

2020機械通氣重症繼續教育課程

# Weaning from Mechanical Ventilation

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## Outline

- Epidemiology of MV weaning
- Strategies of ventilator weaning
  - Role of SBT
  - SBT technique
- Decision to Extubate
- Post-extubation care
- Prolonged mechanical ventilation (PMV)

#### Epidemiology

#### **Burden of MV & Outcomes**



\*MV days (Median): 5 days \*ICU stay (Median) : 7 days

## Weaning Outcome in Taiwan



#### 呼吸器預後資料:個人化 vs 群體平均









#### Tailored Outcome Data "A patient like me"



Methodology: please refer to Ruan SY. Ann Am Thorac Soc. 2020

#### **Strategies of Ventilator Weaning**

#### **Clinical Course of Respiratory Failure**





#### **Strategies of Weaning:** How to Predict Readiness to Liberation

- Spontaneous breathing trial (SBT)
- Predictors (demand/capacity/combination)
  - V<sub>E</sub>, RSBI, CROP index ..... (Meade. CHEST 2001)



#### Landmark Study about Weaning Methods



The NEW ENGLAND JOURNAL of MEDICINE



#### **Comparison of Weaning Methods**



#### **Evolution of Weaning Practice**



## **Best Practice in MV Weaning**

- Once-daily SBT for discontinuation assessment is recommended in weaning guidelines. (*MacIntyre. CHEST. 2001, Boles. Eur Respir J. 2007*)
- SBT technique
  - Several techniques are used to conduct an SBT. (*Boles. Eur Respir J. 2007*)
  - With vs. without inspiratory pressure augmentation (Schmidt. Am J Respir Crit Care Med. 2017)

## Assessment of Readiness to Wean (Criteria for Starting SBTs)



#### **Assessment of Readiness to SBT**



#### • Subjective criteria

- Physician believes discontinuation possible
- Resolution of disease acute phase

#### **Assessment of Readiness to SBT**

#### Objective criteria

- No vasopressor, HR < 140
- Adequate mentation
- Adequate oxygenation
  - P/F ratio  $\geq$  150 or FiO<sub>2</sub>  $\leq$  0.4
  - PEEP  $\leq 8 \text{ cm H}_2\text{O}$
- Adequate pulmonary function
  - RR ≤ 35/min
  - MIP ≤ -25
  - V<sub>T</sub> > 5 mL/kg
  - RSBI < 105



MacIntyre. Chest 2001 Boles. Eur Respir J 2007

## **SBT Techniques**

Method? Duration? Failure criteria?

#### **SBT Methods & Durations**



#### **Practice Variation in SBT Techniques**





p = 0.14

#### (SBT success%) x (1 – Reintubation%)



#### **PSV** vs. T-piece, Meta-analysis

Outcome	No. of Studies	No. of Patients	Pooled Risk Ratio
SBT success	8	1381	1.06 [1.01-1.12]
Re-intubation	7	1365	0.93 [0.72-1.20]
Liberation success	11	1904	1.06 [1.02-1.10]

#### AMERICAN THORACIC SOCIETY DOCUMENTS

Official Executive Summary of an American Thoracic Society/American College of Chest Physicians Clinical Practice Guideline: Liberation from Mechanical Ventilation in Critically III Adults

**ATS/CHEST recommendation**. For acutely hospitalized patients ventilated more than 24 hours, we suggest that the initial SBT be conducted with inspiratory pressure augmentation (5-8 cm  $H_2O$ ) rather than without (T-piece or continuous positive airway pressure) (Conditional recommendation).



#### Effect of Spontaneous Breathing Trial Duration on Outcome of Attempts to Discontinue Mechanical Ventilation



#### **PS-8** x 30' vs. **T-piece** x 120'



#### **Physiology of SBT: Meta-analysis**



## **Criteria of SBT Failure**

- Subjective
  - Agitation, diaphoresis, cyanosis
  - Evidence of increasing effort
- Objective
  - RR > 35/min or **↑ ≥ 50%**
  - HR > 140/min or **↑** ≥ **20%**
  - Systolic BP > 180/min or  $\uparrow \ge 20\%$
  - SpO<sub>2</sub> < 90% or PaO<sub>2</sub> < 50-60 mmHg
  - $PaCO_2 > 50$  or  $\uparrow > 8$  mmHg

# Decision to Extubate (After SBT Success)

#### **Decision to Extubate: Airway Protection**

- Neurological function
  - Glasgow Coma Scale
- Cough strength
  - Peak expiratory flow rate
  - Maximal expiratory pressure
  - White card test
- Secretion volume
  - Suctioning frequency
- Post-extubation airway edema
  - Cuff leak test

#### **Post-extubation Stridor**

- Incidence: 6-37%
- A <u>cuff leak test</u> is suggested for <u>high risk</u> patients
- Risk factors:
  - Traumatic intubation
  - Intubation more than 6 days
  - Large endotracheal tube
  - Female sex
  - Reintubation
- Systemic steroids at least 4 hours before extubation
  - Conditional recommendation

## **Post-extubation Care**

At risk for extubation failure? Preventive management?

#### **Extubation to Preventive NIV ?**

Outcome	No. of RCTs	No. of Patients	Pooled Risk Ratio
Extubation success	5	525	1.14 [1.05-1.23]
ICU mortality	4	485	0.37 [0.19-0.70]

ATS/ACCP Guidelines: Strong recommendation
High risk groups: Hypercapnia, COPD, Heart failure

#### **Post-extubation High-Flow Nasal Cannula**

- **Low-Risk** Patients (HFNC vs. O<sub>2</sub>)
  - N = 527
  - Reintubation: 4.9% vs. 12.2% (p= 0.004)

(Hernández. JAMA. 2016)

#### • High-Risk Patients (HFNC vs. NIV)

- N = 604
- Reintubation: 22.8% vs. 19.1%

(Hernández. JAMA. 2016)

#### **Prolonged Mechanical Ventilation**

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#### **Difficult-To-Wean**

#### **Difficult-To-Wean**

- Epidemiology
  - PMV in Taiwan: 15%
  - Difficult & prolonged weaning: 20%
  - Associated with poor outcome (Risk factor studies)
- Limited EBM recommendations
- Permanently ventilator-dependent: 3 months of weaning attempts have failed (2001 ACCP Guidelines)
  - Unless there is evidence for clearly irreversible disease
- Structured approach

#### **Structural Approach**



**Figure 1. Framework for the evaluation of difficult-to-wean patients.** For each patient, diagnostics as described in the white box should be performed to assess the reasons(s) for difficult weaning. Endocrine dysfunction is probably relatively rare and therefore is not included in the first line of evaluation. Possible treatment/interventions are mentioned but, of course, need to be individualized. If the first-line evaluation does not improve weaning, proceed to the next level (within the affected column). For instance, if airway resistance is elevated but is not affected by albuterol and optimizing ventilator settings, diagnostic bronchoscopy should be performed to visualize the central airways. Risks and benefits should be weighed in each patient. ACTH, adrenocorticotrophic hormone; BNP, brain natriuretcic peptide; CAM-ICU, confusion assessment method for the intensive care unit; DO<sub>2</sub>, oxygen delivery; ECG, electrocardiogram; EIC, end inspiratory cycling; EMG, electromyography; iv, intravenous; P<sub>0.1</sub>, airway occlusion pressure at 100 ms; PEEPi, intrinsic positive end-expiratory pressure; Pi, max, maximal inspiratory pressure; PSV, pressure support ventilation; SBT, spontaneous-breathing trial; SvO<sub>2</sub>, mixed venous oxygen saturation.





#### **Thank You for Listening**

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