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External Compression of a Nasotracheal Tube due to the Displaced Bony Fragments of Multiple LeFort Fractures

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AIRWAY obstruction is a recognized life-threatening complication of facial fractures. Approximately 27% of patients who present with LeFort fractures require a tracheostomy or a tracheal intubation for the management of airway obstruction or respiratory depression.[1] However, obstruction of a secured endotracheal tube caused by external compression of the fracture fragments has not been reported. We present a case of intraoperative airway obstruction in a patient with multiple LeFort fractures that occurred despite the placement of a nasotracheal tube *in situ*. The anatomical features of facial fractures and the presence of a nasotracheal tube predisposed the patient to this complication. Nasotracheal intubation using fiber-optic guidance in patients with basal skull fracture and alternative airway-management strategies are discussed.

Case Report

A 72-yr-old man involved in a high-speed motor vehicle accident was referred to our hospital for urgent trauma management. The patient had a left LeFort III and right LeFort II fracture that extended into a depressed frontal skull fracture, and other fractures of the extremities. The patient was orally intubated at the scene of the accident because of a depressed level of consciousness, but was hemodynamically stable and was mechanically ventilated at time of hospital admission. Later that day, cerebral spinal fluid was noted to be leaking from the patient's nose. Consequently, the patient was scheduled to undergo a frontal craniotomy to repair the site of cerebral spinal fluid leakage and to decompress the frontal fractures. In addition, the concomitant stabilization of the midface fractures was planned to reduce the likelihood of a persistent cerebral spinal fluid leak. The plastic surgeons requested that the orotracheal tube be replaced with a nasotracheal tube to obtain adequate exposure of the oral cavity. In addition, it was decided that temporary intraoral maxillary–mandibular fixation wires would be placed during the surgery to facilitate the reduction of the LeFort fractures. The risk of cranial intubation resulting from the nasotracheal intubation was considered reduced with the careful fiber-optic guidance of the tube through the nasopharynx. The neurosurgeon decided that the risk of meningitis as a result of the nasotracheal tube was acceptable; therefore, nasotracheal intubation was chosen instead of elective tracheostomy, the alternative option.

The patient was anesthetized and the orotracheal tube was replaced by a 8.0 mm nasotracheal tube (Mallinckrodt Medical, Pointe Claire, Quebec, Canada). To ensure that the basal skull plates were not disrupted, the tube was gently inserted into the nasopharynx and trachea under direct vision using a fiber-optic bronchoscope. Bilateral air entry was noted and the nasotracheal tube was securely sutured to the nasal septum. The initial airway pressure was 25/3 cm H_2O and oxygen saturation measured by pulse oximetry was 99%, with a fraction of inspired oxygen of 0.40. The patient remained in the supine position and was draped for the frontal craniotomy. During the ensuing 2 h of surgery, the airway pressures gradually increased to 30/2 cm H_2O, and the peak airway pressure increased from 33 to 41 cm H_2O during the subsequent 40 min of surgery. The end-tidal pressure of carbon dioxide increased from 29 to 36 mmHg and a marked increase in the slope of the end-tidal pressure of carbon dioxide trace was observed.

The differential diagnosis for an increase in airway pressures included kinking of the tube by external compression, endobronchial intubation, herniation of the cuff, and occlusion of the lumen by mucus or a foreign body. Manual ventilation confirmed a high airway resistance and auscultation of the lung fields revealed equal air entry. Although no kinking was evident at the nasal aspect of the tube, attempts to pass a suction catheter down the nasotracheal tube were unsuccessful. Fiber-optic examination showed an obstruction of the tube secondary to external compression in the nasopharynx at approximately 5 cm from the nasal orifice. Despite multiple attempts to alleviate the kinking by applying traction to the distal end of endotracheal tube or the intraoral segment, the obstruction persisted. How-

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ever, after the craniotomy was halted and the neurosurgical drapes were removed, the application of gentle forward traction to the mobile maxilla relieved the obstruction of the endotracheal tube, and airway pressures immediately declined to preoperative values. The nasotracheal tube was expeditiously changed to a number 8.0 mm orotracheal tube under direct laryngoscopy and the surgery continued without maxillary–mandibular fixation. Postoperatively, the patient was stable on return to the intensive care unit and remained orotracheally intubated during the next few days. Twelve days later, the patient underwent tracheostomy for prolonged airway management and was transferred, in stable condition, to an intensive care unit closer to his home for recovery.

Discussion

The classification of facial LeFort fractures has been previously reviewed.[2] The most life-threatening complication of facial fractures is airway obstruction. Airway obstruction secondary to the displacement of fragments is less likely with LeFort I and II fractures than with LeFort III fractures. However, because of the associated laryngeal, pharyngeal, chest, or closed-head injuries, emergency airway management may be required with any midface fracture.[1] Nineteen of 117 patients with LeFort fractures required treatment for airway obstruction, the majority of whom (16 of 19 patients) underwent urgent tracheostomy.[1] An additional 39 of 86 patients with no acute airway compromise underwent elective tracheostomy before the repair of facial fractures. Therefore, airway intervention is common in patients with LeFort fractures.

Intraoral maxillary–mandibular fixation and occlusion of the teeth may be required to facilitate the alignment and internal fixation of fracture fragments.[3] Airway management in these patients is often dealt with using elective tracheostomy. An alternative surgical method used to secure the airway is a rarely used submental approach, which involves the insertion of a reinforced endotracheal tube through a submental incision that extends into the floor of the mouth.[4,5] The risks associated with this approach are similar to the risks associated with tracheostomy, such as infection and displacement of the tube. However, in many instances, maxillary–mandibular fixation is required only temporarily during the surgical procedure, and a less-invasive alternative airway strategy may be preferred. Nasal intubation was traditionally contraindicated in LeFort II or III fractures because of the possible disruption of the cribriform plate and the risk of cranial intubation[6,7] or meningitis.[2,8,9] However, several reports have described the successful placement of a nasotracheal tube over a fiber-optic bronchoscope without cranial intubation or other complications.[10,11] Therefore, in certain cases a nasotracheal tube has been used instead of elective tracheostomy to facilitate the surgical alignment and repair of LeFort II and III fractures.

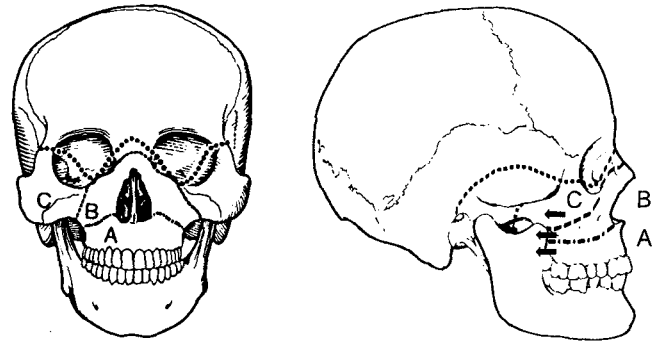

Fig. 1. Anteroposterior and lateral views of the human skull. Fracture lines are indicated for (*A*) LeFort I, (*B*) LeFort II, and (C) LeFort III fractures. In the lateral view, arrows show possible posterior displacement of fragments from each fracture type. Adapted with permission.[2]

An additional risk of associated with the use of nasotracheal intubation instead of tracheostomy includes the occlusion of the lumen by nasal turbinates, mucus, or blood clots.[12] Also, kinking of the tube at the naris can occur because of the weight of the breathing circuit tubing[13] and can be avoided by carefully supporting and securing the breathing circuit. External compression of a nasotracheal tube is more likely to occur after the polyvinyl chloride tube has been warmed and softened by the patient's body heat. Because the obstruction of the nasotracheal tube can develop insidiously and at any time during the procedure, constant vigilance is required.

To the best of our knowledge, this is the first reported case in which the posterior displacement of fracture fragments (fig. 1) caused an external compression and the subsequent kinking of an unreinforced nasotracheal tube. Therefore, this complication should be included in the differential diagnosis of intraoperative airway obstruction and be considered an added risk of nasotracheal intubation in patients with LeFort fractures. In this patient, the obstruction was relieved by applying gentle forward traction to the midface. If this technique fails, expedient and definitive treatment by orotracheal intubation or urgent tracheostomy is required.

The problem experienced during the treatment of this patient, in addition to any risk of cranial intubation or meningeal contamination, would have been avoided if the airway had been secured by elective tracheostomy. Moreover, the LeFort fracture reduction and fixation

could have proceeded as planned. Therefore, our experience suggests that preliminary tracheostomy is still the choice method for securing an airway in patients undergoing the repair of complex LeFort and skull fractures during which the face is neither exposed nor accessible to the anesthetist.

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Macroglossia: Compartment Syndrome of the Tongue?

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MACROGLOSSIA is an infrequent but potentially lethal postoperative complication following intracranial neurosurgical procedures in the posterior fossa.[1-11] The incidence of this complication has been estimated to be 1%[9]; however, the complication may be underreported, and its actual incidence is unknown. The etiology of macroglossia is uncertain, and has been attributed to arterial compression, venous compression, mechanical compression, or to neurogenic origin.[6,9] Recently, Kuhnert *et al.* described a case of massive postoperative macroglossia following a C1-2 laminectomy using the sitting position in a patient with Crouzon syndrome. Although the etiology remained unclear, the case revived interest in this complication.[10]

This report documents our experience with a patient who experienced this complication during her first procedure for resection of an acoustic neuroma, and who returned 9 yr later for resection of the recurrent tumor. In addition, another case of a "near miss" is described. These two cases lend new insight to the etiology of this complication, and suggest that venous obstruction leading to arterial insufficiency and resulting in reperfusion injury is the primary etiology in many of these cases.

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