The Effects of Acupuncture(ST36. LI4) on the Colonic Transit Time in Chronic Constipation Patients

Un Jung Lee*, Dong Woung Kim

Department of of Internal Medicine, Chenju Oriental Hospital College of Oriental Medicine of Wonkwang University

Background and Purpose : We were to investigate whether simple and electric acupuncture can affect the colonic transit time in both normal persons and chronic constipation patients. Methods : Twenty one volunteers were divided into two groups; first, normal control group(N=12) who had normal defecation habits, second, chronic constipation group(N=13). Before acupuncture, colonic transit time was checked using radio-opaque markers. Then simple acupuncture was done at four acupoints(both ST36, LI4) and maintained for 15 minutes during 4 days. Electric acupuncture was done using same methods except for applying 2Hz electrical stimulation. Result : In the normal group, after simple acupuncture, each transit time in the total, right, left was not changed statistic significance compared to pre-acupuncture($P>0.05$), but which of rectosigmoid colon shortened statistic significance($P<0.05$). After Electric acupuncture, transit time of right colon was shortened($P<0.05$), and extended($P>0.05$) in rectosigmoid colon compared to pre-acupuncture and simple acupuncture. In constipation group, after simple acupuncture, only rectosigmoid colonic transit time shortened statistic significance compared to pre-acupuncture($P<0.05$). After electric acupuncture, also the transit time of rectosigmoid colon was shortened statistic significance compared to pre-acupuncture($P<0.05$), but not to simple acupuncture($P>0.05$). Conclusion : In normal persons without constipation, acupuncture affect the colonic transit time differently to the methods of it. In chronic constipation group, simple and electric acupuncture only reduces the rectosigmoid colonic transit time statistically significant($P<0.05$).

Key words : Simple Acupuncture, Electric acupuncture, Colonic transit time, Chronic constipation

Introduction

Constipation, one of the most common medical complaints of daily life, is among the symptoms resulted from the abnormal motility of large intestine, when transit time of contents of it are prolonged or too much water excretion from it due to the obstruction of the exit of it[1]. But, normal rates of defecation are varied from 3 times per day in some people to 3 times per week in others, so constipation is diagnosed when defecation is less than 3 times per week[2]. Acupoints of ST36(Zusanli) and LI4(Hegu) are frequently used in the treatment of constipation; the former is essential in the disease of large intestine, the later has effects on both stomach and large intestine, which has been known to reflect gastrointestinal disease[3]. Recent studies proved that acupuncture was effective means in the treatment of constipation by promoting the release of neurotransmitters involved in gastrointestinal motility and changing the excitability of autonomic nervous system[4,5]. Especially, many studies were about the effects of acupuncture on the physiology of gastrointestinal tract, such as discharge of gastric acid[6], gastrointestinal motility[7], neurohormonal change and sensory threshold. And the neuroanatomical mechanism of acupuncture was proved in vitro[8]. In vivo, Klauser et al[9] investigated the clinical effects of acupuncture on chronic constipation, but sample size was not large enough and it was rarely random-based. So we did this study to investigate whether the simple and electric acupuncture at the point of ST36 and LI43) are effective in the treatment of chronic constipation by comparing the transit time of large intestine and the defecation characteristics of chronic constipation group with the normal group.

* To whom correspondence should be addressed at : Un Jung Lee, Chenju Oriental Hospital College of Oriental Medicine, Wonkwang University, Chonbuk, Korea
E-mail: ejlee@wonkwang.ac.kr, Tel: 063-270-1016
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Subjects and Methods

1. Subjects

1) Normal control group

Total 12 subjects, consisted of 7 males and 5 females, were included into normal control group, whose mean age was 54.84±0.23 years old. They didn't have any past history of

gastrointestinal diseases and any problem in defecation habits and fecal forms. They had been observed for 7 days before measuring colonic transit time to ensure not to have diarrhea or constipation and finally selected unless no abnormality in the laboratory tests such as stool examination, urinalysis, CBC and blood biochemistric examination.

2) Chronic constipation group

Total 13 subjects, consisted of 7 males and 6 females, were included into chronic constipation group, who had been suffered from chronic constipation, average 55.51±1.61 years old. They had been observed for 7 days before measuring colonic transit time and finally selected if any other abnormality founded including above-mentioned laboratory tests.

Table 1. Characteristics of the 25 Study Subjects

	Normal Group	Constipation Group
Age(year)	54.84±0.23	56.51±1.61
Defecation(week)	6.70±1.34	2.64±0.32
Constipation(year)		6.12±0.47
Sex		
male	7	7
female	5	6
Total	12	13

2. Methods

1) Methods for assessing colonic transit time

We classified segmental area of colon into right, left and rectosigmoid portions based on Arhan et al[9]; right colon is above the line between the 5th vertebra and right pelvic outlet and the right side of transverse spinal process; left colon is above the line between the 5th vertebra and anterior superior iliac crest and the left side of transverse spinal process; rectosigmoid colon is below the line between right pelvic brim and anterior superior iliac crest(Fig. 1).

Fig. 1. The measurement method of colonic transit time in plain abdomen radiograph. The colon is divided right colon, left colon, rectosigmoid colon by black lines.

The subjects had been taken Sitzmarks capsule (Konsyl Phamaceuticals, Inc. Texas. USA) during the first 3 examination days and taken simple abdominal X-ray film on the day 4. Then we counted the circular radio-opaque rings on the film and calculated colonic transit time through multiply it by 1.2 (Fig. 1).

2) Measurement of the colonic transit time before acupuncture

We observed the fecal forms and defecation rates for 7 days before acupuncture to set up the standard colonic transit time. And the subjects were taken Sitzmarks capsule(Konsyl Phamaceuticals, Inc. Texas. USA) including 20 radio-opaque markers in each of it at 9:00 a.m. on the days 8, 9 and 10. Then on the day 11, simple abdominal X-ray was taken for all of the subjects and colonic transit time were measured.

3) Measurement of the colonic transit time after acupuncture

(1) Measurement of the colonic transit time after simple acupuncture

After 4 off-days from radio-opaque markers were taken, simple abdominal X-ray was taken again for ensuring radio-opaque markers fully extracted. Then during the next 3 days at 8:00 a.m., acupuncture was done at both S36 and LI4 and maintained for 15 minutes. At 9:00 a.m. on the same days, Sitzmarks capsule(Konsyl Phamaceuticals, Inc. Texas. USA) was taken and 3days after, simple abdominal X-ray was taken again for measuring colonic transit time.

(2) Measurement of the colonic transit time after electric acupuncture

After 4 off-days from radio-opaque markers were taken, simple abdominal X-ray was taken again for ensuring radio-opaque markers fully extracted. Then during the next 3 days at 8:00 a.m., electroacupuncture, poniter F-3(ITO Co., LTD. Tokyo Japan) with 2Hz low frequency, was done at both ST36 and LI4 and maintain for 15 minutes. At 9:00 a.m. on the same days, Sitzmarks capsule(Konsyl Phamaceuticals, Inc. Texas. USA) was taken and 3days after, simple abdomen X-ray was taken again for measuring colonic transit time.

4) Observation of fecal forms

We recorded fecal forms and defecation rates at 9:00 a.m. during 7 days of pre-acupuncture and post-acupuncture in both normal and constipation groups.

Results

1. Fecal forms and Colonic Transit time in Normal Control Group

1) Fecal forms and Colonic Transit time before acupuncture

Mean defecation rate 7 days before acupuncture was 6.70 ±1.34 times per week, and fecal forms were soft normal in 8 cases, loose in 2 cases and hard in 2 cases. Mean transit times of total, right, left and rectosigmoid colon were 18.36±0.77, 5.72 ±0.43, 9.02±0.41, 4.04±0.91 hours respectively(Table 2).

Table 2. Colonic Transit Time before Acupuncture Stimulation in Normal Group

mean colonic transit time(hour)			
Rt. Colon	Lt. Colon	Rectosigmoid	Total Colon
5.72±0.43	9.02±0.41	4.04±0.91	18.36±0.77

2) Fecal forms and Colonic Transit time after Simple Acupucture

Acupuncture was done during 15 minutes every 7 days. Fecal forms were normal in 9 cases, loose in 2 cases and hard in 1 cases, not different to pre-acupuncture state in all. Mean defecation rate was 6.47±0.22 times per week. Mean transit times of total, right and left colon were 20.21±0.72, 7.68±0.43, 9.72±0.17 hours respectively, no statistic significance compare to pre-acupuncture($P>0.05$), and in the rectosigmoid colon, it was 2.32±0.91 hours, which shortened statistically significant ($P<0.05$)(Table 3).

Table 3. Colonic Transit Time after Simple Acupuncture Stimulation in Normal Group

mean colonic transit time(hour)			
Rt. Colon	Lt. Colon	Rectosigmoid	Total Colon
7.68±0.43	9.72±0.17	2.32±0.91*	20.21±0.72

* P<0.05

3) Fecal forms and Colonic Transit time after electric acupuncture

Mean defecation rate during 7 days-electric acupuncture was 6.45±0.24 times per week. Fecal forms were normal in 7 cases, loose in 3 cases and hard in 2 cases, statistic significance compare to pre-acupuncture state in all. Mean transit times of total colon were 19.71±0.29 hours, statistical significance compare to pre-acupuncture($P>0.05$), and in the right, left and rectosigmoid colon, it was 4.94±0.82, 9.43±0.46, 5.11±0.37 hours respectively, which shortened statistically significant($P<0.05$) (Table 4).

Table 4. Colonic Transit Time after Electroacupuncture Stimulation in Normal Group

mean colonic transit time(hour)			
Rt. Colon	Lt. Colon	Rectosigmoid	Total Colon
4.94±0.82*	9.43±0.46	5.11±0.37*	19.71±0.29

* P<0.05

2. Fecal forms and Colonic Transit time in Chronic Constipation Group

1) Fecal forms and colonic transit time before acupuncture

Mean defecation rate 7 days before acupuncture was 2.64±0.32 times per week, and fecal forms were soft normal in 3 cases and hard in 9 cases. Mean transit times of total, right, left and rectosigmoid colon were 46.14±2.01, 14.07±0.27, 19.84± 0.15, 19.96±4.31 hours respectively(Table 5).

Table 5. Colonic Transit Time before Acupuncture Stimulation in Constipation Group

mean colonic transit time(hour)			
Rt. Colon	Lt. Colon	Rectosigmoid	Total Colon
14.07±0.27	19.84±0.15	19.96±4.31	46.14±2.01

2) Fecal forms and colonic transit time after simple acupuncture

Mean defecation rate 7 days before acupuncture was 2.24 ±0.39 times per week, and fecal forms were soft normal in 3 cases and hard in 9 cases. Mean transit times of total, right and left colon were 43.42±0.69, 14.63±0.92, 17.14±0.11, hours respectively, no statistical significance compare to pre-acupuncture($P>0.05$), and in the rectosigmoid colon, it was 12.10±0.21 hours, which shortened statistically significant ($P<0.05$)(Table 6).

Table 6. Colonic Transit Time after Simple Acupuncture Stimulation in Constipation Group

mean colonic transit time(hour)			
Rt. Colon	Lt. Colon	Rectosigmoid	Total Colon
14.63±0.92	17.14±0.11	12.10±0.21*	43.42±0.69

* P<0.05

3) Fecal forms and colonic transit time after electric acupuncture

Fecal forms were normal in 3 cases and hard in 10 cases, statistical significance compare to before acupuncture state and mean defecation rate was 2.51±0.47 times per week. Mean transit times of total colon were 41.64±0.73 hours, no statistical significance compare to pre-acupuncture($P>0.05$), and in the right, left and rectosigmoid colon, it was 12.11±1.81, 18.17±0.92, 11.71±0.18 hours respectively, which shortened statistically significant($P<0.05$)(Table 7).

Table 7. Colonic Transit Time after Electric acupuncture Stimulation in Constipation Group

mean colonic transit time(hour)			
Rt. Colon	Lt. Colon	Rectosigmoid	Total Colon
12.11±1.81	18.17±0.92	11.70±0.18*	41.64±0.73

* P<0.05

3. Comparison of Mean Colonic Transit Time in Normal Group with Chronic Constipation Group

1) Mean colonic transit time before acupuncture

Mean transit times of total, right and left colon were 18.36±0.77, 5.72±0.43, 9.02±0.41 hours respectively in normal group(Table 2). In constipation group, it was 46.14±2.01, 14.07± 0.27, 19.84±0.15 respectively, about 2 times longer than normal group, and in the rectosigmoid colon, it was 4.04±0.91 in normal group and 19.96±4.31 hours in constipation group, about 5 times longer than normal one(Table 5)($P<0.05$).

2) Mean colonic transit time after simple acupuncture

Mean transit time of total, right and left colon was 19.71± 0.29, 4.94±0.82, 9.43±0.46 hours respectively in normal group after simple acupuncture(Table 3). In constipation group it was 43.42±0.69, 14.63±0.92, 17.14±0.11 respectively, about 2 times longer than normal group. Rectosigmoid colonic transit time was 5.11±0.37 in normal group, and 15.10±0.21 hours in chronic constipation group, about 4 times longer than normal one ($P<0.05$) (Table 6)(Fig 2).

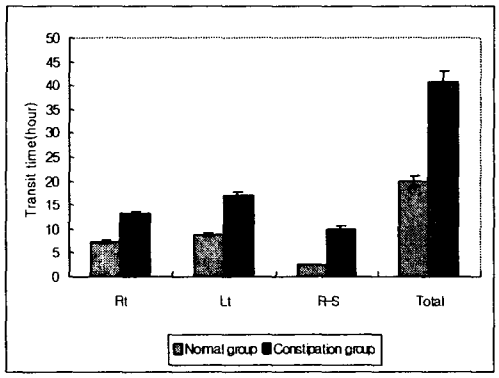

Fig. 2. Comparison of normal group and constipation group after simple acupuncture. Rt:Rt.colon, Lt:Lt.colon, R-S: Rectosigmoid colon Total: Total colon

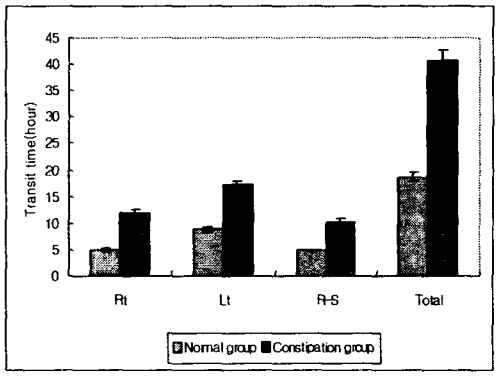

Fig. 3. Comparison of normal group and constipation group aftetr electro acupuncture. Rt:Rt.colon, Lt:Lt.colon, R-S: Rectosigmoid colon Total: Total colon

3) Mean colonic transit time after electric acupuncture

Mean transit times of total, right and left colon were 20.21±0.72 7.68±0.43 9.92±0.17 hours respectively in normal group after electric acupuncture(Table 3). In constipation group it was 41.64±0.73 12.11±1.81 18.17±0.92 respectively, about 2 times longer than normal group. In rectosigmoid colon, colonic transit time was 2.64±0.32 in normal group, and 11.70±0.18 hours in constipation group, about 4 times longer than normal one($P<0.05$)(Table 7). In chronic constipation group, mean transit times of total, right and left colon were about 2 times longer than normal one, and in the rectosigmoid colon, it was about 4 times longer than normal one, irrespective of the methods of acupuncture($P<0.05$)(Fig 3).

Discussion

Large intestine absorbs water, electrolytes and residual nutrients passing from the small intestine not absorbed, which is processed by the enterobacteria in the large intestine, and transits or preserves its contents[10]. If the large intestine malfunctions, diverse symptoms or disease are develop, such as functional diarrhea, chronic constipation and irritable bowl syndrome[11]. Defecation is precipitated by gastrointestinal reflex after meal, in most persons after breakfast, transforming the fecal mass[12]. But without any specific disorder, normal transient constipation can be induced by the environmental change or emotional stress which cause the restriction of gastrointestinal reflex or defecation impulse[10-13]. Idiopathic chronic constipation, characterized by the reduced frequency, amplitude and duration of the propulsive contraction of the large intestine, is caused by the motility dysfunction of it[14]. In Oriental Medicine, acupoints such as ST36, famous acupoints to effect control of various gastrointestinal diseases and LI4, points at hand having combining effect on both stomach and large intestine, are frequently used in constipation for normalization of the current of Qui of the large intestine[3]. There were many studies on whether acupuncture can influence the gastrointestinal motility in relation with the autonomic nervous system[15,16]. And it was proved partially in the experimental animals which were removed vagus nerve[15,17]. Furthermore, Tougas et al[18] reported that electric acupuncture suppressed the discharge of gastric acid by influencing parasympathetic vagus nerve. So it was concluded that acupuncture could regulate gastrointestinal function in the level of spinal cord, pons, midbrain and cerebral cortex mediated by afferent autonomic nerves[15]. Many factors affect gastrointestinal motility, and it can be observed through diverse methods. In 1969, Hinton et al[19] first measured large intestinal transit time using radio-opaque markers. After this there were great improvements in understanding the physiology of gastrointestinal mortality[18-20]. Especially, Metcalf

et al[20] reported very useful method in measuring large intestinal transit time. In this study, we assessed the large intestinal transit time of both normal and constipation group in pre- and post-acupuncture state using radio-opaque markers. In normal group, our results in pre-acupuncture state were longer than previous study from Korea[21], in which the transit times of total, right, left and rectosigmoid colon were 10.57, 3.87, 3.31, 3.27 hours respectively. But it was shorter than other study[21] from western country[21], in which transit time of total, right, left and rectosigmoid colon were 34.4, 6.9, 9.1, 18.4 hours respectively. It is thought that because in the previous one[21], the average age of the subjects was 39 years old comparing our's 57 years old and the change of large intestinal mortality and the preference of liquid to solid foods in the older people. Also more fiber-rich diets in Korean than Western country seems contribute to the different results. Many studies on the effects of acupuncture for treating abnormal gastrointestinal function proved that it was mediated by opioid peptides and neuronal transmission tract resembling analgesic mechanism of acupunctures[8], although the accurate mechanism has not been resolved until now[18]. In recent studies, opioid peptides were known to broadly function through the gastrointestinal tract and had similar effects to that of the exogenous ones[18,22]. Especially enkephalin, one of the endogenous opioid peptides, could function ambivalently, increasing the contractibility of normal gastrointestinal tract or reducing abnormally increased mortality[23]. Also, the effects on the autonomic nervous system were changed according to the handling technique of acupuncture[25]. And the intensity of electric acupuncture affected the discharge of the endorphin; low-frequency induced beta-endorphine and high-frequency induced meta-endorphine[22]. It was supported by the fact that beta- and meta-endorphin had affinity for different receptors[22,23]. In this study, in normal group, simple acupuncture shortened the transit time of large intestine, but not electric acupuncture so that it can be induced that in normal people, different methods of acupucture have different effects. As to the difference of methods of acupuncture, it was reported that high-frequency electric acupuncture and classical handling technique of acupuncture were more effective than low-frequency, but, in long term, low-frequency electric acupuncture was more effective[26].

Klauser et al[7] first investigated whether acupuncture affected the defecation rate and colonic transit time in chronic constipation patients using radio-opaque markers. They selected acupoints such as ST25 and ST37, but failed to get any positive results.

In our study, colonic transit time was same irrespective of sites of colon and tended to be longer than that of the study by Chaussade et al[24], and the transit time of rectosigmoid colon also longer than the patients of colon atrophy studied by Lim et al[25]. But, after acupuncture, the transit time of rectosigmoid colon was shortened to statistically significant level, so it appears to be that acupuncture can affect only the transit time of rectosigmoid colon, not influencing other sites of colon, which thought to be related to the distribution of nerves.

In rectum, mesenteric nerve plexus are distributed irregularly in the coarse multiple forms, so receive less intrinsic motor regulation than other colon. And there are many intramural pelvic nerve connected with extracolonal motor nerve in distal colon, also different to other parts of colon, so motor activity are easily changed sensitively to external factor such as acupuncture[27]. The subjects in this study were patients of chronic constipation, and were not choose based on the Oriental medicine differencial diagnosis of symptoms or Western classification, so those should be considered later time. And there should be investigations involved other acupoints more than S36, LI4 using sham acupuncture or pseudo needle[28] and more rigorously controlled.

Conclusion

The effects of simple and electric acupuncture on colonic transit time in both normal and chronic constipation patients are followed. In normal control group, mean colonic transit times of total, right and left colon after simple acupuncture were not changed statistical significance compared to pre-acupuncture($P>0.05$). But in rectosigmoid colon, mean colonic transit time was shortened statistically significant($P<0.05$). In normal control group, mean colonic transit times of right colon after electric acupuncture were shortened statistical significance compared to pre-acupuncture and simple acupuncture($P<0.05$). But in left colon, mean colonic transit time was not change statistical significance($P>0.05$). In normal control group, mean colonic transit time of rectosigmoidal colon after electric acupuncture was shortened statistical significance compared to pre-acupuncture and simple acupuncture($P<0.05$). In chronic constipation group, mean colonic transit time of rectosigmoid colon after electric and simple acupuncture was shortened statistical significance compared to pre-acupuncture($P<0.05$). In chronic constipation group, mean colonic transit time of rectosigmoid colon after electric was shortened statistical significance compare to pre-acupuncture($P<0.05$), but not severe to simple acupuncture($P>0.05$).

So we can conclude that acupuncture at ST36 and LI4

don't affect the colonic transit time of left and right colon in normal control group, but, in the rectosigmoid colon, many effects can be induced according to the methods of acupuncture. In chronic constipation patients, simple and electric acupuncture can shorten colonic transit time of rectosigmoid colon, but there were no differences between simple and electrical acupuncture.

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