Please note – this learning resource has been produced by the GUMS Academic Team. It is possible that there are some minor errors in the questions/answers, and other possible answers that are not included below. Make sure to check with other resources.

1. **Which of the following is the PRIMARY stimulator of respiratory drive in a healthy adult?**
2. O2
3. CO2
4. H+
5. Noradrenaline
6. **In which of the following scenarios would you expect a patient’s SpO2 to be below normal?**
7. In a healthy adult after strenuous exercise for 30 minutes
8. In a patient with anaemia
9. In a patient with a pulmonary embolism (PE)
10. In a patient with carbon monoxide (CO) poisoning

NOTE

Physiologically both C and D are correct as

C = PE -> physiological dead-space -> ventilation with reduced perfusion -> inability to oxygenate haemoglobin -> decreased SpO2

D = CO poisoning -> Increased carboxyhaemoglobin (CO on haem) -> decreased oxyhaemoglobin

Although CO poisoning causes a reduction in oxyhaemoglobin, the current standard SpO2 pulse oximetry CANNOT screen for CO, as it cannot differentiate between carboxyhaemoglobin from oxyhaemoglobin. Therefore although there is a reduction in oxyhaemoglobin, there is no perceived change in SpO2.

1. **Which of the following statements is INCORRECT?**
2. 2,3 DPG aids in offloading oxygen from red blood cells, causing a left shift in the Hb dissociation curve
3. Increased temperature destabilises the heme group within Hb, causing a right shift in the Hb dissociation curve
4. Carbon monoxide poisoning results in a left shift in the Hb dissociation curve
5. Exercise induces a right shift in the Hb dissociation curve
6. **List some of the most important diagnoses that you must rule out in a person presenting with acute shortness of breath (SOB) and chest pain? (i.e. what diagnoses are potentially deadly)**

* Pneumothorax
* PE
* ACS (Acute coronary syndrome) /MI (heart attack)
* Cardiac tamponade
* Aortic dissection

1. **Differentiate between metabolic and respiratory acidosis and alkalosis, giving some examples of what can cause each.**

Metabolic Acidosis

Uncompensated low HCO3 and low pH

Caused by excessive metabolic acid formation

Conditions include;

- Diarrhea

- Renal disease

- Untreated diabetes

-Starvation

- Excessive alcohol ingestion

Respiratory Acidosis

Uncompensated high CO2 and low O2

Caused by Hypoventilation

Conditions include;

- Impaired lung function

< Chronic bronchitis

< Emphysema

< Cystic fibrosis

- Impaired respiratory movement

< Paralysed respiratory muscles

< Drug induced depression of respiratory centres

Metabolic Alkalosis

Uncompensated normal HCO3 and high pH

Caused by loss of body acid

Conditions include;

- Vomiting

< Loss of H and K

- Diuretics

< Loss of K and H

- Excessive aldosterone

< Conns disease

Respiratory Alkalosis

Uncompensated low CO2 and high pH

Due to hyperventilation

Conditions include;

- Psychogenic

< Anxiety

< Fear

- Hypoxaemia

< Asthma

< High altitude

**6. You are a 1st year medical student lost in the depths of the hospital ED, you see your friendly neighbourhood intern talking to a patient. All clammy hands and weak knees forgotten you go and talk to the intern, who gives you the following details (they are really quite bored).**

**The patient (Dia Betus) presented to the ED 30 minutes ago looking to be confused and disoriented with a distinct ‘fruity’ smell to her breath. The patient’s vitals are as follows.**

|  |  |
| --- | --- |
| **Body Weight** | **53kg** |
| **Height** | **160cm** |
| **Temperature** | **36.5℃ (normal 36.1 – 37.9℃)** |
| **Heart Rate** | **112 (normal 60-100)** |
| **SpO2** | **97% on room air** |
| **Respiratory Rate** | **28 breaths/min (normal 12-20)** |
| **Chest Sounds** | **Chest is clear bilaterally, vesicular breath sounds, no added sounds** |
| **Blood Pressure** | **160/98 mmHg (normal 100/60-140/90)** |

1. **What are the differential diagnoses at this point?**

* DKA
* Alcohol intoxication
* Drug overdose e.g. cocaine, ecstasy

**b) Dia Betes presented with fruity breath, what are some other key symptoms she might also present with for DKA?**

THE FOLLOWING THREE ARE HIGH YIELD

- Polydipsia

- Polyuria

- weight loss

These are all primarily signs of hyperglycaemia

Specific DKA signs

- Hyperventilation

- Abdominal pain

- Altered mental status

**c) What are the principles of DKA management?**

1. Correction of fluid and electrolyte abnormalities

- Infusion of isotonic saline

- Correction of K deficit (if present)

- Administration of insulin (should be delayed if K less then 3.3 mEq/L, due to Insulin causing K’s movement into cells)

NOTE

Acidosis will cause K to move out of cells, due to the polydipsia there is the potential for excessive K loss (through the urine) causing the hypokalaemia (note Griffith exams say DKA will ALWAYS cause hypokalaemia, in real world land it can be normal or low)

If patient has euglycemic DKA (normal blood glucose), insulin and dextrose should be given

**d) What are some causes of shortness of breath in a patient with clear lung sounds?**

* Metabolic acidosis
  + CKD – Chronic kidney disease
  + DKA – Diabetic ketoacidosis
  + Sepsis
* MI
* PE (can pleural friction rub or other sounds, sometimes no sounds)
* Anaphylaxis (may have stridor)
* CO poisoning
* Anxiety
* Anaemia

Following your initial examination, you decide to take an arterial blood gas (ABG). The results are as follows.

|  |  |  |
| --- | --- | --- |
|  | **Result** | **Ref. Range (Arterial Blood)\*** |
| **PO2** | **112 mm Hg** | **80-100 mm Hg** |
| **PCO2** | **22 mm Hg** | **35-45 mm Hg** |
| **Bicarbonate HCO3-** | **12 mmol/L** | **22-32 mmol/L** |
| **pH** | **7.23** | **7.35-7.45** |
| **BE** | **-3.7** | **-2–+2 mmol/L** |
| **Total Haemoglobin** | **130 g/L** | **130-180 g/L (M) (115-165 g/L (F))** |

1. **Report the findings of this ABG**

* Partially compensated metabolic acidosis
* Acidosis: pH <7.35
* Metabolic: Low bicarbonate
* Partially compensated: CO2 below normal but pH still below normal

1. **What is the physiological explanation for the decreased levels of CO2?**

* Central chemoreceptors detect a decreased pH within the blood (NOTE ONLY CO2 diffuses through BBB, it then turns into H+ which is detected by the central chemoreceptors )
* Can be explained by CO2 + H2O ↔ H2CO3 ↔ H+ + HCO3-
* More CO2 pushes the equation to the right, leading to more H+ formation around the chemoreceptors
* This increases respiratory drive, causing the body to blow off more CO2 and thereby decreasing blood levels of CO2. This raises the pH of the blood, in order to compensate for metabolic acidosis

**7. After a healthy lunch of gravy and chips, you see another patient (Steph Ococcus), an 89-year-old woman with a 3-day history of shortness of breath, shivering and cough productive of rust coloured sputum. Her vitals are as follows:**

|  |  |
| --- | --- |
| **Temperature** | **39.1℃ (normal 36.1 – 37.9℃)** |
| **Heart Rate** | **118 (normal 60-100)** |
| **SpO2** | **91% on room air** |
| **Respiratory Rate** | **32 breaths/min (normal 12-20)** |
| **Chest Sounds** | **Bronchial breath sounds with right middle zone and coarse crackles.**  **Right pleural friction rub evident** |
| **Blood Pressure** | **133/72 mmHg (normal 100/60-140/90)** |

1. **List some differentials based on the above findings**

* Community acquired pneumonia
* Aspiration pneumonia
* LRTI (Lower respiratory tract infection)
* Need to rule out lung cancer

1. **List some of the common presenting signs and symptoms of pneumonia and provide their physiological basis**

**SYMPTOMS**

* Cough -> irritation of cilia from mucous
* Fever -> resetting hypothalamus thermostat due to macrophage production of cytokines which induce COX-1 production of prostaglandins
* SOB -> loss of lung function (V/Q mismatch)
* Sputum production -> innate immune response
* Haemoptysis -> destruction of lung capillaries

**SIGNS**

* Febrile >38deg -> as above
* RR >20 -> compensating for reduced PaO2 and V/Q mismatch
* PaO2 reduced -> V/Q mismatch
* Audible crackles -> exudate accumulation in airways
* Bronchial breath sounds -> consolidation causing distortion of the sound waves through a solid medium

1. **What are the most common typical and atypical organisms for pneumonia?**

**TYPICAL**

* Streptococcus pneumoniae
* Haemophilus influenzae
* Staphylococcus aureus (hospital acquired)
* Pseudomonas aeruginosa (hospital acquired)

**ATPICAL**

* Mycoplasma pneumoniae
* Chlamydophila pneumonia
* Legionella pneumophila

1. **Provide a basic treatment plan for his management**

* O2 vial nasal prongs to achieve SpO2 >95% (preferably humidified O2)
* +/- antipyretics EG Panadol
* Antibiotics: PO amoxicillin OR benzylpenicillin + doxycycline if determined mod-sev pneumonia
* Probable referral to hospital ED given reduced O2/hypoxia, increased RR/HR and elderly age
* Referral to inpatient physiotherapist ( ☺ NB: This worksheet was written by 2 physiotherapists)

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