Kantonsspital
St.Gallen

# Diagnosis of PH

## What the New Guidelines Might Tell Us

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# Diagnosis of PH

- The 2015 guidelines
- Problems of the 2015 definition
- The 2018  proposal
- 2018 proposal: perfect solution?

European Heart Journal (2016) **37**, 67–119
doi:10.1093/eurheartj/ehv317

ESC/ERS GUIDELINES

# 2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension

**The Joint Task Force for the Diagnosis and Treatment of Pulmonary Hypertension of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS)**

**Endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC), International Society for Heart and Lung Transplantation (ISHLT)**

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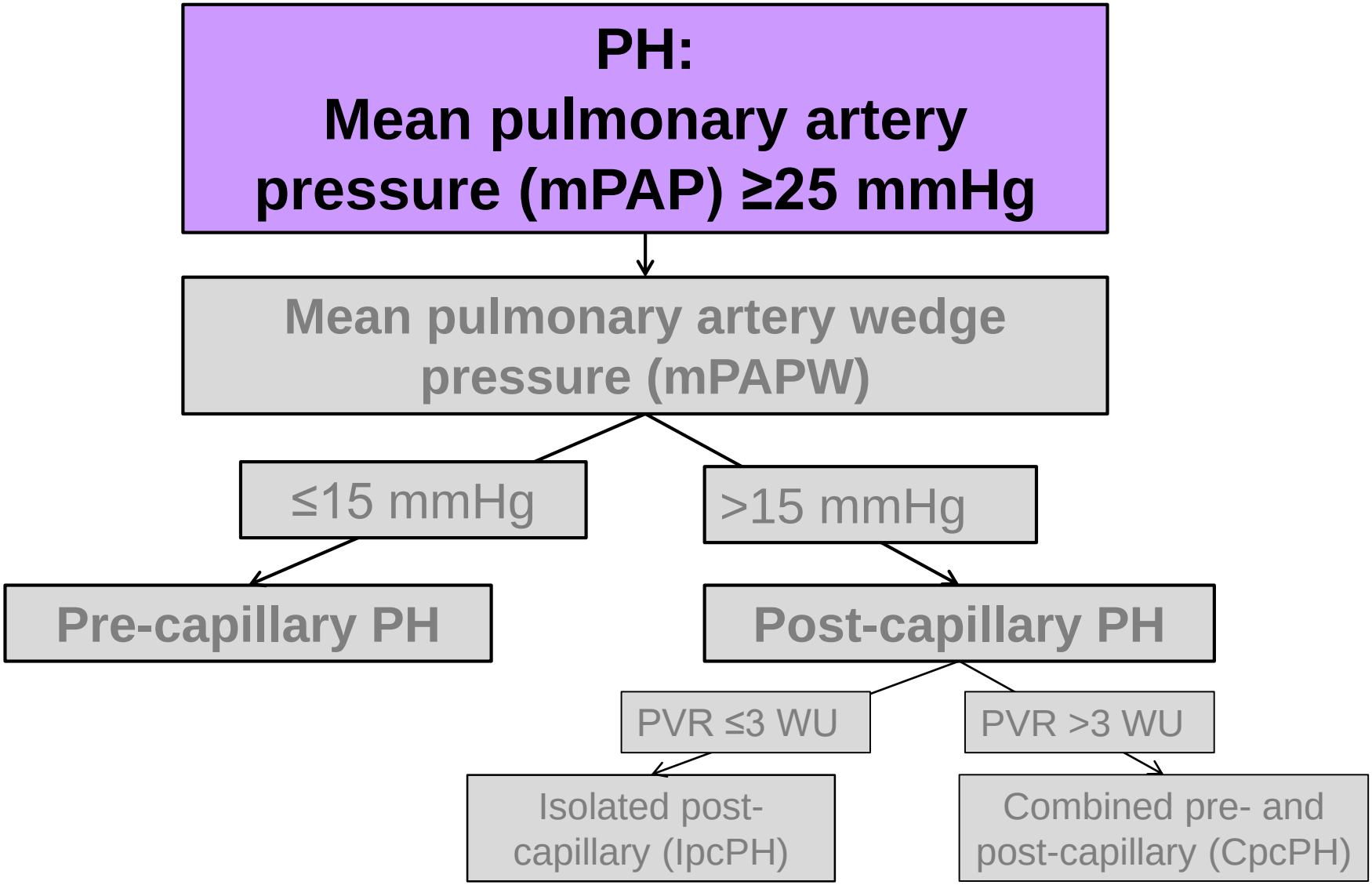
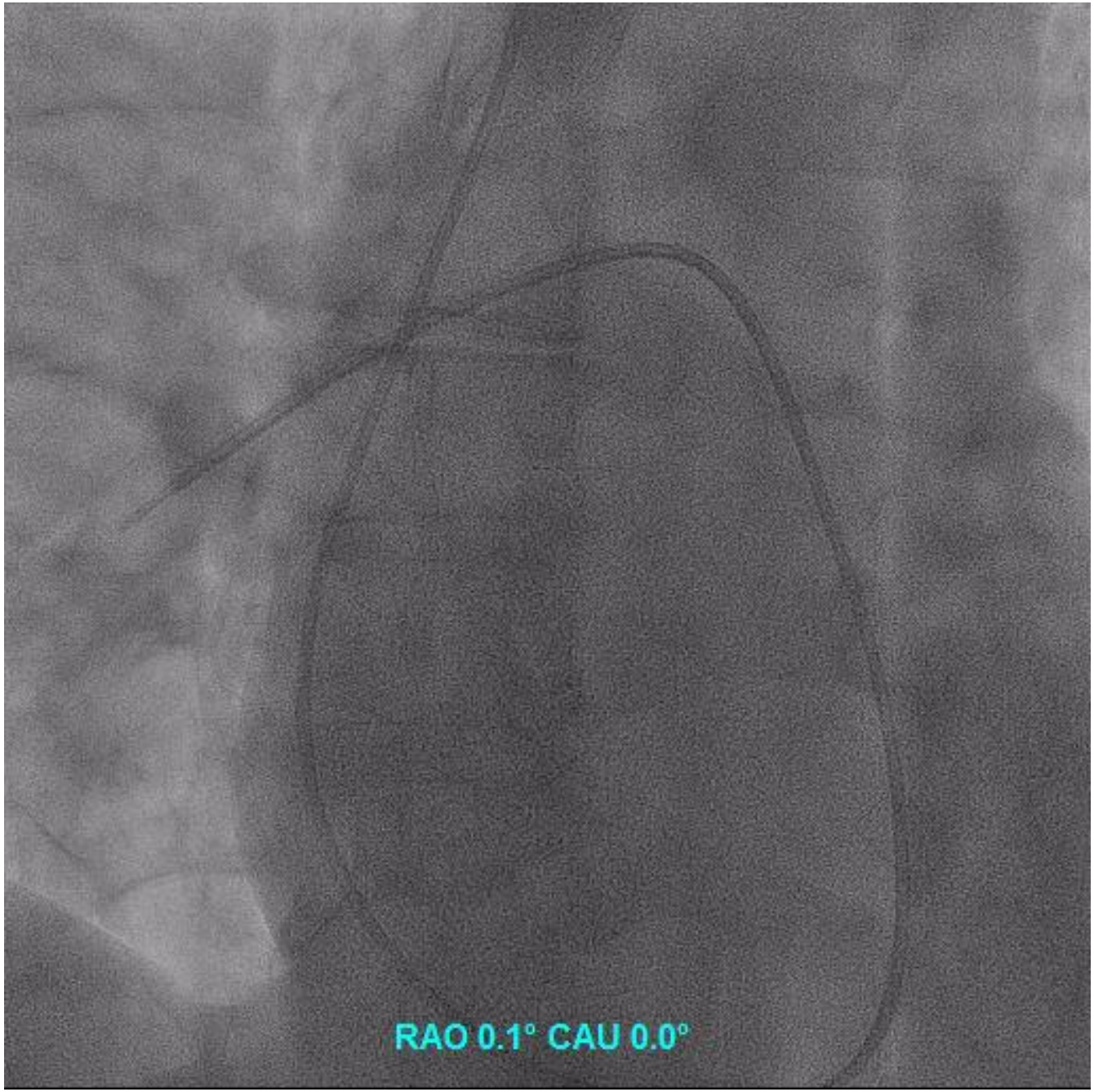
Galie N et al. Eur Heart J 2015

# PH Definition 2015

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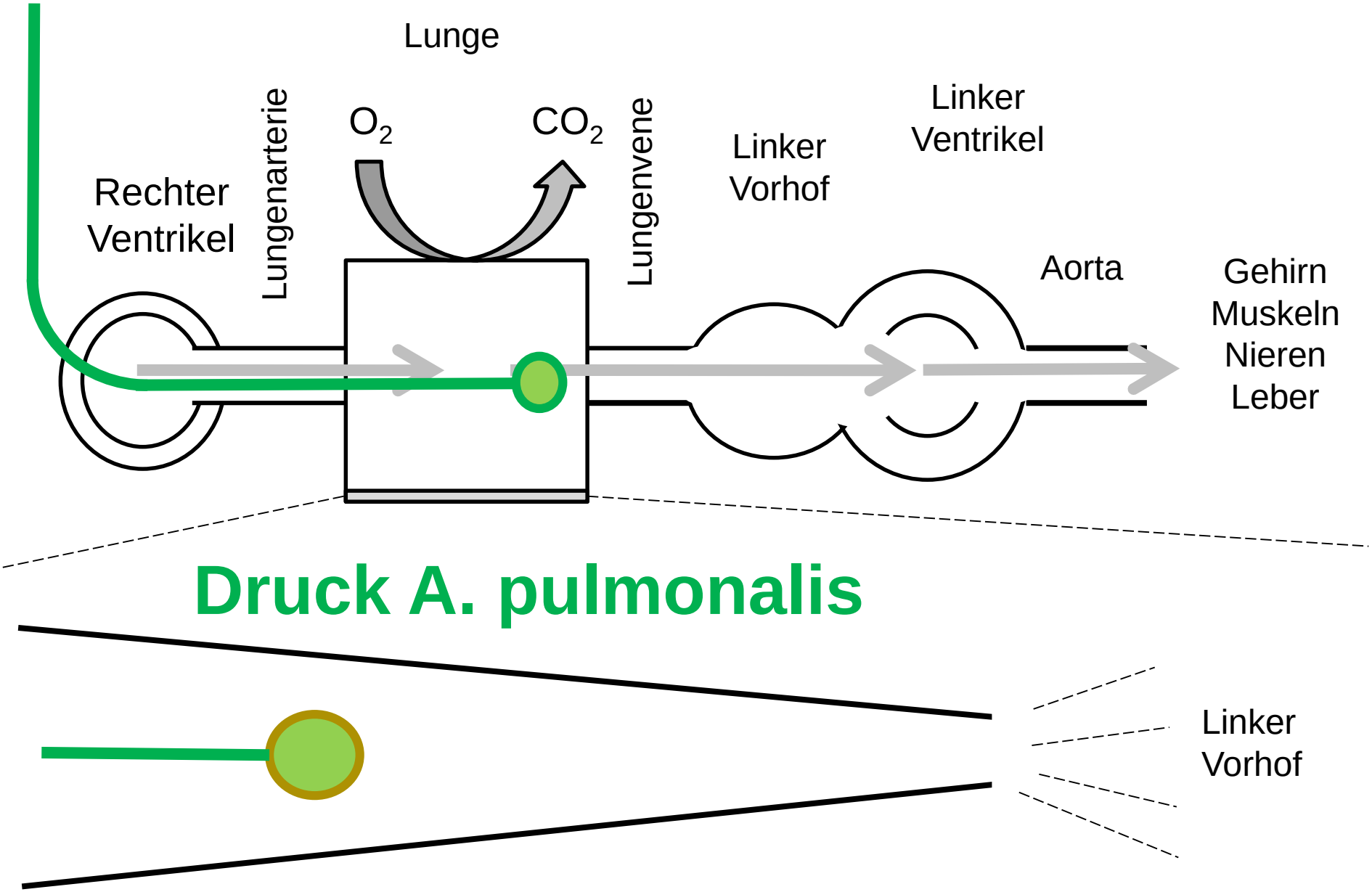
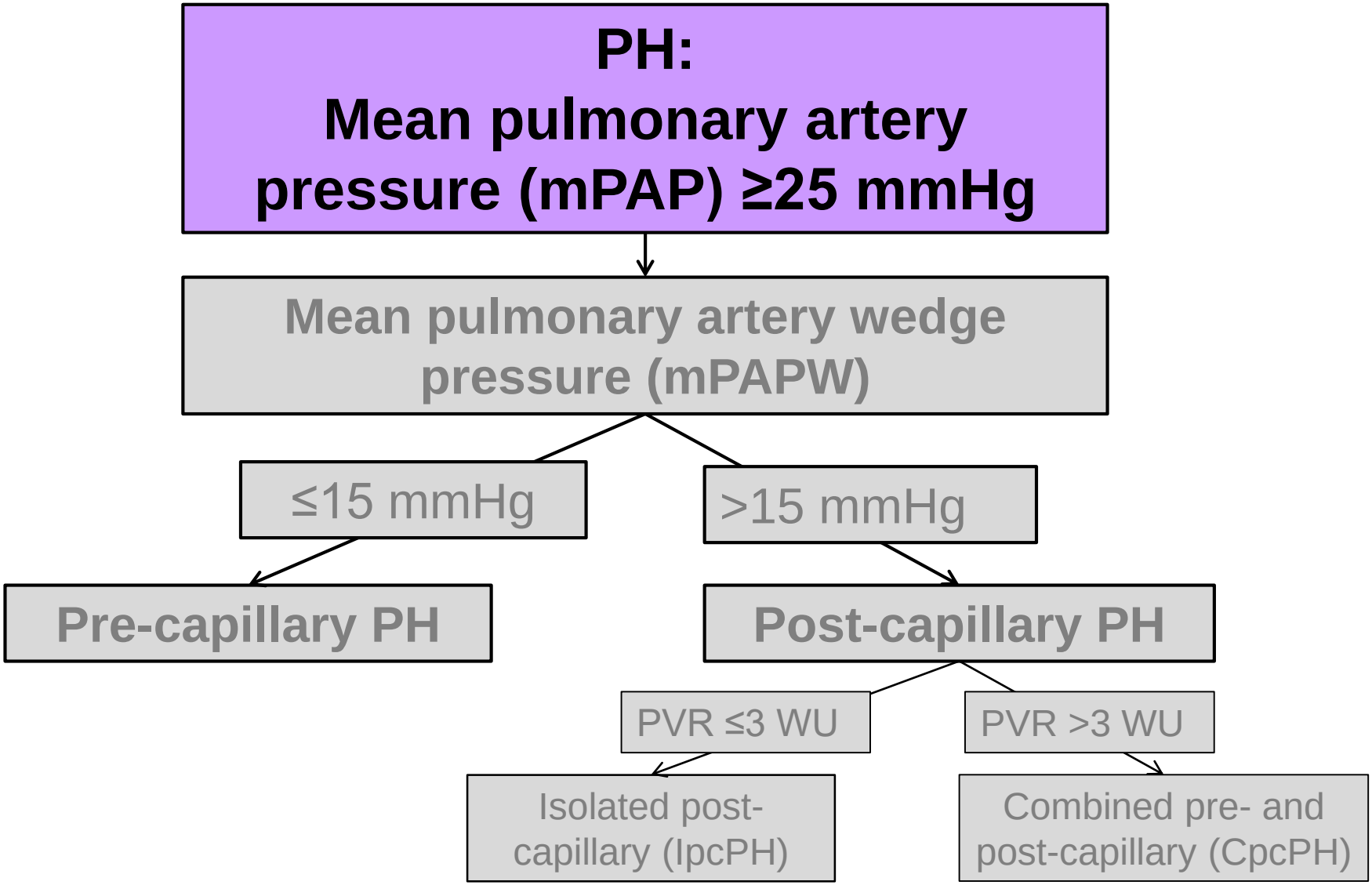
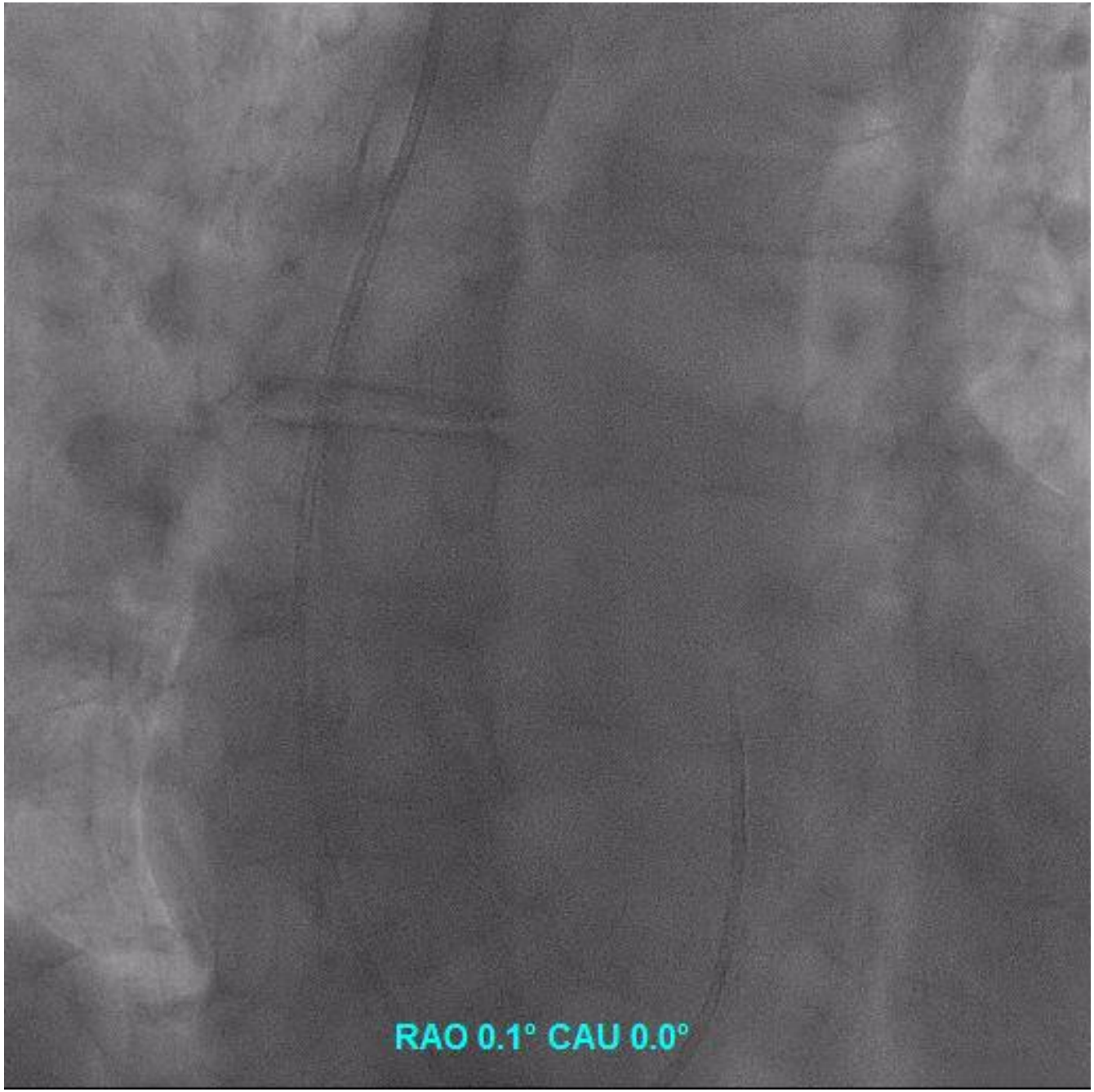

Lunge
Lungenarterie
$O_2$
$CO_2$
Lungenvene
Linker Vorhof
Linker Ventrikel
Rechter Ventrikel
Aorta
Gehirn
Muskeln
Nieren
Leber
Druck A. pulmonalis
Linker Vorhof

# PH Definition 2015

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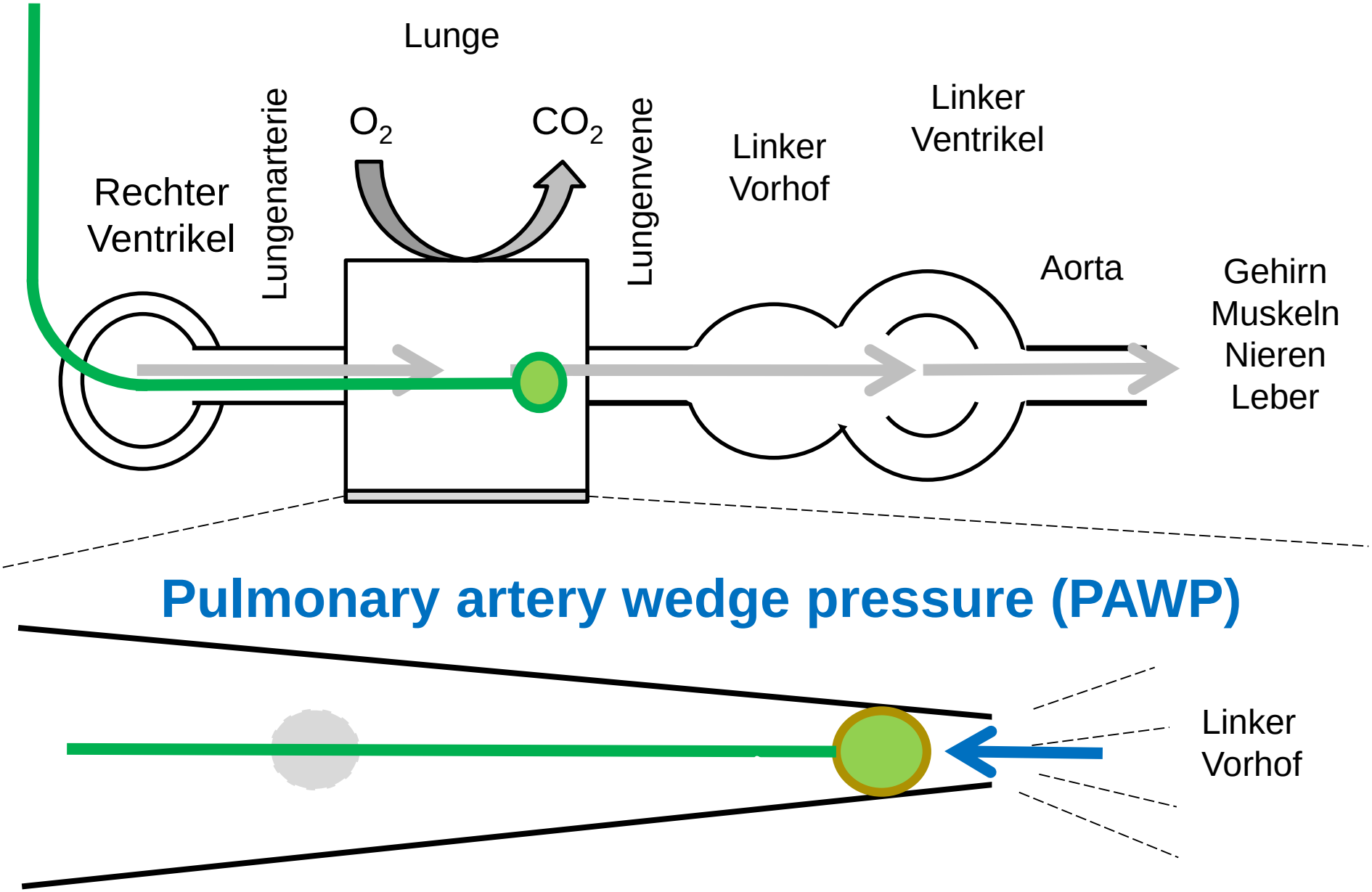
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Rechter Ventrikel
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Pulmonary artery wedge pressure (PAWP)
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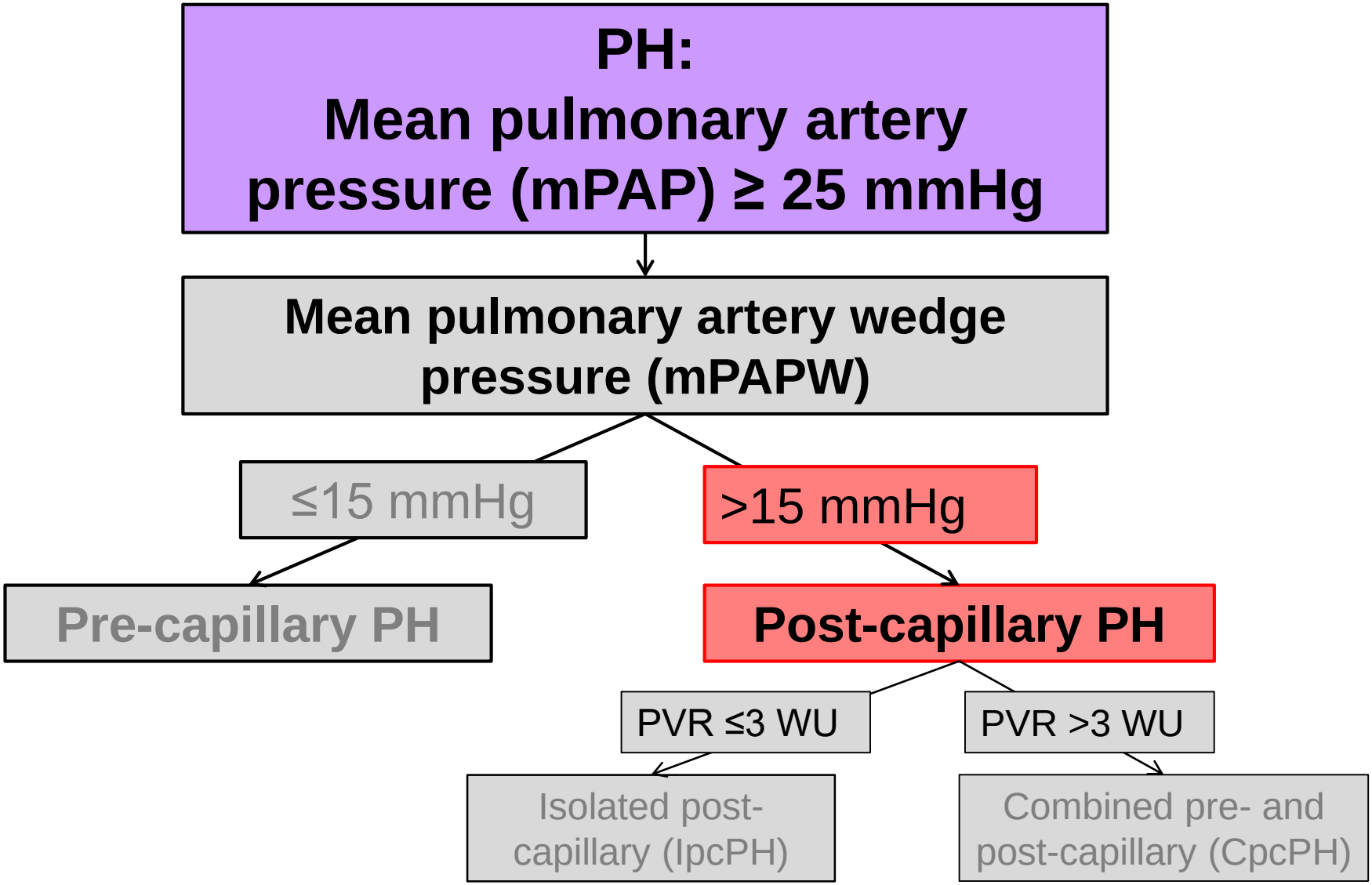
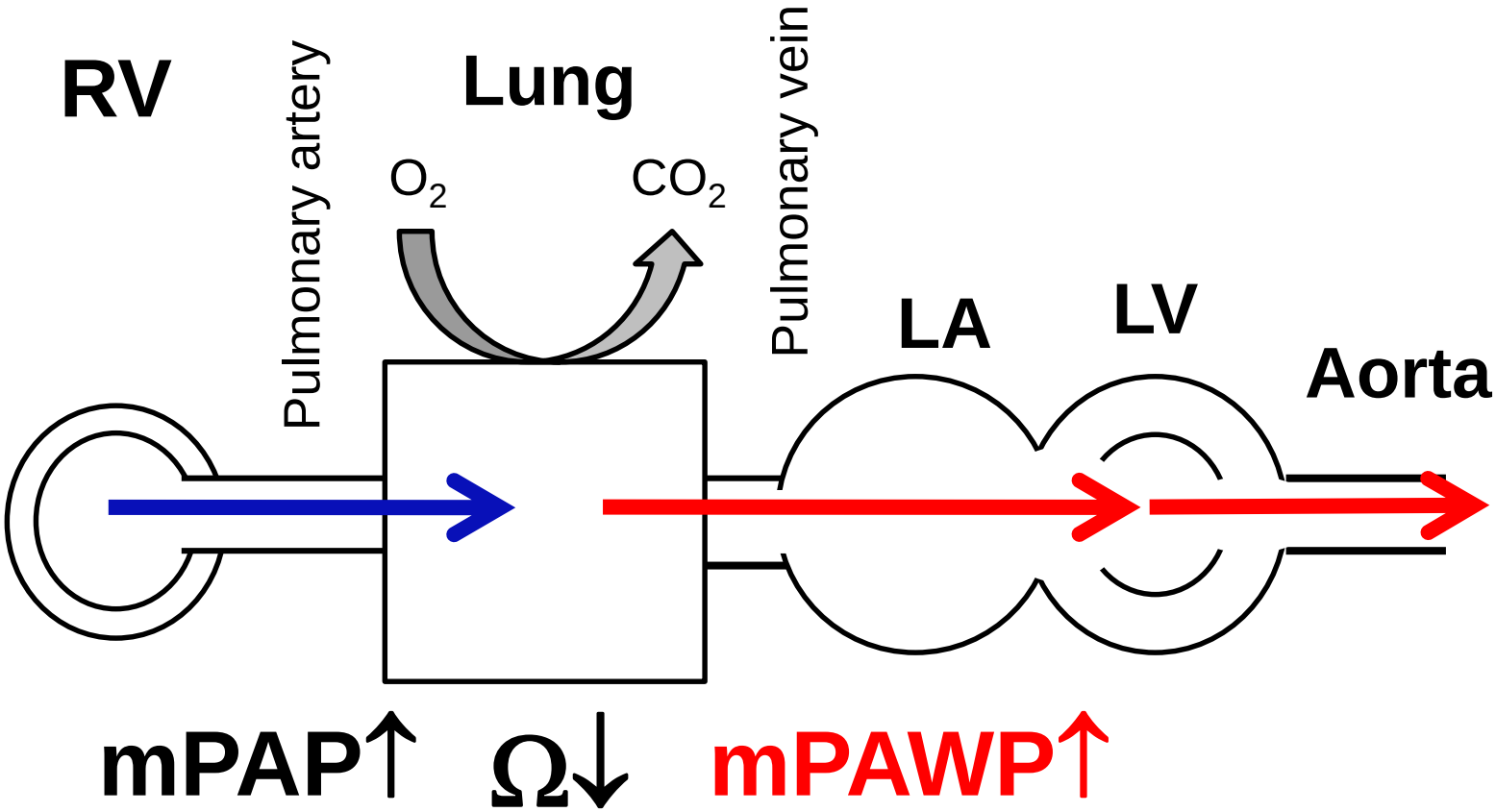
# PH Definition 2015






# Post-capillary PH

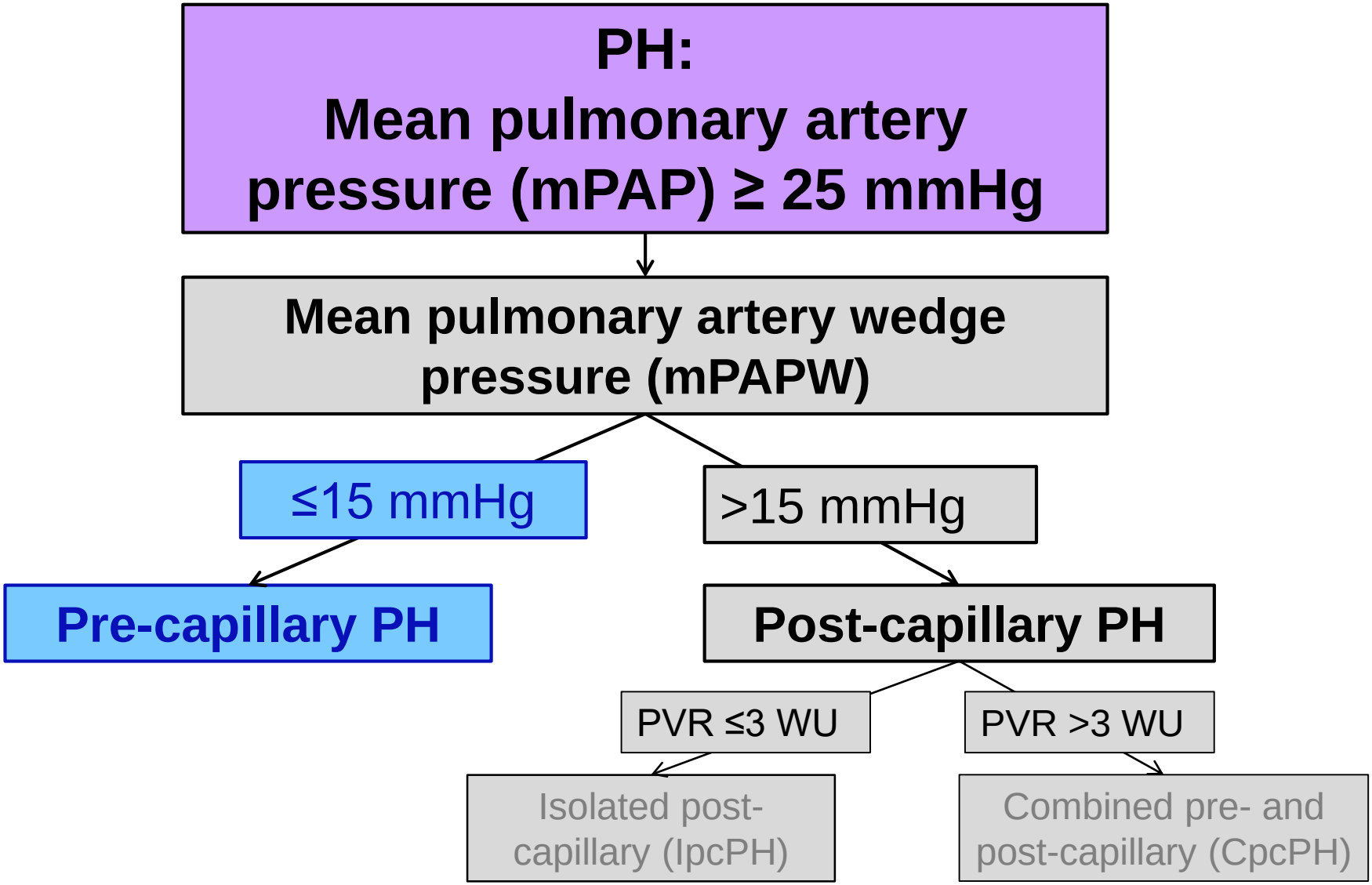
**mPAP** **mPAWP↑**

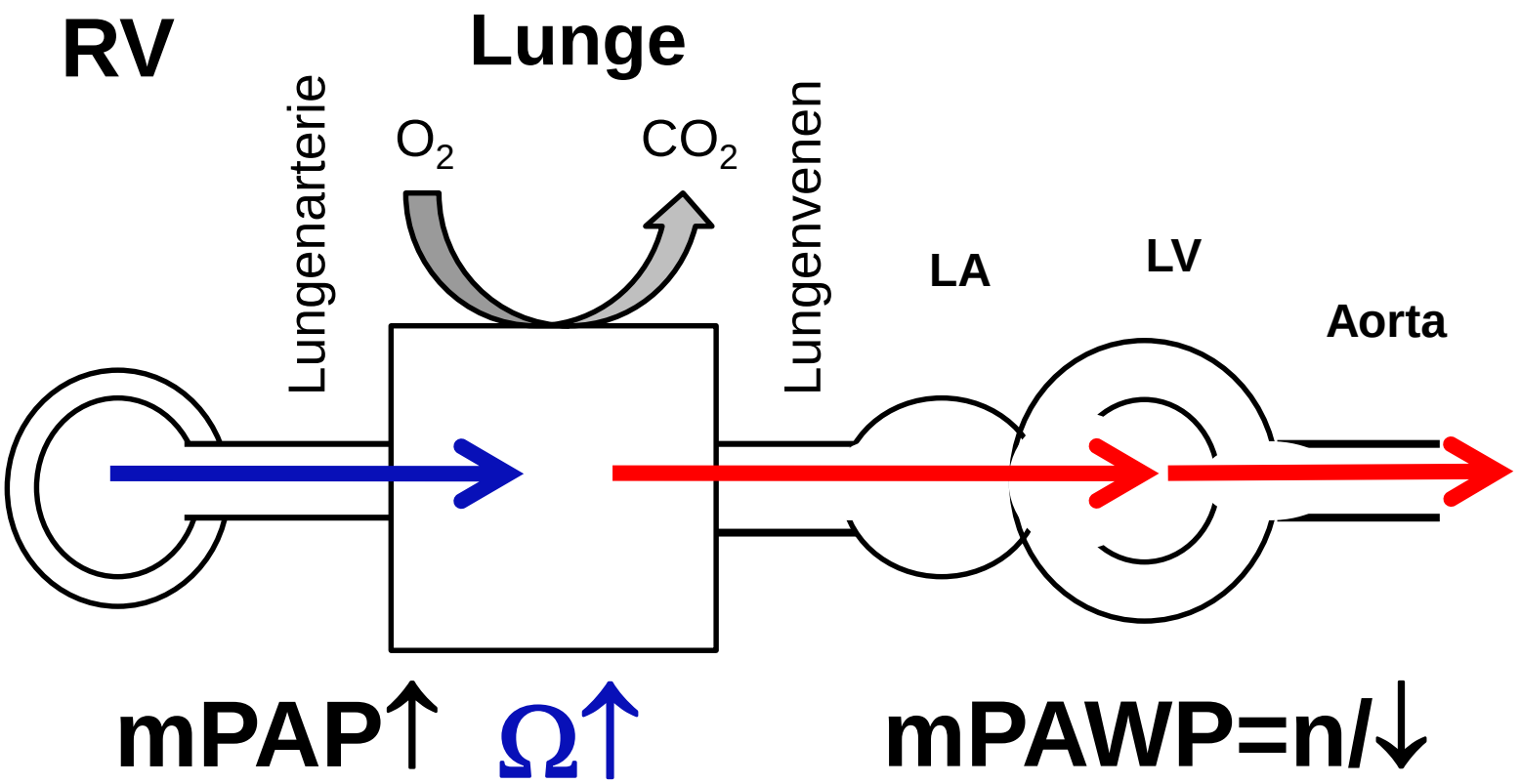

**TPG**


TPG=mPAP-mPAWP

**Transpulmonary Gradient (TPG)↓, i.e. PVR ↓**

# PH Definition 2015

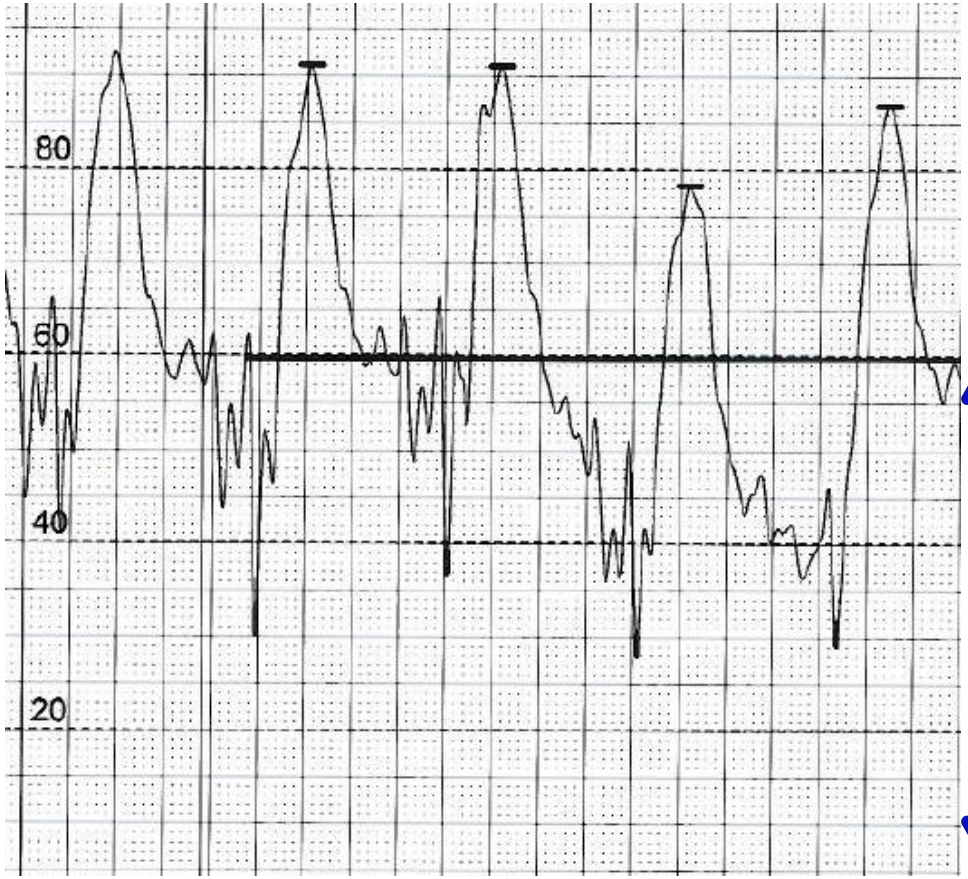




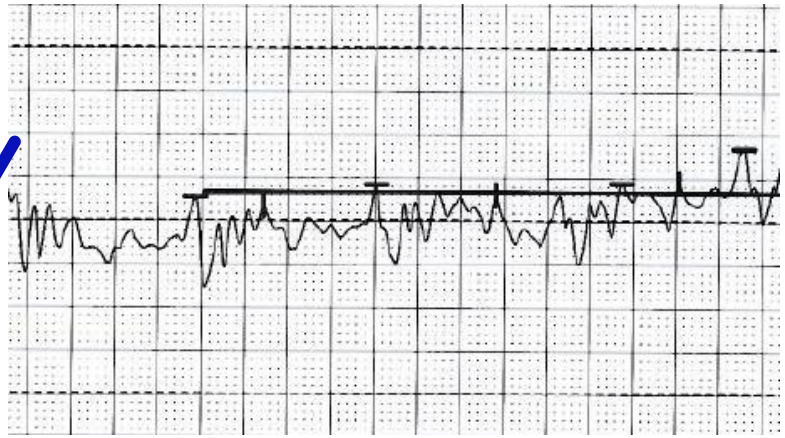

# Pre-capillary pulmonary hypertension

# mPAP

# mPAWP↓




**Transpulmonary Gradient (TPG) and PVR ↑**



TPG=mPAP-mPAWP

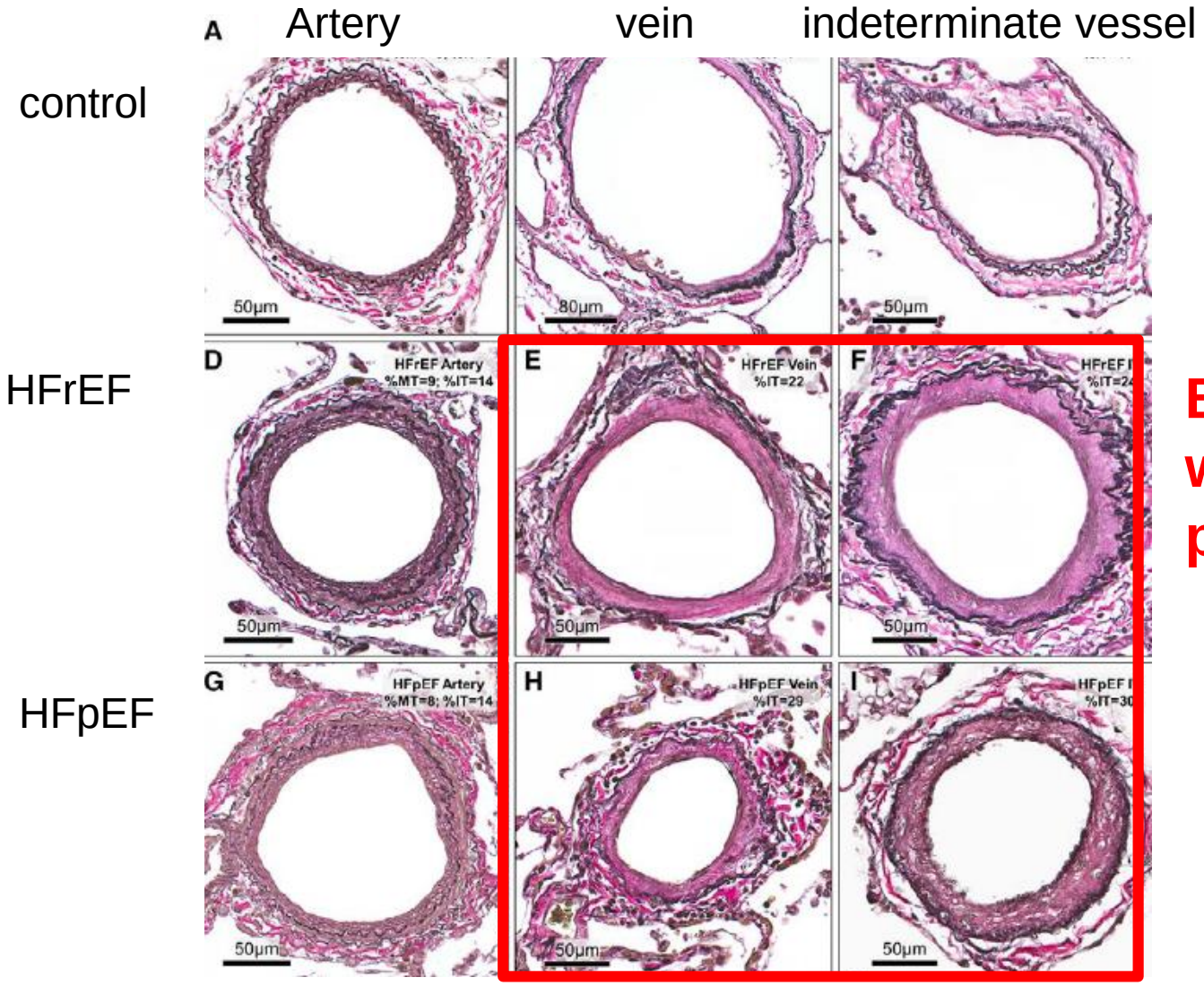
PVR= TPG/cardiac output

# 2015 PH classification

| Group | Pulmonary hypertenion (PH) | Hemodynamics |
|---|---|---|
| **1** | **Pulmonary arterial hypertension** | **Pre-capillary** |
| | Idiopathic, hereditary, drugs/toxins, connective tissue diease/HIV/liver disease/congenital heart disease | |
| **2** | **PH in left heart disease** | **Post-capillary** |
| | Systolic/diastolic dysfunction, valve disease | |
| **3** | **PH in patients with chronic lung disease/hypoxia** | **Pre-capillary** |
| **4** | **Chronic thromboembolic PH** | **Pre-capillary** |
| **5** | **PH with unknown/multifactorial mechanism** | **Pre-capillary** |

Galie N, et al. Eur Heart J 2016

# Pulmonary vascular remodeling in HFpEF-CpcPH

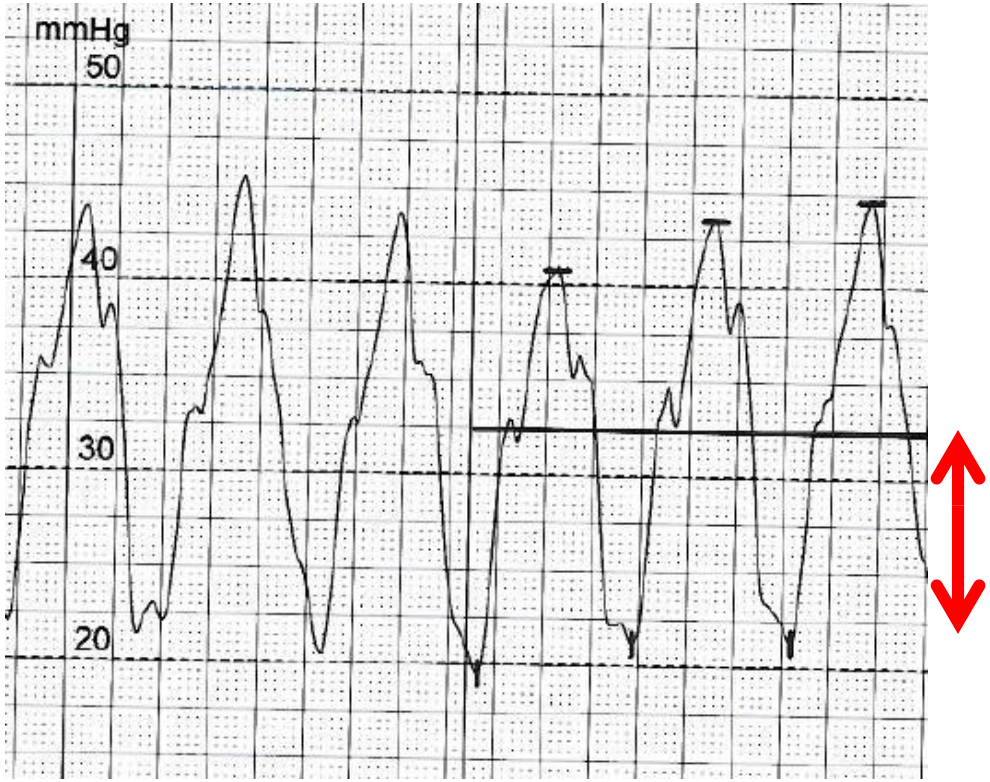


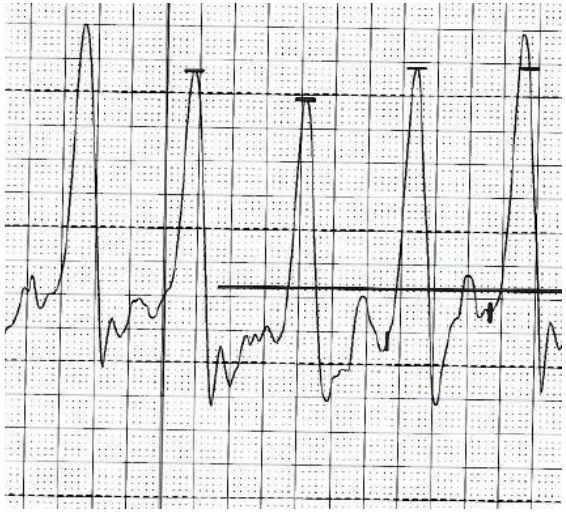

**Best correlation with PA pressure**

Fayyaz AU et al. Circulation 2018

# mPAP

# mPAWP↑

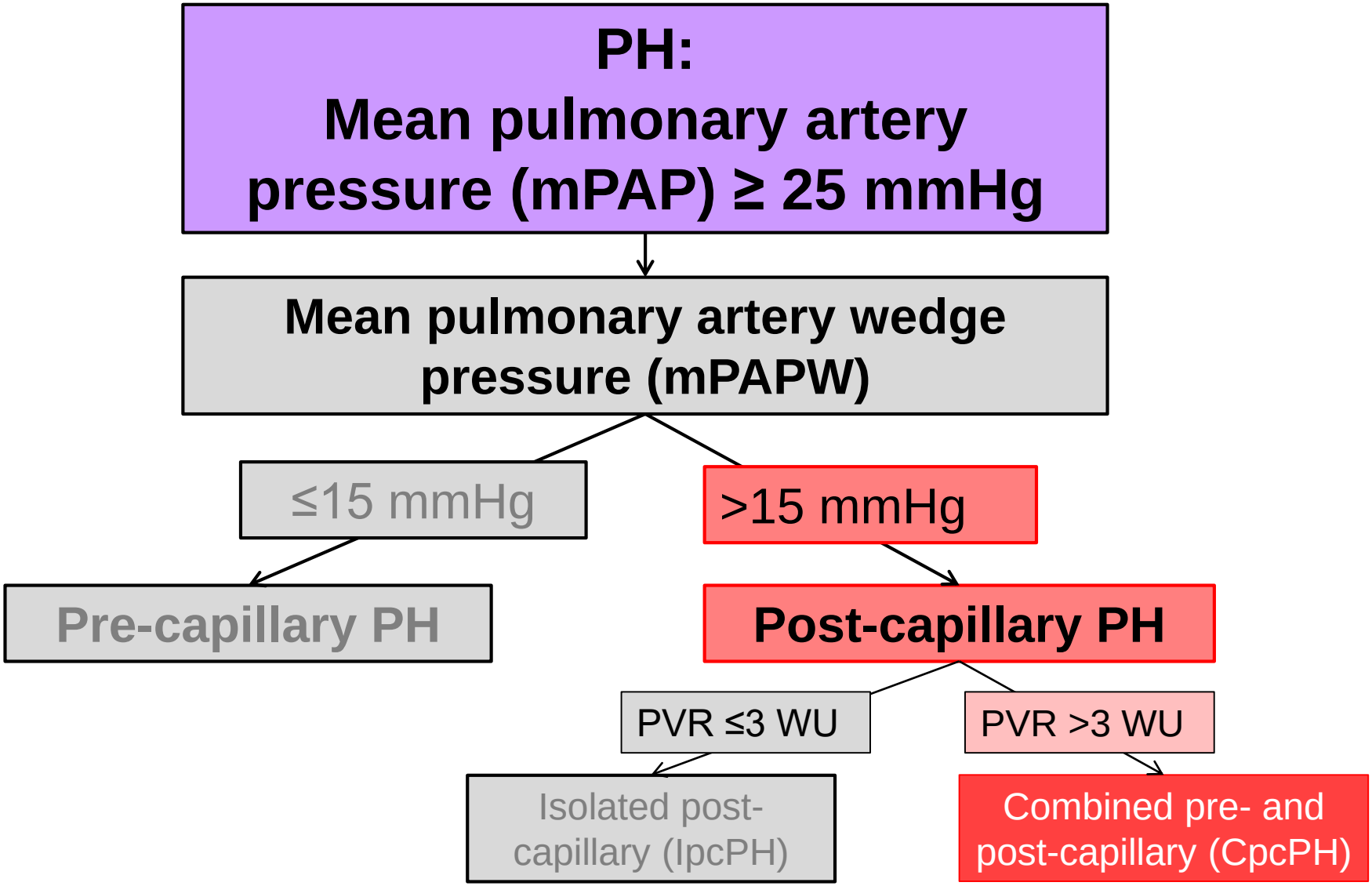


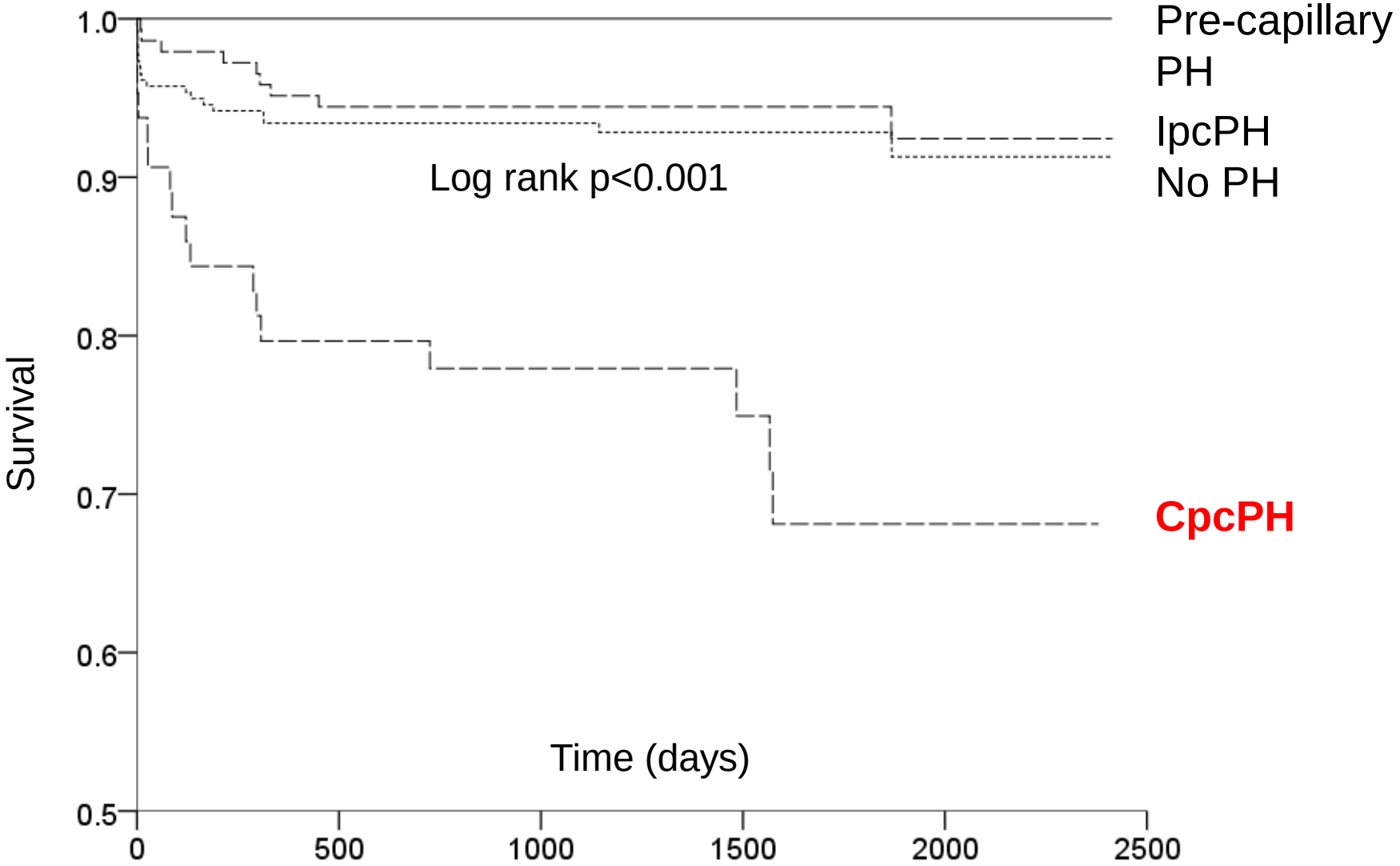
**But TPG/PVR also↑**

**Combined pre- and post-capillary PH**

# PH Definition 2015



# Pre-AVR CpcPH and long-term post-AVR mortality




Weber L et al. Eur J Heart Heart Fail 2018

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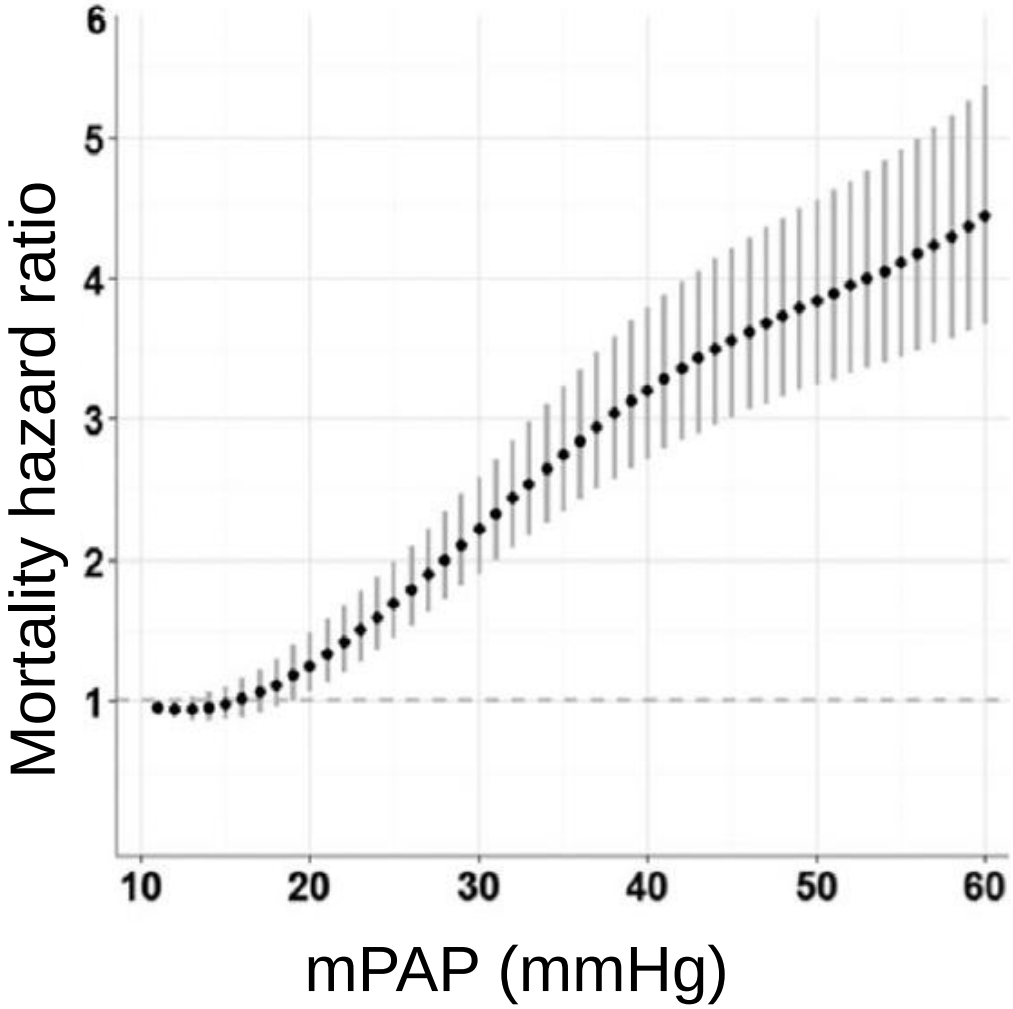
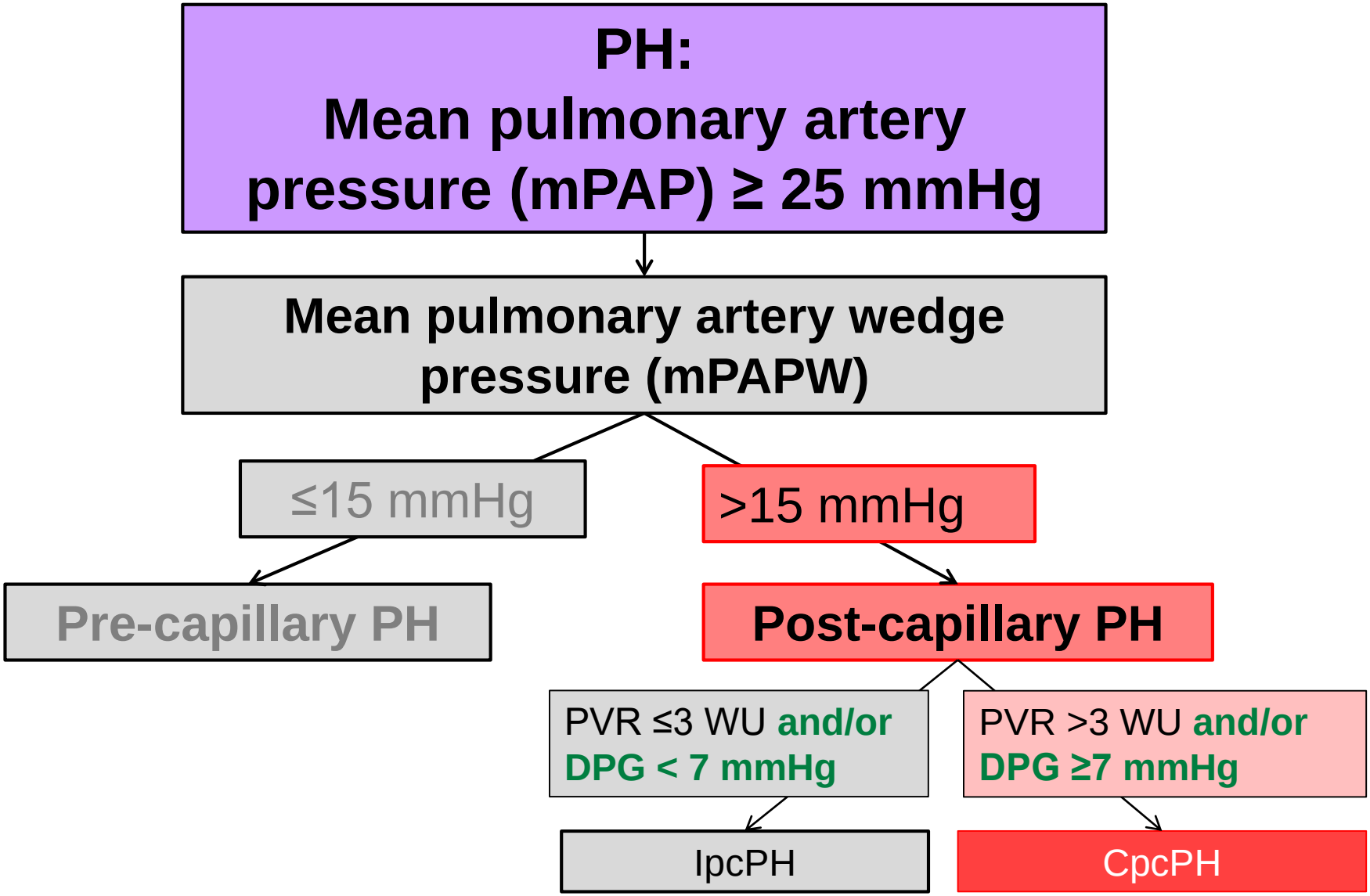
# Pulmonary pressure and prognosis



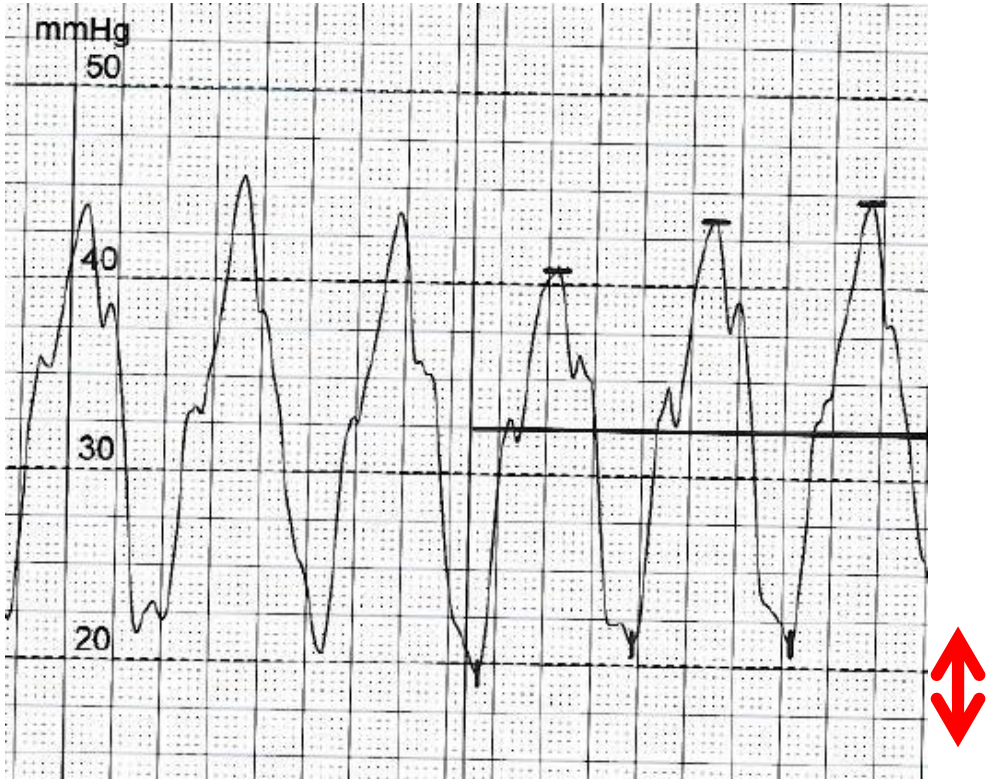

Maron B et al. Circulation 2016

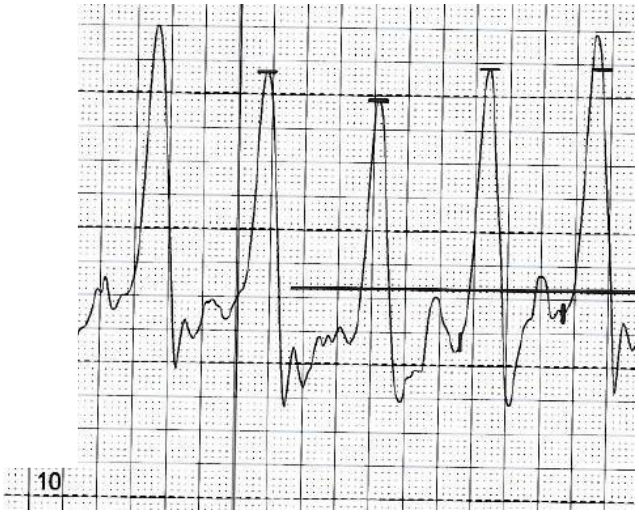
# PH Definition 2015



# mPAP

# mPAWP↑




**DPG=dPAP-mPAWP**

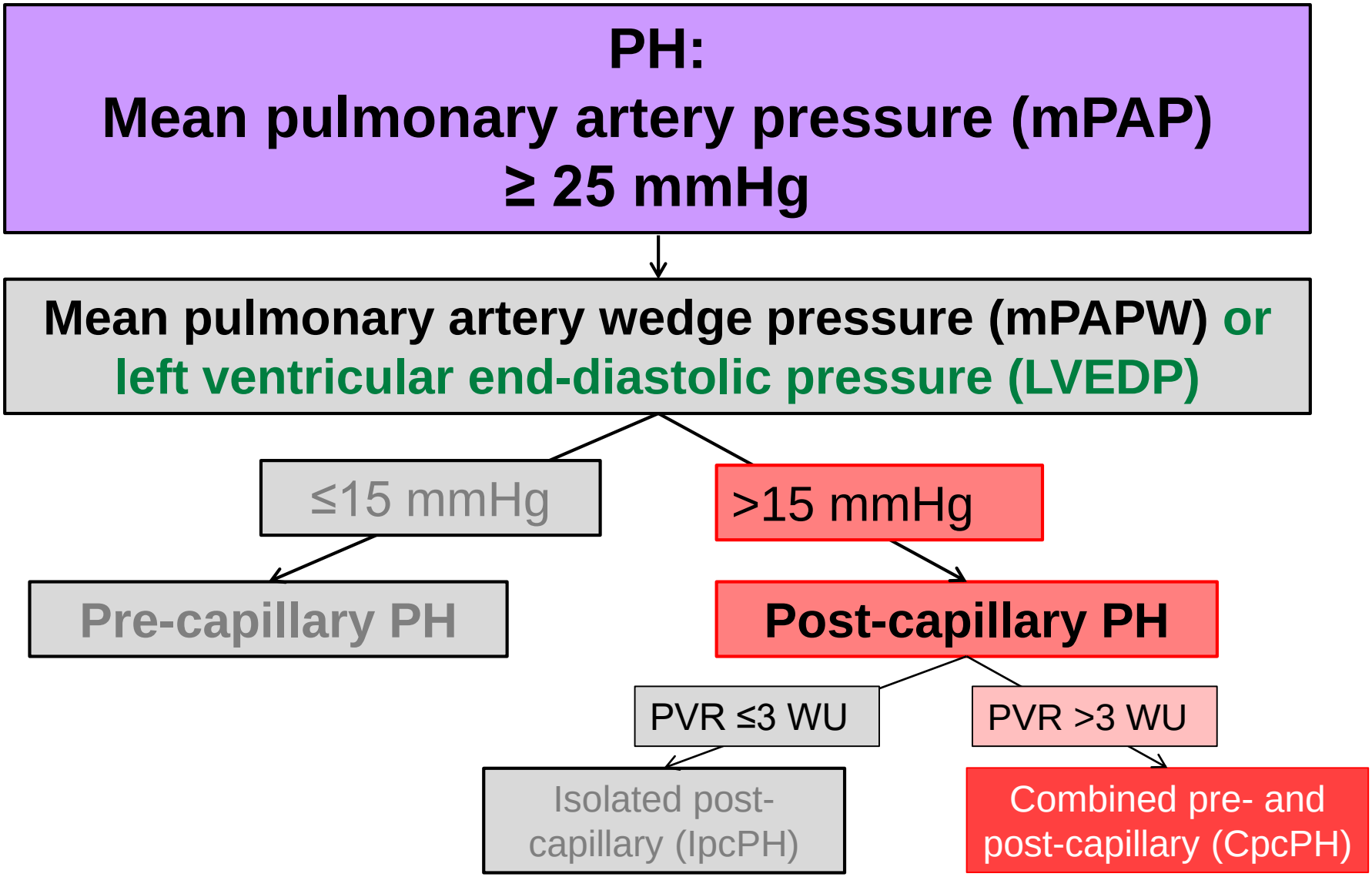
TABLE 1 Patients with pulmonary hypertension (PH) due to left heart disease (n=1506, mean pulmonary artery pressure ⩾25 mmHg, and mean pulmonary artery wedge pressure >15 mmHg) stratified by diastolic pulmonary vascular pressure gradient (DPG) and pulmonary vascular resistance (PVR)

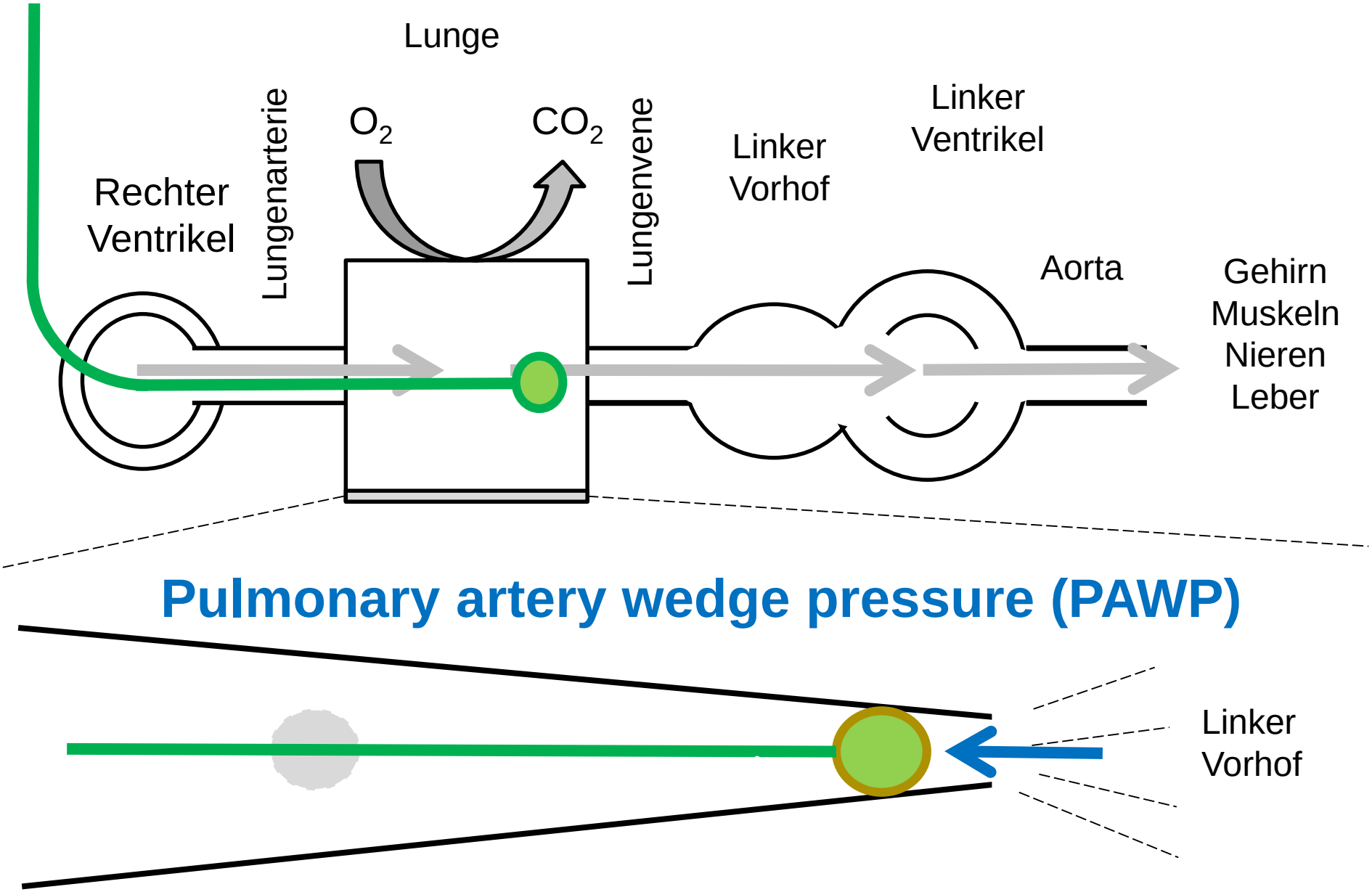
| | **DPG <7 mmHg** | **DPG ⩾7 mmHg** |
|---|---|---|
| **PVR ⩽3 WU n (%)** | 858 (57.0)[#] | **44 (2.9)** |
| **PVR >3 WU n (%)** | **388 (25.8)** | 216 (14.3)[¶] |

Numbers in bold indicate the number of patients (432 (28.7%)) with DPG/PVR combinations that are unclassifiable using the current definition of the 2015 European Society of Cardiology and the European Respiratory Society guidelines [1, 2]. WU: wood units. [#]: isolated post- and pre-capillary PH with DPG <7 mmHg and/or PVR ⩽3 WU; [¶]: combined post- and pre-capillary PH with DPG ⩾7 mmHg and/or PVR >3 WU.

Gerges et al. Eur Respir J 2016

# PH Definition 2015




Lunge
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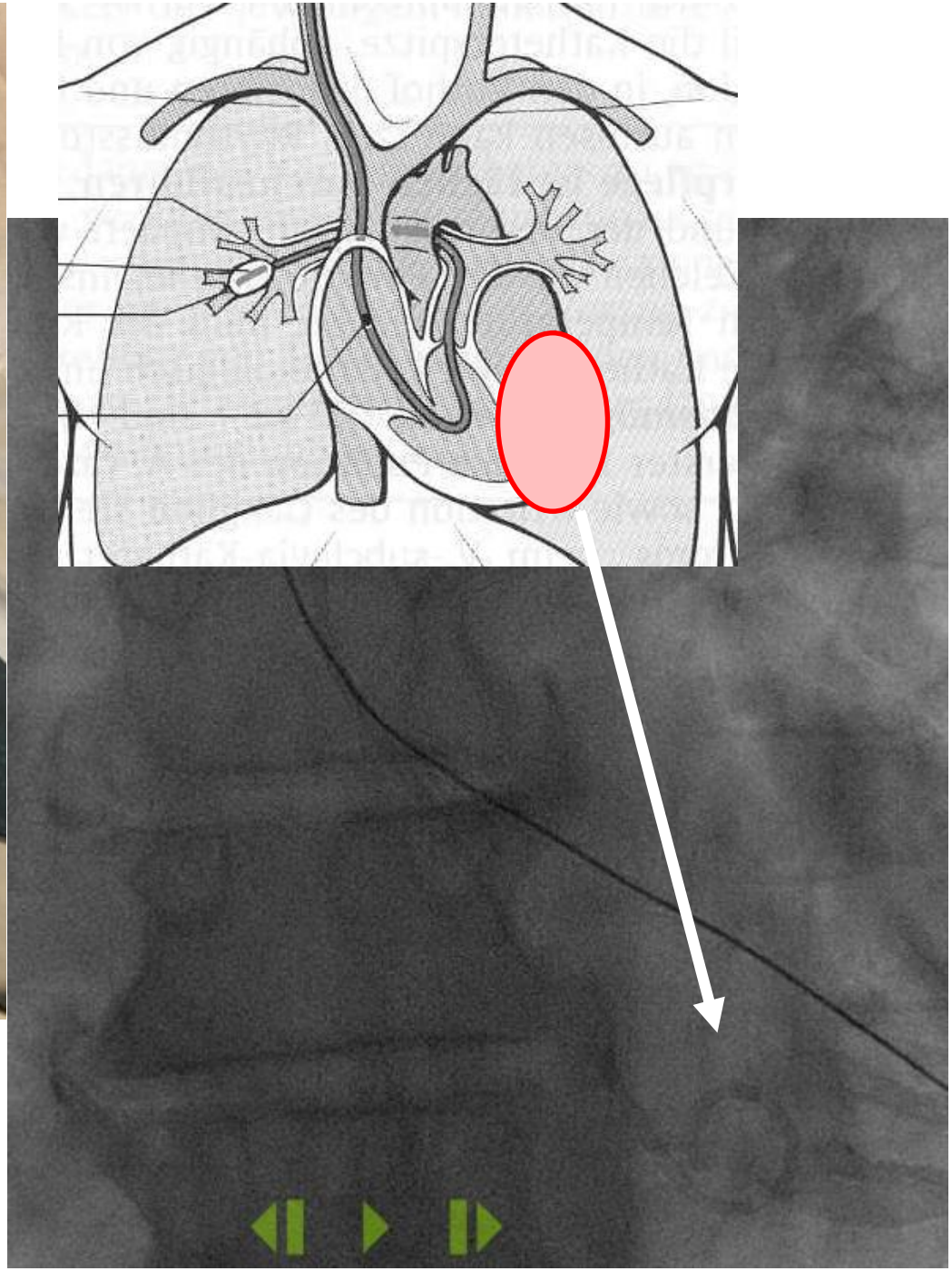
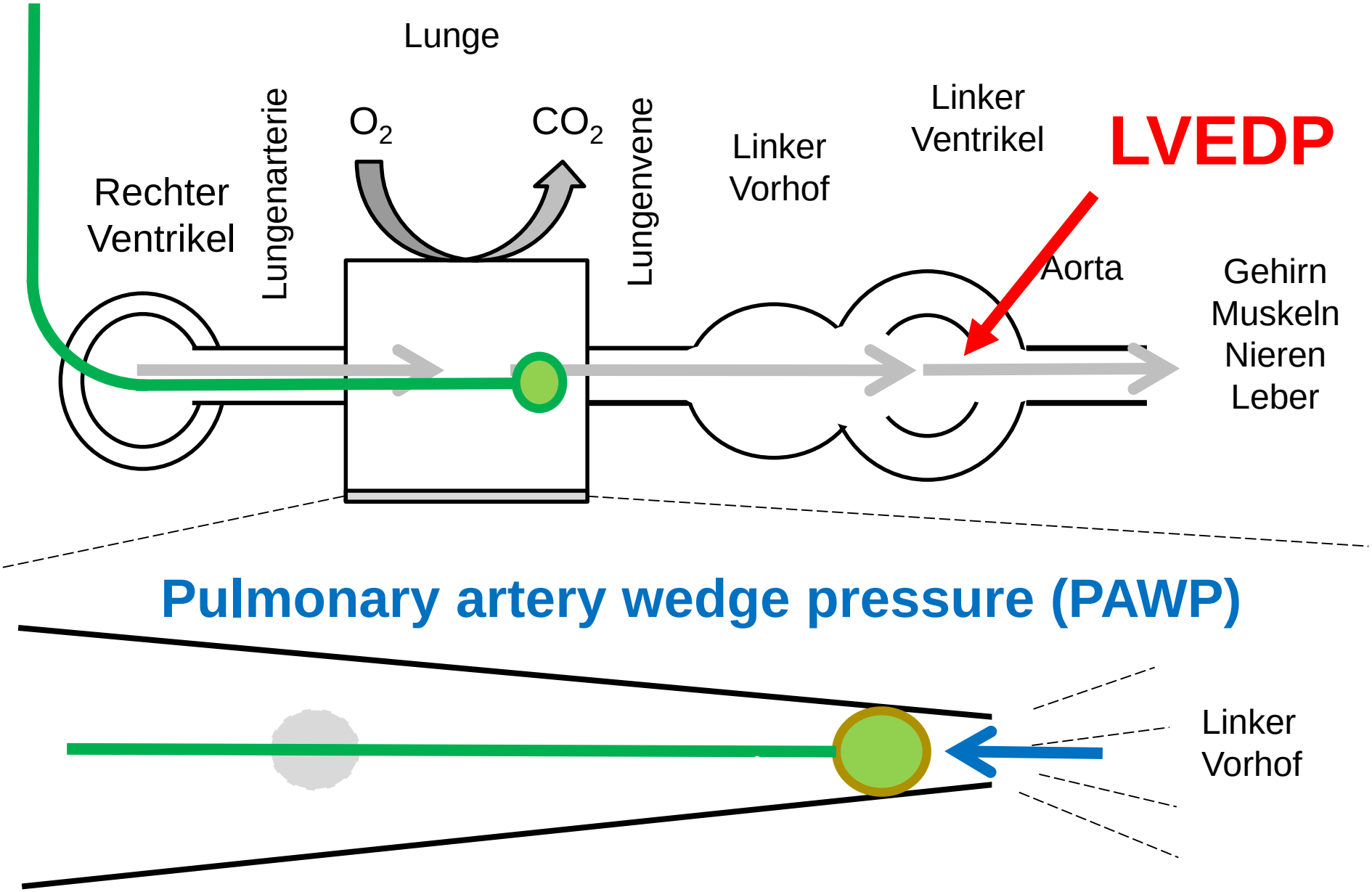
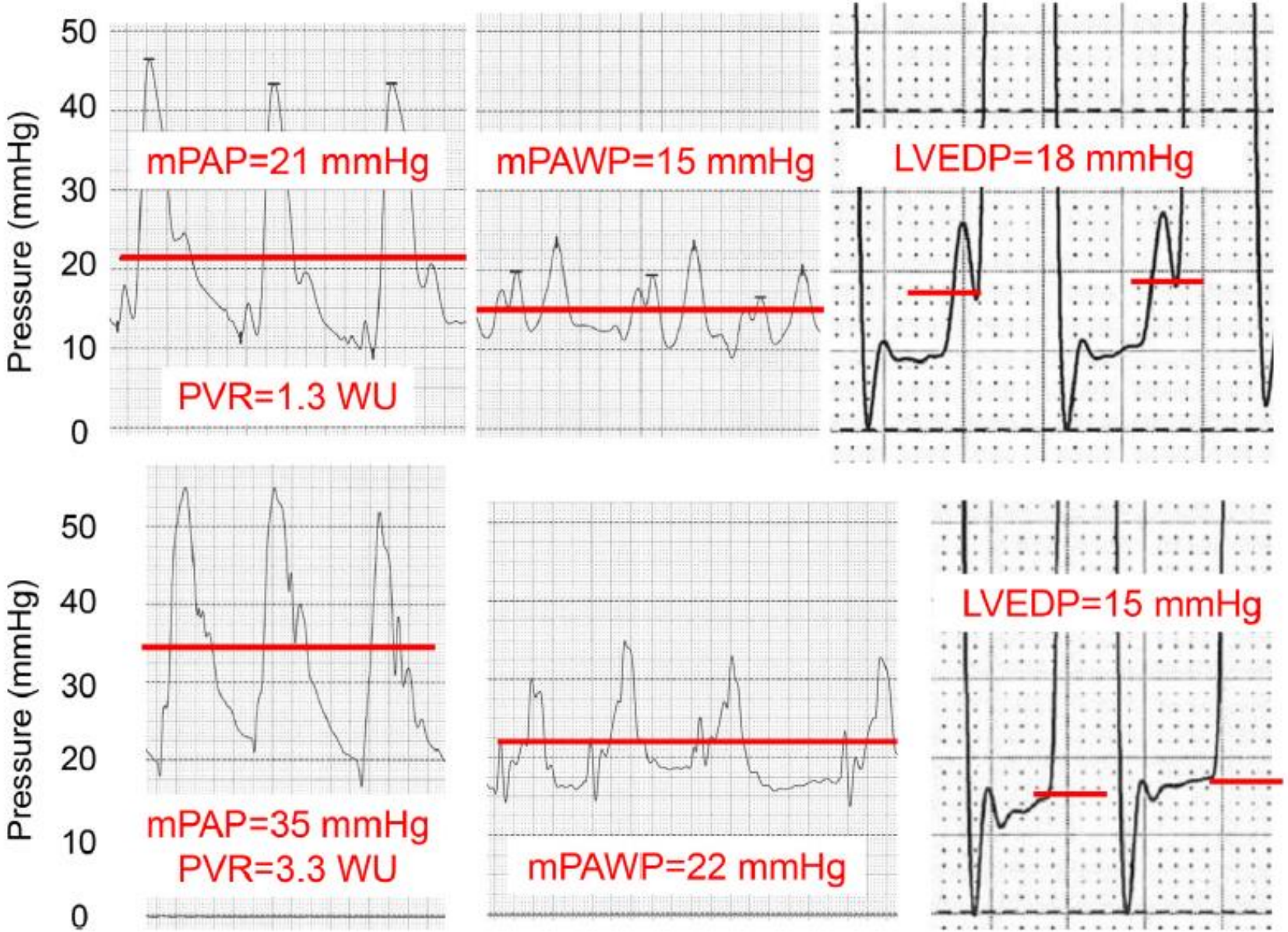
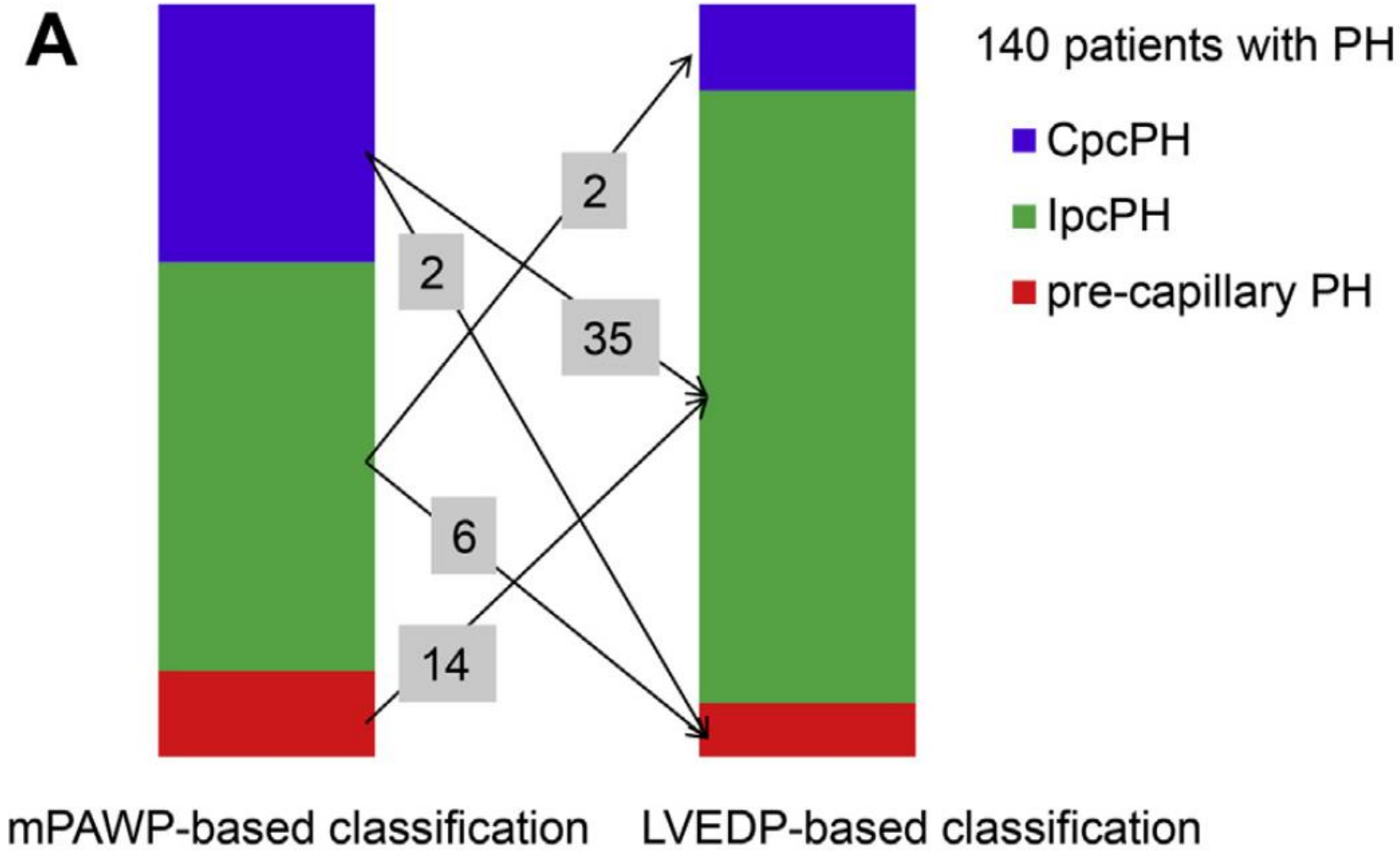



Lunge
Lungenarterie
$O_2$
$CO_2$
Lungenvene
Linker Vorhof
Linker Ventrikel
LVEDP
Rechter Ventrikel
Aorta
Gehirn
Muskeln
Nieren
Leber
Pulmonary artery wedge pressure (PAWP)
Linker Vorhof

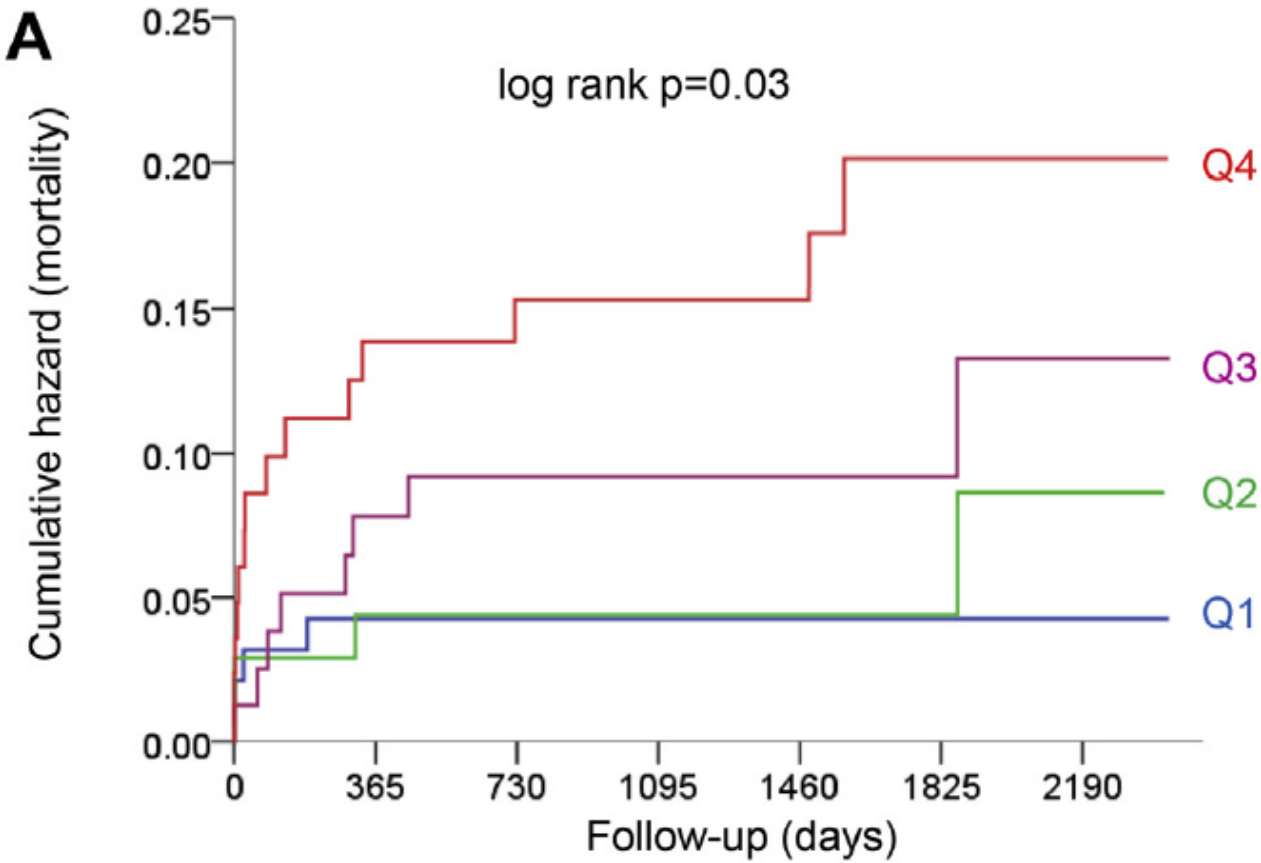



Maeder MT et al. Trends in Cardiovasc Med 2021




Maeder MT et al. CJC open 2021

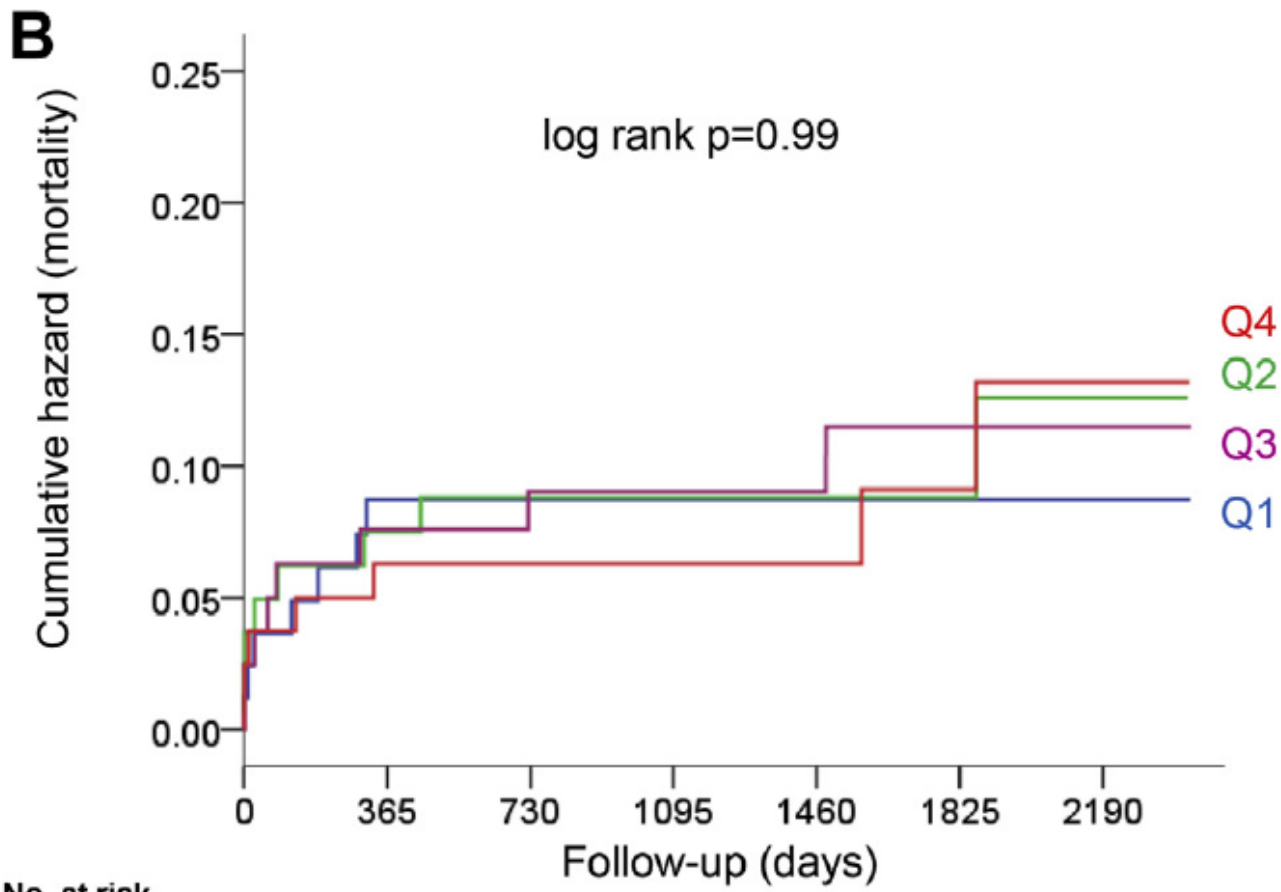
# AS: mPAWP and prognosis after AVR




| No. at risk | | | | | | | |
|---|---|---|---|---|---|---|---|
| mPAWP Q1 | 98 | 91 | 87 | 67 | 43 | 22 | 9 |
| mPAWP Q2 | 72 | 67 | 66 | 55 | 39 | 26 | 11 |
| mPAWP Q3 | 80 | 73 | 72 | 58 | 43 | 28 | 13 |
| mPAWP Q4 | 85 | 74 | 69 | 58 | 44 | 31 | 13 |

Maeder MT et al. CJC open 2021

# AS: LVEDP and prognosis after AVR




| No. at risk | | | | | | | |
|---|---|---|---|---|---|---|---|
| LVEDP Q1 | 85 | 76 | 76 | 67 | 43 | 25 | 11 |
| LVEDP Q2 | 86 | 77 | 75 | 61 | 42 | 29 | 14 |
| LVEDP Q3 | 82 | 76 | 69 | 55 | 42 | 26 | 14 |
| LVEDP Q4 | 82 | 77 | 75 | 56 | 43 | 26 | 7 |

Maeder MT et al. CJC open 2021

# Diagnosis of PH

- The 2015 guidelines
- Problems of the 2015 definition
- The 2018 proposal
- 2018 proposal: perfect solution?

SERIES
WORLD SYMPOSIUM ON PULMONARY HYPERTENSION

# Haemodynamic definitions and updated clinical classification of pulmonary hypertension

Gérald Simonneau[1,2], David Montani[1,2], David S. Celermajer[3], Christopher P. Denton[4], Michael A. Gatzoulis[5], Michael Krowka[6], Paul G. Williams[7] and Rogerio Souza[8]

Number 4 in the series
"Proceedings of the 6th World Symposium on Pulmonary Hypertension"
Edited by N. Galiè, V.V. McLaughlin, L.J. Rubin and G. Simonneau

Simonneau G et al. Eur Respir J 2019

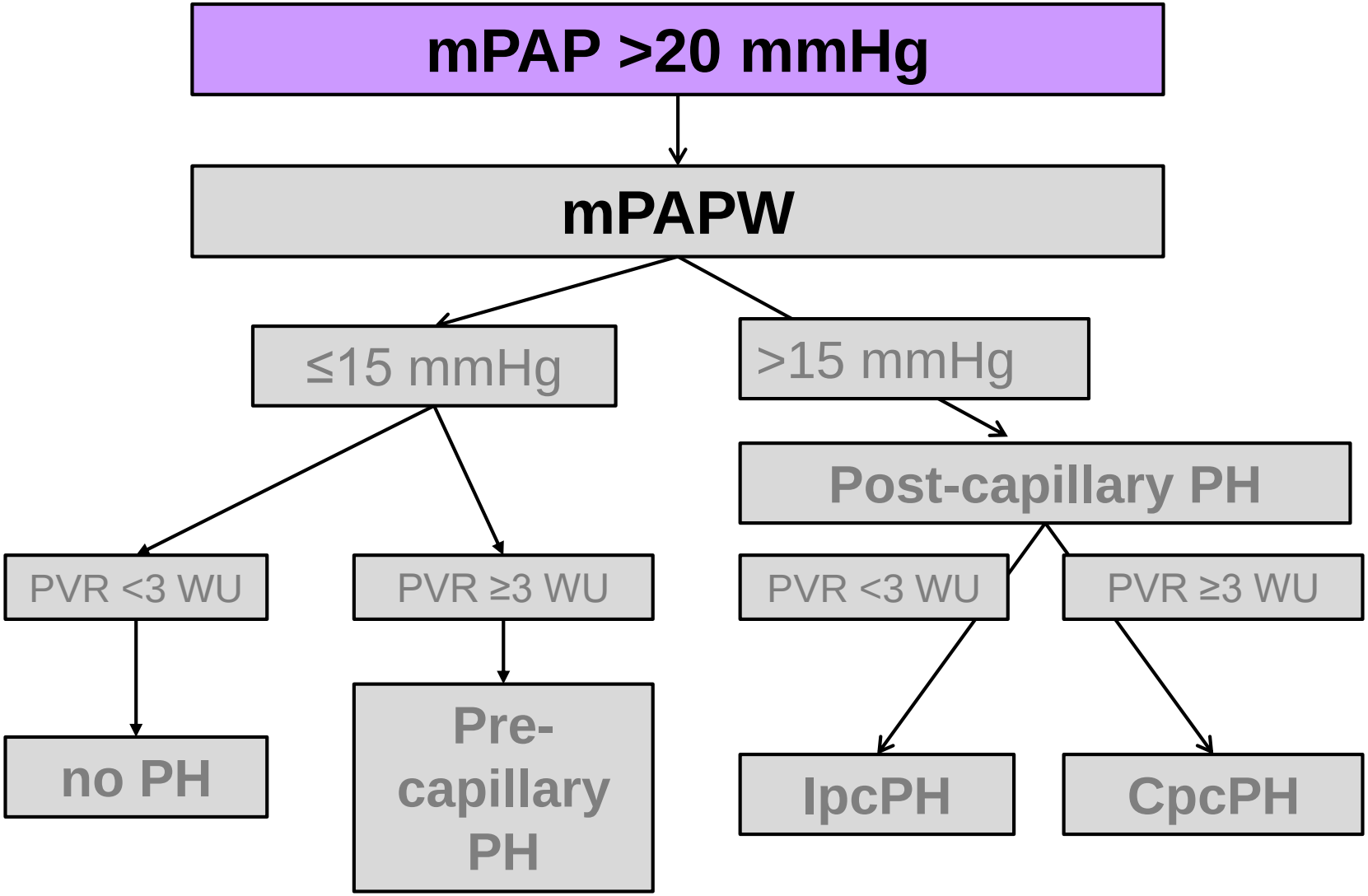
TABLE 1 Haemodynamic definitions of pulmonary hypertension (PH)

| Definitions | Characteristics | Clinical groups[#] |
|---|---|---|
| **Pre-capillary PH** | mPAP >20 mmHg<br>PAWP ⩽15 mmHg<br>PVR ⩾3 WU | 1, 3, 4 and 5 |
| **Isolated post-capillary PH (IpcPH)** | mPAP >20 mmHg<br>PAWP >15 mmHg<br>PVR <3 WU | 2 and 5 |
| **Combined pre- and post-capillary PH (CpcPH)** | mPAP >20 mmHg<br>PAWP >15 mmHg<br>PVR ⩾3 WU | 2 and 5 |

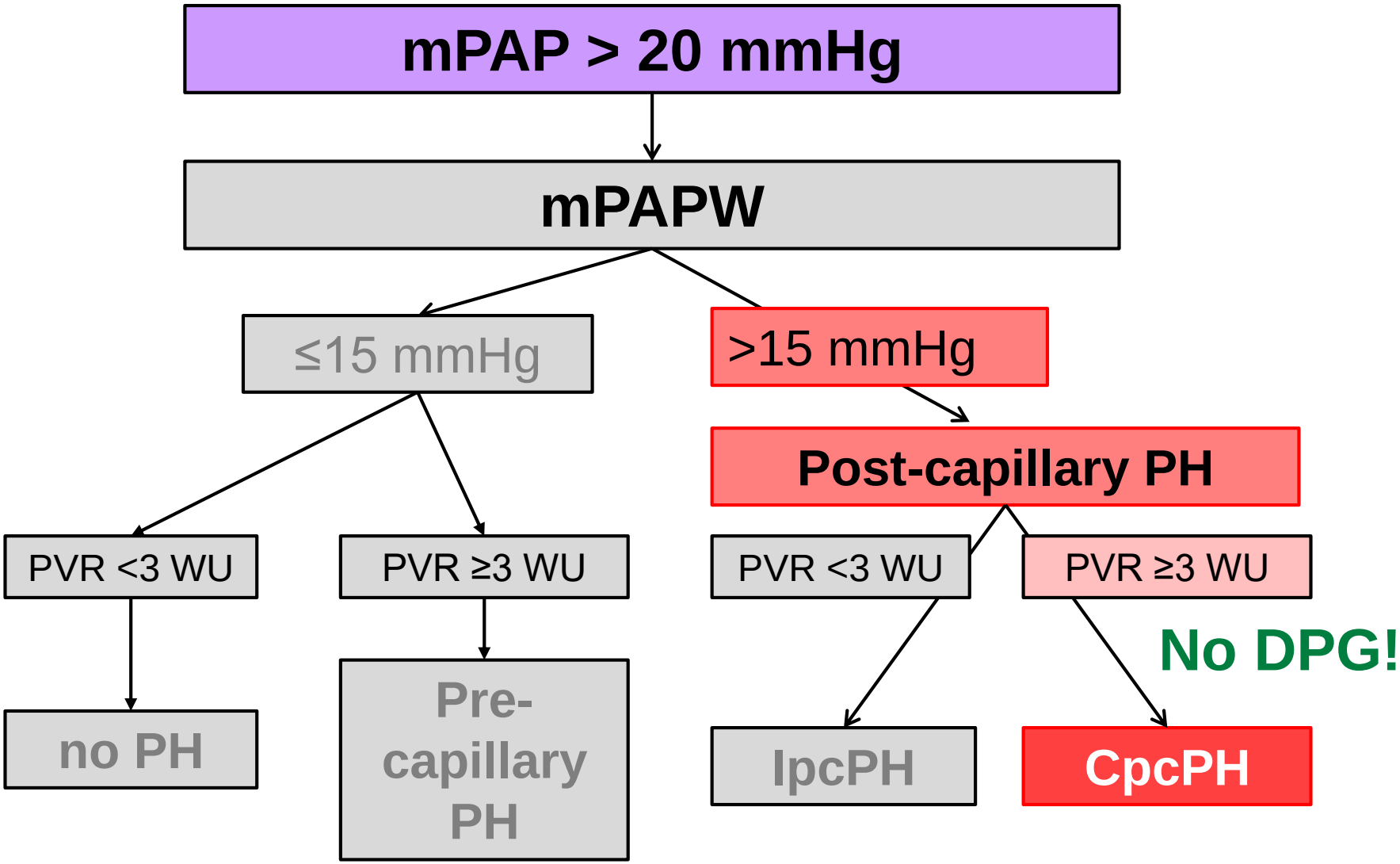
mPAP: mean pulmonary arterial pressure; PAWP: pulmonary arterial wedge pressure; PVR: pulmonary vascular resistance; WU: Wood Units. [#]: group 1: PAH; group 2: PH due to left heart disease; group 3: PH due to lung diseases and/or hypoxia; group 4: PH due to pulmonary artery obstructions; group 5: PH with unclear and/or multifactorial mechanisms.

Simonneau G et al. Eur Respir J 2019

# PH Definition 2018



# PH Definition 2018



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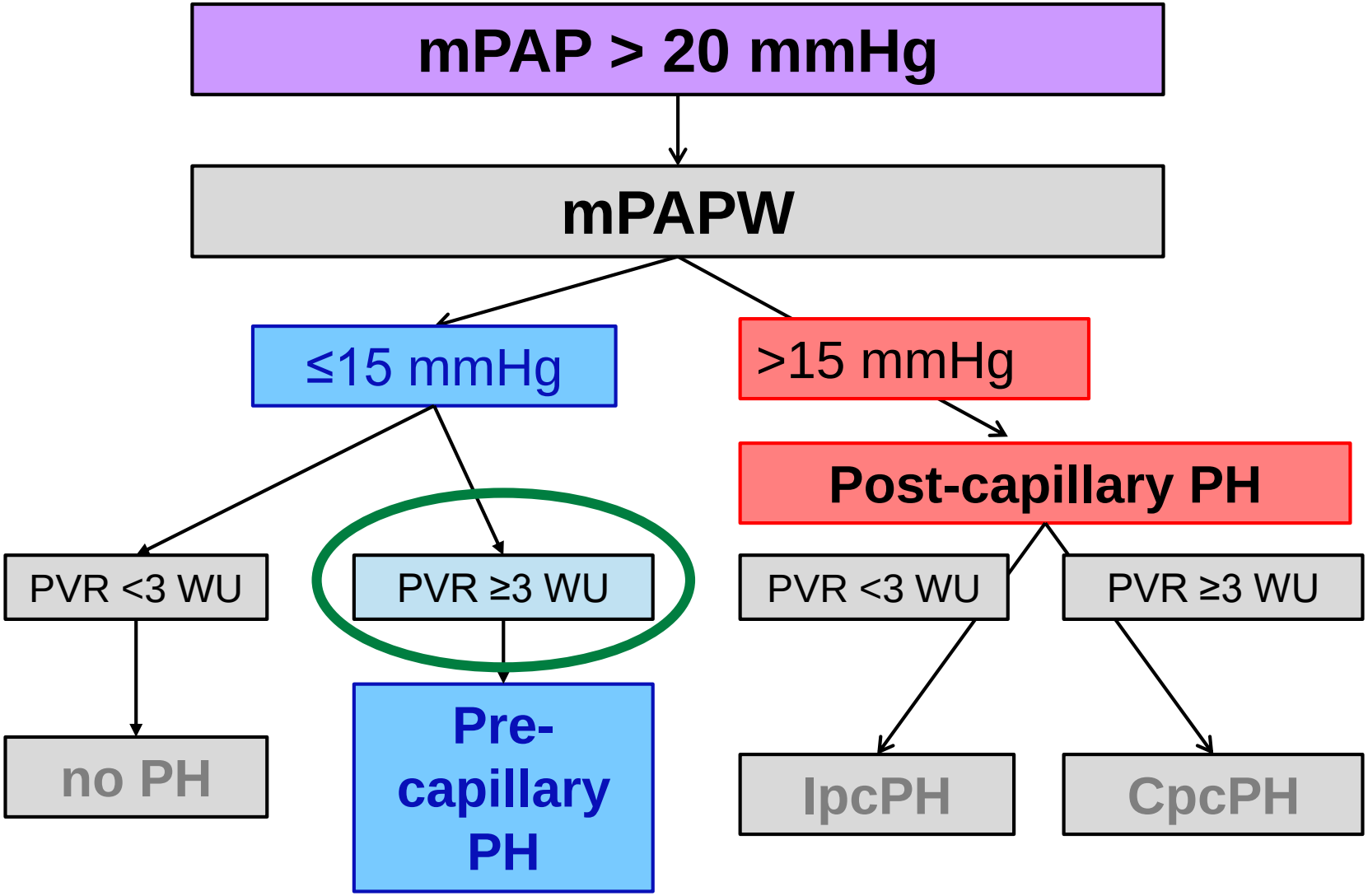

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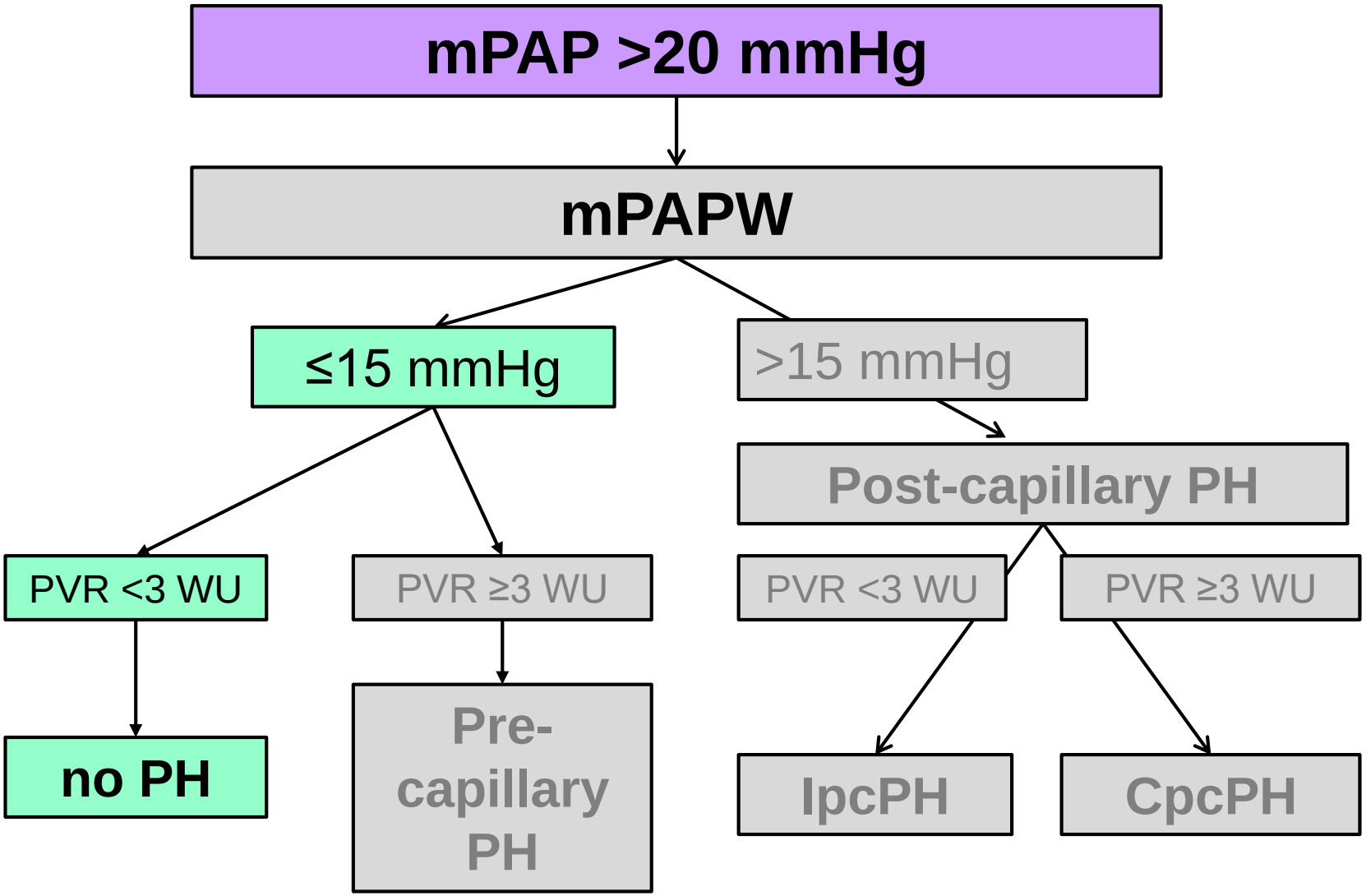

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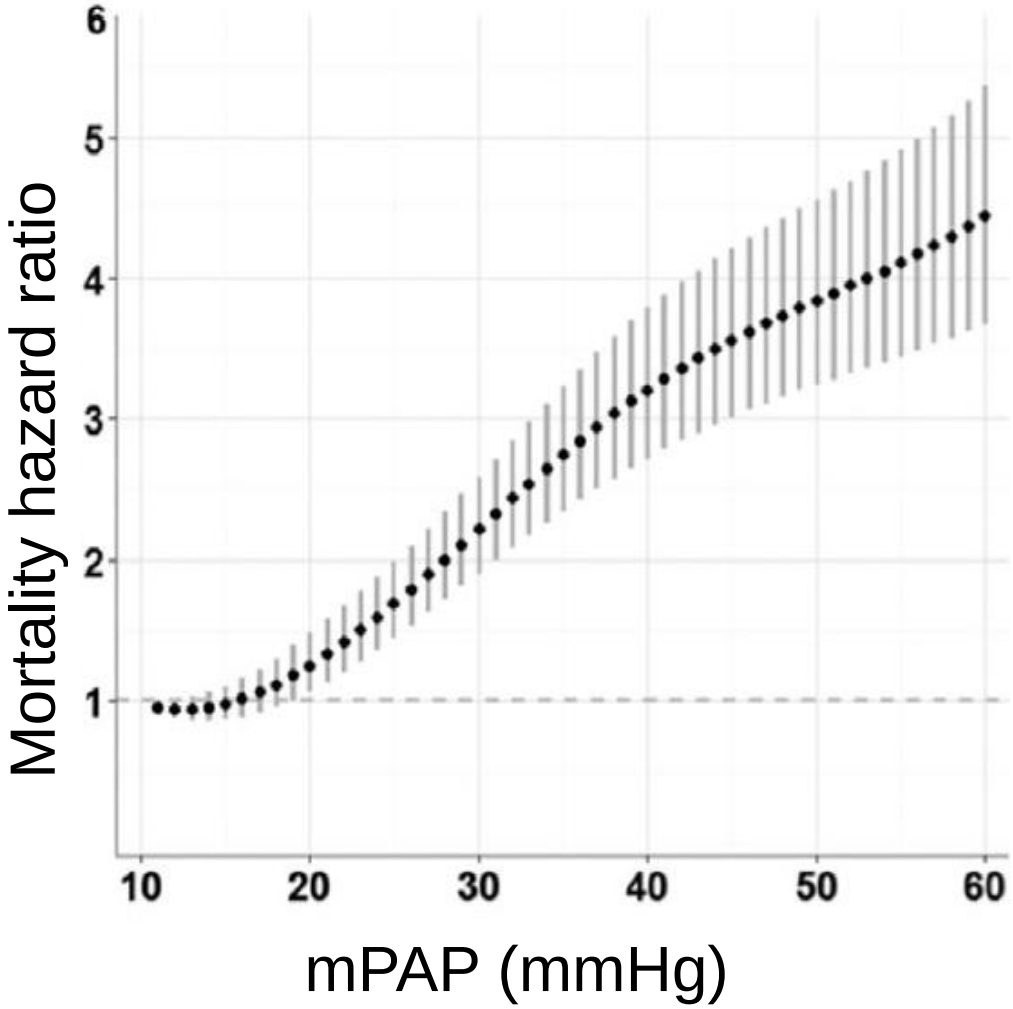



Maron B et al. Circulation 2016

**Effective:** PDEi, Selexipag

**Effective:** Diuretics

**Effective:** ERA, Riociguat, Prostacyclin analogues, dual therapy, triple therapy

**+/- Effective:** ERA, dual therapy

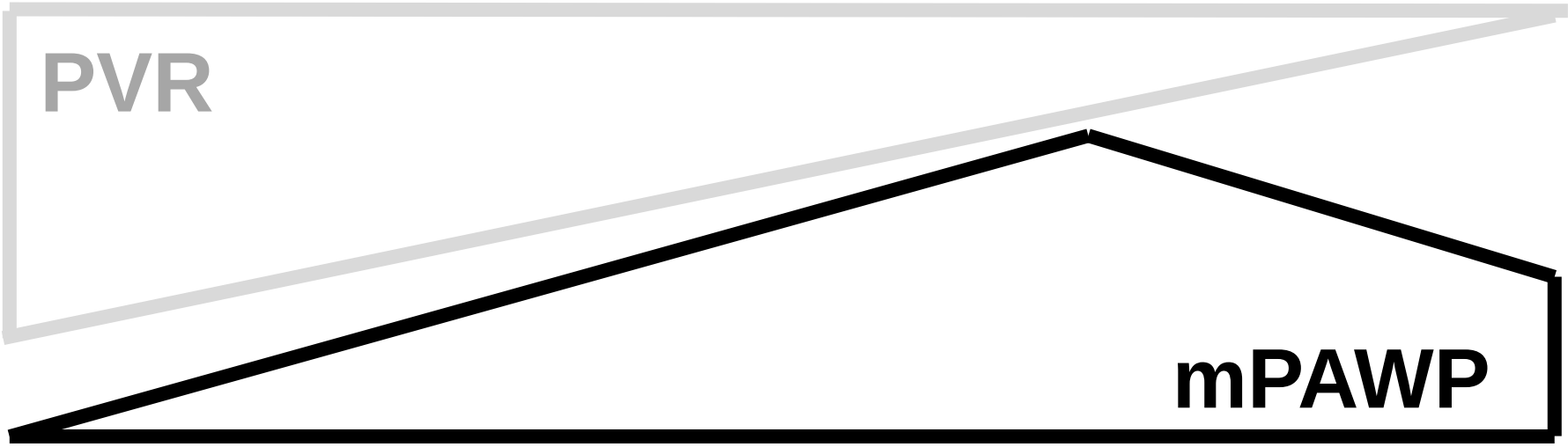
**Harmful:** ERA

**Effective:** IAS

**Conflicting data:** PDEi

**Not effective:** PDEi

**Potentially effective** Levosimendan, Sac/Val, MRA, SGLT2i, catheter ablation for AF




**Typical PAH**

**Atypical PAH**

**PAH + HFpEF**

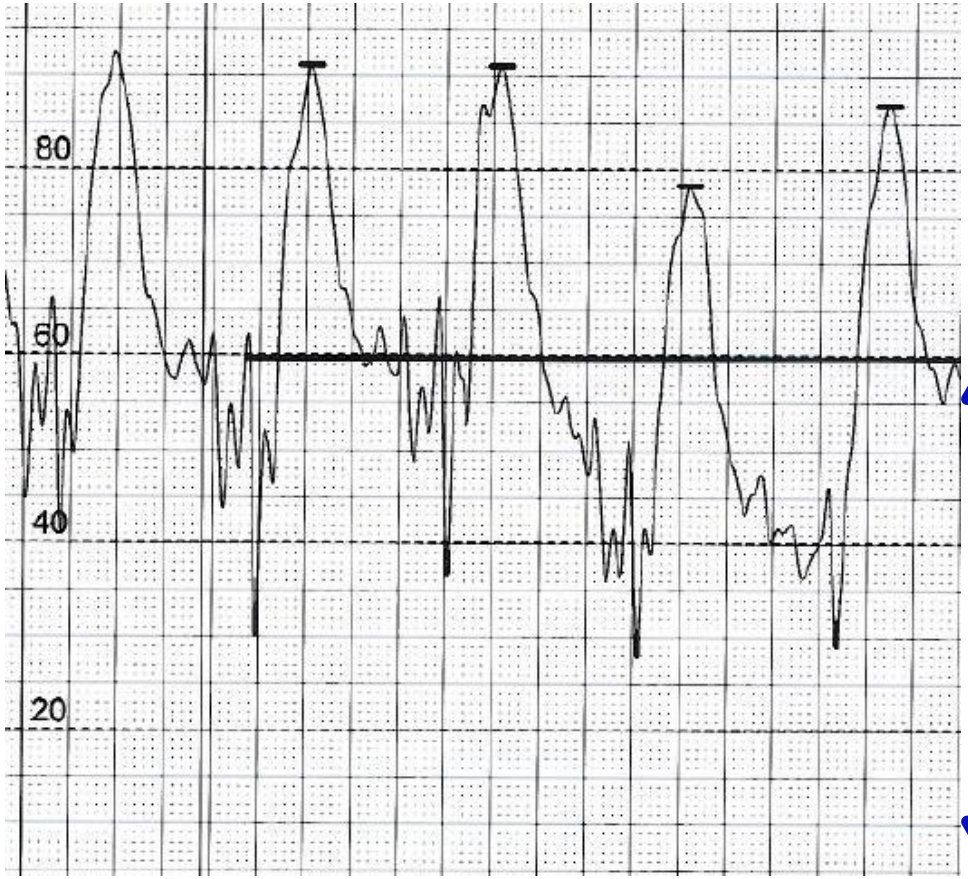
**HFpEF with CpcPH**

**HFpEF with IpcPH**

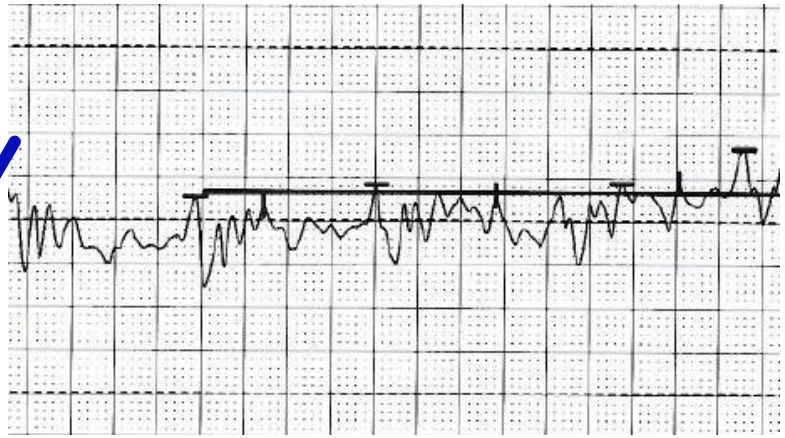
Maeder MT. Eur J Heart Fail 2022

# mPAP

# mPAWP↓

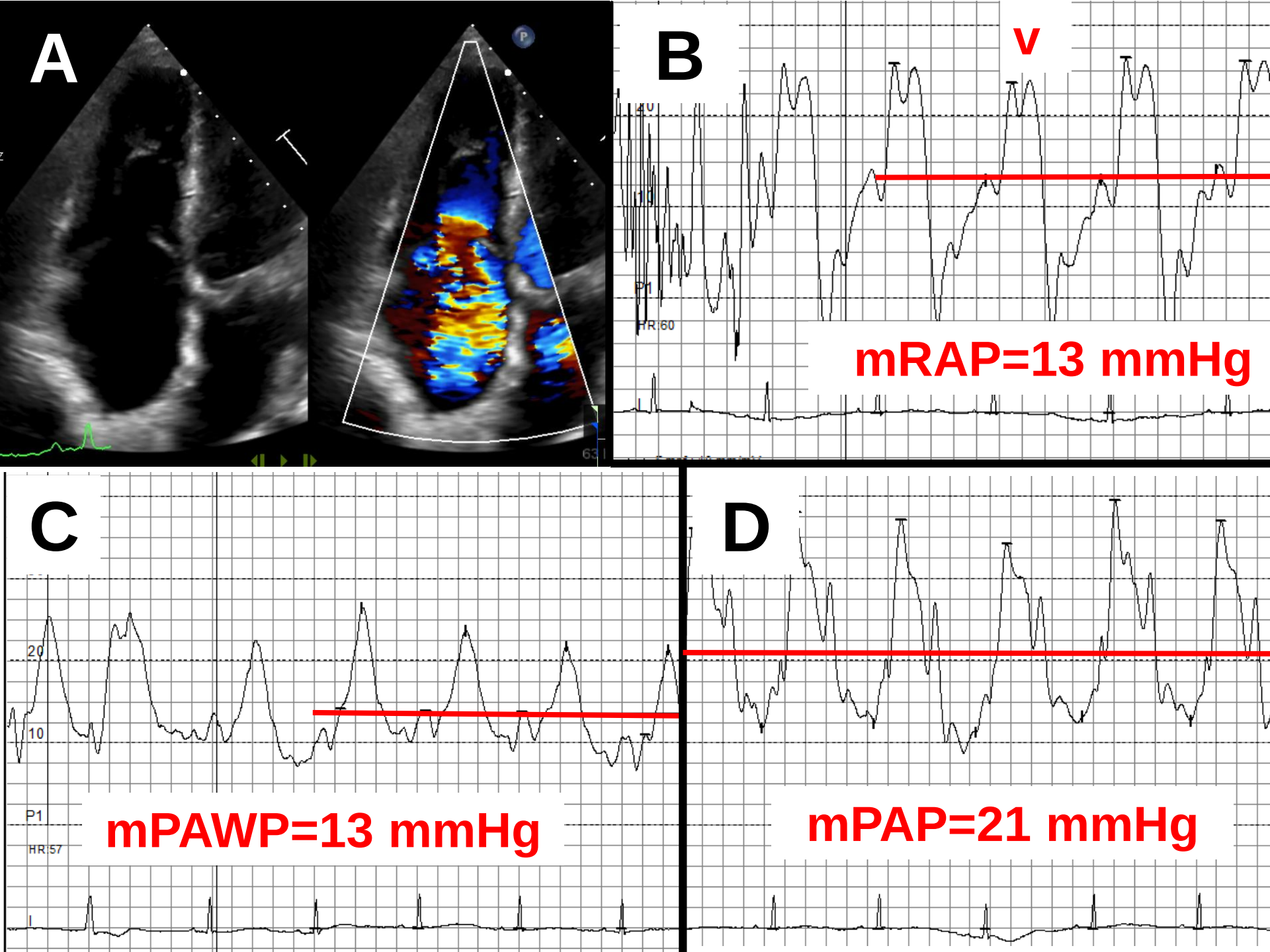



**Transpulmonary Gradient (TPG) and PVR ↑**



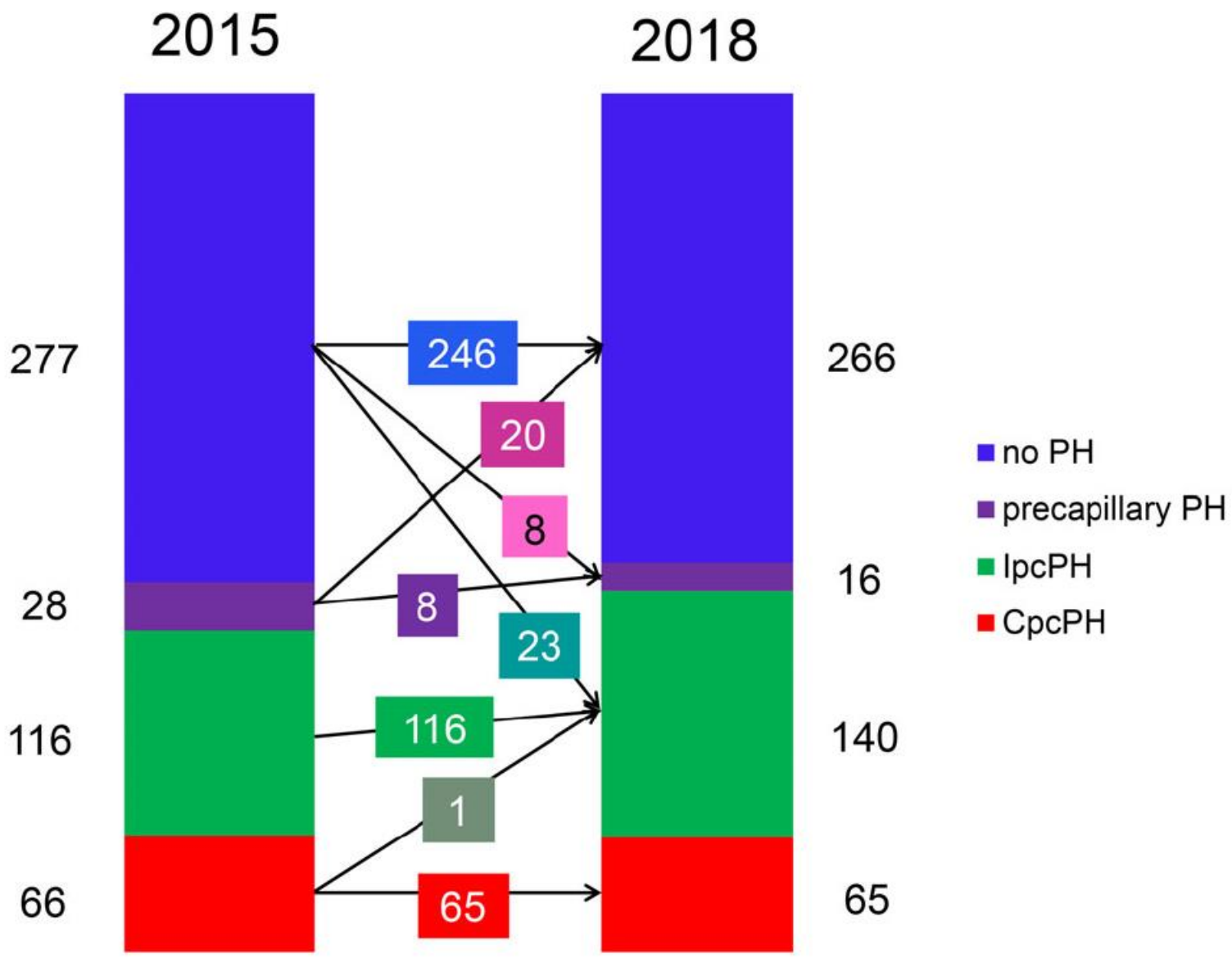
TPG=mPAP-mPAWP

PVR= TPG/cardiac output


A
B
v
P1
HR 60
mRAP=13 mmHg
C
20
10
P1
HR 57
mPAWP=13 mmHg
D
mPAP=21 mmHg

| | Baseline | Post-contrast (40 ml) | Exercise |
|---|---|---|---|
| Aorta (s / d - m; mmHg) | 170 / 63 (102) | | |
| RA (a / v - m; mmHg) | 8 / 5 (4) | | |
| PA (s / d - m; mmHg) | 44 / 15 (26) | 47 / 17 (27) | 60 / 23 (40) |
| PAWP (a / v - m; mmHg) | 20 / 19 (13) | 17 / 18 (14) | 33 / 33 (28) |
| TPG (mmHg) | 13 | 13 | 12 |
| PVR (WU) | 3.4 | | |
| $SaO_2$ (%) | 95 | | |
| $SvO_2$ (%) | 69 | | |
| CO (l/min) | 3.8 | | |
| CI (l/min/$m^2$) | 2.3 | | |

| | Baseline | Post-contrast | Ruhe, Beine angehoben | Exercise |
|---|---|---|---|---|
| Aorta (s / d - m; mmHg) | 170 / 63 (102) | | | |
| RA (a / v - m; mmHg) | 8 / 5 (4) | | | |
| PA (s / d - m; mmHg) | 44 / 15 (26) | 47 / 17 (27) | | 60 / 23 (40) |
| PAWP (a / v - m; mmHg) | 20 / 19 (13) | 17 / 18 (14) | 26 / 31 (23) | 33 / 33 (28) |
| TPG (mmHg) | 13 | 13 | | 12 |
| PVR (WU) | 3.4 | | | |
| $SaO_2$ (%) | 95 | | | |
| $SvO_2$ (%) | 69 | | | |
| CO (l/min) | 3.8 | | | |
| CI (l/min/$m^2$) | 2.3 | | | |

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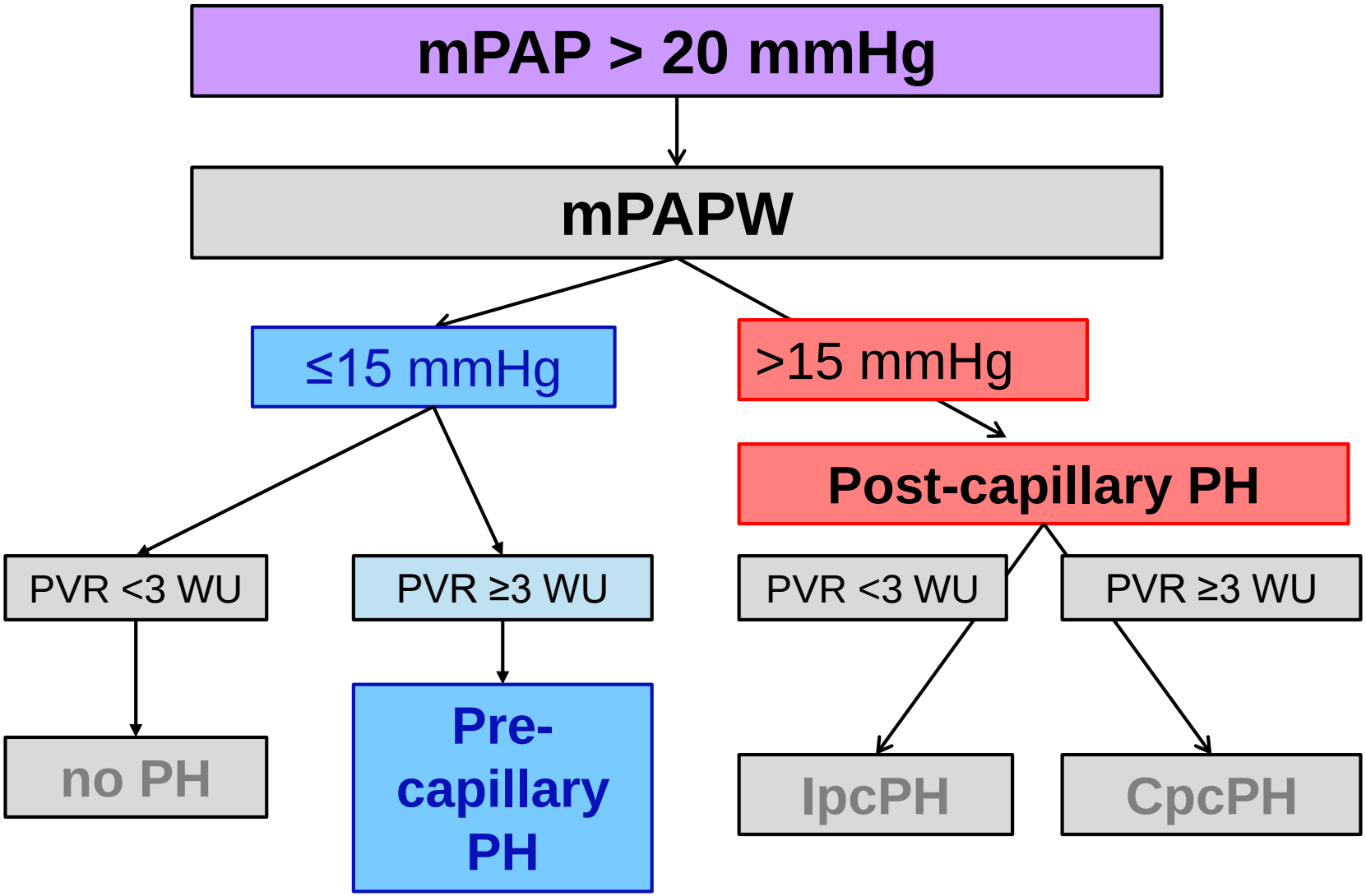
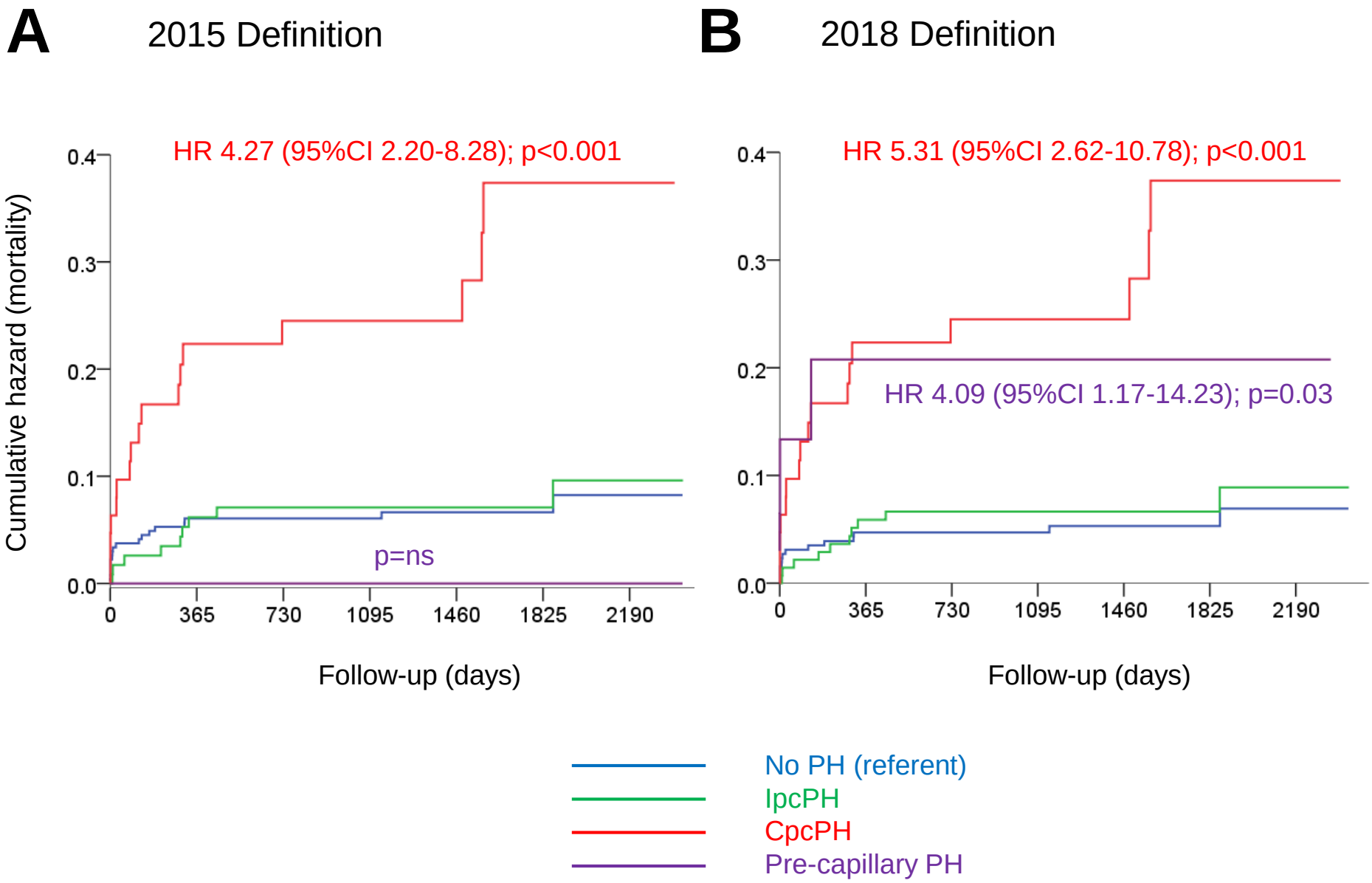
# PH Definition 2018



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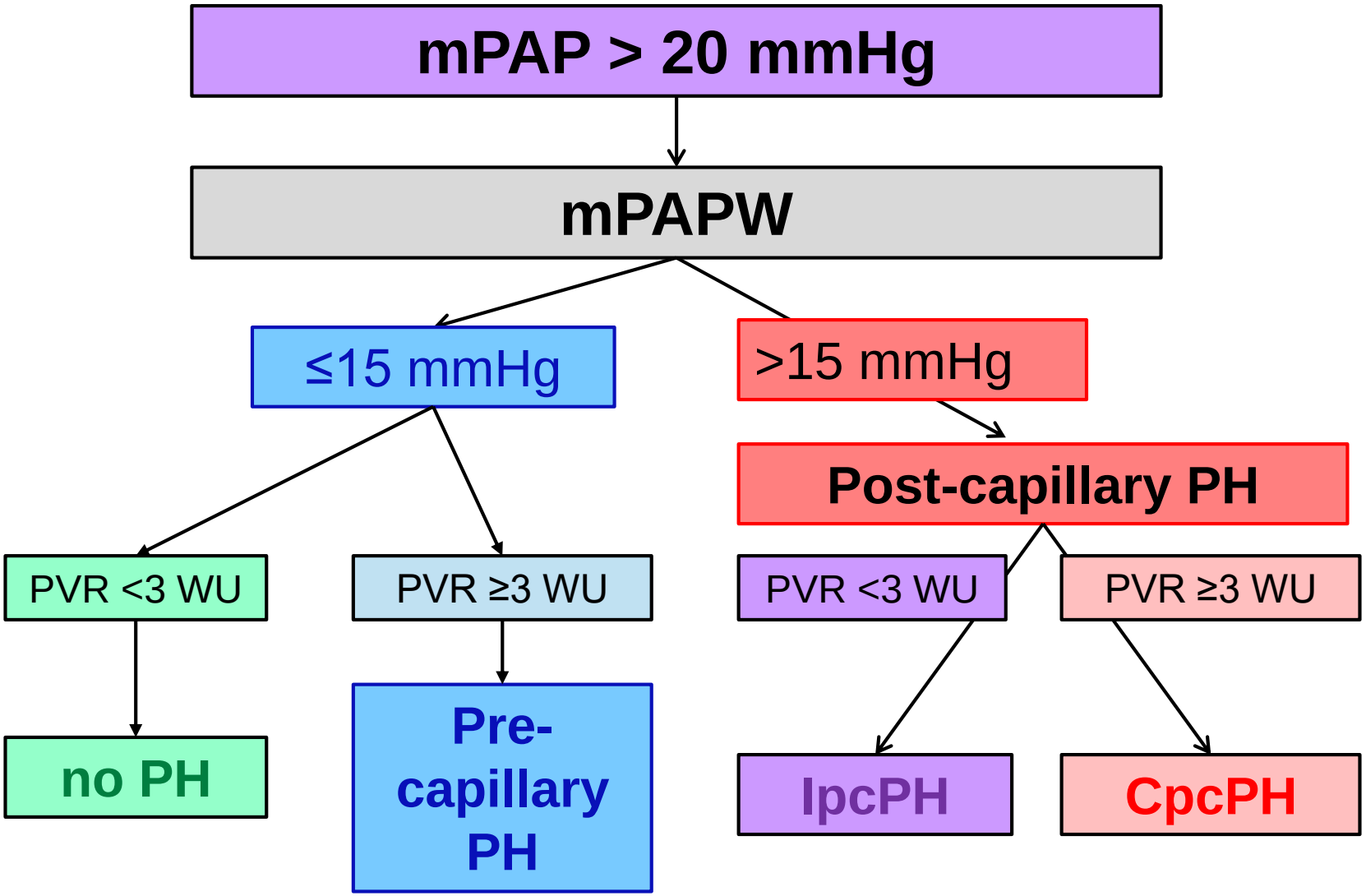
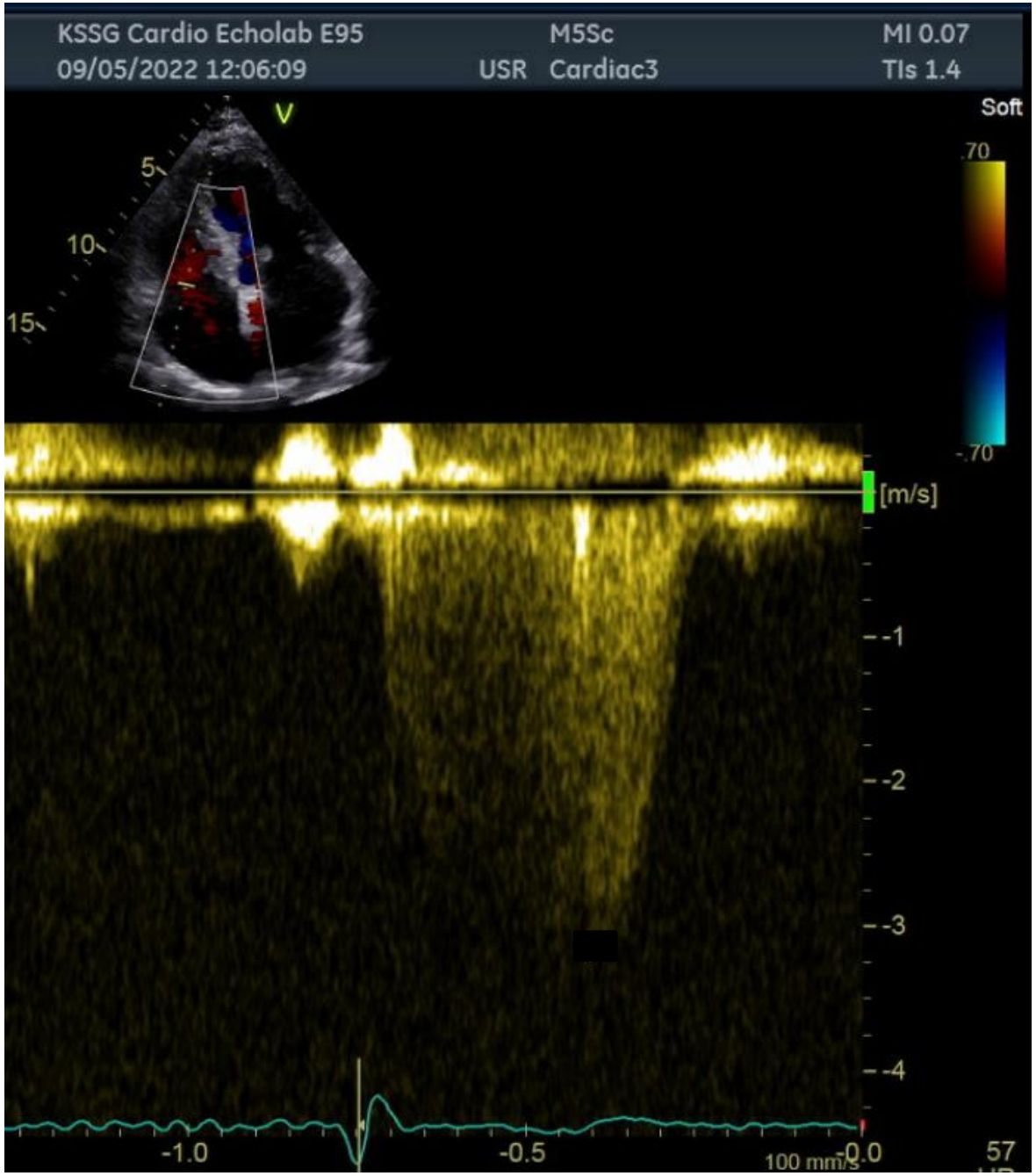
# PH Definition 2018






Pulmonary Hypertension?

Pulmonary arterial hypertension?

## Low PH probability

- TRV **≤2.8 m/s** (sPAP ≤36 mmHg) or not measurable **AND NO** indirect signs of PH

## Intermediate PH probability

- TRV **≤2.8 m/s** (sPAP ≤36 mmHg) **AND indirect** signs of PH
- **TRV 2.9-3.4 m/s** (sPAP 37-50 mmHg) **AND NO** indirect signs of PH

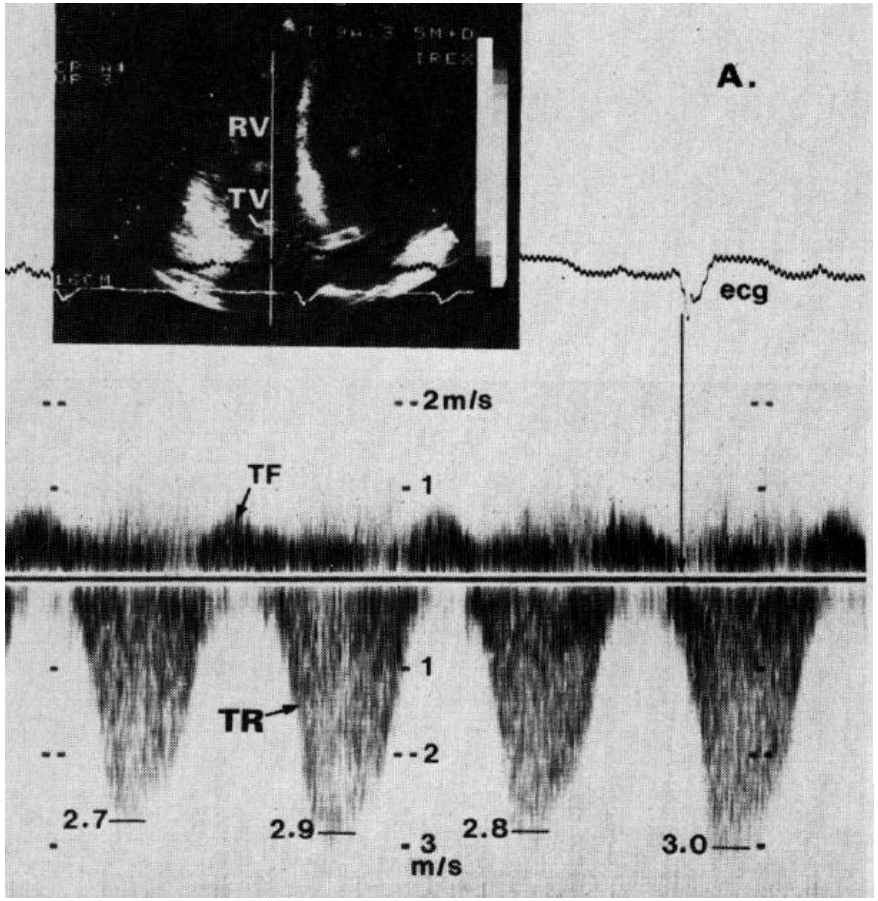
## High PH probability

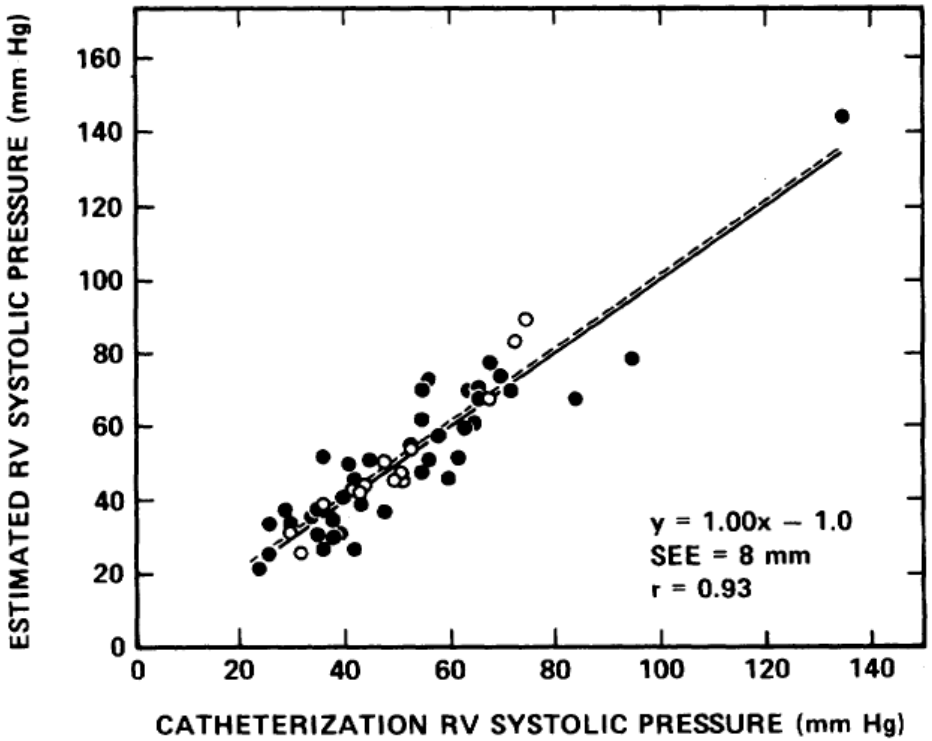
- **TRV 2.9-3.4 m/s** (sPAP 37-50 mmHg) **AND indirect** signs of PH
- **TRV >3.4 m/s** (sPAP >50 mmHg) **WITH/WITHOUT** indirect signs of PH

Galie N et al. Eur Heart J 2015

# Diagnosis of PH

- The 2015 guidelines
- Problems of the 2015 definition
- The 2018  proposal
- 2018 proposal: perfect solution?




Yock&Popp. Circulation 1984

# Thank you!

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