COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

SECOND PART EXAMINATION

EXAM REPORT AUGUST / OCTOBER 2014

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. Candidates should discuss the report with their tutors so that they may prepare appropriately for future examinations.

The exam comprises a written section and an oral section. The written exam consists of two 2.5hr 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 clinicals "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 four previous exams is provided.

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

Overall Performance	**October 2014**	**May 2014**	**October 2013**	**May 2013**	**October 2012**
Presenting for written (Including OTS)	53	35	53	27	43
Carrying a pass from a previous attempt	3	8	11	7	13
OTS Exempt	0	0	0	0	0
Total number presenting (written + carry + OTS)	56	43	64	34	55
Invited to orals (>50% in written section)**	40	15	28	18	29
Total number invited to oral section	43	23	39	25	42

Analysis of Performance in Individual Sections	October 2014	May 2014	October 2013	May 2013	October 2012
Successful in the written section	40/53 75%	15/35 43%	28/53 53%	18/27 67%	29/43 67%
Successful in the Hot Case section	21/42 50%	15/23 65%	22/39 56%	9/25 36%	21/41 50%
Successful in both Hot Cases	12/42 29%	6/23 26%	10/39 26%	7/25 28%	10/41 24%
Successful in the Viva section	25/42 60%	22/23 96%	30/39 77%	15/25 60%	36/41 86%

Sectional Pass Rates	October 2014		May 2014		October 2013		May 2013	
	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark	Pass rate	Highest individual mark
Hot Case 1	36%	88%	43%	70%	54%	80%	52%	75%
Hot Case 2	57%	85%	61%	85%	49%	90%	44%	90%
Viva 1	76%	95%	91%	85%	56%	70%	48%	75%
Viva 2	90%	92%	83%	90%	85%	90%	88%	81%
Viva 3	31%	78%	61%	89%	62%	90%	56%	75%
Viva 4	55%	90%	87%	85%	85%	95%	52%	76%
Viva 5	86%	100%	87%	85%	54%	80%	60%	90%
Radiology Viva	2%	61%	74%	90%	72%	100%	64%	83%
Communication Viva	24%	85%	61%	94%	49%	87%	44%	88%
Procedure Viva	48%	80%	78%	100%	79%	76%	20%	98%

Oral Section Pass Rates	October 2014	May 2014	October 2013	May 2013	October 2012	May 2012
Candidates who scored >50% in written section and passed the overall exam	20/40 **50%**	15/15 **100%**	18/27 **67%**	11/18 **61%**	24/29 **83%**	19/26 **73%**
All candidates invited to oral section and passed the overall exam (written + carry + OTS)	22/42 **52%**	19/23 **82%**	28/39 **72%**	13/25 **52%**	31/42 **74%**	20/37 **54%**
Overall Pass Rate	22/55 **40%**	19/43 **44%**	28/64 **44%**	13/34 **38%**	31/56 **55%**	20/52 **38%**

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 invasive pulmonary aspergillosis, SSEPs, management of confusion and fever in a young woman post-partum and management of respiratory failure in a patient with an anastamotic leak post-oesophagectomy.

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 seems that candidates do not always read the questions carefully and thoroughly. Candidates are also reminded to include in their answer only information that is relevant to the question and to make sure their writing is legible.

Candidates who failed the written section passed an average of 12/30 questions compared with candidates scoring >50% and gaining an invitation to the oral section, passing an average of 20/30 questions.

Hot Cases

The overall pass rate for the Hot Cases was lower than the previous exam but representative of the mean pass rate for recent exams. *Comments expressed by the examiners, relating to candidates' performance in the Hot Cases, included the following:*

- Candidates should address and answer the question asked of them at the start of the hot case.
- Candidates need to interpret and synthesise information as opposed to just describing it.
- 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 or sometimes even possible.
- 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.
- The seeking of information relevant to the case.
- Ability to interpret and synthesise their findings appropriately
- 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
- Overall performance at the expected level (competent Senior Registrar / 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 and/or on review of imaging
- Asking a large number of questions at the start of the case, of which many are 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
- Poor interpretation of imaging and data
- Limited discussion as a consequence of missed clinical signs and incomplete differential diagnosis
- Inability to confidently answer the question "What would *you* do?"
- Inability to convey the impression that he/she could safely take charge of the unit

Candidates are advised that they should not sit the Second Part Examination until they can confidently examine patients, present the relevant clinical findings and discuss management issues at the appropriate level, **i.e. demonstrate that they are capable of safe, effective, independent practice as a competent Senior Registrar / Junior Consultant.** Candidates are also encouraged to practise examination of individual systems.

Vivas

The pass rate for the vivas was lower than the previous exam but comparable with other recent exams. Four vivas had a pass rate less than 50%; Viva 3 (therapeutic hypothermia post cardiac arrest), and the radiology, procedure and communication stations. Examiners' comments relating to these vivas were as follows:

Viva 3

There appeared to be some confusion about temperature management post cardiac arrest and prognostication and candidates were reluctant to commit to a course of action.

Viva 6 – Procedure Station

Candidates were unable to demonstrate correct use of PPE for droplet precautions.

Viva 7

Candidates missed or misinterpreted key findings and appeared unfamiliar with reviewing standard images.

Viva 8 – Communication Station

It was noted that, although candidates demonstrated empathy, in some cases the conversation lacked direction and did not address the key issues, leaving the next-of-kin confused.

SECOND PART WRITTEN EXAMINATION

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

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

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

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

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

GLOSSARY OF TERMS

Critically evaluate:	Evaluate the evidence available to support the hypothesis.
Outline:	Provide a summary of the important points.
List:	Provide a list.
Compare and contrast:	Provide a description of similarities and differences (E.g. Table form).
Management:	Generic term that implies overall plan. Where appropriate, may include diagnosis as well as treatment.
Discuss:	Explain the underlying key principles. Where appropriate, this may include controversies and/or pros and cons

NOTE

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

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

Question 1

You are asked to review a 47-year-old male in the Emergency Department with hypotension that has not responded to rapid infusion of 2 litres intravenous crystalloid. On examination his temperature is 40^{o}C, he is warm peripherally with a respiratory rate of 24 breaths per minute, an arterial oxygen saturation of 98% on room air, a heart rate of 140 beats per minute, and a blood pressure of 80/40 mmHg with an arterial lactate concentration of 6 mmol/L.

Describe the steps for the initial haemodynamic management of this patient, including a brief discussion of the underlying evidence for each step.

Answer Template

Step 1

Initial fluid resuscitation

Give more volume 1000 – 2000 ml or 20 ml/kg up to minimum 30 ml/kg in total

Evidence:

Surviving sepsis guidelines recommendation

Rivers et al EGDT study although ProCESS (NEJM May 2014) showed no outcome benefit from protocolised care in septic shock

Usual care in ICU based upon physiological reasoning with relative volume depletion due to vasodilation in sepsis

Avoid starch
Evidence:
6S and CHEST studies

Probably just use crystalloid (0.9% NaCl or Hartmanns)
Evidence:
SAFE – no difference with albumin or crystalloid

Consider 4% albumin
Evidence:
SSG recommendation for refractory hypotension in sepsis

Blood transfusion if bleeding/low haemoglobin
Evidence:
Rivers EGDT recommend target haematocrit 30%
SSG aim for haemoglobin 70-90 g/L
TRICC and Patient Blood Management Guidelines recommend transfusion trigger at Hb <70 g/L

Step 2
Assess response and need for more fluid
Monitoring:
Clinical reassessment after fluid bolus; HR, BP, peripheral perfusion, urine output
Lactate clearance
Evidence:
SSG recommends ongoing fluid resuscitation according to response using dynamic or static variables
Jones et al JAMA 2010 lactate clearance had no additional benefit in addition to $ScvO_2$ for guiding resuscitation in sepsis

Arterial line and target MAP >? 60 mmHg ? 65 mmHg
Evidence:
Asfar et al NEJM Mar 2014 no outcome benefit in 65-75 mmHg MAP v 80-85 mmHg MAP except higher MAP with pre-existing hypertension had less renal replacement therapy but more atrial fib

CVC and target CVP >8-12 mmHg
Evidence:
Convention but no good evidence (Marik meta-analyses 2008 and 2013)
EGDT/SSG recommends CVP >8-12 but very controversial regarding use of static pressure measurements to determine fluid responsiveness.

Use of dynamic measure of fluid responsiveness
E.g. Passive leg raising, PPV, echo
Evidence:
Many small physiological studies but no large RCTs with patient oriented outcomes to guide practice

$ScvO_2$ or SvO_2
Evidence:
$ScvO_2$ in SSG / supported by RCT evidence. SvO_2 requires PAC and not commonly used in this particular scenario

PAC and PAOP
Evidence:
PAC-Man study and Connors SUPPORT study JAMA 1996 - PA catheters do not improve / may worsen outcome

Step 3
Commence vasopressors

If hypotensive and not responsive to further filling will need vasopressor, probably noradrenaline as first line, but adrenaline probably acceptable

Evidence:

SSG/ EGDT study

CAT study showed no real difference in outcomes with adrenaline v noradrenaline

Step 4
Consider adequacy of cardiac output

Consider Echo, ScvO2, SvO2, PiCCO or other measure of cardiac output

If low consider inotrope as well as vasopressor - either dobutamine or adrenaline

Evidence:

Low cardiac output (absolute or relative) is common in sepsis, inotropic support recommended in SSG and in the EGDT resuscitation algorithm

PAC-Man and SUPPORT study

Step 5
Refractory hypotension

Consider vasopressin 0.03 u/min

Evidence:

VASST study NEJM 2008 did not demonstrate an improvement in outcome with additional vasopressin in patients receiving low dose noradrenaline.

Not recommended as first line vasopressor

If hypotensive following fluid resuscitation and vasopressors, consider hydrocortisone 200mg daily.

Evidence:

Very mixed evidence to use of steroids (Annane JAMA 2002 - Pro) and CORTICUS NEJM 2008 - No support for hydrocortisone). Erring to no benefit. Awaiting results of ADRENAL ANZICS CTG study

Pass rate	43%
Highest individual mark	7.5

Additional Examiners' Comments:
Candidates omitted resuscitation end-points and assessment of fluid responsiveness. Some candidates did not describe the management of septic shock

Question 2

A 42-year-old male presented with a stroke. He was admitted to a general ward with a right-sided hemiplegia, neglect and speech deficits.

The day following admission, you are called to the ward because the patient has just become drowsy, and is no longer following commands. The team has performed a CT scan of the head and this shows extensive left middle cerebral artery territory infarction, with no haemorrhage, and early evidence of raised intracranial pressure.

a) Outline your initial plan of management.

The family asks if there is any surgical option to "save" the patient.

b) What is the evidence for surgery in this situation, and how would you advise the family?

Answer Template

a)
The patient should be admitted to an intensive care or stroke unit for close monitoring and comprehensive treatment.

Transfer to a higher level centre is reasonable if comprehensive care and timely neurosurgical intervention is not available locally.
Maintain SpO_2 >95% - any safe comments or values.
Intubate if usual concerns regarding airway protection in neurologically impaired patient.
"Safe" blood pressure (Extreme hypertension associated with haemorrhagic transformation.
Concerned about malignant brain swelling with possible temporal herniation and the need to reduce the space occupying effects of that swelling.

a) Elevate the head of the bed to 30°.
b) Do not hyperventilate $PaCO_2$ 35-40 mmHg
c) Increase levels of sedation +/- paralysis:
d) Barbiturate infusion – option, but not advocated in guidelines.
e) Osmotic therapy:
    a. 3% Saline 100-200mL aliquots; Na^+≤155mmol/L
    b. Mannitol 0.5-1.0g/kg
    c. Aim for serum Osm 300-320mOsm/L
f) Target normoglycaemia
g) Hypothermia- temperature 35-36.5^oC
    a. Prospective randomized studies are currently underway to further evaluate therapeutic hypothermia in patients with cerebral infarcts.

b)
Evidence

a. Three prospective, randomized trials (i.e. DESTINY, DECIMAL and HAMLET)
    - Supratentorial infarctions treated with decompressive craniectomy, usually within 48 hours of stroke onset. Age <60. Older populations being currently studied.
    - With hemicraniectomy compared with medical management:
        - Reduced mortality (22% versus 71% - pooled analysis)
        - No individual study showed an improvement in the percentage of survivors with good outcomes (mRS score, 0–3),
            - Only shown in a pooled analysis (43% versus 21%).
            - Only 14% of surgical survivors could look after their own affairs without assistance (mRS score, 2)

Note:
Names / excessive detail of studies not expected

Advice

I. The patient's age <60 fits the studies' inclusion criteria
II. Decompressive craniectomy for supratentorial infarction with swelling results in a reproducible large reduction in mortality.
    - But mortality after large ischaemic strokes with cerebral oedema remains between 20% & 30% despite medical and surgical interventions.
    - Nearly all post-surgery survivors suffer residual permanent disabilities:
        - One half are severely disabled
        - A third are fully dependent on care
        - 50% will suffer from depression
III. There may be a discrepancy between physical disability and quality of life, with many patients and families rating a good quality of life despite severe functional handicap. Ultimate advice and decisions will be based on a balance between survival and level of disability.

Pass rate	45%
Highest individual mark	7.25

Additional Examiners' Comments:
Candidates did not accurately read the question. Answers re advice to the family were not at the required level of sophistication

Question 3

3.1

With regards to antibiotic dosing:

Look at the diagram below, representing antibiotic drug concentration versus time, and answer the questions below:

Diagram omitted

a) **What does "A" represent? Name one class of antibiotic for which this is important with regards to dosing.**

b) **What does "B" represent? Name one class of antibiotic for which this is important with regards to dosing.**

c) **What does "C" represent? Name one class of antibiotic for which this is important with regards to dosing.**

Answer Template

a)
C_{MAX}: Maximum concentration
Aminoglycosides

b)
AUC > MIC: Area under the curved where drug concentration is greater than MIC
Quinilones

c)
T>AUC above MIC: Time greater than Area under the curved where concentration is greater than MIC
Penicillins, Carbenepenems

3.2

Look at the diagram below, representing antibiotic drug concentration against time. Curves D and E represent concentrations after regular bolus administration of the same dose of an antibiotic to the same patient at different points of time.

Diagram omitted

a) **What pharmacokinetic changes are demonstrated in D and E?**

b) **List the clinical conditions that could explain the difference between E and D.**

Answer Template

a)
PK changes – Increased plasma concentrations with E relative to D for the same dose indicating reduced clearance and increased half-life.

b)
Hepatic dysfunction
Renal dysfunction

3.3

List the factors that result in failed resolution of sepsis despite antibiotic therapy.

Answer Template

Wrong antibiotic choice
Delayed administration of antibiotics
Inadequate source control
Inadequate antimicrobial blood levels
Inadequate penetration of the antimicrobial to the target site,
Antimicrobial neutralization or antagonism,
Superinfection or unsuspected secondary bacterial infection,
Non-bacterial infection
Non-infectious source of illness

Pass rate	94%
Highest individual mark	9.25

Question 4

With respect to open or video-assisted thorascopic surgical lung biopsy in the management of respiratory failure in the critically ill, discuss the indications, advantages, limitations and complications.

Answer Template

<u>Indications</u>
Not common.
Usually performed in setting of progressive and non resolving respiratory failure/ARDS where no aetiologic diagnosis has been reached by conventional testing such as:

- Radiological techniques
- Microbiological/serological/histological examination of sputum and secretions
    - Bronchoscopic samples required
- Radiologically guided (CT or ultrasound) biopsies
- Serological testing

Decision to perform lung biopsy based on:
The need to make a specific diagnosis and thereby direct specific treatment
With-hold potentially harmful or ineffective empiric treatment when other investigations including biopsy obtained by less invasive techniques have been inconclusive
Provide important prognostic information

<u>Diagnostic/therapeutic advantages</u>
May be useful in identifying a range of potentially treatable pathologies

- Infectious
    - Bacterial
    - Viral
    - Fungal
    - Other e.g. PJP
- Inflammatory
    - COP (cryptogenic organising pneumonia aka BOOP)
    - Other interstitial pneumonias
    - Connective tissue disease
    - Capillaritis etc.

May diagnose other less treatable pathologies that may alter directions of treatment (limitation of care or palliation)

- Malignant disease
- Fibrotic disease e.g. IPF
- Other : e.g. veno-occlusive disease

Potentially avoid administration of high dose steroids or other potent immunosuppressants if concern exists about a possible infectious aetiology.
Also may allow cessation of unnecessary/toxic anti-infective medications.

- However, if all such treatments are initiated empirically then it is often argued that the procedure is unnecessary (see "limitations" below)

Obtain larger and/or multiple samples
Ability to treat co-existing pathology e.g. perform pleurodesis, drain empyema simultaneously

Limitations

May be difficult to know where best to biopsy (especially if radiology unhelpful) or the most likely useful area may be inaccessible to the surgeon.
May not give useful diagnostic information especially if not performed early enough,
If all treatment modalities are administered empirically, the value of the test is debatable.

Potential complications

General
Bleeding, infection, poor wound healing etc.

Specific
Increased analgesia requirements post open procedure
Pneumothoraces (persistent/tension etc.)
Persistent air leak (may be prolonged >7 days)(difficult to treat): **most common Cx**
Haemothorax, massive haemorrhage, pseudotamponade, circulatory collapse
Serous effusions, empyema
Need for single lung ventilation during surgery (VATS)

- Respiratory decompensation intra/post procedure

Death

May not obtain adequate sample

Summary statement *(for example)*
There is no high-grade evidence for its utility in this context. However, there are multiple case series in the literature that describe high rates of specific diagnostic yield (65-95%), with results leading to treatment alterations in the majority of cases (42 – 89%). All series had a low serious complication rate, and air leaks were the commonest complication.

Pass rate	79%
Highest individual mark	8.0

Additional Examiners' Comments:
Some candidates misread the question as 'compare and contrast'
Overall well answered

Question 5

Outline the important anatomic features that affect airway management in the paediatric airway and, where appropriate, strategies that may be used to overcome these.

Answer Template

- **Prominent occiput** - Causes some neck flexion in the supine position. This can interfere with attempts to visualize the glottic opening during laryngoscopy. Placing a towel roll under the shoulders can improve airway alignment.
- **Large tongue** - Infants and young children have large tongues relative to the size of the oral cavity. Can cause airway obstruction and interfere with laryngoscopy.
- **Larger tonsils and adenoids** - Can cause airway obstruction. Placement of nasal airway may cause bleeding and aspiration.

- **Superior laryngeal position** - located opposite the C3 to C4 vertebrae, compared with the C4 to C5 in adults. Visualization of glottis more challenging.
- **Large, floppy epiglottis** - the epiglottis projects into the airway and covers more of the glottis. A straight blade needed to directly lift the epiglottis for improved visualisation during direct laryngoscopy.
- **Short trachea -** The short trachea predisposes to right endobronchial intubation or inadvertent extubation. Use of formula (age/2 +12 cm from lower lip) to estimate tube length. Special attention to fixation.
- **Narrow trachea** - Small decreases in the airway size from secretions, oedema, or external compression will cause obstruction. The needle or surgical cricothyroidotomy technically challenging in infants and children. (0.5)
- **Anatomic subglottic narrowing** - this narrowing can create an effective anatomic seal without the need for a cuffed ETT. Foreign bodies can become lodged below the cords.

Pass rate	87%
Highest individual mark	9.0

Additional Examiners' Comments:
Some candidates did not read the question thoroughly and did not include strategies in their answer

Question 6

Note: All images omitted.

6.1

A 45-year-old man presents to the Emergency Department with worsening shortness of breath. His ECG is shown below.

a) Describe the main ECG abnormality?

Answer Template

- Deep symmetrical inverted T waves in V2-V4

b) What is the likely lesion?

Answer Template

- Critical stenosis of the LAD

c) What cardiac management is required?

Answer Template

- Coronary angiography + / - stenting
- Anti-platelet therapy
- Anti-coagulation
- Beta-blockade
- ACE inhibitor
- Statin

6.2

A 25-year-old male presents to hospital with atypical chest pain. His ECG is shown below.

a) Describe the ECG abnormalities?

Answer Template

- Widespread concave ST elevation, most prominent in the mid- to left precordial leads (V2-5)
- Notching or slurring at the J-point
- Prominent, slightly asymmetrical T-waves that are concordant with the QRS complexes

b) What are the most likely differentials in this patient for these ECG changes?

Answer Template

- Pericarditis
- Benign early replolarisation

6.3

A 50-year-old female presents to hospital having been involved in a motor vehicle crash. She was the driver and was trapped by the legs requiring extrication.

a) Describe the ECG changes?

Answer Template

- Broad complex rhythm, not typical of a BBB pattern.
- Left axis deviation
- Absent P waves

b) What is the explanation for the ECG changes?

Answer Template

- Hyperkalaemia due to rhabdomyolysis

c) What is the immediate pharmacological management?

Answer Template

- Intravenous calcium
- Intravenous sodium bicarbonate
- Salbutamol / dextrose-insulin

Pass rate	62%
Highest individual mark	9.0

Question 7

A 28-year-old Australian aid worker, returns from the Philippines' flood disaster and is subsequently admitted to your ICU. Twelve days following her return she developed fevers, headaches and severe myalgias. This continued for a week, and then improved. Despite feeling weak she remained well for three days before deteriorating again.

On clinical examination the following is evident:

> **She appears unwell, respiratory rate 24 breaths per minute; bibasal crackles on auscultation, heart rate 102 beats per minute, blood pressure 92/45 mmHg, cool peripheries, conjunctival suffusion, and mild meningism. She is confused but with no focal neurological signs.**

Results of investigations are as follows:

Parameter	Patient Value	Normal Adult Range
Haemoglobin	**86 g/L***	**115 – 160**
White blood cell	**21 x 10^9/L with a left shift***	**4.0 – 11.0**
Platelets	**95 x 10^9/L***	**140 – 400**
International Normalised Ratio (INR)	**1.6***	**0.8 – 1.2**
Activated partial thromboplastin time (APTT)	**39 seconds***	**30 – 34**
Creatine kinase (CK)	**3000 U/L***	**< 100**
Urea	**19.0 mmol/L***	**2.1 – 7.1**
Creatinine	**350 µmol/L***	**46 – 90**
Alanine aminotransferase (ALT)	**272 U/L***	**< 34**
Aspartate aminotransferase (AST)	**240 U/L***	**< 31**
Gamma glutamyl transferase (GGT)	**92 U/L***	**< 38**
Alkaline phosphatase (ALP)	**300 U/L***	**42 – 98**
Bilirubin	**87 µmol/L***	**4.0 – 12.0**

a) List the features on the history, examination and results of investigations, given above, that are in keeping with a diagnosis of leptospirosis in this patient.

b) Briefly describe the natural course of this disease.

c) Discuss the specific treatment of this patient for this condition.

Answer Template

a)
Contracted in a flooding tropical environment

1. Biphasic pattern of illness
2. Conjunctival suffusion
3. The combination of hepatitis and renal failure in the setting of a tropical febrile illness.

b)
The natural course of leptospirosis falls into 2 distinct phases:

A. Septicaemic - During this stage, which lasts about 4-7 days, the patient experiences fever, chills, weakness, and myalgias. Other symptoms include sore throat, cough, chest pain, haemoptysis, rash, frontal headache, photophobia, mental confusion, and other symptoms of meningitis.

B. Immune - This stage occurs as a consequence of the body's immunologic response to infection and lasts 0-30 days or more. Aseptic meningitis, renal failure, cardiomyopathy, pulmonary manifestations, uveitis.

During a brief period of 1-3 days between the 2 phases, the patient shows some improvement.

Weil syndrome is the severe form of leptospirosis and primarily manifests as profound jaundice, renal dysfunction, hepatic necrosis, pulmonary dysfunction, and hemorrhagic diathesis - occurs at the end of the first stage and peaks in the second stage.

c)
Penicillin (1.5 million units IV every 6 hours) OR
Doxycycline (100 mg IV twice daily) OR
Ceftriaxone (1 to 2 g IV once daily), OR
Cefotaxime (1 g IV every 6 hours).
The duration of treatment in severe disease is usually seven days.
Initiation of antibiotic treatment may be associated with the Jarisch-Herxheimer reaction (inflammatory reaction to endotoxins released by bacterial lysis)

Use of intravenous corticosteroid therapy has been proposed given the vasculitic nature of severe leptospirosis, particularly in the setting of pulmonary involvement; however there is insufficient evidence for routine use of corticosteroids.

Pass rate	41%
Highest individual mark	8.8

Question 8

a) Define tumour lysis syndrome (TLS).

b) List the risk factors associated with the development of TLS.

c) List the strategies used for the prevention and/or treatment of TLS and provide a rationale for the use of each strategy.

Answer Template

a)
Tumor lysis syndrome (TLS) is an oncological emergency that is caused by massive tumor cell lysis with the release of large amounts of potassium, phosphate, and nucleic acids into the systemic circulation

b)
Tumour-related factors
- High tumour cell proliferation rate or large tumour burden
- Chemo sensitivity of the malignancy
- Transformation to acute leukemia

Patient factors
- Pre-treatment hyperuricemia or hyperphosphatemia
- A pre-existing reduction in renal function
- Volume depletion
- Surgery/Stress
- Steroid treatment

Ongoing Intensive monitoring of electrolyte (K, calcium, phosphate, uric acid, urea creatinine) and fluid status important as part of both prevention and treatment
Justification - significant changes in electrolytes expected - hyperkalemia, hypocalcamia and hyperphosphataemia and early identification of onset of TLS

c)
- Hydration to achieve urine output of at least 1 – 1.5 ml/kg (or 80 to 100 mL/m^2) per hour.
  Justification: To minimize the chance of uric acid precipitation in the renal tubules.

- Avoid potassium and calcium containing fluids and medications
  Justification: To minimize risk of hyperkalemia and calcium phosphate deposits

- Allopurinol in doses ranging from 300 to 600 mg/day
  Justification: To decrease uric acid formation by blocking xanthine oxidase enzyme

- Rasburicase: this is recombinant urate oxidase enzyme that converts uric acid to allantoin (5-10 times more soluble than uric acid).
  Justification: Conversion of uric acid to allantoin makes it more soluble. Rasburicase is particularly useful in patients with pre-existing hyperuricemia.

- Alkalinization of urine e.g. with ural – not a common strategy
  Justification: To convert uric acid to a more soluble urate salt, thereby diminishing the likelihood of uric acid precipitation in the tubules. However, there are no data demonstrating the efficacy of this approach.

<u>Treatment</u>

- Repeated dose of rasburicase
  Justification as before

- Consideration of fluids + diuretic therapy
  Justification as before

- Specific management of hyperkalemia, hypocalcamia and hyperphosphataemia
  Justification – avoid adverse effects and maintain normal physiology

- Haemodialysis, for standard indications; severe electrolyte abnormalities, oliguria, fluid overload, acidosis.
  Justification: Removes metabolites accumulated as a result of renal failure and also lowers uric acid levels very effectively

Pass rate	75%
Highest individual mark	9.5

Question 9

A 65-year-old male with a background history of chronic obstructive pulmonary disease has been ventilated for ten days for respiratory failure related to community-acquired pneumonia. He develops a new fever and a sputum sample is positive for *Aspergillus* spp.

a) Discuss the difficulties in confirming a diagnosis of invasive pulmonary aspergillosis (IPA) in this patient.

b) What findings on history and examination are associated with increased risk of IPA?

c) What investigations are used to confirm a diagnosis of IPA?

Answer Template

a)
Inavsive pulmonary aspergillosis is an important diagnosis to make as the mortality of the disease is high.
In ICU patients it is more difficult due to;

- symptoms and signs difficult in these patients
- classic radiology signs difficult in ventilated patients
- biopsy often not able to be done
- Occurs in immune competent patients where there may be a low index of suspicion for this diagnosis

Colonisation is common in patients, and so distinguishing colonisation from invasive disease may be difficult

b)
Background history

- Neutropenia > 10 days and immunosuppressed
- HIV,
- Haematological or oncological malignancy treated with cytotoxics
- Congenital or acquired immunodeficiency
- Prolonged steroid use,
- Chronic airflow limitation
- Bone marrow transplant,
- Cirrhosis or acute hepatic failure,
- Solid organ transplant,
- Chronic renal failure

Acute clinical features

- Fever refractory > 3 days Rx
- Pleuritic chest pain
- Pleural rub
- Dyspnea
- Haemoptysis
- Worsening respiratory insufficiency in spite of adequate antibiotic and ventilator support

c)
Radiology

CT scan:

Halo sign (pulmonary mass surrounded by ground glass)
Air crescent sign (crescentic radiolucencies around a nodular consolidation)

Respiratory secretions-BAL

Microscopy showing branched hyphae
Galactomannan antigen
PCR
MALDI tof

Blood

PCR
Galactomannan Ag; low sensitivity and difficult to interpret in immune competent patients and interaction with Tazocin
MALDI tof

Biopsy

Pass rate	4%
Highest individual mark	5.5

Question 10

10.1

A 58-year-old farmer with a history of depression was found collapsed in his shed. On arrival at the Emergency Department, his Glasgow Coma Scale score was 10 (E2, V3, M5), respiratory rate was 23 breaths per minute, and mouth ulceration was noted with a green coloured substance staining his lips, hands and clothes.

His arterial blood gas and biochemistry on admission were as follows:

Parameter	Patient Value	Normal Adult Range
FiO_2	**0.5**	
pH	**7.29***	**7.35 – 7.45**
PCO_2	**35 mmHg (4.6 kPa)**	**35 – 45 (4.6 – 6.0)**
PaO_2	**68 mmHg (9.0 kPa)**	
HCO_3	**16 mmol/L***	**24 – 28**
Base Excess	**-9.0 mmol/L***	**-2.0 – +2.0**
Sodium	**140 mmol/L**	**135 – 145**
Potassium	**4.3 mmol/L**	**3.5 – 5.0**
Chloride	**111 mmol/L***	**95 – 105**
Glucose	**7.2 mmol/L***	**4.0 – 6.0**
Lactate	**5.2 mmo/L***	**< 2.5**
Haemoglobin	**162 g/L***	**130 – 160**
Creatinine	**230 µmol/L***	**60 – 120**

a) Characterise the acid-base and blood gas abnormalities.

Answer Template

Combined high anion gap and normal anion gap metabolic acidosis with inadequate respiratory compensation (respiratory acidosis)
A-aDO_2 = 245

b) What is the likely diagnosis?

Answer Template

Paraquat ingestion

c) List the important principles of management specific to this condition.

Answer Template

Risk assessment based on estimate of quantity of Paraquat ingested
Gastrointestinal decontamination with diatomaceous earths, activated charcoal or sodium resonium
Monitoring for organ dysfunction (respiratory, CVS, renal, GIT, adrenal, hepatic, CNS)
Avoid high FiO_2

10.2

These are the biochemical results taken from a 48-year-old male, missing from an alcohol rehabilitation program and found in his home, comatose, by police, three days from the time he was last seen.

Parameter	Patient Value	Normal Adult Range
Sodium	**126 mmol/L***	**138 – 145**
Potassium	**3.5 mmol/L**	**3.5 – 5.0**
Creatinine	**250 □mol/L***	**40 – 100**
Urea	**7.0 mmol/L**	**3.1 – 7.5**
Bilirubin (total)	**509 □mol/L***	**2.0 – 22.0**
Protein (total)	**40 g/L***	**65 – 85**
Albumin	**20 g/L***	**38 – 48**
Alkaline phosphatase (ALP)	**153 IU/L***	**40 – 100**
Gamma glutamyl transferase (GGT)	**459 IU/L***	**0 – 50**
Alanine aminotransferase (ALT)	**336 IU/L***	**0 – 45**
Creatine kinase (CK)	**400 IU/L***	**30 – 180**
Glucose	**3.2 mmol/L***	**3.5 – 4.6**
Ammonia	**342 □mol/L***	**0 – 50**
Lactate	**3.7 mmol/L***	**0.6 – 2.4**

a) **Comment, with explanation, on each of the biochemical abnormalities.**

Answer Template

Liver dysfunction as demonstrated by elevated enzymes, reduced albumin. Hypoglycaemia with decompensation indicated by marked elevation of ammonia. Hyponatraemia in keeping with cirrhosis.

Raised lactate as a result of liver dysfunction / alcoholic ketoacidosis / sepsis / thiamine deficiency
Raised creatinine indicates renal dysfunction and urea may be apparently “normal” because of decreased hepatic dysfunction and possible nutritional deficiencies. Urea:creatinine ratio suggests that GI bleed and/or dehydration are unlikely

b) **List <u>three</u> possible causes of his altered conscious state.**

Answer Template

Alcohol intoxication
Hepatic encephalopathy

Drug ingestion
Sepsis
Intracranial bleed
Wernickes encephalopathy

Pass rate	91%
Highest individual mark	8.75

Question 11

a) What are short-latency (N20) somatosensory evoked potentials (SSEPs)?

b) Describe how SSEPs can be used for prognostication in patients with hypoxic-ischaemic brain injury.

c) Explain whether, and if so how, induced hypothermia impacts on the validity of SSEP results.

Answer Template

a)
- Evoked potentials are the electrical signals generated by the nervous system in response to sensory stimuli.
- Somatosensory evoked potentials (SSEPs) consist of a series of waves that reflect sequential activation of neural structures along the somatosensory pathways.
- Somatosensory evoked potentials are usually derived from the median nerve and the tibial nerve
- SSEP components typically are named by their polarity and typical peak latency in the normal population. N20 is a negativity that typically peaks at 20 milliseconds after the stimulus.

b)
- SSEP is the most reliable test to predict poor outcome in this patient group.
- SSEP does not predict good outcome.
- Pre-test probability for poor outcome essential: use test only in patients who remain unconscious following hypoxic-ischaemic insult (M score ≤ 3).
- Validated to use as early as 24 hours after cardiac arrest.
- SSEP not influenced by sedatives, analgesics, paralysing agents or metabolic insults.
- Bilaterally absent short latency peaks (N20 peaks) have 100% predictive value for poor outcome (death or severe disability), with false positive rate nearly 0% and narrow confidence intervals.

c)
- Hypothermia affects SSEP test results: mainly delayed peaks (prolongation conduction times); no consistent effect on voltages (amplitudes).
- After rewarming of the patient SSEPs have comparable test characteristics as compared with studies done before therapeutic hypothermia and as such have been validated for prognostication following hypoxic-ischaemic brain injury after rewarming with similar low false positive rate.

Pass rate	19%
Highest individual mark	6.0

Question 12

12.1

A 19-year-old female has been admitted to your ICU 12 hours after an isolated severe traumatic brain injury. She is intubated and mechanically ventilated with FiO_2 = 0.3. Complete radiological imaging and clinical examination does not demonstrate any other injuries.

You have been called to review her as she is persistently hypotensive and has not responded to fluid therapy or vasopressor treatment. She is currently receiving 30 μg/min of nor-adrenaline and 15 μg/min of adrenaline.

Her vital signs are:

- **Heart rate 135 beats per minute, sinus rhythm**
- **Blood pressure 70/35 mmHg**
- **CVP 11 mmHg**
- **SpO_2 100%**

Two images from the CT scan (CT scan A and B) of her head are shown.

Note: CT images omitted.

What is the cause of her hypotension and how would you treat it?

Answer Template

Secondary adrenal insufficiency secondary to pituitary injury. Treatment is with IV hydrocortisone.

12.2

You are called to review a 54-year-old female who is obtunded, 5 days post total knee replacement. She has a history of hypertension and mild depression and is on regular medication for both conditions. She has no other known co-morbidities. Her biochemistry profile is as follows:

Parameter	Patient Value	Normal Adult Range
Sodium	**114 mmol/L***	**135 – 145**
Potassium	**4.6 mmol/L**	**3.5 – 5.0**
Chloride	**87 mmol/L***	**95 – 105**
Bicarbonate	**18 mmol/L***	**24 – 32**
Urea	**6.6 mmol/L**	**2.9 – 8.2**
Creatinine	**72 μmol/L**	**70 – 120**

a) What are the likely causes for these results in this patient?

b) Briefly outline how you will determine the underlying cause.

Answer Template

a)
Inappropriate fluid therapy post op
SIADH (possible SSRI therapy)
Thiazide diuretic
Vomiting and/or diarrhoea
Salt-wasting (cerebral or renal)

Less likely as no other co-morbidity CCF, cirrhosis, hypoadrenalism, hypothyroidism (kidney failure excluded from results)

b)
History of medications and fluid input/output
Clinical assessment of fluid status, presence of heart/liver failure
Serum osmolality
Urine osmolality and sodium
Random cortisol
TFTs

12.3

The following arterial blood gas report was obtained from a 75-year-old female admitted to hospital with gastric outlet obstruction. She has had a rapid response team call for tachypnoea with a diagnosis of aspiration pneumonia.

Parameter	Patient Value	Normal Adult Range
FiO_2	**0.3**	
pH	**7.53***	**7.35 – 7.45**
PCO_2	**31 mmHg (4 kPa)***	**35 – 45 (4.6 – 6.0)**
PO_2	**83.7 mmHg (11 kPa)**	
Bicarbonate	**25 mmol/L**	**22 – 28**
Standard Base Excess	**3.3 mmol/L***	**-2.0 – +2.0**

a) Comment on the acid-base status.

b) Give an explanation for these results.

Answer Template

a)
Mixed respiratory and metabolic alkalosis

b)
Respiratory alkalosis from the hyperventilation due to the pneumonia
Metabolic alkalosis from vomiting (or diuretic use).

Pass rate	83%
Highest individual mark	10

Question 13

a) With respect to meta-analysis of randomised controlled trials, what is a funnel plot?

b) In the funnel plot above:

Note: image omitted.

i. What do the outer dashed lines indicate?

ii. To what does the solid vertical line correspond?

c) List <u>three</u> factors that result in asymmetry in funnel plots.

Answer Template

a)
A funnel plot is a scatter plot of the effect estimates from individual studies against some measure of each study's size or precision. The standard error of the effect estimate is often chosen as the measure of study size and plotted on the vertical axis with a reversed scale that places the larger, most powerful studies towards the top. The effect estimates from smaller studies should scatter more widely at the bottom, with the spread narrowing among larger studies.

b)
Outer dashed lines-triangular region where 95% of studies are expected to lie
Solid vertical line- no intervention effect

c)
Heterogeneity

- Size of effect differs according to study size
- Clinical differences

- Methodological differences

ii) Reporting bias
- Publication bias- delayed publication, language, citation, multiple publication bias
- Selective outcome reporting
- Selective analysis/inadequate analysis reporting
- Poor design
- Fraud

iii) Chance

Pass rate	13%
Highest individual mark	7.5

Additional Examiners' Comments:
It was expected that candidates regularly attending journal club would have the knowledge to answer this question but overall it was not well answered and explanation of terms was poor

Question 14

A 43-year-old female with a history of paranoid schizophrenia and multiple episodes of self-harm, presented to the Emergency Department with decreased conscious state. She had been seen three days earlier for possible worsening of her psychosis and discharged home.

Her haematology and biochemistry results at both presentations are as follows:

Parameter	Patient Value		Normal Adult Range
	1st Presentation	2nd Presentation	
Haemoglobin	**134 g/L**	**135 g/L**	**115 – 160**
White cell count	**12.6 x 10^9/L***	**7.5 x 10^9/L**	**4.0 – 11.0**
Platelet count	**250 x 10^{12}/L**	**76 x 10^{12}/L***	**150 – 400**
Prothrombin time		**40.0 seconds***	**12.3 – 16.6**
International Normalised Ratio (INR)		**4.1***	**0.9 – 1.3**
Activated partial thromboplastin time (APTT)		**35.0 seconds**	**27.0 – 38.5**
Fibrinogen		**1.8 g/L***	**2.0 – 4.0**
Sodium	**139 mmol/L**	**136 mmol/L**	**134 – 146**
Potassium	**3.6 mmol/L**	**4.6 mmol/L**	**3.4 – 5.0**
Bicarbonate	**18 mmol/L***	**21 mmol/L***	**22 – 32**
Urea	**5.0 mmol/L**	**18.9 mmol/L***	**3.0 – 8.0**
Creatinine	**56 µmol/L**	**448 µmol/L***	**45 – 90**
Bilirubin total	**6.0 µmol/L**	**81 µmol/L***	**< 20**
Alanine aminotransferase (ALT)	**31 U/L**	**11700 U/L***	**< 35**
Alkaline phosphatase (ALP)	**88 U/L**	**245 U/L***	**35 – 135**
Gamma glutamyl transferase (GGT)	**13 U/L**	**104 U/L***	**< 40**
Lactate		**4 mmol/L**	**< 1.5**
Paracetamol	**< 10 mg/L**	**10 mg/L**	
Urine Ethanol		**Not detected**	
Urine Amphetamines		**Not detected**	
Urine Benzodiazepines		**Detected**	
Urine Cannabinoids		**Not detected**	
Urine Opiates		**Not detected**	

a) What is the underlying diagnosis?

b) List the possible causes in this patient.

c) Outline your immediate management.

Answer Template

a)
Hyperacute (fulminant) hepatic failure

b)
Paracetamol
Idiosyncratic drug reaction
Other toxin e.g. Amanita phalloides
Viral (hepatitis A and E as hyperacute consider B, CMV, Epstein Barr)
Ischaemic hepatitis
Budd-Chiari

c)
Concurrent resuscitation and institution of supportive care and monitoring with focussed assessment to identify underlying cause and definitive management as indicated.

Airway management and oxygen – likely to need intubation and mechanical ventilation with ARDSNet targets and PCO_2 32-38 mmHg

Haemodynamic support for adequate MAP and CPP >60 and appropriate monitoring (A-line, PAC/PiCCO, bedside echo etc.). Avoid fluid overload

Strategies to offset cerebral oedema (head-up, neutral position, sedation, PCO_2 targets, Na 145-155 etc.)
ICP monitoring controversial

Consider renal replacement therapy
Extracorporeal albumin dialysis therapies (SPAD, MARS and Prometheus) have limited evidence to support use

Monitoring of coagulopathy using TEG/ROTEM to guide correction. Correction to cover invasive procedures or if bleeding otherwise not.

Monitor blood glucose

Screening for infection and antibiotics as indicated +/- empiric broad spectrum cover including anti-fungal

Stress ulcer prophylaxis

Nutrition

Specific
NAC
Lactulose / Neomycin / Rifaximin controversial and use varies from unit to unit

Investigations including liver USS, viral screen

Discussion with liver transplant team / transfer to ICU with liver unit (does not currently meet transplantation criteria)

Pass rate	47%
Highest individual mark	8.0

Question 15

Image of intraosseous needle removed.

a) Identify this piece of equipment.

b) What are the physiological principles underlying its use in the shocked patient?

c) List <u>four</u> sites where it may be used.

d) How would you confirm appropriate placement?

e) List <u>four</u> complications of its use.

f) What are the contraindications to its use?

Answer Template

a)
Intraosseous needle (with insertion driver).

b)
The marrow of long bones has a rich network of vessels that drain into a central venous canal, emissary veins, and, ultimately, the central circulation. Therefore, the bone marrow functions as a non-collapsible venous access route when peripheral veins may have collapsed because of vasoconstriction. This approach is particularly important in patients in shock or cardiac arrest, when blood is shunted to the core due to compensatory peripheral vasoconstriction. The intraosseous route allows medications and fluids to enter the central circulation within seconds.

c)
- Proximal tibia
- Femur
- Distal tibia (medial malleolus)
- Proximal humerus
- Manubrium (upper sternum)

The anterior inferior iliac spine, clavicle, and distal radius have also been used successfully for IO vascular access as have bones without medullary cavities, including the calcaneous and radial styloid

d)
- Aspiration of bone marrow
- Ability to flush fluid with no evidence of extravasation

e)
- Extravasation of fluid/Compartment syndrome
- Infection/Osteomyelitis/Bacteraemia
- Fracture
- Haematoma
- Growth plate injury (in children)
- Fat embolus

f)
- Proximal ipsilateral fracture
- Ipsilateral vascular injury
- Local cellulitis/infection
- Inability to locate landmarks
- Osteogenesis imperfecta

Pass rate	91%
Highest individual mark	8.1

Question 16

A 53-year-old male presents to the Emergency Department with headache and vomiting. He has a left hemiparesis and has a Glasgow Coma Scale score of 5. Soon after presentation he is seen to have a tonic clonic seizure.

a) Outline your priorities for the management of this seizure. Include approximate dosing for any drugs you might use.

After 30 minutes the seizure is terminated and the patient is intubated and paralysed and sent for CT brain that confirms high-grade sub-arachnoid haemorrhage. On return to ICU the neurosurgeon asks you to "lighten" the patient for assessment. On reducing sedation, further seizure activity is noticed. This happens on 3 occasions.

b) Describe your approach to this problem.

c) Describe when and how you would cease sedation in this patient.

d) Using the information given above, give an assessment of this patient's prognosis.

Answer Template

a)

1. ABC+monitoring; BSL; Thiamine;
2. Cease the seizure
    i. Clonazepam 0.01–0.02 mg/kg
    ii. Midazolam 0.1 mg/kg or 2-5 mg boluses
    iii. Or similar/reasonable alternative
3. Prevent further seizures
    iv. Phenytoin 20 mg/kg @ max 50 mg/min
    v. Valproate: 15–20 mg/kg IV
    vi. Levetiracetam: 500–2000 mg depending on renal function
    vii. Or other reasonable choice

b)

Should recognize this is status epilepticus: defined as a continuous state of seizures, or multiple seizures, without return to baseline, resulting in observable or even subjectively perceived sensory, motor, and/or cognitive dysfunction for at least 30 minutes. Other definitions exist so whatever is reasonable.
Involvement with neurosurgeons for reversible factors.
Further benzodiazepine or similar → infusion
Propofol IV: loading dose: 1–5 mg/kg; infusion rate: 1–15 mg/kg/hr
Other agents – e.g. barbiturates if available
Early EEG monitoring to clarify seizure and confirm cessation (i.e. that a non-convulsive state is not present).
Avoid muscle relaxants.

c)

Reduction of sedative medication needs to be discussed as a potentially difficult situation.
Balance of determining neurological function against the return of a convulsive or non-convulsive state.
Continuous EEG monitoring should be discussed in this patient due to the prolonged, difficult to control and recurrent seizures.
Timings and how medications are reduced needs to be logically explained and must be gradual.
Therapeutic drug monitoring to confirm phenytoin levels are in the therapeutic range

d)

Outcome after status epilepticus is determined primarily by the aetiology.
Relating to the Sub-arachnoid haemorrhage: High grade sub-arachnoid haemorrhage based on Hunt & Hess; World federation of neurosurgeons & Fisher grading scales.
Relating to the fitting: status epilepticus secondary to the SAH infers a poorer prognosis. Various series quote 20-35% "all comers" in this age group. A discussion should include the contribution

and guarded prognosis from the SAH and coupled with this the status epilepticus prognosis.

Pass rate	91%
Highest individual mark	8.5

Question 17

With reference to transthoracic echocardiography (TTE) in the critically ill:

17.1

a) **Outline the potential uses of TTE in the management of a patient in cardiac arrest.**

b) **Which TTE view is the most appropriate to use during cardiac arrest resuscitation?**

17.2

The four images shown on pages 4 and 5 are TTE images taken from two patients during resuscitation from cardiac arrest.

Figures 1a and 1b are from patient 1 (shown on page 4). Figures 2a and 2b are from patient 2 (shown on page 5).

For each TTE image:

i. **Describe the main abnormalities.**

ii. **Give the underlying diagnosis.**

Answer Template

17.1

a)
1) enable rapid diagnosis of potentially treatable causes of cardiac arrest e.g. PE, tamponade, hypovolaemia
2) guide interventions undertaken during cardiac arrest e.g. guide needle placement for pericardiocentesis
3) assess response to therapy e.g. IVC diameter post fluid bolus in hypovolaemia

b)
Subcostal view (below the xiphoid sternum) – can be done without interfering with CPR.

17.2

For Patient 1

1) Very large pericardial effusion
2) Right ventricular compression.

Cardiac tamponade

For Patient 2

1) Grossly dilated right ventricle (and atrium in fig 4)
2) D-shaped septum
3) Underfilled left heart

Massive pulmonary embolus

Pass rate	89%
Highest individual mark	9.75

Question 18

a) **What is the endothelial glycocalyx? Outline its potential importance in sepsis.**

b) **Name factors that can disrupt the endothelial surface layer (ESL).**

c) **What are the effects of glycocalyx disruption?**

Answer Template

a)
The endothelial glycocalyx forms the basal skeleton that *in vivo* interacts dynamically with plasma constituents forming an endothelial surface layer (ESL)

- forms the interface between the vessel wall and moving blood
- protein-free space below the glycocalyx
- maintenance of the vascular permeability barrier
- mediation of shear-stress-dependent nitric oxide production
- retention of vascular protective enzymes (e.g. superoxide dismutase)
- retention of coagulation inhibition factors (e.g. antithrombin, the protein C system and tissue factor pathway inhibitor)
- modulation of the inflammatory response by preventing leukocyte adhesion and binding various ligands (e.g. chemokines, cytokines and growth factors)

b)
Glycocalyx shedding and disruption is associated with:

- TNFα, redox stress and oxidised lipoproteins,
- ischaemia/reperfusion
- hyperglycaemia, hypernatremia
- hypervolemia,
- trauma, surgery,
- artificial colloids such as hydroxyethyl starch

c)
Effects of glycocalyx damage

- capillary leak
- edema
- hypercoagulability
- inflammation
- loss of vascular responsiveness
- platelet aggregation

Pass rate	42%
Highest individual mark	8.5

Question 19

A 26-year-old female presents from home confused with a low-grade fever. Her blood pressure is 160/100 mmHg. She has no gross motor deficits on neurological examination.

Ten days prior to this presentation, she had induction of labour and delivery of a still-born foetus, at 32 weeks gestation, complicated by disseminated intravascular coagulation. She had been on labetalol for pregnancy-induced hypertension.

Her discharge medications included paracetamol, tramadol and a selective serotonin reuptake inhibitor. She has a six-year history of uncomplicated Hepatitis C infection.

a) **List the differential diagnoses for her confusion and temperature.**

b) **Outline your approach to establishing the diagnosis.**

Answer Template

a)
Pregnancy related: Eclampsia / preeclampsia / HELLP, Posterior reversible encephalopathy syndrome (PRES), Hypertensive encephalopathy

Primary neurological: Infection (meningitis / encephalitis), cerebral venous thrombosis, seizure disorder, other cerebro-vascular

Metabolic: Sodium (hypo/hyper), Glucose (hypo/hyper), Renal failure, Liver failure (HCV / Paracetamol / Antidepressants),

Drugs: Accidental / intentional overdose, drug reactions (serotonin syndrome)

b)
History: Collateral, Pregnancy issues, Ongoing blood loss, bleeding / bruising, drug ingestions, mood / affect, headaches

Examination: BP, uterine size / discharge, oedema, meningism, neurological (tone, reflexes, symmetry), chronic liver disease

Investigations:
FBC: Bleeding, platelets, WCC
UEC: urea / creatinine, Na, Ca, glucose
Coagulation: DIC, INR for CLD
LFT / Ammonia: hepatic encephalopathy, drug reactions ABG: hypoxia / hypercardia
Urinary drug screen / paracetamol level
Sepsis Screen, CT head +/- LP

Pass rate	26%
Highest individual mark	7.5

Question 20

A 51-year-old male has just been transferred to ICU from the surgical ward with worsening shortness of breath five days post-oesophagectomy, and a presumed anastomotic leak.

On arrival in ICU he is tachypnoeic and extremely agitated.

Arterial blood gas analysis on FiO_2 0.6-0.8 via reservoir (non-rebreathing) mask shows:

Parameter	Patient Value	Normal Adult Range
pH	**7.12***	**7.35 – 7.45**
PaO_2	**50 mmHg (6.6 kPa)**	
$PaCO_2$	**50 mmHg (6.6 kPa)***	**35 – 45 (4.6 – 6.0)**
HCO_3	**16 mmol/L***	**22 – 28**

Chest X-ray shows bilateral pulmonary infiltrates.

a) **List the possible causes for his respiratory failure.**

The patient is intubated and mechanical ventilatory support is initiated.

b) **Describe the ventilator settings you will prescribe, giving the rationale for your decision.**

Following intubation, there is no immediate improvement in the patient's oxygenation.

c) List the initial strategies that may be used to improve oxygenation.

Answer Template

a)
Differential diagnosis should include:

- ARDS secondary to sepsis from any source or other inflammatory insult including the following
- Pneumonia (hospital-acquired)
- Aspiration
- Atelectasis/pleural effusions/empyema
- Fluid overload secondary to resuscitation, renal failure
- Exacerbation of pre-existing condition e.g. heart failure, valvular heart disease, post-op ischaemia/MI, arrhythmia
- Lung diseases e.g. lymphangitis carcinomatosis

b)

- Use a mode with which one is familiar and aim to limit ventilator-associated lung injury, i.e oxygen toxicity, barotrauma, volutrauma, shear stress and biotrauma
- Choice of mode *(any appropriate answer acceptable e.g. APRV for recruitment benefit, or volume assist control as staff familiarity and no one mode shown to have benefit over another)*
- Avoid over-distention of alveoli by keeping tidal volumes at 6-8 ml/kg (predicted body weight which in the ARDSnet studies was ~20% below actual body weight and calculated by a formula linking height and sex)
- Use PEEP to minimise alveolar collapse and derecruitment.
- Titrate PEEP to achieve a PaO_2 of 60 mmHg with lowest FiO_2 that is needed using decremental PEEP trial post recruitment manoeuvre.
- I:E ratio of $\geq$ 1:1
- Permissive hypercapnea to avoid large minute volumes and alveolar injury through collapse and expansion of lung units

c)

- High FiO2 (titrated to lowest possible level to limit toxicity)
- Confirm ETT position and patency
- Exclude readily reversible cause of hypoxia e.g. PTX, mucus plug, large effusion
- Increased inspiratory time
- Increased PEEP
- Recruitment manoeuvre with decremental PEEP trial
- Prone positioning for at least 16/24 hours per day
- Ensure adequate cardiac output

Pass rate	17%
Highest individual mark	6.75

Question 21

A 54-year-old previously healthy male was admitted to the ICU after 45% total body surface area burns. He was pulled out of his garden shed, unconscious, by the fire brigade and was intubated at the scene of the incident by ambulance personnel. He was admitted to the ICU within one hour of injury.

a) Describe your initial fluid resuscitation plan for this patient, including the type of fluid, the rationale for your choice and how you would estimate the fluid requirements.

Three hours later, the patient remains hemodynamically unstable:

Heart rate 125 beats per minute
Blood pressure 85/45 mmHg (on noradrenaline 30 μg/min and vasopressin 0.04 units/min)

b) What are the diagnostic possibilities?

Answer Template

a)

Type of fluid:

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

Estimating fluid requirements:

- No formula provides a precise method for determining the burn victim's fluid requirements; the formulas described provide only a starting point and guide to initial fluid resuscitation. Patient age, severity of burns and co-morbidities can substantially alter the actual fluid requirements of individual patients. Patient response to fluid therapy needs careful monitoring and adjustment as clinically indicated

- *arkland (or Baxter or consensus) Formula* (most widely used):
  Fluid requirement (ml) = 4 x body weight x percentage of burns. (Only deep)
  One half of the calculated fluid is given over the first eight hours and the remaining over the next 16 hours.
  The rate of infusion should be as constant as possible; sharp decrease in infusion rates can cause vascular collapse and increase in edema.

- *Modified Brooke Formula:*
  Fluid requirement (ml) over the initial 24 hours = 2 x body weight x percentage of burns.
  This formula may reduce the total volume used in fluid resuscitation without causing harm.

- Following initial resuscitation, IV fluids are administered to meet baseline fluid needs and maintain urine output.

- Care should be taken to avoid fluid overload, as associated with multiple co-morbidities.

b)

- Unidentified blood loss / inadequate fluid resuscitation
- Distributive shock with large fluid shifts
- Cyanide toxicity
- Compartment Syndrome, including abdominal compartment
- Cardiogenic Shock (severe myocardial suppression caused by burns)
- Carbon monoxide poisoning
- Ingestion of toxins (ethylene glycol, methanol, salicylates)

Pass rate	53%
Highest individual mark	6.75

Additional Examiners' Comments:
Candidates omitted discussion on rationale for choice of fluid

Question 22

In relation to therapeutic plasmapheresis:

a) Describe the principles involved.

b) What are the prerequisites for plasmapheresis to be effective?

c) Give <u>six</u> indications for its use.

d) List <u>three</u> types of potential complications or adverse effects associated with this therapy, and give <u>one</u> example of each.

Answer Template

a)
Extracorporeal blood purification process to-

- remove large molecular weight components of the plasma including antibodies, immune complexes, cryoglobulins, myeloma light chains as examples.
- Removal is by centrifugation of blood into components. Non plasma components are returned to patient, plasma is discarded.
- volume removed is replaced by colloid solutions such as plasma products (FFP), or albumin solutions. In some conditions whereby coagulation or immune factors are deficient then FFP replacement provides an additional therapeutic benefit.

b)
To justify therapeutic plasmaphoresis the substances removed should

A) have a sufficiently long T1/2 such that this process results in more rapid removal than other endogenous clearance (e.g. suppression of macromolecule production),
B) Be key 'toxic' factor in the pathogenesis of the disease

c)
Immunoproliferative diseases with monoclonal immunoglobulins

- Hyperviscosity syndrome
- Cryoglobulinaemia
- Renal failure in multiple myeloma
- Autoimmune diseases due to autoantibodies or immune complexes
- Goodpasture's syndrome
- Myasthenia gravis
- Guillain–Barre´ syndrome
- Chronic inflammatory demyelinating polyneuropathy (CIDP)
- Stiff-man syndrome
- Systemic lupus erythematosus
- Fulminant antiphospholipid syndrome
- Thrombotic thrombocytopenic purpura
- Haemolytic uraemic syndrome
- Rapidly progressive glomerulonephritis
- Coagulation inhibitors
- Autoimmune haemolytic anaemia
- Pemphigus
- Paraneoplastic syndromes

Conditions in which replacement of plasma may be beneficial _ removal of toxins

- Disseminated intravascular coagulation
- Overwhelming sepsis syndromes (e.g. meningococcaemia)

Conditions in which the mechanisms are unknown

- Reye's syndrome

Removal of protein-bound or large molecular weight toxins

- Paraquat poisoning
- ?Envenomation

d)

a. Complications related to vascular access
    i. Catheter-related sepsis
b. Complications related to extracorporeal circuits
    i. Hypotension/loss of blood/thrombocytopenia
c. Complications related to exchange fluid
    i. More common with FFP (vs Albumin)
    ii. Transfusion reactions

iii. Allergic reactions

d. Complications related to anticoagulation
   i. Citrate (hypocalcaemia)
   ii. Heparin (bleeding, thrombocytopenia)

Pass rate	42%
Highest individual mark	6.75

Question 23

A 72-year-old female, body mass index 17.5 kg/m^2, is admitted to the High Dependency Unit following a Medical Emergency Team call for tachypnoea and hypotension. She is known to have sepsis relating to a urinary tract infection and wound infection following extensive surgery for resection of a left thigh chondrosarcoma six weeks earlier.

Her biochemistry results are as follows:

Venous Sample		
Parameter	**Patient Value**	**Normal Adult Range**
Sodium	**139 mmol/L**	**134 – 146**
Potassium	**4.6 mmol/L**	**3.4 – 5.0**
Bicarbonate	**5.0 mmol/L***	**22 – 32**
Urea	**11.2 mmol/L***	**3.0 – 8.0**
Creatinine	**179 µmol/L***	**45 – 90**

Arterial Blood Gas		
Parameter	**Patient Value**	**Normal Adult Range**
FiO_2	**0.3**	
pH	**7.18***	**7.35 – 7.45**
PCO_2	**14 mmHg (1.8 kPa)**	**35 – 45 (4.6 – 6.0)**
PO_2	**104 mmHg (13.7 kPa)**	
Bicarbonate	**5.0 mmol/L***	**22 – 28**
Base Excess	**-22 mmol/L***	**-2.0 – +2.0**
Sodium	**141 mmol/L**	**134 – 146**
Potassium	**4.3 mmol/L**	**3.4 – 5.0**
Chloride	**114 mmol/L***	**98 – 108**
Glucose	**6.9 mmol/L***	**3.0 – 5.4**
Lactate	**1.0 mmol/L**	**<1.5**

Urinalysis	
Parameter	**Patient Value**
5-Oxoproline (Pyroglutamic acid)	**> 3+ (16 mmol/mmol creatinine)**
3-Hydroxybutyrate	**1+**
Acetoacetate	**1+**

a) Interpret her acid-base status.

With reference to her urinalysis:

b) Explain the significance.

c) List the likely predisposing factors in this patient.

d) Briefly outline the underlying pathophysiology.

e) List your management strategies.

Answer Template

a)
Mixed high anion gap and normal anion gap metabolic acidosis with respiratory compensation
(AG = 22 and delta gap = 0.4 – 0.8)
[SID_A abbreviated = Na + K – Cl = 31.3 (decreased SID, raised Cl)]

b)
High levels of PGA imply that this is the cause of her underlying HAGMA
Low levels of ketones relate to relative starvation

c)
Predisposing factors in this patient are:
Elderly patient
Sepsis
Malnutrition
Renal impairment
May have had concomitant treatment with paracetamol and/or flucloxacillin
Liver function not given but liver dysfunction also predisposing factor
Congenital enzyme deficiencies unlikely

d)
Pathophysiology relates to glutathione depletion (sepsis, liver dysfunction, paracetamol via NAPQI) resulting in loss of negative feedback on synthesis of gamma-glutamylcysteine with subsequent increased production of pyroglutamic acid; or 5-oxoprolinase inhibition (flucoxacillin) resulting in decreased conversion of PGA to glutamate

e)
Management strategies
Supportive care and monitoring - oxygen, haemodynamic and renal support as indicated
Cease culprit drugs
Treat sepsis (appropriate antibiotics and surgical debridement)
Improve nutritional status
N-acetyl cysteine

Pass rate	55%
Highest individual mark	9.0

Question 24

The following questions relate to separation from invasive mechanical ventilation:

a) With reference to a spontaneous breathing trial (SBT):

i. What is an SBT?

ii. Over what duration should it occur?

iii. Why would you perform an SBT in a mechanically ventilated patient?

iv. List <u>three</u> methods of performing an SBT.

b) What is the rapid shallow breathing index (RSBI) and how should it ideally be measured?

c) Briefly outline the role of prophylactic (planned) non-invasive ventilation (NIV) immediately following extubation. Explain how this differs from therapeutically applied (rescue) NIV used in the same context.

Answer Template

a)
The SBT is the most direct way to assess a patient's performance or tolerance of **unassisted breathing** without ventilatory support.

OR

A procedure in which a mechanically ventilated patient is given a trial of spontaneous breathing without ventilatory support for a limited time without extubation or formal liberation from the ventilator.

Optimal SBT duration has been examined and good evidence supports that **30minutes is equivalent to 120 minutes with either T piece or PSV.**

The SBT can be used to either assess the patient's suitability for liberation from MV or used daily as a weaning strategy. Multiple studies have found that patients tolerant of SBTs were found to have successful discontinuations at least **77% of the time.**

It can be performed using either: Low level Pressure Support (PSV < 7cm H2O), CPAP circuit, or unassisted via a simple T-piece.

b)

The RSBI is the ratio of frequency of breathing to tidal volume (f/Vt). Rapid shallow breathing as reflected by f/Vt predicts weaning failure with a threshold of about 105 breaths per minute per litre (Yang and Tobin). It is less predictive in those ventilated > 8d.It should be measured during the ***first minute of a T piece trial*** *using a* ***spirometer*** to measure Vt. *It is of limited value when measured during trials of pressure support ventilation.*

Note: references cited are not expected for marks

c)

Prophylactic NIV: the use immediately after extubation **in absence** of respiratory failure-**High risk** patients may benefit (CHF, COPD, high severity scores).

- Ferrer et al , Am J Res and Crit Care Med, 2006 ~ Early NIV avoided respiratory failure and decreased ICU mortality - in this study NIV appeared useful mainly in a subset of ***hypercapnic patients with chronic respiratory disorders.***
- However, of **no benefit** if applied indiscriminately in **unselected** patients, see Su et al, Resp. Care. 2012.

Therapeutic NIV: Used post extubation in the presence of established or evolving respiratory failure- it has no proven benefit in the overall population of patients in this context- it may even **increase mortality** by delaying re intubation, see Esteban, NEJM, 2004.

Pass rate	43%
Highest individual mark	7.7

Question 25

A 76-year-old male is admitted to the ICU with acute lung injury causing respiratory failure, secondary to acute pancreatitis.

a) Outline how you would establish enteral nutrition in this patient, including in the answer your nutritional targets.

b) List the complications that need to be considered with the use of enteral nutrition.

c) When might you consider parenteral nutrition?

Answer Template

a)
Access: Nasojejunal tube although nasogastric (appears safe and well tolerated)
Any reasonable approach OK

1) Determine target rate for enteral nutrition, commencing 30ml/hour and increasing as tolerated and delivered as a continuous infusion to maximise chances of achieving nutritional target rates.

2) Prokinetics could be considered if large aspirates are experienced. A feeding protocol should be utilised to maximise the chances of achieving nutritional target rates.

3) Nutritional targets in the critically ill can be determined by either indirect calorimetry, predictive equations (e.g.: Harris-Benedict equation) or simplistic formulae (25-30kcal/kg/day) with at least 1.2-2g/kg/day of protein.

b)
1) Tube complications
Misplacement: Pneumothorax, inadvertent pulmonary infusion
Sinusitis
Pressure areas on nose/lip
Trauma to nasopharynx, oesophagus, stomach and haemorrhage
2) Feed complications
Inadequate caloric intake from gastric stasis
Diarrhoea
Ventilator associated pneumonia
Aspiration
Electrolyte abnormalities
Hyperglycaemia

c)
Despite following a rigorous enteral feeding protocol, there is inadequate caloric intake after five days. Combined enteral and parenteral nutrition to meet targets may be beneficial.
NEJM article June 2011 comparing early (day 2) with late (day 8) TPN in ICU patients not meeting nutritional targets with EN showed better outcomes in late TPN group

Pass rate	77%
Highest individual mark	10

Question 26

A 50-year-old male patient is admitted to ICU following a laparotomy, splenectomy and partial hepatectomy for intra-abdominal bleeding following a high-speed motor vehicle crash with isolated abdominal trauma. He has had a massive transfusion in theatre. He continues to be fluid responsive with a falling haemoglobin concentration consistent with on-going intra-abdominal bleeding.

a) Outline your management of this problem.

The International Normalised Ratio (INR) result is >10 and subsequent history reveals the patient was taking warfarin for recurrent deep vein thromboses.

b) List the steps you would take to correct the INR.

The INR corrects to 2.0 and a thromboelastometry is performed with the resultant graphs (Image A) as shown on page 11. (Graphs from a normal individual, Image B, are included for comparison.)

c) What coagulopathy do the patient's graphs represent and what therapy is indicated?

Note: Images depicting thromboelastometry graphs from the patient and normal individual for comparison have been omitted

Answer Template

a)
Clinical examination:

Haemodynamics, abdominal examination, drain losses, exclude other sources of bleeding, temperature, urine output.

Investigations:

- Ensure blood cross-matched and available
- FBC and Coagulation tests: aPTT, PR, Platelet count, D-Dimers, TEG, Fibrinogen
- ABG
- CXR

Resuscitation:

- Volume replacement
- Transfusion of blood products
- Correction of electrolyte associated with massive transfusion; e.g. hypcalcaemia
- Prevention and treatment of hypothermia

May consider haematology input and activation of a massive transfusion protocol or similar.

Discuss with the surgical team re returning to theatre.

The INR result is >10 and subsequent history reveals the patient was taking warfarin for recurrent DVTs

b)
Prothrombin Complex concentrate dose 25-50units/kg
Vitamin K 10-20mg
Fresh frozen plasma if ongoing bleeding.(contains Factor VII which is not in PCC)

c)
Thrombocytopaenia / Platelet dysfunction

Platelet therapy +/- cryoprecipitate
Consider DDAVP

Pass rate	66%
Highest individual mark	7.0

Question 27

A 45-year-old previously healthy male was admitted to your ICU 5 days ago after a motor vehicle crash with chest and abdominal injuries. He is currently intubated and ventilated, is on FiO_2 1.0 and positive end-expiratory pressure (PEEP) of 10 cmH_2O. He is deeply sedated and on nor-adrenaline and adrenaline infusions at 10 μg/min each. He has become oliguric.

His blood biochemistry, haematology and arterial blood gases are as follows:

Venous Biochemistry		
Parameter	**Patient Value**	**Normal Adult Range**
Sodium	**138 mmol/L**	**135 – 145**
Potassium	**7.1 mmol/L***	**3.5 – 5.0**
Chloride	**104 mmol/L**	**95 – 105**
Urea	**27 mmol/L***	**2.9 – 8.2**
Creatinine	**260 µmol/L***	**70 – 120**

Haematology		
Parameter	**Patient Value**	**Normal Adult Range**
Haemoglobin	**120 g/L***	**135 – 180**
White blood cell	**12.8 x 10^9/L***	**4.0 – 11.0**
Platelets	**42 x 10^9/L***	**140 – 400**

Arterial Blood Gases		
Parameter	**Patient Value**	**Normal Adult Range**
FiO_2	**1.0**	
pH	**7.01***	**7.35 – 7.45**
PCO_2	**45 mmHg (6 kPa)**	**35 – 45 (4.6 – 6.0)**
PO_2	**70 mm Hg (9.3 kPa)**	
Bicarbonate	**11 mmol/L***	**22 – 26**
Base Excess	**-19 mmol/L***	**-2.0 – +2.0**
Glucose	**7.5 mmol/L***	**4.0 – 6.0**
Lactate	**13 mmol/L***	**< 2.0**

a) Summarise the findings of the blood tests.

b) What are the likely underlying causes of the lactic acidosis?

c) Outline your immediate management priorities at this point.

Answer Template

a)

High anion gap metabolic acidosis (with apparent normal SID). Note AG 33 which is NOT adequately explained just by a lactate of 13 mmol
Inadequate or inappropriate respiratory compensation
Hypoxaemia (P/F ratio 70)
Acute renal failure (note urea:creatinine ratio).
Hyperkalaemia

b)
Sepsis with shock
Ongoing hypovolaemia
Hypoperfusion eg septic cardiomyopathy; abdominal compartment syndrome
Possible gut ischemia
Perhaps adrenaline (also seen with other catecholamines – unpredictable)

c)
Optimise ventilation.

- Exclude pneumothorax.
- Probably needs more PEEP after some volume.
- Minimise airway pressures, limit tidal volume, tolerate hypercarbia (though concerned about pH < 7!!!)

Optimise cardiovascular function.

- Urgent echocardiogram.
- Volume replacement if possible.
- Measure continuous cardiac output (PiCCO or PAC).
- Measure SvO2 or ScvO2.
- Exclude abdominal compartment syndrome
- Rationalise inotropes. Stop adrenaline, use noradrenaline as required

Emergency management of hyperkalaemia with calcium, bicarbonate, insulin, dextrose and then haemodialysis!

Urgent CRRT – for both potassium and acidosis use of hemosol buffer

Broad-spectrum IV antibiotics (rational answer required)

Pass rate	91%
Highest individual mark	9.3

Question 28

You arrive at work one morning to learn that, overnight, the on-call junior trainee committed a medical error that has resulted in a life-threatening adverse outcome for the patient. The trainee has been waiting for your arrival to talk to you.

Outline the key points of this discussion with the trainee.

Answer Template

Facilitation of an emotional debrief not an operational debrief
Allow the trainee to vent and tell his/her version of events
Remain neutral and avoid criticism/censorship of the trainee's actions

Ensure there is on-going psychological and emotional support for the trainee
Give him/her the option of time off work or ensure support if he/she chooses to stay
Arrange an appropriate mentor within the department who is not otherwise involved in this incident (may be self or other senior colleague)
Ensure there is back-up from friends/family at home
Offer professional counselling

Advice on:
Open disclosure with patient's next-of-kin
The medico-legal process that will ensue
Need for comprehensive and accurate documentation in records and factual account for registrar's own records
Early contact with medical defence organisation and hospital medico-legal advisors
Need for reporting to coroner if/when the patient dies
Root Cause Analysis of the event by the hospital

Counselling with regards to future career and training

Plan follow-up meeting with mentor and SOT/departmental head for next day

Pass rate	81%
Highest individual mark	8.5

Question 29

29.1

List the clinical signs on examination that would support the diagnosis of infective endocarditis in a patient with fever and a new murmur.

29.2

A 63-year-old female is admitted from a regional hospital to ICU for respiratory support following an emergency laparotomy for an acute abdomen ten days previously. The findings on examination include the following lesion as depicted in the image below:

Note: Image depicting a large sacral pressure area ulcer has been removed.

a) **What complication has developed?**

b) **What are the risk factors for this complication?**

c) **What is the management of this complication?**

d) **What are the major preventative strategies for this complication in Intensive Care patients?**

Answer Template

29.1

Janeway lesions (small, non-tender erythematous or haemorrhagic macular or nodular lesions on the palms or soles)
Roth spots (retinal haemorrhages with pale or white centres
Oslers nodes (painful, red raised lesions found on the hands and feet)
Splinter haemorrhages
Clubbing
Splenomegaly
Petechiae

29.2

a)
Pressure area ulcer

b)
Duration of surgery
Faecal incontinence and/or diarrhoea
Low albumin concentrations
Disturbed sensory perception
Obesity
Moisture of the skin
Impaired circulation
Use of inotropic drugs
Diabetes mellitus
Too unstable to turn, or other reason for decreased mobility,
High APACHE II score. Waterlow's score, Braden's score or other valid scores

c)
Remove all pressure from area
Appropriate wound management
Plastic surgical review
Adequate nutrition
Wound nurse team.
Bowel management system.

d)
Maintaining clean and dry skin
Visualise skin integrity twice a day
Regular pressure relief and pressure relief mattresses

Pass rate	85%
Highest individual mark	8.9

Question 30

With respect to continuous renal replacement therapy (CRRT) in the critically ill:

a) **Draw a labelled diagram to represent the circuit for continuous veno-venous**

diafiltration (CVVHDF).

b) Define the following terms and briefly explain their relevance in CRRT:

i. Dialysis dose
ii. Transmembrane pressure
iii. Sieving coefficient
iv. Filtration fraction

Answer Template

a)
Diagram expected to be appropriately labelled and depict access and return lines, filter, dialysate, effluent and replacement fluid and include sites of pressure measurement and pumps

b)
(i)
Dialysis dose is equivalent to the effluent rate in ml/kg/hour.
Effluent rate = ultrafiltration rate for haemofiltration (CVVH)
= dialysis rate for haemodialysis (CVVHD)
= ultrafiltration rate + dialysis rate for haemodiafiltration (CVVHDF)
Dialysis doses (effluent rates) greater than 25 ml/kg/hr have not been shown to improve outcome but it is reasonable to run at higher rates to compensate for downtime when the circuit has clotted or been taken down to allow for patient transfer/treatment

(ii)
Transmembrane pressure (TMP) = (Filter pressure + Return pressure) / 2 – (Effluent pressure)
High TMPs with normal return pressures indicate a problem with the filter. High TMPs with high return pressures indicate a problem with the return line +/- the filter
Different filter membrane properties can produce different ultrafiltration rates for the same TMP. Filters that are highly permeable to water (high flux membranes) allow more water to cross the membrane for a given TMP.

(iii)
Sieving coefficient (SC) = Ultrafiltrate concentration / Blood concentration
SC is a measure of how effectively a substance is removed through the filter.
SC = 0 means the substance is not filtered at all e.g. protein sized molecules
SC = 1 means the substance is completely filtered e.g. urea, creatinine
SC depends on solute molecule size, protein binding and filter porousness

(iv)
Filtration fraction = Ultrafiltration rate / Blood flow rate* and should ≤ 0.25
* Strictly plasma flow rate (blood pump rate x 1 – Hct)
I.e. fraction of plasma that is removed from blood during filtration
Higher filtration fractions predispose to filter clotting through haemoconcentration.

Pass rate	51%
Highest individual mark	8,3

SECOND PART ORAL EXAMINATION

CLINICALS "HOT CASES"

75-year-old female, day 5 ICU post jejunal flap to the hard palate for SCC palate and background of cardiomyopathy with PPM/AICD, and chronic kidney disease requiring intermittent haemodialysis, now managed with CRRT. Clinical findings included gross oedema, swollen neck, abdominal incision, previous donor graft sites, AV fistula right upper limb, dusky oral jejunal flap, hypothermia, presence of CRRT circuit and TPN.

- Candidates were told she was day 5 post-jejunal flap for oral cancer and asked to examine her with a view to a plan for ongoing management.

60-year-old male, 2 months in hospital for H1N1 influenza requiring ECMO complicated by ischaemic bowel, acute kidney injury and critical illness weakness syndrome. Clinical findings included flaccid weakness, more so in the upper than lower limbs: spontaneous respiration via tracheostomy with small tidal volumes and poor cough with copious secretions; abdominal wound with ileostomy.

- Candidates were asked to examine him with a view to assessing his suitability for ward transfer and decannulation of the tracheostomy.

60-year-old male, day 6 ICU admitted with GCS 3, query cause, and persisting coma and a background history of alcohol abuse. Clinical findings included GCS 5-7 off sedation, brain stem reflexes present (except oculo-vestibular), weak extension of upper limbs to pain, global hyporeflexia with up going plantar responses bilaterally, and presence of skin abrasions and sacral pressure sore.

- Candidates were asked to examine him with a specific focus on his neurology with a view to establishing a differential diagnosis for his presentation and a management plan.

27-year-old female, day 3 ICU with multi-trauma following motor vehicle crash. Her injuries included traumatic brain injury and raised ICP with bilateral SAH and basal ganglia and intra-parenchymal haemorrhage, blunt chest trauma with right-sided contusion, rib fractures and pneumothorax, liver laceration and multiple facial and limb abrasions. Findings on examination included Codman catheter, right ICC, sandbags supporting C-spine, large scalp abrasion with degloving and extensive skin abrasions.

- Candidates were asked to perform a secondary survey, describe the findings and outline the likely clinical problems.

67-year-old female, day 7 post elective left common carotid stent placement , heparinised for visual disturbance day 1 post stent, complicated by large subdural and intra-parenchymal bleeds and refractory intracranial hypertension despite bilateral craniectomies. Clinical findings included sedation to control ICP, the presence of a femoral arterial puncture site, bifrontotemporal craniectomies and bilateral subdural drains, dilated unreactive pupils with absent corneal and oculo-cephalic reflexes and generalised hyporeflexia.

- Candidates were directed to assess her neurological status and discuss what they would say to the next-of-kin.

65-year-old male day 11 post attempted anterior cervical spinal fixation complicated by arterial bleeding not controlled by attempted stenting and required sternotomy and thoracotomy and suturing of bleeding points. Course in ICU complicated by ventilator-associated pneumonia and failed extubation. Background history of ankylosing spondylitis and life-long low BMI. Clinical findings included severe generalised wasting.

- Candidates were asked to examine him with a view to making a plan for weaning.

63-year-old woman, three weeks in ICU with respiratory failure, secondary to pseudomonas pneumonia, complicated by a probable intracerebral event and slow wean, and a background of chronic lung disease. Clinical findings included presence of tracheostomy, hyperinflated chest, tachypnoea and poor lung compliance, severe cachexia and generalised weakness.

- Candidates were asked to examine her and devise a weaning strategy.

56-year-old man, one month in ICU with severe necrotising pancreatitis, septic shock and multi-organ failure and subsequent right femoral DVT. Clinical findings included GCS 15, cachexia and proximal muscle weakness, ongoing respiratory failure, AF/flutter and low dose vasopressor support and an abdominal drain.

- Candidates were asked to examine him with a view to identifying the ongoing clinical issues and the management priorities

62-year-old female, day 4 in the ICU, who presented with a collapse. She was off sedation but remained unresponsive. Clinical findings included treatment with nimodipine and noradrenaline, 2 external ventricular drains with blood stained CSF and normal ICP, reduced level of consciousness, some brainstem signs, present cough and gag, temperature of 38.2 degrees. A CT brain demonstrated subarachnoid and intraparenchymal haemorrhage.

- Candidates were asked to assess the patient to assess a likely cause for collapse and provide the current priorities in management.

39-year-old male, day 6 in the ICU, who presented following a head injury while intoxicated. He was slow to recover neurological function post-operatively. Clinical findings included invasive ventilatory suport, temperature of 38 degrees, right hemiplegia, brisk reflexes in left leg, bilateral upgoing plantars, normal brainstem reflexes, signs of left sided pneumonia. His CT showed an acute extradural haematoma.

- Candidates were asked to assess the patient with regards to potentially reversible factors that may be contributing to his slow neurological recovery.

78-year-old female, day 2 in the ICU, with a left haemothorax following a recent fall. Clinical findings included intubated and ventilated, left intercostal catheters with 700ml of blood, multiple previous AV fistulae, currently on CVVHDF, multiple bruises, left leg splinted. Chest x-ray demonstrated persistent left haemothorax.

- Candidates were asked to assess the patient with regards to the contributors to her current clinical state and make a plan for ongoing management.

52-year-old male, day 3 in the ICU following elective CABG x 3. He remained ventilated with hypoxic respiratory failure. On examination he was obese, febrile, had high $ETCO_2$, moderate PEEP and FiO_2, reduced breath sounds at both bases. There were no focal neurological issues but he was heavily sedated. His chest x-ray showed bilateral infiltrates.

- Candidates were asked to assess him with regards to the barriers weaning sedation and attempting extubation.

65-year-old male, day 1 in the ICU, with acute hypoxic respiratory failure. His clinical findings included obesity, intubated ventilated, paralysed and sedated, low cardiac index on PiCCO, inotropic and vasopressor support, high FiO2 and PEEP. His bedside echo demonstrated globally reduced left ventricular function, his chest X-ray showed an endobronchial intubation with bilateral infiltrates.
Candidates were asked to assess the patient with regards to his initial management plan.

17-year-old male, day 50 in the ICU. Initially admitted with a reduced level of consciousness secondary to a new onset of a seizure disorder. Current clinical findings include GCS 3, ongoing benzodiazepine infusion, BIS monitor in-situ, intermittent clinical and EEG seizures, bilateral leg swelling, gross global muscle wasting, and still requiring mechanical ventilation via a tracheostomy.

- Candidates were asked to assess his current issues given his prolonged ICU stay.

48-year-old man, day 7 ICU following repair of mycotic coronary artery aneurysms. Background of diabetes, and dialysis-dependent renal failure. Shocked, on adrenaline and noradrenaline infusions and VA ECMO. Clinical findings included fluid overload, AV fistula, poor circulation to the right leg, and oozing from the sternal wound.

- Candidates were asked to assess with regard to the cause of the renal failure.

76-year-old man, Day 6 ICU background of prosthetic aortic valve endocarditis. Findings included ankle oedema, implanted pacemaker and obesity.

- Candidates were told he was recovering from recent cardiac surgery and to assess his suitability for extubation.

45-year-old man, day 13 ICU. Admitted with SCC tongue, necrotising pneumonia, neutropenic sepsis and multi organ failure. Clinical findings included bilateral wheeze, crepitations at the right lung base, and portacath in situ.

- Candidates were informed the patient had a background of intravenous drug use and hepatitis C, and had been admitted with respiratory failure. They were asked to examine and provide a differential diagnosis.

56 year-old-man, day 4 ICU. Background of MI three weeks previously, followed by respiratory failure of uncertain aetiology with bilateral lung infiltrates, normal cardiac output and low filling pressures. Clinical findings included bilateral fine crepitations, evidence of airflow obstruction, and a vasodilated state.

- Candidates were informed that the patient had respiratory failure and shock following a recent MI. They were asked to examine him to find a likely cause.

27-year-old man, day 5 ICU. Post op evacuation of left parietal extradural haematoma. Clinical findings included a craniotomy scar, fever, decreased air entry at the left base and bronchial breath sounds at the right.

- Candidates were informed the patient had been found wandering the streets in an agitated state, and on arrival at the hospital had dropped his GCS from 13 to 7. They were asked to begin by examining the patient's neurology.

84-year-old man, Day 2 ICU. Background of traumatic brain injury following a fall. Currently agitated, requiring restraints. Clinical signs included a GCS score of 6, left hemiparesis, left facial haematoma, left basal bronchial breathing and a soft systolic murmur.

- Candidates were informed the patient had been admitted to ICU 2 days previously having been found at the bottom of his stairs with a GCS of 3. They were asked to examine his neurological system as well as any other systems they thought appropriate and give an overview of his present condition.

65-year-old man, Day 10 ICU. Post operative sterotactic biopsy lesion right temporal lobe. Subsequently slow neurological recovery. Clinical findings included a VP shunt, VI cranial nerve lesion on the right, monoparesis of the right arm, upward plantar on the right.

- Candidates were informed the patient was slow to recover following a neurosurgical procedure. They were asked to assess his neurological state, provide a differential diagnosis, and outline a plan for his further management.

69-year-old lady Day 2 ICU. Post coronary artery grafts and mitral valve repair. Background history of connective tissue disease. Clinical findings included sclerodactyly reduced radial pulse and brisk carotids, absent JVP, pedal oedema, paced cardiac rhythm, pansystolic murmur audible at the left sternal edge.

- Candidates were informed she was day 2 following emergency cardiac surgery. They were asked to examine her cardiovascular system and overall state, and outline plans for ongoing management and ICU discharge.

VIVAS

Viva 1

You are the Consultant Intensivist in charge for the day with a new registrar in their first week working in ICU. You are called about a 53-year-old man with hypotension 30 minutes after elective admission post coronary artery bypass grafts and mitral valve repair. He had an acute myocardial infarction 4 weeks ago; his pre-operative echo showed moderate left ventricular dysfunction and moderate to severe mitral regurgitation. His blood pressure is now 70/45 and the registrar requests your immediate help at the bedside.

Describe your management approach to this problem, including the major differential diagnoses you would consider.

Viva 2

You are the Duty Intensivist at a large neurosurgical centre and receive a call from a General Practitioner in a small rural Emergency Department. She reports that a man in his 40s has been assaulted and beaten unconscious with a crowbar outside a pub.

Upon his arrival at the hospital she intubated him immediately for a low GCS. On examination he has obvious facial and head injuries with a BP of 180/100. No other injuries are immediately apparent but there is no CT scanner.

After speaking to your neurosurgical registrar who has accepted the patient, the GP is now seeking an urgent patient transfer to your intensive care unit.

What initial questions would you ask the GP prior to transfer to provide you with an assessment of the patient?

Viva 3

A 58-year-old morbidly obese woman is admitted to your ICU following an out of hospital cardiac arrest. The arrest was witnessed and bystander CPR was provided immediately and continued for 20 minutes until Ambulance arrival. The initial rhythm was VT and she had a single DC shock with return of spontaneous circulation.

She was making non-purposeful movements in the ED prior to being anaesthetised, intubated and sent to cardiac cath lab. She returns to the ICU with vitals; HR 90 bpm SR, BP 95/55, temperature 37.8.

Outline your initial assessment.

Viva 4

You are taking over the care of a long-term patient in your Intensive Care Unit whom you have not previously treated.

The patient is a previously well 72-year-old female with an admission diagnosis of Guillain-Barre syndrome. She has been an inpatient in your unit for the last three months, and has suffered numerous complications during her stay, but is now reported to be clinically stable. She has a tracheostomy in situ and is awake and responsive, but remains ventilator dependant.

You are taking over the care of this patient for the first time.

Outline your approach and how you would assess her.

Viva 5

A 45 year-old man post-attempted hanging was found 4 days ago by his family in cardiac arrest. His initial rhythm was asystole. He received 45 minutes of cardiopulmonary resuscitation before return of spontaneous circulation.

Past history includes previous suicide attempts, moderate alcohol intake, hypertension and multiple skin cancer excisions.

At present his pupils are fixed and dilated and corneal reflex is absent. He is breathing spontaneously and has a cough reflex. He initially had myoclonus but now only extends to pain. He has not had any sedation for 72 hours. He is on 0.2mcg/Kg/min noradrenaline for BP support and does not have any other overt organ failure.

His CT scan done 24 hours earlier shows loss of grey-white matter differentiation and bilateral thalamic infarcts.

Can you outline the important information about this man’s cardiac arrest and why?

Viva 6

You have been asked to assist with the intubation of a patient with respiratory failure related to influenza infection.

What are the infection control measures that you and the nursing staff need to take for this patient in this situation?

Viva 7 - Radiology Viva

NB: Images removed from this question.

Consisted of 5 plain X-ray images and 3 CT scans for interpretation.

Viva 8 - Communication Viva

You have just started your week on duty as the consultant. On handover you have been advised that the family representative is coming in for a discussion today about George. George is a 67-year-old man, day 7 after resuscitation following an unwitnessed cardiac arrest. He has had no sedation for 3 days, has a Glasgow Coma Score of 3, unresponsive pupils and a weak cough. CT scan of head shows evidence of diffuse hypoxic brain injury. George is also on high levels of respiratory support due to concomitant aspiration pneumonia.

The family has been unwilling to accept his poor prognosis. They have made it clear that he is to have all active treatment, including CPR in the event of an arrest, as George would want “everything” done.

This morning he is looking increasingly unstable with worsening hypoxia.

The family spokesperson has arrived and is waiting to talk to you.