# Symposium: Luchtige Kost?!


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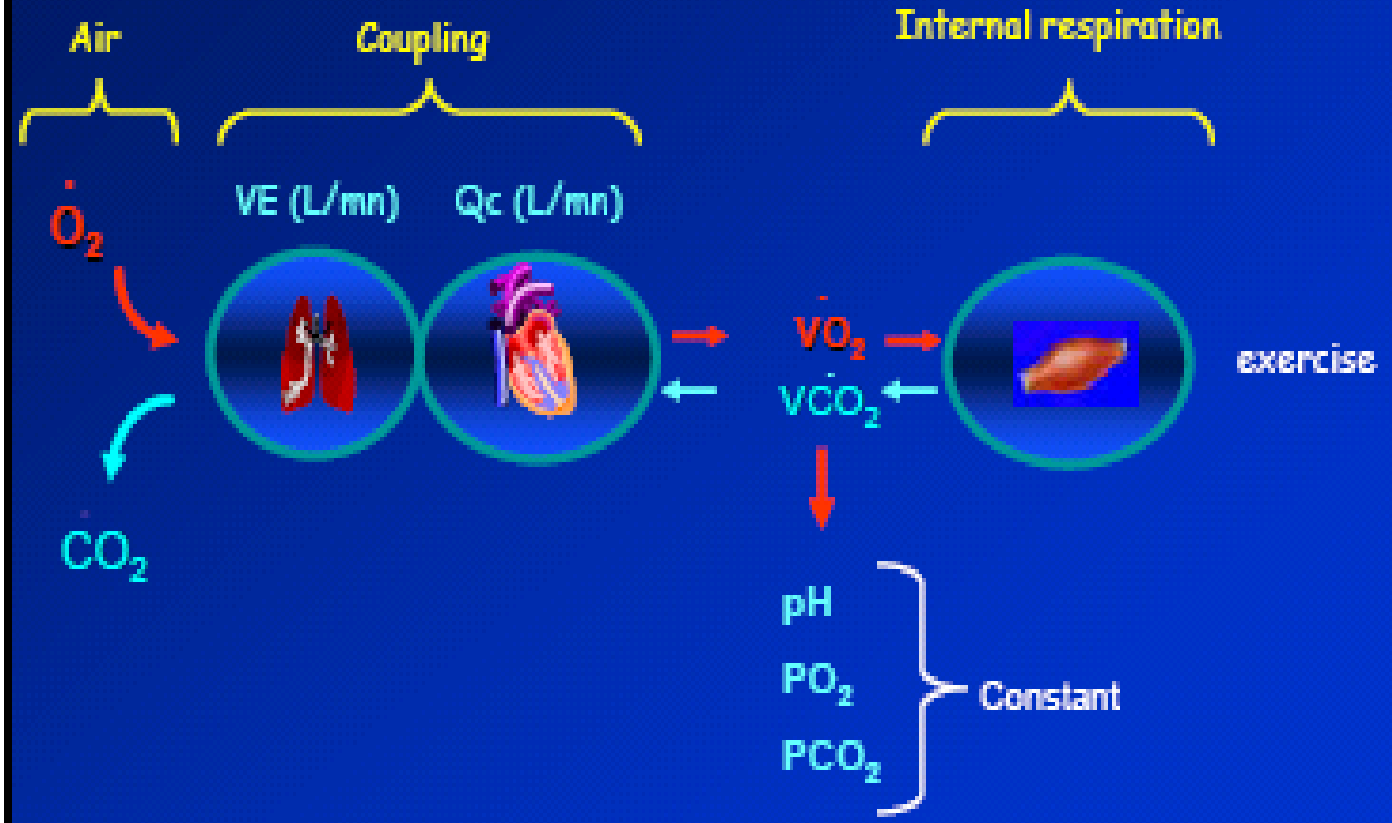
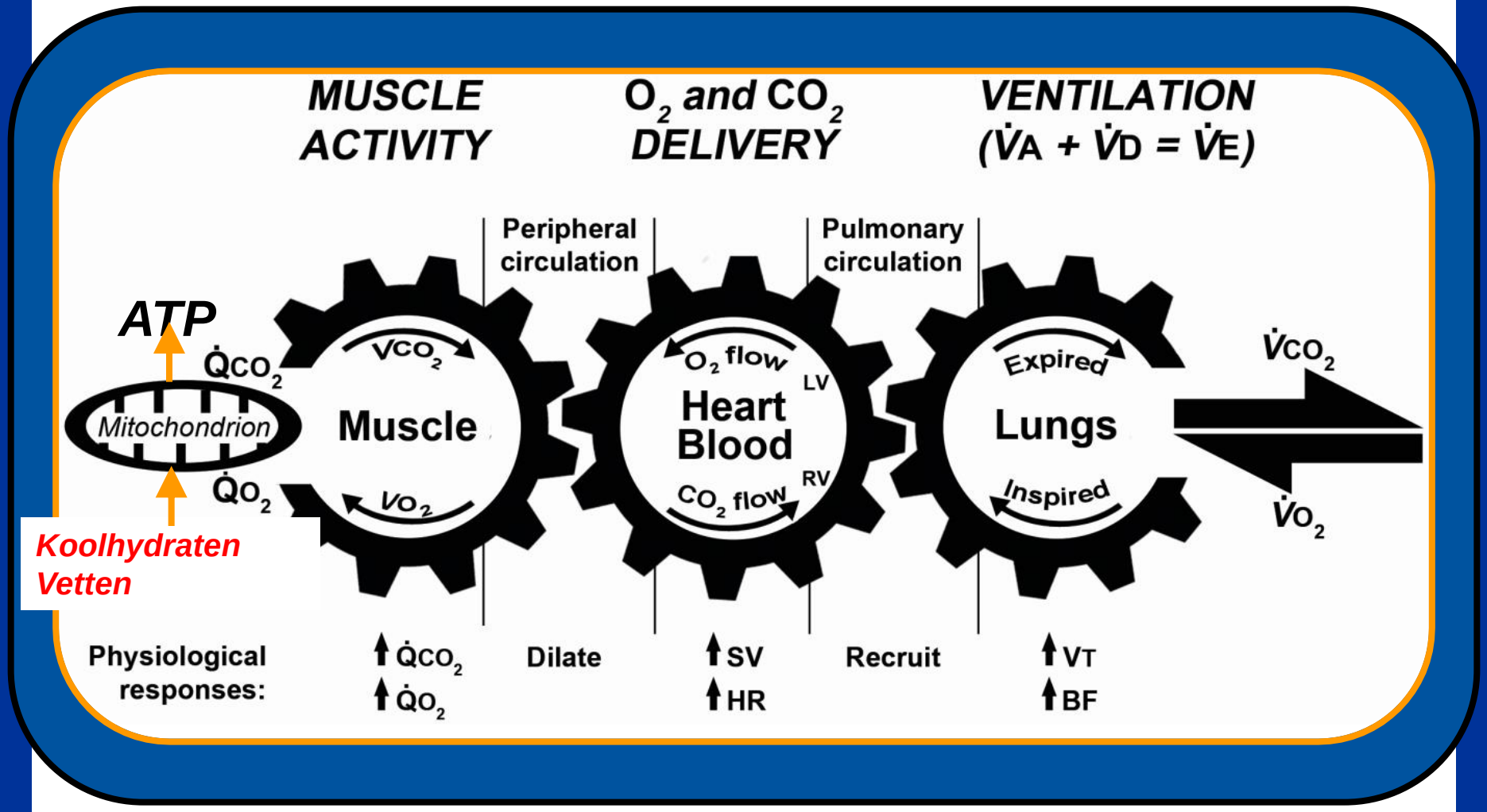
# Ventilation: a model of complexity

**At the beginning everything seems so simple:**

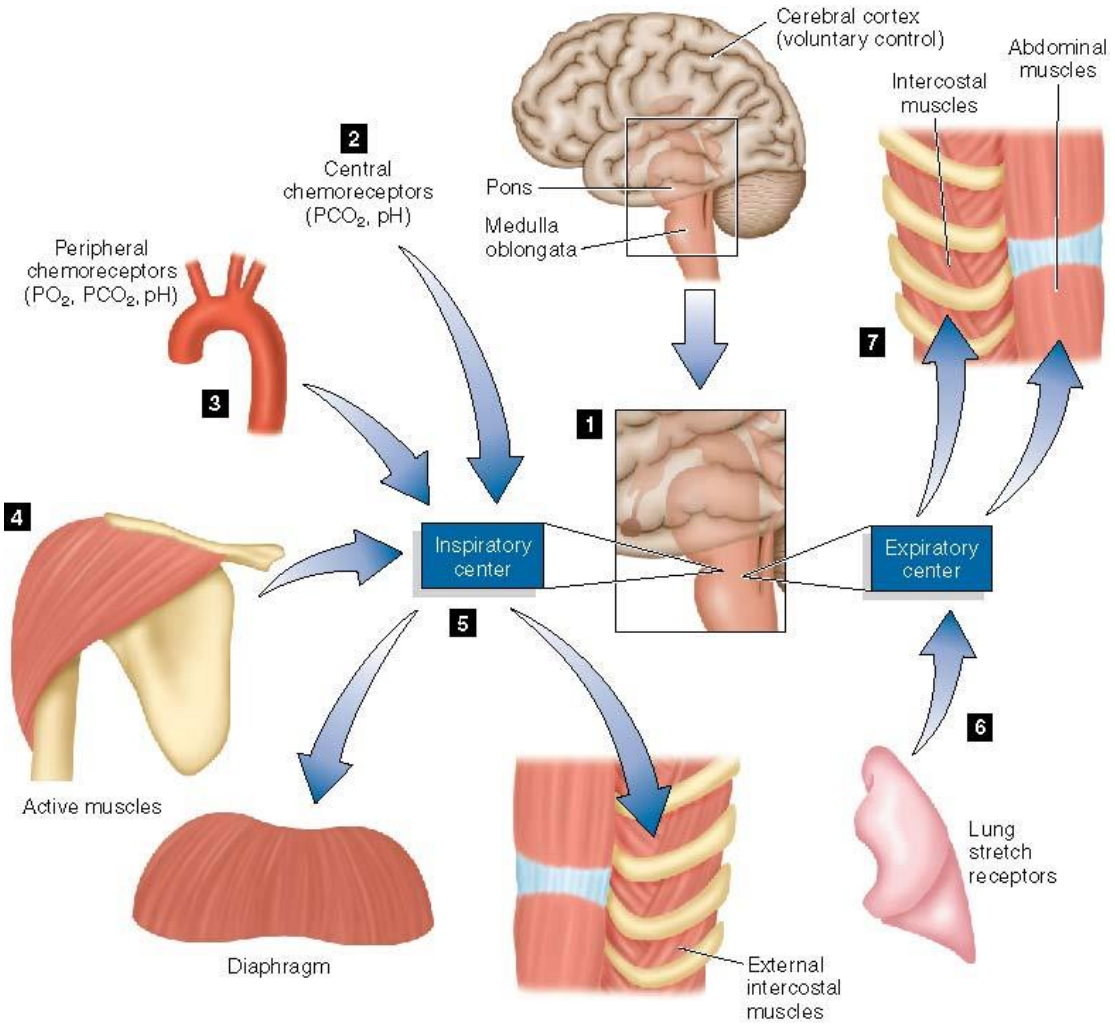


# Fysiologische respons bij spieractiviteit

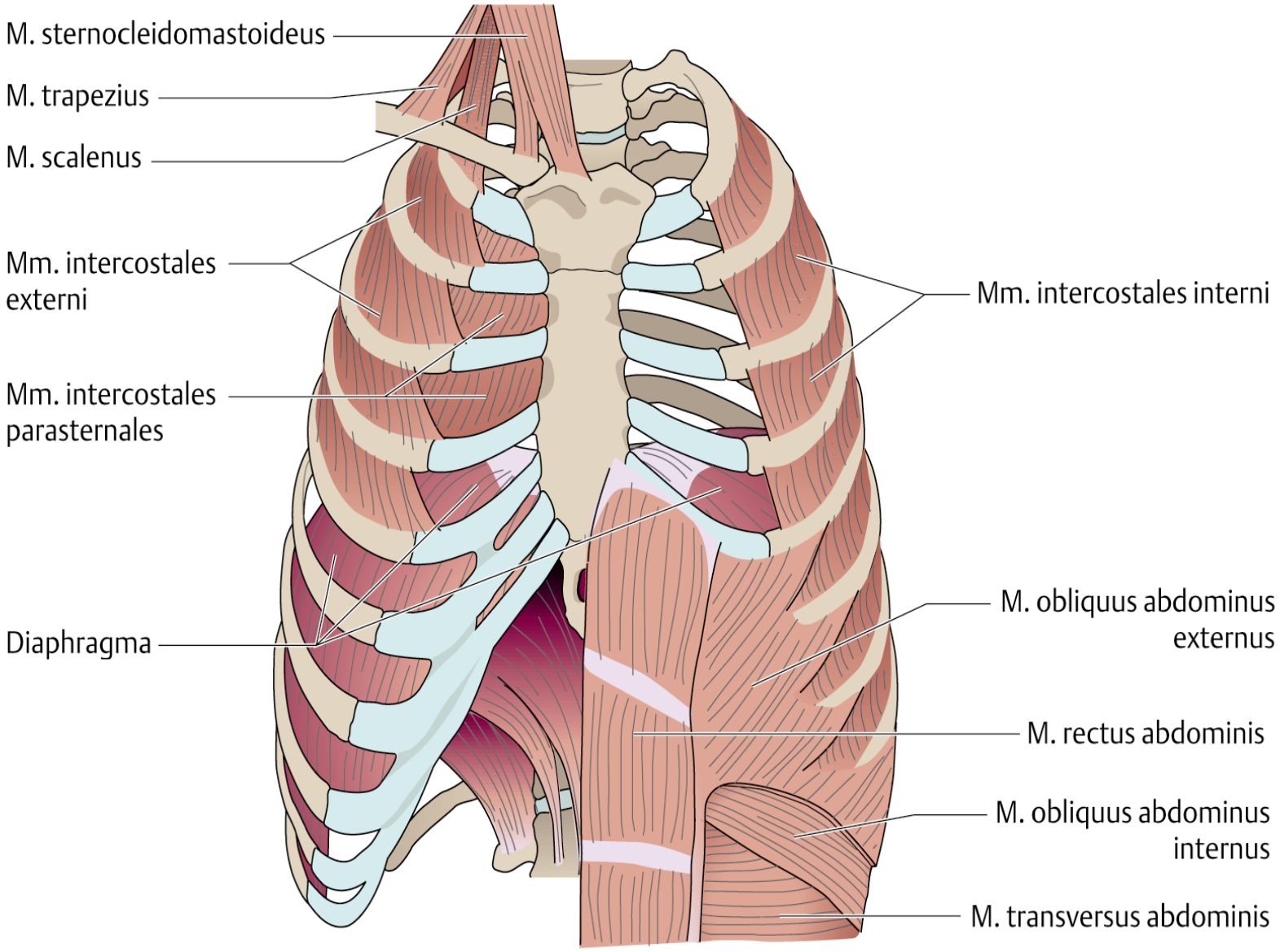



*Wasserman et al., 2005*

# Central and Peripheral Regulators of Respiration



# WHICH RESPIRATORY MUSCLES



# Ademminuutvolume (rust)

- $V_E$ = $V_T$ x f
- $V_{E\ rust}$ = 4 tot 9 liter
- $Bf_{rust}$ = 10 tot 15 keer p/min
- $V_T$ = 400 tot 600 ml

# Ademminuutvolume (inspanning)

- $V_{E\text{-}max}$ = 130 – 200 l/min (25-30x↑)
- $V_T$ : 5 tot 6 ↑ (IRV + ERV; 50%-60% VC)
- Bf : 1 tot 3 ↑ ($T_{Expiratory}$↓↓ en $T_{inspiratory}$↓)

# Ventilatoire overcapaciteit

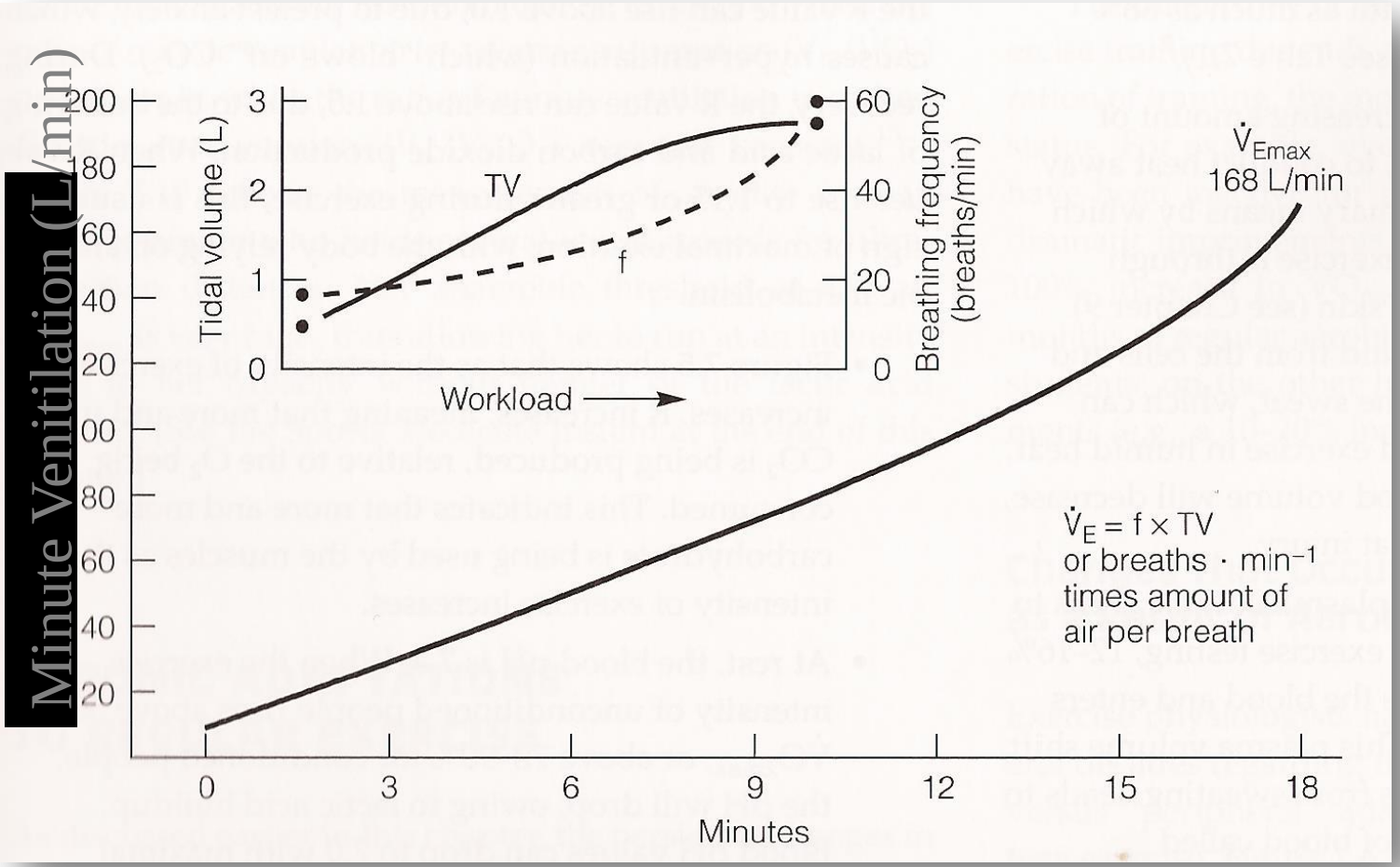
| | Rust | Maximale waarde |
|---|---|---|
| **Circulatie** | | |
| - Hartfrequentie (HF) | 60 – 80 p/min | 150 – 200 p/min |
| - Slagvolume (SV) | 0,06 – 0,08 L | 0,14 – 0,15 L |
| - Hartminuutvolume (HMV) | 4 – 6 L/min | 20- 30 L/min (factor 5) |
| **Ventilatie** | | |
| - Ademfrequentie (AF) | 12 – 16 p/min | 30 – 50 p/min |
| - Teugvolume (TV) | 0,3 – 0,5 L | 1,5 – 2,5 L |
| - Ademminuutvolume (AMV) | 5 – 12 L/min | 45 – 125 L/min (factor 25) |

# Zuurstofverbruik (in)ademspieren

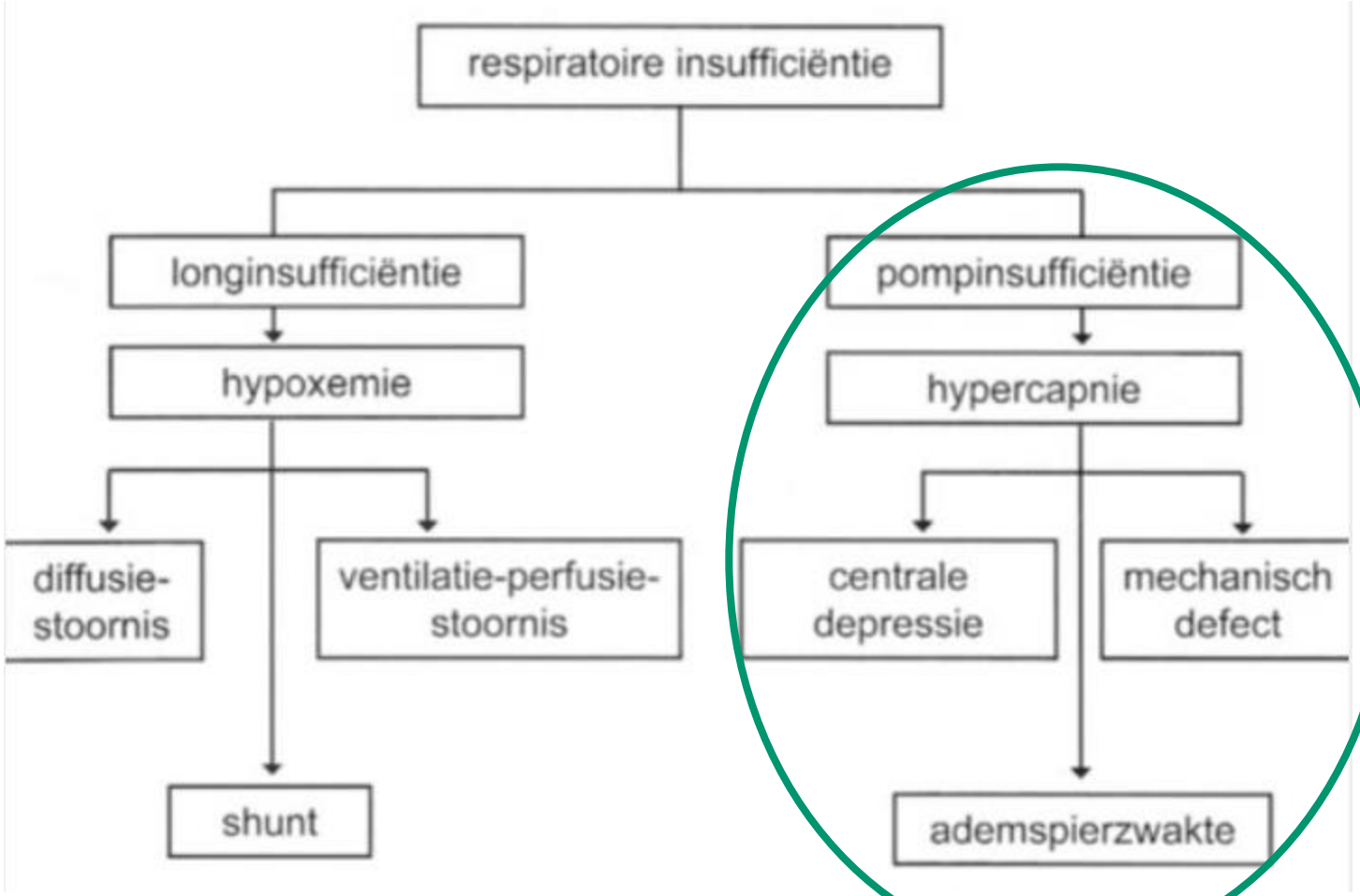
- **Rust : 1% - 2% van $VO_2$-max**
- **Arbeid : 10% - 15% van $VO_2$-max**
- **Herstel : 9% - 12% van $VO_2$-max**

- **$V_E$ / $VCO_2$-rust= 23 - 28 L / 1 L $O_2$-verbruik**
- **$V_E$ / $VO_2$-rust > 30 L / 1 L $O_2$-verbruik**
- **$O_2$-extractie = 80% max. inspanning**

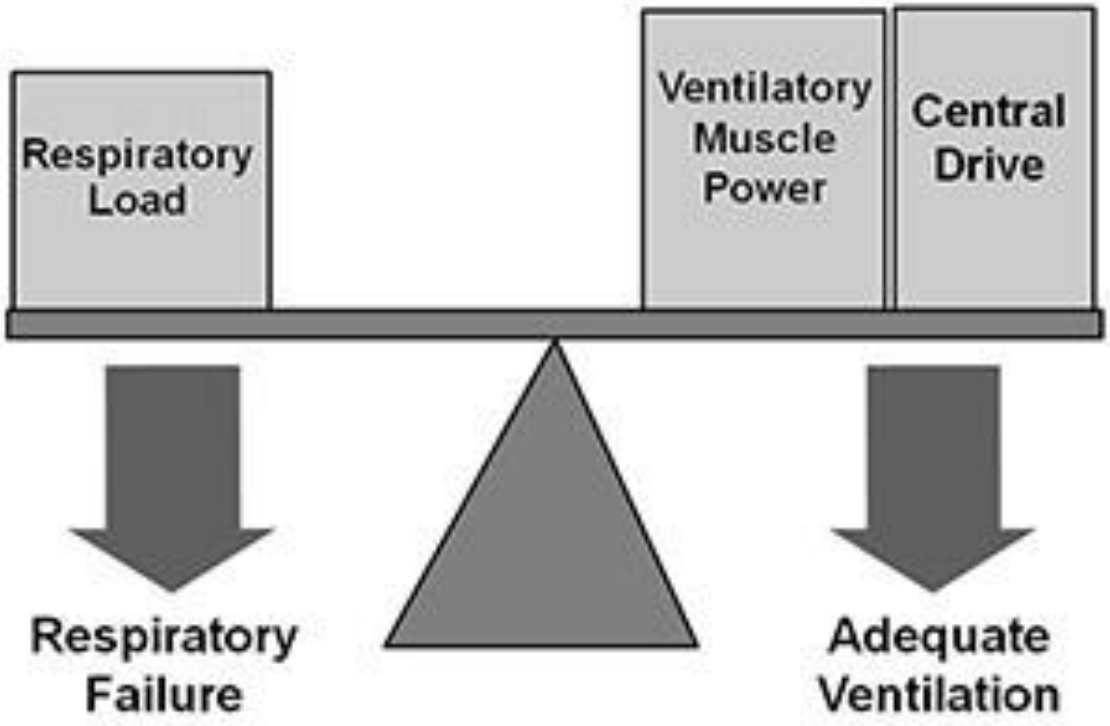
# Ademhaling en Inspanning

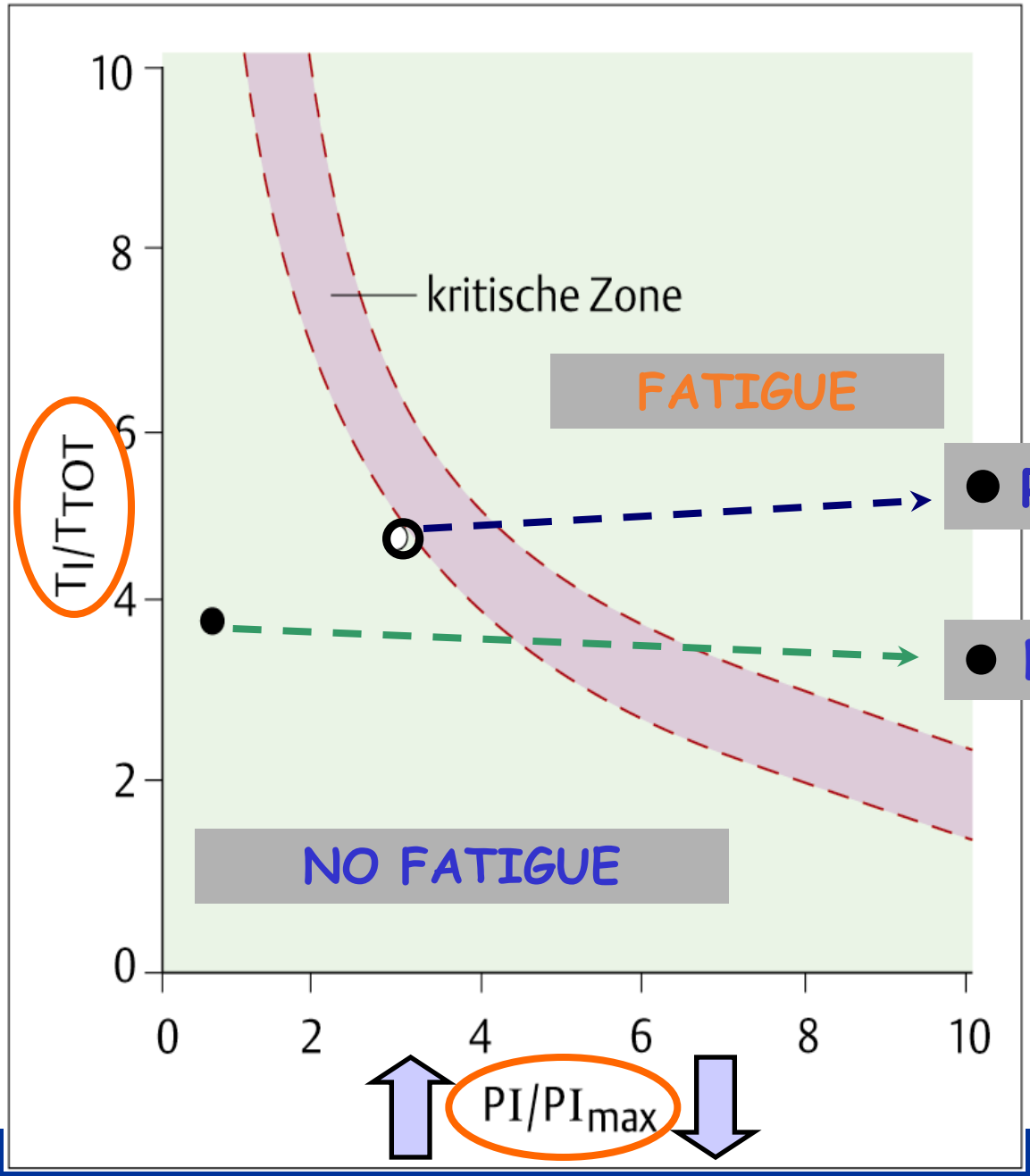



Ventilatie gereguleerd door $P_aCO2$

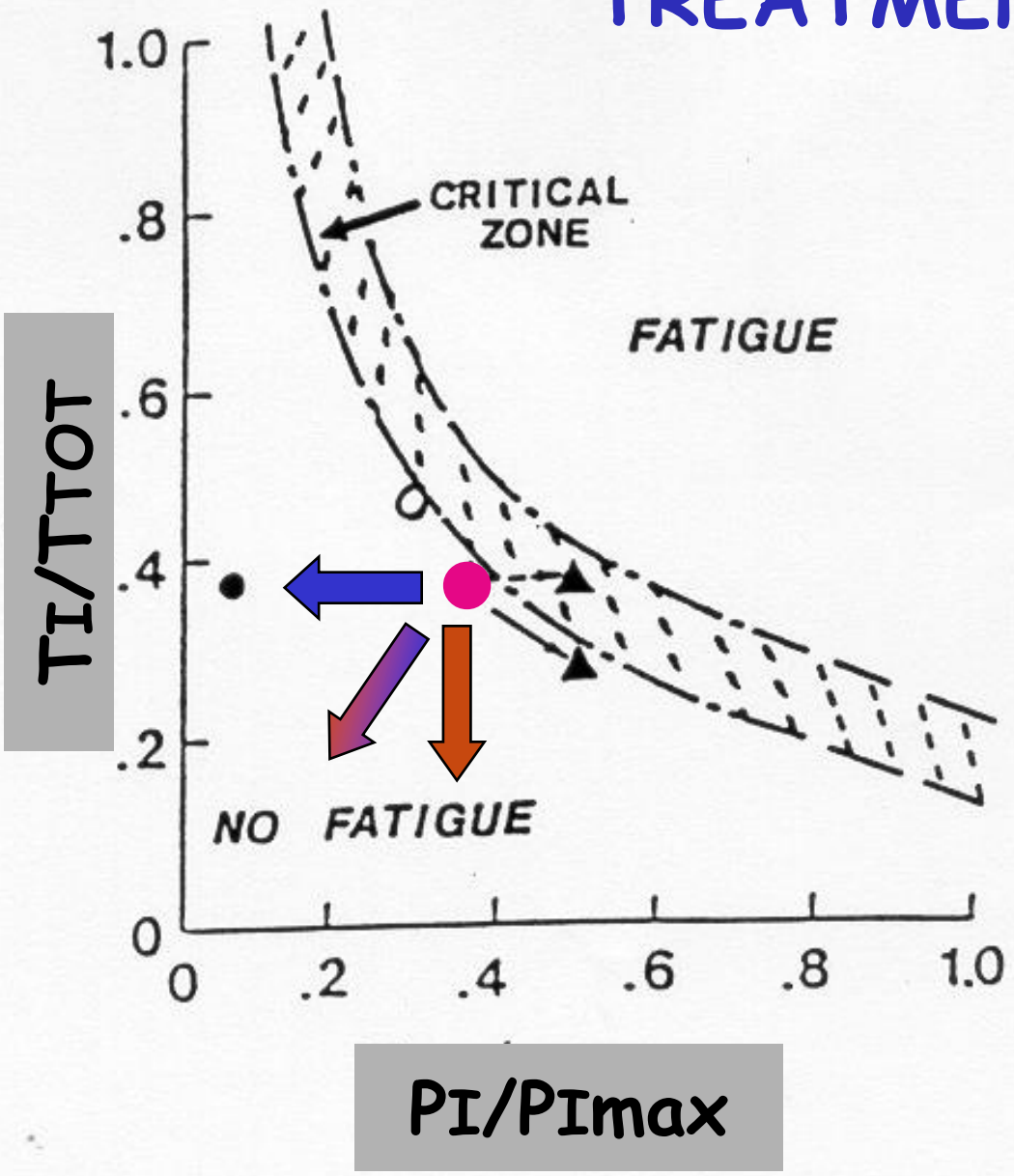

respiratoire insufficiëntie
longinsufficiëntie
pompinsufficiëntie
hypoxemie
hypercapnie
diffusie-stoornis
ventilatie-perfusie-stoornis
centrale depressie
mechanisch defect
shunt
ademspierzwakte

# The Respiratory Balance

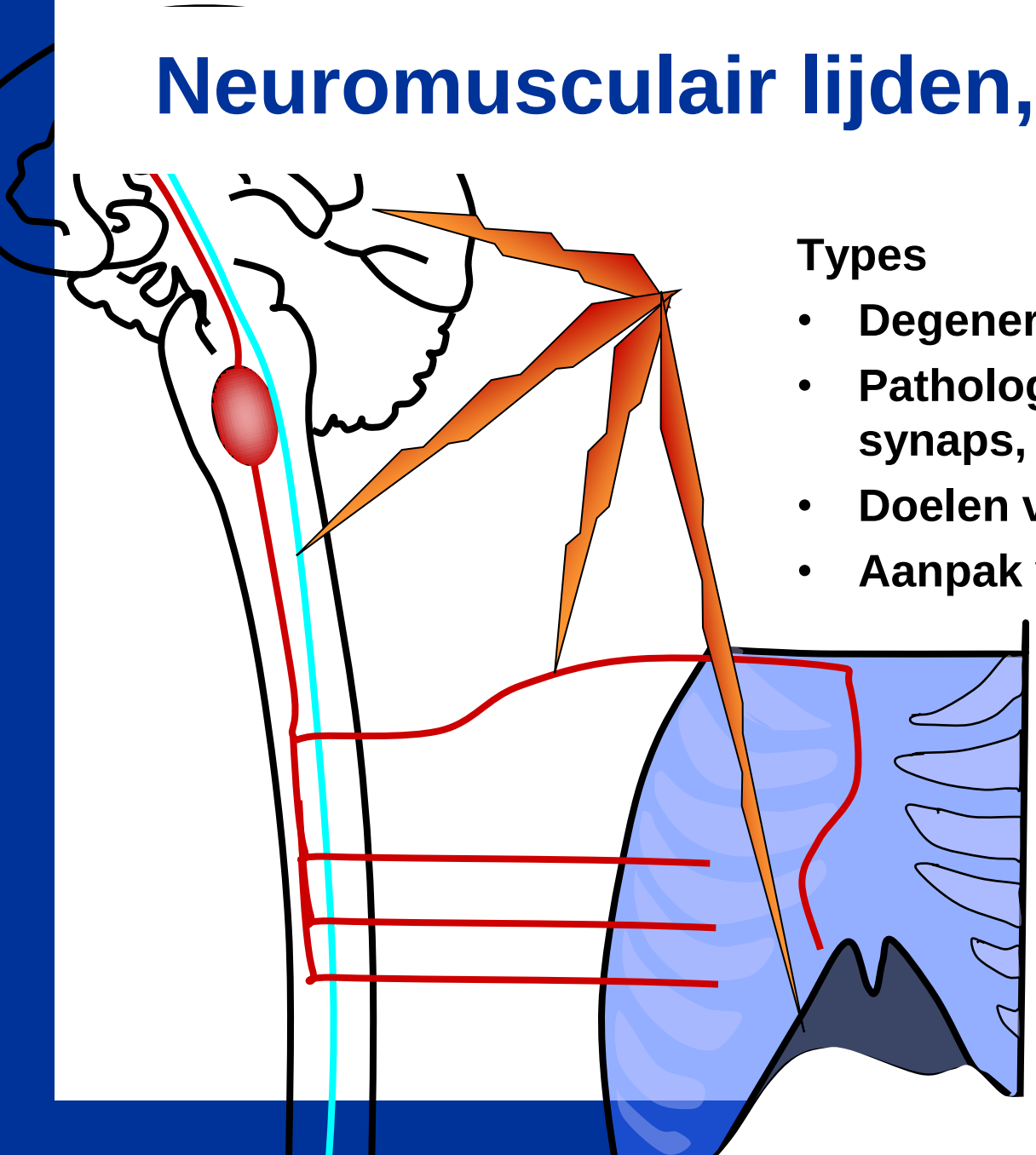



10
8
6
4
2
0
kritische Zone
FATIGUE
NO FATIGUE
$T_I/T_{TOT}$
0
2
4
6
8
10
$PI/PI_{max}$
Respiratory failure
NORMAL

# TREATMENT


1.0
.8
.6
.4
.2
0
0
.2
.4
.6
.8
1.0
CRITICAL ZONE
FATIGUE
NO FATIGUE
TI/TTOT
PI/PImax

# Neuromusculair lijden, brede term



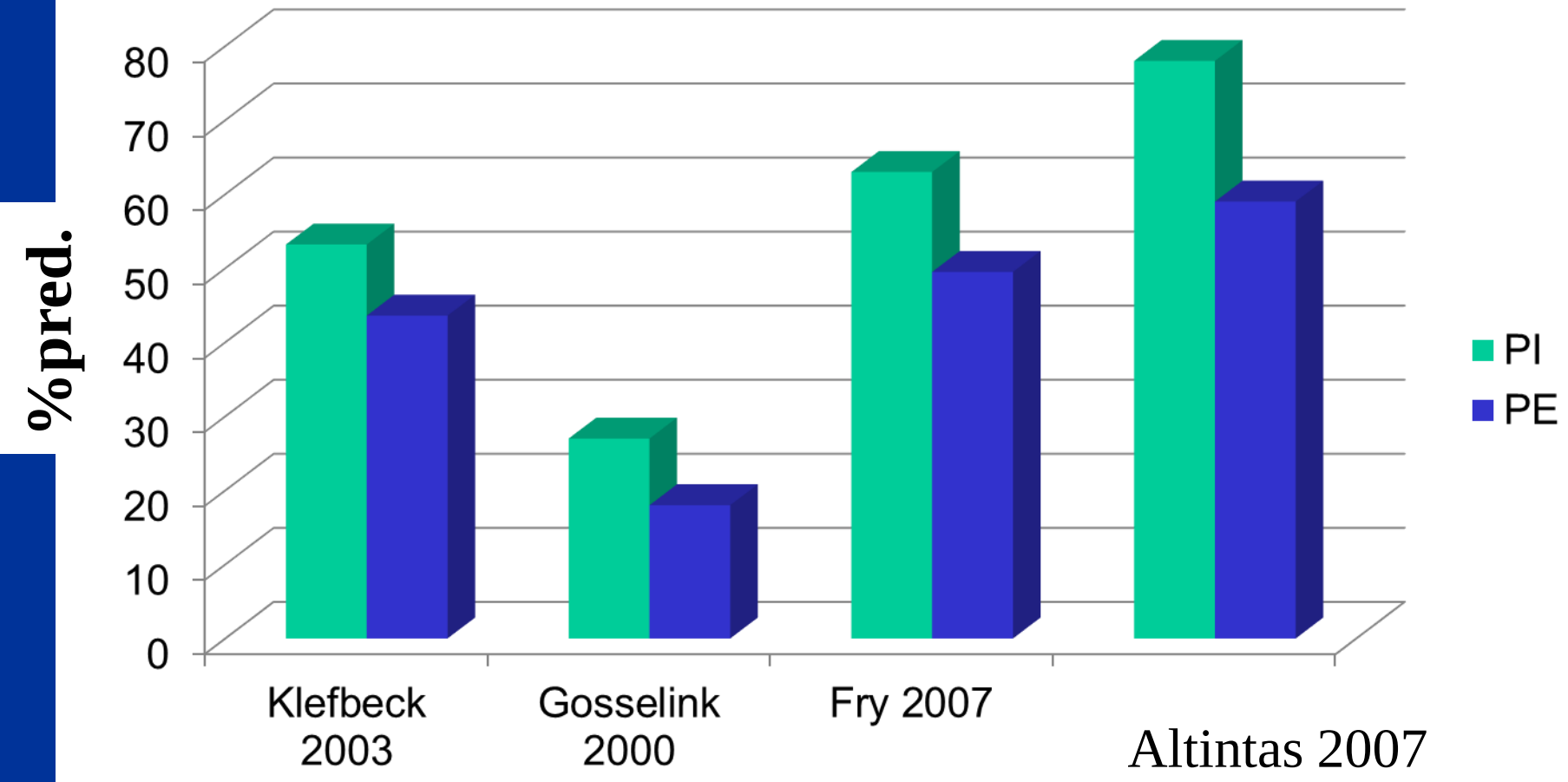
**Types**

- **Degeneratief – niet degeneratief**
- **Pathologie centraal, neuronaal, synaps, musculair**
- **Doelen verschillend!**
- **Aanpak verschillend?**

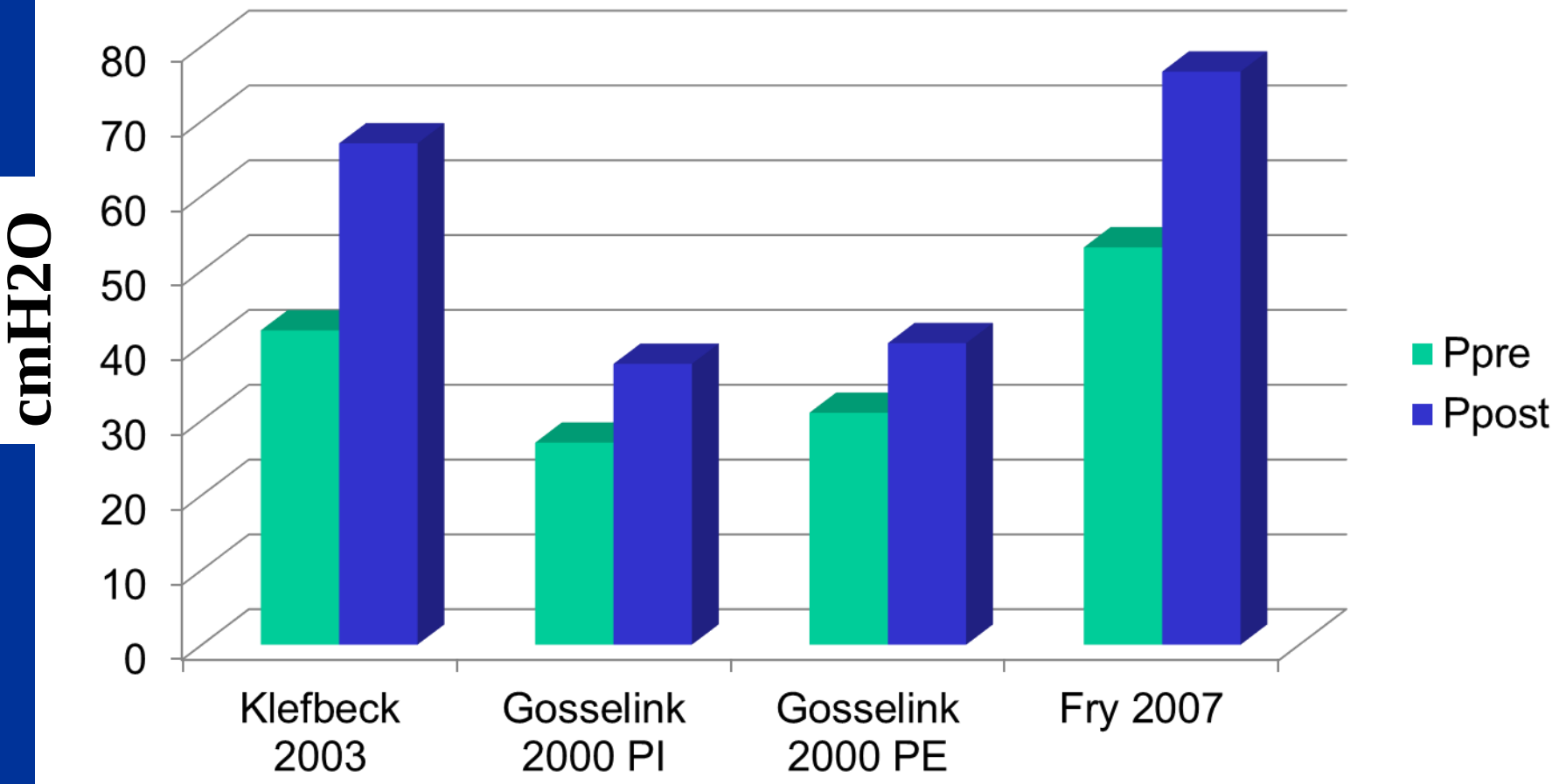
# Multiple sclerosis

- **Degenerative disease; chronic inflammatory disease of CNS**
- **Clinical path variable**
- **Demyelination and scarring Central nervous system and spinal cord**
- **20% of patients who die <50yrs die of respiratory problems (pneumonia/influenza)**

# Inspiratory /expiratory muscle strength MS

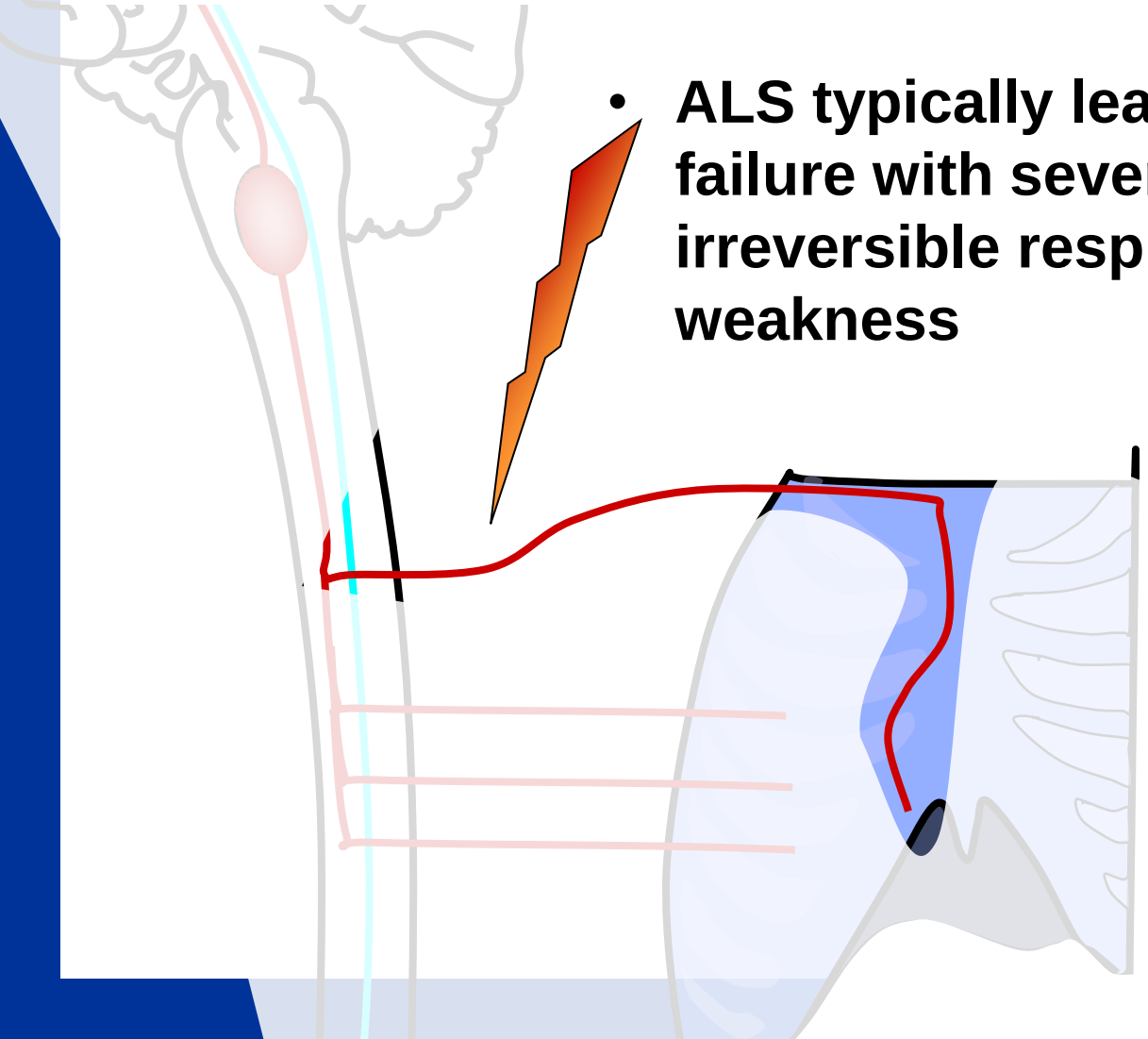


# Inspiratory / expiratory muscle training MS

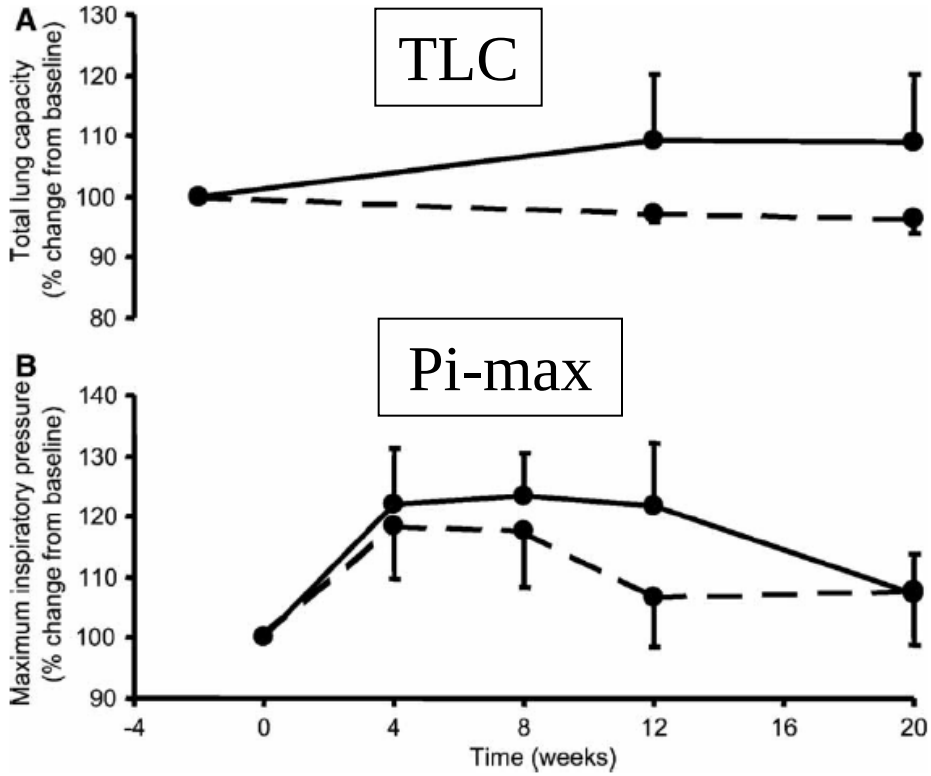


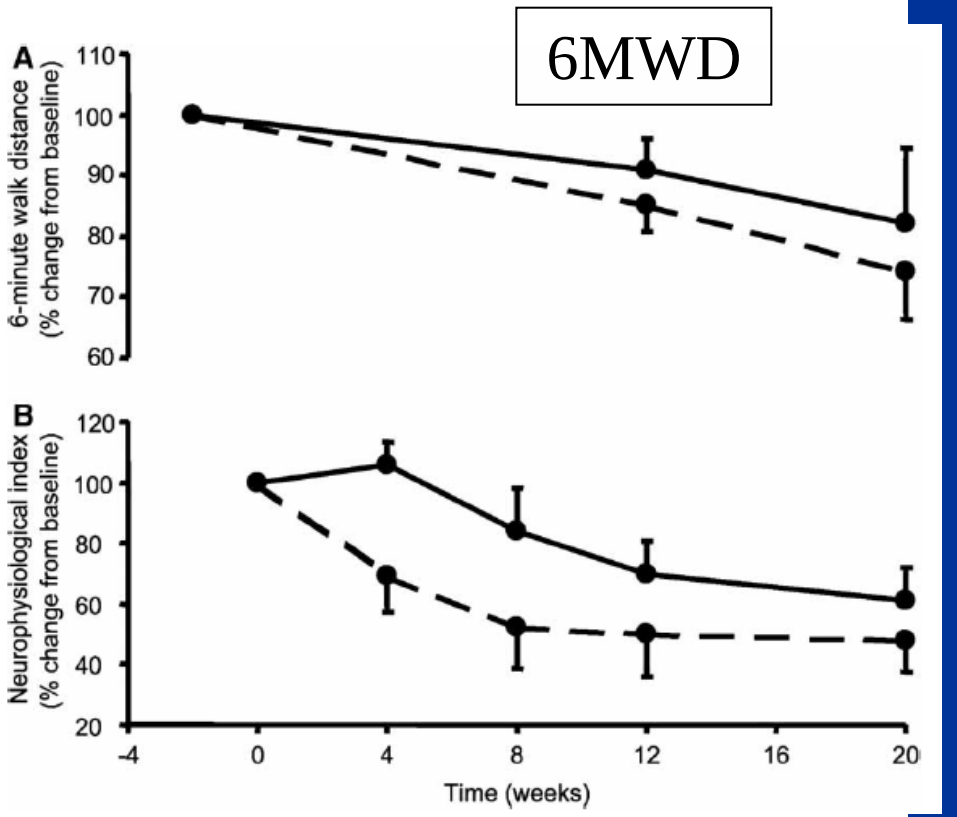
# Motor Neuron diseases e.g. ALS

- **ALS typically leads to ventilatory failure with severe and irreversible respiratory muscle weakness**



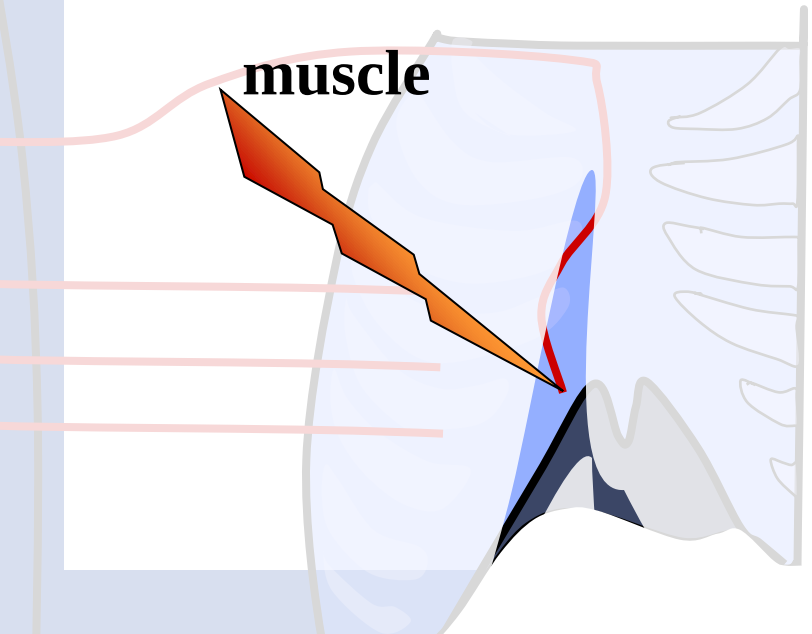
# IMT in ALS

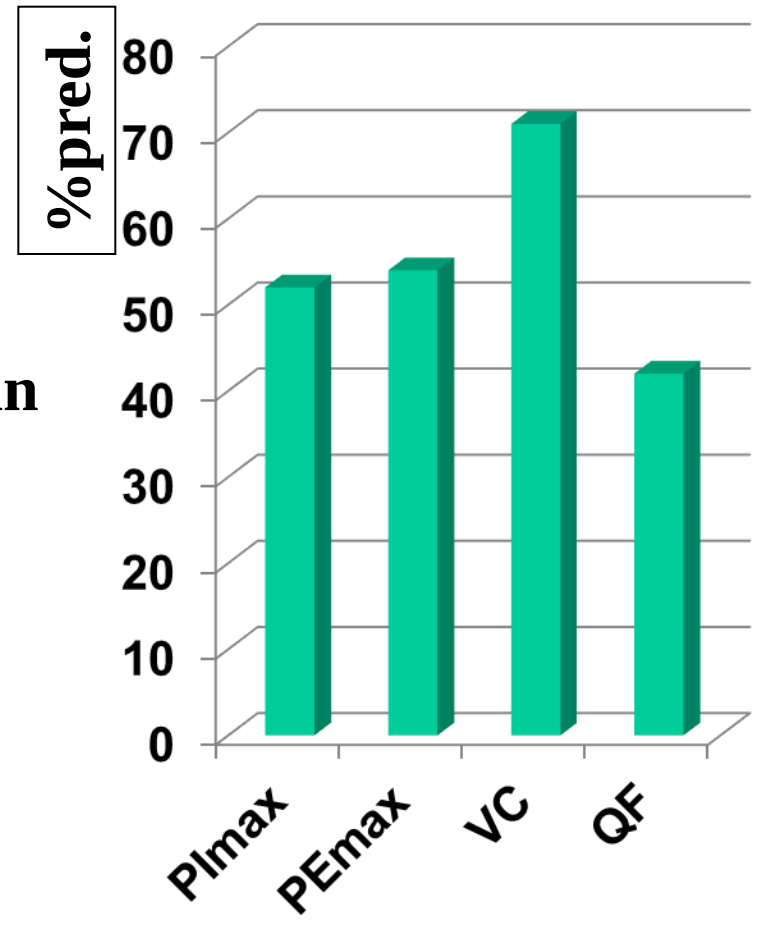

A
Total lung capacity (% change from baseline)
130
120
110
100
90
80
TLC
B
Maximum inspiratory pressure (% change from baseline)
140
130
120
110
100
90
Pi-max
-4
0
4
8
12
16
20
Time (weeks)


6MWD
A
6-minute walk distance (% change from baseline)
110
100
90
80
70
60
B
Neurophysiological index (% change from baseline)
120
100
80
60
40
20
-4
0
4
8
12
16
20
Time (weeks)

# ‘Synaps’ problems (Myasthenia Gravis)

- neuromuscular transmission
- steroid myopathy
- necrosis, atrophy,
- accumulation of lymphocytes in muscle



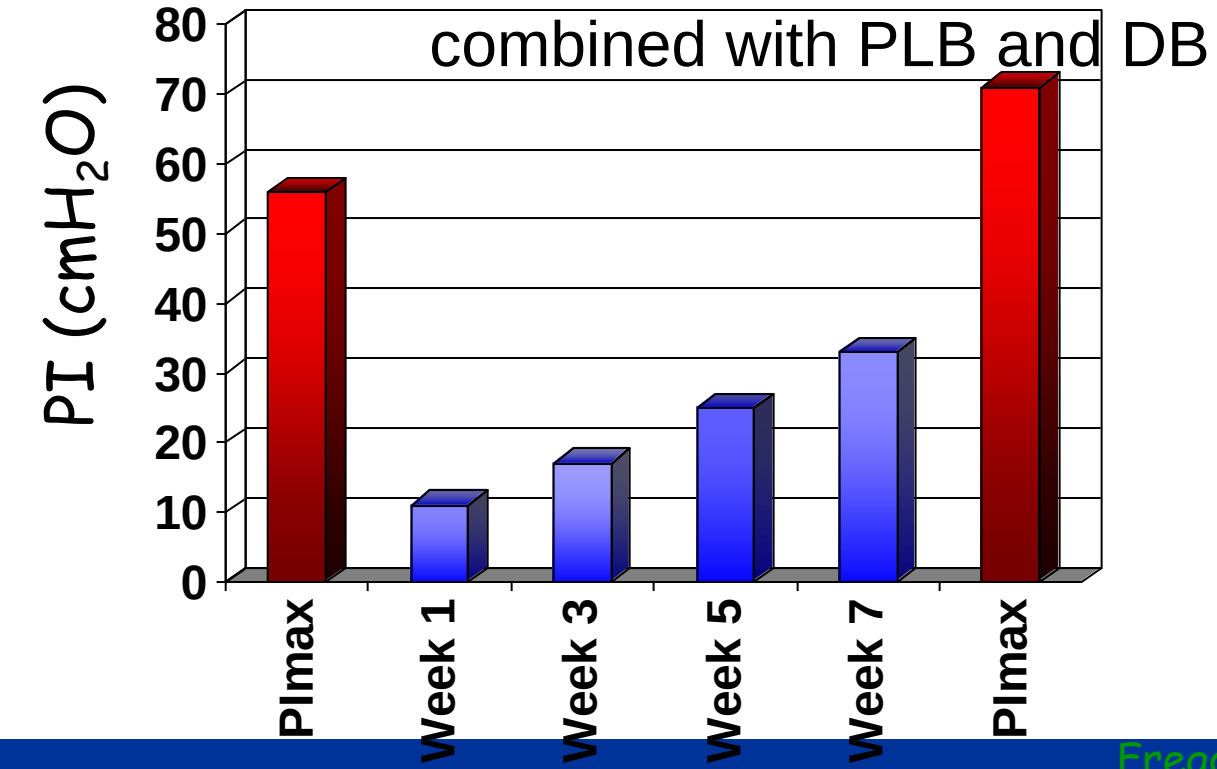



Mier-Jedrzejowicz ARRD 198

# Respiratory muscle training in Myasthenia Gravis

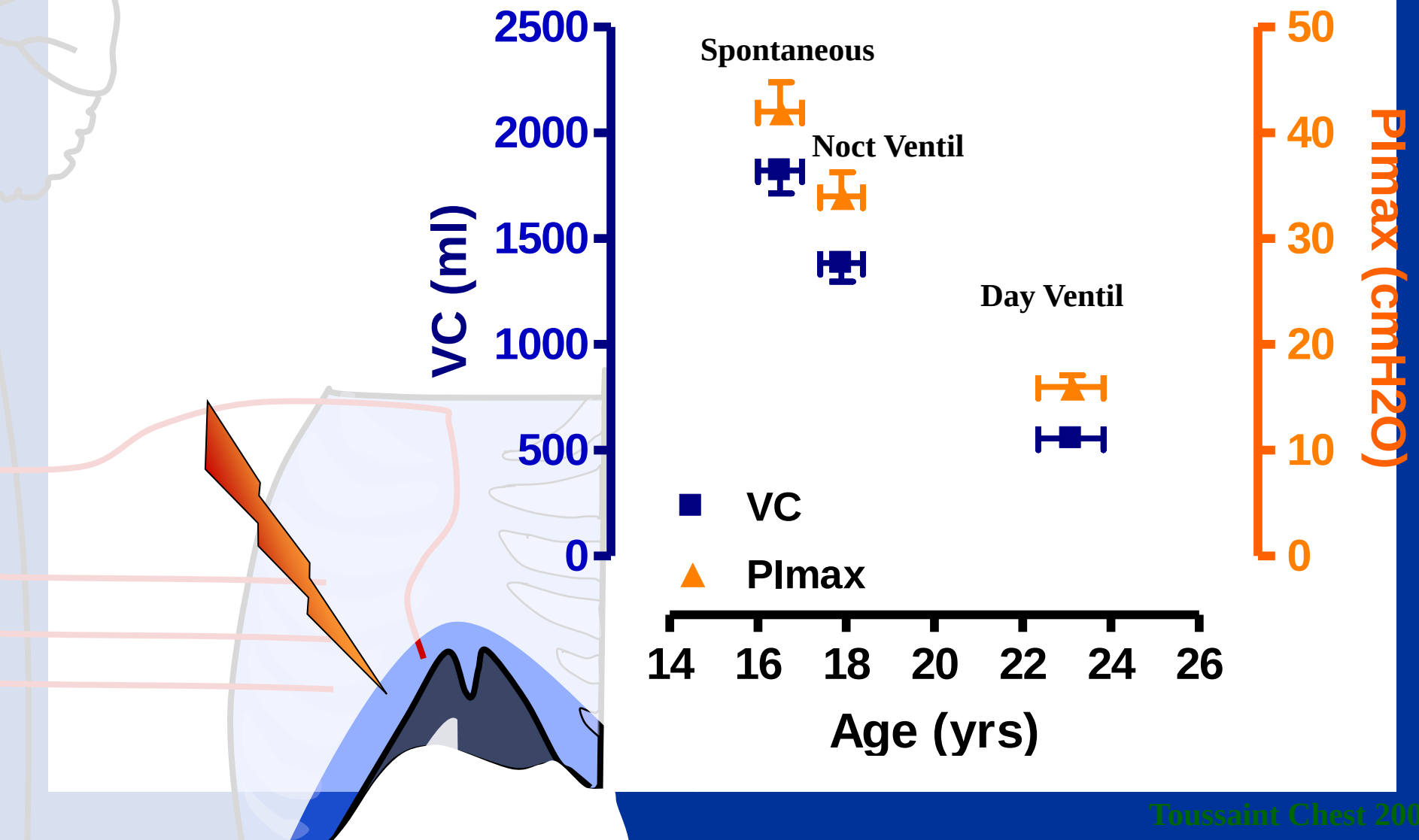
- **Training program: 3/wk**

Interval 5x2 min/day Threshold training combined with PLB and DB

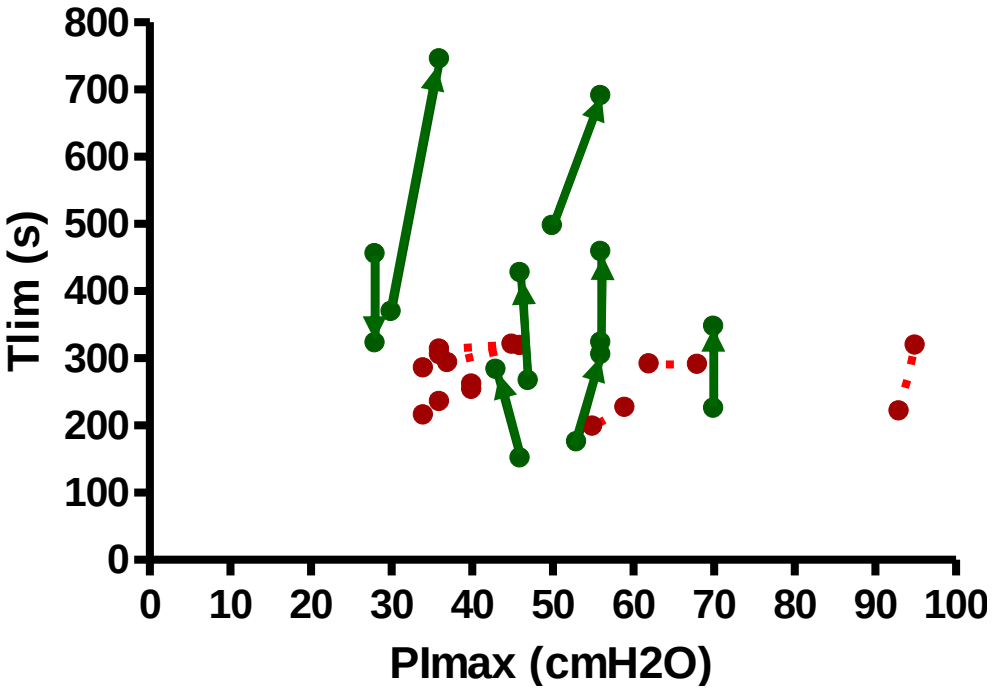



Fregonesi Chest 2005

# Muscular dystrophy (Duchenne)



# Respiratory Muscle training DMD

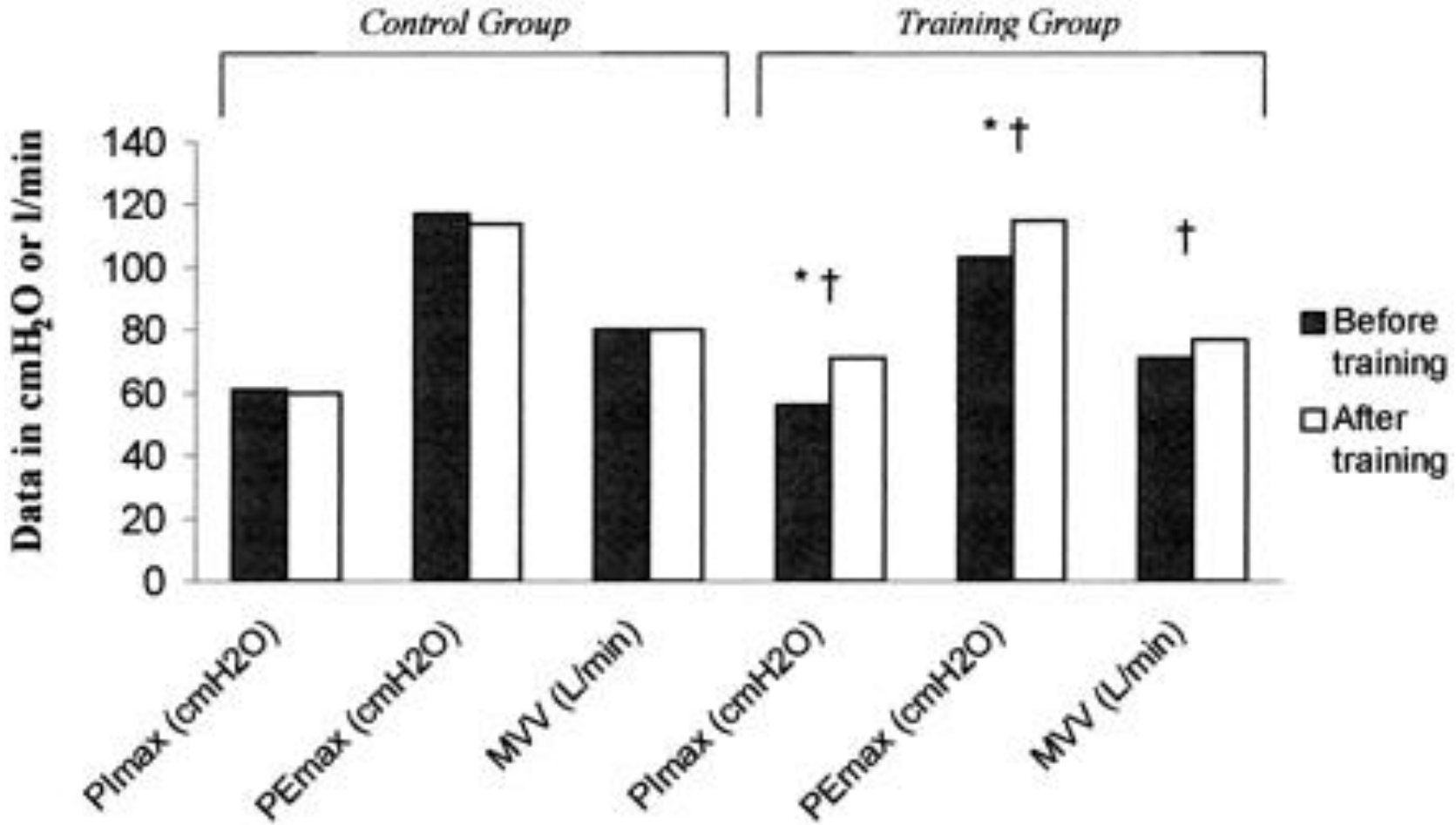



| | Training n=8 | Sham n=8 |
|---|---|---|
| Age (yr) | 14.7 | 12.6 |
| VC (ml) | 1790 | 1920 |
| $P_{imax}$Pre(cmH2O) | 48 | 52 |
| $P_{imax}$Post(cmH2O) | 49 | 50 |

**10 min 2/day**
**30% PImax**
**6 weeks**

Topin Neuromuscular Disorders 2002

# Respiratory muscle training in neuromuscular disease




Improvement in HRQoL (SF 36) in some domains

Fregonesi Chest 2005

# Conclusions

- **IMT in neuromuscular disease tends to enhance respiratory muscle function. Final evidence is not available**
- **Training can be set up as in other chronic diseases**
- **Normocapnic hyperventilation can be used when enhancing MVV is a goal.**
- **Transfer to functional benefits (survival / time to NIMV) is uncertain.**

# Vragen?