mMEDCON International

Round4_MPSC: Genetics (40 points)

Case Study I: **20 POINTS**

Patient Overview: Andy is a 3-year-old boy presented to his GP by his parents with an apparent ear infection. Andy has been getting these quite regularly, and while they never prove serious, his parents are becoming worried due to their frequency. Additionally, around the time the ear infections first appeared, Andy started regressing - while previously meeting his milestones like walking and talking at a normal pace, he has now stopped responding to his name when being called, his functional vocabulary has decreased from full sentences to just words, and he has developed repetitive behaviors such as hand-flapping and rocking back and forth. You prescribe antibiotics to treat the ear infection and refer Andy to a child psychiatrist for further evaluation due to a suspected condition.

1. What is the suspected diagnosis based on Andy's behavioral profile? What test will be used to confirm/reject the diagnosis? *(2 pts, 1 for suspected diagnosis, 1 for a test)*

Andy's parents show up to see you once again, just 2 months later. They tell you that the psychiatrist confirmed your suspicions, and that Andy is now diagnosed with a neurodevelopmental disorder. Additionally, though, Andy has started experiencing diarrhea, his ear infection is back, and he also started struggling with sleeping, sometimes staying awake for days at a time. You ask Andy's parents to collect an early morning sample of Andy's urine, which you subsequently send for laboratory analysis.

2. Andy's urine comes back with elevated glycosaminoglycan levels. What class of disorders does such a finding point towards, and what are 5 examples of syndromes stemming from this type of disorders? *(3.5 pts, 1 for the class of disorders, 0.5 for each of the syndromes, max 2.5)*

3. What is the next type of blood test necessary in order to determine the type of disorder Andy suffers from? For 3 of the syndromes you mentioned earlier, provide a chemical that is being looked for in this differential diagnosis step. *(2.5 pts, 1 for type of test, 0.5 for each pair, max 1.5)*

Andy's test comes back showing an unusual variant of heparan sulfamidase.

4. **What is Andy's diagnosis and what is the gene at fault for this disorder? Are there any other characteristics that could have pointed towards this disorder even in the absence of all laboratory tests, and if so, what are they?** *(3 pts, 1 for diagnosis, 1 for gene and 1 for characteristics, at least 2 required)*

5. Upon Andy's diagnosis, Andy's parents sought to undergo genetic testing, as they were planning on expanding their family further. It is suspected that the kind of mutation responsible for the disorder is a point mutation at a known locus. Define what is meant by

point mutation and explain how such a mutation may lead to the disease in this scenario. List 3 ways by which such a mutation can be detected. *(4.5 pts, 1 for definition, 2 for explanation, 0.5 for each detection method, max 1.5)*

6. What is the inheritance pattern for Andy's disorder, and what is the probability the next offspring will also suffer from this disease? *(2 pts, 1 for each)*

7. What is Andy's prognosis and life expectancy? *(2.5 pts, 1 for life expectancy, 0.5 for each prognosis, max 1.5)*

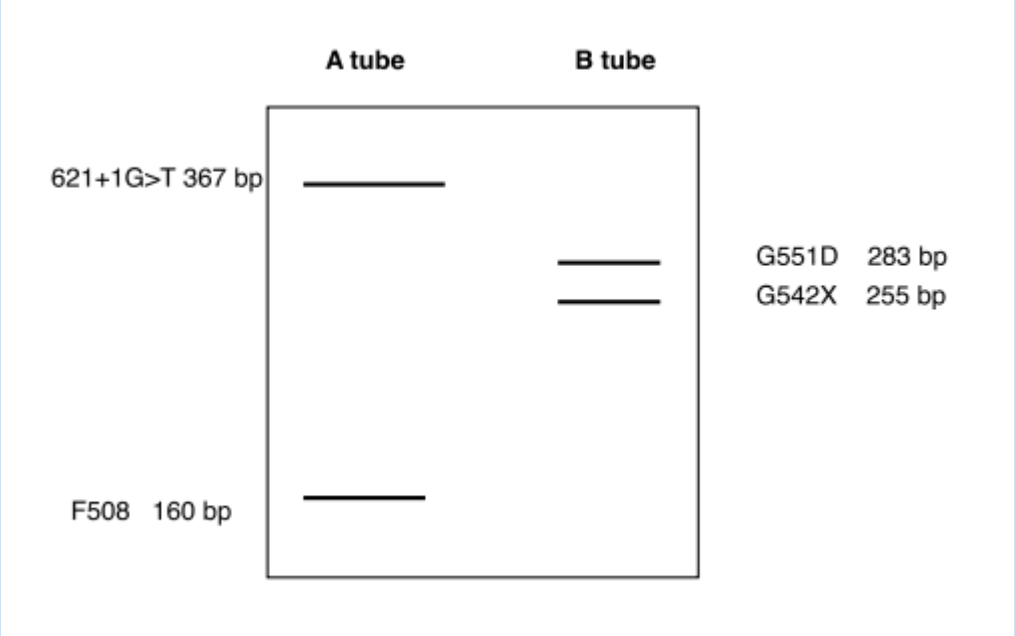
Case Study II: 12 POINTS

Patient Info: A 2-year-old girl with recurrent respiratory infections and failure to thrive is presented to an ORL specialist. Her parents are healthy, and they come from a little island off the coast of Scotland with a very small number of inhabitants, meaning it is difficult to rule out that they are genetically connected (inbred). The doctor asks whether genetic testing has been done, and upon receiving a negative answer, he proposes it to be done with a suspicion in mind.

1. What diagnosis does the doctor suspect given the patient's familial history and symptoms? Why is the note about parental origin relevant for diagnostic purposes? *(2 pts, 1 for suspected diagnosis, 1 for an explanation)*

To assess the patient's condition, an ARMS PCR has been performed on her and her siblings (boy, 4 and a girl, 1). 4 of the most common mutant alleles were tested for, 2 in the results of which are shown below (note that only the wild-type bands are shown for simplicity).

2. Explain the principle by which the ARMS PCR works, and what the reactions A and B mixtures contain based on the diagram below. *(3 pts, 1 for explanation of ARMS PCR and 1 for each mixture)*



3. The following results were obtained for the patient, her brother and her sister respectively. What do you determine the genotypes and phenotypes to be? *(3 pts, 0.5 for each correct genotype and phenotype)*

Patient

Brother

Sister

4. What is the traditional treatment for the disease? Is there any novel treatment? If so, how does it work? *(4 pts, 1 for each treatment and 2 for the explanation of modern treatment)*

Case Study III: 8 POINTS

Patient Info: A 5-year-old boy is referred to you, a neurologist, after experiencing delayed motor milestones, frequent falls, and difficulty climbing stairs. A physical exam reveals pseudohypertrophy of the calf muscles, so you order genetic testing to confirm DMD.

1. What is DMD, what genetic abnormality is responsible for the illness, and on what chromosome is it located? *(3 pts, 1 for definition, 1 for abnormality and 1 for location)*

2. Although both of the biological maternal grandparents are unknown, as the mother had been adopted at an early age, the parents of the boy do not suffer with any similar issues, and neither does anyone else in the family. What are the 2 possible reasons for this? *(3 pts, 1.5 for each of the reasons WITH explanation)*

3. What is the probability that upon growing up, the boy will father a girl suffering from DMD, assuming he is capable of doing so and the carrier prevalence is 1:5000? Why are the chances actually a lot closer to 0% in reality? *(2 pts, 1 for calculation, 1 for explanation)*