MODULE 4 : Respiratory System

Biochemistry – Undergraduate Programme

Faculty of Medicine and Allied Sciences
Rajarata University of Sri Lanka

Broad Objectives

At the end of this course, a student is expected to,

1. be aware of the structure and functions of haemoglobins in respect of gas transport and buffering.
2. know the different types of muscle, their function and energy metabolism.
3. be aware of the importance of lung surfactant.

Specific Objectives

1 Transport of Gases& Buffering

1.1 Recall the physiological / biochemical functions of haemoglobin.
1.2 Draw a sketch of the haemoglobin molecule, HbA, to show the
  1.2.1 major components
  1.2.2 haem pockets
  1.2.3 O_2 binding sites
  1.2.4 2,3 BPG binding site
  1.2.5 H^+ buffering His residues
1.3 Describe the structural features of HbA and show that the structure of haemoglobin is design to suit the different functions it performs.
1.4 Draw the O_2 - haemoglobin association curve of HbA and give biochemical reason to explain why the curve assumes a sigmoidal shape.
1.5 Compare O_2 - haemoglobin association of HbA with those of
  1.5.1 myoglobin (Mb)
  1.5.2 foetal haemoglobin (HbF)
  Give biochemical reasons to explain the differences.
1.6 Give biochemical reasons to explain the shift of the O_2 - haemoglobin association curve brought about by changes, within physiological limits of
  1.6.1 [H+]
  1.6.2 2,3-bisphosphoglycerate (2,3 DPG or 2,3 BPG)
  1.6.3 temperature
1.7 Describe the biochemical mechanism that operate to maintain the iron atom in haem in the ferrous form (Fe2+), reducing any ferric form (Fe3+) formed spontaneously and explain the need for this protective mechanism.
1.8 Giving physiological and biochemical reasons, explain why HbF is a better transporter of O_2 than HbA in foetal life.
1.9 Show that the HbA molecule is design to minimise binding of endogenously formed CO.

1.10 State the properties that enable one to distinguish oxyhaemoglobin, non-oxygenated haemoglobin, methaemoglobin and carboxyhaemoglobin when using the,
   1.10.1 naked eye
   1.10.2 pocket spectroscope

2 Energy Production

2.1 State the three major types of myocytes and describe the distribution of cellular organelles in each and their likely function.
2.2 State the major fuels used by the cardiac and skeletal red and white muscle, and describe the environment present in each to promote energy production.
2.3 State the proteins present in thin and thick filaments of myofibril and sketch their molecular arrangement.
2.4 Describe the molecular events that occur during muscle contraction following stimulation of a nerve ending.
2.5 List the sub units of troponin and their function during muscle contraction and relaxation.
2.6 Describe the status of ATP / ADP ratio in a myocyte when it is resting and active, explaining how the ratio affects energy production under aerobic and hypoxic conditions.
2.7 Describe the role of red and white muscle in athletes trained for short and long distance runs.
2.8 Describe the likely biochemical changes that that could occur in the cardiac muscle, following cessation of blood supply.
2.9 Explain the biochemical changes in the muscle following muscle fatigue after exercise.
2.10 Explain what is meant by 'oxygen debt' in an exhausted sportsman and biochemical mechanisms available in the body to get rid of it.

3 Lung Surfactant

3.1 Know the components that go to form lung surfactant.
3.2 Explain how the surfactant lowers surface tension and prevents the collapse of alveoli.
3.3 Know the implications on respiration of low levels of surfactant.

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