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Gastric Acid Secretion of Rats with Alterative Autonomic Nervous System

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SUMMARY : The role of the autonomic nervous system in the generation mechanism of gastric stress ulcers has long been attracting attention. We have been investigating the ulcer formation in the spontaneously hypertensive rat (SHR) thought to have a functionally facilitated sympathetic nervous system and in the MGS rat in which the function of the sympathetic nervous system may be attenuated. In the present study, we studied the state of gastric acid secretion under a pyloric ligation condition in these rat species, using WKY rats as the control. The pylorus was ligated for 4 hrs, and the volume and pH of gastric juice and the volume of gastric acid secreted were measured. Both SHRs and MSG rats showed higher pH values and smaller volume of secreted acid than WKY rats. Ulcer formation in SHRs was milder than in control rats as reported previously, and this was thought to be related to the high pH value and the low gastric acid secretion observed in the present study. Although ulcer formation in MSG rats was more frequent than in control animals, factors such as mucosal blood flow etc. were suggested to be rather responsible because of the high pH value and low acid secretion in this species.

INTRODUCTION

The role of the autonomic nervous system in the generation mechanism of gastric stress ulcers has long been attracting attention. We have been using the spontaneously hypertensive rat (SHR) and the mono-sodium L-glutamate (MSG) rat for our stress experiments[1]. The SHR established by Okamoto *et al.* has been utilized as an animal model of essential hypertension[2]. The sympathetic nervous system in the SHR is spontaneously facilitated without any treatment[3]. On the other hand, Olney demonstrated in 1969 that the administration of an acidic amino acid, MSG, into neonatal animals caused the destruction of the arcuate nucleus and ventromedial nucleus of hypothalamus, and resulted in obesity after maturation[4]. In this species of rat, the function of the sympathetic nervous system is thought to be depressed[1]. We now focused our attention on the gastric acid secretion in the SHR and the MSG rat which are regarded as experimental animal models of autonomic disorders. The gastric acid secretion was measured by the

pyloric ligation method, and WKY (Wister-Kyoto) rats were used as control animals. The results thus obtained are presented below.

SUBJECTS AND METHODS

The animals used were 7 SHRs, 6 MSG rats and 6 WKY rats (control), all at 24 weeks old and male. Each animal was fasted for 24 hr with free intake of drinking water, and the pylorus was then ligated under ether anesthesia. The stomach was resected 4 hr after pyloric ligation, and the gastric juice colleced. The pH and volume of secreted gastric acid were measured using the automatic pH titrator (Copenhagen Co.).

RESULTS

When the SHRs were compared with the WKY rats, the volumes of both gastric juice and gastric acid were significantly higher in the WKY rats, while the pH was higher in the SHRs. As shown in Fig. 1, the WKY rats showed 3.23 ± 0.95ml/4 hrs for the volume of secreted gastric juice, 1.79 ± 0.10 for the pH and 61.7 ± 16.4 μMol/hr for the volume of secreted gastric acid. In the SHR, the gastric juice secretion was 2.24 ± 0.53ml/4 hrs, pH was 3.45 ± 1.01 and the gastric acid secretion was 19.3 ± 10.8 μMol/hr, and these values in the SHRs were significantly different from those in the WKY rats at risk levels (F-test) of 5%, 1% and 1%, respectively.

In MSG rats, the gastric juice secretion was 0.85 ± 0.22ml/4 hrs, the pH was 2.90 ± 0.42 and the gastric acid secretion was 11.3 ± 2.58 μMol/hr. Thus, WKY rats showed significantly (at a risk level of 1%, F-test) greater volumes of gastric juice and acid and also showed a lower pH value than MSG rats (Fig. 2).

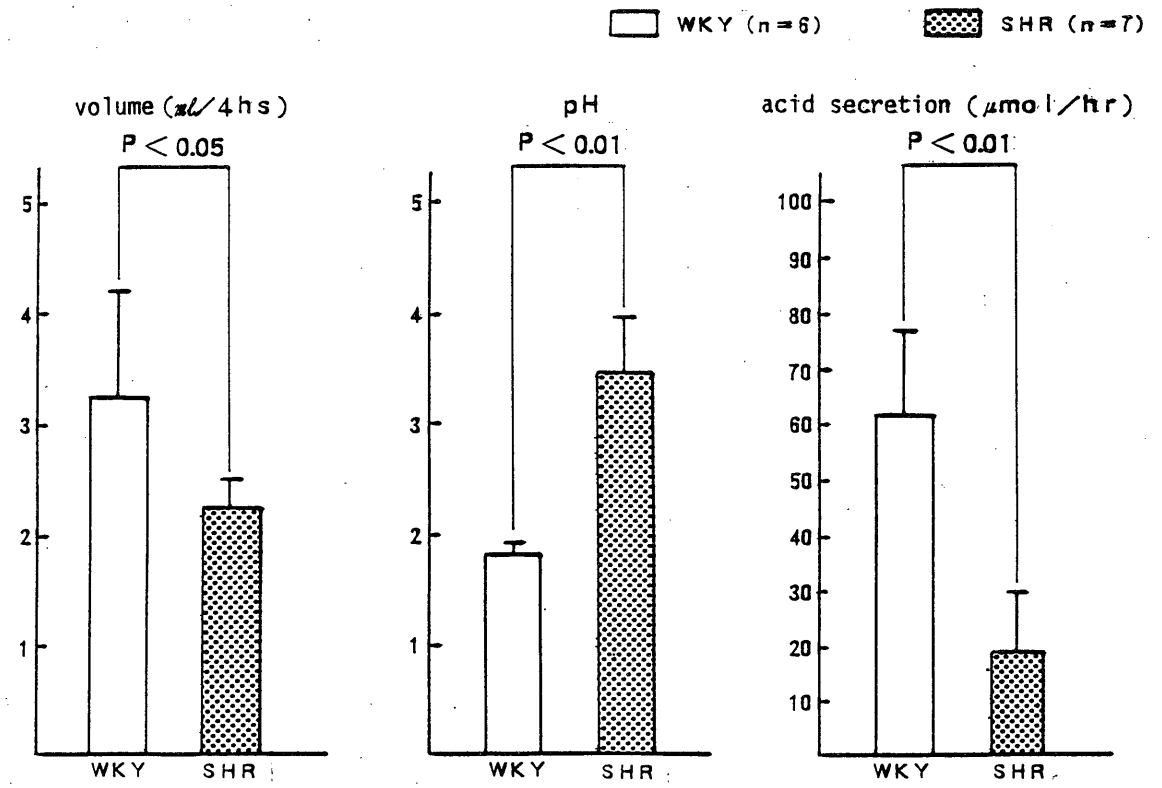

Fig. 1. SHRs and WKY rats

When the SHRs were compared with WKY rats, the volumes of both gastric juice and gastric acid were significantly higher in the WKY rats, while the PH was higher in the SHRs.

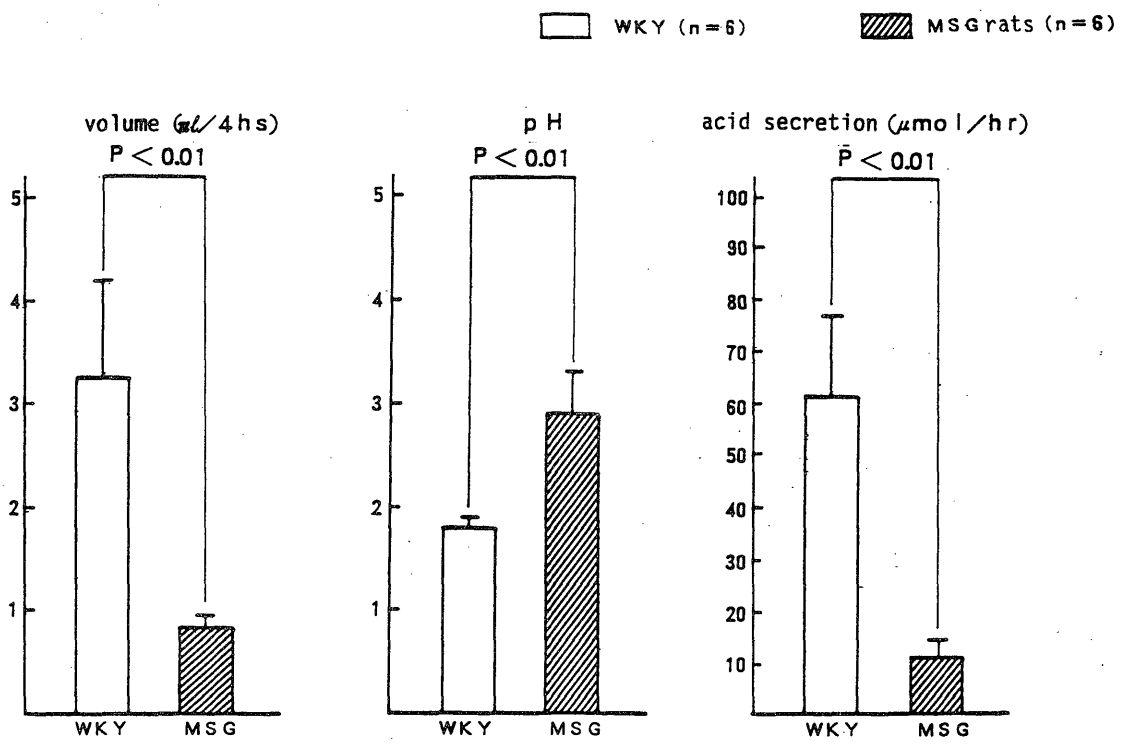

Fig. 2. MSG rats and WKY rats

When the MSG rats were compared with WKY rats, the volumes of both gastric juice and gastric acid were significantly higher in the WKY rats, while the PH was higher in the MSG rats.

DISCUSSION

As we have reported previously[3], the generation rate of gastric ulcers was markedly lower in water immersion-restraint SHRs as compared with WKY rats. It has been thought that the sympathetic nervous system in SHRs is functionally facilitated and this leads to suppression of the genesis of stress-induced gastric ulcer. As clearly shown by the present study, the high pH value and the low gastric acid secretion in SHRs is also thought to contribute to the low generation rate of ulcers. Matsumoto has reported that the density of gastrin-secreting cells is increased in the SHR as compared with the WKY rats[5]. This is thought to be due to a feedback from the persistent low-acid condition in the SHR.

In the case of the MSG rat, gastric ulcer was more frequently generated than in the WKY rat under a water immersion-restraint condition as reported previously[1]. Although the secretion of gastric acid in the MSG rat was initially expected to be more augmented than in the WKY rat, the acid secretion was found to be lower in the MSG rat in the present study. Ridley *et al.* have shown that gastric acid secretion is enhanced when the ventromedial nucleus of hypothalamus (VMH) is destroyed in the rat. Like other hypothalamic obesity animals, MSG rats also have damaged VMH, but characteristically show no hyperphagia[9]. In the case of so-called VMH rats, it is thought that the sympathetic nervous system is depressed, while the parasympathetic nervous system is facilitated, resulting in augmented secretion of gastric acid. Although the sympathetic nervous system in the MSG rat is inferred to be depressed, it is also possible that the parasympathetic nervous system is functionally suppressed or not so facilitated. Since hypergastrinemia has been reported to be present in MSG rats[8], this may be related to the low-

acid condition in these rat species. Further investigations are needed for this point including changes in blood flow.

CONCLUSION

The state of gastric acid secretion was compared between the SHRs and MSG rats, using WKY rats as the control. The pylorus was ligated for 4 hrs, and the volumes of secreted gastric juice and acid and the gastric pH were examined. Compared with control WKY rats, both SHRs and MSG rats showed high gastric pH values and low gastric acid secretion.

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