Prototype of tracheal membrane model: A representation of sensation by suctioning catheter

Author(s)
Colley, Noriyo; Takahashi, Nozomi; Ninomiya, Shinji

Citation
International Meeting on Simulation in Healthcare (IMSH 2016). 2016, San Diego

Issue Date
2016

Doc URL
http://hdl.handle.net/2115/61901

Type
proceedings

File Information
IMSH 2016 poster.pdf
A prototype of tracheal membrane model: A representation of sense of touch by suctioning catheter.

Noriyo Colley, Ed.D. RN¹, Nozomi Takahashi, MS¹, Shinji Ninomiya, Ph.D²

Objective:
Numerous numbers of ventilator-users have spread into the community following to vast medical technological development in Japan. It provides better quality of life with family at home; however, social demand of healthcare in the community has also risen. For instance, in 2012, Japanese Ministry of Health, Labour, and Welfare determined to commence a nationwide training system for non-medically oriented healthcare providers to perform endotracheal suctioning to satisfy the community’s healthcare need. However, current endotracheal suctioning simulation system in Japan does not represent reality of suctioning risks, e.g. softness of membrane or bleeding from tissue of trachea. Therefore, the aim of this paper is to create new, cost-effective simulation system to practice endotracheal suctioning which capacitate to reduce suctioning risks to improve airway management skills.

Method:
A prototype of tracheal membrane model which reproduce the physical property of airway mucosa was comprised of a clear acrylic tube (I/D 18mm), a thin stainless film, and PVA (Polyvinyl Alcohol) hydrogel which covers the stainless film put inside of the acrylic tube (Fig.1). The endospornum was produced electrochemically by inserting a model in an admixture of boric acid (3%), NaCl (2.5%), and 4% PVA, and applying a direct-current through the stainless film as a cathode. Putting another electrode on a tip of suctioning catheter, this electric conductive lining membrane model enables us to detect a contact of a tip of suctioning catheter on the membrane by measuring the change of conductance between them. The applied voltage was 5V. The material used for an electrode was the stainless steel, and lead line was enamel coated copper wire (Fig. 3).

Fig.1. Common simulation model for tracheal suctioning in Japan

Fig.2. A prototype of tracheal membrane model.

Fig.3. Overview of the prototype electrode catheter

Table 1. Variation of conductance between the electrode of catheter and stainless film

<table>
<thead>
<tr>
<th>Position</th>
<th>current (mA)</th>
<th>Conductance (mS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phlegm</td>
<td>15</td>
<td>3.0</td>
</tr>
<tr>
<td>Thick membrane (2mm)</td>
<td>71</td>
<td>14.2</td>
</tr>
<tr>
<td>Thin membrane (&lt;1mm)</td>
<td>102</td>
<td>20.4</td>
</tr>
<tr>
<td>Stainless film</td>
<td>390</td>
<td>78.0</td>
</tr>
</tbody>
</table>

Conclusions:
Different from conventional suctioning simulation model, our model can provide opportunity to evaluate inadequate manipulation of a suctioning catheter by an appearance of the hemosputum and conductance visually. This feedback mechanism remarkably contributes to the improvement of the trainee’s clinical decision-making ability as well as catheter operation skills.

To develop a simulation system reproducing instantaneous biological reaction of endotracheal suctioning technique by interlocking numerical simulation system of cardio-respiratory parameters is a future task.

References:

