Original Paper

A New Method in Auricular Medicine for the Investigation of the Nogier Reflex

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Key Words

Auricular medicine · Auricular therapy · Nogier reflex · Reflex auriculo-cardiac · Vascular autonomic signal · New method · Ear acupuncture · Image recognition

Abstract

Background: Although there is as yet no scientific consensus on this topic, the Nogier reflex or reflex auriculo-cardiac (RAC; also vascular autonomic signal) is an important method in auricular medicine. This article introduces a new methodological approach for the detection and quantification of the RAC. **Methods:** A new high-resolution imaging technique for the registration of pulsatory surface changes might allow the RAC to be quantified reproducibly for the first time. The method combines an innovative microscope system (available at the Medical University of Graz), video analysis software, and special image processing software (from the Beijing University of Science and Technology). **Results:** Even small, pulse-dependent alterations of the skin surface could be clearly visualized. **Conclusion:** The pilot measurement confirmed the validity of the new methodological approach. Further investigations are necessary and in progress.

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Introduction

In the 1950s, Paul Nogier introduced the reflex auriculo-cardiac (RAC; also Nogier reflex or vascular autonomic signal) [1, 2]. The RAC, according to Nogier, is a short-term reaction of the human circulation to different kinds of acupuncture point stimulation of the ear [3]. This

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Fig. 1. Principle of the video analysis method carried out by the MIT. Modified from [8].

reaction is supposed to last for a few seconds and can be felt and used for diagnostic purposes by experienced therapists. However, it should be mentioned critically that RAC diagnosis is not yet generally acknowledged by the scientific community [4–7]; therefore, in the authors' opinion, it represents one of the complementary medical methods that needs new investigative approaches and methodical strategies.

In September 2014, a popular scientific journal published a video [8] demonstrating a new video processing method, which had been developed by the Massachusetts Institute of Technology (MIT) in Boston. In this film sequence, the human pulse is made visible, and it is stated that this method should be introduced soon. The principle and the technical realization of this video method can be seen in figures 1 and 2.

The first two authors of this paper agreed that this method might be useful in RAC research. On closer inspection, however, it was found that this method would only yield limited new evidence with regard to the RAC, not least because of its low resolution. A new approach was needed. Therefore, the research group at the Medical University of Graz started testing a direct way of amplification at a high resolution. The aim of our method is to directly 'amplify' and show images of that part of the skin surface where the RAC is usually felt, using state-of-the-art technical methods.

The results of a pilot measurement are introduced in this article, underlining the fact that our new approach might indeed be a future-oriented option in RAC research.

Methods

First test measurements were carried out in November 2014 (fig. 3), using an innovative microscope system available at the Institute of Pathophysiology and Immunology at the Medical University of Graz as of July 22, 2014: an Olympus fluorescence stereomicroscope SZX16 and the dimension software package (Olympus; Shinjuku, Tokyo, Japan).

Having detected the changes of the pulse under the microscope and registered the video signals using appropriate software packages, it is planned to analyze single images or image sequences comprehensively with sophisticated mathematical methods. This should be done using special image processing programs developed at the Beijing University of Science and Technology [9]. This software allows the presentation of changes within image sequences

Fig. 2. Technical implementation of the MIT video method. Modified from [8].

Fig. 3. Experimental set up and first RAC test measurement for high-resolution imaging of pulsatory surface changes at the laboratory of the Institute of Pathophysiology and Immunology at the Medical University of Graz on November 5, 2014.

using special mathematical algorithms; as a consequence, these alterations become quantifiable. A further goal will be to replace the complex mathematical image processing programs by standard software, thus simplifying analysis. A diagram representing the new procedure to visualize dynamic structures on the skin surface at the radial artery can be seen in figure 4.

The area, e.g. at the radial artery (fig. 4a), is amplified using a special microscope (fig. 4b) and can be presented digitally with analysis programs (fig. 4c). Tiny hairs (black structures in fig. 4c) in the selected area serve as a token of scale. With the application of the image analysis software from the Beijing University of Science and Technology (fig. 4d), special areas can then be magnified (fig. 4e). This can be repeated many times until only single pixels remain (areas framed red in fig. 4f and 5). Such areas appear pulse synchronously because of

Fig. 4. Schematic illustration of the new method for the quantification of surface changes.

the change of position of the surface relative to the microscope in the area of the vessel to be investigated, and the regions of interest can then be quantified by analyzing the single pixels. Using this approach, a quantification of the RAC seems possible.

Results

Some of the results of the pilot registration can be found in figure 5. Sixteen images (a–p), representing the chronology of 4 s, can be seen in figure 5. The two-dimensional surface changes that can be visualized during the dynamic process of the pulse beat are clearly seen. These visualized alterations of the surface at the radial artery serve to quantify possible stimulation-induced changes in the surface tension of a vessel (RAC), which up to now could only be palpated by specially educated therapists.

Discussion

On one of his websites, Raphael Nogier, Paul Nogier's son, reports that there have been several attempts to prove the RAC beyond any scientific doubts since the 1970s [10]. Unfortunately, these attempts lack convincing results and a scientific consensus with regard to this question [11].

In a promising study, Moser et al. [12] were able to find equivalents of the Nogier reflex using modern circulatory-physiological measurement methods. They investigated 10 volunteers with a sensor jacket originally developed for space aviation medicine and found tran-

Fig. 5. Visualization of surface changes in the area of the pulsating radial artery. Note the alterations appearing during the ‘maximum pulse’ (regions of interest framed red; color refers to the online version only).

sient heart rate decelerations as well as biphasic changes of velocities and pulse amplitudes in arteries on the arm. The chronological sequence of these phenomena corresponded well with subjective descriptions of the RAC [12]. However, the authors stated critically that an interference-free proof of the RAC was not possible with the chosen methods at that point in time, and that ‘feasible’ results could only be achieved using averaging procedures [12].

The methods applied in our pilot measurement take a different approach. A therapist’s fingertip sensorium seems to be able to detect tissue changes and hence surface tension subjectively, also with regard to direction. Using innovative instruments, the new method aims to visualize even the smallest stimulation-induced changes of the skin surface and the arteries beneath. The authors are of the opinion that research on the topic of the Nogier reflex will play an important role in integrative medicine [13, 14], especially in acupuncture research.

In a pilot measurement, we have been able to show that the method developed at the TCM Research Center Graz (a combination of a high-tech microscope and analysis software, followed by sophisticated mathematical image processing) is able to visualize changes of the pulse beat reliably, be they ever so small. The next step will be to test whether direction phenomena [a shift of the pulse wave under the therapist’s palpating thumb tip towards the patient’s thumb (positive RAC) or in the other direction (negative RAC)] can also be quantified with the new procedure in order to further investigate reflex-based changes and

the underlying changes in blood flow velocity. Further experiments might deal with the RAC topic and laterality, as performed recently in a body acupuncture point laterality study [15].

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Disclosure Statement

The authors declare that there are no conflicts of interest concerning the publication of this article.

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