



Short Communication

Air evacuation of patients with maxillofacial injuries

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ABSTRACT

The facial region is a complex skeletal structure with the facial musculature forming a curtain around the four apertures, namely the orbital, nasal, auditory, and oral cavities. The area demands significance in view of the portal of entry for the airway, and any traumatic affliction may compromise the outcome for survival, especially in a polytrauma patient. Gunshot wounds (GSWs) and improvised explosive device blasts involving the facial region at forward combat zones necessitating aeromedical evacuation make it pertinent to understand the importance of airway compromise in such cases. With the increase in the incidence of road traffic accidents, more so in inebriated states, the quick evacuation to a tertiary care center for early initiation of definitive care is imperative for successful management by the trauma team. The decision for emergency air evacuation of a facial injury patient is to be seen in the light of airway compromise with the presence of life-threatening debilitation as in severe head injury or poly trauma involving extremities or abdominal injuries. In the eventuality of air evacuation being the only option for transfer as in a forward base at hilly terrain with no motorable roads or from an island base, there is no absolute contraindication except in conditions of extended Le Forte III or IV mid face fractures with anterior or middle cranial fossa fracture and cerebro spinal fluid (CSF) rhinorrhea or otorrhea, with a possible impending danger of air escape into cranial cavity. Air evacuation exposes the vulnerable patient to some peculiar situations attributable to the ill effects of pressure, altitude, sound, air turbulence, and the special aerial environment of flight. It would be pertinent to ascertain the attributes of configuration of the aircraft type, flight duration, expected cabin pressure, and altitude as well as the onboard facilities while considering a probable patient as a candidate suitable for air evacuation.

Keywords: Aeromedical evacuation, Airway compromise, Maxillofacial injuries

INTRODUCTION

The facial skeleton poses a unique complex conglomerate of multiple facial bones with a curtain of facial musculature around the four apertures, namely orbital, nasal, auditory, and oral cavities with cutaneous and mucosal lining around the proximal antero-superior respiratory tract, deglutition arrangement as well as the special sensory apparatus of touch, taste, vision, and smell. Being the most prominently exposed portion of the body, the facial region demands significance in view of the portal for the entry of the airway; any gross disruption due to trauma may compromise the outcome for survival, especially in a polytrauma case. With the increase in the incidence of road traffic accidents, more so in inebriated states as also improvised explosive devices (IEDs) blast injuries, gunshot wounds, accidental falls, equipment-related industrial injuries, sports-related injuries, physical human altercations and battery, the quick evacuation to a tertiary care center for early initiation of definitive care is imperative for successful management by the trauma team. The decision for emergency air evacuation of a facial injury patient, especially in combat zones, is to be seen in the light of the presence of life-threatening debilitation as in severe head injury

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or polytrauma and traumatic shock involving extremities or abdominal injuries.

METHODS

Aeromedical evacuation is often undertaken in a wide variety of emergency clinical situations and such occurrences may go unnoticed due to a lack of documentation. However, comprehensive record maintenance and data archiving of such events have paved the way for derivations to learn from experience to optimize care on air. The initiative to get a systematic review of reports of aeromedical aspects in casualty evacuation (CASEVAC) in general and with respect to maxillofacial trauma cases in particular was undertaken with a search on the open-source medical net literature using the same terms. The search yielded multiple records for both the lead search terms, which were segregated and carefully chosen based on the relevance and appropriateness to cover the topic comprehensively.

REVIEW

The oldest ever record of wounded casualties' evacuation by air transport was during the First World War, when an unmodified French fighter plane was used to evacuate Serbian patients. In 1917, a British air ambulance evacuated an injured soldier with a broken ankle from the camel corps in Turkey, who would have taken 3 days by land transport.^[1] During the Korean war, tactical CASEVAC was introduced using a rotorcraft; however, expansion and refinement of medical care during evacuation by both civil and military organizations were seen during the Vietnam war.^[2]

A total of 7056 patients were moved on the C-9A Nightingale on an "urgent" or "priority" basis during the period 01 July 1969–30 June 1974 in the United States of America. A monthly average of almost 21 C-9A was launched in support of a request for urgent airlift. The domestic aeromedical evacuation missions were highly efficient, successful, flexible, and productive yet inexpensive in comparison with other means of evacuation with continuous medical care. Aeromedical evacuation system necessitated a precedence for the pickup and movement of casualties. Needless, expensive, and hazardous flights could be avoided when the patient is thoroughly evaluated and the urgency for flight movement is established.^[3]

Aeromedical evacuation of critically injured patients has evolved over the years and is now within the realms of reality from difficult terrain as in helicopters to even very long-haul transoceanic flights in dedicated fixed-wing air ambulances. The rendering of continuous in-flight critical care is invariably associated with challenges due to the

peculiar aerial environment. The medical devices and equipment accompanying the patient are deemed to be tested for airworthiness for both safety and effectiveness in the aerial environment well before deployment for flight. The aeromedical evacuation team is trained to deliver the best practice and quality of care to the patient and mitigate the constraints posed by the adverse aerospace environment.

The common stressors encountered during flight such as hypobaric environment, decreased partial pressure of oxygen, turbulence, vibration, changing temperatures, and low humidity affect the medical care during aeromedical transportation of a patient with maxillofacial injuries.^[4]

Even though aeromedical evacuation of critically ill patients has been frequently reported with long-term, multicentric studies reporting the peculiarities and difficulties, there is no special mention of maxillofacial injury CASEVAC in particular. The Royal Centre for Defence Medicine (RCDM) since its inception in June 2001 at Birmingham University Hospitals National Health Service Foundation Trust has actively managed most military personnel Royal British Forces who had sustained maxillofacial injuries while serving at operational locations on foreign soil. Analysis of all recorded cases of maxillofacial injuries evacuated to RCDM between June 2001 and December 2007 was undertaken retrospectively. A total of 119 personnel with maxillofacial injuries were evacuated during that period by air to RCDM for treatment, 83% of whom were injured in Iraq or Afghanistan.^[5]

AEROMEDICAL DECISION-MAKING

The head-and-neck region of a combatant in a hostile operational combat theater is extremely vulnerable to combinations of blunt and penetrating injuries. GSW and IED blasts involving the facial region at forward combat zones necessitating aeromedical evacuation make it pertinent to understand the importance of airway compromise in such cases [Figure 1]. Since the exposed portion of the face makes direct contact with explosive injuries, there is high vulnerability to encounter ocular injuries, complex facial bone fractures and ghastly deep cut lacerations, and burns. The impending danger in most maxillofacial injury cases is airway compromise due to excessive hemorrhage from the highly vascular facial tissues into the oropharyngeal region, profuse inflammatory swelling, and loss of bony skeletal structural integrity. Primary management of such severe maxillofacial injuries involves securing the airway and controlling the hemorrhage and concurrently protecting the brain, cervical spine, and eyes from further injury [Figure 2]. Secondary survey is carried out once the airway and bleeding are controlled for identification and preliminary management of associated additional injuries.

Early prompt effective airway control and stabilization is vital in the overall management of any casualty with severe facial trauma, especially in operational field combat situations. It is the most important clinical skill to be acquired by emergency trauma healthcare responders, and often, the difference between life and death takes precedence over other clinical considerations.

The approach to the management of casualties with blunt trauma to the head-and-neck region is fundamentally different, typically requiring standard spinal immobilization during initial airway management. On the contrary, casualties with severe penetrating and disruptive injuries to the head-and-neck region pose significant airway visualization challenges with the primary focus of the

emergency resuscitation team channelized toward securing the patent airway. Identification of the presence and adequacy of breathing irrespective of consciousness is an integral part of the initial casualty management algorithm through inspection, auscultation, and palpation, popularly known as the look, listen, feel maneuver. Airway patency being compromised may be elicited by looking for the presence or absence of speech, gurgling sound due to fluid in upper airway, snoring due to partial obstruction of upper airway by posterior falling back of tongue at pharyngeal level, hoarseness of voice suggestive of obstruction at laryngeal level, stridor due to partial blockage at either at the laryngeal level called as inspiratory stridor or at the tracheal level known as expiratory stridor, foreshortening of the lower airway causing wheeze or aphonia. Spontaneous swallowing of secretions indicates that the patient's airway protection mechanisms are intact which may be compromised in an unconscious patient wherein the absence of the gag reflex is due to loss of protective airway reflex.

Preparation of a patient with maxillofacial injuries for aeromedical transportation revolves around securing and maintaining a patent airway. The basics of emergency trauma care of advanced trauma life support need not be overemphasized; however, keeping in view of the threat to airway, attention to detail in primary survey and resuscitation by the clinician should be systematic and meticulous. The nasal and oropharyngeal airway has to be secured and free from obstructions. A Guedel's airway mouth gag is a handy tool to keep the jaws apart and give access for thorough suctioning of the oral cavity and clearing the airway. When there is gross disruption and posterior displacement of mid-symphyseal segment (Andy Gump deformity), the rollback of the tongue can be prevented by taking a thick needle bite of the body of the dorsum using a heavy silk and pulling it out to secure it to the chest, thereby keeping the airway patent. When the mandible is split in the midline with or without bilateral condylar fracture, the split ends with the incisors may be fastened with a heavy-gauge nylon thread or 26-gauge stainless steel wire, preventing the collapse of the tongue.

Maxillomandibular or intermaxillary fixation is a routinely undertaken jaw stabilizing procedure to immobilize facial fractures involving the dentate portion of the jaws. Interdental wiring, arch-bar fixation, and custom-made splints secured by tie wires over existing teeth are methods achieving optimum functional approximation of the teeth in centric occlusion and thereby indirectly reducing the fractured bony fragments. The inherent risk of such a fixation is the impending danger of airway compromise and the risk of aspiration. If maxillomandibular wiring with arch bars tied to the teeth is *in situ*, it is best released during flight to prevent airway compromise. Intermaxillary fixation is depicted in Figure 3.



Figure 1: Gunshot wound lower face.



Figure 2: Primary closure and tracheostomy.



Figure 3: Interdental wiring.

Even though a ghastly looking severely lacerated or avulsed facial injury with extensive facial bone involvement may not per se pose a threat for life in an alert and conscious patient, an innocuous bleed from a broken dentoalveolar segment; aspiration of tooth/denture or foreign body; or even aspiration of oral fluids, vomitus, or blood in a comatose patient with head injury may lead to airway embarrassment. The facial bones, including the maxilla, mandible, zygoma, and palate, should be bimanually palpated to evaluate and detect disruption of the structural integrity of the facial skeletal pillars. Traumatic distortion of these anatomic entities leads to compromise or loss of patency of the airway, especially involving the midface or the classical Andy Gump fracture of the mandible, leading to posterior inferior displacement of the oropharynx, thus subsequently leading to airway obstruction. The maxilla invariably is posteriorly and inferiorly displaced in Le Forte I, II, and III mid-face fractures, which get all the more pronounced in a pan facial trauma where the symphyseal mandibular fracture carries the tongue posteriorly, thereby blocking the airway. The immediate intervention for securing and stabilizing the airway is imperative in such severe maxillofacial trauma, having high incidence of airway compromise. Endotracheal intubation (when feasible) or surgical cricothyroidotomy or submental intubation or even emergency tracheostomy are the mainstay in primary intervention for safeguarding the facial trauma victim's airway. Excess blood loss resulting from direct trauma to the highly vascular facial region mandates immediate measures to secure injured vessels or reduce fractured fragments to control hemorrhage. The immediate priorities of damage control, resuscitation, and surgery are undertaken after the airway is secured and active hemorrhage is controlled. Reconstruction by open reduction and rigid internal fixation by plate and screw osteosynthesis along with soft tissue repair can be delayed to a week to several days once the patient is deemed fit and stable from

the aftermath of hypovolemic shock and with respect to the general physiologic and neurologic condition in cases of associated severe head injury.

The ideal timing of primary intervention for facial fractures is within 24 h of the injury before any overwhelming inflammatory edematous swelling has set in. The definitive active surgical intervention may otherwise be deferred to at least 5–7 days later when the swelling would have subsided. In the eventuality of air evacuation being the only option for transfer as in a forward base at hilly terrain with no motorable roads or from an island base, there is no absolute contraindication except in conditions of extended Le Forte III or IV midface fractures with anterior or middle cranial fossa fracture and CSF rhinorrhea or otorrhea, with a possible impending danger of air escape into cranial cavity. Another situation which warrants attention is when combined with a suspected cervical spine injury where in overzealous manipulation of the neck for securing the airway may jeopardize the outcome and hence has to be with minimum manipulation, preferably with the cervical collar. An ideal situation would be a secure airway by nasal or oral endotracheal intubation and control of all active bleeds by pressure pack, tie sutures, or ligation of feeding vessels.

Even though traumatic disruption of the mucosal lining and overlying skin is commonly noticed associated with maxillofacial injuries, the rich vascularity permits early primary closure after appropriate wound debridement. Deep facial wounds sustained in combat or in road traffic accidents have to be thoroughly explored, debrided, and irrigated to remove possible foreign bodies, broken teeth, or prosthetic dentures. Tracheostomy may be considered for better airway management. Maxillofacial injuries complicated with burns involving the peri-orbita can lead to orbital compartment syndrome or even loss of vision which can be prevented in such suspected cases by undertaking early lateral canthotomy. Placement of simple intermarginal frost sutures between the eyelids with bolster dressings can aid in the protection of the cornea against corneal injuries and ectropion formation. Severely avulsed or compounded mandibular fractures are managed best by early stabilization of the shattered bony fragments with primary soft tissue coverage and closure in a minimum of two layers both intra and extra orally after adequate wound drainage, thorough debridement and delayed soft tissue and bony reconstruction with free or vascularized flaps and bone grafts may be required. The dictum mandated in early definitive initial management is thorough exploratory debridement, copious irrigation, repair of hard and soft tissue minimally introducing any foreign surgical material, and coverage of exposed bone with tension-free closure with administration of adequate broad-spectrum prophylactic antibiotic cover to decrease morbidity and improve outcomes.

Aeromedical evacuation in the armed forces is a system of providing continuous patient care during air transport between echelons of operational field locations and levels of definitive curative healthcare setups.^[6] Air evacuation may be undertaken on any critical patient requiring air evacuation to higher echelons of tertiary care; however, air transport exposes the vulnerable patient to some peculiar situations attributable to the ill effects of pressure, altitude, sound, air turbulence, and the special aerial environment of flight. The effects of changing altitude and pressure on a patient on a transport ventilator need to be calibrated by the accompanying critical care anesthetist. It would be pertinent to ascertain the attributes of configuration of the aircraft type, flight duration, expected cabin pressure, and altitude as well as the onboard facilities while considering a probable patient as a candidate suitable for air evacuation. While undertaking a planned aeromedical evacuation, all the drugs, fluids, diets, expendable, and non-expendable medical logistics should be planned for adequate stocking, keeping the container as simple, light, and portable as well as to ensure that the aeromedical evacuation team have comprehensive medical nursing skills to deal with possible onboard exigencies.^[7] Constant monitoring of vitals and oxygen saturation during flight and suctioning to clear blood and mucous secretions along the airway on board to ensure patency cannot be overemphasized. The hazards of hostile atmosphere with pressure and temperature gradients resulting from changing heights above the sea level, especially in high altitude mountainous terrain in non-pressurized air crafts or helicopters, are to be borne in mind in aeromedical transfer of pre-operative or post-operative surgical cases. Any decrease in pressure results in expansion, especially of air or gaseous accumulations entrapped inside body cavities, which holds increased significance at 5500 m or more, especially across the northern and eastern Himalayan range higher reaches and valley forward posts, when the volume of air or gas gets doubled. Such an expansion of entrapped gases at high altitude may pose real danger apart from the intense discomfort and pain wherein the probability of rupture of an associated recently sutured intestine or pneumothorax resulting in imbalance of the cardiopulmonary dynamics.^[8] The effect of barometric changes can also manifest in the paranasal air sinuses of severe facial trauma cases where the condition of a non-ventilated sinus may worsen causing tremendous pain, necessitating adequate pain relief with anesthesia.

Motion sickness is a relatively common phenomenon occurring among human subjects at varying degrees of underlying causative precipitating factors and manifestations. The commonest symptoms are nausea, pallor, cold sweats, and vomiting when exposed to unfamiliar motion stimuli, either real or apparent. The symptoms of motion sickness proliferate as a result of perceived discord in the integration

of conflicting positional cues in the brain's integrating centers. The conflict between vision, vestibular apparatus, and locomotion is an established phenomenon.^[9] Intermaxillary fixation of jaws with elastics or tie wires to immobilize fracture fragments may also precipitate motion sickness following restraint as a stressor in an already predilected patient due to the claustrophobic feeling. Pharmacological preparations such as scopolamine, promethazine, or antihistamines such as dimenhydrinate reduce symptoms when administered prophylactically before undertaking air evacuation.

RECOMMENDATIONS AND CONCLUSION

Aeromedical transfer of a maxillofacial trauma patient, especially from a forward operational combat zone, poses a considerable challenge to the medical evacuation team responsible for continuous medical care between originating and destination echelons of medical care. In a patient with maxillofacial injuries when air evacuation is mandatory, control of a patent airway needs to be established with frequent suctioning. Immobilization of the jaws with wiring or elastics is best avoided to prevent aspiration in case of vomiting. The other possible stressors of air evacuation such as barometric changes and motion sickness are managed with appropriate premedication. To summarize, the effort of air evacuation of casualties with maxillofacial injuries is a challenging exercise in view of the potential airway compromise encountered, and the outcome is successful with efficient primary management on site and meticulous planning before undertaking the task.

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REFERENCES

1. Martin T. Aeromedical transportation: A clinical guide. 2nd ed. Hampshire: Ashgate Publishing Company; 2006. p. 4.
2. Morley GE. Aeromedical casualty evacuation. *Proc R Soc Med* 1967;60:232-4.
3. Johnson A Jr, Cooper JT, Ellegood FE. Five-year study of emergency aeromedical evacuation in the United States. *Aviat Space Environ Med* 1976;47:662-6.
4. Joshi MC, Sharma RM. Aero-medical considerations in casualty air evacuation (CASAEEVAC). *Med J Armed Forces India* 2011;66:63-5.

5. McVeigh K, Breeze J, Jeynes P, Martin T, Parmar S, Monaghan AM. Clinical strategies in the management of complex maxillofacial injuries sustained by British military personnel. *J R Army Med Corps* 2010;156:110-3.
6. Cornelius M. Care in the air: Bringing the wounded closer to home. *Plast Surg Nurs* 2009;29:165-8.
7. Johnson A Jr. Treatise on aeromedical evacuation: II. Some surgical considerations. *Aviat Space Environ Med* 1977;48:550-4.
8. Oxer HF. Aeromedical evacuation of the seriously ill. *Br Med J*. 1975;3:692-4.
9. Rainford DJ, Gradwell DP. *Ernsting's aviation medicine*. 4th ed. London: Hodder Arnold; 2006. p. 645.

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