Management of maxillofacial trauma in emergency: An update of challenges and controversies

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ABSTRACT

Trauma management has evolved significantly in the past few decades thereby reducing mortality in the golden hour. However, challenges remain, and one such area is maxillofacial injuries in a polytrauma patient. Severe injuries to the maxillofacial region can complicate the early management of a trauma patient owing to the regions proximity to the brain, cervical spine, and airway. The usual techniques of airway breathing and circulation (ABC) management are often modified or supplemented with other methods in case of maxillofacial injuries. Such modifications have their own challenges and pitfalls in an already difficult situation.

Key Words: Airway management, bleeding, emergency care, facial injury

INTRODUCTION

Maxillofacial injuries are frequent cause of presentations in an emergency department. Varying from simple, common nasal fractures to gross comminution of the face, management of such injuries can be extremely challenging. Injuries of this highly vascular zone are complicated by the presence of upper airway and proximity with the cranial and cervical structures that may be concomitantly involved. While, with non maxillofacial injuries, a protocol for management of airway, breathing, and circulation is relatively well established; injuries to this region have often been a subject for discussion. We present an overview of the initial management of such patients in terms of airway, cervical spine, and circulation. The challenges and controversies in the management of such patients are discussed.

AIRWAY

The first and foremost maxillofacial injuries are usually complicated by a compromised airway. On account of its location in the “crumple zone” of the face, even minor injuries can result in significant casualty to the airway. The situation may be aggravated by diminished consciousness, alcohol, and/or drug intoxication, as well as altered laryngeal and pharyngeal reflexes, making the patient vulnerable to the risk of aspiration. Furthermore, this scenario is complicated by the presence of broken teeth, dentures, foreign bodies, avulsed tissues, multiple mandibular fractures, and massive edema of glottis which can cause a direct threat to the airway. Alcohol, drugs, and head injury along with ingested and pooled blood can trigger nausea and vomiting. The act of vomiting prompts a rise in intracranial tension which in turn increases the bleeding.

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and salivation that occludes the airway. Vomiting and risk of aspiration are particularly high when patients are in supine position. Technically speaking, in patients with multiple facial fractures, the displacement of maxilla or mandible posteriorly can decrease the airway patency\[1\] [Figures 1 and 2]. Although of less frequency, injuries to larynx and trachea can also create airway embarrassment.

**MANAGEMENT**

Despite recent major medical advancements, the basic fundamental of airway management remain the same. Upper airway obstruction due to craniomaxillofacial trauma invariably results in a threatened airway. The potential concomitant injury to other organs and the presence of an unclear C-spine further complicates airway management. A variety of airway handling techniques are currently available. However, nothing is a fool proof and should be tailored according to a particular situation depends on the magnitude and type of the injury. Supervision of an emergency situation like this demands the experience and technical skills of the emergency operator and he or she should always prognosticate airway obstruction and be qualified enough to perform a surgical airway.

**Initial assessment**

The strategy of look, listen, and feel helps to figure out airway obstruction and anticipated airway complications.\[2\] The airway management approach, particularly in unconscious trauma patients should be complimented with the protection of C-spine. In high-velocity trauma which involves the mandible, swallowing mechanism is altered due to pain and ineffective protective reflex modulation, results in difficulty to keep the airway clear.\[3\] Hence, it is important to protect the airway from blood and vomitus to prevent aspiration and further pulmonary complications. The palpation of trachea reveals any collapse or deviation. Larynx should be auscultated for stridor. The presence of any tracheal tug or laryngeal stridor explains an impending threat to the airway. The “difficult intubation” tray should be accessible all times with complete equipment to deal with, namely tracheal tube introducer, supraglottic airway devices, combitubes, endotracheal tubes, tracheostomy set, and craniotomy kit.\[4\] When management by conventional definitive airway is less likely, it is prudent to have an experienced team at hand for establishing rescue surgical airway.

Strictly speaking, irrespective of the injury, maxillofacial trauma patients should be given adequate oxygenation with uninterrupted saturation monitoring. The spinal collars should be applied with extreme caution to prevent any inadvertent posterior displacement of mandible thus complicating airway. Contrary to other polytrauma, the airway of maxillofacial patient is at constant risk. Hence, the strategy is a systematic analysis of the airway as delayed airway compromise may occur due to the displacement of tissue, bleeding, and swelling.\[2\] High-volume suction should be available to clear the mouth and oropharynx from blood and secretions.\[5\] However, care should be taken not to irritate the oropharynx with suctioning as it predisposes the patient to vomiting. In addition, careful monitoring of patient at this instant shall provide an idea about the response of protective reflexes such as gagging and swallowing. Oropharyngeal guedel can be used effectively, once airway is clear. However, the placement of guedel itself induces retching, laryngospasm, and often displaces the tongue posteriorly thereby further aggravating airway. In the absence of any protective reflex, emergency endotracheal intubation is the rule. In patients with a patent airway and absent spontaneous breathing, bag-mask ventilation is the procedure of choice. A tightly fitted mask with concurrent jaw thrust is often enough to maintain ventilation. Nonetheless, obese patients and patients with beard possess problems thus reducing the effectiveness of ventilation. Preferably, mask ventilation in trauma patients should be a “two-person technique,” one holding the mask tightly fitted to mouth and the other operating the bag. Similarly, adjunctive airway maneuvers such as chin lift and jaw thrust should be performed with care. Head tilt and “sniffing the morning air” positions are absolute contraindications in case of suspected C-spine injury. In patients with suspected C-spine

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**Figure 1:** Posteriorly displaced bilateral parasymphyseal mandibular fracture can complicate the airway

**Figure 2:** Airway in severely comminuted midface fracture can be challenging to manage
injury, the management protocol is to keep the patient supine to further reduce C-spine morbidity as well as immobilizing the cervical spine using hard cervical collars. Such collars may reduce visibility to the oropharynx that may be of considerable importance. Unfortunately in this scheme, the question to be answered is how effectively a trauma team can intubate the patient? On this account, a study reveals that trauma patients present with noisy or clogged airways. The unsuccessful intubation rate is an alarming 12%. While in a study by Martin et al., out of 3423 emergent intubations performed, 10.3% required multiple attempts and were classified as “difficult.”

Definitive airway
The concept of the definitive airway is maxillofacial trauma is probably much more important as compared to trauma to other body parts. The primary indications are given in Table 1. Conventional straightforward definitive airway options are orotracheal intubation, nasotracheal intubation, and surgical airway. Orotracheal intubation with the aid of laryngoscope is the most feasible and safest method of choice. However, if the C-spine is not clear, it is prudent to perform manual axial in-line stabilization during orotracheal intubation. Although evidence in literature imparts that some cervical movement is inevitable, oro-tracheal intubation is comparatively safe in an unclear cervical spine. It is easier to perform, quick and causes minimal mobilization of the cervical spine in skilled hands. In severe avulsive facial injury or in laryngeal or tracheal collapse, placement of orotracheal tube is challenging, and surgical airway is the choice. Nasotracheal intubation is another effective alternative and can be achieved in patients without comminuted midface or skull base injury. This is of particular importance in managing airway obstruction due to lower face injury and suitable for patients in which the mouth opening is inadequate. The methods are of two types either blind or fiberoptic assisted. The traditional blind technique by a trained professional is quick, effective and does not need premedication. The enthusiasm toward fiberoptic technique, on the other hand, is limited by the presence of copious secretions or blood in the airway, technique sensitivity, and increased time required. Similarly, laryngeal mask airway (LMA) and combitube, although not a definitive one, are alternatives to a failed or difficult intubation. These devices purchase time by bridging the airway until a definitive airway is achieved. However, it does not protect the airway from regurgitation and aspiration. Little expertise required and easy placement allow the combitube to be used blindly in emergency or in prehospital settings. However, its use in patients with altered anatomy as in complex maxillofacial trauma may cause injury to the trachea, larynx, and esophagus when not properly placed. Although suggested, retrograde intubation through cricothyroid puncture is very time-consuming and required expertise. Hence, it is of limited use in emergency. During airway maintenance technique, the manipulation of cervical spine should be kept minimal and whatever method you follow, always remember the dictum “to do no further harm.”

When noninvasive techniques for securing airway fail, the surgical airway is the only available option. They are of two types: Cricothyroidotomy and tracheostomy. The cricothyrotomy is the most convenient method in emergency and can be performed by needle (needle cricothyrotomy) or by surgical scalp (surgical cricothyrotomy). Although some schools advocates needle cricothyrotomy, its standard use is debatable. The failure rates and insufficient oxygenation precludes it use, and surgical cricothyroidotomy is the pertinent method of choice in emergency. Tracheostomy in most of the cases is performed as an elective procedure, once the patient is stabilized by cricothyrotomy. Despite percutaneous tracheostomy claims to reduce the operative time and surgical risks in good hands, its routine use is not indicated in emergency.

Protocol for airway management in maxillofacial trauma
- Anticipate and recognize an airway obstruction
- Clear the airway, position the patient. Perform chin lift and jaw thrust maneuver
- Confirm the nasal and oral aperture are clear then use artificial airways and
- Perform bag-valve-mask ventilation. Preferably “two-person technique”
- Oroendotracheal intubation
- In unsuccessful orotracheal intubation or “cannot ventilate cannot intubate situation” perform surgical airway [Figure 3].

Controversies and pitfalls
In the management of airway, the most important perspective is to facilitate a patent airway and protect the airway from saliva, blood, and full stomach. It varies from the simple tactic of patient positioning to complex surgical procedures depend on the degree of injury and propensity of anticipated airway obstruction. The effectiveness of the jaw thrust maneuver in multiple fractures, especially in comminuted mandible fracture is debatable. Apart from having only a finite potential to enhance the airway, the traction movements employed in this method further increases the likelihood of bleeding and associated damage. Likewise, bag-mask ventilation is potentially hazardous, especially in Le Fort II, III, and nasoethmoidal fracture with suspected fracture of the anterior cranial fossa. Mechanical ventilation to maintain the oxygen saturation carries the risk of forcing infectious material into a basilar skull fracture and displacing nasal debris and foreign particles into the brain. The fear of tension pneumocephalus particularly when there is a tear in dura, by this route of ventilation, is not well known among

Table 1: Indications for definitive airway

| Indications of definitive airway in maxillofacial injury |
|-------------------------------------------------------|
| Absent spontaneous breathing                            |
| Comatose patient (glasgow coma scale <9)                |
| Airway injury or obstruction                            |
| Persistent oxygen saturation <90%                       |
| High-risk for aspiration                                |
| Systemic shock (systolic blood pressure <80)            |

"Cannot ventilate cannot intubate" situations
emergency clinicians. This is a life-threatening condition and can cause rapid deterioration of Glasgow Coma score (GCS) and late neurological problems. Although endotracheal intubation is the gold standard definitive airway, one of its potential drawbacks is difficulty in assessment of GCS. Extensive edema of the glottis and retropharyngeal hematoma from fractured spine complicated the use of orotracheal intubation. The nasotracheal intubation is generally contraindicated in patients with comminuted midface fracture due to the fear of iatrogenic penetration of tube via fracture of associated skull base. In a study by Rosen et al. on 82 patients with midface fractures, no incidence of such tube penetration was noted. The authors noted that this potential complication is a matter of concern only in central anterior skull base fractures. Similarly, only three cases of iatrogenic intracranial displacement have been reported in literature. Thus, nasotracheal intubation in not an absolute contraindication in maxillofacial trauma; in fact, it may be the preferred mode of intubation in conscious patients since this need not require neck manipulation or premedication for sedation and muscle relaxation. Failure to perform endotracheal intubation necessitates the use of supraglottic devices (LMA) until a definitive airway is maintained. These devices do not seem to prevent aspiration and are likely to exaggerate gagging, airway resistance, and oropharyngeal decubitus effect. A patient with laryngeal injury is also an absolute contraindication for LMA.

Cricothyrotomy on the other hand, having an airway apparatus that is adjacent to a surgical field could possibly cause wound contamination and cut down access while definitive repair of maxillofacial trauma is carried out by an extra oral route.

A meta-analysis by Hubble et al. has shown that the success rate of needle cricothyrotomy is 65.8% and surgical cricothyrotomy is 90.5% when performed in emergency. Despite the popularity of percutaneous tracheostomy in the last few years, there is no scientific evidence that the closed technique is superior or easier than the standard tracheostomy in emergency. A semi-open tracheostomy is an innovational alternative in patients with C-spine injury and nonpalpable trachea. This is achieved by performing a 2–3 cm skin incision to expose the pretracheal fascia and subsequently by a percutaneous method.

CERVICAL SPINE AND MAXILLOFACIAL TRAUMA

In a complex maxillofacial trauma scenario, cervical spine fracture should always be considered unless proven otherwise. The incidence is very less and ranges from 1% to 10% in all maxillofacial trauma. Because of the proximity of cervical spine any force of such magnitude that causes facial fractures can potentially traumatize the c-spine and its ligamentous attachments.
The clearance of cervical spine consequent to an injury is an area of much debate and discussion. Clinical awareness about the status of cervical spine is achieved using the most commonly used three evidence-based decision protocols, namely Nexus criteria, Canadian spine rule, and Harborview criteria. In patients who are awake, clearance protocol can be effectively implemented by a detailed clinical examination; however, in an unconscious patient, it is not possible. The clearance of such patients hinges on clinical examination, risk, and radiographic examination such as noncontrast computerized tomography, static flexon extension radiography, magnetic resonance imaging, and dynamic fluoroscopy. Generally, without the adjunct of radiographic survey, the patient can be excluded from spine injury if they display the following:

- Patient with perfect neurological condition. (normal GCS)
- Not under the consequence of drugs (alcohol, others)
- Absence of pain/tenderness in posterior midline of cervical spine
- Devoid of distracting, painful impairments.

However, there is a continuing debate about the credibility of these clinical protocols in C-spine without the aid of radiographic assessment. In a neurologically unstable patient, the cervical spine must be immobilized irrespective of the injury. The universally accepted method of C-spine management includes hard collars, block and straps, and manual axial inline stabilization. These management methods are rather emotional and lack adequate scientific basis, especially in conscious patients. However, the generally accepted fact is that the application of collar protects and stabilizes the cervical spine temporarily until definitive management is done. The cervical collar should be applied by an experienced person or a person trained to do that. It should be snugly fitted to aid immobilization and while applying care should be taken not to compress the neck. Improper applications of collars are implicated in airway obstruction and perhaps rise in intracranial pressure by affecting the venous return from the brain. This complicates head injury and increases the cerebrospinal fluid leakage form skull base fractures and creates problems during operative repair of maxillofacial injuries.

The misconception trailing spinal immobilization following trauma described by Benger et al is as follows:

- Injury to cervical spine is a potential complication in trauma patients
- Additional movement of cervical spine after trauma causes supplementary damage to C-spine
- The wearing of cervical collars helps in immobilization and stabilizes C-spine
- As a safety measure, it can be applied to all patients since it is “harmless.”

Trauma patient may have an unstable spine injury. However, the incidence is low (1.7%), of which only 0.1% shows significant neurological problems. Hauswald et al found no convincing differences in neurological events in a study comparing two countries, in which one follows strict spinal immobilization and one not in 454 patients. It can conclude that in trauma the initial impact may cause spinal injury, however, careful movement or handling the neck is unlikely to cause further harm. In addition, even in case of undiagnosed injury, that muscle splinting and pain is the best restraint and is excellent or superior to any externally applied devices. Conscious patients find an appropriate stable position which is most befitting for their particular type of injury. Application of cervical collar is logical in patients those who are incapable of protecting their spine as in an unconscious patient or patient under the leverage of drugs. It is also sensible when the general status of the patient is declining, or the management of patient requires sedation and anesthesia. Nevertheless, a perfectly applied collar by trained personnel allows a minimum 30° of flexion/extension/rotation movement of the neck. Ben-Galin et al has shown there is an average 7.3 mm of hyperextension between C1 and C2 while wearing a collar. Another cadaveric study quoted that significant amount of movement occurs to C-spine while placing and removing of collars. If it is so, studies have proved that a sandbag will offer better protection and immobilization than a rigid collar. Furthermore, the cervical collar has been associated with a number of disadvantages that include reduced access for orotracheal intubation, central venous access, increased intracranial pressure, and problems with surgical management of maxillofacial trauma. Thus, collar we use in the emergency department or prehospital setting may neither provide any benefit nor protection against secondary injuries. There is no scientific evidence for that. Nonetheless, the practice of using a cervical collar is recommended by us taking into account of the fact that all emergency departments and prehospital conditions may not be optimally equipped ideal for a careful and convenient transit.

**CIRCULATION AND HEMORRHAGHE CONTROL**

After the acquisition of airway and addressing breathing problems, attention must be given to circulation. Maxillofacial injuries are very prone to massive hemorrhages, and life-threatening hemorrhage can vary from 1.4% to 11%. One out of every ten complicated facial fractures bleeds significantly. The main vessels involved are an ethmoid artery, ophthalmic, vidian branch of internal carotid, and maxillary artery. In most cases, bleeding can be are easily controlled, but rarely severe epistaxis that ranges from 2% to 4% of all facial trauma arises from the maxillary artery, creating difficulty in hemorrhage control. It is important to differentiate bleeding from the skull base fracture and oral bleeds by careful observation of pharynx for lacerations and tears. Patients with multiple maxillofacial injuries must be taken care. Otherwise, they will go into hemorrhagic shock even though only 1.4% such cases have been reported. In the supine position, bleeding into oropharynx and swallowed blood in a conscious patient may cause vomiting thus, risking the C-spine. Hence, the purpose of hemostasis in maxillofacial trauma patient, is two-fold, namely to protect the airway, and to reduce blood loss.
Control of hemorrhage can be achieved by pressure packing, manual reduction of fractures, balloon tamponade, and in severe cases with angiography followed by trans-arterial embolization or in some cases with direct external carotid artery (ECA) ligation [Figure 4]. Severe nasal bleeding may continue even after adequate anterior and posterior nasal packing [Figure 5]. Sakamoto et al. found that Foley’s catheter balloon tamponade and ECA ligation does not respond in 72.2% of epistaxis. Balloon tamponade should be used with caution in comminuted midface fracture since it may cause displacement of fractured fragment into orbits and brain. The effectiveness of surgical exploration and ECA ligation particularly in cases of nasoorbital ethmoidal fracture are proven ineffective due to superfluent collaterals from the internal carotid artery at this region. In uncontrolled bleeding that does not respond to noninvasive methods, angiography and selective embolization of bleeder is the method of choice. Nevertheless, the use of trans-arterial embolization in managing epistaxis is not favored by many authors except in firearm injuries on the area of anastomoses of external and internal carotid system. However, these anastomoses have an increased risk of passage of embolic material into the brain causing serious neurological problems. The complications of selective embolization have been reported in 50% population, which includes seventh nerve palsy, trismus, necrosis of tongue, blindness, migration of emboli into internal carotid, and eventually a stroke. Once bleeding is controlled maxillofacial injuries not always require early correction. Two large bore IV lines should be placed for replacing fluid loss; similarly, exclude other concealed bleeding from the thorax, abdomen, and vascular injury of other vital organs. Coagulopathy if any should be corrected. Temporary stabilization of patient allows for any further resuscitation, clinical and radiographic investigations, and definitive care.
CONCLUSION

The gravity of all maxillofacial injuries lies in the fact that they pose an immediate threat to life as a consequence of its proximity to both the airway and brain. All the same, each case is unique; thus, the management is exacting even for the most experienced of professionals. In any given scenario no treatment approach can be described as being sure and flawless. The need of the hour is a multipronged approach requiring a partnership between several departments. While new technology and material developments have helped ease the situation, it is the timely intervention, sheer skill, and presence of mind of emergency personnel, and surgeons that counts.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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