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DETERMINATION OF THE CLINICAL AND PROGNOSTIC SIGNIFICANCE OF ABDOMINAL SYNDROME IN CHILDREN WITH SYNTROPIC FUNCTIONAL GASTROINTESTINAL DISORDERS

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Summary

The **purpose** of the study: to analyze the clinical and anamnestic characteristics of the abdominal syndrome with syntropic functional disorders of the digestive system in children and determine its diagnostic and prognostic significance.

Materials and methods. A retrospective analysis of medical cases of 649 children with abdominal syndrome aged 1 to 18 years has been conducted. Surgical pathology was diagnosed in 1/3 of children (248 people (38.2 % (95 % CI 34.4÷42.0))). The most children (401; 61.8 % (95 % CI 58.0÷65.6)) after the exclusion of surgical pathology were diagnosed functional disorders of digestive organs, of which syntropic pathology was established in 68.6 % of patients. The leading functional disorder was the irritable bowel syndrome.

Results of research. According to the results of univariate logistic regression using the odds ratio, the main clinical features in the differential diagnosis of functional and organic pathology in children with abdominal syndrome were determined, which increased the chance of primary diagnosis of the abdominal pathology at the primary examination of the child

before obtaining data from laboratory and hardware examinations. The highest chances of diagnosis of functional disorders of the digestive system were revealed with duration of the disease course up to 2 days (OR 7.9; CI 4.9÷12.6); the presence of abdominal pain of moderate intensity (OR 103.2; CI 58.8÷181.1) without clear localization (OR 7.3; CI 5.1÷10.5); normal body or subfebrile general temperature (OR 29.0; CI 18.2÷46.4); absence of peritoneal irritation (OR 26.7; CI 12.9÷55.6). At the second stage, with the help of binary multivariate logistic regression, a mathematical model with the definition of the quantitative evaluation of each clinical feature and their combination was created, which allowed to conduct a differential diagnosis between functional disorders and intestinal surgical pathology at the stage of the primary care unit with using appropriate coefficients available and probable (Se=95.8 %; Sp=89.1 %; PPV=93.0 %; NPV=94.0 %).

Conclusions. The application of the proposed method of multivariate logistic regression, taking into account the integral estimation of the combination of clinical signs, greatly improves the diagnosis of functional intestinal pathology first of all, and allows to rule on the scope of additional examination and curative management by the primary care physician.

Key words: children, functional disorders of the digestive organs, abdominal syndrome, syntropic pathology.

Introduction. Today, the issue of primary diagnosis at the initial stage of medical care is highly relevant in connection with the need for timely decision-making for the diagnosis verification, especially under conditions characterized by non-specific manifestations.

The timely provision of medical care depends on the quality of the primary diagnosis and the correct management of the patient. In pediatric practice it is important that many conditions are characterized by nonspecific manifestations, in particular abdominal syndrome (AS) can be a manifestation of various pathologies, both organic and functional.

Abdominal syndrome in children is often the leading sign of functional disorders (FD) of the digestive system. Peculiarities of its course in childhood are caused by morphofunctional immaturity of the abdominal cavity organs, violation of the general homeostasis, a special course of inflammatory and adaptive reactions [1–3]. Generalization and nonspecificity of the reactions of the child's organism to inflammation, similar clinical manifestations in various diseases (abdominal pain, temperature, vomiting, defecation disorders), create significant difficulties in diagnosing AS, the patient can be hospitalized both

to somatic and surgical department, which delays carrying out proper medical manipulations [4, 5].

The **purpose** of the study: to analyze the clinical and anamnestic characteristics of abdominal syndrome in syntropic functional disorders of the digestive system in children and to determine its diagnostic and prognostic significance.

Materials and methods of research. To determine the characteristics of the AS, we conducted a retrospective analysis of medical cases of 649 children aged 1–18 years old, who suffered from AS of varying intensity and were necessarily consulted in the Odessa Children's Clinical Hospital at the period of years 2014–2016.

The criterion for selecting children for our study was the presence of abdominal syndrome at visiting the doctor.

1/3 of children (248 people (38.2 % (95 % CI 34.4÷42.0)) who were hospitalized for AS were diagnosed surgical pathology (SP) and surgical treatment for acute appendicitis (AA) was performed after the examination. The majority of children (401; 61.8 % (95 % CI 58.0÷65.6)), after exclusion of surgical pathology and follow-up examination, FD of the digestive organs were diagnosed. Syntropy was revealed in 68.6 % of patients. The leading FD was the irritable bowel syndrome (IBS).

While determining gender peculiarities, it was found that the ratio of boys and girls equally remained in all age categories and amounted to 295 (45.5 %) and 354 (54.5 %), respectively, i.e., AS did not depend on the gender of the child. By average age values, patients did not differ in both groups. The average age of children with AS was (10.7±0.22) years old.

Statistical processing of the material was carried out using the Data Manager module of Statistica 9 (StatSoft corp.). The χ^2 criterion was used as a statistical estimation of the regression model. Wald statistics was used to assess the statistical significance of the regression coefficients. The correlation between clinical signs with the use of the Spearman rank correlation was also studied. The odds ratio (OR, 95 % CI) was calculated, based on the assessment of the frequency of the studied characteristics in two differentiated groups for all clinical signs, which are connected with the diagnosis at the level $p < 0.0001$ according to the coefficient of contingency χ^2 .

Results of research. Seven clinical signs were the most significant features in the differential diagnosis of the FD of the digestive system and SP and they were selected for the analysis of univariate logistic regression: duration of disease, localization of pain, intensity of pain, temperature, vomiting, defecation and flatus disorders, peritoneal irritation. Table 1

gives the listed clinical signs used in the work.

To exclude the interinfluence of some clinical signs on others, a correlation analysis was conducted, the results of which established the lack of correlation between the selected indicators, except for the weak one but statistically significant positive correlation between the intensity of pain and temperature (Table 1).

Table 1. Spearman rank correlation coefficients of basic clinical signs (ρ)

Signs	Duration of disease	AS localization	AS severity	Temperature	Vomiting	Defecation and flatus disorder	Peritoneal irritation
Duration of disease	1.00	0.13	0.37	0.36	0.27	0.28	0.19
AS localization	0.13	1.00	0.40	0.22	0.05	-0.01	0.10
AS severity	0.37	0.40	1.00	0.59	0.34	0.20	0.37
Temperature	0.36	0.22	0.59	1.00	0.31	0.21	0.31
Vomiting	0.27	-0.05	0.34	0.31	1.00	0.33	0.11
Defecation and flatus disorder	0.28	-0.01	0.20	0.21	0.33	1.00	0.15
Peritoneal irritation	0.19	0.10	0.37	0.31	0.11	0.15	1.00

Thus, the studied clinical signs are of independent significance and can be used for the analysis of binary multivariate logistic regression.

In the course of the work, the ratio of the number of children with certain categories of 7 clinical signs (by 14 gradations) in the FD and SP group was studied, as well as OR in 95 % CI for these characteristics (Table 2).

Table 2 shows that 93.3 % of patients with FD, and 63.7 % of patients with SP were hospitalized within first two days. So, if the child seeks medical help for AS within the first 2 days of the disease, the chance of the presence of FD in relation to SP increased 7.9 times statistically significant.

The absence of a clear localization of abdominal pain in 70.1 % of children with FD 7.3 times increased the chance of functional pathology (OR=7.3 (CI 5.1÷10.5)).

The intensity of abdominal pain in patients with FD was predominantly moderate (94.8 %), and 85.1 % of patients with SP had pronounced abdominal pain (OR=103.2 (CI 58.8÷181.1)).

Table 2. Odds ratio according to univariate logistic regression in differential diagnosis of AS in children of somatic and surgical groups

Risk factors	FD (n=401)		SP (n=248)		Odds ratio OR (95 % CI)	χ^2	p ≤ 0.0001
	Abs.	%	Abs.	%			
Duration of disease - ≤ 2 days - ≥ 3 days	374	93.3	158	63.7	7.9 4.9÷12.6	89.7	
	27	6.7	90	36.3			
AS localization - along the abdomen - on the right	281	70.1	60	24.2	7.3 5.1÷10.5	134.2	
	120	29.9	188	75.8			
AS severity - moderate - pronounced	380	94.8	37	14.9	103.2 58.8÷181.1	472.5	
	21	5.2	211	85.1			
Temperature - < 38.0°C - ≥ 38.0°C	373	93.0	78	31.5	29.0 18.2÷46.4	286.5	
	28	7.0	170	68.5			
Vomiting - no/single - multiple	351	87.5	154	62.1	4.3 2.9÷6.3	56.2	
	50	12.5	94	37.9			
Defecation and flatus disorders - no - yes	278	69.3	118	47.6	2.5 1.8÷3.5	30.3	
	123	30.7	130	52.4			
Peritoneal irritation - no - yes	189	47.1	8	3.2	26.7 12.9÷55.6	171.5	
	212	52.9	240	96.8			

The temperature was normal or subfebrile in 93.0 % of children with FD, while 68.5 % of children with SP had fever as a non-specific response of the body to inflammation (OR=29.0 (CI 18.2÷46.4)).

Dyspeptic disorders in children with AS were characterized by the presence of vomiting and defecation disorder, with FD a single vomiting took place as a rule (OR=4.3 (CI 2.9÷6.3)). Defecation and flatus disorder in children with AS did not have high diagnostic value (OR=2.5 (CI 1.8÷3.5)).

Peritoneal irritation was found in almost all patients with SP (96.8 %), and in only in half (52.9 %) of patients with FD. So, the absence of irritation of the peritoneum increased 26.7 times the chance of having FD.

Thus, the highest chances of FD diagnosis we had with duration of disease up to 2

days (OR 7.9), lack of clear localization of abdominal pain (OR 7.3), moderate pain intensity (OR 103.2), normal or subfebrile general temperature (OR 29.0), absence of peritoneal irritation (OR 26.7).

At the second stage, multivariate logistic regression was used to create a mathematical model for the differential diagnosis of FD and SP. As a result of the simulation, those clinical features that contributed much to the differential diagnosis and included the load of those features that were not included in the final model were selected. The final model included 5 clinical signs that sufficiently provided the possibility of differential diagnosis. Table 3 shows the features selected for the mathematical model of the regression equation coefficients and their statistical estimation.

Table 3. Coefficients of the multivariate logistic regression equation and their statistical estimation

Parameters		Coefficient	P	Odds rate OR (95 % CI)
Duration of disease ≤ 2 days	X ₁	1.2295	0.022	3.4 (1.2÷9.9)
Temperature $< 38^{\circ}\text{C}$	X ₂	2.8927	0.0001	18.0 (7.8÷41.9)
Pain along the abdomen	X ₃	2.3879	0.0001	10.9 (5.0÷23.7)
Pain intensity is moderate	X ₄	3.6772	0.0001	39.5 (18.2÷86.0)
Peritoneal irritation is absent	X ₅	3.3328	0.0001	28.0 (9.4÷83.5)
Constant		-6.5543	0.0001	

The total assessment of the model was statistically significant at a high level ($\chi^2=641.8$; $p=0.0001$).

According to the data of the table 3, according to the results of multivariate logistic regression, the following signs (duration of disease up to 2 days, normal or subfebrile temperature, lack of clear localization, moderate intensity of pain, absence of peritoneal irritation) were more likely observed in children in the presence of FD than SP.

As a result of quantitative assessment of risk factors (OR), some variables increased their significance in the differential diagnosis of AS, others decreased. The exponential values of the coefficients in the multiple logistic regression equation reflected the independent nature of their effect on the predicted diagnosis.

Proceeding from the coefficients given in Table 3 of the equation of multivariate logistic regression taking into account the influence of all the signs, the duration of the disease for no more than 2 days was a factor in increasing 3.4 times the probability of FD (CI 1.2÷9.9); normal or subfebrile temperature increased 18 times the chances of FD diagnosis

(CI 7.8÷41.9); absence of clear localization and moderate intensity of pain – 10.9 (CI 5.0÷23.7) and 39.5 (CI 18.2÷86.0) times respectively; absence of peritoneal irritation increased 28 times the probability of FD (CI 9.4÷83.5). At the same time, the most significant factor according the ratio of chances was moderate abdominal pain at the time of admission to the in-patient department, supporting functional disorder.

As a result of mathematical modeling, an equation was obtained that linked a set of clinical signs (predictors) with the probability of FD in children who were admitted to the surgical hospital for abdominal syndrome:

$$Y = -6.5543 + 1.2295 * X_1 + 2.8929 * X_2 + 2.3879 * X_3 + 3.6777 * X_4 + 3.3328 * X_5$$

$$\text{Odds} = \exp(Y)$$

$$P = \text{odds} / (\text{odds} + 1)$$

Note: * multiplication sign

Thus, based on the data of the anamnesis and clinical examination of the patient, the mathematical model made it possible, using the coefficients presented in Table 3, to determine the significance of each clinical sign and to conduct a differential diagnosis between the syntropic functional disorders of the digestive organs and the surgical pathology of the abdominal organs at the stage of the primary medical care units (a primary care physician).

Conclusions. So, using the univariate logistic regression method, at the first stage, an analysis of the odds ratio in the differential diagnosis of FD and SP in children was carried out, which allowed to identify the main clinical signs, which increase the chance of primary diagnosis of pathological processes at the abdominal cavity.

At the second stage, as a result of mathematical modeling, it was possible to obtain a quantitative assessment of each clinical sign and to group them together with the definition of the calculated probability (P), and also an equation was obtained which made it possible, using the coefficients, to conduct a differential diagnosis between the FD and the SP at the primary stage of medical care.

Thus, the use of the proposed method of multivariate logistic regression, taking into account the integrated assessment of the combination of clinical signs, significantly improves the diagnosis, first of all, functional intestinal pathology, suggesting the presence of syntropy and helps making a decision about the scope of additional examination and therapeutic management by the physician of the primary contact.

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