**Archives of Anesthesiology**

**ISSN 2638-4736**

**Volume 2, Issue 1, 2019, PP: 28-31**

# Pediatric Difficult Airway

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**Abstract**

*The pediatric patient has a number of predictable difficult intubation criteria compared to adults. High American Society of Anesthesiologists score and congenital syndromes are among predictors. Cardiac and oromaxillofacial surgery were found to be associated with difficult airway Therefore, hypoxia can easily develop in a short time period. Causes of anatomical airway obstruction include inappropriate head position, inappropriate facial mask technique or large adenoids or tonsils and obesity. There are several advanced techniques for the management of pediatric difficult airway. Compared with direct laryngoscopy, videolaryngo scopes have been shown to provide a better view of laryngeal structures, have a slightly prolonged intubation time with a similar success rate. In guidelines, fibreoptic tracheal intubation through supraglottic airway devices is recommended as another resque method to provide an intact airway. In this review we aimed to analyse different approaches to the difficult pediatric airway management according to the recent literature.*

**Keywords:** *airway management; difficult airway; children.*

## Introduction

### Definition and Incidence

Pediatric difficult airway is defined when a clinician come accrosswith difficult mask ventilation, difficult laryngoscopy or both (1). The unexpected incidence of difficult mask ventilation ranges from 2.8% to 6.6% in children (2). It has been reported that the incidence of unexpected difficult intubation with Cormack and Lehane grades III and IV is between 0.15 and 1.4%. When the incidence of difficult airway is compared in adult and pediatric patients, it is observed that the biggest problem becomes with the mask ventilation. In another study, it was reported that the frequency of difficult intubation may range from 1.5 to 6% in adults and 0.12 to 0.57% in children (3). While difficult laryngoscopy incidence is 1.35%, it increases to 4.9% in adults. Difficult mask ventilation risk is 2.2% in adults and 2.8% in children. Besides 23.8% of the reported difficult airway cases were unexpecte ddifficult airway (3).

### Predictors

The pediatric patient has a number of predictable difficult intubation criteria compared to adults. These include large occiput and are impediment for giving the patient appropriate position. Narrow nostrils can be easily collapsed. Small mouth, large tongue and high larynx cause laryngoscopy particularly difficult. Cricoid structure is narrow. Epiglottis is floppy and can be often difficult to control. On the other side functional residual capacity decreases in children and their oxygen consumption is high. Therefore, hypoxia can easily develop in a short time period. There are some predictors in the preoperative evaluation. The most common disease is obesity nowadays. There is an additional decrease in functional residual capacity in obese children.

Low age is another predictor. The APRICOT study was a multicenter observational study of 261 hospitals and investigated the incidence of severe critical events that may develop during pediatric anesthesia (4). According to the results of 31.127 cases, the incidence of complications in children under 1 year of age was found to be 10.6%, and half of them had severe complications. As a result, it has been reported that children under 3-3.5 years should be managed by pediatric anesthesiologists or tertiary care providers.

High American Society of Anesthesiologists (ASA) score and congenital syndromes are among other predictors. These syndromes includeTrisomy 18, Tracheal agenesis, Laryngeal atresia, Congenital fusion of the jaw, Laryngeal web, Congenital laryngeal stenosis, Cystic hygroma, Goldenhar's, Robin sequence, Treacher-Collin's, Hallerman-Streiff, Hemifacial microsomia, Cleft palate, Nager's, Down's, Cockayne's, Cri-du-chat, Russel-Silver, Dystrophic epidermolysis bullosa, Klippel-Feil, Microstomia, Epiglottitis, Lingual tonsillitis, Abscess, Rheumatoid disease, Ludwig's angina, C-spine injury, Laryngeal trauma, Burns, Hematomas, Achondroplasia, Arthrogryposis multiplex congenita, Beckwith-Wiedemann, Fibrodysplasia ossificans progressiva, Lipoid proteinosis, Lipodosis, Mucolipidosis, Hurler, Hunter, Scheie, Sanfilippo, Morquio, Maroteaux-Lamy, Freeman-Sheldon, Muscle-eye-brain disease, Angio edema, Turner, Noonan, Thalassemia major, Stevens-Johnson, Smith- Lemli-Optiz, Scleroderma, Rubinstein-Taybi, Pompe disease, Laryngotracheal papillomatosis, Marfan, Crouzon, Apert, Cornelia de Lange, Cherubism. Cardiac and oromaxillofacial surgery werefound to be associated with difficult airway (5).

The Pediatric Difficult Intubation (PeDI) registry in 2016 was a prospective cohort analysis (6). According to this analysis, unexpected difficult airway patients experience serious complications more frequently.

## Guidelines

The American Society of Anesthesiologists (ASA) difficult air way management guideline was published in 2013. Awake intubation is recommended for anticipated difficult airway howeverthey stated that if the patient is not cooperative, or is a pediatric patient, tracheal intubation can be tried under general anesthesia (1). German recommendations were published in 2011 (7). In line with these recommendations, it was stated that video laringoscopes could be used in difficult intubation cases and the importance of planning fiber optic intubation in failed intubation was emphasized. After wards in 2015, the Difficult Airway Society published an airway management guideline for children aged 1-8. The most important difference of this guideline from the German recommendations is to question the adequacy of muscle looseness in patients who cannot be ventilated and to recommend paralysis of patients before surgery.

## Airway Obstruction

Oxygenation and ventilation problems can be examined in two parts as anatomical and functional airway obstruction. Causes of anatomical airway obstruction include inappropriate head position, inappropriate facial mask technique or large adenoids / tonsils and obesity. On the other hand, unsuitable depth of anesthesia, laryngospasm, muscle rigidity and bronchospasm cause functional obstruction. Causes of anatomical obstruction can be overcome with simple manuplations without requiring devices, especially under 2 years of age. It is one of these simple attempts to remove the head pillow and elevate the shoulder. The neck flexion can occur in infants when they lie on flat surface. It has been shown that the alignment is effectively achieved and the success of tracheal intubation is increased (9). Additional basic procedures include the use of two-hand mask ventilation, oropharyngeal and nasopharyngeal airways and call for help. Kissing tonsils are another causes of anatomical obstruction (10). Rarely it is observed that vocal cords can easily be passed, but then there may be difficulties due to tracheal stenosis (11).

## Advanced Techniques

The advanced techniques used in pediatric difficult intubation are summarized in Table 1. The gold standard is still the fiberoptic intubation (12). Inadequate cooperation is the most important limiting factor in the application of methods to children in adults (13). Therefore, general anesthesia or deep sedation can be preferred. However, maintenance of spontaneous respiration as much as possible and sedation with a single agent are advantageous for patient safety. Fiberoptic tracheal intubation through the supraglottic airway device is another advanced technique. Intubating LMA (Fastrach) has been used for blind tracheal intubation since 1995 (14). But the most important limitations include that this is a blind

technique and pediatric size is not available. In 2011, the DAS guideline was published tracheal intubation through SAD (15). The technique recommended in this manual was the use of Aintree catheter. However, it can only be used in adolescent or bigger children. Because it has an internal diameter of 4.2 mm and an external diameter of 6.5 mm, which allows intubation with tracheal tubes with an outer diameter ≥7 mm.

In a meta-analysis of 789 patients, the data of 10 studies were evaluated and pediatric air-Q was compared with other Supraglottic Airway Devices (SADs) (16). The ease of insertion and success rate of intubation were significantly lower than the other SADs, however Air-Q provided a better fiberoptic bronchoscopic view. There are different videosingoscopes of many brands in the market. Some of these include Miller: # 0 and 1, Mac-Blade: # 2 pediatric blades for Storz C-MAC. There are also D beads for intubation of children 10 kg and over and their use significantly reduces the need for awake intubation (17). Glide Scope is another type of videolaryngoscope with number 0 for children under <1.5 kg, number 1 for 1.5-3.6 kg, number 2 for 1.8-10kg, and number 2.5 for children between 10-28 kg. McGrath Series 5, Medan VL and Airtraq are among the other pediatric videolaryngoscopes. Compared with direct laryngoscopy, videolaryngoscopes have been shown to provide a better view of laryngeal structures, have a slightly prolonged intubation time with a similar success rate. If direct laryngoscopy fails, success rate with videolaryngoscopes increases slightly. However, there is no evidence of the superiority of a particular device (18). In an observational study, the rates of complications with first-attempt success rate, Overall success and number of attempts were similar for patients who underwent videolaryngoscopy or fiberoptic intubation (19). Moreover, the frequency of the use of combined techniques is increasing day by day (20).

## Conclusion

In conclusion, facial mask ventilation, laryngoscopy or tracheal intubation difficulties may be encountered in pediatric patients. Tracheal stenosis is another associated difficulty beyond the vocal cords. Fiberoptic intubation, which is the recommendation of guidelines in pediatric patients, should be used as a backup plan. Difficult airway management in pediatric patients requires a multidisciplinary approach with team work.

**Table 1.** *Advanced techniques in pediatric patients*

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| Awake fiberoptic intubation |
| Intubation through Supraglottic Airway Devices |
| Videolaryngoscopes |
| Optical stylets |
| Surgical airway |
| Manuel Jet Ventilation |

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**Citation:** **Kemal Tolga Saracoglu, Ayten Saracoglu, Banu Cevik, Recep Demirhan.** *Pediatric Difficult Airway. Archives of Anesthesiology. 2019; 2(1): 28-31*