



# COLLEGE OF INTENSIVE CARE MEDICINE OF AUSTRALIA AND NEW ZEALAND

## SECOND PART EXAMINATION

### EXAM REPORT MARCH / MAY 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 hr 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	May 2016	October 2015	May 2015	October 2014	May 2014	October 2013
Presenting for written (Including OTS)	41	52	35	53	35	53
Carrying a pass from a previous attempt	14	12	21	3	8	11
OTS Exempt	0	0	0	0	0	0
Total number presenting (written + carry + OTS)	55	64	56	56	43	64
Invited to orals (>50% in written section)	27	35	27	40	15	28
Total number invited to oral section	41	47	48	43	23	39

<b>Analysis of Performance in Individual Sections</b>	<b>May 2016</b>	<b>October 2015</b>	<b>May 2015</b>	<b>October 2014</b>	<b>May 2014</b>	<b>October 2013</b>
Successful in the written section	27/41 66%	35/52 67%	27/35 77%	40/53 75%	15/35 43%	28/53 53%
Successful in the Hot Case section	18/41 44%	26/47 55%	32/48 67%	21/42 50%	15/23 65%	22/39 56%
Successful in both Hot Cases	7/41 17%	13/47 28%	17/48 35%	12/42 29%	6/23 26%	10/39 26%
Successful in the Viva section	18/41 44%	31/47 66%	40/48 83%	25/42 60%	22/23 96%	30/39 77%

<b>Sectional Pass Rates</b>	<b>May 2016</b>		<b>October 2015</b>		<b>May 2015</b>		<b>October 2014</b>		<b>May 2014</b>		<b>October 2013</b>	
	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	37%	80%	45%	80%	60%	80%	36%	88%	43%	70%	54%	80%
Hot Case 2	46%	90%	62%	85%	56%	88%	57%	85%	61%	85%	49%	90%
Viva 1	71%	92%	53%	93%	83%	90%	76%	95%	91%	85%	56%	70%
Viva 2	32%	70%	45%	88%	96%	95%	90%	92%	83%	90%	85%	90%
Viva 3	66%	90%	77%	85%	79%	100%	31%	78%	61%	89%	62%	90%
Viva 4	51%	80%	79%	78%	52%	88%	55%	90%	87%	85%	85%	95%
Viva 5	76%	85%	66%	85%	92%	90%	86%	100%	87%	85%	54%	80%
Procedure Viva	66%	85%	40%	90%	46%	81%	48%	80%	74%	90%	72%	100%
Radiology Viva	41%	89%	40%	95%	84%	90%	2%	61%	61%	94%	49%	87%
Communication Viva	10%	85%	47%	78%	65%	100%	24%	85%	78%	100%	79%	76%

Oral Section Pass Rates	May 2016	October 2015	May 2015	October 2014	May 2014	October 2013
Candidates who scored >50% in written section and passed the overall exam	15/27 <b>56%</b>	27/35 <b>77%</b>	19/27 <b>70%</b>	20/40 <b>50%</b>	15/15 <b>100%</b>	18/27 <b>67%</b>
All candidates invited to oral section and passed the overall exam (written + carry + OTS)	18/41 <b>44%</b>	32/47 <b>68%</b>	37/48 <b>77%</b>	22/42 <b>52%</b>	19/23 <b>82%</b>	28/39 <b>72%</b>
Overall Pass Rate	18/55 <b>33%</b>	32/64 <b>50%</b>	37/56 <b>66%</b>	22/55 <b>40%</b>	19/43 <b>44%</b>	28/64 <b>44%</b>

### EXAMINERS' COMMENTS

#### Written Paper

Twelve of the thirty questions had an overall pass rate of less than 50%. Topics covered by questions with a pass rate of less than 30% related to the monitoring of lactate levels in the critically ill, the management of chest trauma, statistics, electrical safety in ICU, toxicology and the impact of physiological changes in ESKD on the critically ill.

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.
- 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.

It appears that candidates do not synthesise information well. For example, the question relating to the impact on the critically ill of physiological changes in ESKD was poorly answered. There was also a lack of knowledge depth for basic ICU topics such as monitoring blood lactate levels. The most common reasons for failing a question cited by the Examiners were inadequate detail and lack of knowledge.

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 15/30 questions compared with candidates scoring > 50% and gaining an invitation to the oral section, passing an average of 19/30 questions.

## 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 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.
- 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.
- Inability to construct an appropriate management plan for the case in question.

- 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 were unable to give an appropriate differential diagnosis and management plan as key clinical findings had been missed or misinterpreted. Some candidates also appeared extremely nervous and hesitant with a negative impact on their overall performance.

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 pass rate for the vivas (44%) was equivalent to the pass rate for the Hot Case section, and substantially lower than in previous years. Vivas with an overall pass rate of less than 50% were Viva 2 (acute kidney injury), Viva 7 (Radiology) and Viva 8 (Communication Viva). 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. Candidates must be able to demonstrate confident and appropriate decision-making in specific clinical situations.

## 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

<b>Critically evaluate:</b>	Evaluate the evidence available to support the hypothesis.
<b>Outline:</b>	Provide a summary of the important points.
<b>List:</b>	Provide a list.
<b>Compare and contrast:</b>	Provide a description of similarities and differences (E.g. Table form).
<b>Management:</b>	Generic term that implies overall plan. Where appropriate, may include diagnosis as well as treatment.
<b>Discuss:</b>	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**

Discuss the role of systemic antibiotic therapy in patients with severe acute pancreatitis.

### **Answer Template**

#### Background / Rationale:

Systemic antibiotics in severe acute pancreatitis (SAP) have a potential role in three areas:

- Infected pancreatic necrosis
  - Necrotising pancreatitis develops in about 15% and approx. half of these become infected with increased mortality
  - Majority of pancreatic infections are from gut derived organisms and may be polymicrobial. Common organisms include E coli, Klebsiella species, Enterobacter species, Proteus, Pseudomonas aeruginosa, Bacteroides species and Enterococcus
  - Should be suspected in patients with pancreatic necrosis who fail to improve after 7-10 days of hospitalisation

- Extra-pancreatic infections
  - Common (up to 20% of patients with SAP), e.g. bloodstream, pneumonia, UTI and associated with increased mortality
- Prophylaxis
  - Theoretically antibiotics could prevent or decrease infection rates and decrease mortality
  - Use of prophylactic antibiotics in SAP is controversial

Disadvantages:

Development of resistant strains of bacteria and selection of fungal infections.

Evidence and Practice Guidelines:

- Infected pancreatic necrosis
  - In suspected infected necrosis or pancreatic abscess, use antibiotics in association with minimally invasive drainage or open surgery.
  - Therapeutic guidelines recommend Tazocin OR if allergic to penicillin's 3<sup>rd</sup> generation cephalosporin and metronidazole OR meropenem OR quinolone and metronidazole.
- Extra-pancreatic infections
  - Antibiotics should be prescribed as clinically indicated.
- Use of prophylactic antibiotics in pancreatitis
  - Controversial
  - Cochrane meta-analysis in 2010:
    - Trends towards increased survival and reduced rates of infections of pancreatic necrosis but not statistically significant
    - Trend towards less incidence of non-pancreatic infections
    - Of subgroup analysis regarding antibiotic therapy, only imipenem had statistically decreased infection rates of necrotic pancreas but no mortality benefit
    - Issues with under powering of studies, not limited to necrotic pancreatitis and heterogeneity of patients
    - Prophylactic antibiotics in established necrosis of acute pancreatitis not recommended.

Summary statement:

- In suspected infected pancreatic necrosis treat with surgical/percutaneous/endoscopic drainage and broad-spectrum antibiotics
- Routine use of prophylactic antibiotics with sterile necrosis to prevent infected necrosis is not recommended
- Antibiotics as indicated for extra-pancreatic infections
- Routine use of prophylactic antibiotics in severe acute pancreatitis is not recommended

Pass rate	83%
Highest mark	8.0

**Question 2**

You are assessing a patient on the first post-operative day following an aortic valve replacement. There are atrial and ventricular epicardial wires in place and the patient is being paced at 90/min in a DDD mode.

- a) Define sensitivity with respect to cardiac pacing. (20% marks)
- b) Describe the steps that you would perform to check and set sensitivity. (30% marks)
- c) In addition to checking sensitivity, what other daily checks would you perform in regards to the temporary pacing system? (20% marks)
- d) The patient becomes completely pacemaker dependent and the pacemaker suddenly completely fails to pace. List the actions to troubleshoot the pacemaker. (30% marks)

### Answer Template

- a)  
The 'sensitivity' (as numerically represented on the pacing generator) is the minimum current that the pacemaker is able to sense. A lower number thus corresponds to a greater sensitivity.
- b)  
This is only checked when the patient has an intrinsic rhythm which affords some cardiovascular stability.
- Set the pacemaker rate 10 below patients intrinsic rate
  - Set the output to a very low value e.g., 0.1mA
  - Setting the pacemaker to asynchronous mode by turning the sensitivity to its lowest value (highest mV setting) after setting the output current to its lowest value (e.g. 0.1mA) so as to not capture but trigger the pacing indicator.
  - The sensitivity is then gradually increased (lower mV) until the pacemaker senses the patients intrinsic HR and the pacing indicator no longer illuminates but the sensing indicator does. This is the sensing threshold.
  - The final setting is usually half this determined value
- OR also acceptable-
- Gradually decrease sensitivity (with output set to low value and pacemaker set to 10 below intrinsic rate) and watch for sensing flash on box to disappear. Final setting is usually half this value.
- c)
- Underlying heart rate
  - Capture threshold
  - Appropriate pacing mode for the patient
  - Impulse generator- battery
  - (Maximum tracking rate, AV interval, post ventricular atrial refractory period (PVARP) should be noted, but do not require daily checks once set)
- d)
- Increase output to maximum (20mA)
  - Select VOO (fixed ventricular pacing) to overcome inappropriate over sensing
  - Check all leads/connections/batteries
  - Replace impulse generator if faulty
  - Consider reversing the polarity on the v wires
  - Consider percutaneous lead through skin

Pass rate	90%
Highest mark	8.75



### Question 3

With regards to high-voltage electrical injuries:

- a) List the factors determining the severity of electrical burn injuries. (30% Marks)
- b) List the potential causes of poor lung compliance in a patient who is receiving invasive mechanical ventilation post high-voltage electrical injury. (40% Marks)
- c) A patient who has suffered a high-voltage electrical injury is noted on day 2 to have dark coloured urine and a creatine kinase (CK) that is elevated at 32 000 U/L. How will you manage this clinical problem? (30% marks)

### Answer Template

- a)
  - Type of circuit – AC current worse than DC
  - Duration of exposure
  - Resistance of tissues : higher the resistance greater the thermal energy produced and greater the damage to the tissues
  - Voltage: > 1000 V is high voltage and causes greater tissue damage.
  - Current
  - Pathway of current: affects the part of the body that is damaged
- b)
  - Chest compartment syndrome due to circumferential trunk burns,
  - Tight burns dressing on the chest
  - Pulmonary oedema due to cardiac involvement
  - Pulmonary aspiration
  - Lung contusions due to trauma associated with incident
  - Abdominal compartment syndrome
  - Undersedation/ventilator dysynchrony
- c)

The patient has rhabdomyolysis.

  - Examine the patient to rule out compartment syndrome.
    - Surgical opinion and fasciotomy should be considered early
  - Prevention of AKI
    - Correction of volume depletion: if present rigorous fluid repletion until it is clear from sequential laboratory values that the plasma CK level is stable and not increasing
    - Prevention of intratubular cast formation- a forced alkaline diuresis, in which the urine pH is raised to above 6.5, may diminish the renal toxicity of haem proteins.
    - Diuresis with mannitol can be considered – currently no evidence
  - Treatment of Established Renal Failure:
    - CRRT

Pass rate	85%
Highest mark	7.25

## Question 4

4.1

A previously fit and well 41-year-old male underwent an anterior resection under general anaesthesia with regional blockade. In recovery he required additional analgesia for escalating pain and treatment for nausea, following which he had an apparent seizure.

The following arterial blood gas sample was taken during resuscitation:

Parameter	Patient Value	Normal Adult Range
FiO <sub>2</sub>	0.6	
pH	6.91*	7.35 – 7.45
pCO <sub>2</sub>	64 mmHg (8.5 kPa)*	35 – 45 (4.6 – 6.0)
pO <sub>2</sub>	158 mmHg (21 kPa)*	75 – 98 (10 – 13)
SaO <sub>2</sub>	96%	
Bicarbonate	12 mmol/l*	22 – 26
Base Excess	-18 mmol/L*	-2 – +2
Sodium	145 mmol/L	135 – 145
Potassium	4.1 mmol/L	3.5 – 5.2
Chloride	110 mmol/L	95 – 110
Lactate	16 mmol/L*	< 2
Haemoglobin	166 g/L*	115 – 160
Glucose	9.0 mmol/L*	3.6 – 7.7

- a) Describe the acid-base abnormality. (20% marks)
- b) Give six possible causes for this clinical and biochemical scenario. (30% marks)

### Answer Template

- a)  
Severe acidaemia due to a mixed metabolic (high anion gap lactic acidosis) and respiratory acidosis. Anion Gap is 27.
- b)  
Dystonic drug reaction  
Intra-abdominal catastrophe  
Acute Intracranial event e.g. SAH  
Local Anaesthetic toxicity  
Myocardial infarction  
Anaphylaxis  
Seizure

## 4.2

The following venous blood results are from a 52-year-old female who has had a prolonged ICU course following extensive surgery for resection of a pelvic sarcoma, complicated by sepsis and multi-organ dysfunction.

Parameter	Patient Value	Normal Adult Range
Venous Blood Gas		
pH	7.06*	7.32 – 7.43
PCO <sub>2</sub>	42 mmHg (5.5 kPa)	27 – 50 (3.5 – 6.6)
PO <sub>2</sub>	44 mmHg (5.8 kPa)	36 – 44 (4.7 – 5.8)
Bicarbonate	11 mmol/L*	22 – 38
Base Excess	-18 mmol/L*	-3 – +3
O <sub>2</sub> Saturation	80%	70 – 80
Sodium	140 mmol/L	135 – 145
Potassium	3.8 mmol/L	3.5 – 5.2
Chloride	119 mmol/L*	95 – 110
Anion Gap	14 mmol/L	7 - 17
Calcium Ionised	1.30 mmol/L	1.12 – 1.32
Glucose	10.6 mmol/L*	3.0 – 5.4
Lactate	1.0 mmol/L	< 1.5
Haemoglobin	116 g/L	115 – 160
Urea	9.3 mmol/L*	3.0 – 8.0
Creatinine	244 µmol/L*	45 – 90

- a) Describe the acid-base disturbance in the above results. (10% marks)
- b) Give possible explanations. (20% marks)

### Answer Template

- a)  
Hyperchloraemic metabolic acidosis (normal/non-anion gap) with respiratory acidosis (no respiratory compensation acceptable)
- b)  
Renal tubular acidosis (probably Type 1) secondary to nephrotoxicity (sepsis, drugs, obstruction)  
GI losses (complicated abdomino-pelvic surgery)  
Resuscitation with hyperchloraemic fluids  
Respiratory depression secondary to opiates (*or any reasonable explanation*)

## 4.3

Define the terms 'base excess' and 'standard base excess'. (20% marks)

### Answer Template

Base excess is defined as the amount of acid or alkali that must be added to fully oxygenated blood to return the pH to 7.40 at a temperature of 37°C and a pCO<sub>2</sub> of 40 mmHg.

*Standard base excess* is the amount of acid or alkali to return the ECF pH to 7.40 at a temperature of 37°C and a pCO<sub>2</sub> of 40 mmHg and is calculated for blood at a Hb of 50 g/L.

Pass rate	100%
Highest mark	9.25

## Question 5

Critically evaluate the role of corticosteroids in the management of severe community-acquired pneumonia.

### Answer Template

#### Rationale / Indications

*Conventional & generally accepted indications include:*

- Pneumonia complicating exacerbated COPD
- PJP infection with lung infiltrates (data from HIV population, and by extrapolation to other immunosuppressed groups)
- Patients who are on long term corticosteroids or otherwise have adrenal suppression
- (With less certainty) those with shock states and vasoplegia as a catecholamine sparing strategy

*Outside of these groups, in a general population with CAP:*

- The basis for use is as an adjunctive therapy in hospitalised patients to reduce inflammation and improve morbidity or mortality.
- Some patients with CAP fail to resolve, and progress to cryptogenic organising pneumonia, (COP) with case series showing response to corticosteroids (and relapse on early cessation)
- Conflicting evidence in the fibro-proliferative phase of ARDS
- Now several studies randomising patients to early use in uncomplicated CAP

#### Potential adverse effects

Super-added infection

Muscle weakness / Proximal myopathy / Critical illness polyneuromyopathy

Difficulty weaning from ventilatory support

#### Evidence

A 2015 Meta-analysis (Siemieniuk et al, 2015):

- 3% decrease in all-cause mortality,
- 5% decrease rate of mechanical ventilation
- Reduced hospital length of stay by 1 day.
- Critique of metanalysis
  - Trials included in metanalyses have been small
  - had high heterogeneity
  - Insufficient power to analyse mortality.
  - Many exclusions
    - (e.g. immunocompromised patients at risk of superinfection, pregnant women, GI bleeding within 3 months as well as patients with neuropsychiatric conditions prone to psychotic side effects of steroids)
  - Small overall effect

A recent RCT (Blum et al, Lancet 2015, 392 pt per group) showed a shorter time to reach a composite endpoint of 'clinical stability' with Prednisolone 50mg daily for 7 days.

Another RCT (Torres et al, JAMA 2015, 60 pt per group) showed that Methylprednisolone 0.5mg/kg 12h for 5 days reduced risk of "treatment failure" compared with placebo in patients with severe CAP and high CRP levels

### *Practical (Translational) Issues*

- No clear data on exact steroid and regimen
  - There is no definitive data on what type of steroid to give and whether to give continuously or in a tapering regimen and for how long.
  - In the idiopathic pneumonia group (COP) steroid tapering can be associated with abrupt relapse
- Pathogen dependent response to steroids
  - Pneumonia due to pathogens like the influenza virus and aspergillus may be associated with worse outcomes with steroid use, PCP better
- Studies in progress that may help
  - The ESCAPE study by the Department of Veterans affairs is assessing the role of steroids in CAP with either placebo, methyl prednisolone 40 mg per day or 20 mg per day for 7 days followed by tapering over 13 days on all cause 60 day mortality.

### Summary statement (For example)

- Subgroups where steroids would be conventional therapy (COPD, PJP)
- Not yet accepted therapy
- Treatment effect small
- But no evidence of adverse effect and demonstrated safety.
- Listed as practice changing update in Up-to-Date
- Should ideally be a conjoint decision with clinician responsible for post ICU management

### *Additional comments:*

*Candidates were lacking in knowledge relating to the evidence for steroids in severe CAP. The detail in above template was not required for a pass mark. Satisfactory answer for a pass mark was expected to include:*

- *Accepted indications for steroids in CAP*
- *Some reference to rationale for use in other groups with CAP*
- *Potential adverse effects*
- *Some reference to evidence*

Pass rate	34%
Highest mark	7.0

### **Question 6**

A 76-year-old female is admitted to the ICU following elective aortic and mitral valve replacement. Transoesophageal echo assessment at the end of surgery showed an ejection fraction of 20%. Her preoperative creatinine was 340 µmol/L. Total bypass time was 240 minutes. On arrival in ICU the patient has the following indices:

Temperature	35°C
Atrial pacing (AAI)	80/min
Systemic blood pressure	85/55 mmHg
Pulmonary artery pressure	60/30 mm Hg

Cardiac index	1.5 litres.min.m <sup>-2</sup>
Systemic vascular resistance	1700 dyn.sec.cm <sup>-5</sup>
Pulmonary artery wedge pressure	10 mmHg
Central venous pressure	8 mmHg
The patient is currently on adrenaline	4 µg/min by infusion

- a) List the specific clinical and haemodynamic issues for this patient on admission to ICU. (40% marks)
- b) Outline your management of these issues. (60% marks)

### Answer Template

- a)
- The main clinical and haemodynamic issues identified are:
- Elderly female patient post double valve surgery
  - Pre-existing renal impairment
  - Long bypass time
  - Systemic hypotension (MAP 65 unlikely to be adequate for this patient)
  - Low output state (CI, EF post bypass).
  - Increased afterload / vascular impedance (SVR).
  - Probable fluid responsiveness (PAWP, CVP).
  - Moderate pulmonary hypertension.
  - Low core temperature
- b)
- This patient is high risk (female, age, long bypass time, pre-existing renal impairment, low EF). Management consists of:
- Re-warming
  - Judicious fluid replacement as she re-warms
  - Improved volume state may augment CI but given poor EF unlikely to be sole intervention needed
  - Titration of adrenaline infusion, aiming for CI >2.2
  - Bedside echo to evaluate effect of fluid and increased adrenaline, exclude tamponade and check valve function (mitral regurgitation can increase PAP and decrease cardiac output)
  - Consideration of other vasoactive agents (dobutamine, milrinone, levosimendan) or IABP insertion if persisting low output state
  - Assess adequacy of pacing and consider changing mode to A-V pacing (heart block common after AVR) and /or increasing rate to 90 bpm
  - Correct post-op coagulopathy and replace blood losses to maintain Hb > 80 G/L. Surgical review if significant blood loss via drains
  - Evaluation of any other cause of low output state e.g. tension pneumothorax, dynamic hyperinflation
  - Close monitoring of renal function and early institution of renal replacement therapy if oligo-anuric or rising creatinine
  - Consideration of inhaled nitric oxide to reduce pulmonary hypertension and RV afterload

Pass rate	95%
Highest mark	8.75

## Question 7

7.1

The following blood results are from a 51-year-old female who presented with arthralgia, jaundice and dark urine.

Parameter	Patient Value	Normal Adult Range
Haemoglobin	68 g/L*	115 – 160
White Cell Count	33.1 x 10 <sup>9</sup> /L*	4.0 – 11.0
Platelets	307 x 10 <sup>9</sup> /L	150 – 400
Red Cell Count	2.22 x 10 <sup>12</sup> /L*	3.80 – 4.80
Haematocrit	0.19*	0.37 – 0.47
Mean Cell Volume	88 fL	80 – 100
Mean Cell Haemoglobin	30.7 pg	27.0 – 32.0
Mean Cell Haemoglobin Concentration	350 g/L	320 – 360
Reticulocytes %	2.5%*	0.2 – 2.0
Reticulocytes Absolute	56 x 10 <sup>9</sup> /L	20 – 130
Comment: The red cells show moderate numbers of spherocytes.		
Serum Haptoglobins	< 0.10 g/L*	0.30 – 2.00
Serum Lactate Dehydrogenase	948 U/L*	140 – 280
Total Protein	69 g/L	60 – 80
Albumin	33 g/L*	35 – 50
Globulins	36 g/L	25 – 42
Total Bilirubin	119 µmol/L*	< 20
Alanine Transferase	276 U/L*	< 35
Alkaline Phosphatase	120 U/L*	30 – 110
Gamma-Glutamyl Transferase	114 U/L*	< 40
Direct Antiglobulin Test:		
IgG	Positive	
C3d	Positive	

a) What is the diagnosis? (20% marks)

b) List three treatment options. (15% marks)

### Answer Template

a) Warm autoimmune haemolytic anaemia.

b) Corticosteroids

IV immunoglobulin

Rituximab

Splenectomy

Danazol

Other cytotoxics / immunosuppressants (e.g. cyclophosphamide, azathioprine, cyclosporine)

Red cell transfusion

## 7.2

A 33-year-old male who is four weeks after gunshot wounds to his chest and abdomen has the following report on his blood film:

Moderate anisocytosis. Moderate polychromasia. Occasional Howell-Jolly bodies. Increased rouleaux formation.

- a) What is meant by the term 'polychromasia' and what is its significance? (10% marks)
- b) What are Howell-Jolly bodies, and what are their significance? (15% marks)
- c) List two other features you might expect to see on the blood picture of a patient with Howell-Jolly bodies. (10% marks)

### Answer Template

- a) Variation in RBC colour due to immature forms.  
Consistent with bone marrow stimulation.
- b) Residual nuclear remnants in red cells that have not been removed the spleen.  
Usually indicates hypofunctional or absent spleen – presumably secondary to the trauma.  
(Occasionally seen in haemolysis or megaloblastic anaemia)
- c) Any two of:
  - Heinz bodies
  - target cells
  - siderocytes
  - poikilocytosis
  - acanthocytes
  - spherocytes
  - Pappenheimer bodies

## 7.3

A 73-year-old female with a background of rheumatoid arthritis has been admitted to your Intensive Care Unit with a history of acute shortness of breath and a fluctuating conscious state. She has been having severe headaches for the last three weeks.

The following investigations were obtained:

Parameter	Patient Value	Normal Adult Range
Haemoglobin	76 g/L*	115 – 160
White Cell Count	23.8 x 10 <sup>9</sup> /L*	4.0 – 11.0
Platelets	198 x 10 <sup>9</sup> /L	150 – 450
Blood Film	2% Plasma cells and rouleaux formation	



Parameter	Patient Value	Normal Adult Range
Sodium	137 mmol/L	135 – 145
Potassium	4.3 mmol/L	3.2 – 4.5
Chloride	106 mmol/L	100 – 110
Bicarbonate	25 mmol/L	22 – 27
Urea	15.0 mmol/L*	3.0 – 8.0
Creatinine	280 $\mu$ mol/L*	70 – 120
Total Calcium	2.75 mmol/L*	2.15 – 2.60
Phosphate	1.3 mmol/L	0.7 – 1.4
Albumin	26 g/L*	33 – 47
Globulins	92.3 g/L*	25.0 – 45.0

a) Give the diagnosis. (20% marks)

b) What urgent treatment is indicated? (10% marks)

### Answer Template

a) Hyperviscosity syndrome secondary to multiple myeloma.

b) Plasmapheresis.

Pass rate	39%
Highest mark	7.75

### Question 8

Critically evaluate the role of monitoring blood lactate levels in the critically ill.

### Answer Template

#### Introduction:

Lactate measurement is easy, widely available and accurate. High blood lactate levels may represent increased production from tissues and/or decreased metabolic clearance.

#### Uses

- End-point of resuscitation – lactate clearance.
- Diagnosis of inadequate tissue oxygenation / ischaemia.
- Risk stratification in ED and ICU – predictor of non-survival.
- Prognostication and assessment of severity in liver disease.
- Prognosis post cardiac arrest.
- Lactate gap (lactate value from POC analyser – lactate value from lab) assists diagnosis in ethylene glycol toxicity.

#### Evidence:

- Lactate levels proportional to mortality – lactate  $\geq 4$  is associated with poorer outcome.
- Poor lactate clearance in trauma patients associated with bad prognosis.
- High lactate levels may indicate underlying sepsis in patients who otherwise appear stable (in Rivers EGDT in sepsis trial, 50% patients with MAP  $>100$  had high lactate).
- Multi-centre study of 100 patients post cardiac arrest showed lower lactate levels in first 24 hours and increased lactate in first 12 hours post arrest were associated with survival and

good neurological outcome.

- Sustained high levels of lactate in paracetamol toxicity related ALF may be a trigger for need for transplantation.

Three studies have looked at lactate-directed versus non-lactate-directed therapy in:

- Post-cardiac surgery patients – showed reduction in morbidity but not powered to look at mortality.
- Septic patients in the ED – testing non-inferiority with ScvO<sub>2</sub> showed no difference in outcomes although some limitations of study.
- ICU patients with raised lactate levels – used GTN when ScvO<sub>2</sub> normalised but lactate remained high. Showed statistically significant reduction in morbidity and trend to reduction in mortality but course of lactate levels in both groups was similar.

Practical points:

Monitoring alone does not improve outcome and treatment needs to target the underlying disease. Adequate understanding of the anaerobic and aerobic mechanisms of production and clearance is essential to correctly interpret the significance of raised lactate levels. Lactate levels should be interpreted with clinical correlation.

Lactate levels not useful in:

- Elevated lactate levels with beta agonist therapy (increased lactate production from increased glycolytic flux).
- Post seizures.

Overall:

- Lactate levels in critical illness not fully understood.
- Lack of high-level evidence showing use of lactate monitoring improves outcomes.

Summary statement:

*For example:*

Lactate appears to be an epiphenomenon and marker of severity in the critically ill. My practice is to use it as an end-point of resuscitation and an indicator of possible underlying tissue ischaemia in the shocked patient but not necessarily to react in patients who are otherwise haemodynamically stable with adequate tissue O<sub>2</sub> delivery.

*Additional comments:*

*Candidates were given credit for including valid points not included in the template. The detail of the studies given in the above template was not required for a pass mark.*

*Satisfactory answer for a pass mark was expected to include:*

*The uses of lactate monitoring*

*Some reference to the supporting evidence*

*Limitations of lactate monitoring*

Pass rate	14.6%
Highest mark	7.0

**Question 9**

With respect to the management of cardiac arrest in the pregnant patient:

- a) Outline the factors that govern the decision to perform peri-mortem Caesarian section (PMCD). (70% marks)

- b) List the other modifications to the standard advanced life support (ALS) protocol that need consideration in this situation. (30% marks)

### Answer Template

- a) Guidelines recommend PMCD for pregnant women in cardiac arrest > 24/40 weeks (with fundus height at or above the umbilicus) when ROSC has not been achieved with usual resuscitation measures with manual lateral uterine displacement (LUD). In extreme circumstances may be considered in 20 – 24/40 week pregnancy but evidence for benefit is limited.

Decisions on the optimal timing of a PMCD for both the infant and mother are complex and require consideration of factors such as the cause of the arrest, maternal pathology and cardiac function, foetal gestational age, and resources. Shorter arrest-to-delivery time is associated with better outcome.

PMCD should be strongly considered for every mother in whom ROSC has not been achieved after ≈4 minutes of resuscitative efforts.

If maternal viability is not possible (through either fatal injury or prolonged pulselessness), the procedure should be started immediately; the team does not have to wait to begin PMCD.

There is no requirement for transfer to an operating theatre, obstetric/surgical expertise, and equipment beyond a scalpel or lengthy antiseptic procedures

- b)
- Manual lateral uterine displacement +/- left lateral tilt to avoid aorto-caval compression.
  - Early intubation to decrease risk of aspiration – likely to be more difficult in pregnant patient
  - Hand placement for chest compressions may need to be slightly higher.
  - Standard pad placement may be difficult because of breast size so consider bilateral (bi-axillary) placement.
  - Early call for obstetric and paediatric help.

Pass rate	31%
Highest mark	8.1

### Question 10

With respect to the trauma patient:

- a) List the key clinical signs of traumatic asphyxia. (30% Marks)
- b) Explain the term resuscitative thoracotomy. Give the indications for and contra-indications to resuscitative thoracotomy in patients with acute chest trauma. (70% Marks)

### Answer Template

- a)
- The key clinical signs to indicate a patient has sustained traumatic asphyxiation include:
- Facial and upper chest petechiae
  - Sub-conjunctival hemorrhages
  - Cervical cyanosis

- Neurological signs due to cerebral edema
- Temporary loss of vision as a result of retinal edema

b) Resuscitative thoracotomy is a procedure of last resort that is nearly always performed in the emergency department and involves gaining rapid access to the heart and major thoracic vessels through an anterolateral chest incision or clam shell incision to control exsanguinating haemorrhage or other life-threatening chest injuries

What are the indications for resuscitative thoracotomy?

- Extremely controversial

#### Accepted Indications

Penetrating / Blunt thoracic injury

- Traumatic arrest with previously witnessed cardiac activity (pre-hospital or in-hospital)
- Unresponsive hypotension (BP < 70 mmHg)
- Rapid exsanguination from chest tube (> 1500 mL)

#### Relative Indications

Penetrating thoracic injury

- Traumatic arrest without previously witnessed cardiac activity
- Penetrating non-thoracic injury and

Blunt thoracic injuries

- Traumatic arrest with previously witnessed cardiac activity (pre-hospital or in-hospital)

#### Contraindications to resuscitative thoracotomy

- The patient has no signs of life at the scene of injury
- Asystole is the presenting rhythm and there is no pericardial tamponade
- Prolonged pulselessness (> 15 minutes) occurs at any time
- Massive, non-survivable injuries have occurred

Pass rate	0%
Highest mark	4.6

### Question 11

A 12-month-old infant is admitted to your ICU with bronchiolitis.

- List five differential diagnoses that should be considered. (30% marks)
- List five signs of severity in bronchiolitis. (30% marks)
- List four risk factors for severe bronchiolitis. (10% marks)
- List the available supportive therapies. (30% marks)

### Answer Template

- Any five of:*
  - Bacterial pneumonia
  - Recurrent viral triggered wheezing in atopic children (but too young for a diagnosis of asthma)
  - Chronic lung disease of ex-prematurity (broncho-pulmonary dysplasia)

- Occult congenital heart disease or cardiac failure
- Foreign body aspiration
- Congenital vascular rings
- Aspiration pneumonia due to gastro-oesophageal reflux

b) *Any five of:*

- Tachypnoea
- Nasal flaring
- Grunting
- Subcostal or intercostal recession
- Tracheal tug
- Use of accessory muscles
- Apnoeic episodes
- Hypoxia on pulse oximetry

c) *Any four of:*

- Ex prematurity
- Less than 12 weeks old
- Chronic Lung Disease
- Upper airway disease
- Congenital heart disease
- Immunodeficiency
- Neurological disease
- Smokers in the household
- Crowded households
- Attending day-care
- Older siblings

d)

- Mild disease:
  - continue feeding, comfort
- More severe disease:
  - Nasogastric feeding and/or iv fluids High flow humidified fresh gas by nasal cannulae (titrated  $F_iO_2$ , FGF 1-2 L/kg/min)
  - Non-invasive CPAP
  - Intubation rarely required

Pass rate	71%
Highest mark	7.5

## Question 12

Three patients with diarrhoea, positive for *Clostridium difficile*, have been identified in your unit.

Describe your approach to specific patient treatment, and infection control and prevention strategies for this problem.

### Answer Template

#### Treatment:

- Immediate goal is to alleviate the active symptoms of diarrhoea and colitis.
- Ultimate goal is restoration of normal gut flora.

- Discontinue all unnecessary antibiotics.
- Fluid and electrolyte replacement as indicated to compensate for GI losses
- Antibiotic therapy
  - First line agent is PO metronidazole especially in milder disease.
  - Second Line is PO vancomycin for patients with more severe disease, or who are intolerant or do not respond to metronidazole. There has been recent debate that vancomycin should possibly be first line therapy, due to increasing treatment failure rates with metronidazole not seen with vancomycin. Cost and increasing nosocomial vancomycin resistance are other issues within this debate.
- Assess for complications of colitis – severe sepsis or toxic megacolon
- Faecal transplant should be considered to restore normal gut flora

Infection Control and Prevention Strategies:

- The ultimate goal in combating disease is prevention/eradication.
- Specific infection control measures, and thus a Unit Policy, are very important MUST be instituted, championed and audited.
  - Isolation of CDI patients in single rooms or cohorted together
  - Hand Hygiene – The “5 Moments of Hand Hygiene”.
    - Soap and water
    - Not alcohol-based hand rubs (don’t kill the spores)
  - Contact Precautions.
    - Gown and glove.
  - Environmental cleaning and disinfection.
    - Ammonium-based disinfectants are not sporicidal
    - Solutions must include unbuffered hypochlorite (bleach), which is sporicidal. In other words, chlorine-based solutions.
  - Restriction of antimicrobial use.
- Education, via a widespread campaign, and audit, of staff and compliance will be important.
- Consider the introduction of a formal CDI Team which would help educate, raise awareness, implement and audit your policy
- Consider the introduction of CDI Bundles similar to other hospitals
  - Education Bundle
  - Prevention Bundle
  - Treatment Bundle
- Introduction of an Antibiotic Stewardship Program would help monitor appropriate antibiotic use and cessation etc.
- Consider restricting the use of gastric acid suppressive agents. Multiple large trials now support the association between CDI and PPI use. One would have to weigh up the risk-benefit on a patient-to-patient basis though.
- Finally there are ongoing trials looking at the use of probiotics for the prevention of CDI. Their role is unclear at present.

Pass rate	73%
Highest mark	7.5

**Question 13**

A 40-year-old male with a history of ankylosing spondylitis and known difficulty with intubation on previous elective surgery is admitted to your ICU for hypoxic respiratory failure. A decision to perform a semi-elective, awake fibre-optic intubation in the ICU has been made.

Describe how you will prepare for this procedure.

## Answer Template

### Preparation of patient

Consent/explanation of procedure

Obtain *history* of previous airway difficulty, technique used, complications, etc. (from patient, letter from anaesthetist). H/o allergies-esp. to local anaesthetics. Fasting status. Other co-morbidities, e.g. coagulopathy.

*Clinical assessment* – of airway itself, mouth opening, nasal cavity/septum, range of neck movement, mental status including ability to understand and cooperate with proposed procedure, degree of hypoxia and ability to pre-oxygenate.

Preparation of environment/personnel

Appropriate lighting with ability to dim

Monitoring - ECG, pulse oximetry, arterial line, capnography set up.

Adequate and working IV access

Establish comfortable and adequate patient position, pillows, etc.

Request help and ensure availability as appropriate- e.g. Anaesthetist

Ensure presence of adequate skilled assistants. Inform them in detail of steps of procedure and assign roles, as appropriate. (E.g. observation of patient, administration of sedatives, optimisation of patient position, injection of LA, etc.) Discuss a plan B, if technique were to fail.

Keep resuscitation trolley easily available and ensure difficult airway equipment available.

### Preparation of equipment

Check oxygen source and suction

Check equipment for bronchoscopy- Intubating bronchoscope, light source, lubricant, suction for bronchoscope, (oxygen can be applied alternately through same port using 3-way tap) and injection port for local anaesthetic. Apply defogging solution, if available.

Airway equipment- range of oral and nasal armoured tubes of appropriate size, oral intubating airways, soft nasopharyngeal airways, and appropriate size laryngeal mask airway. Depending on choice of oral or nasal intubation, check, lubricate and load chosen tube onto bronchoscope.

Equipment required for plan B.

### Preparation of drugs

Systemic-

- Antisialagogue – e.g. glycopyrrolate.
- Consider proton pump inhibitor.
- Midazolam/Fentanyl as appropriate (small doses as patient should be able to cooperate)

Local anaesthetics - very important in order to achieve success. Ensure not to exceed recommended doses and allow adequate time to act.

- Nasal cavity and nasopharynx- 10% lignocaine spray with phenylephrine spray or cotton tipped pledgets soaked in 4% cocaine or nebuliser filled with 5ml of 4% lignocaine.
- Oral cavity and oropharynx- 10% lignocaine spray or 2% lignocaine viscous gargles.
- Extra local anaesthetic may be required to spray during advancement of bronchoscope.

Pass rate	73%
Highest mark	8.5

## Question 14

14.1

28-year-old female with ulcerative colitis on azathioprine and prednisolone was commenced on intravenous infliximab for the worsening of symptoms. Two weeks after the second cycle, she presented with headache, confusion and blurred vision followed by a generalised tonic-clonic seizure.

Cerebrospinal fluid analysis is unremarkable.

Slices from T2 weighted MRI scan of the brain are depicted below (Figure 1).

- a) What is the most likely diagnosis? (20% marks)
- b) List four risk factors for this condition. (20% marks)

### Answer Template

- a) Posterior Reversible Leukoencephalopathy Syndrome
- b) Hypertension  
Eclampsia / Pre-eclampsia  
Immunosuppressive therapy  
Auto-immune diseases  
Porphyria  
Acute or chronic renal diseases  
TTP / HUS  
Infection / sepsis / septic shock

14.2

The image shown below (Figure 2) depicts a slice from the CT scan of the brain of a 43-year-old female who developed decreased conscious state four days after surgical drainage of a C5-6 epidural abscess.

- a) Discuss the CT scan findings. (20% marks)
- b) Explain the mechanism by which this has occurred. (20% marks)
- c) List your management plan. (20% marks)

### Answer Template

- a) CT scan- Axial noncontrast brain CT with pneumocephalus / trapped air in subdural and interhemispheric space bilaterally. Likely tension pneumocephalus based on interhemispheric widening, compression and peaking of the frontal lobes.
- b) Dural tear provides a ball-valve mechanism for the potential route of air entry by the creation of a negative pressure which can draw air into and through the spinal canal, and hence into the cranial cavity through the foramen magnum, but does not allow air to exit. Hence, both a defect in the dura and reduction in intracranial pressure, caused by CSF leakage contribute to pneumocephalus formation.



- c) Management  
 ABC stabilization  
 Neurosurgical review and consider aspiration of air with insertion of drain to drain the pneumocephalus  
 High flow oxygen (nitrogen wash-out)  
 Lie flat  
 Fluid replacement  
 May need surgical repair of CSF leak

Pass rate	66%
Highest mark	7.8

### Question 15

With respect to brain death and organ donation as specified in the ANZICS guidelines:

- List the pre-conditions that would preclude the determination of brain death by clinical examination. (30% marks)
- List the components of the clinical examination to determine brain death and where appropriate the cranial nerve(s) being tested. (40% marks)
- If clinical testing has been precluded what investigations demonstrate a lack of intracranial blood flow? (30% marks)

### Answer Template

- Conditions precluding clinical testing brain death  
 Absence of diagnosis consistent with brain death  
 Hypothermia (< 35 degrees)  
 Hypotension (< 90 mmHg systolic or < 60 mmHg MAP in adult)  
 Recent administration of sedative drugs  
 Abnormalities of electrolyte, metabolic or endocrine function  
 Recent administration of neuromuscular blocking agents or spinal cord injury  
 Inability to adequately examine the brain stem reflexes (surgery to pupils/perforated ear drum)  
 Inability to perform apnoea testing (acute lung injury)

- Examination Components:

#### Observation

Minimum of 4 hour period of observation and mechanical ventilation during which patient has unresponsive coma

#### Clinical Test

- Coma
- Pupillary reflex
- Corneal reflex
- Pain reflex in trigeminal nerve distribution
- Vestibular ocular reflex
- Gag reflex
- Cough reflex
- Breathing effort with apnoea

#### Cranial Nerve

- II, III  
 V, VII  
 V, VII  
 III, IV, VI, VIII  
 IX, X  
 X

- c) Imaging techniques  
 Four vessel intra-arterial angiography with digital subtraction  
 Radionucleotide imaging with Tc 99m HMPAO  
 CT angiography – may be acceptable

Imaging techniques need to be done in association with exclusion of preconditions and assessment of those cranial nerves that can be assessed and results need to be reviewed by 2 appropriate clinicians excluding the clinician performing the test.

Pass rate	88%
Highest mark	8.5

### Question 16

- a) List five clinical signs of severity in chronic aortic regurgitation. (25% marks)
- b) What are the indications for surgery for chronic aortic regurgitation? (25% mark)
- c) List five causes of a pathological systolic murmur over the precordium and briefly list their auscultatory characteristics. (50% marks)

### Answer Template

- a) *Any five of:*
- Collapsing pulse/wide pulse pressure
  - Length of decrescendo diastolic murmur
  - LV third heart sound
  - Soft A2
  - [Austin Flint (mid-diastolic) murmur]
  - Left ventricular failure
  - Displaced apex beat
- b)
- Symptoms- exertional angina, dyspnoea on exertion, syncope.
  - Worsening LV failure (falling ejection fraction)
  - Progressive LV dilatation on serial echocardiography (LV end systolic dimensions >5.5 cm)
- c) *Any five of:*
- Aortic Stenosis-diamond-shaped (crescendo-decrescendo), heard best at the right upper sternal border, radiates to the right supraclavicular area, and to the carotids
  - Mitral regurgitation-blowing, harsh, holosystolic murmur heard best at the apex, usually radiates to the axilla or back.
  - Pulmonary stenosis- diamond-shaped systolic, heard best at the left upper sternal border, may radiate to back
  - Tricuspid regurgitation-harsh, holosystolic murmur heard best at the left lower sternal border.
  - Subaortic stenosis/HOCM-harsh, diamond-shaped, mid-systolic murmur heard best at the left sternal border
  - Mitral Valve Prolapse-mid-systolic click followed by a brief crescendo-decrescendo murmur, usually best at the apex
  - Ventricular Septal Defect- holosystolic murmur, best heard over lower left sternal border, with radiation to the right lower sternal border

- Atrial Septal Defect- mid-systolic flow murmur best heard over the “pulmonic area” of the chest, and may radiate into the back followed by fixed split S2.
- Patent Ductus Arteriosus- To & fro machinery murmur (systolic and diastolic)

Pass rate	49%
Highest mark	6.25

## Question 17

Outline the risk factors and your management strategies for constipation in the critically ill.

### Answer Template

#### Risk factors

Constipation usually results from multiple interacting causative factors:

- Decreased gastrointestinal motility secondary to:
  - sepsis,
  - electrolyte abnormalities
  - drugs e.g. opiates
  - spinal injury
  - neuromuscular conditions such as Parkinsons
  - long-term laxative abuse
- Immobility due to illness, injury or sedation. Bed rest or a period of immobility is thought to result in a weakening of the abdominal wall muscles leading to difficulty in raising the intra-abdominal pressure sufficiently for defecation to occur.
- Stool quality, which may be affected by lack of fluid and fibre
- Lack of access to appropriate toilet facilities and lack of privacy
- Unconscious patients may not feel the need to defecate and cannot express this need
- Using a bedpan increases the likelihood of constipation. Intra-abdominal pressure needs to be raised for successful defecation and this is impaired while lying on a bedpan.
- Increased incidence in the elderly and nursing home residents

#### Management Strategies

- May benefit from routine Bowel Management Protocol.
- Routine laxatives for all, upgraded to stronger agents/enemas if no bowel action after 2 days.
- AXR if no successful bowel movements after 3-4 days.
- Consider surgical/mechanical cause for constipation and rule out with surgical review / AXR / CT.
- Consideration of neostigmine infusion if pseudo obstruction (rule out mechanical obstruction first – CT abdomen transition point).

#### Non-pharmacological Interventions:

- Sedation breaks to allow assessment of need
- Stop medications that cause constipation
- Normal enteral diet (high fibre feed)
- Availability of commodes/toilets near to patient area for ambulant patients
- Minimisation of opiate analgesia as able (consideration of Targin)
- Mobilisation / free patient from unnecessary lines/tubes etc.
- Adequate oral hydration
- Normalise electrolytes

### Pharmacological Interventions:

- Bulk forming laxatives
- Osmotic laxatives
- Enemas
- Contact laxatives
- Prokinetics
- Neostigmine for pseudo-obstruction

Pass rate	73%
Highest mark	8.0

### **Question 18**

You are asked to review a 58-year-old male intubated and ventilated in the ICU for severe community-acquired pneumonia. His oxygenation is adequate on FiO<sub>2</sub> 0.5 with PEEP set at 15 cmH<sub>2</sub>O. Over the preceding 2 hours his noradrenaline requirement has climbed from 4 mcg/minute to 30 mcg/min to maintain target mean arterial pressure  $\geq$  65 mmHg.

- a) List the potential causes for this clinical scenario. (40% marks)
- b) Outline your management of this management. (60% marks)

### **Answer Template**

- a) Probably multifactorial but potential causes:
- Distributive shock
    - Septic shock
  - Cardiogenic shock/cardiac depression from sepsis/drugs
  - Obstructive shock-
    - pneumothorax
    - High PEEP
    - Dynamic hyperinflation
    - Tamponade less likely
    - PE unlikely
  - Hypovolaemic shock less likely but patient may be fluid responsive
  - Drug delivery failure – misplaced CVC / kinked or leaking line
  - Administration of drugs causing hypotension e.g. propofol, IV paracetamol
- b) Clinical exam (ABCs) to assess for cause and resuscitate simultaneously
- Rapid check to verify BP – non-invasive, check transducer position, check arterial pressure trace not damped
  - Recent CXR / lung U/S for pneumothorax
  - Associated oxygen requirements
  - CVP – baseline and change with fluid responsiveness
  - Evidence of end organ perfusion: lactate, urine output, LFTs
  - Response to dynamic manoeuvres (e.g. straight leg raise)

#### Management options:

- Assess for and treat reversible causes:
  - If possible minimise PEEP and sedation
  - Check ventilator settings
  - Judicious fluid filling but conflicting goals given oxygenation difficulties

- Urgent echocardiogram to exclude cardiac cause and assess fluid responsiveness +/- cardiac output monitor (PAC/PiCCO/Vigileo)
  - If hyperdynamic consider addition of steroid therapy and vasopressin
  - If low cardiac output state consider addition of adrenaline +/- other inotrope e.g. milrinone/dobutamine
  - If hypovolaemic appropriate fluid resus
- Maintain adequate oxygenation, ventilation
- Review micro and check sensitivities
- Broad spectrum antibiotics
- Consider fresh bag of noradrenaline

Pass rate	85%
Highest mark	7.75

### Question 19

Explain the following terms as applied to a randomised controlled clinical trial:

- a) Allocation concealment. (25% marks)
- b) Block randomisation, using block sizes of 4, in a trial of drug A versus drug B. (25% marks)
- c) Stratification. (25% marks)
- d) Minimisation algorithm. (25% marks)

### Answer Template

- a) Procedure for protecting the randomization process and ensuring that the clinical investigators and those involved in the conduct of the trial are not aware of the group to which the subject has been allocated
- b) Simple randomisation may result in *unequal treatment group sizes*; block randomisation is a method that may protect against this problem and is particularly useful in small trials. In the context of a trial evaluating drug A or drug B and with block sizes of 4, there are 6 possible blocks of randomisation: AABB, ABAB, ABBA, BAAB, BABA, BBAA. One of the 6 possible blocks is selected randomly and the next 4 study participants are assigned according to the order of the block. The process is then repeated as needed to achieve the necessary sample size.
- c) Stratification is a process that protects against *imbalance in prognostic factors* that are present at the time of randomisation. A separate randomisation list is generated for each prognostic subgroup. Usually limited to 2-3 variables because of increasing complexity with more variables.
- d) This is an alternative to stratification for *maintaining balance in several prognostic variables*. The minimisation algorithm maintains a running total of the prognostic variables in patients that have already been randomised and then subsequent patients are assigned using a weighting system that minimizes imbalance in those prognostic variables.

Pass rate	2.5%
Highest mark	5.0

## Question 20

With respect to Guillain-Barre Syndrome and Myasthenia Gravis, compare and contrast the respective:

- a) Clinical features. (30% marks)
- b) Investigations needed to make the diagnosis. (30% marks)
- c) Specific treatment strategies with the relevant evidence / recommendations for the strategies listed. (40% marks)

## Answer Template

Condition	Clinical Features	Investigations	Treatment Strategies
Guillain-Barre Syndrome	Diarrhoeal prodrome Autonomic instability Symmetrical, progressive ascending weakness with associated areflexia. Ventilatory failure May be cranial nerve involvement. Sensory loss usually mild or absent.	Nerve conduction studies show demyelination (reduction in conduction velocities) CSF analysis: high protein and normal WCC	IVIG Plasmapheresis The use of plasma exchange or IVIG depends on the institution or whether the patient has a contraindication to IG such as IgA deficiency. Both have been shown to be equally efficacious. One Cochrane review suggested that IVIG given within 2 weeks of the onset was as efficacious as plasma exchange, and more likely to be completed than plasma exchange. Their combination is not supported.
Myasthenia Gravis	Fluctuating, often fatiguable, weakness and possible progression to ventilator failure but reflexes intact. Ptosis with associated diplopia.	Auto-antibodies against nicotinic Ach receptors and MuSK Antibodies EMG and NCS studies	Anticholinesterases e.g. Pyridostigmine – symptomatic treatment more effective in antiAChR than MuSK Rapid Immunotherapy (IVIG and PLEX) – recommended for myasthenic crises Chronic Immunotherapy (Steroids and immunosuppressants) – majority require this with antiAChase Thymectomy – not recommended routinely for age>60 unless thymoma present

Pass rate	95%
Highest mark	9.1

## Question 21

Critically evaluate the use of neuromuscular blocking agents in severe respiratory failure due to acute respiratory distress syndrome (ARDS).

### Answer Template

#### Rationale & Theoretical Benefits

- In general will reduce O<sub>2</sub> consumption & CO<sub>2</sub> production
- Avoids patient ventilator dys-synchrony
- Allows evaluation of respiratory mechanics
- Generally required to perform a recruitment manoeuvre
- In patients with pronounced spontaneous respiratory effort:
  - They may draw large spontaneous tidal volumes well in excess of appropriate ARDSnet values (pulmonary *stress*)
  - They may generate large spontaneous negative trans-pulmonary pressures during controlled breaths (pulmonary *strain*)
  - Spontaneous respiratory activity is difficult to otherwise suppress (with sedation only), particularly in the setting of permissive hypercapnia
- Observationally improves oxygenation in the short term
- May reduce cytokine release and biotrauma
- Facilitates prone positioning

#### Theoretical Problems

- Contradicts strategies of maintaining spontaneous efforts and respiratory muscle strength.
- May unmask poor compliance in patients who were generating very negative inspiratory pressures while breathing spontaneously, with consequent difficulties maintaining adequate tidal volume.
- Potential for awareness during paralysis
- Risks of 'Critical Illness Weakness' associated with use of NMBA.
- Risks of accumulation of NMBA drug in critical illness.
- Increased risk of positive fluid balance and thromboembolic risks.

#### Practical Issues

Timing / duration of paralysis not known – Papazian used 48 hr

Which NMB – non-steroid based may be better for reducing risk of weakness (Papazian used cisatracurium)

Train of four monitoring needed

#### Best Evidence

- Single French RCT (Papazian, *NEngJ* Sept 2010)
- Severe ARDS, P/F < 150
- Showed mortality improvement at 90 days with paralysis for 48 hrs in early severe ARDS hours (hazard ratio for death 0.68). No increase in weakness.
- Evidence for improved oxygenation beyond period of paralysis.
- Criticisms:
  - 25% of eligible patients enrolled, limits external validity
  - study used low levels of PEEP (lower than the control of several high vs. low PEEP trials)

### Practice statement

*Anything reasonable – for example:*

I do not use NMBs routinely in severe ARDS but in selected patients e.g. those difficult to ventilate / oxygenate I use cisatracurium infusion with train of four monitoring

Pass rate	34%
Highest mark	5.75

### **Question 22**

22.1

With reference to electrical safety in the ICU:

- a) What is meant by the term: “Cardiac protected electrical area”? (35% marks)
- b) What is meant by the term: “Microshock”? (35% marks)
- c) What patient related factors in a critically ill patient theoretically increase susceptibility to microshock? (30% marks)

### **Answer Template**

With reference to electrical safety in the Intensive Care Unit:

- a) Cardiac protected electrical area:  
Power reticulation and devices are designed and constructed to minimise unequal electrical potentials between different devices, so that potential current flow between a device and a patient is limited to a defined level. Class 1c (cardiac protection) ensures leakage currents do not exceed 50 microamps)
- b) Microshock  
"Micro-shock" is a sub milliamp current applied directly or in very close proximity to the heart muscle of sufficient strength, frequency, and duration to cause disruption of normal cardiac function. There are no incontrovertibly demonstrated fatal cases, but proving causality is difficult.
- c) Microshock Susceptibility:
  - Invasive devices, (CVC, PAC, pacing wires)
  - Altered fibrillation thresholds:
    - Electrolyte abnormality
    - Underlying heart disease

Pass rate	7%
Highest mark	8.0

### **Question 23**

Outline the strategies for management of a persisting broncho-pleural fistula (BPF) in a mechanically ventilated patient. Include in your answer, where relevant, the advantages and disadvantages of the strategy listed.



## Answer Template

### Principles of Management:

#### 1. Drainage

- Adequate drainage of the fistula with an intercostal catheter of adequate size to manage a large air leak.
- May require multiple catheters, and ability to manage large flow rates.
- Minimise suction.

#### 2. Ventilatory management

- Aim is to reduce mean airway pressure to reduce flow through fistula tract.
- Low tidal volume and PEEP.
- Low mandatory breath rate.
- Permissive hypercapnoea.
- Short inspiratory time.
- Attempt to wean to spontaneous breathing mode from mandatory ventilation as soon as practicable and preferably from ventilatory support altogether.

#### 3. Independent Lung Ventilation

- Advantages: - May minimise leak in injured lung whilst preserving gas exchange with conventional parameters in normal lung.
- Disadvantages: -requires some form of double lumen tube – difficult to place and secure.
- May not be tolerated in hypoxic patients.
- Requirement for two ventilators –either synchronous or asynchronous – technically demanding and complex.

#### 4. High Frequency Ventilation

- Advantages are that it may reduce peak air pressures and theoretically reduce air leak.
- Disadvantages - not widely available. Recent evidence suggesting an increase in mortality for this ventilatory technique in ARDS patients.

#### 5. Surgery

- Advantages – Definitive management strategy. May be only option to seal leak.
- Disadvantages – Patient may not be fit enough to tolerate.

#### 6. Endobronchial Occlusion

- Advantages – Widely available, can be definitive treatment.
- Disadvantages – may be technically challenging, not feasible with multiple leaks.

#### 7. Application of PEEP to intercostal catheter

- Advantages – may decrease leak volume and maintain intra-thoracic PEEP.
- Disadvantages – compromise drainage, risk of tension, not feasible with multiple tubes.

#### 8. ECMO

- Advantages – may be only option to treat hypoxia.
- Disadvantages – not widely available, complex, little experience.

Pass rate	73%
Highest mark	9.75

## Question 24

With respect to hyponatraemia:

- a) Outline the classification and underlying causes. (50% marks)
- b) Outline the specific treatment of severe hyponatraemia (i.e. sodium level < 120 mmol/L and/or associated with significant adverse symptoms). (50% marks)


## Answer Template

- a)
- Classify hyponatraemia:
- Hypertonic
  - Isotonic
  - Hypotonic

Further subdivide hypotonic:

- Hypervolaemic
- Euvolaemic
- Hypovolaemic

Serum Na<sup>+</sup> < 135 mmol/L

What is serum osmolality?		
Low (< 285 mOsm/kg)	Normal (285 – 295 mOsm/kg)	High (> 295 mOsm/kg)
	Pseudohyponatraemia <ul style="list-style-type: none"> <li>• Hyperlipidaemia</li> <li>• Hyperproteinaemia</li> </ul>	Hyperglycaemia Hypertonic infusions <ul style="list-style-type: none"> <li>• Mannitol</li> <li>• Glucose</li> </ul>
What is volume status?		
	What is urinary [Na <sup>+</sup> ]?	
	< 20 mmol/L	> 20 mmol/L
Hypovolaemic	Vomiting Diarrhoea Skin losses <ul style="list-style-type: none"> <li>• excess sweating</li> </ul> 3 <sup>rd</sup> space losses <ul style="list-style-type: none"> <li>• Burns</li> <li>• Pancreatitis</li> </ul>	Obstruction Diuretics Renal tubular acidosis Adrenal insufficiency
Normovolaemic	Water intoxication Decreased solute intake	Renal failure Hypothyroidism Adrenal insufficiency SIADH Cerebral salt wasting
Hypervolaemic	Cirrhosis Heart failure Nephrotic syndrome	Acute renal failure Chronic renal failure

- b)
- Management is divided into
- Emergency and short term sodium elevation
  - Specific treatment of the underlying cause

### *Emergency treatment of sodium level*

If the patient is symptomatic, then the serum sodium level needs to be urgently elevated by approximately 2- 4% e.g. 2.5 – 5 mmol/L (these are rough figures).

This is done by giving a specific sodium dose, which is usually in the form of hypertonic saline (e.g. 3%) to avoid any more excess water, over a brief period e.g. 30 minutes.

It is calculated by the following formula.

Sodium dose = Total body water x desired change in sodium level

For example in a 70 kg man, a total of 200 ml of 3% saline will raise the serum sodium by 2.5 mmol/L

### *Short-term sodium management*

Once symptoms have resolved, the aim is to correct the sodium level by roughly 0.5 – 1.0 mmol/L per hour over the next 24 hours. And how this is done depends on the underlying cause.

### *Specific treatment of underlying cause:*

- Fluid restriction for water intoxication / SIADH
- Fluid restriction for cardiac / liver failure
- Fluid rehydration with appropriate fluids for vomiting / diarrhoea
- Aggressive fluid resuscitation for significant fluid losses e.g. pancreatitis or burns
- Stopping of offending medications e.g. diuretics
- Thyroid replacement for hypothyroidism
- Steroids for adrenal insufficiency
- Arginine vasopressin receptor antagonists (e.g. conivaptan)

Pass rate	68%
Highest mark	8.0

## **Question 25**

A 38-year-old male with type 1 diabetes mellitus presents with two days of severe thigh pain. You are called to see him because of hypotension. On examination he is drowsy, BP 80/60 mmHg, HR 140/min and temperature of 40.2°C. There is gross swelling on the medial aspect of his right thigh with obvious cellulitis and visible central necrosis.

Describe the management priorities in the first 24 hours and briefly justify your responses.

### **Answer Template**

#### Resuscitation

High-flow oxygen,  
Support BP with fluids +/- vasopressors  
Measure & fix BSL  
Other organ support as indicated e.g. CRRT

#### Antibiotics

The presentation is that of necrotising fasciitis. T1DM a significant risk factor.

Until microbial aetiology and sensitivities are known, broad-spectrum antibiotics should be administered that cover the most common aetiologies of type I infection (mixed infections with

anaerobes such as *Bacteroides* or *Peptostreptococcus* with a facultative anaerobe such as Enterobacteriaceae [*Escherichia coli*, *Enterobacter*, *Klebsiella*, *Proteus*], MRSA, or non-group A streptococcus), and also type II (group A streptococcus) infection.

Appropriate initial antibiotic regime is Vancomycin / Meropenem / Clindamycin with Pip-Tazo OR Ceftriaxone and Metronidazole OR Ciprofloxacin and Metronidazole as alternatives to Meropenem. Clindamycin is bacteriostatic, has synergistic effect with Vancomycin, inhibits bacterial toxin synthesis by GAS and has a post-antibiotic effect.

When further micro information is available, antibiotic therapy should be narrowed to appropriately target the causative organism(s)

### Surgical Referral and post-operative management

Requires urgent debridement, with removal of dead/infected tissue back to bleeding tissue

Takes priority over other therapies including hyperbaric O<sub>2</sub>

Expectation of major blood loss and massive transfusion

Likely to be highly unstable post-operatively with major support requirement

### Routine ICU care of patient with severe sepsis

### Specific Therapies

#### *Intravenous Immunoglobulin*

In vitro neutralisation of streptococcal super-antigens and clostridial toxins

Streptococcal toxic shock syndrome (with or without nec. fasc.) listed as “emerging” indication for IVIG by ARCBS, and available for use

#### *Hyperbaric O<sub>2</sub>*

Observational studies only

Conflicting results with both reduction and increases in mortality seen cf.

Observational controls

Possible reduction in need for debridement

Usually bd to tds dives of 90 min at 3 atm.

Severe organ failure may limit logistics

Pass rate	81%
Highest mark	8.75

## **Question 26**

26.1

A 54-year-old female walks into the emergency department complaining of palpitations for the past hour. Her ECG is shown below. She has no electrolyte abnormalities.

- Describe the rhythm disturbance. (20% marks)
- How would you treat this rhythm disturbance? (10% marks)
- Name two anti-arrhythmic drugs that are contra-indicated for this rhythm disturbance. (20% marks)

## **Answer Template**

- Atrial fibrillation with an accessory pathway

AF / SVT with aberrant conduction acceptable answer.(The rapid rate precludes AF with bundle branch block so no marks should be given for AF with bundle branch block).

- b) Electrical cardioversion (flecainide, ibutilide, propafenone acceptable).
- c) Digoxin, calcium channel blocker, beta-blockers, amiodarone, adenosine or other agents that preferentially block AV node and not accessory pathway.

26.2

A 64-year-old male is admitted to the ICU following coronary artery bypass surgery. His rhythm strip and central venous pressure waveform is shown below in Figure 2.

Give the likely cause of the abnormality shown. (20% marks)

**Answer Template**

Epicardial (atrial & ventricular) pacing leads reversed.

26.3

- a) Describe the ECG shown in Figure 3. (20% marks)
- b) List four conditions that are associated with the axis abnormality seen in this ECG. (10% marks)

**Answer Template**

- a) Rightward QRS axis  
Peaked P waves in the inferior leads > 2.5 mm (P pulmonale) with a rightward P-wave axis (inverted in aVL)  
Clockwise rotation of the heart with a delayed R/S transition point (transitional lead = V5).  
Right ventricular hypertrophy criteria present  
Right axis deviation of +110° or more.  
Dominant R wave in V1 (> 7 mm tall or R/S ratio > 1).  
Dominant S wave in V5 or V6 (> 7 mm deep or R/S ratio < 1).  
QRS duration < 120 ms (i.e. changes not due to RBBB).  
Right ventricular strain pattern = ST depression / T wave inversion in the right precordial (V1-4) and inferior (II, III, aVF) leads.  
Deep S waves in the lateral leads (I, aVL, V5-V6).
- b) Right ventricular hypertrophy  
Left posterior hemi block  
Lateral myocardial infarction  
Acute right heart strain  
Drug toxicity (e.g. TCAs)

Pass rate	49%
Highest mark	8.9

## Question 27

Outline the strategies, with the rationale, to reduce the likelihood of secondary neurological injury after brain trauma. Give the specific parameters/targets where appropriate.

### Answer Template

Strategy	Rationale
Endotracheal intubation	Prevention of hypoxaemia by preventing airway obstruction and/or aspiration, facilitates mechanical ventilation
Controlled mechanical ventilation <ul style="list-style-type: none"> <li>O<sub>2</sub> saturation &gt;95%</li> <li>PaCO<sub>2</sub> 32 – 38 mmHg (4.2 – 5.0 kPa)</li> </ul>	Avoidance of hypoxaemia, Avoidance of hypercarbia which can lead to cerebral vasodilation and increased ICP Avoidance of hypocarbia with consequent cerebral vasoconstriction and relative ischaemia
Cervical spine immobilisation	Cervical spine injury is commonly associated with traumatic brain injury
Maintain an adequate blood pressure <ul style="list-style-type: none"> <li>Systolic BP &gt;110</li> <li>MAP 80-120 if CPP measured and ICP&gt;20</li> </ul>	Hypotension is associated with poorer neurological outcome Hypovolaemia is common in trauma patients due to associated injuries
Avoid the use of albumin for fluid resuscitation	Albumin is associated with poorer outcomes in patients with TBI
Avoid cerebral venous hypertension <ul style="list-style-type: none"> <li>Care with ETT tapes</li> <li>C-spine collars</li> <li>Elevate head of bed 30-45°</li> </ul>	Obstructed venous drainage can contribute to intracranial hypertension
Maintain normothermia <ul style="list-style-type: none"> <li>Temperature 36-37°</li> </ul>	Elevated temperature increases cerebral metabolic demand Hypothermia has not yet been shown to be associated with improved outcomes
Maintain normoglycaemia <ul style="list-style-type: none"> <li>BSL 6-10 mMol/L</li> </ul>	Hypoglycaemia exacerbates cerebral injury
Avoid hyponatraemia <ul style="list-style-type: none"> <li>Na 140-145 mMol/L</li> </ul>	Hyponatraemia can contribute to cerebral oedema and raised intracranial pressure
Early detection of surgically correctable secondary lesion <ul style="list-style-type: none"> <li>ICP monitoring</li> <li>Low threshold for repeat CT scan if deterioration in clinical neurological state</li> </ul>	Early identification of a surgically correctable lesion <ul style="list-style-type: none"> <li>Reaccumulation of extra-axial collection</li> <li>Hydrocephalus</li> <li>New intraparenchymal haemorrhage</li> </ul> Surgical intervention may prevent further neurological damage
Monitoring of and treatment for intracranial hypertension <ul style="list-style-type: none"> <li>ICP &lt;20</li> </ul>	Strategies to treat intracranial hypertension (in addition to those mentioned above) <ul style="list-style-type: none"> <li>Sedation</li> <li>Neuromuscular paralysis</li> <li>Induction of mild hyperosmolar state</li> </ul>
Detect and treat seizures	Convulsive and non-convulsive epileptic seizures, increase cerebral metabolic demand

Pass rate	90%
Highest mark	7.75

## Question 28

Outline the differences in the assessment and management of poisoning from substance ingestion in the following clinical scenarios, compared with a healthy young adult:

- a) 2-year-old child. (30% marks)
- b) 30-week gestation pregnant female. (35% marks)
- c) 75-year-old adult with chronic kidney disease. (35% marks)

### Answer Template

#### a) 2-year-old child

- Ingested agent likely to be non-pharmaceutical
- Vast majority of ingestions are benign
- Other children may be affected (siblings, playmates)
- Doses ingested likely to be small (2-3 tablets or small handful) and toxic effects mg/kg the same as adults but some agents can be potentially lethal for a toddler if even 1-2 tablets taken (e.g. amphetamines, Ca channel blockers, sulphonylureas) or a mouthful (e.g. organophosphate insecticides, eucalyptus oil, one mothball)
- Unlikely to obtain accurate dosing history – risk assessment and management based on “worst-case scenario”
- Need admission to health care facility with resources for paediatric resuscitation
- Regular check of blood sugar levels
- Usual toxicology screening tests for adult patient not necessary
- GI decontamination with activated charcoal is not routine because of increased risks with aspiration – reserved for severe or life-threatening poisoning where supportive care or antidote treatment alone is inadequate
- If severe intoxication suggesting large, repeated or unusual exposure, consider NAI

#### b) 30/40 pregnant female

- Risks to mother and foetus
- Pregnancy-induced physiological changes impact on drug pharmacokinetics
  - Delayed gastric absorption and GI transit time slows drug absorption and increases period of potential benefit for decontamination
  - Increased blood volume increases  $V_D$  and decreases drug plasma levels
  - Dilution of plasma proteins increases free drug levels
  - Hepatic enzyme systems altered by circulating hormones
  - Increased cardiac output increase renal blood flow and GFR
  - Hypovolaemia and respiratory compromise may go unrecognised until at a late stage
- A few agents pose increased risk to foetus and treatment threshold is lowered (e.g. salicylates, CO, lead, MetHb-inducing agents)
- Excellence in supportive care for the mother ensures best outcome for foetus
- Obstetric and neonatal as well as toxicology input needed including decision for emergency delivery of baby.

#### c) 75-year-old with CKD

- Limited physiological reserve, deteriorating cognition, multiple co-morbidities and polypharmacy lead to exaggerated and unpredictable response in poisoning
- More severe clinical course for same dose of same agent taken by healthy young adult

- Pharmacokinetic changes with ageing and CKD
  - Delayed GI absorption
  - Decreased protein binding and increased free drug levels
  - Reduced liver function with decreased drug metabolism
  - Reduced renal function and reduced elimination
  - Baseline CKD likely to be made worse
  - “Therapeutic” drug doses may be toxic
- Pharmacodynamic differences from drug effects on impaired organs e.g. poor ability to respond to CVS, respiratory and CNS depressant agents
- Greater incidence of complications e.g. delirium, pneumonia, thrombo-embolism
- Longer ICU and hospital stay

Pass rate	0%
Highest mark	4.75

### Question 29

List the pathophysiological changes, system by system, associated with end-stage kidney disease (dialysis dependent), and briefly explain how these may impact on the management of critically ill patients.

### Answer Template

<b><i>Pathophysiological change</i></b>	<b><i>Management implications</i></b>
<b>Respiratory:</b> Prone to pulmonary oedema	Fluid restriction/ positive pressure ventilation as needed
<b>Cardiovascular:</b> Hypertension Dyslipidaemia, Atherosclerosis, Pericarditis	Appropriate drug therapy, aim higher MAP targets based on baseline BP Monitor for pericardial effusion
<b>Neurological:</b> Dialysis disequilibrium Polyneuropathy and myopathy	Low dose dialysis to prevent rapid shifts
<b>Renal:</b> Low/no urine output	Fluid prescribing/restriction, nutrition depends on dialysis plan
<b>Metabolic:</b> Hyperkalaemia  Metabolic acidosis	K <sup>+</sup> restriction, Caution with K-sparing drugs (ARBs, ACE-Is, Spironolactone) May be worsened by critical illness
<b>Mineral &amp; Bone disorders:</b> Secondary hyperparathyroidism, Hyperphosphataemia, Hypocalcaemia	Phosphate restriction/binders, Calcitriol and calcium supplementation, Care to prevent fractures
<b>Gastrointestinal:</b> Impaired gastrointestinal motility Peptic ulceration & bleeding Malnutrition	Aspiration risk, enteral feeding difficulty Stress ulcer prophylaxis Early feeding
<b>Skin:</b> Fragile skin	Meticulous pressure area care
<b>Haematological:</b> Anaemia Platelet dysfunction (uraemic)	Appropriate transfusion, EPO Bleeding risk, DDAVP may have a role



<b>Immunological:</b> Increased risk of infection	Antimicrobial prophylaxis/therapy as appropriate
<b>Endocrine:</b> Thyroid dysfunction	Difficult to interpret TFTs during critical illness
<b>Pharmacological:</b> Altered clearance of renally excreted medications	Dose adjustment based on GFR, dialysis regime
<b>Vascular access:</b> <input type="checkbox"/> Fistulas used for dialysis may complicate CVC and arterial access	Consider choice of site avoiding site of fistula, Monitor fistula function during critical illness

Pass rate	29%
Highest mark	6.5

### Question 30

30.1

A 52-year-old male diabetic presents with a week-long history of fever, headache, confusion, facial nerve palsy with pain and a black, purulent nasal discharge. He is referred to Intensive Care for his deteriorating level of consciousness.

- b) Give the most likely diagnosis. (20% marks)
- c) List four predisposing factors. (10% marks)
- d) List the specific management of this condition. (40% marks)

### Answer Template

- a) Rhinocerebral mucormycosis or fungal sinus infection with cerebral spread.
- b) HIV/AIDs  
Diabetes  
Cancer – lymphoma  
Renal failure  
Organ transplantation  
Long term steroid or immunosuppressive therapy  
Cirrhosis  
Deferoxamine therapy  
Iron overload  
Burns
- c) Investigation with MRI or CT to determine the extent of the spread.  
Blood culture and biopsy to obtain tissue for fungal culture +/- Surgical debridement if amenable  
Amphotericin B  
Possibly hyperbaric oxygen therapy.

30.2

65-year-old female with rheumatoid arthritis has been admitted to ICU with an acute confusional state following a two-day history of fever and headache.

Investigations reveal:

Blood culture: Gram-positive bacilli at 24 hours.

- a) Give the most likely causative organism (10% marks)
- b) Give the specific therapy for this condition (10% marks)
- c) List three risk factors for this condition (10% marks)

### Answer Template

- a) Diagnosis:  
Listeria monocytogenes
- b) Treatment:  
Benzylpenicillin 2.4 g IV, 4-hourly  
Or  
Trimethoprim+sulfamethoxazole 160+800 mg IV, 6-hourly (in case of penicillin allergy)
- c) Risk Factors:  
Extremes of age  
Pregnancy  
Immunosuppression  
Malignancy

Pass rate	66%
Highest mark	8.1

## SECOND PART ORAL EXAMINATION

### Clinicals “Hot Case”

- A 66-year-old male, with a background history of hypertension, who presented with increasing difficulty walking due to a high cervical canal stenosis. He underwent surgery on his upper cervical spine, and post-operatively had ongoing respiratory failure and subsequently a tracheostomy. Findings on examination included; bilateral upper motor neurone signs, normal cranial nerves, probable delirium, recent tracheostomy.

Candidates were asked to assess his neurology and outline a management focus for the day.

Discussion points included the interpretation of his neurological findings, interpretation of his chest x-ray, a discussion of the implications of his neurological findings with respect to his respiratory weaning.

- A 43-year-old female, previously well who presented with a WFNS grade IV subarachnoid haemorrhage from a basilar tip aneurysm. She had a complicated course, developing an ileus, and subsequent bowel perforation, and recurrent intraabdominal sepsis. Examination findings included ventilation via a tracheostomy, clear sensorium, global weakness and depressed reflexes in keeping with critical illness polymyoneuropathy, an open abdomen with a VAC dressing and ileostomy. She was febrile at 39°C.

Candidates were asked to assess her with regards to why she had an ongoing ventilation requirement.

Discussion points included complications of high grade SAH, interpretation of her neurological signs, and interpretation of an abdominal CT scan showing evidence of a perforated viscus, cause and treatment of fever.

- 62-year-old male, background of paroxysmal AF, now day 11 in the ICU following a high speed motor vehicle collision (car v tree). He had multiple injuries. On examination he had a GCS 3, with only low dose opiate, a chest drain with an ongoing air leak, ventilated via a tracheostomy, distended abdomen, evidence of surgery to both lower limbs, traction to right leg.

Candidates were asked to examine him to gather information pertinent to discussing his prognosis with his family.

Discussion points included his neurological status, an interpretation of his CT brain and a discussion of diffuse axonal injury, management of his ongoing air leak and management of his respiratory status.

- 52-year-old male with a background of lymphoma, stem cell transplant x 2, graft v host disease and hepatitis C, day 5 in the ICU with acute respiratory failure, acute kidney injury and delirium. Examination findings included jaundice, wasted male, globally diminished reflexes, multiple petechiae, obeying commands or at least localising. He was somewhat dysynchronous with the ventilator.

Candidates were asked to examine him with regards to the contributors to his delirium and consider how they might proceed with his management.

Discussion was regarding the contributors to his delirium, interpretation of the clinical signs, a discussion of the relevant haematology and biochemistry results and interpretation of a CT

chest, as well as contemplation of strategies for liberation from the ventilator.

- A 49-year-old male, day 2 in the ICU with acute delirium. He was admitted to the medical ward a few days prior, had a large volume of ascites drained and then developed acute delirium and was referred to the ICU. Clinical examination revealed signs of chronic liver disease, an ascitic drain still draining clear fluid, haematuria, decreased breath sounds both bases but low FiO<sub>2</sub> requirement.

Candidates were asked to examine him to identify a cause for his delirium and consider the management from an ICU perspective.

Discussion included the interpretation of his clinical signs, the differential diagnosis for his decompensation, the ICU management of delirium and strategies to progress him towards extubation.

- A 39-year-old male, day 11 in the ICU with alcoholic pancreatitis. He has ongoing problems with difficulty with ventilation and acute renal failure requiring dialysis. Examination findings included ongoing sedation and neuromuscular paralysis, ventilation with high inspiratory pressures, bibasal crepitations, oliguria and CVVHDF, distended abdomen with high intra-abdominal pressure (25 mmHg), TPN.

Candidates were asked to identify relevant clinical issues and provide a management plan.

Discussion was around issues regarding the management of abdominal compartment syndrome, measures to improve this patient's ventilation, feeding strategies in acute pancreatitis and interpretation of radiology.

- A 42-year-old male, day 24 in the ICU. He originally presented with abdominal pain and was found to have severe pancreatitis. He now has ongoing high fever. On examination he was ventilated via an oral ETT, had purulent discharge from a recent (surgical) tracheostomy site, distended abdomen and generalised oedema.

Candidates were asked to examine him with regards to the identifying a possible cause of his ongoing fevers.

Discussion was about the cause of his fever. Candidates were asked about the management of severe pancreatitis including the role of necrosectomy. Microbiology results were discussed including the implication of Staph. epi in blood cultures and the management of *C. difficile*.

- A 37-year-old male, who had presented with a severe psychotic episode, requiring ICU admission for a course of electro convulsive therapy (ECT). He had a background history of severe psychotic depression and aggressive behaviour and was known to be positive for Hepatitis C. He was due for a second course of ECT and had developed a fever overnight. Relevant clinical findings included heavy sputum production, respiratory signs, tattoos, and the use of high dose sedation.

Candidates were asked to examine him for a potential cause of the fever.

Discussion points included the causes of fever in ICU patients, diagnosis of ventilator associated pneumonia, and complications of high dose sedation and ECT.

- A 75-year-old male involved in a road traffic accident three days ago. Relevant clinical signs included evidence of delirium, agitation and the use of restraints. Additionally there was a low-grade fever and tachycardia, bruising on the right thigh, tenderness over the right side of the chest, and evidence of chronic airways disease.

Candidates were informed that his spine had been cleared and were asked to examine him from the perspective of his recent trauma, and to identify his management priorities and formulate a management plan.

Discussion points included the management of chest trauma including options for analgesia, the potential plan for extubation and the role of tracheostomy.

- A 78-year-old female, found on the floor at home with a GCS of 6 five days ago, and admitted to the ICU following the insertion of an external ventricular drain. She had a background history of hypertension. Relevant clinical findings included a fever, neck stiffness, upper motor neurone signs in all limbs, up going plantars, absent corneal reflexes, and bloodstained CSF drainage from the EVD.

Candidates were asked to identify her ongoing issues.

Discussion points included a differential diagnosis, the source of the fever, the role of tracheostomy, and the management plan should there be an acute drop in GCS.

- A 58-year-old female who had been in ICU for 18 days. Candidates were informed that she was a traveller from South Korea with a known history of lung disease, and had arrived in Australia in acute respiratory failure. Relevant clinical findings included a thoracostomy tube with an air leak. Additionally there was evidence of sclerodactyly, cachexia and an elevated jugular venous pressure.

Candidates were asked to examine her and assess her progress.

Candidates were asked to comment on investigations including a CXR, CT, CTPA and to give a differential diagnosis. Discussion also included the management of a bronchopleural fistula, failure to wean, nutritional support, and critical care polymyoneuropathy.

- A 54-year-old female who had been in ICU for one month following a meningioma resection. Relevant clinical findings included flaccid tetraplegia, morbid obesity, fever, normal conscious level and cranial nerve examinations, and a vancomycin infusion.

Candidates were asked to examine her, identify the main issues keeping her in ICU and suggest ways to move her forward.

Candidates were also asked to comment on the likely cause of her weakness, (a brainstem infarct following surgery) and suggest relevant investigations. Other discussion points included strategies for weaning, the implications of obesity in critically ill patients and the role and use of tracheostomy speaking valves.

- 54-year-old male day 9 ICU following a complicated course post extensive upper GI surgery for gastric cancer including gastrectomy, distal pancreatectomy, splenectomy and partial resection of the left hemi-diaphragm. He had an acute deterioration the previous day with an anastomotic leak and was taken back to theatre. Clinical findings included cachexia and peripheral oedema, evidence of septic shock, left ICC in the left pleural space and a right abdominal drain with left-sided 'whiteout' on his CXR.

Candidates were asked to give a differential diagnosis for his acute deterioration.

Discussion points included choice of anti-microbial agents, fluid management, management of diarrhoea and assessment of intra-abdominal pressure.

- 65-year-old male who had presented to hospital 2 days earlier with headache, unsteadiness of gait, agitation and confusion on a background of recently diagnosed non-small cell lung cancer with cerebellar metastases. Clinical findings included mechanical ventilation with no spontaneous respiratory effort, GCS E1VTM4 and increased tone left upper limb and up going left plantar reflex. MRI brain showed hydrocephalus and cerebellar tonsillar herniation.

Candidates were asked to assess his neurological state and provide a differential diagnosis.

Discussion points included discussion of the imaging, and management of intra-cranial pressure, ventilation and haemodynamic status.

- 78-year-old male day 8 ICU who presented to the Emergency Department following a collapse at home He had been intubated for airway control and subsequently had been slow to regain consciousness. Significant history included previous CVA, ischaemic heart disease and hypertension. Clinical findings included mechanical ventilation, bronchial breathing left lung, enlarged liver and signs of a right-sided stroke.

Candidates were asked to perform a general examination and report on their findings.

Discussion points included the differential diagnosis, causes of the hepatomegaly and weaning from ventilatory support.

- 39-year-old female day 5 ICU who had presented with respiratory failure requiring ventilation, and a background history of a recent viral illness affecting close family members. On desedation she was found to have a new onset left hemiparesis. Clinical signs included sedation and ventilation in spontaneous mode with CPAP 10 and PS 14, left-sided bronchial breathing and bilateral polyphonic wheeze, GCS E1VTM4, intact cranial nerves, left hemiparesis affecting her arm more than her leg with a physical restraint of her right arm, hyper-reflexia and bilateral clonus, and a heparin infusion with haematuria.

Candidates were asked to assess her for suitability for extubation.

Additional discussion points included review of imaging, the differential diagnosis and further management.

- 55-year-old male, day 1 post coronary artery bypass surgery with background including T2DM, hypertension, ex-smoker and previous coronary stenting. Clinical findings included extubated patient, sternotomy and leg wounds, chest drains with minimal drainage and haemodynamically stable with VVI pacing.

Candidates were asked to assess his suitability for discharge to the ward.

Discussion points included ongoing management of pacing, drains and catheters, post-operative pain management and peri-operative management of thrombocytopaenia.

- 33-year-old male, day 8 ICU, admitted with multi-trauma following a motor-bike v car crash. GCS at the scene was 4/15, systolic BP 90/ and SpO<sub>2</sub> 88%. His injuries included chest trauma, traumatic brain injury, C-spine fractures and intra-abdominal injury. He was intubated with a right-sided ICC and an ICP monitor. He was febrile at 38.6°C. ICPs were labile.

Candidates were asked what they would say to his family with respect to his prognosis.

Additional discussion points related to interpretation of the imaging and management of ICP.

- 79-year-old male, day 5 ICU, had presented with melaena and a background of AF on warfarin. He had a seizure episode on day 2 and now, despite desedation for 3 days, was not waking up. Clinical findings included intubation, the presence of EEG monitoring, jaundice and GCS E1VTM3 with reactive pupils.

Candidates were asked to examine him and assess the reasons for his failure to wake.

Discussion points included interpretation of his CT brain and biochemistry, management of fitting and management of the bleeding patient with a mechanical mitral valve.

- 69-year-old female, day 3 ICU, presented 4 days earlier with severe headache and confusion secondary to aneurysmal sub-arachnoid haemorrhage. Initial attempt at coiling failed and she had had 2 aneurysms clipped the previous day. Clinical findings included intubation, ventilation and sedation, high vasopressor requirements, the presence of renal replacement therapy, nimodipine infusion and an EVD, right hemiparesis with bilateral up going plantar responses.

Candidates were asked to determine the reasons for her current neurological state.

Additional discussion points included interpretation of imaging, management of her vasopressor support, reasons for renal replacement, prognostication and the significance of fever in the context of SAH.

- 55-year-old female, day 1 in ICU, having presented overnight with chest pain, collapse and hypotension secondary to aortic dissection. Echo at presentation and shown aortic regurgitation and a pericardial effusion. She underwent emergency surgery. Clinical findings included intubation and ventilation with FiO<sub>2</sub> 0.8, open sternum, drain losses 100-250 ml/hr and sodium nitroprusside and milrinone infusions.

Candidates were asked to determine the underlying cause for her collapse and comment on her current management.

Additional discussion points included post-operative management of aortic dissection, reasons for her hypoxic state, management of the drain losses and timing of closure of the sternal wound.

## **VIVAS**

### **Viva 1**

You are called to the Emergency Department. A 50-year-old male has been brought in by ambulance with a systolic blood pressure of 65 mmHg. He is confused and his heart rate is 130 beats per minute.

What are the sources of an inaccurate manual blood pressure reading?

*The viva focussed on management of shock states with interpretation of echo images.*

## Viva 2

A 72-year-old male was admitted to ICU five days ago following primary resection and anastomosis of a perforated sigmoid diverticulum. He has a stable vasoactive agent requirement and is receiving empiric antibiotics. Over the last 12 hours he has produced a total of 200 mL of urine, and his creatinine has doubled from baseline to a value of 300 micromol/L.

What is your differential diagnosis for the oliguria and what is your management?

*The viva focussed on the prevention and management of acute kidney injury in the critically ill.*

## Viva 3

Describe the principles of Pressure Control Ventilation.

*The viva focussed on modes and settings of mechanical ventilation.*

## Viva 4

A 23-year-old female is admitted to your Intensive Care Unit following a seizure at work.

A collateral history suggests that she had been acting unusually for a few days before she was seen to collapse this morning with a tonic-clonic seizure. Midazolam 5mg IV was administered by the paramedics but she continued to seize.

In the emergency department she was given additional midazolam IV (2 mg, 5 mg, 5 mg) and was loaded with Levetiracetam (1g IV). After 20 minutes she continued to have sporadic seizure activity with a best Glasgow Coma Scale of 6 and a decision was made to intubate her (Propofol 180 mg and Rocuronium 100 mg).

She has arrived in your unit on a Propofol infusion at 20 mg/hr. She is ventilated on SIMV with SpO<sub>2</sub> 100% on FiO<sub>2</sub> 0.3. Mean arterial pressure is 75 mmHg on no supports and she is warm and well perfused.

Outline your approach to her care over the next 12 hours?

*The viva focussed on the management of refractory status epilepticus.*

## Viva 5

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

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

Temperature	39.5°C
Respiratory rate	30 breaths/min
SpO <sub>2</sub>	92% on 15 L/min oxygen via a reservoir mask
Heart rate	120 beats/min (atrial fibrillation)
Blood pressure	88/48 mmHg



She is icteric, has right upper quadrant tenderness and is mildly confused.

What is your differential diagnosis?

*The viva focussed on the management of biliary sepsis*

### **Viva 6 – Procedure**

An obese 65-year-old male has been ventilated in your ICU for 10 days with severe community acquired pneumonia. A decision has been made to perform a tracheostomy.

Describe the preparation, including the indications and contraindications and equipment you require prior to commencing a percutaneous tracheostomy procedure in your ICU.

### **Viva 7 – Radiology**

*The viva comprised 3 Chest X-rays and 3 CT scans (one with an accompanying echo image) for interpretation.*

*Candidates spend the two-minute reading time reviewing the images as they wish.*

### **Viva 8 – Communication**

Leona, a 38-year-old female, who is 16 weeks pregnant, was admitted to ICU with grade 5 sub-arachnoid haemorrhage (SAH) 2 weeks ago. Foetal monitoring has been reported to be normal during this time. Her stay has been complicated by severe vasospasm and her latest CT brain scan shows a hemispheric infarct. She has been off sedation for 48 hrs.

Since 0600 hr this morning her pupils have been 5 mm and fixed. She has no observed cough, gag or spontaneous respiratory effort.

The Neurosurgeons have recommended palliation.

You are the ICU Consultant In-charge for her care. Her partner and her partner's sister are anxiously waiting to talk to you.