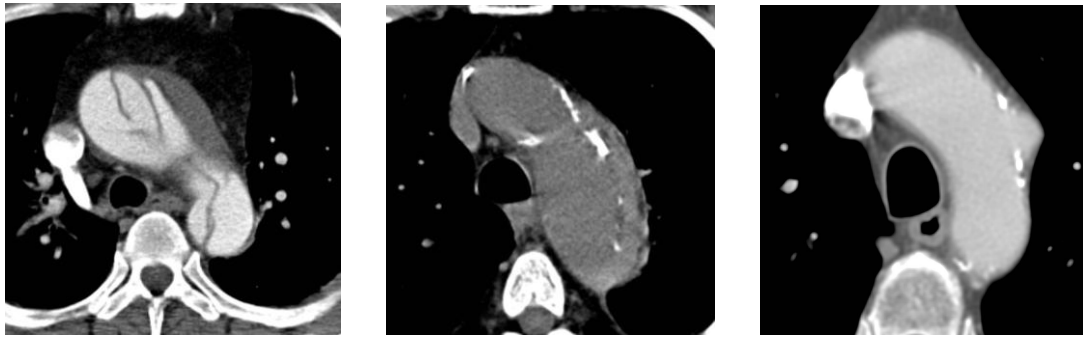
8th Nordic Course in Emergency Radiology
May 8-11, 2023 – Aarhus, Denmark

NORDICFORUM www.nordictraumarad.com
TRAUMA & EMERGENCY RADIOLOGY

Acute Aortic Syndrome (AAS) – Thoracic Aorta



Nothing to disclose

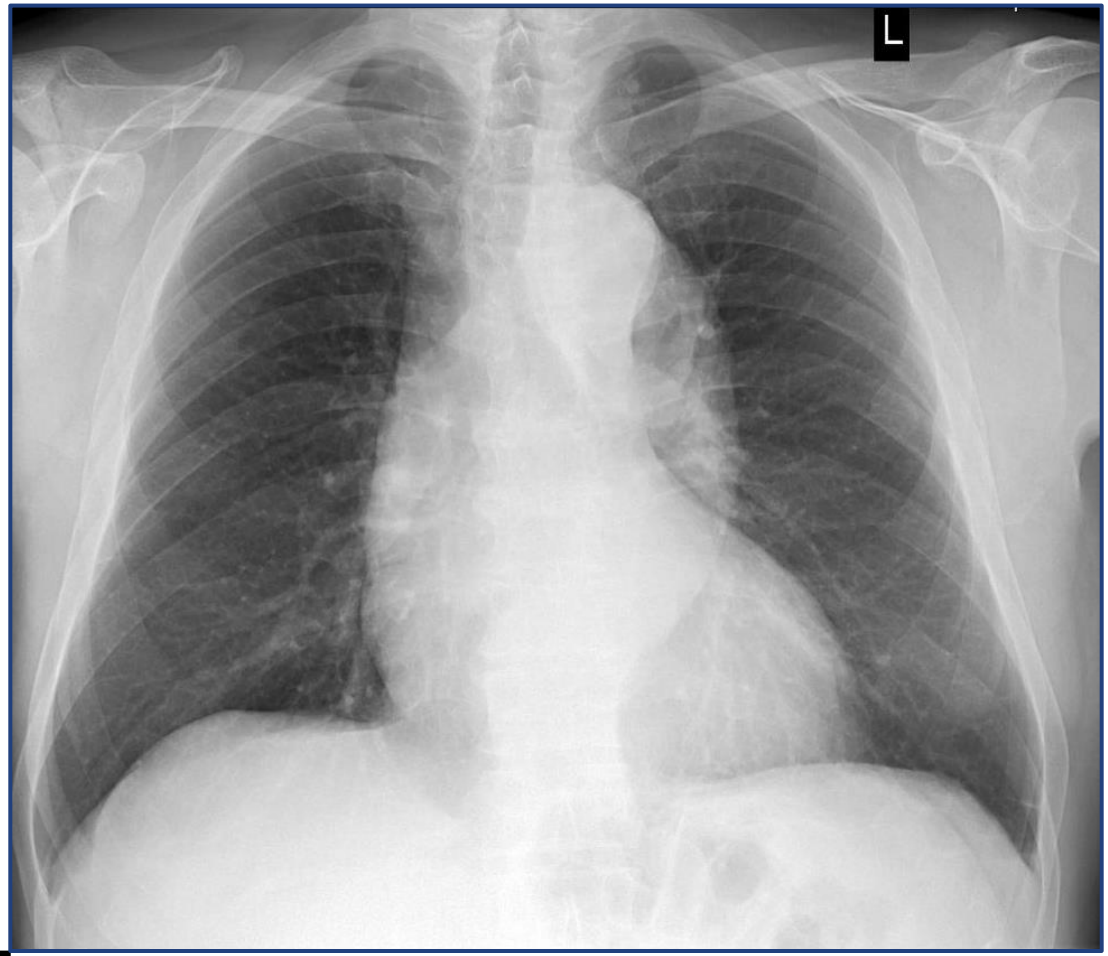
Ferco Berger
Emergency & Trauma Radiologist
Sunnybrook, University of Toronto, Canada
fhberger@gmail.com

Sunnybrook
HEALTH SCIENCES CENTRE
when it matters MOST

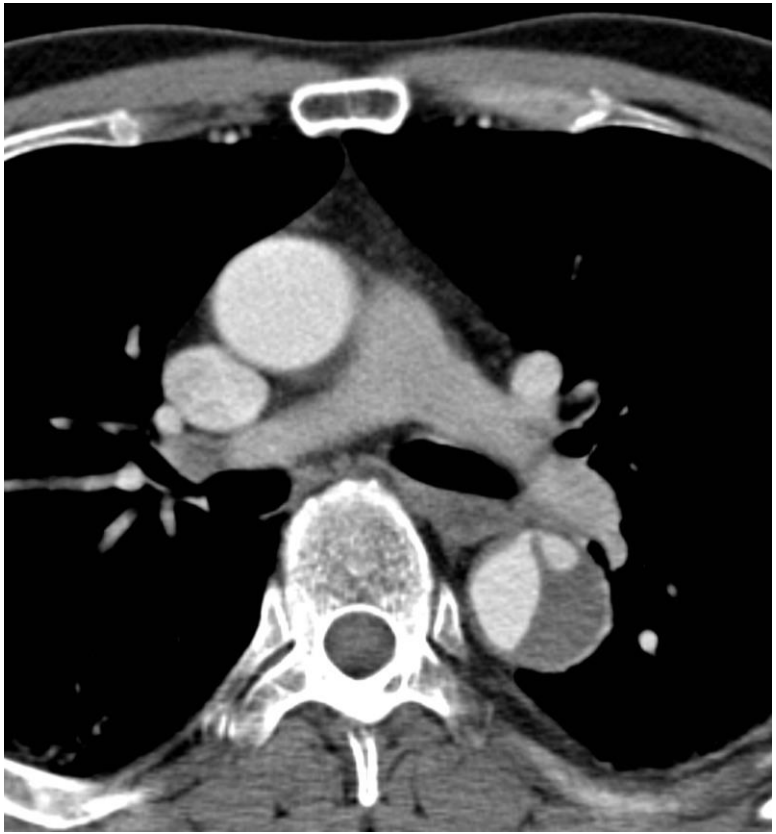
Objectives

- Describe the different entities of AAS and how to distinguish
- Understand the classification systems and controversy
- Know imaging protocol selection and optimization

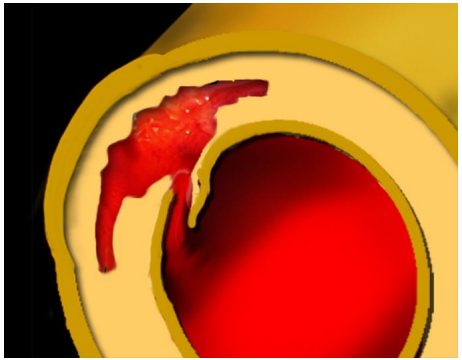
Case 1



Case 2

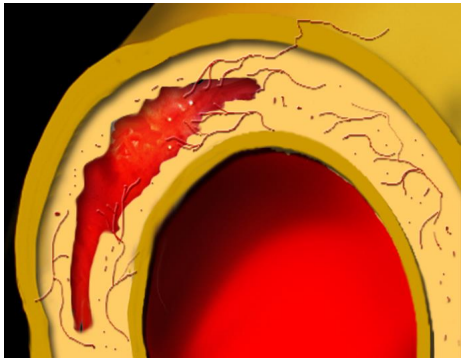


Acute Aortic Syndrome (AAS)



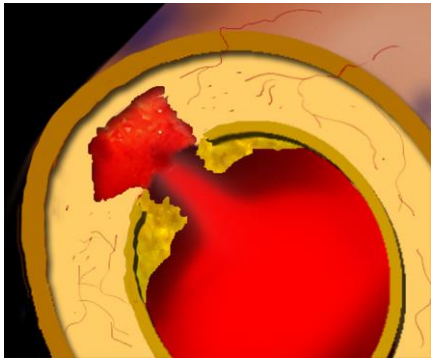
Typical Aorta Dissection

TAoD



Intramural Hematoma

IMH



Penetrating Atherosclerotic Ulcer

PAU

www.radiologyassistant.nl

Dr. Robin Smithuis

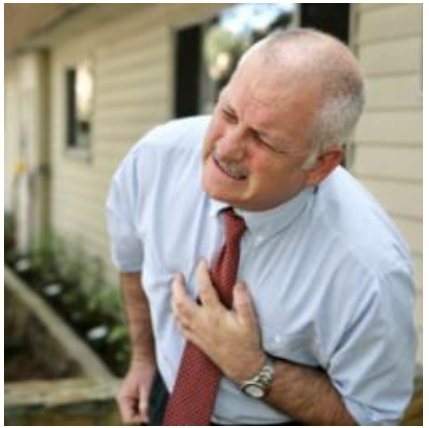
Acute Aortic Syndrome (AAS)

TAoD & **IMH** & **PAU** have very similar:

- Clinical presentation
- Imaging approach
- Classification
- Treatment (often)

Clinical presentation AAS

- Older patients, average 60-70 y, 2/3 male
- Hypertension, longstanding
- ‘Aortic’ acute chest pain: Severe, tearing, migratory
  - Location of pain may relate to origin



- *Sometimes*:
  - Syncope
  - Pulse deficit (only TAoD)
  - Complications secondary to organ hypo-perfusion (malperfusion syndrome)

MC Shiau, Applied Radiology, 2010

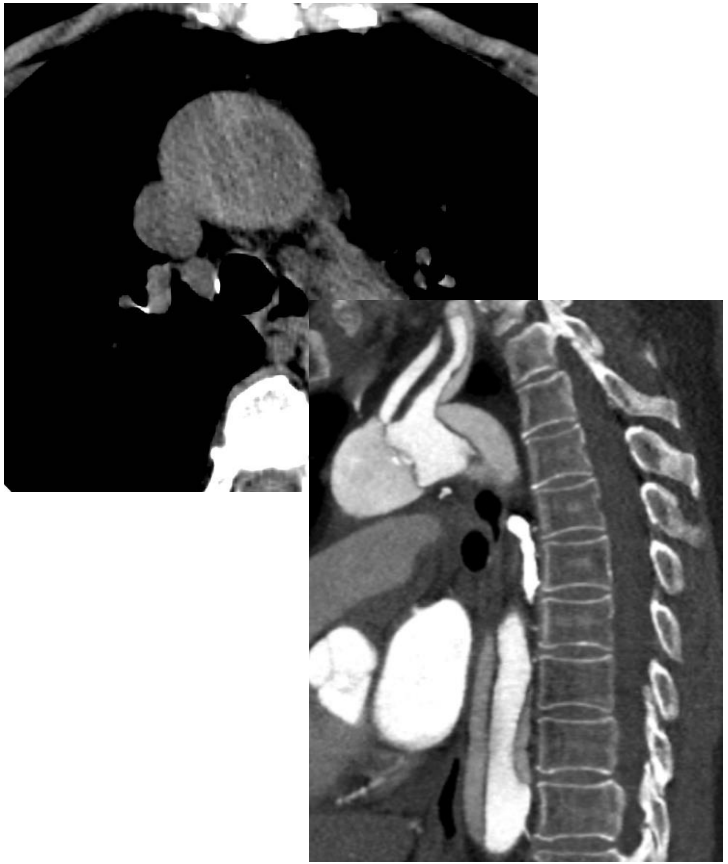
Acute Aortic Syndrome

Acute imaging = MDCT

Non contrast chest
- Hyperdense IMH / thrombus false lumen

Arterial chest, abdomen, pelvis
- Assess extension intimo-medial flap
- Assess side branch patency

Delayed (chest,) abdomen, pelvis
- Assess organ perfusion / enhancement



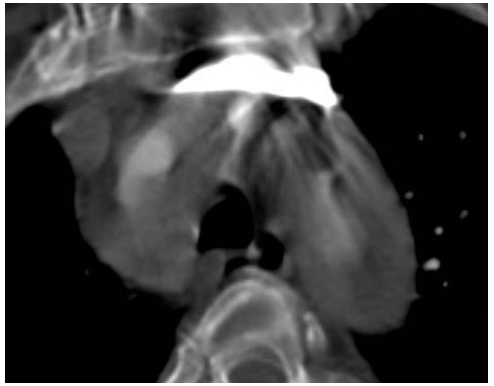
Acute Aortic Syndrome

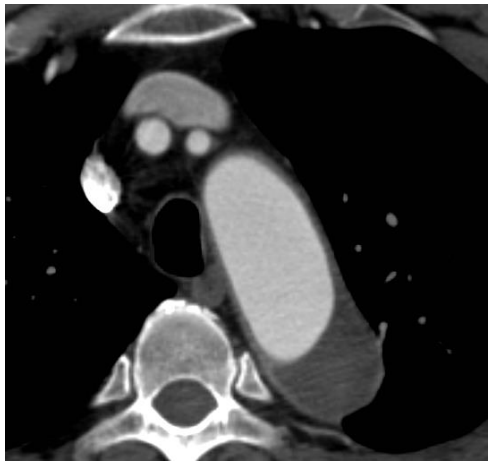
Acute imaging = MDCT

Non contrast chest
- Hyperdense IMH / thrombus false lumen

Arterial chest, abdomen, pelvis
- Assess organ perfusion / enhancement

I.V. contrast via RIGHT arm





CT Acute Aortic Syndrome

- High risk patients: all phases

  If you have spectral/DECT: may leave out NECT

- Low pre-test probability: be more selective

  Active monitoring: be there!

- Cardiac gating?

Cardiac gating?

- Reduce pulsation artifact aortic root

  However:

  - Known pitfall
  - Characteristic appearance
  - Non-gated less radiation exposure

- Younger patient: non-gated preferred
  - Low pretest probability
  - If needed additional imaging, rarely necessary
- HR < 65/min

High-end scanners, high table speed

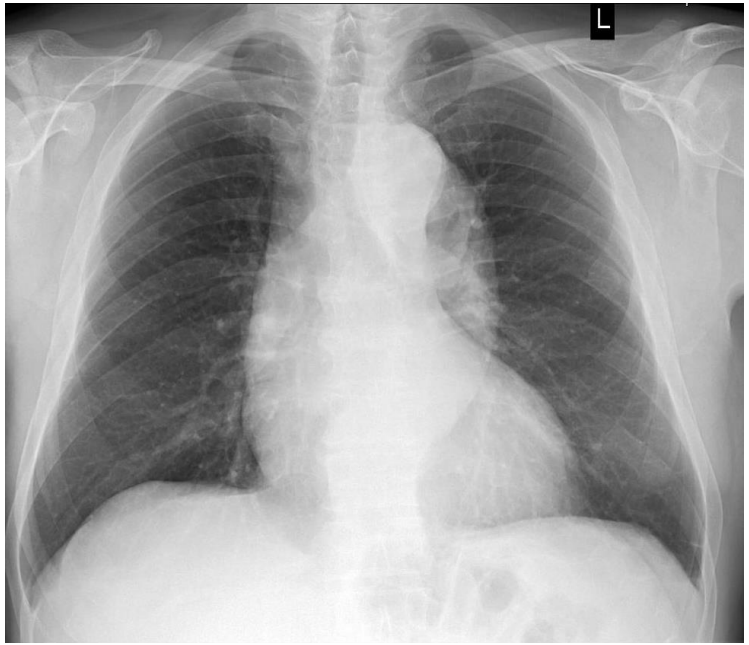
MA McMahon, Radiographics 2010

Chest Radiographs?

- 25% normal
  does not exclude dissection

- 75% abnormal mediastinum
  does not confirm dissection

- However, may exclude differential



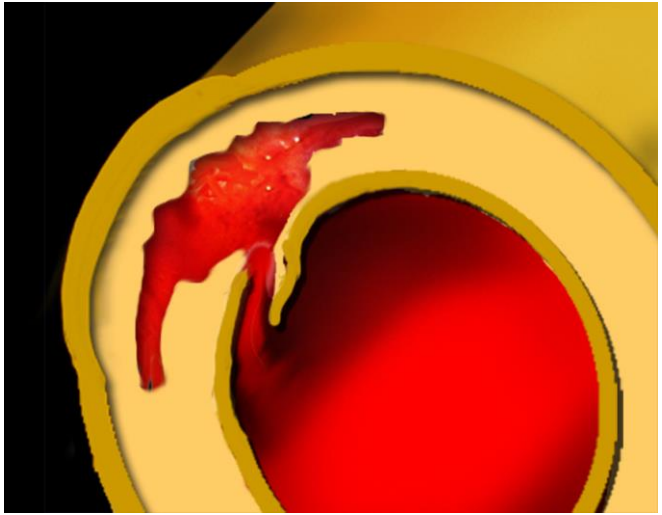
Typical Aortic Dissection

Torn intima with intimomedial flap

Blood dissects media = double lumen

Imaging:

- Displaced intimal calcifications
- Entry site
- Spirals

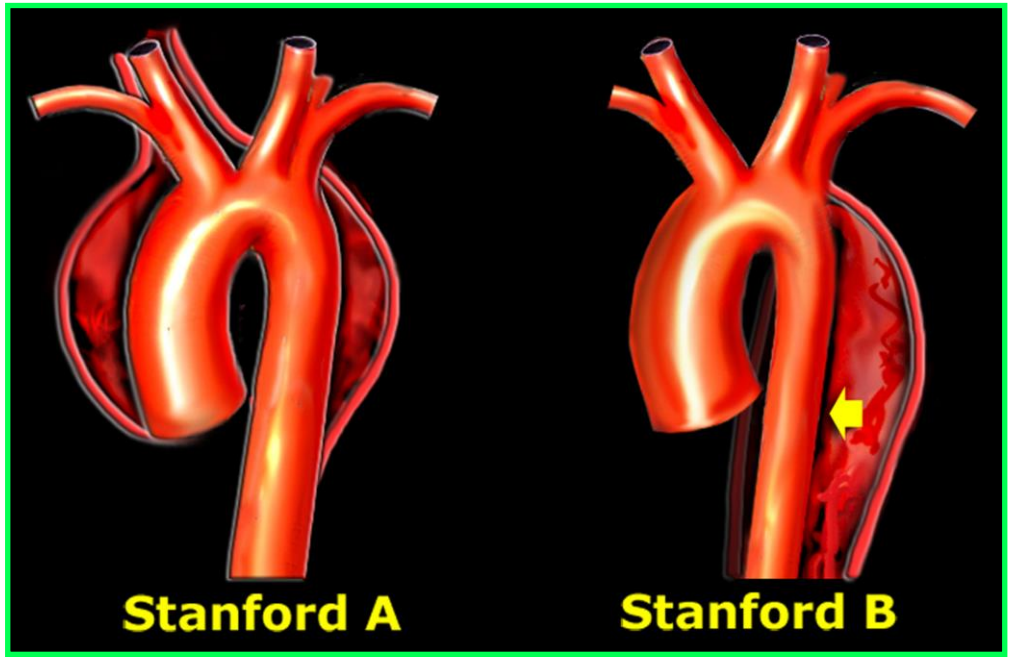


www.radiologyassistant.nl

E Castaner, Radiographics 2003

Radiological Classification

www.radiologyassistant.nl



Surgical? Medical?

Classification issues

- Different interpretations in radiological and surgical literature
- Involvement of the aortic arch is not defined
- Some authors include a separate class if *arch involved*, ***but not*** the ascending aorta:

  non-type-A, non-type-B

- If *ascending aorta* not involved, many now treat non-operatively

Classification issues

SVS/STS REPORTING STANDARDS DOCUMEN

Editors' Choice

Society for Vascular Surgery (SVS) and Society of Thoracic Surgeons (STS) reporting standards for type B aortic dissections

Joseph V. Lombardi, MD (SVS Co-Chair),[a] G. Chad Hughes, MD (STS Co-Chair),[b] Jehangir J. Ap
Joseph E. Bavaria, MD,[d] Adam W. Beck, MD,[e] Richard P. Cambria, MD,[f] Kristofer Charlton-Ouv
Mohammad H. Eslami, MD,[h] Karen M. Kim, MD,[i] Bradley G. Leshnower, MD,[j] Thomas Maldona
T. Brett Reece, MD,[l] *and* Grace J. Wang, MD,[d] *Camden, NJ; Durham, NC; Calgary, Alberta, Canada; Ph*
Pittsburgh, Pa; Birmingham, Ala; Brighton, Mass; Houston, Tex; Ann Arbor, Mich; Atlanta, Ga; New York, N
and Denver, Colo

Journal of Vascular Surgery
Volume 71, Number 3

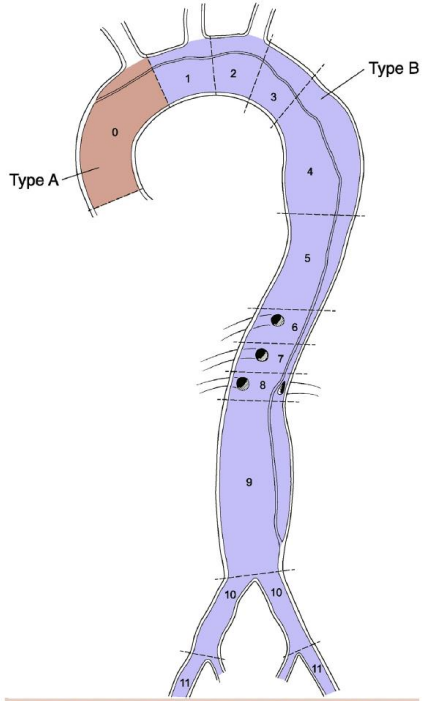


Fig 3. Society for Vascular Surgery/Society of Thoracic Surgeons (SVS/STS) Aortic Dissection Classification System of dissection subtype according to zone location of primary entry tear.

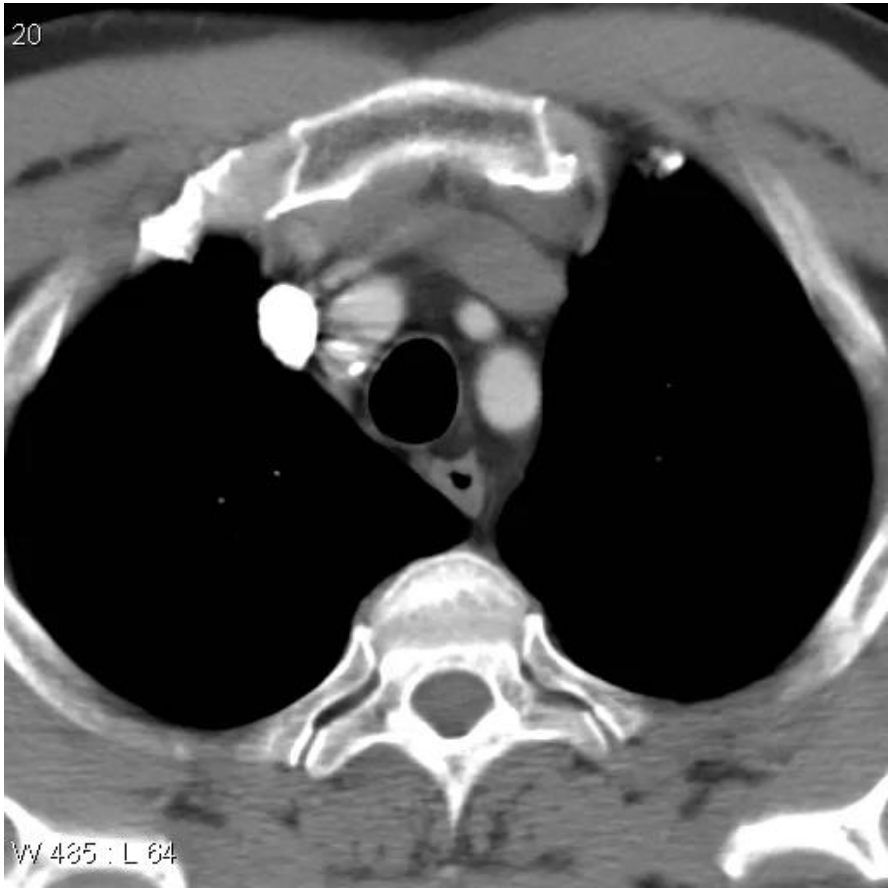
Lombardi JV et al. J Vasc Surg, March 2020

TAoD: True vs False lumen

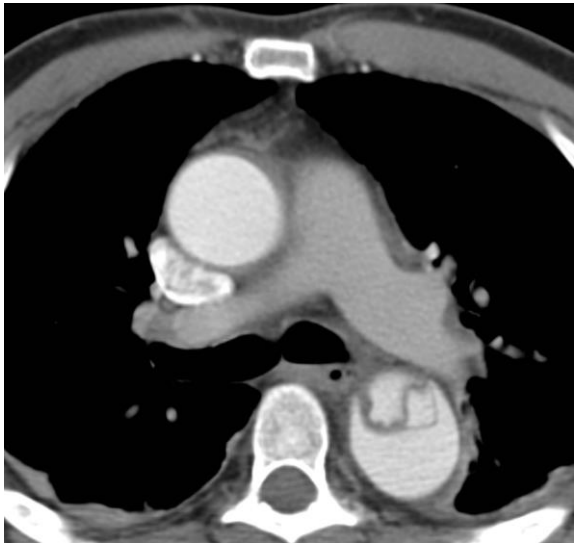
	True lumen	Flase lumen
size	small	BIG
continuous with non-dissected	+	-
calcification	circumferential	central wall only
position	lesser curve	spirals around TL
density arterial phase	higher	lower
“beak sign”	-	+
“cobwebs”	-	+
(usually) supplies	celiac trunk, SMA, right renal artery	left renal artery

www.radiologyassistant.nl
MA McMahon, Radiographics 2010

Typical Aortic Dissection

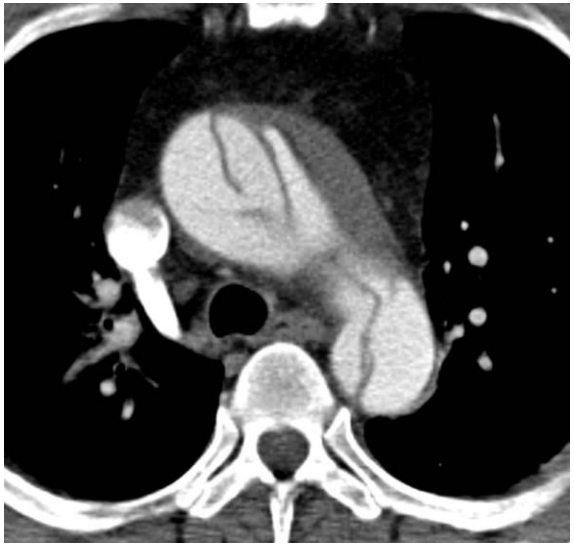


Identification False Lumen



Beak
Cobweb

Contrast differential
Thrombus



Type A
Central true lumen
ascending Ao / Arch

Complications

- Rupture
  - Irregular outer wall
  - Extravasation of contrast
  - Hyperdense pleural effusion (hemorrhage)
- Extension
  - Retrograde or antegrade
- Aneurysm formation
  - 1/3 cases, tend to rupture → late death

Complications

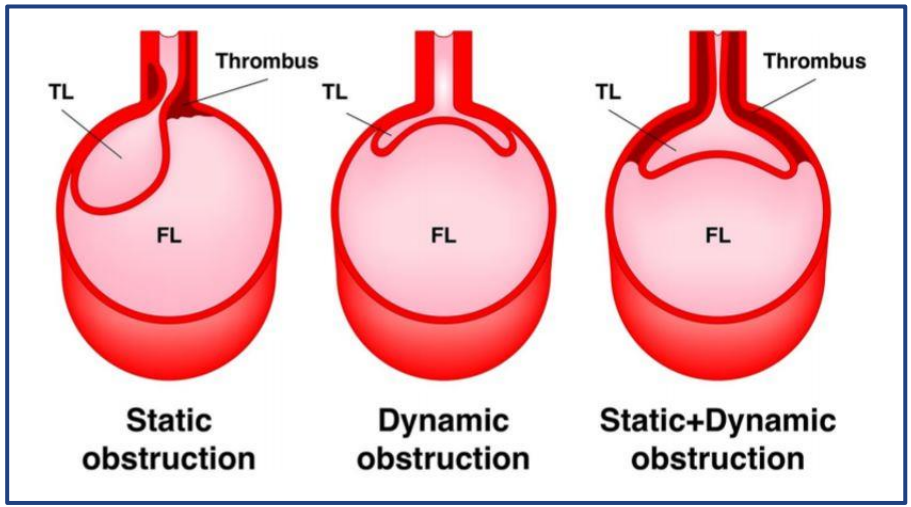
Type A:

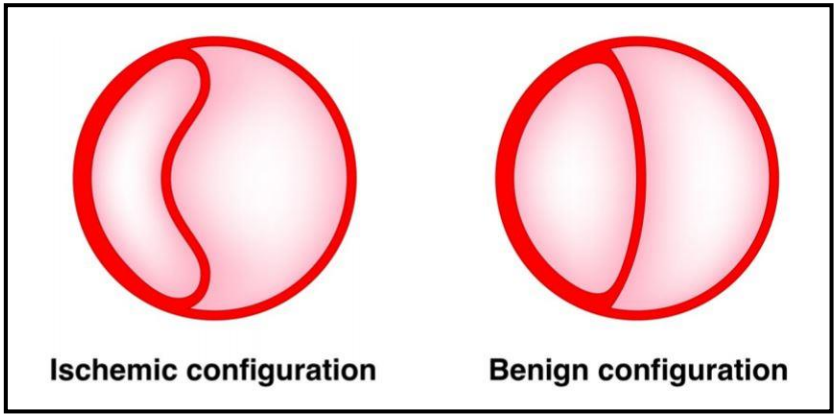
- Intra-pericardial rupture → cardiac tamponade
- Cerebral or coronary artery involvement
- Aortic valve regurgitation

Type A and B:

- Malperfusion syndrome, strong predictor of poor outcome
- Static vs dynamic obstruction (or combination)

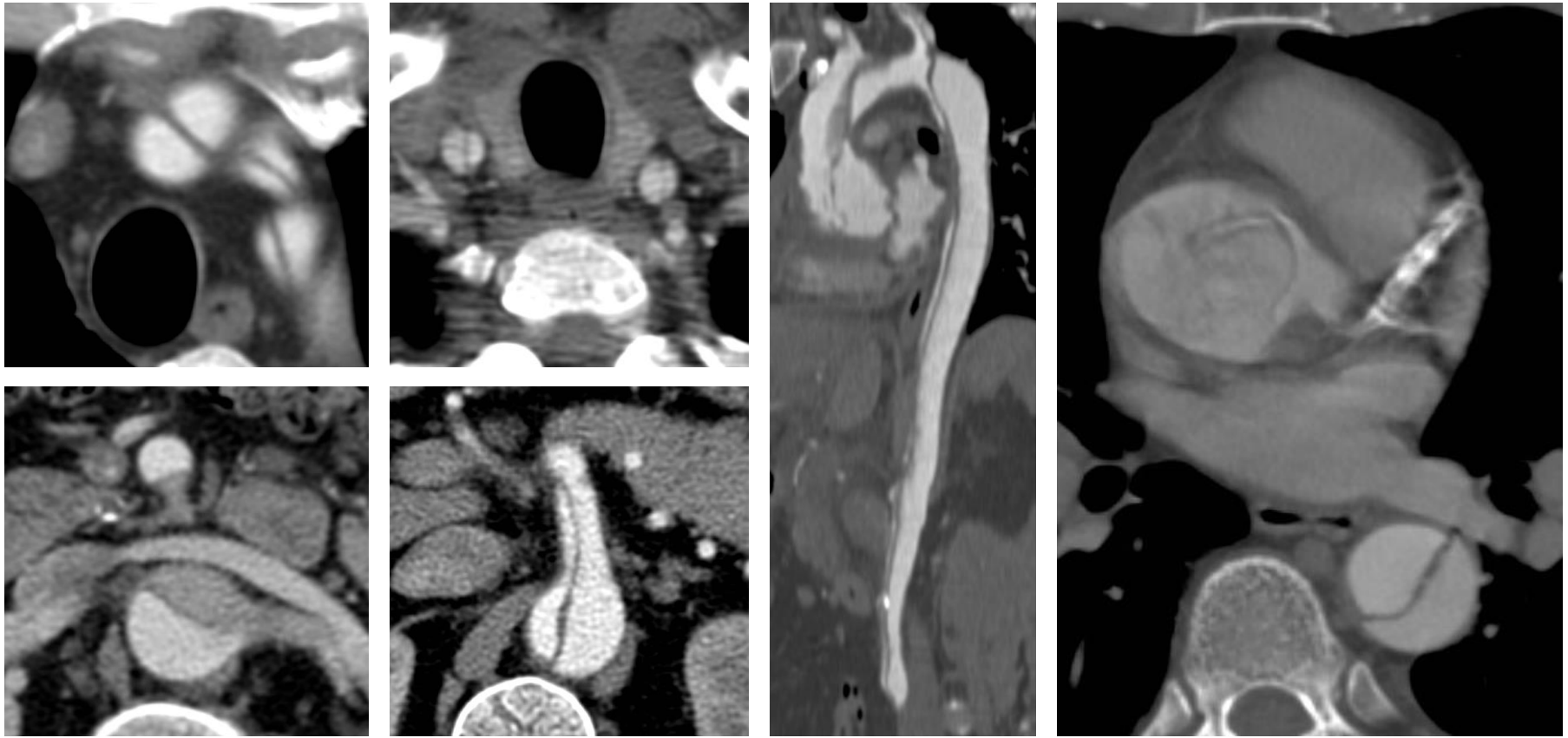
Malperfusion Syndrome





S. Kaji
Gen Thor Cardiovasc Surgh, 2018

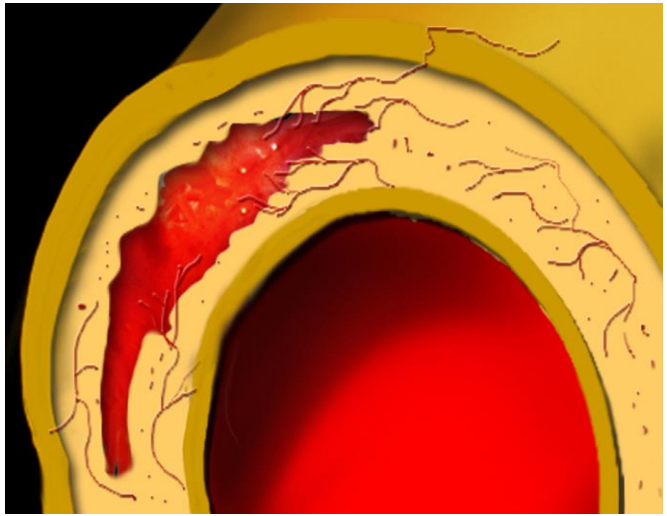
Report intimomedial flap



Intramural hematoma (IMH)

- 10-20% acute aortic syndrome
  - Older patients, mean 69y
  - Hypertension
  - Sometimes incidental finding

- Rupture vasa vasorum
- Intimal tear without visible entry?



www.radiologyassistant.nl

IMH

Non-enhanced CT:

- Smooth crescent or circumferential hyperdense collection in aortic wall
- No lumen narrowing
- Not spiraling
- Internal displacement intimal calcifications
- Most frequent: ascending / proximal descending aorta

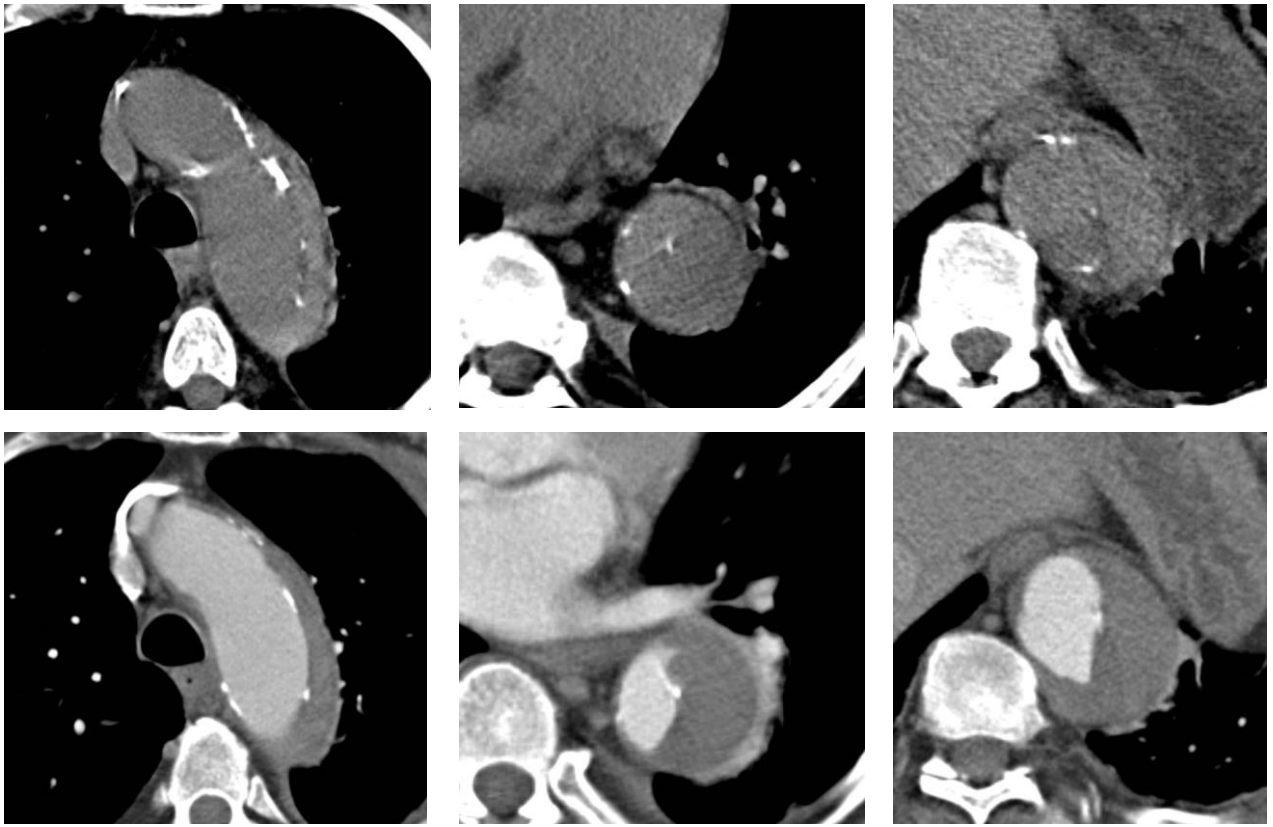
CTA:

- No enhancement, can be obscured by contrast
- Typically no branch occlusion

IMH

Unenhanced

CTA



Complication IMH

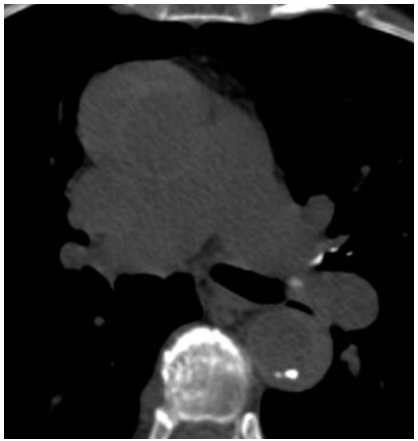
- Progression to dissection 16 - 47%
- Rupture 20 - 45%
- Ulceration → Saccular aneurysm
- Common late complication: fusiform aneurysm

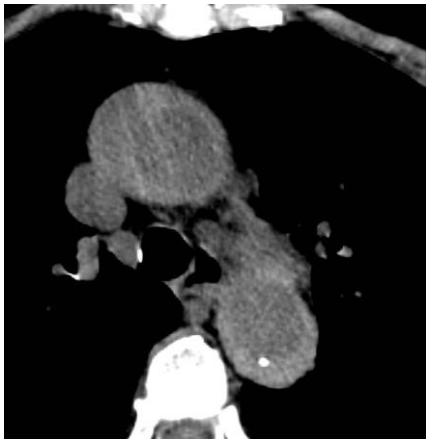
- Predictors complication:
  - Type A
  - Diameter aorta > 5 cm
  - Thickness IMH > 2cm, or increasing
  - Pericardial or pleural fluid

- Normal aortic diameter: resolution in up to 80%

E. Castañer, Radiographics 2003

High risk IMH





narrow window

Intramural Blood Pool (IBP)

IBP

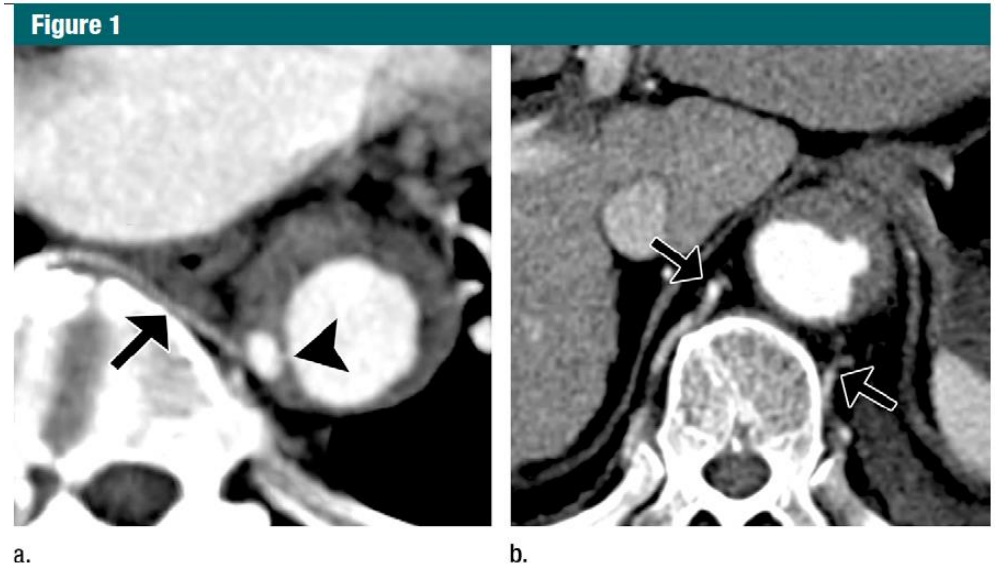


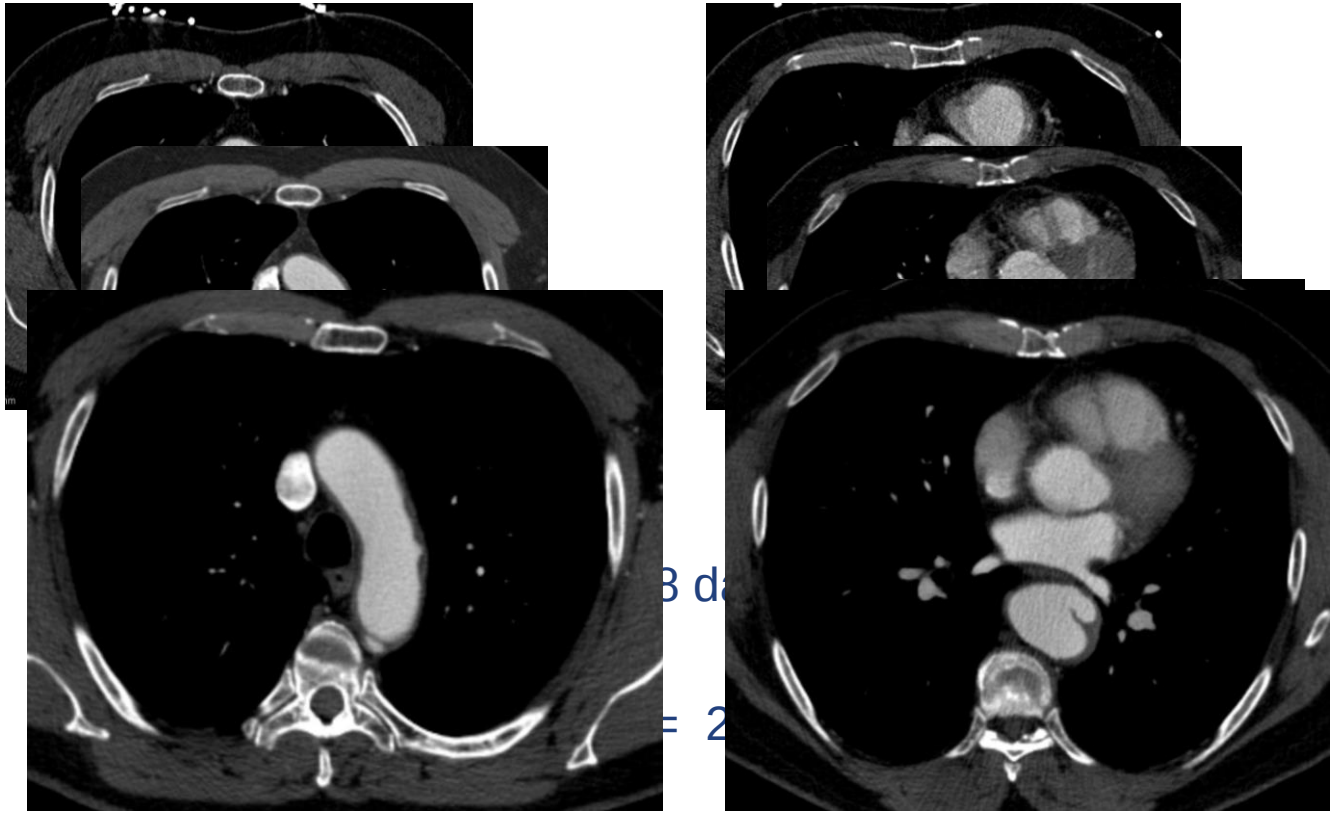
Figure 1: Multidetector CT images show comparison of IBP and ULP accompanying aortic IMH. **(a)** IBP in IMH. Arrowhead = tiny intimal orifice of IBP. Arrow = intercostal artery. **(b)** ULP in IMH. ULP has overt and wide intimal disruption and no connection with branch artery (arrows).

Ulcer like projection (**ULP**)

IBP ***not*** associated with poor prognosis

MT Wu, Radiology 2011

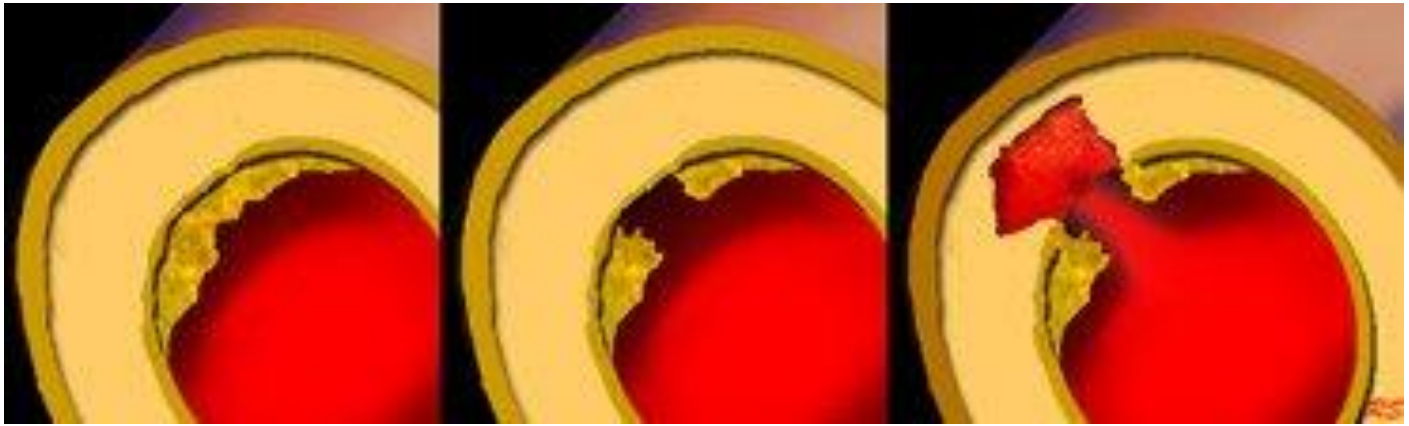
IPB vs ULP



T = 6 weeks

fhberger@gmail.com

Penetrating atherosclerotic ulcer (PAU)



www.radiologyassistant.nl

- Ulceration of atheromatous plaque
- Penetrating intima
- Hematoma within media
- More distal than TAoD & IMH

E. Castañer, Radiographics 2003

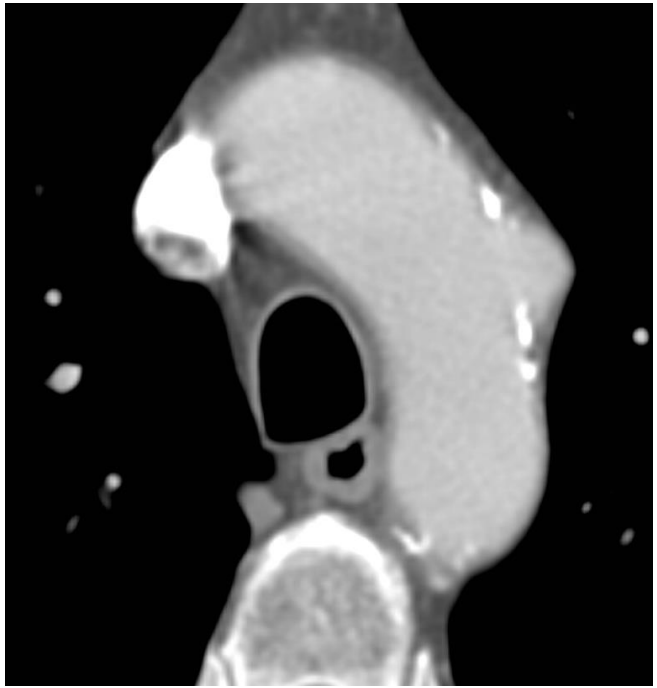
PAU

- Advanced atherosclerotic disease
- Focally displaced intima calcifications
- Focal ulcer, often multiple
- Adjacent focal media hematoma
  - if not, be cautious to mention PAU
- Possibly enhancing aortic wall

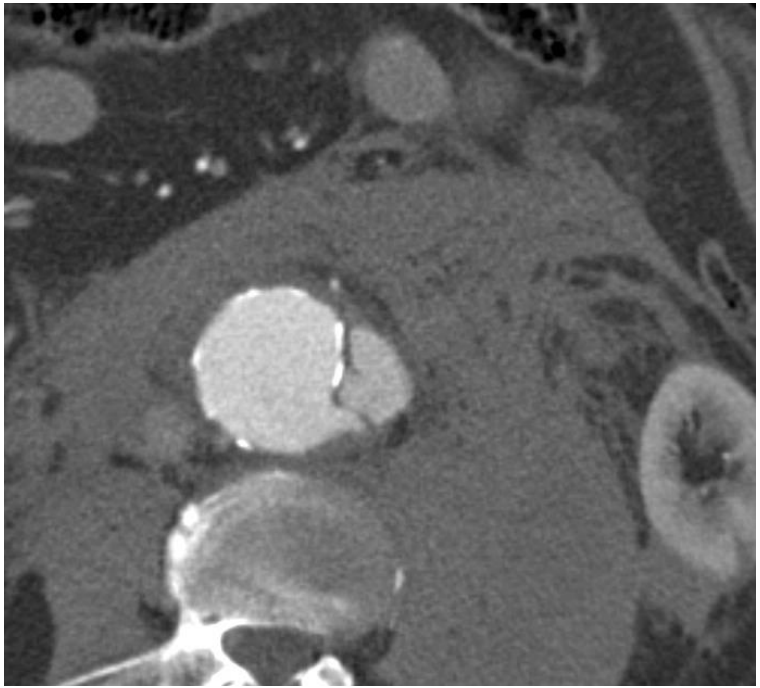
- Prognosis:

  diameter > 20 mm, depth >10 mm

  → high risk progression



saccular aneurysm

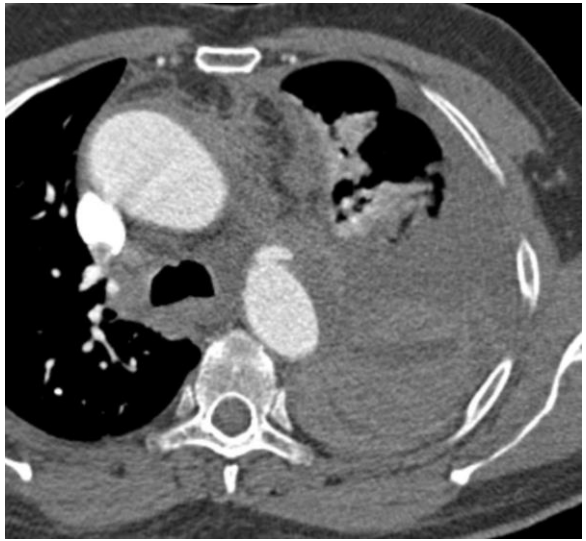


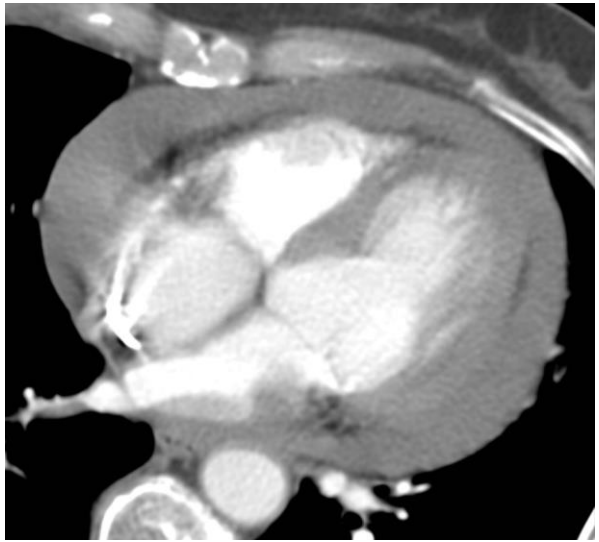
rupture

AAS management

- Has evolved last decades
- Less aggressive, less open surgery: more medical treatment / stents
- Stents now also available for arch and branches
- In acute stage: blood pressure control

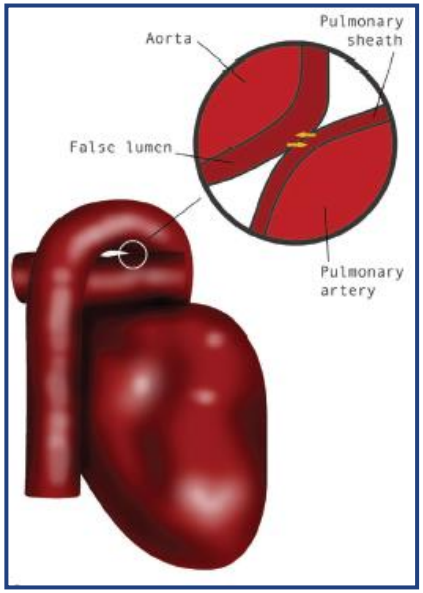
Complications needing urgent treatment



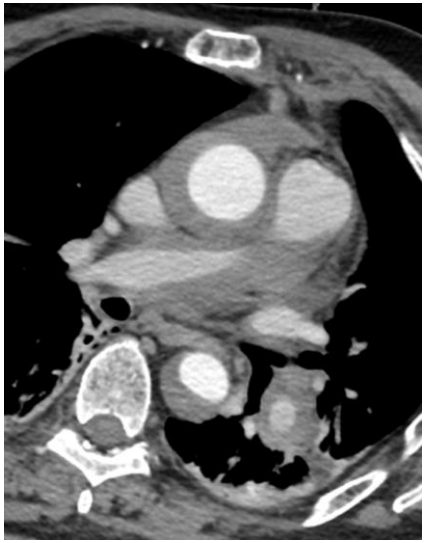


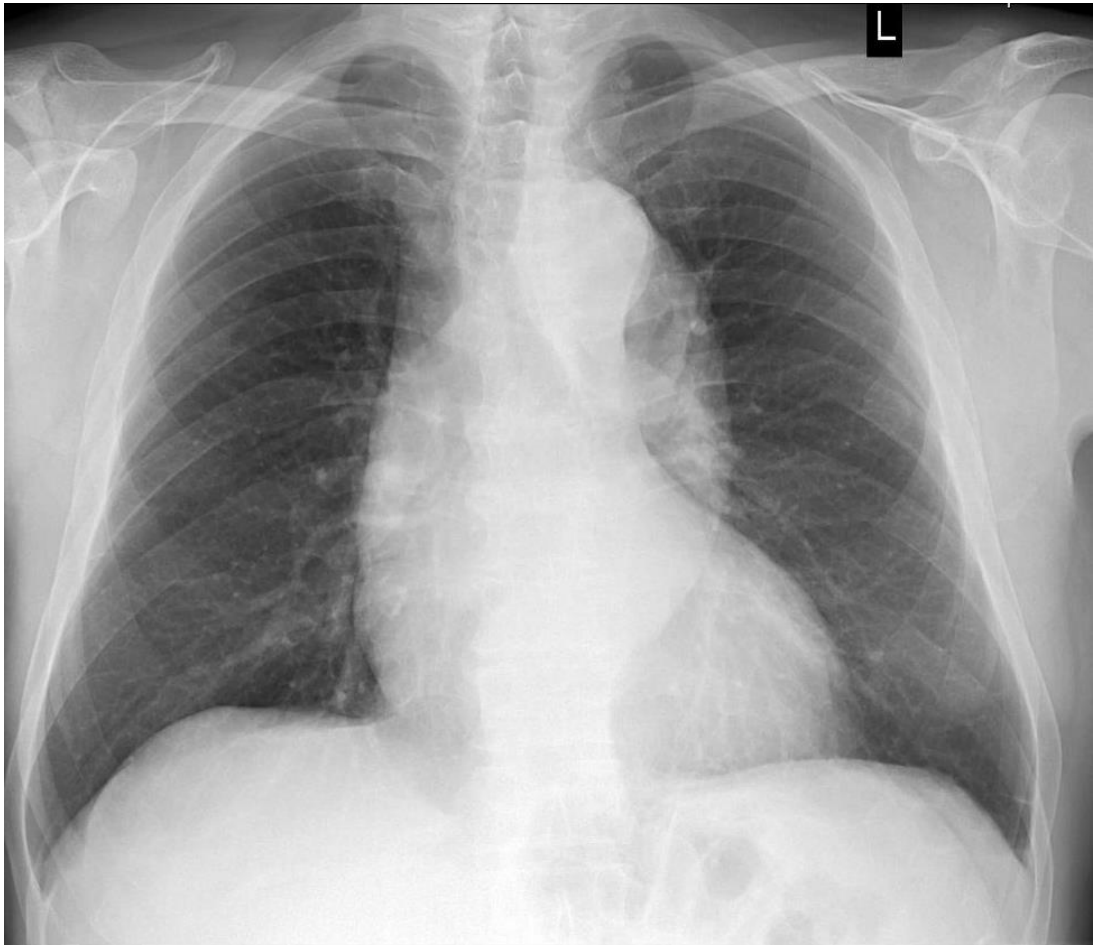
Long-term complication – rupture false lumen

Involvement Pulmonary Artery

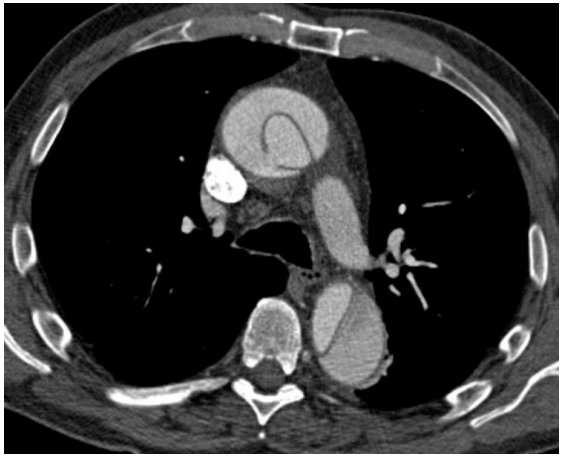


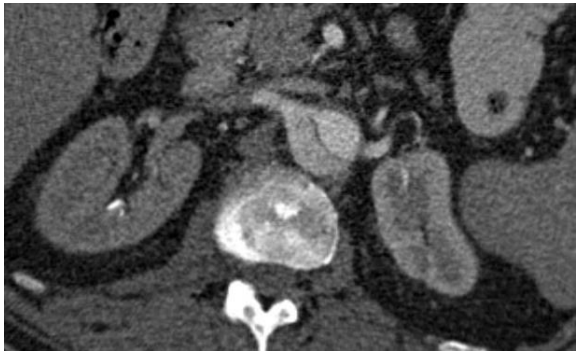
E. Castañer
Radiographics, 2003



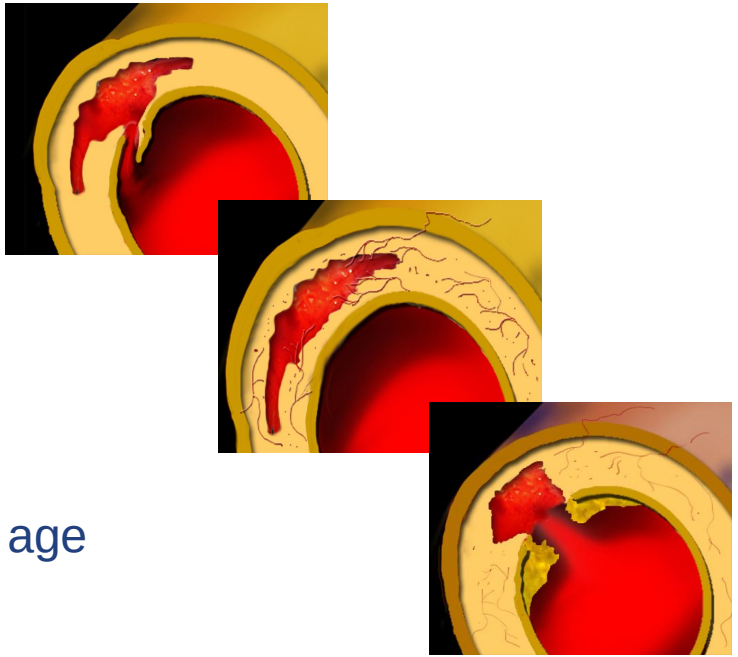

L

Type A dissection!





Take to work - AAS



Acute Aortic Syndrome:

- Life threatening
- Spectrum of same disease
- Hypertension & atherosclerosis

- Don’t trust chest radiograph
- Use CT protocols according to probability / age
- Contrast via RIGHT arm

- Talk to your surgeons about desired classification / arch involvement

If you'd like more Emergency Radiology

www.aser.org