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Gastrointestinal bleeding in children: diagnosis, analysis, and structure

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The incidence of gastrointestinal bleeding is a significant concern among adult patients with gastrointestinal tract (GIT) disorders, as it is a leading cause of mortality. However, there is growing evidence of changes in the pattern of gastrointestinal pathologies among children, primarily attributed to an increasing number of cases related to peptic ulcer disease (PUD) and erosive processes of the GIT.

Purpose – to investigate the prevalence and analyze changes in the structure of GIT diseases in children complicated by upper gastrointestinal bleeding (GIB), based on esophagogastroduodenoscopy (EGD) data.

Materials and methods. Based on the clinic's records, a total of 4,457 children underwent EGD at the Regional Medical Center of Family Health in Dnipro. Among them, 1,393 (31.25%) patients were admitted to the surgical department with suspected GIB. In 201 (14.4%) cases, EGD was performed during active bleeding to determine its origin. The utilization of EGD during the acute phase in patients with suspected GIB is considered highly effective for both diagnosing the bleeding source and initiating early-stage treatment. The data were processed using the methods of variation statistics using the Statistica v 6.1 software package. To compare the relative indicators, the Pearson Hi-quadrat test (χ^2) and the two-sided Fisher's exact test (TCF) were used. The critical level of statistical significance (p) was accepted as <0.05.

Results. To conduct a comparative analysis of diagnosed cases of GIB, two groups of children with endoscopically confirmed GIB were formed: the Group I (n=125) representing the period of 2012–2013, and the Group II (n=201) – the period of 2020–2021. The results revealed an increase of 1.6 times in the number of patients with upper GIT diseases accompanied by bleeding in the Group II. Additionally, a significant rise in the frequency of GIT diseases, specifically erosive esophagitis, was observed. The number of patients with erosive esophagitis tripled in the Group II compared to the Group I.

Conclusions. In recent years, there has been a notable rise in GIT diseases accompanied by upper GIB. The number of such cases increased by 1.6 times, from 125 to 201 patients. Notably, there is a pronounced increase in the incidence of erosive esophagitis, particularly among children in the early and younger age groups.

The research was carried out in accordance with the principles of the Helsinki Declaration. The study protocol was approved by the Local Ethics Committee of participating institution. The informed consent of the patient was obtained for conducting the studies.

No conflict of interests was declared by the authors.

Keywords: GIB, pediatric surgery, esophagogastroduodenoscopy.

Шлунково-кишкові кровотечі в дітей: діагностика, аналіз та структура

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Відомо, що серед дорослих пацієнтів із патологією шлунково-кишкового тракту (ШКТ) однією з основних причин летальності є кровотеча з ШКТ. На сьогодні спостерігається стійка тенденція до збільшення частоти запальних захворювань ШКТ і в дітей,

насамперед за рахунок збільшення загальної кількості хворих, які страждають на виразкову хворобу та ерозивні процеси ШКТ, ускладнені кровотечею.

Мета – вивчити поширення та проаналізувати зміни в структурі захворювань ШКТ у дитячому віці, ускладнених кровотечею з верхніх відділів, на основі даних езофагогастродуоденоскопії (ЕФГДС).

Матеріали та методи. За матеріалами клініки, у регіональному медичному центрі родинного здоров'я м. Дніпро 4457 дітям виконано ЕФГДС, із них 1393 (31,25%) хворих госпіталізовано до хірургічного відділення з підозрою на шлунково-кишкову кровотечу (ШКК). У 201 (14,4%) випадку ФЕГДС виконано на висоті кровотечі з виявлення його джерела. Дані опрацьовано з використанням методів варіаційної статистики за допомогою пакету програм «Statistica v6.1». Для порівняння відносних показників використано критерій Хі-квадрат Пірсона (χ^2) та двосторонній точний критерій Фішера. Критичний рівень статистичної значущості (p) прийнято за <0,05.

Результати. З метою порівняльного аналізу результатів діагностики хворих створено дві групи дітей з у перше ендоскопічно підтвердженою ШКК: I група (n=125) охоплювала період 2012–2013 рр.; II група (n=201) – період 2020–2021 рр. За результатами отриманих даних, кількість пацієнтів із захворюваннями ШКТ, ускладненими кровотечею з верхніх відділів, у II групі збільшилася в 1,6 раза. Значна динаміка зростання частоти серед патології ШКТ відмічалася в ерозивних езофагітів, у II групі кількість таких пацієнтів збільшилася утричі порівняно з відповідним показником I групи.

Висновки. Останніми роками відзначається тенденція до значного приросту захворювань ШКТ, ускладнених кровотечею з верхніх відділів. Кількість таких пацієнтів збільшилася в 1,6 раза (зі 125 до 201 випадку). Найбільш значна динаміка зростання спостерігається в ерозивних езофагітів, особливо в дітей раннього та молодшого віку.

Дослідження виконано відповідно до принципів Гельсінської декларації. Протокол дослідження ухвалено Локальним етичним комітетом зазначеної в роботі установи. На проведення досліджень отримано інформовану згоду пацієнтів.

Автори заявляють про відсутність конфлікту інтересів.

Ключові слова: шлунково-кишкові кровотечі, дитяча хірургія, езофагогастродуоденоскопія.

Introduction

It is known that among adult patients with pathology of the gastrointestinal tract (GIT) one of the main causes of death is gastrointestinal bleeding (GIB) [1,3,7]. However, there is a steady trend of increasing incidence of inflammatory diseases of the GIT in the children. Today, the literature shows changes in the structure of gastrointestinal pathologies in the children and primarily due to increasing total number of patients suffering from peptic ulcer disease (PUD) and erosive processes of GIT [1,8,9].

This trend is caused by many factors: nutritional, allergic, immune, genetic, hormonal, foreign bodies and others, including occurrence of so-called stress ulcers in the children of young age and even newborns on the background of sepsis and hormone therapy [4–6,9,10]. Generally, all this affects development of inflammatory diseases of the digestive system. The primary cause of this pathology is a change in the diet of children, leading to a shift in human nutrition patterns. As a result, a significant portion of inflammatory gastrointestinal diseases can be complicated by GIB. [2,3,9,10].

The **purpose** of the research – to investigate the prevalence and analyze changes in the structure of GIT diseases in children complicated by upper GIB, based on esophagogastroduodenoscopy data.

Materials and methods of the research

Undoubtedly, the main and most informative method of diagnosing diseases of GIT that complicated by bleeding from upper parts is esophagogastroduodenoscopy (EGD). Today we widely use EGD in all stages of diagnosis and treatment diseases of GIT in children, due to the increasing frequency of severe diseases of the digestive system in the patients of all age groups. Examination of GIT in the children with syndrome «bleeding of GIT» and verification of diagnosis in the most cases was carried out in emergency or delayed manner in accordance with treatment protocols for children by the specialty «Pediatric gastroenterology» (Order of Ministry of Health of Ukraine No. 438 from 26.05.2010 and No.59 from 29.01.2013). However, EGD control was carried out in a planned manner. In the children of younger age and children with labile psychics, EGD was performed under general anesthesia. According to the protocol of endoscopic examination, results of the examination must be recorded on an electronic information carrier. Before research, the child must be examined (general blood test, determination of blood coagulation function, other laboratory tests according to the indications), consultations with a pediatrician, gastroenterologist and other specialists.

Over the last two years, 4457 children underwent endoscopic examination the upper parts of GIT by EGD in Dnipro Regional Children's Hospital. Among them 1393 (31.25%) patients were hospitalized in the emergency surgery department with suspicion on GIB, i.e., in 656 (47.1%) cases children were examined the first time, and in 737 (52.9%) cases the patients were re-examined in the stages of treatment. The most common cases diagnosed in this group were erosive esophagitis – 165 (11.8%) patients, erosive gastritis – 261 (18.7%), duodenitis – 66 (4.7%), duodeno-gastric reflux – 98 (7.0%), bubbles – 95 (6.8%). In 201 (14.4%) cases EGD was performed on the height of bleeding in order to identify its source.

In order to conduct comparative analysis results of a diagnosis in the patients with endoscopically confirmed

Table 1
Distribution of children with syndrome of GIB, by age, abs. (%)

Age of children, years	Totally (n=326)	Groups of children		Difference between groups (p)
		I (n=125)	II (n=201)	
Before 1 y.o.	23 (7.0)	17 (13.6)	6 (3.0)	<0.001
1–3	53 (16.3)	23 (18.4)	30 (14.9)	0.408
4–6	29 (8.9)	10 (8.0)	19 (9.5)	0.654
7–15	79 (24.2)	18 (14.4)	61 (30.3)	<0.001
16–18	142 (43.6)	57 (45.6)	85 (42.3)	0.558

Note: p – the level of statistical significance of differences between indicators between groups (according to χ2 Pearson's criterion).

Table 2
Nosological structure syndrome of GIB in the I and II groups, abs. (%)

Diagnosis	Totally (n=326)	Groups		Difference between groups (p)
		I (n=125)	II (n=201)	
Varicose expansion veins of the esophagus	25 (7.7)	7 (5.6)	18 (9.0)	0.268
Mallory–Weiss syndrome	16 (4.9)	10 (8.0)	6 (3.0)	0.042
Cardiac insufficiency	63 (19.3)	19 (15.2)	44 (21.9)	0.137
Erosive esophagitis	49 (15.0)	12 (9.6)	37 (18.4)	0.030
Erosive gastritis	34 (10.5)	10 (8.0)	24 (11.9)	0.258
Acute and chronic ulcers of the stomach and duodenum	90 (27.6)	43 (34.4)	47 (23.4)	0.031
Source of bleeding is not identified	49 (15.0)	24 (19.2)	25 (12.4)	0.097

Note: p – the level of statistical significance of differences between indicators between groups (according to χ^2 Pearson's criterion).

diagnosis of GIB, and to identify a possible tendency to increase number of such patients, an analysis was performed in the groups, similar in the terms and syndrome, covering period 2012–2013 (n=125) and corresponds to the period of updating endoscopic medical equipment and start of electronic accounting of the examination results in the clinic. Thus, 2 groups of children with the firstly endoscopically confirmed GIB were identified: the Group I (n=125) covers period 2012–2013 years and the Group II (n=201) covers period 2020–2021.

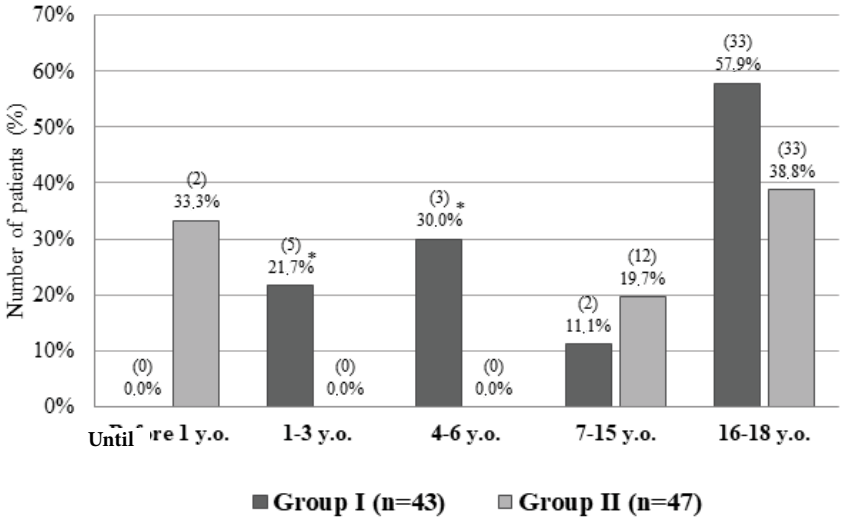
The data were processed using the methods of variation statistics using the Statistica v 6.1 software package (license number AGAR909E415822FA). To compare the relative indicators, the Pearson Hi-quadrat test (χ^2) and the two-sided Fisher's exact test (TCF) were used. The critical level of statistical significance (p) was accepted as <0.05.

Results of the research and discussion

The analysis of the obtained data (Table 1) showed a significant increase in GIT diseases accompanied by bleeding from the upper divisions. The number of such patients increased from 125 cases to 201, which is a 1.6-fold increase. As evidenced by the data table 1, the main increase in diseases occurred among children aged 7 to 15 years – 61 (30.3%) cases in the Group II versus 18 (14.4%) children in the Group I (p<0.001). At the same time, the number of infants with gastrointestinal syndrome decreased by 4.5 times (from 13.6% to 3.0%) (p<0.001).

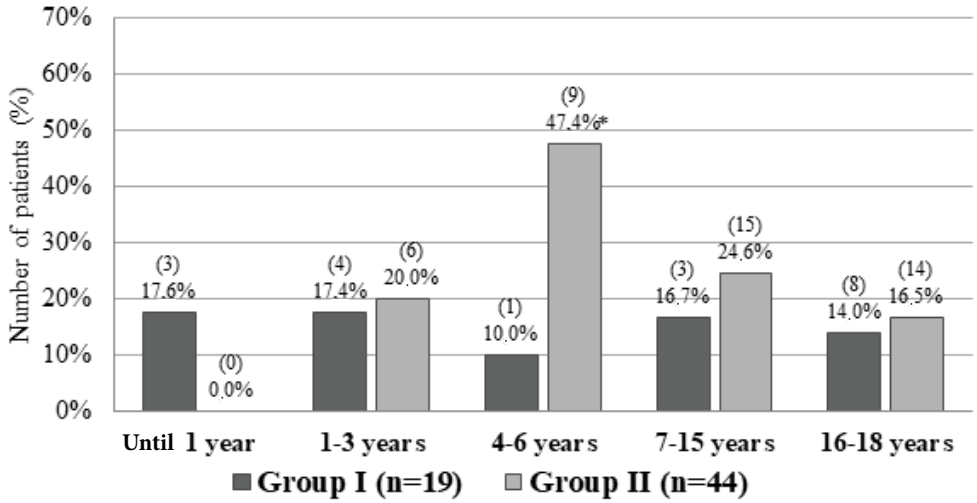
In the first place by the frequency of detection there are acute and chronic gastric and duodenal ulcers in both groups – 43 (34.4%) and 47 (23.4%) of patients in the Groups I and II, respectively (Table 2). It should be noted a decrease in the total proportion of such patients in the Group II (p=0.031 between groups), especially among children of early and young age. In the Group I, gastric and intestinal ulcers accompanied by the GIT were observed in 5 (21.7%) out of 23 children aged 1 to 3 years and in 3 (30.0%) out of 10 children aged 4 to 6 years, while in the Group II, no similar cases were recorded (p=0.012 and p=0.033 according to the F-test) (Fig. 1).

Common by the frequency pathology accompanied by GIB is cardiac insufficiency (19.3%). Mechanism of bleeding in this form, in our opinion, is prolapse of gastric mucosa into the lumen of esophagus with the release of blood «per diapedesum» and increasing of intragastric pressure (vomiting, etc.) as a result of weakness of lower esophageal sphincter. The frequency of registering this pathology increased in the Group II compared to the



Notes: 1. The absolute number of cases of the disease in the Groups I and II of children of the corresponding age is in brackets. 2. The percentage is calculated on the total number of children in each group (Table 1). 3. * – significant discrepancies between the groups (p<0.05) according to the F-test.

Fig. 1. The incidence of gastric and duodenal ulcers as a cause of the GIT, depending on the age of children



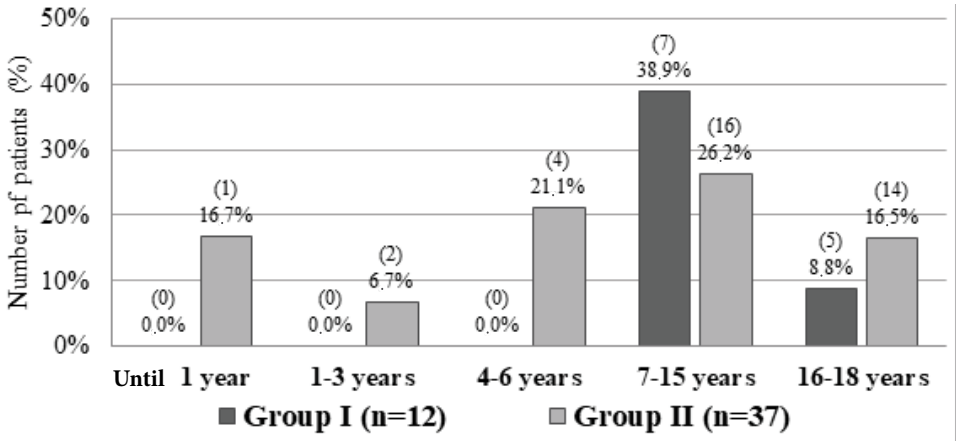
Notes: 1. The absolute number of cases of the disease in the Groups I and II of children of the corresponding age is given in brackets. 2. The percentage is calculated on the total number of children of a given age in the group (Table 1). 3. * – significant discrepancies between the groups (p<0.05) according to the F-test.

Fig. 2. Frequency of cases of cardiac insufficiency as a cause of GIB, depending on the age of children

Group I (21.9% of cases versus 15.2% in the Group I at p=0.137), particularly in the 4–6 years age group (47.4% of cases versus 10.0% at p=0.044). (Table 2, Fig. 2).

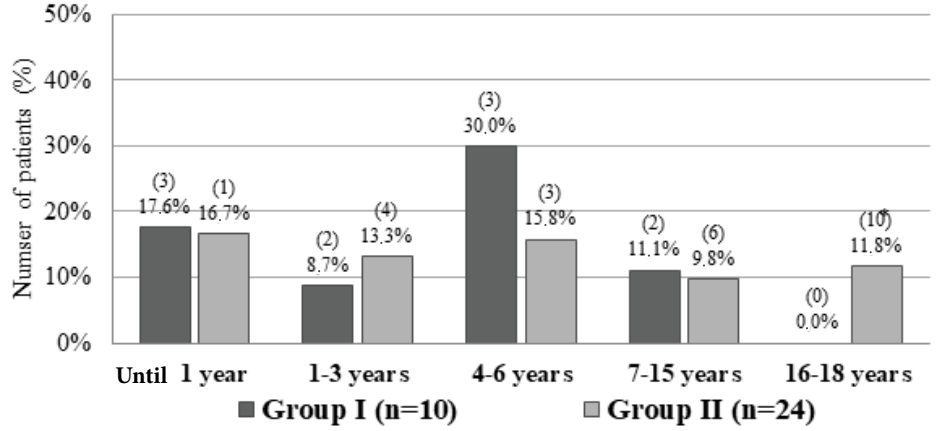
The most significant increase in frequency among GIT pathologies was observed in erosive esophagitis. In absolute numbers, the quantity of erosive esophagitis cases increased threefold (from 12 to 37 cases), and in relative numbers, it increased 1.9 times (from 9.6% to 18.4%, p=0.030) (Table 2). First of all, draws attention to the appearance of such diseases in the children of young age (from birth up to 6 y.o.) – 7 cases (12.7%) out of 55 children in the Group II and not a single case (0.0%) in the Group I (p=0.028 by F-test) (Table 1, 2; Fig. 3). Erosive esophagitis is one of the symptoms of gastroesophageal reflux. The last one, unfortunately, is increasingly diagnosed in the children of different ages (Fig. 3) and in some cases require surgical treatment.

Thus, take into account the connection between increasing number of detected cases of erosive esophagitis and cardiac insufficiency that complicated by bleeding



Notes: 1. The absolute number of cases of the disease in the Groups I and II of children of the corresponding age is given in brackets. 2. The percentage is calculated on the total number of children of a given age in the group (Table 1).

Fig. 3. Frequency of cases of erosive esophagitis as a cause of GIB, depending on the age of children



Notes: 1. The absolute number of cases of the disease in the Groups I and II of children of the corresponding age is in brackets. 2. The percentage is calculated on the total number of children in each group (Table 1). 3. * – significant discrepancies between the groups ($p < 0.05$) according to the F-test.

Fig. 4. The frequency of cases of erosive gastritis as a cause of GIB, depending on the age of children

(growth together with 24.8% to 40.3%, p=0.004 by χ^2) with gastroesophageal reflux, this should be a cause for concern of pediatric surgeons and gastroenterologists.

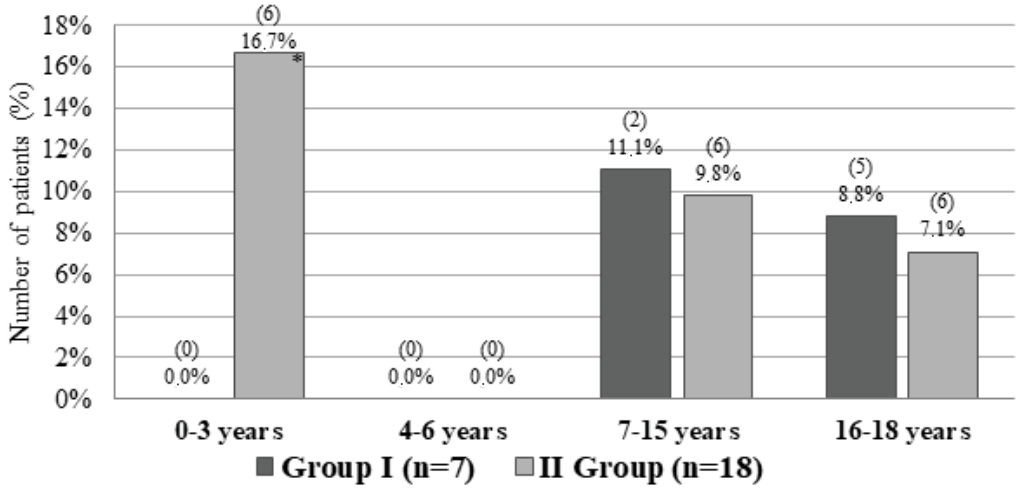
On the background of general increasing cases of gastritis, number of erosive gastritis in the children has increased significantly, especially in the older age group, which is the basis for PUD in children and one of the causes of the GIT bleedings (Fig. 4).

In the recent decades, there has been shown a tendency to increase number of children with portal hypertension, and one of the most formidable symptoms of portal hypertension is bleeding from varicose extended veins of the esophagus. According to our research the relative frequency of such cases increased 1.6 times – from 5.6% to 9.0% (p=0.268 for χ^2), especially in children under the age of 1 and from 1 to 3 years – 6 (16.7%) cases out of the total number of 36 children of this age of the Group II (p=0.009 for F-test) (Table 2, Fig. 5). Bleeding from varicose extended veins of the esophagus is usually massive. A classic example of the first aid to stop bleeding is use of a Blackmore probe, but in 15 children with syndrome of GIB, we successfully performed endoscopic hemostasis.

The only pathology that has decreased slightly in the recent years, according to our data, is Mallory–Weiss syndrome, especially due to a decreasing number of this pathology in the children of young age (Fig. 6).

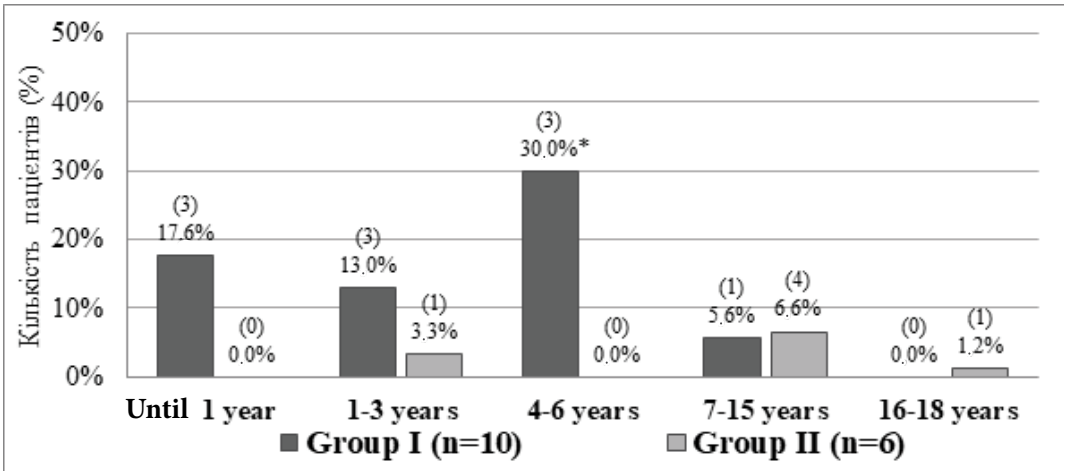
It should also be noted that the improvement of the methods of endoscopic examination of gastrointestinal diseases in children allowed for a 10-year period to reduce the percentage of uncertainty about the source of bleeding from 19.2% to 12.4% (p=0.097 per c2).

Therefore, there has been a significant increase in the number of children with GIT pathology, often accompanied by bleeding from the upper sections in recent years, primarily in the age group of 7–15 years, while there has



Notes: 1. The absolute number of cases of the disease in the Groups I and II of children of the corresponding age is in brackets. 2. The percentage is calculated on the total number of children in each group (Table 1). 3. * – significant discrepancies between the groups (p<0.05) according to the F-test.

Fig. 5. The incidence of varicose veins of the esophagus as a cause of GIB, depending on the age of children and the observation period



Notes: 1. The absolute number of cases of the disease in the Groups I and II of children of the corresponding age is in brackets. 2. The percentage is calculated on the total number of children in the each group (Table 1). 3. * – significant discrepancies between the groups (p<0.05) according to the F-test.

Fig. 6. Frequency of manifestations of Mallory–Weiss syndrome as a cause of GIB, depending on the age of children

been a decrease in the number of cases in the first year of life (p<0.001). Moreover, there have been changes in the nosological structure of the GIT syndrome, both in general and depending on the age of the children. During this period, the relative number of cases of erosive esophagitis and cardiac insufficiency increased (from 24.8% to 40.3%, p=0.004), along with erosive gastritis (from 8.0% to 11.9%, p=0.258) and varicose veins of the lower extremities of the esophagus (from 5.6% to 9.0%, p=0.268), against a significant decrease in the manifestations of Mallory–Weiss syndrome (from 8.0% to 3.0%, p=0.042) and acute gastric and duodenal ulcers (from 20.0% to 10.5%, p=0.016). In the nosological structure of the GIT syndrome in young children, there has been a decrease in the number of cases of Mallory–Weiss syndrome, cardiac insufficiency, and erosive gastritis (from 9 – 52.9% of cases to 1 – 16.7%, p=0.123), as well as in determining the source of bleeding (from 8 – 47.0% to 1 – 16.7%, p=0.190).

In the group of young children (1–3 years old), there was an increase in cases of bleeding from the dilated veins of the esophagus (5–16.7%, p=0.061), but no cases of GIB due to gastric and duodenal ulcers were registered (p=0.012). For children in the younger age group (4–6 years), there was a significant increase in cases of GIB due to cardiac insufficiency (from 1–10.0% to 9–47.4% of cases, p=0.044) in recent years, as well as an increase in the prevalence of erosive esophagitis

(4–21.1%, p=0.118) and a decrease in negative manifestations of gastric and duodenal ulcers (p=0.033) and Mallory–Weiss syndrome (p=0.033).

While the number of hospitalized children aged 7–15 years with GIB syndrome increased significantly (from 14.4% to 30.3%, p<0.001), the nosological structure of the causes of GIB remained relatively stable, with the consequences of erosive esophagitis (26.2%), cardia insufficiency (24.6%), and peptic ulcer of the stomach and duodenum (19.7%) being the leading causes.

In the largest group of older children (16–18 years old) with endoscopically confirmed GIB, there was a nearly doubling of cases with erosive esophagitis over this period (from 8.8% to 16.5%, p=0.186).

It should be noted that endoscopic methods play a crucial role in diagnosing GIT pathology, which is often accompanied by bleeding from the upper sections. The significance of EGD in this situation cannot be overstated, and it is important for gastroenterologists, pediatricians, and family doctors to know and remember that diagnosed and untreated GIT diseases can lead to significant complications.

Conclusions

In recent years, there has been a significant increase in gastrointestinal diseases accompanied by upper GIB. The number of patients with such conditions has increased by 1.6 times, from 125 cases to 201. The most notable increase is observed in infants and young children, particularly in the case of erosive esophagitis.

The highest increase in the incidence of diseases occurred among children aged 7 to 15 years, with gastric and duodenal ulcers being the most prevalent. Conversely, there has been a significant decrease in the number of infants with gastrointestinal syndrome, which has decreased by 4.5 times, from 13.6% to 3.0% (p<0.001).

Esophagogastroduodenoscopy remains one of the main diagnostic methods, used among others, in the acute phase for patients with GIB, and it is highly effective in diagnosing the source of bleeding, serving as an integral part of early-stage treatment.

We believe that the main factors contributing to the rise of this pathology in children include changes in dietary patterns, lifestyle routines, and increased levels of stress factors during adolescence in modern society.

No conflict of interests was declared by the authors.

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