Physiotherapy in Tracheostomy
Decannulation in PWH
Neurosurgical Unit

Fong Wai Kuen Pauline
PWH PT 1

Definition of tracheostomy:
- Greek word: tracheos plus stoma (mouth)
- Incision into the trachea that forms a temporary or permanent opening. A tube is inserted through this stoma (opening) to provide an airway, facilitate respiration, and to remove secretions from the lungs

Tracheostomy Procedures

Surgical tracheostomy
- can be permanent or temporary and is performed in theatre
- An incision is made between the 2nd and 3rd tracheal rings 4–6 cm in length

Percutaneous Tracheostomy
- is more temporary and is performed in the critical care unit
- involves making a small hole between the 1st and 2nd or 2nd and 3rd tracheal rings

Mini-tracheostomy
- A mid-line incision is made in cricothyroid membrane and the mini tracheostomy is inserted using a guidewire and dilator
Indications for tracheostomy:

1. Upper airway obstruction
2. Requirement of an artificial airway for longer than 1 to 2 weeks
3. Severe facial/head and neck injuries
4. Post major head and neck surgery
5. Prolonged absence of laryngeal reflexes and/or inability to swallow and therefore high risk of aspiration
6. Sputum retention (patient unable to clear secretions effectively) and if insertion of a mini tracheostomy is inappropriate due to tenacious secretions requiring greater than size 10 catheter

Advantages

Reduce the upper airway dead space by up to 150 ml (50%) - significantly reduced effort in breathing compared to the naso- or oropharyngeal route

There is consequently significantly reduced airway resistance and increased alveolar ventilation.
(Alveolar ventilation = tidal volume - dead space volume) (Bradley 1997)
Fenestrated tube (CFN)

Fenestrated low pressure cuffed tracheostomy tube (FEN)

Complications associated with tracheostomy insertion: (immediate)
- Peri-operative e.g. haemorrhage, pneumothorax, surgical emphysema
- Misplacement of the tube in pre-tracheal tissues/right main bronchus
- Occlusion of tip of tube against carina/tracheal wall
- Accidental displacement of the tube
- Recurrent laryngeal nerve injury
Intermediate

- Sputum plugging
- Accidental displacement of tube
- Bleeding
- Infection
- Tracheal distension
- Mucosal ulceration
- Tracheo-oesophageal or tracheo-vascular fistulas

Late complication

- Granulation around tracheostomy tube
- Tracheomalacia
- Tracheal stenosis
- Infection
- Delayed healing of stoma
- Revision of scar required
- Chest infection

Decannulation

The process whereby a tracheostomy tube is removed once patient no longer needs it.

Benefits of Decannulation

- Tracheostomy tubes (foreign body) may cause bronchorrhea/excessive cough
- Tracheostomy tubes impairs normal tracheal elevation during swallowing, may impair swallowing
- Air bypass the vocal cord, affect coughing effect
Indications for decannulation

- When the initial indication for a tracheostomy no longer exists
- Original upper airway obstruction is resolved
- Airway secretions are controlled
- Mechanical ventilation is no longer needed

Pre-weaning

- Decannulation of patients with prolonged tracheostomy is not as straightforward as tube removal following a resolved acute upper airway obstruction
- If patient decannulate in non-appropriate time, subsequently experience life-threatening airway compromise requiring emergency reinsertion of the tracheostomy tube

Different approaches for pre-weaning

- Direct removal of tracheostomy tube
- Downsizing
- Cuffed to cuffless tube
- Spigot/ capping of the fenestrated tube
Air flow at trachea with tracheostomy

gas flows in the channel between the trachea and the outer wall of the tube and around the deflated cuff. Flow is also obstructed anteriorly by the tracheostomy tube as it enters the trachea.

Upper airway respiration with tracheostomy tube capped

- Around the tube with cuff deflated and the tube capped
- Using a fenestrated tracheostomy tube with cuff deflated and the tube capped

Rationale of weaning process

1. Gradually increase the proportion of air breathed around the tracheostomy tube while decreasing the proportion breathed through the tube
2. Increased level of resistance (inspire the same volume of air through the smaller airway)

Rationale of weaning process

1. Able to tolerate the greater resistance
2. Able to increase work of breathing without s/s of distress or SOB ( >30% work of breathing  Christopher KL 2005 )
3. Indication of readiness of decannulation
A pre-weaning assessment is advocated to determine the optimum time to begin weaning.

Tracheostomy weaning is labour intensive process.

The weaning process may be complicated by number of issues that may slow the weaning process owing to uncertainty about whether the patient can manage without the tracheostomy.

Smaller, fenestrate, no cuff

Experimental support for the use of smaller, fenestrated inner tubes in the weaning process. It provides minimal resistance to airflow (Hussey and Bishop, 1996).

Also suggest for cuff deflation, it increase use of upper airway (Beard and Monaco 1993) though the work of breathing increases.

Literature review on tracheostomy weaning

The literature contains a variety of recommended weaning methods and reflect their clinical practice.

Methods included:

- Simple removal of the tube
- Progressive downsizing the tube before final removal
- Temporary placement of tracheostomy button,
- Use of fenestrated inner tube and speaking valves, etc.

Vital capacity & Peak cough flow

Bach and Saporito (1996) prospective studies four variables as a predictors for successful decannulation in patients with predominantly neuromuscular respiratory failure.

- Age
- Extent of pre-decannulation ventilator use
- Vital capacity, and
- Peak cough flow

Result showed only a peak cough flow of >160 liter/min was a predictive of successful decannulation.
Gag reflex

It may be helpful to check for a gag reflex prior to decannulation. However, up to 20% of normal individuals may have no gag reflex. (Hoffman 1995)

Thus, the absence of this reflex does not reliably predict abnormal swallow

GCS

Most of the literatures studies the use of GCS as an indicator for successful weaning and extubation from mechanical ventilation rather than as a predictor for successful decannulation from tracheostomy tube

Reduce consciousness does not preclude a patient from the weaning process (Coplin et al, 2000)

Pulmonary function test

MIP, MEP, PaO2, PaCO2

Pulmonary Function test may not be possible for many neurological patients Because most patients are cognitively impaired (Braine 2006; British Journal of Neuroscience Nursing)

Useful in identifying mechanically ventilated patients for discontinuation of mechanical ventilation

Reduce GCS

Reduce GCS unable to maintain a clear airway
- Low tone around URT unable to maintain airway
- High tone (spasticity) around URT impeding airway
- Increased salivation due to malfunction of ANS (patient may lack suppression of salivation)
- Poor swallowing leading aspiration eg. Loss of CNS / PNS innervation or tracheostomy
- Poor mobility easily prompt to nosocomial pneumonia
- Poor cough effort due to absent / reduced innervation of abdominal muscles
- Reduce CNS / PNS innervation to diaphragm or respiratory muscle
- Low GCS also resulting in reduced cough reflex
- GCS=8
Cough effort

Adequacy of a cough effort is an important factor to maintain an airway
However, the capacity to protect the airway and to expel secretion with an effective cough may not apply in the neurologically injured patients

Different weaning approach

Some studies compared different weaning approach

- The use of cap vs. a one-way speaking valve (La et al, 1999)
  - No sig. difference
- Progressive downsizing vs. cuff deflation for 24–48 hrs (Thompson-ward et al, 1999)
  - Cuff deflation was valid indicator

General consideration for decannulation

- Cough, abdominal muscle strength
- Sputum amount, chest infection, poor gag reflex/swallow
- NG vs PEG tube for feeding, silence aspiration
- Upper airway patency, vocal cord palsy, granulation tissue, Supraglottic edema, OSA, size of ETT, forget deflate the cuff
- Cheyne stokes respiration
- Respiratory muscle, general physics

Aim of physiotherapy for tracheostomised patient

- Maintain chest clearance
- Promote air entry
- Wean off tracheostomy ASAP to breath through normal airway
Physiotherapy techniques

Maintain chest clearance by:

- Cough
  - Forced expiration with a high expiratory flow rate by sudden opening of glottis → shift distal secretions to proximal
- Huffing
  - Similar to cough but with open glottis
- Vibration
  - An intermittent chest wall compression performed during expiration
  - To dislodge thick secretions
- Postural drainage
  - Positioning of bronchial tree to assist drainage of secretions from upper segments of lungs by gravity
- Suction

Enhance airway and chest expansion

- Therapeutic positions, e.g. prop-up
- Optimizing regional ventilation
- Training of respiratory muscle with incentive spirometry, mediflo etc...
- With an appropriate exercise regime to facilitate early mobilization, etc

Manual Lung Hyperinflation (Bagging)

- Providing large inspiratory volume and positive inflation pressure to stretch elastic lung tissue
- Sudden release of pressure causing high expiratory flow to mobilize secretions and recruiting alveoli
- Indicated for:
  - Intubated patients where the patient has significant loss of lung volume on auscultation
  - Intubated patients where secretions have not moved with postural drainage, manual techniques and suction

PWH Neurosurgical Team – Tracheostomised patients

- Characteristics:
  - GCS >3
  - Tracheostomised with shiley CFN 6
  - Room air or with oxygen supplied
  - Minimal to large amt of secretions
  - No/ fair to strong cough effort or strong cough reflex
  - Sufficient to clear secretions
PWH Neurosurgical Team – Tracheostomy weaning Protocol

Steps & Decision making, criteria

1. Assess patient’s medical condition for spigot when fulfill listed criteria:
   - Room air with SpO2 > 94%
   - No respiratory distress
   - Minimal secretions (only require suction less than 2 times per day or once after 4–6 hours)
   - Strong cough effort or strong cough reflex sufficient to clear secretions
   - No upper airway obstructions
   - Stable vital sign (SBP 90–160mmHg; HR 60–90)
   - Absence of specific indication for mechanical ventilation

2. Begin spigot trial and monitor vital signs.
   - Begin daytime spigot tracheostomy, if stable throughout the trial (9am to 9pm), monitor by physio
   - Observe and monitor patient’s vital signs (keeping SpO2 > 94% and with stable haemodynamics).

3. Repeat monitor spigot for 2 to 3 days.

4. The spigot trials are considered as successful if there are no respiratory distress and fulfilled criteria.
Following removal of the tracheostomy tube

- Closely monitor for 24 hr after removing the tube
  - Ensure tolerance for decannulation
- Clean the wound with occlusive dressing
  - Eg. Duoderm, will promote epithelialisation and help healing
- Encourage patient to apply gentle pressure to the dressing when coughing and talking
  - Prevent loosening of the dressing
  - Prevent air leakage
- If overgrowth of healing tissue (overgranulation) around the wound refer to ENT
Case Study

Mr. X
68/M
Dx: Cerebellar Haemorrhage with IVH

HPI: c/o dizziness & nausea + headache for 2 days. No HI or LOC before attended hospital in Mainland China

CTB showed ICH and therefore transfer to NDH, then transfer to PWH on 6.4.2007
Admitted to NS ward GCS 15/15
Repeat CTB decrease IVH
Developed respiratory arrest --> intubated in ward
Repeat CTB: increase cerebellar haematoma with hydrocephalus

"E" OT x posterior fossa craniotomy Burr hole for intracranial pressure + clot evacuation on 6.4.2007

PT assessment

Size 6 CFN
Vital signs stable, SpO2 94% (RA) & afebrile
On NG tube fair gag reflex
Chest: TS+ on auscultation
Moist cough/huff
Cough reflex fair to strong
Still productive with moderate amount of yellowish sputum
Spt C/ST pseudomonas aeruginosa (13/6/07)
Spigot in supine SpO2 (RA) 92–93%
Trial of spigot
Capping for 10–15 sec.
Increase SOB and desaturation
Noisy breathing sound
? Stridor
Trial of sputum suction → but no significant increase sputum found

Noisy breathing Video

? Problem with upper airway patency

PT assessment & comment
Consult ENT for
? upper airway obstruction
? suggest need downsize tracheostomy tube
? Change NG tube to PEG
Continue chest physiotherapy

Chest physiotherapy
PT assess the tracheostomy pt for the respiratory complications:
- Immobility
- Retained secretions
- Pulmonary consolidation
- Acute/progressive atelectasis

Immobility
Retained secretions
Pulmonary consolidation
Acute/progressive atelectasis
ENT assessment & comment

Bil. swollen arytenoid + AE fold (aryepiglottic fold)
Bil vocal cord mobile
Size 4 tracheostomy tube change, CFN
Imp: Supraglottic swelling, not fit for weaning at this moment

Difficulty in weaning/ troubleshooting

- Respiratory insufficiency?
- Respiratory muscle/abdominal strength? Ability to cough?
- Sputum retention?
- Upper airway obstruction?
  - Granulation tissue
  - Vocal cord palsy
  - OSA
- Aspiration?
  - Swallowing problem
- Patient anxiety?
Anatomy of the upper airway

This describes the portion of the airway that lies above the vocal cords.
Includes:
- The nasal passages (septum, turbinates, and adenoids)
- The oral cavity (teeth and tongue)
- The pharynx (tonsils, uvula, and epiglottis)
- The glottis

Motor innervation:

The external branch of the superior laryngeal nerve is responsible for innervation of the cricothyroid muscle.

The recurrent laryngeal nerve provides a motor supply to all the muscles of the larynx (posterior and lateral cricoarytenoid muscles) except the cricothyroid muscle:
- The lateral cricoarytenoid adducts the cords
- The posterior cricoarytenoid abducts the cords
Laryngeal anatomy, showing major muscles and cartilages. 
(A) Posterior view of larynx, and 
(b) cross section of larynx from above.

Vocal cord

Vocal cord palsy or paralysis

Unilateral vocal cord paralysis. (Left) 
Larynx in abduction. (Right)

Larynx in adduction, showing paralyzed vocal cord (arrow).
Vocal cord palsy/paralysis

- Unilateral damage to the recurrent laryngeal nerve causes hoarseness
- Bilateral damage causes respiratory distress and stridor
- Whilst chronic damage can cause aphonia

Consult ENT

Swallowing

Speech and Language Therapist (SLT) play a key role in assessing swallowing function of patient with tracheostomy

The swallowing assessment involves:

- Oro-motor function
- Tolerance of secretions
- Tolerance of oral intake

Swallowing

The normal swallowing:

- a. Oral preparatory stage
- b. Oral stage
- c. Pharyngeal stage
- d. Oesophageal stage
Mechanism of normal swallowing

The impact of the tracheostomy tube on swallowing function

Mechanical impact

- “The normal swallow” laryngeal elevation is impeded

- Over inflated cuff can impinge on the tracheal–oesophageal wall that it can obstruct the passage of the bolus as it passes through the oesophagus

Physiological impact

- Loss or reduction of airflow into the upper airway
- (according to law of physics) Airflow will always take the path of least resistance
- This can result in
  - Absent or weak cough

- Altered airway pressure
  - With an open tracheostomy tube the pressure reduced and result in increase pharyngeal residue post-swallow

airflow being redirect along the path of least resistance
Reduction in the **glottic closure** reflex

- Studies have shown that the presence of the tracheostomy tube can affect the speed of this response, making **aspiration** of material a potential hazard. (Shaker et al. 1995, Saud et al. 1997)

**Blue dye test**

- Performed by SLT and give additional information regarding patient’s swallow.
- Undertake following cuff deflation
- Administration of the measured amount of blue dye in mouth
- Presence of **blue dye stained in sputum** would indicate the patient is **aspirating**
- It should be used in conjunction with other swallowing assessment techniques

**Conclusion**

- **Weaning and decannulation** is a frequent intervention in the management of a patient with a tracheostomy
- The management of tracheostomy patients should be multidisciplinary and requires active collaboration by all health professionals involved
- The weaning or decannulation process is individual to each patient’s needs

- **Assessment and reassessment** is crucial for ensure safe and effective weaning
- PT has a role to ensure that care is safe and to maximize the patient’s potential during the weaning process
- A systematic decannulation algorithm is useful
- Critical and analytic mind is important
THANK YOU