

Student Guide

Case 1 – Mammogram

Name: _____

Date: _____

Class/Period: _____

BACKGROUND INFORMATION

Primary mammographic signs that raise suspicion for malignancy are density, contour, and size of masses and/or lesions. Signs of malignancy for each of these is:

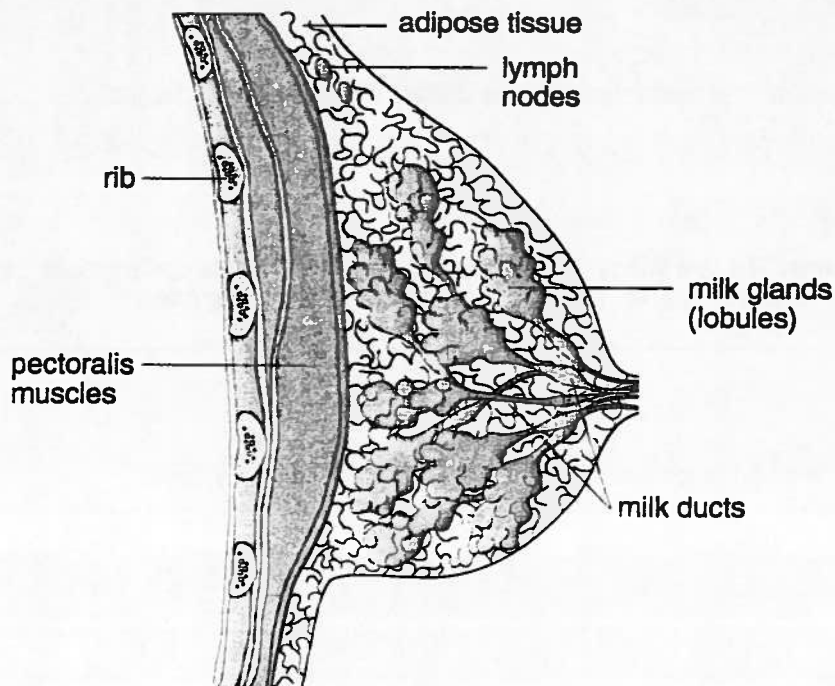
- Density - the lesion is of relatively high-density radiopacity.
- Contour - the margins of the lesion is irregular and only vaguely definable; the border is densely spiculated, in a "starlike" pattern.
- Size - considered only if there are previous studies to allow for the assessment of rate of tumor growth. Malignant cells often exhibit a fast growth rate.

A well-outlined, regular, clear spot is more likely to be a benign lesion, such as a cyst (non-cancerous). A poorly outlined, opaque area is more likely to suggest a breast cancer. However, not all benign lesions are perfectly round, and some cancers may appear well-defined. When findings suspicious for a cancer are found on a mammogram, a biopsy is performed to determine if a lesion is benign or cancerous.

When x-rays strike dense tissues in the body, such as bones, they are absorbed and appear white on an x-ray picture. Less dense tissues, such as muscles and organs, block fewer of the x-rays (so more of the x-rays pass through) and appear in shades of gray. X-rays that pass only through air appear black.

Many small tumors can be seen on a mammogram before they can be felt during a breast exam. There are more treatment options and a greater likelihood of a cure for cancer that is discovered in an early stage.

Mammograms do not differentiate between types of masses. They just show dense masses. The rule-of-thumb is that any breast mass needs to be evaluated as a possible malignancy. If the mass is known to be solid, it is surgically excised and sent for pathologic analysis to see if it is a cancer. If the radiologist suspects the mass may have fluid in it, an ultrasound is performed. If there is fluid in the mass, a needle aspiration of the cyst may be suggested. If the fluid can be drawn off and is not bloody, it is a benign cyst, and continued observation is the course of action.



PATIENT HISTORY

Images 1a and 1b are mammograms that were taken 1 year apart. Before having mammogram 1b done, the patient, 45 year old Mary Jones, noticed a lump while doing a self-exam. She has no family history of breast cancer.

RESOURCES

<http://webmd.lycos.com/encyclopedia/article/1689.52398>

<http://www.uhrad.com/mamarc.htm>

http://www.breastcancer.org/pathology_breast.html

<http://www.womenshealthchannel.com/breastcancer/breastanatomy.shtml>

QUESTIONS

1. What conditions are mammograms useful in diagnosing?
2. If malignancy is suspected, what is the next step?
3. Why are mammograms recommended at all if there is neither a lump found during a breast exam nor any risk factors?
4. What are some possible causes of a lump in the breast?
5. What would you expect to see in a mammogram if the patient had a malignant tumor?
6. Compare the mammograms. The two images were take one year apart. State observations about the density, contour, and size of the mass in image 1b. What can you conclude about the mass?
7. What course of action would you recommend for this patient? Explain your answer.

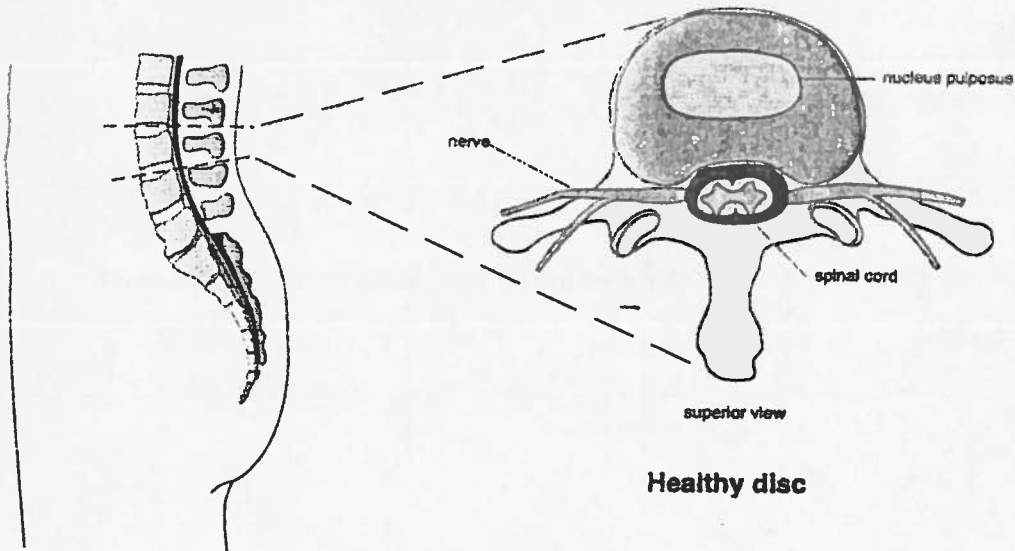
Student Guide

Case 2 – Lumbar Spine MRI

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Date: _____
Class/Period: _____

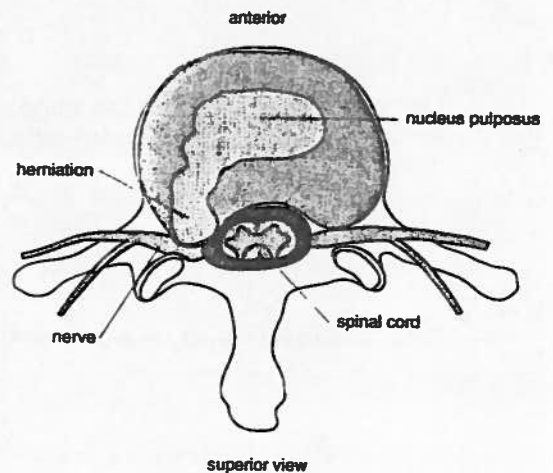
BACKGROUND INFORMATION

The bones that form the spine in your back are cushioned by small discs. These discs are round and flat, with a tough, outer shell (capsule) that surrounds a jellylike material (nucleus).



Healthy discs act as shock absorbers for the spine and keep the spine flexible. When these discs are damaged they may bulge or break open (rupture). When a disc bulges or ruptures, it is called a herniated disc (or sometimes a slipped or ruptured disc).

Although injury to the outer covering of a disc (capsule) can cause pain, often a herniated disc by itself does not cause any pain. Pain occurs when there is pressure from the herniated disc on nerve roots or the spinal cord. Pain or numbness may occur in the area of the body to which the nerve goes. For example, a herniated disc that presses on the nerve root of the sciatic nerve (a large nerve that extends from the lower back down the back of the leg) may cause pain and numbness in the leg (a condition called sciatica). Sciatica is the most common symptom of a herniated disc in the lower back.



Herniated disc

Herniated discs can occur in any part of the spine. They are most common in the lower back. Ninety-five percent of herniated discs occur in the lower back and in the neck (cervical spine).

Most back pain is not caused by a herniated disc. Other common causes of back pain are strained muscles and degenerative disc disease. Degenerative disc disease occurs as the spine ages. The disc slowly degrades as the water content within the disc decreases and settling occurs. In degenerative disc disease, the spaces between the vertebrae decrease. Muscle strain cannot be seen in medical images.

PATIENT HISTORY

Robert Smith, shown in image 2a, is a 40 year old construction worker. William Jones, shown in image 2b is 25 and is a chef. Both patients are complaining of lower back pain. Neither is aware of any recent injury.

RESOURCES

<http://my.webmd.com/encyclopedia/article/1661.52257>
<http://www.aliveat55.com/bp4.htm>

QUESTIONS

1. What are some causes of back pain?
2. What would you expect to see on a medical image for each of the following conditions?

Strained muscles -

Herniated disc -

Fractured vertebrae -
3. Compare the two MRIs to the spine diagram and each other. Both patients complain of lower back pain. Give a possible explanation for each patient's complaint and support your diagnosis with observations from the images.
4. What treatment would be recommended for each patient?
5. What is sciatica? How does this relate to back problems?
6. What are the advantages of an MRI over an x-ray when diagnosing back pain?

Student Guide

Case 4 – Barium Enema X-ray

Name: _____

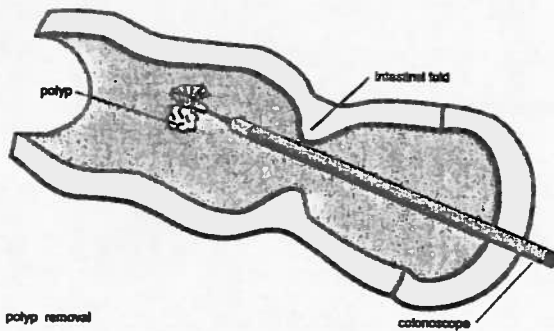
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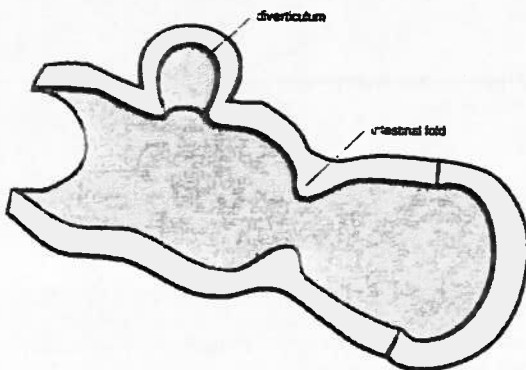
BACKGROUND INFORMATION

A colon polyp is extra tissue that grows inside the large intestine. The bigger the polyp, especially if it is larger than 1 cm (0.39 in.), the more likely it is to be pre-cancerous (adenomatous) or cancerous. Pre-cancerous and cancerous tumors should be removed. During a colonoscopy to remove the polyp, the entire colon will be checked for other polyps. If other colon polyps are found higher in the colon during colonoscopy, they will usually be removed during the procedure. Removing and testing polyps allows the doctor to determine if a polyp is the type that is likely to develop into cancer. If it is found to be cancerous or pre-cancerous, the removal may stop an existing cancer from spreading, and the patient would be watched more closely. Removing a non-malignant polyp removes the chance that it may become cancerous. People may be predisposed to polyps as a result of their genetic inheritance. Usually, there are no symptoms. There may be pain if polyps are so large they are blocking the intestine. Common symptoms for cancerous polyps are fatigue, nausea, change in bowel habits, narrow stools, and weight loss.

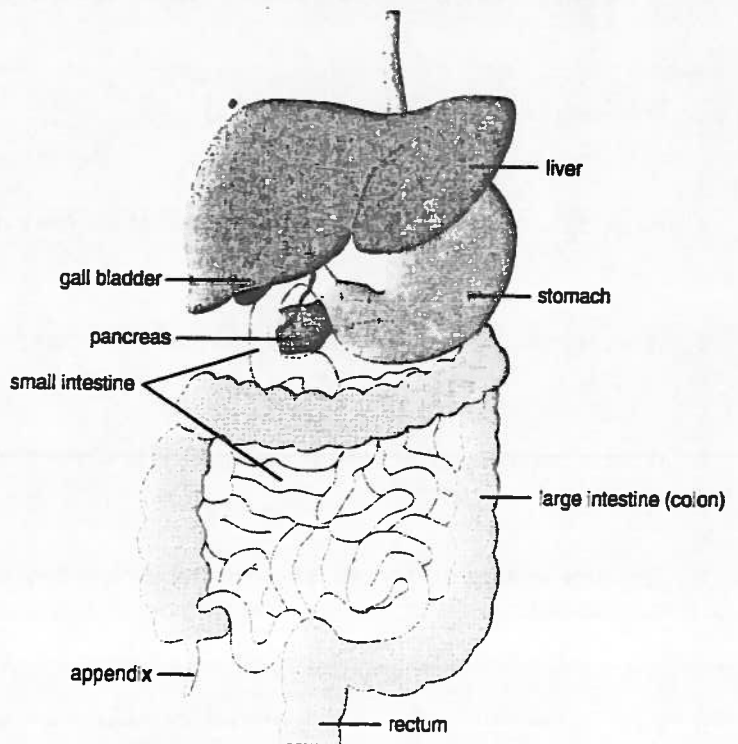
A low fiber diet can result in muscle strain to move stool that is too hard. This increased pressure in the colon might cause weak spots in the colon to bulge out and become small pouches called diverticula. Each pouch is called a diverticulum. There are usually no symptoms. Symptoms that might occur are mild cramps and bloating. The condition of having diverticula is called diverticulosis. About half of all Americans age 60 to 80, and almost everyone over age 80, have diverticulosis. No treatment is needed. A high fiber diet is recommended to reduce symptoms. When the pouches become infected or inflamed, the condition is called diverticulitis. This happens in 10 to 25 percent of people with diverticulosis. Symptoms are abdominal pain, fever, cramps, and constipation. An antibiotic is prescribed to treat the infection. A colon resection may be needed in very serious cases. The patient should a) follow a high fiber diet, b) drink 8 glasses of water or other beverages that do not contain caffeine or alcohol, c) respond to bowel urges, and d) exercise regularly. These measures should help to reduce symptoms.



Colon with polyp



Colon with diverticulum



Lower human digestive system

Irritable bowel syndrome is caused by disturbances in the spontaneous movement of muscles in the small and large intestines, generally worsened by emotional stress. There is no abnormality in the structure of the intestines. Irritable bowel syndrome is characterized by a combination of abdominal pain and altered bowel function. The condition occurs more frequently in women and usually begins in those between 20 and 30 years old. Predisposing factors may be a low fiber diet and emotional stress. Symptoms may include diarrhea alternating with constipation, abdominal pain following meals which is relieved by bowel movement, abdominal fullness, gaseous, bloating, nausea, vomiting, loss of appetite, emotional distress, and depression. Tests usually reveal no abnormalities. Irritable bowel syndrome may be a lifelong chronic condition. The objective of treatment is to relieve symptoms. Treatment may include increasing dietary fiber, eliminating gastrointestinal stimulants such as caffeine, reducing anxiety, regular exercise, and counseling in cases of severe anxiety or depression.

PATIENT HISTORY

Edward Johnson's test results are shown in image 4a. He is a 65-year-old man who has been experiencing lower abdominal discomfort, bloating, and flatulence. These symptoms have been present for about two months without much relief. Image 4b belongs to Linda Brown, a 30-year-old executive. She has been experiencing alternating bouts of constipation and diarrhea and abdominal pain immediately following meals. Her diet consists of mostly take-out food because of her busy schedule.

RESOURCES

<http://www.niddk.nih.gov/health/digest/pubs/colonpolyp/colonpolyp.htm>
<http://my.webmd.com/encyclopedia/article/1811.51063>
<http://www.nursing.uiowa.edu/sites/adultpain/GenPain/DIVERTnt.htm>
http://www.bestheath.com/surgery/ColonDiverticula_5.html

QUESTIONS

1. What conditions can a barium enema be used to diagnose?
2. What symptoms would lead a doctor to recommend a barium enema?
3. Why are polyps removed?
4. What causes polyps and diverticula and what are the symptoms of each?
5. What is the difference between polyps and diverticula?
6. What is the difference between diverticulitis and diverticulosis? What is the treatment for each one?
7. Compare images 4a and 4b. What do you think is causing the symptoms of each patient? Explain your conclusions.
8. What would you recommend for the next course of action for each of these patients? Explain your answer.

Student Guide

Case 5 – Knee X-ray

Name: _____

Date: _____

Class/Period: _____

BACKGROUND INFORMATION

The knee joint is the junction of three bones: the femur, the tibia, and the fibula. The patella rides on the knee joint as the knee bends. The ends of the three bones in the knee joint are covered with cartilage, a tough, elastic material that helps absorb shock and keeps the bones from grinding into each other. The meniscus is a crescent-shaped disc between the tibia and femur that acts as a shock absorber, cushioning the lower part of the leg from the weight of the rest of the body and allowing the bones to slide freely on each other. The patella is connected to the quadriceps muscle and the tibia. Ligaments connect the femur to the fibula and tibia.

Not all knee pain is a result of injury to these bones, tendons, or ligaments.

- **Arthritis** of the knee is most often osteoarthritis. In this disease, the cartilage in the joint gradually wears away. Osteoarthritis may be caused by excess stress on the joint from deformity, repeated injury, or excess weight. It most often affects middle-aged and older people. A young person who develops osteoarthritis may have an inherited form of the disease or may have experienced continuous irritation from a torn meniscus or other injury.

Someone who has arthritis of the knee may experience pain, swelling, and a decrease in knee motion. A common symptom is morning stiffness that lessens as the person moves around.

Diagnosis may be confirmed from x rays, which typically show a loss of joint space. Most often, osteoarthritis of the knee is treated with pain-reducing medicines and exercises to restore joint movement and strengthen the knee. Losing excess weight can also help people with osteoarthritis.

- **Osgood-Schlatter disease** is caused by repetitive stress on the bone growth plate of the upper tibia. Bones grow at the ends near the joint at an area called the growth plate. These areas of growth are made of cartilage, not bone. The tendon from the patella attaches to the growth plate. In Osgood-Schlatter's disease, the tremendous forces generated when the quadriceps muscles contract pull at the attachments of the tendons on the growth plate of the tibia, causing inflammation and pain.

The disease most commonly affects active young people, particularly boys between the ages of 10 and 15, who play games or sports that include frequent running and jumping. The pain usually worsens with activity and is relieved by rest. Usually, the motion of the knee is not affected. Pain may last a few months and may recur until the child's growth is completed.

Osgood-Schlatter disease is most often diagnosed by the symptoms. An x-ray is usually normal. Sometimes, in more serious cases, a bone fragment is seen separating from the tibia. Usually, the disease resolves without treatment. Applying ice to the knee when pain begins helps relieve inflammation and is sometimes used along with stretching and strengthening exercises. The doctor may advise the patient to limit participation in vigorous sports. Activities which put stress on the knee, especially squatting, bending, or running uphill (or up stadium steps) cause the tissue around the growth plate to become inflamed and painful. Kneeling or a bump on the tender area can be very painful.

PATIENT HISTORY

James Young, the patient in image 5a, is 15 years old. His complaint is knee pain when he runs during baseball practice. He does not recall injuring his knee.

Robert Oldman, the patient in image 5b, is an overweight 40-year-old man. He has been experiencing pain in his left knee almost daily for many months.

RESOURCES

<http://www.niams.nih.gov/hi/topics/kneeprobs/kneeqa.htm>
<http://www.hopkinsmedicine.org/orthopedicsurgery/sports/osgood-schlatter.html>
<http://www.hosprract.com/issues/1999/02/aronen.htm>

QUESTIONS

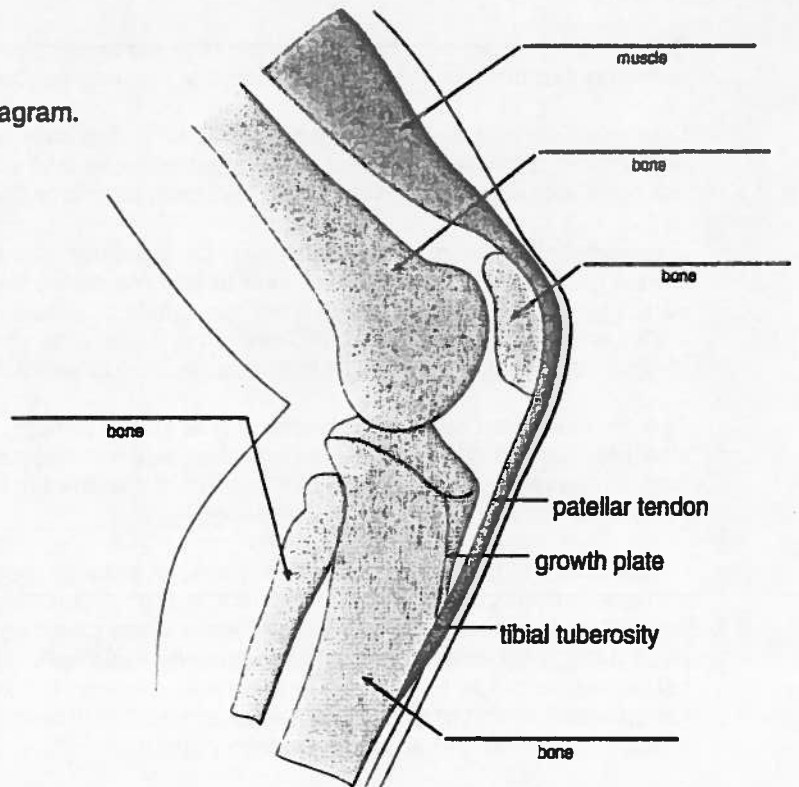
1. What are some causes of knee pain?
2. What would you expect to see on x-rays for the following conditions?

Arthritis —

Injury —

Osgood Schlatter's disease —

3. Label the parts of the knee shown in the diagram.



4. Compare images 5a and 5b to each other and to the diagram above. Both patients are complaining of knee pain. Give a possible explanation for each and explain your diagnosis..
5. What treatment would you recommend for each patient?

Student Guide

Case 8 – Head CT Scan

Name: _____

Date: _____
Class/Period: _____

BACKGROUND INFORMATION

A stroke occurs when the blood supply to any part of the brain is interrupted or when a blood vessel in the brain bursts, resulting in tissue death and loss of brain function. The brain requires about 20% of the body's total circulation of blood. The blood enters the brain from two carotid arteries in the neck, which branch off into multiple arteries, each of which supply blood to a specific area of the brain. See the diagram on page S8-2. If blood flow in any of these arteries is interrupted for longer than a few seconds, brain cells can die, causing permanent damage. The resulting stroke-related symptoms depend on the area of the brain affected, the extent of the damage, and the cause of the stroke.

The blood supply to the brain may be interrupted by a thrombus or embolus. A thrombus is a blood clot that forms in the brain. A stroke caused by a thrombus is most common in older people; often, there is underlying atherosclerosis (thickening and hardening of the arteries due to the build-up of fatty substances on the insides of the artery walls) or diabetes. This type of stroke may occur at any time, even when the person is at rest. The person may or may not lose consciousness.

An embolus is a blood clot, piece of plaque, or other material that travels to the brain from another location. Strokes caused by embolism are most commonly a result of a heart disorder. The material travels through the bloodstream and becomes stuck in a small artery in the brain. This type of stroke occurs suddenly and causes immediate and maximum damage to the brain.

A hemorrhagic stroke is the result of bleeding that occurs within brain tissue when a blood vessel ruptures. See the diagram on page S8-2. Bleeding irritates the brain tissues, causing swelling. Blood collects into a mass called a hematoma. Both swelling and hematoma will compress and displace brain tissue, causing more damage.

The risk of stroke is increased by smoking, hypertension, diabetes, and heart disease. Rarely, strokes may happen in women on birth control pills — the risk is increased if a woman also smokes and is older than 35. Women have a higher risk of stroke during pregnancy and the weeks immediately after pregnancy. Risks for hemorrhagic stroke include anything that can weaken the arteries supplying blood to the brain. These can include high blood pressure, substance abuse, and hereditary malformations.

Stroke symptoms vary with the cause of the stroke. A patient having a stroke caused by a thrombus may exhibit mild symptoms that come on gradually. Most strokes begin suddenly and develop rapidly, causing brain damage within minutes. Below is a list of symptoms that can indicate a stroke.

- Seizures or breathing difficulties
- Loss of consciousness
- Sudden vision change or loss of vision in one or both eyes
- Sudden, severe headache
- Loss of movement (paralysis) or weakness of any body area
- Loss of coordination
- Decreased sensation, tingling or other sensation changes
- Language difficulties (slurred, thick, difficult speech, inability to speak)
- Inability to understand speech
- Difficulty with reading or writing
- Inability to recognize or identify sensory stimuli on one side of the body
- Loss of memory
- Vertigo (abnormal sensation of movement)
- Swallowing difficulties

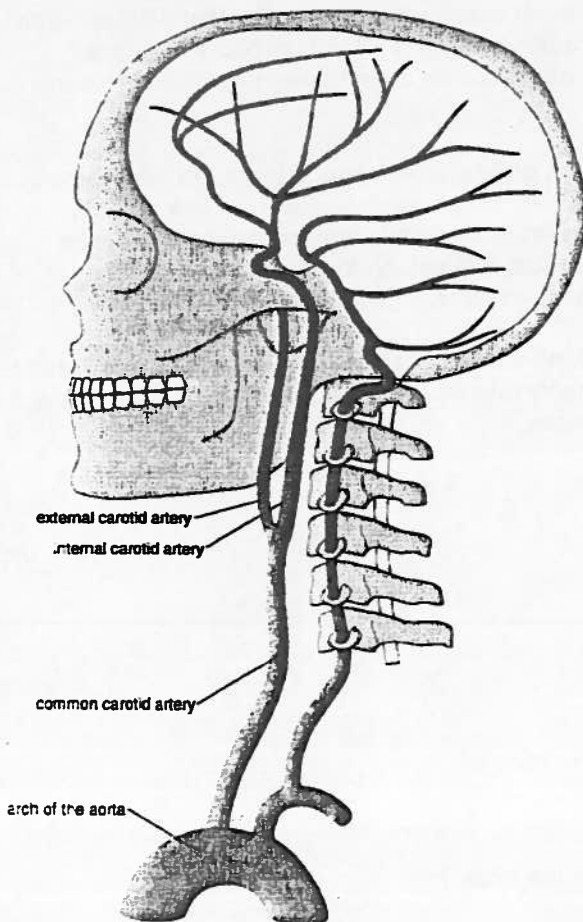
- Personality changes
- Mood/emotion changes (such as depression or apathy)
- Appearing sleepy/stuporous/somnolent/lethargic/comatose/unconscious
- Lack of control over the bladder and/or bowels
- Cognitive decline
- Dementia
- Impaired judgment
- Limited attention span
- Inability to recognize family members or common objects

Examination may indicate increased intracranial pressure. Eye examination may show abnormalities of movement, or changes may be seen in the retinal examination (examination of the back of the eye). Reflexes may be abnormal in extent, or abnormal reflexes may be present.

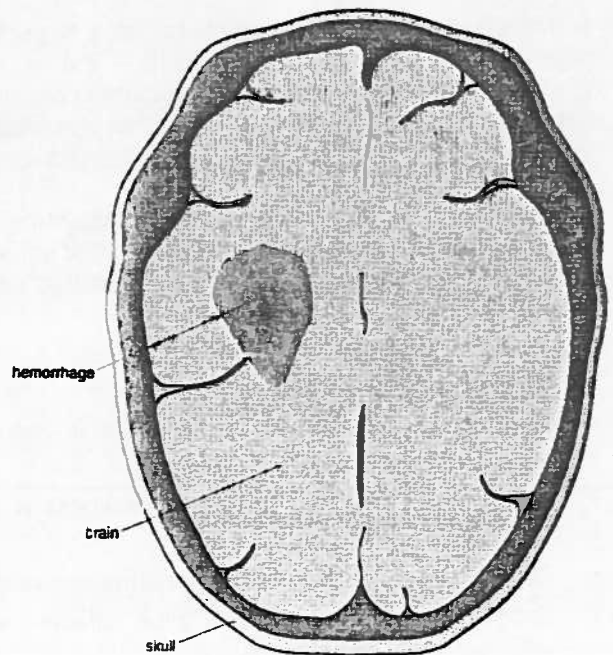
Hemorrhagic stroke may be confirmed, and the location and amount of bleeding and brain tissue damage determined, by a head CT scan or MRI. An ECG (electrocardiogram) may be used to determine underlying heart disorders. An echocardiogram may be used if the cause is suspected to be cardiac embolus.

t-PA (tissue plasminogen activator) is a medicine that dissolves the clot and potentially restores blood flow to the affected area to prevent cell death and permanent damage. There are strict criteria for the administration of t-PA and the stroke victim must be treated within 3 hours of onset of symptoms.

Anticoagulants, such as heparin, dicumarol, aspirin, and warfarin, are used to prevent recurrent strokes. Analgesics may be needed to control severe headache. Antihypertensive medication may be needed to control high blood pressure.



Blood supply to the brain



Brain with hemorrhage

PATIENT HISTORY

Images 8a and b belong to Bertha Shoemaker, a 76-year-old retired female. Her daughter noticed that the left side of Bertha's face is drooping slightly and she seems confused. Image 8c is a normal CT scan/

RESOURCES

<http://www.nlm.nih.gov/medlineplus/ency/article/000726.htm>
<http://www.strokeassociation.org>
<http://www.brain-mind.com/StrokeBrainScans.html>
http://www.umassmed.edu/strokestop/module_three/carotid_vert_1.html

QUESTIONS

1. Why would a patient who was suspected of having had a stroke not be x-rayed?
2. Why would a doctor send a patient for a CT scan?
3. In what way are CT scans more useful than x-rays?
4. Notice the small skull profile at the bottom right of image 8a and image 8b. What do these profiles show?
5. What differences in the brain do you see between the normal head in image 8c and the head of the patient with the problems shown in images 8a and b?
6. What are some possibilities that could be causing the abnormality shown.
7. Images 8a and b are both CT scans of the same person. Why is the same abnormality black in one image and white in the other?
8. If a patient came into the emergency room complaining of a splitting headache, confusion, and slurred speech, what treatment options could the doctor use and what would be the reason for using them?

Student Guide

Case 10 – Intraoperative Cholangiogram

Name: _____

Date: _____

Class/Period: _____

BACKGROUND INFORMATION

Gallstones form when bile, the liquid stored in the gallbladder, hardens into pieces of stone-like material. Bile is made in the liver and stored in the gallbladder until it is needed to digest fats. When needed, the gallbladder pushes the bile into the common bile duct, which carries it to the small intestine. Bile contains water, cholesterol, fats, bile salts, proteins, and bilirubin. If the liquid bile contains too much cholesterol, bile salt, or bilirubin, it can harden into stones.

Gallstones can block the flow of bile if they lodge in the ducts that carry bile from the liver to the small intestine. Bile trapped in these ducts can cause inflammation in the gallbladder, the ducts, the liver, or pancreas, which also has a duct going to the common bile duct. If any of these ducts remain blocked for a significant period of time, severe damage or infections can occur. Warning signs of a serious problem are fever, jaundice, and persistent pain.

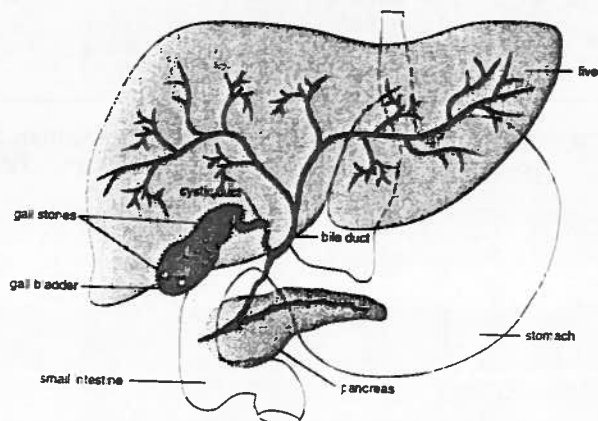
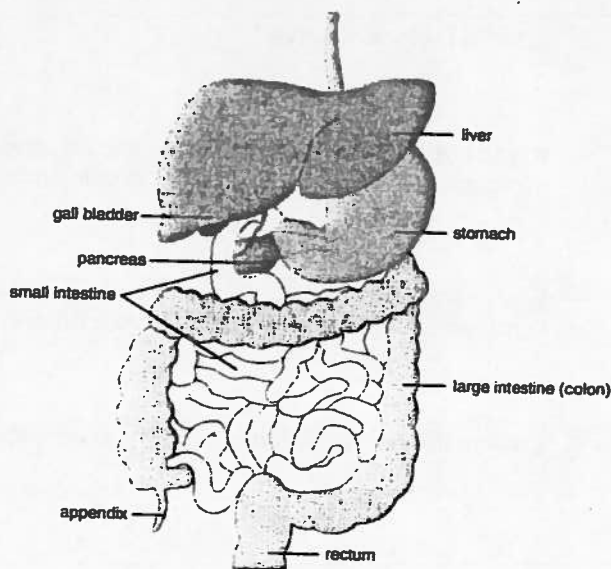
Cholecystectomy, the surgical removal of the gallbladder, is the standard method for treating symptomatic gallstones and gallbladder disease. Currently, 90 percent of cholecystectomies are done laparoscopically. A common surgery is a laparoscopic cholecystectomy with intraoperative cholangiogram.

A cholangiogram is an x-ray of the biliary duct system. The ducts that transport bile between your liver, gallbladder, and small intestine cannot be seen on x-ray without the use of a radiopaque dye. Radiopaque dye is a contrast material that does not allow the passage of x-rays and shows up as a light area on an x-ray. A cholangiogram can show blockages within the common bile duct or hepatic ducts. The most common reason for this exam is to look for remaining stones or stone fragments in the ducts after surgery.

The surgeon may perform an intraoperative cholangiogram if there is any doubt as to the identification of the biliary structures. This procedure may also be done if it is suspected that a stone has lodged in the remaining ducts, which could lead to inflammation of the ducts or damage to the liver or pancreas. Cholangiography is also helpful in detecting any unusual anatomy.

During a cholangiogram, a small incision is made in the cystic duct, a catheter is slipped into the cystic duct, and a radiopaque dye is injected into the biliary duct system. The injected material is then monitored with a device called a fluoroscope as it travels through the biliary ducts, and the surgeon obtains an image similar to a real-time x-ray. Failure of any biliary duct to fill with the dye alerts the surgeon to an obstruction.

The cholangiogram has generally been replaced by non-invasive procedures such as MRI, CT scan, or sonograms except during surgery.



PATIENT HISTORY

The patient in image 10 is Paula Thorpe, a 40-year-old female who has been diagnosed with gallstones. Her physician has recommended that Paula's gallbladder be removed laparoscopically with an intraoperative cholangiogram.

RESOURCES

<http://www.niddk.nih.gov/health/digest/pubs/gallstns/gallstns.htm>
<http://www.medmal-law.com/lapchole/article.htm>

QUESTIONS

1. What does a cholangiogram show?
2. Why is it used?
3. What is radiopaque dye?
4. It was determined that the patient should have her gallbladder removed because of "chronic problems with symptomatic gallstones." Define chronic and symptomatic.
5. Is removal of the gallbladder a reasonable course of action for a person who suffers from "chronic pain with symptomatic gallstones." Explain your answer.
6. Look at image 10. Did the surgeon leave forceps in this patient? Explain your answer.
7. Do you think that gallstones were the cause of the patient's discomfort? Explain.
8. If the laparoscopic cholecystectomy removes the gallbladder (the source of the stones), why do a cholangiogram at the same time?
9. Why would a cholangiogram not be the technique of choice to determine whether or not a patient has gallstones? Why would it be the procedure of choice during the surgery?