# The Correlation of Transferrin Saturation and Ferritin in Non-Splenectomized Thalassemic Children

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**Abstract**

Thalassemia is a public health problem in Thailand. Progressive iron overload is the life-limiting complication commonly found in thalassemic patients. The assessment of body iron stores is essential for determining the need and efficacy of iron chelation. The parameters of serum iron, total iron binding capacity (TIBC), and serum ferritin were studied in 79 children with thalassemia diseases. The ages ranged from 1 to 17 years with a mean of 7 years and 10 months. Neither of them had clinical symptoms of hepatitis. The correlation between transferrin saturation (TS = serum iron/TIBC x 100) and serum ferritin was shown in the equation of TS = 10.253 ln (ferritin) ($r = 0.956$, $p = 0.000$). For example, TS = 70.83 per cent indicates serum ferritin of 1,000 ng/ml.

Thus, where serum ferritin is not feasible but serum iron and TIBC are available, TS can be used to estimate the level of serum ferritin. Therefore, the assessment of iron stores and monitoring of iron chelation in thalassemic patients can be effectively achieved.

**Key word** : Transferrin Saturation, Ferritin, Thalassemia

Thalassemia is the most common hereditary hemolytic anemia in Thailand and is found in 1 per cent of population(1). The affected patients present symptoms of chronic anemia, jaundice, hepatosplenomegaly, "thalassemia faces", and failure to thrive. A life-long transfusion dependence is required in the majority of patients. Moreover, the increment of iron absorption from the gastrointestinal tract is also found among these patients. The accumulated iron will induce damage to the liver, heart and various endocrine glands. The assessment of iron stores is essential for determining the need and efficacy of iron chelation. The assay of serum ferritin, which directly reflects the iron stores, is not always feasible. However, the assay of serum iron and TIBC are commonly available. Thus, TS can be calculated by the equation of serum iron/TIBC x 100.

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This paper presents the correlation between TS and serum ferritin in thalassemic children.

## MATERIAL AND METHOD

From April 1996 to December 1997, 79 children with thalassemia diseases from the Department of Pediatrics, Faculty of Medicine, Ramathibodi Hospital were enrolled in the study. The levels of serum iron, TIBC and serum ferritin were simultaneously determined. The serum iron and TIBC were assayed by colorimetric analysis as recommended by the International Committee for Standardization in Hematology[2]. Then, TS was subsequently calculated by the equation of serum iron/ TIBC x 100. In addition, serum ferritin was assayed by microparticle enzyme immunoassay described by the manufacturer[3].

**Statistics** The correlation between TS and serum ferritin was calculated by simple linear regression[4]. A p value of less than 0.05 was considered significant.

## RESULTS

Seventy-nine samples from 72 children with thalassemia diseases were studied. They were beta-thalassemia major (n = 10), beta-thalassemia/ Hb E disease (n = 42), AE Bart's disease (n = 7), Hb H disease (n = 16) and Hb H disease with Hb Constant Spring (n = 4). The ages ranged from 1 to 17 years with a mean of 7 years and 10 months. The female to male ratio was 0.8:1. There were no patients with clinical symptoms of hepatitis.

The statistical correlations among the parameters of iron stores were carried out. There was no correlation between serum ferritin and serum iron or TIBC. Moreover, there was also no linear correlation between serum ferritin and TS. However, when serum ferritin was transformed by natural logarithm (ln), a normal distribution curve was obtained. Subsequently, TS was shown to be highly correlated with the ln-transformed serum ferritin in the equation of TS = 10.253 ln (ferritin) (r = 0.956, p = 0.000) as shown in Fig. 1. For example, TS of 70.83 per cent indicates serum ferritin of 1,000 ng/ml.

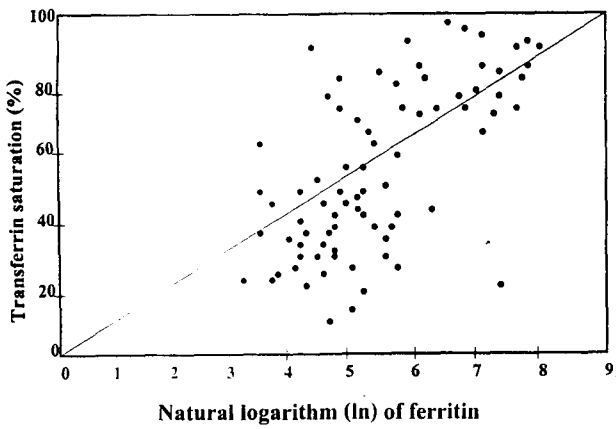


**Fig. 1. The correlation between transferrin saturation and natural logarithm (ln) of ferritin.**

## DISCUSSION

The assessment of body iron stores is crucial for evaluating the need and efficacy of iron chelation. The iron stores can be demonstrated by serum iron, TIBC, TS, serum ferritin, iron content in the liver or bone marrow and magnetic resonance image scan. Although there are a number of techniques used for these purposes, none is ideal. Serum ferritin correlates with body iron stores when there is no infection or inflammation. The ferritin also increases in hereditary hemochromatosis[5-7], thalassemia disease and in other forms of iron overload[8-10]. Serum ferritin can be determined by a variety of sensitive methods which are all based on quantitative immunologic reaction employing specific anti-ferritin antibodies and radioactive or enzyme tracers. In this study, serum ferritin was determined by enzyme immunoassay which produced fluorescence. A special equipment was required for the laboratory test. Through the statistical analysis, a linear correlation between TS and serum ferritin did not differ from another study[9]. However, one study revealed the correlation between TS and serum ferritin in the equation of TS = -0.7395 + 10.7868 log (ferritin)[11] but the serum ferritin was measured by radioimmunoassay. The assay of serum ferritin, which is not always available in the laboratories of various provincial hospitals in Thailand, requires a skillful technique. On the contrary, the assays of serum iron and TIBC, which are commonly available, are simple, easy to perform and less expensive.

## SUMMARY

Where serum ferritin is not feasible but serum iron and TIBC are available, TS can be used

to estimate the level of serum ferritin. Therefore, the assessment of iron stores and monitoring of iron chelation in thalassemic patients can be effectively achieved.

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## ความสัมพันธ์ของ transferrin saturation และ ferritin ในผู้ป่วยเด็กโรคธาลัสซีเมีย

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ธาลัสซีเมียเป็นปัญหาสาธารณสุขที่สำคัญของประเทศไทย ภาวะเหล็กเกินเรื้อรังในผู้ป่วยธาลัสซีเมียเป็นภาวะแทรกซ้อนที่ทำให้เสียชีวิตก่อนวัยอันควร ดังนั้นจึงได้ศึกษาภาวะเหล็กสะสมในผู้ป่วยเด็กธาลัสซีเมีย โดยการตรวจวัด serum iron (SI), total iron binding capacity (TIBC), transferrin saturation (TS) และ serum ferritin จากตัวอย่างเลือด 79 ตัวอย่างจากผู้ป่วย 72 รายที่มีอายุตั้งแต่ 1-17 ปี (เฉลี่ย 7 ปี 10 เดือน) และผู้ป่วยไม่มีภาวะตับอักเสบ ผลการศึกษาพบว่าค่า TS มีความสัมพันธ์กับค่า serum ferritin ในรูปของ ln (ferritin) ดังสมการ TS = 10.253 ln (ferritin) ถ้า TS เท่ากับ 70.83% serum ferritin จะเท่ากับ 1,000 ng/ml

ดังนั้นในกรณีที่ไม่สามารถตรวจวัดค่า serum ferritin ได้ การตรวจวัดค่า SI, TIBC ก็สามารถประเมินค่า serum ferritin เพื่อประเมินเหล็กสะสมในร่างกายในผู้ป่วยเด็กธาลัสซีเมีย และใช้ติดตามผลการรักษาภาวะเหล็กเกิน โดยใช้ยาขับเหล็กได้อีกด้วย

**คำสำคัญ** : ทรานสเฟอร์ริน อิ่มตัว, เฟอไรติน, โรคธาลัสซีเมีย

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