Influences of Taurine on Functions of Rat Neutrophils

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A large variety of interesting reports has been published on recent advances in pharmacological and physiological studies on taurine (1-5). Although it is definitely known that the concentration of taurine is 500 times greater in leukocytes than in plasma (6), the meaning of this fact has yet to be clarified. The excretion of taurine into the urine increases in instances of acute infection (7). Reports have also been published on the effects of taurine in prophylaxis and therapy against Staphylococci (8). Myeloperoxidase existing in leukocytes plays an important role in their bactericidal capacity, and the activities of this enzyme are regulated by taurine (9). Reports have been made that neutrophils among other leukocytes react promptly to act as a major factor in the physical defense against purulent bacteria which induce acute infections (10). In the present study, the administration of taurine increased its concentrations in neutrophils and strengthened both the phagocytic and bactericidal capacities of neutrophils.

Male Wistar rats, 6 weeks old each, weighing about 120 g and 30 weeks old...

![Graph](image-url)

Fig. 1. Effect of taurine oral administration on phagocytosis of yeast by neutrophils from rats that are 9 (a) and 33 (b) weeks old. Taurine was dissolved in drinking water and given for 3 weeks. Neutrophils were obtained from casein-elicited rat peritoneal exudates (10 ml/100 g body weight 0.2% sodium caseinate, 16 hr before cells were collected). Neutrophils (1.0x10^7 cells/ml) and yeast (2.5x10^8 cells/ml) were suspended in RPMI 1640 containing 1% gelatin and 10% autologous serum. The phagocytic capacity of neutrophils was determined by counting numbers of phagocytized yeast for more than 100 neutrophils. -O-: control, - - : taurine p.o., - - : control (9 weeks old). Each point is the mean value with S.E. of 4 (a) and 3 (b) experiments. Significantly different from the control, *P<0.01, ***P<0.05. Significantly different from the neutrophils from 9 weeks old rats, **P<0.05. Statistical evaluation of the data was performed using the analysis of variance.
weighing about 370 g were employed. Drinking water containing 0.3% of taurine was given to the animals for 3 weeks. The taurine dose calculated from the consumption of drinking water was approx. 470 mg/kg/day (6 weeks old rats) and 185 mg/kg/day (30 weeks old rats). According to the method described by Read and Tepperman (11), neutrophils were prepared from 9 and 33 weeks old rats. A 0.2% casein solution was intraperitoneally administered to the rats, and peritoneal exudates were collected 16 hr thereafter. The neutrophils in the exudates were collected by centrifugal separation at 1,000 rpm for 5 min and then washed twice with suspension culture medium (Medium RPMI 1640 "Nissui") and suspended in 1% gelatin-RPMI 1640. Taurine concentrations in the serum and neutrophils were determined with an amino acid analyzer (Model 835-30, Hitachi). In the control group (9 weeks old rats, n=5), concentrations were 35.0±2.30 μmol/dl in the serum and 10.0±0.72 μmol/10⁹ in neutrophils, while the group with taurine (9 weeks old rats, n=5) showed 53.8±2.12 μmol/dl and 15.0±0.70 μmol/10⁹, respectively, demonstrating a significant increase over the control group. Statistical evaluation of the data was performed using Student's t-test. The phagocytic capacity of neutrophils was determined according to the method proposed by Takehiro et al. (12). Results are shown in Fig. 1a. The administration of taurine for 3 weeks (33.4%) caused an obvious increase in this phagocytic capacity. Neutrophil bactericidal capacity was determined by the method devised by Quie et al. (13) with some modifications. Escherichia coli strain NIH Jc-2 was used as the bacterial strain. Results are illustrated

![Graph](Image)

**Fig. 2.** Effect of taurine oral administration on bactericidal capacity for *Escherichia coli* of rat neutrophils from rats that are 9 (a) and 33 (b) weeks old. Neutrophils were prepared as described in Fig. 1. *E. coli* were cultured overnight in heart infusion agar and then opsonized with 1% serum. Neutrophils (1.0×10⁷ cells/ml), *E. coli* (10⁶~10⁷ colony-forming units/ml) and 1.5% heat-inactivated serum in 1% gelatin-RPMI 1640 were incubated at 37°C under rotation (15 rpm). The bactericidal capacity of neutrophils was indicated by the viable bacterial count decreasing in comparison with the count of the blank containing no neutrophils. —○—: control, •: taurine p.o., --x--: control (9 weeks old). Each point is the mean value with S.E. of 6 (a) and 3 (b) experiments. Significantly different from the control, *P<0.01. Significantly different from the neutrophils from 9 weeks old rats, **P<0.01. Statistical evaluation of the data was performed using the analysis of variance.
in Fig. 2a and indicate that the viable bacterial count decreased in comparison with the count of the blank which contained no neutrophils. The bactericidal capacity of the neutrophils against *E. coli* was strengthened 24.5% by the administration of taurine, a significant difference.

It is generally claimed that the concentration of taurine in fetal blood is high (14). The taurine in the heart and spleen of rats increases (15); and in retina and cornea, it decreases with age (16). Taurine contents in the serum and neutrophils of 33 weeks old rats were 30.3±1.33 μmol/dl and 4.3±0.41 μmol/10⁹ (n=3), respectively, showing a lesser concentration of this substance in the neutrophils. Also, from the viewpoint of functions, neutrophil phagocytosis decreased by 15.0% in comparison with that of animals 9 weeks of age (Fig. 1b), and their bactericidal capacity also decreased a remarkable 21.5% (Fig. 2b). However, in rats 33 weeks old to which taurine had been orally administered continuously for 3 weeks, concentrations were 31.2±1.33 μmol/dl in the serum and 7.0±1.51 μmol/10⁹ in neutrophils (n=3). In neutrophils, although insignificant, the taurine concentration was increased by 62.8% more than the control group. The phagocytosis of the neutrophils was strengthened by 12.4% in comparison with that of the control group (Fig. 1a); their bactericidal capacity was also strengthened by 25.8% (Fig. 2b). Both results were thus significantly different. These activities were comparable to levels at 9 weeks of age.

From the above-mentioned results, it can be realized that taurine does strengthen, albeit only slightly, both phagocytic and bactericidal capacities of neutrophils, and through them, taurine plays an important role in the mechanism of host defense.

References