Hemolysis in a girl with type 1 diabetes mellitus and glucose-6-phosphate dehydrogenase deficiency

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Objectives:

Glucose-6-phosphate dehydrogenase (G6PD) is the key enzyme of the pentose phosphate pathway. G6PD deficiency is a X-linked enzymopathy due to mutations of the G6PD gene. Many individuals have no symptoms, while some patients could suffer severe hemolytic anemia. Hemolysis during type 1 diabetes mellitus (T1DM) treatment in patients with G6PD deficiency has been reported, but the underlying pathogenesis is not fully clarified. In this report, we we try to explore the association between the two diseases.

Methods:

We report a girl in whom hemolysis occurred after diabetic ketoacidosis (DKA) treatment, and review relevant literature.

Results:

A 10 year-old girl was admitted for T1DM and a moderate DKA. She was treated with fluids replacement and intravenous insulin, and rapidly recovered. Normoglycemia recovery and the disappearance of blood and urine ketone bodies were achieved within 24 hours, and subcutaneous insulin injections were introduced, with good glycemic control. On day 9 after admission, the patient appeared transient hypoglycemia (2.7 mmol/L) after heavy exercise, and two days later she developed pallor, jaundice and hemoglobinuria, and blood tests showed hemolytic anemia. Since the girl's younger sister was diagnosed with G6PD deficiency after neonatal screening, the same diagnosis was considered. The patient's G6PD activity was 0.12 (normal 1.0-2.3). Both methemoglobin reduction test and heinz body detection were positive. G6PD gene analysis showed that the patient was double heterozygous for mutations c.1376G>T and c.1388G>A. The patient's mother was heterozygous for mutation c.1376G>T and her father was hemizygous for mutation c.1388G>A. The parents had never show hemolysis, probably because the mosaic proportion of deficient red blood cells is too low and the enzymatic activity may relatively decrease not obviously. The mechanism of our patient's hemolysis may includes two points. One is that, severe hyperglycemia reduced G6PD activity so that antioxidant from erythrocyte decreased, meanwhile metabolism disorder of DKA promoted the erythrocyte depletion in antioxidant. The other is that, during DKA treatment the glucose levels progressively decreased and even hypoglycemia occurred, making the source of glucose that should have involved the pentose phosphate pathway decreased, and enhancing the inability of the old red blood cells to generate the antioxidant.

Conclusions:

The possibility of hemolysis in patients with G6PD deficiency would be increased in case of diabetes crisis. Reducing of G6PD activity by reason of hyperglycemia and decrease source of glucose in the pentose phosphate pathway because of decrease glucose levels may be the mechanism of hemolysis during DKA treatment.

References:

[1] Cappellini MD, Fiorelli G. Glucose-6-phosphate dehydrogenase deficiency. Lancet 2008; 371: 64-74.
[2] Shalev O, Eliakim R, Lugassy GZ, Menczel J. Hypoglycemia induced hemolysis in glucose-6-phosphate Dehydrogenase deficiency. Acta Haemat 1985; 74: 227-9.
[3] Messina MF, Lombardo F, Crisafulli G, Salzano G, Rossano M, Di Giorgio RM. Hemolityc crisis in a non-ketotic and euglycemic child with Glucose-6-phosphate dehydrogenase deficiency and onset of type 1 diabetes mellitus. J Ped End Metab 2004; 17: 1671-3.
[4] Vanelli M, Lucentini L, Picco P, et al. Blood glucose normalization induced haemolysis in three adolescents with type 1 diabetes mellitus at onset and unknown G6PD deficiency. J Ped End Metab 1996; 9: 193-6.
[5] Haroun M. G6PD deficiency induced hemolysis in diabetic twins. Indian Pediatrics 2005; 42 (17): 705-7.
[6] Tsinopoulou AG, Arvanitakis S N. Glucose 6 phosphate deydrogenase deficiency induced hemolysis in newly diagnosed diabetic monozygotic twins. J Ped End Metab 2000; 13: 669-72.
[7] Rais N, Churi C, Shah A, Kapoor A. Glucotoxicity and oxidative hemolysis in G6PD deficiency. Diab Care 1993; 16: 1215-6.
[8] Le Pommelet C, Le Moullec N, Zunic P. Diabetic ketoacidosis revealing glucose-6-phosphate dehydrogenase deficiency. Diabetes Metab 2006; 32: 636-637.
[9] Shalev O,Wollner A, Menczel J. Diabetic ketoacidosis does not precipitate haemolysis in patients with the Mediterranean variant of Glucose-6-phosphate Dehydrogenase deficiency. British Med J 1984; 288: 179-80.
[10] Yan JB, Xu HP, Xiong C, Ren ZR, Tian GL, Zeng F, Huang SZ. Rapid and reliable detection of glucose-6-phosphate dehydrogenase (G6PD) gene mutations in Han Chinese using high-resolution melting analysis. J Mol Diagn 2010; 12(3): 305-11.
[11] Chiu DT, Zuo L, Chen E, et al. Two commonly occurring nucleotide base substitutions in Chinese G6PD variants. Biochem and Biophys Res Commun 1991; 180(2): 988.
[12] JiangW, Yu G, Liu P, et al. Structure and function of glucose-6-phos phosphate dehydrogenase-deficient variants in Chinese population. Hum Genet 2006; 119(5): 463-78.
[13] Saha N. Association of glucose-6-phosphate dehydrogenase deficiency with diabetes mellitus in ethnic groups of Singapore. J Med Genet 1979; 16(6): 431-4.
[14] Monte Alegre S, Saad ST, Delatre E, Saad MJ. Insulin secretion in patients deficient in glucose-6-phosphate dehydrogenase. Horm Metab Res 1991; 23(4): 171-3.
[15] Zhang Z, Liew CW, Handy DE, Leopold JA, Hu J, Guo L, et al. High glucose inhibits glucose-6-phosphate dehydrogenase, leading to increased oxidative stress and beta-cell apoptosis. FASEB J 2010; 24: 1497-505.
[16] Carette C, Dubois-Laforgue D, Gautier JF, Timsit J. Diabetes mellitus and glucose-6-phosphate dehydrogenase deficiency: from one crisis to another. Diabetes Metab 2011; 37(1): 79-82.

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