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Mechanical Ventilation and the SLP

What should you know?

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for SpeechPathology.com
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Presenter Background, Disclosures, and Contact Info

- MS, Speech Pathology 1999
- Clinical experience: ICU/LTAC with Neuro & Respiratory emphasis
- Clinical Consulting & Educating re: trach/vent since 2002
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Program Objectives

To foster a functional understanding of ventilation and the need for a "big picture"/"think outside of the box" approach when treating medically complex patients

Participants will:

- Define the following: tidal volume, peak inspiratory pressure, mandatory respiratory rate, spontaneous respiratory rate, FiO2, pressure support, and PEEP
- Name 3 possible methods by which ventilator dependent individuals can verbally communicate
- Explain how to use manometry and/or the minimal leak technique for cuff inflation
- Discuss two benefits of/applications for above-the-cuff suction with ventilator dependent patients
- State 1 pro and 1 con of vent dependent individuals eating with the cuff DEFLATED

Goals of Mechanical Ventilation

- Provide adequate oxygenation and ventilation
- Normalize acid-base imbalance
  - Normalize arterial blood gas levels, OR achieve normal baseline for the patient, given the disease state
  - Improving ventilation eliminates more CO2, which increases pH/restores more normal pH

Arterial Blood Gases

Norms

pH: 7.35-7.45

PaO2: 80-100 mmHg

(may be as low as 60 mm Hg in geriatric patients)

PaCO2: 35-45 mmHg

HCO3-: 22-28 mEq/l

* Pa = Partial pressure of oxygen (PaO2) and carbon dioxide (PaCO2) is the force needed to transport O2 and CO2 in the blood (respectively)

Why look at them?

- Identify patient trends
- Identify changes in patient status; alert other team members of these
- Have more informed conversations with RT and MDs
- Better discern when it is/is not appropriate to work with a patient

Glossary of Terms related to Mechanical Ventilation

Tidal Volume: Amount of gas inhaled or exhaled during a breath

- Vti: Inhaled volume
- Vte: Exhaled volume
- Tidal volume is recorded in milliliters (ml) or liters (L)
  - Example: 600 ml = 0.6 L

Minute Volume: The total volume of gas entering the lungs per minute

- Recorded in liters. Vti x RR = MV
- Physicians prescribe tidal volume/minute volume by considering age, weight, gender, diagnosis, and the patients' lung dynamics

Respiratory Rate: Number of breaths per minute

- Mandatory Rate: Number of breaths per minute delivered by the ventilator or manual resuscitator
- Spontaneous Rate: Number of breaths initiated by the patient per minute
- Total Respiratory Rate: The sum of the mandatory and spontaneous rates

Glossary of Terms continued…

Peak Inspiratory Pressure (PIP): The maximum pressure reached during a ventilator-delivered breath

Inspiratory Time/I-Time (TI): The duration of inspiration (seconds)

Peak flow: The velocity with which the inspiration is delivered. Some ventilators allow for peak flow to be set, while on others a specific I-time is set. Peak flow and I-time are inversely related; increasing peak flow reduces inspiratory time.

Sensitivity: This setting determines the amount of patient effort needed to initiate a ventilator delivered breath

- Different ventilator manufacturers use different terms for sensitivity. These include P-Trigger, V-Trigger, PSENS, VSENS, etc.

Glossary of Terms continued…

Pressure Support: Positive pressure provided during a spontaneous inspiration

- Common values used with patients that Speech Therapists treat: 8-20 cm H2O

FiO2: The concentration of supplemental oxygen provided

- "Room air" contains approximately 21% oxygen
- Common quantities of supplemental O2 used are 28, 35, 40, 50, 60, 80 & 100%

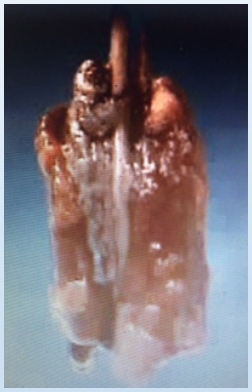
Atelectasis: Collapsed alveoli

CPAP/PEEP: Continuous Positive Airway Pressure/Positive End Expiratory Pressure

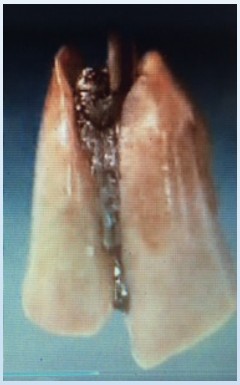
- Pressure provided during inspiration and expiration via an endotracheal tube, tracheostomy tube, or non-invasive ventilation mask in order to keep the alveoli slightly inflated

Alveolar Recruitment Video

Alveoli without PEEP



Alveoli with PEEP



Modes of Ventilation

<u>Modes most often seen by SLPs:</u> (This is NOT a complete list!)

Assist Control (AC)

Synchronized Intermittent Mandatory Ventilation (SIMV)

Continuous Positive Airway Pressure + Pressure Support (CPAP + PS)

Pressure Regulated Volume Control (PRVC)

- Also abbreviated VC+ by other ventilator manufacturers

<u>Vent modes NOT compatible for SLP intervention:</u>

- APRV: patient has very long inhalation time, very brief exhalation
- CMV: full support mode; patient is locked out and unable to initiate a breath at all

<u>Note:</u> the Drager ventilators use the nomenclature "CMV" for their Assist Control mode, so on these ventilators, even if a patient is in CMV, they still may be appropriate for SLP intervention

Pressure Controlled Ventilation (PC or PCV):

Pressure is the controlled/set variable. Volume fluctuates.

AC

The Patient receives:

- A set pressure (ex: 15 cm H2O) which is delivered on all mandatory and patient-initiated breaths
- A set RR
- Set PEEP (ex: 5 cm H2O)
- Set FiO2

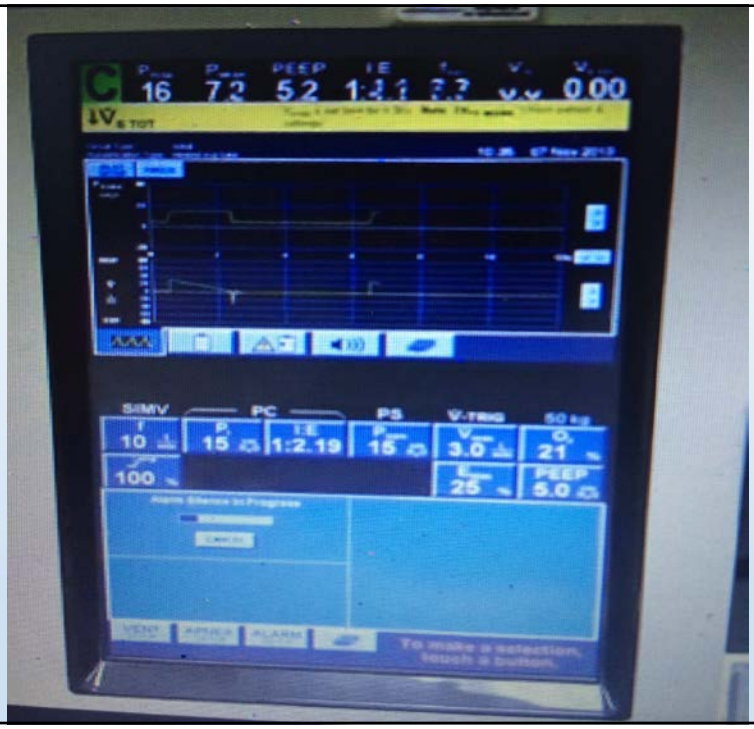
Tidal volume may vary breath to breath

SIMV

The Patient receives:

- A set pressure (ex: 15) on every mandatory breath
- For patient-initiated breaths:
  - Pressure can vary if no PS is set.
  - If PS is set, the pressure equals the set amount of PS
- A set RR
- Set PEEP
- Set FiO2

Tidal volumes may vary breath to breath



Volume Control Ventilation (VC or VCV):

Volume is the controlled/set variable. Pressure fluctuates.

Volume ventilation AC

The Patient receives:

- A set Tidal Volume which is delivered on all mandatory and patient-initiated breaths
- Set RR
- Set PEEP
- Set FiO2

PIP (pressure) may vary breath to breath

Volume Ventilation SIMV

The Patient receives:

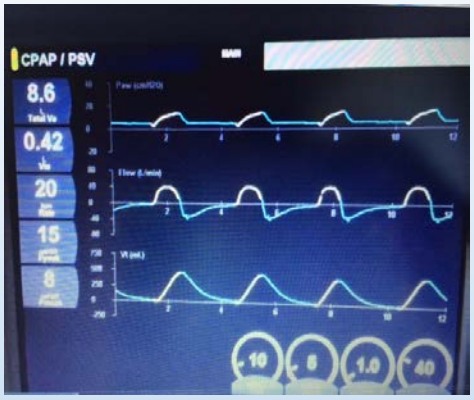
- A set Tidal Volume which is delivered only on the mandatory breaths. Tidal volume for patient-initiated breaths will vary. The vent will not deliver a mandatory breath on top of a patient-initiated breath (i.e., it will not "breathstack")
- Set RR
- Set PEEP
- Set FiO2
- Usually also have a set Pressure Support level for spont. breaths

CPAP + PS

The patient ONLY receives:

- Set Pressure Support level
- Set CPAP level
- Set FiO2

The RR and TV are determined by patient effort



Secretion Management Techniques

In-exsufflation
Manual cough Assist
Tracheal Suction
Above-the-Cuff (Subglottic) Suction

VAP/VAE

Nomenclature:

- Old: Ventilator Associated Pneumonia (VAP)
- New: Ventilator Associated Events (VAE)
  - New, more stringent methods for facilities to measure/track incidents of pneumonia which occur within the first 48 hours of presence of an artificial airway
  - Reimbursement sources no longer pay for VAE treatment
  - More pressure on healthcare facilities to prevent these infections

VAE Prevention is the key to managing healthcare costs and maximizing patient outcomes

In-Exsufflation

(Also known as CoughAssist™, In-Exsufflator, Cofflator™ and "Cough machine")

- **Procedure**:
  - Connect tubing to a mask, mouthpiece, or tracheostomy tube (with cuff inflated)
  - Apply alternating positive and negative pressures to enhance cough and secretion removal
  - Several cycles are done for complete treatment
- **Covered diagnoses**: ALS, MD, MS, SCI, SMA where the neuromuscular disease reduces cough ability and other techniques such as chest percussion have failed
- **Billing**: HCPCS E0482 = Cough stimulating device, alternating positive and negative airway pressure

  http://www.hipaaspace.com/Medical_Billing/Coding/Healthcare.Common.Procedure.Coding.System/E0482

In-exsufflation Videos

Phillips CoughAssist™

Patient Video

https://www.youtube.com/watch?v=ztxz9y-7OYw

Another reference:

For complete Phillips CoughAssist T70 training video:

https://www.youtube.com/watch?v=QHdqcRYIkmU

MANUAL Cough Assist

Procedure

- Rule out contraindications/check with MD as needed
- Contraindications may include sternal fractures, rib fractures, abdominal injury/surgery, AAA, presence of a chest tube, etc.
- Perform with patient in supine position when possible

Training videos

Video 1: (begin ~5:30)

https://www.youtube.com/watch?v=o_xJQ0JJNd4

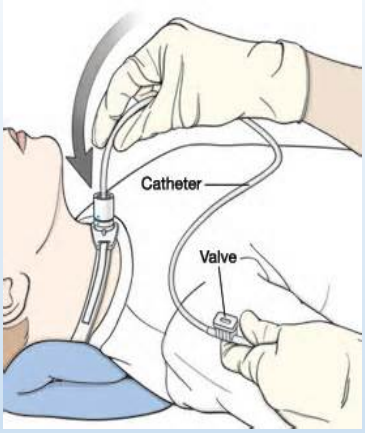
Video 2:

- Limitation of this video is that the "patient" shown is WFL/does not have neuromuscular dz
- https://www.youtube.com/watch?v=ZvXvqQyje5o

Deep Tracheal Suction Technique

American Association of Respiratory Care (AARC) Guidelines are very helpful when learning the procedure and designing competencies:

http://aarc.org/daz/rcjournal/rcjournal/x.RCJOURNAL.COM%2002.21.07/online_resources/cpgs/etscpg.html



To avoid mucosal damage:

- Set the suction regulator between 80 & 120 mm Hg (negative pressure)

Above-the-cuff Suction Benefits

- Decreases secretion aspiration
- May reduce tracheal suction frequency
- Immediate use post-trach placement helps alleviate blood/mucous aspiration
- Helpful in identifying food/liquid aspiration
  - May be helpful to reduce aspiration & increase QOL in situations where patients decline to follow diet recs
- ***Reduces ICU LOS, duration of mechanical ventilation, and rates of VAP**

*Journal of Critical Care, 2011, Vol 39, No. 8

Above-the-cuff Suction Options
(USA)

Suction line on OUTER cannula:

- Increased potential to suction tracheal mucosa if suction pressure is too high
- When the suction line becomes clogged, a complete trach change is usually required to reinstate suction ability
  - High cost expenditure
  - Invasive for patient
  - Risk of losing airway access

Portex® Suctionaid®

Above-the-cuff Suction Options

Suction line on INNER cannula:

- Suctioning line on disposable inner cannula aligns with fenestration on outer cannula
- In the event of blockage:
  - Remove and flush outside of patient
  - If unable to clear, replace with a new cannula

Blom® Subglottic Suctioning Inner Cannula

Subglottic Suction Applications pertaining to SLP Intervention

ALWAYS perform subglottic suction prior to cuff deflation

- Reduces quantity of secretions that drop into lungs
- Reduces patient coughing, anxiety, discomfort

Utilize after p.o. trials/meals to monitor p.o. tolerance

- May help improve accuracy of MEBDT
- Increased clinician confidence in diet tolerance over time, especially if patients no longer on SLP caseload

Verbal Communication Options for Mechanically Ventilated Patients

Electrolarynx

Talking Trach Tubes

Leak speech/Cuff deflation

Inline Speaking Valve

Blom® Speech Cannula

Electrolarynges

Pros:

- Ease of use
- Can be used as needed (not just during ST) by patient, trained staff/caregiver

Cons:

- Consistent placement if patient unable to hold/control unit
- Training issues
- Loaners can get lost

Cost: varies depending on the unit, BUT there are now some more affordable options

- Griffin labs *demo* product 2 for 1 deal
- Blom Singer EL 1000 cost = approx. $200
- Liberty

Inhealth webpage for Blom-Singer® EL 1000:

- http://www.inhealth.com/SearchResults.asp?Search=Blom+singer+EL1000&Submit=

Atos webpage for Liberty™, TruTone™, SolaTone™, Servox®:

- http://www.atosmedical.us/Corporate/Products/Throat/USElectrolarynx

Lauder Electrolarynx company for Servox, SolaTone, TruTone, Cooper Rand, & NuVois™:

- http://www.electrolarynx.com/pages/catalog/ElectroLarynges.html

Griffin™ Labs for SolaTone, TruTone, demo supplies

- http://griffinlab.com/

Talking Trach Tubes

Bivona® Fome-Cuf® Tracheostomy Tube with Talk Attachment

How to use:

- Attach port to 8-12 L of compressed air
- Air passes down the air line, out of a hole near the cuff and up thru VF
- Not widely used
  - Patients c/o dry throat
  - Low vocal intensity
  - Holes may clog quickly, requiring complete trach change to reinstate speech function

Leak Speech/Partial Cuff Deflation

Pros

- Some patients report that these techniques are easier to tolerate than one-way valves
- Some patients may achieve speech without setting off low volume vent alarms

Cons

- Secretions drop into lower airways (unless subglottic suction used first)
- Low vocal intensity & short speech duration
- Phonating at height of inhalation:
  - Normal speech breathing pattern disrupted
  - Difficult to learn to coordinate
- Ventilator setting manipulation may be needed by RT to compensate for volume loss
- Ventilator alarm manipulation may be needed by RT

Inline Speaking Valves

Pros

- Improved speech during exhalation
- Better vocal intensity than with leak speech

Cons

- Secretions drop into lungs
- Ventilator setting adjustments required to compensate for volume loss
  - SLP/RT co-treatment can be difficult to coordinate

Passy-Muir® Valve 007

Montgomery® Ventrach™

CONTINUED™

BLOM® Speech Cannula

Pros

- Speech on exhalation
- Cuff deflation not required
  - Can be used w/cuff inflated or deflated
- No tidal volume loss
- No secretion aspiration
- Optional Alarm management: Exhaled Volume Reservoir (EVR™)
  - Inhale: bellows expand & trap 30-50 ml per breath
  - Exhale: bellows recoil, air returns from EVR to the ventilator to be measured as exhaled volume

Cons

- May require vent adjustments to achieve proper I:E ratio, etc.
  - RT/SLP co-treatment can be difficult to coordinate

BLOM® Speech Cannula Function

Inhalation

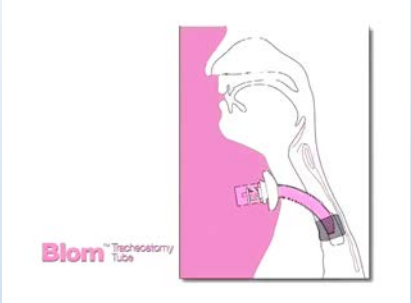
✓Bubble Valve Expands; Flap valve opens; Air is delivered to lungs

Exhalation

✓Flap Valve Closes; Bubble Valve Collapses; Air goes through fenestration to vocal cords, allowing for speech

Contraindications:

Upper airway obstruction; PEEP > 10 cm H2O; FiO2 > 60%; Thick secretions or suction > 5x/hour; excessively dilated stoma



Definitions & Adult Physiologic Norms

Heart Rate (HR):

- 60-100 bpm (breaths per minute)
- Bradycardia: slow heart rate
- Tachycardia: fast heart rate

Respiratory Rate (RR):

- 12-18 / min
- It is not uncommon to see RR accepted into the mid-upper 20's with vent dependent patients

O2 Saturation (O2 Sats): the percentage of hemoglobin saturated with oxygen

- 90 or 92% +

Blood Pressure (BP):

- 120/80
- Check with MD or RN for a patient's acceptable range, as this may vary by diagnosis/medical status

The Evaluation Process

A. Chart review & compiling a thorough case history:

- Date of onset. What happened? List injuries and any surgeries/dates
- Date of intubation. Extubations? Self-extubations?
- Date of trach. Percutaneous v. Open.
- Co-morbidities, PMH, history of respiratory failure, prior intubations/trach history
- Trends in and current ABG results
- CXR results and previous trends
- Medications

The Evaluation Process continued…

B. Ventilation-related points to document

- Type of ventilation used (i.e., Pressure Control v. Volume Control)
- Mode of ventilation used
- Mandatory respiratory rate (Not applicable in CPAP or CPAP + PS)
- Spontaneous respiratory rate
  - (Total respiratory rate – Mandatory respiratory rate = Spontaneous RR)
- Baseline peak inspiratory pressure (PIP)
- Pressure support level (this would apply if the patient were in CPAP + PS, or SIMV)
- PEEP
- FiO2
- Trends in, and current physiologic parameters: RR, HR, O2Sats

The Evaluation Process continued…

C. Before going in to see the patient:

- Consult with RT and RN re: patient stability, any recent medical or cognitive changes, etc.
  - Remember that lethargy and new onset (or worsening) confusion can be symptoms of CO2 retention, infection, medication changes, etc. and should be noted

The Evaluation Process continued…

D. What to assess once with the patient:

- Nutrition source
- Brand, style of tracheostomy tube
- Cognitive status
- Oral motor strength, ROM
- Secretions:
  - Viscosity
  - Quantity
  - Frequency of suctioning by RT and RN
  - Any active infection?
    - Check patients' labs for sputum culture results

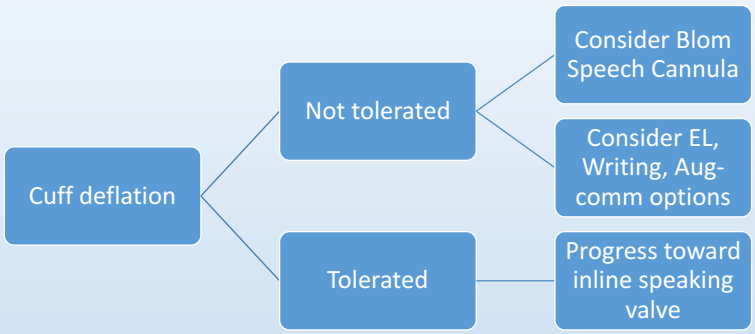
Initiating Intervention

Complete Suctioning:

- Above-the-cuff suction
- Deep tracheal suction
- Velo-pharyngeal suction using Yankauer
- In-exsufflation as needed (RT)

If not contra-indicated, attempt cuff leak/deflation

Decision Making



Speech Assessment

For any verbal speech techniques…

- **Auscultation during respiration and speech output**
  - Where to place the stethoscope
  - Why use it?
    - Garner more clinical information
    - Cuff re-inflation: Minimal Leak Technique
  - What to listen for:
    - Lack of airflow
    - Restricted airflow
    - Wheeze
    - Stridor
    - Wetness/gurgling

- **Also Assess:**
  - Vocal intensity
  - Vocal quality
  - Duration of sustaining vowels
  - Number of syllables/words per breath. Counting or alphabet.
  - Cough strength/ability
- **Provide cues & model secretion expectoration if "wet" vocal quality appreciated**

Therapeutic Intervention

- Provide instruction & practice with pacing/phrasing/coordinating speech with vent cycle
- Discuss daily/current events
- Oral reading (if patient able)
- Play games, cards incorporating conversation
- Family interaction and education
- Co-treat with OT/PT to determine how well speech is tolerated in conjunction with exercise
- Discuss end-of-life decisions
- Initiate swallow evaluations/p.o. trials
- Complete cognitive/linguistic evals/tx
- Therapy length HIGHLY dependent on patient variables:
  - Co-morbidities, Anxiety, Cognitive status, Secretion clearance

Appropriate Cuff Inflation Techniques

- Manometry is best practice
  - Cuff pressure should not exceed 25 cmH2O
- Minimal leak technique also acceptable
- NEVER(!) inflate a cuff based on how much air (ml) you removed
  - Risk of Tracheomalacia
  - Patient discomfort

Swallowing Considerations

- Approach swallowing intervention from a practical perspective
- Introducing p.o. with the cuff deflated is generally considered most preferable practice, HOWEVER…
- **Some patients do not tolerate cuff deflation well, and become more tachypneic/fatigue**
  - **Swallowing while tachypneic is counterproductive and may induce worse swallow function**
- Determine feasibility of patient eating meals/meeting nutritional needs without respiratory compromise with cuff deflated**. If necessary, evaluate swallowing with cuff inflated too.**
- Complete bedside trials, instrumental exams, and FULL meals before initiating a diet

Swallowing Considerations, cont.

- Assess tolerance of meals at different times of day to determine if fatigue is an issue
- Stay with the patient for the whole meal!
  - Suction part-way through the meal and once the patient is finished eating/drinking
- Use continuous subglottic suction after p.o. to rule out delayed aspiration from pharyngeal residue
- Consult with MD and RN regarding med administration and timing around meals so patients are alert
  - Be careful starting meals with patients who are having meds adjusted or have a lot of PRN meds with sedative effects

Food for thought…

- The scope of our practice continues to expand
- Multi-disciplinary collaboration is imperative to maximize outcomes
- Do NOT practice by absolutes
- This is a dynamic, complex population requiring critical thinking and consideration of EACH patient's individual scenario
  - It's OK to have ideals about how you would OPTIMALLY like to practice, but recognize that you may often have to abort mission and consider other avenues
  - It's all about the patient, family, and delicate balance between safety and QOL
  - At the end of the day, think about if you or your family member were the patient

THANK YOU!!!