Successful steps towards complete management biology essay

Science, Biology

Introduction

The word (Thalassemia) comes from two parts (thalassa) which means sea and (haima)which means blood and it is Greek word. Beta thalassemia is a genetic disease that occurs due tothe decreased synthesis of beta globin chain or complete loss of beta globin chain. The resultantoutcome would be anemia and a decline in the synthesis of red blood cells(RBCs). In addition , to the amount of Hb inside red blood cells(RBCs) is also diminished. During the early two yearsof age, patients with beta thalassemia develop symptoms including the need for blood transfusionand acute anemia.. Beta thalassemia can be subdivided into three classes: major. Intermedia andminor. (1) Acute anemia that resulted in Beta thalassemia patients occurs due to decreased ortotal absence of hemoglobin A synthesis(HbA) that consists of two alpha chains and two betachains(α2 β2). Total lack of beta globin synthesis causes β0 Thalassemia while decrease in thesynthesis of hemoglobin causes β+ Thalassemia . Symptoms of β-thalassemia are determined towhich grade the divergences between α and β globin chain occur. These divergences affecterythropoiesis by blocking maturity of erythroid precursors(2)Fatality in beta thalassemiaessentially originates from heart disorders that resulted from excess levels of iron despite theimprovements during the latter two decades in therapy including blood transfusion, bone marrowtransplanrtation and chelation therapy. These improvements led to give better prediction for β-thalassemia health(1). This paper will review the principal classes of beta thalassemia , severity ofsymptoms and the various methods of treatment with focusing on the gene therapy treatment ofbeta thalassemia.

Genetics of Beta-thalassemia

The genetics of β-thalassemia is in autosomal recessive way. This means for a child to beaffected, his parents should be heterozygous for this disease which means that each parent hasonly one copy of the defective gene(beta globin chain gene). After pregnancy, there is apossibility of 25% of having normal child without symptoms, 25% of having child with thedisease and 50% of having children with a copy of the defective gene and withoutsymptoms(carriers). With each gestation, there ia a hazard of 25% of developing a child carriedbeta thalassemia in heterozygous parents(1).

Types of Beta-Thalassemia

Beta-Thalassemia Major

Beta –thalassemia major or Cooley anemia indicates combined heterozygous orhomozygous form of the disease. It is also known as Miditerranean anemia and Von Jakschanemia. It is represented by presence of severe symptoms such as hemolysis, unable to grownormally, jaundice in addition to acute anemia. This disease results in ineffectiveerythropoiesis. The above symptoms start in early age of the patient(3). Patients with β-thalassemia major develop symptoms such as fever, pallor, irritability in addition to problemsduring feeding and diarrhea. Splenomegaly may also appear. Starting blood transfusion with Hblevel of (95-105)g/L can manage these problems and help the patient to grow normally till theage of 10 or 11 years old in case the disease is diagnosed at this stage. Insufficient bloodtransfusion can lead to the iron accumulation that can be dangerous for the patients. Before thethird decade, non proper transfusion of blood could

lead to death in patients with β-thalassemiamajor. About 71% of mortality rates in β-thalassemia major are found due to heart problems. Heart problems are the essential threatening problems resulted from excess iron level. Siderosisresulted from blood transfusion can be responsible for heart problems. Expectation for patientshealth become unlimited in patients receive essential chelation and transfusion ofblood.(4). Iron overload can result from transfusion of blood and can lead to development ofmany problems in children such as retardment in sexual maturation and delay ofgrowth. Hardness of problems caused by excess iron levels and the prevelance of such problemsare highly determined by the modified use of Iron chelation treatments(1).

Beta-Thalassemia Intermedia

Compound heterozygous β+ , homozygous β0or homozygous δ β mutations can result inβ-thalassemia intermedia.(3). Patients with β thalassemia intermedia do not need regulartransfusion of blood or they infrequently need transfusion of blood besides the development ofmoderate anemia. Delay of development and growth occur in these patients despite the fact thatthey are able to live without the need for frequent transfusion of blood. The clinical symptomsusually appear between the age of 2 and 6 years old. The raised absorption of iron from theintestine in β-thalassemia intermedia leads to increase the possibility of developing excess ironlevel. There is infrequent occurrence of diabetes, hypogonadism and hypothyroidism(1). Theproblems resulting from excess iron level can be dangerous and similar to these problems foundin patients with β-thalassemia major that arise due to their

dependence on blood transfusionalthough these problems can appear at late age(4). Comparing with β-thalassemia major, growthand development are improved for patients with β-thalassemia intermedia and sexual maturationis enhanced. Although these pateints may develop problems like heart problems, liver failure andchronic anemia, they have more extended life compared with β-thalassemia major(3).

Beta-Thalassemia Minor

Individuals with β-thalassemia minor appear without developing symptoms of the diseasealthough there is an evidence of developing moderate anemia(1). These patients develop normallife despite the presence of moderate symptoms. Patients with β-thalassemia minor do not needtreatment although they have moderate anemia. Iron deficiency demonstrates that the presence ofβ-thalassemia minor and it is indicative for the diagnosis of the disease(3).

Management of Beta-Thalassemia

Blood Transfusion

Blood transfusion is important to repair the anemia, inhibition of erythropiesis andsuppression for absorption of iron in the gastrointestine. These results occur due to theineffective and increased erythropoiesis in patients do not depend on the bloodtransfusion(1). Transfusion of blood should be done every 2 or 3 weeks. The goal of transfusion ofblood is to achieve Hb concentaration of (95-100)g/L(4). The laboratory results for diagnosis ofthis disease are the essential determinants for stating blood transfusionin children. Testing theblood that is transfused against Hepatitis C

started in1991 and against human immunodeficiencyviral infections started in 1985. Testing the blood before transfusion is highly important toreduce the occurrence of infections due to blood transfusion. The appropriate amount of bloodeach year depends on supply of blood in each visit, levels of Hb and the weight of thepatient(3). With blood transfusion, there is a chain of dangerous problems that make the patientsmore liable for developing hazardous outcomes despite their vital role in patient recovery. Themost crucial problem accompanied blood transfusion is excess iron level(1).

Bone Marrow and Cord Blood Transplantation

The single applicable method that provides complete treatment for beta thalassemiapatients is bone marrow transplantation(BMT)(1). Transplantation in bone marrow employshematopoietic stem cells(HSCs) that are found in umbilical cord blood, peripheral blood or bonemarrow. The presence of matched sibling donor, the state of the organ in the children receivedchelation therapy in addition to the efficient performance of transplantation are crucial factors forthe powerful outcomes of transplantation(2). Immunological problems arise in makingunsuccessful transplantation and this makes the choice of the donor is highly essential. HLA-matched siblings can give high results of transplantation. Cord blood transplantation is essentiallyused in pediatric patients. This method includes several profits such as its convenience, lowpresence of GVHD and contamination with viruses is also limited. Unsuccessful umbilical cordblood transplantation is due to the limited size or the insufficient number of stem cells inumbilical cord blood(3). The opportunity of developing graft versus

host disease(GVHD) orrejection for the graft in addition to the possibility of matched donor make the principallimitation for (HSCs)transplantation(2).

Gene Therapy

Gene therapy proves its ability to be the absolute therapeutic method that can repair the genetic defect in β-thalassemia and Sickle cell disease(5). 4/25/2013(1) Galanello R, Origa R. Review: Beta-thalassemia. Orphanet J Rare Dis 2010; 5(11).(2) Rachmilewitz EA, Giardina PJ. How I treat thalassemia. Blood 2011 Sep 29; 118(13): 3479-3488.

(1) Galanello R, Origa R. Review: Beta-thalassemia. Orphanet J Rare Dis 2010; 5(11).

(1) Galanello R, Origa R. Review: Beta-thalassemia. Orphanet J Rare Dis 2010; 5(11).