INSPIRATORY MUSCLE TRAINING IN ICU PATIENTS WITH FAILURE TO WEAN

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réanimation 2024
PARIS 12-14 JUIN

DÉCLARATION DE LIENS D'INTÉRÊT POTENTIELS

réanimation 2024
PARIS 12-14 JUIN

Beatrix CLERCKX, Leuven

☑ Je n'ai pas de lien d'intérêt potentiel à déclarer

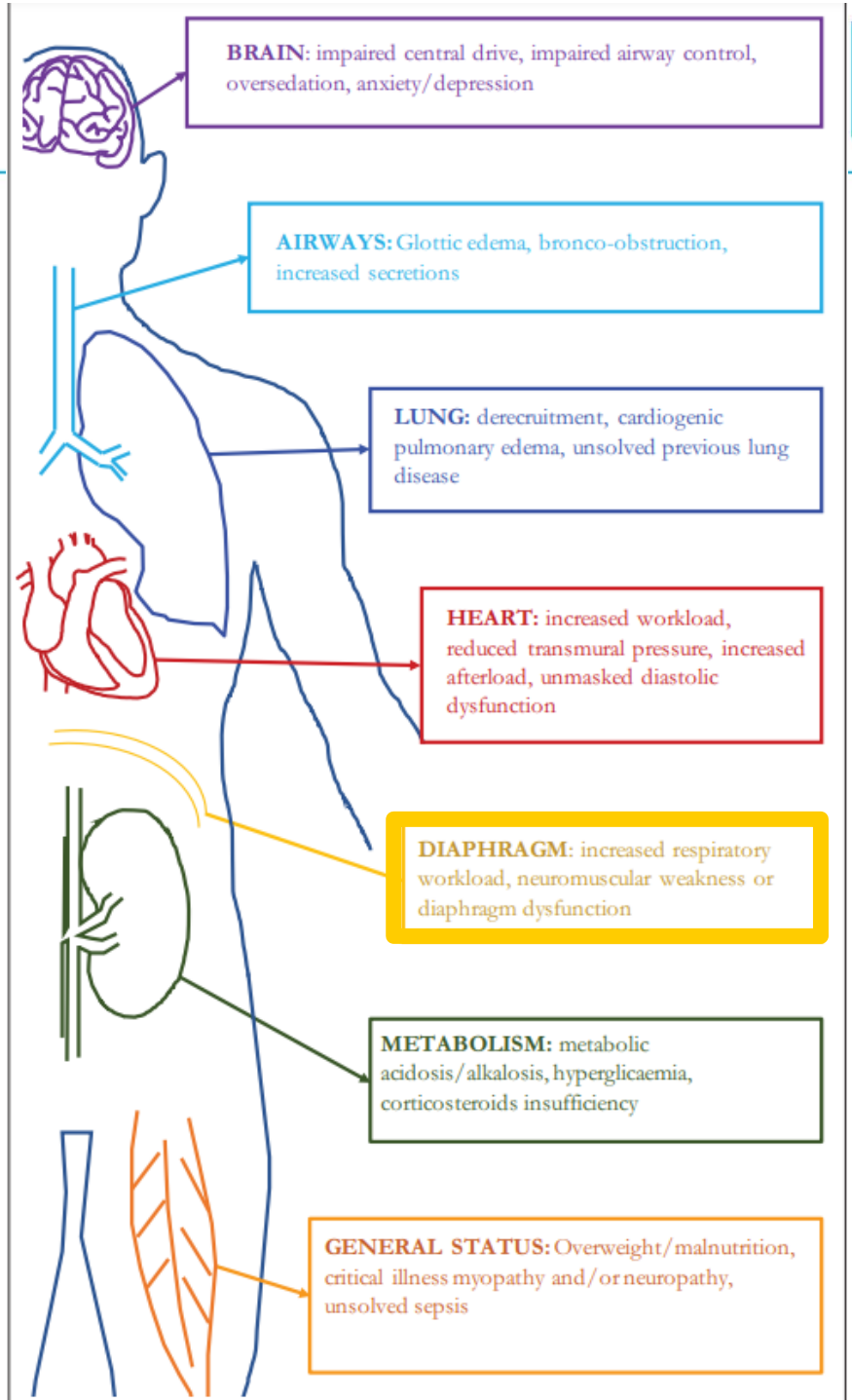
Can Inspiratory muscle training improve weaning outcomes in difficult to wean patients?

PRO - CON DEBATE

NOT ONLY BLACK AND WHITE

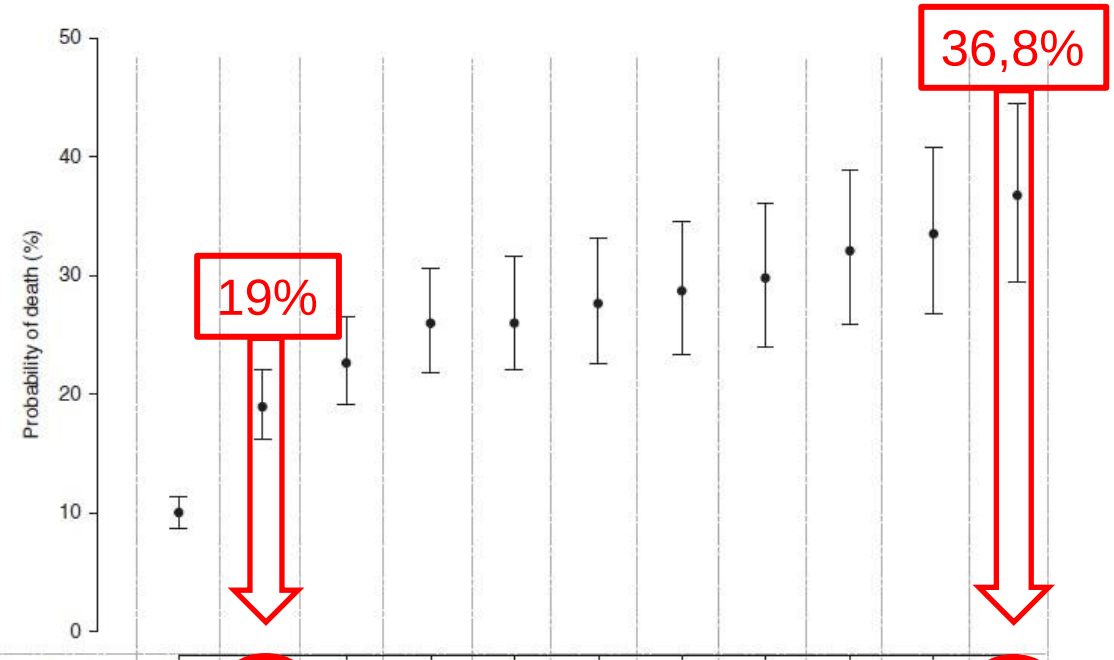

BUT A LOT OF GREY

Common mechanisms leading to weaning failure



Santangelo E et al. Curr Opin Crit Care 2022

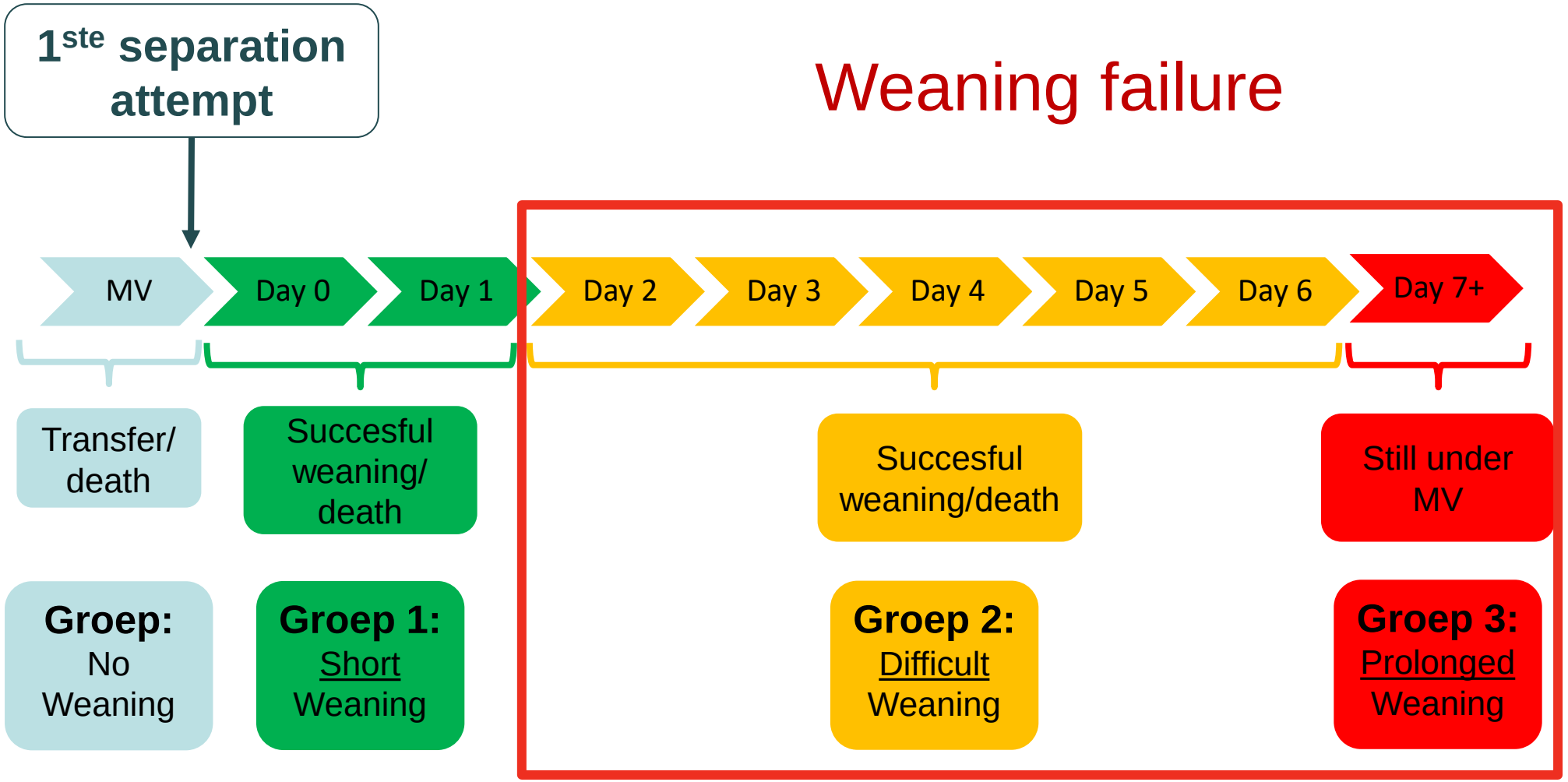
The longer
the weaning duration
the higher
the mortality rate!



Days after the 1st SA	0	1	2	3	4	5	6	7	8	9	10
Nb at risk*, N	2,051	723	508	404	342	293	268	235	212	188	166
Group 1, N	1,543	215	0	0	0	0	0	0	0	0	0
(%)	(75.2)	(29.7)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Group 2, N	273	273	273	169	107	58	33	0	0	0	0
(%)	(13.3)	(37.8)	(53.7)	(41.8)	(31.3)	(19.8)	(12.3)	(0)	(0)	(0)	(0)
Group 3, N	235	235	235	235	235	235	235	235	212	188	166
(%)	(11.5)	(32.5)	(46.3)	(58.2)	(68.7)	(80.2)	(87.7)	(100)	(100)	(100)	(100)

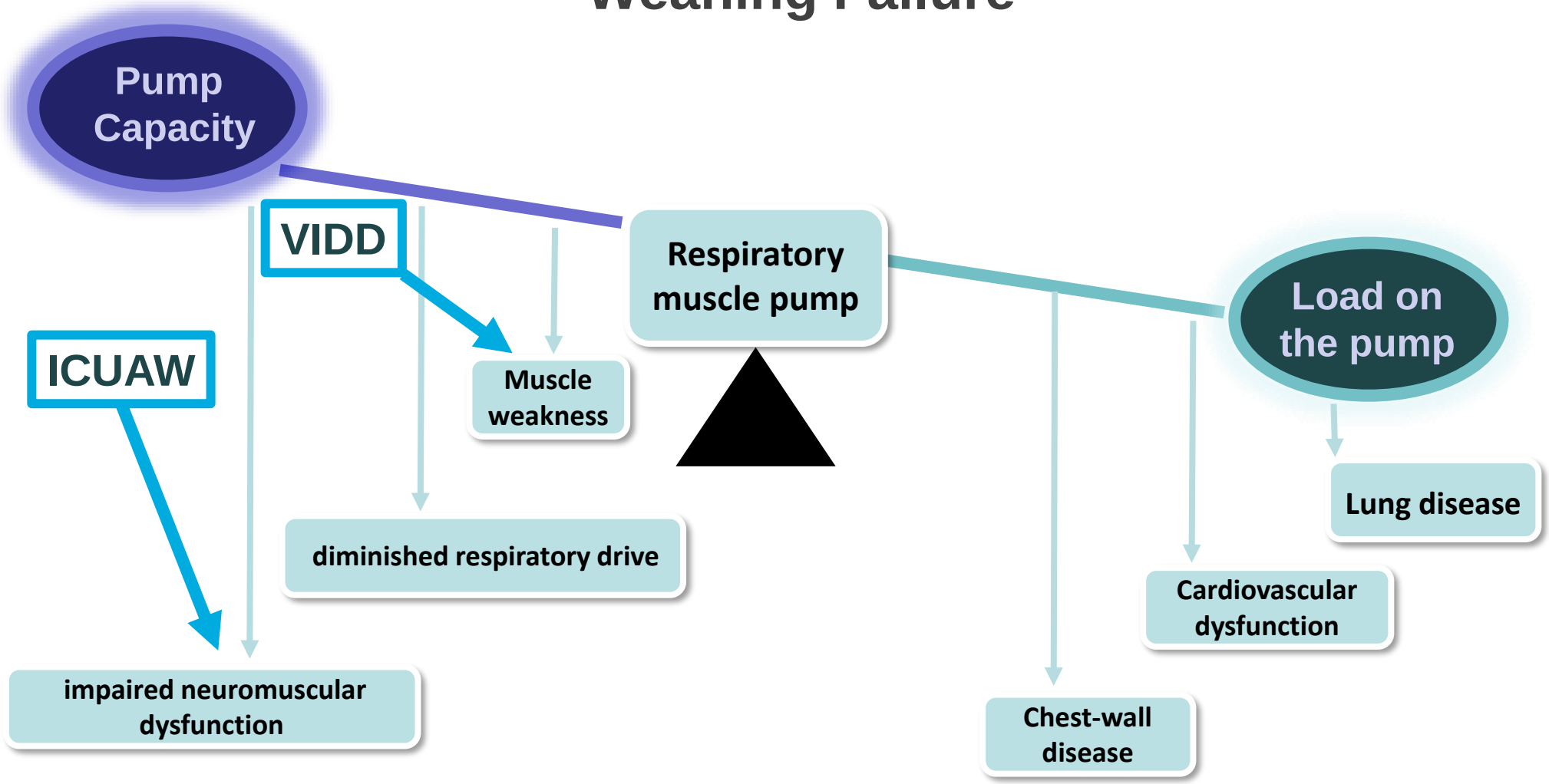
Beduneau G, et al. Am J Respir Crit Care Med 2017

New classification: WIND study



Beduneau G, et al. Am J Respir Crit Care Med 2017

Weaning Failure



After Moxham J.

Task: training of inspiratory muscles

- **Assessement**
- Training
  - Endurance training
  - Additional strength training (IMT)

Objective measurements

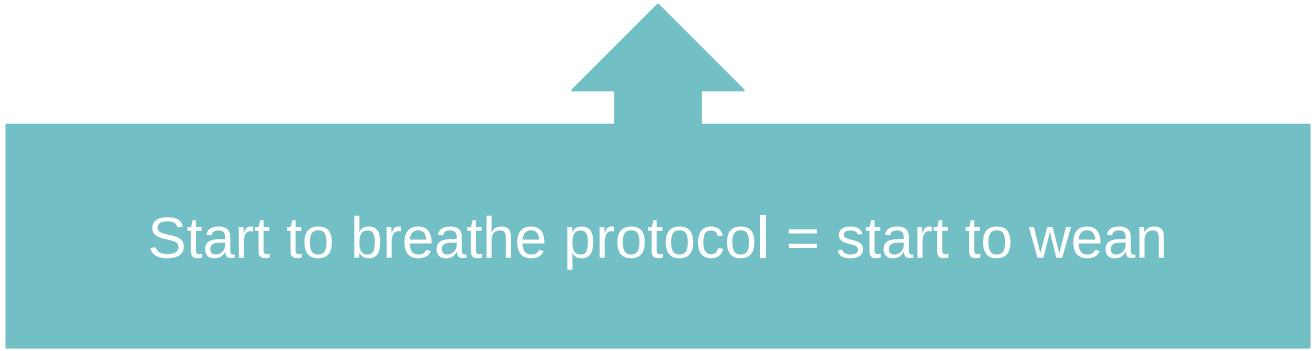
Considerations for assessing readiness to wean	
	Adequate oxygenation
	S_{a,O_2} >90% on ≤F_{I,O_2} 0.4 (or $P_{a,O_2}/F_{I,O_2}$ ≥150 mmHg)
	PEEP ≤8 cmH_2O
	Adequate pulmonary function
	f_R ≤35 breaths·min^{-1}
	MIP ≤-20– -25 cmH_2O
	V_T >5 mL·kg^{-1}
	VC >10 mL·kg^{-1}
	f_R/V_T <105 breaths·min^{-1}·L^{-1}
	No significant respiratory acidosis

J-M. Boles et al. Eur. Resp. J. 2007; 29: 1033-1056

Task: training of inspiratory muscles

- Assessement
- **Training**
  - Endurance training
  - Additional strength training (= IMT)

In analogy with the UZL ‘start to move ASAP’ protocol



Gosselink R. et al. Netherlands J Crit Care. 2011; 15(2):1-10

Endurance training: Start to breathe protocol

3 activities:

- Spontaneous breathing
- Cycling with legs, arms (bed-chair)
- Chair (in bed/out of bed)

→ first activities separately
→ 2 activities at the same time
→ 3 activities at the same time

Strength training: IMT

Intermittent loading of the respiratory muscles

AIM = increasing strength of the inspiratory muscles

IMT devices: MTL - TFRL

Threshold

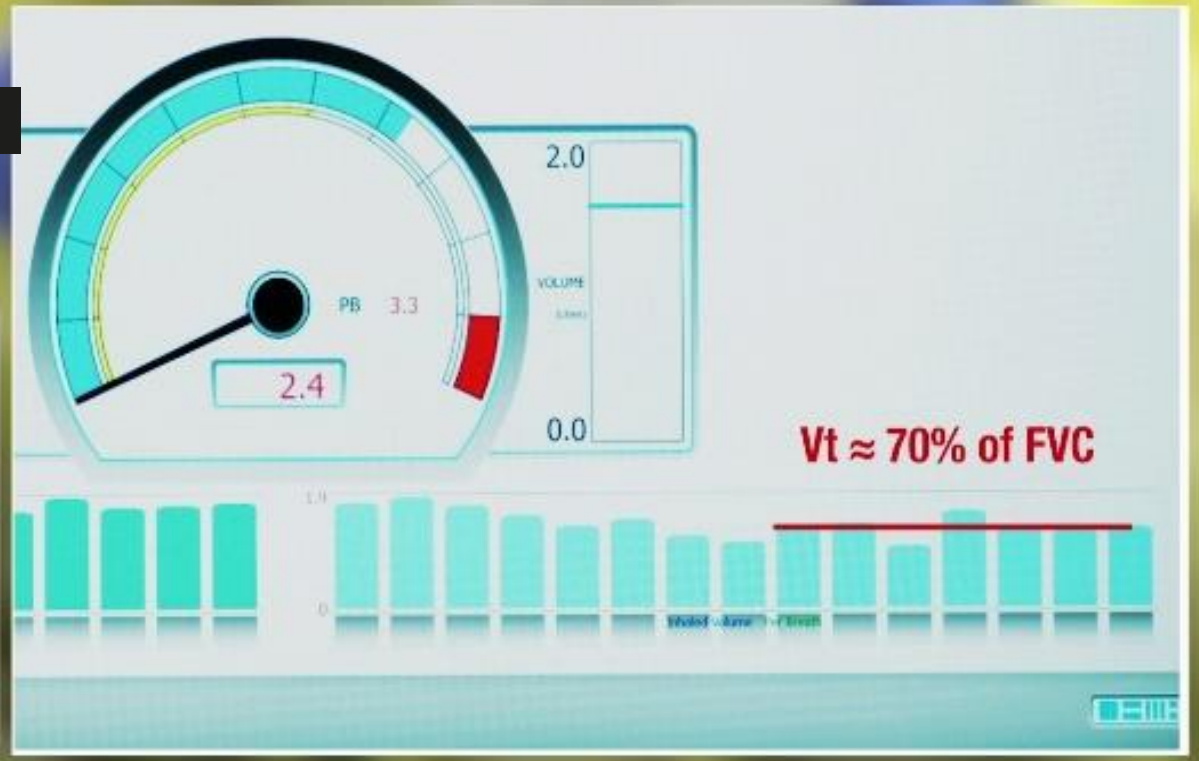
POWERbreathe ®

Highest tolerable load based on:

Daily progression based on:

BORG scores
(aim: 4-6 on effort and dyspnea)

Vt ≈ 70% of FVC



Hoffman M, et al. BMJ Open 2018

What does literature say?

IMT facilitates weaning from MV among patients in the ICU: a systematic review

- Inspiratory muscle strength
- Rapid shallow breathing index
- Weaning duration
- Weaning success ⬆
- Duration of MV
- Length of stay in the ICU/Hospital
- Non-invasive ventilation (shorter time)

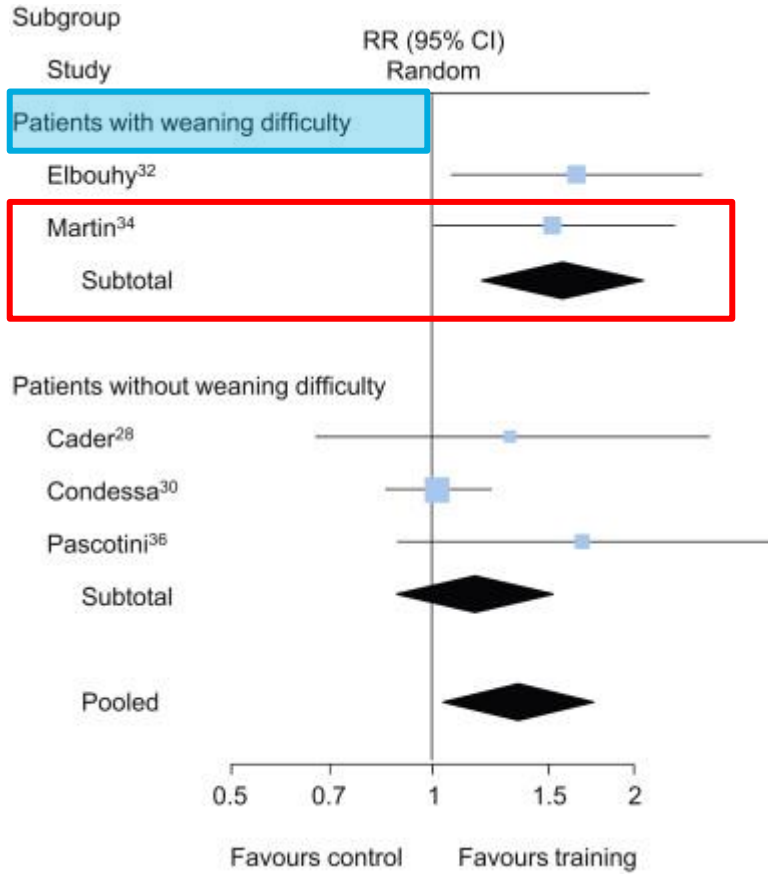
Comparison

Inspiratory Muscle Training versus sham / no training

Elkins M et al. Journal of Physiotherapy 2015

Weaning failure patients may benefit from IMT

Weaning success= RR: 1.34 (95%CI: 1.02-1.76)

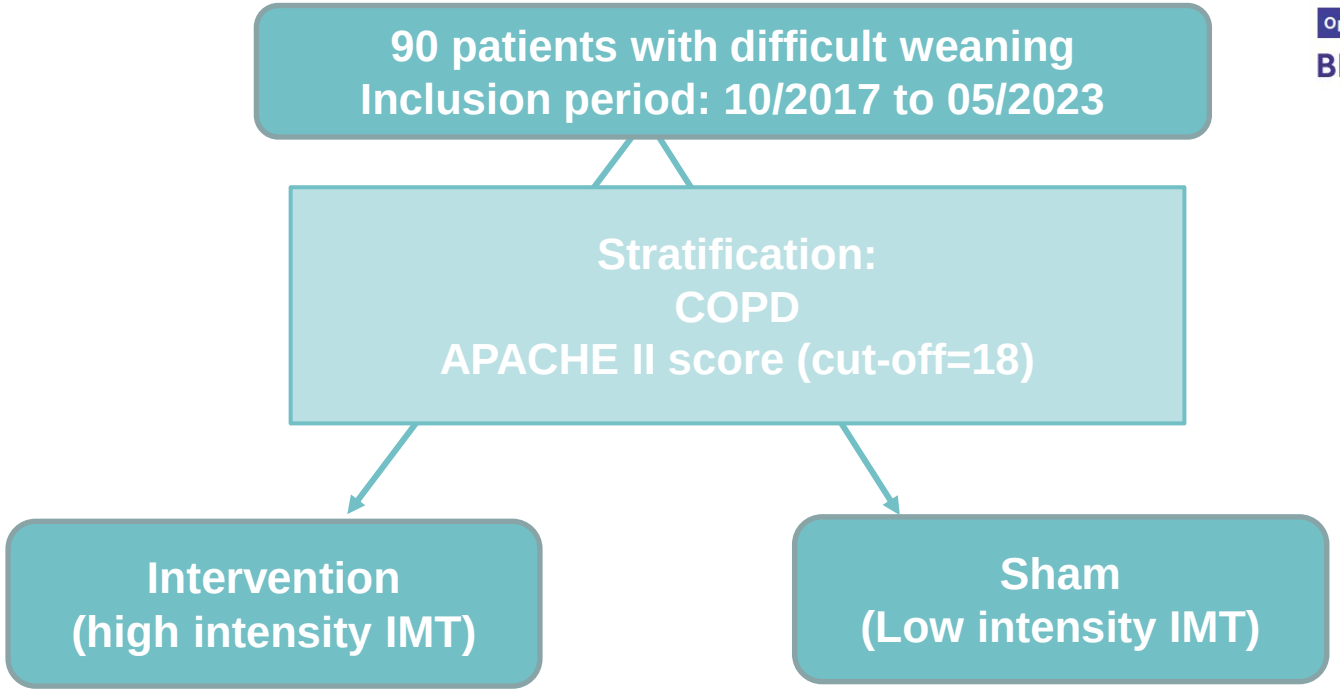


Proportion weaning success

Training	Control
90%	55%
71%	47%

Elkins M et al. Journal of Physiotherapy 2015

Design: I'MweanT study



Open access Protocol
BMJ Open

Can inspiratory muscle training improve weaning outcomes in difficult to wean patients? A protocol for a randomised controlled trial (IMweanT study)

Mariana Hoffman,[1,2,3] Marine Van Hollebeke,[2,3] Beatrix Clerckx,[2,3] Johannes Muller,[3] Zafeiris Louvaris,[2,3] Rik Gosselink,[2,3] Greet Hermans,[4,5] Daniel Langer[2,3]

BMJ Open. 2018

⇨ **Only 1 study used a sham intervention as controlled condition**

Martin *et al. Critical Care* 2011, **15**:R84
http://ccforum.com/content/15/2/R84

CRITICAL CARE

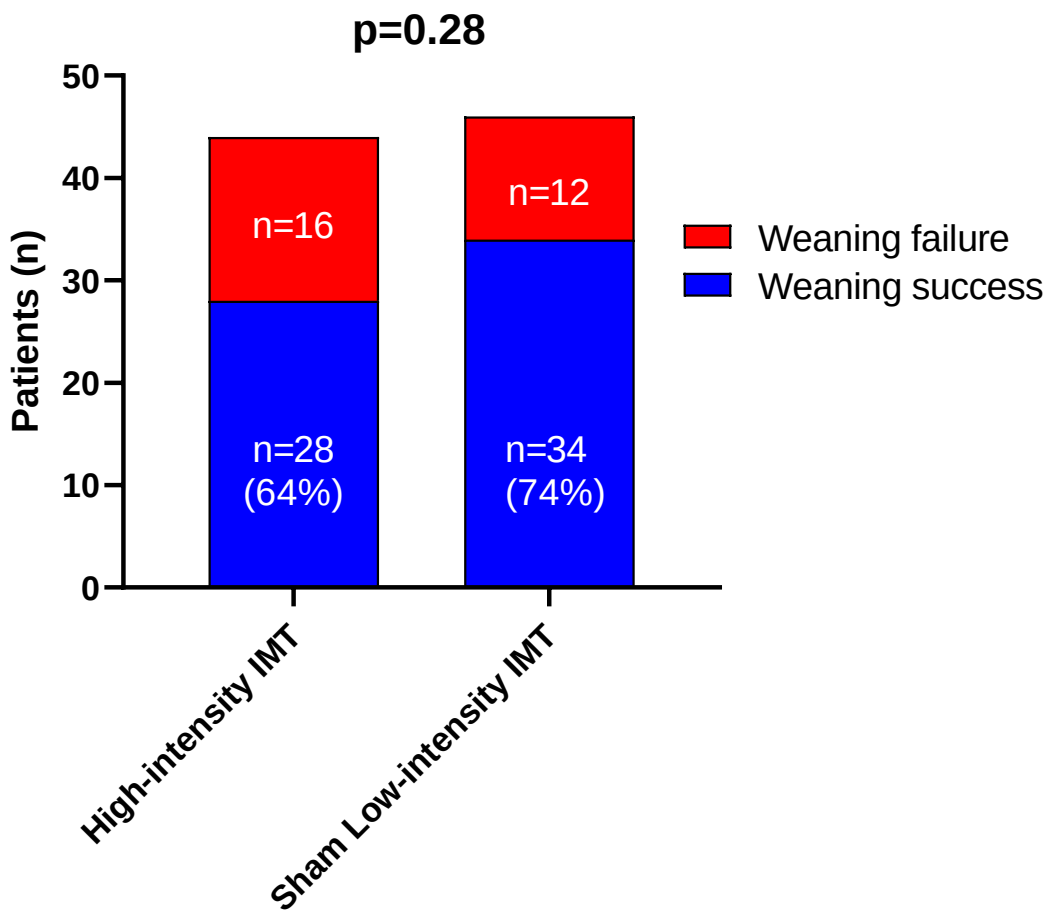
RESEARCH Open Access

Inspiratory muscle strength training improves weaning outcome in failure to wean patients: a randomized trial

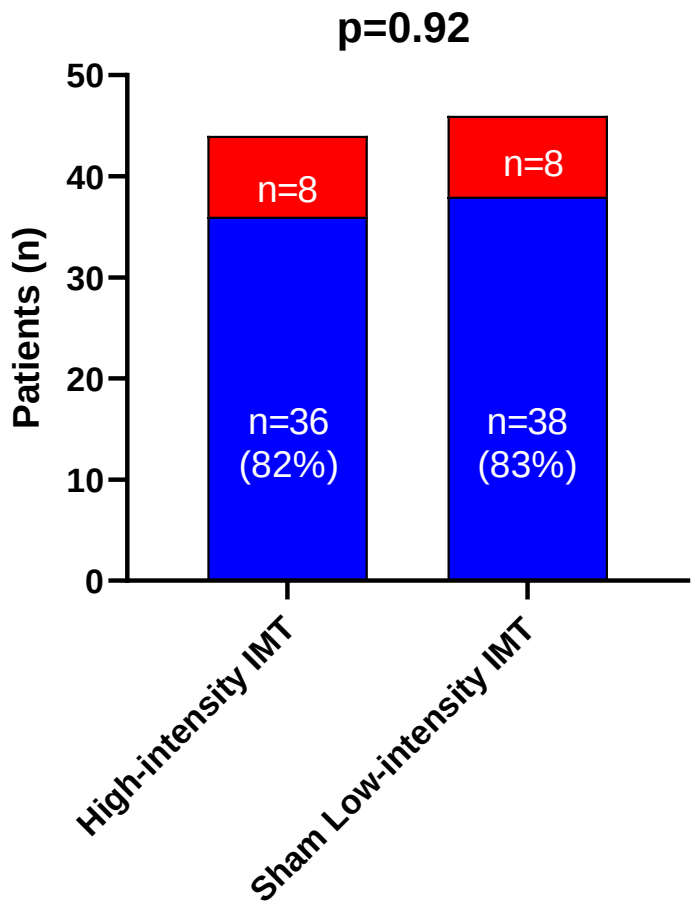
	Intervention		Sham	
	Martin	I'MweanT	Martin	I'MweanT
Frequency	Daily (5/7)	Daily (7/7)	Daily (5/7)	Daily (7/7)
Intensity	The highest pressure setting that the subject could consistently open during inspiration **≥15%** MIP	**≥30%** MIP (PImax)	Largest opening of a resistive training device	**<10%** MIP (PImax)
Time	4 sets of 6-10 **forceful inspirations**	4 sets of 6-10 **full VC** and **fast inspirations**	4 sets of 6-10 **long, slow inspirations**	4 sets of 6-10 **full VC** and **deep inspirations**
Type	Threshold PEP device (IMT)	TFR Loading	Resistive training device (Pflex)	TFR Loading or no resistance if baseline MIP < 25cmH_2O
Mean difference (Pimax)	**+10 cmH_2O**	**+15 cmH_2O**	**+2 cmH_2O**	**+14 cmH_2O**
Weaning success %	**71%**	**64%**	**47%**	**74%**

No significant difference in weaning success rate (primary outcome)

At 28 days after start IMT



At ICU discharge



Conclusion I'M WEANT Study

- Intervention/Sham result in **similarly high weaning success rate**
- Intervention/Sham result in **similar increases in IMS**

Is the training stimulus that we provide with IMT different when applying and High or Low external load?

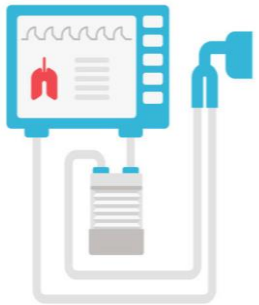
- Characterize the training stimulus during IMT in difficult to wean patients?
- Instructions on velocity of breathing matters:
  - slow, deep or fast, deep inspirations against low load?
  - fast, deep inspirations against high load?

Poddighe D et al. in preparation

Explorative assessments (in progress)

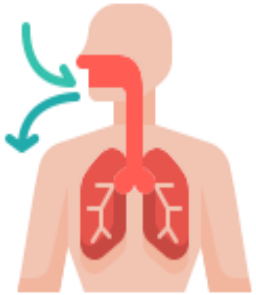
Breathing conditions

1

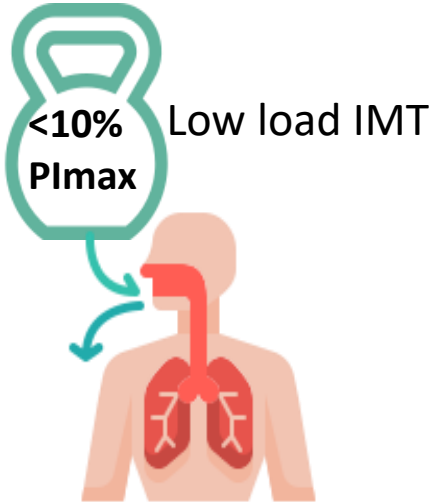


1 minute

2 Unsupported spontaneous breathing



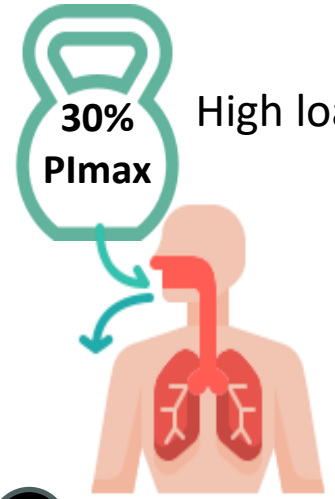
1 minute



Low load IMT

3 1 set slow and deep inspirations (control group study Martin et al)

4 1 set fast and deep inspirations (control group I'mweanT)



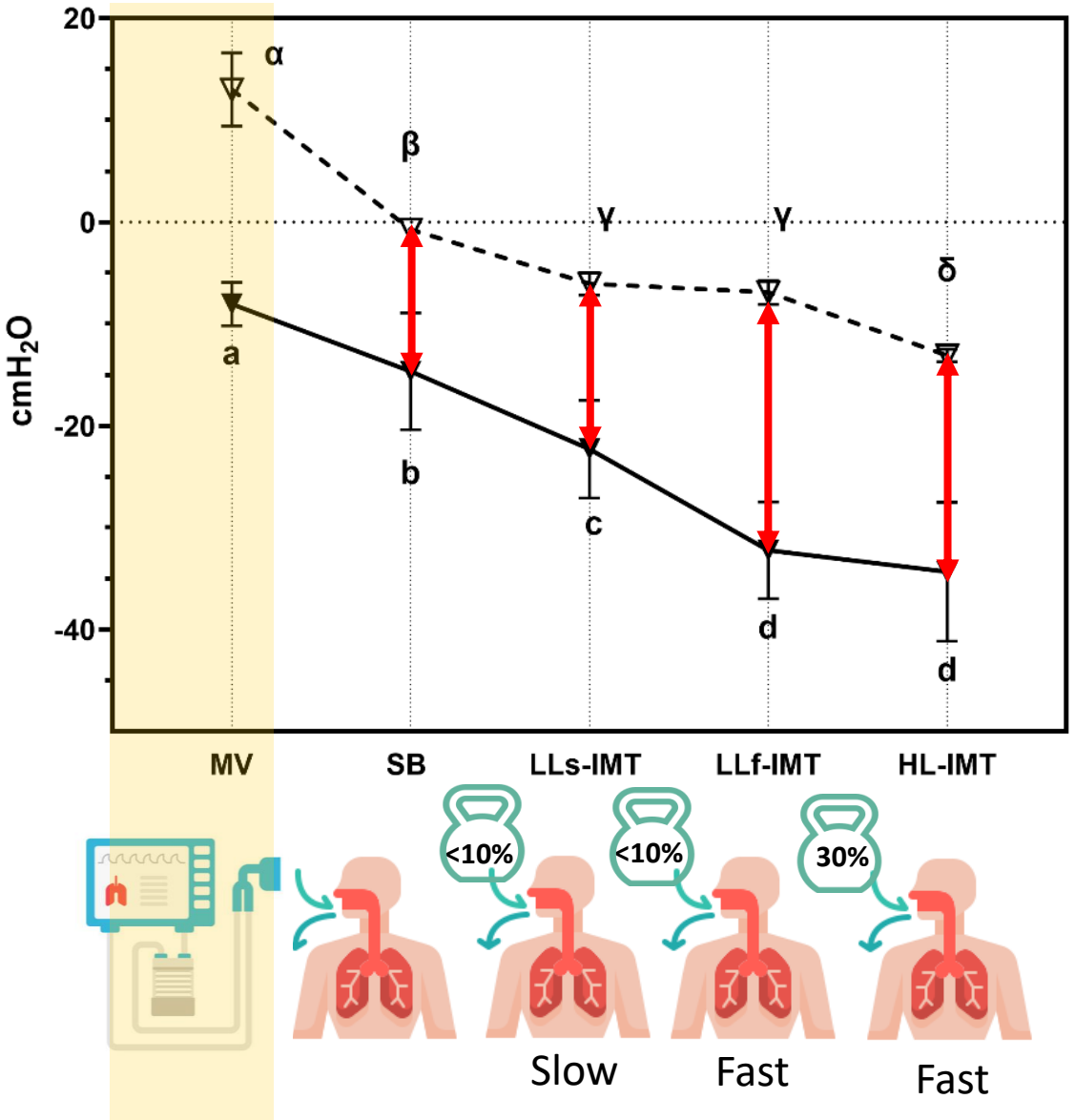
High load IMT

5 1 to 2 sets fast and deep inspirations (Intervention group (I'MmweanT)

Poddighe D et al. in preparation

Images: flaticon.com

Results:



ΔPaw

ΔPes

ΔPaw, determined by the external load imposed during IMT, and **Inspiratory flow**

ΔPes = index of inspiratory effort

We neglected around two third of the total inspiratory effort

Total inspiratory effort was lower when IMT is executed with slow and deep inspirations

Total inspiratory effort was similar when IMT is executed with fast and deep inspirations against both a low or high load

Poddighe D et al. in preparation

Conclusions

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Hindsight:
Factors Influencing Trial Design

Age & ICU LOS,
Frailty Comorbidity

Population

Awake, timing of
Weaningprotocol

Comparator

Defining Usual
care / Sham
intervention

Type,frequency,
dose & intensity

Intervention

Timing of onset

Outcome

Timing of
assessment

Martin,2011

Systematic
Review:

Elkins, 2015
Vorona, 2018

Van Hollebeke
(in press) 2024

Future direction
of IMT
research;

RCT's focused
on addressing
methodological
unknowns

Experiental learning; Advancing field of knowledge; Reflection on publications and study results

Connelly et al. Thorax 2018