Analysis of Circulatory Hemodynamics and Stress Response in SHR and WKY with a Telemetry System.

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Purpose : We continuously measured blood pressure (BP), heart rate (HR) and activity (ACT) in conscious and unrestrained experimental animals for a long term with the use of a telemetry system for chronic experiments. HR and BP changes were monitored according to the ACT in the circadian rhythm. In order to estimate the effect of various drugs on circulatory hemodynamics (CH) or the responses to stress in using this system, it is necessary to evaluate the relationships between ACT, HR, BP and circadian rhythm at first. In the present study we evaluated the differences of CH and its responses to stress in SHRs and WKYs.

Methods : Male SHRs and WKYs of 16 weeks old were used. A sensor catheter was inserted into the abdominal aorta and a transmitter was fixed in the peritoneal cavity under halothane anesthesia. Each rat was kept separately in a cage at 24°C with a light-dark condition (light on at 6:00, light off at 18:00), and given rat chow and water freely. Signals were recorded every 5 minutes in a computer for 40 days. The right side of the jaw was raised 2.5mm by bite raising sprints as stress in the oral region. The sprints were maintained for 20 days.

Results : On the first day of implantation surgery of the transmitter, ACT of SHRs and WKYs decreased remarkably, and HR increased significantly compared with the stabilization period. Compared with the stabilization period, systolic blood pressure (SBP) and diastolic blood pressure (DBP) increased significantly in WKYs but not in SHRs. SHRs and WKYs were allowed at least 7 to 10 days after surgery to recover stable BP, HR and ACT. In the stable recovery stage, circadian rhythms of ACT and HR were observed in SHRs and WKYs with a peak around 2 a.m., but the circadian rhythm of BP was not clear. There were no significant differences in HR between SHRs (226 beats/min) and WKYs (247 beats/min) at rest time (activity 1 count/5min), and HR at ACT of 50 counts/5 min was increased (305 beats/min and 327 beats/min). SBP and DBP at rest was significantly higher in SHR than WKY (168/118mmHg SHR, 122/89mmHg WKY). BP at ACT of 100 counts/5min increased to 186/132mmHg in SHRs and 131/96mmHg in WKYs. This indicated a statistically positive correlation of the increments of SBP and DBP which were followed by an increase of ACT and HR; the increment rate was larger in SHRs. After the bite raising sprints were placed, ACT and HR in SHRs and WKYs decreased remarkably; SBP, DBP and the variation range tended to increase in SHRs and WKYs. The variation range was larger in SHRs. ACT and HR increased 3-5 days after removing the sprints and the circadian rhythm appeared again. SBP, DBP and the variation range tended to decrease.

Conclusion : We suggest that it is necessary to study the stress responses, considering the circadian rhythm and the variation of ACT, HR and BP, in an individual animal when we continuously observe CH of SHRs and WKYs for a long term with the use of a telemetry system.