

Question 1 (18 marks)

A 60 year old male weighing approximately 160 kg presents to the emergency department (ED) complaining of worsening shortness of breath over the last 4 days. Clinical examination reveals widespread wheeze throughout the lung fields.

His observations on arrival:

HR 110 bpm regular
BP 178/40 mmHg
SaO₂ 88 % on room air
Temp 37.8 °C
GCS (E3, V5, M6) – drowsy

An arterial blood gas (ABG) taken on room air shows the following:

		Reference range
pH	7.31	7.35 – 7.45
pCO ₂	108	35 – 45 mmHg
pO ₂	58	60 – 90 mmHg
HCO ₃ ⁻	56	22 – 26 mmol/L

- a) Regarding his ABG, complete the calculations and provide an interpretation of your findings in the context of this patient's presentation. (5 marks)

Expected HCO₃⁻ for chronic respiratory acidosis (1 mark)	$= 24 + 4 (\text{PCO}_2 - 40) / 10$ $= 24 + 4(108 - 40) / 10$ $= 24 + 4(6.8)$ $= 24 + 27.2$ $= 51.2$ Accept range from 48-52
A-a gradient (1 mark)	$\text{PAO}_2 - \text{PaO}_2$ $\text{PAO}_2 = (\text{PCO}_2 \times 1.25) , \text{PAO}_2 \text{ on room air} = 150$ $= 150 - (108 \times 1.25)$ $= 150 - (135)$ $= 15$ $\text{PAO}_2 - \text{PaO}_2 = 15 - 58 = -43$
Expected A-a gradient for age (1 mark)	$= (\text{Age} / 4) + 4$ $= (60 / 4) + 4$ $= 19$
Interpretation (2 marks)	1. Acute Respiratory Acidosis or Resp Failure Type 2 2. Chronic respiratory acidosis 3. Metabolic alkalosis. MUST mention acute resp acidosis (i.e.: that there is an acute process going on, not just chronic) to get full marks. If only mentions "respiratory acidosis" then get 0.5 marks If mentioning A-a gradient in interpretation need to acknowledge that number is negative/bizarre, could be due to being on supplemental oxygen prior to gas being taken

*First 3 parts of the question – half-marks may be awarded for correct formula but incorrect maths.
Interpretation – max. 2 marks - 1 mark awarded for any of the above answers.*

The patient's condition deteriorates whilst in the ED and you prepare for possible intubation.

- b) State six (6) anatomical or physiological sequelae of obesity that affect RSI (rapid sequence intubation) in the bariatric patient. (6 marks)

Respiratory (4 marks)	• Increased upper airway resistance making BVM ventilation difficult • Pharyngeal overcrowding of soft tissues making intubation difficult • Reduced functional residual capacity, total lung capacity increases risk of desaturations not accepting just decreased TV – must mention FRC • Higher pressures required to ventilate patient due to increased chest wall mass/ stiffness, accept decreased chest wall compliance • Poor anatomic landmarks- difficult tracheostomy/ surgical airway • Regional ventilation- perfusion mismatching and airway closure • Accept increased baseline CO₂ but with a reason – i.e.: obesity hypoventilation/chronic hypoventilation • Increased pressure on diaphragm from abdominal contents
Cardiovascular (1 mark)	• Increased intra-abdominal pressures leading to reduced venous return • Increased metabolic demand leading to more rapid desaturation • Cor pulmonale/RV failure • Increased myocardia oxygen demand • Underlying CVS disease Not accepting HT/tachycardia/inc circulating blood volume/decreased CO/increased afterload or SVR/high output cardiac failure
GIT (1 mark)	• Increase gastric volume: GORD and aspiration risk

c) You are preparing to intubate this patient. State three (3) strategies you will employ to improve first pass success. (3 marks)

1. _____

2. _____

3. _____

- Patient positioning – ramped up on pillows/ towels/ wedge pillow – take weight off lungs/increase FRC
- Airway positioning – external auditory meatus to sternal notch level
- Apnoeic oxygenation with nasal prongs – to increase time to desaturation
- Use of NIV prior to intubation during pre-oxygenation phase
- Accept bagging through apnoeic period
- Tape breast down to prevent interference during intubation/use stubby handle laryngoscope
- Use of video laryngoscope over direct laryngoscopy
- Optimal drug dosing

NOT accepting just bougie

Need to elaborate – more than just “preoxygenation”

Can’t mention stubby handle AND VL (one or other)

Not accepting – most experienced operator as the candidate is performing the intubation

The patient desaturates post successful intubation. A chest X-ray shows a right main bronchus intubation resulting in a complete collapse of the left lung.

d) State four (4) interventions you would perform to improve his oxygenation. (4 marks)

1. _____
2. _____
3. _____
4. _____

- **Reposition ETT to level above the carina**
- Place patient at a 45-degree angle if lying flat
- Change to pressure-controlled ventilation mode
- Overinflating of endotracheal cuff prior to manoeuvres to prevent air leaks
- Increase FiO₂ to 1.0 to help improve oxygenation
- Increase PEEP to 40 cmH₂O in a graded fashion, every 30-40 seconds (20-30-40 cmH₂O) (sometimes pressures up to 50-60 cmH₂O for obese patients)
- Reduce PEEP to 25, then 22.5, then 20, then 17.5 or then an absolute minimum of 15 cm H₂O every three minutes until a decrease in SaO₂ ≥ 1% from maximum SaO₂ is observed (the decruitment point)
- Ensure sedated and paralysed
- If just mention BVM 0.5 mark
- PEEP must be increased to 10 or greater
- ZERO score for this sub-question if remove ETT completely
- Not accepting seek and treat other causes of desat
- If going to recruit have to say HOW
- Not accepting increase TV

Must include repositioning of ETT to get full marks, 1 mark awarded for any of the above points to a maximum of 4.

Answers stating a safe technique with increasing and decreasing PEEP for recruitment manoeuvres acceptable.

Question 2 (12 marks)

An 85 year old female is brought in by ambulance to your tertiary emergency department with a 6 hour history of bright red per rectum bleeding and lower abdominal discomfort.

Her medications include warfarin because of atrial fibrillation.

a) List the seven (7) most likely causes of bleeding in this patient. (7 marks)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

One mark for each of:

1. colonic diverticula/diverticulosis/diverticular disease/diverticulitis
2. Angiodysplasia/telangiectasia/AV malformation
3. colorectal carcinoma/ GI carcinoma
4. polyps/ benign neoplasm
5. Ano-rectal varices/haemorrhoids
6. Rectal trauma/fissure/ulcer
7. upper gastrointestinal bleeding (14% of bright red blood originates from an UGI source)
8. anticoagulation therapy (over-warfarinisation (most frequent cause in warfarinised patients)
9. colitis infective/ischaemic/radiation/inflammatory/Crohn's/ulcerative colitis

Half marks for less common things:

- Radiation telangiectasia
- Aortoenteric fistula
- Foreign body
- Post-procedural
- Endoscopy, biopsy site bleeding
- Immunosuppressive disorder, e.g. HIV/AIDS
- Drug related, e.g. NSAIDs, steroids
- Meckel's Diverticulum

Half marks for repeats of the same theme e.g. ischaemic colitis = 1, followed by ulcerative colitis = ½

No marks for intussusception, volvulus, rectal prolapse.

The patient continues to bleed and her blood pressure drops to 85/40. Her INR result is pending. Resuscitation has been commenced with packed red cells. You decide to empirically reverse the warfarin.

b) List three (3) agents, including doses, that you would use to reverse her warfarin. (3 marks)

	Agent / Dose (3 marks)
1	Prothrombin Complex Concentrate: 25-50U/kg IV
2	Fresh Frozen Plasma: 150-300ml IV
3	Vitamin K: 5-10mg IV

- No marks for TXA/tranexamic acid
- ½ for agent, ½ for dose, disregard route as not asked for
- 1-2 U is acceptable for FFP dose
- 15 ml/kg of FFP or 2-4U is only if PCC unavailable – no (half) mark for this dose if reason not stated, as it is a tertiary setting and PCC should be available.

c) While you are considering investigations to locate the source of bleeding, a junior doctor asks for an explanation between the two listed imaging studies. Give one (1) rationale for each investigation. (2 marks)

Investigation	Rationale (2 marks)
CT angiogram	Locate <u>fast</u> active bleeding Determine if the source of bleeding is amenable to IR or surgery
Radionucleotide scan	Locate <u>slow</u> active bleeding May not be visible to IR

Question 3 (18 marks)

An 80 year old male is brought into an emergency department after being struck by a car. He has isolated severe left knee pain. The skin is intact.

His X-ray is provided.



a) What significant abnormality is shown on this X-ray? (1 mark)

- Anterior knee joint dislocation

Must state anterior knee joint dislocation to score whole mark.

b) State the knee joint structure that is most commonly damaged with this injury. (1 mark)

- Posterior cruciate ligament (50%)

c) Complete the following table. State three (3) neurovascular structures that may be injured and two (2) supportive examination findings for each. (9 marks)

Neurovascular Structure (3 marks)	Supportive Examination Finding (6 marks)
Popliteal artery	• Rapidly expanding haematoma • weak or absent pulses • pallor • Paraesthesia • Pain • palpable thrill • audible bruit
Common peroneal nerve	• Foot drop/ dorsiflexion of foot/extension/toe dorsiflexion/eversion and/or ankle extension • Paraesthesia to dorsum of foot • Sensation of 1st web space and great toe
Tibial nerve	• Weakness of posterior compartment of the leg muscles • Weakness of intrinsic foot muscles • Paraesthesia of the skin to the sole of the foot
Popliteal vein	• Swelling bruising popliteal fossa and swelling lower leg

- d) List three (3) bedside investigations to evaluate for a vascular injury or complication.
(3 marks)

1. _____

2. _____

3. _____

- Ankle brachial index <0.9
- Doppler ultrasound for arterial occlusion or hand held doppler
- Compartment pressure measurement
- Sats

CT scanning is not a bedside investigation.

- e) List four (4) patient factors that significantly impair your assessment of distal limb neurovascular status. (4 marks)

1. _____

2. _____

3. _____

4. _____

- Obesity or oedema
- Hypothermia
- Shock
- Pre-existing peripheral vascular disease
- Pre-existing peripheral neuropathy
- Communication issues – E.g. Pre-existing significant cognitive impairment (e.g. dementia), language, hearing impairment
- Sedation or intoxication (uncooperative)
- Severe pain as distracting injury
- Spinal pathology including MS paraplegia

Question 4 (18 marks)

A 59 year old male was brought to your emergency department by ambulance after suffering a brief tonic-clonic seizure.

He has been unwell with lethargy and vomiting, after undergoing his first session of chemotherapy for a newly diagnosed malignancy a few days ago.

His observations are:

GCS	15
Temp	37.9 °C
HR	120 /min
BP	105/60 mmHg
RR	26 /min
SaO ₂	95 % on room air

You suspect tumour lysis syndrome as the cause of his symptoms.

a) List four (4) risk factors for development of tumour lysis syndrome. (4 marks)

1. _____
2. _____
3. _____
4. _____

- Large tumor burden/ Bulky tumor mass
- Extensive marrow involvement
- High tumor sensitivity to chemotherapeutic agents
- Hematological malignancies e.g. ALL/ Burkitt lymphoma (have to specify)
- Pre-existing renal failure
- Administration of Glucocorticoids, hormonal agents (letrozole/tamoxifen), monoclonal antibodies (rituximab/gemtuzumab), Ionizing radiation
- Use of chemotherapeutic agents like cisplatin, etoposide, fludarabine, intrathecal Methotrexate, paclitaxel (half mark if only says "type of agent" full marks if name an agent)
- LDH levels >1500 IU (half mark if wrong cutoff or no value specified)
- Volume depletion/dehydration
- Pre-treatment hyperuricaemia
- Pre-treatment hyperphosphataemia
- WCC >50,000 (half mark if wrong cutoff)
- First chemo dose

b) List four (4) biochemical findings on lab results to support your suspected diagnosis.
(4 marks)

1. _____

2. _____

3. _____

4. _____

- Hyperkalaemia
- Hyperphosphataemia
- Hyperuricaemia
- Hypocalcaemia
- Raised creatinine and urea / renal failure

Renal dysfunction, raised urea/creatinine/decreased GFR may only score 1 mark in total

Lab tests confirm tumour lysis syndrome.

- c) List five (5) treatments for the correction of the biochemical abnormalities. Explain your rationale. State no more than two (2) options for each abnormality. (10 marks)

Management (5 marks)	Mechanism (5 marks) Must be specific
IV hydration	Improve dehydration as a cause of renal failure; increase uric acid excretion (Can mention dehydration on its own if has mentioned renal failure in part (b))
Insulin/Dextrose	Shift K intracellularly
B agonist nebs	Shift K intracellularly
Potassium binding resins	Bind K in gut and prevent absorption
Phosphate binders	Bind phosphate in gut and decrease absorption
Calcium Gluconate	Replenish Calcium in symptomatic (in this case seizure) Hypocalcemia <i>(Note: cardiac stabilisation is not a correction of biochemical abnormality, thus not accepted as rationale)</i>
Recombinant urate oxidase (rasburicase)-	Enhance Uric acid elimination
<u>S</u> odium bicarbonate	Urinary alkalinisation to increase uric acid solubility and excretion – in presence of Metabolic Acidosis Shift K intracellularly – in ACIDOSIS <i>(Must mention acidosis for these answers)</i>
Renal replacement therapy / Dialysis	Treat hyperkalemia and hyperphosphatemia; Support renal function
Allopurinol	Decreases uric acid production
Furosemide	ONLY if specifies clearance of K in fluid overload

Question 5 (12 marks)

You are tasked to investigate a critical incident in your emergency department.

At the end of a busy shift a junior doctor prescribed IV Augmentin to a 5 year old male with a penicillin allergy who had presented with a dog bite. Subsequently he had severe anaphylaxis and required management in ICU.

a) State four (4) actions you would take in investigating and managing this incident. (4 marks)

1. _____

2. _____

3. _____

4. _____

- **Open Disclosure to patient and family**
- Investigation (examine records, interview staff)
- Reporting (eg. Electronic incident system, RCA, medicolegal)
- Education (inc. M&M)
- Feedback (debrief staff, counsel JMO, family)
- Recommendations

Must give open disclosure to score full marks in this sub-question
Other appropriate answers will be accepted.

- b) List three (3) system factors (not practitioner) that may have contributed to this error. (3 marks)

1. _____

2. _____

3. _____

- Lack of mandatory recording of patients' allergies
- Lack of an alert system e.g. Electronic prescribing that is used and functional
- Lack of a process mandating allergy checking / double-checking prior to drug administration

At least 1 of the above three factors is required to score full marks.

- Shift length and roster patterns
- Supervision – was there adequate senior supervision
- Overcrowding

Following the investigation, you submit recommendations to change hospital processes.

- c) List three (3) characteristics of the 'SMART' methodology that should be considered when writing a constructive recommendation. (3 marks)

1. _____

2. _____

3. _____

SMART methodology of constructing goals/recommendations.

- Specific: In a manner that clearly defines what, how and why an action needs to be done
- Measurable: In a manner that makes measurement possible
- Achievable/Attainable: With consideration as to whether they are achievable
- Result driven/Relevant/Realistic: The goals of the recommendation need to be clear for later evaluation of success
- Timely: Need to ensure timeframes for completion are set and are realistic whilst still creating a practical sense of urgency

Either name or describe correctly 3 of the above. (Correct name, but poor description earns 0.5 marks)

d) State two (2) potential barriers to change that might exist in the hospital. (2 marks)

1. _____

2. _____

- Organisational culture
- Silos – poor communication / information flow between departments
- Tribalism – unwillingness to accept change proposed by a different craft group
- “change resistors” – stakeholder resistance
- Scarce resources, (e.g. Staffing, financial, IT systems etc.)
- Leadership instability,
- Competing demands,
- Magnitude of change

Other appropriate answers will be accepted.

Examiner Reference

Figure 1. IHI Framework for Engaging Physicians In Quality and Safety

