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Original research article

Visibility of the glottis in children using video and direct laryngoscopy during induction of general anesthesia: a retrospective comparative study

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Abbreviations
ASA – American Society of Anesthesiologists
BMI – body mass index
DL – direct laryngoscopy
VL – videolaryngoscopy

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Abstract

***Background and purpose**: Hypertrophic tonsils can limit the visibility of glottis as a prerequisite for successful intubation. Although expected, studies have not unequivocally proven that videolaryngoscopy improves the visibility of the glottis in children. The aim of this study was to compare the visibility of the glottis using direct (DL) and video laryngoscopy (VL) during induction of general anesthesia in children undergoing adenotonsillectomy or adenoidectomy.*

***Materials and methods:** This retrospective study was performed by reviewing the medical charts of 88 children, up to 8 years of age, who underwent adenotonsillectomy/adenoidectomy in the period from January to December 2024 at the Sveti Duh University Hospital in Zagreb. General data were taken for each patient: age, gender, height and weight; preoperative anesthesiology data; ASA classification, Mallampati; intraoperative anesthesia data: difficulty of manual ventilation (according to Han), glottic visualization according to the Cormack Lehane classification, intubation (orderly, difficult, impossible), type of laryngoscope used, type of mechanical ventilation (volume, pressure) and postoperative data on postoperative respiratory complications. Thirty-eight children had complete data.*

***Results:** The Cormack-Lehane classification distribution was similar between the VL and DL (p=0.250). The distribution of glottic visibility according to the Cormack-Lehane classification from 1 to 4 in the VL group (n=13), was as follows: 10 (76.9%), 3 (23.1%), 0 (%), and 0 (0%), while in the DL group (n=25) was as follows: 18 (72%), 3 (12%), 4 (16%), and 0(0%).*

***Conclusion:** In our patient sample, VL compared to DL did not increase glottic visibility according to the Cormack-Lehane classification.*

INTRODUCTION

Pediatric patients face unique challenges in airway management due to their anatomical and physiological characteristics. Children typically have a larger proportion of soft tissue in the pharyngeal area, a shorter neck, and a larger laryngeal angle, which can complicate endotracheal intubation *(1)*. In addition, adenotonsillar hypertrophy, common in pediatric patients, may clinically present as a compact obstruction intruding into oropharynx which disrupts clear visualization of the laryngeal inlet (glottis) into larynx *(2)*.

Although direct laryngoscopy (DL) has traditionally been the gold standard for airway management, videolaryngoscopy (VL) has been

introduced as an alternative with many benefits which may improve difficult airway management in adults. The suggested VL benefits are higher rates of successful intubation on the first attempt with improved glottic views, whereas there are fewer rates of failed intubation and complications such as hypoxemia and esophageal intubation *(3,4,5)*. However, for children there is only partially evidence support for these benefits *(6,7)*. Given the lack of consensus and the anatomical challenges faced by children undergoing adenotonsillectomy or adenoidectomy, this study aimed to compare glottic visibility between DL and VL in pediatric patients undergoing these procedures.

MATERIALS AND METHODS

We conducted a retrospective study by reviewing anesthesia records and surgical protocols of children who underwent adenotonsillectomy or adenoidectomy at the Department of Otorhinolaryngology and Head and Neck Surgery, Sveti Duh University Hospital in Zagreb from January to December 2024. The study was approved by local Ethical committee of Sveti Duh University Hospital in Zagreb (decision, No 03-3559, 16th May 2025).

Patient Selection

We included children under the age of eight who underwent adenotonsillectomy or adenoidectomy under general anesthesia with documented airway management details. We excluded patients with incomplete records, congenital airway anomalies, neuromuscular diseases, or those requiring alternative airway management techniques to direct laryngoscopy or videolaryngoscopy (e.g. supraglottic devices). We initially identified 88 children, but the complete data was available for 38 patients.

For each child, we recorded demographic data (age, gender, height, weight, and body mass index (BMI) (8)), preoperative assessment data (American Society of Anesthesiologists (ASA) classification (I-VI)*(9)* and Mallampati score (1-4) *(10)*), airway management data (manual ventilation according to the Han scale (11)), glottic visualization using the Cormack-Lehane classification (1-4) *(12),* recorded intubation difficulty (easy if one attempt, difficult if two or more attempts), type of laryngoscope used (direct or video), type of mechanical ventilation (pressure- or volume-controlled)), and postoperative data (respiratory complications immediately after extubation and during early recovery). The healthy weight for children means BMI being between the 5th percentile to less than the 85th percentile. An underweight child is less than the 5th percentile. An overweight child is between the 85th percentile to less than the 95th percentile. An obese child is the 95th percentile and greater. Severe obesity is defined as 120% of 95th percentile, or greater or 35kgm^{-2} or greater *(8)*.

Statistical Analysis

Data was first processed by descriptive methods and the results were presented tabularly and graphically. Categorical data (gender, ASA, BMI category, Mallampati score, Cormack Lehane score, type of laryngoscopy, type of mechanical ventilation, respiratory complications, were expressed in absolute numbers and corresponding percentage. Quantitative data (age, height, weight, BMI) was tested for normality by the Kolmogorov-Smirnov test and the Shapiro- Wilk test. Quantitative data compatible with normal distribution (height) was presented as mean and standard deviations, while data incompatible with a normal distribution (age, weight, BMI) were presented as medians and interquartile range. Unpaired t-test was used for the comparative analysis of normally distributed quantitative date between the direct laryngoscopy and videolaryngoscopy group. The Mann-Whitney U test was used to compare non-normally distributed quantitative data between the direct laryngoscopy and videolaryngoscopy group. The Fisher 's exact test was used for the comparative analysis of categorical data. The results were interpreted at the 5% significance level. We used IBM SPSS software for Windows, version 30.0.0.0 (IBM SPSS Inc., Chicago, Il, USA) statistical program.

RESULTS

We analyzed data from 38 pediatric patients who underwent adenotonsillectomy or adenoidectomy (Table 1). The study population was predominantly boys with median age 6 (minimal 3, maximal 8). Children were mostly weighed healthily (44.7%). There were only ASA I and ASA II children. Distribution of the Mallampati score from 1 to 4 was as follows: 17 (44.7%), 20 (52.6%), 1 (2.6%), 0 (0%). Distribution of the Cormack Lehane score from 1 to 4 was as follows: 28 (73.7%), 6 (15.8%), 4 (10.5%), 0 (0%). Manual ventilation was not difficult in any patient. Intubation was successful in the first attempt in 31 cases (81.6%). There were no more than two attempts recorded in any intubation. The videolaryngoscopy group (VL) included 13 patients, while the direct laryngoscopy group (DL) consisted of 25 patients.

Demographic and Airway Management Characteristics between the VL and DL groups

The two study groups had comparable demographic characteristics, except for height (p=0.036) (Table 2). There was no statistical difference in distribution of Mallampati, and the Cormack Lehane score between the study groups (Table 2). The distribution of Cormack-Lehane score (1-4) in the VL group was as follows: 10 (76.9%), 3 (23.1%), and no cases of 3 or 4. In the DL group the distribution of Cormack-Lehane score (1-4) was as follows: 18 (72%), 3 (12%), 4 (16%), and no cases of 4. Difficult intubation with

Table 1. *Demographic and airway management characteristics of the study population (N=38)*

Variable	
Male gender	23 (60.5 %)
Female gender	15 (39.5 %)
Age[a], years	6 [5.0-7.0]
ASA I	26 (68.4 %)
ASA II	12 (31.6 %)
Weight[a] kg	23.8 [17.8-29.3]
Height[b] cm	119.5±12.2
BMI[a] kgm^{-2}	16.4 [13.9-17.4]
BMI underweight	7 (18.4 %)
BMI healthy weight	17 (44.0 %)
BMI overweight	14(31.6 %)
BMI obesity	1 (2.6 %)
BMI severe obesity	1 (2.6 %)
Mallampati 1	17 (44.7 %)
Mallampati 2	20 (52.6 %)
Mallampati 3	1 (2.6 %)
Mallampati 4	0 (-)
Mallampati ≥ 2	21 (55.3 %)
Mallampati ≥ 3	1 (2.6)
Mallampati ≥ 4	0 (-)
Cormack Lehane 1	28(73.7 %)
Cormack Lehane 2	6 (15.8 %)
Cormack Lehane 3	4 (10.5)
Cormack Lehane 4	0 (-)
Cormack Lehane ≥ 2	10 (26.3 %)
Cormack Lehane ≥ 3	4 (10.5)
Cormack Lehane ≥ 4	0 (-)
Pressure controlled ventilation	21 (55.3 %)
Volume controlled ventilation	17 (38.5 %)
Difficult manual ventilation	0 (-)
Difficult intubation	7 (18.4%)
Postintubation respiratory complications	1 (-)
Postextubation respiratory complications	1 (2.6 %)

[a] data not normally distributed presented as median (25^{th} percentile to 75^{th} percentile); [b] data normally distributed presented as mean ± standard deviation; ASA – American Society of Anesthesiologists score; BMI - body mass index

the successful second attempt occurred in 2 (15.4%) of VL cases and 5 (20%) of DL cases (p=1.000).

Pressure-controlled ventilation was used in similar manner in VL and DL cases (p=0.734) (Table 2). There was no statistical difference in respiratory complications between the study groups. One patient in the DL group experienced postintubation bronchospasm (4%) (p=1.000), while one patient in the VL group experienced postextubation bronchospasm (7.7%) (p=0.342).

DISCUSSION

We aimed to compare glottic visualization using videolaryngoscopy (VL) and direct laryngoscopy (DL) in pediatric patients undergoing adenotonsillectomy or adenoidectomy. Contrary to our expectations, the results showed no significant difference in glottic visualization based on the Cormack-Lehane classification between the two methods.

Several studies have suggested that VL improves glottic exposure and facilitates intubation in children, particularly in difficult airway scenarios *(13).* Moreover, the most recent European Society of Anaesthesiology and Intensive Care and British Journal of Anaesthesia joint guidelines in neonates and infants recommended the use a videolaryngoscope with an age adapted standard blade as first choice for tracheal intubation with the strong recommendation, but moderate quality evidence *(14).* However, our findings align with studies indicating that VL does not always provide superior visualization in pediatric patients *(7,15),* likely due to anatomical differences such as a proportionally larger tongue and a more anteriorly positioned larynx *(2).* In our study, Cormack-Lehane Grade 1 visualization was achieved in predominant and similar incidence in VL cases and DL cases, suggesting that DL remains a reliable method for glottic visualization in pediatric population.

Despite VL being associated with improved first-pass success in adults *(3,4,5),* pediatric studies have reported mixed results regarding intubation success with VL (16,17). In our study, difficult intubation defined as the intubation in second attempt occurred in 2 (15.4%) of VL cases and 5 (20%) of DL cases, with no statistically significant difference between VL and D. These findings suggest that, in routine pediatric airway management, DL remains a viable option, particularly for experienced anesthesiologists.

Postprocedural respiratory complications were rare in both groups, consistent with previous studies *(18,19,20).* Only one patient in the DL group had postintubation respiratory problems and one in the VL group experienced postextubation respiratory complication, indicating that the choice of laryngoscope had minimal impact on postprocedural respiratory outcomes.

This study has several limitations. First, the retrospective design and small sample size limit the generalizability of our findings. Second, the operator experience was not standardized, which may have influenced glottic visualization and intubation difficulty. Finally, our study population was without preoperative characteristics for anticipated difficult airway, so our results may not apply to children with anticipated difficult airways.

Table 2. *Demographic and airway management characteristics of children intubated with videolaryngoscopy (VL) (n=13) and direct laryngoscopy (DL) (n=25)*

Variable	VL (n=13)	DL (n=25)	p value
Male gender	9 (69.2%)	14 (56.0%)	p=0.501
Female gender	4 (30.8 %)	11 (44.0%)	
Agea, years	7 [5.5-8.0]	6 [5.0-6.5]	p=0.113
ASA I	10 (76.9%)	16 (64%)	p=0.486
ASA II	3 (23.1 %)	9 (36%)	
Weighta kg	23 [21.0-31.0]	21 [17.5-26.0]	p=0.075
Heightb cm	125.2±12.3	116.6±11.29	p=0.036
BMIa kgm^{-2}	17.1 [14.1-18.5]	15.9 [14.2-17.1]	p=0.418
BMI underweight	3 (23.1%)	4 (16%)	p=0.429
BMI healthy weight	4 (30.8%)	13 (52%)	
BMI overweight	5 (38.5%)	7 (28%)	
BMI obesity	1 (7.7%)	0 (-)	
BMI severe obesity	0 (-)	1 (4%)	
Mallampati 1	4 (30.8%)	13 (52%)	p=0.299
Mallampati 2	9 (69.2%)	11 (44%)	
Mallampati 3	0 (-)	1 (4%)	
Mallampati 4	0 (-)	0 (-)	
Mallampati ≥ 2	9 (69.2%)	12 (48%)	p=0.307
Mallampati ≥ 3	0 (-)	1 (4%)	p=1.000
Mallampati ≥ 4	0 (-)	0 (-)	-
Cormack Lehane 1	10 (76.9%)	18 (72%)	p=0.250
Cormack Lehane 2	3 (23.1%)	3 (12%)	
Cormack Lehane 3	0 (-)	4 (16%)	
Cormack Lehane 4	0 (-)	0 (-)	
Cormack Lehane ≥ 2	3 (23.08%)	7 (28%)	p=1.000
Cormack Lehane ≥ 3	0 (-)	4 (16%)	p=0.278
Cormack Lehane ≥ 4	0 (-)	0 (-)	-
Pressure controlled ventilation	8 (61.5%)	13 (52%)	p=0.734
Volume controlled ventilation	5 (38.5 %)	12 (48%)	
Difficult manual ventilation	0 (-)	0 (-)	-
Difficult intubation	2 (15.4%)	5 (20%)	p=1.000
Postintubation respiratory complications	0 (-)	1 (4%)	p=1.000
Postextubation respiratory complications	1 (7.7%)	0 (-)	p=0.342

[a] data not normally distributed presented as median (25^{th} percentile to 75^{th} percentile); [b] data normally distributed presented as mean ±standard deviation; ASA – American Society of Anesthesiologists score; BMI – body mass index

CONCLUSION

Our findings indicated that videolaryngoscopy did not significantly improve glottic visualization compared to direct laryngoscopy in pediatric patients undergoing adenotonsillectomy or adenoidectomy. Both methods provided adequate airway management, with no significant difference in intubation difficulty or postprocedural respiratory complications. Future studies with larger sample sizes and standardized operator experience are needed to further evaluate the role of VL in pediatric airway management.

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