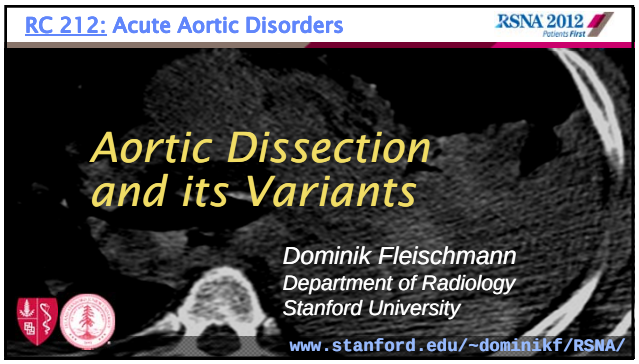
RC 212: Acute Aortic Disorders

RSNA 2012



Aortic Dissection and its Variants

Dominik Fleischmann
Department of Radiology
Stanford University
www.stanford.edu/~dominikf/RSNA/

Background & Clinical Context

Acute aortic syndrome:

acute life-threatening abnormalities of aorta assoc. with intense chest or back pain, traditionally include:

Aortic dissection (AD), Intramural hematoma (IMH), Penetrating atherosclerotic ulcer (PAU)

Vilacosta, Heart 2001

Background & Clinical Context

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RARE: 2.6-3.5 /100k/yr in US
(~ 440 /100k/yr for myocardial infarction)

LIFE THREATENING

Vilacosta, Heart 2001

Acute aortic syndromes
Natural History of Type A Dissection
(approx 60% of dissections are Type A)

- 40% die immediately (~50% within 48 hrs), mainly from rupture
- 2% per hour mortality (1-3% die in hour before surgery)
- end-organ malperfusion occurs in 16-30%, dramatically reduces survival
- short term (in-hospital and 30 day) mortality: 3.4% - 25%

Background & Clinical Context

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LIFE THREATENING

DIAGNOSIS/MANAGEMENT: IMAGING BASED

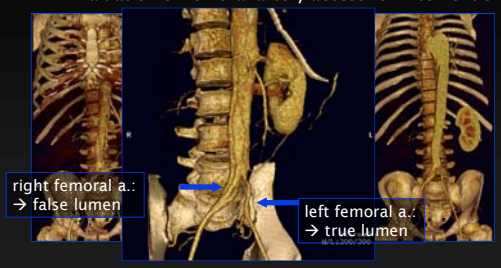
Aortic Dissection and its Variants
OUTLINE

- Imaging Strategy
- Pathology and Classification
- Side Branch Ischemia / Malperfusion
- Dissection Variant

Acute Aortic Syndromes
Imaging Strategy

	Thick./Rec.-Int.
Precontrast series · recommended in acute setting	3mm/3mm
CTA series · CTA chest-abdomen-pelvis scanning range: thoracic inlet → femoral a. bifurcation !!	1mm/0.7mm
· Gated chest + (abd.-pelv. non-gated CTA)	

Acute Type B Dissection
Evaluation of femoral artery access for intervention

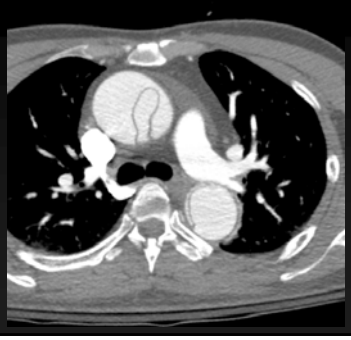


Acute Aortic Syndromes
Imaging Strategy

	Thick./Rec.-Int.
Precontrast series · recommended in acute setting	3mm/3mm
CTA series · CTA chest-abdomen-pelvis scanning range: thoracic inlet → femoral a. bifurcation !!	1mm/0.7mm
· Gated chest + (abd.-pelv. non-gated CTA)	

49 y/o man
- acute chest pain;
  RR 170 / 20

Gated CTA of
chest (+ abd pelv)
r/o aortic disease



QUIZ *CT of the Thoracic Aorta*

QUIZ RSNA 2012 Patients First

The contour irregularity in the ascending aorta is

A. clearly a pulsation artifact
B. favor artifact, but aortic lesion not ruled out
C. can't tell
D. likely aortic lesion, but artifact possible
E. definite aortic lesion

QUIZ

CT of the Thoracic Aorta

with ECG gating

QUIZ

RSNA 2012 Patients First

The contour irregularity in the ascending aorta is

A. clearly a pulsation artifact
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with ECG gating

Aortic Dissection and its Variants

Pathology and Classification

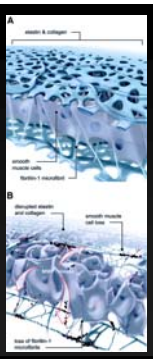
Aortic Dissection: Manifestation of a Diseased Media

- Marfans (fibrillin)
- Ehlers Danlos IV (collagen)
- familial TAA
- severe hypertension !!!!
- normal aging

Elastic Lamina of Aortic Wall

'cystic medial necrosis' (Erdheim)

- elastolysis (elastic & collagen fiber loss)
- mucoid degeneration
- smooth-muscle cell loss and dedifferentiation



Fedak, P., et al. Circulation 2002

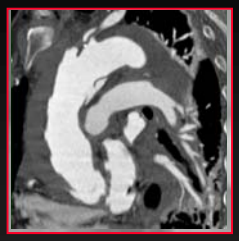
Classic Aortic Dissection

- false lumen within the media
  'intimal flap'=inner 2/3 of med + intima → intimo-media flap

- entry tear (primary intimal tear [PIT]
- exit tear(s) ['reentry tear', fenestrations]

Acute Type-A Dissection

CTA

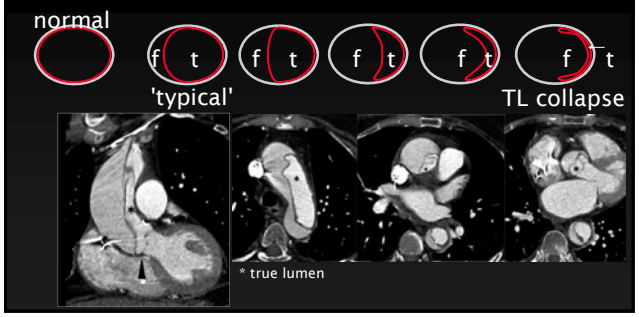


primary intimal tear

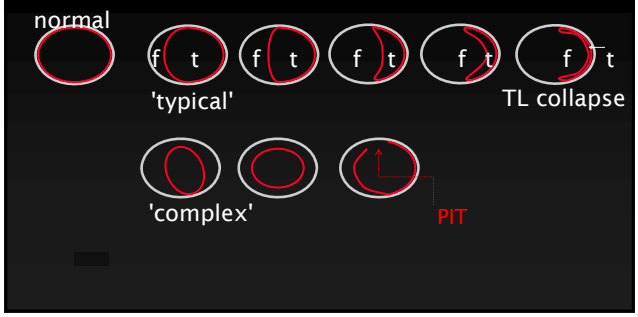
DSA

true / false lumen (DSA)

Acute Type-A Dissection

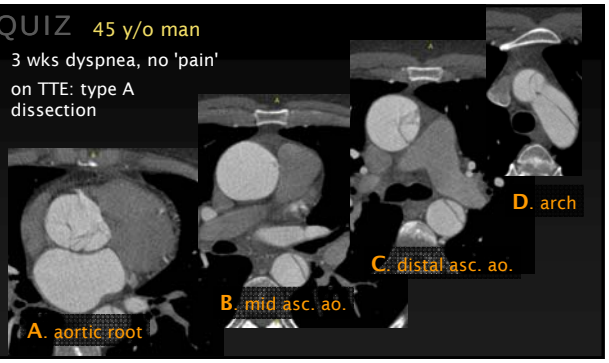


True versus False Lumen



QUIZ 45 y/o man

- 3 wks dyspnea, no 'pain'
- on TTE: type A dissection



QUIZ

RSNA 2012 Patients First

This is an aortic dissection, which begins in …

A. aortic root
(filling defect in root is dissection flap)

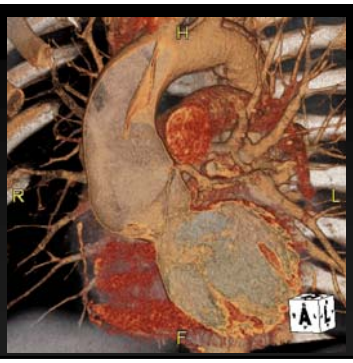
B. mid ascending aorta
(filling defect in root is artifact from aortic valve, but tiny abnormality in mid ascending aorta

C. distal ascending aorta
(mid ascending aorta and root is normal)

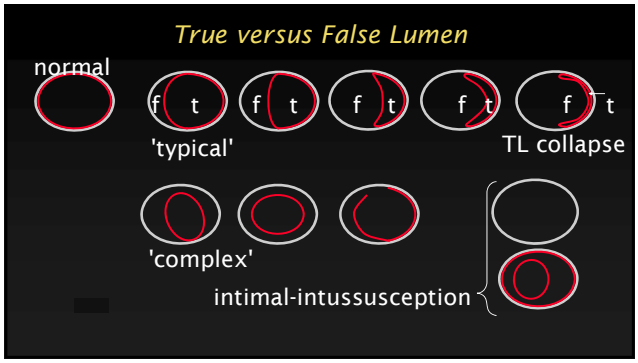
D. aortic arch

45 y/o man

- 3 wks dyspnea, no 'pain'
- on TTE: type A dissection



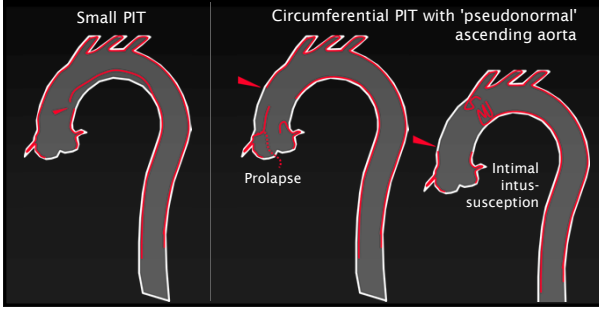
True versus False Lumen



48 yo man

- hx of crack cocain use;
- outside hx of type-A IMH which was evacuated, but not repaired

Aortic dissection: Primary Intimal Tear (PIT)



Aortic Dissection - Classification

Clinical

- acute dissection (< 2 weeks symptoms)
- chronic dissection (> 2 weeks)

Anatomic

- location and extent of dissection flap (true/false lumen)
- presence and location of primary intimal tear

Aortic Dissection

Stanford Classification (dissection flap)

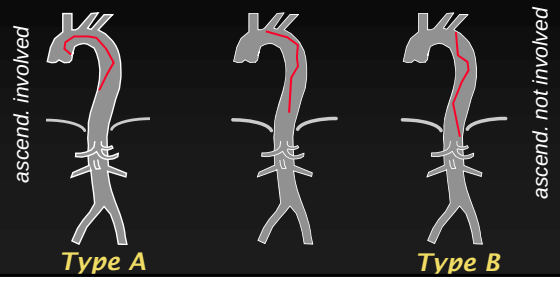
- Type A: intimal flap involving ascending aorta
- Type B: no involvement of ascending aorta

Daily PO et al, Ann Thorac Surg. 1970;10:237-247

QUIZ

Aortic Dissection

Stanford Classification



QUIZ

RSNA 2012 Patients First

An aortic dissection with the dissection flap starting in the aortic arch is classified as*

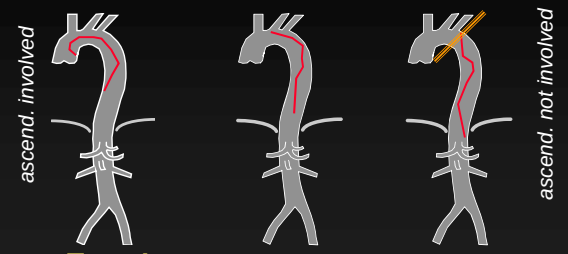
A. Type A aortic dissection
B. Type B aortic dissection
C. Not defined in Stanford Classification

*Aortic arch: thoracic aorta between brachiocephalic and left subclavian artery origins

QUIZ

Aortic Dissection

Stanford Classification



Aortic Dissection

Stanford Classification (intimal flap)

Type A: intimal flap involving ascending aorta
→ immediate surgery

Type B: no involvement of ascending aorta
→ conservative, unless complicated

(pre-stentgraft era)

Daily PO et al, Ann Thorac Surg. 1970;10:237-247

Aortic Dissection and its Variants

Side Branch Malperfusion Syndromes

Side-branch Malperfusion Syndromes

- in approx. 1/3rd of pat. with type A dissection

Mortality

- coronary arteries
- cerebral arteries/parapl.
- renal (ATN, hypertens.)
- mesenteric
- peripheral (extremity)

Diagnosis

- clincal and labs (not CT imaging)

Aortic Dissection
Role of CT in Side-branch Malperfusion

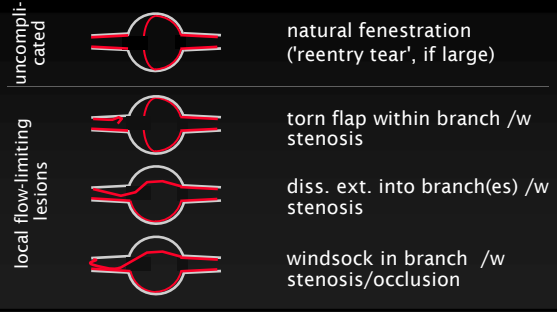
- identify anatomy to explain mechanism causing ischemia

→ determines treatment !

Possible mechanisms

- local obstruction at branch ostium
- limited inflow into true lumen (true lumen collapse, due to compression by false lumen)

Local Side Branch Involvement in Dissection



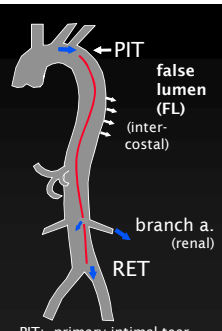
Aortic dissection with true lumen collapse

mesenteric and renal ischemia

Intima

Aorta

False Lumen: Outflow

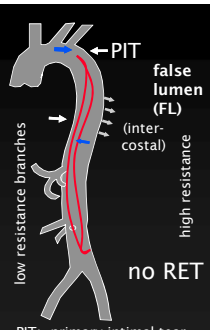


PIT: primary intimal tear
RET: re-entry tear

False Lumen: Outflow

true lumen collapse

aortic 'windsock'



PIT: primary intimal tear
RET: re-entry tear

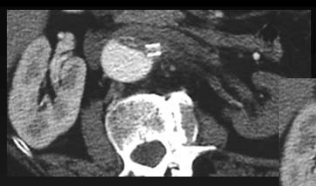
Aortic dissection with true lumen collapse

mesenteric and renal ischemia

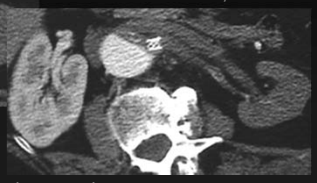
Intima

Aorta

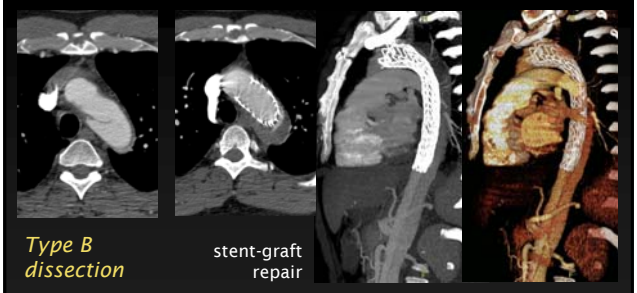
Type B dissection



courtesy G. Rubin



- true lumen collapse, left renal artery occlusion with stent-placement



Type B dissection

stent-graft repair

52 y/o hypertensive man
- acute type B dissection
  - severe abdominal pain radiating to back
  - decreased bowel sounds
  - Creatinine 1.7 (H); Lactic Acid 3.4 (H)

acute bowel ischemia

average IP

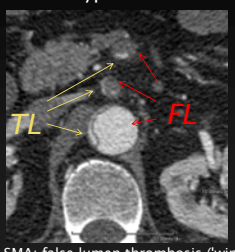
52 y/o hypertensive man
- acute type B dissection

acute bowel ischemia

average IP

52 y/o hypertensive man
- acute type B dissection

acute bowel ischemia



SMA: false lumen thrombosis ('windsock')

Aortic Dissection and its Variants

Dissection Variant:
Limited Intimal Tear
(Limited Dissection)

QUIZ

RSNA 2012 Patients First

Have you ever seen a 'limited dissection' on a CT scan ?

A. yes, definitely (called in dictation)
B. maybe (not sure what a 'limited dissection' is)
C. no, cannot be seen on CT, MR, or US

ESC Task force, European Heart Journal (2001)
AHA/ACC/ATS/ACR [..] Guidelines, Circulation 2010

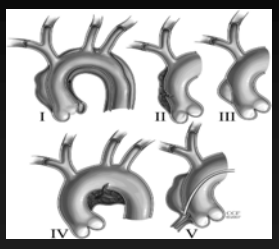
class 1: classic dissection

class 2: intramural haematoma

class 3: discrete/subtle dissection 'limited dissection'

class 4: penetrating athero-sclerotic ulcer

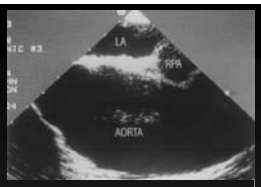
class 5: iatrogenic and traumatic dissection

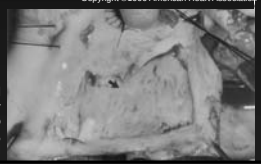


Svensson, L. G. et al.
Circulation 1999;99:1331-1336

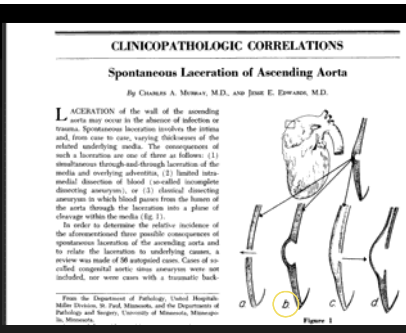
Dissection variant: Limited Intimal Tear

8 surgical cases, none of whom diagnosed preoperatively with imaging





Top, TEE of patient 2 whose initial clinical presentation was suspicious for aortic dissection but in whom no dissecting flap or hematoma was found, although aortic aneurysm was noted



CLINICOPATHOLOGIC CORRELATIONS

Spontaneous Laceration of Ascending Aorta

By Charles A. Murray, M.D., and Jesse E. Edwards, M.D.

LACERATION of the wall of the ascending aorta may occur in the absence of infection or trauma. Spontaneous laceration involves the intima and, from case to case, varying thicknesses of the related underlying media. The consequences of such a laceration are one of three as follows: (1) simultaneous through-and-through laceration of the media and overlying adventitia, (2) limited intramedial dissection of blood (so-called incomplete dissecting aneurysm), or (3) classical dissecting aneurysm in which blood passes from the lumen of the aorta through the laceration into a plane of cleavage within the media (fig. 1).

In order to determine the relative incidence of the aforementioned three possible consequences of spontaneous laceration of the ascending aorta and to relate the laceration to underlying causes, a review was made of 56 autopsied cases. Cases of so-called congenital aortic sinus aneurysm were not included, nor were cases with a traumatic back-

From the Department of Pathology, United Hospitals Miller Division, St. Paul, Minnesota, and the Departments of Pathology and Surgery, University of Minnesota, Minneapolis, Minnesota.

Figure 1
potentials following spontaneous laceration of the ascending aorta. (a.) through-and through laceration resulting in hemopericardium. (b.) incomplete dissecting aneurysm. (c.) Classical dissecting aneurysm. (d.) Classical dissecting aneurysm complicated by saccular aneurysm.

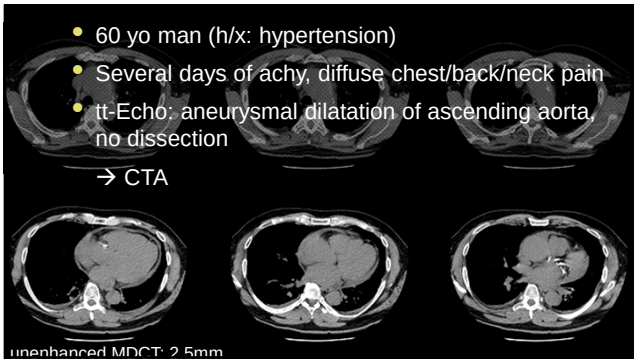
Murray, Circulation, Volume XLVII, April 1973

CT of the Thoracic Aorta

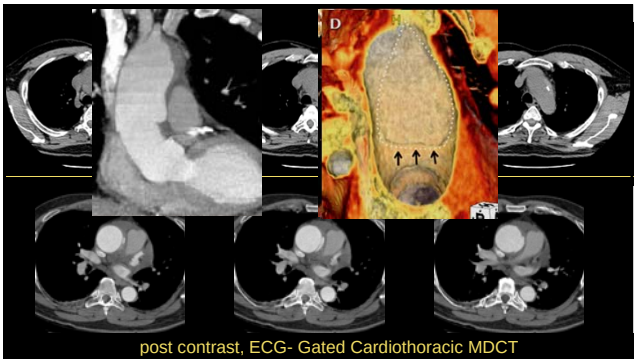
with ECG gating

- 60 yo man (h/x: hypertension)
- Several days of achy, diffuse chest/back/neck pain
- tt-Echo: aneurysmal dilatation of ascending aorta, no dissection

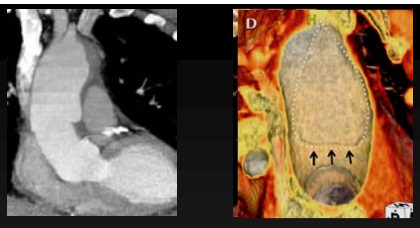
→ CTA



unenhanced MDCT: 2.5mm



post contrast, ECG- Gated Cardiothoracic MDCT



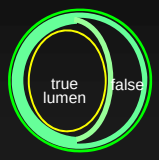
Limited intimal tear

(dissection variant)

Classic Dissection

False lumen

- within the media
- entry / exit tear



Dissection Variant

Limited Intimal Tear

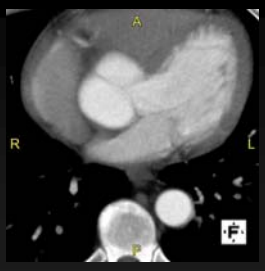
- through intima into media
- 'bulging' of residual wall

- no false lumen / no flap
- linear filling defects from undermined edges

QUIZ 54 y/o man

severe chest pain when waterskiing

- negative workup for acute MI
- stress-echo aborted for aortic aneurysm → CT



CTA, non-gated 3mm section thickness

QUIZ

RSNA 2012 Patients First

WHAT IS AN APPROPRIATE NEXT STEP?

A. this is an aortic lesion, take the patient to OR immediately

B. this could be an acute aortic lesion, repeat CT with gating, clear coronaries, then to OR

C. this is an aortic aneurysm, follow up CT/MR/TTE in 1, 3, and 6 months and annually, take to OR when >5.5 cm

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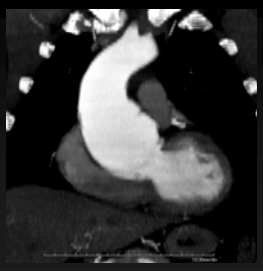
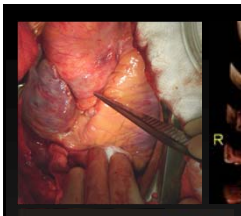
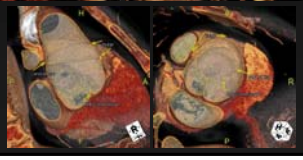


CTA, non-gated 3mm section thickness



Pathology

gated CT preoperative



RC 212: Acute Aortic Disorders

RSNA 2012 Patients First

to be continued …

www.stanford.edu/~dominikf/RSNA/