Part X: Trauma

Chapter 68: Faciomaxillary and Upper Airway Injuries

P G Moore

Faciomaxillary and upper airway injuries are common and pose problems in airway management. In severe cases, there are often associated injuries to the cranial fossae and brain, cervical spine, skeleton and chest. Management often involves many specialty disciplines (ie, otolaryngologists, oral surgeons and dentists, plastic surgeons, ophthalmologists, neurosurgeons, anaesthetists and trauma surgeons). Fragmented care is to be avoided and the intensivist may play an important role in coordinating the various services.

Mechanisms of Injury

Faciomaxillary and upper airway trauma are due to sharp or blunt injuries to the head or neck. Sharp injuries usually result in lacerations and penetrating injuries, whilst blunt injuries result in fractures to the facial skeleton. Over 50% of facial trauma are the result of motor vehicle accidents, most of the remainder are due to physical violence or sporting injuries, which tend to be less severe, and a small number occur as falls and work-related accidents. The severity of facial fractures are directly related to the degree of force applied and the velocity of injury. Over 50% of severe faciomaxillary injury are accompanied by other associated injuries.

Penetrating neck wounds are commonly due to knife and gunshot wounds. They may result in injury to the air passages (ie, pharynx, larynx, trachea, and lung), nervous system (ie, spinal cord, brachial plexus, cranial nerves, or peripheral nerves), blood vessels (ie, aortic arch, innominate vessels, carotid, jugular and subclavian vessels) and the gastrointestinal tract (ie, pharynx and oesophagus). Blunt injuries to the neck are rare and are commonly due to motor vehicle accidents or physical violence. They cause damage to the supraglottic airspaces, larynx and trachea and may lead to severe airway problems.

The pattern of injury has changed in recent years. Passenger restraining devices and improved motor vehicle design (ie, windscreen glass, dashboards and steering columns) have reduced the incidence and severity of facial injuries, and the use of helmets has decreased mortality and the incidence of facial and neurological injury in motorcyclists.

Acute Management

The acute management of faciomaxillary and neck injuries focus on airway patency, which is the major priority. Once the problems of airway management have been addressed, management of other life-threatening injuries and trauma-related major system failure will follow. Thus, treatment priorities are to clear and secure the airway, control haemorrhage, treat hypovolaemia, and evaluate for associated life-threatening injuries. When these are satisfied, management is directed towards the facial, neck and other injuries.

1. Airway Management.

The airway must be assessed in the early triage, to exclude airway obstruction, rupture, or bleeding, and determine conscious level and presence of a full stomach and cervical, skull, or associated injuries. Simple measures to clear the airway by suction, posture and insertion of an oropharyngeal airway wil suffice in many cases. An oropharyngeal airway is best avoided in the conscious patient, as discomfort or vomiting may result. Nasopharyngeal airways should be avoided in all injuries to the middle third of the face or with basal skull fractures. The airway should be observed regularly in the acute phase of injury, as increasing oedema, swelling and haematoma may compromise a previously patent airway. Stridor, voice changes, dysphagia, dyspnoea, haemoptysis or surgical emphysema following blunt injury to the neck, may indicate serious injury to the larynx, pharyngeal airspaces, or extrathoracic trachea.

Immediate orotracheal intubation by a *skilled* person under direct vision is indicated in cases of:

(a) severe obstruction;

(b) respiratory depression; and when

(c) general anaesthesia is required to manage concomitant injuries.

Thus, foreign material can be removed and correct tube placement ascertained. When anatomical disruption makes intubation difficult or impossible, an emergency cricothyroidotomy may be life-saving.

Nasotracheal intubation should not be attempted when midfacial injuries are present, and is absolutely contraindicated when basal skull fractures are suspected. The use of a fibreoptic laryngoscope may be difficult for anatomical reasons, and because blood may obscure lens vision. Furthermore, suctioning through the fibreoptic instrument may be inadequate to remove secretions, blood and foreign material. Blind intubation techniques are contraindicated in the acute phase of injury, because a disrupted anatomy may be present. If intubation difficulties are anticipated, tracheostomy under local anaesthesia should be considered. Formal tracheostomy is best performed as a planned procedure in the operating room under local or general anaesthesia provided airway patency and protection can be maintained.

Soft tissue injuried and facial lacerations may mitigate against the use of an air-tight face mask for oxygen therapy or general anaesthesia. The presence of an associated cervical spine injury should be confirmed when possible, and appropriate measures (ie, a cervical collar or neck traction) taken to minimize movement if intubation or tracheostomy is planned. In some cases, cervical injury is suspected but not confirmed, and urgent airway intervention is required. Under these circumstances, while the airway takes priority, care should be taken to minimize neck movement when intubation is performed.

2. Control of Haemorrhage.

Haemorrhage from the midface or base of skull may occasionally be massive, and in severe cases, difficult to successfully control. Provided the airway is secured, the use of topical vasoconstrictors, nasopharyngeal packs, or a Foley balloon catheter inflated in the nasopharynx, may control or reduce blood loss. If bleeding persists, coagulation studies should be performed and appropriate replacement therapy given. Operative reduction of fractures and direct ligation of bleeding vessels may be attempted when simple measures fail to control bleeding. When these measures are unsuccessful, more radical measures, including ligation of the external carotid artery or intra-arterial embolization performed under angiographic control, should be considered.

3. Clinical Evaluation of Injuries.

A history of how the injury occurred should be taken from the patient, bystanders, police, or paramedics. Physical examination includes inspection for facial deformity or asymmetry, malocclusion of dentition, palpation of facial bones (including orbital margins), instability and movement of facial fragments, motor and sensory function, visual disturbances (ie, diplopia, limitation of eye movement, and loss of vision) and presence of cerebrospinal fluid (CSF) rhinorrhoea.

4. Specific Investigations.

Most facial fractures can be easily diagnosed with a minimum of X-ray studies. Useful studies include stereo Water's view, stereo Caldwell's view, postero-anterior, lateral oblique and Panorex views. Two-dimensional and 3-dimensional CT provide additional information about specific patterns of fracture, and may facilitate surgical care. CT may also be useful when laryngeal injury is suspected.

General Management

Patients without airway obstruction are more comfortably nurse in 30° head-up position, to encourage drainage of blood, saliva and CSF away from the airway, while preventing obstruction by disrupted tissue. Once airway patency is secured or confirmed, maxillary and mandibular fragments can be repositioned and a headwrap applied to maintain stabilization. Any other associated injuries are then assessed.

After life-threatening matters have been addressed, definitive reduction of faciomaxillary fractures can be planned. There is a "grace period" of up to 10 days for such surgery. While there is no strong evidence that early fixation may be beneficial, patient comfort might be best served by such an approach. In some cases, particularly orbital injuries when ocular function is at risk, early surgery is mandatory. When gross facial swelling occurs, definitive surgery should be delayed while measures are instituted to reduce swelling. These include debridement of open wounds, removal of foreign bodies, closure of facial lacerations, initial non-definitive stabilization measures, use of ice packs, and head-up nursing of the patient to reduce venous pressure and encourage fluid resorption. Prophylactic antibiotics should be used for patients with CSF rhinorrhoea, compound wounds and when operative fixation of fractures is performed.

Specific Injuries

Fractures

The most common fractures of facial bones are the nasal bones (37%), zygoma and zygomatic arch (15%), mandible (11%), orbital floor (11%), and maxilla (8%).

1. Mandibular fractures.

The mandible occupies a prominent facial position, and therefore is easily fractured. Multiple mandibular fractures are common, and common fracture sites are the condylar neck, angle of mandible, alveolar process, symphysis, and body. Coronoid process fractures are uncommon, as the bone is protected by the zygomatic arch. Ramus fractures are rare, because the strength of the bone in this area transmits impact forces to other areas of the mandible. Body of mandible fractures are oftena accompanied by fractures of the opposite angle or condylar neck, due to transmitted forces. Direct symphyseal impact may result in parasymphyseal or bilateral condylar neck fracture. High speed injuries often result in compound or comminuted fractures at the impact point.

Mandibular fragments are often distracted due to the action of the muscle of the lower jaw. Respiratory obstruction may occur following bilateral mandibular angle or body fractures (Andy Gump fractures) due to posterior displacement of the tongue. In emergencies, respiratory obstruction can be relieved by forward traction of the tongue or by placement of an oropharyngeal airway. Mandibular fractures are definitively managed by internal wiring or plating of fractures, and when teeth are present, by intermaxillary fixation by wiring of upper and lower jaws together, using upper and lower arch bars.

2. Maxillary Fractures.

LeFort described a classification of maxillary fractures in 1901 which is still used today, although fractures are usually of mixed types. Airway obstruction often accompanies LeFort injuries. The soft palate may sag against the tongue, posterior pharynx, or a haematoma or oedema in the pharyngeal wall. Foreign debris may be present in the mouth, and nasal obstruction may occur due to septal dislocation, swelling, or blood clots and foreign material.

Isolated maxillary fractures are rare, because the impact needed to cause fractures is usually sufficiently severe to break other facial bones. Mandibular fractures may be present in as many as 55% of cases of maxillary fracture, depending on the type of LeFort injury. Fractures of nasal bones, zygoma, orbit and skull (particularly base of skull fractures) and soft tissue injuries, including ocular injuries, are often associated with maxillary fractures.

(a) LeFort I Fracture.

This is the least severe fracture and occurs in about 30% of maxillary fractures. It is a dentoalveolar fracture which follows a horizontal plane above the floor of the nose. The fracture (sometimes called Guerin's fracture) separates the palate from the remainder of the

facial skeleton, and is usually caused by direct low-maxillary blows or by a lateral blow to the maxilla.

(b) LeFort II Fracture.

LeFort II fractures, also referred to as pyramidal fracturesw, are the most common maxillary fractures (42%). They extend from the lower nasal bridge through the medial wall of the orbit, and cross the zygomatico-maxillary process. They are caused by direct blows to the mid-alveolar area, or by lateral impacts and inferior blows to the mandible when the mouth is open, and consist of a freely mobile pyramidal-shaped portion of the maxilla.

(c) LeFort Fractures.

These are known as craniofacial dysjunctions because the fractures completely separate the midfacial skeleton from the base of the cranium, resulting in the characteristic "dish-face" deformity. The fracture extends through the upper nasal bridge and most of the orbit and across the zygomatic arch. The fracture involves the ethmoid bone, and thus may affect the cribriform plate at the base of the skull. LeFort III fractures usually occur as a consequence of superiorly-directed blows to the nasal bones, and occur in about 28% of patients with maxillary fractures.

Associated basal skull fractures occur in about 20% of LeFort III and some LeFort II fractures, and may lead to CSF leakage, meningitis and pneumocranium. Nasal intubation may result in passage of the endotracheal tube through the cribriform plate and into the cranial cavity. The maxillary antrums are often opaque due to the presence of blood clot.

Despite the LeFort classification, maxillary fractures may often be a mixed variety. Similarly, facial fractures may be comminuted and may not be symmetrically distributed. Nevertheless, comminuted fractures usually follow the LeFort fracture lines. LeFort II and III fractures involve the orbit and are frequently associated with orbital blowout fractures through which ocular muscles may herniate. Definitive surgery may involve internal fixation with wiring and plating, and intermaxillary fixation. Often, external fixation is required with intermaxillary fixation and cranial suspension to wire fixation at frontal bones.

3. Fractures of Zygoma and Orbit.

The malar region absorbs lateral and oblique blows to the mid-face. The zygoma is uncommonly fractures, but its attachments to the maxilla, frontal, and temporal bones are vulnerable and may be disrupted. When the zygoma is displaced, disruption of the lateral wall and floor of the orbit may ensue. The eye and its function must be carefully examined when fractures involving the orbit are suspected.

Isolated zygomatic arch fractures are often stable after operative reduction, and may require no other active management other than "protective" measures to ensure the area is not accidently bumped. Unstable and comminuted fractures require internal or external fixation. "Tripod" fracture of the zygoma require open reduction. Herniation of orbital contents and entrapment of ocular muscles must be relieved by distraction of the fractures which, in turn, are stabilized by wiring. Autogenous bone grafts and use of alloplastic materials may be

required to reconstruct the orbital floor, if the fractures are severely comminuted and if there is bone loss. Orbital blowout fractures are managed in the same manner.

4. Nasal Fractures.

These are the most common fractures of the facial skeleton. Bleeding may be copious, particularly in patients with underlying hypertension or bleeding tendency. Vasoconstrictor agents, such as adrenaline, may be useful in controlling bleeding; in most cases the bleeding will settle. In some cases, nasal packing or inflation and traction of a Foley catheter balloon into the nasopharynx may be required. Closed reduction and external splinting is required to manage nasal fractures and must be performed within 10 days of injury.

Soft Tissue Injuries

Basic tenets of wound management apply to all soft tissue injuries to the face and neck. The region is anatomically complex, and contains many important structures, and extensive wound debridement should be avoided. The rich regional vascular supply, to some extent, protects against nutrient devitalization. Minimal debridement and delayed wound closure provides the best approach to management of the heavily contaminated wound. Where there is extensive tissue loss, once the wound is clean, myocutaneous or osteocutaneous grafts may be performed by microsurgery. Penetrating neck injuries, particularly those due to knife and gunshot wounds, may produce life-threatening exsanguination injuries and require careful evaluation and early surgical exploration.

1. Facial Nerve Injuries.

Any wound around the anatomical vicinity of the facial nerve must be carefully assessed to exclude facial nerve injury. A thorough neurological test of facial nerve function should be performed in the conscious patient. However, because of extensive interneural connections between buccal and zygomatic branches of the facial nerve, a simple laceration of one branch may not produce any obvious clinical signs. Wound exploration should be carefully performed with the aid of a nerve stimulator before wound closure is performed.

Nerve lacerations medial to the orbit are not repaired due to extensive nerve arborization in these areas (before entering the facial musculature). Nerve lacerations lateral to the pupil should be repaired by a primary procedure before wound closure is performed. The amount of recovery of function, even in the best circumstances, is less than 50%. Dyskinesis is a frequent complication of repair, particularly when a major division of the nerve trunk is involved. Lacerations of marginal mandibular branch have poor recovery after repair. There are a number of procedures, including cross-facial nerve grafts and vascularized muscle transplants, which have been used with mixed results to improve outcome in long established facial palsy.

2. Parotid Injuries.

These injuries are characterized by a penetrating wound which lacerates the capsule and separates the parenchyma or parotid ducts. There is an intimate association between the parotid gland and Stensen's duct with the facial nerve, and an injury to one should draw

suspicion to injury of the other. Simple lacerations to the parotid capsule are repaired by closure with absorbable suture. Minor collecting duct injuries require no specific surgical repair and any leakage of saliva soon ceases when the wound heals. The occasional formation of a sialocoele is resolved by serial aspirations. Major duct injury requires microsurgical reconstruction. With an injury to the extraparenchymal portion of Stensen's duct, it may be preferable to manage a parotid fistul to the oral cavity, and perform a delayed surgical repair weeks or months later.

3. Laryngeal Trauma.

Blunt or penetrating injuries to the larynx require immediate attention to the airway. If the airway is acutely compromised, an emergency tracheotomy or cricothyroidotomy may be preferable to blind or hasty intubation, which may misplace the endotracheal tube or extend the injury. Gaping wounds of the larynx can be intubated under direct vision, pending subsequent surgery. Simple contusions of the anterior neck may not cause serious laryngeal injury, and the patient can be managed by neck stabilization, head-up posture, and humidified oxygen therapy by face mask. Swallowing may be painful and may be accompanied by spasm or tracheal aspiration, and oral fluids or solids should not be given for 48 hours.

Blunt trauna to the larynx causing a compromised airway requires immediate attention, as laryngeal fracture or collapse is suspected. After the airway is secured by tracheostomy, a detailed examination including direct laryngoscopy should be performed. When the laryngeal skeleton is disrupted, surgical exploration and repair is indicated. Laryngotomy is required when fracture or disarticulation is present and definitive surgical repair can be performed. Post-traumatic fibrosis of the cricoarytenoid joint leading to impaired vocalization, can be minimized by careful surgical techniques. In some cases, particularly injuries to children, an internal stent may be required to minimise airway narrowing.

Following surgical repair, the tracheostomy is kept open for 7-10 days. After this time, the tracheostomy is plugged to test airway patency, and if satisfactory, the tracheostomy tube is removed. In extreme injuries, laryngeal function may not adequately recover and a permanent tracheostomy may ensue. In less severe cases, delayed reconstructive surgery should be attempted. Permanent voice alteration may remain as the minimum disability after laryngeal trauma.

Outcome

Management of the airway and other life-threatening injuries are priorities in the care of the traumatized patient. Mortality will be influenced by the care in the acute phase. However, appropriate and prompt definitive care of facial and neck injuries may significantly affect morbidity. In most cases, definitive treatment while the patient is receiving life support, may avoid complications which will significantly affect the patient's quality of life after recovery.