Using an Automated Intermittent Subglottic Aspiration System in Long-Term Care Facilities

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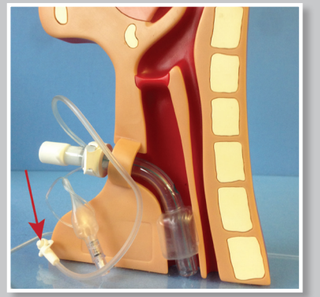
Introduction

Patients with neurological, traumatic or medical disorders (such as ALS, hypoxic brain damage, traumatic head injuries, stroke, bleeds) suffer multi-dimensional failures that often correlate with severe dysphagia. Thus, using the tracheostomy tube (with ballooned cuff) is often required, for the following reasons:

1. Impaired respiration, apnoea
2. Heightened risk of pneumonia due to aspiration of saliva resulting from:
   - **a.** reduced vigilance
   - **b.** reduction in or absence of ability to swallow saliva
   - **c.** loss of throat clearing functions
   - **d.** impaired sensory function in the oropharyngeal region



Example of subglottic tracheal tube with suction port (see arrow) positioned in subglottic space

Importance of the Tracheal Ballooned Cuff

The tracheal ballooned cuff is an inflatable sleeve designed to seal off the area between the tracheostomy tube and the tracheal wall. Aspirate/secretion remains above this ballooned cuff and accumulates.

A complete seal that prevents aspiration can never be fully achieved (Dullenkopf et al. 2003; Oikkonen et al. 1997). Depending on the type of tracheostomy tube, microaspiration can still occur, even if the sleeve pressure is correct. This is due to wrinkling or to the tracheal anatomy of the individual concerned.

The tracheostomy tube is removed/replaced and the ballooned cuff deflated for the following reasons:

1. to allow the tracheostomy tube to be changed
2. to protect the trachea decubitus prophylaxis
3. for rehabilitation activities, such as speech therapy and weaning off the tracheostomy tube

Before the tracheostomy tube is deflated or removed/replaced, the pool of saliva/sputum accumulated above the ballooned cuff must be removed in order to prevent any aspiration of sputum into the lung:

- **a.** using a suction tube capable of accessing the subglottal space
- **b.** using a syringe
- **c.** using automated intermittent subglottic aspiration system

Subglottal Space

The "saliva pool" that accumulates above ballooned cuff consists of a collection made up of:

1. salivary aspirate
2. oropharyngeal secretions that form as a result of a mucosal reaction to the "foreign body"
3. gastric reflux aspirate

It is impossible to devise a hygiene regimen for the subglottal space. This means that offensive-smelling, partially tacky sputum can develop in this area, containing bacteria, fungi and viruses, possibly enriched with dietary residue.

The body's own mechanisms ensure that the mucosa undergoes regular regeneration and the severe dysphagia that exists, in combination with the tracheostomy tube, are responsible for accumulation of residual pool of this contaminated saliva/sputum within the subglottic space.

Consequences of failure to evacuate the subglottal space

1. Paratracheal area:
   - unstoppable spontaneous paratracheal escape of secretions causing constant dampness, erythema and irritation in the skin surrounding the stoma (see images under "Using Manual Suction")
   - hypothermia due to cooling resulting from evaporation – infection hazard
   - stigmatisation caused by wet clothing and bedding
   - development of an odour
2. Above the ballooned cuff:
   - a rise in the hydrostatic pressure within the subglottal area
   - sensory impairment with a negative impact upon vital protective reflexes and clearing functions (swallowing, coughing, throat-clearing)
3. Below the ballooned cuff
   - microaspiration/seepage of bacteria-enriched aspirate down into lower respiratory tract
   - foreign body sensation, shortness of breath, apnoea
   - pneumonia – with all the consequences

Aims of subglottal aspiration

1. Paratracheal area
   - permanently dry area of skin surrounding the stoma
   - to minimize irritation of the skin by salivary digestive enzymes
   - to keep clothing and bedding dry at all times
   - to minimize/prevent cross contamination
   - enhanced patient quality of life
2. Above the ballooned cuff
   - to remove the saliva pool in order to prevent it from seeping downwards
   - to start therapeutic rehabilitation to wean the subject off the tracheostomy tube and ventilator machine (see images under "Using Automated Subglottic Aspiration")
   - to enhance the sensory function so that protective reflexes and cleansing functions can be re-started
3. Below the ballooned cuff
   - to minimize the risk of pneumonia
   - to minimize /prevent need for endotracheal aspiration
   - to avoid a foreign body sensation
   - to protect the respiratory organs
   - to ensure ventilation of adequate quality in the lower respiratory tract
   - to bring costs down by preventing expensive treatment associated with VAP

Conclusion

The benefits of automated intermittent subglottic aspiration system in long term care facility as compared to manual subglottic aspiration far exceeds in terms of overall effectiveness and performance. The key underlying difference is in the volume of aspirate/sputum (mean avg 400 ml) that is removed from the area above the ballooned cuff of tracheostomy tube as compared to manual aspiration (mean avg. 33 ml). With manual aspiration, the difference in volume of aspirate (367 ml) that is not removed, will most definitely microaspirate into lungs or overflow through the mouth and stoma which can potentially contaminate the area around the patient. The benefits of the automated system are: minimizes the chance of microaspiration into the lungs, requires less or no need for painful endotracheal aspiration, minimizes cross contamination, effectively and substantially reduces cost of care and provides better quality of life for patients and facilitates the work of caregivers. This warrants further clinical trials to assess efficacy and overall cost effectiveness of the automated system.

Using Manual Suction

Leakage of sputum/secretion from manual aspiration

Using Automated Intermittent Subglottic Aspiration System

Top image: automated intermittent subglottic aspiration system resulted in large amount of secretion collected. *Middle image:* using automated system prevents overflow of sputum/secretion and results in dry stoma and avoid any cross contamination *Bottom image:* example of a 2nd patient with large amount of secretion

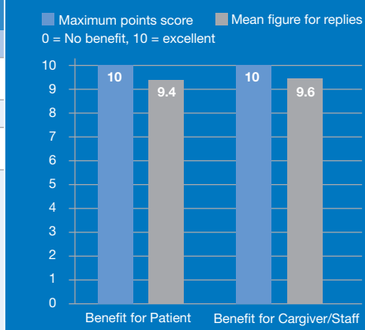
Results

(Based on mean average of 5 patients who were observed for total 10 days. Manual aspiration used during initial 5 days and automated aspiration used in final 5 days. The system parameters tailored to each patient's condition. Aspiration pressure ranging between -100 to -200 mbar, aspiration ON time of 10-15 sec, and OFF time of 10-15 min.)

	Manual ballooned cuff aspiration using a 20 ml syringe	Automated Intermittent Subglottic Aspiration System – SIMEX *cuff* S
	Tracheostomy tubes used: Portex, BlueLineUltra, Suctionaid Gr. 8 or 9	
Mean aspirate volume removed	approx. 33 ml	approx. 400 ml
Duration	5 days => 8 times daily during 8 hour shift	5 days automatic intermittent aspiration
Materials used	40 syringes (20ml), 40 pairs of gloves, 50 dressings	1 ***cuff*** S aspirator, 1 aspirator collection container, 1 suction tube
Results	- aspiration only possible on an interval-type basis - increased risk of sputum to microaspirate into the lungs - time-consuming - severe cough stimulus during aspiration - stoma remains macerated and extremely damp as a result of the enormous amounts of sputum that come out due to overflow - additional stoma care, need for dressings and changes of clothing and bedding - erythematous skin around the stoma - high frequency of endotracheal / bronchial aspiration	- automated intermittent aspiration – 24/7 - minimized risk of any sputum to microaspirate into the lungs - unobtrusive sounds during aspiration - aspiration does not have a negative impact upon breathing, the cough stimulus or physical tone - stoma is dry and less irritated from the first day onwards - immediate positive feedback from nursing staff => see survey - reduction in the frequency of endotracheal/ bronchial aspiration

Survey Results

Total of 26 nurses took part in the care of 5 patients during the 10 day period and completing the survey



References

Dullenkopf et al., Fluid leakage past tracheal tube cuffs: evaluation of the new MICROCUFF* endotracheal tube. *Intensive Care Medicine*. 2003; 29:1849-1853.
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