Hemoglobin A1c in Diabetes

Red blood cell hemoglobin transports oxygen in the blood and can become glycated by blood glucose. Glycated hemoglobin, or HbA1c, is measured to estimate the three-month average glucose level. HbA1c is formed when hemoglobin in red blood cells is exposed to plasma glucose. As blood glucose levels increase, the rate of glycation increases proportionately. Furthermore, HbA1c is indicative of glycation in other tissues also exposed to elevated glucose. An integrative approach can lower blood sugar, reduce glycation and protect tissues from the damage caused by glycation.

Advanced Glycation End-Products (AGEs)
Hyperglycemia can cause increased glycation of many other proteins leading to the formation of advanced glycation end-products (AGEs). AGEs bind to the AGE receptor (RAGE) of immune cells in turn causing the release of cytokines and growth factors (VEGF) from vascular endothelium and smooth muscle. Hyperglycemia and AGEs also lead to activation of protein kinase C (PKC). PKC results in the formation of peroxynitrite, the upregulation of COX-2 and a reduction in nitric oxide (NO). These changes cause impaired vasodilation and reduced antioxidation.

Target Levels
The ADA guidelines set a target HbA1c of 7% or lower if this can be achieved without problematic hypoglycemia. The AACE guidelines set a target HbA1c of 5.5% or lower if this can be achieved without recurrent hypoglycemia. Setting a target of less than 6% is optimal because cellular oxidation, and thus, the development of diabetic complications, increase with HbA1c greater than 5.5%.

Integrative Approach
Exercise - 1 hour 5 days a week including 20-30 minutes of resistance training.
Sleep - Adequate sleep, 7-9 hours.
Stress - Managing stress levels to control cortisol/epinephrine levels.
Diet - A low carbohydrate diet with maximum intake of 30-45 grams of carbohydrates a day.
Supplements - Include a high quality multivitamin/mineral formula as well as a fish oil supplement. Other beneficial nutrients are listed in the table.

Nutrients for Type II Diabetes
- Alpha lipoic acid (R-ALA) 600-900 mg/day
- Gymnema sylvestre 400-2400 mg/day
- Berberine 500 mg 3x/day
- Taurine 1000-1500 mg/day
- Curcumin 250 mg/day or more
- Cinnamon 1000 - 2000 mg/day
- Bilberry extract 180 mg/day or more
- Green tea extract 200 mg/day
- Ginkgo biloba 200 mg/day
- Resveratrol 100 mg/day

Diabetic Pathologies
The detrimental effects of high blood sugar manifests in many areas of the body, each location creating unique pathologies. Underlying these systemic changes are thickening of the basement membrane, microangiopathy and arteriosclerosis.

Vascular Endothelium: Hyaline arteriosclerosis
Neuropathy: Motor and sensory nerve changes from microangiopathy and direct axonal damage
Nephropathy: Sclerosis of capular structures, pyelonephritis and inflammation of kidney tissues
Retinopathy: Cataracts, glaucoma and retinal lesions