

Electrogastrography As A Diagnostic Tool For Overlapping Dyspepsia In Irritable Bowel Syndrome Patients

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Abstract: Introduction: Distinguishing between irritable bowel syndrome (IBS) and functional dyspepsia can be challenging because of the variations in symptom patterns, which commonly overlap. Although the principles of electrogastrography (EGG) have been known for years, it is controversial whether alteration of gastric electrical activity (GEA) could be of clinical relevance in functional gastrointestinal disorders.

Aim of the work was to assess the role of electrogastrography and gastric emptying in diagnosis of overlapping dyspepsia in patients with irritable bowel syndrome (IBS).

Subjects and methods: 120 patients with IBS were compared with 60 healthy controls. EGG was performed before and after a standard meal. Furthermore, gastric emptying (GE) and symptom scores were assessed.

Results: Of 120 IBS patients, 52 (43.3%) had dyspeptic symptoms as well as delayed gastric emptying. IBS patients with overlapping dyspepsia showed significantly more bradygastria (26.9%) than controls (5.9%) ($P < 0.01$), also they had statistically significant lower PR compared to non dyspeptic patients (2.1 ± 1.3 vs. 2.9 ± 1.6 respectively $P < 0.05$), moreover gastric emptying time was delayed in IBS patients with overlapping dyspepsia (14.7 ± 1.8) compared to those without dyspeptic complaints and controls (10 ± 1.27 & 10.6 ± 2.1 respectively) ($P < 0.01$).

Conclusion and recommendation: IBS patients with overlapping dyspepsia frequently reveal impaired gastric emptying and increased bradygastria, lack of a postprandial increase in the EGG amplitude, which may have pathophysiological significance in these patients. Using both EGG and gastric emptying test can aid in the detection of functional disorders associating IBS and therefore achieve greater patient satisfaction with their treatment. [Nature and Science 2010;8(3):115-120]. (ISSN: 1545-0740).

Keywords: Electrogastrography, functional dyspepsia, gastric emptying, irritable bowel syndrome.

Introduction: Irritable bowel syndrome (IBS) is part of a spectrum of functional gastrointestinal disorders that include a component of disordered bowel motility. Dyspepsia may be another part of that spectrum.¹ A high prevalence of overlap between functional dyspepsia and irritable bowel syndrome has been consistently and universally reported. The recognition of IBS in dyspeptic patients has potentially profound therapeutic importance. It could help to reduce the risk of unnecessary cholecystectomy in IBS patients.² Previous studies demonstrating shared common pathophysiological disturbances including delayed gastric emptying and visceral hypersensitivity involving more than one region, suggest that these patients have a generalized rather than regional disorder of the gut.³ Delayed gastric emptying has been reported in IBS patients, whether overlapping dyspepsia correlates with gastric emptying abnormalities in IBS patients or not has not been clarified.⁴ Transcutaneous electrogastrography (EGG) is the only non-invasive method of gastric myoelectric activity assessment which allows to evaluate slow wave activity and peak potentials of gastric contractions.⁵ Although the principles of (EGG) have been known for years, it is controversial whether alteration of gastric electrical activity could be of clinical relevance in functional gastrointestinal disorders.⁶

This study aimed to assess the role of electrogastrography and gastric emptying in diagnosis of overlapping dyspepsia in patients with irritable bowel syndrome (IBS).

Subjects and Methods: 120 patients fulfilled Rome III criteria for IBS recruited from gastroenterology outpatient clinic of Ain Shams University hospital and 60 healthy controls who had no history of GIT disorders were enrolled in this study. (Subjects receiving any medication over an eight week period before the study (that is, antibiotics, antacids, prokinetics, proton pump inhibitors, H₂ receptor antagonists, or non-steroidal anti-inflammatory drugs), those with a history of abdominal surgery, gastrointestinal cancer, DM, renal failure, liver cell failure, neurological diseases, peptic ulcer disease and pregnant females were excluded from the study). Patients and volunteers gave informed consent prior to the investigations.

For all subjects the following was done:

1: Full history taking with special emphasis on **IBS symptoms** ex. abdominal pain and influence of defecation on pain, change in stool frequency or form, sensation of incomplete evacuation after defecation, passage of mucus and flatulence and **dyspeptic symptoms** ex. early satiety (fullness), nausea, vomiting and heart burn. A score for dyspeptic symptom was

assigned using a scale from 0 to 3 (0 = absence of symptoms, 1= mild, symptoms noticed when paid attention, 2 = moderate, symptoms clearly noticed without interfering with normal daily activities, 3 = severe, symptoms interfering with normal daily activities.⁷

2: Clinical examination with special emphasis on local abdominal examination.

3: Standardized workup included laboratory testing (CBC, ESR, blood glucose, renal and liver profile, stool analysis).

4: Abdominal sonography.

5: Upper gastrointestinal endoscope (to exclude organic causes of dyspepsia) in patients with dyspeptic symptoms.

6: Colonoscopy was also performed in all subjects with red flag symptoms.

7: Liquid gastric emptying was evaluated sonographically after overnight fasting in order to calculate the fasting antral area (A fast). Then, after giving 200 ml water, the largest cross-sectional area of the antrum was calculated (A full) and the postprandial variation of the antral area was assessed every 5 minutes till reaching its original size.⁷ Gastric half emptying time (the time taken for the antrum to reach half its full area (GET ($t_{1/2}$, min)) was the index of gastric emptying.⁸

8: Electrogastrography (EGG) was recorded from five disposable silver chloride surface electrodes placed on the upper abdomen for one hour in a fasting state and post prandial recording for one hour after ingestion of pastry and 250 ml milk (350 kcal). Variables assessed were: Dominant frequency (DF), the power of the dominant frequency (DP), power ratio (PR), percentage of bradygastria, normal and tachygastria.^{5,9}

Dominant frequency (DF): The frequency of gastric peak was determined by the absolute peak value ranged from 1 to 9 cycle per minute (CPM), and the mean frequency was computed by averaging the individual spectra, reflects the frequency of the gastric slow waves.¹⁰

Power ratio (PR): The ratio of dominant postprandial

power to pre-prandial power. It is indicative of the post-prandial increase in gastric motor activity.¹⁰

A rhythmic electrical activity ranging from 2.6-3.7 CPM was defined as normal gastric electrical activity. Dysrhythmia was defined as follows:

Tachygastria: Was considered to be present when the running spectrum had a dominant peak at a frequency >3.7 and <10.8 CPM, that at the same time the normal gastric signal was absent in all four EGG signals. **Bradygastria:** When the dominant peak was at a frequency less than 2.6 and more than 0.5 CPM in the absence of a normal 3 CPM component in all four EGG leads.¹¹

Statistical analysis: All collected data were expressed as mean \pm SD for quantitative measures and both number and percentage for categorized data and analyzed by using SPSS version 13 using the following tests: Student t test, Chi-square test, Correlation co-efficient test (r-test), $P > 0.05$ was considered non significant, $P < 0.05$ was considered significant and $P < 0.01$ was considered highly significant.

Results: 120 patients fulfilling ROME III criteria of IBS were enrolled in this study, they were 52 males (43.35%) and 68 females (56.75%), their age ranged from 22-52 with a mean of 34.8 ± 9.50 years. Of 120 IBS patients, 52 (43.3%) had dyspeptic symptoms as well as delayed gastric emptying and 22 (18.3%) had abnormal EGGs. 17 of these 22 patients (77.3%) with abnormal EGGs had delayed GE.

This study included also **sixty ages and sex matched healthy volunteers** as controls they were 30 males (50%) and 30 females (50%), their age ranged from 24-43 with a mean of 35 ± 4.5 years. None of them neither had GIT symptomatology nor delayed gastric emptying, however abnormal EGG was found in 4 (6.7%) of the controls. Comparison between cases and controls as regard EGG and gastric emptying parameters is shown in table (1).

Table (1): Comparison between cases and controls as regard EGG and gastric emptying parameters.

Parameters	IBS(120)	Controls(60)	P
GET $t_{1/2}$ (min)	12.45 \pm 2.8	10.6 \pm 2.1	<0.05
DF(CPM)	3.1 \pm 0.8	3 \pm 0.68	>0.05
PR	1.77 \pm 1.1	2.5 \pm 2.16	<0.05
Normal EGG	98(81.7%)	56(93.3%)	<0.05
Bradygastria	18(15%)	3(5%)	<0.05
Tachygastria	4(3.3)	1(1.7%)	>0.05

IBS patients were subdivided according to bowel symptoms in to:

Group 1 (IBS-D): Sixty diarrhea predominant IBS patients. They were 28 males (46.7%) and 32 females (53.3%). Their age ranged from 23-45 with a mean of 33.13 ± 8.18 years.

Group 2 (IBS-C): Sixty constipation predominant IBS patients. They were 24 males (40%) and 36 females (60%). Their age ranged from 22-52 with a mean of 36.53 ± 9.82 years.

Gastric half emptying time was longer in IBS-C patients (13.7 ± 2.9) compared to IBS-D and controls (11.2 ± 2.8 & 10.6 ± 2.1 respectively) ($P < 0.01$). IBS-C patients had lower PR (1.4 ± 0.7) than did IBS-D and controls (2.14 ± 1.5 & 2.5 ± 2.16 respectively) ($P < 0.01$) as shown in table (2).

Table (2): Comparison between IBS-C, IBS-D and controls as regard EGG and gastric emptying parameters.

	Group 1	Group 2	Controls(3)	1 vs2	1vs3	2 vs.3
GET	11.2 ± 2.8	13.7 ± 2.9	10.6 ± 2.1	<0.01	>0.05	<0.01
DF	3.3 ± 0.9	2.9 ± 0.7	3 ± 0.68	<0.01	<0.05	>0.05
PR	2.14 ± 1.5	1.4 ± 0.7	2.5 ± 2.16	<0.01	>0.05	<0.01

Fasting IBS-C patients showed more bradygastria and tachygastria than controls (29 ± 14 and 9 ± 6 vs. 16 ± 11 and 7 ± 5 respectively), feeding increased bradygastria to (40 ± 15 vs. 13 ± 9) ($P < 0.01$) as shown in table (3).

Table (3): Comparison between IBS-C, IBS-D and controls as regard dominant frequency distribution.

		IBS-D(1)	IBS-C(2)	Controls(3)	1vs.2	1vs.3	2vs.3
Normogastria	Rest	78 ± 18	61 ± 17	77 ± 15	<0.01	>0.05	<0.05
	Meal	78 ± 19	52 ± 18	86 ± 14	<0.01	<0.01	<0.01
Bradygastria	Rest	13 ± 11	29 ± 23	16 ± 11	<0.01	>0.05	<0.01
	Meal	13 ± 7	40 ± 15	13 ± 9	<0.01	>0.05	<0.01
Tachygastria	Rest	8 ± 6	9 ± 6	7 ± 5	>0.05	>0.05	<0.05
	Meal	6 ± 4	8 ± 5	4 ± 2	<0.05	<0.01	<0.01

The IBS patients were further classified according to the presence or absence of overlapping dyspepsia into 52 patients with overlapping dyspepsia and 68 patients without dyspepsia.

Overlapping dyspepsia was more frequent in IBS-C as 44 patients were IBS-C vs. 8 were IBS-D ($P < 0.01$). The electrogastrogram was normal in 93.3% of asymptomatic controls and 92.6% of patients with irritable bowel syndrome who did not complain of dyspepsia ($p > 0.05$). The electrogastrogram was abnormal in 32.7% with IBS patients with overlapping dyspepsia. These patients showed significantly more bradygastria (26.9%) than controls (5.9%) ($P < 0.01$), also they had statistically significant lower PR compared to non dyspeptic patients (2.1 ± 1.3 vs. 2.9 ± 1.6 respectively $P < 0.05$), moreover gastric emptying time was delayed in IBS patients with overlapping dyspepsia (14.7 ± 1.8) compared to those without dyspeptic complaints and controls (10 ± 1.27 & 10.6 ± 2.1 respectively) ($P < 0.01$), however there was no statistically significant difference between non dyspeptic patients and controls as regard gastric emptying time ($P = 0.05$) as shown in table (4).

Table (4): Comparison between IBS patients with overlapping dyspepsia and those without as well as controls as regard EGG and gastric emptying parameters.

	Dyspeptic (1)	Non Dyspeptic(2)	Controls (3)	1vs.2	1vs.3	2vs.3
GET	14.7 ± 1.8	10 ± 1.27	10.6 ± 2.1	<0.01	<0.01	0.05
DF	2.65 ± 1.24	2.96 ± 0.4	3 ± 0.68	>0.05	>0.05	>0.05
PR	2.1 ± 1.3	2.9 ± 1.6	2.5 ± 2.16	<0.05	>0.05	>0.05
Normal	35(67.3%)	63(92.6%)	56(93.3%)	<0.01	<0.01	>0.05
Brady	14(26.9%)	4(5.9%)	3(5%)	<0.01	<0.01	>0.05
Tachy	3(5.8%)	1(1.5%)	1(1.7%)	>0.05	>0.05	>0.05

Gastric half emptying time was longer in patients with early satiety (fullness) compared to patients presented with other dyspeptic symptoms ($P < 0.01$), and it had a negative correlation with severity of symptoms ($r = -0.63$, $P < 0.01$). The dyspeptic symptomatology did not correlate with EGG parameters. However, dominant frequency was negatively correlated with the symptom score ($r = -0.26$, $P < 0.05$). Gastric half emptying time had significant negative correlation with power ratio ($r = -0.73$ & $P < 0.05$).

Discussion: Overlapping dyspepsia was diagnosed in 52/120 (43.3%) IBS patients, which was more frequent in IBS-C (44 in IBS-C and 8 in IBS-D ($p < 0.01$)). High prevalence of overlap between functional dyspepsia (FD) and irritable bowel syndrome (IBS) was reported in the previous studies as Wang and associates¹² found that in questionnaires were returned by 3014 patients FD-IBS overlap was observed in 5% of the patients, while 15.2% and 10.9% of the patients were classified as FD alone and IBS alone, respectively while Corsetti et al.,¹³ reported that in 309 consecutive FD patients, questionnaires revealed that fifty-four percent of the patients had FD alone, whereas 46% had FD + IBS, moreover De Vries et al.,¹⁴ stated that among GERD patients 25% had FD 35% had IBS and 5% had both FD and IBS. Only 35% had neither FD nor IBS. Clinical overlap of FD and IBS-C were more common than IBS-D.^{12, 15}

The electrogastrogram was normal in 93.3% of the controls and 92.6% of patients with irritable bowel syndrome who did not complain of dyspepsia ($p > 0.05$). 32.7% of patients with overlapping IBS and dyspepsia had abnormal electrogastrogram in the form of bradygastria (26.9%) and tachygastria (5.8%). These patients showed significantly more bradygastria (26.9%) than controls (5.9%) ($P < 0.01$). Gastric emptying was delayed in IBS patients with overlapping dyspepsia (14.7 ± 1.8) compared to those without dyspeptic complaints (10 ± 1.27) ($P < 0.01$). However there was no statistically significant difference between non dyspeptic patients and controls as regard gastric emptying time ($P = 0.05$).

These results were supported by *Martinez et al.*,¹⁶ who stated that normogastria is the predominant rhythm in healthy people, although brief dysrhythmia can be recorded that do not have any pathological meaning. Also *Leahy et al.*,¹⁷ who found that the electrogastrogram was normal in 92% of patients with irritable bowel syndrome who did not complain of dyspepsia. The electrogastrogram was abnormal in 25% with irritable bowel syndrome who complained of concurrent dyspepsia and concluded that the electrogastrogram is usually abnormal only if concurrent dyspepsia is present. However *Oba-Kuniyoshi et al.*,¹⁸ stated that gastric dysrhythmias, such as tachy- or bradygastria, have been reported in

patients with functional dyspepsia (FD). Moreover *Lin et al.*,¹⁹ found that 60% of patients with functional dyspepsia had abnormal recording of GEA. Patients with FD frequently reveal impaired gastric emptying and increased tachygastria, which may have pathophysiological significance in these patients *Pfaffenbach et al.*,²⁰ this was confirmed by *Stanghellini et al.*,¹ who found that gastric emptying was delayed in IBS patients with overlapping dyspepsia as IBS patients without overlapping dyspepsia had normal gastric emptying of solids. These data were consistent with the concept that alterations in gastric myoelectrical activity leading delayed gastric emptying play a role in the dyspeptic manifestation in IBS patients.²¹

In this study fasting IBS-C patients showed more bradygastria and tachygastria than controls (29 ± 14 and 9 ± 6 vs. 16 ± 11 and 7 ± 5 respectively), feeding increased bradygastria to (40 ± 15 vs. $13 \pm 9\%$) ($P < 0.01$). However *Mazur et al.*,²² who studied 23 IBS patients matching Manning criteria and 30 healthy volunteers found that fasting IBS pts showed gastric dysrhythmia ($29 \pm 14\%$ vs. $11 \pm 7\%$), feeding (300 kcal) improved dysrhythmia to $20 \pm 13\%$ vs. $8 \pm 5\%$.

We found that IBS patients with overlapping dyspepsia had lower PR compared to those without dyspeptic complaints (2.1 ± 1.3 vs. 2.9 ± 1.6 respectively $P < 0.05$).

Increased sympathetic drive in IBS patients is responsible for gastric dysrhythmias and low PR resulting in gastric emptying delay and dyspeptic symptoms *Mazur et al.*,²² Thus overlapping dyspeptic symptoms in IBS patients should be not be attributed to their high prevalence but to a possible common disease process in a subset of patients.²³

Gastric half emptying time was longer in patients with early satiety (fullness) compared to patients presented with other dyspeptic symptoms ($P < 0.01$), it had significant negative correlation with severity of symptoms and power ratio ($r = -0.63$, $r = -0.73$ respectively & $P < 0.01$). Dominant frequency was negatively correlated with the symptom score ($r = -0.26$, $P < 0.05$).

Previous studies reported conflicting results concerning the association between symptomatology, gastric myoelectrical activity and gastric emptying.

Parkman et al.,²⁵, *Cuomo et al.*,²⁵, *Schaar et al.*,²⁶, *Stanghellini et al.*,¹, *Giovanni et al.*,²⁷, *Sarnelli et al.*,²⁸, *Hou et al.*,²⁹, *Loreno et al.*,⁷ and *Devanarayana et al.*,²¹ agreed with our results as they found an association between bloating and delayed gastric emptying as well as indirect correlation between symptoms severity and gastric emptying rate, moreover *Van der Voort et al.*,⁴ concluded that EGG could be useful as a diagnostic tool in patients with FD and IBS as they reported that eight of 40 patients (20%; three FD, three IBS, two FD and IBS) had delayed gastric

emptying. Disturbed gastric emptying and lack of a postprandial increase in the EGG amplitude were significantly correlated ($r = 0.8$; $P < 0.01$). **Chen et al.**,³⁰ stated that electrogastronomy was abnormal in 26 (44.1%) patients with functional dyspepsia, also symptoms predicted abnormal electrogastronomy in dyspeptic patients with nausea ($OR=3.1$; $P<0.05$). So electrogastronomy is helpful in differentiating subgroups of patients with nausea or satiety.

Other studies failed to correlate dyspeptic symptoms with delayed gastric emptying (**Holtmann et al.**,³¹, **Talley et al.**,³² and **Boeckxstaens et al.**,³³ Moreover, **Pfaffenbach et al.**,³⁴ found that there was no association between clinical subtypes of dyspepsia and abnormalities in EGG. There was no association between normalization of gastric emptying and improvement in symptoms, thus while on the one hand it might be argued that abnormalities of gastric emptying can be directly associated with symptoms, it may be that disturbances in gastric emptying are simply a marker for other underlying abnormalities but are not directly relevant for manifestation of symptoms.

Conclusion and recommendation: IBS patients with overlapping dyspepsia frequently reveal impaired gastric emptying and increased bradygastria, lack of a postprandial increase in the EGG amplitude, which may have pathophysiological significance in some of these patients. Using both EGG and gastric emptying test can aid in the detection of functional disorders associating IBS and therefore achieve greater patient satisfaction with their treatment.

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