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## Correlations of alanine and aspartate aminotransferase levels with high-sensitivity C-reactive protein in pediatric patients with beta-thalassemia major

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## Abstract

**Background:** Beta-thalassemia major is a hereditary blood disorder characterized by severe anemia requiring lifelong regular blood transfusions. Repeated transfusions may lead to iron overload, which can cause oxidative stress, hepatocellular injury, and chronic inflammation. Serum glutamic-pyruvic transaminase (SGPT) and serum glutamic-oxaloacetic transaminase (SGOT) are commonly used to assess hepatocellular injury, whereas high-sensitivity C-reactive protein (hs-CRP) can detect low-grade systemic inflammation.

**Purpose:** To determine the correlation between SGPT and SGOT levels and hs-CRP levels in pediatric patients with beta-thalassemia major.

**Method:** This analytical observational study used a cross-sectional design and secondary data from medical records of pediatric patients with beta-thalassemia major treated at Pringsewu Regional General Hospital. Data were collected in February 2025 from records of patients treated between September and November 2024. A purposive sampling technique was used based on predetermined inclusion and exclusion criteria, resulting in 43 eligible patients. Data were analyzed using the Spearman correlation test with a significance level of  $p < 0.05$ .

**Results:** The mean SGPT, SGOT, and hs-CRP levels were  $58.86 \pm 30.749$  U/L,  $55.67 \pm 23.551$  U/L, and  $1.1216 \pm 1.19167$  mg/L, respectively. A significant positive correlation was found between SGPT and hs-CRP levels ( $p = 0.025$ ;  $r = 0.341$ ), indicating a weak positive correlation. A significant positive correlation was also found between SGOT and hs-CRP levels ( $p = 0.005$ ;  $r = 0.421$ ), indicating a moderate positive correlation.

**Conclusion:** SGPT and SGOT levels were significantly and positively correlated with hs-CRP levels in pediatric patients with beta-thalassemia major. These findings suggest that hepatocellular injury and systemic inflammation may occur concurrently in patients with transfusion-dependent beta-thalassemia.

**Keywords:** Beta-Thalassemia Major; High-Sensitivity C-Reactive Protein; SGOT; SGPT; Systemic Inflammation.

## INTRODUCTION

Thalassemia is a hereditary blood disorder inherited in an autosomal recessive manner due to impaired globin chain synthesis, resulting in inadequate hemoglobin production (Syafira et al., 2024). This condition causes ineffective erythropoiesis, chronic hemolysis, and anemia of

varying severity. Based on the affected globin chain, thalassemia is classified into alpha, beta, delta, gamma, delta-beta, and gamma-delta-beta thalassemia (Purbasari & Lail, 2024). Clinically, the disease is classified as thalassemia minor, intermedia, and major, with beta-thalassemia major

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being the most severe form because patients require lifelong regular blood transfusions to maintain adequate hemoglobin levels (Ayukarningsih et al., 2022).

Thalassemia remains a public health concern in many countries, particularly in the Mediterranean region, the Middle East, South Asia, and Southeast Asia. The World Health Organization reports that thalassemia is among the genetic disorders with a high global prevalence (Suhana & Nurvinanda, 2023). In Indonesia, the number of patients with beta-thalassemia major continues to increase each year and is estimated to be higher than the number of diagnosed cases (Robila et al., 2024). Lampung Province is one of the regions in Sumatra with a relatively high number of thalassemia patients, requiring greater attention to early detection and prevention of disease complications (Xian et al., 2022).

The primary management of beta-thalassemia major is regular blood transfusion. Although transfusion therapy is essential for correcting anemia and maintaining patients' quality of life, long-term transfusion therapy carries a risk of iron overload. Iron accumulation occurs because the body lacks an effective physiological mechanism for eliminating excess iron. This condition increases the production of free radicals through the Fenton reaction, leading to oxidative stress, lipid peroxidation, protein damage, and cellular DNA damage (Coates, 2019). The liver is the primary organ responsible for iron storage and is therefore one of the organs most vulnerable to chronic iron deposition and subsequent injury (Humaida et al., 2022).

Hepatocellular injury causes intracellular enzymes, particularly alanine aminotransferase (ALT), also known as serum glutamic-pyruvic transaminase (SGPT), and aspartate aminotransferase (AST), also known as serum glutamic-oxaloacetic transaminase (SGOT), to be released into the circulation, resulting in elevated serum levels (Suryoadji & Alfian, 2021).

SGPT has greater specificity for hepatic tissue because it is predominantly located in the cytoplasm of hepatocytes, whereas SGOT is also found in the heart, skeletal muscle, and other tissues in addition to the liver (Sunaidi, 2023). Therefore, elevations in

these two enzymes are commonly used as laboratory indicators of hepatocellular injury in patients with thalassemia who undergo repeated blood transfusions (Hussain et al., 2023).

In addition to causing tissue injury, iron overload contributes to the activation of chronic inflammatory responses. Oxidative stress stimulates macrophage activation and the release of pro-inflammatory cytokines, particularly interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF- $\alpha$ ). These cytokines subsequently stimulate hepatocytes to increase the synthesis of C-reactive protein (CRP), an acute-phase protein (Agustina et al., 2020). High-sensitivity C-reactive protein (hs-CRP) testing has greater analytical sensitivity than conventional CRP testing, enabling the detection of low-grade inflammation that may occur in patients with beta-thalassemia major before more severe clinical manifestations develop (Banait et al., 2022).

Several studies have shown that patients with beta-thalassemia major tend to have elevated biomarkers of hepatic injury and inflammation. A previous study reported that hs-CRP levels were significantly elevated in patients with beta-thalassemia major, reflecting the presence of chronic inflammation (Ghareghani et al., 2023). Another study demonstrated that patients undergoing repeated blood transfusions experienced elevated SGPT and SGOT levels due to iron accumulation in hepatic tissue (Goyal & Choudhary, 2023). Meanwhile, other researchers have reported that increased transaminase levels are associated with elevated hs-CRP levels in various clinical conditions involving inflammatory processes (Kuroda et al., 2021). However, studies specifically evaluating the relationship between SGPT, SGOT, and hs-CRP levels in children with beta-thalassemia major remain limited, particularly in Indonesia.

## RESEARCH METHOD

This study used an analytical observational design with a cross-sectional approach. The study was conducted at Pringsewu Regional General Hospital in February 2025 using secondary data obtained from medical records. The laboratory and

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clinical data analyzed in this study were obtained from patient records during September–November 2024.

The study population consisted of 53 pediatric patients diagnosed with beta-thalassemia major and registered at Pringsewu Regional General Hospital during the study period. Patients were selected using purposive sampling based on predetermined inclusion and exclusion criteria. A total of 43 patients met the eligibility criteria and were included in the analysis.

The inclusion criteria were pediatric patients diagnosed with beta-thalassemia major who underwent regular blood transfusion therapy and had complete laboratory data for SGPT, SGOT, and hs-CRP. Patients with documented severe infection, trauma, autoimmune disease, other chronic diseases that could affect inflammatory markers, or immunosuppressive therapy were excluded.

The primary variables were serum SGPT, SGOT, and hs-CRP levels. Demographic and clinical characteristics included age, sex, annual transfusion

frequency, degree of splenomegaly, and serum ferritin level. All data were obtained from medical records using a structured data collection form.

SGPT and SGOT levels were recorded in U/L, while hs-CRP levels were recorded in mg/L according to the laboratory results documented in the medical records. Categorization of laboratory values followed the reference ranges and clinical criteria used by the hospital laboratory.

Univariate analysis was performed to describe the demographic and clinical characteristics of the participants and the distribution of SGPT, SGOT, and hs-CRP levels. Normality testing indicated that the data were not normally distributed; therefore, the Spearman rank correlation test was used to assess the relationship between SGPT and hs-CRP and between SGOT and hs-CRP.

Statistical analysis was performed using IBM SPSS Statistics version 26.0. Statistical significance was determined at  $p < 0.05$ .

## RESEARCH RESULTS

**Table 1. Characteristics of Respondents (N=43)**

| Variable                                | Results              |
|-----------------------------------------|----------------------|
| <b>Age (Mean±SD) (Years) (Range)</b>    | (8.79 ± 3.83) (0-16) |
| Toddlers (0–5)                          | 8/18.6               |
| Children (6–11)                         | 24/55.8              |
| Early adolescents (12–16)               | 11/25.6              |
| <b>Gender (n/%)</b>                     |                      |
| Male                                    | 27/62.8              |
| Female                                  | 16/37.2              |
| <b>Transfusion Frequency/Year (n/%)</b> |                      |
| <20 times                               | 14/32.6              |
| 20–29 times                             | 20/46.5              |
| ≥30 times                               | 9/20.9               |
| <b>Degree of Splenomegaly (n/%)</b>     |                      |
| 0                                       | 6/14.0               |
| I                                       | 11/25.6              |
| II                                      | 7/16.3               |

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|                               |         |
|-------------------------------|---------|
| III                           | 6/14.0  |
| IV                            | 7/16.3  |
| V                             | 4/9.3   |
| VI                            | 2/4.7   |
| <b>Ferritin level (ng/mL)</b> |         |
| <1,000                        | 1/2.3   |
| 1,000–2,500                   | 3/7.0   |
| >2,500                        | 39/90.7 |
| <b>SGPT (n/%)</b>             |         |
| Low                           | 2/4.7   |
| Normal                        | 10/23.3 |
| High                          | 31/72.1 |
| <b>SGOT (n/%)</b>             |         |
| Low                           | 0/0     |
| Normal                        | 8/18.6  |
| High                          | 35/81.4 |
| <b>hs-CRP (n/%)</b>           |         |
| Low                           | 35/81.4 |
| Normal                        | 4/9.3   |
| High                          | 4/9.3   |

Table 1. show majority of patients were children aged 6–11 years (55.8%) and male (62.8%). Most patients received blood transfusions 20–29 times per year (46.5%). Regarding splenomegaly, grade I was the most common (25.6%). Most patients had ferritin levels >2,500 ng/mL (90.7%), indicating a high prevalence of iron overload among the study population. Most patients had elevated SGPT levels (72.09%) and SGOT levels (81.40%). In contrast, most patients had normal hs-CRP levels (81.4%), while 9.3% had normal levels and 9.3% had high levels.

Table 2. Distribution of SGPT, SGOT, and hs-CRP Levels

| Variabel      | Minimum | Maximum | Mean   | Std. Deviation |
|---------------|---------|---------|--------|----------------|
| SGPT (U/L)    | 8       | 141     | 58.86  | 30.749         |
| SGOT (U/L)    | 16      | 122     | 55.67  | 23.551         |
| hs-CRP (mg/L) | 0,50    | 5       | 1.1216 | 1.19167        |

Table 2. The mean SGPT level was  $58.86 \pm 30.749$  U/L, with values ranging from 8 to 141 U/L. The mean SGOT level was  $55.67 \pm 23.551$  U/L, with values ranging from 16 to 122 U/L. Meanwhile, the mean hs-CRP level was  $1.1216 \pm 1.19167$  mg/L, with values ranging from 0.50 to 5 mg/L.

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**Table 3. Correlation Between SGPT and SGOT Levels and hs-CRP**

| Variabel        | p-value | r     |
|-----------------|---------|-------|
| SGPT dan hs-CRP | 0.025   | 0.341 |
| SGOT dan hs-CRP | 0.005   | 0.421 |

There was a significant positive correlation between SGPT and hs-CRP levels ( $p = 0.025$ ;  $r = 0.341$ ), indicating a weak positive correlation. Similarly, SGOT levels were significantly and positively correlated with hs-CRP levels ( $p = 0.005$ ;  $r = 0.421$ ), indicating a moderate positive correlation. These findings suggest that higher SGPT and SGOT levels were associated with higher hs-CRP levels in pediatric patients with beta-thalassemia major.

## DISCUSSION

This study showed that most patients with beta-thalassemia major were aged 6–11 years (55.8%) and were male (62.8%). The predominance of this age group is consistent with the natural course of beta-thalassemia major, in which clinical manifestations generally appear early in life due to impaired  $\beta$ -globin chain synthesis, resulting in severe anemia that requires regular blood transfusions. With advances in transfusion therapy and iron chelation, patient survival has improved, allowing many patients to survive into childhood and adolescence (Sadiq et al., 2024). The difference in sex proportions observed in this study may reflect the characteristics of the study population, considering that beta-thalassemia major is an autosomal recessive genetic disorder with no sex predilection (Moftah et al., 2020; Jabbar et al., 2023).

Most patients underwent blood transfusions 20–29 times per year (46.5%), had grade I splenomegaly (25.6%), and had ferritin levels  $>2,500$  ng/mL (90.7%). These findings indicate that most patients had experienced iron overload due to repeated blood transfusions. Chronic iron accumulation increases the formation of reactive oxygen species (ROS), leading to oxidative stress, hepatocellular injury, and inflammatory responses that contribute to increased liver injury and inflammatory biomarkers in patients with beta-thalassemia major (Farmakis et al., 2021).

The analysis showed a significant association between SGPT and hs-CRP levels ( $p = 0.025$ ;  $r = 0.341$ ). The correlation coefficient indicated a weak positive correlation, suggesting that higher SGPT levels tended to be associated with higher hs-CRP levels. This association can be explained by the iron overload mechanism, in which iron deposition in the liver causes hepatocellular injury and the release of SGPT into the circulation. At the same time, oxidative stress activates pro-inflammatory cytokines, such as interleukin-6 (IL-6) and tumor necrosis factor- $\alpha$  (TNF- $\alpha$ ), which stimulate the hepatic synthesis of C-reactive protein (CRP), thereby increasing hs-CRP levels (Coates, 2019).

These findings are consistent with previous research reporting an association between elevated transaminase levels and increased hs-CRP levels in patients with beta-thalassemia major (Moftah et al., 2020). Similar findings have shown that patients with high ferritin levels tend to have higher SGPT levels and inflammatory biomarkers. These studies further support the role of iron overload as a major mechanism linking hepatocellular injury and chronic inflammation in beta-thalassemia major (Jabbar et al., 2023).

However, the correlation strength in this study was weak, indicating that hs-CRP levels are not influenced solely by SGPT levels but may also be affected by other factors, including the degree of iron overload, frequency of blood transfusions, adherence to iron chelation therapy, and other inflammatory conditions that were not evaluated in this study. Therefore, SGPT assessment together with hs-CRP may be considered as part of early monitoring for complications associated with iron overload in patients with beta-thalassemia major (El-Beshlawy et al., 2024).

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## CONCLUSION

There were significant positive correlations between SGPT and hs-CRP levels ( $p = 0.025$ ;  $r = 0.341$ ) and between SGOT and hs-CRP levels ( $p = 0.005$ ;  $r = 0.421$ ) in pediatric patients with beta-thalassemia major at Pringsewu Regional General Hospital. The correlation between SGPT and hs-CRP was weak, whereas the correlation between SGOT and hs-CRP was moderate. These findings indicate that hepatocellular injury and systemic inflammation may occur concurrently in pediatric patients with beta-thalassemia major.

## REFERENCES

- Agustina, R., Mandala, Z., & Indah, R. N. (2020). Hubungan kadar ferritin serum dengan kadar enzim sgot dan sgpt pada pasien thalassemia  $\beta$  mayor. *Jurnal Ilmiah Kesehatan Sandi husada*, 9(1), 252-257.
- Ayukarningsih, Y., Amalia, J., & Nurfarhah, G. (2022). Thalassemia and nutritional status in children. *Journal of Health and Dental Sciences*, 2(1), 39-52.
- Banait, T., Wanjari, A., Danade, V., Banait, S., & Jain, J. (2022). Role of high-sensitivity C-reactive protein (Hs-CRP) in non-communicable diseases: a review. *Cureus*, 14(10).
- Coates, T. D. (2019). Iron overload in transfusion-dependent patients. *Hematology 2014, the American Society of Hematology Education Program Book*, 2019(1), 337-344.
- El-Beshlawy, A., Dewedar, H., Hindawi, S., Alkindi, S., Tantawy, A. A., Yassin, M. A., & Taher, A. T. (2024). Management of transfusion-dependent  $\beta$ -thalassemia (TDT): Expert insights and practical overview from the Middle East. *Blood Reviews*, 63, 101138.
- Farmakis, D., Porter, J., Taher, A., Domenica Cappellini, M., Angastiniotis, M., Eleftheriou, A., & Yardumian, A. (2022). 2021 Thalassaemia International Federation guidelines for the management of transfusion-dependent thalassemia. *Hemasphere*, 6(8), e732.
- Ghareghani, A., Nikparvar, M., Rafati, S., Eftekhari, E., & Ghareghani, O. (2023). Value of High-Sensitivity C-Reactive Protein, Chronotropic Index, and Heart Rate Recovery in Predicting Cardiac Iron Overload in Patients with Beta-Thalassemia Major.
- Goyal, P., & Choudhary, P. K. (2023). To study the level of serum liver enzymes (SGOT & SGPT) in multitransfused thalassemia major patients. *IP International Journal of Medical Paediatrics and Oncology*, 6(3), 107-109.
- Humaida, R., Budiman, W., & Dewi, A. P. (2022). Hubungan Kadar Ferritin Dengan Kadar Kreatinin Pada Pasien Talasemia Usia 4-13 Tahun. *Binawan Student Journal*, 4(1), 31-37.
- Hussein, G. M., Abdullah, M. A., & Hussein, N. Y. (2023). Association of the changes in hepatic enzymes, bilirubin, and plasma proteins with beta-thalassemia in iron over loaded-patients.
- Jabbar, H. K., Hassan, M. K., & Al-Naama, L. M. (2023). Lipids profile in children and adolescents with  $\beta$ -thalassemia major. *Hematology, Transfusion and Cell Therapy*, 45(4), 467-472.
- Kuroda, R., Nogawa, K., Watanabe, Y., Morimoto, H., Sakata, K., & Suwazono, Y. (2021). Association between high-sensitive C-reactive protein and the development of liver damage in Japanese male workers. *International Journal of Environmental Research and Public Health*, 18(6), 2985.
- Moftah, W. M., Mohammed, E. K., Morsy, A. A., & Ibrahim, A. A. (2020). Ischemia modified albumin and C-reactive protein in children with  $\beta$ -thalassemia major. *Open Journal of Pediatrics*, 10(03), 452.
- Purbasari, D., & Lail, N. A. (2024). Kepatuhan konsumsi Terapi Kelas Besi Dengan Kualitas

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- Hidup Anak Pada Penderita Thalasemia Mayor di RSUD Majalengka. MEJORA Medical Journal Awatara, 2(1), 17-24.
- Robila, T., Amirulloh, M. R., & Sampurna, R. H. (2024). Kualitas pelayanan kesehatan pada penyintas thalasemia di Kota Sukabumi. Kebijakan: jurnal ilmu administrasi, 15(02), 284-292.
- Sadiq, I. Z., Abubakar, F. S., Usman, H. S., Abdullahi, A. D., Ibrahim, B., Kastayal, B. S., & Hassan, H. A. (2024). Thalassemia: Pathophysiology, diagnosis, and advances in treatment. Thalassemia Reports, 14(4), 81-102.
- Suhana, K. H., & Nurvinanda, R. (2023). Faktor Faktor yang Berhubungan dengan Kejadian Thalassemia Beta Mayor pada Anak. Jurnal Penelitian Perawat Profesional, 5(4), 1713-1724.
- Sunaidi, Y. (2023). Overview of serum glutamic pyruvic transaminase and serum glutamic oxaloacetic transaminase levels in covid-19 patients. Jurnal Kedokteran Universitas Palangka Raya, 11(1).
- Suryoadji, K. A., & Alfian, I. M. (2021). Patofisiologi Gejala Penyakit Thalasemia Beta: A Narrative Review. Khazanah: Jurnal Mahasiswa, 13(2).
- Syafira, M., Sribudiani, Y., & Maskoen, A. M. (2024). Systematic Review: Pemodifikasi Genetik B-Thalassemia. Journal of Medicine and Health, 6(1), 91-102.
- Xian, J., Wang, Y., He, J., Li, S., He, W., Ma, X., & Li, Q. (2022). Molecular epidemiology and hematologic characterization of thalassemia in Guangdong Province, Southern China. Clinical and Applied Thrombosis/Hemostasis, 28, 10760296221119807.

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