

Blood Volume Profiles and Correlations with Pressures in Heart Failure with Impaired Renal Function

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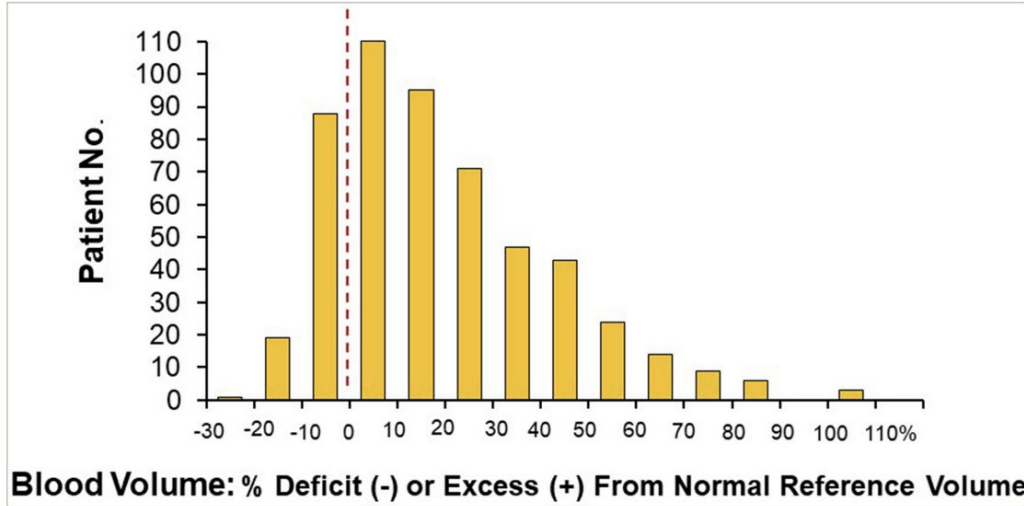
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Disclosure of Relevant Financial Relationships

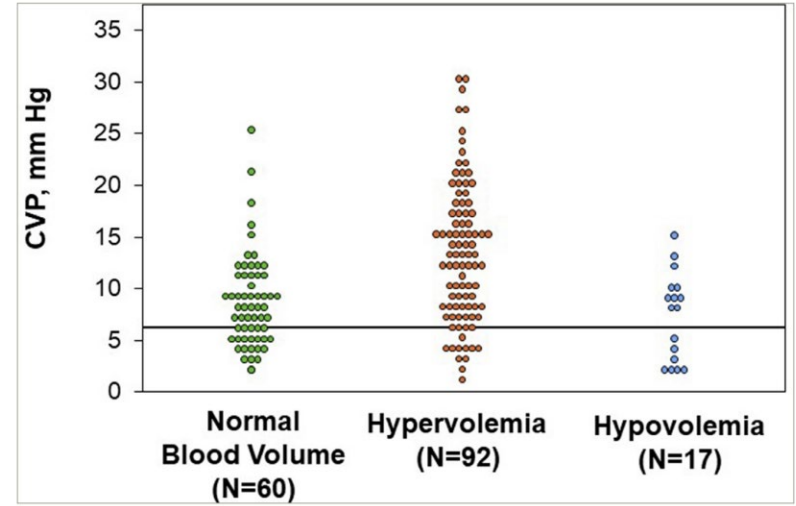
I, Mark Kittipibul ,DO NOT have any financial relationships to disclose.

Volume Expansion in Heart Failure is Complex

Degree of expansion is **heterogenous**

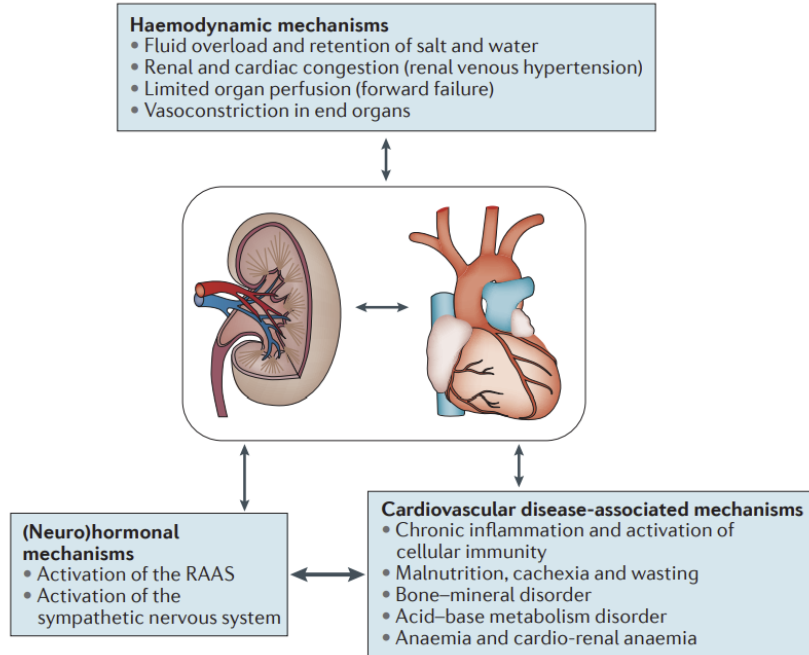


Pressure is **not** reflective of volume



Miller WL, Heart International 2023

Renal Impairment is Common in Heart Failure



- Coexists in 40-50% of patients with HF
- Associated with worse HF outcomes
- Complex interactions
 - Worsening neurohormonal activation
 - Worsening anemia

Does degree of renal impairment affect

- Distribution of volume expansion in HF
- Pressure-volume relationship
- Prevalence and types of anemia

Schefold JC et al, Nat Rev Nephrology 2016

Study Design



3 Medical Centers



259 Chronic HF
NYHA FC II-III

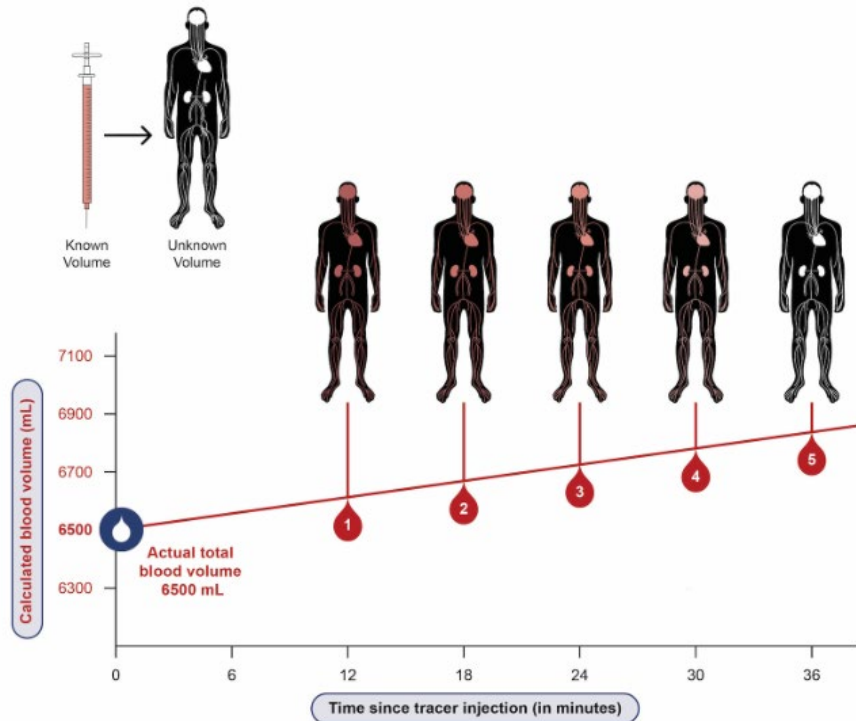


**Blood
Volume
Analysis**



**Right Heart
Catheterization**

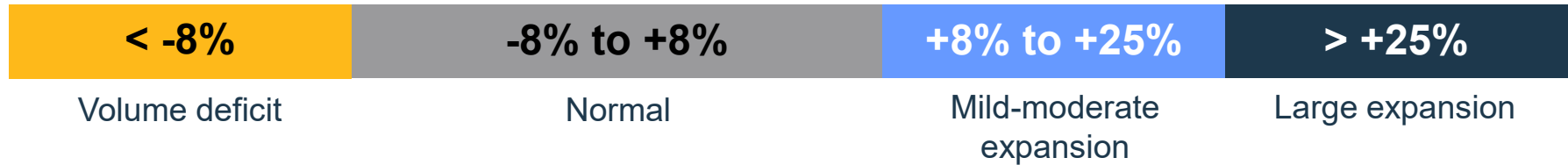
Blood Volume Analysis (BVA)



- Gold standard is indicator tracer dilution technique (I^{131} -albumin)
- One injection of tracer and serial blood draw
- Provide absolute and % deviation from ideal values
 - Total blood volume (TBV)
 - Plasma volume (PV)
 - Red blood cell mass (RBCM)

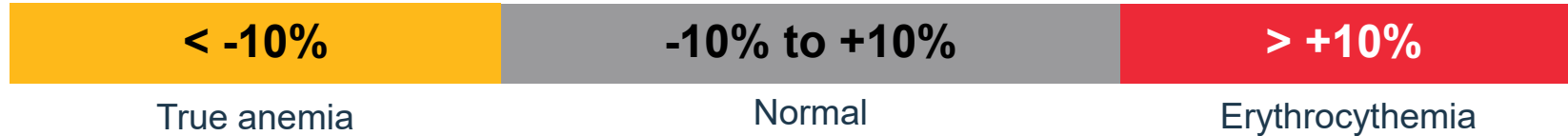
Blood Volume Categories

TBV and PV:



Red Blood Cell Categories

RBCM:

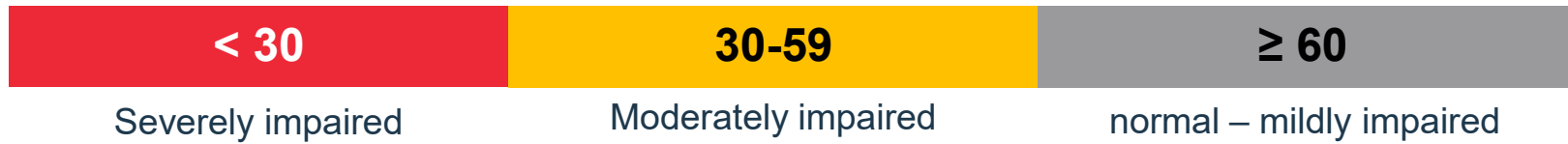


Anemia classification: WHO definition (Hb: Male <13, Female <12)

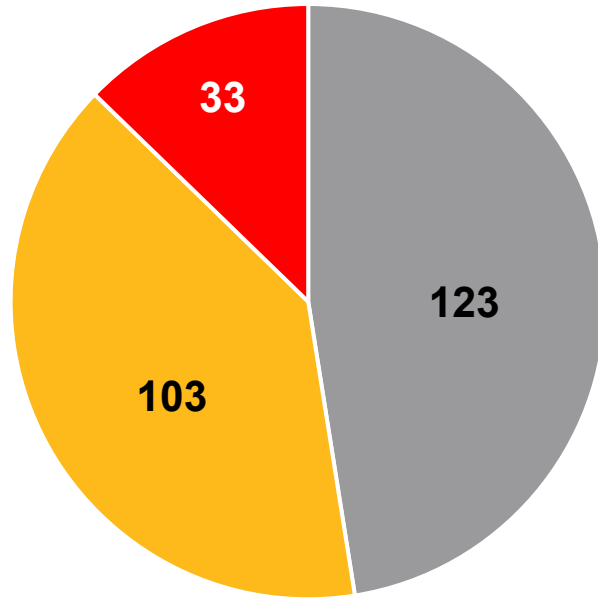


Renal impairment categories

eGFR:



Patient Characteristics



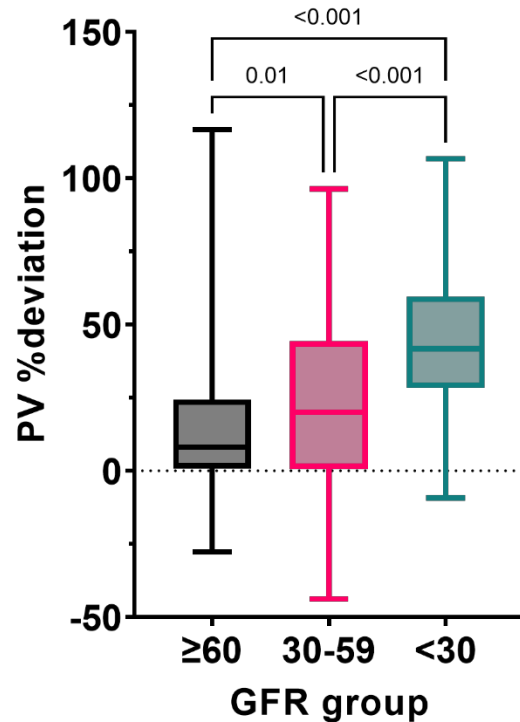
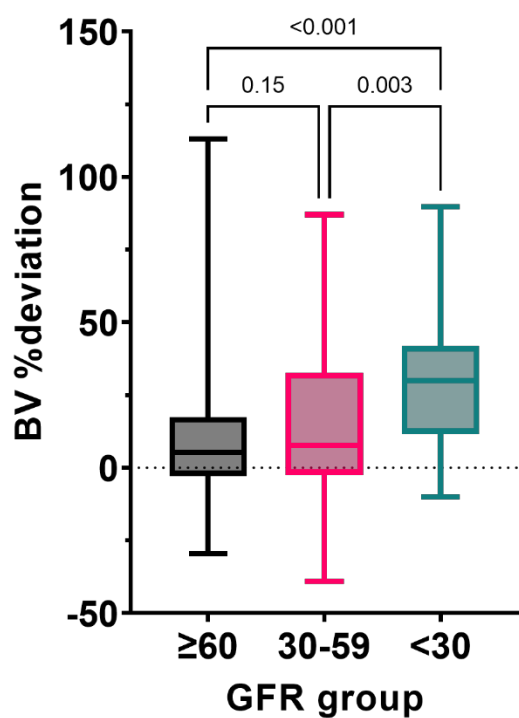
■ ≥60 ■ 30-59 ■ <30

- Total of 259 patients
- Age 61.8 ± 12.9 years
- 40.5% Female
- 13.1% Black
- HFpEF 41.7%

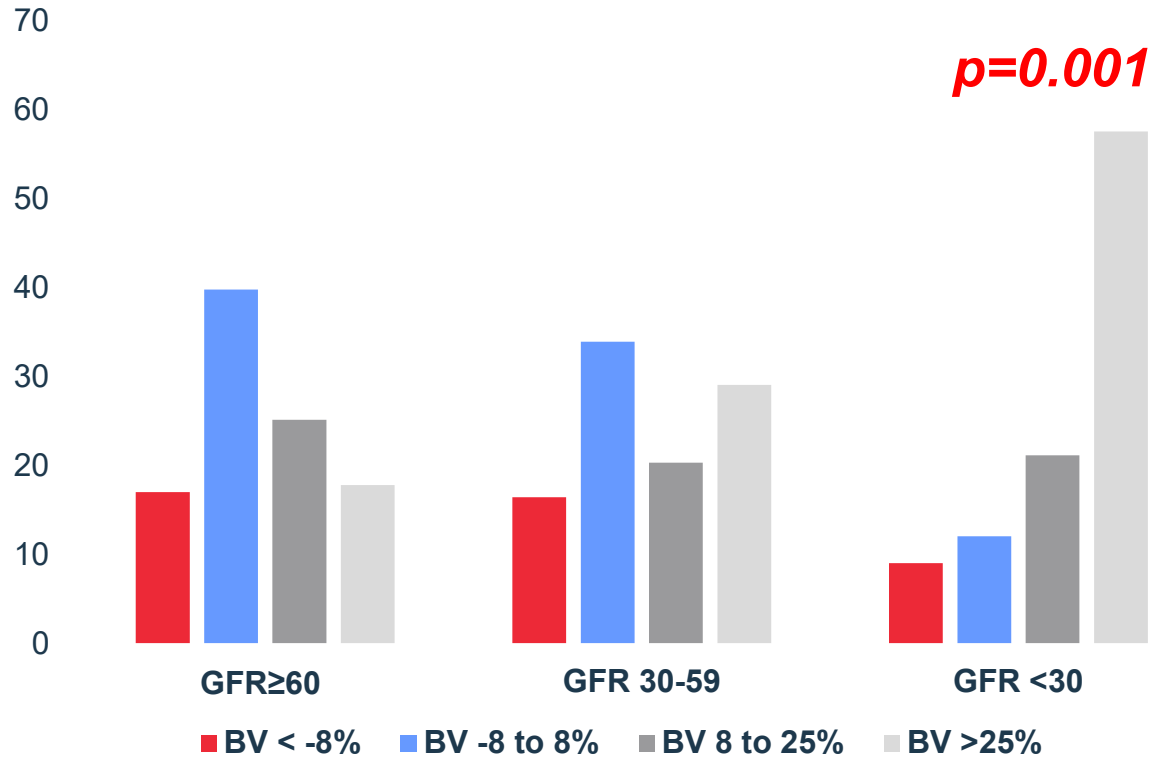
Patient Characteristics

	GFR\geq60 (n=123)	GFR 30-59 (n=103)	GFR <30 (n=33)	p-values
Age	58.5 \pm 13.1	65.2 \pm 11.6	63.8 \pm 13.5	<0.001
Female	57 (46.3%)	38 (36.9%)	10 (30.3%)	0.16
Black race	14 (11.4%)	13 (12.6%)	7 (21.2%)	0.43
BMI	32.7 \pm 7.3	32.2 \pm 7.7	33.9 \pm 7.6	0.51
LVEF	45.8 \pm 18.4	38.3 \pm 18.7	38.1 \pm 17.1	0.004
HFpEF	62 (50.4%)	37 (35.9%)	9 (27.3%)	0.018

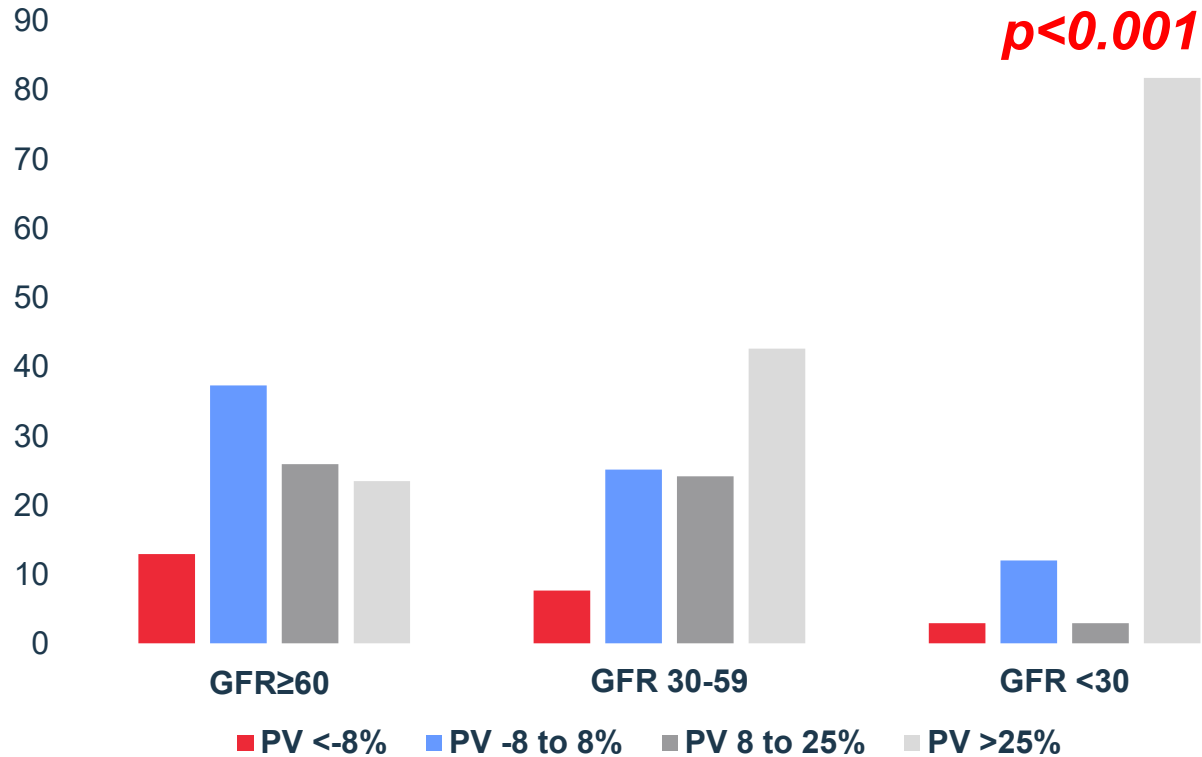
Blood Volume Profiles



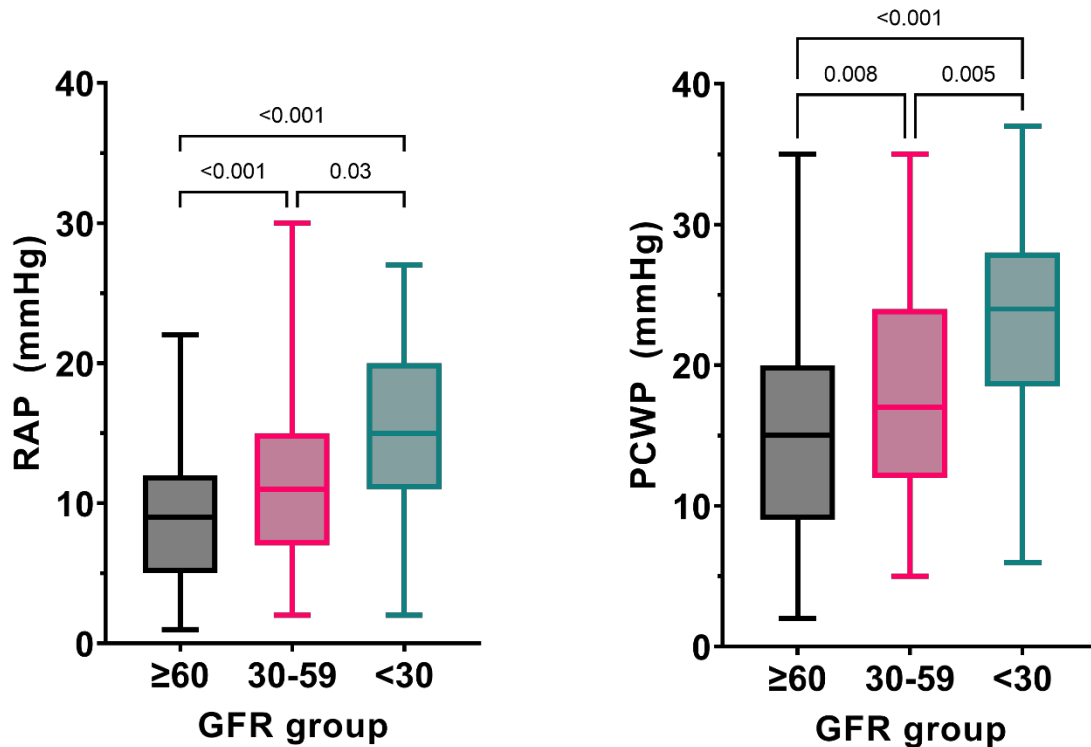
Total Blood Volume Distribution



Plasma Volume Distribution



Pressure Profiles

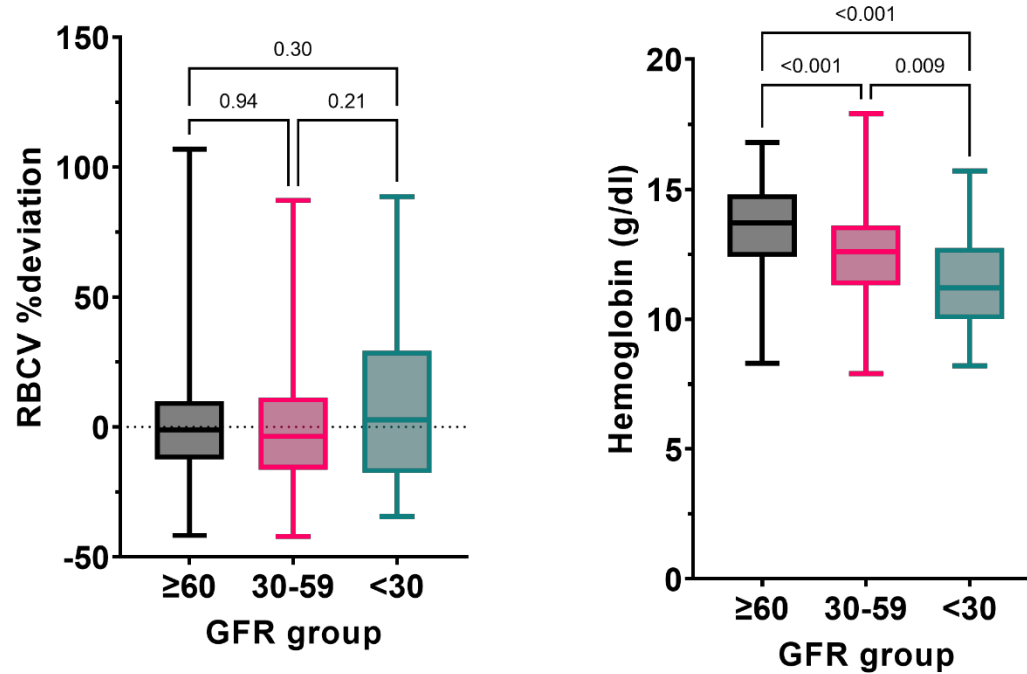


Pressure-Volume Relationship

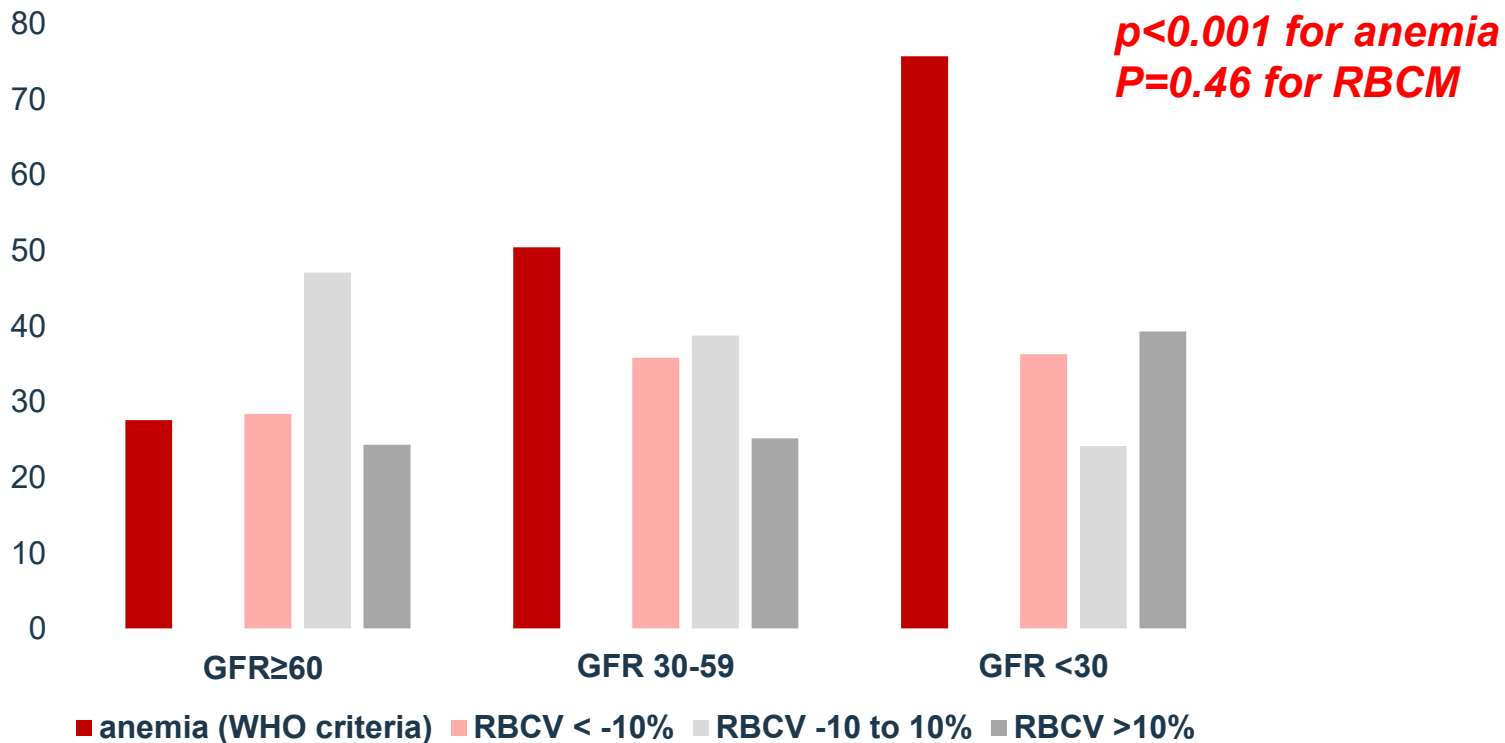
	GFR \geq 60 (n=123)				GFR 30-59 (n=103)				GFR <30 (n=33)			
	RAP		PCWP		RAP		PCWP		RAP		PCWP	
	r	p	r	p	r	p	r	p	r	p	r	p
BV	0.25	<0.01	0.21	0.02	0.54	<0.01	0.38	<0.01	0.40	0.02	0.14	0.43
BV %dev	0.37	<0.01	0.15	0.09	0.47	<0.01	0.28	<0.01	0.29	0.10	0.06	0.76
PV	0.28	<0.01	0.19	0.04	0.56	<0.01	0.38	<0.01	0.44	0.01	0.20	0.27
PV %dev	0.39	<0.01	0.15	0.09	0.48	<0.01	0.29	<0.01	0.36	0.04	0.15	0.39

- Overall weak to moderate correlation
- Stronger correlation between volume with RAP > PCWP

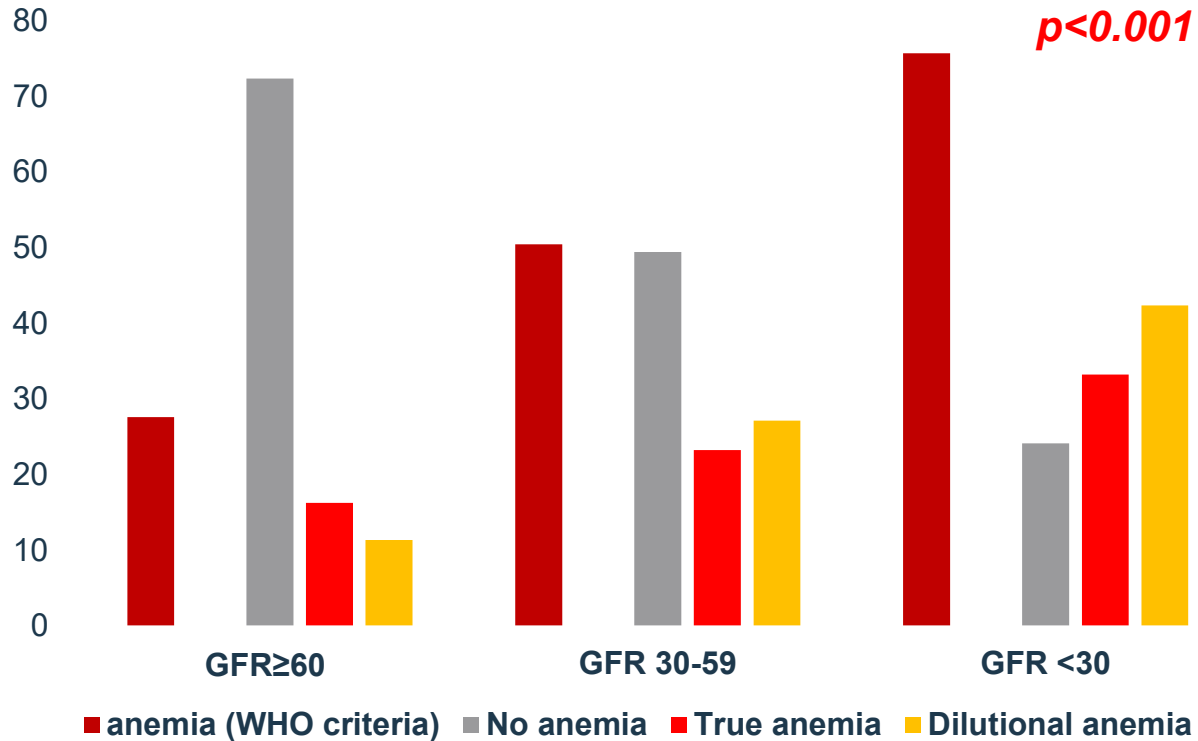
Red Blood Cell Profiles



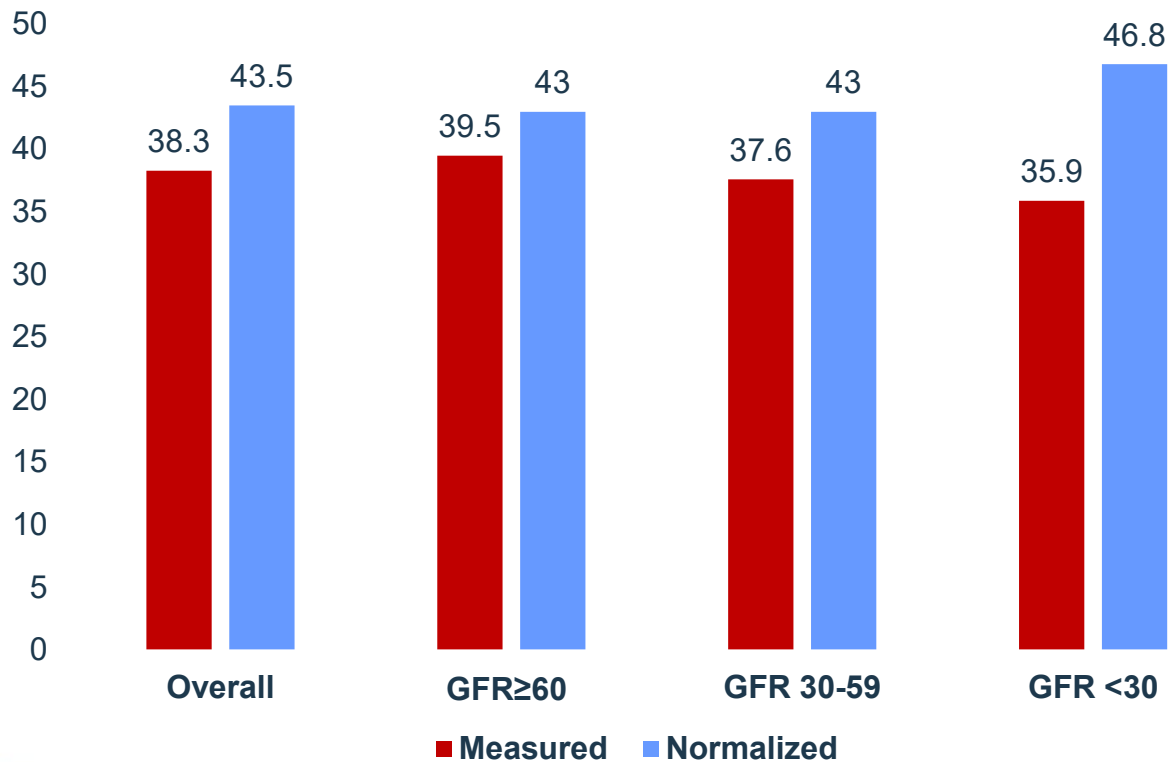
Red Blood Cell Profiles



Anemia Classification



Measured vs. Normalized Hct



p < 0.001 for measured
P = 0.16 for normalized

Conclusions

- **Heterogeneity in volume status exists across renal function**
- **Different patterns of volume status are observed**
 - More patients with large volume expansion with worse renal function
- **Pressure-volume correlation is consistently weak across renal function**
 - Stronger correlation with RAP > PCWP
- **Anemia, esp. dilutional anemia, is more prevalent in worse renal function**
 - No difference in prevalence of true anemia as defined by RBCM or normalized Hct level



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MAYO CLINIC



Thank you

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