

Emergency Cricothyrotomy

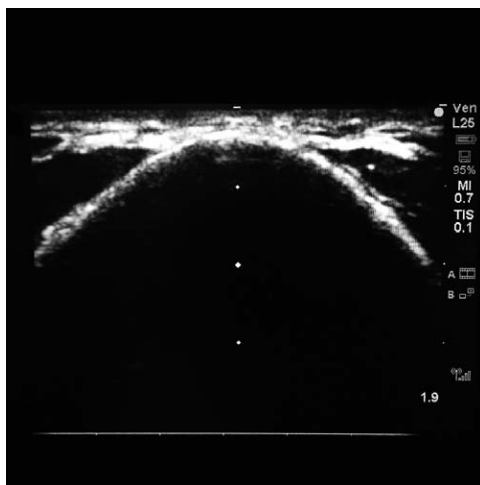
Toward a Safer and More Reliable Rescue Method in “Cannot Intubate, Cannot Oxygenate” Situation

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If oxygenation is difficult due to failed tracheal intubation and difficult ventilation *via* a facemask after induction of anesthesia, all the major guidelines on “difficult airway management” recommend to insert a supraglottic airway, and if that is ineffective, to gain invasive access to the infraglottic airway (such as cricothyrotomy and tracheostomy) as the last resort.^{1–3} Nevertheless, this invasive method as the last resort may also fail, rendering the current strategies for difficult airway management not ideal.⁴ In this issue of *ANESTHESIOLOGY*, Siddiqui *et al.*⁵ have shown that emergency percutaneous cricothyrotomy may frequently produce another life-threatening complication (tear to the posterior tracheal wall) and that ultrasonography may drastically reduce this complication.

Key Findings

Siddiqui *et al.*⁵ randomly allocated 47 anesthesia residents (with no experience in neck ultrasonography) to two groups, after giving didactic teaching and hands-on training of ultrasound-guided cricothyrotomy. In one group, residents performed percutaneous cricothyrotomy after locating the cricothyroid ligament by palpation, whereas in the other group, they did so under ultrasound guidance, in cadavers. The conventional palpation method was associated with a high incidence of moderate or severe injury to the larynx and trachea, and the incidence was 100% when palpation of the cricothyroid ligament was difficult. The use of ultrasound reduced the incidence to 33% in cadavers with difficult palpation of the cricothyroid ligament. In addition, the ultrasound guidance increased the



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success rate of correct insertion in cadavers with difficult and impossible palpation of the cricothyroid ligament although insertion time took longer.

What We Know and What We Do Not

So, what can we learn from the study by Siddiqui *et al.*⁵ in cadavers, and what we still do not know? First, we now know that emergency percutaneous cricothyrotomy may frequently injure the posterior tracheal wall when performed by inexperienced staff, particularly when it is difficult to locate the puncture site by palpation. We do not know whether or not the incidence of the injury is also high when experienced anesthesiologists perform cricothyrotomy, but we should consider that the incidence is likely to be considerably high, because the most “experienced” anesthesiologists would not have expertise in performing the task in a hastily manner, in patients with difficult airways.

Second, Siddiqui *et al.*⁵ used one type of cricothyrotomy device, and we do not know whether or not there are differences in the success rate of insertion and in the incidence of airway injury between different types of cricothyrotomy devices. In addition, although some systematic reviews indicate that emergency cricothyrotomy with a small-bore cannula may frequently be ineffective, evidence is still insufficient to conclude which method of gaining access to the infraglottic airway (such as cannula cricothyrotomy or surgical tracheostomy) is more reliable than another^{6,7} in the “cannot intubate, cannot oxygenate” situation.

Image: J. P. Rathmell.

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Third, the study by Siddiqui *et al.*⁵ has shown that ultrasonography may drastically reduce the incidence of airway injury, but compared with conventional cricothyrotomy, ultrasound-guided cricothyrotomy may take a longer insertion time (the mean time of > 3 min). Therefore, this result suggests that the use of ultrasound may be impractical in a dire situation where the patient would have become severely hypoxic after failed intubation and failed oxygenation. What we do not know is whether or not appropriate training shortens the time required to perform ultrasound-guided cricothyrotomy. Nor do we know whether or not location of the cricothyroid ligament using the ultrasound and marking on the puncture site before induction of anesthesia would increase the success rate of correct access to the infraglottic airway in a “cannot intubate, cannot oxygenate” situation, with a decreased incidence of airway injury. If so, it would be safer to routinely use the ultrasound to locate the puncture site before induction of anesthesia when difficult airway management is predicted. In addition, if airway management is predicted to be extremely difficult, a cannula may be inserted under ultrasound guidance before induction of anesthesia, so that if mask ventilation is difficult, a guidewire is inserted through the cannula, and a cricothyrotomy tube may be passed over the guidewire.

We also do not know how frequently it would be difficult to perform cricothyrotomy, and what are the causes of the difficulty. Routine use of preoperative ultrasound examination of the neck in patients with predicted difficult airway management would enable us to learn the incidence and possible causes of difficulty, such as blood vessels or a tumor at the puncture site, and deformation of the airway. We also do not know whether or not active use of preoperative ultrasound examination of the neck would increase the competence of anesthesiologists in performing emergency cricothyrotomy.

When the posterior membranous part of the trachea is injured, life-threatening tension pneumothorax, pneumomediastinum, mediastinitis, and progressive respiratory failure may occur. Siddiqui *et al.*⁵ have shown that percutaneous cricothyrotomy may frequently damage the airway (even under ultrasound guidance), and thus we now know that the presence or absence of airway injury should be confirmed after establishing emergency cricothyrotomy, by the fiber-optic bronchoscopy, by the chest radiograph, and if necessary by the computed tomography. Surgical intervention is frequently required to repair the injury,⁸ but this may be practically difficult if the patient has become hypoxia due to failed intubation and failed mask ventilation and received “rescue” percutaneous cricothyrotomy. Therefore, there is a real danger of death caused by this “rescue” procedure, and thus we should urgently establish reasonable diagnosis and treatment methods of iatrogenic airway injury.

Conclusions

Since the severity of adverse outcomes associated with airway management was recognized in early 1990s, efforts have been made to reduce the incidence of serious adverse outcomes. As a result of formulating reliable and practical guidelines about difficult airway management, together with development of new reliable airway devices and wide availability of oximetry and capnography, the incidence is likely to be decreased. Nevertheless, “cannot intubate, cannot oxygenate” situation does occur in a limited number of patients, and we still have insufficient knowledge about how most effectively we can save the patient’s life by gaining access to the infraglottic airway. It is now time for us to elucidate the incidence of, and predisposing factors to, difficulties in gaining access to the infraglottic airway and to find suitable access methods. Only through studies (such as the one reported by Siddiqui *et al.*⁵), we can make this “rescue” method safer and more reliable in “cannot intubate, cannot oxygenate” situation.

Competing Interests

The author is not supported by, nor maintains any financial interest in, any commercial activity that may be associated with the topic of this article.

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