Retrospective Evaluation of Pediatric Difficult Intubation Cases in terms of Otorhinolaryngology
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Abstract

Objectives: Difficult intubation cases may result in morbidity and even mortality if necessary precautions are not taken. Pre-operative diagnosis of difficult intubation in these patients is possible with a detailed history and examination of the airway. The aim of this study was to retrospectively review the files of pediatric patients diagnosed with difficult intubation in the operating room, the examination of the causes of difficult intubation from an otorhinolaryngological perspective, and defining parameters that will help clinicians to provide predictability of difficult intubation diagnosis in the preoperative period. Materials and methods: Pediatric patients who underwent general anesthesia for surgical procedures in the operating room and who were diagnosed with difficult intubation by an anesthesiologist and whose files could be accessed were included in the study. Age, gender, weight, accompanying disease, ASA score, thyromental distance, Mallampati score, neck movements, laryngeal level, micrognathia status, Cormack Lehane stage data were retrospectively scanned from the patient files. Results and conclusions: A total of 14 patients were included in the study. 75% of the patients had congenital anomalies. In 13 of the patients, the Mallampati score was determined 3, 4, and the Cormack-Lehane score was determined 4. Considering that the Mallampati score changes with the position of the patient, it is particularly useful to perform a preoperative examination by the Ear Nose Throat clinician and determine the Cormack-Lehane score in advance in determining patients who are likely to have pediatric difficult intubation.

Keywords: Endotracheal intubation; airway management; anesthesia; congenital abnormalities.

INTRODUCTION

Laryngotracheal intubation is inevitable in many surgical interventions and is the safest method used to maintain upper respiratory tract patency, help to breathe and carry out controlled respiration in patients whose breathing stopped. Although intubation in pediatric patients is performed by anesthesiologists in the operating room before surgical procedures with general anesthesia, it is also performed by pediatricians, emergency medicine clinicians, and intensive care specialists in life-threatening situations [1]. The difficult airway is defined as the difficulty of ventilation with a face mask (and/or difficulty in tracheal intubation), while difficult intubation is defined as the failure of the endotracheal intubation procedure despite three or more attempts and the duration of the endotracheal intubation procedure lasting longer than 10 minutes [2].

The rate of difficult intubation was found to be 5.8 % in adults and 0.42 % in children [3, 4]. Even though the likelihood of difficult intubation is higher in adults, this rate is higher in children under the age of 1 compared to older children [5]. Repeated intubation attempts due to difficulty in intubation may lead to closure of airway and make it impossible to be ventilated [6]. The preoperative evaluation of airway of pediatric patients with a history of difficult intubation, radiotherapy applied to the head and neck region, congenital malformation, cervical vertebra disease, obesity, and obstructive sleep apnea, is required to be done together with anesthesiologists and Ear Nose Throat (ENT) clinicians who have detailed knowledge of regional anatomy and surgery to prevent possible catastrophes. This collaboration includes both airway examination with fiberoptic in the preoperative period and emergency tracheostomy in patients who cannot be ventilated and intubated during the peroperative period [7].

Pediatric patients have some anatomical and physiological differences compared to adults. The larynx level, tongue to mouth ratio, epiglottis angle, and size are more pronounced in babies and these
differences decrease as the child grows [8]. Because of these differences, mask ventilation, direct laryngoscopy and endotracheal intubation are relatively more difficult in pediatric patients than in adults. While Mallampati scoring is the most commonly used evaluation method to predict difficult intubation in the preoperative period in adult patients, the use of this scoring in pediatric patients is not objective because the assessment will change depending on the position. Difficult airway diagnosis in the preoperative period in pediatric patients can be easily provided by the fiberoptic evaluation of those who have risk factors by ENT clinicians. Diagnosing difficult intubation in pediatric patients in the preoperative period ensures that necessary precautions are taken in advance to prevent possible catastrophic consequences.

The aim of our study was to retrospectively examine the files of pediatric patients who were diagnosed with difficult intubation by anesthesiologists to evaluate the data to be obtained from an otolaryngological perspective by the ENT clinician to reveal predictive markers that may be useful in predicting patients with difficult intubation.

MATERIALS AND METHODS

This retrospective study was approved by the Selcuk University Faculty of Medicine Ethics Committee with the number of 2020/384. Pediatric patients aged 0-18 years who underwent surgery under general anesthesia between 2012 and 2018 at Selcuk University Medical Faculty Hospital and who were diagnosed with difficult intubation by an anesthesiologist during the endotracheal intubation procedure were included in the study. Age, gender, weight, accompanying disease, ASA score, thyromental distance, Mallampati score, neck movement, laryngeal level, retro/micrognathia status and Cormack Lehane scores from the patient files were scanned by the ENT clinician.

RESULTS

Of the 14 patients included in the study, 4 were girls and 10 were boys. 3 (25%) patients had no concomitant disease, 9 patients (75%) had a congenital or syndromic disorder. The ASA score was found to be I in two patients, while it was II and III in the other patients. One patient with the mitochondrial disease had an ASA IV score. Mallampati score was 3 and 4 in all patients except one. Neck extension was limited in 2 patients who were diagnosed with Freeman Sheldon Syndrome and MPS type 6. All patients except one patient had high larynx. Six patients had micrognathia. Most of the patients were evaluated as grade 4 according to the Cormack-Lehane classification. Tracheal compression was used as an auxiliary maneuver in all patients. More than one intubation attempt was made in all patients and different devices were used in 6 patients. A patient with Freeman Sheldon syndrome was awakened because endotracheal intubation could not be performed despite attempts to be intubated with different devices. In pediatric patients with a diagnosis of difficult intubation included in our study, one or more assistive devices were used at different stages and in different orders to perform endotracheal intubation. Endotracheal intubation was performed in 3 patients in the second trial and in 1 patient in the third attempt, without using any additional device. Frova intubation catheter was used for intubation in seven patients. In one of these patients with Pierre Robin syndrome, the endotracheal intubation attempt with a videolaryngoscope was not successful before successful endotracheal intubation with the Frova catheter. In a patient with Freeman Sheldon syndrome, endotracheal intubation with Frova catheter and Bonfils fiberscope was not successful. The patient was then intubated with a fiberoptic bronchoscope. Two patients required tracheotomy. One of these patients, a newborn with Pierre-Robin syndrome, was awakened without being intubated at the first operation, and tracheotomy was performed in the next session due to serial operations. The other was the patient who was hospitalized due to burns and whose mouth opening was very limited due to a burn scar and could not be evaluated before surgery, could not be intubated with various intubation techniques and mask ventilation could not be provided and an urgent tracheotomy was required (Table 1).
**Table 1: Characteristics of difficult intubation patients**

<table>
<thead>
<tr>
<th>Age</th>
<th>Sex</th>
<th>ASA</th>
<th>Additional disease</th>
<th>Mallampati Score</th>
<th>Tyromental distance(cm)</th>
<th>Neck extension</th>
<th>High larynx</th>
<th>Micromastia</th>
<th>Cormack-Lehane stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>II</td>
<td>CP</td>
<td>3</td>
<td>2.5</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>III</td>
<td>Omphalomesenteric canal anomaly</td>
<td>3</td>
<td>1.5</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>III</td>
<td>VSD, ASD, Pierre-Robin syndrome</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>II</td>
<td>Freeman Syndrome</td>
<td>4</td>
<td>2.5</td>
<td>restricted</td>
<td>+</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>IV</td>
<td>Mitochondrial disease, Epilepsy, CP</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>III</td>
<td>Dandy-Walker Syndrome</td>
<td>3</td>
<td>5</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>II</td>
<td>Goldenhar Syndrome</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>I</td>
<td>-</td>
<td>3</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>III</td>
<td>MPS type 6</td>
<td>4</td>
<td>4</td>
<td>restricted</td>
<td>+</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>III</td>
<td>Craniocytosis</td>
<td>4</td>
<td>3</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>M</td>
<td>I</td>
<td>-</td>
<td>3</td>
<td>7</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>M</td>
<td>III</td>
<td>VSD, cleft-palate lip, left aural atresia</td>
<td>3</td>
<td>2.5</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>M</td>
<td>II</td>
<td>Pierre-Robin Syndrome</td>
<td>3</td>
<td>1.5</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>M</td>
<td>II</td>
<td>(Burn)</td>
<td>could not be evaluated</td>
<td>could not be evaluated</td>
<td>restricted</td>
<td>could not be evaluated</td>
<td>could not be evaluated</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

Among the causes of pediatric difficult intubation, situations where laryngeal structures such as the high larynx cannot be seen (especially craniofacial malformation) are quite common. In patients with difficult intubation conditions, auxiliary for airway management such as Videolaryngoscopes (VLA), Laryngeal mask airway (LMA), Bonfils intubation fiberoptic (Karl Storz Endoscope, Tutlingen, Germany) and Frova intubation catheter (Frova Intubation Catheter, USA) devices are used (1). Considering the patient data, anatomical and physiological changes in patients with congenital anomalies or syndromes seem to be the most important cause of difficult intubation. However, three patients did not have any accompanying disease in our study while other patients had congenital anomalies or syndromes.

Congenital anomalies are among common causes of difficult intubation in pediatric patients [9, 10], since almost all have anatomical and physiological differences. Concerns in one or more parameters such as asymmetry of the head, face and neck, degree of mouth opening, presence or absence of oral pathology, mentohyoid and tyromental distance, adequacy of neck flexion/extension determine the potential of difficult airway management [11, 12]. Mallampati score, evaluating the visibility of oropharyngeal structures or Cormack-Lehane classification evaluating the visibility of laryngeal anatomy may be utilized in the assessment of probable difficult intubation cases [13, 14]. The most important common point in cases seems to be the high grades in the Cormack-Lehane classification. In the study of Eberhart et al. [14], for Grade 3 and 4, the Cormack-Lehane classification was found to be superior to Mallampati classification in predicting difficult laryngoscopy. Flexible laryngoscopy, which is one of the routine clinical practices of otorhinolaryngology, may determine the Cormack-Lehane classification of patients. This classification is employed commonly in many clinics particularly for the evaluation of OSAS patients. Cormack-Lehane score may be very valuable for predicting difficult intubation cases. Rosenblatt et al [15] stated that endoscopic laryngeal examination performed before operation changed the plan of airway management in 26% of patients. While restricted neck extension, mandible size, and Mallampati score can be evaluated by the anesthetist during the examination before anesthesia induction. In difficult intubation cases, unless precautions are taken in advance, urgent problems that may have undesirable consequences may arise.

Tyromental distance defined by Patil et al. [16] is associated with extension capacity of the head, larynx position, length, and depth of mandible. There are studies modifying this evaluation, which is usually used in adults, to the pediatric population [17, 18]. As reported by Rafique et al [17] in children under the age of 5, tyromental distance becomes shorter as the mandible size is reduced. In the present study, there were two cases with neck extension restriction who have Freeman Sheldon syndrome and MPS type 6 respectively. In Freeman Sheldon syndrome, skeletal malformations and head-face anomalies are encountered. In MPS type 6, skeletal anomalies and joint rigidity may be present.
Micrognathia, which was present in half of our cases, is among malformations seen in Goldenhar and Pierre-Robin syndromes [19]. All kinds of anomalies in the head-neck region, craniostenosis, and joint restrictions are among factors rendering intubation more difficult. A high and anteriorly located larynx is present in almost all patients was tried to be manipulated by head extension and tracheal pressure.

In the study of Aida et al., it was stated that 9 out of 10 difficult intubation cases had congenital anomalies [20]. In two of our cases without the additional disease, Mallampati score, and Cormack-Lehane stage were high. These two patients had no congenital malformation or skeletal anomaly. Prediction of difficult intubation in such patients is more difficult than patients with obvious head-neck and skeletal anomalies. Although anatomical characteristics of patients, accompanying diseases, and musculoskeletal or skeletal anomalies suggest the probability of difficult intubation, there are also cases without any previous diseases or problems. Various risk factor schemes, scores and classifications, measurements, and physical examination techniques aiming to predict difficult intubation cases have been described. However, perioperative airway examination, which should be carried out to predict difficult intubation is not easy in pediatric patients. In these cases, pediatric patients who are suspected to have difficulty in intubation or who have syndromes should be examined by an otolaryngologist under outpatient clinic conditions with fiberoptic laryngoscopy. Therefore, it can be suggested that patients with suspicion of difficult intubation should undergo a multidisciplinary preoperative evaluation with the collaboration of the Anesthesiology and Otorhinolaryngology departments.

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