Acupuncture and heart rate variability

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The rhythm of life in general, and that of the heart in particular, has always been of interest to physicians and lay people all over the world. Ancient Chinese physicians examined the pulse of the patient’s radial artery as a part of their diagnostic procedure. Through interpretation of the pulse the physician could get access to knowledge, somehow tacit, in terms understood then as the primary disharmonies in patients. In ancient times, advice and treatment were given accordingly, and later an anticipated change in the pulse should be seen as necessary for a noticeable change in the patients’ health. Balance is still, as in old times, an important aspect of acupuncture, but now formulated with questions like ‘Does acupuncture regulate autonomic functions?’ Quite a few studies indicate that it does.1–5 One aspect of this regulation is a change in sympathetic or vagal activity. Ways of quantifying such autonomic regulation are of importance in research. Heart rate variability (HRV) has been suggested as being an important step in this direction.6 However, the significance and meaning of the many different measures of HRV are more complex than generally appreciated and there is a potential for incorrect conclusions and for excessive or unfounded extrapolations.6

For quantifying HRV, two major constituents are used: spectral powers at the low frequency (LF; 0.04–0.15 Hz) and high frequency (HF; 0.15–0.4 Hz) oscillations of the heart period. The former is thought to represent the sympathetic modulation and the latter is more often considered as an index of vagal/parasympathetic modulation. However, the utility of HRV as an index of sympathetic and vagal modulation of the heart is still under dispute, and its relevance to underlying physiology is far from established.7

Among the spectral indices of autonomic control, the non-normalised HF power of heart period spectrum appears to be the most reliable. It reflects, to a certain extent, vagal modulation of heart rate. In contrast, several studies suggested that LF power is a marker for both sympathetic and vagal influences. This makes interpretation of changes in LF power challenging. On the basis of presumed correspondence between LF and HF powers and sympathetic and vagal modulation of heart rate, it has been suggested that the normalised spectral power (for example, HF/(LF+HF)) may reflect shifts in ‘sympatho-vagal balance’. However, the use of normalised powers poses a serious problem: normalising the spectral powers to each other introduces a significant mathematical confound, and results in an illusion of so-called ‘sympatho-vagal balance’. For example, an increase in LF power, without any change in HF power, unavoidably results in an artificial reduction of the normalised index (because the denominator increases). From this, one would conclude that the ‘balance’ shifted away from vagal control and the vagal modulation of the heart rate is reduced. Yet, in this case, non-normalised HF power suggests that vagal modulation did not change. This hypothetical example demonstrates the erroneous conclusion that would follow from the use of normalised HF power. In fact, the use of normalised powers can dissociate the spectral power from the physiology. For example, cholinergic blockade almost completely eliminates fluctuations in heart period, yet normalised units may show substantial changes in LF and HF spectral powers (−32% and +74%, respectively) despite an almost monotonic heart rate (only a 9% change) and despite the lack of change in muscle sympathetic nerve activity.8 (It should be noted that the ultimate effect of the cardiac autonomic control is on the heart rate.) Therefore, in the absence of direct measurements of vagal and sympathetic activity (eg, via microneurography), reliable conclusions regarding the modulation of autonomic control cannot be drawn from normalised spectral powers. Hence, careful extrapolation of the results from spectral indices of HRV is warranted.

There is a peaceful atmosphere in ancient pictures of pulse-taking in China: both the doctor and the patient seem to be calm. Similar calmness is important when measuring heart rate to assess HRV, and all external factors that may disturb the person under measurement must be reduced to a minimum. Also, the position of the patient is a confounding factor in measurements and should be stated: hence normally all heart period data for quantifying HRV should be acquired when the person in supine position. In addition, it is essential to control, or at least to account for the breathing rate of the subjects during the recording session. This is important because the HF spectral power of the heart period fluctuations (0.15–0.4 Hz) are substantially modulated by breathing, and any observed change in spectral power during recording sessions may simply be because the subjects’ breathing rate changes.

Several studies on acupuncture and HRV have been published, including studies where autonomic regulation may be of importance both for understanding acupuncture and the disease in western medical terms, for example, migraine.9 A recent systematic review concluded that sham controlled RCTs showed variable results and no clear evidence that acupuncture has any specific effects on HRV.10 Therefore,
more rigorous research appears to be warranted.

In this issue of Acupuncture in Medicine, Wright and Aickin put in writing their results related to acupuncture, hot flashes and HRV.\textsuperscript{11} Their conclusions suggest that acupuncture does not change HRV in the participants of their study. Studies on HRV and hot flashes are few, and recent studies draw attention to the role of autonomic control during a hot flush. Altered autonomic regulation has been reported during a hot flush, for example, a decrease in the vagal control; understanding this better may lead to an increase in our knowledge about the physiology of hot flashes.\textsuperscript{12}

In an era of reduced funding for acupuncture and complementary and alternative medicines research in general, Wright and Aickin raise another important aspect of research: the use of early phase studies.\textsuperscript{13} Some important issues when using this methodology are:

1. Early phase studies should make mistakes;
2. The early phase question is whether or not to proceed with further research;
3. Early phase studies should be small.

‘Early phase research allows for innovation, including uncovering novel, unexpected, and even controversial findings that potentially provide new insight and understandings.’\textsuperscript{14}

Acupuncture seems to have found its place among postmenopausal women for treatment of hot flushes, and several studies have reported decreased frequency and substantial patient benefit. So far, HRV has not explained any mechanisms behind the reported effects on hot flashes. However, it is yet too early to close down the use of HRV in acupuncture research on the autonomic nervous system. However, one should be careful in extrapolating the results from spectral indices of HRV to conclusions about autonomic regulation. The use of spectral indices of HRV may not reflect autonomic control fully, may be divorced from underlying physiology, and therefore, may lead to erroneous conclusions. (Mis)use of a method in other publications should not be a justification of its repeated use.

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