الجامعة التقنية الوسطى

كلية التقنيات الصحية والطبية/ بغداد

قسم : قسم تقنيات الاشعة المرحلة: الرابعة

المادة: التصوير المقطعي المحوسب للصدر والبطن والحوض

Title: **العنوان:**

CT Angiography

Name of the instructor: **اسم المحاضر:**

م. حيدر عبد القادر

Target population: **الفئة المستهدفة:**

طلبة المرحلة الرابعة لكلية التقنيات الصحية والطبية في قسم تقنيات الاشعة

Introduction: المقدمة:

CT Angiography (CTA) is a non-invasive computed tomography technique used to visualize vascular structures through the administration of intravenous contrast material combined with rapid image acquisition. CTA has become an essential component of modern CT imaging due to its ability to provide high-resolution anatomical depiction of arteries and veins within a short examination time. CTA plays a key role in demonstrating vascular anatomy, vessel continuity, and spatial relationships between blood vessels and surrounding structures.

Pretest: الاختبار القبلي:

1. **Mention the indication of the angiographic CT?**
2. **Mention the imaging protocols used in angiography CT examinations?**

Scientific Content: المحتوى العلمي:

Indications of CT Angiography

CT Angiography is commonly performed for the evaluation of a wide range of vascular diseases and abnormalities. It is used to assess arterial stenosis and occlusion, including atherosclerotic disease affecting major systemic arteries. CTA plays an important role in the detection and characterization of aneurysms, allowing assessment of aneurysm size, shape, and extent. It is also routinely used in the evaluation of arterial dissections, particularly involving the aorta and its major branches. CTA is widely applied in the diagnosis of acute vascular conditions, such as pulmonary embolism, acute aortic syndromes, and traumatic vascular injuries, where rapid and accurate assessment of vessel integrity is required. In addition, CTA is used to identify congenital vascular anomalies, including abnormal vessel origin, course, or branching patterns. In venous imaging, CTA may assist in the evaluation of venous thrombosis and venous abnormalities when clinically indicated. CTA is also utilized for preoperative planning and post-procedural follow-up, including assessment of vascular stents, grafts, and bypass conduits, to evaluate vessel patency and detect complications. Overall, CTA is indicated whenever detailed visualization of the vascular lumen, vessel continuity, and anatomical relationships is required, providing diagnostic information that cannot be obtained with non-contrast CT examinations alone. CT Angiography is primarily designed for arterial evaluation; however, venous structures may also be assessed when appropriate timing or dedicated venous protocols are applied.

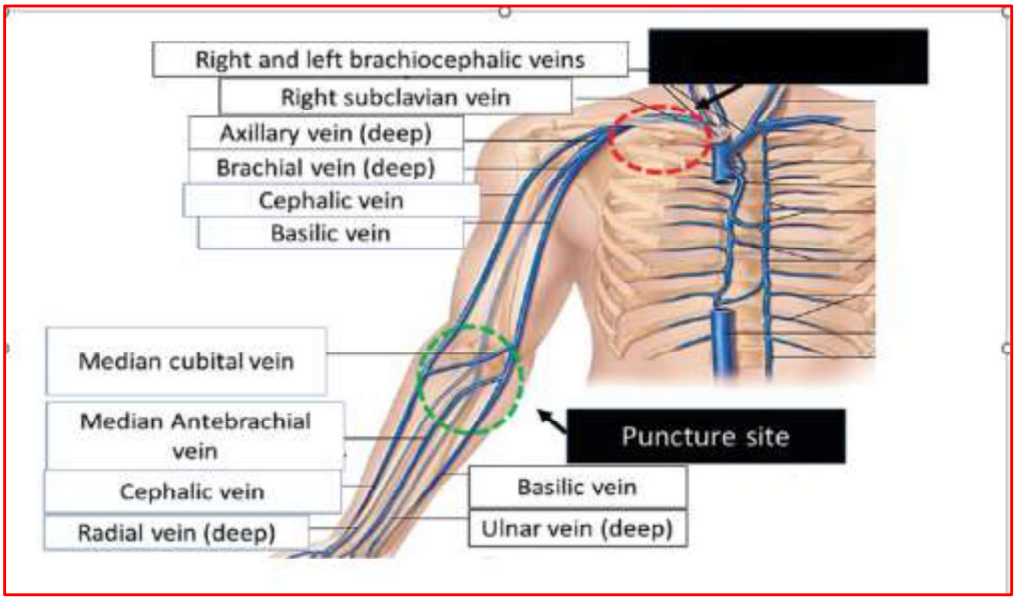
Patient Positioning and Preparation

Proper patient preparation and positioning are fundamental to successful CT Angiography. Before the examination, the procedure is clearly explained to ensure patient understanding and cooperation, with particular emphasis placed on breath-holding instructions to minimize motion during image acquisition.

Patients are positioned according to the anatomical region being examined, ensuring comfort and stability throughout the scan. Metallic objects are removed from the scan area to reduce image artifacts, and intravenous access is established in advance to facilitate contrast administration. Intravenous contrast material is delivered using an automated power injector to ensure consistent
and controlled contrast flow. Image acquisition is carefully timed to coincide with peak arterial or venous opacification within the target vessels, allowing clear visualization of the vascular lumen and accurate assessment of vessel continuity.

Scan timing is commonly achieved using standardized techniques such as the test bolus method or automated bolus tracking. These approaches allow scan initiation to be adjusted according to individual patient circulation and the specific vascular territory being examined. Proper timing helps reduce venous overlap, enhance arterial visualization, and improve overall diagnostic image quality. The selection of the timing technique is guided by clinical indication, anatomical region, and institutional protocol, ensuring flexibility maintaining consistent imaging standards.

Fig(1): patient positioning for angiography CT



Fig(2): right upper – extremities venous anatomy

Contraindications

CT Angiography has several contraindications that must be considered before performing the examination to ensure patient safety and diagnostic effectiveness. Known hypersensitivity or severe allergic reaction to iodinated contrast media represents a major contraindication. Renal impairment is another important consideration, as the use of iodinated contrast may increase the risk of contrast-induced nephropathy. Pregnancy is considered a contraindication due to exposure to ionizing radiation, unless the clinical benefit clearly outweighs the potential risk. In addition, patients who are unable to cooperate with the examination, particularly those who cannot follow breath-holding instructions or remain still, may produce non-diagnostic images and are therefore not suitable candidates for CTA. Poor intravenous access that cannot support contrast injection may also limit the feasibility of the examination. These contraindications should be carefully evaluated prior to CT Angiography, with alternative imaging modalities considered when appropriate.

Technical Considerations

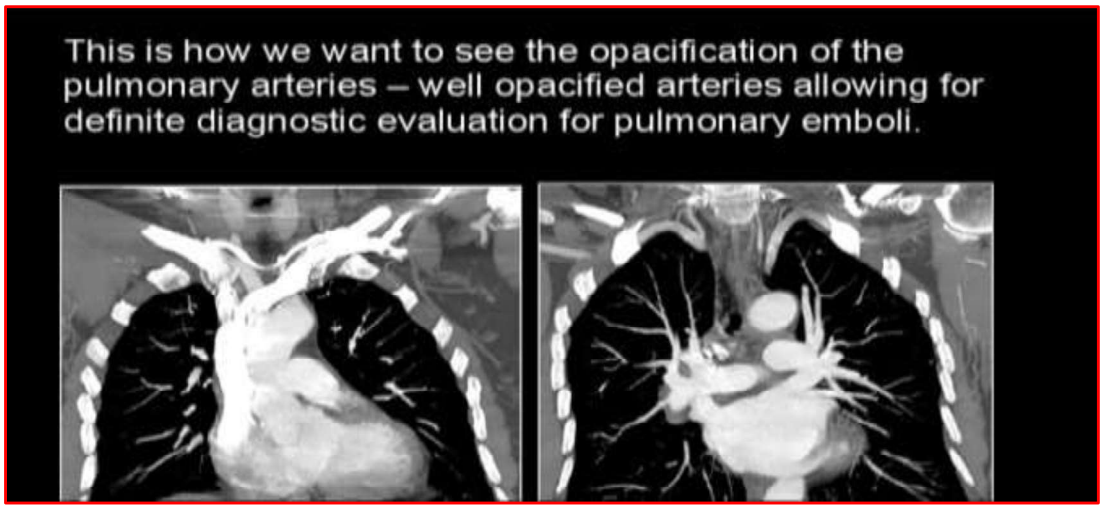
Image quality in CT Angiography depends on the coordinated interaction of several technical factors. Control of patient motion is a critical requirement, as vascular structures are particularly sensitive to movement. Even minor patient motion may degrade vessel sharpness and obscure fine anatomical details, reducing diagnostic accuracy. Another essential factor is the precise coordination between contrast enhancement and image acquisition. Optimal visualization of vascular structures is achieved when scanning is performed during peak intravascular contrast opacification. Inaccurate timing may result in insufficient vessel enhancement or venous contamination, negatively affecting image clarity and interpretability. Appropriate planning of scan coverage also plays a significant role in CTA image quality. Accurate definition of the scan range ensures complete visualization of the vessels of interest while minimizing unnecessary imaging of adjacent regions. Proper scan planning supports efficient image acquisition, optimal diagnostic yield, and appropriate radiation dose management.

The importance of correct breathing technique for "CT pulmonary emboli"- it is not just about having many "slice "in your scanner.

One of most common Couse for failing CT exam is the breathing instruction that given to the patient ,the breathing instruction to the patient should be " stop breathing" and not take "deep breath and hold ".

Most often failed exam depend on dilution of the contrast media in the pulmonary arteries due to mixing with non opacified blood from the inferior Vena Cava.

Another reason why some exams do not turn out excellent is due to the large size of some patient.



Scanning Protocols

CT Angiography examinations are performed using standardized scanning protocols that are tailored to the anatomical region and clinical indication. These protocols define key aspects such as scan coverage, acquisition direction, and image reconstruction strategy to ensure optimal visualization of the target vascular structures. In educational contexts, CTA protocols are presented at a conceptual level to explain their diagnostic purpose rather than specific scanner parameters, allowing learners to understand the principles of protocol selection while reserving detailed optimization for practical training. CTA protocols are broadly classified according to the vascular territory being examined, including thoracic, pulmonary, abdominal, peripheral, and cardiac CT angiography. Although each protocol is adapted to a specific clinical application, all follow common fundamental principles related to contrast timing, motion control, and appropriate scan coverage.

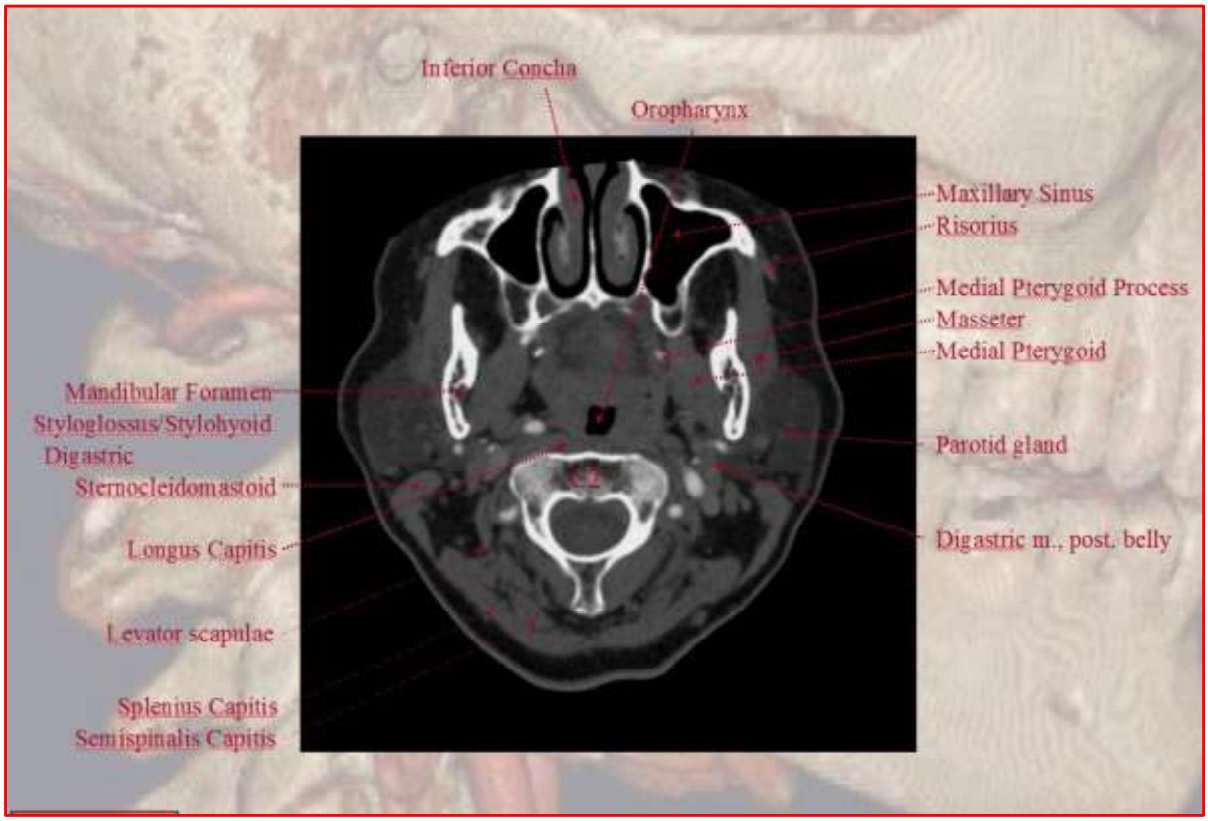
Common CT Angiography Protocols

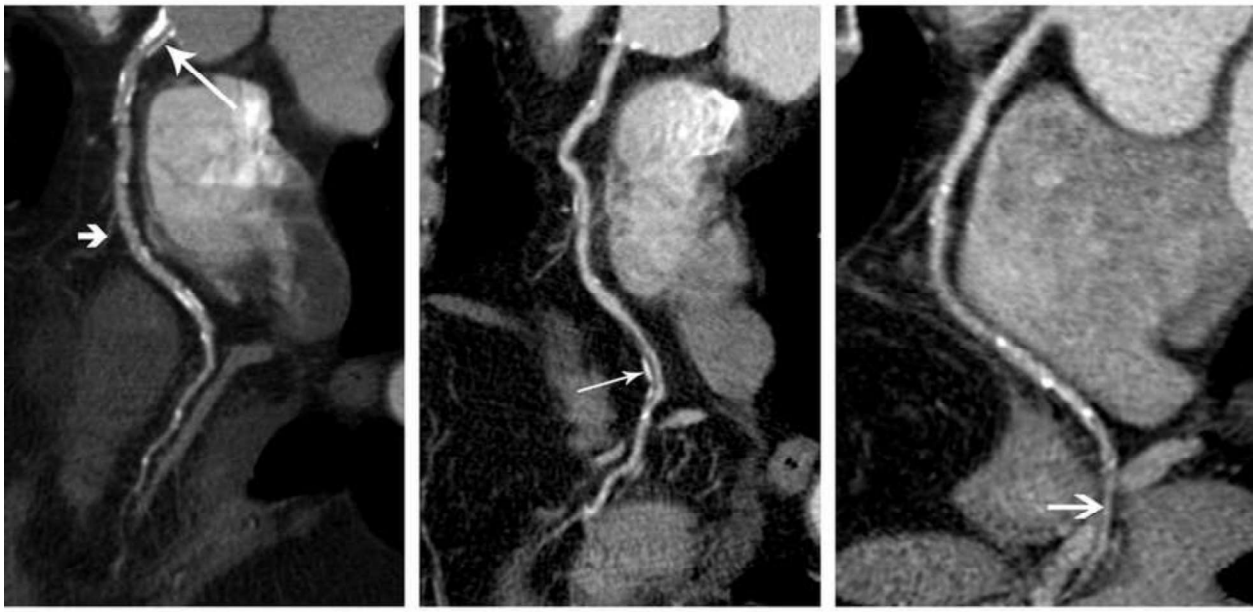
Thoracic CT Angiography is used to evaluate the major thoracic vessels, particularly the thoracic aorta and its branches. It is performed to assess conditions affecting the thoracic vascular system and to demonstrate vessel continuity and anatomical relationships within the chest. (Thoracic Aorta CTA) Pulmonary CT Angiography is primarily performed to visualize the pulmonary arterial system. It focuses on assessment of the pulmonary arteries and their branches and is optimized to demonstrate intravascular contrast within the pulmonary circulation. Like Pulmonary Embolism CTA Abdominal CT Angiography is used to evaluate the abdominal aorta and its major visceral branches supplying abdominal organs. It allows detailed anatomical assessment of abdominal vascular structures and their relationship to surrounding organs. Peripheral CT Angiography is performed to assess the arterial system of the upper or lower extremities. It is used to demonstrate vessel patency, arterial continuity, and overall vascular anatomy along the limbs. like upper and Lower Limb Peripheral CTA Cardiac CT Angiography is specifically designed to visualize the coronary arteries and cardiac vascular anatomy. It focuses on detailed assessment of the coronary arterial system and its anatomical course around the heart like Coronary CTA Neuro (Head and Neck) CT Angiography is performed to evaluate the intracranial

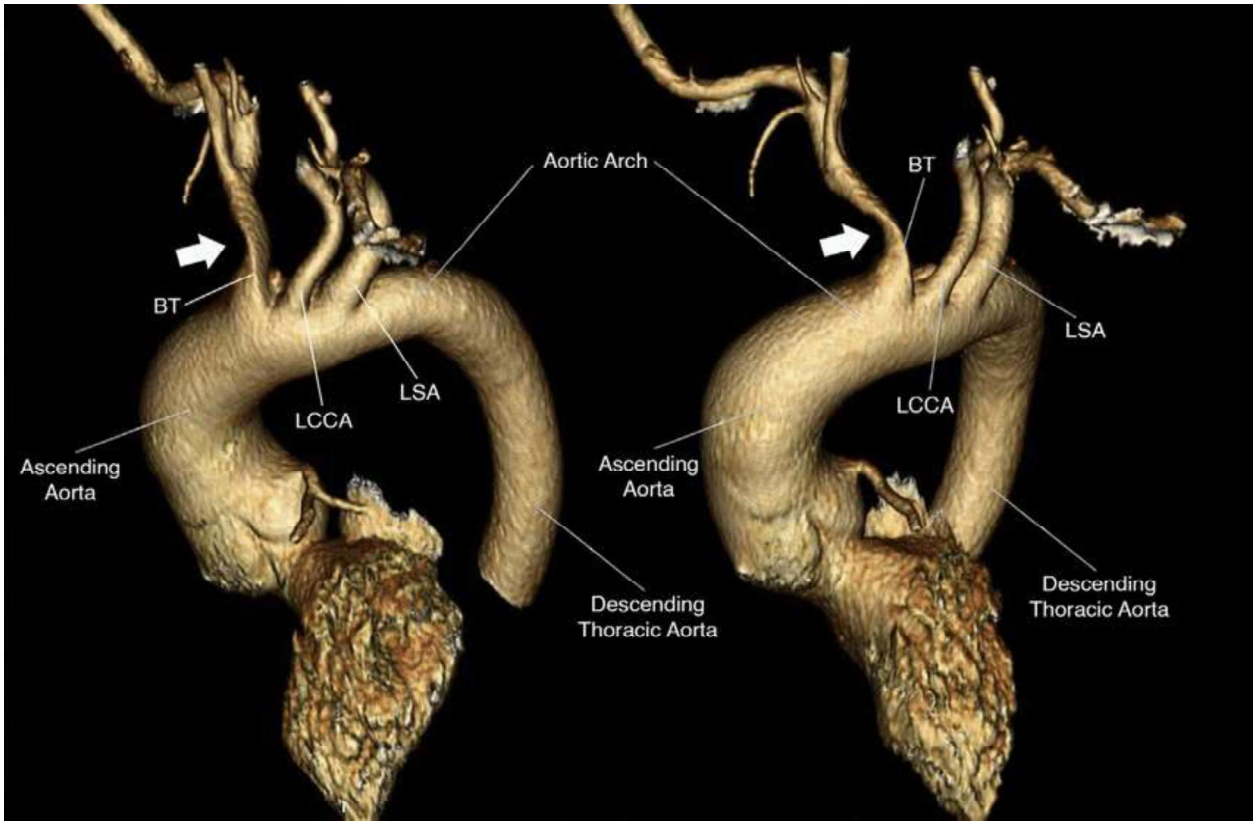
and extracranial arterial circulation. It is used to visualize cerebral arteries and their branches and to assess arterial anatomy within the head and neck region. Head and Neck CTA Although CT Angiography is primarily used for arterial evaluation, CT Venography may be performed using dedicated protocols to assess venous structures when clinically indicated like Cerebral CT Venography ,Abdominal Venography ,and Lower Limb Venography

Image Acquisition and Post-Processing

CTA images are primarily evaluated using axial images, which represent the reference standard for assessing vascular anatomy, image quality, and vessel continuity. Multiplanar reformations (MPR) support visualization of vessel course in different planes, while three-dimensional (3D) reconstructions provide an overall anatomical overview. Although 3D images are useful for visualization and educational purposes, axial images remain essential for accurate diagnostic assessment. Correlation between axial images and reconstructed views is required to ensure reliable image interpretation.

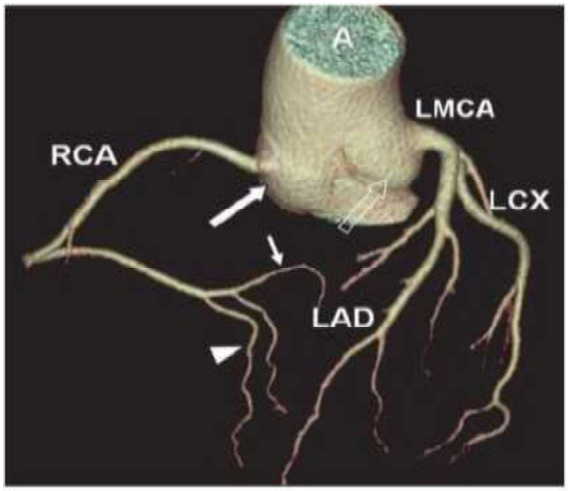




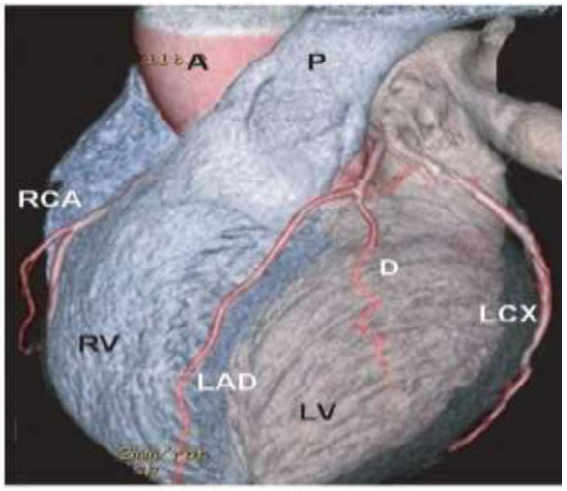


Common CTA Appearances

CT Angiography demonstrates characteristic appearances of normal vascular anatomy, including clear visualization of the vessel lumen, wall definition, and branching patterns. Variations in vessel calibre and anatomical course may be appreciated based on normal anatomical diversity and spatial orientation.



(a)



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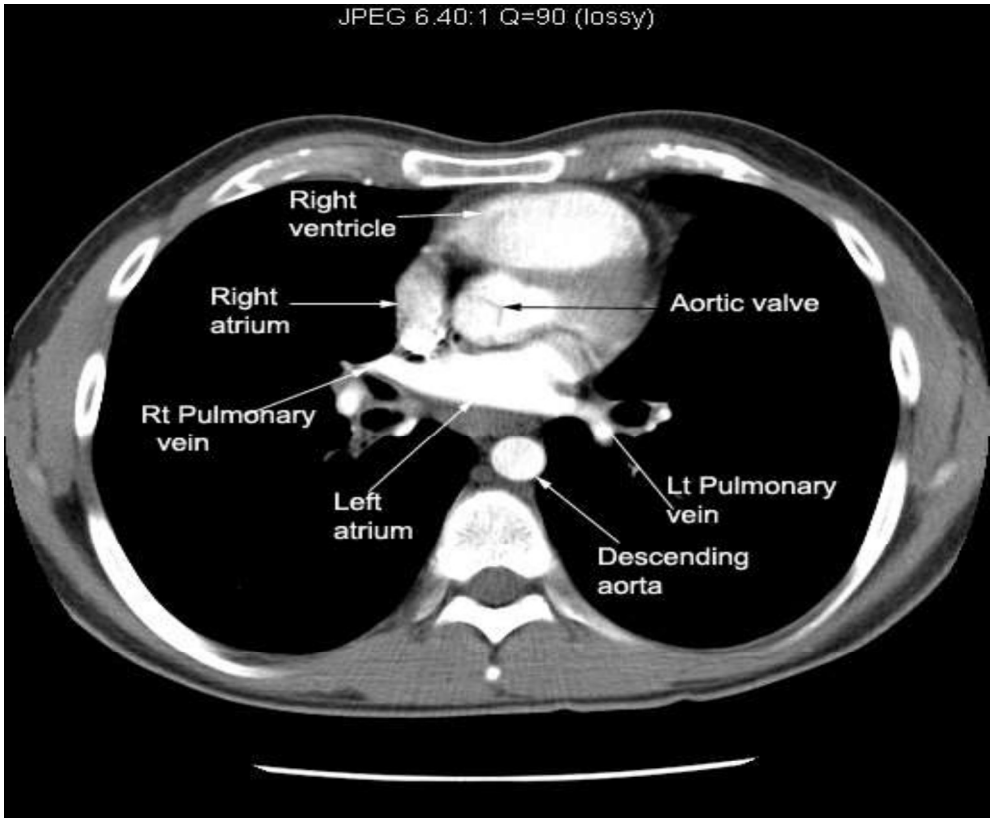

Exam Advantages and limitations

CT Angiography offers several important advantages that make it a widely used imaging modality for vascular assessment. It allows rapid image acquisition with high spatial resolution, enabling detailed visualization of vascular anatomy within a short examination time. CTA provides clear depiction of vessel lumen, wall contours, and branching patterns in a non-invasive manner, reducing the need for more invasive diagnostic procedures. In clinical practice, CT Angiography serves as an essential adjunct to other vascular imaging modalities by offering comprehensive anatomical information across a wide range of

applications, including thoracic, pulmonary, abdominal, peripheral, and cardiac vascular imaging.

Despite its advantages, CT Angiography has recognized limitations. Image quality may be affected by patient motion, improper breath-holding, or suboptimal timing of contrast enhancement, which can reduce vessel opacification. CTA primarily provides anatomical rather than functional information and does not directly assess blood flow dynamics or physiological significance of vascular findings. Additionally, interpretation of CTA images requires awareness of technical and patient-related factors that may influence image appearance.

Posttest: الاختبار البعدي:

1. **Mention common CT Angiography Protocols?**
2. **Numerate CT Angiography advantage & limitation?**

References: المصادر:

References

4. **Romans, L. E. *Computed Tomography for Technologists: Exam Review*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 2011.**
5. **Seeram, E. *Computed Tomography: Physical Principles, Clinical Applications, and Quality Control*. 4th ed. St. Louis: Elsevier; 2016.**
6. **Hofer, M. *CT Teaching Manual: A Systematic Approach to CT Reading*. Stuttgart: Thieme; 2010.**