67 · CONGRESO NACIONAL · 24-26 NOVIEMBRE · BARCELONA 2022

REFORMÚLATE

FUNDAMENTOS BÁSICOS DE VENTILACIÓN MECÁNICA EN EL PACIENTE CRÍTICO

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Servicio de Medicina Intensiva
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- Servicio de Farmacia Hospitalaria del Hospital Universitario de Navarra.
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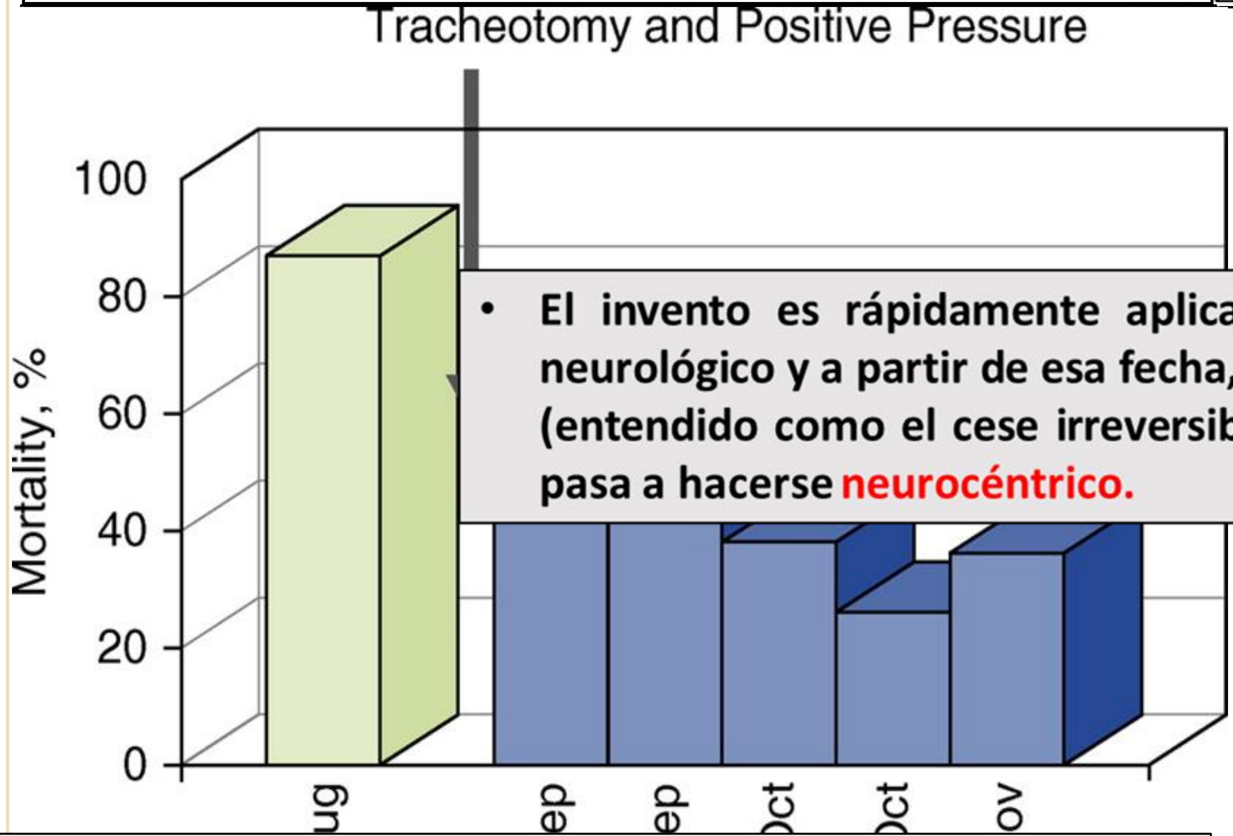
4. Ibsen, B., *[Principles of treatment of respirators complications in poliomyelitis]*. Ugeskr Laeger, 1953. 115(32): p. 1203-5.

Treatment of Severe Cases of Respiratory Paralysis by the Engström Universal Respirator Br Med J 1954



- **El invento es rápidamente aplicado a pacientes en coma de origen neurológico y a partir de esa fecha, el concepto cardiocéntrico de muerte (entendido como el cese irreversible de la actividad cardiorrespiratoria) pasa a hacerse neurocéntrico.**

666 SEPT. 18, 1954 TREATMENT OF RESPIRATORY PARALYSIS BRITISH MEDICAL JOURNAL

TREATMENT OF SEVERE CASES OF RESPIRATORY PARALYSIS BY THE ENGSTRÖM UNIVERSAL RESPIRATOR

BY

CARL-GUNNAR ENGSTRÖM, M.D.

(From the Municipal Hospital for Infectious Diseases, Stockholm)

Respiratory paralysis is by no means exclusively a complication of certain infectious diseases—above all

with two types of cuirass respirators, called after their inventors Sahlin and Freiberger. In spite of supplementing this therapy with tracheotomy, the mortality from respiratory paralysis of central origin, with paralysis of deglutition and other symptoms of brain-stem encephalitis, was about 85%. Clinico-physiological studies on these respirator cases showed that the fatal issue was usually due to an increasing retention of carbon dioxide; application of an additional oxygen supply kept the oxygen saturation in the arterial blood at normal levels (Engström, 1950; Engström and Svanborg, 1950, 1952), as the following typical case history demonstrates.

A 35-year-old patient, pregnant for seven months, fell ill with poliomyelitis on November 6. Two days later a rapidly progressing respiratory paralysis with pareses of the upper extremities supervened. A body respirator was applied, artificial respiration being supplemented by oxygen through a nasal catheter. However, the patient could not synchronize with the respirator, she was restless, and obviously worse. On November 19 tracheotomy was performed because paralysis of the larynx was suspected. In spite of continual oxygen supply by tracheal cannula, blood transfusion, and intravenous drip infusion, her general condition continued to deteriorate. Death occurred at 6 p.m. the following day. At necropsy atelectases of the lungs, lung oedema, and cyanosis of organs were found.

As a result of these studies it was recognized that these body respirators were not sufficient for artificial respiration of severe cases, especially with regard to proper elimination of carbon dioxide. At this point I started trials with intermittent insufflation, and it soon became clear that the unfavourable influence of (purely inspiratory) positive-pressure breathing on the circulation could be avoided by completing the respiratory cycle with an active expiration (rhythmical compression of the thorax).

Based on these experiences, a respirator was constructed (Engström, 1953) which produced an active insufflation and an active expiration either by compression of the thorax or by means of an intermittent negative-pressure phase.

Method

The respirator (Figs. 1 and 2) gives an active insufflation with a predetermined volume which is passed direct into the air passages by means of a face-mask, an intubation catheter, a tracheal tube, or an intratracheal cannula. The active expiration is produced by mechanical compression

Engström universal respirator providing intra-insufflation and active expiration by belt.

thorax by means of an inflatable belt or by use of a special accessory, the so-called Venturi suction apparatus (Engström, 1954) (Fig. 3). The latter applies intermittently an adjustable negative pressure direct into the air passages. For less severe cases the respirator can be used to drive a cuirass. The respiratory frequency, the volume insufflated, and the insufflation rate can be adjusted independently.

The direct insufflation method always permits the administration of a sufficient tidal volume. Since the insufflated volume can be exactly adjusted, adequate ventilation can usually be effected without the help of complicated laboratory control determinations. The rapid decline of the positive insufflation pressure, in combination with the active effect under the expiratory phase, impedes any dangerous rise of mean intrathoracic pressure, which is especially important in cases of impending circulatory shock (Maloney and Whittenberger, 1950). Oxygen can be added to the inspired gas in an exactly defined concentration.

In principle, insufflation is given by way of a half-closed system, thus avoiding the use of accessory apparatus for carbon dioxide absorption. The care of the patient is greatly facilitated by his easy accessibility, which among other advantages allows change of body position at will during treatment. The simple automatic control of resistance in the air passages greatly enhances effective supervision of the air passages in severe cases. The instrument was introduced at a session of the Swedish Medical Association on October 16, 1951 (Sjöberg *et al.*, 1952).

Clinical Experience

The first case treated with the instrument was that of a chronic respirator patient who, after more than 10 years' treatment with a cuirass respirator, contracted an acute complication in the form of a paralytic ileus, probably due to the passage of a renal calculus through the ureter.

The acute complication, which led to death within a few days, started with diarrhoea, pain in the epigastrium, and meteorism. Parallel with increasing meteorism, artificial respiration with the cuirass respirator became deficient, thus eliciting the signs of

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Slutsky AS. History of Mechanical Ventilation. From Vesalius to Ventilator-induced Lung Injury. Am J Respir Crit Care Med. 2015;191(10):1106-1115. doi:10.1164/rccm.201503-0421PP

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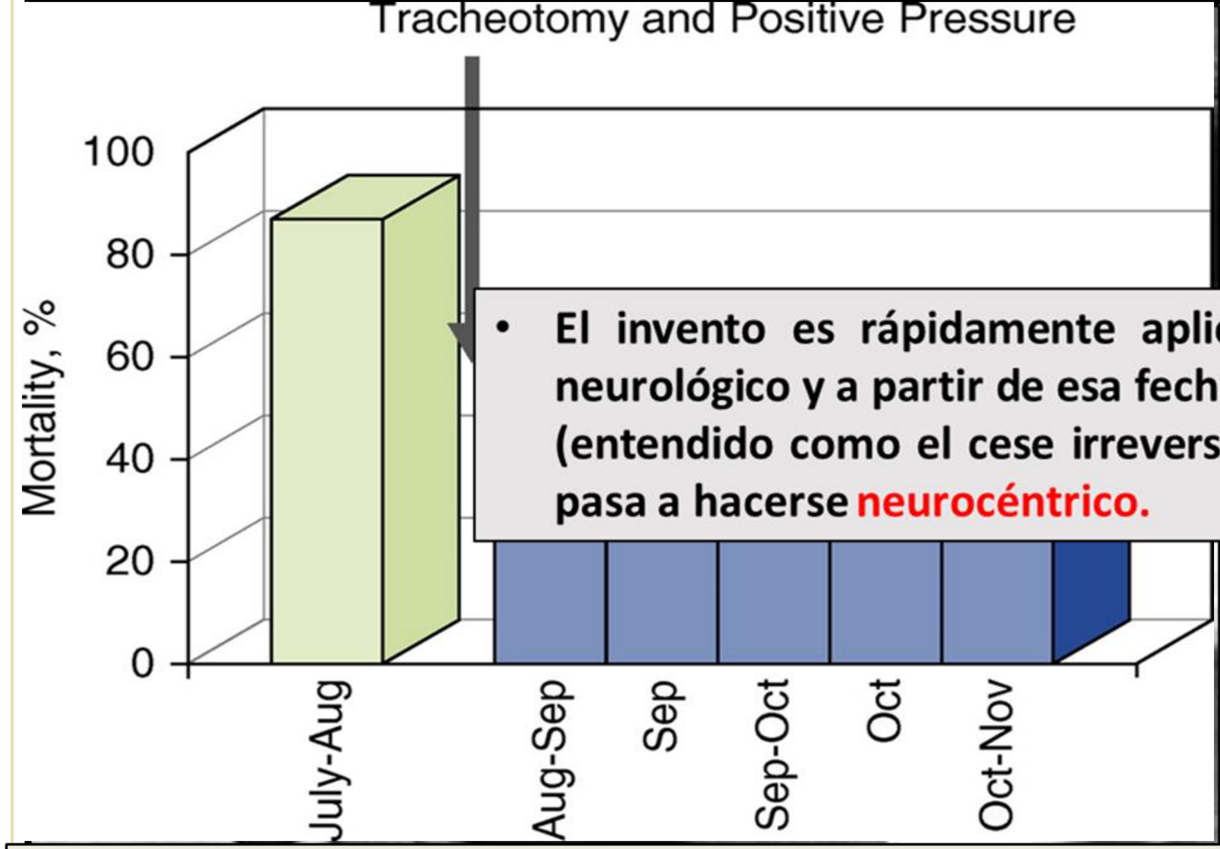

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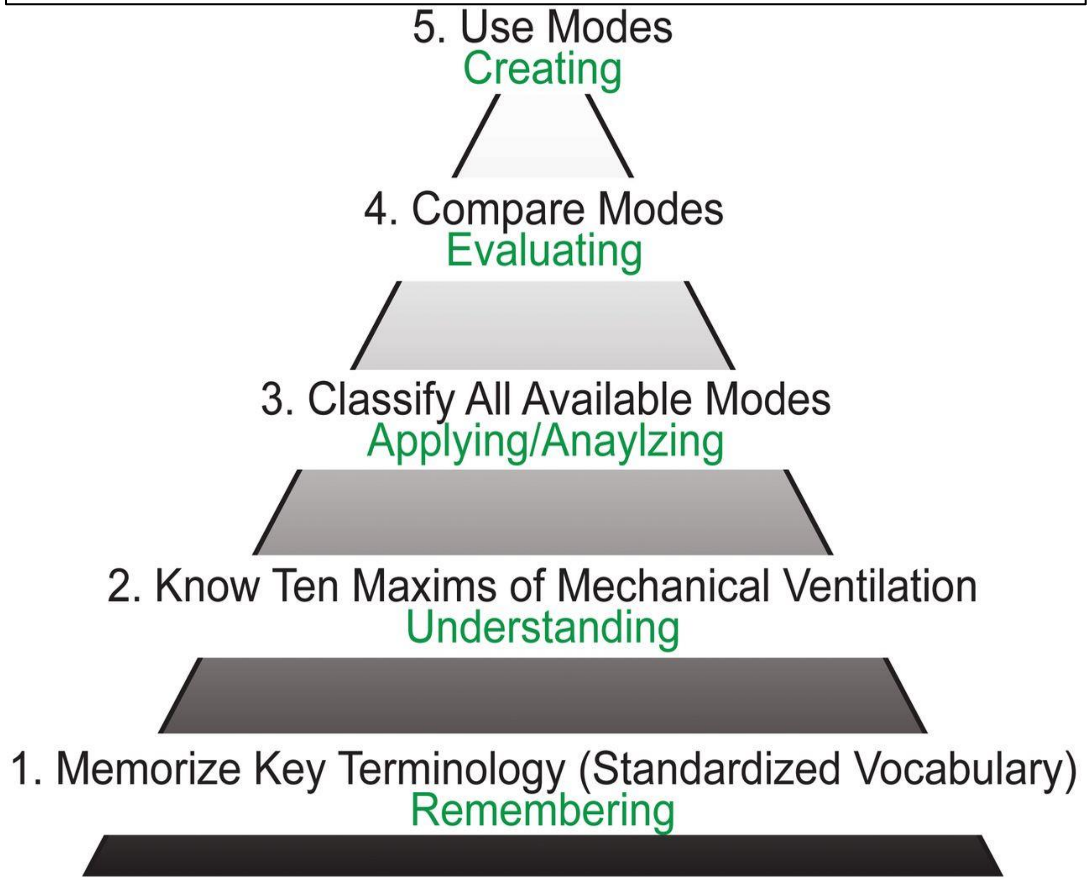


Pyramid of skills required to master ventilator technology.

Robert L Chatburn et al. Respir Care 2014;59:1747-1763

1-Estandarización del vocabulario.

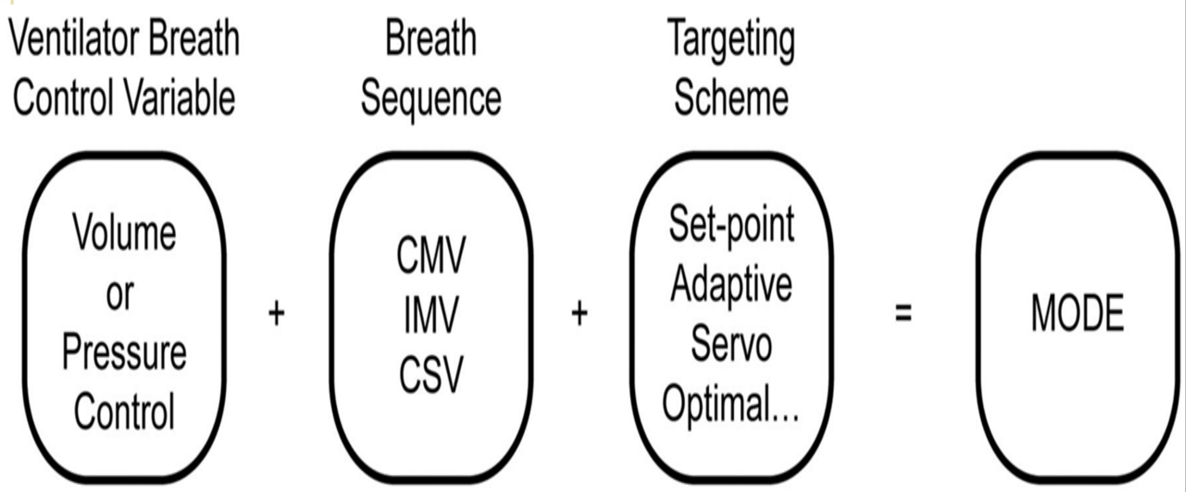
<u>2-Comprensión /10 conceptos.</u>

3-Clasificación de todos las modalidades.

4-Compararlas y evaluarlas.

5-Crear nuevo modos.

Building blocks for constructing a mode.



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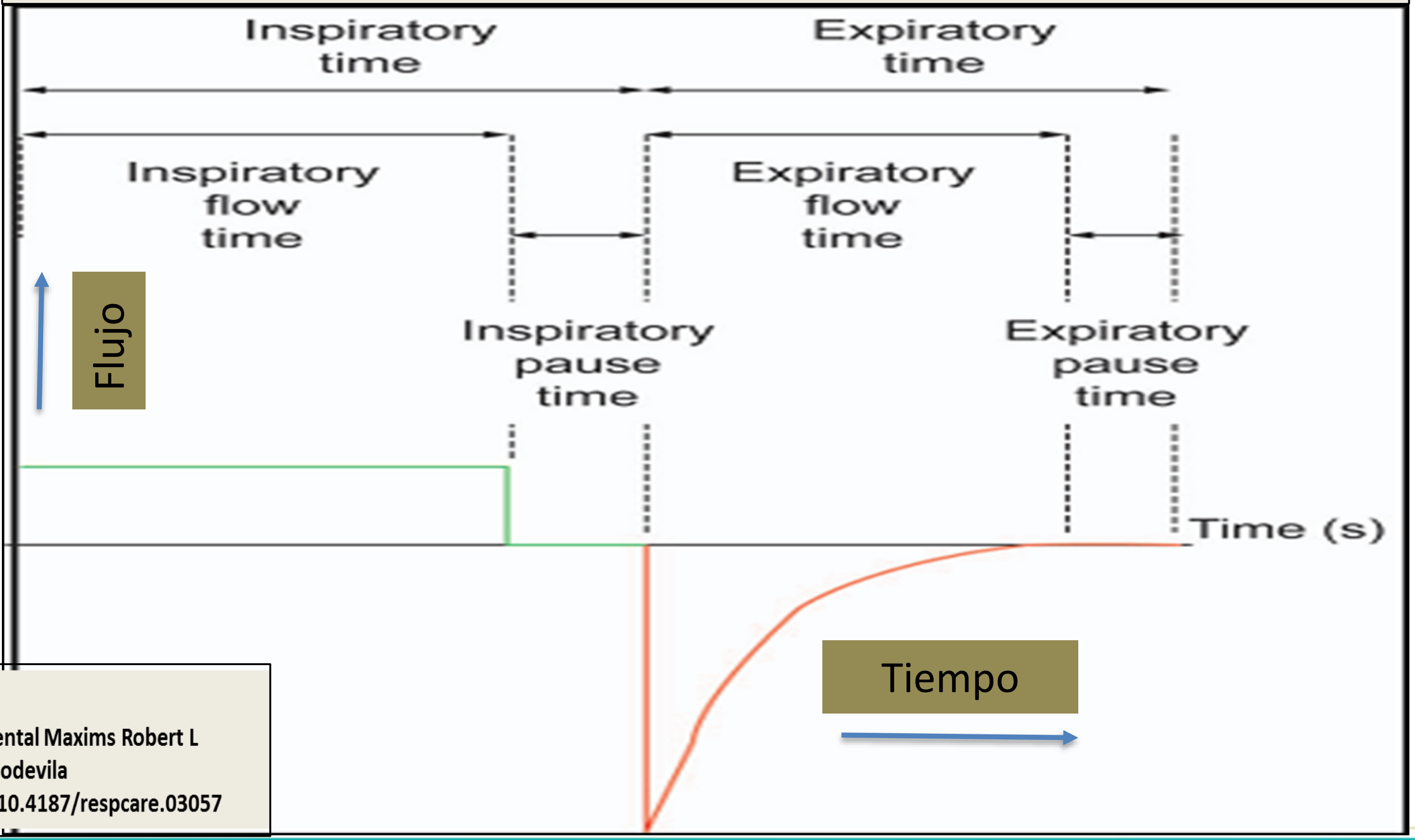
- Variable controlada.
- Secuencia respiración.
- Fedback clínico /paciente / respirador

1ª Una respiración es un ciclo de flujo respiratorio positivo (inspiración) y flujo negativo (espiración) definido en un curva flujo tiempo

- ❑ **Periodo ventilatorio / Tiempo de ciclo : 60 s/ frecuencia**
- ❑ **Tiempo inspiratorio**
- ❑ **Tiempo espiratorio**
- ❑ **Ratio inspiración espiración Relación I:E**



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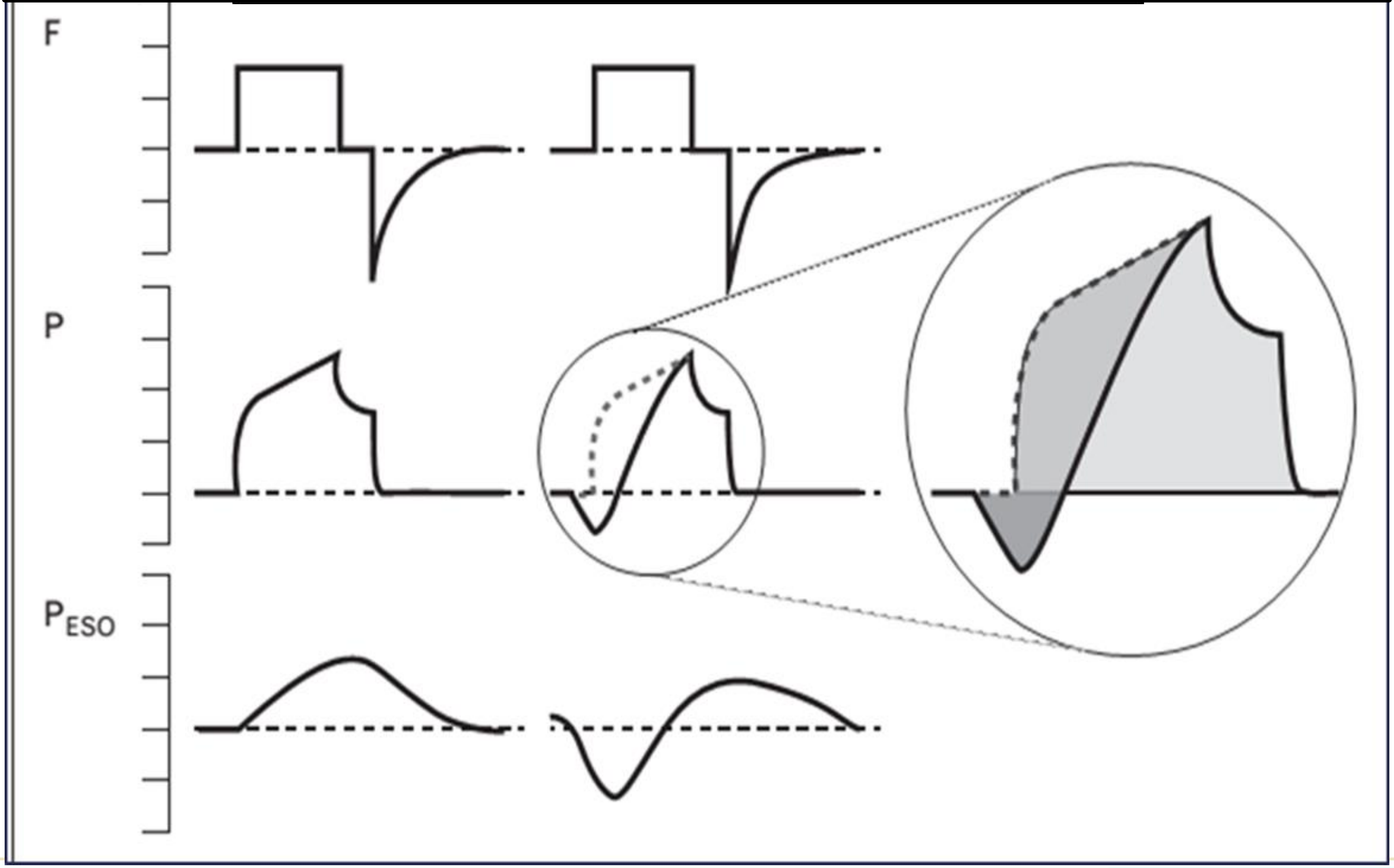
2ª Una respiración se define como asistida si el respirador asume todo o parte del trabajo respiratorio

- **Presión por encima de la basal / Presión transrespiratoria**
  - **Asistencia completa.**
  - **No asistida /CPAP.**

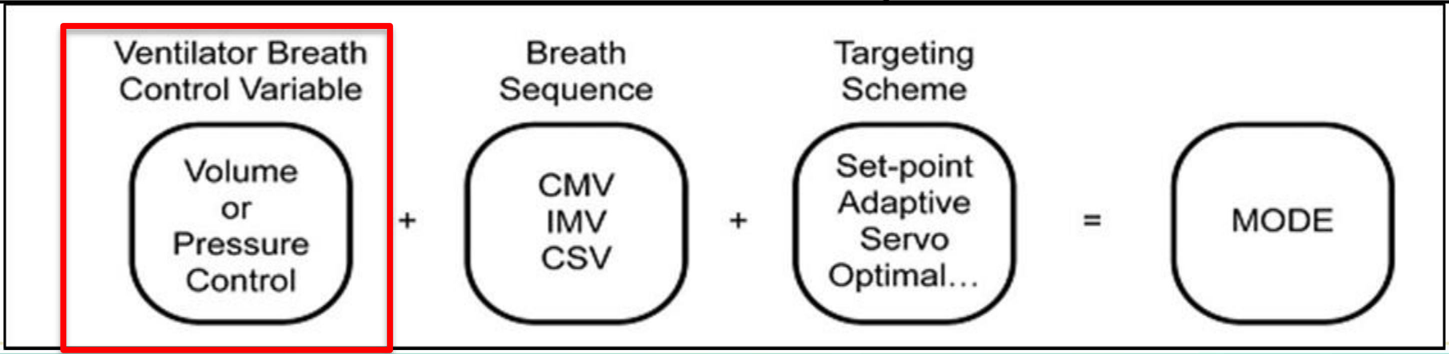


3ª Un respirador asiste usando o presión control o volumen control basado en la ecuación de movimiento del sistema respiratorio.

- **Volumen control : Flujo y volumen predeterminado.**
  - **Presión no controlada**
- **Presión control : Presión predeterminada.**
  - **Volumen /flujo no controlado**

Ecuación de movimiento de la ventilación mecánica

$$Presión\ muscular + Presión\ respirador = \frac{Volumen}{Compliance} + Flujo \times Resistencia$$



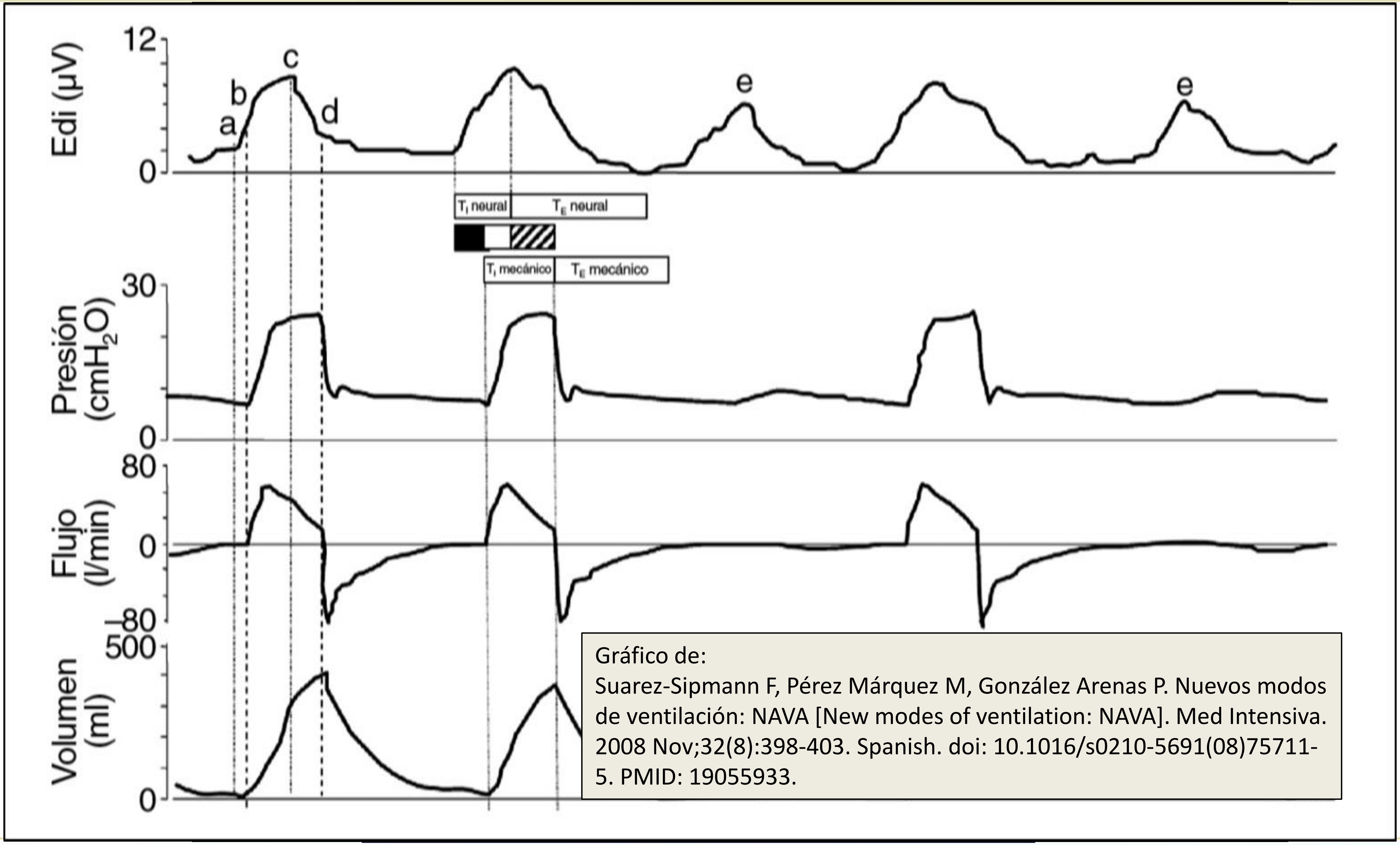


Gráfico de:
Suarez-Sipmann F, Pérez Márquez M, González Arenas P. Nuevos modos de ventilación: NAVA [New modes of ventilation: NAVA]. Med Intensiva. 2008 Nov;32(8):398-403. Spanish. doi: 10.1016/s0210-5691(08)75711-5. PMID: 19055933.

5º Trigger y ciclado pueden ser iniciados por el paciente o por el respirador

6º Las respiraciones serán espontaneas o mandatorias según criterios trigger y ciclado.

7º Los respiradores entregan tres secuencias básicas:

- **CMV: Trigger y ciclado respirador /Trigger paciente y ciclado respirador.**
- **IMV : Posibilidad de espontaneas entre mandatorias o durante ellas.**
- **CSV : Trigger y ciclado paciente.**

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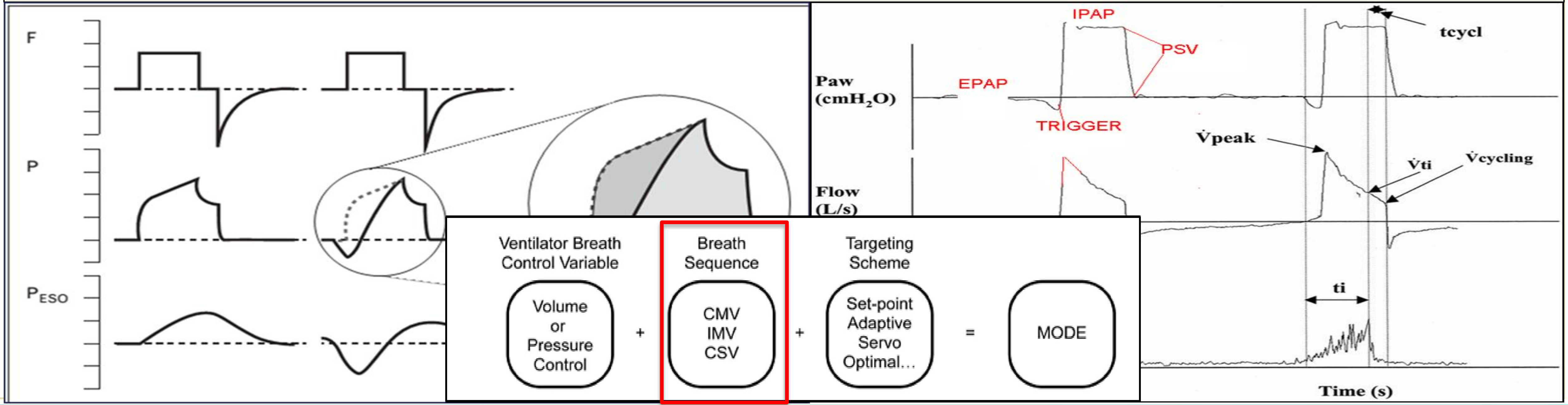

8ª Los respiradores entregan 5 patrones básicos :

- ***VC / CMV : Volumen control mandatorias.***
- ***PC / CMV : Presión control mandatorias.***
- ***VC / IMV : Volumen control mandatorias y espontaneas*.***
- ***PC / IMV : Presión control mandatoria y espontaneas*.***
- ***PC / CSV : Presión control espontaneas.***
- ***VC / CSV : Imposible.***
    - ****Todas las espontaneas son PC***

➢ ***Con esto podríamos ya definir de forma simple cualquier modalidad ventilatoria del mercado***

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9ª **Esquemas por objetivos: Fedback entre clínico con la información que llega del paciente y forma de trabajo del respirador.**

- **Set point : El clínico pauta todos los parámetros.**
  - Ventaja : Sencillez.
  - Desventaja : No adaptación a cambios del paciente.

- **Dual : Volumen control a Presión control en el mismo ciclo.**
  - Ventaja : Puedes controlar ambas variables
  - Desventajas : Compleja

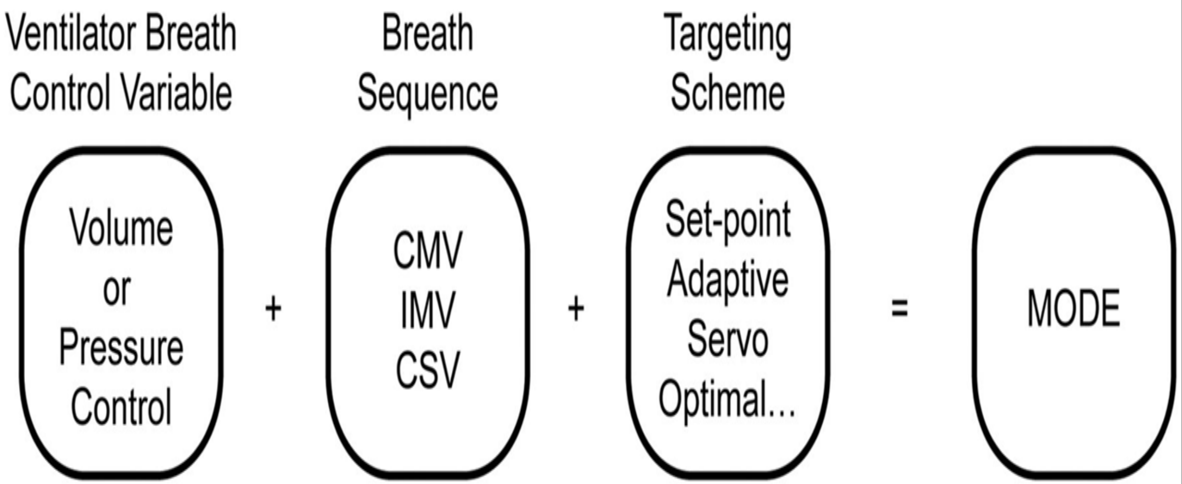
- **Adaptativa: Cambios en la presión según cambios en el paciente.**
  - Ventaja: Adaptación.
  - Desventaja: Ajustes automáticos a veces pocos fisiológicos o seguros sobre con la presión muscular.

- **Servo: Proporcionalidad a la presión muscular y cambios en Compliance y Resistencia.**
  - Ventaja: Ajuste de la proporción. Monitorización de trabajo respiratorio.
  - Desventaja : Complejidad con continuos ajustes.

- **Biovariable: Ajuste atendiendo a la variabilidad.**
- **Óptima.**
- **Inteligente.**

$$\text{Presión muscular} + \text{Presión respirador} = \frac{\text{Volumen}}{\text{Compliance}} + \text{Flujo} \times \text{Resistencia}$$

Building blocks for constructing a mode.



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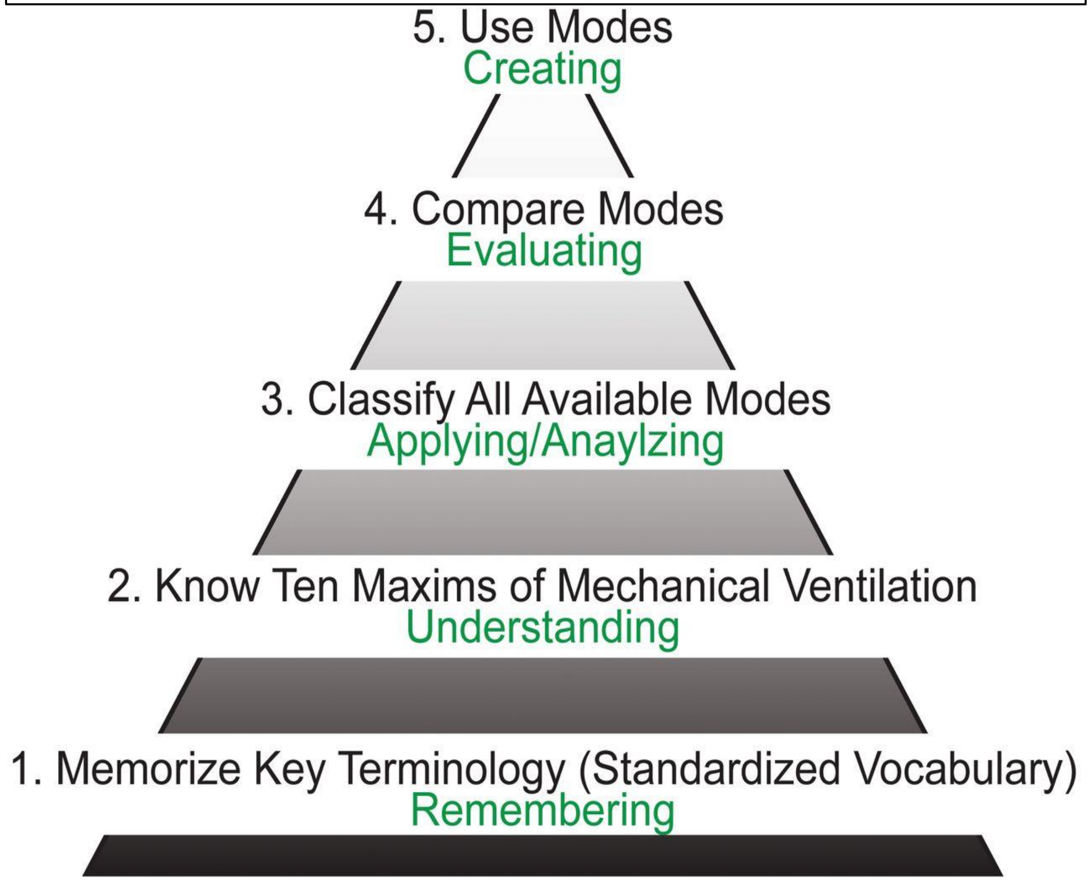

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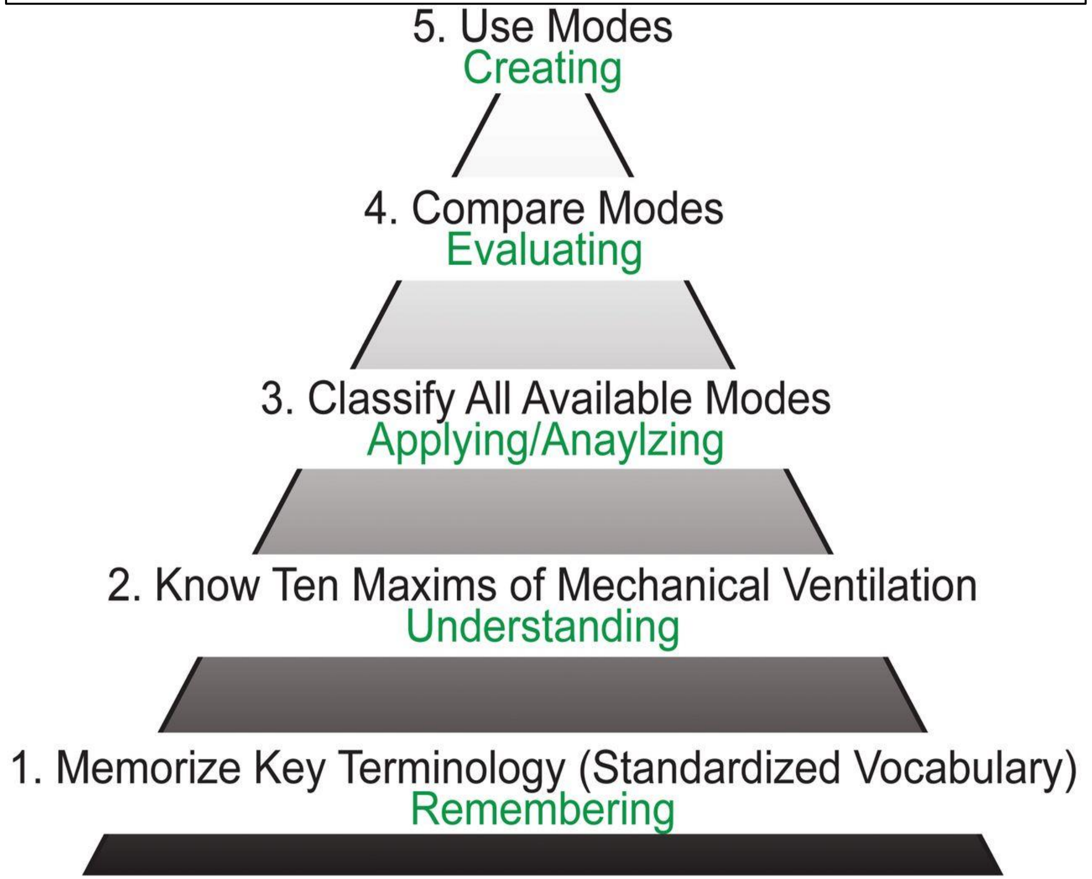

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Las 3 metas u objetivos de la ventilación mecánica

- **Proveer intercambio gaseoso de forma segura (Primum non nocere)**
  - **Intercambio O2 /CO2.**
  - **Evitar lesión inducida por el respirador.**
    - **Volutrauma**
    - **Biotrauma**
    - **Atelectrauma**
    - **Barotrauma**
  - **Alarmas para evitar situaciones de inseguridad.**
- **Proveer confort.**
  - **Evitando asincronías.**
- **Promover lo antes posible la retirada del respirador**
  - **Optimizar el weaning.**

A Rational Framework for Selecting Modes of Ventilation
Eduardo Mireles-Cabodevila, Umur Hatipoğlu, Robert L Chatburn
Respiratory Care Feb 2013, 58 (2) 348-366; DOI: 10.4187/respcare.01839

What we learn from academic studies is knowledge: what we learn from experience is wisdom.

— Mohandas Gandhi

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Sociedad Española de Farmacia Hospitalaria

Gracias por su atención

Gràcies per la seva atenció

Eskerrik asko zure arretagatik

Grazas pola súa atención

REENCUENTRO REDEFINIR REFORMÚLATE RENACER