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ANTHROPOMETRIC ASSESSMENT OF NUTRITIONAL STATUS IN YOUNG CHILDREN WITH POST-INTUBATION CICATRICIAL LARYNGEAL STENOSIS: A RETROSPECTIVE DESCRIPTIVE STUDY

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Abstract

Introduction. Post-intubation cicatricial laryngeal stenosis in young children is a clinically significant condition, particularly among patients who have undergone intensive care and prolonged intubation. In Kazakhstan, most children with this condition are treated at the University Medical Center, while data on their nutritional status remain limited. Chronic upper airway obstruction may increase energy expenditure, impair swallowing, and reduce food intake, potentially increasing the risk of undernutrition. This study aimed to evaluate anthropometric indicators of nutritional status in young children with post-intubation cicatricial laryngeal stenosis.

Materials and methods. A single-center retrospective descriptive study was conducted using medical records of 95 children under 5 years of age with post-intubation cicatricial laryngeal stenosis treated at the University Medical Center. Physical development was assessed according to the 2006 WHO Child Growth Standards using anthropometric Z-score indices: weight-for-age, height-for-age, and weight-for-height. Z-score values below −2 SD were considered indicative of nutritional impairment.

Results. Underweight according to weight-for-age was identified in 27.4 % of children, while linear growth delay according to height-for-age was found in 23.2 % of patients. Signs of acute nutritional impairment according to weight-for-height were recorded in 28.4 % of children. Additional enteral nutrition was administered to 20.0 % of patients. These findings indicate that a substantial proportion of young children with post-intubation cicatricial laryngeal stenosis demonstrate anthropometric signs of both acute and chronic nutritional impairment.

Conclusion. Young children hospitalized with post-intubation cicatricial laryngeal stenosis showed a high frequency of impaired nutritional status, including underweight, wasting, and linear growth delay. The results support the need for routine nutritional screening, early identification of at-risk patients, and further prospective studies evaluating the role of nutritional support in the comprehensive management of children with chronic upper airway obstruction.

Keywords: *post-intubation cicatricial laryngeal stenosis, children, nutritional status, protein-energy malnutrition, anthropometry.*

Introduction

Nutrition deficiency in children with chronic airway and respiratory conditions remains a significant problem in modern pediatrics, as it may be associated with impaired immune response, delayed physical development, increased morbidity, and poorer clinical outcomes [1-4]. Young children who have undergone prolonged intubation and subsequently developed post-intubation cicatricial laryngeal stenosis (hereinafter – PICLS) may represent a clinically vulnerable group, since upper airway obstruction can affect not only respiratory function but also feeding, growth, and general nutritional status [5-6].

Several mechanisms may theoretically contribute to nutritional impairment in children with PICLS. One possible mechanism is difficulty in coordinating breathing and swallowing. In children with upper airway obstruction, respiratory discomfort may make feeding more difficult and may be accompanied by fatigue during feeding, reduced food intake, coughing, choking, or discomfort during swallowing. Similar aerodigestive problems have been described in related pediatric airway conditions; however, direct evidence for these mechanisms specifically in children with PICLS remains limited [7].

Another possible mechanism is an increase in energy expenditure associated with increased respiratory effort. Chronic upper airway obstruction may increase the work of breathing, which can theoretically raise energy and protein requirements. At the same time, reduced oral intake due to respiratory discomfort may create an imbalance between the body's nutritional requirements and actual nutrient intake. These mechanisms are biologically plausible, but in the context of PICLS they should be interpreted as possible contributing factors rather than established causal pathways [5; 8].

General mechanisms of pediatric malnutrition, including metabolic alterations and systemic effects, have been described in previous studies [9-10]. However, these studies do not specifically address children with post-intubation cicatricial laryngeal stenosis.

Inflammation may also play a potential role in nutritional impairment. Increased inflammatory activity and changes in interleukin levels have been described in other obstructive airway conditions, including obstructive sleep apnea [11]. However, these findings cannot be directly transferred to children with PICLS without further investigation. Therefore, inflammation-related catabolism in PICLS should be considered a possible mechanism requiring additional study rather than a confirmed explanation.

Despite the clinical significance of this problem, data on the nutritional status of children with PICLS remain limited. Existing literature mainly addresses nutritional support in critically ill children, chronic respiratory diseases, pediatric upper airway obstruction, and post-extubation airway obstruction [5-6; 8; 12]. These populations and research questions differ from the anthropometric assessment of young children with established post-intubation cicatricial laryngeal stenosis.

Nutritional status in children under 5 years of age can be assessed using the WHO Child Growth Standards, with underweight, stunting, and wasting identified using the corresponding anthropometric Z-scores [13].

Therefore, assessment of anthropometric parameters in young children with PICLS is important for identifying nutritional disorders and determining the need for further nutritional evaluation. The aim of this study is to assess anthropometric parameters of nutritional status in young children with PICLS.

Materials and methods

Study Design. This was a single-center, retrospective, descriptive, observational study.

We analyzed the medical records of children with PICLS treated in the Head and Neck Department of the University Medical Center Corporate Foundation (Astana, Kazakhstan) from January 2021 to December 2023.

Study Object. The study included medical records of young children with a confirmed diagnosis of post-intubation cicatricial laryngeal stenosis. The analysis was based on data contained in the medical records, including age, gender, anthropometric measurements at admission, and diagnosis.

Inclusion criteria: child under 5 years of age; confirmed diagnosis of post-intubation cicatricial laryngeal stenosis; availability of data on the child's weight and height at admission; availability of complete medical records necessary for calculating anthropometric Z-score indices.

Exclusion criteria included age over 5 years, missing data on weight or height, and documented comorbidities with a known independent effect on growth or nutritional status, such as congenital malformations, genetic syndromes, severe neurological disorders, chronic gastrointestinal diseases, endocrine disorders, or severe congenital heart disease.

Anthropometric assessment. Children's physical development was assessed based on age, gender, weight, and height recorded upon hospital admission. The obtained indicators were interpreted in accordance with international WHO standards for assessing the growth and development of young children.

To assess nutritional status, the following anthropometric Z-score indices were calculated: WAZ (weight-for-age); HAZ (height-for-age); WHZ (weight-for-height) (Table 1).

Table 1. Interpretation of anthropometric Z-score indices

Z-score value	Interpretation
$Z \geq -2$ SD	No anthropometric deficit by the lower cut-off
-3 SD $\leq Z < -2$ SD	Moderate impairment
$Z < -3$ SD	Severe impairment

Source: compiled by the authors based on the standards of the World Health Organization [13].

WAZ was used to assess low, normal, high, and very high weight-for-age values, but not to diagnose overweight or obesity. Overweight and obesity were interpreted according to the WHZ index. Nutritional deficiency was defined as a Z-score value below -2 standard deviations. Values of $-3 \leq Z < -2$ were considered moderate impairment; values below -3 SD were considered severe impairment of nutritional status.

Anthropometric Z-scores were calculated according to the WHO Child Growth Standards for children aged 0–5 years. The child's exact age was determined as the difference between the date of admission and the date of birth and was expressed in completed days/months. Weight and length/height values recorded at admission were used for the analysis. For children younger than 24 months, recumbent length was used; for children aged 24 months and older, standing height was used. If the measurement position differed from the WHO-recommended approach, length/height conversion was performed according to the WHO Anthro methodology. Implausible anthropometric values were checked against WHO plausibility criteria and verified using the original medical records. Cases with missing data on age, sex, weight, or length/height were excluded from the corresponding Z-score calculation. Prematurity was considered when such information was available in the medical records; however, correction for gestational age was limited by the retrospective nature of the study.

The WHZ index was used to determine signs of acute nutritional deficiency: wasting (Z-score below -2 SD) and severe wasting (Z-score below -3 SD). The HAZ index was used to assess stunting, reflecting chronic impaired physical development. The WAZ index was used to determine underweight for age.

Statistical analysis. Statistical analysis was performed using descriptive statistics. Categorical variables are presented as absolute values and percentages. When interpreting the results, the influence of potential confounding factors was taken into account, including the child's age, the degree of laryngeal stenosis, the duration of previous intubation, the presence of a tracheostomy, the duration of the disease, the frequency of hospitalizations, and comorbidities. These factors could independently influence the patients' body weight, height, and nutritional status.

Ethical aspects. The study protocol was reviewed and approved by the local ethics committee of the University Medical Center Corporate Foundation. Protocol number: No. 04-023, dated May 12, 2026. The study was conducted in compliance with the principles of confidentiality of patients' personal data. Due to the retrospective nature of the study, the analysis was performed based on anonymized medical records.

Results

Characteristics of the study group. A total of 172 medical records of children admitted to the Head and Neck Department were analyzed. The inclusion criteria were met by 95 children under 5 years of age with PICLS, hospitalized in the Head and Neck Department of the University Medical Center (Astana, Kazakhstan) between January 2021 and December 2023. Of the included patients, 60 were boys and 35 were girls. Thus, boys predominated in the study group (63.2 %), while girls accounted for 36.8 %. The majority of patients were between 3 and 5 years of age.

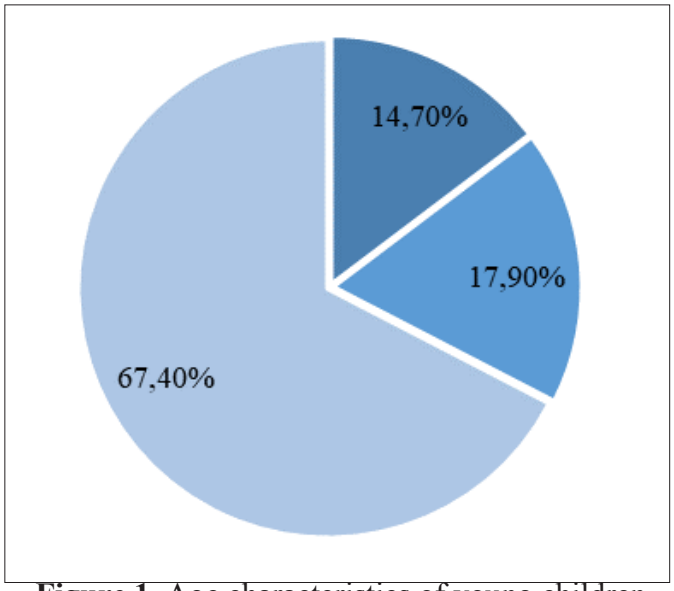


Figure 1. Age characteristics of young children with post-intubation cicatricial laryngeal stenosis treated at the University Medical Center in 2021-2023 (green indicates children younger than 12 months; blue, children aged 1-2 years; yellow, children aged 3–<5 years)
Source: compiled by the authors based on the study data

To assess nutritional status, the anthropometric Z-score indices were calculated: HAZ, WAZ, and WHZ. The results are presented in Table 2. Analysis of the HAZ index, reflecting the child's height for age, showed that the values were within the normal range in most patients. Normal HAZ values were recorded in 70 children, which amounted to 73.7 %. High height for age was noted in 3 patients (3.2 %). At the same time, signs of linear growth retardation of varying degrees of severity were detected in 22 children, which amounted to 23.2 %: growth retardation was noted in 14 patients (14.7 %), and severe growth retardation was noted in 8 patients (8.4 %) (Table 2). According to the WAZ index, which characterizes body weight for age, normal values were recorded in 64 children (67.4 %). Underweight of varying degrees was detected in 26 patients (27.4 %), including 15 children with underweight (15.8 %) and 11 children with severe underweight (11.6 %). High and very high weight-for-age values were uncommon: high WAZ values were recorded in 3 patients (3.2 %), and very high WAZ values were recorded in 2 patients (2.1 %). According to the WHZ index, reflecting body weight for height, normal values were detected in 57 children (60.0 %). Body weight deficiency of varying degrees according to WHZ was noted in 27 patients (28.4 %): wasting was detected in 20 children (21.1 %), and severe wasting in 7 children (7.4 %). Overweight and obesity according to this index were rare and were registered in 5 children (5.3 %) and in 6 children (6.3 %), respectively (Table 2).

Table 2. Anthropometric indices of physical development in children under 5 years of age

Categories	Frequency (n)	Percentage (%)
HAZ – height-for-age		
Tall stature	3	3.2
Normal	70	73.7
Stunting	14	14.7
Severe stunting	8	8.4
WAZ – weight-for-age		
Very high weight-for-age	2	2.1
High weight-for-age	3	3.2
Normal	64	67.4
Underweight	15	15.8
Severe underweight	11	11.6
WHZ – weight-for-height		
Obesity	6	6.3
Overweight	5	5.3
Normal	57	60.0
Wasting	20	21.1
Severe wasting	7	7.4

**Note: percentages are rounded to one decimal place.*
Source: compiled by the authors based on the research results.

An analysis of the protein-energy malnutrition pattern revealed that signs of acute malnutrition, assessed by the WHZ index, were detected in 27 of 95 patients (28.4 %). In the total cohort, wasting was identified in 20 of 95 children (21.1 %), and severe wasting was identified in 7 of 95 children (7.4 %). Signs of chronic malnutrition, assessed by the HAZ index and reflecting delayed linear growth, were recorded in 22 of 95 patients (23.2 %). In the total cohort, stunting was identified in 14 of 95 children (14.7 %), and severe stunting was identified in 8 of 95 children (8.4 %). Thus, anthropometric signs of

nutritional status impairment were detected in a significant proportion of young children with PICLS. Nearly a third of patients showed signs of acute nutritional deficiency, while almost a quarter showed signs of chronic physical impairment.

Discussion

The results indicate that anthropometric signs of nutritional impairment were common among young children with post-intubation cicatricial laryngeal stenosis. Stunting, assessed using the HAZ index, was identified in 22 of 95 children (23.2%), while wasting, assessed using the WHZ index, was identified in 27 of 95 children (28.4%).

These findings highlight the importance of systematic nutritional assessment in children with post-intubation cicatricial laryngeal stenosis. Anthropometric Z-scores allow the identification of underweight, stunting, and wasting. Published prevalence thresholds provide a framework for interpreting stunting and wasting at the population level [14]; however, their application to this selected clinical cohort requires caution. Children with severe anthropometric deficits require further clinical assessment, and decisions regarding nutritional support should consider their clinical condition and follow relevant guidance on the management of severe acute malnutrition [15]. Nutritional screening may help identify children who require specialist assessment and individualized nutritional care.

The observed prevalence of stunting may indicate longer-term growth impairment in this patient group. Nutritional deficits can contribute to impaired growth in children [2; 3]. Increased energy expenditure, feeding difficulties, and reduced food intake are possible contributing mechanisms in children with post-intubation cicatricial laryngeal stenosis; however, these factors were not assessed in the present study. Their contribution to the observed anthropometric deficits remains uncertain, and these deficits cannot be attributed specifically to the stenosis on the basis of these data.

The high incidence of acute malnutrition, detected in almost a third of patients, deserves special attention. Low body weight relative to height may be associated with episodes of respiratory failure, frequent hospitalizations, repeated surgeries, decreased appetite, and increased energy and protein requirements. While this study was unable to establish a direct cause-and-effect relationship between laryngeal stenosis and malnutrition, the data obtained suggest that children with this condition represent a high-risk group for malnutrition.

Pathophysiologically, the development of protein-energy malnutrition in children with chronic upper airway obstruction may be due to several mechanisms. First, increased airway resistance increases respiratory muscle workload and the body's energy requirements. Second, respiratory discomfort and swallowing difficulties may limit actual nutrient intake. Third, chronic inflammation and repeated episodes of decompensation can increase catabolic processes, contribute to a decrease in appetite and a deterioration in overall nutritional status.

An important finding of the study is the low frequency of enteral nutrition supplementation. Only 20.0 % of patients in the overall study sample received specialized enteral formulas. Given the observed incidence of underweight and growth retardation, this may indicate insufficient integration of nutritional support into the comprehensive care of children with post-intubation cicatricial laryngeal stenosis. However, this finding should be interpreted with caution, as the retrospective data did not evaluate the volume, duration, indications for administration, or effectiveness of enteral nutrition.

These findings highlight the need for systematic assessment of the nutritional status of children with post-intubation cicatricial laryngeal stenosis. The use of anthropometric Z-score indices allows for the timely detection of signs of acute and chronic nutritional deficiency, the identification of children at risk, and consideration of the need for consultation with a nutritionist or pediatrician. Inclusion of nutritional screening in the standard examination of this category of patients may have practical significance for the early detection of nutritional disorders and planning of comprehensive treatment.

This study has several limitations. It was conducted at a single center and included a relatively limited number of patients, which may limit the generalizability of the results. The retrospective design of the study does not allow control for all potential confounding factors or the establishment of causal relationships. Furthermore, biochemical markers of nutritional status, body composition, actual daily energy and protein intake, and duration and volume of enteral feeding were not assessed.

When interpreting the results, the potential influence of confounders must also be considered. Anthropometric parameters could be influenced by the child's age, degree of laryngeal stenosis, disease

duration, duration of previous intubation and intensive care unit stay, presence of tracheostomy, frequency of hospitalizations, number of surgeries, prematurity, birth weight, comorbidities, feeding patterns, and socioeconomic factors. These factors could independently contribute to growth retardation or low body weight, independent of the presence of laryngeal stenosis. Thus, the study results demonstrate a high frequency of anthropometric signs of nutritional deficiency in young children with post-intubation cicatricial laryngeal stenosis. The identified abnormalities include both acute nutritional deficiency and chronic growth failure. These findings support the need for mandatory nutritional screening in this patient population, as well as further prospective studies aimed at assessing the effectiveness of early nutritional support and its impact on clinical outcomes.

Conclusion

A high incidence of nutritional status disorders has been identified in young children with post-intubation cicatricial laryngeal stenosis. Underweight (WAZ) was recorded in 27.4 % of patients, growth retardation (HAZ) in 23.2 %, and signs of acute nutritional impairment (WHZ) in 28.4 %. These findings suggest that children with post-intubation cicatricial laryngeal stenosis can be considered a high-risk nutritional group. This justifies the need for regular anthropometric assessment, early detection of signs of protein-energy malnutrition, and a multidisciplinary approach to patient management involving an otolaryngologist, pediatrician, and nutrition support specialist. Further prospective studies are needed to evaluate the impact of nutritional support on the course of the disease, surgical outcomes, and physical development in children with chronic upper airway obstruction.

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ИНТУБАЦИЯДАН КЕЙІНГІ ТЫРТЫҚТЫ КӨМЕЙ СТЕНОЗЫ БАР ЖАС БАЛАЛАРДЫҢ ТАМАҚТАНУ ЖАҒДАЙЫН АНТРОПОМЕТРИЯЛЫҚ БАҒАЛАУ: РЕТРОСПЕКТИВТІ СИПАТТАМАЛЫҚ ЗЕРТТЕУ

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Аңдатпа

Кіріспе. Ерте жастағы балалардағы көмейдің интубациядан кейінгі тыртықтық стенозы, әсіресе қарқынды терапия алған және ұзақ уақыт интубацияда болған пациенттерде, клиникалық тұрғыдан маңызды жағдай болып табылады. Қазақстанда осы патологиясы бар балалардың көпшілігі Университеттік медициналық орталықта ем алады, алайда олардың нутритивтік мәртебесі туралы деректер шектеулі. Жоғарғы тыныс жолдарының созылмалы обструкциясы энергия шығынының артуына, жұтынудың бұзылуына және тағам тұтынудың азаюына әкелуі мүмкін, бұл тамақтану жеткіліксіздігінің даму қаупін арттырады. Зерттеудің мақсаты − көмейдің интубациядан кейінгі тыртықтық стенозы бар ерте жастағы балалардың нутритивтік мәртебесінің антропометриялық көрсеткіштерін бағалау.

Материалдар мен әдістер. Университеттік медициналық орталықта ем алған, көмейдің интубациядан кейінгі тыртықтық стенозы бар 5 жасқа дейінгі 95 баланың медициналық құжаттамасы негізінде бір орталықты ретроспективті сипаттамалық зерттеу жүргізілді. Дене дамуы ДДҰ стандарттарына (2006 ж.) сәйкес жасына шаққандағы дене салмағы, жасына шаққандағы бой ұзындығы және бой ұзындығына шаққандағы дене салмағы бойынша антропометриялық Z-score көрсеткіштері арқылы бағаланды. Z-score мәндерінің −2 стандартты ауытқудан (SD) төмен болуы тамақтану бұзылыстарының белгілері ретінде қарастырылды.

Нәтижелер. Дене салмағының тапшылығы («жасына шаққандағы дене салмағы» көрсеткіші бойынша) балалардың 27,4 %-ында, ал бой өсуінің тежелуі («жасына шаққандағы бой ұзындығы» көрсеткіші бойынша) пациенттердің 23,2 %-ында анықталды. Тамақтанудың жедел жеткіліксіздігінің белгілері («бой ұзындығына шаққандағы дене салмағы» көрсеткіші бойынша) балалардың 28,4 %-ында тіркелді. Пациенттердің 20,0 %-ы қосымша энтеральды тамақтандыру алды. Алынған деректер көмейдің интубациядан кейінгі тыртықтық стенозы бар ерте жастағы балалардың едәуір бөлігінде тамақтанудың жедел және созылмалы бұзылыстарының антропометриялық белгілері байқалатынын көрсетеді.

Қорытынды. Көмейдің интубациядан кейінгі тыртықтық стенозымен ауруханаға жатқызылған ерте жастағы балаларда дене салмағының тапшылығын, жүдеуді (вастинг) және бой өсуінің тежелуін қоса алғанда, нутритивтік мәртебе бұзылыстарының жоғары жиілігі анықталды. Зерттеу нәтижелері

нутритивтік мәртебені күнделікті клиникалық тәжірибеде скринингтен өткізудің, қауіп тобындағы пациенттерді ерте анықтаудың және жоғарғы тыныс жолдарының созылмалы обструкциясы бар балаларды кешенді емдеудегі нутритивтік қолдаудың рөлін бағалау үшін одан әрі проспективті зерттеулер жүргізудің қажеттілігін растайды.

Түйін сөздер: *интубациядан кейінгі тыртықты көмей стенозы, балалар, тамақтану мәртебесі, ақуыз-энергия жеткіліксіздігі, антропометрия.*

АНТРОПОМЕТРИЧЕСКАЯ ОЦЕНКА СОСТОЯНИЯ ПИТАНИЯ У МАЛЕНЬКИХ ДЕТЕЙ С РУБЦОВЫМ СТЕНОЗОМ ГОРТАНИ ПОСЛЕ ИНТУБАЦИИ: РЕТРОСПЕКТИВНОЕ ОПИСАТЕЛЬНОЕ ИССЛЕДОВАНИЕ

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Аннотация

Введение. Постинтубационный рубцовый стеноз гортани у детей раннего возраста является клинически значимым состоянием, особенно у пациентов, перенесших интенсивную терапию и длительную интубацию. В Казахстане большинство детей с данной патологией получают лечение в Университетском медицинском центре, однако данные об их нутритивном статусе остаются ограниченными. Хроническая обструкция верхних дыхательных путей может приводить к увеличению энергозатрат, нарушению глотания и снижению потребления пищи, что потенциально повышает риск недостаточности питания. Целью данного исследования стала оценка антропометрических показателей нутритивного статуса у детей раннего возраста с постинтубационным рубцовым стенозом гортани.

Материалы и методы. Было проведено одноцентровое ретроспективное описательное исследование на основе медицинской документации 95 детей в возрасте до 5 лет с постинтубационным рубцовым стенозом гортани, проходивших лечение в Университетском медицинском центре. Физическое развитие оценивалось в соответствии со стандартами ВОЗ (2006 г.) с использованием антропометрических показателей Z-score: масса тела к возрасту, рост к возрасту и масса тела к росту. Значения Z-score ниже −2 стандартных отклонений (SD) расценивались как признаки нарушения питания.

Результаты. Дефицит массы тела (по показателю «масса тела к возрасту») был выявлен у 27,4 % детей, а задержка линейного роста (по показателю «рост к возрасту») − у 23,2 % пациентов. Признаки острого нарушения питания (по показателю «масса тела к росту») были зафиксированы у 28,4 % детей. Дополнительное энтеральное питание получали 20,0 % пациентов. Полученные данные свидетельствуют о том, что у значительной части детей раннего возраста с постинтубационным рубцовым стенозом гортани наблюдаются антропометрические признаки как острых, так и хронических нарушений питания.

Выводы. У детей раннего возраста, госпитализированных с постинтубационным рубцовым стенозом гортани, выявлена высокая частота нарушений нутритивного статуса, включая дефицит массы тела, истощение (вастинг) и задержку линейного роста. Результаты исследования подтверждают необходимость проведения рутинного скрининга нутритивного статуса, раннего выявления пациентов группы риска и дальнейших проспективных исследований для оценки

роли нутритивной поддержки в комплексном ведении детей с хронической обструкцией верхних дыхательных путей.

Ключевые слова: *постинтубационный рубцовый стеноз гортани, дети, нутритивный статус, белково-энергетическая недостаточность, антропометрия.*

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