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Evaluation of Effects of Sex and Body Weight on Basal Acid Secretion in Rat

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The present study was aimed to evaluate the possible effects of sex and body weight on basal acid secretion in rat. A number of 51 rats ranged between 145 to 370 g in weight, including both sexes were kept at controlled condition. Experiments were started everyday at 8:00 am; the animals were deprived from food but not from water, for 18 h before starting the experiments. They anesthetized with sodium thiopental and a silicon tube was inserted in stomach via duodenum. The amount of acid was measured using automatic titrator, with NaOH 0.1 N up to pH = 7. For evaluation of the results, Student's t-test and Spearman correlation coefficient were used and p-values less than 0.05 were considered significant. The mean of basal gastric acid was not significantly different between male and female. The body weight and stomach weight were more in male ($p<0.05$), but the ratio of stomach/body weight was bigger in female ($p<0.05$). In both male and female, basal acid output was correlated with body weight ($r = 0.44$, $p<0.01$). It is concluded that gastric acid secretion in rat is not different between two sexes; therefore, it seems that both male and female animals can be used for the experiments.

Key words: Basal acid output, sex, body weight, rat

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INTRODUCTION

The amount of gastric acid secretion is not consistent and it changes during different times. Gastric acid secretion can be divided into two phases of basal and stimulated. Basal acid secretion in the absence of peripheral or gastrointestinal stimuli occurred (West, 1990; Guyton and Hall, 2006). Others reported that there were significant changes in basal acid secretion between different spices as well as members of one spices (West, 1990). Factors that control basal secretion are not completely known. However, tonic stimulation of vagus nerve and basal level of gastrin in circulation are shown to contribute to this process. Basal and maximum acid secretion in human is higher in male than female (West, 1990). Basal acid output in human has been reported to be different, from 2.5 to 10 mmol h^{-1} (Lam *et al*., 1997). Much higher alteration of basal acid output in rat (10 to 70 μmol h^{-1}) has been reported by investigators (Uehara *et al*., 1990; Baydoun and Dunbar, 1997; Salim, 1998; Nabavizadeh Rafsanjani and Vahedian, 2004).

A variety of different factors can be involved in the explanation of this variation, i.e., method of acid secretion measurement, time of measurement (Boron and Boulpaep, 2005), anesthetic substance in use, sex (Boron and Boulpaep, 2005) and body weight (Levy *et al*., 2006) of animal. Although the effect of sex on basal acid output in rat has not been well investigated, in accordance with the human experiences (higher secretion in male), the male rat is proposed better and is usually used in the animal experiments; this causes difficulties in research centers. The present study was designed to investigate the possible effects of sex and body weight on basal acid output in rat.

MATERIALS AND METHODS

Animals: All animal experiments were carried out in accordance with the guidelines of Ahwaz Jundishapur University of Medical Sciences for care and use of laboratory animals. This study was doing in 2006. Fifty-one adult Wistar albino rats (26 males and 25 females), ranged between 145 to 370 g in weight were maintained on a 12 h light/dark cycles at 23±2°C with free access to food and water for two weeks before starting the experiments.

Surgery and acid measurement method: To abolish the effect of circadian rhythm, all experiments started at the same time. Animals fasted 18 h before starting the experiments but had free access to water; they anesthetized with sodium thiopental (60 mg kg^{-1}, i.p.) (Debas and Carvajal, 1994). The depth of anesthesia was checked throughout the experiment by the pedal withdrawal (toe pinch) reflex every 30-45 min. If the pedal withdrawal reflex was observed, a supplement dose of anesthetic substance (20 mg kg^{-1}, i.p.) was administered to maintain adequate anesthesia. Body temperature of the animals was measured with a rectal thermometer and maintained at 37°C using homoeothermic blanket control system (Harvard, UK). The trachea was surgically exposed and cannulated by a polyethylene catheter (O.D. 2 mm) to ease respiration and esophagus was closed in neck region. After a midline laparatomy, both stomach and duodenum were exposed; a polyethylene catheter (O.D. 2.5 mm) was inserted into the stomach through duodenum and held in place by ligature around the pylorus. At the beginning of each experiment, the lumen of stomach was gently rinsed with isotonic saline (pH 7) until gastric washout was clear and 30 min delayed for maintenance state.

Evaluation of gastric acid secretion: The acidity in the gastric washout was measured with automatic acid titrator (TTT 80, Radiometer, Copenhagen, Denmark) by automatic potentiometric titration up to pH 7 with 0.1 N NaOH and was expressed as μmol/15 min (Monnikes *et al*., 1996).

To measure the basal acid output, acid secretion in three consecutive 15 min of gastric effluents were collected and mean value of these samples reported as basal acid output for each animal and expressed as μmol/15 min. Washout technique used for gastric acid collection (Lynn *et al*., 1991). At the end of experiments, animals were killed by overdose of i.v. anesthetic agent and stomach was removed and weighted.

Statistical analysis: All results are expressed as mean±SEM and statistical analysis was performed by Student's t-test and p-values less than 0.05 were considered significant. For the determination of correlation between related parameters, Pierson correlation coefficient was calculated and $p<0.05$ were considered significant.

RESULTS AND DISCUSSION

The results showed that the mean of basal gastric acid secretion in male and female rats was not significantly different (Table 1). The basal acid output significantly correlated with both body weight ($r = 0.4$, $p<0.01$) (Fig. 1) and stomach weight ($r = 0.44$, $p<0.01$) (Fig. 2). Also, stomach and body weights showed

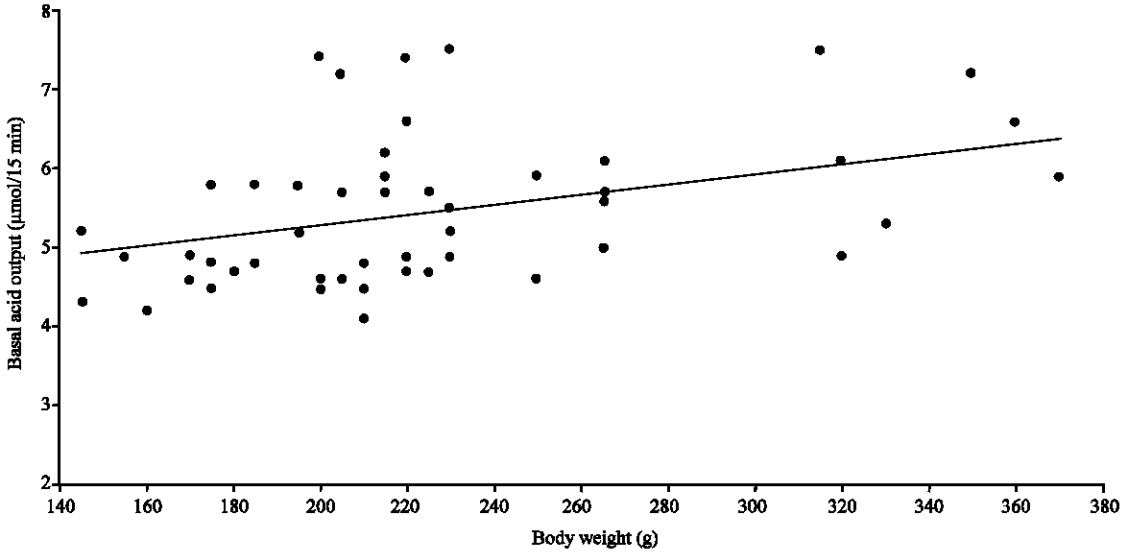

Fig. 1: Correlation between basal acid output and body weight in rats (r = 0.4, p<0.01)

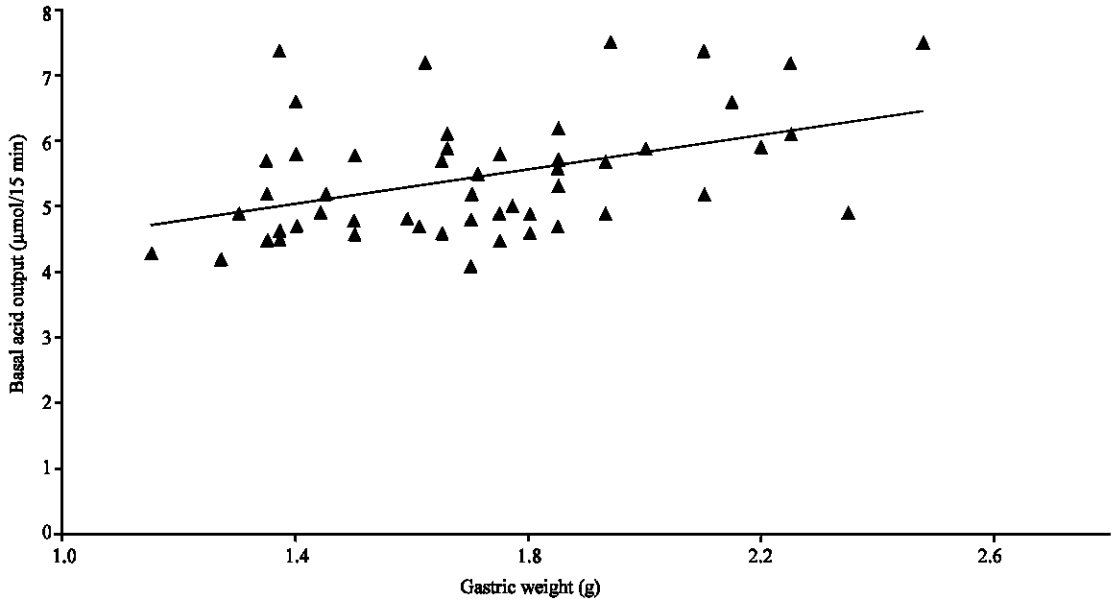

Fig. 2: Relationship between gastric weight and basal acid output in rats (n = 51, r = 0.44, p<0.01)

Table 1: Different parameters values in studied animals

Sex	Body weigh (g)	Stomach weight (g)	Basal acid output (µmol/15 min)	Stomach/body weight ratio
Male	243±14.2 *	1.8±0.1	5.43±0.14	0.74±0.01*
Female	211±6.4	1.6±0.1	5.49±0.12	0.77±0.01

(*: p<0.05) (Values are shown in Mean±Standard Error)

significant correlation (r = 0.78, p<0.001) (Fig. 3). In addition, body weight in male was found to be higher than that in female. The ratio of the stomach/body weight in female was higher than that in male. In these experiments, intra-assay and inter-assay coefficient variations calculated and were 6.5 and 4.8%, respectively.

The results of the present study showed that basal acid output correlated with body weight in both male and female rats. Although body weight was significantly lower in female, however, basal acid output were no difference in male and female rats.

It has been reported that basal acid secretion and parietal cell mass are significantly lower in female than male rats (Adeniyi and Olowookorun, 1989). In human,

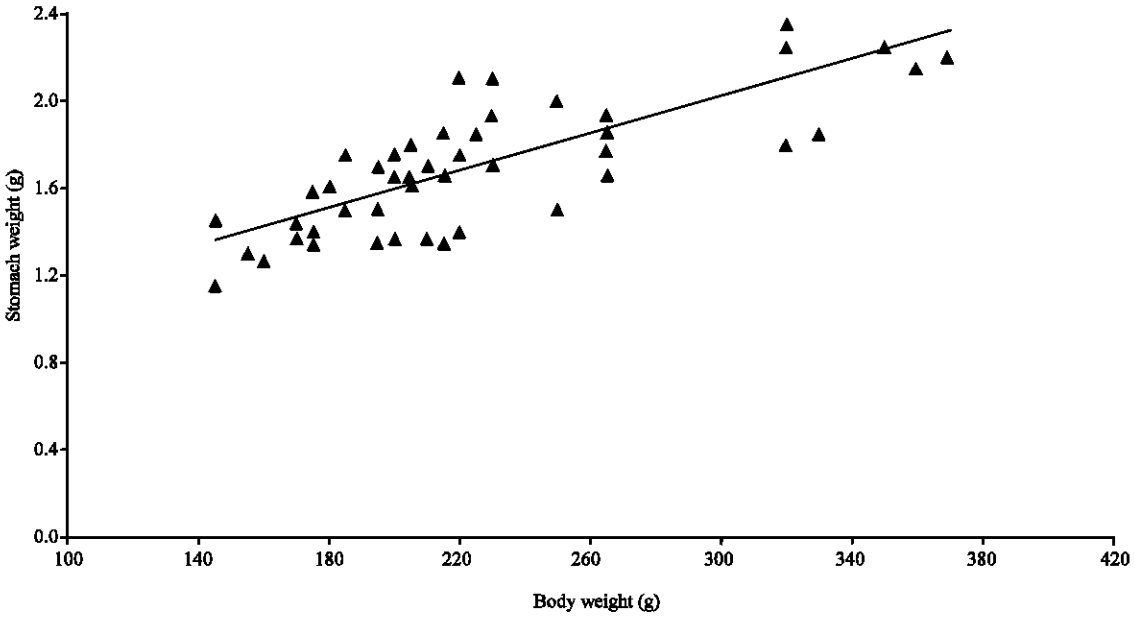

Fig. 3: Correlation between body weight and gastric weight in rats (n = 51, r = 0.78, p<0.001)

also basal acid output is lower in female than male (West, 1990). This is in contrast with our results. However, Haruma *et al.* (1994) showed that the sex is not effective on the amount of acid secretion and basal gastrin in fasting human. Similarly, Girma *et al.* (1997) found that basal acid secretion in both sexes of rat is not different (similar with our results), but the stimulated-acid secretion in male was significantly more than that in female. A study in dogs also showed that maximum acid secretion (in response to histamine) was not different between two sexes and it was only correlated with body weight (Baron, 1997).

The discrepancy between the results obtained from the limited studies including the present one, concerning the effect of sex on the level of gastric secretion, can be explained as follows: (i) Despite lower weights of body and stomach in female rats comparing to males, the ratio of stomach/body weight was found higher in this sex (Table 1). (ii) The density of enterochromaffin-like cells is more enhanced in female (Boorman *et al.*, 1990) and this causes more gastric secretion and probably compensates the lower level of basal acid output in female rats. For these reasons basal acid output did not differ from that of male, indicating that sex-based hormones were ineffective on the processes of gastric secretion.

CONCLUSION

Although sex hormones can affect most body functions and supposed to possibly affect gastric acid secretion too, our results showed no difference in basal acid output between male and female rats. The results of the present study imply that the utilization of this animal for research experiments should not necessarily be limited to the male sex.

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