CT and MRI of Aortic Dissection

Dr Gauri Rani Karur, MD

Toronto Joint Department of Medical Imaging

Peter Munk Cardiac Centre, Toronto General Hospital

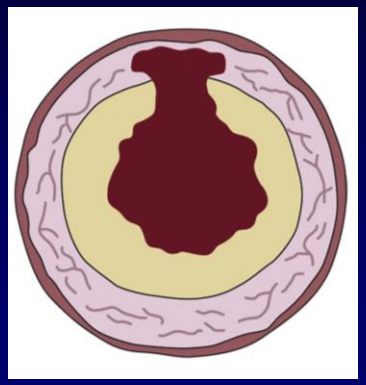
Assistant Professor, Department Medical Imaging

University of Toronto

Objectives

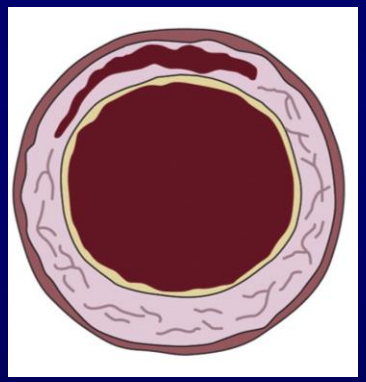
- Discuss the spectrum of acute aortic syndrome (AAS)
- Discuss CT and MR imaging features of aortic dissection (AD)
- Compare CT/MRI vs. echocardiography for imaging of AD

Acute Aortic Syndrome



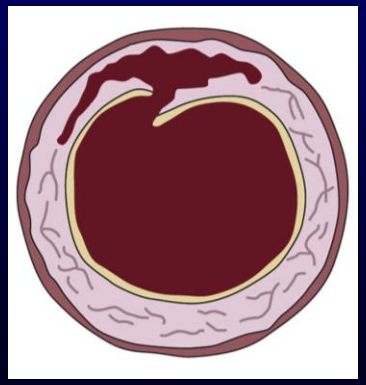
- **Penetrating aortic ulcer (PAU)**

  Crater-like outpouching in the aortic wall, accompanied by significant atheroma



- **Intramural hematoma (IMH)**

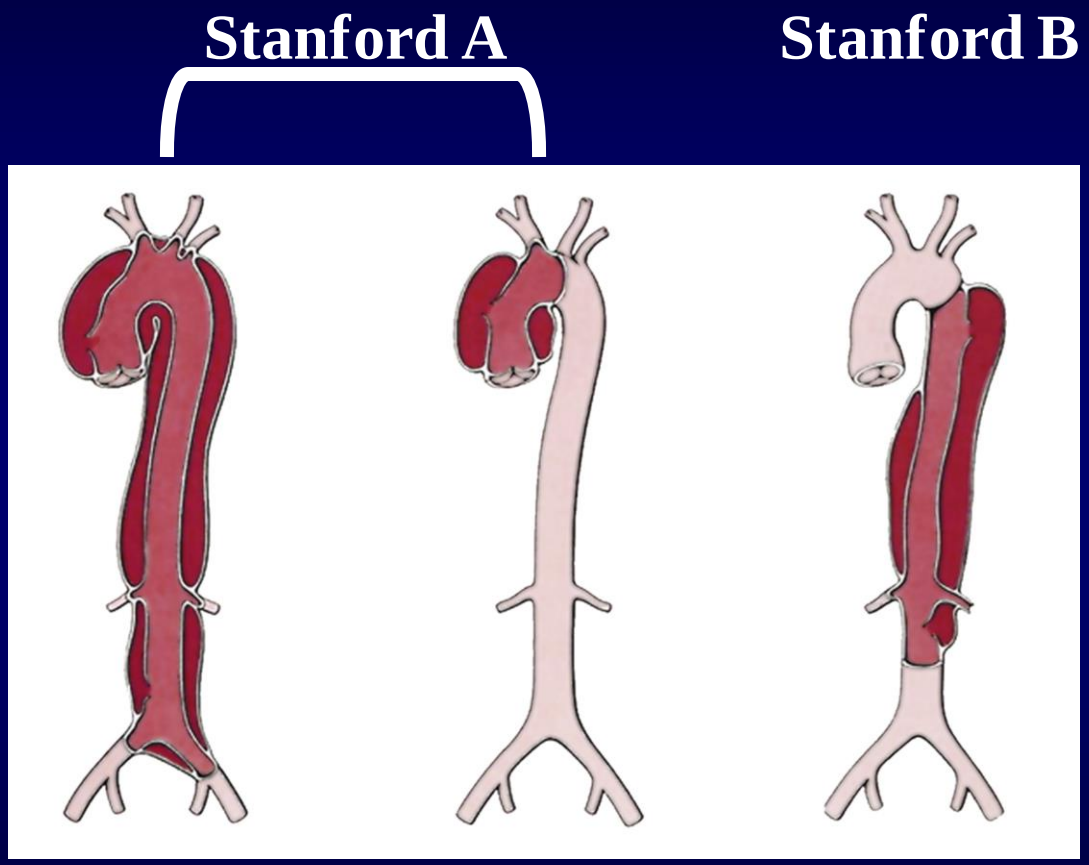
  Hemorrhage into the medial layer



- **Aortic Dissection (AAD)**

  Intimal tear allowing blood to enter medial layer

Classification of Aortic Dissection



Diagnosis & Management of AD

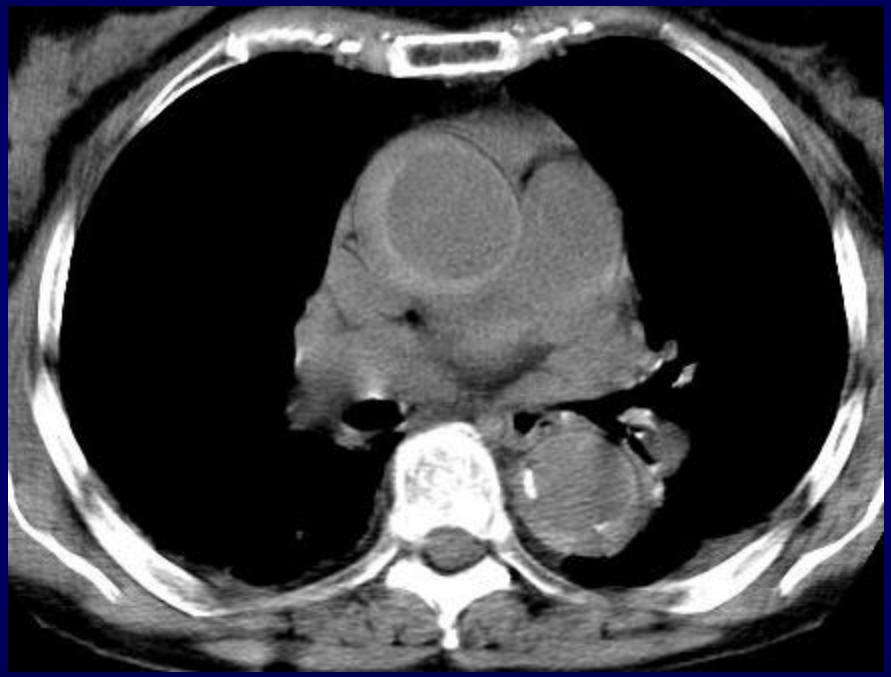
Multidisciplinary approach – patient, clinician, imager, surgeon and anaesthesiologist

Management decisions in AD

- Classification: Type A or Type B
- Organs at risk
- Complications (Coronary occlusion, rupture, aortic insufficiency)
- Diameters of true and false lumina
- Iliac vessel diameter and tortuosity

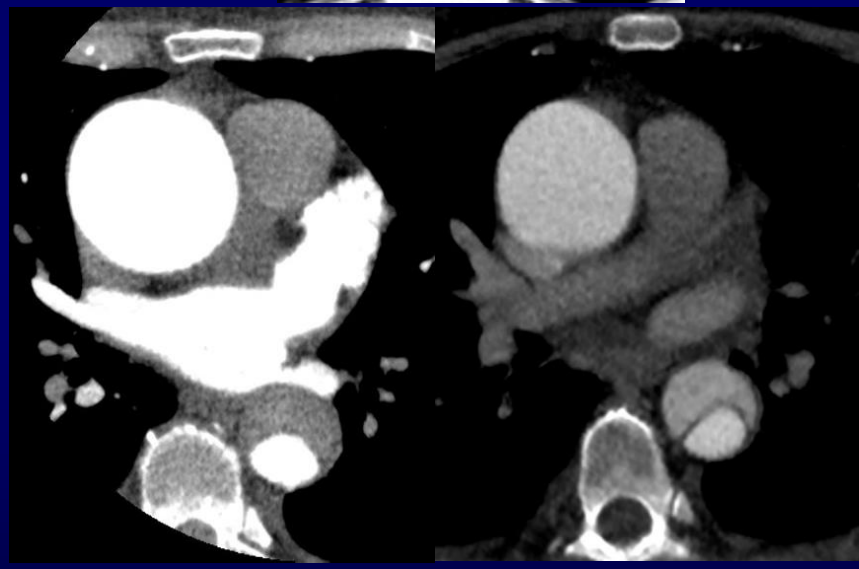
CT Imaging Protocol: Non-contrast CT

- Rule out IMH
- High-density crescent in aortic wall
- Internal displacement of intimal calcification



CT Imaging Protocol

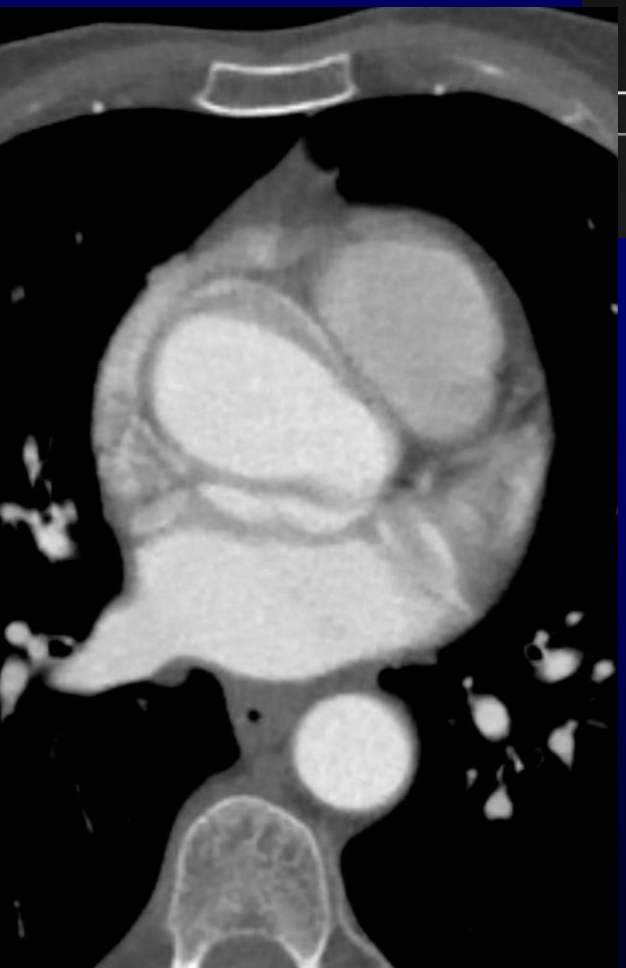
- Non-enhanced CT
  - To identify calcification, hemorrhage

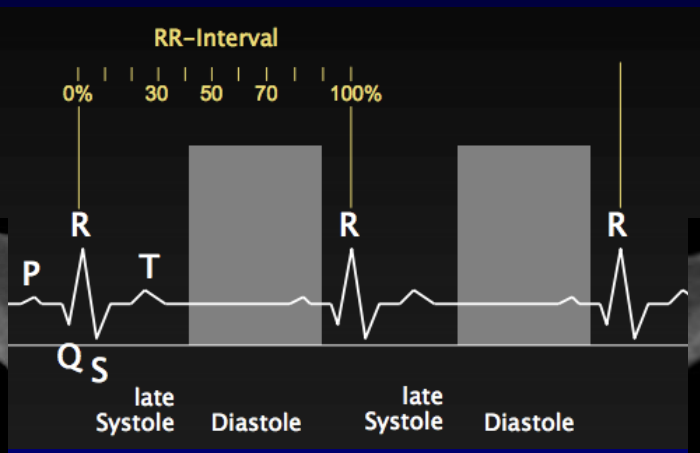


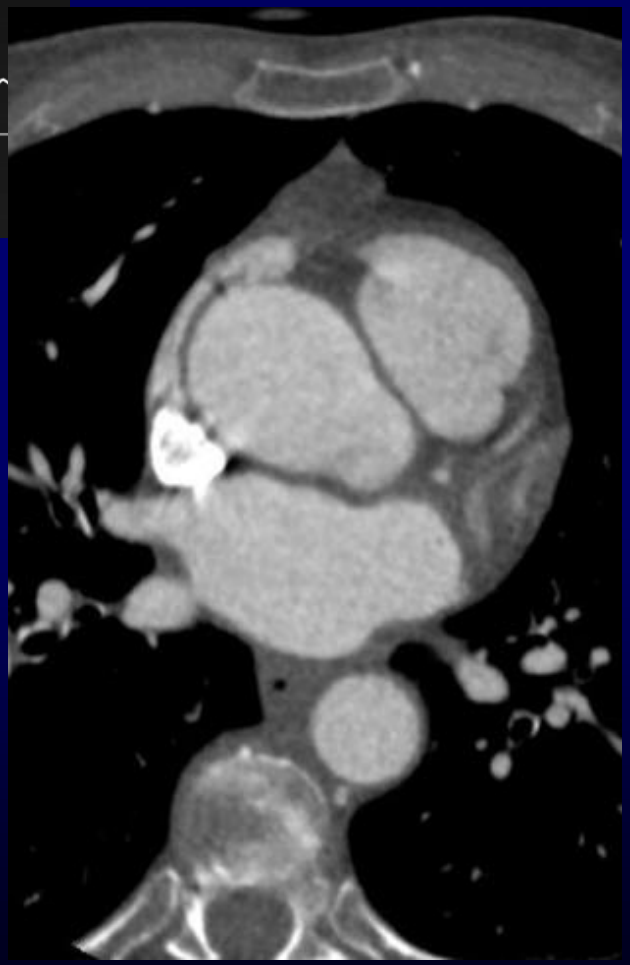
- Contrast-enhanced CT
  - Arterial and delayed phases

- ECG-triggered imaging or cardiac gating
  - Artifact reduction technique

ECG-triggered imaging or “Gating”



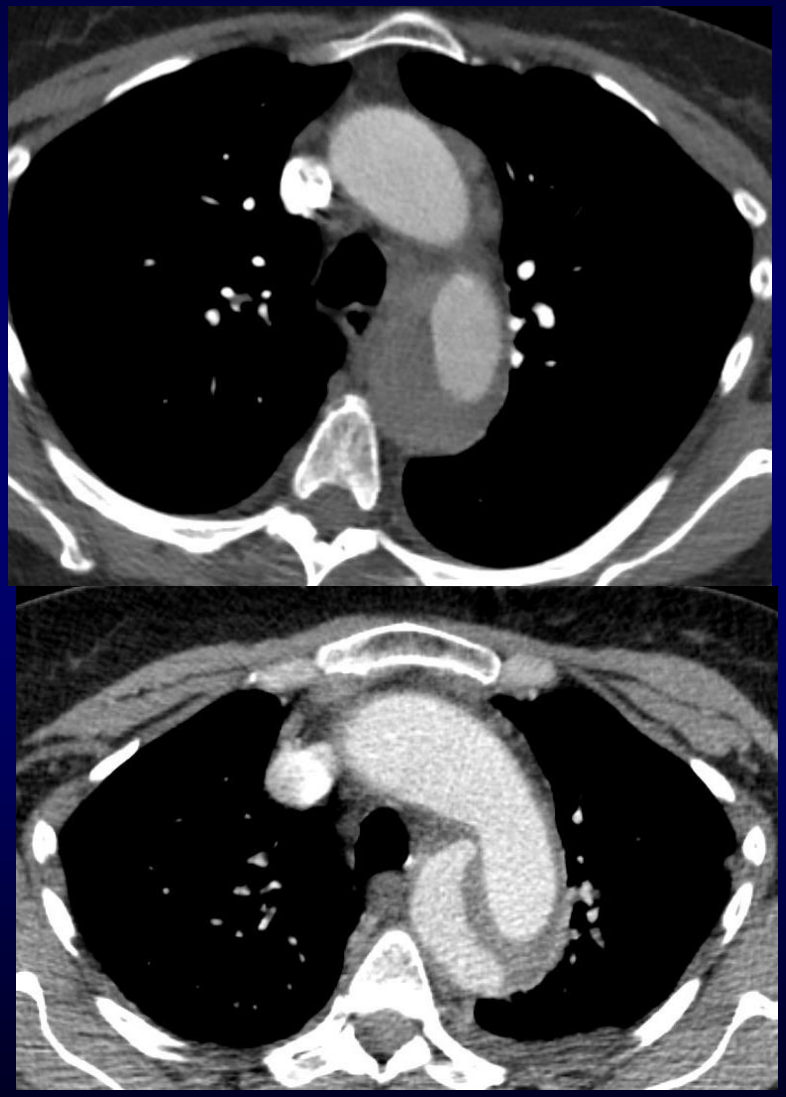




Imaging Features of AD

- Intimal flap (70%)
- Spiralling lumina around each other
- True lumen vs. False lumen

Imaging features of AD

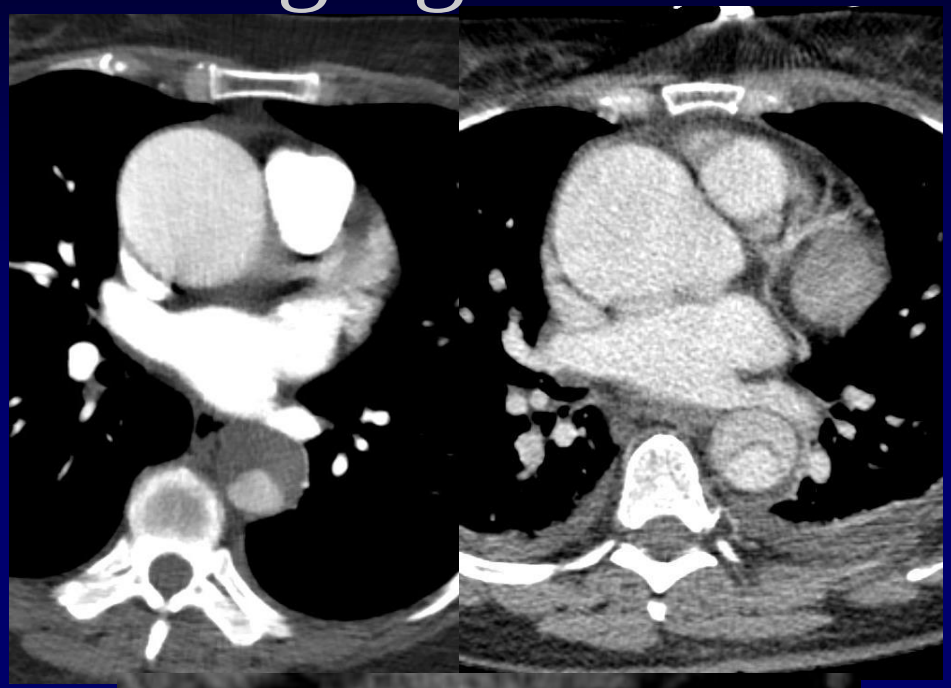


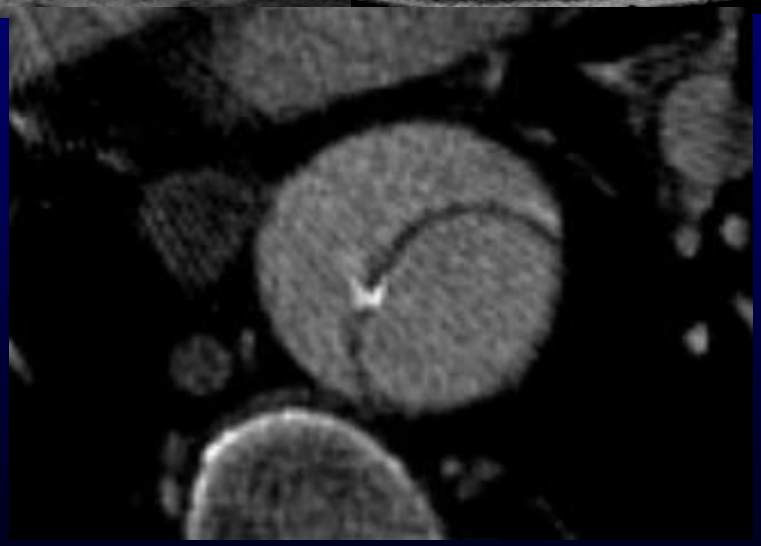
Intimal Flap

Imaging features of AD

Lumina spiral around each other

Imaging features of AD





True vs. false lumen

Property	**True Lumen**	**False Lumen**
Size	Smaller	Larger
Pulsation	Systolic expansion	Systolic compression
Within aortic arch	Inner contour	Outer contour
Signs of slow flow	Rare	Frequent
Thrombus	Rare	Frequent

Identification of involvement of major branches

Origin of major branches

Imaging the extent

Extent of dissection

Complications of AD

Acute

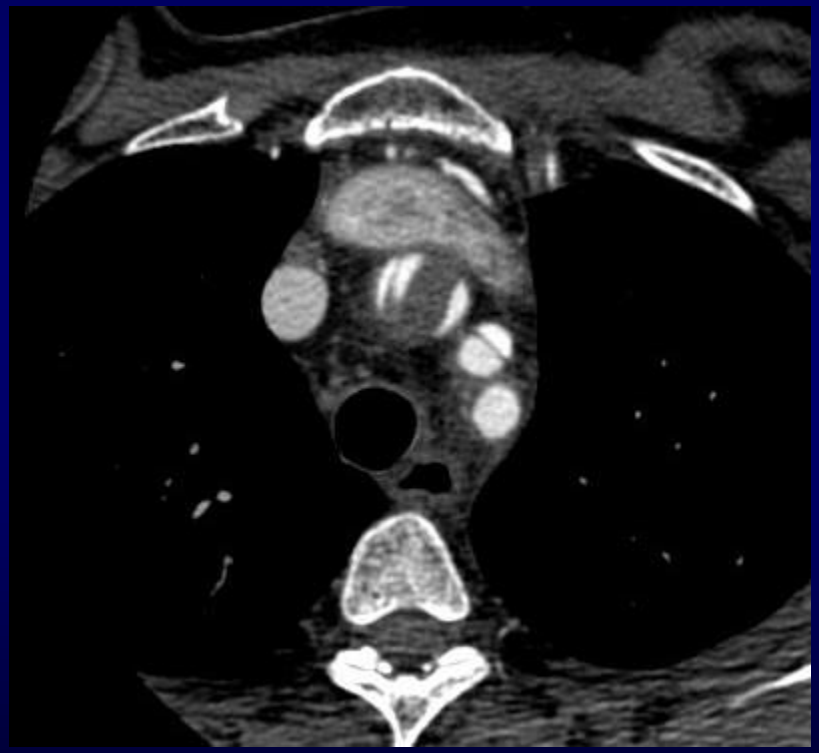
- Dissection in arch and abdominal branches
- Coronary occlusion, myocardial infarction
- Rupture, tamponade, mediastinal hematoma

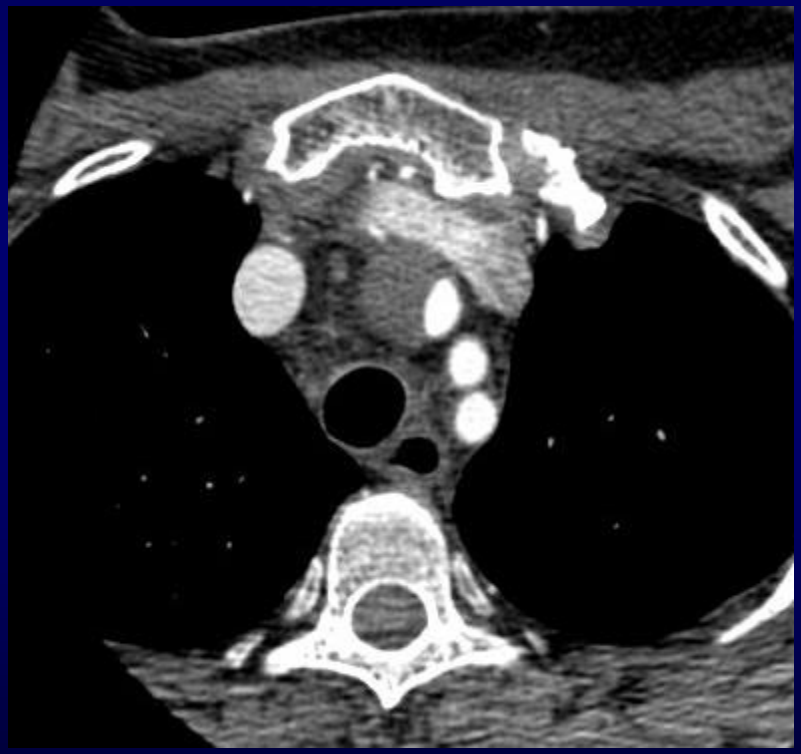
Late

- Progressive aortic insufficiency
- Aneurysm formation and rupture
- Recurrence or progression of dissection
- Leakage at anastomoses/stent sites
- Malperfusion

Complications of AD

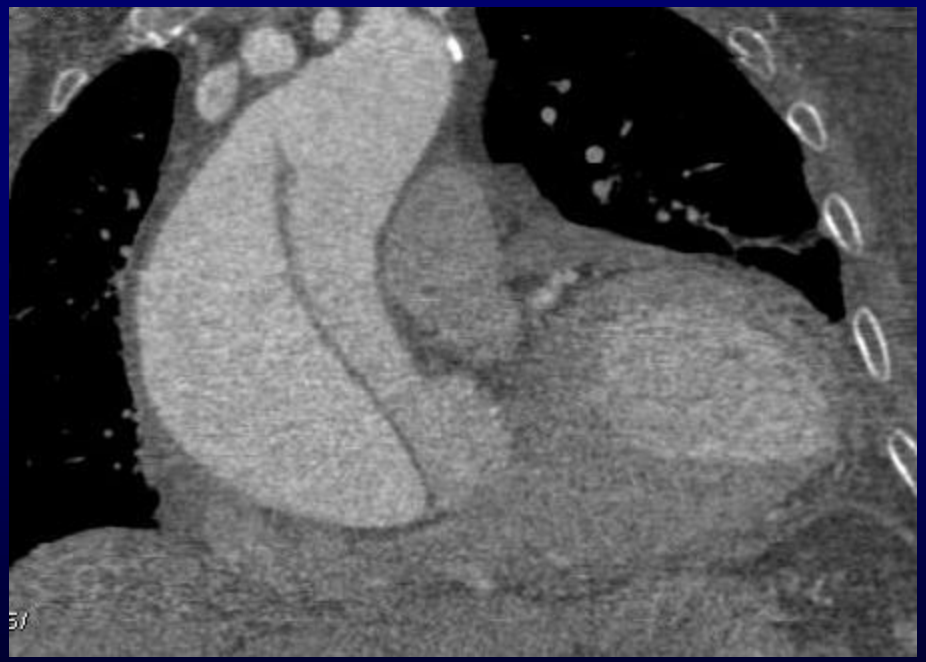
Dissection into arch branches



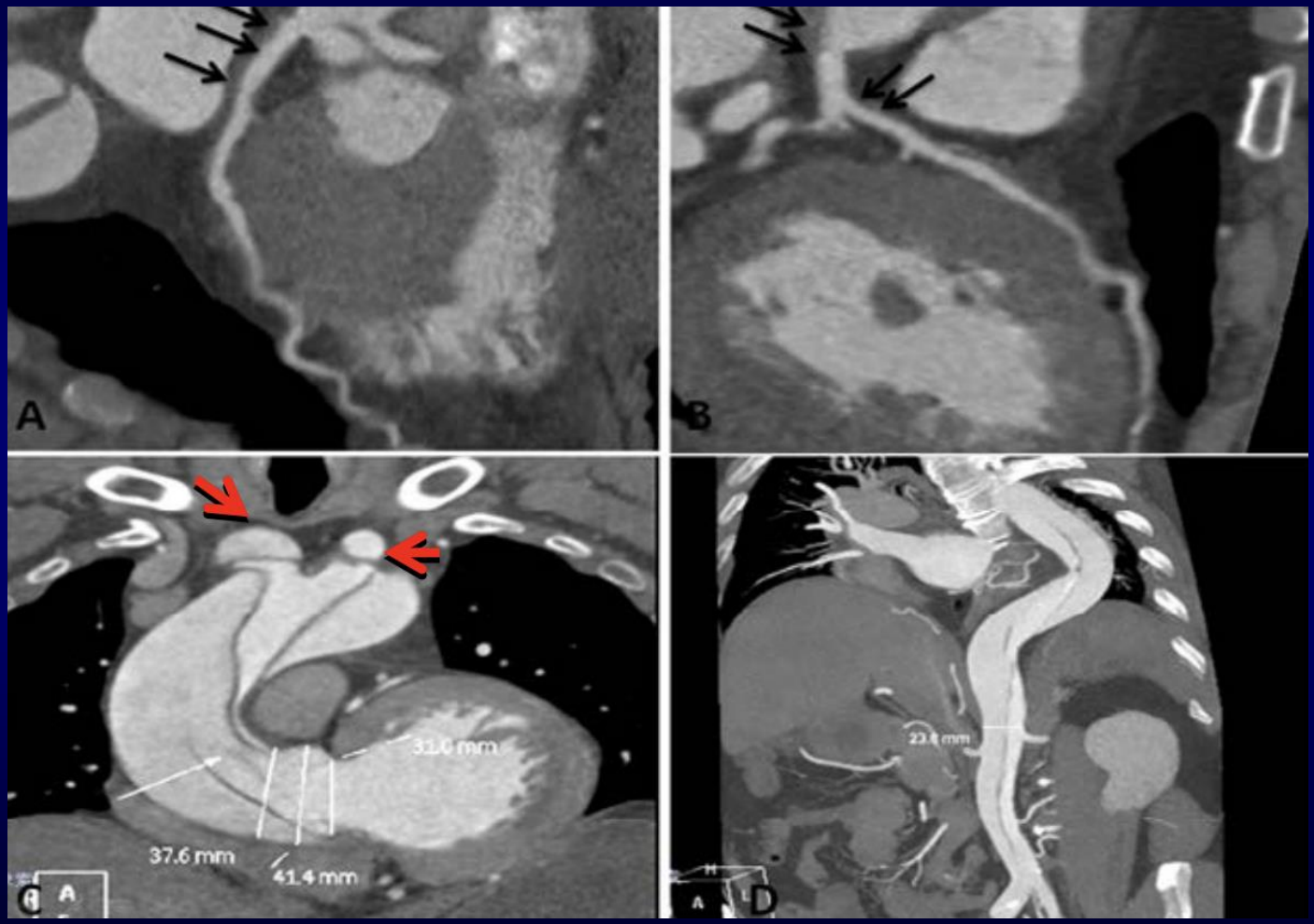


Complications of AD

Coronary occlusion and myocardial ischemia/infarction

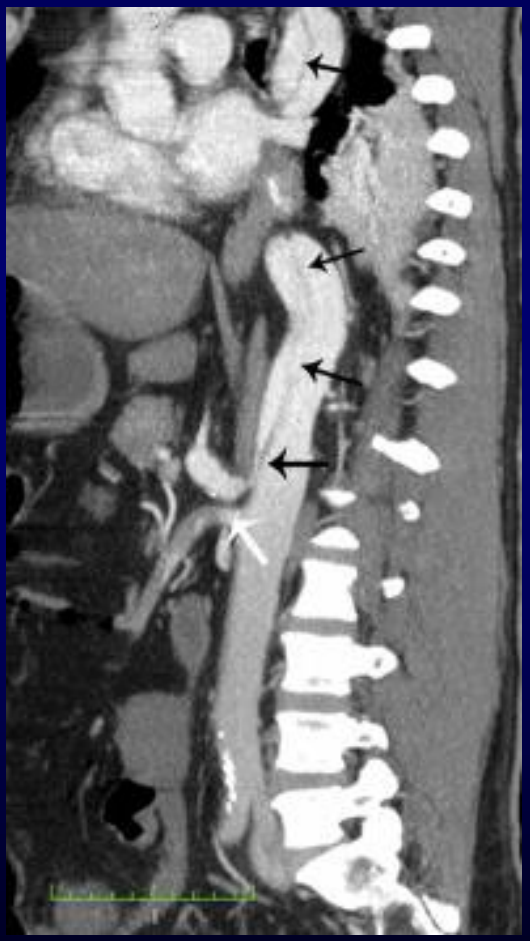


Complications of AD



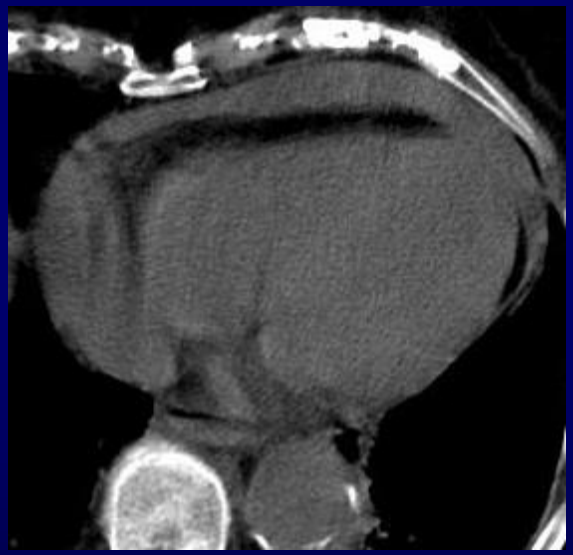
Complications of AD

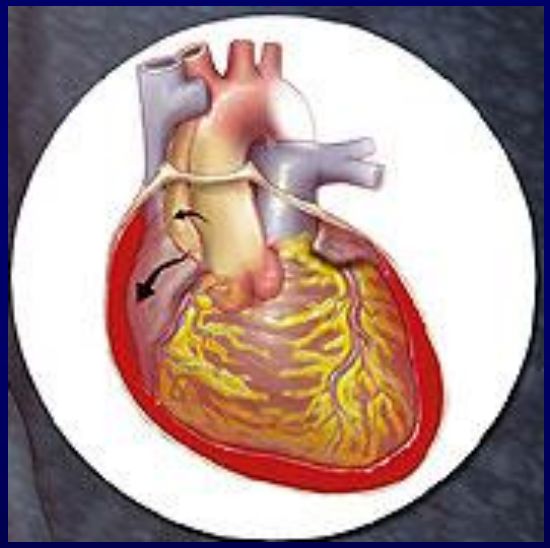
Dissection into abdominal branches



Complications of AD

Rupture





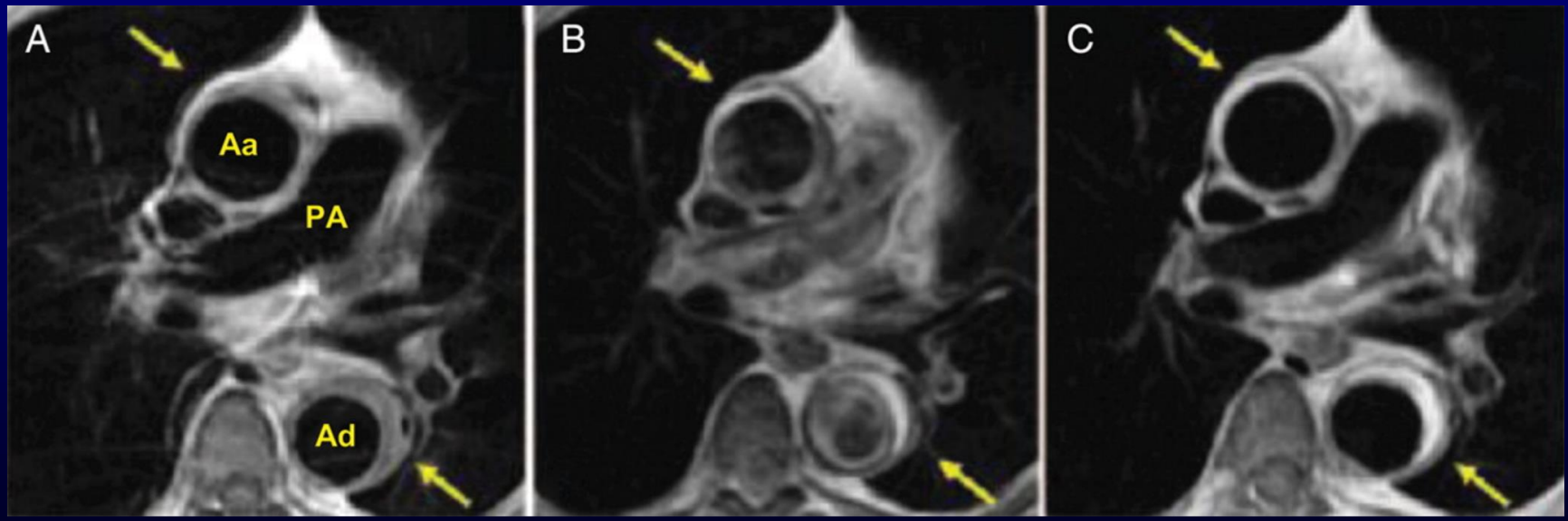
Role of MRI

- Complementary rather than competing modality
- No ionizing radiation
- Preferred for follow-up imaging
- Alternative in
  - Iodinated-contrast allergy
  - Renal failure

Role of MRI: T1 & T2

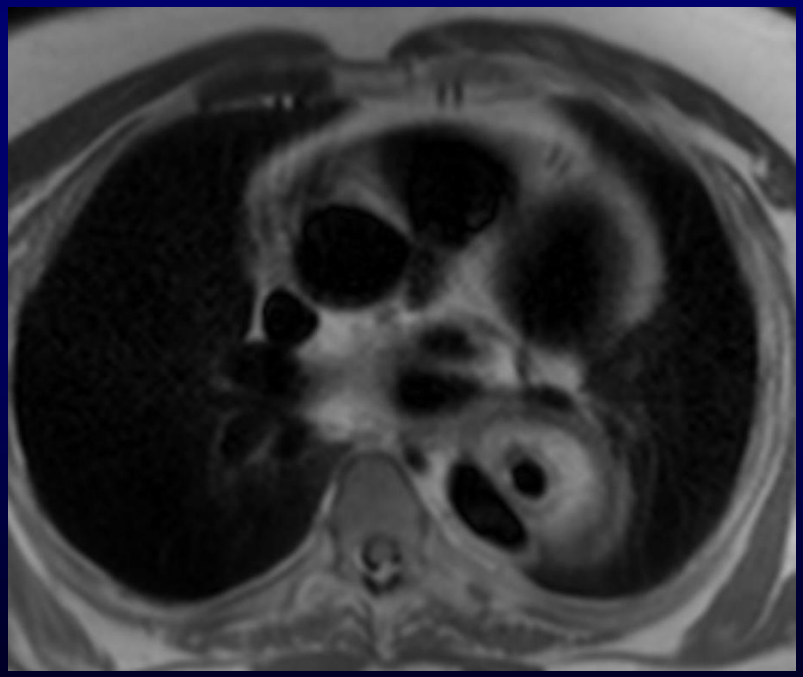
T1w – patho-anatomic detail of IMH, intimal flaps, atheromas

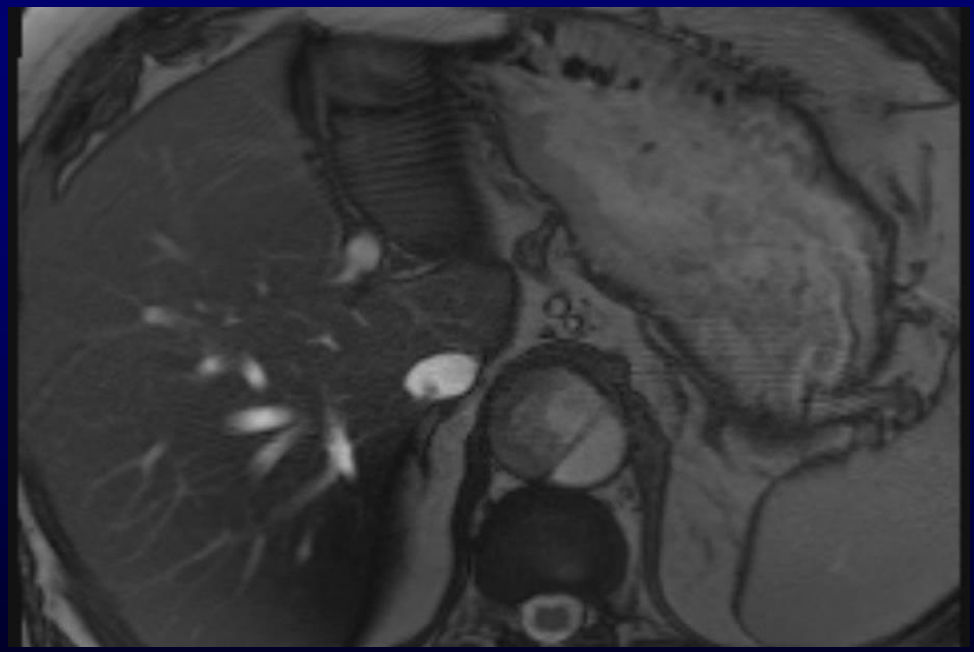
T2w – tissue characterization of aortic wall or blood compounds



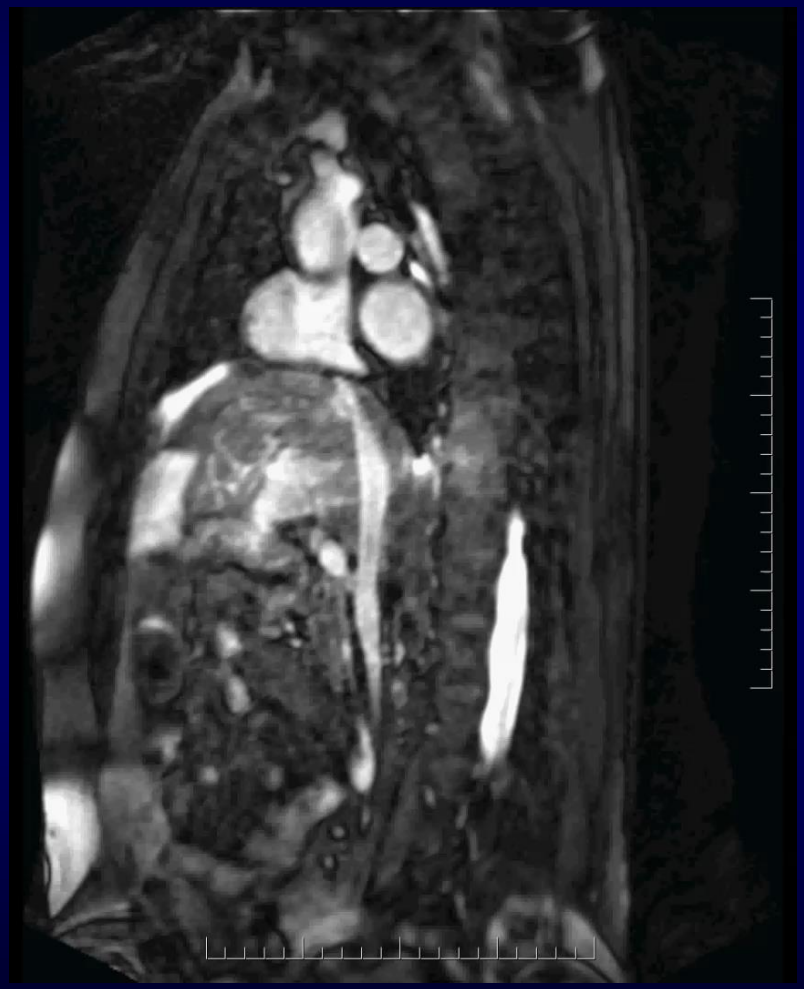
Role of MRI: T1 & T2

- High degree of reliability owing to its ability to delineate intrinsic contrast between bllod flow and vessel wall





Non-contrast MR Angiography

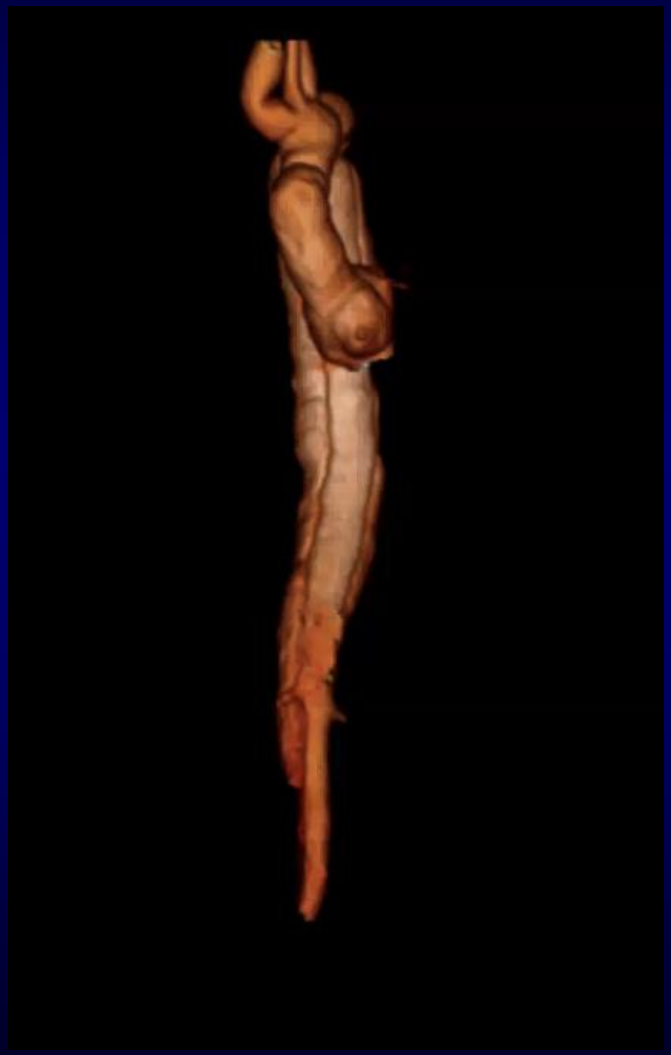


- Flow-related signal enhancement
- Useful under stable conditions when there is risk of contrast nephropathy or nephrogenic systemic fibrosis

Role of MRI: Cine-Imaging

- Differentiating slow-flow blood flow and clot
- Detection of aortic regurgitation

Role of MRI: 3D reconstructions



- Panaromic overview of the dissection morphologic details
- Pre-op planning

Fetal risk from CT in pregnancy

Radiation Risk

- Benefit vs. Risk
- Radiation units
  mGy=absorbed radiation dose
  mSv=effective biological dose

Iodinated-contrast Risk

- No difference in TSH levels among neonates based on antenatal exposure to iodinated contrast
  Rajaram et al. BJR 2011

Fetal risk from CT in pregnancy

- Regular background exposure to fetus throughout gestation 0.1-0.5 mGy
- Increased oncological risk >10 mGy
- Increased teratogenic risk >100 mGy
- Termination recommended >150 mGy
- Severe mental retardation >1000mGy

Absorbed dose from chest CT 0.06 – 1 mGy

Fetal risk from CT in pregnancy

Policy statement from The American College of Obstetricians and Gynecologists:

"Women should be counseled that x-ray exposure from a single diagnostic procedure does not result in harmful fetal effects. Specifically, exposure to less than 50 mGy has not been associated with an increase in fetal anomalies or pregnancy loss."

Comparison of Modalities

	TTE/TEE	MDCT	MRI
Sensitivity	+++	+++	+++
Specificity	+++	+++	+++
Classification	+++	+++	+++
Tear localization	+++	+++	++
Pericardial effusion	+++	+++	+++
Mediastinal hematoma	++	+++	+++
Side branch involvement	++	+++	++
Coronary artery involvement	++	+++	++
X-ray exposure	–	++	–
Patient comfort	+	+++	+
Follow-up studies	++	+++	+++
Intraoperative availability	+++	–	–

Baliga R et al. JACC CV Imaging 2014

Diagnostic Algorithm

Unstable/Critical Condition	
Diagnosis	Follow-up
TEE with colour Doppler	MRI with MRA (with or without Gd)
MDCT with CTA	
Stable Clinical Condition	
Diagnosis	Follow-up
TEE with colour Doppler	MRI with MRA (with or without Gd)
MDCT with CTA	
MRI with MRA	

Nienaber CA. EHJ CV Imaging 2012

Follow-up evaluation

- Imaging at 1, 3, 6 and 12 months and thereafter every year
- MRI > CT > TEE

Thank you for your attention!

gauri.ranikarur@uhn.ca