Diffusion Capacity in Cystic Fibrosis

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The Diffusion capacity or Transfer Factor measurements

- **Validates lung efficiency:**

  How well Oxygen and CO2 moves into/out of the lungs

- **Originally developed for restrictive lung disease**

DLCO may be related to available alveolar volume

Alveolar volume – “The alveolar/Capillary membrane bed”
As measured by TLC - Anatomical dead space

In DLCO test = VA is the alveolar volume during the breath-hold maneuver

This “correction” may be misleading in the presence of

- Incomplete alveolar expansion,
- Diffuse versus localized loss of alveolar units,
- Poor alveolar mixing

Should we perform DLCO in CF

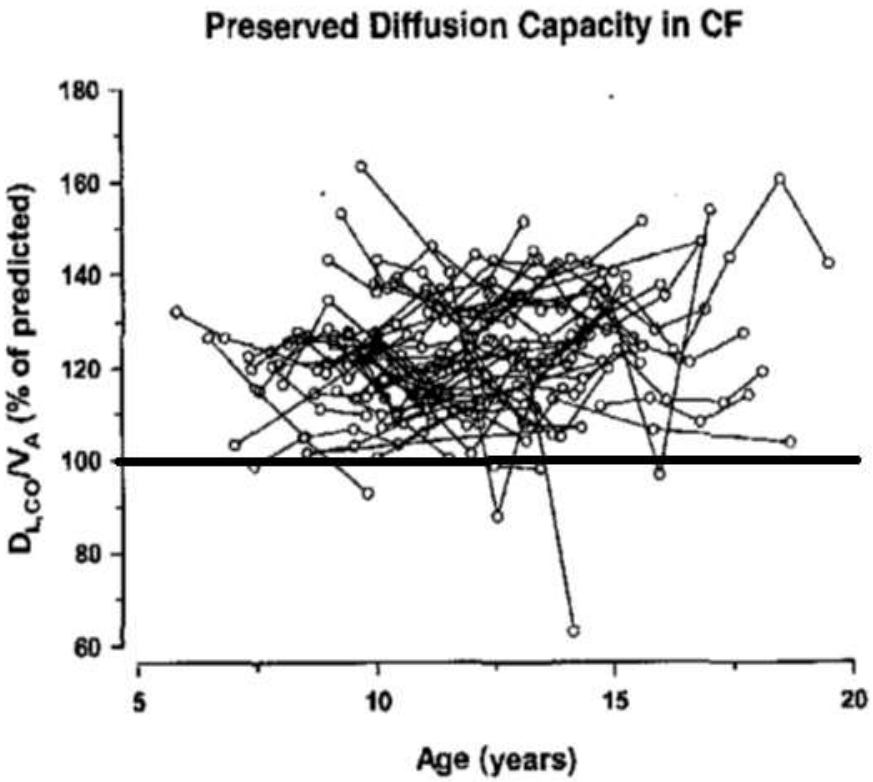
Cystic fibrosis (CF) disease is characterized by:

1. *Airway obstruction*,
2. **Increased trapped air,**
3. **Bronchiectasis**
4. **Parenchyma fibrosis,**

All may affect the volume available for diffusion and the lung's capillary blood

Therefore: One would expect DLCO rate to decrease with progress of disease.

Currently, DLCO appears to play no role in CF assessment compared to spirometry

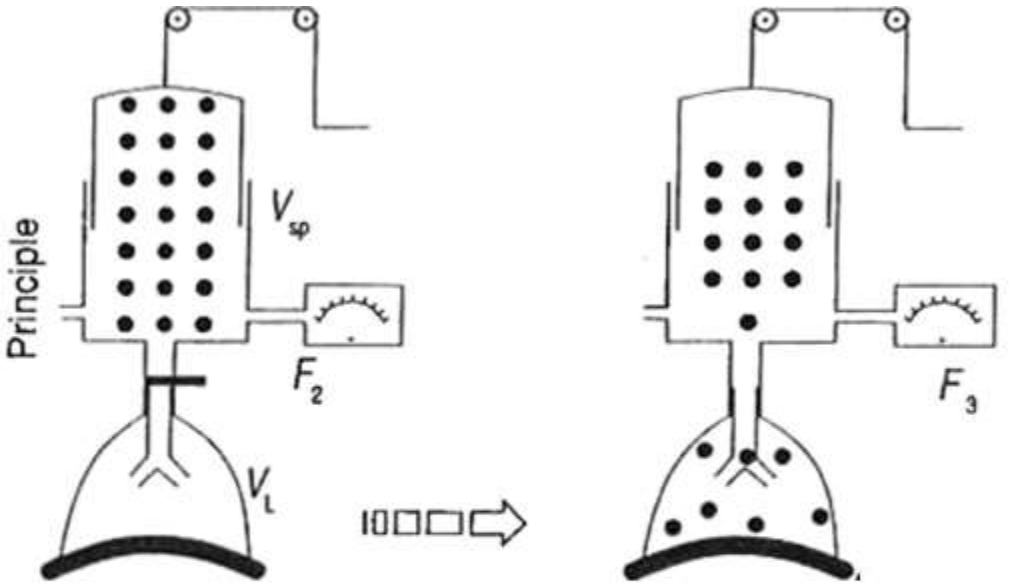


At all ages DLCO is normal or increased

Merkus PJ 2004; de Jong PA 2006;

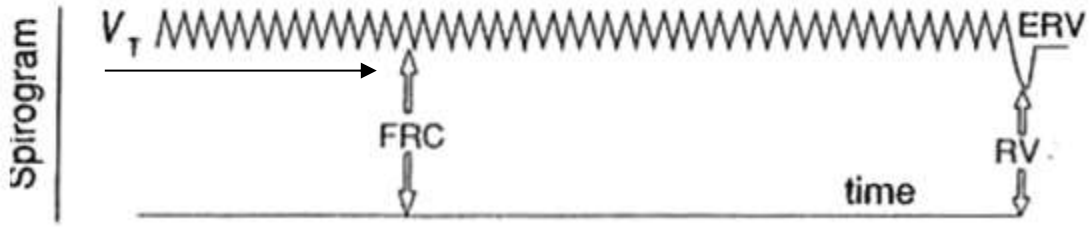
Does alveolar volume measured by DLCO represents the alveolar/Capillary membrane bed in CF

Helium dilution

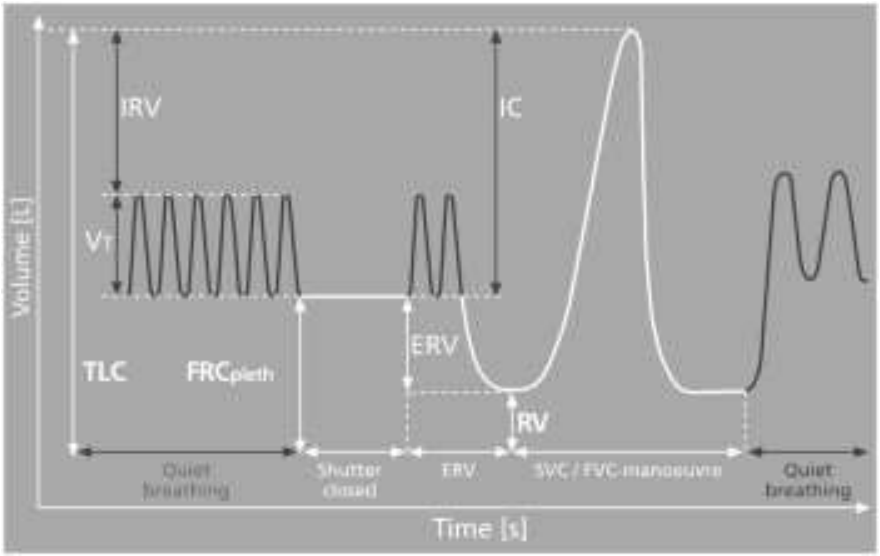


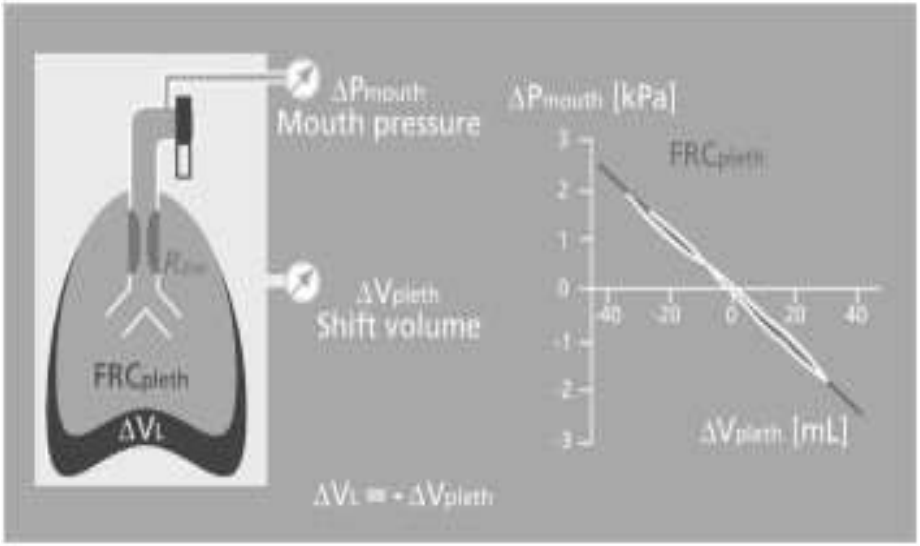
Connecting at FRC point

Dilution – FRC
Tidal volume mixing



Body plethysmograph





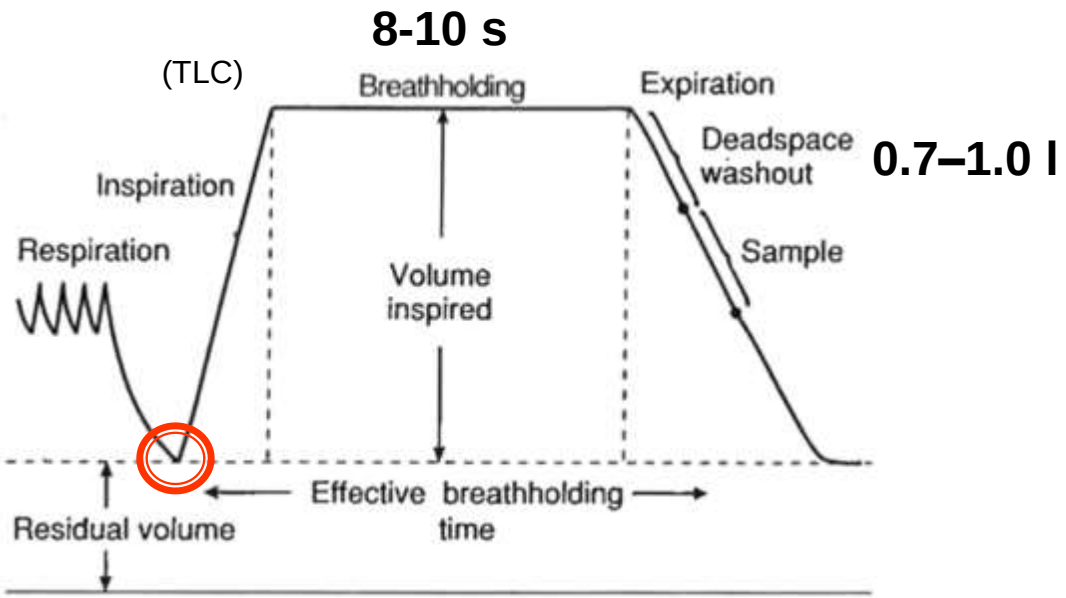
Connecting point - FRC

FRC = The mechanical equilibrium of the opposite forces exerted by the lung tissue and thorax

DLCO Test Procedure

Inhalation of gas mixture

- 0.27%CO - diffusion 10sec breath-holding time
- 14%He - lung volume measurement
- Connecting point Residual Volume



(Cotes JE. Lung function: assessment and application in medicine, 5th Ed. Oxford, Blackwell Scientific Publications; 1993).

	He-dil.	BB	DLCO
Connecting point	FRC	FRC	RV
VA (restrictive LD): TLC-A_{DS}			
Mixing time	3-5min	seconds	10sec
VA (obstructive LD): TLC-A_{DS} + Trapped air			
Mixing time	5-15min	seconds	10sec

Low VA_{DLCO} due to incomplete gas mixing during the breath-hold period would artificially inflate DLCO/VA compared to DLCO/Pleth

To compare the DLCO/VA between

- VA measured by Inert gas during the DLCO test ($DLCO/VA_{SB}$)
- VA calculated from lung volume measurements plethysmography; DLCO/VApleth)

Study design: Retrospective cross sectional.

74 CF patients (m=43) mean age 28 ±10 years, mean BMI 20±3 kg/ht^2.

Exclusion criteria: Exacerbations, Hospitalizations, Hemoptysis

Obtained DLCO data:

1. Lung function data (spirometry, BB, DLCO)
2. Blood-gas levels preferably performed on the same day

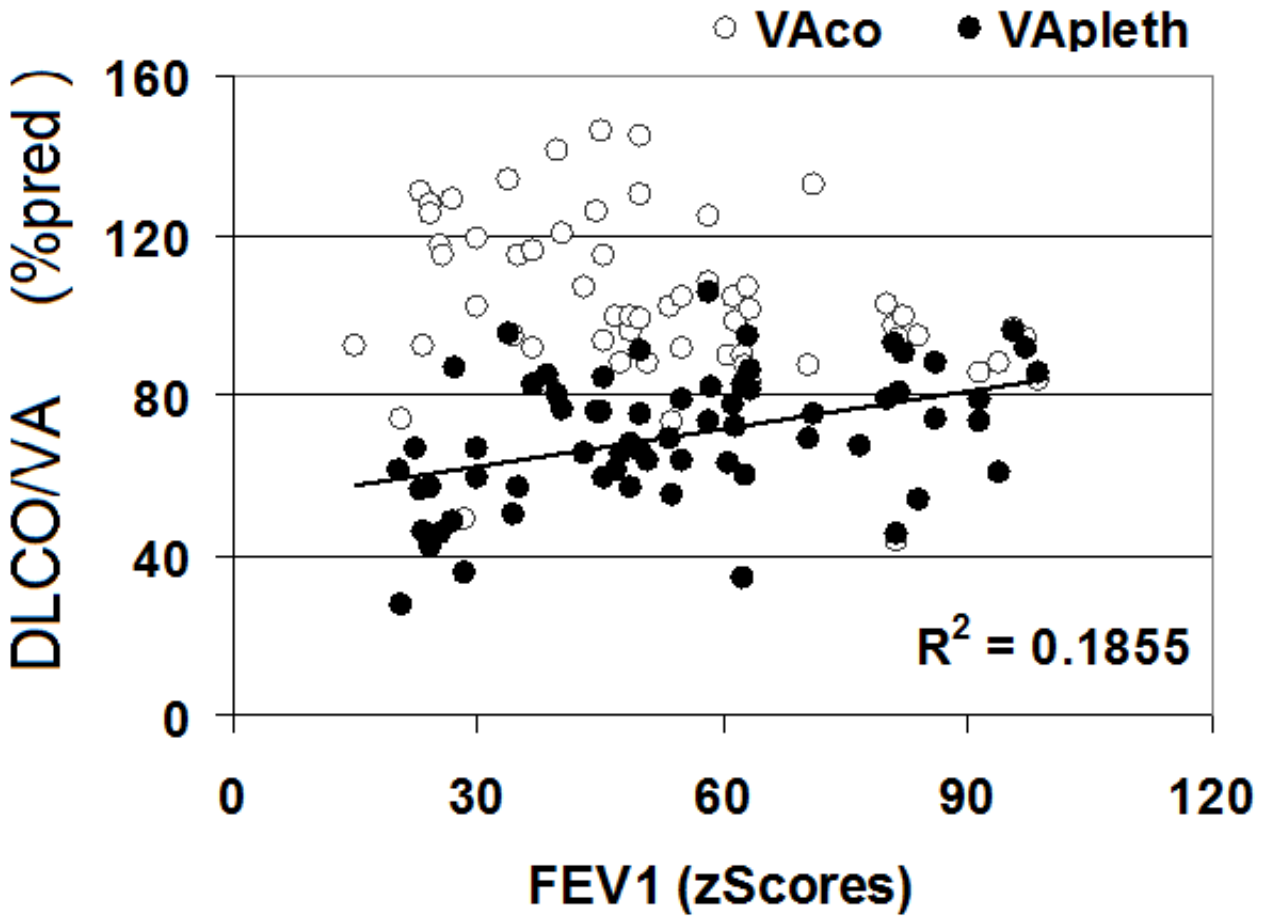
DLCO Volume correction was calculated using

1. VA$_{DLCO}$ based on the single-breath technique (measured 95%TLC)
2. VApleth using TLC assessed plethysmography (=TLC-Ads)

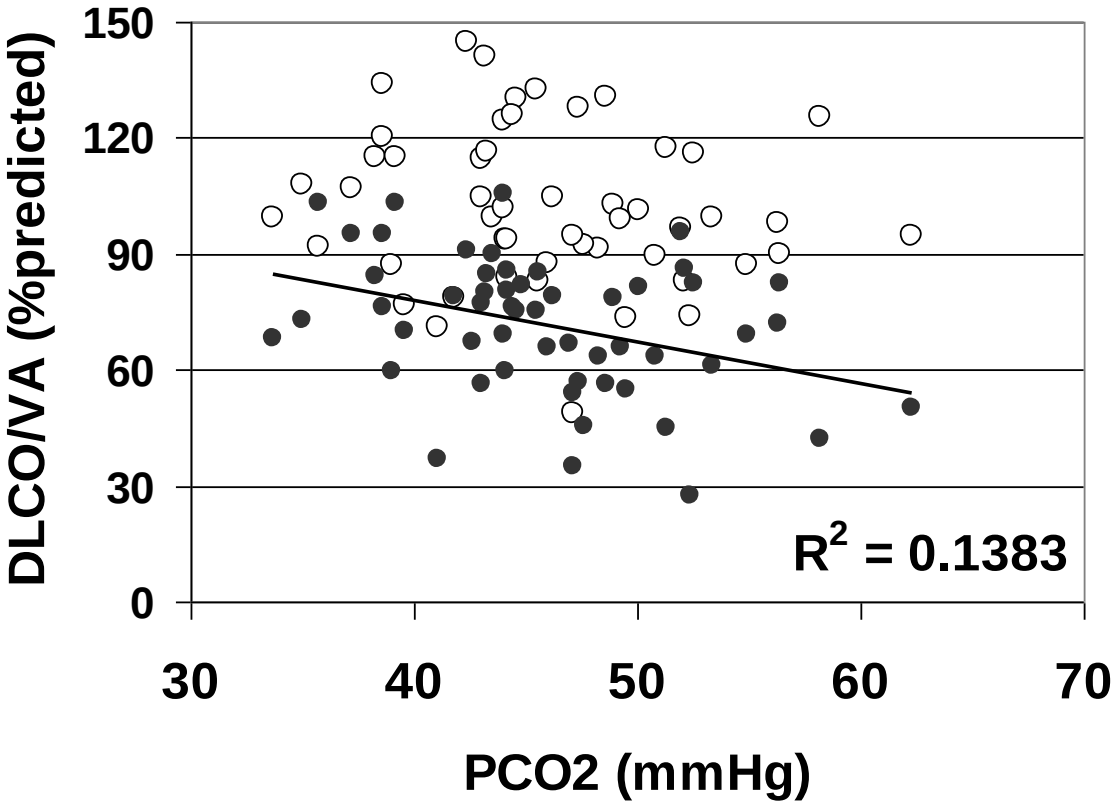
Spirometry	%predicted	zScore (GLI)
FVC	65 ±20	−2.92 ±1.20
FEV1	53 ±23	−3.74 ±1.72

	Inert gas DLCO	Plethysmography	P value
RV	91 ±47	207 ±68	0.0001
VA	73 ±21	99 ±18	
RV/VA	113 ±45	201 ±58	
FRC	75 ±29	137 ±31	
DLCO	71 ±18		
DLCO/VA	102 ±18	68 ±17	

Alveolar Volume and FEV1



DLCO/VA and blood PCO2 level



Conclusions

1. DLCO/VApleth follow spirometry indices deterioration and elevation of PCO2 level.

2. Deterioration in DLCO/VApleth begins when FEV1 was mildly reduced at value.

3. DLCO/VA_{SB} poorly corresponded to elevation in PCO2 level and remains mostly within the normal range because lung volumes measured by inert gas.

4. The findings may justify the use of VApleth measured at same occasion as $DLCO_{SB}$ and suggests that this motion may be clinically meaningful