



Original Article

The Stomach's Communication with Its Related Acupoints, and the "Intelligent Tissue" Hypothesis

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ABSTRACT

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Background: The intelligent tissue hypothesis holds that an organ's states (be it normal function or stressed states) are reflected in real time at its related acupuncture points (acupoints), causing physical, real-time changes in the local tissue. The experiment was devised to test this.

Methods: The patient drank chilled water while the impedance at 6 stomach-related acupoints was monitored in real time (sample rate of 1 kHz). Any changes in the local tissue at the acupoints ought to be reflected in changes in the impedance.

Results: The impedance at every test acupoint showed a response to the chilled water being ingested. Also, the duodenal pacesetter and the stomach's slow waves were clearly visible in the impedance pattern at all the acupoints.

Conclusion: Hence, many separate details of the stomach's function were reflected at these acupoints. The duodenal features were consistent with the traditional indications for these acupoints, which are noted to be able to treat intestinal conditions. Therefore, the results were consistent with the hypothesis and also provided a possible explanation for how the use of these acupoints is able to treat intestinal conditions.

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Introduction

The experiments reported here were part of the author's ongoing research project to obtain objective experimental data to validate the "intelligent tissue" hypotheses which describes what the meridians are, what acupuncture is, and how it corrects organ malfunctions.

A previous experiment in this project [1] demonstrated that the impedance at key stomach acupoints varies throughout the day and is proportional to the strength of the stomach function (i.e. when the stomach was actively digesting a meal, the impedance at its acupoints rose significantly). And other studies have found that when the lungs [2,3] or heart [4,5] are diseased, the impedance at their acupoints is reduced, which suggests that when an organ's function is weak, this is reflected in reduced impedance at its acupoints.

The intelligent tissue hypothesis states that organ information is communicated body-wide on electromagnetic waves. This is filtered so that each organ's information is emphasized along the path of its meridian. Body tissue constantly interprets this information, which causes each organ's states to be reflected

in the tissue at its related meridian and acupuncture points (acupoints). Hence, when an organ is stressed in some way, this causes anomalies in the tissue at its acupoints. This causes the key acupoints to become tender when pressed, or to be cold or red; or for boils, painful joints, or shooting pains to eventually occur along the meridian (phenomena familiar to all Chinese medicine practitioners). By needling such acupoints, this relaxes the local tissue, which reverts to its normal state; and this "return to normal function" is also communicated via the same electromagnetic waves. When these arrive at the related organ, this persuades the organ to follow the same transformation and to also revert to normal function [6].

The current experiment was devised to record the outward communication from the stomach to some of its related acupoints. The impedance at 6 stomach-related acupoints was monitored while the patient drank chilled water. If the hypothesis is correct, the induced shock in the stomach ought to produce real-time physical changes in the local tissue at the acupoints, which would be detectable as changed impedance of the skin and/or the underlying tissue.

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Materials and Methods

The monitored acupoints were bilateral Stomach-19 (*Burong*), Stomach-21 (*Liangmen*), and Stomach-36 (*Zusanli*). The acupoints were first located by an acupuncturist with 12 years experience in Chinese acupuncture, then the location of lowest impedance was verified electrically, and this was used as the test location.

At each acupoint, a pair of custom-made electrodes were used, set at a distance of 6 mm apart (the second electrode acting as a control), and a standard ECG electrode was attached at 4-10 cm from each acupoint, as an earth. Gel was used on each electrode. A 40 kHz 200 mv sine wave was passed through the electrodes, and the voltage monitored. A custom-made unit converted the monitored voltages to DC, then passed these to a data logger which sampled the voltages at 1 kHz. An Access database and macro was used to control the data logger and convert the voltage samples into k Ω values before they were imported into Matlab and filtered to produce the plots. An accompanying online dataset contains links to documents that describe in detail all the equipment and techniques used, including how to reliably locate acupoints electrically [7].

Patient A was a male, aged 34. In Chinese medicine terms, he suffered poor stomach and pancreas function (usually known as “Stomach chi deficiency” and “Spleen chi deficiency”). On the day of the experiment, 31 March 2018, he ate his main meal at 13:30, then went for a long walk outdoors. The recording then began at 17:06. The room temperature was 19.34°C. The water consisted of 140 mL of filtered tap water, chilled to 0.90°C. He was asked to blink when he began swallowing the water, and the researcher marked this by pressing a switch. He drank the water in continuous gulps, and the researcher also marked the last swallow. This produced 2 time values, marked on the plots with vertical green lines.

The patient had participated in this same experiment a few days previously; and shortly after drinking the chilled water, an ache developed at his Ren-12 (*Zhongwan*) acupoint. This time he was asked to pay attention to this ache, to score its intensity between 0 and 10, and to mention the score at any time that the ache seemed to change in intensity.

Patient B was a male, aged 58, who also suffered poor stomach and pancreas function. Readings were taken from this patient to confirm the existence of “duodenal waves” at ST-21, and also that these continued when holding his breath and also when drinking warm water.

Informed consent was obtained from both patients.

Results

The raw experimental data is available online in a dataset [7], which includes the Matlab scripts used to filter the data to produce the charts. Matlab’s findpeaks function was used to locate the peaks in each plot, so that wave analysis could be performed. Such values are given as mean \pm SD (all calculations are included in the accompanying dataset) [7].

Left Stomach-36 and Ren-12

Fig. 1 shows the impedance at left Stomach-36 and at a location 6 mm away. A previous experiment in this research project demonstrated that when contrary motion exists in plots of the impedance at an acupoint and at its 6 mm radius, this indicates that the feature reflects organ information communicated via an electromagnetic wave, as distinct from artefact [8]. In Fig. 1, there was clear contrary motion between the trends of the 2 plots, and also between the many features on the ST-36 plot (marked with

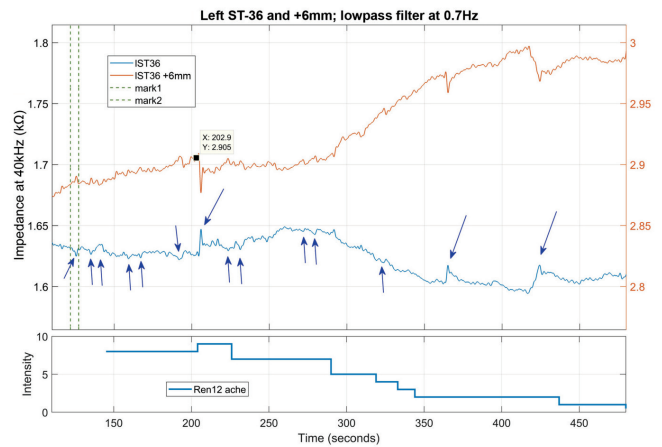


Fig. 1. Impedance at left Stomach-36 and at 6 mm medial, and the Ren-12 ache.

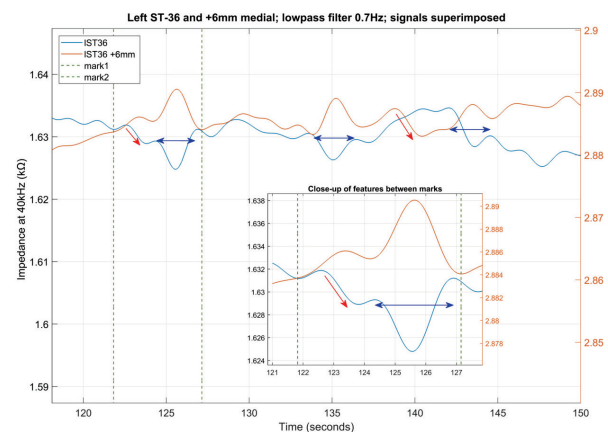


Fig. 2. Close-up of impedance at left ST-36 and 6 mm medial while drinking chilled water.

blue arrows) and the corresponding features in the +6 mm plot, confirming that the features reflect stomach activity conveyed via an electromagnetic wave.

The two green lines to the left of the plot mark the start and end of Patient A swallowing the chilled water, which took about 5 seconds. During the session, when Patient A drank the chilled water, this induced an ache centred on Ren-12. The lower chart indicates the intensity of the ache as reported by the patient (0-10, with 10 being the most intense and 0 being none).

It was striking that at 204 seconds, Patient A felt a distinct increase in the ache and said it was now a 9, which increase coincided with the first large spike in the left ST-36 impedance, which began at 203 seconds. The lag between these two events could be accounted for by the time taken for him to feel the ache and report it.

Fig. 2 shows greater detail in the vicinity of the green marks (the two plots now being superimposed to clearly show the contrary motion). It is said to take around 1s for water to reach the stomach after swallowing [9], and about 1s after the first swallow, the ST-

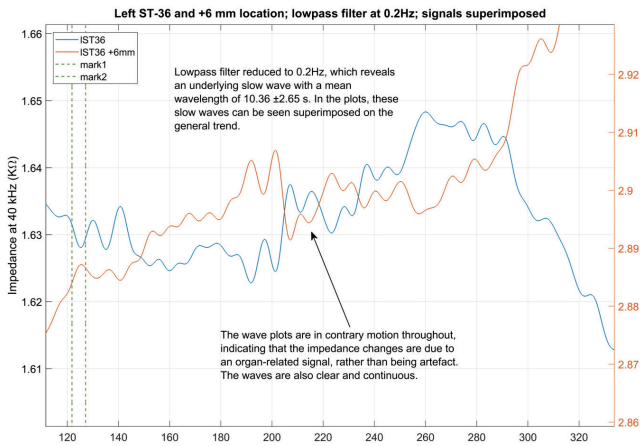


Fig. 3. Impedance readings taken at left ST-36 and its +6 mm location, with a 0.2 Hz lowpass filter applied. The plots are superimposed to show that the 10.36 seconds waves move in contrary motion in the two plots.

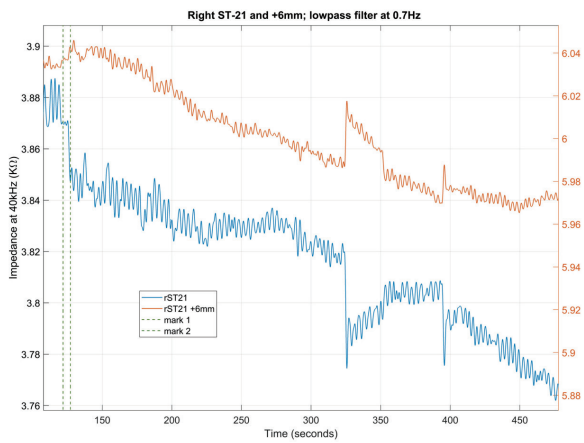


Fig. 4. Impedance at right ST-21 and at 6 mm medial. Both plots contain a pronounced, regular wave.

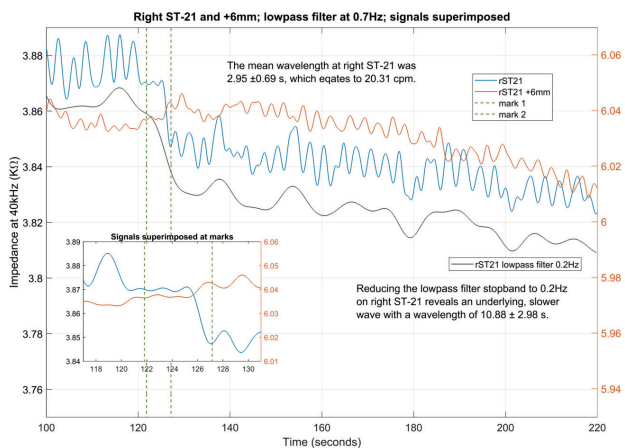


Fig. 5. Impedance at right ST-21 and at 6 mm medial, with close-up at marks (inset), the plots being superimposed to highlight the contrary motion.

36 plot shows a 3Ω dip in impedance (see inset). A decline in impedance at an acupoint can be interpreted as an increase in stress in the related organ, or reduced strength of function [1], so that the 3Ω dip could be interpreted to reflect the stress felt at the inner wall of the stomach when it was first chilled. One second later, the first notable contrary motion feature began. The feature was also a decline in impedance and it lasted for about 1.4 seconds. This could be interpreted as a reflection of the further stress felt by the stomach as its chilling continued. Similar features are also observed at 135 and 143 seconds. A unilateral decline in impedance is also seen in the +6 mm location, at 140 seconds.

As shown in Fig. 3, reducing the stop band of the lowpass filter to 0.2 Hz, revealed a regular underlying wave with a wavelength of 10.36 ± 2.65 seconds.

Right Stomach-21

Both plots in Fig. 4 showed a regular pronounced wave at right ST-21. Fig. 5 showed that this wave was present before the patient drank the chilled water; that they were greatly impeded from about 1 second before the patient's first swallow (the amplitude reducing from around 15Ω to 2Ω); and 5 seconds later, a sharp drop in the impedance at right ST-21 occurred (reflected in contrary motion at the +6 mm location). The waves then resumed their normal amplitude and continued for the remainder of the session. The 1 second anticipation in the reaction of the wave may be accounted for by the first mark having been recorded late due to the inexact method used to mark the first swallow. Alternatively, the anticipation may have been caused by the effect on the patient's stomach of his own anticipation of the Ren-12 ache that was induced the previous time he drank the chilled water.

The average wavelength at right ST-21 was 2.95 ± 0.69 seconds, which equates to 20.31 cycles per minute (cpm). However, reducing the lowpass filter's stop band to 0.2 Hz, revealed a slower, underlying wave with a wavelength of 10.88 ± 2.98 seconds.

Discussion

Ren-12 (*Zhongwan*) is the most influential acupoint for the stomach on the front of the torso. The fact that the patient felt an ache at Ren-12 in response to drinking chilled water, confirmed that stomach stress is reflected at this acupoint in real time. Furthermore, as shown in Fig. 1, the clear spike appearing at left ST-36 also confirmed that such stomach stress is reflected at left ST-36 in real time (if it is accepted that this spike was produced by a changed state in the stomach which also caused the change in the Ren-12 ache). ST-36 is situated below the left knee (78 cm distal to the stomach, in Patient A), which helps to rule out the fact that any such spikes at this acupoint may be biological artefact due to the proximity of the stomach organ.

Is there any correlate in the stomach function for the 2.95, 10.36 and 10.88-second waves shown in Figs. 3, 4 and 5?

To mix food (chyme), the stomach walls regularly contract in peristaltic waves, known as slow waves. It is generally accepted that these are of about 20-second duration, but there is controversy over this. This value was usually obtained using extracellular recordings. In 1978, Sarkawy et al [10] used intracellular recording to measure slow waves of 9.72 seconds (6.17 ± 0.2 cpm, $n = 3$) in the corpus and 14.21 seconds (4.22 ± 0.2 cpm, $n = 31$) in the antrum. In 2010, Sinn et al [11] found that phasic contractions of human fundus muscles were 14.18 seconds (4.23 ± 0.32 cpm, $n = 10$), and 12.3 seconds (4.87 ± 0.28 cpm, $n = 7$) for antrum muscles. In 2011, Rhee et al [12] used intracellular recordings to show that spontaneous slow waves are a prominent feature of

human gastric fundus muscles and that phasic contractions are coupled to these slow waves, which were found to be 10.4 ± 1.7 seconds ($n = 12$) duration in the fundus (and 9.2 ± 1.0 s in the corpus, and 4.4 ± 0.4 seconds in the antrum). Rhee's findings challenge many basic concepts of human gastric electrophysiology, and suggest that extracellular electrical recording has underestimated human slow wave frequency.

The 10.36 ± 2.65 -second impedance waves recorded at left ST-36 (Fig. 3), and the 10.88 ± 2.98 -second waves recorded at right ST-21 (Fig. 5) are comparable with the gastric slow waves at the human fundus reported by Rhee (10.4 ± 1.7 seconds). This suggests that these stomach slow waves are reflected at these acupoints. Note that the greater variation in the wavelength of the impedance waves (when compared to the original, intracellular recordings) is typical of organ information expressed at acupoints, which is discussed below.

The duodenum also features regular contractions, which are of a shorter duration. These have been greatly studied, but there is uncertainty about their duration in humans.

Regular contractions occur throughout the gastrointestinal tract. These further mix the chyme and progress it through the intestines. They are often referred to as the *migrating motor complex*; and the individual contractions have been variously referred to as the *slow wave*, the *basic electrical rhythm*, or the *duodenal pacemaker*. They can begin in the lower oesophagus, the body of the stomach, the pyloric antrum, the duodenum, or at several locations in the small intestine [13]. These contractions occur in the 3rd of 3 phases of activity. Phase 1 is the quiescent phase, where no *migrating motor complex's* occurs (which lasts around 90 minutes); in Phase 2, there is irregular activity; and in Phase 3, there are regular contractions (this phase lasting between 7 and 11 minutes, before the whole cycle repeats) [14,15]. The contractions are thought to be regulated by electrical pulses originating in the first 5-6 mm of the duodenum (sometimes referred to as the *pacesetter potential*, or alternatively as the *duodenal pacemaker*), which regulate the muscular contractions of the duodenum; and this pacesetter potential is thought to occur throughout the 3 phases mentioned above, rather than being intermittent [16]. As the contractions move through the small intestine, their frequency then gradually reduces, which occurs due to a small number of the waves ceasing during their propagation along the intestine [17].

Using electrodes surgically attached to the duodenum of dogs, the frequency of the pacesetter potential was found to be between 18.7 and 19.7 cpm in 4 different dogs, though these frequencies also varied from day to day in the same dog [16]. By measuring the mechanical contractions of the externalized duodenum in 3 dogs, it was found that these were between 17 and 19 cpm, which were a little slower than the pacesetter potential [18]. These frequencies are comparable to the 20.31 cpm recorded at ST-21 in Patient A.

However, many studies have measured the mechanical contractions of the duodenum in humans, using various swallowed, pressure-sensitive devices; and these tended to record frequencies that were notably slower, with mean values of 11.7 ± 0.1 , 11.73 ± 0.45 , and 11.8 ± 0.32 cpm [9,19,20]. But in a 1983 study, which measured the duodenal contractions in humans by monitoring the pressure exerted on a tube inserted through the nose into the stomach, the recordings at the antrum, pylorus and duodenum all showed low amplitude waves of 15-20 cpm [21]. These waves were comparable with those recorded at ST-21 in Patient A (20.31 cpm) and Patient B (17.86 cpm). However, they were notably faster than those found in previous similar studies and (perhaps due to this) the researchers chose to interpret these as artefact due to the pressure of the lungs on the stomach during respiration.

Using surgically implanted electrodes in healthy cats, duodenal

slow waves were found to be 18 cpm [22]. However, in another experiment, when cat small intestines were removed and electrodes used to measure the duodenal pacemaker in vitro, the wave frequency was found to be 14.47 ± 1.16 cpm [17].

The variability of these results fails to identify exactly what the 20.31 cpm waves in the impedance at ST-21 might correlate to. But since the waves are present at a stomach-related acupoint, this suggests that they reflect an aspect of the stomach's function. And since their frequency is similar to that of the duodenal pacesetter potential measured using surgically implanted electrodes in healthy dogs and cats, it is speculated that the waves may relate to the duodenal pacesetter potential in humans, which may be under the influence of the stomach. For brevity, in the remainder of this report, these impedance waves will be simply referred to as duodenal waves.

Could these impedance waves be artefact?

The waves are present in all the stomach-related acupoints monitored in this experiment, even both ST-36 acupoints, which are (on Patient A) about 74 cm below the start of the duodenum, which rules out any mechanical or bioelectrical artefact from the duodenum. And, more impressively, the signals are in contrary motion. If they were due to artefact of any kind, the waves would not appear in contrary motion at two locations on the skin, 6 mm apart. Such contrary motion is a feature of organ information conveyed on an electromagnetic wave and reflected at acupoints [8].

While swallowing, the patient held his breath, yet the waves were still present in the right ST-21 impedance plot, albeit at a greatly reduced amplitude (reduced from 15 to 2Ω). However, to rule out respiratory artefact, the impedance at right ST-21 was monitored again while Patient A simply held his breath, without swallowing water [23]. As in the previous experiment, the duodenal waves continued but this time they were undiminished. Further, the wavelength was 2.85 ± 0.92 seconds, while the patient's breathing cycle was 4.1 seconds, all of which rules out respiratory artefact.

The same experiment was also conducted on Patient B [23], but this time the patient held his breath and then also drank warm water (at 34.25°C) while impedance readings were taken at right ST-21 and also ST-19. The duodenal waves continued while holding his breath, and also while drinking; and the waves were not diminished by the patient drinking warm water, which suggests that this effect in the main experiment was due to the effect of the chilled water on the patient's stomach. On Patient B, the wavelength was 3.36 ± 1.53 s, which equates to 17.86 cpm (compared to 2.95 ± 0.69 s and 20.31 cpm in Patient A). This variability between patients is consistent with the results obtained in other experiments [13,16,19].

The duodenal waves appear in all ST-21 and ST-19 plots

Extra plots are available in the accompanying dataset [7], which show that the ~2.95-second waves were also present in left ST-21, and in right and left ST-19. Generally, the amplitude was less in the left acupoints (about 4Ω, whereas they were around 9Ω in the right).

The correlation with the acupoint's function

The intelligent tissue hypothesis states that organ states (malfunction as well as normal function) are reflected at each organ's related acupoints. When an organ malfunctions, this causes anomalies at key acupoints. When such an acupoint is then stimulated, this causes changes in the states at the local tissue, which are immediately propagated back to the organ and

encourage it to cancel out the malfunction in itself that caused the anomaly at the acupoint. If this hypothesis is correct, the pronounced duodenal waves in the impedance readings at ST-21 and ST-19 suggest that these acupoints ought to be particularly adept at regulating duodenal contractions.

In Chinese acupuncture, the classic indications for ST-21 include stagnation in the abdominal region, abdominal distension; and the acupoint is said to be able to transform food accumulation in the intestines, which may be characterized by palpable masses in the epigastrium. And ST-19 is also indicated for abdominal distension [24]. All these signs and symptoms could be caused by any weakness or irregularity in the intestinal contractions, which are all thought to originate in the duodenum. Through thousands of years of practice, Chinese acupuncture has found that these acupoints, and ST-21 in particular, are able to clear these signs and symptoms, which implies that these acupoints are able to regulate the duodenal contractions.

The fact that the duodenal contractions are clearly reflected at ST-21 (and ST-19) supports the association between these acupoints and such intestinal symptoms; and the implication that ST-21 is able to regulate duodenal contractions is also consistent with the intelligent tissue hypothesis on how acupuncture works (since the duodenal contractions are strongly reflected at ST-21). Hence, the hypothesis provides an explanation of why and how this acupoint is able to regulate the contractions of the duodenum— so that the hypothesis validates the classic indications, and vice versa.

Further, it may be that the stomach's slow wave was reflected more strongly at ST-36 (Fig. 3) than at ST-21 (Fig. 5), because ST-36 has a greater effect on the general stomach function than ST-21 does. This, again, would help to indicate how ST-36 achieves its effect.

Comparing the left and right acupoints

In all the acupoints studied in this experiment, there are marked differences between the impedance readings taken at the left and right instance of each acupoint, which is consistent with the results in other experiments in this research project.

Fig. 6 shows the impedance at right ST-36 and the ache at Ren-12. Comparing this with Figures 1 and 2 (which show the impedance at left ST-36), it can be seen that there is considerably more activity at left ST-36. The left acupoint shows considerably more reaction to the chilled water entering the stomach, and also has much more pronounced features corresponding with the ache induced in the stomach by the chilled water (notably at 203 seconds). Whereas at the right ST-36, there is much less response to the chilled water entering the stomach; there is a 3Ω dip about 3 seconds after the last swallow, and a similar small dip at about 200 seconds, just prior to the Ren-12 ache increasing. The impedance then gradually rises (about 34Ω in total) as the ache diminishes.

The impedance recorded at left ST-21 shows many more notable features than at right ST-21 (Fig. 7). In addition, the duodenal wave is also about half the amplitude in the left acupoint (about 4Ω, compared to 9Ω in the right). Both plots show a sharp fall (the right falling more than the left) in response to the chilled water entering the stomach, but apart from this, there are less direct correlations with the Ren-12 ache than there are at ST-36.

The impedance recorded at both right and left ST-19 show fewer features than at ST-21 (Fig. 8). However, there is still more activity in the left acupoint than the right (just as with ST-36 and ST-21); and again, the duodenal waves are about half the amplitude in the left than they are in the right. And the overall impedance trend at left ST-19 falls by 170Ω while that at right ST-19 gently rises by about 20Ω.

As with all acupoints monitored in this research project, it

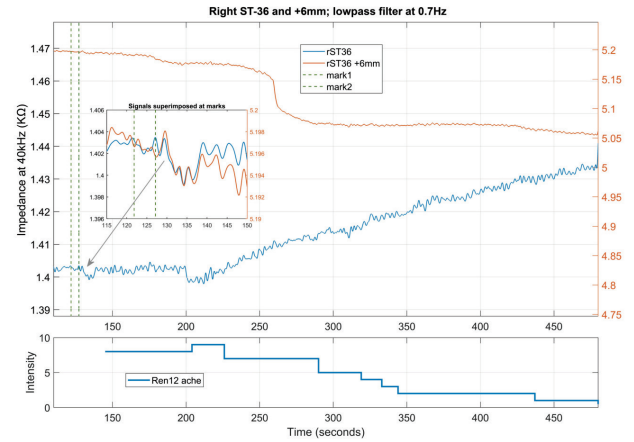


Fig. 6. Impedance at right ST-36 and at 6 mm lateral, and the Ren-12 ache.

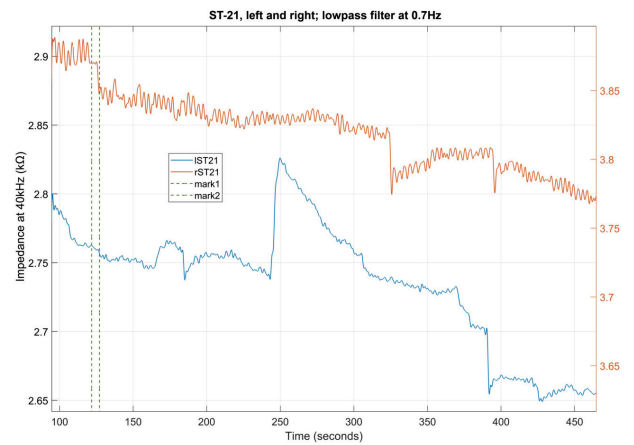


Fig. 7. Impedance at left and right ST-21.

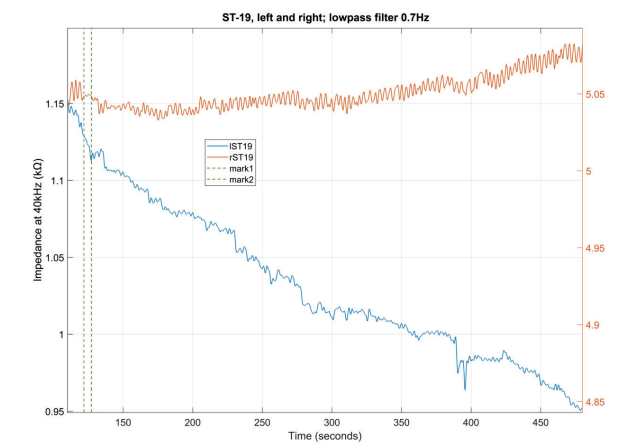


Fig. 8. Impedance at left and right ST-19.

appears that the left and right instance of each acupoint may reflect different aspects of the same organ function. One possible interpretation of this is offered by the Chinese medicine notion of *yin* and *yang*, where the left acupoint reflects the *yin* aspect while the right reflects the *yang* aspect¹. That is, the left acupoint may be considered to reflect the impact on the organ fabric (the chilling effect of the water), while the right may reflect the use of energy or resources. This, of course, is a speculative interpretation.

The variable wavelength and phase shift in the duodenal waves

In the duodenal waves captured at every acupoint in this experiment, the wavelengths varied continuously. For example, at right ST-21 the mean wavelength was 2.95 ± 0.69 seconds; yet it was rare that two consecutive waves had the same length (see spreadsheet in the dataset [7]). The shortest wavelength was 1.21 seconds, and the longest was 5.15 seconds. This pattern was repeated in the waves captured at ST-19 and ST-36. And further, in all the acupoints, there was no correlation in the wavelengths between the left and right instance of the same acupoint. For example, when comparing left and right ST-21, it was rare that a wave in the left acupoint had the same wavelength as the corresponding wave in the right; and the same was true of the other acupoints.

If the source of these waves is some aspect of the duodenal pacesetter mechanism, which is then communicated body-wide by the signal being superimposed upon a direct current, then at any one instant, it would be expected that the waves of the pacesetter would be exactly in phase and have the same wavelength at every location.

If, for example, these waves were being picked up directly by the test electrodes, as bioelectrical artefact, then the waves would be identical at every electrode.

The fact that they are not identical, but instead there are considerable phase shifts and wavelength variations between the waves at each electrode, indicates that they are not due to such artefact. This requires an explanation as to how these anomalies are introduced.

The intelligent tissue hypothesis states that information from each organ is conveyed to every location along the organ's related meridian via an electromagnetic wave. The carrier is assumed to be a direct current conducted via semiconduction, which is calculated to travel through human connective tissue at a theoretical speed of 67,000 m/s [26]. If this is the case, information from the stomach would reach all these three acupoints within 5 μ s. But the local tissue at each acupoint (the skin, muscle, body fluids, etc) must then respond to this information and change in some way, in order for the impedance at that location to change. The author suggests that it is the process of the local tissue responding to the organ information that produces the variable delay recorded in the waves at each acupoint. The variability would stem from the fact that the local tissue may respond at different speeds at different times.

If this is the case, this would explain why it was rare for two consecutive waves to have the same wavelength. When the local tissue responded quickly, this would produce a shorter wave,

¹ Note. Traditionally, left is often considered to be *yang* while right is *yin*. This convention stems from a passage in Chapter 5 of the *Su Wen*. However, from practical observations it is clear that left is *yin* while right is *yang* [25]. Interestingly, this experiment appears to confirm this. When the chilled water was swallowed, this would be expected to initially affect the fabric of the stomach (by chilling its inner surface), and the biggest response to this appears in the plots of impedance at the left acupoints, while often there is little response at the right acupoints. Since the fabric of the organ is considered its *yin*, this reaction appears to confirm that left is *yin*.

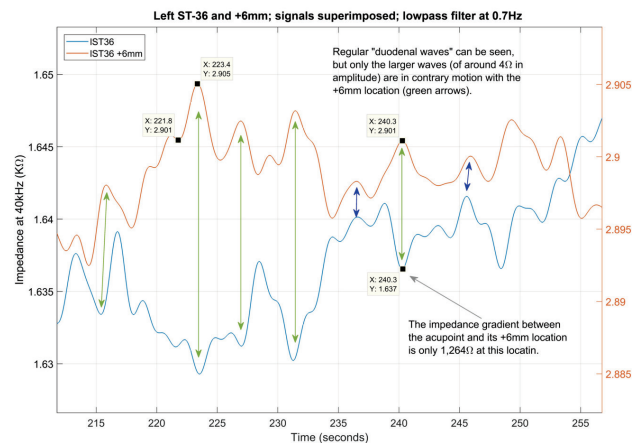


Fig. 9. Impedance at left ST-36 and 6 mm medial, showing contrary motion in larger waves only.

and when it responded slowly, this would produce a longer wave. And this response time would vary from acupoint to acupoint and from second to second, which would then account for the variable wavelengths recorded at each acupoint, and the variable phase shift.

An elaboration of the “contrary motion” rule

Though the duodenal waves appear at right ST-36 and also at its +6 mm location, they are in similar motion throughout the plots, rather than contrary motion. Does this mean that the waves at right ST-36 are artefact?

They could not be biological artefact, since ST-36 is too distal to the intestines. Another possibility is bioelectrical artefact from the duodenal pacesetter or from the muscular contractions, conveyed on a body-wide electromagnetic wave and picked up directly by the test electrodes. However, the similar waves at left ST-36 are mostly in contrary motion with those at its +6 mm location, which rules out such artefact in the left ST-36 waves; and by extension, this implies that these similar waves at right ST-36 are also not artefact of this type. Also, waves due to such artefact would have a wavelength that is as regular as the duodenal pacesetter's waves, which these are not; they share the same variability as all the other duodenal waves recorded in this experiment.

The waves recorded at left ST-36 and at its +6 mm location suggest an explanation. As shown in Fig. 9, between 215 and 250 seconds, there are clear duodenal waves; the larger ones (with an amplitude around 4 Ω) are usually in contrary motion with those at the +6 mm location (as shown by the green arrows), but the lesser peaks are in similar motion with those at the +6 mm location (the blue arrows). This suggests that the contrary-motion rule only applies when the waves are above a certain amplitude, and that waves below that amplitude may appear in similar motion with the +6 mm location, even though they reflect genuine organ-related information conveyed on an electromagnetic wave.

Other factors that may affect the contrary-motion tendency is the impedance gradient between the two locations (this gradient is only 1,264 Ω at left ST-36, but at right ST-36 it is around 3,778 Ω), and also the placement of the primary electrode. If this is not placed exactly at the centre of the acupoint, this may inhibit the contrary-motion phenomenon. Further testing needs to be done to explore all these factors.

In summary, the duodenal waves were featured at all the

test acupoints. Those at right ST-19 and ST-21 had the greatest amplitude, and correlate with the traditional indications for those acupoints. The duodenal waves at both ST-36 acupoints were of a lesser amplitude, and their presence at this acupoint may reflect the fact that ST-36 is one of the most powerful stomach-related acupoints which can affect a wide range of stomach-related conditions. Amongst others, these include epigastric pain, distension and pain of the abdomen, borborygmus, flatulence, diarrhoea, and undigested food in the stool [27], all of which could be treated by the regulation of these intestinal contractions. Therefore, the presence of these waves at ST-36 also correlates with the acupoint's traditional indications.

Other experiments in this project (as yet, unreported) have now established that pacesetter waves (including the respiration pacesetter) are present body-wide in the tissue, rather than restricted only to meridians; but that filtering takes place at the meridians, which affects the amplitude of the related organ's pacesetter waves. This explains why the current results show mainly duodenal waves, rather than respiration pacesetter waves. The author's investigation of this phenomenon is ongoing, and the detailed findings will be published in future papers.

The data reported in this current paper was collected from only two patients. At this early stage in this research project, it is only the intention to identify general principles. There are many facets to this mechanism that acupuncture utilizes (most being beyond the current knowledge of contemporary physiology) and there are also many variables. All these factors need to be understood before a sensible multi-patient trial could take place which monitors the real-time correction of organ malfunction by acupuncture.

Conclusion

Detailed information relating to stomach function was reflected in real-time in the impedance at the stomach-related acupoints ST-19, ST-21, and ST-36. For the impedance to change at any location, it is necessary for physical changes to occur in the local tissue. Since the recorded impedance values closely reflected states in the stomach, the results suggest that the local tissue at each acupoint responds in real time to information from the related organ. This implies that the physical makeup of the local tissue at these acupoints is constantly varying in a pattern that reflects the function of the related organ: the stomach and duodenum.

When the stomach was shocked by the ingested chilled water, the effects of this were also immediately communicated to these acupoints, notably in diminished impedance values, which were interpreted to reflect diminished stomach function. Left ST-36 also reflected the ache that was induced at the key stomach acupoint Ren-12. These results suggested that some aspect of the local tissue must also vary to reflect the overall strength of the related organ's function.

These results are consistent with the author's hypothesis that an organ's states are reflected in real time at its related acupoints; and are also consistent with his hypothesis that acupoints and meridians consist of tracts of distal tissue affected by organ function [28]. These phenomena merit further detailed study.

Due to this responsiveness in body tissue, the tissue could be understood to be constantly interpreting organ information that is probably conveyed via an electromagnetic wave. Hence, the author's hypothesis on how acupuncture works could be described as the "intelligent tissue" hypothesis.

Conflicts of Interest

The author received no financial contribution towards the design

or conducting of this research, nor towards the preparation of this article.

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