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Original Article

A Clinical Study on the Diagnosis and Observation of Functional Dyspepsia - Focused on Algometer

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Objectives: This study aimed to determine whether comparing the pressure pain threshold (PPT) with an algometer before and after treatment for functional dyspepsia is of diagnostic value and investigate a possible correlation between PPT measured using an algometer and symptom improvement before and after treatment.
Methods: A total of 99 patients with functional dyspepsia symptoms admitted to the OO Korean Medical Hospital from April 14, 2020 to January 21, 2021 were investigated. On the 1st and 14th days of hospitalization, the pressure of the first pain complaint at acupuncture points Juque (巨厥, CV14), Shangwan (上脘, CV13), Zhongwan (中脘, CV12), Xiawan (下脘, CV10), Guanuan (關元, CV4), Tianshu (天樞, ST25), and Daju (大巨, ST27) was measured using the algometer, and the visual analog scale (VAS) scores for patient's symptoms were evaluated. The algometer PPT and patient-symptom VAS scores were compared by repeated measures corresponding to the sample t-test to analyze the changes after treatment. A correlation analysis was performed to identify the correlation between patient-symptom VAS scores and algometer PPT.
Results: The PPT measured using the algometer significantly increased after treatment in the 99 patients. The patient-symptom VAS score decreased significantly in most cases as treatment progressed. Analysis of the correlation between algometer PPT and patient-symptom VAS scores revealed some notable negative correlations.
Conclusion: The algometer can help to set the diagnostic and treatment baselines for patients with functional dyspepsia.

Key Words : abdomen, pain measurement, pain threshold, visual analog pain scale, dyspepsia, algometer

Introduction

Functional dyspepsia includes several chronic and recurrent upper gastrointestinal symptoms, such as epigastric pain, epigastric bloating, early satiation, and fullness, and can be diagnosed in the absence of significant organic reasons for the symptoms[1].

In Oriental medicine, one of the most critical diagnostic methods for functional dyspepsia symptoms, such as epigastric distention (心下痞硬), is measuring the pressure pain threshold (PPT) with an algometer[2-4].

However, studies of abdominal examination

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that include PPT measurements obtained with an algometer, particularly PPT values and symptom improvement before and after treatment, are lacking. Studies assessing the PPT measured with an algometer and symptom improvement after the selection of acupuncture points found that PPT measurements can be important diagnostic markers related to the associated symptoms and prognosis of functional dyspepsia and can help to determine patient prognosis.

The purpose of this study was to determine whether the comparison of the PPT measured using an algometer before and after treatment can predict the diagnosis and progression of functional dyspepsia. The correlation between PPT measured with an algometer and symptom improvement before and after treatment was also analyzed.

Methods

1. Participants

Among the patients admitted to OO Korean Medical Hospital between April 14, 2020 and January 21, 2021, we selected patients with functional dyspepsiawho experienced varying symptoms in the epigastrium, such as epigastric bloating, early satiation, epigastric heartburn or pain, nausea, and belching for more than six months without any organic findings. Their average period of illness was 72.64±94.32 months, ranging from at least 3 months to at least 360 months (30 years). In addition, during the hospitalization period, acupuncture and herbal medicine treatments, and complex oriental medicine treatments that depends on the symptoms. Patients who refused to respond to the questionnaire or missed any of the items were excluded from the survey. This study was approved by the Institutional Review Board of OO Korean Medical Hospital (IRB No.: OO00003-21-CR-001), and oral consent was provided by all patients before treatment for the usage of their data in this retrospective study.

2. Methods for measurement

1) PPT measurement using an algometer

An algometer is an instrument in which a numerical value corresponding to force rises as the pressure on the measuring site is increased. For accurate pressure intensity measurements, an electronic algometer (FPX 25; Wagner Instruments, Greenwich, CT, USA) was used. On the 1st and 14th days of hospitalization (after breakfast, before treatment), a Korean medical doctor placed the algometer vertically on the selected abdominal location and then gradually applied pressure at a constant rate (1 kg/s) to measure the pressure of the first pain complaint point (kg/cm^2) twice at 1-min intervals. The selected abdominal locations were acupuncture points *Juque* (巨厥, CV14), *Shangwan* (上脘, CV13), *Zhongwan* (中脘, CV12), *Xiawan* (下脘, CV10), *Guanuan* (關元, CV4), right-side *Tianshu* (天樞, ST25), left-side *Tianshu* (天樞, ST25), right-side *Daju* (大巨, ST27), and left-side *Daju* (大巨, ST27). Among each acupuncture points, especially *Zhongwan* (中脘, CV12), *Guanuan* (關元, CV4), and *Tianshu* (天樞, ST25), which are the abdominal Front Point(募穴) of the stomach, small intestine, and large intestine, were selected, and the rest of acupuncture points were mainly those complaining of abdominal tenderness in clinical practice.

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2) VAS measurement of patient symptoms

On the 1st and 14th days of hospitalization, participants were asked to record changes in the visual analog scale (VAS) for the 11 categories of symptoms, including gastrointestinal and associated clinical symptoms, such as epigastric discomfort, bloating, belching, reflux; chest discomfort; breathing difficulty; heart palpitations; irritated or sore throat; back pain; headache; and dizziness.

3. Research instruments

The research instruments used in this study are as follows:

1) Algometer: FPX 25; Wagner Instruments, Greenwich, CT, USA (Fig 1)
2) VAS scale: Korea Medical Information Cooperation, Korea, pain assessment scale.

Fig. 1. Algometer used in the study

4. Statistical analyses

Statistical significance was defined as $P < 0.05$. The data were processed and analyzed using SPSS software for Windows (Release 19.0K, IBM Corp., Armonk, NY, USA).

The PPT values measured with an algometer and the VAS scores for patient symptoms were analyzed for numerical changes following treatment using a paired sample t-test. The correlation between PPT measured using an algometer and the VAS score for patient symptoms was examined using a correlation analysis.

Results

1. Baseline characteristics of patients

The average age, height, weight, body mass index, and male-to-female ratio of the 99 patients with functional dyspepsia included in the study were 55.30±13.13 years, 161.95±7.80 cm, 55.06±14.31 kg, 21.72±3.28 km/m^2, and 1:2.7, respectively. A total of 65 patients were in the age group of 50-60 years and accounted for 66% of the participants (Table 1).

2. Analysis results of PPT measurement using the algometer

The paired sample t-test in the patient group showed that the PPT value (kg/cm^2) measured in *Juque* (巨厥, CV14) gradually and significantly increased from 3.46±1.36 kg/cm^2 on the 1st day

Table 1. Baseline characteristics of participants

Sex	N	Age (years)	Height (cm)	Weight (kg)	BMI(kg/m^2)
Male	27	51.96±12.11	169.7±4.91	61.65±3.81	22.19±1.81
Female	72	56.56±11.62	159.0±5.44	52.58±9.73	21.55±3.55

BMI, body mass index * $P < 0.05$, Mean ± SD PPT scores

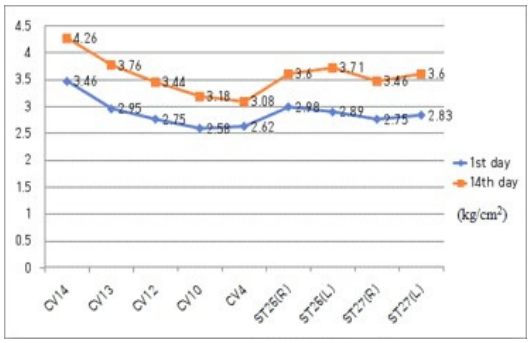

Fig. 2. Pressure pain threshold measurement using the algometer

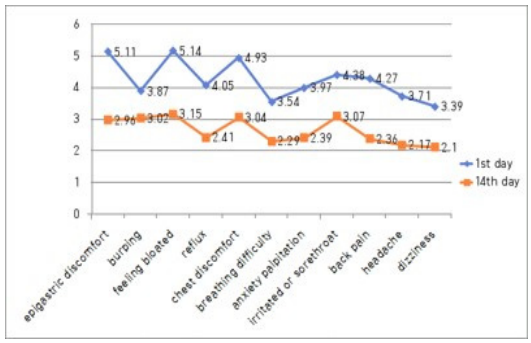

Fig. 3. Visual analog scale scores for patient symptoms

of hospitalization to 4.26±1.29 kg/cm^2 on the 14th day of hospitalization ($P < 0.05$). Similarly, the PPT values measured in *Shangwan* (上脘, CV13), *Zhongwan* (中脘, CV12), *Xiawan* (下脘, CV10), *Guanuan* (關元, CV4), right-side *Tianshu* (天樞, ST25), left-hand *Tianshu* (天樞, ST25), right-side *Daju* (大巨, ST27), and left-side *Daju* (大巨, ST27) increased gradually and significantly ($P < 0.05$) (Table 2, Fig 2).

3. Results of VAS measurement for patient symptoms

The results of the paired sample t-test showed that the VAS scores for symptoms significantly decreased from the days 1 to 14 in all 11 categories, including epigastric discomfort, bloating, belching, reflux, chest discomfort, breathing difficulty, palpitations, irritated or sore throat, back pain, headache, and dizziness (Table 3, Fig 3).

4. Correlation analysis of the PPT measured using the algometer and VAS score for patient symptoms

Analysis of the correlation between the PPT measured using the algometer and VAS for patient symptoms showed a significant negative correlation. In particular, on the 1st day of hospitalization, the PPT at *Juque* (巨厥, CV14) showed a significant negative correlation with the VAS score for belching (-0.429) and palpitations (-0.401). Negative correlations with VAS scores for several symptoms were also seen in *Shangwan* (上脘, CV13), *Zhongwan* (中脘, CV12), *Xiawan*

Table 2. Pressure pain threshold measured using an algometer

	CV14*	CV13*	CV12*	CV10*	CV4*	ST25 (R)*	ST25 (L)*	ST27 (R)*	ST27 (L)*
1st Day	3.46±1.36	2.95±1.04	2.75±0.93	2.58±0.85	2.62±1.00	2.98±1.20	2.89±1.08	2.75±1.10	2.83±1.12
14th Day	4.26±1.29	3.76±1.30	3.44±1.16	3.18±0.95	3.08±0.96	3.60±1.21	3.71±1.31	3.46±1.24	3.60±1.24

CV14, *Juque* (巨厥); CV13, *Shangwan* (上脘); CV12, *Zhongwan* (中脘); CV10, *Xiawan* (下脘); CV4, *Guanuan* (關元); ST25 (R), right-side *Tianshu* (天樞); ST25 (L), left-side *Tianshu* (天樞); ST27 (R), right-side *Daju* (大巨), ST27 (L), left-side *Daju* (大巨).

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Table 3. Visual analog scale scores for patient symptoms

	Epigastric discomfort*	Burping*	Bloating*	Reflux*	Chest discomfort*	Breathing difficulty*	Palpitation*	Irritated or sore throat*	Back pain*	Headache*	Dizziness*
1st day	5.11±2.95	3.87±3.00	5.14±2.97	4.05±3.16	4.93±3.13	3.54±2.92	3.97±2.96	4.38±3.31	4.27±3.27	3.71±3.27	3.39±3.04
14th day	2.96±2.74	3.02±2.49	3.15±2.76	2.41±2.71	3.04±2.84	2.29±2.55	2.39±2.58	3.07±2.90	2.36±2.50	2.17±2.66	2.10±2.42

Table 4. Pearson correlation analysis between the algometer pressure pain threshold and symptom visual analog scale scores for patient symptoms on the 1st & 14th day

1st day / 14th day	Epigastric discomfort	Bloating	Burping	Reflux	Chest discomfort	Palpitation	Irritated or sore throat	Breathing difficulty	Back pain	Headache	Dizziness
CV14	-0.337**	-0.253*	-0.429**	-0.181	-0.258**	-0.401**	-0.142	-0.193	-0.138	-0.205*	-0.217*
	-0.165	-0.117	-0.185	-0.134	-0.162	-0.067	-0.025	-0.143	-0.182	-0.142	-0.109
CV13	-0.308**	-0.211*	-0.396**	-0.113	-0.261**	-0.373**	-0.068	-0.118	-0.111	-0.119	-0.213*
	-0.208*	-0.154	-0.153	-0.114	-0.225*	-0.205*	-0.056	-0.216*	-0.148	-0.161	-0.107
CV12	-0.292**	-0.215*	-0.347**	-0.140	-0.215*	-0.342**	-0.042	-0.112	-0.078	-0.081	-0.165
	-0.188	-0.130	-0.092	-0.057	-0.209*	-0.203*	-0.101	-0.173	-0.174	-0.120	-0.064
CV10	-0.330**	-0.198*	-0.347**	-0.142	-0.242*	-0.388**	-0.079	-0.150	-0.077	-0.170	-0.252*
	-0.144	-0.093	-0.057	-0.022	-0.118	-0.145	0.046	-0.135	-0.128	-0.164	-0.055
CV4	-0.280**	-0.209*	-0.292**	-0.126	-0.257*	-0.366**	-0.077	-0.155	-0.113	-0.175	-0.250*
	-0.253*	-0.212*	-0.161	-0.145	-0.175	-0.148	-0.011	-0.199*	-0.101	-0.097	-0.188
ST25 (R)	-0.285**	-0.180	-0.291**	-0.079	-0.282**	-0.308**	-0.047	-0.106	-0.095	-0.207*	-0.253*
	-0.201*	-0.207*	-0.163	-0.090	-0.197	-0.201*	-0.080	-0.198	-0.131	-0.013	-0.083
ST25 (L)	-0.371**	-0.289**	-0.381**	-0.194	-0.361**	-0.396**	-0.119	-0.230*	-0.158	-0.190	-0.376**
	-0.177	-0.204*	-0.168	-0.182	-0.186	-0.107	0.007	-0.269**	-0.169	-0.084	-0.098
ST27 (R)	-0.277**	-0.112	-0.222*	-0.051	-0.202*	-0.309**	-0.002	-0.074	-0.075	-0.189	-0.258**
	-0.264**	-0.235*	-0.186	-0.135	-0.255*	-0.239*	-0.147	-0.267**	-0.212*	-0.119	-0.168
ST27 (L)	-0.325**	-0.263**	-0.336**	-0.179	-0.348**	-0.362**	-0.145	-0.262**	-0.182	-0.258**	-0.418**
	-0.237*	-0.235*	-0.146	-0.132	-0.207*	-0.178	-0.060	-0.271**	-0.140	-0.062	-0.193

* P < 0.05 ** P < 0.01

CV14, *Juque* (巨厥); CV13, *Shangwan* (上脘); CV12, *Zhongwan* (中脘); CV10, *Xiawan* (下脘); CV4, *Guanuan* (關元); ST25 (R), right-side *Tianshu* (天樞); ST25 (L), left-side *Tianshu* (天樞); ST27 (R), right-side *Daju* (大巨), ST27 (L), left-side *Daju* (大巨).

(下脘, CV10), *Guanuan* (關元, CV4), right-side *Tianshu* (天樞, ST25), left-side *Tianshu* (天樞, ST25), right-side *Daju* (大巨, ST27), and left-side *Daju* (大巨, ST27) (Table 4).

Discussion

Increased PPT indirectly indicates a gradual reduction in the abdominal stiffness after treatment. The significant reduction in VAS scores for patient symptoms, such as epigastric discomfort, bloating, belching, reflux, chest discomfort, breathing difficulty, palpitations, irritated or sore throat, back pain, headache, and dizziness, indicated improvements in symptoms resulting from treatment and indirectly reflected diminished abdominal stiffness.

The PPT measured using the algometer showed a significant negative correlation with several VAS scores for patient symptoms, especially at *Juque* (巨厥, CV14), *Shangwan* (上脘, CV13), *Zhongwan* (中脘, CV12), *Xiawan* (下脘, CV10), *Guanuan* (關元, CV4), right-side *Tianshu* (天樞, ST25), left-side *Tianshu* (天樞, ST25), right-side *Daju* (大巨, ST27), and left-side *Daju* (大巨, ST27), on the 1st day of hospitalization. This can be seen as a result of treatment, indicating that there is some association between symptom improvement and relief of abdominal stiffness. In addition, efficacy of each acupuncture point, which mainly complains of abdominal tenderness, and *Zhongwan* (中脘, CV12), *Guanuan* (關元, CV4), and *Tianshu* (天樞, ST25), which are the abdominal Front Point(募穴) of the stomach, small intestine, and large intestine, is mainly related to gastrointestinal diseases, suggesting the possibility that each acupuncture point can be a diagnostic and treatment point for FD symptoms. The severity of functional dyspepsia symptoms and treatment progress can be objectified and quantified using an algometer. Furthermore, previous studies have shown that algometers are beneficial for assessing treatment status, as they can infer the change in PPT, which is related to improvement in symptoms with treatment progress. Moreover, its high sensitivity for diagnosis suggests that the algometer can be a critical tool for objective measurement of changes in symptoms of functional dyspepsia.

As this study was limited by its relatively small sample size and restriction to patients with functional dyspepsia, further studies that expand on other gastrointestinal diseases are required. As in this study, there are existing previous studies[2-4] to objectification of abdominal examination through PPT measurement, but additional analysis of the case for patients with worsening individual symptoms is needed. Further, although this study increased the objectivity of progression and prognosis of functional dyspepsia using an algometer, more research is needed to obtain and apply standard cutoff values. Cross-validation with more participants and additional objective examinations is necessary to verify the utility of our findings.

Conclusions

The present study found that the VAS scores for the symptoms of 99 patients with functional dyspepsia significantly decreased with treatment. The abdominal PPT measurements using the

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algometer significantly increased with treatment progression, which corresponds to the decrease in the patient symptoms and abdominal stiffness after treatment. Hence, the present findings suggest that when symptoms of functional dyspepsia improve, abdominal stiffness decreases. PPT values can be useful as an objective tool for the quantification of symptoms and treatment progress in the diagnosis and treatment of patients with functional dyspepsia.

References

1. Tack, J., Talley, N, J., Camilleri, M., Holtmann, G., Hu, P., Malagelada, JR., et al. (2006). Functional gastroduodenal disorders. Gastroenterology. 130(5),1466-1479. https://doi.org/10.1053/j.gastro.2005.11.059.
2. Park, Y,J., Park, J,S., Kim, M,Y., Park, Y,B. (2011). Development of a valid and reliable phlegm pattern questionnaire. J Altern Complement Med. 17(9),851-858. https://doi.org/10.1089/acm.2010.0504.
3. Ko, SJ., Kim, H., Kim, SK., Park, K., Lee, J., Lee, BJ., et al. (2016). Reliability and validity of modified algometer in abdominal examination. Evid Based Complement Alternat Med. 2016,3052954. https://doi.org/10.1155/2016/3052954.
4. Ko, SJ., Lee, H., Kim, SK., Kim, M., Kim, J., Lee, BJ., et al. Development of the quantitative indicator of abdominal examination for clinical application: a pilot study. (2015). J Altern Complement Med. 21(6),358-363. https:// doi.org/10.1089/acm.2014.0185.

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