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RETROSPECTIVE COMPARATIVE EVALUATION OF AIRWAY MANAGEMENT WITH DIFFERENT TECHNIQUES OF FIBEROPTIC INTUBATION IN PATIENTS UNDERGOING SURGERY FOR TEMPOROMANDIBULAR JOINT ANKYLOSIS

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ABSTRACT

Background: Temporomandibular fusion has devastating effects on the growth and development of an individual's jaws. Thus, surgical modality is seen as a last resort to its correction. Surgical management of temporomandibular ankylosis cases presents significant challenges to an anesthetist in maintaining airway patency. Thus, this retrospective study evaluated the techniques for combating airway management challenges, emphasizing developing an institutional protocol that effectively minimizes errors. **Methods:** This retrospective study was conducted in the RUHS College of Dental Sciences and attached to the RUHS College of Medical Sciences, Jaipur, Rajasthan, India, for a period of three years. The records of 94 patients who had undergone surgical correction of TMJ ankylosis and were intubated with fiberoptic intubation were compiled. The cases were divided into groups, Group General anesthesia (GA) and Group Regional anesthesia (RA), and analyzed for demographics, successful intubation, and complications. **Results:** In Group GA, 98 % of cases were successfully intubated. Patient movements were 0 in Group GA and 25% in Group RA. Coughing was present in 1.61% of cases of group GA and 98.38% of Group RA. Epistaxis occurred in 35% of cases, and 29% of cases suffered from sore throat after extubation in Group GA. **Conclusion:** The anesthetist dilemma of intubating awake or anesthetized always exists. However, a careful preoperative evaluation and assessment of the patient for mask ventilation helps in the successful anesthetic management of temporomandibular joint ankylosis cases. For the anticipated difficult airway awake, fiberoptic intubation is still the 'gold standard' technique.

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INTRODUCTION

The Temporomandibular Joint (TMJ) is a synovial bicondylar joint formed by the mandibular condyle and the articular fossa of the temporal bone (cranium). It has an essential role in mastication and articulation. Numerous anomalies are found to be associated with TMJ, out of which TMJ ankylosis has been noted to affect tremendously the lives of the patients [1]. The fusion of the mandibular condyle to the bony fossa has devastating effects on the growth and development of an individual's jaws. The facial deformity negatively affects an individual's social and mental well-being, which worsens with growth [2]. The major cause of TMJ ankylosis is trauma, followed by infection. Other causes include congenital, idiopathic, maxillary, mandibular fixation, and prior gap arthroplasty. Rarely, it may result from rheumatoid arthritis, sickle cell anemia, and fibrodysplasia ossificans progressive. A complete assessment of the patient's pathological condition should be established before treatment planning to achieve better results [3].

This condition starts with limited mouth opening, which reduces further and restricts the function. In the early stages, stretching exercises are a part of the cartilaginous calcification treatment modality; in later stages, surgery is advised to restore the jaw functions. Various surgical modalities proposed to treat TMJ ankylosis are gap arthroplasty, condylectomy, distraction osteogenesis, interposition arthroplasty, and total joint reconstruction [4]. Surgical management of TMJ ankylosis cases presents significant challenges to an anesthetist concerning maintaining airway patency. Restricted mouth opening makes direct laryngoscopy not possible. Thus, intubation must be done by blind nasal intubation or fibreoptic bronchoscope. If the pathology has started early and the TMJ ankylosis is of long-standing duration, blind nasal intubation becomes difficult. It has a high possibility of failure even in experienced hands coupled with uncooperativeness (especially in the case of children), coughing, bucking, and reflex responses if awake intubation is attempted. Thus, fiberoptic bronchoscopy has become a gold standard in treating these cases [5]. Cases with TMJ ankylosis are difficult to ventilate as well as to intubate. The difficulty arises due to severe trismus, mandibular hypoplasia with unequal growth of two halves of the mandible, reduced mandibular space with pseudo macroglossia in a confined space with narrowing of pharyngeal passage. Many patients frequently suffer from obstructive sleep apnea [6]. The intubating options are nasopharyngeal airway fluoroscope aided retrograde placement of guide wire for tracheal intubation, retrograde endotracheal intubation using a pharyngeal loop, semi-blind technique of nasal intubation, blind nasal intubation, fiberoptic laryngoscope assisted intubation, seeing optic stylet system (SOS), flexible airway scope tool (FAST), light wand, and tracheostomy [7-10]. Most of the time, the techniques used depend on the expertise of the concerned anaesthesiologists and the resources available. There is no clear consensus regarding the preferred method to be employed.

The dilemma of whether intubated awake or sedated always exists. Both of these have their advantages and disadvantages [6]. In view of the dilemma occurring to an anaesthetist various studies have been published which state their views & consensus reports [11]. In this article, we are presenting a retrospective study by comparing and analyzing all the techniques used at our institution to combat airway management challenges and trying to develop an institutional protocol that is easy to follow and safe for the patient with minimal human errors.

MATERIAL & METHODS

This retrospective study was conducted in the RUHS College of Dental Sciences and attached to RUHS College of Medical Sciences, Jaipur, Rajasthan, India, during a period of three years from April 2014 to March 2017. The data compilation was done from the hospital records, and approval was taken from the institutional ethics committee. Intraoperative records of all patients who had undergone surgical correction of TMJ ankylosis under anaesthesia and were intubated with fibreoptic intubation were identified and compiled to derive a final data set. Patient records with incomplete data and information were excluded. Patient records of 94 cases with American Society of Anesthesiologists (ASA) physical status classification I & II and age range of 5-75 years were included in the study. The need for informed patient consent was waived.

The data regarding the American Society of Anesthesiologists (ASA) physical status, preoperative airway assessment, associated abnormalities, the anaesthetic data regarding the anesthetic technique, induction agents, ventilation prior to intubation, method of intubation, intubation difficulties or failures, events during intubation (desaturation, coughing, and patient movements), muscle relaxants used and their complications were compiled [12,13].

Difficult airway was defined by either specific anaesthesiologist's comments in the record or airway assessment record. An oxygen desaturation event was defined as pulse oximeter saturation (SpO_2) <90% or a decrease to 4% or more below the baseline level [12,13].

The patients were divided into two groups: general anesthesia (GA) and regional anesthesia (RA), on the basis of the fiberoptic intubation technique. Group GA patients were intubated under general anesthesia with muscle relaxation, and Group RA patients were intubated awake under regional anesthesia with sedation. Standard Nil per oral (NPO) guidelines were followed for all patients. An intravenous (IV) line was secured, and all patients were monitored with noninvasive blood pressure, pulse oximeter, electrocardiogram (ECG), and heart rate. Xylometazoline nasal drops were instilled in the patient's nostrils before intubation. Figure 1 shows the institutional protocol.

Group GA Patients were premedicated with Inj. Ranitidine 2mg /kg, Inj. Midazolam 0.02 mg/kg and Inj. Glycopyrrolate 0.005 mg/kg. Analgesia was achieved with Inj. Fentanyl 2 mcg/kg. Patients were induced with Inj. Propofol 2mg /kg after 5 minutes of preoxygenation with 100 % oxygen. Then, after confirmation of adequate mask ventilation, Inj. Succinylcholine 2 mg/kg was given, and the airway was secured with nasal FOI.

Group RA patients were premedicated with Inj. Ranitidine 2mg /kg, Inj Midazolam 0.02 mg/kg and Inj. Glycopyrrolate 0.005 mg/kg. IV sedation was given with Inj Dexmedetomidine (0.5 to 1 mcg/kg) bolus over 10 minutes, followed by 0.5 to 1 mcg/kg/hr titrated so that the patient remained responsive to verbal commands. During awake fiberoptic intubation, the patient's consciousness may vary from completely awake to arousable with moderate stimulation (level 3 or 4 on the Ramsay scale) [7]. The nasopharyngeal airway was anesthetized with a combination of lignocaine nebulization, superior laryngeal nerve block, and transtracheal block. Patients were then intubated with nasal fiberoptic intubation. After that, patients were induced with Inj Propofol 2 mg/kg, and analgesia was achieved with Inj Fentanyl 2 mcg/kg.

After intubation, the position of the tube was confirmed in all the patients, and it was secured properly to prevent displacement. In all the patients, either Atracurium (initial loading dose of 0.4 mg/kg then maintenance dose 0.1mg/kg every 20 min) or Vecuronium (initial loading dose of 0.04 mg/kg then maintenance dose 0.01mg/kg every 30 min) were used for muscle relaxation. Inhalational agents like oxygen, nitrogen oxide, and others were used to maintain anesthesia. At the end of the surgery, patients were reversed with Inj. Neostigmin (0.06 mg./kg.) and Inj. Glycopyrolate (0.05mg/kg.).

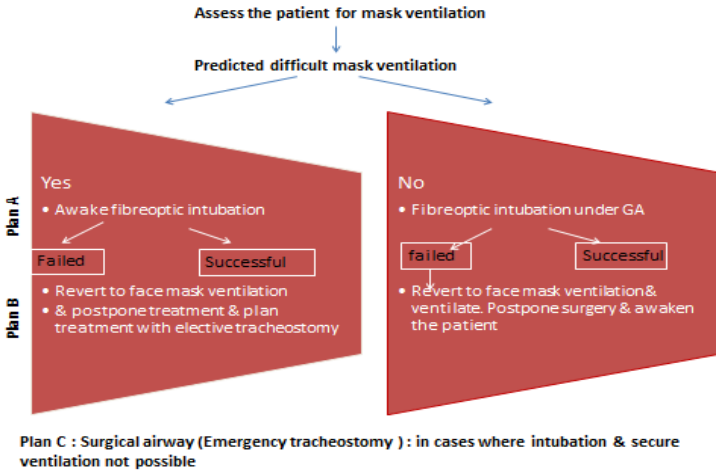

Figure 1: Institutional protocol for airway management of TMJ Ankylosis patients

Statistical analysis

Statistical analysis was done using the SPSS software version 20. Parametric data are presented as mean ± SD (standard deviation). Statistical techniques applied were Chi-square/Fisher t-test for categorical variables.

RESULTS

In the present study, out of the 94 cases, 53.19% were females and 46.81% were males. About 15.95% of patients were below 11 years old, 42.55% were between 11–20 years old, 22.34% were between 21- 30 years old, and 19.14% were above the age of 30 years 28.72%patients had bilateral TMJ ankylosis, and 71.28% patients had unilateral TMJ ankylosis. Table 1 shows the demographic characteristics and ASA criteria of both groups.

Pre-operative airway assessment records revealed that mouth opening was restricted in all the patients. The mean interincisor gap was found to be 5mm. Due to nil or limited mouth opening, Mallampatiscores couldn't be assessed. Thyromental distance and sternomental distance were also seen to be reduced in all the patients. Neck movements in all the patients were normal. Retrognathia, mandibular hypoplasia, and facial asymmetry were common maxillofacial findings.

Table 1: Demographic data

Demographic parameter	Group GA	Group RA	p-value
No. of Cases	62 (66%)	32 (32%)	-
Age in years (mean ± SD)	18.53±10.99	20.75±12.38	0.505
Sex (M/F)	28/34	16/16	0.656
ASA I/II	56/6	29/3	0.962

In Group GA, out of 62 patients, 61 (98 %) patients were successfully intubated. In one patient, a tracheostomy was done to secure the airway (Table 2). Patient movements, coughing, and desaturation events were compared in both groups. During the intubation, pulse oximeter saturation (SpO2) <90% or a decrease to 4% or more below the baseline level was considered oxygen desaturation. Oxygen desaturation was observed in 4.83% of the patients in Group GA. No desaturation event was observed in Group RA. Desaturation events were higher in Group GA, but the difference was insignificant (p>0.05). Patient movements were not observed in Group GA patients but in 25% of patients of Group RA. Thus, patient movements were significantly lower in Group GA (p=0.0001). Coughing was present in 1.61% of patients of Group GA and in 98.38% of patients of Group RA, which was highly significant (p=0.0006) (Table 3). Complications noted were epistaxis and hoarseness. Epistaxis occurred in 56.25% of patients in Group GA and 53.12% in Group RA, but the difference was not statistically significant (p-value> 0.05). The incidence of hoarseness after extubation is lesser in Group GA, but the difference was not statistically significant (p-value> 0.05) (Table 4).

Table 2: Comparison of successful intubation in both the groups

	Group GA	Group RA	p value
Success rate	98.38 %	100 %	0.304 (Not significant)

Table 3: Comparison of the events during fiberoptic intubation in both groups

	Group GA	Group RA	p value
Patient movements			
Present	0	8 (25%)	0.0001(highly significant)
Absent	62 (100%)	24 (75%)	
Coughing			
Present	1 (1.61%)	8 (25%)	0.0006 (highly significant)
Absent	61 (98.38 %)	24 (75%)	
Desaturation			
Present	3 (4.83%)	0	0.5486 (not significant)
absent	59 (95.16%)	32 (100 %)	

Table 4: Comparison of the complications

	Group GA	Group RA	p-value
Epistaxis	35 (56.45 %)	17 (53.12%)	0.759 (Not significant)
Hoarseness	31 (50%)	20 (62%)	0.249 (Not significant)

DISCUSSION

TMJ are highly specialized diarthrodial synovial joints comprising an articulation between the cranium and the mandible. Both the TM joints function as a single unit. Thus, even if only one joint is affected, mouth opening is limited [1]. Ankylosis of TMJ is characterized by an inability to partially or completely open the mouth. In India, the incidence and prevalence are quite high. It was noted to be 0.46 per 1000 in the 3-15 age group [14]. It is seen from 2 to 60 years of age, with a rare congenital presentation with prevalence in ages 6-10 years [15] and 11-20 years [16].

Clinical presentation includes facial asymmetry, restricted mouth opening, trismus, mandibular hypoplasia, malocclusion, anemia and malnutrition. Further complications are increased airway obstruction, structural encroachment on pharyngeal and hypo pharyngeal lumen, subatmospheric intrapharyngeal pressure and hypotonicity of oropharyngeal muscles, obstructive sleep apnea and corpulmonale. All these factors make intubation difficult in such cases [2].

In children, TMJ ankylosis is noticed at later stages when the mouth opening becomes severely restricted and the child encounters difficulty in mastication. When this ankylosis is accompanied by mandibular hypoplasia, it presents as a grave problem for maintaining airway patency. Also,small mouthopening, near total trismus, uncooperativeness of the pediatric patient makes it difficult in securing airway in awake state [8]. In this retrospective study, in 66% of the cases, airway patency was maintained with fibreoptic intubation under GA and in 34% of cases awake fiberoptic intubation was undergone. This is in accordance with the study done by Kiran et al. in 2015[17],

wherein fibreoptic intubation was done in 15 cases out of 16- and one-blind nasal intubation was done. In contrast, awake fibreoptic intubation was done in 61.1% of cases by Yunus et al. in 2018 [18] and Kamat et al. [19].

In the awake group, intubation had a higher success rate, but the difference was not statistically significant (p-value> 0.05). (Table 2) Group GA showed better patient comfort. Group RA observed higher patient movements and coughing events during intubation than Group GA, which was statistically significant (p-value < 0.05). (Table 3) Both groups were comparable with respect to the complications during intubation, such as desaturation and epistaxis. The incidence of hoarseness after extubation was lower in group RA with no statistically significant difference (p-value> 0.05) (Table 4).

In Group GA, patients were induced with Propofol 2mg /kg, which may benefit from avoiding light planes of anaesthesia, a still and clear field of vision, and minimal hemodynamic responses. Using low-dose succinylcholine 2mg /kg acting as a skeletal muscle relaxant aids the anesthetist during intubation. In group GA, out of 62 cases, only one required tracheostomy to maintain airway patency. This may be due to proper depth of anesthesia not being achieved or inadequate muscle relaxation. Even after a good visualization of the glottis and vocal cords, fibreoptic intubation failed due to complete laryngospasm.

In TMJ ankylosis patients with reduced mouth opening, endotracheal intubation is the most challenging task for an anesthesiologist. In pediatric patients, it is difficult to establish a patent airway while awake due to small mouth opening, near total trismus, coughing, bucking, and struggling [20]. Thus, the procedure was done under GA, and undesirable hemodynamic responses were not visualized. The main disadvantages of intubation under GA are that the tongue and pharyngeal tissues lose their tonicity and close down the pharyngeal space, blocking visualization of the larynx. An assistant is required to facilitate laryngeal exposure in the paralyzedpatient, which reduces the apnea time. The assistant should do all the tasks articulated and tactfully, i.e., the endotracheal tube should be mounted on the lubricated fibreoptic bronchoscope and handed over to the anesthetist as soon as the anesthesia mask is removed. Secondly, jaw thrust should be applied to maintain an open oropharynx. Thirdly, regular observation of the apnea time and patient monitoring [13].

For the anticipated difficult airway awake fiberoptic intubation is still the gold standard [21]. In awake patients, fibreoptic intubation is easier as the tongue does not fall back in the pharynx, and spontaneous ventilation keeps the airway open. Also, an awake patient can help the anesthetist locate the glottis in cases of distorted anatomy. Various factors considered critical for successful awake intubation include the psychological preparedness of the patient, adequate delivery of oxygen and its maintenance, an expert endoscopist, and a well-functioning fibreoptic bronchoscope [13].

After comparing and analyzing all the techniques used at our institution, an institutional protocol was established to assess the patient for mask ventilation. If successful, go for awake fibreoptic intubation; if it fails, revert to mask ventilation, postpone the treatment, and plan for elective tracheostomy (Figure 1).

If mask ventilation is predicted to be difficult, fibreoptic intubation under GA is to be performed. If this fails, then revert to face mask ventilation and ventilate. Postpone the surgery and awaken the patient. Surgical airway tracheostomy should be undertaken in cases where intubation and secure ventilation are not possible. Further prospective studies should be done to overcome the limitations of retrospective study designs. Large prospective studies should be undertaken to assess the difficulties, incidences of failures, and complications during awake fibreoptic intubation. Furthermore, the size of the tube, type of fiberscope, timing of neuromuscular blockers, and other technical difficulties should be well documented.

CONCLUSION

For the anticipated difficult airway awake, fiberoptic intubation is still the ‘gold standard technique.’ The present study confirms that experienced anesthetics can handle and manage an anticipated difficult airway well with fiberoptic intubation under GA with muscle relaxation. In difficult situations, a backup plan should be kept handy. The findings of the study established an institutional protocol wherein the patient should be assessed for mask ventilation first. If successful, then the anaesthetist should proceed for awake fibreoptic intubation; if this fails, then revert to mask ventilation. If difficult mask ventilation is predicted, fibreoptic intubation under GA should be performed. In cases of failure, revert to mask ventilation. The treatment should be postponed, and elective tracheostomy should be planned.

FINANCIAL ASSISTANCE
Nil

CONFLICT OF INTEREST
The authors declare no conflict of interest

AUTHOR CONTRIBUTION
Varun Kumar Saini, Priyanka Saini, and Priyanka Soni contributed to conceptualizing and designing the work. Priyanka Saini and Priyanka Soni did the literature search. Manish Khandelwal, Priyani Saini, and Varun Kumar Saini collected the data, did clinical studies, and edited the first draft of the manuscript. Priyanka Saini also contributed to conducting statistical analysis and edited the manuscript draft. All the authors proofread the galley and approved the final draft of the manuscript.

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