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Sympathomodulatory effects of Saam acupuncture on heart rate variability in night-shift-working nurses

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Heart rate variability;
Hierarchical Bayesian model;
Night-shift work;
Saam acupuncture

Summary
Objective: We assessed the effects of Saam (traditional Korean) acupuncture on the autonomic nervous system in night-shift nurses using power-spectral heart-rate variability (HRV) analysis.
Methods: This study had a 2×4 cross-over design with a series of six ($n = 1$) controlled trials. Six night-shift nurses were randomly divided into two groups, and each nurse received four acupuncture treatments on the third day of night-shift work. One group started with Saam acupuncture (gallbladder jeonggyeok), while the other started with sham acupuncture. Saam acupuncture and sham acupuncture were applied in turn. HRV was measured before and after treatment. For statistical analysis, the results of the two groups were combined, and a Bayesian model was used to compare the changes in HRV values before and after treatment, between Saam and sham acupuncture.
Results: As the ratio of low- to high-frequency power (LF/HF) for HRV increased on the third day of night-shift work in the pilot study, HRV measurements were made on the third day. Compared with sham acupuncture, Saam acupuncture reduced sympathetic activity; the overall median treatment effect estimate in LF normalised units decreased by −17.4 (confidence interval (CI): −26.67, −8.725) and that for LF/HF decreased by −1.691 (CI: −3.222, −0.3789). The overall median treatment effect estimate in HF normalised units increased by 17.41 (CI: 6.393, 27.13) with Saam acupuncture, suggesting an increase in parasympathetic activity.
Conclusion: Saam acupuncture may attenuate the imbalance between sympathetic and parasympathetic activities induced by night-shift work in nurses.

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Nursing involves many stressors such as conflicts with physicians, heavy workload and uncertainties regarding treatments.[1] Night-shift work has also been reported as a major source of stress.[2] Shift work can influence cardiac dysfunction such that the heart-rate-corrected QT interval is significantly longer during the shift, resulting in increased risk for cardiovascular mortality.[3] Work performed at night decreases heart-rate variability (HRV), suggesting reduced cardiac sympathetic modulation, and this may play a role in the excessive rate of cardiovascular disease in shift workers.[4] A clinical study of 141 shift-work nurses revealed an increased negative effect on the nurses after shift work, and all subjects had sleep disorders.[5] Although the pathophysiology underlying shift-work-related disease is poorly understood, shift work in nurses may cause a sympathodominant state attributable to depressed vagal tone, resulting in a significant increase in the ratio of low-frequency (LF) to high-frequency (HF) power (LF/HF) and LF components of HRV.[6]

Stress is commonly defined as the inability of the body to adapt to stimulation or change.[7] An analysis of HRV is used as a reliable and non-invasive indicator of autonomic nervous system (ANS) sympathovagal balance following stress.[8,9] After stress, HRV shifts towards sympathetic predominance as a result of parasympathetic withdrawal.[10,11] Positive emotions may increase the HF components of HRV, indicating that parasympathetic nerve activity and negative emotion may increase LF components of the sympathetic nervous system.[12] In addition, the LF/HF ratio reflects the balance of sympathovagal activity, with a high LF/HF ratio indicating hyperactivity of the sympathetic nerves.[13] Notably, the relationship between ANS dysfunction and various cardiovascular diseases such as arteriosclerosis, ischaemic heart disease, acute heart failure, myocardial infarction and arrhythmia is associated with an increased LF or LF/HF ratio, reflecting sympathetic prodominance.[14,15]

HRV changes according to sleep stage; very low frequency and LF powers are higher, whereas HF power is lower during rapid eye movement (REM) sleep compared with levels during stages 2 and 4 of non-REM sleep. Thus, the highest LF/HF ratio occurs during REM sleep.[16] Sleep disturbances may influence ANS activity.[17] Acute sleep deprivation has been associated with increased sympathetic and decreased parasympathetic cardiovascular modulation,[18,19] and chronic sleep deprivation results in decreased HF, LF and total frequency powers.[20] These ANS imbalances may affect health. Therefore, the appropriate restoration of ANS function is necessary to ensure good health.

Several studies focussing on the effect of acupuncture on the ANS have suggested that acupuncture modifies the ANS,[21–23] although one study reported an inability to determine whether the effects of acupuncture were due to the activity of the sympathetic or the parasympathetic nervous system.[24] Nevertheless, acupuncture induces a significant decrease in LF and LF/HF.[25]

Saam acupuncture is a form of traditional Korean acupuncture, and gallbladder jeonggyeok (GB jeonggyeok) is a specific form of Saam acupuncture that focusses on the GB channel to control the spirit and sedate the mind. GB jeonggyeok is frequently used to treat insomnia and stress in Korea. It may also influence the ANS, but no study has examined this aspect. Thus, we investigated whether

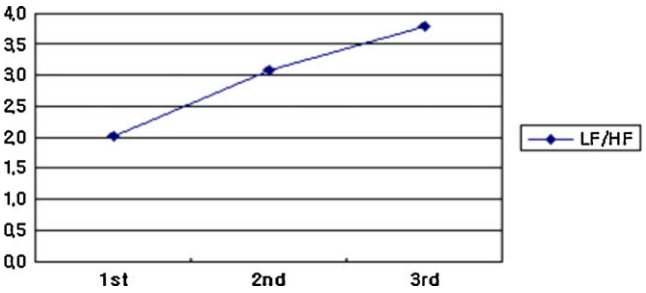

Figure 1 Changes in the mean LF/HF ratio in two nurses after night shifts.

GB jeonggyeok modifies the ANS by assessing HRV before and after treatment with both GB jeonggyeok acupuncture and sham acupuncture in night-shift nurses, using $n = 1$ trial methodology.

Materials and methods

Subjects

The subjects were night-shift nurses working at Kangnam Korean Hospital in Seoul, South Korea. We included healthy night-shift nurses with no major health problems related to the ANS. The potential participants were informed that they would receive physiotherapy advice and acupuncture with one of two different types of acupuncture needles. All study participants provided written, informed consent, and the study was approved by the local ethics committee.

Pilot study

Two female volunteers participated in a pilot study to determine the optimal time for acupuncture treatment during night-shift duty. The subjects worked the night shift once or twice each month, for 3 consecutive days. We measured HRV in the two subjects each day of night-shift duty, and the LF/HF ratio was found to be highest on the third day (Fig. 1).

Study design

The study involved a series of six $n = 1$ controlled trials of acupuncture for ANS imbalance. Fig. 3 illustrates the study design. After obtaining written, informed consent, a study nurse conducted a baseline research assessment. The subjects were randomly divided into two groups, A ($n = 3$) and B ($n = 3$), and were tested at around 08:00 on the third day of night-shift work. Fig. 2 illustrates the testing pro-

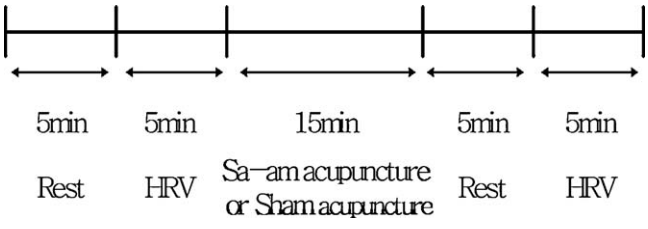

Figure 2 Sequence for heart rate variability (HRV) testing.