



Research Article

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Name of the Authors:

Inas Elkhedr Mohamed

Gastroenterology department, Ain Shams University, Cairo, Egypt

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ABSTRACT

Few studies analyzed changes in gastric myoelectrical activity in inflammatory bowel diseases. This study aimed to evaluate the changes in gastric myoelectrical activity, detected by electrogastrogram, in active inflammatory bowel disease. **Methods:** forty patients proved to have inflammatory bowel diseases, twenty patients with Crohn's disease and twenty with ulcerative colitis, all subjected to clinical examination, routine laboratory tests, measurement of the clinical activity score, endoscopy to measure endoscopic score, and electrogastrography, and a third healthy control group subjected to electrogastrogram. **Results:** among ulcerative colitis patients a significant negative correlation between DF(dominant frequency) and frequency of diarrhea, ESR, hemoglobin and endoscopic activity ($p=0.046$, $p=0.012$, $p=0.024$, $p=0.038$ respectively). A significant positive correlation between Power 3 cpm rest (distribution of power at 3 cpm during rest) and frequency of diarrhea, ESR, clinical and endoscopic activities ($p=0.004$, $p=0.001$, $p=0.21$, $p=0.03$ respectively), while there was a negative correlation between power 3 cpm rest and hemoglobin level ($p=0.003$). The power 3 cpm meal (distribution of power at 3 cpm during the postprandial period) revealed a positive correlation with ESR ($P=0.045$). Both Crohn's disease and ulcerative colitis patients presented with a higher percentage of Brady Gastria during disease activity ($p= 0.041$, 0.024 respectively). **Conclusion:** Activity of inflammatory bowel disease, Crohn's disease, and ulcerative colitis, induces changes in gastric myoelectrical activity detected by electrogastrogram. These changes are in the form of gastric dysrhythmia, predominantly Brady Gastria increases with the more active disease both in CD and ulcerative colitis. Moreover, active ulcerative colitis associated with a decrease in dominant frequency and increase in the resting power at 3 cpm.

KEY WORDS :

ulcerative colitis, Crohn's disease, electrogastrogram, gastric myoelectrical activity.

I. INTRODUCTION

Inflammatory bowel disease (IBD) is a chronic, relapsing, inflammatory disorder of the gastrointestinal tract that includes two entities, namely Crohn's disease (CD) and ulcerative colitis (UC). Which can affect any segment of the gastrointestinal tract from the mouth to the anus, involves "skip lesions," and is transmural. There is a genetic predisposition for IBD, and patients with this condition are more prone to the development of malignancy [1].

It is well known that patients with IBD often suffer from gut motility and/or sensitivity disturbances, which resemble IBS or can be classified as such based on the Rome I-III criteria [2]. Simren et al. looked at IBD patients in remission and found that 33% of UC patients and 57% of CD patients had 'IBS-like' symptoms (mainly abdominal pain, early satiety and diarrhoea), which was two- to threefold higher compared to a control population [3]. In early stages of the disease, the occurrence of functional symptoms in otherwise asymptomatic IBD patients can be misleading [4].

Gastric motility disturbances might play a pathophysiological role, but only a few studies have addressed gastric motility in Crohn's disease [5].

Electrogastrography is a technique for recording gastric myoelectrical activity using cutaneous electrodes placed on the anterior abdominal wall overlying the stomach. EGG has been advocated as a diagnostic test for clinical evaluation of patients with unexplained nausea and vomiting and other dyspeptic symptoms to gain insight into mechanisms of symptoms generation [6-7].

Aim of work:

The study aimed to assess the pattern of gastric myoelectrical activity, detected by electrogastrogram, in active inflammatory bowel disease.

II. MATERIALS AND METHODS:

Forty patients with inflammatory bowel disease recruited from the outpatients clinic of Ain Shams University hospital. The age ranged from 18 to 60 years; twenty patients diagnosed Crohn's disease (CD) and twenty ulcerative colitis (UC). CD diagnosed pathologically according to the presence of (chronic diarrhea, rectal bleeding, abdominal pain, symptoms of intestinal obstruction), endoscopic features (skip lesions, asymmetric involvement, deep ulcers, terminal ileum and ileocecal valve involvement), with a histopathological picture of biopsy. The diagnosis of UC based on the presence of (chronic large bowel diarrhea, tenesmus, rectal bleeding), an endoscopic picture of (diffuse involvement of the colonic mucosa with loss of the vascular pattern, friability, ulceration), with the histopathological examination of the biopsy. A third group included twenty healthy controls who were subjected only to electrogastrogram.

The study protocol was consistent with the ethical guidelines of Helsinki. After informed consent obtained from each participant or responsible family members they subjected to the following: history taking (e.g. number of motions, bleeding, abdominal pain,...), thorough clinical examinations. All patients underwent routine laboratory tests: CBC, ESR, CRP, fasting blood sugar, s. albumin, electrolytes, ferritin, stool analysis.

The following patients were excluded: IBD patients on maintenance steroid therapy, patients with diabetes mellitus, renal impairment, chronic calculous or non-calculous cholecystitis, obstructive airway disease, drugs affecting gastric motility and autonomic function (e.g. prokinetics, erythromycin).

Assessment of the disease activity:

The activity of Crohn's disease and ulcerative colitis measured clinically and endoscopic. The activity of CD measured according to Harvey-Bradshaw simplified activity index: total disease activity score: ≤ 4 = remission, 5-8 = moderately active, ≥ 9 = severely active [8].

For all patients ileocolonoscopy was performed and simple endoscopic score for Crohn's disease measured as the following: the bowel was divided into 5 segments: terminal ileum; right, transverse, and left colon; and rectum. 4 endoscopic variables in the 5 segments were scored from 0 to 3. The variables assessed are the presence and size of ulcers, the extent of ulcerated surface, extent of affected surface, presence and type of narrowing. The SES score can range from 0 to 60, with a higher score indicating more severe disease [10].

The activity of UC was measured according to Sutherland disease activity index of UC: total disease activity score: 2= remission, 3-5= mild, 6-10= moderately active, 11-12= severe [10].

Colonoscopy was performed for all patients and endoscopic activity was measured according to Mayo score: a score of 0 is given for normal mucosa or inactive UC while a score of 1 is given for mild disease with evidence of mild friability, reduced vascular pattern, and mucosal erythema. A score of 2 is indicative of moderate disease with friability, erosions, complete loss of vascular pattern, and significant erythema, and a score of 3 indicates ulceration and spontaneous bleeding [11].

Electrogastrogram:

The procedure performed in motility unit of the gastroenterology department in Ain-Shams university hospital using multichannel cutaneous electrogastrogram (MMS type; Medical Measurement System). Gastric electrical activity was recorded from five disposal parallel pre-gelled silver/silver chloride surface electrodes placed on the upper abdomen. The skin was carefully abraded to decrease resistance to obtain a good signal to noise ratio [12].

The patients were kept in the reclining position to minimize motion artifacts. Four EGG signals were recorded bipolar from these 5 electrodes as the potential differences between each of the four electrodes, and one central electrode (three are placed in the epigastrium, one placed below and to the left of the previous three electrodes, and one left subcostal). A reference electrode was placed at the left clavicle. The EGG signal is polluted by signals from extragastric sources. One of these is respiration artifact, other signals considered as noise in the EGG signals; electrode potential variation (electrode noise), motion artifact, potential variation produced by other internal organs containing smooth muscles. The electrical signals are recorded with appropriate amplification and filtering.

One hour recording while the patient is fasting was done, then given a standardized test meal (mixed fluid and carbohydrate solid meal; pastes and 250milk) and postprandial recording for one hour was done [13]. After the recording session, the EGG signals were subjected to spectral analysis (Fast Fourier Transform) to detect the dominant frequencies in fasting and postprandial time period. The FFT transforms the signals from the time domain to the frequency domain. EGG determines the frequency and regularity of gastric myoelectrical activity. The dominant frequency (DF) corresponds to the gastric basal electric rhythm or frequency of the gastric slow wave [14]. Computer analysis of EGG signal will determine the "power" for each signal frequencies. The power is a reflection of both amplitude and regularity of EGG. Dominant EGG power is statistically higher during gastric contractions than motor quiescence, The power ratio (the ratio of the power of the mean spectrum of the postprandial state to the power of the mean spectrum of the fasting state), as indicative of the postprandial increase in gastric motor activity, was calculated for the first hour of the postprandial period.

The mean of the power spectra for the entire recording period was calculated. EGG signal, the highest power in the 3cpm (cycle per minute) band, was then selected for further analysis. The mean frequency of the normal 3cpm component and its standard deviation and its power content was calculated for the fasting and postprandial period. Dysrhythmia was analysed by visual inspection of the raw signals and the frequency spectra at 3 cpm band on the FFT. Dysrhythmia defined as tachygastric, which was present when the power spectrum contained a sharp-peaked component with a frequency 3.7cpm and 10.8cpm in the absence of the normal 3 cpm component in the all four EGG leads at the same time. Bradygastric was defined as the

presence of a sharp peak at a frequency less than 2.6cpm, in the absence of a normal 3cpm component all four EGG leads [15].

The following parameters obtained from EGG recording: (i) the percentage of recording time with the DF(dominant frequency) in the normal 3cpm, tachygastric, and bradygastric frequency ranges (figures 1,2, and 3). (ii) the percentage distributions of the frequency power in the three frequency bands (%3cpm rest and meal). (iii) the distribution of the postprandial and fasting power of the DF(power rest and meal at DF). (iv) the overall dominant EGG power in the fasting and postprandial periods (power at rest and power at meal).(v) power ratio (the ratio of the postprandial to the fasting power) [16].

III. STATISTICAL METHODOLOGY:

The data were collected, revised, verified then edited on a personal computer. The data was analyzed by the aid of program (SPSS) for windows version 15.2, 2004, USA. Using the following tests: Student "T", Fisher's exact test, Chi-square, ANOVA, Post Hoc test. Descriptive statistics were done for quantitative data as minimum & maximum of the range as well as mean \pm SD (standard deviation) for quantitative parametric data while it was done for qualitative data as number and percentage. correlations were done using Pearson correlation for numerical parametric data. The level of significance was taken at P value < 0.05 is significant.

IV. RESULTS:

Forty patients diagnosed as IBD, twenty with Crohn's mean age 34.05 \pm 8.96 years(range 20-54y), and twenty with UC mean age 36.2 \pm 9.86 (range 21-52). Another twenty healthy controls with mean age 44.3 \pm 14.52 years (18 – 67).

Table (1) a comparison of the three groups regarding EGG parameters. A significant increase in %cpm rest and %cpm meal in the control group than in CD patients (p=0.11, 0.17). A significant increase in power cpm rest, power cpm meal, and power at rest in CD patients than that of control (p=0.001, 0.001, 0.004 respectively). On the other hand a significant increase in the power ratio PR in control group than that of CD patients (p=0.027). The power cpm rest, power cpm meal, and power at rest in UC patients are higher than in control (p=0.001, 0.001, 0.004 respectively). The power ratio PR in control group is higher than that of UC patients (p=0.027).

The data represented in (table 2) no significant correlation between any of EGG parameters and the clinical and endoscopic activity of Crohn's disease.

As shown table (3) and figures (4,5,6) a negative correlation between DF(dominant frequency) and frequency of diarrhea, ESR, and endoscopic activity (p=0.046, p=0.012, p=0.038 respectively; these relation of moderate statistical strength r-0.451, r-0.552, r-0.468 respectively) and a positive correlation with hemoglobin (p=0.024 of moderate statistical strength r 0.502).

There were a positive correlation between Power 3 cpm rest (distribution of power at 3 cpm during rest) and number of diarrhea, ESR, clinical and endoscopic activities; of moderate significance; ($p=0.004$, $p=0.001$, $p=0.21$, $p=0.03$ respectively; r 0.614, r 0.667, r 0.513, r 0.485 respectively). While, a negative correlation between power 3 cpm rest and haemoglobin level ($p=0.003$ r 0.626). The power 3 cpm meal (distribution of power at 3 cpm during the postprandial period) revealed a positive correlation with ESR ($P=0.045$, r 0.452). Power at meal had a moderately significant negative correlation with frequency of diarrhea, temperature, clinical and endoscopic activity ($p=0.006$, 0.006 , 0.003 , 0.001 respectively; r -0.592, r -0.590, r -0.634, r -0.672 respectively), and a positive correlation with haemoglobin and ESR ($p=0.001$, 0.001 ; r 0.689, r 0.681 respectively). Power ratio had a positive correlation with haemoglobin ($p=0.045$, r .452).

Tables (4a and 4b): the severity of Crohn's disease associated with increase gastric dysrhythmia; predominantly bradygastria (8 patients) and fewer tachygastria (3 patients), 45.5% of patients with gastric dysrhythmia are in mild to moderate activity of the disease, and 45.5% of them are in severe activity ($p=0.041$). There was a significant relation between the frequency of diarrhea and gastric dysrhythmia ($p=0.005$).

The percentage of gastric dysrhythmias; predominantly bradygastria, was higher in active UC. 33.3% were in mild to moderate activity and 66.7% were in severe activity ($p=0.024$). A significant relation between gastric dysrhythmia and diarrhea, ESR, haemoglobin, and temperature ($p=0.03$, $p=0.013$, $p=0.004$, $p=0.005$ respectively) (Tables 5a and 5b).

In table (6): an increase in the percentage of gastric dysrhythmia among CD and UC than that in controls ($p=0.008$). One control subject presented with bradygastria (5%) and (95%) were normogastric. On the other hand bradygastria presented 40% among CD and 25% among UC, and tachygastria 15% of CD patients and 5% of UC patients.

V. DISCUSSION:

In IBD practice, alterations in gut motility and sensitivity frequently occur at a level remote from the actual site of inflammation. Very little is known about the pathophysiology of this particular phenomenon [17]. Previously, few studies addressed to discuss motility disorders in IBD patients. This study investigated the association between the symptoms and activity of IBD and the changes in the myoelectrical activity of the stomach recorded by electrogastrogram during fasting and postprandial state.

According to the data presented in this study, both patients with CD and UC had a significant increase in gastric dysrhythmia, predominantly bradygastria, than that observed in the control ($p=0.008$), specially during active disease. In CD patients dysrhythmia increased with increase diarrheal episodes and the clinical activity score of the disease ($p=0.005$, and $p=0.041$ respectively).

The number of patients with gastric dysrhythmias in UC (predominantly bradygastria, five patients, and one showed tachygastria) and the of percentage of dysrhythmia during activity of UC were, 33.3% in mild to moderate activity and 66.7% are in severe activity ($p=0.024$). Also, a significant relation between gastric dysrhythmia and all of diarrhea, ESR, haemoglobin, and temperature ($p=0.03$, $p=0.013$, $p=0.004$, $p=0.005$ respectively).

These results consistent with that of Kohno et al. 2006 who studied 8 patients with CD and 15 healthy subjects, and documented the increase in bradygastria and tachygastria in patients with CD, and there was no relation between gastric motility and the severity of CD using EGG recording [5].

In CD patients other EGG parameters showed no significant correlation with neither symptoms nor clinical and endoscopic activities. Although, CD affects the entire GIT but no significant correlation between EGG parameters and CD activity recorded in this work; this may be related to the small number of active CD patients.

Bracci et al. 2003, reported that 3 cpm waves did not significantly increase in patients with CD compared to healthy subjects, and the peak of dominant frequency did not increase after food ingestion [18]. There were other studies investigated gastric motility disturbance in CD by using other methods such as Annese et al. 1997, who reported the impaired gastrointestinal motility in patients with CD but by using conventional manometry [19].

The study for the first time investigated many EGG parameters in patients with UC, a significant negative correlation between DF (dominant frequency) and frequency of diarrhea, ESR, and endoscopic activity ($p=0.046$, $p=0.012$, $p=0.038$ respectively) and a positive correlation with haemoglobin ($p=0.024$). So, the disturbance of the regular gastric myoelectrical activity (DF) associated with increased severity of the disease. On the other hand Power 3 cpm rest (distribution of power at 3 cpm during rest) showed a significant positive correlation with the number of diarrheal motions, ESR, clinical and endoscopic activities ($p=0.004$, $p=0.001$, $p=0.21$, $p=0.03$ respectively), and this may reflect the pathologically increased gastric contractility during rest with increased disease activity, but this one lacking the regularity denoted by a decrease in DF with increase severity of the disease. Moreover, a significant increase in the power ratio PR and decrease in %cpm rest, %cpm meal and power cpm rest in control group than that of UC and CD patients ($p=0.027$).

According to Sharma et al. 2015, patients with UC showed lower resting DF and insignificant changes after water ingestion compared to normal subjects, they suggested that the patients with UC have dysrhythmic gastric movements and this during the remission phase of the disease. Moreover, they found the dominant power (which reflects the amplitude of gastric myoelectrical activity) and the PR (is believed to be associated with gastric contractility); both increased in the patients with UC and

CD after water ingestion. They suggested that the gastric contractile activity was increased after water ingestion, but not rhythmic, as reflected by the lack of changes in the DF [20].

So, according to the presented results, UC patients showed a significant change specially during disease activity, with a decrease in DF and the increase in power 3cpm at rest. Moreover, both in CD and UC patients the percentage of gastric dysrhythmias, mainly bradygastria, in those who had a higher score of clinical activity.

It is well known that gut motility is altered predominantly towards diarrhea during an inflammatory episode of UC or CD [21] with a consequent increase in stool weight and frequency [22]. Studies of colonic contractility and motility in patients with mild-to-moderate IBD showed a reduction in contractility [23-24], a reduction in spontaneous contractions [25], increased low-amplitude propagation and variably affected colonic transit [26]. The reduced colonic contractility in UC was suggested to be mediated by an increase in noncholinergic non-adrenergic innervation of the gut [27].

Furthermore, dysmotility can affect level distant from the inflamed region of the gut. This suggests that inflammation in IBD modulates gut neuromuscular circuitry, leading to a long-lasting or even permanent modification of general gastrointestinal motor behavior [27]. This fact may explain why, not only patients with CD affect gastric myoelectrical activity, but also the gastric motility is affected in patients with UC.

When the gut wall inflamed, a complex interplay will unfold between its different constituents. Immunocytes become activated, then infiltrate the gut wall will sustain the inflammatory process itself by secreting a number of cytokines. These cytokines equally affect the gut neural apparatus, inducing both morphological changes such as sprouting and neuronal necrosis [28], and functional changes such as neuronal sensitization or hyperactivity [29-31].

During an inflammatory flare, lymphocytes and other inflammatory cells infiltrate the bowel wall, and both local and circulating cytokine levels are elevated in patients with IBD. These cytokines secreted by circulating and resident inflammatory cells and by gut epithelial cells may exert direct influences on the gut neuromuscular apparatus. One of the cytokines that is enhanced in IBD is IL-1 β , which has been shown to impair gastrointestinal motility in animal models both in vivo and in vitro. In patients with UC, this cytokine contributes to colonic motor dysfunction by reducing intracellular Ca²⁺ and hence smooth muscle contractility [16]. This may be a factor that explain the different response of gastric myoelectrical activity during active CD and active UC; this was recorded by multiple changes in EGG parameters detected during active UC.

In both healthy humans and animals, stressors have been shown to result in a characteristic stress induced slowing of gastric emptying, increase in distal colonic motility, and acceleration of intestinal transit [32]. Different stressor factors during activity of CD and UC can also change the gastric myoelectrical response in both diseases. So, physicians should differentiate between gastric motor dysfunction that may associate exacerbation of ulcerative colitis, and other organic upper GI disorders.

VI. CONCLUSION:

Activity of inflammatory bowel disease, Crohn's disease, and ulcerative colitis, induces changes in gastric myoelectrical activity detected by electrogastrogram. These changes are in the form of gastric dysrhythmia, predominantly bradygastria increases with more active disease both in CD and ulcerative colitis. Moreover, active ulcerative colitis associated with a decrease in dominant frequency and increase in the resting power at 3 cpm.

TABLES AND FIGURES:

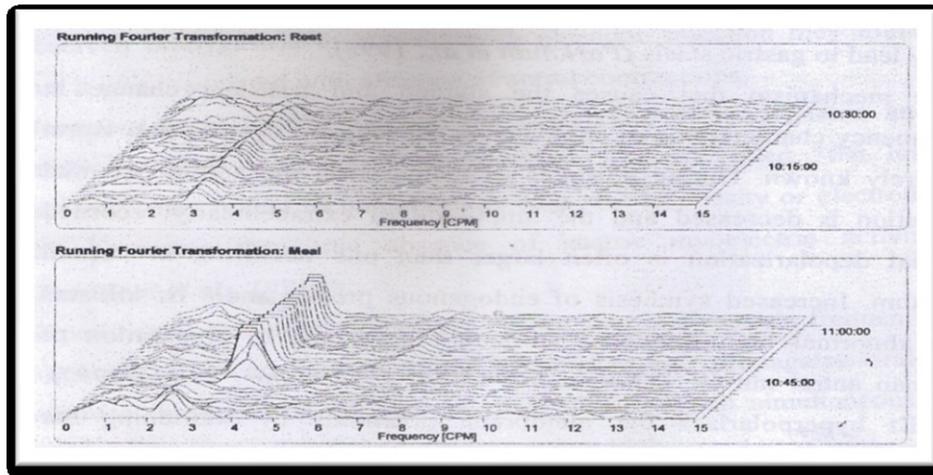


Fig. (1): Running Fourier Transformation at rest and meal in patient with normal 3cpm gastric signal.

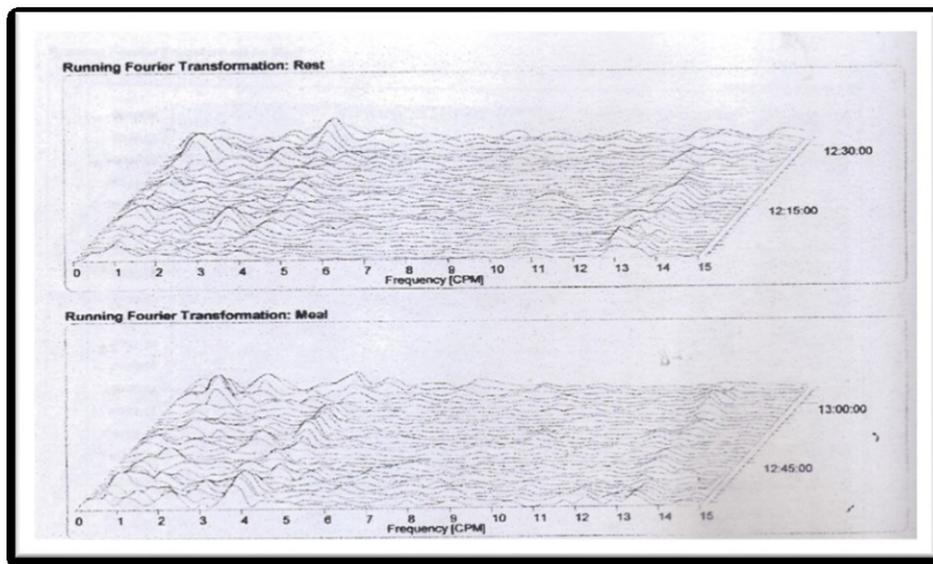


Fig. (2): Running Fourier Transformation at rest and meal in patient with tachygastria and absence of 3cpm gastric signal.

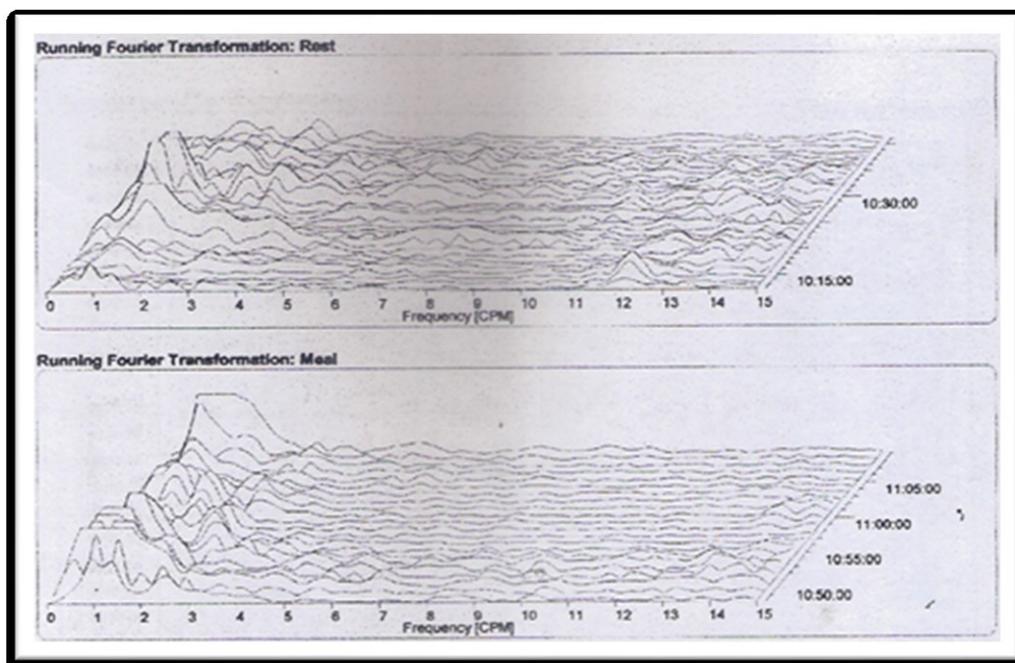


Fig. (3): Running Fourier Transformation at rest and meal in patient with bradygastria and absence of 3cpm gastric signal.

Table (1): Comparison of EGG parameters among three groups.

Variable	Ulcertive colitis		Crohn's disease		Control		ANOVA	
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	p value	sig.
Age	36.2 ± 9.86	21 - 52	34.05 ± 8.96	21 - 54	44.3 ± 14.52	18 - 67	0.038	S*
%cpm rest	75.25 ± 20.55	20 - 100	50.16 ± 33.02	0 - 98.45	76.66 ± 19.34	27.27 - 96.88	0.011	S**
% cpm meal	74.72 ± 23.28	15.15 - 100	50.61 ± 34.36	0 - 100	77.82 ± 23.41	23.33 - 100	0.017	S**
DF	2.48 ± 0.93	0.87 - 3.75	2.61 ± 1.02	1.17 - 4.92	2.99 ± 0.35	2.11 - 3.52	0.05	NS
Power cpm rest	30.94 ± 13.74	12.5 - 52.67	33 ± 17.38	11.18 - 60.87	19.11 ± 5.92	10.9 - 34.5	<0.001	S***
Power cpm meal	33.77 ± 13.97	3.44 - 53.2	34.99 ± 17.39	12.88 - 76	22.98 ± 5.69	12.91 - 32.56	0.001	S***
Power rest	4302.4 ± 3717.68	1113 - 16931	4983.9 ± 5025.08	534 - 15813	1961.3 ± 792.75	934 - 3900	0.004	S***
Power meal	6125.75 ± 3930.11	1868 - 16893	6852.8 ± 5244.68	988 - 15564	5297.05 ± 1900.08	2838 - 9298	0.385	NS
PR	1.97 ± 1.51	0.63 - 6.31	1.84 ± 1.11	0.89 - 5.01	2.93 ± 1.44	1.11 - 6.85	0.027	S***

*Post Hoc test: UC vs CD (NS), CD vs control (NS)and UC vs Control (S)

**Post Hoc test: UC vs CD (S), CD vs control (S)and UC vs Control (NS)

***Post Hoc test: UC vs CD (NS), CD vs control (S)and UC vs Control (S)

Table (2): correlation between symptoms, clinical, endoscopic activity with EGG parameters in Crohn's patients

Variable	Diarrhea	Abdominal Pain	Abdominal Mass	Clinical Activity	Endoscopic Activity
% cpm rest	r-0.217 p0.358	r-0.042 p0.845	r.124 p0.602	r-0.148 p0.535	r.135 p0.571
% cpm meal	r-0.298 p0.202	r-0.167 p0.482	r.338 p0.145	r-0.286 p0.222	r-0.288 p0.218
DF	r-0.148 p0.533	r.074 p0.756	r.024 p0.919	r-0.052 p0.828	r-0.124 p0.603
Power cpm rest	r.192 p0.416	r.225 p0.340	r.-0.105 p0.659	r.252 p0.283	r.210 p0.374
Power cpm meal	r.153 p0.520	r.277 p0.237	r.002 p0.993	r.253 p0.282	r.176 p0.457
Power rest	r.264 p0.261	r.270 p0.249	r-0.036 p0.882	r.299 p0.200	r.232 p0.326
Power meal	r.310 p0.183	r.311 p0.182	r-0.033 p0.889	r.337 p0.147	r.272 p0.246
PR	-0.141 P0.554	r-0.079 p0.741	r-0.006 p0.979	r-0.146 p0.539	r-0.016 p0.945

Cpm: cycle per minute

PR: power ratio

Table (3): correlation between symptoms, laboratory tests, clinical and endoscopic activity with EGG parameters among UC patients.

variable	diarrhea	ESR	Hb	temperature	Clinical activity	Endoscopic activity
%cpm rest	r-0.088 p.712	r-0.084 p0.724	r-0.172 p0.469	r-0.298 p0.201	r-0.140 p0.556	r-0.126 p0.596
%cpm meal	r .062 p.796	r0.157 p0.509	r.013 p0.958	r-0.145 p0.541	r.024 p0.919	r.004 p0.987
DF	r-0.451 p0.046*	r-0.552 p0.012*	r.502 p0.024*	r-0.362 p0.117	r-0.350 p0.130	r-0.468 p0.038*
Power cpm rest	r 0.614 p0.004*	r0.667 p0.001*	r-0.626 p0.003*	r0.374 p0.105	r.513 p0.021*	r.485 p0.030*
Power cpm meal	r0.440 p0.052	r0.452 p0.045*	r-0.435 p0.055	r0.129 p0.587	r.379 p0.100	r.234 p0.322
Power rest	r-0.261 p0.266	r-0.289 p0.217	r0.262 p0.265	r-0.208 p0.380	r-0.313 p0.179	r.385 p0.094
Power meal	r-0.592 p0.006*	r0.689 p0.001*	r0.681 p0.001*	r-0.590 p0.006*	r-0.634 p0.003*	r-0.672 p0.001*
Power ratio	r-0.308 p0.187	r-0.437 p0.054	r.452 p0.045*	r-0.282 p0.228	r-0.335 p0.149	r-0.268 p0.253

Hb: haemoglobin

*Statistically significant correlation

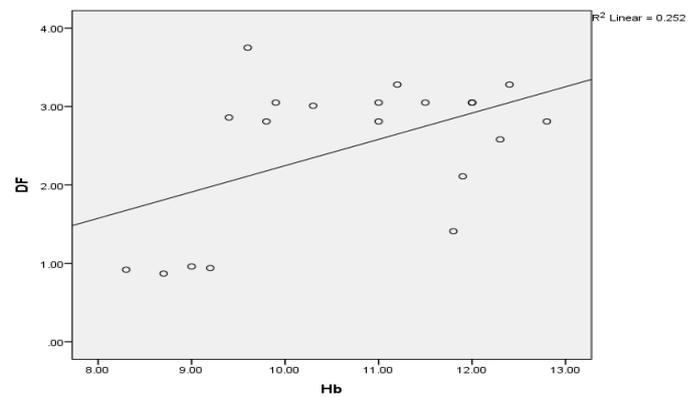
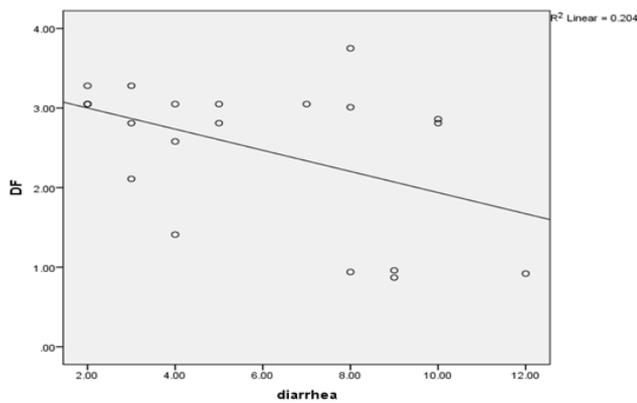


Fig.(4): A negative correlation between Df and frequency of diarrhea in UC. Fig.(5): A positive correlation between DF and haemoglobin in UC patients.

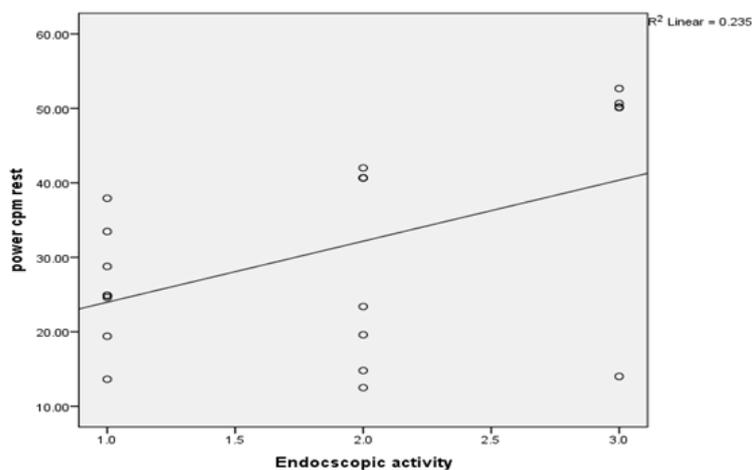


Fig. (6): A positive correlation between power com at rest and endoscopic activity in UC patients.

Table 4a&4b. Relation between gastric dysrhythmia and symptoms, clinical activity in Crohn's patients

Group=CD		Normal gastric rhythm (9)		Gastric dysrhythmia (11)		p value
		N	%	N	%	
Sex	Male	5	55.6%	4	36.4%	0.653
	Female	4	44.4%	7	63.6%	
Abdominal Pain	No	6	66.7%	2	18.2%	0.065
	Yes	3	33.3%	9	81.8%	
Mass	No	8	88.9%	9	81.8%	1
	Yes	1	11.1%	2	18.2%	
Bleeding	No	8	88.9%	10	90.9%	1
	Yes	1	11.1%	1	9.1%	
Clinical Activity	Remission	6	66.7%	1	9.1%	0.041*
	Mild-Moderate	2	22.2%	5	45.5%	
	Severe	1	11.1%	5	45.5%	

Table 4b.

Group=CD	Normal gastric rhythm (9)		Gastric dysrhythmia (11)		p value
	Mean	SD	Mean	SD	
Age	34.00	7.65	34.09	10.29	0.983
Diarrhea	3.89	1.90	7.45	2.81	0.005*

*statistically significant

Table 5a&5b. The relation between gastric dysrhythmia and symptoms, clinical activity in UC patients.

Group= UC		Normal gastric rhythm (14)		Gastric dysrhythmia (6)		p value
		N	%	N	%	
Sex	male	9	64.3%	3	50.0%	0.642
	female	5	35.7%	3	50.0%	
Bleeding	no	9	64.3%	1	16.7%	0.141
	yes	5	35.7%	5	83.3%	
Clinical Activity	remission	5	35.7%	0	0.0%	0.024*
	mild-moderate	8	57.1%	2	33.3%	
	severe	1	7.1%	4	66.7%	

*Statistically significant

Table 5b.

group = UC	Normal gastric rhythm (14)		Gastric dysrhythmia (6)		p value
	Mean	SD	Mean	SD	
Age	38.43	8.34	31.00	11.93	0.125
Diarrhea	4.93	2.79	8.17	2.93	0.030*
ESR	22.57	5.67	30.83	7.19	0.013*
Hb	11.24	1.06	9.45	1.28	0.004*
temp.	37.08	0.22	37.45	0.27	0.005*

*Statistically significant

Table 6: Distribution of gastric dysrhythmia in three groups.

		ulcertive colitis		Crohn's disease		control		Chi square	
		N	%	N	%	N	%	p value	sig.
sex	Male	12	60.0%	9	45.0%	11	55.0%	0.626	NS
	Female	8	40.0%	11	55.0%	9	45.0%		
VA	Normal	14	70.0%	9	45.0%	19	95.0%	0.008*	S
	Brady	5	25.0%	8	40.0%	1	5.0%		
	Tachy	1	5.0%	3	15.0%	0	0.0%		

*Fisher exact test

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