PULMONARY ARTERIAL CAPACITANCE AND MORTALITY IN PULMONARY HYPERTENSION DUE TO LEFT HEART FAILURE

R. Dragu, S. Rispler, H. Hammerman, D. Aronson

Cardiology Dept, Rambam Health Care Campus
Rappaport Faculty of Medicine, Technion
Haifa, Israel

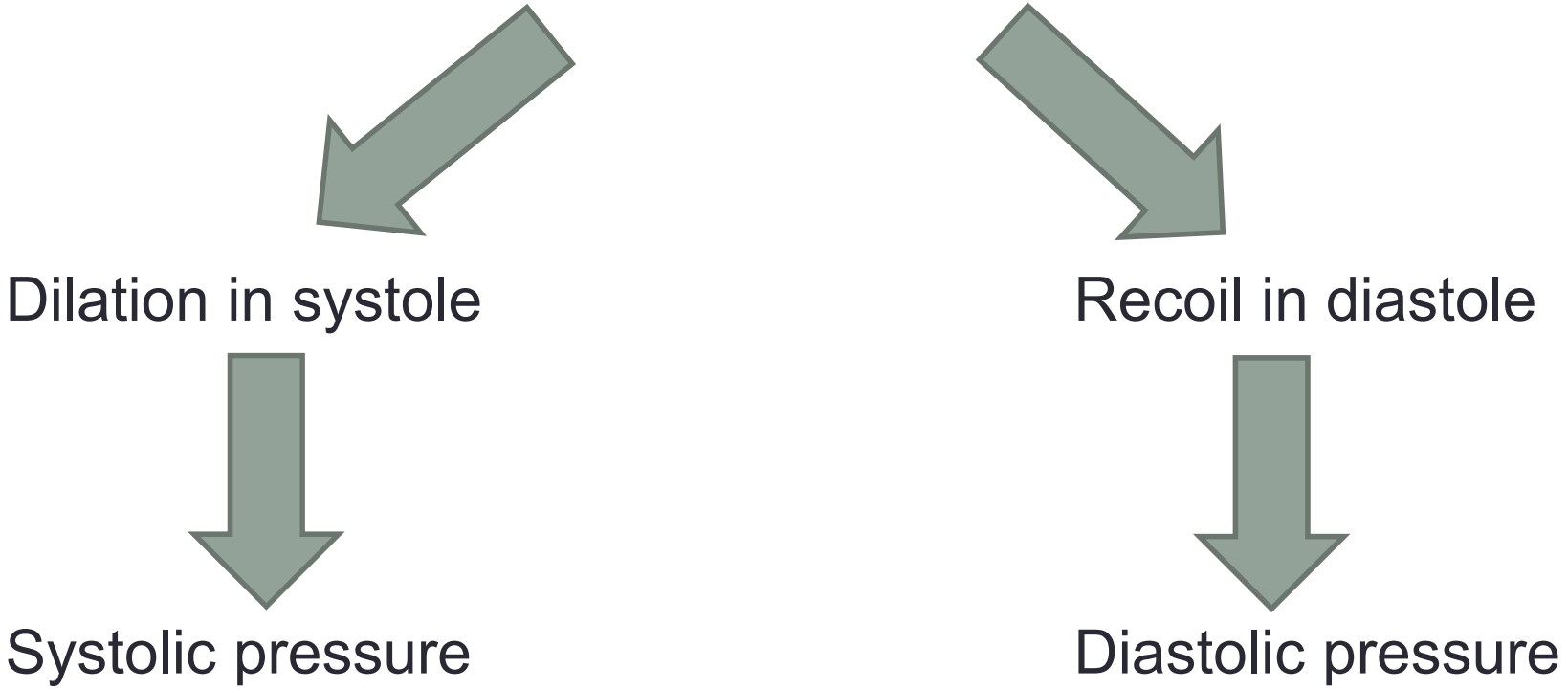
Background

- **Pulmonary Hypertension (PH)** in Heart Failure (HF)
  is an advance stage of the disease

- **Prognosis** prediction remains difficult
  despite clinical and hemodynamic parameters

Background

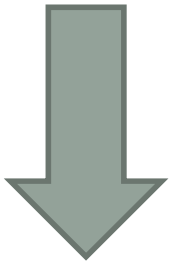
Pulmonary arterial capacitance (PAC)



PAC ~ 1/Pulse Pressure (PP)

Background

Stroke volume (SV)



Pulse Pressure

PAC ~ SV

$$\mathbf{PAC = \frac{SV\ (ml)}{PP\ (mmHg)}}$$

Aim

- To determine:

1. If PAC predicts survival in PH due to HF

2. PAC vs. Pulmonary Vascular Resistance (PVR) prognostic capabilities

Methods

- **Study population:**
  - HF patients with:
    1. NYHA ≥ II
    2. Right heart catheterization 01/2004 – 01/2013

- **PH definitions:**
  - PH type 2: mPAP > 25 mmHg & PCWP > 15 mmHg
  - Passive PH: Trans-Pulmonary Gradient (TPG) ≤ 12 mmHg
  - Reactive PH: TPG > 12 mmHg

- **Follow-up & End-point confirmation:**
  - patient contact
  - national death registry
  - hospital records

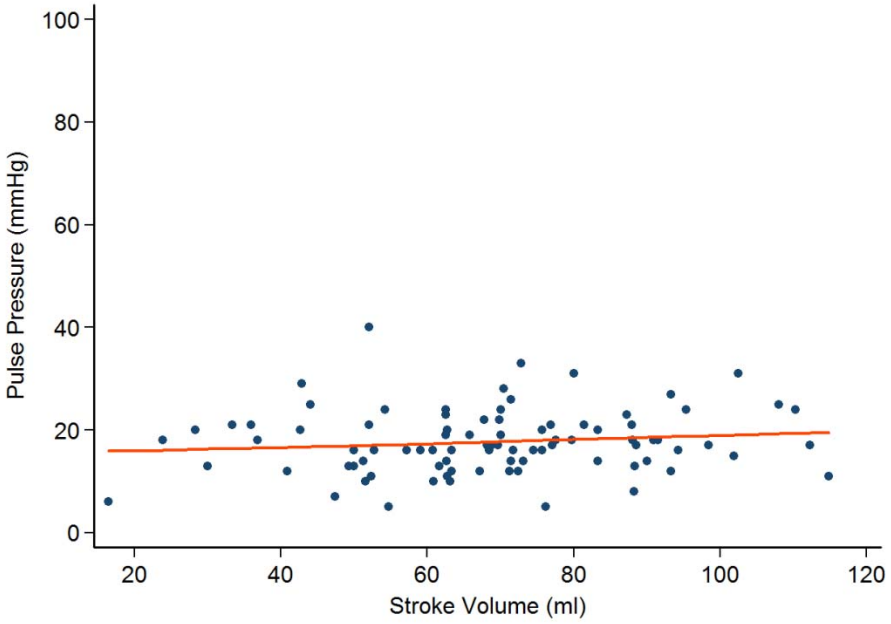
Results

- 389 HF patients & RHC
  - 264 (68%) patients w/ PH
  - 125 (32%) patients w/o PH
    - 123 (47%) passive PH
    - 141 (53%) reactive PH
- Follow-up: Up to 111 months (mean 38)

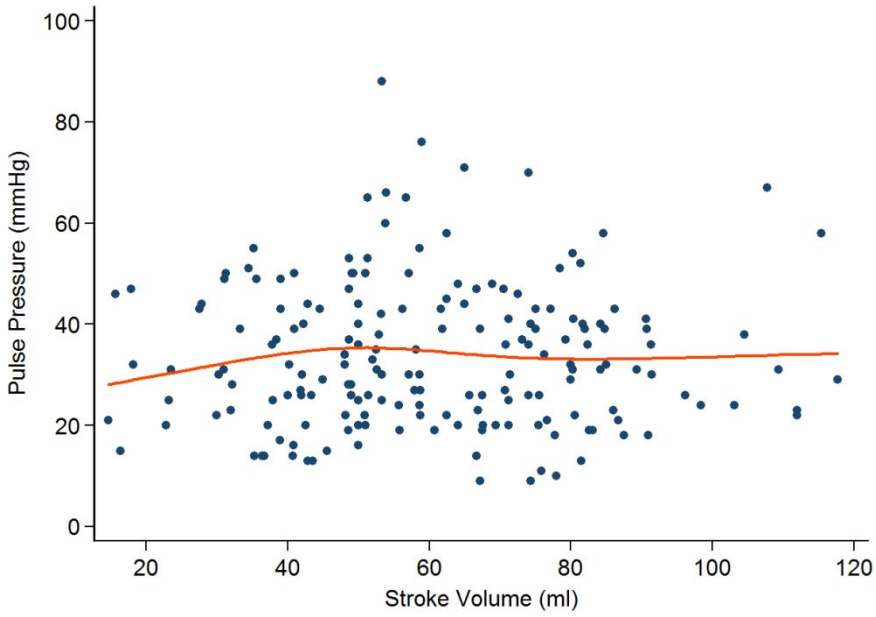
Baseline characteristics – PAC quartiles

	Q1 (<1.25)	Q2 (1.25-1.88)	Q3 (1.89-2.84)	Q4 (>2.85)	p
Age (yr)	61.6	67.9	69.2	66.0	0.015
Female (%)	26.2	23.3	25.2	25.2	0.96
PCWP (mmHg)	28.0	24.7	22.9	21.8	0.0001
mPAP (mmHg)	48.8	41.6	36.9	31.4	0.0001
PP (mmHg)	46.7	37.7	29.8	20.8	0.0001
SV (ml)	40.7	58.3	68.1	82.8	0.0001
RAP (mmHg)	14.9	14.0	13.2	11.5	0.12
TPG (mmHg)	20.9	16.9	14.0	9.6	0.0001
PVR (W.U.)	7.2	3.9	2.8	1.8	0.0001
PAC (ml/mmHg)	0.88	1.56	2.30	4.18	0.0001

SV – PP behavior

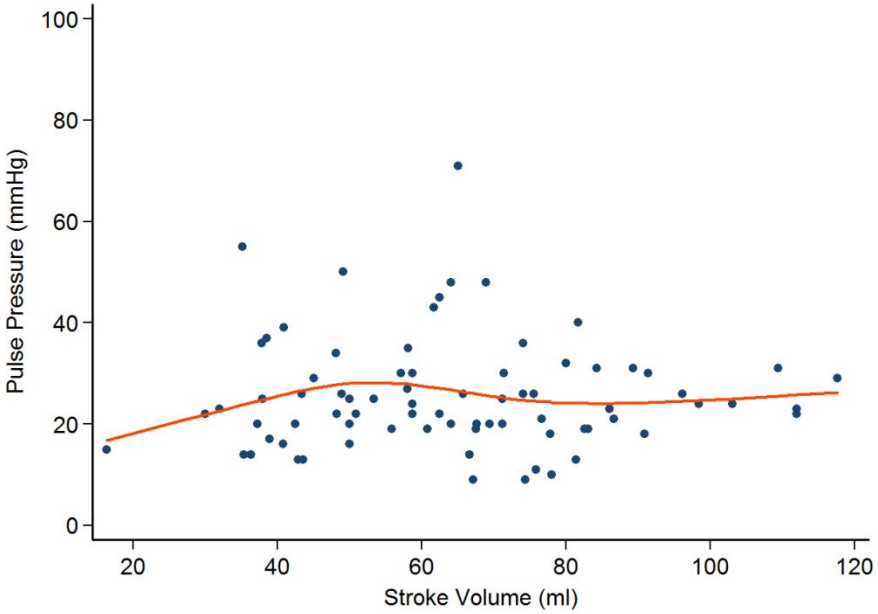


HF w/o PH

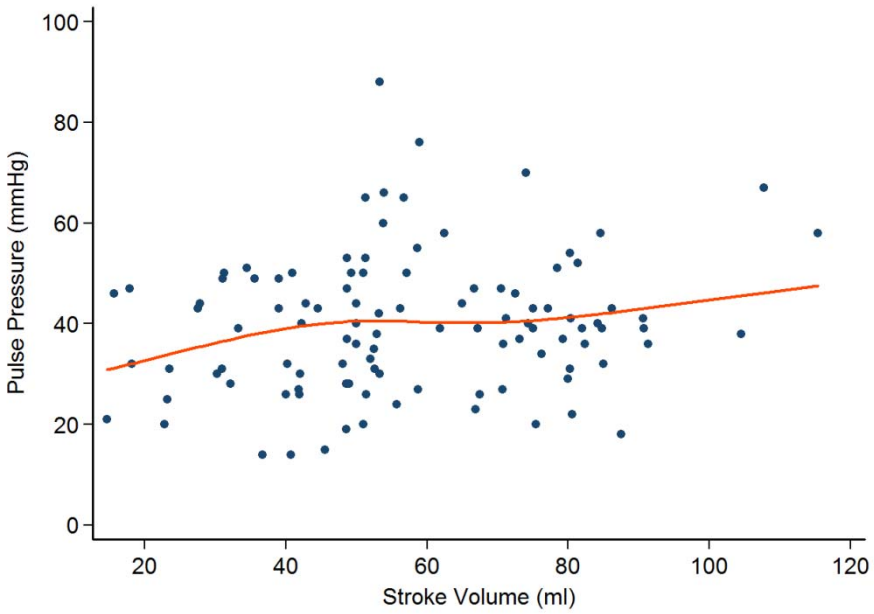


HF w/ PH

SV – PP behavior

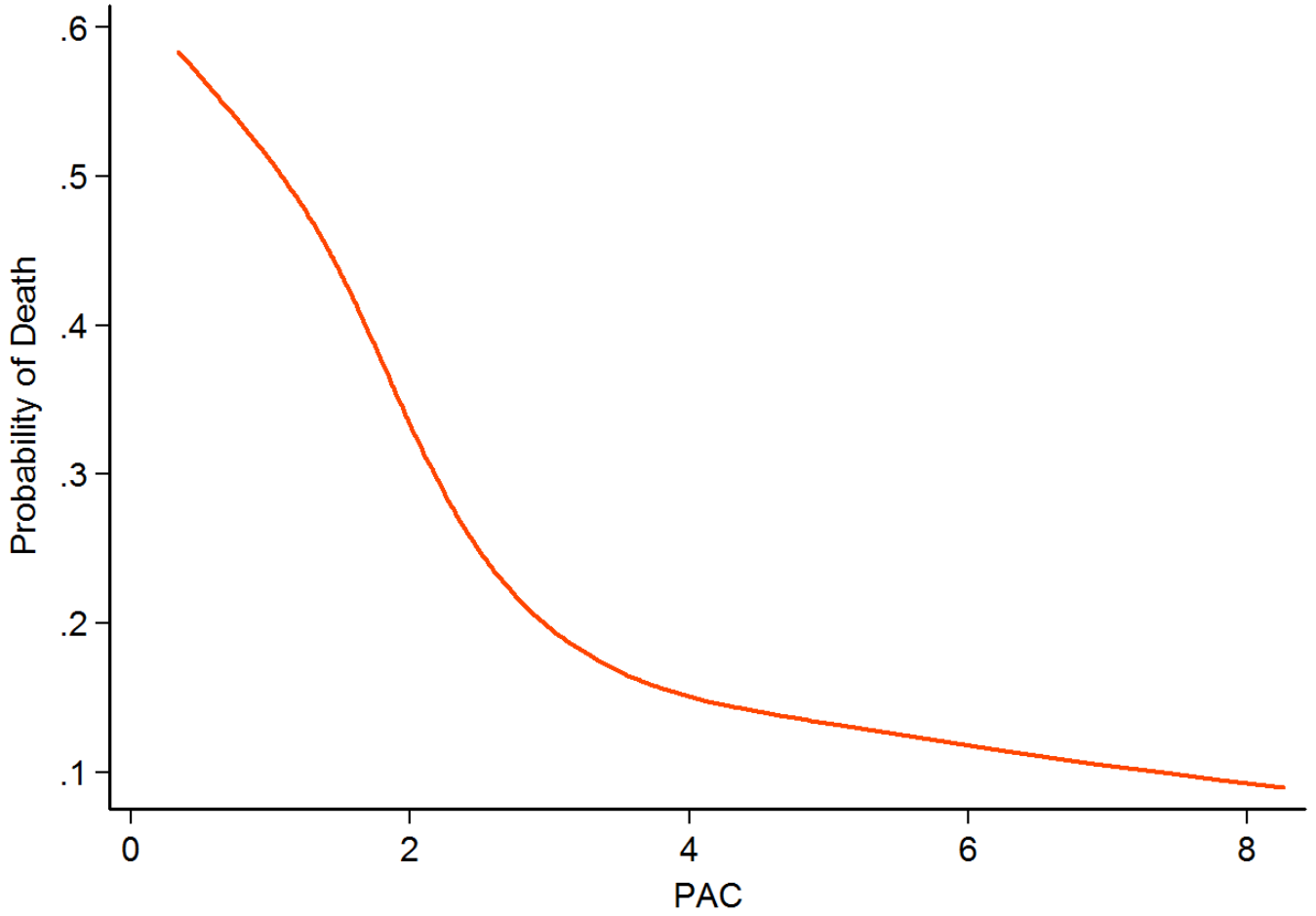


passive PH



reactive PH

Crude mortality by PAC



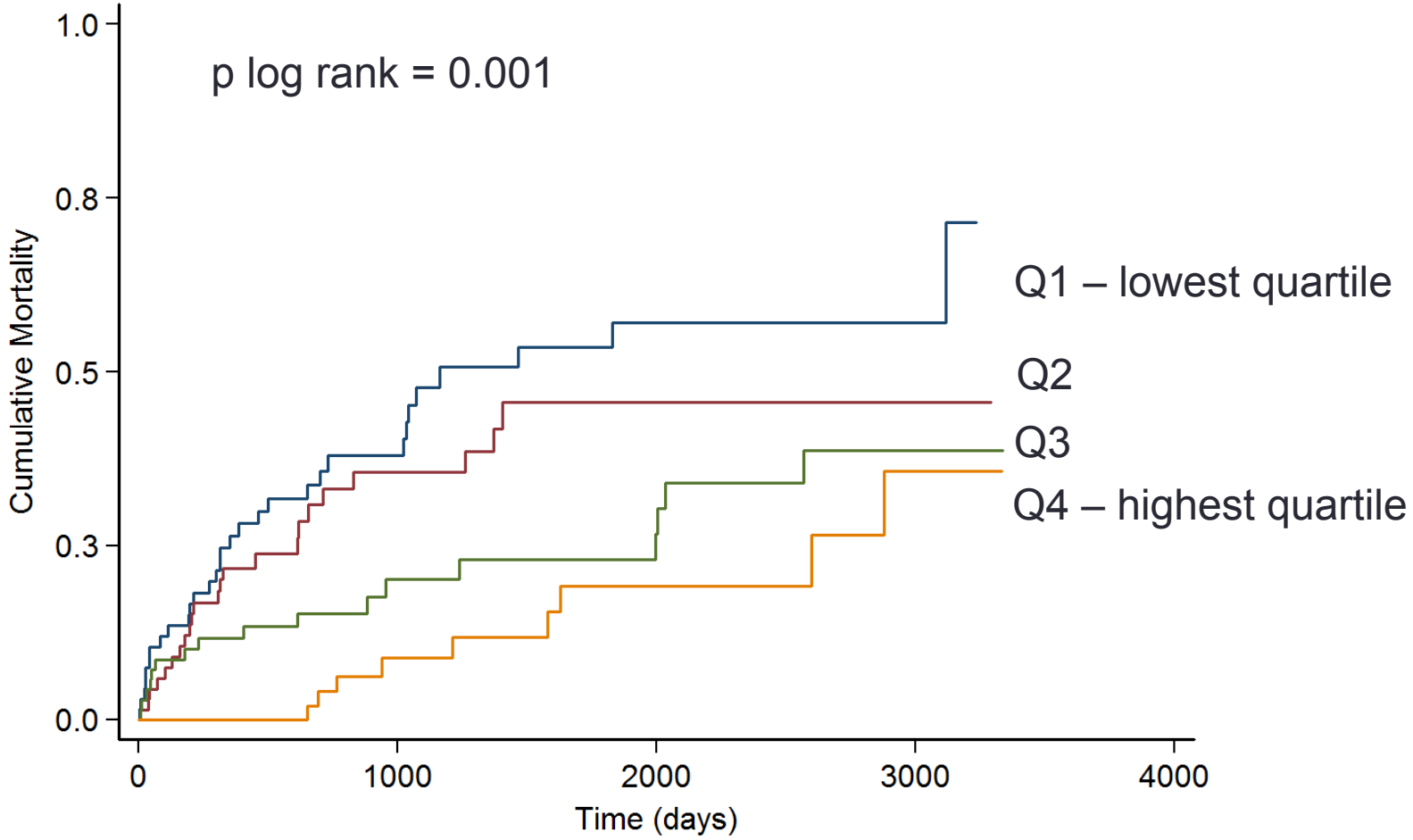
Crude mortality

Heart Failure	Mortality (%)
w/o PH	18.4%
w/ PH	41.7%
	p = 0.0001

Heart Failure & PH

PAC quartile	Mortality (%)
Q1 (lowest quartile)	48.9
Q2	45.7
Q3	27.3
Q4 (highest quartile)	19.1
	p for trend = 0.006

KM model by PAC quartiles



Cox proportional hazard model

Unadjusted

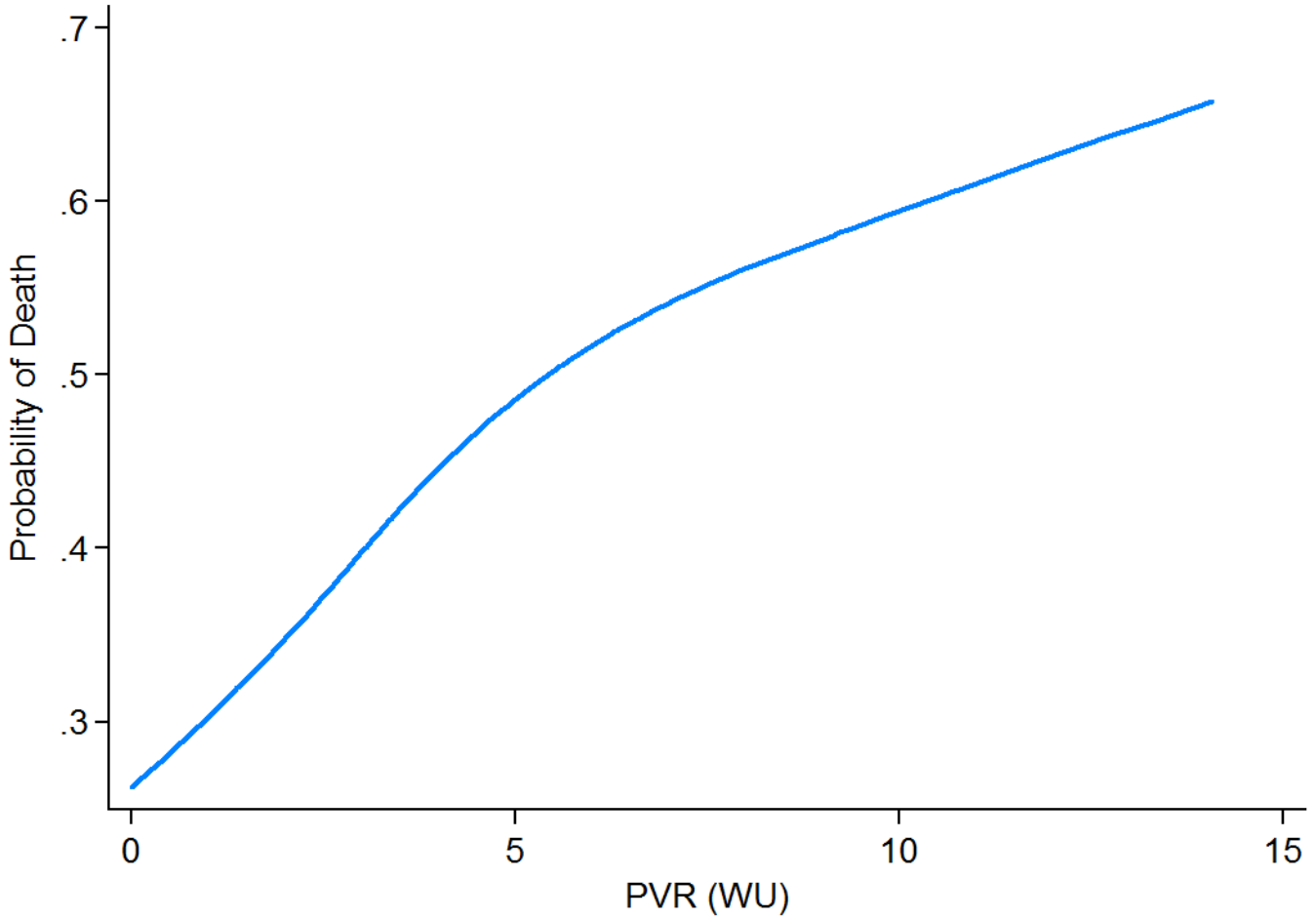
PAC quartile	HR (95% CI)	P Value	P Trend
Q1	3.21 (1.30-7.50)	0.001	0.01
Q2	3.74 (1.56-8.99)	0.003	
Q3	1.68 (0.65-4.36)	0.28	
Q4	1.0	-	

Adjusted *

PAC quartile	HR (95% CI)	P Value	P Trend
Q1	2.90 (1.14-7.32)	0.025	0.04
Q2	2.90 (1.17-7.19)	0.021	
Q3	1.40 (0.53-3.71)	0.49	
Q4	1.0	-	

* Age, Gender, RAP, PCWP, eGFR

Crude mortality by PVR



Cox proportional hazard model

Adjusted *

-2 log Likelihood = 793.3

PVR quartile	HR (95% CI)	P Value	P Trend
Q1	1.0	-	0.01
Q2	1.59 (0.84-3.01)	0.15	
Q3	1.49 (0.79-2.78)	0.21	
Q4	2.10 (1.12-3.94)	0.02	

Adjusted *

-2 log Likelihood = 462.7

PAC quartile	HR (95% CI)	P Value	P Trend
Q1	2.90 (1.14-7.32)	0.025	0.04
Q2	2.90 (1.17-7.19)	0.021	
Q3	1.40 (0.53-3.71)	0.49	
Q4	1.0	-	

* Age, Gender, RAP, PCWP, eGFR

p = 0.001

Example

Patient A

sPAP	54
dPAP	28
mPAP	37
CO	4.2
HR	101
SV	42
PCWP	21
PVR	3.8
PAC	1.51

Patient B

sPAP	45
dPAP	29
mPAP	34
CO	3.2
HR	78
SV	41
PCWP	19
PVR	4.7
PAC	2.6

Conclusion

- Pulmonary Arterial Capacitance is a strong predictor of mortality in Heart Failure patients with Pulmonary Hypertension.

- Pulmonary Arterial Capacitance may be a better predictor of outcome than Pulmonary Vascular Resistance.