**Clinical Study** 

# Instant effect of moxibustion at different points on electrogastrogram of patients with functional dyspepsia

# 艾灸不同穴位对功能性消化不良患者胃电指数的即刻影响

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# Abstract

**Objective:** To observe different effects of moxibustion at Zusanli (ST 36) and Yanglingquan (GB 34) on electrogastrogram (EGG) of patients with functional dyspepsia (FD).

**Methods:** A total of 65 cases were randomized into a Zusanli (ST 36) group (n=33) and a Yanglingquan (GB 34) group (n=32) by random serial number, to receive moxibustion therapy to the corresponding point respectively. The 8-lead EGG was used before and after treatment to collect EGG parameter of the gastric body, antrum of stomach, lesser curvature and greater curvature, including the dominant frequency, slow wave percentage, average frequency, response area and motility index.

**Results:** After treatment, the dominant frequency and slow wave percentage were improved in nearly the whole stomach area in Zusanli (ST 36) group, showing statistical significances (both P<0.05); the slow wave percentage and average frequency were improved in stomach body and antrum of stomach in Yanglingquan (GB 34) group, showing statistical significances (both P<0.05); moxibustion at Zusanli (ST 36) had a significantly higher influence on EGG than Yanglingquan (GB 34), in which the lifting of slow wave percentage was significantly higher than Yanglingquan (GB 34) group (P<0.05).

**Conclusion:** Moxibustion at Zusanli (ST 36) and Yanglingquan (GB 34) has the effect of adjusting abnormal EGG pattern in FD patients. Compared with Yanglingquan (GB 34), Zusanli (ST 36) has a superior effect in improving EGG in stomach area.

**Keywords:** Moxibustion Therapy; Moxa Stick Moxibustion; Dyspepsia; Point, Zusanli (ST 36); Point, Yanglingquan (GB 34); Electrogastrogram

【摘要】目的:观察艾灸足三里、阳陵泉对功能性消化不良(FD)患者胃电指数影响的异同。方法:将65例FD患者 根据随机序列号随机分为足三里组(n=33)和阳陵泉组(n=32),分别予以艾灸足三里和阳陵泉治疗。治疗前后应 用八导智能胃肠电图仪,采集艾灸前后胃体、胃窦、胃小弯和胃大弯四个区域的胃电指数,观察主频、慢波频率 百分比、平均频率、反应面积和运动指数的变化。结果:治疗后,足三里组几乎整个胃部的主频、慢波频率百分 比与本组治疗前均有统计学差异(均P<0.05);阳陵泉组胃体、胃窦部的慢波频率百分比及平均频率与本组治疗前 亦有统计学差异(均P<0.05);艾灸足三里对整体胃电指数的影响较阳陵泉明显,其中慢波频率百分比较阳陵泉组 明显上升(P<0.05)。结论:艾灸足三里和阳陵泉均可调节FD患者的异常胃肌电节律,与阳陵泉比较,足三里对整 个胃区胃电指数的影响更明显。

【关键词】灸法; 艾条灸; 消化不良; 穴, 足三里; 穴, 阳陵泉; 胃电图 【中图分类号】R245.8 【文献标志码】A

Functional dyspepsia (FD), also known as nonulcerative dyspepsia, is a common disease in certain departments and accounts for 2%-5% of the first-visit patients. It has an incidence rate of 20%-40% in Western countries<sup>[1-3]</sup>. The main symptoms in FD patients include frequent abnormal gastric emptying, retention, anorexia, acid reflux, belching, pain behind sternum or upper abdominal region and vomiting<sup>[4]</sup>, which will lay a heavy burden on patients' daily life. The pathogenesis of FD remains unclear. Related study has shown that FD is manifested by delayed gastric emptying process, and low gastric motility after meal. Acupuncture can improve gastric movement, and electrogastrogram (EGG) can be used to evaluate gastric myoelectric activity in FD patients before and after acupuncture treatment<sup>[2]</sup>. To observe different instant effects of gastric myoelectric activity in FD patients when applying moxibustion to Zusanli (ST 36) and Yanglingquan (GB 34), we used EGG to record gastric myoelectric activity before and after moxibustion treatment.

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# **1** Clinical Materials

# 1.1 Diagnostic criteria

FD was diagnosed according to Rome III diagnostic criteria<sup>[5]</sup>. Must include at least 1 of the following symptoms: upper abdominal pain, burning sensation in upper abdominal region; bothersome postprandial fullness; an early satiation without any organic problems.

The onset  $\geq$ 6 months prior to diagnosis, and the duration of symptoms  $\geq$ 3 months.

# 1.2 Inclusion criteria

Conforming to the above diagnostic criteria; age between 18 and 70 years old; no obvious abnormities in electrocardiogram (EKG) and blood pressure; negative fecal occult blood test (FOBT); informed consent.

# 1.3 Exclusion criteria

Intolerance to heat of moxibustion; intake of medicine which may affect therapeutic effect evaluation; with peptic ulcer or gastric cancer; with a history of abdominal operation, endocrine disease, climacteric syndrome or other fatal diseases; with mental diseases; pregnant; poor compliance.

# 1.4 Statistical methods

All data were processed by using SPSS 19.0 version software. The general data were analyzed by descriptive statistical method. The measurement data with normal distribution were expressed by mean  $\pm$  standard deviation ( $\bar{x} \pm s$ ), two independent-sample *t*-test was used for inter-group comparison, and paired-sample *t*-test was used for intra-group comparison; the measurement data with non-normal distribution were described by median (min, max), and Wilcoxon rank sum test was for inter-group comparison, and Wilcoxon signed-rank test was for intra-group comparison. The enumeration data were analyzed by Chi-square test. A *P*-value less than 0.05 indicated a statistical significance.

### 1.5 General data

A total of 65 volunteers were included by advertisement in Guangdong Provincial Hospital of Traditional Chinese Medicine. Members in acupuncture research group were in charge of screening. Volunteers were screened by inclusion and exclusion criteria. The random numbers generated by the SPSS 19.0 version software were packed into an opaque envelope and patients were randomized into a Zusanli (ST 36) group (n=33) and a Yanglingquan (GB 34) group (n=32).

# 2 Treatment Methods

#### 2.1 Preparation before test

For patients included in our study, medication for digestive disorder should stop for 5 d before participating in our test. Patients were informed to keep a good mental state, take a regular life style and avoid greasy or stimulating food before test. Volunteers were told to keep an empty stomach and take a relaxing supine position during test. All electronic device like mobile phone or blue tooth headset should be turned off. The locations of Zusanli (ST 36) and Yanglingquan (GB 34) were based on *Nomenclature and Location of Acupuncture Points* (GB/T12346-2006)<sup>[6]</sup> and marked with a dot on bilateral sides.

Before test, the electrodes of EGG were fixed and recorded for 10 min to guarantee a stable baseline. To be more detailed: after sterilized with 75% alcohol, electrodes smeared with conductive paste were placed at gastric antrum (middle of right papilla and umbilicus), gastric body (middle of right papilla and umbilicus), lesser curvature (upper 1/4 of xiphoid and umbilicus) and greater curvature (middle of xiphoid and umbilicus). Adjusted the relative position according to height and weight of each volunteer. Gastric myoelectric activity was recorded 10 min before moxibustion and at the end of moxibustion.

# 2.2 Moxibustion

Points: Bilateral Zusanli (ST 36) and Yanglingquan (GB 34).

Methods: A moxa stick of 18 mm in diameter and 10 cm in length was used for suspended moxibustion manipulation. A moxibustion shelf (22 cm in width, 17 cm in height) was used to fix the moxa bar. Adjusted the height of the shelf to make patients feel warm without pain (Figure 1). Moxibustion was done on bilateral sides at the same time, and ash was removed every 5-7 min, 15 min each time.



Figure 1. Moxibustion at Zusanli (ST 36)

#### 2.3 Observation items

The EGG-8D8B EGG was used for testing items  $\mathsf{below}^{[7\text{-}8]}.$ 

Dominant frequency (DF): Reflects the main harmonic frequency (slow wave frequency) in EGG.

Average frequency (AF): An indicator reflects the speed of gastric myoelectric rhythm.

Reaction area (RA): An indicator reflects the scope of stomach smooth muscle movement.

Percentage of normal slow wave (PNSW): The normal data range from 2.4 cpm to 3.7 cpm, PNSW  $\geq$  65%

indicating normal gastric myoelectric rhythm, otherwise meaning abnormity.

Motility index (MI): Reflects the relaxation and contraction of stomach smooth muscle.

# 2.4 Safety evaluation

Safety evaluation was done before treatment in case of adverse events (AEs), which may include burning, scald, palpitation or faint, etc. All AEs were recorded in a report form. 6 grades were used for evaluating correlations between moxibustion and AEs: 1=clear, 2=very possible, 3=possible, 4=may not correlated, 5=absolutely not, 6=unknown. For any AEs during treatment, we will conduct investigation and follow-up visit afterwards.

# **3** Results

#### 3.1 Base-line comparison

There were two dropout cases during experiment, 1 in each group, due to the severe cough during EGG measurement. Finally, 63 cases were included (Figure 2). There were no significant between-group differences in

Table	1.	Compa	arison	of the	baseline	data	between	the tv	vo groups

Table 1. Comparison of the baseline data between the two groups										
Cassia		Gender (case)		Age	Disease duration					
	n	Male	Female	[Median (min, max), year]	[Median (min, max), year]					
Zusanli (ST 36)	32	15	17	58.5 (24, 70)	4 (1, 16)					
Yanglingquan (GB 34)	31	16	15	56.5 (22, 67)	3.5 (1, 15)					
Statistical value		0.000 <sup>1)</sup>		$-0.481^{2)}$	$-0.563^{2)}$					
P-value		1.000		0.525	0.466					

Note: 1)  $\chi^2$ -value; 2) Z-value

# 3.2 Zusanli (ST 36) group

Moxibustion at Zusanli (ST 36) can affect EGG indexes on the whole stomach (stomach body, greater curvature and gastric antrum). The DF, PNSW and MI were all significantly changed after moxibustion (All *P*<0.05), (Table 2).

#### 3.3 Yanglingquan (GB 34) group

After moxibustion, EGG indexes on stomach body and gastric antrum in FD patients changed, showing statistical significances, including AF and PNSW (All *P*<0.05), (Table 3).

Table 2. Intra-group comparison of Zusan	ıli (ST	36) group	( X ±s)
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Area	Time	DF (cpm)	AF (cpm)	$RA(\mu V.S)$	PNSW (%)	MI
Castria ha da	Before treatment	2.23±0.29	2.37±0.60	948.79±441.41	49.77±4.20	1370.24±1004.73
Gastric body	After treatment	$3.23{\pm}0.24^{1)}$	2.81±0.62	$998.70{\pm}508.58$	$60.81{\pm}4.08^{1)}$	1552.97±1253.83 <sup>1)</sup>
	Before treatment	2.05±0.31	2.27±0.53	1077.21±573.08	52.68±4.50	1349.18±1104.75
Greater curvature	After treatment	$2.99 \pm 0.23^{1)}$	2.75±0.68	1123.88±506.16	$65.43 \pm 4.27^{1)}$	1392.52±1031.65
Lagger ourseture	Before treatment	2.33±0.22	2.39±0.59	901.26±554.78	53.31±4.18	1290.06±1054.11
Lesser curvature	After treatment	2.56±0.32	2.51±0.55	890.64±529.15	58.09±3.77	1380.61±1210.37
Castria antonio	Before treatment	2.27±0.33	2.49±0.67	989.47±494.82	53.76±2.50	1257.03±1003.09
Gastric antrum	After treatment	$3.18{\pm}0.29^{1)}$	2.92±0.58	1096.70±445.69	$65.46{\pm}2.96^{1)}$	$1391.82 \pm 902.68^{1)}$

Note: Intra-group comparison, 1) P<0.05

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age, gender and duration (all P > 0.05), indicating that

the two groups were comparable (Table 1).

Figure 2. The flow chart

Area	Time	DF (cpm)	AF (cpm)	RA (µV.S)	PNSW (%)	MI			
	Before treatment	2.35±0.24	2.35±0.44	918.49±509.58	50.51±4.36	1005.06±967.18			
Gastric body	After treatment	2.71±0.22	$3.15{\pm}0.61^{1)}$	$998.82{\pm}628.69$	$59.29{\pm}3.87^{1)}$	1096.53±914.80			
	Before treatment	2.42±0.23	2.38±0.41	1008.81±483.62	54.93±3.73	1021.36±979.54			
Greater curvature	After treatment	2.63±0.25	2.64±0.63	$1030.91 \pm 575.71$	58.94±3.63	1102.35±969.92			
T	Before treatment	2.38±0.26	2.42±0.63	930.53±455.77	55.89±3.82	1246.62±967.21			
Lesser curvature	After treatment	2.56±0.49	2.62±0.61	$963.04{\pm}529.67$	60.11±3.71	1302.64±975.81			
	Before treatment	2.41±0.27	2.29±0.48	951.47±430.06	56.03±2.75	1141.42±942.04			
Gastric antrum	After treatment	2.86±0.26	$2.91{\pm}0.52^{1)}$	970.91±566.35	$65.92{\pm}4.22^{1)}$	1237.31±981.09			

Table 3. Intra-group comparison of Yanglingquan (GB 34) group ( $\overline{x} \pm s$ )

Note: Intra-group comparison, 1) P<0.05

# 3.4 Between-group comparison

The MI change in Zusanli (ST 36) group in partial region of the stomach was significantly higher than that in Yanglingquan (GB 34) group. Changes of DF and PNSW in stomach body and PNSW in greater curvature

and gastric antrum in Zusanli (ST 36) group were significantly higher than those in Yanglingquan (GB 34) group (All P < 0.05), indicating that moxibustion at Zusanli (ST 36) has specific adjusting effect on gastric electric rhythm in FD patients (Table 4).

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Group	Area	DF (cpm)	AF (cpm)	RA (µV.S)	PNSW (%)	MI
	Gastric body	$0.90{\pm}1.08^{1)}$	0.39±0.53	50.24±6.69	$12.42{\pm}1.86^{1)}$	103.94±23.21
Zusanli	Greater curvature	$0.84{\pm}0.91$	$0.41 \pm 0.56$	80.14±2.62	$11.65 \pm 2.86^{1)}$	100.94±16.05
(ST 36)	Lesser curvature	$0.23 \pm 0.93$	$0.36 \pm 0.27$	82.47±4.91	6.76±1.90	85.09±19.32
	Gastric antrum	0.85±0.19	$0.42 \pm 0.54$	78.26±3.32	11.46±2.12 <sup>1)</sup>	86.09±35.49
	Gastric body	0.34±0.49	0.60±0.18	56.24±8.23	6.65±4.81	67.87±26.52
Yanglingquan	Greater curvature	$0.33 \pm 0.43$	$0.38 \pm 0.46$	70.97±2.59	5.17±3.08	148.53±39.80
(GB 34)	Lesser curvature	$0.29 \pm 0.40$	0.27±0.13	$61.01 \pm 1.90$	6.72±2.82	$108.84 \pm 21.00$
	Gastric antrum	$0.29 \pm 0.45$	$0.55 \pm 0.22$	39.64±2.30	8.03±2.06	99.51±34.06

Note: Compared with the Yanglingquan (GB 34) group, 1) P<0.05

# 4 Discussion

FD is a common disease closely associated with genetic predisposition, gastrointestinal dysfunction, Helicobacter pylori infection, visceral paresthesia and mental disorders<sup>[9-11]</sup>, but current mechanisms cannot expain all diversified symptoms. Abnormal gastric electric rhythm is the main factor in FD in gastric rhythm research. Interstitial cells of Cajal (ICC) is the main site generating normal gastric electric slow wave<sup>[12]</sup>, and impairment of this site will cause abnormal origination and conduction of slow wave<sup>[13]</sup>. As an objective indicator describing gastric biological electric activities, EGG can record electric changes by placing an electrode on the surface of skin, taken as a non-traumatic test to judge gastric motility disorders<sup>[14-15]</sup>. Research has shown that FD is characterized by delayed gastric emptying process and low gastric motility after meal and EGG can be used for evaluating the influence of acupuncture or medicine on gastric electric parameters<sup>[2,16]</sup>. FD patients in this study showed a PNSW less than 65%, similar to the findings in others' research<sup>[17]</sup>. Therefore, using EGG to study the role of moxibustion in adjusting gastrointestinal electrical activity in FD patients has a theoretical significance.

There is no term defining FD in traditional Chinese medicine (TCM). According to its clinical characteristics and main symptoms, it belongs to stuffiness and fullness, stomachache. Qi stagnation and spleen deficiency is the most important pathogenesis. Stomach is the main location and it's also connected with the liver and spleen<sup>[8]</sup>. In clinical practice, pattern differentiation is used for selecting the appropriate acupoints and treatment, in which Zusanli (ST 36) is used most frequently. Zusanli (ST 36) is the He-Sea point of Stomach Meridian and has the function of adjusting middle jiao, regulating spleen-stomach and directing gi downward to relieve hiccup. Liu WQ, et al<sup>[18]</sup> observed an elevation of frequency and amplitude on EGG in FD patients after meal by acupuncture at Zusanli (ST 36), (P < 0.05). Chang CS, et  $al^{[19]}$  used electroacupuncture to stimulate Zusanli (ST 36) on bilateral sides, and found an improvement of normal gastric frequency percentage in FD patients. Besides, animal experiment showed that stimulating Zusanli (ST 36) with acupuncture can accelerate gastric emptying and adjust secretion of gastric acid and other related hormones<sup>[20-21]</sup>. All above researches have shown that the effectiveness of acupuncture and moxibustion in treating FD is related to the specificity of Zusanli (ST 36). Therefore, Zusanli (ST 36) and Yanglingquan (GB 34) are always combined in clinical practice, which may be also linked with their special point identity. As the He-Sea point of the Gallbadder Meridian and the lower He-Sea point of gallbladder, Yanglingquan (GB 34) has the function of treating bowel disorders and commonly used for gastrointestinal diseases. Previous study showed that by acupuncture or point injection at Zusanli (ST 36) and Yanglingguan (GB 34), clinical symptoms were alleviated and the recovery and effective rate were obviously improved<sup>[22-23]</sup>. While as a special point, the mechanism of Yanglingquan (GB 34) in treating FD remains unclear. Although close to each other in location, these two points belong to different meridians, the Gallbladder Meridian runs on the side of body and doesn't have direct connection with the stomach. Its special effect in treating digestive problems still requires further investigation. Our previous studies have revealed that heat stimulation to Yanglingquan (GB 34) can affect gastric electric activity in healthy people<sup>[24]</sup>, which corresponds to this study. We speculated that this remote regulation function may not relate to course of the meridian, with the help of thermal imaging, we found that moxibustion at Hegu (LI 4) and Zusanli (ST 36) can generate certain response in facial area, but without meridian transmission<sup>[25-26]</sup>. Therefore, compared with Zusanli (ST 36). Yanglingquan (GB 34) may work by stimulating the same afferent passway as Zusanli (ST 36), and affect central nerve system, finally by adjusting sympathetic and parasympathetic nerve through constant temperature receptor to change gastric electric rhythm.

Above all, by observing gastric electric activity before and after moxibustion at Zusanli (ST 36) and Yanglingquan (GB 34), we found that moxibustion at Yanglingquan (GB 34) can also influence normal slow wave rhythm in gastric electric activity. The transmission and integration in nerve system after stimulation may be circulation and metabolism changes in nature<sup>[25]</sup>. Therefore, this study proved that moxibustion at Zusanli (ST 36) and Yanglingquan (GB 34) can influence gastrointestinal motility in FD patients, and provide scientific evidence for moxibustion therapy, while the special effect of acupoint still requires further investigation.

### **Conflict of Interest**

The authors declared that there was no potential conflict of interest in this article.

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#### Statement of Informed Consent

Informed consent was obtained from all individual participants included in this study.

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