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Facing the airway challenges in maxillofacial trauma: A retrospective review of 288 cases at a level i trauma center

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Abstract

Background: Maxillofacial trauma is an apt example of a difficult airway. The anesthesiologist faces challenges in their management at every step from airway access to maintenance of anesthesia and extubation and postoperative care.

Methods: A retrospective study was done of 288 patients undergoing surgery for maxillofacial trauma over a period of five years. Demographic data, detailed airway assessment and the method of airway access were noted. Trauma scores, mechanism of injury, duration of hospital stay, requirement of ventilator support were also recorded. Complications encountered during perioperative anaesthetic management were noted.

Results: 259 (89.93%) of the patients were male and 188 (62.85%) were in the 21-40 year range. 97.57% of the cases were operated electively. 206 (71.53%) patients were injured in motor vehicular accidents. 175 (60.76%) had other associated injuries. Mean Glasgow coma scale score (GCS), injury severity score (ISS) and revised trauma score (RTS) were 14.18, 14.8 and 12, respectively. Surgery was performed almost nine days following injury. The mean duration of hospitalization was 16 days. ICU admission was required in 22 patients with mean duration of ICU stay being two days. Majority of patients had difficult airway. 240 (83.33%) patients were intubated in the operating room and fibreoptic guided intubation was done in 159 (55.21%) patients. Submental intubation was done in 45 (14.93%) cases.

Conclusions: Maxillofacial injuries present a complex challenge to the anaesthesiologist. The fibreoptic bronchoscope is the main weapon available in our arsenal. The submental technique scores over the time-honored tracheostomy. Communication between the anaesthesiologist and the surgeon must be given paramount importance.

Key words: Difficult airway, fibreoptic intubation, maxillofacial injury, videolaryngoscopy, submental intubation, tracheostomy

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INTRODUCTION

According to the World Health Organization, injuries are the cause of death of more than 5 million people worldwide annually equivalent to 9% of global mortality.[1] It is expected that by 2020, trauma will become the third largest cause for mortality in the developing world. In India, a trauma related death occurs every 1.9 min. India loses 2-2.5% approximately, of its GDP to road traffic injuries alone. The mortality associated with severe trauma (Injury Severity Score [ISS] >16) in developing countries is 6 times higher than in the developed world. With ever increasing high speed vehicular traffic, low compliance of traffic rules and inadequate infrastructure, India faces a 3% increase, annually, in road traffic accidents.[2]

Motor vehicle accidents, assaults, sports, accidental falls and work-related accidents account for the majority of maxillofacial injuries.[3] A patient with maxillofacial trauma is a disconcerting site in the emergency room. He or she may be covered in blood and have distorted features that may divert the attention of the treating doctor. The injury may be isolated or may be a component of multiple injuries sustained by the patient.

The failure to intubate, secure or protect the airway has been found to be the leading cause of inpatient mortality in trauma related deaths.[4] Therefore, airway management is a life-saving step in the management of a trauma patient. Maxillofacial trauma, by definition, compromises the patient's airway.[5] The combination of the distorted anatomy, airway edema, soft tissue injury and restricted mouth opening present a complex challenge to the Anesthesiologist. Sharing the airway with the surgeon is the second challenge. Extubation is as challenging as intubation because of airway and soft tissue edema, wiring of the jaw and the presence of an anticipated difficult airway.

MATERIALS AND METHODS

In a retrospective review, 288 patients undergoing surgery for maxillofacial trauma at our level one trauma center over a period of 5 years, from January 2008 to December 2012, were studied. All patients underwent a detailed preanesthetic examination. Detailed airway examination was done which included assessment of mouth opening, dental status, modified Mallampati grade, thyromental and hyomental distances, and neck movements. Demographics, associated injuries and trauma scorings on admission were also noted.

The above details were collected after intensive perusal of patient hospital records. Only those patients, whose recorded data were completed and included in this study. We estimate that 5% of patient data were lost due to incomplete records.

Anesthetic management and intubation technique were planned according to the preoperative airway assessment, type of fractures and the surgical procedure to be done. The surgical requirements and presence of nasal or skull base fractures were the main deciding factors with regards to route of intubation, i.e. oral, nasal or submental. The preoperative airway assessment was a major factor in deciding the specific technique used viz. direct laryngoscopy, fiberoptic bronchoscopy (FOB) guided intubation (FOI) or video laryngoscopic guided intubation.

The surgical approach was discussed with the operating surgeon in the preoperative period. When an intraoral approach was to be used, the anesthetic technique was planned ensuring that the endotracheal tube (ETT) would not encroach upon the surgical field. The options open to us in this circumstance were nasal intubation, submental intubation and tracheostomy.

Premedication with antisialogogue dose of glycopyrrolate was given in patients planned for awake fiberoptic intubation. All these patients received ultrasonic nebulization with 4% lignocaine. Intranasal xylometazoline (0.1%) and lignocaine jelly were applied to those planned for nasal intubation. Gargles with viscous lignocaine (21.3 mg/ml) were done to anesthetize the pharynx. Patients received 10% lignocaine spray to attenuate posterior pharyngeal wall reflexes, if the gargling did not achieve optimal results. Bilateral superior laryngeal nerve and transtracheal blocks with 2% lignocaine were administered under aseptic conditions. Fiberoptic guided intubation was done as per the planned surgery. General anesthesia (GA) was induced with fentanyl (2 μg/kg), 1% propofol (2 mg/kg), with rocuronium or vecuronium for neuromuscular blockade once the tube position was confirmed. Anesthesia was maintained with a balanced technique using inhalational anesthetics, opioids and intravenous agents. Intraoperative analgesia was achieved with opioids administration.

In patients assessed to have an adequate airway, endotracheal intubation under GA was planned. Intubation was accomplished either with direct laryngoscopy, or video laryngoscopy guidance or supraglottic airway device assistance, if the oral route was planned. Nasal intubation was done under GA, with the help of Magill's forceps with either direct laryngoscopy or video laryngoscopy views. The overall procedure for induction and maintenance of anesthesia remained the same. Pediatric patients were induced under inhalational anesthesia with sevoflurane (4-8%), with oxygen and were maintained similarly. Flexometallic ETTs were preferred in all the patients. These reinforced kink-resistant tubes allow for the positioning of the tubes out of the way of the surgical field without increasing resistance and narrowing of the ETT that might occur with polyvinyl chloride ETTs.

The need for postoperative ventilator support was decided on the perioperative status of the patients, associated injuries, duration of surgery, airway and oral edema and the ability of the patient to maintain his airway. The patients in whom the decision to extubate was taken were reversed with neostigmine and glycopyrrolate. Extubation was performed, when the patient was fully awake, with intact airway reflexes and able to respond to commands.

Patients with extensive postoperative airway and soft tissue edema were electively mechanically ventilated till the edema was judged to have decreased. They were then extubated in the intensive care unit (ICU).

RESULTS

Two hundred and eighty-one of the cases were scheduled for surgery electively, and seven cases were operated on an emergency basis. 89.93% (259) of the patients were males. One hundred and eighty-one patients (62.85%) were in the 21-40 age group [Table 1].

We encountered a variety of facial deformities including all three varieties of the Le-fort fractures unilaterally and bilaterally, fractures involving the mandible, maxilla or both, the zygomatic complex and the nasal bones. Panfacial fractures also presented to us for surgery.

The most common cause of the injuries in our patients was motor vehicular accidents followed by accidental falls as depicted in Table 2.

One hundred and seventy-five (60.76%) of the patients had other associated injuries [Table 3]. The mean Glasgow Coma Scale score, ISS, Revised Trauma Score were 14.18, 14.8 and 12, respectively. The scoring was done in the emergency department (ED) upon admission at the center.

We found that most patients with maxillofacial trauma were admitted for definitive management of their injuries on day 5 after injury. Surgery was performed almost 9 days after admission and the average duration of hospital stay was around 16 days. The average duration of intensive care stay when required was about 2 days.

We received 240 (83.33%) of our patients in the operating room with their natural airway intact. Forty-five patients had already undergone tracheostomy in an ED, while three patients were received with oral ETT *in situ*.

The airway characteristics of our patients as per the preoperative assessments are described in Table 4. Majority of the patients had less than two finger breaths mouth opening and Mallampati score of 3 or 4. Dentition was disfigured in majority of them. Three patients had undergone wiring for malocclusion prior to being operated. Thus, most of our patients came under the description of anticipated difficult airways.

The airway management required in our patients is detailed in Table 5. One hundred thirteen (39.24%) of our patients were intubated awake with FOI. In 46 (15.97%) cases, FOI was done under GA. Sixty five (22.57%) of patients were intubated under direct vision. The submental intubation technique was performed in 14.93% i.e. 43 patients. Three patients required tracheostomy.

Table 1: Age distribution of patients with maxillofacial injuries

Age (years)	Number of cases (%)
0-10	9 (3.125)
11-20	60 (20.83)
21-30	123 (42.71)
31-40	58 (20.14)
41-50	24 (8.33)
51-60	9 (3.13)
>60	5 (1.74)

Table 2: Mode of injury in patients with maxillofacial injuries

Mode of injury	Total number of cases (%)
Motor vehicle accident	206 (71.53)
Fall	60 (20.83)
Assault	12 (4.17)
Gun-shot injury	7 (2.43)
Others	03 (1.04)
Total	288

Table 3: Associated injuries in patients with maxillofacial injuries

Associated injuries	Total number of cases
Head	46
Chest	31
Abdomen	26
Extremity	91
Vascular	5
External+others	24
Polytrauma	53
Nil	113

Table 4: Airway characteristics

	Number of patients
Mouth opening	
>3 FB	29 (10.01)
2-3 FB	67 (23.26)
<2 FB	144 (50)
Mallampati grade	
I	00 (0)
II	62 (21.53)
III	101 (35.07)
IV	77 (26.74)
Dentition	
Loose teeth	19
Intact	98
Buck teeth	3
Deformed	10
Broken	7
Missing	31
Wiring *in situ*	3

The average duration of surgery was about 3 h (196.21 min) with a range of 1 h to 8.5 h. The majority (75%) of our patients were extubated in the operating room. In the remaining 25%, the ETT or the tracheostomy tubes were not removed.

The mean duration of time for which the patients required intubation postoperatively was 2.2 days. Twenty two patients (7.64%) required postoperative ventilator support for a mean of 3.66 days. The overall mean duration of ICU stay required postoperatively was 2.1 days with a maximum stay of 24 days [Table 6].

Complications

The average blood loss in the surgeries performed was 262.42 ml though the range was wide (50–1000 mL). Only five patients (4.167%) required blood transfusion intraoperatively. Two patients developed hypertension intraoperatively that required nitroglycerin infusion for the control. One patient had bronchospasm, which resolved with aerosolized salbutamol, steroids and deepening of the depth of anesthesia. In the postoperative period, one patient had two episodes of vomiting. There were no delayed or late complications. We encountered one case in which the patient had airway obstruction due to surgicel left *in situ*. In one patient, the pilot balloon system was damaged during the submental intubation. Four patients required exchange of the ETT over the airway exchange catheter.

Table 5: Airway management in operating room

Airway status in OR	Number of patients (%)
Awake FOI	113 (39.24)
Oral	19
Nasal	94
FOI under GA	46 (15.97)
Oral	12
Nasal	34
Direct laryngoscopic guided intubation	65 (22.57)
Oral	26
Nasal	39
Oral converted to nasal	2
Video laryngoscopic guided intubation	13 (4.51)
Tracheostomy	3 (1.04)

FOI=Fiberoptic intubation, GA=General anesthesia, OR=Odds ratio

Table 6: Details of hospital stay in patients with maxillofacial injuries

	Average duration (days)	Range (days)
Between DOI-DOA	4.68	1-97
Between DOA-DOO	9.3	1-30
Between DOO-DOD	9.125	1-221
Hospital stay (mean)	15.86	2-142
ICU stay (mean)	2.1	0-24

DOI=Day of injury, DOA=Day of admission, DOO=Day of operation, DOD=Day of discharge, ICU=Intensive care unit

DISCUSSION

That trauma affects the young adult, wage earning, population,[1] is reflected in our study. Majority of our patients were in the 21-40 age group with a predilection for males. Maxillofacial trauma is associated with other injuries, especially when the cause is motor vehicular accident or a fall.[3,6] We found that extremity injuries were most commonly concomitant.

The inability to ventilate the patient may lead to considerable morbidity and mortality. In a study of 2594 trauma mortality patients, Gruen *et al*. found that failure to ventilate, secure or protect the airway was the most common factor related to patient mortality, responsible for 16% of inpatient deaths.[4] The patient with maxillofacial trauma can be difficult to mask ventilate. The reasons for this include the presence of blood, debris or vomitus, and secretions in the oral cavity, and distortion of the normal airway anatomy due to soft tissue edema and injury and underlying bone injury. The injury may prevent effective transmission of the air from the mask to the lungs.[5] For the same reasons, direct laryngoscopy and visualization of the vocal cords is challenging.

In emergency conditions, the possible presence of cervical spine injury cannot be ignored. Manual in line stabilization should be done, during airway access, in all patients in whom a cervical spine injury has not been ruled out.[7-9] The maxillofacial trauma patient is considered full stomach due to the presence of swallowed blood, putting him at high risk for aspiration. The advantages of evacuating the stomach must be weighed against the difficulty of putting a nasogastric tube in an uncooperative, confused and sometimes intoxicated patient and thus triggering vomiting.[5,10-13]

Most often, the patient with maxillofacial injuries comes to the operating room 4–7 days after sustaining an injury. Emergency management occurs only in the setting of threat to life or vision. Stabilization of the patient by maintaining a patent airway and hemodynamic status takes precedence over the definitive surgical management of the maxillofacial injury. In most cases, it is possible to wait for edema to resolve allowing for more precise evaluation to take place.[6,14] Some patients may require wiring of the jaw to as treatment for a malocclusion.[6] Furthermore, in most patients, an element of trismus is present.[15,16] This becomes important for the anesthesiologist because cases in whom trismus has been present for more than 2 weeks, some fibrosis may occur. This decreases mouth opening and may not resolve with anesthesia and muscle relaxation. This is an important factor in deciding the technique for intubation of the patient.[17]

We intubated 83.33% of our patients in the operating room. The majority of our patients fit the criteria for anticipated difficult airway. The American Society of Anesthesiologists practice parameters for the management of the difficult airway recommend FOI as a technique for airway access.[18] Fiberoptic bronchoscope guided intubation was performed in patients deemed to have an anticipated difficult airway on preoperative airway assessment. The awake technique is better tolerated, when the patient has had prior counseling, and the airway has been anesthetized. Benzodiazepines can be given to enhance patient cooperation by their anxiolytic effects. Though the learning curve for this technique is steep and the equipment fragile and expensive, fiberoptic guided intubation remains the most reliable tool in accessing the difficult airway.[19] The experience, knowledge and skill of the anesthesiologist are very important in ensuring a smooth procedure. The complications seen with FOB include pneumothorax, pulmonary hemorrhage and respiratory failure. Laryngospasm, vomiting, bronchospasm and episodes of vasovagal syncope have also been reported.[20] There was no major complication or failure to intubate in our study except for one case of bronchospasm which resolved with bronchodilator and deepening the anesthetic depth.

The video laryngoscope is the next option available to us in patients with a difficult airway. We used the C-MAC®. Karl-Storz for this purpose. Limited mouth opening, though, makes the insertion of the blade difficult. Blurred vision by fogging, secretions, blood, or vomitus can also be a cause for difficulty.[19] Operator experience and skill is not as major a factor as for fiberoptic guided intubations. In an editorial, Asai mentions that the causes of difficulty in intubation with a video laryngoscope and with laryngoscopy with a Macintosh blade have not been differentiated as yet.[19] Adequate mouth opening is necessary for the introduction of the Macintosh blade for conventional laryngoscopy. The incidence of failure of intubation is higher with direct laryngoscopy than with video laryngoscopy in a predicted difficult airway.[19,21] We have seen that relaxation of the masseter spasm after anesthesia and muscle relaxation improves the chances of successful direct laryngoscopy.

The choice between oral and nasal routes of intubation depends upon the surgical requirements, the presence of associated nasal and base of skull injuries. Many reports of disastrous consequences with blind nasotracheal intubation, nasopharyngeal airway and nasogastric tube insertion have been reported in patients with sphenoid sinus or cribriform plate fractures.[22-26] This complication can be avoided by intubating under vision with either the FOB or the video laryngoscope.[27] In patients with an adequate airway, the Magills' forceps can be used to guide the nasally introduced ETT into the trachea under direct laryngoscopy or video laryngoscopy views.

The tracheostomy is the definitive surgical airway access. It is a safe procedure, but the morbidity remains high. Hemorrhage, recurrent laryngeal nerve damage, subcutaneous emphysema, tracheal stenosis, and a cosmetically undesirable scar are the complications usually faced. With the option of the submental intubation available, the use of the tracheostomy can now be restricted to patients in whom long term postoperative ventilation is required or as a last resort in securing the airway. The tracheostomy allows for greater patient comfort, easy aspiration of tracheal secretions and a relatively easy reinsertion and better maintenance of oral hygiene.[27,28]

When the surgeon requires a clear intraoral field in a patient with contraindications to the nasal technique, we have found that the submental route to be an effective route instead of a tracheostomy [Figure 1]. Its advantages are that it is easy to perform and can be done within 10 min[29-32] leaves an aesthetic scar that is not easily visible. Sterility is ensured with unimpeded surgical access. There is minimal distortion of soft tissue. It allows dental occlusion. Motor and sensory damage is unlikely. Unlike tracheostomy, specialized postoperative care is not needed. It lessens hospital stay and is cost-effective.[28] Problems that may be encountered include difficulty in suctioning and increased airway pressure.[30] Damage to ETT can occur. It is not feasible for repeated operation and probable re-exploration. Submental intubation is also not feasible in a patient requiring postoperative ventilator support. Complications that have been reported include bleeding, desaturation, accidental extubation, endobronchial intubation and a chance of local infection, fistula, scar or mucocele.[3,28] The only complication we encountered was damage to the pilot balloon assembly, during the procedure requiring a repetition of the entier technique.

We preferred reinforced flexometallic ETTs in all our patients. These tubes are reinforced with a metallic spring, and therefore have a good shape memory, resist kinking and twisting. They remain patent even with

Figure 1: Submental intubation

acute angulations, so are ideal for maxillofacial surgeries especially, when the submental intubation is required.[29]

Postoperative patients of maxillofacial injuries are candidates for a difficult extubation. Airway and soft tissue edema in the immediate postoperative period are main factors for ease of extubation. We preferred to extubate the fully awake patient on the operating table, when he was able to maintain airway reflexes. While visualizing the vocal cords for edema is an option, it is not easy to perform due to the presence of the tube. Performing the cuff leak test prior to extubation provides the Anesthesiologist with an idea of the cord status. Patients with preexisting chest and lung trauma, traumatic brain injury and multiple associated injuries and those requiring jaw wiring for proper occlusion are unsuitable candidates for extubation. It is safer to adopt a more conservative approach with such patients and to extubate them in the ICU once their overall status is stable.

The postoperative care of such patients in the ICU includes regular assessment of the presence of airway edema, careful suctioning (oral and endotracheal), and the maintenance of good oral hygiene. Patients who have undergone maxillomandibular fixation after surgery must be carefully monitored for desaturation, significant dyspnea or severe nausea/vomiting. In these circumstances, wire cutters or scissors kept ready at the bedside can be used to cut the wires. It is very important to teach ancillary staff, which wires to cut because they will invariably, be the first responders in such emergencies.[33]

The use of steroids to decrease airway edema and post extubation stridor remains controversial. Kellman and Losquadro suggest considering steroids to decrease postoperative edema and improve respiratory status.[33] Studies, in which steroids were found to be useful in decreasing airway edema and post extubation stridor, have mostly been done in patients requiring intubation for more than 36 h and with multiple doses. Whether steroids help in the acute case and in the perioperative period, especially in surgery duration of less than 6 h, remains to be seen.[34-38]

CONCLUSION

Anesthetic management of the airway in a patient with maxillofacial injuries remains a challenge to the practicing Anesthesiologist. Only a miniscule number of patients will require urgent surgical intervention and majority patients will be operated electively. The advent of the fiberoptic bronchoscope has helped reduce the morbidity associated with the surgical airway. Addition of video laryngoscope in the airway equipment armamentarium is helpful in patients with anticipated difficult airway. The submental approach is a feasible technique to decrease the requirement of tracheostomy in such patients. Surgery is associated with minimal average blood loss. Good communication between the anesthesiologist and the surgeon is of paramount importance in providing the patient with the best anesthetic technique, with least discomfort and morbidity.

REFERENCES

1. WHO Injuries. Available from: http://www.who.int/topics/injuries/about/en/index.html [Last accessed on 2014 Apr 11; Last cited on 2014 Mar 11].
2. Indian Society for Trauma and Acute Care (ISTAC®). A Group for Advancement of Trauma Education and Research. Available from: http://www.traumaindia.org/traumainindia.htm. [Last accessed on 2014 Apr 11; Last cited on 2014 Mar 11].
3. Stewart C, Fiechti JF, Wolf SJ. Maxillofacial trauma: Challenges in ED diagnosis and management. Emerg Med Practe 2008;2:524-33.
4. Gruen RL, Jurkovich GJ, McIntyre LK, Foy HM, Maier RV. Patterns of errors contributing to trauma mortality: Lessons learned from 2,594 deaths. Ann Surg 2006;244:371-80.
5. Krausz AA, El-Naaj IA, Barak M. Maxillofacial trauma patient: Coping with the difficult airway. World J Emerg Surg 2009;4:21.
6. Koshy JC, Feldman EM, Chike-Obi CJ, Bullocks JM. Pearls of mandibular trauma management. Semin Plast Surg 2010;24:357-74.
7. Manoach S, Paladino L. Manual in-line stabilization for acute airway management of suspected cervical spine injury: Historical review and current questions. Ann Emerg Med 2007;50:236-45.
8. Santoni BG, Hindman BJ, Puttlitz CM, Weeks JB, Johnson N, Maktabi MA, *et al.* Manual in-line stabilization increases pressures applied by the laryngoscope blade during direct laryngoscopy and orotracheal intubation. Anesthesiology 2009;110:24-31.
9. Robitaille A, Williams SR, Tremblay MH, Guilbert F, Thériault M, Drolet P. Cervical spine motion during tracheal intubation with manual in-line stabilization: Direct laryngoscopy versus GlideScope videolaryngoscopy. Anesth Analg 2008;106:935-41.
10. Ellis DY, Harris T, Zideman D. Cricoid pressure in emergency department rapid sequence tracheal intubations: A risk-benefit analysis. Ann Emerg Med 2007;50:653-65.
11. Levitan RM, Kinkle WC, Levin WJ, Everett WW. Laryngeal view during laryngoscopy: A randomized trial comparing cricoid pressure, backward-upward-rightward pressure, and bimanual laryngoscopy. Ann Emerg Med 2006;47:548-55.
12. Noguchi T, Koga K, Shiga Y, Shigematsu A. The gum elastic bougie eases tracheal intubation while applying cricoid pressure compared to a stylet. Can J Anaesth 2003;50:712-7.
13. Haslam N, Parker L, Duggan JE. Effect of cricoid pressure on the view at laryngoscopy. Anaesthesia 2005;60:41-7.
14. Lynham A, Tuckett J, Warnke P. Maxillofacial trauma. Aust Fam Physician 2012;41:172-80.
15. Dhanrajani PJ, Jonaidel O. Trismus: Aetiology, differential diagnosis and treatment. Dent Update 2002;29:88-92, 94.
16. Kamadjaja DB, Soesanto R. Jaw locking after maxillofacial trauma. Dent J (Maj Ked Gigi) 2007;40:106-13.
17. Ferrari LR, Nargozian C. Anesthesia for otolaryngologic surgery. In: Barash PG, Cullen BF, Stoelting RK, Calahan MK, Stock MC, Ortega R, editors. Clinical Anesthesia. Philadelphia: Wolters Kluver | Lippincott Williams and Wilkins; 2013. p. 1370.
18. Apfelbaum JL, Hagberg CA, Caplan RA, Blitt CD, Connis RT, Nickinovich DG, *et al.* Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 2013;118:251-70.
19. Asai T. Videolaryngoscopes: Do they truly have roles in difficult airways? Anesthesiology 2012;116:515-7.
20. Agrawal P, Gupta B, D'souza N, Bhatnagar N. Fiberoptic bronchoscope assisted difficult airway management in maxillofacial trauma. Ann Maxillofac Surg 2011;1:95-6.
21. Aziz MF, Dillman D, Fu R, Brambrink AM. Comparative effectiveness of the C-MAC video laryngoscope versus direct laryngoscopy in the setting of the predicted difficult airway. Anesthesiology 2012;116:629-36.
22. Ferreras J, Junquera LM, García-Consuegra L. Intracranial placement of a

nasogastric tube after severe craniofacial trauma. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;90:564-6.
23. Genú PR, de Oliveira DM, Vasconcellos RJ, Nogueira RV, Vasconcelos BC. Inadvertent intracranial placement of a nasogastric tube in a patient with severe craniofacial trauma: A case report. J Oral Maxillofac Surg 2004;62:1435-8.
24. Schade K, Borzotta A, Michaels A. Intracranial malposition of nasopharyngeal airway. J Trauma 2000;49:967-8.
25. Martin JE, Mehta R, Aarabi B, Ecklund JE, Martin AH, Ling GS. Intracranial insertion of a nasopharyngeal airway in a patient with craniofacial trauma. Mil Med 2004;169:496-7.
26. Marlow TJ, Goltra DD Jr, Schabel SI. Intracranial placement of a nasotracheal tube after facial fracture: A rare complication. J Emerg Med 1997;15:187-91.
27. Vidya B, Cariappa KM, Kamath AT. Current perspectives in intra operative airway management in maxillofacial trauma. J Maxillofac Oral Surg 2012;11:138-43.
28. Das S, Das TP, Ghosh PS. Submental intubation: A journey over the last 25 years. J Anaesthesiol Clin Pharmacol 2012;28:291-303.
29. Shenoi RS, Badjate SJ, Budhraja NJ. Submental orotracheal intubation: Our experience and review. Ann Maxillofac Surg 2011;1:37-41.
30. Caubi AF, Vasconcelos BC, Vasconcellos RJ, de Morais HH, Rocha NS. Submental intubation in oral maxillofacial surgery: Review of the literature and analysis of 13 cases. Med Oral Patol Oral Cir Bucal 2008;13:E197-200.
31. Valsa A, Kumar L, Sumir G, Williams A, Singh M, Victor JV. Submental intubation for airway management of patients with complex caniomaxillofacial injuries: Our experience. Anesth Essays Res 2012;6:161-6.
32. Biglioli F, Mortini P, Goisis M, Bardazzi A, Boari N. Submental orotracheal intubation: An alternative to tracheotomy in transfacial cranial base surgery. Skull Base 2003;13:189-95.
33. Kellman RM, Losquadro WD. Comprehensive airway management of patients with maxillofacial trauma. Craniomaxillofac Trauma Reconstr 2008;1:39-47.
34. Fan T, Wang G, Mao B, Xiong Z, Zhang Y, Liu X, *et al.* Prophylactic administration of parenteral steroids for preventing airway complications after extubation in adults: Meta-analysis of randomised placebo controlled trials. BMJ 2008;337:A1841.
35. Lee CH, Peng MJ, Wu CL. Dexamethasone to prevent postextubation airway obstruction in adults: A prospective, randomized, double-blind, placebo-controlled study. Crit Care 2007;11:R72.
36. Bagshaw SM, Delaney A, Farrell C, Drummond J, Brindley PG. Best evidence in critical care medicine. Steroids to prevent post-extubation airway obstruction in adult critically ill patients. Can J Anaesth 2008;55:382-5.
37. François B, Bellissant E, Gissot V, Desachy A, Normand S, Boulain T, *et al.* 12-h pretreatment with methylprednisolone versus placebo for prevention of postextubation laryngeal oedema: A randomised double-blind trial. Lancet 2007;369:1083-9.
38. Meade MO, Guyatt GH, Cook DJ, Sinuff T, Butler R. Trials of corticosteroids to prevent postextubation airway complications. Chest 2001;120:464S-8.

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