

ETIOLOGY AND EPIDEMIOLOGY OF VIRAL INTESTINAL INFECTIONS IN BAKU CITY

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Background. Acute intestinal infections of viral etiology represent a significant public health concern, particularly in children. **This study aimed** to characterize the etiological structure and epidemiological features of viral intestinal infections among pediatric patients in Baku, Azerbaijan. **Material and methods.** A total of 411 children aged 0–18 years admitted with intestinal infection of unknown etiology were examined between 2018 and 2020. Fecal samples were tested for rotavirus group A, adenovirus serotypes 40/41, and human astrovirus (HAstV) using enzyme-linked immunosorbent assay (ELISA; R-Biopharm RIDASCREEN, Germany). Descriptive, evaluative, and analytical epidemiological methods were applied. **Results.** Intestinal viruses were identified in 56.2% of patients. Monoviral infection was detected in 32.6% of children, and mixed viral infection in 23.6%. Among monoviral cases, adenovirus 40/41 predominated (38.8%), followed by HAstV (36.6%) and rotavirus group A (24.6%). The highest overall detection rate was observed in the 1–3 year age group (73.6%). Boys showed slightly higher infection rates than girls. Seasonal analysis revealed rotavirus predominance in spring-summer, adenovirus in summer, and astrovirus in winter. The epidemic process for each pathogen demonstrated distinct cyclical patterns throughout the year. **Conclusions.** Adenovirus serotypes 40/41 were the leading etiologic agent of viral intestinal infections in Baku city children. Children aged 1–3 years were most affected. These findings underscore the need for enhanced viral surveillance and targeted preventive strategies in pediatric populations.

Keywords: acute intestinal infections, rotavirus, adenovirus, astrovirus, enzyme-linked immunosorbent assay

Introduction. Currently, acute intestinal infections (AII) of viral etiology are becoming increasingly important for practical medicine. A clear trend toward a shift in the etiologic spectrum of pathogens causing AII of viral etiology in children has also been noted [1, 3, 4, 8].

According to official data from the World Health Organization (WHO), 1.7 billion cases of diarrhea are registered annually worldwide, 4 million of which die, and 60–70% of deaths are in children under 14 years of age [2].

Among the causative agents of acute intestinal infections of nonbacterial origin, viruses are most often considered the etiologic agents. Enteroviruses, adenoviruses, rotaviruses, astroviruses, coronavirus viruses, and caliciviruses are known causes of acute diarrhea in children [5–7, 9, 10].

Objective. To characterize the etiological structure and epidemiological characteristics of viral intestinal infections in children in Baku city.

Material and Methods. The study was conducted from 2018 to 2020 at the Research Institute of Medical Prevention named after V.Yu.Akhundov, Ministry of Health of the Republic of Azerbaijan. We observed 411 patients aged 0 months to 18 years with a diagnosis of "intestinal infection of unknown etiology" admitted to various pediatric clinics in Baku. Fecal samples from the children were tested for certain intestinal viruses—rotaviruses, adenoviruses, and astroviruses—using a serological method.

In 2018, 59 samples (14.4%) were tested, from January to October 2019 – 293 samples (71.3%), and in February–March 2020 – 59 samples (14.4%).

The age distribution of the children examined was as follows: 93 children under 1 year old (22.6%); 129 children aged 1–3 years (31.4%); 98 children aged 3–7 years (23.8%); and 91 children over 7 years old (22.1%). Of all the pediatric patients examined, 219 were boys (53.3%) and 192 were girls (46.7%).

A study was conducted to determine the incidence, age and gender characteristics, intra-annual dynamics, monthly detection rates, and seasonality of the above-mentioned viral intestinal infections. A solid-phase sandwich assay (R-Biopharm, RIDASCREEN, Germany) was used to detect antigens of rotavirus group A, adenovirus serotypes 40/41, and human astrovirus by enzyme-linked immunosorbent assay.

Descriptive, evaluative, and analytical epidemiological and statistical methods were used to study the epidemiological characteristics of viral intestinal infections.

Results and discussion. The detection rate of group A rotaviruses as the etiologic agent of monoviral intestinal infections was $24.6 \pm 3.7\%$, adenovirus serotypes 40/41 – $38.8 \pm 4.2\%$, and human astroviruses (HAstV) – $36.6 \pm 4.2\%$. As can be seen from the frequency of occurrence, adenovirus serotypes 40/41 predominate (Fig. 1).

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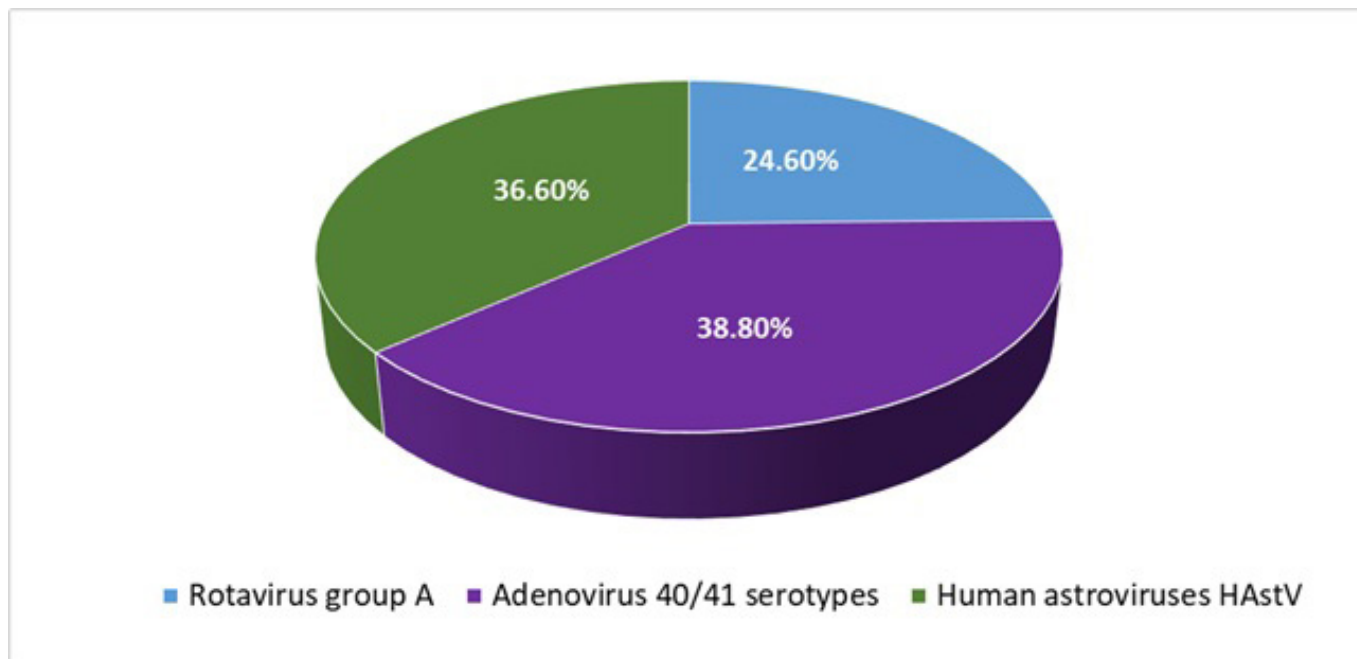


Fig. 1. Frequency of occurrence of monoviral intestinal infection among children (%)

A study of the frequency of occurrence of the investigated etiologic agents of monoviral intestinal infections among children, such as rotavirus group A, adenovirus 40/41 serotypes, and human astrovirus (HAstV), in a single case in different age groups revealed that rotavirus group A was detected in 14 children (15.1±3.7%) in the group under one year old, 40 children (31.0±4.1%) in the group aged 1-3 years, 25 children (25.5±4.4%) in the group aged 3-7 years, and 18 children (19.8±4.2%) in the group over 7 years.

The frequency of detection of adenovirus (40/41 serotypes) intestinal infection in different age groups was as follows: under 1 year – 18.3±4.0% (17 children); 1-3 years old – 36.4±4.2% (47 children); 3-7 years old – 36.7±4.9% (36 children); and over 7 years old – 22.0±4.3% (20 children).

Astrovirus intestinal infection among children under one year old was observed in 13 patients (14.0±3.6%), in the 1-3 years old group – in 54 children (41.9±4.3%), among children aged 3-7 years – in 34 (34.7±4.8%), and in the over 7 years old group – in 17 children (18.7±4.1%). Overall, the incidence of viral intestinal infections with a confirmed etiologic agent was 32.3±4.8% in children under 1 year of age, 73.6±3.9% in children aged 1-3 years, 67.3±4.7% in children aged 3-7 years, and 44.0±5.2% in the group over 7 years ($p<0.001$).

The results show that, among the surveyed

children, adenoviruses of serotypes 40/41 are the leading etiologic agent of monoviral intestinal infections, followed by rotavirus group A.

Among children in the surveyed age groups, the highest detection rate of viral intestinal infection was in the 1-3 age group – 73.6±3.9%. The lowest detection rate of viral intestinal infection was observed in children under one year of age – 32.3±4.8% ($p<0.001$). A study of viral intestinal infection detection rates by gender revealed that the incidence of viral intestinal infections was 59.8±3.3% (131 children) among boys and 52.1±3.6% (100 children) among girls. Monoviral intestinal infection involving a single virus was observed in 75 boys (34.2±3.2%) and 59 girls (30.7±3.3%).

Among boys, the incidence of adenovirus (40/41 serotypes) and astrovirus (HAstV) intestinal infections was almost identical – 32.9±3.2% and 32.4±3.2%. The incidence of rotavirus (group A) intestinal infection was slightly lower – 22.8±2.8%. The results of determining the incidence of viral intestinal infections depending on the etiologic pathogen also differed. Thus, adenovirus (40/41 serotypes) intestinal infection was more common among girls – 25.0±3.1%. Rotavirus (group A) and astrovirus (HAstV) intestinal infections were detected somewhat less frequently, but equally – 24.5±3.1% (Table).

Overall, monovirus intestinal infection was observed in 57.3±4.3% of cases among boys and 59.0±4.9% among girls.

Frequency of occurrence of various intestinal viruses among children depending on gender

№	Gender of children	Rotavirus group A		Adenovirus 40/41 serotypes		Human astrovirus	
		Abs. number	%±m	Abs. number	%±m	Abs. number	%±m
1	Boys	50	22,8±2,8	72	32,9±3,2	71	32,4±3,2
2	Girls	47	24,5±3,1	48	25,0±3,1	47	24,5±3,1

To study the incidence of monoviral intestinal infections depending on the season, all examined children were grouped by season: winter, spring, summer, and autumn. A total of 127 children were examined in the winter season (December, January, February), 188 children in the spring months (March, April, May), 55 children in the summer season (June, July, August), and 41 children in the autumn months (September, October, November).

The detection rate of certain intestinal viruses—rotavirus group A, adenovirus serotypes 40/41, and human astrovirus—as the etiologic factor of viral intestinal infections in children, depending on the season, was as follows: in the winter season—55.9±4.4%, in the spring season—54.8±3.5%. In the summer season – 54.5±6.4% and in the fall season – 51.2±7.8%. As can be seen, in general, viral intestinal infections are recorded more frequently in the win-

ter, spring, and summer seasons (from 54.8% to 65.6%), and less frequently in the fall season.

In the structure of viral intestinal infections, the highest detection rate of monoviral intestinal infection occurs in the spring season – 69.4±7.7%, while the lowest occurs in the winter season – 54.9±5.9%.

During the study period (2018-2020), the frequency of occurrence of certain intestinal viruses was also studied – rotavirus group A, adenovirus serotypes 40/41, and human astrovirus as the etiologic agent of viral intestinal infections among children, depending on the season. It was established that rotavirus intestinal infection (group A) was recorded almost throughout the year in all seasons, relatively more in the spring season - 25.5 ± 3.2%, slightly less in the summer season - 21.3 ± 3.2%, and in the autumn season - 22.0 ± 3.2%. In children, rotavirus intestinal infection (group A) was mainly characterized by a spring-summer seasonality (Fig. 2).

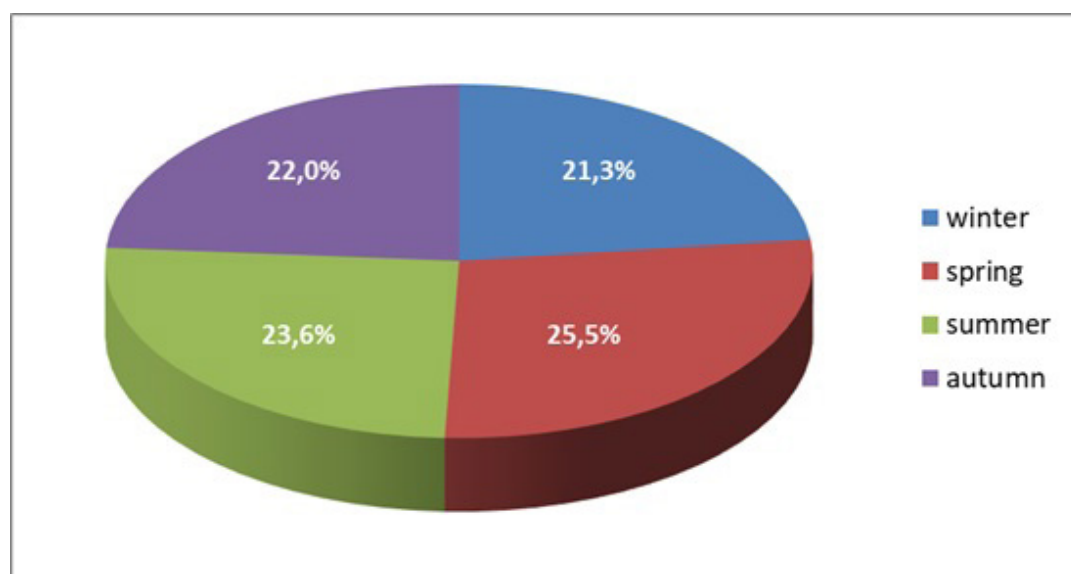


Fig. 2. Frequency of Rotavirus Intestinal Infection (Group A) in Children by Season

Analysis of the prevalence of adenovirus intestinal infection (40/4 serotypes) among the surveyed children by season revealed that the highest detection

rate for this intestinal infection occurred in the summer season – 34.5±5.4%, while the lowest detection rate occurred in the fall season – 24.4±6.7% (Fig. 3).

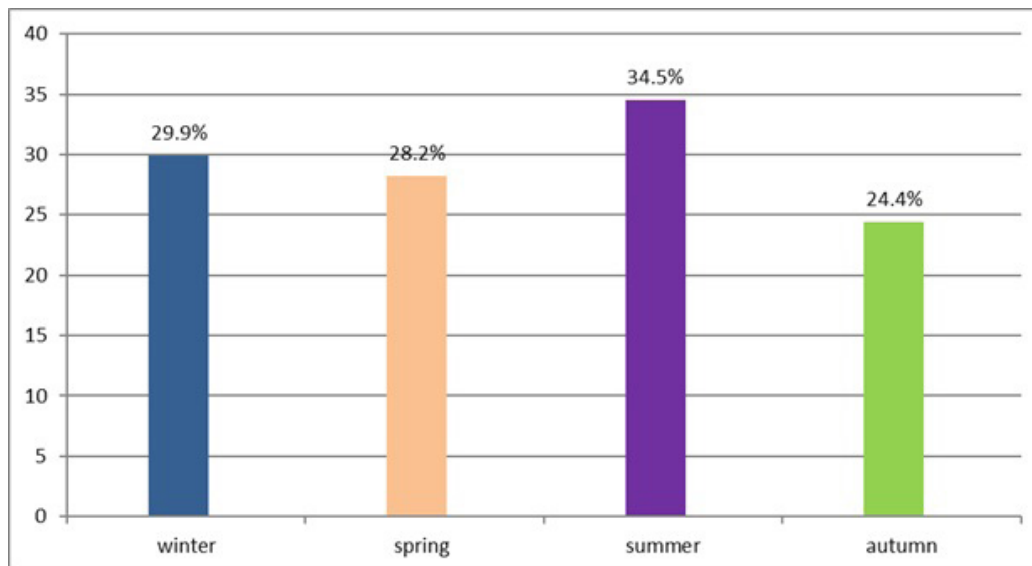


Fig. 3. Results of registration of adenovirus intestinal infection (40/41 serotypes) in children depending on season

Analysis of the detection rate of human astrovirus intestinal infection among children depending on season reveals that the highest detection rate occurs in the winter season – $31.5 \pm 4.1\%$, while the lowest detection rate occurs in the fall season –

$26.8 \pm 6.9\%$. The detection rate of human astrovirus intestinal infection in children was almost identical in the spring and summer seasons: $27.7 \pm 3.3\%$ in the spring season and $27.3 \pm 6.0\%$ in the summer season (Fig. 4).

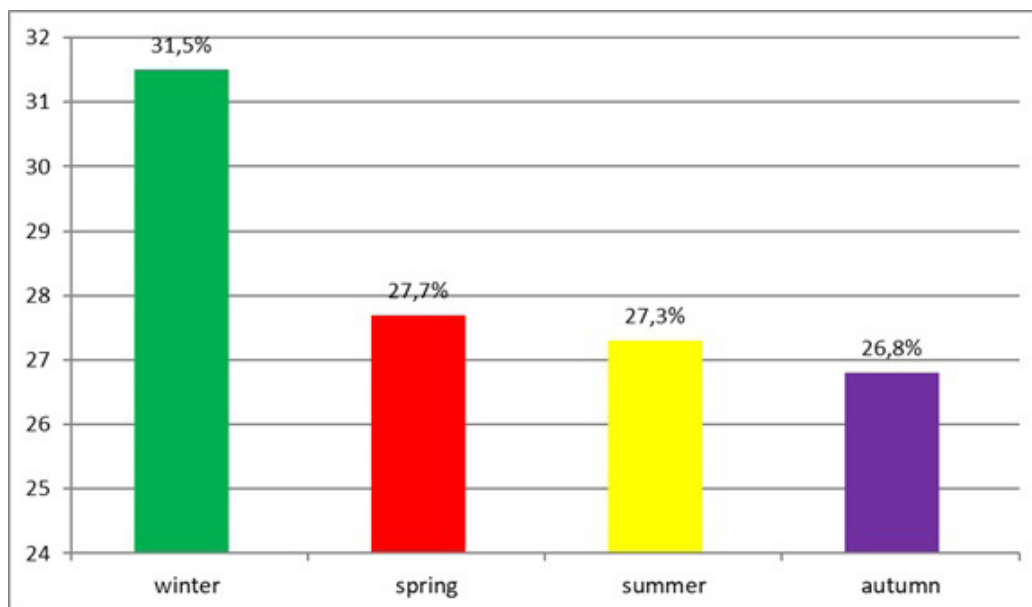


Fig. 4. Incidence of human astrovirus intestinal infection among children depending on season

A study of the monthly dynamics of human astrovirus intestinal infection revealed that the epidemic process of human astrovirus intestinal infection consists of periodic, year-round recorded cycles of epidemic increases and decreases in incidence.

Of the six epidemic cycles observed, two were minor, three were moderate, and one was severe. The incidence of human astrovirus intestinal infection among children increased beginning in

January, with the first epidemic increase observed in February at $41.1 \pm 6.6\%$, increasing slowly from March onward. The incidence culminated in a second epidemic increase in April at $26.8 \pm 5.3\%$. The third medium-amplitude epidemic cycle in June was characterized by an incidence rate of $31.3 \pm 6.7\%$. Beginning in July, it continued to increase sharply, reaching its highest peak point of 100.0% in August. The duration of the season for human astrovirus intestinal infection was 2 months.

Conclusions

1. Among children, monovirus intestinal infection was observed in 134 children (32.6%), and mixed virus intestinal infection in 97 children (23.6%). The detection rate of group A rotaviruses as etiologic agents of monovirus intestinal infections was 23.6%, 29.2% for adenoviruses of the 40/4 serotypes, and 28.7% for human astroviruses.

2. Among children, rotavirus intestinal infection (group A) was more frequently detected in the 1-3 year age group – 31.0±4.1%. Rotavirus intestinal infection (group A) was recorded more often among girls (24.5±3.1%) compared to boys (22.8±2.8%). Rotavirus intestinal infection (group A) was most frequently detected in the spring season – 25.5±3.2%, and somewhat less frequently in the winter season – 21.3±3.6%. In rotavirus intestinal infection (group A), the epidemic process manifested itself in a zig-zag pattern and consisted of four epidemic peaks and four epidemic declines in morbidity.

3. It was established that the maximum incidence of adenovirus intestinal infection (40/41 serotypes) was 36.7±4.9% in the group of children aged 3-7 years. Adenovirus intestinal infection (40/41 serotypes) was detected in 32.9±3.2% of cases in boys, and in 25.0±3.2% in girls. The highest incidence of adenovirus intestinal infection (40/41 serotypes)

was observed in the summer – 34.5±6.4%, while the lowest incidence was observed in the fall – 24.4±6.7%. The epidemic process consisted of two medium- and two high-amplitude epidemic cycles, demonstrating an unstable trend with a sharp rise and a sharp decline in the incidence of adenovirus intestinal infection (40/41 serotypes).

4. The highest incidence of astrovirus intestinal infection in humans was observed in the 1-3 year age group – 41.9±4.3%. The incidence of astrovirus intestinal infection was high among boys (32.4±3.2%) compared to girls (24.5±3.1%). Astrovirus intestinal infection was more frequently observed in the winter (31.5±4.1%) and less frequently in the fall. The epidemic process of astrovirus intestinal infection in humans consists of two minor, three medium, and one high-amplitude cycles, with epidemic peaks and troughs in incidence, recorded periodically throughout the year in all seasons. Among the examined children, intestinal viruses were not detected in 180 patients (43.8%), while various intestinal viruses were identified in 231 patients (56.2%). Overall, monoviral intestinal infection was observed in 134 children (32.6%), and mixed viral intestinal infection was observed in 97 children (23.6%).

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XÜLASƏ

BAKI ŞƏHƏRİNDƏ VİRUSLU BAĞIRSAQ İNFEKSİYALARININ ETİOLOGİYASI VƏ EPİDEMIOLOGİYASI

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Giriş. Virus etiologiyalı kəskin bağırsağ infeksiyaları, xüsusilə uşaqlarda əhəmiyyətli ictimai səhiyyə problemi. **Tədqiqatın məqsədi** Bakı şəhərində pediatrik xəstələr arasında viruslu bağırsağ infeksiyalarının etioloji strukturunu və epidemioloji xüsusiyyətlərini xarakterizə etmək olmuşdur. **Material və metodlar.** 2018–2020-ci illərdə “naməlum etiologiyalı bağırsağ infeksiyası” diaqnozu ilə hospitalizasiya edilmiş 0–18 yaş 411 uşaq müayinə edilmişdir. Nəcis nümunələri A qrupu rotavirus, 40/41 serotip adenovirus və insan astrovirusu (HAsV) üçün immunferment analizi (ELISA; R-Biopharm RIDASCREEN, Almaniya) metodundan istifadə edilərək test edilmişdir. Təsviri, qiymətləndirici və analitik epidemioloji metodlar tətbiq edilmişdir. **Nəticələr.** Xəstələrin 56,2%-ində bağırsağ virusları aşkarlanmışdır. Monoviruslu infeksiya uşaqların 32,6%-də, mikst viruslu infeksiya isə 23,6%-də müəyyən edilmişdir. Bu zaman adenovirus 40/41 serotip üstünlük təşkil etmişdir (38,8%), daha sonra HAsV (36,6%) və A qrupu rotavirus (24,6%) aşkar olunur. Ən yüksək aşkarlama göstəricisi 1–3 yaş qrupunda müşahidə edilmişdir (73,6%). Oğlanlarda qızlara nisbətən bir qədər yüksək infeksiya göstəricisi qeydə alınmışdır. Mövsümi təhlil rotavirusun yazda-yayda, adenovirusun yayda, astrovirusun isə qışda üstünlük təşkil etdiyini üzə çıxarmışdır. **Yekun.** 40/41 serotipi adenovirus Bakı uşaqlarında viral bağırsağ infeksiyalarının aparıcı etioloji agenti olmuşdur. 1–3 yaşlı uşaqlar ən çox zərər çəkən qrup olmuşdur. Bu nəticələr pediatrik əhalidə virusoloji nəzarətin gücləndirilməsinin vacibliyini və məqsədyönlü profilaktik tədbirlərin zəruriliyini vurğulayır.

Açar sözlər: kəskin bağırsağ infeksiyaları, rotavirus, adenovirus, astrovirus, immunferment analiz

РЕЗЮМЕ

ЭТИОЛОГИЯ И ЭПИДЕМИОЛОГИЯ ВИРУСНЫХ КИШЕЧНЫХ ИНФЕКЦИЙ В ГОРОДЕ БАКУ

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Введение. Острые кишечные инфекции вирусной этиологии представляют собой серьёзную проблему общественного здравоохранения, особенно среди детей. **Целью данного исследования** являлась характеристика этиологической структуры и эпидемиологических особенностей вирусных кишечных инфекций у педиатрических пациентов в г. Баку. **Материал и методы.** В период с 2018 по 2020 год обследованы 411 детей в возрасте от 0 до 18 лет, госпитализированных с диагнозом «кишечная инфекция неустановленной этиологии». Образцы фекалий тестировались на ротавирус группы А, аденовирус серотипов 40/41 и астровирус человека (HAsV) методом иммуноферментного анализа (ИФА; R-Biopharm RIDASCREEN, Германия). Применялись описательные, оценочные и аналитические эпидемиологические методы. **Результаты.** Кишечные вирусы выявлены у 56,2% пациентов. Моновиральная инфекция обнаружена у 32,6% детей, смешанная вирусная инфекция — у 23,6%. Среди моновиральных случаев преобладал аденовирус 40/41 серотипов (38,8%), за ним следовали HAsV (36,6%) и ротавирус группы А (24,6%). Наиболее высокий показатель выявляемости зафиксирован в возрастной группе 1–3 года (73,6%). У мальчиков показатели инфицирования были несколько выше, чем у девочек. Сезонный анализ показал преобладание ротавируса весной и летом, аденовируса — летом, астровируса — зимой. **Заключение.** Аденовирус серотипов 40/41 являлся ведущим этиологическим агентом вирусных кишечных инфекций у детей г. Баку. Наиболее поражённой группой оказались дети в возрасте 1–3 лет. Полученные данные подчёркивают необходимость усиления вирусологического надзора и разработки целенаправленных профилактических мероприятий в педиатрических популяциях.

Ключевые слова: острые кишечные инфекции, ротавирус, аденовирус, астровирус, иммуноферментный анализ

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