Hemoglobin, the oxygen carrier and allosteric interactions in crocodile hemoglobi...

Health & Medicine, Body

Question one

Microscope

(Polyethylene reservoirs) (Short rectangular capillary)

plati-num wire electrode

This is because the red blood cell would be clearly observed using rectangular capillary. This column would enable observation of the movement of particles hence a thorough study of the mobility of the components of the red blood cells would be taken into account. Because a person is able to evaluate or rather observed the change of red blood in the capillary column is reason enough to diagnose Martin b the disease.

Question two

HbS S molecules would be likely to clump together because of the presence of the sickle cell anemia. It would affect the transportation of oxygen to the blood vessels. The infection of sickle cell anemia increases the likelihood of HbS molecules clumping together. In addition, it is facilitated by the fact the affinity for mutation of a normal á chains.

Question three

A hundred percent of Oxygen can be administered to a particular patient if she or she is having trouble in breathing. This type of complication is brought along by the sickle cell anemia whereby the blood vessel got blocked. It thus implies that the body is not getting sufficient oxygen supply due to the blockage of blood flow. It means that giving a patient 100% oxygen would saturate the hemoglobin though the oxygen has a chance of dissolving

within the body’s plasma. This is a suitable way of treating or reducing fatal cases of sickle cell anemia. It ensures all body organs get sufficient oxygen for the normal operations.

Question four

Hydroexyurea is extensively used in essential thrombocythemia and finds use in myeloproliferate disorders. It also finds extensive use in reduction of the rate of occurrence of painful attacks in patients suffering from sickle cell disease. It also displays antiretroviral properties, which come in handy when dealing with diseases like AIDS. Hydroexyurea finds its application in the fight against sickle cell disease because it affects production of fatal hemoglobin. It has been proven that it helps in increasing the concentration in blood of fatal hemoglobin. It does this by increasing nitric oxide levels, which in turn causes guanyiyi cyclase to be activated. This further result in cyclic GMP and causes gammaglobin to be synthesizes and synthesis of the latter is highly essential for fetal hemoglobin.

It has been proven that oxidation of Hydroexyurea can take place and result in the production of nitric oxide in human beings. It has also been proven that Hydroexyurea can react with oxyhemoglobin and deoxyhemoglobin ant this reaction results in the formation of metHb. This in turn reacts with Hydroexyurea resulting in the formation of iron nitrosyl hemoglobin. Production of NO may also result from the hydrolysis of Hydroexyurea to hydroxylamine. This reaction is followed by more rapid reactions between hydroxylamine and hemoglobin. It is a well-known fact that the administration of Hydroexyurea increases with a great deal of significance

the levels of NO and cGMP levels in the plasma of patients suffering from sickle cells. Hydroexyurea acts like a NO donor who increases the cGMP levels which contributes to gamma globin gene expression in the erythroid cells of human beings.

NO plays a pivotal role in the treatment of sickle cell disease. It produces relaxation of smooth muscles vasodilatation and causes an increase in the regional flow of blood and this helps prevent the adhesion of cells to endothelial cells. This helps anemia patients as it ensures optimum blood flow to all tissues of the body and ensures optimum oxygen delivery where it is needed.

Question one

The term Allosteric modulator refers to a substance, which influences the activities of a protein either as an amplifier or as an attenuator. In human beings, hemoglobin is tasked with transporting oxygen from the lungs to numerous respiring tissues and this is achieved when hemoglobin goes through a conformatorial change from its previous relaxed state or high oxygen affinity state to its tense state or low oxygen affinity state. The body has developed a large number of Allosteric mechanisms, which regulate the delivery of oxygen either by increasing or by decreasing the oxygen affinity of hemoglobin. An example of these Allosteric modulators includes 2, 3-bisphosphoglycerate, adenonsine triphosphate and nitric oxide. Nitric oxide has the ability to cause blood vessel relaxation, which increases the amount of blood flowing hence increases oxygen delivery. The phosphates have the ability to decrease oxygen affinity in blood in relation to purified hemoglobin.

Question two.

Myoglobin is a protein that binds iron and oxygen in muscle tissues in most mammals and vertebrates. It is highly related with hemoglobin which is the protein tasked with binding of iron and oxygen in blood. Myoglobin acts as the main oxygen transporting pigment in tissues of muscles. High concentrations of Myoglobin in muscle tissues can therefore enable organisms to hold their respective breaths for, longer periods. Diving mammals have a high abundance of Myoglobin in their muscle tissues and are thus able to hold their breaths for elongated times under water for example whales.

Question three.

It has been proposed that bicarbonate serves as an Allosteric modulator of hemoglobin in crocodiles since crocodiles have low levels of Myoglobin in their tissues yet are able to hold their breadths for long times. The source of this bicarbonate can be explained in terms of CO2 produced in cells of the crocodiles, which results from combustion of food. The CO2 reacts with and dissolves in water resulting in production of protons and bicarbonate.

Question four.

This graph clearly shows that oxygen binding affinity for hemoglobin increases with increase in concentration of the bicarbonate and also decreases significantly with decrease in concentration of the bicarbonate.

Question five and six.

In the attempt to engineer a human hemoglobin molecule with similar bicarbonate binding properties as crocodile hemoglobin, not all residues directly interacted with bicarbonate. The amino acid residues that do not interact directly with bicarbonate molecules might distort the structure and result in creation of a site for binding rather than participating directly in the process. The remaining amino acids bond with the bicarbonate ions. The phenol ate ion of Tyr 42 and Tyr 41 were actively involved in hydrogen bonding with the bicarbonate ions.

Question seven.

Other animals have also adapted to using small molecules as Allosteric effectors to encourage at a greater rate the release of oxygen by hemoglobin molecules. These molecules have diverse and different structures but studies have shown that there might exist some similarities between the structures of these molecules. A comparison of the structure of ATP and the structure of IPs has revealed that they both are characterized by presence of negative charges or in other words they both carry a negative charge. This negative charge plays a key role when it comes to binding with hemoglobin as it enables the molecules to bond with hemoglobin molecules. Some of these molecules exhibit a very large number of negative charges and this is pivotal to the molecule’s potential to bind with hemoglobin.