LMA and Videolaryngoscopy-Assisted Nasal Fiberoptic Intubation in the Management of Concomitant Le Fort, Mandibular and Thoracic Spine Fractures

University of Colorado Anschutz Medical Campus

Kylee Miner SAA, Jeremy Bengson MD

University of Colorado, Department of Anesthesiology

Introduction

Blunt force, mid-face trauma can result in mandibular and Le Fort pattern fractures that can cause facial disfiguration and complex anatomy. Le Fort fractures account for around 15% of all facial fractures and follow suture lines within the maxillary, mandibular, zygomatic bone processes as well as the pterygoid plate. These fractures complicate airway management in the perioperative period and require careful consideration of any craniofacial manipulation, the delivery of positive pressure ventilation, as well as the potential presence of laryngeal swelling, airway bleeding, deformity, cervical and thoracic spine instability, cribriform plate injury, CSF leak and more. This case presentation describes the successful airway management utilizing a combination of techniques for a patient with bilateral mandibular and Le Fort III craniofacial fractures, as well as an unstable T6 Chance fracture, subdural hematoma, and multiple rib fractures.

Learning Objectives

- Discuss relevant airway management considerations for patients with maxillofacial trauma
- Describe the relevant anatomy delineating Le Fort fractures
- Describe acute and long term complications of craniofacial fractures
- Discuss spine, ICP, and sinus precautions associated with acute craniofacial and spinal trauma
- Discuss the implications of surgical wiring of the jaw in patients with Le Fort fractures
- Highlight the utility in combining airway techniques in the management of difficult airways and the potential advantages and disadvantages of each

Case Presentation

This case involves a 34 year old M with a PMHx of anxiety, alcohol and marijuana use who initially presented to the University of Colorado ED as a trauma activation (motorcycle vs. truck) with ejection suffering multiple traumatic injuries including: subdural hemorrhage, Le Fort III fractures, L rib fractures 3-5, and a complex T6 Chance fracture with instability. He was remarkably awake and mentating on arrival with C-collar in place and plan for staged repair of his injuries, starting with a T5-T9 percutaneous fusion and subsequent ORIF of bilateral midface fractures, possible orbital floor fractures, and mandibular fracture with maxillomandibular fixation.

Prior to intubation for the T5-T9 posterior instrumentation, CTs of the brain, face, cervical spine and neck were reviewed (Figure 1). Bedside airway exam was limited due to pain so the severity of any oropharyngeal trauma was unknown. Awake fiberoptic intubation was not considered due to patient's baseline anxiety level and intoxication. C-spine, T-spine and sinus precautions were maintained throughout given the patient's significant maxillofacial instability. We initially induced with ketamine alone to maintain spontaneous ventilation in case of failure to intubate and to facilitate "awake" insertion of a hyperangulated laryngoscope blade. Once a clear view of the epiglottis and glottic opening was quickly confirmed, we proceeded with an RSI with propofol and rocuronium given the risk of aspiration, inability to provide mask ventilation, and distorted facial anatomy. A Grade I view was obtained and the patient was intubated uneventfully. Considerations were made regarding fixating the patient's head in Mayfield pins vs. ProneView. After discussion with neurosurgery and ENT, decision was made that pinning may lead to excessive traction on unstable midface fractures and that positioning in a ProneView would minimize further damage, with the understanding of the risk of facial injury due to compression. The patient underwent a successful T5-T9 percutaneous fusion, was extubated and brought back to the surgical ICU for continued monitoring.

Three days later, the patient re-presented to the OR for repair of his Le Fort III and mandibular fractures. Due to the need for surgical access to the oropharynx and plan for wiring of the jaw pre-emergence, nasal intubation was indicated. Blind nasal intubation with McGill forceps was avoided due to the risk of basilar skull fracture and inadvertent intracranial advancement of ETT. CT imaging did not reveal any overt basilar skull fractures. However, nasal fiberoptic intubation was planned for better visualization and and to identify any potential microfractures along the track from the nasopharynx to glottis. Given the rapid time to desaturation with a nasal fiberoptic technique and sinus precautions, which precluded the ability to provide any positive pressure ventilation via mask, we decided to induce and immediately place an LMA to allow for continuous oxygenation and ventilation during the careful advancement of the fiberoptic scope through the nasal passages, nasopharynx, and oropharynx. Once the LMA was visualized with the fiberoptic scope, the LMA was removed and a videolaryngoscope blade was inserted to facilitate visualization and advancement of the fiberoptic scope through the glottis into the trachea. The tube was advanced successfully over the fiberoptic scope and position confirmed with EtCO2 monitoring and fiberoptic visualization. The patient underwent successful surgical fixation and jaw wires applied. The patient calmly emerged from anesthesia on dexmedetomidine and remifentanil infusions and was extubated without issue. He was later discharged from the hospital on POD#3.

Figure 1: Demonstration of LMA-assisted nasal fiberoptic intubation

Figure 2: Demonstration of video-laryngoscopy-assisted nasal fiberoptic intubation

Complications of Le Fort Fractures.

Acute Complications	Long Term Complications
• Bone fragmentation compromising nerves, vessels and blood brain barrier (BBB) • Basilar skull and cribriform plate fractures contraindicating nasal intubation or NG tube placement • CSF leak and subsequent meningitis • Oropharyngeal bleeding and edema impairing visualization • Epistaxis, swelling, hematoma and nasal obstruction • Intracranial hemorrhage that may increase ICP or require emergent decompression • Associated cranial nerve (CN) injuries (e.g. V2 branch of the trigeminal nerve CN V and the olfactory nerve CN I are most likely to be injured, followed by CNs II, IV, VI and VII) • Altered dentition including loose teeth	• Retrobulbar hemorrhage and subsequent vision loss • Post-operative nasal deformity and nasal obstruction • Malocclusion and facial asymmetry • Tracheal stenosis, subcutaneous emphysema, laryngeal nerve damage • Trismus (lockjaw) and infraorbital nerve damage • Neurologic deficits resulting from concussion and brain trauma • Chronic pain

Discussion

Spinal Precautions in Trauma:
Oftentimes, Le Fort fractures are merely one feature of a larger traumatic event. Spinal precautions in trauma often involve the utilization of a C-collar, log-rolling maneuvers, rigid backboard, and minimizing unnecessary and excessive movements of the head, neck and back to avoid secondary injury. With airway management a necessity in the acute perioperative setting, these procedures are often performed with C-spine precautions in place, restricting intubation options. Always perform an airway exam as able and review available imaging before formulating an airway plan with multiple contingency plans. Maxillofacial reconstruction and stabilization is often not emergent and can be delayed, so choice of intubation should be carefully selected.

Sinus Precautions in Trauma:
In the setting of basilar skull or midface fractures, sinus precautions are often instituted, which includes but is not limited to restriction of nose blowing, closed mouth sneezing, and use of positive pressure (PPV) via bag mask ventilation (BMV). PPV can potentially introduce foreign infectious material from the airway into the brain. Additionally, if a dural tear is present, BMV can lead to life-threatening tension pneumocephalus or infection (e.g. meningitis).

Intracranial Pressure (ICP) Considerations in Trauma:
Cranio-facial trauma raises the concern of elevated intracranial pressures due to acute hemorrhage from vascular injury. ICP status alters our anesthetic agent choices and should be carefully considered. This patient was found to have a small 5 mm subdural hematoma on head CT without evidence of midline shift. Additionally, there were no signs/symptoms of elevated ICP on physical exam (e.g. decreased level of consciousness, nausea/vomiting, pupillary changes, hemodynamic instability). Due to these findings, it was determined that use of ketamine for induction to maintain spontaneous ventilation during airway management could be used safely.

Maxillomandibular Fixation Considerations:
Surgical wiring of the jaw is often indicated in Le Fort fracture repairs. Once the jaw is wired, the mouth cannot be opened or easily manipulated. It is best practice to wake the patient up fully before extubation due to the limited available methods of reintubation should the patient require it. Wire cutters should be immediately available should the need arise to re-access the oropharynx for emergent reintubation. Suctioning of the oropharynx can be achieved by placing a soft suction catheter down the nares or by having the patient fully awake and swallowing to remove excess secretions. Extubation may be delayed if a patient does not meet criteria for safe extubation immediately after surgery.

Conclusion

When formulating an airway management plan in the setting of complex maxillofacial and spinal trauma, combining airway devices/techniques should be considered. Advantages of multiple devices can be leveraged for safe manipulation and management of tenuous airways.

Intubation Techniques for Maxillofacial Fracture Surgery:

Videolaryngoscopy

- **Pros**: Rapid intubation time. Less cervical manipulation compared to DL. Possible awake assessment/intubation.
- **Cons**: Risk of oropharyngeal injury. May be hindered due to structural damage and distorted anatomy. Blood and secretions may obscure camera view. Despite view, may be difficult to advance ETT anteriorly. Expensive and still not widely available.

Fiberoptic Intubation

- **Pros**: Allows for navigation of distorted anatomy. Can be performed awake in spontaneously breathing patients. Can be advanced orally or nasally.
- **Cons**: Slower process. Risk of aspiration. Requires experienced operator. If awake, requires cooperative patient. Blood and secretions may obscure camera view. Nasal intubation contraindicated with basilar skull fracture. Contraindicated with impending or complete upper airway obstruction.

Submandibular or Submental Intubation

- **Pros**: Avoids complications associated with cricothyrotomy or tracheostomy. Useful when nasal intubation is contraindicated. Permits manipulation of maxilla and mandible and allows access to oropharynx. Does not interfere with maxillomandibular fixation.
- **Cons**: Potential for loss of airway or bleeding. Risk of damage to submandibular structures and the lingual nerve. Risk of orocutaneous fistula.

Retrograde Wire Intubation

- **Pros**: Useful when visualization from upper airway is obscured. Provides direct conduit between mouth and laryngeal inlet.
- **Cons**: Slow process. Requires experienced operator. Risk of catheter entering fractured pathways instead of direct path to oropharynx. Risk of esophageal perforation, laryngospasm, vocal cord damage or laryngeal damage. Contraindicated in patients with severe deformities, nonpalpable landmarks.

Surgical Cricothyrotomy or Tracheostomy

- **Pros**: Does not require access to oropharynx, nasopharynx, or maxillofacial structures. Durable, can be used for long-term airway, oxygenation, and ventilation needs.
- **Cons**: Potential loss of airway, hemorrhage, subcutaneous emphysema, recurrent laryngeal nerve damage, tracheal stenosis, trachea-esophageal fistula and scar. Requires experienced operator.

Combined LMA + Nasal Fiberoptic Intubation (Figure 1)

- **Pros**: Quick placement of LMA. Allows for continuous oxygenation and ventilation through fiberoptic process, reducing risk of desaturation. Fiberoptic allows for visual assessment of entire ETT track.
- **Cons**: Risk of aspiration. Potential for oropharyngeal trauma from LMA placement obscuring fiberoptic view. Requires experienced operator.

Combined Videolaryngoscopy + Nasal Fiberoptic Intubation (Figure 2)

- **Pros**: Improved visualization of oropharyngeal structures (2 cameras). Allows for anterior displacement of structures potentially obscuring fiberoptic view (e.g. tongue) with minimal footprint. Fiberoptic allows for visual assessment of entire ETT track.
- **Cons**: Requires at least two experienced operators. Slow process. No conduit for ventilation during fiberoptic advancement.

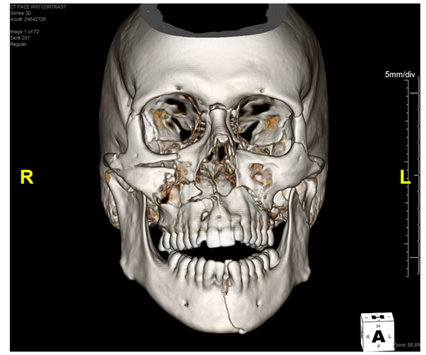

Figure 3: CT face 3D reconstruction demonstrating complex maxillofacial fractures

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