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SUBMENTAL ENDOTRACHEAL INTUBATION IN MAXILLOFACIAL TRAUMA – A Clinical Study

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ABSTRACT The aim of this study is to evaluate the outcome of airway management in patients with complex maxillofacial fractures by the use of submental intubation in patients when oral and nasal routes of intubation were contraindicated. Achieving a secure airway is of utmost importance in patients under general anesthesia. The two most common methods of airway management include oro-tracheal and nasotracheal intubation. However, both of these are contraindicated in complex maxillofacial trauma, like pan-facial fractures requiring surgical access to the oral and nasal cavity in the same surgery. This work presents our current experience of airway management using submental intubation in such situations. This technique has proved to be a simple solution for many problems one would encounter during maxillofacial surgical procedures. It allows a safe and reliable route for the endotracheal tube during intubation while staying clear of the surgical field and permitting the checking of the dental occlusion, without causing any significant morbidity for the patient.

KEYWORDS : Panfacial trauma, submental orotracheal intubation, tracheostomy

INTRODUCTION

Maxillofacial injuries and fractures are nearly always associated with moderate to severe road traffic accidents due to prominent anatomical location[1]. Modern surgical management of fractures of the craniomaxillofacial skeleton will usually involve open reduction and accurate rigid fixation using mini and microplate osteosynthesis. For the accurate functional reconstruction of the facial fractures, a period of intraoperative maxilla-mandibular fixation is essential to check for the restoration of pre-traumatic occlusion[2]. Delivery of anesthesia for maxillofacial surgeries is a challenge because the anesthesiologist has to share the upper airway field with the surgeon. Maintenance of the airway without interfering with the treatment of fractured segments is an important consideration at the time of surgery. Temporary intraoperative maxillo-mandibular fixation is needed to check the alignment of the fracture fragments, making conventional orotracheal intubation unsuitable. Options in airway management in these patients include nasotracheal intubation, tracheostomy, and submental endotracheal intubation[1]

Nasotracheal intubation can be used in these patients as it allows the establishment of occlusion and maxillomandibular fixation without interfering with intraoral surgical approach[3], but it is not recommended in the presence of pan facial fracture, fracture of nasal bones, cribriform plate of ethmoid or naso-orbital-ethmoid complex, cervical spine injury, skull base fracture with or without cerebrospinal fluid rhinorrhea, when nasal packing is indicated. Potential complications of nasotracheal intubation are mucosal dissection, injury to adenoids, meningitis, sepsis, sinusitis, epistaxis, dislodgement of bony fragments, and obstruction of the tube by the distorted airway anatomy or rarely intracranial intubation[1].

Tracheostomy is one of the oldest surgical operations, with references dating back to more than 3,500 years ago. In 1909, *Jackson* described the modern technique for tracheostomy[4]. General indications for performing tracheostomy in the context of maxillofacial injury include upper airway obstruction, facial edema, insecure oro or nasotracheal intubation, airway diversion during and after facial fracture repair, and the need for tracheobronchial hygiene. Early complications of tracheostomy include bleeding, pneumothorax, recurrent laryngeal nerve injury, and dislodgment of the tracheal tube due to postoperative swelling. Long-term complications include scarring, tracheomalacia, tracheal stenosis, and the development of tracheoesophageal and tracheocutaneous fistulas[5].

Submental intubation was first reported by *Francisco Hernandez Altemir* in 1986. The first case report and case series from India on submental endotracheal intubation was published by *Malhotra et al.* in 2002. It is a useful alternative to tracheostomy with minimal complications[1]. It consists of exteriorizing an oral endotracheal tube through the floor of the mouth and submental triangle. Submental intubation allows free intraoperative access to re-establish functional occlusion in the presence of nasal pyramid fractures, skull base trauma, and congenital deformities where nasotracheal, oral endotracheal intubation or where tracheostomy is not indicated, without endangering the patient and at the same time avoid trans-tracheal dissection[6].

In the present study, we evaluated the efficacy of submental intubation in 10 patients with pan facial trauma. We assessed the duration of the procedure, intraoperative complications with airway management, and postoperative complications concerning the incision site, and injury to vital structures in the submental region.

Method Of Collection Of Data

In this study, ten patients with complex fractures of the maxillofacial region and airway management done by submental endotracheal intubation, over a period between January 2017 and September 2019, and intraoperative and postoperative evaluation included assessment of the time required for intubation, accidental extubation, postoperative complications like the healing of the wound at intra-oral and submental region and submental scar formation at the incision site.

Operative Technique

After standard orotracheal intubation, a temporary draping of the mouth and chin was carried out. A 2 cm skin incision was made in the region of the submental area, slightly off the midline directly adjacent to the lower border of the mandible.

Fig 1: Orotracheal Intubation

Fig 2: Skin Incision At Submental Region

The muscular layers of platysma and mylohyoid muscles were traversed by blunt dissection using a Kelly forceps that was always in contact with the lingual cortex of the mandible.

Fig 3: Submental Tunneling

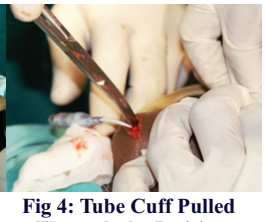

Fig 4: Tube Cuff Pulled Through the Incision

The mucosal layer on the floor of the mouth incised over the distal end of the forceps and the forceps were then opened, creating a tunnel. During the dissection, it was important that the width of the submental access should be sufficient to pass the tube without any interference.

After the surgical access was made, the hemostat passed into the oral cavity through the submental incision; the endotracheal tube cuff was grasped first and pulled through the submental incision.

Fig 5: Endotracheal Tube Pulled through the incision

Fig 6: Fixation of Tube at Submental Region

A second pass was made with the hemostat to grasp the endotracheal tube itself with the connector removed. The tube was readily delivered through the submental incision.

The anesthetist reattached the connector to the armored tube and reconnected the anesthetic equipment. When capnography and lungs auscultation confirmed the correct tracheal position of the tube, the tube was fixed with a 2-0 silk suture.

At the termination of the surgical procedure, the anesthetic circuit was disconnected, and the endotracheal tube cuff and endotracheal tubes were passed back through the incision into the mouth, reversing the original path. Again reconnection of the endotracheal tube with an anesthetic circuit was established. The correct position of the tracheal tube was checked. The suturing was done with 5-0 prolene at the submental region later the extubation was carried out in a classical manner.

RESULTS

All ten patients (100%) were male with the mean age of 36.50±9.75 years had a combination of fractures involving dental occlusion (mandible & maxillary fractures) and fracture of a front-naso-ethmoidal skeleton. The length of the incision varied from1.5 to 2cm. All the incisions were placed over skin in the submental region slightly off the midline (paramedian), directly adjacent to the lower border of the mandible. The minimum duration for submental intubation was 7.360 minutes, and the maximum duration was 8.5 minutes. The mean Time of duration was 8.089 with a standard deviation of 0.424. Out of ten patients, there was no incidence of accidental extubation, and the patients extubated after reversing the endotracheal tube from the submental to the oral route.

The incidence of complications at the incision site was noted on the 1st day and 7th day post-operatively. There was no incidence of hematoma, no injury to the sublingual duct, no damage to Wharton's duct, no harm to the lingual nerve, and no incidence of infection at the surgical site. No significant complication was associated with submental intubation, healing of wound at the intraoral region was satisfactory on the 7th and 30th day, and scar formation at the submental area was mild in all patients on day 30.

DISCUSSION

In maxillofacial trauma, an anesthesiologist has to share the upper airway field with the surgeon. In these injuries, apart from an aesthetic consideration, the surgeon's requirement is a significant factor in deciding the technique of intubation. There are various methods available for airway management in patients with maxillofacial trauma. Still, the choice of a particular technique depends upon many factors like the extent of facial injury, the composition and the anatomy of the injury, the choice of surgery, associated injuries (head injury, cervical spine injury), bleeding, and expertise of anaesthesiologist. With the available new techniques and technology, almost all facial fractures are treated with open reduction and internal fixation using mini-plates. For this, a period of intraoperative dental occlusion by inter-maxillary fixation is required for the proper alignment of the fracture fragments and their rigid fixation. So, surgeons prefer to have nasotracheal intubation as it gives them the freedom to operate and accuracy of dental occlusion[7]. Nasotracheal intubation is not recommended in the presence of facial panfacial fracture, cervical spine injury, and skull base fracture with or without cerebrospinal fluid rhinorrhea, systemic coagulation disorders, distorted nasal anatomy, and when nasal packing is indicated[1]. Anesthesia via tracheostomy was the alternative route for short-term airway management. However, tracheostomy may cause many general, local, early, and late complications. Early general complications include cardiac arrest caused by stimulation of the vagus nerve, post-hypercapnic shock due to sudden lowering of the carbon dioxide level, and aeroembolism. Early local complications comprise hemorrhage, subcutaneous or mediastinal emphysema, and recurrent laryngeal nerve damage with all its consequences. Late complications include laryngeal or tracheal stricture, bleeding from large blood vessels caused by decubitus of vessel walls, tracheo-oesophageal fistula, extensive granulation, and inflammatory complications.

There have been several attempts to achieve short-term airway management, submental intubation becomes the choice of intubation technique in these cases. There are several modifications to the original submental intubation technique that have been tried. Preoperative submental intubation in craniofacial injuries was first proposed by a Spanish faciomaxillary surgeon, Francisco Hernandez Altemir, in 1986. He used a single tube, wherein a 2cm Para-medial incision is given in a sub-periosteal plane & the nasal speculum facilitates tube passage through the submental region[1]. Many authors have tried several modifications for submental intubation. *Green & Moore (1995)*[8]used a two-tube approach, *Altemir et al. (2000)*[9] utilized a reinforced laryngeal mask airway, *Nwoku et al. (2001)*[10] advocated a 2 cm laterosubmental incision use of 2 endotracheal tubes with non-detachable universal connector reinforced tube of the laryngeal mask. *Altemir et al. (2003)*[11] utilized a reinforced combi tube, *Ball et al. (2003)*[12] used a Flexible tracheal tube with an intubating laryngeal mask, *Nyarady et al. (2006)*[13] used a sterile nylon guiding tube over the distal end of the tube, *Biswas et al. (2006)*[14] used the percutaneous tracheostomy dilatational kit. Inspite of many modifications there is not sufficient evidence in the literature to support a single modification to reduce the complications.

In this study, ten patients in the age group of 15-55 years were included. All ten patients (100%) were male with a mean age of 36.50±9.75 years. The parameters taken into consideration were: 1) Time required for intubation 2) Accidental extubation 3) Postoperative complications like hemorrhage, injury to the sublingual glands, Wharton's duct, lingual nerve, and infection 4) Healing of the intraoral wound and 5) Submental scar formation at the incision site.

The time required for intubation was calculated as starting from submental incision to the fixation of the submental tube. The mean time required for submental intubation was 8.089 minutes with a standard deviation of 0.424min. The minimum duration for submental intubation was 7.360 minutes and the maximum duration was 8.5 minutes. The range of the duration was 1.140 min. It was 5 min in a retrospective study conducted by *Biglioli et al. (2003)*[15] in 24 patients, was 10 min by *Kim et al*. (*2005)*[16] in 4 patients and *Taglialatelaet al. (2006)*[17] in 107patients, *Shenoi RS et al. (2011)*[18] in 10 patients, *Gadre and Waknis et al. (2010)*[19] in 400 patients, was 4 min *Nyaradyet al. (2006)*[13] studied 13 in orthognathic surgery patients, was less than 10 min in 13 patients of maxillofacial trauma by using non reinforced ETT in a retrospective study by *Caubiet al.(2008)*[6]and *Agarwal M et al. (2011)*[20]in 15 patients, was 20 min 44 orthognathic surgery patients of a retrospective study of *Chandu et al. (2008)*[21],9 min for 20 patients in oromaxillofacial surgery by *Sharma et al. (2008)*[22] in 17 Patients average time required was 5–6 min in study of *Elizar' Eva et al. (2008)*[23], was 7 min in study by *Navaneetham A et al. (2011)*[24] by paramedian technique in 15 cases of maxillofacial trauma, was 8.90 min for40Patients with complex craniomaxillofacial injuries in study by*Valsa A et al*. (*2012)*[25],*Tidke AS et al*. (*2013)*[26]used Trans-mylohyoid with a paradigm shift in airway management in 35 patients of panfacial trauma and reported the mean time of 15.51±1.85min, a retrospective study by *Rodrigues et al. (2014)*[27]in 28 patients of panfacial fractures it was 8.07±4.0min. The procedure was 8-10 min *Kishoria N et al.* (*2014)*[28]in patients with pan facial fractures, in 41 patients with complex maxillofacial trauma *Kumar Nilesh et al. (2015)*[3]performed submental intubation and they found that the average time required for intubation was 11.46 min.

Maxillofacial surgeries require head extension and manipulation of head position during operation. So this may lead to an increased chance of endotracheal tube disconnection, displacement, endobronchial migration, and accidental extubation. Out of 10 patients in our study, there was no incidence of accidental extubation.

Although the submental intubation technique is a good option for the treatment of patients with multiple fractures in the maxillofacial region, it is not free of complications. The possible complications include submental infection, abscess formation in the floor of the mouth, injury to the submandibular salivary ducts or sublingual glands, Mucocele formation, injury to the marginal mandibular branch of the facial nerve, damage to facial vessels, and keloid or hypertrophic scarring in the submental region.

In this study, the incidence of postoperative complications at the incision site was recorded on 1st day and 7th day post-operatively. There was no incidence of hematoma [0%], no injury to the sublingual duct injury [0%], no damage to Wharton's duct [0%], no injury to the lingual nerve [0%], and no incidence of infection at the surgical site [0%].

But complications were observed in the study by *C. TaglialatelaScafati et al* [17] reported 11 cases had suppuration in the cutaneous wound and salivary fistula in 8 cases out of 107 patients for pan facial injuries. *Chandu et al. (2008)*[21] out of 44 patients, encountered temporary paraesthesia of lingual nerve in one case, one case of superficial infection at the site of the submental incision, and one patient had Mucocele in the floor of the mouth. Superficial wound infection was noted in two cases, among ten patients in their study of *Manganello Souza &Tenario cabezas*[29] et al.(1998) In 2012, *Jundt et al* [30] conducted a systematic review of submental intubation. Their review represented 41 articles and 842 patients. Minor complications were reported in 60 patients which included superficial skin infections (n=23), damage to the tube apparatus (n=10), fistula formation (n=10), right main-stem bronchus tube dislodgement/obstruction (n=5), hypertrophic scaring (n=3), accidental extubation in paediatric patients (n=2), excessive bronchial flexion (n=2), lingual nerve paraesthesia (n=1). They concluded that submental intubation is a safe, effective, and time-efficient method for securing an airway when increased surgical exposure or restoration of occlusion is a priority.

In the present study, patients were evaluated for the healing of intraoral wounds on postoperative day's 7th and 30th postoperative days. Out of ten patients, healing was satisfactory in all patients [100%] on the 7th and 30th postoperative days.

Mayer et al. (2003)[31] in 25 cases of maxillofacial trauma, reported 2 cases of abscess formation in the floor of the mouth. We evaluated the patients for distortion of the submental scar at the incision site on the 30th postoperative day. Out of ten patients, the deformation of the submental scar at the incision site was mild in all patients [100%]. The scar was less visible and well tolerated by all patients. It was noted in a case, study of *Mayer et al. (2003)*[31] in 25 cases of maxillofacial trauma. *Gadre and Wakins et al. (2010)*[19] reported keloid formation at the submental incision site in 2 patients in a study on 400 patients with maxillofacial trauma.

Since the first description, submental intubation has undergone various modifications and found new indications. It could be safely used in patients with midfacial or pan facial fractures with the possible base of skull fractures, as well as in patients undergoing elective Le Fort osteotomies or simultaneous elective mandibular orthognathic surgery and rhinoplasty procedures. In our present study, submental intubation was done in all the patients without any significant complications, allowing unlimited manipulation of the fractured fragments, the satisfactory achievement of occlusion, establishment of maxillomandibular fixation, and complete assessment of facial symmetry, as well as easy access to endotracheal tube for the anesthesiologist. Moreover, extubation was to be simple, and the cosmetic results were acceptable, with no long-term morbidity.

In conclusion, the submental intubation offers an adequate, accessible, and minimally invasive alternative for poly traumatized patients with affected middle and lower facial thirds, allowing for an adequate reduction and fixation of fracture segments with no intubation tube interference in the surgical layer, particularly reducing fractures in the nasal cavity when it is necessary to conduct at the same time and intermaxillary fixation to re-establish occlusion in patients.

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