

Received: 29 January 2022 / Accepted: 17 April 2022 / Published online: 30 April 2022

DOI 10.34689/SH.2022.24.2.004

UDC 616-22:617-089

## FEATURES OF ETIOPATHOGENESIS OF LARYNGEAL STENOSIS AND METHODS OF ITS ELIMINATION: A RETROSPECTIVE ANALYSIS

**Aliya Turayeva<sup>1\*</sup>**, <https://orcid.org/0000-0001-5809-882X>

**Almat Bekpan<sup>2</sup>**,

**Gulmira Mukhamadieva<sup>1</sup>**, <https://orcid.org/0000-0002-0652-6463>

**Nataliya Papulova<sup>1</sup>**,

**Amanzhol Baimenov<sup>3</sup>**,

**Adil Mustafin<sup>1</sup>**, <https://orcid.org/0000-0002-4278-5489>

**Darkhan Autalipov<sup>2</sup>**

<sup>1</sup> NJSC "Astana Medical University", The Department of ENT Diseases, Nur-Sultan, Republic of Kazakhstan;

<sup>2</sup> National Research Center for Maternity and Childhood of the Corporate Foundation "UMC", Department of Head and Neck surgery, Nur-Sultan, Kazakhstan;

<sup>3</sup> Central Hospital of Ministry of Internal Affairs of the Republic of Kazakhstan, Nur-Sultan, Republic of Kazakhstan.

### Abstract

**Objective:** To analyze the features of etiopathogenesis and the methods of surgical correction of laryngeal stenosis in children in Nur-Sultan, the Republic of Kazakhstan.

**Methods:** A retrospective analysis of archival data of patients with laryngeal stenosis treated at the clinic of the National Research Center for Maternity and Childhood in Nur-Sultan from 2018 to 2020 was carried out.

**Results:** When analyzing the case histories of 292 patients with laryngeal stenosis, the features of etiopathogenesis and methods of surgical treatment in the conditions of the center were studied and revealed.

**Conclusion:** Observations show that, laryngeal stenosis developed due to prolonged stay on the artificial lung ventilation apparatus due to various somatic and surgical pathologies. The share of patients with laryngeal stenosis among the total number of operated with ENT pathology accounts for 44.24% due to the fact that our clinic is the leading center for the elimination of laryngeal stenosis in the Republic of Kazakhstan. Endolaryngeal methods of treatment give good results, but given the sometimes recurrent course, it is necessary to improve new methods and approaches in the treatment of laryngeal stenosis, depending on their type, degree and severity, thereby improving the results of treatment of patients.

**Keywords:** *laryngeal stenosis in children, endolaryngeal surgery, complication of prolonged intubation, subglottic laryngeal stenosis.*

### Резюме

## ОСОБЕННОСТИ ЭТИОПАТОГЕНЕЗА СТЕНОЗА ГОРТАНИ И МЕТОДЫ ЕГО УСТРАНЕНИЯ: РЕТРОСПЕКТИВНЫЙ АНАЛИЗ

**Алия Г. Тураева<sup>1</sup>**, <https://orcid.org/0000-0001-5809-882X>

**Алмат Ж. Бекпан<sup>2</sup>**,

**Гульмира А. Мухамадиева<sup>1</sup>**, <https://orcid.org/0000-0002-0652-6463>

**Наталия М. Папулова<sup>1</sup>**, <https://orcid.org/0000-0001-5809-882X>

**Аманжол Ж. Байменов<sup>3</sup>**,

**Адиль А. Мустафин<sup>1</sup>**, <https://orcid.org/0000-0002-4278-5489>

**Дархан Х. Ауталипов<sup>2</sup>**

<sup>1</sup> НАО «Медицинский университет Астана», Кафедра ЛОР-болезней, г. Нур-Султан, Республика Казахстан;

<sup>2</sup> Национальный исследовательский центр материнства и детства Корпоративного фонда «УМС», отделение хирургии головы и шеи, г. Нур-Султан, Республика Казахстан;

<sup>3</sup> Центральная больница Министерства Внутренних Дел Республики Казахстан, г. Нур-Султан, Республика Казахстан.

**Цель:** Проанализировать особенности этиопатогенеза и методы хирургической коррекции стеноза гортани у детей г. Нур-Султан, Республика Казахстан.

**Материалы и методы:** Проведен ретроспективный анализ архивных данных пациентов со стенозом гортани, проходивших лечение в клинике Национального исследовательского центра материнства и детства в Нур-Султане с 2018 по 2020 год.

**Результаты:** При анализе историй болезни 292 больных стенозом гортани изучены и выявлены особенности этиопатогенеза и методы хирургического лечения в условиях центра.

**Вывод:** Наблюдения показывают, что, стеноз гортани развился из-за длительного пребывания на аппарате искусственной вентиляции легких вследствие различных соматических и хирургических патологий. Доля пациентов со стенозом гортани среди общего числа оперированных ЛОР-патологией составляет 44,24% благодаря тому, что наша клиника является ведущим центром по элиминации стеноза гортани в Республике Казахстан. Эндоларингеальные методы лечения дают хорошие результаты, но учитывая иногда рецидивирующее течение, необходимо совершенствовать новые методы и подходы в лечении стеноза гортани в зависимости от их вида, степени и тяжести, тем самым улучшая результаты лечения больных.

**Ключевые слова:** стеноз гортани у детей, эндоларингеальная хирургия, осложнение длительной интубации, подгортанческий стеноз гортани.

Түйіндеме

## КӨМЕЙ СТЕНОЗЫ ЭТИОПАТОГЕНЕЗІНІҢ ЕРЕКШЕЛІКТЕРІ ЖӘНЕ ОНЫ ЖОЮ ӘДІСТЕРІ: РЕТРОСПЕКТИВТІ ТАЛДАУ

**Алия Г. Тураева<sup>1</sup>**, <https://orcid.org/0000-0001-5809-882X>

**Алмат Ж. Бекпан<sup>2</sup>**,

**Гульмира А. Мухамадиева<sup>1</sup>**, <https://orcid.org/0000-0002-0652-6463>

**Наталия М. Папулова<sup>1</sup>**, <https://orcid.org/0000-0001-5809-882X>

**Аманжол Ж. Байменов<sup>3</sup>**,

**Адиль А. Мустафин<sup>1</sup>**, <https://orcid.org/0000-0002-4278-5489>

**Дархан Х. Ауталипов<sup>2</sup>**

<sup>1</sup> КеАК «Астана медицина университеті», ЛОР-аурулары кафедрасы, Нұр-Сұлтан қ., Қазақстан Республикасы;

<sup>2</sup> УМС корпоративтік қорының Ана мен бала ұлттық ғылыми орталығы, бас және мойын хирургиясы бөлімі, Нұр-Сұлтан қ., Қазақстан Республикасы;

<sup>3</sup> Қазақстан Республикасы Ішкі істер министрлігінің Орталық ауруханасы, Нұр-Сұлтан қ., Қазақстан Республикасы.

**Мақсаты:** Қазақстан Республикасы Нұр-Сұлтан қаласындағы балалардағы көмей стенозының этиопатогенезінің ерекшеліктерін және хирургиялық түзету әдістерін талдау.

**Әдістері:** 2018-2020 жылдар аралығында Нұр-Сұлтан қаласындағы Ана мен бала ұлттық ғылыми орталығының клиникасында емделген көмей стенозы бар науқастардың мұрағаттық деректеріне ретроспективті талдау жасалды.

**Нәтижелер:** Көмейдің стенозымен ауыратын 292 науқастың ауру тарихын талдау кезінде орталықта этиопатогенез ерекшеліктері мен хирургиялық емдеу әдістері зерттеліп, анықталды.

**Қорытынды:** Бақылаулар көрсеткендей, кеңірдектің стенозы әртүрлі соматикалық және хирургиялық патологияларға байланысты вентиляторда ұзақ тұрудан дамыған. ЛОР патологиясы бойынша ота жасалғандардың жалпы санындағы көмей стенозымен ауыратын науқастардың үлесі 44,24% құрайды, себебі біздің емхана Қазақстан Республикасында көмей стенозын жою бойынша жетекші орталық болып табылады. Эндоларингеальды емдеу әдістері жақсы нәтиже береді, бірақ кейде қайталанатын ағымды ескере отырып, олардың түріне, дәрежесіне және ауырлығына байланысты көмейдің стенозын емдеудің жаңа әдістері мен тәсілдерін жетілдіру, сол арқылы науқастарды емдеу нәтижелерін жақсарту қажет.

**Түйінді сөздер:** балалардағы көмейдің стенозы, эндоларингеальді хирургия, ұзартылған интубацияның асқынуы, кеңірдектің субглоттикалық стенозы.

### Bibliographic citation:

Turayeva A., Bekpan A., Mukhamadieva G., Papulova N., Baimenov A., Mustafin A., Autalipov D. Features of etiopathogenesis of laryngeal stenosis and methods of its elimination: a retrospective analysis // *Nauka i Zdravookhranenie [Science & Healthcare]*. 2022, (Vol.24) 2, pp. 32-39. doi 10.34689/SH.2022.24.2.004

Тураева А.Г., Бекпан А.Ж., Мухамадиева Г.А., Папулова Н.М., Байменов А.Ж., Мустафин А.А., Ауталипов Д.Х. Особенности этиопатогенеза стеноза гортани и методы его устранения: ретроспективный анализ // *Наука и Здоровоохранение*. 2022. 2(Т.24). С. 32-39. doi 10.34689/SH.2022.24.2.004

Тураева А.Г., Бекпан А.Ж., Мухамадиева Г.А., Папулова Н.М., Байменов А.Ж., Мустафин А.А., Ауталипов Д.Х. Көмей стенозы этиопатогенезінің ерекшеліктері және оны жою әдістері: ретроспективті талдау // *Ғылым және Денсаулық сақтау*. 2022. 2 (Т.24). Б. 32-39. Doi 10.34689/SH.2022.24.2.004

### Introduction

Today there are many methods of diagnosis and treatment of laryngeal stenosis, but despite this, the problem still remains relevant. Laryngeal stenosis is manifested not only by difficulty in external breathing, but also by a violation of the swallowing function and also the quality of voice in children [13, 12].

Laryngomalacia, which is the cause of laryngeal stenosis, is 54.88% among all congenital anomalies of the larynx [7]. Among children, Wegener's granulomatosis with polyangiitis is common, which increasingly affects the lower respiratory tract, causing stenosis [8].

Ultrasound, CT of the larynx and fiber optic laryngoscopy are informative in the diagnosis of motor disorders of the larynx, but direct laryngoscopy remains more informative [6].

The most common causes of repeated hospitalization with laryngeal stenosis were respiratory distress syndrome (36%) and infection (24%) [4]. Recurrence of laryngeal stenosis after balloon dilation is more common in children under one year of age [1]. The study showed that the study of the immune system is important in the elimination of stenosis due to papillomatosis of the larynx [14]

A systematic review of the authors describes conservative methods of treating patients with laryngeal stenosis using hormonal drugs (ketalog) and mitomycin, where high efficiency was achieved, sometimes replacing tracheostomy [1].

Tracheostomy, which is a necessary step in eliminating laryngeal stenosis, can also lead to subglottic stenosis [5]. Now in the practice of laryngologists, the multiplicity of endolaryngeal operations is increasing and thereby the need for tracheostomy is reduced [9]. Tracheostomy was also required in 16% of patients with subglottic laryngeal stenosis [3].

Such operations as balloon dilation, augmentation, the use of a CO<sub>2</sub> laser, laryngoplasty and the installation of a T-shaped tube are selected individually for patients with laryngeal stenosis, taking into account the age and severity of the pathology [10]. Endolaryngeal elimination of laryngeal stenosis in laryngeal papillomatosis increases the possibility of decannulation, thereby reducing the risk of repeated tracheostomy [11]. In balloon dilation, it is advisable to use a balloon with an outer diameter equal to the diameter of the endotracheal tube to prevent relapses of stenosis [12].

### Objective

Due to the development of medical technology, the criteria for live birth and viability of newborns are changing. This has led to an increase in the number of premature babies with congenital malformations, which are successfully nursed. But there are children among them who need to undergo a number of operations and /or transfer to long-term care in a hospital due to the severity of the general condition. In many cases, premature newborns that were born prematurely need careful care, and with deterioration of vital signs, a transfer to an artificial lung ventilation apparatus is necessary, in which the development of subglottic laryngeal stenosis is possible. This factor is directly related to the professionalism of the intensive care specialist and the hospital's equipment with the necessary intubation tubes for the age of children.

Thus, laryngeal stenosis in children still remains an urgent problem in ENT practice, despite numerous methods of its elimination. For the reason, we have analyzed the features of etiopathogenesis and the methods of surgical correction of laryngeal stenosis in children in Nur-Sultan, the Republic of Kazakhstan.

**Materials and methods.** The analysis of the history of 292 patients with laryngeal stenosis who were undergoing surgical treatment from 2018 to 2020 at the clinic of the National Research Center for Maternity and Childhood in Nur-Sultan was carried out. The age of the patients ranged from 3 months to 17 years. Age and gender category: 58.2% of boys and 41.8% of girls, 64.8% (n=189) were born at term (>37 weeks of gestational age), 35.2% (n=103) had low birth weight.

**Ethical approval:** Our study did not require approval the Local ethical committee NCJSC "Astana Medical University".

**Results.** The statistic shows that the number of boys in 2019 and 2020 was more than girls - 58.2%, which corresponds to international statistics [12].

As can be seen from statistical findings, a greater number of children under the age of 3 years were found with laryngeal stenosis compared to other age groups. But according to international statistics, children under the age of one year prevail over other age categories [3]. In 2020, there were significantly more children under the age of one year in comparison with other years. The lowest indicator for the number of patients was found among adolescents.

About 23% of patients (n=64) needed intubation at birth. Congenital anomalies of the upper respiratory tract were reported in 16.4% (n=56) of patients. Of the 292 patients, about 33.98% of the patients were chronic cannulants.

According to the localization of airway constriction, the following types of laryngeal stenosis were recorded: vestibular stenosis – 1.7%, stenosis at the level of the vocal folds (anterior commissural synechia, cicatricial bridge between the vocal folds, posterior commissural synechia) – 11.06%, subglottic laryngeal stenosis – 41.11% and tracheal stenosis (cicatricial granulation "visor", at the level of the tracheostomy and below the lower edge of the tracheostomy) - 5.6%.

According to the classification of *Myer Ch. and R.T. Cotton*, the following data on laryngeal stenoses were revealed: I-degree - 17.2%, II-degree - 45.92%, III-degree - 33.9% and IV - 2.9%.

The gold standard for the diagnosis of laryngeal stenosis is direct laryngoscopy using an endoscope. Children with severe laryngeal stenosis in the medical center underwent direct laryngoscopy and revealed the following changes in the larynx: neoplasms of the supraglottic region, annular constrictions in the subglottic space, subglottic stenosis, inter-vocal membrane, narrowing at the level of the vocal folds, tracheal stenosis, and granulation at the tracheal level. Cicatrices in the subglottic space were also revealed: a cicatricial granulation "visor" was detected in 11.8% of cases, which was the result of unskilled tracheostomy, damage to the cricoid cartilage.

The "eight-shaped" deformation of the glottis of the larynx is an example of the consequences of choosing an intubation tube of an inappropriate size for a patient (Figure 1).



Figure 1. Patient V., born in 2018, diagnosed with stenosis of the vocal larynx I degree with an "eight-shaped" deformation of the glottis.

Also, untimely sedation of the child before intubation led to damage to the vocal folds and subsequently formed cicatricial deformities on the larynx.

When analyzing the medical history, we identified various factors for the development of laryngeal stenosis (Table 1).

As can be seen from Tables 1, the main cause of laryngeal stenosis was prolonged intubation of the child due to various pathologies: in 61.1% due to congenital malformation and respiratory distress syndrome, followed by operations at an early age (17.4%), severe acute viral respiratory infection and pneumonia (14.04%), laryngeal papillomatosis (14.3%), laryngomalacia (10.6%), aggravated obstetric history (11.02%), chemical and thermal burns (3.42%), foreign bodies of the larynx (3.42%), malformations of the skull and neuromuscular diseases (3.08%), road accident (2.05%), less often the cause was suicide (0.34%). Congenital malformations of the respiratory tract, in turn, are risk factors for the development of inflammatory pathology of the respiratory tract and pneumonia.

Table 1.

**Factors for the development of laryngeal stenosis.**

Causes of laryngeal stenosis:	Observation period		
	2018 (n=72)	2019 (n=103)	2020 (n=117)
Prolonged AVL due to congenital malformation and respiratory distress	12,3%(36)	8,6%(25)	11,3%(33)
Operations at an early age	2,7%(8)	5,5%(16)	9,2%(27)
Severe acute respiratory viral infections	1,03%(3)	6,2%(18)	6,8%(20)
Laryngomalacia, congenital stridor	2,4%(7)	4,1%(12)	4,1%(12)
Papillomatosis and laryngeal hemangioma	3,4%(10)	1,7%(5)	2,1%(6)
Aggravated obstetric history of the child's mother	1,03%(3)	2,7%(8)	2,4%(7)
Chemical and thermal burn	0,7%(2)	2,1%(6)	0,7%(2)
Foreign body	0,3%(1)	1,7%(5)	1,4%(4)
Road accident	0,3%(1)	1,03%(3)	0,7%(2)
Cerebral palsy	0,3%(1)	1,4%(4)	1,4%(4)
Suicide	0	0,3%(1)	0

The average number of hospital bed days was 9±04 days. Patients who were scheduled for laryngotracheal resection, in the preoperative period, in order to determine the extent of cicatricial stenosis of the larynx, a CT scan of the larynx and fiber optic laryngotracheoscopy were prescribed. The results of CT of the larynx in 23 patients indicated the presence of laryngeal stenosis, but at the I-degree of stenosis, the CT data of the larynx were uninformative. Histology of laryngeal neoplasms in 6.5% (n=19) patients confirmed laryngeal papillomatosis, granulation in 11.3% (n=33) and laryngeal hemangioma in 0.68% (n=2). The postoperative period in all operated patients went smoothly, the appointment of antibacterial therapy made it possible to quickly stop the inflammatory process.

The mandatory selection criterion for reconstructive plastic surgery on the larynx with stenosis was the weight of the child, which should be at least 10 kg. The following operations were performed depending on the severity of the type of laryngeal stenosis: direct laryngoscopy with balloon dilation, installation and removal of a T-shaped tube, decannulation, lower tracheostomy, endolaryngeal removal of granulomas and neoplasms of the larynx (laser vaporization of papillomas, the use of a microdebrider), partial laryngotracheal resection, direct laryngoscopy with the installation and removal of a stent, augmentation, laryngoplasty with CO<sub>2</sub> laser, incision of stenoses with CO<sub>2</sub> laser (Table 2).

Table 2.

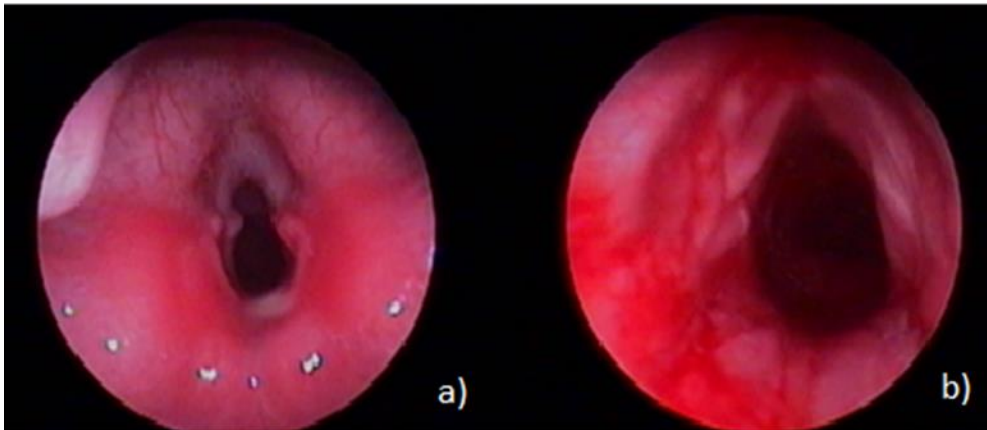
**Types of surgical interventions depending on the severity of laryngeal stenosis.**

Degrees of laryngeal stenosis (according to Myer Ch. and R.T. Cotton)	Direct laryngoscopy with balloon dilation (n=198)	Endolaryngeal removal of neoplasms and granulomas (n=54)	Bougie (n=32)	Installation and removal of the stent (n=5)	Laryngoplasty (n=3)	Partial L-t resection (n=2)	Elimination of stenosis with CO <sub>2</sub> (n=47)	Installation and removal of the T-shaped tube (n=10)
1 degree	22	9	19					
2 degree	85	12	8				36	
3 degree	88	33	5	3	2	1	11	7
4 degree	3			2	1	1		3

All operations were performed under general anesthesia. Direct laryngoscopy was performed in all patients in order to diagnose laryngeal stenosis and assess the condition of the glottis before and in the postoperative period. The following operations in some cases of laryngeal stenosis were performed in stages. More often, patients with II, III and IV degrees of laryngeal stenosis underwent several operations during hospitalization in the clinic. For example, a patient with III degree of subglottic laryngeal stenosis underwent direct laryngoscopy, laser excision of stenosis, balloon dilation (twice with an interval of 7-9 days).

Thus, the number of operations turned out to be more than the total number of patients.

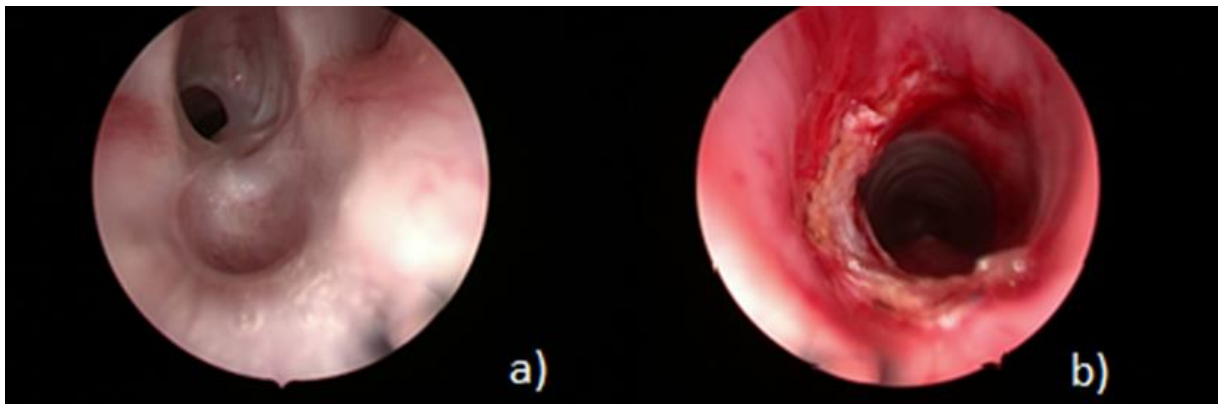
Direct laryngoscopy with balloon dilation was performed more often than other types of operations (n=198 patients), dilation with a pressure of up to 12 atm was performed using a balloon. If the presence of granulomas was noted during examination in the stoma area after balloon dilation, they were removed using micro-forceps and a microdebrider. Stenoses of the vocal and subglottic parts of the larynx of the I-II degrees were eliminated by balloon dilation (Figure 2). Sometimes with a CO<sub>2</sub> radial incision in 3 places.



**Figure 2.** Patient V., born in 2018, diagnosed with stenosis of the vocal part of I degree with "eight-shaped" deformation of the glottis, before (a) and after surgery (b).

For dissection of the scar tissue with CO<sub>2</sub> laser was used mode "CW-REPEAT" - "SuperPulse-REPEAT" 6w

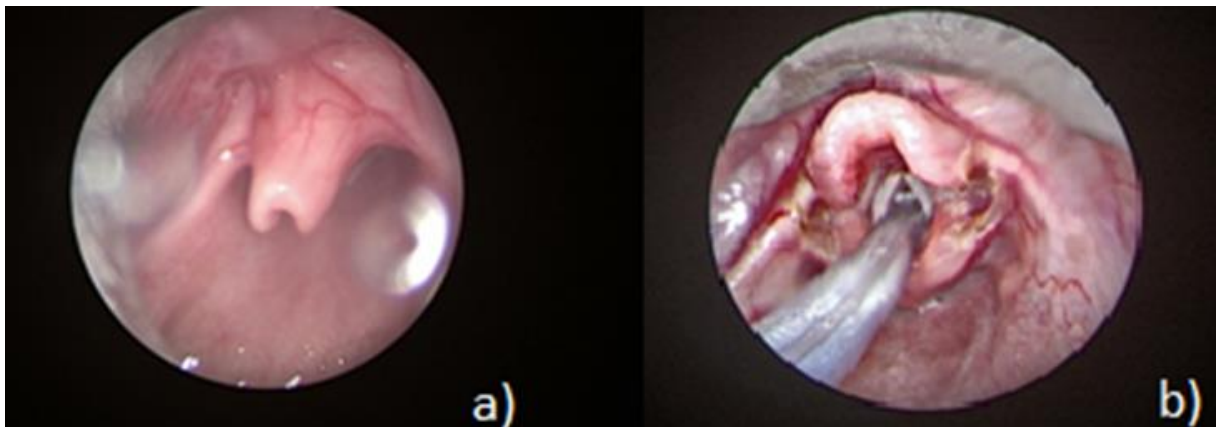
round lain depth 1 mm. Indications: stenosis of the vocal and subglottic parts of the larynx of II-III degrees (Figure 3).



**Figure 3.** Patient Kh., born in 2018, diagnosed with subglottic stenosis of the larynx II-III degree, before (a) and after surgery (b).

Also, laryngeal stenosis of the II-III degree due to laryngomalacia was eliminated with a CO<sub>2</sub> laser (Figure 4).

94 patients were treated with a CO<sub>2</sub> laser to eliminate laryngeal stenosis.



**Figure 4.** Patient B., born in 2019, diagnosed with laryngomalacia, vestibular larynx stenosis II degree, before (a) and after surgery (b).

When eliminating the stenosis of the larynx of the III-IV-degree, the first stage was a tracheostomy for the administration of anesthesia. Direct laryngoscopy, installation and removal of the stent were indicated for patients with III-IV degrees of laryngeal stenosis. The number of patients in this category was 5 children.

Direct laryngoscopy with elimination of stenosis of the anterior commissure using microscissors and CO<sub>2</sub> was performed with stenosis at the level of the vocal folds. In the same way, stenoses of the subglottic space of the larynx of the II degree were eliminated (Figure 5).

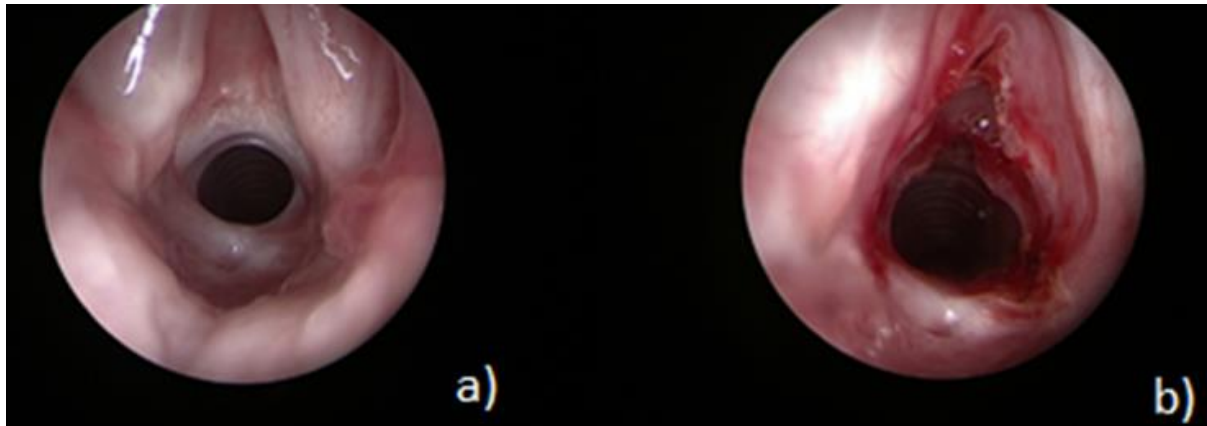


Figure 5. Patient M., born in 2018, diagnosed with subglottic stenosis of the larynx II degree, before (a) and after surgery (b).

Surgical treatment of laryngeal hemangiomas using a CO<sub>2</sub> laser was carried out in the superpulse mode, continuously, with a tracheostomy, vaporization of laryngeal hemangiomas was performed using a CO<sub>2</sub> laser of the

AcuPulse "Lumenis" System with a high-quality micromanipulator, an average power of 5-6 W with a maximum energy density, and in case of laryngeal papillomatosis - 4-5 W (Figure 6).

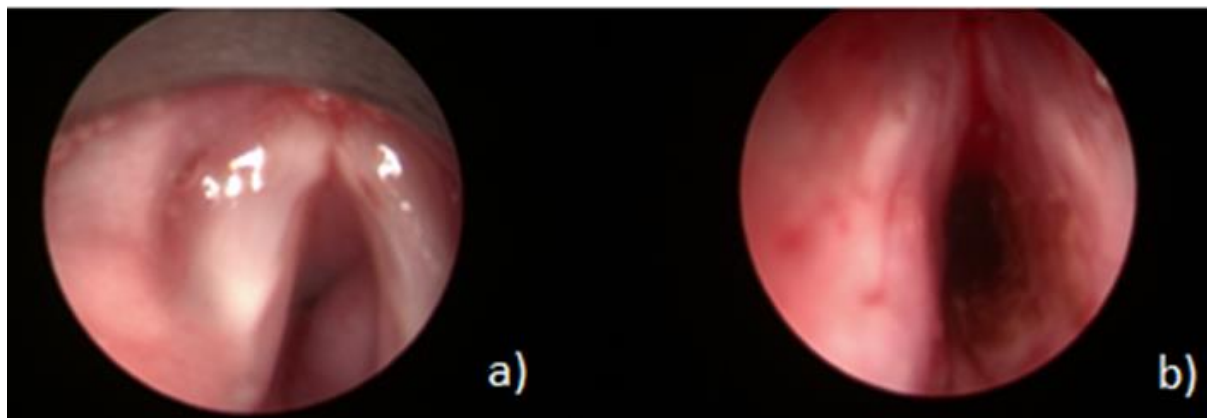


Figure 6. Patient M., born in 2019, diagnosed with laryngeal hemangioma before (a) and after surgery (b).

The indications for the installation of a T-shaped tube (10 patients) and for partial laryngotracheal resection (2 patients) were laryngotracheal stenosis of the larynx III-IV

degree. Laryngoplasty was performed in 3 patients with laryngeal stenosis of III-IV degree (Table 3).

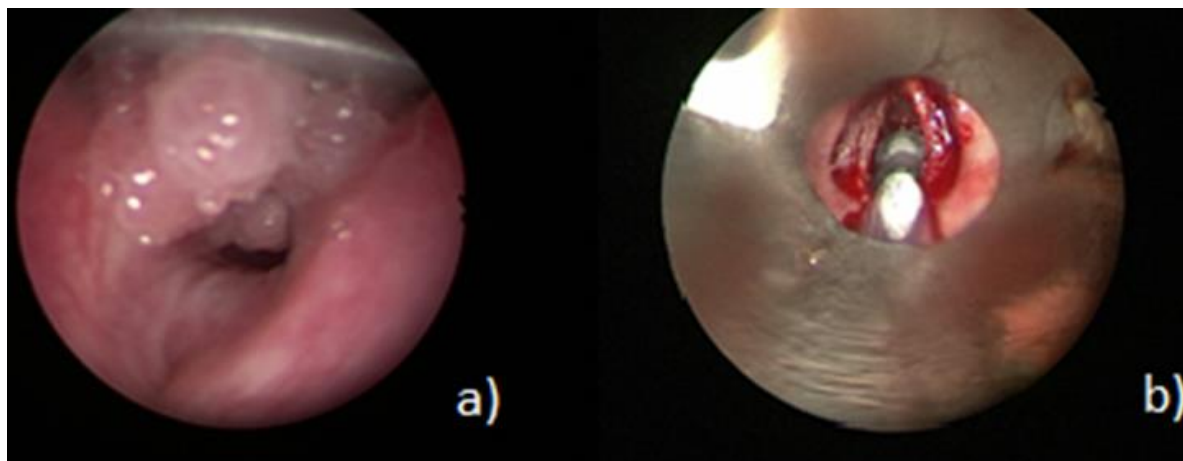
Table 3.

**Types of surgical interventions depending on the localization of stenosis of the larynx.**

Level of stenosis localization	Direct laryngoscopy with balloon dilation (n=198)	Endolaryngeal removal of neoplasms and granulomas (n=54)	Bougie (n=32)	Installation and removal of the stent (n=5)	Laryngoplasty (n=3)	Partial laryngotracheal resection (n=2)	Elimination of stenosis with CO <sub>2</sub> (n=47)	Installation and removal of the T-shaped tube (n=10)
Vestibular part							5	
Vocal folds	27	19	11				24	
Subglottic area	160	33	18	3	2	1	18	5
Trachea	8	2	3	1	1	1		5

With stenosis of the larynx and trachea of II-III degree, laser destruction of the scar was performed, followed by bougie of the larynx and trachea (32 patients). Bougie was performed with Guigard's bougie, a rigid endoscope tube, and plastic bougie through the glottis and tracheostomy tube.

In 19 patients, papillomatous growths on the vocal folds were eliminated with microdebrider and then vaporization was performed with a CO<sub>2</sub> laser (Figure 7).



**Figure 7.** Patient M., born in 2018, diagnosed with laryngeal papillomatosis, laryngeal stenosis III degree, before (a) and after surgery (b).

Analyzing the results of the performed operations, we believe that the operating team should be equipped with instruments, medicines and medical devices to the maximum before the operation, since it is often necessary to make a decision during the operation and change the tactics of the operation depending on the type and degree of stenosis.

Decannulation was successful in 33.98% (n=99) of patients and was achieved on the first attempt in 86.9% (n=86) of cases. Failed decannulation occurred in only 13.1% of patients and reoperations were required. Repeated operations were necessary for patients with severe cerebral palsy, myodystrophy, and severe somatic diseases (heart disease, bacterial destruction of the lungs due to pulmonary fibrosis). Some patients are not subject to decannulation due to severe comorbidities.

In 19.2% (n=56) of patients, a second operation was required to eliminate stenosis of the larynx, that is, repeated bougie of the larynx was required. The reason for this was age up to 1 year, neoplasms of the larynx, prolonged stay on AVL due to concomitant pathology or in the postoperative period after the first surgery, congenital malformation in a child, respiratory distress syndrome. It should be noted that the reasons for repeated operations were such factors as large distances between regions in our country; operated patients do not come to the follow-up examination in time, due to the lack of coordination in polyclinics for the rehabilitation of patients with stenosis of the larynx.

#### Conclusion

Observations show that in most patients, laryngeal stenosis developed due to prolonged stay on the artificial lung ventilation apparatus due to various somatic and surgical pathologies.

The risk factors were mainly congenital malformations in newborns and an aggravated obstetric history. These patients were tracheostomized due to the long stay of the patient on the artificial lung ventilation apparatus in order to maintain the vital signs of the patients. Also, when analyzing the case history, it was revealed that the correction of stenosis of the larynx in children was mainly carried out by endolaryngeal access, under general anesthesia, and in stages. A mandatory selection criterion for surgical interventions was the patient's body weight of at least 10 kg.

Repeated surgeries were also performed to eliminate stenosis of the larynx in early childhood and in children under 3 years old.

To prevent stenosis of the larynx in childhood, we recommend intubation strictly according to indications and take into account the size of the endotracheal tube according to age and timely sedation in the pre-intubation period. Appropriate endotracheal tubes and low cuff pressure should also be used to reduce subglottic laryngeal stenosis.

Endolaryngeal methods of treatment give good results, but given the recurrent course, it is necessary to improve new methods and approaches in the treatment of laryngeal stenosis, depending on their type and severity, thereby improving patient outcomes. And each patient requires an individual approach.

#### Declarations

##### Ethics approval and consent to participate

Not applicable.

**Consent for publication:** Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient. A copy of the consent form is available for review by the Editor of this journal.

**Availability of data and materials:** The data sets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

**Competing interests:** The authors declare that they have no competing interests.

**Funding:** None

##### Authors' contributions

*Aliya Turayeva:* was responsible on formulation and writing this article, collected materials in the center and analyzed, chose photos from archive materials for illustration, keep contact with all authors and change the article after all editing by them.

*Almat Bekpan:* was editing the article on all steps of writing; he corrected on surgical methods of treatment, helped with access to the archived data of the clinic. He, as a treating and operating surgeon of the department, clearly monitored the correctness and compliance of actions with the writing of the article.

*Gulmira Mukhamadiyeva:* has edited final approval of the version to be published and supported with translation of the article.

*Nataliya Papulova:* has edited this article on all steps of formulation. She has supported and helped on writing design this article. She has helped to write conclusion of this article.

*Amanjol Baimenov:* was responsible to be accountable for all aspects of the work in ensuring that questions related to the

accuracy, integrity of any part of the work is appropriately investigated and resolved.

*Adil Mustafin: has corrected on surgical methods of treatment. He has supported to collect materials for this article.*

*Darkhan Autalipov: was editing the article on all steps of writing; he corrected on surgical methods of treatment.*

All authors have read and approved the final version to be published.

Acknowledgements: Not applicable.

#### References:

1. *Bavishi A. et al.* Outcomes after endoscopic dilation of laryngotracheal stenosis: An analysis of ACS-NSQIP // Journal of Clinical Outcomes Management. 2018. № 3 (25).
2. *Pullens B. et al.* Voice outcome and voice-related quality of life after surgery for pediatric laryngotracheal stenosis // Laryngoscope. 2017. № 7 (127). P.197-205.
3. *Schweiger C. et al.* Tracheostomy in children: a ten-year experience from a tertiary center in southern Brazil // Brazilian Journal of Otorhinolaryngology. 2017. № 6 (83). P.197-210.
4. *Chew L. et al.* 30-Day readmission rates, diagnoses, and risk factors following pediatric airway surgery // International Journal of Pediatric Otorhinolaryngology. 2020. (136). P.18-29.
5. *Urena-Chavarria E. et al.* Clinical and epidemiological characteristics of patients with tracheostomy at the national children's hospital in Costa Rica: 2008 - 2015 // Pediatric Pulmonology. 2018. № Supplement 1 (53). P.13-22.
6. *Jabłońska-Jesionowska M., Zawadzka-Głós L.* Diagnostic difficulties in children with iatrogenic vocal cord paralysis in the material of the Department of Pediatric Otorhinolaryngology of the Medical University of Warsaw // New Medicine. 2018. № 1 (22). P.39-45.
7. *Jiang M. et al.* Clinical study of congenital laryngopharyngeal structural abnormalities in neonatal intensive care unit // Chinese Journal of Applied Clinical Pediatrics. 2020. № 14 (35). P.122-134.
8. *Lee P. Y. et al.* The presentation and management of granulomatosis with polyangiitis (Wegener's Granulomatosis) in the pediatric airway // Laryngoscope. 2017. № 1 (127). P.138-142.
9. *McCormick M.E.* Trends in Subglottic Stenosis Management: Resource Utilization and Pediatric Otolaryngology Training // Laryngoscope. 2020. P.156-162.
10. *Razumovsky A.Y., Strizhova D.N.* Reconstructive surgeries on the larynx and cervical trachea in children // Russian Journal of Pediatric Surgery. 2021. № 6 (24). P.16-32.
11. *Scatolini M.L. et al.* Laryngeal reconstruction in children with recurrent respiratory papillomatosis // International Journal of Pediatric Otorhinolaryngology. 2018. (115). P. 22-28
12. *Sharma S.D. et al.* Safe balloon sizing for endoscopic dilatation of subglottic stenosis in children // Journal of Laryngology and Otology. 2017. № 3 (131). P.67-84.
13. *Svystun O. et al.* Dysphagia in healthy children: Characteristics and management of a consecutive cohort at a tertiary centre // International Journal of Pediatric Otorhinolaryngology. 2017. (99). P.67-89.
14. *Turayeva A. et al.* A Patient with Juvenile Recurrent Respiratory Papillomatosis Complicated by Laryngeal Stenosis after Laryngeal Microsurgery: A Clinical Case // Open Access Macedonian Journal of Medical Sciences. 2022. № C (10). C. 24–27.

#### Corresponding author:

**Turayeva Aliya** - doctoral student in the specialty "Medicine", NJSC "Astana Medical University", The Department of ENT Diseases, Nur-Sultan, Republic of Kazakhstan

**Mailing address:** Republic of Kazakhstan, 010000, Nur-Sultan, street Satpaeva 23/2, Flat-100,

**E-mail:** cvetalnur@mail.ru

**Tel:** + 7 707 368 10 54