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Dr. Ardija Singh

Department of Anesthesiology,
Apollo hospitals, Guwahati,
Assam, India

Dr. Geeta Patkar

Professor, Department of
Anesthesiology, LTMMC
& LTMGH, Sion,
Mumbai, India

Dr. Bharti Tendulkar

Professor & HOD,
Department of Anesthesiology,
LTMMC & LTMGH,
Sion, Mumbai, India

Peri operative airway and respiratory complications in children undergoing cleft lip and palate repair at a tertiary institute: An observational study

Dr. Ardija Singh, Dr. Geeta Patkar and Dr. Bharti Tendulkar

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Abstract

Introduction: Airway related problems have always been a major concern in paediatric patients more so in patients presenting with cleft lip/palate.

Objective: Our aim was to determine the incidence of various types of perioperative airway and respiratory complications in children undergoing cleft lip and palate repair and their management at our tertiary care centre.

Methodology: This prospective observational study was conducted over a period of 18 months in 50 ASA I and II paediatric patients (age group new born to 12 years) undergoing cleft lip/palate surgery. Complications during induction, intubation and postoperative period were noted.

Results: Difficult laryngoscopy in 10% (n=5) patients & difficult intubation in 4% (n=2) patients were noted. No incidences of failed intubation were seen. Tube disconnection (n=1) and tube repositioning (n=2) after mouth gag placement. Desaturation occurred in 4% (n=2) patients, one during difficult intubation and one after mouth gag placement. One patient had laryngospasm during intubation. One patient had an episode of post extubation breath holding spell. One patient had tongue fall postoperatively.

Conclusion: Airway and respiratory complications can be encountered during cleft lip and palate surgeries. Preoperative assessment and identifying any airway problems, congenital anomalies and comorbid conditions is important. Adequate preparation for difficult airway should be done before induction of anaesthesia to avoid morbidity and mortality. Intraoperative airway complications due to the shared airway have to be anticipated. Postoperative airway obstruction may be encountered and has to be treated prophylactically.

Keywords: cleft lip/ palate, anaesthesia, airway complications

Introduction

Cleft lip and palate are the most common craniofacial anomalies seen in children, with an incidence of 1 in 700 live births. They can occur in three patterns: cleft lip alone; cleft palate alone; and cleft lip and palate [1, 2]. About 400 syndromes may be associated with cleft deformities, though all are rare. Some have considerable anaesthesia implications and many involve potential airway problems. The most well-known are the Pierre Robin sequence, Treacher Collins syndrome, Klippel-Feil syndrome, Goldenhar syndrome, Down's syndrome etc. Congenital heart disease occurs in 5-10% of these patients. Other associated anomalies may include brachial arch development defects; renal or skeletal anomalies [3, 4]. Surgical treatment of clefts is ideally done during infancy, and is not only a challenge for the surgeon but also for the anaesthesiologist. Most of the anaesthetic morbidity is related to the airway management. Airway related problems have always been a major concern in paediatric patients more so in patients presenting with cleft lip/palate. The anatomical defects may increase the risk of difficult mask ventilation, difficult laryngoscopy and intubation. The intra-oral site of surgery can lead to problems related to endotracheal tubes. Recurrent respiratory tract infections due to constant irritation and aspiration increases airway reactivity and can cause laryngeal and bronchospasm [5, 8].

Aims: The aim of the study was to assess the incidence of airway and respiratory complications in children undergoing cleft lip and palate repair at a tertiary referral centre.

Corresponding Author:

Dr. Ardija Singh

Department of Anesthesiology,
Apollo hospitals, Guwahati,
Assam, India

Settings and Design

This was a prospective observational study conducted over a period of 18 months in 50 ASA I and II paediatric patients (TABLE 1) undergoing cleft lip/palate surgery in plastic surgery OT, LTMMC & LTMGH, Mumbai.

Table 1: Demographic data

| Parameters | n=50 |
|--------------------|----------|
| Age (yrs) | |
| Upto 6 months | 16 (32%) |
| 7 to 24 months | 27 (54%) |
| Above 24 months | 7 (14%) |
| Gender (%) | |
| Male | 30 (60%) |
| Female | 20 (40%) |
| Weight (Kg) | |
| Upto 10 Kg | 42 (84%) |
| 11 to 20 Kg | 6 (12%) |
| Above 20 Kg | 2 (4%) |

Methods and Material

Study was carried out after institutional ethics committee clearance and written informed consent from the parents/guardians. Patients were thoroughly evaluated regarding fitness for general anaesthesia. Patients satisfying the inclusion criteria were selected (TABLE 2). Any preoperative medical and airway problems and associated congenital anomalies were noted (TABLE 3). All baseline investigations (complete blood count, urine examination, chest x-ray, bleeding time & clotting time) were checked. Cleft type was noted (TABLE 4). After checking the starvation status for 6 hours, patients were taken on the operating table and placed in supine position on a small bolster under the shoulder to achieve an ideal position for intubation. Pulse oximeter, ECG and non-invasive BP monitors were connected. Baseline parameters like heart rate, blood pressure and oxygen saturation were checked and noted. Depending on the anaesthetist's choice either intravenous (thiopentone sodium/propofol) or inhalational (sevoflurane) induction of anaesthesia was carried out after antisialogogue administration. Adequate depth of anaesthesia was confirmed by the loss of eye lash reflex. Mask ventilation was checked. After confirming ventilation muscle relaxant (succinylcholine 2mg/kg) was administered. Patients were ventilated with 100% O₂ till adequate muscle

relaxation was obtained. Laryngoscopy and endotracheal intubation was performed by a well-trained anaesthesiologist (with 2 years' experience) using a curved blade of appropriate size. To prevent the laryngoscope from falling into the cleft, we used a piece of gauze packed into the cleft to fill the defect. It also protected the soft tissue structures from getting injured. Proper positioning of the child can aid in visualization of the larynx. All patients in our study were intubated with RAE tube of appropriate size and fixed in the centre of chin. Tube position was confirmed by auscultation and capnography.

The ease of laryngoscopy was graded (TABLE 5) according to the attempts required to get good laryngoscopic view (Cormack Lehane I and II). Cormack-Lehane grading of laryngoscopic view was noted. Whether any external laryngeal manipulation (ELM) was required for better visualisation was also noted. The ease of intubation (TABLE 5) was graded.

Use of stylet, if required, for assisting intubation was noted. Time for intubation was noted as the time interval from removal of face mask to the appearance of first square capnograph wave. Correct insertion of the tube was confirmed by auscultation and capnography reading of EtCO₂. Anaesthesia was maintained as per the standard anaesthesia protocol practiced in the hospital with O₂, N₂O, muscle relaxant (atracurium) and sevoflurane/propofol infusion. Analgesia was maintained with intra-operative opioids (inj fentanyl 2-5 µg/kg or buprenorphine 2-3 µg/kg). All our patients received inj. Dexamethasone 0.08mg/kg to prevent airway edema. Postoperative analgesia was given with paracetamol suppository 20mg/kg inserted after induction of anaesthesia or inj paracetamol 15mg/kg IV given half an hour before extubation. Type & duration of surgery was noted (TABLE 6) and any special surgical flaps, if performed, were noted. At the end of surgery, the throat pack was removed and surgical site was inspected to rule out any bleeding. Residual neuromuscular blockade was reversed and patients were extubated after they were fully awake with spontaneous, adequate and regular respiratory rhythm capable of maintaining free airway. Patients were monitored in PACU and any immediate postoperative complications were noted. Complications during surgery (TABLE 7) were recorded.

Table 2: Inclusion & exclusion criteria

| Inclusion criteria |
|--------------------------------------------------------------------------|
| 1. ASA-I and II |
| 2. Either sex |
| 3. Age group newborn to 12 years |
| Exclusion criteria |
| 1. ASA III and above |
| 2. Active URTI like fever, cough, sore throat, nasal discharge, sneezing |
| 3. Active LRTI |
| 4. Non-consenting patient |

Table 3: Associated congenital anomaly

| Associated Congenital Anomaly | Frequency | Percent |
|---------------------------------------------|-----------|---------|
| Nil | 47 | 92.00% |
| OS ASD (7 Mm With L-R Shunt) | 1 | 2.00% |
| Robert's Syndrome (Phacomelia) | 1 | 2.00% |
| VSD With PFO, Syndromic Facies- Microcornea | 1 | 2.00% |

Table 4: Type of cleft

| Cleft Type | Frequency | Percent |
|-------------------------------|-----------|---------|
| unilateral cleft lip | 12 | 24.00% |
| Unilateral cleft lip & palate | 9 | 18.00% |
| Bilateral cleft lip | 2 | 4.00% |
| Bilateral cleft lip & palate | 12 | 24.00% |
| Isolated cleft palate | 15 | 30.00% |

Table 5: Ease of laryngoscopy & intubation

| Ease of laryngoscopy | |
|----------------------|-------------------------------------------------------------------------------------------------|
| Easy | single attempt |
| Difficult | more than 1 attempt |
| Ease of intubation | |
| Easy | if successful with one or two attempts (by a single anaesthetist) |
| Difficult | if requiring more than two attempts |
| Failed | intubation not possible with three attempts (even after attempt by an expert anaesthesiologist) |

Table 6: Type of surgery

| Type of Surgery | Frequency | Percent |
|-----------------------------|-----------|---------|
| Lip repair | 16 | 32.00% |
| Palate repair | 26 | 52.00% |
| Lip+ anterior palate repair | 8 | 16.00% |
| Total | 50 | 100.00% |

Table 7: Perioperative complications

| Complications | Frequency | Percent |
|------------------------------------------------|-----------|---------|
| During induction | | |
| Difficult face-mask ventilation | 0 | 0.00% |
| difficult laryngoscopy | 5 | 10.00% |
| difficult intubation | 2 | 4.00% |
| failed intubation | 0 | 0.00% |
| Endotracheal tube related complications | | |
| tube dislocation | 0 | 0.00% |
| tube obstruction | 0 | 0.00% |
| tube disconnection | 1 | 2.00% |
| tube repositioning | 2 | 4.00% |
| Intraoperative complications | | |
| desaturation | 2 | 4.00% |
| laryngospasm | 1 | 2.00% |
| bronchospasm | 0 | 0.00% |
| Post extubation complications | | |
| tongue fall | 1 | 2.00% |
| upper airway obstruction | 0 | 0.00% |
| laryngeal edema | 0 | 0.00% |
| Breath holding spell | 1 | 2.00% |

Statistical Analysis Used

The data was analysed as mean, frequency and percentage as appropriate for the study. Basic statistics was assessed by using MS Excel Office 2007 data analysis Tool Pack. For preparation of tables of frequency distribution and percentages, SPSS software (Version 20) was used. The associations between two variables were determined by the Pearson Chi-Square test and Fisher's exact test. For all statistical comparisons in this study, a P value < 0.05 was considered to be significant and a P value < 0.01 was considered highly significant.

Results

This observational study was conducted over a period of one and a half years (Jan 2014-june 2015) in 50 ASA I and II paediatric patients undergoing cleft lip/palate surgery. The age group ranged from new-born to 12 years. The duration

of procedure ranged from 90 to 240 minutes. All patients were evaluated preoperatively for any associated congenital anomalies. 94% patients did not have any associated anomaly. Two patients had cardiac defects – Ostium Secundum ASD (7 mm with L-R shunt) & VSD with PFO & syndromic facies and microcornea. One patient was a case of Robert's syndrome (Phacomelia with cleft lip). None of our patients had any obvious retrognathia or history of obstructive sleep apnea. One patient gave a retrospective history of breath holding spasms in the post-operative period. One patient had tongue tie leading to difficulty in laryngoscopy. The data collected from the study were analysed and summarized as follows (TABLE 7). No patient had difficult face mask ventilation. Difficult laryngoscopy was noted in 5 patients. Difficult intubation was seen in 2 patients. There was no incidence of failed intubation. Tube disconnection occurred in 1 patient and tube repositioning was required in 2 patients after mouth gag placement. There were no episodes of tube dislocation or obstruction. There was one episode of desaturation (SpO₂=85%) when the patient could not be intubated in the first attempt using 4.0 size tube. Bag mask ventilation was done (SpO₂=99%) and patient was intubated with tube no 3.5. One patient had laryngospasm during intubation for which 2nd dose of inj succinylcholine was given. One patient has an episode of post extubation breath holding spell. The patient desaturated (87%). The patient was mask ventilated for 15 minutes and saturation improved. One patient had tongue fall postoperatively for which patient was placed in lateral position. No patient had any episodes of bronchospasm or laryngeal edema postoperatively. All patients had an uneventful recovery. We found a very strong association (P value< 0.01) between the Cormack Lehane grading and difficulty in laryngoscopy (TABLE 8). All incidence of difficult intubation occurred in Cormack Lehane grade II or III. The association between difficult laryngoscopy and type of cleft (TABLE 9) and difficult intubation and type of cleft (TABLE 10) was found to be insignificant.

Table 8: Association between difficult intubation & cormack lehane

| Difficult Intubation | | Cormack-Lehane Grade | | | Total |
|----------------------|---------|----------------------|---------|----------------|--------|
| | | I | II | III | |
| Yes | Count | 1 | 0 | 1 | 2 |
| | Percent | 3.0% | 0.0% | 33.3% | 4.0% |
| No | Count | 32 | 14 | 2 | 48 |
| | Percent | 97.0% | 100.0% | 66.7% | 96.0% |
| Total | Count | 33 | 14 | 3 | 50 |
| | Percent | 100.0% | 100.0% | 100.0% | 100.0% |
| Chi-Square Test | Value | Df | P Value | Association Is | |
| Pearson Chi-Square | 7.386 | 2 | 0.025 | Sig | |

Table 9: Association between difficult laryngoscopy & cleft type

| Difficult Laryngoscopy | | Cleft Type | | | | | Total |
|------------------------|---------|----------------------|-------------------------------|------------------------------|------------------------------|-----------------------|--------|
| | | Unilateral Cleft Lip | Unilateral Cleft Lip & Palate | Bilateral Complete Cleft Lip | Bilateral Cleft Lip & Palate | Isolated Cleft Palate | |
| Yes | Count | 0 | 2 | 0 | 2 | 1 | 5 |
| | Percent | 0.0% | 22.2% | 0.0% | 16.7% | 6.7% | 10.0% |
| No | Count | 12 | 7 | 2 | 10 | 14 | 45 |
| | Percent | 100.0% | 77.8% | 100.0% | 83.3% | 93.3% | 90.0% |
| Total | Count | 12 | 9 | 2 | 12 | 15 | 50 |
| | Percent | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Chi-Square test | Value | df | P Value | Association is | | | |
| Pearson Chi-Square | 3.827 | 4 | 0.430 | Not Sig | | | |

Table 10: Association between difficult intubation & cleft type

| Difficult Intubation | | Cleft Type | | | | | Total |
|----------------------|---------|----------------------|-------------------------------|------------------------------|------------------------------|-----------------------|--------|
| | | Unilateral Cleft Lip | Unilateral Cleft Lip & Palate | Bilateral Complete Cleft Lip | Bilateral Cleft Lip & Palate | Isolated Cleft Palate | |
| Yes | Count | 1 | 0 | 0 | 1 | 0 | 2 |
| | Percent | 8.3% | 0.0% | 0.0% | 8.3% | 0.0% | 4.0% |
| No | Count | 11 | 9 | 2 | 11 | 15 | 48 |
| | Percent | 91.7% | 100.0% | 100.0% | 91.7% | 100.0% | 96.0% |
| Total | Count | 12 | 9 | 2 | 12 | 15 | 50 |
| | Percent | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| Chi-Square test | Value | df | P Value | Association | | | |
| Pearson Chi-Square | 2.257 | 4 | 0.689 | Not Sig | | | |

Discussion

Surgical repair of the cleft lip/palate in infants and children is a great challenge to the anaesthesiologist. The anaesthesiologist shares the airway with the surgeon during the surgery and has to deal with other problems such as the pediatric age group, intubation difficulties and morbidity associated with the developmental anomalies. The airway of infant as such differs from that of the adults [49]. Presence of cleft with its associated anomalies may further make laryngoscopy and intubation difficult. The major responsibility of anaesthetist is to provide adequate ventilation to the patient because it is estimated that about 1/3 of all anaesthetic deaths in neonates and children are due to failure to intubate and ventilate. Preoperative assessment for difficult intubation is difficult in paediatric patients. Despite the lack of a definitive test for difficult intubation, children should be examined pre-operatively for signs of retrognathia. The history must also include questions to pick up any obstructive sleep apnea or feeding difficulties since birth, how they were managed and whether they have resolved. Patients with cleft lip and palate can be syndromic. The anatomical defects in cleft lip/palate may increase the risk of difficult mask ventilation. Mask ventilation was possible in all patients. None of the previous studies have reported any difficulty in mask ventilation. Charles

Nargoian [10] stated that during cleft surgery there is a tendency of the tongue to fall into the cleft and it may obstruct the nasal airway. Somerville *et al.* [11] stated that difficult face mask ventilation is very rare. If the airway becomes obstructed after loss of consciousness, treatment options include turning the patient lateral or semi prone and the use of a nasal or oral pharyngeal airway. If the airway gets obstructed, stomach inflation can occur as the anaesthetic gases pass through the path of least resistance. This may further jeopardize the ventilation by causing splinting of the diaphragm.

In our study, difficult laryngoscopy due to wide cleft defect requiring more than one attempt for intubation was seen in 5 patients (10%). External laryngeal manipulation was required in 28% of patients for better visualisation of the larynx. None of the patients had any injury during laryngoscopy. Xue *et al.* [12] reported 4.77% incidence of difficult laryngoscopy in their study. Gunawardana [13], in his study of 800 cleft lip/palate repairs reported the need for external laryngeal pressure in 86% of cases with Cormack and Lehane Grade III and IV airway grades. This could be because he didn't use a muscle relaxant which might have led to inadequate intubation conditions. Michael Tremlett [14] found that an adequate view of the larynx is usually easily achieved with gentle cricoid pressure and a choice of

curved or straight laryngoscope blades.

Cormack Lehane grading was noted for each patient. 66% patients had Cormack Lehane I, 14% had Cormack Lehane II and 6% had Cormack Lehane III. There was no significant association seen between age, weight and sex of the patient and Cormack Lehane grading. There was a significant association between Cormack Lehane grading and type of cleft (TABLE 8). All patients with cleft lip alone had Cormack Lehane I. Patients with both cleft lip and palate had the highest incidence of Cormack Lehane II (57.14%) and III (9.5%). 20% of patients with isolated cleft palate had Cormack Lehane II and III. 33.3% patients with Cormack Lehane grade III had difficult intubation. This compares well with the study conducted by Xue *et al.*^[12] in which difficult intubation occurred mainly in infants with laryngoscopic views of grade III and IV. Gunawardana^[13] found that intubation was difficult in 67 patients (8.38%), of which 51 (76.12%) had a grade III or IV view and 16 (23.88) had a grade I or II view. There was a highly significant association between the anomaly and laryngoscopic view.

In our study a 4% (n=2) incidence of difficult intubation was recorded. Both the patients had Cormack Lehane grade III and required two attempts for successful intubation. There was one episode of desaturation (SpO₂=85%) when the patient could not be intubated in the first attempt using a size 4.0 tube. Bag mask ventilation was done (SpO₂=99%) and patient was intubated with tube no 3.5. There were no failed intubations. Our observation compares well to 4.77% (n=47) incidence of difficult intubation obtained by Xue^[12]. Gunawardana^[13] did not use muscle relaxants for intubation and obtained higher values of 8.38% (n=67) of difficult intubation and 1% (n=8) of failed intubation. He attributed this mainly to the age of the patient (less than 6 months) and Cormack Lehane grade III and IV (n=51). Adenekan *et al.*^[15] reported one case of difficult intubation and one case of failed intubation in total of 116 patients. Desalu *et al.*^[16] reported 2% incidence of failed and difficult intubation in his study of 50 patients. Qureshi *et al.*^[17] reported 1.16% (n=2) incidence of difficult intubation in 172 patients. Thomas Fillies *et al.*^[18] encountered difficulties during intubation which led to fiberoptic intubation in one infant, and reintubation in another.

The incidence of intraoperative laryngospasm in our study was 2% (n=1). The laryngospasm occurred during intubation and was relieved by administration of a second dose of inj succinylcholine. Patient had no episode of hypoxemia. Laura *et al.*^[19] found that laryngospasm is reported more commonly in paediatric patient (17.4/1000) than in the general population (8.7/1000). In the study conducted by Maharjan SK *et al.*^[20], intraoperative laryngospasm occurred in 4 children out of 250 in TIVA group and 2 had required endotracheal intubation and positive pressure ventilation. Laryngeal spasm (6%) and Bronchospasm (4%) occurred in surgeries for cleft palate repair only in study by Desalu *et al.*^[16].

Problems with the endotracheal tube are common intraoperatively due to the shared airway. It may be pulled out, pushed into the right main bronchus when the head is moved or kinked under the mouth gag. The introduction of a mouth gag can compress or move the tube. This is easily detected by airway pressure monitoring and capnography tracing which emphasises the importance of adequate monitoring for early detection^[21]. Tracheal tube problems

occurred in 3 patients (6%) in our study of which there was tube disconnection in one, and repositioning was required in two patients. All but one (disconnection) occurred in patients having cleft palate repair. One patient had an endobronchial displacement of tube after positioning. The patient desaturated (SpO₂= 87%). The tube was repositioned and the saturation improved. Desalu *et al.*^[16] reported incidences of 6% tube disconnection, 2% tube compression, 2% accidental extubation and 14% desaturation.

In the post-operative period these children are at risk for acute upper airway obstruction as a result of upper airway narrowing, edema, blood, and residual anaesthetic effects as well as preoperative OSA. Infants are obligate nasal breathers. Cleft palate closure may result in upper airway compromise. Profound tongue edema can occur from venous engorgement after use of the Dingman mouth retractor.⁵ Postoperative respiratory distress in patients with cleft lip/palate has been described by many authors. In the study done by Smith *et al.*^[22], five developed respiratory distress post-operatively and four required oxygen, both events significantly associated with pre-operative obstructive sleep apnoea (p = 0.001 and 0.015, respectively). Four desaturated within 24 hours. They concluded that pre-operative obstructive sleep apnoea correlated significantly with post-operative respiratory distress, supplementary oxygen requirement, nasopharyngeal airway insertion and hospital stay. No patient in our study had any episodes of bronchospasm, laryngospasm or laryngeal edema postoperatively. Maharjan SK *et al.*^[20] recorded post extubation laryngospasm in 8 children out of 400 patients and all were managed with mask ventilation with 100% oxygen. Stephen *et al.*^[23] studied 50 patients and reported one case of postoperative laryngospasm following extubation which required reintubation immediately. Postoperatively there were four cases of mild hypoxaemia and one patient with transient apnoea. All were treated with supplementing oxygen. Lee *et al.*^[24] reported a case where massive lingual edema after cleft palate repair resulted in a life-threatening airway obstruction. The patient was reintubated and elective ventilatory support was given till the edema subsided.

Conclusions

- Airway and respiratory complications can be encountered during cleft lip and palate surgeries.
- Preoperative assessment and identifying any airway problems, congenital anomalies and comorbid conditions is important.
- Adequate preparation for difficult airway should be done before induction of anaesthesia to avoid morbidity and mortality.
- Difficult laryngoscopy and intubation may be encountered. Proper positioning of the patient along with placing a gauze piece in the cleft may aid in laryngoscopy and intubation.
- Use of muscle relaxant to facilitate laryngoscopy should be judicious as intubation can be difficult and should be given only after confirmation of adequate mask ventilation.
- Applying external laryngeal manipulation improves the Cormack Lehane grading and may contribute to the reduced incidence of difficult intubation.
- Intraoperative airway complications due to the shared

airway have to be anticipated.

- Postoperative airway obstruction may be encountered and has to be treated prophylactically.
- The association between airway complications and type of cleft was found to be insignificant.

Limitations

Our study was limited by the number of cases included. It is difficult to compare our results with other published studies because of the small number of study population. A study over a longer period of time would be needed to determine the incidence of these complications more correctly.

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