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Chapter 1 : Angiography - Wikipedia

Diagnostic Angiography (or Arteriography) at UCLA. In This Section. What is a Diagnostic Angiography? When is this procedure used and how does it work? What are some other uses of this procedure? Diagnostic Angiography CSC rate reporting ; What is a Diagnostic Angiography? An arteriogram or angiogram is a study of the blood vessels.

URL of this page: It is also called peripheral angiography. Angiography uses x-rays and a special dye to see inside the arteries. Arteries are blood vessels that carry blood away from the heart. How the Test is Performed This test is done in a hospital. You will lie on an x-ray table. You may ask for some medicine to make you sleep and relax sedative. The health care provider will shave and clean an area, most often in the groin. A numbing medicine anesthetic is injected into the skin over an artery. A needle is placed into that artery. A thin plastic tube called a catheter is passed through the needle into the artery. The doctor moves it into the area of the body being studied. The doctor can see live images of the area on a TV-like monitor, and uses them as a guide. Dye flows through the catheter and into the arteries. X-ray images are taken of the arteries. Certain treatments can be done during this procedure. Dissolving a blood clot with medicine Opening a partially blocked artery with a balloon Placing a small tube called a stent into an artery to help hold it open The health care team will check your pulse heart rate , blood pressure, and breathing during the procedure. The catheter is removed when the test is done. Pressure is placed on the area for 10 to 15 minutes to stop any bleeding. A bandage is then put on the wound. The arm or leg where the needle was placed should be kept straight for 6 hours after the procedure. You should avoid strenuous activity, such as heavy lifting, for 24 to 48 hours. How to Prepare for the Test You should not eat or drink anything for 6 to 8 hours before the test. You may be told to stop taking certain medicines, such as aspirin or other blood thinners for a short while before the test. Never stop taking any medicines unless told to do so by your provider. Make sure your provider knows about all the medicines you take, including those you bought without a prescription. This includes herbs and supplements. Tell your provider if you: Are pregnant Are allergic to any medicines Have ever had an allergic reaction to x-ray contrast material, shellfish, or iodine substances Have ever had any bleeding problems How the Test will Feel The x-ray table is hard and cold. You may want to ask for a blanket or pillow. You may feel some stinging when the numbing medicine is injected. You may also feel some pressure as the catheter is moved. The dye can cause a feeling of warmth and flushing. This is normal and most often goes away in a few seconds. You may have tenderness and bruising at the site of the catheter insertion after the test. Seek immediate medical help if you have: The test may also be done to diagnose: Bleeding Swelling or inflammation of the blood vessels vasculitis Normal Results The x-ray shows normal structures for your age. What Abnormal Results Mean An abnormal result is commonly due to narrowing and hardening of the arteries in the arms or legs from plaque buildup hardening of the arteries in the artery walls. The x-ray may show a blockage in the vessels caused by: Aneurysms abnormal widening or ballooning of part of an artery Other diseases of the arteries Abnormal results may also be due to: Inflammation of the blood vessels Injury to the blood vessels.

Chapter 2 : Cerebral Angiography (Brain Angiogram)

(A) Angiogram of the left carotid artery in the neck shows the internal and external carotid arteries - subtracted view. (B) Unsubtracted view. A C B D (C) Angiogram of the left carotid artery supply to the brain with the internal carotid artery, the anterior and middle cerebral arteries - subtracted view. (D) Unsubstracted view.

To put this in perspective, it is important to remind ourselves that angiography of an arterial tree is only warranted when the clinical presentation and noninvasive imaging have predicted a high likelihood of the presence of a flow-limiting lesion and the invasive study is used as a means of planning the treatment. Other indications for angiography include vasculitis and aneurysms. However, in a proper patient setting, when there are inconsistencies among various noninvasive modalities, angiography can be justified as the gold standard to determine lesion severity. Contrast Agents Contrast agents can be divided into 3 categories: There are two major classes of tri-iodinated contrast agents: Adverse reactions to iodinated contrast agents are unfortunately common, but the majority are minor. Most of the minor complications are linked to the osmolality of the contrast agent, so that the overall incidence is lower with nonionic contrast agents. The two major adverse reactions to iodinated contrast agents are anaphylaxis and renal failure. True anaphylaxis is distinguished from a vasovagal response by tachycardia and respiratory distress. The incidence of life-threatening anaphylaxis due to iodinated contrast is approximately 1 per 40, to ,, with mild reactions such as urticaria and nasal stiffness occurring more commonly especially with ionic contrast. Renal failure following administration of iodinated contrast agents is a clinical entity as part of a broad spectrum of clinical presentation of contrast-induced nephropathy CIN , which is defined as rise of serum creatine by 0. The rise usually starts within 24â€”36 hours following exposure to contras, peaking at 72â€”96 hours. Patients are usually oliguric, but may become anuric. Management is usually expectant, as the creatinine should return to baseline in 7â€”14 days. Iodinated contrast is administered during the angiographic procedures by a hand or power injection. A typical strategy is to use mechanical injection for aortography and hand injection for selection angiography. The low but real incidence of adverse reactions to iodinated contrast agents has led to the use of alternative contrast agents in selected circumstances, particularly in patients with past histories of the true anaphylactic reactions to iodinated contrast, or unstable renal function. Two alternative contrast agents have been described for patients who cannot tolerate iodinated contrast agents: Experience is most extensive with CO2, which functions as a negative contrast agent. The gas briefly displaces the blood volume in the lumen of the vessel, resulting in decreased attenuation of the X-ray beam. The digital subtraction technique is therefore essential for diagnostic imaging. The buoyant nature of CO2 results in preferential filling of anterior structures. The CO2 gas is highly soluble, excreted from the lungs. CO2 can be used for abdominal aortography, selective visceral injections, and lower-extremity runoffs. Mechanical injectors for CO2 are not available in the United States. Therefore, all injections must be performed by hand. CO2 is contraindicated for angiography of the thoracic aorta, cerebral arteries, or upper-extremity arteries due to potential neurological complications. Gadolinium chelates were developed as contrast agents for magnetic resonance imaging MRI. The safety profile of these contrast agents is superior to that of iodinated contrast, and there appears to be lower nephrotoxicity. Digital subtraction angiography is necessary, as the low gadolinium concentration in the available formulations results in relatively weak opacification of deep arteries. The main limitations of this agent are the expense, the small total volume that can be used, and the relatively low radiopacity. Gadodiamide-based arteriography has been used during renal artery interventions in patients with baseline renal insufficiency. This technique may enhance the renal-protective effect of renal artery stenting in this high-risk population with renal artery stenosis. Cineangiography simply takes multiple X-ray pictures of the contrast-filled vessel, as well as the surrounding tissue. For static vascular structures that are surrounded by radiodense structures, the frame per second fps needs to be adjusted, and the usual 15â€”30 fps used for coronary intervention, is not appropriate. The advantage of cineangiography is lower amounts of radiation and the ability to track the entire vessel. For imaging certain vascular beds, such as the aortic arch and lower extremity, the image intensifier must be large enough to accommodate the area of interest. For DSA, the initial

images obtained when stepping on the X-ray pedal are used to generate the baseline image from which all radio-opaque structures are subtracted. Subsequent images obtained following contrast injection will be the subtracted images and will, therefore, demonstrate only the contrast-filled vascular structures. The DSA imaging modality requires that the patient not move during image acquisition. In vascular territories where the vessels may move during respiration or swallowing e. A limitation of this technique is that it does not allow panning of the field of view. In comparing the two imaging modalities, it is important to consider that in general DSA mode requires more radiation per frame, but it may lead to lower total body radiation because it requires a lower number of frames. Carotid and Vertebral Arteries Anatomic considerations. The right common carotid artery CCA in most cases arises from the bifurcation of the innominate artery. In contrast, the origin of the left CCA is variable. At the level of the upper border of the thyroid cartilage, each CCA bifurcates into an external and internal branch. During diagnostic angiography, the angle of mandible serves as a useful landmark for the carotid bifurcation, although significant variation in the level of carotid bifurcation is common. The external carotid artery ECA is easily recognized, owing to its numerous branches to the face, scalp, and thyroid. A basic understanding of the anatomy of the ECA is important because this vessel and its branches are often wired during carotid intervention. Anterior branches arise in the following order: The occipital branch arises posteriorly at the level of facial artery. The ECA terminates by giving off the internal maxillary branch that is directed anteriorly, and the superficial temporal branch that runs along the path of ECA toward the temporal-scalp region. These relationships may be appreciated in the lateral projections Figure 2. By convention, the ICA is divided into four sections Figure 3: The pre-petrous or cervical segment. This defines the segment of vessel between the CCA bifurcation and the petrous bone, and contains no arterial branches. Most carotid intervention involves treatment of atherosclerosis of the ostium and proximal portion of this segment of ICA. This refers to the L-shaped section of vessel i. This courses through the cavernous sinus. This gives off the important ophthalmic, posterior communicating, and anterior choroidal branches, and terminates in the middle and anterior cerebral arteries. The ophthalmic artery supplies the ipsilateral retina and optic nerve and is an important route for collateral flow between the ECA and ICA via the supraorbital branch, in addition to the maxillary branches and other branches of the facial artery. Likewise, the posterior communicating branch links the ICA with the posterior cerebral artery, establishing an important collateral flow between the anterior and posterior cerebral circulation. Catheter angiography of the extra cranial carotid and vertebral arteries should begin with a flush aortic injection through a 5 Fr pigtail catheter positioned so that the side holes are in the transverse portion of the aortic arch and the end of the catheter proximal to the take-off the innominate artery in the ascending aorta above the aortic valve. Next, DSA is performed with a 9-inch or large image intensifier at 4 fps in a 30â€”60 degrees LAO left anterior oblique projection Figure 4. This obliquity usually 45 degrees opens up the arch to show the origins of the innominate, left common carotid, and left subclavian vessels. The injection rate, using a power injection, is from 20â€”30cc per second for 2 or 3 seconds. If there is a question about the right common carotid or subclavian artery origin, a second injection in the right anterior oblique RAO projection should be obtained. Lower rates of contrast injections 15â€”20 cc over 1â€”2 sec may be used in children and young adults. Next, selective common carotid angiography is performed. For right common carotid artery RCCA , the innominate artery is first selectively engaged with a 5 Fr diagnostic catheter [catheter shape should be based on aortic arch type and angle of vessel take off JB1 , Judkins right JR4 , Headhunter HA-1 , or Bernstein catheter for simple arches and Vitek or Simmons catheter for complex arches Figure 5. A hydrophilic wire 0. For selective left common carotid artery LCCA angiography, similar principles of diagnostic catheter choices apply. Once optimal position of the catheter is achieved in RCCA or LCCA, cine angiography or DSA of the common carotid, internal and external carotids in the oblique and lateral views are obtained using hand injections of 7â€”9cc contrast Figures 6a and b. It is important to visualize the intracranial distributions of the cerebral arteries, including the Circle of Willis, in both the AP and lateral views Figure 7. This is done to evaluate for additional atherosclerotic disease carotid siphon 2nd most common site , evaluate collateral flow, and obtain baseline imaging for comparisons. It can also be used to screen for other pathologies such as: Two criteria are used to quantify carotid stenosis: While according to the ECST criteria, the estimated position of the external wall of

the carotid sinus determines the normal reference diameter. Thus, overestimating the lesion stenosis. The Artery of Adamkiewicz Although a detailed description of the spinal cord arterial supply is beyond the scope of this review, knowledge of the anatomy of the artery of Adamkiewicz is critical for physicians involved in surgical or endovascular treatment of thoracoabdominal aneurysms. This artery often originates from the left posterior intercostal artery at the level of T9-T12 Figure 9A , but it may also originate from higher levels and on the right side. Although this artery has been originally characterized by selective angiography, currently MRA and CTA are safer methods of identifying this artery Figure 9B. Abdominal Aorta and Iliac Arteries Anatomy. The abdominal aorta begins at the level of the diaphragmatic crura and terminates in a bifurcation into the common iliac arteries. This bifurcation is usually in the region of the L4â€"L5 disk interspace. The aorta is constant in location and presence, although there is extensive variability of the anatomy of the branch vessels. The average diameter of the abdominal aorta is 1. The anterior branches of the abdominal aorta are the celiac, superior mesenteric SMA , gonadal, phrenic, and inferior mesenteric arteries IMA , see Table 4. The lateral branches are the renal and middle adrenal arteries. The posterior branches are the lumbar arteries one pair for each lumbar vertebral and the middle sacral artery arising at the aortic bifurcation. The anatomy of the testicular and ovarian arteries is similar in the abdomen, but divergent in the pelvis. The gonadal arteries pass to the pelvis along the anterior surface of the psoas muscles, adjacent to the gonadal veins and ureters, and anterior to the iliac vessels. In the pelvis, the testicular arteries have a lateral course, entering the spermatic cord to continue into the scrotum. These arteries are the sole blood supply to the testes. The ovarian arteries have a more medial path, through the suspensory ligament of the ovary. The ovarian arteries provide branches to the ovary and fallopian tubes. The artery then continues medially to the uterus, where it anastamoses with the uterine artery in the broad ligament. The lumbar arteries are paired vessels that arise from the posterior wall of the abdominal aorta at the levels of the lumbar vertebrae.

Chapter 3 : Catheter Angiography Examination of the Body's Veins and Arteries

Diagnostic and interventional angiography is a procedure in which blood vessels (arteries or veins) are injected with a dye that shows up on X-Ray to detect narrowing or blockages.

Cerebral angiography is a procedure that doctors use to image blood vessels in the brain. This allows your physician to diagnose narrowing or blockages of blood vessels, abnormally dilated blood vessles, atherosclerotic disease hardening of blood vessels inside the head or in the neck, intracranial aneurysms and other abnormalities of the blood vessels. With this information your physicians can recommend a course of treatment you need and how it should be performed. The angiogram is a minimally invasive procedure. A catheter long thin flexible plastic tube is placed into a large artery in your leg and is guided through the blood vessels of the body to reach the neck and head. An x-ray dye is injected to highlight the vessels simultaneously when pictures are taken from several angles. The procedure is done in the angiography suite with a special team of physicians, physician assistants, nurses and technologists. The test generally lasts hours. Unlike computed tomography CT or magnetic resonance MR angiography, the use of a catheter makes it possible to combine diagnosis and treatment into one procedure. Additionally, the degree of detail displayed by catheter angiography cannot be obtained with any other noninvasive procedure. Although a cerebral angiogram is a valuable diagnostic tool with a low risk of complication, feelings of anxiety before and during the procedure are normal. Risks Associated with Cerebral Angiogram The chance of any complication with a cerebral angiogram is small. However, it is important to be aware of the possible risks, which include an allergic reaction, stroke, and hemorrhage. Of course your physician will be carefully monitoring for any complications and is fully trained to respond if one arises. Some patients can have an unusual allergic reaction to the contrast. Reactions range from mild skin irritation, itching, a drop in blood pressure, difficulty breathing, loss of consciousness or death. You should tell your doctor of a previous allergy history prior to iodine. There is a very tiny risk that blood will form a clot around the tip of the catheter, blocking the artery and causing a stroke. The chance of developing a permanent stroke weakness, numbness or paralysis as the result of a cerebral angiogram is approximately 0. If you have diabetes or kidney disease, the kidneys could be injured when contrast material is eliminated through the urine. Very rarely, the catheter can injure the vessel wall. Very rarely, the blood vessel the catheter was inserted into becomes blocked and prevents blood from going to your lower leg and foot. This requires an emergency operation to reopen the blocked blood vessel. Delayed bleeding at the site of catheter insertion is very uncommon but it is the major reason that you are observed for four to six hours after your test is completed. With interventional radiology procedures using x-rays, the level of risk depends on the type of procedure because some use very little radiation, while complex procedures use more. This document will help to prepare you for a cerebral angiogram. You will check in at the front entrance Pueblo and Bath of the hospital. Prior to the procedure you will need to give your informed consent. This means you will speak with the physician or one of our Nurse Practitioners and acknowledge the potential risks of cerebral angiography in order to investigate your symptoms and plan appropriate treatment. This is also your opportunity to have any questions answered about the procedure. Preparing for the Procedure Do not eat or drink anything after midnight the day before your procedure Patients who take medications routinely should check with their physician. If routine medication is allowed the day of the test, it should only be taken with a small sip of water. If you take a medicine called Glucophage metformin you should NOT take it 2 days prior to the angiogram. You will not take this medication for 48 hours after the angiogram. Please tell your doctor if you are taking any oral diabetes medicines. It is recommended that you leave all valuables at home. A small amount of blood will be drawn to make sure your kidneys are working and your blood is clotting normally. If you are a female of childbearing age, a pregnancy test will be done to make sure you are not pregnant as x-rays and x-ray dye could be harmful. It is important to inform the angiogram technician if you have any of the following conditions: If you are pregnant or breast-feeding, please let us know when we call to schedule the angiogram. We generally like to hold off on doing the angiogram until after the baby is delivered. As most people go home the same day, you should arrange to have someone drive you home after the test. You can

NOT drive for 24 hours after the test. Plan to have someone stay with you that night, just in case any problems occur and you need care right away. Prior to the angiogram Patients are asked to change into a hospital gown and remove any jewelry around their head and neck that would interfere with the x-ray beam. An electrocardiogram EKG or chest x-ray is also performed. If the patient is a female of childbearing age, a pregnancy test is done to make sure they are not pregnant as x-rays and x-ray dye could be harmful. In the nursing unit, a mild sedative and fluids are administered through an IV. When it is time for the angiogram, the patient is taken to the angiography suite and positioned on an x-ray table. Then the patient is given medicine to help them relax. Once they are ready, the groin area just above the leg near the hip bone and inner thigh is shaved and then cleansed with a liquid that may feel very cold. This may sting briefly but usually makes the rest of the procedure pain free. During the Angiogram During the test, the patient needs to lie very still in order to get the best results. The neuroradiologist directs the catheter long flexible plastic tube through the arterial system to the desired location and then injects the contrast x-ray dye several times. During the procedure the patient will not feel the catheter in the artery but when the contrast material is injected, they may have a sense of warmth on the side of their neck and face, lasting seconds. This is a normal sensation. X-rays are taken when the contrast is injected. The clicking noise coming from the x-ray machines is normal. The patient may also notice the lights in the room turning on and off and the doctors and staff stepping out of the room temporarily while the x-rays are being taken. After the Angiogram After the angiogram is completed, the catheter is removed and the puncture site closed. The incision site can be closed by applying pressure for minutes to stop bleeding, or by using a special closure device. When the bleeding stops, a thick dressing is placed on the incision. At this point the doctor will discuss the results of the test with the patient and finally proceed to the waiting room to discuss the results with the family and answer any questions they might have. The patient is then moved to an observation area where they will stay for the next hours for their recovery, depending on the reason for the test, the catheter size, and the type of device used to close up the artery. During this time, the patient is asked to lie flat and drink plenty of fluids in order to flush the dye from their system. The patient should inform the nurse if they notice any bleeding, bruising, swelling or pain at the site where the catheter entered the skin. When the patient is feeling okay, and is able to get up and walk, then they will be able to go home. At this point the nurse will go through the discharge instructions with the patient and their family and make sure that a responsible adult will be driving the patient home. The Discharge Instructions should include: No heavy lifting, exercise, and driving for 48 hours. Do not operate machinery for at least 24 hours. It is important not to stress the incision site. During the next 24 hours continue to drink plenty of fluids to flush the contrast dye from the kidneys. Avoid beverages that dehydrate the body, such as alcohol or coffee. Resume a regular diet. Activities for the Next Week You will be allowed to shower the day after the angiogram, but do not soak in a bath tub or hot tub. You should not do any heavy lifting over 10 pounds. You may remove the bandage over the groin the next day and gently wash the area with a mild soap and water. Do not rub this area to dry the skin. If bleeding occurs at the puncture site, apply direct pressure and go to the nearest emergency room. What to Expect The puncture site might be tender or sore. This often goes away after a few days, but it can last up to one week. You may notice some bruising in your groin. This goes away after weeks. Some patients feel a small hard bump about the size of a peanut at the groin site. This is normal and generally goes away after several months. If swelling occurs at the site, or loss of feeling. If you experience sudden confusion. If you have severe pain or spasm in the leg. Urination is difficult A change or loss of vision occurs Swallowing or talking is difficult If numbness or tingling occurs in the extremities arms, legs or face. If an allergic reaction develops, including itching, hives, rash, rapid heart beats, dizziness, chest pain, or shortness of breath.

Chapter 4 : Diagnostic Cerebral Angiography

Although a cerebral angiogram is a valuable diagnostic tool with a low risk of complication, feelings of anxiety before and during the procedure are normal. Risks Associated with Cerebral Angiogram The chance of any complication with a cerebral angiogram is small.

Description An angiogram is commonly performed under sedation with the use of local anesthesia. The procedure usually starts with a needle put into the femoral groin artery. From one treatment site, areas all over the body can be treated. After access is established, catheters thin tubes and wires are threaded through the arterial system to a specific area of interest or throughout the entire body. As a contrast agent iodine dye is injected, X-ray images are taken to let your vascular surgeon view the flow of the dye and identify blockages. The surgeon can then choose the best mode of therapy for you - whether during or following the angiogram. This decision depends on your symptoms and the severity and characteristics of the blockages. Two common therapies that can be provided during the angiogram are balloon angioplasty and stent placement. Angioplasty can be used to open arterial blockages. Guided by X-ray, your vascular surgeon navigates through the blockage with a wire and introduces a special device equipped with an inflatable balloon. After positioning the balloon device across the blocked portion of the artery, the vascular surgeon inflates the balloon to expand the artery and compress the blockage. The balloon is then deflated and removed while keeping the wire in place across the area that has been treated. Next, contrast dye is injected to assess the result. If the vessel is still considerably narrowed, placing a stent may be the next step. Stents are used to prop open an artery at the site of a narrowing. Stents are generally placed after balloon angioplasty when there is residual narrowing or insufficient blood flow in a treated vessel. Stents are considered a permanent implant and cannot be used if you have a metal allergy. Stents that are used in the leg are constructed of a nickel-titanium alloy Nitinol , a memory-shaped metal. This alloy has a predetermined size and shape at body temperature and expands to this size and shape after being introduced through a catheter. These stents resist kinking and are flexible so that damage from activities that involve your legs is minimized. All invasive procedures can have complications. The most common complications are related to the arterial access site. Allergic reaction to the iodine contrast dye, which can lead to the development of kidney failure. This can worsen blood flow. Your vascular surgeon will specify how to prepare. You will likely need to stop eating and drinking hours before the procedure. Occasionally, certain medications may need to be stopped. After the procedure, expect hours of bed rest to avoid bleeding at the artery access site. Because sedation is often utilized, you will likely not be able to drive yourself home. Be sure to arrange for transportation after the procedure. Once home, you should avoid heavy lifting, stooping or bending for 2 days to reduce the risk of bleeding at the arterial puncture site. Most other activities can be resumed.

Chapter 5 : Diagnostic Cerebral Angiograms | The Stroke and Neurovascular Center of Central California

Coronary angiography is often done along with cardiac catheterization. This is a procedure which measures pressures in the heart chambers. This is a procedure which measures pressures in the heart chambers.

You should inform your physician of any medications being taken and if there are any allergies, especially to iodinated contrast materials. Also inform your doctor about recent illnesses or other medical conditions. You will be asked to remove some of your clothes and to wear a gown during the exam. You may also be asked to remove jewelry, removable dental appliances, eye-glasses and any metal objects or clothing that might interfere with the x-ray images. Women should always inform their physician and x-ray technologist if there is any possibility that they are pregnant. Many imaging tests are not performed during pregnancy so as not to expose the fetus to radiation. If an x-ray is necessary, precautions will be taken to minimize radiation exposure to the baby. See the Safety page for more information about pregnancy and x-rays. If you are breastfeeding at the time of the exam, you should ask your doctor how to proceed. It may help to pump breast milk ahead of time and keep it on hand for use after contrast material has cleared from your body, about 24 hours after the test. If you are going to be given a sedative during the procedure, you may be asked not to eat or drink anything for four to eight hours before your exam. Be sure that you have clear instructions from your health care facility. If you are sedated, you should not drive for 24 hours after your exam and you should arrange for someone to drive you home. Because an observation period is necessary following the exam, you may be admitted to the hospital for an overnight stay if you live more than an hour away. The equipment typically used for this examination consists of a radiographic table, one or two x-ray tubes and a television-like monitor that is located in the examining room. Fluoroscopy, which converts x-rays into video images, is used to watch and guide progress of the procedure. The video is produced by the x-ray machine and a detector that is suspended over a table on which the patient lies. The catheter used in angiography is a long plastic tube about as thick as a strand of spaghetti. How does the procedure work? Catheter angiography works much the same as a regular x-ray exam. X-rays are a form of radiation like light or radio waves. X-rays pass through most objects, including the body. Once it is carefully aimed at the part of the body being examined, an x-ray machine produces a small burst of radiation that passes through the body, recording an image on photographic film or a special detector. Different parts of the body absorb the x-rays in varying degrees. Dense bone absorbs much of the radiation while soft tissue, such as muscle, fat and organs, allow more of the x-rays to pass through them. As a result, bones appear white on the x-ray, soft tissue shows up in shades of gray and air appears black. When a contrast material is introduced to the bloodstream during the procedure, it clearly defines the blood vessels being examined by making them appear bright white. How is the procedure performed? This examination is usually done on an outpatient basis. A nurse or technologist will insert an intravenous IV line into a small vein in your hand or arm. A small amount of blood will be drawn before starting the procedure to make sure that your kidneys are working and that your blood will clot normally. A small dose of sedative may be given through the IV line to lessen your anxiety during the procedure. The area of the groin or arm where the catheter will be inserted is shaved, cleaned, and numbed with local anesthetic. The radiologist will make a small incision usually a few millimeters in the skin where the catheter can be inserted into an artery. The catheter is then guided through the arteries to the area to be examined. After the contrast material is injected through the catheter and reaches the blood vessels being studied, several sets of x-rays are taken. Then the catheter is removed and the incision site is closed by applying pressure on the area for approximately 10 to 20 minutes or by using a special closure device. When the examination is complete, you may be asked to wait until the radiologist determines that all the necessary images have been obtained. Your intravenous line will be removed. A catheter angiogram may be performed in less than an hour; however, it may last several hours. What will I experience during and after the procedure? Prior to beginning the procedure, you will be asked to empty your bladder. You will feel a slight pin prick when the needle is inserted into your vein for the intravenous line IV. Injecting a local anesthetic at the site where the catheter is inserted may sting briefly, but it will make the rest of the procedure pain-free. You will not feel the catheter in

your artery, but when the contrast material is injected, you may have a feeling of warmth or a slight burning sensation. The most difficult part of the procedure may be lying flat for several hours. During this time, you should inform the nurse if you notice any bleeding, swelling or pain at the site where the catheter entered the skin. You may resume your normal diet immediately after the exam. You will be able to resume all other normal activities 8 to 12 hours after the exam. A radiologist , a physician specifically trained to supervise and interpret radiology examinations, will analyze the images and send a signed report to your primary care or referring physician , who will discuss the results with you. What are the benefits vs. Benefits Angiography may eliminate the need for surgery. If surgery remains necessary, it can be performed more accurately. Catheter angiography presents a very detailed, clear and accurate picture of the blood vessels. This is especially helpful when a surgical procedure or some percutaneous intervention is being considered. By selecting the arteries through which the catheter passes, it is possible to assess vessels in several specific body sites. In fact, a smaller catheter may be passed through the larger one into a branch artery supplying a small area of tissue or a tumor; this is called superselective angiography. Unlike computed tomography CT or magnetic resonance MR angiography , use of a catheter makes it possible to combine diagnosis and treatment in a single procedure. An example is finding an area of severe arterial narrowing, followed by angioplasty and placement of a stent. The degree of detail displayed by catheter angiography may not be available with any other noninvasive procedures. X-rays usually have no side effects in the typical diagnostic range for this exam. Risks There is always a slight chance of cancer from excessive exposure to radiation. However, the benefit of an accurate diagnosis far outweighs the risk. If you have a history of allergy to x-ray contrast material, your radiologist may advise that you take special medication for 24 hours before catheter angiography to lessen the risk of allergic reaction. Another option is to undergo a different exam that does not call for contrast material injection. If a large amount of x-ray contrast material leaks out under the skin where the IV is placed, skin damage can result. If you feel any pain in this area during contrast material injection, you should immediately inform the technologist. Women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant. Manufacturers of intravenous contrast indicate mothers should not breastfeed their babies for hours after contrast medium is given. However, both the American College of Radiology ACR and the European Society of Urogenital Radiology note that the available data suggest that it is safe to continue breastfeeding after receiving intravenous contrast. The risk of serious allergic reaction to contrast materials that contain iodine is extremely rare, and radiology departments are well-equipped to deal with them. There is a small risk that blood will form a clot around the tip of the catheter, blocking the artery and making it necessary to operate to reopen the vessel. If you have diabetes or kidney disease, the kidneys may be injured due to the contrast material. In most cases, the kidneys will regain their normal function within five to seven days. Rarely, the catheter punctures the artery, causing internal bleeding. It also is possible that the catheter tip will separate material from the inner lining of the artery, causing a block downstream in the blood vessel. Patients with impaired kidney function, especially those who also have diabetes, are not good candidates for this procedure. Patients who have previously had allergic reactions to x-ray contrast materials are at risk of having a reaction to contrast materials that contain iodine. If angiography is essential, a variety of methods is used to decrease risk of allergy: You may be given one or more doses of a steroid medication ahead of time. Contrast material without iodine may be used instead of standard x-ray contrast. Catheter angiography should be done very cautiouslyâ€”if at allâ€”in patients who have a tendency to bleed.

Chapter 6 : Angiogram | Society for Vascular Surgery

Diagnostic Cerebral Angiography. A comprehensive iPad application developed and shown to our patients before their angiograms. The video describes diagnostic cerebral angiography as performed in Interventional Neuroradiology.

History of invasive and interventional cardiology The technique of angiography itself was first developed in by the Portuguese physician Egas Moniz at the University of Lisbon for cerebral angiography , the viewing of brain vasculature by X-ray radiation with the aid of a contrast medium introduced by catheter. Heart catheterization was first performed in when the German physician Werner Forssmann inserted a plastic tube in his cubital vein and guided it to the right chamber of the heart. For their work in the discovery of cardiac catheterization and hemodynamic measurements, Cournand, Forssmann, and Richards shared the Nobel Prize in Physiology or Medicine in The first radial access for angiography can be traced back to , where Eduardo Pereira , in Lisbon, Portugal, first cannulated the radial artery to perform a coronary angiogram. Mason Sones , a pediatric cardiologist at the Cleveland Clinic , accidentally injected radiocontrast in a coronary artery instead of the left ventricle. Although the patient had a reversible cardiac arrest, Sones and Shirey developed the procedure further, and are credited with the discovery Connolly ; they published a series of 1, patents in Proudfit et al. Since the late s, building on the pioneering work of Charles Dotter in and especially Andreas Gruentzig starting in , coronary catheterization has been extended to therapeutic uses: With multiple incremental improvements over time, simple coronary catheterization examinations are now commonly done more rapidly and with significantly improved outcomes. Indications for cardiac catheterization include the following: The patient being examined or treated is usually awake during catheterization, ideally with only local anaesthesia such as lidocaine and minimal general sedation , throughout the procedure. Performing the procedure with the patient awake is safer as the patient can immediately report any discomfort or problems and thereby facilitate rapid correction of any undesirable events. Equipment[edit] Coronary catheterization is performed in a catheterization lab, usually located within a hospital. With current designs, the patient must lie relatively flat on a narrow, minimally padded, radiolucent transparent to X-ray table. More advanced equipment, termed a bi-plane cath lab, uses two sets of X-ray source and imaging cameras, each free to move independently, which allows two sets of images to be taken with each injection of radiocontrast agent. Diagnostic procedures[edit] Coronary angiography of a critical sub-occlusion of the common trunk of the left coronary artery and the circumflex artery. See arrows During coronary catheterization often referred to as a cath by physicians , blood pressures are recorded and X-ray motion picture shadow-grams of the blood inside the coronary arteries are recorded. By design, the catheter is smaller than the lumen of the artery it is placed in; internal intra-arterial blood pressures are monitored through the catheter to verify that the catheter does not block blood flow. The catheter is itself designed to be radiodense for visibility and it allows a clear, watery, blood compatible radiocontrast agent, commonly called an X-ray dye, to be selectively injected and mixed with the blood flowing within the artery. Typically 3â€”8 cc of the radiocontrast agent is injected for each image to make the blood flow visible for about 3â€”5 seconds as the radiocontrast agent is rapidly washed away into the coronary capillaries and then coronary veins. Without the X-ray dye injection, the blood and surrounding heart tissues appear, on X-ray, as only a mildly-shape-changing, otherwise uniform water density mass; no details of the blood and internal organ structure are discernible. The radiocontrast within the blood allows visualization of the blood flow within the arteries or heart chambers, depending on where it is injected. See the single frame illustration of a coronary angiogram image on the angioplasty page. For guidance regarding catheter positions during the examination, the physician mostly relies on detailed knowledge of internal anatomy, guide wire and catheter behavior and intermittently, briefly uses fluoroscopy and a low X-ray dose to visualize when needed. This is done without saving recordings of these brief looks. When the physician is ready to record diagnostic views , which are saved and can be more carefully scrutinized later, he activates the equipment to apply a significantly higher X-ray dose, termed cine , in order to create better quality motion picture images, having sharper radiodensity contrast, typically at 30 frames per second. The physician controls both the contrast injection, fluoroscopy and cine application timing so as to minimize the

total amount of radiocontrast injected and times the X-Ray to the injection so as to minimize the total amount of X-ray used. Doses of radiocontrast agents and X-ray exposure times are routinely recorded in an effort to maximize safety. Though not the focus of the test, calcification within the artery walls, located in the outer edges of atheroma within the artery walls, is sometimes recognizable on fluoroscopy without contrast injection as radiodense halo rings partially encircling, and separated from the blood filled lumen by the interceding radiolucent atheroma tissue and endothelial lining. Calcification, even though usually present, is usually only visible when quite advanced and calcified sections of the artery wall happen to be viewed on end tangentially through multiple rings of calcification, so as to create enough radiodensity to be visible on fluoroscopy. Percutaneous coronary intervention By changing the diagnostic catheter to a guiding catheter, physicians can also pass a variety of instruments through the catheter and into the artery to a lesion site. The most commonly used are 0. By injecting radiocontrast agent through a tiny passage extending down the balloon catheter and into the balloon, the balloon is progressively expanded. The hydraulic pressures are chosen and applied by the physician, according to how the balloon within the stenosis abnormal narrowing in a blood vessel responds. The radiocontrast filled balloon is watched under fluoroscopy it typically assumes a "dog bone" shape imposed on the outside of the balloon by the stenosis as the balloon is expanded , as it opens. As much hydraulic brute force is applied as judged needed and visualized to be effective to make the stenosis of the artery lumen visibly enlarge. The hydraulic pressures applied within the balloon may extend to as high as mmHg 2, kPa. Prevention of over-enlargement is achieved by choosing balloons manufactured out of high tensile strength clear plastic membranes. The balloon is initially folded around the catheter, near the tip, to create a small cross-sectional profile to facilitate passage though luminal stenotic areas, and is designed to inflate to a specific pre-designed diameter. If over inflated, the balloon material simply tears and allows the inflating radiocontrast agent to simply escape into the blood. Additionally, several other devices can be advanced into the artery via a guiding catheter. These include laser catheters, stent catheters, IVUS catheters, Doppler catheter, pressure or temperature measurement catheter and various clot and grinding or removal devices. Most of these devices have turned out to be niche devices, only useful in a small percentage of situations or for research. Stents, which are specially manufactured expandable stainless steel mesh tubes, mounted on a balloon catheter, are the most commonly used device beyond the balloon catheter. The balloon is removed and the stent remains in place, supporting the inner artery walls in the more open, dilated position. Advances in catheter based physical treatments[edit] Interventional procedures have been plagued by restenosis due to the formation of endothelial tissue overgrowth at the lesion site. Sirolimus , paclitaxel , and everolimus are the three drugs used in coatings which are currently FDA approved in the United States. As opposed to bare metal, drug eluting stents are covered with a medicine that is slowly dispersed with the goal of suppressing the restenosis reaction. The key to the success of drug coating has been a choosing effective agents, b developing ways of adequately binding the drugs to the stainless surface of the stent struts the coating must stay bound despite marked handling and stent deformation stresses , and c developing coating controlled release mechanisms that release the drug slowly over about 30 days. One of the newest innovations in coronary stents is the development of a dissolving stent. Abbott Laboratories has used a dissolvable material, polylactic acid , that will completely absorb within 2 years of being implanted. Alternative approaches[edit] Angiography left and CT middle and right of chronic total occlusion lesions at the left anterior descending coronary artery LAD and right coronary artery RCA. CT angiography can act as a less invasive alternative to Catheter angiography. Instead of a catheter being inserted into a vein or artery, CT angiography involves only the injection of a CT-visible dye into the arm or hand via an IV line. CT angiography lowers the risk of arterial perforation and catheter site infection. It provides 3D images that can be studied on computer, and also allows measurement of heart ventricle size. Infarct area and arterial calcium can also be observed however those require a somewhat higher radiation exposure. That said, one advantage retained by Catheter angiography is the ability of the physician to perform procedure such as balloon angioplasty or insertion of a stent to improve blood flow to the artery.

Chapter 7 : Coronary catheterization - Wikipedia

Catheter angiography uses a catheter, x-ray imaging guidance and an injection of contrast material to examine blood vessels in key areas of the body for abnormalities such as aneurysms and disease such as atherosclerosis (plaque). The use of a catheter makes it possible to combine diagnosis and treatment in a single procedure.

Many attempts have been made to bundle the work of diagnostic angiography into vascular interventional codes. These efforts stem largely from a lack of clarity on what constitutes a diagnostic angiogram, work that is separate from the radiologic supervision and interpretation work inherent to an intervention. This lack of clarity has led to erroneous reporting of diagnostic angiography in cases where the imaging and guidance for performance of an intervention was mistaken for the work of a diagnostic angiogram, and thus the work was reported and paid for twice during the same procedure. To do so, there needs to be an understanding of the work included in diagnostic angiography CPT codes, as well as the work included in the codes describing vascular interventions. Although there may be gray areas between these two types of imaging, there are some basic guidelines that can help distinguish between the two in most cases. All vascular therapeutic codes include imaging to guide the intervention. In current practice, a single provider almost always performs both aspects of the service, and this has led to "bundling" the two components of work into single codes. This includes all fluoroscopy, contrast injections, and angiography performed to accomplish the intervention, as well as all imaging to confirm previously diagnosed anatomy and pathology, vessel sizing, guidance for the intervention, and follow-up imaging to inform progress and completion of the intervention. It also includes imaging performed to document the presence or absence of local complications at the end of the procedure. The patient may then be scheduled for a therapeutic intervention based on these findings. In cases where a complete diagnostic study has been performed, and the therapeutic intervention has been scheduled based on that study, a repeat diagnostic angiogram is not likely to be needed, and typically should not be repeated or reported. This is true even if no previous catheter-based angiography has been performed. At the time of intervention, imaging that is performed to confirm the pathology identified on the diagnostic study is considered inherent to the imaging of the intervention, and therefore it is not reported as a diagnostic angiogram. In the case of catheter-based diagnostic angiography, there are times when the diagnostic study may be performed, but the intervention gets postponed until a later date. In these cases, the initial diagnostic angiogram is unlikely to need repeating at the time of the intervention. There are some specific circumstances in which repeat diagnostic angiography at the time of intervention is indicated and may be reportable: This is particularly pertinent if the diagnostic study was performed elsewhere, and the quality of the study could not be controlled by the intervening physician. There may be mitigating factors that could lead to the need to repeat the diagnostic angiography, such as an uncooperative patient, leading to an inability to perform a complete study at the time of the initial diagnostic angiography. However, consideration should then be given to reporting one of the diagnostic angiography procedures with a modifier to designate that it was not a complete study. A significant clinical change occurs during the intervention, requiring repeat diagnostic study to determine what is causing the clinical change. When a diagnostic angiography is required and a complete study is performed in the same setting as an intervention, it should be reported with a modifier appended to the diagnostic angiography code s. If only a partial diagnostic study is needed or performed, the modifier may be used to indicate that a reduced service was performed or required. She has disclosed that she has no financial interests that pertain to this topic. Krol may be reached at

Chapter 8 : Cardiac catheterisation and coronary angiography - NHS

An MRA is a test that lets your doctor see inside your blood vessels -- your arteries and veins. MRA stands for Magnetic Resonance Angiogram or MR Angiography. Your doctor may ask you to get one.

Diagnostic Coronary Angiogram What is it? The test involves the insertion of a long thin catheter into an artery in the groin or wrist under local anaesthetic. The catheter is moved up the inside of the artery until it reaches the heart. When the catheter is in place, a small amount of dye will be injected into it. X-rays will be taken as the dye travels through the coronary arteries. A standard angio takes approximately minutes. Preparation You will need to fast for 6 hours prior to the procedure. Hospital admission is required and is generally a day case however some patients are required to stay in overnight depending on how they recover from the test. Take all of your usual medications unless instructed otherwise by your cardiologist. You may not drive after the procedure and are also not allowed to be alone that evening. X-rays will be taken as the dye moves through your coronary arteries Different catheters are needed to study the various arteries so one will be removed and the next introduced Some people have nausea or chest discomfort when the dye is injected but this does not last long A standard angiogram takes about minutes. When the test is completed the catheter will be removed and pressure applied to the insertion site You will be transferred to the ward or recovery area to rest in bed for at least four hours. Night attire, including dressing gown and slippers non-slip Toiletries Results Your doctor will inform you of the results at the end of the procedure. A follow up appointment will more than likely be organized a couple of weeks later in the consulting rooms. Following discharge If you are discharged on the same day you will not be permitted to drive home after the procedure and will need to have someone stay with you that evening. If you live in a regional centre, you may be advised to stay locally for a few days after the procedure. It is important to talk to your cardiologist regarding his own instructions for dressing removal and wound care. Once the dressing s has been removed it requires little care. Keep clean and dry, avoid using powder. Check daily for signs of infection and report any possible signs of infection to your cardiologist promptly. Please discuss any possible driving restrictions and medication changes with your cardiologist. Risks As with any medical procedure there are some risks involved but serious problems are rare. Most people have no trouble and the benefits usually far outweigh the risks. Every effort is made to minimize your risk but should complications occur emergency equipment is readily available to help deal with them. Exact risks vary from patient to patient and can include: Very rarely, significant internal bleeding can occurâ€”your doctors will be prepared to deal with this risk. Infection Infection is rare and usually occurs in the area of skin overlying the catheter insertion sites. If an infection should occur it will be treated with the appropriate antibiotic. Reaction to this contrast is usually minor and can result in hives but on rare occasions it can lead to shock a dramatic fall in blood pressure. If you have had no previous reaction with the use of contrast then the risk is extremely low. Please inform your cardiologist if you have had a previous reaction to any contrast mediums. Acute closure or rupture of coronary artery Rarely, coronary angioplasty can cause the artery to become completely blocked or rupture. Should this happen an emergency coronary artery bypass operation would be performed. Heart attack Occasionally patients can have a heart attack during this procedure. Your cardiologist will be prepared to deal with this risk. Follow up appointment A follow up appointment will be made with your cardiologist usually within a week or two and you will be discharged with the appropriate medications. If you have any questions or concerns about the risks involved with this type of procedure please discuss them with your cardiologist.

Chapter 9 : Diagnostic Coronary Angiogram - Cardiology Procedures | SA Heart

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URL of this page: How the Test is Performed Coronary angiography is often done along with cardiac catheterization. This is a procedure which measures pressures in the heart chambers. Before the test starts, you will be given a mild sedative to help you relax. An area of your body the arm or groin is cleaned and numbed with a local numbing medicine anesthetic. The cardiologist passes a thin hollow tube, called a catheter, through an artery and carefully moves it up into the heart. X-ray images help the doctor position the catheter. Once the catheter is in place, dye contrast material is injected into the catheter. X-ray images are taken to see how the dye moves through the artery. The dye helps highlight any blockages in blood flow. The procedure most often lasts 30 to 60 minutes. How to Prepare for the Test You should not eat or drink anything for 8 hours before the test starts. You may need to stay in the hospital the night before the test. Otherwise, you will check in to the hospital the morning of the test. You will wear a hospital gown. You must sign a consent form before the test. Your health care provider will explain the procedure and its risks. Tell your provider if you: Are allergic to any medicines or if you have had a bad reaction to contrast material in the past Are taking Viagra Might be pregnant How the Test will Feel In most cases, you will be awake during the test. You may feel some pressure at the site where the catheter is placed. You may feel a flushing or warm sensation after the dye is injected. After the test, the catheter is removed. You might feel a firm pressure being applied at the insertion site to prevent bleeding. If the catheter is placed in your groin, you will be asked to lie flat on your back for a few hours to several hours after the test to avoid bleeding. This may cause some mild back discomfort. Why the Test is Performed Coronary angiography may be done if: You have angina for the first time. Your angina that is becoming worse, not going away, occurring more often, or happening at rest called unstable angina. You have aortic stenosis or another valve problem. You have atypical chest pain, when other tests are normal. You had an abnormal heart stress test. You are going to have surgery on your heart and you are at high risk for coronary artery disease. You have been diagnosed as having a heart attack. Normal Results There is a normal supply of blood to the heart and no blockages. What Abnormal Results Mean An abnormal result may mean you have a blocked artery. The test can show how many coronary arteries are blocked, where they are blocked, and the severity of the blockages. Risks Cardiac catheterization carries a slightly increased risk when compared with other heart tests. However, the test is very safe when performed by an experienced team. Generally, the risk for serious complications ranges from 1 in 1, to 1 in Risks of the procedure include the following: