Field Airway Management Disasters

Achim von Goedecke, MD, MSc*

Holger Herff, MD*

Peter Paal, MD*

Volker Dörges, MD†

Volker Wenzel, MD, MSc*

A half century ago, a patient with impaired ventilation was at high risk of imminent death. Successful airway management profoundly reduces the risk of morbidity and mortality in a severely injured or ill patient. Unsuccessful airway management kills patients. Studies have questioned the usefulness of endotracheal intubation by relatively inexperienced rescuers because of its deadly complications (1,2). The impressive study from Timmermann et al. (3) reveals similarly catastrophic disasters after intubation in the field, as detected by emergency medical service (EMS) physicians arriving by helicopter and performing laryngoscopy upon arrival at the scene to verify endotracheal tube position. Although brief and rapidly detected esophageal intubation may not cause harm, seven patients with spontaneous circulation on initial examination developed asystole after esophageal intubation. This suggests iatrogenic hypoxia resulting in cardiac arrest. We can only assume that the steps required to detect esophageal intubation were either incorrectly performed or completely omitted in these cases.

Unfortunately, these cases from Göttingen, Germany are not isolated incidents of bad luck. After we published eight cases of catastrophic airway management (4), another five cases quickly surfaced, suggesting that these potentially deadly problems are common.

Case 1: A woman suffered multiple trauma in a car accident, but was breathing spontaneously. Because of severe head trauma, intubation was performed to prepare for helicopter transport. After intubation, her oxygen saturation decreased rapidly, and asystole developed. During continuous cardiopulmonary resuscitation (CPR), the patient was flown to the next hospital, where esophageal intubation was detected. The patient died.

Case 2: A man collapsed at home after suffering myocardial infarction and was intubated by EMS staff. Advanced cardiac life support was unsuccessful and abdominal distension developed. Esophageal intubation was corrected but CPR failed and the patient died.

Case 3: A child suffered multiple trauma in a car accident and was intubated by a physician. Laryngoscopy at the scene did not confirm endotracheal intubation, but as oxygen saturation was >90%, transport was performed without further measures. A computed tomography scan in the hospital revealed esophageal intubation. The child died of massive brain edema.

Case 4: A man suffered cardiac arrest at a public swimming pool. EMS staff did not succeed with several intubation attempts, resulting in severely swollen tissues. An arriving anesthesiologist was subsequently unable to intubate, but performed cricothyrotomy, enabling ventilation. CPR was continued, but the patient died at the scene.

A patient does not die from lack of attempted intubation, but because of the failure to ventilate the lungs. This can be caused by undiagnosed esophageal intubation or failure to ventilate with a bag and mask during multiple unsuccessful intubation attempts (5). It is unclear whether the rescuers fully understood the importance of verifying endotracheal intubation or the catastrophic risk of undetected esophageal intubation.

All EMS units carry intubation equipment as part of their standard supplies. However, the tools to verify endotracheal intubation, such as end-tidal carbon dioxide detection devices, are frequently not available. A

From the *Department of Anesthesiology and Critical Care Medicine, Innsbruck Medical University, Innsbruck, Austria; and the †Department of Anesthesiology and Critical Care Medicine, University of Schleswig-Holstein, Campus Kiel, Germany.

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Address correspondence and reprint requests to Achim von Goedecke, MSc, MD, Department of Anesthesiology and Critical Care Medicine, Innsbruck Medical University, Anichstrasse 35, 6020 Innsbruck, Austria. Address e-mail to achim.von-goedecke@i-med.ac.at.

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recent study (6) showed that only 32% of physician-manned ground EMS units in the state of Bavaria in Germany carried end-tidal carbon dioxide detection devices. This lack of technical equipment combined with lack of airway management skills is responsible for the unacceptably high incidence of failure to adequately ventilate the lungs.

One fall-back strategy to endotracheal intubation is bag-valve-mask ventilation. This cannot provide the same level of ventilatory support that endotracheal intubation provides, and risks aspiration, especially during cardiac arrest (7). However, if the tools to verify endotracheal intubation are not available, or if the rescuer is not highly skilled, then it may be better to defer endotracheal intubation to hospital admission. However, tragic complications still occur.

Case 5: A man suffered multiple trauma in a car accident. The usual drugs were given by an arriving physician (e.g., he gave the patient 20 mg of etomidate, 0,1 mg of fentanyl and 100 mg of succinylcholine) but he was unable to intubate. Bag-valve-mask ventilation was performed en route to the hospital. The patient had a cardiac arrest during the 40-min transport. Pulse oximetry was available to the rescuers, but was not used to verify the adequacy of ventilation and CPR. The patient was easily intubated in the hospital, but subsequently died.

To optimize intubation strategies, it may be wise to search for underlying mechanisms of intubation problems and complications. To reach a 90% success rate with the first intubation attempt, an average laryngoscopist needed at least 57 intubation attempts (8). In one German study, an EMS physician performed an average of nine intubations per year, indicating about one intubation every 1.4 mo. When considering that most cardiac arrest victims are relatively simple to intubate, a given EMS physician or paramedic may be confronted with an extremely difficult airway only once or twice a year (9). A study from Los Angeles assessing pediatric airway management identified 15 esophageal intubations or airway disconnections resulting in 14 deaths (1). In this study, the paramedics intubated a child approximately once every 180 mo.

Without regular clinical experience in anesthesia or critical care medicine, an EMS physician or paramedic may not be able to maintain airway management skills. In contrast, a success rate of 100% in orotracheal intubations within three attempts was reported in three German helicopter EMS services (10), with the third attempt being necessary in only five of 342 (1.5%) patients. However, these aforementioned helicopter EMS units use trained trauma anesthesiologists and paramedics, confirming that daily experience in managing difficult airways ensures excellent quality.

Our health care system often does not recognize that individual clinical experience and skill differs greatly among practitioners. Accordingly, the "gold standard" endotracheal intubation for cardiac arrest and shock patients may be easily achieved by some individuals, but is an obstacle for others. Practitioners must recognize their level of airway management competence and experience, and plan an airway management strategy accordingly. Perhaps an individual who rarely performs intubation should consider bag-valve-mask ventilation with 100% O_2 if endotracheal intubation cannot be secured *and verified* on the first two intubation attempts. Because of the high regurgitation and aspiration risk when performing bag-valve-mask ventilation in an emergency patient with an unprotected airway, using a supraglottic airway device such as a laryngeal mask (11) or laryngeal tube (12) may be even better. For example, laryngeal tube insertion by nurses in out-of-hospital cardiac arrest patients was successful within two attempts in 90% of patients (13). An alternative for those uncomfortable with intubation would be to insert a laryngeal mask or laryngeal tube first, rather than to attempt intubation at all. If adequate ventilation cannot be confirmed, then the device should be removed and ventilation provided using bag-valve-mask device and 100% O_2.

Accordingly, providers of emergency resuscitation in the field must recognize the paramount importance of ventilation and the dire risks of failure to ventilate the lungs. They must have proper equipment to intubate the trachea and to verify endotracheal intubation. They must have alternative airway equipment, such as laryngeal masks, laryngeal tubes, or Combitubes to support ventilation should conventional orotracheal intubation fail. And, we must document failure of airway management in the field to understand, and then correct, this avoidable source of iatrogenic injury.

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