MECHANICAL VENTILATION

OBJECTIVE, PRINCIPLE, BENEFITS

VENTILATION PLAYS A CRUCIAL ROLE IN TREATING PATIENTS IN EMERGENCY SITUATIONS:

MAINTAINING RESPIRATORY FUNCTION & ENSURING OXYGEN SUPPLY

If the patient is no longer able to breathe unassisted, mechanical ventilation offers a number of advantages compared to manual ventilation, and can save lives.[1]

WHAT DOES MECHANICAL VENTILATION MEAN?

DEFINITION

Spontaneous breathing = Autonomous physiological process

In a healthy person, this takes place continuously and unconsciously.

Under certain pathological conditions (e.g. serious trauma or illness), spontaneous breathing may be impaired or lost completely.

The patient must be ventilated!

2 NECESSARY VENTILATION METHODS

FOR THIS THERE ARE

MANUEL VENTILATION:

Using a ventilation bag and mask or tube

MECHANICAL VENTILATION:

- Use of a respirator to regulate and support alveolar ventilation
- Transportation of the respiratory gas into the lungs via:

Constant respiratory volume or airway pressure		Constant respiratory rate	Positive airway pressure
Vt = const.	plusp = const.	Freq. = const.	PEEP > Pamb

WHY IS MANUAL VENTILATION DIFFICULT?

Bag-valve-mask ventilation is a method that is frequently used because it is supposedly easy to do.

1. A ventilation bag (usually connected to an oxygen source) is attached to a face mask.
2. The mask is held on the patient's face, covering the nose and mouth.
3. The bag is sequeezed, causing air to flow through the patient's airways. The valve prevents the return flow of air into the bag.

KEY PREREQUISITES:

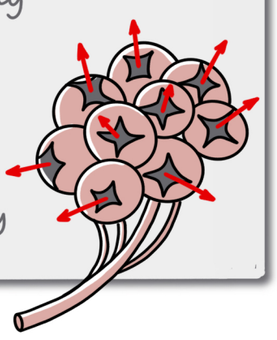
- ✓ Free airways
- ✓ Sufficiently tight-fitting mask
- ✓ Correct technique
- ✓ And ideally two rescuers

Even experienced rescuers have difficulties implementing this method.[2]

RISKS OF BAG-VALVE-MASK VENTILATION:

Only limeted control of effective volume delivery by sequeezing the bag. Reliable measurement of the ventilation volume or pressure is not possible.

- **HYPOVENTILATION**[4]: If the mask is not fitted tightly
- **HYPERVENTILATION**[3]: If the respiratory rate and minute volume are too high (breaths per min)
- **RISK OF ASPIRATION**: Due to "gastric insufflation" (blowing air into the stomach)
- **BAROTRAUMA**: With pressure peaks from excessively fast volume delivery



Traumatized alveoli

Because the tidal volume and respiratory rate vary, there is a high risk of hyper- and hypoventilation and dangerous pressure peaks from excessively fast volume delivery.

SCENARIOS INVOLVING MECHANICAL VENTILATION

AT THE EMERGENCY SCENE

DURING TRANSPORTATION BY AMBULANCE OR PATIENT TRANSFER

- The patient is anesthetized and can no longer breathe independently.
- The patient suffers a cardiac arrest and must be resusciated as quickly as possible.
- The patient must be given support in their respiration, as it is no longer sufficient.
- Ensuring a constant and continuous oxygen supply to the patient, without emergency service personnel having to leave their seat to administer ventilation.

Mechanical ventilation also contributes to user safety!

Ventilators are not only used for invasive ventilation - different ventilation modes can also support non-invasive ventilation, e.g. when using CPAP therapy to treat a cardiac pulmonary edema.

WHAT ARE THE ADVANTAGES OF VENTILATORS COMPARED TO BAG-VALVE-MASK VENTILATION?

EFFECTIVENESS OF VENTILATION:

Studies show greater effectiveness during resuscitation.[4]

- Hypo- and hyperventilation can be effectively avoided thanks to the device's setting and monitoring functions.
- An adjustable pressure relief valve further reduces the risk of overpressure damage (= barotrauma).

CREW-RESOURCE-MANAGEMENT (CRM):

With a ventilator, rescuers can

- complete more tasks,
- document more fully and
- treat the patient better and more effectively.[5]

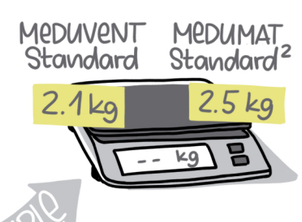
- It reduces the manual work required and ties up fewer medical staff, who can then concentrate on treating the cause of the emergency.

CONVENIENCE:

The ventilator is mobile and can be lightweight.

EASE OF USE & FUNCTIONALITY:

It is easy to operate and its functionality is less dependent on the rescuer's precise technique.



FOR EXAMPLE

- ✓ Step 1
- ✓ Step 2
- ○ Step 3

MASK ON AND OFF YOU GO!

The ventilator makes ventilation safer right from the start, rather than successful intubation.

HANDS AND HEAD FREE!

Once the patient has been intubated and supplied with a supraglottic airway (e.g. laryngeal mask), and connected to a ventilator, a rescuer is free to plan and implement further important steps for treating the patient.

VISUAL BY ANNA BREWER

[1] Idris Ahamed H. Bag-Valve-Mask Ventilation and Survival from Out-of-Hospital Cardiac Arrest: A Multicenter Study. 2023
[2] Chauhan A. et al. Comparison of hemodynamic consequences of hand ventilation versus machine ventilation for transportation of post-operative pediatric cardiac patients. 2023
[3] Aufderheide TP, Sigurdsson G, Pirrallo, RG, Yannopoulos D, McKnite S, Von Briesen C, Sparks CW, Conrad CJ, Provo TA, Lurie KG. Hyperventilation-induced hypotension during cardiopulmonary resuscitation. Circulation. 2004;109(16):1960-1965

WEINMANN medical technology

[4] Hernández-Tejedor A. Ventilatory improvement with mechanical ventilator versus bag in non-traumatic out-of-hospital cardiac arrest: SYMEVECA study, phase 1. 2023
Chauhan A. et al. Comparison of hemodynamic consequences of hand ventilation versus machine ventilation for transportation of post-operative pediatric cardiac patients.2023
[5] Weiss SJ, Ernst AA, Jones R, Ong M, Filbrun T, Augustin C, Barnum M, Nick TG. Automatic transport ventilator versus bag valve in the EMS setting: a prospective, randomized trial. South Med J. 2005 Oct;98(10):970-6