

# Appendix B

## Answers to Clinical Practicum Questions

### Clinical Practicum 5.1

1. This rash has the classic appearance and history for poison oak exposure. The rash is the result of an inflammatory reaction to pathogens deposited by contact with the poison oak plant. These pathogens are deposited as the plant is brushed over the skin, therefore it is in a linear pattern. Inflammatory reaction to this pathogen results in a type of rash known as a contact dermatitis.
2. Exposure to poison oak deposits allergic pathogens on the skin which incite an inflammatory response. The cells of the immune system already within the skin release locally acting cytokines which result in recruitment of other inflammatory cells to the area as well as increased permeability of the blood vessels in the area. The release of cytokines and histamines by the inflammatory cells results in the local pruritis (itching). The increased permeability of the blood vessels causes local edema. This edema seeps into intercellular spaces particularly within the stratum spinosum. Increased intracellular fluid in this area may cause blistering. Because a full-fledged reaction to the allergic pathogen requires recruitment of additional inflammatory cells, appearance of symptoms is delayed approximately 24 hours after exposure.
3. Topical steroids are the basis of treatment for poison oak to inhibit the inflammatory response. Often antihistamine medications are given to decrease pruritis in order to diminish risk of secondary infection because of scratching of the rash by the patient. The antihistamines may also relieve patient discomfort.

### Clinical Practicum 6.1

1. In the subdural space on the left there is a fluid collection causing mass effect on the brain. This pressure on the brain can explain the significant changes in the patient's mental status. With changes in mental status and evidence of mass effect on the brain, concern for herniation of brain tissue is real. The brain can herniate laterally under the falx cerebri or downward past the tentorium or through the foramen magnum. Any of these changes is life threatening.
2. A defect is seen in the posterior wall of the frontal sinus. This defect is caused by erosion of bone secondary to the patient's sinus infection. This communication of the frontal sinus with the subdural space allows infected fluid to move from one space to the other. Immune reaction also contributes to the fluid collection in the subdural space.
3. The diagnosis is a subdural empyema secondary to the patient's sinus infection.
4. The fluid in the subdural space must be removed for two reasons. First, it must be removed to relieve the pressure on the brain and lessen the risk of herniation. Second, it must be removed in order to help clear the infection. Antibiotic treatment must also be administered.

### Clinical Practicum 6.2

1. This patient has suffered a fracture of the L2 vertebral body.
2. Retropulsion of fracture fragments into the spinal canal causes compression of the spinal cord. At the level of this injury the portion of the cord injured is most likely the cauda equina. The injury may be due to compression and swelling secondary to the fracture or due to damage to the nerves themselves. The nature of this injury could be further delineated by MRI. The patient's neurologic deficits are manifest in his legs because the nerves innervating the legs originate at the lumbar and sacral levels of the spine.

3. The seat belt fixes this portion of the body (L1–L3) and causes it to become a fulcrum on which the rest of the body bends during the extreme deceleration of an automobile accident. The extreme force of bending focused at this spot leads to compression and fracture of the vertebral body.

### Clinical Practicum 7.1

1. This is a compound comminuted fracture of the distal radius and ulna with dorsal displacement and angulation. It is a comminuted fracture because there are multiple fragments in each fracture. It is an open fracture because the fractured bones are exposed to the outside of the body through a soft tissue defect. The fracture fragments are displaced dorsally because of the mechanism of injury. This type of fracture of the distal radius is classically known as a Colles' fracture.
2. In an open fracture the ends of the fracture fragments are exposed to the environment through an open wound. This exposes the bone marrow cavity to infectious environmental pathogens. The bone marrow is a good growth medium for bacteria. These fractures are at greater risk of developing infection within the bone which may interfere with healing.
3. Considering the amount of displacement seen on the radiographs, vascular and nervous injuries associated with the bony trauma would be quite possible. Vascular injury may be manifest as a pulseless cold hand. Neurologic injury could have symptoms of either weakness or decreased sensation. These are emergencies which would require immediate surgical attention. Muscular injury is also very likely. Continuing vascular and neurologic exams must be performed on the patient over the ensuing 24 to 48 hours to watch for possible compartment syndrome. Compartment syndrome occurs when swelling or hemorrhage secondary to an injury causes increased pressure within one of the compartments defined by the fascial planes between the muscle groups of an extremity. This increased pressure within the compartment causes vascular compromise leading to neurologic injury.

### Clinical Practicum 7.2

1. There is erosion of the bone of the acetabulum. This is demonstrated as an area of decreased density just superior to the acetabulum on the plain film and is clearly shown on the CT scan. This may represent several different entities, but considering the patient's history of thyroid cancer, this is most likely an osteolytic bony metastasis. The proximity of this lesion to the acetabulum explains why this patient has increased pain with walking or weight bearing. These activities put increased pressure on the abnormal bone causing pain.
2. Metastatic bone lesions are prone to "pathologic fracture." By eroding the bone they weaken its structure. Often bony metastasis and other bony lesions will initially present as fractures only to have the lesion found on radiographic evaluation. The risk of pathologic fracture in this patient is great considering its location near the acetabulum and the weight-bearing/weight-distributing function of the pelvis.

### Clinical Practicum 8.1

1. Examination of the radiograph shows narrowing of the joint spaces of several of the distal and proximal interphalangeal joints. This joint space narrowing is due to erosion of the articular cartilage. Chronic rubbing of bone against bone has resulted in bony remodeling as evidenced by the presence of subchondral sclerosis and osteophyte formation. Osteophytes are bony excrescences which form at the margins of joints affected by degenerative change. Soft tissue swelling is also seen around several of the affected joints.

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- Osteoarthritis. The distribution of joint involvement, symptoms, and physical findings are classical for idiopathic osteoarthritis. This is a common degenerative disease of the joints that affects many people as they age. They will report pain with use of the affected joints as well as morning stiffness in the joints which resolves quickly with movement. In this disease the articular cartilage on the ends of bones degenerates leading to joint space narrowing and bony remodeling secondary to bone-on-bone articulation. Osteoarthritis of the hands classically involves the distal and proximal interphalangeal joints and the wrist, but sparing the metacarpophalangeal joints. This differs from rheumatoid arthritis, which usually involves the metacarpophalangeal joints first. Swelling around the distal interphalangeal joints is a classic physical finding of osteoarthritis known as Heberden's nodes.
- Osteoarthritis is a common degenerative disease that affects many joints of the body as people age. The most common joints affected include distal and proximal interphalangeal joints, wrist, acromioclavicular, hips, knees, and facet joints of the cervical and lumbar spine.

**Clinical Practicum 8.2**

- The patient has dislocated his shoulder. The head of the humerus has been forced out of the glenoid cavity by the force of his fall.
- The dislocation must be reduced by moving the head of the humerus back into alignment with the glenoid cavity. This can be very painful and is often performed under anesthesia, because it requires a great amount of traction on the arm. A radiograph is taken after reduction to check that the head of the humerus is correctly positioned. Then the shoulder is immobilized to allow healing of the muscles of the rotator cuff.
- Because of the structures that pass through the axilla, a dislocation can damage nerves, arteries, or muscles around and within the shoulder. Nerve damage may result in weakness and numbness in the shoulder. Arterial damage may result in pain and impairment of blood flow to the arm. Muscle damage may result in recurrent dislocations of the shoulder, even after minor injuries, as well as limited range of motion if rotator cuff injuries occur.

**Clinical Practicum 9.1**

- A low-density area with peripheral enhancement is seen adjacent to the psoas major muscle. Low-density collections with peripheral enhancement such as this are suggestive of an abscess. This abscess is closely related to the psoas major muscle and does not seem to be related to any of the surrounding organs. These abscesses generally form from hematologic spread of bacteria secondary to an infection in another part of the body.
- The iliopsoas test is a physical examination maneuver performed when there is suspicion of an intra-abdominal inflammation. The patient lies on the right (unaffected) side and tries to extend her left leg at the hip against the examiner's hand. Abdominal pain upon extension of the left leg occurs because of the stretching of the inflamed psoas major muscle. This is known as a positive psoas sign.
- The abscess must be drained. This is done by inserting a tube into the abscess and allowing it to drain over several days. Antibiotics must also be administered to deal with the infection.

**Clinical Practicum 9.2**

- This patient has suffered a tibial tuberosity avulsion fracture.
- The muscles that extend the knee joint are the rectus femoris, vastus medialis, vastus intermedius, and vastus lateralis. These muscles comprise the quadriceps femoris group and have a common tendon, the quadriceps tendon, which extends to the patella. Between the patella and the tibia is the patellar ligament that attaches at the tibial tuberosity. This patient is unable to extend his leg at the knee because the tibial tuberosity has avulsed from the tibia. Therefore the quadriceps femoris muscle cannot exert force on the tibia.
- Two major muscle groups, the quadriceps femoris and the hamstrings span the knee. The quadriceps group extends the knee joint, whereas the hamstring group flex the knee joint. In the relaxed individual these muscle groups are in direct opposition to one another and hold the knee in a neutral, or straight, position through their resting muscle tone. Since the quadriceps femoris can no longer exhibit force on the tibia because of the

injury, the hamstrings are acting unopposed on the knee. The resting muscle tone of the hamstrings holds the knee in a slightly flexed position.

**Clinical Practicum 10.1**

- liver
- psoas major muscle
- kidney
- gallbladder containing gallstones
- spleen
- parietal peritoneum

**Clinical Practicum 11.1**

- This collection of blood is known as an epidural hematoma, and it is usually caused by a skull fracture which severs the middle meningeal artery. The arterial blood collects between the dura mater and the skull. These two boundaries give the hematoma its smooth borders. Because the dura mater is adherent to the cranium, it resists being stripped from the bone by the accumulating blood. This is what gives the hematoma its pointed tips. The shape is said to be lenticular (lens-shaped) and is characteristic of this type of intracranial hematoma.
- The initial trauma to the brain in these types of injuries is usually minimal, as evidenced by her brief loss of consciousness. The danger occurs later as the growing hematoma presses on the brain, raising the intracranial pressure until coma is induced.
- The expanding hematoma forces the brain to shift toward the opposite side, as seen in this CT scan. As the brain shifts, the medial portion of the temporal lobe often compresses the oculomotor nerve against the tentorium, causing the pupil to dilate.

**Clinical Practicum 12.1**

- The patient herniated an intervertebral disc of the lumbar spine. Each disc has tough circular fibers which surround and contain a soft jellylike center known as the nucleus pulposus. In a herniated disc, the soft nucleus pulposus has pushed (herniated) through a weakened area of the fibers to press on a nerve root. Initially, this causes pain in the distribution of the affected nerve. If continued, it can also result in numbness/pain and motor deficits specific to the nerve root.
- By knowing neuroanatomy you can surmise which nerve root is irritated and therefore which disc is herniated:

Disc	Nerve Root	Numbness/Pain	Motor Deficit	Lost Reflex
L3–L4	L4	Anterior leg	Tibialis anterior muscle	Patellar
L4–L5	L5	Superior foot	Extensor hallucis longus muscle	None
L5–S1	S1	Lateral foot	Gastrocnemius muscle	Tendo calcaneus

- The fibers that surround the nucleus pulposus are naturally weakest in the right and left posterior aspects. This means that herniations usually bulge to the right or to the left, thereby affecting only one leg. If the nucleus pulposus herniates straight back, however, it presses on the cauda equina instead of just a single nerve root. This may cause numbness of the perineum and dysfunction of bowel or urinary bladder control. This is known as cauda equina syndrome and it requires immediate referral to a specialist.

**Clinical Practicum 13.1**

- Although several conditions of the lung can look like this on the radiograph, this man's history favors one diagnosis. He is a lifetime smoker, he has developed a chronic cough, and he has been losing weight. He most assuredly has lung cancer.
- The apex of the lung is in close proximity to the brachial plexus. This apical tumor is either pressing on the trunk or chords of the brachial plexus, or it has actually eroded through the pleura and is invading the plexus, causing the arm symptoms.
- The apex of the lung is also very close to the sympathetic chain in the upper thorax and the neck. Tumor invasion in this location afflicts sympathetic innervation to one-half the head. The result is loss of muscle tone in the eyelid, loss of pupil dilation, and inability of the skin to sweat on that half of the face.

**Clinical Practicum 14.1**

1. The patient's recent change in facial appearance and the change to his hands and feet are due to excessive growth hormone. Growth hormone is released by the pituitary gland. This man has developed a pituitary tumor (seen on the MR image) that is secreting excess growth hormone, and which will be confirmed by measuring the hormone in the lab.

Excess growth hormone during childhood greatly accelerates growth, resulting in gigantism. However, if this occurs after a person has reached full stature (i.e., after the epiphyseal plates of the long bones have already ossified), the result is increased growth of other bones such as facial bones and increased soft tissue growth of the hands and feet. This condition is termed acromegaly.

2. A MRI of the head is necessary to determine the size of the pituitary tumor.
3. The optic chiasma sits superior and just anterior to the pituitary gland. If a pituitary tumor gets large enough it compresses the optic chiasma, interfering with neuronal transmission through the optic fibers that cross in this structure.

**Clinical Practicum 15.1**

1. The fracture involves the floor of the orbit, which is mainly composed of the maxillary bone. Small portions of the palatine and zygomatic bones make up the remainder of the orbital floor. In this case, the fracture involves the maxillary bone.
2. There are four paranasal sinuses: frontal, ethmoidal, sphenoidal, and maxillary. The maxillary sinus lies just inferior to the orbit inside the maxillary bone. The inferior wall of the orbit makes up the superior wall of the sinus. Therefore, a fracture of the inferior wall of the orbit must also involve the maxillary sinus.
3. As in this case, when fracture fragments of an inferior orbital wall fracture are displaced into the maxillary sinus, herniation of the orbital contents into the sinus is a common occurrence. In most cases, this involves only orbital fat. However, in this case as well as others, the inferior rectus muscle may also herniate into the sinus and become entrapped. Entrapment of the inferior rectus muscle prevents movement of the eye.

**Clinical Practicum 16.1**

1. A dissection flap. In a dissection, there is a defect in the tunica intima of the vessel. This allows blood to enter into the potential space between the tunica intima and tunica media. In a high-pressure vessel such as the aorta this blood can dissect between these layers for some distance creating a true and false lumen to the vessel. The dissection flap therefore represents the tunica intima separating the true from the false lumina.
2. The descending aorta. Because this dissection involves only the descending aorta the treatment would involve controlling the patient's hypertension. No surgical treatment is necessary. However, dissections of the ascending aorta are surgical emergencies because they may extend into the coronary arteries affecting the blood supply to the heart.
3. The dissection has extended into the left subclavian artery as it comes off the aortic arch. The raising of the dissection flap narrows the lumen of the artery. This decreases blood flow and in turn blood pressure in the left arm.

**Clinical Practicum 16.2**

1. The noise is called a bruit (pronounced broo-ee). It is caused by turbulent blood flow through a narrowed artery, and it is analogous to the noise of water flowing through a kinked garden hose. The arteriogram shows stenosis of the left renal artery, which is likely the source of the abdominal bruit.
2. The stenosis of the renal artery is, in effect, starving the left kidney of blood. The kidney interprets this decrease in blood supply as a sign that the body is low on blood (such as after massive hemorrhage). It subsequently activates a hormone system called the renin-angiotensin-aldosterone system whose actions increase blood pressure by direct vasoconstriction and by retention of salt and water. This mechanism is life-saving if the body's blood volume is truly low, but it is detrimental if triggered by renal artery stenosis.
3. Renal retention of salt and water is accomplished at the expense of potassium loss in the urine.

**Clinical Practicum 17.1**

1. Although the patient has an underlying pulmonary infection causing some shortness of breath, the acute worsening of his symptoms is due to a tension pneumothorax. The tension pneumothorax occurred secondary to a bronchopleural fistula resulting from the patient's underlying infection. This makes ventilation of the left lung very difficult. A tension pneumothorax is a type of pneumothorax in which gas collects in the pleural space resulting in increased intrathoracic pressure which affects both cardiac and pulmonary function in a life-threatening manner.
2. As the left pleural space fills with air, it shifts the mediastinum to the opposite side putting pressure on both the heart and the lung. This makes it more difficult for the right lung to expand during inspiration and for the heart to fill with blood. With each breath the patient takes, more air is drawn into the left pleural space. The more the patient struggles for breath, the more the pleural space fills with air.
3. Treatment of a tension pneumothorax is a medical emergency requiring placement of a chest tube to relieve the increased intrathoracic pressure and the reexpansion of the collapsed lung. If the patient's clinical condition is critical, decreasing the intrathoracic pressure becomes the priority and may be accomplished through the placement of a needle through the chest wall. A chest tube would then be placed when the patient stabilized.

**Clinical Practicum 17.2**

1. No normal lung is identified in the left hemithorax. Multiple air-filled tubular structures are seen in the left hemithorax consistent with loops of bowel. These loops of bowel also exhibit some mass effect on the mediastinum shifting it to the right.
2. A congenital diaphragmatic hernia allowed multiple loops of both large and small bowel to herniate into the left hemithorax. This results in compression of the lung causing the patient's respiratory distress.
3. No, her breathing will improve, but it will take a significant amount of time before it will become normal. The left lung has not developed normally because it was not allowed to expand *in utero*. Normal development of the lung requires expansion of the lung through inspiration of amniotic fluid by the fetus. In the case of a large diaphragmatic hernia, bowel occupies the space into which the lung would normally expand. By preventing this expansion, the normal development of the lung has been retarded. Once the hernia has been repaired and the bowel returned to the abdomen, the lung may then expand and develop over time, with the infant's normal inspiration.

**Clinical Practicum 18.1**

1. The blebs are called diverticulae and this condition is called diverticulosis. Each colonic diverticulum is a herniation of mucosa through the muscularis layer of the colon. Diverticulae tend to occur at the weakest parts of the muscularis where nutrient vessels penetrate the muscle. They are more numerous with advancing age and are thought to result from the high pressures the colon generates when moving hard feces.
2. His abdominal pain was likely the result of diverticular inflammation (diverticulitis). It is believed that bacteria and undigested food can clog a diverticular sac, leading to infection. Symptoms can range from mild to severe depending on the extent of infection.
3. Erosion of a diverticular vessel can produce massive, painless, rectal bleeding.

**Clinical Practicum 18.2**

1. McBurney's point is a point on a line connecting the right anterior superior iliac spine and the umbilicus. The point lies approximately one-third of the way from the anterior superior iliac spine to the umbilicus. This point on the skin overlies the expected location of the appendix. In acute appendicitis pain is said to eventually localize to McBurney's point. This is also a landmark for surgeons where the incision for an appendectomy is made.

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2. This CT is consistent with the diagnosis of acute appendicitis. The appendix is dilated with a thickened wall. The periappendiceal fat is infiltrated and edematous. These findings are consistent with inflammation of the appendix. An appendicolith is also seen near the orifice of the appendix.
3. This white object is an appendicolith. It is a calcified fragment of fecal matter lodged within the lumen of the appendix. By lodging with and obstructing the appendix, the appendicolith leads to the initial inflammation and infection causing acute appendicitis.
4. Appropriate treatment is surgery to remove the appendix.

**Clinical Practicum 19.1**

1. There is a large filling defect in the urinary bladder seen on the intravenous urogram. Normally the mucosa of a distended urinary bladder has a mucosa of smooth appearance. In this case there is a large irregularity demonstrated in the urinary bladder. This most likely represents a transitional cell carcinoma of the bladder, a malignant neoplasm of the urothelium. Considering the patient's history of hematuria, this is the most likely source of his bleeding.
2. The CT scan shows a mass filling a significant portion of the lumen of the urinary bladder. This greatly decreases the functional volume of the bladder. Therefore a smaller amount of urine will fill the urinary bladder. This leads to stimulation of the stretch receptors of the bladder, leading to the urge to urinate.
3. Transitional epithelium lines the renal calyces, renal pelvis, ureters, urinary bladder, and urethra. Any of these structures may be involved by synchronous tumor. Continued surveillance of all these organs must also be performed to evaluate for recurrence of cancer.

**Clinical Practicum 19.2**

1. The identified object has the same density as bone, meaning that it contains a significant amount of calcium. This density lies within the expected course of the ureter. These findings are most consistent with a stone within the left ureter. Either an intravenous urogram or a spiral CT may confirm this diagnosis.
2. The intravenous urogram demonstrates that there is a stone within the upper third of the left ureter. This stone is large enough to cause partial obstruction of the ureter, leading to dilation of the collecting system. Dilation of the collecting system causes increased pressures within the kidney. This in turn decreases renal function. If these changes are long-standing, permanent damage to the kidney occurs.
3. The ureter has a structure similar to many other hollow organs in the body. Deep to the mucosa there is a layer of smooth muscle which is surrounded by a serosa. This smooth muscle layer undergoes periodic peristaltic contractions to propel the urine from the kidney to the urinary bladder. In the setting of a stone within the ureter these contractions become painful as the smooth muscle exerts pressure on the stone. Because these peristaltic waves are only intermittent the pain is intermittent.

**Clinical Practicum 20.1**

1. The testicular self-exam for males is, in a way, equivalent to the breast self-exam for females. It is a screening test for testicular cancer, the most common malignancy among young adult males. It involves examining both testes on a monthly basis to check for changes in contour, nodules, or areas of tenderness. If performed properly and at timely intervals this exam may result in earlier detection of testicular neoplasms. By detecting these cancers at earlier stages it is hoped that they may be more effectively treated.

2. The venous drainage of the left testis is via the left renal vein. Abnormal lymph nodes could be found along the course of this vein in the retroperitoneal space. Around the left renal vein and in the periaortic region are also common areas to find abnormal lymph nodes. It would be unusual to find abnormal nodes isolated to the inguinal area because the inguinal nodes are not within the direct lymphatic drainage of the scrotum.
3. Ultrasound is an imaging modality which uses the reflection of sound waves from tissue interfaces to create representative images of the anatomy. No radiation is used during an ultrasound examination. This is of particular importance not only in imaging of the testis but also in imaging of the ovary. Because of the high meiotic rate in these organs, the DNA in these tissues is particularly susceptible to radiation-induced damage which can potentially lead to genetic mutation. Therefore ultrasound, a modality that uses no radiation is safer than radiographic evaluation.

**Clinical Practicum 21.1**

1. These foci of endometrial tissue are susceptible to hormonal influences just like normal endometrial tissue. During the time of menstruation, these tissues bleed. Recurrent bleeding in the pelvis leads to scarring which can distort the pelvic anatomy causing pain and infertility.
2. Several theories exist as to how endometrial tissue is found outside the uterus in the disease endometriosis. Some aspect of each of these theories is likely true. Direct spread of endometrial tissue from the uterine cavity back out through the uterine tubes is the most likely way that ectopic endometrial tissue forms in the pelvis. Spread of endometrial tissue through vascular and lymphatic structures can also occur.
3. a. Pain with defecation  
b. Pain with urination  
c. Postprandial pain  
d. Pain with breathing

**Clinical Practicum 22.1**

1. Considering the physical exam findings and the location of this mass on the CT, it most likely originates from the ovary. Its heterogeneous appearance on CT tells us that many different types of tissue are found within the mass. This mass therefore, most likely represents a dermoid cyst.
2. This benign mass arises from the germ cells of the ovary. Because this mass arises from germ cells it has the potential to form all types of tissue. It is very common to find teeth, hair, and fat within a dermoid cyst. In this case two teeth and a significant amount of fat can be identified.
3. The vast majority of dermoid cysts are benign, however a very small percentage will undergo malignant degeneration. The greater concern with such a benign mass is that with increasing size there is increased risk of ovarian torsion. In this condition the ovary twists, causing occlusion of the ovarian vessels, which may lead to ischemia. When a dermoid cyst becomes larger than 4 cm the risk of ovarian torsion becomes great enough that surgical removal is warranted.