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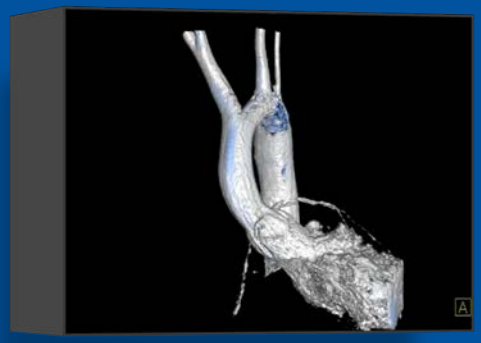
Low gradient CoA in the adult: what to treat ?



Michiel Voskuil, MD, PhD
Dept Cardiology
Associate Professor

In memoriam

Marc Buijsrogge

Thoracic surgeon

48y

Heart & lung transplantation

Mechanical assist devices

Minimal invasive surgey

Trainer of residents

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Why do a CoA intervention in an adult?

- **Hypertension!**

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CoA – Hypertension

- Hypertension in ⅔rd of adult patients after successful CoA repair
- Untreated, average survival is 35 years; 75% died <50 yrs: heart failure, coronary artery disease, aortic dissection
- Causes hypertension:
  - re-CoA
  - baroreceptor dysfunction
  - increased arterial stiffness
  - elevated sympathetic nerve activity / increased RAS activation
  - Aortic arch hypoplasia / gothic arch #
    - Stenting safe / efficient? *

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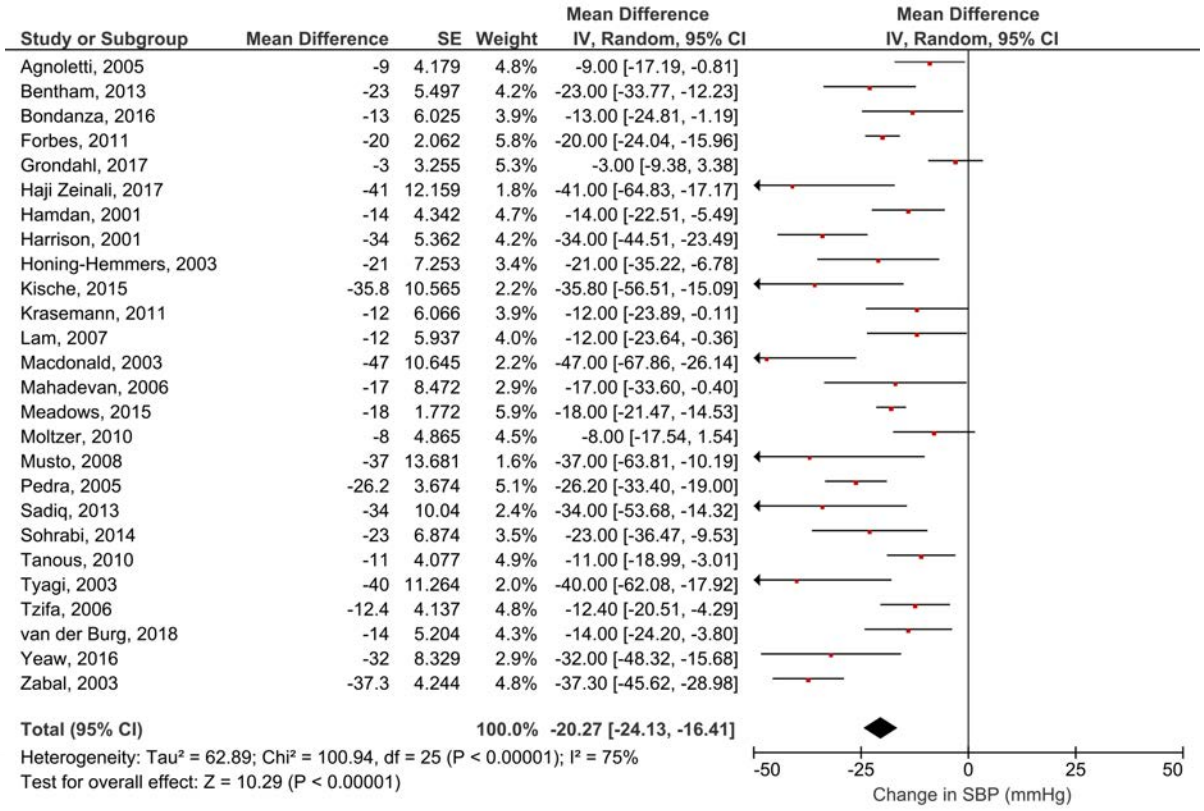
Weber Hs et al. J Am Coll Cardiol 1993;21:1002-7

* Warmerdam EG et al, Neth Heart J Nov 29 [Epub ahead of print]

Stenting of CoA – effects on BP

Medium-term systemic blood pressure after stenting of aortic coarctation: a systematic review and meta-analysis

Timion A Meijs,[1] Evangeline G Warmerdam,[1] Martijn G Slieker,[2] Gregor J Krings,[2] Mirella M C Molenschot,[2] Folkert J Meijboom,[1] Gertjan T Sieswerda,[1] Pieter A Doevendans,[1,3] Berto J Bouma,[4] Robbert J de Winter,[4] Barbara J M Mulder,[4] Michiel Voskuil[1]



Meijs TA. Heart 2019 Oct;105(19):1464-1470

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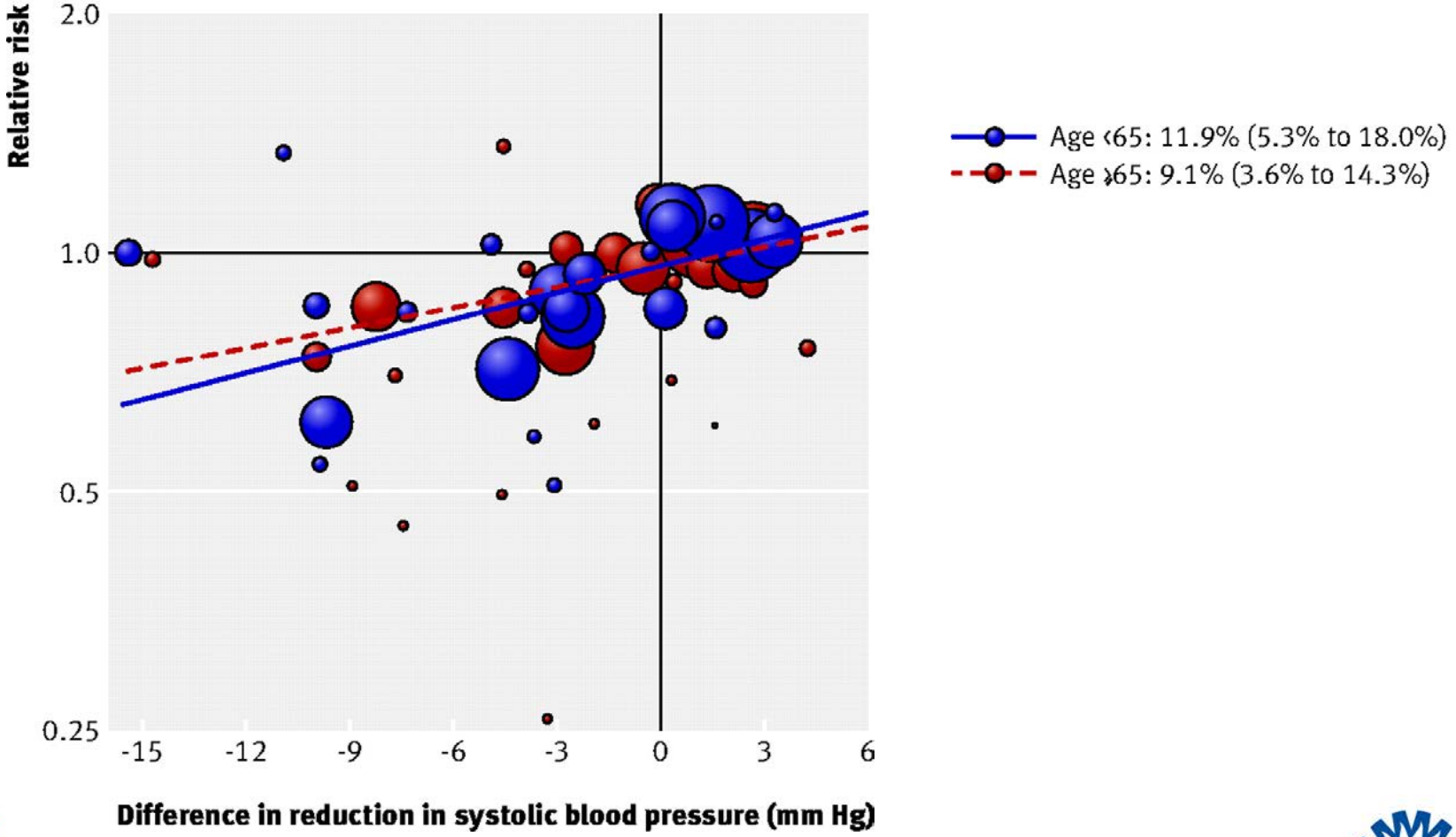
Effects of treatment of HT – clinical outcome

Associations of reduction in blood pressure with risk reduction for total major cardiovascular events for adults aged <65 and ≥65



BMJ. 2008;336(7653):1121–3

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Stenting of CoA – effects on clinical outcome??

- National registry of adult congenital patients in Netherlands
- 1035 patients from this CONCOR database
- Mean FU 30.3y; mean age 36.9y
- Cardiovascular events (myocardial infarction, aneurysm, dissection, TIA/stroke, heart failure, death): **213/753 (28%)**

- ➢ Predictors events?
- ➢ Blood pressure?
- ➢ Effects interventions?

Stenting in mild CoA – efficacious?

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Stenting mild CoA?

Case

- Male, 38y
- Coarctation aortae
- Bicuspid valve
- Hypertension
- 2001: stent implantation (15mm)

- 2017: hypertension borderline controlled; 2 antihypertensives
- MR: non-conclusive

➢ Cath

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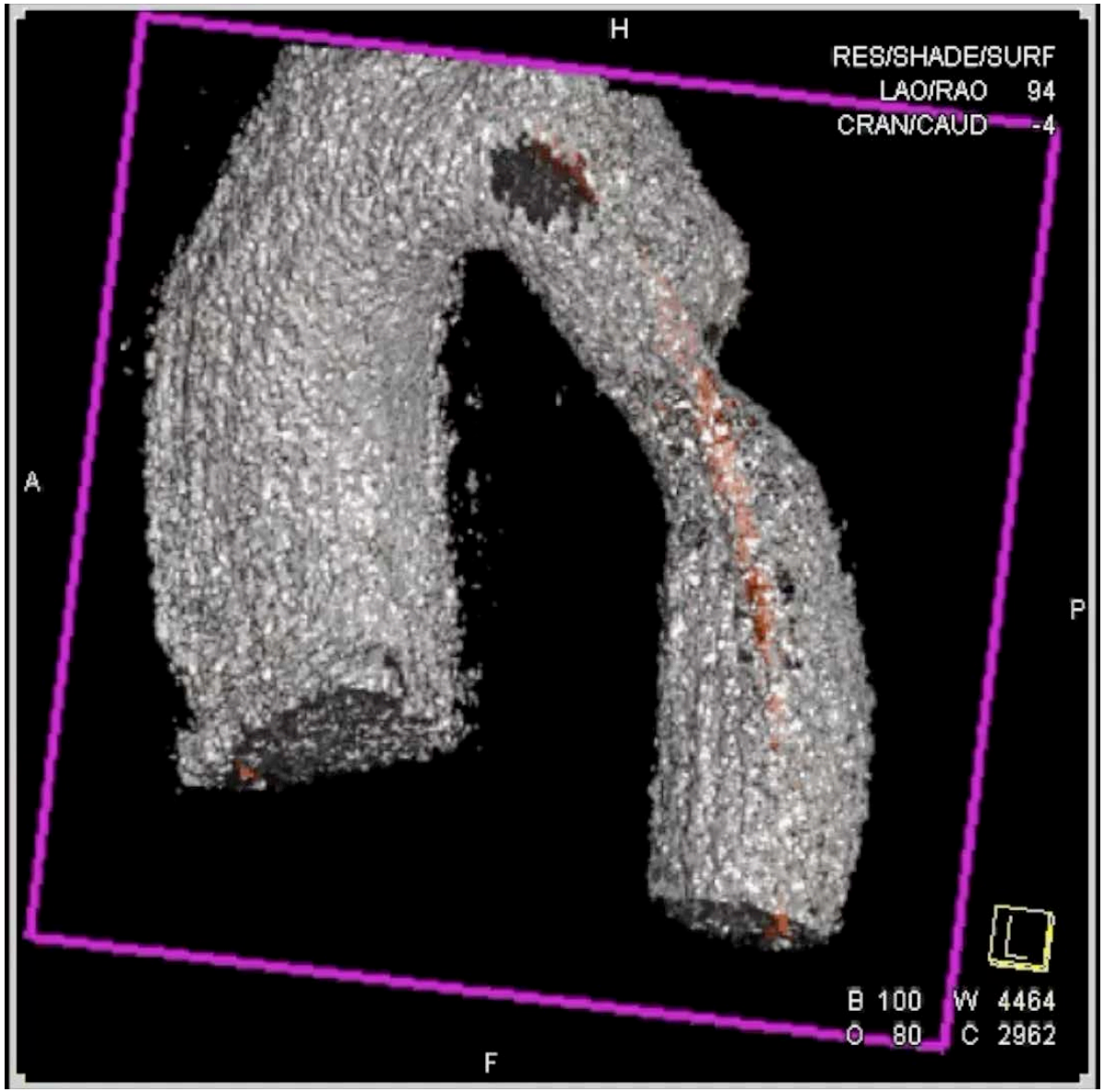
Stenting mild CoA?

3DRA



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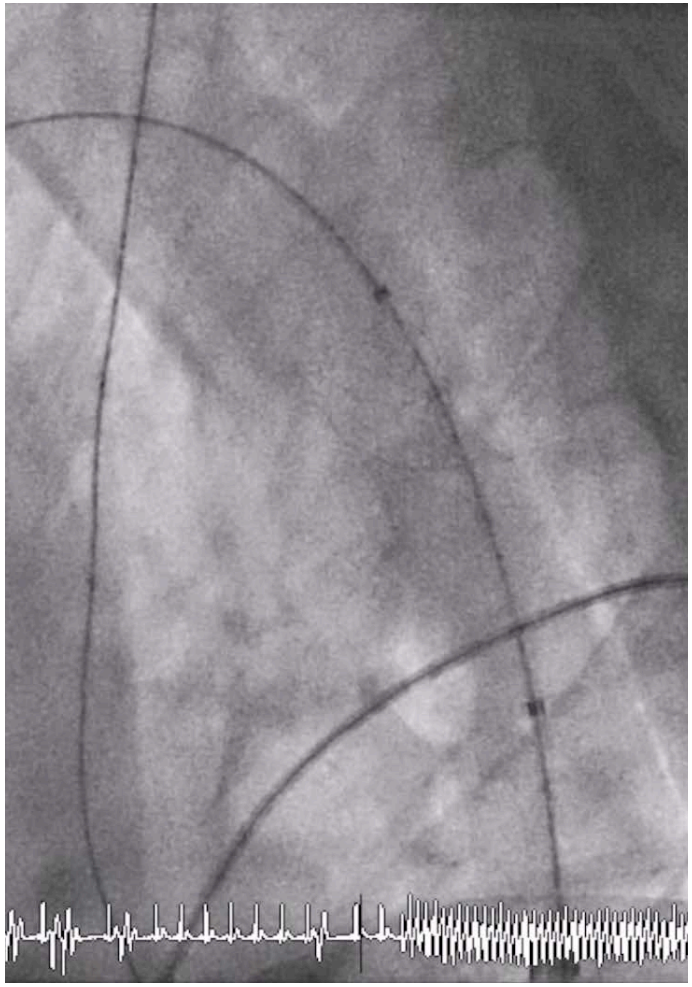
Stenting mild CoA?

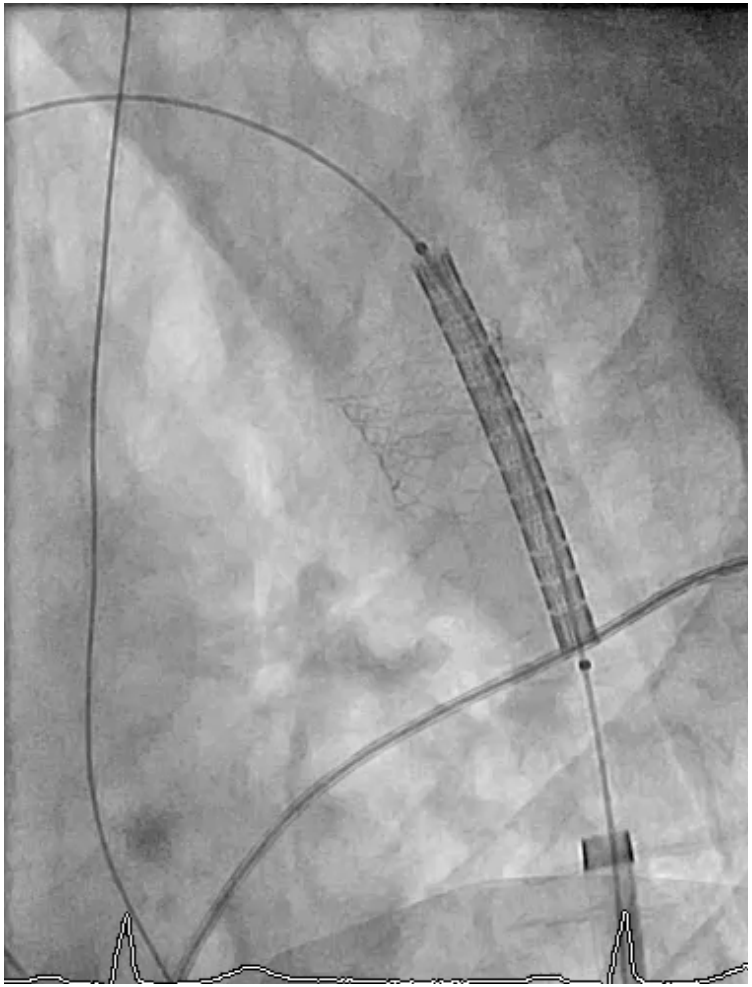
Pressures

- Anesthesia:
  - No gradient under BP 100/60 mmHg
- After 50ug ephedrine: no gradient
- RA pacing 120/min => gradient 15-20 mmHg
- After adrenaline 30ug (BP 180mmHg systolic):
  - ➢ gradient 35 mmHg

Stenting mild CoA?

Intervention





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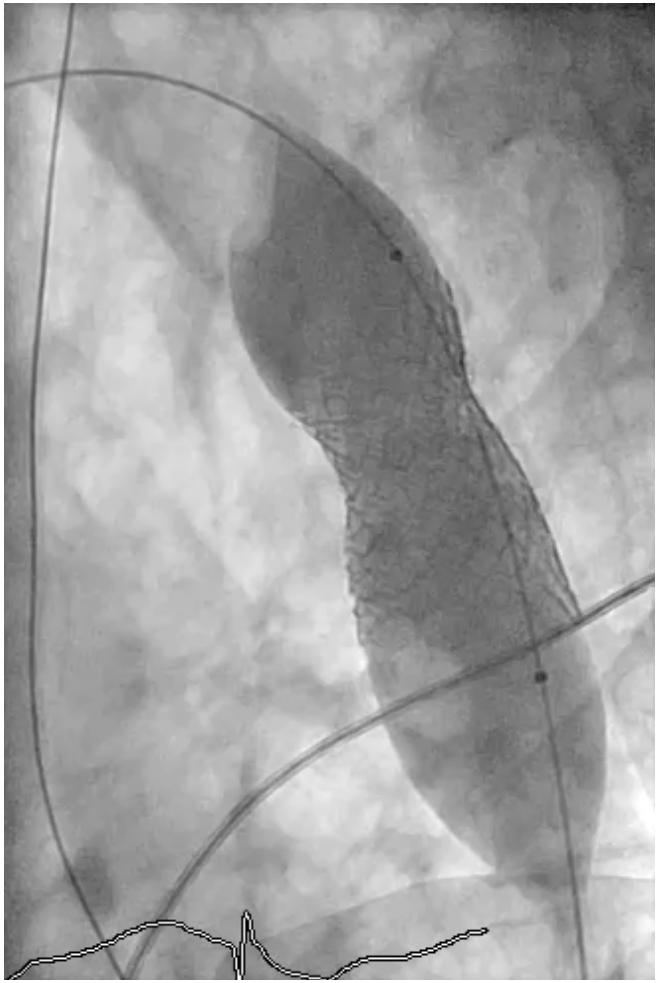
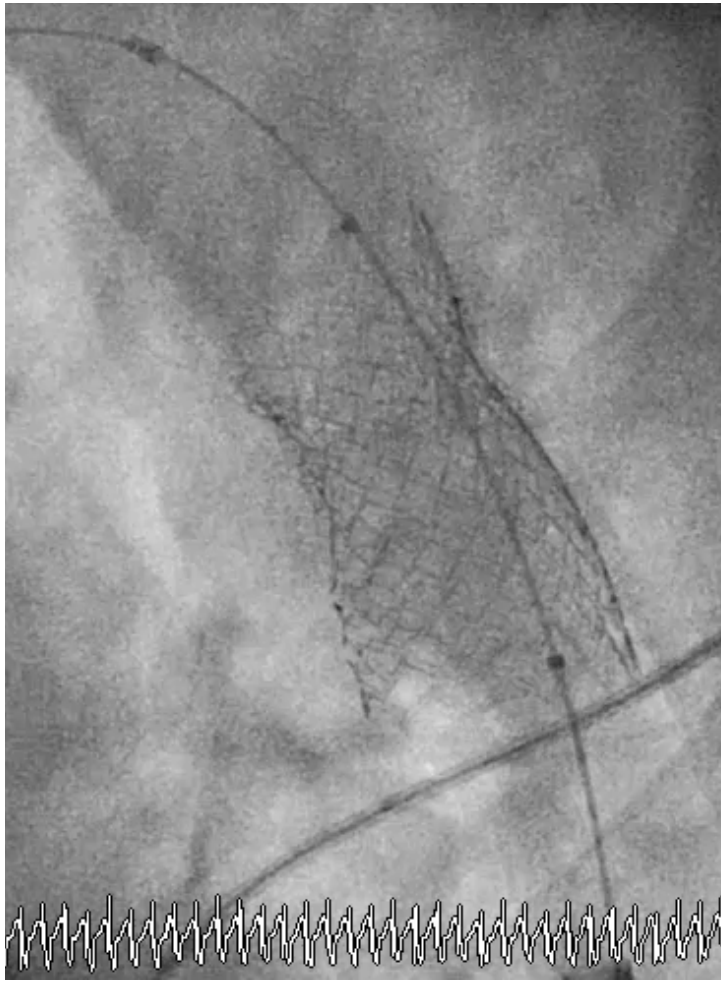
Stenting mild CoA?

Intervention





BeGraft Aortic 24x48mm

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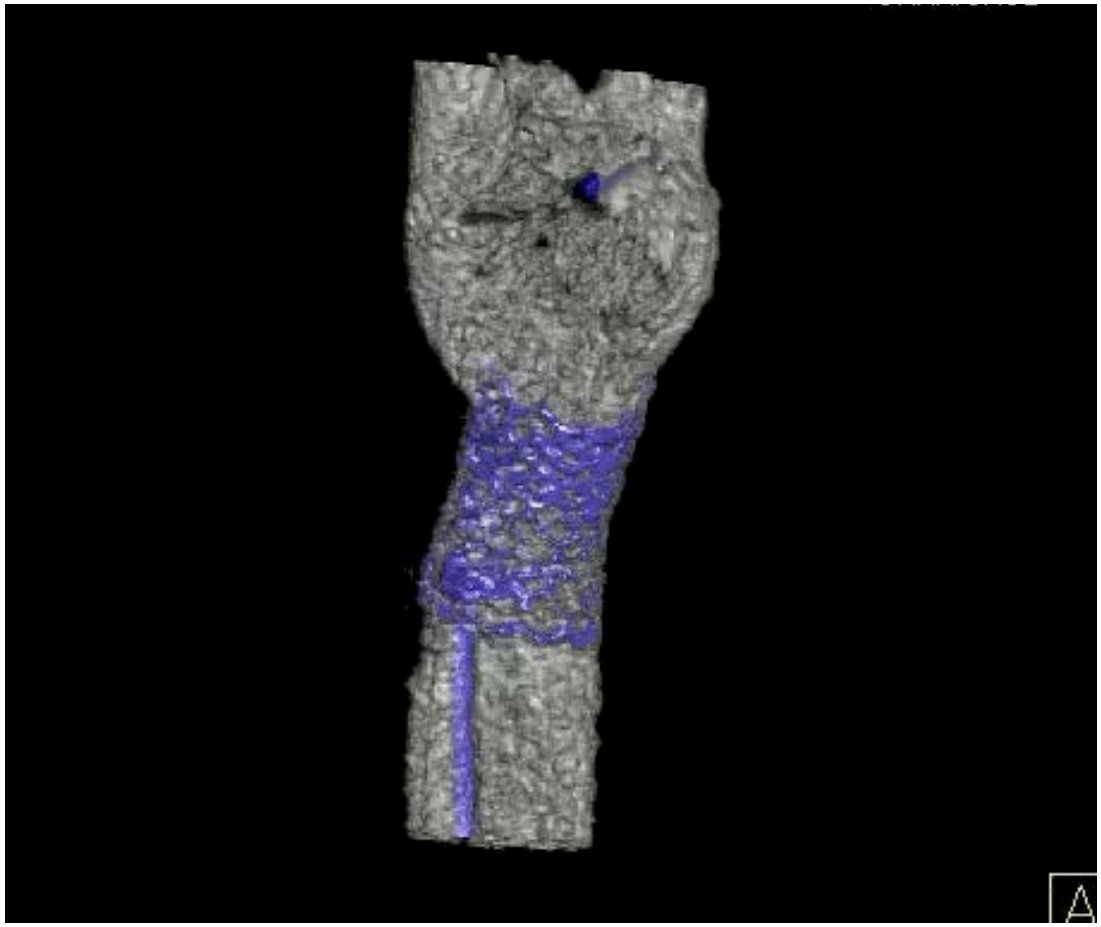
Stenting mild CoA?

Outcome



- <5 mmHg gradient after stenting
- Follow-up: 24h ABPM: 125/74, nice nocturnal dip (ramipril 10mg)

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Stenting mild CoA?

Case II

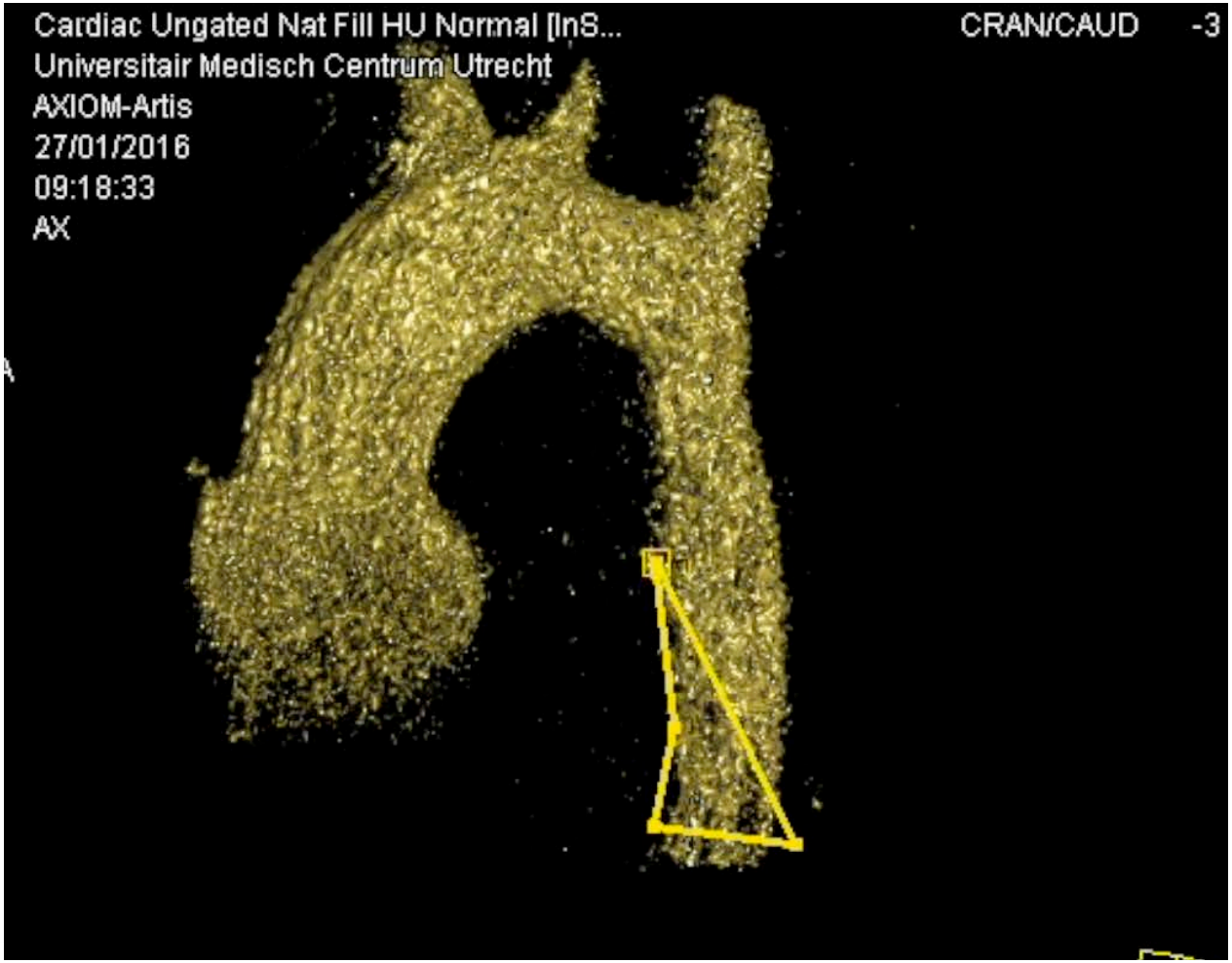
- Male 26y

- Medical history
  - 1989: coarctectomy patch angioplasty (Goretex)
  - 1989: Surgical closure perimembranous VSD (Goretex)
  - 2011: Exercise test: hypertensive; TTE en MR no Re-CoA
  - 2012: Suspicion re-CoA: gradient 15mmHg -> conservative
  - 2015: hypertension

  ➢ Re-cath

Stenting mild CoA?

Case II



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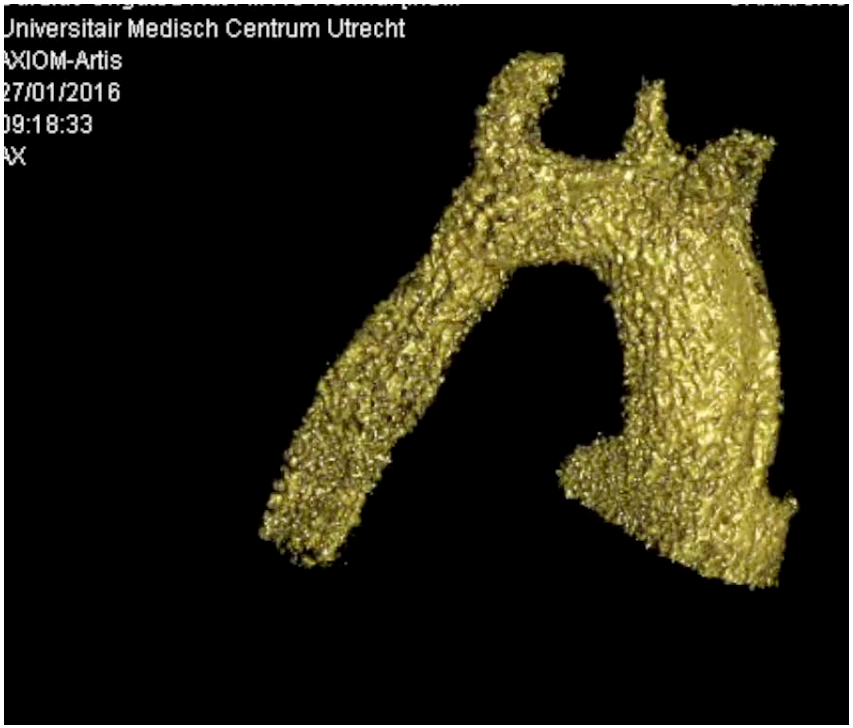
Stenting mild CoA?

Case II



- 0 mmHg gradient after stenting
- Follow-up: 24h ABPM: 120/68, nice nocturnal dip (no medication)

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Case III

- Male, 37 years of age
- TGA with VSD and CoA
- History:
  - 1980: correction CoA (patch angioplasty); banding PA
  - 1982: arterial switch with closure VSD, removal banding PA and patch plasty RVOT
  - 2012: gradient aortic arch 30mmHg – balloon interrogation; considered too complex for stenting
  - 2013: hypertension; multiple antihypertensives

    (3 types in 2017)

3DRA pre

Gradient 15mmHg; after adrenaline 50ug: 60 mmHg
(BP 180 mmHg systolic)

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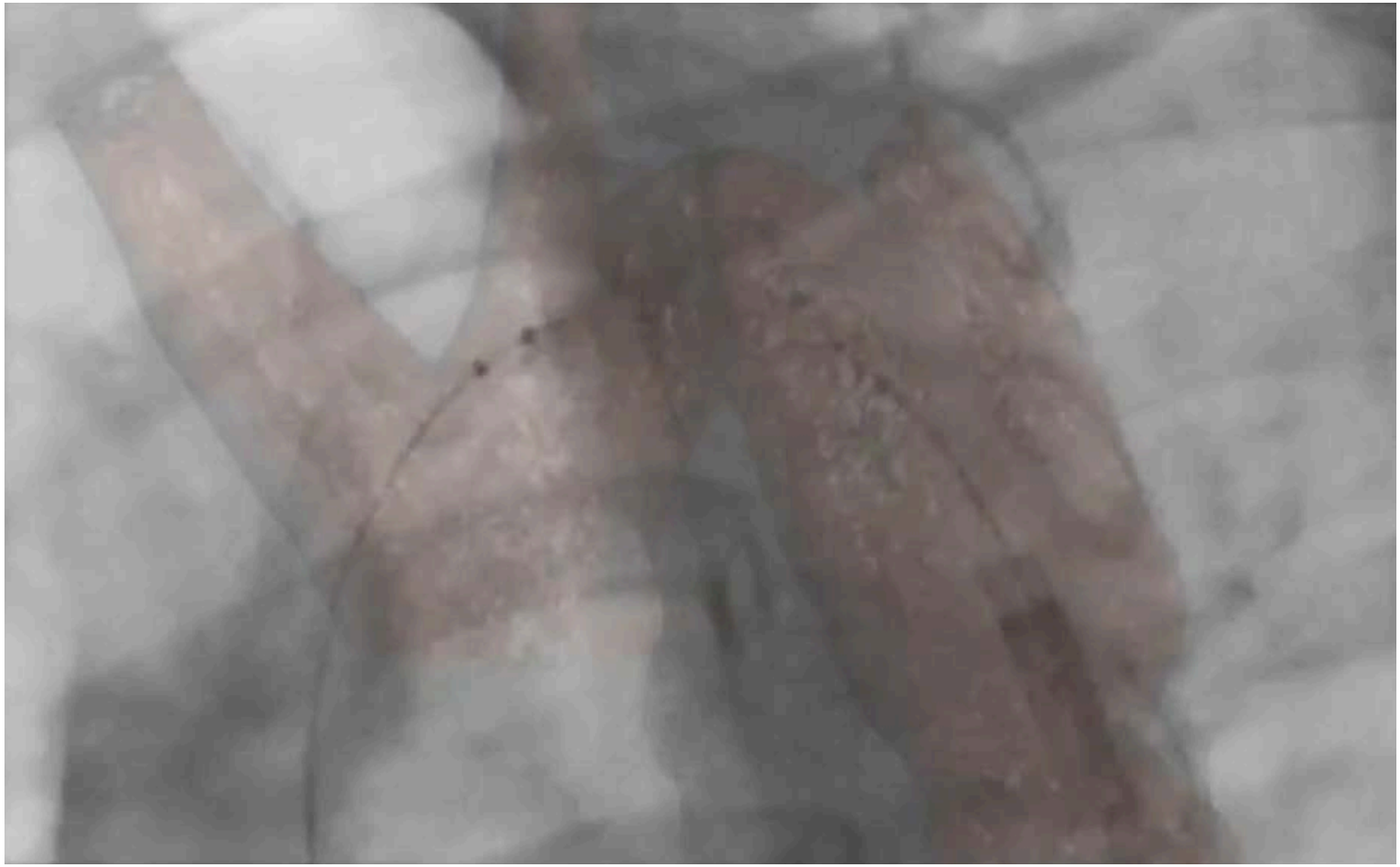
Balloon interrogation



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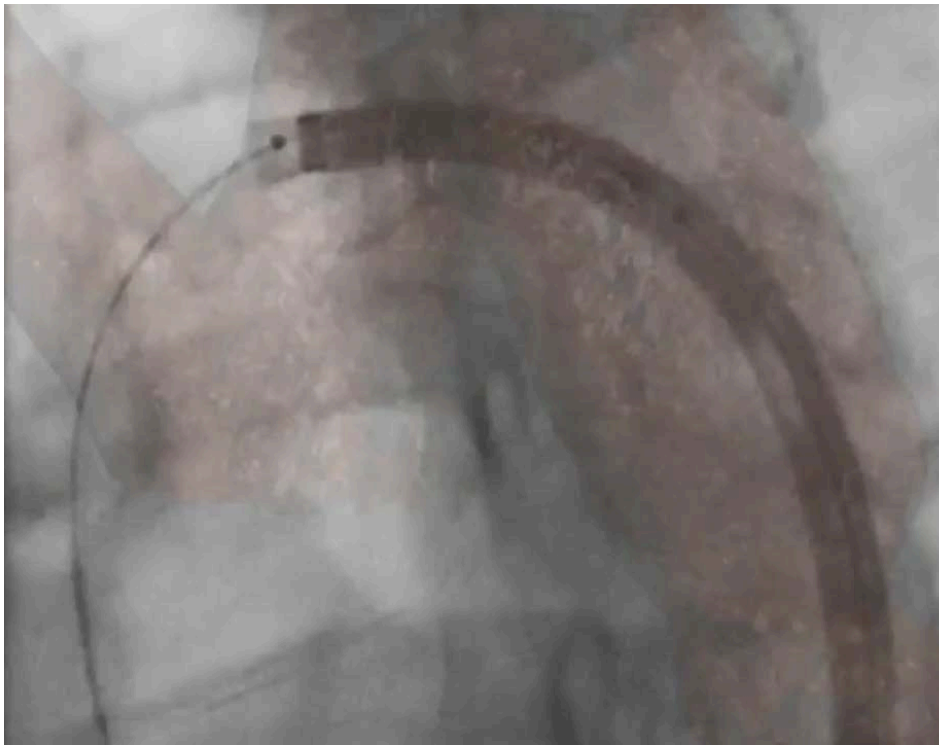
Stent implantation



No 1

No 2

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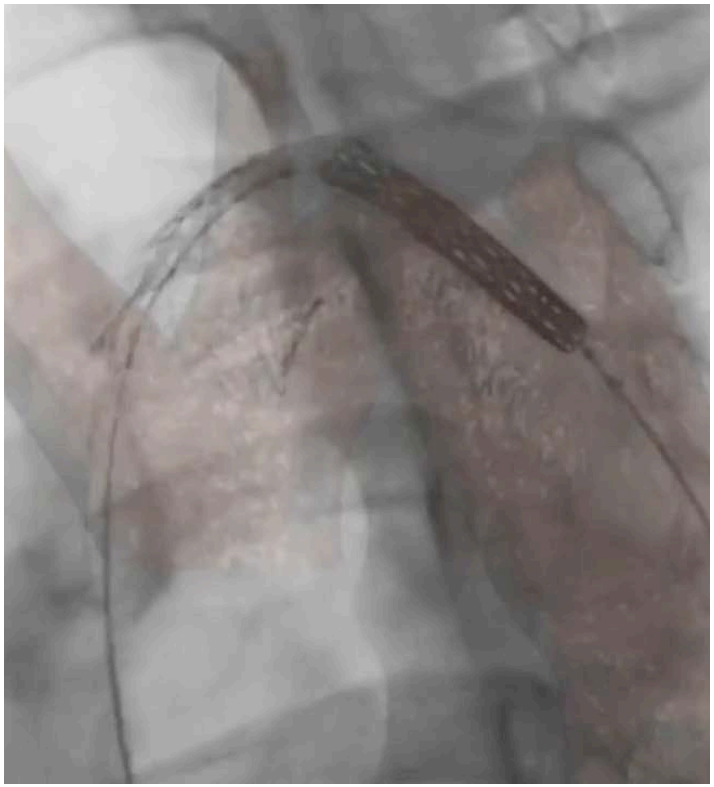
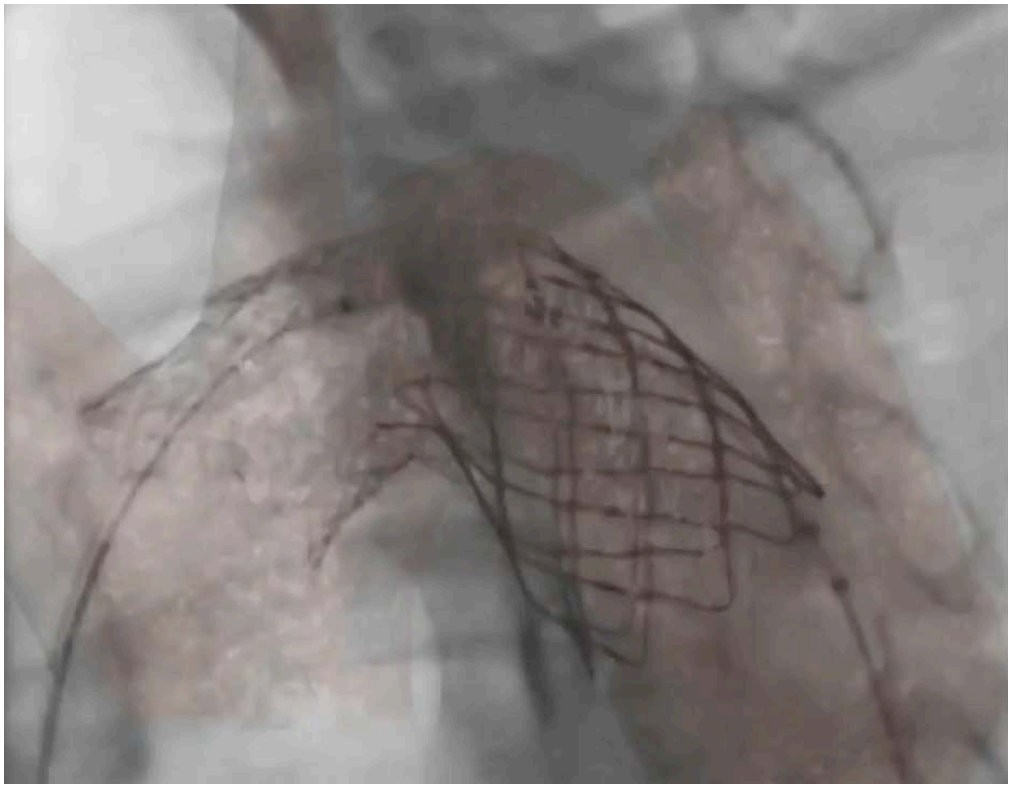
Stent implantation





No 3 (CP)

postdil

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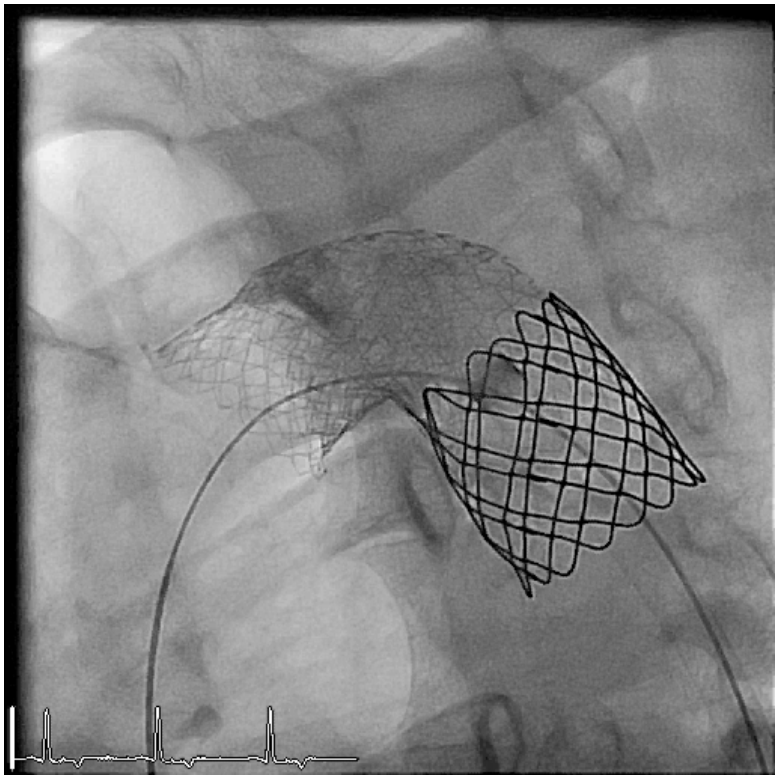
End result

Pressure measurement after stenting:

Gradient 0 mmHg at BP 145 mmHg systolic

➔ *Follow-up: normotensive; all medication stopped*



Angio

3DRA

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Stenting mild CoA?

2018 AHA/ACC Guidelines Adults With Congenital Heart Disease

Therapeutic

I	B-NR	6. Surgical repair or catheter-based stenting is recommended for adults with hypertension and significant native or recurrent coarctation of the aorta.[S4.2.6-1,S4.2.6-2,S4.2.6-8–S4.2.6-12]
I	C-EO	7. GDMT is recommended for treatment of hypertension in patients with coarctation of the aorta.[S4.2.6-13]
IIb	B-NR	8. Balloon angioplasty for adults with native and recurrent coarctation of the aorta may be considered if stent placement is not feasible and surgical intervention is not an option.[S4.2.6-14]

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Circulation. 2019;139:e698–e800

Stenting mild CoA?

2018 AHA/ACC Guidelines Adults With Congenital Heart Disease

- Significant native or recurrent aortic coarctation has been defined as follows:
  - upper extremity / lower extremity resting peak-to-peak gradient >20 mm Hg or mean Doppler systolic gradient >20 mm Hg
  - upper extremity / lower extremity gradient >10 mm Hg or mean Doppler gradient >10 mm Hg plus either decreased LV systolic function or AR
  - upper extremity / lower extremity gradient >10 mm Hg or mean Doppler gradient >10 mm Hg with collateral flow
  - This should be coupled with anatomic evidence for CoA, typically defined by advanced imaging (CMR, CTA)
  - ➢ Presence <u>systemic hypertension</u>!

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Circulation. 2019;139:e698–e800

Stenting mild CoA?

2018 AHA/ACC Guidelines Adults With Congenital Heart Disease

- Systemic hypertension ***may not consistently be identifiable at rest***; therefore, ambulatory blood pressure monitoring can be useful in identifying and appropriately managing patients with ambulatory hypertension

➢ Why not measure gradients with ‘exercise’ at the cathlab?!

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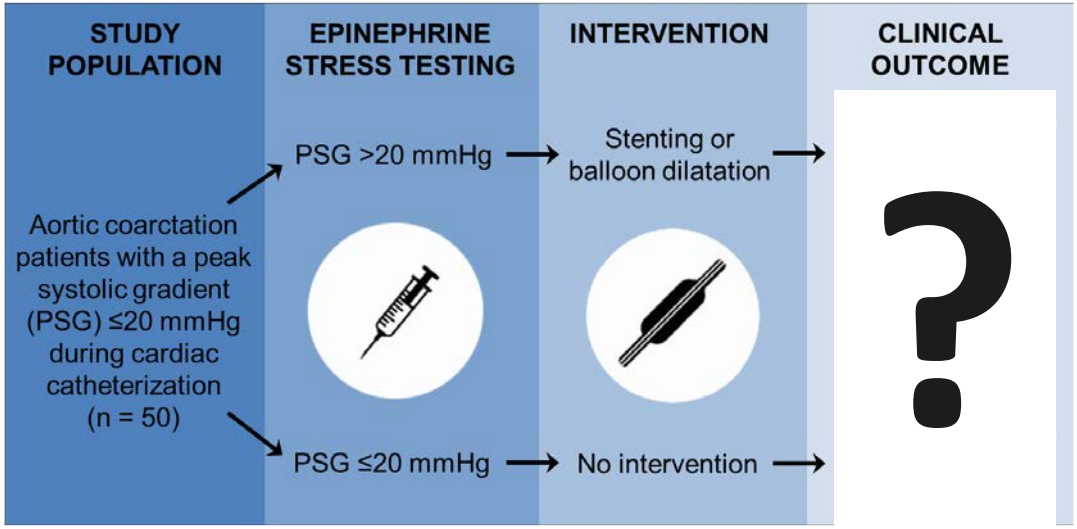
Circulation. 2019;139:e698–e800

Stenting mild CoA?

- Retrospective study in 50 CoA patients >50kg with a peak systolic gradient (PSG) ≤20 mmHg during cardiac catheterization
- Subsequent interventional management (stenting or balloon dilatation), complications, and medium-term clinical outcome were assessed.



Meijs TA et al. Submitted

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Stenting mild CoA?

Table 1. Baseline characteristics and invasive measurements during cardiac catheterization.

	Overall	**Epinephrine PSG >20 mmHg**	**Epinephrine PSG ≤20 mmHg**	
	n=50	n=24	n=26	
	n (%) or mean±SD	n (%) or mean±SD	n (%) or mean±SD	*p*-value*
Age at catheterization (years)	27.3±13.2	22.4±11.5	31.7±13.4	**0.011**
Female sex	18 (36)	7 (29)	11 (42)	0.39
BMI (kg/m^2)	23.1±3.8	22.7±4.2	23.4±3.6	0.49
Number of prior CoA interventions				0.93
0	9 (18)	4 (17)	5 (19)	
1	25 (50)	13 (54)	12 (46)	
≥2	16 (32)	7 (29)	11 (35)	
First CoA intervention				0.06
Surgery	25 (61)	9 (45)	16 (76)	
Stenting	9 (22)	5 (25)	4 (19)	
Balloon angioplasty	7 (17)	6 (30)	1 (5)	
Non-invasive systolic right arm-leg gradient (mmHg)	8±14	12±12	4±15	0.12

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Meijs TA et al. Submitted

Stenting mild CoA?

Table 1. Baseline characteristics and invasive measurements during cardiac catheterization.

	Overall	**Epinephrine PSG >20 mmHg**	**Epinephrine PSG ≤20 mmHg**	
	n=50	n=24	n=26	
	n (%) or mean±SD	n (%) or mean±SD	n (%) or mean±SD	*p*-value*
Office hypertension	34 (68)	16 (67)	18 (69)	1.0
Hypertension on 24-hour ABPM	29 (78)	15 (75)	14 (82)	0.70
Hypertensive response to exercise	18 (67)	11 (92)	7 (47)	**0.019**
Use of any AHM	18 (36)	9 (38)	9 (35)	1.0
Number of AHM	0.7±1.0	0.9±1.1	0.5±0.8	0.26
LV mass index ($g/m^{2.7}$)	38±14	36±17	39±11	0.58
LV hypertrophy	8 (21)	3 (15)	5 (26)	0.45

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Meijs TA et al. Submitted

Discussion

- High incidence adverse events in CoA patients because of high incidence of hypertension

- Re-CoA treatable cause of hypertension

- Even a subgroup of mild CoA (and arch hypoplasia?) can be treated to improve outcome

➢ More long-term robust follow-up is needed

➢ Early detection of re-CoA crucial

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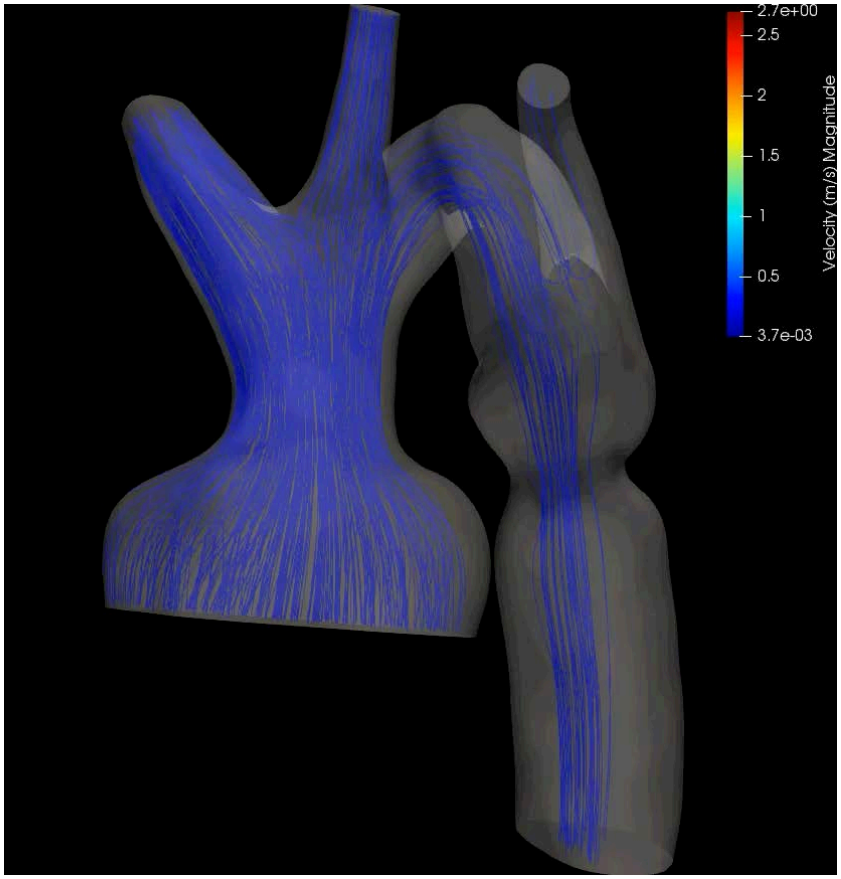
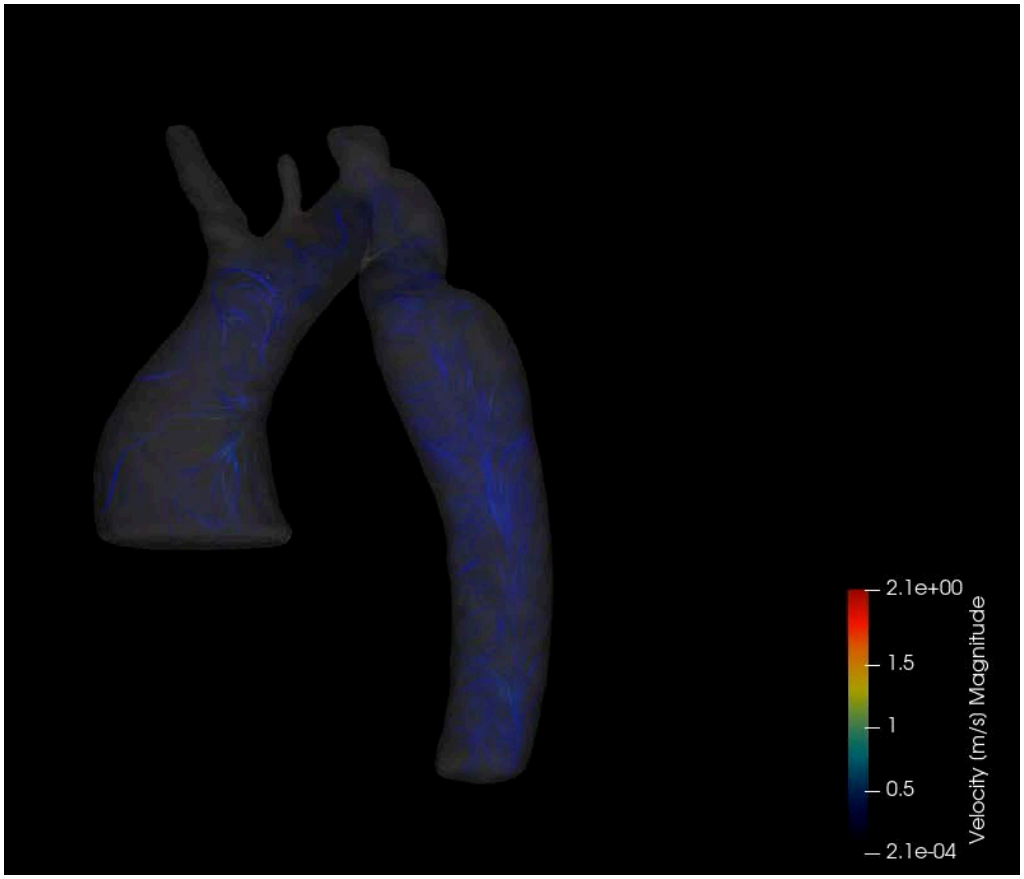
Future





CFD

M Conijn

4D MRI

E Warmerdam

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Thank you

WKZ
Gregor Krings
Mirella Molenschot
Heynric Grotenhuis
Hans Breur
Gabrielle van Iperen
Paul Schoof
Felix Haas
Bram van Wijk

AZU
Gert-Jan Sieswerda
Folkert Meijboom
Han Dronkert
Heleen van der Zwaan
PhD
Evangeline Warmerdam
Timion Meijs
Anouk Franken (student)

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