

Original Article

## The Correlation between Deviation Indexes of *Ryodoraku* and Acute Stress in Patients with Functional Dyspepsia

Guk-Hyeon Eom, Sang-Hyub Yoon, Joon-Suk Lee, Hyun-Kyung Kim,  
Seon-Young Lee, Won-Young Hur, So-Yeon Kim, Jin-Sung Kim, Bong-Ha Ryu

3rd Dept. of Internal Medicine, Oriental Medicine, Kyung-Hee University

**Objectives :** The aim of this study was to investigate the relationship between stress type and *Ryodoraku* score (RS) in patients with functional dyspepsia.

**Methods :** 92 (30 male, 62 female) patients with functional dyspepsia were included in this study. Degree of stress was evaluated by GARS and BEPSI scale which can assess acute and chronic stress, respectively. RS of the patients was measured, and mean, sum of gaps and standard deviation (SD) in their RS were taken. First, patients were divided into two groups by sex, and by mean RS 40 $\mu$ A (above and below). GARS and BEPSI scale of each group was compared. Second, correlation between stress scales (GARS and BEPSI) and variation indexes of RS (sum of gaps and SD) was examined.

**Results :** 1. The mean RS is higher in male patients than in female ones. 2. No significant difference was noted in GARS and BEPSI scale associated with above and below the mean 40 $\mu$ A RS. 3. The sum of gaps and SD of RS has significant correlation with GARS scale but not with BEPSI scale.

**Conclusions :** These results suggest that the sum of gaps and SD of RS are associated with acute stress in patients with functional dyspepsia. Thus, it is thought that RS can be useful in assessing acute stress in patients with functional dyspepsia.

**Key Words :** functional dyspepsia, *Ryodoraku*, stress, GARS, BEPSI

### Introduction

Functional dyspepsia is the most frequent disorder among gastrointestinal diseases<sup>1,2</sup>. Recent studies on the disease report its major causes largely as gastrointestinal motor abnormality, sensory abnormality and neuropsychiatric abnormality, etc.<sup>3</sup> Of them, stress is an important cause of neuropsychiatric abnormality but agreement has not been reached over its correlation with dyspepsia<sup>4-8</sup>. However, reports that stress

stimuli applied to the central nervous system considerably lower the motility of the stomach<sup>9</sup>, patients with functional dyspepsia are frequently exposed to stress events<sup>10,11</sup> and their awareness of negative daily events is high<sup>10</sup> suggest that stress may be involved in the pathophysiology of functional dyspepsia.

Stress is a very subjective feeling observed in around a third of the adult population<sup>12</sup> but it is not easily measurable because it is not clear whether it has related symptoms and there is no clinicopathologic evidence. In the psychiatric area, stress is assessed in three ways - interview, written test (using an assessment scale and a questionnaire) and direct observation<sup>13</sup>, but they are all dependent on the subjectivity of the assessor and the assessed, so they are not objective.

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Corresponding author : Sang-Hyub Yoon,  
3rd Dept. of Internal medicine Kyunghee Medical Center, 1,  
Hoegi-dong, Dongdaemun-gu, Seoul, Korea  
Tel : 82-2-958-9142 / FAX : 82-2-958-9136  
E-mail : sandrock58@nate.com

Therefore, it may be greatly helpful for treatment and prognosis if stress of patients with functional dyspepsia can be quantified with mechanical numbers.

*Ryodoraku* and a pulse analyzer are used as mechanical diagnosis methods based on contemporary technologies and methods for systematizing and objectifying diagnosis in Oriental medicine. *Ryodoraku* has been widely studied for its range of applications not only in the East but also in the West<sup>14-20)</sup>, but not many studies have been made to distinguish between normal and abnormal states. However, Kim et al. reported a qualitative correlation between the chronic fatigue of patients with functional dyspepsia and the results of *Ryodoraku*<sup>16)</sup>.

This study, which was conducted as research subsequent to Kim et al.<sup>16)</sup>, obtained the result that *Ryodoraku* check reflects acute stress of patients with functional dyspepsia and reports it here.

## Subjects and Methods

### 1. Subjects

The subjects of this study were 92 functional dyspepsia patients aged between 30~49 selected from those who visited the Digestive System Internal Department of the Oriental Medicine Hospital of the Kyunghee Medical Center with dyspepsia as the chief complaint during the period from January 2004 to November 2005. We excluded those who had a history of irritable bowel syndrome, erosion, ulcer or reflux oesophagitis of gastric mucosa in endoscopy, gastrectomy or digestive troubles causing dyspepsia, those who were taking drugs affecting the endocrine system or the nervous system, anti-hypertensive, lipid depressant or prokinetic drugs, and those who could not complete the questionnaire by themselves.

This study was approved by the Clinical Ethics Committee of the Korean Hospital of the Kyunghee Medical Center, and conducted after obtaining the patients' written consent.

### 2. Methods

#### 1) *Ryodoraku* measurement and evaluation

*Ryodoraku* was measured using Medira (Neomyth Co., Korea). The transducer for measuring *Ryodoraku* was of a round form 8mm in diameter and made of copper, and the measuring room was constantly maintained at 20°C. The patients were instructed not to have acupuncture or physiotherapy before *Ryodoraku*. We removed all metallic objects from the patients and had them relax on the bed for 15 minutes. To minimize the effect of perspiration, the site for measurement was kept exposed during the period of relaxation and measuring. The measuring site was wet with gel just before measuring. The measured *Ryodoraku* points were six spots on each hand (*Tàiyuān*, *Dàlǐng*, *Shénmén*, *Yánggǔ*, *Yángchí*, *Yángxī*) and six spots on each foot (*Tàibái*, *Tàichōng*, *Tàixī*, *Shùgǔ*, *Qǐxū*, *Chōngyáng*), so a total of 24 spots over two hands and two feet. The result was represented as the *Ryodoraku* score (RS) and its unit was  $\mu\text{A}$ . *Ryodoraku* indexes used for assessment were: first, the mean of the 24 *Ryodoraku* points (mean RS); second, the sum of the absolute values of the gaps of RS from the physiological range<sup>36</sup> measured based on the mean RS (sum of gaps); and third, the statistical standard deviation of the *Ryodoraku* points.

In this study, the physiological range was determined as electric current ( $\mu\text{A}$ ) within 7mm above and below the mean RS obtained from the results of *Ryodoraku*. (Table 1) shows the physiological range at each mean RS according to the result of *Ryodoraku*.

**Table 1.** Physiological Range in Relation with Each Level of Mean RS

Mean RS( $\mu$ A)	over 7mm	under 7mm	Range( $\mu$ A)
20	+12	-10	10 - 22
30	+13	-12	18 - 43
35	+14	-12	23 - 49
40	+14	-13	27 - 54
45	+14	-14	31 - 59
50	+16	-14	36 - 66
55	+18	-14	41 - 73
60	+20	-14	46 - 80
70	+20	-16	54 - 90
80	+20	-20	60 - 100
90	+20	-20	70 - 110

## 2) Stress assessment

Stress was divided into a week's acute stress and a month's chronic stress. Acute stress was measured using GARS (Global Assessment of Recent Stress) scale with eight questions, which was translated by Koh<sup>21)</sup>. Each question gives a score between 0~9 points according to the severity of the symptom. Chronic stress was measured using Korean-version BEPSI (or M-BEPSI or BEPSI-K) [Modified Korean-translated BEPSI(Brief Encounter Psychosocial Instrument)], a questionnaire modified by Yim et al<sup>22)</sup>. This questionnaire contains five questions of 1-5 points according to Likert's scale asking about stress felt by the patients. Each type of stress was assessed by summing up the scores of these questions.

## 3) Statistical analysis

All collected data were represented as mean  $\pm$  SD, and Student's t-test was used to compare mean RS, standard deviation, GARS and BEPSI. Correlation analysis used Pearson's correlation coefficient. Significance was accepted when  $P < 0.05$ .

## Results

### 1. General characteristics

The patients' mean age was  $37.44 \pm 5.42$ . Of the subjects, 32 were male and 60 were female, so the number of females was two times larger than that of males. Significance according to gender appeared only in mean RS but not in sum of gaps, standard deviation, GARS and BEPSI. Mean RS was  $51.56 \pm 12.71 (\mu A)$  in the male patients, and  $42.60 \pm 12.95 (\mu A)$  in the female ones ( $p = 0.002$ ). Sum of gaps was  $60.78 \pm 66.06$  in male patients, and  $58.43 \pm 74.95$  in female ( $p = 0.841$ ). Standard deviation was  $13.76 \pm 6.51$  in male patients and  $12.61 \pm 6.40$  in female ( $p = 0.416$ ). GARS scale was  $31.00 \pm 10.21$  in male patients and  $31.97 \pm 10.84$  in female ( $p = 0.608$ ), and BEPSI scale was  $11.69 \pm 4.1$  in male patients and  $13.05 \pm 4.45$  in female ( $p = 0.454$ ) (Table 2).

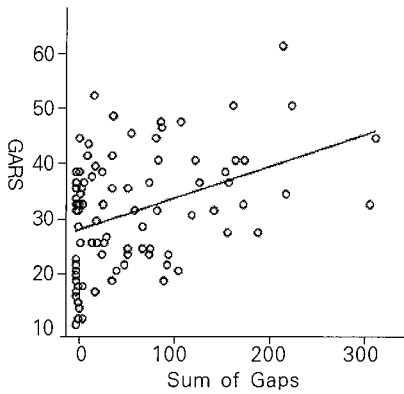
As in the research of Kim et al.<sup>16)</sup>, when the subjects were divided into two groups, one with mean RS above  $40 \mu A$  and below  $40 \mu A$ , GARS

**Table 2.** Change of Mean RS, Sum of Gaps, SD of RS, GARS Scale and BEPSI Scale Associated with Sex

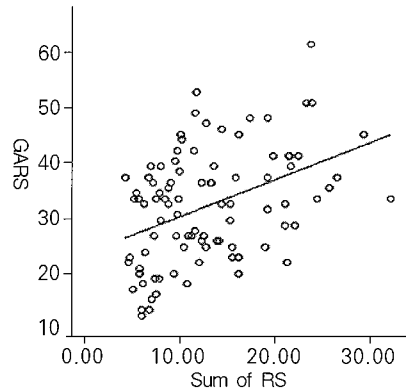
Sex	N	Mean RS	Sum of Gaps	SD of RS	GARS	BEPSI
M	32	$51.56 \pm 12.71$	$60.78 \pm 66.06$	$13.76 \pm 6.51$	$31.00 \pm 10.21$	$11.69 \pm 4.10$
F	60	$42.60 \pm 12.95$	$58.43 \pm 74.95$	$12.61 \pm 6.40$	$31.97 \pm 10.84$	$13.05 \pm 4.45$
P value		0.002 <sup>1)</sup>	0.841	0.416	0.608	0.454

<sup>1)</sup>  $p < 0.050$ ; by Student's t-test

a) mean  $\pm$  S.D. RS : Ryodoraku score. SD : standard deviation.



**Fig 1.** The correlation between GARS and sum of gaps, and its regression.  
 $Y=0.06X+28.22$ ,  $R^2=0.15$ ,  $p=0.000$



**Fig 2.** The correlation between GARS and SD of RS, and its regression.  
 $Y=0.69X+22.67$ ,  $R^2=0.17$ ,  $p=0.000$

scale was  $31.35 \pm 10.37$  vs.  $32.30 \pm 11.25$  ( $p=0.477$ ) and BEPSI scale  $12.46 \pm 4.28$  vs.  $12.85 \pm 4.63$  ( $p=0.755$ ), showing no significant difference between the two groups in both scales (Table 3).

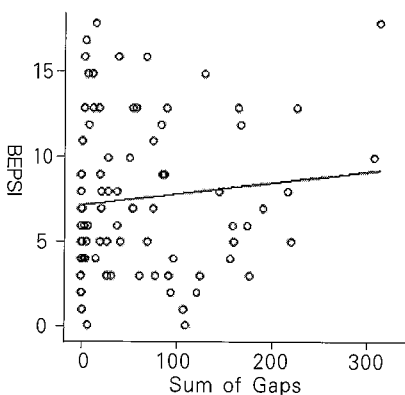
**Table 3.** GARS and BEPSI Scores of Above and Below  $40 \mu A$  of Mean RS

Group	GARS	BEPSI
$\geq 40 \mu A$ of Mean RS	$31.35 \pm 10.37$	$12.46 \pm 4.28$
$< 40 \mu A$ of Mean RS	$32.30 \pm 11.25$	$12.85 \pm 4.63$
p value	$p=0.477$	$p=0.755$

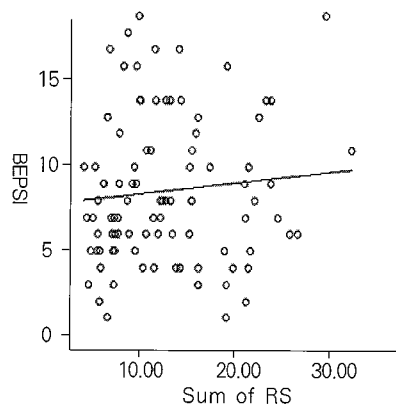
2. Sum of gaps of the Ryodoraku points, standard deviation and stress scale

Sum of gaps (correlation coefficient  $r=0.390$ ,  $p=0.000$ ) and standard deviation ( $r=0.418$ ,  $p=0.000$ ) showed significant correlation with GARS scale (Fig. 1, 2) but not with BEPSI scale (sum of gaps  $r=0.109$ ,  $p=0.303$ ; standard deviation  $r=0.097$ ,  $p=0.356$ ) (Fig 3, 4).

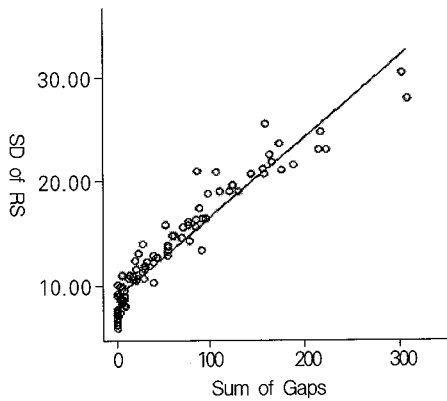
In addition, sum of gaps showed a strong correlation with standard deviation ( $r=0.954$ ,  $Y=7.94+0.09X$ ,  $R^2=0.91$  ( $X$ =sum of gaps,  $Y$ =



**Fig 3.** No correlation between BEPSI and sum of gaps, and its regression.  
 $Y=7.18+0.01X$ ,  $R^2=0.01$ ,  $p=0.303$



**Fig 4.** No correlation between BEPSI and SD of RS, and its regression.  
 $Y=+6.72+0.07X$ ,  $R^2=0.01$ ,  $p=0.356$



**Fig 5.** The correlation between sum of gaps and SD of RS.  
 $Y=7.94+0.09X$ ,  $R^2=0.91$ ,  $p=0.000$

standard deviation)  $p=0.000$ ) (Fig 5).

## Discussion

In this study, we examined if *Ryodoraku*, which reflects functional dyspepsia patients' body surface sympathetic nerve activity, can assess the patients' stress quantitatively.

According to Rome Criteria II, functional dyspepsia is diagnosed when there are epigastric pain, postcibal satiety, early satiety, anorexia, retching, abdominal distention, vomiting, nausea, belching, weight loss, etc. without any specific organic lesion in the stomach and secondary cause<sup>23)</sup>.

Stress, which is a neuropsychiatric factor, is drawing attention as a cause of functional dyspepsia. According to previous research, sudden excessive stress has been known to affect gastrointestinal functions and particularly cause epigastric symptoms by influencing the autonomic nervous system<sup>24,25)</sup>. In actuality, it was observed in experiments that when cats were irritated their vagus nerves were stimulated, which in turn increased the secretion of gastric acid, and when people were exposed to

rotational stimuli their gastrointestinal functions dropped by the secretion of sympathetic nerve hormone<sup>9)</sup>. Thus, most medical scientists admit that acute stress affects gastrointestinal functions. However, it is still controversial whether chronic stress also affects gastrointestinal functions and causes relevant symptoms and whether chronic epigastric symptoms can be explained with the mechanism of gastrointestinal changes by acute stress<sup>26,27,28)</sup>.

Thus, this study assessed acute stress with GARS scale and chronic stress with BEPSI scale, and conducted *Ryodoraku* in order to evaluate the effect of stress on the autonomic nervous system. GARS scale is known to be indicative of a week's acute stress<sup>21)</sup> and BEPSI of a month's chronic stress<sup>22)</sup>, and the validity of both has already been proved<sup>21,22,29)</sup>. In the results of our research, no difference was observed in either scale between men and women. This suggests that there is no significant difference in acute-chronic stress between men and women functional dyspepsia patients. Among reports on the difference of stress between men and women, some said that difference between men and women is observed depending on the type of stress such as stress from employment and public speaking<sup>30,31)</sup> but none of them mentioned sensitivity to general stress and few reports compared the stress of men and women using GARS and BEPSI. In our results, the patients' mean GARS scale was  $31.63 \pm 10.58$  and their mean BEPSI scale was  $12.57 \pm 4.36$ . Although we did not set up a normal control group, compared with the control groups of other studies<sup>32,33,34)</sup>, our results suggest that functional dyspepsia patients feel more stress than ordinary people.

*Ryodoraku* is a biological function test reported

by Nakatani, and one of methods for measuring EDR (electrodermal response). It is generally admitted that EDR is closely related to the activity of sweat glands under the control of sympathetic nerves<sup>35)</sup>, and is considered more practical than catecholamine as an indicator for the activity of body surface sympathetic nerves<sup>18)</sup>. With *Ryodoraku*, the condition of physical strength is assessed using the level of mean current, which may change according to time, season, environment and age as well as physiological activities such as eating, defecation and emotional change<sup>35)</sup>. However, according to Nakatani's definition 40 $\mu$ A is the lowest permissible limit of mean current regarded as healthy, regardless of gender and season<sup>14)</sup>, and Kim et al.<sup>16</sup> proved the qualitative significance of correlation with fatigue based on mean current of 40 $\mu$ A in skin resistance. Weng et al. also reported that the lower obese patients' BMI is, the higher is the mean value of *Ryodoraku* score<sup>17)</sup>.

In this study, the mean current of *Ryodoraku* was significantly higher in men than in women, a result consistent with Kim's research<sup>16)</sup>. When the patients were divided into two groups based on mean current of 40 $\mu$ A and GARS and BEPSI were compared between two groups, no difference was observed. When this result is considered in connection with the results of Kim's research<sup>16)</sup>, it suggests that fatigue is not correlated with stress.

Nakatani defined the 14mm wide range, 7mm above and below the mean of *Ryodoraku* points, as the physiological range, and said that when the *Ryodoraku* points are within the range the body is in a healthy state<sup>36)</sup>. Sancier reported that the standard deviation of *Ryodoraku* points decreased after Qigong therapy. Because a small standard deviation means that *Ryodoraku* points

are distributed closely to the mean, it also means high probability that the points would be within the physiological range. Thus, he considered the decrease of standard deviation as the improvement of Qi balance<sup>14)</sup>.

The actual physiological range of *Ryodoraku* points is widened with the overall increase of current, but by modifying the vertical axis of the record sheet, which indicated current, we widened the divisions of the low current zone so that the width of the physiological range became constant at 14mm. The record sheet used in our research had lines at 7mm above and below the mean RS, indicating the physiological range, so gaps with the physiological range can be obtained by measuring the part beyond the lines. However, when the patients were measured, many recorded current data were different from the position of points marked on the record sheet (the position of the mean value was accurate). Thus, using a rule, we measured 7mm above and below the mean and calculated the value corresponding to the width of 14mm (Table 1). Then, points distributing out of the range were selected, the gaps were calculated, and their absolute values were summed up. Because a large gap means a high degree of scattering, we calculated standard deviation as well. Because the correlation coefficient of the two elements (sum of gaps and standard deviation) is 0.954, they can be used interchangeably.

Our research derived the result that, regardless of the physiological range, if the sum of gaps is large (or the standard deviation is large), that is, if *Ryodoraku* points are distributed widely above and below the mean RS, the patient's acute stress is high. Therefore, Nakatani's physiological range appears to explain that the activity of body surface sympathetic nerves is in a stable state and

that *Ryodoraku* points out of the physiological range are not subjective excess and deficiency.

What is more, this research could not find correlation between the standard deviation of *Ryodoraku* points and chronic stress. This may be considered to support indirectly the previous report that acute stress has a stronger effect on functional gastrointestinal diseases than chronic stress<sup>37,38</sup>.

In order to set the range of abnormal stress in functional dyspepsia patients, we need to undertake research with a larger sample related to *Ryodoraku* and stress as well as with a normal control group. However, because people cannot be free from all stress in life, further consideration is necessary on how to select the control group.

### Conclusions

When *Ryodoraku* was applied to functional dyspepsia patients, acute (around a week) stress was high when the deviation of *Ryodoraku* point data was large based on the mean of *Ryodoraku* Scores, but chronic stress did not show any significant correlation. Accordingly, the standard deviation of *Ryodoraku*, an Oriental medical test, is considered applicable as a tool for assessing functional dyspepsia patients' acute stress.

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