

# **Cystic Fibrosis PBL case for Journey to Medicine: an MSC Summer School 2019**

## **Tutor Notes**

## **PBL Case Details**

Alice was born, 5 weeks ago, weighing 3.5 kg. Since birth she failed to gain much weight, despite a ravenous appetite. She has continuous diarrhoea, with fatty, foul smelling stools. She has also been coughing a lot. On admission to hospital, clinical examination revealed a pale, thin little girl whose breathing was a little wheezy. Blood samples were taken to investigate haemoglobin, red and white blood cell counts, and plasma proteins. The results revealed anaemia and hypoproteinaemia. Alice was sent for a chest x-ray and a sweat test was carried out.

Alice was diagnosed with cystic fibrosis (CF). The immediate treatment was to maintain breastfeeding for as long as possible and to supplement her diet with high calorie, high protein nutrition and pancreatic enzymes. Her parents were advised on the necessity for twice daily chest physiotherapy and postural drainage to remove mucus from the lungs.

Alice's parents, who were both of European descent, wanted to know the cause of her condition and the likelihood of a future child also being affected. They attended a genetic clinic for CF gene mutation analysis. The results showed that both were carriers of the F508del mutation.

Alice's mother became pregnant again 5 years after her birth. Chorionic villus sampling was performed in week 11 of gestation and DNA tests revealed that the fetus had not inherited two CF gene mutations. The pregnancy and subsequent birth were uneventful.

Alice thrives for the first 7 years but school requires her to go to the nurse to obtain enzymes but she often forgets and gets a *Pseudomonas* infection that is treated with inhaled antibiotics. At age 8 begins daily chest physiotherapy with a Vest.

## **ILO's for the case**

- Work in small groups effectively to understand a clinical problem.
- To demonstrate knowledge of the relationship between genes and proteins, and the basic principles of protein synthesis-through the production of the CFTR gene.
- To demonstrate knowledge of how changes in DNA can produce clinical disease. E.g. how does mutation of the CFTR gene result in cystic fibrosis?
- To demonstrate knowledge of Mendelian patterns of inheritance and associated risks in families. How is cystic fibrosis inherited?
- To demonstrate basic knowledge of the structure and function of pancreas
- To demonstrate basic knowledge of the anatomy of the respiratory system- focusing on the lungs.
- Describe how cystic fibrosis is diagnosed.
- To demonstrate knowledge of how cystic fibrosis is treated.
- Understand the implications surrounding non-adherence to treatment as a clinician.
- To demonstrate some knowledge of the ethical issues that arise as a result of diagnosis of a serious inherited condition- in this case genetic screening.

## **Tutoring the sessions**

The PBL case is based on a child with cystic fibrosis, the students should be familiar with this disease, as they will have come across it at GCSE/A level.

The students will only have 1 hour scheduled for self-study time so try to keep the detail to a minimal I have attached my slides as a guide to the depth

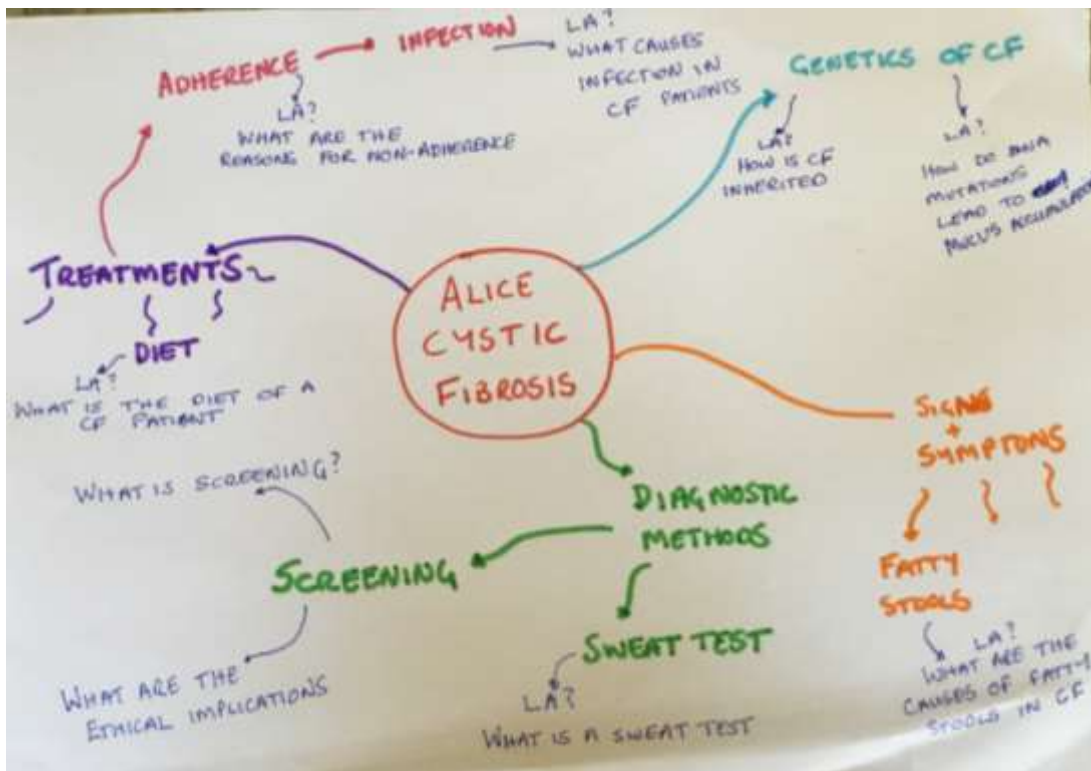
As in year 1 and 2 on the MBChB programme the case will have an opening session in which they will develop a simple learning agenda by looking for cues in the case. I have attached an example mind map to guide you in directing them.

In the opening session the tutor should act as chair and ask for a volunteer scribe. At the end of this session a chair and new scribe for Wednesday should be appointed.

Students won't have laptops or ipads in the sessions, but they can bring paper notes to the second session.

Don't worry if, in the second session, all the Learning agenda isn't covered and a more topical discussion around screening takes over. The emphasis is participation, enjoyment and understanding the process of PBL.

Alice with CF should be at the centre of the case and a mind map developed from that an example is given below



An Example learning Agenda (LA) with cues is given below. This is only an example please feel free to run the session as you like. This should really be a fun way of introducing the students to PBL and how to study for it.

Cues	LA Questions
Unknown Terms	What is: anaemia, hypoproteinaemia, postural drainage, Chorionic villus?
Since birth she failed to gain much weight, despite a ravenous appetite.	Why does Alice not gain weight?
Diagnosed with cystic fibrosis	What is cystic fibrosis?
Sweat test	How is cystic fibrosis diagnosed?
Attended a genetic clinic for CF gene mutation analysis	How do changes in DNA lead to cystic fibrosis?
Alice is coughing a lot	Basic structure of the lungs

Breathing was a little wheezy	How does mucus build up in the lungs of CF patients?
F508del mutation	<p>What is a mutation?</p> <p>What are the different types of mutation?</p> <p>What gene is mutated in cystic fibrosis?</p> <p>What is the function of the protein?</p>
Both parents carried the common F508del mutation	How is cystic fibrosis inherited?
pancreatic enzymes	How does CF affect the pancreas?
<p>treatment was to maintain breast-feeding for as long as possible and to supplement her diet with high-calorie, high-protein nutrition and pancreatic enzymes.</p> <p>Her parents were advised on the necessity for twice daily chest physiotherapy and postural drainage to remove mucus from the lungs.</p>	How is cystic fibrosis treated?
chest physiotherapy with Vest	What is chest physiotherapy with Vest?

Chorionic villus sampling was performed in week 11 of gestation and DNA tests revealed that the fetus had not inherited two CF gene mutations	<p>How can we screen for Cystic Fibrosis?</p> <p>Should we screen?</p> <p>What are the ethical implications?</p>
Alice thrives for the first 7 years but school requires her to go to the nurse to obtain enzymes but she often forgets	<p>What behaviours are associated with non-adherence?</p> <p>Why do patients not adhere to their treatment?</p>
gets a Pseudomonas infection that is treated with inhaled antibiotics.	<p>Why are people with CF more susceptible to infections?</p> <p>What are the major pathogens that infect CF patients?</p>

**To guide you on the depth and information given to the students I have attached the slides for the lecture the students will get. Other useful information is given below**

The fact that Alice's birth weight was 3.5kg (normal) and subsequently she did not grow further, suggests that the problem is related to a condition that was not evident when she was absorbing nutrients through her mother's blood and the placenta, implicating malabsorption of nutrients due to a defect in her GI tract.

Alice presents as pale and thin and has not gained much weight since birth. The strategy is to check a variety of molecular and cellular indicators of normal physiological function. In this case, the molecular components are the plasma proteins and haemoglobin, and the cellular components are red and white blood cells. In addition, the faeces are analysed for content, e.g. faecal fat to determine pancreatic function, and any infective organisms. The sweat test is done in cases of cystic fibrosis since it is almost diagnostic of the disease and cheaper than genetic tests.

The coughing could indicate an obstruction or an infection. In this case the source of the irritation is the thickened mucus in the respiratory tract that cannot be moved by normal physiological mechanisms (the beat of cilia in the respiratory tract) and has to be removed by more violent means. The malfunctioning of the chloride channels due to a mutation in the CFTR gene in the epithelial leads to thickening of the mucus in the respiratory tract and in the mucus glands of the exocrine pancreas

**Thank you all very much for you help**

**Michelle**