



Rechts catheterisatie

De meerwaarde van rechtscatheterisaties

Vanessa van Empel

We bespreken



01

Korte introductie

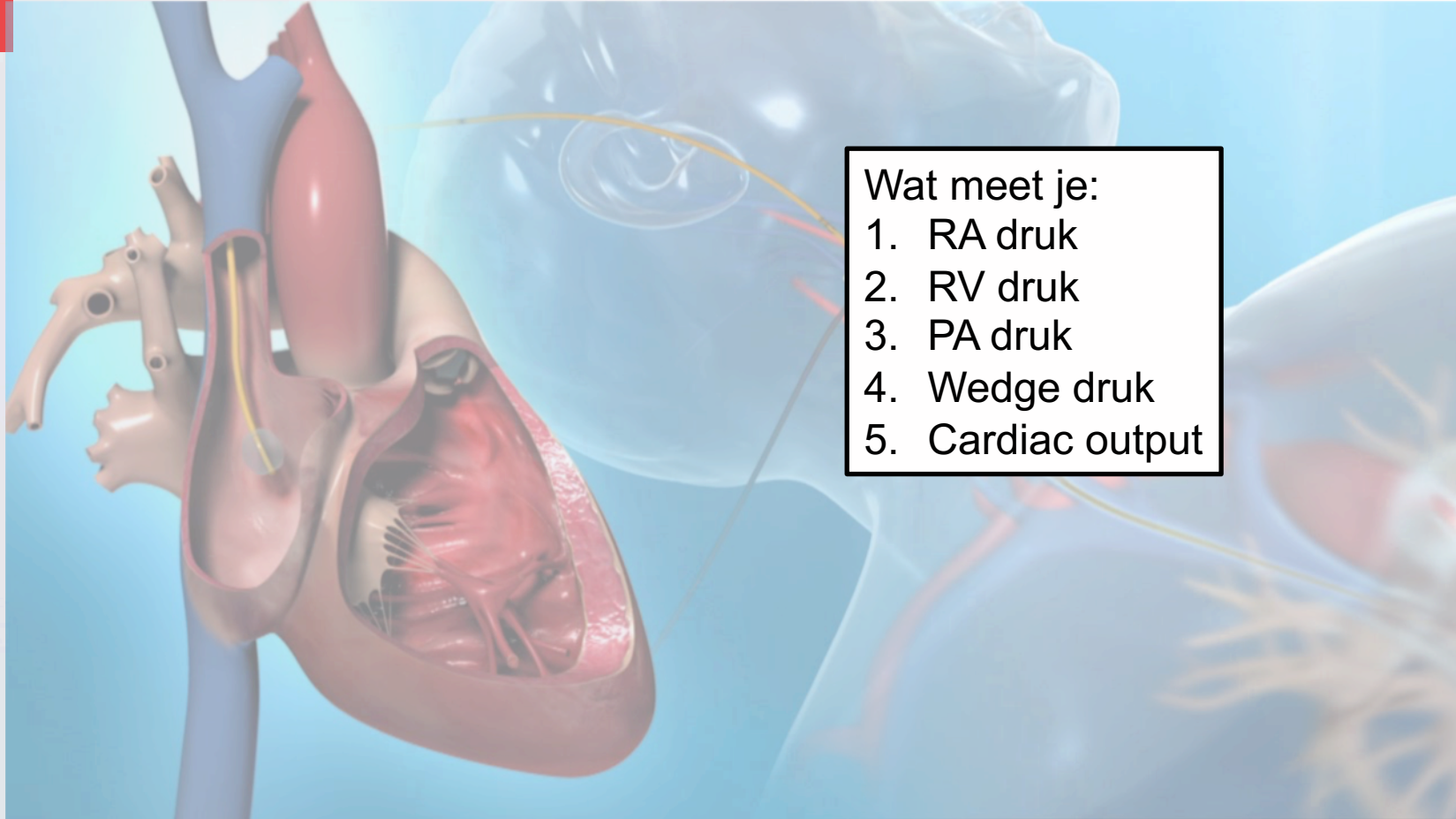
02

Meerwaarde m.b.t. hemodynamiek

03

Casuïstiek

Korte introductie



Wat meet je:

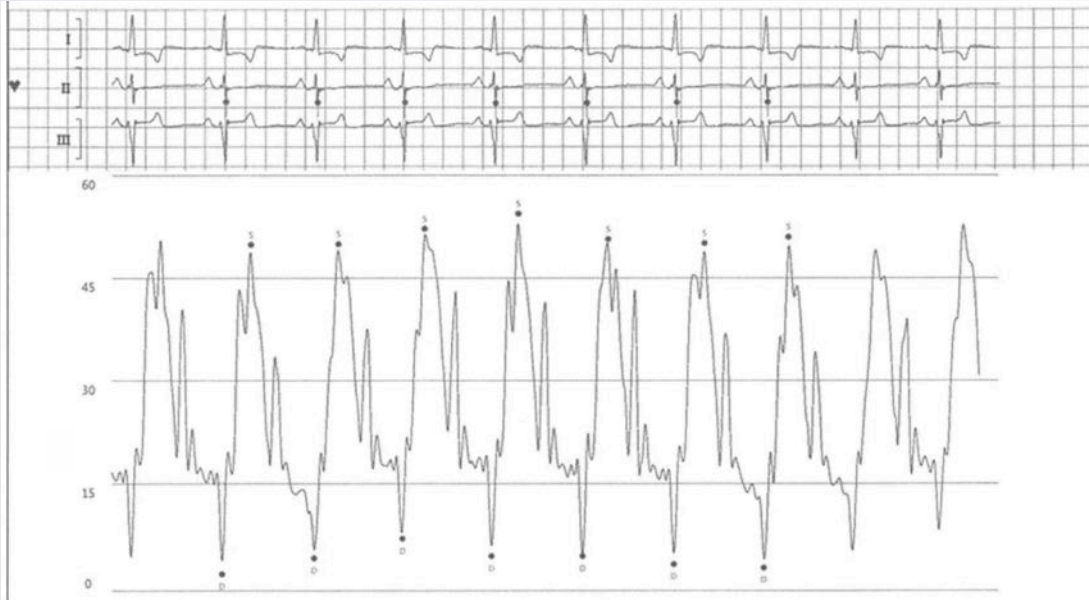
1. RA druk
2. RV druk
3. PA druk
4. Wedge druk
5. Cardiac output

Wat meet je?



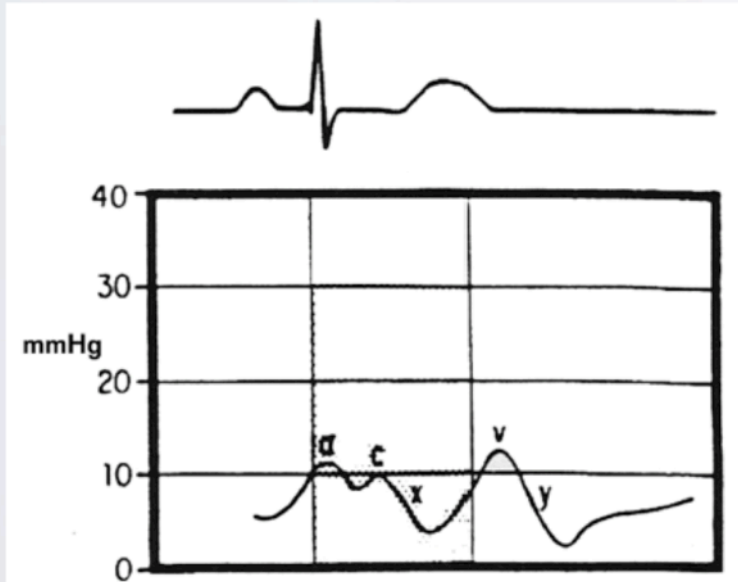
RV curve

Wat meet je?



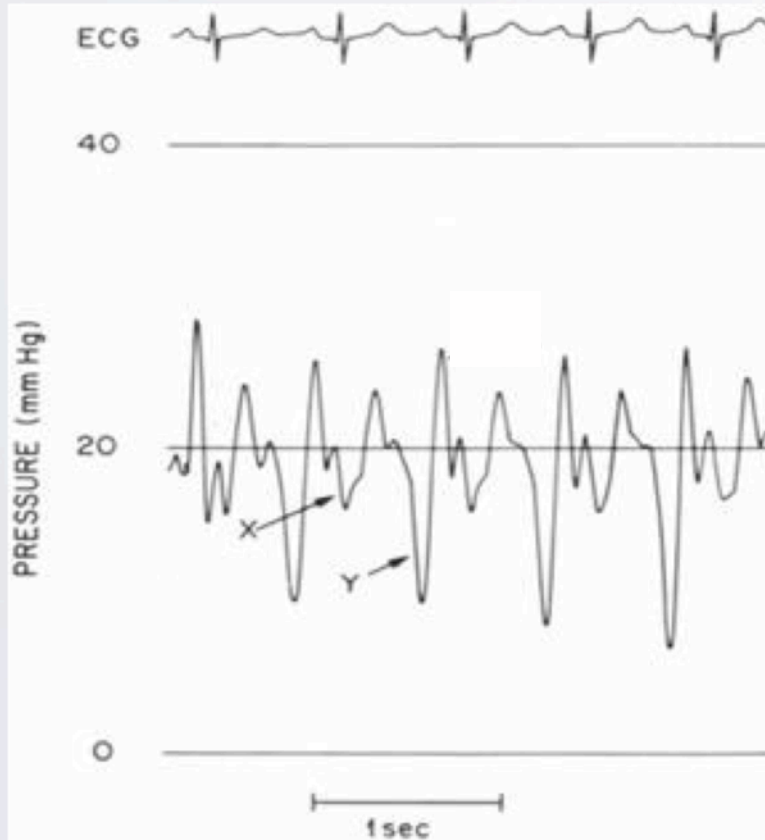
PA curve

Wat meet je?



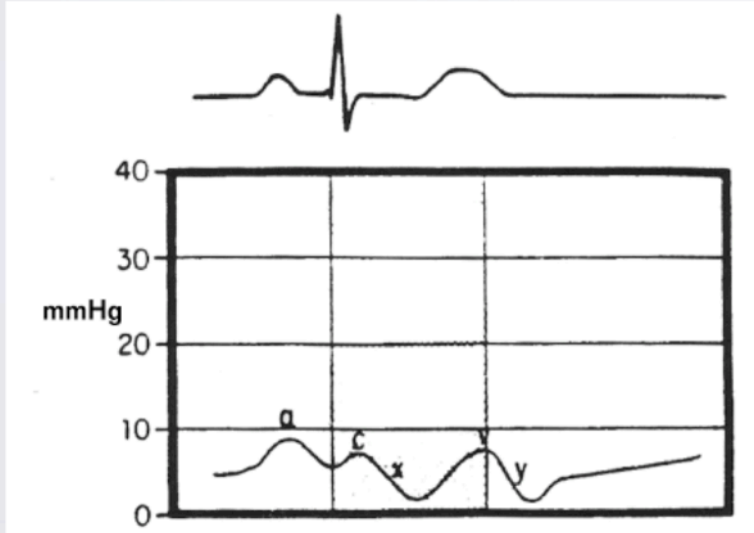
PCWP curve

Wat meet je?



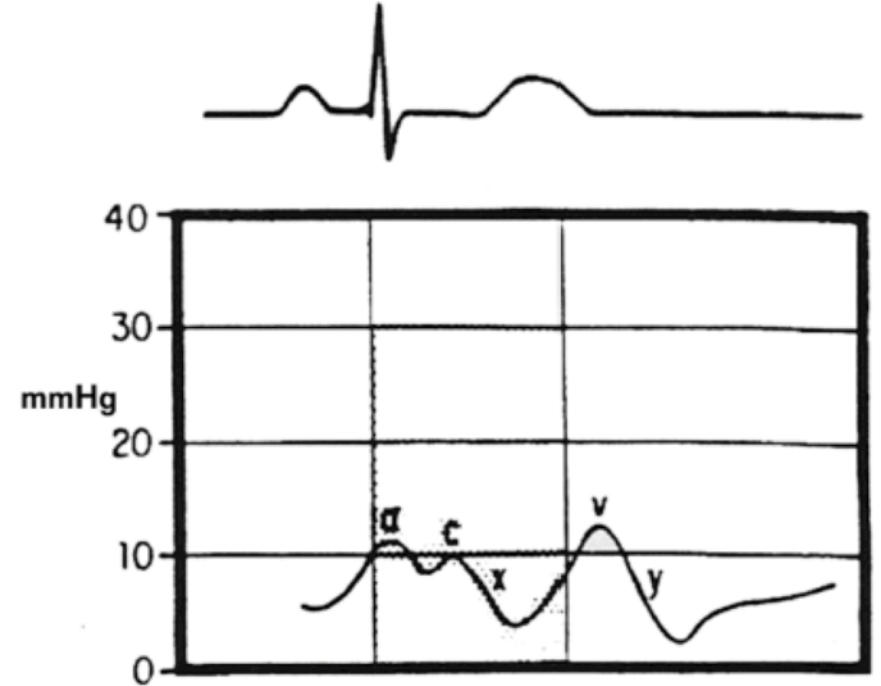
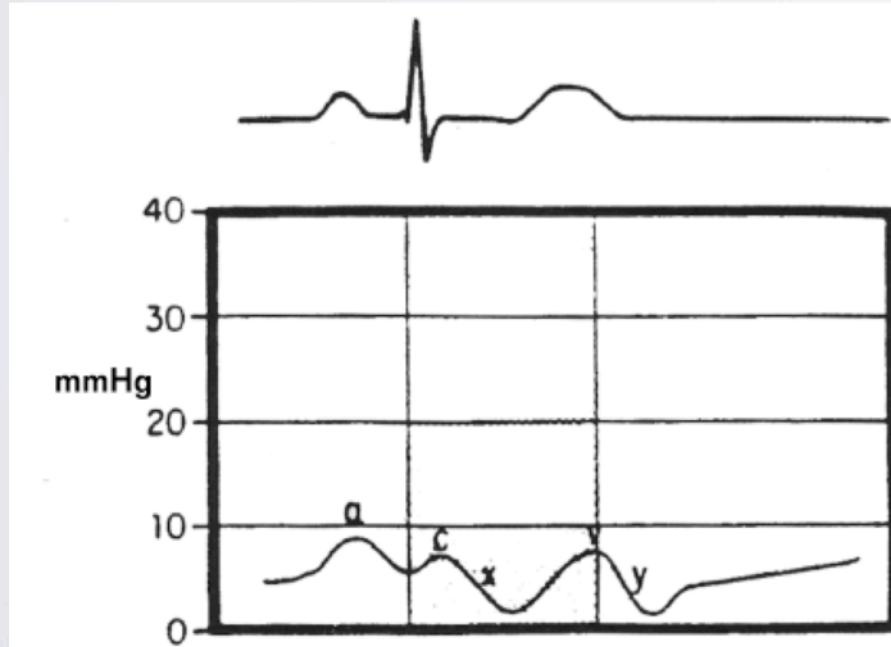
RA curve

Wat meet je?



RA curve

Verschil RA en PCWP?



Wat meet je?



1. RA druk
2. RV druk
3. PA druk < 25 mmHg
4. Wedge druk < 15 mmHg
5. Cardiac output 4 – 8 L/min

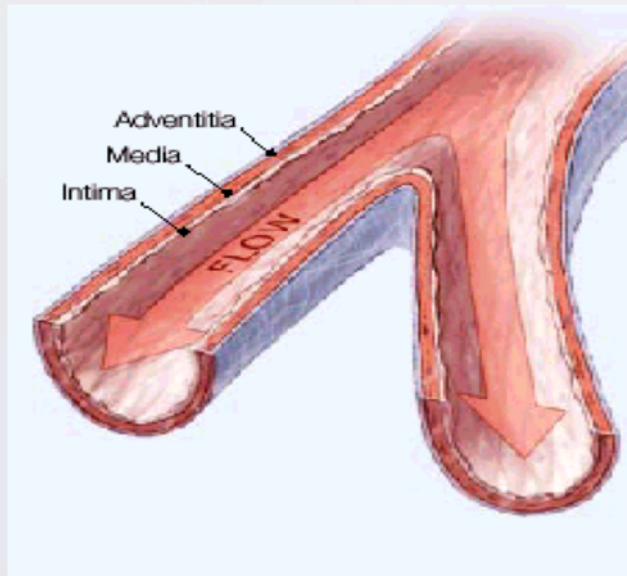
Wat bereken je?

1. Pulmonale vaatweerstand
2. Perifere vaatweerstand

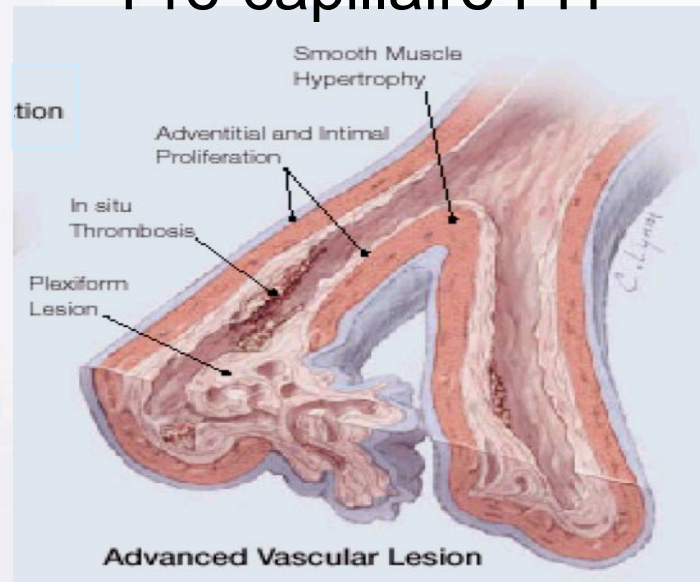
Wat is pulmonale vaatweerstand



Normal



Pre-capillaire PH



Pulmonale vaatweerstand (PVR) = $\frac{\text{mPAP} - \text{PCWP}}{\text{cardiac output}}$

We bespreken



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Meerwaarde m.b.t. hemodynamiek

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Casuïstiek

Wanneer rechts catheterisatie?



- Bij verdenking pulmonale arteriële hypertensie
 - Bij verdenking post-capillaire pulmonale hypertensie
 - Bij verdenking HFpEF
 - Screening HTx
-
- Kleplijden?
 - Shunts?
 - Onbegrepen dyspnoe?

Meerwaarde mbt PH



1. Is er sprake van PH?

- $mPAP > 20 \text{ mmHg}$ **en** $PVR > 3WU$ (240 dynes)

2. Welke soort PH?

- Pre capillaire PH
- Post capillaire PH
- Gecombineerde pre en post capillaire PH

Differentiaal diagnose

1 Pulmonary arterial hypertension (PAH)

- 1.1 Idiopathic
- 1.2 Heritable
 - 1.2.1 BMPR2
 - 1.2.2 ALK1, endoglin (with or without hereditary haemorrhagic telangiectasia)
 - 1.2.3 Unknown
- 1.3 Drugs and toxins induced
- 1.4 Associated with (APAH)
 - 1.4.1 Connective tissue diseases
 - 1.4.2 HIV infection
 - 1.4.3 Portal hypertension
 - 1.4.4 Congenital heart disease
 - 1.4.5 Schistosomiasis
 - 1.4.6 Chronic haemolytic anaemia
- 1.5 Persistent pulmonary hypertension of the newborn

1' Pulmonary veno-occlusive disease and/or pulmonary capillary haemangiomatosis

2 Pulmonary hypertension due to left heart disease

- 2.1 Systolic dysfunction
- 2.2 Diastolic dysfunction
- 2.3 Valvular disease

3 Pulmonary hypertension due to lung diseases and/or hypoxia

- 3.1 Chronic obstructive pulmonary disease
- 3.2 Interstitial lung disease
- 3.3 Other pulmonary diseases with mixed restrictive and obstructive pattern
- 3.4 Sleep-disordered breathing
- 3.5 Alveolar hypoventilation disorders
- 3.6 Chronic exposure to high altitude
- 3.7 Developmental abnormalities

4 Chronic thromboembolic pulmonary hypertension

5 PH with unclear and/or multifactorial mechanisms

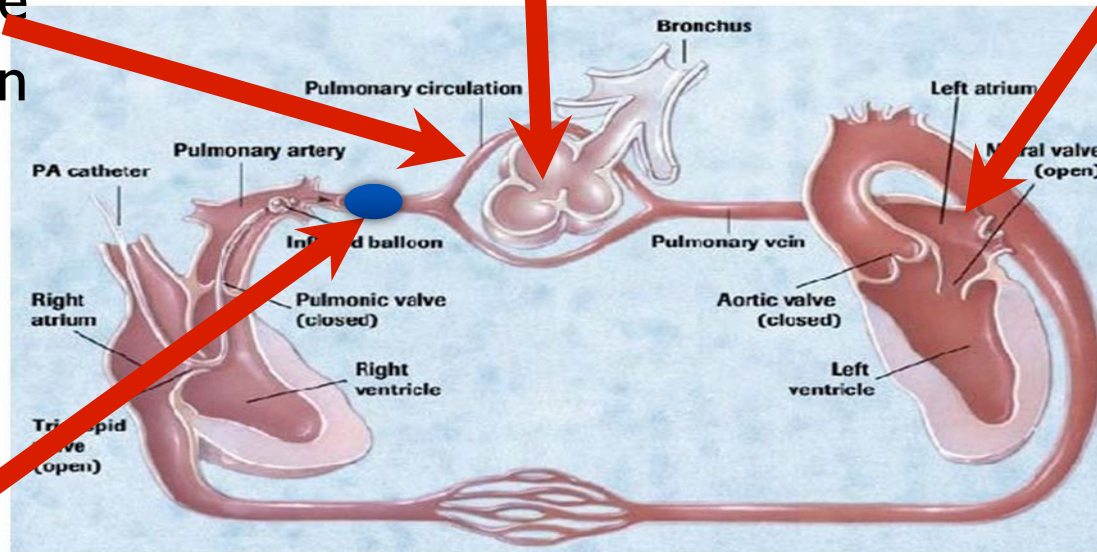
- 5.1 Haematological disorders: myeloproliferative disorders, splenectomy.
- 5.2 Systemic disorders: sarcoidosis, pulmonary Langerhans cell histiocytosis, lymphangioleiomyomatosis, neurofibromatosis, vasculitis
- 5.3 Metabolic disorders: glycogen storage disease, Gaucher disease, thyroid disorders
- 5.4 Others: tumoural obstruction, fibrosing mediastinitis, chronic renal failure on dialysis

Classificatie

1. Pulmonary Arterial Hypertension

2. Left Heart Disease

3. Lung disease & Hypoxemia



4. Thromboembolic

5. Miscellaneous

-Sarcoid, fibrosing mediastinitis

Verschil tussen pre capillair en
post capillaire PH?





mPAP

PCWP

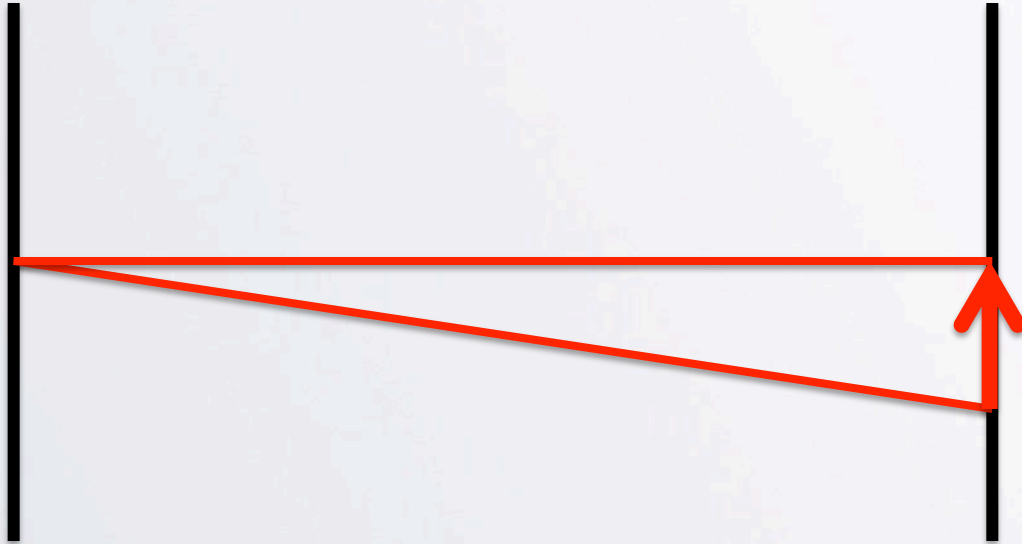
Transpulmonary
Pressure
Gradient





mPAP

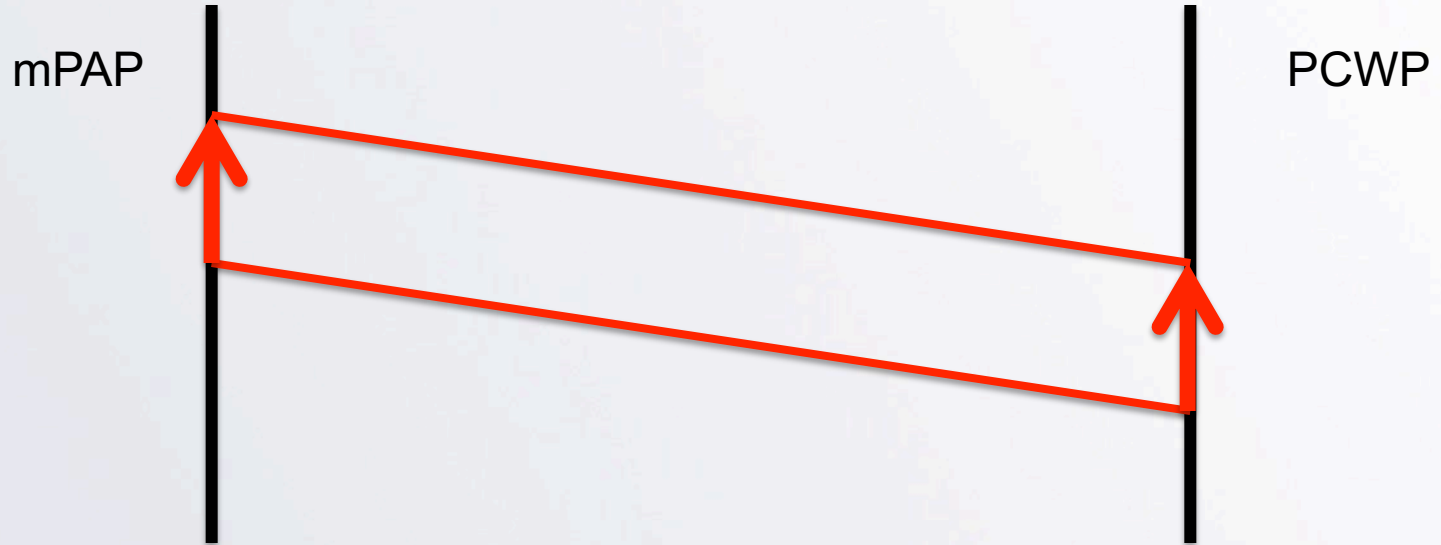
PCWP



Post capillaire PH



PCWP omhoog, mPAP omhoog
Pulmonale vaatweerstand normaal



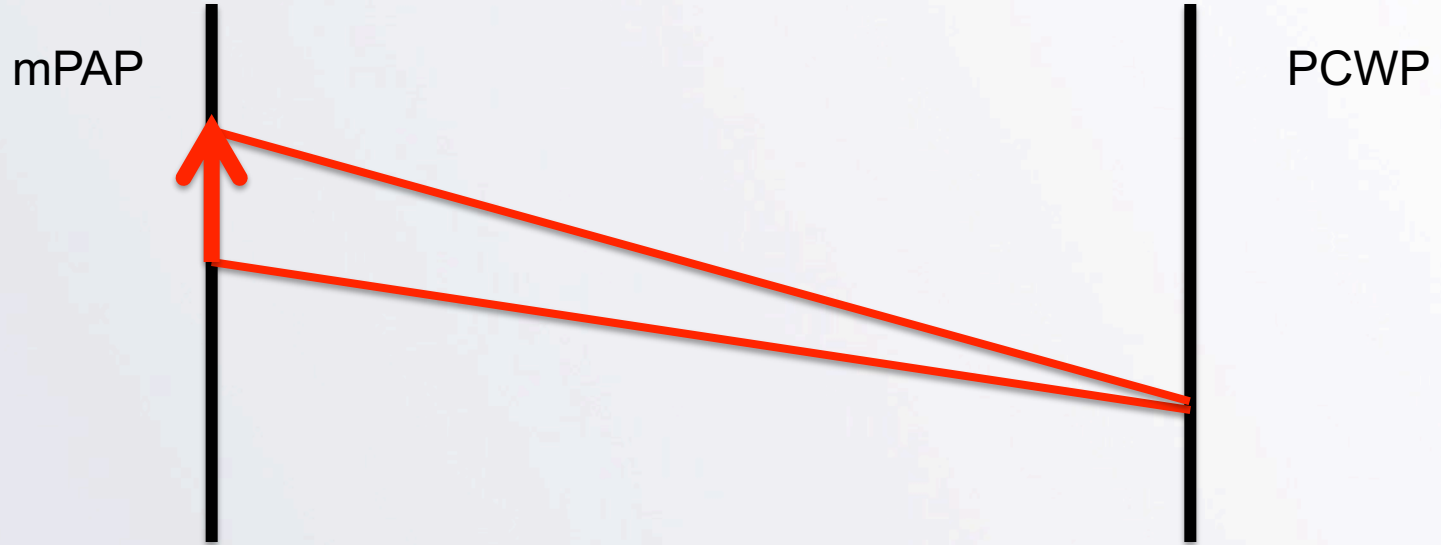


mPAP

PCWP

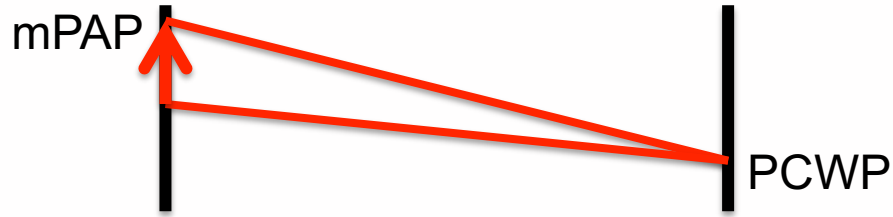


Pre capillar PH



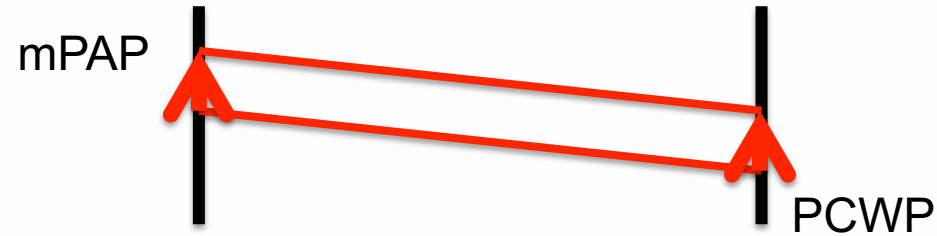
Pre versus post capillaire PH

Pre capillaire PH



PCWP normaal, mPAP omhoog
Pulmonale vaatweerstand omhoog

Post capillaire PH



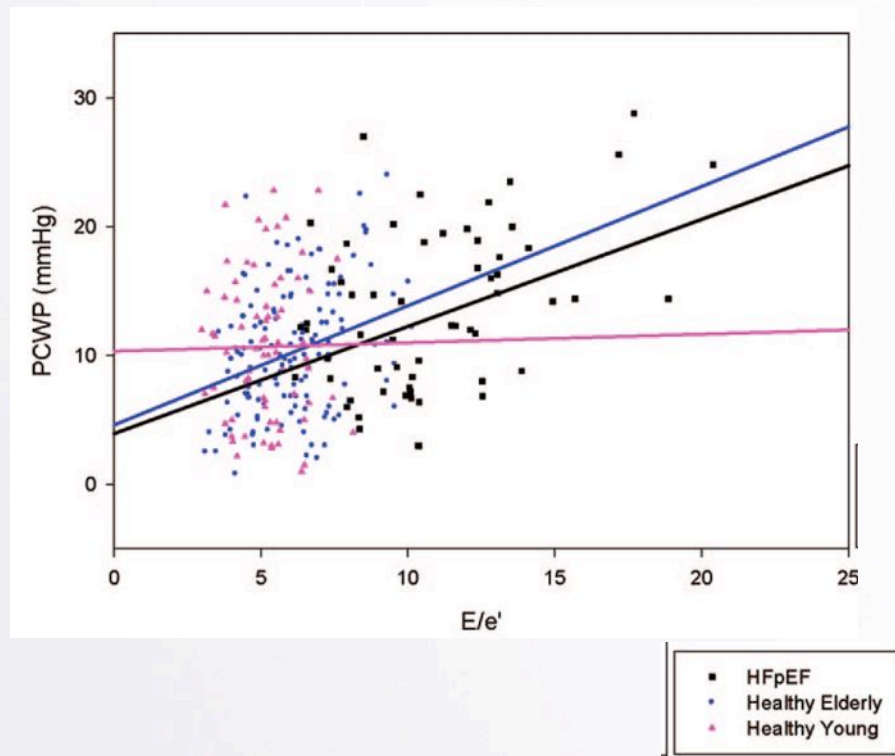
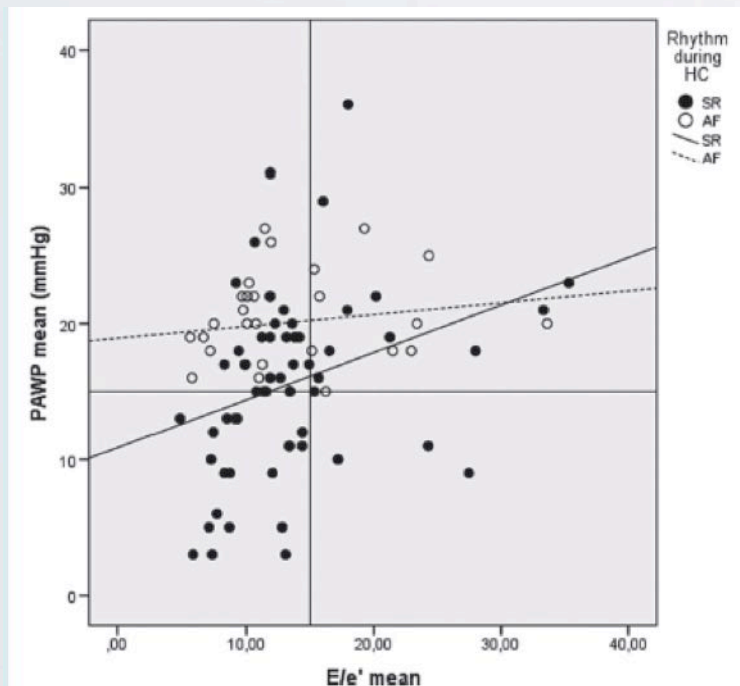
PCWP omhoog, mPAP omhoog
Pulmonale vaatweerstand normaal

Gecombineerde pre- en post-capillaire PH

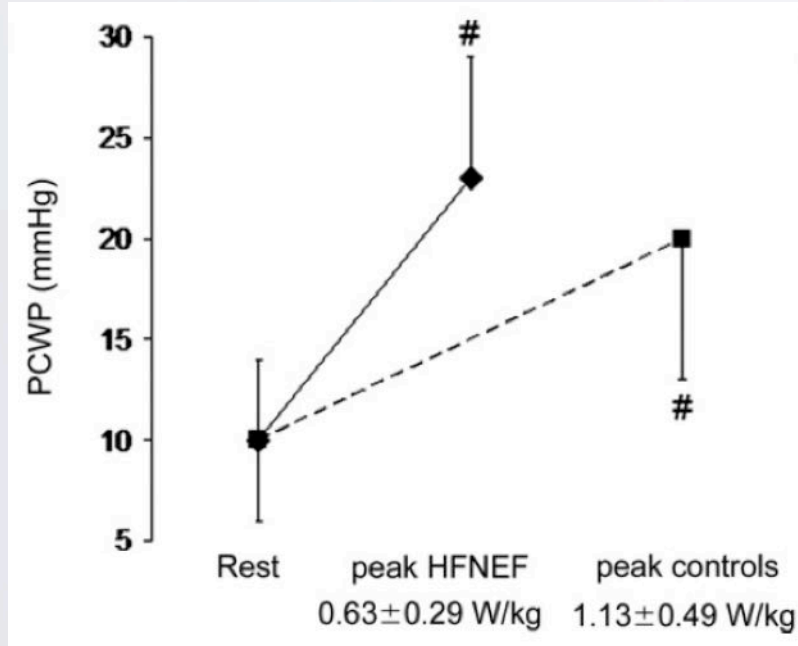


PCWP omhoog, mPAP omhoog
Pulmonale vaatweerstand ook verhoogd

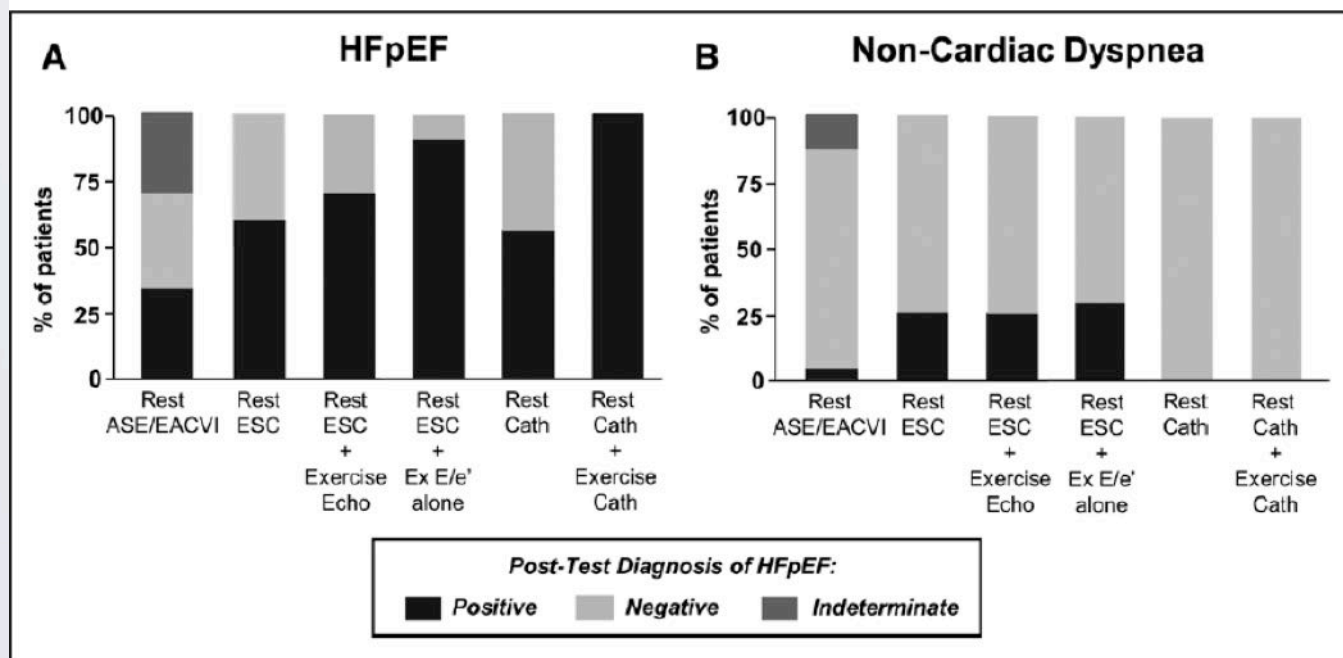
Meerwaarde bij HFpEF



Inspannings hemodynamiek



Wat is beste manier om HFpEF te diagnosticeren?



We bespreken



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Casuïstiek

Casus 1



- Progressieve dyspnoe d'effort, NYHA klasse 2-3
Op ski vakantie (2000m hoogte) dyspnoe d'effort
- Fibromyalgie
- Dieet pillen gebruikt 1990 (apotheek België)
- Nooit DVT of LE
- Niet bekend met astma of allergie
- Hyperreactiviteitsklachten bij koude, vocht, schoonmaakmiddelen
- Familie anamnese: geen HVZ, geen auto immuunziekten, geen reuma.

Echocardiografie



Verdere diagnostiek?



- X-thorax: vergroot cor
- ECG: rechtsbelasting
- Echo cor: RVSP 50 mm Hg, verwijd RV
- Longlijden:
 - Longfunctie: normaal
 - HRCT: geen interstitiële afwijkingen, geen longemfyseem
- Auto immuunlijden:
 - Immunologie serologie: negatief
- Chronische Longembolie:
 - VP scan: normale perfusie

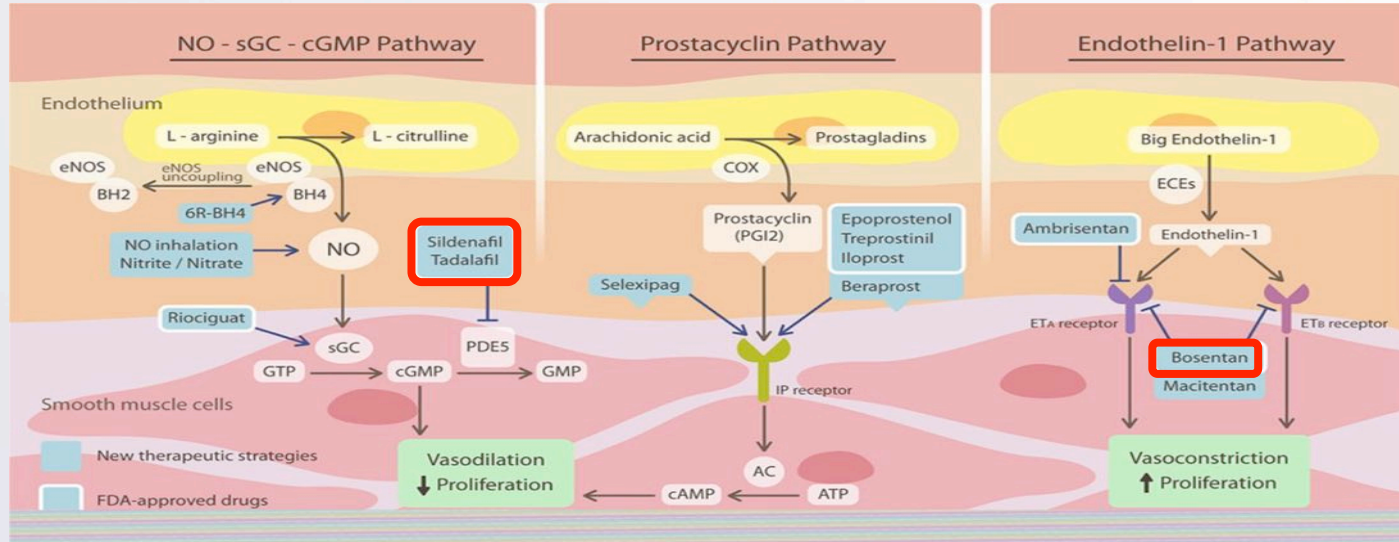
Rechts catheterisatie



- mPAP 59 mmHg [< 25 mmHg]
- PCWP 13 mmHg [< 15 mmHg]
- CO 3.3 L/min [4 – 8 L/min]
- PVR 2051 dynes*s*cm-5 [<240 dynes*s*cm-5 = 3 WU]

Idiopatische (of toxisch) PAH

Behandeling



Start Sildenafil (Revatio) 3x20 mg
Bosentan (Tracleer) 2x125mg

Follow up



Determinants of prognosis ^a (estimated 1-year mortality)	Low risk <5%	Intermediate risk 5–10%	High risk >10%
Clinical signs of right heart failure	Absent	Absent	Present
Progression of symptoms	No	Slow	Rapid
Syncope	No	Occasional syncope ^b	Repeated syncope ^c
WHO functional class	I, II	III	IV
6MWD	>440 m	165–440 m	<165 m
Cardiopulmonary exercise testing	Peak VO ₂ >15 ml/min/kg (>65% pred.) VE/VCO ₂ slope <36	Peak VO ₂ 11–15 ml/min/kg (35–65% pred.) VE/VCO ₂ slope 36–44.9	Peak VO ₂ <11 ml/min/kg (<35% pred.) VE/VCO ₂ slope ≥45
NT-proBNP plasma levels	BNP <50 ng/l NT-proBNP <300 ng/l	BNP 50–300 ng/l NT-proBNP 300–1400 ng/l	BNP >300 ng/l NT-proBNP >1400 ng/l
Imaging (echocardiography, CMR imaging)	RA area <18 cm ² No pericardial effusion	RA area 18–26 cm ² No or minimal, pericardial effusion	RA area >26 cm ² Pericardial effusion
Haemodynamics	RAP <8 mmHg CI ≥2.5 l/min/m ² SvO ₂ >65%	RAP 8–14 mmHg CI 2.0–2.4 l/min/m ² SvO ₂ 60–65%	RAP >14 mmHg CI <2.0 l/min/m ² SvO ₂ <60%

Follow up rechtscatheterisatie

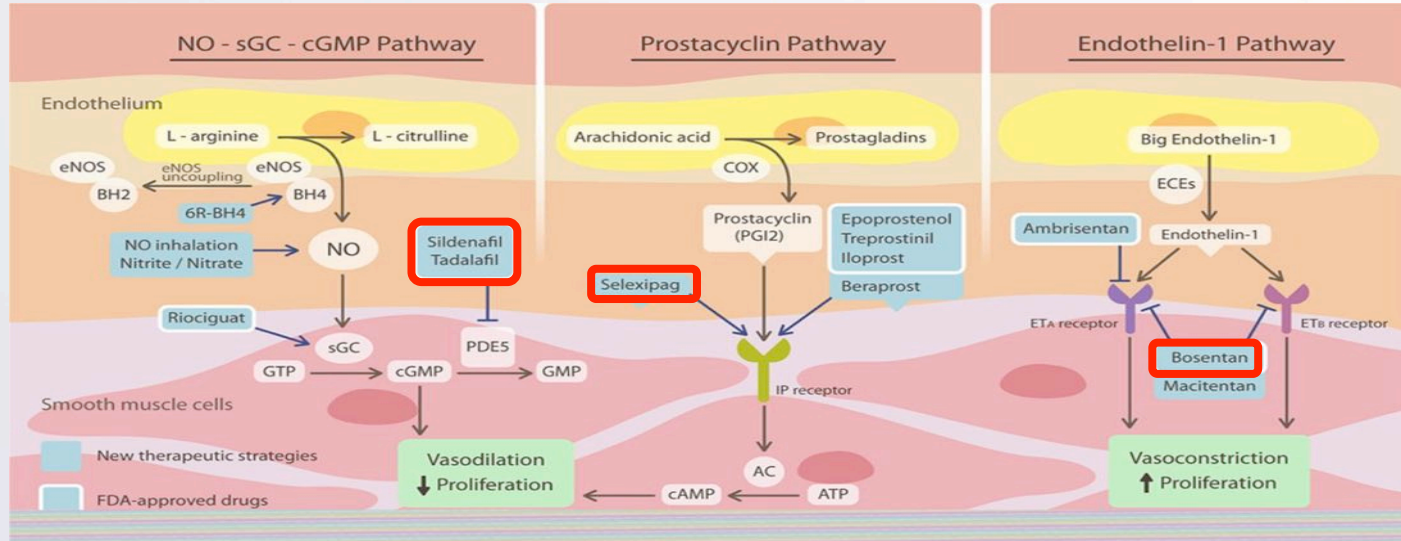


	2009	2011
mPAP (mmHg)	59	35
PCWP (mmHg)	13	12
CI (L/min/m ²)	1.8	2.4
PVR (dynes)	2051	428
RAP (mmHg)	14	9

Follow up

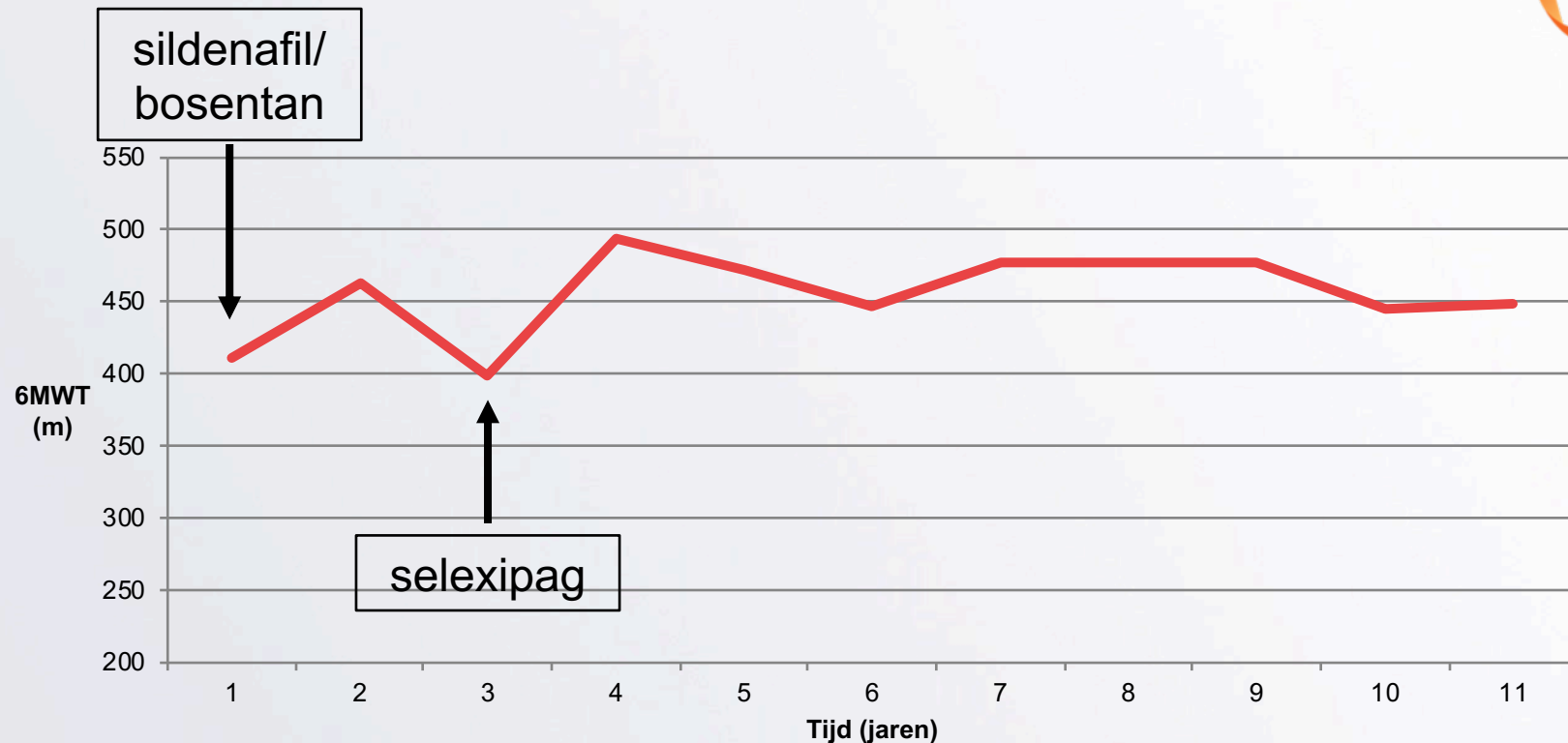


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Add on selexipag

6 minuut wandeltest



Casus 2



- Vrouw, 44 jaar oud
- Dyspnoe d' effort, NYHA 3
- 3 maanden geleden DVT en LE
- Sinds 1 week progressie van klachten
- Geen palpitations, geen pijn op de borst, geen orthopnoe,
- enkel oedeem aanwezig

Voorgeschiedenis



- DVT en longembolie -> start vit K antagonist (acenocoumarol)
- Ijzergebreks anemie
- Spina bifida, hydrocephalus, ventriculo-peritoneal shunt,
- milde cognitieve beperking

Medicatie

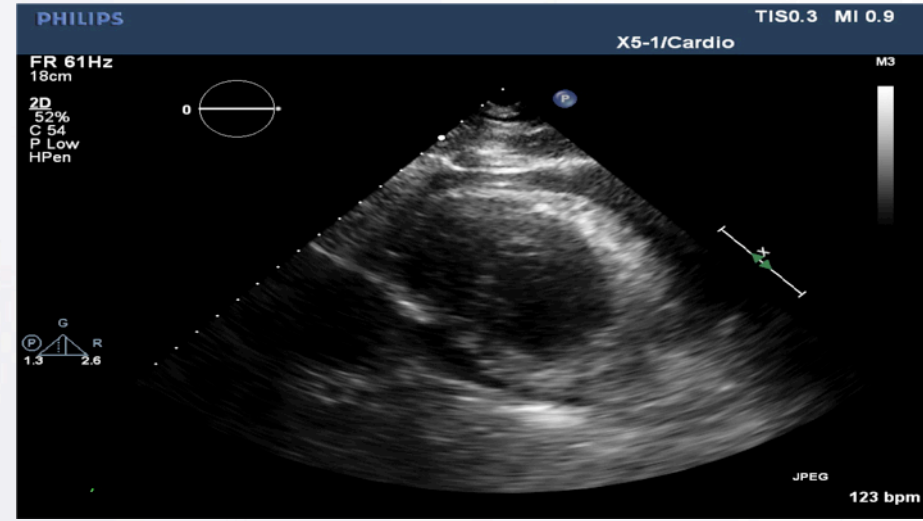
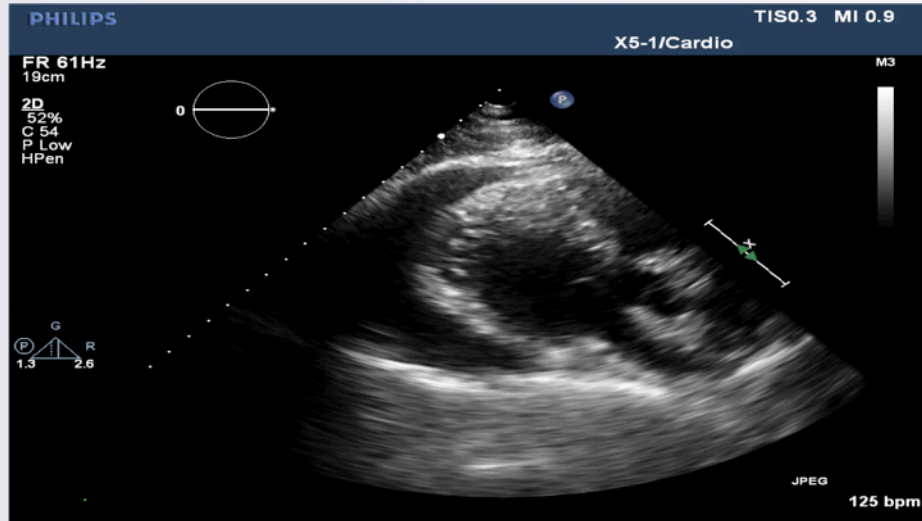
Acenocoumarol, ferrofumaraat

Lichamelijk onderzoek



- Tachypnea
- RR 105/70 mmHg, heart rate 112 bpm
- Normal heart sounds, normal lung sounds
- Peripheral edema, increased venous pressure

Echocardiografie



Echocardiografie



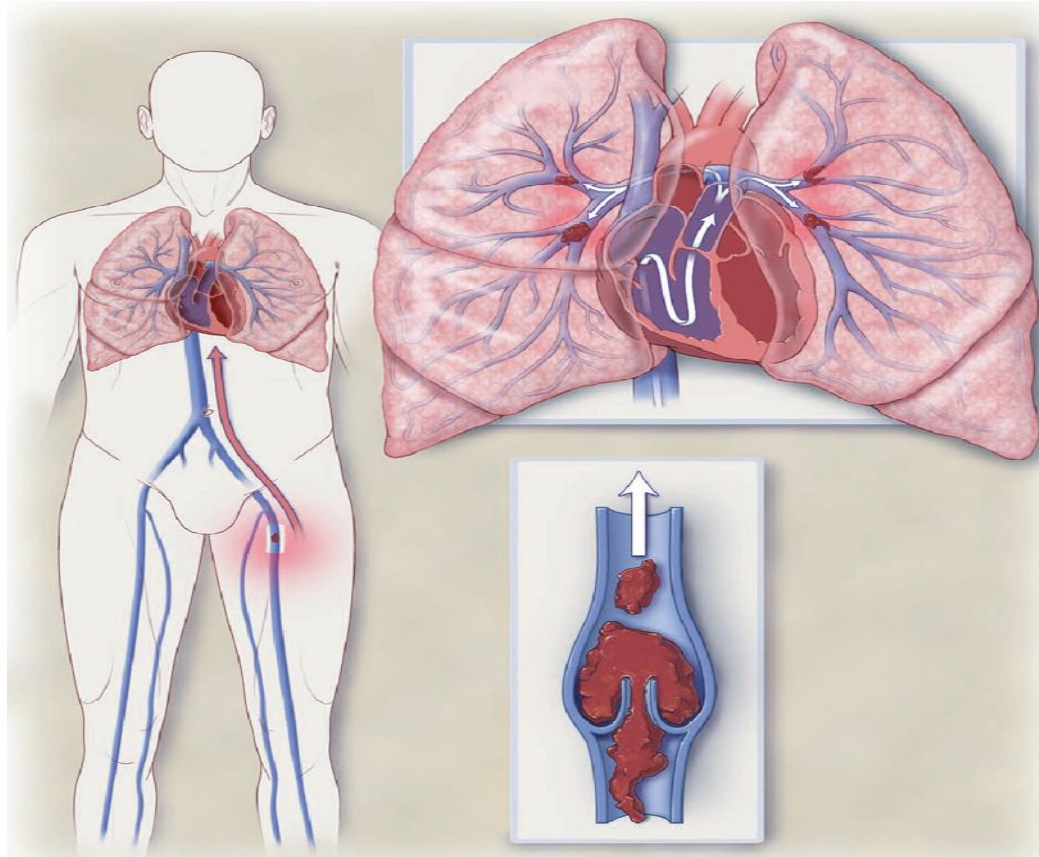
- Normale LV systolic functie
 - Rechter ventrikel dilatatie
 - RVSP 100 mmHg
 - Pericard effusie
-

Rechts catheterisatie

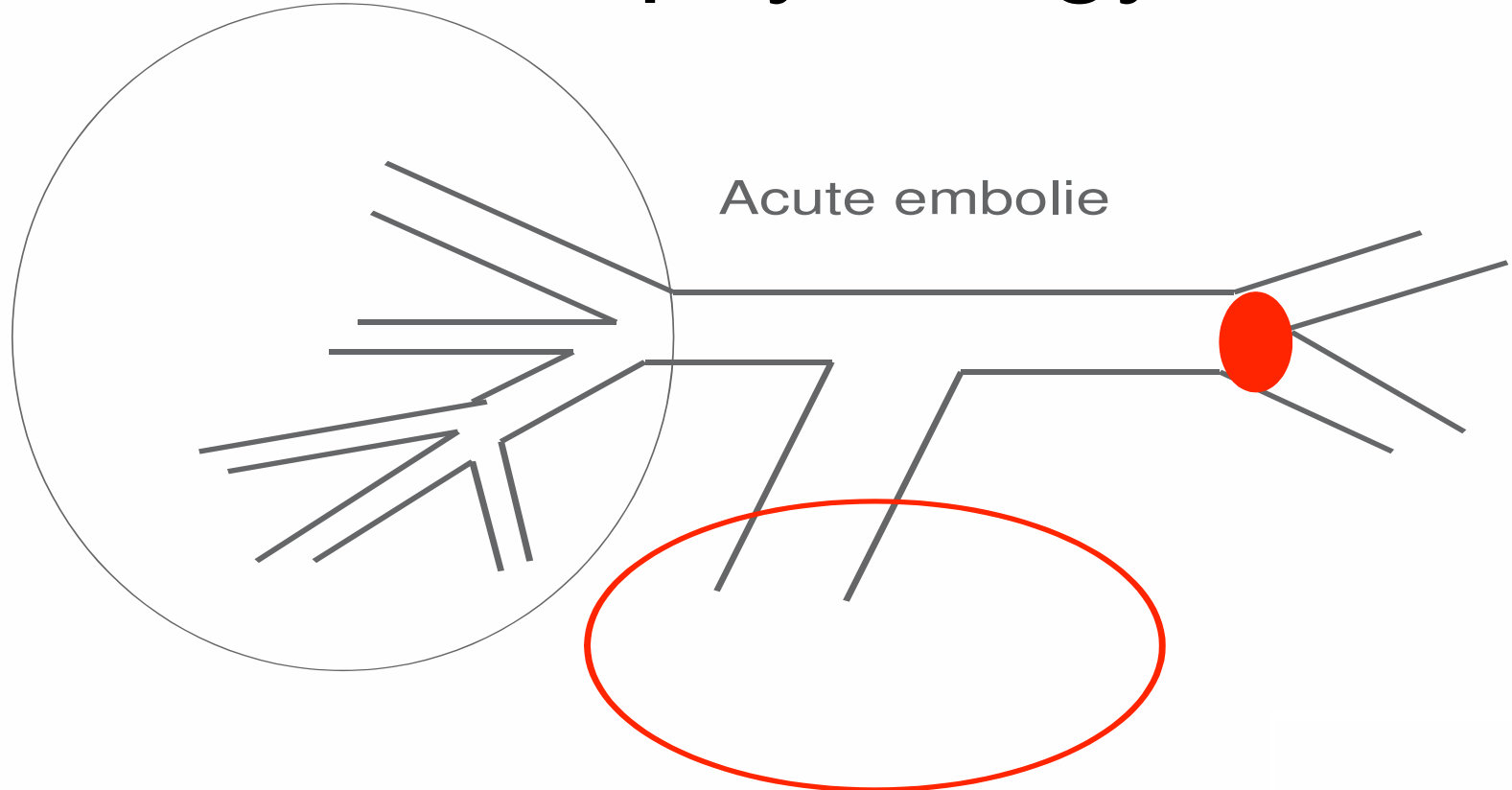


- Pulmonary artery pressures
PAP 108/39, mPAP 62 mm Hg (<25 mmHg)
- Pulmonary capillary wedge pressure
PCWP 15 mm Hg (<15 mmHg)
- Cardiac output
CO 3.1 L/min, CI 1.9 L/min/m²
- Pulmonary vascular resistance
PVR 15 WU = 1213 dynes*s*cm⁻⁵ (< 240 dynes*s*cm⁻⁵)

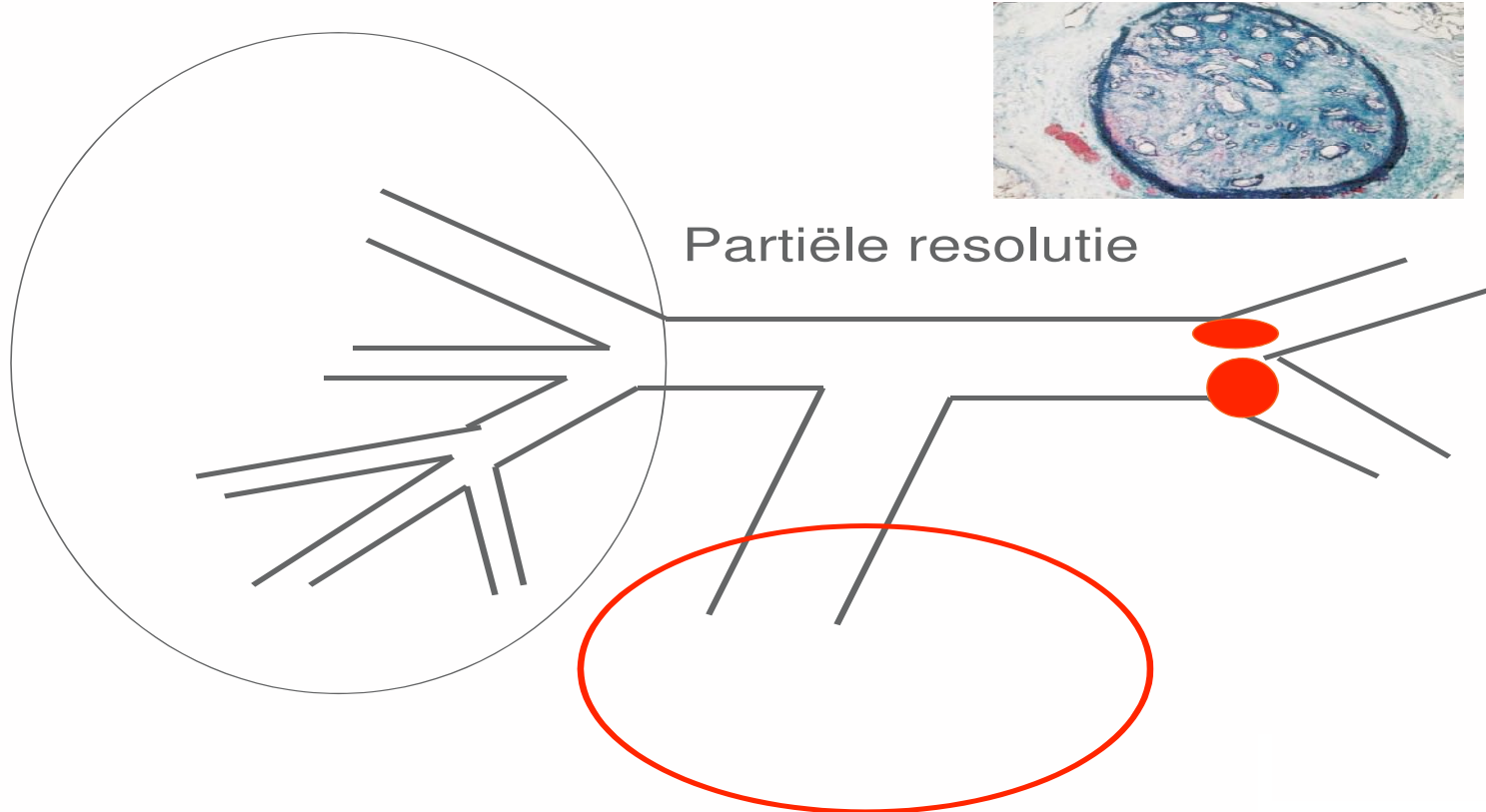
CTEPH



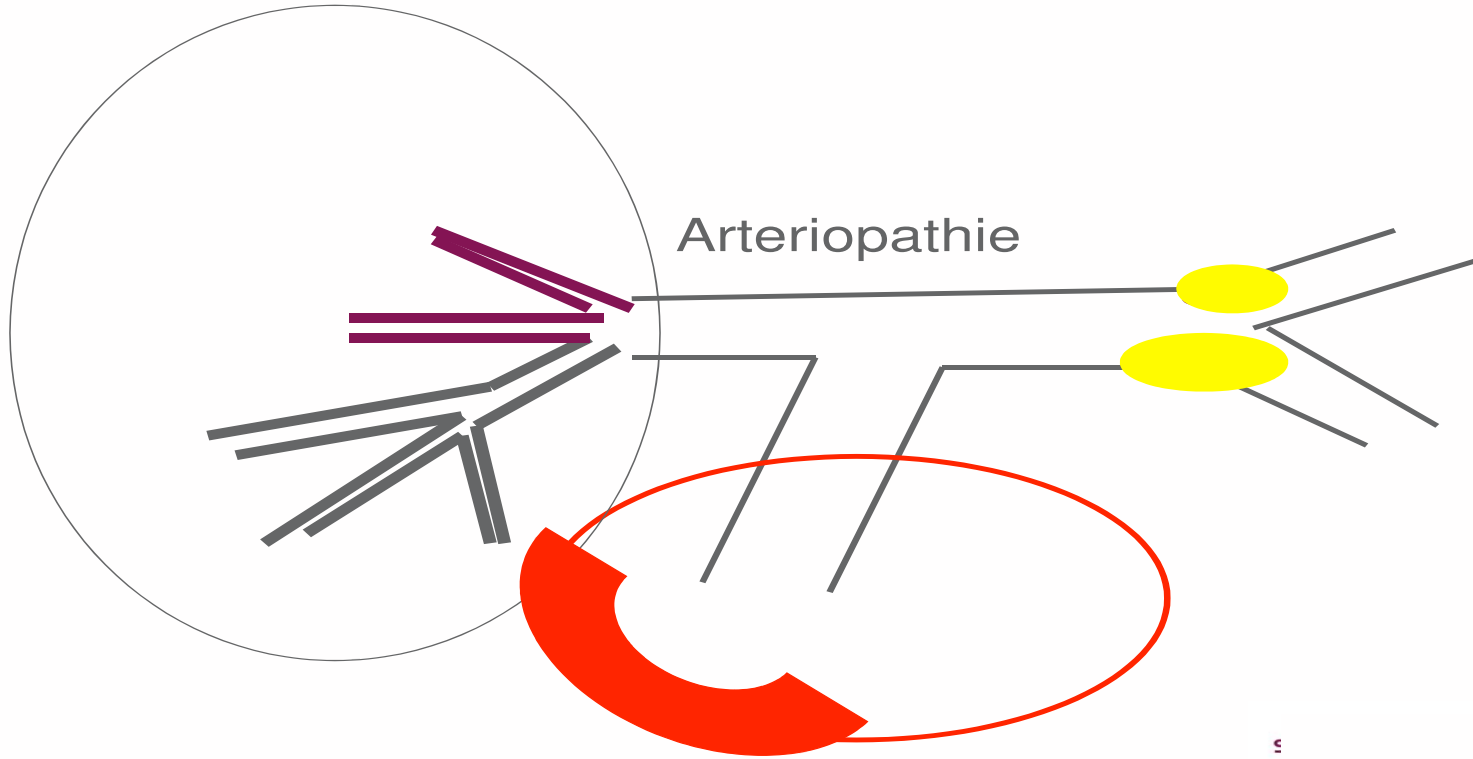
Pathophysiology



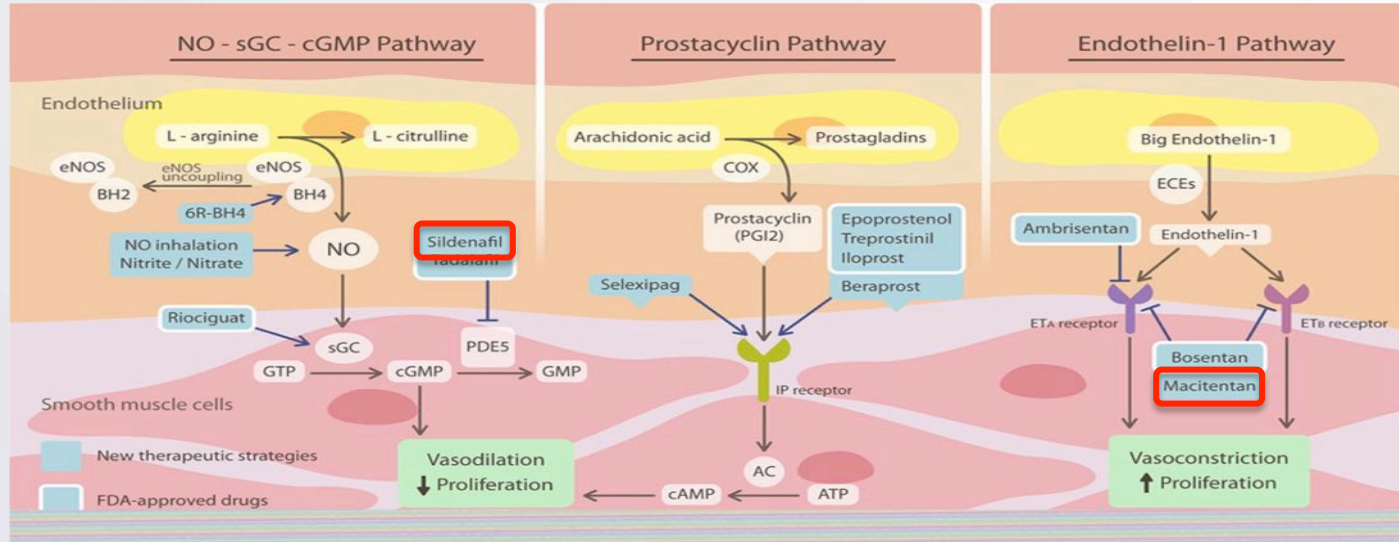
Pathophysiology



Pathophysiology



Behandeling



Start Sildenafil (Revatio) 3x20 mg
Macitentan (Opsumit) 1x10mg

PHILIPS

TIS0.4 MI 0.9

X5-1/Cardio

FR 50Hz
14cm

2D
53%
C 54
P Low
HPen



P

M3



G
P R
1.3 2.6



JPEG

98 bpm

PHILIPS

TIS0.4 MI 0.9

X5-1/Cardio

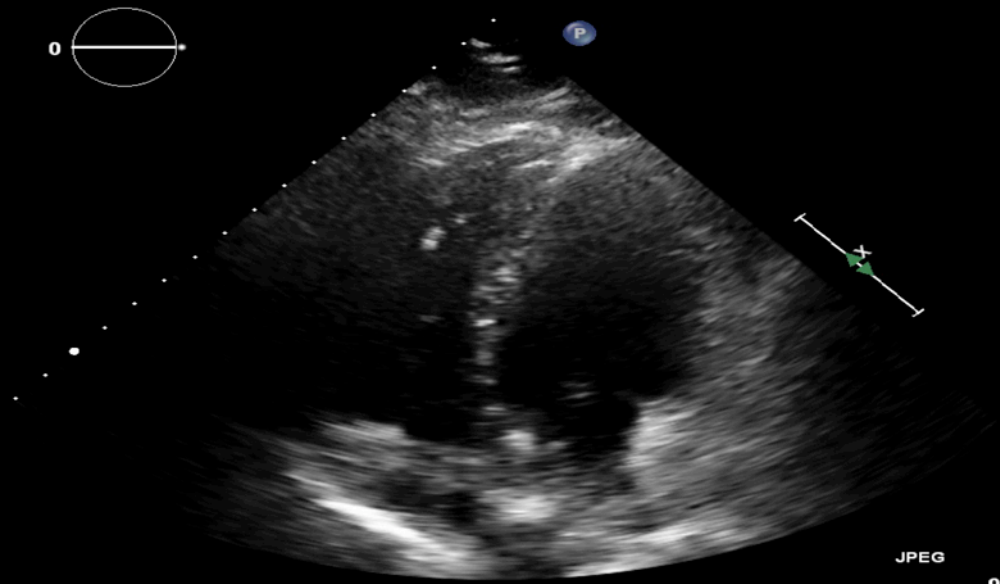
FR 50Hz
17cm

M3

2D
54%
C 54
P Low
HPen



G
P R
1.3 2.6



JPEG

97 bpm

Behandeling



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Therapeutische opties



1. Uitbreiden medicatie
2. Endarteriectomie
3. Ballon angioplastiek?

Take home message



Invasieve hemodynamiek

- 01** Van toegevoegde waarde in meerdere ziektebeelden voor diagnostiek en follow-up
 - HFpEF, PH
 - Betrouwbaarheid tov echo
- 02** Essentieel in onderscheid pre-capillaire en post-capillaire PH

Vragen?

Feel free

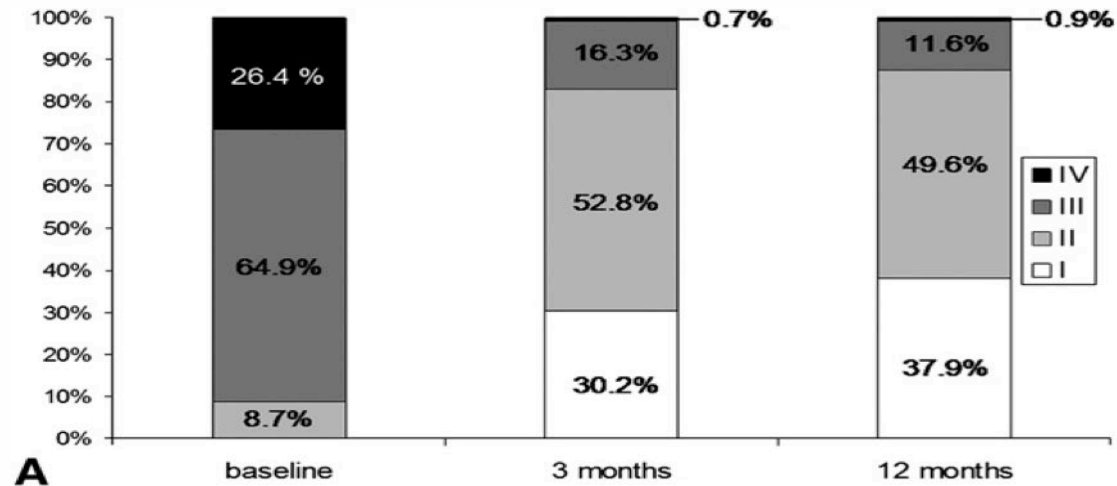


Endarterectomy

- 4.7 % mortality
- Deep hypothermia, circulation arrest



After PEA

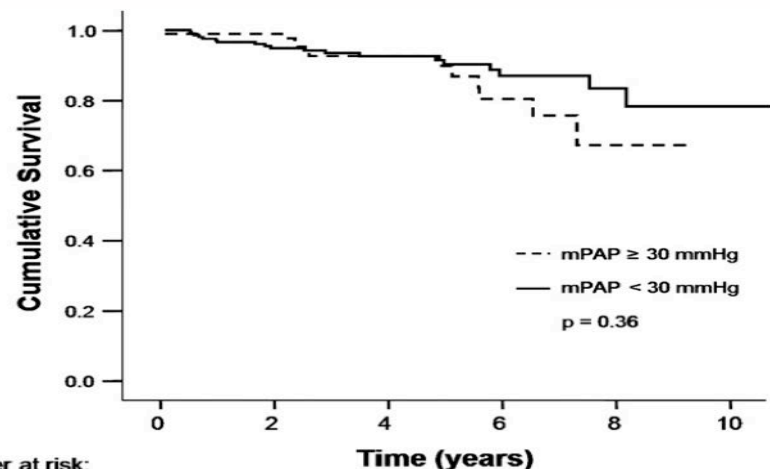


Residual PAH

TABLE 2. Comparison between patients without (group 1) or with (group 2) residual pulmonary hypertension (median \pm interquartile range)

3 mo after operation	Group 1 (n = 210)	Group 2 (n = 96)	P value
mPAP (mm Hg)	20 \pm 5	38 \pm 8	<.001
PVR (dynes \cdot s ⁻¹ \cdot cm ⁻⁵)	181 \pm 88	541 \pm 250	<.001
CI (L \cdot min ⁻¹ \cdot m ⁻²)	2.5 \pm 0.6	2.5 \pm 0.62	NS
SMWD (m)	386 \pm 106	337 \pm 97	<.001
NYHA class I or II (n)	88.1% (170/193)	68.9% (62/90)	<.001

mPAP, Mean pulmonary artery pressure; *PVR*, pulmonary vascular resistance; *CI*, cardiac index; *NS*, not significant; *SMWD*, 6-minute walk distance; *NYHA*, New York Heart Association.



Number at risk:

mPAP < 30 mmHg	210	157	97	52	16	3
mPAP ≥ 30 mmHg	96	85	41	21	6	

FIGURE 3. Effect of residual pulmonary hypertension on survival after hospital discharge. *mPAP*, Mean pulmonary artery pressure.