

“...unexpected Outcomes”

Gastrointestinal & Haematology Block – Case 2

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Learning Objectives:

This PBL Package targets the following objectives:

- Link the anatomy and histology of the large bowel with physiologic functions.
- Discuss the pathology of colonic polyps, and colorectal cancer.
- Construct a mechanism showing how a colon cancer occupying the sigmoid region resulted in the patient's symptoms, signs and laboratory results.
- Discuss mechanisms of blood loss and investigations needed for a patient with blood loss anaemia.
- Discuss the process of iron absorption, metabolism, and common causes of iron-deficiency anaemia.
- Construct a brief management plan showing management goals, and management options for a patient with colon cancer.
- Discuss the importance of public awareness about early detection of colon cancer.



Trigger

Faisal Abdul Karim, a 54-year-old primary school teacher is referred by his family physician to Dr Olyan Imam, a gastroenterology consultant because of bleeding per rectum on and off for about 10 weeks. Faisal also gives a history of weight loss of about 5 kilograms over about the same time. He also has noticed changes in his bowel habits, sometimes he has diarrhoea for 2 to 3 days followed by constipation for 2 to 3 days. He used to have his bowels opened regularly, once daily.

Discussion Questions:

- Are there any difficult words you do not understand?
- List the key information about Faisal.
- Identify Faisal's presenting problems.
- For each problem, generate a list of possible causes (hypotheses).
- What further information would you like to know from history and clinical examination to refine your hypotheses?

Trigger (Problem)

Faisal Abdul Karim, a 54-year-old primary school teacher is referred by his family physician to Dr Olyan Imam, a gastroenterology consultant because of bleeding per rectum on and off for about 10 weeks. Faisal also gives a history of weight loss of about 5 kilograms over about the same time. He also has noticed changes in his bowel habits, sometimes he has diarrhoea for 2 to 3 days followed by constipation for 2 to 3 days. He used to have his bowels opened regularly, once daily.

New Terms/Difficult words

- *Bowel habits*
- *Diarrhoea*
- *Rectum.*

Tutor: Encourage students to use a medical dictionary resource to discuss the meaning of each of these words.



Problems/Hypotheses

Bleeding per rectum:

- Piles (Hemorrhoides)
- Anal fissure.
- Dysentery.
- Ulcerative colitis (ulceration of the colon or rectum)
- Cancer/polyps.
- Vascular anomalies/ malformation.
- Diverticulitis.
- Blood disorders.

Problems/Hypotheses

Inability to gain body weight:

1. Decreases in gain:
2. Increases in energy loss

FIRST: DECREASES IN GAIN

1. **Decreased intake:**

- voluntary (dieting)
- fever, acute illness.
- cancer: increased catabolism
- loss of appetite.

2. **Maldigestion/Malabsorption**

- Problems with the stomach
- Problems with the intestine
- Problems with the pancreas
- Lymphatic obstruction
- Increased motility

3. **Problems with metabolism**

- Chronic liver problems
- Endocrine problems
- Chronic kidney problems



Problems/Hypotheses

Inability to gain body weight:

1. Decreases in gain:
2. Increases in energy loss

SECOND: INCREASES IN ENERGY LOSS

1. Excessive exercise:

2. Metabolic disorders:

- Thyrotoxicosis
- Untreated diabetes

3. Increased catabolism

- Cancer
- Chronic infections e.g., tuberculosis



Problems/Hypotheses

Altered bowel habits (constipation followed by loose bowel motions)

- Intestinal obstruction (partial obstruction) and presence of infection.
- Changes in the motility of the colon.
- Chronic constipation and the use of laxatives from time to time.

Facilitation Questions

What is normal bowel habits?

What are the physiologic factors that could affect normal bowel habits?

- *Travel.*
- *Changes in the type of food we eat.*
- *Stress*
- *Exercise*

How does the body normally maintain its bodyweight on a day-to-day basis?

By keeping a balance between:

- *Energy gain*
- *Energy loss*

What are the sources/mechanisms underlying energy gain?

- *Food intake.*
- *Swallowing*
- *Digestion*
- *Absorption.*
- *Metabolism*
- *Hormonal balance*

What are the sources/mechanisms underlying energy loss?

- *Exercise*
- *Catabolism and hormonal balance*

Further Questions

- Do you have anal pain on passing stool?
- Do you feel any small mass at the anal orifice?
- Do you strain to pass stools or have you any abdominal pain?
- Do you pass any mucus with the blood in stools?
- Do you bruise easily or have you ever had bleeding from anywhere?
- Do you have any nausea or vomiting?
- Any family history of colonic problems?
- Are you on any medications?
- Have you ever been admitted to hospitals? Any past investigations?
- Do you have any joint pains, skin rash, or fever?

Please Read The History

History

Dr Imam takes a detailed medical history. Faisal says, "... about 10 weeks ago, I started to notice little blood mixed with my stools." He adds that he does not strain or has abdominal pain or anal pain during defecation. There is no mucous in his stools. He gives no history of vomiting blood or bleeding from anywhere else and he does not bruise easily. He also noticed a loss of about 5 kilograms in bodyweight despite no changes in his diet. He always feels tired and has no energy to do his usual daily work. He has no history of fever, urinary trouble, arthralgia, or skin rash.

He used to open his bowels regularly, once daily, but for the last 6 months he noticed changes in his bowel habits with a tendency to have constipation for 2 to 3 days followed by loose bowel motions for another 2 to 3 days. About six months ago, he was seen by a family physician and was referred for colonoscopy but he missed the appointment.

Past Medical History

He was diagnosed to have irritable bowel syndrome about 10 years ago. No past history of hospital admission, or past investigations.

History

Family History

His younger brother was recently diagnosed to have a colonic polyp after colonoscopy.
No family history of anaemia.

Medication and Allergy

Nil

Alcohol and Smoking

He smokes 20 cigarettes a day for the last 20 years.

Social History

He is married and has 5 grown-up children. He plans to visit his elderly son who is married and lives in Dubai.

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- Identify Faisal's new problems. Provide hypotheses for each problem.
- Use the new information obtained to refine your hypothesis.
- What further information would you like to know from clinical examination to refine your hypotheses?

New Terms

(Tutor: encourage students to use their medical dictionary to find out more about these words)

- Constipation.
- Colonoscopy
- Mucous
- Irritable bowel syndrome.
- Colonic polyp.

Tutor: Encourage students to use a medical dictionary resource to discuss the meaning of each of these words/phrases.

Problems

Most people feel tired at some time of their life. What are the reasons that would cause someone to seek medical advice?

- Interference with daily activities.
- Sudden onset.
- Severity of symptoms.
- Patient's health beliefs.
- Advice from a third person.
- Patient's mental state.
- Appearance of other symptoms, e.g, bleeding etc.

Are his current symptoms consistent with irritable bowel syndrome?

Explain your views.

No. His rectal blood loss and loss of body weight are not consistent with irritable bowel syndrome.

What is the normal lining of the colon?

What is the significance of his brother's polyp?

Detection of one polyp puts the patient at a higher risk of developing more polyps and the risk of developing colon cancer.

Facilitation Questions

Is there anaemia that occurs in families?

Yes, e.g., Thalassaemia.

What are the possible causes of tiredness?

- Infection.
- Anaemia.
- Cancer.
- Chronic diseases such as heart failure, lung failure.
- Depression.
- muscle diseases.
- Psychological e.g., stress
- Lack of sleep.

Ranking/Hypotheses

Bleeding per rectum:

- Piles (Hemorrhoides) 0
- Anal fissure. 0
- Dysentery. 0
- Ulcerative colitis (ulceration of the colon or rectum) 0
- Cancer/polyps. +++
- Vascular anomalies/ malformation.? /+
- Diverticulitis. ?/+
- Blood disorders 0

Ranking/Hypotheses

Inability to gain body weight:

1. Decreases in gain:
2. Increases in energy loss

FIRST: DECREASES IN GAIN

1. Decreased intake:

- voluntary (dieting) 0
- fever, acute illness. 0
- cancer: increased catabolism ??
- loss of appetite. ?+

2. Maldigestion/Malabsorption

- Problems with the stomach 0
- Problems with the intestine 0
- Problems with the pancreas 0
- Lymphatic obstruction 0/+
- Increased motility +/-

3. Problems with metabolism

- Chronic liver problems 0
- Endocrine problems 0
- Chronic kidney problems 0



Hypotheses: Ranking

Inability to gain body weight:

1. Decreases in gain:
2. Increases in energy loss

SECOND: INCREASES IN ENERGY LOSS

1. Excessive exercise: 0

2. Metabolic disorders:

- Thyrotoxicosis 0
- Untreated diabetes 0

3. Increased catabolism

- Cancer ++
- Chronic infections e.g., tuberculosis 0

Hypotheses

Altered bowel habits (constipation followed by loose bowel motions)

- Intestinal obstruction (partial obstruction) and presence of infection. + / +++
- Changes in the motility of the colon. +
- Chronic constipation and the use of laxatives from time to time. 0

Please Read The Clinical Examination

Clinical Examination

Faisal has a Body Mass Index (BMI) of approximately 31 kg/m² (his bodyweight is 90 kgs, and his height 170 cm). He looks pale and there is pallor of conjunctivae and mucous membranes. He has no skin rash, bruises or palpable lymph nodes.

His vital signs are summarised in the table below:

Vitals Signs	Faisal's results	Normal range
Temperature	37 °C	36.6-37.2 °C
Pulse rate	100/min, regular	70-110/min
Respiratory rate	15/min	12-16/min
Blood pressure	120/80 mmHg	100/65 - 135/80 mmHg

Investigations

Abdominal Examination

- His abdomen is soft and not rigid or tender.
- His liver, spleen and kidneys are not palpable.
- No palpable masses
- Percussion of the abdomen: No shifting dullness (no free fluid in the peritoneal cavity)
- Digital per-rectum examination: No anal tenderness, no anal fissure, no anal masses, there is fresh blood on the gloved examining finger. No mucous.

Cardiovascular and Respiratory Examinations:

- Normal

Discussion Questions

Preliminary Investigations:

Dr Imam arranges for Faisal some tests including complete blood tests (CBC), blood film and microscopic examination of stools. The results of these tests are shown below.

Complete Blood Count

Blood Test	Faisal's results	Normal range
Haemoglobin	9.0	11.5-13.5 g/100ml
White blood cell count	5500	5,000 -10,000 mm ³
PCV	39	37-47%
MCV	67	80-96 fl
MCHC	277	300-350 g/L
Platelet count	344,000	160,000-500,000 mm ³

Blood film: shows microcytic hypochromic type of anaemia. No target cells.

Stool Analysis (microscopic examination):

Stools are semi-solid. There are no ova, eggs or parasites. Blood: RBCs +++++. No pus cells.

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- Identify Faisal's new problems. Provide hypotheses for each problem.
- Use the new information obtained to refine your hypothesis.
- Work out with your group your "learning issues".

Difficult words

- Palpable lymph nodes.
- Anal fissure.
- Spleen
- Liver.
- Shifting dullness on percussion
- Hypochromic microcytic anaemia.
- Target cells.

Facilitating Questions

What is the significance of pallor of conjunctivae and mucous membranes?

Pallor may occur in:

- Shock
- Hypotension.
- Anaemia

The fact that his blood pressure and pulse rate are fine indicate that his pallor is most likely due to anaemia.

What are the possible causes of anaemia?

- Blood loss e.g., from the bowel. (likely as he has blood loss per rectum).
- Inadequate dietary intake, e.g., food rich in iron, B12, folic acid (less likely)
- Defect in the synthesis of haemoglobin (less likely, no family history of anaemia).
- Bone marrow problems (less likely because white blood cells and platelets are normal).
- Increased red blood cell destruction (less likely)

Tutor: These issues are new to the students. They might add them to their learning issues.

Facilitating Questions

Why do we ask for CBC?

- Simple, inexpensive, readily available.
- Reliable, sensitive,
- Needed to confirm anaemia (Low Hb).
- Useful to differentiate types of anaemic (e.g., MCV, MCH etc).
- Provides information about other blood cells (e.g., platelets, and white blood cells).

What is the significance of MCV?

1. Low: in iron deficiency anaemia and thalassaemia.
2. High in vitamin B12 deficiency and folate deficiency.

How is the blood film is useful?

*Microcytic hypochromic changes: iron deficiency anaemia and thalassaemia.
Macrocytosis with hypersegmented neutrophils: vitamin B12 deficiency.*

What is iron? How iron is absorbed from the intestine?

What is the normal iron metabolism?

Tutor: *These issues are new to the students. They might add them to their learning issues.*

Hypotheses: Ranking

Most likely:

Colon cancer (evidence loss of blood per rectum, altered bowel habits, iron deficiency anaemia, and weight loss)

Less likely/excluded:

- Piles – examination is normal
- Anal fissure – examination is normal
- Ulcerative colitis – no history of fever, skin rash, arthralgia or systemic symptoms.
- Dysentery – no history of infection, no mucous in stools.
- Blood disorders – no family history of anaemia..
- Bone marrow disorders – other components such as platelets and white blood cells are normal.
- Irritable bowel syndrome – weight loss, bleeding per rectum.
- Peptic ulcer- less likely to present with fresh blood loss per rectum.
- Duodenal ulcer - less likely to present with fresh blood loss per rectum, and other symptoms are not consistent with peptic/duodenal ulcer.

Learning Issues

(Tutor: Encourage students to identify their learning issues that reflect key issues raised in the case. They might need to edit their learning issues into sentences or questions. Usually learning issues are about 5-7 key principles. See examples shown below).

Learning Issues

- Anatomy of the large bowel and the functions of the colon.
- Discuss pathology of colonic polyps and their clinical significance.
- Apply knowledge from physiology, histology, and pathology to discuss the pathogenesis of colon cancer.
- Discuss a mechanism showing how changes in the structure of the colon and the development of colon cancer could result in the patient's symptoms, signs and laboratory results.,
- Discuss the process of iron absorption, metabolism, and causes of iron deficiency anaemia.
- What are the investigations needed for the patient with blood loss anaemia?
- A brief management plan showing management goals, and management options.

Tutorial Two

Discussion Questions

After the students spent about 60 minutes addressing their learning issues. You might spend 10-15 minutes on these questions:

Discussion Questions:

- What is your final hypothesis? Explain why?
- What could possibly be the mechanisms underlying his presenting problems?
- What should the doctor do at this stage?





Do you know a Nobel prize laureate whose work has contributed to the advancement of our knowledge in physiology and/or pharmacology related to this case? What was exactly his/her work about? Give a summary.

Student: You could also after the completion of this case submit your work about the Nobel Prize laureate for this case to Professor Sammy Azer at (sazer@ksu.edu.sa) or hand it to him.



Discussion Questions

Answer to Q3:

First: Assess for the cause of his anaemia: The history of loss of blood per rectum and body weight loss together with tiredness raises the possibility of loss of blood from the large bowel e.g., colorectal cancer (colonoscopy).

Second: the exact anatomical location of the lesion (colonoscopy and CT scan of the abdomen).

Third: Assess the nature of the lesion (biopsy and histological diagnosis).

Fourth: Assess for the extent of the lesion and if other body organs are affected e.g., metastasis (CT scan of the abdomen and chest)



PLEASE READ PROGRESS 1

Progress 1

Dr Imam arranges for a few tests (full blood count, liver function tests, colonoscopy, and CT- scan of the abdomen and chest). The results of Faisal's test results are shown in the tables below.

Complete Blood Count

Blood Test	Patient	Normal range
Haemoglobin	9.0	11.5-13.5 g/100ml
White blood cell count	5500	5,000 -10,000 mm ³
PCV	39	37-47%
MCV	67	80-96 fl
MCHC	277	300-350 g/L
Platelet count	344,000	160,000-500,000 mm ³

Progress 1

Liver Function Tests

Test	Patient	Normal Range
Serum bilirubin	4	0-19 $\mu\text{mol/L}$
AST	34	0-40 IU/L
ALT	40	0-55 IU/L
ALP	50	0-120 IU/L
γ -GT	29	0-50 IU/L
Serum albumin	40	35-50 g/L
Prothrombin Time	12 seconds	10-14 seconds

Progress 1

Colonoscopy

A normal colonoscopy image is shown also for comparison.

A) Faisal's colonoscopy

B) Normal colonoscopy



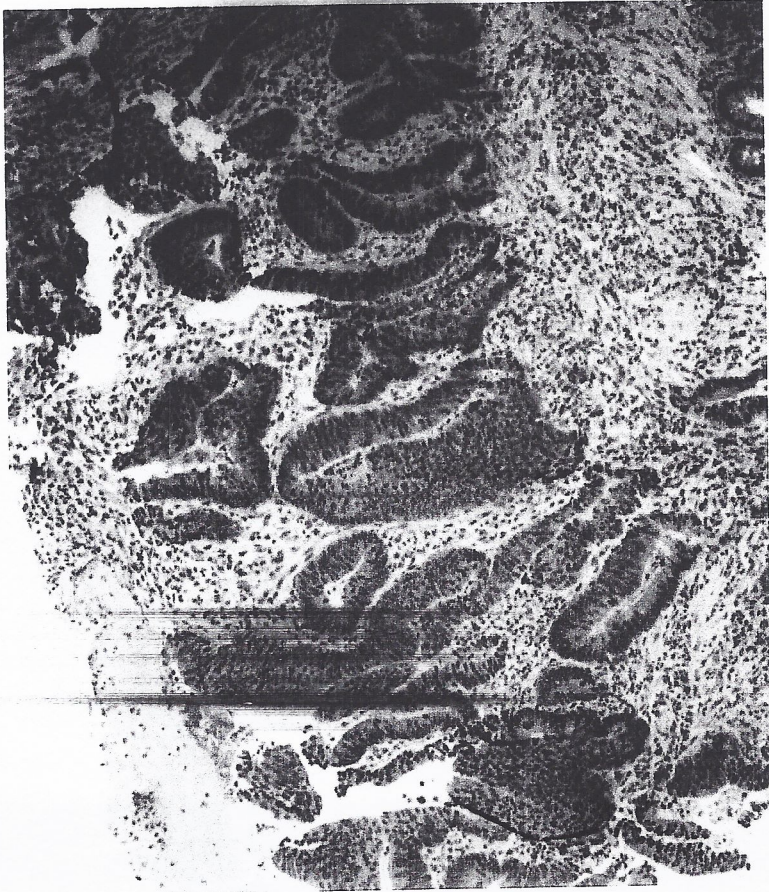
Source: http://www.hgu.mrc.ac.uk/people/m.dunlop_researchb.html

Report: A mass of about 5-6 cm in diameter is seen at the sigmoid region (about 20 cm from the anus). Its surface is irregular and shows multiple ulcers, necrotic and bleeding areas.

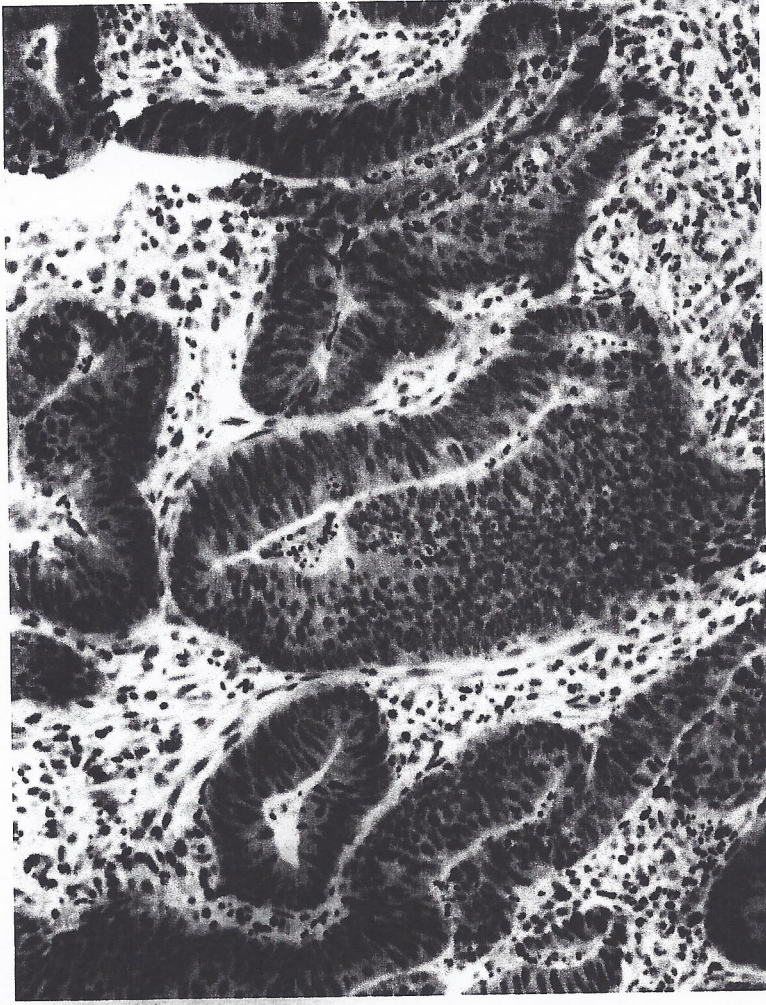
Progress 1

Histopathology

Sections from Faisal's colon mass
Low Power



High Power



Report: Primary adenocarcinoma invading the wall of the colon. Sections show disturbance in the normal structure of the colon, presence of neoplastic epithelial cells and invading neoplastic epithelial cells. The high magnification shows that the neoplastic epithelial cells have abnormal cytological characteristics but are still forming rudimentary glands. There is a striking absence of goblet cells.

Progress 1

CT-Scan Abdomen

Report: a tumour mass occupying the sigmoid colon of approximately 5.5 cm is seen. Multiple metastatic masses are present in the draining abdominal lymph nodes. No metastases are noted elsewhere.

CT-Scan Chest

Report: Both lungs are clear. No noted.

Stool Analysis (microscopic examination):

Stools are semi-solid. There are no ova, eggs or parasites. Blood: RBCs +++++. No pus cells.

Discussion Questions

- Are there any terms that you do not understand?
- Summarize the key information that you have obtained from this progress.
- Refine your hypotheses and identify your most likely hypothesis.
- What is your management goals and your management options?

Facilitation Questions

- What is the pathology of colorectal cancer?
- Who is at risk of developing colorectal cancer?
- How do colorectal cancer metastasize?
- What is the significance of his liver function test results?
- What is the significance of diagnosing colorectal cancer and the fact that Faisal's brother has a colonic polyp?

PLEASE READ PROGRESS 2

Progress 2

Faisal comes in to see Dr Imam and discuss the investigation results. Dr Imam explains that he has a growth forming a tumour mass in the lower part of the large intestine. The investigations reveal that the tumour mass is about 5-6 cm in diameter and it extends into the lumen of the colon and interferes with the passage of stools during defecation, which explains the changes in Faisal's bowel habits to constipation for 2-3 days followed by loose bowel motions (because of action of colonic bacteria on the accumulated stools). The surface of the colonic mass also shows several bleeding areas, which explains Faisal's bleeding per rectum and low haemoglobin levels.

Dr Imam discusses with Faisal the goals of management and available management options. He says, "the radiological images of the abdomen and the chest show that there are no tumour masses in the lungs or in the liver. Dr Imam adds, "After surgery, we will examine the resected parts of the colon, and the adjacent lymph nodes. If there is evidence of spread of cancer cells to the draining lymph nodes, chemotherapy is needed".

Dr Imam answers Faisal's questions and adds, "therefore the aims of the management are surgical resection of the malignant areas of the colon (colectomy) and because of the spread of the cancer cells to the abdominal lymph nodes, chemotherapy is needed after the surgery to kill cancer cells in the lymph nodes and lymphatics. The use of chemotherapy after surgery has shown to improve symptoms, and prolong survival of patients."

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- On the basis of the new information, what is your final hypothesis?

**PLEASE READ
PROGRESS 2**

Progress 2

Faisal is prepared for the surgery. He undergoes a resection of the tumour mass, pericolic lymph nodes and lymphatics along with the normal colon (about 10 cm proximal and distal to the tumour mass). An anal sphincter-saving approach has been preferred and continuity is then restored by direct anastomosis of the two ends. Prior to surgery, Faisal was counseled about the nature of the operation and the possible need for a stoma formation (a temporary opening of the terminal end of the intestine into the anterior abdominal surface).

The surgery is followed by chemotherapy. An oncologist reviews Faisal's condition and starts him on 5-fluorouracil for 6 months. To reduce the toxicity of 5-fluorouracil, the oncologist adds folinic acid. The oncologist explains to Faisal, that there is evidence from research that the chemotherapeutic drug 5-Fluorouracil improves both symptoms of the disease and increases overall survival.

A few months later, Faisal reviews Dr Imam who examines him and arranges for a follow up test by measuring carcino-embryonic antigen (CEA) levels. About six months post-surgery, Faisal becomes aware that his uncle who used to live in England and died about 20 years ago had a colon cancer. He brings this piece of information to the attention of his treating doctor. Dr Imam, explains to Faisal, "this information together with the fact that your younger brother has colonic polyps suggest that your first-degree relatives are at a higher risk of developing colon cancer than normal population. Therefore screening for colon cancer in first-degree relatives is needed for early detection of any changes. .

Two years later, Faisal and his brother become interested in working with the Saudi Gastroenterology Society as volunteers to promote screening programs for cancer colon and public awareness about this disease.

Discussion Questions

- Are there words that you do not understand?
- Summarize key information that you have obtained from this progress.
- Construct a mechanism summarizing your final hypothesis with regard to the lesion, the mechanisms underlying Faisal's problems. Provide supportive evidence from history, clinical examination and investigation results.

Please Read the
Closure

Case Closure

Faisal recovers well from the surgery and chemotherapy. He has no symptoms and feels much better. He reviews in the out-patient clinic for medical checkup regularly. He undergoes colonoscopy and measurement of CEA every 12 months. His first-degree relatives undergo colonoscopy when their age is 40 years old. Faisal and his brother continue their volunteer work on promoting knowledge about colon cancer and public awareness.