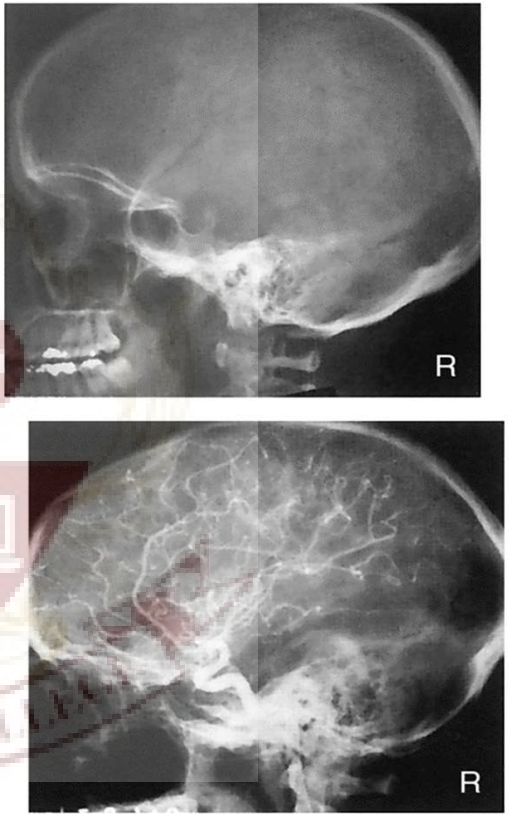
Angiography Procedures

MRT Program

Angiography

- Radiographic examination of blood vessels following injection of positive contrast media.



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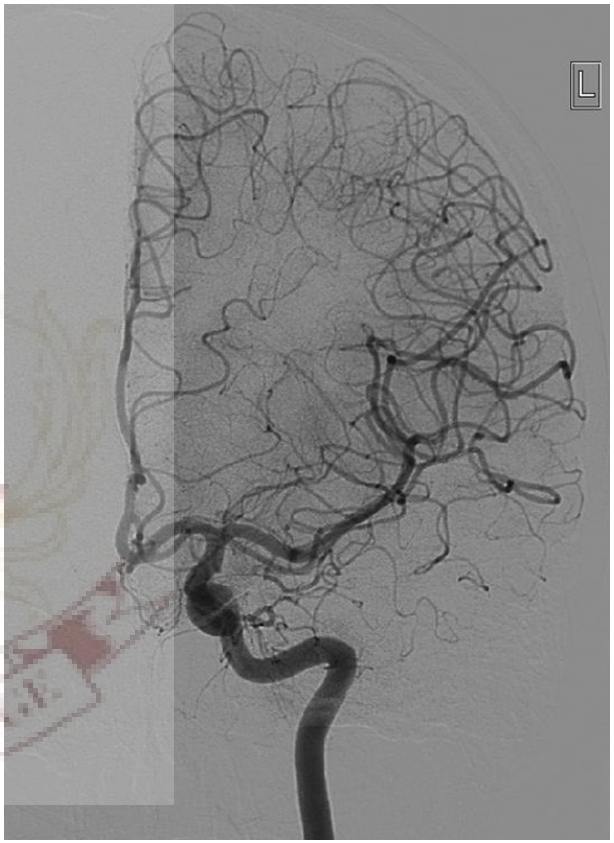
Cerebral Angiographic Procedure

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Cerebral Angiography

- Radiographic examination of blood vessels of the brain
- Clinical indications:
  - Vascular stenosis or occlusions
  - Aneurysms
  - Trauma
  - Arteriovenous malformations
  - Neoplastic disease
- Femoral approach used
- Common vessel images: common carotids, internal carotids, external carotids, vertebral arteries

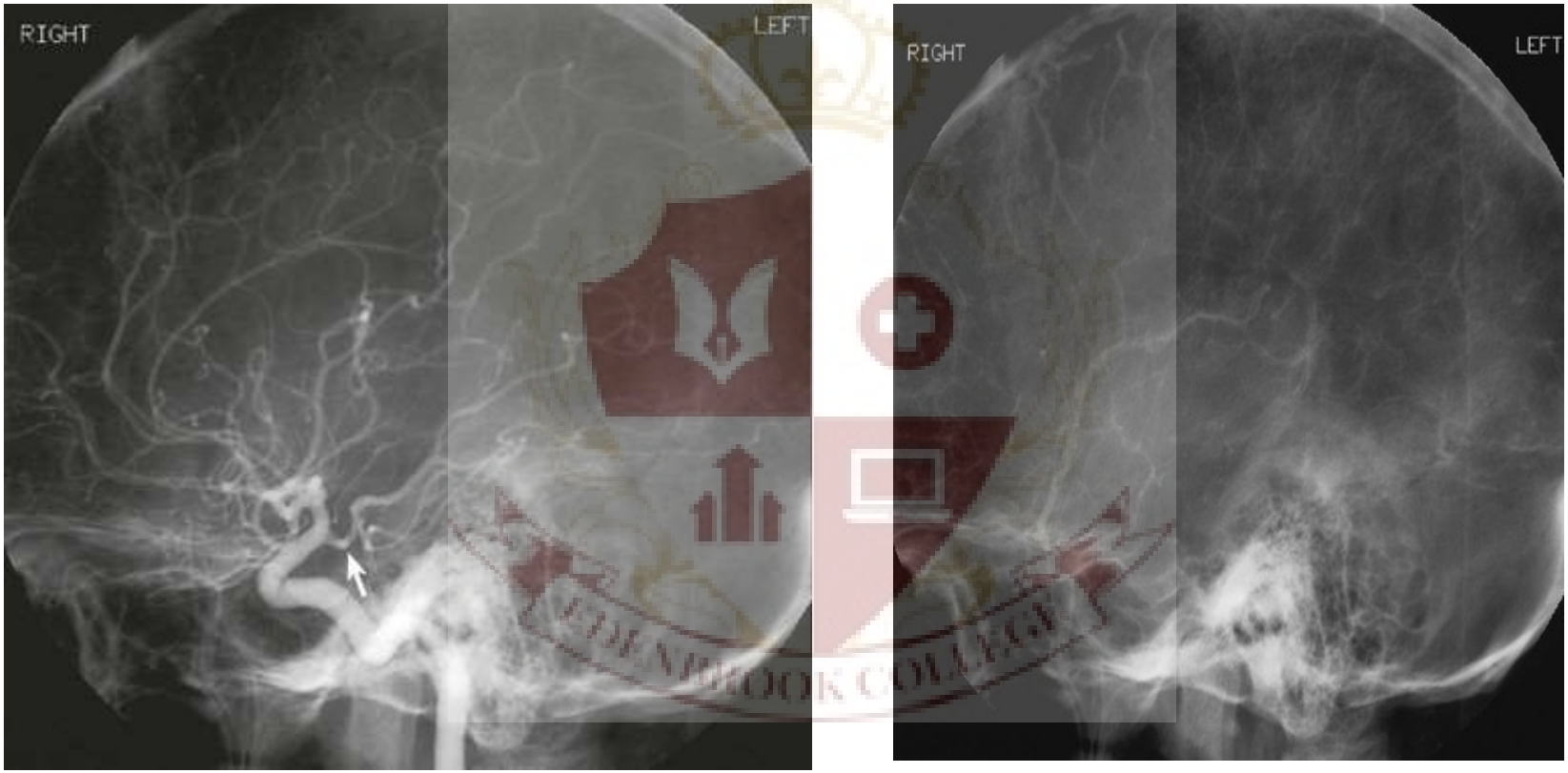


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Cerebral Angiography

- Transit time of cerebral circulation is only 4.1 seconds from the internal carotid to the jugular vein
- Certain pathologies significantly alter cerebral circulation time. AVM- shorten it; arterial vasospasm delays it
- A scout image should be taken prior to arrival of the contrast to serve as a mask and images are taken at 1.5 to 3 images per second in AP and Lateral positions for first 1.5 – 2.5 seconds of the exam
- After the arterial phase this can slow to 1 image per second for capillary phase and maintained at 1 image per second or every other second for venous phase
- Entire exam is over in 7-10 seconds

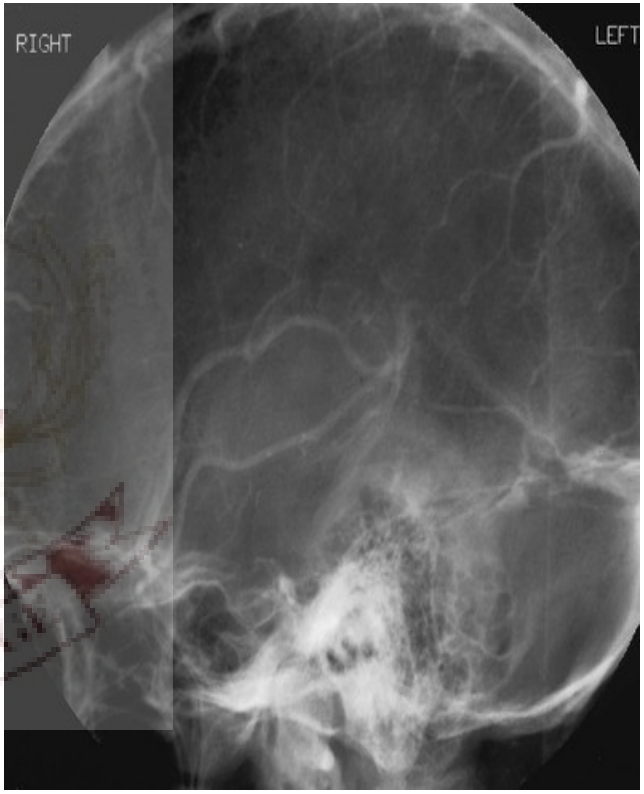
Phases of a Cerebral Angiogram



- Merrills Atlas of Radiograhic Positioning and Procedures

Phases of Cerebral Angiogram

- Injection rates and volumes through the catheter are coupled with the imaging program
- Injection rates of 5-10 mL for 1 to 2 seconds



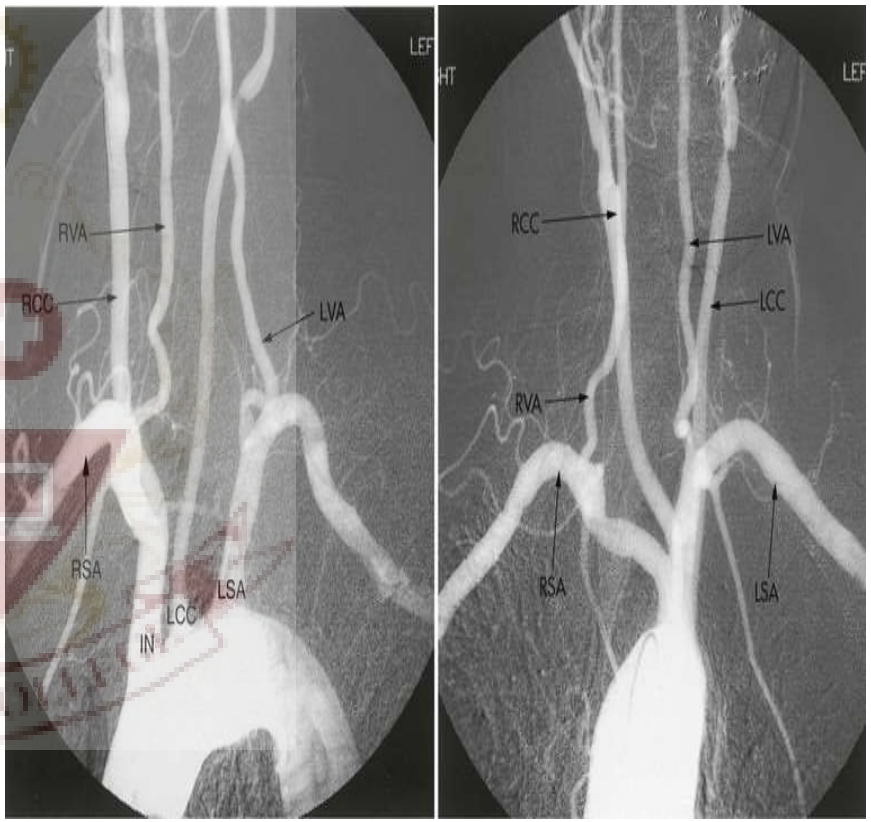
- Merrills Atlas of Radiograhic Positioning and Procedures

Aortic Arch Angiography

- Visualize atherosclerotic or occlusive disease of extracranial or common carotid, vertebral and subclavian arteries
- Multiple hole catheter is positioned in the ascending thoracic aorta
- Simultaneous biplane projections are produces so superimposition is minimized
- Place the IR 35 degree RPO
- Opens the arch and origins of great vessels and frees carotid and vertebral arteries as well
- Raise pt chin to superimpose inferior margin pf the mandible onto the occipit to open the neck

Aortic Arch Angiogram

- Relax patients shoulders down
- Position the lateral IR similar to the AP to get another image of the vessels
- CR perpendicular to the IR 3 cm superior to the sternal angle



- Merrills Atlas of Radiograhic Positioning and Procedures

Common Carotid Arteriogram

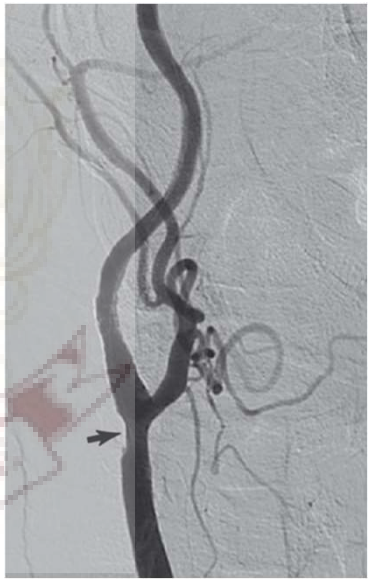
AP projection of right common carotid.



Arrows indicate bifurcation as a common area of interest.

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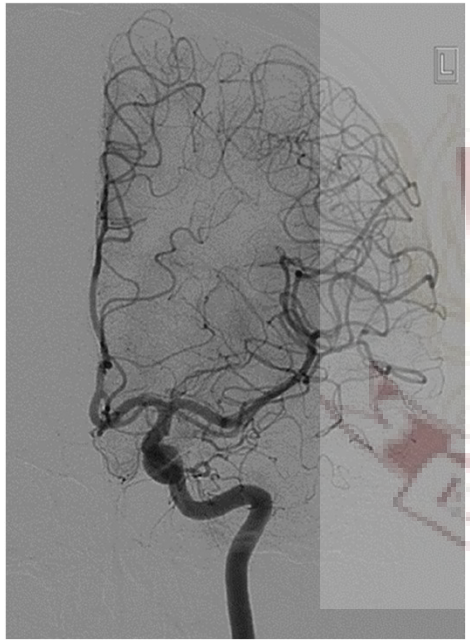
Lateral projection of common carotid artery with high-grade stenosis.



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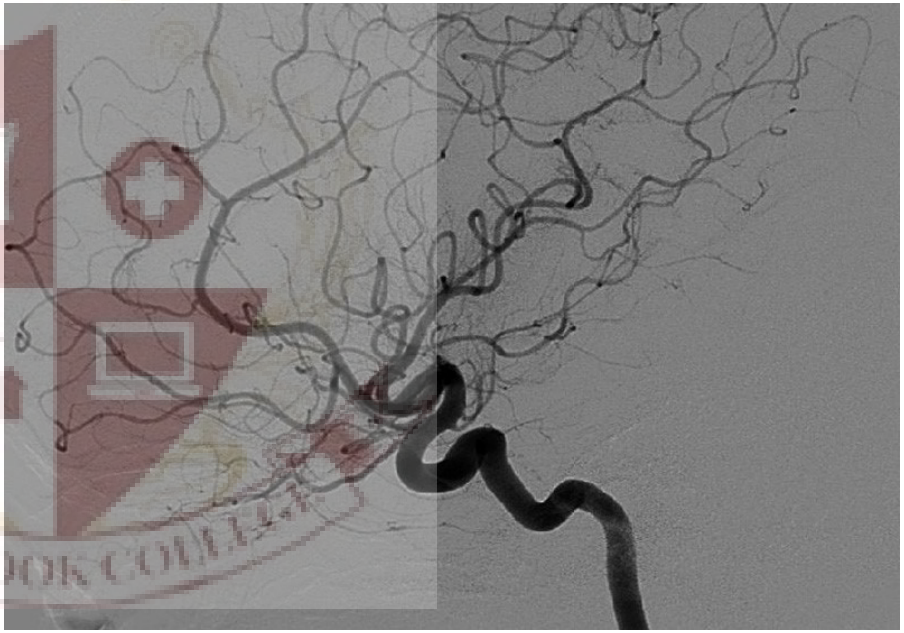
Internal Carotid Arteriogram

PA: left internal carotid arteriogram



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Lateral: left internal carotid arteriogram



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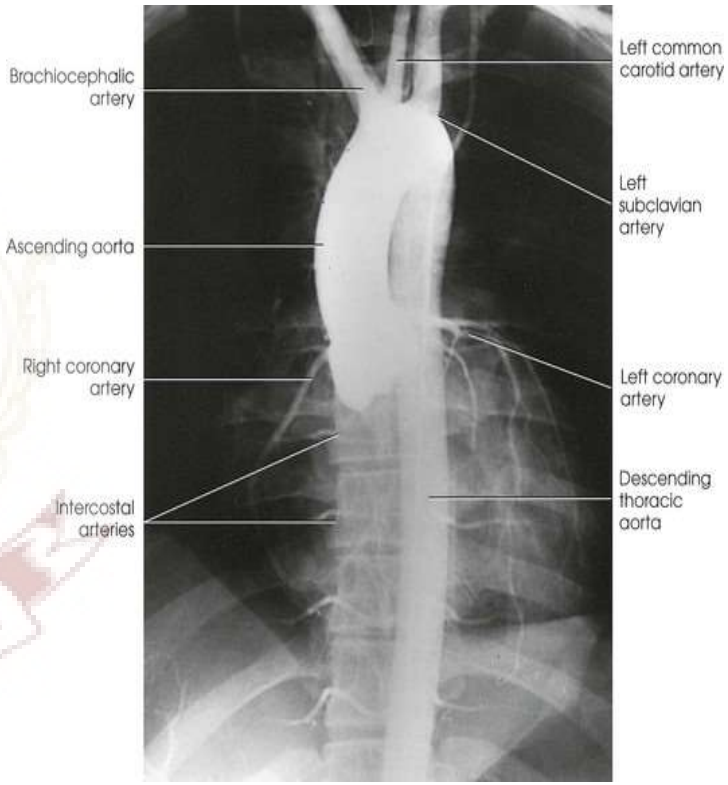
Thoracic Aortography

- Radiographic examination of thoracic aorta
- Clinical indications:
  - Aneurysms
  - Congenital abnormalities
  - Vessel stenosis
  - Embolus
  - Trauma-aortic dissection
- Includes the ascending, the arch of the aorta and descending aorta and the major branches.
- Multi hole catheter used
- Patient is supine
- Access through femoral artery.



Thoracic Angiography

- LAO 45 degrees to see arch of aorta free of superimposition.
- Biplane imaging preferred
- Move patients arms up for lateral and increase SID
- CR perpendicular T7
- Contrast 30–50 ml
- Entire thoracic aorta seen including proximal brachiocephalic, left common carotid and left subclavian arteries
- Suspend on inspiration



- Source: Merrills Atlas of Radiograhic Positioning and Procedures
- ermission.

Pulmonary Arteriogram

- Selective angiographic study of pulmonary vessels to investigate a pulmonary embolism
  - 25–35 ml of contrast used
  - Femoral vein access preferred and fed up through IVC into right side of the heart into the pulmonary arteries
  - Demonstrates arterial phase
  - Widely replaced with pulmonary CT angiography as it provides superior imaging

AP-pulmonary arteriogram (DSA)



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Angiocardiography

- Clinical indications:
  - Coronary artery disease and/or angina
  - Myocardial infarct
  - Valvular disease
  - Atypical chest pain
  - Congenital heart anomaly
  - Other heart or aorta pathology

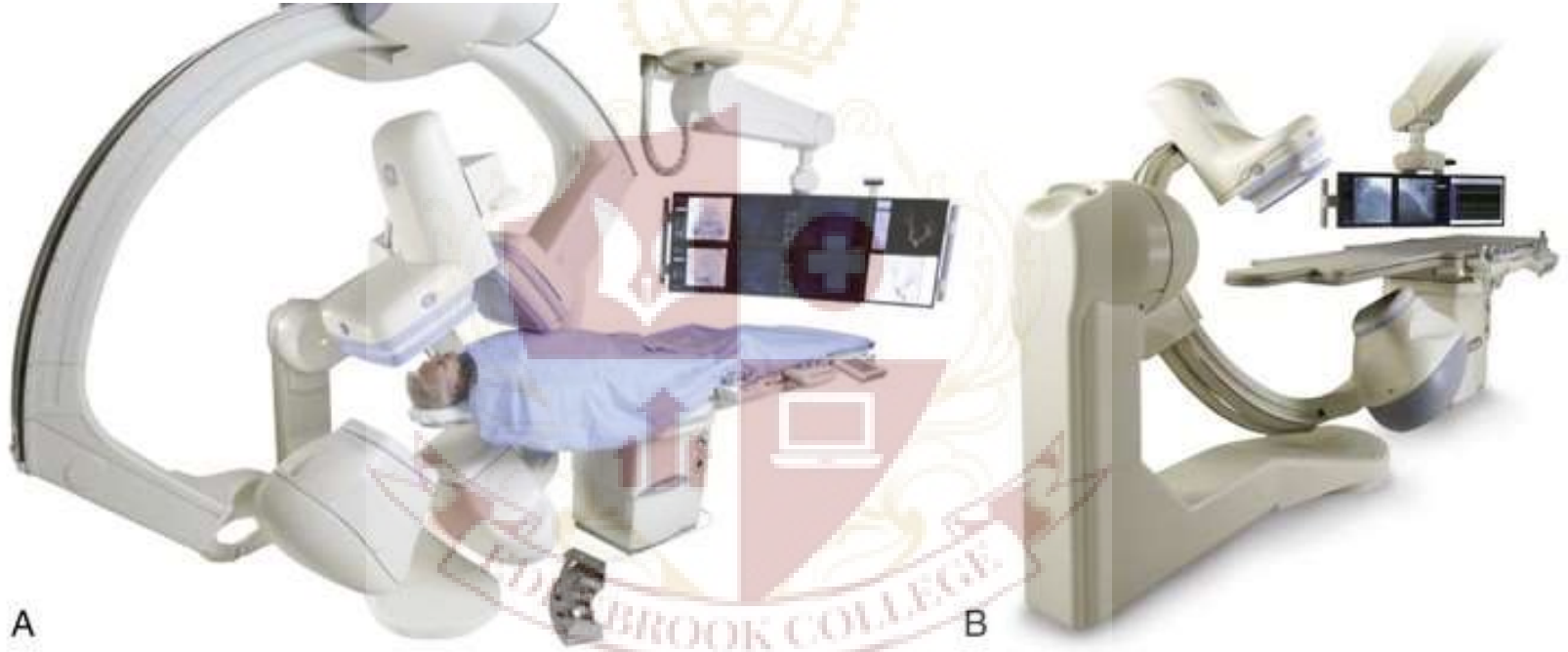


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Patient Positioning for Cardiac Catheterization

- Positioned to reduce superimposition of cardiac vasculature
- Moving the patient is undesirable
- The II or FPD are mechanically suspended in a C-Arm configuration to allow equipment rotation around the patient and provide cranial or caudal angulation
- Detector is above tube is below
- Patient is placed supine
- Projections of catheterization procedure cannot be specified and adapted individually

Imaging Equipment



- Merrills Atlas of Radiograhic Positioning and Procedures

Angiocardiography

- Various catheters are used and selectively placed depending on what part of the heart is being imaged.
- Right side of heart is accessed via the femoral vein.
- 30–40 ml of non-ionic contrast is injected for ventriculogram (pigtail catheter used).
- Imaging rates very rapid: 15–30 frames per second.
- Images archived on compact disk or PACS and viewed in cine mode on playback.

Left Cardiac Catheterization

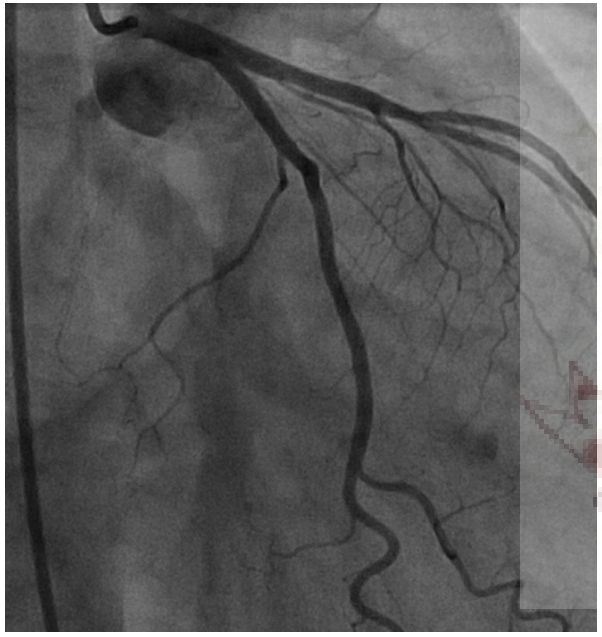
- Widely performed
- Catheter advanced from femoral artery to ascending aorta
- Blood pressure measurements are taken and arterial oximetry catheter moved through aortic valve into the left ventricle
- Blood pressure measurements again and angiography is performed
- Left ventriculography provides information about valvular incompetence, and is seen as the backward flow of contrast from the left ventricle into the left atrium

Catheterization of Right Side of Heart

- Catheter inserted into a vein in groin, antecubital fossa, internal jugular or subclavian and advanced to the vena cava- into the right atrium across the tricuspid valve to the right ventricle, through the pulmonary valve to the pulmonary artery

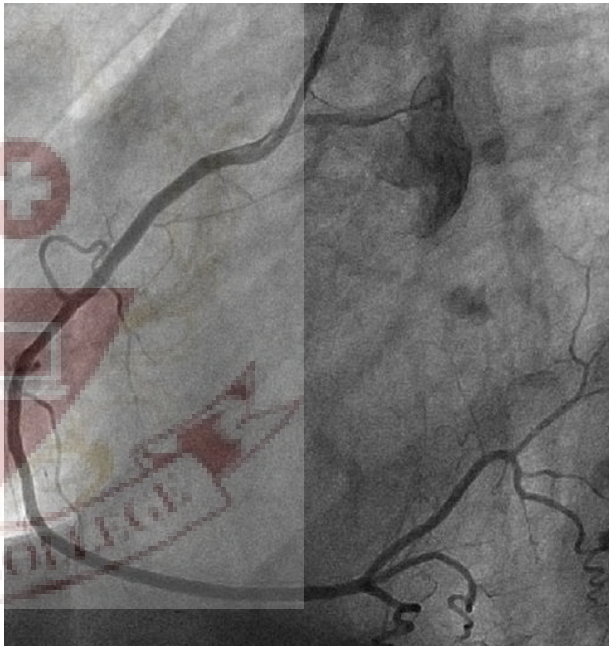
Angiocardiography

Left Coronary Artery



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Right Coronary Artery



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Abdominal Angiogram

- **Aortography:** Angiographic study of aorta (30–40 ml contrast)
- **Venacavography:** Demonstrates superior and/or inferior vena cava (requires femoral vein puncture) (30–40 ml of contrast)
- **Selective angiographic studies:** Celiac, renal, SMA/IMA artery examinations (depends on vessel imaged)
- Patient supine, obliques are C-arm manipulated

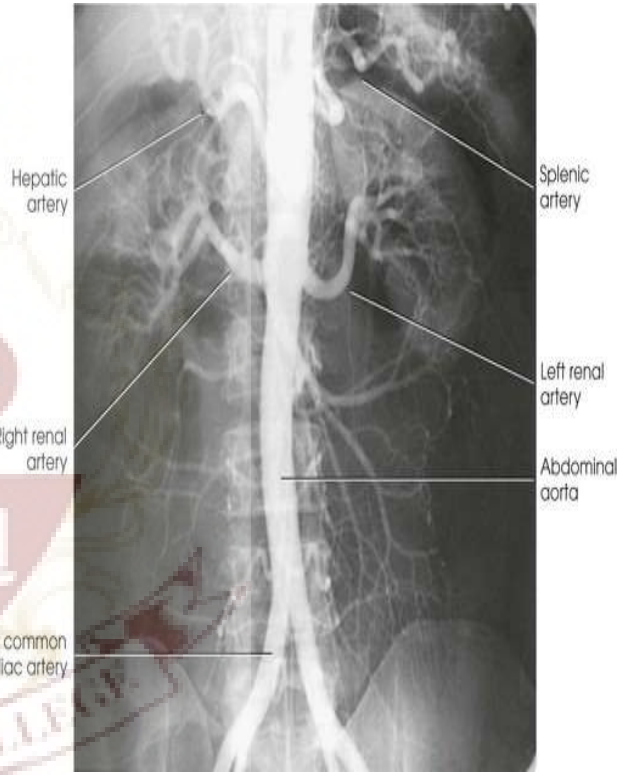
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Abdominal Angiography

- Clinical indications:
  - Aneurysm (AAA)
  - Congenital abnormalities
  - GI bleed (selective studies celiac axis, renal arteries, SMA and IMA)
  - Stenosis or occlusion
  - Trauma
  - Pig tail catheter generally used to supply large amount of contrast
  - Advanced to level of interest the via femoral artery access
  - 30 – 40 mls contrast
  - Simultaneous AP, lateral and possibly oblique projections taken on expiration
  - CR perpendicular at L2 and arms raised for lateral

Abdominal Aortography

- AP shows best the renal origins, the aortic bifurcation, and the course and general condition of all abdominal visceral branches



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Lateral Abdominal Aortography

- Best shows the origins of the celiac and superior mesenteric arties because these arise from the anterior abdominal aorta



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Selective Peripheral Abdominal Angiography

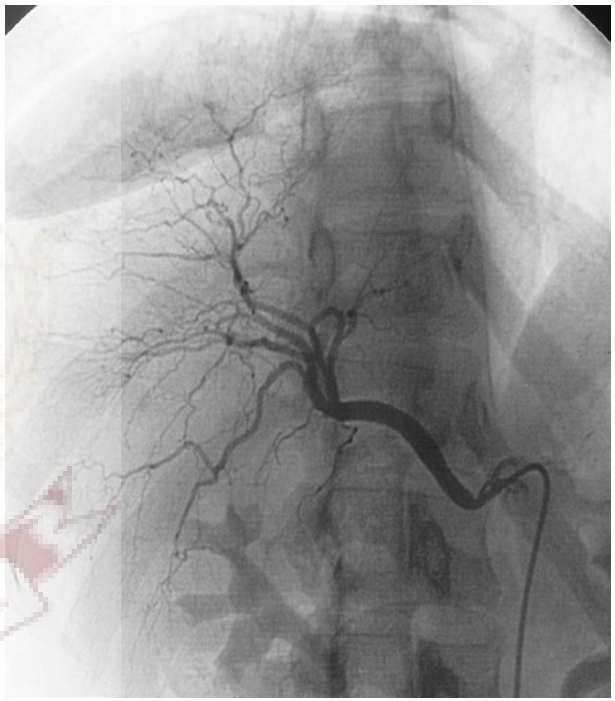
- Celiac Arteriogram
  - Normally arises at level of T12
  - Provides blood to the stomach, proximal duedenom, liver, spleen and pancreas
  - CR - L1



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Selective Peripheral Abdominal Angiography

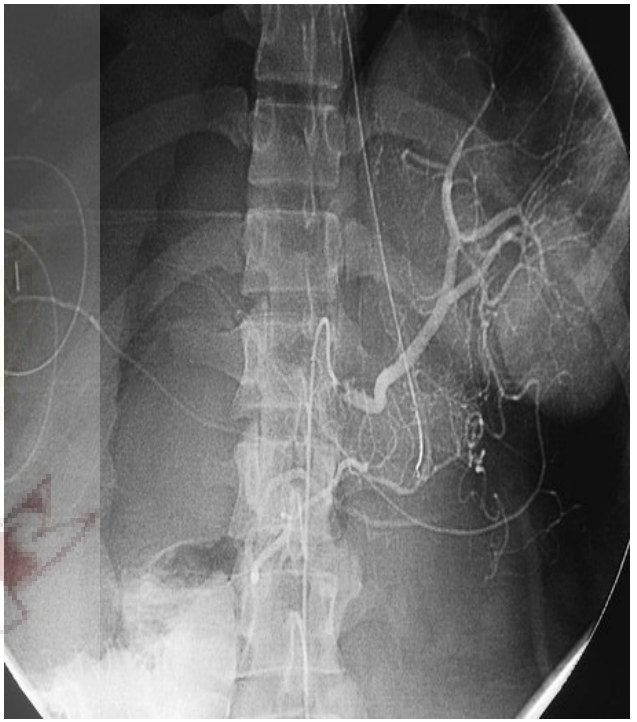
- Hepatic Arteriogram
  - Common hepatic artery branches from right side of celiac artery and supplies circulation to the liver, stomach and proximal duodenum and pancreas
  - Centre over the liver



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Selective Visceral Abdominal Angiography

- Splenic Arteriogram supplies blood to pancreas and spleen
  - Centre over left and upper margins of the spleen
  - Injection can show portal venous system on the late venous images
  - To show portal vein center the patient to the IR



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Selective Visceral Abdominal Angiography

- Superior Mesenteric Arteriogram (SMA)
- Supplies blood to small intestine and ascending and transvers colon
  - Arises at level of L1 and descends to L5–S1 and centre to patient midline
  - CR at L3
- When attempting to visualize a bleed, extend exposure duration by 60 seconds or according to radiologist preference.



Selective Visceral Abdominal Angiography

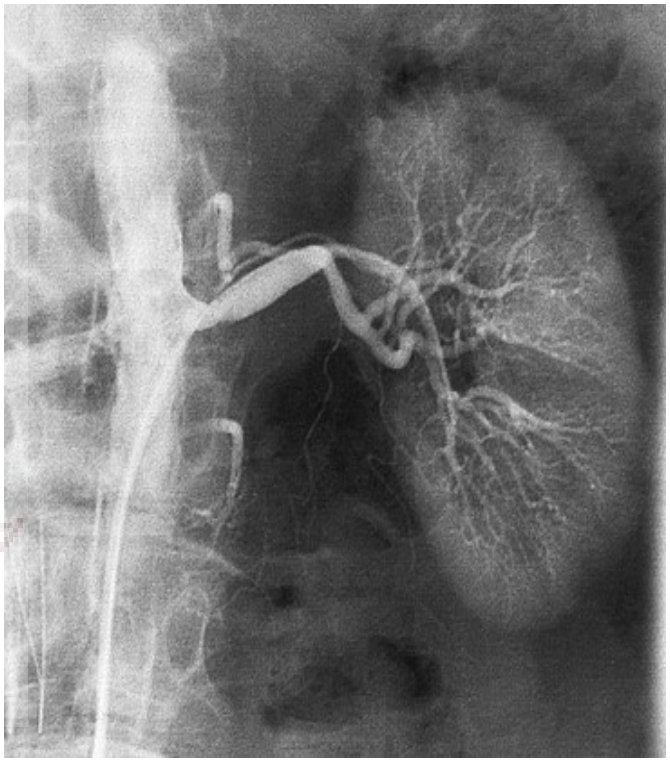
- Inferior Mesenteric Arteriogram
- IMA supplies blood to splenic flexure, descending and rectosigmoid area
  - Arises from left side of aorta at L3 and descends into pelvis
  - Use 15 degree RAO or LPO position
  - Imaging the same as for SMA



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Selective Visceral Abdominal Angiography

- Renal Arteriogram
- The renal arteries arise from the right and left side of the aorta between L1 and L2.
- A renal flush aortogram is completed 25 ml/sec for 40ml total volume of contrast injected.
- For a right renal arteriogram, position the patient so the CR enters at the level of L2 midway between the midsagittal plane and patient's right side.
- For the left renal arteriogram, position the pt. so the CR enters at the level of L1 and midway between the midsagittal plane and the patient's left side.
- Approximately 8 ml/sec for a 12 ml total volume of contrast is injected into the selected renal artery to demonstrate anatomy and possible pathologic conditions.



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Peripheral Angiography

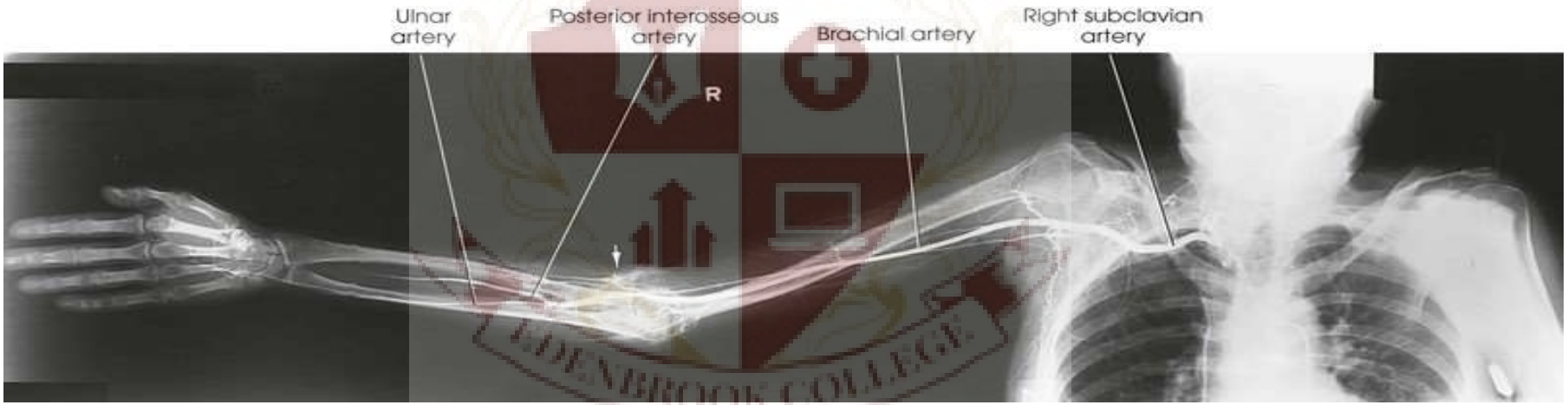
- Upper limb Arteriograms
- Evaluate traumatic injury, atherosclerotic disease, or other vascular lesions
- Selective injection into axillary or subclavian arteries
- Hand prone or supine in position
- Arm in true AP and extended
- Injection rates vary 3-4 mL/sec to 10mL/sec
- Images obtained using bolus chase method or serial runs over each segment of extremity
- Unilateral exam usually



- Severe Arterial Occlusion disease shown by arrows after a cold temperature injury

Right Subclavian Artery Injection

- Right subclavian artery injection showing a iatrogenic occlusion of the radial artery



Upper Limb Arteriography

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DSA of left hand



Peripheral Angiography

- Lower Limb Arteriograms
- Performed to determine whether atherosclerotic disease is causing claudication
- Catheter tip positioned superior to the aortic bifurcation
- Bilateral exam
- If unilateral tip is placed below bifurcation in femoral artery
- Patient supine single plane AP projections to include renal arteries down to ankles
- Internally rotate legs 30 degrees
- Subtracted or subtracted bolus chase selections used to follow flow of contrast down
- Exposures of abdominal aorta bifurcation on expiration



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Peripheral Angiography

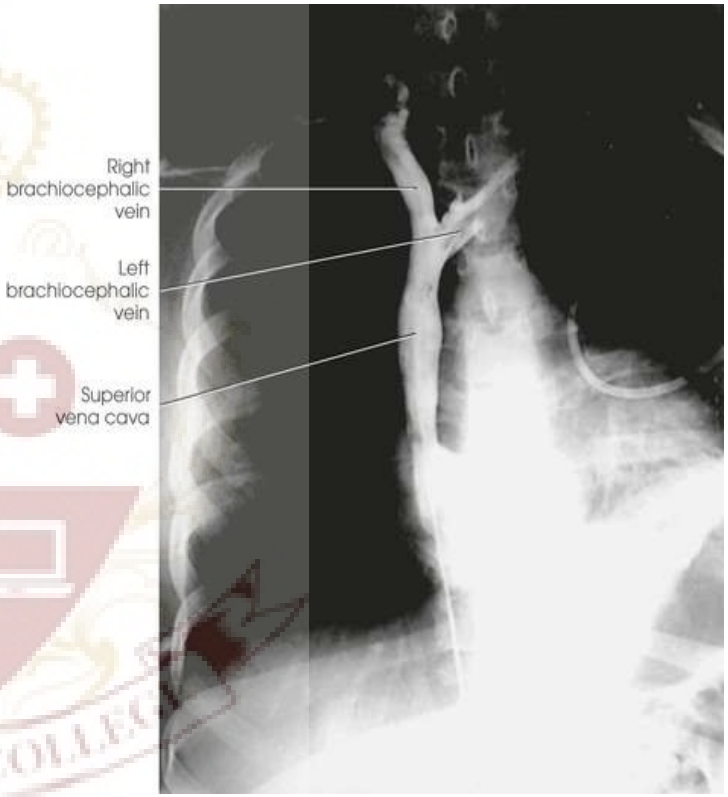
- Specific areas can be examined as well
- Popliteal fossa or the foot are done occasionally
- Femoral artery injection site
- AP, lateral or both projections may be obtained with patient centered to designated area

Venography

- Venous blood flows proximally toward the heart
- Injection into central venous may not opacify peripheral veins
- Peripheral; veins can be indirectly seen by filling defect form unpacified blood in the opacified central vein
- Place the patient supine for either single or biplane imaging
- Move patients arms out of the way
- Obtain lateral projections at increased SID to reduce magnification

Superior Venacavogram

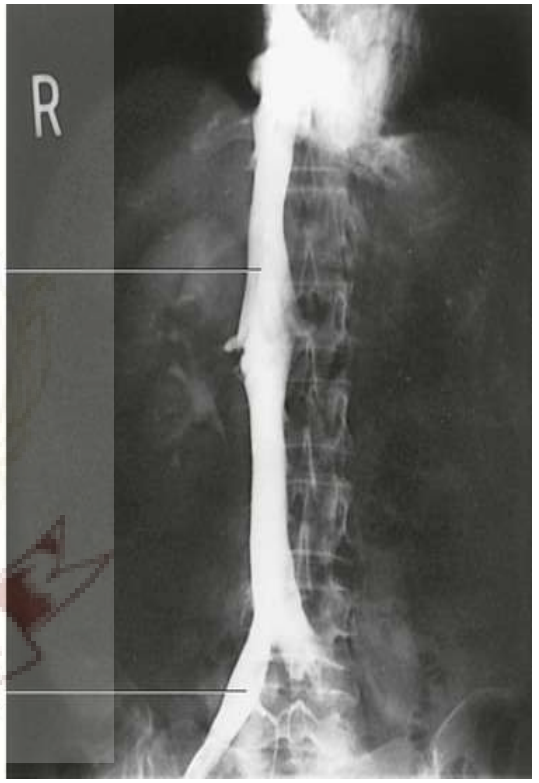
- Performed to rule out thrombus or occlusion
- Contrast introduced into via catheter through antecubital fossa or in the axillary or subclavian vein
- Opacified subclavian vein, brachiocephalic vein, SVC and right atrium demonstrated



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Inferior Venacavogram

- Performed to identify location of renal veins for placement of and IVC filter
- Contrast injected through a multi side hole catheter inserted through the femoral vein and positioned in the common iliac vein or inferior aspect of the IVC



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Visceral Venography

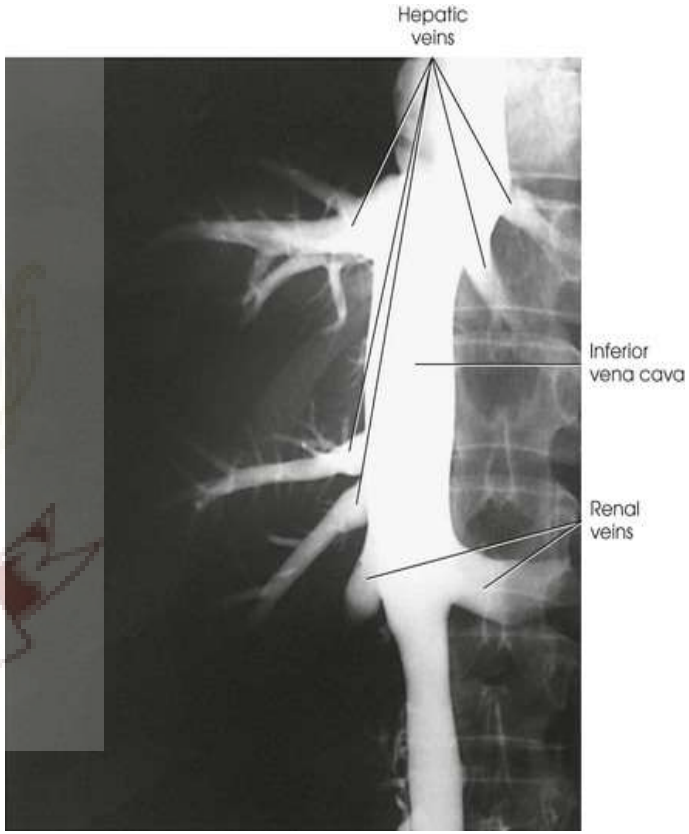
- Visceral veins are often visualized by extending the imaging program of the corresponding visceral artery injection
- Veins that drain the small bowel are normally visualized by extending the imaging program of a SMA
- Portal venography can be performed by injecting the portal vein directly from percutaneous approach but usually late phase imaging of splenic or SMA injection



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Hepatic Venogram

- Performed to rule out stenosis or thrombosis of hepatic veins
- Hepatic veins carry blood from liver to IVC
- Hepatic veins easily catheterized from jugular vein or upper extremity vein or perhaps femoral vein
- AP or PA projections that include liver tissue and extreme upper inferior vena cava



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Renal Venogram

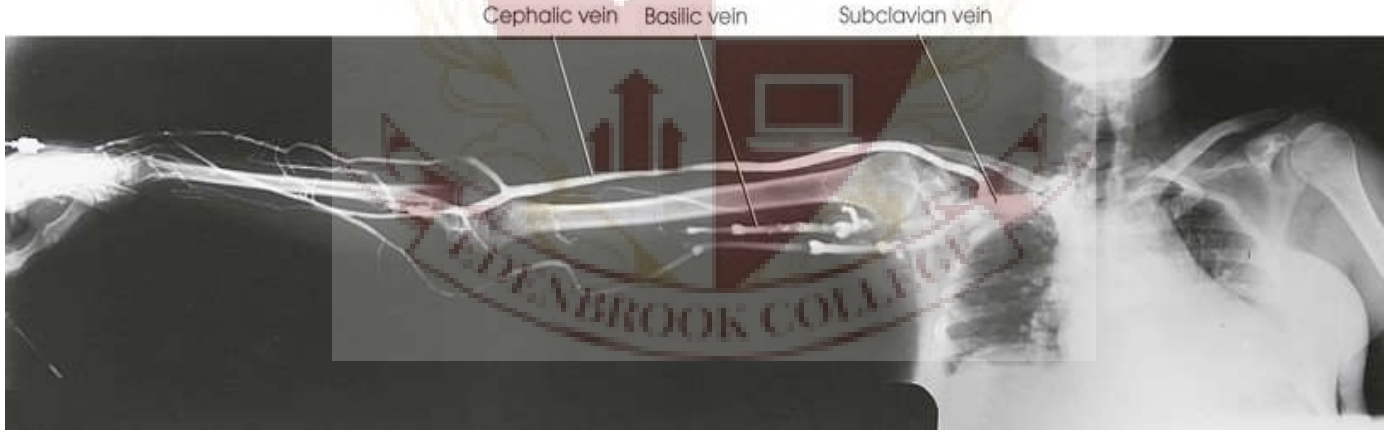
- Performed to rule out thrombosis of renal vein
- Femoral vein access is easiest
- Patient is supine for single plane
- Center selected kidney and collimate to include kidney area and IVC



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Upper Limb Venogram

- Performed to look for thrombosis or occlusion
- Injected through a needle, IV line or catheter into a superficial vein at elbow or wrist
- Should include vasculature from wrist or elbow to subclavian vein



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Lower Limb Venogram

- Visualization of thrombosis of deep leg veins
- Ultrasound is first line diagnostic tool to diagnose DVT
- Contrast is injected directly into popliteal vein with patient prone



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