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 fatigues 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:
   - reduced vigilance
   - reduction in access of ability to swallow saliva
   - loss of throat clearing functions
   - impaired sensory function in the oropharyngeal region

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. saliva 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 mucous 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. Parachordial area:
   - unstoppable spontaneous parasternal 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
   - stagnation caused by well clothing and bedding
   - development of an odour
2. Below 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 of subglottal aspiration

Aims of subglottal aspiration
1. Parachordial 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 maximize/preserve correct function
   - to maintain 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 cleaning functions can be re-started
3. Below the ballooned cuff:
   - to minimize the risk of pneumonia
   - to minimize/delay need for tracheal suctioning
   - 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 exceed 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. 35 ml). With manual aspiration, the difference in volume of aspirate/sputum (357 ml) that is not removed, will most definitely microaspirate into the lungs or overflow through the mouth and stoma that is removed from the area above the ballooned cuff of tracheostomy tube as compared to manual aspiration (mean avg. 35 ml). With manual aspiration, the difference in volume of aspirate/sputum (357 ml) that is not removed, will most definitely microaspirate into the lungs or overflow through the mouth and stoma which can potentially contaminate the area around the patient. The benefits of the automated system are minimized 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
Using Automated Intermittent Subglottic Aspiration System

Consequences of failure to evacuate the subglottal 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. Aspiration/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 balloon cuff deflated for the following reasons:
1. To allow the tracheostomy tube to be changed
2. To protect the tracheal deabulaus prophylaxis
3. For rehabilitation activities, such as speech therapy and weaning off the tracheostomy tube.

References
Dullenkopf et al., Fluid leakage post tracheostomy tube cuff: evaluation of the new MICROFLO™ endotracheal tube, Intensive Care Medicine, 2000; 26:1469-1473.
Oikkonen et al., leakage of fluid around low-pressure tracheal tube cuffs. Anaesthesia 1987; Vol 50, Issue 8, 657-659.

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

Results

Using Automated Intermittent Subglottic Aspiration System

Survey Results

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

Mean aspirate volume removed
Mean aspirate volume removed approx. 33 ml approx. 400 ml

Materials used
40 syringes (20ml), 40 pairs of gloves, 50 dressings

Results
- aspiration only possible on an interval-type basis
- increased risk of aspiration to microaspiration into the lungs
- severe cough stimulus during aspiration
- sputum removed trachealised and externally deep 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/intubation aspiration

Survey Results

Maximum points score Mean figure for replies
10 10 = excellent
6 6 No benefit
3 3 = no cross contamination
0 0 = No benefit

Benefit for Patient Benefit for Caregiver/Staff

Table: Comparison of Manual and Automated Subglottic Aspiration

| Aspiration System | Manual ballooned cuff aspiration using a 20 ml syringe | Automated Intermittent Subglottic Aspiration by MICROLUX® S
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<tbody>
<tr>
<td>Tracheostomy tubes used: Portex, BlueLineUltra, Suctionaid Gr. 8 or 9</td>
<td>Mean aspirate volume removed approx. 33 ml</td>
<td>approx. 400 ml</td>
</tr>
</tbody>
</table>

| Duration | 5 days x 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 |

<table>
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<tr>
<th>Results</th>
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Nursing Care and Hygiene Management

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 stem and avoid risk of cross contamination. Bottom image: example of a 2nd patient with large amount of secretion.