altered renal function secondary to calcineurin inhibitors
Altered adrenal function secondary to steroid use. Consider need for steroid cover
Glycaemic control with increased steroid dose
Other co-morbidities and issues related to reason for heart-lung transplant, e.g. vascular disease, diabetes

**Other**
Early referral to transplant centre
Involvement of multi-disciplinary team – transplant unit, ID, respiratory, cardiology, physiotherapy
Psychological support of patient and next of kin

*Valid points not mentioned in the template were given credit*

*Additional Examiners' Comments:*
*Candidates who did not pass had knowledge gaps in this area.*

| | |
|---|---|
| Percentage Passed | 51% |
| Maximum Score | 8.0 |

**Question 29**

With respect to positive end-expiratory pressure (PEEP) in a ventilated patient with acute respiratory distress syndrome (ARDS):

a) Describe the possible approaches to setting PEEP. (70% marks)

b) List the disadvantages of excessive PEEP in this situation. (30% marks)

**Answer Template**

a)

- PEEP setting adjusted to $FiO_2$, increasing with increasing $FiO_2$ according to the ARDSNet studies (low Vt study NEJM 2000, PEEP 5 – 20+ with $FiO_2$ 0.3 – 1.0 and ALVEOLI high PEEP study NEJM 2004 PEEP 5 – 24 with $FiO_2$ 0.3 – 1.0) or clinical assessment
- Use of lung mechanics to set PEEP – requires the static measurement of P-V curve e.g. using super-syringe. Patient sedated and paralysed and ventilated at FiO2 1.0 and zero PEEP with lung inflation in 50-100ml increments from FRC using a super-syringe followed by deflation in similar steps. Pressure and volume are recorded simultaneously and the P-V curve is constructed from the data.
  Typically requires identification of lower infection point on P-V curve (on VC mode) and setting of PEEP 2 cm $H_2O$ above the LIP.
- PEEP adjusted to maximise static compliance
  ($C = Vt / (P_{plateau} – PEEP)$
- Optimal (or best) PEEP – a level of PEEP that optimizes $PaO_2$ and compliance without interfering with tissue oxygen delivery – ideally achieved during or immediately after recruitment manoeuvre, e.g. in Staircase Recruitment Manouevre best PEEP is 2.5 cm$H_2O$ above derecruitment point
- Transpulmonary pressures (TPP) to guide setting of PEEP – this requires real time measurement of oesophageal pressures (by placement of an oesophageal balloon) to keep the TPP (Paw-Pes) < 25 cm $H_2O$ at end inspiration and between 0 – 10 cm $H_2O$ at end expiration, while applying the low tidal volume ARDSNet ventilation strategy.

b) Disadvantages of excessive PEEP in patients with ARDS

- Overdistention of non-diseased alveoli resulting in further injury (VILI)
- Increased risk of barotrauma
- Increased dead space effect due to over-distension and also due to reduction in blood flow to alveoli
- $CO_2$ retention
- Reduced venous return to the heart, decreased cardiac output and a fall in blood pressure, vital organ perfusion.
- May decrease venous return from the abdomen, increasing renal/portal vein pressure and decreasing perfusion of kidneys/gut and increasing IAP
- Increased ICP
- May increase right to left shunt (increased pulmonary vascular resistance)

*Additional Examiners' Comments:*
*Overall there was poor understanding of this topic and some candidates were unable to provide basic details. In the responses to part (a) there was generally good breadth in regard to the options of setting best PEEP, however there was often little depth in the options given. In part (b) most answers focused on the cardiorespiratory complications. There were very few candidates who mentioned increased intra-abdominal and intra-cranial pressures as potential complications.*

| | |
|---|---|
| Percentage Passed | 45% |
| Maximum Score | 8.5 |

**Question 30**

30.1

The following results are from a 29-year-old post-partum female, day 6 following elective Caesarean section at 37 weeks gestation for placenta accreta, complicated by massive intra-operative haemorrhage. She made a good recovery but has had a persisting dull headache, dizziness, lethargy, polyuria and failure of lactation.

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Sodium | 114 mmol/L* | 135 – 145 |
| Potassium | 4.6 mmol/L | 3.5 – 5.0 |
| Bicarbonate | 26 mmol/L | 22 – 32 |
| Urea | 2.2 mmol/L | 3.0 – 8.0 |
| Creatinine | 46 mmol/L | 45 – 90 |
| Serum osmolality | 232 mOsm/L* | 275 – 295 |
| Urine osmolality | 493 mOsm/L | |

a) Give the diagnosis for this clinical picture. (20% marks)

b) How will you confirm the diagnosis? (20% marks)

c) Outline the underlying pathophysiology of this condition. (20% marks)

d) What is your immediate treatment? (10% marks)

**Answer Template**

a) Sheehan's syndrome.

b) MRI brain showing empty pituitary fossa
Hormone profile – cortisol, TFTs, prolactin

c) Ischaemic pituitary necrosis due to severe post-partum haemorrhage. Vasospasm, thrombosis and vascular compression of hypophyseal arteries with an enlarged pituitary gland and DIC are possible factors.

d) Hydrocortisone.

30.2

A 30-year-old female who is 34 weeks pregnant (G1P0) has presented with nausea and vomiting for 3 days with right upper quadrant pain. On examination she is confused, jaundiced with a blood pressure of 120/70 mmHg.

The following are results from a venous blood sample taken on admission:

| Parameter | Patient Value | Normal Adult Range |
|---|---|---|
| Sodium | 138 mmol/L | 135 – 145 |
| Potassium | 3.8 mmol/L | 3.5 – 5.0 |
| Urea | 15.0 mmol/L* | 3.0 – 8.0 |
| Creatinine | 245 µmol/L* | 45 – 90 |
| Albumin | 30 g/L* | 33 – 40 |
| Glucose | 2.5 mmol/L* | 3.0 – 7.8 |
| Bilirubin (total) | 142 µmol/L* | < 20 |
| ALP | 293 U/L* | 30 – 110 |
| AST | 99 U/L* | < 31 |
| ALT | 88 U/L* | < 34 |
| GGT | 67 U/L* | < 40 |
| LDH | 180 U/L | 110 – 250 |
| Uric acid | 0.72 mmol/L* | 0.15 – 0.5 |
| APTT | 45 sec* | 36 – 38 |
| INR | 2.8* | < 1.2 |
| Platelets | 123 x $10^9$/L* | 150 – 450 |

List three likely differential diagnoses for the above clinical picture. (30% marks)

**Answer Template**

Acute fatty liver of pregnancy (AFLP):
HELLP (Haemolysis, elevated liver enzymes and low platelets) Syndrome:
Pre-eclampsia with hepatic involvement
Viral hepatitis – commonest cause of jaundice in pregnancy
ALT and AST would be expected to be greatly elevated (>500 – 1000 U/L) and DIC is rare
Intrahepatic Cholestasis of Pregnancy

*Additional Examiners' Comments:*
*Many candidates did not complete part 2.*

| | |
|---|---|
| Percentage Passed | 55% |
| Maximum Score | 8.5 |

# EXAMINERS' COMMENTS

## Hot Cases

The Hot Cases run for twenty minutes with an additional two minutes at the start of each case for the candidate to be given both a verbal and a written introduction to the case in question. This is to give candidates more opportunity to take in the relevant information and to plan a focussed approach to examination of the patient.

The following comments are a guide to the expected standard for performance in the Hot Cases:

- Candidates should demonstrate professional behaviour, treating the patient with consideration and respect.
- Candidates should address and answer the question asked of them in the introduction to the Hot Case.
- Candidates should interpret and synthesise information as opposed to just describing the clinical findings.
- Candidates need to seek information relevant to the clinical case in question.
- Candidates should be able to provide a sensible differential diagnosis and appropriate management plan. A definitive diagnosis is not always expected and in some cases may yet to be determined.
- Candidates should not rely on a template answer or key phrases but answer questions in the context of the clinical case in question.
- Candidates must be able to describe, with justification, their own practice for specific management issues.

Candidates who performed well in the Hot Cases, as in previous exams, were able to demonstrate the following:

- A professional approach showing respect and consideration for the patient.
- Competent, efficient and structured examination technique and also able to appropriately adapt the examination to suit the clinical case in question.
- Seeking of information relevant to the case.
- Appropriate interpretation and synthesis of their findings
- Presentation of their conclusions in a concise and systematic fashion, addressing the issue in question
- Listing of a differential diagnosis that is relevant to the clinical case in question
- Discussion of management issues in a mature fashion, displaying confident and competent decision-making
- An appreciation of the complexities and key issues of the case
- Overall performance at the expected level (Junior Consultant)

Candidates who did not perform at the acceptable standard did so for reasons including the following:

- Missing or misinterpreting key clinical signs on examination
- Asking a large number of questions at the start of the case, of which many were not relevant or necessary for the case in question
- Poor interaction with a conscious patient
- Failure to perform a focussed examination relevant to the case in question
- Incomplete or poor technique for examination of a system
- Poor synthesis of findings with limited differential diagnosis, sometimes compounded by missed key clinical signs on examination
- Poor interpretation of imaging and data
- Failure to grasp the key issues relevant to the case in question and a lack of insight into the problems
- Inability to construct an appropriate management plan for the case in question

- The need for significant prompting during the discussion with knowledge gaps
- Limited time for discussion as a consequence of taking too long to present the clinical findings or to interpret basic data
- Inability to convey the impression that he/she could safely take charge of the unit

It was noted that some candidates had adequate theoretical knowledge but were unable to contextualise the information for the clinical case in question. Some candidates voiced management decisions that were potentially harmful to the patient. Overall, the standard of performance in the Hot Cases was higher than in previous exams.

Candidates are advised that they should not sit the Second Part Examination until they can confidently examine patients, present the relevant clinical findings, synthesise all the information and discuss management issues at the appropriate level, **i.e. demonstrate that they are capable of safe, effective, independent practice at the level of a Junior Consultant.** Candidates should practise Hot Cases from the commencement of their exam preparation. To this end, candidates are encouraged to do the following in their daily clinical practice as preparation for the Hot Cases:

- Seek the opportunity to take charge of the unit and be responsible for management decisions.
- Practise examination of individual systems.
- Treat every case to be assessed at work as a Hot Case, i.e. pose a relevant question (e.g. 'Why is this patient not progressing?' 'What is the cause of the new fever?' 'Is this patient ready for extubation?'), perform a focussed exam and then present your findings to a colleague.

**Vivas**

The overall pass rate for the vivas (79%) was the highest sectional pass rate for this exam, compared with 69% for both the written paper and the Hot Cases. There were only two vivas with a pass rate of less than 50%: Viva 4: Type 1 respiratory failure in a patient with interstitial lung disease and Viva 5: Brain death. Of concern, it was noted that more than half the candidates did not fully understand the preconditions for determination of brain death as specified in the ANZICS statement. Candidates who failed a viva mostly did so because of knowledge gaps. As in the discussion for the Hot Cases, candidates should not rely solely on generic statements, key phrases and template answers, and, instead, tailor their responses to the specifics of the question and be able to justify and expand their response.

## SECOND PART ORAL EXAMINATION

### CLINICALS "HOT CASES"

A 73-year-old male who had sustained a fall at home seven days ago resulting in an isolated head injury, and who was at the time of examination sedated and ventilated. Candidates were asked to examine him and outline a management plan for the next twenty-four hours. Discussion points included the management of raised intracranial pressure, CT findings and prognosis.

A 55-year-old male who had been admitted following a motorcycle accident five days prior. He had been intubated for hypoxia at the scene, and was sedated and ventilated at the time of the examination. Candidates were asked to outline a management plan to liberate him from mechanical ventilation. Discussion points included the impact of obesity, pain and agitation on weaning and candidates were expected to provide a logical weaning plan.

A 44-year-old male who had been admitted to the ICU four days before. He had been recently diagnosed with HIV and been admitted to the Unit in the setting of an in-patient respiratory deterioration. At the time of the examination he was intubated and ventilated, and candidates were asked to examine him, determine his current major problems and provide a management plan going forward. Discussion points included the diagnosis and management of the patient's respiratory disease, ventilatory strategies, management of the renal failure, and issues related to HAART.

A 53-year-old male who had been admitted fifty-two days previously with Guillain-Barre syndrome. Candidates were informed they were due to take over his care as the supervising consultant and to examine him and formulate a management plan for the next few days. Discussion points included the need for a weaning plan, complications related to long-term intensive care stay, communication strategies for patients with trachoestomies in-situ and prognosis.

A 76-year old male admitted to the ICU seven days earlier with acute respiratory failure. He had a background history of squamous cell carcinoma of the lung, chronic airways disease and recurrent lymphoma treated with radiotherapy. At the time of the examination he was mechanically ventilated and afebrile. Candidates were asked to examine him with a view to assessing the factors contributing to his respiratory failure. In addition to the written stem, candidates were given access to the patient's most recent chest x-ray during the two-minute preparation time. Discussion points included differential diagnosis and investigation of the respiratory failure, interpretation of radiological investigations, and ventilatory rescue strategies.

A 61-year-old male with a history of heavy smoking, who was intubated six days ago. At the time of examination, he remained mechanically ventilated. Candidates were asked to examine him and discuss his failure to wean. Discussion points included clinical findings consistent with severe chronic airways disease, potential ventilatory strategies, and the role of myoneuropathy.

A 63-year-old female admitted four days previously with headaches and a Glasgow Coma Score (GCS) of 13. Her GCS dropped to 8 and she required intubation and ventilation. A CT scan demonstrated a subarachnoid haemorrhage and she proceeded to middle cerebral artery aneurysm coiling. Candidates were asked to examine her with an emphasis on the neurological system, and to provide a plan of management. Discussion points included the differential diagnosis for the initial drop in GCS, diagnosis and management of vasospasm, and the role of various neurosurgical interventions.

A 61-year-old female, day 4 ICU, admitted following a MET call for shortness of breath, with a background of biventricular heart failure with hypotension and bradycardia, diabetes and HIV positive. Candidates were asked to examine her for the cause of her respiratory failure. Discussion points included assessment and management of her heart failure and management of respiratory tract infections in HIV +ve patient.

A 64-year-old male admitted the previous day following semi-urgent coronary artery bypass surgery with three grafts. He had a background of smoking, ethanol abuse and hypothyroidism. Candidates were asked why he had not yet been extubated. Discussion points included the indications for insertion and removal of an intra-aortic balloon pump; management of temporary cardiac pacing following cardiac surgery; and identification of clinically significant post-operative bleeding.

An 80-year-old male admitted two days ago with respiratory failure on a background of hypertension and chronic obstructive airways disease. Candidates were asked to discuss the causes for his respiratory failure. Discussion points included the investigation and management of community acquired pneumonia, and ventilatory strategies for ARDS.

A 76-year old male who had been admitted thirty days previously following off-pump coronary artery bypass grafts. His post-operative course had been complicated by bleeding and a return to theatre. He had a background of hypertension, dyslipidaemia, and paroxysmal atrial fibrillation. On the day of examination he remained mechanically ventilated. Candidates were asked to provide potential causes for why the patient remained ventilator dependant. Discussion points included the causes and management of delirium, management of a difficult wean from mechanical ventilation, and causes of hypercalcaemia in intensive care.

A 56-year-old female admitted to the Intensive Care Unit five days prior with an ST elevation myocardial infarction requiring urgent percutaneous intervention with a circumflex stent. She had suffered a significant cardiorespiratory deterioration in the previous twenty-four hours and candidates were asked to assess her and outline potential causes for her shocked state. Discussion points included the differential diagnosis of shock, complications of myocardial infarction, the role of intra-aortic balloon pump, and the management of hospital acquired pneumonia.

A 55-year-old male admitted five days previously following a motorbike accident. At the time of the examination he was ventilated with a new fever. Candidates were asked to assess him for the cause of the fever. Areas of discussion included the approach to investigation of fever, review of radiological images, the complications of basal skull fracture, and the management of nosocomial meningitis.

A 47-year-old male admitted four days previously following a motor vehicle accident with a neurological injury. Candidates were asked to assess this along with any other injury. Areas for discussion included the clinical findings of a T6 paraplegia and T10 sensory level, and management issues around spinal injury, including pain and bowel management. Issues arising post splenectomy were also discussed.

A 74-year-old female admitted to the ICU seven days prior. She had a background of angina and exertional dyspnoea requiring an elective coronary angiogram. Two days after the angiogram she was admitted to the ICU following a MERT call. She had a background of ischaemic heart disease with coronary stents in 2004, diabetes and hypertension. On the day of examination she remained mechanically ventilated. Candidates were asked why she was still unconscious.

A 60-year-old male on day 9 of his ICU admission. He had suffered an out of hospital cardiac arrest and had undergone a percutaneous coronary intervention on the day of his presentation, followed by a return to the coronary catheter laboratory forty eight hours later when an intra-aortic balloon pump had been inserted. On the day of examination he was intubated, sedated and intermittently sedated. Candidates were asked to assess his suitability for extubation. Areas of discussion included temperature management after cardiac arrest, the role of tracheostomy, prognostication, and potential reasons for his return to the catheter lab.

A 67-year-old male on day 10 of his ICU admission. He had been admitted with a sub arachnoid haemorrhage and had undergone a clipping of a middle cerebral artery aneurysm on the day of his admission. Candidates were asked to assess his neurological state and discuss further management from this point. Areas of discussion included neurological prognostication, interpretation of CT brain findings, the role of tracheostomy, management of his fever, and DVT prophylaxis.

A 37-year-old male admitted to the ICU 22 days previously. He had presented with respiratory failure and had a background of morbid obesity. On the day of examination he was mechanically ventilated via a tracheostomy and was exhibiting signs of delirium. Candidates were asked what the barriers to weaning were.
Areas of discussion included the issues of caring for morbidly obese patients, management of delirium, and causes of the ongoing fever.

A 76-year-old female four days post clipping of a cerebral aneurysm following a sub arachnoid haemorrhage. At the time of the examination she remained mechanically ventilated. Candidates were asked to assess her neurological state and discuss relevant management from this point. Discussion points included interpretation of CT images, ongoing supportive care and prognosis.

A 65-year-old male admitted nine days prior following a witnessed out of hospital cardiac arrest. He had a background history of a viral cardiomyopathy and at the time of examination was intubated and ventilated. Candidates were asked to comment on his neurological prognosis.

A 64-year-old male admitted 3 days prior with chest pain and shortness of breath. He had a background history of chronic airways disease, obesity and a nephrectomy. At the time of examination he was intubated and ventilated. Candidates were asked to examine him with a view to finding the cause of his respiratory failure. Clinical findings included bronchial breathing and hepatomegaly, and discussion points centred on differential diagnoses, interpretation of investigations, and issues relating to acute kidney injury.

A 72-year-old female on day four of her ICU admission. She had presented with a rapid onset of respiratory distress, as well as lethargy, loose bowel motions and a skin rash. She had a background history of colectomy for colon cancer in January 2016, and treatment with fluorouracil and more recently penitumumab. At the time of examination she was receiving nocturnal BIPAP and supplementary oxygen during the day. Candidates were informed that she was being assessed for discharge and they had been asked to provide her daughter with a progress update.

A 51-year-old female who had been admitted to the ICU seven days before with hypoxia and a decreased conscious state. She had a background of morbid obesity and at the time of examination required nocturnal BiPAP and daytime high flow oxygen. Candidates were asked to assess her appropriateness for discharge and outline her main issues. Discussion points included fluid balance, treatment of her cellulitis, the optimal inspired oxygen concentration, and the possibility of occult pulmonary embolus.

A 67-year-old male admitted to the ICU three days prior with dyspnoea and hypotension. He had a significant smoking history. Candidates were asked to examine him and identify the issues and their approach. A thoracostomy tube was in situ. Discussion points included interpretation of imaging results, the cause of the hypotension, and the pleural fluid cytology.

## VIVAS

### Viva 1

A 75-year-old male has been in your ICU for 4 days following a mitral valve replacement and coronary artery grafts, ventilated and shocked, requiring significant ongoing cardiovascular support. Over this time, his platelet count, (normal range 150 – 450 x $10^9$/L), has fallen, as per the table below:

| Pre-op | Post CPB | Day 1 | Day 3 | Day 5 |
|---|---|---|---|---|
| 386 | 109 | 151 | 142 | 61 |

What are the likely causes for the thrombocytopaenia in this situation?

*This viva focussed on the investigation and management of thrombocytopenia.*

**Viva 2**

You are part of a multi-disciplinary team that assesses high-risk cardiac surgical patients. You have been asked to assess an 84-year-old female with symptomatic severe aortic stenosis for aortic valve replacement. She has had coronary artery bypass surgery 10 years ago and femoro-popliteal artery bypass surgery 4 years ago. She has treated hypertension, diabetes, emphysema and chronic kidney disease.

What further information / investigations would you obtain and why?

*This viva focussed on the preoperative assessment of high risk cardiac surgical patients.*

**Viva 3**

A 25-year-old cyclist has just been admitted to your ICU after a crash at 40 km/h. His Glasgow Coma Score (GCS) was 4 at the scene, and he has been intubated. CT brain demonstrates several petechial haemorrhages at the grey-white junction but no extra-axial mass lesion. No other injuries have been identified on thorough imaging and clinical evaluation. Currently he is sedated with morphine and midazolam (5 mg/hr each).

He is intubated and ventilated with SIMV: ventilator rate 14 breaths/min, tidal volume 550 ml, PEEP 10 $cmH_2O$.

His observations are as follows: Temp 36.5°C, Heart rate 90 beats/min, BP 100/55 mmHg, $SPO_2$ 96% on $FiO_2$ 0.3, $EtCO_2$ 40 mmHg (5.2 kPa).

Outline your management that is specific to the patient's head injury.

*This viva focussed on the management of traumatic brain injury.*

**Viva 4**

You have been asked to review a 56-years-old female in recovery, who became hypoxic post bronchoscopy. Bronchoscopy was done to investigate a history of 2 weeks increasing shortness of breath, associated with bilateral chest infiltrates on chest X-ray. She is currently intubated and ventilated, with a $SpO_2$ of 88% on $FiO_2$ 1.0.

Her respiratory function tests from one week prior to admission are tabulated below:

| | Pre-Bronchodilator (BD) | | | Post- BD | |
|---|---|---|---|---|---|
| Test | Actual | Predicted | % Predicted | Actual | % Change |
| FVC (L) | 1.73 | 4.37 | 40 | 1.79 | 4 |
| $FEV_1$ (L) | 1.57 | 3.65 | 43 | 1.58 | 0 |
| $FEV_1$/FVC (%) | 91 | 84 | | 88 | - 3 |
| RV (L) | 1.01 | 1.98 | 51 | | |
| TLC (L) | 2.68 | 6.12 | 44 | | |
| RV/TLC (%) | 38 | 30 | | | |
| DLCO* corr | 5.13 | 32.19 | 16 | | |
| DLCO/VA | 1.00 | 5.12 | 19 | | |
| *DLCO is measured in ml/min/mmHg | | | | | |

List the differential diagnosis of hypoxia post bronchoscopy in this patient, and outline your management.

*This viva focussed on the investigation and management of interstitial lung disease.*

**Viva 5**

You are managing a 45-year-old male who had elective surgery 2 days ago for removal of an arachnoid cyst. This was complicated by a localized posterior fossa haemorrhage requiring an emergency craniotomy and evacuation of the clot within 6 hours of the original surgery. Prior to the emergency surgery, he had fixed dilated pupils. His sedation (propofol and morphine) has now been off for 24 hours and on examination he has a GCS of 3, no cough or gag, and fixed dilated pupils.

CT Report (prior to emergency craniotomy) is shown below:

Findings:
Evidence of occipital craniotomy. Posterior fossa arachnoid cyst has been removed.
There is a large acute, posterior fossa haemorrhage that compresses the brain stem. There is mild inferior displacement of the cerebellar tonsils through the foramen magnum. Basal cisterns are intact.
The fourth ventricle remains normal in size as do the remainder of the ventricles.
Supra-tentorial structures appear normal.

Conclusion:
Acute posterior fossa haemorrhage with compression of the brain stem and early cerebellar tonsil herniation.

What would be your approach to prognostication?

*This viva focussed on the diagnosis of brain death.*

**VIVA 6 – Procedure Station**

You have been asked to teach a skill station in an educational day for the junior medical staff on management of the difficult airway.

Scenario: An unexpected failed intubation in a hypoxic patient who is also difficult to ventilate with a bag-valve-mask (BVM). The patient has been given sedation and a non-depolarising neuromuscular blocker.

Participant: Junior ICU Registrar.

Equipment available:

- Bag-valve-mask
- Oropharyngeal and nasopharyngeal airways
- ET tubes
- Laryngeal masks
- Macintosh laryngoscope
- Intubating bougie
- Intubating stylet
- Intubating laryngeal mask
- Video laryngoscope

Guide the junior registrar through the appropriate steps following an unexpected failed intubation in a hypoxic patient, who is known to be difficult to BVM ventilate.

*This viva focussed on the use of intubation aids for intubation and extubation in a patient with a difficult airway.*

**Viva 7 – Radiology Station**

*The radiology station comprised five plain films and three CT scans.*

**VIVA 8 – Communication Station**

Mavis is a 77-year-old female, previously fiercely independent who has been very clear as to her end of life wishes with her family. She collapsed in a shopping centre, with a grand mal seizure, and was intubated and ventilated by the paramedics. She was transferred to the Emergency Department and a CT scan showed an acute sub-arachnoid haemorrhage with a moderate amount of blood and no midline shift. She has been ventilated in your ICU overnight.

Assessment of Mavis this morning shows the following:

Receiving infusions of Propofol @ 150 mg/hr and fentanyl @ 100 µg/hr
CPAP/PS 5 $cmH_2O$ / 5 $cmH_2O$
Tidal volume: 450 ml
Respiratory rate: 20 breaths/min
Glasgow Coma Scale: E1 VT M5
Blood pressure: (no vasoactive agents) 145/75 mmHg (MAP 82)
Afebrile

The neurosurgeons have planned to proceed with a digital subtraction angiogram (DSA) and coiling of the aneurysm later today.

Her son/daughter has arrived this morning. You have been told that he/she is upset and angry that Mavis is on life support as this is something she has never wanted.

You are about to meet her son/daughter.