COLLEGE OF INTENSIVE CARE MEDICINE
OF AUSTRALIA AND NEW ZEALAND

**SECOND PART EXAMINATION**

**EXAM REPORT**

**AUGUST / OCTOBER 2020**

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

The exam comprises a written section and an oral section. The written exam consists of two 2.5hr papers of 15 short answer questions each. The pass mark for the written section is derived by the Angoff method and for this sitting was set at 52.5%. The oral exam consists of eight interactive vivas and two separate clinical "hot cases". Due to COVID, the vivas were completed online over three consecutive days, and the clinicals were completed locally in several locations over a two-week period.

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 must demonstrate performance consistent with that of a trainee who is ready to enter the transition year of the CICM training program, i.e., that of junior consultant by demonstrating they have the ability for safe, effective, independent practice as an Intensivist. Candidates who are not at this level are strongly encouraged to defer their attempt at the exam.**

| Overall Performance | 2020.2 | 2020.1 | 2019.2 | 2019.1 | 2018.2 | 2018.1 |
|---|---|---|---|---|---|---|
| Presenting for written (Including SIMG) | 45 | 50 | 57 | 44 | 67 | 49 |
| Carrying a pass or exempted from a previous attempt | 2 | 11 | 7 | 13 | 7 | 11 |
| SIMG Exempt | 0 | 0 | 0 | 0 | 0 | 0 |
| Total number presenting (written + carry + SIMG) | 47 | 61 | 64 | 57 | 74 | 60 |
| Invited to orals (passed written section) | 29 | 37 | 34 | 20 | 47 | 28 |
| Total number invited to oral section | 31 | 48 | 40 | 33 | 54 | 38 |

| Analysis of Performance in Individual Sections | 2020.1 / 2020.2 | | 2019.2 | 2019.1 | 2018.2 | 2018.1 |
|---|---|---|---|---|---|---|
| Successful in the written section | 29/45<br>64% | 37/50<br>74% | 34/57<br>60% | 20/44<br>45% | 47/67<br>70% | 28/49<br>57% |
| Successful in the Hot case section | 45/74<br>61% | | 27/40<br>68% | 24/33<br>73% | 33/54<br>61% | 23/38<br>61% |
| Successful in both Hot cases | 26/74<br>35% | | 15/40<br>38% | 11/33<br>33% | 19/54<br>35% | 11/38<br>29% |
| Successful in the Viva section | 55/74<br>74% | | 33/40<br>83% | 26/33<br>79% | 36/54<br>67% | 31/38<br>82% |

| Sectional Pass Rates | 2020.1 / 2020.2 | | | | | | 2019.2 | | 2019.1 | | 2018.2 | | 2018.1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pass rate | | | Highest individual mark | | | Pass rate | Highest individual mark | Pass rate | Highest individual mark | Pass rate | Highest individual mark | Pass rate | Highest individual mark |
| Hot case 1 | 55% | | | 90% | | | 55% | 88% | 64% | 88% | 57% | 85% | 58% | 85% |
| Hot case 2 | 51% | | | 90% | | | 60% | 83% | 55% | 80% | 65% | 90% | 58% | 90% |
| | Day 1 | Day 2 | Day 3 | Day 1 | Day 2 | Day 3 | Day 1 | | Day 1 | | Day 1 | | Day 1 | |
| Viva 1 | 87% | 55% | 73% | 95% | 76% | 72% | 83% | 92% | 73% | 80% | 56% | 75% | 76% | 95% |
| Viva 2 | 57% | 77% | 82% | 88% | 85% | 85% | 80% | 80% | 61% | 85% | 46% | 95% | 87% | 100% |
| Viva 3 | 70% | 55% | 95% | 78% | 71% | 85% | 90% | 85% | 76% | 77% | 74% | 85% | 87% | 100% |
| Viva 4 | 63% | 82% | 73% | 79% | 75% | 90% | 50% | 85% | 61% | 93% | 63% | 95% | 71% | 98% |
| Viva 5 | 37% | 41% | 91% | 85% | 100% | 85% | 65% | 90% | 48% | 83% | 70% | 83% | 50% | 80% |
| Procedure Viva | 53% | 41% | 86% | 85% | 93% | 83% | 45% | 93% | 85% | 90% | 81% | 95% | 53% | 90% |
| Radiology Viva | 40% | 59% | 36% | 89% | 69% | 61% | 90% | 91% | 36% | 67% | 30% | 77% | 76% | 97% |
| Communication Viva | 57% | 50% | 91% | 95% | 95% | 88% | 50% | 95% | 67% | 88% | 50% | 90% | 53% | 84% |

| Oral Section Pass Rates | 2020.2 | 2020.1 | 2019.2 | 2019.1 | 2018.2 | 2018.1 |
|---|---|---|---|---|---|---|
| Candidates who passed in written section and passed the overall exam | 14/29<br>**48%** | 28/37<br>**76%** | 24/34<br>**71%** | 17/20<br>**85%** | 35/47<br>**75%** | 22/28<br>**79%** |
| All candidates invited to oral section and passed the overall exam (written + carry + SIMG) | 16/31<br>**52%** | 36/48<br>**75%** | 30/40<br>**75%** | 26/33<br>**79%** | 39/54<br>**72%** | 30/38<br>**79%** |
| Overall Pass Rate | 16/47<br>**34%** | 36/61<br>**59%** | 30/64<br>**47%** | 26/57<br>**46%** | 39/74<br>**53%** | 30/60<br>**50%** |

*NB: The overall pass rate for 1st sitting and 2nd sitting is based on when the candidates sat the written paper, as all candidates who sat the oral section did so at the time of the second exam sitting.*

## EXAMINERS' COMMENTS

### Written Paper

The pass rate for the written section was 64%. Examiners commented that candidates had not appeared to consider the mark distribution in some multi-part questions, spending too little time on the sections which were allocated more marks.

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

Candidates that failed questions most often gave insufficiently detailed answers that were not at the level expected of a junior consultant. Candidates often gave generic answers which were not contextualised and did not deal with the specific issues in the question.

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

Candidates who failed the written section scored an average of 49% compared with those candidates who passed, whose average score was 59%.

## 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 relating to a topic. |
| **Outline:** | Provide a summary of the important points. |
| **List:** | Provide a list. |
| **Compare and contrast:** | Provide a description of similarities and differences. You may tabulate your answer. |
| **Assessment:** | Generic term that implies determining an underlying diagnosis, encompassing; history, clinical examination, and relevant investigations |
| **Management:** | Generic term that implies determining an overall management plan, encompassing; resuscitation, initial and ongoing monitoring, supportive treatment, and definitive treatment. |
| **Discuss:** | Explain the underlying key principles. Where appropriate, this may include controversies and/or pros and cons. |
| **Explain**: | Make plain, interpret, and account for. |

## NOTE

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

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

### Question 1

a) Define intra-abdominal hypertension (IAH) and intra-abdominal compartment syndrome (ACS). (20% marks)

b) Describe how intra-abdominal pressure (IAP) is commonly measured. (40% marks)

c) Briefly outline the management principles of intra-abdominal compartment syndrome (ACS). (40% marks)

### ANSWER TEMPLATE

(a)
Intra-abdominal hypertension (IAH) is defined as a sustained or repeated pathologic elevation of IAP > 12 mmHg.

Abdominal compartment syndrome (ACS) is defined as a sustained increase in IAP > 20 mmHg that is associated with new organ dysfunction / failure.

(b)
Intra- abdominal pressure is commonly measured indirectly by intra- vesical or bladder pressure
This can be done continuously or intermittently
The principles of measurement are

- can be measured using proprietary devices
- requires pressure transducer set up connected to indwelling urinary catheter
- one approach is to cross-clamp the tubing of the drainage bag and insert a 16-gauge needle through the aspiration port, which is connected to a pressure transducer
- Alternatively, a T-piece connector or a three- way stopcock is inserted between the catheter and the drainage bag
- end of expiration
- supine
- zeroed at iliac crest in the mid-axillary line (WSACS recommendation; other sources suggest using the pubic symphysis)
- instillation of 25mL of saline into the bladder (1ml/kg for children up to 25 kg, minimum of 3 mL)
- measured 60 seconds after instillation to allow detrusor muscle relaxation
- in absence of active abdominal muscle contraction (neuromuscular blockade if intubated)
- Usually measured every 4 hours (more frequent if IAP >12mmHg or otherwise concerned)

(c)

- NBM with NG tube and gastric decompression
- Decompressive laparotomy (open abdomen) if surgically indicated
- Intubation and Neuromuscular blockade
- Diuresis- if indicated
- Renal replacement therapy for fluid management or metabolic acidosis, hyperkalaemia etc-
- Lung protective ventilation, accepting that peak airway pressures may not be reflective of transpulmonary pressure (avoid proning)
- Colonic decompression
- Supportive care for other organ failure.

| | |
|---|---|
| Maximum Score | 8.36 |
| Percentage scoring >5/10 | 66.7% |

**Question 2**

a) What do you understand by the term 'balanced crystalloid solution'? (10% marks)

b) Compare and contrast the constituents of normal saline and any <u>one</u> balanced crystalloid solution. (20% marks)

c) Discuss the advantages and disadvantages of balanced crystalloid solutions and normal saline in the fluid management of diabetic ketoacidosis. (70% marks)

**ANSWER TEMPLATE**

**Definition of balanced crystalloid:**
Balanced crystalloids are crystalloid solutions with electrolyte compositions closer to that of plasma when compared to normal saline.

**Composition of Normal Saline:**
**Composition of balanced electrolyte solution (either one):**
Essential details were important to know rather than precise numbers e.g., Plasmalyte / Hartmann's less sodium than NS with small quantity of potassium and Calcium. Less chloride with addition of lactate as buffer (CSL).

| | Normal Saline | Plasmalyte | Hartmann's / CSL |
|---|---|---|---|
| Sodium | 154 | 140 | 129 |
| Potassium | | 5 | 5 |
| Magnesium | | 3 | |
| Calcium | | | 4 |
| Chloride | 154 | 98 | 109 |
| Lactate | | | 29 |
| Acetate | | 27 | |
| Gluconate | | 23 | |

**Management of diabetic ketoacidosis**
**Normal Saline:**
**Advantages**
Traditional choice hence could be considered current standard of care therefore generally considered safe traditional choice.
Cheap and readily available worldwide
**Disadvantages**
Causes a post infusion acidosis especially with large volumes (reduced strong ion difference, normal anion gap). Not formally assessed in trials.
Acidosis may contribute to mismanagement of ketosis or prolong ICU stay
Hyperchloremia may be associated with renal injury
**Balanced Crystalloid: (only expect answers relevant to fluid choice)**
**Advantages**
Much less likely to cause a secondary metabolic acidosis due to presence of buffer (reduced chloride, increased strong ion difference) therefore more rapid correction of academia overall compared to NS.
Small quantity of potassium may reduce need for potassium supplementation
**Disadvantages**
Slightly hypotonic and hence may theoretically increase risk of cerebral oedema, particular concern in children
Greater cost (Plasmalyte)
Lactate accumulation in shocked states or liver failure (Hartmann's, CSL) may also cause hyperglycaemia
Plasmalyte contains acetate which theoretically may contribute to ketosis

**Overall approach**
Patients with diabetic ketoacidosis (DKA) have a hyperosmolar state secondary to an osmotic diuresis, which also results in severe volume contraction / body fluid deficit. Volume resuscitation is vital to correct fluid losses and restore circulating volume and tissue perfusion. This may be achieved with either type of solution.
Most current guideline advocate the use of normal saline and there is no high-level evidence showing improvement in patient centred outcomes comparing one fluid type to the other. Small studies show the potential for early resolution of acidosis, and this may influence individual practitioner preference for balanced electrolyte solutions.

| | |
|---|---|
| Maximum Score | 7.33 |
| Percentage scoring >5/10 | 57.8% |

**Question 3**

With regard to severe post-partum haemorrhage (PPH):

a) List the causes. (20% marks)

b) Outline the management. (80% marks)

**ANSWER TEMPLATE**

Causes can be broken down into 4 main groups: the "4 T's"

- Tone: uterine atony (most common)
- Trauma: Bleeding at surgical sites including episiotomy, genital tract laceration [vagina/cervix etc], uterine rupture
- Tissue: Retained tissue (placenta) and/or membranes
- Thrombin: Previously present or acquired maternal coagulation defect. Examples of acquired defects include those seen in severe pre-eclampsia, severe sepsis, amniotic fluid embolism, placental abruption or in the setting of massive transfusion.

Management can be broken down into initial resuscitation and specific treatment, with specific treatment having surgical and non-surgical modalities. Resuscitation and treatment should occur simultaneously.

**Resuscitation**

- ABCDE approach. Assemble team (ICU/Anaesthesia/Obstetrics etc.)
- Appropriate monitoring: ECG / NIBP / Arterial line / CVC if time or indication
- Large bore IV access x2
- Initial resuscitation with crystalloids / 4% albumin
- Activation of PPH protocol Activation of massive transfusion protocol / Use O neg blood (but likely to know blood group already and use group specific blood) early if no X matched blood available
- No specific Hb triggers for when to use blood, suggested after no more than 30mls/kg resusc fluids or evidence of ongoing bleeding
- Other products as required: NBA Obstetric guidelines suggest FFP 15mls/kg, platelets one pooled bag, cryoprecipitate 3-4g (8-10 bags): use local protocols if possible and involve specialist Haematologist.
- Keep fibrinogen >2.0 or replace if dropping (normal in pregnancy 4-6g/L: use cryoprecipitate or fibrinogen concentrate) Emphasis on early fibrinogen
- Viscoelastic tests
- Avoid hypothermia, hypocalcaemia, and acidosis

**Non-Surgical Treatment Bimanual uterine compression**

- Pharmacological Therapy (uterotonics): oxytocin, misoprostol, prostaglandin F2 alpha
- Tranexamic Acid (TXA): [the WOMAN trial showed a substantial mortality benefit if given within 3 hours]
- Balloon tamponade (Bakri balloon)
- Vaginal/Uterine packing
- Interventional Radiology: selective arterial embolization/balloon tamponade
- Consider Factor VIIa as rescue therapy
- Treatment of underlying cause if possible – e.g., sepsis

**Surgical treatment**

- EUA: repair of lacerations / evacuation of retained placental fragments etc.
- Laparotomy: Uterine or iliac artery ligation, B-lynch brace suture
- Pelvic packing Aortic compression / X clamp
- Hysterectomy

| | |
|---|---|
| Maximum Score | 8.85 |
| Percentage scoring >5/10 | 84.4% |

**Question 4**

4.1

The following results were obtained from a 32-year-old female admitted with severe asthma.

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| $FiO_2$ | 0.4 | |
| pH | 6.92* | 7.35 – 7.45 |

| | | |
|---|---|---|
| $PO_2$ | 81 mmHg (10.8 kPa) | |
| $PCO_2$ | 71.0 mmHg (9.5 kPa) * | 35.0 – 45.0 (4.6 – 6.0) |
| $SpO_2$ | 95% | |
| Bicarbonate | 14.0 mmol/L* | 22.0 – 26.0 |
| Base Excess | -16.0 mmol/L* | -2.0 – +2.0 |
| Lactate | 9.0 mmol/L* | 0.5 – 1.6 |
| Sodium | 139 mmol/L | 135 – 145 |
| Potassium | 4.2 mmol/L | 3.5 – 5.0 |
| Chloride | 108 mmol/L* | 95 – 105 |
| Glucose | 19.2 mmol/L* | 3.5 – 6.0 |

a) Describe the abnormalities and give a potential reason for each. (40% marks)

4.2

A 22-year-old male is brought into the Emergency Department with a decreased conscious state with a history of having been missing for over twenty-four hours. Results of his investigations are given below:

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| Sodium | 149 mmol/L* | 135 – 145 |
| Potassium | 6.0 mmol/L* | 3.5 – 5.0 |
| Chloride | 114 mmol/L* | 95 – 105 |
| Bicarbonate | 19.0 mmol/L* | 22.0 – 26.0 |
| Creatinine | 210 µmol/L* | 45 – 90 |
| Urea | 10.1 mmol/L* | 3.0 – 8.0 |
| Calcium | 1.75 mmol/L* | 2.10 – 2.60 |
| Phosphate | 2.29 mmol/L* | 0.80 – 1.50 |
| Magnesium | 1.42 mmol/L* | 0.70 – 1.30 |
| Albumin | 21 g/L* | 35 – 50 |
| Alkaline phosphatase (ALP) | 62 IU/L | < 120 |
| Gamma-glutamyl transferase (GGT) | 22 IU/L | < 50 |
| Alanine aminotransferase (ALT) | 424 IU/L* | < 55 |
| Aspartate aminotransferase (AST) | 1679 IU/L* | < 50 |
| Total bilirubin | 12 µmol/L | < 19 |
| T Protein | 38 g/L* | 60 – 82 |
| Creatinine Kinase | 10315 IU/L* | < 175 |

a) Give the likely diagnosis and list <u>five</u> possible underlying causes. (30% marks)

4.3

The following arterial blood gas results are from a 72-year-old male admitted for investigation of nausea, vomiting and severe abdominal pain. He has a history of type 2 diabetes and atrial fibrillation.

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| $FiO_2$ | 0.6 | |
| pH | 6.98* | 7.35 – 7.45 |
| $pO_2$ | 92 mmHg (12.3 kPa) | |
| $pCO_2$ | 31.0 mmHg (4.1 kPa) * | 35.0 – 45.0 (4.6 – 6.0) |
| $SpO_2$ | 99% | |
| Bicarbonate | 7.0 mmol/L* | 22.0 – 26.0 |
| Base Excess | -22.0 mmol/L* | -2.0 – +2.0 |
| Lactate | 14.5 mmol/L* | 0.5 – 1.6 |

| | | |
|---|---|---|
| Sodium | 146 mmol/L* | 135 – 145 |
| Potassium | 5.3 mmol/L* | 3.5 – 5.0 |
| Chloride | 103 mmol/L | 95 – 105 |
| Glucose | 7.7 mmol/L* | 3.5 – 6.0 |
| Creatinine | 711 µmol/L* | 60 – 110 |
| Haemoglobin | 108 g/L* | 135 – 180 |

a) Comment on the abnormalities on this arterial blood gas. (15% marks)

b) List five likely causes for the acid-base disturbance. (15% marks)

**ANSWER TEMPLATE**

4.1
a)
Primary respiratory acidosis – likely secondary to asthma,
Secondary high anion gap metabolic acidosis – shock, sepsis
Concomitant non-anion gap metabolic acidosis – fluid resuscitation, (delta ratio 0.5)
Increased Aa gradient – pulmonary sepsis
Elevated lactate – sepsis, B2 agonist use
Elevated glucose – pre-existing diabetes, stress, B2 agonist, steroids

4.2
a)
Rhabdomyolysis

Crush/pressure injury
Drug/Toxins
Hyperthermia
Prolonged status
Inflammatory myopathies
Infective – viral, bacterial myositis
Neuroleptic malignant syndrome

4.3
a)
Elevated Aa gradient
Profound lactic acidosis
High Anion Gap Metabolic Acidosis (36)
Associated respiratory acidosis or incomplete compensation
Delta ratio 1.41 – suggests pure elevated anion gap acidosis
Renal impairment

b)
Metformin induced
Ischaemic gut
Pancreatitis
Sepsis
Cardiogenic shock

| | |
|---|---|
| Maximum Score | 9.30 |
| Percentage scoring >5/10 | 100% |

**Question 5**

a) Define massive pulmonary embolism. (10% marks)

b) Discuss the advantages and disadvantages of thrombolysis, catheter directed clot removal and surgical embolectomy, in the treatment of massive pulmonary embolism. (90% marks)

**ANSWER TEMPLATE**

**Definition**
Massive pulmonary embolus is defined as a pulmonary embolus resulting in significant obstruction to flow in the pulmonary outflow tract, manifested clinically by low cardiac output (obstructive shock) and hypotension (SBP <90mmHg for > 15 minutes), or requiring inotrope support).

**Thrombolysis**
Systemic thrombolysis (typically Alteplase (TPA) or Reteplase) may be delivered intravenously to hasten clot dissolution.

Advantages:
- Easily administered and available.
- May be administered during CPR (case reports of success post arrest).
- Readily available without the need for specialist training or equipment.
- Commonly used in the setting of massive PE with no contraindication (i.e., reasonable current standard of care).
- Currently supported by CHEST guidelines and European Society of Cardiology guidelines
  Disadvantages:
- Major bleeding risk, including intra-cranial haemorrhage
- Some absolute and relative contraindications
  - Examples of relative = hypertension, recent surgery, previous ischaemic stroke > 3 months ago, pregnancy, age >75 years) (example required)
  - examples of absolute contraindications (= recent brain or spinal surgery, recent head trauma, previous intracranial haemorrhage, ischaemic stroke within past 3 months) (example required)
- Limited efficacy (especially if delayed > 48 hours post onset of PE)
- Makes surgical embolectomy in event of treatment failure, much higher risk

**Catheter Directed Clot Removal**
Requires the use of interventional radiology and the placement of specialised catheters directly into the pulmonary arteries. May be used alone (fragmentation and aspiration) or in combination with a reduced, catheter directed dose of thrombolytics.

Advantages:
- Reduced systemic bleeding risk.
- Minimally invasive.
- Able to be used in many post-operative settings.
- Some supportive literature

Disadvantages:
- Requires specialist equipment and training hence limited availability.
- Time delays common.
- Risk of intracranial haemorrhage still present.
- Risk of vascular access injuries and contrast-related complications
- Risk of failure

**Surgical Embolectomy**
Direct surgical removal hence requiring cardiac surgeon and theatre.

Advantages:
- Can be performed when thrombolysis contraindicated.

- Enables more complete and rapid clot removal of large proximal clots.

Disadvantages:
- Highly invasive with anaesthesia risks
- Only available in specialised centres with immediate access to cardiothoracic surgery.
- Potential time delays to implementation.
- Useful for proximal clots only not for distal fragmented clots.

| | |
|---|---|
| Maximum Score | 8.25 |
| Percentage scoring >5/10 | 91.1% |

**Question 6**

With regard to mechanical ventilation, describe the mechanism of action of flow and pressure triggering and list the advantages and disadvantages of both.

**ANSWER TEMPLATE**

**Flow Sensing/Triggering**
A continuous fresh gas flow is sent through the ventilator circuit during patient expiration. Flow is measured at the inspiratory and expiratory limb. On spontaneous inspiration, expiratory flow will be less than inspiratory flow. The ventilator senses the decrease in flow returning through the circuit, and a breath is triggered. The (I-E) flow difference is the trigger value set by the operator.
Pros
- Continuous gas flow allows inspiration to occur before the inspiratory valve opens
- Minimal phase delay between inspiratory effort and machine response
- Sensitive, i.e., little patient effort is required to trigger a mechanical breath, and therefore the patient's work of breathing is not "wasted" on triggering the ventilator.
- Therefore, more comfortable
- It permits a lower level of sedation
- It may reduce patient-ventilator dyssynchrony particularly when the dyssynchrony is due to wasted effort (e.g., an insufficiently sensitive trigger)
- As the result of all these benefits, flow triggering permits earlier extubation (weak evidence).

Cons
- Relatively complicated, although now standard in all modern ventilators
    - dependent on accuracy and stability of the flow sensors in the device
- As it is sensitive, it is prone to false triggering (“auto-triggering”):
    - leaks (BP fistula, uncuffed tubes)
    - cardiac oscillation (hyperdynamic circulation)
    - standing waves in the circuit
    - fluid in the circuit

**Pressure Sensing/Triggering:**
The ventilator is set to detect a defined fall in circuit pressure (usually -1 to -2 cm$H_2O$ measured at the inspiratory limb) below PEEP to trigger the inspiratory phase of ventilation.
*Pros:*
- Simple
- less subject to false triggering as above (leaks, cardiac oscillation, etc.)
- It can be used to test the power of the respiratory musculature, in the context of an assessment of readiness for extubation. (A patient who is able to trigger the ventilator by generating a negative intrathoracic pressure of -20 cm $H_2O$ is unlikely to fail extubation due to the weakness of their respiratory muscles.)
- Can be used for periods of inspiratory muscle training

*Cons:*
- No inspiratory gas flow until valve opens. Triggering, or threshold work is high, as no inspiratory flow is generated while the patient is inhaling against a closed inspiratory valve

- Phase delay between patient effort and machine response (approx 40 msec)
- Therefore, associated with patient-ventilator dyssynchrony
- It is less comfortable for the patient
- It may result in increased sedation requirements because of the above factors

| | |
|---|---|
| Maximum Score | 8.50 |
| Percentage scoring >5/10 | 51.1% |

**Question 7**

A 61-year-old male is diagnosed with a large haemothorax after a fall. He has a history of atrial fibrillation and takes rivaroxaban. He becomes increasingly hypoxic and hypotensive, and a decision is made to urgently correct the coagulopathy and insert a chest drain.

His first set of coagulation tests are as follows:

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| International normalised ratio (INR) | 2.0* | 0.9 – 1.3 |
| Activated partial thromboplastin time (APTT) | 37.0 sec | 27.0 – 38.5 |
| Fibrinogen | 5.4 g/L* | 2.0 – 4.0 |

a) What is the mechanism of action of rivaroxaban? (10% marks)

b) What other information do you need from history and investigations to make an assessment of his coagulation status? (40% marks)

c) What steps will you take to correct his coagulopathy? (50% marks)

**ANSWER TEMPLATE**

a)
Rivaroxaban binds directly to Factor Xa and inhibits it preventing factor Xa from cleaving prothrombin to thrombin.

b)
Further history: rivaroxaban dose and interval since last dose, any other anticoagulant/antiplatelet medications being taken concurrently.
Also, any history of bleeding/bruising and relevant comorbidities
Investigations:

- Anti-factor Xa chromogenic assay calibrated specifically for rivaroxaban – correlates more closely with the anticoagulant effect of rivaroxaban than INR or APTT.
- Renal and liver function – as half -life of rivaroxaban is dependent on this. Severe renal or hepatic impairment may affect the degree and or duration of anti-coagulation
- FBC (check platelet count), platelet function
- Other tests for coagulation:
  - ABG for pH and iCa++.
  - ROTEM correlates only weakly with plasma concentration, particularly at low doses. Limited data regarding the reliability of these point of care tests. -
  - Plasma assays of the drug itself is available at some sites, although the time to result will likely be too long in this scenario to be clinically useful.

c)
General principles; Consult hematology early. Discontinue rivaroxaban. Correct other coagulation disorders which may co-exist (e.g., transfuse platelets if <50, correct hypocalcaemia, maintain body temperature and pH)

Tranexamic acid 15-30mg/kg IV load followed by infusion
Prothrombin complex concentrate. This would ideally be 4-factor. If unavailable, can use Prothrombin-x 50U/kg and supplement with plasma to provide extra fVII. FEIBA (activated PCC/factor VIII inhibitor activity bypassing agent) may be equally effective, but data is currently lacking. rFVIIa is not currently recommended for use in reversing DOAC effect.
Oral activated charcoal if the most recent dose was within 2 hours, provided airway is protected.

| | |
|---|---|
| Maximum Score | 9.25 |
| Percentage scoring >5/10 | 95.6% |

**Question 8**

*"All patients with return of spontaneous circulation after out of hospital cardiac arrest should have an urgent cardiac catheterisation, including patients with normal post resuscitation ECGs."*

What are the advantages and disadvantages of this approach?

**ANSWER TEMPLATE**

**Pros**
a. In the presence of ST elevation post OHCA (Out of Hospital Cardiac Arrest) all patients without absolute contra-indications should go to cath lab

b. Patients without clear symptoms or signs of ischaemia may still have had an ischaemic cause for arrest. Case series and registries of OHCA have suggested that 1/4 cases taken to cab lab with no ECG evidence of ischemia will have lesions requiring treatment. Treatment in these patients will lead to a 60% survival improvement with a 90% chance of good neurological recovery. Most studies have published a number needed to treat of 4 to prevent one death with a 90% chance of good neurological recovery.

c. Current recommendations from the American Heart Association suggest that any OHCA with ROSC should go to cath lab if ischemia is suspected

d. Transfer to cath lab with treatment may prevent further cardiac arrests

e. Professional (American Heart Association and European Resuscitation council) bodies who have made recommendations say there is no role in waiting to assess neurological recovery

**Cons**
a. These may be unstable patients

b. The cath lab maybe isolated from other emergency services and take staff away from ED or ICU

c. Transfer to another centre may be required

d. Experienced staff are required to anaesthetize a patient undergoing coronary angioplasty or stenting.

e. Taking all comers to cath lab may lead to many poor outcomes due to high pre OHCA morbidities.

f. Many patients may be taken after prolonged cardiac arrest who may go onto survive with poor neurological recovery

g. There are financial consequences to running a 24-hour cath lab service

h. If there is another explanation for the cardiac arrest the time in the catheter lab maybe detrimental to the patient

i. Anti-coagulation and anti-platelet medications may increase the risk of haemorrhage

j. Difficulty with targeted temperature management in cath lab environment

| | |
|---|---|
| Maximum Score | 8.50 |
| Percentage scoring >5/10 | 88.9% |

**Question 9**

You have been asked to see a 52-year-old female in the Emergency Department who presented with a fever of 39.5ºC and generalised tonic-clonic seizures. Apart from a persistent reduced level of consciousness, her vital signs are currently stable.

a) List three central nervous system (CNS) and three non-CNS aetiological classifications for her presentation, with an example of each. (30% marks)

b) List six findings on physical examination that would be important in differentiating between potential diagnoses. (30% marks)

c) Describe the specific laboratory tests/investigations you would perform or request in this patient with justification for your inclusions. (40% marks)

**ANSWER TEMPLATE**

a)
CNS aetiologies of fever and seizures

- Infective
    - e.g., Viral encephalitis, (HSV, EBV), Bacterial meningitis (S pneumoniae, N meningitidis
- Epilepsy
    - Prolonged seizure
    - Non-compliance
    - Intercurrent illness
- SOL
    - Brain abscess
- Autoimmune
    - e.g., ADEM, Anti-NMDA receptor, Para neoplastic etc.
- Vasculitis
    - SLE
- SAH/Intracranial haemorrhage
- Infective endocarditis with cerebral emboli

Non-CNS Toxidromes/ intoxication

- E.g., Cocaine, Amphetamines
- Withdrawal syndrome
    - Alcohol
    - benzodiazepine
- Endocrine
    - E.g., Hyperthyroidism
- Exertional/environmental
    - Heat stroke, exertional hyponatraemia

b)
Localising neurological signs
High Blood pressure
Pupillary reaction (size for drug reactions, reactive/equal for SOL)
Fundoscopy- subhyloid haemorrhage, papilloedema
Signs of meningeal irritation: Nuchal rigidity, Kerning's sign, Brudzinski's sign
Signs of coning or neurological emergency if SOL/brain abscess
Peripheral stigmata of infective endocarditis (any)
Signs of vasculitis (any)

Signs of drug use (track marks etc)
Signs of thyrotoxicosis (goitre etc)
Fluid state: dehydration in heat stroke giving hypotension
Rash for some infections e.g., meningitis
Tense compartments

c)
Blood Tests:
To rule out cause of seizures
BSL and electrolytes
Ionized calcium
Culture, bloods x2
FBC- baseline but WCC difficult to interpret as increased in seizures and infection
ELFTS- check for rhabdo if heat stroke, AKI if rhabdo.
Drug levels screen for toxidromes, e.g., cocaine
TFTs- Thyrotoxic crisis
Coags prior to LP
Meningococcal/Pneumococcal PCR
Serological for vasculitis's if clinical suspicion

Urine
dipstick: as an infective cause.
Urine antigen for legionella and S. pneumoniae

CSF
(C/I if focal neurology or signs of increased ICP clinically or radiological)
GM stain CSF to see any organisms
PCR: for Viruses like herpes and for meningitis: bacteria like: N. meningitides, S. pneumoniae
Examine the opening pressures: often high with high ICP
glucose proteins and cell count: proteins and cell count will be high with CNS infection
Serology: IgM antibodies for viruses may be useful: if not detected on CSF examination
Anti-NMDA receptor Abs

| | |
|---|---|
| Maximum Score | 7.33 |
| Percentage scoring >5/10 | 88.9% |

**Question 10**

10.1

The following results were obtained from a 62-year-old female one week following a subarachnoid haemorrhage with increasing confusion:

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| Sodium | 130 mmol/L* | 135 – 145 |
| Potassium | 4.0 mmol/L | 3.5 – 5.0 |
| Chloride | 96 mmol/L | 95 – 105 |
| Bicarbonate | 26.5 mmol/L* | 22.0 – 26.0 |
| Glucose | 5.5 mmol/L | 3.5 – 6.0 |
| Urea | 2.5 mmol/L* | 3.0 – 8.0 |
| Creatinine | 37 µmol/L* | 45 – 90 |
| Magnesium | 0.87 mmol/L | 0.75 – 0.95 |
| Albumin | 33 g/L* | 35 – 50 |
| Protein | 74 g/L | 60 – 80 |
| Total bilirubin | 10 µmol/L | < 26 |
| Alanine transferase | 26 U/L | < 35 |
| Serum Osmolality | 274 mosm/kg* | 285 – 295 |

| | | |
|---|---|---|
| Ionised calcium | 1.19 mmol/L | 1.10 – 1.35 |
| Calcium corrected | 2.34 mmol/L | 2.12 – 2.62 |
| Phosphate | 0.97 mmol/L | 0.80 – 1.50 |

a) What are the two most likely causes for this biochemical profile? (10% marks)

b) How would you distinguish between the two biochemically and clinically? (30% marks)

10.2

The following arterial blood gas was obtained from a 19-year-old chemistry student who presents with dyspnoea, cyanosis and feeling unwell. He has been handling chemicals today and admits to recreational drug use but takes no prescribed medicines. His observations on 8 L/min oxygen via a Hudson mask are as follows:

Temperature: 37.2ºC
Heart rate: 130 beats/min sinus
Blood Pressure: 140/73 mmHg
Oxygen Saturation: 82%

His initial arterial blood gas analysis is given below:

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| $FiO_2$ | 0.4 | |
| pH | 7.45 | 7.35 – 7.45 |
| $pO_2$ | 219 mmHg (29.2 kPa) | |
| $pCO_2$ | 37.8 mmHg (5.04 kPa) | 35.0 – 45.0 (4.60 – 6.00) |
| $SpO_2$ | 98.1% | |
| Bicarbonate | 26.6 mmol/L* | 22.0 – 26.0 |
| Base Excess | 2.6 mmol/L* | -2.0 – +2.0 |
| Lactate | 0.9 mmol/L | 0.5 – 1.6 |
| Sodium | 139 mmol/L | 135 – 145 |
| Potassium | 3.9 mmol/L | 3.5 – 5.0 |
| Chloride | 107 mmol/L* | 95 – 105 |
| Ionised Calcium | 1.18 mmol/L | 1.15 – 1.29 |
| Glucose | 7.1 mmol/L* | 3.5 – 6.0 |

a) What is the diagnosis? (10% marks)

b) Name two recreational drugs and two chemical compounds that can cause this condition other than prescribed medicines. (20% marks)

c) What emergency treatment would you give? (20% marks)

d) In what circumstance would your treatment of choice be contraindicated? (10% marks)

**ANSWER TEMPLATE**

10.1

a) and b)

- Consistent with either SIADH or CSWS after SAH, (hyponatraemia with reduced urea, creatinine, and albumin).
- High urine osmolality favours SIADH. High urinary sodium favours CSWS.
- Need clinical assessment of volume status and urine volume to distinguish between the two. Hypvolaemia favours CSW, and euvolaemia favours SIADH

10.2

a) Methaemoglobinaemia

b)
Recreational drugs:
inhaled nitrates, cocaine, phenylamine
Chemical compounds:
Copper sulphate
Aniline dyes, nitrobenzene, naphthalene, nitromethane, toluidine
Sodium chlorite, ammonium carbonate, dinitrophenol
Paraquat, aluminium phosphide

c) Emergency management:
Cease precipitating agent if known
i.v. methylene blue
Hyperbaric oxygen and exchange transfusion have also been used.

d) Methylene blue is contraindicated in G6PD deficiency.

| | |
|---|---|
| Maximum Score | 7.83 |
| Percentage scoring >5/10 | 55.6% |

**Question 11**

You are asked to review a 74-year-old female in the Emergency Department who has presented with an infective exacerbation of her Chronic Obstructive Pulmonary Disease (COPD).

On examination she is conscious, but unable to speak in sentences. She has a respiratory rate of 36 breaths/min and oxygen saturations of 88% on high flow nasal prongs (HFNP) with $FiO_2$ = 0.4, and 50 L/min of flow. Heart rate is 108 beats/min and blood pressure 156/84 mmHg.

Her blood gas shows:

| | |
|---|---|
| pH | 7.34 |
| $PaO_2$ | 58 mmHg (7.73 kPa) |
| $CO_2$ | 52 mmHg (6.93 kPa) |
| Lactate | 3.2 mmol/L |

What factors would influence your decision to choose non-invasive ventilation or invasive ventilation in this patient?

**ANSWER TEMPLATE**

<u>Non-invasive ventilation</u>
BiPAP or mask delivered pressure support is generally the mode of NIV choice in COPD exacerbation as it reduces work of breathing, augments TV for each breath leading to less mechanical disadvantage and improved gas exchange. Outcomes are better.

Reasons for choosing NIV in this patient include

- Her conscious state appears to be intact
- Her blood gases are not terrible; hypercapnia is not extreme, oxygenation acceptable
- Not shocked
- No evidence of other organ dysfunction
- Early use generally increases success rate
- For all these reasons, this should be the modality of choice in this patient
- General benefits:
    - If tolerated, there is a reduced requirement for intubation.

    - Reduced rate of complications, mortality and hospital stay
    - Preservation of consciousness
- May be destination/ceiling of care if this lady has advanced disease, or there are advance care directives in place favouring a conservative pathway
- In some hospitals it can be used in a respiratory ward environment hence reducing need for an ICU admission

Problems and (relative) contraindications:

- May not be tolerated; can induce claustrophobia in some patients (especially if there is a history of trauma/abuse)
- Unable to cough and clear secretions with face mask. An issue if there is an active bronchitis with a significant secretion load
- Risk of aerosolising infection using NIV especially with viral pathogens
- Difficulty with nutrition if BiPAP dependent and NGT affects seal of mask

Invasive Ventilation

Note there are no major indications for ventilation at this point; If patient does not tolerate NIV a further observed period using HFNP may be appropriate.

- Need to ensure it is consistent with patient wishes and is medically appropriate
- Failure of NIV with physiologic deterioration
- If COVID infection (or other highly infectious agent) confirmed or suspected.
- More appropriate if she develops other organ dysfunction, including haemodynamic instability or altered LOC
- If exhausted and very distressed may be the best option to relieve discomfort and maintain clinical stability & preserve life

| | |
|---|---|
| Maximum Score | 8.00 |
| Percentage scoring >5/10 | 55.6% |

**Question 12**

a) With respect to the diagnosis of pulmonary tuberculosis, describe what investigations are available in ICU patients and their advantages and limitations. (50% marks)

b) What infection control precautions should be taken when admitting a patient with active pulmonary tuberculosis to the ICU? (50% marks)

**ANSWER TEMPLATE**

a)

CXR

- Often does not differentiate between active and inactive disease.
- Many different appearances
- Simple, easily available

CT

- May increase sensitivity and assess for alternative diagnoses.
- Requires transport – infection control issue

Sputum

- Simple and widespread availability, cheap
- AFB smear and culture (and drug susceptibility testing) – need at least three high-quality specimens at least 8 hours apart, at least one in the early morning
- At least one sputum for nucleic acid amplification (NAA) testing
    - NAAT take only hours to run, and results are usually available within a day
    - High sensitivity (>95%) in smear-positive specimens, but lower sensitivity (17-80%) in smear-negative specimens - so negative result does not exclude TB.

- If unable to produce adequate sputum sample, sputum induction (e.g., nebulised saline) or bronchoscopy.
    - Yields from induced sputum and BAL are comparable, and so induced sputum is reasonable initial test if patient able to comply.

Blood

- Quantiferon Gold will detect activity against TB antigen
- It cannot differentiate between latent and active TB
- Immunocompromised patients can have variable QFN Gold outcomes depending on degree of immunocompetency

Tuberculin skin test (or interferon-gamma release assay)

- Positive result supports diagnosis of active TB infection.
- Negative result does not rule out.

Tissue biopsy or sampling

- e.g., lung parenchyma, LN
- Consider when other investigations non-diagnostic
- Invasive.

(b)

Airborne/Respiratory precautions.

- Admit to isolation room with negative pressure ventilation
- Signage
- Healthcare workers and visitors should wear N95 mask while in contact with the patient (including on transports). Staff should be fit-tested to determine appropriate mask for them. If unable to use an N95 due to poor fit etc., a PAPR should be used.
- Minimise aerosol-generating procedures
- Patients should cover mouth and nose when coughing/sneezing.
- Patients should wear a surgical mask when outside the negative pressure room.
- Appropriate cleaning of instruments such as bronchoscope.
- If ventilated, bacterial filter in the ventilator circuit with closed suction
- Vulnerable people, e.g., immunosuppressed, or young children, should not visit
- Vulnerable staff members (immunosuppressed, diabetes, autoimmune disease or pregnant) should not care for this patient
- Clearly label laboratory specimens as possible TB. Place in biohazard bag.

| | |
|---|---|
| Maximum Score | 7.33 |
| Percentage scoring >5/10 | 64.4% |

**Question 13**

List and briefly discuss the considerations in managing a patient with dialysis dependent End Stage Renal Failure (ESRF) admitted to the ICU post-operatively from an uncomplicated Hartmann's procedure.

**ANSWER TEMPLATE**

***Specific***

Vascular Access and Care:

- Venous access and BP measurement away from the fistula arm
- Preservation of subclavian vessels for future AV fistulae (subclavian vein stenosis is common after subclavian lines, and impairs venous limb function of any future AV fistula, monitoring of AV-f to ensure its function/? MAP targets
- re-consider need for arterial access:
    - high incidence of atherosclerotic disease increases rates of complication, and insertion difficulty.
    - aim to preserve radial and brachial arteries for future AV fistulae
- Difficult IV access due to multiple fistulae and central venous access

- Do not use AV fistula for CRRT; but short-term cannulation for conventional HD acceptable if performed by renal trained staff. In longer sessions there is risk of dislodgement, haemorrhage, and possible damage to AV fistula.
- Acceptable to use existing semi-permanent implanted venous dialysis catheter. Anticoagulant locks after use critical to maintain function. Meticulous asepsis with access and de-access

Diet/nutrition:

- generally, give normal nutrition and calorie load, with adequate dialysis (CRRT or intermittent HD)
- may require lower $K^+$ and $PO_4$ in TPN or EN, depending on dialysis

Renal Replacement Therapy

- can use CRRT or intermittent dialysis in the ICU. This will depend on CVS stability, electrolyte derangement, acid base status, fluid balance.
- may be able to continue automated PD; liaise with renal unit.
- sicker, and emergency surgical patients will generally need CRRT
- decision between CRRT and IHD may depend on logistic factors, such as availability of reverse osmosis treated water source for IHD

Fluid management

- Does the patient normally pass urine, knowledge of dry weight, avoidance of hyper and hypotonic fluids?

Analgesia:

- requires careful consideration, especially opiate retention.
- NSAIDs are usually appropriate if completely anephric.

***General***

Consultation with renal team managing patient
Drug dosing: dose adjustment for renal failure
Higher infection risk
More likely to be colonized with multidrug resistant organisms due to attendance at hospital for treatment
Co morbid diseases likely e.g.

- very high incidence of atherosclerotic vascular disease, heart, CNS, peripheral
- silent cardiac ischaemia if diabetes
- hypertension, with left shifted autoregulation, may require higher MAP if cerebrovascular disease; alternatively, lower targets may be appropriate in younger patients as no need to support renal perfusion.
- Bleeding risk due to uraemic platelet dysfunction

Higher mortality than non ESRF patients- controversial
Advance care directives and treatment limitations maybe in place
Previous transplant and immunosuppressive therapy
Previous or recent corticosteroid use

| | |
|---|---|
| Maximum Score | 6.00 |
| Percentage scoring >5/10 | 8.9% |

**Question 14**

With respect to management of the cervical spine in an intubated ICU patient who has suffered a multi-trauma:

a) What are the advantages and disadvantages of radiological clearance of the cervical spine with MRI compared to CT? (40% marks)

b) List the complications of prolonged immobilisation when spinal precautions are used for a suspected cervical-spine injury. (60% marks)

**ANSWER TEMPLATE**

Multi-trauma patients with potential spinal injuries need to have their spine immobilised until the spine is cleared of instability. This is a controversial area where the adverse effects of immobilisation need to be balanced by the risk of exacerbating or causing a spinal cord injury. Determining stability and management of fracture patterns is complex and will normally a specialist service (e.g., trauma team, neurosurgery, or orthopaedics)

| | CT | MRI |
|---|---|---|
| Cost/ availability | ○ Cheap and readily available<br>○ Often performed as part of initial CT trauma | ○ More expensive and not always available<br>○ Specialised equipment and frequently a delay to available slot |
| Transport | ○ Less risks associated with transport as familiar environment to ICU staff<br>○ Short time out of unit as images quick to acquire | ○ Risks associated with unfamiliar environment and often requires anaesthetist<br>○ MRI compatible monitoring<br>○ Lengthy time out of unit due to time to set up and acquire images |
| Image quality | ○ Improved technology with improved sensitivity for ligamentous injuries<br>○ May still miss significant injuries despite this (4%)<br>○ Modality of choice for bony injuries | ○ Most sensitive at detecting ligamentous injuries<br>○ False positives mean collar remains in situ unnecessarily for patients with no C-Spine injury<br>○ Less sensitive for bony injury<br>○ Direct visualisation of spinal cord for oedema/haematoma which can be useful in prognostication |
| Other | ○ Clearance of spine usually occurs more quickly and therefore associated with less complications from immobility<br>○ Significant thyroid radiation | ○ Maybe contraindicated if unstable patient, MRI incompatible material e.g., PPM/other past procedures or from management of trauma e.g., ex fix to leg |

Complications of prolonged spinal immobilisation

- Respiratory
  - Increased aspiration risk from supine position
  - Increased risk of VAP from lack of physio, gastroparesis, and inability to provide optimal oral care
  - Increased difficulty with reintubation in a neutral position with collar in situ
- Procedural issues
  - CVC access more complex as IJ route frequently unable to be used
  - Transportation of the patient more complex => may lessen appropriate Ix or interventions
  - Less interventions performed such as physiotherapy / mobilisation whilst potentially unstable
  - Full immobilisation increases nursing workload with complex turns; potential need for specialised beds and equipment (e.g., Engrit beds, Jordan frames, skull tongs)
  - Issues with other types of surgery not able to be performed if patient needs to be positioned differently e.g., lateral side for thoracotomy or head and neck surgery where neck movement required
- Neurological
  - Maintenance of otherwise unnecessary sedation pending ‘clearance’ / Delayed extubation
  - In patients with TBI collar may impede venous return/raise ICP and inability to sit patient up may exacerbate intracranial hypertension
- General issues
  - Pressure areas from collars and mattresses due to inadequate pressure relief
    - Associated increased risk of infection
    - Routine pressure relieving mattresses commonly used on ICU beds do not provide adequate spinal precautions in unstable injuries and are therefore unable to be used
  - Increased DVT risk
  - Increased gastroparesis from prolonged immobility
  - Poor tolerance of feeds

| | |
|---|---|
| Maximum Score | 6.92 |
| Percentage scoring >5/10 | 24.4% |

**Question 15**

a) List six clinical features associated with myotonic dystrophy. (30% marks)

b) List five clinical signs of severity in chronic aortic regurgitation. (25% marks)

c) List three causes of coma with bilateral miosis. (15% marks)

d) List six clinical features of lateral medullary syndrome. (30% marks)

**ANSWER TEMPLATE**

a)
Frontal baldness
Myotonic facies
Wasting of facial muscles, sternocleidomastoids, muscles of distal extremities Myotonic spasms (e.g., delay in opening fingers after making a fist)
Percussion myotonia
Cardiomyopathy
Cataracts
Testicular atrophy
Slurred speech (pharyngeal myotonia)
Intellectual impairment
Absent reflexes

b)
Collapsing pulse/wide pulse pressure
Length of decrescendo diastolic murmur
LV third heart sound
Soft A2
Austin Flint (mid-diastolic) murmur
Left ventricular failure
Displaced apex beat

c)
Pontine lesions
Thalamic haemorrhage
Metabolic encephalopathy
Organophosphate
Other cholinergic agents (e.g., donepezil for Alzheimers) Opioids, barbiturates, GHB, clonidine
Mushroom intoxication (cholinergic effect)

d)
Ptosis
Miosis
Anhidrosis
Enophthalmos
Nystagmus
Ipsilateral V, IX and X cranial nerve lesions
Ipsilateral cerebellar signs
Contralateral pain and temperature (spinothalamic) loss over the trunk and limbs

| | |
|---|---|
| Maximum Score | 9.25 |
| Percentage scoring >5/10 | 82.2% |

**Question 16**

The following questions relate to targeted critical care transthoracic echocardiography (Level 1 haemodynamic assessment) performed in the ICU.

a) In a patient with suspected pericardial tamponade:

   i. Which view on transthoracic echocardiography would you use to assess the heart and why? (10% marks)

   ii. Describe three features of pericardial tamponade that you would expect to see in this view. (30% marks)

b) In a patient with a history of ischaemic heart disease who is cold, clammy, and hypotensive, describe how you would assess left ventricular systolic function in the parasternal short axis (PSSA) view. (30% marks)

c) In a previously healthy patient with a traumatic leg amputation, describe how you would assess volume status in the subcostal view. (30% marks)

**ANSWER TEMPLATE**

a)
i) Subcostal view. Can easily visualise the effusion, and qualitatively assess R atrial/R ventricular free wall compression, if present. It is also the view that is used to guide pericardiocentesis
ii)

- presence of a pericardial collection, size depends on whether it is an acute effusion (usually smaller) or a chronic effusion (which can be much larger). The essence of the answer is that the effusion is clearly visible, and that the diagnosis depends on the presence of the effusion plus evidence of haemodynamic effects.
- qualitatively assess compression of the R atrial/R ventricular free wall. Measurement of respiratory variation in inflow through the mitral valve is beyond level 1 scanning and should not be required, however if it is stated then that is acceptable.
- a dilated inferior vena cava with no respiratory variation. This indicates high right atrial pressures.
- the appearance of an underfilled or 'empty' left ventricle, consistent with reduced right and therefore left sided preload.

b)

- The PSSA view is the only view that shows all the coronary artery supply territories and is therefore a great view for assessing for regional wall motion abnormalities (RWMAs). RWMAs would be important in this man given his history of ischaemic heart disease.
- Qualitative assessment – the left ventricle can be assessed visually for how vigorous the systolic contraction is. At level 1 scanning, qualitative classification into mild, moderate, or severe systolic dysfunction is reasonable.
- Quantitative assessment – a simple 2-D measurement is fractional area change (FAC). In essence, this quantifies the difference in blood filled area between systole and diastole and converts it into an estimate of stroke volume. Candidates do not need to describe how FAC is determined. An awareness of quantitative assessment is sufficient.

c)

- Inferior vena cava – you would expect this patient to be hypovolaemic, with a non-dilated IVC that collapses with respiration.
- The left ventricle will appear underfilled, due to decreased preload from hypovolaemia.
- The left ventricle is likely to appear hyperdynamic. In a normal heart, the response to hypovolaemia is to increase the heart rate. The combination of tachycardia and near complete emptying of the underfilled left ventricle contribute to the qualitative impression of a hyperdynamic LV.

| | |
|---|---|
| Maximum Score | 9.75 |
| Percentage scoring >5/10 | 55.6% |

**Question 17**

Discuss the advantages and disadvantages of the following three techniques for assessing fluid responsiveness:

a) Pulse pressure variation. (40% marks)

b) Passive leg raising. (30% marks)

c) Fluid bolus. (30% marks)

(Note to candidates: details of how the techniques are performed are not required.)

**ANSWER TEMPLATE**

**Pulse pressure variation**
**Pros**
-Information readily available at the bedside
-Measurement incorporated into modern ICU monitoring systems
-Relies only on presence of an arterial line.
-Multiple studies have validated the measure
-Doesn't require the administration of volume

**Cons**
Several preconditions required for PPV to have adequate discrimination, thereby limiting its utility in many patients
-Patient mechanically ventilated with VT~8ml/Kg and 'normal' lung compliance
-Absence of spontaneous breathing (patient paralysed or adequately sedated)
-Absence of arrhythmias e.g., AF
-Absence of intrabdominal hypertension
-Absence of right heart failure

**Passive leg raising**
**Pros**
-Highly predictive of fluid responsiveness
-May be used in circumstances when PPV is not validated such as spontaneous breathing, low VT, AF
-Reversible hence doesn't require the administration of fluid
**Cons**
-Not possible in setting of movement restrictions e.g., lower body trauma, raised ICP.
-Contraindicated with certain femoral cannula e.g., IABP, ECMO

**Fluid bolus**
**Pros**
Definitive test for fluid responsiveness
Likely preferred option when volume depletion highly likely clinically (e.g., bleeding) and low clinical risk of volume overload
**Cons**
Requires administration of volume
Often given for indications that have little specificity for hypovolaemia e.g., oliguria
Repeated fluid challenges can lead to large volumes of (unnecessary) fluid administration

| | |
|---|---|
| Maximum Score | 7.87 |
| Percentage scoring >5/10 | 26.7% |

**Question 18**

Outline the ICU management of a 25-year-old male who has fulfilled brain death criteria and is awaiting surgery for organ donation.

**ANSWER TEMPLATE**

**Temperature Maintenance:**
- Hypothermia is common due to cold fluids, heat loss through exposure, inability to vasoconstrict or shiver, reduced metabolic rate.
- Maintain normal core temperature
  - o Cover patient
  - o Warm room
  - o Warming blanket
  - o Warm fluids especially high volume
  - o Humidification

**Respiratory support:**
- Aim to avoid fluid overload
- Aim for adequate Sp02 and normocarbia with lowest Fi02 and limit tidal volumes • Bronchoscopy for persisting collapse
- Chest physiotherapy may be helpful

**Circulatory Support:**
Immediately prior to brain death there is often a period of sympathetic hyperactivity with associated tachycardia and hypertension. This is lost following brain death commonly resulting in vasodilation and hypotension
- Maintain adequate mean arterial pressure. Use judicious volume expansion and low dose inotropes (usually noradrenaline)
- Monitor peripheral perfusion and urine output regularly
- Continue maintenance fluids

**Metabolic haematology and biochemistry:**
Diabetes insipidus is common and if not recognized and treated can quickly lead to hypernatraemia and hyperosmolality
- Measure electrolytes and creatinine regularly and treat as appropriate to maintain normal ranges
- Treat Diabetes insipidus with desmopressin (DDAVP) 4-8µgrams intravenously and repeat if necessary, or low dose vasopressin
- Start low dose insulin infusion if blood glucose persistently above 12mmol/L
- Stop bleeding, correct coagulopathy, thrombocytopaenia and anaemia
- Avoid hypernatremia
- Other electrolyte abnormalities – K, PO4, Ca, Mg
- Consider thyroxine replacement
- Family - counsel, explain, keep updated
- Liaison with donor coordinator and surgical retrieval teams

| | |
|---|---|
| Maximum Score | 6.62 |
| Percentage scoring >5/10 | 17.8% |

**Question 19**

With regards to veno-arterial extra-corporeal membrane oxygenation (VA-ECMO):

a) List <u>six</u> major conditions for which VA-ECMO is indicated. (40% marks)

b) List <u>four</u> contraindications for VA-ECMO. (40% marks)

c) List <u>four</u> life threatening complications of VA-ECMO. (20% marks)

**ANSWER TEMPLATE**

(a)

- Cardiogenic shock from AMI or its complications (e.g., acute valvular pathology, refractory VT / VF), that is refractory to conventional management
- Post cardiac surgery: unable to wean safely from cardiopulmonary bypass using conventional supports
- Drug overdose with profound cardiac depression
- Fulminant myocarditis
- Life threatening Pulmonary embolism
- Early primary graft failure in heart / heart-lung transplant
- Advanced valvular or prosthetic valve dysfunction
- Severe hypothermia
- Decompensated chronic heart failure where there is expectation of recovery to bridging therapy is an option
- ECMO-CPR in selected circumstances

(b)

- Severe irreversible non-cardiac organ failure e.g., neurological disease, Child Pugh B, or greater cirrhosis (ascites, encephalopathy, or recent varices) that limits survival
- Irreversible cardiac failure where transplant or VAD would not be considered
- Current intra-cranial haemorrhage
- Active malignancy with limited survival
- Chronic pulmonary hypertension
- Unwitnessed cardiac arrest or CPR > 60min prior to commencement of ECMO (this includes set up & cannulation time)
- Structural conditions – Severe aortic regurgitation or unrepaired aortic dissection
- Refusal to accept blood products
- Vascular access limitations
- Severe non correctable coagulopathy

(c)

- Pump failure
    - Pump head dis-engagement, electrical motor failure
- Catastrophic bleeding from accidental de-cannulation and/or circuit rupture
- Circuit air embolism
- Thrombosis of circuit/intra-cardiac thrombosis
- Catastrophic intracranial bleed from therapeutic anticoagulation / Embolic stroke
- Oxygenator failure
    - Heat exchanger rupture
- Limb ischemia
- Major Vessel/other injury during insertion

| | |
|---|---|
| Maximum Score | 9.00 |
| Percentage scoring >5/10 | 93.3% |

**Question 20**

20.1

The following venous blood results are from a 56-year-old patient presenting with abdominal pain.

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| Sodium | 130 mmol/L* | 135 – 145 |
| Potassium | 5.1 mmol/L* | 3.5 – 5.0 |
| Chloride | 101 mmol/L | 95 – 105 |

| | | |
|---|---|---|
| Bicarbonate | 10 mmol/L* | 22 – 28 |
| Creatinine | 305 μmol/L* | 50 – 100 |
| Urea | 75.6 mmol/L* | 3.5 – 7.2 |
| Glucose | 5.2 mmol/L | 3.5 – 6.0 |
| Calcium corrected | 2.05 mmol/L* | 2.12 – 2.62 |
| Ionized Calcium | 0.97 mmol/L* | 1.14 – 1.30 |
| Phosphate | 3.97 mmol/L* | 0.73 – 1.37 |
| Protein | 66 g/L | 61 – 83 |
| Albumin | 29 g/L* | 35 – 50 |
| Alkaline phosphatase | 220 U/L* | 30 – 110 |
| γ-Glutamyl transferase | 30 U/L | < 40 |
| Alanine transferase | 27 U/L | < 35 |
| Magnesium | 0.83 mmol/L | 0.75 – 0.95 |

a) Interpret the biochemical results, giving underlying reasons to explain the abnormalities. (40% marks)

20.2

A 44-year-old male presents following an intentional overdose. His arterial blood gases (ABG) are presented below:

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| $FiO_2$ | 0.21 | |
| pH | 7.36 | 7.35 – 7.45 |
| $pCO_2$ | 16.0 mmHg (2.13 kPa) * | 35.0 – 45.0 (4.60 – 6.00) |
| $pO_2$ | 111 mmHg (14.8 kPa) | |
| $SpO_2$ | 97% | |
| Bicarbonate | 9.0 mmol/L* | 22.0 – 26.0 |
| Base Excess | -15.0 mmol/L* | -2.0 – +2.0 |
| Lactate | 25.0 mmol/L* | 0.5 – 1.6 |
| Sodium | 150 mmol/L* | 135 – 145 |
| Potassium | 4.5 mmol/L | 3.5 – 5.0 |
| Chloride | 117 mmol/L* | 95 – 105 |
| Glucose | 4.0 mmol/L | 3.5 – 6.0 |

a) Describe the acid base abnormalities. (40% marks)

His lactate as measured on ABG is 25 mm/L, but the result on a venous blood sample taken at the same time and measured in the laboratory is only 5 mmol/L.

b) What is the most likely diagnosis? Explain the mechanism of the differences in measured lactates. (20% marks)

**ANSWER TEMPLATE**

20.1

a)
Chronic renal failure with secondary hyperparathyroidism
Elevated urea and creatinine
Decreased calcium, raised ALP and phosphate

Dehydration or GI bleed
Raised U:Cr

Mixed HAGMA and NAGMA
Low $HCO_3$ and delta ratio >1
Chronic renal failure (uraemia and RTA)
Acute on chronic renal failure (sepsis, dehydration, GI bleed etc)

20.2
a)
Metabolic acidosis and respiratory alkalosis
Elevated anion gap
Delta AG/Delta $HCO_3^-$ 0.8 evidence of non-anion gap acidosis
Elevated lactate

His lactate as measured on ABG is 25 mm/L, but the result on a blood sample taken at the same time and measured in the laboratory is only 5 mmol/L.

b)
Ethylene glycol toxicity
(Less commonly reported = paracetamol and isoniazid)
Ethylene glycol itself is not involved in lactate production.
EG metabolites (glycolic and glyoxylic acid) react with the analytical reagent L-lactate oxidase used in lactate electrodes which equip many blood gas analyses due to similar structures with lactic acid. Serum lactate measured using a different technique so "lactate gap" develops

| | |
|---|---|
| Maximum Score | 9.25 |
| Percentage scoring >5/10 | 97.8% |

**Question 21**

You are called to the Emergency Department to review a 56-year-old female found floating in the surf. Her initial rhythm was asystole, although return of spontaneous circulation was achieved within 5 minutes of ambulance arrival. She is currently intubated with a correctly positioned endotracheal tube, is being ventilated adequately with 100% oxygen, and has an unsupported blood pressure of 130/65 mmHg.

What are the management issues that must be considered in her further care? For each issue briefly outline any specific interventions or treatments required.

(Note to candidates: general details of resuscitation such as providing standard monitoring or obtaining vascular access are not required.)

**ANSWER TEMPLATE**

**1. Potential multi trauma:**
**Primary and Secondary ATLS survey** to exclude obvious external haemorrhage / obvious external wounds /open head injury etc
- Cervical or other spinal injury: **full spinal precautions**- cervical collar, log roll, immobilisation
- **Requires appropriate imaging** and bloods: Exclude pregnancy, check FBE/coags/UEC etc, CT imaging brain/cervical spine and probable pan scan
- **Treat injuries based on clinical/radiological findings**: laparotomy/interventional radiology /neurosurgery as indicated, ICP monitoring would need to be considered in closed head injury with low GCS.

2. **Drowning/Near drowning**
-likely aspiration of seawater (volume variable)
-**Potential significant lung injury**, mainly due to surfactant loss, development of ARDS. Compounded by lung contusion if present.
-depending on water quality, may have significant bacterial contamination of lungs. -antibiotics empirically depending on clinical status, then as directed by cultures

-sodium and water homeostasis problems and relative hypovolemia may occur due to hypertonic seawater ingestion (rare)
**-use lung protective ventilation, with low tidal volumes and titrated PEEP levels, to try and prevent worsening of lung injury/ARDS**.
-Allowing permissive hypercapnia may be challenging if significant head injury with raised ICP, and in the post arrest setting.

**3. <u>Post out-of-hospital cardiac arrest management:</u>**
**Target temperature management** 33 or 36 degree centigrade for 24 hours.
**Consider cause of arrest:** this may a primary cardiac event or secondary – Cardiac investigations including ECG and ECHO.
Unknown downtime with asystole- patient may have suffered hypoxic ischaemic injury along with the brain injury. Initial CT brain may show evidence of this.

**<u>4. Hypothermia management</u>**
-may well be hypothermic from water exposure depending on water temperature: this may be a good thing post arrest but would also compound haemorrhage etc.
-**Rewarming measures- passive or active**, may need to be instituted depending on the core temperature and bleeding status of the patient.
- prognostication of neurology and management of cardiac arrest/length of resuscitative efforts are influenced by severe hypothermia

| | |
|---|---|
| Maximum Score | 9.00 |
| Percentage scoring >5/10 | 66.7% |

**Question 22**

You are called to the children's ward to review a 6-year-old boy with Trisomy 21/Down's Syndrome (DS). He has been diagnosed with pneumonia. He is severely hypoxemic despite high flow nasal $O_2$.

Describe the important features of Down's Syndrome and outline the impact they may have on his management.

**ANSWER TEMPLATE**

| Feature | Impact on management |
|---|---|
| Developmental/Cognitive:<br>Variable intellectual impairment | Interacting with child in a manner appropriate to understanding. Engagement with caregivers to help them comfort and reassure |
| Airway:<br>Midface hypoplasia<br>Macroglossia<br>Relatively large tonsils and adenoids<br>High rates of obstructive sleep apnoea<br>Subglottic area relatively small<br>Association with tracheal stenosis and tracheal-oesophageal fistula | Expect airway obstruction on induction<br>Anticipate difficult intubation, use most experienced intubator<br>Expect to use ETT 0.5 size smaller than age predictions |
| Cervical spine/musculoskeletal:<br>Ligamentous laxity, most importantly atlanto-axial instability. AAI often asymptomatic. | Assume AAI present<br>Intubate with neck in neutral position, consider video laryngoscopy<br>Careful positioning of neck and other joints when sedated |
| Respiratory:<br><br>Tendency to obesity and short stature<br><br>Recurrent respiratory tract infections common.<br>Risk of bronchiectasis | If obese, closing capacity may encroach on FRC supine resulting in rapid desaturation<br><br>Consider presence of atypical organism |

| | |
|---|---|
| Cardiovascular:<br>Congenital heart disease common.<br>AV canal defect, ASD, VSD most common.<br>Tetralogy of Fallot increased c.f. general population.<br>If not corrected intracardiac shunt may be present/precipitated by factors that increase pulmonary vascular resistance<br>Pulmonary hypertension in the absence of valvular disease<br><br>Conduction disturbances common after repair ASD, VSD and TOF.<br><br>Reduced cardiopulmonary reserve and higher incidence of diastolic abnormalities even in structurally normal hearts. | Expect significant structural abnormalities to have been diagnosed and repaired, but sequelae may persist<br><br>Correction of/avoidance of factors that promote pulmonary vasoconstriction and may worsen pulmonary hypertension e.g., hypoxia, hypercapnoea, acidosis<br>Caution with airway pressures and potential for high PEEP/Pawp to increase RV afterload and precipitate failure.<br><br>Caution with negatively inotropic drugs e.g., induction agents, sedation<br><br>Care with IV lines re asepsis and bubbles<br><br>Consider alternative diagnosis e.g., cardiac failure, endocarditis |
| Gastrointestinal:<br>Increased risk of gastrooesophageal reflux | Consider RSI, balancing risk of reflux against risk of cricoid pressure resulting in poorer view and of altering neck position |
| Immune:<br>Relative immune dysfunction, often recurrent infections | Consider risk of multi-resistant organisms |
| Metabolic:<br>Shorter stature, increased risk of obesity | If measured weight not available, use age-based weight prediction specific to DS.<br>Drug dosing based on ideal body weight. |

| | |
|---|---|
| Maximum Score | 7.00 |
| Percentage scoring >5/10 | 8.9% |

**Question 23**

Regarding prolonged intravenous infusions of beta-lactam antibiotics in septic patients:

a) Explain the pharmacological rationale for this method of drug delivery. (30% marks)

b) List the advantages and disadvantages of this method of drug delivery. (40% marks)

c) What is the available evidence for this method of drug delivery? (30% marks)

**ANSWER TEMPLATE**

a) Explain the pharmacological rationale (a graph is not essential in the answer)

The pharmacodynamic effect of beta-lactams relates to the duration of exposure which is measured as the percentage of the dosing interval that the concentration of free drug remains above the minimum inhibitory concentration (MIC) of the pathogen. Good bactericidal effect is achieved when the free drug concentration exceeds the pathogen's MIC by approximately fourfold for 40 to 60 percent of the dosing interval.
Prolonged infusion administration strategies for intravenous beta-lactam antibiotics (may include either a continuous infusion or an extended infusion) allow the free drug concentration to exceed the pathogen's MIC for a longer duration of time.
It may be most beneficial for beta-lactams with a shorter half-life, or narrower therapeutic margin (noting that generally beta-lactams as a group have a high therapeutic margin). It may also be more effective for more difficult to eradicate infections (e.g., cystic fibrosis, endocarditis, and organisms with a higher MIC).

b) List the advantages and disadvantages of these regimes.

Advantages

- Critical illness can also lead to variable pharmacokinetics, such as augmented drug clearance, altered volumes of distribution, abnormal fluid balance, and/or changes in protein binding. Higher doses and prolonged infusions may be the best pharmacologic approach in such situations in achieving adequate serum levels of antibiotics
- Infections due to pathogens that demonstrate higher MICs but are still within the susceptible range would be expected to benefit from prolonged infusion strategies
- Reduced time in the presence of sub-MIC antibiotic concentrations may result in rapid bacterial killing, reduced organism burden and reduced opportunities for pathogens to develop resistance.
- Economic: some infusion recommendations require less administered drug over 24 hours than short infusion dosing (e.g., piperacillin-tazobactam 3.375-4.5 g maybe dosed qid with short intermittent infusions and dosed tds with 4 hourly infusions. In addition, there may be economic benefits associated with potential benefits outlined in c

Disadvantages

- Logistical barriers — Administration of prolonged infusions require utilization of the intravenous pump for longer periods of time, which may be problematic for patients with limited intravenous access or lower levels of nursing care
- Compatibility with other drugs needs to be considered.
- Stability — If drugs are administered over a prolonged period of time, they must be stable over that time, and so not all drugs are appropriate for prolonged infusions
- Less opportunity for patient to freely mobilise
- Need to flush give set to ensure full dose delivered

c) What is the available evidence for this method of drug delivery?

- Clinical data supporting prolonged infusion beta-lactam antibiotic administration resides largely in observational or non-randomized prospective studies, predominantly in adults.
- A clinical benefit of prolonged infusion strategies has not been definitively demonstrated in randomized controlled trials. Possible reasons that existing randomized controlled trials have not yet demonstrated benefit include small sample size and low study quality.

| | |
|---|---|
| Maximum Score | 9.00 |
| Percentage scoring >5/10 | 57.8% |

**Question 24**

a) Define delirium. (20% marks)

b) Outline your approach to the prevention of delirium in patients in your ICU. (80% marks)

**ANSWER TEMPLATE**

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

Patients in ICU are at risk of developing delirium. Methods of preventing delirium can be divided into
Non-pharmacological methods include

- treating medical illness such as sepsis
- adequately managing pain, for example the use of positioning, splints etc
- - maintaining the day/night cycle - sleep hygiene, cluster cares if appropriate etc
- familiar objects in the room, such as photographs
- familiar faces, visitors, regular staff
- frequent orientation
- the presence of natural light
- trips outside for long stay ICU patients, if appropriate

Pharmacological methods include

- minimising polypharmacy
- avoiding medications associated with a higher incidence of delirium such as benzodiazepines
- preventing withdrawal - ensuring patient receiving usual medications especially anti-depressants and regular, long-term analgesics
- preventing withdrawal – instituting a weaning plan if the patient has been on high dose narcotics, benzodiazepines, clonidine for a period of time
- managing withdrawal – for example use of the alcohol withdrawal scale or a nicotine patch, if appropriate
- managing pain – multi modal
- promoting sleep – as an example, the use of melatonin

| | |
|---|---|
| Maximum Score | 8.75 |
| Percentage scoring >5/10 | 91.1% |

**Question 25**

A 75-year-old male patient presented with bone pain. His biochemical profile is shown below:

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| Sodium | 140 mmol/L | 135 – 145 |
| Potassium | 5.1 mmol/L* | 3.5 – 5.0 |
| Chloride | 108 mmol/L* | 95 – 105 |
| Bicarbonate | 21.0 mmol/L* | 22.0 – 26.0 |
| Glucose | 6.0 mmol/L | 3.5 – 6.0 |
| Urea | 25.0 mmol/L* | 3.0 – 8.0 |
| Creatinine | 250 µmol/L* | 45 – 90 |
| Magnesium | 1.10 mmol/L* | 0.75 – 0.95 |
| Albumin | 25 g/L* | 35 – 50 |
| Protein | 95 g/L* | 60 – 80 |
| Total bilirubin | 26 µmol/L* | < 26 |
| Aspartate transferase | 60 U/L* | < 35 |
| Alanine transferase | 60 U/L* | < 35 |
| Alkaline phosphatase | 250 U/L* | 30 – 110 |
| γ-Glutamyl transferase | 40 U/L* | < 40 |
| Ionised calcium | 1.50 mmol/L* | 1.10 – 1.35 |
| Calcium corrected | 2.90 mmol/L* | 2.12 – 2.62 |
| Phosphate | 1.8 mmol/L* | 0.8 – 1.5 |
| Lactate Dehydrogenase | 350 U/L* | 50 – 150 |
| Beta2 microglobulin | 6 mg /L* | < 1 |

a) Give the most likely diagnosis. (10% marks)

b) List the factors that may predispose to infection in this patient. (20% marks)

25.2

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

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

| Parameter | Patient Value | Adult Normal Range |
|---|---|---|
| Haemoglobin | 125 g/L* | 130 – 180 |
| White Cell Count | 7.4 x $10^9$/L | 4.5 – 11 |
| Platelets | 255 x $10^9$/L | 150 – 400 |

| | | |
|---|---|---|
| Mean Cell Volume | 110 fL* | 80 – 98 |
| Mean Cell Haemoglobin | 30 pg/cell | 27 – 33 |
| Mean Cell Haemoglobin Concentration | 320 p/L | 310 – 360 |

a) Give six possible causes for the findings on his FBC. (30% marks)

25.3

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

Her investigations are as follows:

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

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

b) List two confirmatory tests. (20% marks)

**ANSWER TEMPLATE**

25.1

a)
Multiple myeloma

b)
- Immunosuppressive effect of disease:
  - Hypogammaglobulinemia due to B cell defect (number and function) increases risk of encapsulated organism infection.
  - Lymphopenia with T helper cell dysfunction due to cytokine production of myeloma cells
  - Neutropenia due to marrow infiltration
- Complications of renal failure
- Complications of treatment:
  - dexamethasone, lenalidomide, melphalan

25.2

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

25.3

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

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

| | |
|---|---|
| Maximum Score | 9.00 |
| Percentage scoring >5/10 | 80.0% |

**Question 26**

A 68-year-old male remains intubated four days after an out of hospital cardiac arrest. He is agitated on low dose propofol and only intermittently follows commands. His ventilation is pressure support (PSV) with $FiO_2$ 0.45, PS 10 $cmH_2O$ and PEEP 8 $cmH_2O$. He is generating tidal volumes of 460 mls with a respiratory rate of 22 breaths/min and oxygen saturations of 94%.

Outline how you would determine his readiness for extubation.

**ANSWER TEMPLATE**

Standard criteria for extubation

1. Disease process resolved or satisfactorily stabilised
    - Resuscitation phase complete
    - Not requiring ongoing complex cardiac supports like IABP
    - No immediate requirement for further intervention e.g., PPM/AICD/Urgent CABG as a result of the arrest
    - No immediate requirement for further investigations e.g., angiogram/MRI where he would need sedation/GA to facilitate
2. Neurology
    - Ideally assess sedative free (stop propofol and therefore have more accurate assessment of neurologic status and agitation).
    - Overall trend in neurological progress important, should be GCS > 8 is described as a minimum criterion, but GCS crude assessment. Ideally obeying commands reasonably consistently for this patient. Gradual ongoing improvement encouraging.
    - Brainstem reflexes present (especially gag and cough – must be able to protect own airway, clear secretions).
    - Muscle power reasonable (e.g., lift head off bed).
    - Able to manage his agitation post extubating and without propofol.
3. Airway
    - Presence of a cuff leak (not routinely assessed).
    - Grade/difficulty of intubation important – higher threshold for extubation if difficult airway.
    - Adequate cough (able to cough up ETT), acceptable volumes of secretions.
4. Ventilation
    - Adequacy of gas exchange - moderate FiO2 requirement (e.g., 40% or less), minimal support settings (e.g., PEEP 5, PS 10 (or similar range) with SpO2/SaO2 and CO2 in normal range
    - Work of breathing assessment – stable work of breathing, and not excessive. Generates adequate tidal volumes (>5mL/kg).
    - 
    - +/- RSBI, with discussion around utility/parameters looked for.
    - +/- SBT, with discussion around use and what it would involve,
    - No ongoing pulmonary oedema

5. Cardiovascular
    - Low level of haemodynamic support
    - No ongoing ischaemia/arrhythmias
    - Presence of significant ventricular impairment or significant other condition (e.g., mitral regurgitation) may mean higher threshold needed before extubation.
6. Other
    1. No major abnormality acid base status
    2. Euvolaemic/appropriate fluid balance
    3. No evidence of sepsis that would impact his care
    4. Appropriate time of day and skill level within the unit especially if marginal extubation

| | |
|---|---|
| Maximum Score | 8.00 |
| Percentage scoring >5/10 | 71.1% |

**Question 27**

Regarding randomised clinical trials, explain the following terms:

a) External validity. (20% marks)

b) Allocation concealment. (20% marks)

c) Stratification. (20% marks)

d) Sensitivity analysis. (20% marks)

e) Fragility Index. (20% marks)

**ANSWER TEMPLATE**

a) External validity
External validity is the extent to which the results of a study can be generalised to other situations, e.g., different case-mix

b) Allocation concealment
Procedure for protecting the randomization process and ensuring that the clinical investigators and those involved in the conduct of the trial are not aware of the group to which the subject has been allocated

c) Stratification
Stratification is a process that protects against *imbalance in prognostic factors* that are present at the time of randomisation.
A separate randomisation list is generated for each prognostic subgroup. Usually limited to 2-3 variables because of increasing complexity with more variables. An example would be stratifying patients in a trial of septic shock into medical and surgical subtypes.

d) Sensitivity analysis
A technique in which a trials results are reanalysed with an alteration in some assumptions or methods. An example would be a trial with an endpoint of six-month mortality in which a reanalysis assumed all patients lost to follow up died.

e) Fragility Index
A parameter that indicates how many subjects in a clinical trial would have to have had the opposite outcome in order to change the significance level of the trial.

| | |
|---|---|
| Maximum Score | 9.25 |
| Percentage scoring >5/10 | 73.3% |

**Question 28**

Critically evaluate early versus late initiation of Renal Replacement Therapy (RRT) in the critically ill patient.

**ANSWER TEMPLATE**

Introductory statement
Outside of immediate life-threatening indications in AKI it is unclear whether the provision of early vs late Renal Replacement Therapy (RRT) improves mortality and morbidity

**Advantages**
**Early-**
Early improved fluid balance, acid base and electrolyte management there by preventing more serious/ life threatening complications.
Enhanced toxin removal.
If life threatening complication develop no delay in commencement
**Late-**
Reduced costs as some of the patients may recover without needing renal replacement therapy.

**Disadvantages**
**Early –**
fluid removal maybe difficult due to hemodynamic instability in the early stages of acute illness
Patients may be exposed to unnecessary RRT
Complication of vacate insertion including CRBSIs.
Miss diuresis as an indicator of renal recovery.
Logistics and cost of RRT
**Late -**
May expose the patient to life threatening complication
Delay to initiation when life threatening complications arise

**Evidence -**
(marking suggestion: majority of bolded points required for full marks in this section)

4 RCTs
**STAART AKI Study NEJM July 2020**
Multinational RCT looking at early (<12 hrs of AKI) vs standard indications (conventional indications + AKI persistent for >72 hrs. Nearly 3000 patients included in the study and analysis. Found no difference in 90-day mortality. However, the early RRT group had a higher risk of dependence on RRT and had more adverse events compared to the standard indication group.

Gaudy NEJM 2016 620 pts RCT for AKIKI group **no mortality or ICU length of stay benefit** between early vs late. approx. 30% of pts in late grp recovered spontaneously and did not require RRT. **Less CLABSI in delayed group**. Supports the argument **in favor of waiting** for spontaneous renal recovery.

Tarbuck JAMA ELAIN study 2016 n=231 pts. **Surgical population**. **Single centre**. **reduced 90d mortality** in the early initiation group. **Widely criticized** trial. Critique – short time difference between groups, unusual mortality benefit (NNT=7), high fragility index (of 3), enrolled kidgo 2 (not 3), dialysed based on kidgo stage rather than clinical indication. **Can't be used to justify early RRT**.

Barbar IDEAL-ICU. **multi center** n=488 pts. **Septic shock AKI**. RCT stopped early as no benefit to early vs late NEJM 2018. **Underpowered**. **No conclusion can be drawn**.

Earlier studies:
Seabra et al (2008) - nonsignificant 36% mortality risk reduction associated with early RRT but heterogeneity among the trials precluded definitive conclusions.
Wierstra et al (2016) - systematic review, Critical Care. Nine "high quality" studies which were included in the final analysis, n=1042 patients. No survival benefit for early rrt

Summary statement/what I do in my practice.

| | |
|---|---|
| Maximum Score | 7.50 |
| Percentage scoring >5/10 | 66.7% |

**Question 29**

You are the appointed welfare advocate for your unit. 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 another 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

| | |
|---|---|
| Maximum Score | 8.50 |
| Percentage scoring >5/10 | 73.3% |

**Question 30**

*(Images removed from report.)*

30.1

A 69-year-old female has been admitted to the ICU for monitoring, after an uncomplicated laparoscopic cholecystectomy. Her routine admission ECG is shown on page 12 (ECG 30.1).

a) Describe the ECG and the diagnosis. (25% marks)

b) Name <u>three</u> drugs that could contribute to the manifestation of this ECG pattern. (15% marks)

30.2

A 76-year-old male presented to Emergency Department with chest pain.

a) Describe the ECG shown on page 13 (ECG 30.2). (15% marks)

b) Describe the anatomical lesion/s resulting in these ECG changes and the mechanism of the changes in the aVR lead. (25% marks)

30.3

A 57-year-old male patient is admitted to the ICU with urosepsis secondary to an obstructed urinary tract. He is haemodynamically stable with no chest pain. His ECG is shown on page 14 (ECG 30.3).

a) What is the most likely diagnosis, and the immediate pharmacological therapy? (20% marks)

**ANSWER TEMPLATE**

30.1

a)

- r on AVR, sinus tachycardia, V3-V4 ST depression, prolong QT
- Brugada syndrome

b)
TCA e.g., amitriptyline, lithium, alcohol, cocaine

30.2

a)

- ST elevation in aVR, ST depression v3-v6 and lateral leads, sinus tachycardia.
- ST elevation (STE) in aVR is suggestive of left main coronary artery (LMCA) occlusion or proximal left anterior descending (LAD) occlusion in this case.

b)

- The mechanisms of STE in aVR including:
  - Reciprocal change from the lateral leads ST depression due to diffuse subendocardial ischaemia
  - infarction of the basal septum which is supplied by the very proximal branch of LAD

30.3

a)
Severe hyperkalaemia from acute Kidney Injury.
Intravenous Calcium and sodium bicarbonate

| | |
|---|---|
| Maximum Score | 7.00 |
| Percentage scoring >5/10 | 28.9% |

## EXAMINERS' COMMENTS

### Clinicals "Hot cases" Section

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

The following comments are a guide to the expected standard for performance in the hot cases:

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

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

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

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

- Missing or misinterpreting key clinical signs on examination.
- Failure to perform a focussed examination relevant to the case in question.
- Incomplete or poor technique for examination of a system.
- Poor synthesis of findings with limited differential diagnosis, sometimes compounded by missed key clinical signs on examination.
- Poor interpretation of imaging and data.
- Failure to grasp the key issues relevant to the case in question and a lack of insight into the problems.
- Inability to construct an appropriate management plan for the case in question.
- Hesitancy and/or uncertainty in stating a management plan.
- The need for significant prompting during the discussion with knowledge gaps.
- Limited time for discussion as a consequence of taking too long to present the clinical findings or to interpret basic data.
- Inability to convey the impression that he/she could safely take charge of the unit.

It is apparent that some candidates are very nervous, and this affects their exam performance. Candidates badly affected by nerves may benefit from sessions with a performance psychologist, drama coach, public speaking coach or similar.

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

- Seek the opportunity to lead management decisions for patients, whilst still having appropriate support available.
- Practise examination of individual systems as well as holistic examination
- Treat every case to be assessed at work as a hot case, i.e., pose a relevant question (e.g., 'Why is this patient not progressing?' 'What is the cause of the new fever?' 'Is this patient ready for extubation?'), perform a focussed exam and then present your findings to a colleague.

**Vivas**

The overall pass rate for the vivas was 74%, compared with 64% for the written paper and 61% for the hot cases. Candidates who failed a viva mostly did so because of knowledge gaps, poorly structured answers, and inability to give the rationale for their responses. As in the discussion for the hot cases, candidates should not rely solely on generic statements, key phrases, and template answers, and, instead, tailor their responses to the context and specifics of the question being asked, and furthermore be able to justify and expand their response. Candidates are encouraged to practise viva technique and to discuss patient management, including the rationale for their decisions, with senior colleagues. As with the hot cases, candidates who are very nervous or have a poor technique may benefit from training with a performance coach.

## SECOND PART ORAL EXAMINATION

The clinical 'hot cases' require candidates to assess patients currently in the ICU, with regard to answering specific questions around clinical assessment, diagnosis, investigations, and management. Five examples of clinical 'hot case' questions from this examination sitting are given below.

- *This patient was admitted to the ICU following a MET call for respiratory distress and required intubation soon after admission. Can you please examine him and outline the current clinical issues, then we will review and discuss his current and recent investigations, and finally devise a management plan for the next 48 hours.*

- *This patient was admitted to the ICU following three days of chest and a subsequent collapse. Please examine him and determine the likely cause of his presentation, as well as outlining the complications of his presentation and his ICU admission.*

- *This patient presented to the Emergency Department with fever, sudden loss of consciousness, and a seizure. 10 days prior to this presentation she had a collapse in the community with an associated brief loss of consciousness. Please examine her with reference to her potential underlying diagnosis, and outline your priorities for progressing her current management.*

- *This patient is 14 days post an out-of-hospital cardiac arrest. Please examine him and identify the reasons for the difficulties in weaning him from mechanical ventilation.*

- *This patient was admitted to the ICU after a MET call on the ward for progressive respiratory failure. Please examine him and provide a differential diagnosis for the cause of his respiratory failure.*

The clinical 'hot cases' were assessed at the following venues:

New Zealand
- Auckland City Hospital
- Christchurch Hospital

Hong Kong
- Prince of Wales Hospital (HK)

NSW, Australia
- Liverpool Hospital
- Nepean Hospital
- Royal North Shore Hospital
- Royal Prince Alfred Hospital
- St Vincent's Hospital Campus

QLD, Australia
- Gold Coast University Hospital
- Prince Charles Hospital
- Princess Alexandra Hospital
- Royal Brisbane and Women's Hospital

VIC, Australia
- Alfred Hospital
- Austin Hospital
- Monash Medical Centre
- Royal Melbourne Hospital

SA, Australia
- Flinders Medical Centre
- Lyell McEwin Hospital
- Royal Adelaide Hospital

WA, Australia
- Fiona Stanley Hospital
- Sir Charles Gairdner Hospital

**VIVAS STEMS**

**DAY 1**

**Viva 1**

A 27-year-old female presents to the Emergency Department after a collapse at work which was followed by a brief tonic-clonic seizure. She is 30 weeks pregnant with no previous pregnancies or other significant medical history.

She currently localises bilaterally to painful stimulus but does not open her eyes or vocalise. Her blood pressure is 170/50 mmHg, her urine analysis is unremarkable, and the CTG is 'reassuring'. The Emergency Physician and Obstetrician have asked for your assistance with her management.

What is your differential diagnosis for her current neurological state?

| | |
|---|---|
| Maximum Score | 9.50 |
| Percentage Passed | 87% |

*(This viva dealt with the assessment and management of patient presenting with a seizure during pregnancy.)*

**Viva 2**

You are asked to review a 64-year-old male who had an emergency abdominal aortic aneurysm repair last night. His sedation has been ceased in anticipation of extubation, but the bedside nurse is concerned that he appears to be in a lot of pain.

His relevant co-morbidities include ischaemic heart disease, type 2 diabetes mellitus and chronic back pain for which he has been on long term opioid treatment.

Outline how you would assess the situation.

| | |
|---|---|
| Maximum Score | 8.75 |
| Percentage Passed | 57% |

*(This viva dealt with the assessment and management of a patient presenting with significant post-operative pain after emergency abdominal / vascular surgery.)*

**Viva 3**

You are called into the resuscitation room in your Emergency Department to assess a trauma patient who has been involved in a high-speed car crash. She appears morbidly obese with an estimated weight of 170 kg.

How does the pattern of traumatic injury differ in obese patients?

| | |
|---|---|
| Maximum Score | 7.75 |
| Percentage Passed | 70% |

*(This viva dealt with the assessment and management of trauma in the obese patient.)*

**Viva 4**

A 65-year-old male has just been admitted to your ICU following an out of hospital cardiac arrest.

He is currently receiving 6 mcg/min of adrenaline with a blood pressure of 100/70 mmHg and has been anuric for the last two hours. He has a Glasgow Coma Score of 6. His current temperature is 37.6ºC.

What factors would you take into consideration in managing this patient's temperature?

| | |
|---|---|
| Maximum Score | 7.85 |
| Percentage Passed | 63% |

*(This viva dealt with the principles and practice of temperature management post cardiac arrest.)*

**Viva 5**

You are part of a multidisciplinary team that assesses high-risk cardiac surgical patients. You have been asked to assess a 69-year-old female with symptomatic severe aortic stenosis for aortic valve replacement.

She has had coronary artery bypass surgery 5 years ago and femoro-popliteal artery bypass surgery 4 years ago. She has treated hypertension, diabetes, emphysema, and chronic kidney disease.

What further information/investigations would you obtain and why (or why not)?

| | |
|---|---|
| Maximum Score | 8.5 |
| Percentage Passed | 37% |

*(This viva dealt with the assessment and management of patient undergoing high-risk cardiac surgery.)*

**Viva 6 – Radiology Station**

| | |
|---|---|
| Maximum Score | 8.94 |
| Percentage Passed | 40% |

*(The radiology station consisted of 4 plain X-rays and 3 CT scans.)*

**Viva 7 – Procedure Station**

An obese 65-year-old male has been ventilated in your ICU for 10 days with severe community acquired pneumonia. A decision has been made to perform a tracheostomy, and you will be asked to discuss the procedure.

What are the indications and contraindications for performing a percutaneous tracheostomy?

| | |
|---|---|
| Maximum Score | 8.50 |
| Percentage Passed | 53% |

*(This viva consisted of a description and discussion of percutaneous tracheostomy.)*

**Viva 8 – Communication Station**

Tina is a 40-year-old female who was admitted 8 days ago after an overdose of propranolol. On presentation to the Emergency Department, she had a witnessed cardiac arrest, requiring 5 minutes of CPR.

She has required mechanical ventilation, dialysis, and high dose adrenaline infusion resulting in ischaemic fingers and toes. She has been improving in the past 48 hours, with a reduction in adrenaline requirement. Sedation was ceased this morning to facilitate neurological assessment. She is yet to show any signs of regaining consciousness.

You are about to have a videoconference with Tina's sibling, and next of kin, Sam. The bedside nurse tells you that when they spoke over the phone this morning, Sam said they don't want Tina to suffer anymore.

| | |
|---|---|
| Maximum Score | 9.50 |
| Percentage Passed | 57% |

*(This viva consisted of a discussion with the family of a patient who has concerns that she was suffering from her management in the ICU.)*

**DAY 2**

**Viva 1**

A 50-year-old farmer with a history of alcohol abuse and depression is brought to the Emergency Department having been found collapsed in his garage. He is semi-conscious and unable to move.

What is your differential diagnosis?

| | |
|---|---|
| Maximum Score | 7.55 |
| Percentage Passed | 55% |

*(This viva dealt with the assessment and management of a patient presenting with toxic ingestion.)*

**Viva 2**

You are taking over the care of a 26-year-old male who remains ventilated in ICU one week after a motor vehicle accident in which he sustained multiple fractures, severe intra-abdominal and head injuries. He had a splenectomy and repair of a bowel perforation at the time of trauma laparotomy.

He has had persistent fevers since admission and has received a course of Piperacillin and Tazobactam. He is currently receiving low dose noradrenaline and parenteral nutrition via a non-tunnelled central venous catheter.

He has a history of intravenous drug use.

Give a differential diagnosis for the fever in this patient and outline your management.

| | |
|---|---|
| Maximum Score | 8.50 |
| Percentage Passed | 77% |

*(This viva dealt with the assessment and management of a patient with parenteral nutrition and fungal sepsis.)*

**Viva 3**

A 45-year-old male is admitted to hospital with an upper gastrointestinal bleed and undergoes endoscopy and banding of oesophageal varices. His Glasgow Coma Scale (GCS) at presentation was 15.

Over the next 24 hours the patient has a progressive decrease in conscious level, and you have been asked to consider him for admission to the ICU.

How would you assess the patient to determine the cause of the altered level of consciousness?

| | |
|---|---|
| Maximum Score | 7.05 |
| Percentage Passed | 55% |

*(This viva dealt with the assessment and management with an altered level of consciousness in the context of upper GI bleeding.)*

**Viva 4**

You are working as a Locum Intensive Care Specialist in a regional hospital with no tertiary paediatric service. You are called as part of the trauma team to the Emergency Department to assist with the management of an 8-year-old child with burns.

The paramedics report the child was found semi-conscious and breathing in the downstairs hallway of a home on fire less than an hour ago.

Describe your initial assessment and monitoring priorities for this child.

| | |
|---|---|
| Maximum Score | 7.50 |
| Percentage Passed | 82% |

*(This viva dealt with the assessment and management of burns in a paediatric patient.)*

**Viva 5**

A 50-year-old male has been admitted to your ICU with acute respiratory failure. He has a two-day history of fatigue, weakness, generalized myalgia, headache, and fever; followed by dry cough and increasing shortness of breath. He is previously well.

Physical examination reveals temperature of 39ºC, heart rate 120 beats/min, blood pressure 140/75 mmHg. He is being ventilated with $FiO_2$ of 0.65 with oxygen saturations of 92% and has bilateral crepitations audible on chest auscultation. He has been commenced on IV Ceftriaxone and Azithromycin as empirical antimicrobial therapy.

Given the history, what infections will you consider as a cause for this man's presentation?

| | |
|---|---|
| Maximum Score | 10 |
| Percentage Passed | 41% |

*(This viva dealt with the assessment and management of a patient presenting to the ICU with respiratory failure due to an infective process.)*

**Viva 6 – Radiology Station**

| | |
|---|---|
| Maximum Score | 6.88 |
| Percentage Passed | 59% |

*(The radiology station consisted of 4 plain X-rays and 3 CT scans.)*

**Viva 7 – Procedure Station**

You are called by your registrar for a 68-year-old male two days post emergency aortic valve replacement for aortic stenosis with good left ventricular function.

His recovery has been uneventful other than a junctional bradycardia of 30 bpm that has required VVI pacing at 80 bpm via an epicardial right ventricular wire placed at the time of surgery.

Your registrar asks for your help as his blood pressure has been falling. He is on nasal prong oxygen and remains conscious.

His bedside monitor looks like this:

How would you approach this problem?

| | |
|---|---|
| Maximum Score | 9.25 |
| Percentage Passed | 41% |

*(This viva consisted of a description and discussion of cardiac pacing.)*

**Viva 8 – Communication Station**

Zachary is a previously well 19-year-old male admitted to your ICU three days ago with refractory status epilepticus. No infective cause has been found and the working diagnosis is auto-immune encephalitis.

Zachary has been intubated and sedated. He continues to have frequent seizures despite adequate treatment with phenytoin, midazolam and levetiracetam and so propofol sedation has been increased to induce burst-suppression on continuous EEG monitoring.

The neurologist responsible for Zachary is considering immunosuppressive therapy, which you agree is appropriate treatment for this condition.

As the Intensivist, you have arranged a teleconference with his parent Sam who is overseas. The nurse caring for Zachary has told you that Sam is concerned about his ongoing treatment.

| | |
|---|---|
| Maximum Score | 9.50 |
| Percentage Passed | 50% |

*(This viva consisted of a discussion with the family of a patient who had concerns and objections regarding aspect of his clinical management.)*

**DAY 3**

**Viva 1**

A 58-year-old obese female 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 the ambulance arrived. The initial rhythm was ventricular tachycardia (VT), she had a single DC shock with return of spontaneous circulation.

She was making non-purposeful movements in the Emergency Department prior to being anaesthetised, intubated, and sent to cardiac catheterisation laboratory. She returns to the ICU with vitals; heart rate 90 beats/min sinus rhythm, blood pressure 95/55mmHg, temperature 37.8ºC.

Outline your initial assessment of this patient.

| | |
|---|---|
| Maximum Score | 7.20 |
| Percentage Passed | 73% |

*(This viva dealt with the assessment and management post cardiac arrest.)*

**Viva 2**

You are taking over the care of a long-term patient in your ICU 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 dependent.

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

Outline your approach and how you would assess her.

| | |
|---|---|
| Maximum Score | 8.50 |
| Percentage Passed | 82% |

*(This viva dealt with the assessment and management of patient with GBS, focussing on aspects of weaning from mechanical ventilation.)*

**Viva 3**

A medical registrar has called you from the Emergency Department of a small regional hospital requesting advice.

The patient is a 23-year-old female who presented to hospital following a seizure at work.

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

On arrival to the Emergency Department, she was given additional midazolam IV (2 mg, 5 mg, 5 mg) and was loaded with Phenytoin 20 mg/kg IV. After 20 minutes she continued to have sporadic seizure activity with a best GCS of 6 and was subsequently intubated.

Vitals given to you over the phone are as follows:

A= Intubated
B= SIMV, $FiO_2$ 0.5, $SpO_2$ 100%
C= blood pressure 140/70 mmHg, heart rate 98 beats/min
D= Fentanyl 50 mcg, Propofol 100 mg, Rocuronium 100 mg for intubation. Now on 50 mg/hr of Propofol

The availability of radiology and pathology services is limited.

The retrieval team has been contacted and will take 45 minutes to arrive.

The patient has been accepted by your ICU. The medical registrar wants advice on how to optimise the patient's condition prior to transfer.

| | |
|---|---|
| Maximum Score | 8.45 |
| Percentage Passed | 95% |

*(This viva dealt with the assessment and management of a patient with status epilepticus.)*

**Viva 4**

A 75-year-old male has been in your ICU for 4 days following a mitral valve replacement and coronary artery grafts, requiring significant ongoing cardiovascular support.

Over this time, his platelet count, (normal range 150 - 450 x 109/L), has fallen, as per the table below:

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

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

| | |
|---|---|
| Maximum Score | 9.00 |
| Percentage Passed | 73% |

*(This viva dealt with the assessment and management of a patient with thrombocytopenia post-operative cardiac surgery.)*

**Viva 5**

A 23-year-old female is the driver of a car involved in a high-speed motor vehicle crash and is brought to your hospital. She had a prolonged extrication time, however, she was talking and obeying simple commands at the scene.

On arrival, she has obvious facial and scalp lacerations and localises bilaterally to pain but does not open her eyes or vocalise. She has blood in her mouth, her breathing sounds noisy and obstructed with a respiratory rate of 22 breaths/min, and oxygen saturations are 91% on high flow oxygen.

Her heart rate is 130 beats/min, systolic blood pressure is 60 mmHg. Paramedics have splinted her left lower leg, which was significantly deformed.

Outline your immediate management.

| | |
|---|---|
| Maximum Score | 8.50 |
| Percentage Passed | 91% |

*(This viva dealt with the assessment and management of a patient who has sustained multiple injuries due to a MVA.)*

**Viva 6 – Radiology Station**

| | |
|---|---|
| Maximum Score | 6.05 |
| Percentage Passed | 36% |

*(The radiology station consisted of 4 plain X-rays and 3 CT scans.)*

**Viva 7 – Procedure Station**

This is a procedure viva, and you will be asked to discuss the management of a patient and how you would perform specific procedures.

As the Intensivist at a regional hospital, you are asked to attend the Emergency Department to assist in the resuscitation of a 4-week-old infant that has presented in a moribund state. The child was the product of a normal pregnancy and delivered at 38 weeks with no complications. The baby had been gaining weight and feeding well at home until a few days ago. There has been a history of diarrhea and vomiting in the family for the past few days.

The child is grey in colour, making weak crying noises, and has a respiratory rate of 50 breaths/min.

How would you assess this child's circulation?

| | |
|---|---|
| Maximum Score | 8.25 |
| Percentage Passed | 86% |

*(This viva consisted of a description and a discussion of procedures during the resuscitation of a paediatric patient.)*

**Viva 8 – Communication Station**

You are the intensivist looking after 59-year-old Pat. Pat was admitted to hospital with dysarthria and limb weakness, and then rapidly deteriorated with respiratory distress requiring intubation. Three days later, she is awake but appears locked in, with only eye movements and blink intact. An MRI reveals extensive occlusion of the basilar and distal left vertebral arteries with acute pontine infarction.

The bedside nurse has had a phone conversation with Chris, who is next of kin for Pat.

Chris has shared some concerns with the nurse:

- Lack of understanding of what has happened to Pat.
- Anger that Pat does not appear to be improving, despite an earlier telephone call from an Emergency Department doctor saying that Pat had a "90% chance of full recovery".

You are now going to teleconference with Chris.

| | |
|---|---|
| Maximum Score | 8.75 |
| Percentage Passed | 91% |

*(This viva consisted of a discussion with the family of a patient who further questions and clarifications around aspects of his clinical management.)*