Assessment of Qigong-related effects by infrared thermography: a case study

Luis C. Matos1, Mário J. Goncalves1,2,3, António R. Silva4, Joaquim G. Mendes4, Jorge P. Machado1, Henji J. Greten1,2,3
1. Institute of Biomedical Sciences (ICBAS), University of Porto, 4099-020 Porto, Portugal
2. German Society of Traditional Chinese Medicine, 69126 Heidelberg, Germany
3. Heidelberg School of Chinese Medicine, 69126 Heidelberg, Germany
4. Department of Mechanical Engineering, Faculty of Engineering, University of Porto, 4200-465 Porto, Portugal

KEYWORDS: Qigong; thermography; infrared rays; TCM theories; case reports

A contemporary understanding of traditional Chinese medicine (Heidelberg Model of TCM) considers TCM to be a traditional model of system biology. This model focuses on the fact that the core technical terms of TCM such as yin, yang and the phases or elements may be understood as terms of vegetative regulation. Hence TCM diagnosis is understood as a comprehensive description of the vegetative functional state of a patient.

Qigong is a therapeutic method of TCM and combines slow and soft movements with breath control and a specific mental state of “awareness” and imagination. The traditional explanation of Qigong-related effects is that qi flow and homeostasis (balance of yin and yang) are promoted. Many findings on the physiological basis of Qigong-related effects remain contradictory or have not been reproduced on a sufficient scale. From a Western standpoint these exercises may be understood as traditional vegetative feedback exercises. This was the reason why the authors are searching for consistent vegetative functional changes during Qigong exercise.

As the authors were experimenting with a special kind of Qigong, the “White Ball” system, consistent changes of skin temperature by infrared thermography were observed, which were shared with other researchers so as to objectify vegetative Qigong-related effects in the future. Unlike other qi exercises, the “White Ball” system only takes some 5 to 6 min to perform, but apparently has some clinical value. A subjective qi sensation is evoked relatively easily and quickly.

1 Cases for study

In the first case study, a male Caucasian, aged...
37 years, presenting in an overall healthy state, with three years of regular Qigong practice, volunteered in a probationary application of a thermography camera for measuring Qigong-related effects. The Qigong exercise selected for this study was the “White Ball”. The main aspects of this exercise are well described by Greten[6], Johnson[7] and Jin[8] with regards to posture, breathing and mind focus. In brief, this traditional exercise system is based on posture control, but does not require movements which would possibly interfere circulatory activation. The image of holding a rice paper ball in front of the lower dantian almost immediately evokes a so-called qi sensation. Control interventions in Qigong are a difficult matter, as so far no placebo Qigong exists. As a preliminary control intervention (PCI), the control performed precisely the same exercise and only omitted the part in which the mental imagination of the rice paper ball between the hands combined with “awareness” was obtained.

Experiments were performed at a mean room temperature of 20 °C measured with a type K thermocouple connected to a Labfacility digital thermometer, model 2000L. An infrared camera from a forward looking infrared radar (FLIR), model A325 (sensitivity < 0.07 °C; precision ±2%) was used and supported by a tripod placed 2 m away from the individual. Capture and image analysis were carried out with the program ThermoCAM Researcher Pro 2.9 from the FLIR system, and the recording frequency was one photo every 10 s. For later comparison of methodologies in Qigong, we defined the vegetative activation time as the time to increase temperature by 1 °C on the tip of the middle finger.

We also studied the phenomenon in a group of seven children to evaluate whether the changes observed in the first case study could be regularly confirmed. This group of Caucasians, aged between 10 and 12 years, six females and one male, were students of a transverse flute of a municipal music academy in Portugal. They took part in a training program of “White Ball” Qigong for performance-related anxiety over seven weeks[8]. The program was part of a master study of Oporto University, and the children were also routinely examined for a number of other vegetative variables (data not shown). After the observation within the individual, we performed additional infrared thermography in these children. The study was approved by the ethical commission of Oporto University according to the Helsinki Declaration, and informed consent of the children and their parents was obtained.

Measurements were taken in a similar manner as in the individual mentioned above prior and after the seven-week Qigong training program.

2 Results

The first individual thermography indicated changes in local microcirculation (MC) during the exercises (Figure 1).

![Figure 1: Thermograms of the Qigong exercise](image)

A: Before exercise; B: After 600 s.

The thermography measurement showed that “White Ball” exercises could change temperature of the fingers within this individual. Changes in skin temperature such as this may be interpreted as an increase of MC.

The PCI measurements resulted in a lack of subjective qi sensation, and the typical changes in finger MC did not appear, resulting in pictures similar to Figure 1A (not shown).

Furthermore, in PCI measurements no subjective qi sensation was observed in the fingers, and
neither normal natural breathing nor so-called forced (abdominal) breathing would evoke changes in MC. However, when the special mental state of awareness was achieved and the qi sensation was felt, skin temperature increased to up to 37 °C. Moreover, when abdominal breathing was used, the activation time was lower and the increase in temperature was quicker.

Regarding the question whether the findings can be generalized is of importance to confirm TCM theory and the explanatory models of TCM, as a first step we therefore added more cases of “White Ball” trainees and measured them by the same infrared thermography. These further measurements were performed in school children as described above after seven weeks of training. Increases in temperature were also evident in five out of seven of these children as can be seen in Figure 2. Two children were described as noncompliant with the exercises, not reaching consistent qi sensations (C and G). The others showed noticeable increases of temperature on the tip of the middle finger after “White Ball” training of seven weeks (average increment of 9 °C and a maximum of 13 °C for children E).

The vegetative activation time was less than 2 min in all compliant individuals tested, which confirms that the empirical application time of only 5 to 6 min may be enough to change vegetative functions.

![Temperature on the tip of the middle finger of seven children (A to G) at the beginning and the end of the Qigong exercise](image)

3 Discussion

In a PCI we were able to show differences which seemingly were only caused by a change in the mental attitude and imagination, a valuable hint for the further development of control interventions. Vegetative activation in the form of a temperature difference could be generalized to compliant participants.

We hope that our observations support the build-up of objective study designs in general. As the verum intervention of “White Ball” Qigong is short and seems to change vegetative parameters, a short control intervention might be easier to find than one for longer exercises which, by their length, may carry more unspecific and suggestive effects.

Further problems of objective Qigong studies are the development of blinding and double-blinding procedures to find further objective, consistent and reproducible parameters, the further standardization of verum Qigong and the development of placebo exercises.

Qigong belongs to the framework of TCM, and it has been suggested that TCM diagnosis may define the functional vegetative status of the human system biology\[1,3,4\]. If the observations of this case study could be further generalized, they would be compatible with both the classical TCM postulates and the explanatory Heidelberg Model of TCM in some aspects.

4 Conclusion

The qi sensation may indicate some functional vegetative change in the tissue. Qi was related to the vegetative functional capacity of a tissue or organ which may evoke the sensation of flow, tearing or pressure. Blood-related clinical effects of TCM, like activating body regions, warming, moisturizing, nourishing, etc., were related to some aspects of MC according to the Heidelberg Model. Even the symptoms of the hyperdynamic state of blood (heat or calor) were related to local and systemic effects of MC\[1,3,10\]. If an increase in MC would mean an activation of the “energy” known in TCM as blood, the observations would be compatible with the postulate that “qi guides blood”, as qi sensation seems to be a necessity to increase MC (blood). If a homeostatic or regulatory effect of the exercises exits, according to TCM this may be due to warming all the bodies conduits or meridians (the fingers contain the “wells” of all six pairs of conduits/meridians according to the Shanghanlun), or activating the phases or elements which are associated with the fingers as frequently used in tuina and hand acupuncture.

5 Acknowledgements

We would like to thank Petra Fröschen, Heidelberg School of Chinese Medicine, for writing and editing assistance and for reviewing the manuscript.

6 Competing interests

The authors declare that they have no competing interests.

REFERENCES


13 Lin S. Research leading to a systems/cellular/molecular model for the benefits of Qigong and Tai Chi on health and healing. In: Scientific and Skill Papers on Qigong, published in coordination with The World Qigong Forum 2007 and 10th World Congress on Qigong and Traditional Chinese Medicine, Tokyo. 2007: 3-8.


**使用温度记录法衡量气功的治疗效应**

Luis C. Matos¹, Mário J. Goncalves²,³, António R. Silva³, Joaquim G. Mendes¹, Jorge P. Machado¹, Henry J. Greten¹,²,³

1. Institute of Biomedical Sciences (ICBAS), University of Porto, 4099-020 Porto, Portugal
2. German Society of Traditional Chinese Medicine, 69126 Heidelberg, Germany
3. Heidelberg School of Chinese Medicine, 69126 Heidelberg, Germany
4. Department of Mechanical Engineering, Faculty of Engineering, University of Porto, 4200-465 Porto, Portugal

**关键词**: 气功; 温度记录法; 红外线; 中医学说; 病例报告