Blood flow differences in cun-kou (radial) artery and anterior tibial artery: normal people vs patients with chronic gastritis

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Abstract

OBJECTIVE: To explore the blood flow differences in cun-kou (radial) artery and anterior tibial artery between normal people and patients with chronic gastritis

METHODS: Using doppler ultrasonography, blood flow charts (peak systolic velocity (VP), maximum blood flow velocity in diastole (VD), mean blood flow velocity (VM), pulse index (PI), resistance index (RI), blood vessel diameter (D), vessel volume (SV), circulation blood flow periodic time (ET)) measured by at cun-kou (radial) artery and anterior tibial artery in normal group (n = 30) and chronic gastritis group (n = 30) in department of ultrasound, Beijing Anzhen hospital, capital medical university.

RESULTS: In the doppler flow charts of the normal group, there were statistically significant differences in VD, VM, D, RI, SV, ET between cun-kou artery and anterior tibial artery (P < 0.05), and there were more statistically significant differences in PI between cun-kou artery and anterior tibial artery (P < 0.01). In the comparison of doppler flow charts between normal group and chronic gastritis group, there were statistically significant differences in SV, ET between normal group and chronic gastritis group (P < 0.05), and there were more statistically significant differences in PI between normal group and chronic gastritis group (P < 0.01).

CONCLUSION: Based on the differences in doppler flow charts between the normal group and the chronic gastritis group, the doppler flow charts of cun-kou artery and anterior tibial artery were not only proved to be significantly different, but also provided quantitative objective indexes for the study of cun-kou artery and anterior tibial artery doppler flow charts of normal people and chronic gastritis patients. This study also proves that the doppler flow chart of the anterior tibial pulse is of great significance for the diagnosis of chronic gastritis.

Keywords: Tibial arteries; Cun-kou artery; Ultrasonography, doppler

INTRODUCTION

The method of taking pulse at anterior tibial position diagnosis method is an important part of Traditional Chinese Medicine (TCM) pulse diagnosis method and...
is one of the important contents in "Huang Di Nei Jing" and Zhang Zhongjing’s pulse method of three regions (renying, cun-kou, anterior tibial). Zhang Zhongjing points out clearly in his preface of "Treatise on Cold-Damages" that "It is wrong for the following situations to occur when taking the pulse: the doctor only takes cun pulse but not chi pulse. The doctor takes the hand pulse but not the foot pulse. Doctors cannot synthetically consider the renying pulse, cun-kou pulse, anterior tibial pulse. The doctor cannot take pulse as long as fifty breaths. In this way, some doctors criticized the diagnosis of disease is not serious, hasty neglect of the position of anterior tibial and other parts of the diagnosis. There is a total of 25 (to repeat) statements about the anterior tibial in "Treatise on Cold-Damages". We can find that Zhang zhongjing mainly used the anterior tibial pulse for the diagnosis of spleen and stomach system disease, and judged the prognosis and outcome of the disease according to the amount of stomach Qi.

In modern clinic, there are various characteristic TCM pulse diagnostic instruments and various kinds of pulse atlas. Any pulse has its three-dimensional spatial position and hemodynamic image, and its specific spatial position and pulse map state are of great value for clinical pulse diagnosis, and the above basis can be summarized as vascular pulse. Modern medical physiology considers the pulse to be a kind of oscillations in the blood and vessel wall caused by cardiac ejection activity. This is a mechanical vibration, along the walls of blood vessels do wave energy transmission, so called pulse wave. If the pulse pulsating track is recorded by the instrument, it becomes a pulse chart. The rapid development of medical ultrasound diagnosis technology, especially the use of color doppler ultrasound, can provide two-dimensional visualization and spatial orientation of blood flow signal, providing a new means for the objective study of pulse condition. This study, using doppler ultrasonography and human body test, aimed to detect blood flow differences in cun-kou (radial) artery and anterior tibial artery between normal subject and chronic gastritis patients.

MATERIALS AND METHODS

Materials

From May 2016 to December 2016, 60 subjects were randomly divided into 2 groups by random number table method from the department of ultrasound, Beijing Anzhen hospital, capital medical university for ultrasonic doppler test [Hitachi erlangshendoppler ultrasonic instrument manufactured by Hitachi medical (Guangzhou, China) Co., Ltd., probe frequency: 5.0-9.0 mhz]). The normal group consisted of 30 patients, including 14 males and 16 females, with an average age of (42 ± 12) years. In the chronic gastritis group, there were 30 cases, including 17 males and 13 females, with an average age of (40 ± 12) years.

Diagnostic criteria for chronic gastritis

TCM diagnostic criteria: with reference to "evidence-based guidelines of clinical practice in TCM (internal medicine)". This guideline is based on the standards of "Diagnosis by combination of Chinese and Western Medicine, syndrome differentiation and curative effect criteria of chronic gastritis", "Diagnosis and treatment of chronic gastritis by integrated Traditional Chinese and Western Medicine", "Clinical guiding principle of TCM new drug" and other Chinese medical textbooks, through the development of clinical questionnaire, to collect the information of four medical diagnose methods and other relevant clinical data of patients with chronic gastritis, and to conduct the syndrome differentiation of Chinese and western medicine by combining the Western medicine biochemical examination.

Disease diagnosis in TCM

The diagnosis of chronic gastritis is mainly symptom diagnosis. For those with stomachache as the main disease, the diagnosis is stomach pain or stomachache; with the lump fullness in stomach for the main disease, as lump fullness or stomach lump. If the symptoms of stomachache or lump fullness in stomach are not obvious, the symptoms can be diagnosed as acid regurgitation, belching, stomach upset and other diseases according to the main symptoms.

Clinical manifestation

Some patients with chronic gastritis may not have obvious clinical symptoms, some patients have symptoms. Symptoms are mainly manifested as non-specific dyspepsia, such as upper abdominal discomfort, fullness, pain, loss of appetite, belching, acid regurgitation, and so on. Some of them can also have mental and psychological symptoms such as forgetfulness, anxiety and depression. These symptoms can be induced by poor diet, emotional excitement or depression, overwork and climate change.

Western medical diagnostic criteria

Referring to the 2012 Chinese Society Of Gastroenterology "Consensus opinion on chronic gastritis in China", the current diagnosis of chronic gastritis mainly depends on endoscopy and histopathological examination.

Endoscopy: the chronic gastritis is divided into two types under endoscopy, superficial gastritis, and atrophic gastritis with erosion, bile reflex, and bleeding if signs, such as the diagnosis of superficial gastritis or atrophic gastritis with erosion, bile reflux, etc.

(a) The basic manifestations of non-atrophic gastritis, such as erythema dots, flaps and bands, rough mucosa, bleeding spots (plaques), mucosal edema, and exudation, can be seen under the superficial endoscopy.

(b) The endoscopic appearance of atrophic gastritis showed red and white mucosa, mainly white mucosa,
the folds became flat or disappeared, and some mucosal blood vessels were exposed, which could be accompanied by particles or nodules.

Pathological biopsy
(a) Chronic superficial gastritis: inflammatory cells (mainly lymphocytes and plasma cells) are confined to the gastric pits and the inherent mucosa surface. The glands are intact.
(b) Chronic atrophic gastritis: the gastric mucosa inflammation develops deep, involving the gland area, resulting in the destruction and reduction of glands, and then the gland atrophy, and the gastric mucosa gradually becomes thin. Severe cases may be accompanied by intestinal metaplasia and/or atypical hyperplasia. Chronic inflammation pathological biopsy if the inherent gland atrophy, can be diagnosed as atrophic gastritis.

Normal group
Target population: healthy people aged between 20 and 70 in universities, enterprises, institutions and communities in Beijing.
Inclusion criteria: the subjects had no history of organic diseases or infectious diseases; the subjects had no obvious self-conscious symptoms or occasionally 1-2 mild self-conscious symptoms; Subjects had normal physical examination, normal electrocardiogram (ECG), normal X-ray chest examination; subjects were mentally normal, articulate and cooperative; subjects signed informed consent and voluntarily participated in the study.

Chronic gastritis group
Target population: patients aged 20 to 70 years old in the outpatient department of Traditional Chinese Medicine of guoyi tang of Beijing university of Chinese medicine, the outpatient department of digestive department of Beijing Anzhen hospital, capital medical university or the clinic of other hospitals.
Inclusion criteria: subjects who meet the diagnostic criteria of chronic gastritis (Chronic gastritis must be diagnosed by western medical fibrogastroscopy and histopathology within 30 d) and do not meet the exclusion criteria.

Exclusion criteria
Having other serious primary diseases (such as heart, brain, kidney, blood, etc.) and mental dysfunction; pregnant and lactating women; those who are allergic to ultrasound or have a heart pacemaker installed; there are local plaques or expansions in the arteries of the upper and lower limbs, and thickening or plaques in the endothelium.

Sample size
As this study was an exploratory study, 30 patients were assigned to the normal group and 30 patients to the chronic gastritis group.

Detection methodology
Matters needing attention before test:
(a) After determining the evaluation time: do not drink alcohol within 24 h before the test, avoid stimulating diet, do not overdo exercise and maintain normal living habits; do not do electric therapy, acupuncture, thermal therapy, freezing therapy, massage, cupping and other stimulating physiotherapy within 24 h before the test; avoid constriction or dilatation of blood vessels, such as antihypertensive and hypoglycemic drugs, on the day before test; Do not exercise within 4 h before test, do not take a shower within 1 h and do not smoke within 30 min.
(b) After arriving at the test waiting room: the test should be carried out 1 h after the meal. You need to rest for more than 15 min, during which time you can fill out an individual clinical questionnaire; do not wash your hands or feet with cold water for 20 min before the test. Don’t sit close to the conditioner and heating.
(c) In the process of examination room testing: we should keep the examination room and the examination process quiet, so as to avoid affecting to listen to the doppler audio signal to judge the nature of pathological blood flow. To avoid the interference of audio signals, it is best to place only one instrument in the examination room. All test should be performed in the doppler ultrasound room, the room temperature should be kept in 20 °C-25 °C; subjects should maintain comfortable posture; subjects should rest for a certain time before the test, and try not to move their body position during the examination.

Body position: the instrument needs 10 min for warm-up after turning on. The paper speed of doppler ultrasound instrument was set as 25 mm/S, and the scale was set as 30 cm/S. The subject’s limbs are naturally relaxed and fully exposed. When the subjects with the subject in the supine position test upper limb blood vessels, the arms abduction degree is at a 90 degree or a little and extortion and the palms are flat on the bed (subjects are required to maintain the same level of cun-pulse position and heart. The ultrasonic probe was applied with appropriate coupling agent at the guan-pulse position of the subject). When the subjects with the subject in the supine position test lower limb blood vessels, the limbs were abduction and extortion, their lower limbs were straightened, and their feet were closed. Examiners touch the most obvious place by the middle finger on the anterior tibial pulse position, put the ultrasonic probe with daub proper amount of coupling agent on it. The probe must be closely attached to the skin without causing the vessel to be compressed into an artificial turbulence. On the oscillograph screen, a two-dimensional image of the measured pulse longitudinal section is displayed first, and then a cross-section is taken to display color blood flow. Relevant data are measured. When the best graph is found on the display screen (the graph base line is
stable, the main wave amplitude is highest, and the lifting branch is steep and uncut), the sampling wave is drawn on the four-lead recording paper with the plotter. The probe frequency is 5.0-9.0 MHz, and the wall filter is set at 50-100 Hz (to prevent the low-speed blood flow from being filtered out). The sampling volume is 2-4 mm and placed in the center of the lumen, parallel to the blood vessels. The Angle between the acoustic beam and blood flow is less than 60 degrees.

**Observation index**
Respectively to observe the possible subjects cun-kou artery and anterior tibial artery doppler blood flow diagram, analyze the detection index: peak systolic velocity (VP), maximum blood flow velocity in diastole (VD), mean blood flow velocity (VM), pulse index (PI), resistance index (RI), blood vessel diameter (D), vessel volume (SV), circulation blood flow periodic time (ET) has obvious differences, and to explore the differences between possible cun-kou artery and anterior tibial artery.

**Statistical methods and data processing**
Access 2010 (Microsoft, Redmond, Washington, USA) is used to establish the basic information database of subjects. It has a friendly interface and is easy to input. It can realize automatic jump and relevant database connection. In order to guarantee the quality of data entry, the trained third-party personnel will input the original data into the Access database.

All data were analyzed using SAS (vers 8.2, SAS Institute, Chicago, IL, USA) software. Measurement data to mean ± standard deviation (\( \bar{x} \pm s \)) description, count data expressed as a percentage (%). All hypothesis tests were bilateral tests, and \( P < 0.05 \) was considered statistically significant. The comparability among groups was evaluated for baseline data, and double-tailed statistical test was performed at the level of \( P < 0.05 \). The measurement data of cun-kou artery and anterior tibial artery doppler in normal group were compared by independent \( t \) test. The measurement data of cun-kou artery and anterior tibial artery doppler in patients with chronic gastritis were compared using independent \( t \) test. The blood flow differences between the two groups were compared.

**RESULTS**

**Doppler flow chart of cun-kou artery and anterior tibial artery in normal group**
VD, VM and D were statistically different in the comparison of the doppler blood flow chart of cun-kou artery with that of the anterior tibial artery in the normal group \( (P < 0.05) \) (Table 1). It indicated that VD, VM, and D of cun-kou artery doppler flow map were significantly different from that of anterior tibial artery, and VD, VM and D of cun-kou artery were all larger than that of anterior tibial artery (Table 1).

In the comparison of the doppler blood flow chart of cun-kou artery and anterior tibial artery in the normal group, the RI, SV and ET of cun-kou artery and anterior tibial artery had a statistical difference \( (P < 0.05) \), and the PI of cun-kou artery and anterior tibial artery had a more significant statistical difference \( (P < 0.01) \) (Table 2). The results showed that there were significant differences in RI, PI, SV and ET between cun-kou artery and anterior tibial artery doppler flow chart under normal condition. The value of RI and PI is greater than that of cun-kou artery, and the value of SV and ET is greater than that of anterior tibial artery (Table 2).

**Doppler flow chart of cun-kou artery and anterior tibial artery in chronic gastritis group**
In the comparison of the doppler blood flow chart of cun-kou artery and anterior tibial artery in the chronic gastritis group, the VD, VM and D of cun-kou artery and anterior tibial artery had a statistical difference \( (P < 0.05) \) (Table 1). In chronic gastritis, there were significant differences in VD, VM and D between cun-kou artery doppler flow chart and anterior tibial artery doppler flow chart, and the parameter value of cun-kou artery was greater than that of anterior tibial artery (Table 1).

In the comparison of the doppler blood flow chart of cun-kou artery and anterior tibial artery in the chronic gastritis patients group, there were statistically significant differences in RI, SV and ET between cun-kou artery and anterior tibial artery \( (P < 0.05) \), and there were more statistically significant differences in PI between cun-kou artery and anterior tibial artery \( (P < 0.01) \) (Table 2). The results indicated that there were significant differences in RI, PI, SV and ET between cun-kou artery and anterior tibial artery doppler flow map in chronic gastritis. The value of RI and PI of anterior tibial artery is greater than that of cun-kou artery, and the value of SV and ET of cun-kou artery is greater than that of anterior tibial artery (Table 2).
Doppler blood flow chart of anterior tibial artery in normal group and chronic gastritis group

In the comparison between the normal group and the chronic gastritis group, SV and ET in the normal group and the chronic gastritis group were significantly different (P < 0.05), while PI in the normal group and the chronic gastritis group were more significantly different (P < 0.01) (Table 2). The results showed that there were significant differences in PI, SV and ET between normal group and chronic gastritis group (Table 2). The PI value in the chronic gastritis group was higher than that in the normal group, and the SV and ET values in the chronic gastritis group were higher than that in the normal group (Table 2).

DISCUSSION

The location of anterior tibial artery (Chong-yang acupuncture point) is followed by foot Yangming stomach meridian of foot, so it is mainly used to diagnose spleen and stomach system diseases, and to judge the amount of stomach Qi in human body, which has a good guiding role in the prognosis and outcome of human diseases. It is found in modern studies that the artery diagram studies potential energy changes, with certain limitations. However, the pulse composition is affected by a variety of information, such as pressure pulsation, luminal volume, blood flow velocity, and three-dimensional movement of the vessel. Therefore, the study of the pulse condition must start from the omni-directional influence factors of the pulse condition, such as the biomechanical characteristics of the heart movement and arterial movement.

From the perspective of modern anatomy, cun-kou position is the pulsating position of the radial artery, and the anterior tibial position is the pulsating position of the dorsal foot artery. Two-dimensional ultrasound image of normal pulse: without pressure, the contraction and pulsation of the radial artery in normal people is nearly circular, with pulsating wall around. The wall structure is unclear, with anechoic area in the middle. When pressure is applied to the radial artery, the vessels may be spindle, oval, and olive. In normal people, the contraction and pulse of the dorsal foot artery is nearly circular and close to the skin. The initial diameter of the superficial branch of the radial artery was 1.00–3.00 mm. From the perspective of modern anatomy, the radial artery was closer to the heart and the dorsal foot artery was farther from the heart. The above anatomical features provide objective conditions for the hemodynamic characteristics of cun-kou artery, so VP, VM and D of cun-kou artery are larger than that of anterior tibial artery.

PI and VP can reflect whether the pulse pulsation is strong or not, and show the pulse strength. RI indicates the smoothness of the pulse. However, the pulsating force and fluidity of pulsations are also affected by factors such as blood flow velocity, vessel tenderness and anatomical location.

Table 1 Changes in VP, VD, VM, D ( ± s )

<table>
<thead>
<tr>
<th>Group</th>
<th>VP</th>
<th>VD</th>
<th>VM</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cun-kou pulse of patients</td>
<td>53.38±11.37</td>
<td>9.31±7.16</td>
<td>18.12±8.72</td>
<td>2.25±0.43</td>
</tr>
<tr>
<td>Cun-kou pulse of normal</td>
<td>53.92±9.09</td>
<td>8.39±5.82</td>
<td>17.72±7.26</td>
<td>2.13±0.39</td>
</tr>
<tr>
<td>Anterior tibial pulse of patients</td>
<td>50.00±18.96</td>
<td>5.16±7.23</td>
<td>12.57±10.79</td>
<td>2.00±0.38</td>
</tr>
<tr>
<td>Anterior tibial pulse of normal</td>
<td>49.43±10.23</td>
<td>3.85±4.46</td>
<td>12.15±5.09</td>
<td>1.89±0.25</td>
</tr>
</tbody>
</table>

Notice: cun-kou pulse of patients: using doppler ultrasonography, blood flow charts measured by at cun-kou (radial) artery in chronic gastritis group; cun-kou pulse of normal: using doppler ultrasonography, blood flow charts measured by at cun-kou (radial) artery in normal group; anterior tibial pulse of patients: using doppler ultrasonography, blood flow charts measured by at anterior tibial artery in chronic gastritis group; anterior tibial pulse of normal: using doppler ultrasonography, blood flow charts measured by at anterior tibial artery in normal group; VP: peak systolic velocity; VD: maximum blood flow velocity in diastole; VM: mean blood flow velocity; D: blood vessel diameter. Compared with cun-kou pulse of chronic gastritis group, 1P < 0.05; compared with cun-kou pulse of normal group, 2P < 0.05.

Table 2 Changes in RI, PI, SV, ET ( ± s )

<table>
<thead>
<tr>
<th>Group</th>
<th>RI</th>
<th>PI</th>
<th>SV</th>
<th>ET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cun-kou pulse of patients</td>
<td>0.84±0.12</td>
<td>3.41±2.42</td>
<td>0.59±0.39</td>
<td>844.63±119.57</td>
</tr>
<tr>
<td>Cun-kou pulse of normal</td>
<td>0.87±0.13</td>
<td>3.39±2.41</td>
<td>0.45±0.24</td>
<td>803.77±126.39</td>
</tr>
<tr>
<td>Anterior tibial pulse of patients</td>
<td>0.94±0.13</td>
<td>6.44±4.61</td>
<td>0.37±0.37</td>
<td>777.70±123.43</td>
</tr>
<tr>
<td>Anterior tibial pulse of normal</td>
<td>0.95±0.10</td>
<td>4.48±1.90</td>
<td>0.20±0.11</td>
<td>714.10±101.24</td>
</tr>
</tbody>
</table>

Notice: cun-kou pulse of patients: using doppler ultrasonography, blood flow charts measured by at cun-kou (radial) artery in chronic gastritis group; cun-kou pulse of normal: using doppler ultrasonography, blood flow charts measured by at cun-kou (radial) artery in normal group; anterior tibial pulse of patients: using doppler ultrasonography, blood flow charts measured by at anterior tibial artery in chronic gastritis group; anterior tibial pulse of normal: using doppler ultrasonography, blood flow charts measured by at anterior tibial artery in normal group; RI: resistance index; PI: pulse index; SV: vessel volume; ET: circulation blood flow periodic time; compared with cun-kou pulse of chronic gastritis group, 1P < 0.05; compared with cun-kou pulse of normal group, 2P < 0.05; compared with cun-kou pulse of chronic gastritis group, 3P < 0.01; compared with anterior tibial pulse of normal group, 4P < 0.01; compared with cun-kou pulse of normal group, 5P < 0.01; compared with anterior tibial pulse of normal group, 6P < 0.05.
Relevant scholars have shown that the data of expansion and contraction of radial artery in autopsy is different from that in vivo, so radial artery belongs to the middle artery with greater elasticity. And the radial artery is closer to the heart, the blood flow is big, the blood vessel expands, the pulse pressure is high. Therefore, normal people have a lower RI of cun-kou pulse and a higher SV. Anterior tibial pulse is floating and moderate. According to Mr. Wu Zhongwen, the working hours should be four times for one breath or 60 to 75 times per minute of normal anterior tibial pulse. Modern research shows that through the multi-function pulse chart instrument we analyzed pulse diagram of cun-kou artery and anterior tibial artery, it can be concluded that the position of anterior tibial pulse is shallower than guan pulse. The anterior tibial pulse appears floating, and the PI is obvious, which indicates the filling of Qi and blood. The VD, VM, D, SV and ET of cun-kou vein were greater than that of anterior tibial artery, indicating that cun-kou artery could reflect the internal blood circulation of human body more obviously in the condition of blood flow. Therefore, ancient people proposed the diagnosis method of “taking cun-kou alone”. The PI and RI of the anterior tibial artery are larger than the cun-kou artery, indicating that the beating degree of the anterior tibial artery under the finger is more obvious than the cun-kou artery. Chong-yang acupoint, that is the location of the anterior tibial, is the original acupoints of Yangming stomach meridian foot. “Plain Questions” records: Yellow emperor asked that people suffering from diseases, stomach pain, what should be diagnosed? Qibo replied: “we should examine the stomach pulse.” Therefore, since ancient times, anterior tibial pulse has been an important basis for the diagnosis of spleen and stomach system diseases. In patients with chronic gastritis, AM, D, SV, ET and PI are all affected by the disease, showing a downward trend. The blood flow chart PI of the patient with chronic gastritis in position of anterior tibial is significantly different from that of the patient with chronic gastritis at location of cun-kou and normal people, so the doppler blood flow chart of anterior tibial is helpful for the diagnosis of gastric disease. According to the literature, the doppler flow charts of cun-kou artery and anterior tibial artery are of great significance for the study of related diseases. In clinical practice, when the human body is in a variety of critical conditions (Qi and blood are extremely weak), it is easier to take the anterior tibial pulse than cun-kou pulse. Therefore, the ancients paid more attention to the role of anterior tibial pulse in “judging death by stomach Qi” in the critical condition.

In conclusion, based on the differences in doppler flow charts between the normal group and the chronic gastritis group, the doppler flow charts taken cun-kou artery and anterior tibial artery were not only proved to be significantly different, but also provided quantitative objective evidence for the study of doppler flow charts measured at cun-kou artery and anterior tibial artery from normal people and chronic gastritis patients.

REFERENCES