TABLE 433e-1 FEATURES OF GLYCOGEN STORAGE DISEASES AND GALACTOSE AND FRUCTOSE DISORDERS

Type/Common Name	Basic Defect	Clinical Features	Comments
Liver Glycogenoses			
Disorders with hepatomegaly and hypoglycemia			
Ia/von Gierke	Glucose-6-phosphatase	Growth retardation, enlarged liver and kidney, hypoglycemia, elevated blood lactate, cholesterol, triglycerides, and uric acid	Common, severe hypoglycemia. Complications in adulthood include hepatic adenomas, hepatic carcinoma, and renal failure.
Ib	Glucose-6-phosphate translocase	As for Ia, with additional findings of neutropenia and neutrophil dysfunction	~10% of type I
IIIa/Cori or Forbes	Liver and muscle debranching enzyme	*Childhood:* hepatomegaly, growth retardation, muscle weakness, hypoglycemia, hyperlipidemia, elevated liver aminotransferases. Liver symptoms improve with age. *Adulthood:* muscle atrophy and weakness; onset in third or fourth decades; variable cardiomyopathy, liver cirrhosis, progressive liver failure	Common, intermediate severity of hypoglycemia. Hepatic adenomas, liver cirrhosis, and hepatic carcinoma can occur.
IIIb	Liver debranching enzyme (normal muscle debrancher activity)	Liver symptoms same as in type IIIa; no muscle symptoms	~15% of type III
VI/Hers	Liver phosphorylase	Hepatomegaly, variable hypoglycemia, hyperlipidemia, and ketosis. Symptoms may improve with age.	Rare, often a "benign" glycogenosis, severe cases being recognized
IX/phosphorylase kinase deficiency	Liver phosphorylase kinase α subunit	As for VI	Common, X-linked, typically less severe than autosomal forms; clinical variability within and between subtypes; severe cases being recognized
0/glycogen synthase deficiency	Glycogen synthase	Fasting hypoglycemia and ketosis, elevated lactic acid and hyperglycemia after glucose load, no hepatomegaly	Decreased glycogen stores
XI/Fanconi-Bickel	Glucose transporter 2	Failure to thrive, short stature, hypophosphatemic rickets, metabolic acidosis, hepatomegaly, proximal renal tubular dysfunction, impaired glucose and galactose utilization	Rare, consanguinity in 70%
Disorders with liver cirrhosis			
IV/Andersen	Branching enzyme	Failure to thrive, hypotonia, hepatomegaly, splenomegaly, progressive liver cirrhosis and failure (death usually before fifth year); some without progression	One of the rarer glycogenoses. Other neuromuscular variants exist.
Muscle Glycogenoses			
Disorders with muscle-energy impairment			
V/McArdle	Muscle phosphorylase	Exercise intolerance, muscle cramps, myoglobinuria on strenuous exercise, increased CK, "second-wind" phenomenon	Common, male predominance
VII/Tarui	Phosphofructokinase—M subunit	As for type V, with additional findings of compensated hemolysis, myalgia	Prevalent in Ashkenazi Jews and Japanese
Phosphoglycerate kinase deficiency	Phosphoglycerate kinase	As for type V, with additional findings of hemolytic anemia and CNS dysfunction	Rare, X-linked
Phosphoglycerate mutase deficiency	Phosphoglycerate mutase—M subunit	As for type V	Rare, most patients African American
Lactate dehydrogenase deficiency	Lactic acid dehydrogenase—M subunit	As for type V, with additional findings of erythematous skin eruption and uterine stiffness resulting in childbirth difficulty in females	Rare
Fructose 1,6-bisphosphate aldolase A deficiency	Fructose 1,6-bisphosphate aldolase A	As for type V, with additional finding of hemolytic anemia	Rare
Pyruvate kinase deficiency	Pyruvate kinase—muscle isozyme	Muscle cramps and/or fixed muscle weakness	Rare
Muscle phosphorylase kinase deficiency	Muscle-specific phosphorylase kinase	As for type V. Some patients may have muscle weakness and atrophy.	Rare, autosomal recessive
β-Enolase deficiency	Muscle β-enolase	Exercise intolerance	Rare
Disorders with progressive skeletal muscle myopathy and/or cardiomyopathy			
II/Pompe	Lysosomal acid α-glucosidase	*Infantile:* hypotonia, muscle weakness, cardiac enlargement and failure, fatal early *late onset (juvenile and adult):* progressive skeletal muscle weakness and atrophy, proximal muscle and respiratory muscle seriously affected	Common, undetectable or very low level of enzyme activity in infantile form; variable residual enzyme activity in late-onset form
PRKAG2 deficiency	AMP-activated gamma 2 protein kinase	Severe cardiomyopathy and early heart failure (9–55 years). Congenital fetal form is rapidly fatal with hypertrophic cardiomyopathy and Wolff-Parkinson-White syndrome.	Very rare, autosomal dominant
Danon's disease	Lysosomal-associated membrane protein 2 (LAMP2)	Severe cardiomyopathy and heart failure (8–15 years)	Very rare, X-linked

(*Continued*)