# Taurine Metabolism in a Patient Receiving Long-term Total Parenteral Nutrition

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## SUMMARY

A patient with short-bowel syndrome maintained on total parenteral nutrition was received the reduced glutathione (600 mg/day) for 8 months. The concentration of reduced glutathione in blood was slightly increased after glutathione infusion, whereas the concentration of oxidized glutathione was slightly decreased. The concentration of taurine in blood was rapidly increased after glutathione infusion to reach normal range in 20 days after glutathione infusion. The urinary excretion of taurine was dramatically increased after about 50 days of glutathione infusion to reach plateau in about 4 months after glutathione infusion. The urinary excretion of inorganic sulfate was also increased after glutathione infusion. These results suggest a possibility that biosynthesis of taurine from glutathione via cysteine in a patient was significantly increased by glutathione infusion.

## INTRODUCTION

Taurine is one of the most abundant amino acid in mammalian tissues and plays an important role in the function of excitable tissues such as central nervous system, retina and heart[1,2,3]. Taurine in mammals is derived from dietary taurine or biosynthesis from cysteine via cysteine dioxygenase pathway. It has been considered that the biosynthetic ability of taurine from cysteine in human was limited by much lower activity of cysteine sulfinic acid decarboxylase[4]. Furthermore, it has been reported that the low taurine concentrations in plasma or blood cells were observed in patients undergoing long-term parenteral nutrition with taurine free parenteral solutions[5,6]. On the other hand, Kohashi *et al*[7]. reported that the rate of taurine biosynthesis in rats was depended on the intake of sulfur amino acids.

This paper deals with sulfur amino acid metabolism in a patient receiving total parenteral nutrition. The effect of intravenous infusion of reduced glutathione on sulfur amino acid metabolism was examined.

## MATERIALS AND METHODS

*Subjects.* A male patient of 61-year-old who had short-bowel syndrome. This patient had received a surgical operation of a total resection of intestine and colon, and an ileostomy on April 1986. Total parenteral nutrition was initiated immediately after resection.

*Parenteral nutrition.* Daily intake of various nutrients from parenteral nutrition are shown in

Table 1.

Table 1. Parenteral intake of nutrients

| Nutrient | Daily intake |
|---|---|
| Calorie | 1710 Kcal |
| D-glucose | 200 g |
| D-Fructose | 100 g |
| Xylitol | 50 g |
| Lipid | 20 g |
| Amino acids | 45 g |
| Methionine | 1732 mg |
| Cystine | 92 mg |

*Infusion of reduced glutathione.* Intravenous infusion of reduced glutathione (600 mg/day) was carried out for 8 months from August 1986 to April 1987.

*Measurement of the metabolites from cysteine.* An appropriate volume of blood (1 ml) was diluted with 4 volumes of 0.1 M potassium phosphate buffer, pH 7.5 containing 5 mM $Na_2EDTA$ and was deproteinized by the addition of a half volume of 10% trichloroacetic acid. The denatured protein was removed by the centrifugation and the clear supernatant was washed three times with 4 volumes of ether to remove trichloroacetic acid, and aqueous layer was used for the quantitative analysis of taurine and glutathione. For the analysis of urinary taurine, 24 hour urine sample was collected from 7 a.m. to 7 a.m. Urinary and blood taurine were measured by the method previously reported[8]. Glutathione was measured by colorimetric method using 5, 5′-dithiobis(2-nitrobenzoic acid)[9,10]. Urinary inorganic sulfate was measured by the method as previously reported[8].

## RESULTS AND DISCUSSION

The infusion of reduced glutathione was started from 4 months after the beginning of total parenteral nutrition. As shown in Figure 1, the concentration of total glutathione in blood was not significantly changed by 3 months of glutathione infusion, while the concentration of reduced glutathione was increased about 2-fold. On the contrary, the concentration of oxidized glutathione in blood was gradually decreased after glutathione infusion.

The concentration of taurine in blood was decreased about 50% of normal subjects by 3 months of total parenteral nutrition, as shown in Figure 2. The concentration of taurine in blood was rapidly increased after glutathione infusion to reach normal range in 20 days after glutathione infusion. This increase in blood taurine level is mainly due to an increase in blood cell taurine, since the concentration of taurine in plasma was much less than those of blood cells. The concentration of taurine in blood was gradually decreased after 8 months of glutathione infusion. Two months after cessation of glutathione infusion, taurine concentration was decreased again below normal range.

In the contrast to the blood taurine level, no significant change in urinary taurine level was observed

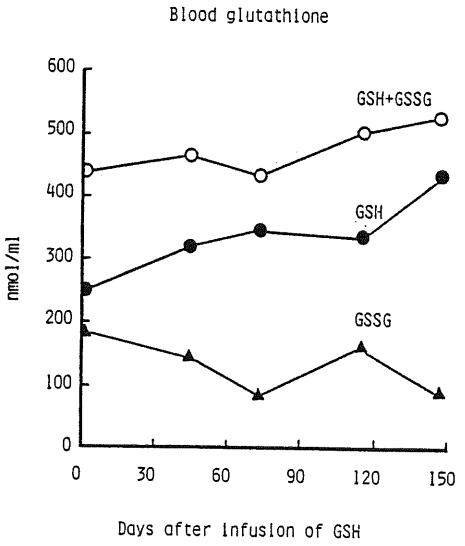


Fig. 1. The blood glutathione level in a patient receiving total parenteral nutrition. The infusion of glutathione (600 mg/day) was started 4 months after beginning of parenteral nutrition (day; 0).

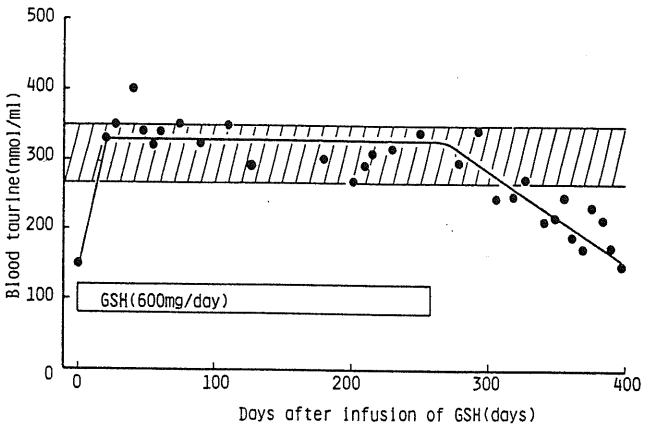


Fig. 2. The blood taurine level in a patient before and after glutathione infusion. Hatched area denotes means$\pm$1 SD in control (n=10).

by 50 days after glutathione infusion, as shown in Figure 3. The urinary taurine excretion, however, was dramatically increased after 50 days. After about 4 months, urinary taurine level reached plateau. The delay of an increase in urinary taurine level may be due to a depletion of body taurine level, since the urinary taurine excretion was related to the level of body taurine as well as daily intake. The urinary taurine excretion was progressively decreased during experiment after cessation of glutathione infusion.

The urinary excretion of inorganic sulfate, another metabolite from cysteine, was also increased

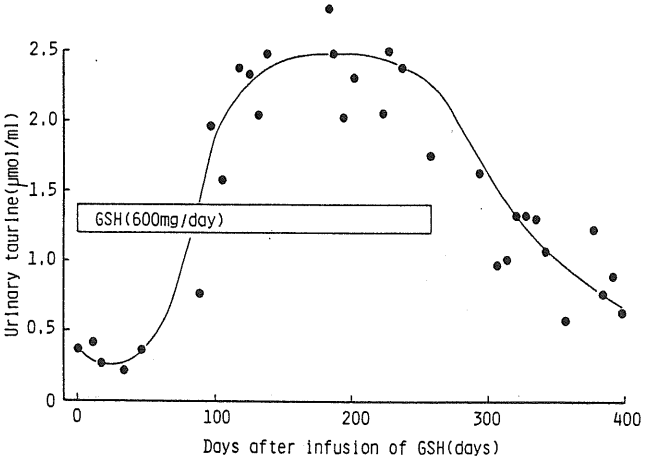


Fig. 3. The urinary taurine excretion in a patient before and after glutathione infusion.

about 2-fold in about 50 days after glutathione infusion, as shown in Fig. 4. The urinary excretion of inorganic sulfate was rapidly decreased after cessation of glutathione infusion.

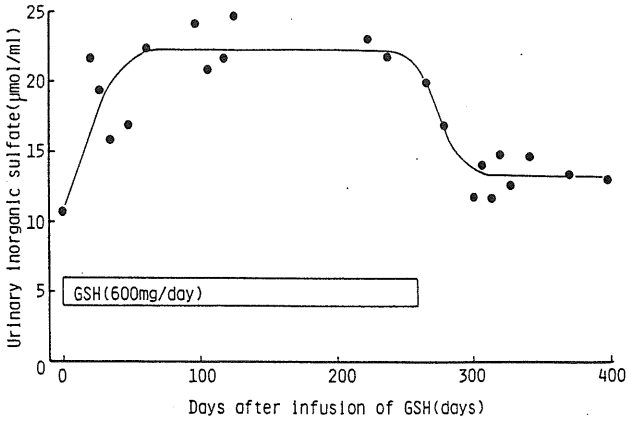


Fig. 4. The urinary excretion of inorganic sulfate in a patient before and after glutathione infusion.

Geggel *et al*[5]. and Vinton *et al*[6]. also found low taurine concentrations in plasma or blood cells in patients receiving long-term parenteral nutrition. One possible explanation for low taurine level in blood or urine is that the supply of sulfur amino acid was insufficient, since the rate of taurine biosynthesis in rats was depended on the intake of sulfur amino acid[7]. As shown in Table 1, methionine and cystine were supplied by parenteral solution at level of 1792 mg/day and 92 mg/day, respectively. These amount were, in general, much greater than the estimated requirement (methionine+cysteine; 10 mg/day/kg body weight) in normal adults[11]. However, glutathione infusion at level of 600 mg/day led to an increase in blood or urinary taurine level. Thus, it is likely

that the amount of methionine and cysteine or the ratio of methionine and cysteine may be inappropriate to maintain tissue cysteine or glutathione pool.

From these results, it is concluded that the infusion of glutathione may lead to an increase of tissue glutathione or cysteine pool, resulting in an increase of taurine biosynthesis from cysteine.

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