

^{129}Xe MR Spectroscopy Reveals Abnormal Gas-exchange in Moderate and Severe Asthma

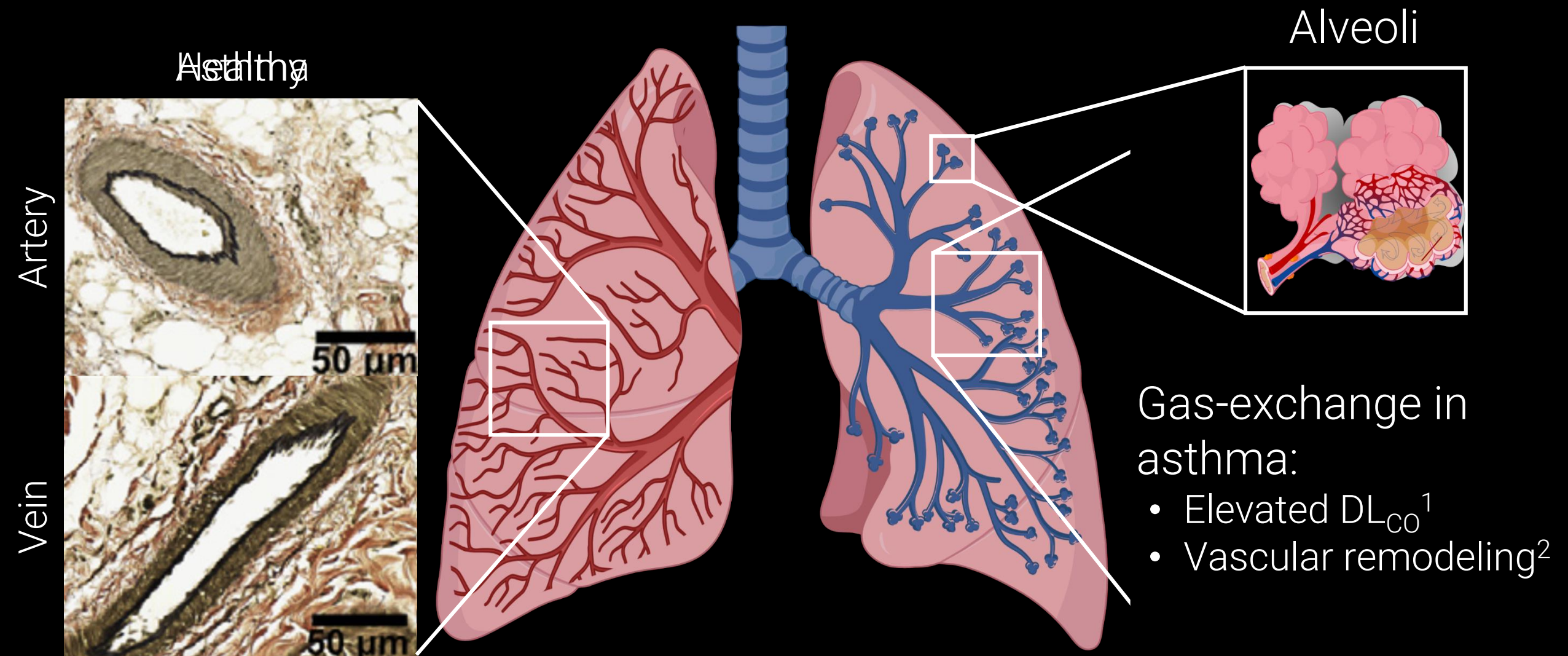
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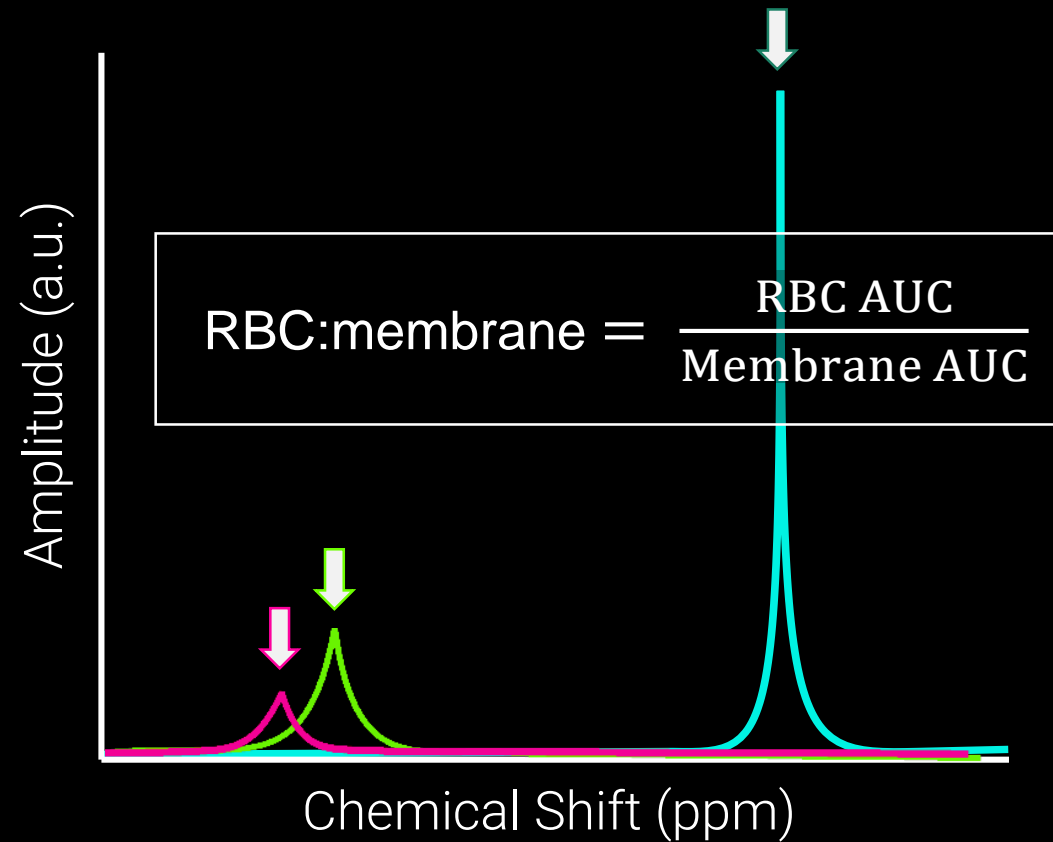
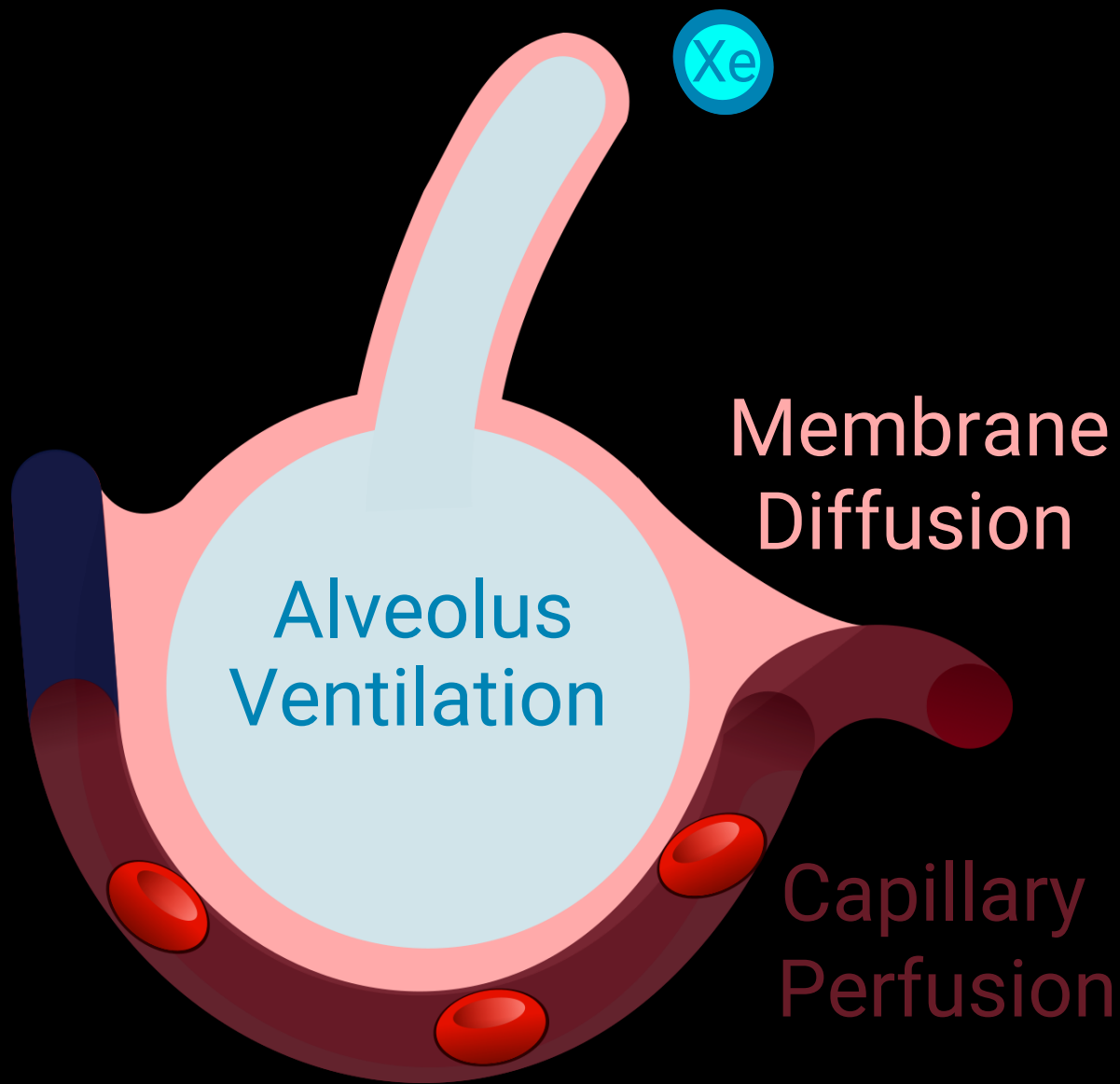
Asthma: Beyond Airways Disease



Gas-exchange in asthma:

- Elevated DL_{CO} ¹
- Vascular remodeling²

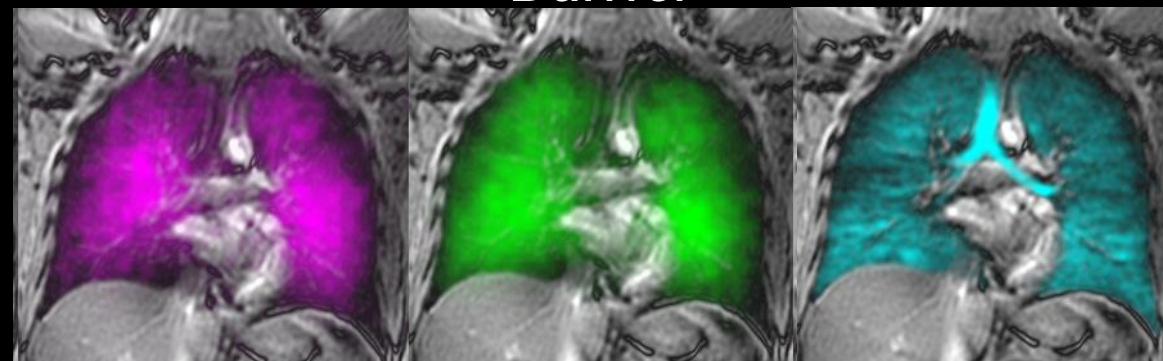
^{129}Xe MR Spectroscopy



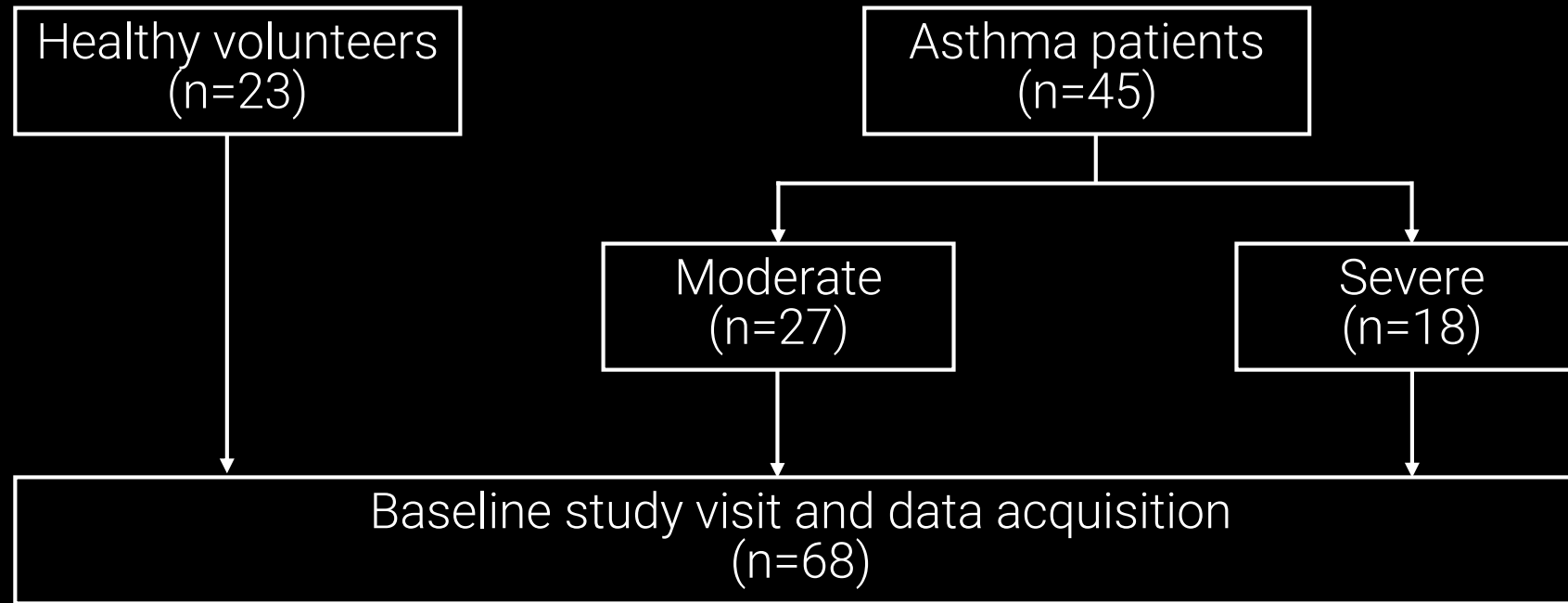
RBC

Barrier

Gas



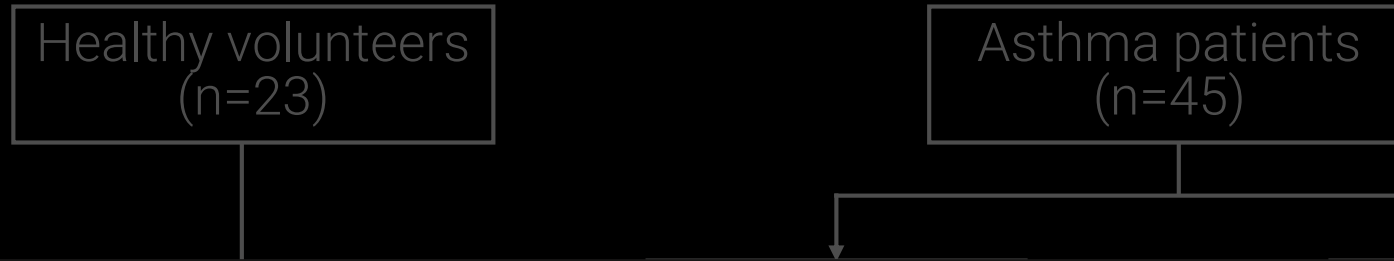
Study Design



Study visits included:

- ^{129}Xe MRI and MRS
- Pulmonary Function Tests
- Complete Blood Count
- Quality-of-life Questionnaires

Study Design



Hypothesis:

^{129}Xe MRS measurements are significantly different in healthy volunteers and patients with moderate and severe asthma

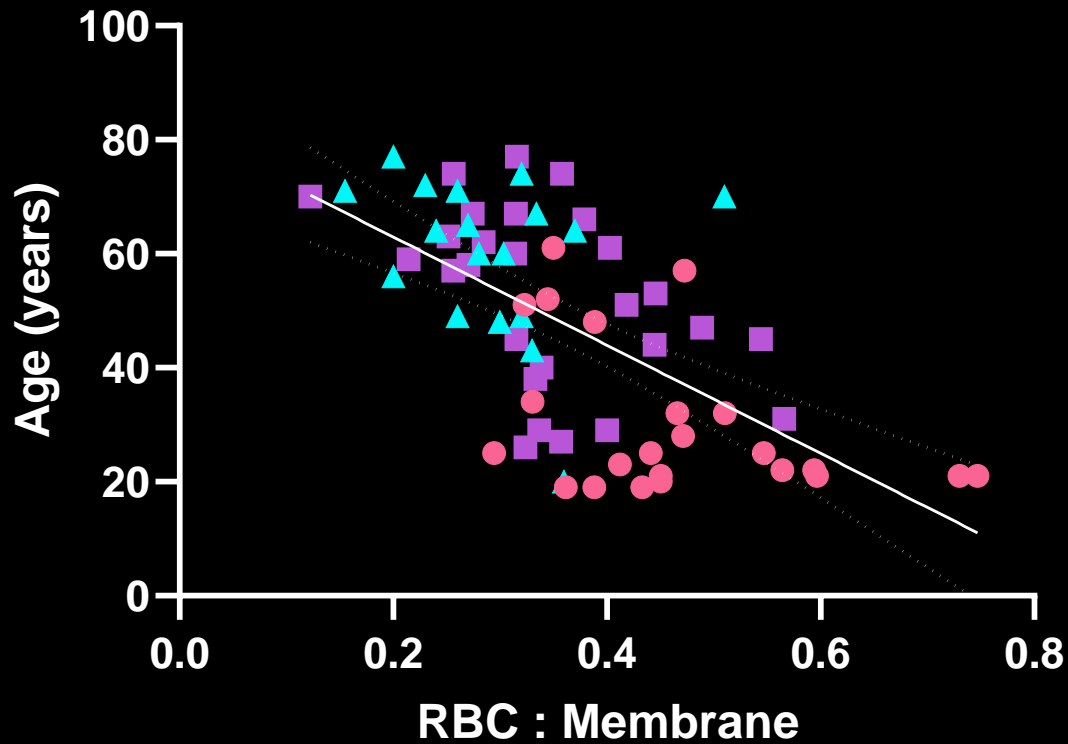
- ^{129}Xe MRI and MRS
- Pulmonary Function Tests
- Complete Blood Count
- Quality-of-life Questionnaires

Participant Demographics

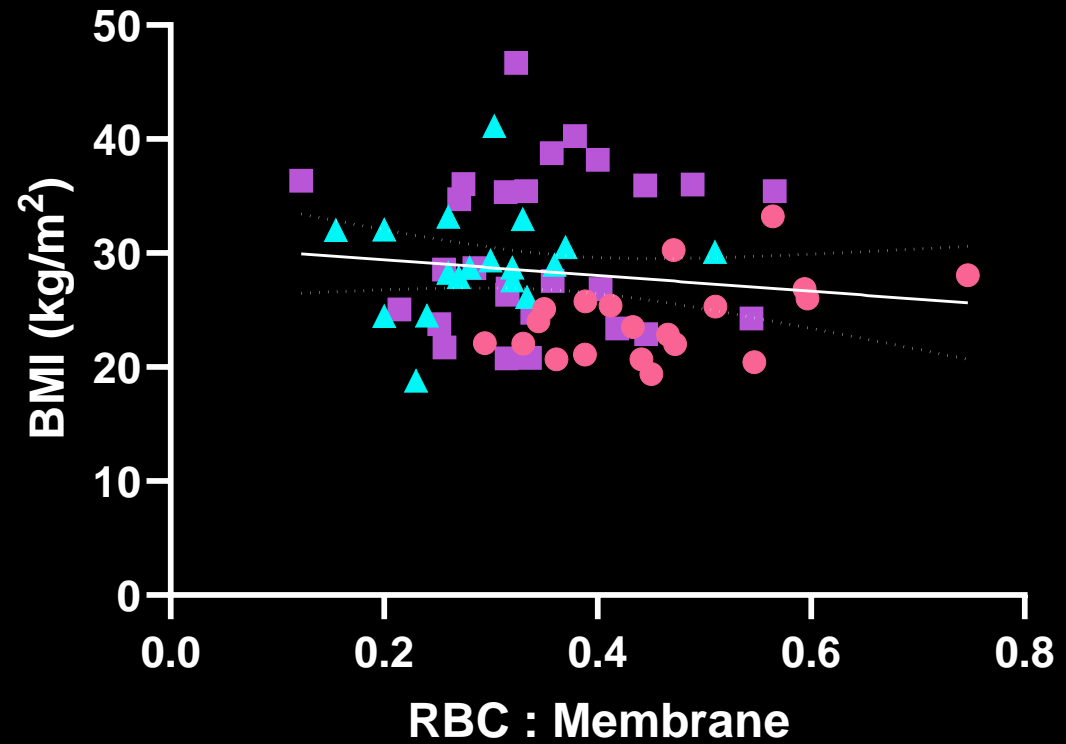
Parameter mean(±SD)	All (n=68)	Healthy (n=23)	Moderate (n=27)	Severe (n=18)	ANOVA P-value
Age [years]	47 (19)	30 (13)	54 (15)	60 (14)	<.001
Females [n(%)]	47 (70)	10 (43)	23 (77)	14 (77)	.02
BMI [kg/m ²]	28 (6)	24 (4)	31 (7)	29 (5)	.005
FEV ₁ [L]	2.7 (1.1)	3.9 (0.8)	2.1 (0.7)	2.1 (0.7)	<.001
FEV ₁ [% _{pred}]	82 (21)	96 (13)	72 (19)	80 (23)	<.001
FVC [L]	3.7 (1.3)	4.8 (1.2)	3.3 (1.0)	3.0 (0.8)	<.001
FVC [% _{pred}]	92 (16)	98 (12)	87 (13)	90 (21)	.03
FEV ₁ /FVC	72 (13)	82 (7)	65 (12)	70 (10)	<.001
DL _{CO} [% _{pred}]	118 (18)	118 (18)	-	-	-
Eos [cells/μL]	466 (354)	-	374 (236)	583 (445)	.08
RBC : M	0.37 (0.12)	0.46 (0.12)	0.34 (0.10)	0.29 (0.08)	<.001
M : Gas	0.92 (0.24)	0.96 (0.27)	0.88 (0.25)	0.93 (0.19)	.4
RBC : Gas	0.35 (0.16)	0.45 (0.19)	0.30 (0.11)	0.28 (0.10)	<.001



Relationships: Age and BMI

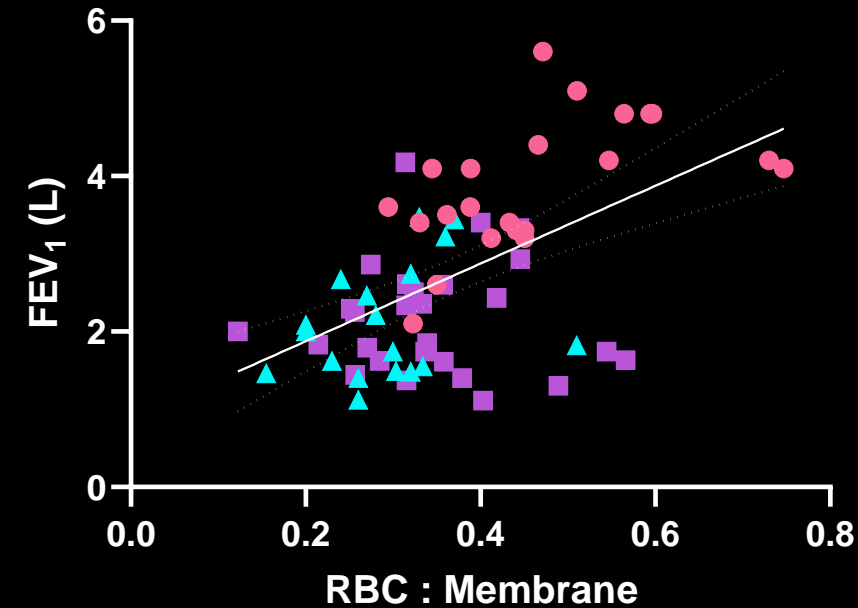


- Healthy: $\rho = -.31$, $P = .1$
- Moderate: $\rho = -.47$, $P = .01$
- ▲ Severe: $\rho = -.33$, $P = .1$
- All: $\rho = -.63$, $P < .001$



- Healthy: $\rho = .47$, $P = .02$
- Moderate: $\rho = .08$, $P = .7$
- ▲ Severe: $\rho = .19$, $P = .5$
- All: $\rho = -.14$, $P = .3$

Relationships: Airflow Obstruction

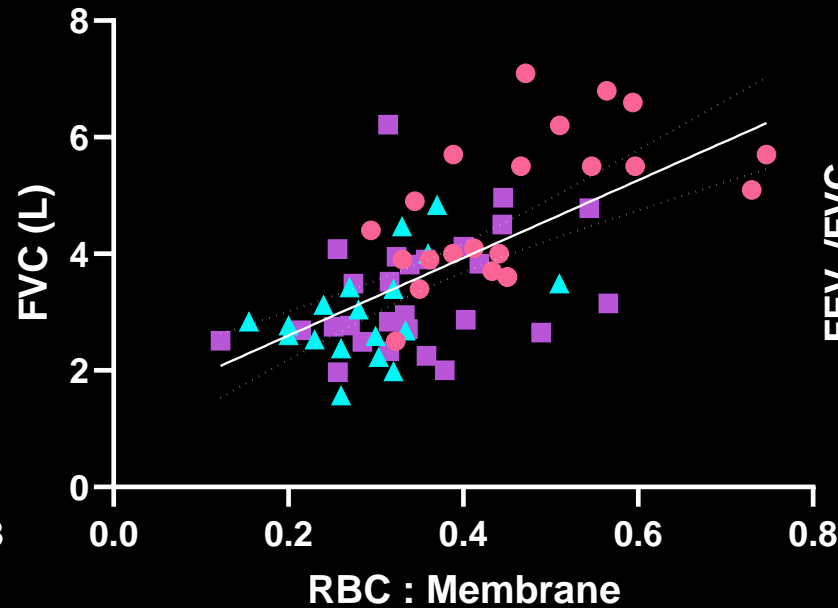


● **Healthy: $\rho=.64$, $P=.001$**

■ Moderate: $\rho=-.06$, $P=.8$

▲ Severe: $\rho=.38$, $P=.1$

— **All: $\rho=.50$, $P<.001$**

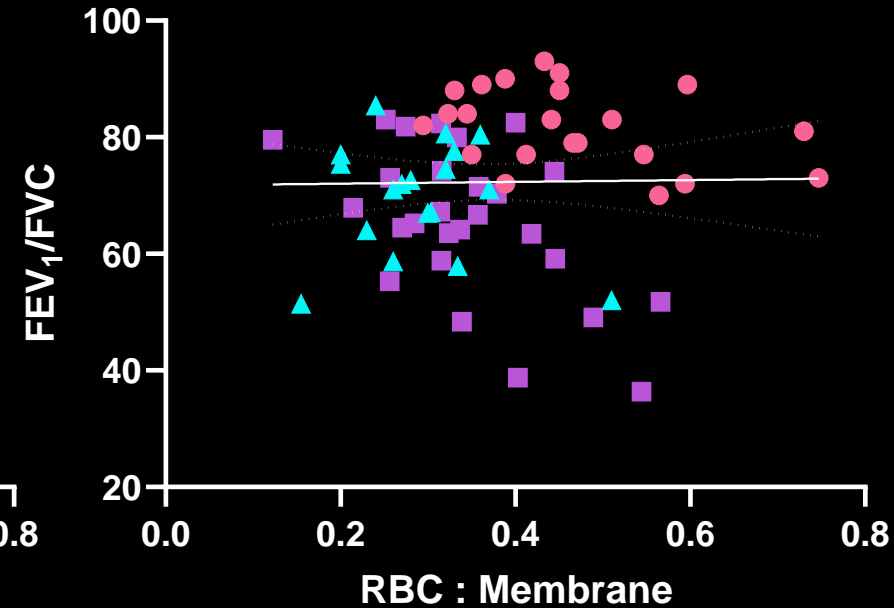


● **Healthy: $\rho=.63$, $P=.002$**

■ Moderate: $\rho=.34$, $P=.07$

▲ **Severe: $\rho=.48$, $P=.04$**

— **All: $\rho=.63$, $P<.001$**



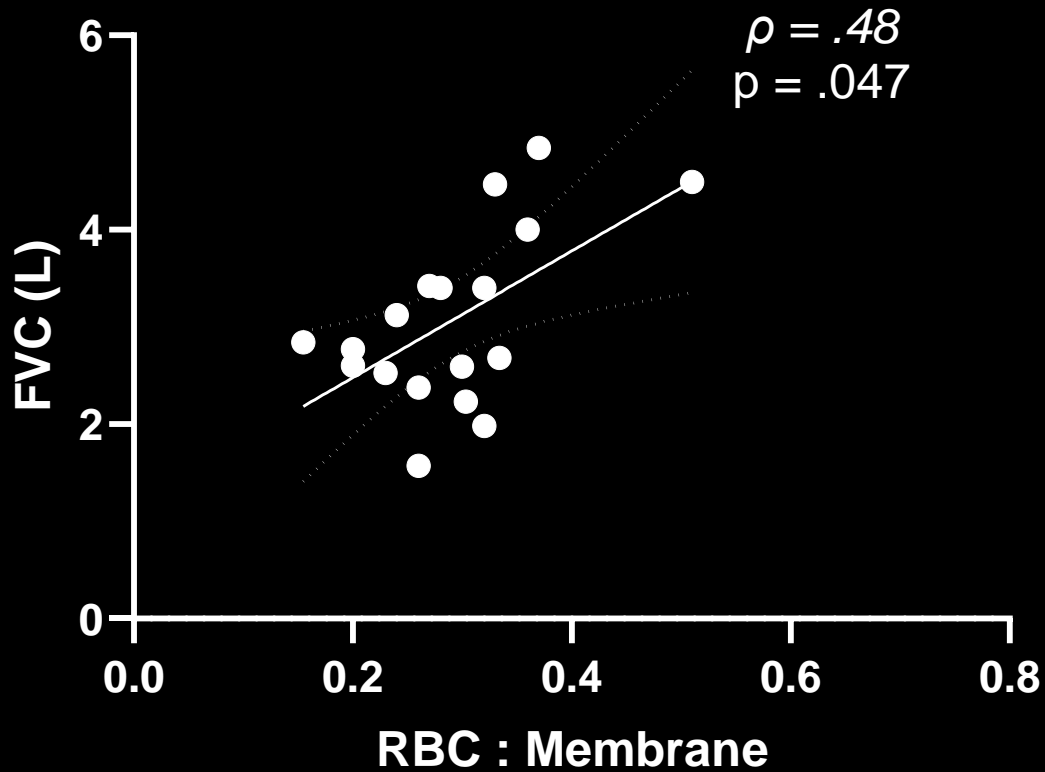
● Healthy: $\rho=-.34$, $P=.1$

■ **Moderate: $\rho=-.46$, $P=.01$**

▲ Severe: $\rho=.02$, $P=.9$

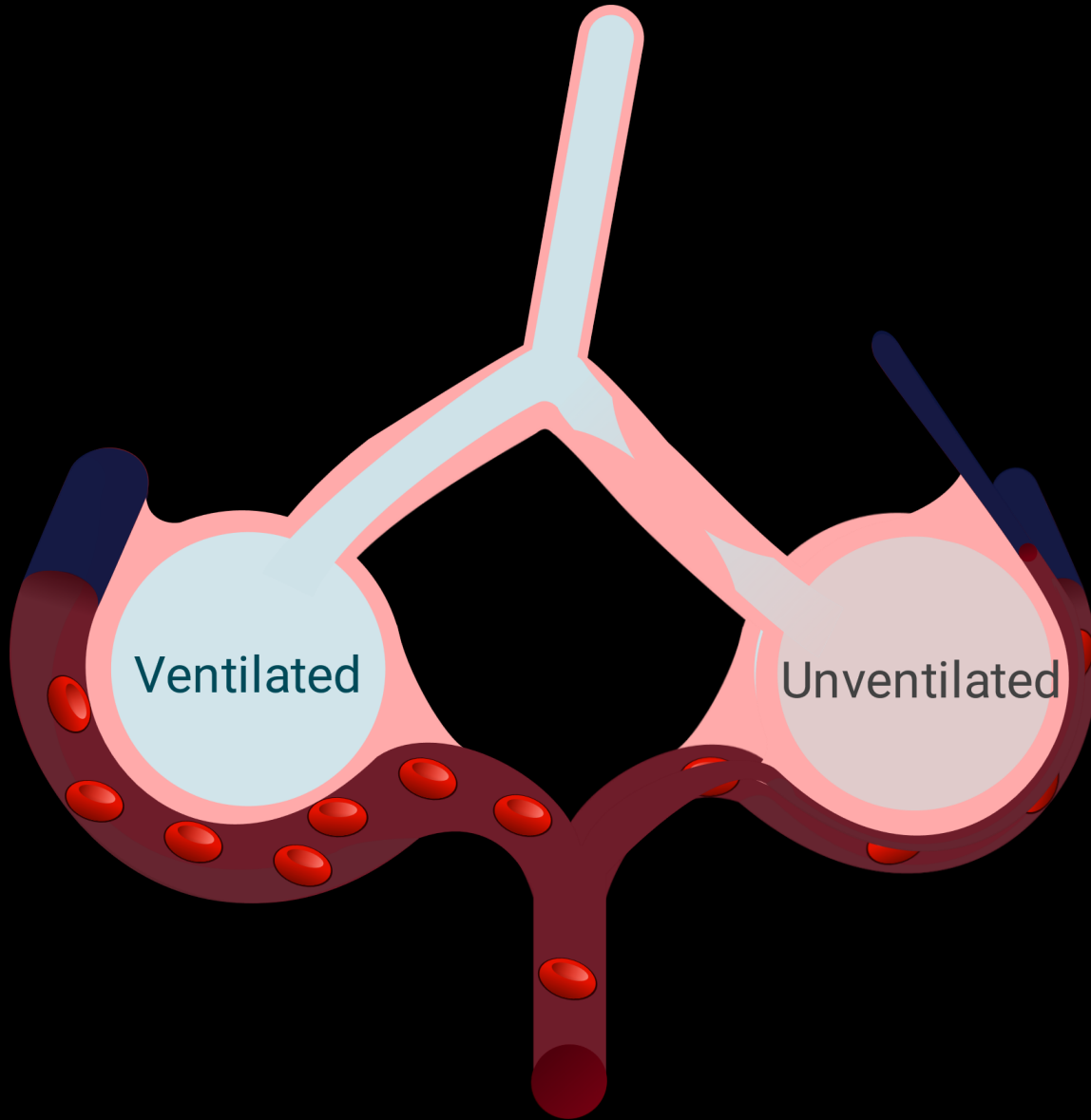
— All: $\rho=.1$, $P=.4$

Relationships: Gas-exchange



- ^{129}Xe MRS RBC:membrane ratio is abnormal in patients with asthma
- RBC:membrane ratio decreases with increasing asthma severity
- RBC:membrane ratio correlates with spirometry measures of airflow obstruction in asthma

Abnormal Gas-exchange in Asthma



Gas-exchange and vascular abnormalities in asthma may reflect:

1. Pulmonary vascular remodeling
2. Chronic hypoxic vasoconstriction
3. Acute hypoxic vasoconstriction
4. SHUNT!

Future work:

- Acquire follow up data in moderate and severe asthma
- How does RBC:membrane respond to bronchodilation?
- Is vasoconstriction permanent or reversible?

Conclusions

- ^{129}Xe MRS gas-exchange differences between healthy volunteers, moderate and severe asthma
- Findings agree with previous demonstration of pulmonary vascular remodeling in asthma¹
- ^{129}Xe MRS gas-exchange markers correlate with obstruction

^{129}Xe MRS abnormalities differ across asthma severity suggesting worsening gas-exchange with worsening disease severity



Thank You!

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