

## Mortality in Maxillofacial Trauma – A Review

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### Review Article

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**Abstract:** Trauma remains one of the principal causes of mortality in the world, especially among young adults. The most serious immediate life-threatening complication following maxillofacial trauma is airway obstruction. The onset can be sudden, as with foreign body aspiration, or following soft-tissue damage that can lead to a later stage to airway-compromising edema. The medical literature regarding facial trauma appears to support the hypothesis that maxillofacial trauma alone is rarely life threatening or will not lead to life-threatening conditions unless associated with airway compromise. There are some causes of life threatening complications following trauma to the maxillofacial region such as massive bleeding or undiagnosed cervical spine injury. However, there are some situations that may cause irreversible damage unless immediate operation is undertaken. The almost complete lack of reports dealing with death or irreversible damage in trauma involving the maxillofacial region prompted us to review the mortality following trauma to the maxillofacial region.

**Keywords:** Trauma, Mortality, Death, Face.

### INTRODUCTION

Patients with maxillofacial fractures have varying degrees of concomitant injuries. Etiologic factors, socioeconomic factors, geographic location, and type of facility can influence both the type and severity of these injuries[1,2]. Trauma continues to be a major threat to public health. Maxillofacial trauma occurs in a significant number of severely injured patients and may be a clue to concomitant serious or life-threatening injuries.

Knowledge of associated injuries can lead to the rapid assessment and initial treatment of these patients. In addition, our understanding of causes, severity, and specifics such as facial fracture site, hospital complications, and discharge status will improve our abilities of prevention. Motor vehicle accident (MVA) and assault remain the primary causes of maxillofacial fractures[3,4]. Alcohol intoxication at the time of trauma continues to be an important factor related to injury. Serious concomitant injuries with facial fractures have been documented, but further study is important for both patient care and directed research[4-6]. Facial injuries have been the focus of attention in many parts of the world because of its high incidence and diversity[7]. Worldwide indices show road traffic accident to be the major cause of maxillofacial injury. An estimated 1.2 million people round the globe are killed as a result of road traffic injuries each year and the situation in a developing country like India is no different[8]. Many factors affect mortality rate and outcome after trauma. Age of the

patient, concomitant head injuries and increased bleeding are some of the variables of increasing death rates after maxillofacial trauma[9,10]. Another factor affecting mortality is the standard of surgical care in maxillofacial patient. Studies in industrialized countries have shown a rate of death from inpatient surgery of 0.4 to 0.8% and a rate of major complications of 3% to 17%. These rates are likely to be much higher in developing countries[11,12]. Knowledge of injuries associated with maxillofacial fractures provides useful strategies for patient care and prevention of further complications. Cerebral and pulmonary injury are often associated with maxillofacial fractures in severely injured trauma patients. Coordination of trauma teams, emergency room physicians, and surgical teams such as neurosurgeons is vital for the early stabilization and treatment of patients with facial fractures. Because of high hospital complication rates, ongoing care of these patients is an important factor in their morbidity and mortality rates. Ultimately, prevention of injury from

violence and MVA will prove most valuable to society in terms of both public health and cost.

### **COMPLEXITY OF SITUATION**

The maxillofacial trauma patient often presents a problem of difficult mask ventilation and difficult intubation. The trauma usually disrupts the normal anatomy and causes edema and bleeding in the oral cavity. The mask cannot be properly close-fitted to the face, to enable effective mask ventilation. Furthermore, an injured airway may prevent efficient air transferring from the mask to the lungs. The challenge in performing the intubation arises mainly from a difficulty in visualizing the vocal cords with conventional direct laryngoscopy. The oral cavity, pharynx and larynx may be filled with blood, secretions, debris, soft tissue and bone fractures, all of which preclude good visualization of the vocal cords. The indications for tracheostomy have been revised as follows: (1) Acute airway obstruction and failed endotracheal intubation (2). Expected prolonged intubation due to difficulties weaning from the ventilator (3). Multiple facial fractures combined with basal skull fractures (4). Complete destruction of nasal anatomy combined with multiple facial injuries. Severe pain, independent of medical therapy, may cause sudden, unexpected death. Cardiac arrest is the cause, and practitioners need to know how to spot a high-risk patient. Sudden, unexpected death may occur in a severe, chronic pain patient, and the terminal event may be unrelated to medical therapeutics. Fortunately, sudden death is not as commonly observed in pain patients as in past years most likely due to better access to at least some treatment. Sudden death still occurs, however, and practitioners need to know how to spot an "at-risk" patient. Unexpected, sudden death due to severe pain is poorly appreciated, since many observers still view severe pain as a harmless nuisance rather than a potential physiologic calamity. In many cases, just prior to death, the patient informs their family that they feel more ill than usual and seek relief in their bed or on their couch. Unfortunately, some of these patients don't awaken. Other patients die, without warning, in their sleep or are found collapsed on the floor. Modern medicine's aggressive toxicology and forensic procedures after death have contributed to the poor understanding of pain's death threat. In some cases, a pain patient that was being treated appropriately with an opioid or other agent with overdose or abuse potential has suddenly and unexpectedly died. Drugs were found in body fluids after death, and in my opinion a coroner wrongly declared the death to be an "accidental overdose" or "toxic reaction" to drugs rather than implicate the real culprit, which may have been an "out-of-control" pain flare.

### **Mechanisms of death**

Severe pain is a horrific stress[13,14]. Severe pain flares, acute or chronic, cause the hypothalamic-pituitary adrenal axis to produce glucocorticoids

(cortisol, pregnenolone) and catecholamines (adrenalin and noradrenalin) in an effort to biologically contain the stress[15,16] Catecholamines have a direct, potent stimulation effect on the cardiovascular system and severe tachycardia and hypertension result[17]. Pulse rates may commonly rise to more than 100 beats per minute and even rise to more than 130 beats per minute. Blood pressure may reach more than 200 mmHg systolic and more than 120 mmHg diastolic. In addition to adrenal catecholamine release, pain flares cause overactivity of the autonomic, sympathetic nervous system, which add additional stimulation to catecholamine-induced tachycardia and hypertension. Physical signs of autonomic, sympathetic overactivity, in addition to tachycardia and hypertension, may include mydriasis (dilated pupil), sweating, vasoconstriction with cold extremities, hyperreflexia, hyperthermia, nausea, diarrhea, and vomiting. The combined physiologic effects of excessive catecholamine release and autonomic, sympathetic discharge may put such strain on the heart to cause coronary spasm, cardiac arrhythmia, and sudden death[18]. Pain patients who have underlying arteriosclerosis or other cardiac disease are at higher risk of sudden death. For example, a patient with angina or generalized arteriosclerosis is at high risk and should be aggressively treated. Anecdotal reports have been made in which a patient whose pain was well controlled on opioids died unexpectedly with an underlying cardiac disease. In one report, a 40-year-old pain patient on opioids was found dead and the autopsy revealed previously unrecognized coronary artery disease, which was determined to be the cause of death. Some patient deaths may be due to other comorbid conditions, whether known or not known, and may not be related to the pain problem.

### **DISCUSSION**

Trauma accounts for thousands of deaths and financial burden on any country. It has been labeled as "neglected disease of modern society". It involves universal young productive lives and male predominance. For every death, two people suffer permanent disability. Maxillofacial injuries need special attention due to many reasons. These injuries are with or without head injury and cervical spine fractures or polytrauma. Early airway control requires sound judgment and considerable experience. Skillful experienced personnel are mandatory. In order to have a good outcome with minimal risks and maximal success in airway management, should be in collaboration with the anesthesiologist or trauma team leader is must[19]. ATLS protocol must be followed in all cases of maxillofacial trauma with immediate attention to life-threatening injuries[20]. Gruen *et al.* found that, failure to intubate, secure or protect the airway was the most common factor related to patient mortality, responsible for 16% of inpatient deaths[21]. Emergency trauma care was not part of this study since primary care was given separately. The time lag between the injury and surgery

is variable depending on primary care institutional protocols and may range from few hours to few days according to associated injury, facial edema and preoperative optimization of general condition. Resolution of facial edema during this time allows for more accurate clinical evaluation of airway and ease of intubation. Capasi *et al.* suggested that the delay in final reconstruction of facial fractures in critically ill patient has an acceptably low complications rate and may be advantageous in decreasing operative risk[22]. Hutchinson *et al.* addressed six specific situations associated with maxillofacial trauma, which may adversely affect the airway: 1. Postero-inferior displacement of a fractured maxilla parallel to the inclined plane of the skull base, 2. bilateral fracture of the anterior mandible, 3. hemorrhage 4. soft tissue swelling and edema, 5. trauma to the larynx and trachea, 6. foreign bodies – dentures, debris, shrapnel, exfoliated teeth, bone fragments[23]. Planned reconstruction schedule is required to achieve maximum, satisfactory function and appearance as unnecessary delay in surgery may predispose to complications like malunion and infections. Approach to the maxillofacial trauma patient's airway evaluation and preparation is the key to a successful anesthetic management. Extent of injury, the composition and the anatomy of the injury along with Mallampatti classification, atlantoaxial mobility and thyromental distance provides good airway assessment[19]. But these all may not be accurate in the presence of tissue edema, disrupted anatomy and muscle spasm. The risk of airway-related complications during the peri-operative period was studied by Peterson *et al.* [24]. They analyzed the American Society of Anesthesiologists Closed Claims database to identify the patterns of liability associated with the management of the difficult airway. They found that complications arose throughout the peri-operative period: 67% upon induction, 15% during surgery, 12% at extubation and 5% during recovery. As with every difficult airway situation, the equipment for difficult intubation should be prepared and ready to use. The approach should be chosen according to the patient's injuries, airway status and the care provider's experience with such equipment and procedures. Management of the airway is a major concern in patients with maxillofacial trauma (gunshot wounds, facial fractures, cervical spine injuries, laryngotracheal injuries) because a compromised airway can lead to death. The method of intubation to use in these patients remains a controversial topic. Although there are many options available, each one has specific indications, and the choice will ultimately depend on the patient's situation and the expertise of the anesthesiologist[25]. Several studies have explored the association among craniofacial trauma, intracranial injury, and death[26-29]. Although many of these studies were primarily descriptive, they suggested important differences in the outcomes according to the regional facial involvement. Death and intracranial injury have been observed to be increasingly common

with the involvement of more superior facial regions[27,30]. Lee *et al.* [28] had previously found that head trauma after midface fracture is most often minor and postulated that the fragile bones of the midface might act as a cushion for the neurocranium. Mithani *et al.* [30] expanded on these findings in one of the largest comparative facial trauma series to date and noted that serious head injury was relatively less common in midface fractures overall. However, with bilateral midface trauma, a significant association was found with basilar skull fractures and mortality[30,31] Immediate management of maxillofacial injuries is required mainly when impending or existing upper airway compromise and/or profuse hemorrhage occurs. Hutchinson *et al.* [23] addressed six specific situations associated with maxillofacial trauma, which may adversely affect the airway: 1. Posteroinferior displacement of a fractured maxilla parallel to the inclined plane of the skull base may block the nasopharyngeal airway. 2. A bilateral fracture of the anterior mandible may cause the fractured symphysis to slide posteriorly along with the tongue attached to it via its anterior insertion. In the supine patient, the base of the tongue may drop back, thus blocking the oropharynx. 3. Fractured or exfoliated teeth, bone fragments, vomitus and blood as well as foreign bodies – dentures, debris, shrapnel etc. – may block the airway anywhere along the upper aerodigestive tract. 4. Hemorrhage, either from distinct vessels in open wounds or severe nasal bleeding from complex blood supply of the nose, may also contribute to airway obstruction. These situations should be addressed immediately using various manual and/or instrumental techniques, in accordance with the "A" step in the ABC treatment protocol suggested by the ATLS[19]. Endotracheal intubation should be considered if it was not performed earlier. 5. Soft tissue swelling and edema resulting from trauma to the head and neck may cause delayed airway compromise. 6. Trauma to the larynx and trachea may cause swelling and displacement of structures, such as the epiglottis, arytenoid cartilages and vocal cords, thereby increasing the risk of cervical airway obstruction. A high index of suspicion, meticulous physical examination and close observation of the patient may assist in the early detection of such situations and facilitate proper and timely management in order to avoid future complications. Once airway management has been completed and all hemorrhage sites controlled, definitive management of bone and soft tissue injuries resulting from maxillofacial trauma may be deferred until life- and/or organ-threatening injuries have been properly managed. Early intervention is always needed to improve the prognosis. Airway, breathing and circulation compromises may be affected. It is important to understand the uniqueness of the facial region, both in terms of its anatomy and the neighboring structures. Early diagnosis and treatment of life-threatening situations and compromised vital structures, will improve the prognosis. The team approach to maxillofacial trauma should involve general, oral-

maxillofacial and ophthalmology surgeons for optimal care.

## CONCLUSION

It can be concluded that Oral and Maxillofacial Surgery is specialty with an extremely low mortality rate. Respiratory complications are the most common cause of death in patients who survive from maxillofacial trauma. General anesthesia poses a negligible mortality risk to ASA class I patients. The only anesthesia related death was that of an ASA class III patient. We recommend that All patients of maxillofacial trauma or otherwise should be thoroughly examined for any respiratory and cardiac abnormalities and referred promptly to other specialties when required. The position of a full time emergency medicine specialist should be mandatory in all maxillofacial units that exist outside of a medical hospital. Another study of the same kind should be repeated after every 5 years as a form of a clinical audit to see any improvements or otherwise in the management of patients at this unit. An annual mortality and morbidity conference should be held in the department involving maxillofacial surgeons and allied specialists from the medical field to conduct a critical appraisal of the multidisciplinary treatment approach of patients and suggest ways to decrease the existing morbidity and mortality rate. Residents of Oral and Maxillofacial Surgery should have a minimum of 2 months rotations in a medical or surgical ICU at par with other mandatory rotations fulfilling the requirements for MDS.

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