

Short Research Article

The effects of silymarin on serum soluble apoptosis markers in β -thalassemia major patients receiving desferrioxamine

Abstract

Despite appropriate chelation therapy with desferrioxamine, iron deposition in visceral organs causes tissue damage in thalassemia patients. Excess iron can generate reactive oxygen species (ROS) that may lead to cell death and apoptosis. Thereby, antioxidants such as plant flavonoids can be an effective treatment to reduce ROS in thalassemia patients. In this study, we measured the serum levels of apoptosis markers in thalassemia patients treated by silymarin and desferrioxamine. Serum levels of soluble apoptosis markers including soluble Fas (sCD95, sFas), sCD95 ligand (sCD95L, sFasL), sTNF receptor type 1 (sTNFR1), sTRAIL and cytochrome C, were measured in two groups of 40 thalassemia major patients with ELISA kits. The patients were randomized into two groups: one group was received desferrioxamine and placebo and the other group received the combination of desferrioxamine and silymarin. There was no statistically significant difference between desferrioxamine group and combined therapy group in serum concentration of apoptosis markers. In conclusion, measuring the membrane levels of these markers is necessary to validate these results, as they are not expressed equally in different tissues.

Keywords: thalassemia, iron overload, desferrioxamine, silymarin, sTNFR1, sCD95, sTRAIL, cytochrome C, sCD95L, Fas

Introduction

Iron overload is the most common clinical complication in thalassemia patients. Despite appropriate chelation therapy (e.g. desferrioxamine), iron deposition in visceral organs causes tissue damage. [1]The exact mechanism of tissue damage and iron deposition in visceral organs is not clear; however, it seems that generation of Reactive Oxygen Species (ROS) through the Fenton reaction is one of the possible mechanisms.[2]Antioxidants such as plant flavonoid can be an effective treatment to reduce ROS in thalassemia patients. Silymarin is a non-toxic flavonoid, which widely consumed as a dietary supplement for its strong antioxidant and hepatoprotective activities. In a recent clinical trial, thalassemia patients with severe iron overload were safely treated with a combination of silymarin and desferrioxamine. Silymarin was generally well tolerated with no detectable abnormalities in complete blood count, cell differential, liver or renal functions.[3, 4]

Apoptosis initiated by death-inducing transmembrane receptors. These receptors include TNF receptors and a variety of immune cell receptors and their corresponding ligands.[5] Also, apart from membrane-bound, receptors are detectable in soluble forms, due to shedding from the cell surface. In the present study, we measured the concentration of soluble apoptosis markers, including: CD95 (sCD95, sFas), sCD95 ligand (sCD95L, sFasL), sTNF receptor type 1 (sTNFR1), sTRAIL and cytochrome C, in the serum of thalassemia patients and determined the changes in these markers after a combined therapy with silymarin and desferrioxamine.

PATIENTS AND METHODS

Homozygous β -thalassemia major patients were selected from referrals to Sayed-Al-Shohada clinic of thalassemia, Isfahan University of Medical Sciences. All patients were received regular transfusion by leucodepleted blood prophylactically matched for D, C, E, c, e, and K1 blood group to maintain the hemoglobin level above 9.5 g/dL and treated by subcutaneous desferrioxamine. Patients were excluded from the trial if they had one of the following conditions: under 12 years of age, chronic renal or heart failure, iron chelation therapy with iron chelators other than desferrioxamine, hepatitis B or C infection, a history of a positive HIV test, pregnancy, and antioxidant or herbal medicine consumption. Oral and written informed consents were obtained from all patients. The protocol for this study was approved by the Ethics Committee of the Isfahan University of Medical Sciences (Isfahan, Iran).

This study was a randomized, double-blind, placebo controlled, 6-month clinical trial of silymarin add-on therapy in β -thalassemia major patients on regular iron chelation therapy by desferrioxamine. Patients were randomized into a treatment group and a placebo group based on the date of their first visit after enrollment. The treatment group was received 140 mg Legalon®, MadausPharma orally, at least an hour before food, three times a day, 7 days a week with their routine desferrioxamine (Novartis Pharma AG, Basel, Switzerland) dose of 4–6 days per week. The placebo group was received tablets, identical to Legalon®, that were specially prepared for this study. During the study period, no change was allowed in the dose of desferrioxamine. Compliance with Legalon was assessed by pill counts and diary cards that recorded the time and date of taking each pill. Patients received a new supply of capsules every month, and they returned all diary cards at the same time. Blood was taken from patients before a scheduled transfusion. Fasting blood samples were drawn from all subjects and allowed to clot at room temperature. Serum was stored at -80°C until analysis. Serum soluble apoptosis markers in both placebo and silymarin groups were measured using enzyme-linked immunosorbent assay (ELISA) kits, according to the manufacturer's instructions (Bender Med Systems, Vienna, Austria). The sensitivity of the ELISA kits was 13.2 pg/ml for sFas, 0.7 ng/ml for sFasL, 0.05 ng/ml for sTNFR1, 0.05 ng/ml for cytochrome C, and 5 pg/ml for sTRAIL.

Statistical analysis

Statistical analysis was performed using SPSS 15 version for windows program. Statistical significance of the differential circulating levels of apoptotic markers in thalassemia patients was determined using t-test of two independent samples. The mean $\pm$ standard deviation (SD) was calculated for all data and significance was set at P value < 0.05 .

Results

Clinical characteristics of β -thalassemia major patients are summarized in Table 1. A total of 80 thalassemia patients in two groups were successfully recruited to the study. In the placebo group,

40 patients continued receiving desferrioxamine, and in the silymarin group, 40 patients received a combined regimen of desferrioxamine and Legalon. There were no statistically significant differences in the mean levels of sFas, sFasL, TNFR1 and cytochrome C between placebo group and silymarin group at the baseline and after treatment. Moreover, the concentration of these serum soluble markers was slightly higher or below the kits detection limits in both groups. The sTRAIL was not detectable in two groups. Results are expressed as the mean of soluble apoptosis markers $\pm$ SD in Table 2.

Discussion

In the present study, we found that the serum levels of sFas, sFasL, sTNFR1, sTRAIL and cytochrome C showed no significant difference between silymarin and placebo groups; however, serum level of sTNFR1 was significantly reduced after silymarin treatment, while no change was observed in sTNFR1 levels in placebo treated patients. In various pathologic conditions including chronic inflammatory diseases and infections, the serum concentrations of TNF α and sTNFR increase, which their balance may appear to reflect the activation state of the TNF α /TNFR system. Soluble forms of TNFR are the only natural molecules known to interfere with TNF activity by competing for TNF binding with receptors on target cells. Elevated levels of serum TNF α was reported previously in β -thalassemia major patients, which was decreased significantly by silymarin treatment. Therefore, our observation of decreased circulating concentrations of sTNFR1 in silymarin-treated patients correlates with decreased TNF α levels, which may reflect anti-inflammatory activity of silymarin in β -thalassemia major patients. Although we do not yet completely understand the underlying mechanism of apoptosis in thalassemia patients, the production of ROS through Fenton reaction and iron-mediated oxidation as well as death receptor mediated pathways such as Fas-FasL ligand interactions could be possible explanations for inducing apoptosis in thalassemia patients [1, 6]. Previous studies revealed that murine sFasL is a non-apoptotic ligand and can act as an antagonist of membrane-bound FasL (mFasL) activity. [7] Considering the high percentage of CD3⁺Fas⁺ T lymphocytes in thalassemia major patients previously reported by Gharagozloo et al. [8], the low serum levels

of sFas and sFasL markers may correspond to high levels of Fas⁺ T lymphocytes in β -thalassemia major patients.

Since apoptosis markers are not expressed equally in different tissues and affected by several factors, evaluation of membrane apoptosis markers is necessary to verify the result of current study on serum soluble markers. In this study we compared the levels of apoptotic factors in their soluble forms, further trials assessing the membrane levels of such markers and related parameters can help us to have a better understanding of the underlying mechanism of apoptosis and tissue damage in thalassemia patients and how silymarin can affect this phenomenon.

References

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Table 1. Clinical and biological features of patients with β -thalassemiaMajor

Features	Values
Age (year)	21.8 $\pm$ 5.4
Hemoglobin (g/dl)	9.5 $\pm$ 0.9
Body mass index (kg/m ²)	20.26 $\pm$ 2.6
Desferrioxamine dosage (mg/kg)	40–50
Desferrioxamine treatment(nights/week)	5 $\pm$ 1
Transfusion interval (day)	16.8 $\pm$ 3.2
Transfusion volume (ml) ^a	535 $\pm$ 123
Splenectomy (%)	45.71

^a Transfusion volume is the volume of blood that is transfused to patients in each transfusion referral.

Table2. Serum concentrations of sFas, sFasL, TNFR1, and cytochrome C in thalassemia patients treated by silymarin or placebo. Results are expressed as the mean of soluble apoptosis markers $\pm$ SD.

Apoptosis markers	Placebo (n=40)			Silymarin (n=40)		
	before	after	P Value	before	after	P Value
sFas (pg/ml)	22.15 $\pm$ 15.82	19.52 $\pm$ 12.08	0.142	24.68 $\pm$ 24.22	26.17 $\pm$ 29.84	0.516
sFasL (pg/ml)	117.41 $\pm$ 95.34	114.87 $\pm$ 62.44	0.896	172.18 $\pm$ 155.13	126.89 $\pm$ 113.56	0.150
sTNFR1 (ng/ml)	0.12 $\pm$ 0.09	0.11 $\pm$ 0.11	0.747	0.16 $\pm$ 0.12	0.11 $\pm$ 0.10	0.029
Cytochrom C (ng/ml)	0.15 $\pm$ 0.02	0.15 $\pm$ 0.02	0.595	0.17 $\pm$ 0.16	0.21 $\pm$ 0.29	0.204