

Imaging Aortic Pathologies in Computed Tomography (CT)

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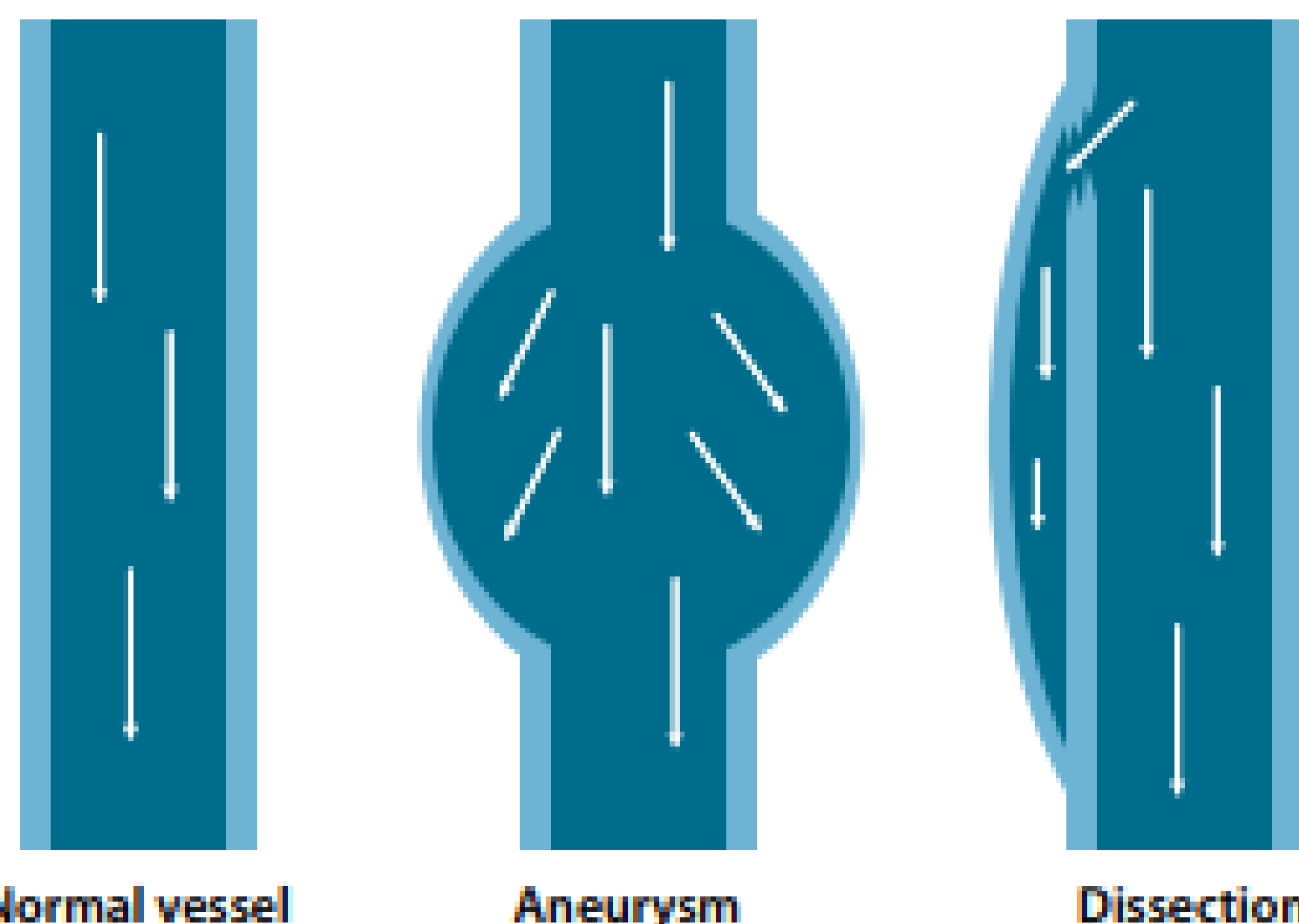
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Introduction

- The aorta is the largest vessel in the body
- Beginning at the left ventricle of the heart, the aortic root moves superiorly to become the aortic arch, where it gives rise to the brachiocephalic trunk, left common carotid artery, and left subclavian artery
- The abdominal aorta supplies numerous structures with blood before bifurcating into the iliac arteries at the level of the fourth lumbar vertebra (Gialanella & Troller, 2021, p. 400).
- Susceptible to several pathologies that can quickly become fatal due to constant high blood volume

Aortic Pathologies

1. Dissections: The inner layer of the aorta tears and blood flows between the layers, separating them.
 - 50% mortality within the first 48 hours
 - Often missed upon presentation to the emergency department (Levy, Goyal, Grigorova, Farci, & Le, 2022, para. 2)
2. Aneurysms: A weakness in part of the vessel wall, which causes it to dilate.
3. Rupture: A result of either of these pathologies and can be fatal.



Aneurysm vs Dissection
(Gialanella & Troller, 2021, p. 401).

Signs and Symptoms

Can vary widely, but generally:

- Ascending aorta: Anterior chest pain
- Descending aorta: Back pain
- Hypertension

Risk Factors:

- Congestive heart failure
- Acute coronary syndrome
- Hypotension (Ko et al., 2021, p. 405)
- Marfan's syndrome
- Family history
- Pregnancy and delivery (Levy et al., 2022, para. 4)

Prognosis and Treatment

- Ascending aorta: Surgical emergency, often treated immediately with open surgical repair
- Descending aorta: Managed with medication or an endovascular repair procedure (Ko et al., 2021, p. 405)
- **Endovascular repair:** Minimally invasive stent placement to minimize and repair damage to the vessel wall, while also preventing rupture. A surgical alternative that can improve patient prognosis (Uchida & Sadahiro, 2018, pp. 464-465).

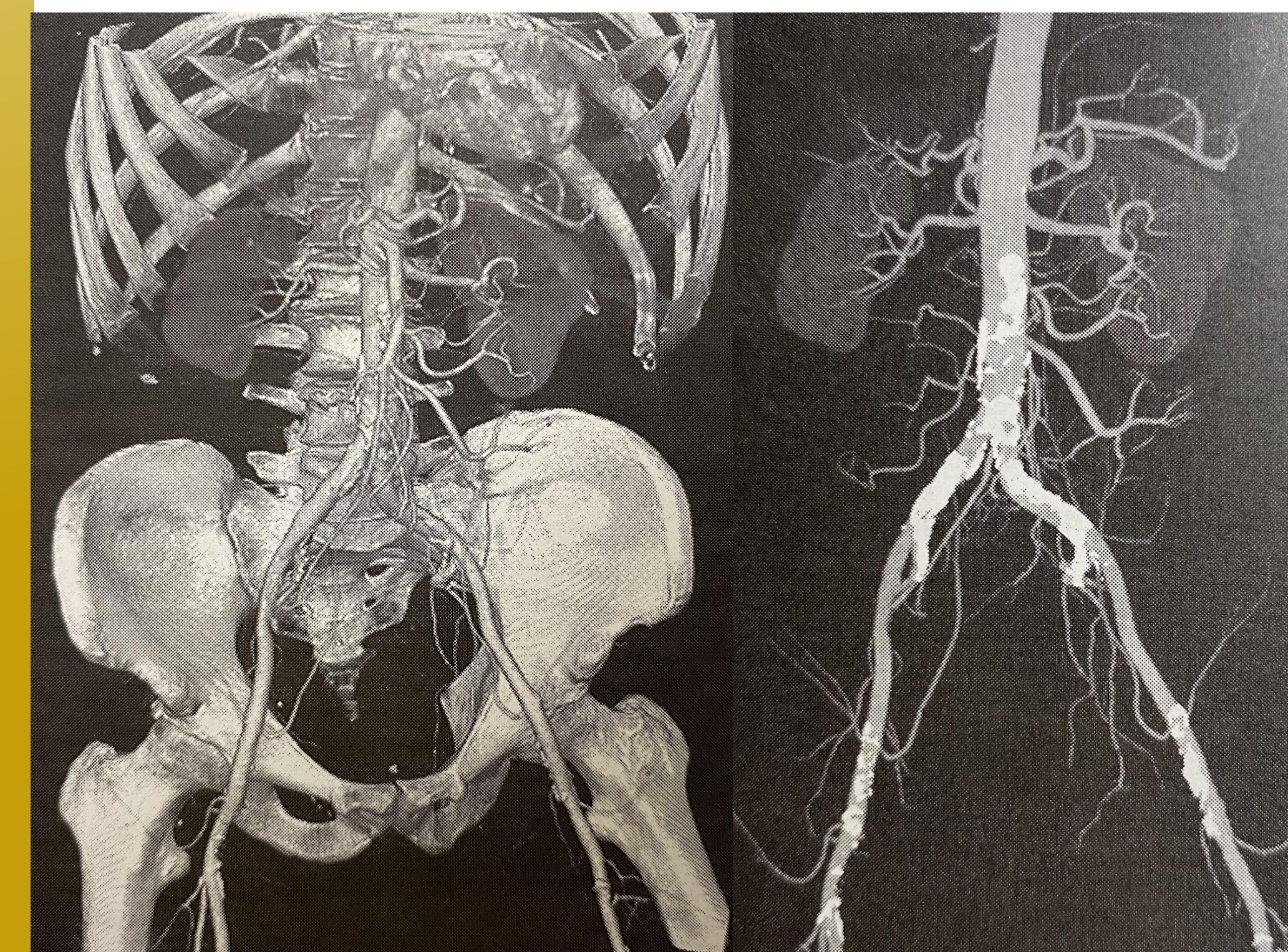
Digital Definitions

Most CT studies of the aorta consist of these post-processing reconstructions:

1. **Multiplanar Reformating (MPR)**- Data acquired during the scan in the axial plane can be reformatted into the coronal and sagittal planes through computer post-processing.

Digital Definitions (cont.)

2. **Maximum Intensity Projection (MIP)**- Only the brightest parts of the image are identified and mapped to create the final image.
3. **Shaded Surface Display (SSD)**- An opaque surface is created on the structure of interest to display dimension and allow for easier identification of pathology.
4. **Volume Rendering (VR)**- A three-dimensional reconstruction of the anatomy of interest, with the potential for subtraction of other structures (Kelley & Petersen, 2018, pp. 8-11).



SSD and MIP reconstructions of the abdominal aorta (Kelley & Petersen, 2018, pp. 10,12).

CT Protocols

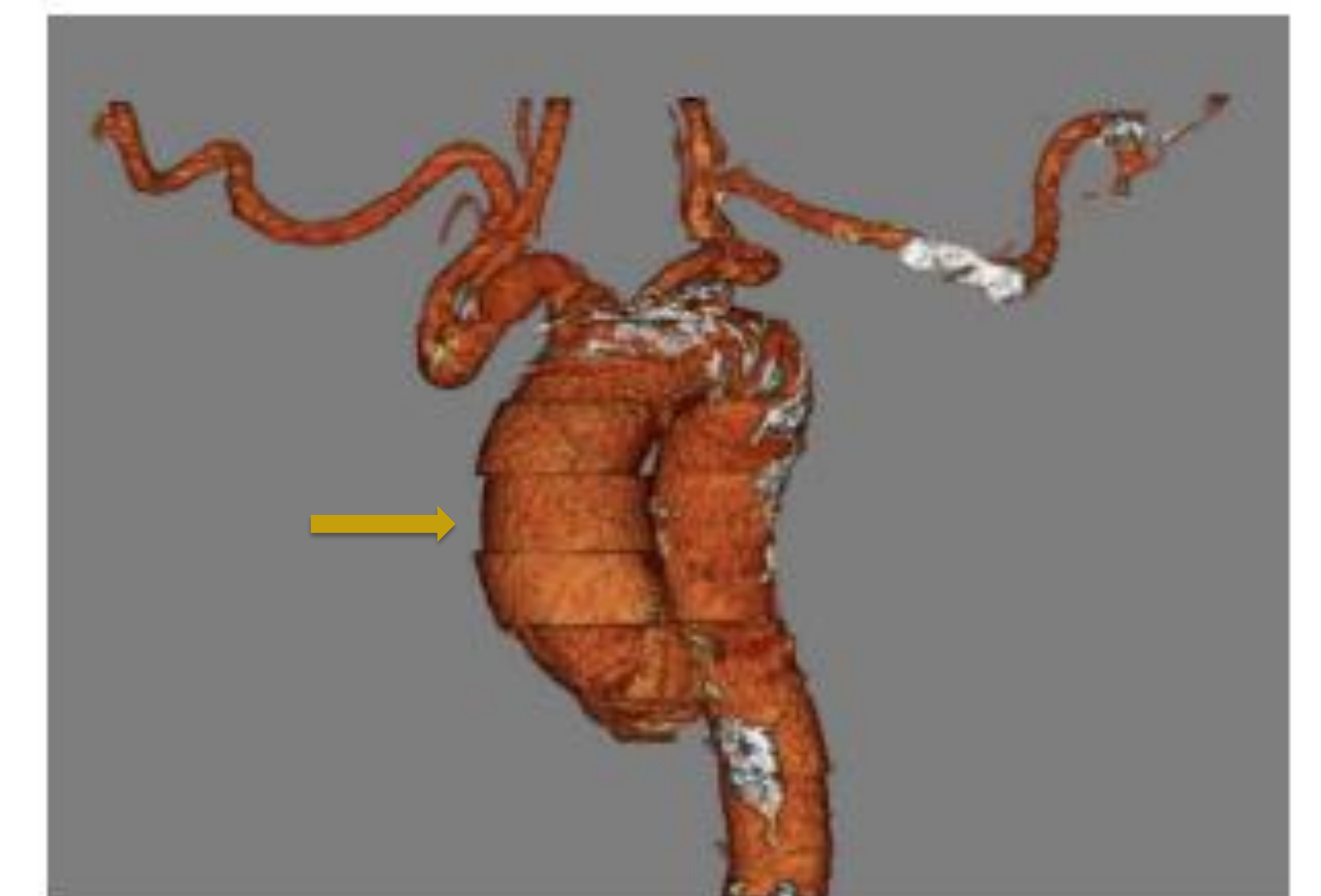
CT is the modality of choice for aortic pathologies because of its fast acquisition times and detailed images.

Procedure: Injection of iodinated contrast media at a high rate of speed with a timed bolus. Images are acquired at peak opacification, but motion artifact from the heart must be avoided.

CT Protocols (cont.)

ECG gating: Attaching heart leads to the patient so the scan can be completed without involuntary motion artifact.

- **Prospective gating:** Images acquired during diastole, when there is no cardiac motion. Requires a steady heart rate, but lowers radiation dose.
- **Retrospective gating:** Images acquired during the entire cardiac cycle, but only some are selected for reconstruction. Better for unpredictable heart rhythms or a high heart rate (Gialanella & Troller, 2021, pp. 405-406).



Stair-step artifact can occur if the wrong type of ECG gating is used (Gialanella & Troller, 2021, p. 407).

Conclusion

CT is the gold standard for imaging of the aorta and its vessels. The accuracy, speed, and image quality to do so has improved over time and will only continue to improve.

Aortic pathologies are serious and must be precisely identified, mapped, and treated in the shortest time possible to allow the best chance of recovery for the patient. Because of CT, the long-term prognosis for these aortic pathologies is no longer as grim as it used to be.