

1,5-Anhydroglucitol (GlycoMark[®])

FOR MONITORING POSTPRANDIAL HYPERGLYCEMIA AND SHORT-TERM GLYCEMIC CONTROL

Test Highlights

- Decreases in plasma 1,5-anhydroglucitol (1,5-AG) occur due to increases in hyperglycemic states.
- 1,5-AG is the most robust indicator of postprandial hyperglycemia and provides information that is complementary to hemoglobin A1c.
- Controlling postprandial hyperglycemia is important, due to its association with cardiovascular complications of diabetes.

Disease Overview

- Diabetes mellitus (DM) is a chronic illness characterized by disordered glucose metabolism and is responsible for significant morbidity and mortality.
- Well-established methods for assessing glycemic control include hemoglobin A1c (average past two to three months) and fructosamine (average past two to three weeks). However, these are insensitive markers of postprandial hyperglycemia and the level of glycemic control over the previous one to two weeks.
- Epidemiological studies have demonstrated that postprandial glucose concentrations are strongly associated with DM-related mortality and that improved glycemic control decreases acute complications and improves long-term outcomes.

Pathophysiology

- 1,5-AG is a naturally occurring dietary monosaccharide that is well absorbed in the intestine and minimally metabolized. 99.9 percent of filtered 1,5-AG is reabsorbed by the renal tubule.
- The plasma concentration of 1,5-AG is maintained due to a steady state of ingestion, distribution, and excretion.
- Reabsorption of 1,5-AG is competitively inhibited by glucose, so when the concentration of plasma glucose exceeds its renal threshold (~180 mg/dL), 1,5-AG is excreted in the urine. Therefore, poor glycemic control leads to *decreased* concentrations of plasma 1,5-AG.

Indications for Ordering

- Identify hyperglycemia in patients with moderately controlled (hemoglobin A1c <8 percent) DM.
- Identify recent (one to two weeks) excursions of postprandial hyperglycemia.
- Evaluate short-term glycemic control in patients undergoing adjustments to therapy.

Clinical Utility

- In a cohort study¹ of 77 patients with DM (71 percent type 2) with suboptimal glucose control (hemoglobin A1c \geq 7 percent) who underwent therapies to reduce hemoglobin A1c by \geq 1 percent over eight weeks, 1,5-AG demonstrated a median increase of 93 percent within two weeks, compared to a decrease of only 7 percent for fructosamine. Hemoglobin A1c showed no decrease until week four.

- In a longitudinal study² of 34 patients with DM (29 percent type 2), stable glycemic control, and a hemoglobin A1c between 6.5 and 8 percent, 1,5-AG was significantly correlated with postprandial glucose excursions >180 mg/dL ($r=-0.48$) at the end of the study interval (day seven) which was better than hemoglobin A1c ($r=0.36$) or fructosamine ($r=0.33$). Furthermore, only 1,5-AG was significantly different between patients when they were sorted into two groups based on the median result of postprandial excursions >180 mg/dL. The authors concluded that 1,5-AG reflected postprandial glycemic excursions more robustly than other glycemic indicators and suggested that serial 1,5-AG measurements could be useful for assessing postprandial hyperglycemia.
- Due to the complementary information it provides in conjunction with hemoglobin A1c, an algorithm that incorporates 1,5-AG into clinical decision making has been proposed.³ In patients with suboptimal glucose control (hemoglobin A1c <8 percent), the concentration of 1,5-AG can help guide treatment decisions. In patients with normal concentrations of 1,5-AG, treatment should be aimed at normalizing fasting plasma glucose, while in those with abnormal 1,5-AG, treatment should be aimed at normalizing postprandial glucose.

Limitations

- 1,5-AG will be decreased in individuals with renal glucose thresholds that are markedly different from 180 mg/dL (e.g., chronic renal failure, pregnancy, dialysis) and in those undergoing steroid therapy.
- α -glucosidase inhibitors can decrease 1,5-AG by interfering with its intestinal absorption.
- In patients with poorly controlled DM, 1,5-AG is less sensitive to modest changes in glycemic control due to continuous glycosuria.
- 1,5-AG may be increased during intravenous hyperalimentation.

Methodology

1,5-AG is measured via the colorimetric detection of hydrogen peroxide produced by the oxidation of 1,5-AG by pyranose oxidase. As this enzyme also reacts with glucose, the sample is pretreated by an enzyme reaction using glucokinase, which converts glucose to glucose-6-phosphate and renders it nonreactive with pyranose oxidase.

References

1. McGill JB, et al. Circulating 1,5-anhydroglucitol levels in adult patients with diabetes reflect longitudinal changes in glycemia. *Diabetes Care* 2004;27:1859–1865.
2. Dungan KM, et al. 1,5-anhydroglucitol and postprandial hyperglycemia as measured by continuous glucose monitoring system in moderately controlled patients with diabetes. *Diabetes Care* 2006;29:1214–1219.
3. Dungan KM. 1,5-anhydroglucitol (GlycoMark) as a marker of short-term glycemic control and glycemic excursions. *Expert Rev Mol Diagn* 2008;8:9–19.

Test Information

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For specific collection, transport, and testing information, refer to the ARUP Web site at www.aruplab.com.

For information on test selection, ordering, and interpretation, refer to ARUP Consult® at www.arupconsult.com.