Sickle cell disease

Part Cystic fibrosis follows simple Mendelian autosomal recessive inheritance. Affected people carry two copies of the mutated Cystic Fibrosis Transmembrane Conductance Regulator (CFTR) gene, one inherited from each parent. Carriers will have one normal and one mutated copy of the CFTR gene and their health is normal. However, the carriers will have the potential to pass on the affected gene to their offspring.

Let us suppose that both the friend and her fianc are carriers of the mutated CFTR gene, then

1. There is 1 in 4 chance that their baby will have cystic fibrosis.

2. There is 1 in 4 chance that their baby will not have cystic fibrosis and do not carry mutated CFTR gene.

3. There is 1 in 2 chance that their baby will not have cystic fibrosis and will carry a mutated CFTR gene.

The chances of my friend being a carrier are one out of four. Both her grandparents were carrier of mutated CFTR as they were healthy and one of their progeny (uncle) had cystic fibrosis. The chance of one of her parents being a carrier is 1 in 2 (1/2). Assuming that one of her parents had normal copies of CFTR and the other parent was a carrier, the chances of their siblings being a carrier is 1 in 2 (1/2). So the chances of my friend being a carrier is x , i. e , one out of four.

The chances of my friend's fianc being a carrier are , since his sister has the disease.

Assuming that both my friend and her fianc are carriers, the chances of their baby having the disease are 1 in 4. Therefore, the overall chance of their baby having cystic fibrosis is x x . 1/32, one in a 32.

Both my friend and her fianc would need to undergo a genetic screening

before starting a family, as there is 1 in 32 chance that their baby could have cystic fibrosis.

Part 2:

Sickle cell disease: Sickle cell disease is a genetic disorder caused by mutations of the -globin gene. There is a mutation of one single nucleotide from A to T, which results in a glutamic acid being replaced by valine at position 6 of the -globin gene. GAG, a codon, which codes for glutamic acid is changed to GUG resulting in replacement with valine (Pauling et al., 1949). In several forms of this disease, the red blood cells (RBC's) change their shape (Herrick, JB., 1910), upon deoxygenation caused by polymerization of abnormal sickle hemoglobin (Hanh and Gillespie, 1927). This results in the damage of the RBC's and can lead to these cells getting stuck in capillaries. The downstream tissues that are supplied by these capillaries are deprived of oxygen causing ischemia, leading to organ damage, as in stroke. Sickle cell disease follows autosomal recessive pattern of inheritance. The knowledge of genetics helps identifying the risk of having a Sickle cell disease in the progeny. Carriers or heterozygotes the polymerization problem is very less, with problems occurring only when they are exposed to very low oxygen levels. However, in homozygotes the problem is severe. The chances of person being a carrier depend on the family history and family's ethnic background (people from West Africa, Middle east and central India). Abnormal hemoglobin (i. e., sickle hemoglobin) can be detected by hemoglobin electrophoresis, a gel in which various types of hemoglobin move at different speed (Robinson et al., 1957). Genetic testing is rarely required for diagnosis.

Treatment options include zinc supplements which help in stabilizing the RBC

membrane. Pain is treated with analgesics, sometimes requiring opioid administration. The first drug approved for treating sickle cell disease is hydroxyurea, was shown to reduce the number and severity of the symptoms. Bone marrow transplantation could be very effective in treating the disease in some young patients. Butyric acid was also shown to increase the normal hemoglobin levels and is being tested as a treatment option (Fathallah and Atweh, 2006). Gene therapy in mice could prevent the sickle cell disease in mice (Pawliuk et al., 2001).

Thus assessment of genetic risk, diagnostic tools, genetic test and various treatment options including gene therapy would be useful in controlling and treating sickle cell anemia in future.

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