

BC368 – Biochemistry of the Cell II Case Study #6:

Case Background:

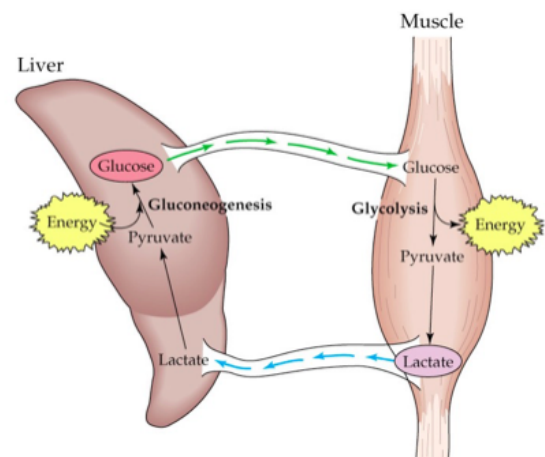
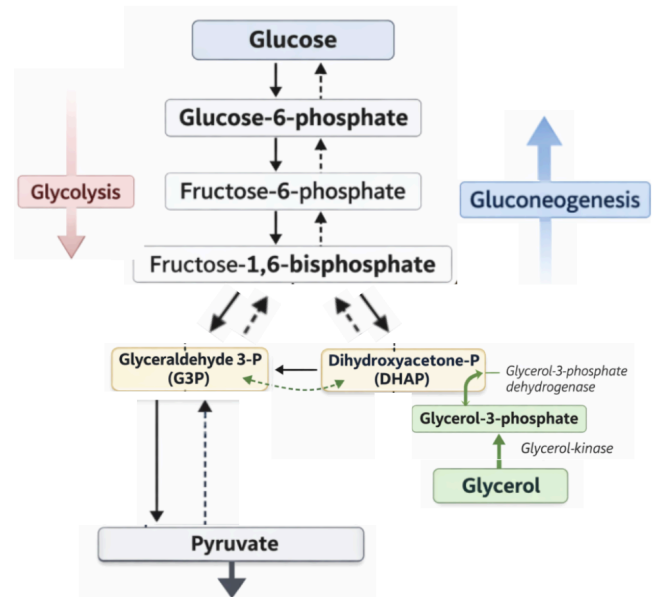
A 28-month-old girl was brought to the emergency department with lethargy and respiratory distress. She had a fever the day before, followed by multiple episodes of vomiting. At the time of presentation, she had a temperature of 97.6 °F, a heart rate of 160 bpm, and a respiratory rate of 52 bpm (normal is 30-60) with increased work of breathing. An abdominal examination revealed hepatomegaly. The patient had no prior hospitalizations, allergic reactions, or toxin ingestion.

Lab Findings:

Laboratory results revealed hypoglycemia (blood glucose 50 mg/dL), lactic acidemia (blood lactate ~9.8 mmol/L), severe acidosis (blood pH 6.84), and elevated glycerol levels. The total white blood count was $42,800 \times 10^9/L$ (normal is 4–10.5).

Biochemistry:

After a meal, blood glucose levels rise, and excess glucose is stored in the liver as glycogen. During fasting, the liver helps maintain blood glucose through glycogen breakdown and the production of new glucose. Muscles and RBCs produce lactate via glycolysis, which is transported to the liver and converted back to glucose via the Cori cycle.



Question 1: What metabolic pathway might be causing this condition? What specific enzymes could be involved? In your response, consider why lactate and glycerol might be elevated.

Part 2: Whole exome sequencing revealed a homozygous pathogenic mutation in the FBPase-1 gene, which encodes the enzyme that converts fructose 1,6-bisphosphate to fructose 6-phosphate. FBPase-1 deficiency is a heritable autosomal recessive disease with an incidence between 1/350,000 and 1/900,000 making it one of the rarest diseases. FBP1 deficiency leads to multiorgan failure and has a high mortality rate if left untreated (1).

Question 2: Lab tests found normal to elevated levels of fructose 1,6-bisphosphate (F16BP). Would intravenous infusion of glucose or Vitamin B7 help this patient's symptoms, why or why not?

Question 3: Doctors treated the patient with bicarbonate supplementation and recommended avoiding taking in too much sweet food (especially sucrose) and food with high protein. Instead, they recommend the use of uncooked starch. Why?

Bibliography

- (1) Pokhrel, S.; Sainju, S.; Lamsal, P.; Chhetri, U. D. A Rare Case of Fructose-1, 6-Bisphosphatase Deficiency: Clinical Features in a Pediatric Patient. *Molecular Genetics and Metabolism Reports* 2024, 41, 101143.
DOI:10.1016/j.ymgmr.2024.101143.
- (2) Xu, Ke, Xue-qin Liu, Chun-yu Zhang, Ying Wang, Xing Li, Ye Wu, Yanling Yang and H J Xiao. "[Genetic diagnosis of fructose-1, 6-bisphosphatase deficiency: a case report]." *Beijing da xue xue bao. Yi xue ban = Journal of Peking University. Health sciences* 46 5 (2014): 681-5 .