

Correlations between the responses of electrogastrograms, heart rate and respiratory rate to the stress of the mirror drawing test in human subjects

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Abstract

An electrogastrogram (EGG) recorded on the skin is believed to reflect the electrical activity of the gastrointestinal tract. In this study, linear correlations were calculated for the EGG spectral frequencies and the power ratios, changes in heart and respiratory rate before and during mirror drawing test (MDT) stress and after having meals, with the changes in the sympathetic tone indicator (LF/HF) and HADS anxiety and depression scores in human subjects (n=48). Depression scores had a negative linear correlation with the EGG resting frequencies of the epigastric and supraumbilical 6 cpm groups (5.0–7.4 cpm). Anxiety scores had a positive linear correlation with the EGG area power ratio of the resting to MDT stress responses of the epigastric and infraumbilical 6 cpm groups (6 cpm area during MDT/that during fasting rest). The resting LF/HF had a positive linear correlation with the EGG area power ratio of the resting to MDT stress responses of the epigastric and infraumbilical 3 cpm groups (2.5–4.9 cpm). The resting LF/HF ratio had a negative correlation with the area power ratio of the resting to postprandial responses (postprandial power/resting power) in the epigastric, supraumbilical and infraumbilical 6 cpm groups. The resting LF/HF ratio had a positive linear correlation with the heart rate at rest and during MDT-stress. In contrast, the resting LF/HF ratio had a negative linear correlation with the respiratory rate at rest and during MDT-stress. EGGs of the surface electrical activities of the gastrointestinal tract were influenced by acute MDT-stress and their frequencies and their response power ratios were correlated linearly with anxiety scores, depression scores and the sympathetic tone indicator, the LF/HF ratio.

Key words: electrogastrogram, anxiety, depression, LF/HF of RRI, Mirror drawing test-stress

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Introduction

We have reported previously that the acute stress of performing mirror drawing tests (MDT) induced both excitatory and inhibitory effects on the power ratio of EGGs (peak power of a spectral group during MDT/that at rest) as well as an increase in both heart and respiratory rate (Homma, 2005a). The sympathetic tone indicator, LF/HF, significantly increased in association with the increase of heart rate and respiratory rate with MDT. As for EGGs, the resting LF/HF was not significantly different in the excitatory and inhibitory groups in resting spectral frequencies and power ratio changes with MDT. Anxiety and depression scores for the two groups were, however, significantly different in some spectral frequency groups. The excitatory groups of 6 cpm (5.0–7.4 cpm) with lower resting frequencies had significantly higher depression scores than the inhibitory ones. Similarly, the excitatory groups of 1- (0–2.4 cpm) and 3-cpm (2.5–4.9 cpm) had higher anxiety scores than the inhibitory ones (Homma 2005a). These results strongly suggested linear correlations between the EGG indices and the anxiety and depression scores, and perhaps the LF/HF ratio. Furthermore, the results on the relationships between the postprandial power and the LF, HF and LF/HF ratios during mirror drawing test stress or the postprandial period were not clear in the previous report which was based on a comparison of the mean values of the various indices alone. Therefore, in this study we have calculated the linear correlations between anxiety scores, depression scores, the LF/HF ratios and the EGG spectral frequencies and the power ratios of resting to mirror drawing test or to postprandial power. We have found some positive and negative linear correlations among them. Preliminary results of these correlations have been published in abstract form (Homma, 2005b).

Methods

The methods used are essentially as described previously (Homma *et al.*, 1999). The subjects were healthy volunteers 20–38 years old ($n=48$; 42 male, 6 female), each of whom had given their informed consent. The project was approved by the ethics committee of Niigata University, School of Medicine (project no. 179). Unipolar EGGs were recorded at 16 locations on the thoracoabdominal surface of the body (see Fig. 1; Homma, 2005a), with a reference electrode attached to the right leg, using a modified EEG amplifier (time constant = 5 sec, high cut = 0.5 Hz, low cut = -6 dB/oct, and high cut = -12 dB/oct, Biotop 6R12-4, NEC Sanei, Japan) (Homma *et al.*, 1999). After cleaning the skin with ethanol, disc electrodes for EEG recordings ($\phi = 11$ mm) were fixed on the skin with surgical tape and electrode cream (Signa cream, Parker Lab., Inc., USA). EGGs were recorded after more than 8 hours fasting and sampled every 128 sec (1 file). EGGs were also recorded for about 30 min, during the fasting rest phase and 5 min during the period of MDT-stress and 30 min after having a meal (CUP NOODLE, 364 kcal/cup,

Abbreviation of words: cpm, cycle per minute; ECG, electrocardiogram; EGG, electrogastrogram; HF, high frequency focus; LF, low frequency focus; MDT, mirror drawing test; R, correlation coefficient; α , inclination of linear regression line.

Nissin, Japan), with 1-sec sampling clock.

The MDT involves tracing around the cue figure of a metal star which was reflected onto a mirror, using an electric pen which gives a click alarm when the tracing runs off the edge of the star. A supine position was maintained during the fasting rest period and during the MDT-stress period, but an upright position was maintained during the meal. The EGG was not sampled in the upright posture during a meal because of the movement artifacts which would need to be removed from the EGG recording. After the meal, a supine position was resumed. EGGs were analyzed spectrally by the MEM (maximal entropy method) and running spectra were drawn. Ensemble means of the spectra during the fasting rest phase (sampled file number, $n=7-10$), during MDT-stress ($n=2$), and after the meal ($n=7-10$) were calculated. Five spectral frequency groups were defined and their peak frequencies were determined (Homma *et al.*, 1999). The spectral frequency groups were the 1 cpm group (0–2.4 cpm), the 3 cpm group (2.5–4.9 cpm), the 6 cpm group (5.0–7.4 cpm), the 8 cpm group (7.5–9.9 cpm) and the 10 cpm group (10.0–12.9 cpm). For convenience, CH1 was defined as the mean of the epigastric spectral EGGs of electrodes 3, 4, 5 and 6; CH2 was the mean of the supraumbilical electrodes 7, 8 and 9; CH3 was the mean of the infraumbilical electrodes 12, 13 and 14 (see Fig. 1 in Homma, 2005a). ECGs (electrocardiograms) were also recorded simultaneously with the electrogastrograms (EGGs). The LF (0.039–0.148 Hz), HF (0.148–0.398 Hz) and LF/HF were calculated from the R-R intervals obtained by spectral MEM analysis (Ambulatory ECG recorder, SM50, Fukuda Denshi).

Representative running spectra together with the continuous LF/HF during rest, during MDT-stress and after a meal (postprandial period) are illustrated in Fig. 2 in Homma (2005a). Anxiety and depression scores were estimated using HADS (hospital anxiety and depression scales) (Zigmond and Snaith, 1983; Mykletun *et al.*, 2001). The peak power ratio of a certain frequency group was defined as (peak power during MDT or after having a meal/peak power at rest). Peak power is the peak amplitude expressed as power in the power spectrum (peak pr in Table 3). The area power of a certain frequency group (power content) was defined as (power area of a certain frequency group/total area of a spectrum, or the area encircled by a spectrum envelope line and abscissa). The area power ratio of a certain frequency group (area power of a certain frequency group during MDT or after having a meal/power area at rest) (% pr in Table 3) was also calculated. Mean and standard errors (SE) were calculated and the Student's *t*-test was used with *P* values below 0.05 were considered to be significant.

Results

Correlation between anxiety and depression scores

As anxiety scores increased, depression scores increased and the two scores were positively correlated each other ($n=48$, $P<0.01$, $\alpha=0.55$, $R=0.43$).

Correlation between anxiety or depression and LF/HF, LF/HF during the mirror drawing test (MDT)

Linear correlations were not found between the anxiety or depression scores and either the

Table 1. Correlation of the resting LF, the resting HF, and the resting LF/HF ratio with resting heart rate (rest. hr), resting respiratory rate (rest. rr), and MDT-stress heart rate (MDT hr) and MDT-stress respiratory rate (MDT rr)

	rest. LF	rest. HF	rest. LF/HF	MDT-LF/HF
rest. hr		0.0084 (-48.3) (R=0.38)	$P=0.042$ (0.049) (R=0.30)	
rest. rr	0.050 (-114.1) (R=0.29)		0.012 (-0.17) (R=0.36)	
MDT hr		0.0007 (-50.4) (R=0.48)	0.040 (0.041) (R=0.30)	0.0051 (0.063) (R=0.40)
MDT rr			0.044 (-0.11) (R=0.30)	
ppr rr			0.0038 (-0.15) (R=0.42)	

Only significant correlations and the slope (in parenthesis) are shown. P values and slope values are also in parenthesis. R, correlation coefficient. $n=39-43$.

resting LF/HF or the postprandial LF/HF. But depression scores had a negative linear correlation with the MDT LF/HF ($\alpha=-0.572$, $P<0.05$, $R=0.308$). Anxiety scores, however, did not have a significant linear correlation with the MDT LF/HF ($\alpha=-0.572$, $P=0.0865$). Resting HF had a negative linear correlation with the heart rate at rest and during the MDT (Table 1).

Correlation of anxiety scores, depression scores, resting LF, resting HF, and resting LF/HF with both heart rate and respiratory rate

Anxiety and depression scores had no significant linear correlation with 1) heart rate, 2) respiratory rate or 3) LF, HF and LF/HF at rest either during MDT-stress or during the postprandial period. The resting LF/HF had a negative linear correlation with the respiratory rate at rest ($P<0.05$), during MDT-stress ($P<0.05$), and after a meal ($P<0.05$). In contrast, the LF/HF had a positive linear correlation with heart rate at rest and during MDT-stress ($P<0.05$). In contrast, the resting HF had a negative correlation with heart rate at rest ($P<0.01$) and during MDT-stress ($P<0.001$) (Table 1).

Correlation of both anxiety and depression scores and LF/HF with EGG peak frequencies at rest, during either MDT-stress or the postprandial period

The excitatory EGG frequency groups were defined as significant frequency increases from rest during MDT-stress while the inhibitory groups were defined as significant frequency decreases during MDT-stress. It was reported in our previous paper that the depression scores for the excitatory frequency groups of each of the epigastric ($n=23$, out of 43), supraumbilical ($n=22/43$), and infraumbilical 6 cpm groups ($n=21/43$) were significantly higher ($P<0.05$) with resting frequencies significantly lower ($P<0.001$) than those of the inhibitory groups (Homma, 2005a). As expected, a negative linear correlation was found between the depression scores and the resting frequencies of the 6 cpm groups (5.0–7.4 cpm) in both the epigastric ($P<0.05$) and supraumbilical regions ($P<0.05$). Significant negative linear correlation was also found between the anxiety scores and the infraumbilical resting frequency of the 3 cpm group ($P<0.05$) ($n=48$)

Table 2. Linear correlation of anxiety scores (A) and depression score (D), resting LF/HF ratios (r.LF/HF) and the peak frequencies of the 5 spectral frequency groups

	(epigastric)		r. LF/HF	(supraumbilical)		(infraumbilical)	
	A	D		A	D	A	D
rest. 3 cpm						0.029 (-1.65) (R=0.32)	
rest. 6 cpm		0.028 (-1.63) (R=0.32)	0.0054 (1.31) (R=0.40)		0.022 (-1.48) (R=0.33)		
MDT 6 cpm	0.032 (1.60) (R=0.31)			0.016 (1.75) (R=0.35)			
ppr 6 cpm				0.047 (1.61) (R=0.30)			

rest.: resting fast, MDT: during mirror drawing test, ppr: postprandial period. The statistical *P* values of the Student's *t*-test and the slope values (in parenthesis) of the linear correlation are shown. Only significant correlations are shown. The five spectral groups are the 1 cpm group (0–2.4 cpm), the 3 cpm group (2.5–4.9 cpm), the 6 cpm group (5.0–7.4 cpm), the 8 cpm group (7.5–9.9 cpm), and the 10 cpm group (10.0–12.9 cpm). The first line, second line and third line indicate the *P* value, inclination (α) and (R), correlation coefficient, respectively. n=40–43.

(Table 2). The resting LF/HF had a positive linear correlation with the frequencies of the epigastric 6 cpm group ($P<0.001$). Anxiety scores also had a positive linear correlation with both the epigastric and supraumbilical frequencies of the 6 cpm groups during MDT ($P<0.05$) (Table 2).

Correlation of both anxiety and depression scores and both resting LF, HF and the LF/HF ratio with the EGG power ratio during MDT-stress to resting (MDT/r)

The number of subjects with an MDT excitatory peak power ratio (peak MDT/r of >1.0) (30–37 out of 43) was much higher than that of the inhibitory peak power ratio (5–12/43). In addition, the anxiety scores for the MDT excitatory peak power ratio of both the infraumbilical 1 and 3 cpm groups were significantly higher ($P<0.05$) than those of the inhibitory groups as reported in the previous paper (Homma, 2005a). Contrary to our expectations, however, no positive linear correlation was found between the anxiety scores and the peak power ratio of the infraumbilical 1 and 3 cpm groups. But a positive linear correlation was found between the anxiety scores and the area power ratio of both the epigastric and infraumbilical 6 cpm components ($P<0.05$) (Fig. 1A and Table 3).

The resting LF had a positive linear correlation with the epigastric area power ratios (MDT/r) of the 3 cpm components and the infraumbilical 6cpm components. The resting LF also had a positive linear correlation with the infraumbilical resting to postprandial area power ratio of the 3 cpm components (ppr/r). The resting HF also had a positive linear correlation with the infraumbilical resting to postprandial area power ratio of the 6 cpm components (ppr/r) (Table 3).

As for the relationship between the resting LF/HF and the spectral EGG power ratio (MDT/r), the resting LF/HF had a positive linear correlation with the area power ratio of the epigastric ($P<0.05$) and infraumbilical 3 cpm components ($P<0.01$) (Fig. 1B and Table 3) and

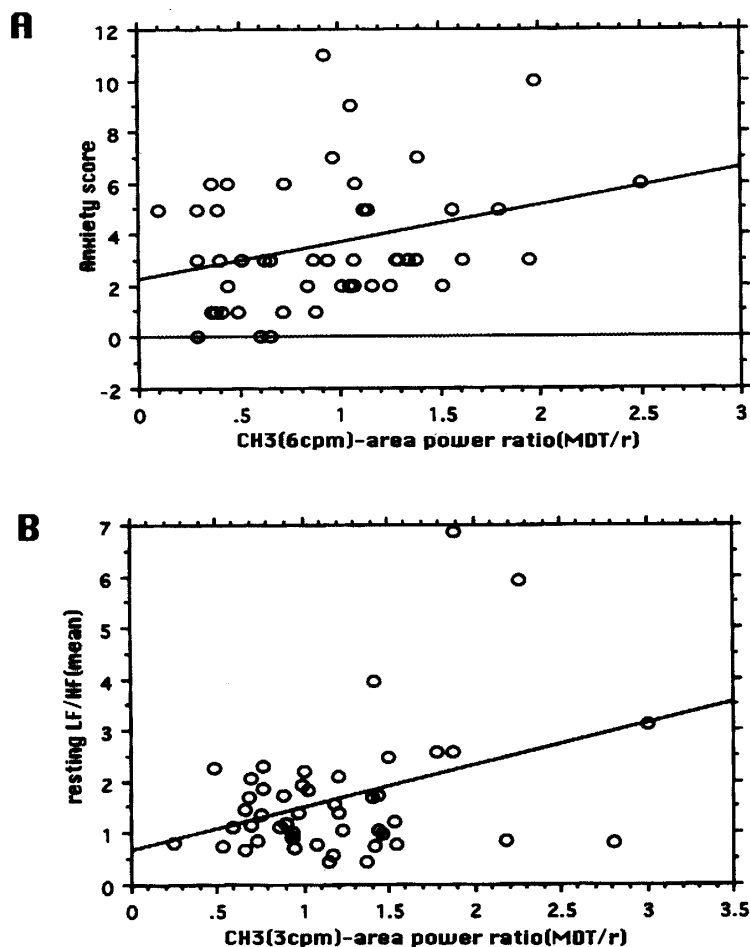


Fig. 1. A. The linear correlation between anxiety scores and the EGG area power ratio (% pr) of the mirror drawing test to resting (MDT/r) in the CH3 infraumbilical 6 cpm component ($P=0.038$, $\alpha=1.45$, $R=0.30$). B. The linear correlation between the mean resting LF/HF ratio and the EGG area power ratio of MDT/r in the CH3 infraumbilical 3 cpm component ($P=0.0088$, $\alpha=0.83$, $R=0.38$).

also with the peak power ratio of the infraumbilical 3 cpm group ($P<0.001$) (Table 3). On the other hand, the resting LF/HF had a negative linear correlation with the area power ratio of the epigastric ($P<0.05$), supraumbilical ($P<0.05$, $\alpha=-1.05$, $R=0.37$) and infraumbilical ($P<0.05$, $\alpha=-0.88$, $R=0.34$) postprandial 6 cpm % components (Table 3).

We also calculated the linear correlation between the LF/HF ratio during MDT-stress (MDT-LF/HF) and during the postprandial period (ppr-LF/HF), as well as the resting to MDT-stress or postprandial power ratio (MDT/r and ppr/r). The MDT-LF/HF had no linear correlations with power ratios at all (MDT/r). However, only the ppr-LF/HF ratio had a negative linear correlation with the epigastric area power ratio of the 8 cpm components (ppr/r) ($P<0.05$, $\alpha=-1.725$, $R=0.324$, not shown in the Table 3).

Table 3. Correlation of anxiety and depression scores and the resting LF/HF ratio with either the power ratio of MDT (MDT/r) or the postprandial power to resting power ratio (ppr/r) (peak power ratio = peak pr, or % area power ratio = % pr) in the 5 spectral groups

	anxiety	resting LF	resting HF	resting LF/HF
MDT/r				
CH1%pr (3 cpm)		0.023 (1.12) (R=0.35) (n=42)		0.048 (1.08) (R=0.29) (n=47)
CH1%pr (6 cpm)	0.023 (1.26) (R=0.33) (n=48)			
CH3 peak pr (3 cpm)				0.0009 (0.0072) (R=0.47) (n=48)
%pr (3 cpm)				0.0088 (0.83) (0.38) (n=48)
CH3%pr (6 cpm)	0.038 (1.45) (R=0.30) (n=48)	0.007 (754) (R=0.41) (n=42)		
ppr/r				
CH1%pr (6 cpm)				0.010 (-0.92) (R=0.37) (n=43)
CH1%pr (10 cpm)	0.0030 (2.07) (R=0.42) (n=43)			
CH2%pr (6 cpm)				0.012 (-1.05) (R=0.37) (n=43)
CH3%pr (3 cpm)		0.001 (806) (R=0.40) (n=39)		
CH3%pr (6 cpm)			0.025 (140) (R=0.35) (n=42)	0.019 (-0.88) (0.34) (n=43)

Only significant correlations and the slope (in parenthesis) are shown. CH1, epigastric, CH2, supraumbilical and CH3, infraumbilical EGGs. *P* values, inclination (α) and correlation coefficient (R), are shown. n=48. Depression had no linear correlation with MDT/r.

Discussion

Correlation between anxiety and depression scores

The hospital anxiety and depression scale (HADS) (Zigmond and Snaith, 1983) appears to be a reliable and easy self rating instrument for basic screening psychometry (Mykletun *et al.*, 2001) and was deemed to be an appropriate psychometric scoring tool to use in this study. The HADS anxiety and depression scores used in this study correlated positively with each other with a correlation coefficient between their average scores of 0.43. It has already been reported that there is a high correlation coefficient ($r=0.58$) between anxiety and depression scores (Beck *et al.*, 1987).

Correlation between anxiety or depression and LF, HF, LF/HF during the MDT (mirror drawing test)

Depression scores showed a significant negative linear correlation with the MDT LF/HF ratio. Similarly, the anxiety scores had a negative linear correlation, but this was not significant. These results may suggest that the response capacity or reserve of the autonomic nervous system to stress, especially that of the sympathetic system, is reduced in a highly depressed state. A positive linear correlation between the resting LF/HF ratio and heart rate both at rest

and during MDT-stress is plausible, because the LF/HF ratio is considered to be a sympathetic tone indicator. In addition, a negative linear correlation between resting HF and heart rate at rest and during MDT-stress is also plausible because HF is considered to be a parasympathetic indicator.

Correlation of heart rate and respiratory rate with both anxiety and depression scores, resting LF, resting HF, and the resting LF/HF ratio

As we measured only the respiratory rate and did not record tidal volume, we were unable to determine if there was a correlation between the minute respiratory volume and the autonomic nerve indices LF, HF and the LF/HF ratio. But it is noteworthy that the resting LF/HF ratio, a sympathetic nerve tone indicator, has a positive linear correlation with heart rate both at rest and during MDT-stress. In contrast, the resting HF, a parasympathetic tone indicator, had a negative linear correlation with the heart rate both at rest and during MDT-stress. We reported that MDT-stress increased both the heart and respiratory rates, but that the anxiety and depression scores had no correlation with the resting LF, the resting HF, the resting LF/HF ratio and the LF/HF ratio during MDT-stress in the supine position. The LF/HF ratio is suggested to be an indicator of relative sympathetic activity (Pagani *et al.*, 1986; Pagani *et al.*, 1991). These results seem to be in accord with the report by Virtanen *et al.* (2003), indicating that LF and HF under supine rest do not reflect symptoms of anxiety, hostility and depression. MDT-stress increased the respiratory rate, but the resting LF/HF ratio was found to be negatively correlated with the respiratory rate at rest, during MDT-stress and after a meal. The underlying physiological neural mechanisms are not clear.

Correlation of anxiety and depression scores with spectral frequencies of the EGG

A negative linear correlation was found between the depression scores and the epigastric and supraumbilical resting frequencies of the 6 cpm group (5.0–7.4 cpm) as expected from our previous report (Homma, 2005a). Depression generally means inhibitory effects on physiological function and the inhibitory effects on the EGG resting frequencies are intuitively understandable. Anxiety scores, however, also correlated negatively with the infraumbilical resting frequency of the 3 cpm group. In contrast, anxiety scores had a positive linear correlation with frequencies of the epigastric and supraumbilical 6 cpm groups during MDT-stress and with the postprandial frequency of the supraumbilical 6 cpm group (Table 2). We can only conclude that depression and anxiety influence the resting, MDT stress and postprandial frequencies of EGGs of certain frequency groups. The epigastric 3 and 6 cpm group electrical activities of the EGG were suggested to reflect those of the colon on the basis of EGG results obtained after total gastrectomy (Pezzola *et al.*, 1989; Homma *et al.*, 1995). We have also suggested that the infraumbilical 3 and 6 cpm EGG activities were derived from colonic electric activity, again on the basis of EGG results obtained after total colectomy (Homma, 1997; Homma *et al.*, 1999; Homma *et al.*, 2000). Therefore, the basic electric rhythm of the stomach (epigastric 3 cpm) and the colon (infraumbilical 3 cpm) might be influenced by anxiety and depression.

Correlation of both anxiety and depression scores and the LF/HF ratio with the spectral power ratio of the EGG during MDT to rest

In contrast to our expectation, we could not find a positive linear correlation between anxiety scores and the MDT-stress peak power ratio of the infraumbilical 1 cpm group (Table 3). We found, however, a linear positive correlation between the anxiety scores and the epigastric and infraumbilical area power ratio of the 6 cpm groups (Fig. 1A and Table 3). In contrast, depression scores had no correlation with the EGG power ratio. It is difficult to interpret the physiological meaning of the positive linear correlations between the resting LF and the area power ratio of the resting to mirror drawing test (MDT/r). The resting HF, a parasympathetic tone indicator, had a positive linear correlation with the infraumbilical resting to postprandial area power ratio of the 6 cpm components (ppr/r) (Table 3). We have suggested that infraumbilical 6 cpm activity reflects colonic EGG activity (Homma *et al.*, 1999; Homma *et al.*, 2000). The increased infraumbilical EGG activity during the postprandial period perhaps reflects the gastrocolic or gastrocolonic response. A negative linear correlation between the LF/HF ratio during the postprandial period (ppr-LF/HF) and the epigastric resting to postprandial area power ratio (ppr/r) of the 8 cpm component perhaps suggests an inhibition of epigastric intestinal activity as a result of increased postprandial sympathetic tone, ppr-LF/HF.

In addition, the resting LF/HF ratio had a positive linear correlation with the area power ratio of both the epigastric ($P < 0.05$) and infraumbilical ($P < 0.01$) 3 cpm components and with the peak power ratio of the infraumbilical 3 cpm components ($P < 0.001$) (Table 3). We have suggested that the infraumbilical 3 and 6 cpm EGG activities were derived from colonic electrical activity (Homma *et al.*, 1999; Homma *et al.*, 2000). Therefore, the anxiety scores and the resting LF/HF ratio facilitated the colonic electrical activities, especially of the infraumbilical area. In response to stress, it has been shown in rats that CRF (corticotropin releasing factor) acting in the PVN (paraventricular nucleus) induces via the autonomic nervous system both an inhibition of gastric emptying and stimulation of colonic motor function (Monnikes *et al.*, 1992; Tache *et al.*, 1993). These reports may be relevant to our previous report, because MDT-stress induced dual excitatory or inhibitory effects on the frequency and power amplitude and power ratio of the electrical activity of the gastrointestinal tract, the EGG activity (Homma, 2005a). It is conceivable that both gastric and colonic, and even small intestinal electrical activity may be excited or inhibited by stress. In addition, stress sensitivity may be different from person to person. As for human subjects, it has been reported that psychological stress induced an increase in colonic activity (Naruducci *et al.*, 1985; Rao *et al.*, 1998; Welgan *et al.*, 1985; Welgan *et al.*, 1988). MDT-stress, in particular, induced a significant increase in the colonic motility of patients with irritable bowel syndrome, with an increase in heart rate variability, but not in healthy controls (Fukudo and Suzuki, 1987). Psychological stressors producing anger and anxiety increased the colonic motility in normal healthy controls and irritable bowel syndrome patients (Welgan *et al.*, 1988). MDT-stress significantly increased the pulse rate and respiratory rate in this study. It is reported that anxiety is associated with increased bowel frequency, while depressed patients tend to be constipated (Gorard *et al.*, 1996). It is also reported that anxiety correlated negatively with rectal mucosal blood flow (Emmanuel *et al.*, 2001). Anxiety is reported to facilitate antral meal retention (Lorena *et al.*, 2004). It is reported that increased

tolerance to colonic distension was associated with a reduction in depression in patients with irritable bowel syndrome (Guthrie *et al.*, 2004). These reports suggest that anxiety and depression correlate with gastrointestinal motility. We also found that the anxiety and depression scores and the resting LF/HF ratio correlated positively or negatively with EGG activity, reflecting some gastrointestinal motility. Furthermore, the resting LF/HF ratio had negative linear correlations with the postprandial area power ratios of the epigastric, supraumbilical and infraumbilical 6 cpm EGG components, which are probably the colonic ones. The higher sympathetic tone may also be inhibitory to the postprandial 6 cpm EGG activity of the colon.

In conclusion, acute MDT-stress changed the EGG electrical activity of the gastrointestinal tract and the changes were shown to be correlated with both anxiety and depression scores and with the sympathetic tone indicator, the LF/HF ratio.

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