Changes in Mean Level and Stability of Arterial Blood Pressure after Bilateral Sectioning of the Carotid Sinus Nerves in Conscious Rabbits

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We¹⁾ previously reported the mean level and variability of mean arterial blood pressure (MAP) for 6 hrs in unanesthetized rabbits. The variability of MAP was significantly small, if MAP was in the normotensive range. This suggests that the carotid sinus and aortic arch baroreflex systems might powerfully control arterial blood pressure (AP) in a normotensive state. However, there are quantitative differences in responsiveness of the carotid sinus and aortic arch baroreceptors. The carotid sinus baroreceptor responds to change in AP above 50–60 mmHg and functions most powerfully at around 100 mmHg^{2,5)}. The aortic arch baroreceptor initiates to respond to AP above 80–90 mmHg and operates most strongly at 120–160 mmHg^{2–5)}. In a normotensive state, the carotid sinus baroreceptor is considered to contribute much to regulation of AP in comparison with the aortic arch baroreceptor. If the carotid sinus baroreflex does not function, AP could become unstable.

In the present study, effects of bilateral sectioning of the carotid sinus nerves on mean level and stability of MAP were examined in conscious rabbits. MAP recordings for 6 hrs were performed before and after sectioning the carotid sinus nerves. Mean value and standard deviation of MAP in carotid sinus denervated rabbits were compared with those in intact rabbits.

Materials and Methods

The surgical procedure for catheterization and the experimental conditions were

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similar to those reported previously¹⁾. Five Japanese white rabbits of either sex (3.0 to 3.6 kg and aged 6 to 12 months) were anesthetized by an intravenous injection of pentobarbital sodium in a dose of 20.0 mg/kg. A large bore catheter was chronically implanted into the aortic arch via the left subclavian artery and filled with heparin (500 unit). A few days after the catheterization, the rabbits were confirmed to be fully conscious and active and used for AP recording. AP was monitored with a catheter-transducer system. MAP derived from AP using a low-pass filter with a time constant of 2 sec, was fed into a digital computer every second for 6 hrs from about 10 a.m. to 4 p.m. through an analogue-to-digital converter. After all the rabbits were used for MAP recording under intact conditions, they were anesthetized again with pentobarbital sodium (15.0 mg/kg) and sectioned the bilateral carotid sinus nerves. Three to five days were allowed to recover from anesthesia and the surgery. MAP was recorded again under the same experimental conditions as those in the intact rabbit.

Results and Discussion

Mean (M) and standard deviation (SD), calculated from each successive MAP record for 6 hrs before and after bilateral sectioning of the carotid sinus nerves, were shown in Table 1. Mean (M_{int}) and standard deviation (SD_{int}) of MAP in the intact rabbit ranges from 78.6 to 96.3 mmHg (mean $\pm$ SE, 88.6 ± 2.7 mmHg) and from 6.1 to 9.7 mmHg (mean, 7.4 mmHg), respectively. After severing the carotid sinus nerves, an elevation of MAP and an increase in variation of MAP were observed in each rabbit. Mean (M_{cs}) and standard deviation (SD_{cs}) of MAP in the carotid sinus denervated rabbit varied from 93.3 to 105.1 mmHg (mean $\pm$ SE, 100.8 ± 2.0 mmHg) and from 8.1 to 10.8 mmHg (mean, 9.4 mmHg), respectively. The M_{cs} was significantly larger than the M_{int} ($p < 0.05$, Wilcoxon matched pair rank test). The SD_{cs} was also significantly large in comparison with the SD_{int} ($p < 0.05$, Wilcoxon matched

Table 1. Changes in mean and standard deviation of MAP for 6 hrs after bilateral sectioning of the carotid sinus nerves.

Rabbit No.	Sex	B.W. (kg)	M_{int} (mmHg)	SD_{int} (mmHg)	M_{cs} (mmHg)	SD_{cs} (mmHg)
1	F	3.6	86.2	6.1	102.0	8.1
2	F	3.0	88.4	7.9	105.0	9.5
3	M	3.3	93.3	9.7	98.9	10.8
4	M	3.1	78.6	6.8	93.3	9.7
5	F	3.0	96.3	6.5	105.1	8.9
Mean	/	3.2	88.6	7.4	100.8	9.4
$\pm$ SE	/	0.1	2.7	/	2.0	/

F: Female, M: Male, B.W.: Body weight. M_{int} and SD_{int} represent mean and standard deviation of MAP for 6 hrs in the intact rabbit, respectively. M_{cs} and SD_{cs} represent mean and standard deviation of MAP for 6 hrs in the denervated rabbit, respectively.

pair rank test).

SD is one index of variability of AP. Increase or decrease in SD has been employed for estimation of control ability of the arterial pressure control system^{1,6-8)}. In the present study, the increase in the SD means that the overall control ability of the baroreflex system was decreased by sectioning of the carotid sinus nerves. Hosomi *et al.*⁹⁾ reported that bilateral sectioning of the carotid sinus nerves decreased the open-loop gain of the rapidly acting arterial pressure control system by about 59.5% in the anesthetized rabbit. According to the control theory⁹⁻¹¹⁾, a decrease in the open-loop gain results in a decrease in capacity of homeostasis, i.e., a decrease in stability, and causes in an increase in variation of the controlled value, that is, arterial pressure. Therefore, the variation of MAP (SD) should be estimated about 15 mmHg. In the present study, the SD was 9.4 mmHg after sectioning the carotid sinus nerves. This difference may depend on a compensatory increase in pressure control ability of the remaining baroreflex systems, i.e., the aortic arch and cardiopulmonary baroreflex systems. The other possible reason may be that the aortic arch baroreflex system operated near its optimum range, since MAP increased from 88.6 to 100.8 mmHg after sectioning the carotid sinus nerves.

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