RESEARCH BRIEF

Hematological Parameters in Adolescents with Hyperuricemia

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Objective: To examine the association between hematological indices and serum uric acid in adolescents with hyperuricemia. **Methods:** 10-year retrospective cohort study of 607 patients with hyperuricemia registered with the Pediatric Nephrology Department. **Results:** There was a statistically significant positive correlation between serum uric acid levels and BMI Z-scores (r=0.406, *P*<0.001), white and red blood cell counts, hemoglobin and hematocrit. Higher levels of hemoglobin, hematocrit and red blood cells were found in adolescents with metabolic syndrome than in groups without this condition. **Conclusion:** Hematological parameters could be important biological markers of cardiometabolic risk in adolescents with hyperuricemia.

Keywords: Association, *Metabolic syndrome, Platelet count, Risk, Uric acid*.

The prevalence of hyperuricemia is increasing in adults and adolescents [1]. Although hyperuricemia is not included in the definition of metabolic syndrome, it is observed in 37.2% of hypertensive and obese adults, and in 90% of adolescents with primary hypertension [2]. There are a few studies that demonstrate relationships between hematological parameters and metabolic syndrome. A previous study suggested that increased erythropoiesis in peripheral blood could be part of the metabolic syndrome [3]. Uric acid crystals may cause inflammation through complement activation and induce platelet activation resulting in higher mean platelet volume. Patients with increased mean platelet volume are at risk of death due to ischemic heart disease [4]. An increased platelet count and mean platelet volume has been reported in hypertensive adolescents, but not in pre-hypertensive teenagers [5]. Several studies have reported a positive association between mean platelet volume and blood glucose, blood pressure, or lipid profile [6] but adequate attention has not been paid to possible correlation between hematological parameters and serum uric acid. The aim of this study was to determine if hematological indices correlate with serum uric acid levels and lipid profile in adolescents with hyperuricemia.

METHODS

The current research is part of a 10-year retrospective cohort study of patients registered with the Pediatric Nephrology Department at Medical University of Bialystok, Poland. Demographic, clinical, and laboratory data were obtained. Hematological indices (red and white blood cell count, hemoglobin, hematocrit, platelet count, and mean platelet volume) serum creatinine, urea, uric acid, total cholesterol, triglycerides, urinalysis, and glomerular filtration rate (GFR) were assessed.

The inclusion criteria were: 11- to 21-year-old adolescents with serum uric acid >5.5 mg/dL who were referred to our department in the primary care office because of elevated casual blood pressure. The exclusion criteria were heart failure, diabetes mellitus, renal or hepatic dysfunction, hematological disease, systemic inflammatory conditions, autoimmune diseases, secondary hypertension, and treatment with medications that affect uric acid levels and blood pressure values.

The Bioethics Committee of the Medical University of Bialystok approved the protocol. Bodyweight and height were measured using a balance beam scale and a wall-mounted stadiometer, respectively. Body mass index (BMI) was calculated using standard formula. Age- and gender-specific reference values for BMI were generated by the LMS method [7]. The LMS values were taken from the study by Kulaga, *et al.* [8]. We defined metabolic syndrome according to the criteria established by Cook, *et al.* [9]. The diagnosis of hypertension was based on recommendations of European Society of Hypertension [10], and hyperuricemia was defined as serum uric acid level >5.5 mg/dL. Overweight and obesity were defined using criteria developed by Cole, *et al.* [10].

WHAT THIS STUDY ADDS?

- In adolescents with hyperuricemia, there is a positive correlation between serum uric acid and white and red blood cell count, hematocrit, and hemoglobin.
- Hyperuricemic adolescents with metabolic syndrome – have higher levels of hemoglobin, hematocrit, and red blood cell count than those without metabolic syndrome.

Blood samples were collected in the morning, after overnight fasting. The venous blood samples were combined with dipotassium EDTA and tested within 30 minutes of collection. Complete blood counts were measured using an automated blood counter. Serum creatinine was determined by updated Jaffe reaction and uric acid was assessed using the colorimetric method. Serum cholesterol, HDL-cholesterol and triglycerides were determined by the enzymatic method using Hitachi 912 (La Roche Japan). Serum glucose was measured with the Integra 800 analyzer. GFR was assessed by updated Schwartz formula [11].

RESULTS

We examined 607 adolescents (474 boys) during the study period; 187 (31%) had metabolic syndrome. In the adolescents with hyperuricemia but without metabolic syndrome (420), primary hypertension was found in 48% and obesity in 19.7% patients. There was a statistically significant positive correlation between serum uric acid level and BMI-Z-score ($P<0.001$), white blood cell count ($P<0.001$) and red blood cell count ($P<0.001$), hemoglobin ($P<0.001$), and hematocrit ($P<0.001$).

The study showed statistically significant correlations between white blood cell count and lipid profile in hyperuricemic adolescents. White blood cell count correlated positively with total cholesterol (r =0.14, $P<0.001$) and triglycerides ($P=0.032$), and negatively with high-density lipoproteins ($P=0.045$). Additionally, a positive relationship was found between BMI Z-score and platelet count ($P=0.002$) and between BMI Z-score and red blood cell count ($P=0.005$), and a negative relationship between BMI Z-score and mean platelet volume ($P=0.038$) (***Fig.* 1**).

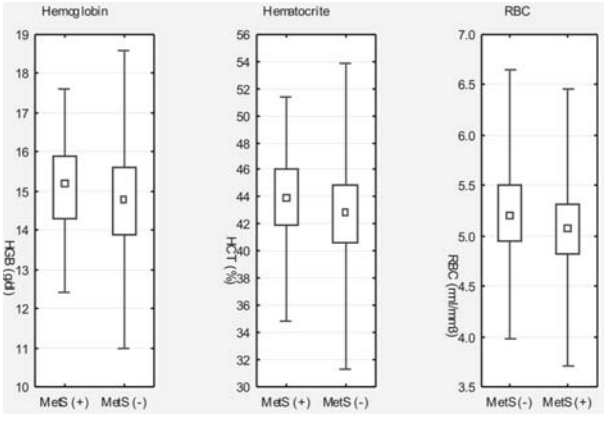

FIG. 1 *Comparison of hematological parameters between adolescents with (MetS (+)) and without (MetS (-)) metabolic syndrome.*

The results showed significantly higher hemoglobin, hematocrit, and red blood cell count ($P<0.001$, $P<0.001$, and $P=0.032$, respectively) in patients with metabolic syndrome than in those without this diagnosis.

DISCUSSION

The results of this retrospective study showed that in adolescents with hyperuricemia, serum uric acid levels correlated with white and red blood cell count, hematocrit, and hemoglobin. We found significantly higher levels of hemoglobin, hematocrit, and red blood cell count in adolescents with metabolic syndrome than in the group without it.

Our findings are in general agreement with the earlier reports [3,12,13] in children and adolescents with obesity, hypertension, and/or metabolic syndrome. Increased insulin resistance and other components of the metabolic syndrome were earlier shown to be associated with increased white and red blood cell count, hemoglobin, and hematocrit, and as a consequence, increased blood viscosity [14]. Our finding of no correlation between serum uric acid and platelet count and mean platelet volume was contrary to other reports [15] Although there is some evidence linking increased white and red blood cell count, hemoglobin, and hematocrit with hyperuricemia, role of confounding variables like chronic inflammation and obesity-associated obstructive sleep apnea cannot be ruled out.

This preliminary study suggests that increased hematocrit, hemoglobin, and white and red blood cell count could be important biological markers of metabolic syndrome and hyperuricemia in adolescents.

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