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Research

Comparison of the Use of Videolaryngoscopy and Direct Laryngoscopy Methods in Achieving Intubation Before Pediatric Cardiac Surgery

Pediatrik Kalp Cerrahisinde Videolaringoskopi ile Direkt Laringoskopi Uygulamalarının Karşılaştırılması

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ABSTRACT

Objective: Intubation is one of the essential components of preoperative airway management in the context of congenital heart surgery. Accordingly, it is aimed in this study was to compare the uses of direct laryngoscopy (DL) and videolaryngoscopy (VL) in achieving intubation in cases younger than two years of age who will undergo congenital heart surgery.

Methods: This study was conducted on patients younger than two years old who underwent congenital heart surgery in the hospital, where the study was conducted between September 1st, 2020, and April 1st, 2021. The cases included in this study were divided into two groups based on the method used to achieve intubation before the cardiac surgery, as the DL and VL groups. These groups were then compared in terms of hemodynamic parameters, difficulty, duration and number of intubation, Cormack-Lehane grades, and complications that developed in association with intubation. The results obtained were analyzed statistically.

Results: Each DL and VL group comprised 60 cases. The median age of the cases included in this study was four months (minimum one day & maximum 24 months). Fifty-three percent of the cases were male, and 47% were female. There was no significant difference between the groups in terms of gender, weight, presence of syndromes, presence of cyanotic heart disease, and frequency of redo cases ($p>0.05$). Systolic and diastolic arterial pressures were significantly higher ($p<0.05$), whereas the total intubation time was significantly shorter in the VL group compared to the DL group (21.5 and 30 seconds, respectively; $p<0.05$). There was no difference between the groups in terms of any need for intubation maneuver, the presence of backward, upward, rightward, pressure maneuver, the presence of (optimal external laryngeal manipulation), Cormack-Lehane grades, intubation attempts, and use of stylet ($p<0.05$). However, the desaturation period (0% vs. 13.1%) and aspiration requirement rate (13.3% vs. 41.7%) were lower in the VL group ($p<0.05$).

Conclusion: The findings of this study indicate that intubation can be achieved in a shorter time and with a similar complication rate with VL than with DL, thereby providing a better contribution to hemodynamics. Consequentially, the use of VL may be considered to achieve intubation in newborn and infant cases who will undergo congenital heart surgery.

Keywords: Pediatric, airway management, direct laryngoscopy, videolaryngoscopy, congenital heart surgery

ÖZ

Amaç: Bu çalışmada konjenital kalp cerrahisi operasyonu geçirecek iki yaşından küçük olgularda direkt laringoskopi (DL) ve videolaringoskopi (VL) ile entübasyon uygulamalarının etkilerinin karşılaştırılması amaçlandı.

Gereç ve Yöntem: Bu çalışma 1 Eylül 2020-1 Nisan 2021 tarihleri arasında hastanemizde konjenital kalp cerrahisi operasyonu geçiren iki yaşından küçük olgular üzerinde gerçekleştirildi. Olgular ameliyat öncesi entübasyon uygulama şekline göre DL ve VL olarak iki gruba ayrıldı. İşlemler hemodinamik parametreler, entübasyon zorluğu, süresi, sayısı, Cormack-Lehane skoru ve gelişen komplikasyonlar açısından karşılaştırıldı. Sonuçlar istatistiksel olarak değerlendirildi.

Bulgular: Çalışma döneminde her iki gruptan 60'şar olgu mevcuttu. Medyan yaş 4 ay (1 gün-24 ay) idi. Olguların %53'ü erkek ve %47'si kızdı. Grupların cinsiyet, ağırlık, sendrom varlığı, siyanotik kalp hastalığı varlığı, redo olgu sıklığı birbirine benzerdi ($p>0,05$).VL kullanılan olgularda

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sistolik ve diyastolik arter basıncı daha yüksekti (p<0,05). Total entübasyon süresi VL grubunda DL grubuna göre daha kısaydı (21,5 vs 30 saniye, p<0,05). Gruplar arasında entübasyon manevra ihtiyacı, arka, yukarı ve sağa doğru basınç manevra varlığı, optimal dış laringeal manipülasyon varlığı, Cormack Lehane skoru, entübasyon denemesi, stile kullanımı arasında fark yoktu (p>0,05). VL grubunda desatürasyon süresi periyodu (%0 vs %13,1) ve aspirasyon ihtiyacı oranı(%13,3 vs %41,7) daha düşük oranda görüldü (p<0,05).

Sonuç: VL kullanımı ile DL kullanımına göre benzer komplikasyon oranında daha kısa sürede entübasyon gerçekleştirilerek hemodinamiye daha iyi katkı sağlanabilir. Bu nedenle artan deneyim ile ilişkili olarak konjenital kalp cerrahisi uygulanacak yenidoğan ve infant olgularda entübasyonda VL kullanımı düşünülebilir.

Anahtar Kelimeler: Çocuk, hava yolu yönetimi, direkt laringoskopi, videolaringoskop, konjenital kalp cerrahisi

INTRODUCTION

Airway management in children presents many challenges for pediatricians and anesthetists. The airway anatomy of children is different from that of adults. The upper location of the larynx, a relatively larger tongue, and a more limited mouth opening create difficulties for laryngoscopy and intubation (1,2). An adequate visualization of the airway and associated structures are required for successful intubation. In this way, prolonged or repeat intubation attempts would also be prevented to a large extent (3). First-pass success in tracheal intubation is particularly important in these patients because repeated intubation attempts can lead to airway trauma, increased obstruction, and hypoxemia, which can lead to potentially fatal outcomes (4,5).

It is crucial to perform fast, safe, and less traumatic intubation in infants with low or borderline oxygen saturation due to cardiac pathology who will undergo cardiac surgery. In this respect, the use of videolaryngoscopy (VL) in pediatric patients, which is more commonly used in adults, is increasingly recommended in airway management guidelines considering its efficiency in facilitating tracheal intubation (6,7). VL involves the use of video imaging and optical technology to facilitate indirect visualization of the larynx during intubation and is of evolutionary importance in intubation technology. Its use in pediatric patients has become prominent in the last 5-10 years in particular (1,8). However, extensive clinical studies on the efficacy of VL in routine daily practice or in children with difficult airways are scarce and inconclusive (9,10).

In view of the foregoing, it is aimed in this study to compare the uses of direct laryngoscopy (DL) and VL to achieve endotracheal intubation in pediatric patients aged 0-2 years who had undergone congenital heart surgery in terms of the effects thereof on hemodynamics, Cormack-Lehane image grades, total intubation times, maneuver needs, and complication rates.

METHODS

Our medical data about patients were recorded prospectively in to the anesthesiology clinical database. All patients agreed to participate in the study and written informed consent was obtained from each participant. The study was planned in accordance with the Declaration of Helsinki after obtaining the required approval from the local ethics committee (University of Health Sciences Turkey, Başakşehir Çam and Sakura Hospital - no: 2021.04.72). After gathering ethical committee approval, the data which were recorded in the database, about patients younger than two years old who underwent congenital heart surgery in the hospital, between September 1st, 2020, and April 1st, 2021 was taken out and analyzed. Patients who were over the age of two at the time of intubation, brought to the operating room from the intensive care unit as already intubated or resuscitated, and whose records could not be reached were excluded from the study. Patients included in this study were divided into two groups based on the method used to achieve intubation before the cardiac surgery, as the DL and VL groups. A patient information form that includes demographic, clinical, and hemodynamic characteristics of the patients, i.e., age, gender, weight, presence of syndromes, presence of redo and intubation information, etc. was created, and filled out for each patient. Patients whose oral intake was discontinued in accordance with the guidelines, that is, solid food, breast milk, and clear liquid intake were discontinued 6 h, 4 h, and 2 h before the procedure, respectively, were monitored by electrocardiography, pulse oximetry, non-invasive blood pressure measurement, and near-infrared spectrometry after they were brought into the operating room. After that, patients with intravenous access were administered 0.05 mg/kg midazolam for premedication. Mask ventilation was started after the administration of 1 mg/kg ketamine, 1 µg/kg fentanyl, and 0.1 mg/kg rocuronium in anesthesia induction. Orotracheal intubation was performed after two minutes of mask ventilation. A conventional laryngoscope [size 0 to 2 Macintosh and Miller blades (Heine Optotechnik, Munich, Germany)] was used in the DL group. A C-MAC videolaryngoscope [endolarynx videolaryngoscope size 0 to 2 Macintosh and Miller blades, 3 inch liquid crystal display screen, viewing angle above 60 degrees, front-to-back rotation angle 0-130 degrees, 225 gr, USB memory (Karl Storz GmbH, Tuttlingen, Germany)] was used in the VL group.

Patients' pre- and post-intubation pulse rates, systolic and diastolic arterial pressures, and SpO_2 levels were recorded. The time from the insertion of a blade into the mouth till monitoring the end-tidal carbon dioxide on the screen was recorded as the total intubation time. Along with the intubation time, the number of intubation attempts, the need for BURP (backward, upward, right, pressure) maneuver, the need for OELM (optimal external laryngeal manipulation), the Cormack-Lehane grades, the need for stylet and aspiration, the need for tube replacement due to post-intubation leakage, whether the tube number used was cuffed, and complications such as difficult intubation during the procedure, the presence of desaturation, esophageal intubation, oral and dental mucosal injury was recorded in the patient information form. The results obtained were analyzed statistically both within and between the groups.

Statistical Analysis

The descriptive statistics used to summarize the research data were tabulated using mean ± standard deviation or median, minimum and maximum values in case of continuous (numerical) variables, depending on whether they conform to the normal distribution, and as numbers and percentages in case of categorical variables. Shapiro-Wilk, Kolmogorov-Smirnov, and Anderson-Darling tests were used to check whether the numerical variables conformed to the normal distribution. In the comparative analysis of two independent groups; the independent samples t-test was used for cases when numerical variables were determined to conform to the normal distribution, and the Mann-Whitney U test was used for cases when numerical variables were determined not to conform to the normal distribution. In the comparative analysis of the differences between categorical variables per the group; Pearson's chi-square test was used in the case of 2x2 tables, which are expected to have 5 or more cells, Fisher's Exact test was used in the case of 2x2 tables, which are expected to have less than 5 cells, and Fisher-Freeman-Halton Exact test was used in the case of RxC tables, which are expected to have less than 5 cells. Statistical analysis were performed using the Jamovi project (2020) version 2.0.0.0 computer software (retrieved from https://www.jamovi.org) and JASP version 0.14.1.0 software (retrieved from https://jasp-stats.org). Probability (p) values calculated as <0.05 in statistical analyses were deemed to be statistically significant.

RESULTS

Each DL and VL group comprised 60 cases. The median age of the cases included in this study was 4 months (minium 1 day & maximum 24 months). Fifty-six (46.7%) cases were female, and 64 (53.3%) were male. Sixty-six (55.0%) of the cases had cyanotic congenital heart disease (CHD). A genetic syndrome was detected in 36 (30.0%) cases. Forty-five (37.5%) cases had a difficult intubation, and 69 (57.5%) cases required intubation maneuvers. BURP and OELM maneuvers were performed in 59 (49.2%) and 68 (56.7%) cases, respectively. The demographic characteristics of the groups are shown in Table 1. In terms of Cormack-Lehane grading, 33 (27.5%) cases were grade 1, 55 (45.8%) cases were grade 2, 25 (20.8%) cases were grade 3, and 7 (5.8%) cases were grade 4. There was no significant difference between the groups in Cormack-Lehane grades (p=0.232). A stylet was required in 20 (16.7%) of the cases. The aspiration was required in 33 (27.5%) cases. The need for aspiration was significantly higher in the DL group than the VL group (41.7% vs. 13.3%, p=0.001). However, no significant difference was found between the groups in terms of intubation tube replacement, post-intubation leakage, esophageal intubation rates, intubation tube number, or the number of intubation attempts (p>0.05). The desaturation period was significantly longer in the DL group than in the VL group (11.7% vs. 0%, p=0.013). Additionally, total intubation time was significantly longer in the DL group (30.0 seconds; 15.0-60.0) than in the VL group (21.5 seconds; 7.0-100.0) (p=0.016). The clinical characteristics of the groups are shown in Table 2.

Pre- and post-intubation systolic blood pressures of the patients who underwent DL were significantly lower than the patients who underwent VL [83.4 mmHg±19.1 mmHg vs. 101.1 mmHg±18.9 mmHg (p<0.001), 92.2 mmHg±17.6 mmHg vs. 106.1 mmHg±21.6 mmHg (p<0.001), respectively]. In parallel, pre- and post-intubation diastolic blood pressures of the patients who underwent DL were significantly lower than the patients who underwent VL [43.7 mmHg±13.1 mmHg vs. 59.3 mmHg±17.3 mmHg (p<0.001), 50.1 mmHg±13.0 mmHg vs. 65.3 mmHg±15.8 mmHg (p>0.001), respectively].

There was no significant difference between the groups in terms of peripheral oxygen saturation (SpO_2) levels (p=0.267). Post-intubation SpO_2 levels were significantly higher in the VL group (99.0; 82.0-100.0) than in the DL group (98.0; 72.0-100.0) (p=0.040). However, there was no significant difference between the groups in terms of pre- and post-intubation pulse rates (p=0.187 and p=0.404, respectively). The hemodynamic characteristics of the groups are shown in Table 3.

DISCUSSION

This study is one of the few studies that compared the uses of DL and VL to achieve endotracheal intubation in pediatric patients aged 0-2 years in the American Society

Table 1. Comparison of sociodemographic, clinical and hemodynamic characteristics of patients who underwent DL and VL

		Group		p-value
	Total (n=120)	DL (n=60)	VL (n=60)	
Age	4.0 (0.0-24.0)	4.0 (0.0-24.0)	5.5 (0.0-24.0)	0.317**
Gender				
Female	56 (46.7)	25 (41.7)	31 (51.7)	0.360***
Male	64 (53.3)	35 (58.3)	29 (48.3)	
Weight (kg)	5.8±2.4	5.4±2.2	6.0±2.4	0.058*
Height (cm)	60.7±11.3	59.6±12.2	61.9±10.0	0.098*
Redo (yes)	7 (5.8)	4 (6.7)	3 (5.0)	0.999***
Cyanotic heart disease (yes)	66 (55.0)	30 (50.0)	36 (60.0)	0.359***
Syndrome (yes)	36 (30.0)	21 (35.0)	15 (25.0)	0.319***
Type of syndrome				
Down	22 (61.1)	13 (61.9)	9 (60.0)	0.219***
George	2 (5.6)	0 (0.0)	2 (13.3)	
Other	12 (33.3)	8 (38.1)	4 (26.7)	
Difficult intubation (yes)	45 (37.5)	22 (36.7)	23 (38.3)	0.999***
Video (yes)	60 (50.0)	0 (0.0)	60 (100.0)	<0.001***
Video blade type (yes)	108 (90.0)	57 (95.0)	51 (85.0)	0.128***
Video blade size number				
N. 1	31 (25.8)	9 (15.0)	22 (36.7)	0.004***
N. 2	81 (67.5)	44 (73.3)	37 (61.7)	
N. 3	8 (6.7)	7 (11.7)	1 (1.7)	
Need for intubation maneuver (yes)	69 (57.5)	33 (55.0)	36 (60.0)	0.712***
BURP (yes)	59 (49.2)	27 (45.0)	32 (53.3)	0.465***
OELM (yes)	68 (56.7)	31 (51.7)	37 (61.7)	0.357***
Hyperextension (yes)	44 (36.7)	30 (50.0)	14 (23.3)	0.004***

*Independent sample t-test, **Mann-Whitney U test, ***Pearson's chi-squared test/Fisher's Exact test/Fisher-Freeman-Halton Exact test, DL: Direct laryngoscopy; VL: Videolaryngoscopy, BURP: Backward, upward, rightward, pressure, OELM: Optimal external laryngeal manipulation

of Anesthesiology III-IV group who had undergone congenital heart surgery, in terms of the effects thereof on hemodynamics, Cormack-Lehane image grades, total intubation times, maneuver requirements, and complication rates associated with the intubation procedure. Consequentially, it was found that the use of VL shortened the intubation time and had a significant positive effect on hemodynamics by ensuring higher systolic and diastolic arterial pressures.

CHDs are a group of diseases that feature with different pathologies, and are observed in 4-8 cases per 1,000 cases of live birth. It is crucial to be careful during the intubation phase in this pediatric patients population due to reasons such as insufficient cardiopulmonary reserve, presence of craniofacial anomalies, and complexity of the anatomical airways. Despite the newly developed equipment and evidence in pediatric airway management, DL remains the primary method used in achieving intubation. Nevertheless, difficult airways, in particular, have a negative effect on mortality and morbidity in pediatric patients with CHD, and in this context, there has been an increase in the use of VL recently, mainly due to the Coronavirus disease-2019 (COVID-19) pandemic and the adverse effects of DL in cases with difficult airways. However, not enough studies demonstrate the advantages of VL over DL in the management of difficult airways in pediatric patients with CHD. In the few studies available in the literature, the effects of DL and VL were compared, and various suggestions have

Table 2. Comparison of clinical characteristics of patients who underwent DL and VL

	Total (s=120)	Group		p-value
		DL (s=60)	VL (s=60)	
Cormack-Lehane grade				
Grade 1	33 (27.5)	19 (31.7)	14 (23.3)	0.232**
Grade 2	55 (45.8)	30 (50.0)	25 (41.7)	
Grade 3	25 (20.8)	9 (15.0)	16 (26.7)	
Grade 4	7 (5.8)	2 (3.3)	5 (8.3)	
Need for stylet (yes)	20 (16.7)	11 (18.3)	9 (15.0)	0.806**
Need for aspiration (yes)	33 (27.5)	25 (41.7)	8 (13.3)	0.001**
Intubation tube replacement (yes)	16 (13.3)	10 (16.7)	6 (10.0)	0.420**
Post-intubation leakage (yes)	11 (9.2)	8 (13.3)	3 (5.0)	0.206**
Esophageal intubation (yes)	3 (2.5)	3 (5.0)	0 (0.0)	0.244**
Desaturation period (yes)	7 (5.8)	7 (11.7)	0 (0.0)	0.013**
Bradycardia (yes)	7 (5.8)	5 (8.3)	2 (3.3)	0.439**
Intubation tube n (%)				
N. 3	5 (4.2)	4 (6.7)	1 (1.7)	0.172**
N. 3. 5	56 (46.7)	32 (53.3)	24 (40.0)	
N. 4	43 (35.8)	19 (31.7)	24 (40.0)	
N. 4. 5	14 (11.7)	5 (8.3)	9 (15.0)	
N. 5	2 (1.7)	0 (0.0)	2 (3.3)	
Cuffed intubation tube (yes)	94 (78.3)	39 (65.0)	55 (91.7)	0.001**
Difficult intubation during practice (yes)	23 (19.2)	12 (20.0)	11 (18.3)	0.999**
Total number of attempts	1.0 (1.0-5.0)	1.0 (1.0-5.0)	1.0 (1.0-3.0)	0.466*
Total intubation times	25.0 (7.0-100.0)	30.0 (15.0-60.0)	21.5 (7.0-100.0)	0.016*

*Mann-Whitney U test, **Pearson's chi-squared test/Fisher's Exact test/Fisher-Freeman-Halton Exact test, DL: Direct laryngoscopy; VL: Videolaryngoscopy

been made (9-11). To give a few examples; Riveros et al. (12) asserted that VL has no direct advantage over DL in pediatric cases ranging from newborns to cases of ten years of age and that its use should be limited to difficult airways; Hajiyeva et al. (13) concluded as a result of their study conducted with 56 pediatric patients aged 5-10 years who underwent elective surgery that VL is a good alternative for DL in routine and difficult intubation; and in another study (14) including training of anesthesia assistants and anesthesia technicians using a 3-6 month-old Pierre Robin syndrome dummy, VL was found to be more advantageous over DL, as it provides a good glottic view and required less number of attempts. In comparison, in this study, VL was found to be more advantageous over DL in the patient group with CHD as it provided an excellent glottic view, required a lesser number of attempts and did not result in any complications. Javaherforooshzadeh and Gharacheh (11) reported as a result of their study, including 60 pediatric cases, that the total intubation time was significantly lower in the DL group than in the VL group (51.13±17.88 seconds vs. 59.66±45.91 seconds, p=0.006), the rates of the first three attempts was comparable, and the rate was significantly less in the VL group after the third attempt. Fiadjoe et al. (4) reported as a result of their study, including cases with typical normal airway anatomy, that VL resulted in a longer total intubation time than DL (22.6 seconds vs. 21.4 seconds), yet provided a better and faster glottis vision for intubation. Lastly, Sinha et al. (15) did not find any significant difference between the DL and VL groups in terms of intubation times (24.80±7.90 vs. 27.90±10.90 seconds) in pediatric cases aged 4-14 years. In comparison, in this study, the total intubation time was found to be significantly lower in the VL group than in the DL group (21.5 seconds vs. 30 seconds, p=0.016). The discrepancy between the respective results of this study

Table 3. Comparison of vital signs (hemodynamic characteristics) patients who underwent DL and VL

		Group		p-value*
	Total (n=120)	DL (n=60)	VL (n=60)	
SBP				
Pre-intubation	92.3±20.9	83.4±19.1	101.1±18.9	<0.001
Post-intubation	99.2±20.8	92.2±17.6	106.1±21.6	<0.001
p-value**	-	<0.001	0.007	
DBP				
Pre-intubation	51.5±17.2	43.7±13.1	59.3±17.3	<0.001
Post-intubation	57.7±16.3	50.1±13.0	65.3±15.8	<0.001
p-value**	-	<0.001	0.003	
SpO_2				
Pre-intubation	91.0 (50.0-100.0)	93.5 (56.0-100.0)	90.0 (50.0-100.0)	0.267
Post-intubation	99.0 (72.0-100.0)	98.0 (72.0-100.0)	99.0 (82.0-100.0)	0.060
p-value **	-	<0.001	<0.001	
Pulse rate				
Pre-intubation	135.8±16.5	133.8±15.9	137.8±16.9	0.187
Post-intubation	144.0±14.9	142.8±12.6	145.1±16.9	0.404
p-value **	-	<0.001	<0.001	

*Independent samples t-test/Mann-Whitney U test, **Paired-sample t-test/Wilcoxon test, DL: Direct laryngoscopy, VL: Videolaryngoscopy, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SpO_2: Peripheral oxygen saturation

and the results of the comparable studies with respect of the total intubation time can be attributed to the increase in the experience of pediatric anesthesiologists over the years, and particularly to the fact that VL has become part of daily practice along with the COVID-19 pandemic. The blade type used in DL and VL has been reported to have affected the intubation success and complication rates (9-13). In this study, in parallel with the studies reported in the literature, three of the size 0 to 2 MAC 57 Miller type blades were used in the DL group, and nine of the size 0 to 2 MAC 51 Miller type blades were used in the VL group. A higher number of size 1 blades were used in the VL group than in the DL group. The differences between the groups in terms of types of blades used were attributed to the differences in the physical structures of the patients. Working principles of different types of VL are the same, yet they differ in terms of screen placement, different blade types, blades with different size numbers, and endotracheal tube placement strategies (10). GlideScope, Storz DCI, Bonfils, C-MAC, Truview PCD pediatric, Airtraq, McGrath series 5 are among the VL types that can be used in pediatric airway (9). Given its design similar to DLs, C-MAC VL has been recommended as the most suitable models for use by anesthesiologists, particularly in the pediatric patient population (8). In line with this recommendation, C-MAC VL was used in this study. Endotracheal intubation in pediatric patients requires different maneuvers due to the varying characteristics of the airway, and the associated complications also differ from case to case (7-11). In a study involving 60 cases diagnosed with CHD, 40%, 40%, and 20% of the DL cases were graded as grade 1, grade 2, and grade 3 as per the Cormack-Lehane grading system, respectively, and none (0%) was graded as grade 4. In comparison, 73% and 27% of the VL cases were graded as grade 1 and grade 2 as per the Cormack-Lehane grading system, respectively, and none (0%) was graded as grade 3 or grade 4 (11). In comparison, in this study, 32%, 50%, 15%, and 3% of the DL cases were graded as grade 1, grade 2, grade 3, and grade 4 as per Cormack-Lehane grading system, respectively, whereas 23%, 42%, 28%, and 8% of the VL cases were graded as grade 1, grade 2, grade 3, and grade 4 as per Cormack-Lehane grading system, respectively. Accordingly, there was no significant difference between the groups in terms of Cormack-Lehane grades. The rates of the associated complications were also found to be similar to the respective results reported in the literature. Significant hemodynamic changes may develop during intubation. For example, pulse rate may increase due to catecholamine discharge that occurs following intubation

and laryngoscopy (16). In their study involving adult cases, Maassen et al. (17) found that the increase in pulse rate and systolic blood pressure in the VL group was significantly less than in the DL group. In another study, significantly higher pulse rates and lower SpO_2 levels were reported in the VL group compared to the DL group ($p<0.05$) (11). In comparison, in this study, significant hemodynamic changes were observed following intubation in both the DL and VL groups, which were manifested as increases in systolic blood pressure, diastolic blood pressure, peripheral oxygen saturation, and pulse rate. Systolic and diastolic blood pressures and pulse rate was significantly higher in VL than in DL. This difference was attributed to low cardiac reserves of congenital heart patients and low VL intubation times.

The main limitations of this study are that it was conducted as a single-center study and with a relatively limited number of patients.

CONCLUSION

It has been concluded because of this study that VL can be used safely in routine anesthesia practice in the pediatric population of 0-2 age group with CHD, which is a risky patient population, by experienced specialists and with suitable equipment. Additionally, the findings of this study indicate that intubation can be achieved in a shorter time with VL compared to DL, with an excellent glottic appearance, without the need for auxiliary intubation maneuvers and any increase in the associated complications. Large-scale case series are needed to corroborate the results of this study.

ETHICS

Ethics Committee Approval: The study was approved by the University of Health Sciences Turkey, Başakşehir Çam and Sakura Hospital Ethics Committee (no: 2021.04.72).

Informed Consent: All patients agreed to participate in the study and written informed consent was obtained from each participant.

Authorship Contributions

Surgical and Medical Practices: H.D.Ö., Concept: H.D.Ö., F.G.Ö., Design: H.D.Ö., F.G.Ö., Data Collection or Processing: H.D.Ö., Analysis or Interpretation: H.D.Ö., F.G.Ö., Literature Search: H.D.Ö., F.G.Ö., Writing: H.D.Ö.

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