

2022 Virtual Advanced Complex Surgical Airway Management Case Study Series:

Optimizing Heat-Moisture Exchange Usage in Patients with Tracheostomies

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June 16th, 2022



First case study

SLP

Patient S

- 67-year-old male, Army Veteran
- Part-time cable installer
- *Medical history:*
 - T3N2cM0 Hypopharyngeal SCC s/p chemoradiation at non-VA facility April 2020;
 - Adjustment disorder with depressed mood;
 - Radiation-associated dysphagia
- Establishes care with Minneapolis VA ENT and Speech-Language Pathology clinics in April 2021



<https://www.va.gov/minneapolis-health-care/>



July-August 2021

OP ENT visit:

- Progressive dysphagia, odynophagia, difficulty managing secretions, weight loss

Flexible scope:

- Radiation changes
- Posterior pharyngeal wall 1.5cm x 1cm *"divoting"*

PET/CT:

- Hypermetabolism in the posterior hypopharynx and retropharyngeal space
- No distant disease

Plan:

- Schedule for DL/biopsy

OP ENT walk in:

- Patient worsening: dysphagia, odynophagia, severe neck pain, difficulty managing secretions, SOB, progressive weakness, falls, wt loss
- Flexible laryngoscopy: Increased supraglottic edema

Underwent planned tracheostomy and biopsy:

- 7-0 Portex Cuffed
- Gastrostomy tube placement

MRI Spine & Pathology:

- Soft tissue defect in the hypopharynx with prevertebral fluid collection from C1-C7
- ORN and discitis osteomyelitis
- Epidural abscess, abundant bacteria; ischemia to spinal cord
- No evidence of malignancy

ENT recommendations and plan:

- IV antibiotics
- D/c to CLC for trach and FT cares
- PT/OT
- SLP for OWSV, dysphagia
- "Humidity at all times"

Respiratory:

- RR: 16-18; HR: 77; BP 117/64
- SpO2: 95-98%
- O2 therapy: 21% HTD
- Trach: Changed to Portex BLUselect 7.0 Uncuffed
- Secretions: Variable: thin to thick; min to copious amounts; clear to creamy color
- Suctioning: 1-3x/shift, tracheal
- Cough: Variable: Loose, wet, productive, can move almost to trach hub, but requiring suctioning to remove
- Voice: Hypophonic with open trach, ~85%-90% intelligible, 3-5 syllables



Physical, functional:

- Profound, diffuse, and symmetrical weakness
- NPO with feeding tube
- Ceiling lift transfer, cannot walk, can be assisted to sit up to EOB
- OT: Able to raise arms but fingers cannot grip/squeeze, able to sustain holding hand to mouth or neck for 5-10 seconds

Psychosocial, emotional:


- Intermittent confusion, especially at night
- Typically refusing to get OOB with therapies
- Keeps room dark, throws blanket over his head
- Allows nursing to perform most/all tasks
- Expresses clear overwhelm with dramatic decline
- Full code



<https://lms.rn.com/getpdf.php/1839.pdf>

- Speech-Language Pathology consulted by ENT to assess for one-way speaking valve (OWSV)
- Initially did not place OWSV due to upper airway edema; cuffed trach; brand new trach
- Re-evaluation for OWSV after trach was changed to uncuffed → Patient consistently reports feeling increased WOB and resistance with OWSV on
- Chronic trach expected
- Issued OWSV with specific orders for placement:
 - *Duration of use:* Daily, unrestricted amounts of time
 - *Supervision level:* 1:1 supervision with valve on
 - *Level of placement:* RT, SLP, RN

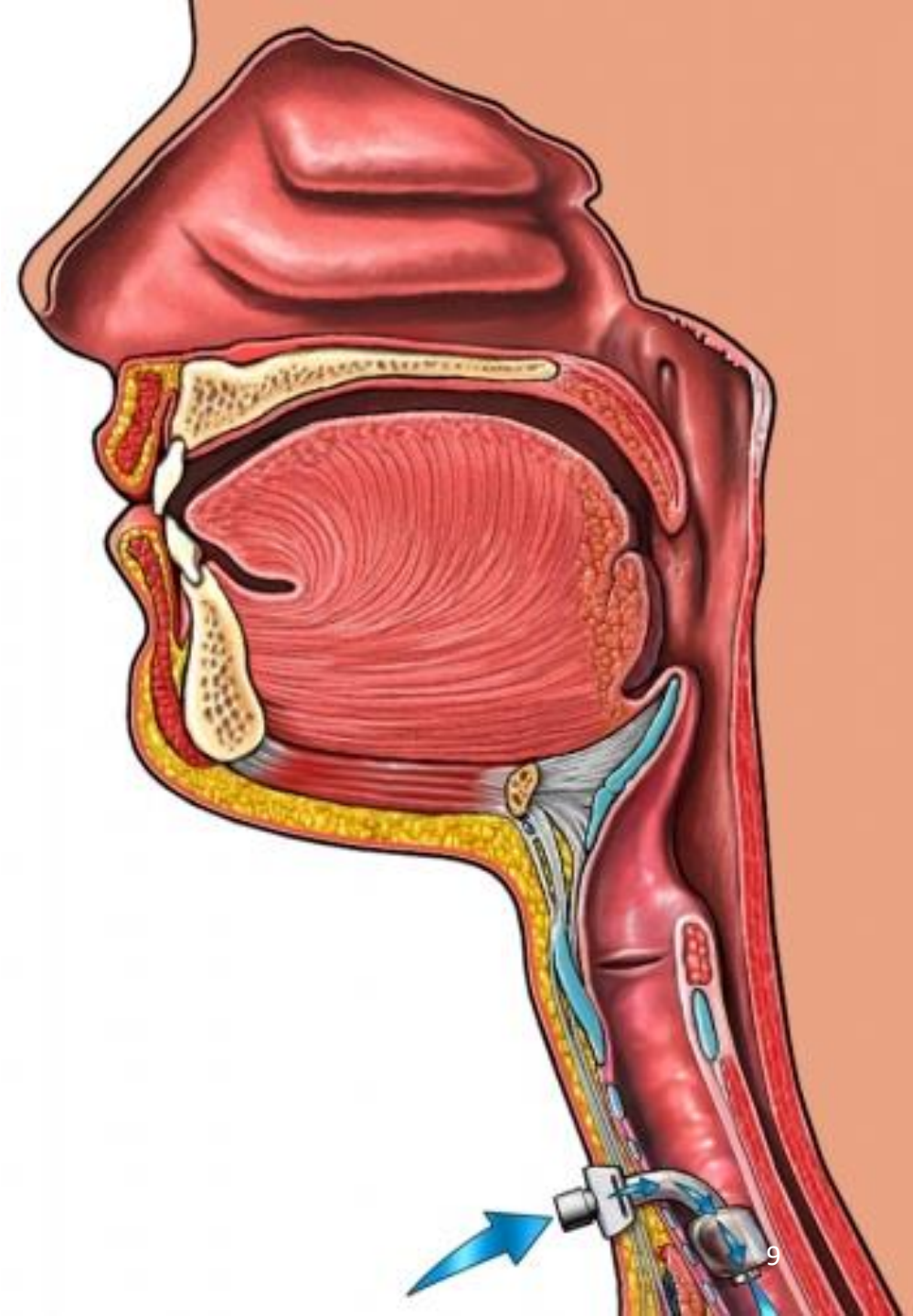




Could this patient benefit from using a heat and moisture exchange (HME)?

Anatomy check

- Tracheostomy tube in situ:
 - Disconnect between upper and lower respiratory tract → leading to loss of temperature-regulating (warming) and humidifying function of the upper airway
 - Increased risk of dried secretions or mucus plugs → may block the trach tube and cause obstruction
- Negative effects of tracheostomy on pulmonary status are substantial, and potentially equal to the effects of total laryngectomy on pulmonary status (Ward and van As-Brooks, 2014; Roessler et al., 1988)



Heat and moisture exchange (HME)

- Pulmonary rehabilitation: Need for initial/postsurgical and ongoing humidification
- Humidification for a surgical airway may be either:
 - *Active*: External humidifier
 - *Passive*: Heat and moisture exchange (HME) system
 - Positioned directly over hub of trach
 - Some brands can be attached to speaking valve
- HME: allows for more normal mucociliary function prevent excessive, thick secretions as a result of humidity loss (Ward & van As-Brooks, 2014)



Decision-making: Using a Heat and Moisture Exchange (HME)

Knowledge of device

- HME vs. other option
- What is it not intended to do?

Clinical decision-making

- Collaboration with whole surgical airway team
- Secretions

Risk-benefit analysis

- Goals (Clinician and patient)
- Contraindications
- Safety, infection control

Knowledge of variations in product

- Different HME types, brands, features

Knowledge of device

- HME vs. external humidification:
 - Systematic review → HME preferred choice in spontaneously breathing neck breather patients: Reduction of pulmonary complaints, overall better patient compliance, and improvements in relative QOL aspects (Wong et al., 2016)
 - Study using patient questionnaire → Compliant HME users tend to make less use of external humidifiers (Brook, Bogaardt, & van As-Brooks, 2013)
- HME device *alone* is not expected to:
 - Give supplemental O2
 - Give respiratory treatments or medications
 - Contribute to speedier decannulation

Clinical decision-making

- No one standardized HME pathway exists
- Highly patient-specific and individualized
- Decision to place, or not place, should be made in conjunction with the rest of the medical team
- *Secretions*: Consistency, quantity, suctioning frequency, cough ability
 - Should inspect and visualize the inner cannula
 - Check with MD on medications which may influence secretions
- Clinical practice: Many stable, adult patients with adequate systemic hydration often tolerate little supplemental humidity or heat (Lewarski, 2005)



Risk-benefit analysis

Low volume, high risk population

- What are the goals: Patient? Clinician?
 - What can the patient do?
 - What level of supervision can be provided? What is nursing familiarity?
- Infection control for patient and staff → Some HMEs can help prevent respiratory viruses including COVID-19 from entering through the stoma (Brook, 2020)
- *Using caution* → Patients who may not be appropriate for HME usage:
 - Cuffed trachs
 - Thick and viscous sputum which may occlude the HME and suffocate the patient
 - Limited pulmonary reserve
 - Inability to remove the HME due to profound physical and/or cognitive limitations and insufficient supervision

Knowledge of variations in product

- Wide variety of devices and features exist!
- Do you have additional patient goals or needs?
 - Suctioning access
 - O2 ports or adaptors
 - Dual function speaking valve capability
 - Varying resistance levels
- Does your facility have a preferred HME?
- Check out your options!



- SLP places HME
- *Decision-making:*



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Knowledge of device

- ✓ Patent upper airway
- ✓ Patient requires humidification
- ✓ Does not require supplemental O₂

Clinical decision-making

- ✓ Secretions relatively thin and not clogging inner cannula
- ✓ Infrequent suctioning
- ✓ Adequate systemic hydration from feeding tube

Risk-benefit analysis

- ✓ Limited mobilization, but will plan to initiate bed and in-room mobility with PT
- ✓ Chronically open trach with loss of upper airway resistance; could benefit from some resistance
- ✓ Has extremely close RN supervision
- ✓ Infection control for patient and staff

Knowledge of variations in product

- ✓ Provox XtraFlow + HME trach adaptor
- ✓ Pictures and instructions posted bedside

- *Clinical outcomes, retrospective chart review, post HME placement:*
 - No documented adverse events that could be attributed to problems from inadequate humidity relative to the surgical airway:
 - Mucus plugging
 - Hospital admission
 - Secretions have remained thin in consistency and manageable
 - Nursing notes document longer periods of uninterrupted sleep without bubbling noise/chest wetness
 - Able to leave room in new power wheelchair from PT while wearing HME
 - Less isolation with door closed due to AGP
 - Improved nursing satisfaction, understanding of, and experience with device
 - No need to wear N95
 - Provide a bedbound patient with one less line

- Modified Palliative Care approach
 - Permanent tracheostomy anticipated due to SOB, feelings of anxiousness with OWSV, and need for pulmonary toileting
- No further SLP goals identified
- Patient rounded on in Surgical Airway Rounds, led by SLP, virtually, every Tuesday and Thursday
- Using HME mainly round the clock, humidifier “on standby”
- Several reported aspiration events and hypoxia after attempting to eat candy
- Remains on CLC at the present due to complex social work needs





Second case study

RT

Case Study

- 56-year-old male admitted for neck dissection, tracheostomy and PEG tube placement due to Stage 2 Squamous Cell Oropharyngeal Cancer
- *Past Medical History:* CAD, Hypertension, Hyperlipidemia, current smoker with 36 pack year history, COPD
- *Social history:* No alcohol use, no illicit drug use
- *Occupation:* Automotive body repair for 31 years

Pulmonary and Occupational History

- COPD

- Comprised of Emphysema and Chronic Bronchitis

- Chronic Bronchitis: overproduction and hypersecretion by goblet cells and the decreased elimination of mucus are the primary mechanisms responsible for excessive mucus in chronic bronchitis (Ramos et al., 2014)

- COPD patients have a significant decrease in ciliary function which impacts mucociliary clearance, potentially contributing to retention of secretions and subsequent infection

- Patient does have chronic, productive cough for moderate amounts of thick white sputum

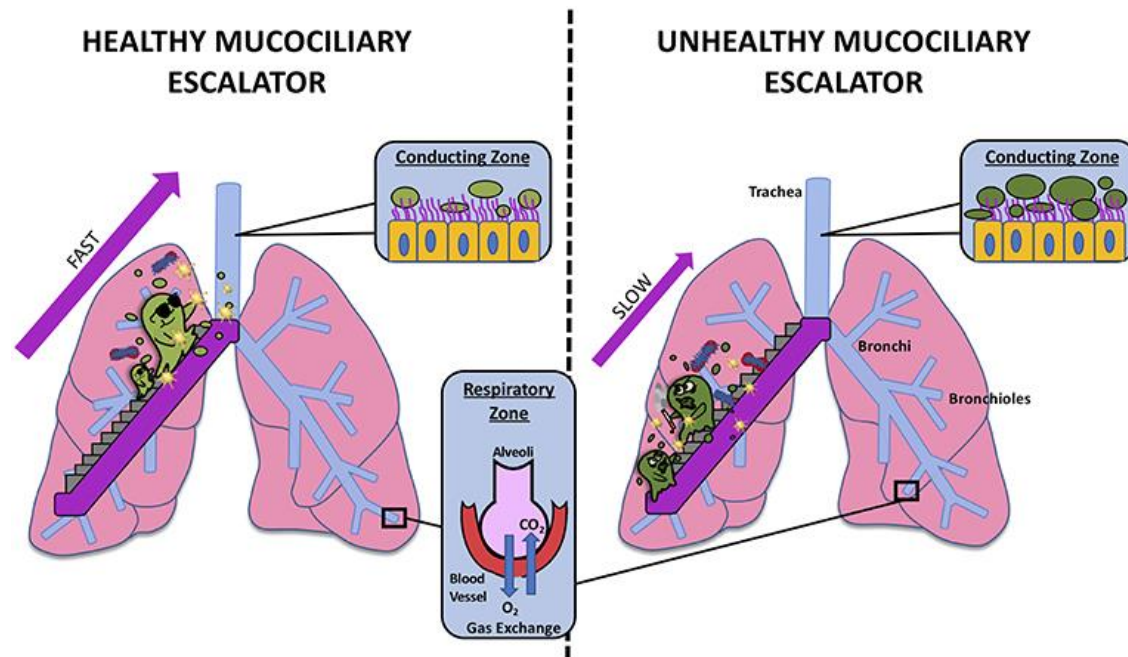
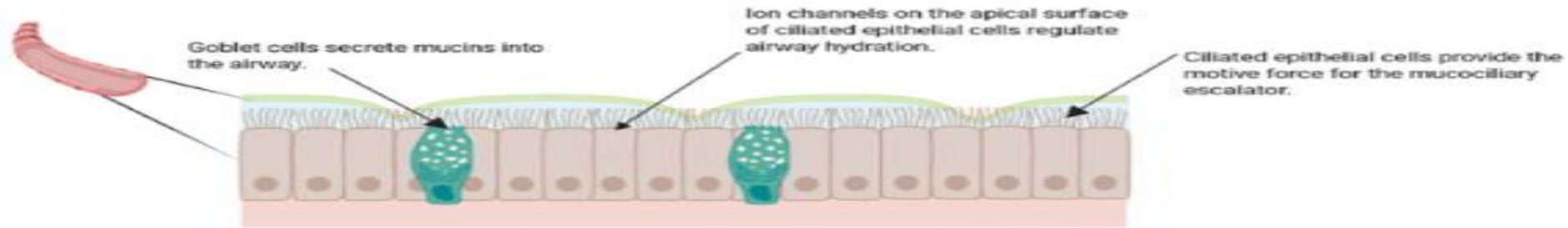
- Occupational history: dust, fumes, chemicals

- Patient does not wear mask or protective equipment

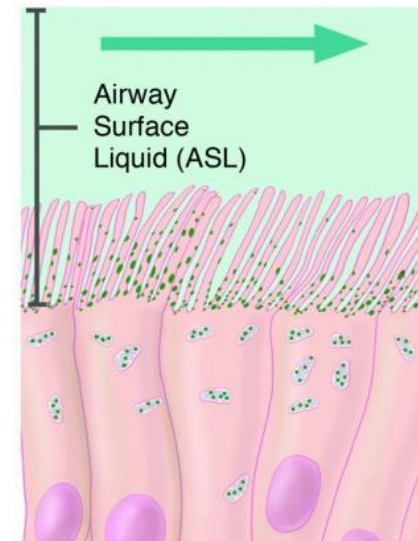
- All contributory to potential pulmonary concerns and reduction in ciliary function

Mucociliary Escalator

Healthy airway epithelium

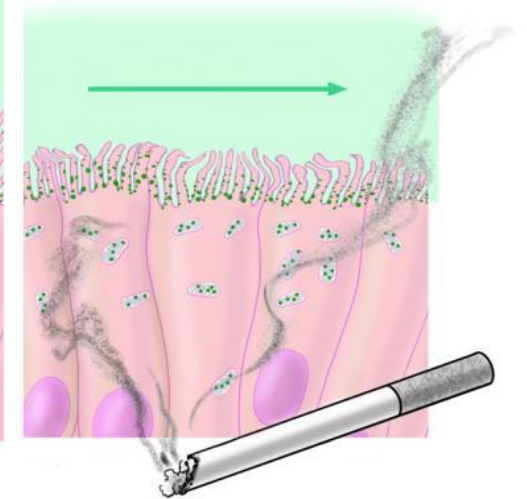


Normal mucociliary transport



CS effect on cilia

- shorten cilia length
- decrease beat frequency
- decrease ASL



Post Operative Care

- Tracheostomy (#8 Cuffless) placed by ENT sutured and twill tied in place
- POD 0:
 - Trach Collar with active humidification ordered at FiO2 of 0.28
 - Patient refusing to wear trach collar: “too cold”, “my chest gets wet”, “I don’t want to be tethered to the wall”
 - Q1Hour tracheal suctioning ordered for first 24 hours post op
 - Patient refusing to be suctioned by hour 10 due to discomfort and pain
- POD 1: Secretions becoming thicker, noticeable via inner cannula lumen wall with sputum adherence
 - Discussed HME usage with ENT
 - ENT declined. Did not want anything on trach or trach tube manipulation (except trach care)

Post Op Care cont.

- POD 2:

- Patient continues to refuse to be suctioned and active humidity

- SpO2 on Room Air 89-91%

- Application of Oxy Trach at 2 L/min

- Oxy Trach

- Device capable of delivering 1 to 15 liters of O2
 - FiO2 range from ~23% to 83%
 - Low noise, no wetness, less confining
 - DRY GAS

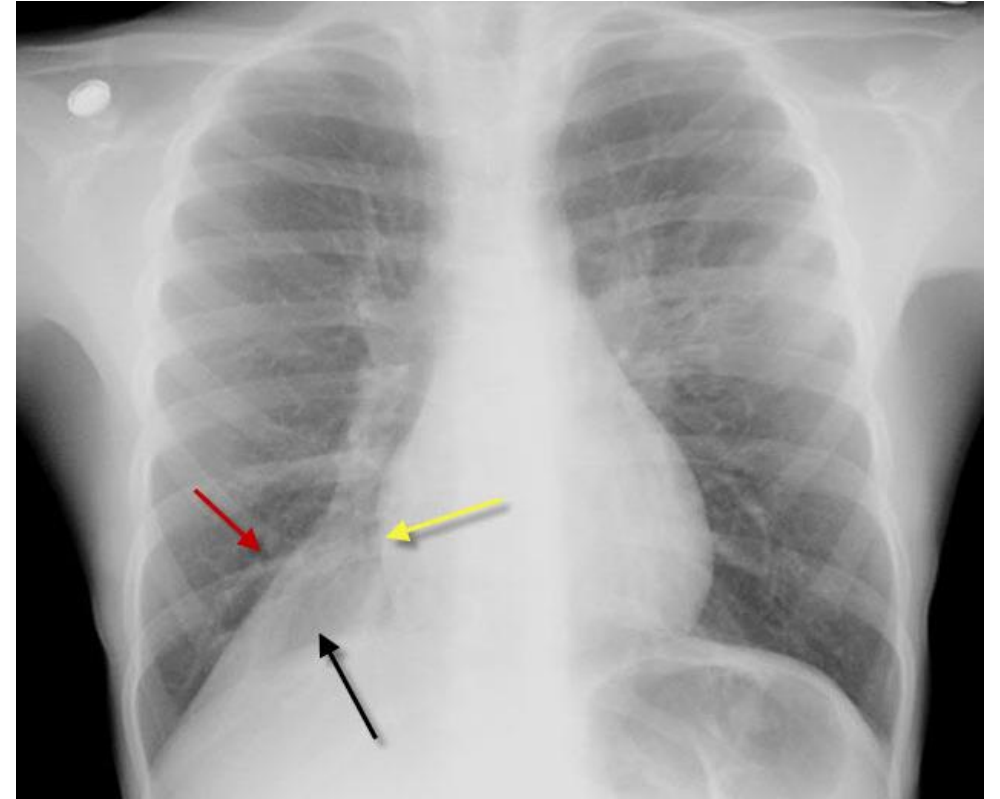
- ENT made aware

- Incentive Spirometer ordered
 - Declined HME usage



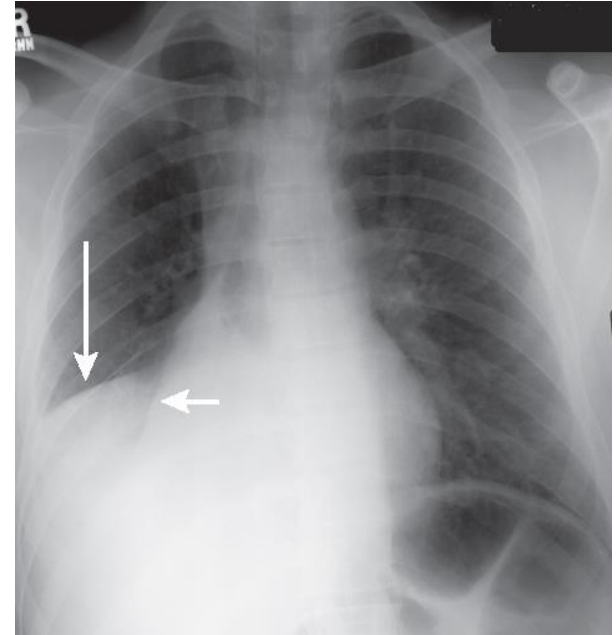
Post Op Care cont.

- POD 2 into 3:
 - Increasing work of breathing
 - SpO2 88% on 2 L/min Oxy Trach
 - Very thick secretions via cough
 - CXR ordered: RLL atelectasis
 - ENT orders:
 - FiO2 increase to maintain SpO2 >90%
 - Albuterol nebulization Q4 hours
 - Encourage tracheal suctioning q1 hour



Post Op Care cont.

- POD 4:
 - RR 26-30 with obvious increased WOB
 - HR 115-125
 - Oxy Trach at 15 L/min, SpO2 91%
- CXR ordered: RML and RLL collapse
- ENT removed #8 trach and inserted #6 cuffed trach
 - Patient placed on mechanical ventilator
 - High peak pressures on mechanical ventilator indicative of increased of airway resistance. 50+ cmH2O.



Care cont.

- POD 5:
 - Bronchoscopy performed:
 - Copious amounts of thick secretions and numerous mucus plugs removed from right lung
 - Lavage of 120 mL
- Chest X-ray post bronchoscopy:
 - Right middle and lower lobe now open with good aeration bilaterally
- Ventilator peak pressures: 20-25 cmH₂O, FiO₂ 0.28
- Ventilator weaning initiated:
 - Successfully weaned within 4 hours post bronchoscopy
 - Placed on trach collar at 28%
 - Transitioned to HME on POD 7 with ENT approval
 - Very close monitoring due to cuff on trach tube

HME Utilized

- Teleflex Trach-Vent
- Hospital purchase
 - Explore options
 - Know the dead space
 - Important for advanced lung illness
- All HME devices are not the same



Outcome and Learnings

- Patient remained using HME with q24 hour change out for remainder of hospital stay, trach changed to #6 cuffless on POD day 11 and patient was discharged on POD 13 with order to continue HME usage
- Collaboration is imperative from all disciplines
- Never underestimate the importance of airway humidity in the dry hospital environment
- Continually assess secretion viscosity, know their history and what effects their current disease states may have on secretion production and consistency

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