175. You are shown arterial and venous phase views (Figures 1 and 2) of a common hepatic angiogram. What is the MOST LIKELY diagnosis?

A. Hepatocellular carcinoma  
B. Hepatic abscess  
C. Giant hemangioma  
D. Intrahepatic hemorrhage

**Findings:**
There are normal caliber, not enlarged, feeding arterial branches of the left hepatic artery. There is early appearance of numerous and variably sized spots of contrast. There is delayed visualization of these spots, during the venous phase. There is no arteriovenous shunting.

**Rationale:**
A: This is not the typical appearance of a primary hepatic malignancy. The feeding arterial branches would be enlarged and there may be arteriovenous shunting. Venous invasion may also be present.
B: An abscess would not show any internal angiographic architecture. There would be no central vascularity.
C: The findings on the angiogram are typical for a giant hepatic hemangioma. These include normal feeding arterial branches, a “cotton wool appearance” to the tumor stain and persistence of the vascularity, as evidenced by opacification of the splenic and portal veins, late into the venous phase. The cotton wool appearance corresponds to the nodular enhancement pattern seen on CT and MRI scans. Present in 20% of the U.S. population, hemangioma is the commonest benign liver tumor. Any intra-hepatic hemangioma equal to or greater than 4 cm in size is termed a giant hemangioma. Mass effect by this large tumor is shown by cephalad and medial deviation of the gastroduodenal artery and its branches.
D: There is no puddling or pooling of contrast to reflect active arterial bleeding.
176. You are shown a single image (Figure 3) from a contrast-enhanced CT of the abdomen. What is the MOST LIKELY diagnosis?

   A. Superior vena cava syndrome
   B. Liver laceration
   C. Regenerating nodule
   D. Focal fatty sparing

**Findings:**
There is contrast enhancement of the medial segment of the left lobe of the liver (segment IV or quadrate lobe). There is opacification of superficial veins in the right abdominal wall (right arm injection), and azygous vein collaterals.

**Rationale:**
A: The presence of multiple collateral veins and the characteristic enhancement pattern of segment IV of the liver is diagnostic of SVC syndrome. None of the three other choices would explain the collateral veins. Liver Lacerations are typically more linear in configuration and do not enhance to the degree seen on the image depicted. Focal nodular fatty sparing occurs in the setting of a fatty liver and the area of the enhancement here is not really nodular to consider a regenerating nodule or fat sparing.
B: Incorrect.
C: Incorrect.
D: Incorrect.
Figure 4

177. You are shown a single image (Figure 4) from a left upper extremity arteriogram. What is the MOST LIKELY diagnosis?

A. Giant cell arteritis
B. Fibromuscular dysplasia
C. Takayasu’s arteritis
D. Polyarteritis nodosa

Findings:
Web-like stenoses alternating with small aneurysms affect segments of the left subclavian and brachial arteries.

Rationale:
A: Although subclavian, axillary and brachial arteries are frequently affected by giant cell arteritis, the characteristic appearance is long irregular stenoses.

B: Alternating webs and aneurysms are the characteristic appearance of fibromuscular dysplasia. Although renal artery involvement is commonest, fibromuscular dysplasia may affect any medium sized artery. Taken together, brachial, axillary and subclavian arteries are the fifth most common location. The pathogenesis of the disease is unknown, but it is not an atherosclerotic or inflammatory process.

C: Resembling giant cell arteritis in both pathological and angiographic appearance, long, tapered, non ostial common carotid and subclavian stenoses are common findings.

D: Polyarteritis nodosa is a systemic necrotizing arteritis characterized by multiple small aneurysms adjacent to the arteries, or arterial occlusions, in either case caused by destruction of the wall of the artery by the disease process.
178. A patient presents with hemoptysis (Figure 5). Which of the following is the MOST LIKELY cause?

A. Sarcoid
B. Pulmonary AVM
C. Swan-Ganz catheter
D. Lung cancer

Findings:
There is a hypertrophied bronchial artery. Contrast injected into the bronchial artery opacifies the pulmonary artery.

Rationale:
A: Chronic lung inflammation, tuberculosis, cystic fibrosis, in this case sarcoidosis, regardless of the cause leads to occlusion of the pulmonary arterioles. This results in hypertrophy of the bronchial circulation in the respiratory mucosa. These hypertrophied vessels under systemic arterial pressure have the propensity to rupture causing massive hemoptysis.
B: Pulmonary AVMs are communications between pulmonary arteries and veins, not, as shown here, between systemic and pulmonary arteries.
C: A single pseudoaneurysm is the expected angiographic abnormality from hemoptysis caused by rupture of a pulmonary branch artery from inflation of the balloon of a Swan-Ganz catheter.
D: Certainly neoplasia can cause hemoptysis, but there is no mass to be seen, nor is a cancer likely to cause bronchial artery hypertrophy and shunting to the pulmonary arteries.
179. You are shown a single image from a superior mesenteric arteriogram (Figure 6). Which one of the following collateral pathways is indicated by the arrow?

A. Arc of Buhler
B. Arc of Barkow
C. Arc of Riolan
D. Marginal artery of Drummond

**Findings:**
There is a catheter placed in the superior mesenteric artery via a left axillary approach. There are two collateral pathways depicted here. The arrow is on the larger of the two, the arc of Riolan. More laterally located, and in this patient the smaller of the two, is the marginal artery of Drummond. Both collateral pathways connect the middle colic to the left colic artery.

**Rationale:**
A: This is an anastomotic pathway between the superior mesenteric artery and either the celiac trunk, the hepatic or splenic arteries.
B: Arc of Barkow, arcus epiploicus magnus of Barkow, as the long name implies, is a long collateral pathway between the right epiploic and left epiploic arteries in the posterior layer of the greater omentum.
C: See description of findings.
D: See description of findings.
180. You are shown a single lateral radiograph of the right leg (Figure 7). What structure is indicated by the arrow?

A. Popliteal artery  
B. Anterior tibial artery  
C. Posterior tibial artery  
D. Peroneal artery

**Findings:**
There is medial calcific sclerosis - Monckeberg's arteriosclerosis - forming calcified tubular casts of the major arteries in the leg.

**Rationale:**
A: The arrow is below the knee, at a level where the popliteal artery has already divided into the trifurcations vessels.
B: The anterior tibial artery is usually the first of the trifurcation vessels to arise from the popliteal artery below the knee. It traverses the intraosseous membrane and runs down the lateral aspect of the leg along the medial margin of the fibula.
C: The posterior tibial artery, as suggested by its name, runs posterially in the calf. Maybe I will put the arrow on this artery, or the peroneal artery in a future quiz.
D: Usually the smallest of the three arteries, it is located posterior to the anterior tibial artery.
181. You are shown an aortogram (Figure 8) and a selective left renal arteriogram (Figure 9) from a young woman with hypertension. What is the MOST LIKELY diagnosis?

A. Fibromuscular dysplasia
B. Catheter spasm
C. Neurofibromatosis
D. Takayasu’s arteritis

**Findings:**
The aortogram shows no abnormalities. Specifically the artery supplying the upper pole of the left kidney is normal. The selective left renal arteriogram shows a tapered narrowing of the artery supplying the left upper pole.

**Rationale:**
A: There is more than one subtype of fibromuscular dysplasia that will not display the typical string of beads appearance, but rather a tapered narrowing that resembles the appearance shown here on the selective renal arteriogram. But the fact that this artery is normal before the catheter is placed indicates that this is catheter spasm, and not a fixed deformity.

B: Catheter induced vasospasm is produced by mechanical stimulation of a muscular artery or coronary artery by poking or prodding these vessels with a guidewire or catheter. The fact that the artery here is normal on the mid stream aortogram and narrowed after selective catheterization indicates it is an iatrogenic abnormality.

C: In addition to subtypes of fibromuscular dysplasia, other conditions including neurofibromatosis, Takayasu's arteritis, even encasement of the left renal artery by a pancreatic carcinoma may cause narrowing of the renal artery. But the fact that the artery was normal on the aortogram and constricted after catheterization indicates that this is catheter spasm.

D: In addition to subtypes of fibromuscular dysplasia, other conditions including neurofibromatosis, Takayasu's arteritis, even encasement of the left renal artery by a pancreatic carcinoma may cause narrowing of the renal artery. But the fact that the artery was normal on the aortogram and constricted after catheterization indicates that this is catheter spasm.
182. You are shown a collimated angiographic image of the lower abdomen and pelvis (Figure 10). What is the BEST diagnosis?

A. IVC filter thrombosis
B. May-Thurner syndrome
C. Femoral vein thrombosis
D. Iliac artery dissection

Findings:
Contrast injected into the femoral vein shows narrowing of the left common iliac vein just before its confluence with the right iliac vein. There is thrombus filling the iliac veins upstream from the stenosis. The vena cava is free of clot downstream from the obstructing lesion, as is a portion of the opacified right iliac vein.

Rationale:
A: There is no filter, nor thrombus shown in the portion of the IVC included in the image.
B: Alternatively called Cockett’s syndrome or perhaps best named the iliac vein compression syndrome, this entity stems from the compression of the left common iliac vein between the right common iliac artery and the vertebral column. Chronic arterial pulsations lead to intimal hypertrophy and stenosis of the compressed vein. Thrombus formation occurs upstream as a result of venous stasis.
C: Although very likely the femoral vein is thrombosed, the thrombus shown on this image involves the iliac veins. And to select this response is to overlook the stenosis of the proximal common iliac vein responsible for the disease.
D: Superficially the contrast tracking around the thrombus in the iliac veins might resemble contrast opacification of a false channel of an iliac artery dissection, perhaps the complication of an endovascular procedure gone awry. But then why would the vena cava opacify?
You are shown images of the chest before (Figure 11) and after (Figure 12) placement of a temporary dialysis catheter. What is responsible for the abnormal densities in the lungs?

A. A complication of vertebroplasty  
B. The repair of a pulmonary AVM  
C. The residue of granulomatous disease  
D. A complication of a lymphangiogram

Findings:
In addition to the dialysis catheter, there is an infusion port, an NG tube and an endotracheal tube. There is opaque material in the pulmonary arteries. There is opaque material in two adjacent vertebral bodies.

Rationale:
A: Percutaneous vertebroplasty involves the injection of acrylic cement (polymethylmethacrylate) into a diseased vertebral body. It is now well recognized that the cement can intravasate into the perivertebral venous plexus and migrate to the pulmonary arteries.  
B: It is unusual to repair pulmonary AVMs with glue rather than coils, and then there is the cement in the vertebral bodies to account for.  
C: The branching nature of the opacities should indicate that they are in tubular structures and are not calcified granulomas.  
D: Lymphangiography is very rarely performed nowadays. Lymphangiographic contrast material, Ethiodol, will embolize to the pulmonary arteries, but it will be distributed more peripherally and diffusely than cement and can best be appreciated at the base of the lungs.
184. You are shown a single image (Figure 13) from an abdominal angiogram. What is the MOST LIKELY diagnosis?

A. Aortocaval fistula  
B. Duplicated inferior vena cava  
C. Dialysis access fistula  
D. Duplicated abdominal aorta

Rationale:
A. Aortocaval fistulas are rare. Most develop as a consequence of an aortic aneurysm eroding into an adjacent venous structure, the vena cava, an iliac or a renal vein.

B. There are two opacified approximately parallel structures, in the abdomen. The one on the patient's right should be recognized as the inferior vena cava. The one on the left containing the catheter is in the normal position for the aorta, has the shape of a fusiform aneurysm, and the direction of flow is peripheral, not towards the heart.

C. This would be a very unusual location.

D. Duplicated aortic arches and duplicated vena cavae do exist, but not to my knowledge duplicated abdominal aortas.
185. Which of the following will result in the lowest skin dose to the patient during fluoroscopic procedures in terms of imaging geometry when the system is used with automatic brightness control? (A cross-section from top to bottom of an image intensifier, patient, tabletop, and x-ray tube is illustrated for each choice.)

A. A
B. B
C. C
D. D

**Rationale:**
A. This geometry is poor because the source to object (patient) distance (SOD) is closer than C or D; also the source to image distance (SID) is larger than necessary (II is not as close to the patient as possible), resulting in magnification and a greater SID, resulting in greater exposure to the patient.
B. This geometry is poor because of the relatively short SID and SOD, although the geometry of the II is OK (close to the patient). This is the “second-best” geometry.
C. The problem with this geometry, although the SOD is relatively large, is that the SID is also very large, causing a large decrease in x-ray photons getting to the detector, with a commensurate increase in the dose to the patient.
D. This is the best geometry for reducing dose to the patient, as the SOD is large and the SID is at a minimal distance from the source. Inverse square law provides the best dose sparing in this situation.
186. The amount of scatter emerging from the patient during a fluoroscopy exam will be greatest at which direction indicated in the figure below? (Note: x-rays are emerging from under table tube.)

A. 1  
B. 2  
C. 3  
D. 4

**Rationale:**
A. X-ray scatter is roughly isotropically distributed (similar magnitude in all directions from a point scattering source). Therefore, because the largest x-ray fluence is at the entrance to the patient, those scattering points closest to the entrance of the x-ray beam will produce the greatest amount of scatter. For those x-rays scattered toward the direction indicated by 1, the intervening body will attenuate a larger fraction of the scattered x-rays. 

B. See rationale for distracter A. Towards direction 2, the x-ray scatter will also be less because of more intervening body tissue between the scatter direction exit and the majority of the scattering sites. 

C. See rationale for distracter A. At 90 degrees, there will be a slightly less probability of scatter, but the major reason why scatter isn’t as great in this direction is the intervening body tissues. 

D. This is the correct answer because in the diagnostic energy range, the propensity for an x-ray to be backscattered is similar to forward scatter (or essentially at any direction, within small variations). Since there is much less tissue between the scattering sites that receive the greatest x-ray fluence, a much greater amount of scattered radiation will be present at 135 degrees (if 0 degrees is forward-directed scatter). Thus, over-table x-ray fluoroscopy units will have much greater scatter towards the eye of the fluoroscopist, and laterally positioned fluoroscopy beams will have much greater scatter towards the user on the entrance side of the patient.
187. Regarding uterine artery embolization for the treatment of adenomyosis of the uterus, which of the following statements is TRUE?

A. The procedure differs from that for uterine fibroids.
B. The dose to the ovaries is about 5 to 10 mGy.
C. Clinical success depends on the presence of fibroids.
D. It is an effective treatment for symptomatic relief.

Rationale:
A: The procedure, bilateral uterine artery embolization with particles, does not differ from that for symptomatic uterine fibroids.
B: The dose to the ovary is in the range of 100 to 200 mGy
C: Effectiveness of the procedure does not rely on the presence or absence of fibroids.
D: Reported clinical success rates for uterine artery embolization for the treatment of adenomyosis range from 73% to 92%. Symptoms do tend to recur in up to 44% of patients, two years following the procedure.

188. The only primary vasculitis associated with stenosis of the aorta is:

A. Behçet’s disease.
B. polyarteritis nodosa.
C. Buerger’s disease.
D. Takayasu’s disease.

Rationale:
A. Venous diseases (occlusion and varix formation) are more common than arterial system involvement in Behçet’s Disease. Arterial complications are found in 7% of cases, with aneurysm formation and occlusive disease being most common. Aneurysm of the thoracic and abdominal aorta is rarely seen.
B. Polyarteritis nodosa is a small and medium-sized vessel arteritis. Arteries most commonly affected are the renal and visceral arteries. Microaneurysm formation in these arterial distributions represents the arterial hallmark of this disease. Vascular pruning and narrowing are less common features.
C. Patients with thromboangiitis obliterans, Buerger’s disease, have segmental thrombotic occlusions of small- and medium-sized arteries in lower and upper extremities. Aortic involvement is not a manifestation of this disorder.
D. Also named nonspecific aortoarteritis, Takayasu’s arteritis is a large-vessel vasculitis. The thoracic or/and abdominal aorta can be affected as well as their branches, especially the subclavian arteries. Granulomatous inflammatory infiltration of the media leads to vessel wall thickening, with eventual stenoses and occlusions.
189. Therapeutic transcatheter occlusion of which of the following arteries is MOST LIKELY to cause postprocedural morbidity?

A. Right hepatic artery  
B. Inferior epigastric artery  
C. **Superficial femoral artery**  
D. Gastroduodenal artery

**Rationale:**
A. Venous diseases (occlusion and varix formation) are more common than arterial system involvement in Behçet’s Disease. Arterial complications are found in 7% of cases, with aneurysm formation and occlusive disease being most common. Aneurysm of the thoracic and abdominal aorta is rarely seen.
B. Polyarteritis nodosa is a small and medium-sized vessel arteritis. Arteries most commonly affected are the renal and visceral arteries. Microaneurysm formation in these arterial distributions represents the arterial hallmark of this disease. Vascular pruning and narrowing are less common features.
C. Patients with thromboangiitis obliterans, Buerger’s disease, have segmental thrombotic occlusions of small- and medium-sized arteries in lower and upper extremities. Aortic involvement is not a manifestation of this disorder.
D. Also named nonspecific aortoarteritis, Takayasu’s arteritis is a large-vessel vasculitis. The thoracic or/and abdominal aorta can be affected as well as their branches, especially the subclavian arteries. Granulomatous inflammatory infiltration of the media leads to vessel wall thickening, with eventual stenoses and occlusions.

190. Which of the following statements is TRUE regarding transvascular liver biopsy?

A. The left jugular vein is the preferred access site.  
B. Transvascular liver biopsy is contraindicated in the setting of ascites.  
C. **There is a lower incidence of post-biopsy hemorrhage than in percutaneous biopsy.**  
D. It facilitates obtaining tissue samples from small hepatic foci near the vena cava.

A: Access via the right internal jugular vein, in contrast to the left internal jugular vein or more rarely the external jugular veins, offers the straightest line through the superior vena cava and right atrium to the ostia of the hepatic veins in the intrahepatic inferior vena cava.
B: The fact is, that owing to the increased risk of hemorrhage with percutaneous liver biopsy in the setting of ascites, the presence of ascites is an indication for this technique.
C: Due to the increased risk of hemorrhage with percutaneous liver biopsy, transvascular biopsy is often performed in coagulopathic patients. By avoiding needle puncture of the liver capsule, the risk of catastrophic intraperitoneal bleeding is decreased. In addition, intraparenchymal bleeding may communicate with the hepatic veins, in essence "bleeding into the vessel" and thus of no consequence.
D: There is no directionality to the needle. The technique is used for diffuse liver disease in patients at risk for hemorrhage.
191. You are consulted about possibly placing an IVC filter in a patient with DVT who, although fully anticoagulated, has recurrent pulmonary embolism. Which of the following responses is CORRECT?

A. **This is an absolute indication for a filter.**
B. This is a relative indication for a filter.
C. This is a relative contraindication for a filter.
D. This is an absolute contraindication for a filter.

**Rationale:**
A: There are 360,000 patients in the United States that suffer symptomatic pulmonary emboli and 240,000 deaths from this disease each year. The mortality if untreated or inadequately treated may be in the 60 to 70% range. Following filter placement there is a 2 to 5% rate of recurrent PE, and less than 1% of patients will die from this disease. Absolute indications for filters include proven venous embolic disease where anticoagulation fails to prevent recurrent PE, or when anticoagulation results in hemorrhage, or if anticoagulation is contraindicated.
B: See rationale with the correct answer.
C: See rationale with the correct answer.
D: See rationale with the correct answer.

192. What is the advantage of a surgically created endogenous arteriovenous fistula for patients requiring permanent hemodialysis?

A. **Superior longevity**
B. Rapidity with which it can be used after insertion
C. Patient comfort
D. Ease of insertion

**Rationale:**
A: Arteriovenous fistulas have superior longevity compared to synthetic grafts. 85% versus 50% at two years. Longevity is the key. Excluding a successful transplant, these patients will require dialysis for the rest of their lives. And access sites are limited. Infection and central vein thrombosis preclude a policy of long-term maintenance dialysis through tunneled central vein catheters.
B: Following the creation of a fistula it usually requires three or four months, if it happens at all, for the egress vein to enlarge sufficiently for efficient dialysis. This compares to a perhaps two week period after a synthetic graft is bridged between the brachial artery and vein. A straight or tunneled dialysis catheter can be used immediately.
C: Unlike the fistula, a patient doesn't have to get stuck three days a week with a temporary central vein catheter.
D: A temporary dialysis catheter can be quickly placed, and at the bedside if necessary.
193. A patient is to be sent home with nephrostomy tubes in place. At what interval should the patient return to have the drains exchanged for new tubes?
   
   A. Every week  
   B. Every 3 or 4 weeks  
   C. Every 2 to 3 months  
   D. Not unless there is a problem

Rationale:
A: Incorrect.  
B: Incorrect.  
C: Nephrostomy tubes do not last forever. Despite diligent irrigation the tubes become encrusted with particulate matter which over time will both obstruct the tubes and prevent their ready exchange. The patient should be instructed to return every two to three months and have new tubes exchanged for the old ones. If the patient begins to leak urine onto their skin, they should come in immediately for a tube check.  
D: Incorrect.

194. It is the standard of the Society of Interventional Radiology that percutaneous radiofrequency ablation of hepatic tumors is:
   
   A. preferable to liver transplantation for patients who have HCC and are eligible for surgery.  
   B. preferable to resection for patients who have colorectal metastases and are eligible for surgery.  
   C. to be reserved for selected patients with colorectal metastases, but not for patients with HCC.  
   D. a safe and effective treatment for selected patients with HCC and colorectal metastases.

Rationale:
A: Incorrect.  
B: Incorrect.  
C: Incorrect.  
D: "It is the position of the Society of Interventional Radiology that percutaneous RF ablation of hepatic tumors is a safe and effective treatment for selected patients with HCC and colorectal carcinoma metastases." Patients eligible for cure should undergo surgical resection of colorectal metastases or orthotopic liver transplantation for HCC.
195. A carotid duplex ultrasound is reported as showing 50% to 69% stenosis of the left internal carotid artery. What parameter is reduced by 50% to 69%?

A. Intra-arterial blood pressure  
**B. Diameter of the artery**  
C. Cross-sectional area of the artery  
D. Flow velocity

**Rationale:**
A: Incorrect.
B: When angiography was used as the reference standard for setting Doppler criteria for internal carotid artery stenoses, the degree of stenosis was determined by comparing the narrowest diameter of the residual lumen to an estimate of the diameter of the original lumen in the same location.
C: Incorrect.
D: Incorrect.

196. A peritoneovenous shunt is used to treat:

A. congestive heart failure.  
B. chronic renal failure.  
**C. refractory ascites.**  
D. hydrocephalus.

**Rationale:**
A: Incorrect.
B: Incorrect.
C: A peritoneovenous shunt is designed to provide continuous drainage of ascites into the systemic circulation as a treatment for refractory ascites. It can be placed surgically or percutaneously.
D: Incorrect.