

# Myoelectric functional stomach disorders in children and teenagers with *Helicobacter pylori* infection and gastroesophageal reflux disease

Zaburzenia czynności mioelektrycznej żołądka u dzieci i młodzieży z zakażeniem *Helicobacter pylori* i chorobą refluksową przełyku

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**Key words:** myoelectric stomach function, *Helicobacter pylori* infection, gastroesophageal reflux disease, children and teenagers.

**Słowa kluczowe:** czynność mioelektryczna żołądka, zakażenia *Helicobacter pylori*, choroba refluksowa przełyku, dzieci i młodzież.

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## Abstract

**Introduction:** *Helicobacter pylori* infection can induce disorders of myoelectric stomach functions and can have an influence on the frequency and grade of intensification of acid pathological gastroesophageal reflux (GER). The GER pathomechanism is also closely connected with stomach motor activity by affecting the tension in the lower oesophageal sphincter.

**Aim:** The aim of the study was to try to answer whether there are significant disorders in myoelectric stomach functions in children and teenagers with gastritis and/or duodenitis coexisting with *H. pylori* infection and GERD (gastroesophageal reflux disease).

**Material and methods:** One hundred and one patients over the age of 3 with dyspeptic symptoms who underwent endoscopic examination of the upper part of the digestive tract, pH-metric oesophagus test, and electrogastrographic test (EGG) were qualified for the examination. *Helicobacter pylori* infection was confirmed in the histopathological test and/or in the urease test and urea breathing test.

**Results:** Among the examined patients in 50 cases the result of the pH-metric test was abnormal (group A [ $n = 50$ ]), and in 51 patients the reflux index was below 4% (group B [ $n = 51$ ]). In the analysis of the difference in percentage of normogastria, bradygastria, tachygastria and arrhythmia appearance before and after a meal in the EGG record in patients with confirmed *H. pylori* infection in group A (incorrect result of pH-metric test) and in the group of children with the correct result of the pH-metric test (group B) a statistically significantly higher percentage of bradygastria was verified in

## Streszczenie

**Wstęp:** Zakażenie *Helicobacter pylori* może indukować zaburzenia czynności mioelektrycznej żołądka i wpływać na częstość oraz stopień nasilenia kwaśnego patologicznego refluksu żołądkowo-przełykowego. Patomechanizm refluksu przełykowego (*gastroesophageal reflux* – GER) również pozostaje w ścisłym związku z motoryką żołądka przez wpływ na napięcie dolnego zwieracza przełyku.

**Cel:** Próba odpowiedzi na pytanie, czy istotne zaburzenia czynności mioelektrycznej żołądka występują u dzieci i młodzieży z zapaleniem błony śluzowej żołądka i/lub dwunastnicy współistniejącym z zakażeniem *H. pylori* i chorobą refluksową przełyku (*gastroesophageal reflux disease* – GERD).

**Materiał i metody:** Do badania zakwalifikowano 101 pacjentów powyżej 3. roku życia z objawami dyspeptycznymi, u których wykonano badanie endoskopowe górnego odcinka przewodu pokarmowego, badanie pH-metryczne przełyku oraz badanie elektrogastrograficzne (EGG). Zakażenie *H. pylori* potwierdzono w badaniu histopatologicznym i/lub w teście ureazowym oraz mocznikowym teście oddechowym.

**Wyniki:** Wśród 101 pacjentów u 50 chorych wynik badania pH-metrycznego był nieprawidłowy [grupa A ( $n = 50$ )], u 51 pacjentów indeks refluksowy wynosił poniżej 4% [grupa B ( $n = 51$ )]. W analizie różnicy między odsetkami występowania normogastrii, bradygastrii, tachygastrii i arytmii przed jedzeniem i po jedzeniu w zapisie EGG u pacjentów z potwierdzonym zakażeniem *H. pylori* w grupie A (nieprawidłowy wynik pH-metrii) i w grupie dzieci z prawidłowym wynikiem badania pH-metrycznego (grupa B) stwierdzono istotnie statystycznie większy odsetek bradygastrii w grupie Ia w zapisie przedpościłko-

group A in the record before a meal through the fourth electrode (C4) ( $p = 0.02$ ).

**Conclusions:** In children and teenagers with gastritis and duodenitis with coexisting GER, disorders of myoelectric stomach function happen. In this group of patients it would be advisable to administer prokinetic medicine.

## Introduction

Myoelectric functional stomach disorders are closely associated with gastroesophageal reflux disease and with gastritis and/or duodenitis induced by *Helicobacter pylori* infection. The interaction of both these pathologies in some way happens by the influence on stomach motor functions.

In gastroesophageal reflux disease (GERD) pathogenesis the influence of stomach factors such as *H. pylori* infection and postponed stomach emptying caused by stomach-duodenum coordination disorders is analysed [1-3]. Abnormal stomach emptying causes stomach extension which leads to spontaneous relaxation of the lower oesophageal sphincter (LES). The disorders of tonic LES tension and the increase of idiopathic (not connected with swallowing) temporary spontaneous relaxations of the lower oesophageal sphincter are fundamental for pathological retraction of chyme to the oesophagus [1].

In complicated regulation of digestive tract function motor neurons of the digestive tract have an important role. They are called the enteric nervous system (ENS) [4] and they generate two types of potentials: electrical control activity (ECA) and electrical response activity (ERA) which determine stomach motor functions. Electrical control activity is built of interstitial cells of Cajal (ICC) which appear in the longitudinal muscular coat [5-10]. Electrical control activity is connected with repetitive depolarization of the cell membrane and it does not initiate gastrospasm. In ECA stomach cells the basic activity is generated – 3 cycles/min (cpm). Electric impulses are dispersed in different places and change the muscular cells' mucosa potential in the direction of the pylorus and duodenum [6, 9]. The correct rhythm of ECA is 3 cpm in the stomach. The abnormal frequency of the ECA is tachygastric, bradygastric, or mixed rhythm. They all cause abnormal motor functions of the stomach [6, 9, 11, 12]. Electrogastrography (EGG) is a non-invasive method which permits one to register myoelectric stomach function using probes placed on the skin of the stomach.

The interaction of *H. pylori* infection and GER is shown in many aspects. The infection may induce disorders of myoelectric functions and influence the frequency and the grade of acid pathological intensification of gastroesophageal reflux.

wym przez czwartą elektrodę (C4) – okolica przedodźwiernikowa żołądka ( $p = 0,02$ ).

**Wnioski:** U dzieci z zapaleniem błony śluzowej żołądka i/lub dwunastnicy ze współistniejącym GER występują zaburzenia czynności mioelektrycznej żołądka. W tej grupie pacjentów byłoby wskazane podanie leków prokinetycznych.

## Aim

The aim of the study was to try to answer whether there are significant disorders in myoelectric stomach functions in children and teenagers with gastritis and/or duodenitis coexisting with *H. pylori* infection and GERD (gastroesophageal reflux disease).

## Material and methods

One hundred and one patients over the age of 3 years with dyspeptic symptoms who underwent endoscopic examination of the upper part of the digestive tract, pH-metric oesophagus test, and electrogastrographic test (EGG) were qualified for the examination. The exclusion criteria were:

- previous diagnosis of *H. pylori* infection and its treatment,
- previous diagnosis of GERD and its treatment (neutralizing agents, proton pump inhibitors – PPI, H2 blockers),
- antibiotic therapy present or applied within 4 weeks' time,
- PPI or H2 blockers treatment present or applied within 2 weeks' time.

Patients were put into two groups:

- A) patients with mucosa infection of stomach and/or duodenum coexisting with *H. pylori* and GER infection,
- B) patients with mucosa infection of stomach and/or duodenum coexisting with *H. pylori* and without GER infection.

All the patients underwent endoscopic examination of the upper part of the digestive tract during which a prepyloric mucosa sample was taken to perform the urease test and histological examination. Confirmation or exclusion of *H. pylori* infection was done by performing the urea breathing test. *Helicobacter pylori* infection was confirmed in histopathological examination and/or in the urease test and the urea breathing test.

To assess the exposure of oesophageal mucosa to the gastric contents all the patients underwent pH-metric examination of the oesophagus. In this study the complete percentage duration of pH below 4 (reflux index exceeding 4%) shows the presence of pathological gastroesophageal reflux.

The myoelectric stomach activity was registered by using transdermal multichannel EGG with the use of a POLYGRAM NET TM device made by Medtronic. After

standard preparation of the patient's skin, six electrodes were attached – four active, one reference and one earthing. The third electrode was attached half way between the xiphoid process and the navel (it is the standard location in one-channel electrogastrography). The fourth electrode was attached 4 cm horizontally to the right in relation to the third one. The second and the first electrode were attached at a 45° angle up and left from the third electrode with a 4-6 cm span. The earthing electrode was attached on the left rib arch horizontally to the third electrode and the reference electrode was attached at the point of intersection of a horizontal line with the first electrode and at the point of intersection of a vertical line with the third electrode. The movement sensor was placed on the transabdominal above the fourth electrode.

The registration of myoelectric stomach activity was conducted for 30 min on an empty stomach and for 60 min after eating a standard meal (a sandwich with butter and with a boiled egg). This examination considered:

- the percentage value of normogastria (2.4-3.7 cpm),

- the percentage value of bradygastria (0.5-2.4 cpm),
- the percentage value of tachygastria (3.8-10 cpm),
- the percentage value of arrhythmia.

Using the test for two fractions the hypothesis about the lack of difference between normogastria, bradygastria, tachygastria and arrhythmia occurrence percentage before and after eating in children and teenagers with mucosa infection of stomach and/or duodenum coexisting with *H. pylori* and with GER and without GER infection was verified. The percentage of normogastria, bradygastria, tachygastria and arrhythmia registered by 4 electrogastrographic electrodes was analysed.

## Results

The examinations were performed on 101 children of age 5-18 years (mean: 13.2 ± 3.09 years). Among these there were 50 ill children and teenagers whose pH-metric examination result was abnormal (group A [*n* = 50]) and 51 patients had a reflux index below 4% (group B [*n* = 51]).

**Table I.** The results of the analysis showing normogastria, bradygastria, tachygastria occurrence in EGG recording in groups A and B (with GER and without GER) – the recording before eating

**Tabela I.** Wyniki analizy występowania normogastrii, bradygastrii, tachygastrii w zapisie EGG w grupach A i B (z GER i bez) – zapis przed jedzeniem

		%Norm	%Brady	%Tachy	%Aryt	%Norm	%Brady	%Tachy	%Aryt
		C1%				C2%			
GER(-)	0	31	18	32	22	34	23	27	19
	1	14	27	13	23	11	22	18	26
	<i>n</i>	45	45	45	45	45	45	45	45
	%1	31.1	60.0	28.9	51.1	24.4	48.9	40.0	57.8
GER(+)	0	29	27	28	24	30	30	30	27
	1	18	20	19	23	17	17	17	20
	<i>n</i>	47	47	47	47	47	47	47	47
	%1	38.3	42.6	40.4	48.9	36.2	36.2	36.2	42.6
<i>u</i>		-0.72	1.68	-1.17	0.21	-1.23	1.24	0.38	1.47
<i>p</i>		NS	NS	NS	NS	NS	NS	NS	NS
		C3%				C4%			
GER(-)	0	27	27	27	22	32	18	25	23
	1	18	18	18	23	13	27	20	22
	<i>n</i>	45	45	45	45	45	45	45	45
	%1	40.0	40.0	40.0	51.1	28.9	<b>60.0</b>	44.4	48.9
GER(+)	0	31	32	25	25	30	30	32	24
	1	16	15	22	22	17	17	15	23
	<i>n</i>	47	47	47	47	47	47	47	47
	%	34.0	31.9	46.8	46.8	36.2	36.2	31.9	48.9
<i>u</i>		0.59	0.81	-0.66	0.41	-0.75	<b>2.31</b>	1.24	-0.004
<i>p</i>		NS	NS	NS	NS	NS	<b>0.02</b>	NS	NS

**Table II.** The results of the analysis showing normogastria, bradygastria, tachygastria occurrence in EGG recording in groups A and B (with GER and without GER) – the recording after eating

**Tabela II.** Wyniki analizy występowania normogastrii, bradygastrii, tachygastrii w zapisie EGG w grupach A i B (z GER i bez) – zapis po jedzeniu

		%Norm	%Brady	%Tachy	%Aryt	%Norm	%Brady	%Tachy	%Aryt
		C1%				C2%			
GER(-)	0	22	10	8	23	19	12	11	24
	1	23	35	37	22	26	33	34	21
	<i>n</i>	45	45	45	45	45	45	45	45
	%1	51.1	77.8	82.2	48.9	57.8	73.3	75.6	46.7
GER(+)	0	23	7	13	24	20	12	11	22
	1	24	40	34	23	27	35	36	25
	<i>n</i>	47	47	47	47	47	47	47	47
	%1	51.1	85.1	72.3	48.9	57.4	74.5	76.6	53.2
<i>u</i>		0.004	-0.91	1.14	-0.004	0.03	-0.12	-0.12	-0.63
<i>p</i>		NS	NS	NS	NS	NS	NS	NS	NS
		C3%				C4%			
GER(-)	0	31	8	6	22	29	9	5	21
	1	14	37	39	23	16	36	40	24
	<i>n</i>	45	45	45	45	45	45	45	45
	%1	31.1	82.2	86.7	51.1	35.6	80.0	88.9	53.3
GER(+)	0	30	6	4	24	29	8	1	25
	1	17	41	43	23	18	39	46	22
	<i>n</i>	47	47	47	47	47	47	47	47
	%1	36.2	87.2	91.5	48.9	38.3	83.0	97.9	46.8
<i>u</i>		-0.51	-0.67	-0.047	0.21	-0.27	-0.37	-1.85	0.63
<i>p</i>		NS	NS	NS	NS	NS	NS	NS	NS

In the analysis of the difference in occurrence percentage of normogastria, bradygastria, tachygastria and arrhythmia before and after eating in children and teenagers with gastritis and/or duodenitis coexisting with *H. pylori* and with GER (group A) and in the group of children with the correct result of pH-metric examination (group B) a statistically significantly higher percentage of bradygastria was registered in group 1a in the before-eating recording made by the fourth electrode (C4) ( $p = 0.02$ ). The exact data of the analysis are shown in Tables I and II and Figure 1.

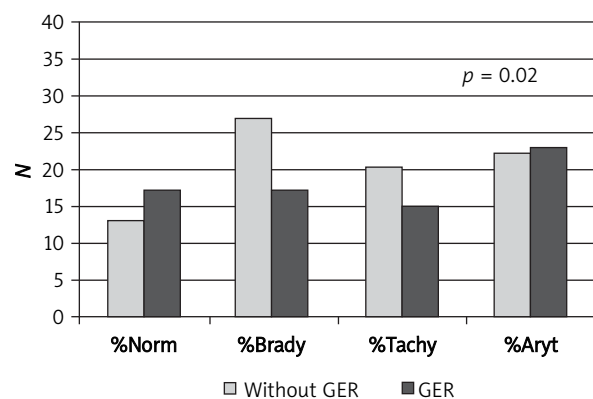
## Discussion

The influence of *H. pylori* infection on the upper part of the digestive tract seems to be connected with the mechanism of Cajal cell functional damage by an induced inflammatory state which leads to disharmony in the ICC [13, 14]. It causes a change in regularity of ECA and secretion disorders and it also influences antrum adaptation [8]. The eradication of the infection should

lead to the normalization of myoelectric stomach functions or should improve the EGG recording.

In the studies of Pytrus *et al.* [15] the percentage of dysrhythmia before and after eating was recorded in children with *H. pylori* infection. These scientists observed that after eradication of the infection there was a decrease of bradygastria percentage and an increase of normogastria percentage before and after eating. The same conclusions were reached by American scientists [16]. Motor function disorders of the upper part of the digestive tract are also the basis of gastroesophageal reflux and gastroesophageal disease [1].

The patients we examined were children and teenagers with dyspeptic symptoms. The phrase is rather extensive and relates to patients with symptoms which happen in *H. pylori* infection and in induced stomach mucosa inflammation and also in gastroesophageal disease. In our group of patients we confirmed or excluded acid pathological gastroesophageal reflux almost with the same frequency. It can be supposed



**Fig. 1.** The analysis of abnormal values of normogastric, bradygastric, tachygastric and arrhythmia percentage occurrence registered by the fourth electrode in patients with gastritis and/or duodenitis coexisting with *H. pylori* in the group with and without GER

**Ryc. 1.** Analiza występowania nieprawidłowych wartości odsetkowych normo-, brady-, tachygastrii i arytmii zarejestrowanych w okresie przedposiłkowym przez elektrodę 4. u pacjentów z zapaleniem błony śluzowej żołądka i dwunastnicy ze współistniejącym zakażeniem *H. pylori* z i bez GER

that myoelectric stomach function registered by EGG will be different in both groups and the difference will relate to the pericardial area (C1 and C2). Remembering that the highest concentration of bacteria is in the prepyloric part of the stomach and in focuses of stomach metaplasia [after 17] deviations in the C3 and C4 probe recordings of multichannel electrogastrography can be expected. However, our results show more frequent occurrence of bradygastric in the before-eating recording in the prepyloric area of the stomach.

The pathomechanism of such a mutual dependence and also of the influence on the motor stomach activity between *H. pylori* infection and GERD is connected with the increase of gastrin, acidity and volume concentration in the stomach acid (stomach glands mainly remain in the body of the stomach and in the fundus of the stomach), with acceleration of emptying the stomach and with the decrease of LES tension [18, 19]. Unfortunately, there are only a few studies in the available literature which analyse similar parameters of multichannel electrogastrography recordings. The results of studies of single channel electrogastrography recordings are not comparable and they differ greatly.

In the studies of Toporowska-Kowalska *et al.* [13] in children with diabetes and *H. pylori* infection the before-eating bradygastric occurrence was more frequent than

in the group without infection and in the control group. Stadek *et al.* [19] claimed that *H. pylori* infection did not have any influence on the myoelectric stomach functions. Zielińska *et al.* [21] noted in EGG recordings of children with acid gastroesophageal reflux an increased percentage of arrhythmia in the pericardial area which depended on reflux intensity. In the studies of Leahy *et al.* [22] in 90% of patients with gastroesophageal reflux the percentage of normogastric recording was 70% higher.

## Conclusions

In children and teenagers with gastritis and duodenitis with coexisting GER, disorders of myoelectric stomach function occur. In this group of patients it would be advisable to administer prokinetic medicine.

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