CORRESPONDENCE

Front-of-neck airway meets front-of-neck simulation: improving cricothyroidotomy skills using a novel open-access three-dimensional model and the Airway App

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To the Editor,

Although anesthesiologists, intensivists, and emergency physicians rarely perform cricothyroidotomy, these specialists must maintain the knowledge, decision-making, and procedural skill sets to perform cricothyroidotomy quickly and safely. The 2015 Difficult Airway Society guidelines recommend bougie-assisted scalpel cricothyrotomy coupled with regular simulated practice.¹ Regardless of the technique used, the training must be realistic, addressing both technical and non-technical skills and facilitating reflection and data gathering. We outline a novel approach to cricothyrotomy training that we introduced at a recent airway workshop.^A We are eager to share it, receive feedback, and further develop this airway education and patient safety initiative.

Previously, as in many centres, our airway workshops focused on the acquisition of manual skills using mannequins and isolated pig tracheas. As the Canadian Airway Focus Group emphasizes, however, manual skills are only one aspect required for reliable patient rescue in a “cannot intubate/cannot oxygenate” emergency.² Specifically, we wished to address the oft-cited

reluctance to cut another human's neck.³ Accordingly, we sought to create a tool that would increase manual skills and could be coupled with human factors' training. Non-technical steps are just as likely to go wrong as technical endeavors, so mental preparedness and cognitive rehearsal⁴ are essential. The use of mannequins is commonly criticized for unrealistic anatomy/haptic feedback and lack of “stress inoculation”.^B Although isolated pig tracheas provide more realistic airway anatomy and the “feel” of tissue, there are no real-life hindrances (e.g., from a patient's chin or thick neck) to overcome with problem-solving. Both mannequins and pig models may also inadvertently send a message that cricothyrotomy requires an elaborate or expensive setup.

Inspired by the lecture given by Dr. Ciaran McKenna,^C we created a three-dimensional (3D) cricothyroidotomy model based on the original 3D anatomic program from The University of Dundee and BodyParts 3D: The Database Center for Life Science Computer Science departments. To achieve the realism of performing cricothyrotomy on a real person, the authors conceptualized modifications to enable this model to be fitted on the neck of a real person. The original Dundee model was modified to include a slightly larger cricothyroid space to accommodate a 6.0 mm endotracheal tube. The posterior aspect of the model is flat and solid. Therefore, despite using scalpels,

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^A University of British Columbia Whistler Anesthesiology Summit, Whistler, Canada. March 2–5, 2017. Available from URL: www.whistleranesthesia.ca (accessed June 2017).

^B Weingart S. Stress Inoculation Training. Available from URL: <https://emcrit.org/blogpost/on-stress-inoculation-training/> (accessed June 2017).

^C Social Media and Critical Care (SMACC) Meeting, Dublin, Ireland, June 2016.

Figure Cricothyrotomy model (panels A-C): anterior, side, and back views, respectively. Note that the backing posterior to the cricothyroid space, like the signet ring shape of the cricoid cartilage, provides a hard-stop for a scalpel. Model of the neck of a participant (panels D-F), wrapped in cotton batting and Coban©

“skin”. The setup allows laryngeal palpation. It can be made more challenging by increasing the amount of cotton batting over the model and attempting post-insertion bougie-assisted scalpel cricothyrotomy with a 6.0 endotracheal tube *in situ*

participants could practice on one another safely (Figure, panels A-C). Although we believe that practicing cricothyrotomy within the model is safe, it may not always protect against an inaccurate cricothyrotomy incision made well outside the model’s confines. Therefore, it is recommended that a flexible Kevlar®^D neckguard be worn at all times underneath the model. Importantly, by using this model, we could practice non-technical skills (such as overcoming the “fear of using a scalpel on another’s neck”), managing one’s own stress responses and maintaining communication while performing this high-risk, high-stakes procedure.

This cricothyrotomy model need not be expensive. Precise costs depend on factors such as the specific print plastic and ancillary materials chosen. We found all ancillary materials of our setup could be repurposed from unused operating room waste. The cricothyrotomy model was “sandwiched” between cotton batting. The “cricothyroid membrane” was created using waterproof

tape. Coban© dressing (3M Canada, London, ON, Canada) wrapped around the participant’s neck simulated overlying “skin” and kept the cricothyrotomy model in place while permitting realistic laryngeal mobility (Figure, panels D-F).

We are pleased to provide our 3D-printable cricothyrotomy file as a free-of-charge download on our website (www.airwaycollaboration.org). We encourage readers to print their own 3D model. We also encourage readers, should they perform an emergency cricothyrotomy, to share their experiences anonymously on the Airway App⁵ (available free of charge from the Apple App Store or Googleplay) so others can learn from their experiences.

Of note, we have not yet confirmed that the above approach improves performance or saves lives. The first step, of course, is to receive feedback, with our next steps focused on studying whether this type of training can change proficiency in technical and non-technical cricothyroidotomy skills. Regardless of the eventual technique or teaching model, we believe that something as important as cricothyroidotomy is too important to be left to chance.

^D https://www.dkhardware.com/cut-protection-kevlar-neck-protector-99995-product-42608.html?gclid=CjwKEAjwtse7JBRCJ576SqoD7lCkSJABF-bKuDmVilnP0NF3iPgysp92I2hsj3gCDgxfiEP_jZBaIhoCzw3w_wcB.

Conflicts of interest None declared.

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