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Circadian clock and cardiac vulnerability: A time stamp on multi-scale neuroautonomic regulation¹

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Cardiovascular vulnerability displays a 24-hour pattern with a peak between 9AM and 11AM. This daily pattern in cardiac risk is traditionally attributed to external factors including activity levels and sleep-wake cycles. However, influences from the endogenous circadian pacemaker independent from behaviors may also affect cardiac control. We investigate heartbeat dynamics in healthy subjects recorded throughout a 10-day protocol wherein the sleep/wake and behavior cycles are desynchronized from the endogenous circadian cycle, enabling assessment of circadian factors while controlling for behavior-related factors. We demonstrate that the scaling exponent characterizing temporal correlations in heartbeat dynamics over multiple time scales does exhibit a significant circadian rhythm with a sharp peak at the circadian phase corresponding to the period 9-11AM, and that this rhythm is independent from scheduled behaviors and mean heart rate. Our findings of strong circadian rhythms in the multi-scale heartbeat dynamics of healthy young subjects indicate that the underlying mechanism of cardiac regulation is strongly influenced by the endogenous circadian pacemaker. A similar circadian effect in vulnerable individuals with underlying cardiovascular disease would contribute to the morning peak of adverse cardiac events observed in epidemiological studies.

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