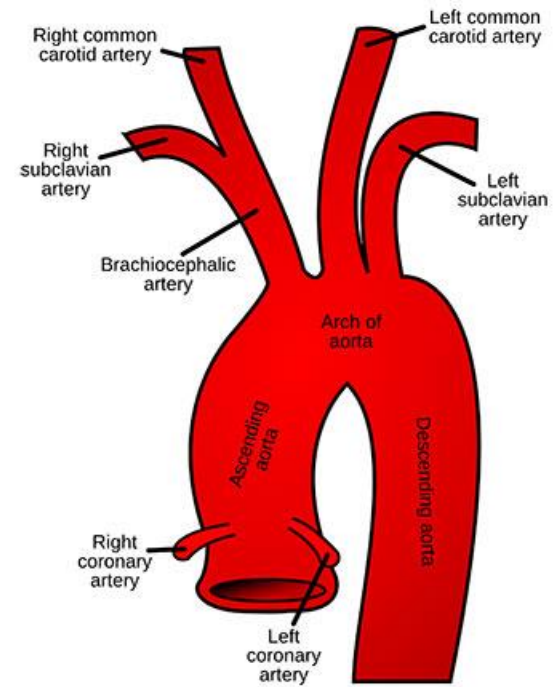


Figure 8 – Transversal Cut of the Descending Aorta Showing the Dissection Line with an Intimal Flap.
TL: True lumen, FL: False lumen.



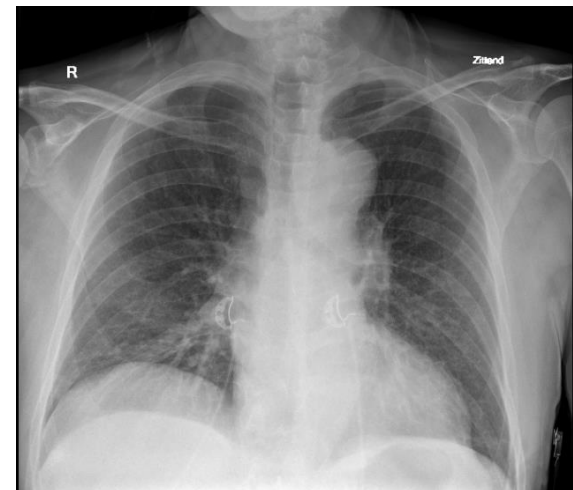
Aortapathologie

Sabri Ozturk

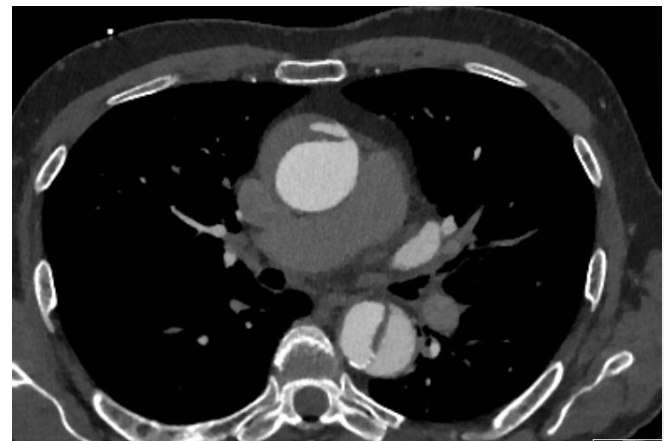
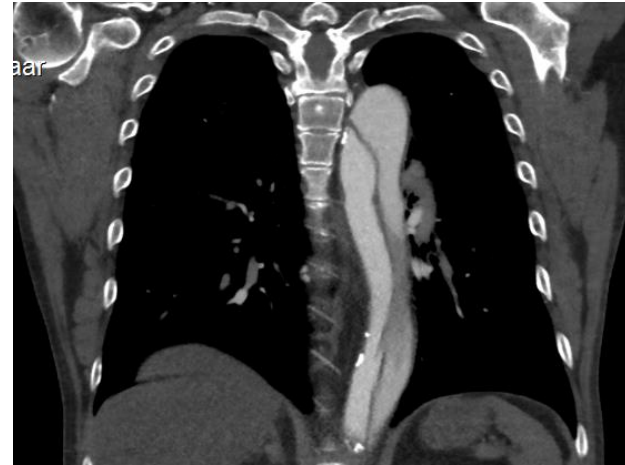
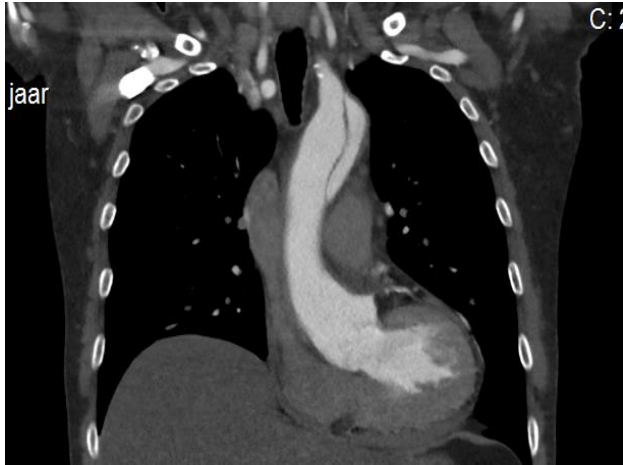
AIOS CTC

Casus

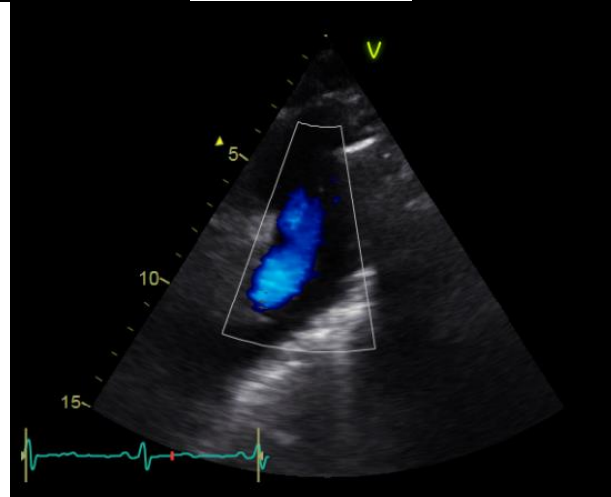
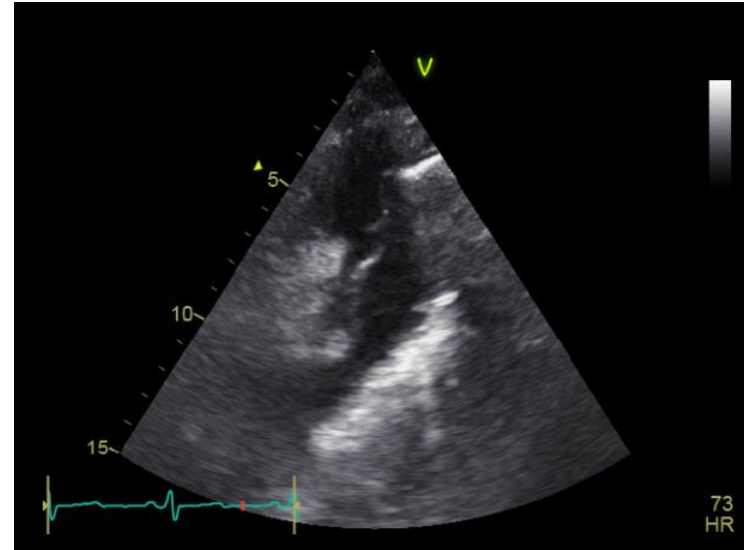
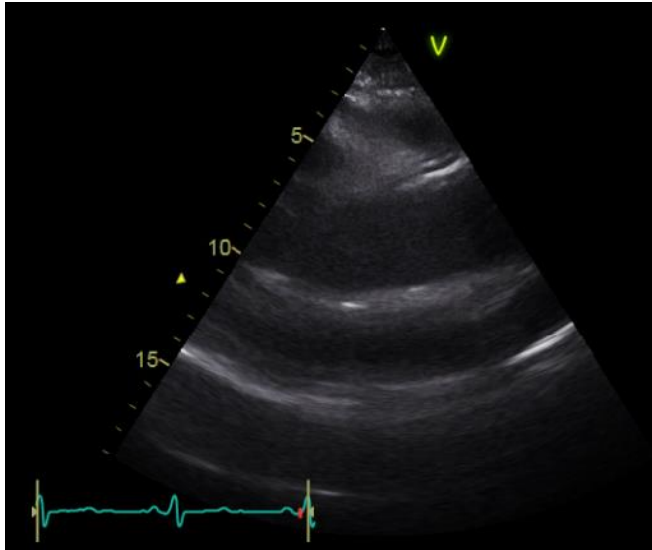
- Man 69 jaar oud
- VG : hypertensie
- A : Bandgevoel al 11 uur lang, zeurend en continue aanwezig. Misselijk geweest, 4x dunne ontlasting gehad. Klam en zweterig. Uitstraling naar rechter schouder. Pijn zakt maar niet af. Roken + Alcohol +
- LO : 148/89 p 61 T 37 SpO2 100%
- Geen afwijkingen tijdens LO
- ECG : SR met microvoltages
- Xth →



CT scan



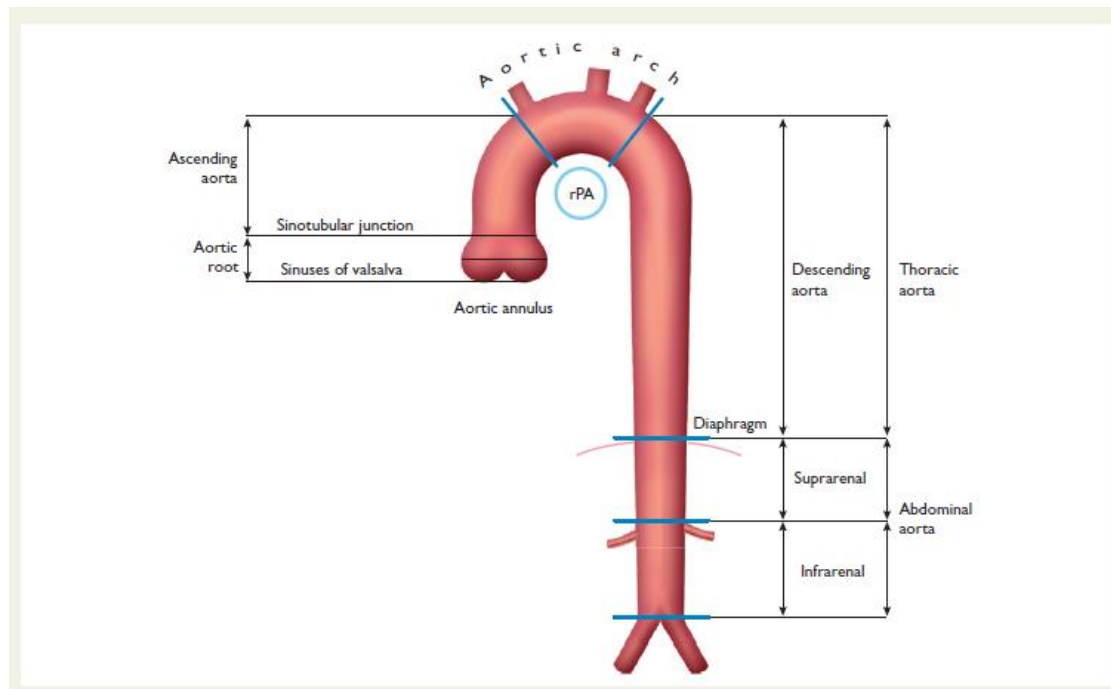
TTE



Aorta

Aorta bestaat uit 3 lagen

- Tunica intima (endotheel)
- Tunica media (collagen fibers en smooth muscle cells)
- Tunica adventitia (collagen, vasa vasorum en lymfevaatjes)



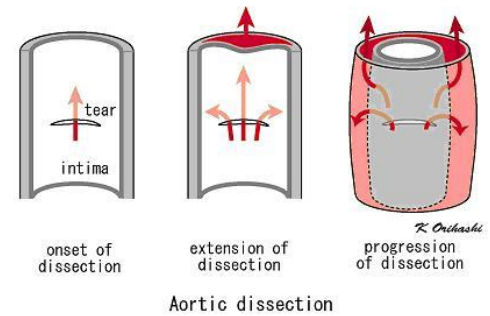
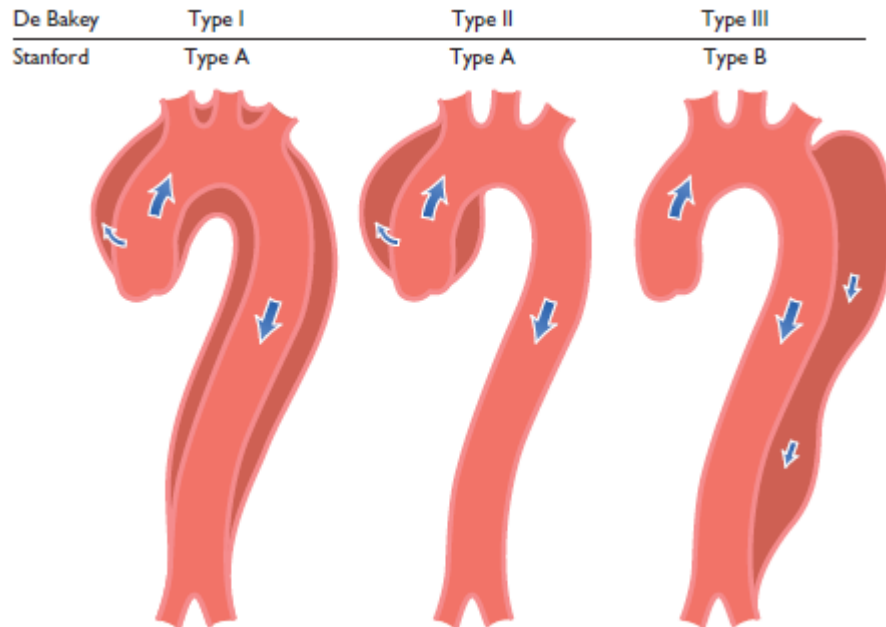
TAD

- 20% overlijden voor aankomst ziekenhuis
- 30 % overlijden in het ziekenhuis
- 20% overlijden binnen 10 jaar na ontslag

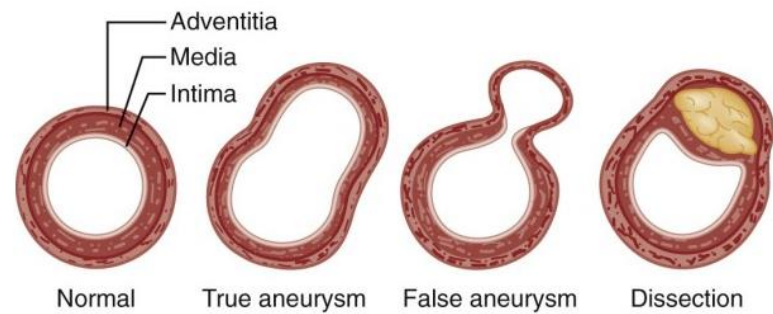
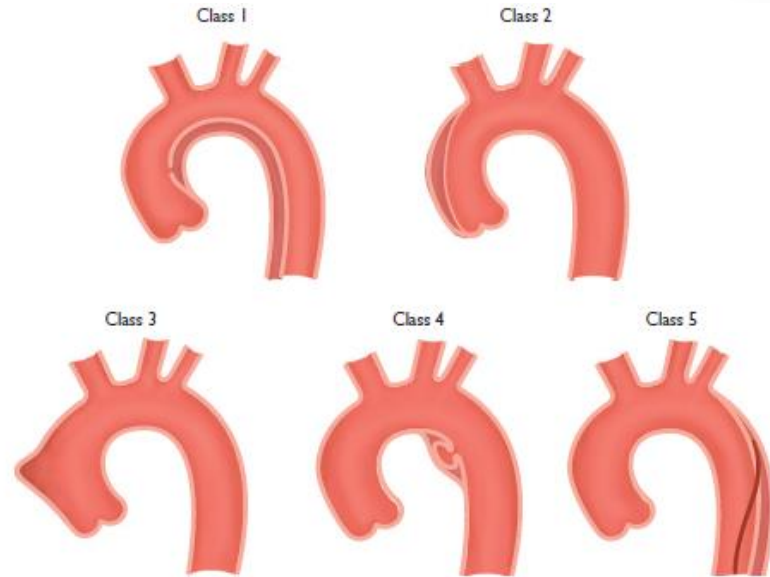
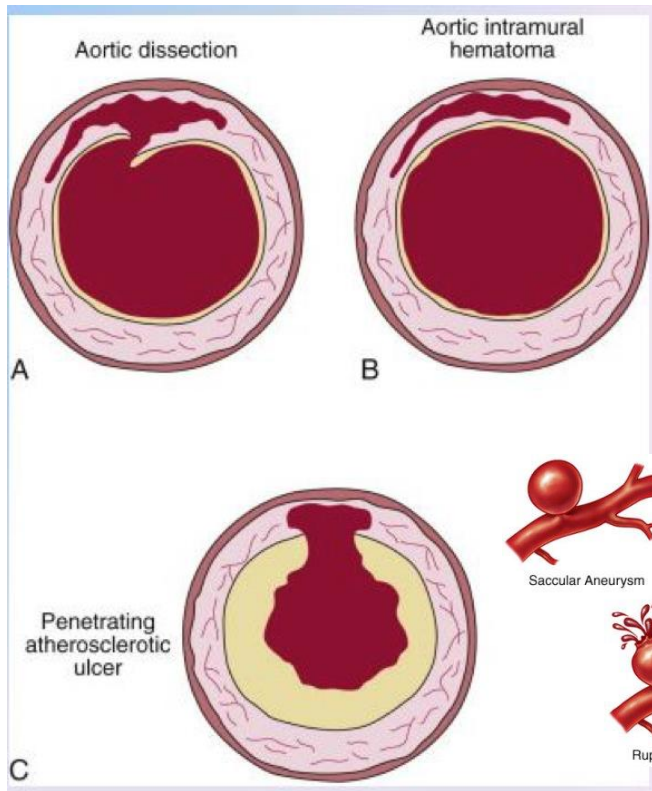
- Acute dissectie < 14 dagen
- Subacuut 15-90 dagen
- Chronische dissectie > 90 dagen

- Preventie : electieve operatie bij gedilateerde aorta ascendens

Aortapathologie



Aortapathologie



Aorta ascendens

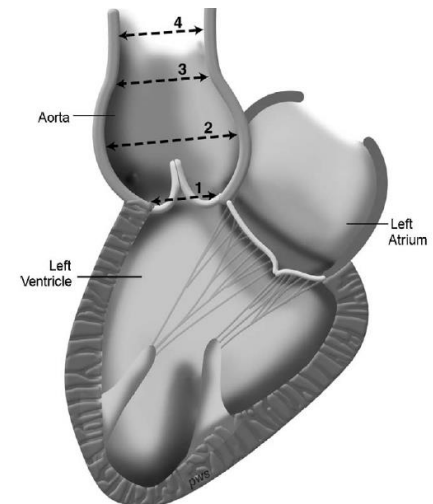
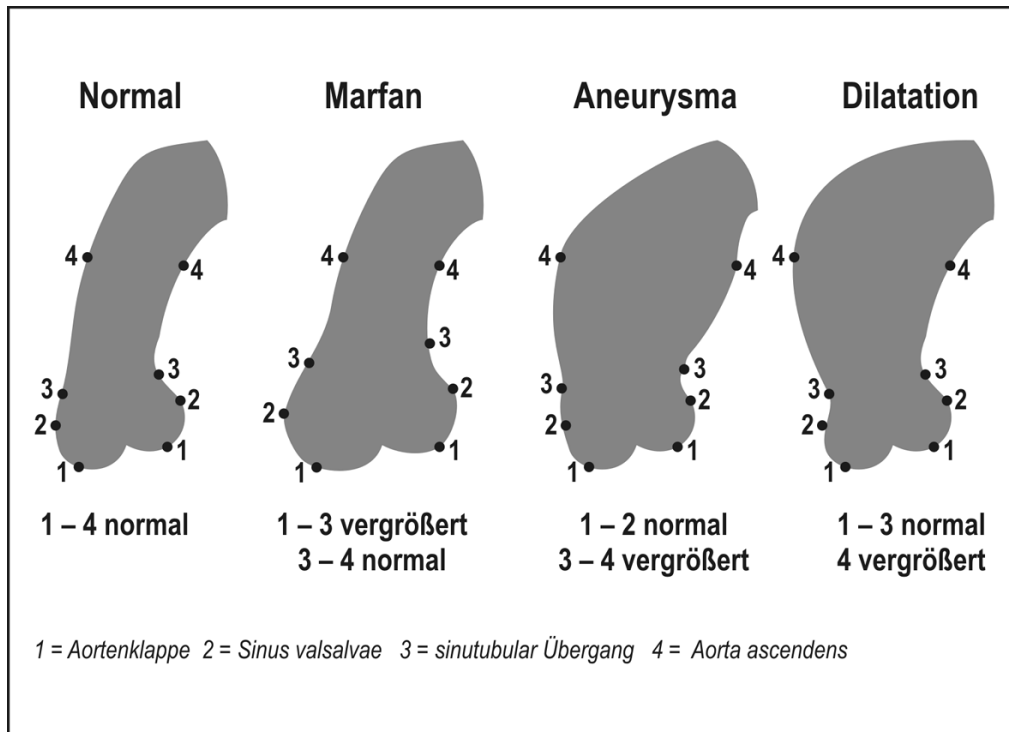


Fig. 1. Preoperative transesophageal echocardiography was used to measure aortic diameters at the aortic annulus (1), the sinus segment (2), the sinotubular junction (3) and the ascending aorta (4).

Aorta dimensions

Aorta root dimensions in normal adults

Parameter	MALE	FEMALE
Annulus (mm)	26 ± 3	23 ± 2
Annulus/BSA (mm/m ²)	13 ± 1	13 ± 1
Sinus of Valsalva (mm)	34 ± 3	30 ± 3
Sinus of Valsalva/BSA (mm/m ²)	17 ± 2	18 ± 2
Sinotubular junction (mm)	29 ± 3	26 ± 3
Sinotubular junction/BSA (mm/m ²)	15 ± 2	15 ± 2
Proximal ascending aorta (mm)	30 ± 4	27 ± 4
Proximal ascending aorta (mm/m ²)	15 ± 2	16 ± 3

Presentatie

Klinisch onderzoek

Thoracale klachten

AoI

Myocardische mie

Hartfalen

Pleuravocht

Syncope

Neurologische symptomen

Mesenteriale ischemie

Nierfalen

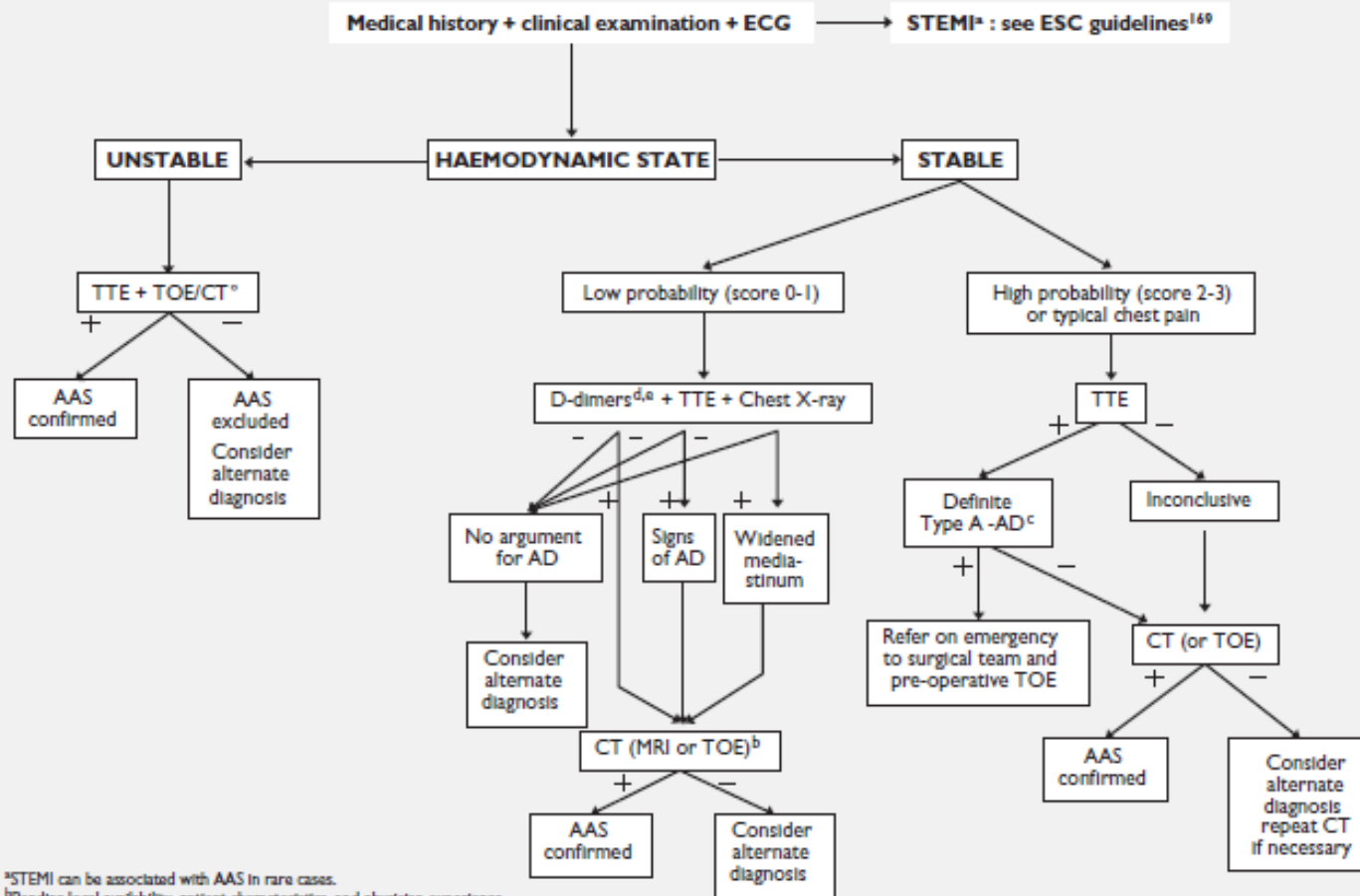
	Type A	Type B
Chest pain	80%	70%
Back pain	40%	70%
Abrupt onset of pain	85%	85%
Migrating pain	<15%	20%
Aortic regurgitation	40-75%	N/A
Cardiac tamponade	<20%	N/A
Myocardial Ischaemia or Infarction	10-15%	10%
Heart failure	<10%	<5%
Pleural effusion	15%	20%
Syncope	15%	<5%
Major neurological deficit (coma/stroke)	<10%	<5%
Spinal cord Injury	<1%	NR
Mesenteric Ischaemia	<5%	NR
Acute renal failure	<20%	10%
Lower limb Ischaemia	<10%	<10%

Presentatie

Table 7 Clinical data useful to assess the a priori probability of acute aortic syndrome

High-risk conditions	High-risk pain features	High-risk examination features
<ul style="list-style-type: none">• Marfan syndrome (or other connective tissue diseases)• Family history of aortic disease• Known aortic valve disease• Known thoracic aortic aneurysm• Previous aortic manipulation (including cardiac surgery)	<ul style="list-style-type: none">• Chest, back, or abdominal pain described as any of the following:<ul style="list-style-type: none">- abrupt onset- severe intensity- rippling or tearing	<ul style="list-style-type: none">• Evidence of perfusion deficit:<ul style="list-style-type: none">- pulse deficit- systolic blood pressure difference- focal neurological deficit (in conjunction with pain)• Aortic diastolic murmur (new and with pain)• Hypotension or shock

ACUTE CHEST PAIN



^aSTEMI can be associated with AAS in rare cases.

^bPending local availability, patient characteristics, and physician experience.

^cProof of type-A AD by the presence of flap, aortic regurgitation, and/or pericardial effusion.

^dPreferably point-of-care, otherwise classical.

^eAlso troponin to detect non-ST-segment elevation myocardial infarction.

Imaging

- X - thorax
- TTE/TEE
- CT (ECG – gated CT)
- PET-CT
- MRI
- Aortagrafie

Recommendations on imaging of the aorta

Recommendations	Class ^a	Level ^b
It is recommended that diameters be measured at pre-specified anatomical landmarks, perpendicular to the longitudinal axis.	I	C
In the case of repetitive imaging of the aorta over time, to assess change in diameter, it is recommended that the imaging modality with the lowest iatrogenic risk be used.	I	C
In the case of repetitive imaging of the aorta over time to assess change in diameter, it is recommended that the same imaging modality be used, with a similar method of measurement.	I	C
It is recommended that all relevant aortic diameters and abnormalities be reported according to the aortic segmentation.	I	C
It is recommended that renal function, pregnancy, and history of allergy to contrast media be assessed, in order to select the optimal imaging modality of the aorta with minimal radiation exposure, except for emergency cases.	I	C
The risk of radiation exposure should be assessed, especially in younger adults and in those undergoing repetitive imaging.	IIa	B
Aortic diameters may be indexed to the body surface area, especially for the outliers in body size.	IIb	B

Imaging

Aortic dissection
Visualization of intimal flap
Extent of the disease according to the aortic anatomic segmentation
Identification of the false and true lumens (if present)
Localization of entry and re-entry tears (if present)
Identification of antegrade and/or retrograde aortic dissection
Identification grading, and mechanism of aortic valve regurgitation
Involvement of side branches
Detection of malperfusion (low flow or no flow)
Detection of organ ischaemia (brain, myocardium, bowels, kidneys, etc.)
Detection of pericardial effusion and its severity
Detection and extent of pleural effusion
Detection of peri-aortic bleeding
Signs of mediastinal bleeding
Intramural haematoma
Localization and extent of aortic wall thickening
Co-existence of atheromatous disease (calcium shift)
Presence of small intimal tears
Penetrating aortic ulcer
Localization of the lesion (length and depth)
Co-existence of intramural haematoma
Involvement of the peri-aortic tissue and bleeding
Thickness of the residual wall
In all cases
Co-existence of other aortic lesions: aneurysms, plaques, signs of inflammatory disease, etc.

Diagnostiek

Table 9 Diagnostic value of different imaging modalities in acute aortic syndromes

Lesion	TTE	TOE	CT	MRI
Ascending aortic dissection	++	+++	+++	+++
Aortic arch dissection	+	+	+++	+++
Descending aortic dissection	+	+++	+++	+++
Size	++	+++	+++	+++
Mural thrombus	+	+++	+++	+++
Intramural haematoma	+	+++	++	+++
Penetrating aortic ulcer	++	++	+++	+++
Involvement of aortic branches	+ ^a	(+)	+++	+++

^aCan be improved when combined by vascular ultrasound (carotid, subclavian, vertebral, celiac, mesenteric and renal arteries).

+++ = excellent; ++ = moderate; + = poor; (+) = poor and inconstant; CT = computed tomography; MRI = magnetic resonance imaging; TOE = transoesophageal echocardiography; TTE = transthoracic echocardiography.

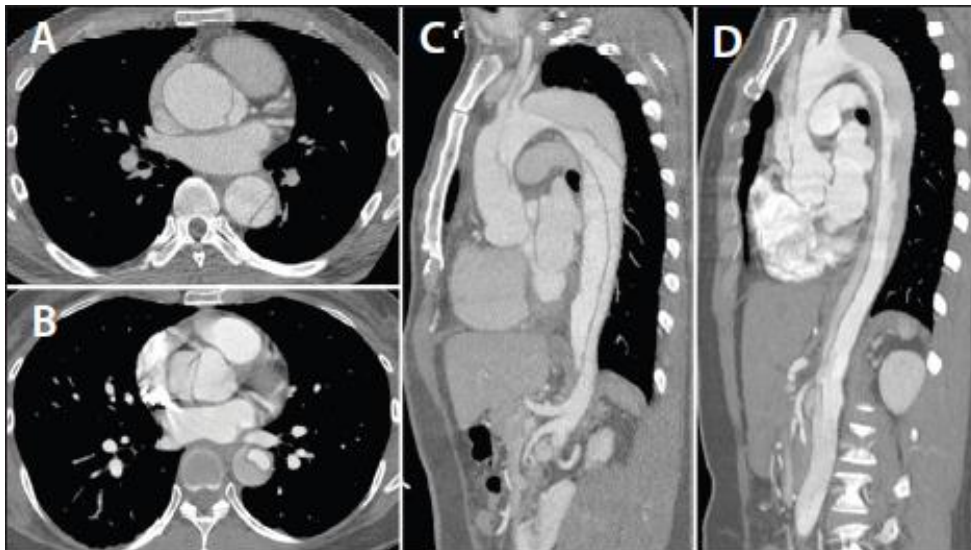
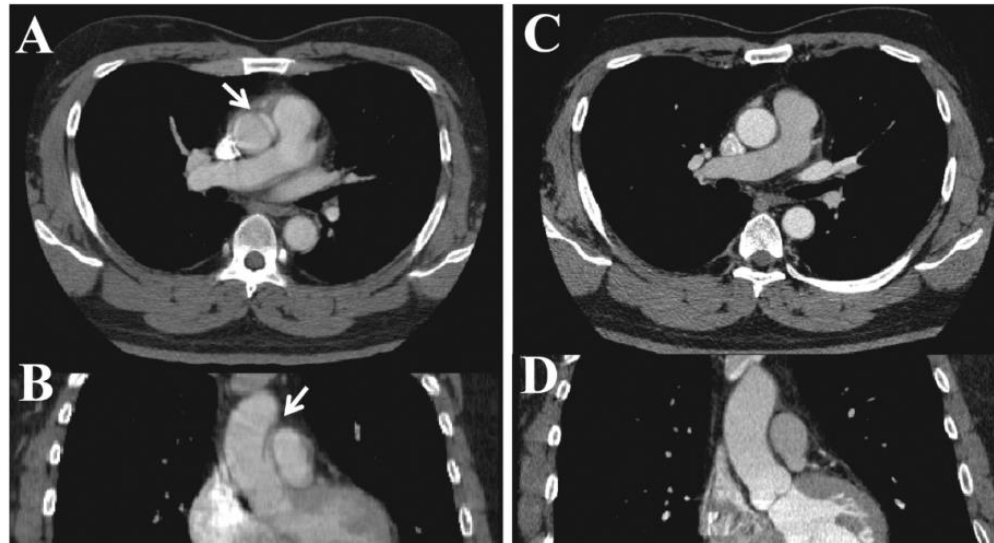
ECG Gated CT scan

TABLE 1. DIFFERING QUALITIES OF TRUE AND FALSE LUMENS IN AD

	True Lumen	False Lumen
Lumen size	Usually smaller	Usually larger than true lumen
During systole	Expansion	Compression
	Antegrade flow	Reduced antegrade flow or absent or retrograde flow
Localization within the arch	Inner curvature	Outer curvature
Sign of slow flow	Rare	Frequent, depending on degree of communication
Thrombus	Rare	Frequent, depending on degree of communication

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- A/B zonder ECG CT = wel dissectie
- C/D met ECG CT = geen dissectie



- A/C ECG CT scan
- B/D zonder ECG : afwijkende FU waarden

Behandeling

- CAD
- CKD
- DM
- Dyslipidemie
- Hypertensie (streef naar max 140/90)
- Stoppen met roken
- Lichamelijke beweging

Behandeling

- Labetolol iv op bewaakte afdeling (CCU/ICU) (systolische RR 100-120 mmHg)
- Pijnstilling
- Arterielijn bdz
- 6 x PC
- Type A : spoed OK (zo snel mogelijk CTC inlichten)
- Malperfusie organen ?
 - Interventieradioloog
 - Vaatchirurg
- Type B : ongecompliceerd / gecompliceerd
- Conservatief
- TEVAR
- TAAA

Recommendations for treatment of aortic dissection

Recommendations	Class ^a	Level ^b	Ref. ^c
In all patients with AD, medical therapy including pain relief and blood pressure control is recommended.	I	C	
In patients with Type A AD, urgent surgery is recommended.	I	B	1,2
In patients with acute Type A AD and organ malperfusion, a hybrid approach (i.e. ascending aorta and/or arch replacement associated with any percutaneous aortic or branch artery procedure) should be considered.	IIa	B	2,118, 202–204, 227
In uncomplicated Type B AD, medical therapy should always be recommended.	I	C	
In uncomplicated Type B AD, TEVAR should be considered.	IIa	B	218,219
In complicated Type B AD, TEVAR is recommended.	I	C	
In complicated Type B AD, surgery may be considered.	IIb	C	

- Marfan > 50 mm aortawortel
 - Marfan + risicofactoren > 45 mm *
 - BAV + risicofactoren > 50 mm **
 - Zonder elastopathie > 55 mm
-
- Lagere normen bij mensen met afwijkende BSA, snelle progressie, Aol, zwangerschapswens, voorkeur patiënt
-
- Aortaboog > 55 mm
 - Reeds OK voor aneurysma a.ascendens/descendens mag boog preventief meegenomen worden
-
- * Fam +, > 3mm groei per jaar, ernstige Aol
 - ** Coarctatio, HT, Fam +, > 3mm groei per jaar

Recommendations on interventions on ascending aort aneurysms

Recommendations	Class ^a	Level ^b
Surgery is indicated in patients who have aortic root aneurysm, with maximal aortic diameter ^c ≥50 mm for patients with Marfan syndrome.	I	C
Surgery should be considered in patients who have aortic root aneurysm, with maximal ascending aortic diameters: <ul style="list-style-type: none"> • ≥45 mm for patients with Marfan syndrome with risk factors.^d • ≥50 mm for patients with bicuspid valve with risk factors.^{e,f} • ≥55 mm for other patients with no elastopathy.^{g,h} 	IIa	C
Lower thresholds for intervention may be considered according to body surface area in patients of small stature or in the case of rapid progression, aortic valve regurgitation, planned pregnancy, and patient's preference.	IIb	C
Interventions on aortic arch aneurysms		
Surgery should be considered in patients who have isolated aortic arch aneurysm with maximal diameter ≥55 mm.	IIa	C
Aortic arch repair may be considered in patients with aortic arch aneurysm who already have an indication for surgery of an adjacent aneurysm located in the ascending or descending aorta.	IIb	C

BAV

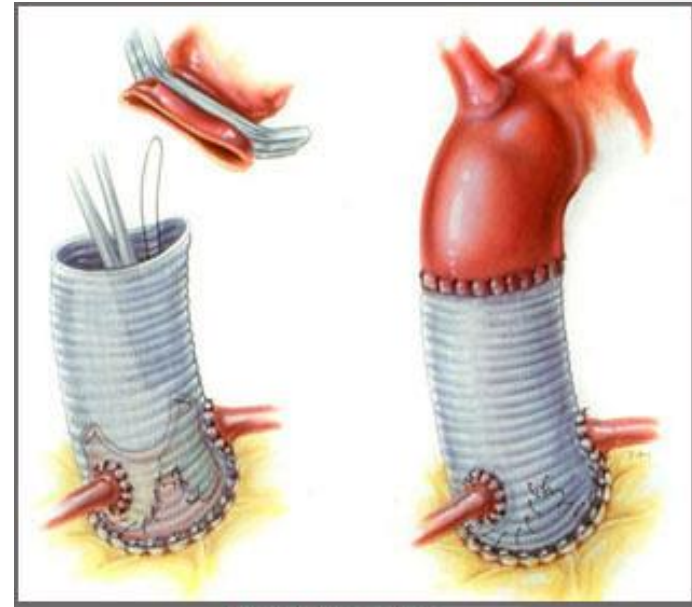
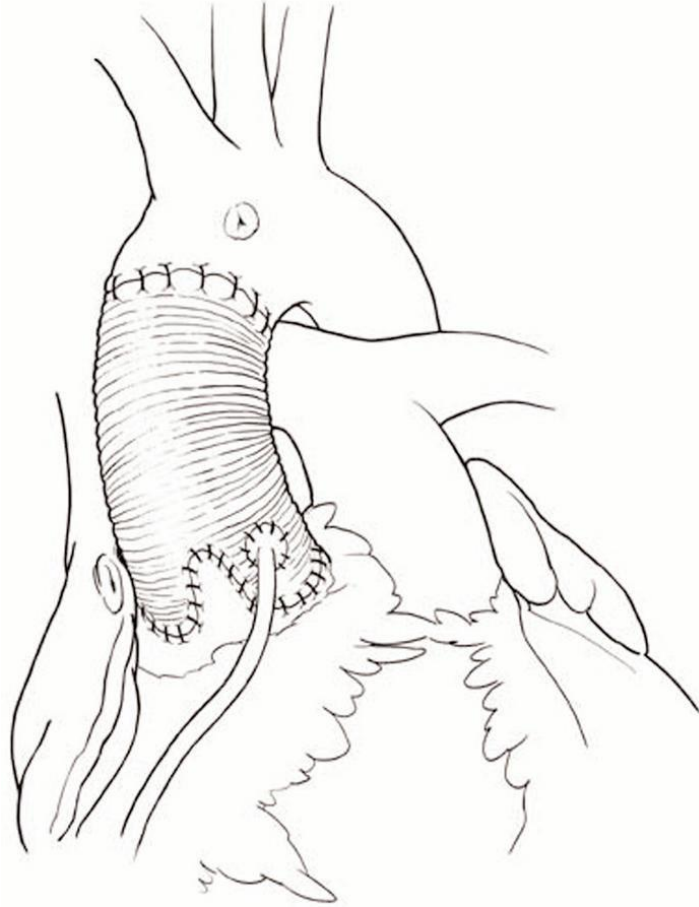
- BAV = TTE voor diameters aortawortel en aorta ascendens
- CMRI/ CT scan voor optimale diagnostiek indien TTE onvoldoende is
- FU afh van aortametingen, groei en familie anamnese
- Aorta ascendens > 45 mm of groei van > 3 mm = jaarlijks TTE
- Aorta ascendens > 50 mm of groei van > 3 mm = CT/MRI
- Aortawortel of aorta ascendens > 55 mm = AVR + aorta OK
- Aortawortel of aorta ascendens > 50 mm * = AVR + aorta OK
- Sowieso AVR dan al bij 45 mm grens om aorta mee te opereren
- Beta blokkers BAV en > 40 mm aortawortel
- Screening 1^e graads familieleden
- Krachttraining (acuut veel druk) vermijden

Recommendations	Class ^a	Level ^b
Patients with known BAV should undergo an initial TTE to assess the diameters of the aortic root and ascending aorta.	I	C
Cardiac MRI or CT is indicated in patients with BAV when the morphology of the aortic root and the ascending aorta cannot be accurately assessed by TTE.	I	C
Serial measurement of the aortic root and ascending aorta is indicated in every patient with BAV, with an interval depending on aortic size, increase in size and family history	I	C
In the case of a diameter of the aortic root or the ascending aorta >45 mm or an increase >3 mm/year measured by echocardiography, annual measurement of aortic diameter is indicated.	I	C
In the case of aortic diameter >50 mm or an increase >3 mm/year measured by echocardiography, confirmation of the measurement is indicated, using another imaging modality (CT or MRI).	I	C
In cases of BAV, surgery of the ascending aorta is indicated in case of: <ul style="list-style-type: none"> • aortic root or ascending aortic diameter >55 mm. • aortic root or ascending aortic diameter >50 mm in the presence of other risk factors.^c • aortic root or ascending aortic diameter >45 mm when surgical aortic valve replacement is scheduled. 	I	C
Beta-blockers may be considered in patients with BAV and dilated aortic root >40 mm.	IIb	C
Because of familial occurrence, screening of first-degree relatives should be considered.	IIa	C
In patients with any elastopathy or BAV with dilated aortic root (>40 mm), isometric exercise with a high static load (e.g. weightlifting) is not indicated and should be discouraged.	III	C

Operatie technieken

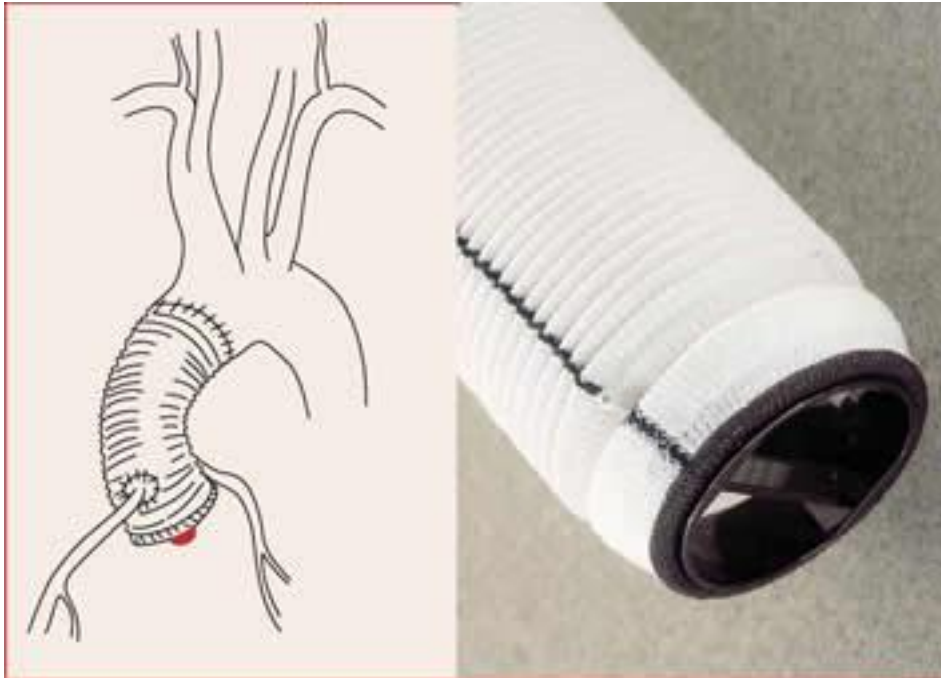
- Aorta wortel operaties
 - Valve-sparing (David/Yacoub)
 - Aortic root + valve (Bio/Mech Bentall)
 - Cabrol
 - Homograft
 - Ross procedure

ARR



David Procedure

Bentall



Cabrol

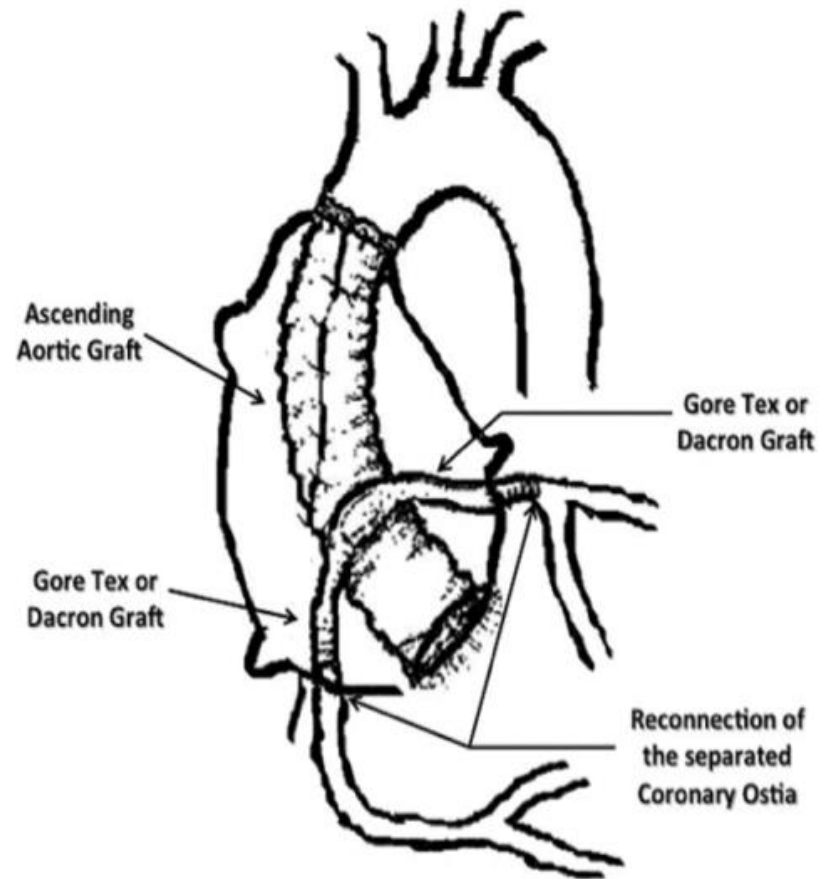
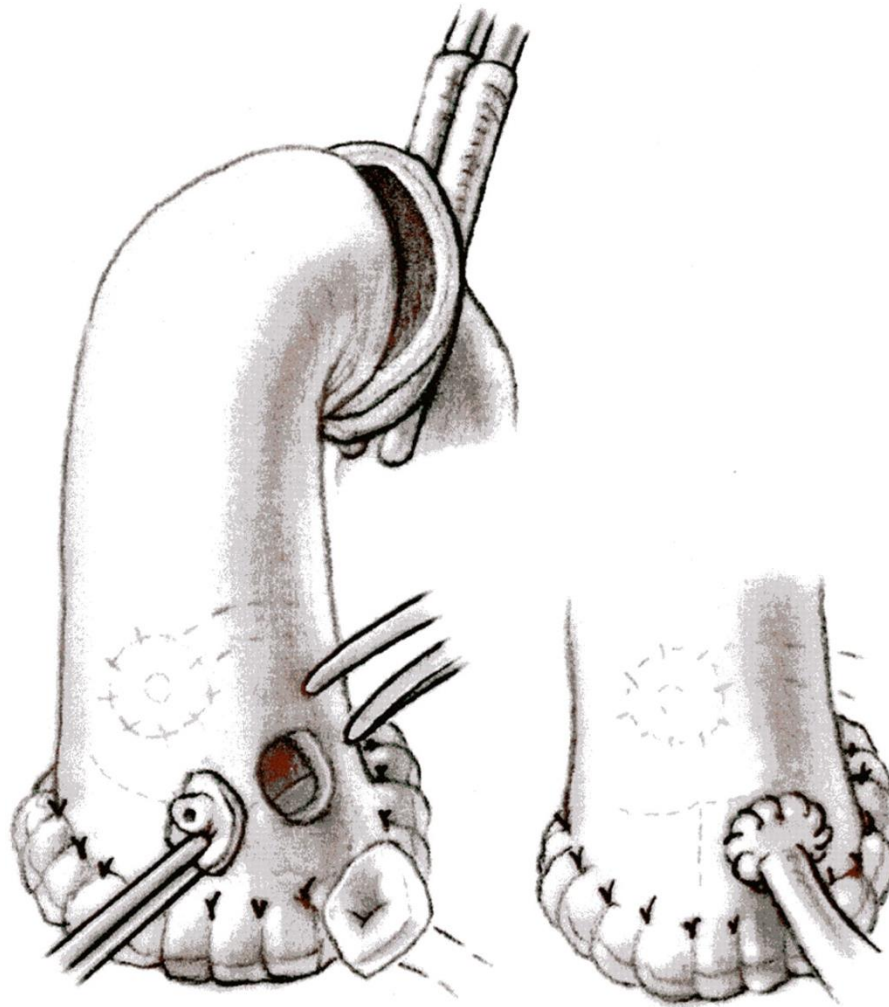


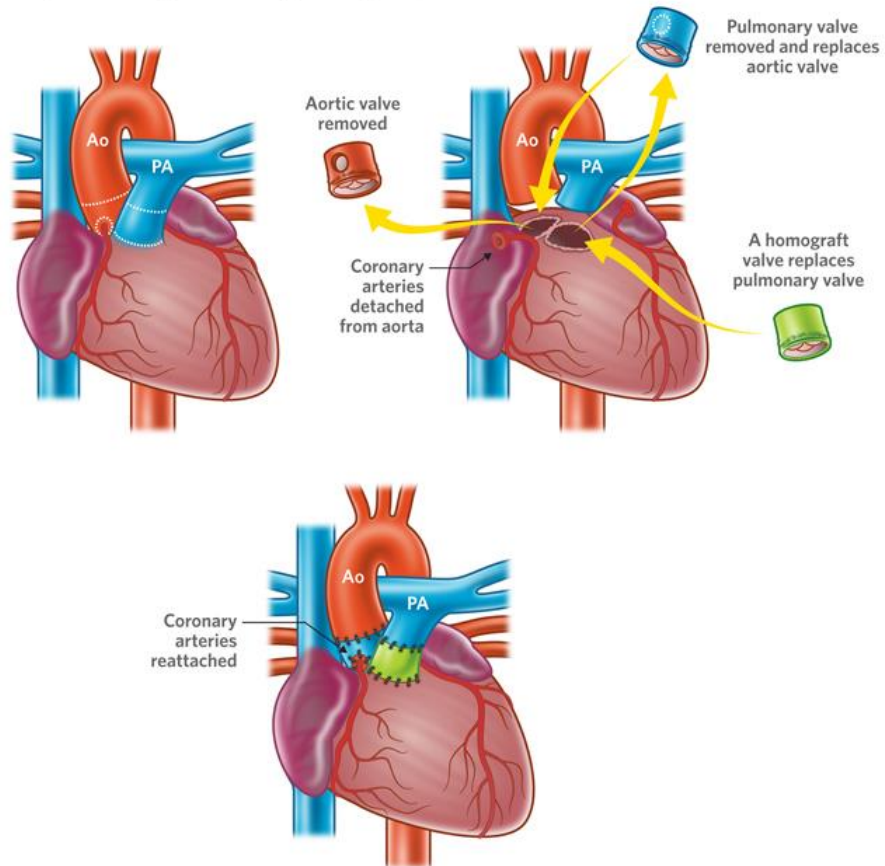
Figure 1. Drawing describing the Cabrol technique, which involves connecting a separate Dacron or Gore-Tex tube, usually between 5-8 mm in diameter, in a side-to-side fashion from the main ascending aortic graft to the separated opening of the coronary ostia; the coronary ostia having been separated from the aorta during placement of the aortic graft and leaving its end open to be connected to the Dacron or Gore-Tex tube.

Homograft



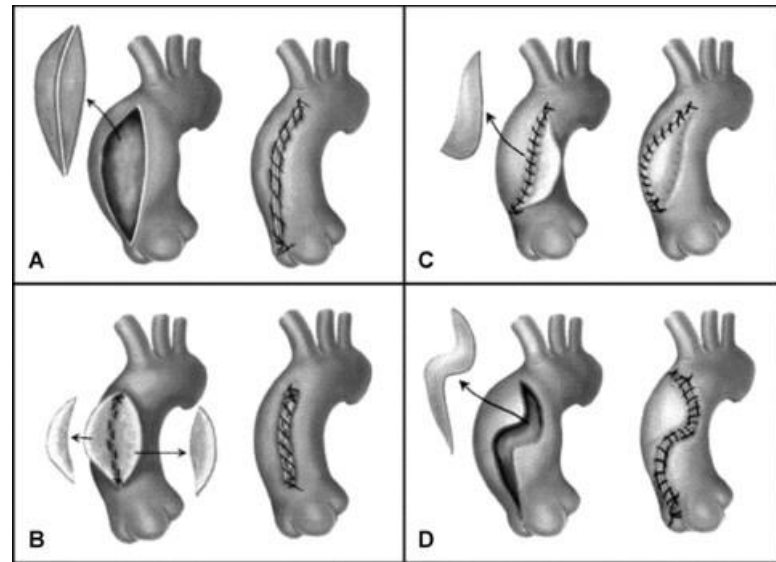
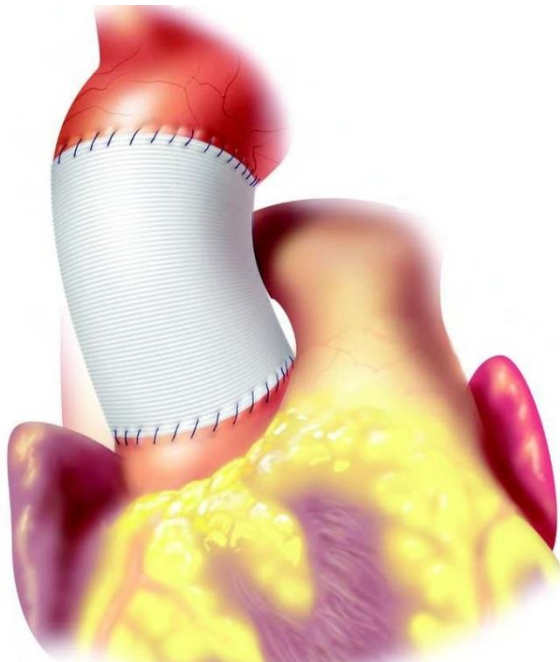
Ross operatie

Ross operation (pulmonary autograft)

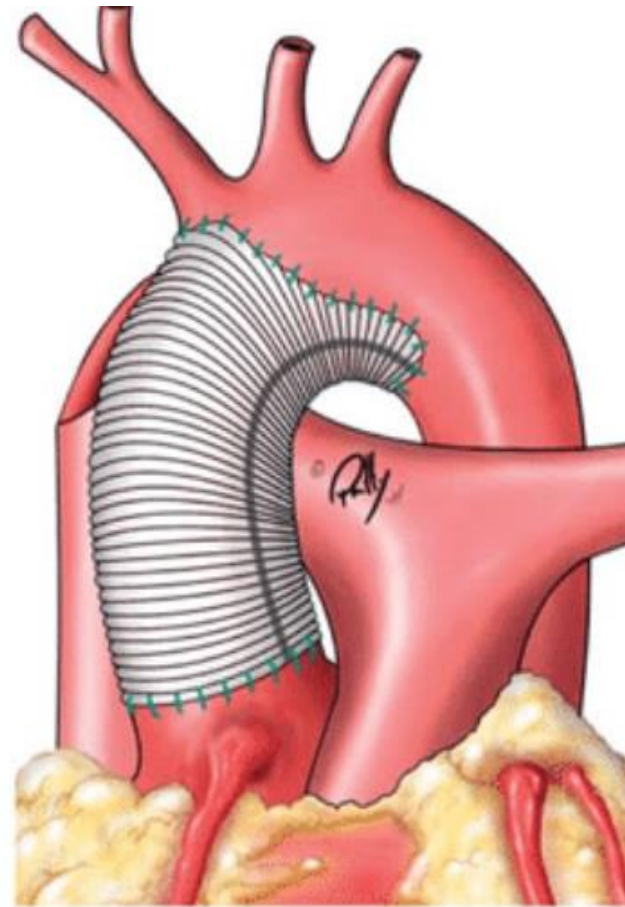
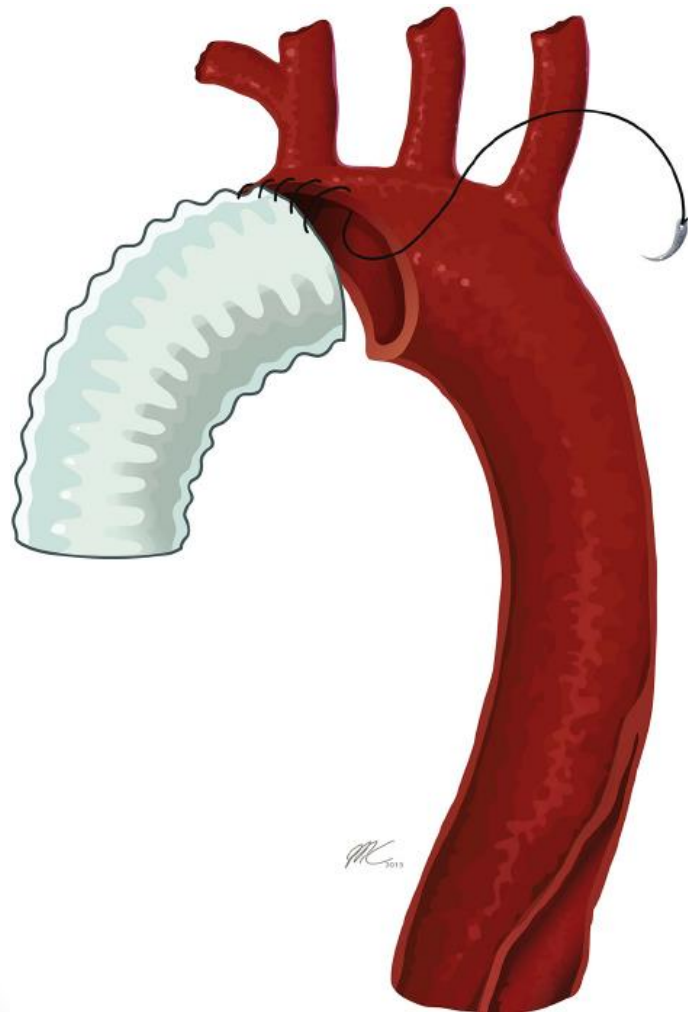


Aorta ascendens

- SCAR/SCAV
- Reven aorta
- Supporting aortaplasty

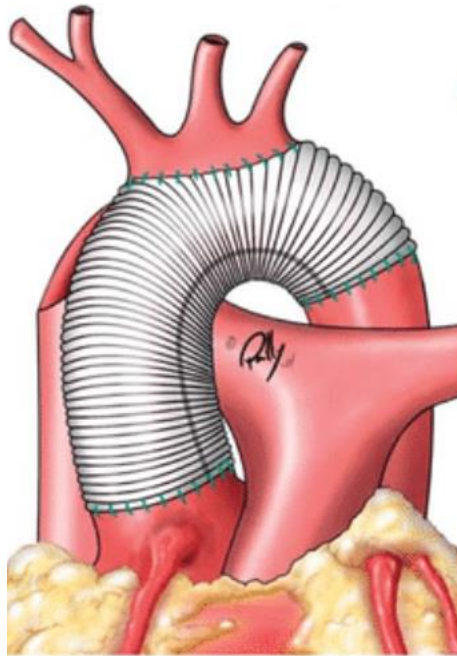


Hemiboog

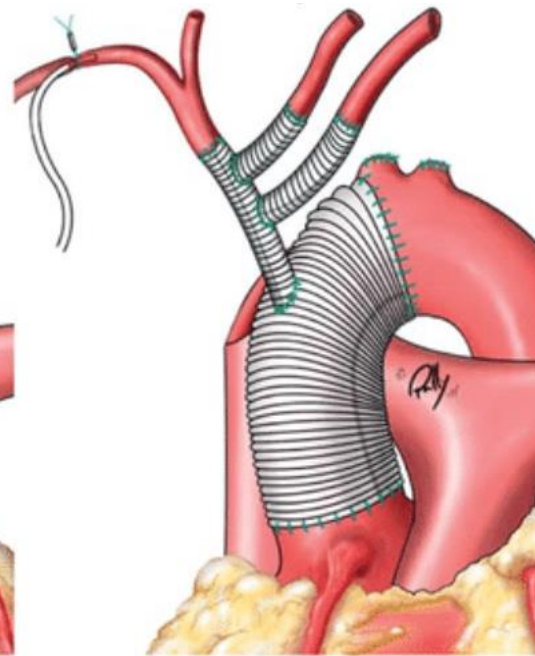


b Hemiarch replacement

Totale boogvervanging

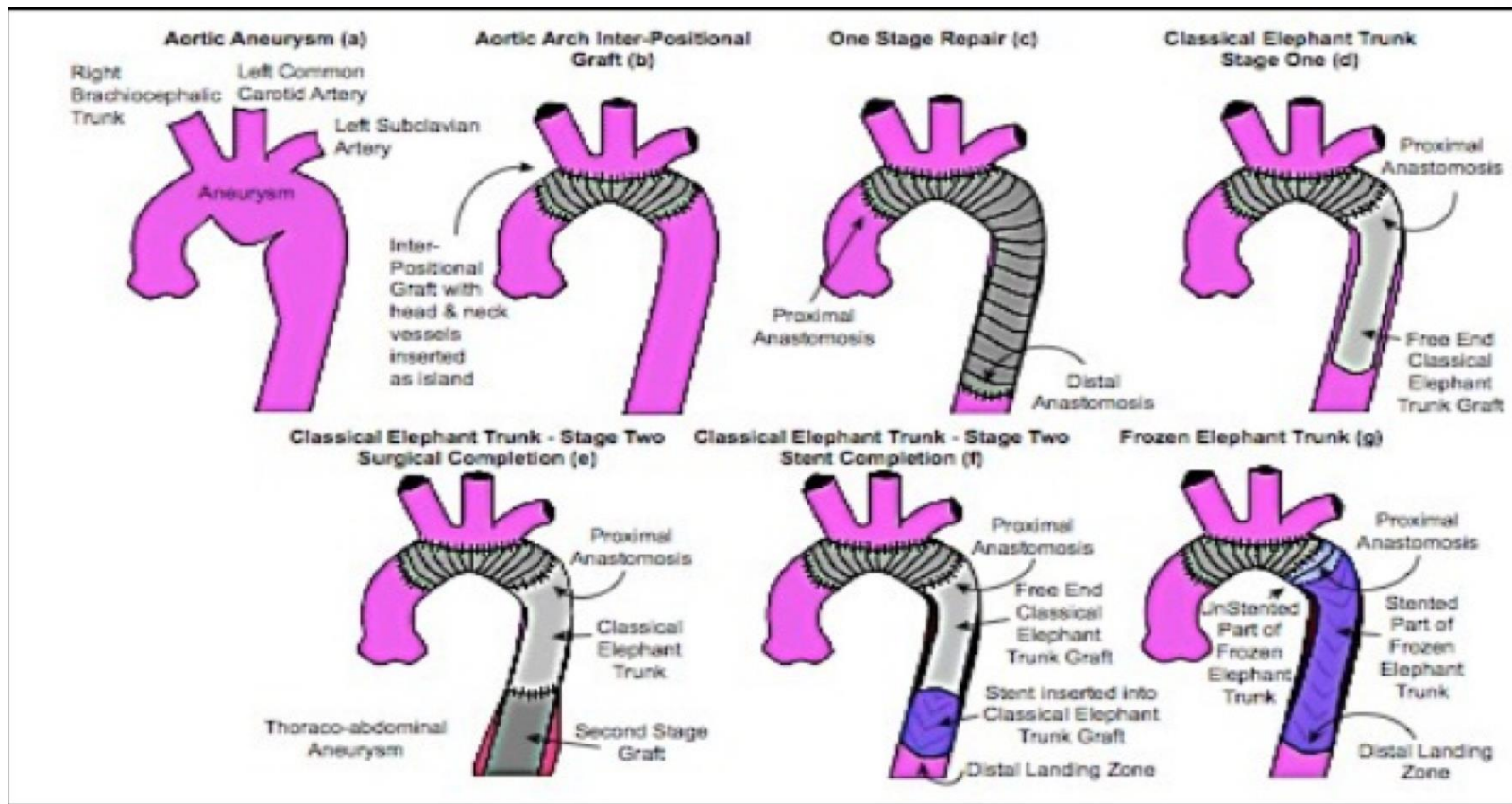


c Total arch replacement



d Trifurcated graft

Aorta descendens



FU poli richtlijn OLVG

- CT scan voor ontslag
- CT scan 3 mnd post OK
- CT scan na 6 maanden post OK
- CT scan na 1 jaar post OK
- Daarna jaarlijks CT

- Adviezen
- RR controle < 130 systolische druk
- Zware lichamelijke inspanning vermijden (werk , overleg bedrijfsarts)
- Zwaar tillen vermijden (werk , bedrijfsarts)
- Contact sporten vermijden
- Eerstegraads familieleden screenen

Cardiogenetica

- Turner syndroom
- Marfan syndroom
- Ehlers – Danlos syndroom type IV (vasculair type)
- Loeys – Dietz syndroom
- Arterial tortuosity syndrome
- AOS (aneurysms-osteoarthritis syndrome)

Recommendations on genetic testing in aortic diseases

Recommendations	Class ^a	Level ^b
It is recommended to investigate first-degree relatives (siblings and parents) of a subject with TAAD to identify a familial form in which relatives all have a 50% chance of carrying the family mutation/disease.	I	C
Once a familial form of TAAD is highly suspected, it is recommended to refer the patient to a geneticist for family investigation and molecular testing.	I	C
Variability of age of onset warrants screening every 5 years of 'healthy' at-risk relatives until diagnosis (clinical or molecular) is established or ruled out.	I	C
In familial non-syndromic TAAD, screening for aneurysm should be considered, not only in the thoracic aorta, but also throughout the arterial tree (including cerebral arteries).	IIa	C

^aClass of recommendation.

^bLevel of evidence.

TAAD = thoracic aortic aneurysms and dissection.