

Fructosamine

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Reference Range

A serum fructosamine (a glycated protein) level, similar to a hemoglobin A1c (HbA1c) level, enables assessment of long-term glycemic control in patients with diabetes mellitus. [1, 2, 3, 4, 5]

Normal values vary in relation to the serum albumin concentration and are 200-285 $\mu\text{mol/L}$ when the serum albumin concentration level is 5 g/dL. [4] Reduction in serum albumin lowers the serum fructosamine value.

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Interpretation

Fructosamine levels indicate the average level of blood glucose control over the past 2-3 weeks. [2, 3, 4] In individuals with diabetes mellitus, an increased level of serum fructosamine is associated with prolonged hyperglycemia for 2-3 weeks prior to testing. The higher the fructosamine value, the poorer the degree of glycemia control. A trend from high to normal fructosamine levels may indicate that changes to a person's treatment regimen are effective.

Since the fructosamine concentrations of people with well-controlled diabetes may overlap with those of people who are not diabetic, the fructosamine test is not useful as a screening test for diabetes.

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Collection and Panels

See the list below:

- Specimen type: Serum
- Collection method: Venipuncture
- Minimum specimen volume: 0.5 mL
- Specimen container: Serum separator tube; also acceptable is pink (K_2 EDTA) or green (lithium heparin)
- Unacceptable conditions: Hemolyzed specimens (may cause falsely elevated results)
- Methodology: Colorimetry or quantitative spectrophotometry

- Transport temperature: Room temperature
- Specimen stability: room temperature, 7 days; refrigerated, 14 days; frozen, 30 days
- Related tests: Plasma glucose, hemoglobin A1c (HbA1c), serum albumin, serum total protein

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Background

Serum fructosamine is formed by nonenzymatic glycosylation of serum proteins, predominantly albumin. [1, 4] The degree of protein glycation is proportional to the concentration of plasma glucose over the lifetime of the protein. Albumin, the most common serum protein, typically accounts for 80% of all fructosamine. Because a half-life of serum albumin is 14-21 days, serum fructosamine generally reflects the state of glycemic control for the preceding 2-3 weeks.

The half-life of hemoglobin A1c (HbA1c) is much longer than that of albumin (the half-life of a red blood cell is 120 d), and glycohemoglobin measurement reflects average glycemic control over 3-4 months. [4] HbA1c and fructosamine are highly correlated. The relationship between the fructosamine level and the HbA1c level can be present as a linear regression analysis, [4] as follows:

- $HbA1c = 0.017 \times \text{fructosamine level } (\mu\text{mol/L}) + 1.61$

In practice, fructosamine testing refers to a laboratory test for diabetes management that it is rarely used in clinical practice (simple blood glucose monitoring or HbA1c testing are preferred). However, the main advantage of the test is that it can detect overall changes in blood glucose control within a few weeks, rather than months (like HbA1c). Fructosamine can be also useful when the HbA1c measurement may be unreliable.

Indications/applications

Testing of serum fructosamine is indicated for monitoring of glycemic control in the following circumstances:

- Effect of the change (< 6 wk) in diet, exercise, or medication
- When a narrow time frame is required, such as for ascertaining glycemic control at the time of conception in diabetic women who recently became pregnant
- Conditions in which HbA1c may be unreliable, such as hemoglobinopathy (eg, sickle cell disease), hemolytic anemia, or recent blood loss

A study by Mendes et al indicated that in pregnant women with gestational diabetes mellitus, neonatal complications, as well as newborn respiratory disorders, are more likely to exist in the presence of higher maternal fructosamine and glycosylated albumin levels. According to the investigators, these glycemic markers are better indicators of these complications than HbA1c. [6]

A study by Connor et al involving Hispanic and non-Hispanic white women with invasive breast cancer found the mortality risk to be higher in the presence of diabetes and elevated fructosamine levels. The likelihood of all-cause mortality was more than twice as great, and the risk of breast cancer-related death over four times higher, in study subjects with raised fructosamine than in those with normal levels. [7]

A study by Shohat et al indicated that fructosamine levels are a prognostic indicator for patients undergoing total hip arthroplasty (THA). The investigators reported that in patients with fructosamine levels above 293 $\mu\text{mol/L}$, the adjusted odds ratios for periprosthetic joint infection and

readmission were 6.37 and 2.68, respectively, compared with individuals with lower levels. Among the theories as to why this glycated protein can predict outcomes in THA, it has been suggested that fructosamine levels reflect glucose fluctuations that are themselves associated with pro-inflammatory protein activation and excessive oxidative stress. [8]

Considerations

All conditions that affect serum albumin production (eg increased or decreased turnover) may affect the reliability of fructosamine assay, such as the following:

- Hepatic diseases (eg, cirrhosis)
- Nephrotic syndrome
- Thyroid disease
- Paraproteinemia

High levels of ascorbic acid interfere with the fructosamine assay. Patients should abstain from ascorbic acid supplements for a minimum of 24 hours prior to sample collection.

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Questions & Answers

Overview

What is the reference range of fructosamine?

What is the clinical interpretation of fructosamine?

How are the collection and panel specifications for fructosamine testing?

What is fructosamine?

What is the relationship between hemoglobin A1c (HbA1c) and fructosamine?

What are indications for fructosamine testing?

Which factors may affect the reliability of fructosamine test results?

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