The Functions of GH in Brain Damage and Ageing

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Abstract

A decline in cognitive function, including a problem with the creation and retention of new memories, is often linked to advanced age. Ageing has a particularly negative impact on the hippocampus, which is essential for memory and learning, especially when it comes to spatial learning. A decline in the quantity of neural stem and precursor cells, a reduction in the production of adult-born neurons (neurogenesis), and deficiencies in neural circuitry are only a few of the adverse effects of ageing on the brain that can ultimately lead to reduced cognitive performance. It's important to note that exercise may enhance learning and memory and has been demonstrated to help several of these deficiencies. In this context, Growth Hormone (GH) is a crucial protein hormone that lowers with ageing and increases following physical exercise.

Keywords: Growth hormone deficiency

Introduction

Initially recognized for its function in longitudinal development, GH is now known to serve a number of additional crucial tasks, particularly in connection with the brain. One of the most well-known aspects of neuroendocrine ageing is the consistent decline in GH levels that occur after puberty. Growth hormone replacement treatment can improve the negative effects of Growth Hormone Deficiency (GHD) on brain function. It has been demonstrated that exercise raises circulating GH levels. In addition, we recently showed that enhanced cognitive performance in the elderly mice is dependent on an increase in exercise-mediated GH. Here, we look at the various functions that GH performs, especially in the ageing brain and after trauma, radiation, and stroke, and how raising GH levels might improve impairments.

The importance of the pituitary gland for growth has long been recognized. Cushing proposed that the pituitary gland contains a "hormoneof growth" in 1912. This theory was supported by experiments conducted in the 1920s using intraperitoneal injections of bovine pituitary gland extracts to accelerate the growth of rats. Growth Hormone (GH) was eventually discovered, but its effective purification required many decades, beginning with the separation of oxen GH in 1944 and ending with the purification of Human GH (hGH) in 1956. Within two years of this finding, reports on the beneficial impact of GH therapy on human growth were published. As procuring human pituitary glands was necessary in order to treat patients with pure hGH, GH treatment was only used in the most extreme cases of GH insufficiency.

A larger spectrum of people can now be treated with GH because to the effective cloning and expression of hGH made possible by the finding of the hGH sequence in the 1960s and the sequence of bovine GH shortly after. The actual receptor was then cloned, and the mechanisms governing its signaling were clarified.

Beginning in the 1960s, it was possible to test the amounts of circulating hGH using an immunoassay due to the availability of pure hGH. Next Tannenbaum and Martin recorded the pulsatile release of GH. It was found that young girls had the greatest GH peaks, with both men and females having several peaks during the day and night. It soon became clear that circulating levels of GH fluctuated throughout the course of a person's lifespan, reaching their peak for both sexes during puberty. After this, both general baseline levels and pulsatile peak heights in both sexes decline with age. It is now generally acknowledged that peak GH levels go down after age 30 by around 10% to 15% every decade.

Somatopause is the name given to this decline together with a general slowdown in metabolism and body composition. GHD has frequently been identified in those over 60. Compared to age-matched controls, people with adult-onset GHD often have abnormalities in body composition, cognitive function, and general wellbeing.

Age-related declines in specific cognitive ability categories coincide with age-dependent declines in GH levels. The creation and maintenance of new memories, particularly those involving spatial learning, seem to be particularly vulnerable to ageing. A variety of cognitive activities, including learning and good memory retention, depend on the hippocampus, a part of the brain. It is also one of two major brain areas in mammals that, through a multi-step process known as neurogenesis, continue to produce new neurons into adulthood. The dentate gyrus of the hippocampus produces neurons that are essential for spatial learning. The Sub Ventricular Zone (SVZ) of the lateral ventricle is the second area that maintains neurogenesis throughout adulthood.

The SVZ produces immature neurons that go to the olfactory bulb where they integrate and aid in smell. With advancing age, both brain regions are negatively impacted, leading to deficits at each stage of neurogenesis, including a decrease in adult-born neurons, a decrease in the number of activated Neural Stem Cells (NSCs), deficits in cognitive function, including reduced fine olfactory discrimination, and deficits in spatial learning.