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TQIP Mortality Reporting System Case Reports: Unanticipated Mortality due to Airway Loss

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Summary

The TQIP Mortality Reporting System is an online anonymous case reporting system designed to share experiences from rare events that may have contributed to unanticipated mortality at contributing trauma centers. The TQIP Mortality Reporting System Working group monitors submitted cases and organizes them into emblematic themes. This report summarizes unanticipated mortality from three cases of airway loss in injured patients and presents strategies to mitigate these events locally, with the hope of decreasing unanticipated mortality nationwide.

Key Words:

Quality Improvement;

Wounds and Injuries;

Cause of Death;

Medical Errors/prevention and control;

Trauma Center

The American College of Surgeons Trauma Quality Improvement Program (ACS TQIP) Mortality Reporting System collects anonymous self-reported cases from participating trauma centers in a structured format. The purpose of this system is to collect and describe cases with opportunities for improvement that may not be widely recognized due to the rare nature of these events, and to disseminate evidence-based strategies to improve care nationally. A total of 395 reports have been submitted to the American College of Surgeons TQIP Mortality Reporting System, with 133 (34%) considered unanticipated mortalities after quality review. Death due to hypoxemia occurred in 52 (13%) cases, with airway loss directly attributed in nine cases.

Case Reports from the TQIP Mortality Reporting System:

A 24-year-old woman was brought to the emergency department after a motor vehicle crash. In the field her Glasgow coma score was 3 and she was immediately intubated with an endotracheal tube (ETT) by emergency medical services providers. She underwent an abbreviated primary survey in the trauma bay, and was then taken for computed tomography imaging. When placed in the scanner, she became difficult to ventilate and hypoxemic. As the team attempted to return her to the trauma bay, she had a bradycardic arrest. During cardiopulmonary resuscitation, her ETT was found to be in the esophagus. She was reintubated with confirmation of proper endotracheal intubation, but was unable to be resuscitated.

A 5-year-old child was struck by a car and admitted to the pediatric intensive care unit (PICU) with a subdural hematoma, atlanto-occipital dissociation,

severe chest trauma, abdominal solid organ injury, and femur fracture. His abdominal injuries were managed nonoperatively and his ventilator settings were gradually weaned. On hospital day four, he was taken to the operating room (OR) for atlanto-occiptal fixation. On the OR table, he was noted to have a large leak around the ETT, which the anesthetist attempted to exchange. During the exchange, the team was unable to re-establish an airway and the patient had an anoxic arrest which resulted in death.

A 44-year-old male was taken to the OR for fixation of an unstable C1/C2 fracture with dislocation. The case lasted longer than 7 hours, and ended late at night. There were multiple handoffs between anesthetists during the case. At the end of the case, the patient was spontaneously ventilating. After discussion between the spine surgeon and the anesthetist, the patient was extubated. After extubation, the patient appeared to be somnolent. An oral airway was placed, and the patient was transported to the post-anesthesia care unit (PACU) with face mask oxygen, where he developed progressive hypoxemia. The anesthetist attempted reintubation, but was unable to establish an airway. The patient went into cardiac arrest which resulted in death.

While the principles of Advanced Trauma Life Support (ATLS) training emphasize the primacy of the airway during initial resuscitation in the trauma bay, ensuring a secure airway remains a critical priority across all phases of care and throughout the hospital stay.[1,2] Loss of airway events are rare, but often have devastating consequences and quickly result in severe

morbidity or death.[2] Though uncommon, learning from these events represents an important opportunity to reduce preventable mortality.

The four key factors that contribute to any negative patient outcome including loss of airway are (i) the task, (ii) the setting, (iii) patient factors, and (iv) clinician factors (Table 1). First, airway loss can occur during common clinical tasks such as intubation, confirming the position of an endotracheal or tracheostomy tube, or tube exchange. These are common clinical tasks that are usually performed in an elective fashion but failure to anticipate potential challenges with any of these tasks can result in complications. Second, airway loss can occur in several clinical settings because severely injured patients experience many transitions in care from the scene of injury to the trauma bay, the radiology suite, the operating room, and the intensive care unit. Transitions across these settings create heightened risk for adverse events due to the risk of dislodgement when physically moving the patient as well as the lack of requisite equipment or skilled personnel in the area of the hospital that the airway loss occurred. Third, there are many patient factors that contribute to the risk of airway loss in the acutely injured patient such as neck immobilization, altered sensorium, or tissue swelling and anatomic abnormalities due to facial fractures. Finally, clinician factors such as experience, expertise, technical skills, and non-technical skills all contribute to physicians' ability to prevent and successfully respond to loss of airway.

The first case highlights the risk of overlooking one of the most fundamental clinical tasks in trauma care—adequate airway protection. The core function of the primary survey as taught by the ATLS curriculum is to rapidly assess and address immediate threats to life in the

acutely injured patient.[1] The ABCDE mnemonic provides an easy to remember sequence of assessing airway, breathing, circulation, disability, and exposure in a rapid and systematic manner. The importance of airway protection in the primary survey cannot be overstated. An airway that is placed in the prehospital setting must be immediately evaluated on the patient's arrival to the hospital for proper position via multiple confirmatory modalities including presence of bilateral chest rise and breath sounds, capnography, chest x-ray, and either video or direct laryngoscopy confirming that the endotracheal tube traverses the vocal cords. Each of these modalities has limitations, but confirmation of position with direct laryngoscopy is the gold standard for confirming the tube is in the trachea. While the rest of the case highlights the need for frequent reassessment of adequate airway protection, failure to recognize a tube that is too shallow or malpositioned as a part of the primary survey led to this devastating and likely preventable outcome. Incorporating airway confirmation with capnography or laryngoscopy as a "hard stop" should be mandatory prior to moving on to the secondary survey. Additionally, to reduce the risk of dislodging tubes that are at high risk of dislodgement when moving the patient, an "airway check" should be used prior to moving a patient from the stretcher to the bed or from a bed to the CT scanner.

The second case highlights patient factors that are known to increase the risk of airway complications. A child with atlanto-occiptal dissociation, traumatic brain injury, and lung dysfunction has multiple risk factors based on injury pattern alone. Additionally, the airway of a 5-year-old child is different from an adult and management requires knowledge of specific anatomical, technical, and material details. Although a tube exchange is a common task for an anesthesiologist, routine work in a known high-risk situation is no longer routine. This outcome

may have been avoided if additional safeguards had been in place to maximize the success of tube exchange in this high-risk situation. For example, if the trauma surgeon had been present at the time of tube exchange, a surgical airway could have potentially saved this child's life.

The ability to anticipate high-risk situations is an important element of harm reduction interventions. Risk factors for airway complications include head or neck injury, abnormal cervical anatomy, traumatic indication for intervention, multiple medical comorbidities, combined posterior and anterior operations, and prolonged operative time.[3] As such, many institutions have implemented ***clinical protocols and pathways to reduce the risk of airway complications***.[3] Whether protocols focus on the required skill mix of the treatment team (e.g. an anesthesiologist with specific expertise for spine cases), clinical decision rules (e.g. no extubations in the OR for cases over 5 hours), or organization of material resources (e.g. a patient must be accompanied by a high-risk airway box stocked with necessary equipment), their overall goal is to reduce the risk of negative outcomes in high-risk situations.

The third case further highlights the contributions of the clinical setting and clinician factors. The settings pertinent to this error include the evening after multiple shift changes, the end of a long case, and the transition from the OR to the PACU. Provider factors include the multiple handoffs between anesthesia providers, the fact that the evening anesthesiologist was not a dedicated neuro-anesthesiologist with experience in cervical spine operations, and the in-the-moment decision making between the anesthesiologist and surgeon.

Although this case redemonstrates the value of established clinical protocols for known anticipated high-risk scenarios, it also highlights unanticipated pitfalls that clinicians must be aware of and develop the skills to overcome. For example, having a dedicated team of neuro-anesthesiologists may be practical most of the time, but personnel constraints may make it implausible for every case.

In order to provide an additional layer of resilience against both known and unknown threats to good outcomes, clinicians must develop the requisite skills to navigate the ever-changing, complex clinical environment. ***Developing non-technical skills such as situation awareness, decision making, communication, and leadership can help clinicians successfully navigate both anticipated and unanticipated high stakes, high stress situations***. Non-technical skills are known to play a role in optimizing outcomes across many high-risk scenarios, including surgery and anesthesia.[4] Non-technical skills are often the last line of defense against error when protocols and checklists break down. More important to quality improvement and patient safety, non-technical skills can be reliably assessed, learned, and improved upon through dedicated teaching, skill development, and feedback. In this case, having the situation awareness to know that a late case is a high-risk moment for decision fatigue and the decision-making skills to consider all possible options could have led to a better outcome, with or without the aid of a protocol or checklist.

Lastly, all of these cases ***highlight the role, responsibility, and leadership of the trauma surgeon across the many phases of care and diverse care teams that an injured patient may navigate***. In any environment, regardless of resources, decisions regarding high-risk airways

(e.g. if an airway is secured, when to exchange a tube, when to extubate) require the leadership of the trauma attending who is mindful of protocols in place for injured patients and who applies their own technical and non-technical skills to ensure that patients receive optimal care regardless of the task, setting, patient factors, and clinician team factors.

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Table 1: Framework to Prevent Loss of Airway Complications

- The four key factors that contribute to any negative patient outcome including loss of airway are the task, the setting, patient factors, and clinician factors.
- Protocols for confirmation of an intact airway at each transition in care should be incorporated as standard work prior to each transition, as the primacy of the airway remains critically important across all phases of trauma care from the pre-hospital setting to late in the hospital course.
- High-risk situations can be anticipated. Dedicated teams, clinical protocols, and management pathways can be used to reduce the risk of airway complications in high-risk situations.
- Intentional clinician training in non-technical skills such as situation awareness, decision making, communication, and leadership can help clinicians successfully navigate both anticipated and unanticipated high-stakes, high-stress situations.
- Trauma surgeons are responsible for the entirety of the care of injured patients, including and especially the airway. Trauma surgeons should have an active leadership role in developing clinical protocols to mitigate risk in known high-risk situation and they should also apply both their technical and non-technical skills to reduce the risk of airway loss during unanticipated moments of crisis.