Case Study #6

MYOCARDIAL INFARCTION
Myocardial infarction (heart attack) is the leading cause of death in the United States. It is estimated that one in every five deaths in the US is due to a heart attack. Approximately one million patients are admitted to hospitals each year due to heart attacks. 200,000 to 300,000 individuals die from heart attacks before ever receiving medical care. In Case #2 we’ll join 48-year-old Jason Dixon as he experiences a life-threatening heart attack.
48 year old Jason Dixon had not been feeling well all day and around 10:00 p.m he went to bed. At around 4:00 a.m. his wife awakened to see him slump to the floor, breathing with difficulty and drenched in perspiration. Alarmed when he told her of the pain in his chest, neck and arm, she called 911. Within 12 minutes, emergency response team personnel (EMTs) were on the scene.

During this critical period, EMT personnel performed the standard emergency treatment protocol for a patient with symptoms of a myocardial infarction, commonly referred to as a heart attack.
Case Questions

1. What symptoms did Jason exhibit?

2. If you were an emergency medical technician treating a suspected myocardial infarction (heart attack), what would you do for initial assessment of the patient?

3. What initial treatment would you give the patient?
The patient carried several risk factors related to both lifestyle and family history. He was 80 lbs. over his ideal weight and worked long hours in a high stress environment as an advertising agency manager. He was also a moderate cigarette smoker. According to his wife, he exercised very little and paid virtually no attention to diet, often eating fast food, as well as eating late at night. His father died at age 56 from heart disease.
Case Question

4. Summarize the lifestyle risks of the patient.
Before we progress further into this relatively complex case, let's review module 6 in the Case Study Workbook: The Heart, Pathway of Blood Flow, Coronary Blood Supply, and Myocardial Ischemia and Infarction

- Heart anatomy
- Procedures
- Open Heart Surgery
- Helpful heart website
Case Questions

5. Find and view the slide show on the structure of a preserved heart. This is interesting to view but in depth. You will not be tested on this!

6. Study the structure of the heart. Learn about the roles of blood vessels including arteries, veins, and capillaries.

7. Describe the pulmonary, coronary and systemic circulatory systems.

8. What prescription is given for a healthy heart?

9. How can the heart’s health be monitored by a physician?

10. Define echocardiograph.

11. Define electrocardiography.

12. List invasive heart procedures
You MUST visit the following sites on your own time

- http://www.medicinenet.com/heart_attack/article.htm

- http://www.pbs.org/wgbh/nova/heart/
Case Questions

13. Describe how an echocardiogram works.

14. List information about the heart that can be gained from an echocardiogram.

15. What information cannot be learned from an echocardiogram.

16. Which health professional would be responsible for performing an echocardiogram?
Enroute to the ER, the patient's acute symptoms had been relieved by the prompt action of the emergency care personnel. Vital signs had stabilized, his chest pain was relieved by nitroglycerin, and breathing was made easier by the increased oxygen flow.

Arriving at the hospital emergency room, the patient was immediately surrounded by medical professionals including critical care nurses, ER physicians and others. Blood was drawn and sent to the laboratory (along with the initial blood drawn by the EMTs,) for STAT (immediate!) analysis of cardiac serum markers, a CBC and electrolytes. A chest radiograph (x-ray) and echocardiogram were also performed. The patient's EKG findings were carefully reviewed by the ER physician and the on-call cardiologist was summoned.

In the Case Study Workbook, Module 6, review the Conduction System of the Heart.
This is a critical decision point for the cardiologist. There are several algorithms (flow chart protocols) for treating patients with chest pain suggestive of an acute heart attack. They include the patient's symptoms and history; the interpretation of the 12-lead EKG; the results of cardiac enzyme markers and cardiac-specific proteins, the echocardiogram results and others. Based on available evidence, the cardiologist implemented the following treatments:

1. Intravenous beta blockers for decreasing oxygen demand to the heart, as well as other symptoms.
2. Intravenous streptokinase to dissolve clots and promote vascular healing.
3. Admission to the coronary care unit (CCU) for careful observation and additional testing.
4. Continued aspirin therapy (300 mg twice a day)

Treatment of heart attack patients depend on several factors: The cardiologist's assessment, results of diagnostic testing and the patient's overall response to initial therapy. More aggressive options may be needed. There are several websites listed under "additional links of interest" that will give the interested student an overview of heart attack treatments such as angioplasty and coronary bypass surgery.
18. Describe how beta blockers, streptokinase, and aspirin therapy are effective heart attack treatments.
Cardiac Markers

Cardiac markers are biomarkers measured to evaluate heart function. They are often discussed in the context of myocardial infarction, but other conditions can lead to an elevation in cardiac marker level.

<table>
<thead>
<tr>
<th>Cardiac Marker</th>
<th>Normal Range</th>
<th>Patient Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatine Phospho Kinase (CPK)</td>
<td>25-90 U/L</td>
<td>130 U/L</td>
</tr>
<tr>
<td>CPK-MB (cardiac fraction)</td>
<td>0-7 U/L</td>
<td></td>
</tr>
<tr>
<td>Troponin I</td>
<td>0-0.4 ng/ml</td>
<td>1.5 ng/ml</td>
</tr>
</tbody>
</table>
Cardiac Markers

As we can see from these cardiac enzyme tests from the blood sample taken by the EMTs at the scene, most tests still remain in the normal range, or are slightly elevated. The results of the blood drawn in the ER were similar. As expected, in what appears to be a myocardial infarction of the anterior left ventricle as shown by the depressed S-T segment on the electrocardiograph. This baseline information is critical for physician's assessing the scope of damage to the heart, as well as predictive of possible complications from the loss of blood supply to cardiac tissue. Over the next several days, additional cardiac enzyme measurements will be performed and compared to these early results.
19. How does measuring the level of cardiac enzymes help detect a myocardial infarction (MI)?

20. Why are Mr. Dixon's cardiac enzyme levels normal or only slightly elevated, even though it appears he has just experienced an acute MI?

21. What health care professional is responsible for determining cardiac enzyme levels?
Mr. Dixon was admitted to the hospital's coronary care unit (CCU) and carefully monitored by specially-trained coronary care nursing personnel. In patients with an AMI, the risk of sudden death is usually within the first 24 hours of the initial attack.

Early on the second day, the patient was scheduled for an angiogram to help assess the patient's coronary blood flow.
Case Questions

22. What is an angiogram?

23. Why is this test done?

24. What health care professional assisted the physician in performing the angiogram?
An expanded blood chemistry work-up was ordered to include a second measurement of cardiac enzymes.

<table>
<thead>
<tr>
<th>Cardiac Marker</th>
<th>Normal Range</th>
<th>Patient Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatine Phosphokinase (CPK)</td>
<td>25-90 U/L</td>
<td>630 U/L</td>
</tr>
<tr>
<td>CPK-MB (cardiac-specific)</td>
<td>0-7 U/L</td>
<td>45 U/L</td>
</tr>
<tr>
<td>Troponin 1</td>
<td>0-0.4 ng/ml</td>
<td>3.9 ng/ml</td>
</tr>
</tbody>
</table>

As we see from the results above, there is a significant rise in the cardiac serum enzymes and the cardiac-specific protein troponin-I. This is expected in patients with AMI and represents the heart's delayed response to release of these substances after tissue damage. Typically, these markers "plateau" after 24-48 hours and then begin to return to normal as the heart tissue heals.
The risk factor tests show increases in total cholesterol, triglycerides and phospholipids. These are lipids (fats) bound to their carrier protein molecules and abnormal levels are contributors to the formation of coronary plaque. The decrease in High Density Lipoproteins (the so-call "good cholesterol") is significant because they play an important role in bringing cholesterol back into tissue, thus reducing plaque formation by reducing the amount circulating in the bloodstream. The increase in the "bad cholesterol" LDL, is also significant because it increases oxidative processes that contribute to plaque formation in the coronary vessel wall.

### Additional Blood Tests Relating Risk Factors of Heart Disease:

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Normal Value Range</th>
<th>Patient Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol (total)</td>
<td>150-250 mg/dl</td>
<td>325 mg/dl</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>75-165 mg/dl</td>
<td>275 mg/dl</td>
</tr>
<tr>
<td>Phospholipids</td>
<td>150-380 mg/dl</td>
<td>465 mg/dl</td>
</tr>
<tr>
<td>High Density Lipoprotein</td>
<td>34-69 mg/dl</td>
<td>21 mg/dl</td>
</tr>
<tr>
<td>Low Density Lipoprotein</td>
<td>105-180 mg/dl</td>
<td>265 mg/dl</td>
</tr>
</tbody>
</table>
After 2 full days in the CCU, Mr. Dixon continued to improve and was transferred to the regular medical floor of the hospital for continued observation of vital signs, monitoring of serum cardiac markers and other key parameters. After 6 days, he was discharged from the hospital with specific orders for post-AMI recovery.

Mr. Dixon was lucky to have survived this heart attack, as they are the nation's number 1 killer of adult males with over 800,000 deaths/year. The keys to his survival were the quick action by his wife by calling 911 and the EMTs, who administered life-saving, on-scene assessment and treatments that contributed greatly to his survival. Prompt emergency room care by physicians and critical personnel, coupled with proper treatments and care gave this patient a second chance. In the long run, and to help reduce further cardiac problems, Mr. Dixon will have to make several lifestyle changes: These will include controlling weight and making dietary changes, reducing work-related stress, stopping smoking and implementing a plan for moderate exercise.
1. A patient presented with classic symptoms of a heart attack. A blood clot had formed in a coronary artery narrowed by atherosclerotic plaque formation, usually related to high blood lipoproteins such as triglycerides, cholesterol and lipids. This in turn cut off the blood supply to an area of heart muscle, medically called ischemia.

2. Symptoms include acute chest pain, often radiating down the arm, sweating, vomiting and shortness of breath.

3. His wife called 911 and within minutes emergency response personnel were administering life-saving care, including medication, breathing assistance and other measures. Transported to the emergency room, diagnostic tests such as the electrocardiogram, echocardiogram, MRI and serum cardiac markers helped confirm an acute myocardial infarction commonly called a heart attack.

4. This critically ill patient was admitted to the hospital's coronary care unit where he received around-the-clock care. Cardiologists, critical care nurses and monitoring of cardiac damage by blood tests and procedures such as the angiogram are critical to helping a patient recovering from a heart attack. Mr. Dixon received aspirin, anticoagulants (Streptokinase) to prevent further clots, a beta blocker medication to reduce cardiac demand and continued monitoring of essential serum cardiac markers.

5. After hospitalization for several days, the patient was released to further recover at home. He will have to make several lifestyle changes to include smoking cessation, exercise, diet and stress reduction. Medications are available to reduce cholesterol levels, regulate blood pressure and other abnormalities that contribute to coronary heart disease risk.

6. Myocardial infarction (heart attack) is the number one cause of death in the United States. It is fatal if not treated. Although heart damage always occurs in a heart attack, patient's who are treated may continue to live for many years.

7. Emergency medical technicians gave initial care to the patient. They were relieved at the hospital by an emergency room team consisting of emergency room doctors and nurses. Clinical laboratory scientists performed blood testing to determine cardiac enzyme levels. After admittance to the CCU, a specialized team of nurses and a cardiologist monitored Mr. Dixon. The cardiovascular team were responsible for the electrocardiogram (EKG technologist), and the angiogram (cardiovascular technologist and cardiologist).
1. Jason was slumped over, had difficulty breathing, and was perspiring excessively. He also had pain in his chest, neck, and arm.

2. Initial Assessment: Take vitals, perform EKG, check O2 level (O2 Saturation), start I.V., take brief history, and draw blood for cardiac markers, serum electrolytes, and coagulation studies.

3. Treatment: Give oxygen, aspirin, nitroglycerin, and morphine if needed.


The following "answers" provide help finding the links within the web site. From here, the answers should be self-explanatory.

"The Heart" Web Site

5. Link on development on the first page. Then find the link titled "View the structure of a preserved heart."

6. Link on "structure" on the first page. From here link on "blood vessels." From this page you can link on "artery," "vein," or "capillary" and explore and learn.

7. Link on "body systems" on the first page. From here link on "circulatory" and from here you can go to "pulmonary," "coronary," and "systemic"

8. Link on "healthy heart" from the first page.
   2. Follow a good diet.
   3. Keep your heart clean and drug-free.

9. Check by feel and sound.
   Check vital statistics (blood pressure and pulse).
   X-ray
   Echocardiograph
   (Links can be found from first page, "monitor")
10. (Link on monitor, echocardiography) Echocardiography is the process of mapping the heart through echoes. The pulses are sent into the chest and the high-frequency sound waves bounce off of the heart's walls and valves. The returning echoes are electronically plotted to produce a picture of the heart called an echocardiogram.

11. (Link on monitor, electrocardiography) Every time the heart beats, tiny electrical impulses are discharged. Using a process called electrocardiography, those electrical discharges can be recorded and used to measure the heart's condition. Several thin wires are attached to the body. The wires conduct the electrical charges into a machine that measures them and produces a readout.

12. Link on monitor, exploratory, open heart surgery.

13. An echocardiogram is also known as ultrasound examination or sound wave picture of the heart. It uses the same technology that's used to take pictures of the fetus in pregnant women. The pictures are taken by a highly trained technician who places a hand-held plastic ultrasound probe against the patient's chest. The probe is connected to a large computer with a video screen. The probe emits sound waves that pass through the chest to the heart. The heart then reflects those sound waves back to the probe. The probe transmits those reflected signals to the computer which reconstructs them into a picture of the heart. This picture is displayed on the screen and recorded on videotape or on a digital storage medium.

14. An echocardiogram shows:
   a. The sizes of the 4 chambers of the heart.
   b. The strength of the heart muscle.
   c. The presence of fluid around the heart.
   d. Problems with the valves of the heart.
   e. Congenital heart disease. Babies born with holes in their hearts or abnormal connections between the cardiac chambers can be accurately diagnosed with an echocardiogram. It can even be done on the unborn fetus to make a diagnosis so the doctors are ready when the baby is born.
   f. Information about the pressures within the chambers of the heart.
   g. Information about why a person may have an erratic heart beat.
Answers to Case Questions

15. Echocardiograms do not give a picture of the arteries of the heart.
17. An electrocardiogram measures the heart rhythms and electrical impulses.
18. Beta blockers slow the heart rate decreasing the strain on the heart and its need for oxygen. Streptokinase helps dissolve blood clots. Aspirin decreases further blood clot formation.
19. Cardiac enzymes are elevated following a myocardial infarction.
20. Most cardiac enzymes do not peak until several hours following a M.I. (See link for cardiac enzymes).
21. Clinical Laboratory Scientist
22. An angiogram is an x-ray picture of dye moving through coronary arteries. The dye is inserted into a catheter which is placed inside the heart.
23. An angiogram is done: To make a definitive diagnosis of blocked arteries when other clinical information and tests are equivocal.
To determine if the blockages in the arteries are severe enough to be responsible for any symptoms the patient may be having.
To determine if a patient’s blockages would be best treated by procedures such as an angioplasty or bypass surgery.
To assess the risk of future heart attacks in patients who have already had a heart attack or damage to their heart muscle.
24. Cardiovascular technologist.
Echocardiogram

Ventricular Septal Defect
Standard Emergency Treatment Protocol for MI Symptoms

CHEST PAIN SUGGESTIVE OF AN ACUTE MYOCARDIAL INFARCTION < 10 MINUTES

- Immediate Assessment
  - Obtain Vital Signs with Continuous Readout
  - Obtain Standard 12-Lead Electrocardiogram with Continuous Readout
  - Check Breathing (oxygen saturation)
  - Obtain I.V. Access
  - Brief, Targeted History
  - Obtain Blood for Cardiac Serum Markers, Electrolyte and Coagulation Studies

- Immediate General Treatment
  - Oxygen at 4/Liters minute
  - Aspirin 160-325 milligrams
  - Nitroglycerin either sub-lingual or spray
  - Morphine for Pain if not Relieved by Nitroglycerine

- Transport to Hospital Emergency Facility
EKG Results

The upper diagram is the normal heartbeat as viewed on the electrocardiogram (ECG or EKG).

The bottom three are ECG's from myocardial infarctions in different areas of the heart's ventricles.

We see Mr. Dixon's type of ECG pattern on the left with depressed S-T segment presumptively indicating a ventricular infarction.
Coronary Blood Flow

Simplified Version:

Left ventricle → Aorta → Coronary arteries → Coronary veins → Coronary sinus → Right atrium