# Mechanical Ventilation in Prehospital Care

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# Disclosures

- None
- Views are my own

# Overview

- History
- Mechanical ventilation in EMS
- Data
- Vent modes evidence
- Conclusions

# Normal Breathing

- Pressure gradient
- Intercostals and diaphragm contract which expands chest cavity lowering pressure below atmospheric pressure causing air to flow into lungs (negative pressure inhalation)
- Exhalation occurs passively as muscles relax and chest cavity returns to resting state

# Respiratory Failure

- Oxygenation
- Ventilation
- Variety of medical and traumatic causes

# Mechanical Ventilation History

- First ventilators in 1800s
- 1920s- Philip Drinker developed the first widely used negative-pressure apparatus, the "iron lung," to assist patients with polio
- 1950s- The polio epidemics highlighted the need for positive-pressure ventilation, leading to the development of more effective and portable ventilators
- 1960s- development of PEEP
- 1980s to present day- Advances in technology have resulted in smaller, more user-friendly ventilators, as well as the development of non-invasive ventilation techniques like CPAP and BiPAP

- As far back as 2001, it was recommended to “provide a ventilator to every ambulance”

# History- Iron Lung

- Negative pressure ventilator
- Metal box
- Inside the box, bellows or other devices are used to create negative pressure, which pulls air into the lungs, stimulating breathing
- As the pressure changes, air is drawn into and out of the lungs, mimicking the natural process of breathing
- Made popular during polio epidemic
- Medical innovation to solve public health problems
- Modern vents are now more effective and portable with advanced monitoring features

# Positive Pressure Mechanical Ventilation

- Positive pressure gradient during inhalation pushing gas mixture into lungs
- Exhalation occurs with removal of the positive pressure supplied by the ventilator
- Used today in critical care settings

# History of Positive Pressure in EMS

- Began with the use of non-invasive positive pressure ventilation
- Demonstrated decreased rates of intubation on arrival to EDs
- Rise of critical care transport teams with advanced capabilities

# Crew Composition and Capability

- EMT
- Paramedic
- Critical Care Nurse
- Physician
- Advanced Practice Provider

# Decision to Intubate

- Shift over time from an early airway protection strategy to a resuscitation and intubate strategy
- Hypovolemia, anesthetic combined can lead to peri-intubation cardiac arrest
- First question should be does the patient need to be intubated?
- Relies on oxygenation, ventilation, and perfusion

# Prehospital Intubation Capability

- Requires proper training on technique and drugs
- More challenging in environments outside of the hospital
- Infrequently performed
- In some instances has a higher rate of failure and complication
- Requires involvement and quality assurance programs

# Decision to Intubate

- Many different protocols
- Differences in military and civilian practice
- Variability in availability
- Specialized transport and some prehospital agencies have the capability to intubate

# Supraglottic Airways

- Rise in favor given ease of placement and less training requirements
- Inserted into the pharynx, above the vocal cords, to facilitate ventilation, oxygenation

# Bag Valve Mask Ventilation

- manual ventilation is associated with hypo- and hyperventilation, variable tidal volumes, and barotrauma, gastric inflation
- Requires consistent presence of a provider
- PEEP valves-  controlled levels of resistance on exhalation valve

NAEMSP Prehospital Airway Position Papers

# Prehospital Mechanical Ventilation: An NAEMSP Position Statement and Resource Document

**Amado Alejandro Baez**, Zaffer Qasim, Susan Wilcox, William B. Weir, Patrick Loeffler, Bradley Michael Golden, ...show all

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- EMS clinicians, including those performing emergency response as well as interfacility transports, should consider using mechanical ventilation after advanced airway insertion.
- Prehospital mechanical ventilation techniques, strategies, and parameters should be disease-specific and should mirror in-hospital best practices.
- EMS clinicians must receive training in the general principles of mechanical ventilation as well as detailed training in the operation of the specific system(s) used by the EMS agency.
- Patients undergoing mechanical ventilation must receive appropriate sedation and analgesia.

# Presence of Ventilators in EMS

- Is there a need for a ventilator?
- For critical care transport, this allows for more precise management of oxygenation and ventilation
- Improved simplicity and portability



# Benefits

- Consistent and controlled ventilation
- Ability to reduce potential harmful effects of bag valve mask ventilation
- Free up a provider for other tasks

# Use of Prehospital Ventilators

- Data does exist on non-invasive positive pressure ventilation in the prehospital environment
- Less but emerging evidence of the use of intubated positive pressure systems
  - Associated with increased on scene time
  - No difference in mortality at ED discharge

# More Recent Mechanical Ventilation Data

- Appropriate ventilation improves patient outcomes in various disease processes
- Challenging to maintain parameters with a bag
- QA programs focus more on rate of successful intubations and first passes than quality of oxygenation and ventilation

*For EMS transport of patients who are ventilator-dependent, mechanical ventilators provide a safe and more efficient alternative to manually ventilating the patient throughout transport.*

# Barriers to MV in the Field

- Cost
- Perceived complexity
- Discomfort
- Infrequent use
- Continuing training
- Weight

# Vent Modes- Current Practice

- Pressure Control?
- Volume Control?
- CPAP?
- No standard rather “disease specific”
- Use of end tidal CO2- could be less accurate in patients with significant lung disease

# Research and Development

- We need further studies to inform best practices on most beneficial vent strategies
- Reduced PEEP may be better in hemorrhage
- When to forgo positive pressure
- Innovation into technology to maximize minute ventilation while minimizing risk of barotrauma

# Conclusions

- In EMS agencies, mechanical ventilation could be a safe and effective strategy to maximize limited resources and improve patient oxygenation and ventilation
- Additional, larger studies are required
- We need more data to guide recommendations

# Thank You!


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