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Meeting Abstract

Glycocylated Hemoglobin and the Role of Exercise on the Management of Type 2 Diabetes Mellitus

Hemoglobina glicosilada y el rol del ejercicio en el manejo de la Diabetes mellitus tipo 2

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The world's population faces a diabetes epidemic that progresses uncontrollably. According to the Pan American Health Organization (OPS) (1), Diabetic population worldwide has grown from 30 million in 1985 to 220 million in 2009 and it is expected that by 2030, this figure should reach 336 million. Diabetes is defined as a metabolic disorder of multiple etiologies, characterized by chronic hyperglycemia with disturbances in the metabolism of carbohydrates, fats and proteins, which result from defects in secretion and/or insulin's action (2).
Since its appearance, hemoglobin A1C (HbA1c) has been considered the most reliable indicator to monitor diabetic patients, and thanks to its recent standardization, the American Diabetes Association (3) (ADA) has incorporated the test as the main diagnostic criteria for diabetes in asymptomatic patients or in individuals with clinical suspicion of this disease. The ADA has defined three categories for HbA1c: ≤ 5.6%, non-diabetic level; between 5.7% and 6.4%, pre diabetic level; and ≥ 6.5%, compatible with diabetes diagnosis. Also, ADA maintains as treatment goal an HbA1c level ≤ 7%.
The purpose of this summary is to review the use of HbA1c in the context of diagnosis and management of diabetes. To achieve the objective, three aspects will be mentioned: (a) epidemiological history of diabetes, (b) What is the HbA1c?, (c) Effects of exercise on the control and management of diabetes.

Epidemiological History of Diabetes

Decades ago, the epidemic of type 2 diabetes mellitus (DM2) was predicted by epidemiologists, who observed significant and rapid increases in the prevalence of diabetes among indigenous peoples who adopted Western life styles. Later, it was shown that populations who enjoyed hearty meals and lifestyles with lower physical demands reached middle age and old age with an increased risk of developing diabetes and its complications. The global epidemic of type 2 Diabetes has been documented in a series of increasingly precise and refined projections. In general, these studies project that the number of adults with diabetes worldwide will more than

double between 2000 and 2030, with the largest increase in developing countries, particularly in Asia.
The overall number of people with diabetes is projected to be 150 million to 220 million in 2010 and 300 million by 2025. Most cases will be DM2, which is extremely associated with a sedentary lifestyle and obesity. This trend of increasing prevalence of diabetes and obesity has already imposed a huge burden on health systems and it will continue to increase in the future (4).
Not surprisingly, the countries with the largest population will have the greatest number of people with diabetes. The most recent studies project that by 2030; India will have 79 to 87 million and China from 42 to 63 million adults with diabetes (5).
Type 2 DM is responsible for about 95% of all cases of diabetes and almost 100% of cases undiagnosed diabetes (6). Pre-diabetes is an asymptomatic condition in which high blood glucose levels occur, with values higher than normal but lower than those established for diagnosis. That is why according to the natural history of diabetes, and taking into account the micro and macro vascular complications, reliable and easily reproducible diagnostic elements should be considered.

What is Hb1Ac?

Hemoglobin or glycohemoglobin glycated (HbA1c) is a generic term referring to a group of substances formed from biochemical reactions between hemoglobin A (HbA) and some sugars present in the bloodstream (8). Under normal conditions, erythrocytes have a life span of 120 days in the bloodstream. HbA constitutes 97% of adult hemoglobin (state achieved from the first year of life; through glycation mechanisms, part of the HbA becomes HbA1c. There is a direct relationship between the percentage of HbA1c and the average serum glucose level, because glycation (no glycosylation) of hemoglobin is a relatively solw process (8).

A study by Stratton (2000) (9) determine the impact of the increase in the percentage of glycation of hemoglobin with the rate of increase in the risk of acute myocardial infarction, proposing a model of linear estimation in which indicates that for every 1 % increase of HbA1c, the risk of stroke increases by 14%.

Effects of Physical Exercise in the Control and Management of Diabetes

There is convincing evidence that type 2 DM occurs most often in people who are not sufficiently active, ie, do not get enough daily physical activity showing a clearly sedentary lifestyle. Exercise, in combination with other strategies related to healthy lifestyles, has direct effect in preventing the onset of type 2 Diabetes Mellitus, and by improving glycemic levels in control subjects who are diagnosed as pre diabetics (10-15). The application of exercise in type 2

DM today is based on evidence that suggest an increase of glucose transport via GLUT-4 after acute and chronic exercise (16).
Wojtaszewski et al. year 2002 (17), they found a sharp increase in the activity of insulin and its corresponding higher increase of glucose in the lower extremity that was exercised compared with the limb at rest, suggesting higher acute sensitivity or the existence of an alternative pathway to incorporate glucose, which is dependent of muscle contraction. Similarly, in 1993, Romijn (18) proposed that the contribution of plasmatic glucose as well as intramuscular glycogen is dependent on exercise intensity; therefore, moderate to high intensity exercise would facilitate glycemic control.
Just line the effects of exercise on glycemic control are well documented, it is also common that diabetes is associated with changes in the morphological structure as well as changes in body composition, especially in visceral adiposity. This evidence is supported by a study conducted Ibañez et al (2005) (19), in which after a period of 16 weeks of resistance training, visceral adiposity was reduced and insulin sensitivity increased ($p < 0.01$ and $p < 0.001$, respectively) in elderly diabetics.

On the other hand, in addition to studying the effects of both acute and long-term exercise in diabetes, recent studies have focus on the effects of detraining and/or how long-lasting are these changes after a training period. A study conducted by Yuing et al. (20) proposes that both types of training (aerobic and overload) produce significant changes after 6 weeks of training in glycemia, HbA1c and lipid profile of people with diabetes, but these values revert to pre workout more significantly in subjects who underwent aerobic training in comparison with those who performed resistance training, ie positives effects on subjects who underwent resistance training tend to last longer than in subjects that performed aerobic training.

The purpose of this brief summary was to present some general but no less important aspects in understanding HbA1c as a tool for control and management of diabetes, as well as the effects of exercise on glycemic control, in benefit of people with this pathology.

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