DYSPHAGIA RELATED TO TRACHEOSTOMY & VENTILATOR DEPENDENCE

Presented By:
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Ventilation

Indications
- Disruption of normal air exchange into and out of lungs
- Causes of respiratory failure:
  - Respiratory illness
  - Cardiac events
  - Neurological injury
  - Neuromuscular disease
  - Trauma
  - Environmental contamination
  - Airway obstruction

Associated Complications
- Lung barotrauma
- Oxygen toxicity
- Atelectasis
- Nosocomial pneumonia
- Decreased venous return
- Decreased cardiac output
- Hypotension
- Gastrointestinal bleeding
- Malnutrition
- Decreased urine output/ altered renal function
- Altered fluid balance
- Increased intracranial pressure
- Respiratory alkalosis
- Accidental disconnect of ventilator/ power loss
- Loss of airway pressure

Artificial Airways

- Maintain patent airway
- Connect to mechanical ventilation
- Provide access to lungs for pulmonary toilet
- Control ventilation
- Control oxygenation
- Circumvent airway obstruction
- Reduce aspiration potential
Endotracheal Intubation
- Insertion of endotracheal tube into airway
- Somewhat flexible but retains shape in airway
- Used for short-term:
  - To provide artificial airway
  - To connect to mechanical ventilation for airway protection and ventilation
  - May stabilize severe facial fractures
  - May not be possible with tracheal stenosis and tumors

Orotracheal Intubation
- Orotracheal: Inserted into mouth, passing through pharynx and vocal folds into trachea

Nasotracheal Intubation
- Nasotracheal: Inserted into nose, passing into pharynx and vocal folds into trachea

Short-Term Endotracheal Intubation Complications
- Trauma
- Otitis media
- Damage to vocal folds or recurrent laryngeal nerve
- Hypoxemia
- Improper positioning
- Esophageal intubation or rupture
- Cardiac complications
- Traumatic extubation with cuff inflated
- Increased intracranial pressure

Long-Term Endotracheal Intubation Complications
- Pressure necrosis
- Granuloma
- Stenosis
- Laryngeal web
- Glottic incompetence

Cricothyroidotomy
- Emergency surgical opening into cricothyroid membrane
- Potential complications:
  - Chronic vocal changes
  - Injury to:
    - Trachea
    - Larynx
    - Vocal cords
    - Esophageal perforation
    - Subglottal stenosis
Tracheotomy

- Surgical opening directly into trachea
- May be maintained as long as needed

Tracheostomy

- Surgical or endoscopic procedure
- Between 2nd and 3rd tracheal rings
- Horizontal vs. vertical incision

Tracheostomy Materials

- Disposable:
  - Can retain bacteria
  - Should be discarded and replaced every 28-30 days
  - Non-disposable: Must be sterilized routinely

Tracheostomy Materials: PVC

- Disposable
- Inexpensive
- Widely used
- More rigid than silicone
- Soften in heat

Tracheostomy Materials: Silicone

- Disposable or non-disposable
- Flexible
- Softer than PVC or metal
- May weaken and collapse over time
- Contains fewer chemical additives
- Properties reduce encrustation of secretions and tendency of bacteria to adhere to tube

Tracheostomy Materials: PVC/Silicone Mix

- Commonly used
- Strength of PVC with bacteria resistance of silicone
Tracheostomy Materials: Metal
- Silver or stainless steel
- More sanitary
- Not typically used for individuals requiring ventilation
- Less comfortable
- Often used at home

Tracheostomy Size
- Often denoted on flange
- Typically measured in French sizes
- Determined based on age, weight, and height
- Goal:
  - Tube with sufficient airflow but not too large
  - Fill no more than $\frac{2}{3}$-⅔ of tracheal lumen

Tracheostomy Components
1. Outer Cannula
2. Cuff
3. Pilot Line
4. Pilot Balloon
5. 15 mm hub
6. Flange
7. Obturator
8. Button
9. Inner cannula
10. Syringe

Tracheostomy Components: Flange
- Allows tube to be held in place with string ties
- Prevent:
  - Tube from advancing into trachea
  - Accidental decannulation
- Often denotes some features

Tracheostomy Components: Outer Cannula
- Provides basic structure
- Remains in place to maintain airway
- Single lumen tubes:
  - Have only outer cannula
  - Least airway resistance

Tracheostomy Components: Inner Cannula
- Can be removed:
  - For cleaning
  - Quickly if obstructed
  - Smaller lumen increases work of breathing
  - May be disposable or non-disposable
Tracheostomy Components: Fenestration

- Windows/holes in body of outer or inner cannula
- Allows air to pass from trachea to vocal folds
- Not used in individuals at high risk for aspiration
- Often used as part of weaning process
- Improperly aligned fenestration may result in:
  - Granulation
  - Occlusion

Fenestrated Inner Cannula

Non-Fenestrated Inner Cannula

Tracheostomy Components: Cuff

- Cuff:
  - Internal balloon surrounding body of tracheostomy tube
  - Compensates for area in tracheal lumen not filled by tube
  - Soft plastic molds to tracheal walls
  - Prevents air from escaping around tube, especially during ventilation
  - Reduces risk of aspirated material immediately entering trachea
- Cuffless: Allows air to escape around body of outer cannula to upper airway

High volume, low pressure

Low volume, high pressure

Pressure-controlled

Foam

Tracheostomy Components: Pilot

If tracheostomy is cuffed:
- Pilot line: pathway for air to inflate and deflate cuff
- Pilot balloon:
  - Indicates amount of air in cuff
  - Prevents air escape from cuff
**Tracheostomy Components**

- Obturator

- **Button:**
  - Closes tracheostomy
  - Used during weaning/decannulation process

**Tracheostomy Benefits (Compared to ET tube)**

- Decreased risk of accidental decannulation
- Improved secretion management
- Larynx is not involved in procedure
- Decreased airflow resistance
- Increased comfort
- Decreased physical restriction
- Increased options for oral feeding and communication
- Options for transfer out of intensive care unit

**Tracheostomy Complications**

- Pneumothorax or in trachea
- Bleeding
- Inadvertent decannulation
- Cardiorespiratory arrest
- Thyroid injury
- Recurrent laryngeal nerve damage
- Cuff rupture
- Discomfort
- Infection at stoma

**Dysphagia Related to Tracheostomy & Ventilator Dependence**

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**Swallowing Physiology**

**Impact**

- Swallow may or may not be affected by presence of tracheostomy
- Potential for dysphagia is increased due to:
  - Tracheostomy tube presence
  - Surgical procedures
  - Neurological/respiratory impairments
- Risk of aspiration is increased by presence of tracheostomy
- Consequences of aspiration are more serious
- Impaired smell and taste

**Impact: Laryngeal Excursion**

- Reduced due to:
  - Fixation of muscles
  - Weight of equipment and tubing
  - Cuff inflation anchors tracheostomy tube
- Results in:
  - Decreased tongue base movement and propulsion force
  - Dragging along walls during attempts at elevation
  - Inflated cuff partially obstructing esophagus
Impact: Laryngeal Excursion

- Esophageal Bulge
- Cuff in Place

Impact: Secretions

- Disturbance in saliva and secretion management due to:
  - Airflow disruption
  - Medication side effects
  - Thick secretions
  - Infections
  - Interruption of filtration and hydration

- Results in:
  - Insufficient saliva
  - Excess saliva

Impact: Airway Pressure

- Decreased subglottic pressure:
  - When normal, prevents oropharyngeal contents from entering airway
  - Valsalva maneuver

- Results in: accumulation of residue in pharynx
  - Mechanical ventilation may result in less aspiration than spontaneous breathing with tracheostomy

Impact: Glottic Competence

- Decreased glottic closure response:
  - Gradual loss of laryngeal sensation
  - Eliminates reflexive cough and throat clear
  - Increased cough effectiveness

- May use inspiratory airflow of ventilator for airway clearance if cuff is deflated
  - Incoordination of glottic closure with swallow
  - Disruption of apneic interval when ventilator is required
  - Protective function does not immediately return once cuff is deflated

Normalizing Airway Pressure

- During swallow, nearer normal pressure can be attained by:
  - Digital occlusion
  - One-way valve
  - Capping

- Individuals who are ventilator-dependent:
  - Often swallow worsens when on ventilator
  - Tidal volume may be increased to compensate for lost volume and to provide increased subglottic pressure
  - Must learn to time swallow with ventilator cycle of expiration
  - With ventilator, instruct in glottic control to compensate for air leak during cuff deflation
Cuff Deflation

- At least partial cuff deflation should be attained prior to swallow assessment and feeding:
  - Cuff deflated sufficiently for air to move through larynx
  - Allows brief occlusion of tracheostomy
  - Cuff must be at least partially deflated to identify potential aspiration
  - Full cuff deflation is goal

With Cuff Inflation

- Fully inflated cuff should not completely seal against tracheal walls
- Aspirated material can pool on top of cuff and may:
  - Fall into airway when cuff is deflated even with proper suctioning after cuff deflation
  - Fall between trachea and cuff, especially as cuff slides with movement of larynx
  - Become bacterially colonized

Without cuff deflation, only oral stage and ability to trigger swallow can be assessed

Individuals who are so medically fragile as to preclude cuff deflation are usually not candidates for significant oral intake
With Cuff Inflation

- Oral intake should be deferred until at least partial cuff deflation is achieved
- If medical clearance cannot be attained:
  - Fully explain and document limitations and dangers of swallowing in presence of inflated cuff
  - If physician has been educated and still desires individual eat with fully inflated cuff, recommendations made during dysphagia assessment are useless

Suctioning and Cuff Deflation

- “...Clinicians must be competent to perform any activity by virtue of education, training, and experience”
- Appropriate training and support is necessary to undertake any activity in which SLP is not already competent
- SLP may perform suctioning and cuff deflation if accepted under State Licensure and fully trained
- “Suctioning is complicated and can be a life threatening procedure. The procedure should always be done by those who are properly trained and know the complications and the individual.”

ASHA’s Code of Ethics

Suctioning Indications

- Inability to effectively clear secretions
- Need to remove material from airway to prevent obstruction
- Respiratory conditions

Suctioning Material Above Cuff

- Foreign materials collect in airway above level of cuff
- Suctioning through tracheostomy tube with inflated cuff does not remove material above cuff
- Materials above cuff are cleared by suctioning via mouth and through vocal folds or after cuff deflation
Suctioning Complications

- Mucosal trauma
- Cardiac arrhythmia
- Hypoxemia due to oxygen being removed from lungs
- Laryngospasm

Cuff Deflation

- Medical clearance by physician is necessary before any attempt at deflation
- Some individuals are not candidates for deflation

Ventilation With Cuff Deflation Benefits

- Improves access to upper airway during suctioning
- Normalizes airflow through upper airway for airway protection reflexes
- Air escapes on inspiration and travels through upper airway instead of remaining in closed loop between ventilator and individual
- Reduces trauma to mucosal tissue
- Decreases interference with laryngeal elevation during swallowing

Clinical Assessment

History

- Additional information which is useful:
  - Intubation:
    - Date
    - Planned vs. emergent
    - Associated trauma
  - Extubation:
    - Date
    - Associated trauma
  - Tracheostomy information
  - Secretions
  - Ventilator history
Contraindications to Assessment

- Decreased alertness
- Extreme agitation
- Severe cognitive impairment
- Medical instability
- Extreme fragility
- Inflated cuff

Clinical Assessment

- Valuable but limited information is gathered
- Rarely is final step in tracheostomy dysphagia assessment:
  - Typically leads to instrumental assessment
  - Only if completely confident of individual’s ability to manage oral intake should recommendation for oral feeding be made based solely on clinical assessment
  - More often, stand-alone when already eating and there are questions regarding management of particular diet or when aspiration is overt
  - May require multiple sessions

Clinical Assessment Procedure

- Oro-motor assessment
- Suction
- Deflate cuff
- Digital occlusion or one-way valve placement:
  - Phonate
  - Cough
  - Clear throat

Clinical Assessment Procedure

- Dry test swallow:
  - Prior to advancing to trial swallows, consider if individual can:
    - Swallow
    - Phonate
    - Clear throat
    - Expectorate secretions

Clinical Assessment Procedure

- Trial swallows:
  - Assess with tracheostomy unoccluded and with tracheostomy occluded during swallow
  - Provide controlled bolus sizes and types

Clinical Assessment Procedure

- Observe:
  - Oral transit/control
  - Initiation speed
  - Pharyngeal swallow
  - Vocal-quality changes
  - Cough: cough may occur unrelated to swallow due to changes in sensations and pulmonary status
  - Increased secretions or need for suctioning
  - Typical signs of dysphagia and aspiration
Clinical Assessment Procedure

- Encourage cough or throat clear if needed
- Suction, rest, re-suction
- Re-inflate cuff and return to baseline ventilator settings, if needed

Clinical Assessment Reliability Limitations

- Possible loss of cough reflex
- Changes in vocal quality or inability to phonate
- Secretion management differences
- General decreased reliability of clinical assessment in identifying aspiration
- Cannot assess:
  - Cause of aspiration
  - Compensatory strategies

Cervical Auscultation

- Tracheal sounds observed with tracheostomy differ from those without tracheostomy

Blue Dye Test

- Used to enhance ability to discern bolus from surrounding mucosa or secretions
- May identify aspiration of more than trace amounts
- May not effectively identify trace aspiration
- Optimally performed over several sessions during 48-72 hour period

Blue Dye Test Protocol

- Place 2-3 drops of sterile water mixed with blue food coloring on tongue
- Suction trachea immediately and at 15-minute intervals over 1 hour period, recording presence of any blue material in tracheal secretions
- Can repeat secretion testing every 4 hours over 48-hour period
- Does not compromise individual, as individual only aspirates own secretions

Blue Dye Test Protocol

- If no evidence of aspiration of saliva, can mix blue dye with food consistencies
- Proceed one consistency at time, waiting at least 4-6 hours between consistencies
- Positive result:
  - Presence of blue material in any tracheal suctioning
  - Alerts to presence of aspiration
  - Dictates conservative approach to further assessment
- Negative result:
  - Absence of dye
  - Allows further test swallows
Blue Dye Test Protocol

- Alert nursing and respiratory care staff that blue dye test is in progress
- Cuff status should be noted during presentations and suctioning
- Bedside tracking sheet assists with documentation of suctioning results

Blue Dye Test Tracking Sheet

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME</th>
<th>CONSISTENCY</th>
<th>PRESENTED</th>
<th>CUFF STATUS</th>
<th>DYE PRESENCE</th>
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<tbody>
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<td></td>
<td></td>
<td>None</td>
<td>Min.</td>
<td>Mod.</td>
<td>Sev.</td>
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</tbody>
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Blue Dye Test Limitations

- Up to 50% false-negative error rate
- Subjective grading of degree of dye present
- Unable to determine:
  - Cause of aspiration
  - Timing of aspiration
  - Quantity of aspiration
  - Effectiveness of compensatory strategies
- Should be interpreted conservatively and not used exclusively to determine candidacy for oral feeding

One-Way Valve Use

Function:
- Allows air to enter tracheostomy tube on inspiration
- During expiration, valve is closed, and air is directed into trachea and upward to vocal folds
- Can be used with individuals using oxygen, humidified air, or ventilator
- Entire team should be aware of purpose and use of valve

One-Way Speaking Valves

“It is the role of the speech-language pathologist, following referral from and in collaboration with medical specialists, to determine the need for and appropriate type of voice prostheses. The speech-language pathologist also assesses the effectiveness of these communication devices and provides rehabilitation to help the individual obtain an optimum level of communication function.”
One-Way Speaking Valve Benefits
- Normalizes airflow
- Restores more normalized physiology
- Design inhibits secretions from entering tracheostomy

One-Way Speaking Valve Requirements
- Awake and alert
- Tolerance of full cuff deflation:
- Proper size of tube relative to tracheal lumen
  - 48-72 hours after tracheostomy initially performed or tracheostomy change to allow for decrease in edema

One-Way Speaking Valve Contraindications
- Inflated cuff
- Tracheostomy tube with sponge or foam-filled cuff
- Airway obstruction that affects airflow through upper airway even when tracheostomy size is adjusted and cuff deflated
- Bilateral adductor vocal cord paralysis
- Severe tracheal/laryngeal stenosis
- Unstable medical/pulmonary status
- Reduced lung elasticity which may create air trapping
- Unmanageable, thick, copious pulmonary secretions
- Endotracheal tube
- Unconscious; comatose; sleeping
- Laryngectomy

One-Way Speaking Valve Cautions
- Respiratory treatments or medications should not be administered during valve use
- Caution should be taken with:
  - End-stage pulmonary disease
  - Heat moisture exchange device

One-Way Speaking Valve Procedure
- Position individual optimally
- Instruct with procedure for deflation and speaking valve placement
- Suction appropriately (tracheal and oral)
- Deflate cuff:
  - Allow acclimation prior to initial placement of valve
  - Make necessary changes to ventilator settings
  - Cuffless tracheostomy is ideal and should be considered
- Monitor continually
- Remove T-Piece if needed

Airflow with One-Way Valve and Cuff Inflated
One-Way Speaking Valve Procedure

- Observe for:
  - Adequate airflow around tube
  - Signs of respiratory distress
  - Prolonged, excessive coughing
- If any distress (or at completion of trial):
  - Remove valve
  - Replace T-piece
  - Re-inflate cuff
  - Return to original ventilator settings

Swallow Treatment

After assessment, treatment can proceed similarly to individuals without tracheostomy

- If swallow is not elicited, treatment focus is on indirect treatment to elicit swallow until individual consistently swallows independently
- Therapeutic feeding trials: considerations same as with clinical assessment with tracheostomy
- When full cuff deflation is not possible:
  - Some exercises can be used to strengthen and prepare for swallow
  - Repeated laryngeal elevation required by some exercises increases potential for tracheo-esophageal fistule
  - Consider each exercise individually

Compensatory Techniques

- Changes in posture:
  - Chin tuck
  - Head turn
  - Chin tuck & turn
  - Head tilt
  - Head back
  - Reclined
  - All may be physically difficult due to equipment in place

Compensatory Techniques

- Diet modifications:
  - Non-oral options
  - Changes in consistency of liquids
  - Changes in consistency of solids
  - Teach digital occlusion during swallow and for several seconds after swallow

Compensatory Techniques

- Changes in bolus presentation:
  - Bolus size
  - Rate
  - Placement
  - Clearance
  - No straw
  - Liquid by spoon
  - No talking
  - Moisten mouth prior to meal
  - Can proceed as without tracheostomy
Compensatory Techniques

- Increased sensory input:
  - Temperature
  - Pressure
  - Flavor
  - Texture
  - Can proceed as without tracheostomy

Facilitation Strategies (Caution with Full Cuff Inflation)

- Effortful Swallow
- Mendelsohn Maneuver: Often used in individuals with tracheostomy
- Supraglottic Swallow Maneuver: Difficult to maintain breath hold unless digital occlusion or one-way valve is in place
- Super-Supraglottic Swallow Maneuver: Difficult to maintain breath hold unless digital occlusion or one-way valve is in place

Therapeutic Techniques

- Oral motor exercises
- Tongue base exercises
- Pharyngeal exercises: Caution with full cuff inflation
- Laryngeal elevation exercises: Contraindicated with full cuff inflation
- Laryngeal closure exercises: Breath hold difficult to maintain unless digital occlusion or one-way valve is in place
- Thermal-tactile stimulation
- Sour bolus swallows
- VitalStim: Adjustments are made to electrode positioning
- DPNS: Contraindicated

Other Issues

- Endotracheal Intubation
  - First meal after extubation, individual is at high risk for aspiration
  - Greatest risk of aspiration is within 24 hours following extubation
  - Greatest risk of respiratory distress and reintubation is within 4-6 hours after extubation
  - Immediately after extubation, individual often exhibits hoarseness, spontaneous coughs, and congestion, making clinical observations unreliable

Consider

- Goal is to reduce risk for clinical decompensation
- Must consider when treating individuals with tracheostomy:
  - Aspiration characteristics
  - Condition of individual
  - Underlying lung condition
  - Systemic factors can interfere with compensation
- Continued monitoring is crucial, since individuals with tracheostomy often demonstrate more rapid and frequent changes in tolerance of feedings than other populations
References
