Development of a Device to Improve the Safety of Video Laryngoscopy

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Background/Introduction: Video laryngoscopy (VL) offers significant advantages over conventional direct laryngoscopy. However, despite the benefits afforded by this technique, video laryngoscopy does have some important limitations. There have been an increasing number of case reports of pharyngeal injuries associated with video laryngoscopes[1-11]. Pharyngeal injury associated with video laryngoscopy is thought to occur due to blind advancement of the styleted endotracheal tube. While the common teaching is to always look in the mouth when inserting the endotracheal tube, a natural inclination is to prematurely look at the video screen and wait for the endotracheal tube to appear. Given the frequency with which providers prematurely divert their visual attention away from the mouth during VL, and given that it's difficult to resist this natural tendency, some authors have suggested that we need explore fundamental changes to video laryngoscope technology[12].

Methods: To help overcome a fundamental limitation of video laryngoscopy and to improve the safety of this increasingly popular technique, we set out to develop a navigation system that lets providers know if the endotracheal tube is in a safe position and orientation during video laryngoscopy. The system is designed to help providers safely navigate the "blind spot" by automatically changing the color of the laryngoscopes' handle based on the measured trajectory of the endotracheal tube. If the endotracheal tube is determined to be in a safe position, close to the curve of the laryngoscope, the handle of the video laryngoscope will illuminate green. Once the navigation system determines the endotracheal tube has safely traversed the "blind spot", the handle *blinks* green to indicate that it's now safe to divert visual attention away from the mouth and towards the VL display. The intubation can then safely proceed under visual guidance. The navigation system utilizes an array of 3D magnetometers that are integrated into the optical cable of the video laryngoscope. The magnetometers detect the presence of an endotracheal tube stylet that has a magnetized distal tip. A microcontroller aggregates sensor data and controls a series of LEDs on the video laryngoscope handle to provide visual feedback. The device was tested on an intubation mannequin.

Results: A prototype device was successfully designed, developed and tested in a simulation environment. The navigation system accurately represented the 3-dimensional position, orientation, and trajectory of the endotracheal tube and accurately indicated when the "blind spot" had successfully been traversed.

Conclusion: A navigation system to help providers safely navigate the "blind spot" during video laryngoscopy was successfully developed. The components are inexpensive and the technology can be integrated into virtually any video laryngoscope. The technology does not require any changes to workflow and provides visual feedback in an easily-interpretable, unobtrusive manner. Future studies will aim to determine the extent to which this technology improves the safety of video laryngoscopy.

Pictures

References

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